Methodologies and best practices for the participation of the stakeholders involved in flood risk prevention

TRENTO 3-4 October 2011

Consorzio Comuni Trentini - Sala Convegni

The hydro-geological risk in the alpine environment and the 2007/60/EC directive

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Scaletta (Durata: 20 min):

1. La direttiva flood e il ts.
2. Dia Giampilieri + DIA Sarno + Dia Adda in Valtellina (dire che riguarda anche i grandi fiumi, citare il collasso arginale, poco prevedibile.
3. Focalizzarsi all'alta montagna (Illgraben + Aquabona)
4. Passare il rassegna i problemi.
5. Volumi
6. Velocità
7. Tempi brevi
8. Combinazione dello stato precedente (può essere un aiuto per la PC) e l'evento intenso.
9. La mappatura della pericolosità
10. Modello matematico
11. Citare i bifasici x 3 ragioni:
    - simulano correttamente il deposito e l'erosione,
    - si agganciano all'evento meteo e quindi consentono di definire il TR e le soglie di allarme
    - Riproducono la fisica e quindi consentono una taratura responsabile
    - Campeggio Sauris Welt
12. il dtm
13. BUWAL e le carte
14. Le misure strutturali
15. Le misure non strutturali (far vedere un cellulare e citare messina per la chiusura della strada)

filmati:

1. **Acquabona.avi**
2. **Fondo_tirante_secondo.avi**

DIRECTIVE 2007/60/EC

OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2007
on the assessment and management of flood risks

CHAPTER III
FLOOD HAZARD MAPS AND FLOOD RISK MAPS
Article 6

…

5. Flood risk maps shall show the potential adverse consequences associated with flood scenarios referred to in paragraph 3 and expressed in terms of the following:

....

(d) other information which the Member State considers useful such as the indication of areas where floods with a high content of transported sediments and debris floods can occur and information on other significant sources of pollution.

Effects of sediments on floods

Alpine debris flows: water as subsidiary fluid

Experimental basin
Acquabona (BL)

Courtesy of
Prof. R.Genevois
Università di Padova

Major problems related to debris flows

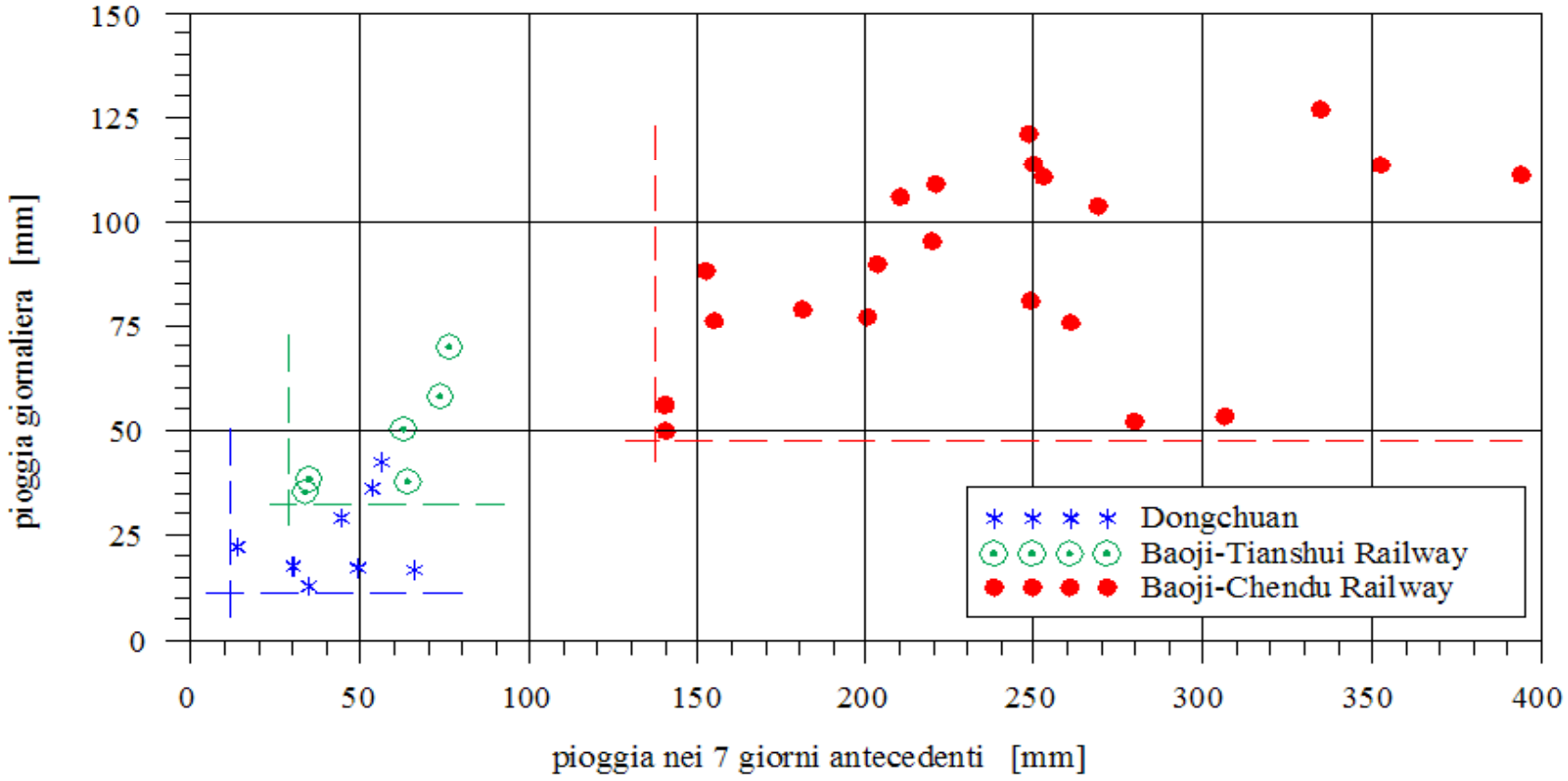
1. Uncertainty in the triggering conditions
2. Huge volumes and discharges
3. High velocity and huge boulders

