FONDAZIONE CIMA
CIMA RESEARCH FOUNDATION

CENTRO INTERNAZIONALE IN MONITORAGGIO AMBIENTALE
INTERNATIONAL CENTRE ON ENVIRONMENTAL MONITORING

DRIHM project and the Genoa 2014 event

DRIHM

DISTRIBUTED RESEARCH INFRASTRUCTURE
FOR HYDRO-METEOROLOGY

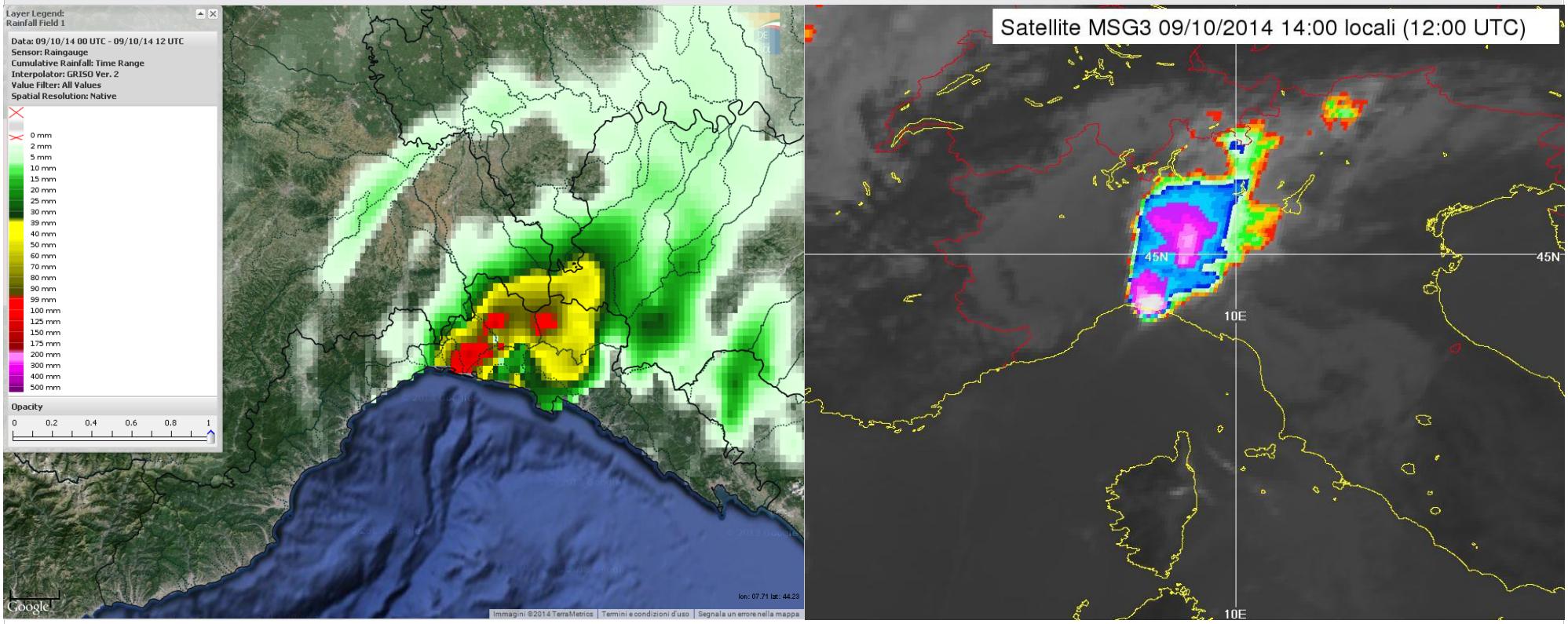
Antonio Parodi – CIMA RESEARCH FOUNDATION - ITALY

Osservare per prevedere, prevedere per prevenire

GENOVA

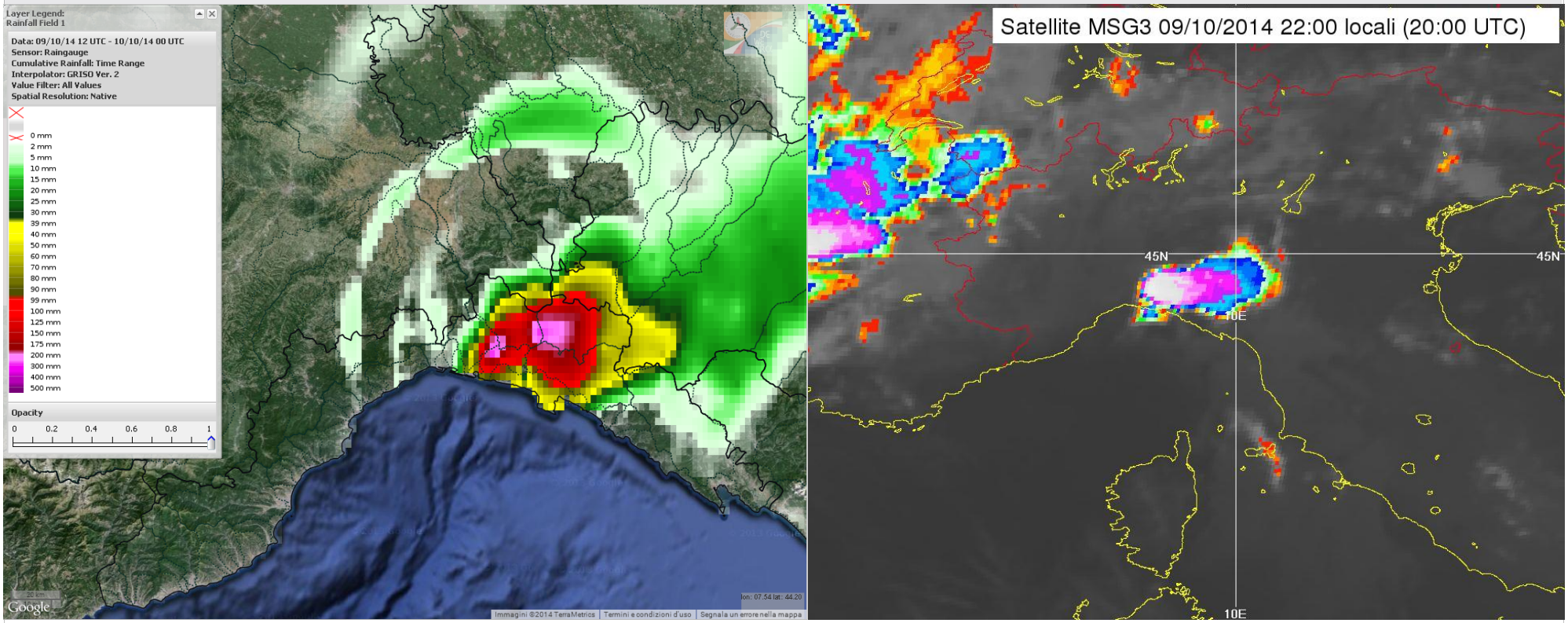
The high impact weather event, which affected Genoa city on october 9 2014, was characterized by two distinct phases .
The first one from the morning 8UTC till to the early afternoon 12UTC, with rainfall depths between 50 (Davagna, Genova CF) ed i 130 mm (Gavette, Creto, Geirato)
After a break in the rainfall processes, the second phase developed very rapidly between 19UTC and 22UTC with observed rainfall depths between 150 mm and 260 mm, with hourly rainfall peaks around 100-130mm between 20UTC and 21UTC.
The daily peak rainfall depth was around 400mm (Geirato). The average rainfall depth over the Bisagno catchment (100 km^2) was 220 mm.
As a consequence of these torrential rainfalls the Bisagno river produced a deadly flash-flood in the city center (around 21UTC).

First phase



Observed rainfall depths (00-12UTC) and MSG image 12UTC

Second phase



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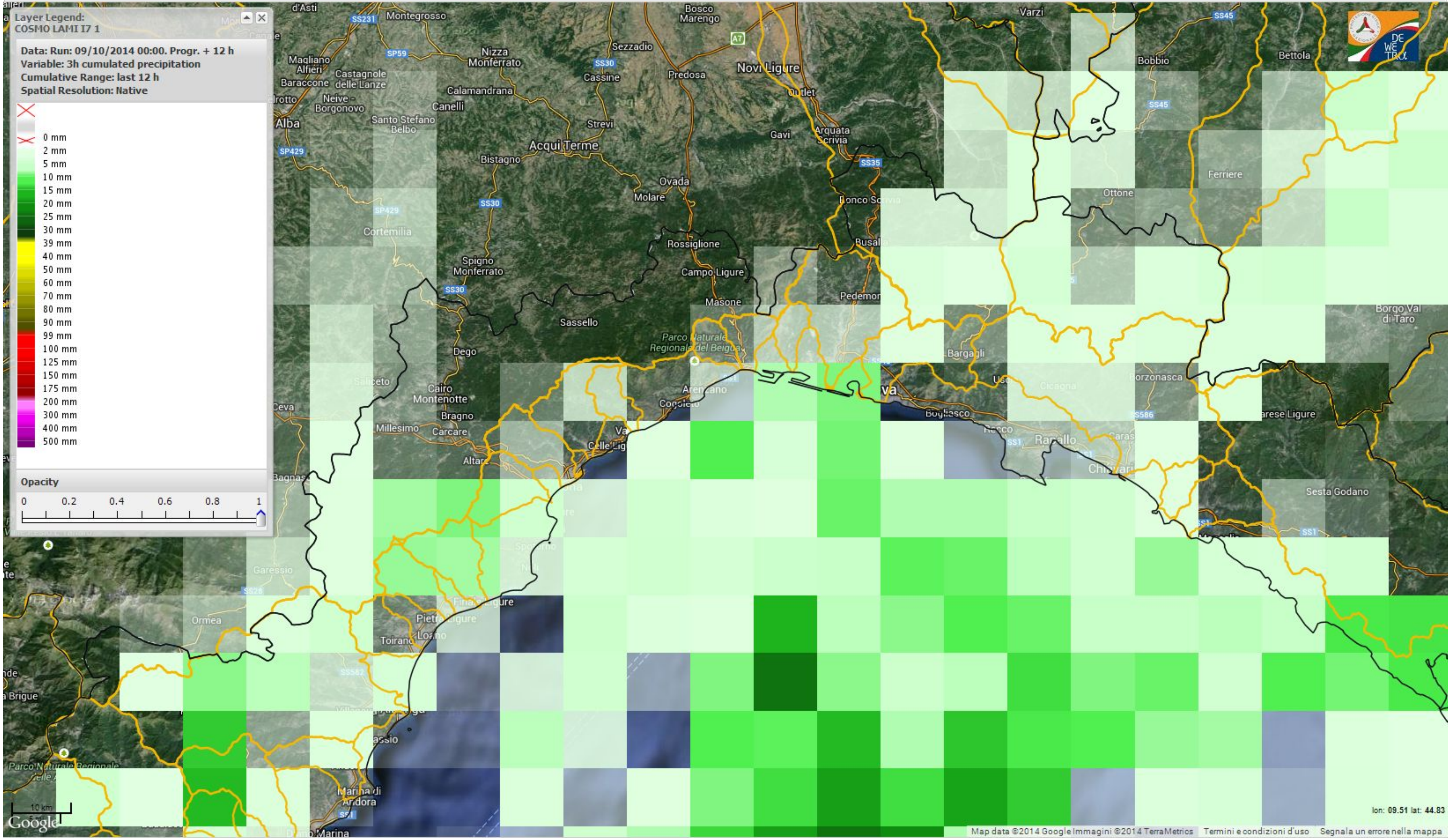
COSMO-I7 - run 00UTC 09/10/2014
QPF 00-12UTC 09/10/2014



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CENTRO INTERNAZIONALE IN MONITORAGGIO AMBIENTALE
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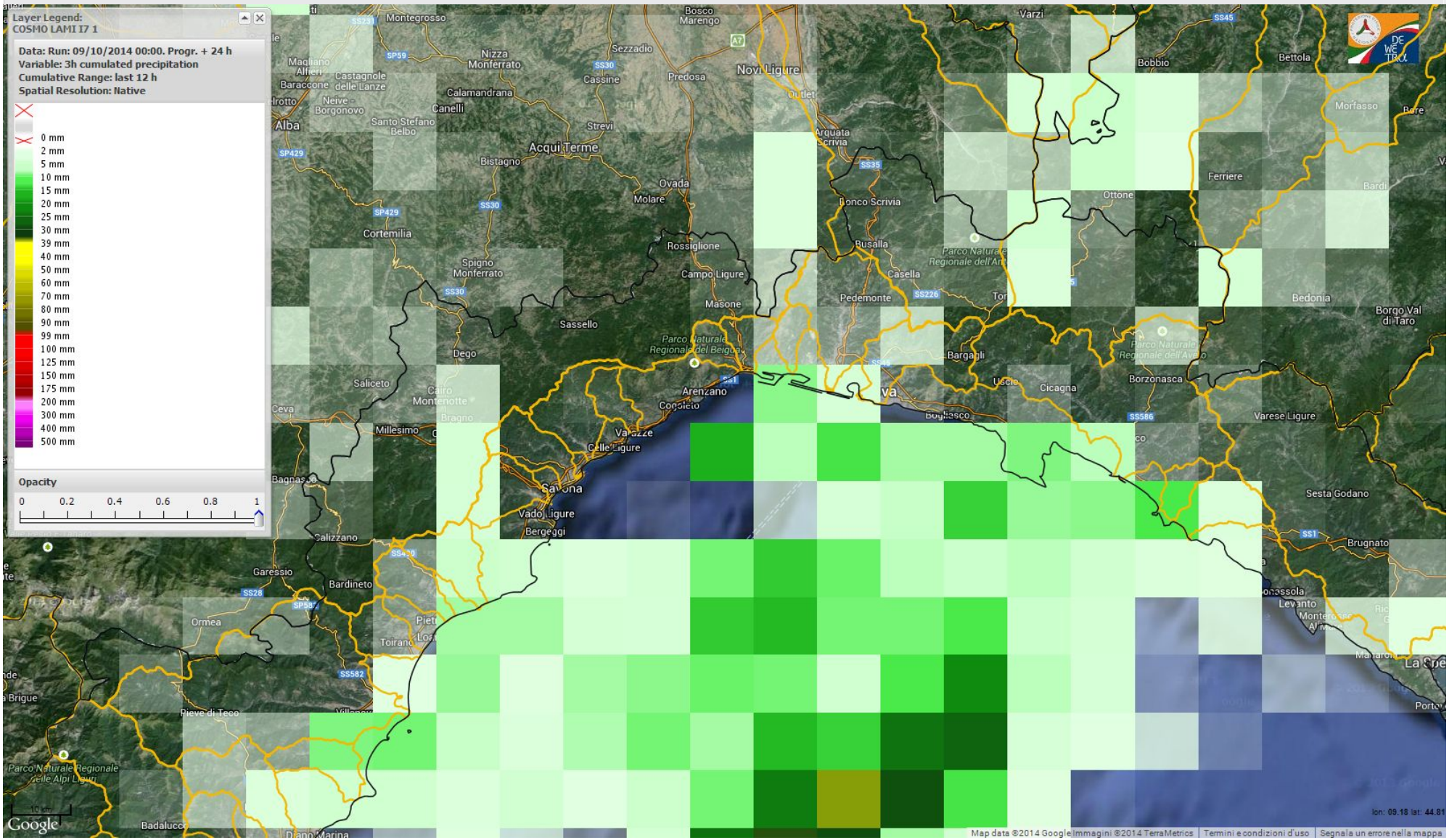
COSMO-I7 - run 00UTC 09/10/2014
QPF 12-24UTC 09/10/2014



