DRIHM

DISTRIBUTED RESEARCH INFRASTRUCTURE FOR HYDRO-METEOROLOGY

Contract number: EU-INFSO-RI-283568

Coordinating person:
Eng. Antonio Parodi, PhD

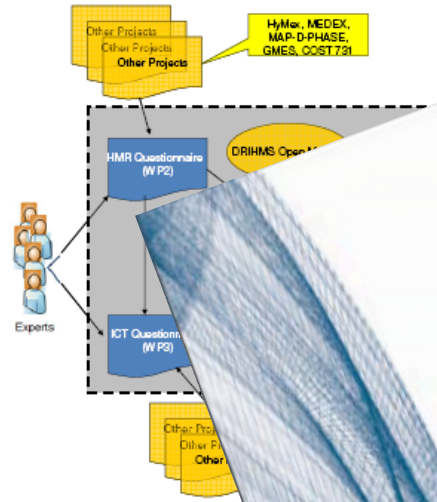
www.drihm.eu

European Commission
Information Society and Media

- User driven
  - Hydro-Meteorology Research (HMR) community
  - related earth science communities
- e-Infrastructure based
  - leverages European e-infrastructures
  - DEISA/PRACE, EGEE/EGI, NGIs
- Long-term sustainability
  - new services for long-term provisioning over European e-infrastructures
  - Cooperation with different Earth science related communities
- DRIHM builds up on DRIHMS results (White Paper)

DRIHMS – A preparatory study for DRIHM

DRIHMS Consultation Process



DRIHMS project st

HMR Hot Topics

	Full audience	Meteorology	Hydro-Meteorology	Hydrology	Others
	Probabilistic forecasting	Probabilistic Forecasting	Model verification metrics	Model verification metrics	Model verification metrics
	verification metrics	Other	Data merging / fusion	Probabilistic forecasting	Probabilistic Forecasting
	ging /	Model verification metrics	Probabilistic forecasting	Precipitation downscaling	Precipitation downscaling
		Precipitation downscaling	Precipitation downscaling	Data merging / fusion	Data merging / fusion

nts revealed clear choices of hot topics and accompanying ICT

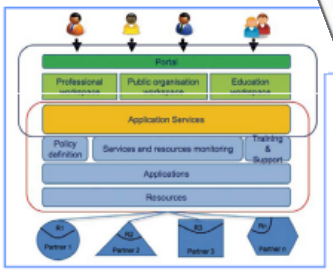
hot topics for HMR research were identified as probabilistic among meteorologists) and model verification metrics meteorologists and hydrologists);
g, the most important ICT challenges were the definition of ts, definition of libraries of tools for data handling and liability and reliability of high-performance computing

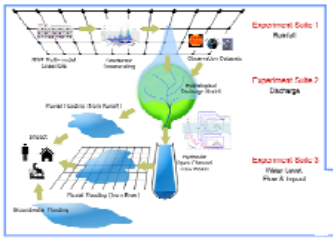
s, the key ICT challenges were availability of model patible formats, and the availability of libraries of well-

ctices yielded a large variety of methods of working, the processing and communication of large data sets research;
sing was given only a secondary priority by this ounting and billing issues seem to be regarded as

