# Alaro experiences in Croatia

Martina Tudor, Stjepan Ivatek-Šahdan, Antonio Stanešić

# Outline

- Operational suite in 3 resolutions
  - Small scale convection
  - Flood case
  - Cold front
- Testing …. testing ….
  - the roughness length (Z0) and other stuff underneath
  - such as the sea surface temperature (SST)
- Final thoughts

# Operational suite

The operational limited area model (LAM) version used is AL38T1 with ALARO0 physics for 8 and 4 km forecasts. Operational forecast run for:

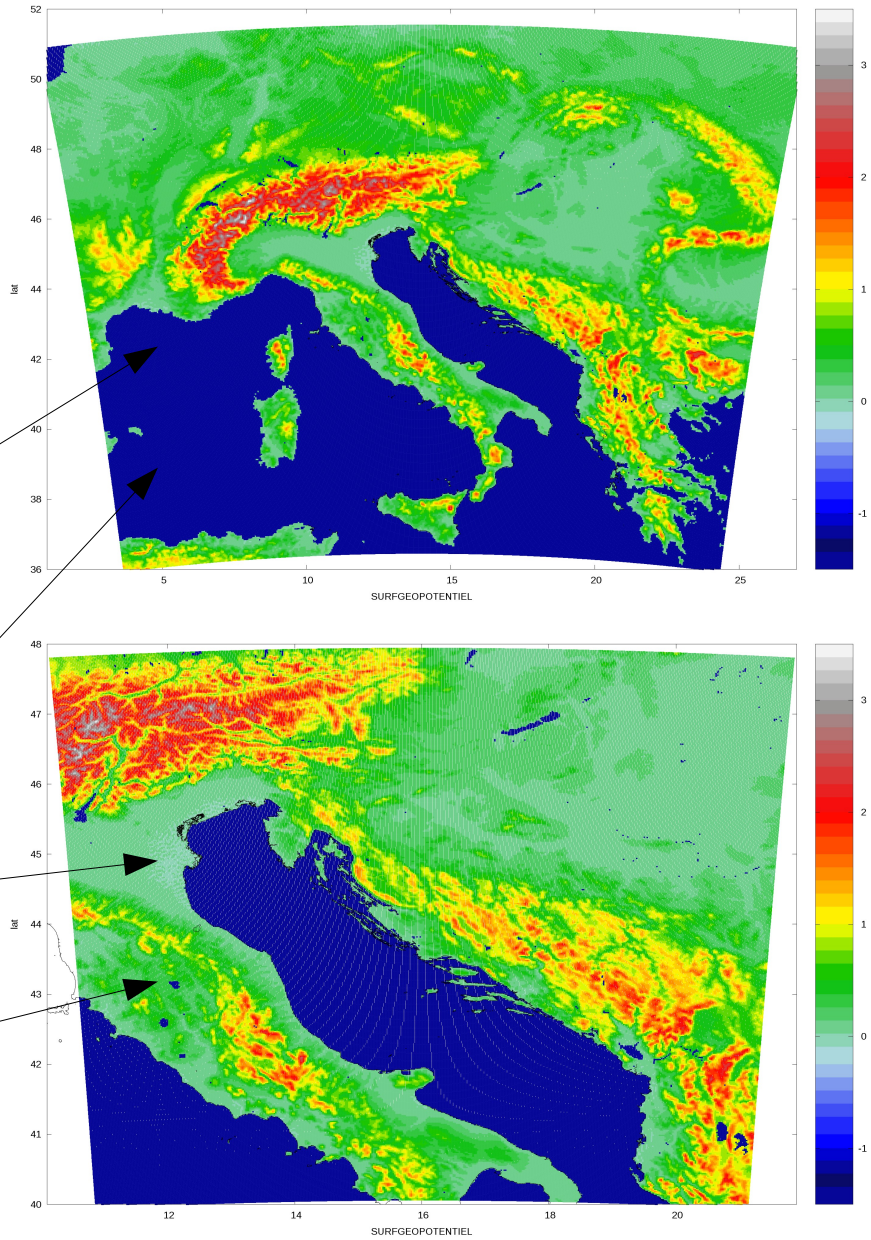
- 8 km resolution, 4 times per day, 3DVAR upper air analysis and surface OI, 6 h cycling, to 72 hours, coupled to IFS, 37 levels.

- 4 km resolution, 00 UTC up to 72 hours, surface OI, 6h cycling, coupled to IFS, 73 levels, to do: 3DVAR.

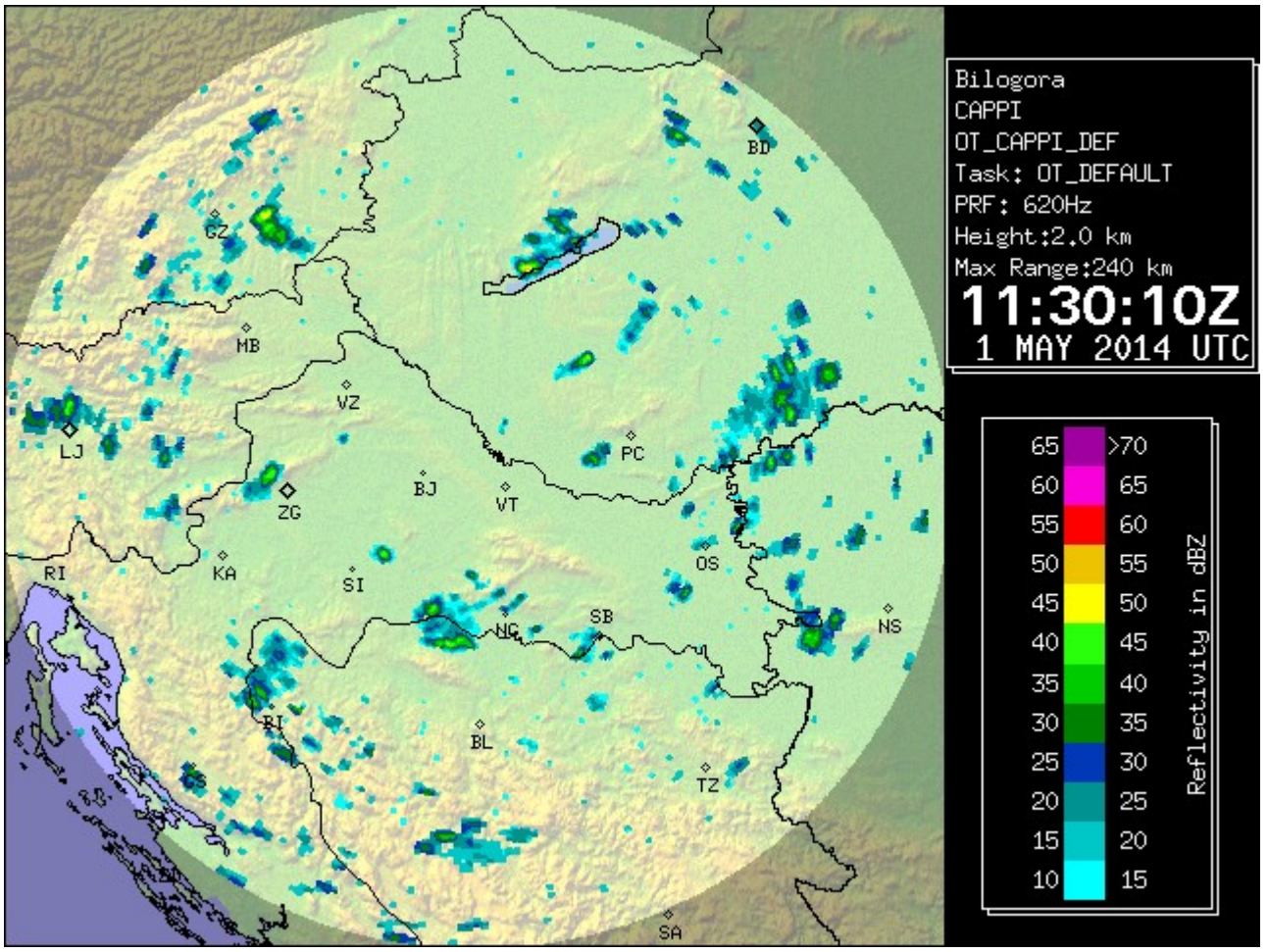
- 2 km hydrostatic dynamical adaptation, hourly, up to 72 hours,

- 2 km non-hydrostatic, 06 UTC up to 24 hours

Article in Cro. Met. Jour.



# Small scale convective cells – radar reflectivity for 1st May 2014



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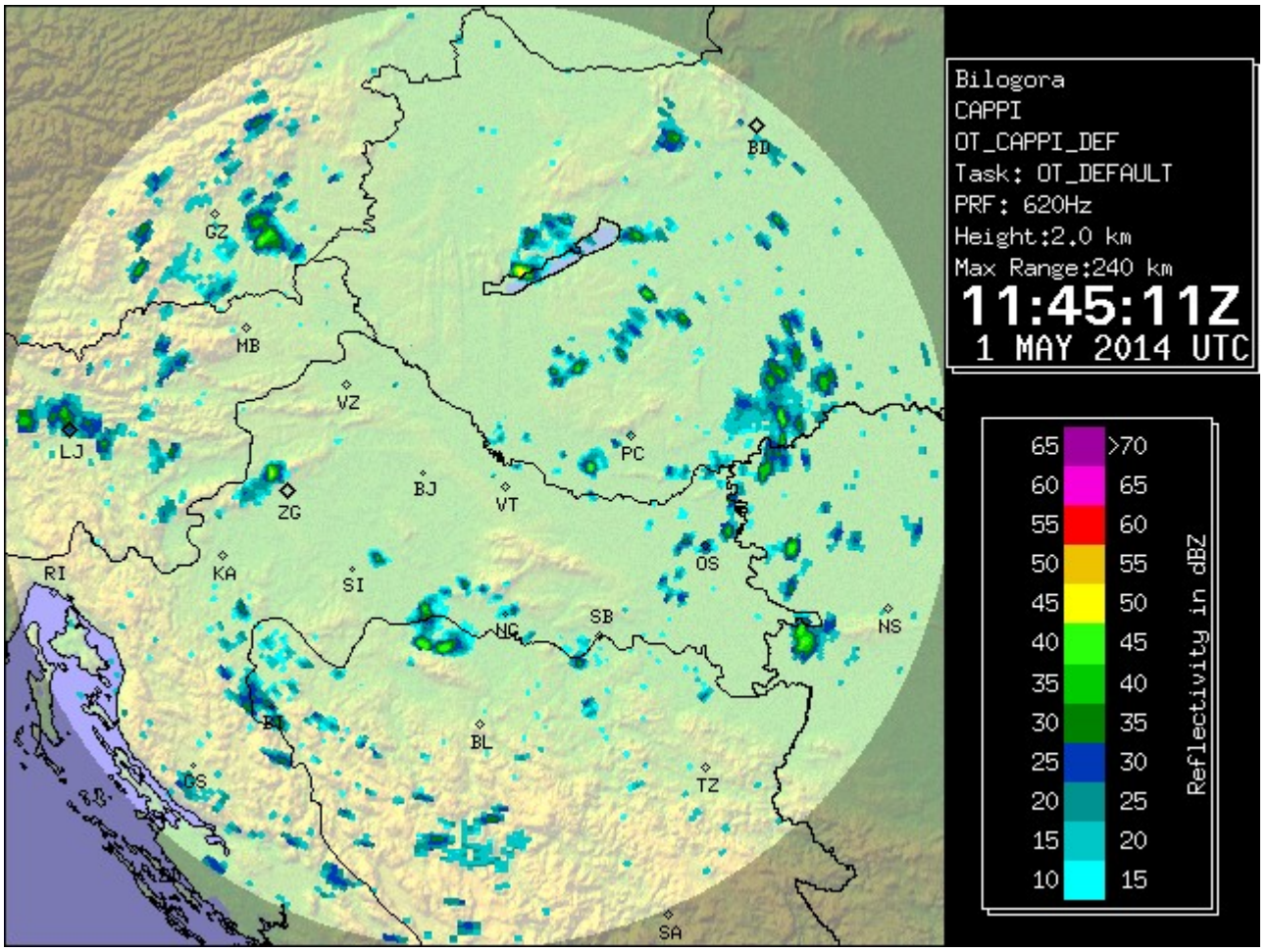

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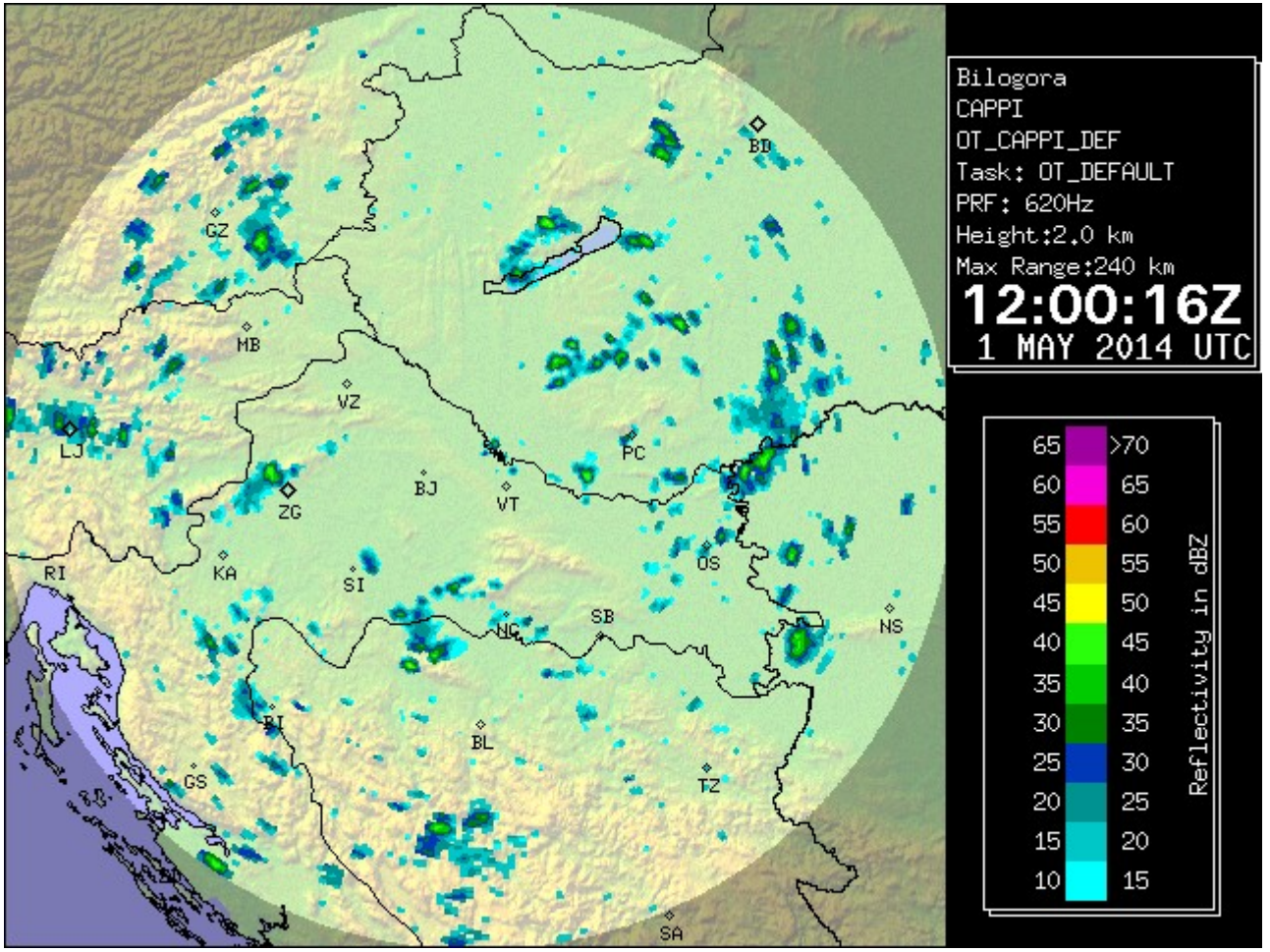

