Advances in Flood Forecasting and the Implications for Risk Management International Workshop
Alkmaar, The Netherlands 25-26 May 2010

THE COST731 ACTION- PROPAGATION OF UNCERTAINTY FROM METEOROLOGY INTO HYDROLOGICAL MODELS

Massimiliano Zappa, Andrea Rossa, Katharina Liechti, Michael Bruen, Urs Germann, Günther Haase, Christian Keil, Peter Krahe

& all the COST 731 contributors

Contacts:
Massimiliano Zappa
massimiliano.zappa@wsl.ch

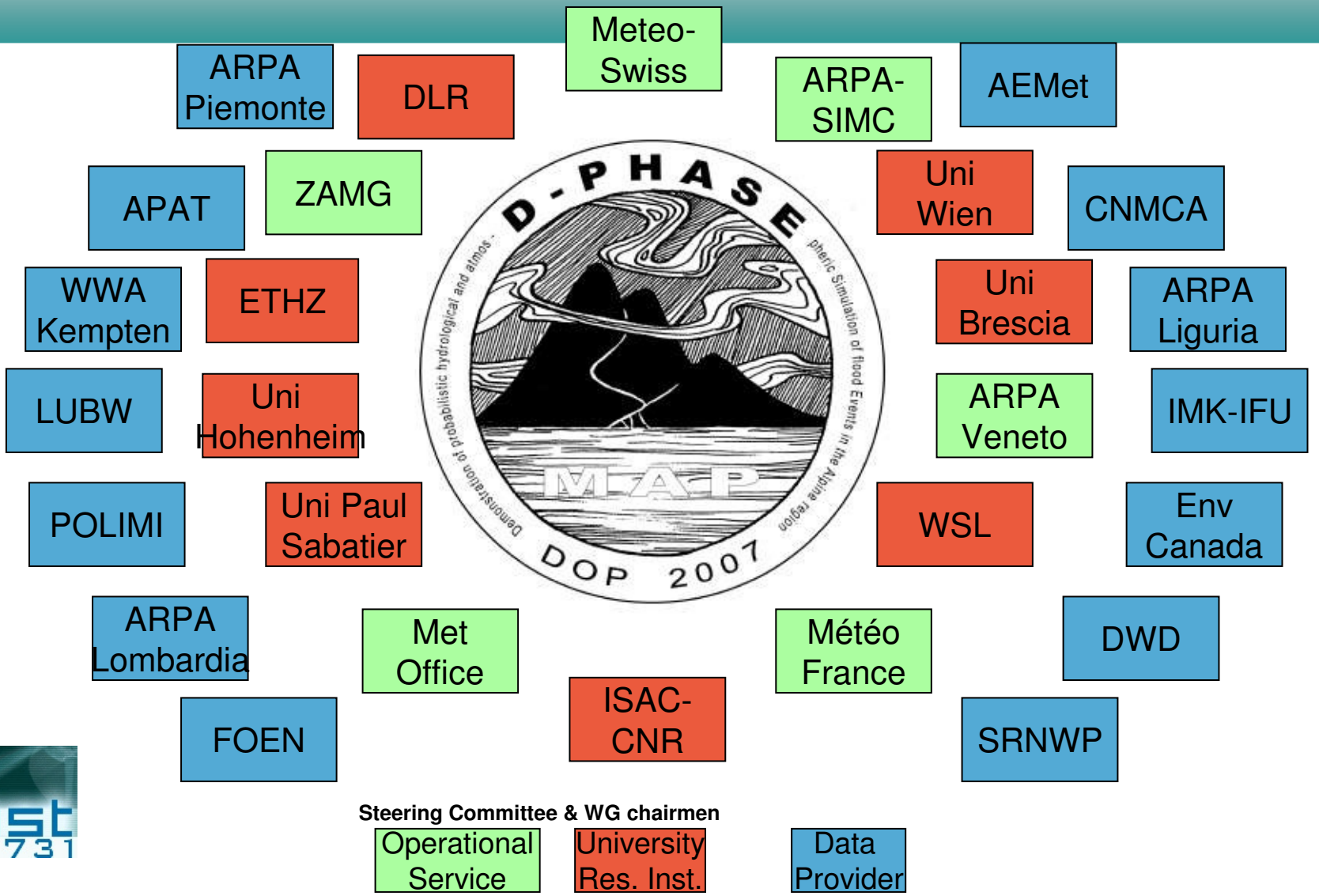
EU-Initiative for networking national efforts

Belgium, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland, United Kingdom

Australia

MAP D-PHASE and COST 731 - Common proof of concepts

-> Presentation of Walser et al.

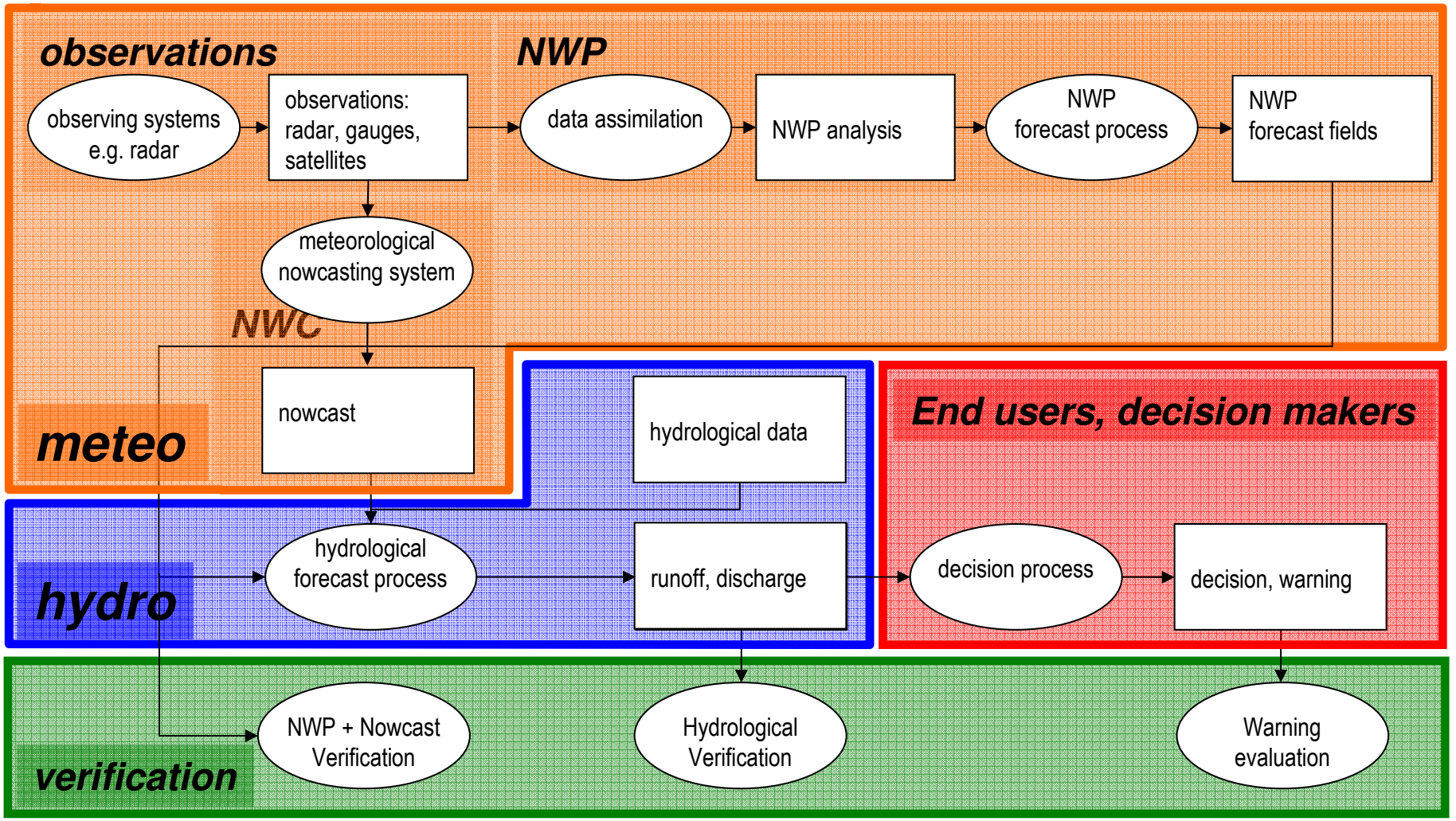


Rotach, M.W. et al., 2009. MAP D-PHASE: Real-time Demonstration of Weather Forecast Quality in the Alpine Region. *Bulletin of the American Meteorological Society*, doi: 10.1175/2009BAMS2776.1

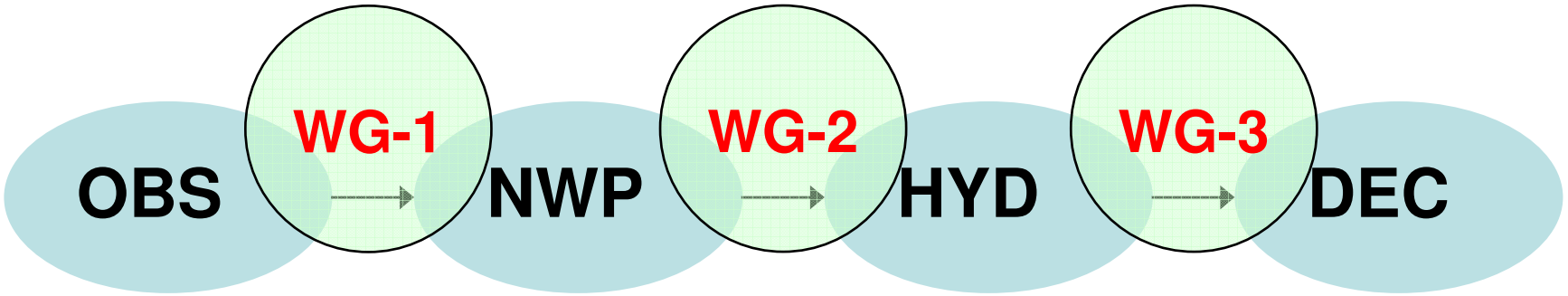
COST 731: outstanding questions

- how to further enhance interaction between hydrology and NWP
- aspects of radarQPE assimilation techniques (COST 717)
- characterization of quality/uncertainty of unconventional observations
- propagation of observation uncertainty in hydrological and NWP models
- How to communicate and use uncertainty measures in decision making

