

The Po Valley: a challenge for the T2m forecast

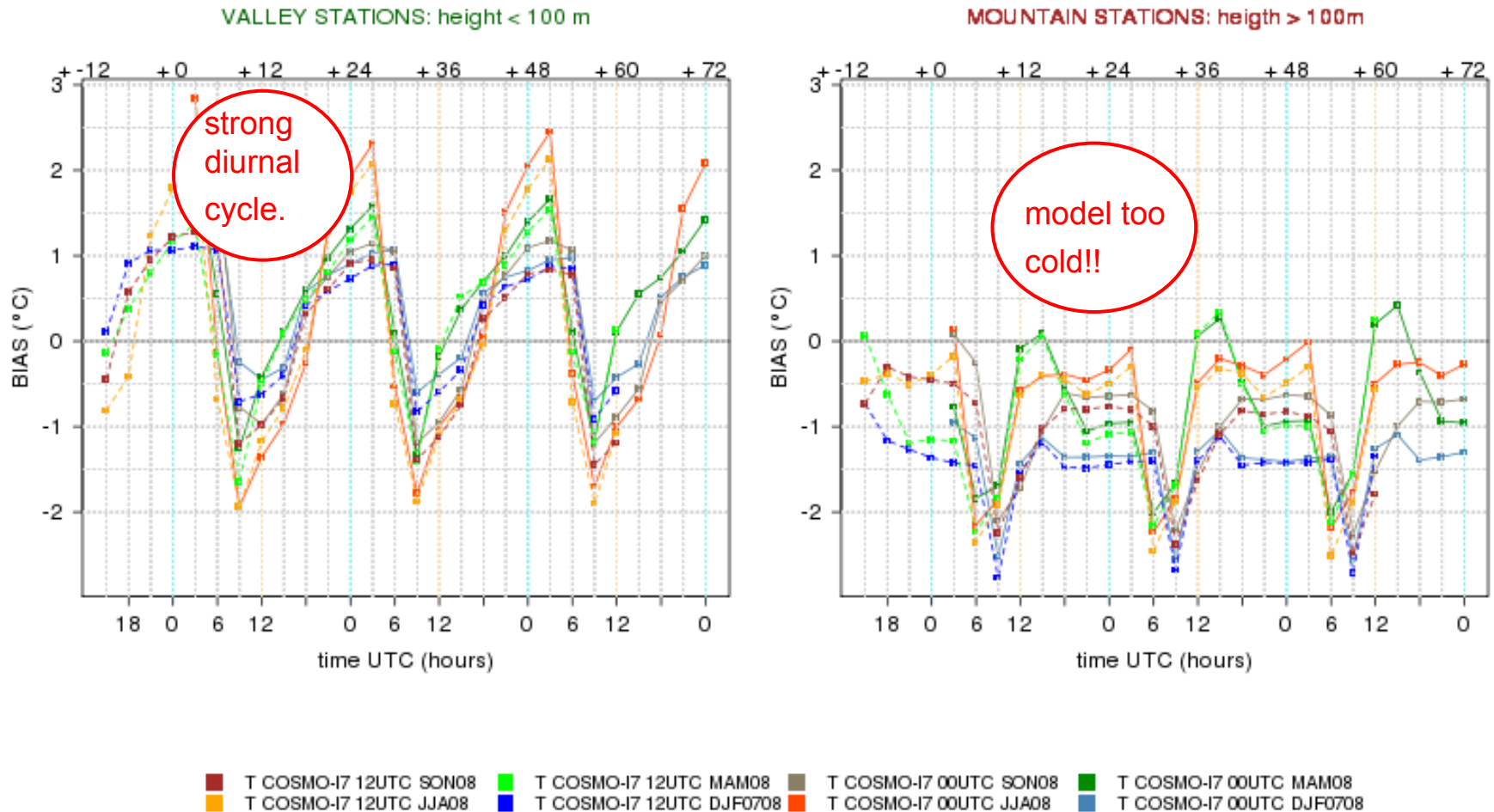
Antonella Morgillo, C. Marsigli, F. Grazzini

ARPA-SIMC: meteo-hydrological Service of Emilia-Romagna, Italy

Thanks to: M.S. Tesini (ARPA-SIMC), U. Schaettler (DWD) and A. Walser (MeteoSwiss)

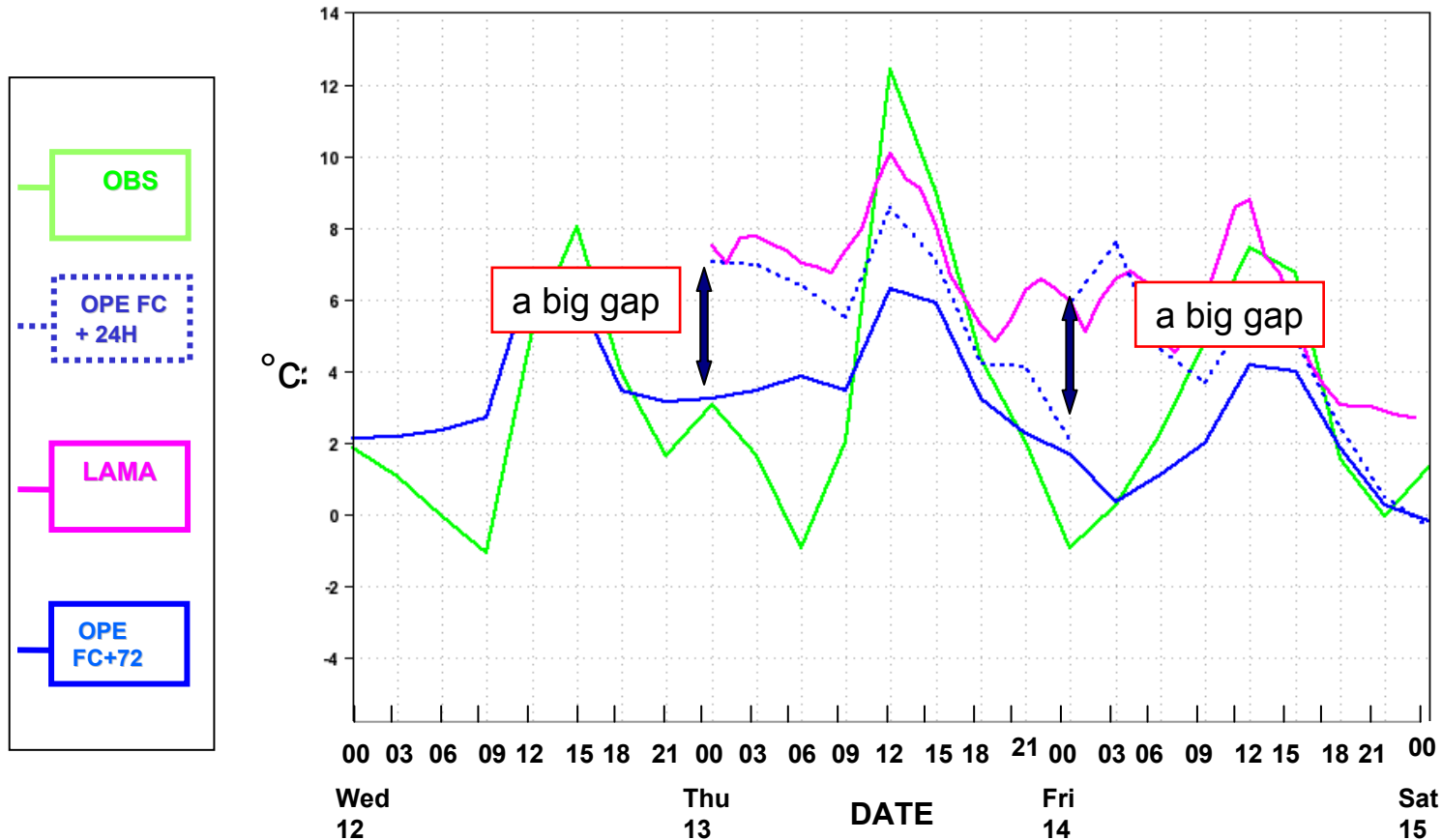
MOTIVATION OF THE WORK (1)

Time series of the 2m temperature bias for the COSMO I7 model over North Italy for the 4 season in 2008 for “plain” stations (on the left) and “mountain” stations (on the right).



MOTIVATION OF THE WORK (2)

Time series of 2m temperature predicted by COSMO I7 for a synop station (Brescia) in the Po Valley.



The question is : are these errors due to a wrong PBL parametrization or they are due to wrong initial conditions derived from a bad analysis (maybe too warm)?