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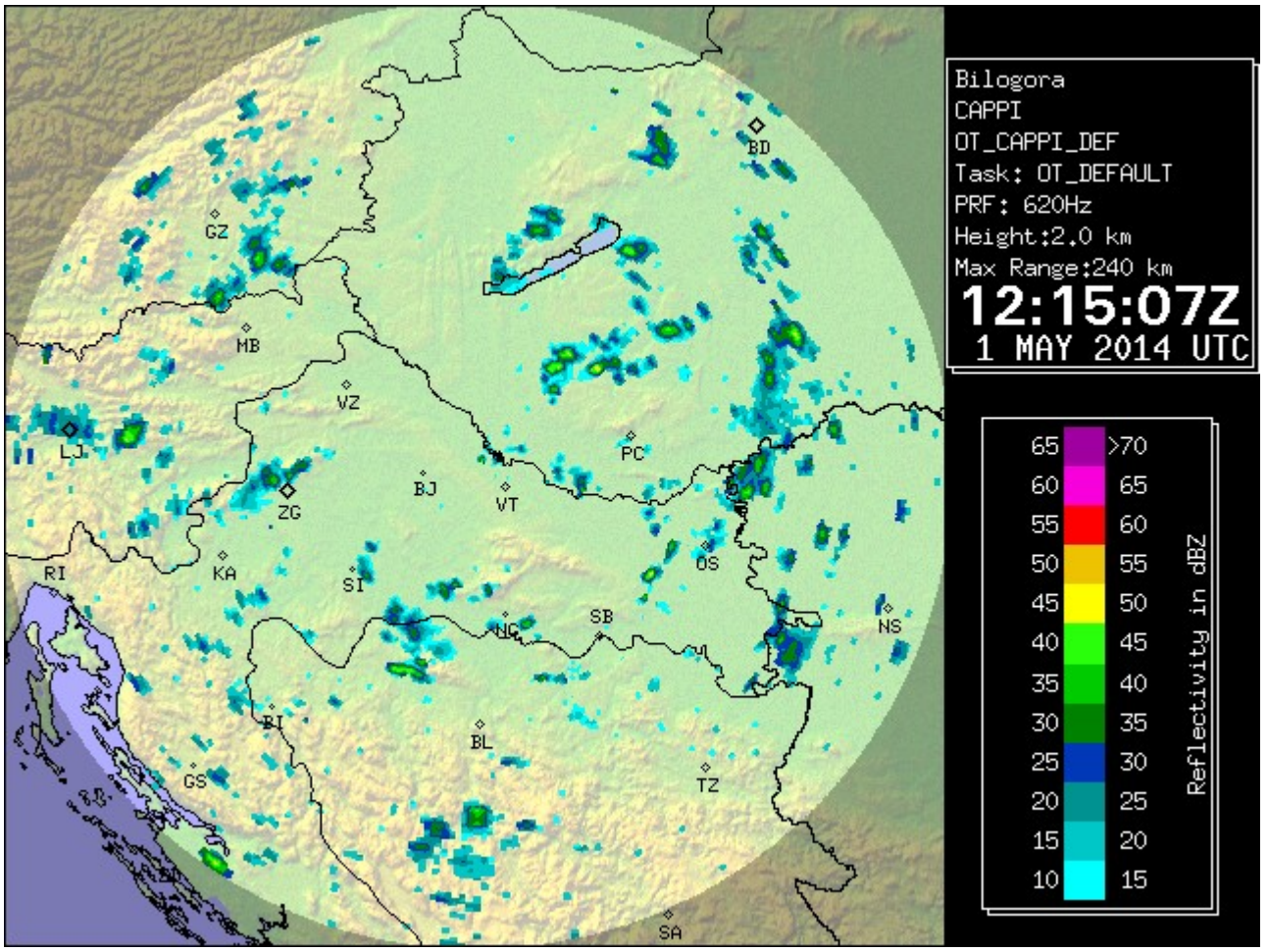

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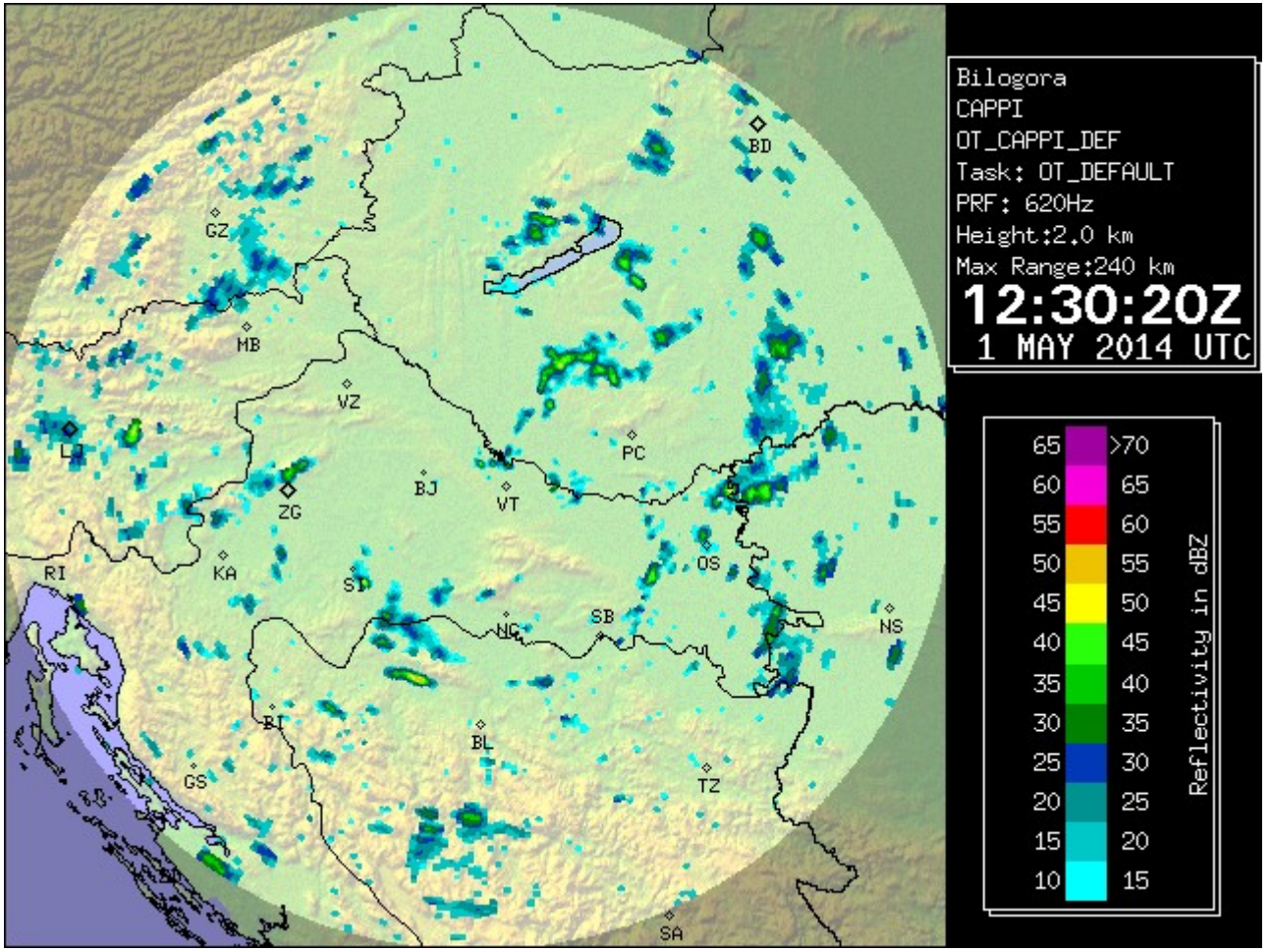
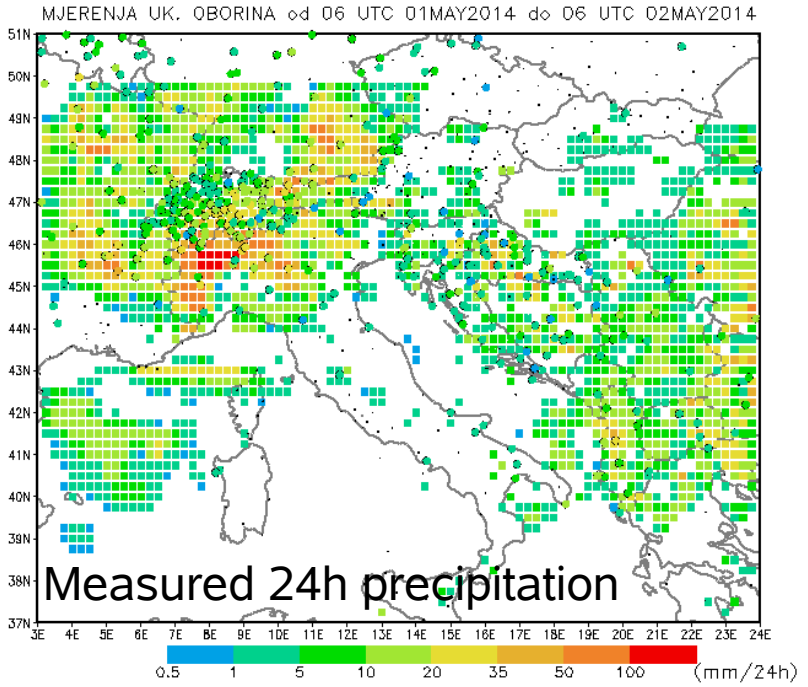
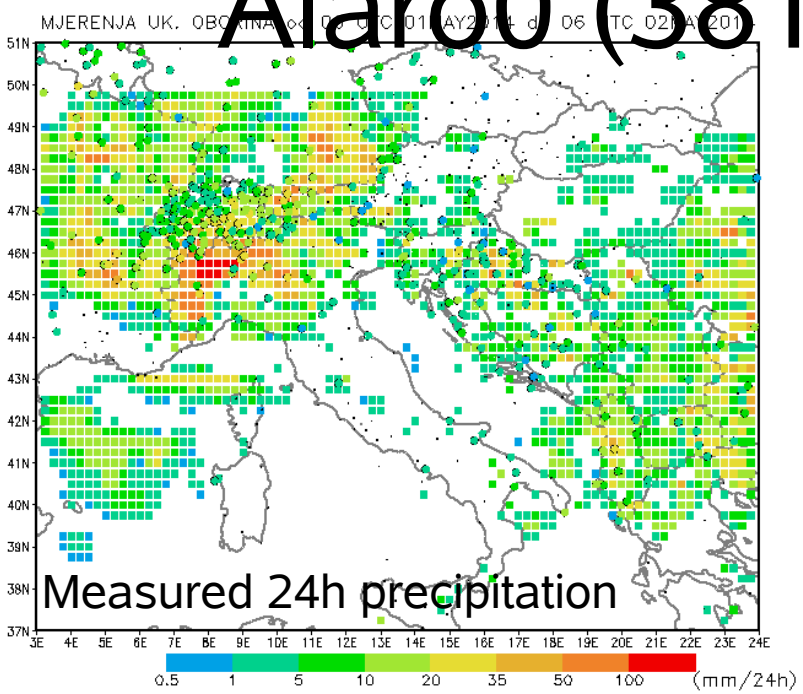


# Measured precipitation

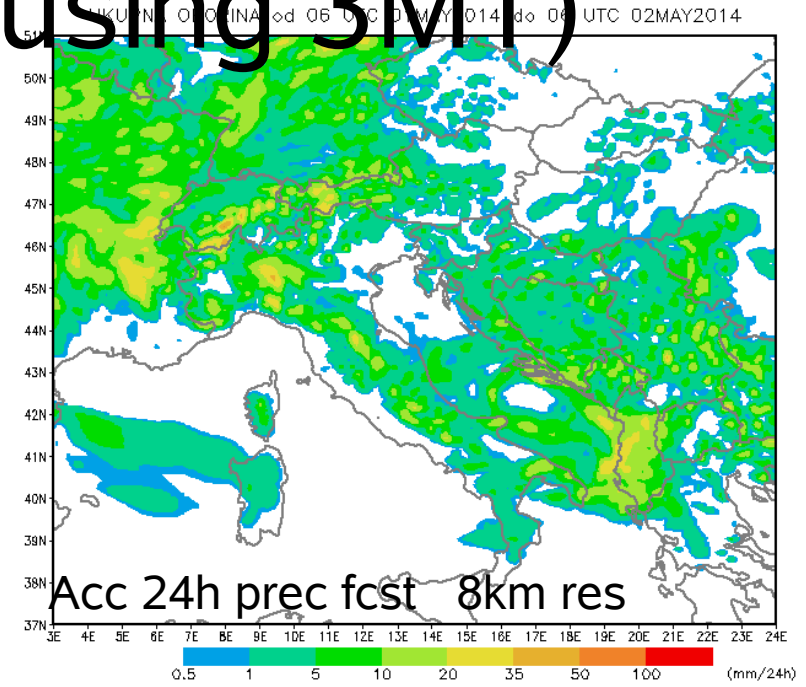
- 24 hourly (dense network raingauges delayed)
- Accumulated from 06 UTC until the 06 the next day
- Circles – raingauges
- Squares – TRMM data (3B42RT) estimalte from combined satellite measuremets



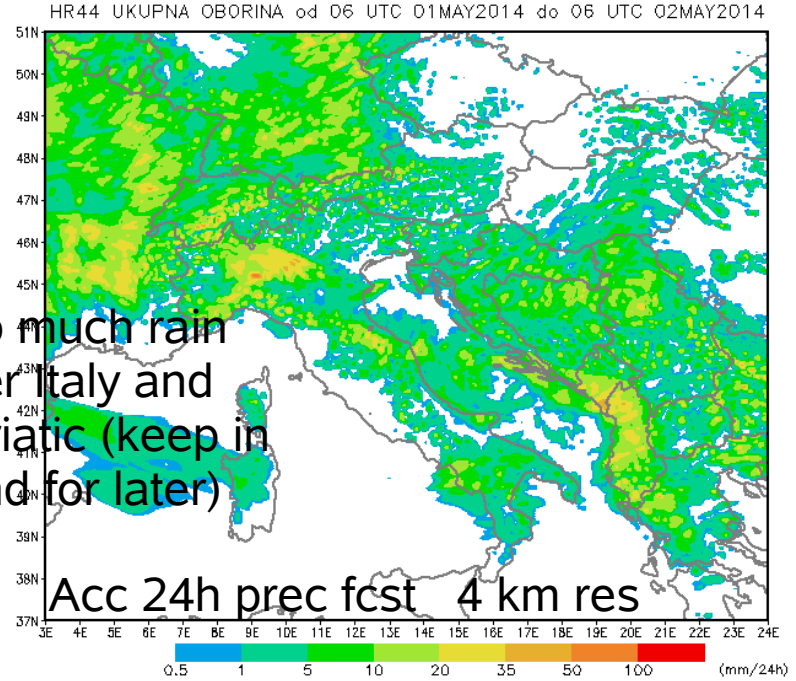
# Alaro0 (38T1 using 3MT)