NAIRE

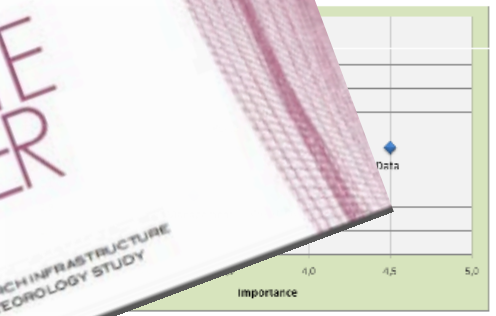
A Roadmap for HMR e-Science





Conceptual view of t
meteorological proba
forecasting chai

for HMR

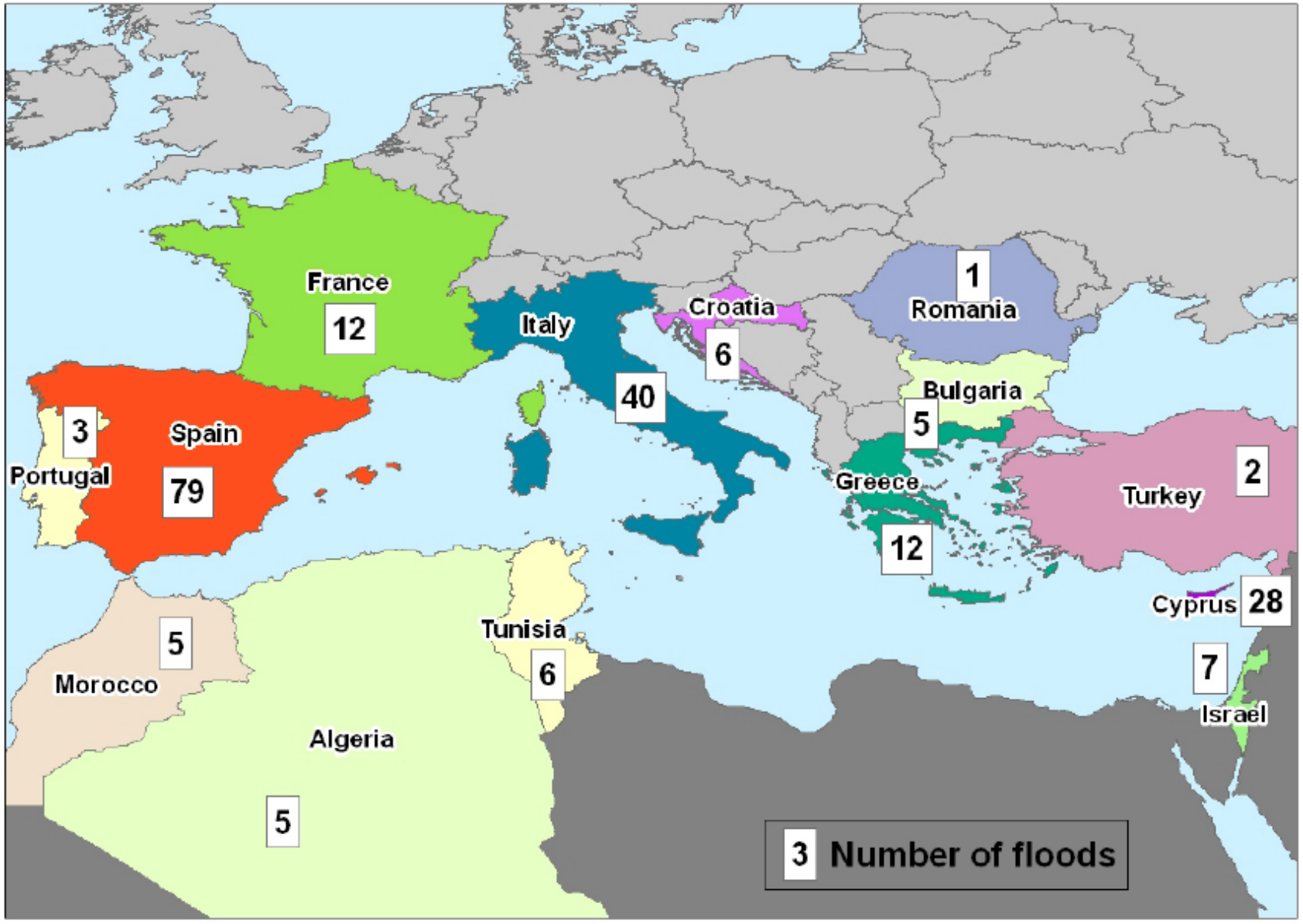


portant results related to the HMR hot topics are:
espondents perceive data management as very important but they do not see significant progress in the next years.
•High Performance Computing is perceived important and they expect significant progress within the next years.
•Workflow management is perceived important but no significant progress is expected even short term.
•Portals and user interfaces are perceived important and the existing solutions seem to fulfill most of the requirements already.
•Virtual Organization (VO) management is perceived to be less important but sufficiently mature already.

DRIHM Objectives

- **To support** the development and deployment of a **HMR e-Science environment**
- **To promote** the establishment and diffusion of a **service-oriented culture** (involving specialist scientist users, members of public services, members of the general public)
- To provide **integrated HMR services**
- To design and deploy **user-friendly interfaces**
- To provide HMR e-Science **support centres** and corresponding **training activities**
- To support hydro-meteorological **forecasting chains**

- Forecasting severe storms and floods is a key topic in HMR/early warning
- Storms do not respect country boundaries – a pan-European approach to data access and modeling is necessary
- The analysis carried out within the FLASH project estimated over 29 billion euros the material damages produced by floods in the Mediterranean region during the 1990-2006 period
- The total number of casualties has been estimated over 4,500, concentrating in the Mediterranean African countries especially.



A preliminary distribution of flood cases between 1990 and 2006 (Llasat et al., 2010).

A DRIHM critical case

- The city of Genoa, which nestles between the Tyrrhenian sea and the Apennine mountains, was rocked by severe flash floods on 4th November 2011. About 450 millimeters of rain - a third of the average annual rainfall - fell in six hours. Six people were killed. The raging waters uprooted trees, swept cars, shattered shops and flooded the town center;
- The torrential rainfall inflicted the worst disaster Genoa has experienced since the flash flood of 1970, when a similar event killed 25 people on the 7th October.

270 300 330 0 30

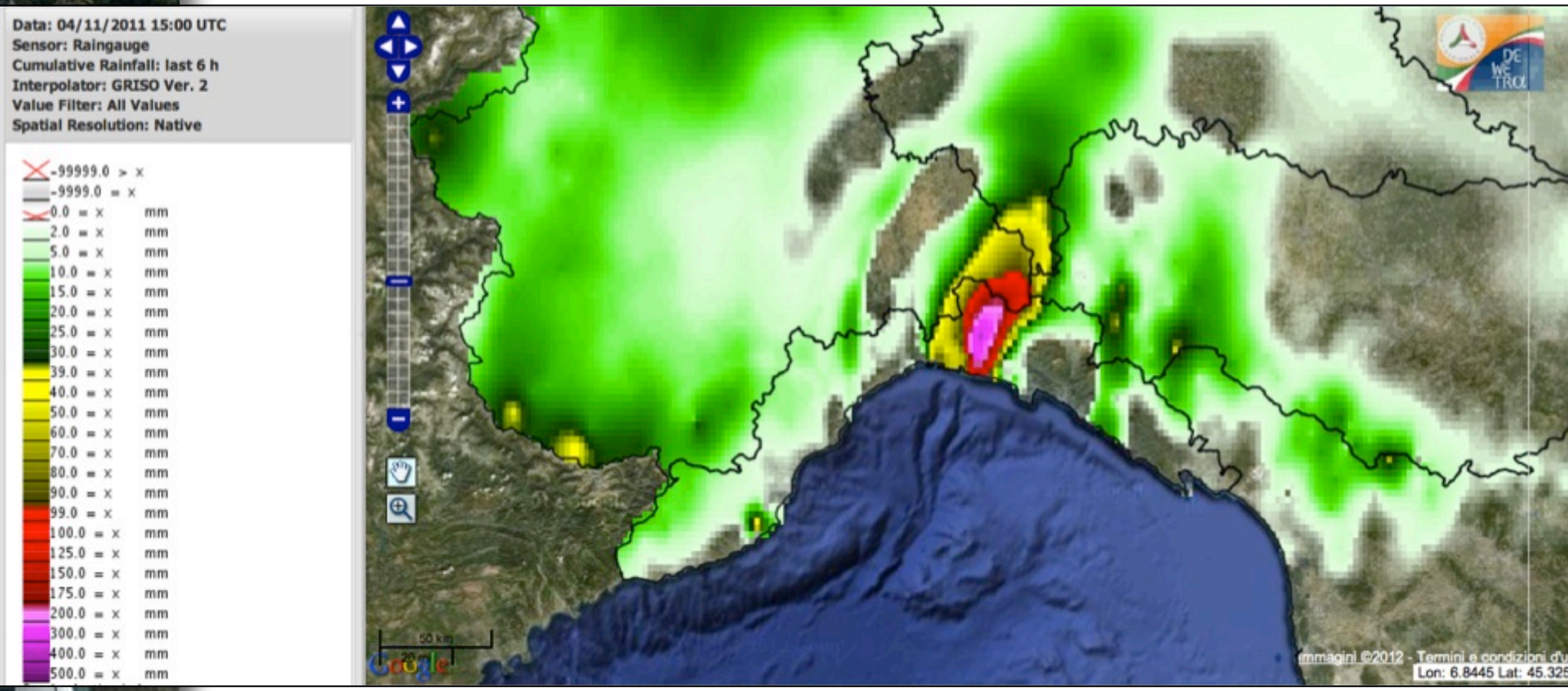
90 60 30

4 november

29-30 october

Liquid Water: 0.0 0.5 1.0 1.5 2.0 (milimeters)