END-TO-END Flood forecasting chain



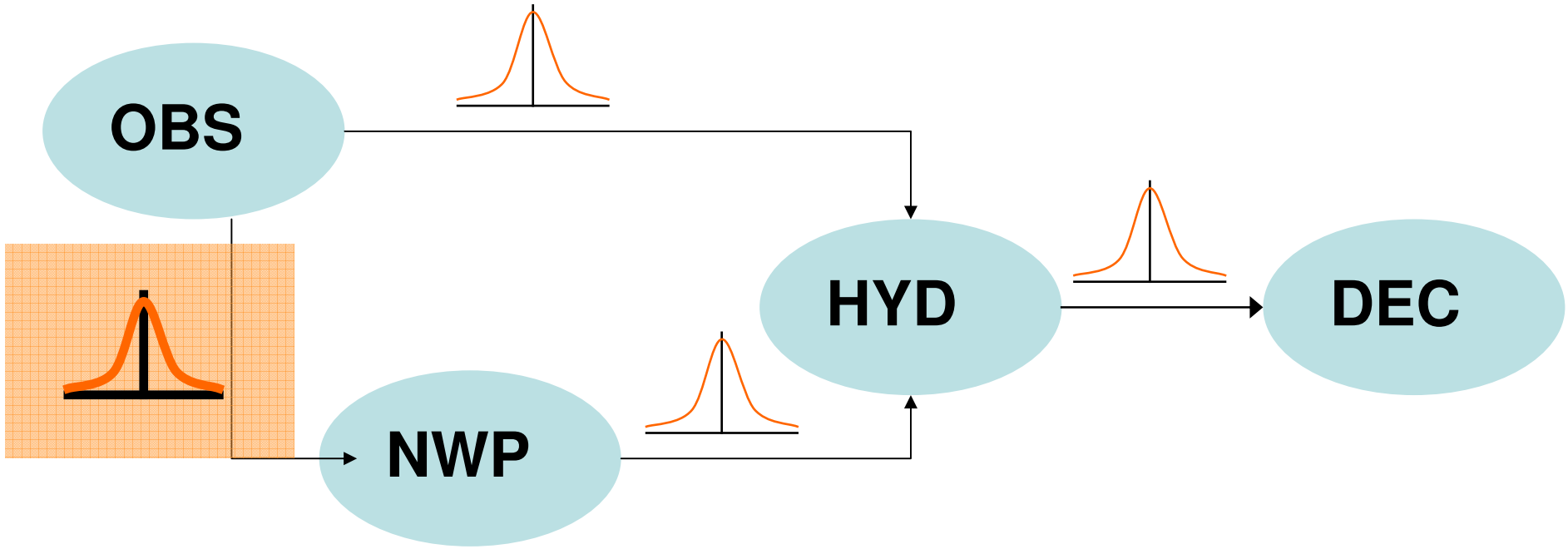
COST 731 WG Structure: community interaction



- WG-1: Propagation of uncertainty from observing systems (radars) into NWP
- WG-2: Propagation of uncertainty from observing systems and NWP into hydrological models
- WG-3: Use of uncertainty in warnings and decision making

WORKING-GROUP 1

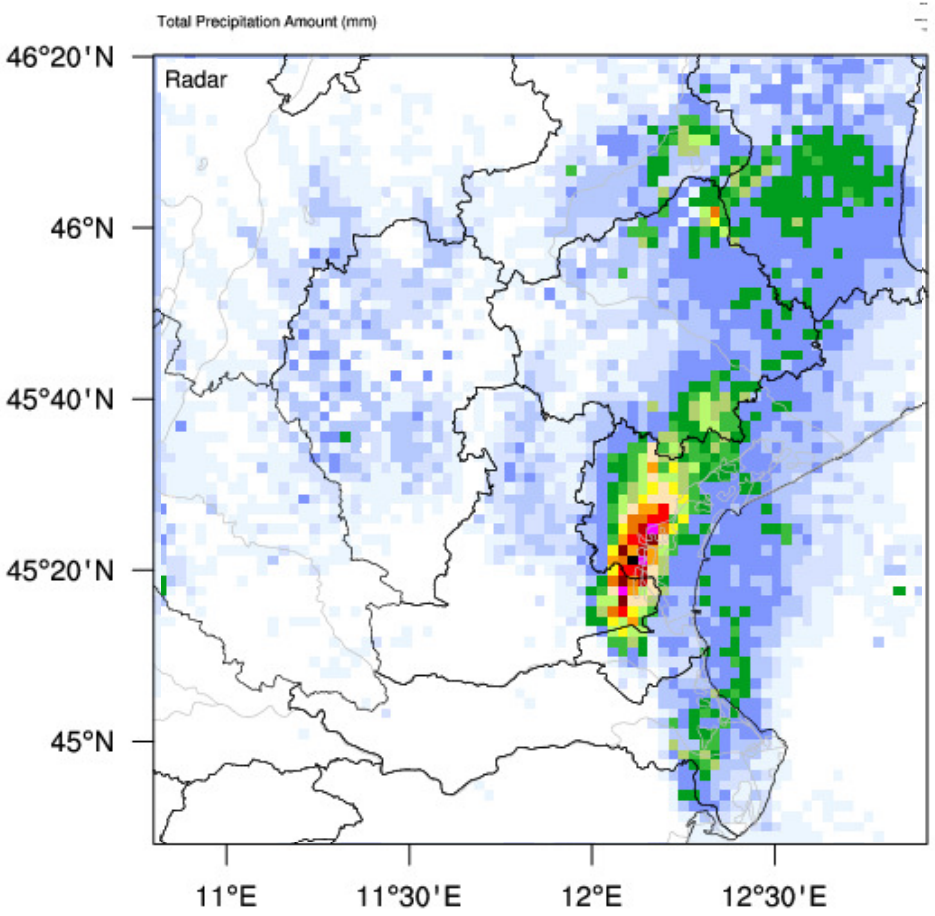
Propagation of uncertainty from observing systems (radars) into NWP

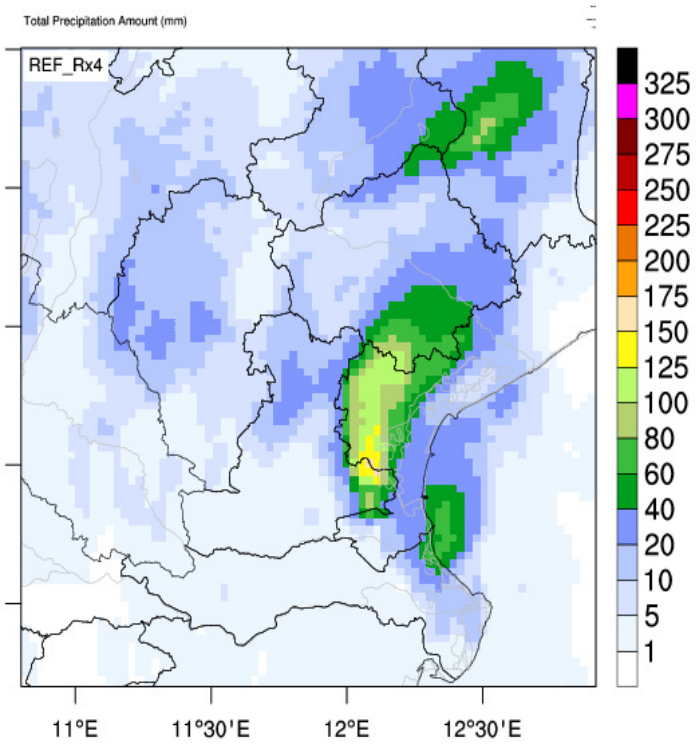


Radar rainfall assimilation exps: storm total precip

Radar QPE accumulation

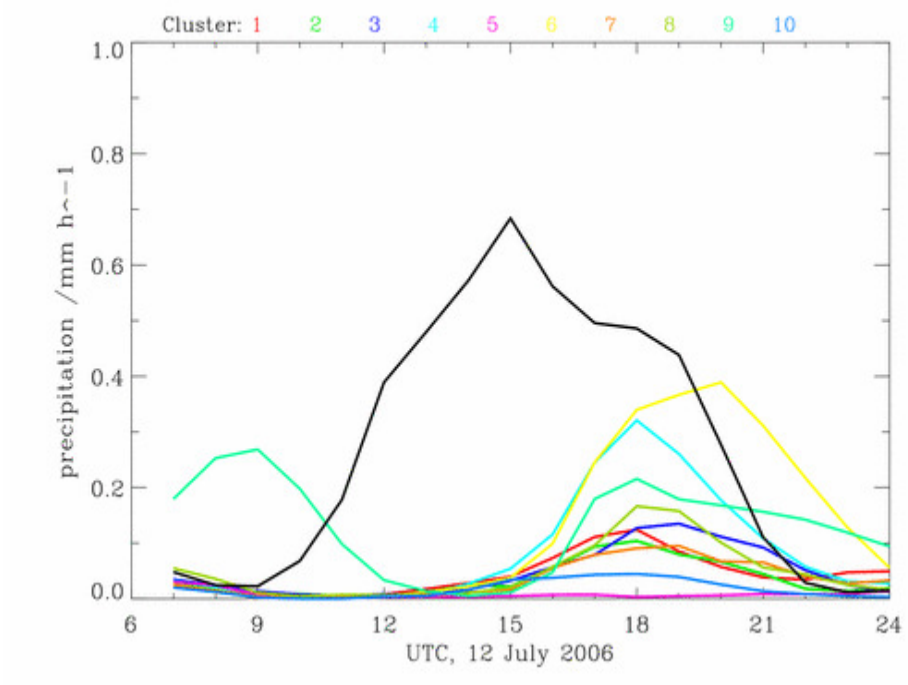
With radar data assimilation

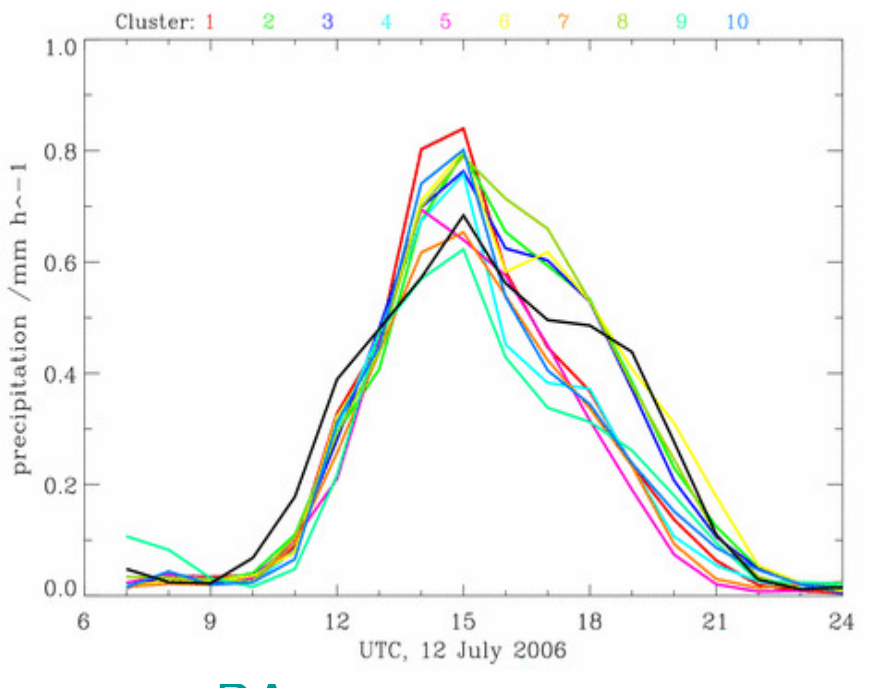




Leuenberger et al., MeteoSwiss

COSMO-2 + LHN ensemble (COSMO-LEPS)





