

The Arno River Basin Authority

The Serchio River Basin Authority



The Po River Basin Authority

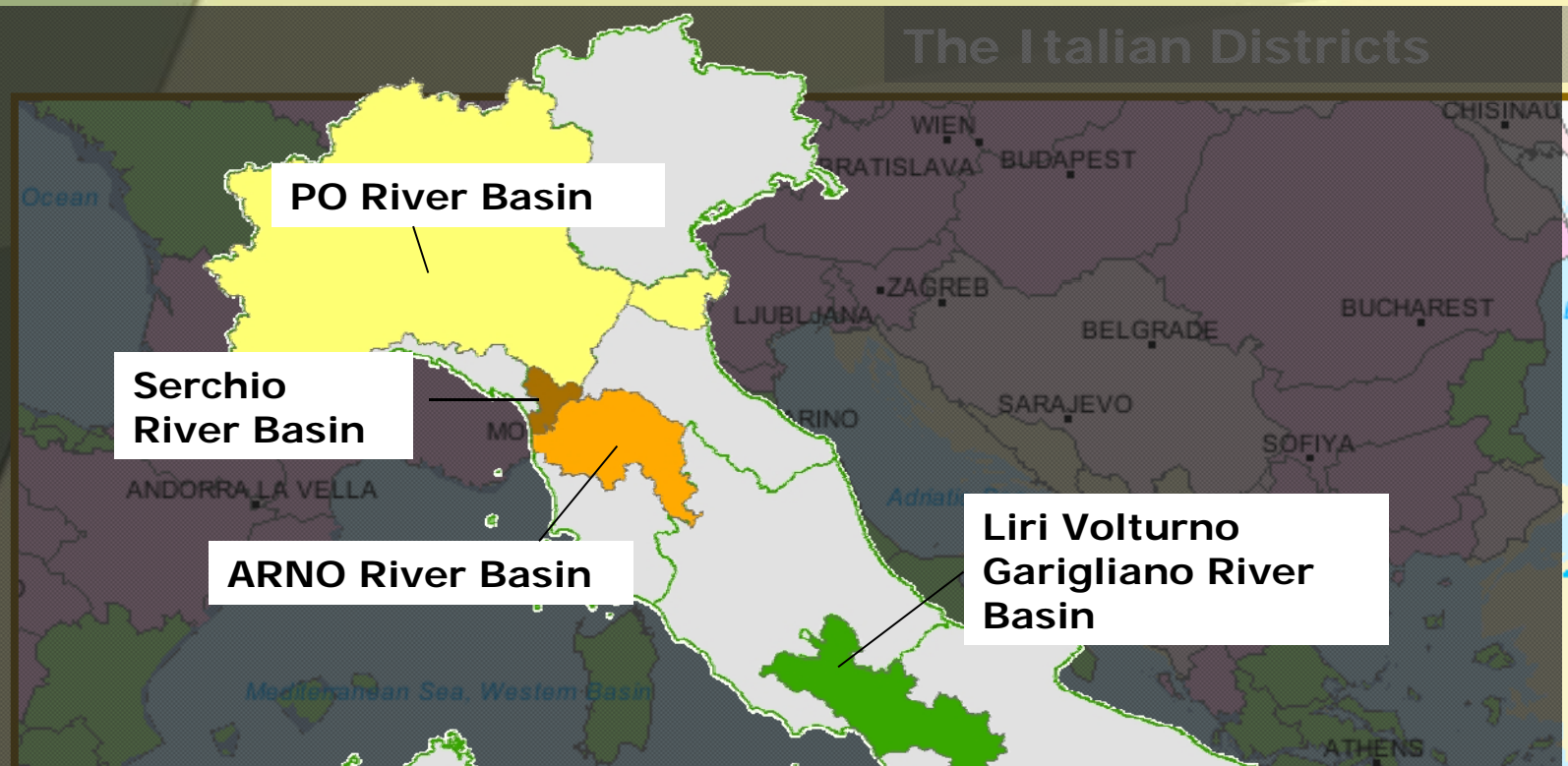
The Liri Garigliano-Volturno Basin Authority

***Results of the test activities carried out by the Italian River Basin Authorities:
Arno, Po, Serchio, Liri-Volturno-Garigliano***

MEETING OF THE EC EXPERT GROUP ON WATER SCARCITY AND DROUGHT - Venice, 13-14 October 2011

***Gaia Checcucci
Secretary General
The Arno River Basin Authority
www.adbarno.it***





The Italian River Basin Authorities that are participating to the WS&D Indicators' Test Case Exercise are:

The Arno River Basin Authority

The Po River Basin Authority

The Serchio Pilot Basin Authority

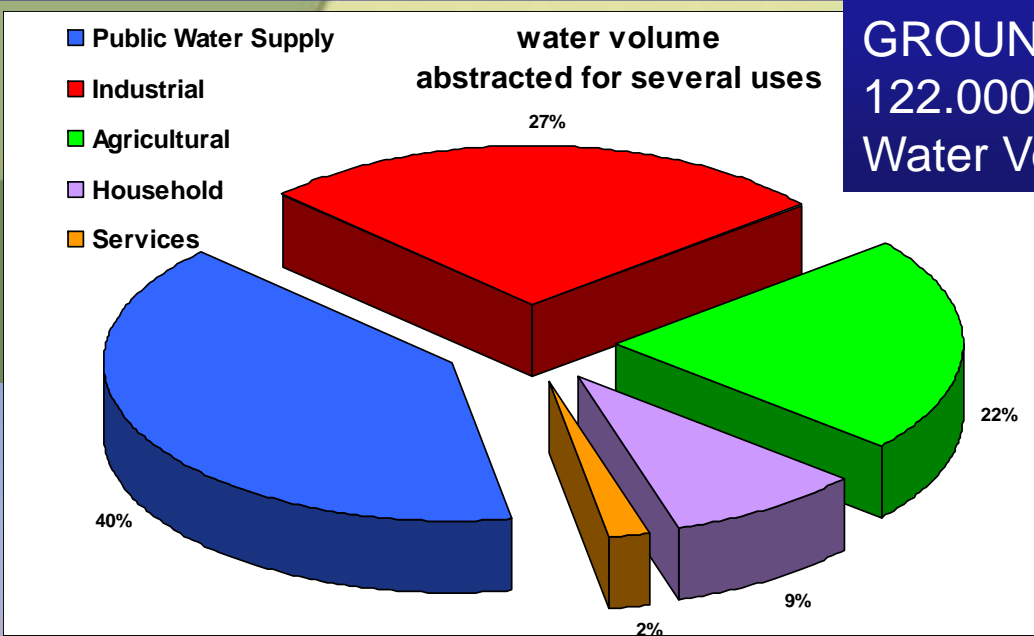
The Liri – Volturno Garigliano Basin Authority

