



THE DRIHM and DRIHM2US PARADIGM



*DRIHM and DRIHM2US are co-funded by the EC
under the 7th Framework Programme*



POLITÉCNICA



advancing the frontiers

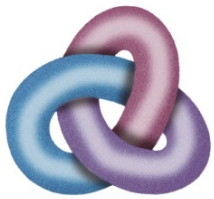




Outlook

- Motivations
- Mediterranean area and a paradigmatic event
- Scientific challenges
- Hydro-meteorology, science gateway and e-Infrastructure: DRIHM project
- DRIHM2US ... think globally





Motivations

- Severe storms, and floods/flash-floods are highly impacting on human society and economical activities



Flood			
	2013	2003-2012	
Occurrence	145	172	
Killed	9 545	5 689	
Affected	31 350 240	106 139 202	
Damage US\$ (in US\$ billion)	53.90	25.35	

Storm			
	2013	2003-2012	
Occurrence	95	99	
Killed	9 197	17 527	
Affected	48 629 303	30 638 289	
Damage (in US\$ billion)	47.84	58.90	

Earthquake (incl. Tsunami)			
	2013	2003-2012	
Occurrence	27	28	
Killed	1 120	67 882	
Affected	7 029 162	8 111 667	
Damage (in US\$ billion)	12.01	46.01	

Mass movement wet			
	2013	2003-2012	
Occurrence	11	18	
Killed	235	896	
Affected	1 031	344 166	
Damage (in US\$ billion)	—	0.15	

Drought			
	2013	2003-2012	
Occurrence	9	15	
Killed	—	39	
Affected	7 955 904	36 407 747	
Damage (in US\$ billion)	1.08	4.93	

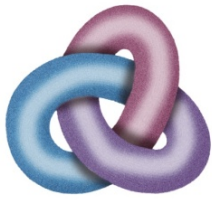
Wild fires			
	2013	2003-2012	
Occurrence	9	10	
Killed	34	72	
Affected	8 381	211 967	
Damage (in US\$ billion)	—	2.55	

Extreme temperature			
	2013	2003-2012	
Occurrence	15	25	
Killed	2 102	14 435	
Affected	270 016	9 011 290	
Damage (in US\$ billion)	—	3.83	

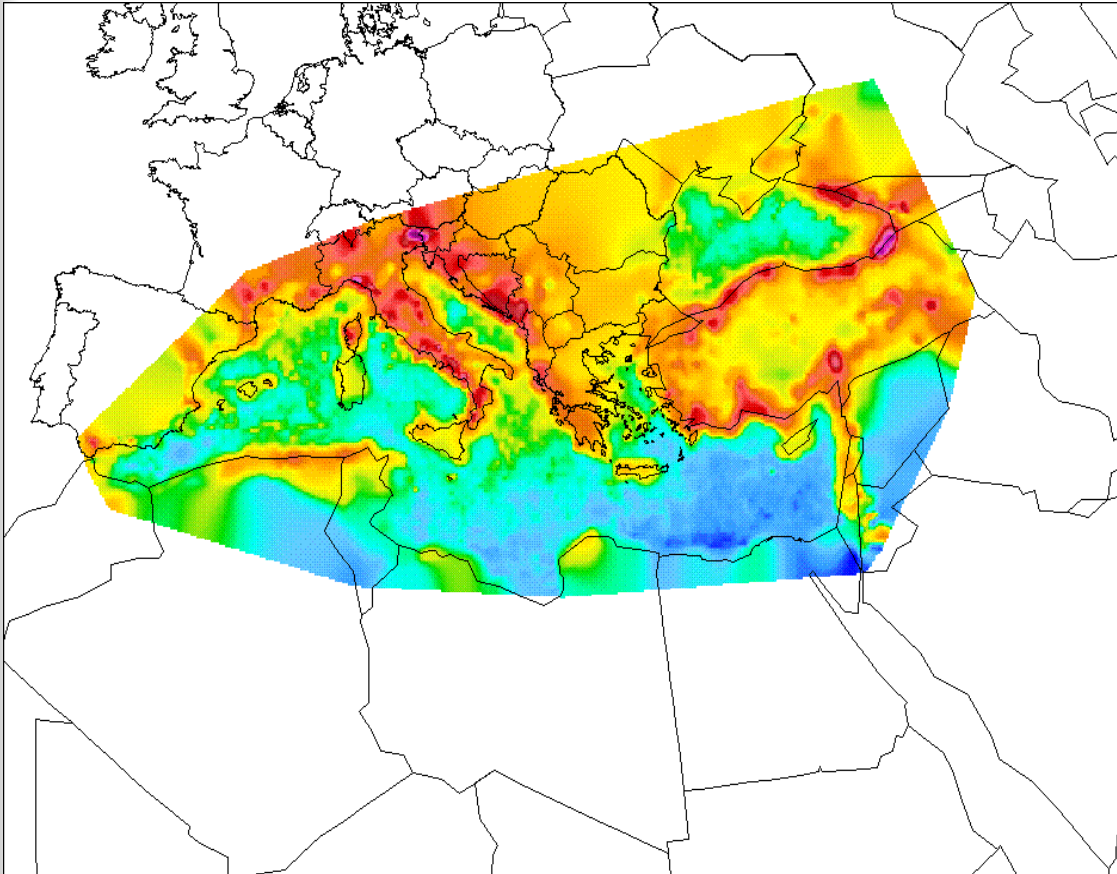
Mass movement dry			
	2013	2003-2012	
Occurrence	1	1	
Killed	46	23	
Affected	2	408	
Damage (in US\$ billion)	0.048	—	

Volcano			
	2013	2003-2012	
Occurrence	3	6	
Killed	—	36	
Affected	105 106	116 207	
Damage (in US\$ billion)	—	0.015	





The Mediterranean region



SSMI and rain gauge
observations
1978-1994

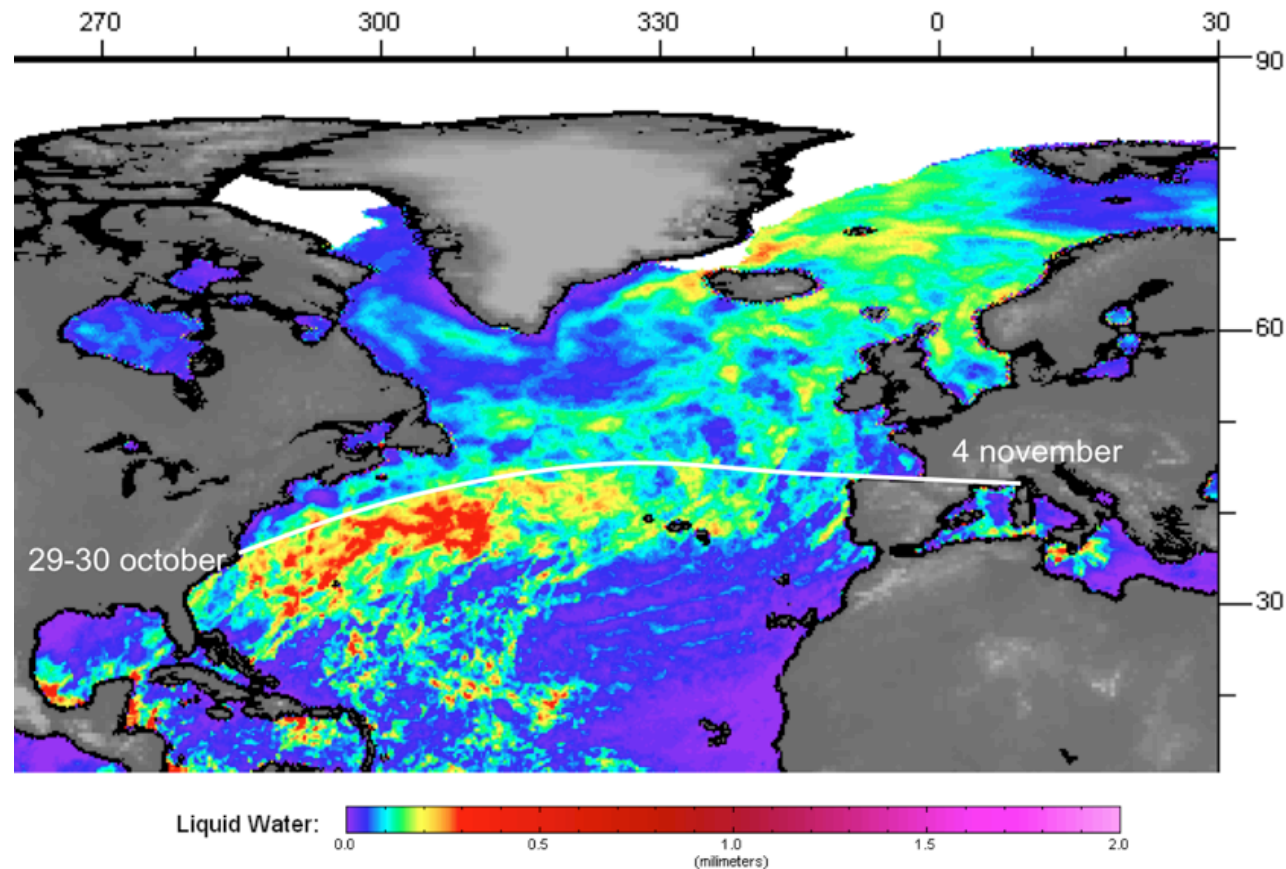
- The FLASH project estimated over 29 billion euros the material damages produced by floods in the Mediterranean region during the 1990-2006 period
- The total number of casualties has been estimated over 4,500, concentrating in the Mediterranean African countries.