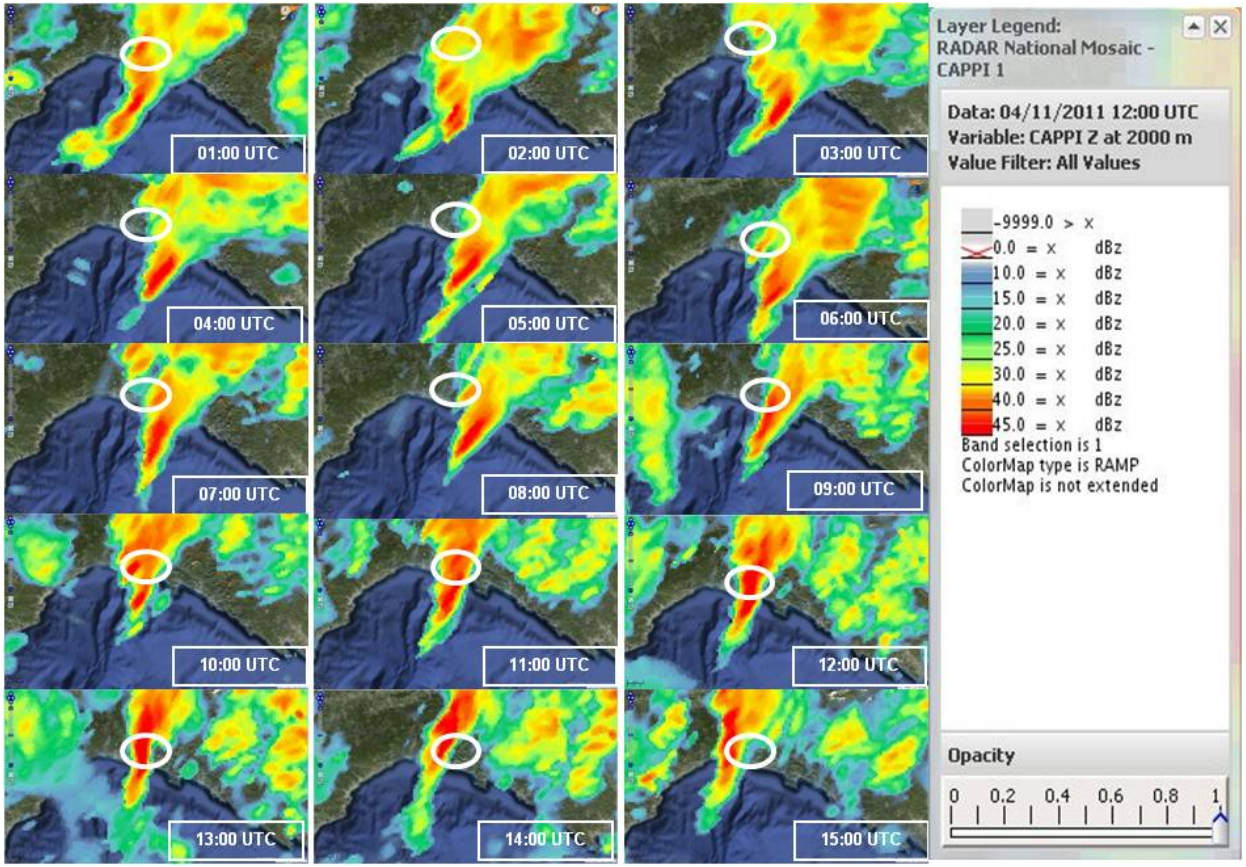
Satellite cloud liquid water composite (week ending 5/11/2011) clearly shows the cyclone track from USA east coast to Mediterranean.



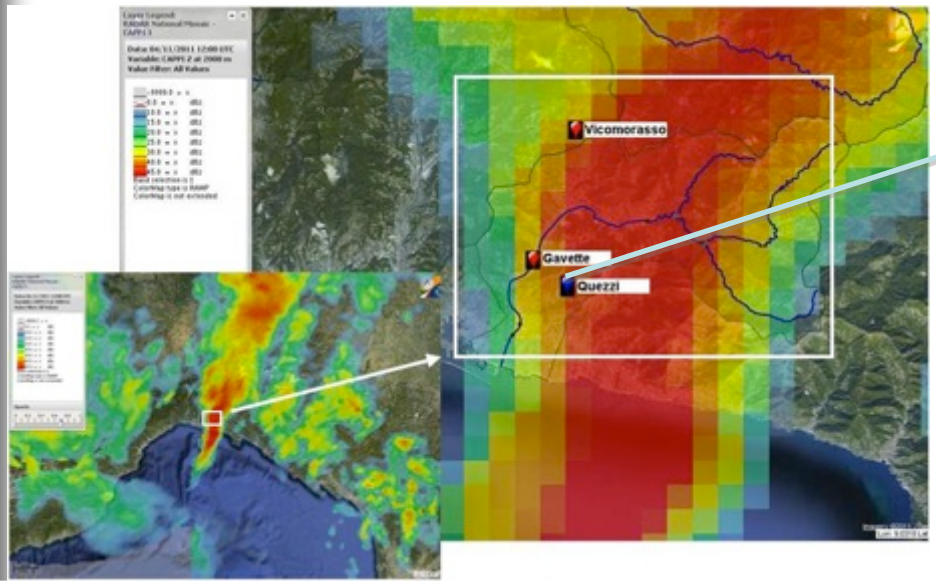
Total rainfall depth between 9 and 15UTC, as provided by the ICPD raingauge network.

