DRIHM and DRIHM2US implications for operational activities at the regional scale: the Liguria Region Environment Protection Agency

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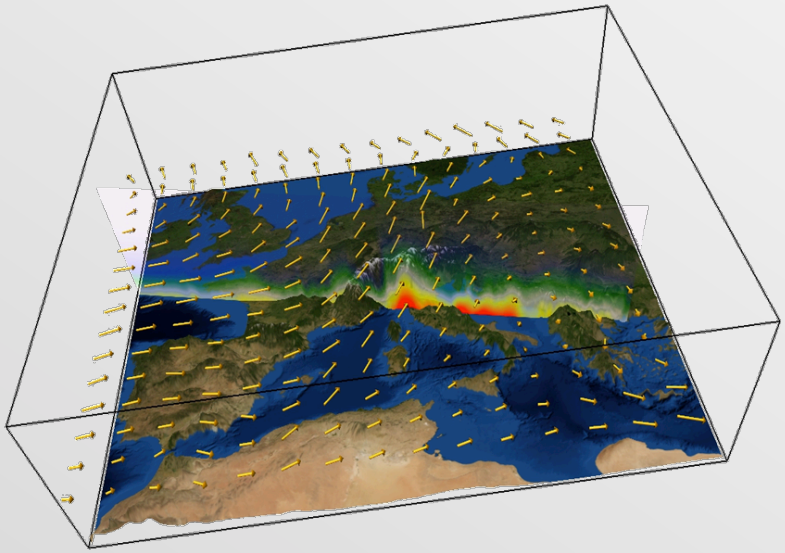
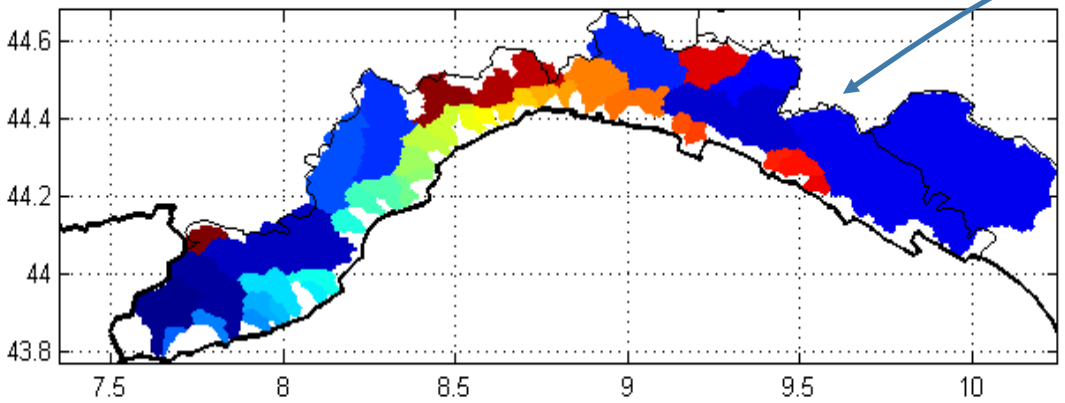
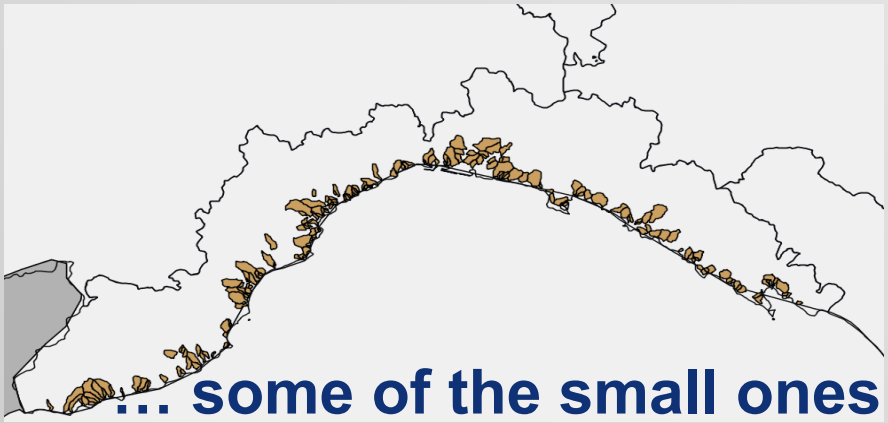