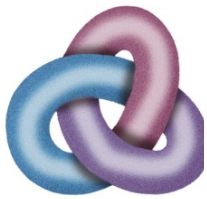


And the rest of the world

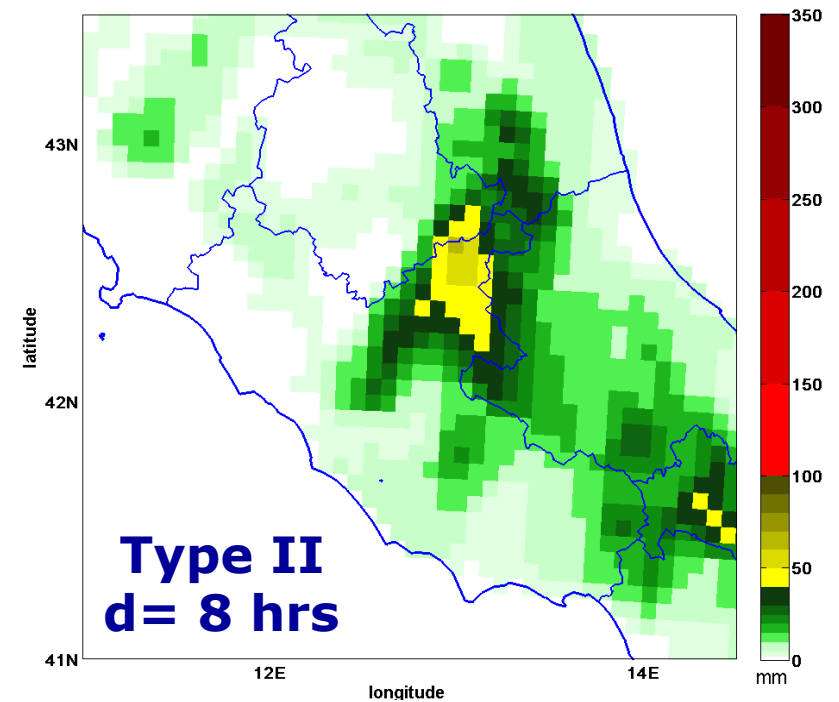
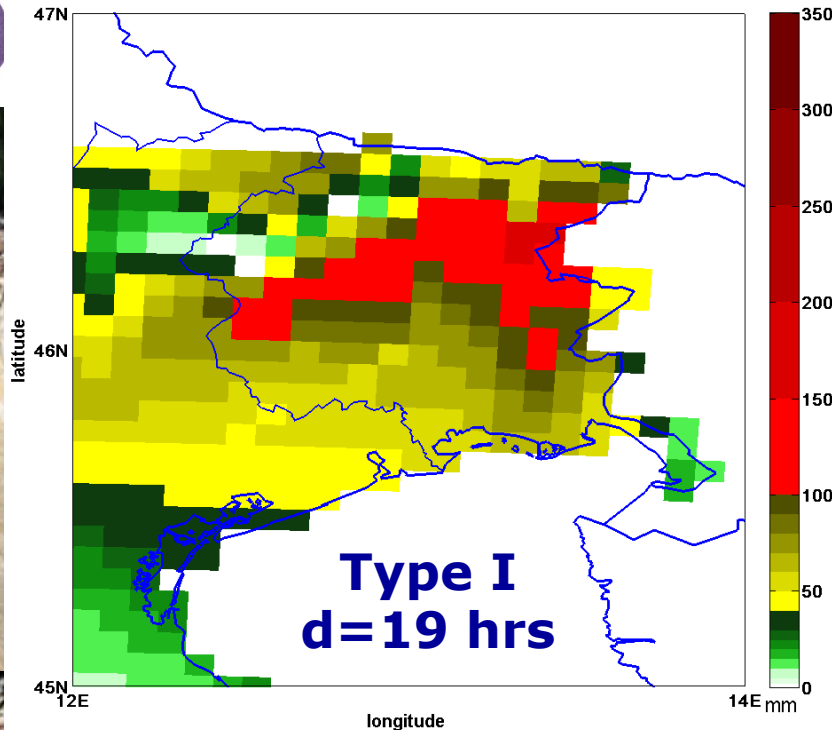
Storms do not respect country boundaries – a pan-European approach to data access and modeling is necessary



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



Severe events classification



Type I events:

- Long-lived (lasting more than 12 hours)
- Spatially distributed (more than 50x50 km²)

Type II events:

- Brief and localized (lasting less than 12 hours)
- Spatially concentrated (less than 50x50 km²)



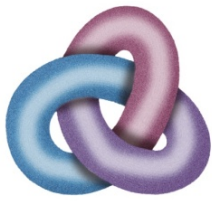
A Mediterranean critical case

Genoa 2011 flash-flood

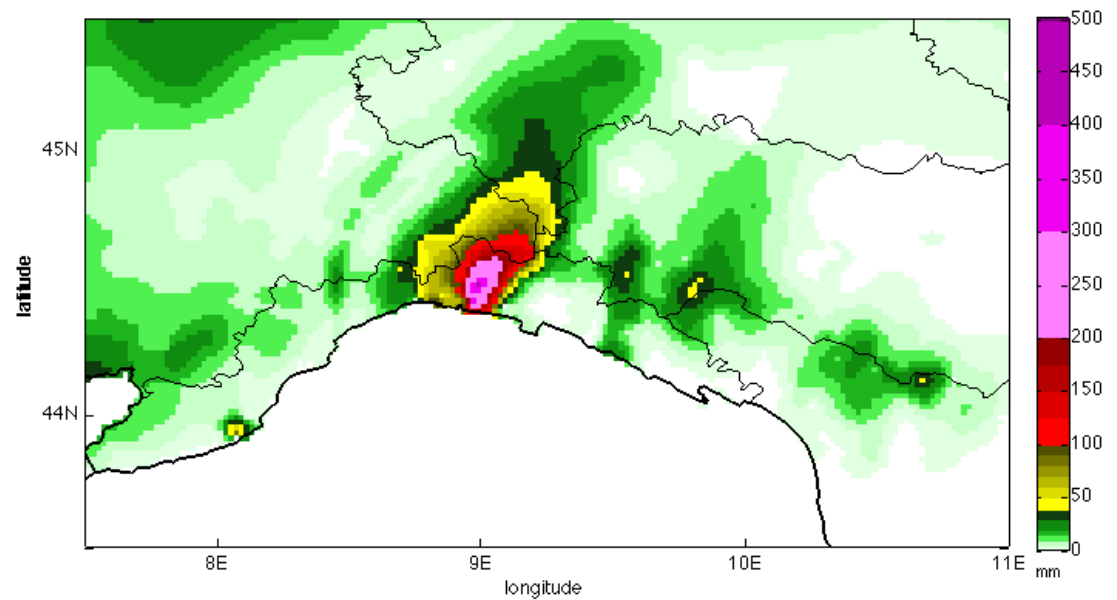
On November 4th, the city of Genoa, Liguria region capital, was gutted by a torrential rainfall event with about 500 millimeters of rain – a third of the average annual rainfall - fell in 5 hours (between 10 and 15 UTC). Six people were killed. Television footage showed cars floating freely and people wading knee-deep through flooded streets.



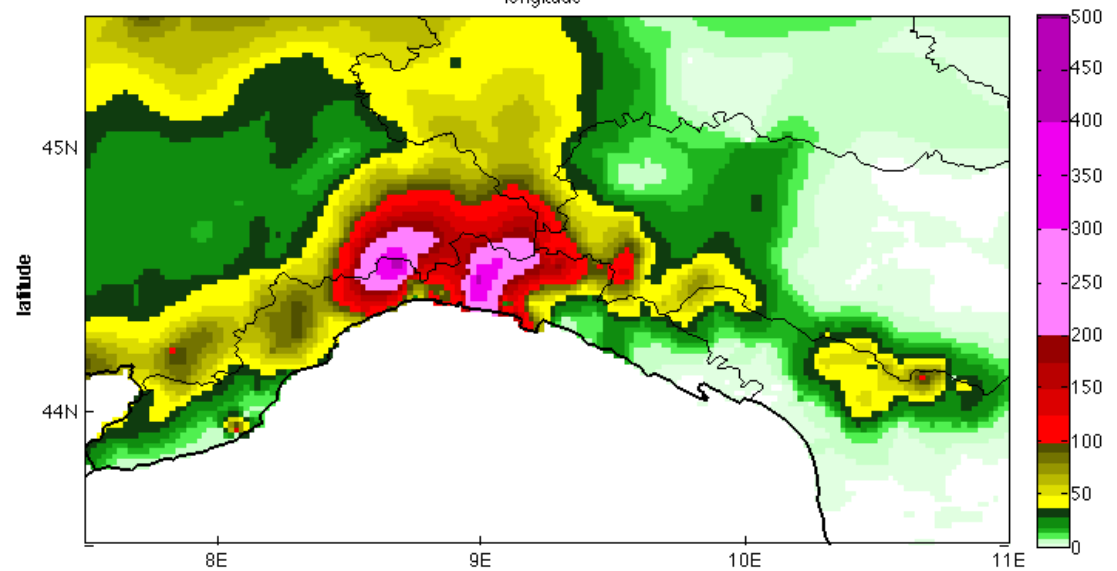
Flash flood of the Genoa town center. Top right corner: the similar event of 1970

