Screen-level non-GTS data assimilation in COSMO-I2

"PBL Initialisation with screen-level data and PBL profiles", WG1

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Outline

- Aim of the work
- Method
- First test cases
- Preliminary conclusions
- Longer test period
- Results
- Conclusions

Aim of the work

- Improvement of the COSMO model analysis with the assimilation of non-GTS variables
- Test of the effect of this approach on the first 12h of forecast (nowcasting)

Number of available stations in Piemonte	
T2m	386
W10m	112
Rh2m	178

Method

• For each run, we have performed simulations of 24h (or 36h) in which the assimilation takes place in the first 12h.

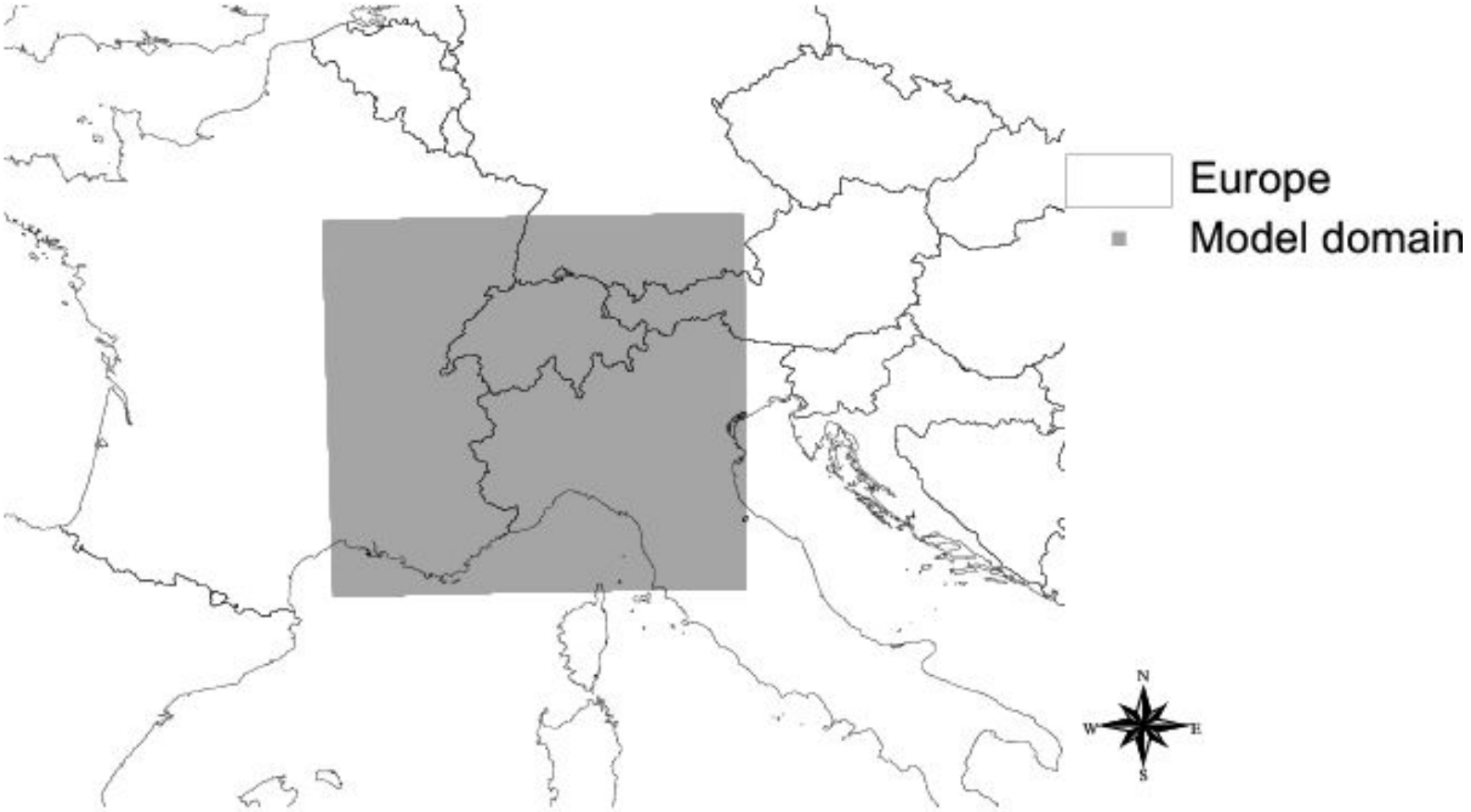
• We started from the ECMWF initial and boundary conditions to produce the 7 km simulations which are then used as initial and boundary conditions for the 2.8 km simulations.