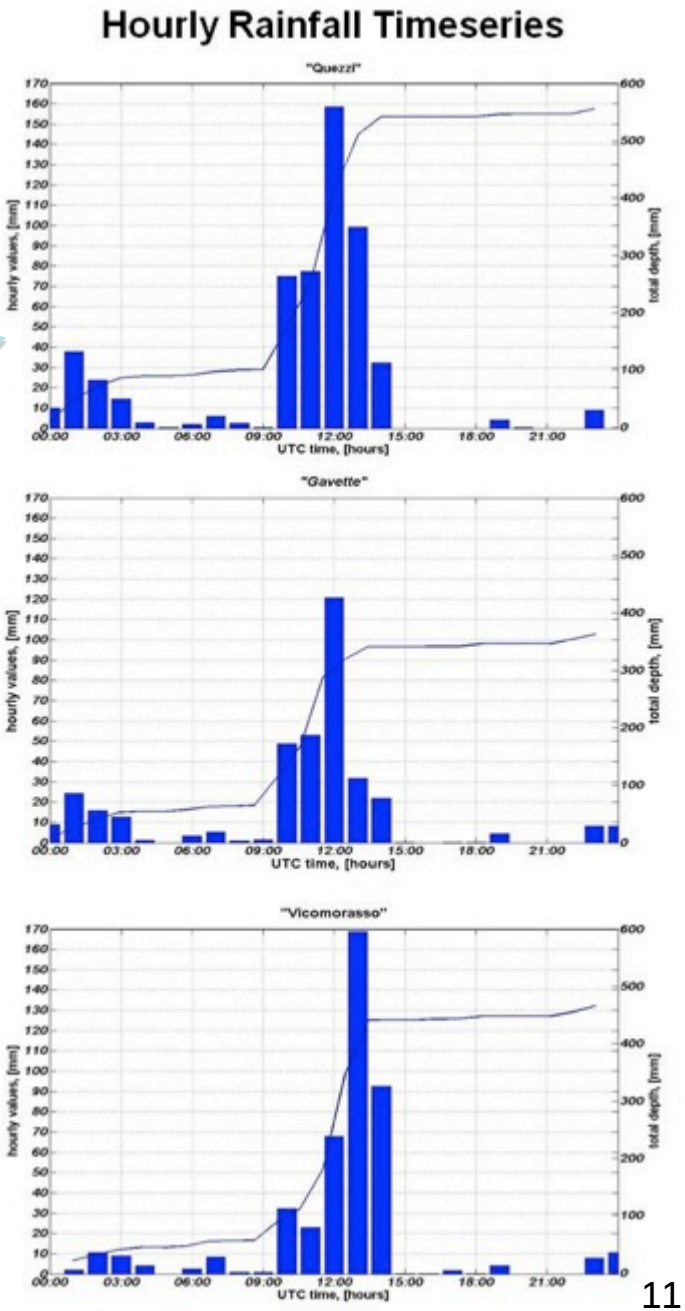
Flash flood of the Genoa town center. Top rigth corner: the similar event of 1970

Radar maps from the Italian radar network showing the intense thunderstorm wandering along the Liguria coastline (1-15UTC): White ellipsoid identifies the mostly affected area



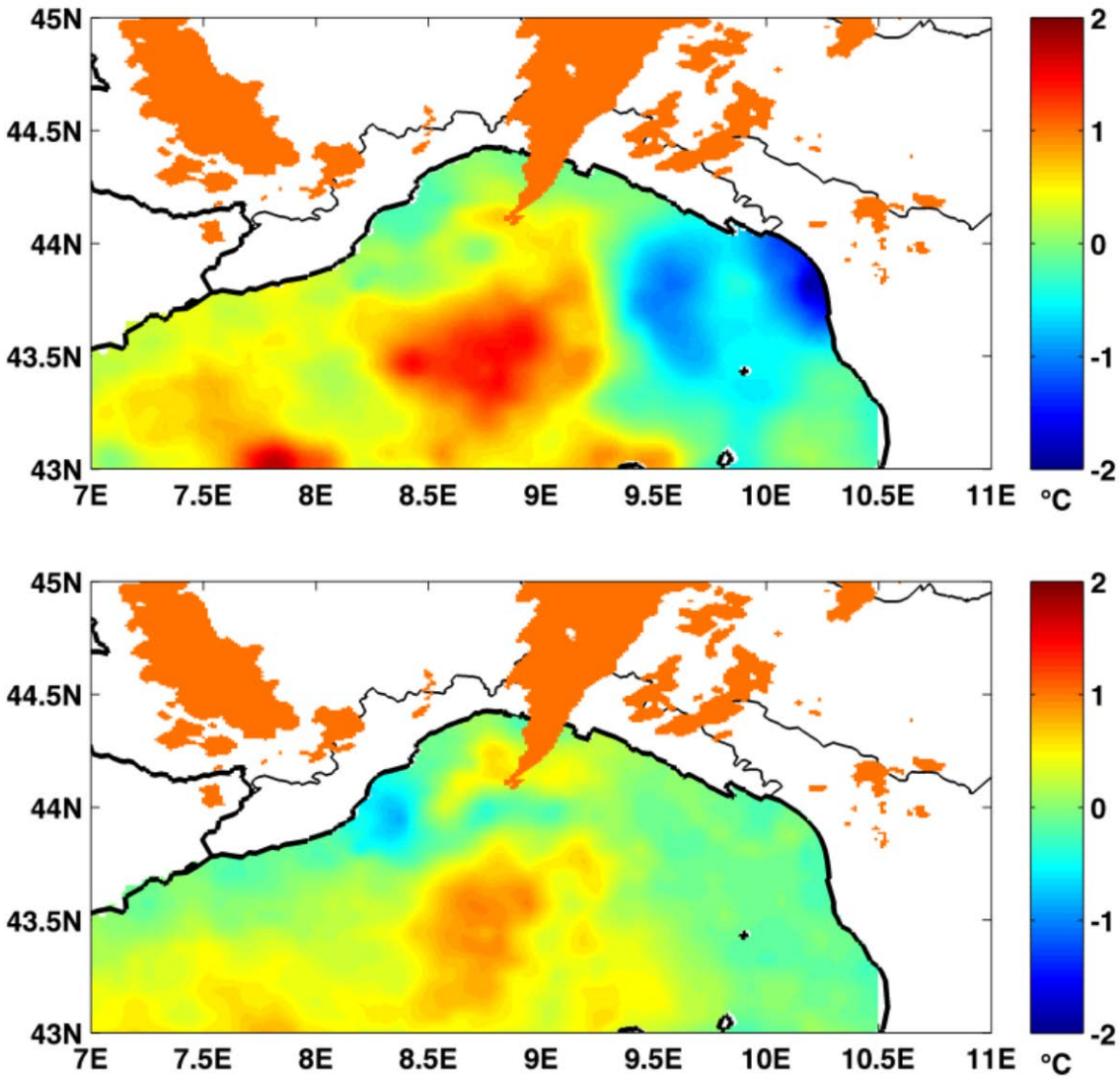
About 90 Personal Weather Stations (PWS) are available in Liguria (LIMET group): *http://www.centrometeoligure.it/rete/reteosservativa.php*





- PWS were useful in the real-time monitoring of the event together with official weather stations
- A PWS, “Quezzi”, owned by a citizen-scientist, registered the peak rainfall depth over 6 hours (about 450 mm) observed during the torrential event
- The PWS captured the tremendous fine-grained structure of the thunderstorm (see comparison with official weather stations “Gavette” and “Vicomorasso”)
- PWS data will be published on the DRIHM e-Infrastructure
- Possible contribution of LIMET citizen-scientists to the DRIHM User Forum

Courtesy of Tatiana Bedrina, PhD Student



Reflectivity footprint of the precipitation structures considered in this paper: the orange areas represent the pixels with reflectivity values larger than 25 dBZ (Italian Radar Mosaic, November 4th at 11:00 UTC). Sea Surface Temperature Anomaly by G1SST (upper panel) and GMES MyOcean (lower panel).