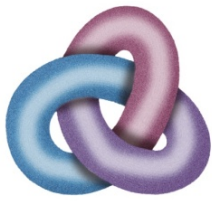


**Observed rainfall
depth 9-15 UTC**

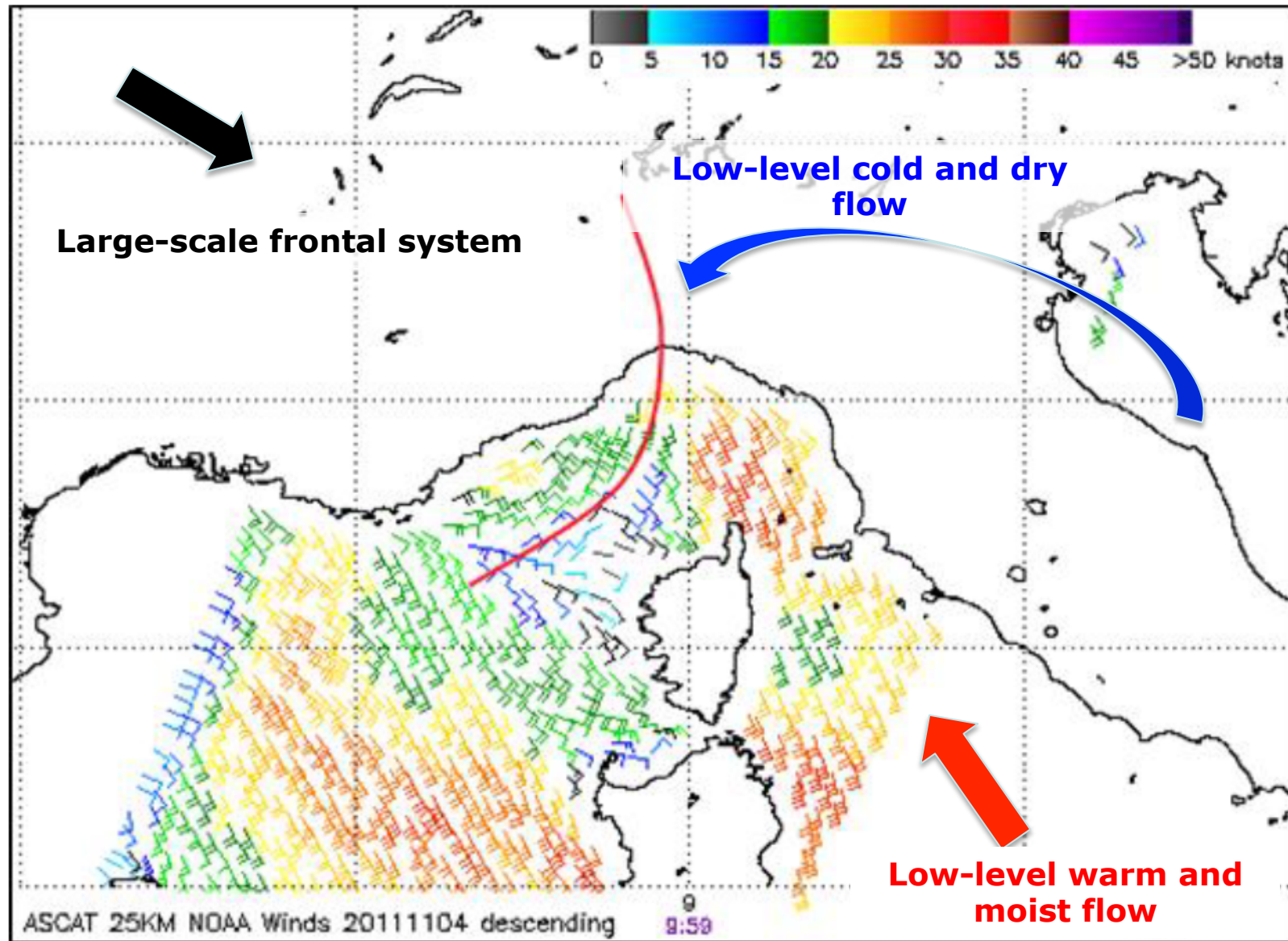


**Observed rainfall
depth 0-24 UTC**

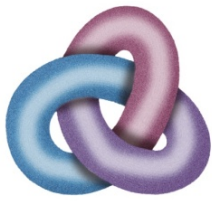




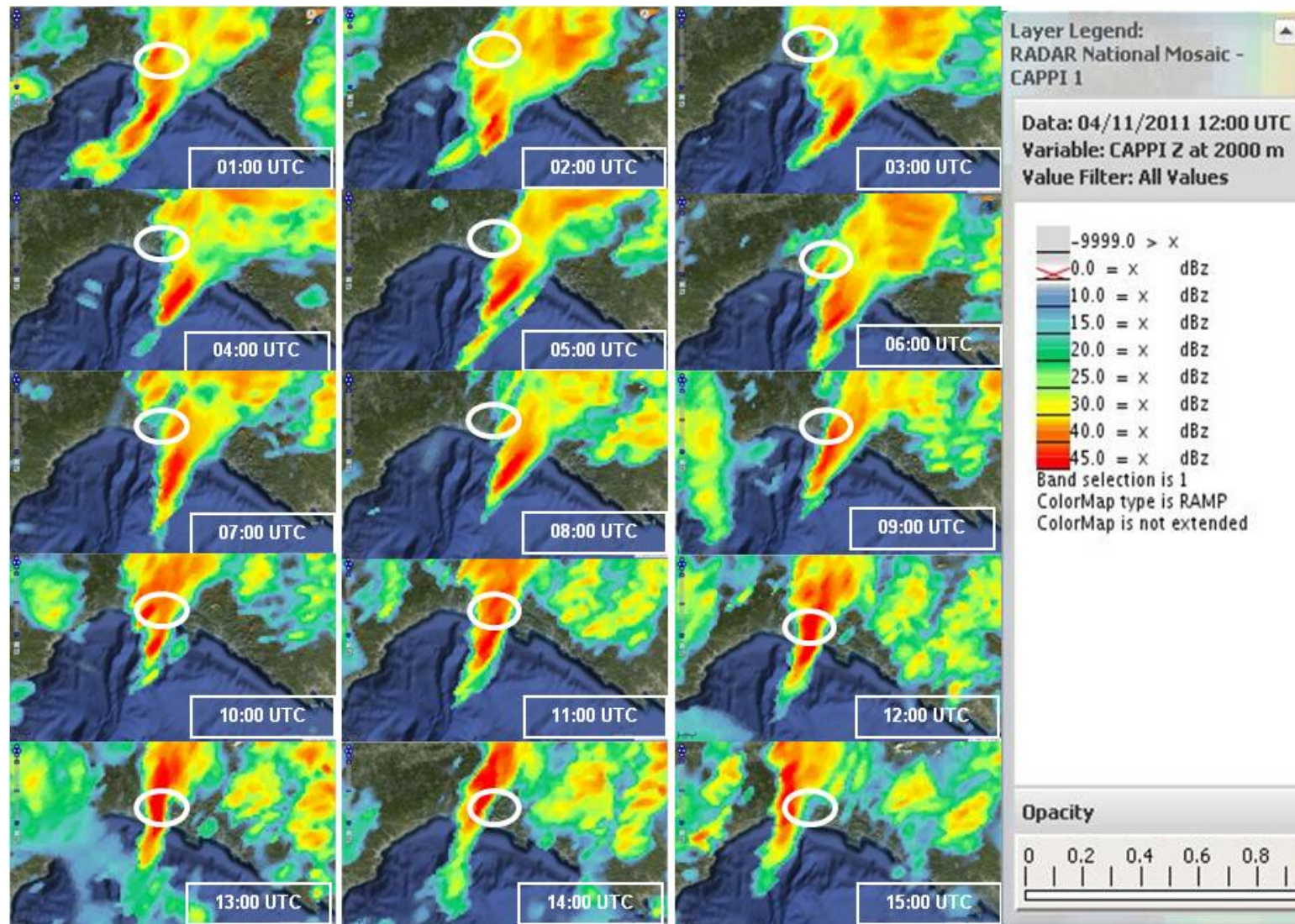
A multiscale severe event: mesoscale



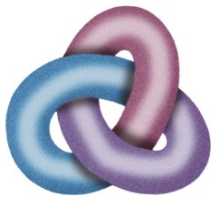
Advanced Scatterometer (ASCAT) ocean surface wind vectors data of 25km resolution, on november 4th 2011, descending pass (10 UTC)⁹



A multiscale severe event: mesoscale

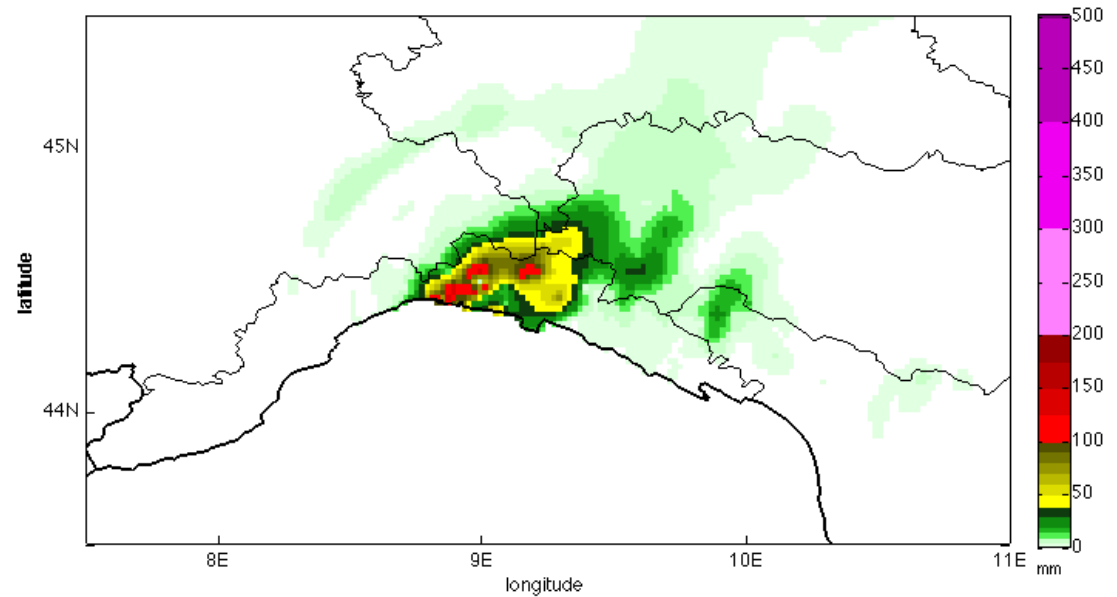


Radar maps from the Italian radar network showing the intense thunderstorm wandering along the Liguria coastline (1-15UTC): White ellipsoid identifies the mostly affected area