The case of the Arno River Basin

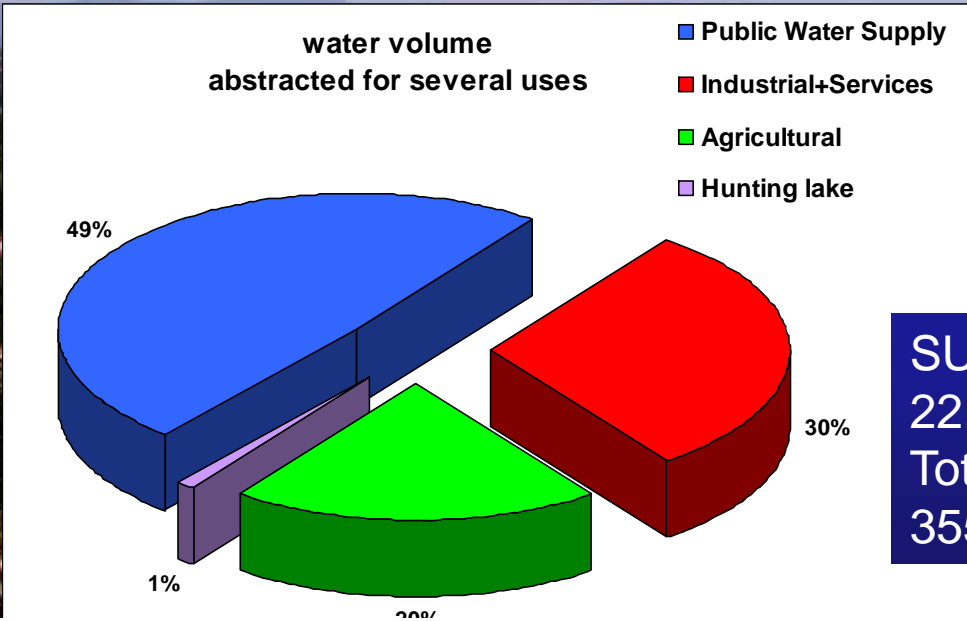
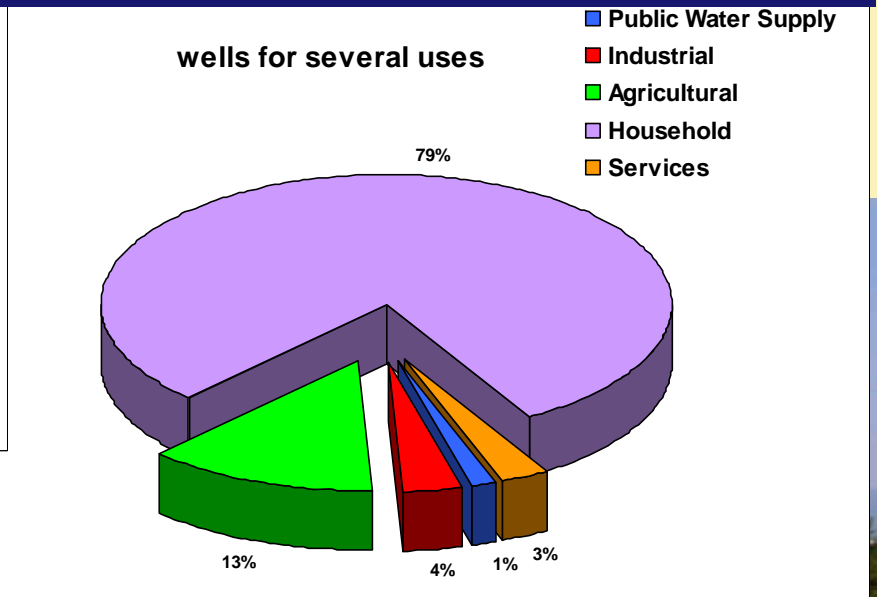
- Basin surface 9.100 sq km
- Main channel (Arno river) length: 241 km
- Maximum discharge in Florence: 4100 cm³/sec (1966)
- Maximum discharge in Pisa: 2290 cm³/sec (1966)
- Minimum discharge in Florence: 0.56 cm³/sec (1958)
- Minimum discharge in Pisa: 2.2 cm³/sec (1931)
- Surface water bodies - 24000 km
- Groundwater 17 phreatic and confined aquifers

Water Scarcity in the Arno River Basin:
The *Water Balance Plan* highlights water criticalities. WS&D mainly occur during the Summer Months (June – September).

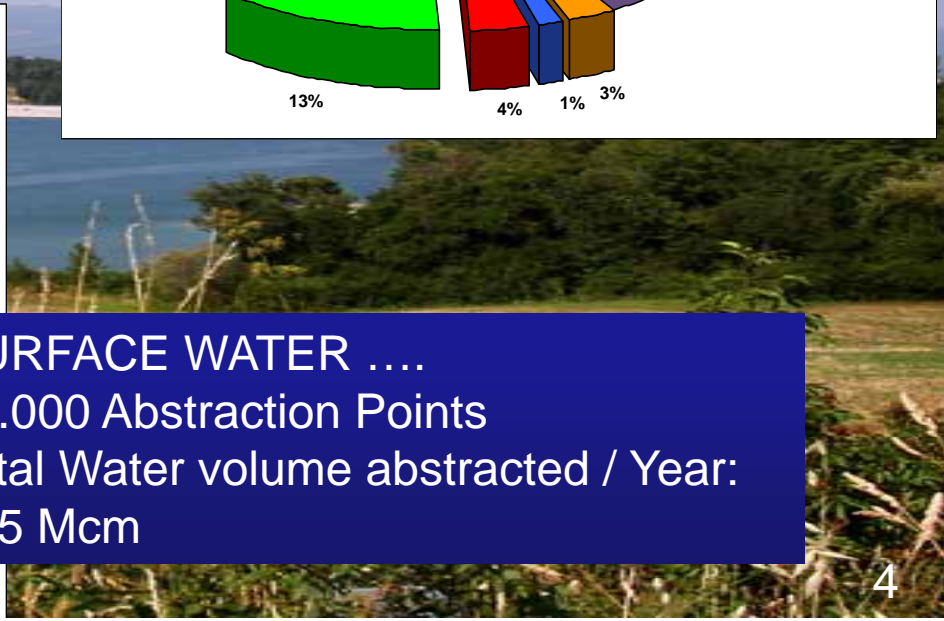
Water resources in the Arno River Basin



GROUNDWATER
 122.000 Wells
 Water Volume Abstracted / Year: 320 Mcm/Year



SURFACE WATER
 22.000 Abstraction Points
 Total Water volume abstracted / Year:
 355 Mcm