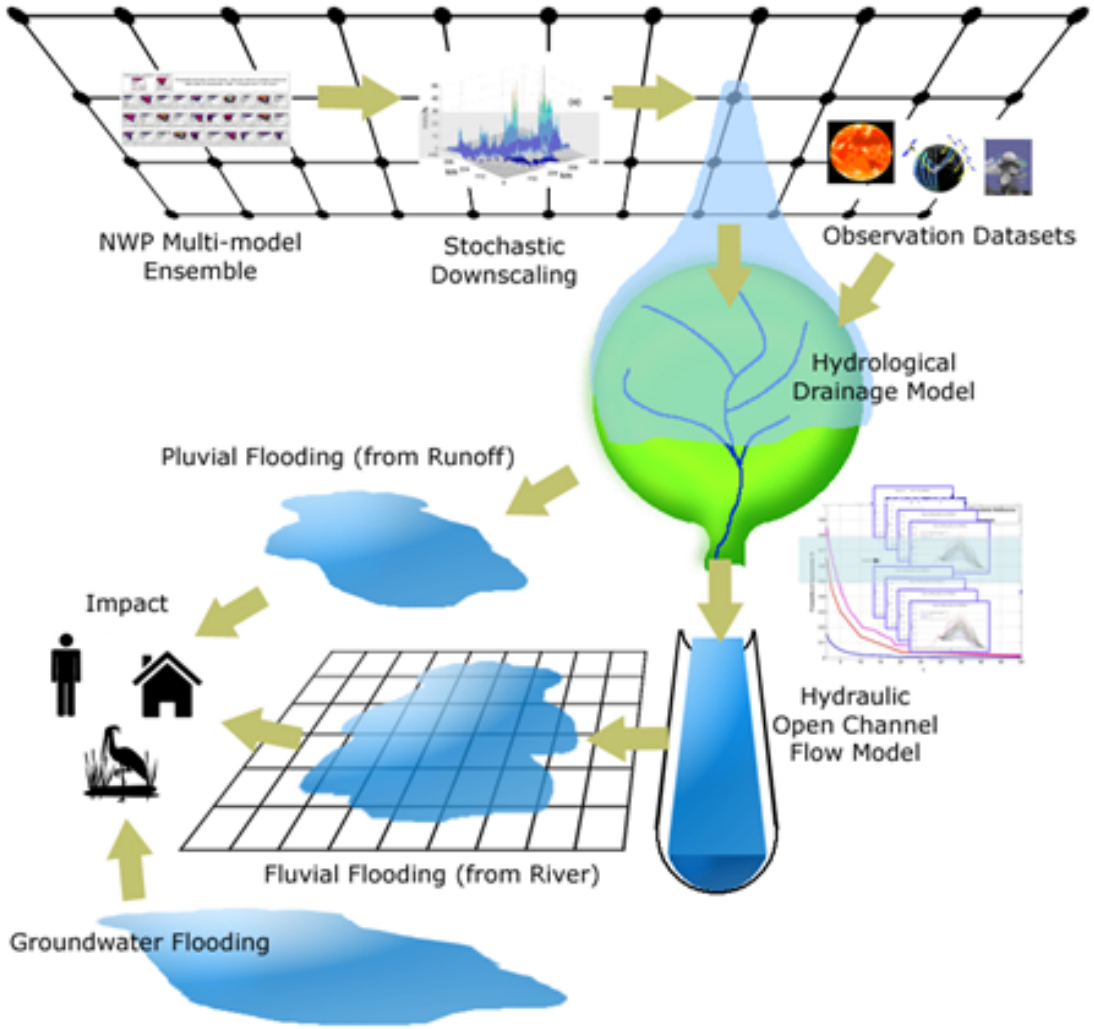
All together, these observations challenge our current scientific understanding and call for focused and joint hydro-meteorological and ICT research to:

(a) understand, explain and predict the physical processes producing such extreme storms

(b) understand the possible intensification of such events in the Mediterranean region and their physical origin;

(c) explore the potential of the increasing computational power and Information Communication Technology (ICT), such as grid computing and petascale computing systems, to provide deeper understanding of those events through fine resolution modeling over large areal extents