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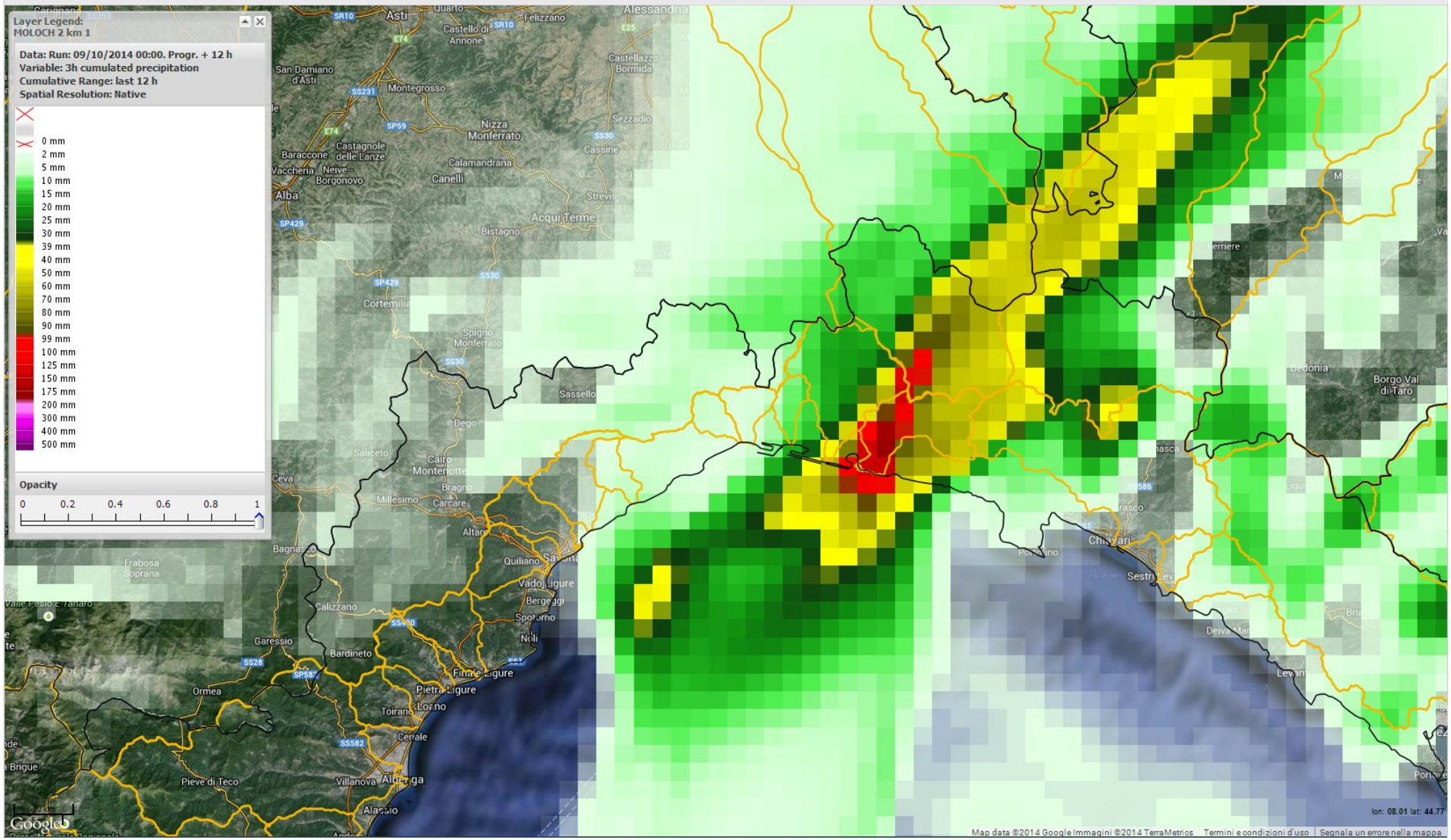
MOLOCH- run 00UTC 09/10/2014
QPF 00-12UTC 09/10/2014



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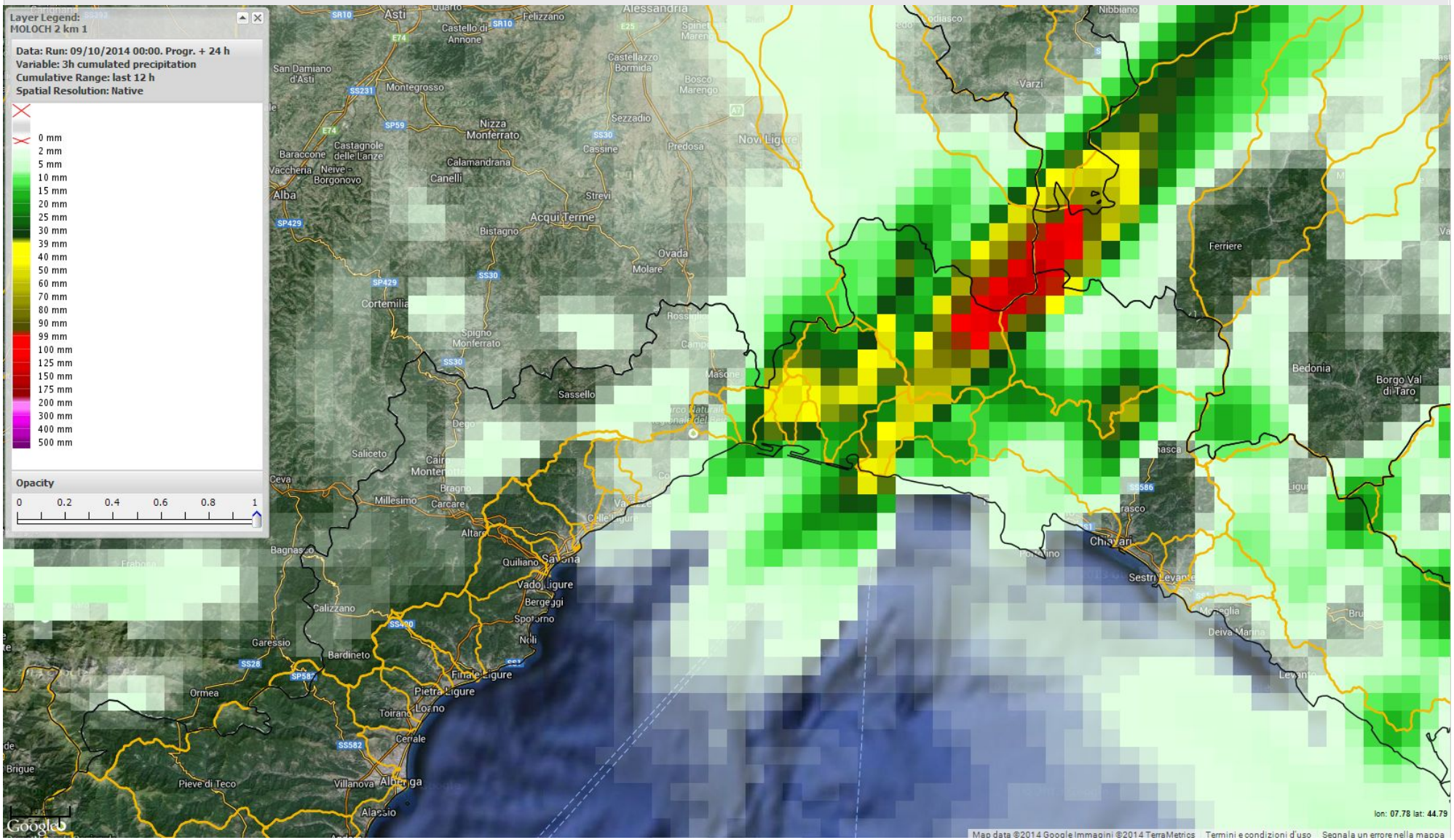
CENTRO INTERNAZIONALE IN MONITORAGGIO AMBIENTALE
INTERNATIONAL CENTRE ON ENVIRONMENTAL MONITORING

MOLOCH- run 00UTC 09/10/2014
QPF 12-24UTC 09/10/2014



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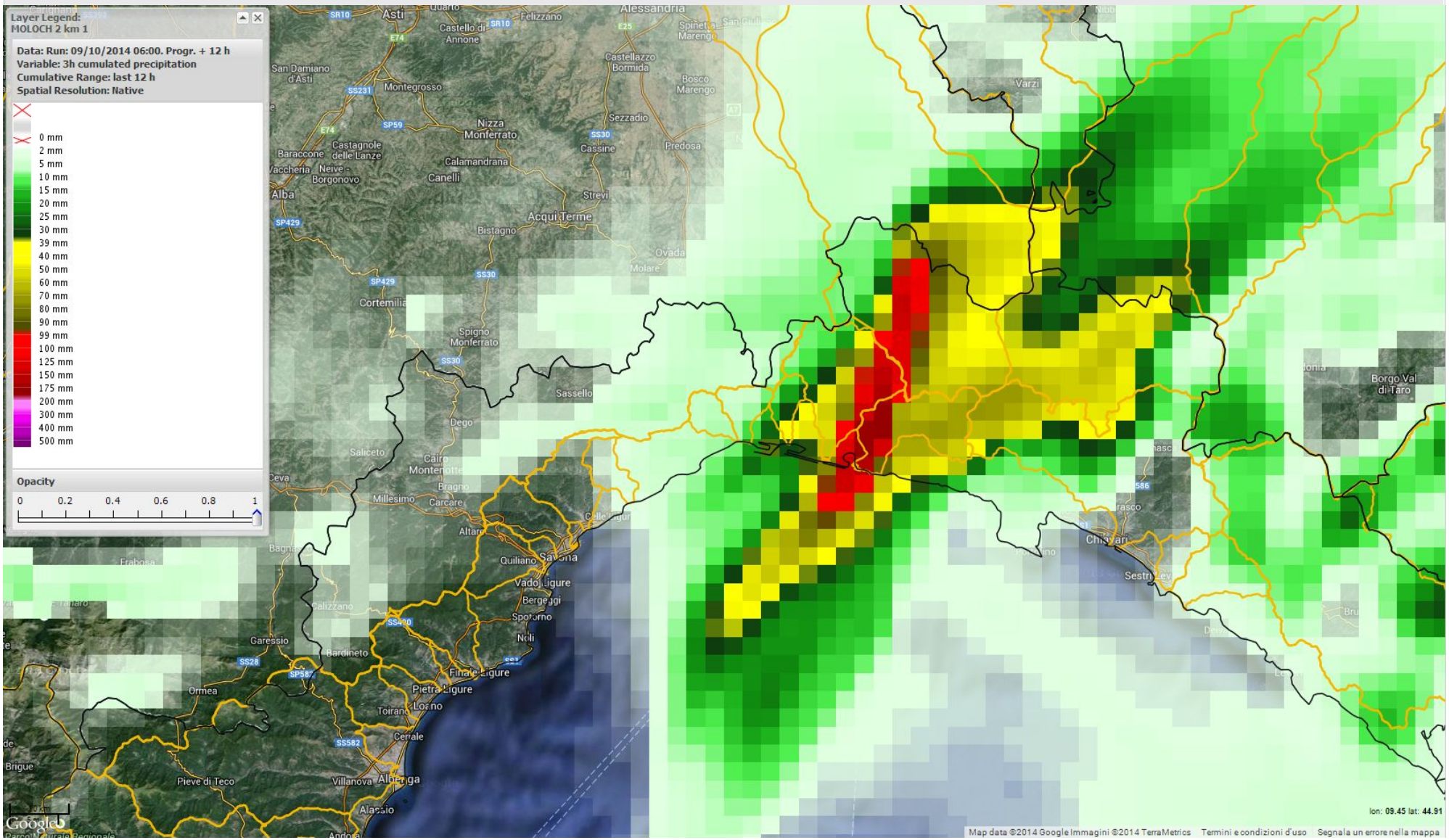
CENTRO INTERNAZIONALE IN MONITORAGGIO AMBIENTALE
INTERNATIONAL CENTRE ON ENVIRONMENTAL MONITORING

MOLOCH- run 06UTC 09/10/2014
QPF 06-18UTC 09/10/2014



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CENTRO INTERNAZIONALE IN MONITORAGGIO AMBIENTALE
INTERNATIONAL CENTRE ON ENVIRONMENTAL MONITORING