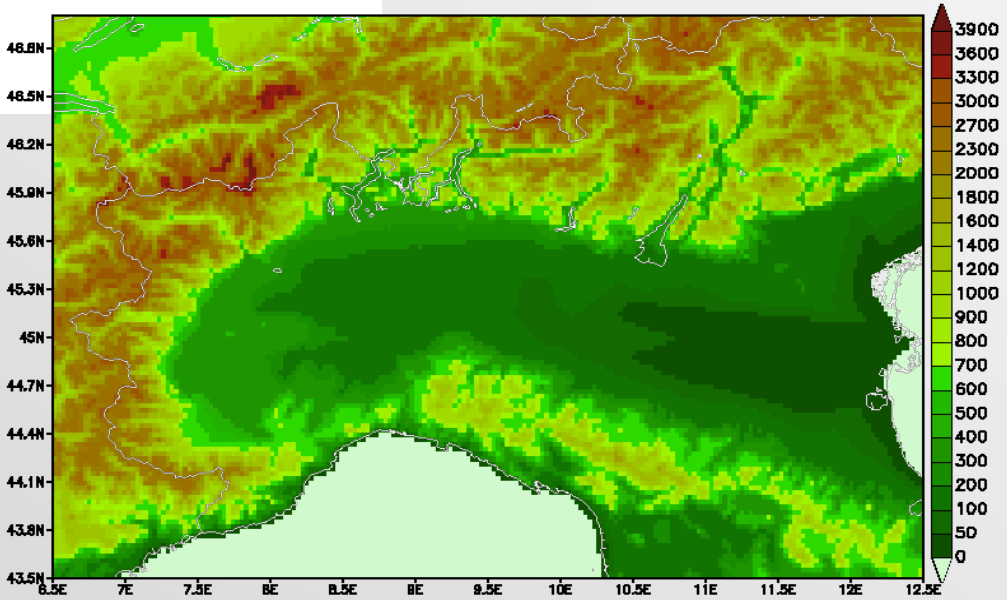
Liguria: a perfect case study



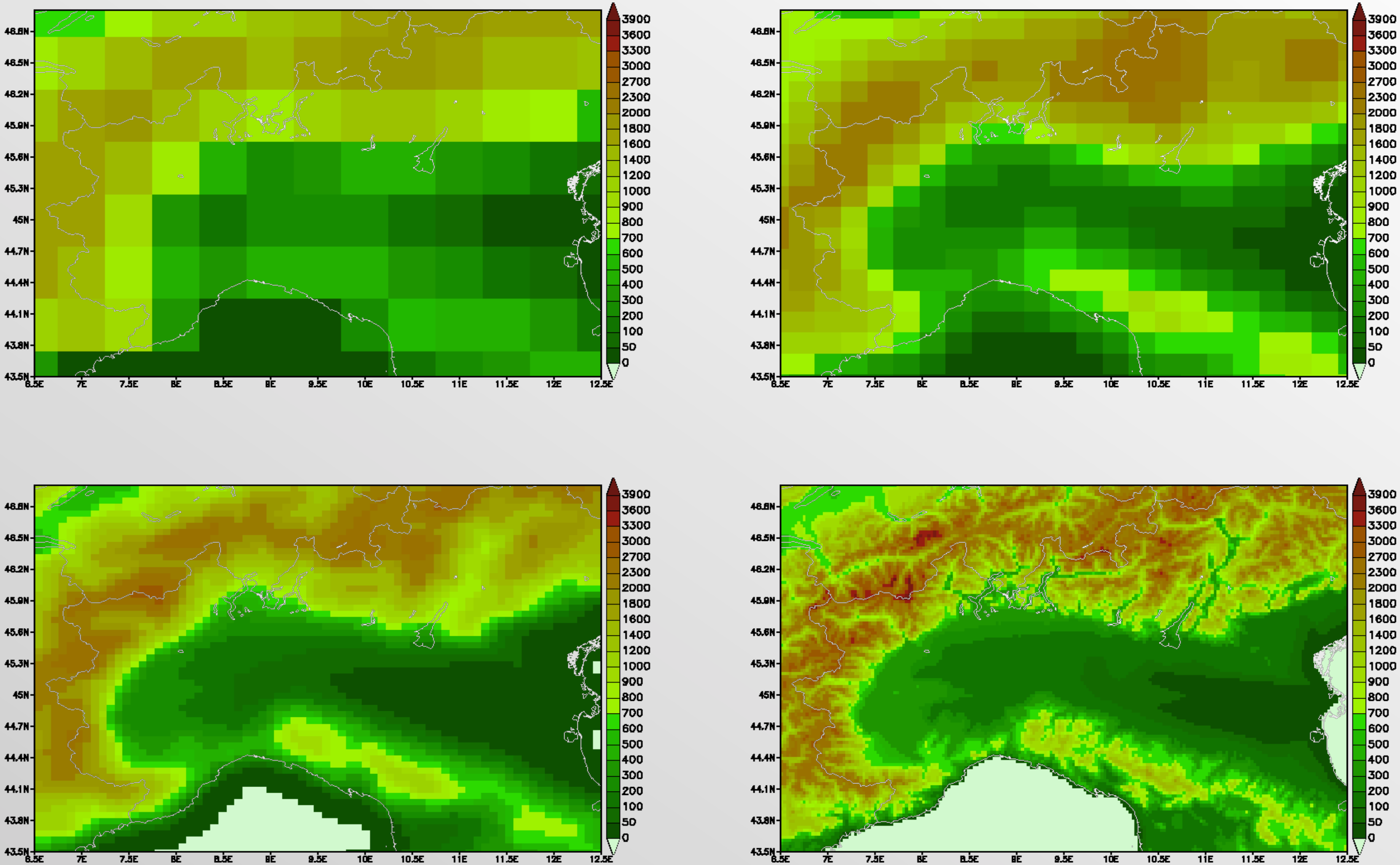
The Ligurian large catchments!