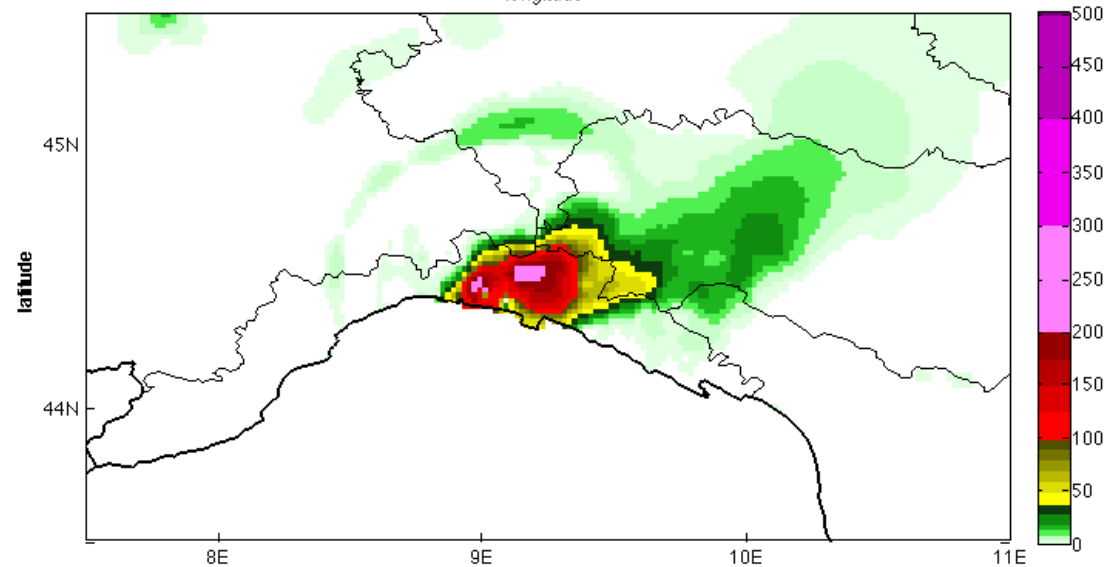


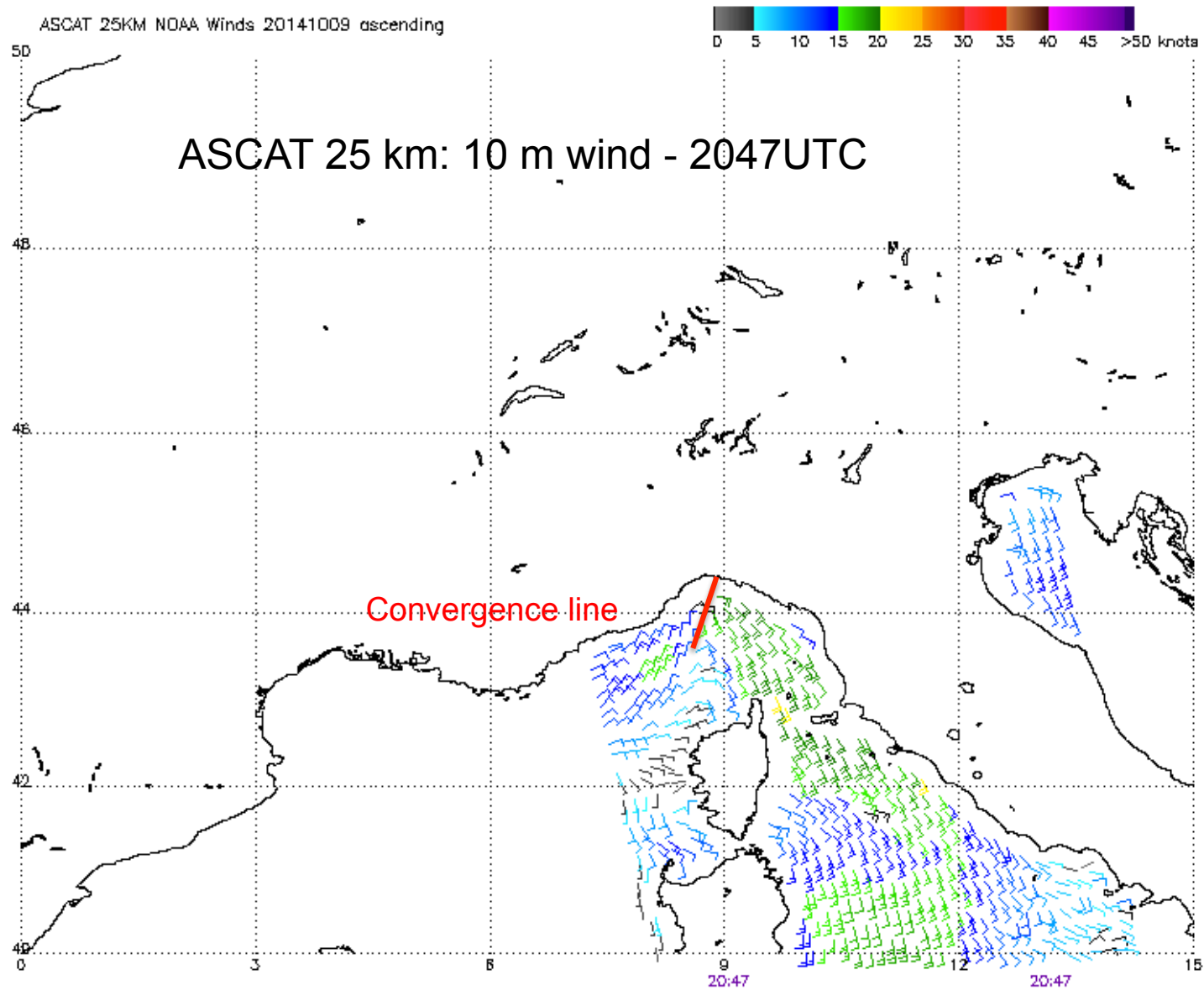
Another flash-flood critical case: Genoa 9 october 2014

**Observed rainfall
Depth 00-12 UTC**



**Observed rainfall
depth 12-24 UTC**





Note: 1) Times are GMT 2) Times along bottom correspond to measurement at 45N
3) Data buffer is 22 hrs from 20141009 4) Black circles indicate possible contamination
NOAA/NESDIS/Office of Research and Applications

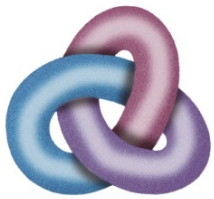


Scientific challenges

All together, these events 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 scientific gateway solutions, easy model coupling, grid computing and petascale computing systems, to provide deeper understanding of those events.*





