Meeting of the EC Expert group on Water Scarcity and Drought

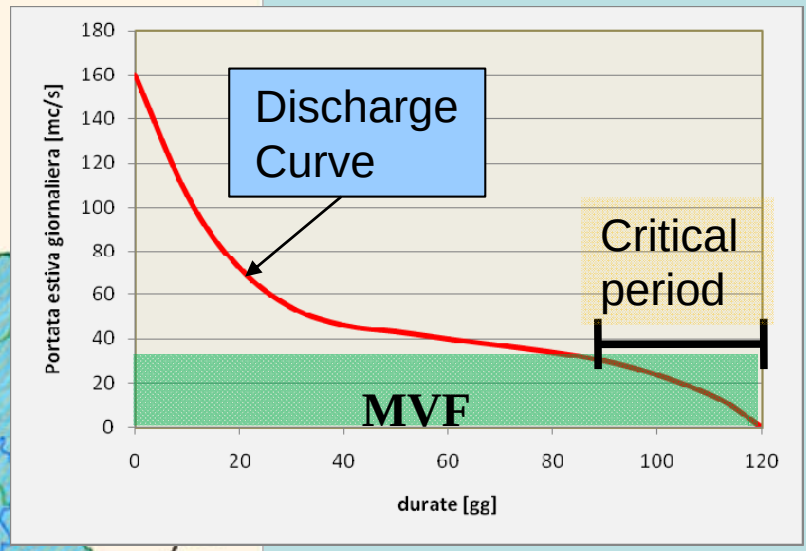
Monitoring systems in use in the Basin Authorities Arno, Po, Serchio, Liri-Volturno-Garigliano

Venice, 13-14 October 2011

Pasquale Coccaro, Liri-Garigliano-Volturno River Basin Authority
Francesco Falaschi and Prof. Raffaello Nardi, Serchio River Basin Authority
Francesco Comsumi, Arno River Basin Authority
Claudia Vezzani, Po River Basin Authority

Management and Monitoring of Reservoirs in the Arno River Basin: *Water balance*

Critical Areas Mapping



Class	Water deficit level	Days with negatives values of WB
C4	Extreme	> 60 dd
C3	Severe	30-60 dd
C2	Moderated	1-30 dd
C1	Null	0 dd

Evaluation of Critical Conditions of each subbasin through the comparison between Discharge Curves and Minimum Vital Flow (MVF)

Management and Monitoring of Reservoirs in Arno River Basin: Water Protection Commission

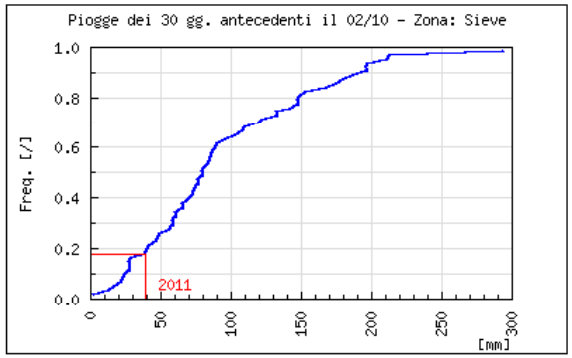
During drought times the Water Protection Commission, that meets periodically at the Arno River Basin Authority, manages water resources and in particular dam-impounded water

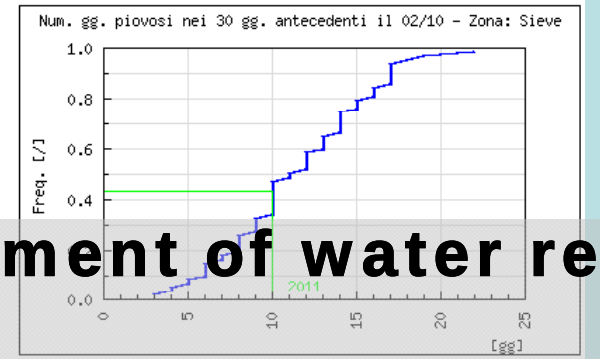
Management and Monitoring of Reservoirs in the Arno River Basin: Water Protection Commission

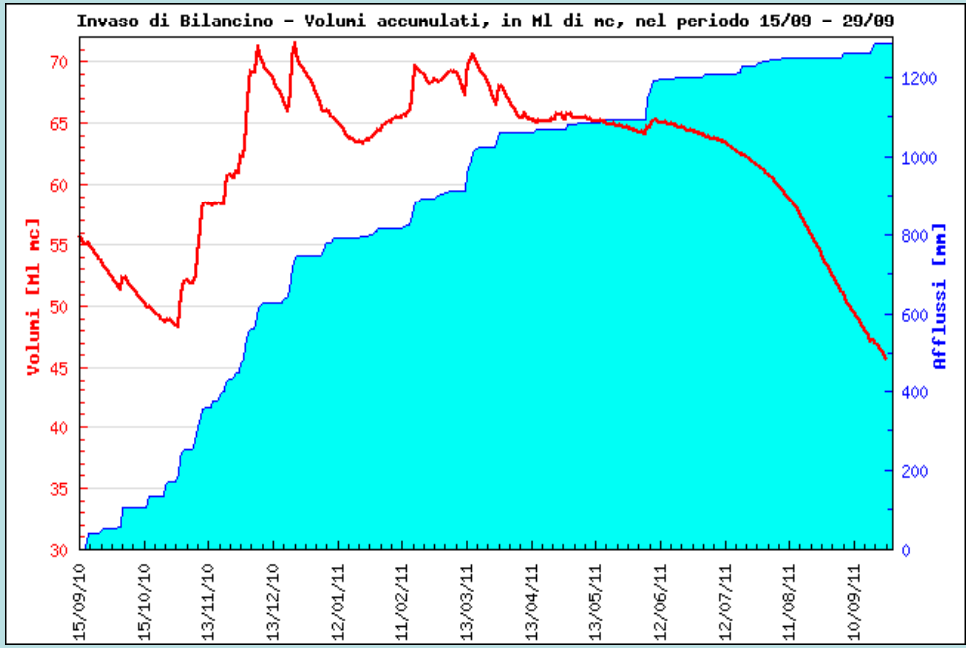
Afflussi cumulati

Zona: Sieve - Data di riferimento: 02/10 - Durata: 30 giorni

CFD [/]	Anno	Prec.Cum. [mm]	Num. giorni piovosi [gg]
0.02	1985	2.2	3
0.03	1983	13.1	10
0.05	1958	17.0	5
0.06	1988	22.0	9
0.08	1997	22.7	4
0.10	1970	24.2	5
0.11	1980	26.7	4
0.13	1962	26.8	8
0.15	1954	27.0	8
0.16	1992	28.9	10
0.18	2011	39.4	10
0.19	2003	40.1	12
0.21	2000	41.6	8
0.23	1957	47.4	9
0.24	1956	48.2	6
0.26	1978	49.3	7
0.27	1986	55.6	6
0.29	1990	57.7	14
0.31	1977	58.0	10
0.34	1975	60.3	9
0.36	1964	65.0	6
0.38	1971	66.2	9