Measured 24h precipitation

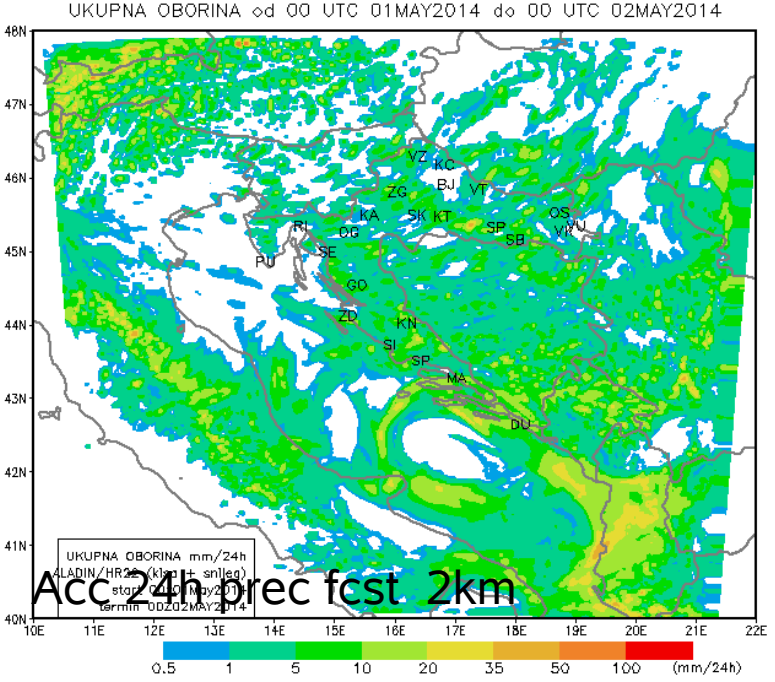



Acc 24h prec fcst 8km res




Too much rain over Italy and Adriatic (keep in mind for later)

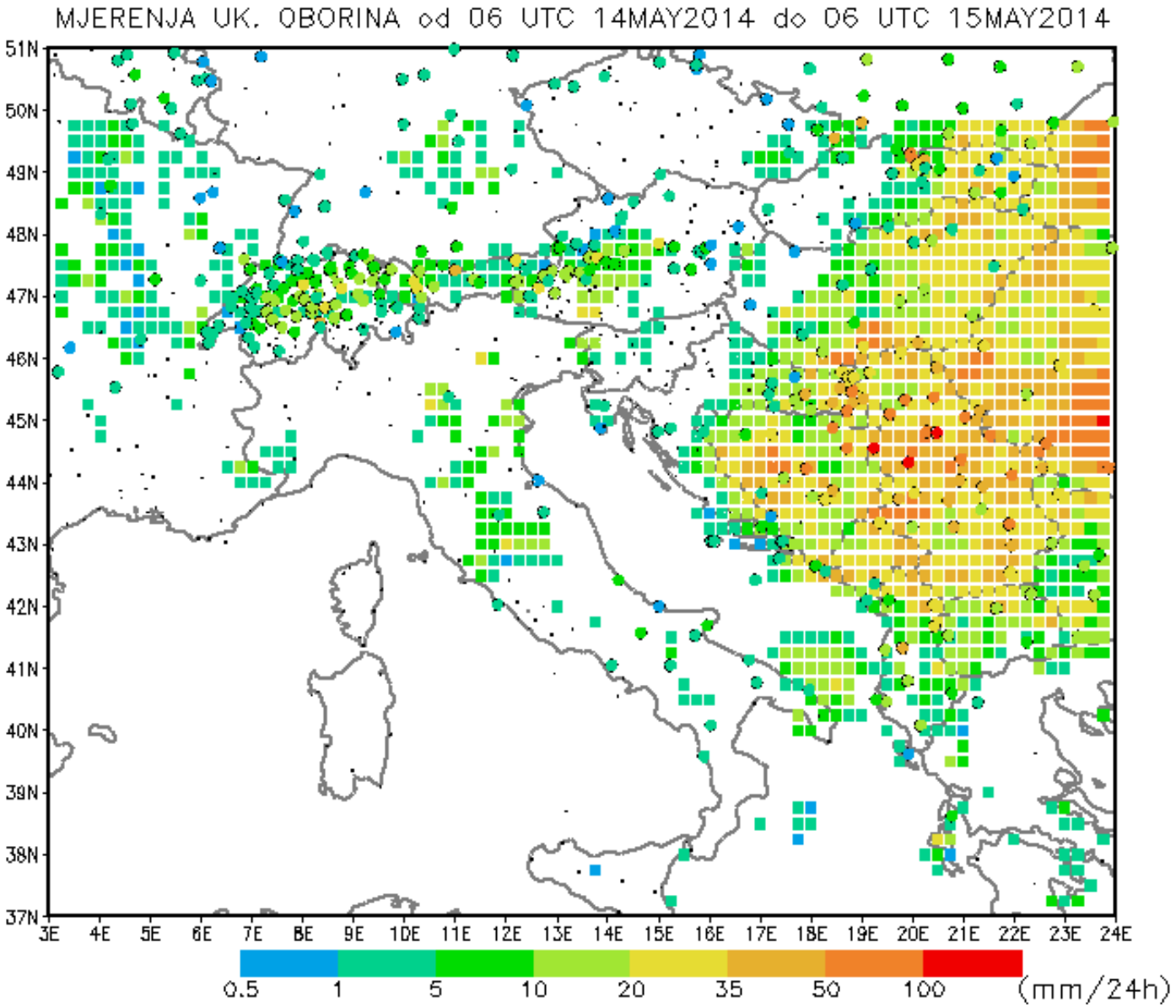
Acc 24h prec fcst 4 km res

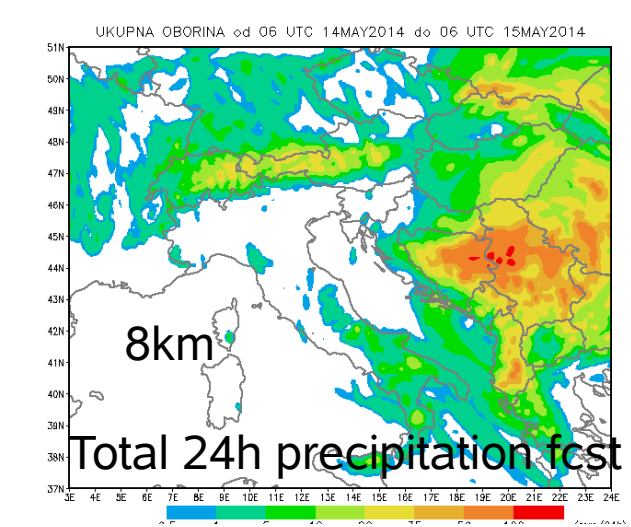


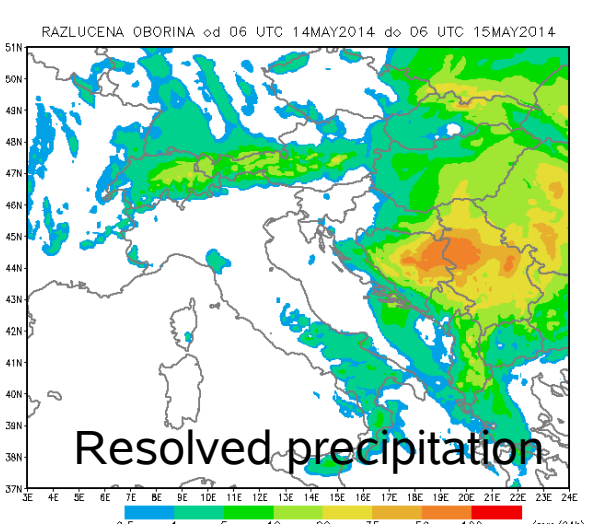

Acc 24h prec fcst 2km

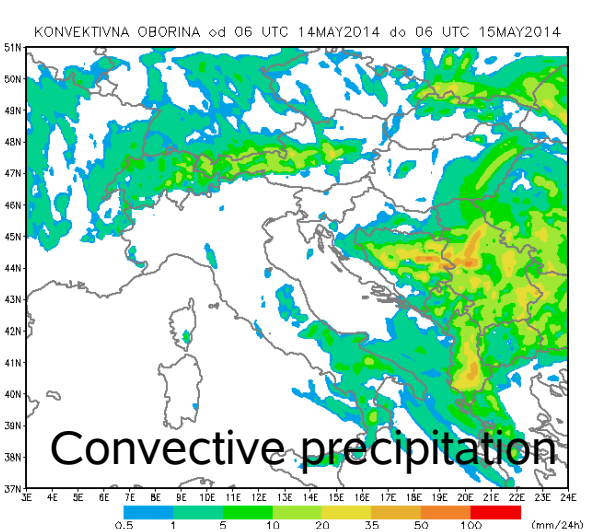
# Heavy flash flood case

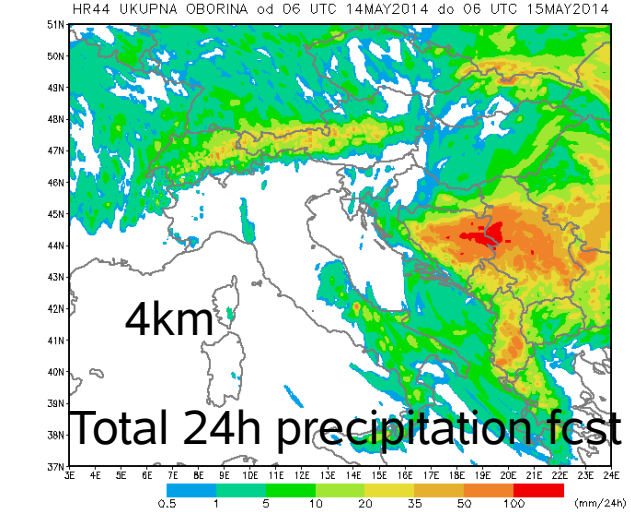
- TRMM underestimated rainfall
-

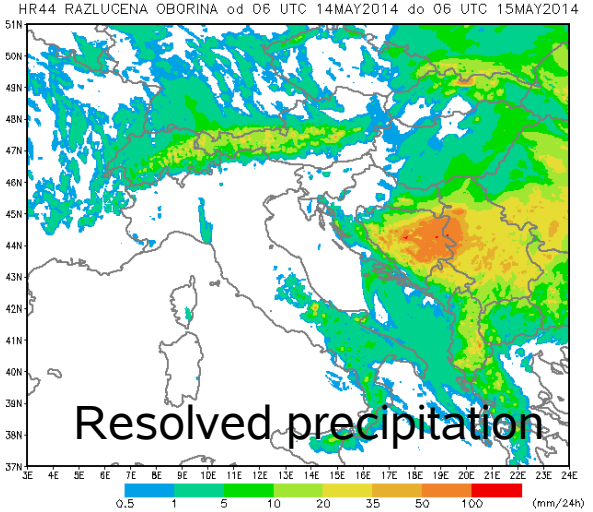


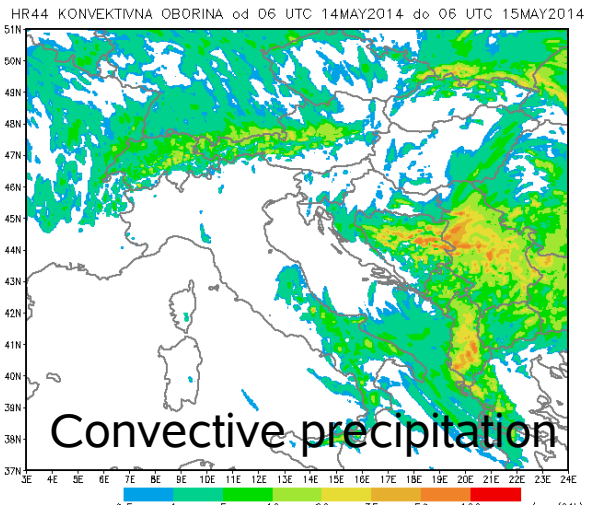

UKUPNA OBORINA od 06 UTC 14MAY2014 do 06 UTC 15MAY2014
8km
Total 24h precipitation fcst

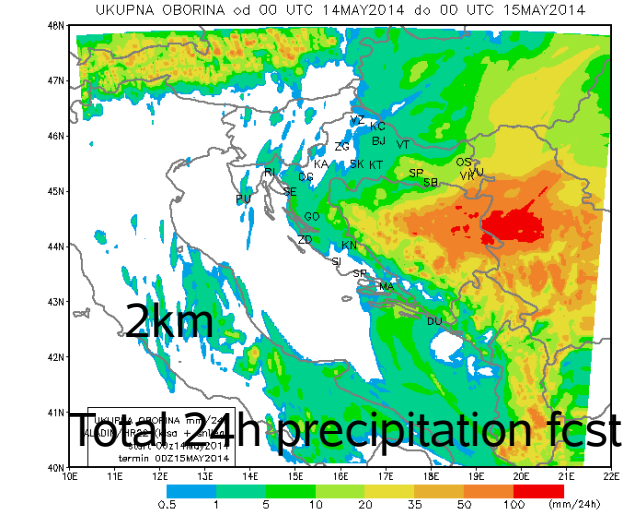

RAZLUCENA OBORINA od 06 UTC 14MAY2014 do 06 UTC 15MAY2014
Resolved precipitation

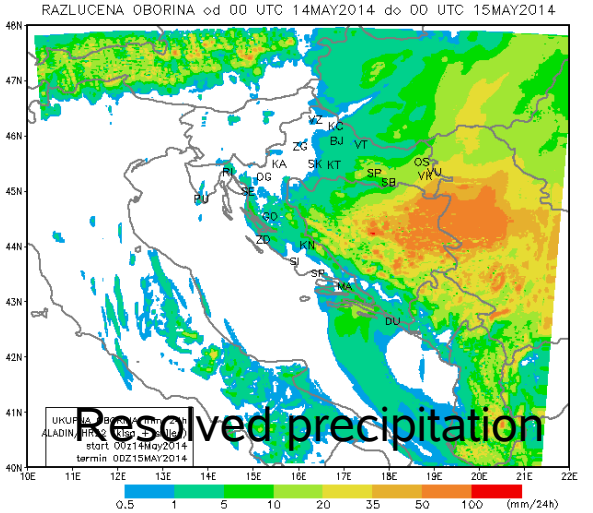

KONVEKTIVNA OBORINA od 06 UTC 14MAY2014 do 06 UTC 15MAY2014
Convective precipitation

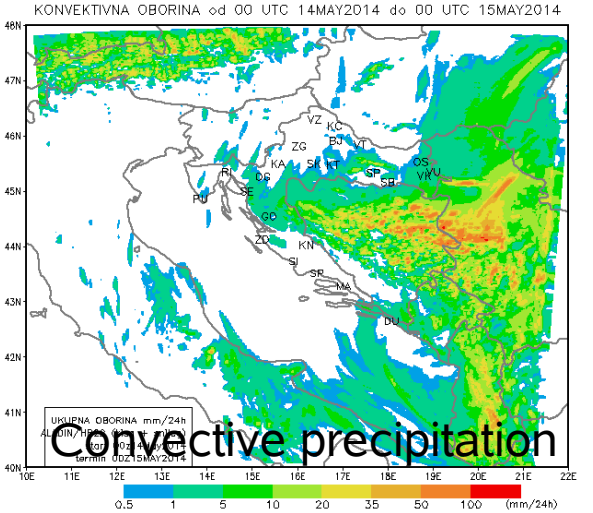

HR44 UKUPNA OBORINA od 06 UTC 14MAY2014 do 06 UTC 15MAY2014
4km
Total 24h precipitation fcst


