CRUE
FLOODING ERA-NET

2nd ERA-Net CRUE Funding Initiative: Flood resilient communities – managing the consequences of flooding

Mid-term meeting of Research Projects

Madrid, 19th-20th October 2010

Venue: **Fundación Gómez Pardo**
Calle de Alenza, 1
28003 Madrid

Project website: http://www.crue-eranet.net/

Contact : http://www.crue-eranet.net/contact.asp

Funding Initiative website: http://www.crue-eranet.net/calls.asp

Host: **Ministry of Science and Innovation (MICINN), Spain**

MICINN contact point: **Prof. Lucila Candela**
lucila.candela@upc.edu
SCP contact point: **Manijeh Schwindt**
schwindt@alps-gmbh.com

AGENDA 19TH OCTOBER 2010

09.00 – 12.00:	Meeting of the Steering Committee	Additional Project Meetings: DIANE-CM, IMRA, SUFRI

12.30 – 13.00:	Registration of participants
13.00 – 13.10:	Moderation: Wouter Vanneuville Welcome by host Valentin Gonzalez (Jefe del Dep. Técnico de Medio Ambiente y Recursos Naturales, MICINN)
13.10 – 13.30:	Welcome by CRUE ambassador Wouter Vanneuville
13.30 – 15.00:	Session 1: Presentations of DIANE-CM, FIM FRAME and FREEMAN *(20 min presentation, each followed by a discussion of 10 min)*
15.00 – 15.30:	Tea/Coffee break
15.30 – 17.30:	Moderation: Stefano Mariani Session 2: Presentations of IMRA, RISK MAP, SUFRI and UR-Flood *(20 min presentation, each followed by a discussion of 10 min)*
17.30 – 17.45:	Information on tomorrow's discussion groups and upcoming dissemination activities *(by the SCP)*

AGENDA 20TH OCTOBER 2010

08.45 – 09.15:	Moderation: Annegret Thieken Marta Moren (Directora General del Agua; Secretaría de Estado del Medio Rural y Agua; Ministerio de Medio Ambiente y Medio Rural y Marino) Flood risk, prevention and control in the Mediterranean: the case of Spain
09.15 – 10.45:	Discussion groups on different topics *(4 topics related to the overarching questions will be announced)* *CRUE partners should moderate the group discussion. A CRUE researcher should act as a rapporteur.* Moderators: - Sean Longfield - Thomas Deppe - Stan Irvine - Wouter Vanneuville Rapporteurs have to be determined at the beginning of the discussion.
10.45 – 11.15:	Tea/Coffee break
11.15 – 11.45:	Moderation: Lucila Candela Enrique Playan (CSIC-MICINN): Joint Programming Initiative Water
11.45 – 12.00:	Information on the final symposium *(by Helmut Knoblauch (TU Graz) and SCP)*
12.00 – 12.45:	Presentation of the results of the discussion groups by the rapporteurs *(approx. 5 min presentation, followed by a general discussion)*
12.45 – 12.55:	Remarks of the evaluators
12.55 – 13.00:	Final remarks of CRUE ambassador
13.00:	Meeting closure by Lucila Candela

14.00 – 15.30:	Meeting of the Steering Committee (with evaluators)	Additional Project Meetings: FREEMAN, FIMFRAME, RISK MAP, URFlood
15.30 – 17.00:		

2nd ERA-NET CRUE Research Funding Initiative
Flood resilient communities – managing the consequences of flooding
Interim Report

*Decentralised Integrated ANalysis and Enhancement of Awareness through Collaborative Modelling and Management of Flood Risk [DIANE-CM]**

Prof. Dr. Mariele Evers (Leuphana University of Lueneburg) (Coordinator)
Prof. Čedo Maksimović (Imperial College London)
Dr. Andreja Jonoski (UNESCO-IHE Institute for Water Education, Delft)
Leonie Lange, Environmental Scientist (Leuphana University of Lueneburg) (Project Manager)

*Funded by Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung – BMBF) (Germany), Environment Agency (EA) (England and Wales) and Ministry of Transport, Public Works and Water Management (Ministerie van Verkeer en Waterstaat – MinVenW) in the framework of the 2nd ERA-Net Research Funding Initiative.

1 Introduction

The DIANE-CM project aims at enhancing flood risk awareness by collaborative modelling and social learning. This process is being carried out in two case studies in Germany and the United Kingdom. The DIANE-CM approach shall enhance the capacity of the stakeholders to better cope with flood risk by means of interaction with experts and with assistance of computer tools. The second aim is to better understand how data from hazard and vulnerability analyses and improved maps as well as the near real time flood prediction can be used to initiate a public dialogue contributing thus to overall reduction of vulnerability (increase of resilience) to flooding.
This interim report covers the period 01.09.2009 to 31.08.2010.

Definitions
The following definitions show how the terms “resilience” and “community” are interpreted and used within DIANE-CM.

Resilience
In the DIANE-CM project the term “resilience” is used in line with the definition by Floodsite project: The ability of a system/community/society/defence to react to and recover from the damaging effect of realised hazards (Floodsite 2005). N. Watson et al. (2008) describe it as institutional and social responses to flooding from a resilience perspective. This concept considers all three types of resilience: resistance, restoration and reconfiguration, and defines resilience as the ability of a system to return to a normal situation after flooding of a part of the area caused by a peak discharge.
One of the key objectives of the project is to develop further, upgrade and customise knowledge for direct use by the stakeholders in raising their capacity to reduce flood vulnerability. That means new scientific achievements that will assist the local communities to make informed decisions improved by vertical (top-down and bottom-up) and horizontal (interdisciplinary) interactions and by promoting innovative tools of collaborative modelling and their implementation in two selected case studies.

Community

In general, communities are characterised by citizens in a respective area such as a river basin and/or municipality. The citizens are represented by relevant stakeholders regarding the project activities.

DIANE-CM focuses on local communities in a municipality level since this is the relevant level for concrete actions and measures. The project aims to "demystify" the scientific innovations and present them in an easy-to-understand visual form. Therefore we deal with "customisation" of data, information, and reduced uncertainty in order to help in the decision making. Additionally, the local community should have local flood professionals capable of transferring top-down and bottom-up information. That means "local champions" will be identified and trained; they will act as mediator between the scientific project and the public and these persons will guarantee a sustainable implementation of the project deliverables and also provide technical support to the local professional organisations.

The identification process of these local champions and their characterisation is described in Chapter 3, results of WP1.

In the UK case study (Redbridge) the community can be described as the citizens and other stakeholders of the Cranbrook catchment, which is located within the London Borough of Redbridge situated on the northeast part of Greater London. The Cranbrook is a tributary of the Roding River, which, in turn, is a tributary of the River Thames.

In the German case study (Alster Catchment) the community can be described as the citizens and other stakeholders in the catchment area of the Alster River in the City of Hamburg and municipalities in the Alster catchment in the neighbouring Land of Schleswig-Holstein.

Given the mutual interactions within the Alster and Roding urban catchments, both local and regional stakeholders need to be involved in the DIANE-CM project.

2 Methods

WP 1 – Stakeholder Analysis and vertical (top-down and bottom-up) and horizontal (multidisciplinary) interactions

The following social research methods are used in WP1:

- Stakeholder analysis
- Expert interviews
- Development of an organi- and sociogram for each case study area
- Visualisation of stakeholder information in a parameter table
- Stakeholder meetings in both case study areas

The stakeholder analysis is used to identify all relevant stakeholders including the general public that could be affected by or could have an influence on flood (risk) management in the two case study areas. Based on the analysis, the workshop participants (core-stakeholder) as well as online-participants and multiplicators were identified (cf. section 3).

Expert interviews are used to elicitate and visualise the vertical and horizontal interactions between the stakeholders, respectively. For this purpose a guideline for expert interviews was developed and tested in a pre-test. At present the interviews are being conducted. The interview results are first of all the basis for the organi- and sociogram (D 1.2), which is developed according to the manual of the GTZ[1] (Gesellschaft für technische Zusammenarbeit) (GtZ n.d.). Additionally, the results are gathered in a parameter table in order to support the development of the organi- and sociogram as well as the development of the target-group specific communication strategy.

Besides the expert interviews with the workshop participants, stakeholder meetings are used to improve the exchange and the cooperation among and between researchers and stakeholders.

[1] Stakeholder Mapping based on a rainbow-diagram, which allows the classification of stakeholder.

WP 2 – Data, Modelling, Mapping and NRT forecast for stronger involvement of the local champions, and providing links with the topic 2 (Event Management) of the CRUE programme

The methodologies are adjusted to the needs of both case studies and their use is coordinated among the project partners. However, due to different local conditions and focal targets of the technical partners or stakeholders, respectively, the approaches for the two case studies differs to certain extend.

In general it can be said that the approach in the UK case is focusing on pluvial flood problems and event management without neglecting mid- and long-term planning and management. In Germany the priorities are the other way around. That means that DIANE-CM includes different perspectives and adjusts the methodologies applied in the different case study areas as much as possible.

In the Redbridge/UK case study the following methodology has been implemented:

- Existing data and data processing tools (DTM, river and sewers network info has been compiled and customised for implementation in this project). Furthermore AOFD (Automatic Overflow Delineation) tool is being used in order to obtain flood vulnerable areas.
  Missing data has been obtained by either requesting it from the different institutions or by own network of newly installed sensors and wireless data transmission system. Real time data acquisition and processing system has been put in place and tested. The following sensors were installed during March and April of 2010 (i) 3 tipping bucket rain gauges, (ii)1 pressure sensors for Roding River level monitoring (iii) 2 sensors for water depth measurement in sewers and (iv) 1 sensor for water depth measurement in open channels. All of them are equipped with data acquisition and real-time access wireless communication units, which allow for measurements to be accessed in real-time via Internet.
- Short term rainfall and pluvial flood forecasting methods are in the final phase of development and testing. Regarding rainfall forecasting, it has to be taken into account that modelling of urban pluvial flooding requires short term rainfall prediction with high spatial and temporal resolution. In order to fulfil these requirements, an integrated methodology consisting of rainfall models and observation techniques over multiple spatial and temporal scales is currently under development at Imperial College London in cooperation with MetOffice (UK) and the University of Bristol. The aim of the techniques is to increase the lead-time of the rainfall forecast as well as to improve its resolution, accuracy and reliability. With regard to short term pluvial flood forecasting, it also has to be carried out at a small temporal and spatial scale. To do this, models that account for the complexity of urban catchments as well as for the interactions that occur between the surface system and the sewer system when heavy rainfall occurs are being developed. In this particular case, 1D-1D Infoworks models of the overland and sewer networks of the study area are being customised. To develop the 1D surface network, a special tool called Automatic Overland Flood Delineation (AOFD) was developed at Imperial College; the AOFD tool uses a high-resolution DTM (Digital Terrain Model), obtained from 1 m resolution LiDAR data) for creation of the network of ponds and preferential pathways that connect them. The output of the AOFD software is an Infoworks 1D model that can be easily coupled with the sewer network model, a model of the river is being developed using Infoworks RS (it is now in the calibration phase).

In the German case study area in Hamburg and Schleswig Holstein a three-level-approach is followed. For the 1st level a broad modelling approach for stakeholder involvement for the whole catchment of the River Alster is chosen. It is supposed to be used for collaborative modelling with stakeholders and by the Web platform to discuss scenarios via the platform and during the workshops. On the 2nd level extreme scenarios are built as an implication on the model set up in the first level. These scenarios will be discussed together with the stakeholders. And on the 3rd level radar data forecasting and dual drainage model to run pluvial flood scenarios will be used. The stakeholders involved in the 3rd level are different from those involved in levels 1 and 2. For the 1st level a rainfall-runoff model and a conceptional model have to be set up.

- Existing data are collected and processed for the model.
- Using GEORAS extension tool in GIS geometrical data are extracted from the DEM data.
- HEC-RAS 1D hydraulic modelling software is used to set up a 1D river model.

- Existing hydrologic model (Kalypso model) and 1D river model (MIKE 11 model) for the upper part of the case study area are requested and will be used for the case study. It will be coupled with the downstream area model.

The extreme scenarios which will be simulated were selected during a workshop with different representatives from various authorities in Hamburg. The following events will be modelled: 100 year return period, 500 year return period and 100 year return period with simultaneous pump failure. Result from the simulation of these scenarios will be presented in the form of flood hazard maps during the workshops and possible measures to deal with these events will be discussed with the stakeholders. In the 3rd level the dual drainage modelling concept implemented in the UK case study will be tested for a selected part of the German case study area in Hamburg. Quality of the available radar rain data forecasted using two radars in Hamburg will also be assessed to determine if it is usable for the dual drainage model.

WP 3 – Development of shared flood risk strategies using a collaborative platform

The primary users of the collaborative platform will be the identified stakeholders in the two case studies. They will use the platform during the planned stakeholder workshops and in the periods between and after the workshops. In this process they will be supported by the DIANE-CM research team, which will prepare the initial platform implementation, and provide maintenance and necessary platform adaptations (when needed or requested by the involved stakeholders) as the collaborative modelling process develops.

As described for WP1 the actual types of stakeholders in the two case studies will be somewhat different. This situation will inevitably lead to different implementations of the DIANE-CM platform for the two case studies. Nevertheless, the generic objectives of the collaborative modeling process are quite similar for both cases, as is the way in which this process is conceived to develop. This allows for development of *one*, generic conceptual design for the collaborative platform.

The general objective of the collaborative platform is to support the processes of individual and social learning, through collaborative modelling[2].

Consequently, the collaborative platform needs to support the collaborative modelling activities of the identified stakeholders. This support will be offered both during the planned workshops and in the periods when the stakeholders will collaborate online via the web. The objectives of the collaborative platform are therefore in supporting the collaborative activities of these stakeholders. These objectives are identified below[3]:

1. Development of shared understanding of current flood risk
2. Development and evaluation of alternatives (sets of measures) for flood risk reduction or (re)distribution
3. Flood risk alternatives testing under different scenarios
4. Support for negotiation and selection of commonly agreed alternatives

Furthermore it is obvious that the collaborative platform will be web-based and it will support all the activities mentioned, via appropriate web-based visualizations and tools.

WP 4 – Collaborative Modelling for flood risk management and enhancing awareness

The main interactions with the local stakeholders to enhance their resilience will be performed through the collaborative modelling exercise within WP4. The web-based platform for collaborative modelling, developed in WP3, will be used as a kind of socio-technical instrument. That means that the platform can not only be used as a tool for e.g. scenario building and visualisation but also as a "medium" for communication and mutual learning. Stakeholders will influence the content and partly also the functionalities of this tool for shared decision making. By doing so, transparency of information and results, confidence in the process and acceptance of negotiated measures can be reached, which is crucial in Flood Risk Management.

[2] Specified in D3.1 where the socio-technical framework for participatory flood risk management is introduced.
[3] Further details about the objectives of the collaborative platform could be found in Jonoski (2010) (D3.2).

Based on the stakeholder analysis conducted in WP1 the workshop participants (core-stakeholder) were identified and will be addressed and encouraged to take part in a series of 3-4 workshops in each case study area with maximum 30 participants. Additionally, a range of online-participants will have the possibility to follow and influence the process via the collaborative platform. The collaborative platform will be used for support during and between the workshops A kick-off event together with the technical partners is planned in order to announce the workshop series, provide information and motivate stakeholders to take part in it.

For the German case study the different workshop meetings will be structured as follows:
Kick-off meeting: Announcing the workshop series, providing information and motivate the stakeholders to participate
1st meeting (Nov 2010) – Focus information: Making clear boundary conditions for process, clarification of terms and official framework, explanation of tools, inform about results (so far), gathering ideas and elucidate need for information
2nd meeting (Dec 2010) – Discussion/Discourse: Scenarios, possible measures, brainstorming on possible measures, discussion and trade off measures
3rd meeting (Jan/Feb 2011) – Negotiation/Conclusion: Conclusion on measures and implementations
Possibly 4th meeting (mid of March/end of March) – Negotiation/Conclusion and "Wrap-up"
For the UK case study, the different workshops will be structured as follows:
A first workshop (informative session) has already been held with the most relevant stakeholders
2nd meeting (Oct/Nov 2010) – Information/Discussion: The first draft of the collaborative platform will be presented and the methodology for collaborative modelling will be explained in order to carry out a discussion about possible improvements, additional scenarios that should be analysed, clarification of terms and official framework. Feedback from the participants to be structured and used in the follow-up.
3rd meeting (Dec 2010) – Collaborative modeling exercise: Analysis of scenarios, measures to be implemented, ways of dealing with flooding and rising flood risk awareness. This will be done using the collaborative platform.
4th meeting (Jan/Feb 2011) – Conclusion "Wrap-up": Conclusion on measures and implementations

WP 5 – Enhancing Resilience through Training, Awareness Raising and Dissemination
The e-learning framework and platform developed for DIANE-CM support a constructivist approach to knowledge development by enabling partners and stakeholders to add to the learning material, thus contributing to the transmitted body of knowledge. This is especially important where training is not directed to university students, but rather to stakeholders with significant experience and knowledge on the ground. As this type of knowledge is difficult to capture, this approach is considered important. The project will adopt a continuous development approach for the e-learning material: WP leaders will contribute appropriate elements of their work (incl. ppts, demos, software, interviews with stakeholders etc.) as the project progresses and effort will be made to capture all activities, deliverables or actions that have educational value, while the project is evolving.
The concept of the e-learning tool differs from the collaborative modelling platform in the following way: While the collaborative platform aims at creating knowledge and interaction amongst the stakeholders and with the project members, the aim of the e-learning platform is to capture knowledge and to develop transferable lessons individually. The DIANE-CM e-learning platform will be developed in Moodle (http://moodle.org/). The platform will allow access to the material of the project, in an organised fashion, designed to improve clarity and allow for collaboration between "trainers" and "trainees".
In terms of the methodology the development of the e-learning is based on the following:

- Development has to be continuous – rather than an afterthought ("develop as we go")
- Record training sessions and collaborative modelling exercises (both as a process (video) and as modelling (screen capture video)
- Record invited talks and stakeholder process (incl. interviews of DIANE participants)
- Presentations as lectures

- Demo models and case studies as exercises
- Quizzes (from issues and *lessons learned* by researchers – i.e. from internal evaluation reports)

3 Results and Discussion

WP 1 – Stakeholder Analysis and vertical (top-down and bottom-up) and horizontal (multidisciplinary) interactions

A common framework for the stakeholder analysis (STA) was developed and used in both case study areas to ensure comparability.

First of all, a common framework for the stakeholder analysis (STA) was developed, which is used for both case studies areas to ensure comparability. This also includes the joint development of the communication strategy and the evaluation questionnaire.

So far the following results for the German case study area can be listed:

- First stakeholder list developed during the first three months of the project covering over 200 stakeholders. This list is based on an internet enquiry and regular telephone as well as direct exchange with the technical partner LSBG (Agency for Streets, Bridges and Waters) (D1.1)
- According to the analysis the stakeholders cover five groups:
  1) Administrations on federal and regional/district level in Hamburg and Schleswig-Holstein, which in particular include water management and planning authorities on the two levels;
  2) Political bodies on federal and regional level in Hamburg and Schleswig-Holstein;
  3) Organisations (like nature conservation organisations or farmer associations), citizen clubs and sport clubs on federal, regional and local level in the catchment of River Alster;
  4) Larger business companies in the Alster catchment;
  5) Affected properties and general public in the Alster catchment
- Categorisation of stakeholders in core-stakeholder and secondary-stakeholder according to their relevance for flood risk management in the catchment of River Alster. The categorisation was based on a literature review and a close exchange with the technical partner LSBG. Lists of the categorised stakeholders have been produced (including contact details etc.).
- Additionally, possible multiplicators (e.g. schools) were identified and listed in order to involve the public into the process (via the platform).
- Stakeholder organi- and sociograms have been created based on expert interviews with core-stakeholders. Based on these organi- and sociograms an overall organi- and sociogram is produced (D1.2). The organi- and sociograms clearly show information exchange, coordination and cooperation processes as well as conflict potential, which is very valuable for the research process.
- The information provided by the expert during the interviews is gathered in a parameter table and additionally gives in particular an overview over interests, perceptions, and concerns of the stakeholders with regard to flood risk management and with regard to the DIANE-CM project, as well as their responsibilities in flood risk management and benefits they could obtain from their participation in the DIANE-CM project. This information is used for the target group specific communication strategy (D1.3), which has been drafted.
- The local champions have not been identified yet as the identification and training during the workshop series seems more applicable. Nonetheless, it could be assumed that more than one local champion is necessary to cover the project area.
- Finally, a first draft questionnaire for the evaluation of the stakeholders' flood risk awareness has been developed together with ICL, which will be elaborated further during the next weeks.

In the UK case study the following results have been produced:

- A list of the most relevant stakeholders of the study area was produced (D1.1).
- Structured interviews with representatives of main stakeholders were carried out and summarised in a parameter table (like in the German case study).
- Using the information collected in the structured interviews and through literature review, the stakeholders were classified according to two different criteria:

1) According to their role in flood management and to the type of activities that they carry out, four categories of stakeholders were defined:
   - General public
   - Planners
   - Emergency managers
   - Flood management professionals (consultants, modellers)

   This categorisation will be used in order to produce e-learning material tailored to each type of stakeholder (taking into account their needs of information, their activities, role in flood modelling, management, etc.).
2) According to their relevance to the DIANE-CM project and to the way in which they could be engaged in it, four categories of stakeholders were defined using a multi-criteria analysis (MCA). Some of the criteria considered in the MCA are the following: willingness to participate in further DIANE-CM project workshops and training programmes; technical capabilities with regard to pluvial flood modelling and management; degree of responsibility with regard to pluvial flood management; previous experience with flood risk management; power and influence to make changes; information, human and financial resources available; pluvial flood risk awareness and knowledge; interaction with other stakeholders; degree of public engagement. These criteria were evaluated for each of the stakeholders involved in the analysis and a weighted average was estimated. The four categories that were defined and the stakeholders identified within each of these categories are the following:
   - Champions (initial list, can be updated at the later stage):
     - The Environment Agency (local office close to Redbridge area)
     - Redbridge Emergency Planning Department

   The Champion Stakeholders will be fully trained to take over the tools and methodologies developed in the project, so that they can use them for their daily operation in order to improve flood risk management and enhance resilience of the local community to flooding.
   - Primary Stakeholders:
     - Fire Brigade of Redbridge
     - Thames Water (private utility company in charge of the sewer system of Redbridge)
     - Redbridge Highways and Engineering Services Department

   The Primary Stakeholders have a high relevance in flood risk management, but due to limitations in skills, available resources (including time availability) and/or conflicts of interests, they are not suited for directly operating the tools developed throughout the DIANE-CM project. However, these stakeholders will have direct access to the results/outputs produced with these tools, since these constitute an important and useful input for their operation. Furthermore, the Primary Stakeholders will participate in the workshops and will take part in the collaborative modelling exercises to be carried out using the Collaborative Platform.
   - Secondary Stakeholders:
     - Redbridge Planning Department
     - Local Councillors

   The Secondary Stakeholders are not so involved in flood emergency management, but instead are more involved in planning and also act as a bridge for risk communication between the flood risk management authorities and the public. They will have access to flood risk maps and other outputs of the project and training material will be tailored to meet their needs and will be made available to them through the E-learning Platform.
   - Tertiary Stakeholders:
   - Local community groups, such as the Maybank Association and the Broadmead Road Baptist Church.

   The Tertiary Stakeholders will be involved in the project through the E-learning Platform, where training material tailored to them (easy to understand for general public) will be made available.

- Based on the information gathered from the structured interviews and taking into account the above categorisation, a diagram that summarises the governance networks and flows of information operating between stakeholders was produced (D1.2). Potential multipliers to promote the DIANE-CM project and the use of the e-learning platform and to spread flood risk awareness were identified. Some of these are: schools (who have also been involved in the preliminary phase by allowing for raingaguges to be

installed on their roofs), local media, libraries, NSH GP surgeries, local religious groups and Neighbourhood Watch Committees. Corresponding lists were created (including, contact details, etc.).

- A questionnaire–survey was developed together with Leuphana University for evaluating the public's flood risk awareness and determining the best ways of engaging public in flood risk management.
- A preliminary assessment of the public's flood risk awareness was made through examining a previous public survey which was validated by stakeholder interview data. From this analysis it was found that a commonly held belief amongst the interviewed stakeholders is that the public are unaware and apathetic towards flood risk, unless they have previous experience of flooding. It was also found that despite being aware of flood risks, some residents had not taken any preventative measures to protect their properties from flood damage. It was also found that schemes aiming to increase public awareness and thereby resilience to flooding have not been entirely successful; for example, a survey evaluating the effectiveness of an attempt by the Local Council to educate and provide flood guidance to the public through a newspaper article shows that it had limited effect, as a minority of residents actually read it. There was a recurrent theme amongst the public wishing for structural measures to protect themselves and their property from flooding and there was limited recognition for self-resilience measures such as a flood kit.
- Initial activities have been performed to secure longevity (sustainability) of the project deliverables. Contacts have been established with the Local Government Flood Forum (LGFF), which is a think-tank organisation with a network of over 40 members made up of local authorities, local organisations and national agencies. The LGFF already runs regular training programmes and discussion forums on various aspects of floods and it is well placed to raise awareness and promote the new observation and prediction systems to local practitioners. They will include the deliverables of DIANE-CM in their training programme and discussion forums.

Discussion:
The activities in WP1 took more time than expected and should be judged as a long-term-process. A very detailed STA was necessary to ensure the involvement of all relevant groups and the development of the organi- and sociogram requires well prepared expert interviews with most of the potential workshop participants (about 30 in the German and 10 in the UK case study area). Nevertheless, the stakeholders show great interest in the project and have been so far very cooperative in providing information and taking part in the project. Now the important task is to keep their interest in the project high. To ensure motivation and interest among the stakeholders the communication strategy is central and should be developed thoroughly, particularly with regard to the engagement of the general public ("ordinary" citizens). Furthermore the communication strategy should consider conflicts of interest and conflict potential among the stakeholders that are sensed during the expert interviews and visualised by the organi- and sociogram.
The STA in the German case study showed that the identification of the local champions is not suitable and necessary prior to the workshop series because various stakeholders could act as mediator between the scientific project and the public. In fact, the local champions will be identified together with the stakeholders during the first workshop. Taking over the role/responsibility of a local champion depends on various (personal) factors (in particular enough time and adequate competences) and furthermore necessitates an in-depth understanding of collaborative modelling (e.g. platform usability). Therefore it is appropriate to identify and train the local champions during the workshop series. This will also promote the sustainable implementation of the project.
.

WP 2 – Data, Modelling, Mapping and NRT forecast for stronger involvement of the local champions, and providing links with the topic 2 (Event Management) of the CRUE programme

Data analysis and modelling tools have been exchanged with other project partners and the briefing on their use has been performed.
The initial slow start caused by the change of the person coordinating the research has been overcome and the activities are back on track as planned. Methodology for creation of input needed for development of the

Platform (WP3) and e-learning tool (WP5) have been discussed and agreed upon with WP3 and WP5 coordinators

For the Redbridge (UK) case study, the following tasks have been fully or partially completed:

- Data required for setting up the models has been collected, analysed and organised (D2.1). The models are in the final phase of the set up and updated flood risk maps will be produced shortly.
- Rainfall and level gauges have been installed in the study area and they provide real time information about the relevant atmospheric and hydrological processes in the catchment.
- Short term rainfall and flood forecasting techniques are in final phase of development.
- The scenarios that will be analysed in the collaborative platform have been defined: (1) fluvial flooding only; (2) pluvial flooding only; (3) coincidence of fluvial and pluvial flooding.
- Information for the collaborative platform is being organised and put in the agreed form suitable for collaborative modelling and advanced dissemination (D2.2).
- Local champions have been identified. They will be trained in order to take over the methodologies and tools developed in the project after its end. (D2.3)

For the Alster catchment (Germany) a three level approach as explained in section 2 is used.

Concerning the first level, the following steps have been carried out:

- Data collection is completed and data base created.
- Setup for 1D river model using HEC-RAS modelling software is completed.
- Calibration of the 1D model is in progress.

The extreme scenarios for the second level have been defined within a workshop with representatives of different authorities in Hamburg. The selected scenarios will be conducted during the next weeks. For the 3rd level first discussions were made with Hamburg Wasser (owner of the sewer network data) to specify a location for testing the dual drainage concept. Here the following work steps have been identified:

- Identifying an area where pluvial flooding is a problem in city of Hamburg
- Analysing the area with the AOFD tool to identify surface drainage patterns
- Collecting the sewer network data for the selected area,
- Developing a dual drainage simulation model using SWMM
- Calibrating the simulation model

Discussion:

The general progress in this WP can be considered as satisfactory. All stakeholders involved highlight the need for as well as difficulties expected in providing and implementing short term pluvial flood prediction. Some problems with data confidentially and access to it have been identified for the German case. Some confidentiality agreements were made, but some problem still persist. Alternative sources of data secured to limited extent.

WP 3 – Development of shared flood risk strategies using a collaborative platform

The conceptual design of the web-based collaborative platform is presented below, in Figure 1. On the client side will be the interfaces for the different stakeholders for accessing all functionalities of the platform. The general design of the web user interface includes two separate panels (spaces): *main panel* - for visualisation and manipulation of flood risk information (including objectives, management alternatives and scenarios) by the individual stakeholders; *collaborative panel* - devoted to stakeholder collaboration. The two panels will be integrated in a way that enables stakeholders to simultaneously work (and progressively adjust) both individual assessments as well as those of the whole participating stakeholder group.

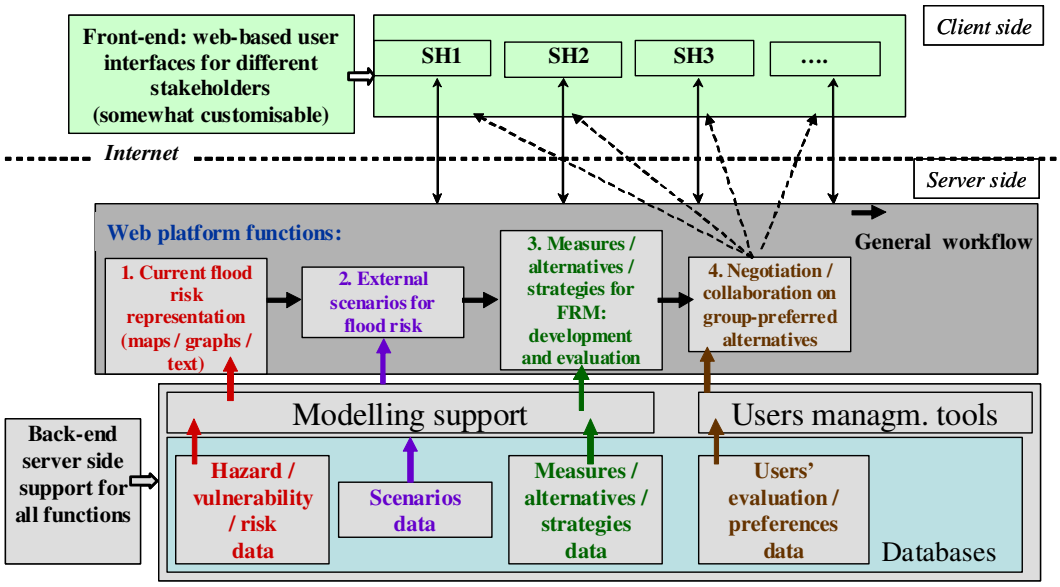


Figure 1. Conceptual framework and general workflow on the platform

The different functionalities of the platform will be served from the server side. As depicted in Figure 1, the platform will enable the workflow that follows the objectives described in previous section.

A first version of the collaborative platform with content and information for the two case studies was launched in August.

For the collaborative panel, since it is conceived to be independent from the main panel, some readily available (but customisable) tool will be used ('Collabtive', 'Google waves', or similar). For the main panel – standard technologies for web application development will be used, such as HTML, Javascript and AJAX. For the dynamic and interactive presentation of spatial information on maps, technologies such as Google Maps, Google Earth and Open Layers combined with a GIS server such as GeoServer will be used. Server side, server-side technologies such as PHP, Jason, Java and mySQL databases will be used for all data manipulation[4]. See for the detailed concept Jonoski (2010).

Discussion:

The conceptual design phase of the collaborative platform progresses well, with some small delay. It needs to be clarified that even though the conceptual design is similar, in fact there will be two separate platform implementations for the two case studies. This is necessitated by the fact that the issues and the context of the two cases are still quite different.

It may be expected that for the Alster case study the proposed conceptual design, as described here will fit quite well. There will be some technical challenges, but the main challenge will be in the organisation of the usage of the collaborative platform with large and diverse number of stakeholders. The use of German language is necessary if the collaborative modelling exercises are to be successful with the local community. For the Redbridge case study the proposed conceptual design, as described here, may need some adjustments, but the research team of DIANE-CM maintains that the adaptations that may be needed are feasible to be implemented. Apart from the technical challenges, the main challenge here will be in bringing all relevant stakeholders for flood event management together to collaboratively bring forward the novel approach proposed above towards practical implementation

The first information about the case study areas are generated for the collaborative platform. Other material will be produced during the project process.

[4] A detailed overview over the concept for the web-based platform could be found in Jonoski (2010) (D3.2).

WP 4 – Collaborative Modelling for flood risk management and enhancing awareness

A first workshop (informative session) with the most relevant stakeholders was carried out for the Redbridge case study. It was held on June 17th 2010 and in this session general information about the project and about the expected participation of the stakeholders in it was provided. Furthermore, the stakeholders shared ideas, concerns, previous experiences, etc. regarding flooding and regarding the DIANE-CM project. In Germany the workshop series has not yet started which is, however, in line with the time schedule. Nonetheless, the identified stakeholders for collaborative modelling workshops in the two case study areas (WP1) are already an important result for the design of the workshops. The design of the workshops and the whole process is currently in progress. A clear process is designed on how to go about the workshops series and activities which will end in March 2011. This is illustrated in a detailed programme and structure which shows the respective purpose and topic for each workshop, features of the platform that will be used and content ; this structure will be presented in the mid-term conference in Madrid.

WP 5 – Enhancing Resilience through Training, Awareness Raising and Dissemination

The concept, the time schedule and the outline for the e-learning material were discussed and agreed upon in the last International Working Group meeting on 28./29. June in Delft.
The input that each WP leader will provide to WP5 has been discussed and agreed upon. The necessary templates and forms for inputs during training sessions have been prepared.
A draft version of the e-learning platform has been developed and presented to project partners for initial feedback. A "Live" draft is already uploaded (http://www.diane-learning.org/)

4 Contributions to overarching questions

Connection to Floods Directive (FD)

DIANE-CM does not deal much with preliminary flood risk assessment, as specified in the requirements of the FD, since the case studies are quite localised, where preliminary analysis has already identified significant flood risks.
DIANE-CM will contribute in providing information, data, and modelling activities in order to create and improve flood hazard maps and flood risk maps. The realisation of the aspects of the FD is strengthening the role of the "receptors" i.e. stakeholders in the flood prone areas. Furthermore the project addresses individual dominant overarching issues in the three participating countries.[5]
Additional types of flood risk assessments and mapping may emerge from the stakeholder interactions planned in the project.
In the UK case study, which is within a limited scale of a small urban catchment, a novel detailed flood modelling and mapping approach will be tested, for purposes of more effective flood event management. Furthermore, in UKDIANE-CM is providing compatibility with the recommendations of Pitt Review and the intentions of the new Flood and Water Management Bill.
Not only that the project will contribute to providing information, data, and modelling activities in order to create and improve flood hazard maps and flood risk maps but it will increase the reliability of the maps at the fine scale of street and property level in urban fluvial flood management. In addition to preliminary flood risk assessment fine scale of flood risk and flood hazard maps will be used in pluvial flood forecast.

[5] In Germany the project will provide data, information and maps for the implementation of the floods directive (e.g. flood hazard maps and input for Flood Risk Management Maps). In Alster case study, the development of flood hazard maps will be carried out for 1 in100-years flood event, required by the directive, and two lower likelihood events (1 in 200 years and 1 in 500 years flood events).

Especially appropriate measures both for mid-term planning but also for event management in the case of flood will be elaborated, analysed, discussed and negotiated with stakeholders. In line with the requirements in the FD, for the Alster case study such plans will include measures for reducing flood risk categorised as *prevention* and *protection* measures (more focused on mid- term and long term planning). In the Redbridge case study, the focus will be more on *preparedness* measures (more focused on event management). The findings can be integrated in the flood risk management plans (FRMP). Risk management will include real time prediction for fine scale flood risk forecast.