Major problems of the hazard of debris flows

Uncertainty in the triggering condition and in the determination of concurrency probability.
Debris flow often hit unexpectedly densely populated areas.

http://tg24.sky.it/tg24/cronaca/photogallery/2009/10/04/messina_nubifragio_giampilieri_popup.html?p=6

Influence of the soil saturation degree.

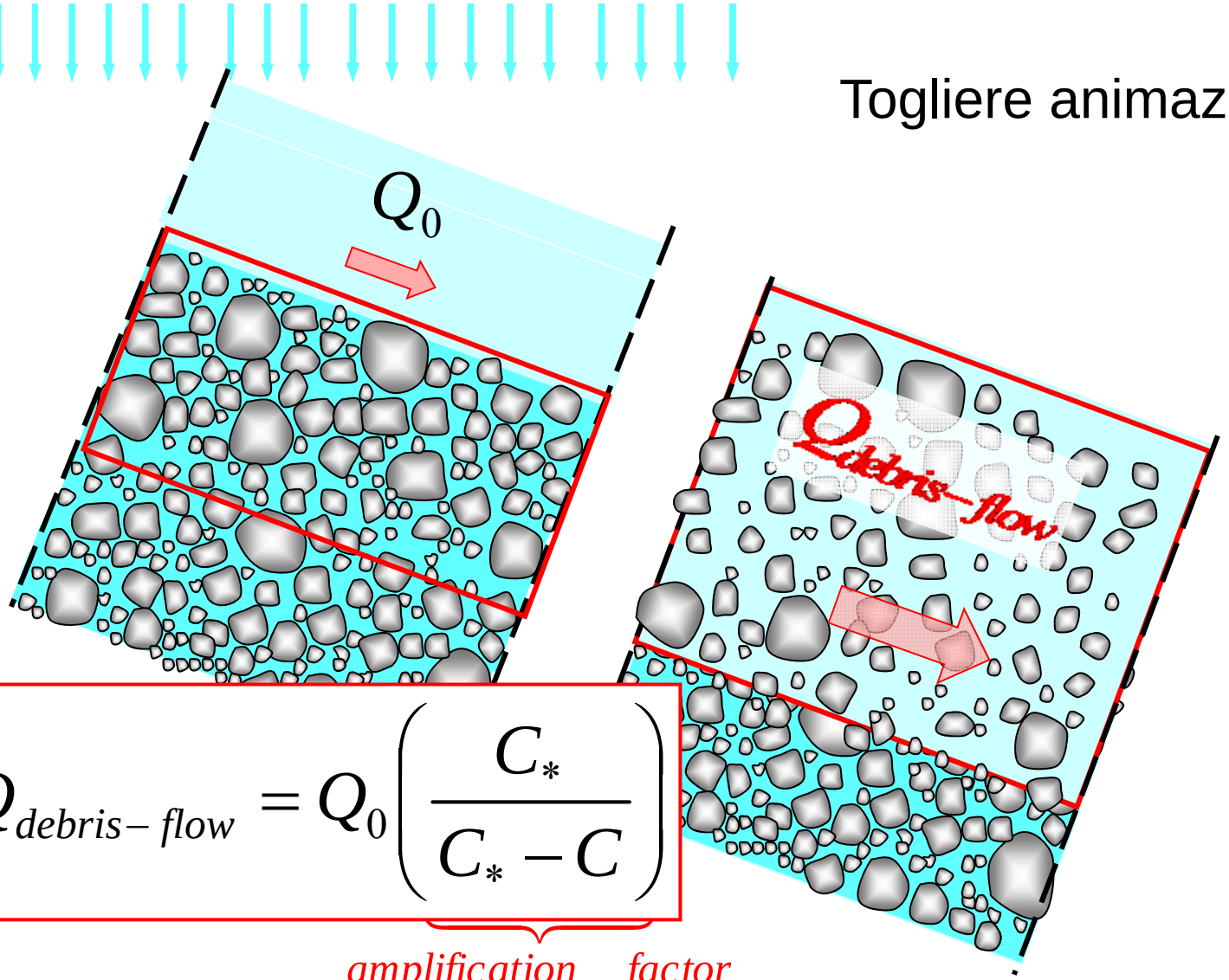


Major problems of the hazard of debris flows

Huge solid and liquid volumes and discharges

The problem of the magnitude (volumes and discharges)