The DRIHM Showcase

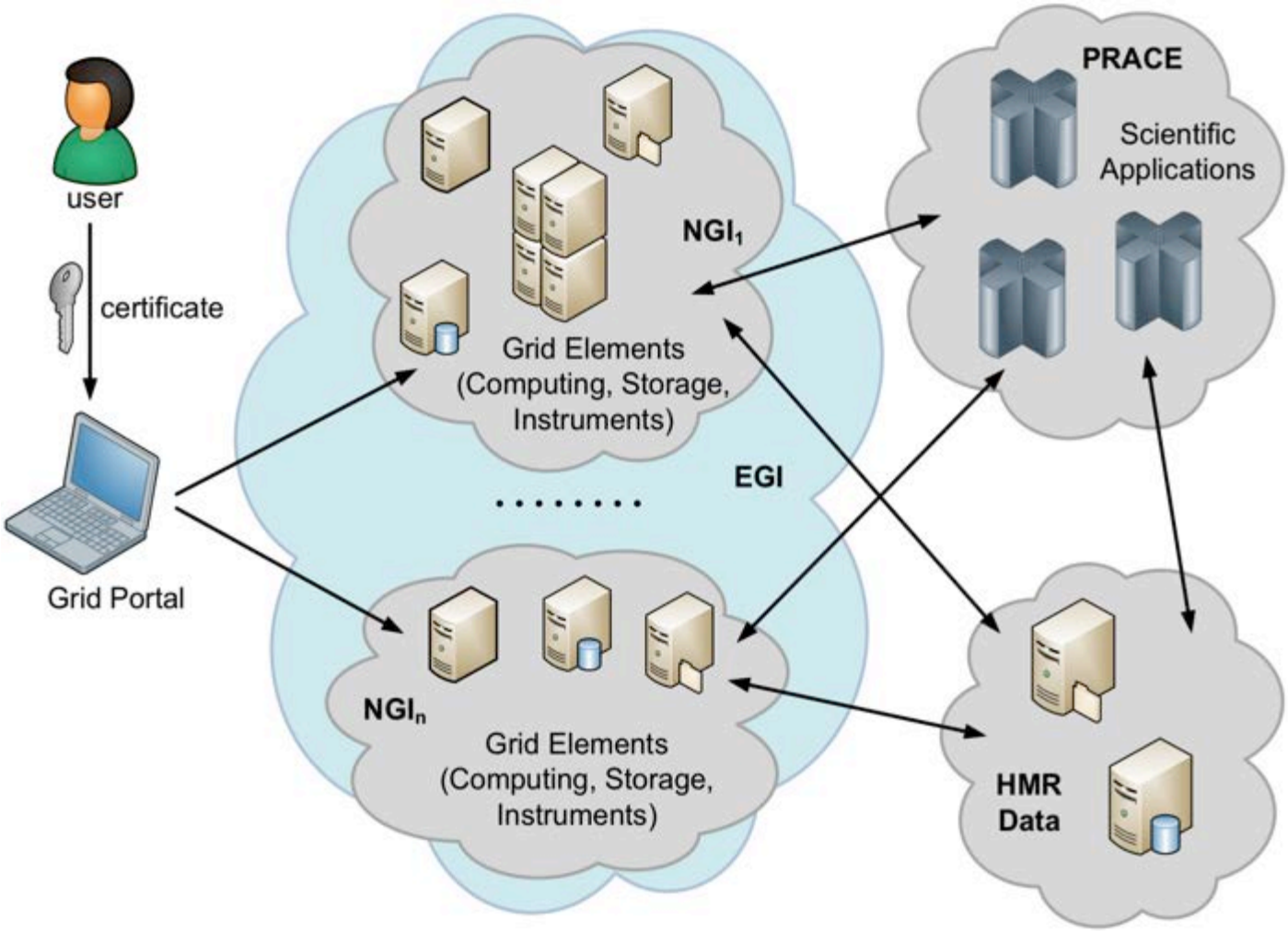


Experiment Suite 1
Rainfall

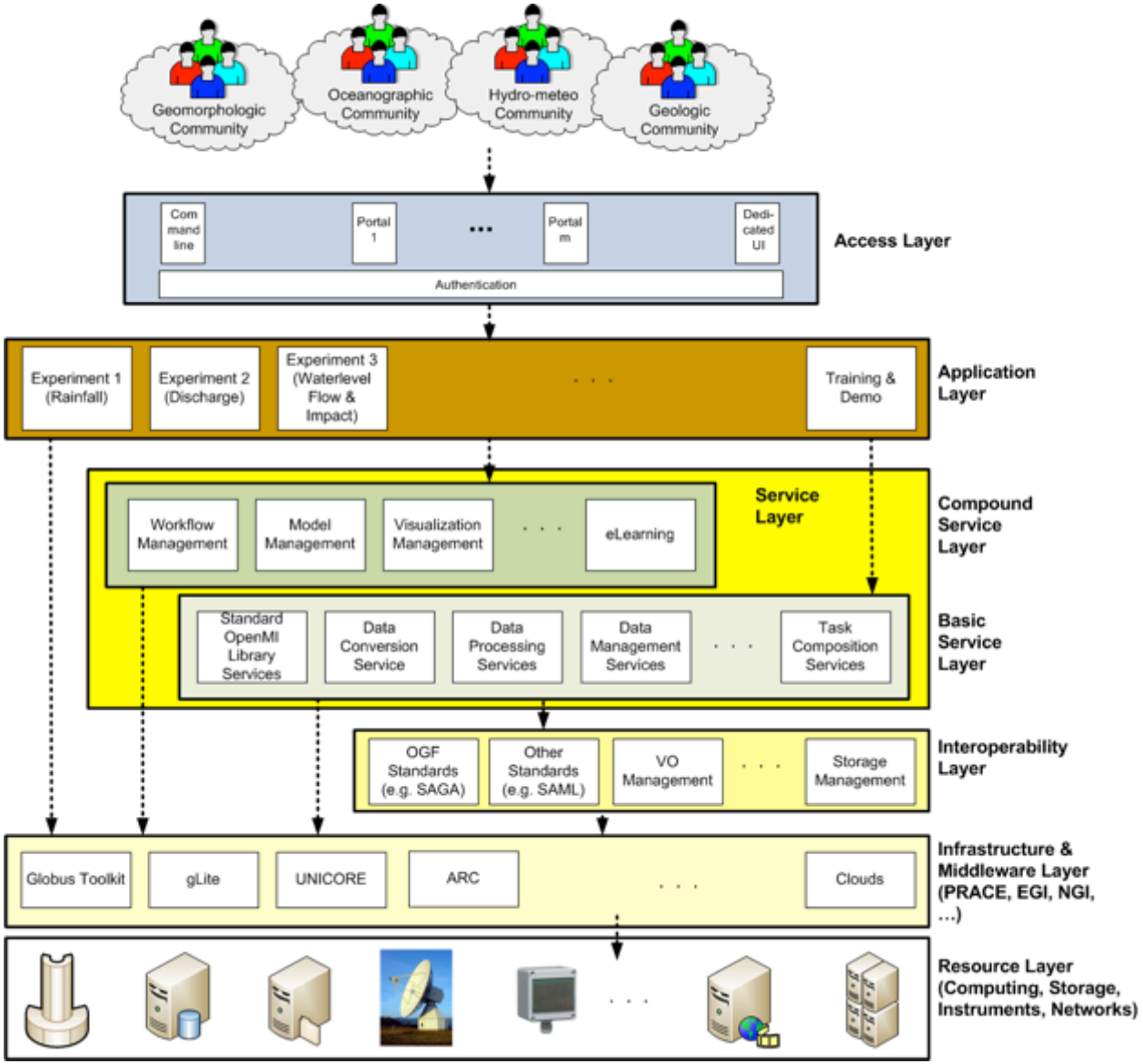
Experiment Suite 2
Discharge

Experiment Suite 3
Water Level,
Flow & Impact

DRIHM e-Science environment



The e-Science Environment Structure



The DRIHM Models

Meteorologic

- Cb-TRAM (DLR)
- Arome EPS (CNRS)
- Meso-NH (CNRS)
- RainFARM (CIMA)
- COSMO-Model (CIMA)
- WRF-ARW (CIMA)
- PhaSt (CIMA)
- WxFUSION (DLR)
- Rad-TRAM (DLR)
- WRF-NMM (RHMSS)

