SHF, Lyon, 18-19/11/2008

Real-time demonstration of hydrological ensemble forecasts in MAP D-PHASE

Roberto Ranzi, Baldassare Bacchi, University of Brescia, DICATA (I)
Alessandro Ceppi, Politecnico di Milano, DIIAR (I)
Matteo Cislaghi ARPA Lombardia, (I)
Uwe Ehret Wasserwirtschaftsamt Kempten, (D)
Simon Jaun, IAC ETH Zurich, (CH)
Andreas Marx, Forschungszentrum Karlsruhe, IMK-IFU (D)
Christoph Hegg, Massimiliano Zappa, WSL, (CH)

Outline of the presentation

- MAP D-PHASE presentation
- Impact areas in the Alps
- Criteria for meteorological and hydrological warning thresholds
- Results of hydrological forecast chains
- Hydrology-oriented end users feedback

MAP D-PHASE

- Follow up of **MAP-M**esoscale **A**lpine Programme (Bougeault et al., Bull. Am. Meteorol. Soc., 2001)
- **D**emonstration of **P**robabilistic **H**ydrological and **A**tmospheric **S**imulation of flood **E**vents in the Alpine region is the second (after Sydney Olympics) Forecast Demonstration Project of the WWRP-World Weather Research Programme. Real time in June-Nov. **2007**
- Main **objective** was to **test and demonstrate** to **end-users** the benefits in forecasting heavy precipitation and related flood events in **real-time, and especially in ensemble mode**.
- Meteorological aspects Rotach et al., Bull. Am. Meteorol. Soc., 2008 (submitted)

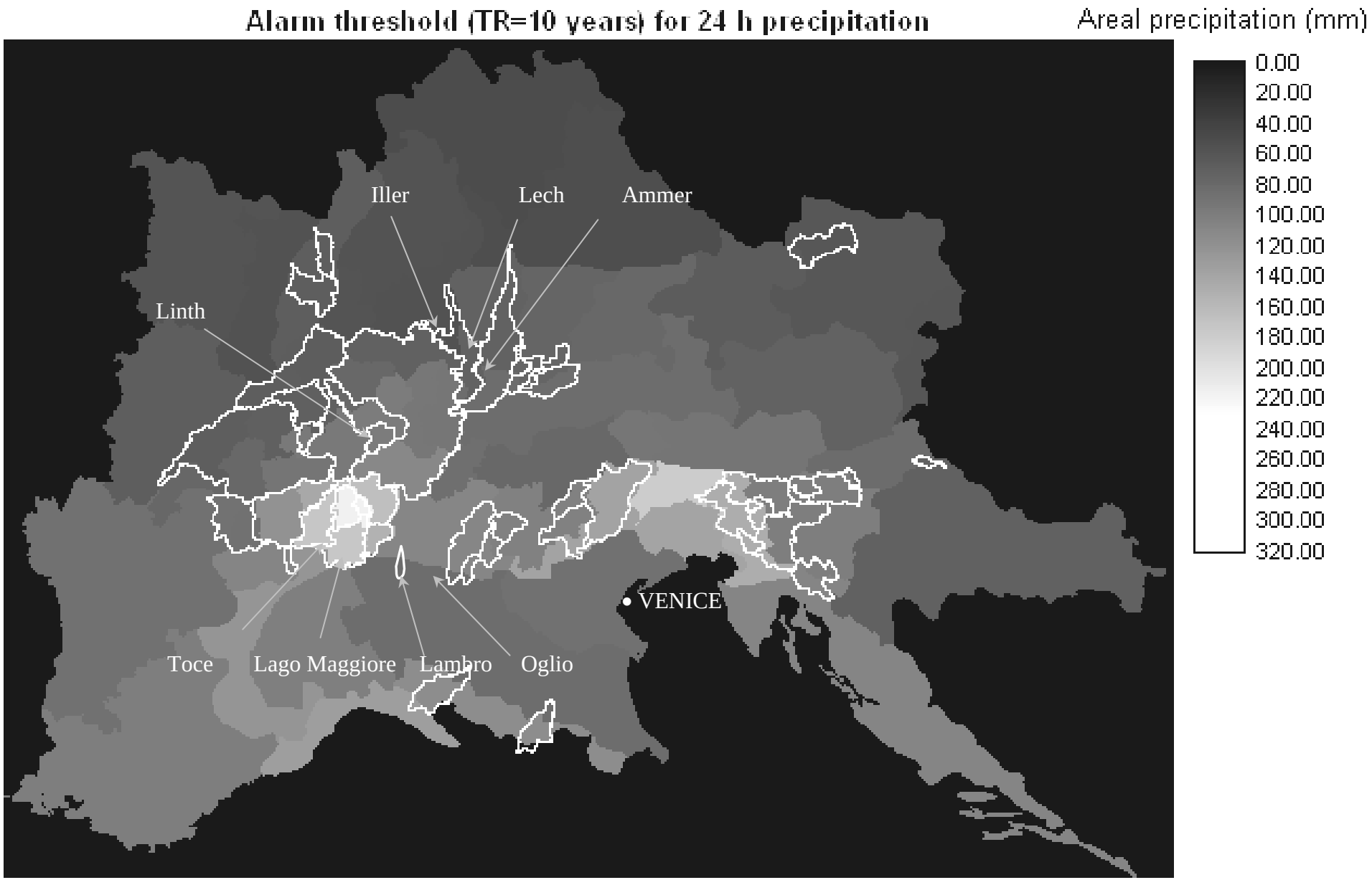
WG HEU ‘Hydrology and End users’

Chairs: ***Christoph Hegg*** (WSL, CH), ***Roberto Ranzi***

Main tasks:

1. definition of the **hydrological basins (‘impact areas’)** and the control sections where average precipitation, and runoff will be computed for verification;
2. definition of common needs of **hydrological modellers** and end users with respect to atmospheric model output (e.g., parameters, **meteorological warning thresholds**,..);
3. Collect **feedback from** end users who had access to a **Visualisation Platform**
4. definition of common format of hydrologic model output and **runoff warning levels thresholds**

Impact areas (hydrological basins) in the Alps



Meteorological thresholds over > 100 of target and impact areas for duration of 3, 6, 12, 24, 48, 72 h

1. **Attention level (yellow): annual maxima corresponding to mean of annual maxima m- 2St.dev. From theoretical considerations of Poisson occurrence of events with exponential probability distribution function this corresponds to about 7 events/year of the daily precipitation statistics.**

2. **Alert level (orange): return period of 1.15 years in the tables corresponding to mean of annual maxima m-St.dev corresponding to about 2 events/year of the daily precipitation statistics.**

3. **Alarm level (red): return period of 10 years.**

The ‘engineering’ solution for the threshold task:

From Frei 2006 0.25° gridded daily precipitation,

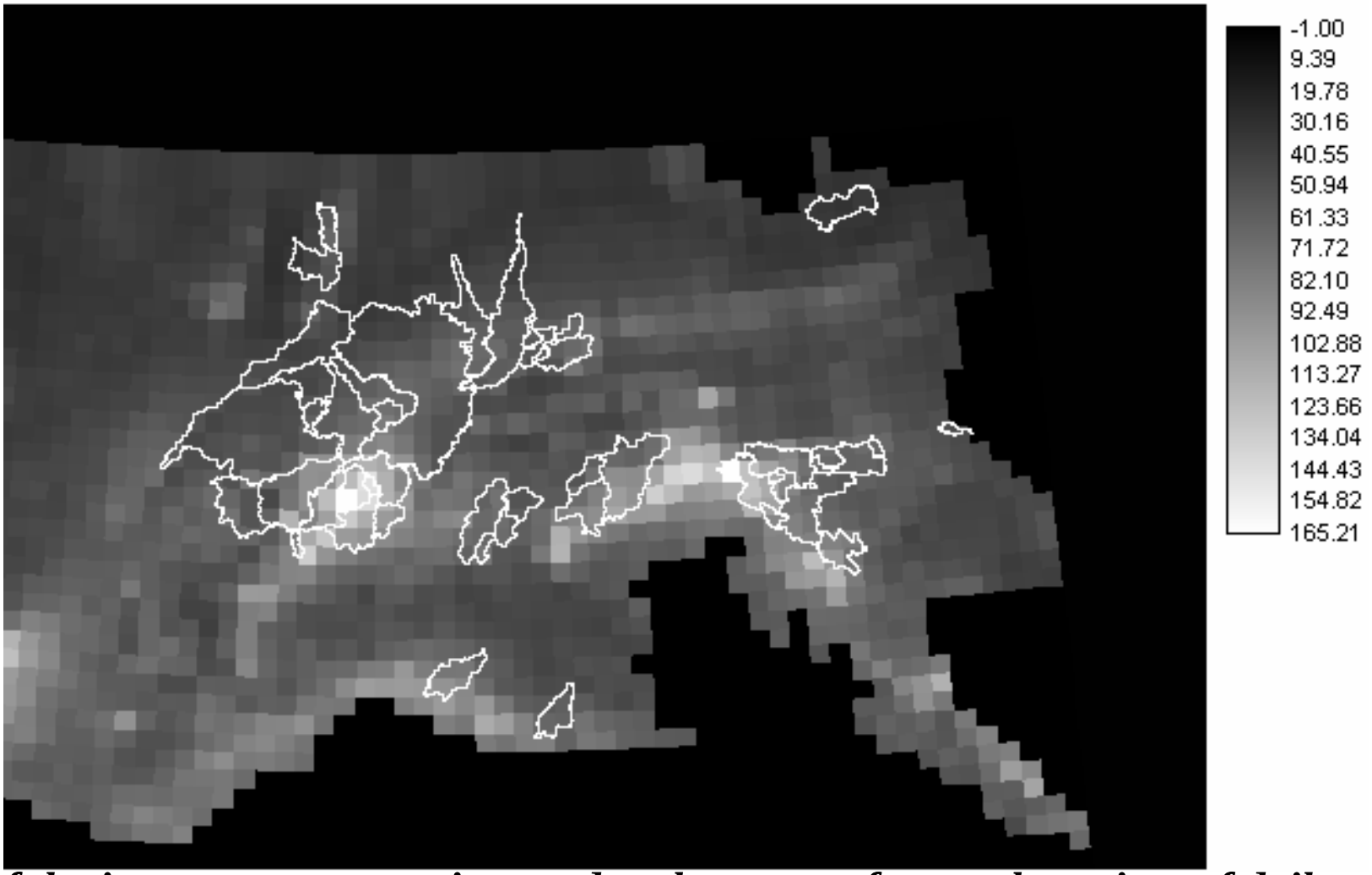
- statistics of gridded annual maxima were computed,
- Extreme Value of the 1st type Cumulative Distribution Function
- and scaling of rainfall depth *h* with duration *d* was assumed $h=ad^n$ with exponent *n* increasing with altitude (after literature)
- Areal Reduction Factor scaling with area and duration

Ticino	m-2s 7/ yr	m-s 2/yrs	T=10 Years
03h	20	29	59
06h	28	41	83
12h	40	58	117
24h	56	82	165
48h	79	115	233
72h	97	141	284

Toce	m-2s 7 / yr	m-s 2/yrs	T=10 Years
03h	16.6	27	62
06h	23	38	87
12h	33	54	123
24h	46	76	173
48h	65	106	243
72h	79	130	297

Hydrological Impact areas

Mean of annual maxima of daily precipitation



Map of the impact areas superimposed to the mean of annual maxima of daily precipitation, computed after the Frei, 2006 climatology. Notice: impact areas are nested into larger basins and are not visible.