HR44 RAZLUCENA OBORINA od 06 UTC 14MAY2014 do 06 UTC 15MAY2014
Resolved precipitation


HR44 KONVEKTIVNA OBORINA od 06 UTC 14MAY2014 do 06 UTC 15MAY2014
Convective precipitation


UKUPNA OBORINA od 00 UTC 14MAY2014 do 00 UTC 15MAY2014
2km
Total 24h precipitation fcst

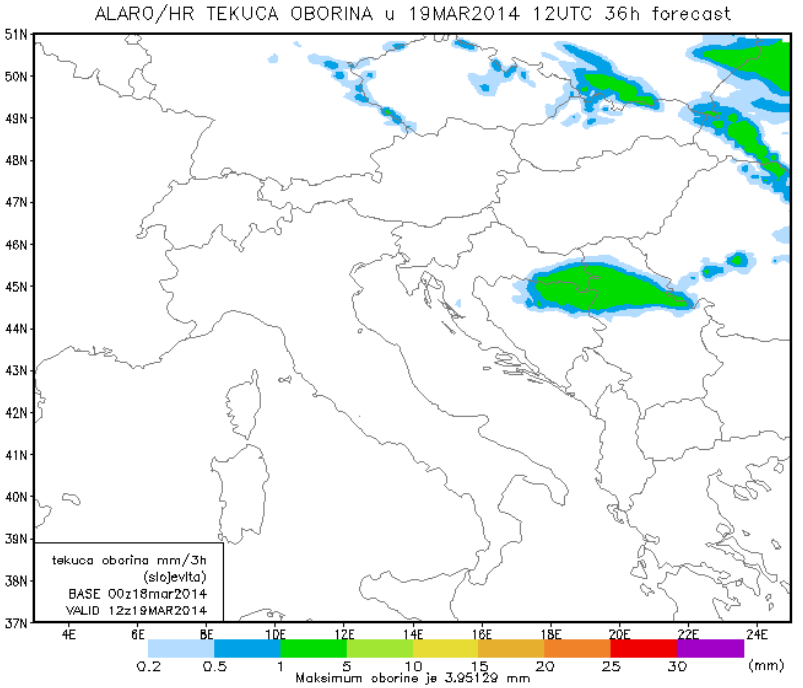

RAZLUCENA OBORINA od 00 UTC 14MAY2014 do 00 UTC 15MAY2014
Resolved precipitation

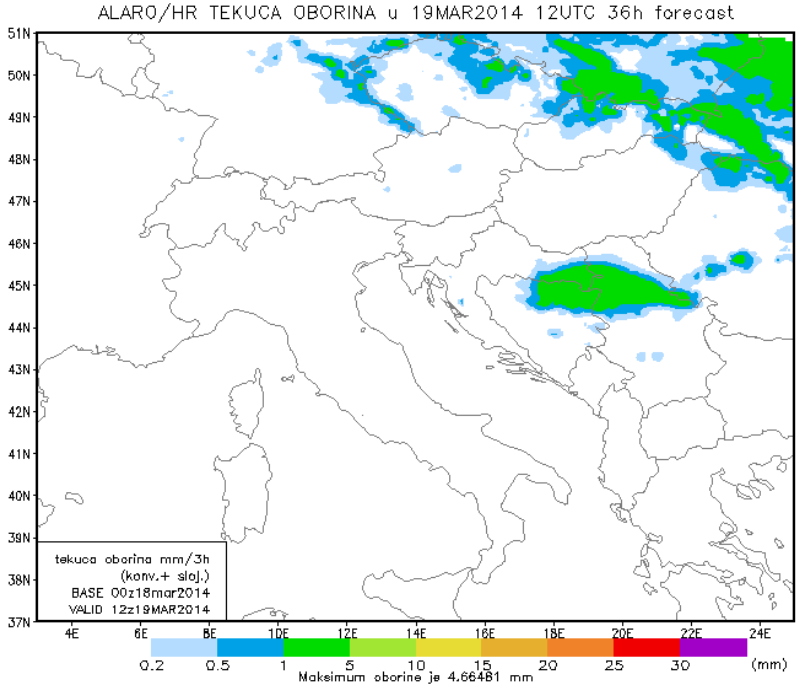

KONVEKTIVNA OBORINA od 00 UTC 14MAY2014 do 00 UTC 15MAY2014
Convective precipitation

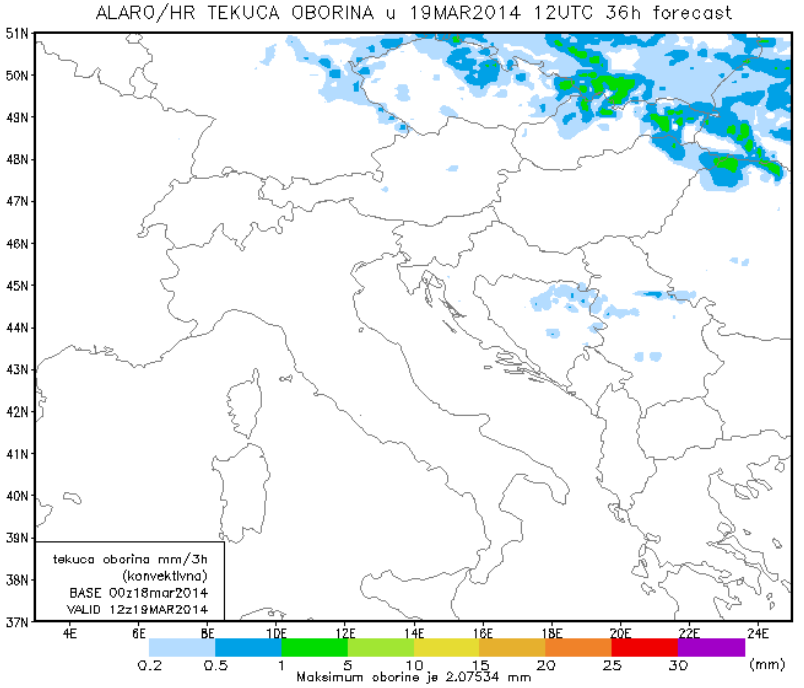
# Convective precipitation

Resolved in 8km

Total precipitation 3h (below), resolved (right) and unresolved convective (lower right) associated to a cold front.

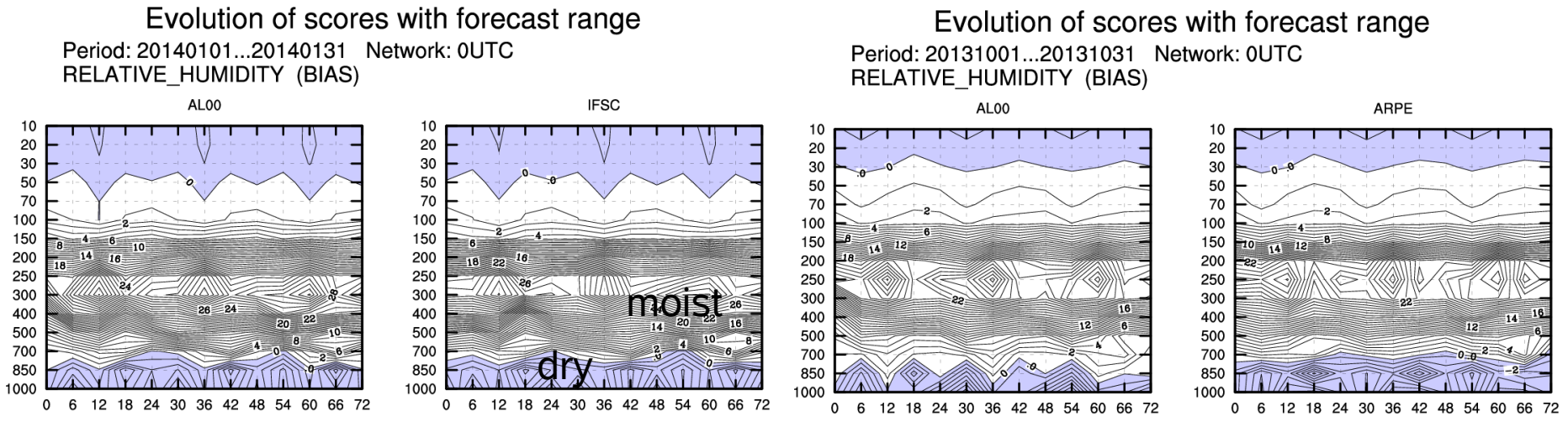


# Change in the LBCs

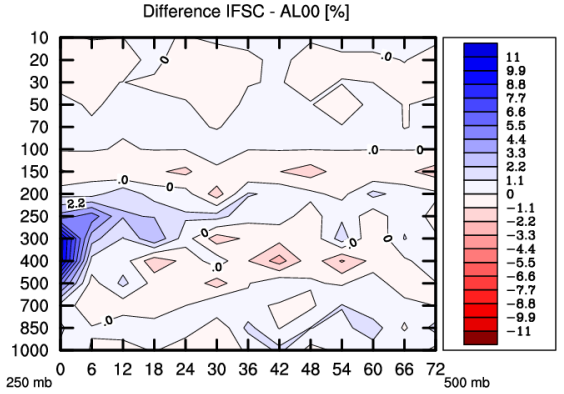
- Difference in initial conditions due to data assimilation soon dominated by advection through boundaries