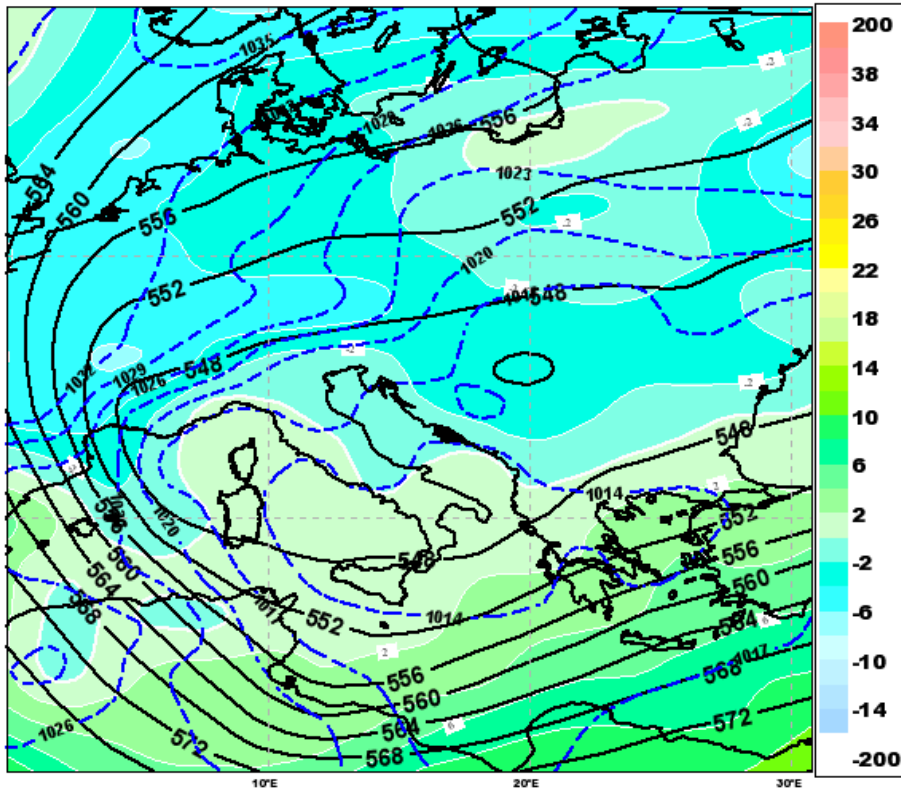
Case study: 12 december 2007

Z500 and T850 analyses

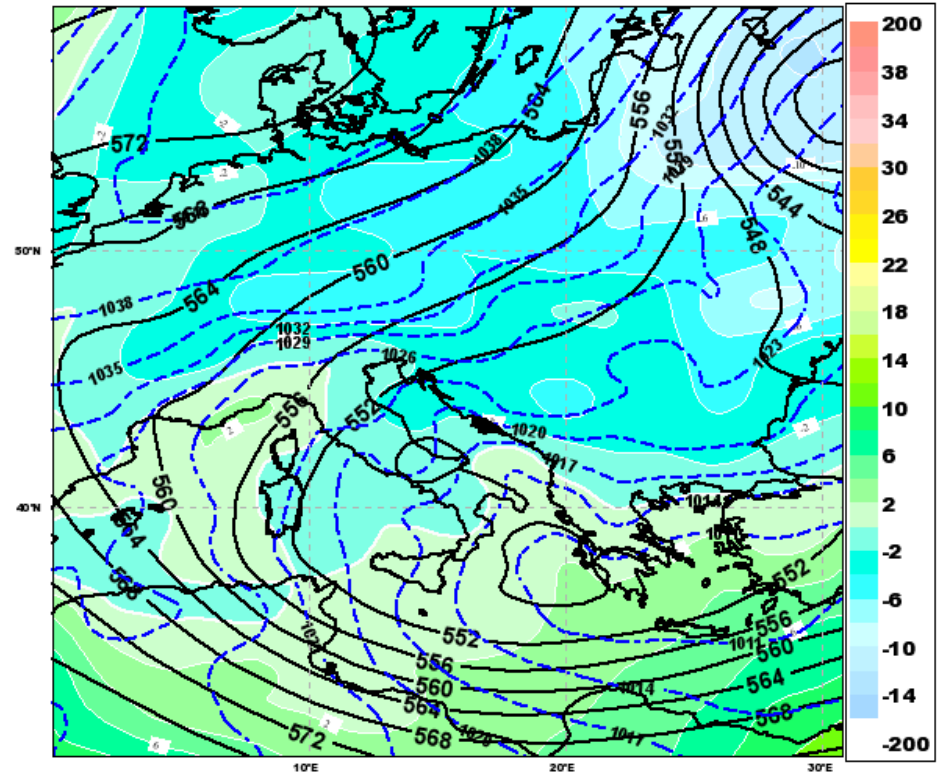
12/12 00 UTC

13/12 00 UTC

ECMWF AN VT:Wed 2007-12-12 00UTC 850hPa T/ Z/ MSL



ECMWF AN VT:Thu 2007-12-13 00UTC 850hPa T/ Z/ MSL



Italy, and in particular the Po Valley, was over the influence of an easterly flux of cold and dry air. So the weather was mainly with clear sky and very low temperature during the night

Experimental Set Up

control run: no assimilation

- ❖ initial date 12/12/2007 00 FC + 72 hours
- ❖ model version: COSMO 4.3 – int2lm 1.7
- ❖ IC from IFS analyses, BC from IFS forecasts

list of experiments:

Every experiment get the IC from 12h assimilation cycle (from 11/12/2007 12 UTC with IC and BC from IFS analyses)

○ Continuous assimilation (CA):

- 72h run (without T2m nudging);
- BC from IFS forecasts

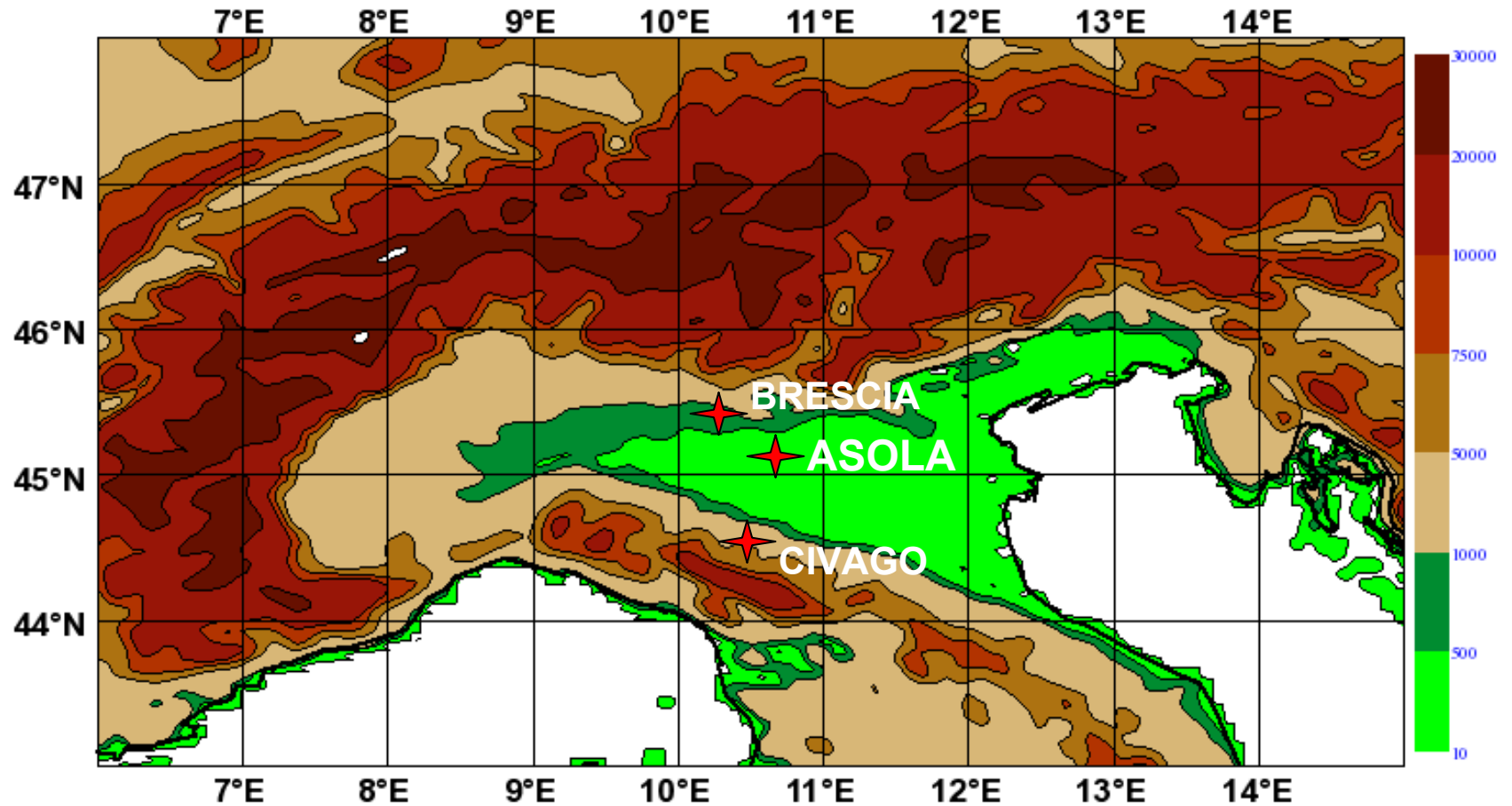
○ Continuous assimilation temperature (CAT):