Questionnaires feedback

METEO (+hydro + users):

1. ARPA-FVG OSMER Friuli
2. ARPA-Valle d'Aosta
3. Meteotrentino
4. *ARPA-ER***
5. *CNR.ISAC***
6. ARPA-Liguria**
7. APAT**

***run meteo models*

HYDRO-Forecasters in real-time

1. *University of Brescia*
2. *ARPA Lombardia*
3. *Politecnico di Milano and Arpa Piemonte*
4. *WSL, IACETH (CH)*
5. IMK-IFU Karlsruhe (D)
6. Wasserwirtschaftsamt Kempten (D)

HYDROLOGY- ORIENTED END USERS:

1. **ENEL – Mestre (I)**
2. **Consorzio dell'Oglio Water Authority (I)**
3. ***ARPA Lombardia, (I)***
4. SOI-Ufficio Dighe–PAT–Trento (I)
5. Protezione Civile Regionale- FVG (I)
6. *ARPA Piemonte (I)*
7. *Several in Switzerland*
8. *WWA (D)*
9. Env. Agency of Slovenja (SLO)
10. Meteo-Hydro Service (HR)

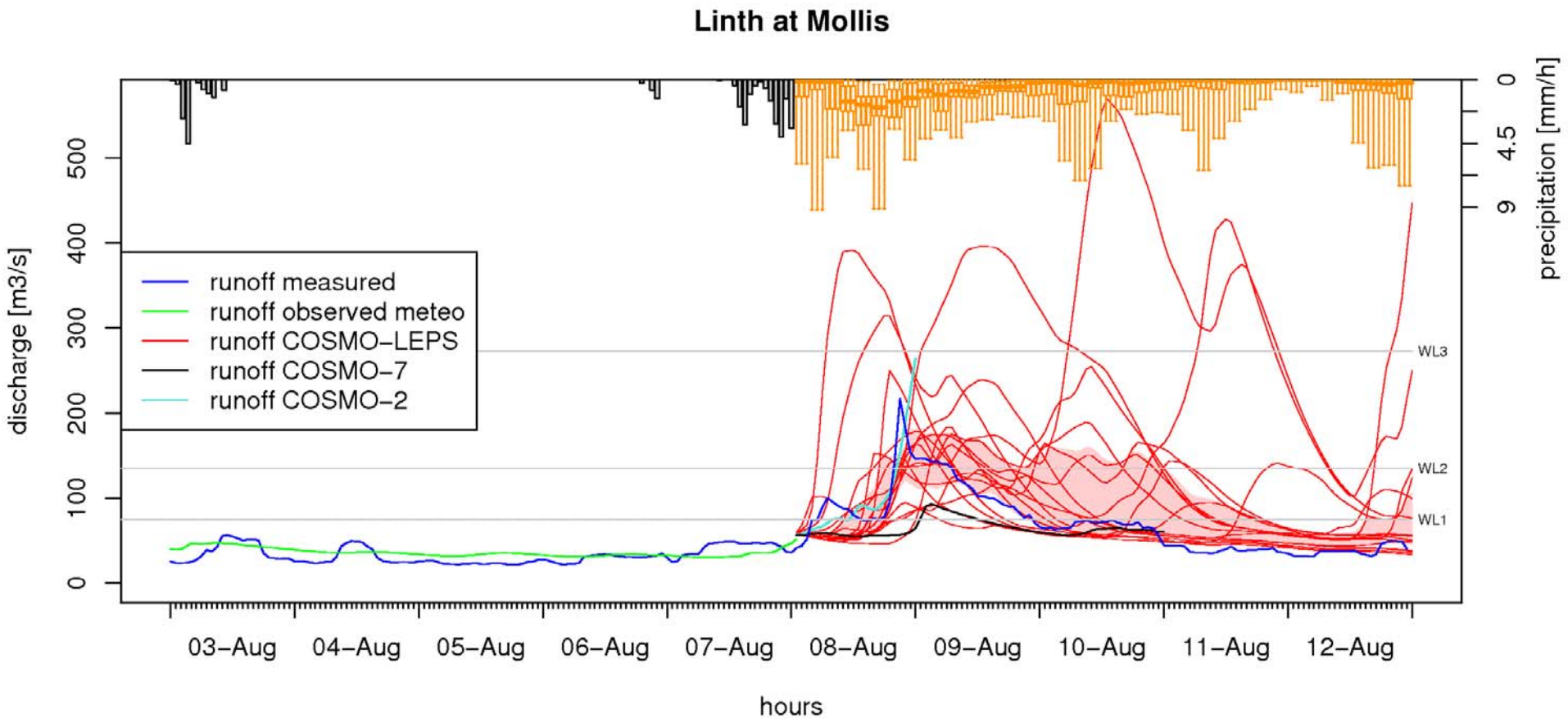
Real-time modelling chains

(Italian Alps)

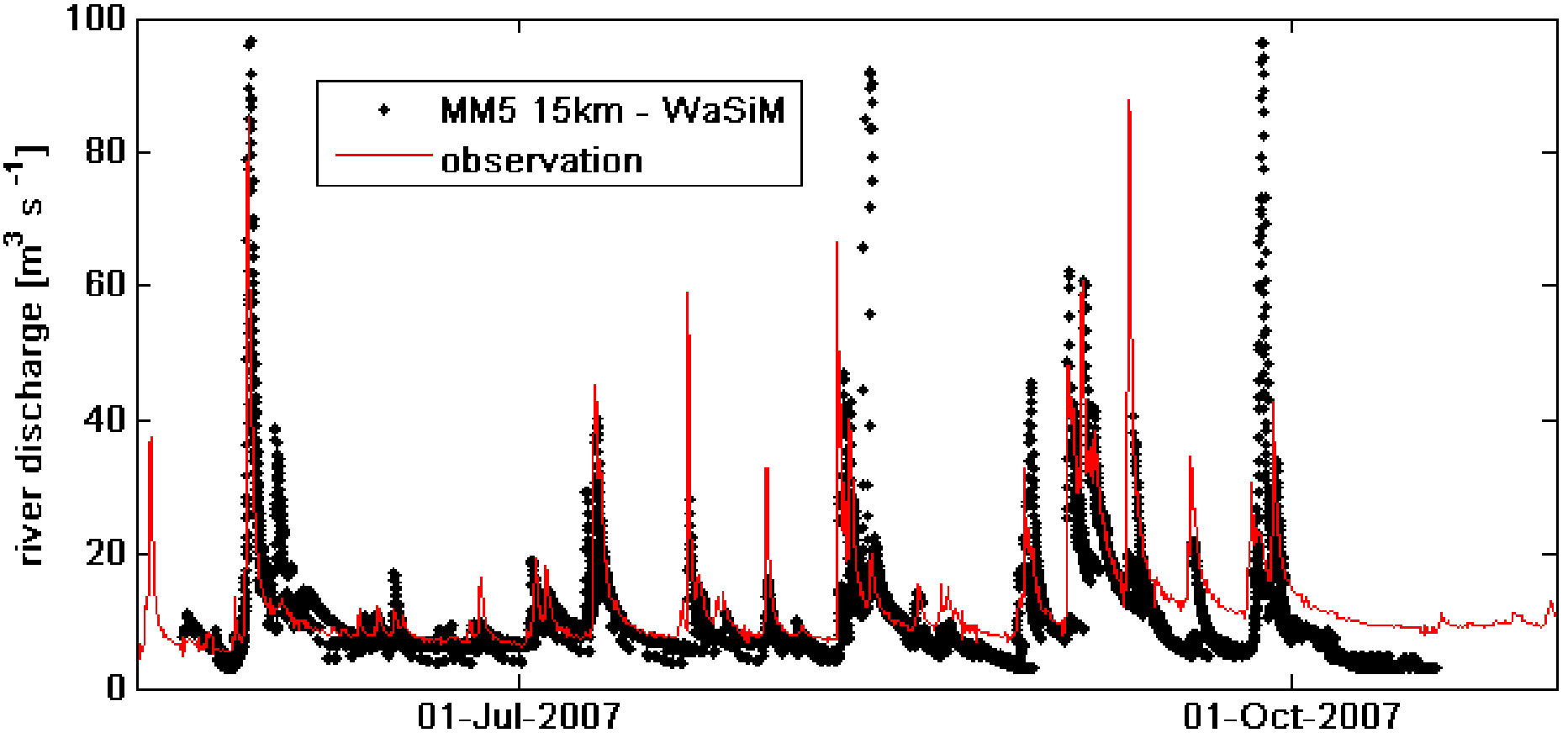
Hydrological models forced by ensemble (E) and deterministic (D) high resolution meteorological models

	Meteorological model						
Hydrological Model	CLEPS (E)	ISACMOL (D)	ISACMOL2 (D)	COSMOCH2 (D)	COSMOCH7 (D)	LAMI28 (D)	ARPALMOL (D)
DIMOSOP	•	•	•				
LAMBRO	•	•				•	•
FEST	•	•					
PREVAH	•		•	•	•		