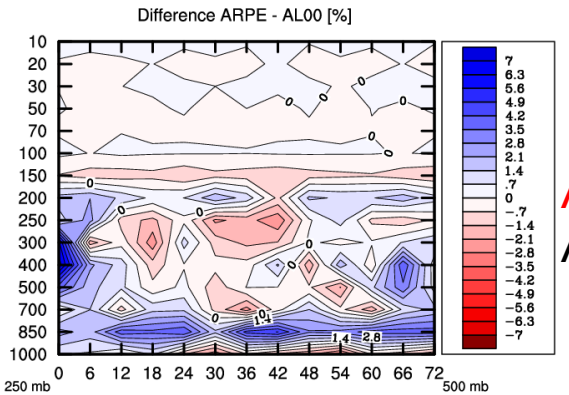




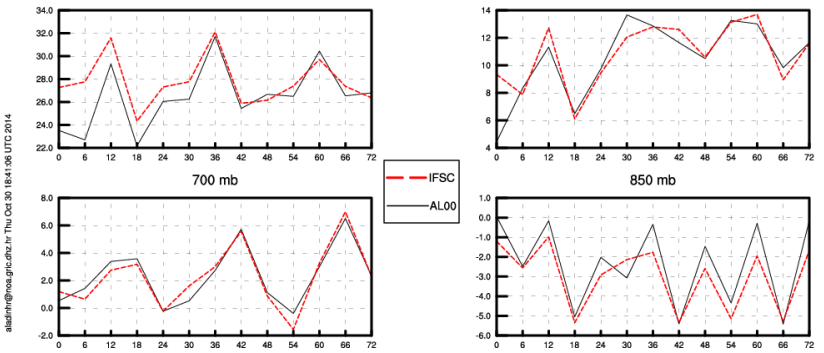
IFS - ALADIN

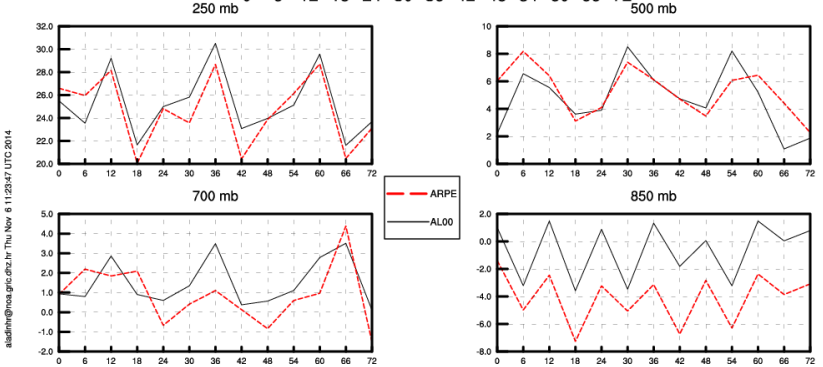



All too moist above 850 hPa, Too dry below ALADIN very similar to LBCs



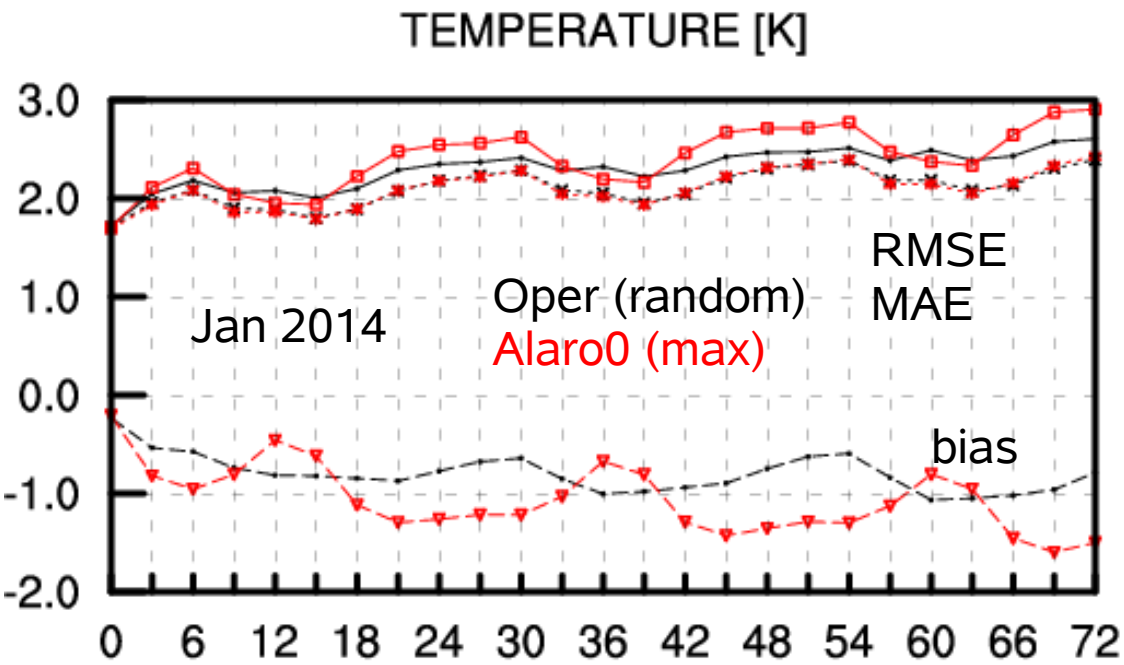

ARPEGE ALADIN

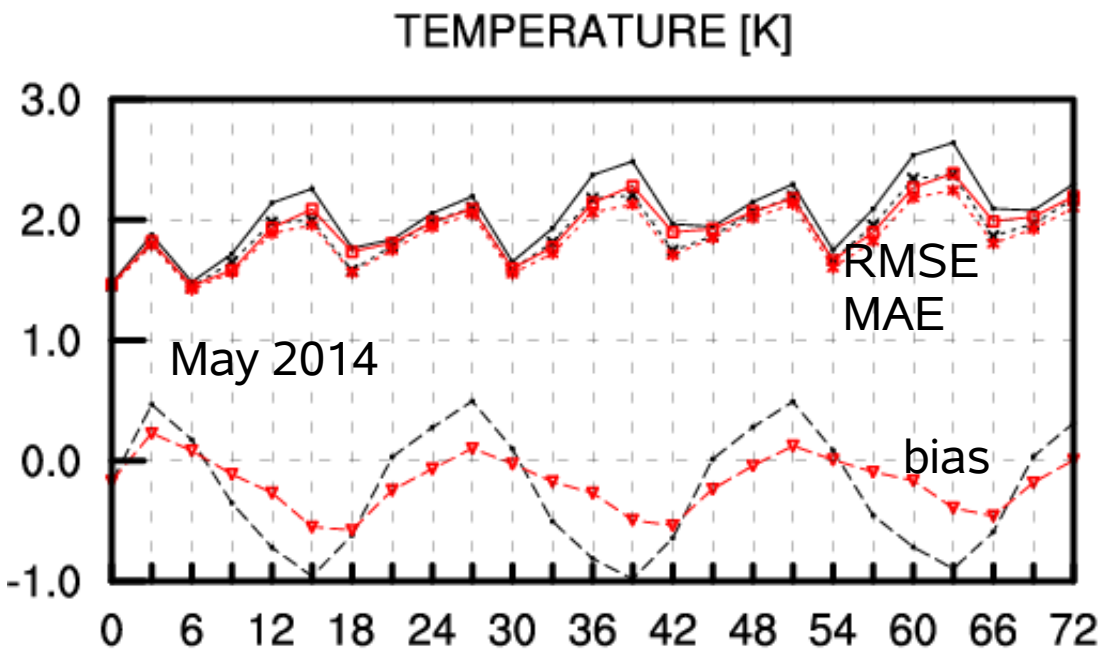


# Overlaps and vertical discretization

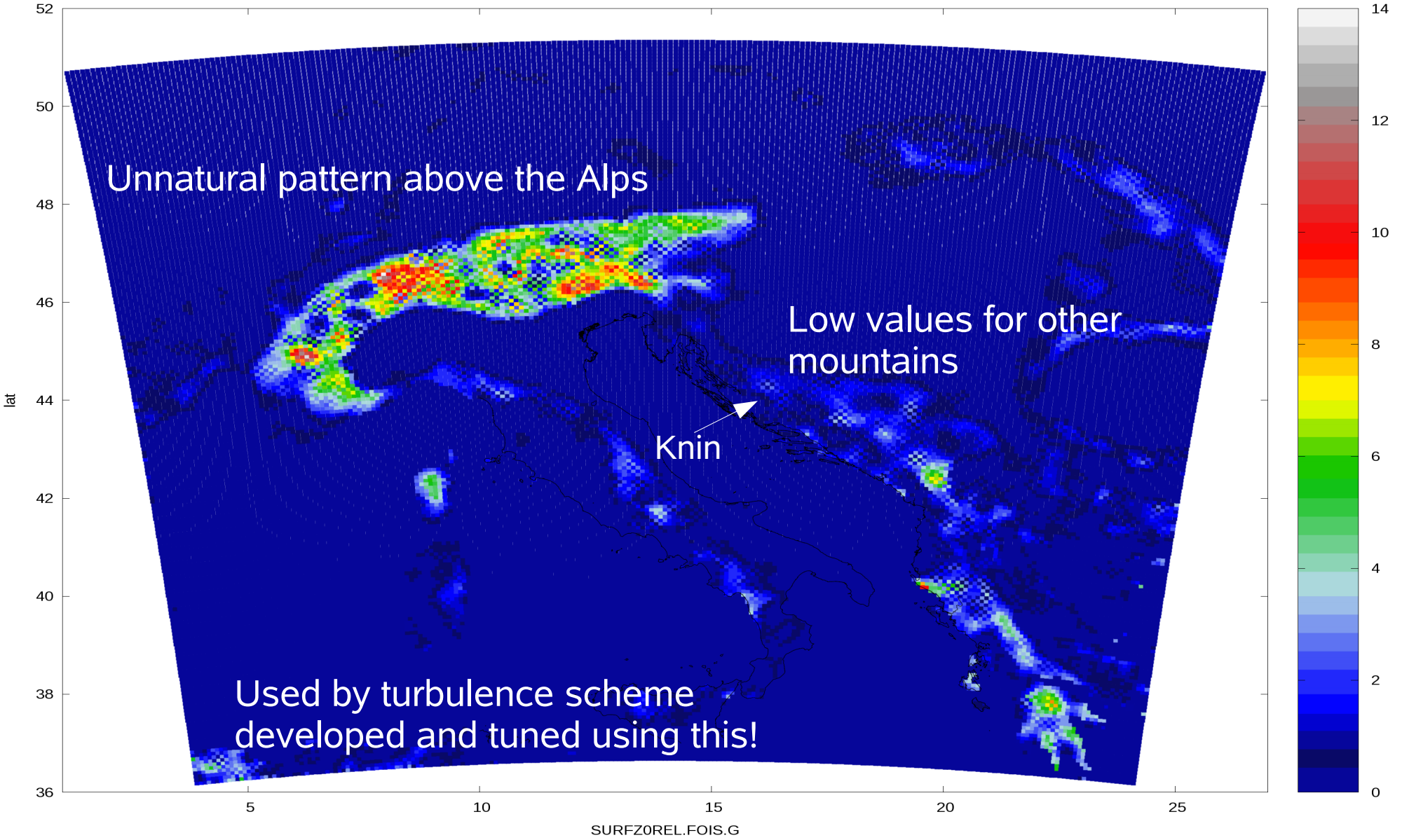
- Maximum overlap yields better T2m forecast in late spring and summer, random overlap better in winter.
- But we can spoil the above conclusion when we introduce vertical finite elements (VFE).



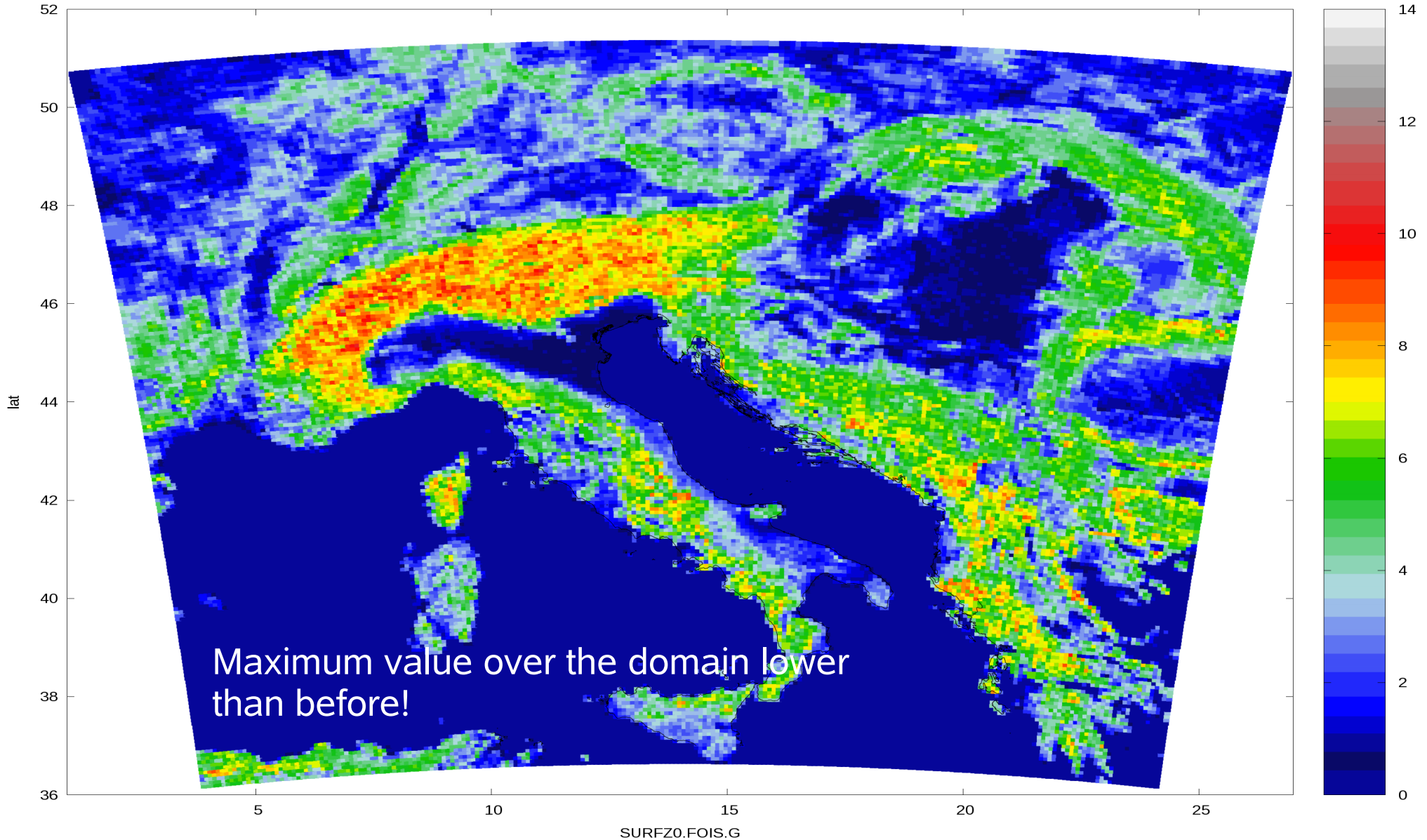
# Roughness length 8 km res – from e923

This is used by turbulence scheme, computed from low resolution database (20 years old)
That contains some errors :) to say the least



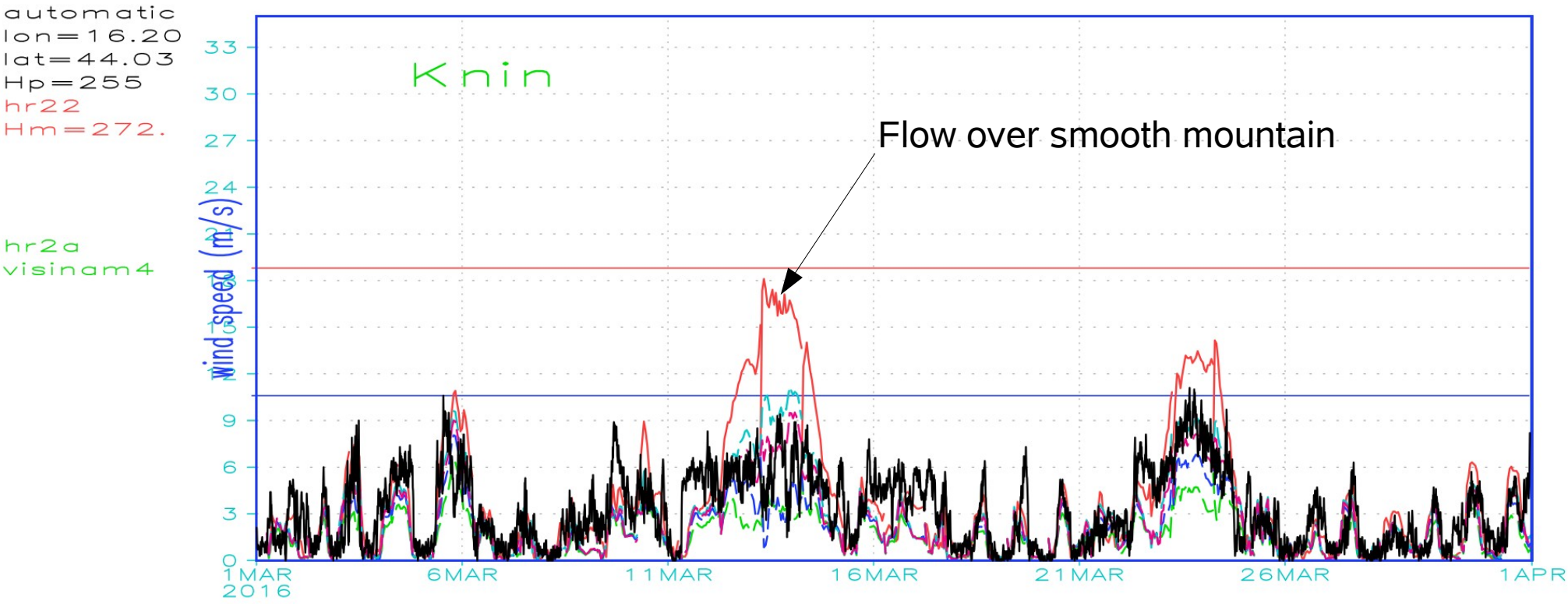
# Roughness length 8 km res – sqrt(g*sigma from surfex)

The idea is to compute roughness length using input from high resolution database



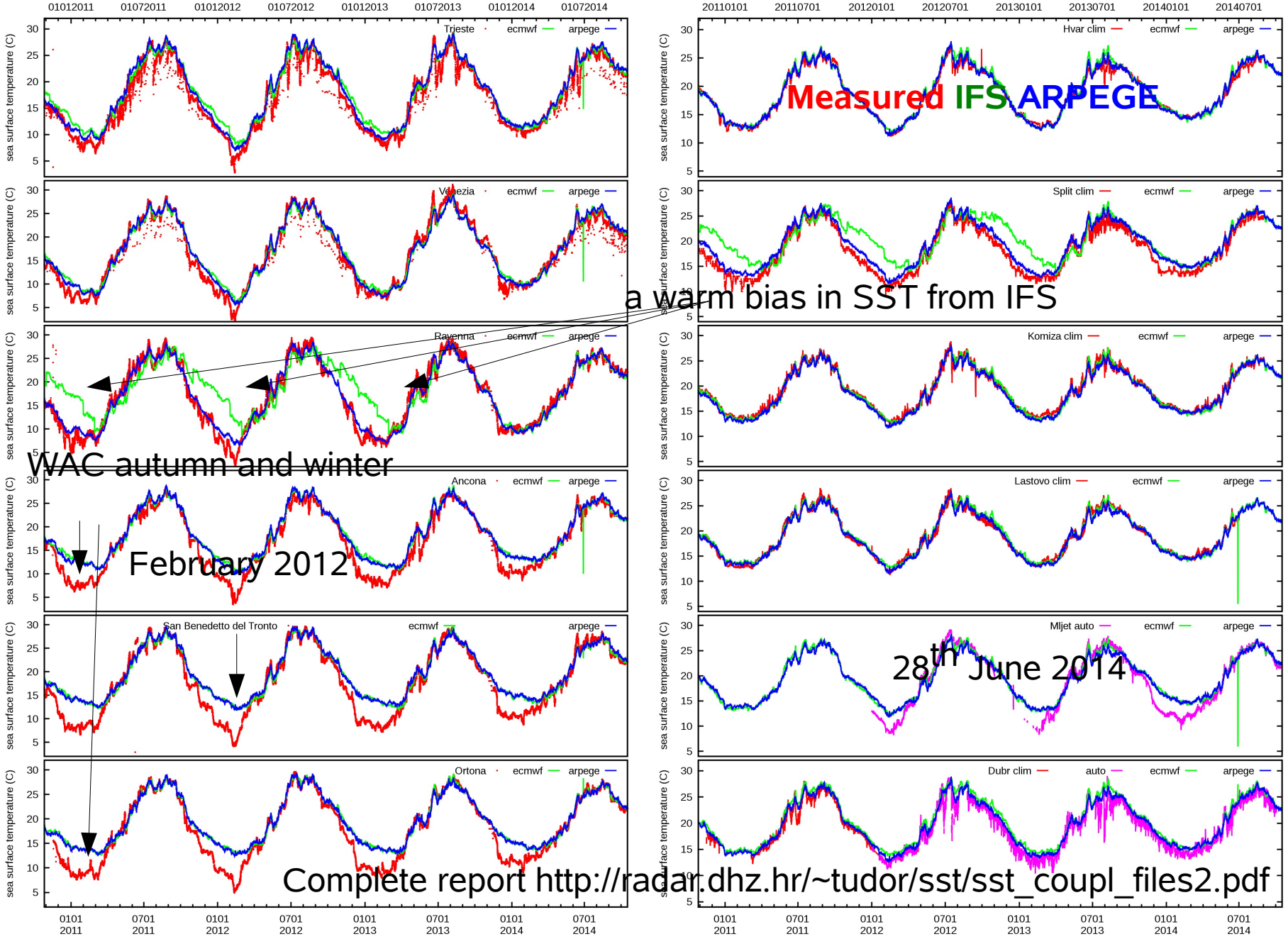
# Month of 2km 24 hourly forecasts

The wind forecast using new z0 is a bit too weak in situations with severe wind, while the old one overestimates wind. The idea is to tune z0 instead of re-tuning the turbulence scheme.