Participation

Participation plays a central role in the DIANE-CM project. In order to consider all potentially affected or affecting parties an extensive stakeholder analysis is conducted in both case study areas and the horizontal and vertical collaboration and relationships are analysed.

Based on the findings of the stakeholder analysis the stakeholders are grouped, addressed according to their interest, knowledge as well as background, and included in the interactive process in cooperation with local technical partners.

The DIANE-CM project contributes a lot to strengthen public participation in the establishment of future FRMP, as a central part of the project is to test a new participatory/collaborative method for flood risk management. In particular, the approach proposed in DIANE-CM creates possibilities for alternative flood risk assessment by the participating stakeholders. The final results of the project should show if this approach indeed led to such alternative flood risk assessments that go beyond the requirements of the FD, and may potentially lead to specific adjustments in the future FRMP.

Within the communication strategy that is currently under development, creative ways of disseminating information and engaging public are being planned. An example of this is using real testimonies of people who have experienced flooding in the past within the study areas; it would demonstrate people that it could also happen to them and would motivate them to participate more in flood risk management plans (and to use the tools we are creating).

The existing perception of stakeholder participation often is that this is a costly and time-consuming process. Yet it is clearly required in the implementation of the FD. Regarding this problem the project will provide valuable recommendations on the potential of using web-based platform and tools for achieving effective and more efficient stakeholder participation.

Public authorities/institutions gain valuable lessons for active stakeholder involvement and participation processes as well as for technical approaches for improved maps and the near real time flood prediction.

In the UK, a new Flood and Water Management Act has been recently enforced which gives local authorities more responsibility regarding management of pluvial flooding. In spite of having more responsibilities, local authorities have not been given more resources to cope with it. This project (a pilot case in London Borough of Redbridge) will develop and test the methodology that can be replicated in many other cases, not only within the UK, but also around Europe.

The DIANE-CM project illustrates approaches for how authorities could include stakeholders in order to get feedback from them on risk perception and potential measures to reduce and manage flood risk.

It offers the possibility for the stakeholders to influence the processes and policies in Hamburg and Redbridge; they can influence the implementation of the FD. Furthermore this project contributes to the enlargement of the already existing stakeholder networks in the two case study areas. In addition, in the UK case study area the tools developed in this project will be taken over by the local authorities and will enable them to better deal with flood risk management and to better involve public in it.

Harmonisation

In this project, the experiences and knowledge of each of the participating countries are being improved through research and new developments and the new products are being integrated into a “common core” that can be used by each partner by customising the tools to the specific needs of each case study. This common core and the experiences collected from the implementation in our two case studies will be made

available, so that the new technologies and tools developed in this project can be implemented in many other cases throughout Europe.
The two case studies will integrate existing results from past and ongoing projects in The Netherlands (where there is no specific case study within this project). This approach will highlight the potential for development of consistent (trans-) national strategies of flood risk management. At the same time, since the case studies are quite localised, the project results will indicate the limits of implementations of such consistent approach and indeed point to some potential needs for tailor-made solutions on local scale. The first aspect, which is predominantly expert-driven and framed in the FD, will serve as point of departure in the planned collaborative modelling by the involved stakeholders. The second aspect emerges predominantly from the social/stakeholder context. Therefore the project will generate insights about the balance between the two needs through the actual process of stakeholder involvement via collaborative modelling.

Restrictions
Restrictions for broader implementation of the project results as see in the moment can be briefly summarised as follows:

- Lack of data with appropriate resolution at various levels to address the issues of pluvial flooding beyond verbal support.
- Complacency of the relevant UK central institutions (EA etc, to act timely in raising the capacity of the local institutions)
- Lack of resources of local government to fully resume responsibilities in pluvial flooding
- Problems with getting access to urban drainage data in Hamburg

Due to the in-depth stakeholder analysis in both case study areas a wide range of different social groups are considered.
Both case studies include fluvial and pluvial floods. However, Redbridge is focusing more on pluvial floods and Hamburg more on fluvial floods. In both cases coincidence between the two will be addressed. Results of the previous flooding will be used for calibration of models and for enhancement of risk assessment methodology.
The different level of flood risk awareness has to be considered. However, this shortcoming will be addressed by evaluation of the increased flood risk awareness in both case study areas along one common methodology.

Uncertainty is one of the three major challenges in risk management. The others are complexity and ambiguity (Renn 2008).

- We deal with uncertainties by working with scenario technique, meaning developing different scenarios for instance of flood hazard probability or failure of infrastructure.
- Another way to deal with uncertainties or reduction of uncertainties, respectively, is to improve the quality of (modelling) data.
- Include stakeholders and integrate different expertise, ways of dealing with events
- Improve preparedness of stakeholders and citizens in addition to identifying (and implementing) measures

5 Dissemination

Date	Place	Description
27.11.2009	Paris	Presentation of the DIANE-CM Approach on the Conference "Road Map Towards a Flood Resilient Urban Environment"
2009		Evers, M, Jonoski, A. & Maksimovic, C. (2009): Enhancing stakeholder role reducing urban flood vulnerability – the DIANE-CM approach. In: Pasche, E., Evelpidou, N., Zevenbergen, C., Ashley R. & Garvin S. (Eds.): Road Map Towards a Flood Resilient Urban Environment. ISBN 978-3-937693-12-5
20.01.2010		Web Page (http://www.leuphana.de/mariele-evers/forschung-projekte/diane-cm.html)
10.11.2010 - 12.11.2010	Hamburg	Poster at the "acqua alta" conference and fair with brief information about the DIANE-CM project
15.06.2010	Cosenza	Training course given at Cosenza, Italy, and organized by the Universita della Calabria. This course was based on the methodologies that have been developed throughout the DIANE-CM project. Maksimović, Č., Simões, N., Wang, L., Ochoa, S., McDonald, A. and Anglés, A. (2010): Advanced Modelling and Forecasting of Urban Pluvial Floods. V International Short Course "Advances In Knowledge Of Urban Drainage From The Catchment To The Receiving Water. Technical Solutions In Stormwater Management". Cosenza, Italy.
30.05.2010-03.06.2010	Davos	Presentation and paper based on the results of the DIANE-CM Project. Maksimović, Č., Simões, N., Wang, L. (2010). Modelling, Management and Prediction of Extreme Urban Pluvial Floods. International Disaster and Risk Conference (IDRC) Davos 2010. Davos, Switzerland.

6 Project Progress

WP 1- Stakeholder Analysis and vertical (top-down and bottom-up) and horizontal (multidisciplinary) interactions Work Steps: - Specification of the stakeholders and regional players - Vertical and horizontal participation diagram - Evaluation of stakeholders flood risk awareness - Concept for successful stakeholder involvement ⇨ First step completed in the case study area Alster / on-going in Redbridge ⇨ Second step to be completed on time prior to the workhops ⇨ Development of evaluation framework almost completed ⇨ Draft concept for successful stakeholder involvement almost finished Concrete reasons: - Successful implementation of DIANE-CM Approach depends on a very detailed STA. The amount of work increases particularly due to the planned involvement of citizens / the public	☐on schedule ☒behind schedule, but can easily be caught up ☐seriously behind schedule
WP 2- Data, Modelling, Mapping and NRT forecast for stronger involvement of the local champions, and providing links with the topic 2 (Event Management) of the CRUE programme Slight initial delay caused by change of RA, but this has now been offset and activities are back on track as scheduled. The 3rd level approach (German case study area) is not started yet as sewer network data not yet available.	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule
WP 3- Development of shared flood risk strategies using a collaborative platform Slight delay in the conceptual design of the web-based collaborative platform, caused by initial lack of detailed information about the stakeholders and modelling aspects in the two case studies. Implementation of the platform is now ongoing.	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule
WP 4- Collaborative Modelling for flood risk management and enhancing awareness	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule
WP 5- Enhancing Resilience through Training, Awareness Raising and DisseminationComments:	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule

Contact Details of Authors

Project partner #1 (Co-ordinator) ◄ **Prof. Dr. Mariele Evers**
Leuphana University of Lueneburg
Scharnhorstsstraße 1
D-21335 Lüneburg
evers@uni.leuphana.de

Project partner #2 ◄ **Prof. Dr. Čedo Maksimović**
Imperial College London
South Kensington Campus
GB-London SW7 2AZ
c.maksimovic@imperial.ac.uk

Project partner #3 ◄ **Dr. Andreja Jonoski**
UNESCO-IHE
Westvest 7
NL-3015 Delft
a.jonoski@unesco-ihe.org

References

Books

Methods H, et al. (2007) Flood plain modeling using HEC-RAS. Exton, Pennsylvania: Bentley Institute Press.

Renn, O. (2008) Risk Governance: Coping with uncertainty in a complex world. London: Earthscan.

Conference Papers

Evers, M, Jonoski, A. & Maksimovic, C. (2009) "Enhancing stakeholder role reducing urban flood vulnerability – the DIANE-CM approach". In: Pasche, E., Evelpidou, N., Zevenbergen, C., Ashley R. & Garvin S. (Eds.). Road Map Towards a Flood Resilient Urban Environment. Paris.

Maksimović, Č., Simões, N., Wang, L. (2010) "Modelling, Management and Prediction of Extreme Urban Pluvial Floods". International Disaster and Risk Conference (IDRC) Davos 2010. Davos.

Watson, N. Kashefi, E. Medd, W. & Walker, G., Tapsell, S., Twigger-Ross, C. (2008) Institutional and social responses to flooding from a resilience perspective, paper presented at at FloodRisk 2008. Oxford.

Reports

Floodsite (2005) Language of Risk. Project definitions. ttp://www.floodsite.net/html/partner_area/project_docs/ FLOODsite_Language_of_Risk_v4_0_P1.pdf

Gesellschaft für technische Zusammenarbeit (GtZ) (n.d.) Mainstreaming Participation. Instrumente zur Akteursanalyse - 10 Bausteine für die partizipative Gestaltung von Kooperationssystemen. http://www.gtz.de/de/dokumente/de-SVMP-Instrumente-Akteursanalyse.pdf

Jonoski, A. (2010). Conceptual design of the DIANE-CM web-based collaborative platform for participatory flood risk management. Delft. (Unpublished draft version).

Pitt, M. (2008) The Pitt Review: Lessons learned from the 2007 floods. Cabinet Office, London.

Training courses

Maksimović, Č., Simões, N., Wang, L., Ochoa, S., McDonald, A. & Anglés, A. (2010) "Advanced Modelling and Forecasting of Urban Pluvial Floods". V International Short Course "Advances In Knowledge of Urban Drainage From The Catchment To The Receiving Water. Technical Solutions In Stormwater Management". Cosenza.

2nd ERA-NET CRUE Research Funding Initiative
Flood resilient communities – managing the consequences of flooding
Interim Report

Flood Incident Management – A FRAMEwork for improvement – FIM FRAME

Darren Lumbroso, HR Wallingford Ltd, UK
Karin Stone, Deltares, The Netherlands
Freddy Vinet, GESTER, University of Montpellier III, France
Eric Gaume, Laboratoire Des Ponts Et Chaussées, France

1 Introduction

This interim report has been produced as part of the ERA NET CRUE research project entitled Flood Incident Management – A FRAMEwork for improvement (FIM FRAME). The objectives of the research can be summarised as follows:

- To assess the "effectiveness" of a sample of flood emergency plans in the UK, The Netherlands and France
- To evaluate the current tools that are used to inform flood emergency plans and the ability of these tools to support future flood event emergency planning with the main aim of reducing residual risk
- To establish how currently available tools (e.g. guidelines, models) can be used to improve emergency management plans for floods and whether there are any gaps in the tools that are available
- To provide a framework by which flood incident management can be improved that will be tested in a number of case studies

The research has been carried out in six Work Packages (WPs) as follows:

- WP1 - Effectiveness and robustness of flood emergency plans
- WP2 - Comparison of currently available tools for the emergency planning of floods
- WP3 - Development of a framework to improve flood event management
- WP4 - Case studies utilising the developed framework to improve emergency plans working together with emergency responders, emergency planners and other stakeholders
- WP5 - Dissemination of the results
- WP6 - Management and coordination

In terms of this research the terms "resilience" and "community" have been interpreted in the following ways. Resilience has been interpreted as "the ability of a community to return, quickly and easily, to normal after it has been flooded" (adapted from De Bruijn & Klijn, 2001, De Bruijn, 2005). Community has been interpreted as "a social group of any size whose members reside in a specific locality and share the same governance

structure or other social characteristics".

With reference to the FIM FRAME project the overarching aim is how emergency plans for floods can be improved to allow communities to survive and recover as rapidly as possible from the effects of floods. In the past structural mitigation measures have been put in place to reduce exposure and risk to flooding of communities. It is now widely acknowledged that flood risk cannot be completely eliminated through structural measures. The paradigm of attempting to reduce the flood risk as much as possible purely through structural measures has progressively been overtaken by a more holistic approach to flood risk management (Lagadec, 2002).

In the past decade, the emergency management of floods in Europe has placed increasing importance on developing enhanced and preparedness capacities. In this regard, the concept of emergency management has shifted from a primary focus on responding to the flood and its impacts to one of increased attention to communities to prepare and become more resilient to the impacts of floods. The capacity to respond effectively remains important, however, emergency responders and planners are looking more intently at the earlier stages of emergency planning and how plans can be improved.

2 Methods

WP 1 – The effectiveness and robustness of emergency plans for floods

An emergency plan may be defined as a "coordinated set of protocols for managing an adverse event, whether expected or untoward in the future" (Alexander, 2005). Research carried out by Alexander has found that there is an "enormous variety and lack of homogeneity" amongst emergency planning documents in many parts of the world. Alexander postulates that this implies that there is "a shortage of adequate standards [or metrics] for creating, evaluating and approving emergency plans" (Alexander, 2002, 2003, 2005) and that "virtually no appropriate standards seem to exist" (Alexander, 2005). Alexander also found that there was little in the way of metrics via which the "fitness for purpose" of emergency management plans can be assessed.

As part of WP1 the following was carried out:

- Twenty-two metrics were developed to assess flood emergency plans. These fall into six categories as follow:
    1. Objectives, assumptions and target audience
    2. Organization and responsibility
    3. Communication
    4. Flood hazard
    5. Flood risk to receptors (e.g. people, buildings, critical infrastructure)
    6. Evacuation
- Thirty-eight flood emergency plans in England and Wales, France and the Netherlands were assessed using these metrics. The development of the metrics also allowed the plans to be "scored" in a quantitative manner
- An online survey was sent to stakeholders in England and Wales, France and the Netherlands. The questions focused on the requirements for information in the plan development stage, and its usefulness and required level of detail. In total 208 people responsible for formulating and contributing to emergency plans responded to the survey
- Face-to-face meetings and consultations were held with emergency planners and responders in England and Wales, France and the Netherlands with regards to the effectiveness of emergency plans for floods

WP 2 – Comparison of currently available tools for the emergency planning of floods

Research was undertaken with flood managers in England and Wales, France and the Netherlands to gain an idea of the level of awareness that they had of the tools that have been developed and that could be potentially used to improve flood emergency plans. Stakeholders were engaged through two main methods:

- Face-to-face discussions
- An online survey that was disseminated to flood managers who contribute to emergency plans within the three countries

A review of tools that are available in the three countries and that are relevant to flood emergency planning was also undertaken. The tools reviewed fell into the following categories:

- Guidelines and checklists
- Flood hazard mapping tools
- Tools related to assessing the risk to people, vehicles, evacuations times and safe havens

WP3 - Development of framework to improve flood event management

A framework, for preparing or enhancing a flood emergency management plan, has been developed. This framework has been designed to be:

- Simple, to be applied by anyone without specific training
- Transportable, to be applied independently anywhere and by any flood emergency management team
- Generic, to allow it to be adapted by the user for their specific purpose

The framework is structured in three steps:

1. Appraise – applying the metrics to 'flag up' general issues
2. Tackle - structuring\de-structuring the process and identifying specific issues
3. Implement - taking actions forward and updating the plan

The framework has been based on methods developed by Mayon-White and Dyer (1997). Figure 2.1 shows a diagram of the developed framework.

The three steps do not need to be applied sequentially and the framework can be used by starting from any of them. For example, if no plan is in place the framework can be applied starting from step 2. If some issues have already been identified e.g. as result of a post-emergency appraisal or an exercise, then the starting point could be step 3. The framework can also be used to re-appraise a plan after its last update.

Stage 2 ('Tackle') is based on an interpretation of how the 'Business Elements Method' could be applied for emergency planning (Mayon-White and Dyer, 1997). The Business Elements Method (BEM) is a tried and tested guide for analysing any process (or event); in this case the flood emergency plan. This method consists in examining the process in terms of five factors:

- Processes and procedures
- Roles and responsibilities
- Data and information

- Tools
- Audit

Considering these elements can help to produce a clearer picture of the process, and assist in gaining an understanding of the interdependencies between the different components. This can help to identify possible issues and provide a clear understanding of how to address these and how these can affect the process if they are not addressed.

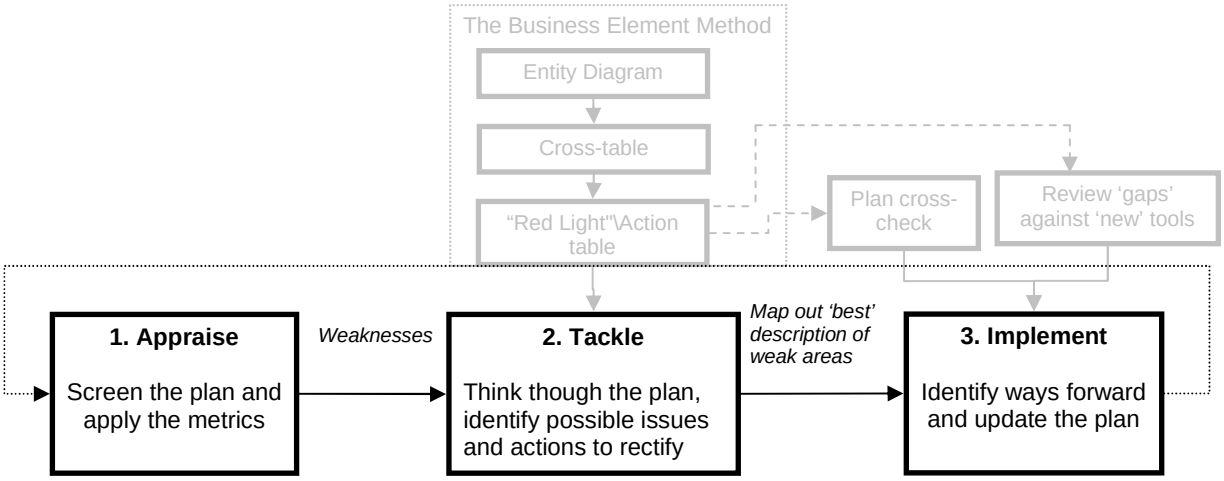


Figure 2.1 Diagram of the proposed framework

The proposed framework was tested in a workshop held with emergency planners and responders in the England and Wales. The framework will be further tested in the Netherlands and France. In the Netherlands two workshops will be organised in the coming months in cooperation with two Safety Regions of which one is responsible for the city of Dordrecht. The city of Dordrecht has been designated as case study area in the Netherlands for the FIM FRAME project. In France several workshops have been planned in the Gard Region. The outcome of the workshops will aid in refining the framework. The Framework has been set up to be generally applicable. In addition it provides an opportunity for allowing the people responsible for event planning to become more familiar with applying it.

WP4 Case studies

There are three cases studies being carried out as part of WP4. Three case studies have been selected for consideration within this work package, these are:

- Orb River basin, France
- The city of Dordrecht in the Netherlands
- The city of Sheffield in South Yorkshire in the UK

The framework produced as part of WP3 will be tested on the emergency plans for floods that have been produced for these areas. In each of the case study areas different types of floods were addressed as follows:

- Flash and fluvial floods in the Orb River basin, France
- Coastal floods in the Netherlands
- Surface water floods and dam breaks in the city of Sheffield, UK

Orb basin, France

The Orb River basin is a 2500 km^2 coastal Mediterranean catchment near the city of Beziers in southern France. Over 20,000 people are prone to floods. Ten flood emergency plans (Plans Communaux de Sauvegarde (PCSs)) have been already set up in the Orb River basin but they only partially cover the requirements of the at-risk community and need to be improved.

As part of the FIM FRAME project three French researchers have been working in the catchment. They worked closely with local emergency planners and local communities regarding the PCSs in various communes. Work has been undertaken on:

- Perception and knowledge of the PCSs in two communes of Orb River basin
- The dissemination of PCSs in the Herault Département: A survey of mayors' attitudes to the legal requirements of PCSs
- What flood risk information is relevant for emergency managers for the production of PCSs in the Gard Département

The results of this research has been published and disseminated in French to the relevant stakeholders in the case study area.

The city of Dordrecht in the Netherlands

The city of Dordrecht has a population of around 120,000. The city is located on an island which is threatened by floods from the tidal reaches of the Rivers Meuse and Rhine. Part of the city is situated in flood prone areas, not protected by dikes. The regional police and fire departments are involved in the so-called "veiligheidsregio (Safety Region) Zuid-Holland zuid". In this area the prediction times for floods can be very short. A flood will cause the island to fill up rapidly with water, because the inner dike area is below river level and large water depths are possible. Preparing for an evacuation is an important issue for this area. The emergency plan assumes a total evacuation of the island. Experts and emergency planners expect this to be an impossible task, owing to the number of people and time it would take to evacuate them.

In the case study the contribution of different evacuation options and strategies, e.g. the current strategy versus options to evacuate to safe havens within the area is being investigated. Use of new enabling technologies (e.g. dynamic evacuation and loss of life models) identified in WP2 will be applied to evaluate the effectiveness of the different strategies. The research will be carried out in cooperation with the responsible Safety Region. We will investigate how the new enabling technologies and the resulting information on evacuation possibilities would improve the response to floods and reduce the residual risk.

The city of Sheffield in the England

Sheffield is a major industrial city in the north of England that is characterised by many hills and narrow river valleys. There are a number of large dams located upstream of Sheffield many of which are over 150 years old. The city suffered badly from pluvial flooding in July 2007, which caused widespread disruption. In the nineteenth century some 300 people were killed as the result of a dam break upstream of Sheffield. As part of the research the team has been liaising with the South Yorkshire Fire and Rescue service, which forms part of the Local Resilience Forum; who are responsible for producing the emergency plan. As part of the case study application, models are being applied to simulate the impacts resulting from a dam failure, and how the resulting flood wave impacts the downstream population in terms of loss of life. These models will help to demonstrate the use of enabling technology as part of the research. The research may also consider the impacts from a high rainfall event, such as that in July 2007.

WP5 Dissemination of the results

This is covered in the section below.

WP6 Management and coordination

The project is coordinated and managed by HR Wallingford. In order to ensure good communication between the partners, regular telephone conferences have been held, as well as various face-to-face meetings between the project partners.

3 Results and discussion

WP 1 – The effectiveness and robustness of emergency plans for floods

The review of the emergency plans found that there was often a lack of homogeneity between the emergency plans. Many of the plans reviewed had what could be classed as a large amount of generic "cut and paste" text on flooding but had limited text on local or regionally specific issues. It appears from the research that many of the responders would like more specific information especially with regards to the nature of the flood hazard and the accessibility of roads to emergency services and other vehicles for different flooding scenarios. In many densely populated areas it would be relatively easy to develop such maps for different probabilities of flood events.

Metrics related to organisational aspects of the plan such as: plan activation; roles and responsibilities; communication with other agencies; and target audience and updating scored well in all three countries. However, the assumptions made by the plans did not appear to be well defined. Details of previous floods although covered reasonably well in England and Wales, and France were not covered well in the Netherlands; this probably as a result of the fact there have been no major flood events in the Netherlands since 1953.

Metrics related to the possible impacts of floods on receptors such as businesses; critical infrastructure; people; vulnerable people and NaTechs (Natural Hazard Triggering a Technological Disasters) all scored well below average in all three countries, as well as the metrics concerned with evacuation aspects. The metric covering the relationship between complementary plans in England and Wales scored "above average"; however, in France and the Netherlands this metric scored "below average" indicating that there may be a "disconnect" between different complementary plans and that if other plans are referenced there is often not a detailed or clear link provided to them.

As part of the online survey carried out the responders were asked to briefly list up to five criteria that they believed make a flood emergency management plan effective. The various responses for each country were grouped under generic headings. The top five generic responses are given in Table 3.1. In all three countries stakeholders indicated that for plans to be effective the roles and responsibilities should be clearly defined. One responder summed up that an effective flood emergency plan needed to have "*Roles and responsibilities clearly spelt out and agreed (with no assumptions made by any organisation)*".

The role of "trigger levels" also featured in many responses in all three countries. A trigger level can be defined as "an action causing the automatic invocation of a procedure". Many responders stated that for a plan to be effective clear triggers are needed to invoke actions and responses. Clarity, adaptability, accessibility and brevity of the plan were also mentioned by many responders as being important; however, the

research found that the ease of navigation of a plan may actually play a more important part in its accessibility than its length.

Information on the flood hazard was also seen as important. Responders stated that they would like to see the inclusion in plans of larger maps or maps showing more detail; maps highlighting "hotspots" and the inclusion of the flood maps on integrated GIS systems. Details of flood depths and velocities were also seen as important, as well as having a number of different flood scenarios.

Table 3.1 Criteria perceived by stakeholders to make a flood emergency plan effective

Rank	England and Wales	France	The Netherlands
1	Roles and responsibilities	Roles and responsibilities	Roles and responsibilities
2	Trigger levels	Trigger levels	Information on the flood hazard and related information
3	Information on the flood hazard	Information on the flood hazard	Clarity and accessibility of plans
4	Clarity and brevity of the plan	Adaptability and simplicity	Training in the use of the plan
5	Relationship with other plans	Training in the use of the plan	Trigger levels

The research found that there was a discrepancy between the level of details required by emergency planners and the actual level of detail that is available within emergency plans for a number of issues. This discrepancy is less critical for the metrics related to communication and organisation. It can therefore be concluded that the emergency plans do not comply with the requirements on issues related to receptors such as critical infrastructure, people and buildings.

A detailed report has been produced as part of WP1 describing the work that has been carried out. This has been appended as an Annex A to this interim report.

WP 2 – Comparison of currently available tools for the emergency planning of floods

A brief review of tools that are available in the three countries was carried out. The tools reviewed fall into the following categories:

- Guidelines and checklists
- Flood hazard mapping tools
- Tools related to assessing the risk to people, vehicles, evacuations times and safe havens

Research was undertaken with flood managers to gain an idea of the level of awareness that they had of the tools that have been developed and that could be potentially used to improve flood emergency plans. Stakeholders were engaged through two main methods:

- Face-to-face discussions and meetings
- An online survey in English, Dutch and French that was disseminated to flood managers within the three partner countries

For each of the countries the flood managers were asked about the tools, methods and guidelines that they currently use or knew of that could be of assistance in formulating emergency plans for floods.

The research also investigated what tools are actually being used by flood managers to help them inform emergency plans, and also the reasons why tools were not being used. Finally flood managers were asked to provide comments on tools, methods or guidance that could usefully contribute to improving emergency plans for floods. In England and Wales there was 53 Environment Agency staff who responded to the survey of which 39 completed all the questions. In France 77 flood managers commenced the survey with 31 people completing all the questions. It is important to note that in the Netherlands the response rate to the survey was low. There were eight responses of which five people worked for a Dutch research institute who produce tools for flood risk management.

From the research carried out many flood managers are often not aware of the tools that are available to assist them in providing information to emergency plans for floods. Based on the online survey of flood managers in the three countries, the two main obstacles to tools not being used appear to be:

1. Lack of awareness of the methods that are available
2. Availability of data

In formulating emergency plans for floods it would appear that "expert judgement" is often used rather than specific tools. Many responders to the survey mentioned that they used a combination of information rather than specific methods or tools. For example in the survey in England and Wales around half to a third of the responders stated that they were aware of or used the following methods to inform Multi-Agency Flood Plans (MAFPs):

- Accessibility of inundated roads
- Optimisation of the location of shelters
- Damage to critical infrastructure
- Optimal evacuation routes
- Effects of improvements in flood warning on the risk to people
- Methods to assess potential injuries and loss of life

However, none of the 44 responders who are involved in providing information to assist with the formulation of MAFPs explicitly mentioned any methods or tools that provide such information.

In France the awareness level of the tools and methods available would appear to be lower than that in England and Wales and the Netherlands. The lack of awareness in general may be as a result of a need to improve the dissemination of the tools and the relevant research. The lack of awareness of tools to assess the consequences of flooding or to assess potential damage has already been pointed out in many articles and reports in France (Hubert & Ledoux, 1999).

In all three countries there would appear to be a requirement for some form of guidance on what tools are available, what data they require and how they can be implemented to give information that can be used to improve emergency plans for floods.

Another detailed report has been produced as part of WP2 describing the work that has been carried out. This has been appended as an Annex B to this interim report.

WP 3 – Development of framework to improve flood event management

A workshop was held in England and Wales with emergency planners in July 2010 to:

- Present the draft framework
- Gather feedback on the framework and possible ways forward
- Provide the basis for discussion on emergency planning issues that might lead to potential actions to tackle some of the identified issues and how they could be addressed within the framework

The stakeholders at the workshop provided feedback on the next steps of the project and relative timescales. These will include:

- Reviewing the framework and running a second workshop by the end of October 2010
- Running a workshop to discuss the application of the framework in the case studies by the end of February 2011
- Updating the framework and running national events for sharing the experience of those who participated to the project, as well as gaining a broader feedback on the framework before the end of June 2011

Preparations are being made for similar workshops in France and the Netherlands to be held around October 2010.

WP 4 – Case studies

In terms of the case studies the following has been carried out:

- Data has been collected in all three case study areas
- Work has been carried out setting up initial tools in the case study areas that can be used to help assist with and improve emergency management plans. These include a Life Safety Model that can be used to assess evacuation times and the potential loss of life for various flood emergencies
- Numerous meetings have been held with stakeholders in the case study areas produced that have provided direction to the outputs
- Three reports have been produced for stakeholders in the south-west of France these are on the subjects of: Perception and knowledge of PSCs for two communes in the Orb River basin; the dissemination of PCSs in the Herault Département - a survey of mayors' attitude to the legal requirements of PCSs; A study on which information is relevant for emergency managers to produce PCS plans in the Gard Département

WP 5 – Dissemination of the results

This is covered in the section below.

WP 6 – Management and coordination

The project is coordinated and managed by HR Wallingford. In order to ensure good communication between the partners, regular telephone conferences have been held, as well as various face-to-face meetings between the project partners.

4 Dissemination

The dissemination activities that have taken place to date are detailed in Table 4.1.

Table 4.1 Dissemination of the research

Date	Place	Description
September 2009 to date	Sheffield, England	Ongoing dialogue and dissemination with stakeholders in the Sheffield case study area
September 2009	Wallingford, England	Meeting with Environment Agency flood incident staff to discuss the metrics and outputs of project
October 2009	Rome, Italy	Presentation of FIM Frame project at the ERA NET CRUE Rome meeting
October 2009	Not applicable	Project web site www.fimframe.net set up
November 2009	Ipswich, England	Meeting with emergency planners
November 2009 to January 2010	Throughout France	Face to face meetings held with emergency planners to discuss the metrics and the output of the project
November 2009	Throughout the Netherlands	Various face to face meetings with emergency planners held by the project team
December 2009	Paris, France	Meeting held with project partners to disseminate the objectives, direction and outputs of the project
December 2009	Wallingford, England	Meeting with Environment Agency flood incident staff to discuss outputs of project
December 2009	Sheffield, England	Meeting held with stakeholders in Sheffield case study area to discuss the project and disseminate the objectives
January 2010	Throughout the Netherlands	On line survey in Dutch sent to emergency managers
January 2010	Throughout France	On line survey in French sent to emergency planners
January 2010	Throughout the Netherlands	On line survey in Dutch sent to emergency planners
January 2010	Throughout England and Wales	On line survey in English sent to flood managers
January 2010	Throughout France	On line survey in French sent to flood managers
January 2010	Throughout the Netherlands	On line survey in Dutch sent to flood managers
February	Reading, England	Meeting held with Environment Agency staff to disseminate the objectives of the research and the development of the metrics
March 2010	Birmingham, England	Meeting held with UK Project Board to review project progress, particularly the WP1 and WP2 draft reports
May 2010	Not applicable	Production of report detailing WP1 work disseminated to relevant stakeholders

Table 4.1 Dissemination of the research - continued

Date	Place	Description
May 2010	Not applicable	Production of report detailing WP2 work disseminated to relevant stakeholders
May 2010	Roche Sur Yon, France	One day meeting with emergency services to discuss the use of enabling technologies and tools in the production of emergency plans for floods
June 2010	Not applicable	Production of note on proposed framework disseminated to relevant end users
June to September 2010	Gard Département, France	Various meetings with emergency managers for the production of PCSs. Report produced and disseminated in France
June to September 2010	Herault Département, France	Meetings with various mayors responsible for emergency planning. Report produced and disseminated in France
June to September 2010	Orb River basin, France	Various meetings with emergency managers for the production of PCSs. Report produced and disseminated in France
June 2010	Throughout France	Short ten page briefing note produced in French to disseminate the results of WP1 and WP2 to French stakeholders
June 2010	Sheffield, England and Wales	Meeting held with the fire service and emergency planners to discuss enabling technologies that could be used in the case study
July 2010	Ipswich, England and Wales	Workshop for testing proposed framework
July 2010	Roche Sur Yon, France	Meeting with emergency planners
July 2010	Not applicable	Paper entitled "An assessment of flood emergency plans in England and Wales, France and the Netherlands" submitted to the Journal of Natural Hazards
August 2010	Not applicable	Draft paper produced entitled "Tools to improve the production of emergency plans for floods – are they being used by the people that need them?" This paper will be submitted for publication in the Journal of Emergency Management
August 2010	Not applicable	Paper entitled "Agent-based modelling to inform flood emergency planning and management" accepted for publication in the Journal of Emergency Management

5 Contributions to the overarching questions

This section addresses the contributions to the overarching questions. These are detailed in the section below.

How does your project contribute to the implementation of a) preliminary flood risk assessment, b) flood hazard maps and flood risk maps and c) flood risk management plans?

In terms of the implementation of the preliminary flood risk assessment and the flood hazard and flood risk maps these are not applicable to this research. However, the research will contribute to the implementation of flood risk management plans. Flood risk management plans should focus on prevention, protection and preparedness (EC, 2007) this encompasses emergency plans and planning, particularly the impacts on receptors.

The results of the research undertaken to date including the online surveys give a good overview of the aspects of emergency planning that need to be improved within each of the three countries. The research has shown that often tools (e.g. software, guidelines and methods) that are available which can produce useful information to improve emergency plans are often not currently being used by emergency planners. The metrics produced by the research provides emergency planners with a simple and flexible instrument for evaluating and improving their emergency plans across Europe.

The framework brings the different tools developed within the FIM Frame project together and provides an easy to use method for evaluating and improving the emergency plans and process. These outputs will help to improve flood risk management plans.

How did you account for interests of all potentially affected parties, i.e. general public, trans-boundary parties, policy maker etc. and how did that impact your results?

From the start of the project, close contact has been kept with the affected parties. This has been done through the face-to-face interviews, through the internet surveys asking the affected parties for their input, opinion and experiences and through a number of workshops. This has resulted in a high level of participation in the research. The research has been carried out in close cooperation with the Environment Agency, the Dutch National Water Board and emergency planners in England and Wales, France and the Netherlands. The contact with the affected parties has impacted the development of the surveys used in the research and the development of the framework so that it is compatible for the needs of emergency planners.

How does your project contribute to a) strengthen public participation in the establishment of future flood risk management plans, b) valuable lessons for public authorities/institutions and c) good governance?

In all three countries the general public are currently not directly involved in the creation of emergency plans for floods. However, the framework that has been developed as part of the research could help to facilitate the process of engaging the public in the future. The project has and will contribute valuable lessons to public authorities/institutions. For example, the research has shown that at present emergency plans for floods tend to be

inconsistent and are not always "fit for purpose". The framework produced as part of the research will help to bring together the stakeholders responsible for producing emergency plans such as the Environment Agency in England and Wales, Water Boards in the Netherlands and local authorities in France. The research has also shown that enabling technologies, such as tools, the results of which can help to improve the content of emergency plans are generally not being used by flood managers and emergency planners. The case studies and guidance that are being produced as part of this research will help to improve this situation.