DA

Experiments without LHN

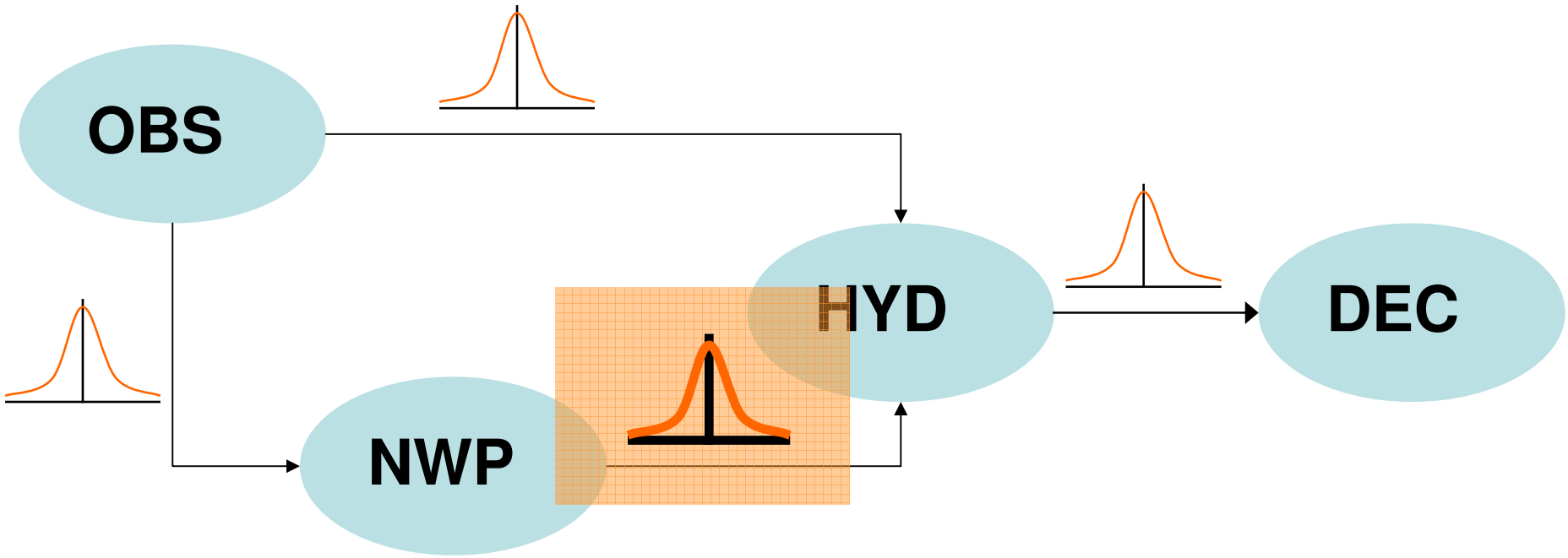
Experiments with LHN

QPF on 12 July 2006

Keil et al., DLR

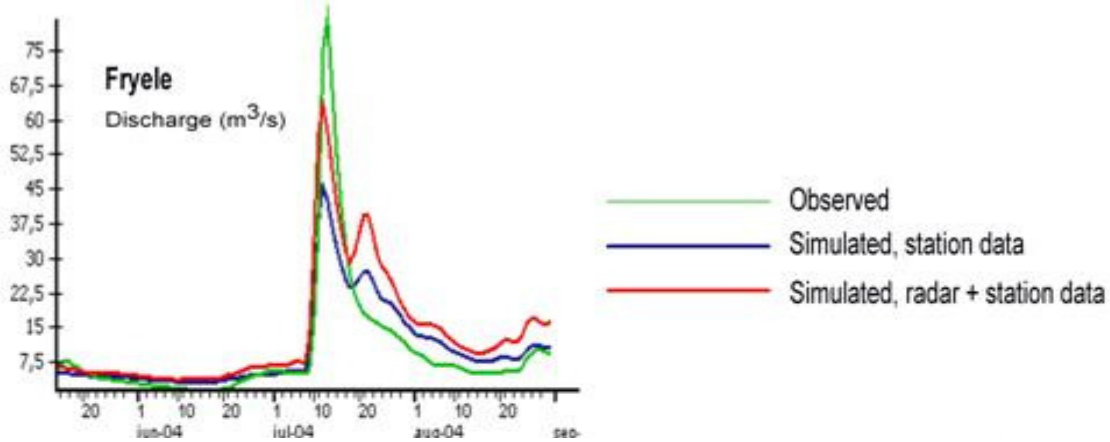
WORKING-GROUP 2

Propagation of uncertainty from observing systems and NWP into hydrological models