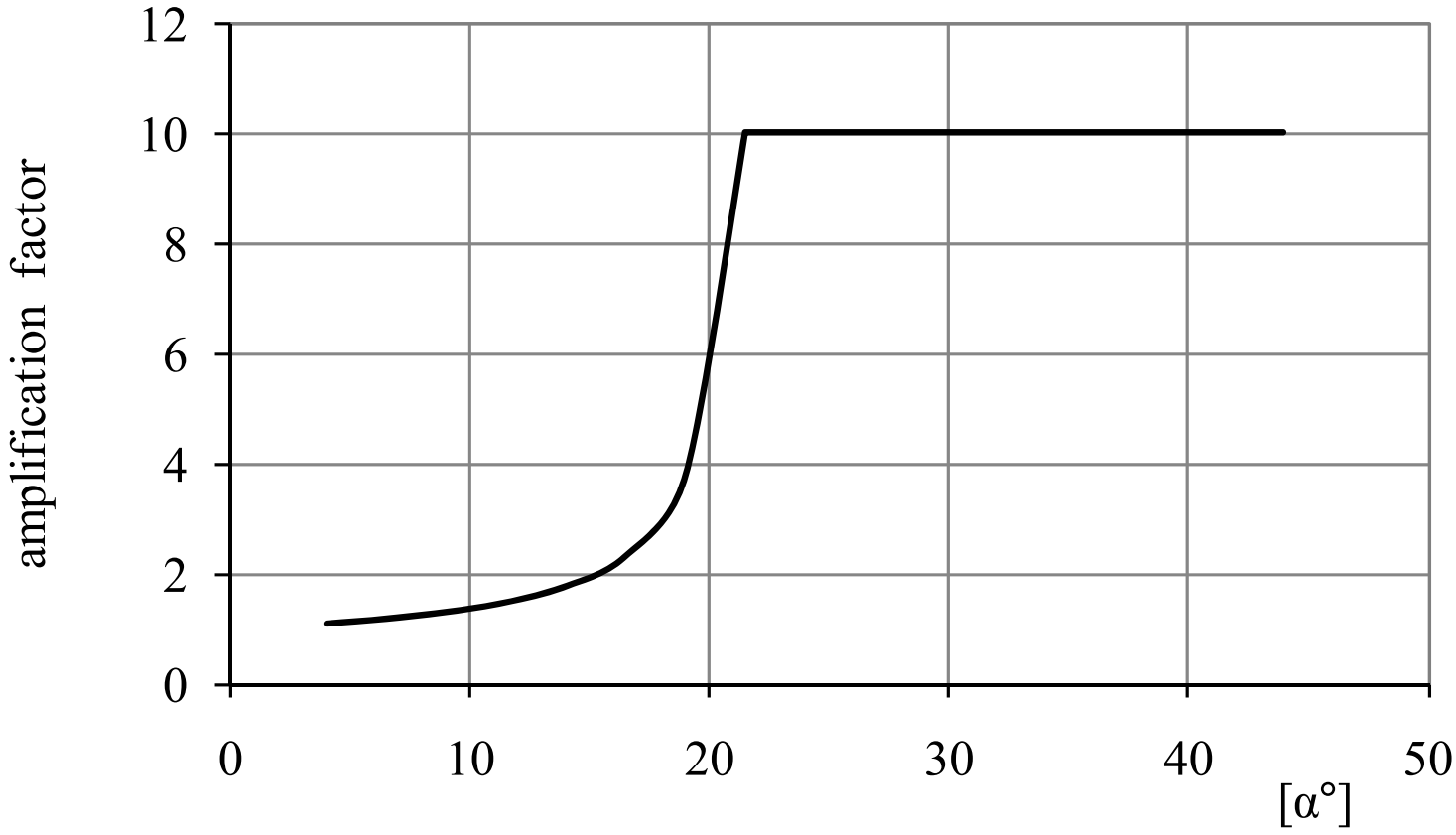
Togliere animazione



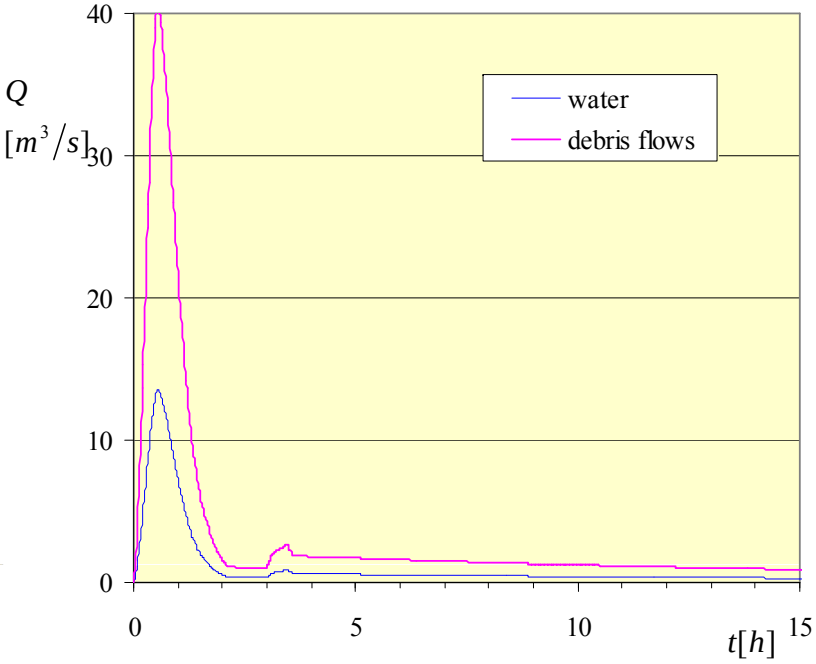
$$Q_{debris-flow} = Q_0 \left(\frac{C_*}{C_* - C} \right)$$