- **Management of water releases to minimize impacts**
- **Hydrometeorological data, Streamflow Data and Groundwater Level Processing**
- **Forecasting models**

Water Scarcity and Drought

Expert Group

Autorità di Bacino Pilota del Fiume Serchio

Serchio River Basin

Pilot River Basin Authority

www.autorita.bacinoserchio.it

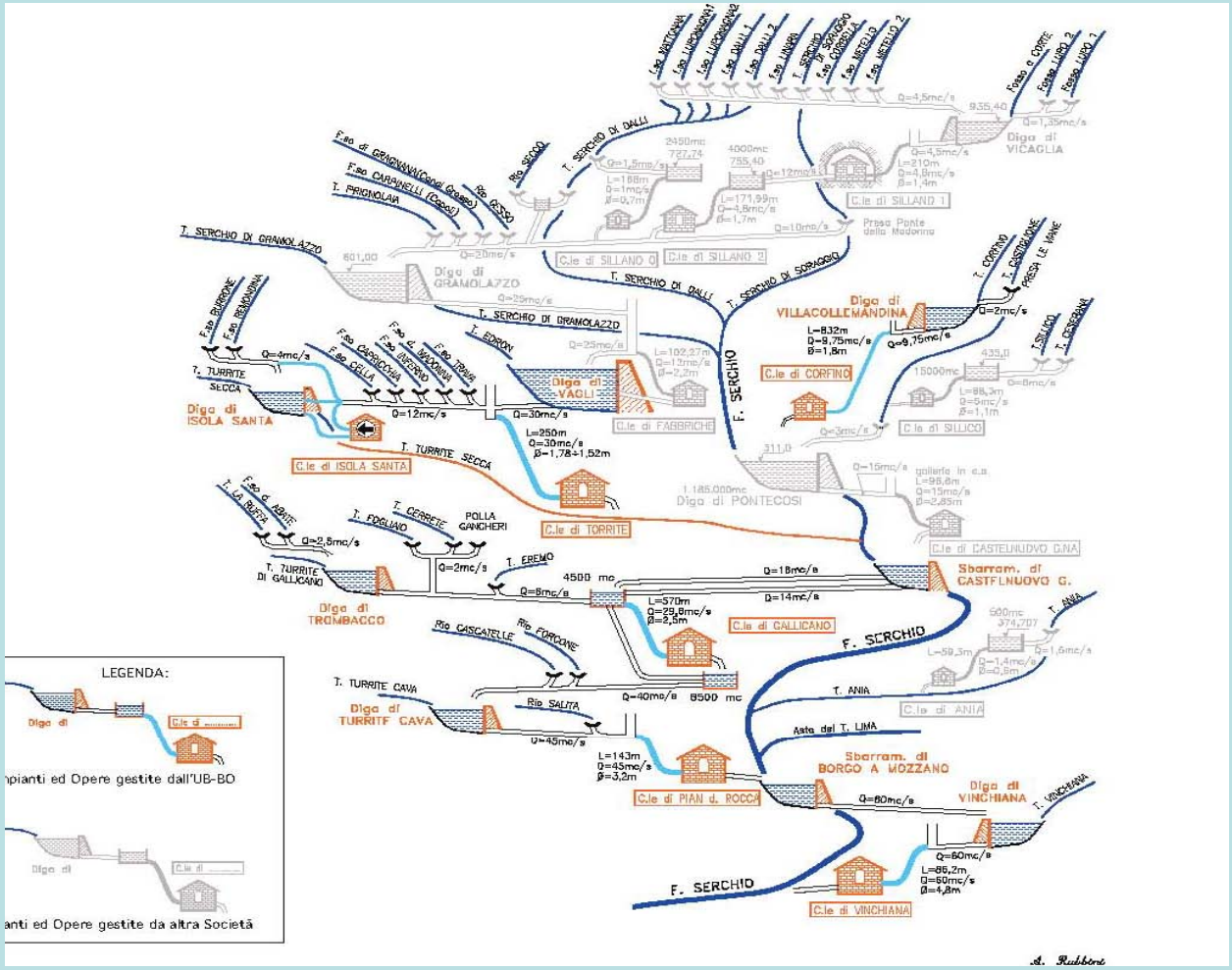
Prof. Raffaello Nardi
(Segretario Generale)

Geol. Francesco Falaschi

Autorità di Bacino BACINO PILOTA DEL FIUME SERCHIO — *Distretto Idrografico* PILOTA DEL FIUME SERCHIO

Autorità di Bacino Pilota del Fiume Serchio – Via Vittorio Veneto, 1 – 55100 (LU), ITALY

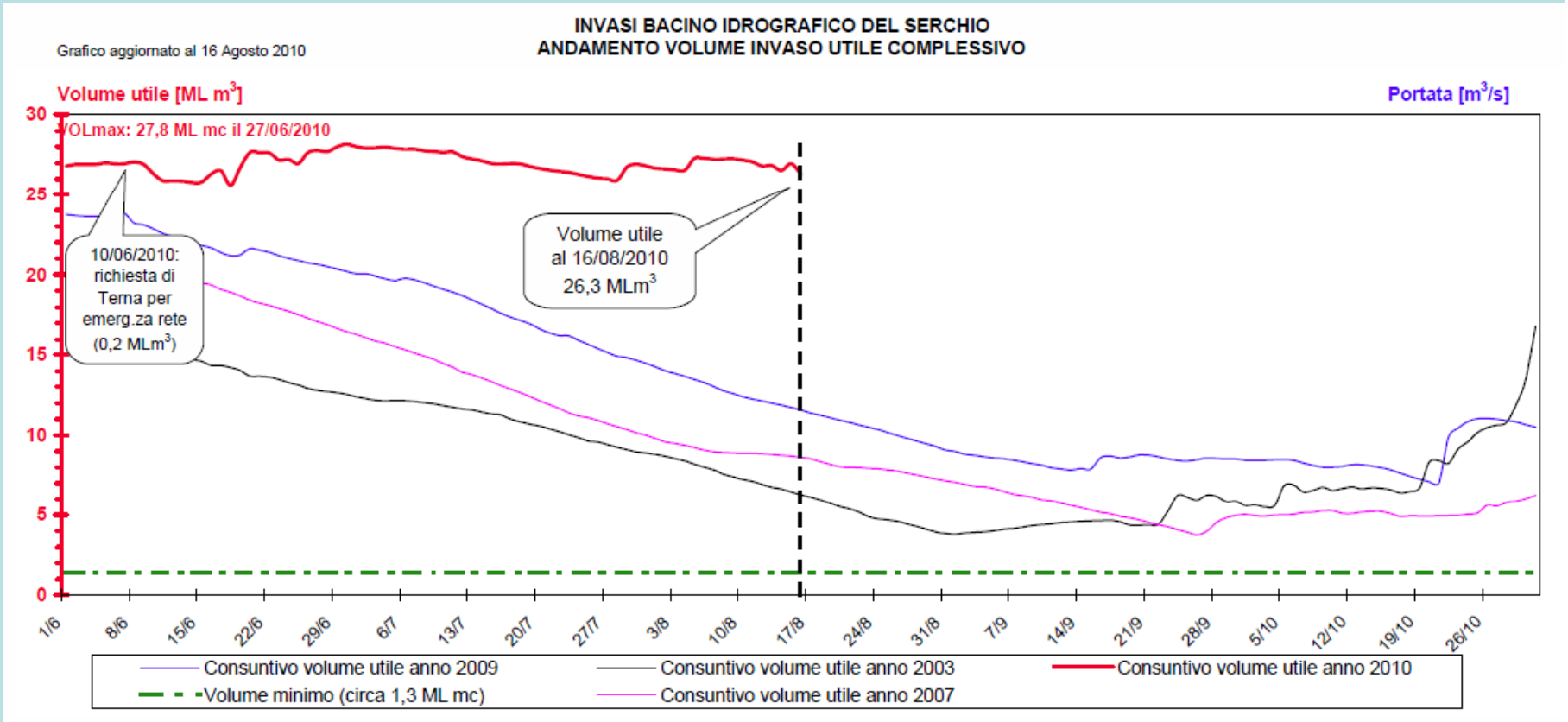
WS&D: the Serchio River Basin monitoring and regulation activity