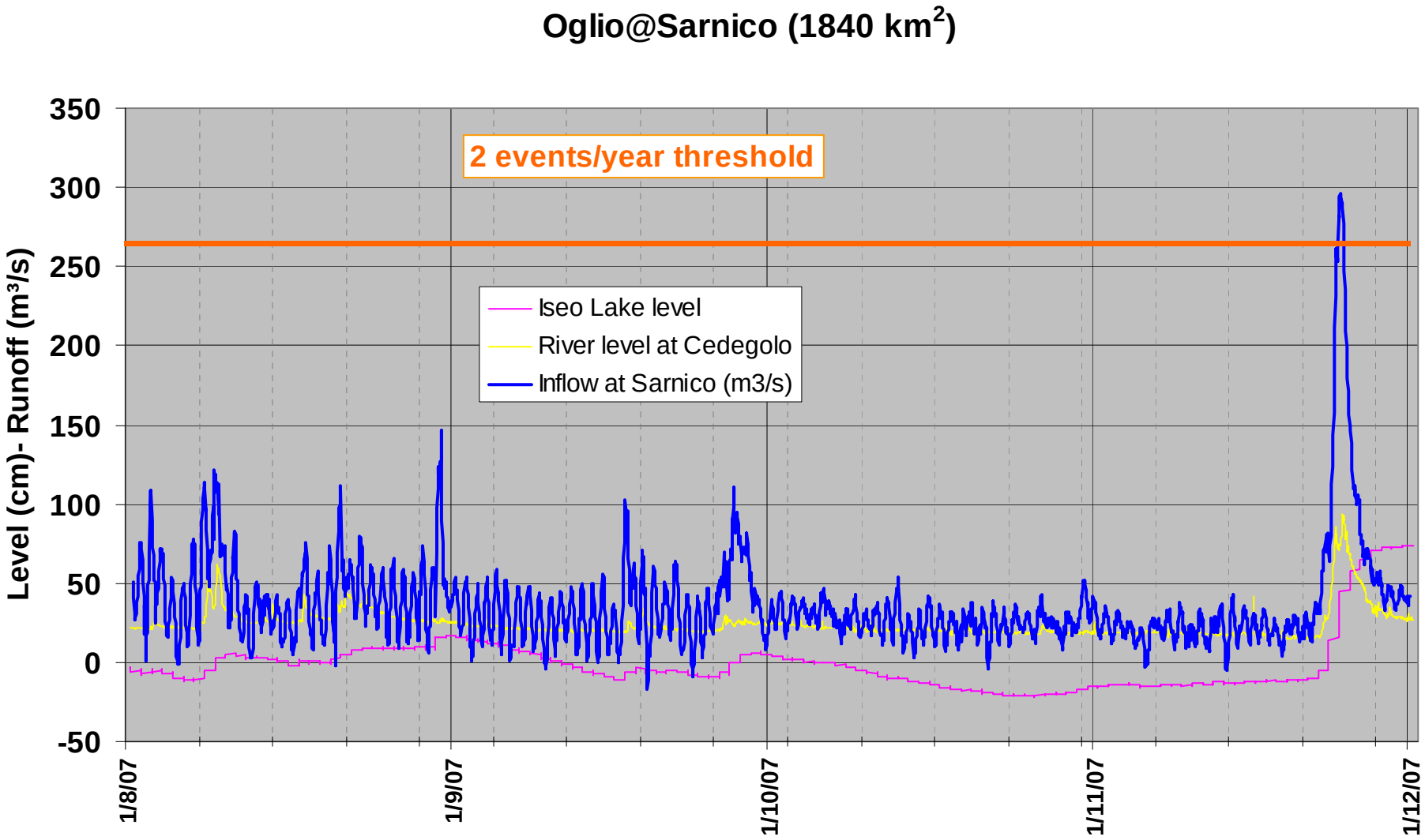
In Switzerland
COSMO 2km & LEPS (Meteo)
and Radar Ensemble (Germann et al. 2008)
+PREVAH (Hydro)



In the Bavarian Alps
MM5 15 km + WaSim
for Ammer watershed (710 km2)



In the Italian Alps



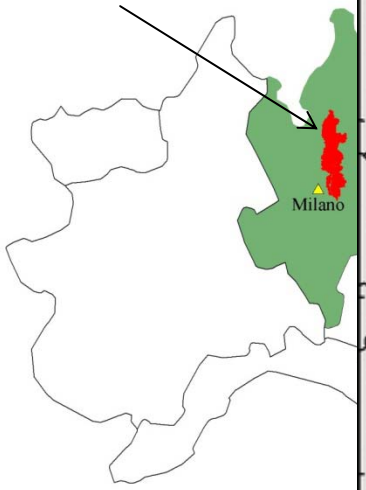
Agenzia Regionale
per la Protezione dell'Ambiente
della Lombardia