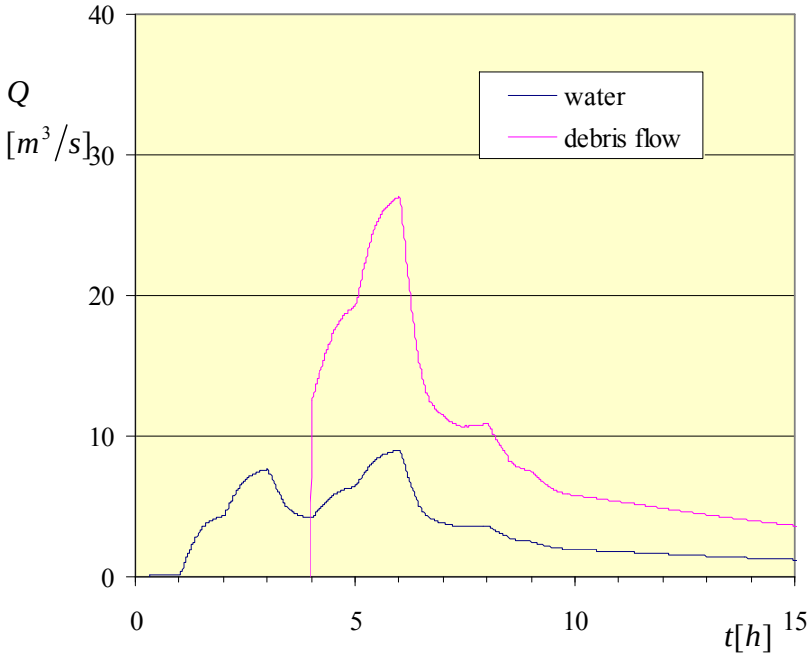
amplification factor

Amplification factor



The problem of the critical hydrograph





Major problems of the hazard of debris flows

- **high velocities**
- **strong dynamic impacts**

http://tg24.sky.it/tg24/cronaca/photogallery/2009/10/04/messina_nubifragio_giampilieri_popup.html?p=6

Major problems of the hazard of debris flows

Transportation of huge boulders

Rationale for debris flows rheology

Debris flows are essentially:

- **Two phase flows dominated by:**
  - **collisions and friction among particles (granular fluid)**
  - **Newtonian interstitial fluid, but the viscosity is very often negligible;**
- **Sometimes the interstitial fluid con be treated as non-Newtionian (mud flows)**

Mathematical models: two-phases isokinetic models

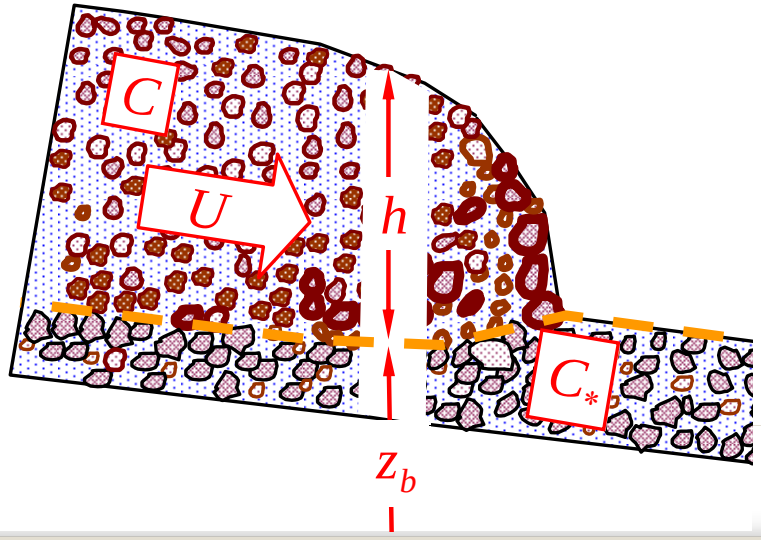
$$\begin{cases} \dfrac{\partial h}{\partial t}+\dfrac{\partial hU}{\partial x}+\dfrac{\partial z_b}{\partial t}=0 \\ \dfrac{\partial hC}{\partial t}+\dfrac{\partial hUC}{\partial x}+C^*\dfrac{\partial z_b}{\partial t}=0 \\ \dfrac{\partial}{\partial t}\left(\overline{\rho}hU\right)+\dfrac{\partial}{\partial x}\left(\overline{\rho}hU^2\right)+g\dfrac{\partial h}{\partial x}\left(\dfrac{1}{2}\overline{\rho}h^2\right)+gh\dfrac{\partial \overline{\rho} z_b}{\partial x}=-\tau_o \end{cases}$$