A permanent techinal board is active since 2006, to act decisions during crisis.

Under normal conditions, the rules for releases from reservoirs are contained in the RBMG as a specifyc measure.

Monitored total water volume (reservoirs)



When the crisis starts, the techical board is in the faculty of changing temporarily the rules, in order to best preserve environmental and ecological functions of the river, industrial, agricoltural and drinking water supplies.

Monitoring system analisys in Volturno Basin and RBD of Southern Appennines

Liri-Garigliano and Volturno Basin Authority has defined a topology and functional structure of monitoring system installed in its basin territory.
Monitoring system assessment have been realised on the basis of the physiographic unit features analisys, in order to put in evidence:

- functional features
- water bodies “coverage”
- criticalities
- system enhancement hypothesis.

Monitoring system has been assessed also in RBMP, according with regional Agencies for environmental protection. Following assessment results, in RBMP has been defined a proposal of monitoring program, according with WFD requests.

Enhancement of monitoring system in Volturno basin

On the basis of the results of the analysis performed for its planning action, Liri-Garigliano and Volturno Basin has designed and realised an enhancement of the monitoring system.
The main goal of this project has been to solve information lack aout water bodies status, improving knowledge.
Proposal includes 24 new station (already installed) as specified below:

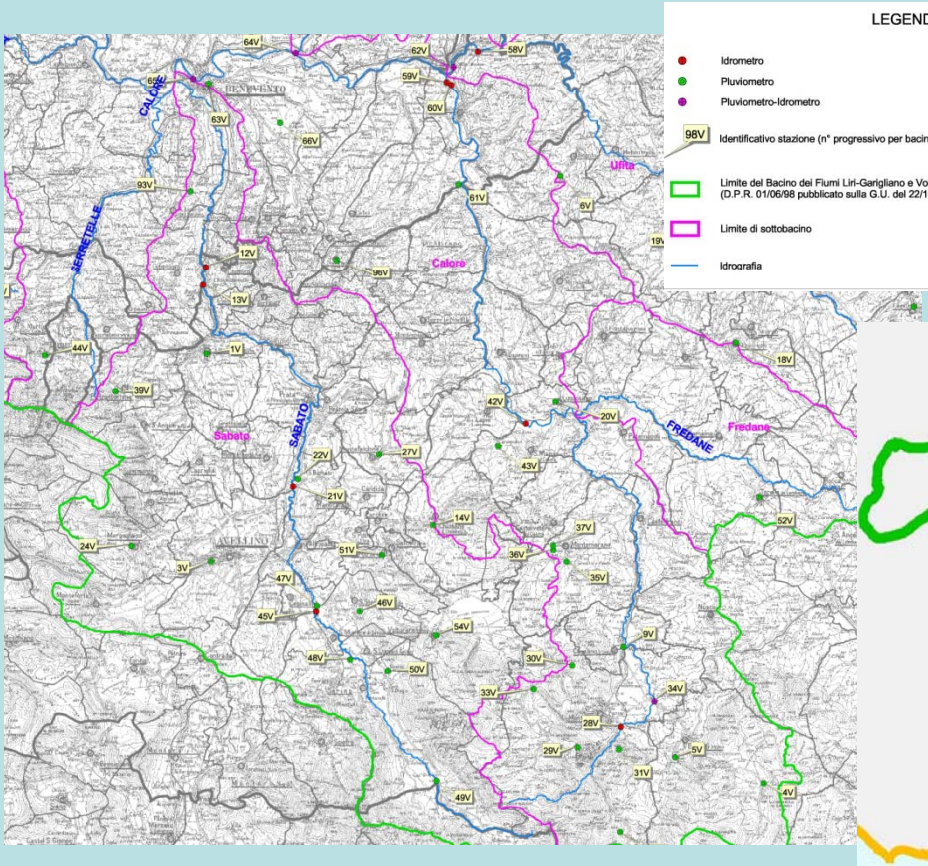
Groundwater bodies

- **Terminio-Tuoro (2 stations - quantity)**
- **Monte Matese (7 stations - quantity)**
- **Monti Durazzano mountain (2 stations - quantity)**
- **Roccamonfina (1 stations – quantity / and 3 station - quality and quantity)**
- **Monte Maggiore mountain (2 stations - quantity / 1 station - quality and quantity)**
- **Monte Taburno (1 quantity station)**