MOLOCH- run 06UTC 09/10/2014
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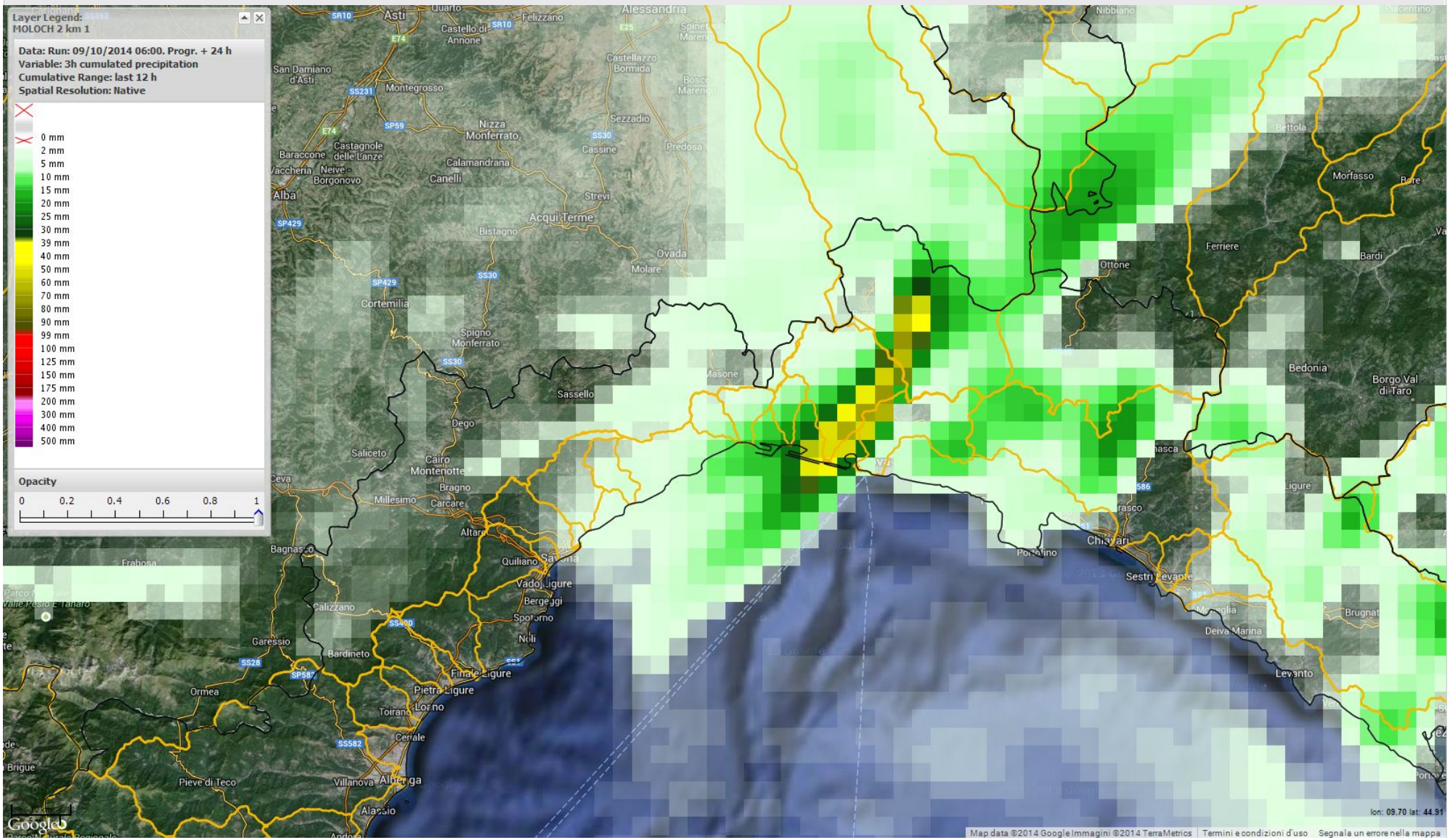

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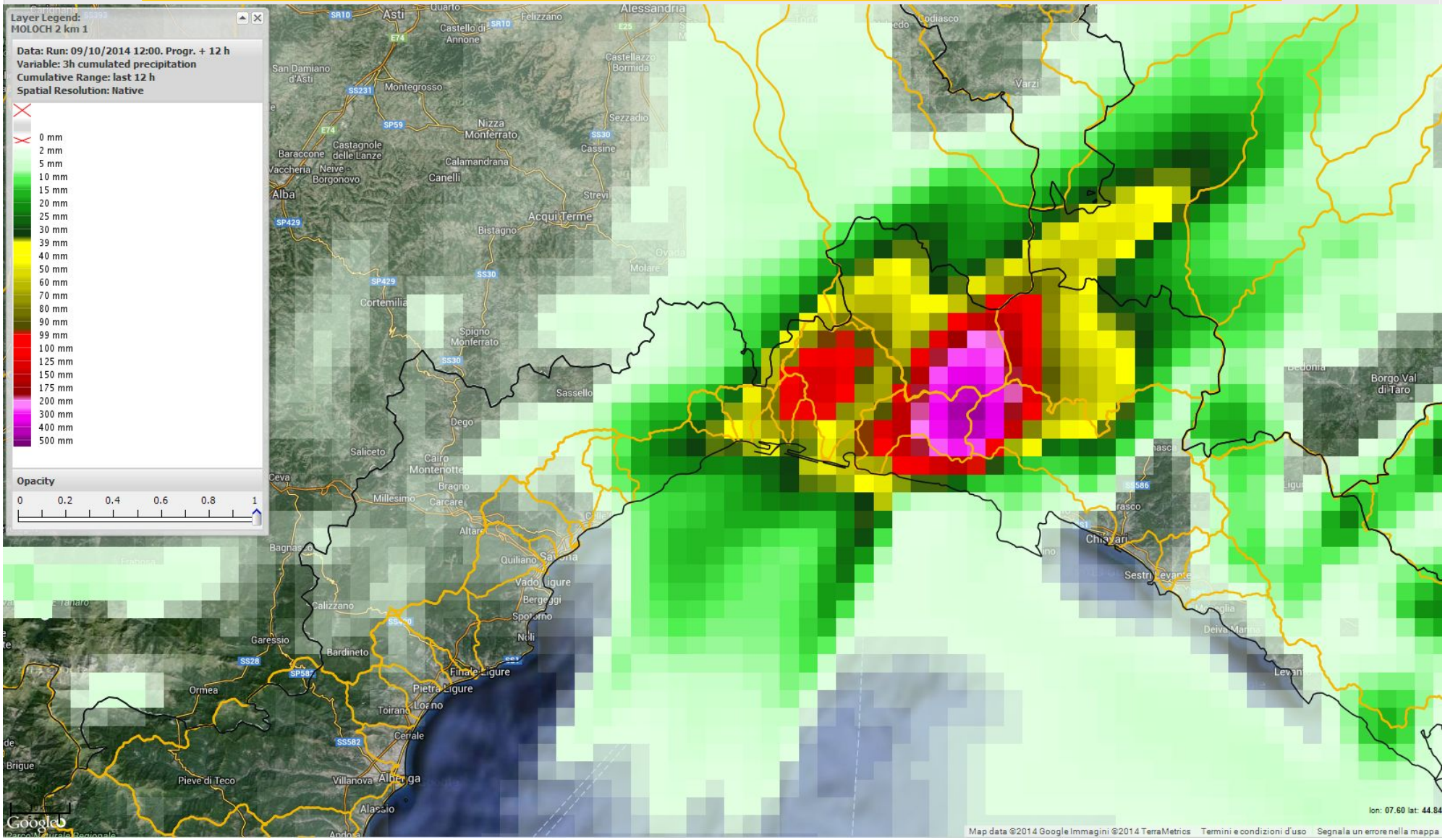
CENTRO INTERNAZIONALE IN MONITORAGGIO AMBIENTALE
INTERNATIONAL CENTRE ON ENVIRONMENTAL MONITORING

MOLOCH- run 12UTC 09/10/2014
QPF 12-24UTC 09/10/2014



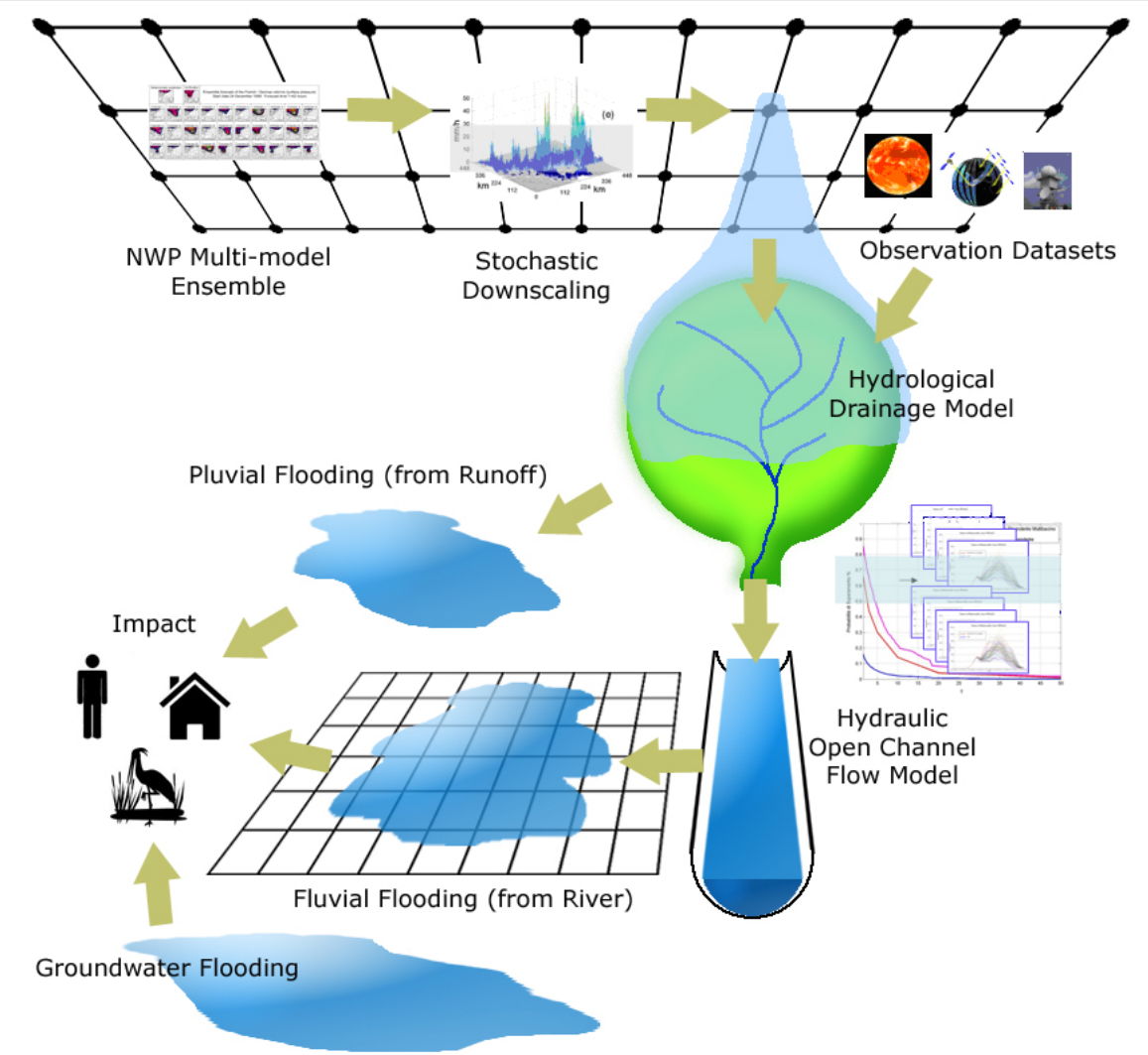
All together, these events challenge our current scientific understanding and call for focused and joint hydro-meteorological and ICT research to:

(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 grid computing and petascale computing systems, to provide deeper understanding of those events.