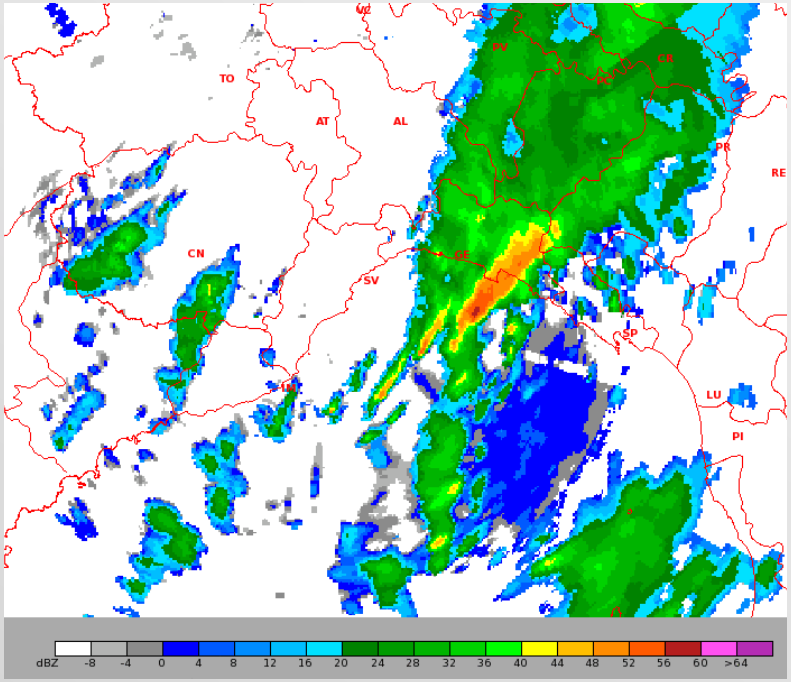


… some of the small ones



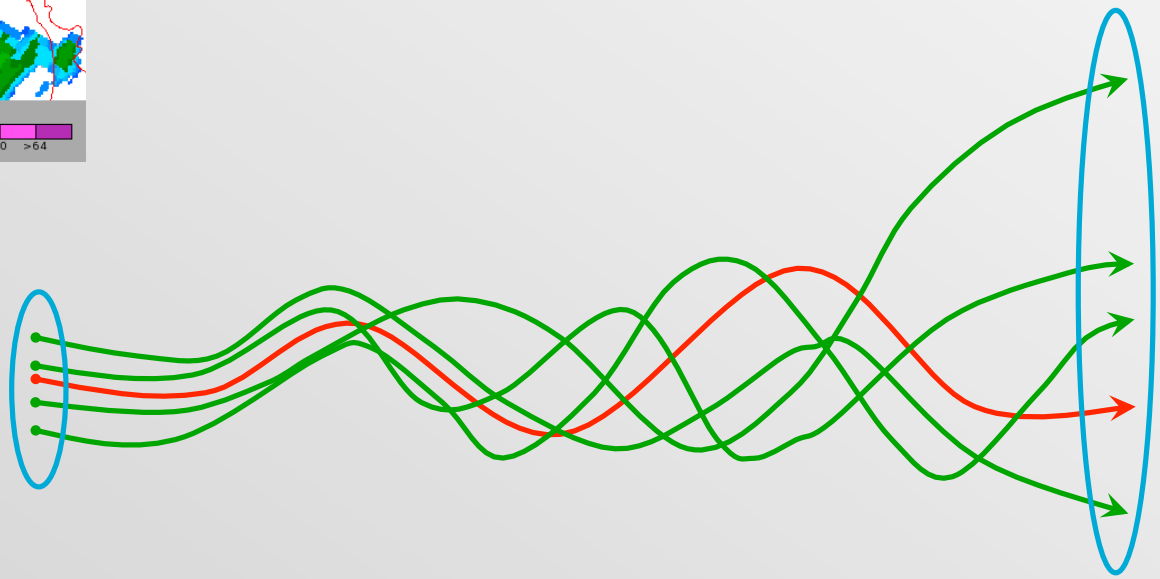
The horography at different resolutions



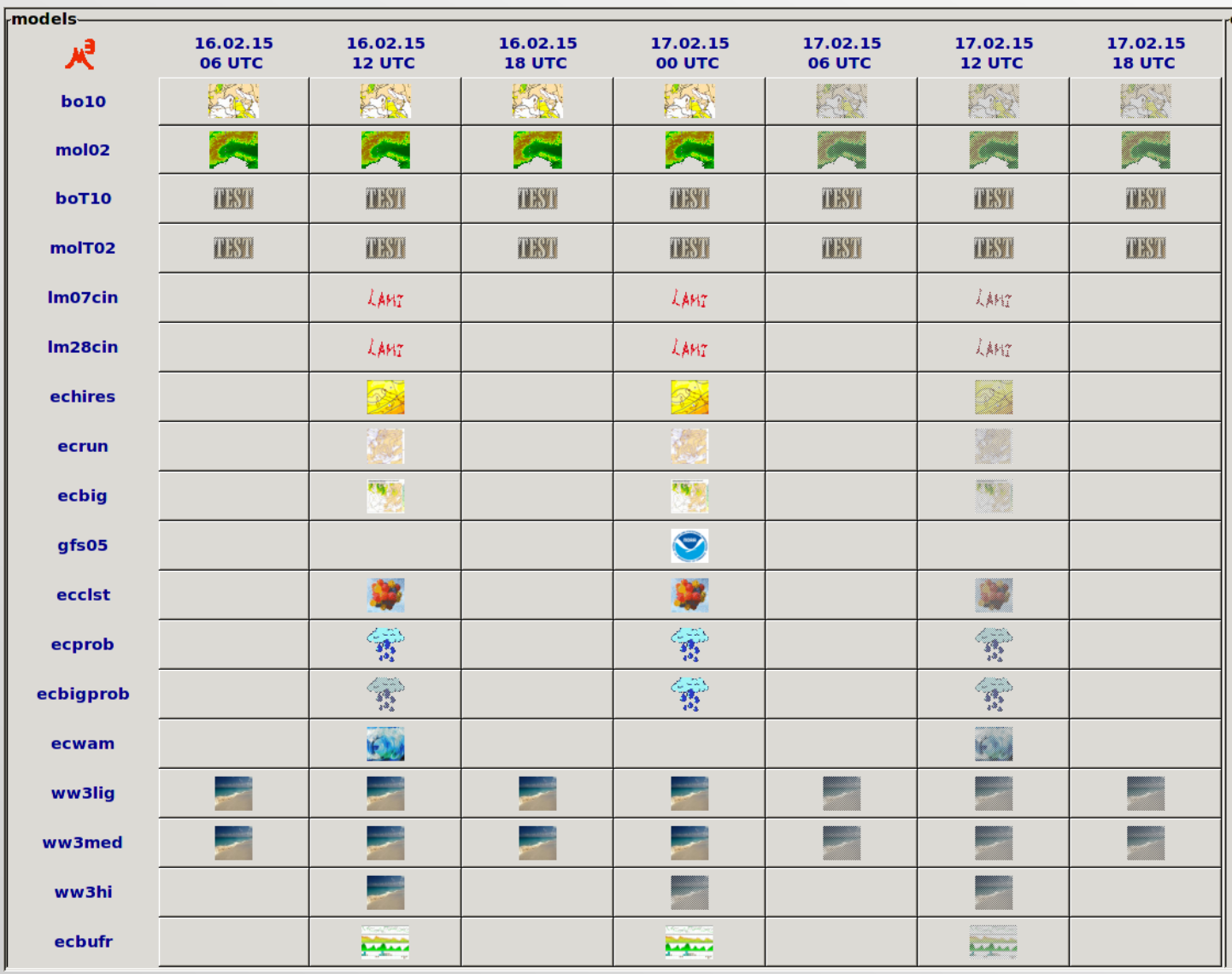


Flash floods: small scale convective systems.

Predictability of few hours.

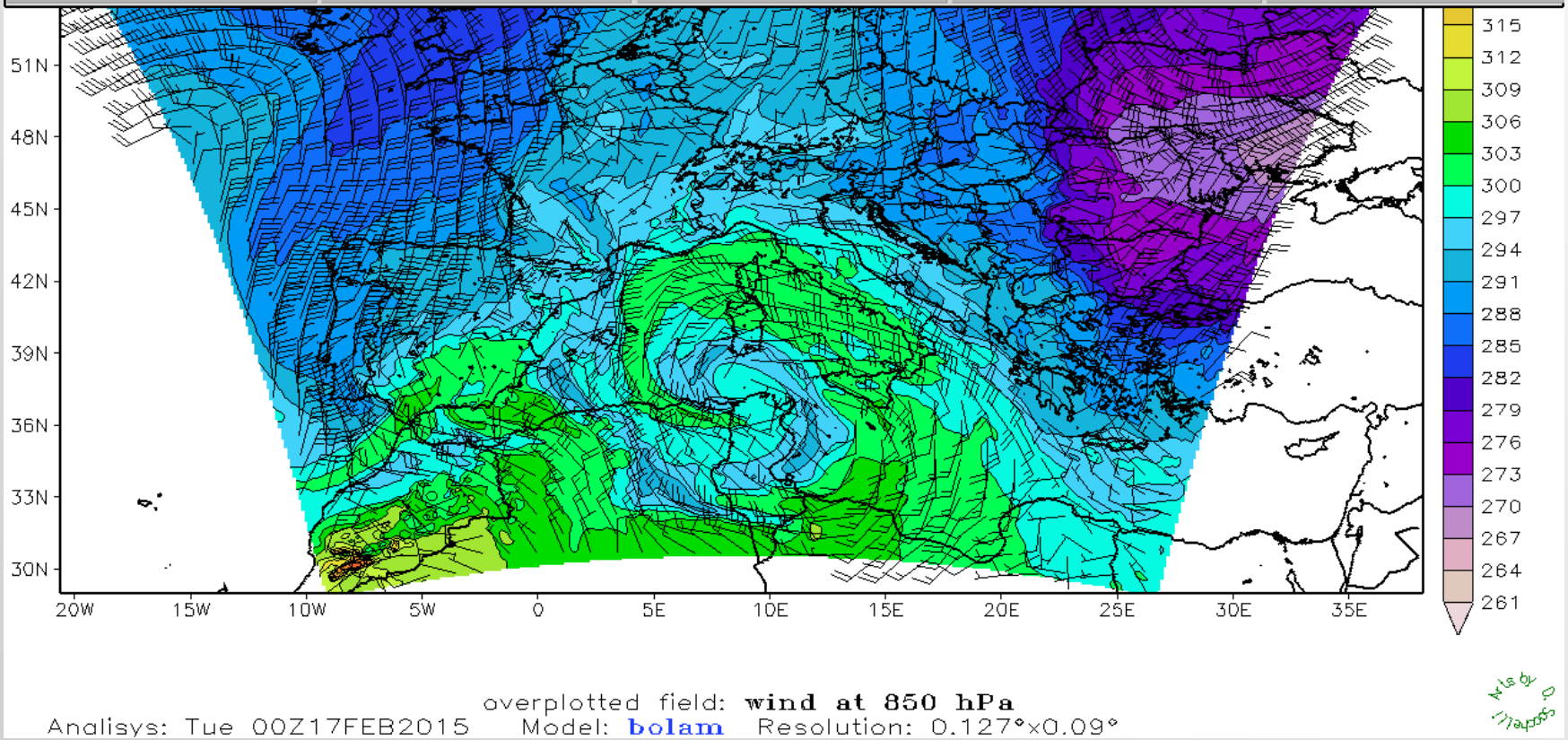


Main Model Manager (MMM)



Gridview

3D: thetae	IT: 1 00Z17+0	AREA: all	CROS: off	CNTRL: on
2D: MSLP	ID: all	MAPP: horiz	STL1: shdnlbl	OVER: 3winds
2DC: TP	LEVL: 6 [850]	PROV: LIG	STL2: barb_col	PRNT: off
DEF: hma	TDIF: 0 [0h]	ZONA: co+in	SKIP: auto	LOCL: gmthighmap
SCLN: 1	LDIF: 0 [LEVL-NONE]	SLCT: off	WSEC: HORIZ	FILL: filled