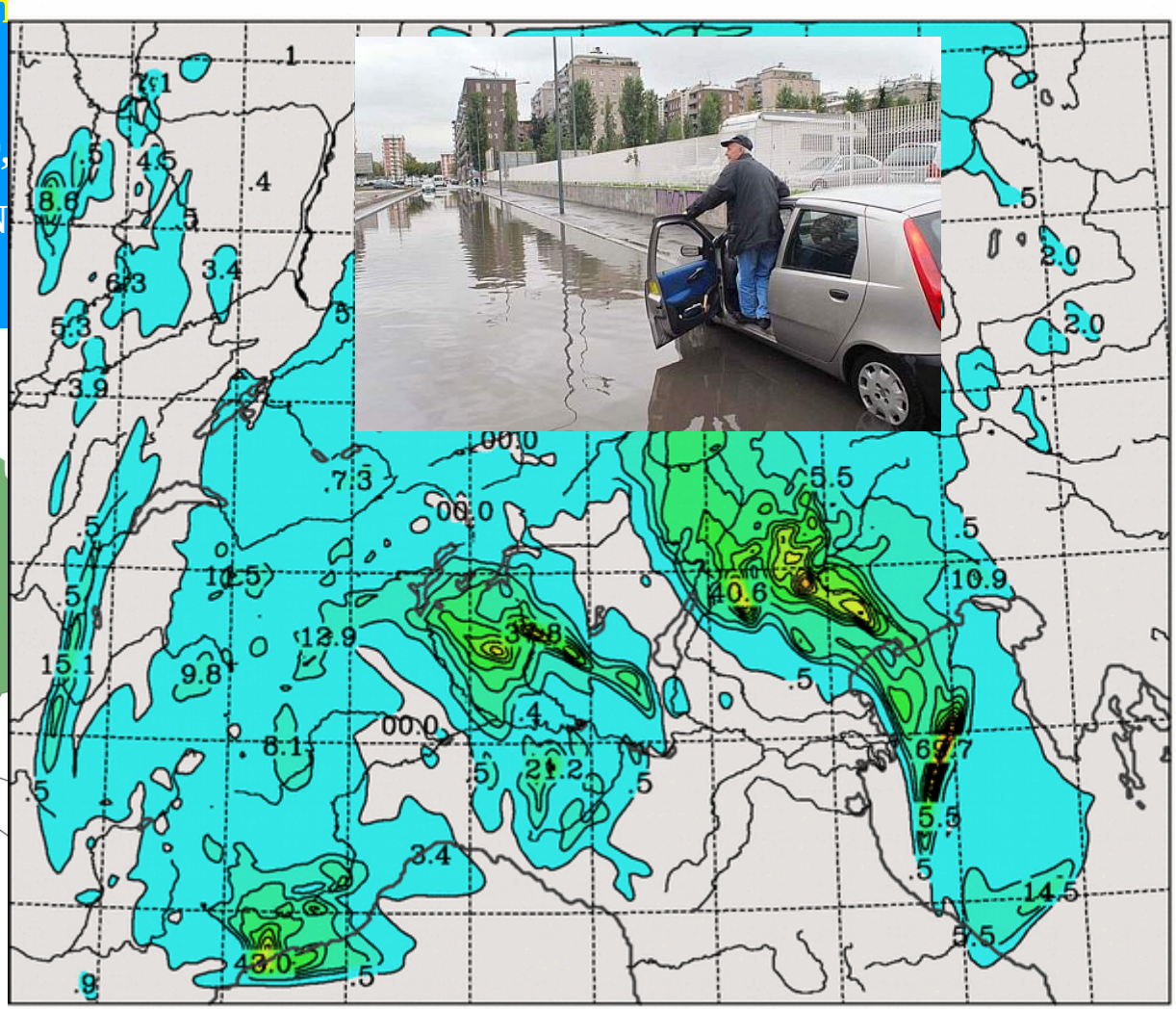
ARPA

ARPA Lombardia us
to perform real time h

- **CLEPS (ARPA Emr,**
- **LAMI28 (ARPA Emr,**
- **ISACMOL (ISAC CN**
- **ARPALMOL (ARPA**

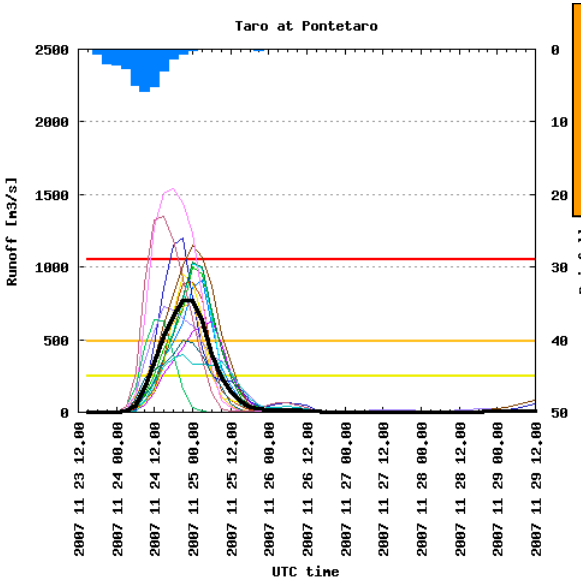
Lambro basin

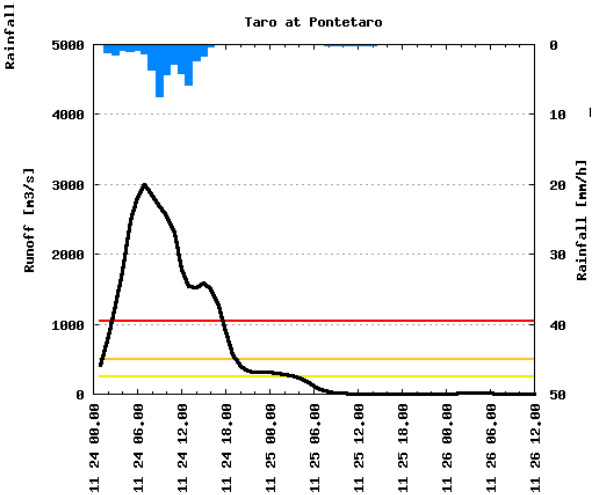


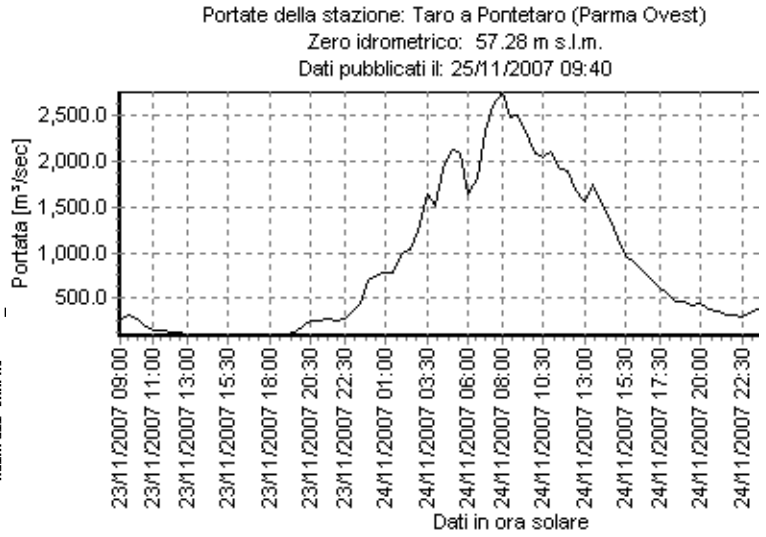


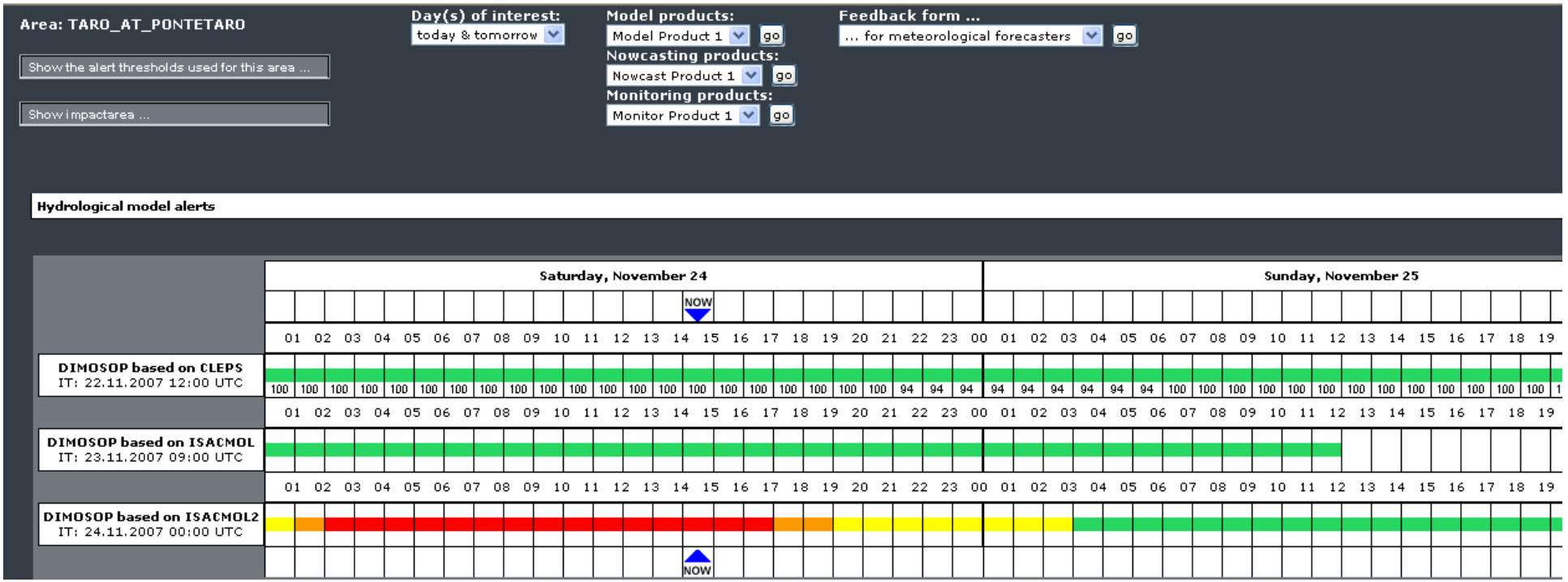
TARO T>10 yrs

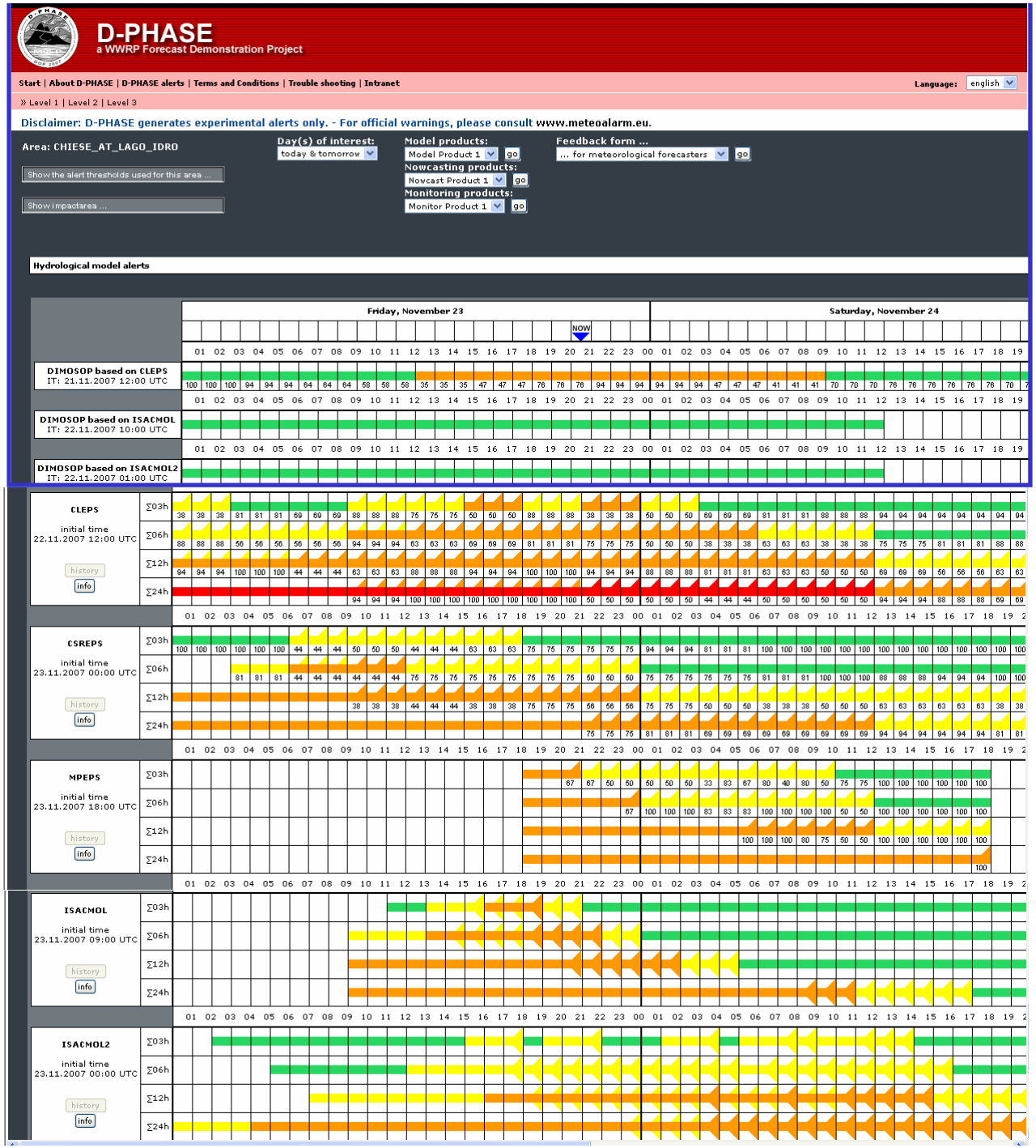
G. Grossi, UNIBS





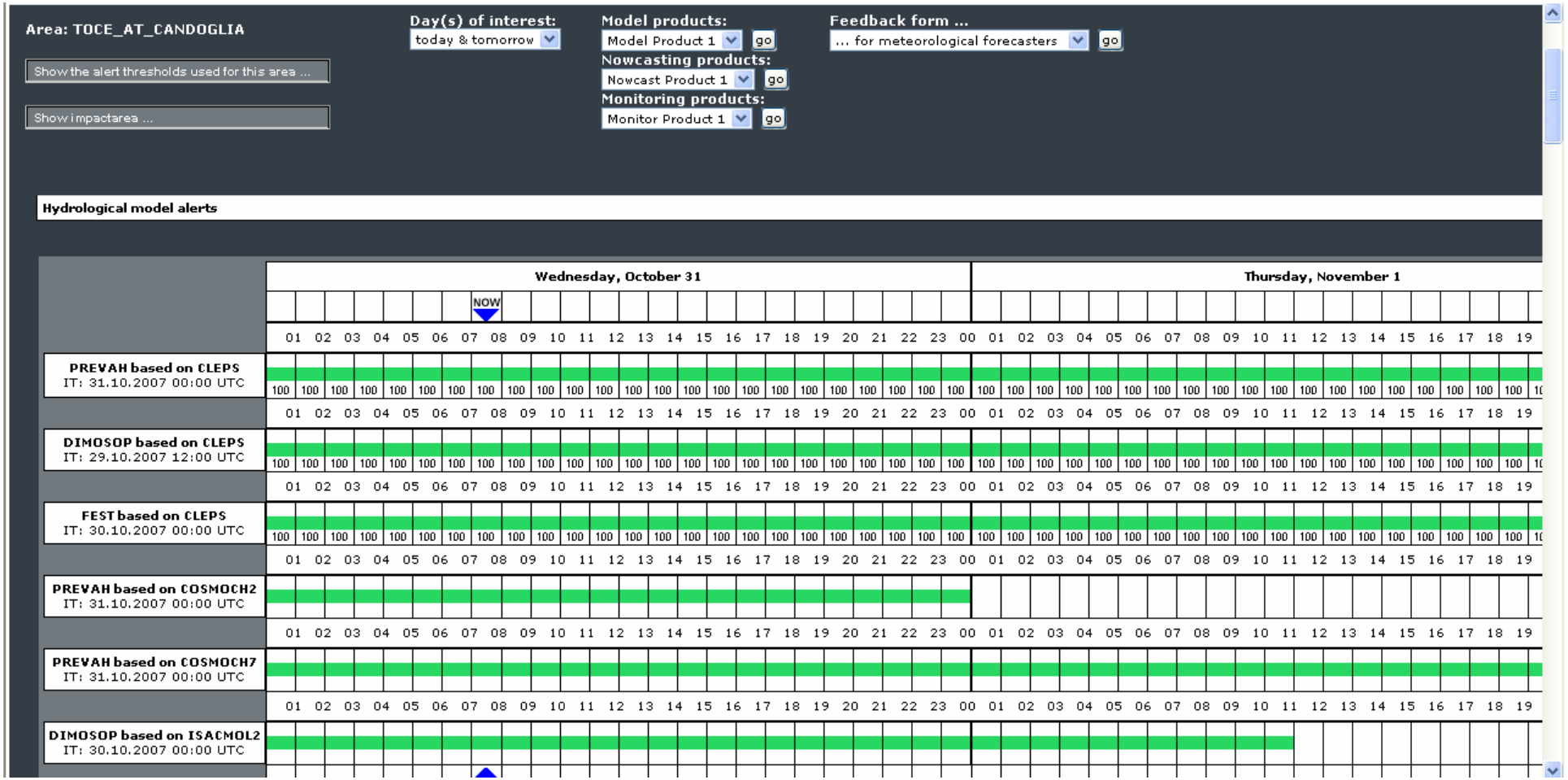




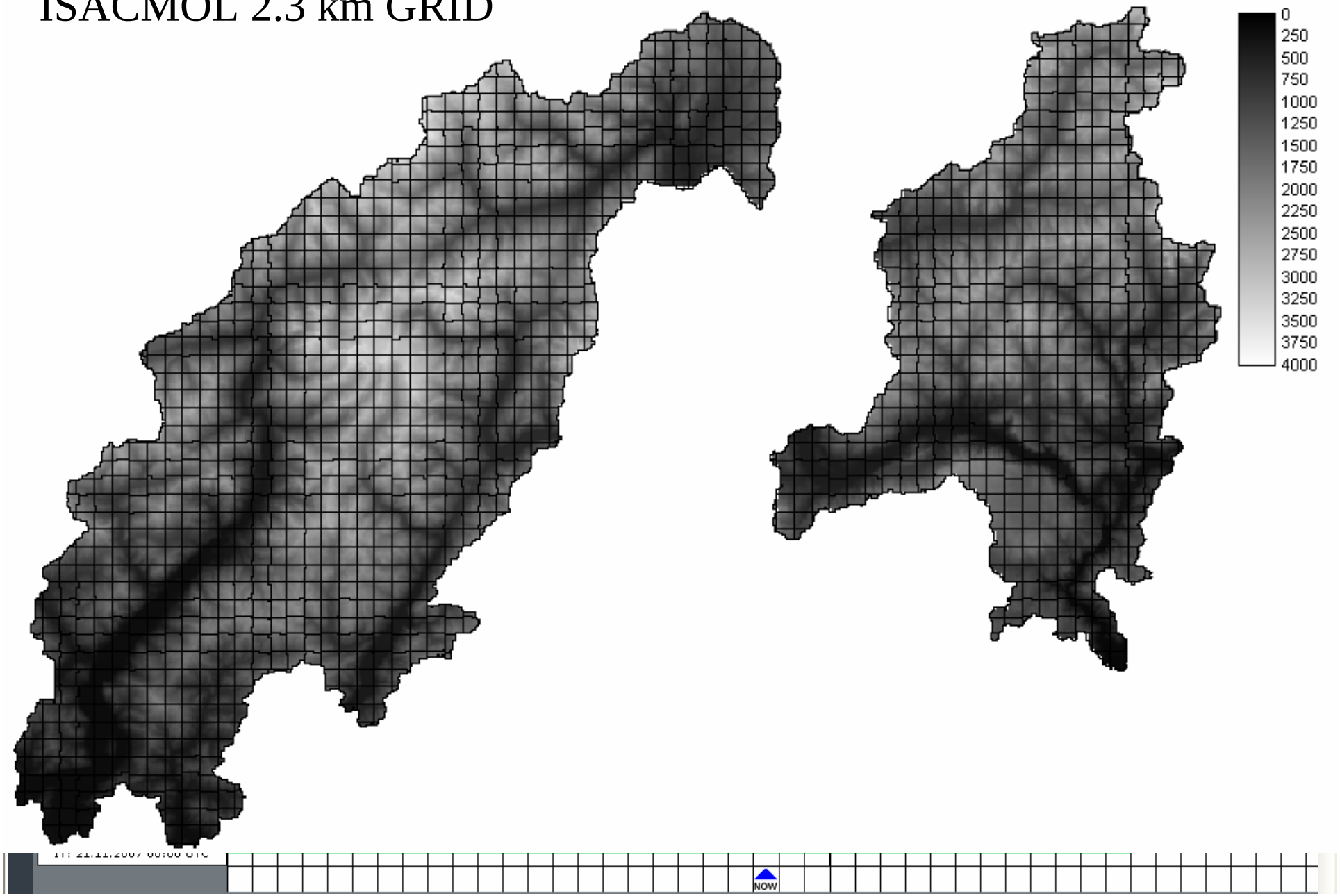

D-PHASE
a WWRP Forecast Demonstration Project
Start | About D-PHASE | D-PHASE alerts | Terms and Conditions | Trouble shooting | Intranet
Language: english
» Level 1 | Level 2 | Level 3
Disclaimer: D-PHASE generates experimental alerts only. - For official warnings, please consult www.meteoalarm.eu.
Area: CHIESE_AT_LAGO_IDRO
Show the alert thresholds used for this area ...
Show impactarea ...
Day(s) of interest:
today & tomorrow
Model products:
Model Product 1
go
Nowcasting products:
Nowcast Product 1
go
Monitoring products:
Monitor Product 1
go
Feedback form ...
... for meteorological forecasters
go
Hydrological model alerts
Friday, November 23
Saturday, November 24
NOW
DIMOSOP based on CLEPS
IT: 21.11.2007 12:00 UTC
DIMOSOP based on ISACMOL
IT: 22.11.2007 10:00 UTC
DIMOSOP based on ISACMOL2
IT: 22.11.2007 01:00 UTC
CLEPS
initial time
22.11.2007 12:00 UTC
history
info
CSREPS
initial time
23.11.2007 00:00 UTC
history
info
MPEPS
initial time
23.11.2007 18:00 UTC
history
info
ISACMOL
initial time
23.11.2007 09:00 UTC
history
info
ISACMOL2
initial time
23.11.2007 00:00 UTC
history
info
Σ03h
Σ06h
Σ12h
Σ24h

Starting with the end of October it was possible to compare in real-time the results of up to 7 meteo-hydrological forecasting chains (3 Ensemble+ 4 Detetministic) for the Toce at Candoglia.

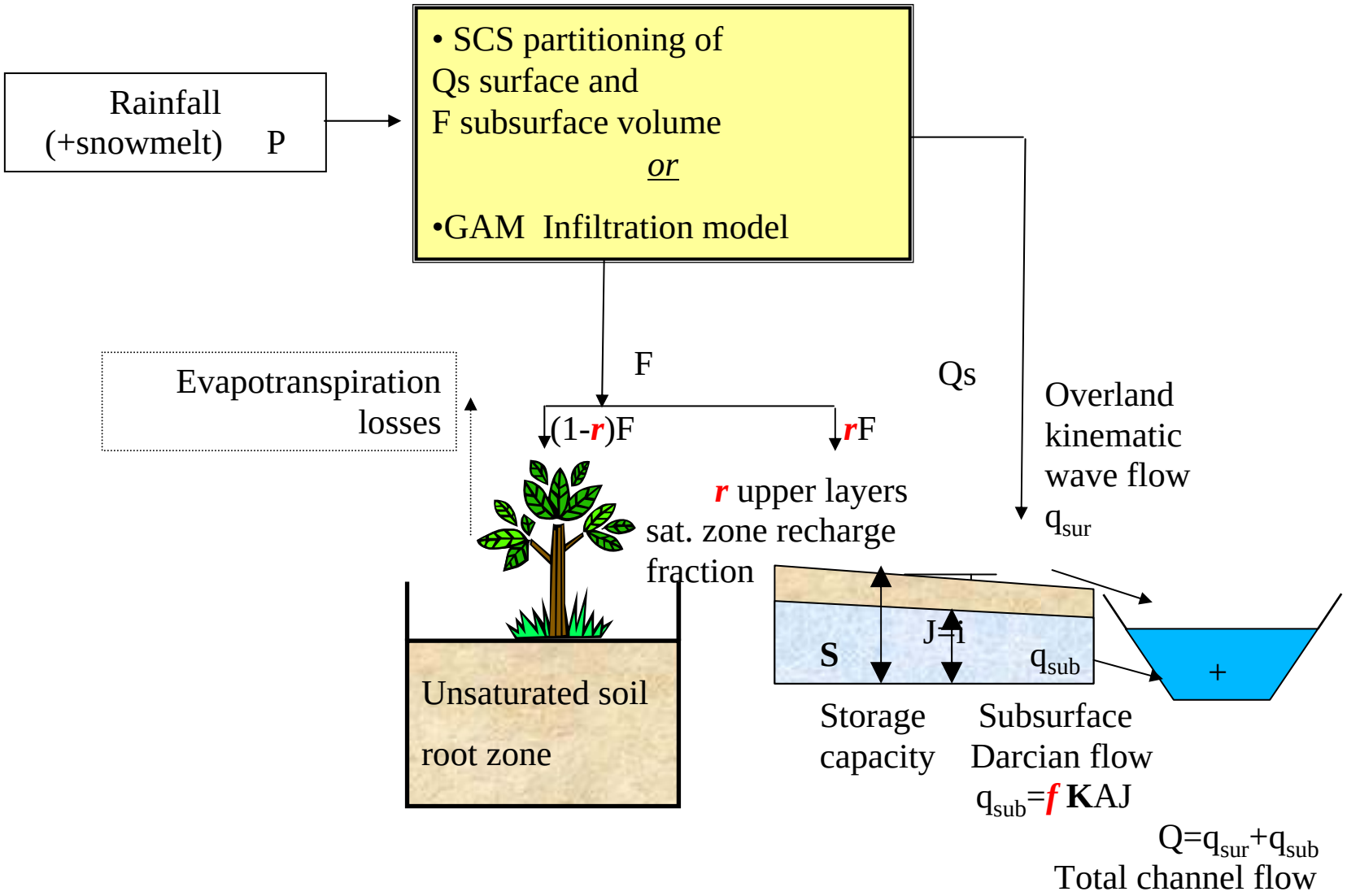
(Map case study e.g. Bontron, Djerboua, & Obled, LHB, 2002.