Conceptual showcase

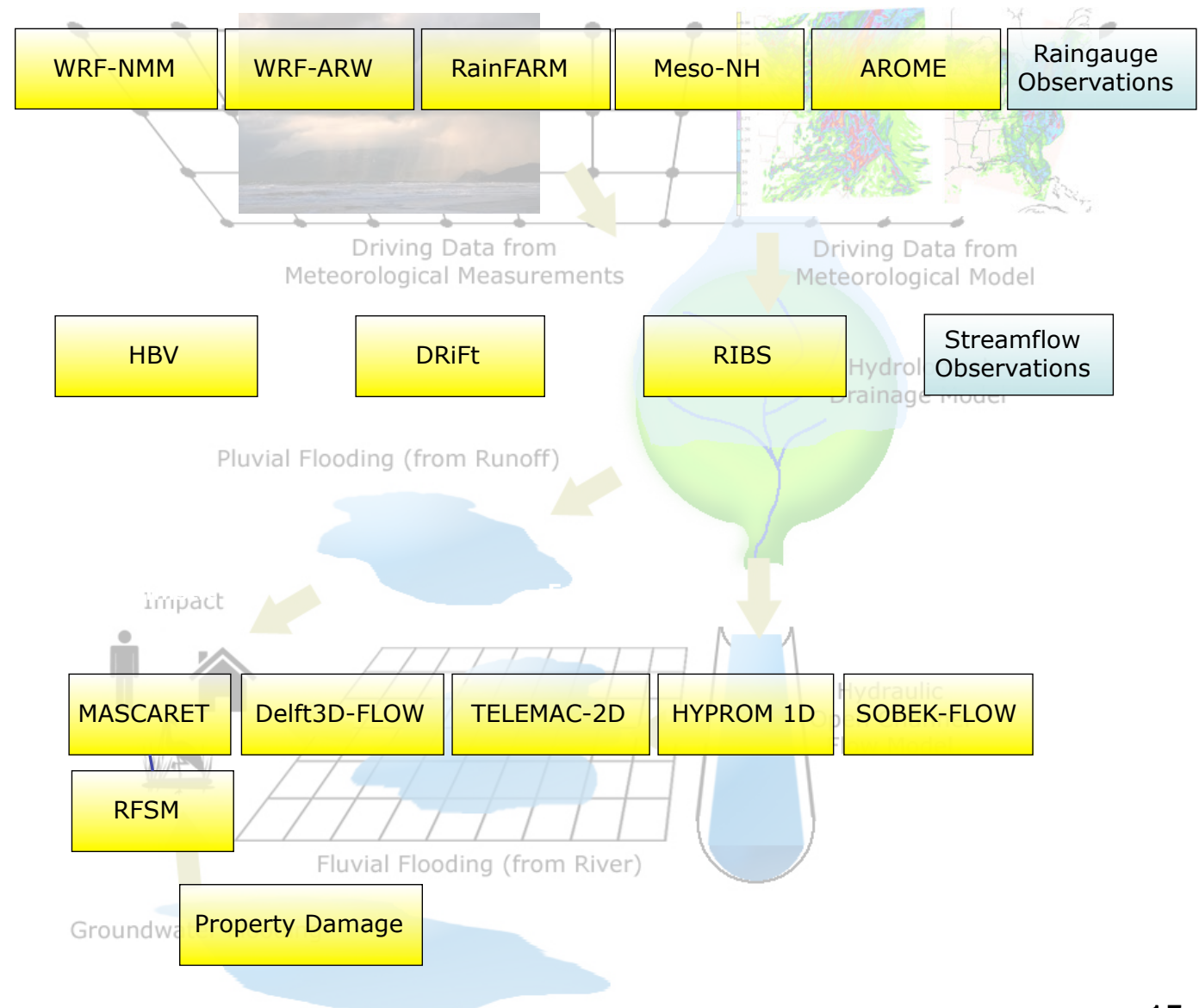


Rainfall

Discharge

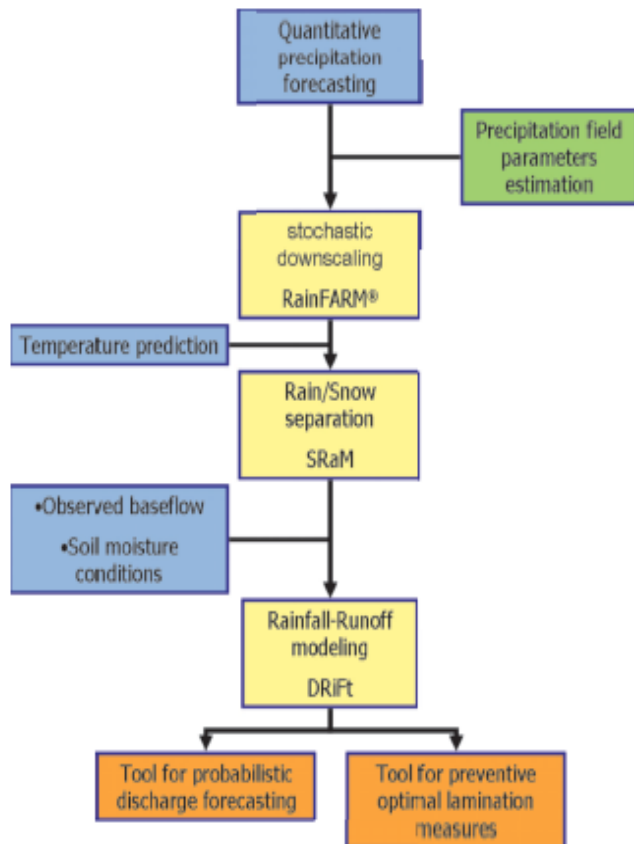
Water Level

Impact

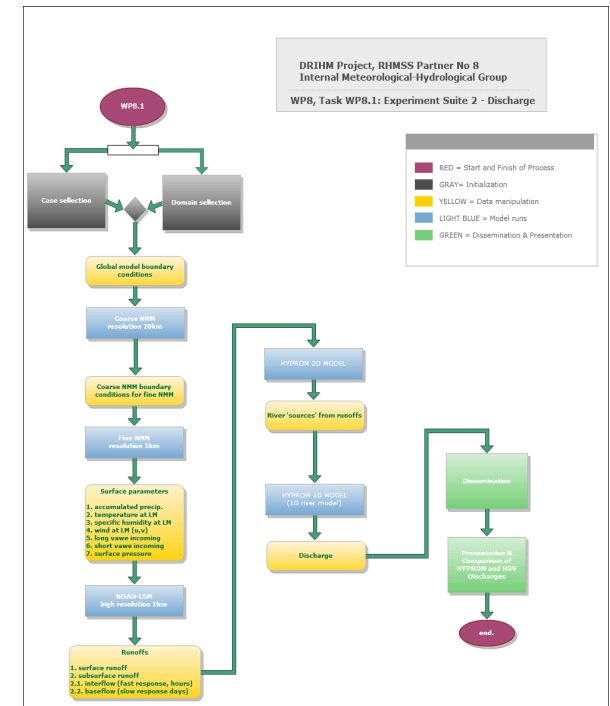
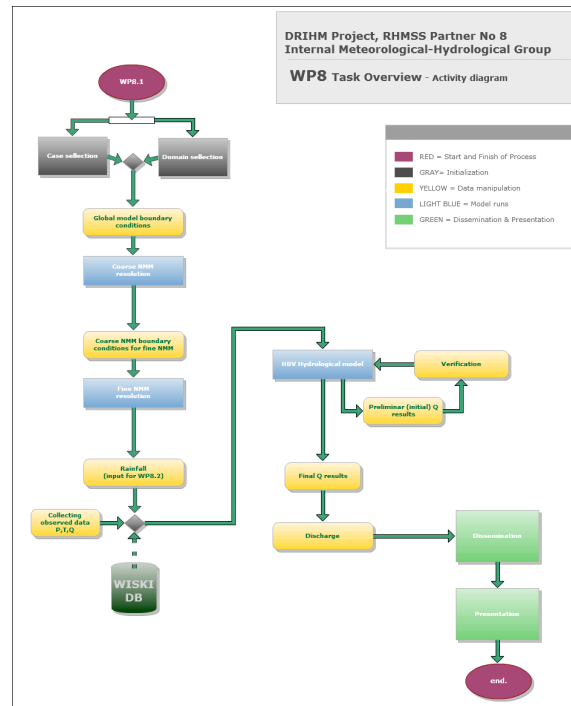




The ICT-HMR challenge...



CIMA baseline chain



RHMSS baseline chain



Requirements collection & Limitations today¹⁶



Outlook

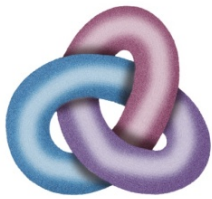
HRM chains are usually clumsily stitched together so that it is ONLY model i (of level 1) and model j (at level 2) and model k (at level 3) that fit together because somebody worked for many years to get it together.

Adding another data set, replacing model j by model j_2 , finding out sensitivities etc is tedious and thus hampers progress.

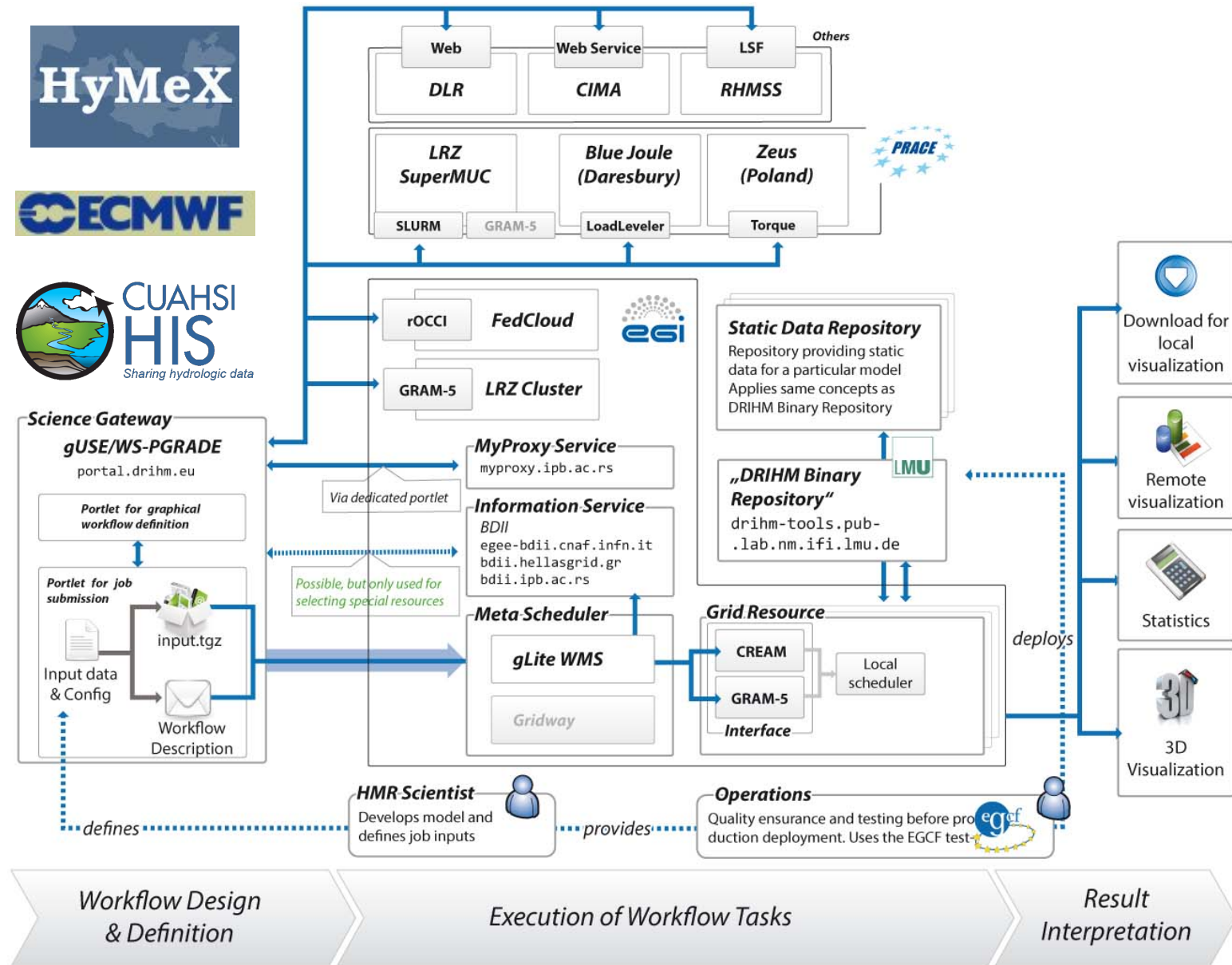
DRIHM makes possible to work in a modular environment.