Conceptual showcase



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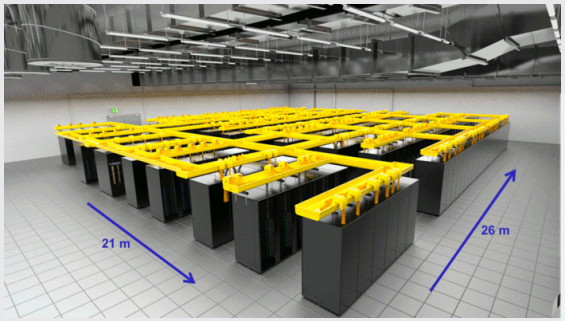
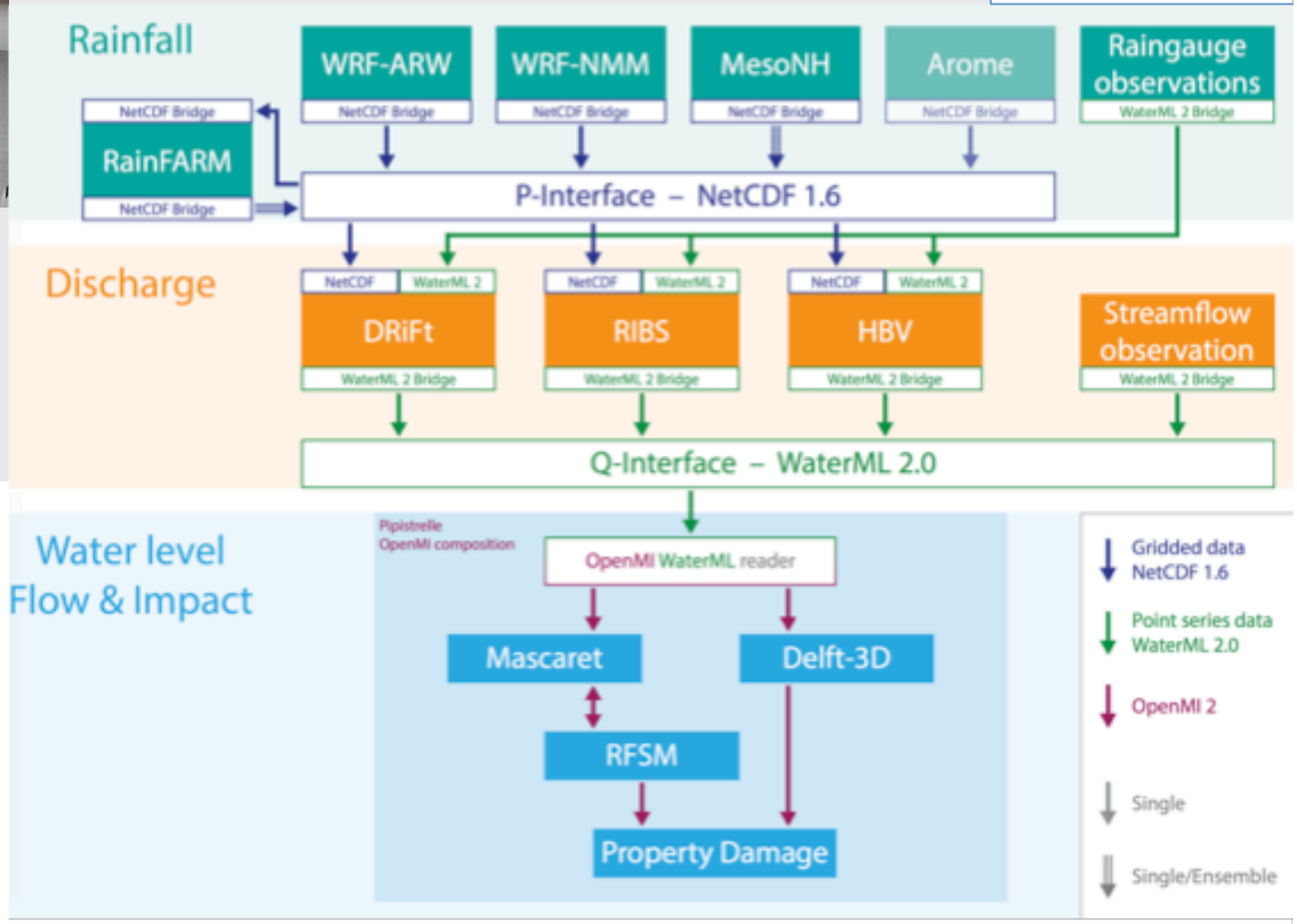
DRIHM
DISTRIBUTED RESEARCH INFRASTRUCTURE FOR HYDRO-METEOROLOGY

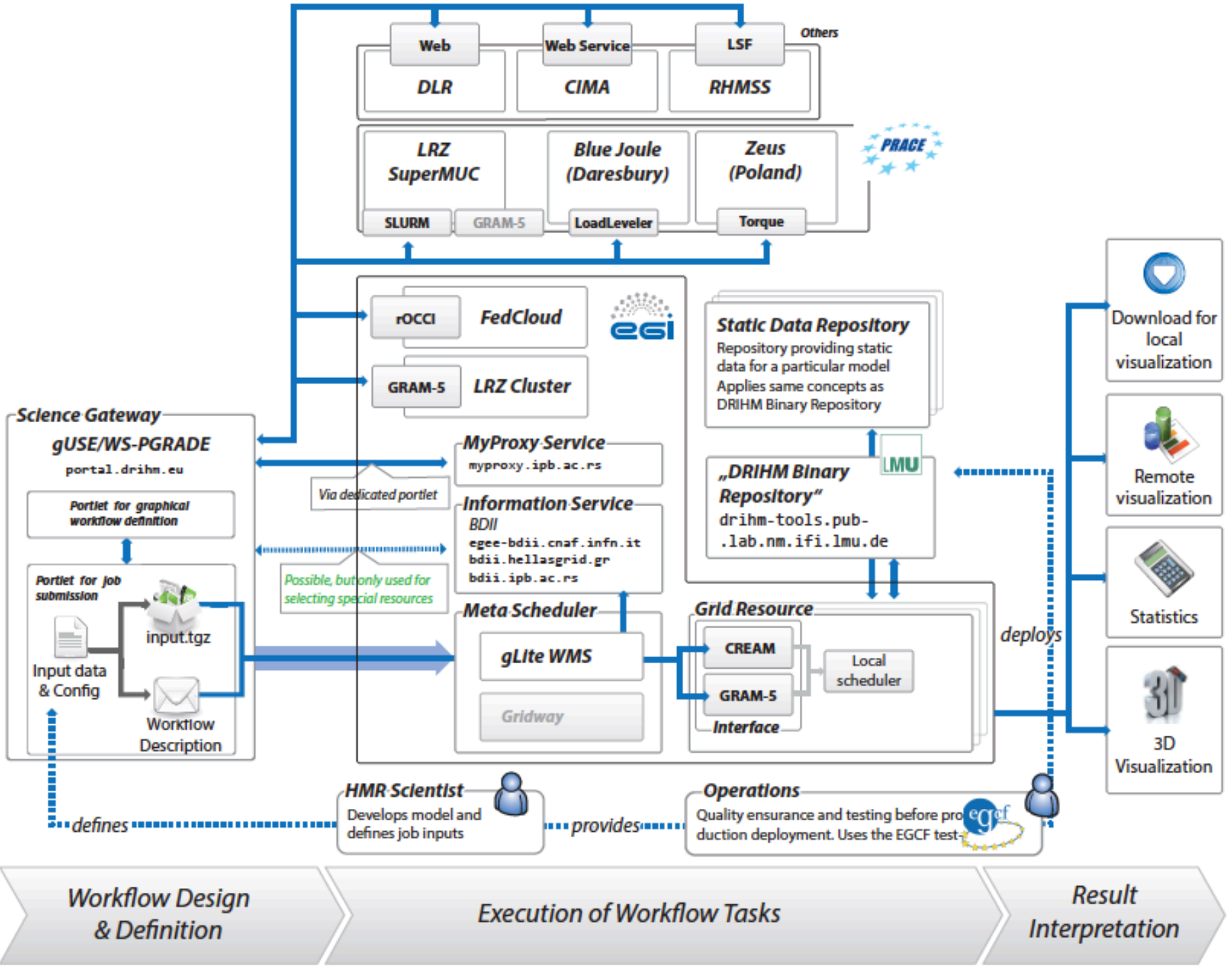
HPC



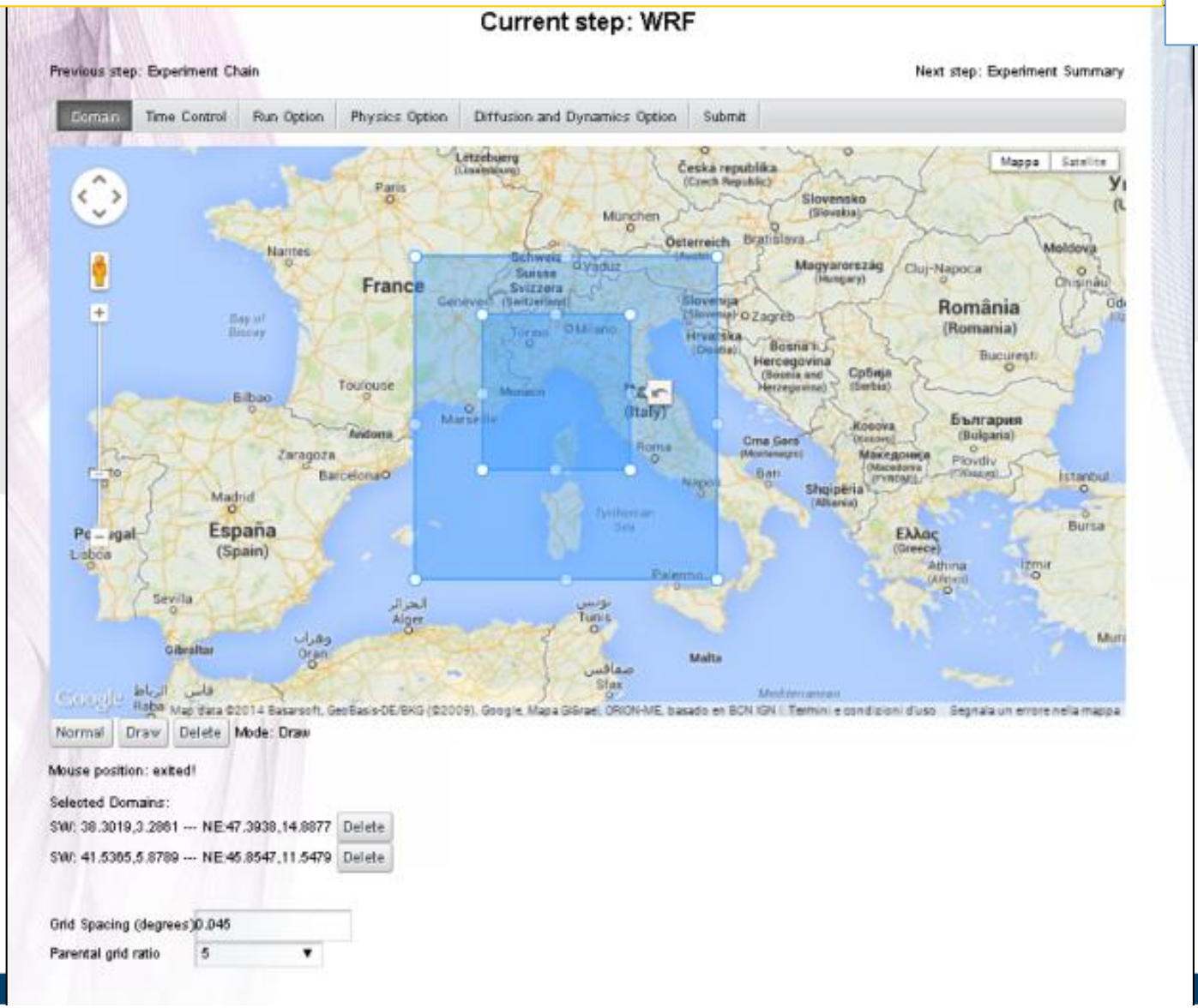
HTC



Osservare per prevedere, prevedere per prevenire

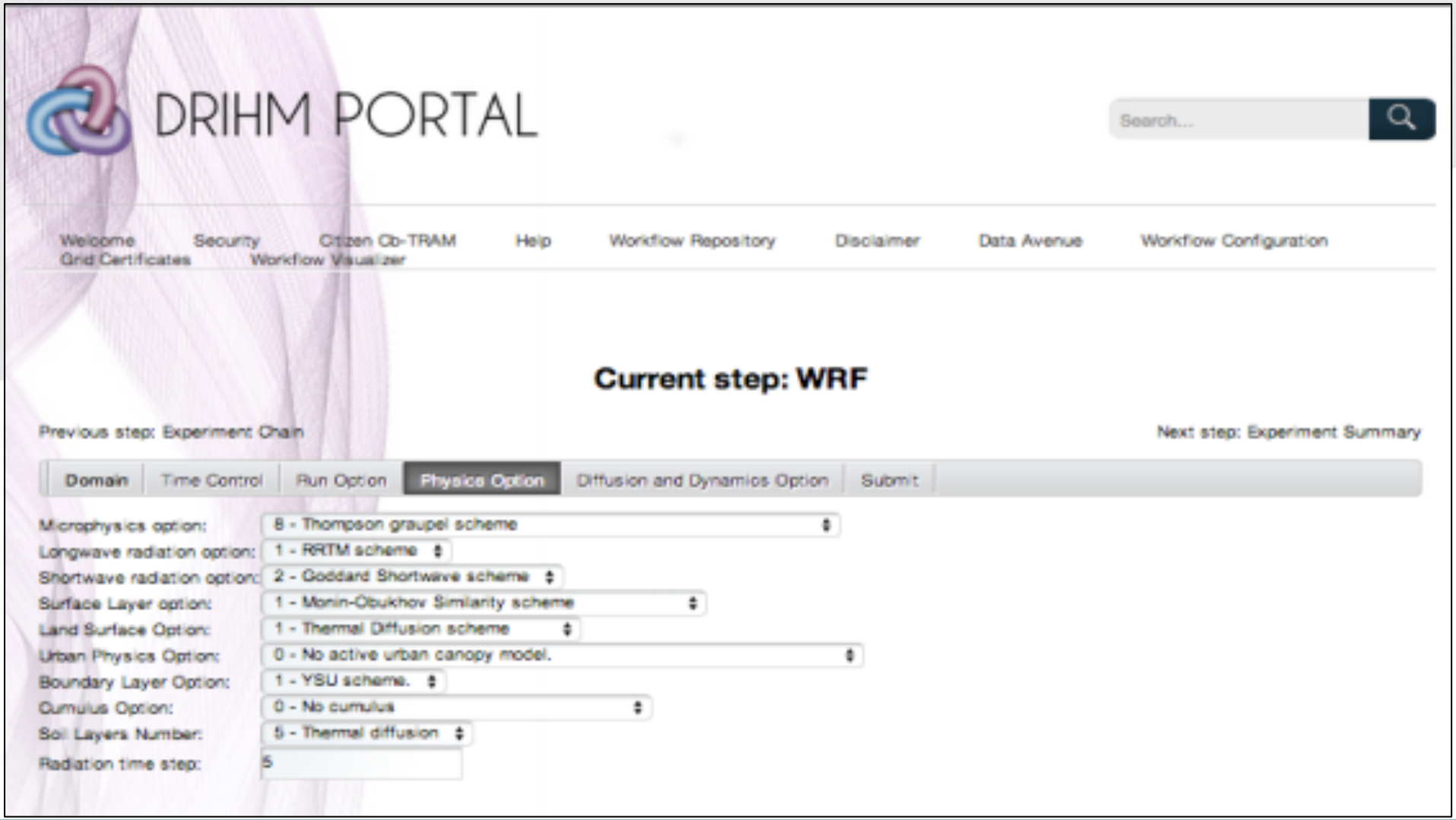

Web
Web Service
LSF
Others
DLR
CIMA
RHMSS
LRZ SuperMUC
Blue Joule (Daresbury)
Zeus (Poland)
PRACE
SLURM
GRAM-5
LoadLeveler
Torque
rOCCI
FedCloud
egi
GRAM-5
LRZ Cluster
Static Data Repository
Repository providing static data for a particular model
Applies same concepts as DRIHM Binary Repository
Download for local visualization
Science Gateway
gUSE/WS-PGRADE
portal.drihm.eu
MyProxy Service
myproxy.ipb.ac.rs
Via dedicated portlet
Information Service
BDII
egee-bdii.cnaf.infn.it
bdii.hellasgrid.gr
bdii.ipb.ac.rs
Possible, but only used for selecting special resources
„DRIHM Binary Repository"
drihm-tools.pub-.lab.nm.ifi.lmu.de
LMU
Remote visualization
Statistics
Portlet for graphical workflow definition
Portlet for job submission
input.tgz
Input data & Config
Workflow Description
Meta Scheduler
gLite WMS
Gridway
Grid Resource
CREAM
GRAM-5
Local scheduler
Interface
deploys
3D Visualization
HMR Scientist
Develops model and defines job inputs
Operations
Quality ensurance and testing before production deployment. Uses the EGCF test-
defines
provides
Workflow Design & Definition
Execution of Workflow Tasks
Result Interpretation