fluid mass balance

granular mass balance

Mixture momentum balance

$$\overline{\rho}=C\rho_s+(1-C)\rho$$

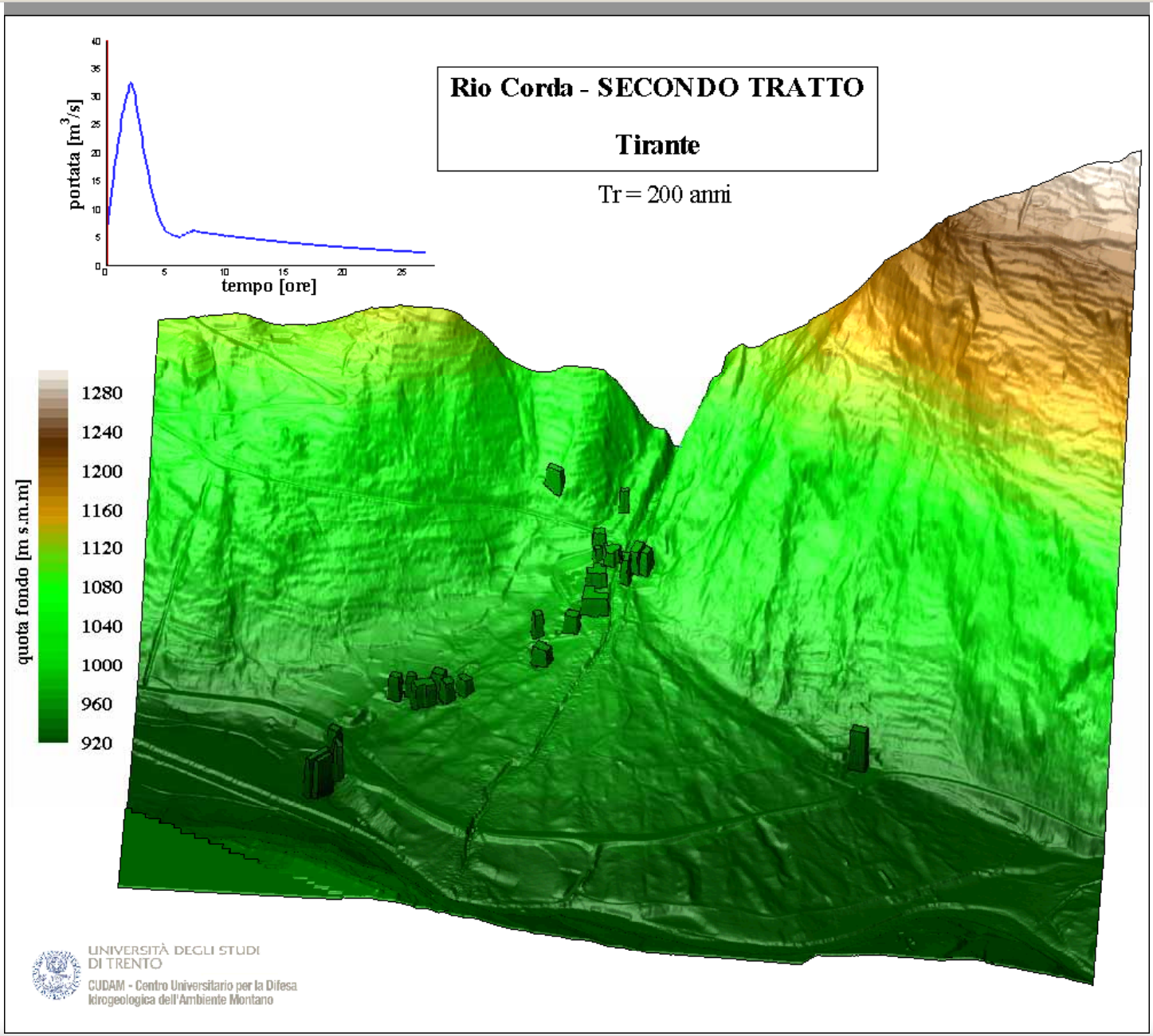


Role of mathematical models

Given the discharge at the input section (hydrograph), the model provides in all the section of the stream and of the alluvial fan:

1. flow velocities (dynamic impact forces);
2. flow depths (sediment inundations)
3. Depositions (overflows)
4. Erosion (structural collapses).