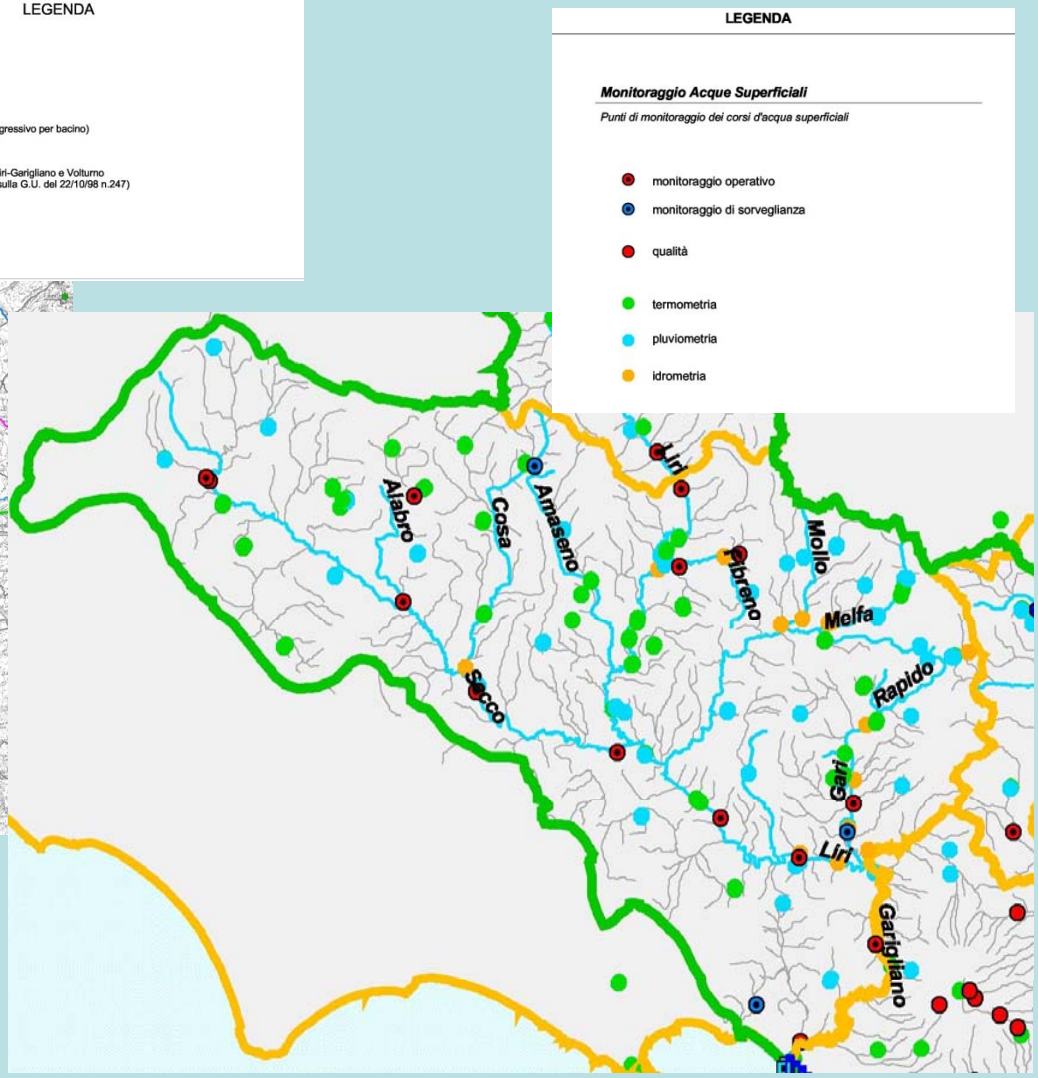
Surface water:

- **Volturno river (2 stations - quality and quantity)**
- **Tammaro river (2 stations - quality and quantity)**
- **Ufita river (1 station - quality and quantity)**
- **Agnena river (1 station - quantity)**
- **Savone river (1 quantity station)**