• The version 4.3 of the COSMO model has been used.

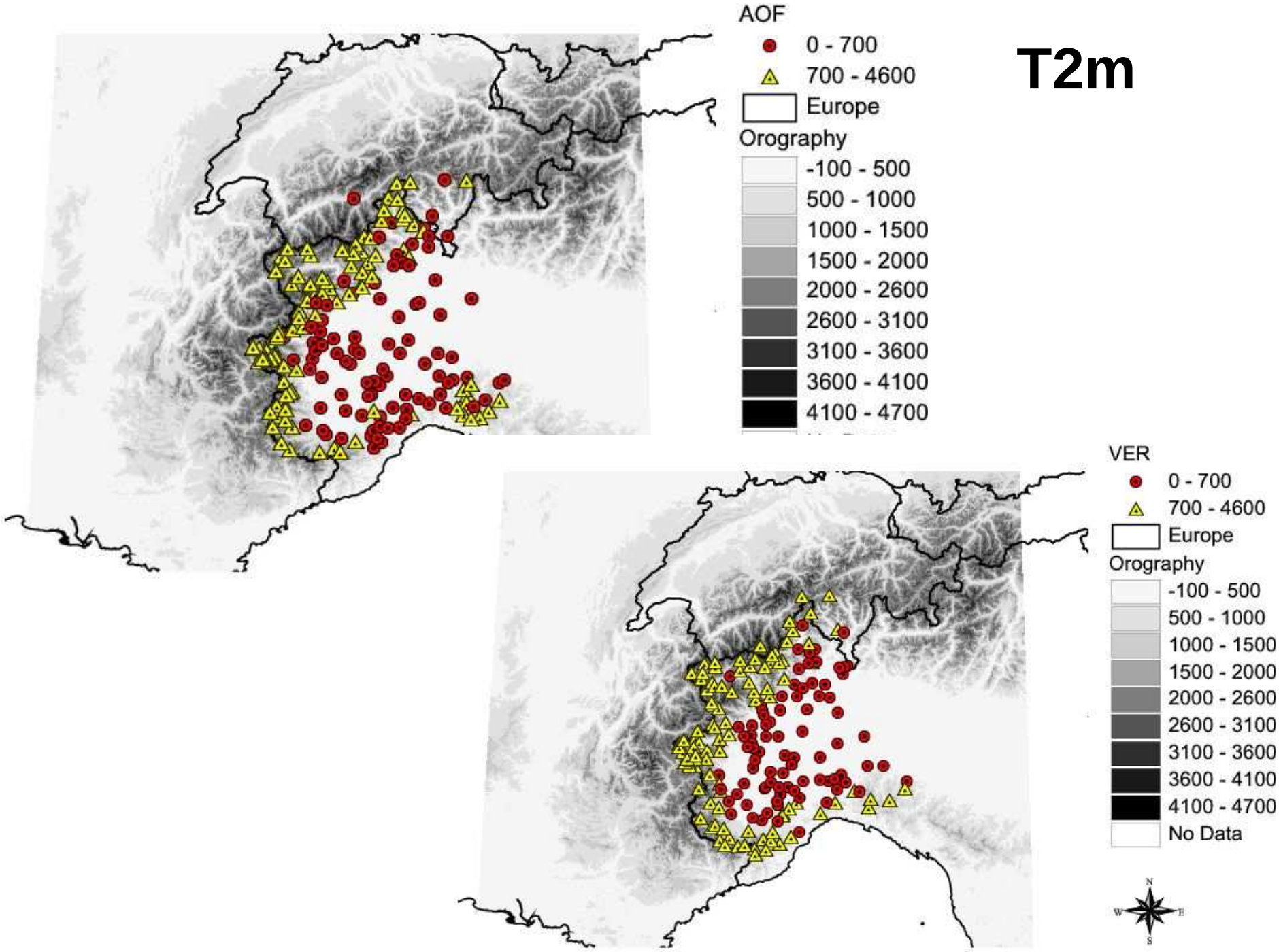
• In the 7 km simulations we used the operational settings.