Water Scarcity & Drought: ... the most relevant indicators for the Arno River Basin

Water
Exploitation
Index
WEI and WEI+

Standard
Precipitation
Index
(SPI)

Stream
Flow

Groundwater
Level

Water Exploitation Index (WEI) and the WEI + in Arno River Basin

WEI components	WEI+ components
ABSTRACTION (<i>Eurostat definition</i>)	ABSTRACTION (<i>WISE-SoE definition</i>)
Excludes hydropower	Includes hydropower
LTAA WATER RESOURCES AVAILABILITY	RENEWABLE WATER AVAILABILITY (RWA)
$P_{LTAA} - Eta_{LTAA} + I_{LTAA}$	$P - Eta + I + R - WR$ (<i>ENV, treaties</i>)

WEI =

WEI + =

CRITICALITIES:

**The annual basis calculation does not allow
the identification of summer water balance deficits**

20%

21%

Standard Precipitation Index in the Arno River Basin

**Daily Precipitation Data
from 177 hydro-meteorological stations**

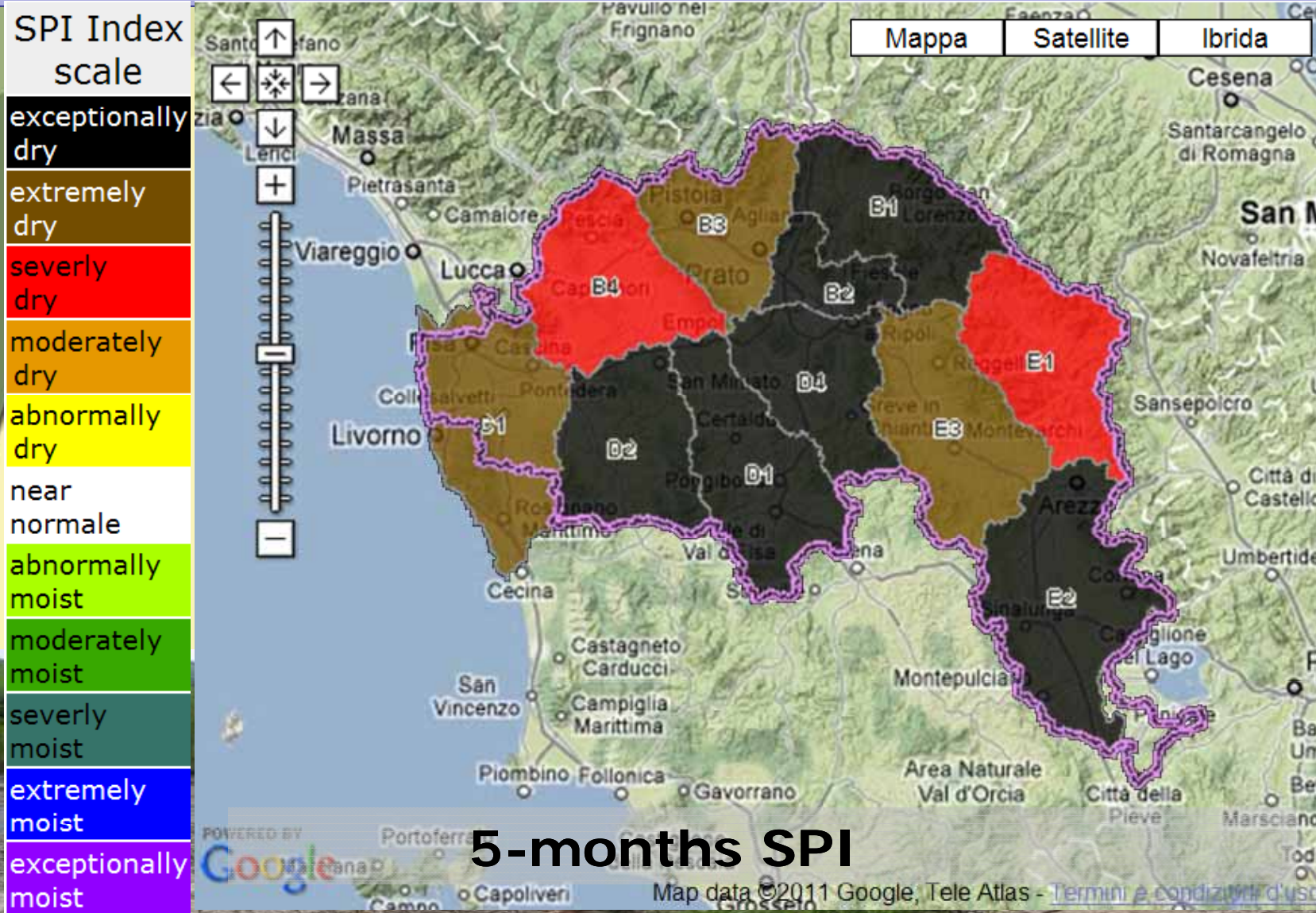
**Observation of precipitations in 11 sub-basins
Time scales 30, 60, 90, 120 e 180 days**

Hystorical series 1951-2010 (60 years)