Hydrologic

- Contiuum (CIMA)
- DRiFt (CIMA)
- HBV (RHMSS)
- RIBS (UPM)
- HYPROM (RHMSS)

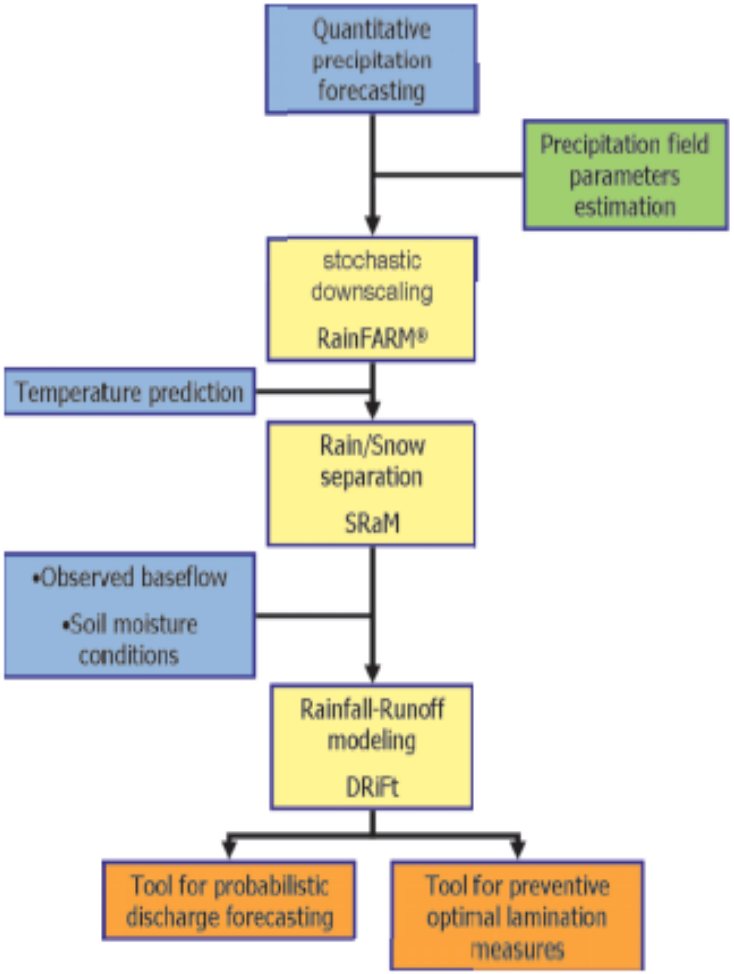
Impact

- SISYPHE (HR Wallingford)
- Property Damage (HR Wallingford)

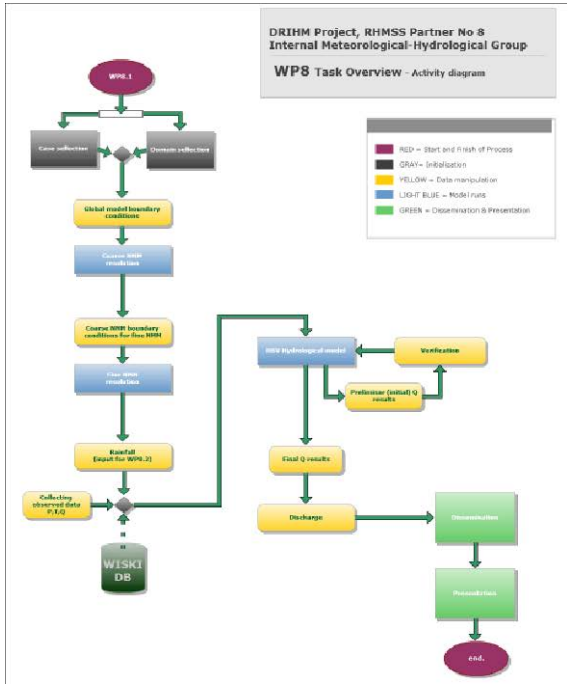
Hydraulic

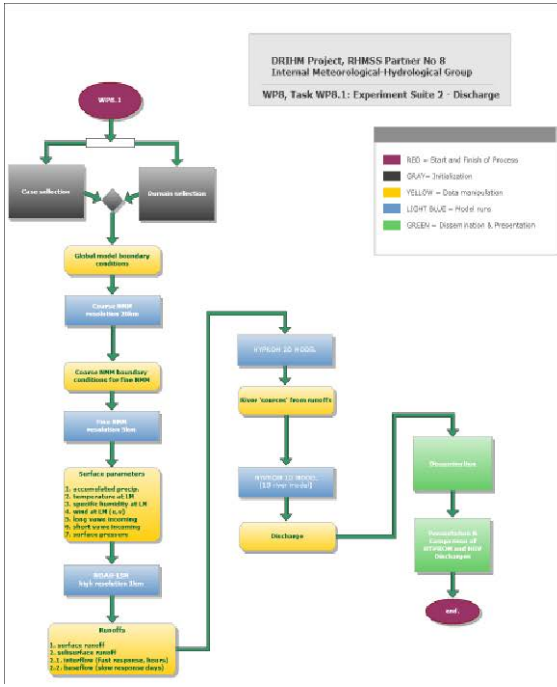
- MASCARET (HR Wallingford)
- SOBEK-FLOW (Deltares)
- TELEMAC-2D (HR Wallingford)
- RFSM (HR Wallingford)
- Delft3D-FLOW (Deltares)
- Inundator (CIMA)