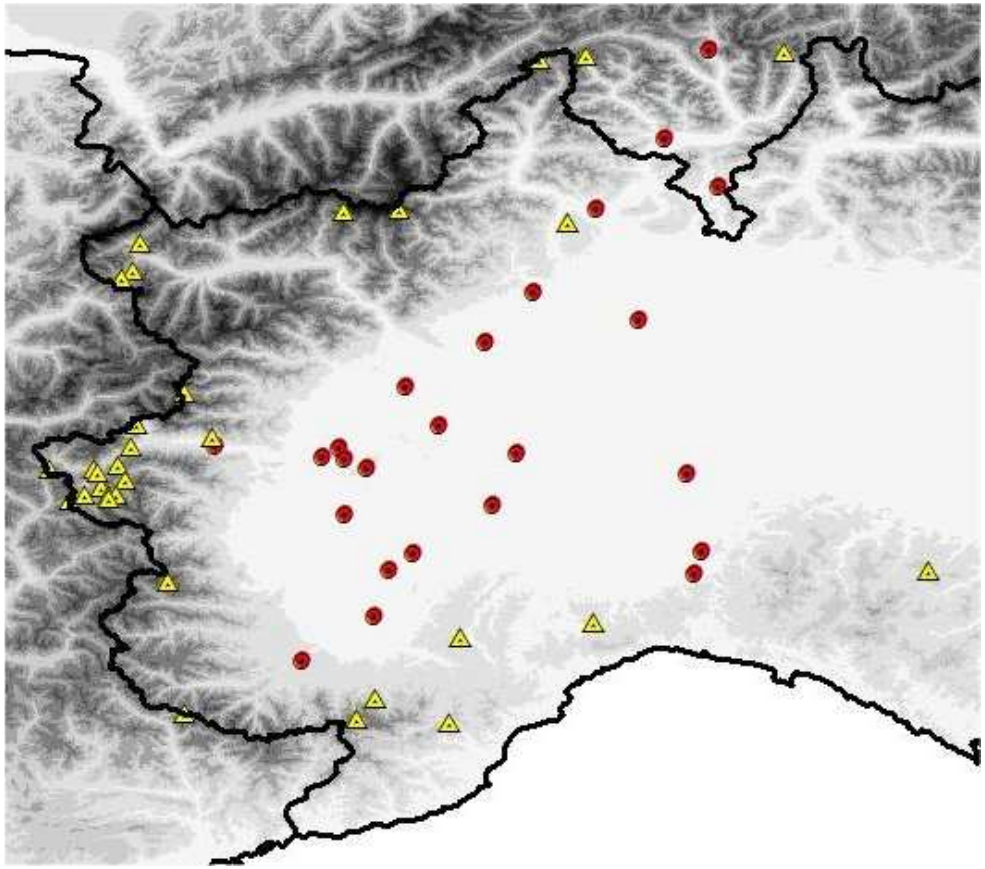
• A different horizontal correlation coefficient has been used in the 2.8 km runs, because of the increased density of the observations

• In order to evaluate if the performances of the two model versions are statistically different, we adopted an approach based on hypothesis testing (Hamill, 1999) in which we construct a confidence interval for the performance differences (Jolliffe, 2007).