The principles of good governance suggest that this must be: coherent (with good communications between all parties); proportional; open (with access to information); effective; participatory and engaging. Recent flooding in Europe has highlighted that currently local responses to flood events are often too reactive and may not meet the needs of communities. Proactive action is necessary to support communities. The research has produced metrics that allow authorities to assess the strengths and weaknesses of their emergency plans. The framework provides a generic method for improving and formulating emergency plans for floods. The framework should contribute to good governance in the countries where it is being developed as many of the people responsible for the implementation of emergency plans in all three countries are elected officials.

The project will also help to contribute to good governance by helping to ensure that all the relevant stakeholders can be heard and have fair access to the decision making processes when emergency plans for floods are drawn up. The framework should enable relevant stakeholders to understand how the plan has been produced and how it can be improved.

What insights will your case studies provide to balance the drive for consistent, (trans-boundary) national flood risk management strategies and the need for local tailor-made solutions?

Although it is seen from the case studies that a wide range of flood situations occur across Europe, the way emergency planning is tackled, shows many similarities. The generic framework has been developed to support the emergency planning in a uniform manner. The survey results show that there is a concern amongst emergency planners about the lack of consistency and the gap between national and local scale emergency plans. The framework that is being produced is generic and it can be used for both national and local emergency planning, and allow site-specific parts of flood plans to be considered in more detail, whilst remaining within the bounds of the overall plan.

To what extent is the generalisation of the results restricted by context variables in the case study area, such as: a) social/socio-cultural-historical/legal-institutional/political/economic characteristics, b) the flood type and degree of awareness and c) uncertainties and the way they are dealt with?

In selecting the case studies, the project team sought to choose different types of flood hazards (e.g. fluvial, coastal, surface water and dam break floods) as well as different flood risks (e.g. people, properties). This will allow the outputs from the research to be tested against as many different flooding combinations as possible. Although there will always be an issue of the case study results not being generally applicable, the work packages do seek to draw general conclusions, based around the national flood plans in the three countries. The developed framework is designed to be generic and cut across the national differences and will provide a consistent appraisal methodology and guidance.

Contact details of authors

Project partner #1 (Co-ordinator) ◄	**Name**	**Darren Lumbroso**
	Address	**HR Wallingford, Howbery Park, Wallingford, Oxfordshire, OX10 8BA, UK**
	Email	**d.lumbroso@hrwallingford.co.uk**
Project partner #2 ◄	**Name**	**Karin Stone**
	Address	**Deltares, Rotterdamseweg 185, Delft, The Netherlands**
	Email	**karin.stone@deltares.nl**
Project partner #3 ◄	**Name**	**Freddy Vinet**
	Address	**GESTER, University of Montpellier III, 17, Rue Abbe De L'Epee Porte 4, 34090 Montpellier, France**
	Email	**freddy.vinet@univ-montp3.fr**
Project partner #4 ◄	**Name**	**Eric Gaume**
	Address	**Laboratoire Des Ponts Et Chaussées, BP 4129, 44341 Bouguenais, France**
	Email	**eric.gaume@lcpc.fr**

References

Alexander, D. (2002) Principles of emergency planning and management, Terra Publishing, Harpenden and Oxford University Press, New York

Alexander, D. (2003) Towards the development of a standards in emergency management training and education, Disaster Prevention and Management Vol. 12 No. 2 pp 113-123

Alexander, D. (2005) Towards the development of a standard in emergency planning, Journal of Disaster Prevention and Management Vol.14 No. 2, 2005

De Bruijn, K. M. and Klijn, F. (2001) Resilient flood-risk management strategies. Proceedings XXIX IAHR Congress, Beijing 2001

De Bruijn, K. M. (2005) Resilience and flood risk management: A systems approach applied to lowland rivers, Delft University Press Publication

European Commission (EC) (2007) Directive 2007/60/EC on the assessment and management of flood risks

Lagadec P. and Guilhou X. (2002) La fin du risqué zéro, Eyrolles société – Les échos éditions, 316 pages, Paris

Mayon-White W. M. and Dyer B. W. (1997) Principles of good practice for information management, BSI DISC PD0010.

Tobin, G. A. (1999) Sustainability and community resilience: The holy grail of hazards planning? Environmental Hazards 1 (1999) 13 25

2nd ERA-NET CRUE Research Funding Initiative
Flood resilient communities – managing the consequences of flooding
Interim Report

FREEMAN
Flood Resilience Enhancement and Management: a pilot study in Flanders, Germany and Italy

Irene van der Craats*, Jan Cools*, Jörg Krywkow** & Jaroslav Mysiak^
* Soresma, Belgium
** Seeconsult, Germany
^ CMCC, Italy

*Funded by Flanders Hydraulics (B), Bundesministerium für Bildung und Forschung (DE) and Instituto Superiore per la Protezione e la Ricerca Abientale, S.c.a.r.l (I) in the framework of the 2nd ERA-Net Research Funding Initiative.

1 Introduction

The objective of the FREEMAN project is to assist efforts in improving the resilience of communities in flood prone areas. The overall aim of FREEMAN is to design a framework and define indicators/measures of resilience. In doing so, FREEMAN will be able to provide guidance on the integration of flood resilience into operational Flood Risk Management – and provide practical policy recommendations to aid the implementation of the EU Flood risk Directive (FRD).

The five main objectives of FREEMAN are:

- To convey the concept of resilience to decision makers, flood managers and the general public, and help to translate its basic assumptions into flood management practices.
- To identify important factors that affect flood resilience as well as strategies and measures that increase flood resilience.
- To identify quick wins to enhance flood resilience on case study level.
- To provide guidance on the integration of flood resilience into flood risk management as a contribution to the implementation of the Flood Risk Directive (FRD).
- To spread project results to the policy level, as well as to the scientific community.

With respect to the concept of resilience followed, for practical reasons FREEMAN considers **resilience to correspond to adaptive capacity**, the latter being one of the three main components of vulnerability (as shown in Fig.1). This pragmatic hypothesis is currently being tested and is chosen as a promising approach to bring resilience into operation at flood risk authorities. It is thereby

assumed that increasing flood resilience is an additional method to reduce flood risk, and to lower the potential damage. Consequently, this will decrease the level of vulnerability.

This hypothesis is based on the fact that flood risk authorities already have experience with the first two components of vulnerability (exposure and sensitivity, as can be seen in Figure 1). Flood risk maps as a representation of exposure and flood hazard maps (estimate of sensitivity) are demanded by the Flood Risk Directive. Few operational experiences though exists for adaptive capacity, and are mostly linked to work on 'non-structural measures' or 'good governance'. By viewing adaptive capacity and resilience as one operational concept, FREEMAN aims to contribute to bringing this into practice.

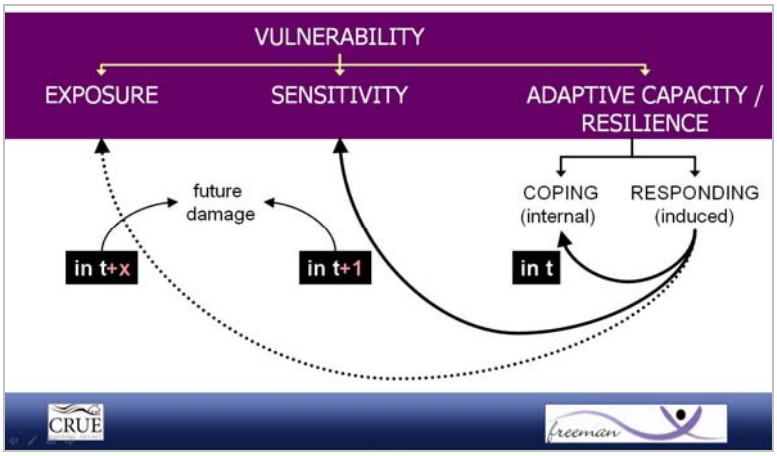


Figure 1. Resilience according to FREEMAN

With respect to definition, we consider resilience as "*the ability to cope and respond before, during and after a hazard occurs. Resilience is about returning to the original state or beyond".* Resilience is an ongoing dynamic process, which will not only return to its original equilibrium, but preferably will gradually increase and thereby bring its equilibrium to a higher level. Our definition is (amongst others) based on Cutter et al., 2008; Gallopin, 2006; Folke, 2006; Schoon, 2005, Adger et al., 2004 and Buckle et al., 2001. FREEMAN focuses on social resilience and institutional resilience, Within FREEMAN, it is considered that economic resilience is a part of social resilience as suggested by Bharwani *et al*. (2008).

The municipality is viewed as the basis of our community-resilience. We argue that people living in the same geographic entity share the needed characteristics that identify groups or communities (shared interest or stakes) (Dwyer, 2004; Maguire & Cartwright 2008). In order to improve resilience, effective interaction and coordination will involve all scales (national, sub-national, local, individual) and sectors (mainly river basin management and emergency response) involved in flood risk management is required. A further description of the target 'community' for resilience in given at overarching question 2.

2 Methods

FREEMAN consists of five work packages, out of which three are specifically aimed at measuring resilience. Work package 1 focuses on project management and the development of the overarching framework. Work package 5 consists of guidelines and dissemination. Three remaining work packages target separate yet intertwined aspects of resilience, namely risk perception and communication, flood risk modelling tools and the institutional aspects. Each work package will be executed in all three case study areas (Demer valley (B), Leine-Innerste catchment (DE) and Calabria (I)).

In order to be able to compare the different case studies and different aspects of resilience a Case Study Report (CSR) will be filled out by all partners. The CSR consists of a list of predetermined questions covering all work packages and all predefined indicators. It will measure each characteristic using several indicators. In the end, the collected Case Study Reports will give a state of the art overview on the level of operational resilience in the chosen case study areas. In the figure below a schematic overview is given of the FREEMAN approach (Fig.2).

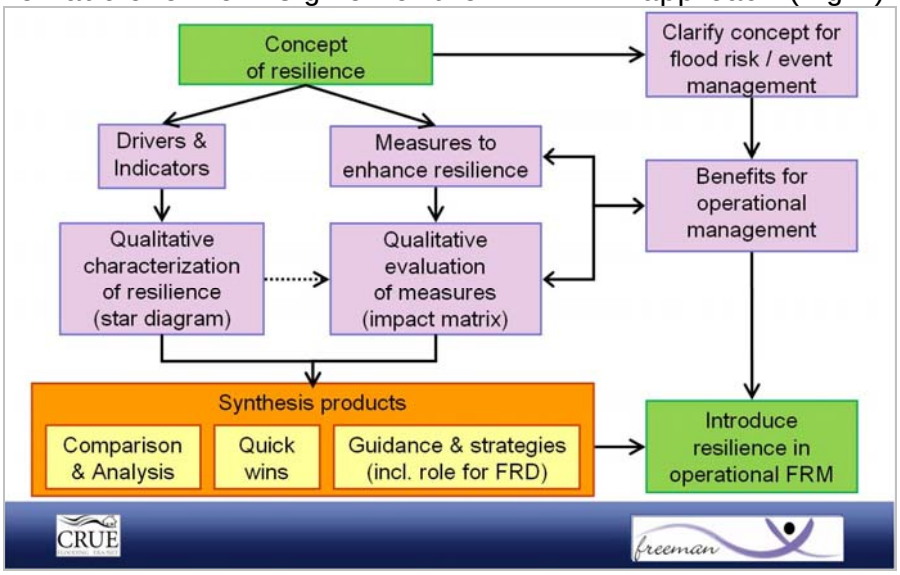


Figure 2. Methodology within FREEMAN

The progress of the separate work packages will be discussed in more detail below. Each of the work packages has been divided into operational deliverable. These deliverables will serve as the guideline for describing the progress so far.

Additionally, the main purpose is to find indicators that describe resilience and management alternatives that improve resilience. This will be done by looking at historic flood events that occurred in the past.

WP 1 – Project Management and framework development.

Project coordination

Work package 1 deals with the overall project coordination, securing the interlinkages and knowledge transfer between work packages and the development of an overarching framework. The later is an important tool in coping with the complicated nature of the project (operationalising resilience) and the interconnectivity between the work packages. Furthermore a steering

committee has been assembled to provide feedback to the project. Each project partner has engaged one or more steering committee members.

Stakeholder and project team meetings
The first successful steering committee meeting has been held in Venice in early March (2010). As a start all case study partners were expected to collect basic data on their case studies. These were shortly presented and discussed in the Venice meeting in March of 2010. Two stakeholders also presented their view on their case study area, and pointed out aspects they deemed important concerning the enhancement of the level of reliance in their area. In the coming stakeholder meeting of February 2011 more time will be spend on all this (case study characteristics, view on resilience), linking it to the preliminary results of the research conducted until then. Minutes of these meetings have been made and sent to the Flemish project officer with each progress report (three monthly).

An altered schedule for Project Team (PT), Steering Committee (SC) meeting and CRUE ERA-NET meetings has been set up. This was due to the additional planning of the not foreseen CRUE ERA-NET meetings in Madrid in Berlin which we will attend. Furthermore, during the first months of the project it was recognised it would be more useful to postpone the first SC meeting so that we would be able to present some first results. To save on travel time and budget we agreed to pre-pone the PT to that month (M7 – March 2010) as well. For the same reason the second SC meeting and 3rd PT meeting are held simultaneously in M18 (February 2011).

Meeting overview

Type	*Where*	*When (planned)*	*When (actual)*
Kick-off, project team	Ghent, Belgium	September 2009 (M1)	September 2009 (M1)
CRUE ERA-NET	Rome, Italy	October 2009 (M2)	October 2009 (M2)
Project team & Steering Committee	Venice, Italy	February 2010 (M6)	March 2010 (M7)
CRUE ERA-NET & Project team	Madrid, Spain	September and October 2010 (M13/14)	October 2010 (M14)
Project team & Steering Committee	Osnabrück, Germany	February 2011 (M18)	February 2011 (M18)
CRUE ERA-NET, Project team & Steering Committee	Berlin, Germany	August 2011 (M24)	*Assumed:* September/October 2011 (CRUE ERA-NET end meeting) (M25/26)

Build synergies with other projects
Besides securing the transfer of knowledge within our project and between the project partners, FREEMAN has been working hard to improve knowledge exchange with fellow projects dealing with resilience. For instance, in the beginning of 2010 FREEMAN participated in a scientific colloquium organised by the fellow CRUE ERA-NET project of IMRA. At the stakeholder meeting in March the project of UR-FLOOD was represented. Furthermore, knowledge exchange has been set up with the project of KLIFWA concerning the case study in Germany. Other contacts regarding discussing the operational use, definition and

measurement of the term *resilience* are part of this (for instance with the CORFU project & the MARE project).

In October of 2010 one of the partners of FREEMAN (CMCC) organises an international workshop on resilience. The scope of the workshop is to bring together a multidisciplinary audience to learn about recent attempts to introduce resilience in policies and programs that support natural disaster risk reduction. Representatives of various EC projects include CliWatAdapt, ENSURE, Water2Adapt, MEDIATION, RESPONSES, DIANE-CM and IMRA. The policy view on Resilience will be represented by United Nation International Strategy for Disaster Reduction (UNISDR), EC Directorates General for Research, UNESCO, The Academies of Science for Developing World, Wetlands International, The Red Cross/Red Crescent Climate Center and ACRA.

Overarching framework
The Overarching Framework (OF) has been developed as a guideline for the entire project. The OF describes in detail the projects view on the essential concepts of Resilience, Vulnerability and Adaptive Capacity. Furthermore it describes the methodology to be followed to operationalise resilience. A first draft of the OF is developed for the Venice meeting (March 2010, M7). An updated version is developed in August 2010 (M12). Throughout the project, it will be considered as a living document and also the basis of the guidelines which will be developed in WP5.

WP 2 – Risk perception and communication

This work package started off first, in November of 2009.

Interviews
So far several interviews have been conducted with key persons in all of the affected case study areas. Therefore a standardized semi-open interview scheme was developed. The interview scheme deals not only with WP2, but concerns all three work packages, thereby providing an holistic view on the case study. Combining the interviews will also ease the burden on the people whose input is asked for (e.g. town mayors).

Interview overview	
Case study area	*No. of people interviewed*
Flanders	13
Germany	5
Italy	+/- 40
Total no. of interviewees:	58

The total amount of people interviewed per case study differ due to the local circumstances and case study characteristics (e.g. Italy consists of two study sites, whereas the Flanders and German case study consist of one site).

Questionnaire

In order to measure the perception of the people living in the stricken areas of the floods under investigation a questionnaire has been developed. Originally the questionnaire was planned for August 2010. However, this assignment is postponed to October 2010, because essential data from the online questionnaire are missing for known reasons (e.g. delay of local events in the German case study to which the questionnaire would have been appended). An additional argument was the collection of data by means of the abovementioned interviews. By conducting the interviews good relations were established with the targeted municipalities.

Since both deliverables belonging to this WP2 are very much intertwined the team decided to change the due date of the deliverables to January 2011 (official a two month delay). The added value of postponing the questionnaire was deemed important enough to shift the due date with two months.

WP 3 – Flood event management tools

In WP3 a framework is being designed to be used for the evaluation of existing flood event management tools. In FREEMAN, we target early warning systems and (existing) flood event management plans. Currently WP3 is identifying the potential for an improved use of the tools. We consider indicators for the evaluation of tools as a proxy for indicators characterizing resilience. Next to the indicators for flood event management tools a scoring system has been set up enabling comparison between the several case studies.

WP 4 – Flood policy framework

The WP4 activities started in May 2010 (month 9). In the first phase (to be completed by October 2010) the attention is paid to the review of the existing flood institutions, i.e. flood protection policies and legislation, organisations in charge of flood management etc., in participants' countries will be examined. A framework for assessment of the effectiveness is being elaborated on the base of the insights gained from the case studies. So far, a field research is nearly completed in the Calabria region. A survey involving ca. 40 stakeholders (citizens, NGOs, public authorities) from both Soverato and Vibo Valentia has been conducted.

WP5 - Guidelines and disseminations

The next step of dissemination activities were planned for M12 (task 5.3), in form of a policy brief. It should address the over-aching framework as well as first results of the case studies. Since both were delayed, it was decided to slightly postpone the policy brief, and prepare it just in time for the CRUE ERA-NET meeting in October in Madrid.

3 Results and Discussion

WP 2 – Risk perception and communication

Results concerning the risk perception of the people is expected in January 2011. So far, it has been found that in order to have an effective crisis communication it is necessary to establish sound communication lines between all the relevant actors prior to the disaster.

WP 3 – Flood event management tools

This work package has just started, so there is no solid base for results yet. However, the first preliminary results seem to point out the importance of technical tools like an Early Warning System and open access to rainfall information contribute to the enhancement of the level of resilience. It has been shown that since the last floods in the Demer Valley response has significantly been improved. In the German case study the lack of reliable forecasting data has been mentioned as a constant concern and is needed for proper flood event management planning.

WP 4 – Flood policy framework

The WP4 started only a few months ago. The task 4.1 will be completed by September 2010. The first insights confirm the importance of analysing the past flood events within the institutional context of each country.

4 Contributions to overarching questions

Numbers correspond to those mentioned in the guiding document for preparing the Interim Report.

Connection to the Floods Directive:
1. How does your project contribute to the implementation of
a) preliminary flood risk assessment?

We do not address the assessment of flood risks in a preliminary stage.

1b) flood hazard maps and flood risk maps and
1c) flood risk management plans?
In WP3 a methodology to evaluate the existing flood event management plans will be developed. The evaluation is done both from a technical and socio-economic point of view. The evaluation will focus on increasing the utilisation of the available tools in order to generate more flood resilience rather than on technical improvements. A harmonized methodology is developed suitable for the implementation of the Flood Risk Directive (FRD) (linked to task 5.1) in cooperation with flood managers and flood experts.

In cooperation with case studies representatives, the potentials for improvements will be identified. As the current flood management tools already focus on engineering, this project will focus on socio-economic and behavioural improvements that result in an enhanced flood resilience. Through the Steering Committe (having case study representatives) and bilateral cooperation (partner-authority), the active engagement of flood managers is ensured.

Participation:
2. How did you account for interests of all potentially affected parties, i.e. general public, transboundary parties, policy maker etc. and how did that impact your results?

In the case study areas all relevant stakeholders have been mapped as a part of the case study description. This means that stakeholders from every level of

governance have been involved in the project, to some extent. An analysis was performed of the current emergency management and of the current water management structure. As for the impact on our results it was essential in creating a thorough overview of the case study set up. In flood risk management it is important to know and acknowledge all the actors, and know their position and role in this field.

In FREEMAN, we therefore consider the target 'community' for resilience at four levels (in accordance with Tapsell et al. 2010 & Fekete, 2009):

- Individual: meaning the individual person.
- Community: meaning a municipality, or system acting as a community (serving the same goals and objectives).
- Sub-national: this can be water basins, regions, provinces etc. This depends on the governmental structure of a country.
- National: meaning the national government or national based institutions and organisations.

Interview overview – actors and representatives of:		
Flanders	*Germany*	*Italy*
Fire brigade (local)	Municipality (local)	Citizens (local)
Town mayors (local)	Waterproviders (local to subnational)	Fire brigade (local)
Water authorities (sub-national)	District of Hildesheim (subnational)	Local administrations (local)
Emergency department (national)	Disaster management (subnational)	Civil protection (regional)
Emergency department (sub-national)	Flood and coastal protection agency (sub national)	Water Authority (regional)
Civil protection (national)		Environmental NGOs (regional)

3. How does your project contribute to
a) strengthen public participation in the establishment of future flood risk management plans?
It does not aim to strengthen public participation, though the evaluation of existing plans could reveal that an increased public participation from the beginning is relevant. Additionally, the questionnaire conducted in WP2 could provide useful insights with respect to the public perception and potential needs for participation.

3b) valuable lessons for public authorities/institutions and
3c) good governance?
A questionnaire will be conducted with the aim to reveal the specific communication requirements of vulnerable citizens. Afterwards, an action plan for communication at case study level is designed and addressed to citizens and authorities. The main aim is to clarify the role of the authorities for citizens as well as the citizens' own responsibility. The existing flood forecasting tools are evaluated in-depth in task 3.3 and recommendations given to improve the utilisation of flood forecasting tools.

By involving the organizing actors like municipalities, water authorities and crisis response units the project can find indicators contributing to good governance and best practices.

Harmonisation:
4. What insights will your case studies provide to balance the drive for consistent, (trans-) national flood risk management strategies and the need for local tailor-made solutions?

FREEMAN aims at finding ways to make resilience operational. For more details, please look at Fig. 2 in this document.

Restrictions:
5. To what extent is the generalisation of the results restricted by context variables in the case study area, such as:
a) social/socio-cultural-historical/legal-institutional/political/economic characteristics,
b) the flood type and degree of awareness and
c) uncertainties and the way they are dealt with?

We expect to reveal this restrictions through the questionnaires, interviews and forthcoming analysis and comparison across case studies.

5 Dissemination

(use the following table)

Dissemination up to and including August 2010

Date	Place	Description
September 2009	-	First multilingual brochure on FREEMAN
October 2009	Rome, Italy	CRUE ERA-NET meeting
October 2009	Brussels, Belgium	EC Coordinators Meeting
January 2010	-	Website online and operational
January 2010	Wuppertal, Germany	Scientific Colloquium IMRA project
March 2010	Venice, Italy	Stakeholder meeting, invited UR-FLOOD project present
July 2010	Brussels, Belgium	EC Coordinators meeting

6 Project Progress

(Indicate the progress of each work package against the agreed project programme and explain the reason for the delay.)

WP 1- Project Management and framework development Reason for delay: Comments:	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule
WP 2- Risk perception and communication Reason for delay: • Apart from the interviews a questionnaire aiming to identify resilience indicators as well as flood risk perception of individuals and households in the targeted communities, is required. The implementation of this online (and paper version) questionnaire was planned in parallel with the celebration of the start of local dyke building activities. This event never occurred, so that the questionnaire was published after the holiday period in August 2010, and will be closed by mid September. A questionnaire of citizens of targeted communities can only be successful in close co-operation with the local authorities. Comments:	☐on schedule ☒behind schedule, but can easily be caught up ☐seriously behind schedule
WP 3- Flood event management tools Reason for delay: Comments:	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule
WP 4- Flood policy framework Reason for delay: Comments:	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule
WP 5- Guidelines and disseminations Reason for delay: Comments:	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule

Contact Details of Authors

Soresma (coordinator) ◄ **Irene van der Craats**
Jan Cools

Poortakkerstraat 41
9051 Gent
Belgium

Irene.vandercraats@soresma.be
Jan.cools@soresma.be

Seecon Deutschland GmbH ◄ **Jörg Krywkow**

Wissenschaftspark Osnabrück
Sedanstrasse 61
49076 Osnabrück
Germany

jkrywkow@seeconsult.org

Centro Euro-Mediterraneo per i Cambiamenti Climatici S.c.a.r.l. ◄
Jaroslav Mysiak
Via Augusto imperatore 16
73100 Venice
Italy

Jaroslav.mysiak@cmcc.it

References

Adger, W. N., Brooks,N., Bentham, G., Agnew,M.,Erikson, S. (2004). New indicators of vulnerability and adaptive capacity, Tyndall Centre for Climate Change Research. Technical Report 7**:** 128.

Bharwani, S., Magnuszewski, P., Sendzimir, J., Stein, C. & Downing, T.E. (2008). *Vulnerability, adaptation and resilience: Progress toward incorporating VAR concepts into adaptive water resource management. Report of the NeWater project.* Oxford: Stockholm Environment Institute.

Buckle, P., Marsh, G., Smale, S. (2001). *Assessment of Personal & Community Resilience & Vulnerability.* Report EMA Project 15/2000.

Cutter, S. L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., Webb, J. (2008). A place-based model for understanding community resilience to natural disasters. *Global Environmental Change, 18(2008)*; 598-606.

Dwyer, A., Zoppou, C., Nielsen, O., Day, S., Roberts, S. (2004). *Quantifying Social Vulnerability: A methodology for identifying those at risk to natural hazards.* Australian Government, Geoscience Australia Record 2004/14**;** 92.

Fekete, A. (2009). Validation of a social vulnerability index in the context to river-floods in Germany. *Natural Hazards and Earth System Sciences (9):* 393-403.

Folke, C. (2006). Resilience: The emergence of a perspective for social-ecologhical systems analyses. *Global Environmental Change*, *16(2006);* 253-267.

Gallopin, G. C. (2006). Linkages between vulnerability, resilience, and adaptive capacity. *Global Environmental Change, 16(2006)*; 293-303.

Maguire, B. & Cartwright, S. (2008). *Assessing a community's capacity to manage change: a resilience approach to social assessment.* Canberra: Bureau of Rural Services.

Schoon, M. (2005). *A short historical overview of the concepts of resilience, vulnerability and adaptation.* Bloomington: Indiana University.

Tapsell, S.; McCarthy, S.; Faulkner, H. & Alexander, M. (2010). *Social vulnerability to natural hazards.* Flood Hazard Research Centre, Middlesex University.

2nd ERA-NET CRUE Research Funding Initiative
Flood resilient communities – managing the consequences of flooding
Interim Report – revised

*IMRA – Integrative flood risk governance approach for improvement of risk awareness and increased public participation**

Silvio Bagnini (AB Tevere), Alessia D'Andrea (IRPPS-CNR), Giovanni Fangucci (AB Tevere), Carlo Ferranti (AB Tevere), Katja Firus (T6), Mark Fleischhauer (TUDO), Stefan Greiving (TUDO), Patrizia Grifoni (IRPPS-CNR), Tiziana Guzzo (IRPPS-CNR), Gernot Kobotschnig, (AKL), Susanne Korber (Revital), Paola Malvati (AB Tevere), Marc Scheibel (Wupperverband), Norbert Sereinig (AKL), Therese Stickler (Umweltbundesamt), Valentina Vitale (AB Tevere), Sylvia Wanczura (TUDO)

*Funded by Bundesministerium für Bildung und Forschung (BMBF, D), Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (BMLFUW, A) and the Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA, I) in the framework of the 2nd ERA-Net Research Funding Initiative

Table of contents

Tables

1 Introduction

This interim report is only a short summary of the project results. The full version of this report as well as the complete set of deliverables and additional documents can be downloaded from the ERA-Net CRUE researcher area.

1.1 Background and objectives

As the call on "Flood resilient communities – managing the consequences of flooding" (2nd ERA-Net CRUE Funding Initiative) stressed, "*a particular challenge for governmental institutions and water authorities is to strengthen public participation in the establishment of future approaches to flood risk management [cf. Article 10 of the Floods Directive].*" This becomes necessary in particular in context of setting up flood risk management plans in accordance with Article 7 of the Floods Directive. This public participation does not end in itself and is much more than just an information campaign with regard to final results. This becomes clear when looking at § 2 of Article 10: "*Member states shall encourage the active involvement of all interested parties into the production, review and updating of the flood risk management plans.*"

Decisions in the area of so called "traditional" risks like flooding are normally based on probabilities because they are past-oriented and informed by statistics. Climate change related effects on temperature and precipitation, however, will certainly lead to new uncertainties, because past events might be not representative anymore. Here, the perspective changes from probabilities to just possibilities. With public decision-making not having any precise information at hand, restrictions for private property rights are probably not legally justifiable anymore. Hereby, consensus about thresholds and response actions becomes more important. Moreover, measures, based on mandatory decisions of public administration as well as measures which are in the responsibility of private stakeholders need to be accepted widely for their implementation. This is clearly visible when looking at evacuation orders, building protection measures to be taken by private households, risk awareness etc. Having these facts in mind, the "active involvement", propagated by the Floods Directive, has to be seen as crucial for the success of the Directive's main objective, the reduction of flood risks.

The overarching goal of the IMRA project is to influence and change real decisionmaking in the addressed case study areas and to produce best practice examples which could serve as references for other authorities dealing with flood risk management plans in Europe. Moreover, a practical handbook which contains the main lessons learned from the project will be the second main result of benefit

for Europe in general and further countries/authorities facing the given risk setting.

The following research questions, raised by the call, will be addressed by the project:

- What is the relationship between true flood risk and the public's risk perception? What factors determine this relationship? What are the implications for FRM policy?
- How can public participation in flood risk management be increased through better risk communication and greater risk awareness?
- How can participation in the establishment of FRM plans be encouraged and improved as a feature of "good governance"?
- What can institutions learn from improved understanding of risk communication approaches, tools and techniques? How can this learning be applied to improve the effectiveness of communications to the public (across a range of FRM activities, e. g., mapping, planning, event management etc.)?

The research questions will be answered along selected case studies in Austria, Germany and Italy. In all case studies the following working steps will be commonly carried out in order to guarantee for comparable results:

- **Step 1:** Inventory of existing data with regard to the so called "true flood risk" based on scientific risk analysis and assessment.
- **Step 2:** Surveys and discussions on risk perception at the stage of the beginning of the project's work, in the middle and at the end of the project.
- **Step 3:** Assessment of the performance of the existing management systems in terms of attention paid to risk governance principles.
- **Step 4:** Regional workshops.
- **Step 5:** Communication strategy.

Moreover, due to an evaluation of the case study work, effects of improved risk communication in practice, which includes communicating residual risks, will be analysed.

WP 1 aims at the development of a scalable resilience and "multidimensional integrative risk governance concept", taking into account existing discursive approaches, carried out in particular by Science and Society projects like STARK, TRUSTNET-IN-ACTION, RISK NETWORK, RISKBRIDGE and MIDIR (see list of references for further information on these projects). The IMRA project builds upon these research projects as risk governance is the main objective of the

project. Further, there have been several other EU funded Projects in the area of floods in which, although the main subject was focussed on measurement and forecasting, workshops with institutional and public stakeholders were organised (Carpe Diem, Music, etc.). These results will be collected and analysed for the further development of the communication strategy. Other aspects such as flood forecasting and warning systems etc. however are touched in selected sections of the deliverables but do not belong to the project objectives.

The project rather focuses on the question how to get the right information to the people and to increase their willingness to take on own/private actions to flood risk management in addition to the public actions. Nevertheless, involving the general public by explaining the impact and reduction of risk due to flood warnings and how flood warnings should be perceived and interpreted plays a certain role in the activitie for the public, too.

IMRA will thus build a bridge between different disciplines engaged in risk governance.

The work is organised in two tasks:

- Task 1.1: Development of concept for participatory flood risk management aiming at the improvement of risk awareness and increased public participation and verification with external experts,
- Task 1.2: Adjustment of concept for participatory flood risk management process to the different legal, administrative and cultural environments, covered by the project.

What is needed for implementation on the ground is a benchmarking and monitoring tool in order to assess the performance of a flood risk management system in regard to ideal risk governance principles. The most important commonly accepted risk governance principles in Europe were recently identified in the 6th FP project MIDIR ("Multidimensional Integrated Risk Governance", see Wanczura et al., 2007) and have now been further developed for IMRA. In addition, guidelines how to improve the performance of management systems and how to take care of better public involvement and risk communication, will be elaborated. In doing so, the possibility to implement different measures, defined in flood risk management plans, can be considerably improved. IMRA wants to make sure that communication and governance strategies are in the core of the overall flood risk management.

The further development of the existing conceptual frame from the MIDIR project was in the focus of Deliverable 1.1 in particular by analysing methods for identifying the interests of the affected stakeholders. Stakeholder involvement is

especially addressed in the above mentioned indicator system by the key performance indicators “Representation”, “Information”, and “Dialogue”. In this context the main questions are:

- Who are the relevant stakeholders?
- What are their interests and expectations?
- What kind of information is relevant for the stakeholders?
- What kind of dialogue process is suitable/applicable for stakeholder involvement?

A preliminary version of the concept was discussed among the consortium, but also with external experts, representing the flood risk community, but also research in risk governance. A Scientific Colloquium was held for this purpose on 15 January 2010 in Wuppertal, Germany. On the basis of the collected feedback at the Scientific Colloquium, the concept was adjusted and released in its final draft.

Based on the identified needs of the end-users of the project results, represented by the involved water management authorities, the concept has now been and still will be adapted to the special characteristics of flood risks and the legal, administrative and physical environments, the case study areas are characterised by.

1.2 Definition of terms

1.2.1 General terms on flood risk management

A first consensus among the IMRA project partners was already reached concerning the definition and mutual understanding of some central terms during the kick-off meeting. In addition, other relevant terms are discussed in the following section. These definitions can be seen as a basic glossary for the internal project work. The glossary may be extended whenever needed.

Stakeholders and the public

Neither normative concepts like sustainable development or “Good Governance” nor the European Water Framework Directive do specify what public participation or the participation of users means in detail.

The **public** means “everybody”: an open and more or less unlimited group of persons that are affected by or interested in a topic or a project/a process. A good

example of such an unlimited circle is the term "water users" – no one can be excluded from that description. To differentiate between the public as a whole and more or less organised parts of the public very often the terms "broad public" for all citizens and "stakeholder" for representatives of organised interests or the administration are used.

Stakeholder is a much used term and can be used in a narrow sense of the word or with a broader understanding (Carina and Keskizalo, 2004). Sometimes "stakeholder" is used for groups with a specific long-term objective and a clear institutionalised organisational structure (= organised public e. g. chambers). Often organisations of civil society like human rights and environmental organisations (NGOs) are included in this understanding. In scientific projects the term stakeholders is often used for representatives of the institutionalised public and of (non-institutionalised) organised interest groups. In contrast, the Intergovernmental Panel on Climate Change (IPCC) or the World Bank have a broader understanding of the term stakeholder: it is everybody that is affected or interested by a project/activity.

It is recommended to make clear what the term "stakeholders" should describe from the beginning of the project. Within the project CRUE-IMRA we distinguish between two groups of stakeholders:

- **(Institutional) stakeholders:** Those (organised) groups that represent specific interests ("stakes"). These can be (a) formal decision-makers that are involved in flood risk management in the case study areas and that have official tasks ("administrative" or "decision-making" stakeholders) and (b) those that influence decisions more indirectly (interest groups, NGOs etc.). Institutional stakeholders will be addressed in Step 3 of the methodological approach in WP 2.
- **Public:** The institutional stakeholders have to be distinguished from other stakeholders such as the public/local citizens. These stakeholders will be addressed in Step 2 of the methodological approach in WP 2. When addressing the public with a communication strategy it is important to address the different groups within the public specifically. E. g., older people that still remember flooding events of the past have to be addressed differently than younger people or people that have just moved to a hazard-prone area and that are not at all aware of the flooding hazard. Stakeholders and the broad public can both be involved in public participation projects; but not necessarily at all stages of the project and in the same intensity.

Hazard and risk

The definition of "hazard" and "risk" in the IMRA project follows the understanding of these terms in the risk management research community. The terms flood and flood risk are explicitly defined in the Floods Directive 2007/60/EC (Article 2):

- **Flood risk** means the combination of the probability of a flood event and of the potential adverse consequences for human health, the environment, cultural heritage and economic activity associated with a flood event.
- **Flood** means the temporary covering by water of land not normally covered by water. This shall include floods from rivers, mountain torrents, Mediterranean ephemeral water courses, and floods from the sea in coastal areas, and may exclude floods from sewerage systems.