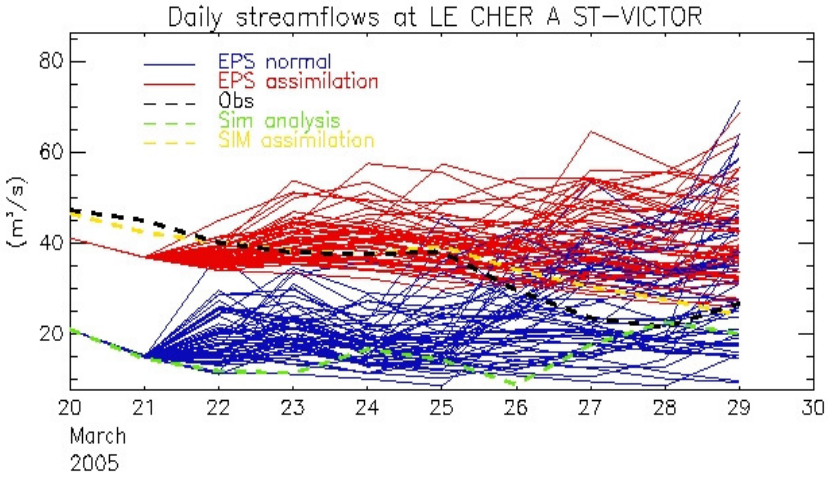


COST 731: Some contributions from the WG2 members

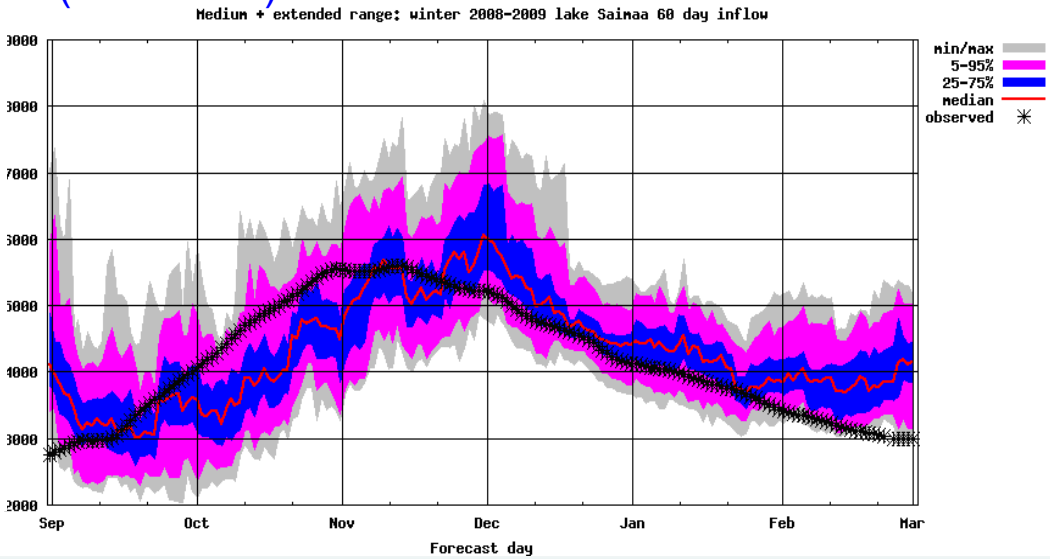
Sweden: radar QPE



France: medium range

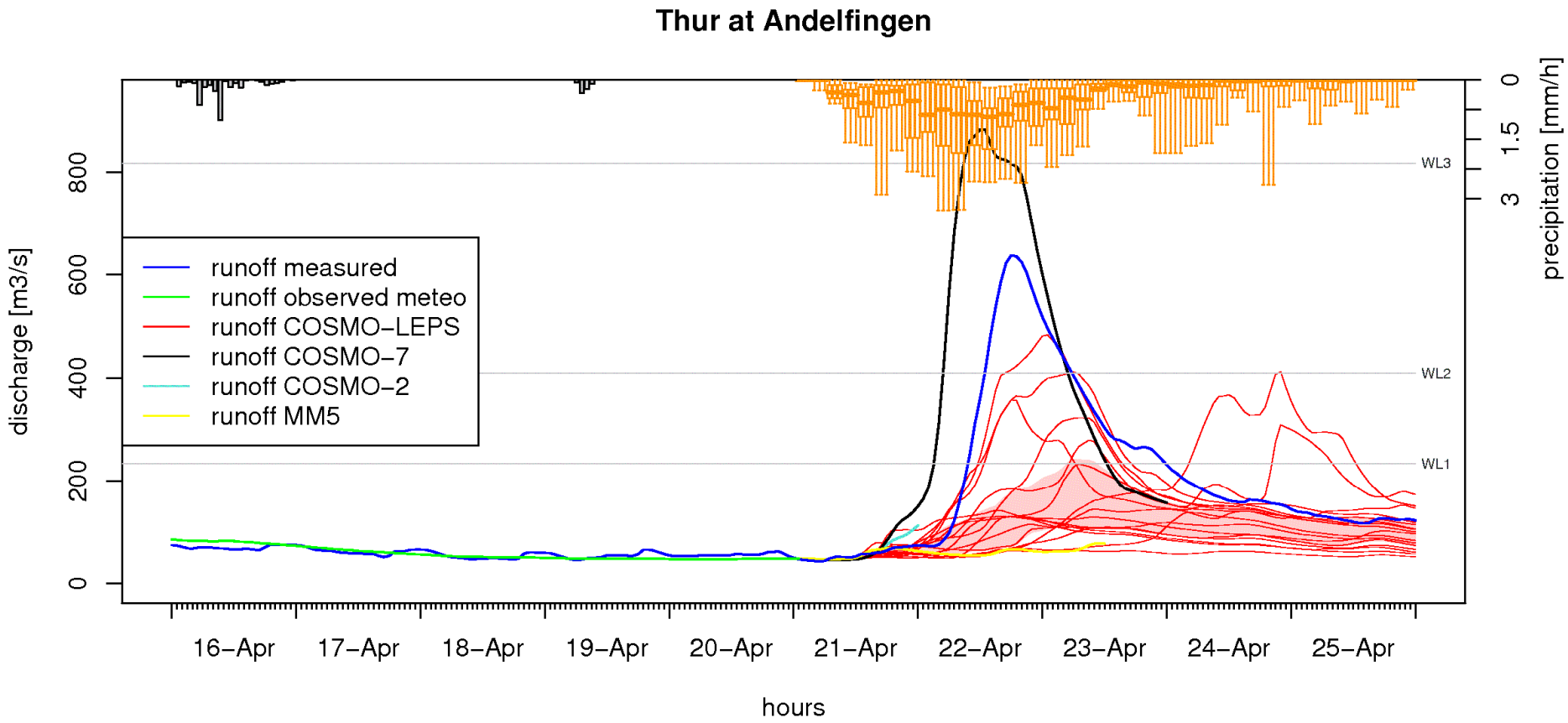


Finland: medium to long range (seasonal)



EPS/NWP - Hydrological Model Chain

Monday April 21st 2008, Day -1 -> Do NWP Models agree?

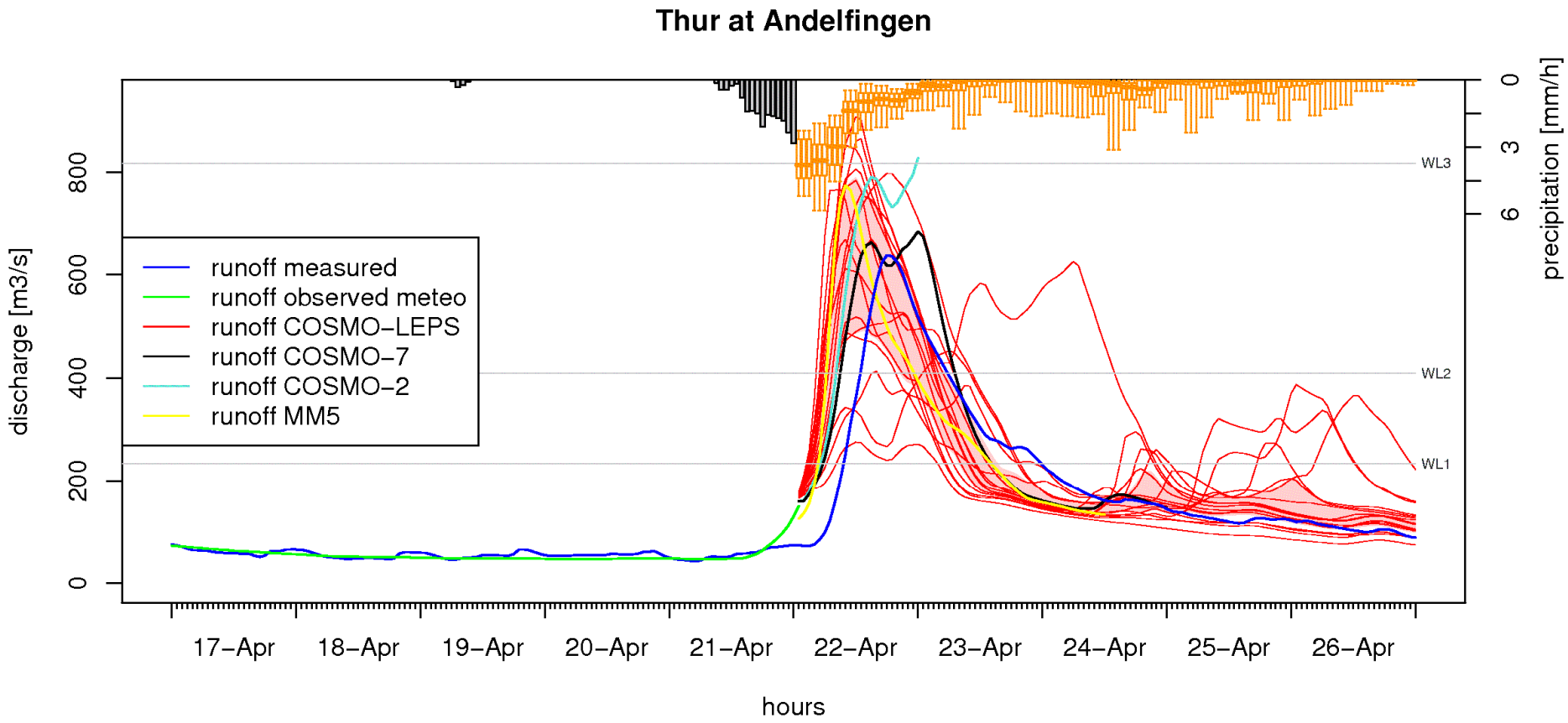


Updated DAILY since April 2007

Plot: Simon Jaun, WSL/IACETH

EPS/NWP - Hydrological Model Chain

Tuesday April 22nd 2008, Day 0 -> YES, they do! ….. Too Late?



Updated DAILY since April 2007

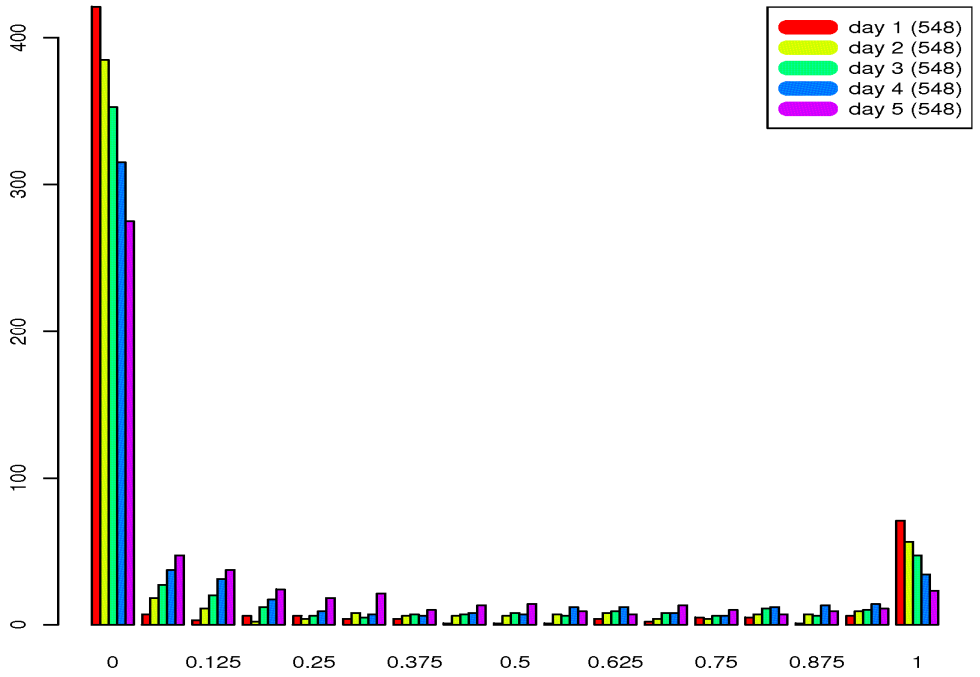
Plot: Simon Jaun, WSL/IACETH

Verification of two HEPS chains June 2007 to November 2008

See Poster of Diezig et al.

Rank Histograms – Ticino Bellinzona

PREVAH_COSMO_LEPS_WSL_ETHZ

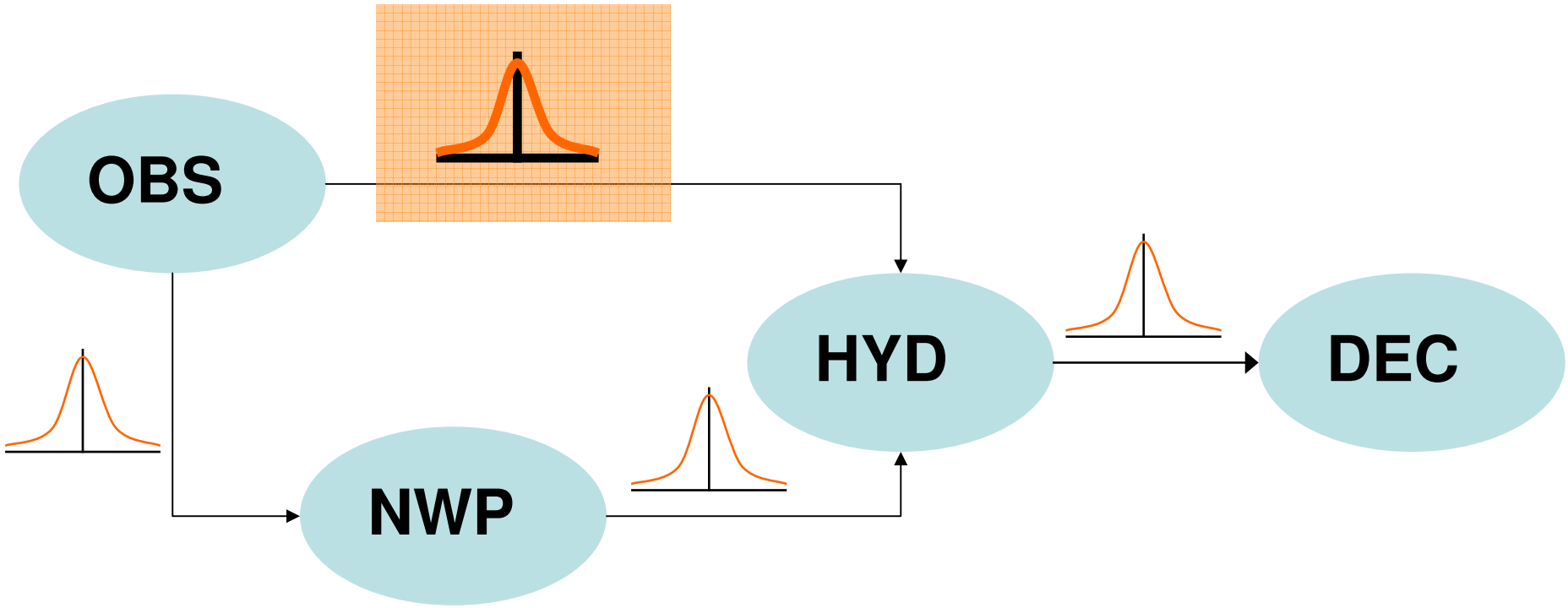


Low flows periods strongly influences the statistics

Plot: Diezig, Vogt, Jaun and Fundel, 2010

WORKING-GROUP 2

Propagation of uncertainty from observing systems and NWP into hydrological models