Monitoring system in Volturno Basin and RBD of Southern Appennines

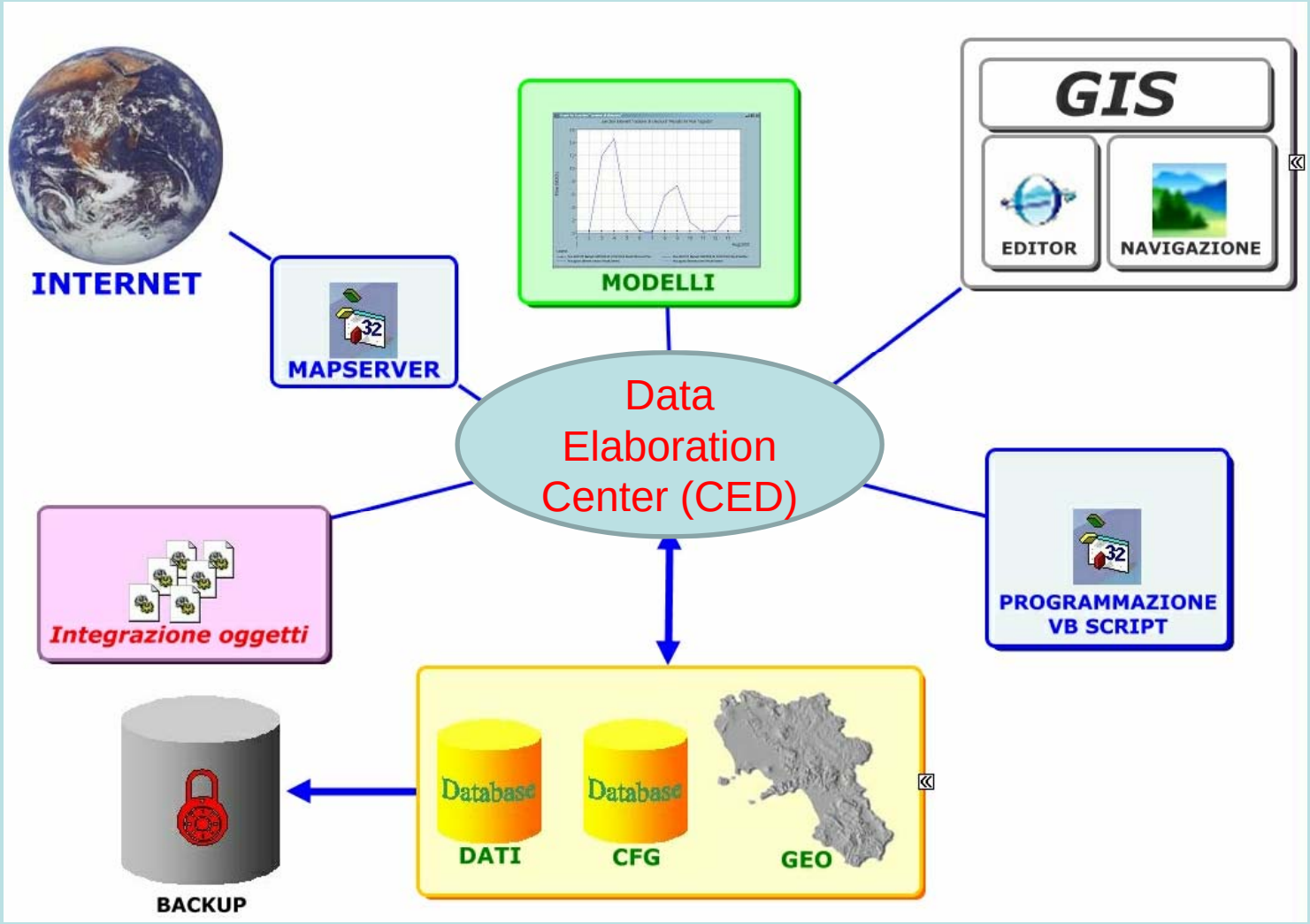


Volturno Basin - Calore Irpino river

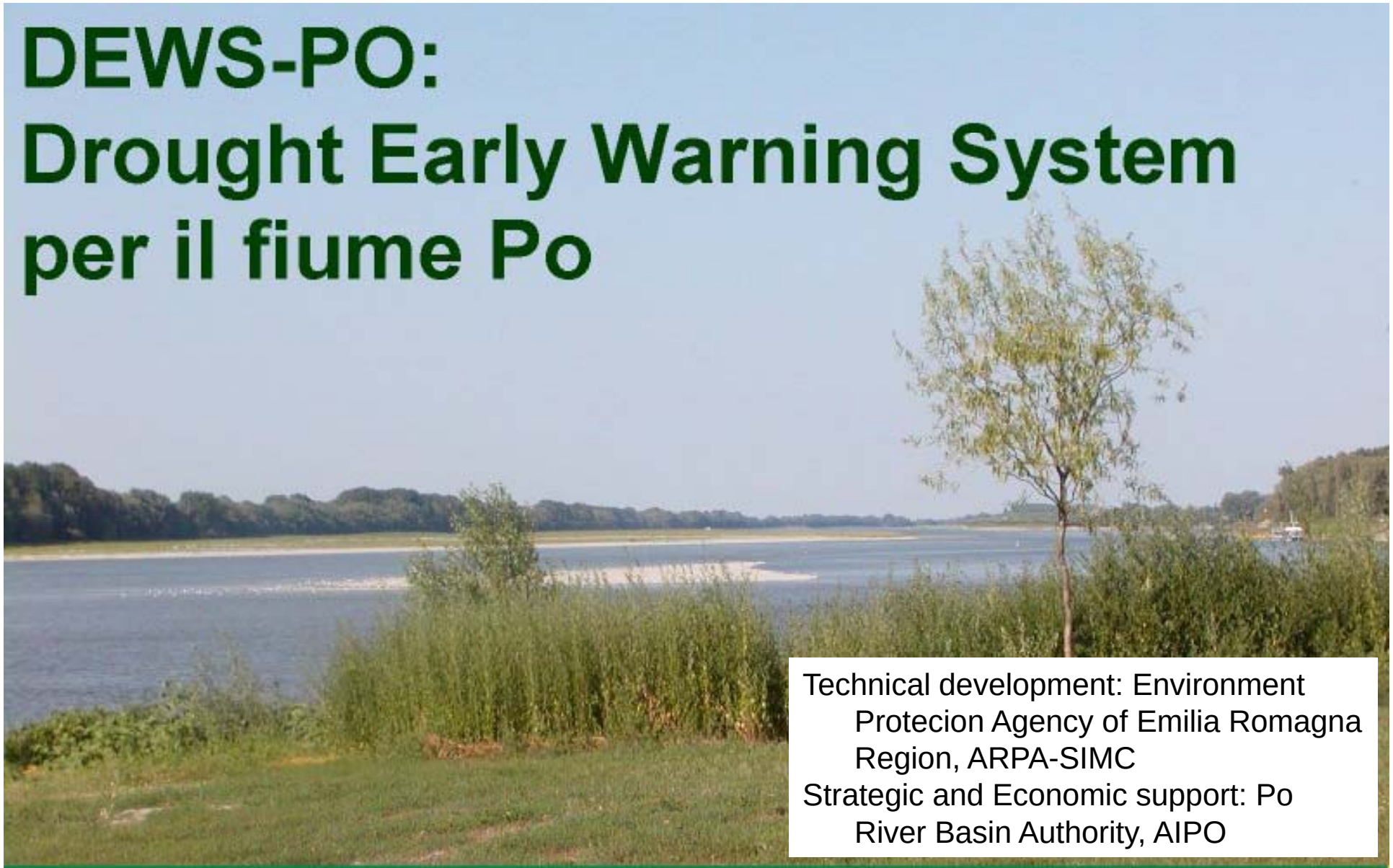


RBD – Garigliano river

System global layout



DEWS-PO:
Drought Early Warning System per il fiume Po



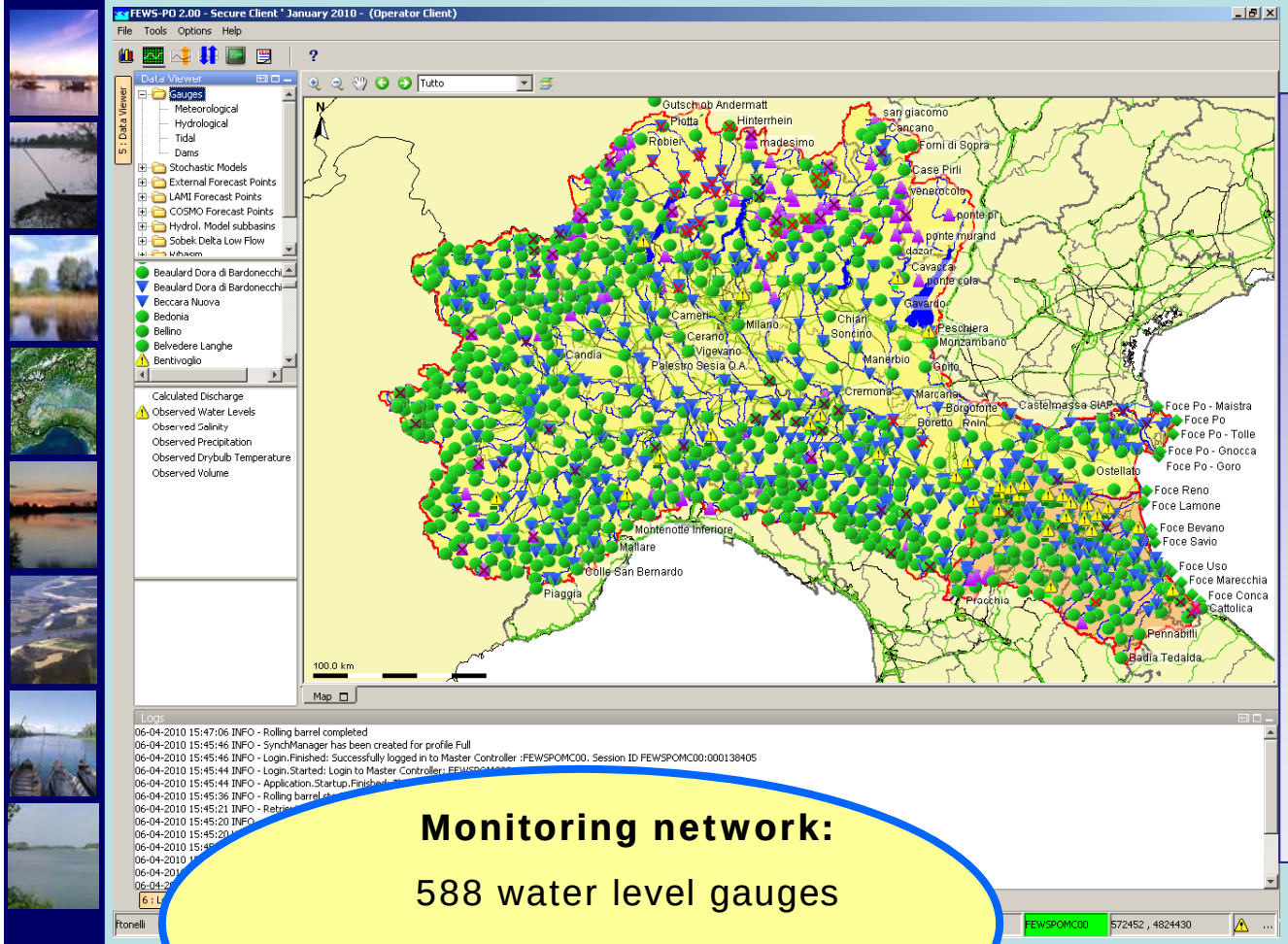
Technical development: Environment Protecion Agency of Emilia Romagna Region, ARPA-SIMC