ISACMOL 2.3 km GRID

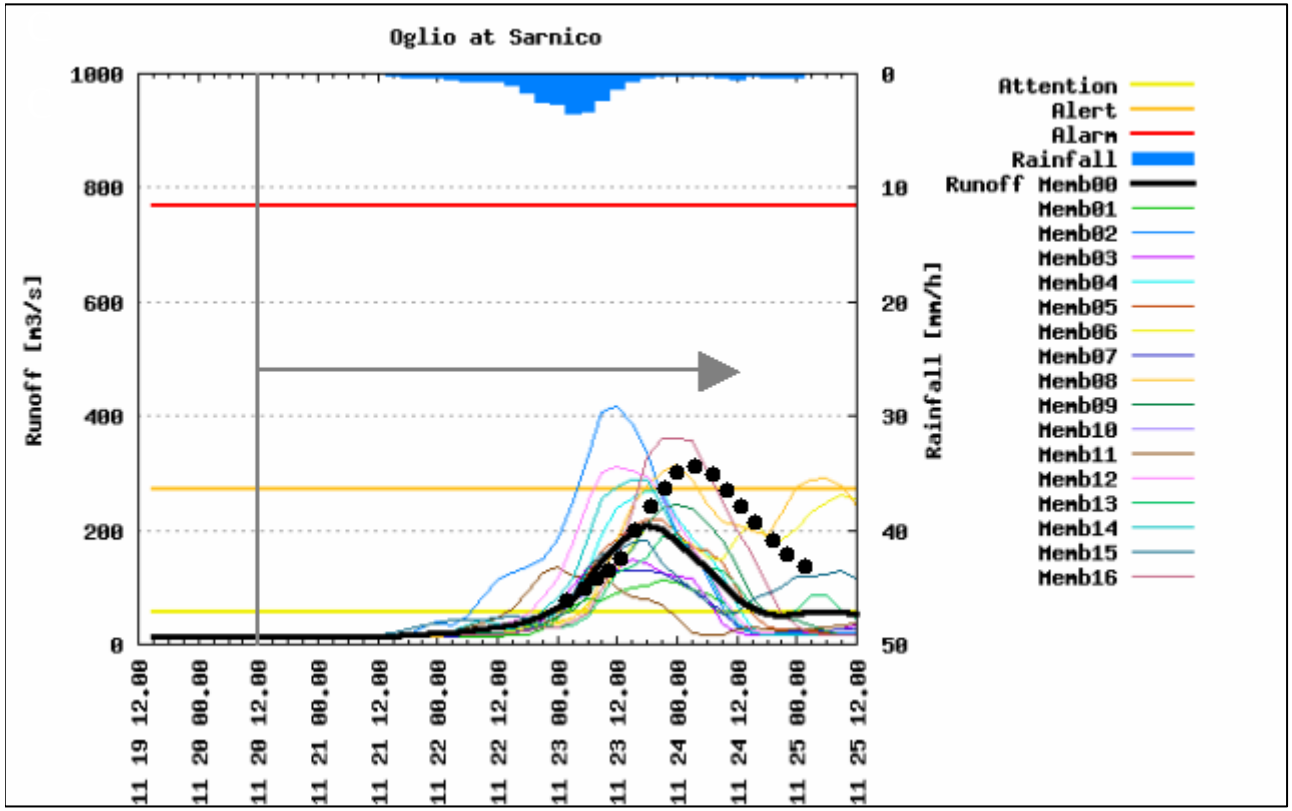


Model scheme



Calibration of ***r***-recharge and ***f***-transmissivity parameters

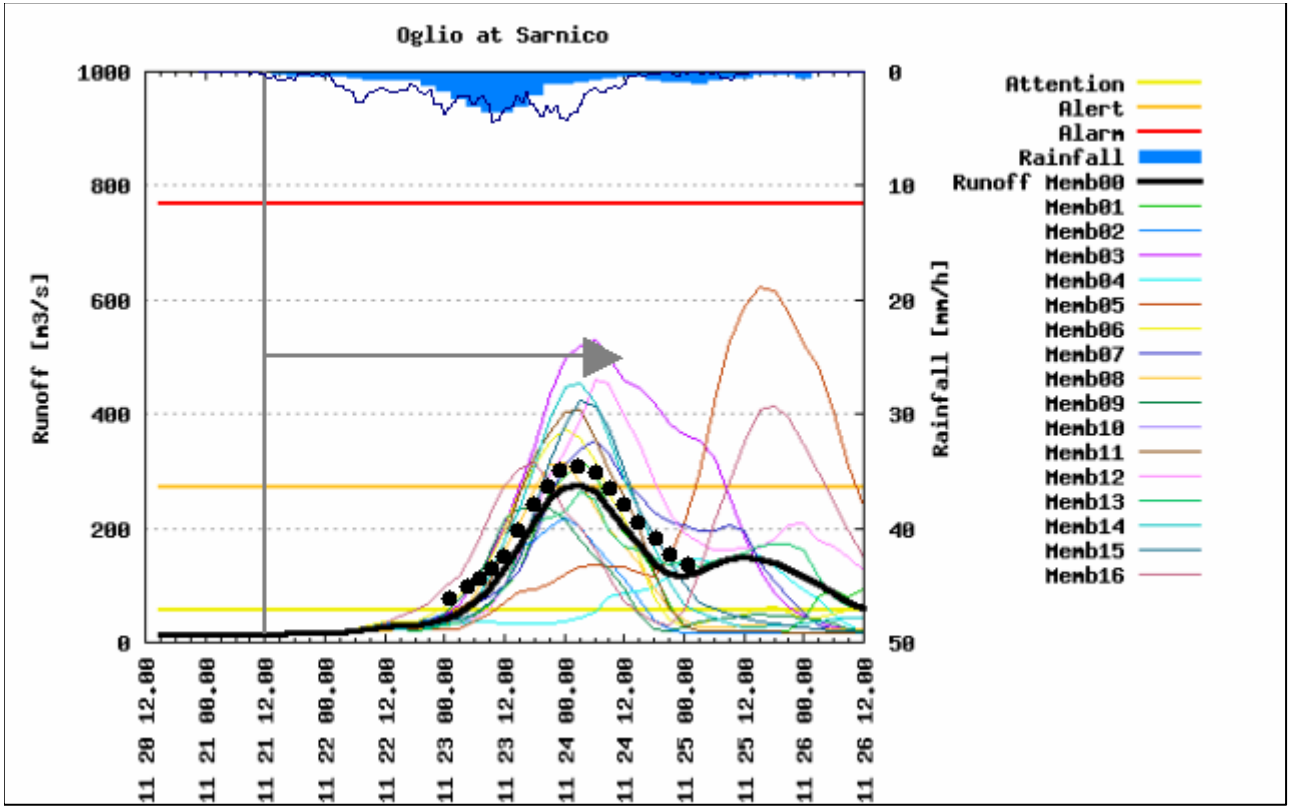
End user feedback (interview to M.Buizza, Consorzio dell'Oglio dam Authority on the basis of the feedback form)