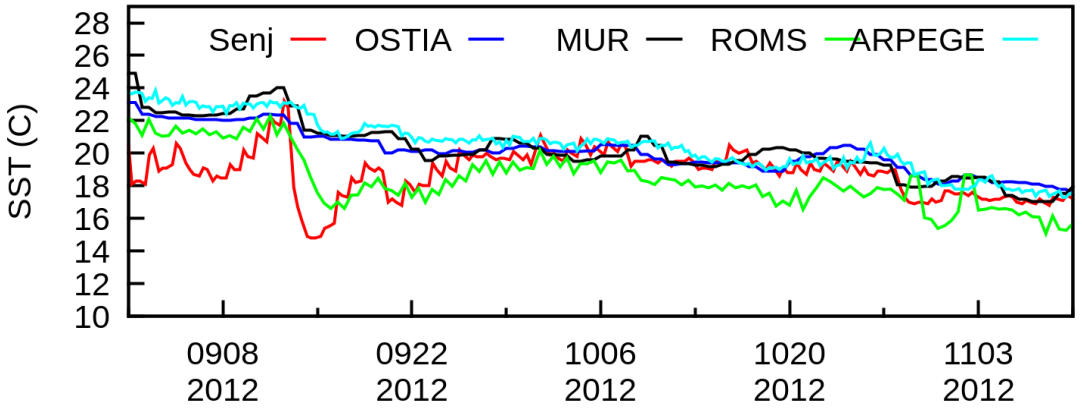



Wind at 10 m at Knin station during March 2016: measured 10 minute average (black), forecasts in 2 km resolution using **Alaro0** with z0 from old clim database (red), z0 computed from new database as sqrt(stdevH) (green), and new z0 scaled.

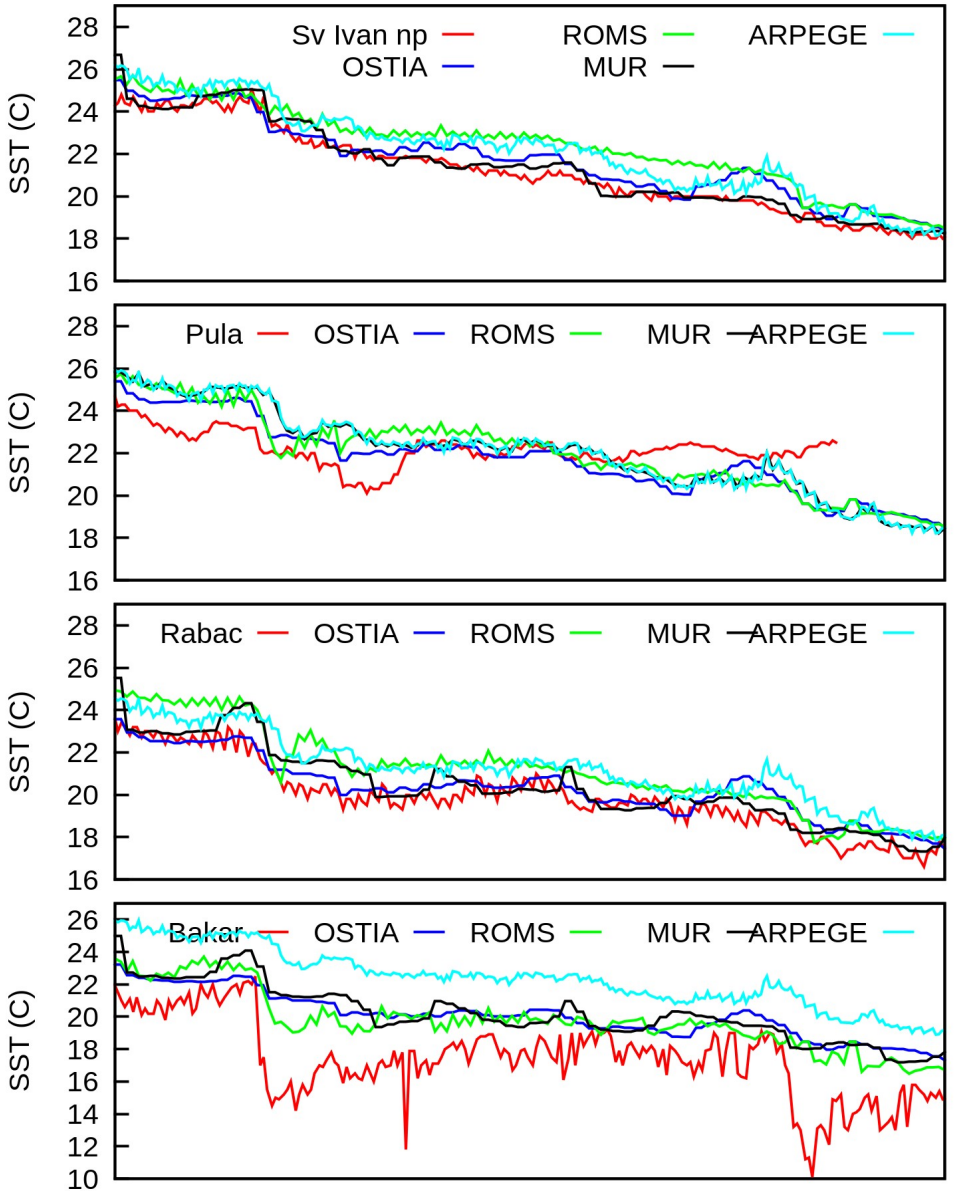
# Sea surface temperature (4 years)



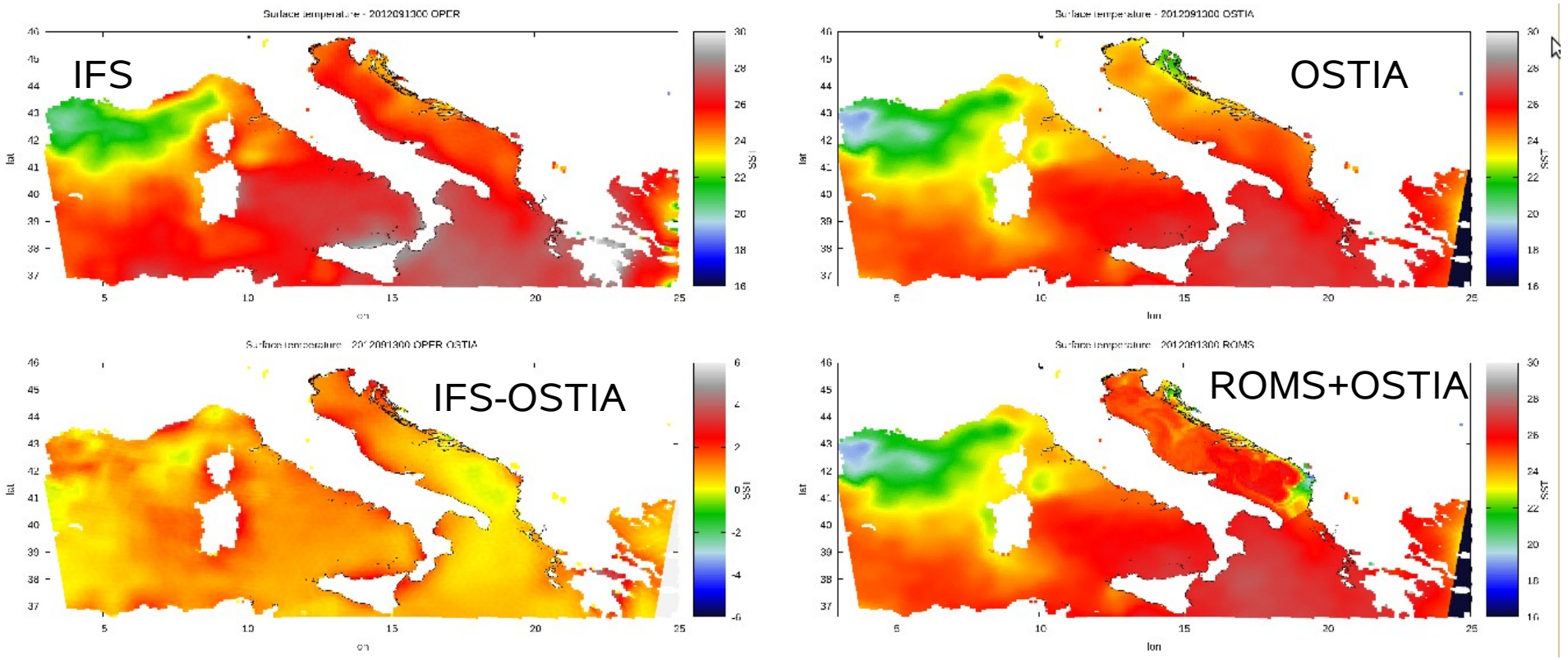
# SST from different sources during 2 months




Sea surface temperature: measured (red), from the nearest sea point in OSTIA (blue), MUR 1 km resolution analysis from NASA (black), ROMS ocean model (green) and ARPEGE (cyan). These stations are in Kvarner bay (Rabac, Bakar), Velebit channel (Senj) and western Istria (sv Ivan).
Both global models have much warmer SST that it is in real life (ECMWF not shown but closer to ARPEGE than OSTIA)



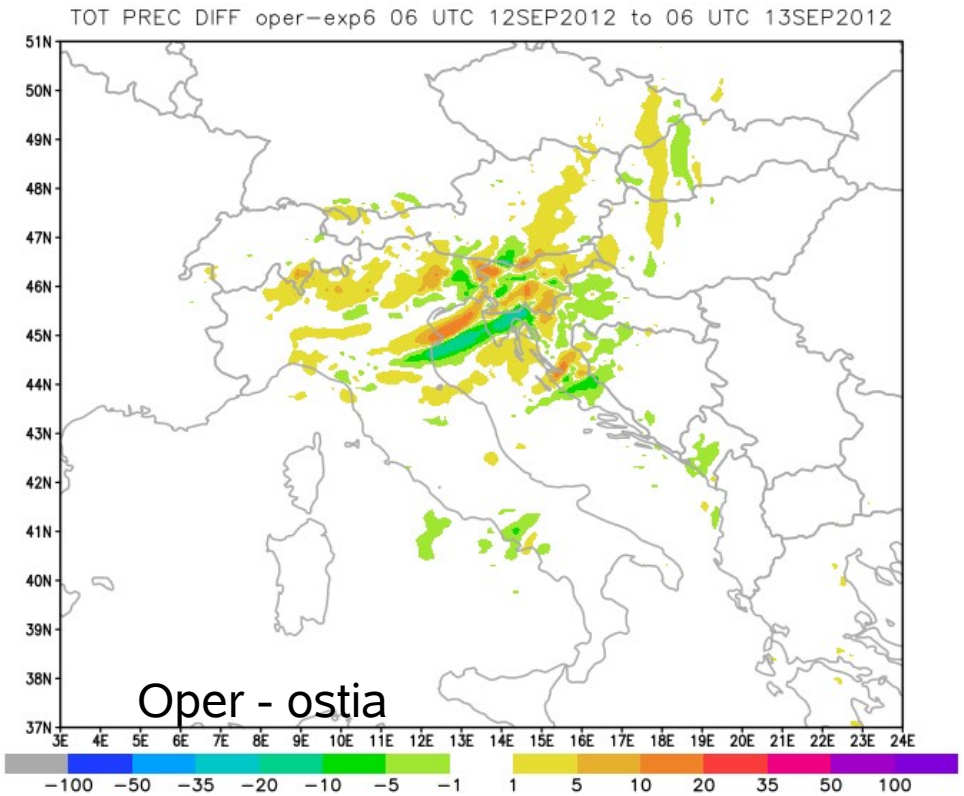
# Which SST are we using?

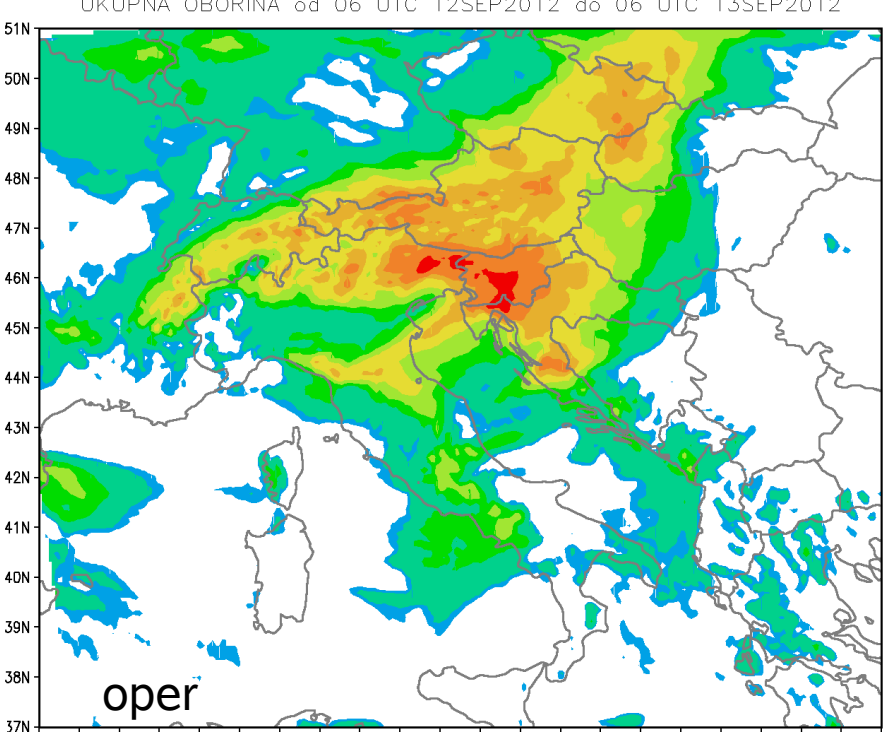


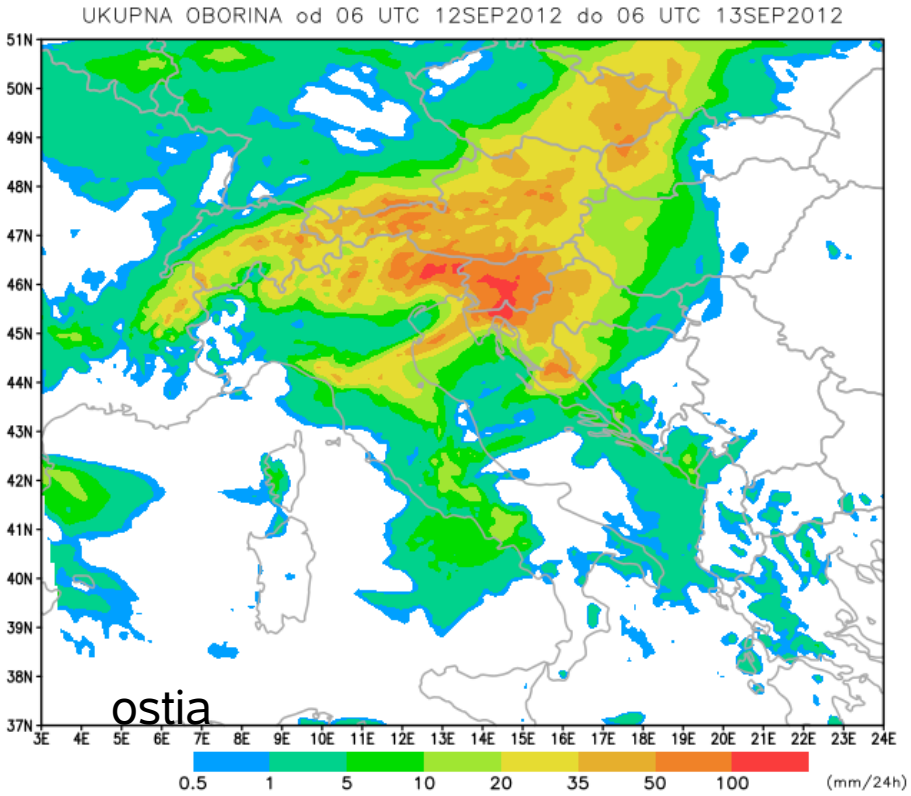

SST from the initial conditions remains fixed during the 72 hour forecast.
The above figures are for 13 September 2012.
SST used operationally is too warm over most of the Adriatic, especially Kvarner Bay and western Adriatic current.