Genova 2014:
WRF-ARW model setup

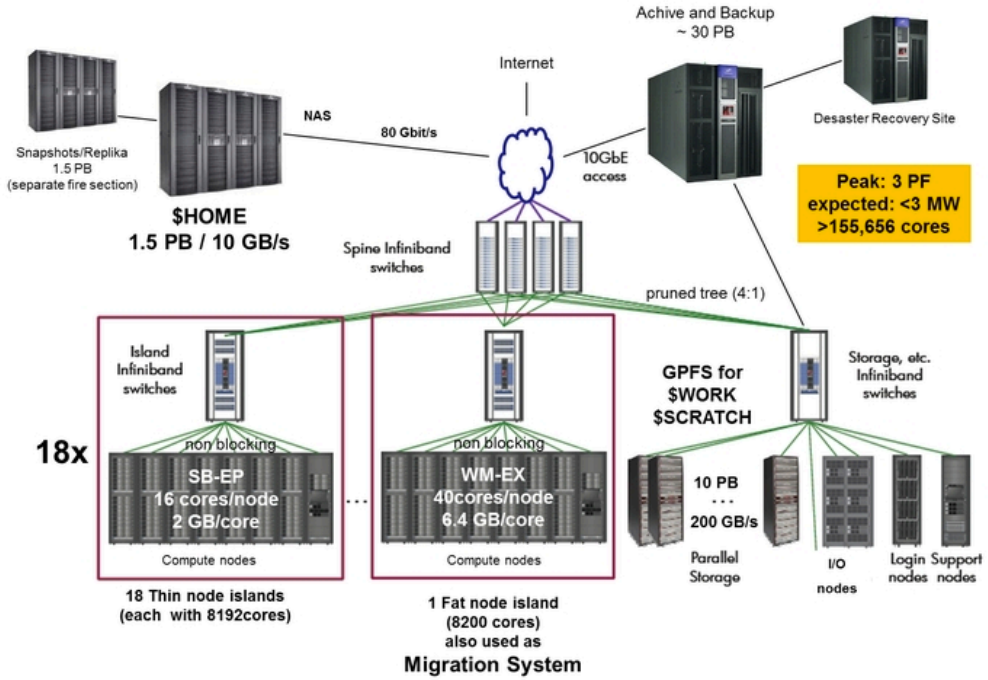


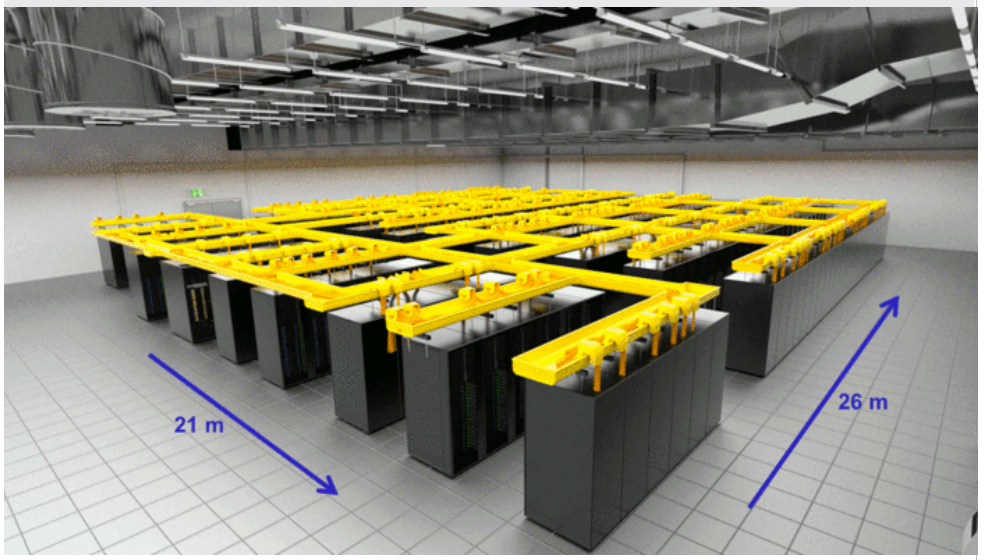
Genova 2014:

WRF-ARW model setup



SuperMUC Petascale System





Simulation 1: domains 5 e 1 km, 22 millions of points, **640 processors**:

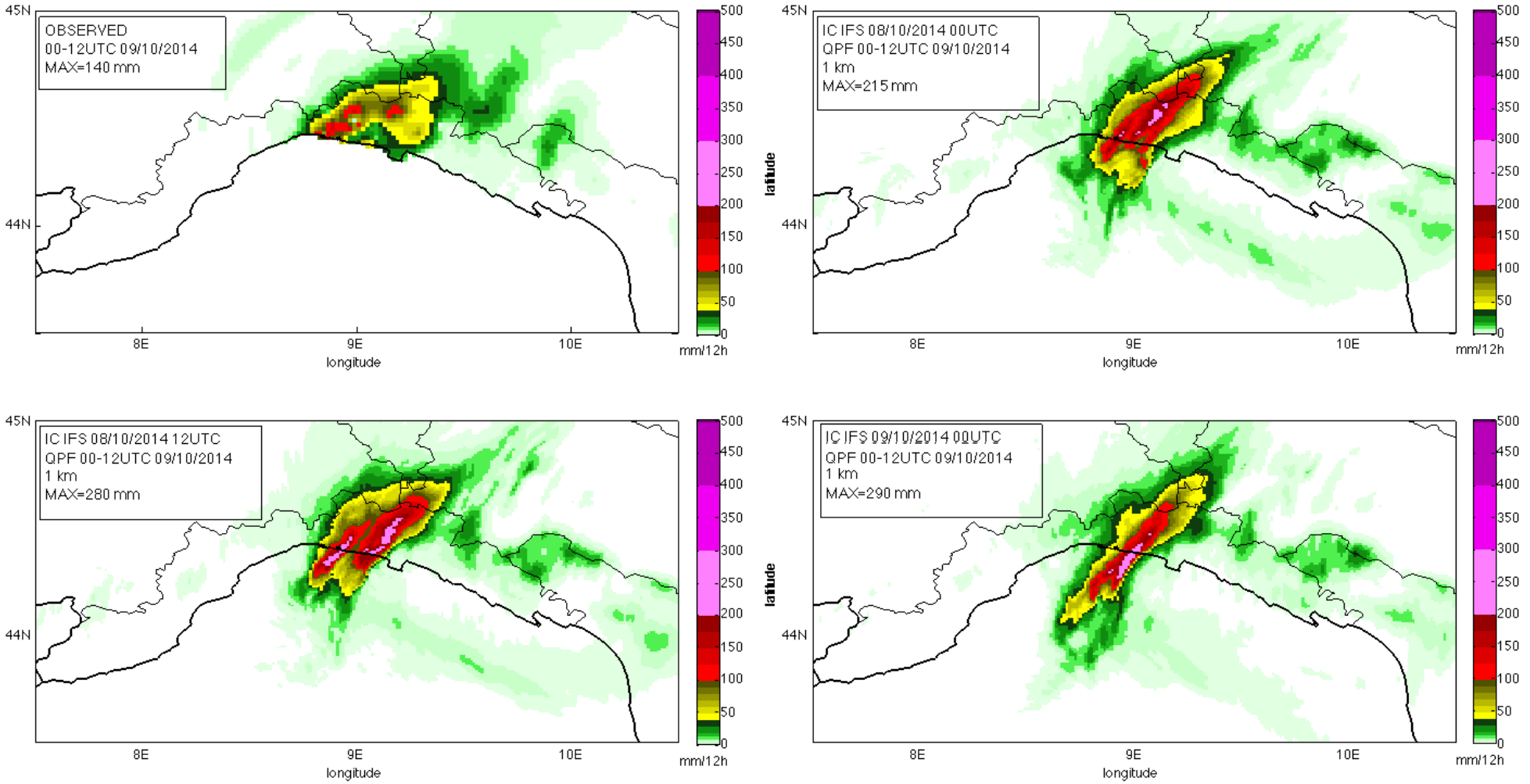
24 hours of prediction in 3 hours

Simulation 2: domains 5, 1 km e 200 m, 75 millions of points, **640 processors**:

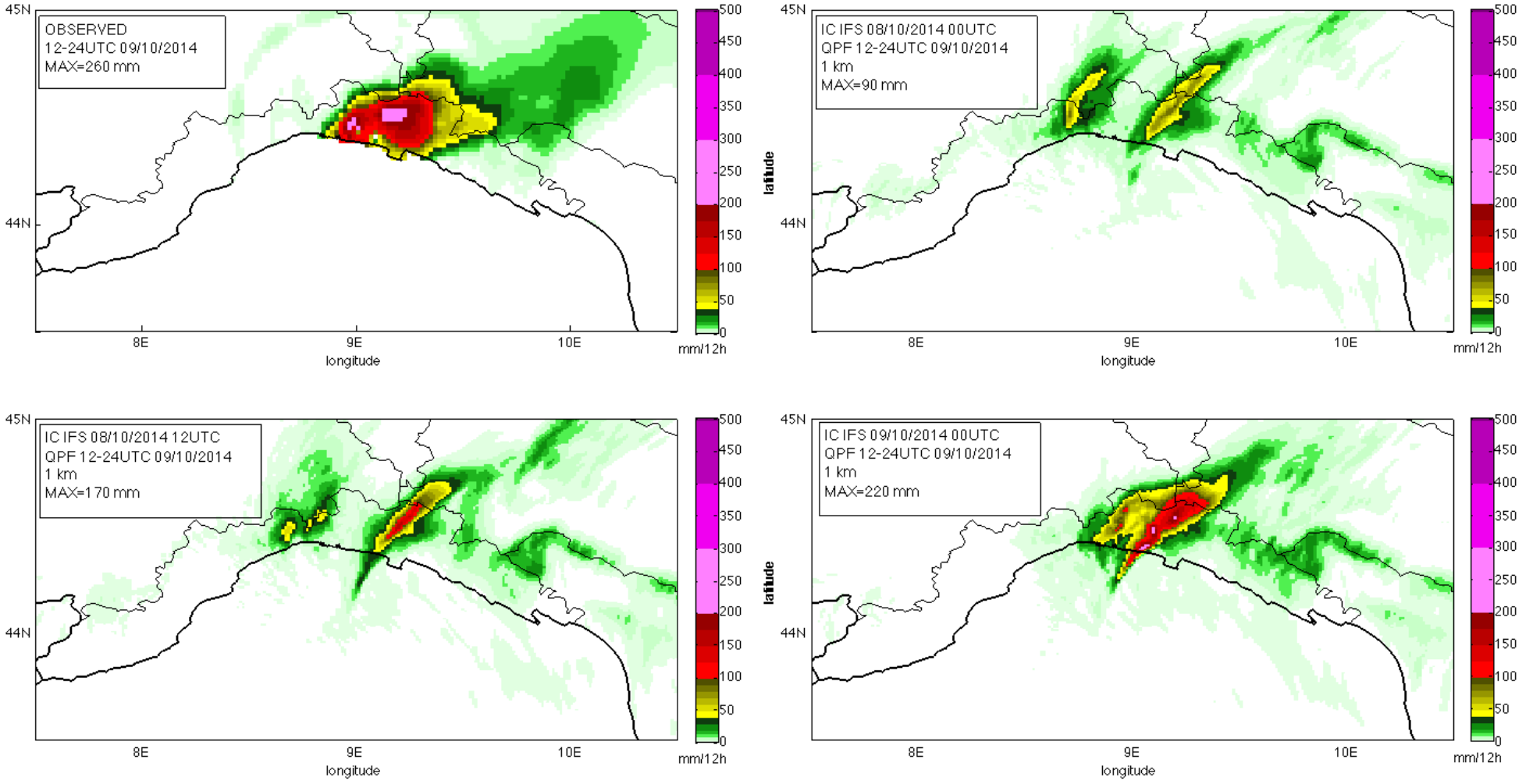
24 hours of prediction in 20 hours

Different initializations
@
cloud permitting resolution (1 km)

WRF-ARW run 1000 m driven by IFS-ECMWF – **run 00UTC 8 october 2014, 12UTC 8 october 2014, 00UTC 9 october 2014 – QPF 00-12UTC vs QPE 00-12UTC**



WRF-ARW run 1000 m driven by IFS-ECMWF – **run 00UTC 8 october 2014, 12UTC 8 october 2014, 00UTC 9 october 2014 – QPF 00-12UTC vs QPE 12-24UTC**



Cloud permitting resolution (1 km)
vs
cloud resolving resolution (200 m)