Domain of the 2.8 km simulations


AOF
0 - 700
700 - 4600
Europe
Orography
-100 - 500
500 - 1000
1000 - 1500
1500 - 2000
2000 - 2600
2600 - 3100
3100 - 3600
3600 - 4100
4100 - 4700
T2m
VER
0 - 700
700 - 4600
Europe
Orography
-100 - 500
500 - 1000
1000 - 1500
1500 - 2000
2000 - 2600
2600 - 3100
3100 - 3600
3600 - 4100
4100 - 4700
No Data
N
W
E
S



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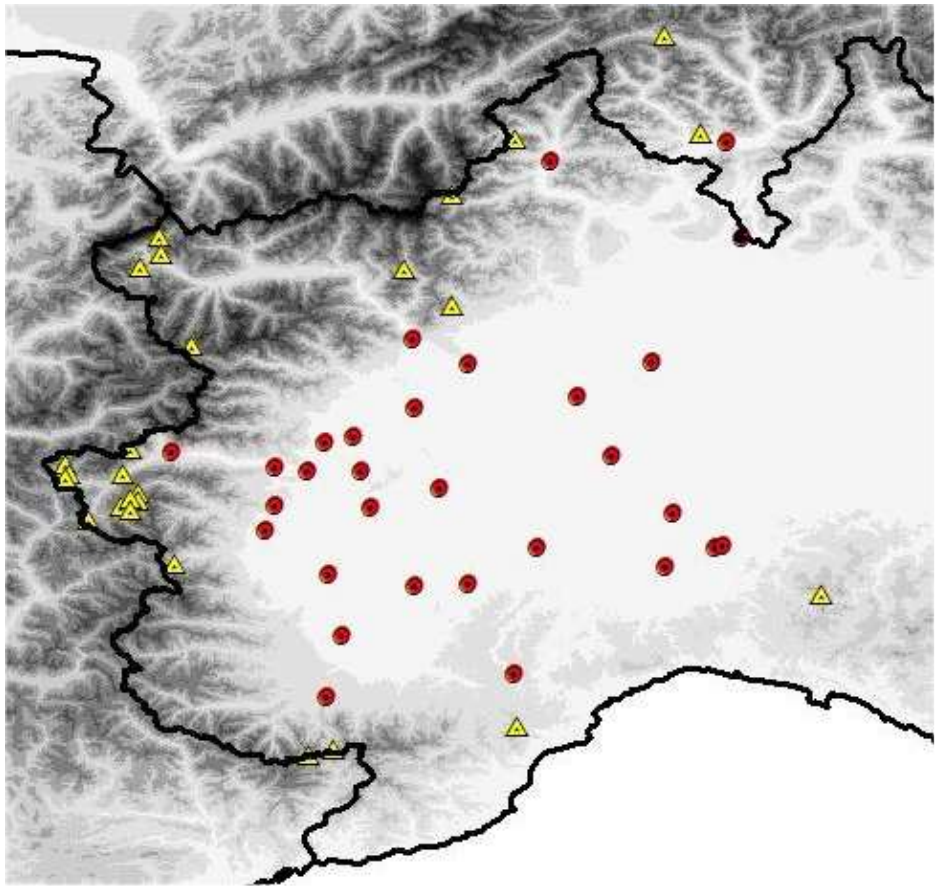
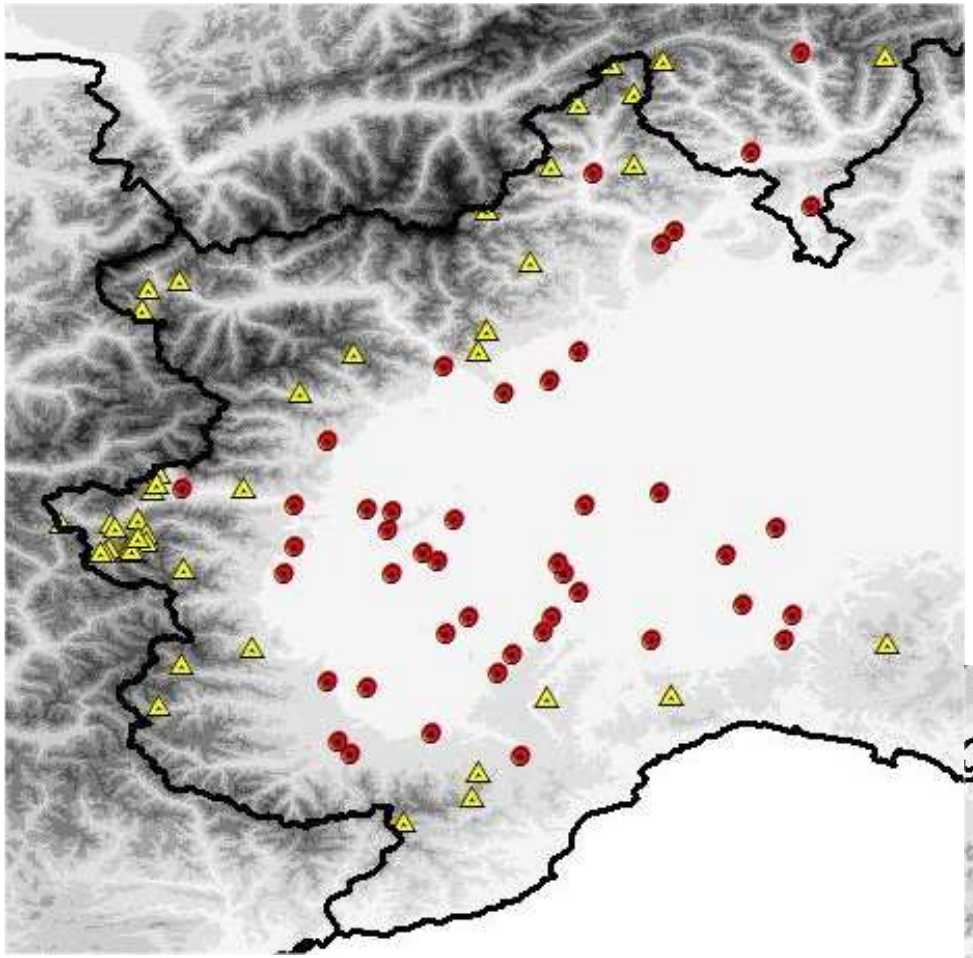
W10m