Flood (as the natural hazard) in combination with the potential negative consequences (often described as damage potential) thus result in risk. This can be shown in the following equation (UNISDR 2004, p. 36; 41):

Risk = Hazard potential (Probability x Magnitude) x Damage potential / Coping Capacity.

The term "hazard", however, is not explicitly defined in the Floods Directive but there are appropriate definitions used in literature, e. g.:

Hazard is a potentially damaging event, phenomenon or human activity that may have a negative impact on cultural, economic, environmental, institutional, physical or social assets. Hazards may include latent conditions that represent future threats and can have different natural or human-induced origins. Hazards can be single, sequential or multiple in their origins and effects, which can be biological, geological, hydrological, atmospheric, social, psychological or technological. A hazard is characterised by its location, magnitude, frequency and probability.

Following the equation above we can, for example, have a probability (e. g. once every 200 years) for an event (e. g. a flood) the magnitude (height of water level), the damage potential (possible economic or social damage or loss) which will be alleviated by response actions like mitigation and reaction measures which are in their quality determined by the coping capacity (e. g. by poverty, lack of insurance, lack of relief schemes and early warning systems, competent planning efforts, self-help networks and "social capital" etc.).

1.2.2 Resilience and community

An overarching question for all ERA-Net CRUE projects is how the terms "resilience" and "community" are interpreted and used within each of the projects.

Resilience can be very broadly defined as the ability of a system to maintain its functions under duress than as its direct resistence to stresses or shocks. In the context of the IMRA project resilience can be understood as the capacity of a society or region to absorb stresses and shocks such as natural hazard impacts. Here it should be stressed that resilience (of a community) goes beyond the scope of the above mentioned definition because it encompasses another – spatial and societal – dimension.

Community can also be defined in a narrower or wider way. A narrow definition would restrict members of a community to those people who live inside certain administrative borders (e. g. a town or district). A wider definition in the context of flood risk would encompass all those that are directly or indirectly potentially affected by flood risk, i. e. a group of people that have in common that they are somehow exposed to flood risk and/or will have to be involved in flood risk management activities.

In the IMRA project we will use the broader definitions of these terms.

2 Methods

As in all applied research a variety of methods was used in the different project phases, starting from desk top research to more advanced approaches to stakeholder involvement or survey techniques. The methods that were used in the IMRA project so far are described along the workpackages. As WP3 has not started yet there is no description of the methods in this WP so far.

2.1 Development of conceptual framework (WP1)

In the first project phase **explorative reading** was carried out to validate the research design and to derive first working theses. This first phase was followed by an intensive **desktop research** on available literature and good or best practice results in order to gather information about the state of the art and successful approaches to flood risk management and governance. This phase was accompanied by **explorative interviews** with selected external stakeholders (e. g. representatives from municipalities) as well as with those stakeholders that

are directly involved in the project (representatives from the river basin authorities responsible for the rivers Wupper, Möll and Chiascio).

The first project phase ended with the compilation of the draft version of the IMRA conceptual framework. This draft version was then sent to a selected group of researchers for **external review**. These experts were asked to comment on this version and to discuss about the conceptual framework and the project approach in a **scientific colloquium** which was held in January 2010 in Wuppertal, Germany.

2.2 Implementation of concept in case study areas aiming at analysing the effects of improved risk communication and perception of residual risk (WP2)

In WP2 the proposed concept for participatory flood risk management is being implemented in three case study areas: the river Wupper in Germany (Task 2.1), the river Möll in Austria (Task 2.2) and the in Chiascio river basin, a feeding river of the Tevere, in Italy (Task 2.3).

The implementation in the three case study areas follows a common work plan in order to guarantee for comparable results. Thereby, the applicability of the used methodology in different environments can be tested. The work plan follows the one outlined in the project proposal using very different methods:

- Step 1: Inventory of existing data with regard to the so called “true flood risk” based on scientific risk analysis and assessment: **desktop research, analysis of historic photographs, quantitative flood risk models**;
- Step 2: Surveys and discussions on risk perception at the stage of the beginning of the project’s work, in the middle and at the end of the project: **questionnaires (written, oral and online), qualitative interviews, public meetings**;
- Step 3: Assessment of the performance of the existing management systems in terms of attention paid to risk governance principles: **tailored assessment tool (based on balanced scorecard approach with selected key performance indicators)**;
- Step 4: Regional workshops: **stakeholder and public workshops**;
- Step 5: Communication strategy: **desktop research, analysis of best practice examples, qualitative interviews**.

The steps and their theoretical background are described in detail in Del. 1.2. This deliverable is the basis for the work in the case studies.

2.3 Networking and dissemination activities (WP4)

WP4 supports the activities of all other work packages assuring a strong awareness of project objectives and results to the main project audiences: the scientific community and national, regional and local decision makers in the field of flood risk management. The activities and the related products of this WP will follow, step by step, all the achievement of previous WPs, translating into dissemination actions the results reached by the tasks.

The activities of this WP are divided into three different tasks, using the following methods:

- Task 4.1: Dissemination: **project branding, leaflets, publications, practical handbook**;
- Task 4.2: On-line presence: **IMRA website and case study websites**;
- Task 4.3: Networking: **participation in conferences, invitation of other ERA-Net CRUE researchers to scientific colloquium, send information to co-ordination unit**.

2.4 Project Management, Monitoring and Evaluation (WP5)

WP5 is dedicated to project management and the project's monitoring and evaluation. In this WP the following methods are used:

- Project management: **e-mail list, project meetings, internal review of draft versions of reports**;
- Monitoring/evaluation: **assessment of the achievement of project goals and milestones (table), possibility to apply balanced scorecard approach to project)**.

3 Results and discussion

A tailor-made communication is indispensable in order to raise the awareness of the given flood risk, but also to interest stakeholders and the general public in participating actively in the process as requested by the Floods Directive. The IMRA partners discussed planned activities and common strategic elements during

the project meetings in Wuppertal (January 2010) and Großkirchheim (May 2010). It was decided to collect and systematise observations, experiences, "emotions" etc. during the project work in order to have them ready at hand once the handbook will be designed. (WP4) Consequently TUDO prepared an open document where every partner can add relevant elements regularly. It will help to streamline common findings and relevant elements for the envisaged handbook towards the end of the project.

For the second project year IMRA plans to continue with the active involvement of the institutions and authorities that are in charge of FRM (as designated by the Floods Directive) in the case study areas. These institutions have already been involved by stakeholder workshops and supplied with further information about the project. This will be carried on until the end of the project work.

Further, at the project end, a "light version" of the methodology will be available and applicable for the research community.

3.1 Strategic elements of a communication strategy

Main aspects

Strategic elements of a communication strategy identified so far are:

- Make people feel concerned: they must understand that flood risk is something that really is relevant for them and not just an administrative exercise;
- manpower/money as limited resources; effectivity of measures;
- before – after: different perceptions to the topic before or after an event;
- evaluation of communication material: question which material really improves risk perception;
- involve people emotionally (positively!), e. g. by involving witnesses, but: do not make people afraid but raise awareness;
- close to people/key persons: involve interested people into the process and develop strategy in close cooperation to stakeholders and public;
- some striking/prominent examples/people (max. 2-3 people; "doku soap" as a typical newer format in the media to combine facts and fiction).

Other aspects:

- We only look at very small case study areas – in normal life not all areas can be covered in such an intensive communication process.

- Important to involve stakeholders in approach and communication strategy because this increases the acceptance of the approach and they give valuable input to communication elements, how to design the approach and have insider information about the local public, political situation, structure of land owners etc.

In regard to communication activities the following was collected: There are two objectives of a communication strategy: (a) inform the general public and politicians and (b) reach affected people. The communication strategy thus is – of course – very much case study related.

Planned activities:

- Local contact point (A);
- Direct support to house owners/land owners in flood risk areas (G);
- Work with schools (A, G, I): Schools in flood-prone areas; pupils, teachers as multipliers; experts go to schools and/or prepare materials for education; training for teachers;
- Multimedia presentation (I);
- Fire brigade/civil protection training (local) (A): although target group consists of local actors the training has to be organised by regional stakeholders;
- Social media (I);
- Exhibition (A, [I]);
- Fire brigade exercise (suggestion: enlarge it to all actors) (A);
- Articles in local newspapers on project activities (G, A, I);
- Articles on flood risk in specialised magazines (e. g. home owners associations magazine, chambers of commerce newsletters) (G);
- Flyer on flood risk/project: a mix of both might be reaonable (A, G, I);
- Meetings with the public: for the project this could be also done during the 2nd round of workshops in the case study areas (I, G, A).

3.2 Important aspects for the implementation of the communication strategy in case studies

Germany:

- General interest exists but quite low (about 12 % responses to questionnaire;
- Interest in topic depends on previous experiences with water related events (water in basement, historic events);
- Younger people seem to be less interested;
- Maybe need to contact schools and address teachers and pupils for communication strategy;
- Maybe also social networks could be an interesting way to address younger people;
- First results of survey show that newspapers, internet and public meetings/exhibitions are the most wanted information channels;
- People often mentioned that there is no one that helps in case of a flood event;
- so there obviously is a need to inform about what official institutions can do and what not;
- further there is a need to improve self-help and responsibility.

Austria:

- Activities like information campaigns in schools or disaster training for the fire brigade were rated higher than information material/articles (the classic output of scientific projects);
- One result of the stakeholder workshop was that flood risk is not seen as a singular item but in connection with other natural hazards like avalanches and land slides;
- People in Großkirchheim are more concerned about future land slides than about floods. The main problem with land slides is that the geologic situation is changing quite fast and that activities approved two years (e. g. for the Eggerberg) ago are seen as not actual anymore. The devastating floods in the past were connected with land slides.

Italy:

- The presentation of the topic of flood risk in general contributes already to an awareness raising of the importance of the topic, especially at the stakeholders in the public administration. This became obvious from the several meetings;

- Key people who have a particular interest in the topic (as e. g. the technician of the municipality of Assisi or some teachers in schools) are of high importance to promote any activity and involvement;
- Participation has a large range of possibilities for activities. Participation of stakeholders in the form of roundtables is a common practice (and legally binding) for the acceptance of the Hydrogeological Setting Plan. On the contrary the involvement of the general public in the set-up of plans is a new concept. At the moment it is still not relevant, as the plans are all in place.
- However, once the plans will be updated (by 2020) a defined process has to be put in place. This was an outcome of the stakeholder workshop;
- Another outcome of the stakeholder workshop was that working with schools is an effective way to reach the general public;
- The first results of the questionnaire show that the public expects more information and involvement on the topic. Therefore the planned public events and the exhibition as well as information material are a good idea;
- The structural flood protection measures (the dam) have the effect that people are feeling completely safe. A specific focus should therefore be put to the residual risk, without provoking fear.

3.3 General comments and observations

After the first months of the work in the three case studies it is possible to make a first analysis and observations.

Problems and hindrances

The analysis of problems and hindrances is dependent from the local situation and individual attitudes. No pattern could be established, however some common elements could be identified that will be taken into consideration for the validation of the concept.

Common observation in all three case studies

Three surveys within 20 months: Three surveys on the flood risk perception of the local population were planned. All case studies chose to perform a questionnaire. It turned out that it will be difficult to receive a significant number of replies on the questionnaire when disseminating it three times. Therefore case studies might

decide to do it only twice, at the beginning and at the end of the case study activities. The third survey might be implemented be other means, e. g. by a focus group on the impact of dissemination material.

Germany:

- Difficult to motivate stakeholders to answer to an external estimation of the Wupperverband's work in Step 3;
- Stakeholder workshop showed that responsibilities are not exactly defined, that there is a need to communicate among stakeholders.

Austria:

- We received negative feedback from interviewees and stakeholders concerning a three-time survey with the same persons within the short timeframe of approximately 1 year. Therefore the project team decided to use the resources foreseen for the mid-time-survey to perform the workshop "comprehensibility of available information material".
- Interviewees were first reluctant to give their names, even with the assurance by the interviewer that personal data would not be made public and all answers would remain anonymous.
- Information about flood risk in Großkirchheim on the internet was declined by the mayor because of possible negative impacts for tourism.
- Reluctance of some parts of the administration to open the planning process at the expert level to the public or representatives of the public.

Italy:

- Already during the very first meeting with the representatives of the concerned municipalities it became clear that the case study area is huge and that their interests and pressing topics are very diverse. In fact the case study area with a largely distributed population. This means that many actors to be contacted and activated which costs a lot of effort of the IMRA project team;
- The flood risk management plan of the Chiascio river basin is already defined and approved. Therefore public participation is more on perception and awareness, less on active participation in definition which is reflected in the communication activities that we planned so far.

Surprising results

Germany:

- People approve very much information by public authorities. They like the dialogue and they like to tell their stories/experiences;
- Quite a lot of newspaper articles and even a short radio reportage;
- People are less afraid of talking about the topic (potential flood risk, residual risk) than thought before;
- Not surprising but should be mentioned: People do not want to talk about strategies or concepts but want to know exactly if their home is affected in case of an extreme event and how severe it may be affected.

Austria:

- Questionnaire:
  - Many people are not used to surveys and need translation;
  - The interviewees did not want more information about flood risk (no: 44, yes: 18, only about community risk: 7).
- Stakeholder Workshop: The most surprising result of the stakeholder workshop was the information that the fire brigade has absolutely no training concerning flood risk prevention and flood emergencies. They are mainly equipped for the cleanup activities. Training activities together with the police and other institutions concerned with civil protection are needed. Especially in Großkirchheim were the last floods happened 45 years ago and no actual experience with dealing with floods is available. Such training activities and a pilot project for a natural hazard commission will be discussed with the stakeholders within the next few months.

Italy:

- The municipality with highest flood risk is the less active and interested in the IMRA project and activities;
- Up to now there is a higher interest from civil protection than from planning municipal level.

Assumed challenges for future project work

Germany:

- Keep the interest of the people at a high level;
- Find ways to address the information people want and need to them adequately.

Austria:

- High expectations by the stakeholders:

  In the first stakeholder workshop and in informal talks a lot of ideas were born. Within CRUE-IMRA only one extensive dissemination activity – the exhibition – could be financed. Other good ideas like the flood risk planning for children have to have financed and organised additionally to the ongoing IMRA project activities;
- Access to and better comprehensible information material;
- Many people see no personal responsibility (prevention, adaptation, financing) concerning flood risk.

Italy:

- The main challenge for the future work in the project is to activate people to participate in the communication activities. To ensure this, one main focus is on the work with school children.

Assumed challenges for public participation in the implementation of flood directive

Public bodies in charge for the implementation of the flood directive lack of internal expertise, time and resources to implement and accompany a useful public participation process. They need external expertise for this. In the IMRA project, this is provided by the various partners. As a consequence, the planning authorities should plan a budget for this work in the future.

4 Contributions to overarching questions

In order to guarantee a comparability of certain questions related to the ERA-Net CRUE objectives and especially the call on “Flood resilient communities –

managing the consequences of flooding" the following chapter relates to overarching questions relevant for all projects of the call.

4.1 Connection to floods directive

How does your project contribute to the implementation of preliminary flood risk assessment, flood hazard maps and flood risk maps and flood risk management plans as designated by the Floods Directive (2007/60/EC)?

The IMRA Project contributes to the realisation of the requirements of the Flood Directive (2007/60/EC) mainly by improving the acceptance basis for both, the assessment with its key elements of hazard and risk maps, but also the management plans. Generally it should be mentioned that the public is a key actor in dealing with (flood) risks. The experience and the perception of the public influence the concepts in dealing with risks (in a positive but also in a negative way). Therefore it is necessary to involve the public from early beginning in the process as principally underlined by section 10 of the Floods Directive:

"1. In accordance with applicable Community legislation, Member States shall make available to the public the preliminary flood risk assessment, the flood hazard maps, the flood risk maps and the flood risk management plans. 2. Member States shall encourage active involvement of interested parties in the production, review and updating of the flood risk management plans referred to in Chapter IV."

However, the Directive does not give concrete advice how preliminary results shall be made available in a tailor-made way to different social groups which form the public. Moreover, nothing is said about how to encourage active involvement.

Both is done by the IMRA project and can be seen as one of the main topics of the project. This procedure will contribute to the increase of risk-awareness because only those who are informed and involved in the process are willing to accept the process as well as the outcome (here: Flood Risk Management Plans) and support it with appropriate measures (especially for cases where the intervention of the government is limited, valid for e. g. property rights).

Fortunately, the stage of the implementation of the Floods Directive differs between the three test cases of IMRA. Therefore, the proposed tools and procedures can be tested for their applicability in different ways: during the first preparation of maps and their communication to the public (Germany), but also afterwards for setting up the management plans and their update (Austria, Italy).

4.2 Participation

How did you account for interests of all potentially affected parties, i. e. general public, transboundary parties, policy maker etc. and how did that impact your results?

The different steps of the IMRA concept have different target groups and aims. The surveys concentrate on the risk perception of the public, whereas the self assessment tool aims at the performance and perceived image of the responsible authority in dealing with risks. Through the self assessment tool the responsible authorities are able to measure their own risk governance process and adapt it according to the needs as well as the results. This kind of tool is not complicated and – after it is implemented – it is easy to work with. Therefore it could be seen as a kind of support for the responsible and appropriate authorities.

The realised surveys highlight the needs and expectations of the public. This concerns not only the needed information (i. e. what kind of information the public is expecting) but also who should provide this information. Trough this procedure the appropriate stakeholders (e. g. the local government or the responsible water authority) gets the information what kind of perception (concerning e. g. the responsibilities) the public is characterised by. On the other hand the surveys can be seen as "education", i. e. they provoke the public to get further information about the topic. This is also aimed by the responsible authorities because this will support the risk awareness of the public and avoid e. g. conflicting activities (flood unadapted way of building in flood prone areas).

There are different activities that already have been carried out or that are planned to actively involve the public exhibition (Austria), surveys (in all case study areas, see above), public meetings (in all case study areas), interviews (Austria). The results and the feedback from the public directly flows into the decision-making process of the involved administrative and political stakeholders.

How does your project contribute to strengthen public participation in the establishment of future flood risk management plans, valuable lessons for public authorities/institutions and good governance?

It is obvious that such a detailed procedure is not always able to be implemented in each case study (especially because the problem concerns not only the local but also the regional level). Nevertheless, the concept focuses on a communication strategy that highlights the public in the whole process of dealing with risks. We should be aware of the fact that we are not planning for the public but planning

with the public ("collaborative science"). Otherwise the results will not be accepted and adapted by the public. And this is aimed by the IMRA project.

4.3 Harmonisation

What insights will your case studies provide to balance the drive for consistent, (trans-) national flood risk management strategies and the need for local tailor-made solutions?

The main aim of the case studies is a validation of the applicability of IMRA's conceptual frame to different environments. Consequently, the case study work focuses rather on deriving tailor-made solutions than co-ordinating the different contributions coming from different sub-basins. However, a particular indicator is about the coordination efforts of the responsible management authorities. In doing so, the concept touches also the need for a horizontal co-ordination.

4.4 Restrictions

To what extent is the generalisation of the results restricted by context variables in the case study area, such as: social/socio-cultural-historical/legal-institutional/political/economic characteristics, the flood type and degree of awareness and uncertainties and the way they are dealt with?

The elaborated concept is explicitly designed for a use in different countries with various social, socio-cultural, historical, legal-institutional, political and economic characteristics (this was proved by the selection of the three case studies). It is flexible enough to be adapted to the given needs and circumstances but it also deals also as a kind of "framework" for dealing with risks. But it also goes beyond this: both case studies in Germany are characterised by the same characteristics mentioned above. The aspect that differentiates both cases is the different degree of awareness due to the experiences made with floods. Also in this case the IMRA concept can be applied.

A potential restriction – which is of course applicable for all publicly funded projects – is how institutions later carry out such an elaborated approach after funding by projects and scientific support has ended. There might be a need to streamline the methodological approach ("light version") in order to make it applicable in the daily routines of regional and local institutions with their restricted financial and personnel resources.

The two main problems that have been envisaged for the practical application of the IMRA results related to risk communication and public participation are:

- planning and budgeting after the project end and
- extension of the target area.

Options to tackle these challenges will be discussed with the responsible authorities in the case study areas to find effective and practical solutions.

5 Project Progress

5.1 Work package progress

More detailed information can be found in the table in Chapter 7.2.

WP 1- Development of Conceptual framework Reason for delay: --- Comments: WP is already finalised.	☒ on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule

WP 2- Implementation of concept in case study areas aiming at analysing the effects of improved risk communication and perception of residual risk Reason for delay: --- Comments: WP is still in progress; individual schedules were agreed concerning the implementation within the case studies.	☒ on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule

WP 3- Validation of concept (WP leader: UBA) Reason for delay: --- Comments: WP has not started yet because it is scheduled for 2011.	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule
WP 4- Networking and dissemination activities (WP leader: CNR-IRPPS) Reason for delay: --- Comments: ---	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule
WP 5- Project Management, Monitoring and Evaluation Reason for delay: --- Comments: ---	☒ on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule

Table 1: Overview of project progress

Source: own elaboration

5.2 Overview of milestones/achieved results

The following Table 2 gives an overview of the planned and achieved results from September 2009 to August 2010.

Table 2: Overview of milestones / achieved results

Month	Date	Results planned (M = milestone; Del. = deliverable)	Results achieved
1	Sep. 09	M5.1: Consortium Agreement (Month 0)	The Consortium Agreement was signed by the administration of the TU Dortmund University on 14.09.2010.
2	Oct. 2009	M5.2: Kick-Off Meeting	The kick-off meeting took place from 20 to 22 October 2009 in Rome.
3	Nov. 09	M4.5/Del.4.2: 1st version of website	Presentation of the 1st version of the website during the kick-off meeting in October 2009.

Table 2: Overview of milestones / achieved results (continuation)

Month	Date	Results planned (M = milestone; Del. = deliverable)	Results achieved
4	Dec. 2009	M1.1/Del. 1.1: Release of first draft concept of for participatory flood risk management aiming at the improvement of risk awareness and increased public participation	Deliverable 1.1 was finalised on 22 December 2009 and sent to prject partners and experts for the IMRA Scientific Colloquium.
		M4.1/Del.4.1.1: Information leaflet in English on project	At the kick-off meeting it was decided to produce the information brochure only in 2010 when first results from the case studies are available.
		M4.5/Del. 4.2: Release of project website	The IMRA project website went online on 19 January 2010 with the URL http://www.imra.cnr.it after it was finally discussed at the project meeting on 14/15 January 2010.
5	Jan 10	M1.2: Scientific Colloquium	The Scientific Colloquium (originally scheduled for December 2009) was shifted to January 2010 and held at the Wupperverband in Wuppertal, Germany on 15 January 2010.
		M5.3: Project meeting	The 2nd project meeting was held on 14/15 January 2010 at the Wupperverband in Wuppertal, Germany.
		M2.x.1: Inventory of existing data for “true flood risk” completed	It was agreed at the 2nd project meeting in January 2010 to shift the deadline for the Inventory to February 2010.
6	Feb 10	M1.3/Del.1.2: Release of final draft of concept for participatory flood risk management aiming at the improvement of risk awareness and increased public participation (26.02.2010)	Del. 1.2 finalised with slight delay in April 2010 in order to include results of Scientific Colloquium properly.
		M4.2/Del.4.1.2: Information leaflets in local languages for case studies (26.02.2010)	During the project meeting in January 2010 it was agreed to take individual steps in the case studies. According to the need for tailoring information material it might be more useful to use funds for activities like exhibitions rather than brochures. For the regional workshops, however, information material (leaflets, presentations) was compiled to inform the stakeholders, public and the media.

Table 2: Overview of milestones / achieved results (continuation)

Month	Date	Results planned (M = milestone; Del. = deliverable)	Results achieved
		M5.4: Interim technical and scientific internal assessment report	Finalised in April 2010.
7	Mar. 10	M2.x.5: 1st regional workshop	Slight delays according to organisational issues: Chiascio case study: 25 February 2010: Bastia Umbra 15 April 2010: Bastia Umbra 27 May 2010: Assisi Möll case study: 5 May 2010: Großkirchheim Wupper case study: 20 May 2010: Buchenhofen
		M2.x.2: 1st survey and discussion with local stakeholders	Möll case study: March 2010 Chiascio case study: May – June 2010 Wupper case study: 1 July 2010: Public meeting Leichlingen 17 July – 20 August 2010: Survey Leichlingen
		M2.x.3: 1st assessment of existing FRM systems performance completed (26.03.2010)	Wupper case study: 21 January 2010: presentation of self assessment tool at the Wupperverband March 2010: adaptation of indicators by the Wupperverband 16 April 2010: self assessment by colleagues from the Wupperverband 20 May 2010: presentation of self assessment tool to participants of stakeholder workshop and request for feedback 1 July 2010: feedback round closed Möll case study: April 2010 Chiascio case study: 25 June 2010

Table 2: Overview of milestones / achieved results (continuation)

Month	Date	Results planned (M = milestone; Del. = deliverable)	Results achieved
8	Apr 10	M2.x.4/Del.2.x.1: Interim reports on case study results	Finalised together with the project Interim Report in August 2010.
		30.04.2010: Zwischenbericht (Interim report/Germany) and Zwischennachweis (Interim proof of use/Germany)	*Reports submitted in due time.*
		M4.6: Website update	Access to case study parts of the website was made a partners in May 2010.
		M5.3: Project meeting (Austria)	Project meeting was shifted to 5-7 May 2010 in Großkirchheim (Austria).
12	Aug 10	M5.3: Project meeting	Shifted to CRUE ERA-Net meeting in October 2010 in Madrid
		M4.6: Website update	Not necessary yet
13	Sep. 10	M5.5: Mid-term report to CRUE Steering Committee	Report submitted on 31 August 2010.

Contact details of authors

TUDO (Co-ordinator)

◄ **Stefan Greiving**

TU Dortmund, Institute of Spatial Planning (IRPUD)

August-Schmidt-Str. 10, D-44149 Dortmund

E-mail address: mark.fleischhauer@tu-dortmund.de

◄ **Mark Fleischhauer**

TU Dortmund, Institute of Spatial Planning (IRPUD)

August-Schmidt-Str. 10, D-44149 Dortmund

E-mail address: stefan.greiving@tu-dortmund.de

◄ **Sylvia Wanczura**

TU Dortmund, Institute of Spatial Planning (IRPUD)

August-Schmidt-Str. 10, D-44149 Dortmund

E-mail address: sylvia.wanczura@udo.edu

Wupperverband

◄ Marc Scheibel

Wupperverband

Untere Lichtenplatzer Straße 100, D-42289 Wuppertal

E-mail address: schei@wupperverband.de

◄ Monika Ebers

Wupperverband

Untere Lichtenplatzer Straße 100, D-42289 Wuppertal

E-mail address: eb@wupperverband.de

CNR-IRPPS

◄ Patrizia Grifoni

Consiglio Nazionale delle Ricerche, Istituto di ricerche sulla Popolazione e le Politiche Sociali

Via Palestro 32, I-00185 Roma

E-mail address: patrizia.grifoni@irpps.cnr.it

◄ Tiziana Guzzo

Consiglio Nazionale delle Ricerche, Istituto di ricerche sulla Popolazione e le Politiche Sociali

Via Palestro 32, I-00185 Roma

E-mail address: tiziana.guzzo@irpps.cnr.it

◄ Alessia D'Andrea

Consiglio Nazionale delle Ricerche, Istituto di ricerche sulla Popolazione e le Politiche Sociali

Via Palestro 32, I-00185 Roma

E-mail address: a.dandrea@irpps.cnr.it

AB Tevere

◄ Carlo Ferranti

Autorità di Bacino Fiume Tevere

Via Bachelet 12, 00185 Roma

E-mail address: carlo.ferranti@abtevere.it

◄ Paola Malvati

Autorità di Bacino Fiume Tevere

Via Bachelet 12, 00185 Roma

E-mail address: paola.malvati@abtevere.it

◄ **Valentina Vitale**

Autorità di Bacino Fiume Tevere

Via Bachelet 12, 00185 Roma

E-mail address: valentina.vitale@abtevere.it

◄ **Silvio Bagnini**

Autorità di Bacino Fiume Tevere

Via Bachelet 12, 00185 Roma

E-mail address: silvio.bagnini@abtevere.it

◄ **Giovanni Fangucci**

Autorità di Bacino Fiume Tevere

Via Bachelet 12, 00185 Roma

E-mail address: gianni.fangucci@abtevere.it

T6 ◄ **Katja Firus**

T6

Via Genova 30, I-00184 Roma

E-mail address: k.firus@t-6.it

UBA ◄ **Therese Stickler**

Umweltbundesamt GmbH, Departement Sustainable Development

Spittelauer Lände 5, A-1090 Wien

E-mail address: therese.stickler@umweltbundesamt.at

AKL ◄ **Norbert Sereinig**

Amt der Kärntner Landesregierung

Arnulfplatz 1, A-9020 Klagenfurt am Wörthersee

E-mail address: norbert.sereinig@ktn.gv.at

◄ **Gernot Koboltschnig**

Amt der Kärntner Landesregierung

Arnulfplatz 1, A-9020 Klagenfurt am Wörthersee

E-mail address: gernot.koboltschnig@ktn.gv.at

Revital

Susanne Korber

REVITAL Ziviltechniker GmbH

Nußdorf 71, A-9990 Nußdorf-Debant

E-mail address: s.korber@revital-zt.com

References

Used in this report

Carina, E. and Keskitalo, H. (2004) A framework for multi-level stakeholder studies in response to global change, Local Environment, 9:5, pp. 425-435.

MIDIR – Multidimensional Integrated Risk Governance (2006-2008), funded within 6FP Priority: Science and Society, Integrative approaches to risk governance, website: http://www.midir.eu.

Risk Network – Risk Communication Network (2005-2007), funded within FP6 Priority: Science and Society, website: not available.

Riskbridge – Building robust, integrative inter-disciplinary governance models for emerging and existing risks (2006–2009), funded within FP6 Co-ordination Action on Integrative Approaches to Risk Governance, website: http://www.riskbridge.eu.

STARK – Stakeholders in Risk Communication (2005-2007), funded within 6FP Priority: Science and Society, website: http://starc.jrc.it/ (not available any more).

Trustnet-in-action – Improving governance of hazardous activities (2004-2006), funded within FP6 Priority: SOCIETY-2.2 Uncertainty, risk and the precautionary principle: analysis and best practice, website: http://www.trustnetinaction.com.

UNISDR – United Nations International Strategy for Disaster Reduction (2004) Living with Risk - A global review of disaster reduction initiatives, Geneva.

Wanczura, S., Fleischhauer, M., Greiving, S., Fourman, M., Sucker, K., d'Andrea, A. (2007) Analysis of recent EU, international and national research and policy activities in the field of risk governance. Del. 1.1 MIDIR Project.

Used in project deliverables

Arbter, K.; Handler, M.; Purker, L.; Tappeiner, G. & Trattnigg, R. (2005) Das Handbuch Öffentlichkeitsbeteiligung. Österreichische Gesellschaft für Umwelt und Technik

(ÖGUT) und Bundesministerium für Land-, Forstwirtschaft, Umwelt und Wasserwirtschaft (Hg.). Wien.

Bezirksregierung Köln (Ed., 2004) Gebietsentwicklungsplan für den Regierungsbezirk Köln. Sachlicher Teilabschnitt Vorbeugender Hochwasserschutz. Köln.

Bischoff, A.; Selle, K.; Sinning, H. (2005) Informieren, Beteiligen, Kooperieren. Kommunikation in Planungsprozessen. Eine Übersicht zu Formen, Verfahren und Methoden, 4. überarbeitete und erweiterte Neuauflage, Dortmund.

Carina, E. and Keskitalo, H. (2004) A framework for multi-level stakeholder studies in response to global change, Local Environment, 9:5, pp. 425-435.

Dibb, S. (2003) Winning the risk game - a three-point action plan for managing risks that affect consumers, National Consumer Council, London 2003.

Dubreuil, G.H.; Bengtsson, G.; Bourrelier, P. H.; Foster, R.; Gadbois, S.; Kelly, G.N. (2002) A report of TRUSTNET on risk governance - lessons learned, Journal of Risk Research, Volume 5, Issue 1 January 2002, pp. 83 – 95.

Federal Ministry of Agriculture, Forestry, Environment and Water Management (2002) The Austrian Strategy for Sustainable Development adopted by the federal government in April 2002; p. 7.

Fleischhauer, M., Greiving, S. & Wanczura, S. (2006) (ed.): Natural Hazards and Spatial Planning in Europe. Dortmund: Dortmunder Vertrieb für Bau- und Planungsliteratur

Friedrich, J. et al. (2001) Synopse der Naturgefahren für die Stadt Köln – Eine Strategie. DKKV Proceedings. Leipzig.

Greiving, S. (2005) Concepts and indicators for measuring institutional vulnerability, Proceedings of the 2nd meeting of the UN expert group on vulnerability. UNU-EHS. Bonn.

Greiving, S., Wanczura, S., Voßebürger, P., Sucker, K., Fourman, M. (2007) Scalable resilience and risk governance concept including guidelines on stakeholder involvement. Del. 1.2 MIDIR Project.

Grünewald, U. (2009) Gutachten zur Entstehung und Verlauf des extremen Niederschlag-Abfluss-Ereignisses am 26.07.2008 im Stadtgebiet von Dortmund – einschließlich der Untersuchung der Funktionsfähigkeit von wasserwirtschaftlichen Anlagen und Einrichtungen der Stadt, Emschergenossenschaft und Dritter in den Gebieten Dortmund-Marten, -Dorstfeld und -Schönau; Gutachten im Auftrag der Stadt Dortmund und der Emschergenossenschaft.

INTEGRAL (2009) Die Sinus Milieus® in Österreich. Available at: http://www.integral.co.at/de/sinus/milieus_at.php

Inter-Agency Secretariat of the International Strategy for Disaster Reduction (UN/ISDR) (2004) Living with Risk - A global review of disaster reduction initiatives, Geneva.

IRGC – International Risk Governance Council (2005) White paper on risk governance: Towards an integrative approach, Geneva: IRGC.

ISDR – International Strategy for Disaster Reduction (2005) Hyogo Framework for Action.

IT.NRW (2009) Kommunalprofil Morsbach. Available at: http://www.it.nrw.de/kommunalprofil/l05374028.pdf

Kleinhückelkotten, S.; Neitzke, H-P.; Wegner, E. (2006): Zielgruppen für die Nachhaltigkeitskommunikation, Kompetenznetz Nachhaltigkeitskommunikation und Ecolog, Hannover, Dezember 2006. Available at: http://www.21-kom.de/fileadmin/user_upload/PDFs/01_NHK_Social_Marketing_Ueberblick/Dokumentation_Expertenwerkstatt.pdf

Kleinhückelkotten, S. (2007): Soziale Milieus als Zielgruppen in der Bürgerbeteiligung und Engagementförderung Freiburg, 20.10.2007, available at: http://www.21-kom.de/fileadmin/user_upload/PDFs/02_Sinus_Milieus/Soziale_Milieus_und_Engagement.pdf

Kolf, R. (2006): Hochwasserschutzkonzept NRW; speech presented during the Rheinkonferenz 2006; available at: http://www.regionale2010.de/fileadmin/user_shares/2010_bildwelten/Rheinkonferenz_2005/Rheinkonferenz_Vortraege/hochwasser/Kolf.pdf

LAWA – Länderarbeitsgemeinschaft Wasser (Ed., 1997) Leitlinien für die Erarbeitung von Hochwasseraktionsplänen für kleine Einzugsgebiete. Schwerin.

MUNLV (2009) Umweltbericht Nordrhein-Westfalen 2009. available at: http://www.umwelt.nrw.de/umwelt/pdf/umweltbericht/umweltbericht_2009.pdf (22.01.2010).

NRWInvest (2010) Standortprofil für Leichlingen (Rheinland). Düsseldorf.

Rheinisch-Bergischer-Kreis (Ed., 2009): Sozialbericht Integration. Bergisch Gladbach. Online available at: http://www.institut-fsi.de/bilder/Sozialbericht%20Integration%20-%20Rheinisch-Bergischer%20Kreis%20-%202009.pdf

Roser-Renouf, C.; Nisbet, M., C., (2008): The measurement of key behavioral science constructs in climate change research, IJSC 3 (2008): 37-95; www.ijsc-online.org

Sjöberg, L. (2000) Factors in Risk Perception, Risk Analysis, Vol.20, Nr.1, 2000, Society for Risk Analysis, p. 9

Steyaert, S., Hervé L., Nentwich, M. (Eds.) (2007) Leitfaden partizipativer Verfahren. Ein Handbuch für die Praxis. Available (in English) at: www.kbs-frb.be – www.viwta.be – www.oeaw.ac.at/ita.