Schematic of the Bolam-Moloch chain

ECMWF

3h

Bolam 10 km

72h forecast

1h

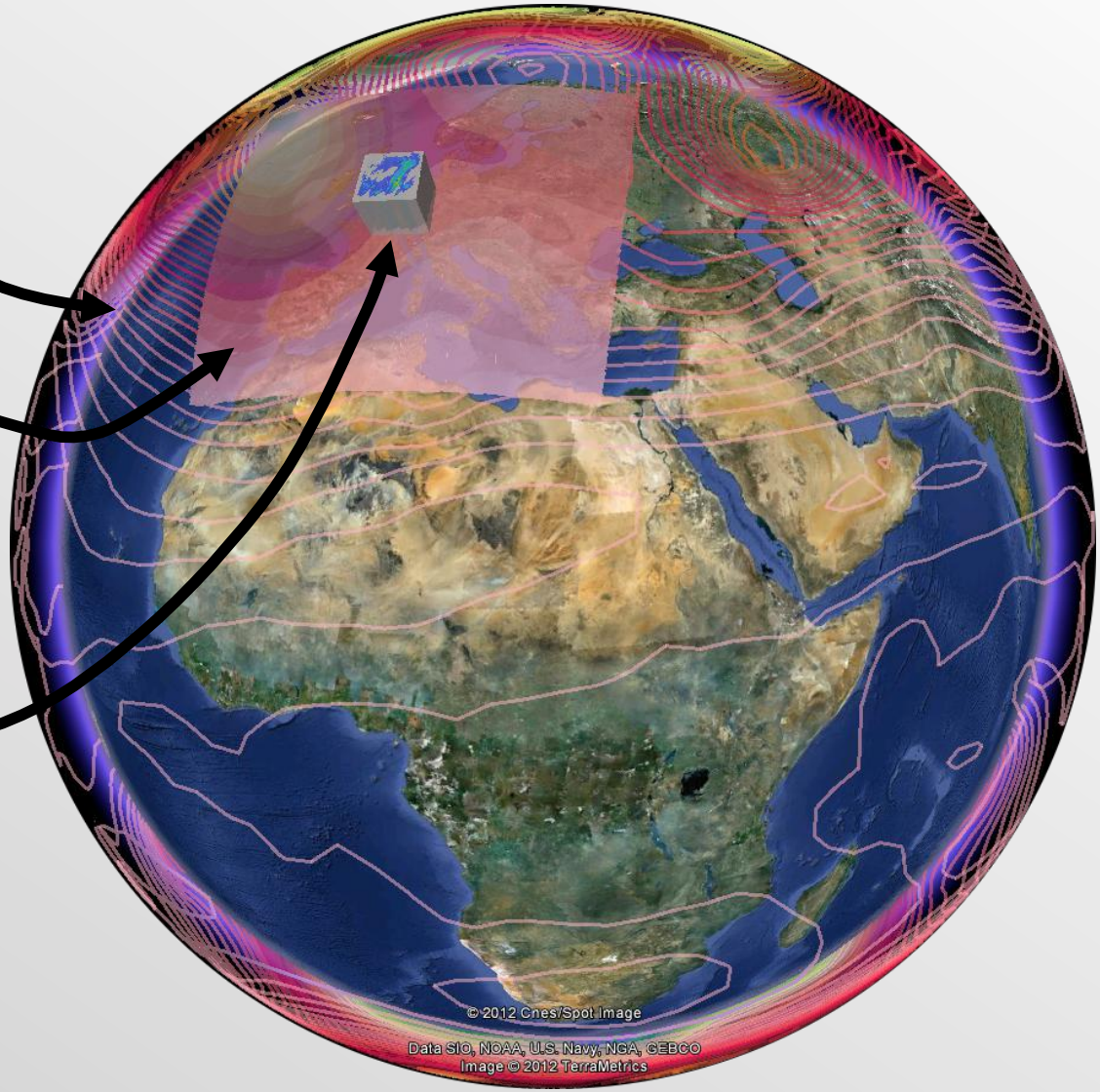
Moloch 2 km

48h forecast

WW3

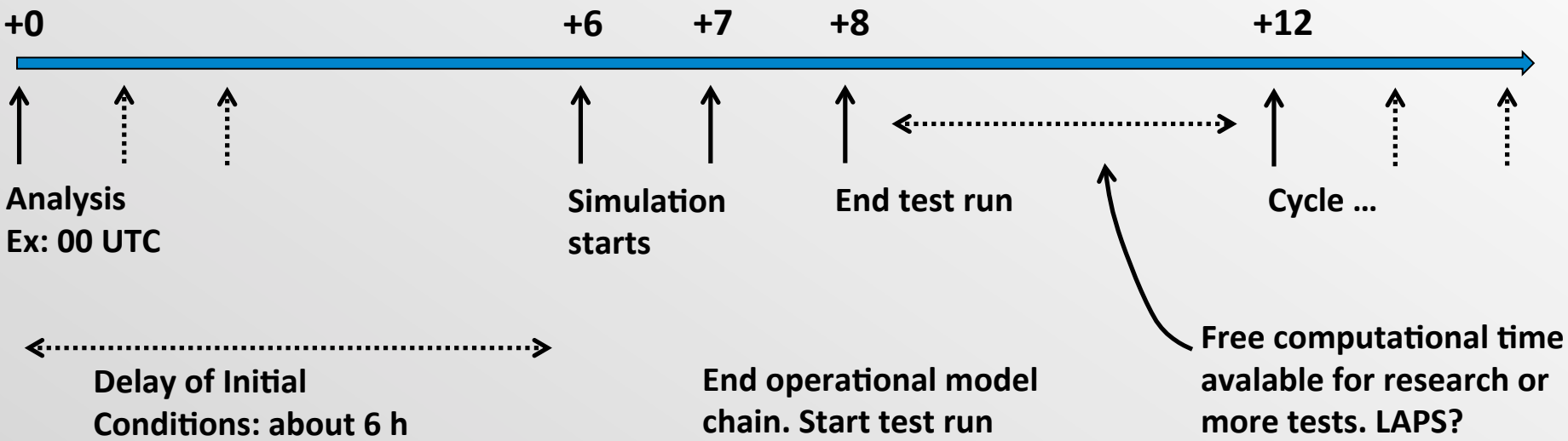
Mediterranean

Ligurian sea



Bolam – Moloch, computational resources

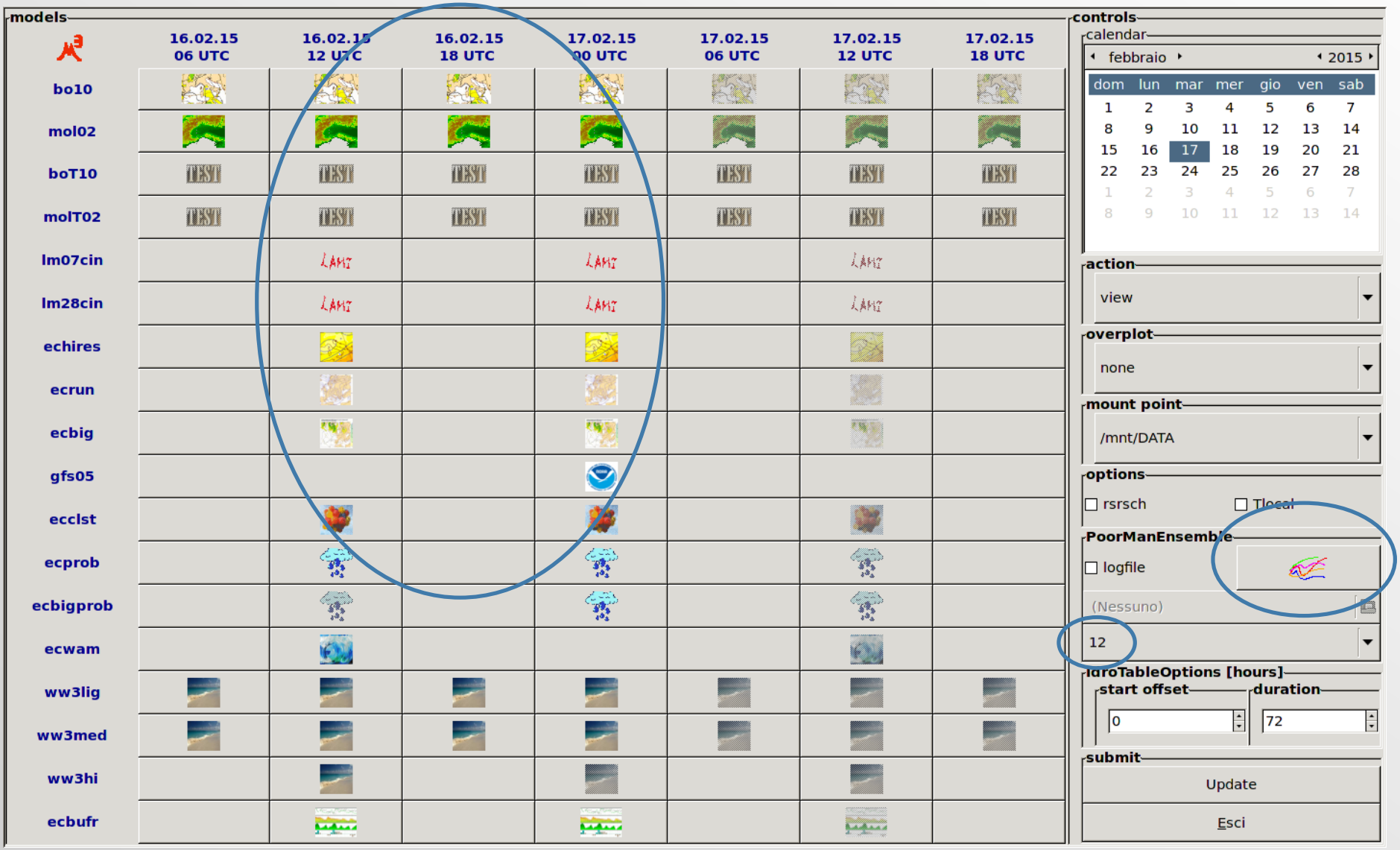
4 runs every day: 00, 06, 12, 18 UTC



GNU/Linux CentOS: 5 hosts, Intel 17-980X 4.20GHz processors, 30 cores:

- 72 h forecast bolam (362 x 322 grid points, 45 levels): 10 minutes computational time
- 48 h forecast moloch (206 x 202 grid points, 50 levels): 40 minutes computational time
- 72 h forecast ww3: about 5 minutes computational time

Ensemble


models
16.02.15 06 UTC
16.02.15 12 UTC
16.02.15 18 UTC
17.02.15 00 UTC
17.02.15 06 UTC
17.02.15 12 UTC
17.02.15 18 UTC
bo10
mol02
boT10
molT02
lm07cin
lm28cin
echires
ecrun
ecbig
gfs05
ecclst
ecprob
ecbigprob
ecwam
ww3lig
ww3med
ww3hi
ecbufr
controls
calendar
febbraio
2015
dom lun mar mer gio ven sab
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
1 2 3 4 5 6 7
8 9 10 11 12 13 14
action
view
overplot
none
mount point
/mnt/DATA
options
rsrsch
Tlocal
PoorManEnsemble
logfile
(Nessuno)
12
idroTableOptions [hours]
start offset
0
duration
72
submit
Update
Esci

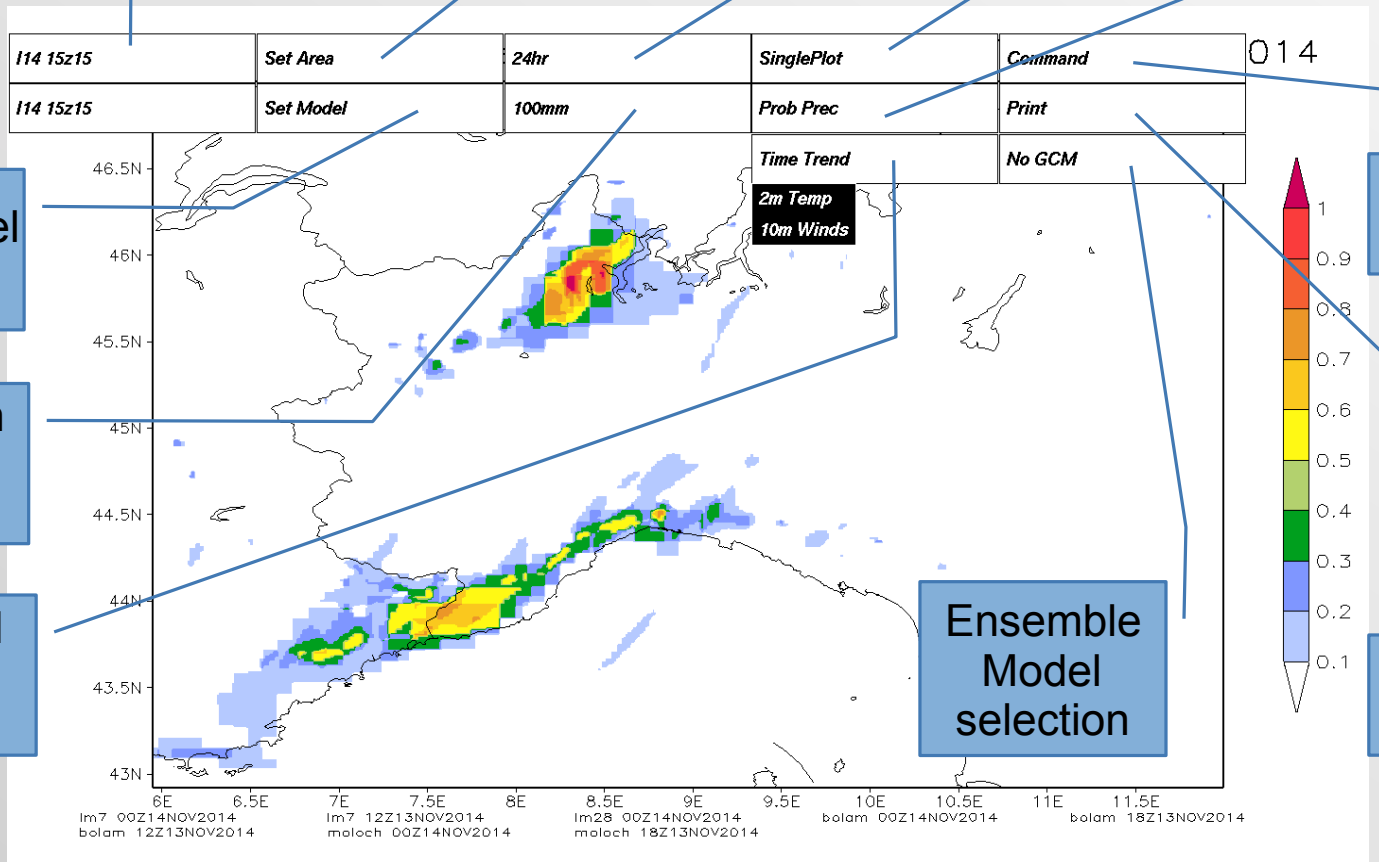
Time menu

Domain menu

Precipitation interval selection

Single model plot

Ensemble plot



Single model selection

Precipitation Threshold selection