	Marks	Relevance for decisions
CLEPS	4	4
ISACMOL	3	3
DIMOSOP	4	4

1=bad,…,6 excellent

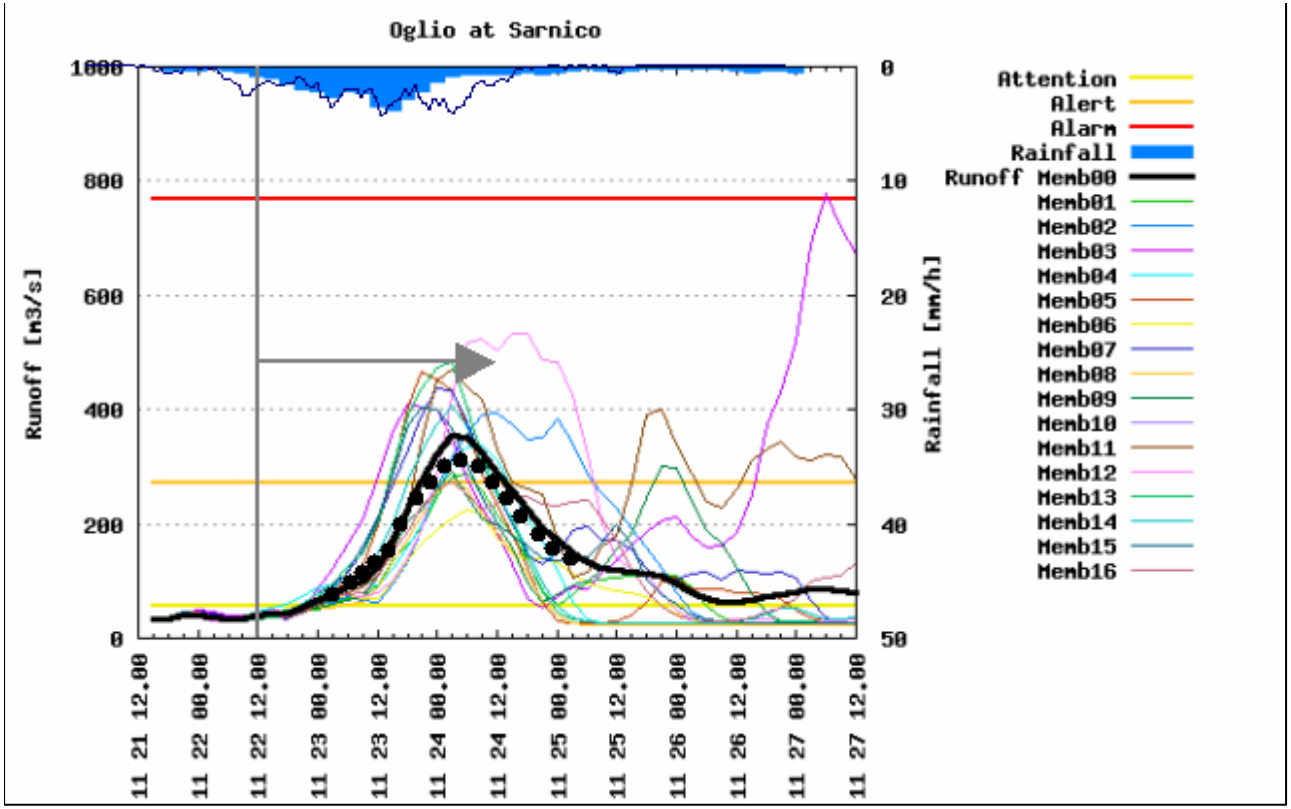
	NWP	HYDROL	NOWCAST	OBSERVATIONS
NO REACTION	X	X	☐	X
CONTACTS WITH HYDROLOGIST	☐	☐	☐	☐
INTERNAL EVALUATION	☐	☐	☐	☐
PERSONNELL ALERTED	☐	☐	☐	☐
ALARM	☐	☐	☐	☐



	Marks	Relevance for decisions
CLEPS	3	3
ISACMOL	2	2
DIMOSOP	4	4

1=bad,…,6 excellent

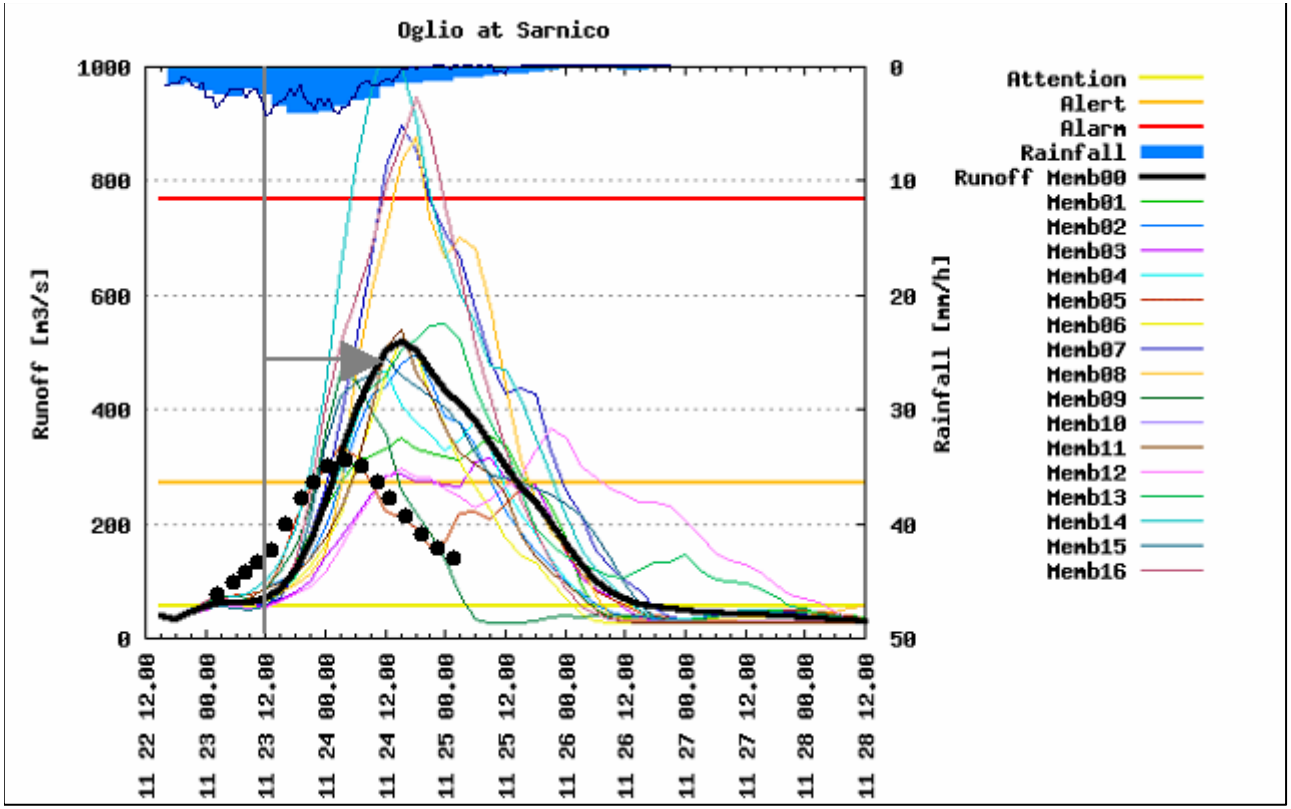
	NWP	HYDROL	NOWCAST	OBSERVATIONS
NO REACTION	X	X	☐	X
CONTACTS WITH HYDROLOGIST	☐	☐	☐	☐
INTERNAL EVALUATION	☐	☐	☐	☐
PERSONNELL ALERTED	☐	☐	☐	☐
ALARM	☐	☐	☐	☐



	Marks	Relevance for decisions
CLEPS	4	4
ISACMOL	3	3
DIMOSOP	4	4

1=bad,…,6 excellent

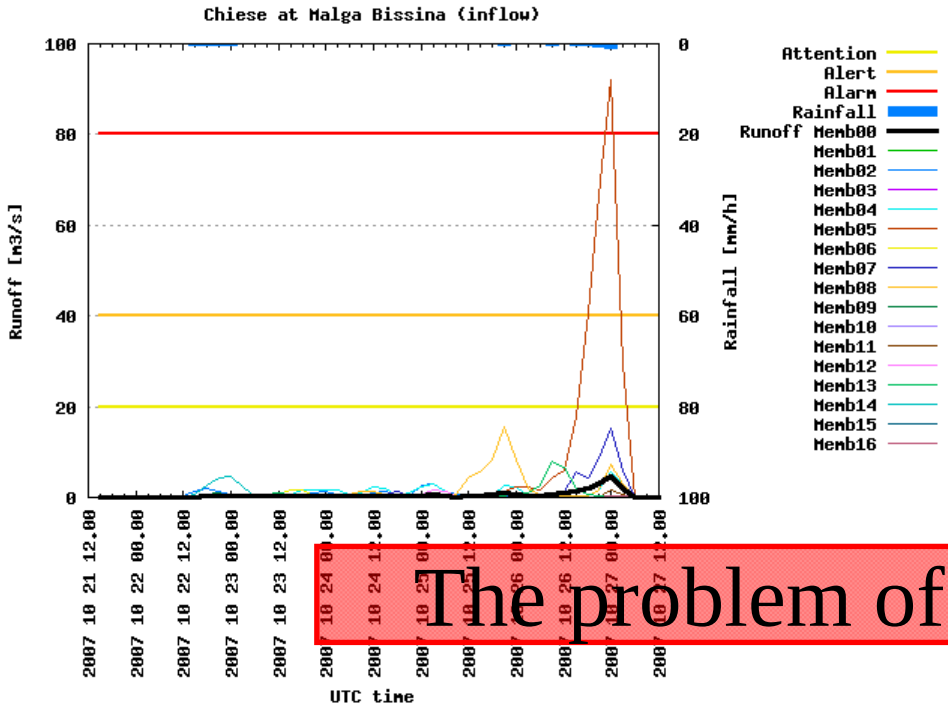
	NWP	HYDROL	NOWCAST	OBSERVATIONS
NO REACTION	☐	☐	☐	☐
CONTACTS WITH HYDROLOGIST	☐	☐	☐	☐
INTERNAL EVALUATION	**X**	**X**	☐	**X**
PERSONNELL ALERTED	☐	☐	☐	☐
ALARM	☐	☐	☐	☐