Tevere River Basin Authority (2006) "Hydrological setting plan"

Tevere River Basin Authority, University of Perugia (2000) "Flood maps for main network in Tevere river basin"

Umbria region, Tevere River Basin Authority, CNR – IRPI Perugia (2005) "Flood maps for secondary network in Tevere river basin"

Umweltbundesamt (Ed., 2003) Sichern und Wiederherstellen von Hochwasserrückhalteflächen. Berlin.

UNISDR – United Nations International Strategy for Disaster Reduction (2004) Living with Risk - A global review of disaster reduction initiatives, Geneva.

Wanczura, S., Fleischhauer, M., Greiving, S., Fourman, M., Sucker, K., d'Andrea, A. (2007) Analysis of recent EU, international and national research and policy activities in the field of risk governance. Del. 1.1 MIDIR Project.

WBGU – German Advisory Council on Global Change (2000) World in Transition: Strategies for Managing Global Environmental Risks. Annual Report 1998. Berlin: Springer.

Wupperverband (2007) Water management for generations. Internet: http://www.wupperverband.de/internet/wupperverbandwys.nsf/files/2008_WV-wawi-generationen_en.pdf/$FILE/2008_WV-wawi-generationen_en.pdf (22.01.2010).

Wupperverband (2008) Hochwasserschutzkonzept des Wupperverbandes, Wuppertal. Available at: http://www.wupperverband.de/internet/wupperverbandwys.nsf/files/Hochwasserschutzkonzept_2.pdf/$FILE/Hochwasserschutzkonzept_2.pdf

2nd ERA-NET CRUE Research Funding Initiative
Flood resilient communities – managing the consequences of flooding
Interim Report

RISK MAP
*Improving Flood Risk Maps as a Means to Foster Public Participation and Raising Flood Risk Awareness: Toward Flood Resilient Communities**

Volker Meyer, Christian Kuhlicke, Herwig Unnerstall, Sebastian Scheuer, Jochen Luther[1]
Sven Fuchs[2]
Sue Tapsell, Sally Priest, Joanna Pardoe[3]
Wolfgang Dorner, Johanna Seidel[4]
Kamal Serrhini, Gaetan Palka[5/6]

1 HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ
2 BOKU University of Natural Resources and Applied Life Sciences, Vienna
3 fhrc Flood Hazard Research Centre
4 Hochschule Deggendorf
5 UNIVERSITÉ FRANÇOIS – RABELAIS TOURS
6 cnrs

* Funded by

Federal Ministry of Education and Research
lebensministerium.at
defra Department for Environment Food and Rural Affairs
Ministère de l'Écologie, de l'Énergie, du Développement durable et de la Mer en charge des Technologies vertes et des Négociations sur le climat

1 Introduction

RISK MAP aims to improve flood risk maps as a means of fostering public participation and raising flood risk awareness. In order to achieve this, RISK MAP: (1) develops guidelines for appropriate stakeholder participation – enabling the incorporation of local knowledge and preferences; (2) improves the content of risk maps by means of a deliberative multicriteria risk mapping tool, which takes into account social, economic, and environmental risks; (3) improves the visualisation of risk maps in order to produce user-friendly risk maps, and; (4) provides quantitative information related to the content of risk maps through the application of the experimental graphic semiology method using the eye tracking approach. The structure of RISK MAP is shown in Figure 1.

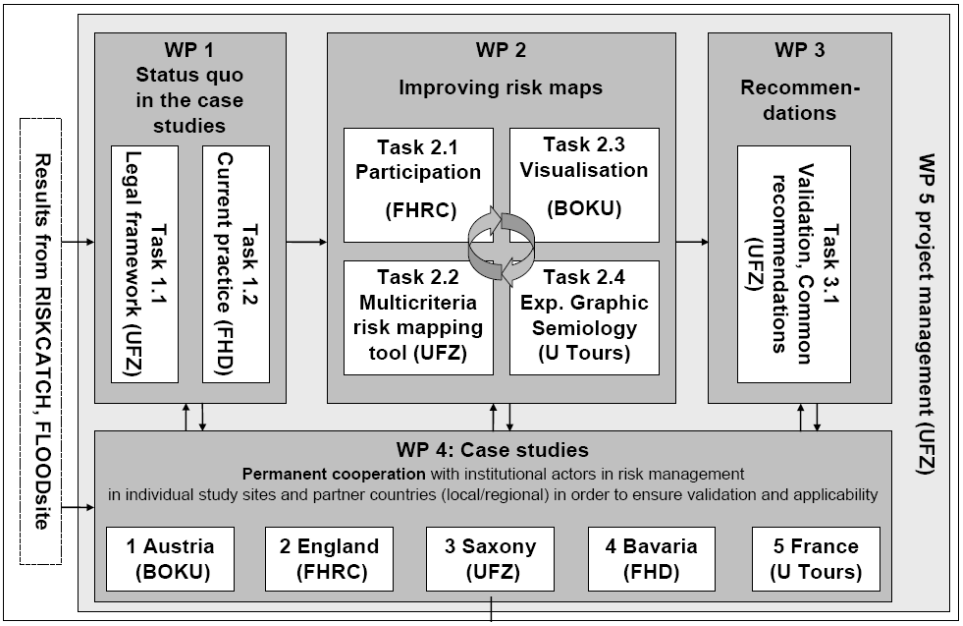


Figure 1: Structure of RISK MAP

According to this structure and the associated work plan, much of the work so far focussed on WP 1 and WP 4, (i.e. the exploration of the status quo of risk mapping in the case studies). Accordingly, this interim report provides an overview of the results of Tasks 1.1 and 1.2, (i.e. the legal situation for risk mapping and participation and the current practice of risk mapping in the case studies), as well as the initial results from WP2.

Concepts such as **resilience** and **community** are central to RISK MAP. However, the definitions and scope of these concepts are widely debated. Therefore, it is important to discuss RISK MAP's conception of these terms in turn.

RISK MAP is an interdisciplinary project, involving natural and social scientists. At this stage of the project, **resilience** is understood as a "boundary object" – facilitating communication between and across different disciplines (Brand and Jax 2007, 8). More specifically, the project understands resilience as a normative concept, enabling a shared understanding about an ideal condition of the system. We define resilience by considering three distinct dimensions: (1) the amount of disturbance a system can absorb and still remain within the same state of domain of attraction; (2) the degree to which the system is capable of self-organisation; (3) the degree to which the system can build and increase capacity for learning and adaptation (Carpenter et al. 2001). RISK MAP's participatory approach is contributing to an enhanced capacity of local communities to self-organise. The project is conceptualised as iterative and mutual learning process, which is ensured by series of interviews and workshops in the respective case-studies.

The concept of "**community**" is far from self-evident or neutral. It requires definition and some critical distance when approaching it. Otherwise, issues such as, social conflicts, social inequity, and social exclusion may be overlooked. For the time being, we therefore prefer to speak of contextualising resilience building for natural hazards, which will often imply to place it on the local scale. Local communities hence comprises of the actors from the organisational level (public, private, and voluntary) as well as individual citizens. Above all, it concentrates on the interaction and forms of cooperation between these different actors and how they may or should contribute to an enhanced resilience (Kuhlicke and Steinführer 2010).

2 Methods

Work package 1: Status quo of risk mapping in the case studies

Task 1.1: Legal framework and administrative practices of public participation in mapping of flood risks (UFZ, FHRC, BOKU, FHD)

This Task compared the current legal situation and the (upcoming) implementation of the Flood Directive (FD) by selected Member States with special focus on whether they include public participation in the process of flood risk mapping and in which form. The comparison also covers the current administrative practices. Therefore, the current legislation, relevant case law, legal literature, and where appropriate, administrative guidelines on public participation in risk mapping, have been collected and analysed by Herwig Unnerstall (UFZ) with the help of the partners from the case studies.

Task 1.2: Current practices of risk mapping in the case studies (FHD, UFZ, FHRC, BOKU)

This Task explored the status quo in risk mapping in practice in the case studies. Therefore, information on existing risk maps have been gathered with a particular emphasis on (1) visualisation of hazard, (2) risk criteria used, and (3) the availability of respective information for the different stakeholders involved. Therefore, a common research framework has been developed by FHD, which was applied in each case study and addresses issues such as, the history and objectives of risk mapping, methods of hazard modelling, and damage evaluation, visualisation, and public participation issues (see Annex 1). Each case study answered these questions by gathering and analysing existing maps and conducting interviews with relevant stakeholders.

Work package 2: Improving risk maps

Task 2.1: Participation and good governance for improving risk maps (FHRC, UFZ, BOKU, FHD)

Stakeholder participation is becoming increasingly embedded within decision making processes (Reed et al 2009). This is primarily the result of increasing legislation and guidelines, such as the Water Framework Directive (2000/60/EC) (WFD) and FD (2007/60/EC), which encourage stakeholder engagement as part of the decision making process). This Task is developing recommendations on how to organise participation under the frame of good governance in the risk mapping process.

The aim of this Task is to develop recommendations for a constructive integration of selected stakeholders in the risk mapping process (key principles, approaches, tools etc.). These recommendations will be open to different contexts across Europe and will be refined and improved during the projects activities and the interaction between authorities, scientists and civil society actors. Based upon the recommendations, local, regional, and public stakeholders have been invited to participate in Workshops organised and conducted in the respective case studies (case studies 1-4). Following these experiences the recommendations will be refined for the final deliverable.

The primary methodology applied in this Task was an extensive literature review, as well as expert interviews with selected stakeholders in the respective case-studies (cf. chapter 5)

Task 2.2: Multicriteria risk mapping tool (UFZ, FHRC, BOKU, FHD)

The main objective of this Task is to extend and adjust a multicriteria risk mapping tool which allows for a compilation and aggregation of social, environmental, and economic risk criteria maps (Meyer et al. 2009). Thus, Task 2.2 aims to improve flood risk maps, which is achieved by extending the multicriteria assessment approach by an ontology-based knowledge base. Ontology can be referred to as a formal specification of a shared understanding (Gruber, 1993).

The purpose of both ontology and a knowledge base is to include local knowledge in flood risk assessment (i.e. the body of knowledge referring to the specific (fact-based) expertise of local stakeholders and the public related to local flood hazard and flood risk conditions (Raymond et al., 2010)). This knowledge is, for example, elicited from the findings and conclusions of the stakeholder interviews and workshops held by the respective case studies.

Local knowledge is often tacit (i.e. given in an informal, experienced-based form). However, a tool-based, knowledge-supported multicriteria flood risk assessment requires explicit and codified knowledge (Giordano et al., 2010). Hence, tacit local knowledge must be structured and formalised to obtain a machine-interpretable knowledge description. This is achieved during the course of the development of the proposed ontology and knowledge base. The knowledge base will comprise of various components, for example, which communicate the elicited knowledge to a user (reporter) and make use of it in the flood risk assessment process (reasoner).

Task 2.3: Visualisation of risk maps (BOKU, UFZ, FHRC, FHD)

The main objective of Task 2.3 is to develop different map contents according to different needs of respective stakeholder groups (i.e. (1) affected citizens, and (2) stakeholders responsible for flood risk management on a local and regional level). Based on the first workshop series in the regional case studies, and considering the work carried out in Tasks 2.1 (participation) and 2.2 (multicriteria risk mapping), a set of map contents and according layout patterns was developed. A major focus was on the deduction of those visual strategies detected during the stakeholder workshops that allow for an efficient and structured understanding of the map content. In close collaboration with U TOURS the suggestions from each individual case study were structured and specified in order to develop the necessary work flow with respect to Task 2.4. The resulting map templates provided the basis for a set of maps prepared for each case study in order to meet the technical and visual requirements for Task 2.4. In particular, the layout for the risk maps from the different test sites was harmonised in order to allow for a systematic test series in Task 2.4. Thus, previous experiences were considered and further developed. Moreover, legend elements necessary for risk management were identified, tested and implemented in the map template.

Task 2.4: Experimental Graphic Semiology (U Tours & UMR CITERES)

Although this Task is yet to officially commence, in order to prepare the test series in Tours (France), the different map layouts were harmonised and tested for their applicability during the eye tracking test (see Task 2.3). A preliminary list of individuals from the different partner countries to be tested during the Experimental Graphic Semiology (EGS) campaign was compiled. As planned in the beginning of RISK MAP, the experimental protocol of the Graphic Semiology approach will take place during October 2010 in Tours. To ensure the transfer of test persons from Germany, Austria and England to Tours, it was necessary to conduct a considerable amount of management and logistics.

Compared to RISKCATCH a forerunner project of RISK MAP (Era-Net Crue 1), and in order to encourage a better veracity of the results, the EGS approach of RISK MAP will be reinforced by two additional tests: acuity visual and colour blind tests.

The EGS protocol has a global duration of about 1h30 per person. The protocol is composed of:

- visual acuity test and chromatic blindness test (approx. 3 minutes)

- eyes movement recording (approx. 15 minutes)
- cognitive survey (approx. 35 minutes)
- puzzle (approx. 30 minutes)

Work package 3: Recommendations

This WP is yet to commence.

Work package 4: Case Studies

Up until now, the work has focussed on the analysis of the current status of risk mapping in each case study, (i.e. providing input for the tasks 1.1 and 1.2). Therefore, existing maps and related documents are gathered and analysed and interviews with regional stakeholders have been conducted. Furthermore, preparatory interviews, as well as stakeholder workshops have been conducted in each case study (for a listing of interviews and workshops see the table in section 5 "Dissemination").

3 Results and Discussion

Work package 1: Status quo of risk mapping in the case studies

Task 1.1: Legal framework and administrative practices of public participation in mapping of flood risks (UFZ, FHRC, BOKU, FHD)

The results of Task 1.1 are described in detail in the report "Legal Framework for Public Participation in Flood Risk Mapping - A comparative study on different European member states and on the requirements of the Flood Management Directive" (Unnerstall 2010) and are outlined in the following. Table 1 which summarises the formal requirements as defined by the different European directives relevant for flood risk management.

Table 1: Public participation requirements in flood risk planning according to EC-directives

Phase / **Require-ments**	FD – Floods Directive	SEAD – Strategic Environmental Assessment Directive	Coordination with WFD – Water Framework Directive
Preliminary Flood Risk Assessment	Ex-post information of general public (Art. 10 (1))	Not subject to the SEAD	No coordination required acc. to Art. 9 S. 2 Nr. 3 FD
Flood Hazard Maps and Flood Risk Maps	Ex-post information of general public (Art. 10 (1))	Not subject to the SEAD	No coordination required acc. to Art. 9 S. 2 Nr. 3 FD
Flood Risk Management Plans	Encourage active involvement of interested parties (Art. 10 (2)), but no formal procedure	Formal consultation of (general) public and opportunity for comments (appropriate time frame)	Coordination required acc. to Art. 9 S. 2 Nr. 3 FD, but unclear which format. Art. 14 WFD

In regards to the FD in Article 10 (1), the (general) public only requires an ex-post information of the three steps of the directive. The more advanced participation type "active involvement of interested parties" is required only for the Flood Risk Management Plans (FRMPs) (Article 10 (2) FD) and not for the preceding steps. "Active involvement of interested parties" as required by Article 10 FD at the development of FRMPs requires some kind of multilateral consultation on the draft FRMPs that allows stakeholders to discuss relevant issues and to contribute to their solution and forces the

planning authority to examine arguments and propositions put forward by the stakeholders. To be effective Flood Hazard Maps (FHM) and Flood Risk Maps (FRM) should also be topic of discussion, as they form the basis for the FRMPs, although the FD does not require a separate consultation procedure. However, the degree of obligation that is attached to active involvement, i.e. to "encourage" (Art 10 (2) FD) it – in contrast to "shall make available" in Article 10 (1) FD – leaves a wide range of implementation options.

The comparison of the current legal situation (and planned implementation of the FD) in the case studies shows some similarities but also differences, especially concerning the progress in implementing the requirements of the FD.

In Austria there are currently a number of different planning instruments available concerning flood risk management which have partly overlapping and partly exclusive scopes of application. They have used different reference events for structuring the information, different criteria for the designation of different degrees of hazards, different intensities and forms of public participation. In general, intensity of participations seems low with the exception of Hazard Zone Plans for Torrent and Avalanche Control (§ 11 Austrian Forest Act). The requirements of the Strategic Environmental Assessment Directive (SEAD) seem to be not yet considered sufficiently, but their relevance for the river development schemes (Gewässerentwicklungskonzepte) is evident.

In England and Wales the FD has been transposed by the Flood Risk Regulations (FRR) in 2009 and the Flood and Water Management Act (FWMA) in 2010. As regards public participation this transposition remains very close to the FD and offers only a few and rather marginal specification. The central requirement of the FD to "encourage active involvement of interested parties" has been transformed to "to consult the public" without giving further details on the design of this process. Only a few concrete rules can be drawn from the Code of Practice on Consultation in this respect. The FWMA 2010 establishes also on a regional level Regional Flood and Coastal Committees (RFCCs). Although the rules for assembling them are not adopted yet, a glance at their predecessors, the Regional Flood Defence Committees (RFDCs), does not give hope to expect them to be more than purely political/administrative committees without civil society participation.

After the heavy floods in 2002, Saxony was the first federal state in Germany to modernise its flood management legislation even before the Federation revised its legislation. By the Saxon Water Act of 2002 (SaxWA 2002) the development of "flood protection concepts" (Hochwasserschutzkonzepte) was decided which include FHM and FRMP as required by the FD. Similarities to the FRMs have the so-called "hazard indicator maps" ("Gefahrenhinweiskarten") that contains a "map of damage potential" (Schadenspotentialkarte), but only for extreme events. For the implementation of "active involvement of interested parties" Saxony has adopted a formal consultation procedure covering the general public. Panels of "interested parties" corresponding to the "water forum" established for the implementation of the WFD have not been established and these existing forums have not extended their subject area. For the planning section of FRMs no specific procedure takes place and hence no specific participation process. However, the upcoming new legislation (Draft Law from the 10.2.2010) exceeds in some points the minimum requirements of the FD regarding public participation.

In the federal state of Bavaria, Germany, the FD will be implemented in the next years according to the Bavarian Water Act (BaWA 2010) and the German Federal Water Act (GFWA 2009). For the implementation of "active involvement of interested parties", Bavaria has yet not adopted any provision that specifies how this process will be carried out, but only assigns the responsibility for it to the State government. Panels of "interested parties" corresponding to the "water forum" established for the implementation of the WFD have not been established and these existing forums have not extended their subject area either. For the planning section of FRMs no specific procedure takes place and hence no specific participation process.

In conclusion, one can assert that that most of member states concentrate in their (planned) implementation of the FD on a formal administrative approach for the "active involvement of interested parties", in which the administration develops the draft for the management plan that is then publicly displayed so that everybody may comment on the plan within a fixed time period. This only fulfils the minimum requirements of the FD for "active involvement". There are attempts for a more

"political approach". The establishment of the "water forum", "round tables" etc. as already occurred in the context of the implementation of the WFD is a step in this direction. The inclusion of flood management issues into the application area of these councils would be the easiest way to go beyond "formal consultation". This way would also promote the aspired coordination between the WFD and the FD.

Task 1.2: Current practices of risk mapping in the case studies (FHD, UFZ, FHRC, BOKU)

The results of the analysis of the current status of risk mapping in the case studies according to the common research framework developed by FHD are summarised in annex 1.

Work package 2: Improving risk maps

Task 2.1: Participation and good governance for improving risk maps (FHRC, UFZ, BOKU, FHD)

Aim of this Task is to develop a framework for a constructive integration of selected stakeholders in the risk mapping process (key principles, approaches, tools etc.). Based on an extensive literature review and interviews with selected stakeholders in the case-studies the: (a) possible advantages of participatory elements in the risk mapping process are outlined, (b) and a typology of different stakeholder is developed.

a) Several studies have been conducted to investigate the potential of participatory approaches (Hagemeier-Klose and Wagner 2009). It may contribute to a better understanding of the content of maps, and to a reduction of mistrust (of information presented). Furthermore, it may also contribute to stimulating people to take action. On a more abstract level, the following benefits can be identified:

- *Normative reasons*: All groups should be consulted when making technical decisions as part of a compliance with democratic ideals;
- *Substantive reasons*: Through participation, additional, local, or native knowledge can be explored and included in the maps. This may increase the breadth and depth of information that may contribute towards better quality decisions as it accounts for the diverse values and interests of end users.
- *Instrumental reasons*: Participation may be a tool for enhancing credibility and trust. The instrumental approach re-affirms the idea that participatory inclusion in decision making facilitates transparency and builds trust in the institutions and organisations.

b) Generally, we propose a broad definition of stakeholders. A stakeholder includes everyone who is affected by or interested in a project or activity. In our understanding this includes everyone who is:

- Affected by hazard and risk maps (e.g. banning of certain forms of settlement, target group of awareness raising campaigns);
- Interested in hazard and risk maps (information seeking etc.);
- Using hazard and risk maps in their daily work (e.g. fire brigades, municipalities etc.);
- Involved in the production of hazard and risk maps (graphic design, modelling etc.);
- Involved in the formulation of the legal frameworks and implementation procedures of hazard and risk maps (high level policy-makers, administrations, politicians etc.).

Based on this general definition of stakeholder and its specification to the RISK MAP project, we distinguish in five different groups of stakeholders:

- *Group 1* - At-risk population living in flood endangered areas: Stakeholders of this group are neither formally nor informally organised with respect to flood risk management. They are usually considered as the 'audience' of hazard and risk maps. In most cases they neither directly nor indirectly participate in the production of the maps or the setting of the legal framework of how to produce, use and/or disseminate maps.
- *Group 2* - Civil-society (formally or informally organised) stakeholders belonging to this group may be part of a local citizens' initiative, of more formally organised groups, such as the Local

Flood Action Groups in England, and Wales or of local, regional, national, or even international interest groups (e.g. nature protection, farmer interest groups etc.,).

- *Group 3* - 'End-Users' on the local and regional level such as municipalities, administrations and organisations: 'End-Users' on the local and regional level such as municipalities (or parts of the municipal administration), administrations (e.g. regional government and their respective entities responsible for risk and disaster management), organisations (e.g. fire brigades, THW) as well as local and regional units of national organisations and institutions (Technical Relief Service (THW), Armed Forces, ...). Stakeholders belonging to this group use and work with hazard and risk maps more or less on a daily basis.
- *Group 4* - Producers of hazard and risk maps on the local, regional and/or national level: These stakeholders are mostly directly involved in the physical production of hazard and risk maps (e.g. modelling of the hazard, design of the maps etc.). Their (legal) role within the production process and their position within the institutional structure is also formally organised (cf. above).
- *Group 5* - Policy-makers on the regional and/or national level: Stakeholders belonging to this group are not directly involved in the map production process; they may even not be familiar with the production process at all. Their concern is rather with long-term strategic orientation of the respective regional /national flood risk management strategy.

The different types of stakeholder may have different roles during the participation process and may differently contribute to the process.

Task 2.2: Multicriteria risk mapping tool (UFZ, FHRC, BOKU, FHD)

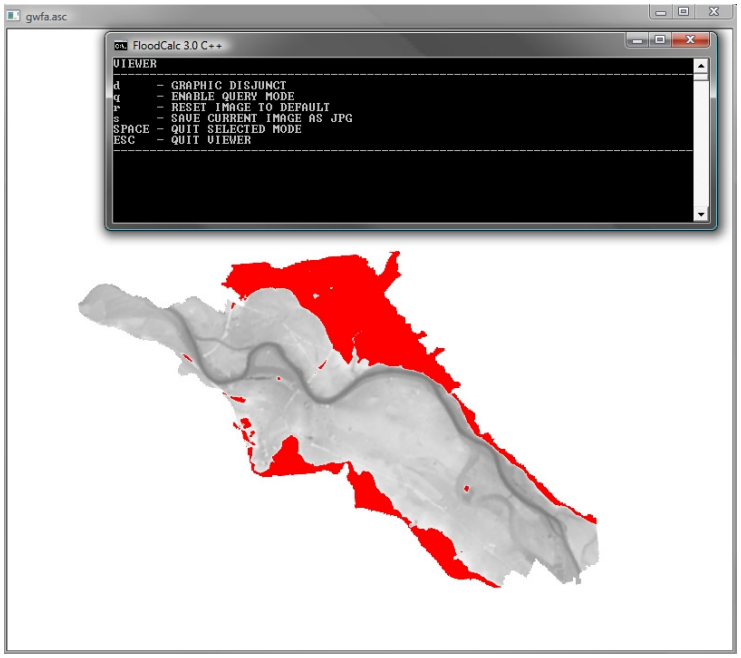


Figure 2: Screenshot of the graphical disjunctive analysis component. Areas (raster cells) exceeding a user-defined threshold value are highlighted in red colour. Other values are visually stretched on a grey scale.

Based on the findings of the workshop, knowledge has been elicited, structured, and codified in the form of a Web Ontology Language (OWL) (Smith et al., 2004). During this process, the relevant steps in flood risk assessment and their final products are described, according to the preferences and requirements of stakeholders. This will, for example, allow to automatically computing user-specific types of maps for different purposes. The software components required to make use of the captured knowledge in the risk assessment process are currently implemented. Other improvements aim to support (non-expert) users in creating multicriteria risk maps (e.g. internationalisation to support different languages) and to allow for a fast visualisation of the computed results (graphical components, Fig. 2).

Task 2.3: Visualisation of risk maps (BOKU, UFZ, FHRC, FHD)

Based on the recommendations of RISKCATCH (Fuchs et al. 2009a, b), preliminary results of the harmonisation of map content and legend patterns were presented and discussed at the Society of Risk Analysis Europe Annual Meeting at King's College, London (Evaluating flood risk maps – Towards a visual risk language, 21-23 June 2010). In summary, the analyses highlighted certain aspects that were identified as being important for an efficient design of risk maps. Since any stakeholder confronted with map templates concentrated on the visual fixations in areas showing coloured zones and written information, the concentration of information in the legend needs to be visible (contrast and colour use) and accessible (limited number of information). So far, a number of general conclusions with respect to the visualisation of risk maps may be drawn (but still has to be evaluated during the EGS campaign in more detail):

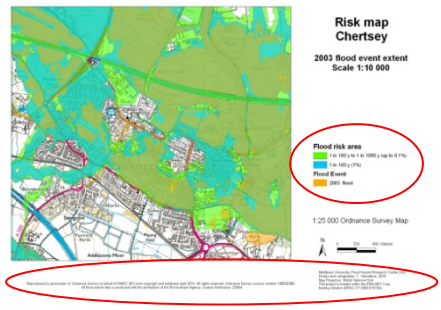
- A map background in bright colour will increase the contrast to informative elements and will avoid an overload of information;
- A sufficiently large legend, preferably on the right side of the central element of the map, with a conservative amount of information (five classes of discretisation) comprised from one range in colour and arranged in decreasing values will increase the accessibility of the map;
- A sufficiently large scale is necessary such that the elements of the map are easily recognisable.

Hence, specific elements of semiology that have to be taken into account when designing risk maps include: the contrast, the level of discretisation, and the colour range and hue. Consequently, if risk maps are adjusted to these findings, risk communication will be enhanced, and awareness-building of the public will be increased. Further results will be available after the eye-tracking test taking place in October 2010.

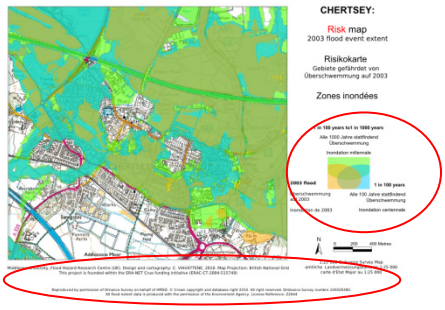
Task 2.4: Experimental Graphic Semiology (U Tours & UMR CITERES)

The first results of the Task 2.4 primarily concern the protocol of EGS, which include: a) The **improvement** of all the test maps of the case studies according to the recommendations of the forerunner project RISKCATCHand, b) the development of a specific **logigram** for the five test sites (see examples below) with the participation of the partners.

a) Improvement of the flood risk maps produced by the partners: "FHRC England", "UFZ Mulde-Saxony" and "BOKU Austria". Test maps of the site "Bavaria" are in the process of finalising. This work takes the recommendations of RiskCatch into consideration.



Before

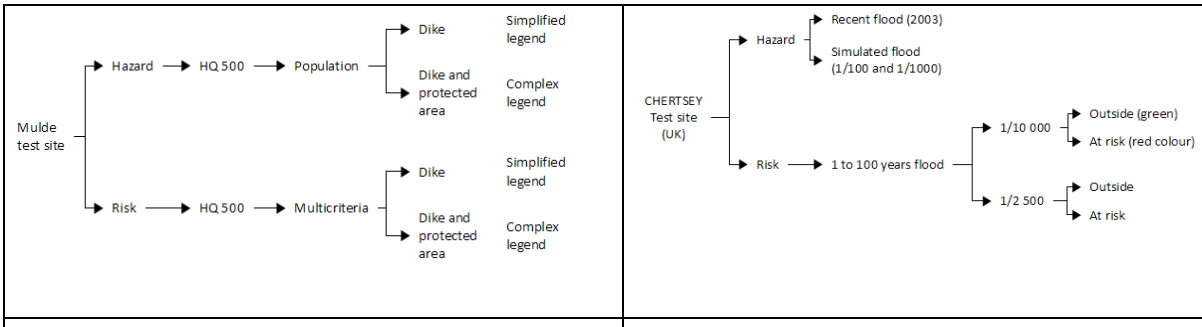


After

- Reorganisation of the legend (according to the recommendations of RiskCatch)
- Repositioning of some map elements (copyright, sources & author, scale source, ...)
- Integration of the three languages (English, German and French)
- Harmonisation with the maps of each country (5 test sites)

Figure 4: Examples for improvements of the test flood risk maps.

b) Development of a specific logigram for each test site according to the expectations of the subjects' tests which were determined during the various workshops from RISK MAP (Task 2.1) and the statutory associated obligations (European FD).



Mulde site logigram (GER) : Axed on the **complexity of the legend**	Chertsey site logigram (UK) : Axed on the **map scales**

Figure 5: logigrams for the Mulde and Chertsey case study.

Work package 4: Case Studies

The results for each case study regarding the legal framework are summarised above (Task 1.1) and the current status of risk mapping can be found in the case study table in Annex 1.

4 Overarching questions

Connection to Floods Directive:

1. How does your project contribute to the implementation of:
a) preliminary flood risk assessment,
b) flood hazard maps and flood risk maps, and
c) flood risk management plans as designated by the Floods Directive (2007/60/EC)?

As discussed above, RISK MAP's aim is to contribute to the implementation of flood maps, especially risk maps. As described above the objective of the project is to give recommendations for risk mapping, with regard to 1) participation, 2) content, and 3) visualisation. However, these recommendations could go beyond the minimum requirements of the Floods Directive.

Participation:

2. How did you account for interests of all potentially affected parties, i.e. general public, transboundary parties, policy maker etc. and how did that impact your results?

The typology of different stakeholders outlined above (chapter 3) ensures that all relevant parties are taken into account. However, not all parties were involved in the different case-studies. For instance, in the Lower Thames case-study an entire workshop was dedicated to the participation of the general public, while the Mulde case-study, as well as in the Bavarian and Austrian case-studies, included the participation of end-users from the local and regional level, producers of maps as well as high-level policy-makers. All stakeholders actively contributed to how the content as well as visualisation of flood risk and hazards maps could be improved. Their experiences, knowledge, and views will feed directly in the production of news maps considering the requirements and demands of the different stakeholder groups.

3. How does your project contribute to:
a) strengthening public participation in the establishment of future flood risk management plans,
b) valuable lessons for public authorities/institutions, and
c) good governance?
The project contributes directly to the strengthening of public participation in the respective case-studies. In the later stages of the project more substantive statements will be given in regards to

lessons learned and governance implications and this will be presented both in an empirical sense (based on the results of the interviews, workshops and surveys), as well as in a normative sense (recommendations for participation in flood risk mapping).

Harmonisation:

4. What insights will your case studies provide to balance the drive for consistent, (trans-) national flood risk management strategies and the need for local tailor-made solutions?

By employing participative approaches (interviews, workshops, experimental graphic semiology) in the case studies, it is one of our aims to find out which demands on contents and visualisation of risk maps are ubiquitary and which are highly context specific. It is further aim of RISK MAP to develop tools and frameworks (like the multicriteria risk assessment tool and a participation framework) which provide a consistent methodological approach on the one hand but on the other hand allow for the inclusion of local knowledge and preferences.

Restrictions:

5. To what extent is the generalisation of the results restricted by context variables in the case study area, such as:
a) social/socio-cultural-historical/legal-institutional/political/economic characteristics,
b) the flood type and degree of awareness, and
c) uncertainties and the way they are dealt with?

We are not entirely sure about the intention of these questions as all flood events as well as flood risk management attempts are embedded in a specific social-socio-cultural-historical-institutional-political-economic context, dependent of flood types and different patterns of awareness and uncertainties. However, by following a similar research design in all case-studies we pay close attention to this question (cf. also “harmonisation” above).