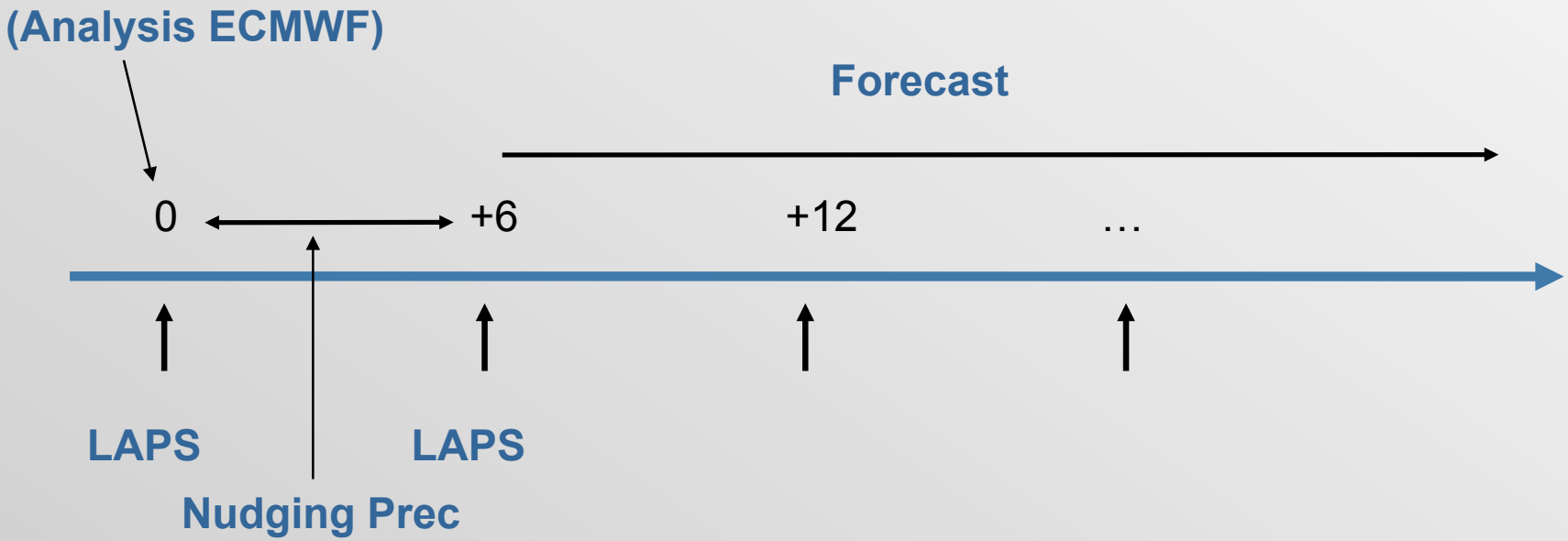
Time trend Ensemble plot

Ensemble Model selection

System menu

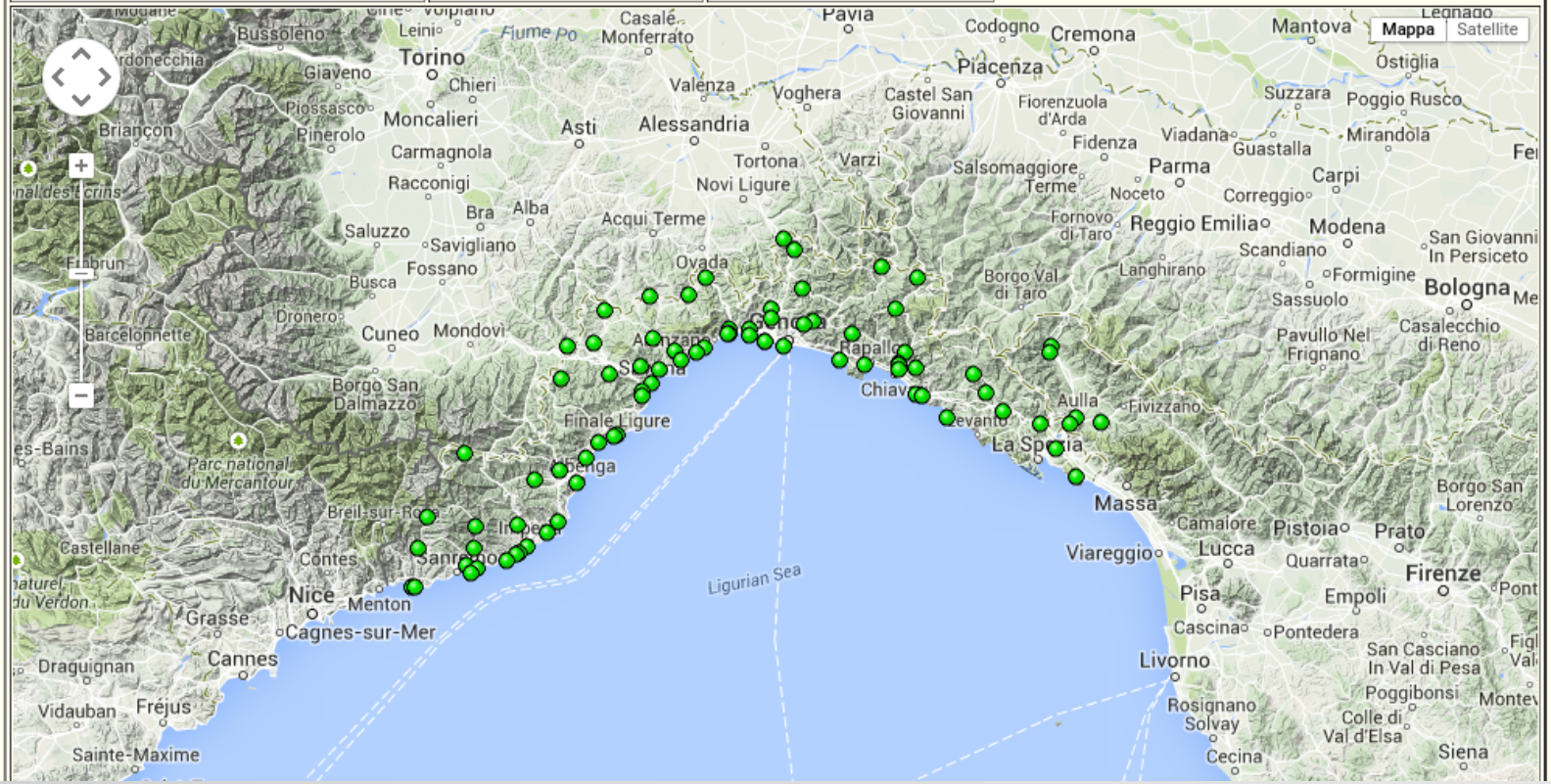
Print menu

LAPS and precipitation nudging for Bolam and Moloch

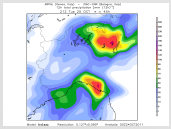
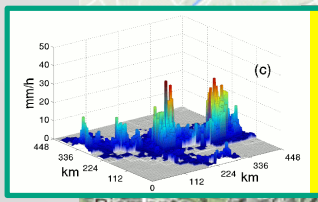
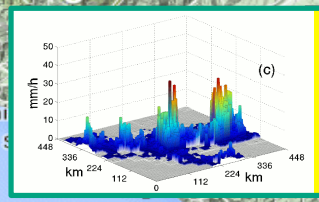
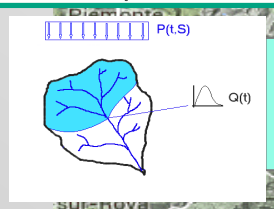


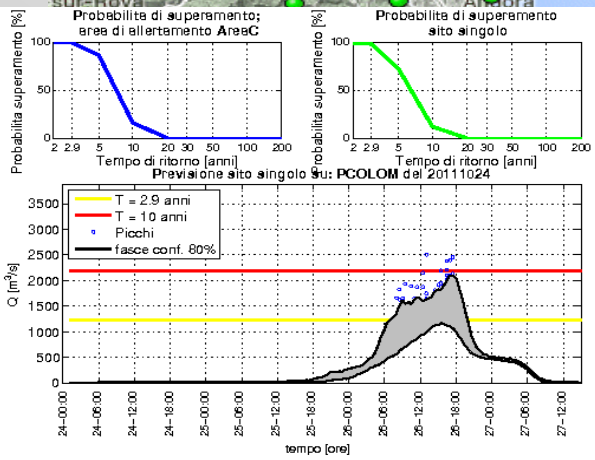
Hydrological models

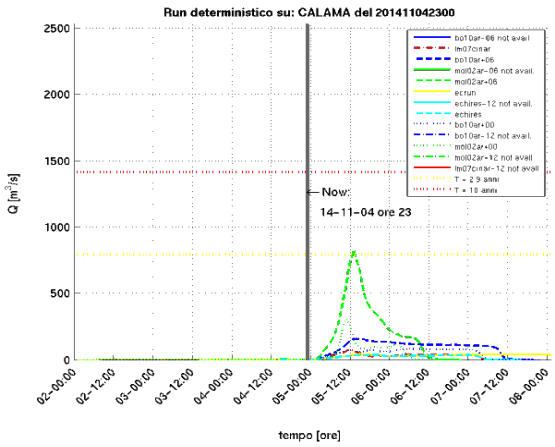
Monitoraggio	Osservato+Phast	Osservato	Piccoli Bacini	
Previsioni soggettiva	Mappa	Box plot		
Previsioni deterministica	Ensemble multimodel			
Previsioni probabilistiche bolam	Rainfarm bo10ar+00	Rainfarm bo10ar+06	Rainfarm bo10ar-06	Rainfarm bo10ar-12
Previsioni probabilistiche moloch	Rainfarm mol02ar+00	Rainfarm mol02ar+06	Rainfarm mol02ar-06	Rainfarm mol02ar-12
Previsioni probabilistiche local	Rainfarm lm07cinar	Rainfarm lm07cinar-12		
Previsioni probabilistiche local 28	Rainfarm lm28cinar	Rainfarm lm28cinar-12		