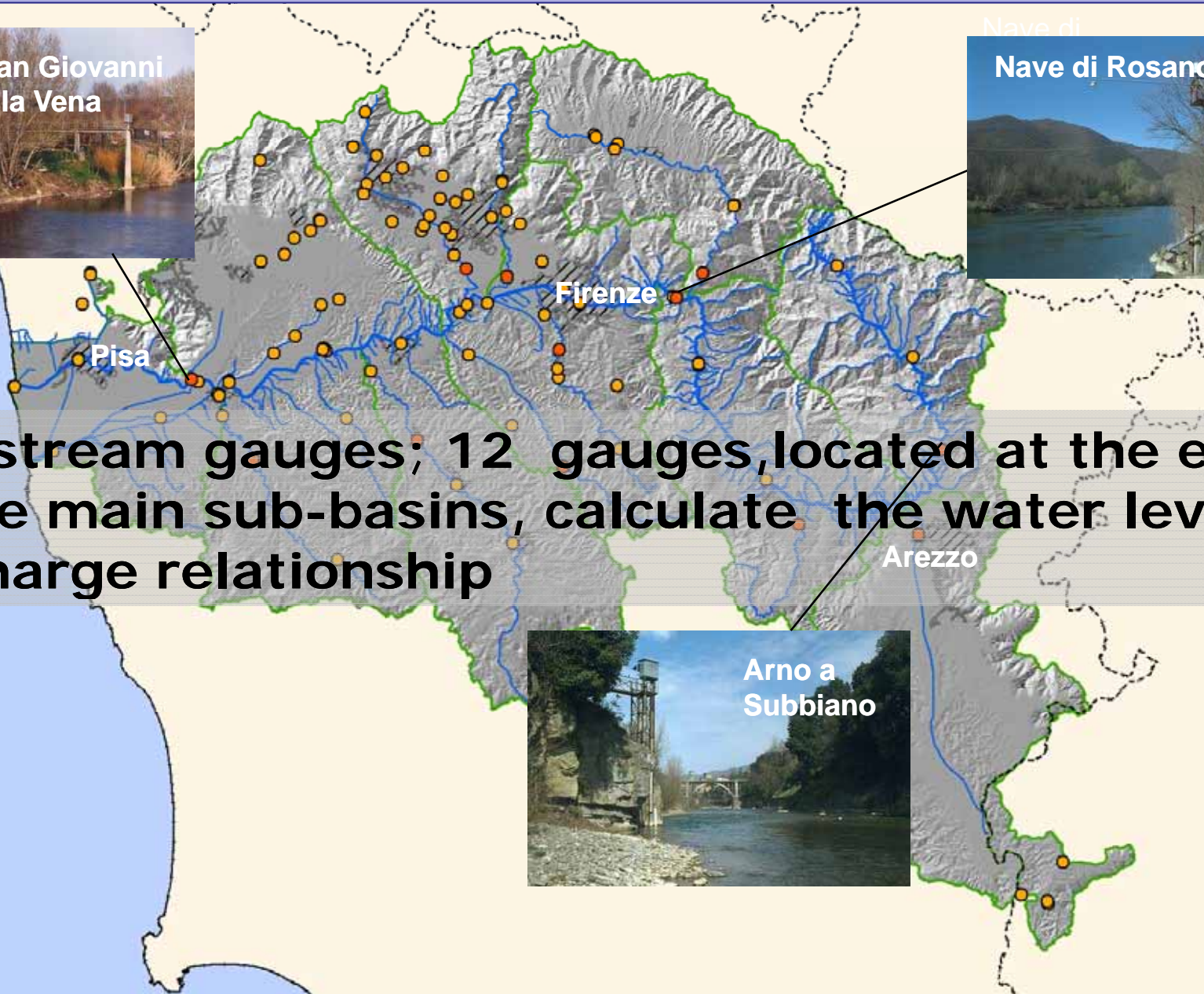


SPI CALCULATION

Standard Precipitation Index in the Arno River Basin



"Streamflow" Indicator in the Arno River Basin

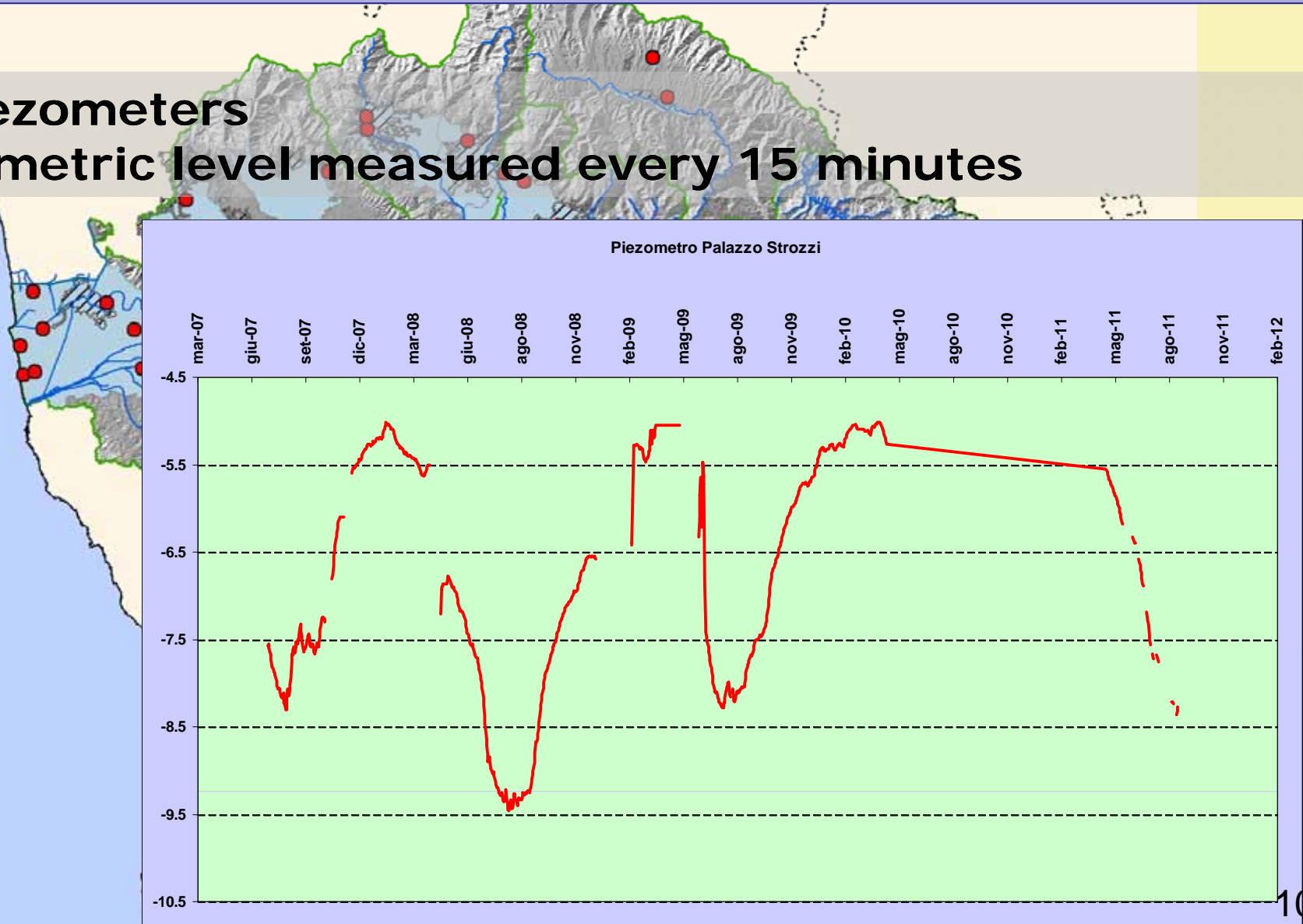


121 stream gauges; 12 gauges, located at the end of the main sub-basins, calculate the water level discharge relationship