5 Dissemination

Date	Place	Type	Description	Audience
			Website: www.risk-map.org	Science/policy
October 2009	Roma	meeting	1st Era-Net CRUE meeting	Science/policy
UFZ				
21.08.2009	Dresden	meeting	1st meeting with the Saxon Flood Centre at the Saxon State Ministry of the Environment and Agriculture (LfULG)	Regional authorities/ science
September 2009	Wien	presentation	Scheuer S, Haase D & Meyer V: Multikriterielle Hochwasserrisikoanalyse - Vorschlag für eine Integration der ökonomischen, ökologischen und sozialen Dimension der Vulnerabilität. Presentation zum Deutschen Geographentag 2009 in Wien.	science
December 2009		publication	Haase D, Scheuer S & Meyer V: Exploring multicriteria flood vulnerability by integrating economic, social and ecological dimensions of flood risk and coping capacity. Nat Hazards (submitted)	science
January 2010	Leipzig	presentation	Meyer V, Haase D: Multikriterielle Bewertung von Hochwasserrisiken & multikriterielle Bewertung von Anpassungskapazitäten. Presentation at the Climate Change day at the Helmholtz Center for Environmental Research in January 2010	science
15.01.2010	Wuppertal	meeting & presentation	IMRA Scientific colloquium, presentation from Ch. Kuhlicke on RISK MAP	science
19.01.2010	Grimma	meeting	Interview: Landratsamt Landkreis Leipzig (District)	Regional authorities
21.01.2010	Delitzsch	meeting	Interview: Regionalbauernverband Delitzsch-Torgau (Regional farmer's association)	Local stakeholders
26.01.2010	Wurzen	meeting	Interview: Stadt Wurzen (City)	Local authorities
16.02.2010	Eilenburg	meeting	Interview: Landratsamt Landkreis Nordsachsen (District)	Regional authorities
24.03.2010	Leipzig	meeting	Interview: Landesdirektion Leipzig (State Directorate)	Regional authorities
14.04.2010	Bennewitz	meeting	Interview: Gemeinde Bennewitz (Municipality)	Local authorities
30.04.2010	Dresden	meeting, presentation	2nd meeting with the Saxon Flood Centre at the Saxon State Ministry of the Environment and Agriculture (LfULG), Presentation from Jochen Luther on first findings from RISK MAP, case study Mulde	Regional authorities/ science
03.05.2010	Rötha	meeting	Landestalsperrenverwaltung Sachsen (LTV), Betrieb Elbaue / Mulde / Untere Weiße Elster (Saxon State Dam Association)	Regional authorities
31.05.2010	Leipzig	workshop	1st stakeholder workshop with representatives from Bennewitz (2), Wurzen (2), District of Leipzig Land (3), State Directorate Leipzig (3) and the (LfULG) (3) and an external moderator (Prof. Dagmar Haase, Humboldt-University Berlin)	Regional &local authorities
June 2010	Leipzig	presentation	Scheuer S, Haase D & Meyer V: Integrated assessment of urban flood risk, coping capacity and vulnerability. Presentation at the 21. IAPS conference in Leipzig	science
July 2010		publication	Scheuer S, Haase D & Meyer V: Operationalization and evaluation of an integrated multicriteria flood risk assessment approach. Manuscript submitted to Environmental Modelling & Software	science

Date	Place	Type	Description	Audience
FHRC				
October 2009	London	presentation and discussion	Start up and dissemination meeting with the Environment Agency and other UK projects involved in the ERA NET crue programme	National authorities
20.05.2010	Chertsey	workshop	1st stakeholder workshop with local residents	public
25.05.2010	Chertsey	workshop	2nd stakeholder workshop with local residents	public
06.06.2010	London	meeting	Interview: Environment Agency Flood and Coastal Risk Management (FCRM) Mapping and Modelling Advisor	National thority
July 2010	Leipzig	presentation	Priest, S, Pardoe, J. & McCarthy, S. Improving flood risk maps as a means to foster public participation and raising flood risk awareness. Presentation at the 21. IAPS conference in Leipzig	science
10.07.2010	Chertsey	poster	Poster advertising Risk Map project to those living in the case study area was displayed at the Chertsey Black Cherry Fair where an estimated 8,000 people attended	public
13.07.2010	Frimley	meeting	Interview: Environment Agency (Area Flood Risk Mapping and Data Management Team Leader)	Regional authority
14.07.2010	Chertsey	poster	Poster advertising Risk Map project to those living in the case study area was displayed at the Chertsey Agricultural Show where an estimated 10,000 people attended	public
September	London	presentation and participation in workshop	Workshop hosted by FHRC and Oxford University "Lost in translation: Bringing researchers and stakeholders together towards practical flood research and management solutions".	Science/ local and regional authorities
FHD				
09.03.2010	Passau	News paper article	„First EU-funded project on campus", Passauer Neue Presse	Public
22.09.2010	Freyung	presentation	Dorner, W.: Die neuen Hochwasserrisikokarten als Einsatzinstrument für den Katastrophenschutz?	Disaster management / Regional authorities
BOKU				
July 2010	Tulln	meeting	Interview with Lower Austrian Civil Protection Authority	Regional and local authorities
July 2010	Altengbach	workshop	Workshop with 20 representatives of the Austrian Torrent and Avalanche Control Service	Regional and local authorities
June 2010	London	presentation	Invited presentation at the Annual Meeting of the Society of Risk Analysis Europe at King's College (Evaluating flood risk maps – Towards a visual risk language)	Science
May 2010	Wien	meeting	Interviews with representatives of the Austrian Torrrent and Avalanche Control Service, Section Vienna, Lower Austria, and Burgenland	Regional and local authorities
February 2010	Wien	meeting	In-depth interviews with representatives of the Austrian Torrrent and Avalanche Control Service, Section Vienna, Lower Austria, and Burgenland	Regional and local authorities

Date	Place	Type	Description	Audience
U Tours				
July 19, 2010 August 31, 2010	Paris	meeting	Mme Frédérique MARTINI, Ministère de l'Écologie, de l'Énergie, du Développement Durable et de la Mer, (chef du bureau des risques météorologiques) - DGPR/SRNH/BRM	National authorities
July 5, 2010 August 31, 2010	Orléans	meeting	M. Didier VIVET, Direction régionale de l'Environnement, de l'Aménagement et du Logement (DREAL Centre)	Regional authorities
April 23, 2010 September 2, 2010	Tours	meeting	M. Frédéric TALLOIS, Syndicat Mixte de l'Agglomération Tourangelle (SMAT)	Local authorities
May 20, 2010 June 18, 2010	Lyon	meeting	M. Bernard CHASTAN, CEMAGREF – Lyon	Scientific actor
2010		publication	Kamal SERRHINI, Juliette ROCHMAN, Elisabeth CHESNEAU, Sven FUCHS, Wolfgang DORNER et Karl SPACHINGER, « Cartographie efficace du risque d'inondation : oculométrie visuelle et sémiologie graphique expérimentale », Revue Internationale de Géomatique, Hermès-Lavoisier, 2010, 38 p. À paraître (in press)	science

6 Project Progress

(Indicate the progress of each work package against the agreed project programme and explain the reason for the delay.)

WP 1- **Status quo of risk mapping in the case studies**	**X** on schedule
WP 2- **Improving risk maps** Reason for delay: Some of the Stakeholder-Workshops were carried out later than expected due to problems in finding possible dates. This also delayed the preparation of new maps. Comments: No serious delay – E.g. test maps for EGS have been prepared on time	☐ on schedule **X** behind schedule, but can easily be caught up ☐ seriously behind schedule
WP 3- **Recommendations** Comments: *not started yet*	☐ on schedule ☐ behind schedule, but can easily be caught up ☐ seriously behind schedule
WP 4- **Case Studies** Reason for delay: Some of the Stakeholder-Workshops in the case studies were carried out later than expected due to problems in finding possible dates. This also delayed the preparation of new maps. Comments: No serious delay – E.g. case study test maps for EGS have been prepared on time	☐ on schedule **X** behind schedule, but can easily be caught up ☐ seriously behind schedule

7 Contact Details of Authors

Helmholtz Centre for Environmental Research - UFZ (Co-ordinator)	◄	**Christian Kuhlicke & Volker Meyer,** **Permoserstraße 15, 04318 Leipzig /Germany** **christian.kuhlicke@ufz.de** **volker.meyer@ufz.de**
University of Natural Resources and Life Sciences - BOKU	◄	**Sven Fuchs** **Institute of Mountain Risk Engineering** **Peter-Jordan-Str. 82, 1190 Vienna, Austria** **sven.fuchs@boku.ac.at**
Flood Hazard Research Centre, Middlesex University - FHRC	◄	**Sally Priest and Joanna Pardoe** **Trent Park, Bramley Road, London, N14 4YZ** **s.priest@mdx.ac.uk** **j.pardoe@mdx.ac.uk**
University of Applied Sciences Deggendorf - FHD	◄	**Wolfgang Dorner** **Edlmairstraße 6+8** **94469 Deggendorf, Germany** **wolfgang.dorner@fh-deggendorf.de**
Université François-Rabelais, Ecole Polytechnique, Département Aménagement, UMR CNRS 6173 CITERES	◄	**Kamal Serrhini** **kamal.serrhini@univ-tours.fr**

8 References

Bradbrook, K., Lane, S., Waller, S.G. and Bates, P. (2004), Two dimensional diffusion wave modelling of flood inundation using a simplified channel representations, Journal of River Basin Management, 2, p211-223.

Brand F S, Jax K (2007) Focusing the meaning of resilence: Resilence as a descriptive concept and a boundary concept. Ecology and Scoeity 12(1): 23. Available via http://www.ecologyandsociety.org/vol12/iss1/art23/. Accessed 01 August 2010

Carpenter S, Walker B, Anderies J M, Abel N (2001) From metaphor to measurement: Resilience of what to what. Ecosystems 4: 765-781.

Dorner, W, Schrenk, C, Spachinger, K & Metzka, R 2006, "Flood risk management plan - Relevance of the hydrological behaviour of a catchment," in XXIII Conference of the Danube Countries on the hydrological forecasting and hydrological bases of water management, Belgrade.

Environment Agency (2010) Flood and coastal risk management risk mapping strategy 2010-2015.

EXCIMAP – European exchange circle on flood mapping 2007, "Handbook on good practices on flood mapping in Europe."

Fuchs, S, Sprachinger, K, Dorner, W, Rochmann, J & Serrhini, K 2009, "Evaluating cartographic design in flood risk mapping." Environmental Hazards, vol. 8, S. 52-70.

Fuchs, S., Dorner, W., Spachinger, K., Rochman, J. & Serrhini, K. (2009b). "Flood risk map perception through experimental graphic semiology". In: Samuels, P., Huntington, S., Allsop, W. & Harrop, J. (eds.), Flood risk management. Research and practice, pp. 705-714. London: Taylor & Francis

Fuchs, S., Spachinger, K., Dorner, W., Rochman, J. & Serrhini, K. (2009a). "Evaluating cartographic design in flood risk mapping". Environmental Hazards, 8(1), 52-70.

Giordano, R., Liersch, S., Vurro, M., Hirsch, D., 2010. Integrating local and technical knowledge to support soil salinity monitoring in the Amurdarya river basin. Journal of Environmental Management 91, pp. 1718-1729.

Gruber, T. R., 1993. A Translation Approach to Portable Ontology Specifications. Knowledge Acquisition 5, pp. 199-220.

Hagemeier-Klose, M & Wagner, K 2009, "Evaluation of flood hazard maps in print and web mapping services as information tools in flood risk communication." Nat. Hazards Earth Syst. Sci., vol. 9, no. 2, S. 563-574.

Hagemeier-Klose, M. and Wagner, K. (2009) "Evaluation of flood hazard maps in print and web mapping services as information tools in flood risk communication". Natural Hazards and Earth System Sciences, 9, 563-574.

Kubal, C, Haase, D, Meyer, V & Scheuer, S 2009, "Integrated urban flood risk assessment – adapting a multicriteria approach to a city." Nat. Hazards Earth Syst. Sci., 9, no. 6, S. 1881-1895.

Kuhlicke, C., Steinführer, A. (2010) Social Capacity Building for Natural Hazards: A conceptual frame. Report for the CapHaz-Net project. www.caphaz-net.org

Länderarbeitsgemeinschaft Wasser 2006, Flood hazard map guidelines of the German Working Group of the Federal States on Water Issues, Länderarbeitsgemeinschaft Wasser.

Meyer V, Scheuer S, Haase D (2009) A multicriteria approach for flood risk mapping exemplified at the Mulde river, Germany. Nat Hazards (2009) 48:17–39

Penning-Rowsell, E., Johnson, C., Tunstall, S., Tapsell, S., Morris, J., Chatterton, J. and Green, C. (2005) The benefits of flood and coastal risk management: A manual of assessment techniques. Middlesex University Press, London.

Raymond, C. M., Fazey, I., Reed, M. S., Stringer, L. C., Robinson, G. M., Evely, A. C., 2010. Integrating local and scientific knowledge for environmental management. Journal of Environmental Management 91, pp. 1766-1777.

Reed, M., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C. and Stringer, C. (2009) "Who's in and why? A typology of stakeholder analysis methods for natural resource management". Journal of Environmental Management, 90, 193301949.

Ridder, D., Mostert, E. and Wolters, H.A. (2005) HarmoniCOP; Learning together to manage together; Improving participation in water management. University of Osnabrück; Osnabrück.

Serrhini, K., Rochman, J., Chesneau, E., Fuchs, S., Dorner, W. and Spachinger, K. "Cartographie efficace du risque d'inondation : oculométrie visuelle et sémiologie graphique expérimentale", Revue Internationale de Géomatique, Hermès-Lavoisier, 2010, 38 p. À paraître (in press).

Smith, M. K., Welty, C., McGuiness, D. L. (Eds.), 2004. OWL Web Ontology Language Guide. URL: http://www.w3.org/TR/2004/REC-owl-guide-20040210/ [Accessed September 2010].

Spachinger, K, Dorner, W, Metzka, R, Serrhini, K & Fuchs, S 2008, "Flood Risk and Flood hazard maps – Visualisation of hydrological risks." IOP Conference Series: Earth and Environmental Science, vol. 4, no. 012043.

Unnerstall, H. (2010). Legal Framework for Public Participation in Flood Risk Mapping - A comparative study on different European member states and on the requirements of the Flood Management Directive. Unpublished RISK MAP project report. UFZ Leipzig.

Annex 1: Summary of the case study findings from Task 1.2 and WP 4

Comments: (e) established standard which is applied, (p) proposed standard, (f) scientific finding

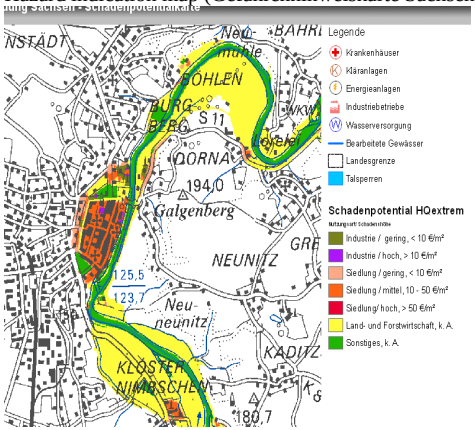
Criteria	Bavaria	Mulde, Saxony	England	Austria
Background				
History of flood hazard and risk maps (Is there a longer history of hazard and risk maps, maybe with a strong legal basis?)	*Flood maps (web map server): Information of flood-prone areas in Bavaria, national level* Hazard and risk maps: only some experiments on a local basis FloodScan ("Large scale adjustment of a new technology for fast, precise and cost-efficient hydraulic 2d-modelling of flood (hazard) areas by combining laser scanning with remote sensing data") [iv] RiskCatch, local basis	e) • Legally binding flood-prone areas (≙ mostly HQ(100)) have been indicated in zoning plans for a long time. Agencies had also hazard maps for floods with rather high probabilities • After the 2002 flood: Set-up of HWSKs (flood protection concepts) for all major rivers (1st Order) including hazard maps for different probabilities, coarse damage potential maps for an extreme flood event, existing and proposed measures, prioritisation of proposed measures, etc. • Legally binding flood-prone areas (HQ(100) according to the Saxon Water Act (Sächsisches Wassergesetz – SächsWG): only restricted development is possible • Hazard and damage maps on the web (Gefahrenhinweiskarte Sachsen): http://www.umwelt.sachsen.de/umwelt/wasser/2339.htm p) • Risk maps will be produced for the EU-floods directive, pilot sites at the Weiße Elster River (project LABEL) and Schwarze Elster River (internal LfULG project) • INGE Tool: Interactive hazard maps for emergency response in municipalities • DISMA Tool: not flood hazard-specific, used by agencies on the regional level f) UFZ-risk maps from Floodsite project for the Vereinigte (Joint) Mulde River (Meyer et al. 2009)	Over 40 years tradition of flood mapping. Two different types of flood hazard maps are provided on a national basis in England and Wales. (e) Outline flood maps (OFM) National Flood Risk Assessment (NaFRA) – although this information is not provided as a mapped layer but as information accessed from clicking on the outline map. Flood maps are generally accessed by a web-based map service.	The national organisation and structure of flood protection in Austria is divided into three parts due to the legal requirements, the diversity in landscapes, and the regionally different responsibilities: (1) Management of water bodies: The Federal Water Engineering Administration is responsible for the management of all waters (except waterways and torrents), in cooperation with provincial authorities and the Federal Ministry of Agriculture, Forestry, Environment and Water Management (Department VII 5 - Water Management and Flood Protection) (2) Torrents: Torrents of which boundaries are defined by ordinance fall into the area of responsibility of the Austrian Torrent and Avalanche Control Service, a branch of the Federal Ministry of Agriculture, Forestry, Environment and Water Management. (3) Maintenance and development of waterways: The rivers Danube, March and Thaya are in responsibility of the Federal Ministry of Transport, Innovation and Technology (BMVIT). Legally, for (1) and(2) flood hazard maps are established with either the 1:100 or the 1:150 event as a design event. *eHora (web map service) -> determined by state and insurance industry, national level, shows the inundation area based on modelling approaches which neglect flood protection.* RiskCatch, local basis

Defined Target groups/des-tinct thematic maps (Will there be specialized hazard and risk maps for defined groups of readers, e.g. citizens, disaster man.) = map types	(p) Flood hazard and flood risk maps as a basis for spatial planning, for local hazard assessment, for emergency planning and for planning technical protection measures (Hagemeiner-Klose & Wagner 2009) (f) Maps are essential for awareness building and for communication about the local hazard situation, the extension of the legally designated flood plain and the use of restrictions (see above)	• Flood-prone areas (Überschwemmungsgebiete): legal basis for (urban) land-use planning (Bauleitplanung) and other activities • Hazard maps for built-up areas (Gefahrenkarten): Public awareness raising, emergency management, urban planning • Hazard indication map for Saxony (Gefahrenhinweiskarte Sachsen), consisting of rather coarse hazard and damage potential maps for 1st Order rivers: long-term regional planning, emergency planning, planning of protection measures	(e) Flood hazard maps originally developed as a basis for spatial planning. However, they were made publically available in 2000 to allow the public to find out about their flood risk – awareness raising and communication about flood risk. (e/p) The maps are also used for emergency planning by a whole range of professionals (such as the emergency services, local authorities, water companies etc)	Flood hazard maps as a basis for any spatial planning, partly for emergency planning and for planning technical protection measures.
Why are maps produced for different target groups?	flood maps serve a variety of purposes → have to fulfil the various demands of the different user groups (Hagemeier-Klose & Wagner 2009)		The same flood maps are produced for the different target groups and although they were primarily produced for planning purposes – they are now used for many different purposes. Those developing properties do commission their own modeling in order to challenge the maps and in some cases this information is incorporated at a local level and used to improve the official maps.	
Relevant national laws and acts (Which national laws and regulations have been established?)	General Regulations in the German Water Act (Wasserhaushaltsgesetz), specific regulations in the Bavarian Water Act from 1994[i] and new modifications in discussion. [ii]	National sectoral planning (federal and state level): • Sächsisches Wassergesetz (SächsWG = Saxon Water Act, 2009 → flood protection concepts with "risk areas", legally binding flood-prone areas) within the frame of the Wasserhaushaltsgesetz (German Water Act, 2010), Gesetz zur Verbesserung des vorbeugenden Hochwasserschutzes (Act to Improve Preventive Flood Control, Artikelgesetz = omnibus bill, 2005) (the two latter on federal level) • Ordinances on Flood Information and Flood Warning and on Flood Notification (Hochwassernachrichten- und Alarmsdienstverordnung – HWNAV, Hochwassermedleverordnung – HWMO, 2008) National overall planning (federal and state level): • Raumordnungsgesetz (Spatial Planning Act), Landesplanungsgesetz (Saxon Spatial Planning Act → Regional Plans with priority and reserved areas for flood protection; Bauleitplanung (BauGB = Town and Country Planning Code)	Environment Agency (EA) established under the Environment Act (1995) - inherited a range of responsibilities flood defence responsibilities principally from Water Resources Act 1991. These relate to defending against flooding from main rivers and the sea, and related activity including providing flood warnings and flood mapping. The Floods Directive is transposed into law in England and Wales through Statutory Instruments (Environmental Protection – The Flood Risk Regulations 2009 [2009 No. 3042] and Environmental Protection – the Flood Risk (Cross Border Areas) Regulations 2010 [2020 No. 1102]	• Forest Act 1975 (Forstgesetz idgF, BGBl. 440/1975) • Decree on hazard maps 1976 (Verordnung des Bundesministers für Land- und Forstwirtschaft vom 30. Juli 1976 über die Gefahrenzonenpläne, BGBl. Nr. 436/1976) • Water Act

Process and implementation guidelines. (Which guidelines, handbooks, reports, …, for the implementation of the flood directive and risk mapping are available?)	LAWA (flood hazard guidelines of the German Working Group of the Federal States on the Water Issues) EXCIMAP (handbook on good practices for flood mapping in Europe) FloodScan	e) • LTV, 2003: Erstellung von Hochwasserschutzkonzepten für Fließgewässer. Empfehlungen für die Ermittlung des Gefährdungs- und Schadenpotenzials bei Hochwasserereignissen sowie für die Festlegung von Schutzzielen [Establishment of flood protection concepts for riverine water bodies. Recommendations for the analysis of the hazards and damage potentials in case of flood events as well as for the definition of protection objectives.] Unpublished document. • Socher M, Sieber H-U, Müller G, Wundrak P (2005): Verfahren zur landesweiten Priorisierung von Hochwasserschutzmaßnahmen in Sachsen [Procedure fort he state-wide priorisation of flood protection measures in Saxony]. Unpublished document. Publication planned for 12/2005. • German Working Group of the Federal States on Water Issues (LAWA) (2010): Recommendations for the Establishment of Flood Hazard Maps and Flood Risk Maps (http://www.lawa.de/documents/LAWA_HWGK15062010_Text_Germany_ENG_fbc.pdf), Recommendations for the Establishment of Flood Risk Management Plans (http://www.lawa.de/documents/LAWA_HWRM-Plaene26032010_Text_Germany_ENG_d09.pdf), Guidelines for Forward-Looking Flood Protection (1995, http://www.lawa.de/documents/Leitlinien_2902_629.pdf) f) UFZ approach: Meyer, V., 2007: GIS-based Multicriteria Analysis as Decision Support in Flood Risk Management. UFZ Discussion Papers 6/2007. Leipzig. Meyer V, Scheuer S, Haase D (2009) A multicriteria approach for flood risk mapping exemplified at the Mulde River, Germany. Nat Hazards (2009) 48:17–39	Guidance is due to be written by the Environment Agency for the local lead flood authorities detailing their new obligations to provide maps. Current explanations of the mapping procedure can be found in: Environment Agency (2006) Using our Flood Map: Identifying and understanding Flood Risk in England & Wales Environment Agency Website, (2008) Understanding the flood map Environment Agency (no date, accessed 2008) Understanding flood risk: Our National Flood Risk Assessment (NaFRA) The Environment Agency's Flood and Coastal Risk Management Risk Mapping Strategy (2010) which sets out the changes in flood mapping planned over the next 5 years.	EXCIMAP eHora RIWA-T: Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (2006): Technische Richtlinien für die Bundeswasserbauverwaltung. Wien For torrent hazard maps only internal guidelines, major items described in Forest Act 1975 and Decree on hazard maps 1976
Data				
Main source of flood data/ methodology (historic events, 1D, 2D models)	FloodScan: 2D modeling of flood plains[iv] RiskCatch: 2d modeling of flood plains (Sprachinger, Dorner, Metzka, Serrhini & Fuchs 2008)	e) • Data from LfULG/LTV • Methodology	Outline flood maps – Uses digital terrain modeling (IFSAR) and mapping (LiDAR) and then modeled with J-FLOW (a 2D Diffusion wave model Environment Agency (2006b). Validated with cross-sectional survey and historical flood outlines (Bradbrook et al., 2005). NaFRA – see risk assessment section below.	Historical events, terrain analysis, modeling (different software)

Main source of economic data for risk assessment (National statistics, mapping, …)	Publicly available data	e) Official damage maps (LfULG) Damage: • Land-use data: ATKIS-Basis-DLM • Asset values: typical asset values per land use category based on other studies, official statistics • Relative Depth/damage functions from other studies (Rhine) f) UFZ-approach: Damage • Land-use data: ATKIS-Basis-DLM • Asset values: from official statistics, broken down to municipality level, assigned to ATKIS-categories • Relative depth/damage functions from 3 different sources (IKSR, Kok et al. and KRIM)	Economic data are currently not used within the Flood Maps of England and Wales. Damage data are available from the Multi-coloured manual (MCM) and Multi-coloured handbook (MCH) (Penning-Rowsell et al., 2005 and 2010)	None, since RISK maps are not yet legally prescribed
Source of social data	…	f) • Official statistics	No social data is currently shown on the maps.	None, since RISK maps are not yet legally prescribed
Source of infrastructural data	… (Sprachinger, Dorner, Metzka, Serrhini & Fuchs 2008)	f) • ATKIS	The only infrastructural data that is used is on the base map which is produced by the ordinance survey – although damage data for infrastructure is available within the MCM and MCH.	None, since RISK maps are not yet legally prescribed
Is climate change considered at this stage?		It is not explicitly considered yet.	Climate change is not currently considered but is considered to be an element to introduce under the Risk Mapping Strategy.	Forest Act 1975, § 11 Abs 9: In case of changes in the fundamentals (process behaviour,…) or the respective assessment the hazard maps have to be updated according to Abs. (3)-(8). Decree on hazard maps 1976, § 8 Abs 2: If general principles change, or underlying conceptions, or the evaluation criteria change, hazard maps have to be revised accordingly by the Austrian Torrent and Avalanche Control Service.
Flood hazard				
Definition of relevant probabilities (10, 50, 100 500 year flood event?)	(p) HQ100 [iv] (f) HQ10, HQ100, HQ1000 (Sprachinger, Dorner, Metzka, Serrhini & Fuchs 2008)	e) LfULG: • Varying: HQ(5/10/20/25), HQ(50), HQ(100), HQ(200/300) • Flood hazard maps are produced for events with return periods of 20 (or 25), 50, 100 and 200 (or 300) years + for so-called "extreme" events (sometimes corresponding to the HQ(200/300) event) f) UFZ: • HQ10, 15, 50, 100, 200, 500	(e) OFM: HQ100 (rivers), HQ200 (coastal), HQ1000 (extreme) NaFRA: HQ75, HQ200.	HQ1, HQ5, HQ10, HQ30, HQ50, HQ100[iii] HQ150 for torrents

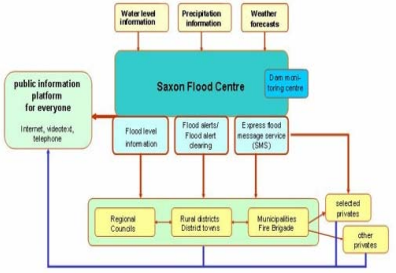
<table>
<tr>
<td>Water levels (Have distinct water levels been defined to be presented in the maps, e.g. 0.1)</td>
<td></td>
<td>e)
The general hazard maps are called “intensity maps HQ(100)” displays three intensity levels (high, medium, low), depending on the water depth. In mountainous areas, these levels depend on the discharge/flow velocity (not applicable near Wurzen/Bennewitz). For non-public use there are five intensity levels.
<table>
<tr><th>Intensitäts-stufe</th><th>Grenzen der Intensitätsstufen</th><th>Gefahrenmerkmale</th></tr>
<tr><td>hoch</td><td>$h_w \geq 2{,}0$ m
oder
$q = v \cdot h_w \geq 2{,}0$ m²/s</td><td>Menschen und Tiere auch innerhalb von Gebäuden stark gefährdet, erhebliche Schäden an Gebäuden, plötzliche Gebäudezerstörung</td></tr>
<tr><td>mittel</td><td>$2{,}0 > h_w > 0{,}5$ m
oder
$2{,}0$ m²/s $> q = v \cdot h_w > 0{,}5$ m²/s</td><td>Menschen und Tiere außerhalb von Gebäuden stark, innerhalb von Gebäuden kaum gefährdet, Sachschäden an Gebäuden</td></tr>
<tr><td>niedrig</td><td>$h_w \leq 0{,}5$ m
oder
$q = v \cdot h_w \leq 0{,}5$ m²/s</td><td>Menschen und Tiere außerhalb von Gebäuden kaum gefährdet, Sachschäden an Gebäuden (v. a. Kellerräume)</td></tr>
<tr><td></td><td colspan="2">h_w … Wassertiefe
v … Fließgeschwindigkeit
q … spezifischer Durchfluss (Durchfluss pro Meter Breite)</td></tr>
</table>
The hazard indication map displays water levels/depth only for the HQ(extreme) and in four levels: 0-0.5 , 0.5-2.0, 2.0-4.0 and >4.0 m.</td>
<td>No water level information is presented on the map or NaFRA layer.</td>
<td>Torrents: 0.7 m is the distinction between red and yellow hazard zones</td>
</tr>
<tr>
<td>Intensity criteria (Which additional intensity parameters such as flow velocity, load, etc. are taken into account?)</td>
<td>Water depth and flow velocity and areas with embankment erosion and sediment deposit (Sprachinger, Dorner, Metzka, Serrhini & Fuchs 2008))</td>
<td>See above</td>
<td>No intensity criteria is shown on the map or NaFRA layer.</td>
<td>Only internal regulations</td>
</tr>
</table>

Risk analysis				
Definition of risk and methodology for its assessment (nat. statistics, on a building basis, …)	Potential adverse consequences of specific flood scenarios[iv] Function of the probability of occurrence of a process and the related extent of damage – RiskCatch (Fuchs, Sprachinger, Dorner, Rochmann & Serrhini 2009)	Risk = annual average damage = P*D e) Official damage maps (LfULG): • Land use data: ATKIS-Basis-DLM • Asset values: typical asset values per land use category based on other studies, official statistics, some critical infrastructures, (no indirect losses) • Relative depth/damage functions also from other studies (Rhine) f) UFZ-approach: Damage • Land use data: ATKIS-Basis-DLM • Asset values: from official statistics, broken down to municipality level, assigned to ATKIS-categories • Relative depth/damage functions from 3 different sources (IKSR, Kok et al. and KRIM)	Only hazard information is provided on the outline flood maps. The NaFRA layer underneath uses the *Risk Assessment of flood and coastal defence for Strategic Planning* (RASP) methodology – this uses a "risk-based probabilistic approach to factor the location, type, condition and performance of flood defences into the risk assessment" (Environment Agency, no date accessed 2008). This is used to provide more information to users about the distribution of the likelihood of flooding to an area.	None, since RISK maps are not yet legally prescribed
Components of risk assessed (economic, social, ecological, aggregated indicators, …)	Social & economic -> legal and financial information for inhabitants and land owners [iv] Social, economic and ecologic (Sprachinger, Dorner, Mezka, Serrhini & Fuchs 2008)	e) Hazard indication map (Gefahrenhinweiskarte Sachsen):  Prioritisation of protection measures: Apart from damages also special vulnerabilities are included: • Human lives • Essential infrastructure facilities (e.g. water plants, hospitals, power plants), • Important infrastructure facilities (e.g. railways, national traffic ways, train stations, …), • Extraordinary cultural heritage or monuments • Also: hazardous substances! f) UFZ risk maps: • economic: annual average damage • Social: people affected & social hotspots • Ecologic: vulnerable biotopes, accumulation areas of polluted material	Only hazard information is presented on the outline maps. The RASP method which is used to produce NaFRA is able to take into account both social and damage data – however only the conditions of defences are taken into account on the version of the maps that is provided via the web-based maps and no socio-economic information	None, since RISK maps are not yet legally prescribed

If relevant the method of aggregation		e) Prioritisation of measures – 100-point assessment scheme: 1a. Cumulative expected damages (25) 1b. Benefit-cost ratio (25) 1c. Effects on Water Management (25) • Retention capacity (10) • Discharge conditions (10) • Water ecology (5) 1d. „Vulnerability“ (25) • Special vulnerability (people, infrastructure, heritage sites) 10 • Potential secondary losses (e.g. hazardous substances) 10 • Special protection needs (lacking possibility of defence) 5 f) Multicriteria risk mapping by UFZ: • additive weighting procedure of risk maps – standardising, weighting and addition of risk maps • disjunctive approach: definition of threshold values for each risk criteria. Threshold exceeded in at least one criterion = high risk area	The different probabilities of inundation are aggregated in order to provide the NaFRA product. But this is only in relation to the hazard.	None, since RISK maps are not yet legally prescribed
Public participation				
Past activities for public participation	RiskCatch (Sprachinger, Dorner, Metzka, Serrhini & Fuchs 2008)	Hazard maps were officially handed over to local and regional authorities by the LfULG	(f) ESRC-funded project *Understanding environmental knowledge controversies* used what they called competency groups to try to incorporate different types of knowledge into flood risk science – but few available outputs so far from this project which has now finished.	Forest Act 1975, § 11 Abs 4: Everybody with legitimate interest is allowed to comment on the draft within the period of four weeks...
How were hazard and risk maps used in public participation processes?	RiskCatch: maps were presented to various user group using the method o exe tracing supplemented by experimental graphic semiology (Fuchs, Sprachinger, Dorner, Rochmann & Serrhini 2009)		Waiting to see the outputs of the above project The flood maps are often used as contextual information when engaging the public about many flood issues	Forest Act 1975, § 11 Abs 4: Everybody with legitimate interest is allowed to comment on the draft within the period of four weeks...: Local meetings with stakeholder groups
Planned activities			None that are known of to date specifically tackling flood risk mapping – outside of this project.	
How is public participation integrated or recognised in national law?			The Environment Agency has a general approach to public participation and communicating and engaging with communities but no activities in relation to flood mapping have been undertaken.	See above
Definition of target groups			Usually targeted at ‘at risk’ populations – which is often defined as being within the 1 in 1000 year flood extent.	Mainly citizens inhabiting endangered areas or having land development plans therein.

Further information (websites, brochures, …)		Information platform flood protection (operated by the Saxon Flood Centre at LfULG, Informationsplattform Hochwasserschutz): http://www.umwelt.sachsen.de/umwelt/wasser/2318.htm Flood warning system: http://www.umwelt.sachsen.de/de/wu/umwelt/lfug/lfug-internet/wasser_13482.html Flood education trail Dresden: http://www.hochwasserlehrpfad-dresden.de/hw/index.html	*Environment Agency (no date) Working with others: Building Trust in Communities. A guide for staff* *http://publications.environment-agency.gov.uk/pdf/GEHO1106BLOJ-e-e.pdf*	Occasional brochures distributed via webpage of the Federal Ministry
Design of maps				
Scale of maps		e) • Legally binding flood-prone areas (Überschwemmungsgebiete): 1:25,000 • Gefahrenkarten (hazard maps): 1:10,000 (partly 1:25,000 and 1:50,000 along the Elbe River), 1:5,000/1:10,000 for hazard maps in settlements (restricted to public authorities?) • Hazard indication maps and damage potential maps: 1:100,000 • Risk maps under development: 1:5,000 and other	Maps provided via the web are provided at the following scales OFM 1: 650,000; 1:100,000; 1: 20,000.	1:50,000 [iv] 1:5,000 or below for torrents
Background (topographic maps, cataster map, …)	DTM [iv] (e) Standard for the design of hazard maps (Länderarbeitsgemeinschaft Wasser 2006)	e) • Legally binding flood-prone areas (Überschwemmungsgebiete): Topographic maps and vegetation maps 1:100,000 • Hazard maps/intensity maps (Gefahrenkarten, Intensitätskarten): Topographic maps and vegetation maps 1:100,000/1:50,000, for hazard maps in settlements topographic maps and vegetation maps 1:50,000 • Hazard indication maps and damage potential maps: Topographic maps 1:100,000	A coloured raster base map produced by the Ordnance Survey This includes road and rail network, built up areas including individual streets, contour information, field boundaries, buildings etc.	DTM [iii] Land register plan Orthophoto map

Colour scheme for water level, risk, extent, …)	(f) Blue for water levels/depth (Hagemeier-Klose & Wagner 2009)	e) • Hazard maps/intensity maps: Different blues/purple for intensity of inundation (see above) • Hazard indication maps: Different greens for floods ≤ HQ(100), different blues/purple for the HQ(extreme) • Colours for intensity of damage (4 different land use classes, 1-3 intensities, see above), reds/orange for settlements, brown/purple for industrial areas, yellow for agricultural areas, green for other land uses	OFM – Two different shades of blue are used: a dark blue for the areas at higher risk than HQ100 (rivers) and HQ200 (sea) and a lighter blue for the area between this flood risk and HQ1000.	Blue -> HQ100 Light pink -> HQ1 Hazard zones: yellow, red[iii] For torrents: According to Decree on hazard maps 1976: § 6. In a hazard map the following areas have to be depicted based on a design event (probability of occurrence ~ 150 yrs., "design event"): a) Red hazard zones indicate those areas endangered by avalanches and torrents where the permanent utilisation for settlement and traffic purposes is not possible or only possible with extraordinary efforts for mitigation measures; b) Yellow hazard zones indicate those areas where a permanent utilisation for settlement and traffic purposes is impaired by hazard processes; Furthermore, specific other areas have to be displayed in the hazard maps: (1) Blue colours mark areas to be provided for future mitigation measures, (2) brown colours indicate areas affected by land slides and rock fall and (3) purple colours indicate areas that can be used as protection due to their natural properties, such as protection forests or natural retention basins.
Level of detail and additional data in the map (hot spots, …)	(f) location of gauging stations (Hagemeier-Klose & Wagner 2009)	e) infrastructure (power plants and other energy assets, waste water treatment plants, hospitals)	Flood defences are shown on the map in purple and black hatching indicates those areas that are protected by the defences. Clicking on the map – provides access to the *Learn more* option whereby information related to the NaFRA assessment is provided.	
Extras				

Information management (centralized or decentralized handling of data, integration with INSPIRE, …)		The flood information & alert service in the Free State of Saxony is headed by the Saxon Flood Centre based in the Saxon State Agency for Environment and Geology (LfULG). The Saxon Flood Centre is responsible for flood information and early warning for all main rivers in Saxony. It provides relevant flood information directly to each authority with flood defence responsibilities as well as to any third parties (private persons) with particular risk of flooding. The following information products are automatically delivered to the recipients when defined alarm stages (flood level thresholds) are reached: • 4 Flood levels / alarm stages, • Flood warnings / all-clear messages and • Flood flash messages via SMS. The following input data are being received regularly: • Up-to-date readings of more than 100 flood level gauges • Precipitation and thaw forecasts of the German Meteorological Service (DWD) • Flows and water levels of reservoirs provided by the State Dam Monitoring Centre • Relevant hydrological and meteorological data for the river Obere Elbe and its tributaries in the Czech Republic are provided by the Czech Hydro-Meteorological Institute. The whole flood information system contains: • An automatic flood level and precipitation data recall unit • An information management system (database) • Forecasting models for the rivers Obere Elbe, Schwarze Elster, Mulde, Weiße Elster, Spree and Lausitzer Neiße • A public internet platform • An automatic information distributor 	The flood maps are held and updated centrally within the Environment Agency – however local teams have mapping and data specialists who provide data and input into the development of the maps.	Organised regionally (Regional branches of respective authorities).