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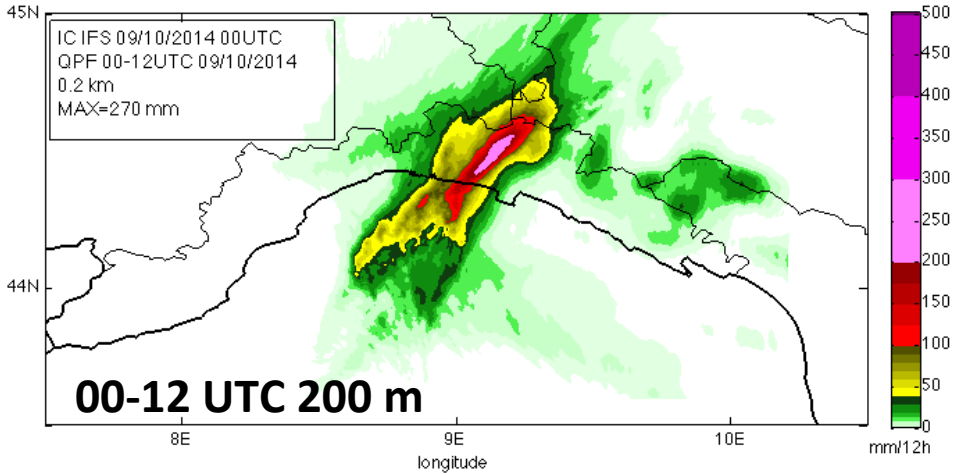
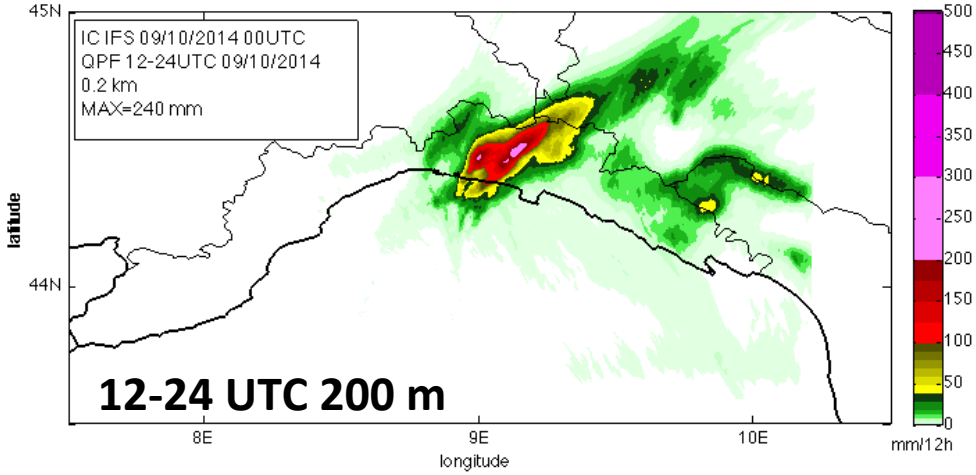
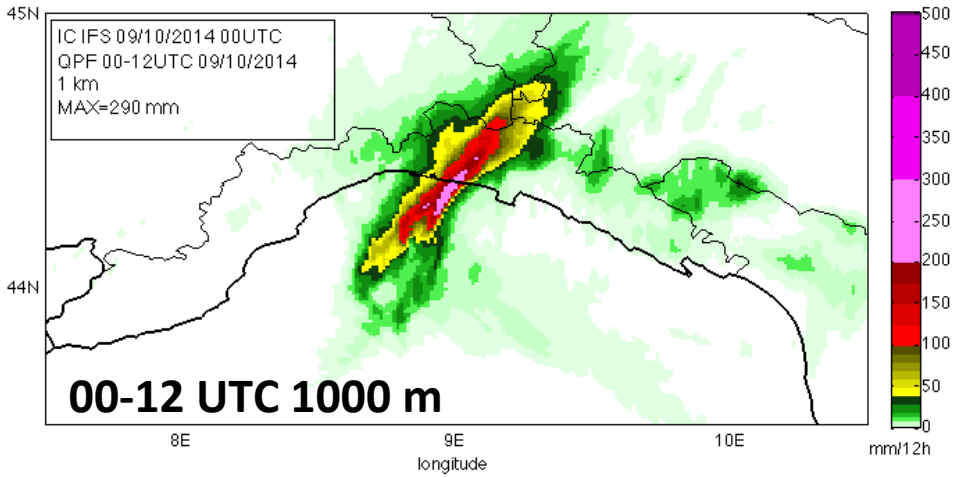
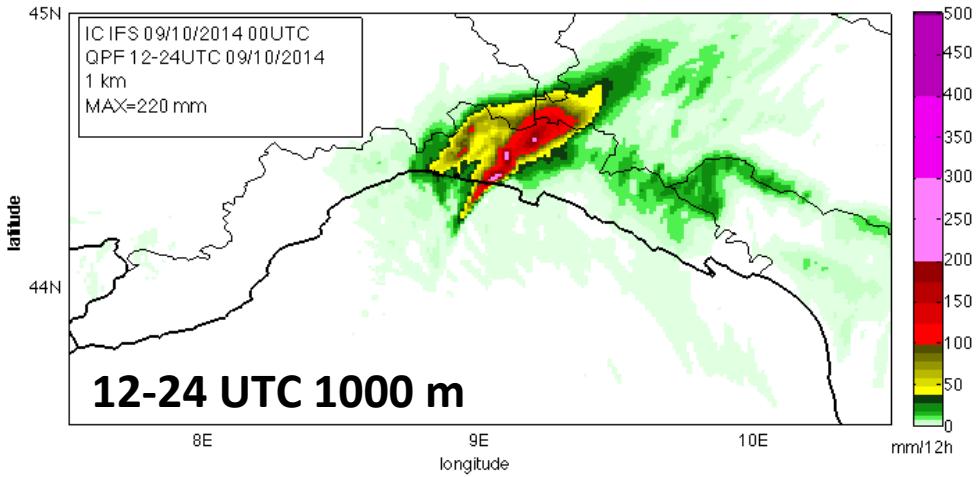
WRF-ARW driven by IFS-ECMWF – **run 00UTC 9 october 2014**
QPF 00-12UTC 1000 and 200 m



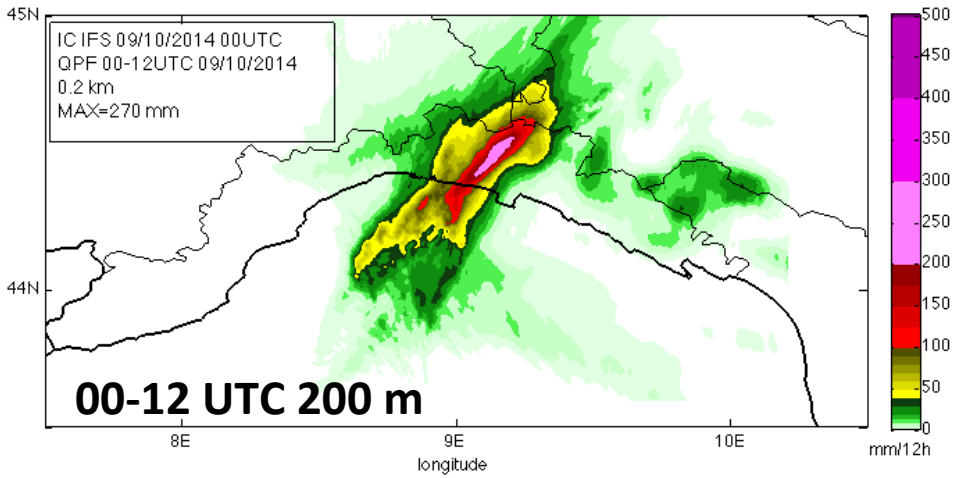


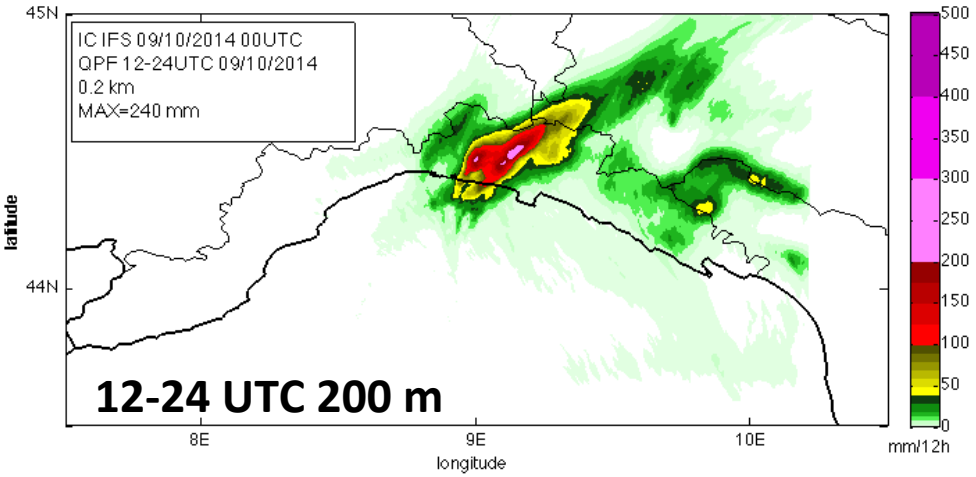


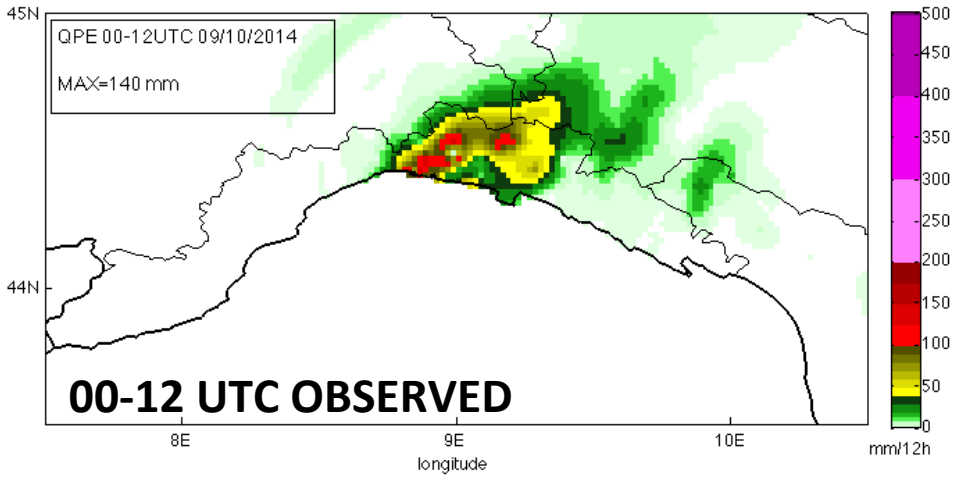


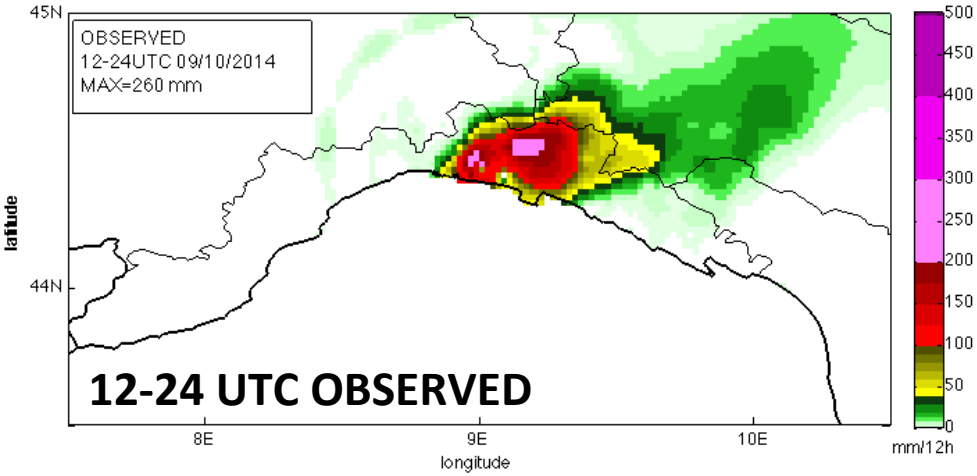
WRF-ARW driven by IFS-ECMWF – **run 00UTC 9 october 2014–**
QPF 00-12UTC, 12-24UTC vs QPE 00-12UTC, 12-24UTC