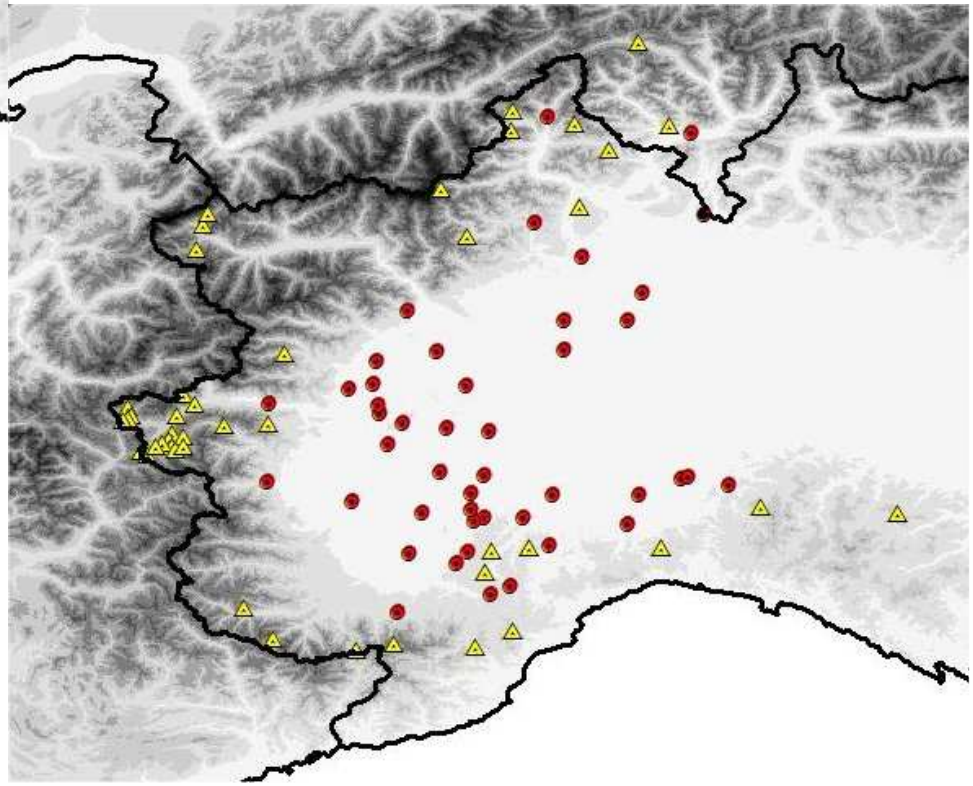
ver

RH2m

aof



ver



First test cases

- Run 20080723 00UTC (+36h): clear sky summer situation
- Run 20080217 00UTC (+36h): stratiform low-level clouds due to eastern winds not correctly forecasted; strong inversion
- Run 20070501 12UTC (+36h): mixed advective/convective situation with thunderstorms not correctly localized by the operational
- Run 20060817 00UTC (+36h): summer situation with stormy weather; super cell in the northern part of the region with underestimation and wrong localisation (PPQPF test case)