Form of presentation (print, handouts, webGIS, …)	Public available web mapping service [iv]	e) The Saxon Flood Centre also operates an "information platform flood protection", providing major contents of the flood protection concepts (…) online. The coverage is already rather comprehensive and will be complete soon. • webGIS (http://www.umwelt.sachsen.de/umwelt/wasser/2339.htm, http://www.umwelt.sachsen.de/de/wu/umwelt/lfug/lfug-internet/wasser_13888.html) • Furthermore, the hazard indication map (Gefahrenhinweiskarte Sachsen) is also available for free on CD-ROM (at selected agencies or upon request) • Printed maps are available for inspection at relevant agencies (Format DIN A3)	Publically available web mapping service[1] Can be accessed as paper copies within Environment Agency office. The information is held within a GIS and so in theory it is possible to access it via this with permission from the EA.	web GIS [iii]
Is there a formal obligation to make maps publicly available?	FloodScan: public web map (guarantee a provision of information on flood plains and flood hazard areas)		There is a formal responsibility on the EA to raise awareness of the public about flooding - but not specifically with regard to the map. The map is required under spatial planning guidance and therefore should be publicly available for purposes of flood risk assessments for new developments - Communities and Local Government (2010 revision)	Yes, see above
Test basins (are there test basins where processes, strategies and ideas have been or are tested)	Test basin Vils and Rott for the development of hazard maps (Dorner u. a. 2006)	p) Official test sites for establishing flood risk management plans according to the EU Floods Directive, including risk maps: • Schwarze Elster River (LfULG) • Weiße Elster River (within the context of the LABEL project, under participation of LfULG f) Risk Maps from UFZ: • Vereinigte Mulde River [Joint Mulde], City of Grimma area	Already produced at a national level.	national level [iii]
Model projects for test basins or the implementation e.g. Interreg, national funding, …)	Test basin Vils and Rott for the development of hazard maps (Dorner, Schrenk, Spachinger & Metzka 2006)			

[i] http://www.verwaltung.bayern.de/Gesamtliste-.115.htm?purl=http://by.juris.de/by/WasG_BY_1994_rahmen.htm

[ii] http://www.bayern.landtag.de/www/ElanTextAblage_WP16/Drucksachen/Basisdrucksachen/0000001500/0000001848.pdf

[iii] http://gis.lebensministerium.at/ehora/frames/index.php?&gui_id=eHORA

1 http://www.environment-agency.gov.uk/homeandleisure/37837.aspx

[iv] http://www.lfu.bayern.de/wasser/fachinformationen/iueg/kartendienst/index.htm

[v] http://www.umwelt.sachsen.de/umwelt/wasser/72.htm

Communities and Local Government (2010 revision) Planning Policy Statement 25: Development and Flood Risk, Available at: http://www.communities.gov.uk/planningandbuilding/planning/planningpolicyguidance/planningpolicystatements/planningpolicystatements/pps25/

Environment Agency (2006b) Using our Flood Map: Identifying and understanding Flood Risk in England & Wales. Available online at http://publications.environment-agency.gov.uk/pdf/GEH00306BKIY-e-e.pdf?lang=_e Accessed January 2007.

Environment Agency Website, (2008) Understanding the flood map Available online at http://www.environment-agency.gov.uk/subjects/flood/826674/829803/858477/858535/?lang=_e, Accessed 6th May 2008.

Environment Agency (no date, accessed 2008) *Understanding flood risk: Our National Flood Risk Assessment (NaFRA)*, Available online at http://publications.environment-agency.gov.uk/pdf/GEH00306BKIX-e-e.pdf?lang=_e. Accessed 6th May 2008.

Environment Agency (no date, accessed 2008) *Understanding flood risk: Our National Flood Risk Assessment (NaFRA)*, Available online at http://publications.environment-agency.gov.uk/pdf/GEH00306BKIX-e-e.pdf?lang=_e. Accessed 6th May 2008.

Environment Agency (2006) Using our Flood Map: Identifying and understanding Flood Risk in England & Wales. Available online at http://publications.environment-agency.gov.uk/pdf/GEH00306BKIY-e-e.pdf?lang=_e Accessed January 2007.

2nd ERA-NET CRUE Research Funding Initiative
Flood resilient communities – managing the consequences of flooding
Interim Report

*SUFRI - Sustainable Strategies of Urban Flood Risk Management with non-structural measures to cope with the residual risk**

S. Ortner, C. Jöbstl, H. Knoblauch (Graz University of Technology)
R. Pohl, A. Bornschein (Dresden University of Technology)
L. Natale, G. Petaccia, P. Ghilardi (University of Pavia)
I. Escuder, S. Perales, A. Morales, J. Castillo (Polytechnical University of Valencia)
A. Bateman, A. Dìaz, V. Medina (Technical University of Catalonia)
G. Grossmann, A. Kulmhofer, T. Berger (University of Graz)

*Funded by Federal Ministry of Agriculture, Forestry, Environment and Water Management of Austria and the Ministry of Science and Innovation of Spain in the framework of the 2nd ERA-Net Research Funding Initiative.

1 Introduction

During the last months the main tasks were focused on work package (WP) 2 with the topic warning systems, WP3 with the topic residual risk and vulnerability analysis, and WP4 with the standardized public opinion poll in regard to risk communication. Further, general information of all five case study areas about e.g. characteristics of the catchment area, population, structural and non-structural measures, existing tools for risk estimation, and so on, has been collected as a basis for the specific tasks in the work packages.
The following chapters will give a brief overview of the work carried out, the dissemination and the participation work.

Within our joint research project the terms “resilience” and “community” are interpreted and used as follows:

Resilience

Resilience considering natural or other disasters like flood events could be defined as the capacity of individuals, families, communities, businesses or institutions to withstand and/or to respond to, cope with, resist, and quickly recover from catastrophic events. Anticipation and planning for the future as well as adaptation and transformation is fundamental to gain a better resilience.

Community

In the SUFRI project community is defined as a group of interacting people that are organized around common values and is attributed with social cohesion within a shared geographical location – community as a comprehensive and integrated body of the population and entities. Depending on the point of view a community can be either a small group of people (e.g. citizens group, neighbourhood) or at a large scale all affected people (including e.g. action forces, politics) also on a trans-national level.

In the project area there are different communities that consist of affected public or authorities or both, and SUFRI aims to vary the way of acting together for a more efficient flood risk management.

2 Methods

WP 1 – Project Management and Coordination

The tasks of the project management consist of detailed project planning and review, regular internal reporting on progress, coordination of public relation activities such as conferences, meetings, and publications, design of a website for faster and enhanced communication and contact with CRUE Steering Committee.

WP 2 – Advanced Warning Systems of Small Urban Catchment Areas

The overall study includes the elaboration of the guidelines for the case studies and a literature review about former warning systems and experiences with the warning system in case of a flood event in Germany and other European countries. The analysis is based on detailed knowledge about the causes and development of flood events and flood propagation. It focuses on measurement data collection, flood forecasting and warning dissemination in small catchment areas. For comparison purposes disaster warning systems in case of dam break, rock slides, landslides, accidents and disaster involving hazardous materials were considered too and experts in flood warning and disaster management were interviewed. In the next steps, some examples of good practice considering public information and measures to increase public awareness will be worked out.

The case studies Graz, Dresden, Valencia – Benaguasil and Arenys de Mar include a data collection about the catchment area, historical flood events and current warning systems. We focus on evaluation of data analysis and comparison of different communication chains, warning methods and devices.

WP 3 – Residual Risk and Vulnerability Analysis

In the overall study the methodology for the quantification of flood risk and how the effect of non-structural measures can be included in the process of flood risk analysis will be developed. It describes the different stages for the formation of the flood risk model that will represent the situation of the specific case study. The methodology includes information requirements, definition of flood scenarios, formation of the model and risk calculations to obtain input data, and finally risk evaluation.
The risk model will be carried out using the iPresas software (UPV, 2010). The risk model will use influence diagrams to solve the event tree which represents the specific case study. Consequently, it will provide results in terms of social and economic risk. F-N graphs (e.g. see Figure 1, p.3) are applied as a tool for flood risk evaluation. These graphs represent the potential loss of life or potential economic loss (in that case, the curve is denoted by F-€) and the annual probability of exceedance (cumulative) of a given value of potential victims. These graphs enable the comparison of alternatives once the effect of non-structural measures has been incorporated to the risk model.

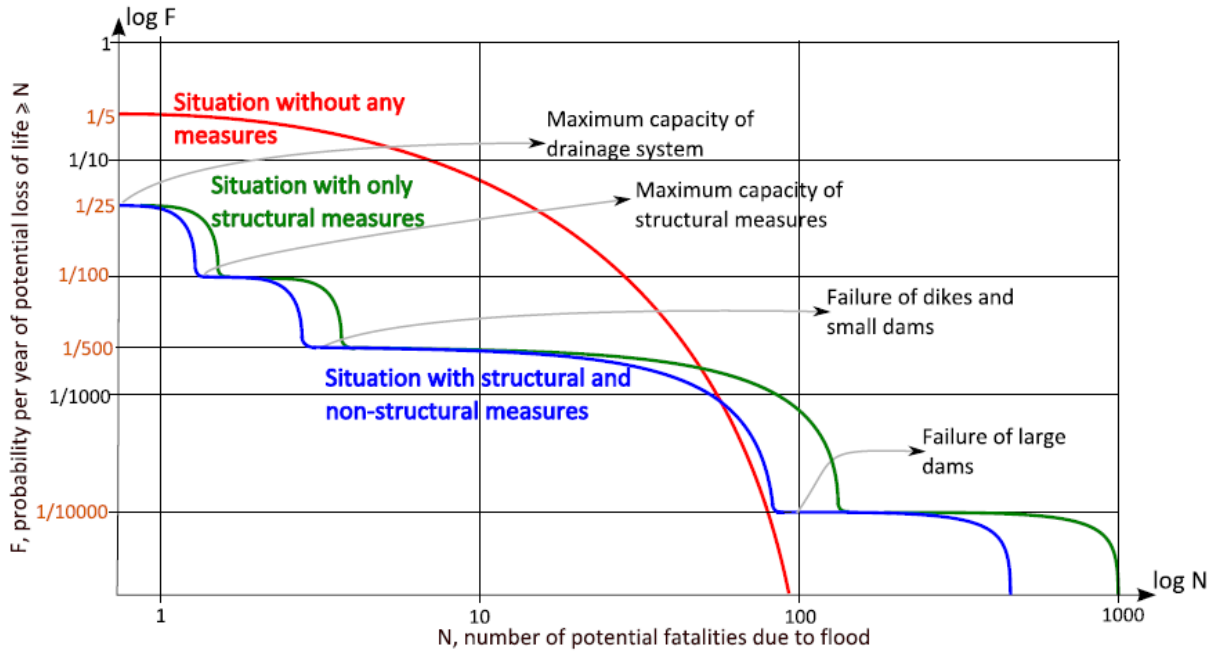


Figure 1: Effect of structural and non-structural measures on the F-N curve for societal flood risk

Therefore, flow charts, tables and schemes will be provided to support the description of the methodology. During the next months (till the end of January 2011) the methodology will be applied for the case studies Valencia, Benaguasil, Graz, and Lodi.

WP 4 – Risk Communication

In an overall study strategies of risk communication have been collected and analyzed, especially a general theoretical introduction about flood risk from the perspective of social science, theoretical approach on risk management, risk perception, and risk communication.
Additionally, the methodology of the standardized public opinion poll has been developed, focusing on risk perception and risk communication in connection with urban floods in different European cities. The empirical analysis investigates the attitude of people affected by flood events, their attitude towards risk perception, their sensitization for flood risks, towards existing prevention orientation and the importance of risk communication in the general context of risk management.

The investigation areas were focused on the following items:

1. Natural hazards and floods in general
   Identifying the degree of threat by natural hazards in general and floods in particular, knowledge with regards to floods, causes of flood events, evaluating measures to reduce floods.

2. Effects of flood events (e.g. see Figure 2, p.4)
   Being affected by floods, flood damage assessment, health impacts.

3. Communication and information
   Necessary preparation for floods, information needed, source of information.

4. Self-protection and provisions

Self-protection knowledge in case of floods, evaluation effectiveness of self-protection measures, implementation of self-protection measures, estimation of the importance of neighborly help in the event of floods.

5. Financial impact of flood events
   Stoppage of work due to flooding, natural disaster insurance, natural disaster funds.

6. Personal questions

Chapter 2:
Consequences of flood events

10. Have you been affected by floods in your present household during the last 10 years?

□ Yes
□ No If not → please continue with question 22

11. In case you have: How often have you been affected by floods in this period?

Number _____

12. When were you last affected by a flood?

Year _____ Month _____

13. How would you rate the personal damage you suffered from the last flood?

	none					massive
Material and financial losses	□	□	□	□	□	□
Health impairments	□	□	□	□	□	□
other:_____	□	□	□	□	□	□

Figure 2: Extract of the opinion poll

WP 5 – Optimization of Disaster Control Management

In the overall study different organizational models for communities in flood emergencies will be collected, specifically the outline of the FEMA (Federal Emergency Management Agency) of the United States to observe their experiences and action plans in flooding emergencies.
The case studies discuss the responsibilities of the entities in case of emergency (phase I) and the development of an action plan (phase II). The purpose of phase I is the establishment and identification of the responsibilities by data survey and interviews with the actors involved in the flood emergency scenarios and the increase of their awareness.

The following investigations will be undertaken:

- National structure of the entities
- Responsibilities of the entities and actors
- Communication chain between entities

- Communication chain between entities and population
- Advantages, disadvantages of the current scheme (actor – responsibility)

Phase II includes emergency scenarios, which will be based on legislation introduced at each site focus with their respective needs at their respective time, e.g. the affected persons differ per time of day (school, companies, …). Further a disaster control exercise will be conducted in the case study area Graz.

WP 6 – Use and International Comparison of Disaster Control Management

This WP unifies the knowledge from all previous WP, thus harmonizing experience as well as the comparison in the methodologies and methods of transnational quantification (assessment) and mitigation of residual risk by means of a criteria catalogue.

3 Results and Discussion

WP 1 – Project Management and Coordination

The following tasks have already been carried out or are in progress:

1. Website 'www.sufri.tugraz.at':
   The website contains a public area with information about how and for what their money is used, the problems in regard to urban floods, the role of the universities improving flood management, and the interaction between different countries.
   Furthermore, the website contains an internal communication platform for all project partners with the following structure:
   - General information (templates, work plans, logos, project folder)
   - Overview of the finished and missing tasks as well as deadlines for the next tasks, and supply of all presently available reports
   - All information about the project and ERA-Net meetings
   - An internal publication list of all project partners
   - Information about interesting conferences

   At present the SUFRI homepage is available in English and German.

2. Project Folder
   A project folder has been developed, at present available in English and German, with information about the project in general, the objectives, case studies, project partners, and contact details.

3. Meetings
   Three internal meetings took place to discuss the guidelines for our work, the ongoing process and to solve problems that occurred during the work. Field trips to the case studies made all project partners familiar with the specific problems on site.

Meetings until now		
1st SUFRI Meeting	27th – 28th July 2009	Graz
Internal Meeting at the ERA-Net CRUE Kick-off Meeting	20th – 21st October 2010	Rome
2nd SUFRI Meeting	15th – 16th March 2010	Dresden

Planned Meetings		
3rd SUFRI meeting and ERA-Net CRUE Meeting	18th – 21st October 2010	Valencia, Madrid
Additional SUFRI Meeting	Spring 2011	Barcelona
4th SUFRI Meeting Final ERA-Net CRUE Meeting	19th – 20th September 2011	Graz
Final International Conference: intended topic "Urban Flood Risk Management"	21st – 23rd September 2011	Graz

4. Interim Report

WP 2 – Advanced Warning Systems of Small Urban Catchment Areas

The final report of WP2 will be finished in October 2010. The following statements are part of the conclusions of the overall study:

- There are many warning systems in operation but only few are applied on small and urban catchment areas.
- The review of warning systems and documentation of operation experiences is often triggered by extreme flood events.
- Automatic warning message dissemination is not common in flood warning systems; the warning chain is often discontinuous in order to check the measurement results of river discharge gauges or to validate the results of rainfall-runoff-models.
- At present, automatic flood warning systems are a main topic in research or are in a planning stage.
- Automatic warning systems considering rockslides or landslides are in operation recently, operational experiences are not yet available.
- Short warning chains are important for a fast warning and enable the inhabitants to have enough time to implement their own flood protection measures or rescue actions.
- Diaphones or sirens are a cost efficient method to disseminate warning messages to a local limited set of people even if they have no access to public media like TV, radio or internet.

The overall study figured out the necessity of a balance of the costs of a warning system with the prevented damages. The analysis and comparison of existing warning systems can give valuable lessons for public authorities and/or institutions and help to establish a good practice in the future. The installation of cost efficient flood warning systems contributes to good governance considering an efficient, accountable and equitable policy.

Case study survey

Since July 2010 data about the characteristics of the catchment area and rivers of each case study (Graz in Austria, Dresden in Germany, Arenys de Mar and Benaguasil, both in Spain) are available. In addition, for these case studies a compilation about historical records of former flood events and damages occurred have been worked out. The catchment areas of the four case studies are between 0.25 and 385 km² and are situated in different climate zones. This is a good representation of the different kinds of small urban river catchments in Europe. Climate and rainfall data are available in all river catchments considered. Measurement data of river discharge are partly on hand.

The case studies are characterized by different flood risk types. If there is only a poor flood protection yearly flood events can create considerable damage (e. g. case study Benaguasil). At other rivers there are structural flood protection measures against more frequent floods, but in case of a 100-year-flood measures like mobile dams require to be prepared in time (e. g. case study Weißeritz, flood event 2002). It is anticipated that there are differences in flood awareness, too.

WP 3 – Residual Risk and Vulnerability Analysis

Once the methodology has been finished, reviewed and properly documented, it will be sent to TUG in September 2010. The document will be updated with comments of all other project partners after the mid-term meeting in Madrid (October 2010) to obtain an overall, clear and robust tool for risk analysis.

WP 4 – Risk Communication

Following the literature survey two research projects have given an interesting contribution to the development of the opinion poll and the different ways of risk perception. The following extracts are part of the overall study:
Steinführer (2007) – FLOODsite research project:

- Conduction of a comparative opinion poll (in Germany, Italy and England) concerning the severe flood events of the year 2002.
- Design for one particular flood event in 2002.
- The FLOODsite analysis will also provide an interesting chance for cross survey comparisons in the final theoretical discussion of WP4.

Tina Plapp (2004):

- Conduction of a survey concerning a general comparison of the different risk perception of different kinds of natural hazards in several German provinces.
- Examination of the risk perception on a general basis.

The results of the investigation shall improve the quality of information managements and their risk communication.
The empirical analysis is currently being conducted in different countries. Until December 2010 results are expected coming from the countries involved.

WP 5 – Optimization of Disaster Control Management

This WP will start end of September 2010. Until now a detailed work plan has been developed.

WP 6 – Use and International Comparison of Disaster Control Management

This WP will start in November 2010. Until now a detailed work plan has been developed.

4 Contributions to overarching questions

Connection to Floods Directive:

The main goal of SUFRI is the improvement of flood risk management plans with non-structural measures, especially for smaller mountainous and/or urban catchment areas. Based on the different demands of five representative case studies new methodologies will be developed to provide general approaches for the optimization of the disaster control management. This includes a methodology for the quantification of flood risk and how the effect of non-structural measures can be included in the progress of flood risk analysis, an approach in trans-national strategies of risk communication, a survey of an actor-responsibility in case of flood emergencies and the obtainment of knowledge regarding flood warning dissemination in urban areas.

Participation:

Each project partner integrates affected parties in their case study area. In most cases policy maker take an active part in the realization of the aims of our project. In Graz a periodical working group with stakeholder and authorities meets every 3 months to review and discuss current situations (tasks, problems, …). Additionally, the local citizens have been informed about SUFRI by a press conference in the city hall of Graz, in March 2010. Further, an informative meeting about our project, the aims and the public opinion poll especially was organized for a citizens' initiative of Andritz (district of Graz). Additional meetings with the affected people took place. In Lodi the UPV-I works together with Lodi's Civil Protection Office, which copes with the Municipal Civil Protection Plan and the flood emergency plan. Up to now the UPC implemented various interviews with state and local authorities. The attention was drawn to the functioning of warning and risk management for the Arenys watershed. In Valencia and Benaguasil the collaboration of authorities has been excellent. There were several meetings with town councillors. They announce the opinion poll on the Town Council website and included information about the project to inform general public. For this purposes the website of SUFRI and a project folder were announced.
Governments and authorities have clear responsibilities on the "structural" measures (new constructions or the integrity of the existing ones), but also "non-structural" responsibilities such as warning, evacuation or urban planning. Thus, the elaborative methodology in this project has to be sensitive and capture the effect of both, "structural" and "non-structural" measures and it contributes to achieve a learning "PROCESS", including risk assessment tools, clear responsibilities, better planning, etc.
The opinion poll survey is a useful tool to public participation. Good governance can be achieved only if interests of citizens are considered and decisions take into account all possible consequences of an action (benefits and costs, in this particular case, regarding flood risk).

Harmonisation:

Case studies in four different countries (Austria, Germany, Italy and Spain) can point out national differences and similarities in national flood risk management strategies (national proceedings, infrastructure, the efforts of rehabilitation, the public's risk perception, as well as the competence of authorities). Thus, efficient local strategies can be helpful for other countries to improve their tailor-made solutions as well as to find trans-national strategies for interacting management plans.

Restrictions:

At this stage of the project it is not yet possible to give information about the restrictions by context variables in regard to our case studies. Some important tasks will be conducted in the next months, e.g. opinion poll, which will provide comprehensive information about this topic. This information will be taken into account when interpreting the results of the case studies.

5 Dissemination

Date	Place	Description
26th-29th August 2009	Lausanne (Switzerland)	11. Treffen junger WissenschafterInnen an Wasserbauinstituten Presentation and Publication in conference proceedings (in German): Nachhaltige Strategien für das urbane Hochwasserschutzmanagement mit nicht-strukturellen Maßnahmen (Jöbstl C., Knoblauch H., Ortner S.)
6th-10th Sept. 2009	Sibiu (Romania)	Conference on Radar in Meteorology and Hydrology Poster: Mitigation of the residual risk of flooding by non structural measures and early warning system in the Arenys de Mar basin
26th-27th Nov. 2009	Paris (France)	Final conference of the COST action C22 urban flood management in cooperation with UNECSO-HIP, 'Roadmap towards a flood resilient urban environment' Presentation and Publication in conference proceedings (in English): SUFRI - Sustainable Strategies of Urban Flood Risk Management with non-structural Measures to cope with the Residual Risk (Jöbstl C., et al)
January 2010	Styria (Austria)	Publication in 'Wasserland Steiermark'(in German): SUFRI Nachhaltige Strategien für das Hochwasserschutzmanagement in Städten zur Beherrschung des Restrisikos mit nicht-technischen Maßnahmen (Hornich R., Jöbstl C., Ortner S., Knoblauch H., Grossmann G., Kulmhofer A., Berger T.)
March 2010	Washington (USA)	USACE Workshop Alexandria: Exploration of Tolerable Risk Guidelines for Levee Systems Publication: Urban flood risk characterization as a tool for planning and managing (Escuder Bueno I., Morales Torres A., Perales Momparler S.)
1st-2nd March 2010	Barcelona (Spain)	Conference on challenges and opportunities of the directive on the assessment and flood risk management Presentation (in English): Transposition and translation of the directive to Austria, presentation of SUFRI project (Hornich R.)
5th March 2010	Graz (Austria)	Press conference Presentation (in German): SUFRI (Zenz G., Grossmann G.)

17th-18th March 2010	Dresden (Germany)	Conference 'Dresdner Wasserbaukolloquium 2010' Poster (in English): SUFRI (Knoblauch H., et al)
9th April 2010	Graz (Austria)	11th Aprilsymposium ‚Brandschutz im neuen Jahrtausend', Brandschutzforum Austria Publication in proceedings (in German): Sustainable Strategies of Urban Flood Risk Management with non-structural Measures to cope with the Residual Risk (Zenz G., et al)
21st May 2010	Graz (Austria)	At a project meeting of SHARE, SEE (SUFRI Factsheets)
26th-28th May 2010	Cagliari (Italy)	Working group F Thematic workshop 'Flash floods and pluvial flooding' Poster (in English): SUFRI (Knoblauch H., et al)
1st June 2010	Valencia (Spain)	RLHE - Red de Laboratorios Hidráulicos de España Seminar, Conference: Herramientas para la estimación del riesgo de inundación y estudio de su reducción a través de medidas no estructurales (Escuder Bueno I., Morales Torres A., Perales Momparler S.)
15th-17th June 2010	Valladolid (Spain)	Spanish National Committee on Large Dams (SPANCOLD) 'IX Spanish Symposium on Dams' Publication (in Spanish): Metodologías de estimación de consecuencias de inundación en zonas urbanas y estudio de su reducción a través de medidas no estructurales (Morales-Torres A., et al) Poster (in Spanish)
17th June 2010	Barcelona (Spain)	Imprints Workshop, Topic: Maresme basins and the residual risk associated due the structural measures
3rd-4th July 2010	Graz (Austria)	City festival SUFRI Folder (in German)
15th October 2010	Valencia (Spain)	Colegio de Ingenieros de Caminos, Canales y Puertos (CICCP) (Professional Association of Civil Engineers) Planned symposium on Risk Assessment by UPV-S. SUFRi project will be presented.

6 Project Progress

WP 1 - Project Management Reason for delay: Comments: The Project Management lasts for the whole project time. Up to now, All scheduled milestone (website, interim report, meetings) have been achieved.	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule
WP 2 – Advanced Warning System of Small Urban Catchment Areas Reason for delay: Comments: All deadlines have been met (overall study, characteristics of the case study area). The last part of the case study survey will be finished at the end of August. The summarizing report of WP2 with the conclusion will be finished at the end of October 2010.:	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule
WP 3 - Residual Risk and Vulnerability Analysis Reason for delay: Comments: All deadlines have been met (overall study, data collection in the case study area). At the present, the methodology development of the residual risk analysis is in progress and will be finished until end of September 2010.	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule
WP 4 - Risk communication Reason for delay: Comments: Comments: All deadlines have been met (overall study, development of standardized opinion poll). The procedure of the opinion poll is currently in work. Results will be available in December 2010.	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule
WP 5 - Optimization of the disaster control management Reason for delay: Comments: This WP will start end of September 2010. Until now a detailed work plan has been developed.	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule
WP 6 - Use and national comparison of disaster control management Reason for delay: Comments: This WP will start in November 2010. Until now a detailed work plan has been developed.	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule

Contact Details of Authors

Graz University of Technology (Co-ordinator)	◄	**Cornelia Joebstl, Simone Ortner, Helmut Knoblauch** **Stremayrgasse 10/II, 8010 Graz, Austria** **helmut.knoblauch@tugraz.at**
Dresden University of Technology	◄	**Reinhard Pohl** **Helmholtzstrasse 10, 01069 Dresden, Germany** **reinhard.pohl@tu-dresden.de**
University of Pavia	◄	**Luigi Natale** **Via Ferrata 1, 27100 Pavia, Italy** **natale@unipv.it**
Polytechnical University of Valencia	◄	**Ignacio Escuder** **Camino de Vera S/N., 46022 Valencia, Spain** **iescuder@hma.upv.es**
Technical University of Catalonia	◄	**Allen Bateman** **C/ Jordi Girona, 1-3, 08034 Barcelona, Spain** **allen.bateman@upc.es**
University of Graz	◄	**Gerhard Grossmann** **Universitätsstraße 15, 8010 Graz, Austria** **gerhard.grossmann@uni-graz.at**

References

Steinführer et al (2007): Social vulnerability and the 2002 flood, Country report Germany (Mulde river), http://www.floodsite.net/html/publications2.asp?documentType=1&Submit=View (04.03.2010)

Plapp (2004): Wahrnehmung von Risiken aus Naturkatastrophen. Eine empirische Untersuchung in sechs gefährdeten Gebieten Süd- und West-Deutschlands, Verlag Versicherungswirtschaft, Karlsruhe

2nd ERA-NET CRUE Research Funding Initiative
Flood resilient communities – managing the consequences of flooding
Interim Report

Understanding Uncertainty and Risk in Communicating about floods - URflood

Prepared by the Joint Project Consortium* consisting of:-

- **Project partner #1, (Joint Project Coordinator)**
  Macaulay Land Use Research Institute
- **Project partner #2,**
  Suomen ympäristökeskus (Finnish Environment Institute)
- **Project partner #3,**
  University College Dublin
- **Project partner #4,**
  Centro Interuniversitario di Ricerca in Psicologia Ambientale
- **Project partner #5**
  Collingwood Environmental Planning

*Funded by Scottish Government, Office of Public Works, Ireland, ISPIRA- Institute for Environmental Protection and Research, Italy and the Finnish Government in the framework of the 2nd ERA-Net Research Funding Initiative.

1 Introduction

This research builds on developments in Europe and the USA in the understanding of social and institutional responses to flooding. Rather than assuming an information deficit model (Irwin,1995), i.e. that providing more or better information will ensure more 'rational' responses to flood events or flood risk; the project considers what different audiences for flood communications already know; how they understand and use these flood communications and whether there are erroneous assumptions being made that negatively effect the choices being made by those responding to a flood event or living with flood risk. Improving individual and collective capacity to respond to flood risk communications and flood warnings in this way will directly contribute to improved community resilience.

Echoing the wider risk communication literature, research on flooding has identified a large number of variables that influence flood warning response either by inhibiting or enabling action by individuals in flood prone locations (Parker et al, 2007). Understanding responses to flood communication requires both understanding the situational factors (physical characteristics, location) of the risk and social, cultural and cognitive attributes (personal and psychological) of individuals for whom the communication is intended (Tobin and Montz, 1997, Werrity et al, 2007).

Making improvements to any single factor, such as the channel of communication, is unlikely to achieve significant changes in response (Twigger-Ross et al, 2008; Miceli et al, 2007). The argument that people typically fail to understand the risk of flooding (or other risks) because they lack information has given rise to a number of critiques:

- Lay people draw on their own forms of judgement and evaluation to assess risk information based on the socio-cultural context of the risk and how it fits in with their everyday experiences and experience of risk information (Pidgeon et al, 2003; Horlick-Jones, 2007) and with their own subjective ways of viewing risk (Slovic, 2000; Vahabi, 2007).
- The degree of trust in the source of the risk information and the institutions that produced it is crucial in people's assessment of a risk (Renn and Levine, 1991) and how they interpret information (Fischer and Glenck, in progress).
- Communication about risk is interpreted in light of wider changes in demographic patterns, communication practices and norms, and awareness of and expectations about risks (Walker et al, 2008; Beck, 1992).

Therefore this project seeks to outline how communities in flood prone areas make sense of the information in order to better tailor flood communications.

Thinking in terms of knowledge systems helps to make sense of how these different elements work to generate responses. Knowledge systems view information as a resource that flows around a network of different actors, is converted to knowledge and may influence practices (Roling and Engels, 1992). It challenges the information deficit model by suggesting that it is important to understand how the knowledge is used in decision making. In essence, the starting point of improving communications needs to be based on how to work with people to achieve the intended behavioural response, rather than starting with the content of the communication itself.

Research shows that it is important in flooding to understand the heterogeneity of "the public" (e.g. Thrush et al, 2005) as different characteristics of people affect how they make sense of flood information (Kenyon, 2007). Most of the research on communication and responses to flooding has focused on individual members of the public. As it would be foolish to assume that the "public" are homogenous it would also be naïve to consider "professional partners" as a single group. The few studies on organisational responses, (e.g. McCarthy 2007, Morss et al 2005) suggest that a range of responses can be found, from an "expert" understanding of uncertainty to responses that are much

closer to a "lay" perspective. This project explores perspectives and knowledge systems of both flood prone communities and the emergency responders, to understand if there are important differences in their perceptions and if these differences have implications for improving resilience to flood events (as recommended by Miceli at al, 2007).

The project contributes to the first theme of the current call (Improving risk awareness and increasing public participation), and seeks to answer the three questions relating to the communication of residual risk and uncertainties (1.3). There is little published literature on how people make sense of so-called "residual risks" associated with structures such as dams and dykes. Given the potentially devastating consequences of a dam or flood defence breach, our Finnish and Irish case studies are selected to explore this residual risk. Furthermore, little research has been done into how information about the likelihood of flooding could be incorporated into flood warnings and what the impact of that information might be on response. Case studies will provide information on how different kinds of uncertainty and risk affect perceptions of and responses to flood communications. Improving relationships and mutual understanding between the emergency responders and the impacted communities will improve resilience to flood events as well as flood communications themselves. The research is intended to support the move towards Flood Risk Assessment and Management (FRAM) under the EU Floods Directive and to assist with improving resilience to the social, economic and environmental consequences of flood risk.

2 Methods

WP 1 – Project Management

This is ongoing throughout the entirety of the project. Project managment and communication between the partners is through a mixture of e-mails, tele-conferences and face to face meetings as facilitated by the wider ERANET network. Each partner is responsible for communication of progress of the work with their own national advisory group.

WP 2 & 3 – Understanding the Role of Uncertainty in Flood Risk Communication

This work package consisted of reviewing relevant previous work undertaken and was synthesised in a literature review that covered a wide range of topics related to uncertainty in flood risk management and its communication. All of the partners contributed to the review and it has been circulated to the funding agencies of individual project partners.

WP 4 – Investigating Knowledge Systems in Selected Flood Prone Areas

At the start up meeting in Rome, the partners developed a conceptual map of the relationship between the senders and receivers of flood warnings and the opportunities for understanding or mis-interpretating the contents of the message sent and received. This is illustrated in Figure. 1. At the same time the consortium have considered how the roles and responsibilities between the different case study countries operate as it was felt that these issues may also contribute to the generation of potential confusion and therefore uncertainty in relation to flood risk communication. These conceptualisations and flow diagrams reflect what should be the correct pathways for all flood risk and flood warning communications to be delivered to vulnerable communities

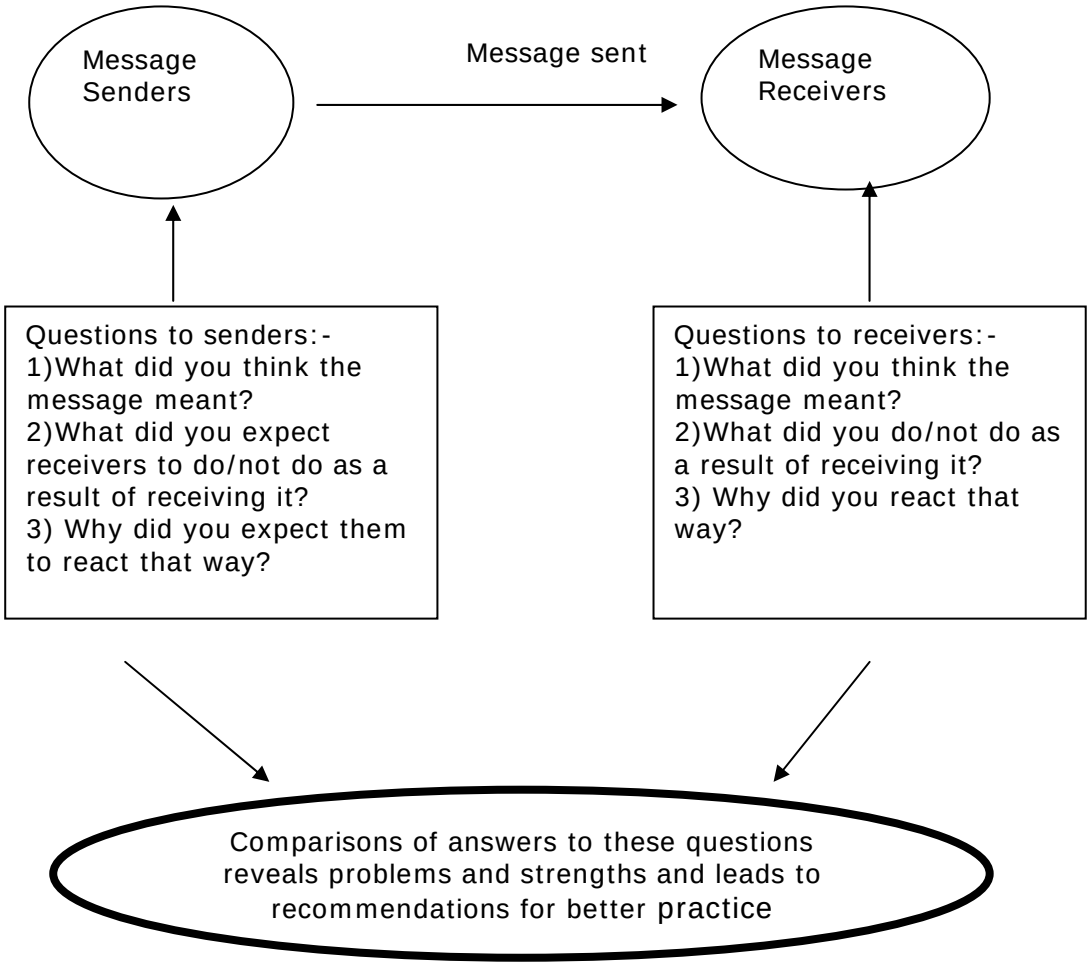


Figure 1 The Basic Model of the Situation at its simplest

The success or otherwise of these communication strategies, in addition to other flood risk issues, are being addressed in WP 4. WP 4, therefore is a significant part of the overall project and consists of case study research in all partner countries. Case studies are using questionnaire surveys that focus on key themes that include people's current awareness of flood risk, their awareness of flood related communications and availability of information, the role of uncertainty in these communications, responses to flood warnings and how these responses could be improved.