- 72h run (with T2m nudging);
- BC from IFS forecasts

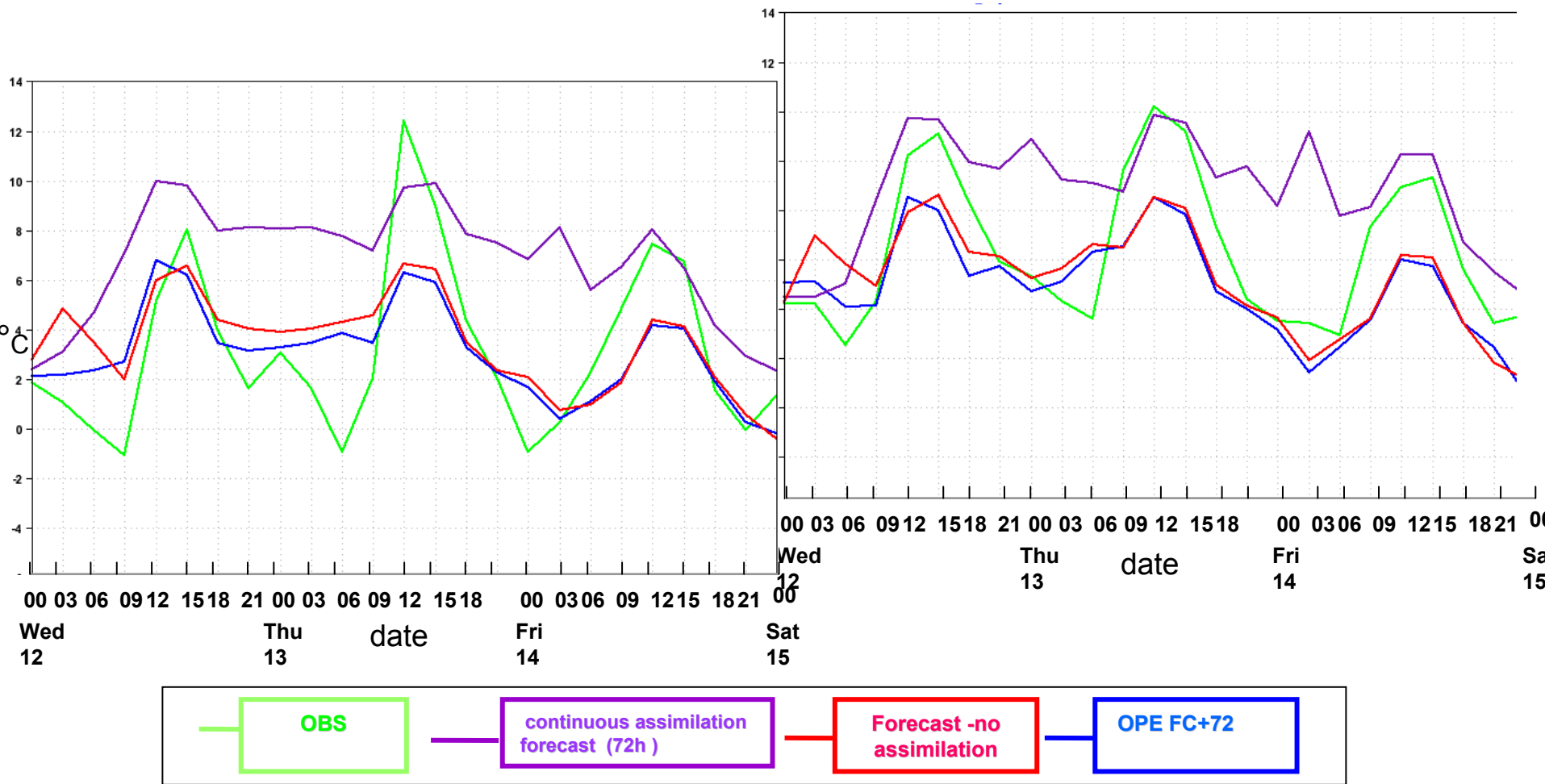
○ “operational like” forecast

- initial date 12/12/2007 00 FC + 72 ore
- IC from 12 h assimilation cycle with 2m temperature nudging, BC from IFS forecastas

COSMO orography and the verification station Brescia, Asola, Civago.



Time series of 2m temperature in two stations on the Po Valley: Brescia (synop) and Asola (not-synop)



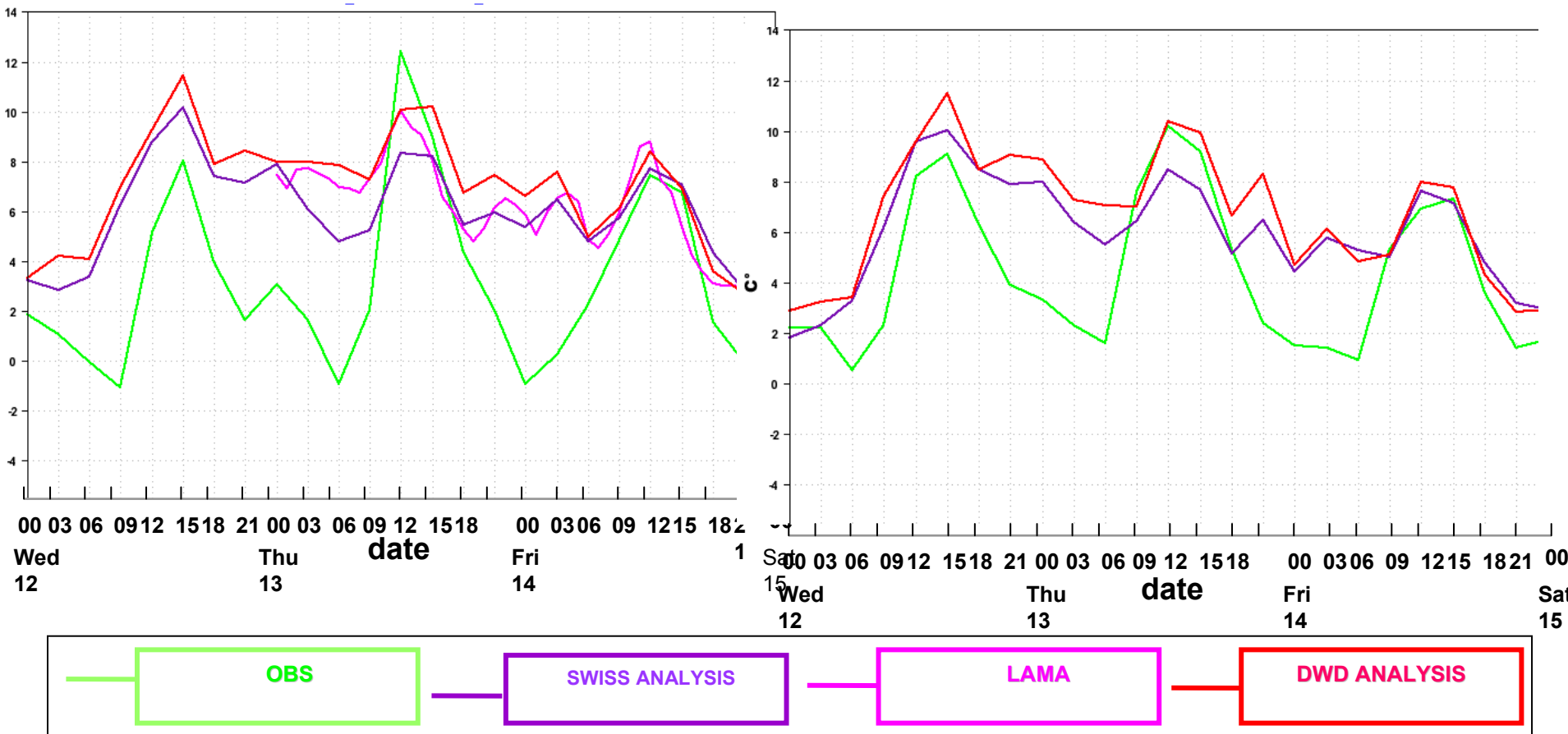
The model is too warm in the night with respect to the observations, and the continuous assimilation exp (CA - violet line) shows this “warm” behaviour even more