DRIHM provides an e-science environment for this goal.

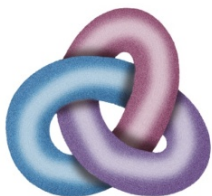




DRIHM DCI



Talk M. Schiffers 18
1400-1425



Current step: WRF-ARW

Previous step: Select Basin

Next step: Rainfarm

Domain Time Control Run Option Physics Option Diffusion and Dynamics Option Submit

Current step: WRF-ARW

Previous step: Select Basin

Domain Time Control Run Option Physics Option Diffusion and Dynamics Option Submit

Time Step: 25
Parallelism degree: 64
E_Vert: 84
Number of Metgrid level: 26 - IFS (Integrate Forecast System), PS (Pressure Levels) \updownarrow
P Top Requested: 5000 \updownarrow

Current step: WRF-ARW

Previous step: Select Basin

Domain Time Control Run Option Physics Option Diffusion and Dynamics Option Submit

Microphysics option: 8 - Thompson graupel scheme \updownarrow
Longwave radiation option: 3 - CAM scheme \updownarrow
Shortwave radiation option: 3 - CAM scheme \updownarrow
Surface Layer option: 1 - Monin-Obukhov Similarity scheme \updownarrow
Land Surface Option: 2 - Noah Land-Surface Model \updownarrow
Urban Physics Option: 0 - No active urban canopy model. \updownarrow
Boundary Layer Option: 1 - YSU scheme. \updownarrow
Cumulus Option: 1 - Kain-Fritsch (new Eta) scheme \updownarrow
Soil Layers Number: 2 - Pleim-Xiu \updownarrow
Radiation time step: 5

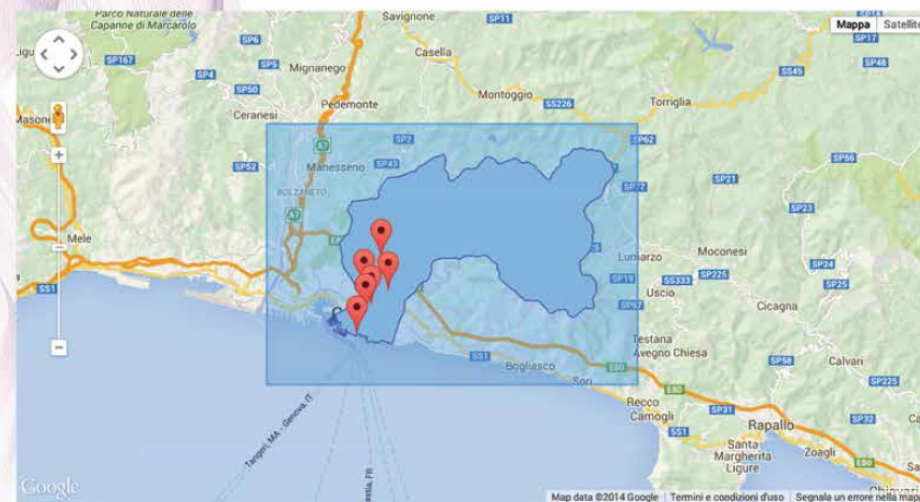
Current step: Ribs

Previous step: Rainfarm

Next step: Experiment Summary

General Model Specific Submit

Basin: Bisagno2



Description
Second version of Bisagno model instance for RIBS.



Mouse position: exited!

Selected Domains:

SW: 43.8401,7.8827 --- NE:45.1526,10.2118 Delete

SW: 44.1562,8.3551 --- NE:44.8457,9.6735 Delete

Event Genoa 2011 \updownarrow

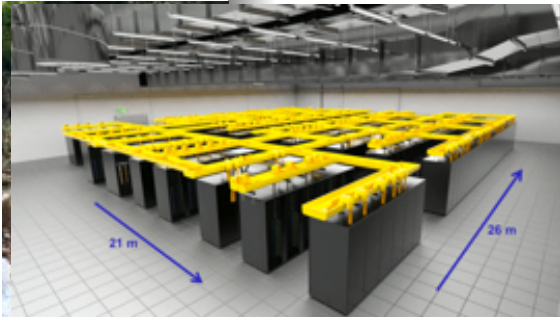
Grid Spacing (degrees) 0.045

Parental grid ratio 3 (suggested) \updownarrow

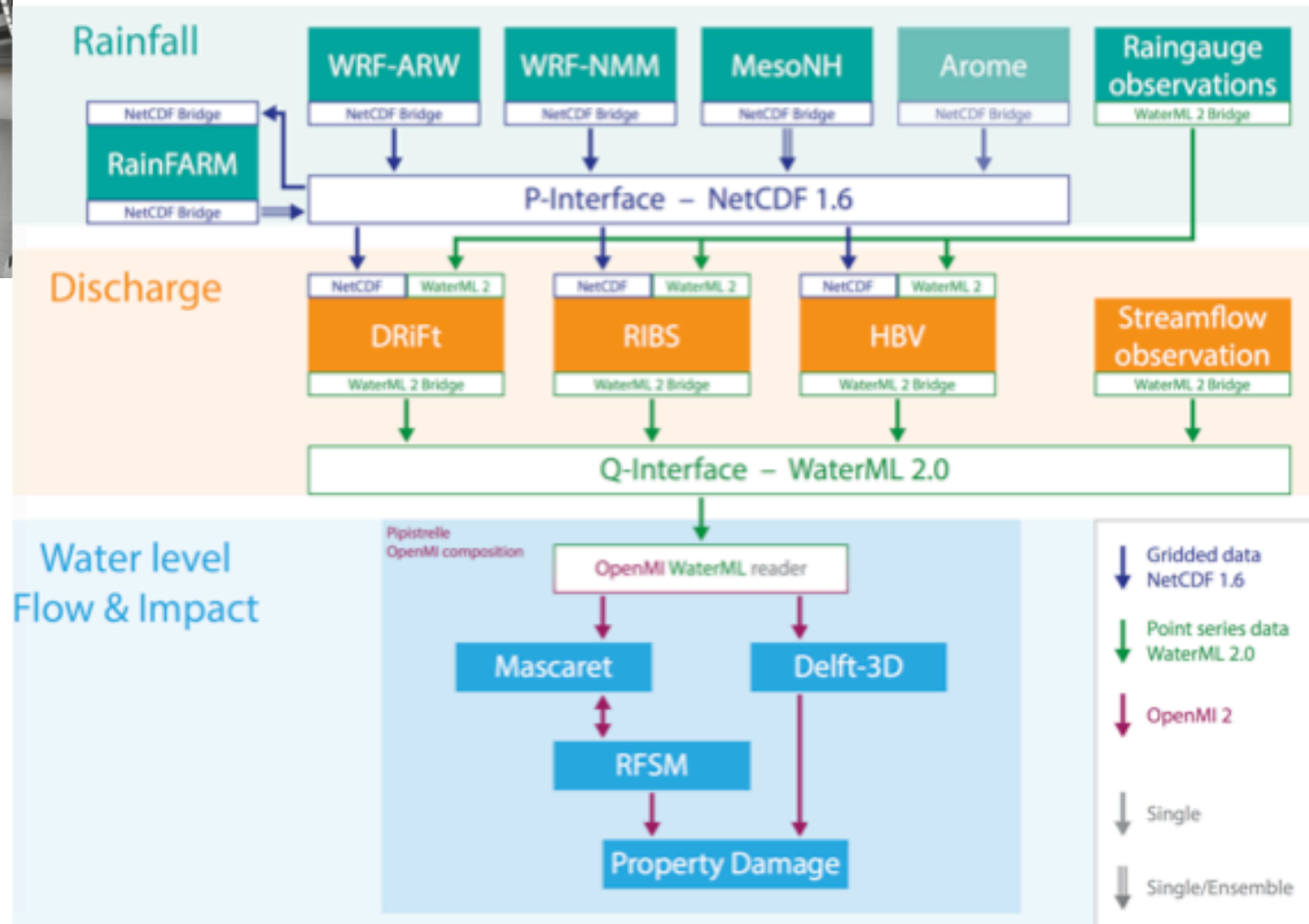


DRIHM Model Chains

HPC



HTC



Talk Q. Harpham²⁰
1025-1100



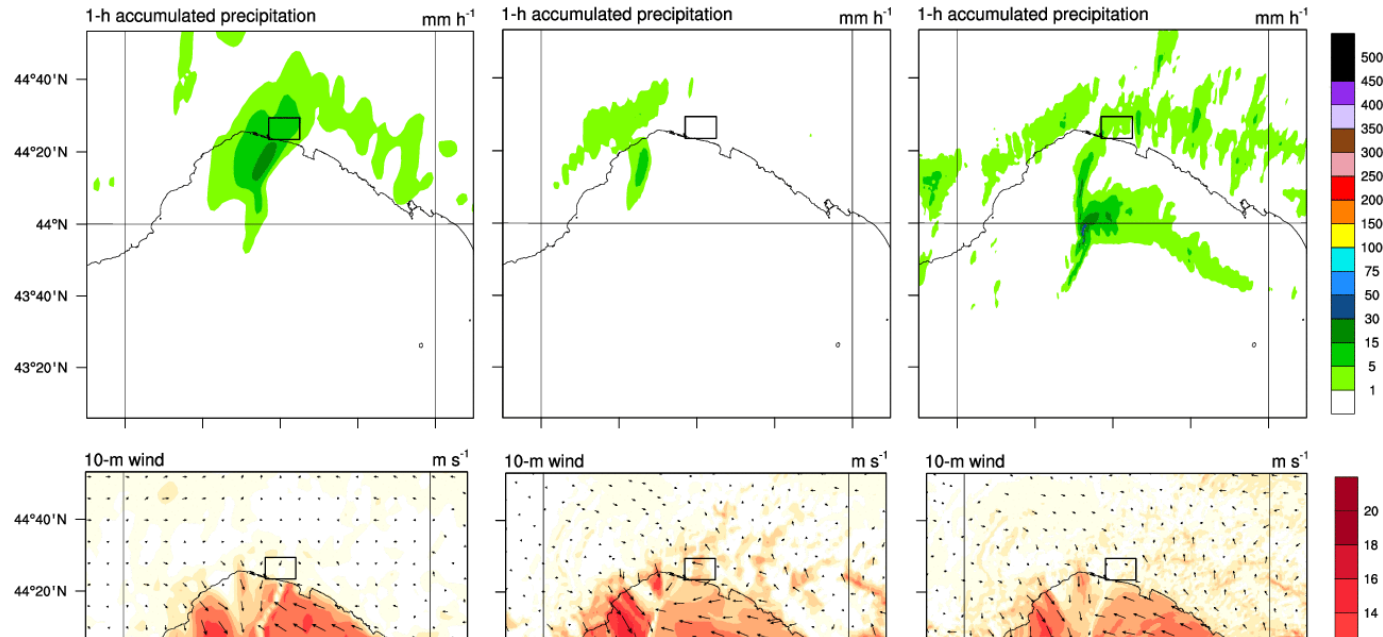
The happy end...



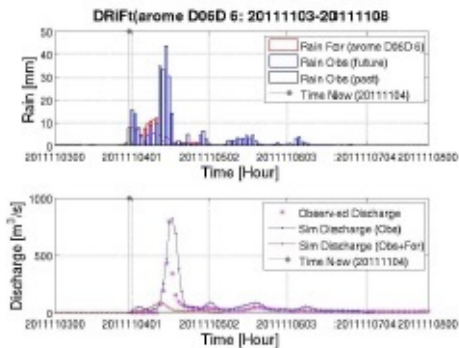
Arome D06D_6 - 01 UTC 4 Nov 2011

WRF83 - 01 UTC 4 Nov 2011

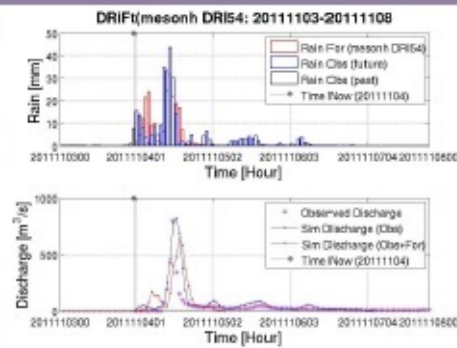
Meso-NH DRI54 - 01 UTC 4 Nov 2011



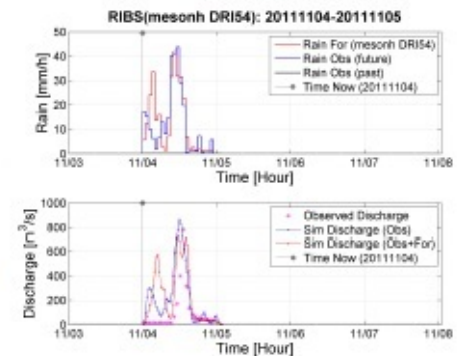
DRIFT driven by an Arome ensemble member



DRIFT driven by a Meso-NH ensemble member



RIBS driven by a Meso-NH ensemble member

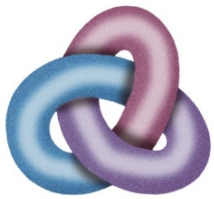


Compare with other
rainfall source

Compare with other
hydrological model

Talk O. Caumont²¹
1120-1150

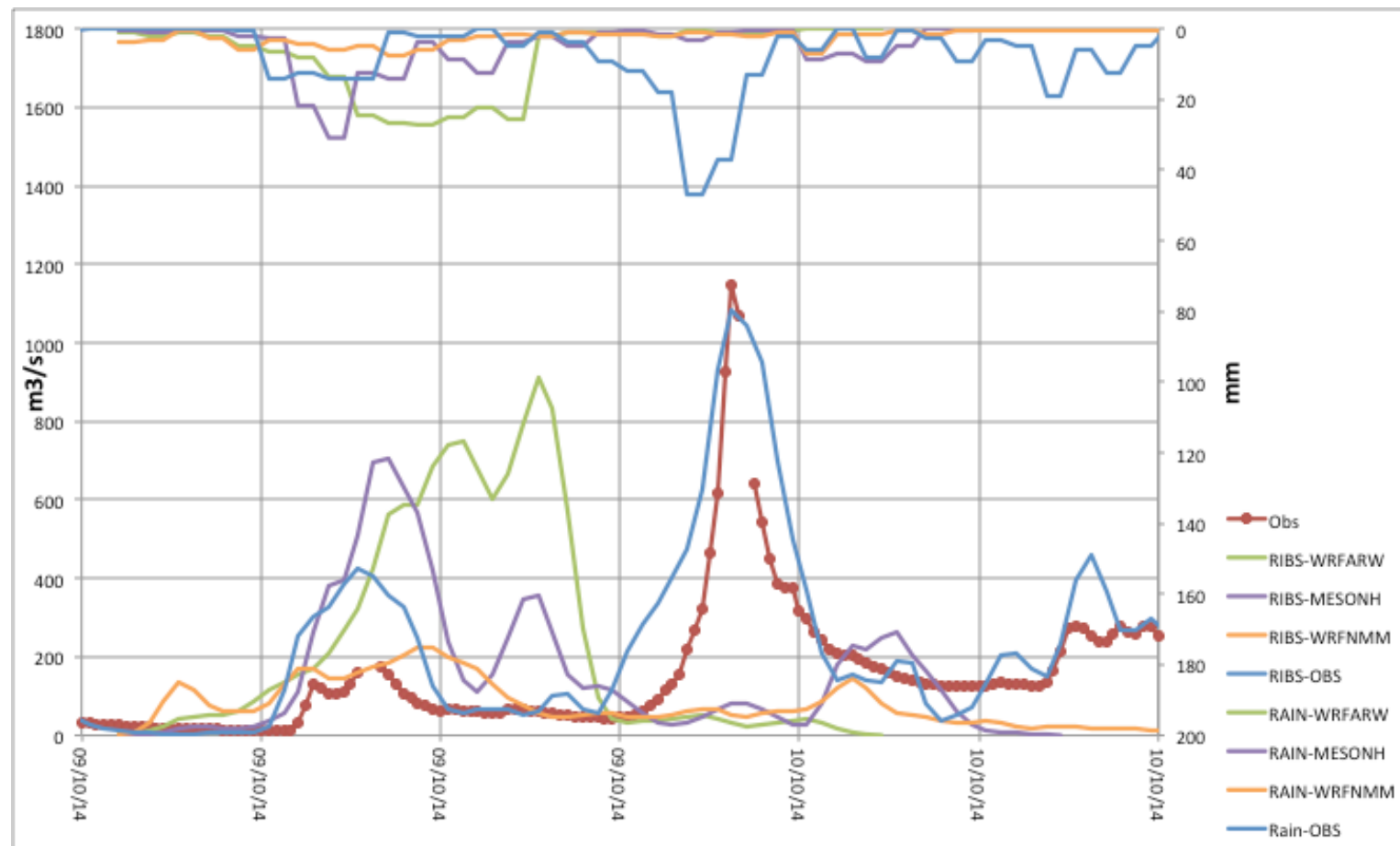


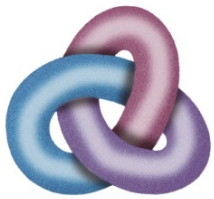


Genoa 2014 case

On October 9th, 2014, a new flash-flood event took place in Genoa city center, affecting to a large extent the very same place of the event of 2011.

The DRIHM e-Science environment allowed to run a fast post-event analysis





Also for citizen scientists



DLR - DRIHM - Cb-TRAM

Temporal Selection

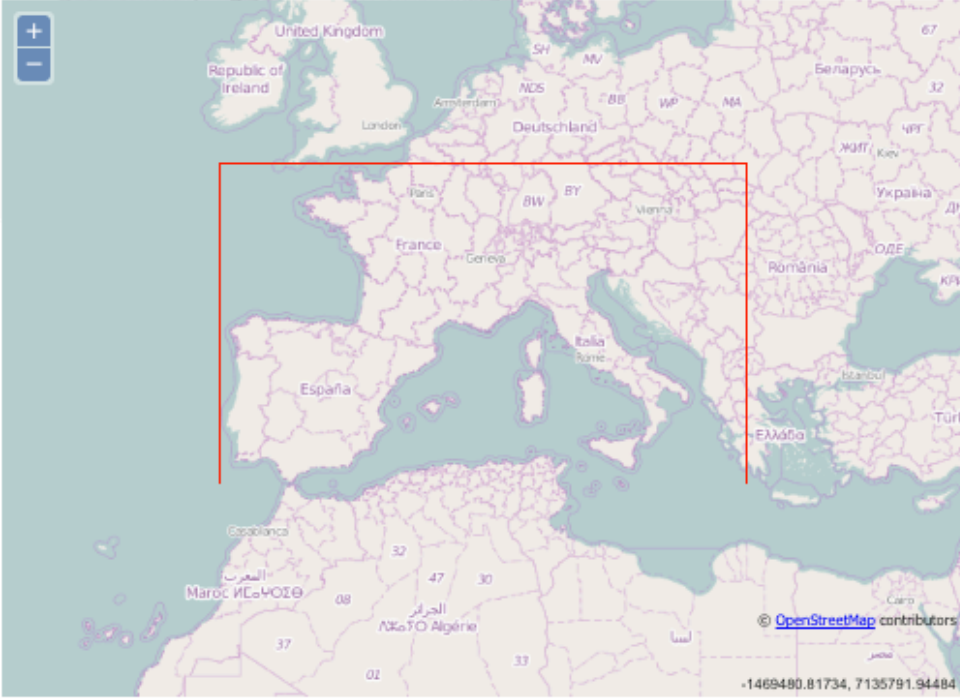
Please note that it takes approximately 2 minutes to calculate one hour of Cb-TRAM results

Selected Date: 2014/10/09

Start Hour: End Hour:

Map Selection

Select a spatial range using the mouse + SHIFT button.