The model gives the hazard maps.


Rio Corda - SECONDO TRATTO
Tirante
Tr = 200 anni
portata [m3/s]
tempo [ore]
quota fondo [m s.m.m]
1280
1240
1200
1160
1120
1080
1040
1000
960
920
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Idrogeologica dell'Ambiente Montano

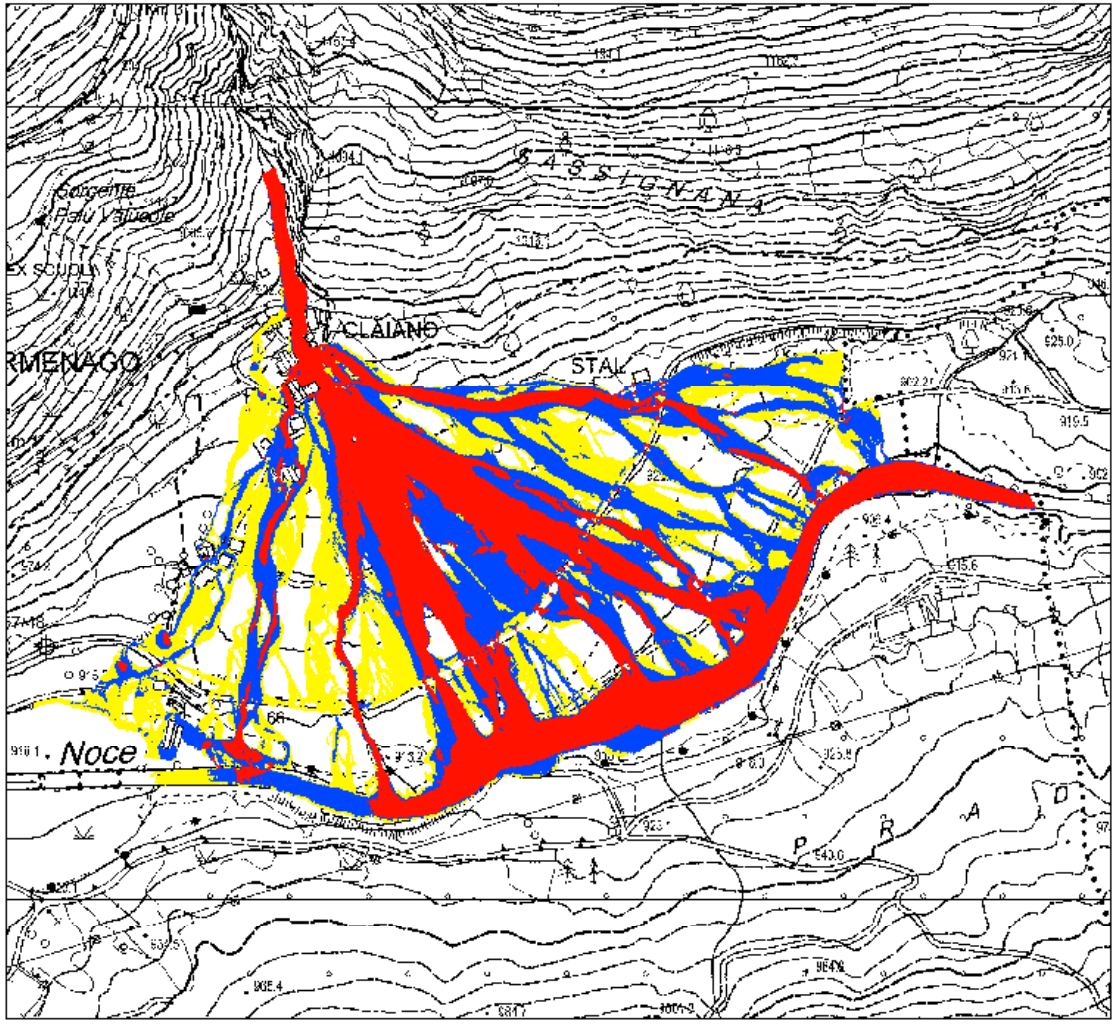
Rio Corda

SECONDO TRATTO

Y=20.28

CARTA DELLE INTENSITA'