“The Po Valley is a very singular place and “data assimilation forecast” doesn’t
lead to a better results, but....
how the other COSMO analyses behaves over this strange place? ”

The analyses Set Up

- Analyses from DWD assimilation cycle;
- Analyses from MeteoSwiss assimilation cycle;
- Lama (lokal model assimilation) from ARPA-SIMC (environment group)
initial date 12/12/2007 00 FC + 12h.
Every run gets the IC from the previous assimilation cycle
BC from GME

Time series of 2m temperature for the COSMO analyses:



Data are provided by courtesy of A. Walser (MeteoSwiss) and U. Schattler (DWD)

The behaviour of the COSMO analyses are similar: too warm with respect to observations (especially during the night)

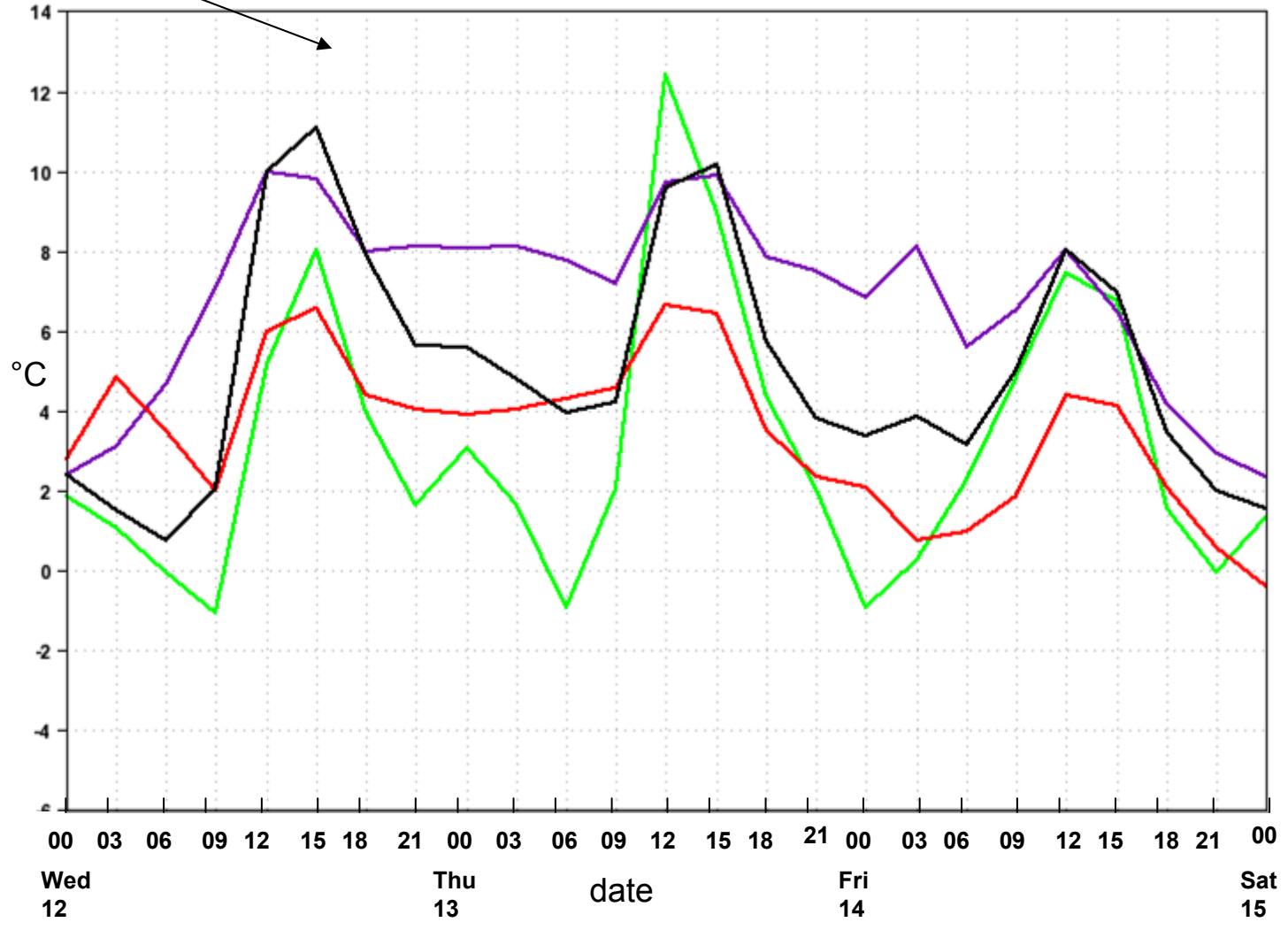
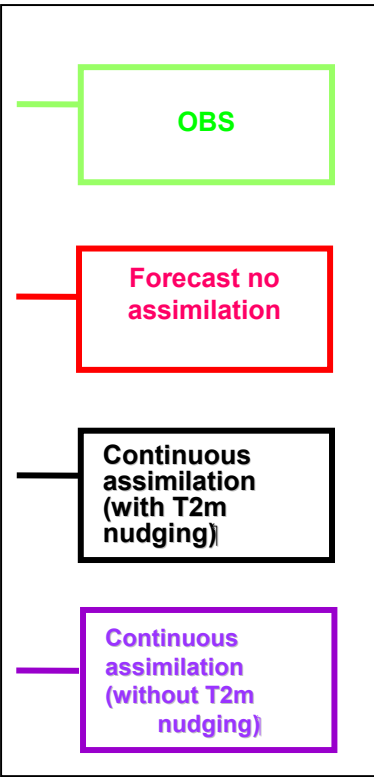
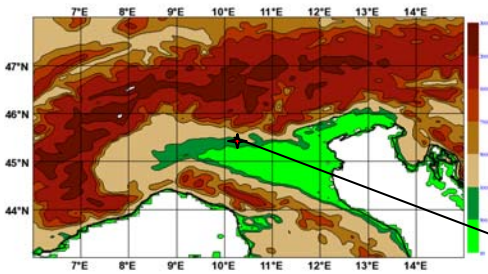
The time series of the 2m temperature both for the operational forecast and for the analyses show that something doesn't work on the Po Valley. The bias is too large for both analyses and operational (generally too warm especially during the night). This warmer behaviour causes the first layer of atmosphere to be too mixed and this does not allow the inversion phenomena on the ground.

What happen if we decide to assimilate the 2 meter temperature in the nudging?

Value of the parameter used in the namelist &nudging:

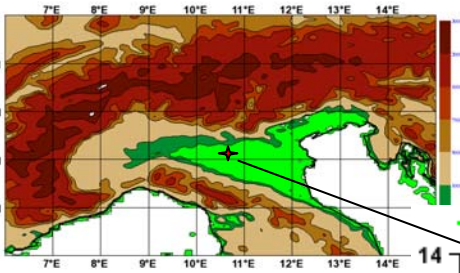
gnudgsu= 0.0006, 0.0012, **0.0006**, 0.0006 (s⁻¹)
(horizontal wind, surface pressure, **temperature**, humidity)