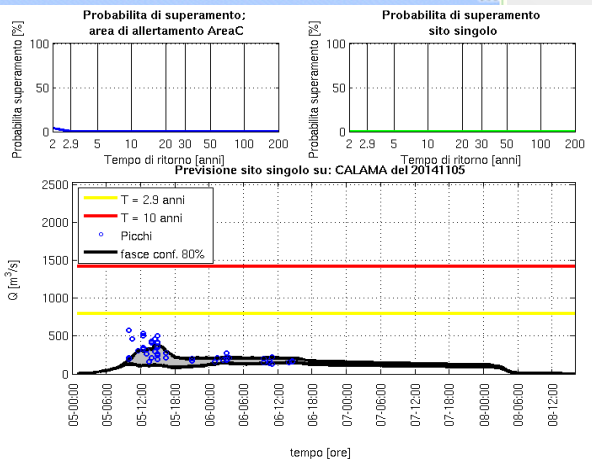


Hydrological models

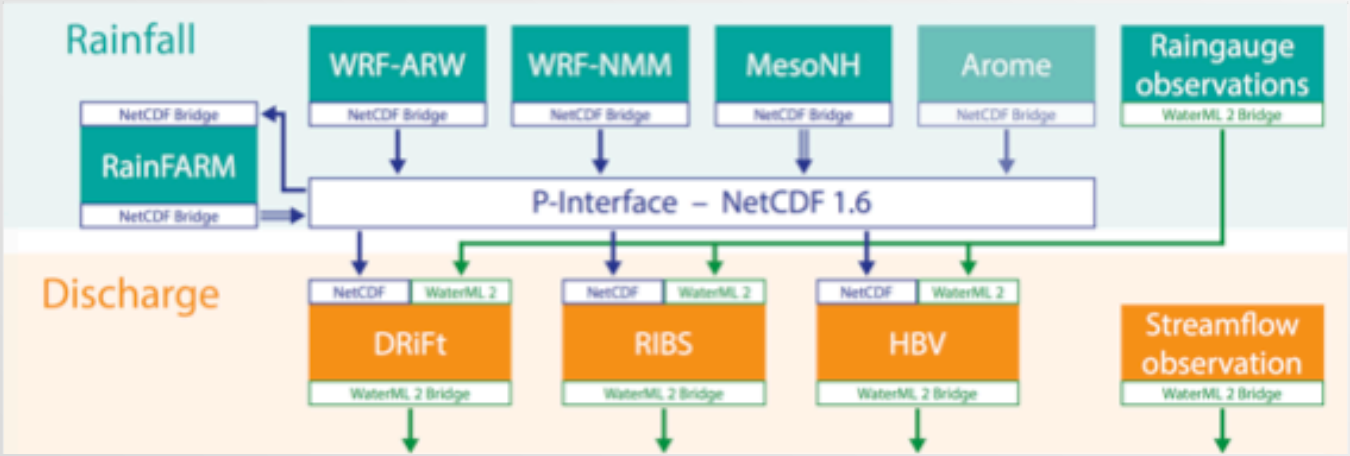
Subjective Chain	Deterministic Chain	Probabilistic Chain
		
Meteo Model	Meteorological Model	Meteorological Model
Forecaster elaboration	----	----
	----	
Downscaling Model (Rainfarm)		Downscaling Model (Rainfarm)
		
R/Runoff Model	Rainfall/Runoff Model	Rainfall/Runoff Model







Similar schemes



Operational framework

Research framework

Bolam

Moloch

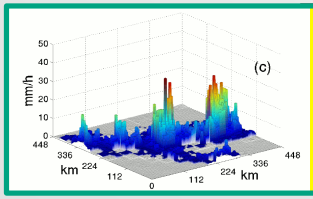
Cosmo

Ecmwf

…

Probabilistic Chain

Meteorological Model



Downscaling Model (Rainfarm)

Rainfall/Runoff Model

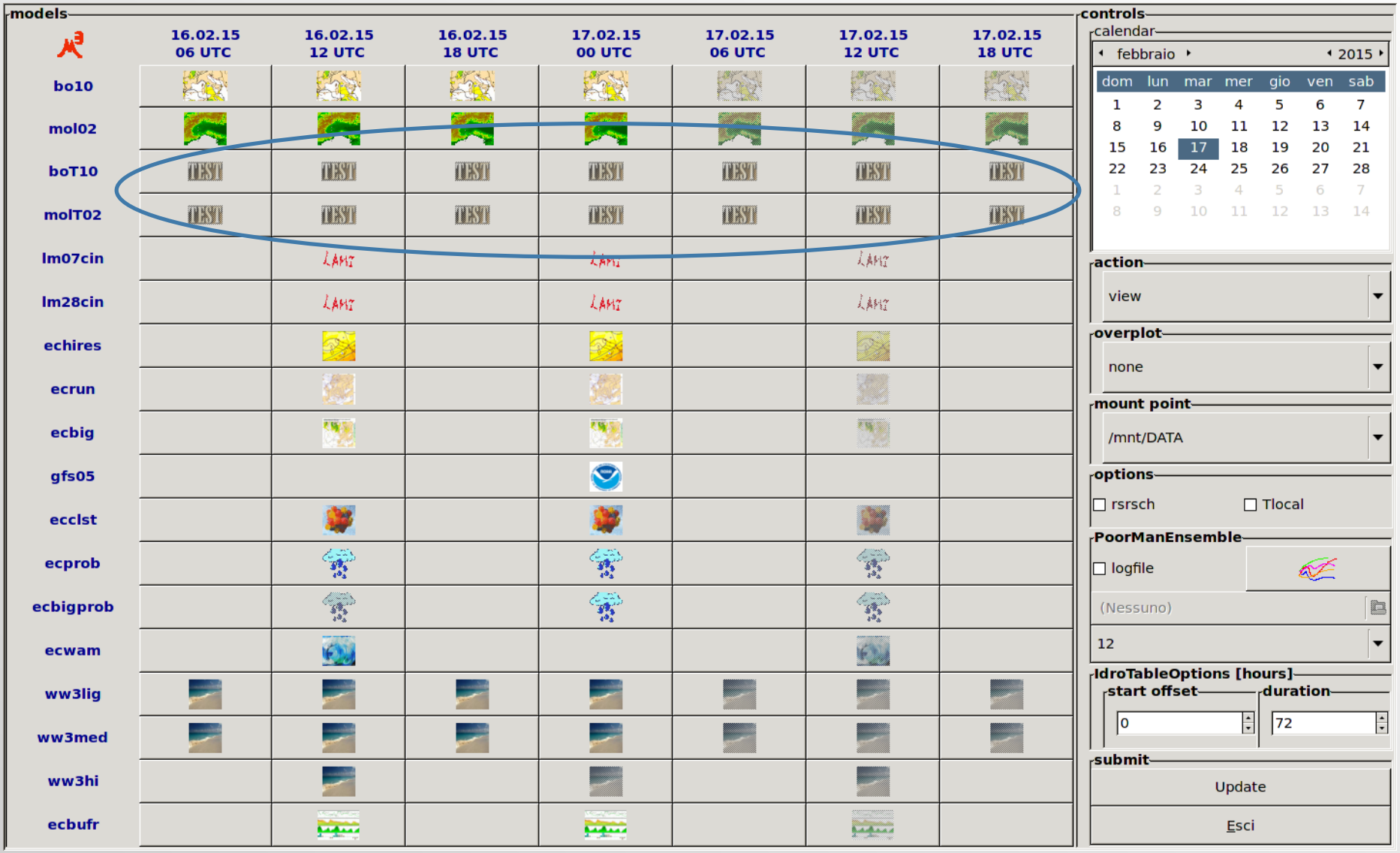
The modeling chain operational at ARPAL – CFMI-PC resemble the modeling structure of the DRIHM and DRIHM2US project.

We do try to use common formats when possible, but no real protocol is set. Many differences are handled using a case to case method.

Adopting DRIHM/DRIHM2US achievements is for sure an improvement, already at the present stage.

Operationally (!) important to consider the risk of allowing simple changes in the model chain configuration:
Forecasters need stability.