per Tr=200 anni



Intensità Tr=200 anni

1

2

3

No Data

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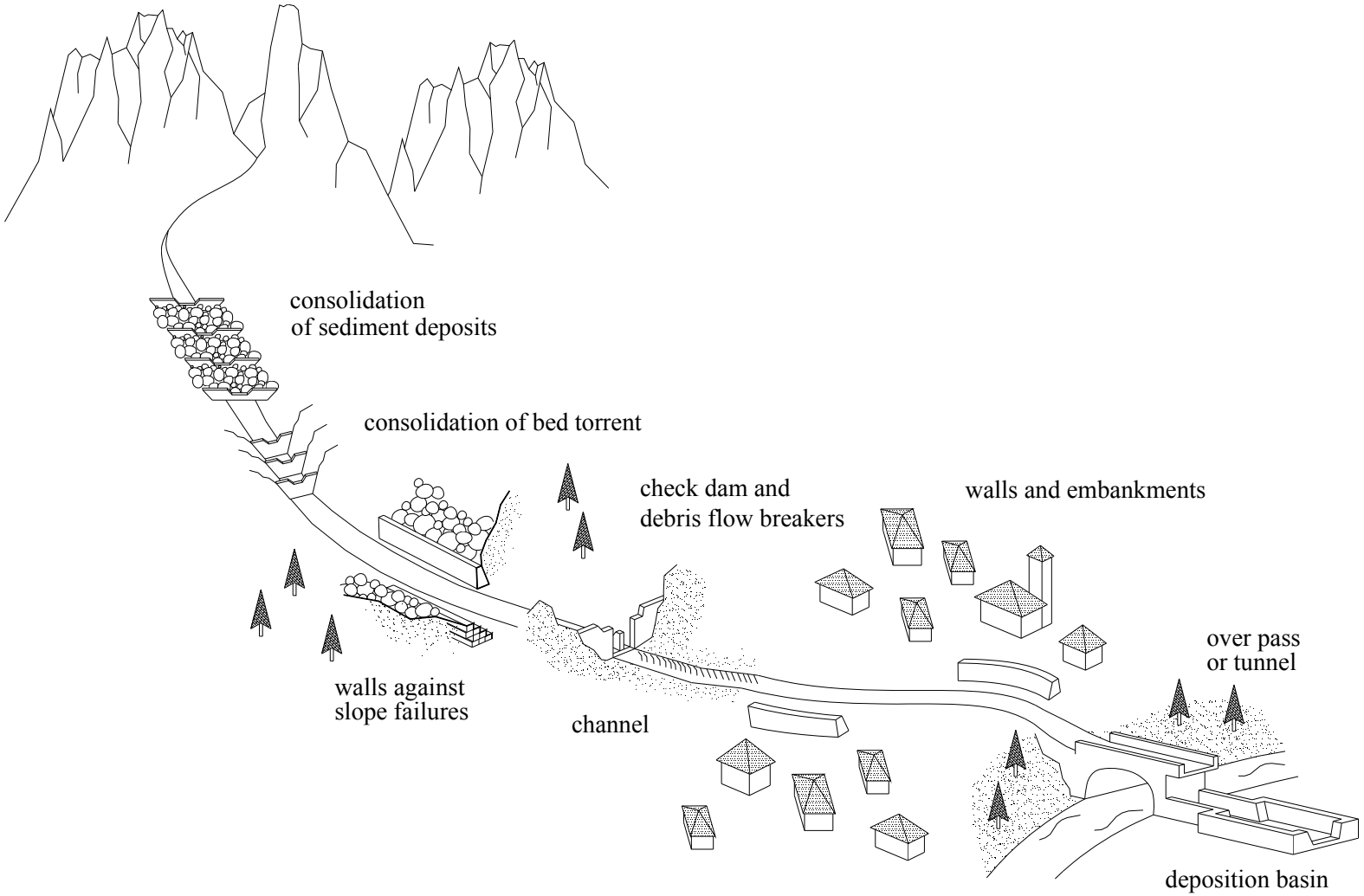
Defence strategy



Check dam + debris flow breaker

Artificial channel for debris flows

cunettone sul rio Dona

Ciò che non si deve fare

Grazie per l'ascolto

Thank you for listening

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