Time Series of T2m : BRESCIA LAT = 45.41, LON = 10.28

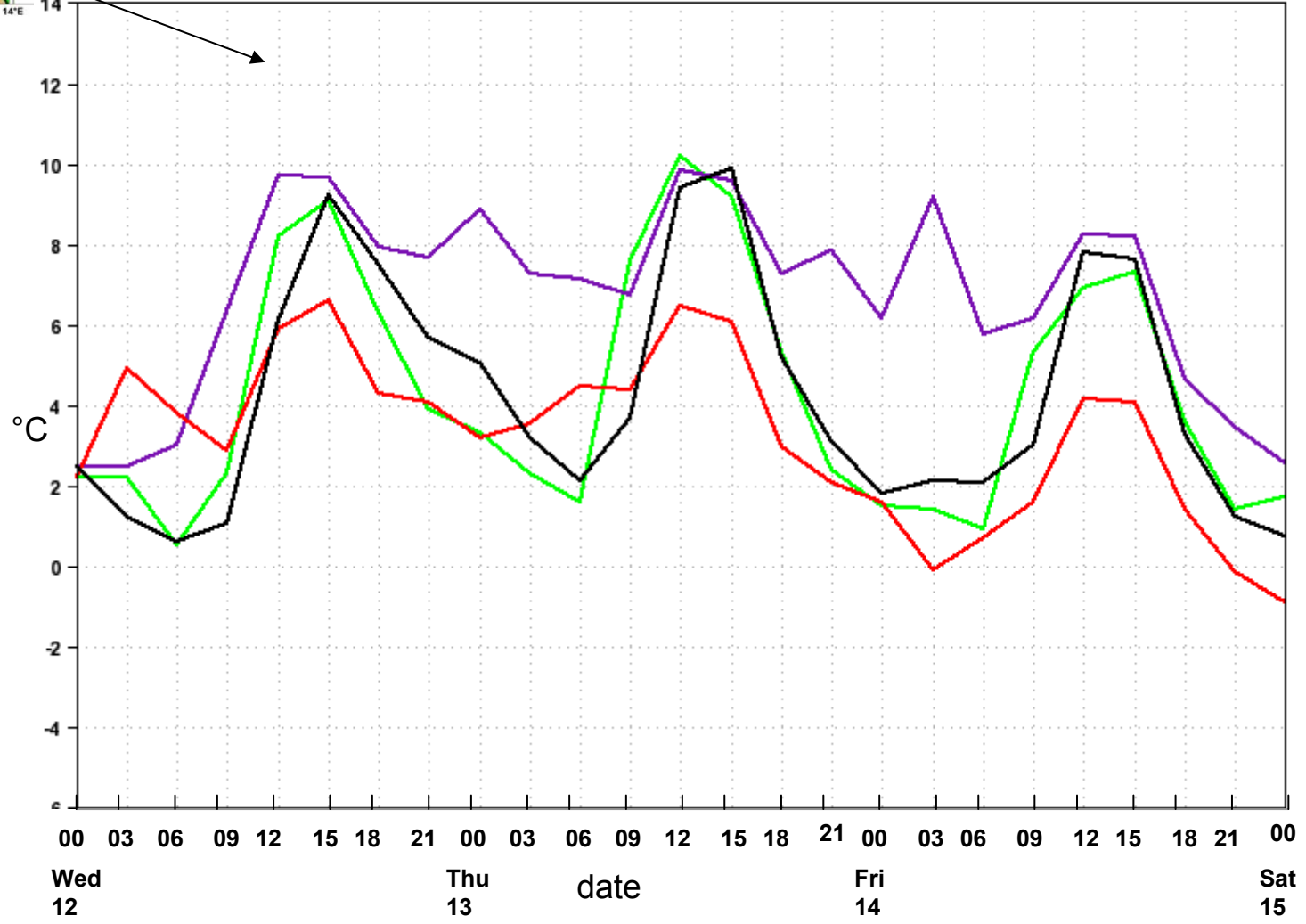
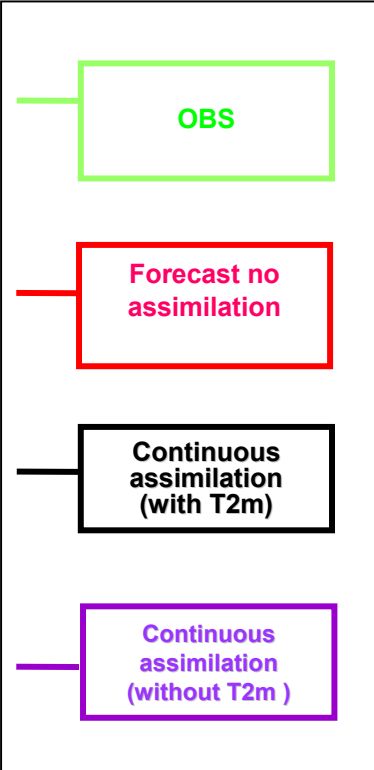


Time Series of T2m : ASOLA (MN)

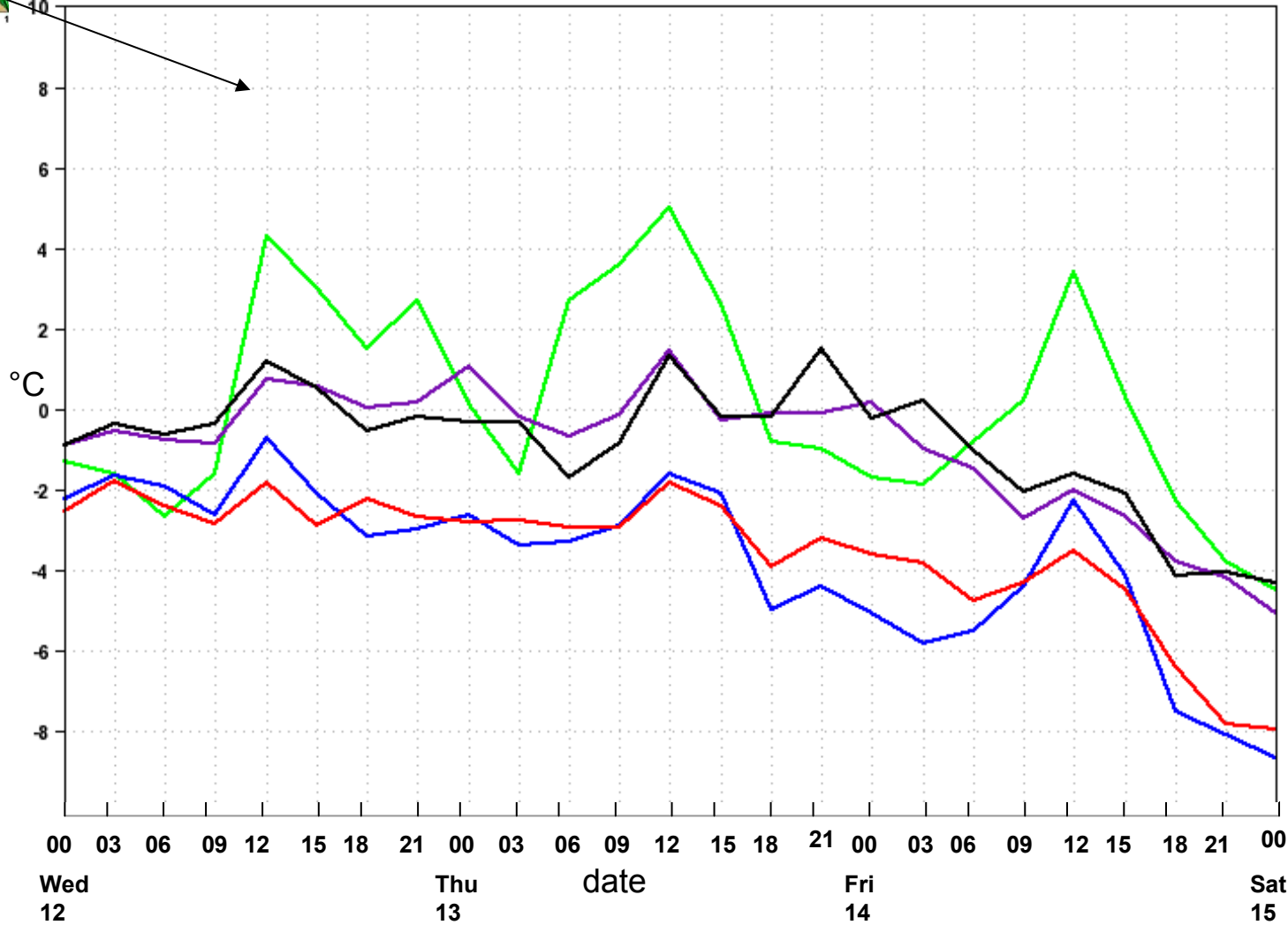
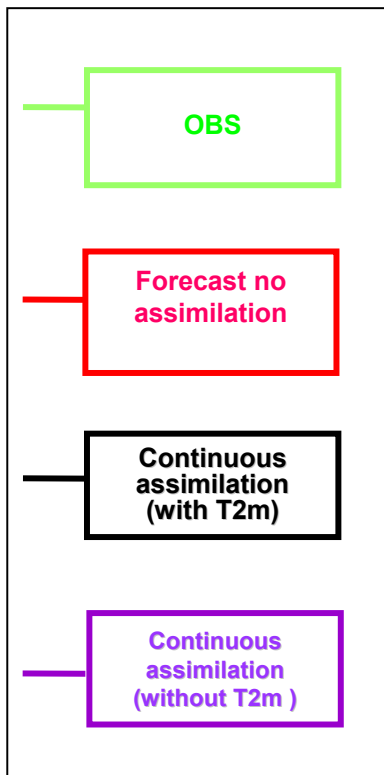
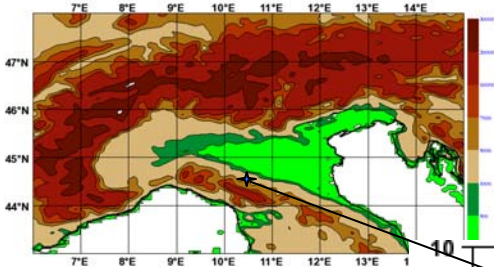
LAT = 45.02, LON = 10.41 ALT=41m