12-24 UTC OBSERVED



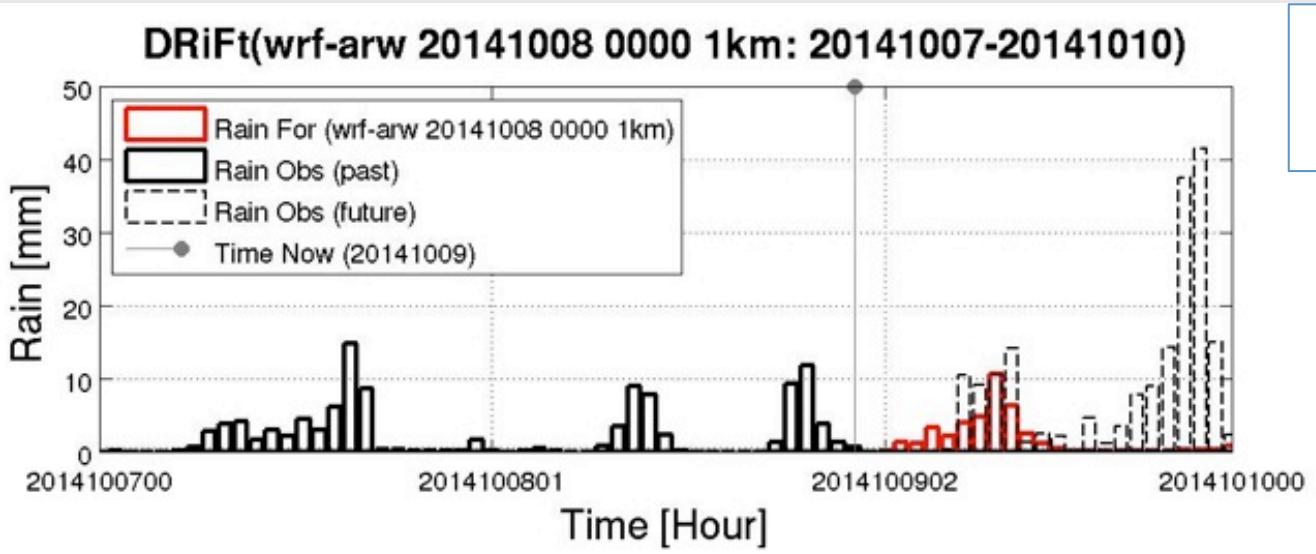


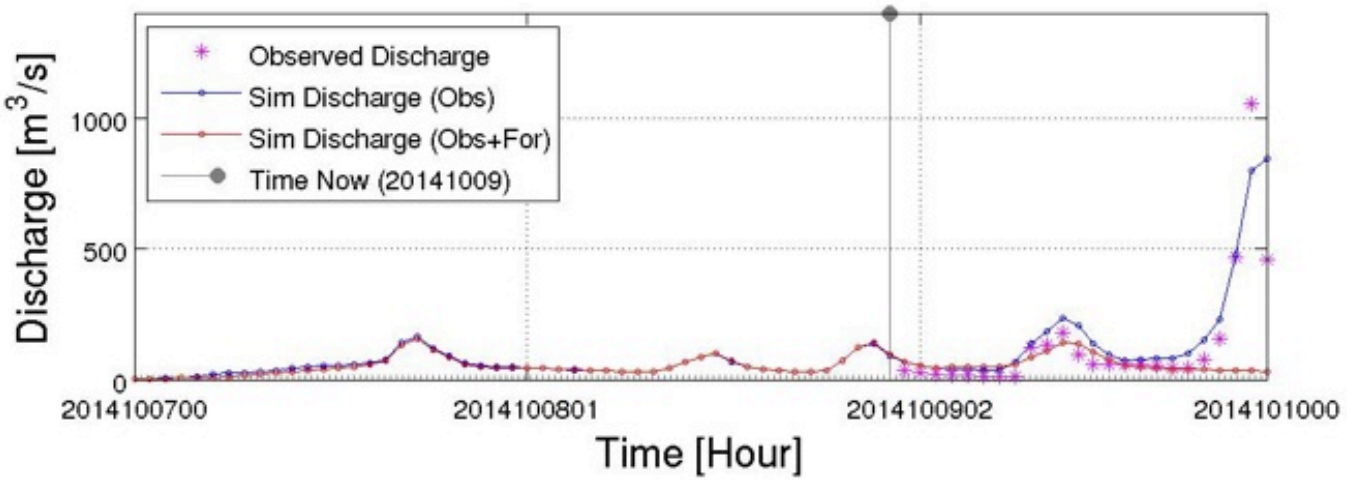




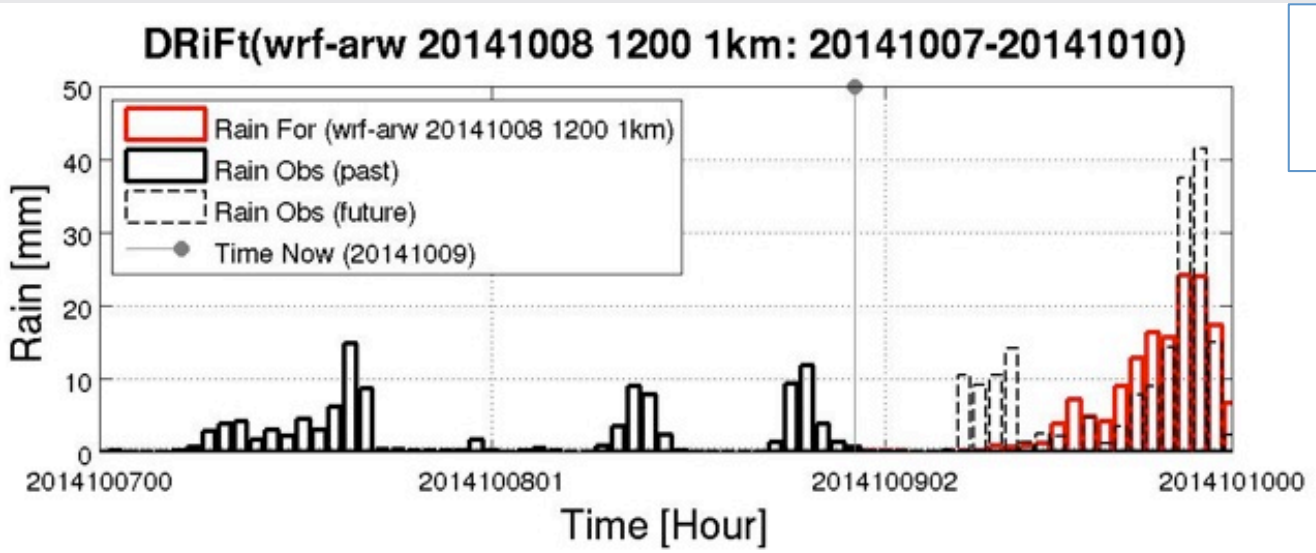
Hydrological results

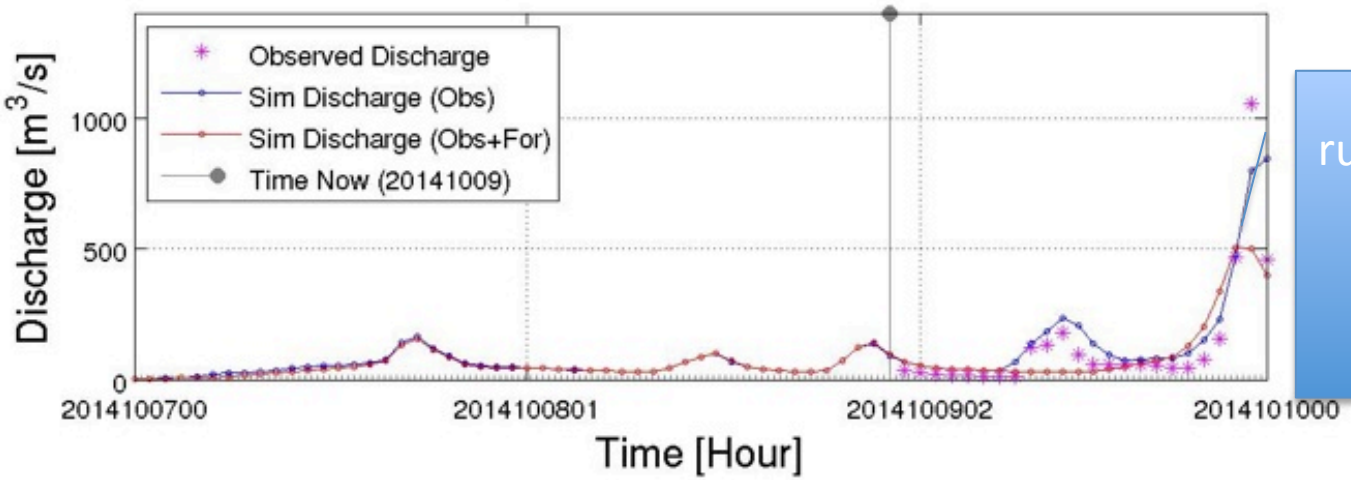
DRiFt model forced by **WRF-ARW** at a **1 km– run 00UTC 08 october 2014**





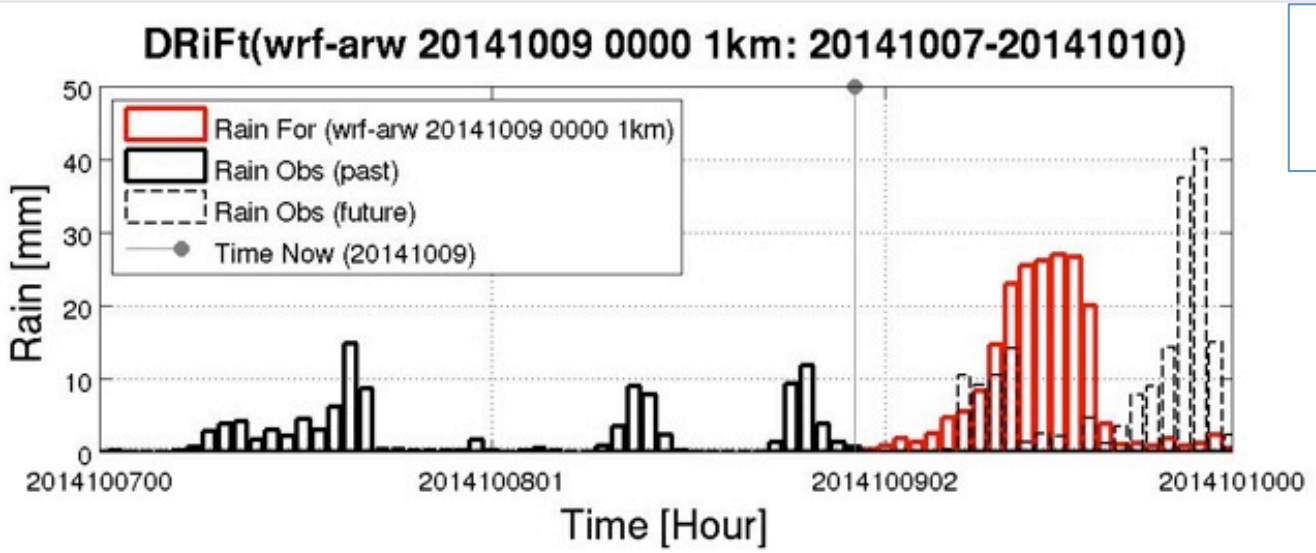
DRiFt model forced by
WRF-ARW at a **1 km– run 12UTC 08 october 2014**

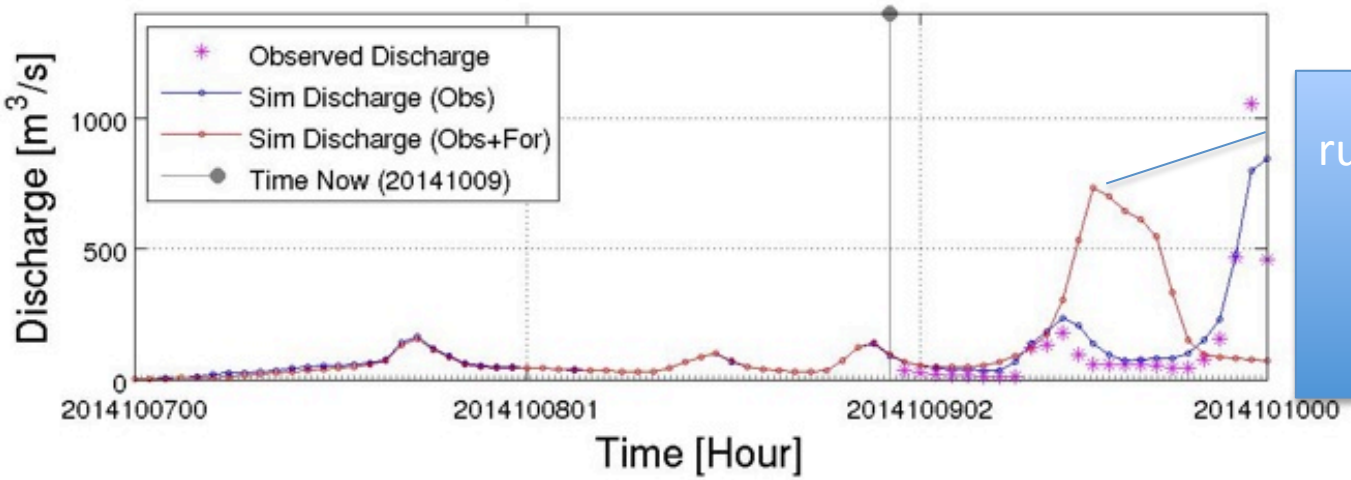




run 8/10 12UTC
1 km
500 m^3/s
at 22 UTC

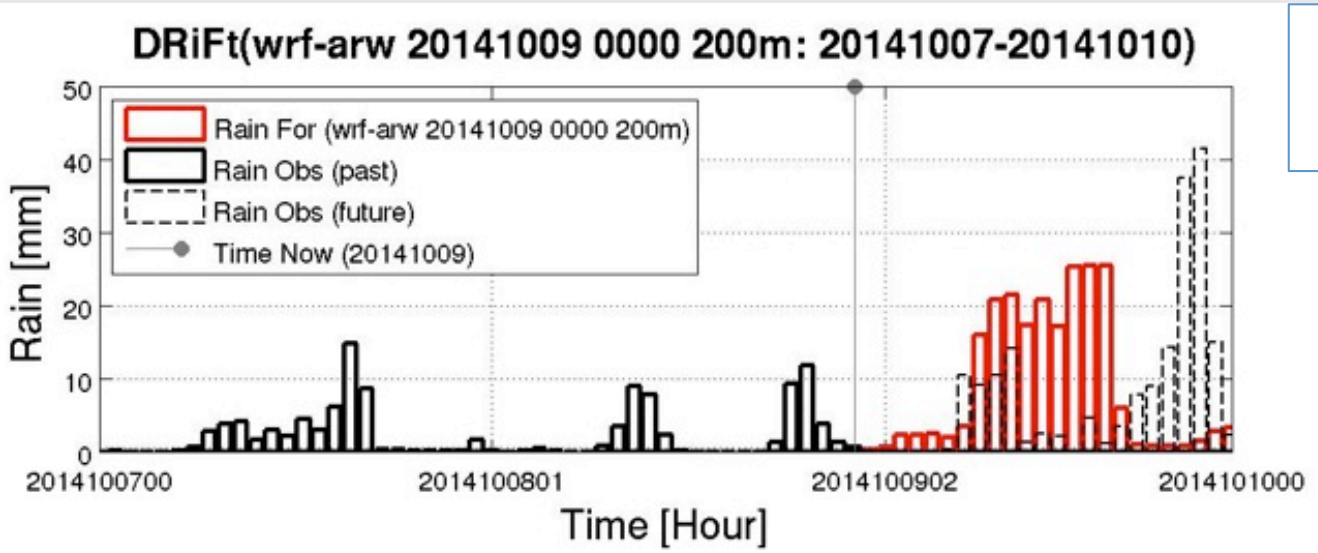
DRiFt model forced by **WRF-ARW** at **1 km– run 00UTC 09 october 2014**