# Impact on precipitation forecast

Accumulated 24 hourly precipitation from 06 UTC 12 September 2012, and their difference (54-30 hour forecast starting from 00 UTC 11 Sep 2012).



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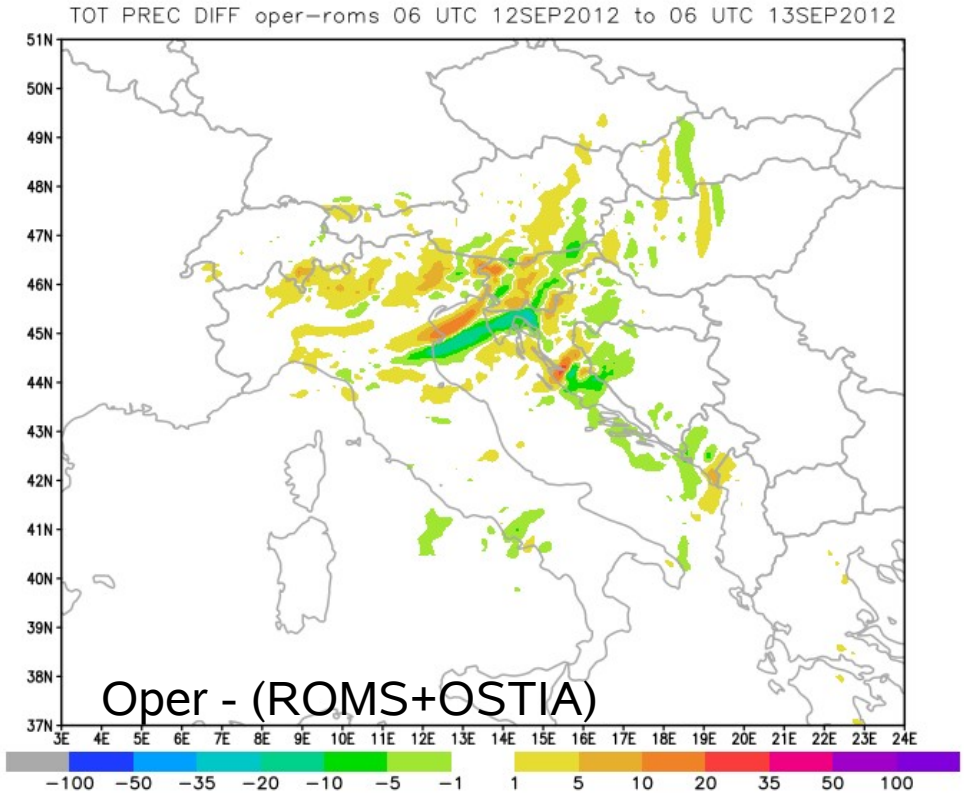
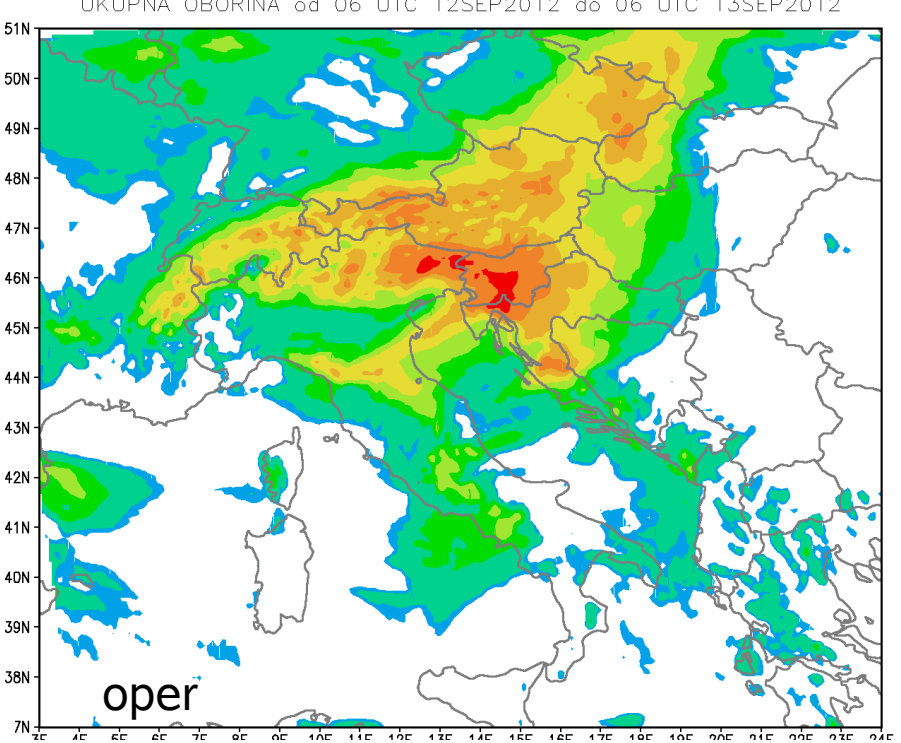
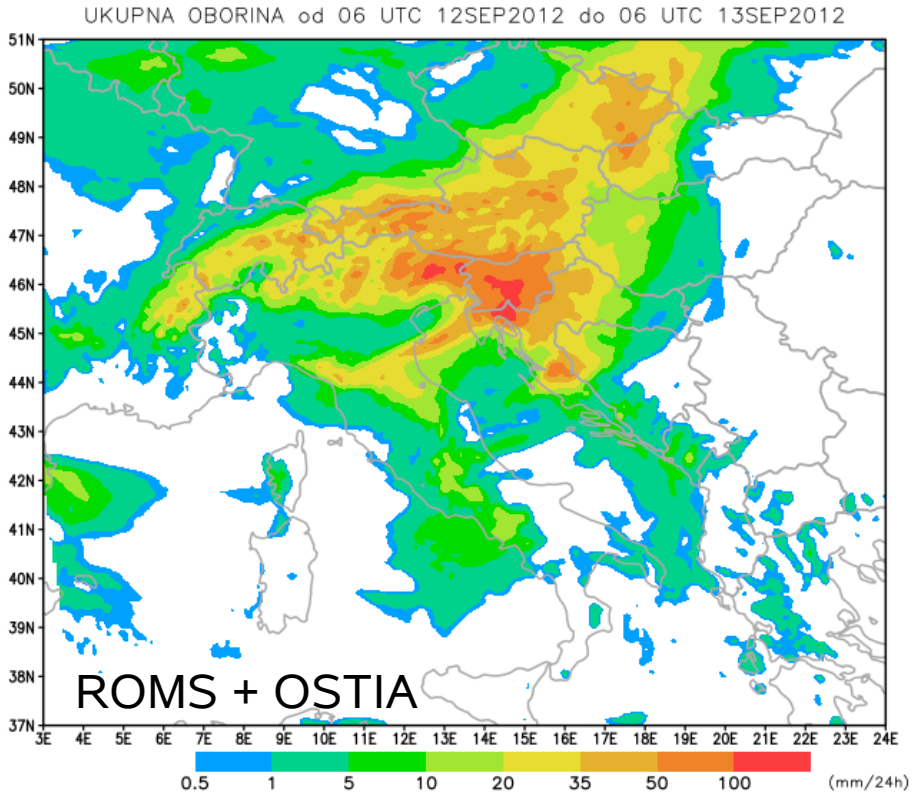
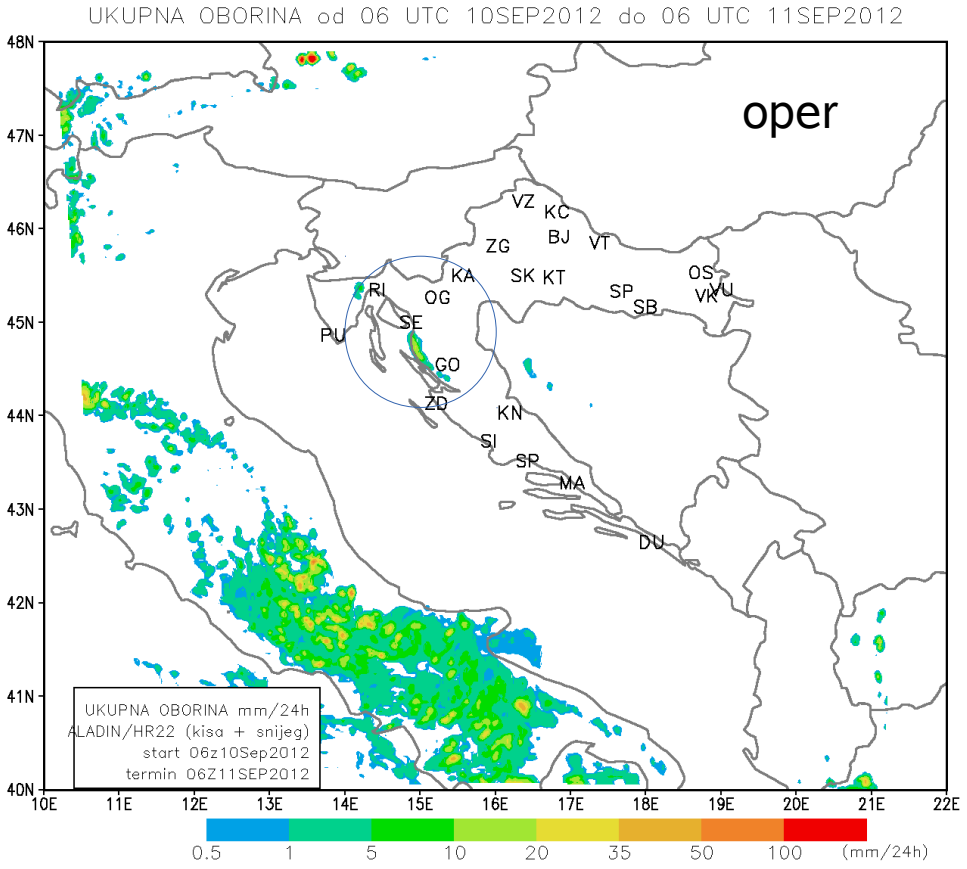
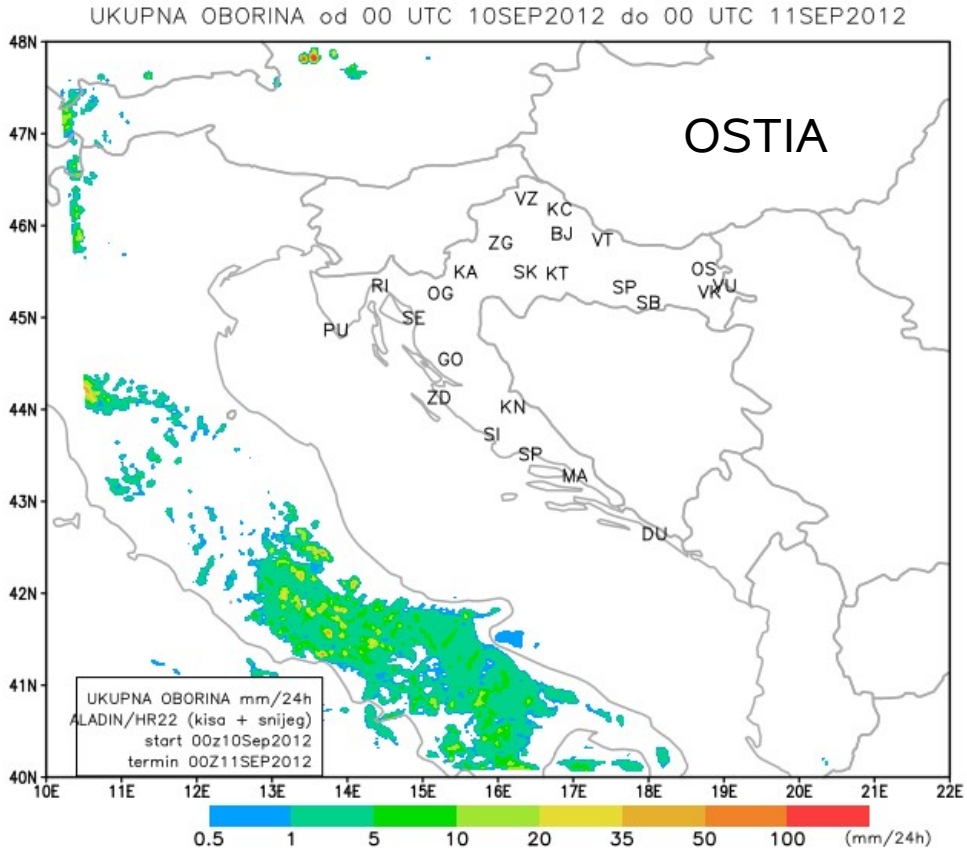