OBS exp_fcp72_as72h exp_fcp72_sa Temp_ass



Time Series of T2m : CIVAGO (RE) LAT = 44.24, LON = 10.44 ALT=1051m

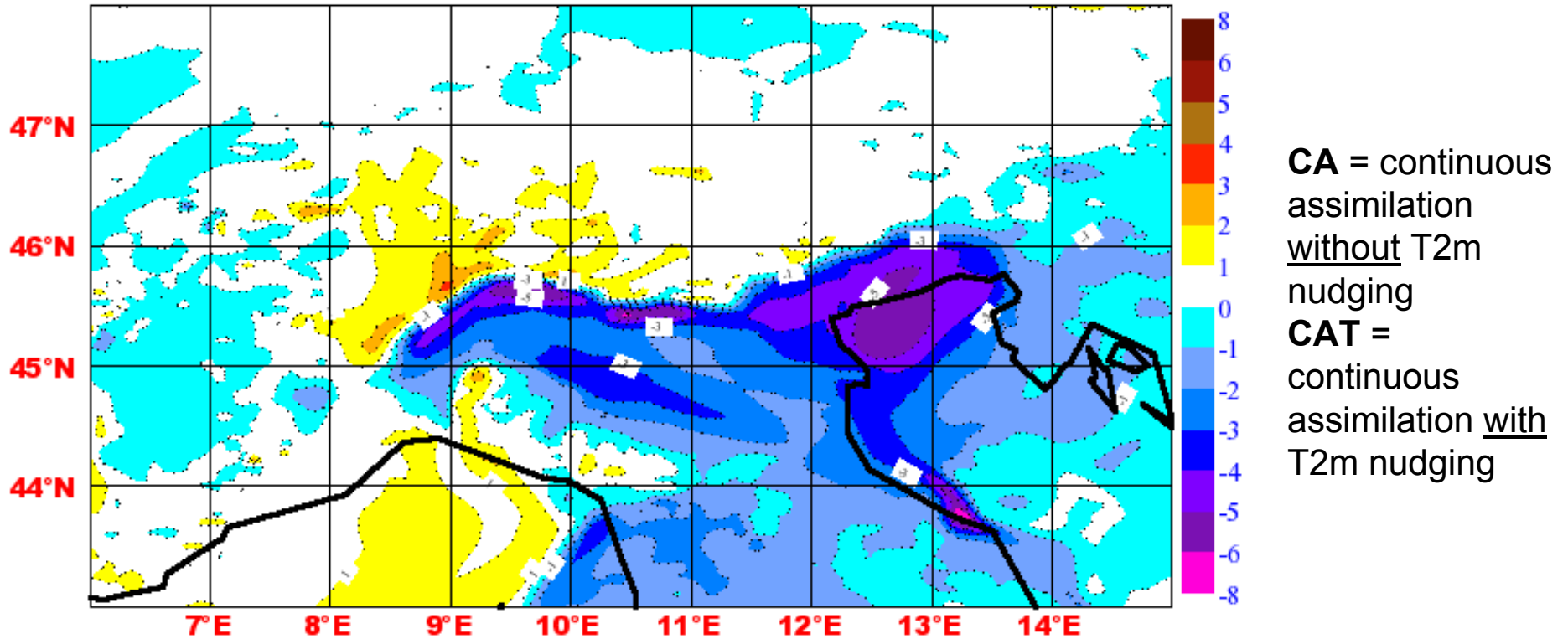


THE IMPACT OF INTRODUCING THE 2M TEMPERATURE IN THE
NUDGING:

DIFFERENCE MAPS BETWEEN THE EXPERIMENTS CAT AND CA:

12 12 2007 FC+ 6 (06 UTC)

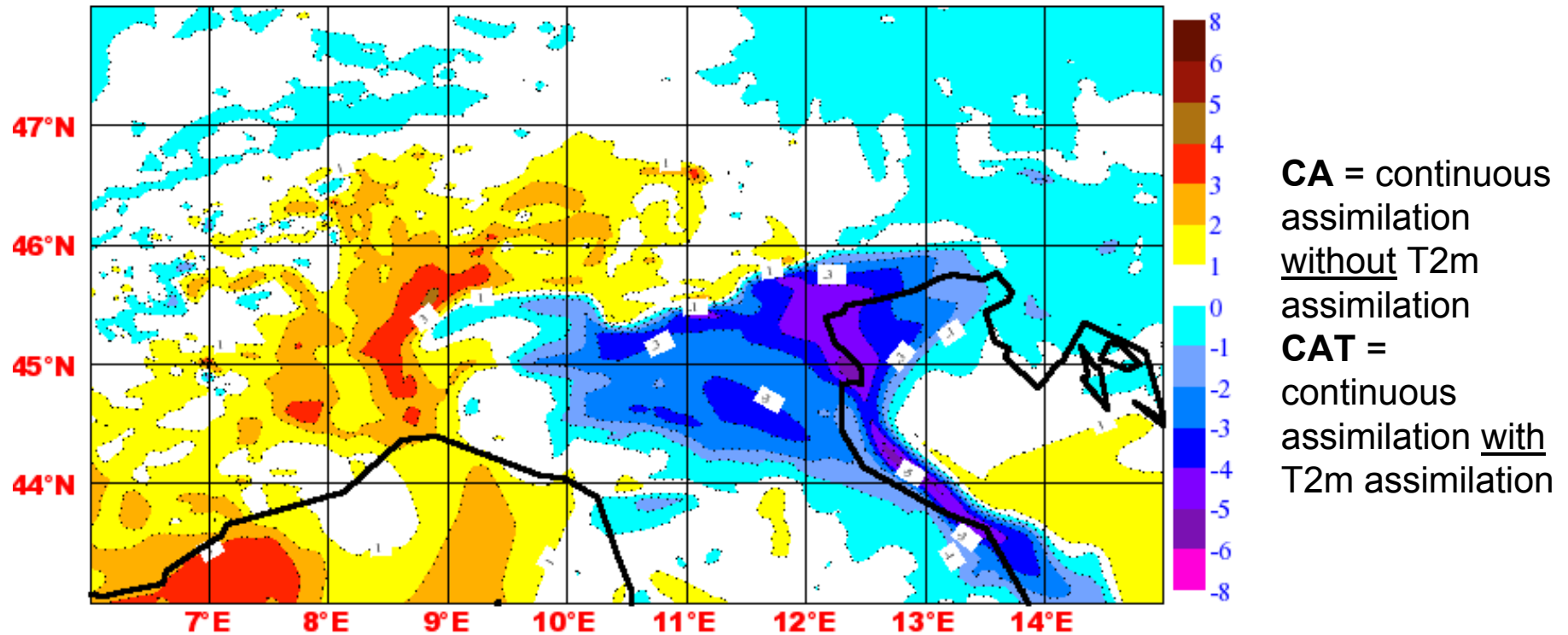
CAT exp – CA exp



The introduction of 2m temperature in the nudging “freeze” the model during the night in the Po Valley.

12 12 2007 FC+ 12 (12 UTC)

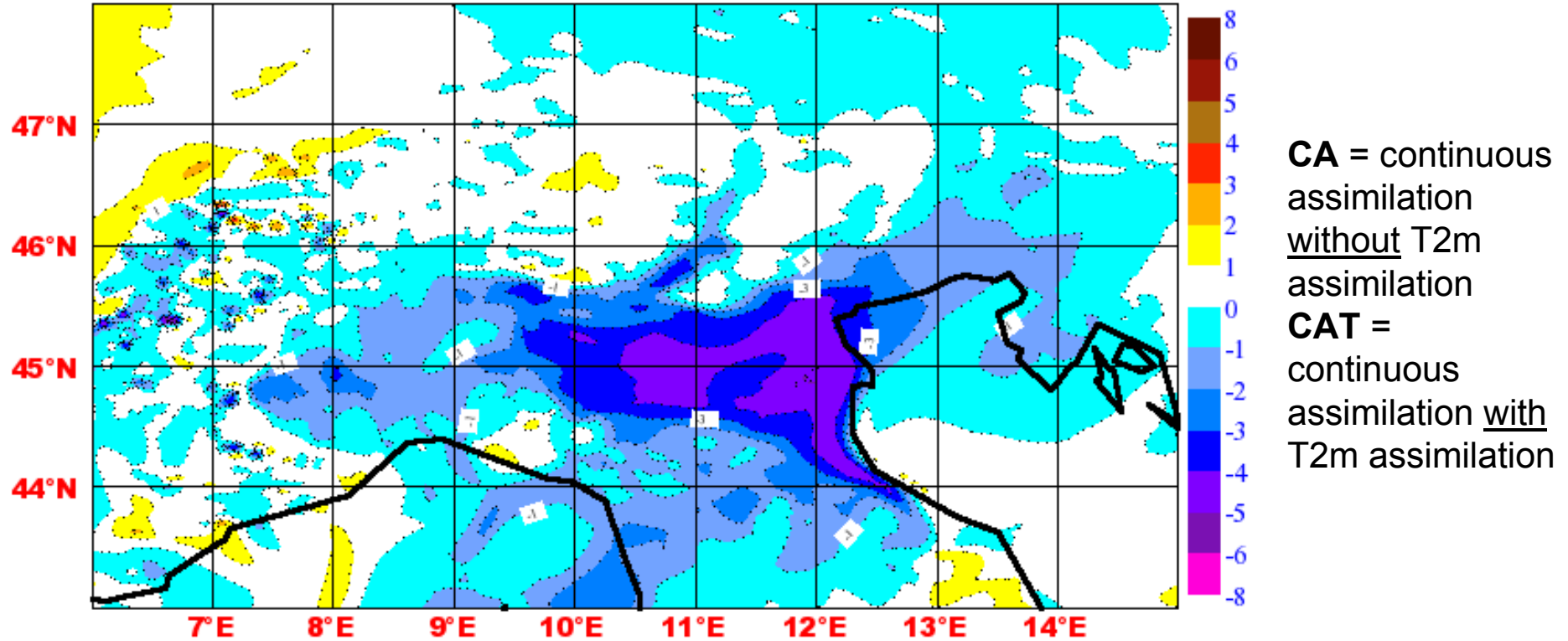
CAT exp – CA exp



But also during the day...