IN THIS PART OF THE WORK WE ASSIMILATED T2M, RH2M AND W10M IN THE FIRST 12H, ALONE AND IN ALL THE POSSIBLE COMBINATIONS (RESULTS SHOWN IN THE COSMO NEWSLETTER 9)

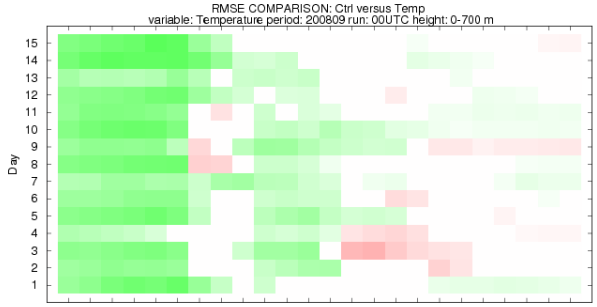
Preliminary conclusions

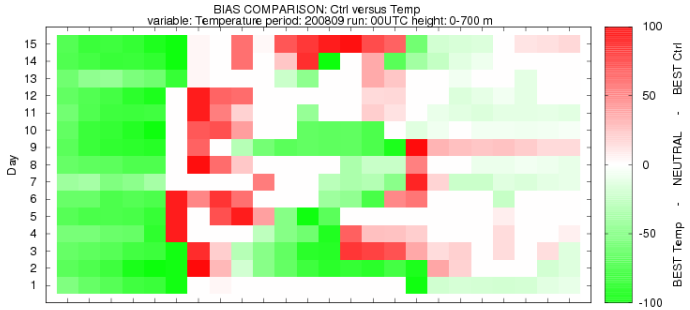
- The assimilation of T2m improves T2m and seems to have neutral or slightly positive impact on the other variables (W10m, RH2m)
- The assimilation of the other variables (alone or in combinations), produces fuzzy results, especially in the assimilation cycle, but sometimes also in the forecast
- The vertical profiles are much less perturbed by the assimilation, but below 1000 m there is a small (positive) impact with T2m assimilation
- The assimilation has a neutral impact on precipitation
- The results look coherent for the four case studies

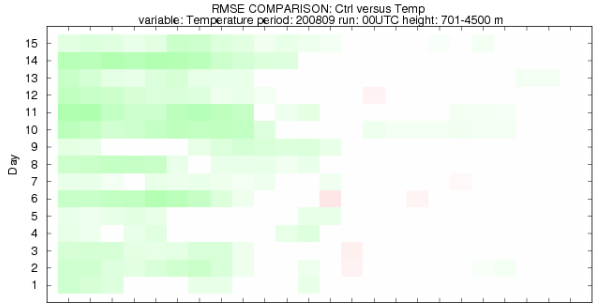
Longer test period

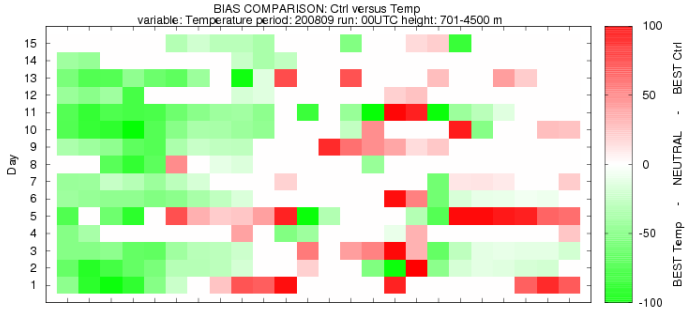
- Run 20080901-20080915: 00UTC and 12UTC (+24h)
- Run 20090103-20090117: 00UTC and 12UTC (+24h)