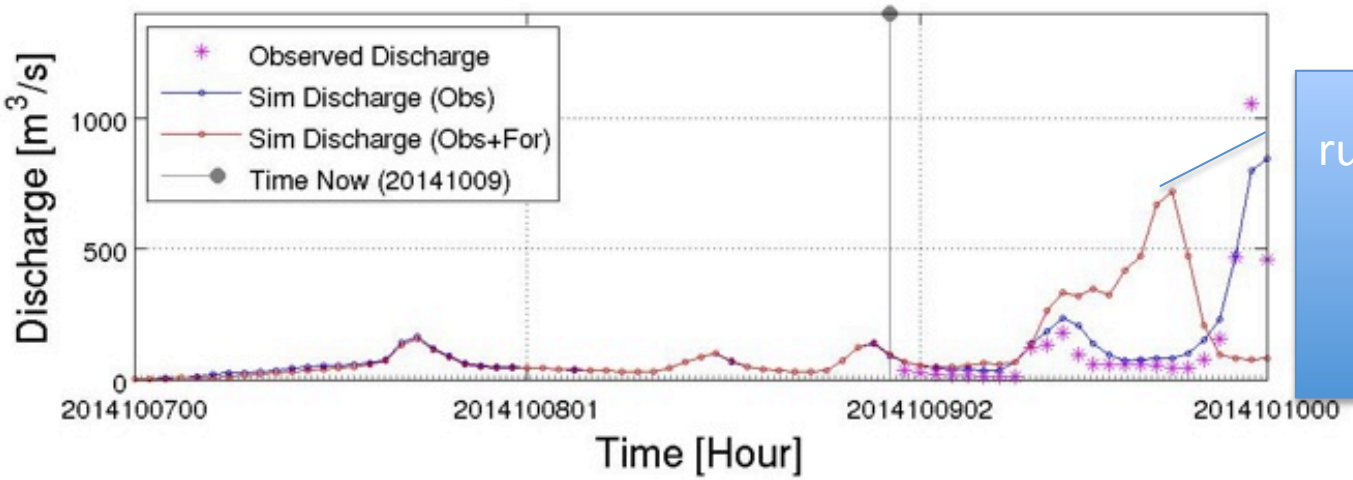




run 9/10 00UTC
1km
650 m^3/s
at 13 UTC

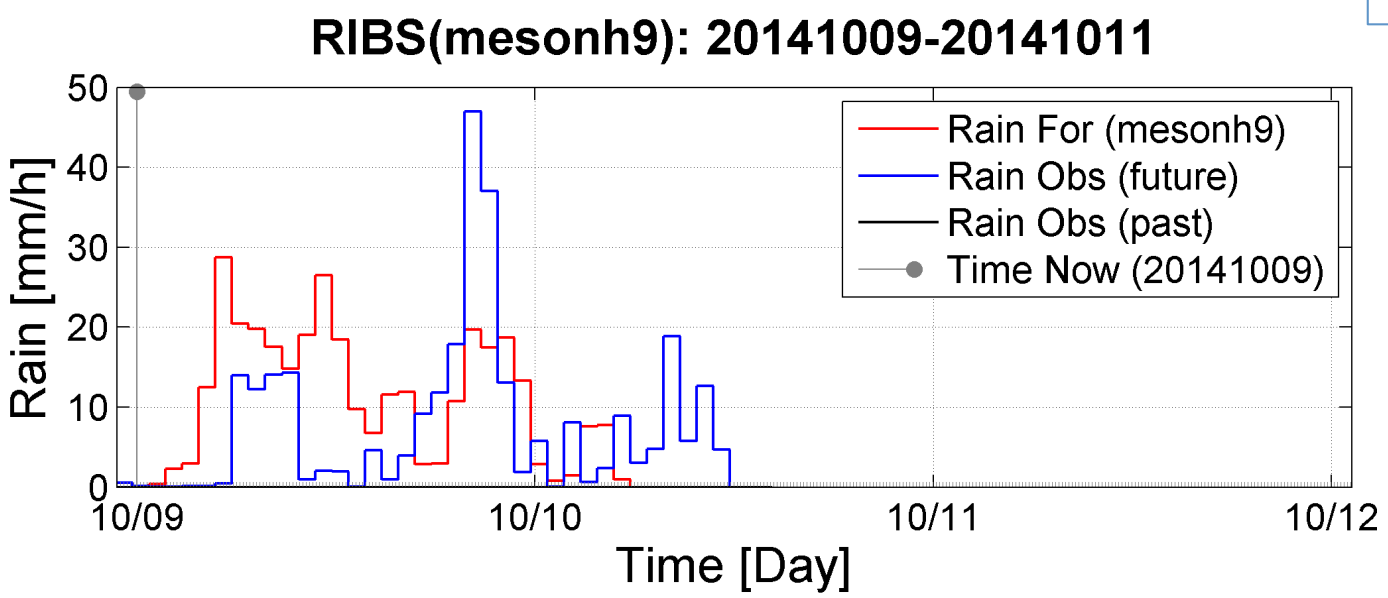
DRiFt model forced by **WRF-ARW** at **200 m– run 00UTC 09 october 2014**

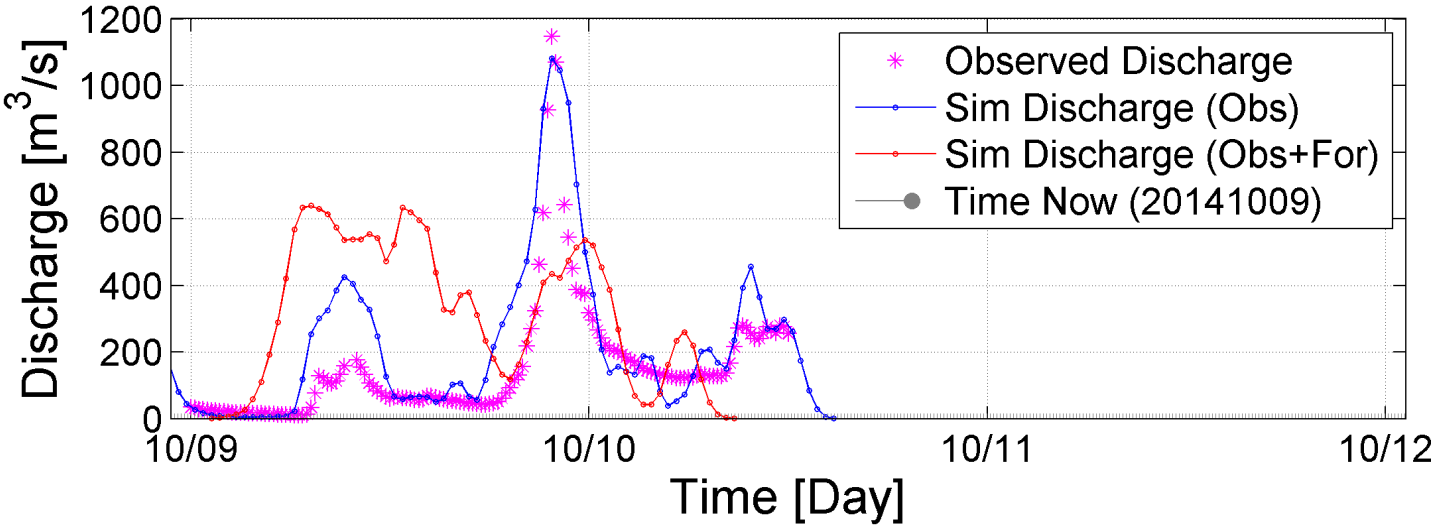


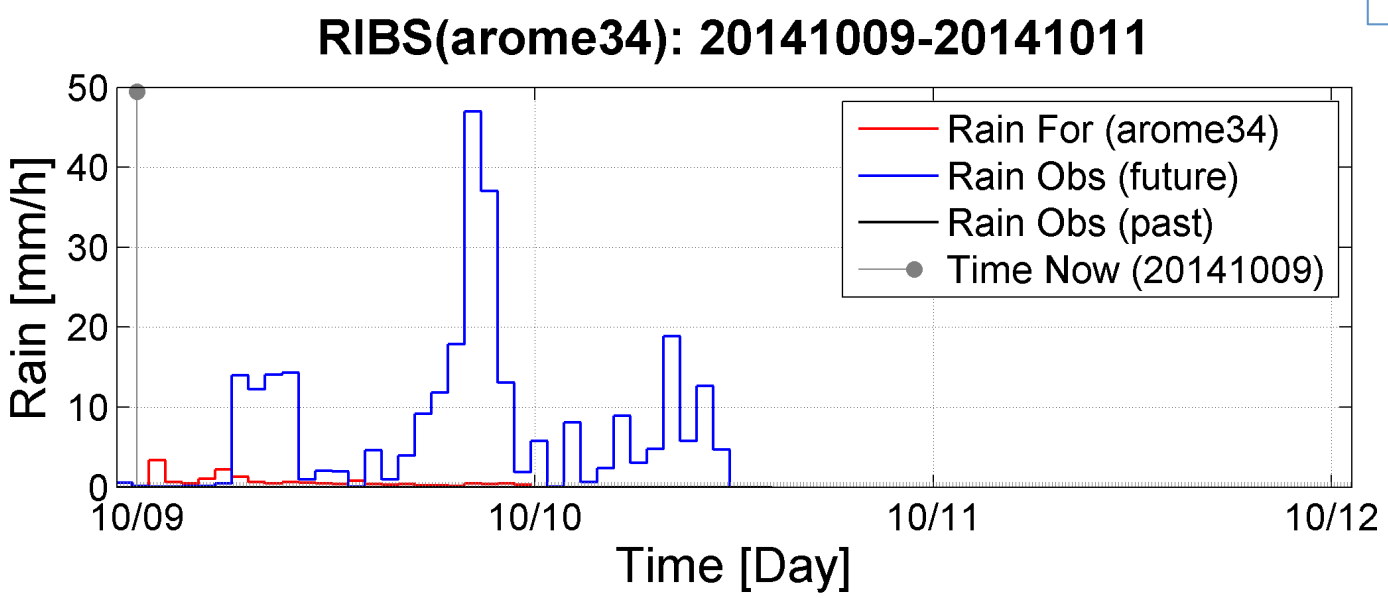


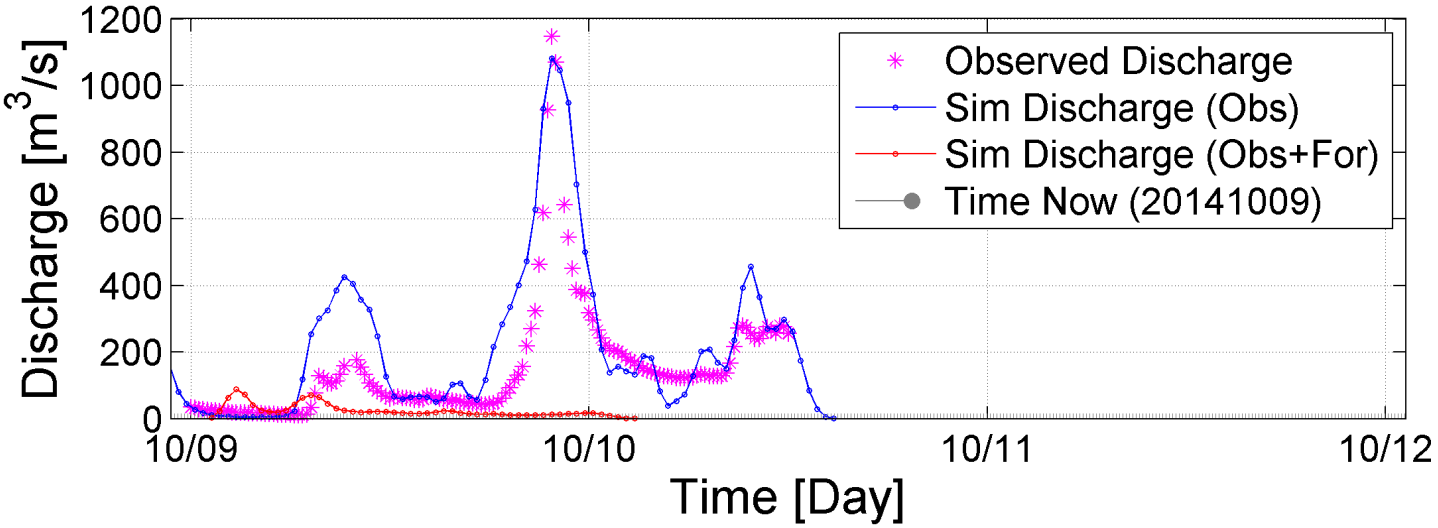
run 9/10 00UTC
200 m
650 m^3/s
At 18 UTC

MESO-NH ensemble 200 m






RIBS(arome34): 20141009-20141011
Rain [mm/h]
50
40
30
20
10
0
10/09
10/10
10/11
10/12
Time [Day]
Rain For (arome34)
Rain Obs (future)
Rain Obs (past)
Time Now (20141009)


Discharge [m3/s]
1200
1000
800
600
400
200
0
10/09
10/10
10/11
10/12
Time [Day]
Observed Discharge
Sim Discharge (Obs)
Sim Discharge (Obs+For)
Time Now (20141009)

on behalf of

CIMA Research Foundation and the DRIHM team

thank you for your attention