13 12 2007 FC + 24 (00 UTC)

CAT exp – CA exp

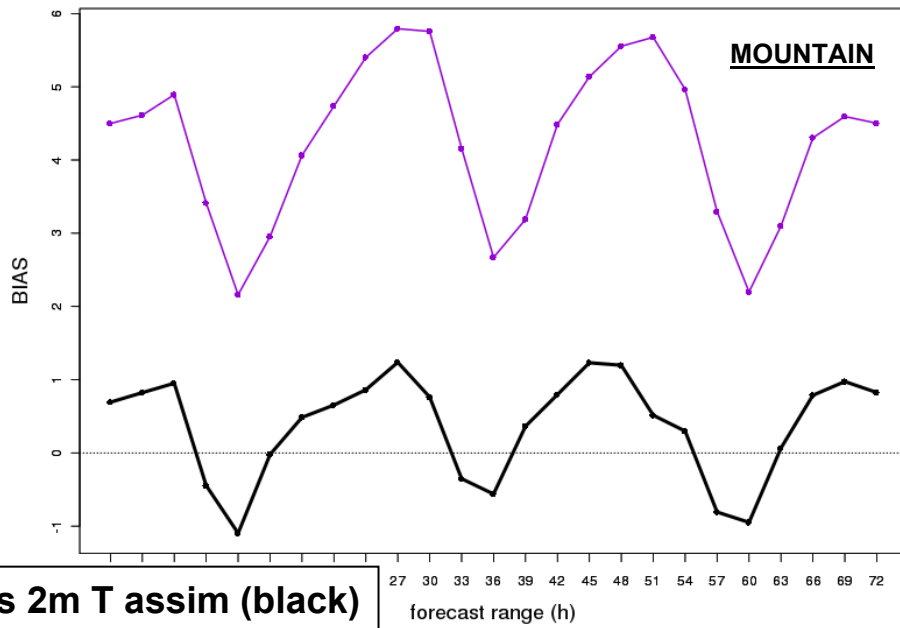
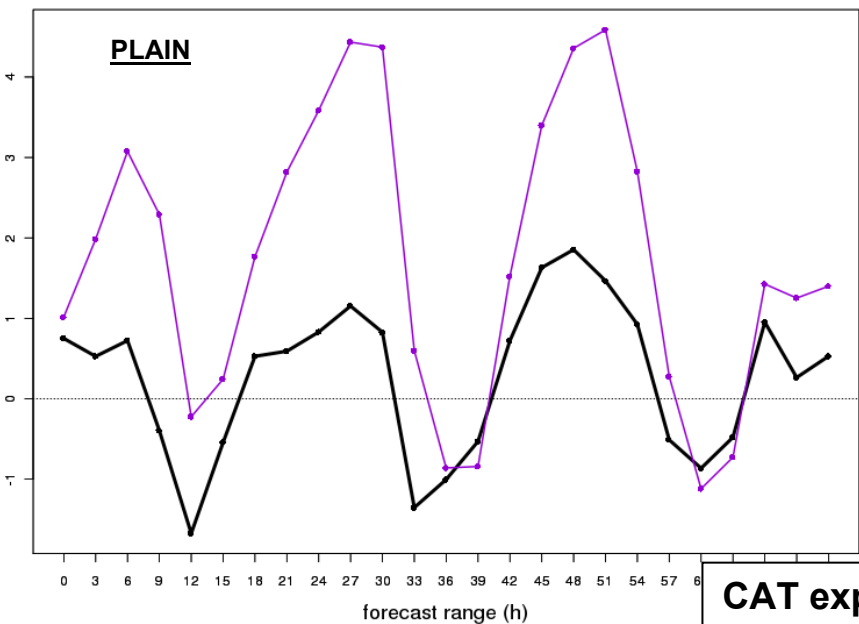


and 24 hours later even more.....

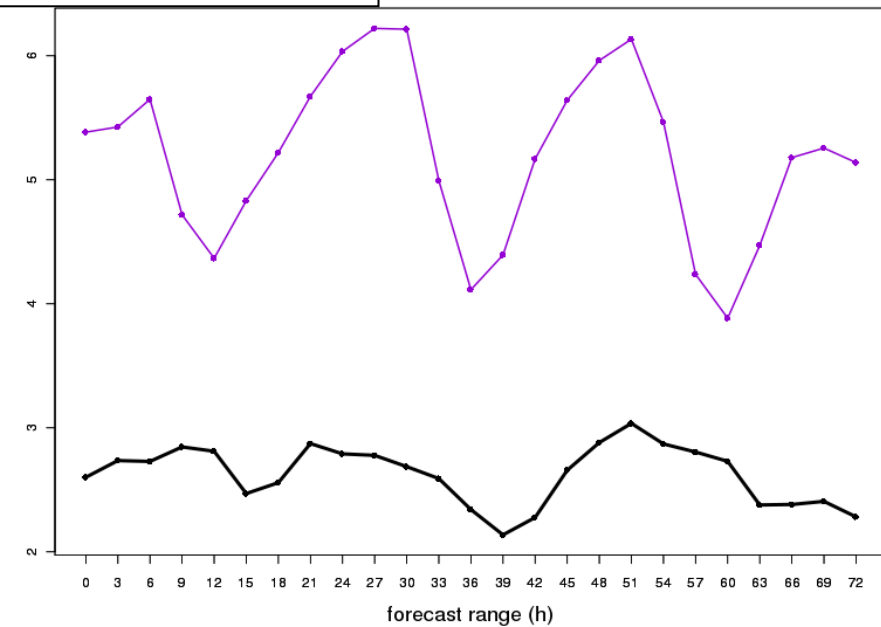
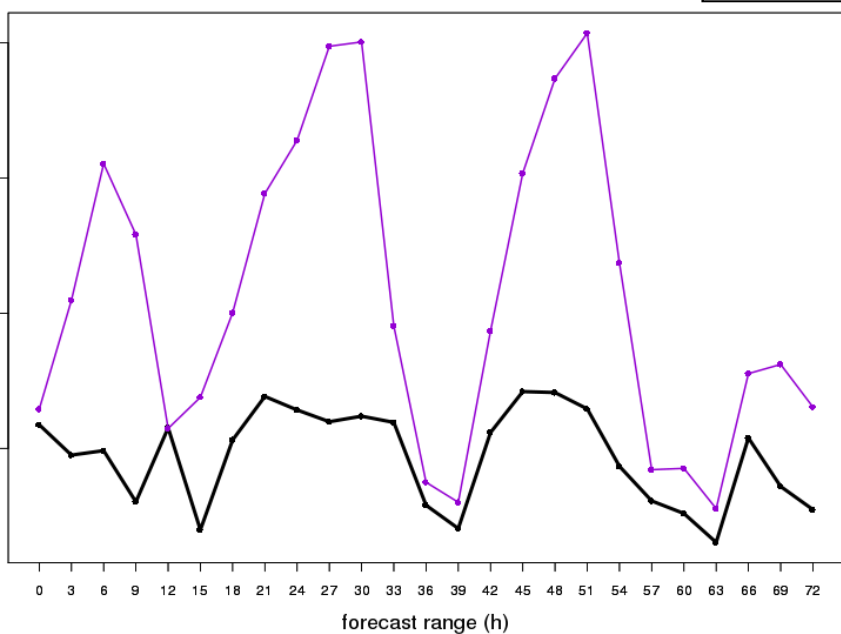
BUT WHAT ABOUT THE REALITY?

THE VERIFICATION ON A SET OF “LOCAL” STATIONS OVER THE NORTHERN
ITALY.