"Groundwater level" Indicator in the Arno River Basin

51 piezometers
Piezometric level measured every 15 minutes



“Water Scarcity & Drought” Indicator in the Arno River Basin



“Water Scarcity & Drought” Indicator in Arno River Basin



“Water Scarcity & Drought” Indicator in the Arno River Basin

Main Issues:

The annual basis calculation of the WEI and WEI+ does not allow the identification of Summer Droughts.

Indicators should be referred to Summer Droughts and clustered at an appropriate scale (most significant sub-basins).

WS&D Indicators should be compared in order to outline the situation in a complete and reliable way



The case of the Serchio River Basin



Area = 1600 Km2	
Popolazione	
295000	ISTAT-2004-2008
1 Regioni	Toscana
Comuni	36
ATO	3



Autorità di Bacino Pilota del fiume Serchio

Data Availability Survey for Water Scarcity and Drought Indicator system (WSDiS)

- 1) Data about water resources availability, water abstraction by source, water use by sector (data from WQ Reporting Tool*)**
- 1) Relevant socio-economic and environmental indicators**

* developed for this purpose of the WISE-SoE#3 Water Quantity Reporting 2009

Data reported by the Serchio Pilot River Basin

Country: IT/Italy
 Responsible: Segreteria Tecnica
 Email: segreteria@bacinoserchio.it
 Remarks:



Overview of the data reported so far

Region code	Region name	Region type	Water balance	Water abstraction	Water use	Wells	Reservoirs	Streamflow st.	Precipitation st.
ITD	Serchio	RBD	YES	YES		18	13	20	58

Water balance


Region: Code ITD, Name Serchio, Type RBD

Hydrometeorological parameters: Water storage, Returned water, Reused water, Desalinated water, Other additional water resources

Clear table

Volume in hm3

	Areal Precipitation	Pot. Evapotranspiration	Act. Evapotranspiration	Internal flow
Month 1 (Jan)				
Month 2 (Feb)				
Month 3 (Mar)				
Month 4 (Apr)				
Month 5 (May)				
Month 6 (Jun)				
Month 7 (Jul)				
Month 8 (Aug)				
Month 9 (Sept)				
Month 10 (Oct)				
Month 11 (Nov)				
Month 12 (Dec)				
Annual				
Wet Season				
Dry Season				
LTAA	2237,2	765,81	749,81	1487,39



Data available (rapidly)

as long term annual average (LTAA).
 Annual data are (very often)
 much more difficult to elaborate

Water balance


Region: Code ITD, Name Serchio, Type RBD

Hydrometeorological parameters: Water storage, Returned water, Reused water, Desalinated water, Other additional water resources

Clear table

Volume in hm3

	Snowpack	Changes in reservoir storage	Changes in groundwater storage
Month 1 (Jan)			
Month 2 (Feb)			
Month 3 (Mar)			
Month 4 (Apr)			
Month 5 (May)			
Month 6 (Jun)			
Month 7 (Jul)			
Month 8 (Aug)			
Month 9 (Sept)			
Month 10 (Oct)			
Month 11 (Nov)			
Month 12 (Dec)			
Annual			
Wet Season			
Dry Season			
LTAA	0	0	0



Data not available

Relevant Socio-economic and Environmental Indicators

Questionnaire answers	Responsible Authority	Autorità di Bacino Serchio	
	Sub Unit	Distretto Idrografico del Fiume Serchio	
	Area [km2]	1.565	
	Indicator	Population	2
		Economy	4
		Land use	5
		Infrastructure	8
		Quality -	6
		Education and	0
		Responses	0
TOTALE	25		

Criticalities

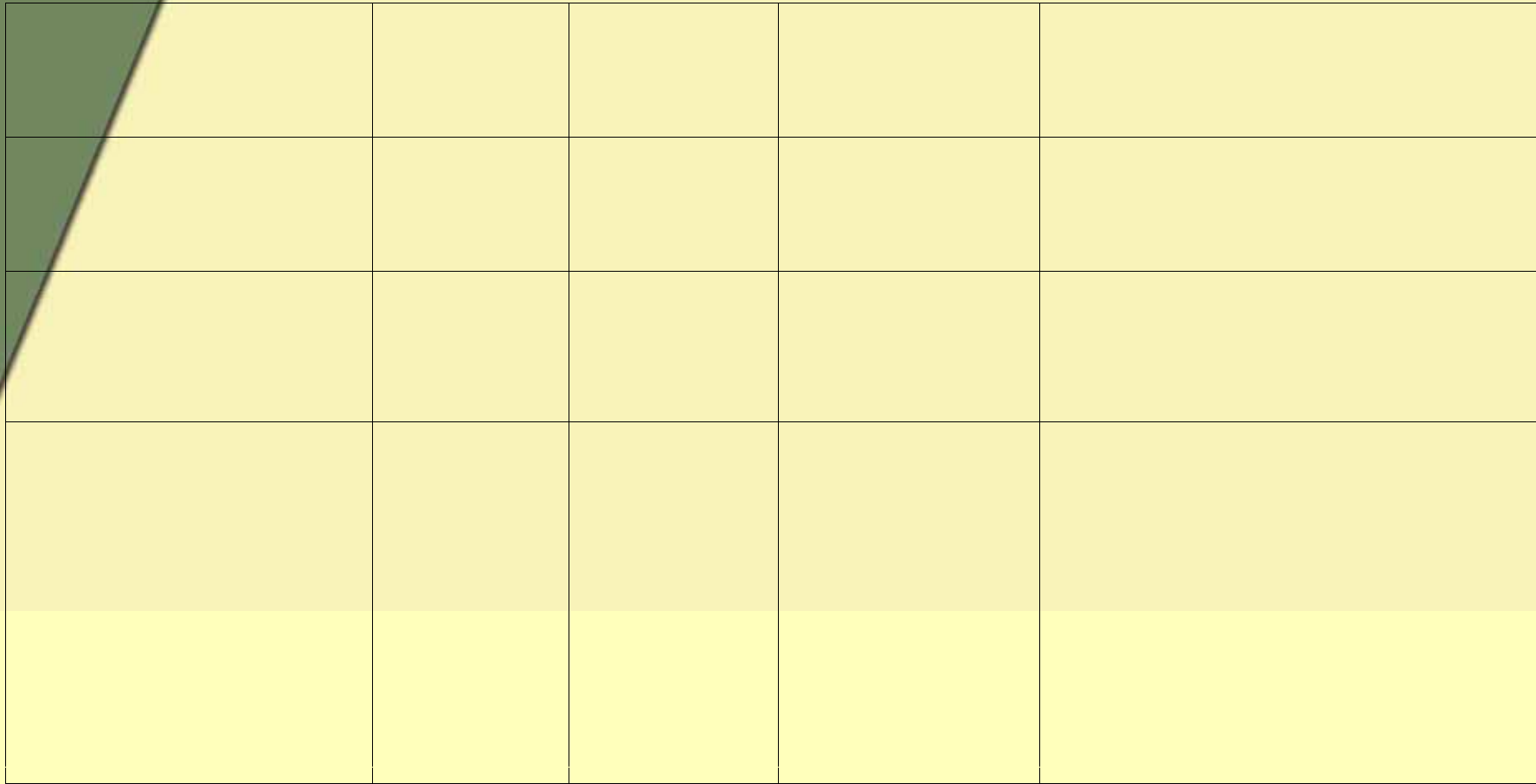
Some population data are not available:

-Seasonal workers in the tourism sector (which are not permanent residents)

-Nights spent at hotels, etc.

***Economic data (incomes per sector, losses due to drought, public expenditures, investments for water infrastructures, etc.) are difficult to collect**

WS&D INDICATORS



The case of Po River Basin



Minimum daily flow rate 168 m³/s
Medium daily flow rate 1500 m³/s
Maximum daily flow rate 10.300 m³/s
Po river course length 652 km
Total length of “natural rivers” network:
22.000 km

GDP : 40% OF THE NATIONAL GDP

Alluvial plain: 42% of the territory

Mountain areas: 58% of the territory

Area = 74.700 Km² (of which 4000 outside Italy)

Population: 17.000.000

Regions: 7

3210 MUNICIPALITIES:

Regione Lombardia	1541
Regione Piemonte	1209
Regione Emilia-Romagna	225
Regione Valle d'Aosta	74
Prov. Autonoma di Trento	62
Regione Liguria	61
Regione Veneto	36
Regione Toscana	2

1) Water Resources Availability, Water Abstraction by source, Water Use by sector – **PO RIVER BASIN AUTHORITY**

Water resources availability: very long daily **streamflow** and **precipitation** series (since 1925...).

Surface water: very good data availability since 2000 also for features ET, PET, Qi, Qo, Reservoir, etc.

Groundwater: poor information, with disomogeneous cover over the basin and over time.

Criticalities

1. Most of the data are collected, calculated or provided by the “Drought early warning system” for the Po basin. Data format don’t match with WISE_SoE request, so programmer’s time is requested to update system procedures.
2. Groundwater data collection requires planning actions and network design.
3. Need of a reference-platform at the district level.

Water abstraction by source and water use by sector: data collected in “Regional Water Protection Plans”, developed in 2004, and transmitted to Po River Basin Authority for the development of RBMP.

Criticalities

1. Need of a “shared procedure” to be defined to organize and activate data transfer.
2. Data are updated to the Regional Water Protection Plans publication. The updating procedures and timing are up to regional services and not coordinated one to each other.

2) Relevant socio-economic and environmental indicators – PO RIVER BASIN AUTHORITY

Questionnaire answers	Responsible Authority		Po River Authority
	Sub Unit		Po District
	Area [Km ²]		74.700
	Indicators (nr. available)	Population	3 (7) ^(*) of 10
		Economy	2 (13) of 17
		Land use	8 (1) of 9
		Infrastructure	2 (3) of 6
		Quality-environment	4 (6) of 10
		Education and awareness	0 (2) of 3
Responses		1 (7) of 8	
Total:		20	

(*)(nr. In brackets: different aggregation/data availability to be verified)

Criticalities

- Data collected by ISTAT- National Statistics Institute, or INEA- National Institute for Agrarian Economy, aggregated on Municipalities'/Provinces'/Regions' boundaries, often not directly suitable for river district.
- Lack of technicians and experts in data managing and analysing.
- In some cases, lack of data, and also of monitoring networks.

Po: “Water Scarcity & Drought” Indicators

Indicator	Scale	Focus	Data Availability	Comment
<p>Relevant Water Stress Indicator (RWSI) = Percent of Total Freshwater Abstracted over the total Renewable Water Availability</p> <p>$RWSI = ABS / RWA$</p>	RBD	WS&D	<p>Variable updating.</p> <p>DB managed by provinces.</p> <p>Data only concerning “annual licensed withdrawal”, not measured!</p>	<p>From Regional Water Protection Plans</p> <p>A systematic data flow from Regional Water Protection Plans to Basin Authority is not enabled.</p>
<p>Water Exploitation Index (WEI) and the WEI+</p> <p>Total Water Abstraction / Renewable Water Availability</p>	RBD	WS&D	<p>Variable updating.</p> <p>DB managed by provinces.</p> <p>Data only concerning “annual licensed withdrawal”, not measured!</p>	<p>From Regional Water Protection Plans</p> <p>A systematic data flow from Regional Water Protection Plans to Basin Authority is not enabled.</p>
Water Use per sector	RBD	Water exploitation	<p>Published in RBMP,</p> <p>Not regularly updated at the district scale.</p>	Data collected by ISTAT- National Statistics Institute, or INEA- National Institute for Agrarian Economy