Strategic and Economic support: Po River Basin Authority, AIPO

AUTORITÀ DI BACINO DEL FIUME PO
Bacino di rilievo nazionale

via Giuseppe Garibaldi, 75 - 43121 Parma - tel. 0521 2761 - www.adbpo.it - partecipo.bilancioidrico@adbpo.it

DEWS-PO: System input



Monitoring network:

588 water level gauges

1014 raingauges

756 thermometers

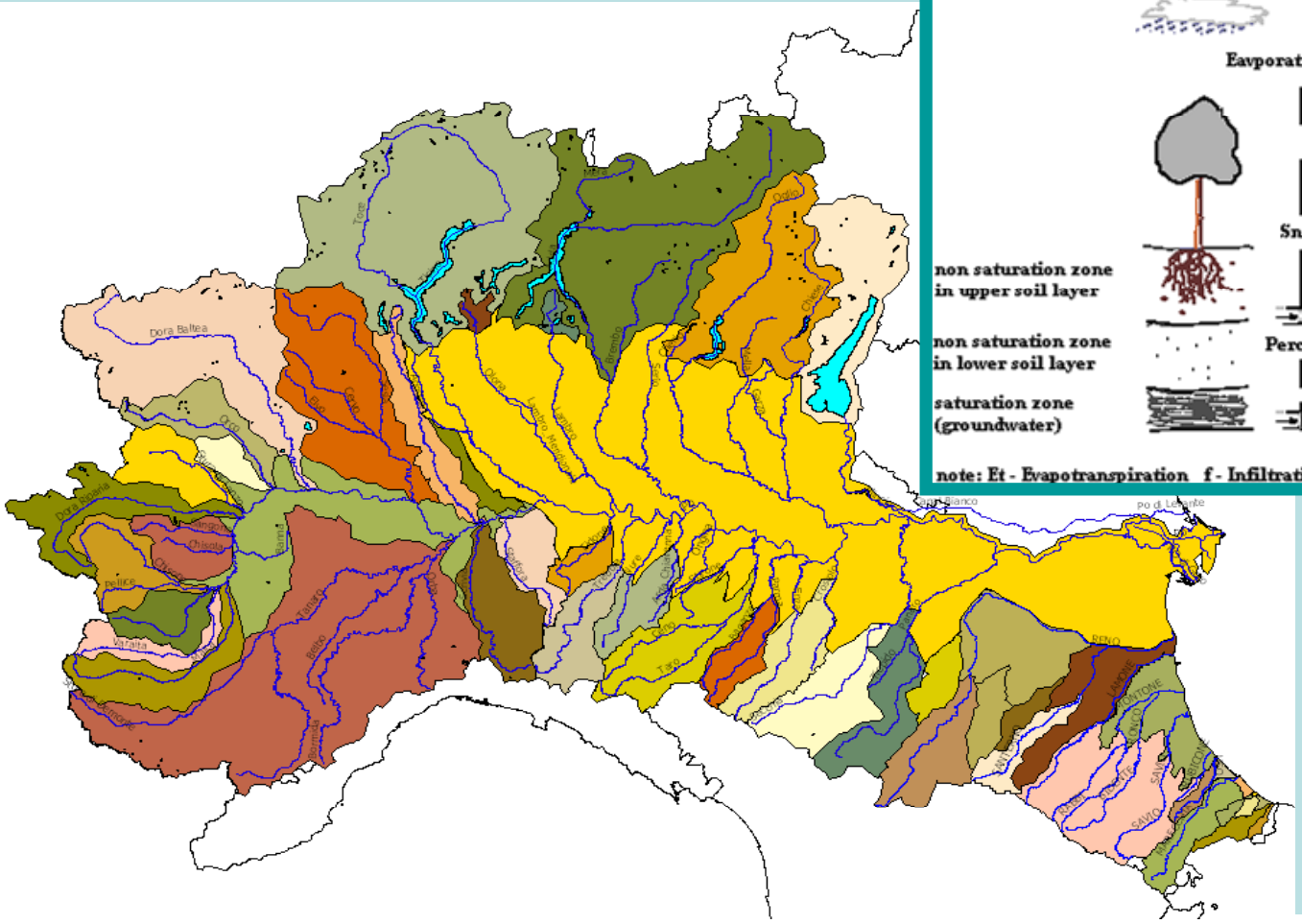
High density observational network:
Rainfall
Temperature
Level / discharge

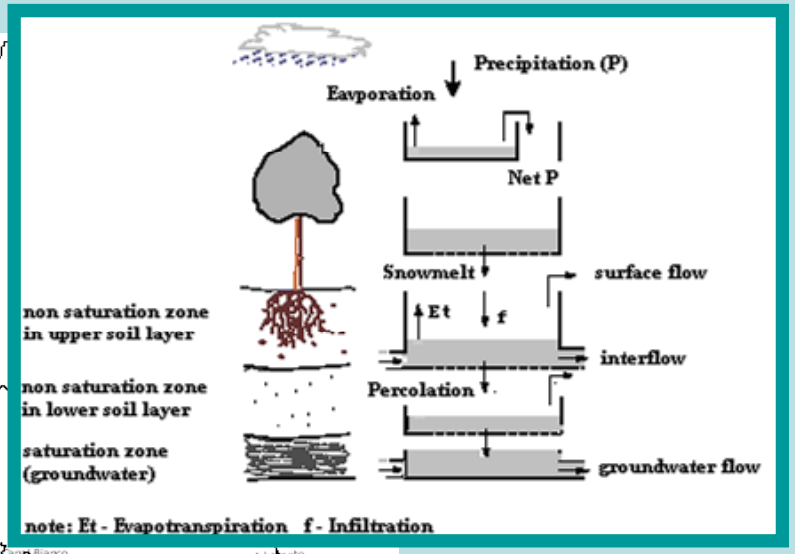
(telemeasured data)

Meteorological input:
Deterministic Model (15 days) (ECWM)
Model ensemble (seasonal forecastings)