Radar Ensemble for Hydrology

Germann et al., QJRMS, 2009

REAL: ensemble generator using LU

estimate of radar error for each point in space and time **(error variances**

+

estimate of how errors are correlated in space and time **(error ovariances)**

Radar-raingauge comparison

vary sligthly

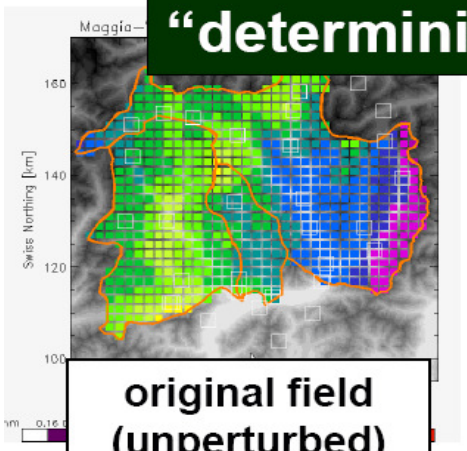
Produce many members, the spread among which represents the radar uncertainty.

stochastic simulation of

SVD of error covariance matrix + auto-regressive filter

perturbation field with correct space-time variances and covariances

“deterministic”

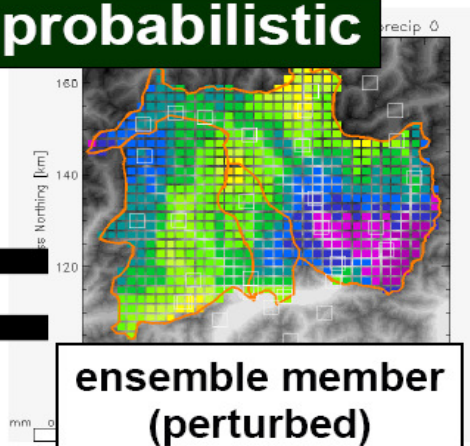


original field (unperturbed)

+

=

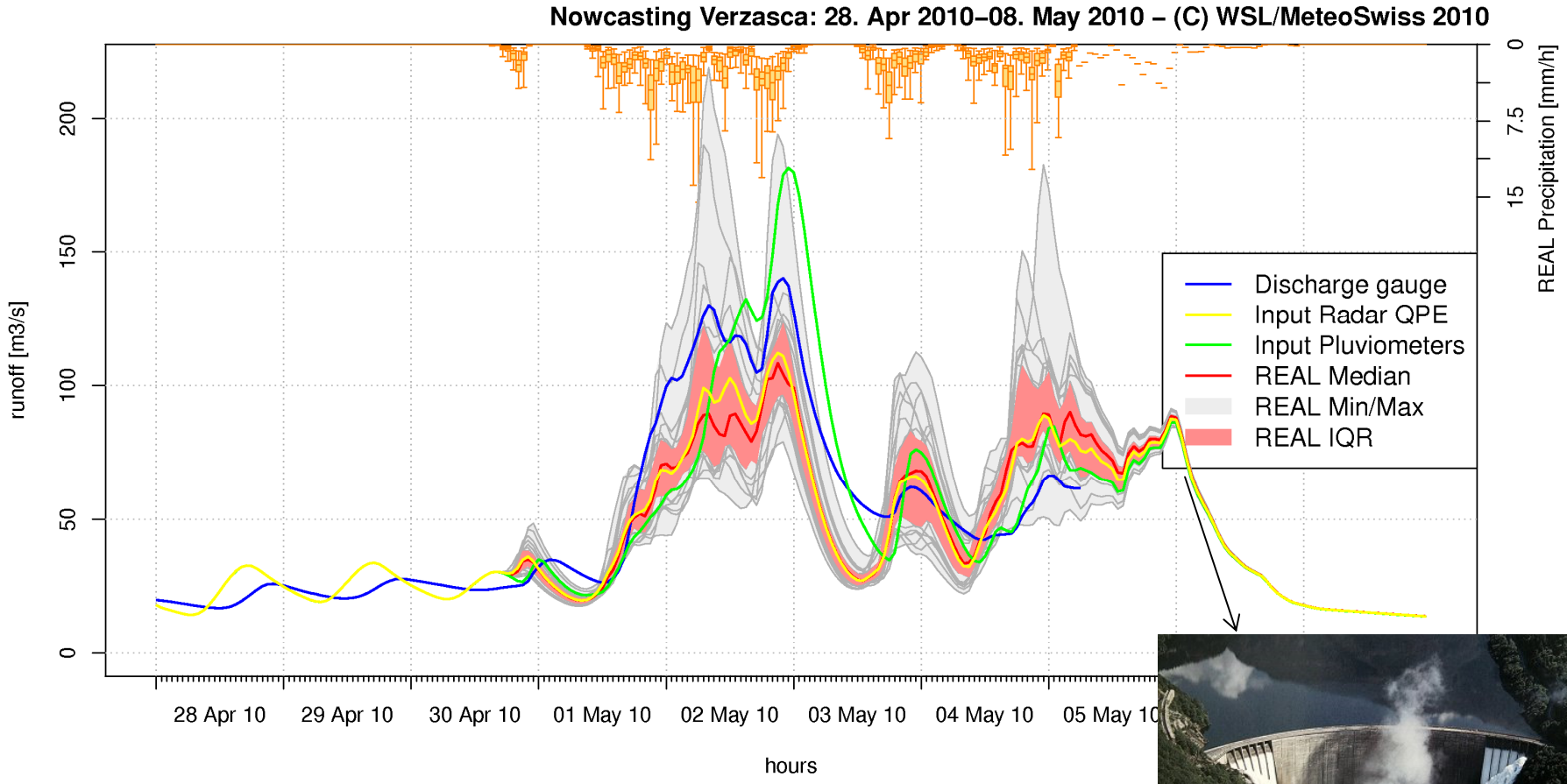
probabilistic



ensemble member (perturbed)