Po “Water Scarcity & Drought” Indicators

Indicator	Scale	Focus	Data Availability	Comment
Snowpack	Subbasin	Drought monitoring	Since 2000, not immediately available (to be extracted from DEWS System)	
Ground water level	Local	Water exploitation and subsidence	Not available	Local data availability (Milano province)
Standardized Precipitation Index (SPI)	RBD	Drought monitoring	Available 1,3,6,12,24 months. Long timeserie.	
Streamflow	RBD	Drought monitoring	Available	Based on this indicator, calculation of secondary return period for drought spells (variables: duration and intensity)
Fraction of absorbed Photosynthetically Active Radiation	--	--	no	

The case of The Liri Garigliano Volturno River Basin

Administrative data:

Municipalities located in the Fucino basin (a) and in the Fucino Plain sub-basin (b):

27 comuni (a)	23 comuni (b)
98.732 abitanti (a)	93.304 abitanti (b)
954,1 km ² (a)	861,53 km ² (b)
1 A.T.O. competente	
4 Comunità Montane	
1 Consorzio di Bonifica	

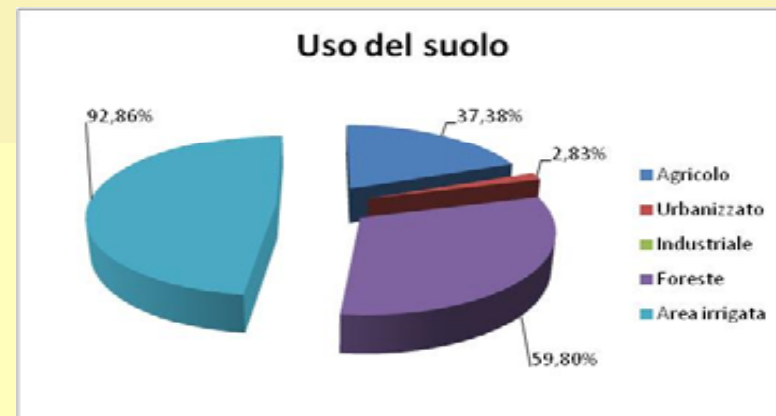
FUCINO Basin



Land use:

Other data:

Wells	748
Springs:	320
Operating Waste Water Treatment Plants:	19
Waste Water Treatment Plants-under construction:	3
Discharges	78

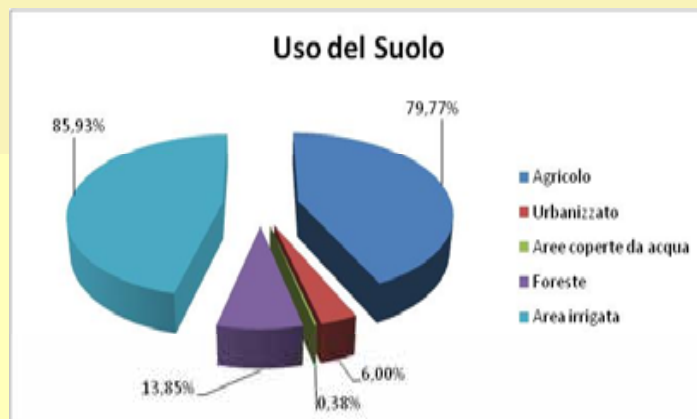


LOWER VOLTURNO BASIN

Administrative data:

Region:	Campania
Province:	Caserta
Basin:	Volturno
Basin Surface:	886 SqKm
Municipalities:	19
Inhabitants since 2005:	180684
Consortium of Municipalities (ATO):	1

Land use:



Other data:

Wells:	1520
Springs:	112
Surface Water Monitoring:	72
Groundwater Monitoring:	56
Waste Water Treatment Plants:	21

Data Availability in LGV Pilot Areas (Lower Volturno Basin, Fucino Basin)

The Volturno River Basin has drafted a water balance plan taking into consideration its whole territory (surface water and groundwater catchments). It includes an estimation of environmental flows (MVF), using an hydrological/environmental methodology and a microhabitats methodology for some relevant river sections.

The Water Balance Plan contains:

1. *Identification of water bodies in order to define “control” volume:*
 - *sub-basin on the basis of their meaningfulness (e.g. river junctions, important control section, relevant contribution from groundwater, ecc.);*
 - *groundwater bodies, on the basis of their hydrogeological features.*
1. *Estimation of upstream contribution*
2. *Estimation of real evapotranspiration volume*
3. *Estimation of infiltration volume*
4. *Estimation of natural stream inflow*
5. *Estimation of usable stream inflow (Minimum Vital Flow-MVF)*
6. *Estimation of total water demand, related to use*
7. *Evaluation of water abstraction by source*
8. *Evaluation of water use by sector*

Data Availability in LGV Pilot Areas (Lower Volturno basin, Fucino basin)

The LGV Basin has availability of the following data:

- **water availability**
- **water abstraction by source**
- **water use by sector**

LGV Basin is also facing some problems regarding data collection:

- **Update of hydrological data time series**
- **Information on water abstractions by source**

Socio-economic data (Lower Volturno basin, Fucino basin)

Usually socio-economic data are not collected and analyzed at basin or sub-basin spatial scale.

Population and economic data are available in ISTAT reports.

Other data on:

- **land use**
- **infrastructure**
- **quality – environment**
- **responses**

should be available at annual scale.

Indicators (Basso Volturno basin, Fucino basin)

Proposed indicator	AdB LGV experience/evaluation:	Criticalities:
<p>Relevant Water Stress Indicator (RWSI)</p> <p>$RWSI = ABS / RWA$</p>	<p>RWA could be difficult to assess, especially when it must take into account water exchanges between neighboring groundwater catchments (contribution included in External Inflow).</p> <p>Moreover, available data are not easy to disaggregate at monthly scale.</p>	<p>The criticalities in RWSI adoption seem to be:</p> <ul style="list-style-type: none"> • <i>ABS assessment for groundwater;</i> • <i>Temporale scale: monthly scale;</i> • <i>Metrics: LTAA.</i>
<p>Water Exploitation Index (WEI) and WEI+</p>	<p>Main Problems: Actual Inflow Evaluation, in order to estimate the volumes deriving from water exchange between neighboring groundwater bodies;</p> <ul style="list-style-type: none"> • Assessment of returned water, especially in order to calculate the volume generated by water losses. <p>Other Parameters are available at yearly scale</p>	<p>The criticalities in WEI+ adoption seem to be:</p> <ul style="list-style-type: none"> • groundwater; • water losses • Temporale scale: monthly scale • Metrics: LTAA.
<p>Water use per sector</p>	<p>Problems in identifying water uses by sector. These problems are related to past water abstraction licenses due to lack of information.</p>	<p>The criticalities in Water Use per Sector seem to be:</p> <ul style="list-style-type: none"> • Data availability for water abstractions licensed in past; • Services sector uses.