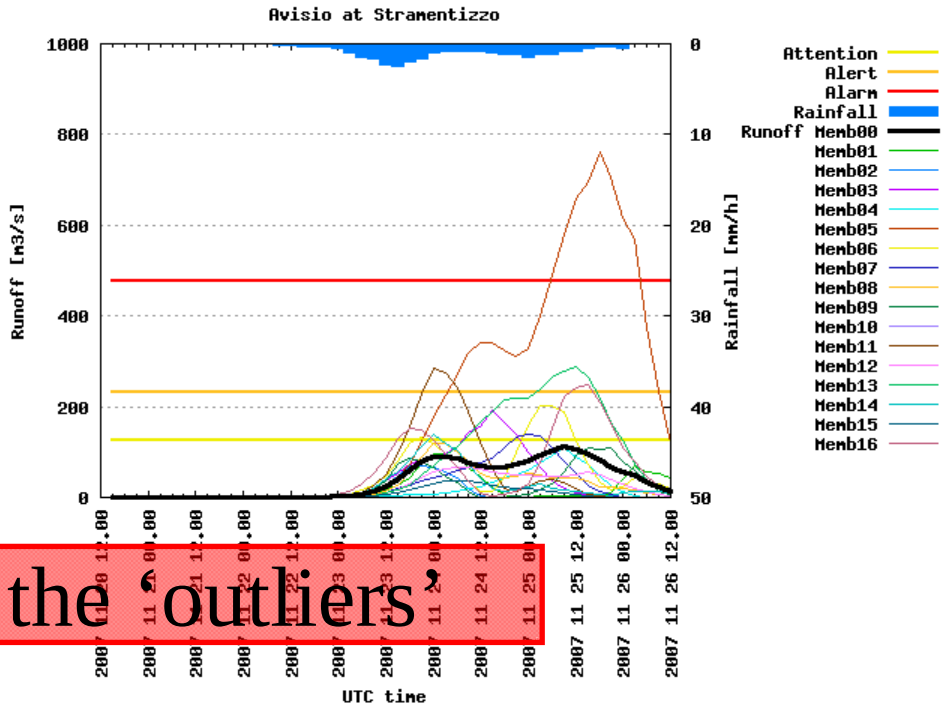


	Marks	Relevance for decisions
CLEPS	3	5
ISACMOL	2	3
DIMOSOP	3	5

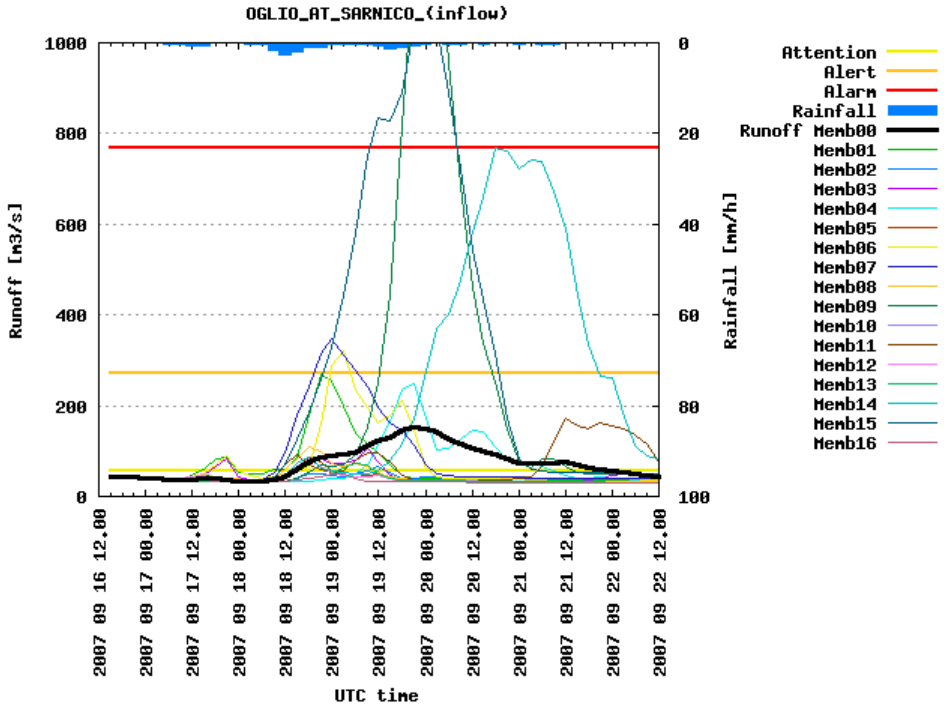
1=bad,…,6 excellent

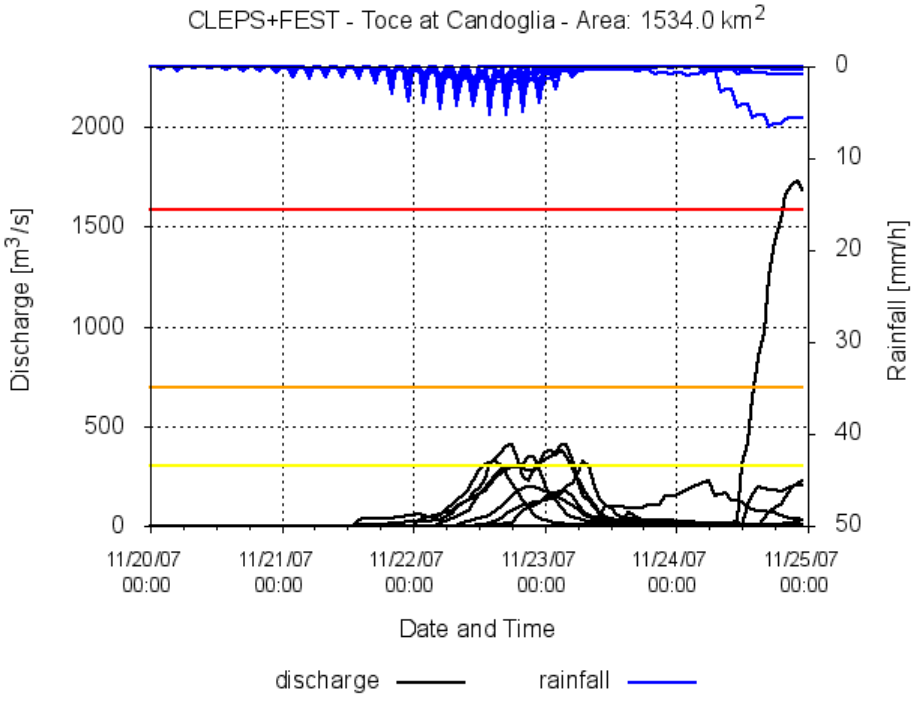
	NWP	HYDROL	NOWCAST	OBSERVATIONS
NO REACTION	☐	☐	☐	☐
CONTACTS WITH HYDROLOGIST	☐	☐	☐	☐
INTERNAL EVALUATION	**X**	☐	☐	☐
PERSONNELL ALERTED	☐	**X**	☐	**X**
ALARM	☐	☐	☐	☐





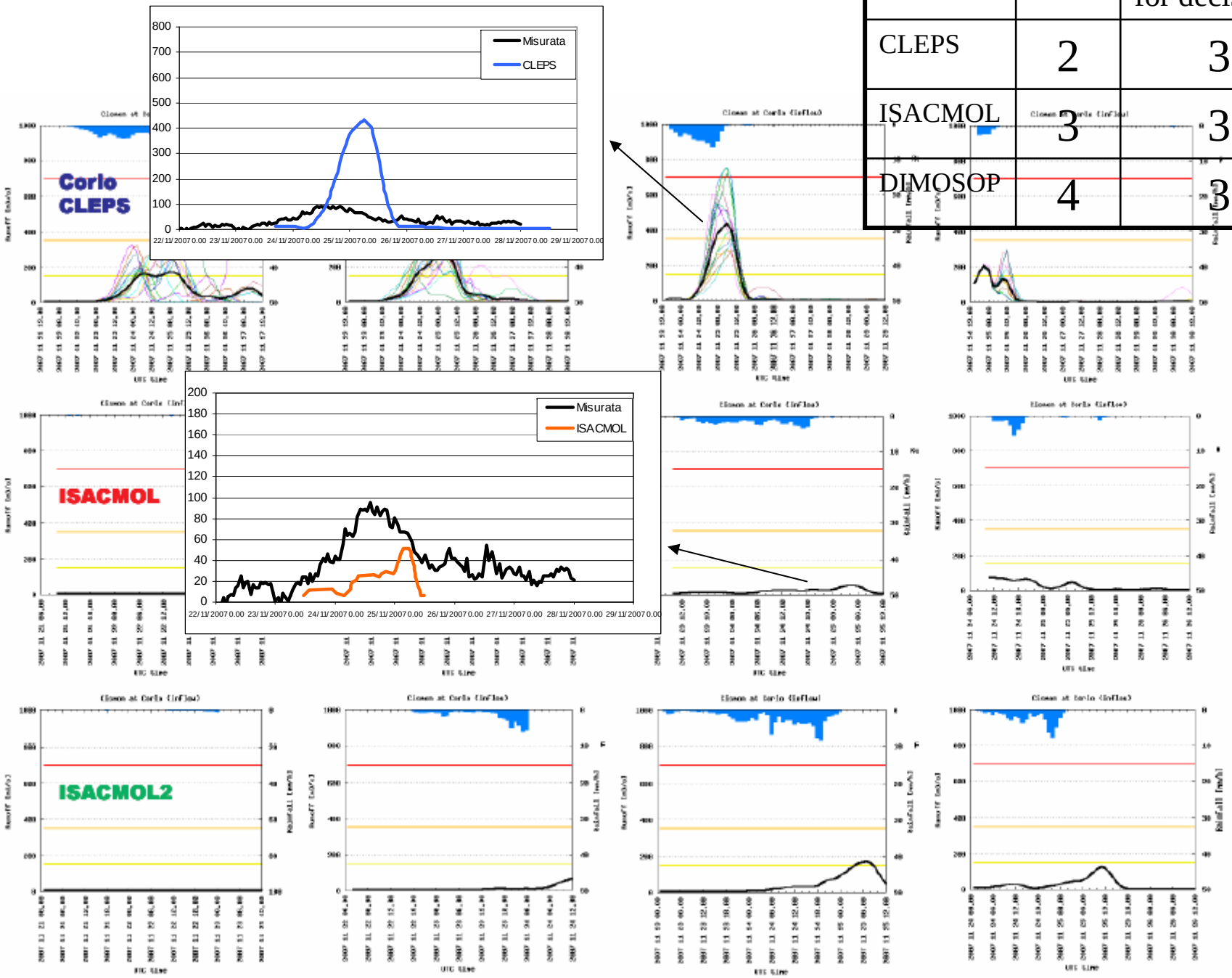
The problem of the ‘outliers’





Feedback from ENEL (Hydropower dams)

	Marks	Relevance for decisions
CLEPS	2	3
ISACMOL	3	3
DIMOSOP	4	3



Conclusions

- 16 modelling chains were in operation in the Alps in D-PHASE and up to 7 in parallel for Toce ☺
- CLEPS **better** than ISACMOL/2 for Chiese and Oglio (good results) but worse for small dam-gauged basins 😐
- Some CLEPS-**outliers** (or 'crazy members') also for dry events might alert a 'risk-adverse' end user. End user training and 'calibration' needed. 😐
- Experienced end users weight the importance of **forecasts vs. observations** for their decision. ☺
- Surface **raingauge and hydrometric real time observation** are of key importance for hydrological model updating and initialisation
- One **sure** hydrological **benefit** from D-PHASE: one discharge measurement done by ARPA Lombardia on the basis of the forecasts