Radar Ensemble for Hydrology

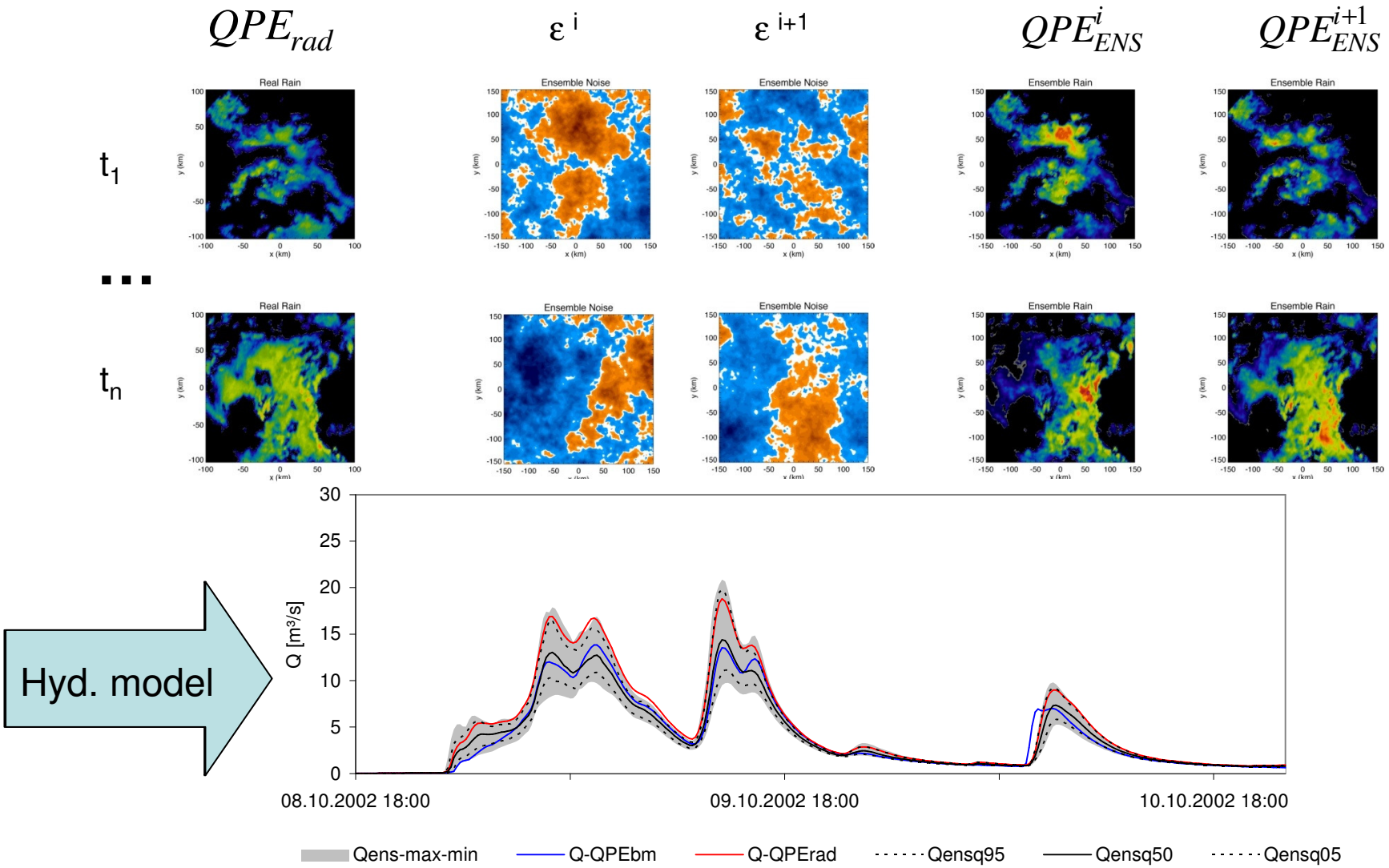
Germann et al., QJRMS, 2009



Updated HOURLY since April 2007

Radar Ensemble for Hydrology

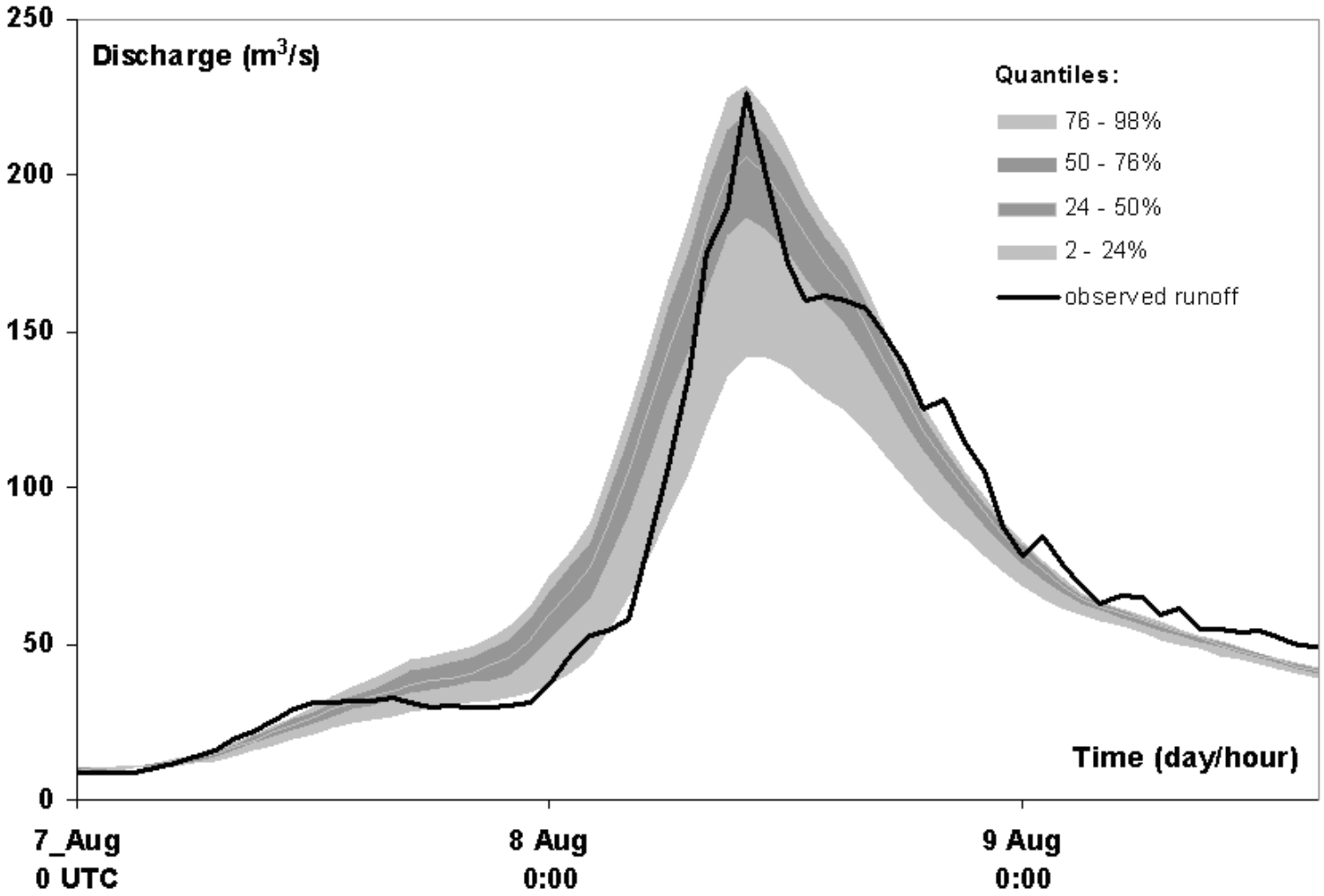
QPE vs BLENDED QPE (external drift Kriging) >> MC-Sampling of errors-PDF



Xavi Llort, Daniel Sempere (CRAHI, Barcelona), Kai Schroeter (TU Darmstadt)