Indicators (Basso Volturno basin, Fucino basin)

Proposed indicator	AdB LGV experience/evaluation:	Criticalities:
Snowpack	Data unavailability for snowpack, because of an inadequate monitoring system. Remote sensing data could be a solution, but don't allow the identification of time series for the previous period of analysis.	The criticalities in Snowpack adoption seem to be: <ul style="list-style-type: none"> • Data availability, because of no monitoring system ; • In case of remote sensing monitoring, there are no data available to define previous time series.
Groundwater level	LGV Basin experienced the lack of information on groundwater level because of an inadequate monitoring program/system. Difficulties to define time series.	Groundwater level: <ul style="list-style-type: none"> • Data availability, because no monitoring system ; • Time series not homogeneous and complete.
Standardized precipitation index (SPI)	Rainfall data are available at daily and monthly scale, then statistical analysis for SPI calculation can be performed.	The criticalities seem to be: <ul style="list-style-type: none"> • Improvement of hydrological variables monitoring system.
Streamflow (Q)	Streamflow is a suitable indicator, also considering its easy implementation.	The criticalities in SPI adoption seem to be: <ul style="list-style-type: none"> • Q(h) function not updated; • Decrease in the streamflow gauges number.
Fraction of Absorbed Photosynthetically Active Radiation	Indicator could be meaningful, if used jointly with other indicators as SPI. Anyway, it also seems to be influenced by other pressures on vegetation (pests, disease, ecc.).	<ul style="list-style-type: none"> • Influenced by pressures not related to WS&D. • Need of joint analysis with other index.



"Water Scarcity & Drought" Indicator: Conclusions



Abstractions for the different uses: available for the most relevant uses

Groundwater level: relevant, generally available indicator
Monitoring stations are not located on the whole territory

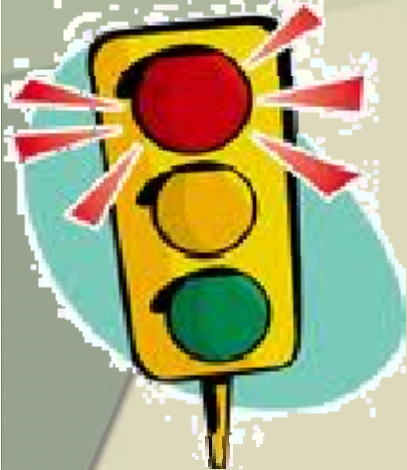
SPI good data availability, extended time series.
Already in use in some areas

Streamflow data are available for the most relevant sub-basins

All Italian River Basin Authorities have tools to analyse and manage WS&D that allow a good reaction to WS&D issues



“Water Scarcity & Drought” Indicators: Conclusions



WEI and WEI+ The annual basis calculation does not allow the identification of Summer Droughts, Parameters: External Inflow, Returned Water and Water Requirements - are difficult to assess

Groundwater level poor and dishomogenous information in some of the River Basins

In some cases **population data** are not available: Seasonal workers in the tourism sector (which are not permanent residents, nights spent at hotels, etc.

Snowpack difficult to retrieve and not relevant

All Indicators should be referred to Summer Droughts and clustered at an appropriate scale (most relevant sub-basins). Indicators should be compared in order to outline the real situation in a complete and reliable way.

ISPRA 's project for the linkage "Osservatori"

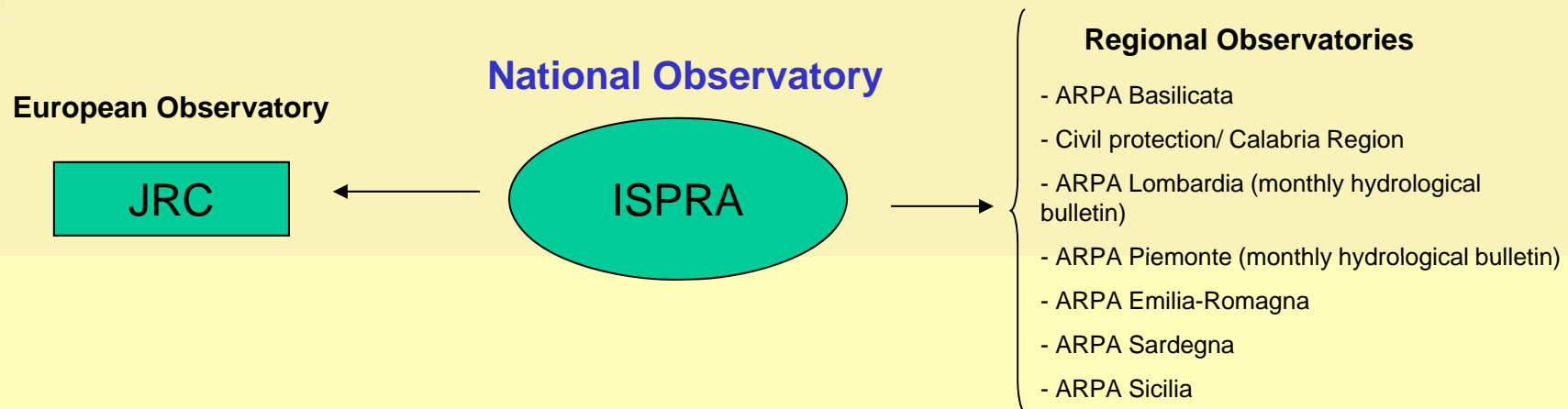
The existing system

Presently it is possible to download from the ISPRA's webpage images of the monthly bulletin of SPI (calculated for 3, 6, 12 and 24 months) on 4 areas (Italy, Mediterranean basin, EU territorial cooperation area CADSES* and Europe) since December 1989.

This bulletin is updated monthly and calculated on the basis of the precipitation reanalysis of NCEP.

The pages are available in Italian and English.

Also the regional observatories and the European observatory EDO developed by JRC are linked up.



http://www.isprambiente.gov.it/pre_meteo/siccitas/index.html

*Central, Adriatic, Danubian and South- East European Space

ISPRA 's project for the linkage "Osservatori"

Designed project

A link enabling easy access to all systems at different level is under construction.

This project will permit the data confrontation and integration and an in-deep analysis in case of WS & D events occurred locally.