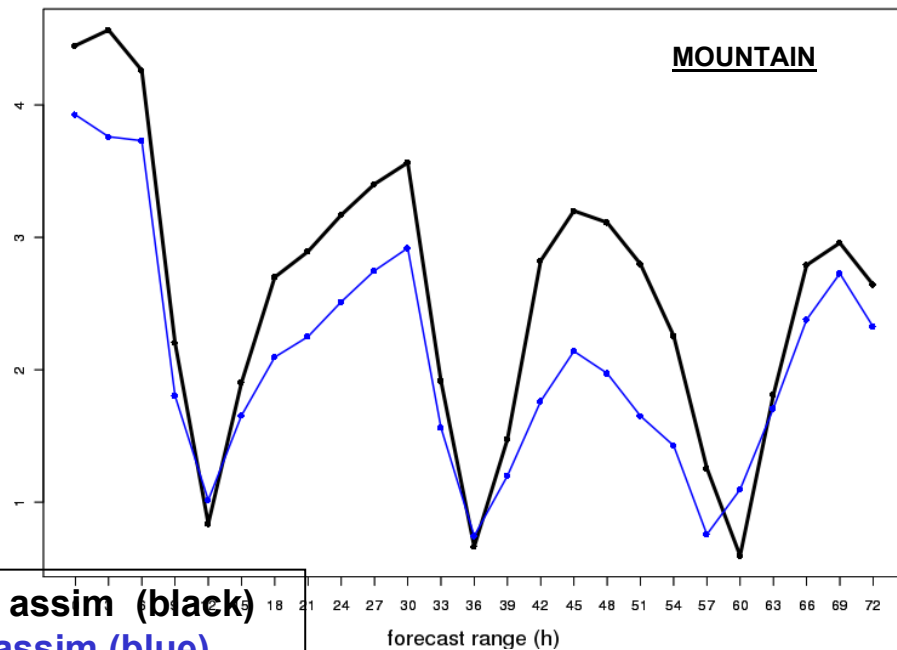
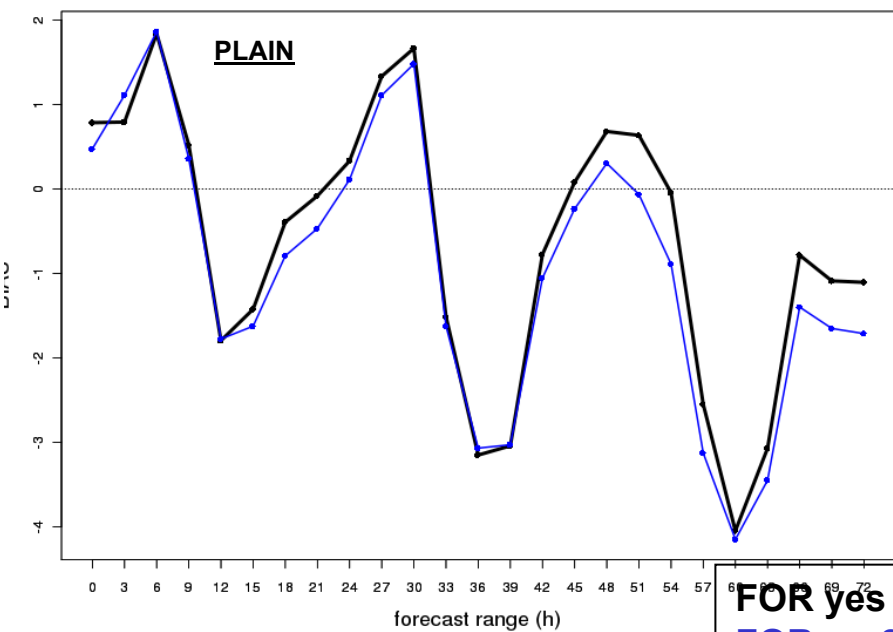
Time series of Bias (top) and MAE (bottom) of T2m for the CA experiments:



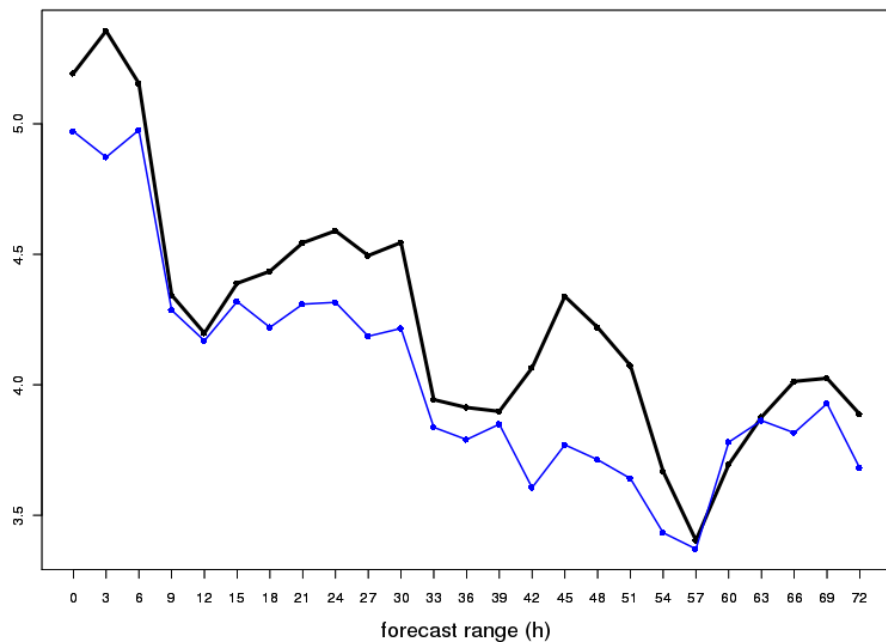
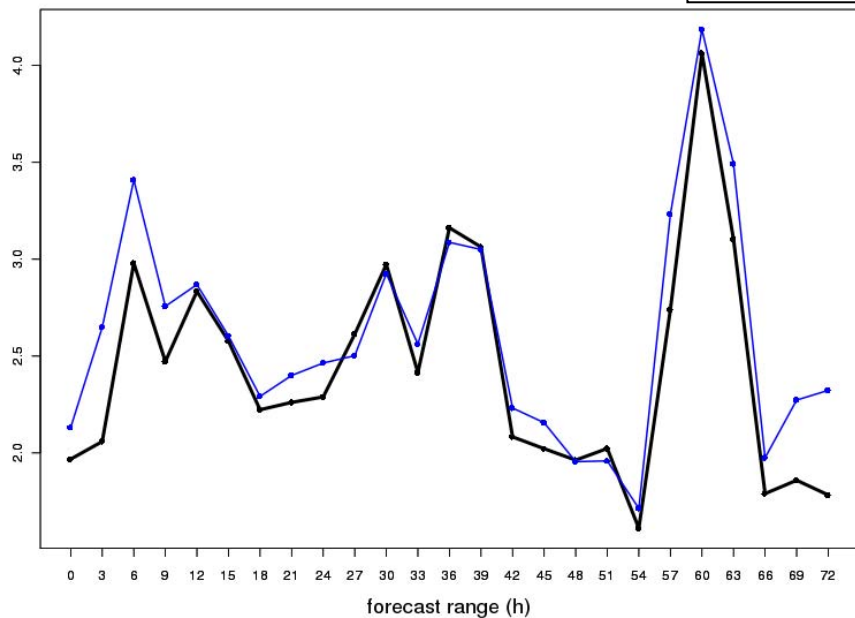
CAT exp yes 2m T assim (black)
CA exp no 2m T assim (violet)



Time series of Bias (top) and Mae (bottom) of T2m for the “operational” forecast :



FOR yes 2m T assim (black)
FOR no 2m T assim (blue)



Conclusions

- ☀ the selected case study shows that the three COSMO analyses considered don't correctly reproduce the time series of temperature in the Po Valley, in particular they don't correctly reproduce the temperature inversion;
- ☀ the “standard” continuous assimilation (without 2m temperature) produce a degradation of the temperature forecast compared both to no-assimilation experiment and operational model
- ☀ the nudging the 2 meter temperature improve the results cooling the forecast in the plain especially during the night (but unfortunately also during the day).
- ☀ the CAT exp shows that the bias over the northern Italy is reduced to value close to zero, and the MAE is also reduced by 2 or 3 degrees for both plain and mountain; this is a good news for producing a better analysis;
- ☀ the “like operational “ forecast shows that there is a little positive impact of using the new analysis only in the first hours of the forecast. But there is a little worsening in the forecast for the mountain.

AND FUTURE WORKS

- ☀ verify the impact of changing the humidity nudging
- ☀ test on another case study or on a more long period to evaluate the dependency on the meteorological situation.

**THANKS FOR YOUR
ATTENTION**