To ensure consisteny across all case studies, a common methodology was adopted. All questionnaires contained core questions that were required for meeting the project objectives. However, characteristics specific to structures and issues in the partner countries that were also addressed in the study required that flexibility be given to project partners to address these in formulating additional questions that may not be common to all case studies. These case studies are reaching their conclusion and the questionnaires that are being used can be downloaded from: http://www.macaulay.ac.uk/urflood/case_studies.php.

WP 5 – Designing New Communication Methods

Work has only recently been initiated on this work package as it entails a detailed analyses of questionnaire responses. The use of this 'needs' based approach by working closely with the communities, was a strong message from the literature review. Finalisation of the analyses and development of the new communication method is a central component to the Madrid meeting in October 2010.

WP 6 – Testing New Communication Methods in Selected Area

The testing of the new communication methods will be undertaken by use of focus group discussions and analysis or through workshops. The final details of the testing of communications will be discussed and agreed by the consortium partners at the mid term meeting in Madrid during October 2010.

WP 7 – Synthesising Results

Not yet initiated.

5 Results and Discussion

WP 2 & 3

A 72 page report on the literature review has been prepared and circulated to the individual country sponsors. The final draft report prepared as work in progress can be viewed from http://www.macaulay.ac.uk/urflood/outputs.php**.** As part of the review and improving a better understanding of how current roles and responsibilities in relation to flood risk communication differs between the case studies each country has prepared flow diagrams of who and how responsibility is shared between the competent authorities. Comparison of the strengths and weaknesses of these will be discussed and analysedat and following the mid term meeting.

WP 4

The case studies selected and the type of flooding they are subjected to are detailed in Table 1.

Country	Site	Type of Flooding	Comment
Scotland	Huntly	Fluvial	
	Glasgow	Fluvial	
	Newton Stewart	Fluvial	Additional option to agreed case study
	Moffat	Fluvial	As above
	Newburgh	Coastal	As above
	Dalbeattie	Fluvial	As above
Ireland	Dublin	Pluvial, fluvial and coastal	
	Clonmel	Fluvial	
	Ballinasloe	Fluvial	
	Wexford Town	Coastal	
Italy	Rome	Fluvial	Different groups of residents
	Venice	Coastal	To be confirmed
Finland	Rovaniemi	Fluvial	

Table 1: Summary information on case studies

Progress with the individual questionnaires in the individual case studies has been sumarised in Table 2 below:-

Case Studies	Questions Finalised (Y/N)	Piloted (Y/N)	Issued (Number)	Collected (Number)	Collated (Y/N)	Discussed with NAG (Y/N)
Huntly	**Y**	**Y**	**86**	**43**	**Y**	**Y**
Glasgow	**Y**	**Y**				**Y**
Dublin	**Y**	**Y**	**In progress**			**Y**
Newton Stewart	**Y**	**Y**	**In progress**			**Y**
Moffat	**Y**	**Y**	**In progress**			**Y**
Newburgh	**Y**	**Y**				**Y**
Dalbeattie	**Y**	**Y**	**In progress**			**Y**
Clonmel	**Y**	**Y**	**650**			**Y**
Ballinasloe	**Y**	**Y**	**350**			**Y**
Wexford Town	**Y**	**Y**	**595**			**Y**
Rome	**Y**	**Y (1)**	**In progress**		**N**	**N**
Venice	**N**	**N**			**N**	**N**
Finland	**Y**	**Y**	**1678**	**375**	**Y**	**Y**

Y = Yes, N = No, NAG – National Advisory Group/ National Funding Bodies. (1) Qualitative study conducted

Table 2: Progress of questionnaires with individual case studies

A critiques and comparison of the questionnairess has been undertaken by one of the partners (University College Dublin).

WP 5

As a precursor to designing a new communication method, a comparison of existing strengths and weaknesses of existing flood warning communication in the case studies has been initiated.
For Scotland some initial observations and comments relating to this are:-

1) Need for multiple communication methods and channels
2) Importance of trust in source of communication
3) Difference between responses from flooded and flood prone areas
4) Need to encourage greater ownership of the problems associated with floods and flood warning so that residents take a more proactive role in considering their options for courses of action.

5) Issue of compulsion to receive flood warning, not opt in but opt out. Currently in many of the case studies the default position is that residents may receive warnings if they wish and subscribe to a service. It may be that the service should be compulsory unless residents wish not to receive flood warnings.

6 Contributions to overarching questions

In respect of the overarching questions our progress this far allows us to comment on questions 1 to 3 but not 4. These initial responses are summarised below:

1. *Which elements of the knowledge systems are used to make sense of flood risk information? How do these alter with stakeholder characteristics?*

A result of the analysis undertaken to date suggests that an important element of the knowledge system is past experience. Another interim result suggests that in relation to the actions to take people prefer direct public announcement rather than visits or use of mass media. Over the coming months we will focus on how to achieve the desired behavioural response and not simply on the content of the communication. Based on the literature review this is likely to be influenced by knowledge of the diversity of populations targeted and tailoring the warnings to suit. The main variants between groups include *psychological and social-psychological factors* (EG past experience of flooding, mental models of flooding, knowledge systems including world views, *expertise in natural hazards* (experts vs. lay people – farmers versus urban populations), vulnerability, hard to reach groups like the very elderly, and *socio-demographic factors* (gender, age, education, income, ethnicity, vulnerability).

2. *What evidence is there that information on probability and uncertainty alter response?*

Some of our initial results from the questionnaires collated and analysed from the case studies show that there is a trustworthiness of the agencies responsible for flood warnings. For example using a five level scale in Scotland suggests that whilst all agencies are trusted there is some variation between them, with the Local Authority perceived as the least trustworthy. In relation to the reliability of the flood warning message the Floodline and Fire Services had the highest reliability. In addition we would anticipate to comment on the need to be clear about the uncertainties in flood warning using concepts of probability but be explicit that public flood protection actions do not provide total security - a residual risk will always remains.

3. *How can flood risk communication be developed considering stakeholders and knowledge systems?*

From the results and discussions with our stakeholders and partners our interim results show that few people consider they are receiving too much information and most people would prefer to receive more information. In relation to how people would prefer to receive information there are differences according to peoples past experience of flooding, if the message relates to warnings and action to take in the event of a flood warning. From a fuller analysis of the data we would hope to clearly identify actions recipients have and should take when in receipt of a flood communication. Similarly we will

report on the use of multiple channels of communication, indirect (media etc), direct (emails, faxes etc) and community (loudhailers, flood wardens in street in street etc) to evoke more timely responses. A further consideration prompted by the literature review is to:

- avoid jargon and technical terminology
- the use of plain language, consistent and accurate in detail
- to use limited range of clearly defined and widely understood terms - flood risk, flood hazard, flood warning, direct damage, indirect damage.
- Demonstrate meaning of terms with examples.
- Avoid or replace more difficult concepts such as probability with ‚odds of' or chance of'.

4. *Where are the mismatches between different knowledge systems and what implications do these have?*

Not enough information has been obtained to date to allow a response. This will be achieved through the next work package due for completion in early 2011.

7 Dissemination

UR_Flood partners have been involved in a range of dissemination activities as listed in Table 3.

Date	Place	Description
Oct. 2009	Rome	Presentation to ERANET kick off meeting
Nov. 2009	Scotland	Press release on URFlood
Jan. 2010	Germany	Participation in IMRA Scientific Colloquim
Feb. 2010	Scotland	Presentation to national conference on flooding
March 2010	Venice	Participation in FREEMAN Stakeholder Meeting
April 2010	WWW	UR Flood web pages updated
July. 2010	Scotland	Progress reported to National Advisory Group
Aug. 2010	Scotland	Workshop on research needs for Flooding in Scotland

Table 3: Highlighted dissemination activities undertaken as part of UR- Flood.

8 Project Progress

(Indicate the progress of each work package against the agreed project programme and explain the reason for the delay.)

WP 1 - Project Management **Reason for delay:** No Delay **Comments:**	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule
WP 2 & 3 - Understanding the Role of Uncertainty in Flood Risk Communication **Reason for delay:** No Delay **Comments:**	☒on schedule ☐behind schedule, but can easily be caught up ☐seriously behind schedule
WP 4 - Investigating Knowledge Systems in Selected Flood Prone Areas **Reason for delay:** Delay is as a result of a key member of staff being ill over the winter months **Comments:**	☐on schedule ☒behind schedule, but can easily be caught up ☐seriously behind schedule
WP 5 - Designing New Communication Methods **Reason for delay:** Delay is as a result of the delays experience in WP 4. **Comments:** This WP has only recently started. The work will be back on schedule by December 2010.	☐on schedule ☒behind schedule, but can easily be caught up ☐seriously behind schedule
WP 6 - Testing New Communication Methods in Selected Area **Reason for delay:** Anticipate delay as a result of the delays experience in WP 4. **Comments:** This WP has not yet started.	☐on schedule ☒behind schedule, but can easily be caught up ☐seriously behind schedule
WP 7 - Synthesising Results **Reason for delay:** Anticipate delay is as a result of the delays experience in WP 4. **Comments:**	☐on schedule ☒behind schedule, but can easily be caught up ☐seriously behind schedule

Contact Details of Authors

Project partner #1 (Co-ordinator) ◄ **Simon Langan**
Macaulay Land Use Research Institute, Aberdeen, Scotland.
s.langan@macaulay.ac.uk

Project partner #2 ◄ **Pia Rotko**
Suomen ympäristökeskus (Finnish Environment Institute), Helsinki, Finland.
pa.rotko@ymparisto.fi

Project partner #3 ◄ **John O'sullivan**
University College Dublin, Dublin, Rep. of Ireland
jj.osullivan@ucd.ie

Project partner #4 ◄ **Marino Bonaiuto**
Centro Interuniversitario di Ricerca in Psicologia Ambientale, Rome, Italy
Marino.bonaiuto@uniroma1.it

Project partner #5 ◄ **Clare Twigger-Ross**
Collingwood Environmental Planning, London, England
c.twigger.ross@cep.co.uk

References

Beck, U., (1992). The Risk Society: Towards a New Modernity. London: Sage.

Miceli, R., Sotgiu, I. and Settanni, M. (2008). Disaster preparedness and perception of flood risk: a study in an alpine valley in Italy. *Journal of Environmental Psychology,* 28,164-173.

Mileti, D.S., Fitzpatrick, C. and Farhar, B.C., (1992). Fostering public preparations for natural hazards. *Environment,* 34, 16-39.

Morss, R. E., Wilhelmi, O. V., Downton, M. W., and Gruntfest, E. (2005) Flood risk, uncertainty, and scientific information for decision making, BAMS, 86, 1593–1601

Parker, D.J., Tunstall, S.M. & Wilson, W (2005) Socio-economic benefits of flood forecasting and warning. Paper presented at the 2005 ACTIF workshop,

Renn, O. and Levine, D., (1991). Credibility and trust in risk communication. In Communicating Risks to the Public. ed. R. Kasperson, P. Stallen, pp. 175–218. Dordrecht, Neth.: Kluwer.

Slovic, P., (2001). The Perception of Risk. London: Earthscan 133. Slovic P., Fischhoff B., Lichtenstein S. 1990. Rating the risk. In Readings in Risk, ed. TS Glickman, M Gough, pp. 61-75. Washington, DC: Resour. Fut.

Walker G., Burningham K., Fielding J., Smith G., Thrush D., Fay H. (2006) *Addressing environmental inequalities: flood risk*. Environment Agency Science Report.

Werrity, A., Houson, D., Ball, T., Tavendale, A. and Black, A. (2007) Exploring the social impacts of flood risk and flooding in Scotland http://www.scotland.gov.uk/Publications/2007/04/02121350/9

2nd ERA-NET CRUE Research Funding Initiative
Flood resilient communities – managing the consequences of flooding

*Scientific coordination project**

Review on Resilience-Summary

Manijeh Schwindt, alpS - Centre for Natural Hazard and Risk Management, Innsbruck, Austria
Annegret Thieken, Climate Service Center, Hamburg, Germany

*Funded in the framework of the 2nd ERA-Net CRUE Research Funding Initiative.

1 Introduction

Recent flood events, e.g. in 2000 and 2007 in the UK, in 2002, 2005 and 2010 in Germany, in 2010 in France or in 2010 in Pakistan point out that natural disasters are phenomena which can cause a large number of fatalities as well as high economic losses in developed as well as developing countries. In order to avoid that natural hazards become disasters, the implementation of adequate mitigation measures and risk management strategies is necessary. Based on data of the Centre for Research and Epidemiology of Disasters (CRED) at the University of Louvain (Belgium), Strömberg (2007) determined an average yearly increase in the number of natural disasters of about 5% since 1960. This development can be traced back to a) climate variability, b) environmental degradation, c) rapid growth of the world population and d) urbanization (Abramovitz, 2001). However, although the dataset of CRED is the most comprehensive, one has to keep in mind that the increase in the number of natural disasters is also determined by an improvement of disaster reporting (Strömberg, 2007). The observable increase in the number and intensity of natural disasters suggests that these events might take unexpected dimensions (e.g. magnitudes never experienced before, new locations). Against this background, one has to accept that absolute safety and perfect prevention are often not possible. Rather, it is important to increase resilience by providing measures which raise the ability of a society to withstand and recover from disasters (Zhou et al., 2010).
However, as will be shown in the following, even after 30 years of research, the

concept of resilience is still diverse. Since the term resilience is used by very different fields of research, each applying different methodologies, one can observe a wide range of definitions. The implementation of correct mitigation strategies requires a better understanding of the concept of resilience. Along with the diversity of definitions comes a lack of a framework on the assessment of resilience.

The following part of this article first gives an overview of the existing concepts of resilience, in particular disaster resilience and then presents two ways to measure resilience.

2 The concept of resilience

The term resilience originates from the Latin word *resiliere* which means "to jump back" (Klein et al., 2003) and was first conceptualized by Holling (1973) in the field of ecology. According to Holling (1973) *resilience* is a "measure of the ability of an ecosystem to absorb changes and still persist" and as such has to be distinguished from *stability* which Holling (1973) defines as the "ability of a system to return to its equilibrium after a temporarily disturbance".[1] Both resilience and stability are important features of an ecosystem, whereby a resilient system might be unstable, i.e. show great fluctuations (Handmer & Dovers 1996). As shown in the following, the concept of resilience developed to an important approach across disciplines.

Timmerman (1981) was among the first to move from the concept of ecological resilience towards social resilience and was followed by Adger (1997) who defined resilience as "the ability of human communities to withstand external shocks or perturbations to their infrastructure such as environmental variability or social, economic, or political upheaval, and to recover from such perturbations". The recognition of resilience in the social sciences went hand in hand with the adaptation of the concept to natural hazards in that the connection of resilience and adaptation to natural hazards was made. Timmerman (1981) defined resilience as a "measure of a system's or part of the system's capacity to absorb and recover from hazardous event". According to Tobin (1999) resilient communities must be characterised by a) a reduction of the exposure to natural hazards, which can be achieved by structural and non-structural measures, b) a lower level of vulnerability, that needs especial care of those politically and economically weak, c) long-term investments in sustainable and adaptable measures, d) the willingness of policy-makers to promote resilience, e) the cooperation of different organizations, f) strong social ties and g) the adequate scale of planning. In recent years, many other approaches occurred, which relate resilience to natural hazards. Thywissen (2006) and Mayunga (2007) give an overview of these definitions (see Table 1). A closer look at the definitions reveals that these differ in some respects.

According to Dovers and Handmer (1992) resilience can be reactive, but also proactive. Thereby, the reactive approach aims to strengthen the status quo in order to be able to withstand changes. In comparison, a proactive understanding of resilience accepts upcoming changes in the system and aims to develop a regime which is able to adjust to new conditions. As such, proactive resilience

[1] For an overview of ecological definitions, see Mayunga (2007).

has an adaptive character including the willingness and the ability of a society to learn and adjust to changes (Klein et al. 2003).

Table 1: Selected definitions of disaster resilience[2]

Author	Definition
Timmerman (1981)	Resilience is the measure of a system's or part of the system's capacity to absorb and recover from occurrence of a hazardous event.
Correira et al. (1987)	Resilience is a measure of the recovery time of a system.
Wildavsky (1988)	Resilience is the capacity to cope with unanticipated dangers after they have become manifest, learning to bounce back.
Buckle (1998)	The capacity that people or groups may possess to withstand or recover from emergencies and which can stand as a counterbalance to vulnerability.
EMA (1998)	Resilience is a measure of how quickly a system recovers from failures.
Mileti (1999)	Local resiliency with regard to disasters means that a locale is able to withstand an extreme natural event without suffering devastating losses, damage, diminished productivity, or quality of life without a large amount of assistance from outside the community.
Adger (2000)	Social resilience is the ability of groups or communities to cope with external stresses and disturbances as a result of social political and environmental change.
Buckle et al. (2000)	Qualities of people, communities, agencies, infrastructure that reduce vulnerability. Not just the absence of vulnerability rather the capacity to 1) prevent, mitigate losses and then if damage occurs 2) to maintain normal living conditions and to 3) manage recovery from the impact.
Buckle et al. (2000)	Not just the absence of vulnerability. Rather it is the capacity, in the first place, to prevent or mitigate losses and then, secondly, if damage does occur to maintain normal living conditions as far as possible, and thirdly, to manage recovery from the impact.
Department of Human Services (2000)	The capacity of a group or organization to withstand loss or damage or to recover from the impact of an emergency or disaster. The higher the resilience, the less likely damage may be, and the faster and more effective recovery is likely to be.
Alwang et al. (2001)	From the sociology literature, resilience is the ability to exploit opportunities and resist and recover from negative shocks.
IPCC (2001)	Resilience is the flip side of vulnerability – a resilient system or population is not sensitive to climate variability and change and has the capacity to adapt.
Handmer (2002)	Details of Resilience might be inherently unknowable – especially in the case of complex communities undergoing constant change.
Pelling (2003)	The ability of an actor to cope with or adapt to hazard stress.
Turner et al. (2003)	The concept [of resilience] has been used to characterize a system's ability to bounce back to a reference state after a disturbance and the capacity of a system to maintain certain structures and functions despite disturbance.[…] resilience of the system is often evaluated in terms of the amount of change a given system can undergo (e.g., how much disturbance or stress it can handle) and still remain within the set of natural or desirable states (i.e., remain within the same 'configuration' of states, rather than maintain a single state).
Disaster Recov. Journal (2005)	The ability of an organization to absorb the impact of a business interruption, and continue to provide a minimum acceptable level of service.

[2] The definitions are adapted from Thywissen (2006) and Mayunga (2007).

Table 1: Selected definitions of disaster resilience (continued)

IRIN/OCHA (2005)	The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing, in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters and improving risk-reduction measures.
Foster (2006)	Regional resilience is the ability of a region to anticipate, prepare for, respond to and recover from disturbance.
Paton and Johnston (2006)	Resilience is a measure of how well people and societies can adapt to a changed reality and capitalize on the new possibilities offered.
Pendall et al. (2007)	A person, society, ecosystem, or a city is resilient in the face of shock or stress when it returns to normal (i.e. equilibrium) rapidly afterward or at least does not easily get pushed into a new alternative equilibrium.

For some researchers, resilience is a long-term process which they measure by the time a system needs in order to return to its original state (Klein et al. 2003, Pimm 1984). The quicker the pre-disaster growth-path is achieved, the more resilient a community is considered to be. However, as Klein et al. (2003) note, this approach is criticized by many ecologists, as ecosystems are dynamic and able to adjust to external changes. In this respect, a return to the original equilibrium is not an improvement, since the system did not advance in its capacity to cope with a shock.

The relationship between resilience and vulnerability is widely discussed. While some researchers see resilience as the opposite of vulnerability, others would understand resilience, next to exposure and resistance, as one of three elements of vulnerability (Blaikie et al., 1994). Thereby the term vulnerability has as many different definitions as the term resilience (e.g. “The insecurity of the well-being of individuals, households or communities in the face of a changing environment” (Moser and Holland (1997) as quoted in Alwang et al., 2001). According to Zhou et al. (2010) resilience refers to the potential of resisting and recovering from a potential loss. Thereby the focus of the process is mainly on the time during the disaster and after the disaster. In comparison, vulnerability is the exposure and sensitivity of a system towards (potential) hazards. As such, its main focus is on the situation before a disaster and ways to increase preparedness.

Some researchers regard sustainability[3] and resilience as positive features of a community (Tobin, 1999). However, as Carpenter et al. (2001), note, in contrast to sustainability, resilience can be a characteristic which is not always desirable (e.g. a resilient dictatorship). In other words, in comparison to resilience, sustainability does account for desired preferences and as such has to be seen as an overarching concept.

[3] According to the World Bank, sustainable development is “a process of managing a portfolio of assets to preserve and enhance the opportunities people face”.

3 Measuring Community Disaster Resilience

There have been many attempts in the past to measure the concept of community resilience (see, among others, Tobin 1999). However, as the assessment has to account for the different interactions on community level (e.g. human, environment), this proved to be a very difficult task. As a result, most frameworks consider a limited number of factors. Due to the lack of appropriate methods to quantify resilience, scientists are still not able to analyze how countries' levels of resilience vary in time and space. The following part of this paper seeks to introduce two approaches aiming to measure resilience in a holistic manner, in that they, according to the authors, account for the majority of necessary variables and the interaction between those. In contrast to the existing literature these approaches allow a comparison of resilience across countries and time.

The PEOPLES Resilience Framework

Renschler, Frazier, Arendt, Cimellaro, Reinhort & Bruneau (2010) use the acronym PEOPLES to highlight the seven dimensions of community resilience, whereby the interaction between these dimensions is crucial for the assessment of community resilience.

a) Population and Demographics

The authors suggest using the social vulnerability index (SoVI) of Cutter (1996) as an indicator for the functionality of population and demographics, since social vulnerability affects a communities' capacity to prevent against disasters through different channels. In this respect the quality of institutions, cultural values but also the structure of the population is expected to be relevant. Cutter (1996), who defines vulnerability as the opposite of resilience, uses 11 indicators for his index, among those, socioeconomic status, elderly and children, development density, rural agriculture, race, gender, ethnicity, infrastructure employment and country debt/ revenue. However, it should be noted that many institutions (e.g. World Bank) offer alternative databases on population and demographics.

b) Environment

The PEOPLES Resilience Framework uses the Normalized Difference Vegetation Index (NDVI) as a proxy for ecosystem productivity and measures if the ecological system is able to cope with a disaster in returning to its original status. The NDVI can be applied in order to measure differences in the capacity of an ecosystem to cope with natural hazards in time and space. However, as suggested by the authors, it should only be used for shocks which alter the NDVI (e.g. floods).

c) Organized Governmental Services

The majority of prevention measures (e.g. police, fire departments) is in the realm of governments and has a public good character. Possible proxies for this

dimension are the per capita expenses for prevention measures or the proportion of people working in related sectors.

d) Physical Infrastructure

For the dimension of physical infrastructure the authors use two indicators, facilities and lifelines. Facilities incorporates housing (i.e. the share of houses not classified as hazardous), commercial facilities and cultural facilities, while lifelines includes food supply, healthcare, utilities, transportation and communication networks.

e) Lifestyle and Community Competence

This dimension of the PEOPLES Resilience Framework aims to account for the ability of people within the community to apply changes which contribute to their resilience. The focus is on participation and involvement of individuals in the process of prevention and catastrophe management rather than in assuming that people are passive actors.

f) Economic Development

According to Kahn (2005) least developed countries do not experience more natural disasters than developed countries. However, the death toll in least developed countries is on average higher. Since economic development is a key indicator of resilience, the authors account for the level of economic activity (for example measured by GDP per capita or employment rate) as well as for economic development (measured by growth). Other indicators could be life expectancy, literacy rate etc.

g) Social-cultural Capital

By social-cultural capital the Authors point out the importance of networks within a community and the willingness of people to participate within the community. Thereby indicators, like education services and child services could be important indicators. In a disaster context, the existence of risk-management plans, rescue plans etc. which require the help of volunteers, usually indicate a high level of social-cultural capital.

The Capital-Based Approach

Mayunga (2007) developed a capital-based approach which accounts for five different forms of capital, which are social, economic, physical, human and natural capital. The framework is built upon the assumption that communities which are economically developed have better access to risk-management strategies and therefore are likely to be more resilient.

a) Social capital

Throughout the years researchers have found different ways to define social capital. In relation to community resilience, social capital refers to the ability of

individuals to cooperate and the extent of that. Mayunga (2007) suggests to measure social capital by the extent of individual involvement in public activities. Thus, possible indicators could be the number of non-profit organizations, voluntary associations, voter participation, newspaper readership etc.

b) Economic capital
The higher the endowment of a community with economic capital, the larger the possibilities of that community to invest in prevention measures which allow absorbing the impact of natural hazards. According to Buckle (2001) a growing economy has better capacities to deal with the aftermath of a natural disaster than an economy in recession.

c) Physical capital
According to Mayunga (2007) physical capital refers to residential housing and infrastructure. Especially in the post-disaster situation, communities which are endowed with more physical capital are more capable to respond to natural disasters. The author suggests to access physical capital by "the number, quality, and location of housing units, business/industry, shelters, lifelines, and critical infrastructures".

d) Human capital
The World Bank defines human capital as "people's innate abilities and talents plus their knowledge, skills, and experience that make them economically productive". Investments in education and health care can increase a country's human capital. As such, human capital contributes to the ability of people to adapt knowledge and skills which are necessary to be able to adapt to natural disasters. In this respect, possible indicators for human capital are education (e.g. years of schooling), population density and growth, the quality of infrastructure, household characteristics etc.

e) Natural capital
Natural capital incorporates natural resources (e.g. water, oil) and the ecosystem required for those. However, the quality and extent of natural capital is often adversely affected by human action. Mayunga (2007) suggests measuring the endowment with natural capital by the quality of, air, soil and water as well as by the existence of parks.

Integrating the Dimensions of Resilience

In order to allow for a comparison of resilience within communities and time, the different dimensions of resilience need to be integrated. In this case the design of an index is common. However, the construction of an index is a challenge at different stages.
The first problem arises from the use of different measures, e.g. number of people, miles, Euros, making simple addition within a resilience index impossible.

Therefore, all indicators of a domain need to normalized, i.e. by transforming the observations to a scale from 0 to 1 or 0 to 100.
A second problem which is crucial for the construction of indexes is the weighting of the determinants of each dimension as well as the dimensions themselves. These can be weighted in different ways: a) Weights can be based on theoretical evidence (e.g. provided by a theoretical model on the concept of community disaster resilience). b) Moreover, weights can be determined on basis of empirical approaches, whereby Mayunga (2007) suggests two alternatives, the disposition of surveys and the application of factor analysis. Research questions with high practical relevance which require the expertise of many stakeholders can be addressed by c) weighting the indicators based on the political relevance of those and by d) accounting for the opinion of stakeholders, policy-makers etc. e) Finally, weights can be distributed equally.
The last challenge of the construction of a resilience index refers to the summation of the determinates of resilience. Simple addition of the indicators could result in cancellation of determinants, i.e. if a good score of one determinant cancels out a bad result of another determinate. One common way of circumventing this problem is the application of exponential transformation. (Mayunga, 2007)

4 Conclusions

As we have seen, the existent definitions for resilience vary in many respects. One can observe differences in the conceptualization of resilience across the disciplines but also within the disciplines. Moreover, resulting from the lack of a unified definition, literature did not agree on how to measure resilience. Most of the frameworks on the assessment of resilience focus on selected factors, thereby neglecting relevant determinants. This overview has presented two possible concepts for a holistic approach. According to Thywissen (2006) the differences in the interpretation of resilience lead to misunderstandings in discussions on disaster reduction. From her point of view an agreement on the key features of resilience would contribute to an increase of the efficiency of initiatives aiming to reduce disaster risk.
Within the framework of the 2nd Funding Initiative of ERA-Net CRUE – Flood resilient communities – managing the consequences of flooding – resilience is understood as a term which integrates a variety of dimensions. Therefore, all results are discussed with respect to the restrictions they underlie, i.e. all projects reveal whether and to what extent their results can be generalised, thereby referring to a) social, socio-cultural-historical, legal-institutional, political and economic characteristics, b) the flood type and the degree of awareness and c) uncertainties and the way they are dealt with.

Contact Details of Authors

Project partner #1 (Co-ordinator) ◄ **alpS - Centre for Natural Hazard and Risk Management**
Manijeh Schwindt
Grabenweg 3, A-6020 Innsbruck
Schwindt@alps-gmbh.com

Project partner #2 (Associated) ◄ **CSC**
Prof. Dr. Annegret Thieken
Bundesstrasse 45a
Annegret.Thieken@gkss.de

References

Abramobitz, J. (2001). Unnatural disasters, Worldwatch Institute Paper No. 158.

Adger, W.N. (1997). Sustainability and social resilience in coastal resource use. CSERGE Working Paper Series, Centre for Social and Economic Research on the Global Environment, University of East Anglia, Norwich and University College London, UK.

Adger, W.C. (2000). "Social and ecological resilience are they related?" Progress in Human Geography, 24(3), 347-364.

Alwang, J., Siegel, P.S. & Jorgensen, S.L. (2001). Vulnerability: A view from different disciplines. Social protection discussion paper # 115, The World Bank, Social protection Unit, Human Department, http://www1.worldbank.org.

Blaikie, P. Cannon, T., Davis, I. & Wisner, B. (1994). At Risk: Natural Hazards, People's Vulnerability and Disasters. Routledge, London, UK.

Buckle, P. (1998). "Re-defining community and vulnerability in the context of emergency management". Australian Journal of Emergency and Management, 1998/199, 21- 29.

Buckle, P., Marsh, G. & Smale, S. (2000). "New approach to assessing vulnerability and resilience". Australian Journal of Emergency Management, 2000, 8-15.

Buckle, P., Marsh, G. & Smale, S. (2001). Assessing resilience and vulnerability: Principles, strategies and actions. Victorian Government publishing services.

Carpenter, S., Walker, B., Anderies, J.M. & Abel, N. (2001). "From Metaphor to Measurement: Resilience of What to What?" Ecosystems, 4(8), 765-781.

Comfort, L. et al. (1999). "Reframing disaster policy: The global evolution of vulnerable communities". Environmental Hazards, 1, 39–44.

Correira; S.R. (1987). Engineering Risk in Regional Drought Studies. pp. 61-86. In: Duckstein; Plate (Eds.): Engineering Reliability and Risk in Water Resources. Martinus Nijhoff Publishers, Dordrecht, Boston, Lancaster.

Cutter, S.L. (1996). "Vulnerability to Environmental Hazards". Progress in Human Geography 20(4), 529-539.

Department of Human Services (2000). Assessing Resilience and Vulnerability in the Context of Emergencies: Guidelines. Victorian Government Publishing Service.

Disaster Recovery Journal (2005). Business Continuity Glossary.<http://www.drj.com/glossary/glossleft. htm>.

Dovers, S.R. & Handmer, J.W. (1992). "Uncertainty, sustainability and change". Global Environmental Change, 2(4),262-276.

Emergency Management Australia (EMA) (1998). The Australian Emergency Management Glossary, http://www.ema.org, accessed August 2006.

Foster, K. A. (2006). A case study approach to understanding regional resilience. A working paper for building resilience network. Institute of urban regional development. University of California.

Handmer, J.W. (2002). We Are All Vulnerable. <http://online.northumbria.ac.uk/geography_research/radix/resources/vulmeeting-pbmelbourne11.doc

Handmer, J.W. & Dovers, S.R. (1996). "A typology of resilience: rethinking institutions for sustainable development". Industrial and Environmental Crisis Quarterly 9(4), 482-511.

Holling, C.S. (1973). "Resilience and stability of ecological systems". Annual Review of Ecology and Systematics, 4, 2-23.

IPCC (International Pannel on Climate Change) (2001). Climate Change 2001. Synthesis Report. A Contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Watson, R.T. et al. (Eds.). Cambridge University Press, Cambridge, New York.

Integrated Regional Information Networks (IRIN) (2006). Disaster Reduction and the Human Cost of Disaster - IRIN Web Special. <http://www.irinnews.org/webspecials/DR/Definitions.asp>.

Kahn M.E. (2005). The death toll from natural disasters: The role of income, geography and institutions. The Review of Economics and Statistics, 87, 271-284.

Klein, R.J.T., Nicholls, R.J. & Thomalla F.T. (2003). "Resilience to natural hazards: how useful is the concept?" Environmental Hazards, 5, 35-45.

Mayunga, J.S. (2007). Understanding and Applying the Concept of Community Disaster Resilience: A capital-based approach. Working Paper prepared for the summer academy for social vulnerability and resilience building. Munich, Germany.

Mileti, D.S. (1999). Disaster by design: A reassessment of natural hazards in the United States. Washington DC, Joseph Henry.

Moser, C.; Holland, J. (1997). Household responses to poverty and vulnerability. In: Confronting Crisis in Cawama. Lusaka, Zambia. Urban Management Programme. Vol. 4, Report No. 24, The World Bank, Washington, D.C.

Paton, D. & Johnston, D. (2006). Disaster resilience: An integrated approach. Springfield, IL, Charles C. Thomas.

Pelling, M. (2003). The Vulnerability of cities: Natural disasters and social resilience. London, UK: Earthscan.

Pendall, R., Foster, K.A. & Cowell, M. (2007).Resilience and regions: Building understanding of the metaphor. A working paper for building resilience network. Institute of urban regional development, University of California.

Pimm, S.L. (1984). "The complexity and stability of ecosystems". Nature, 307, 321-326.

Renschler, C.S., Frazier, A.E., Arendt, L.A., Cimellaro, G.P., Reinhorn, A.M. & Bruneau, M. (2010). Developing the 'PEOPLES' Resilience Framework for Defining and Measuring Disaster Resilience at Community Scale. Presentation held at the Climate Service Center Germany.

Strömberg, D. (2007). "Natural Disasters, Economic Development, and Humanitarian Aid". Journal of Economic Perspectives, 21(3), 199-222.

Thywissen, K. (2006). Components of Risk. A Comparative Glossary. United Nation University, Publication Series of UNU_EHS, No. 2/2006.

Tierney, K. (2009). Disaster response: Research findings and their implications for resilience measures. CARRI Research Report 6. Oak Ridge. www.resilientUS.org.

Timmerman, P. (1981). Vulnerability, Resilience and the Collapse of Society: A Review of Models and Possible Climatic Applications. Institute for Environmental Studies, University of Toronto, Canada.

Tobin, G.A. (1999). "Sustainability and community resilience: The holy grail of hazards planning". Environmental Hazards, 1, 13-25.

Turner, B.L. et al. (2003): A Framework for Vulnerability Analysis in Sustainability Science. Proceedings of the National Academy of Sciences of the United States of America (PNAS). Vol. 100, No. 14. pp. 8074-8079. <http://www.pnas.org/cgi/reprint/100/14/8074.pdf>.

Wildavsky, A. B. (1988). Searching for Safety. New Brunswick, NJ, Transaction.

World Bank (2010). DEP web. http://www.worldbank.org/depweb/english/beyond/global/glossary.html.

Zhou, H., Wang, J., Wan, J. & Jia, H. (2010). "Resilience to natural hazards: a geographic perspective. Natural Hazards", 53, 21-41.