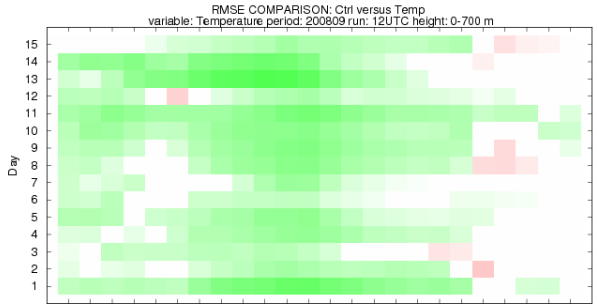
- **Ctrl** run: operational implementation of COSMO-I2 (apart from the domain)
- **Temp** run: assimilation of T2m in the first 12h

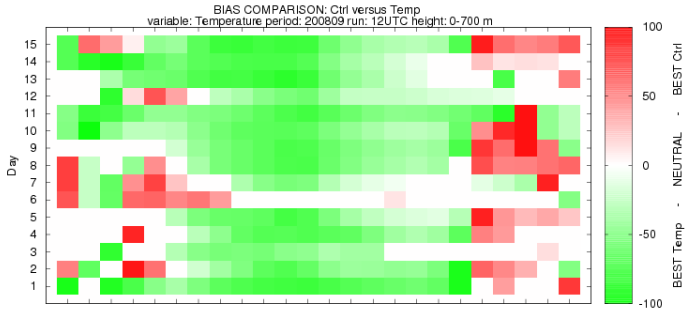


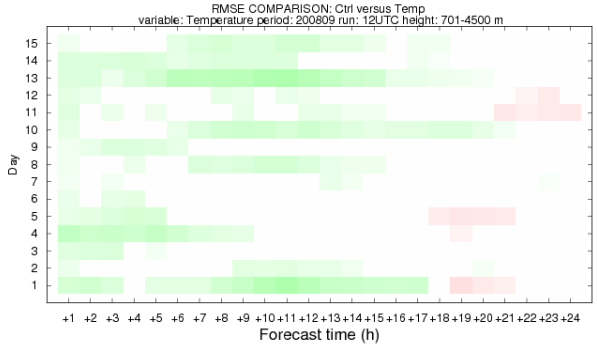


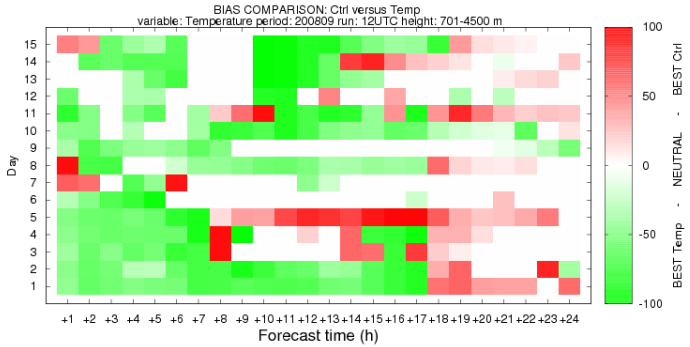










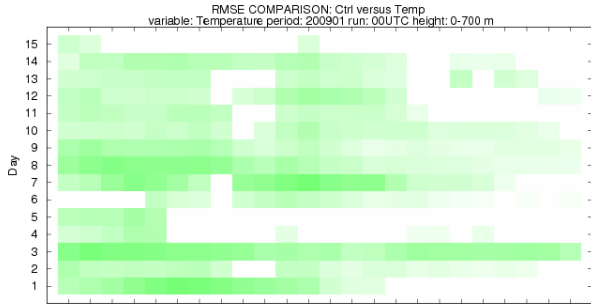


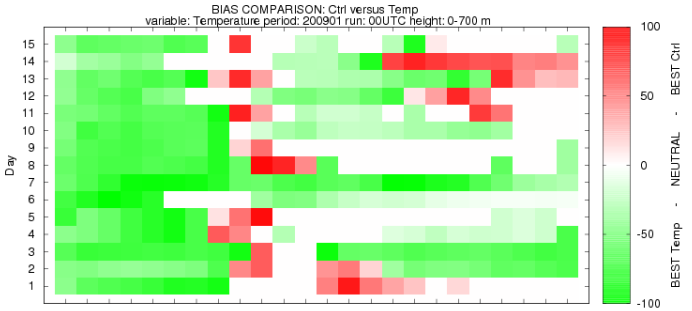