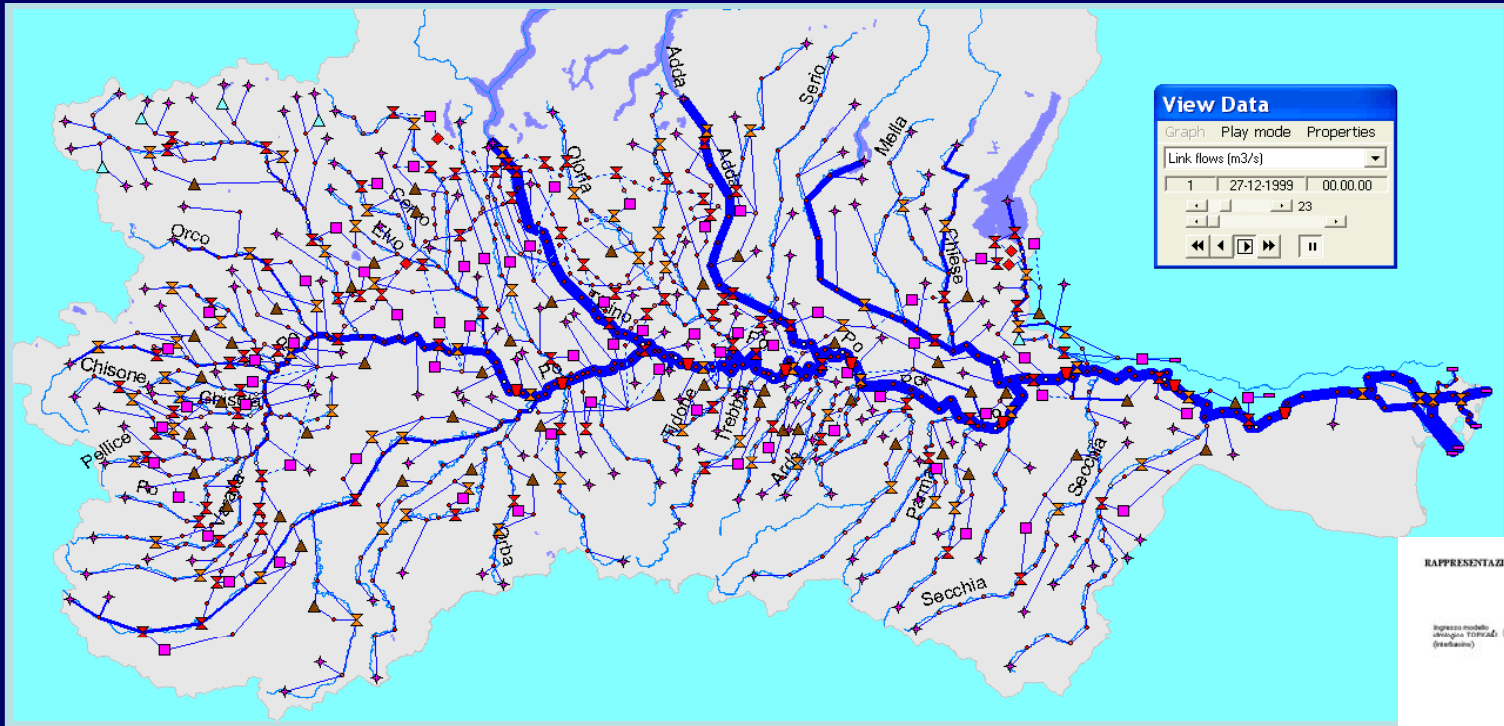
DEWS-PO: hydrologic modelling block

1 – Rainfall-runoff model: TOPKAPY model, continuos, distributed, physcally based model



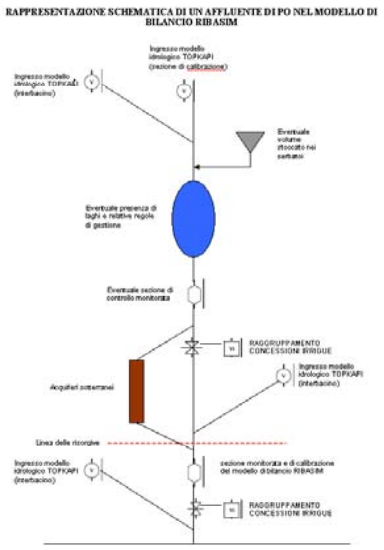


DEWS-PO: hydrologic modelling block

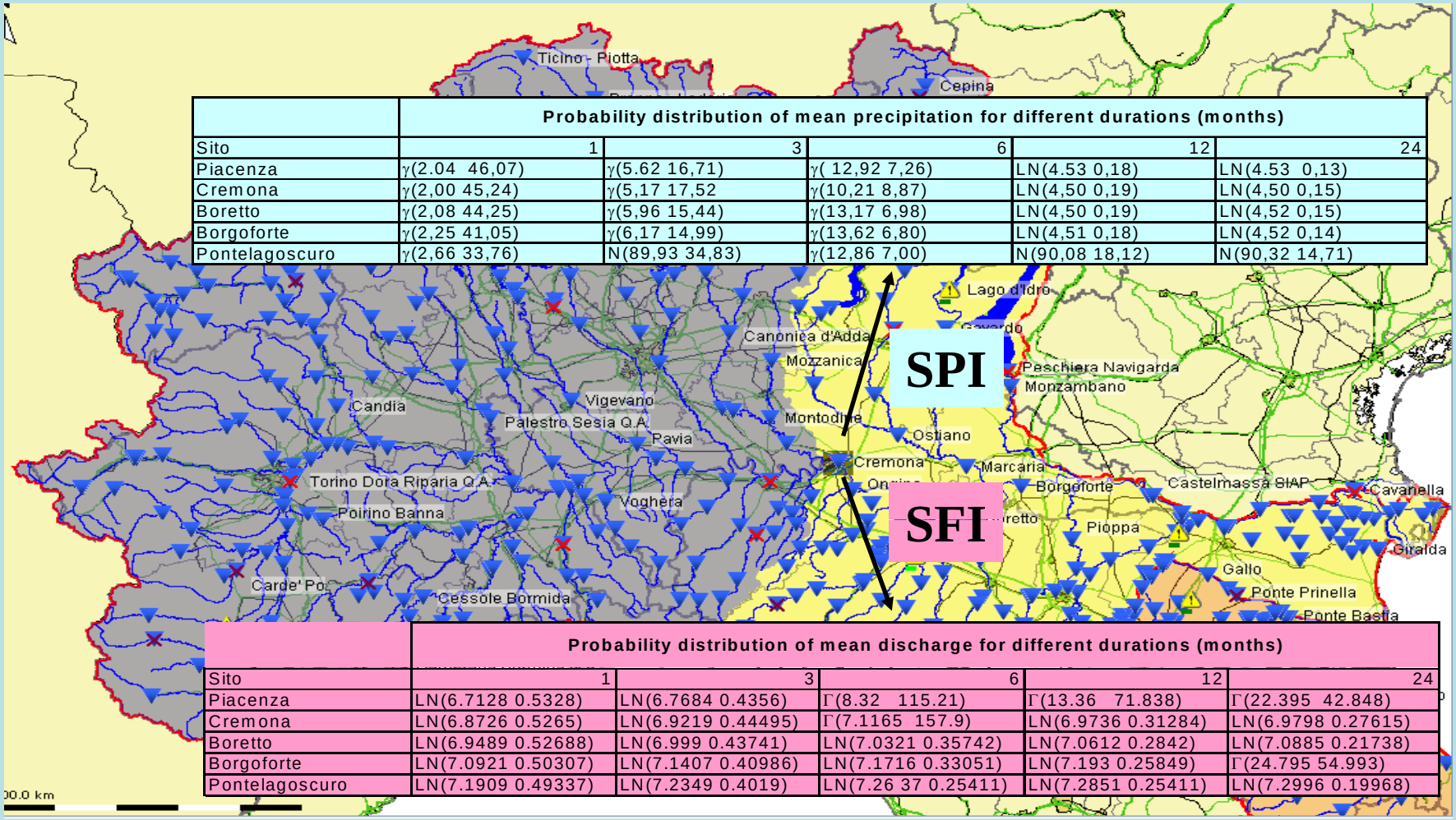


2 – Water Balance Model, RIBASIM (Deltares)