# Bogus precipitation over Velebit mountain

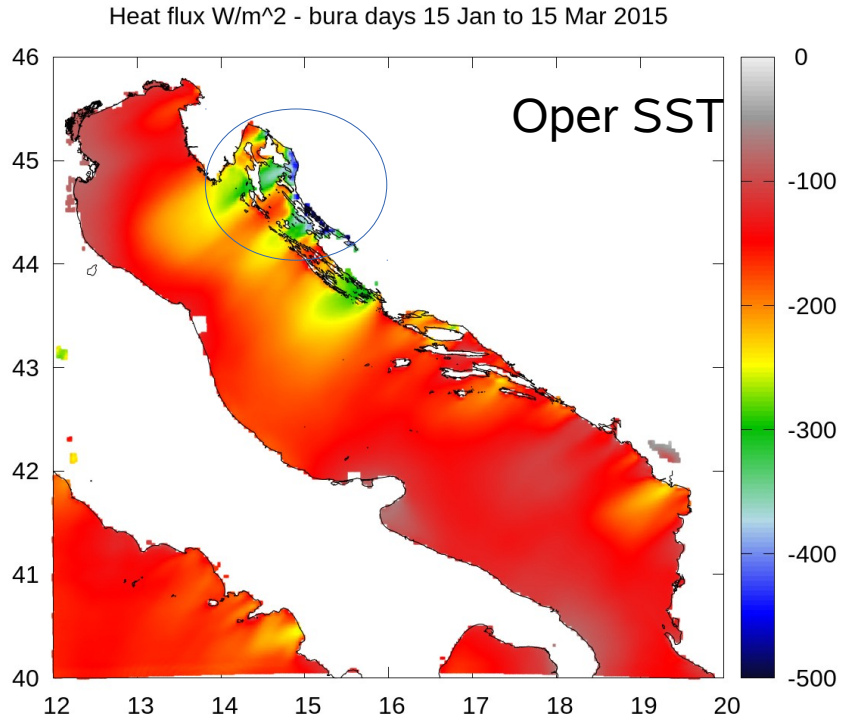


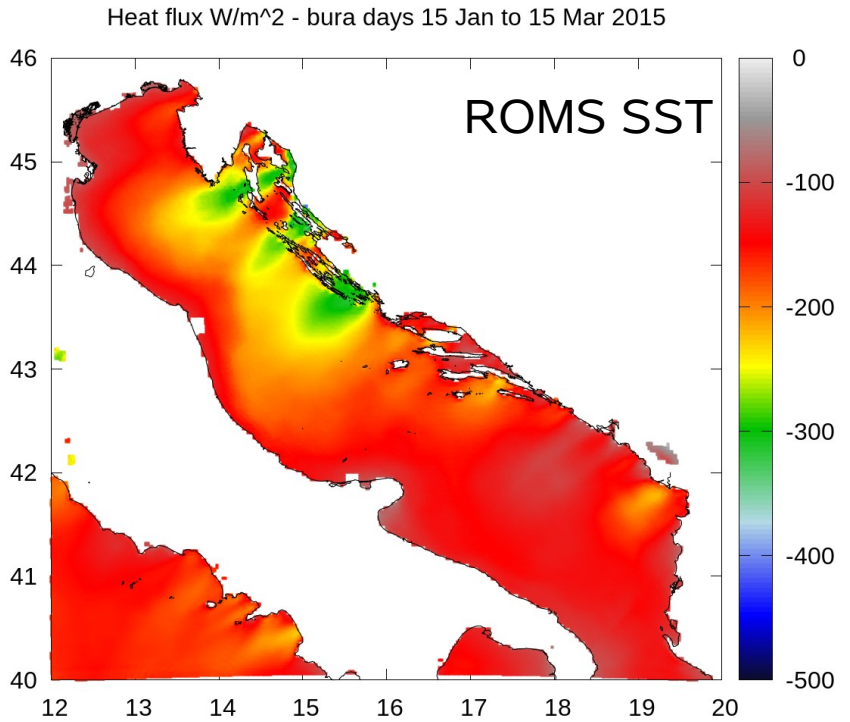




Accumulated 24 hourly precipitation forecast from 06 UTC 10 September 2012
Using operational SST (left) and from OSTIA (right)
Warm SST in Veelbit channel was the cause of wrong precipitation forecast over Velebit!

# Heat fluxes in bura (strong dry wind)

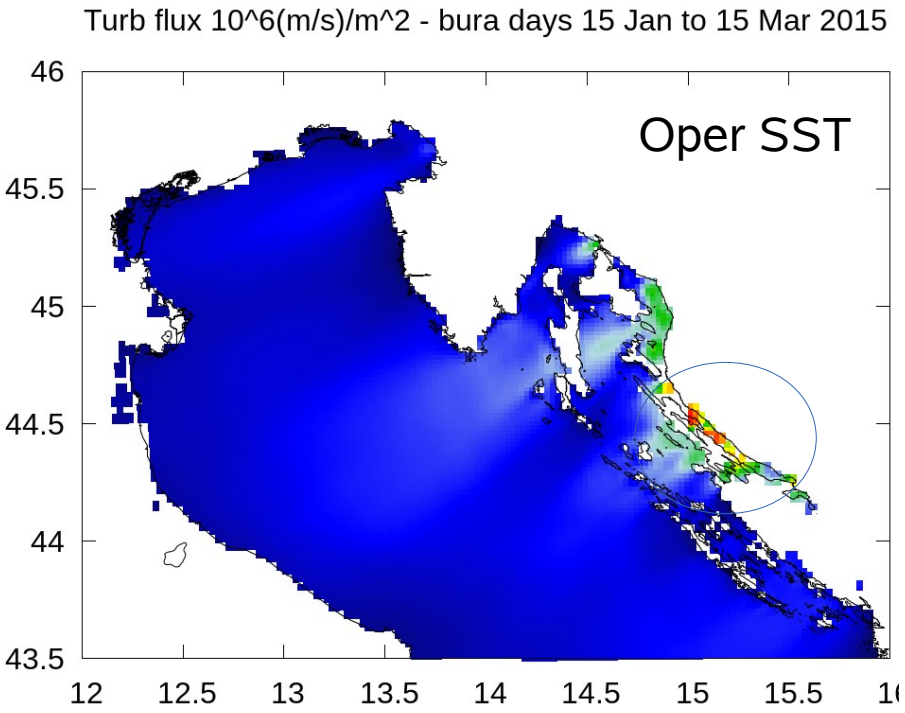
Heat fluxes too strong over too warm sea surface since there is more evaporation. Using improved SST from ROMS model (2 km resolution ocean model with data assimilation over Adriatic) yields more reasonable fluxes in Velebit chanel.

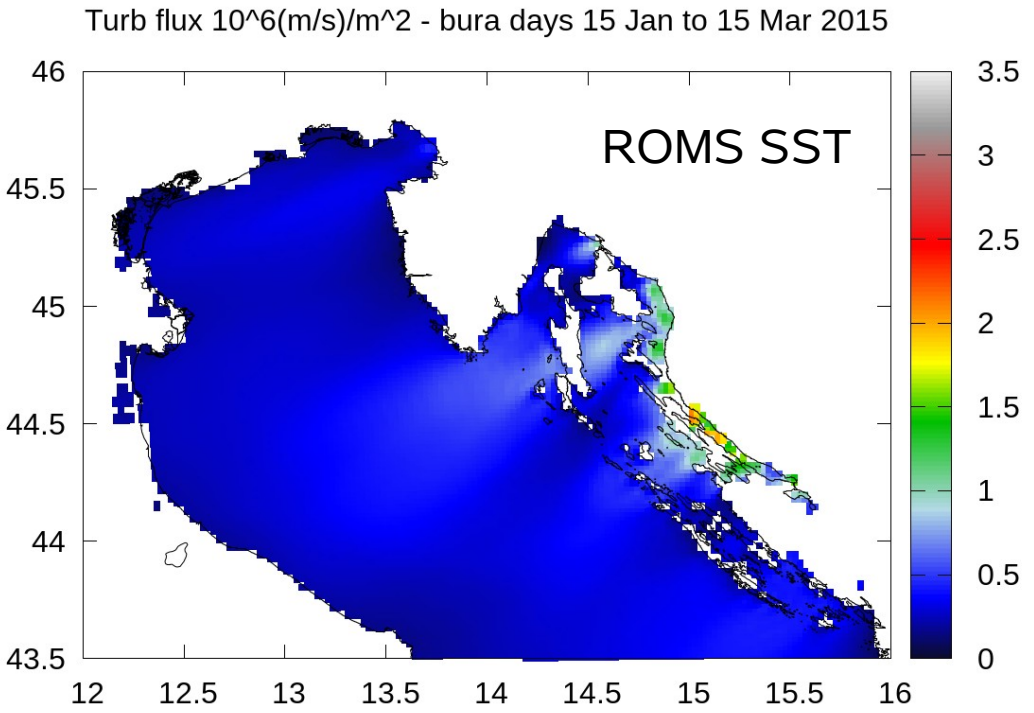


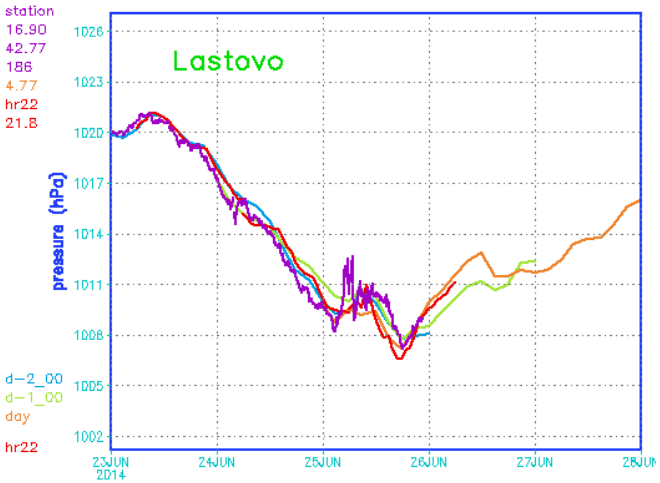
# Turbulent fluxes in bura (strong dry wind)

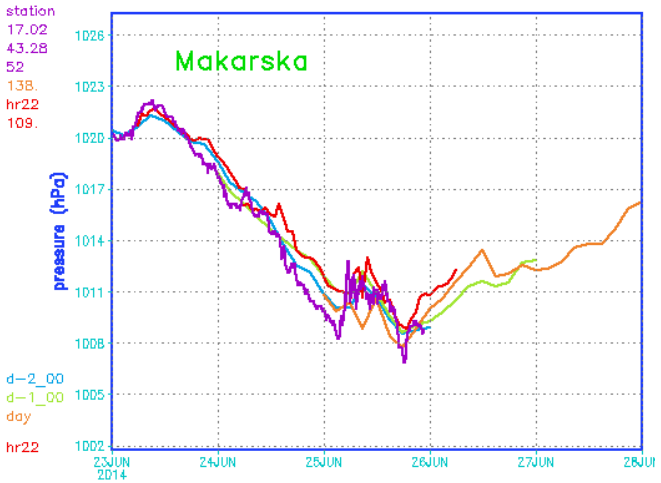
Turbulent fluxes too strong over too warm sea surface since the atmosphere is less stable there.
Using improved SST from ROMS model (2 km resolution ocean model with data assimilation over Adriatic) yields more reasonable fluxes in Velebit chanel.

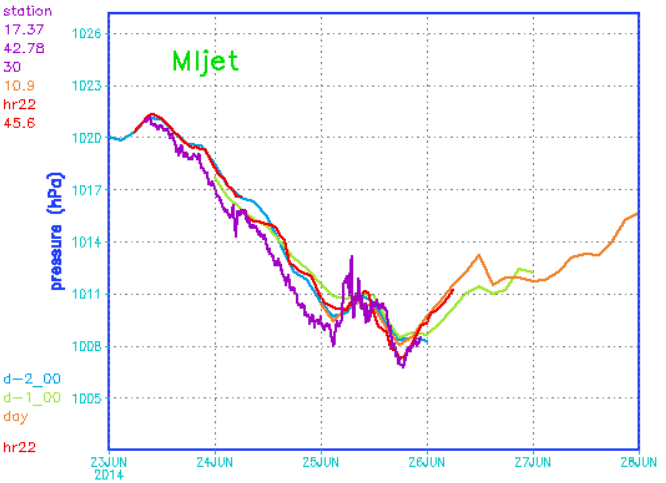


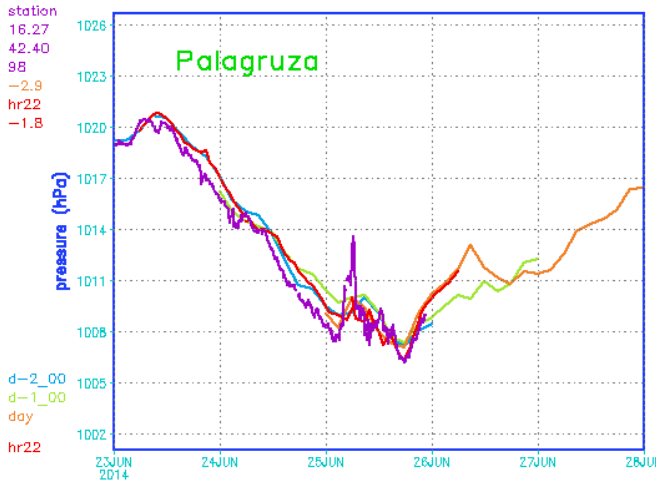



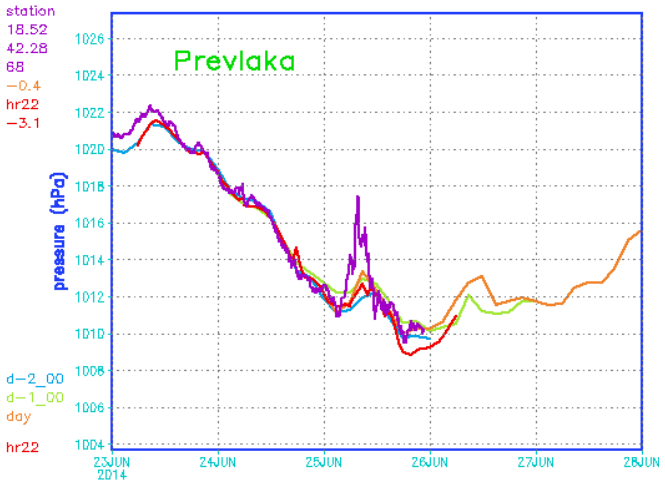
# Meteotsunami – 25.6.2015.

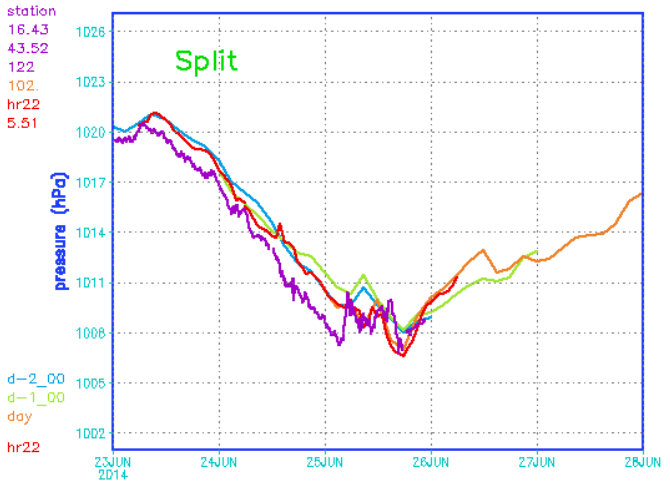



The idea is to forecast pressure disturbances (purple – measured pressure) that can cause a tsunami of meteorological origin – often associated to propagating convection.

# Final thoughts

- The errors in the forecast were linked to conditions from the “outside”.
- How far can we go developing parametrisations while using these background (surface)?
- Inserting right SST after initialization means the atmosphere is adapting to new surface during the forecast.