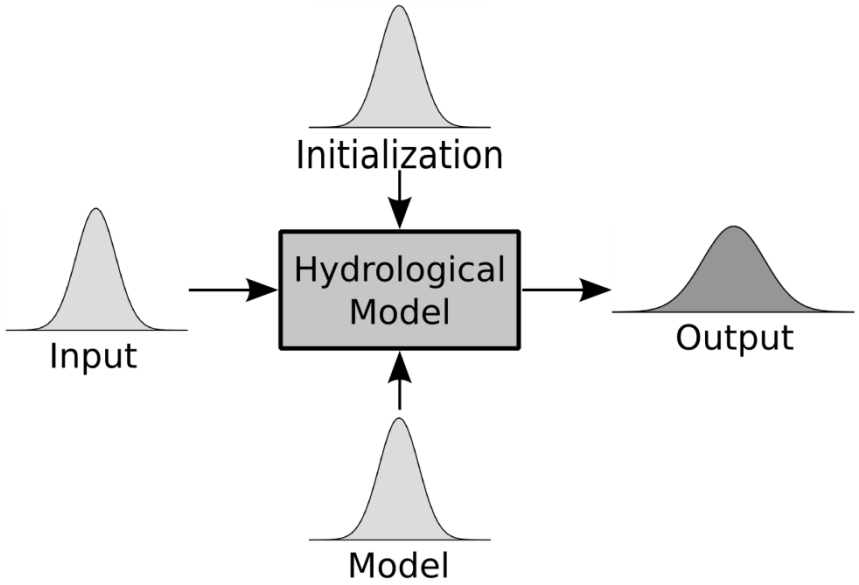
Radar Ensemble for Hydrology

Quality Index (QI) maps >> MC-Sampling of QI-statistics-PDF



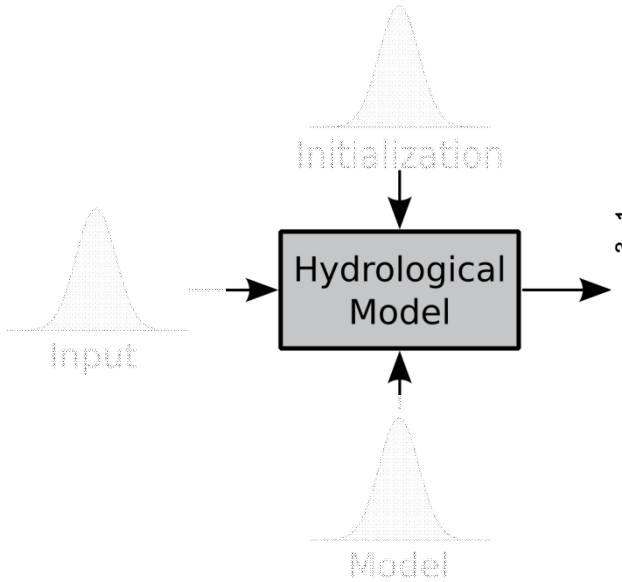
Jan Szturc, Thomas Einfalt

Accounting different sources of uncertainty

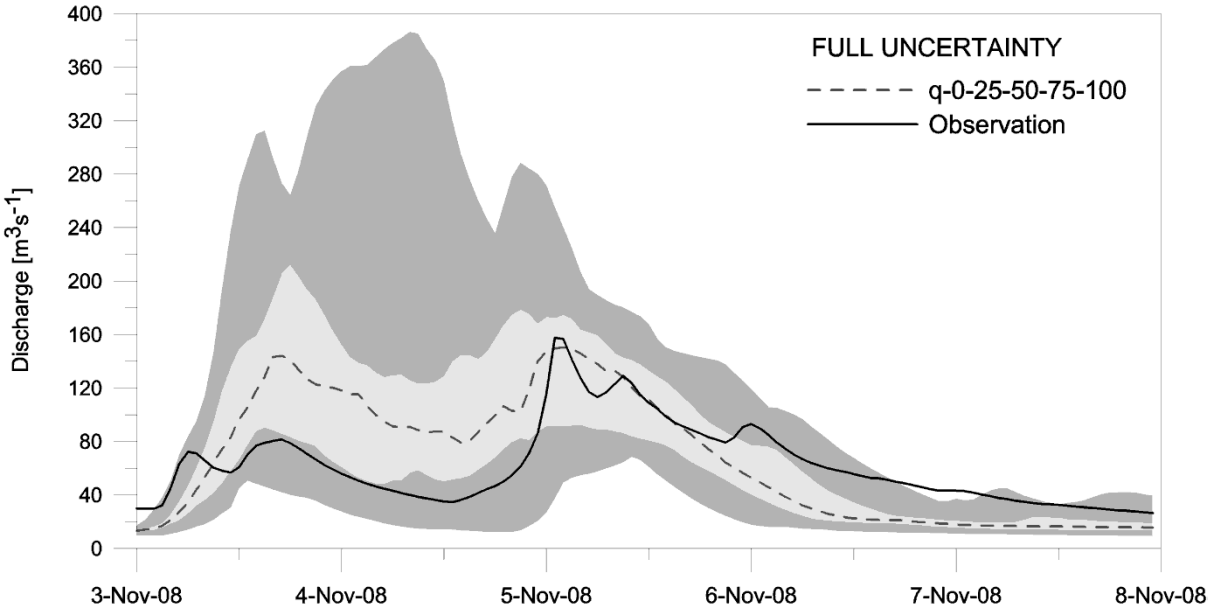


FP7-ENV-2008-1 IMPRINTS 226555

Accounting different sources of uncertainty



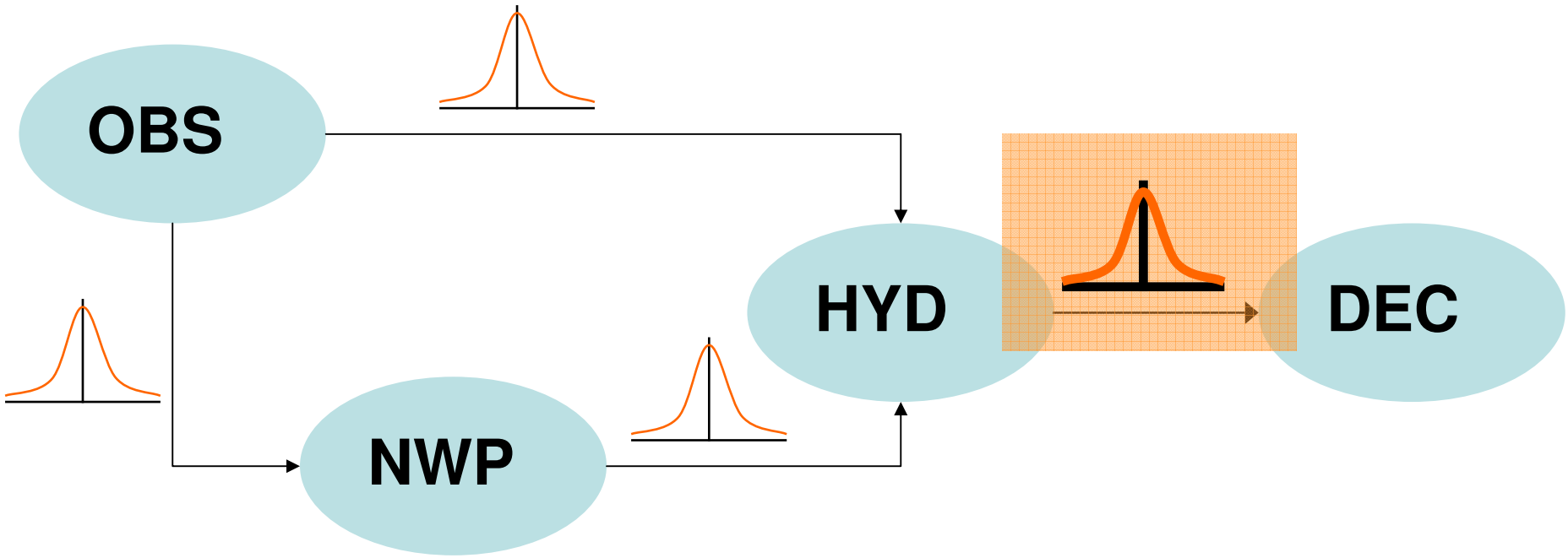
Output uncertainty



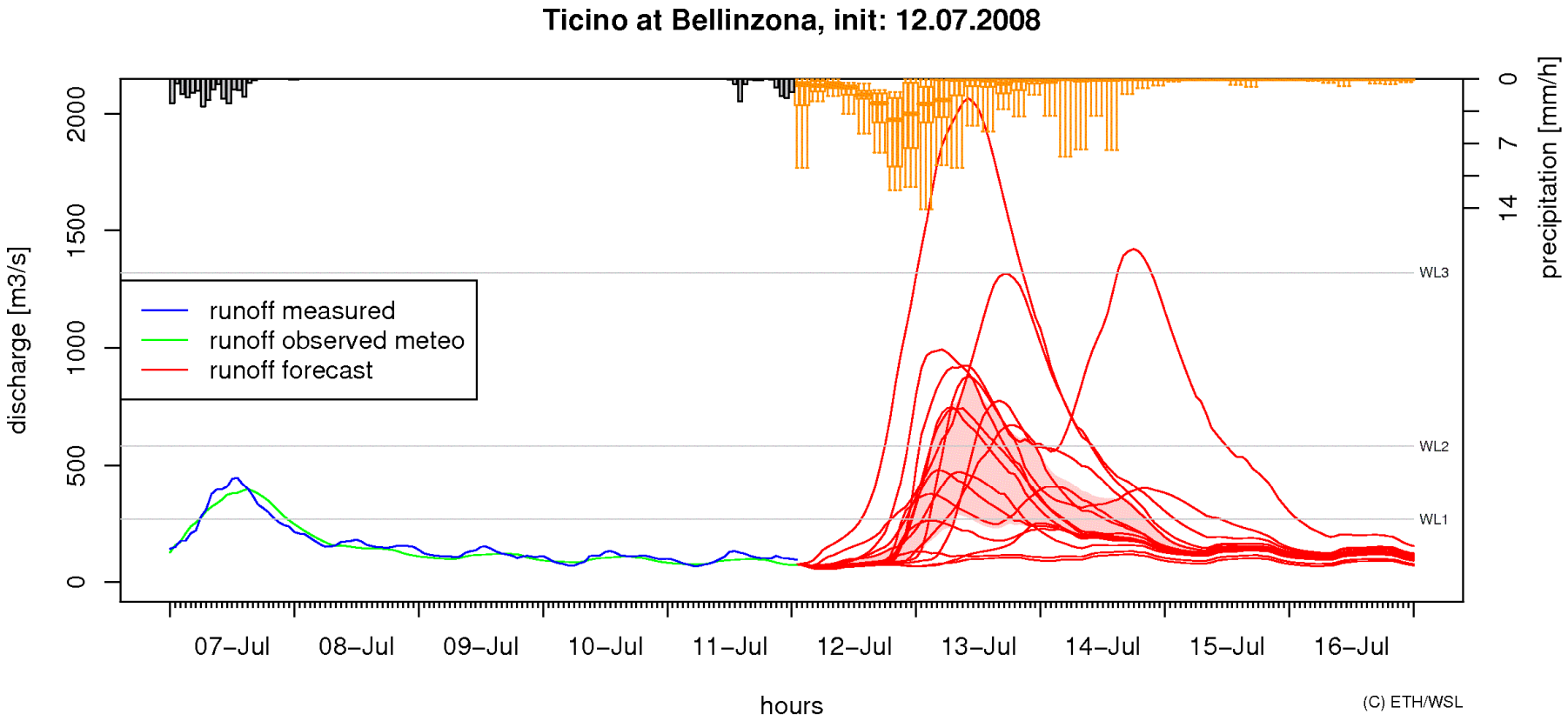
FP7-ENV-2008-1 IMPRINTS 226555

WORKING-GROUP 3

Use of uncertainty in warnings and decision making



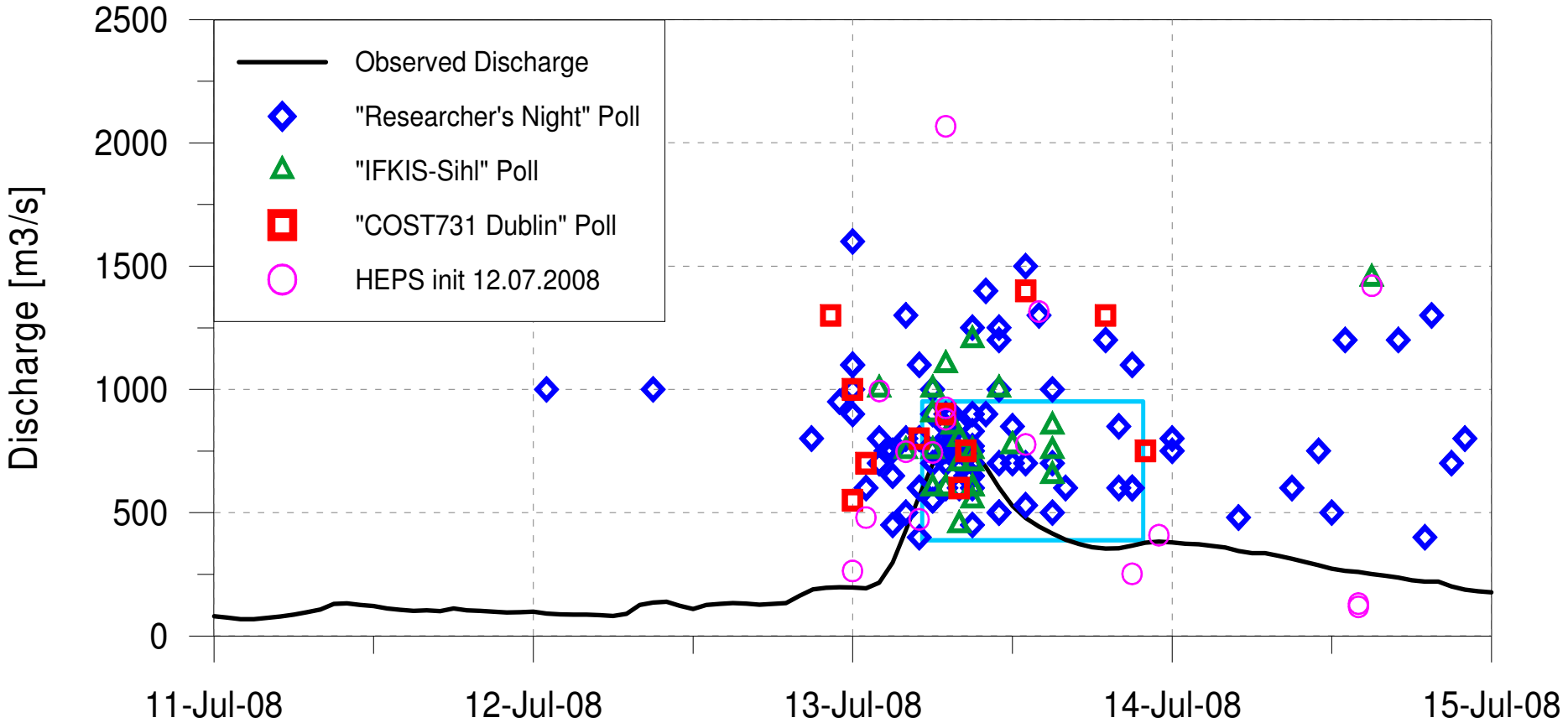
"The spaghetti plot surveys in 2008"
The task



How big will be the peak discharge from this forecast?

At which time will the peak discharge occur?

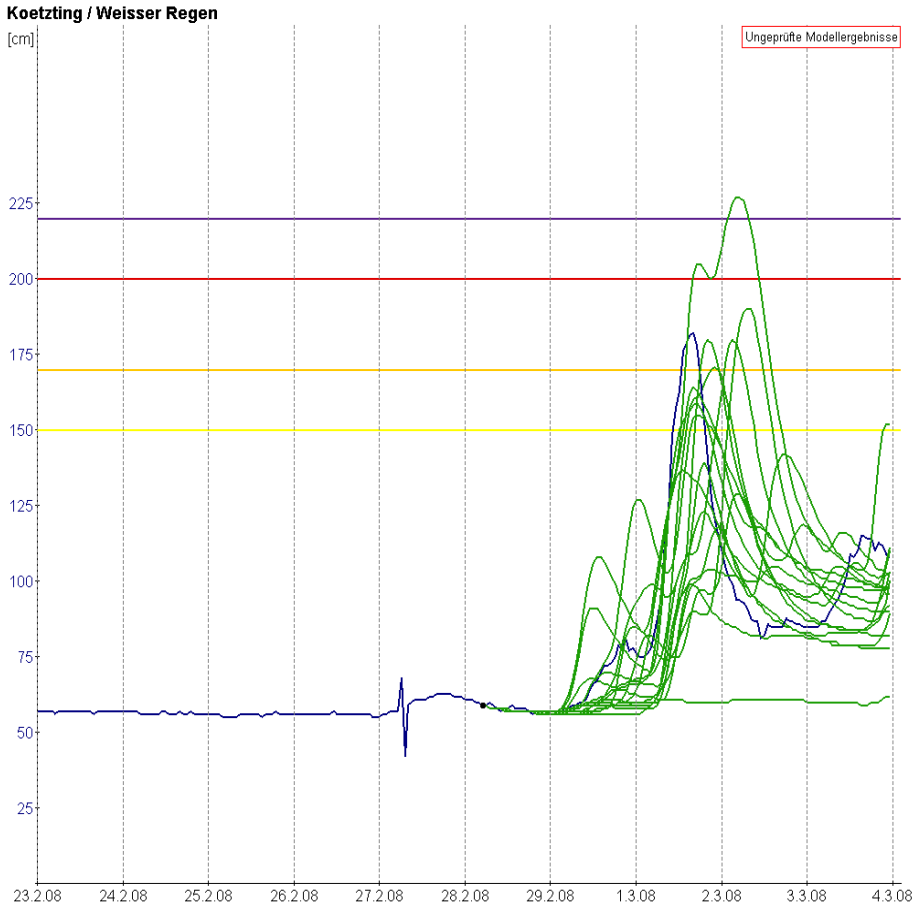
"The spaghetti plot surveys in 2008"
The answers