Real time balance calcutations at nodes
Representation of withdrawals system's operation
Scenarios simulation



DEWS-PO: droughts' frequency analyses



	Probability distribution of mean precipitation for different durations (months)				
Sito	1	3	6	12	24
Piacenza	γ(2.04 46,07)	γ(5.62 16,71)	γ(12,92 7,26)	LN(4.53 0,18)	LN(4.53 0,13)
Cremona	γ(2,00 45,24)	γ(5,17 17,52	γ(10,21 8,87)	LN(4,50 0,19)	LN(4,50 0,15)
Boretto	γ(2,08 44,25)	γ(5,96 15,44)	γ(13,17 6,98)	LN(4,50 0,19)	LN(4,52 0,15)
Borgoforte	γ(2,25 41,05)	γ(6,17 14,99)	γ(13,62 6,80)	LN(4,51 0,18)	LN(4,52 0,14)
Pontelagoscuro	γ(2,66 33,76)	N(89,93 34,83)	γ(12,86 7,00)	N(90,08 18,12)	N(90,32 14,71)

	Probability distribution of mean discharge for different durations (months)				
Sito	1	3	6	12	24
Piacenza	LN(6.7128 0.5328)	LN(6.7684 0.4356)	Γ(8.32 115.21)	Γ(13.36 71.838)	Γ(22.395 42.848)
Cremona	LN(6.8726 0.5265)	LN(6.9219 0.44495)	Γ(7.1165 157.9)	LN(6.9736 0.31284)	LN(6.9798 0.27615)
Boretto	LN(6.9489 0.52688)	LN(6.999 0.43741)	LN(7.0321 0.35742)	LN(7.0612 0.2842)	LN(7.0885 0.21738)
Borgoforte	LN(7.0921 0.50307)	LN(7.1407 0.40986)	LN(7.1716 0.33051)	LN(7.193 0.25849)	Γ(24.795 54.993)
Pontelagoscuro	LN(7.1909 0.49337)	LN(7.2349 0.4019)	LN(7.26 37 0.25411)	LN(7.2851 0.25411)	LN(7.2996 0.19968)

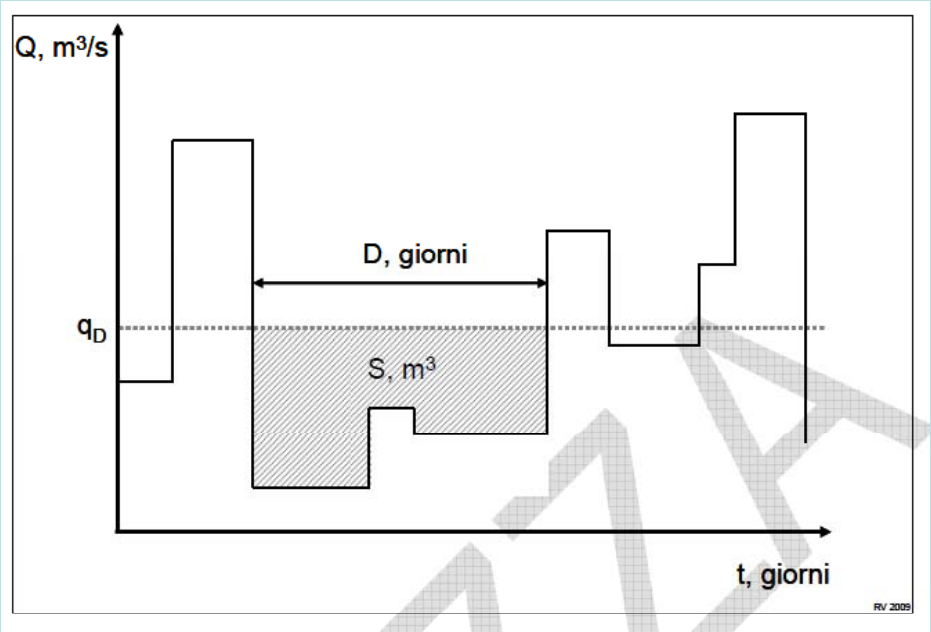
Available hystorical timeseries.

DEWS-PO: droughts' frequency analyses

Run method (Yevjevich, 1967)

D = Duration of low flow event
I = Intensity of low-flow discharge

S = Total "lacking volume"



Using:

Copula & Sklar theorem: $F_{DS}(d, s) = C_\delta (F_D(d), F_S(s))$

It is possible to calculate the RETURN PERIOD of the combined simoultaneous events of given duration and intensity, named "Secondary Return Period" (SRP).
The calculation is enabled also for ongoing event.

DEWS-PO – Run method, example at Pontelagoscuro station (outlet)

Date of event beginning			Severity	Duration	Return period for severity	Return period for duration	Secondary return period
day	month	year	S [m^3]	D [day]	T_S [years]	T_D [years]	ρ_T [years]
26	5	2003	2.34E+09	109	28.42	85.26	249.41
17	9	2003	1.98E+08	21	1.38	1.55	6.14
9	10	2003	1.12E+08	17	0.89	1.17	2.90
29	10	2003	1.37E+06	2	0.30	0.32	0.33
26	6	2004	1.90E+08	16	1.31	1.08	4.06
17	7	2004	1.59E+08	9	1.14	0.61	1.47
31	7	2004	7.54E+07	8	0.68	0.55	1.11
18	8	2004	5.90E+07	6	0.60	0.45	0.79
2	9	2004	4.68E+05	1	0.28	0.29	0.30
8	4	2005	4.05E+06	2	0.33	0.32	0.37
4	6	2005	2.29E+09	86	21.31	17.05	208.05
10	1	2006	6.57E+07	20	0.64	1.38	1.61
28	5	2006	2.84E+09	83	85.26	14.21	205.20
26	8	2006	1.76E+06	1	0.30	0.29	0.32
5	9	2006	4.43E+07	10	0.56	0.68	1.15
19	3	2007	4.68E+05	1	0.28	0.29	0.30
12	4	2007	3.56E+08	23	2.51	1.85	11.99
15	5	2007	2.87E+08	16	1.81	1.08	4.54
1	7	2007	1.30E+09	54	7.75	8.53	107.73
18	10	2007	8.58E+06	8	0.37	0.55	0.53
7	11	2007	8.25E+07	17	0.75	1.17	2.18
21	12	2007	2.95E+05	1	0.27	0.29	0.28
24	12	2007	2.58E+07	8	0.47	0.55	0.82

Po River Basin Authority: questions

How to link DEWS-PO and EDO?

Is the “Index of Hydrologic Alteration” method, based on the study of Environmental Flow Components of Poff at al, 1996, suitable in the assessment of linkages between water quality and water quantity?

Thank you for your attention!