Longitude Min: Latitude Min:

Longitude Max: Latitude Max:

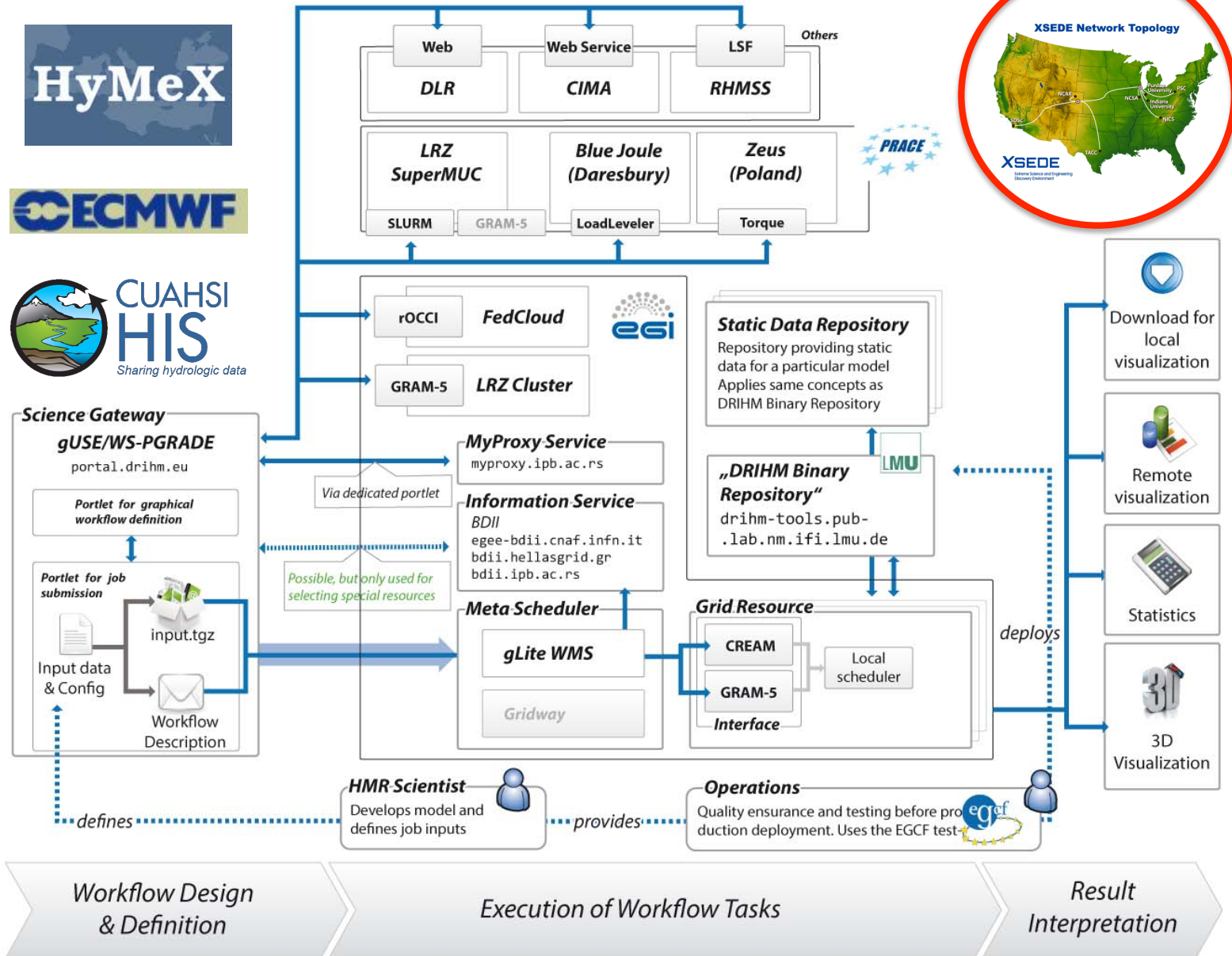
Additional options

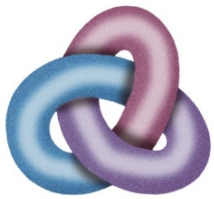
Hover mouse over controls for instructions

Talk A. Tafferner
1215-1230



DRIHM2US ... think globally

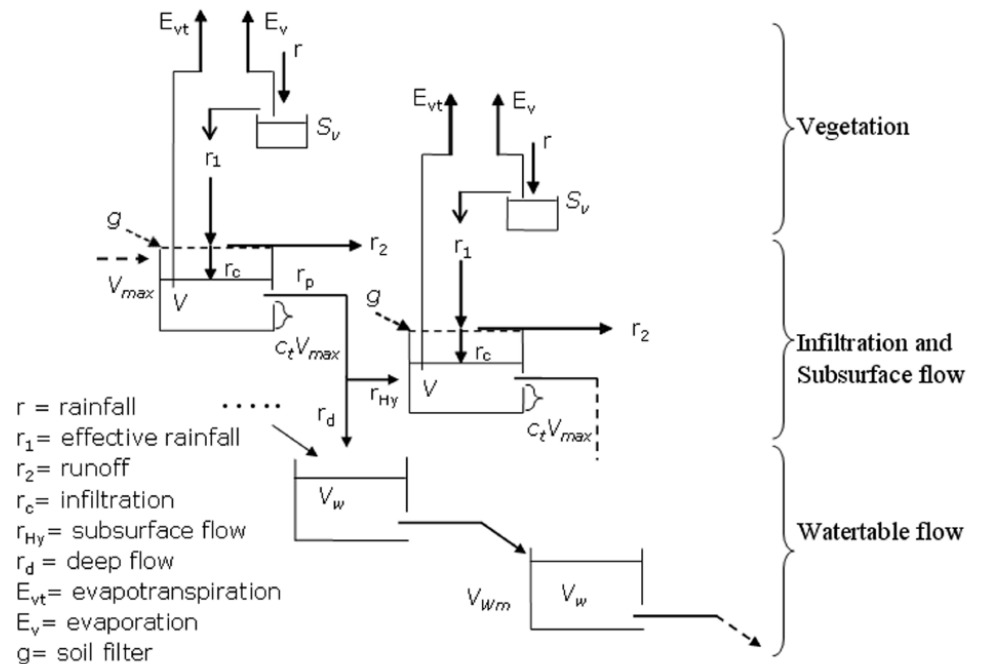
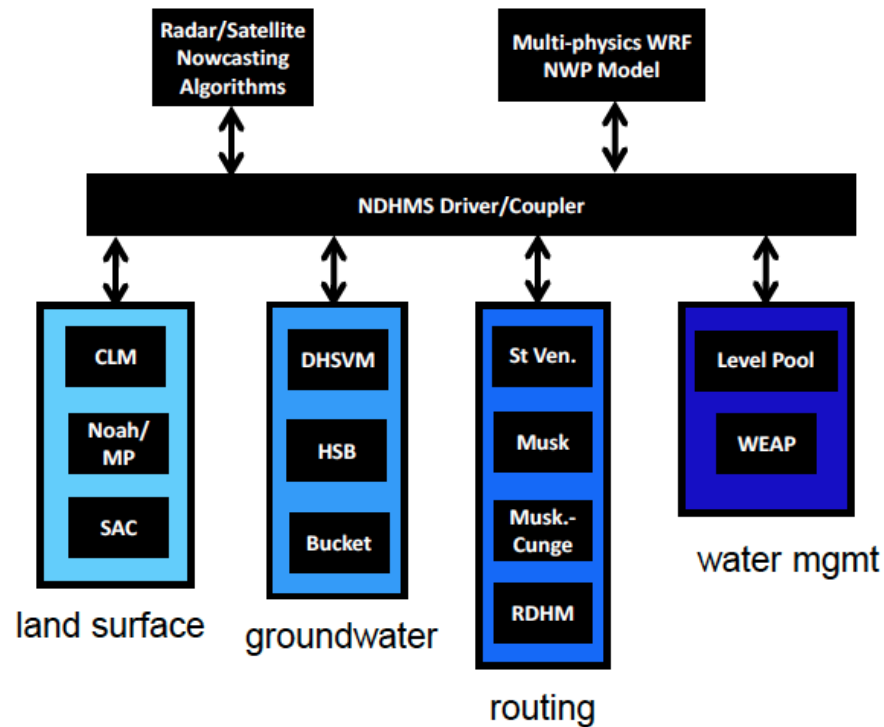


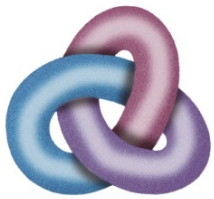


DRIHM2US interoperability testbeds

WRF-HYDRO

CONTINUUM





Questions?