The long path leading to operational chains



Same advantages of the research framework are available during the test process of new configurations

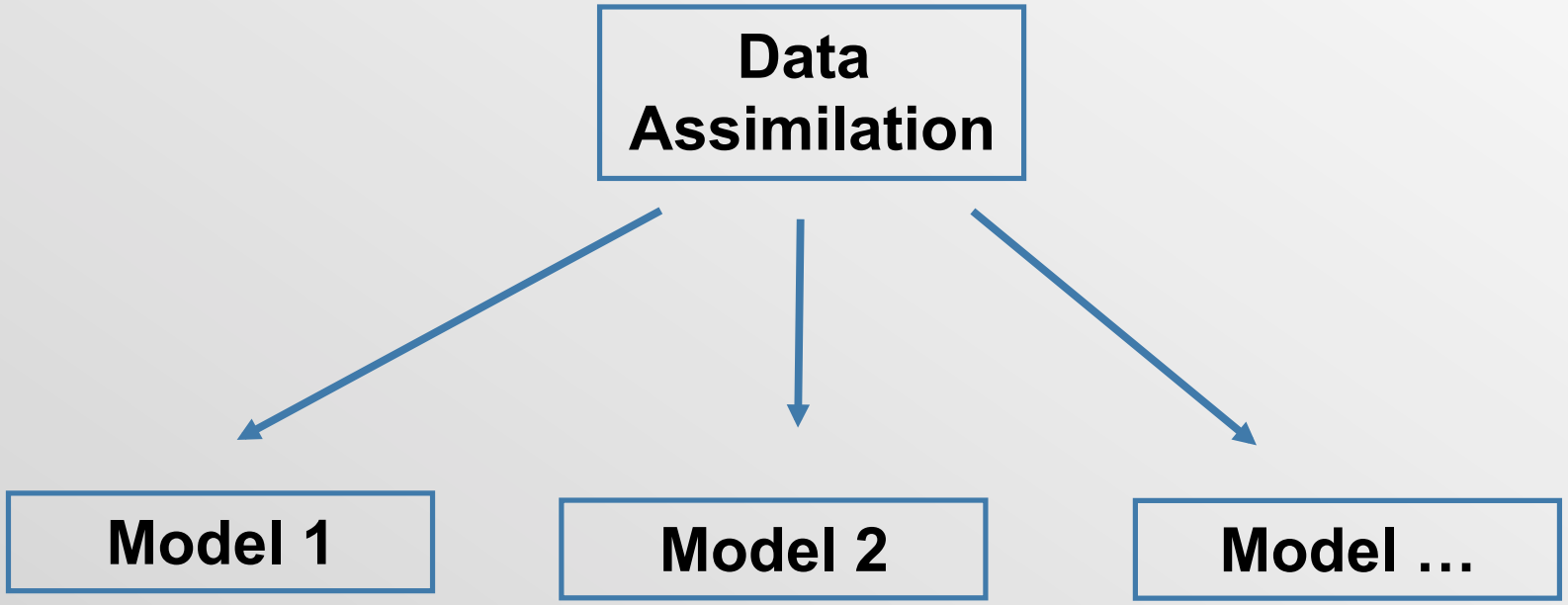
Also allowing for a fast and effective visualization and comparison of different pre-operational choices.

Challenges:

Some modeling tools can be developed in order to be shared by different modeling systems:

Examples: Data Assimilation
Model Output Statistics

Common formats: Data Assimilation

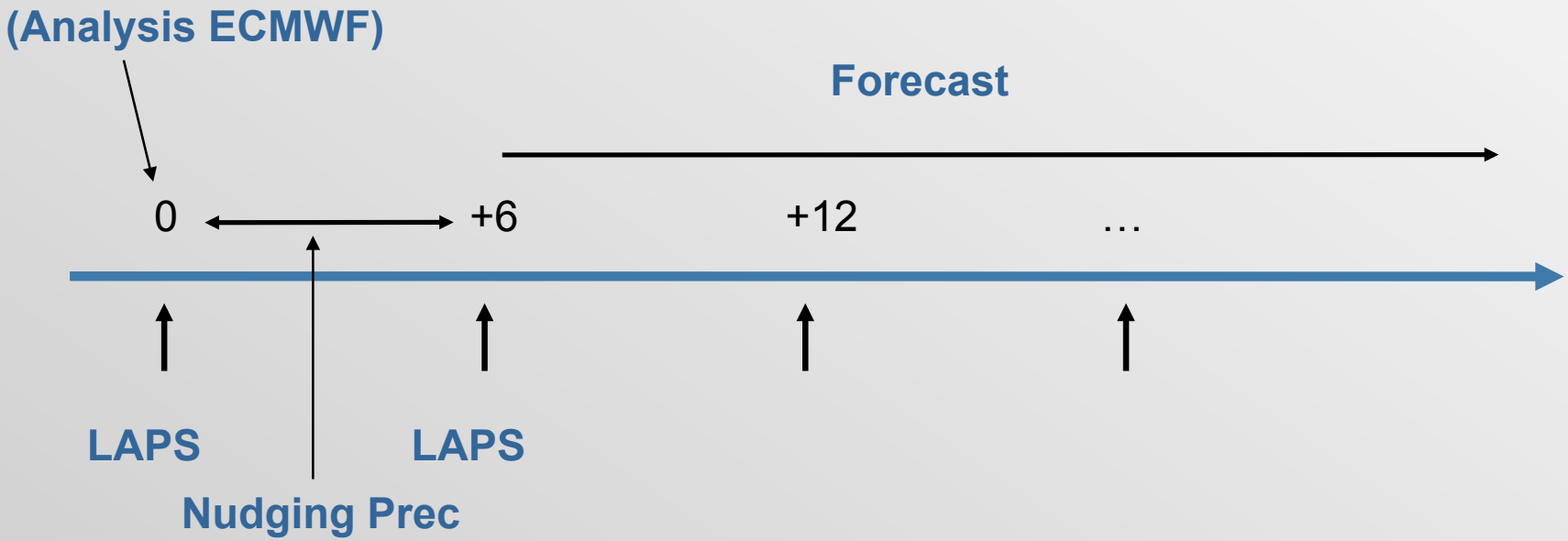


Issues:

- **grid,**
- **uncertatinty statistics,**
- **vertical structure**

Implementing a mantaining an interface for a common data assimilation scheme?

The implementation of LAPS for Bolam and Moloch is an example



Computational resources are “limited” by definition.

But:

Operationally oriented evolution of the DRIHM projects must take into consideration that forecasters and the entire alerting system need stability and known timing.

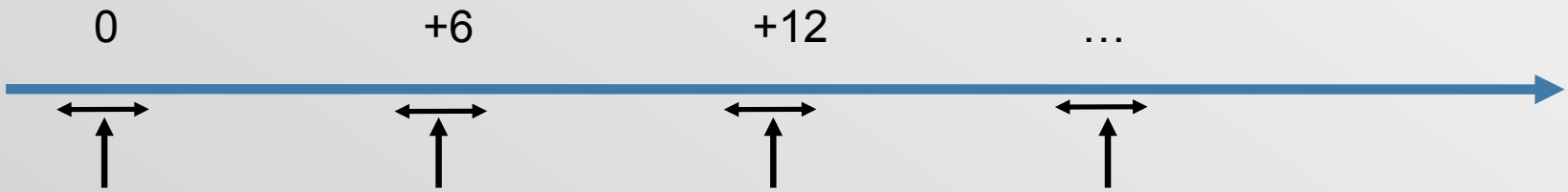
Any distributed solution should include the possibility to get sufficient priority to end the process by a know time.

Minor but not negligible issues also if the system is too efficient respect to expectations.

Challenges:

Is it possible to handle a distributed system capable to accelerate or decelerate in order to respect a regular timing? Or:

Is the civil protection system capable to adapt to computational resources availability?



As before, the advantages of the presently available DRIHM/ DRIHM2US facility for the testing phase are apparent!

In summary

Even if the present stage of the DRIHM infrastructure is research based, it is already capable to provide a high impact in the operational context, in particular in the pre-operational phase.

Further developement in the pre-operational phase include the possibility to share Data Assimilation, Verification and MOS (grid, uncertainty,…). Is it worth? I think it is.

Further developement in the strictly operational phase is particularly challenging.

In particular an efficient extension of the computational resources to the operational world could lead to exciting new possibilities.