The observed value? 785 m^3s^{-1} at 11:00

Communication of probabilistic forecast

Bayerisches Landesamt für Umwelt



Example discharge ensemble ("Spaghettiplot")

by use of COSMO-LEPS from 28.02.2008

Communication of probabilistic forecast

Bayerisches Landesamt für Umwelt

→ Visualisation of the single ensemble member

Pegel Marienthal / Regen (Vorhersage vom 27.02.08 05:00 Uhr)					
Ensemblemember	27.02.	28.02.	29.02.	01.03.	02.03.
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
Abfluss ≥ Meldestufe1	0	0	0	1	13
Abfluss ≥ Meldestufe2	0	0	0	1	8
Abfluss ≥ Meldestufe3	0	0	0	0	1
Abfluss ≥ Meldestufe4	0	0	0	0	0

keine Meldestufe

Meldestufe 1

Meldestufe 2

Meldestufe 3

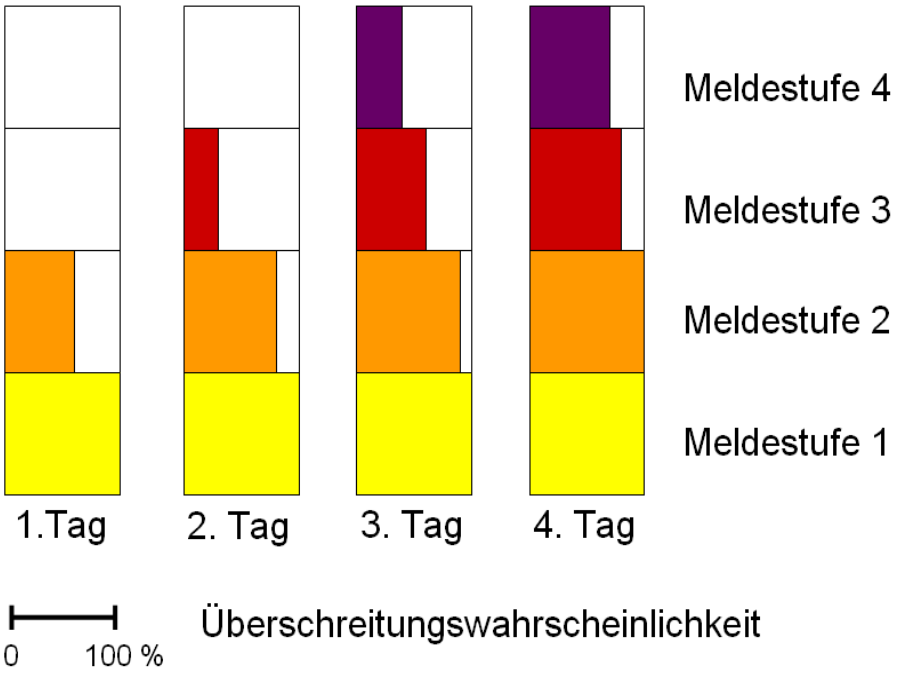
Meldestufe 4

Numer of ensemble member which exceed in a defined time period the warning levels

Communication of probabilistic forecast

Bayerisches Landesamt für Umwelt

→ Visualization of probabilities in graphical form



Communication of probabilistic forecast

Bayerisches Landesamt für Umwelt

→ Comparison of follow up forecasts (persistency)

Kötzting	Maximal erreichte Meldestufen									Häufigste erreichte Meldestufen								
Vorhersagezeitpunkt	25.02.	26.02.	27.02.	28.02.	29.02.	01.03.	02.03.	03.03.	04.03.	25.02.	26.02.	27.02.	28.02.	29.02.	01.03.	02.03.	03.03.	04.03.
Vorhersagelauf																		
25.02.2008																		
26.02.2008																		
27.02.2008					6%	6%	13%							94%	69%	50%		
28.02.2008						6%	6%	6%							50%	50%		
29.02.2008						6%	6%								38%	75%		

keine Meldestufe

Meldestufe 1

Meldestufe 2

Meldestufe 3

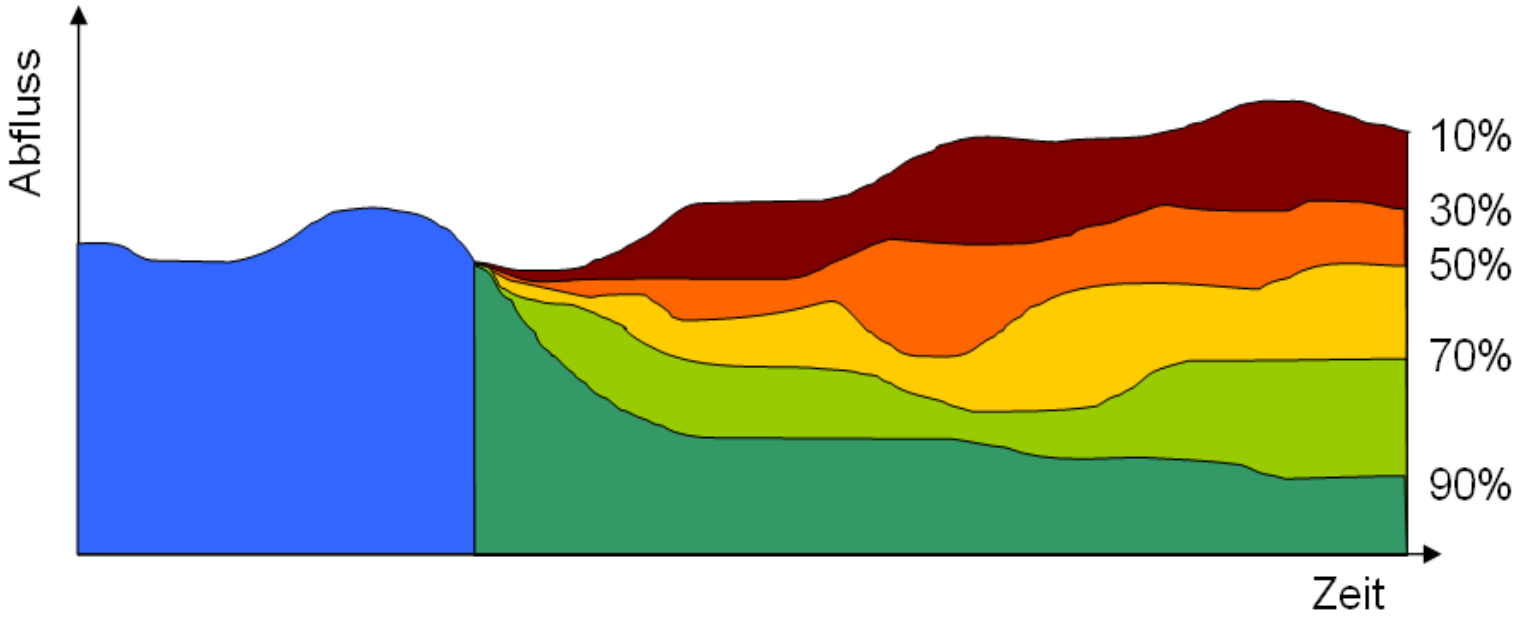
Meldestufe 4

Percentage of ensemble member that reach or exceed the warning level

Communication of probabilistic forecast

Bayerisches Landesamt für Umwelt

→ Visualisation of Percentile (Exceedance probabilities)



Probability that the discharge or water level at a gauging level will be reached or exceeded

ATMOSPHERIC SCIENCE LETTERS

RMetS Royal Meteorological Society

cost 731

Atmospheric Science Letters

SPECIAL ISSUE, due in May 2010:
Joint HEPEX/COST731 workshop on downscaling NWP products and propagation of uncertainty in hydrological modelling Toulouse, 2009

Rossa A, Haase G, Keil C, Pfeifer, M., Bech, J., Ballard, S. 2010a. Propagation of uncertainty from observing systems into NWP: COST-731 Working Group 1. *Atmospheric Science Letters* . doi:10.1002/asl.nnn

Zappa M, Beven KJ, Bruen M, Cofino A, Kok K, Martin E, Nurmi P, Orfila B, Roulin E, Schröter K,Seed A, Stzurc J, Vehviläinen B, Germann U, Rossa A. 2010. Propagation of uncertainty from observing systems and NWP into hydrological models: COST-731 Working Group 2. *Atmospheric Science Letters*. doi:10.1002/asl.248

Bruen M, Krahe P, Zappa M, Olsson J, Vehvilainen B, Kok K, Daamen K. Visualising flood forecasting uncertainty: some current European EPS platforms – COST731 Working Group 3. *2010. Atmospheric Science Letters* . doi:10.1002/asl.258

FINAL COST731 Seminar @ ERAD 2010 (Rumania)

- Uncertainty is a topic of very considerable interest
- subject of ongoing (statistical) research
- COST 731 – a step towards operations (hydrology)
- D-PHASE (Wals… …roof of concept/feasibili…
- Radar QPE: cor… …ent teams
- High-res NWP: s… …s
- Decision support – collect experience
- …OSS attitude… …established

Observation (radar QPE)

NWP

Hydrological modelling

Advances in Flood Forecasting and the Implications for Risk Management International Workshop
Alkmaar, The Netherlands 25-26 May 2010

THE COST731 ACTION- PROPAGATION OF UNCERTAINTY FROM METEOROLOGY INTO HYDROLOGICAL MODELS

Massimiliano Zappa, Andrea Rossa, Katharina Liechti, Michael Bruen, Urs Germann, Günther Haase, Christian Keil, Peter Krahe

& all the COST 731 contributors

Contacts:
Massimiliano Zappa
massimiliano.zappa@wsl.ch