The DRIHM baseline experiments



CIMA chain

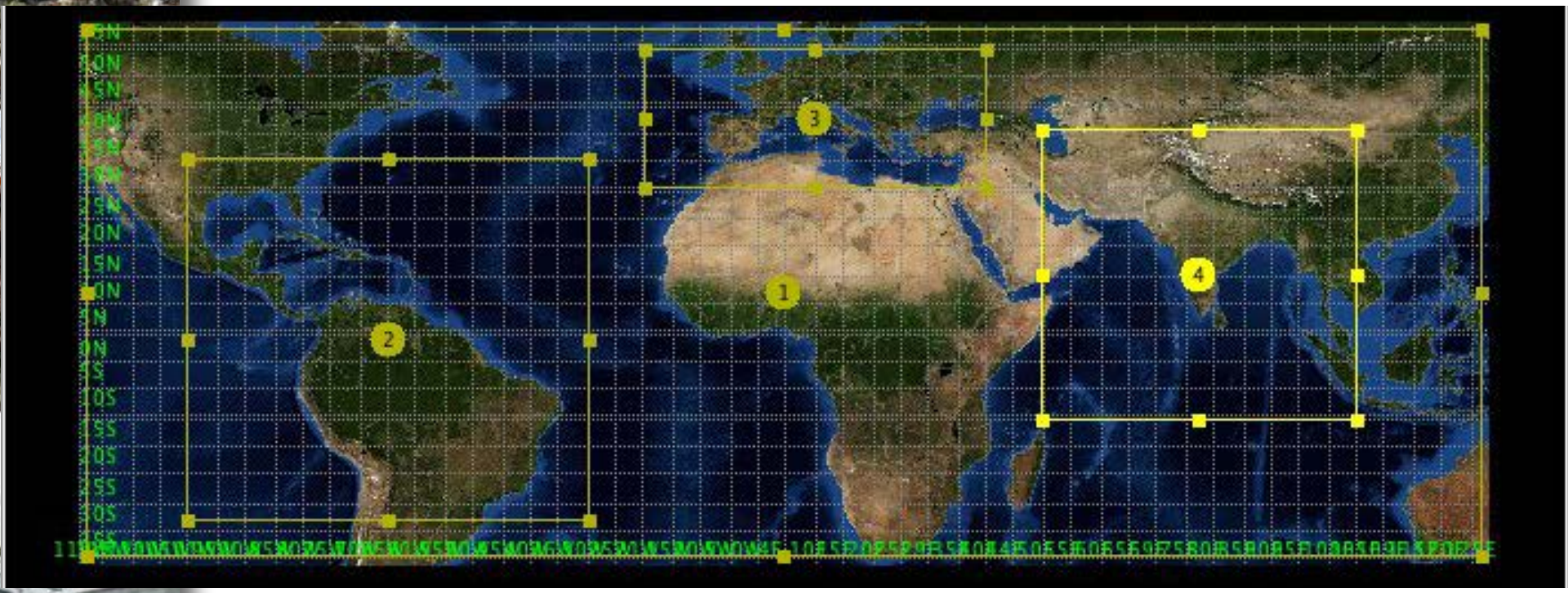




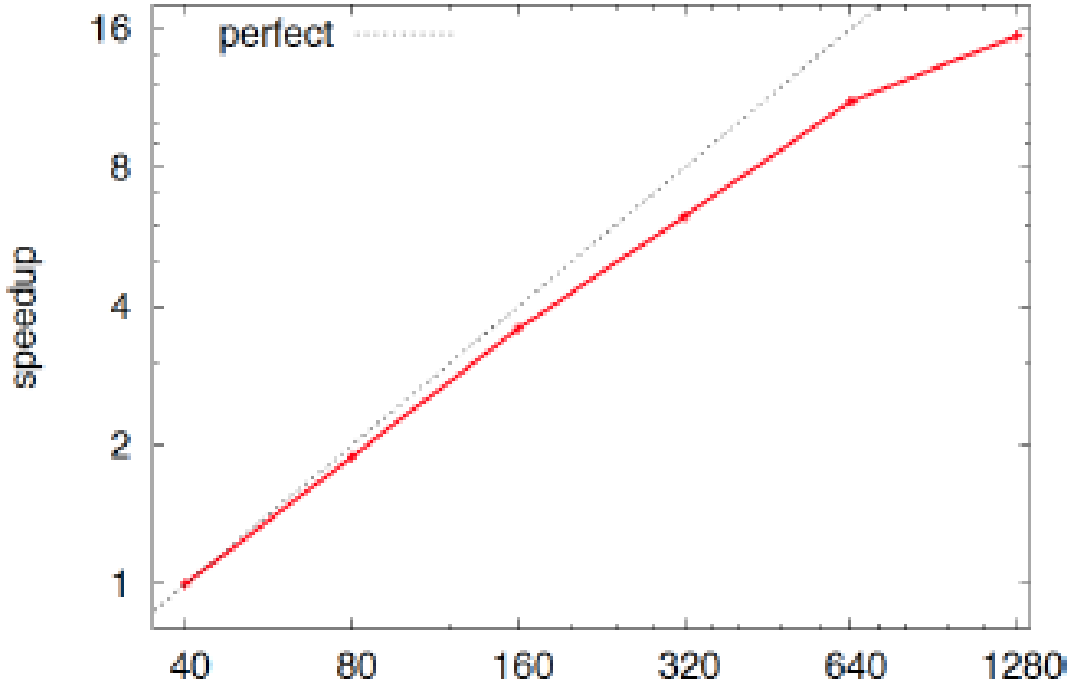
RHMSS chain

“Only” HYDRO-METEO RESEARCH? NO!

EXPRESS-HYDRO (EXtreme PREcipitation and Hydrological climate Scenario Simulations-HYDRO)



Run type	# Runs	# Steps/Run	Walltime/Step	# CPU cores	Total core hours/Type Run
1 (ERA-interim control)	102	19440	8.89 sec	1280	6.25 Mio core hours
2 (EC-Earth control)	102	19440	8.89 sec	1280	6.25 Mio core hours
3 (RCP 4.5 scenarios for 3 time slices)	3x102	19440	8.89 sec	1280	18.75 Mio core hours
4 (RCP 8.5 scenarios for 3 time slices)	3x102	19440	8.89 sec	1280	18.75 Mio core hours



First experiment

mp_physics = 3, 3, 3,
ra_lw_physics = 1, 1, 1,
ra_sw_physics = 1, 1, 1,
radt = 30, 30, 30,
sf_sfclay_physics = 1, 1, 1,
sf_surface_physics = 2, 2, 2,
bl_pbl_physics = 1, 1, 1,
bldt = 0, 0, 0,
cu_physics = 1, 1, 0,
cudt = 5, 5, 5,
isfflx = 1,
ifsnow = 0,
icloud = 1,
surface_input_source = 1,
num_soil_layers = 4,
sf_urban_physics = 0, 0, 0,
maxiens = 1,
maxens = 3,
maxens2 = 3,
maxens3 = 16,
ensdim = 144,
sst_update = 1,

Rain (WRF 0.25° x0.25°). July 1995

Rain (ERA-I 0.25° x0.25°). July 1995

Questions?