Results

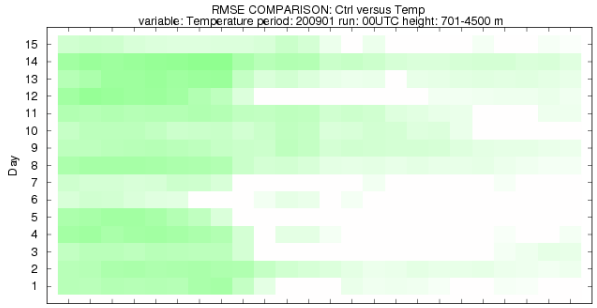
Ctrl vs. **Temp**

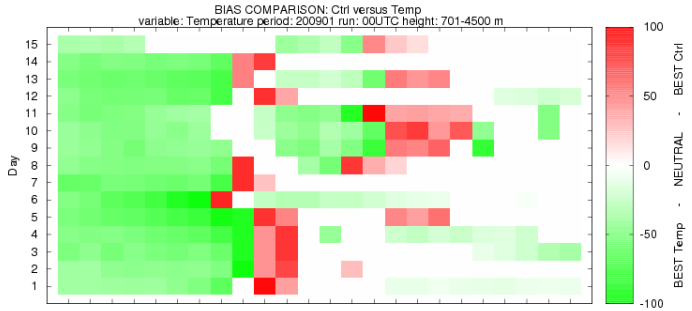
September 2008 simulations showing the RMSE and the BIAS of the 00 and 12UTC runs for stations below and above 700 m.

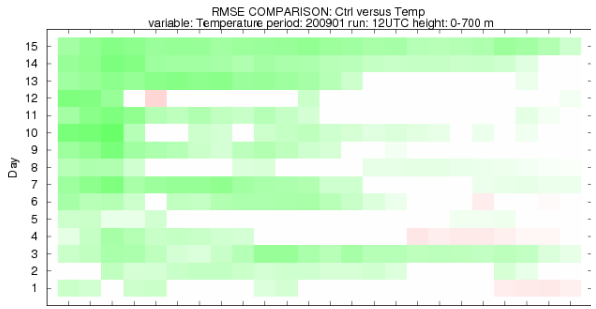
Day (y-axis) vs. forecast time (x-axis).

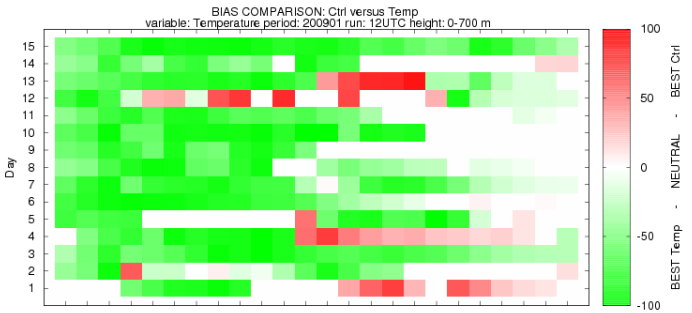


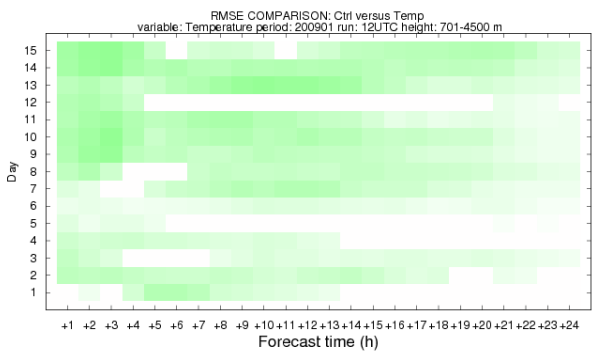


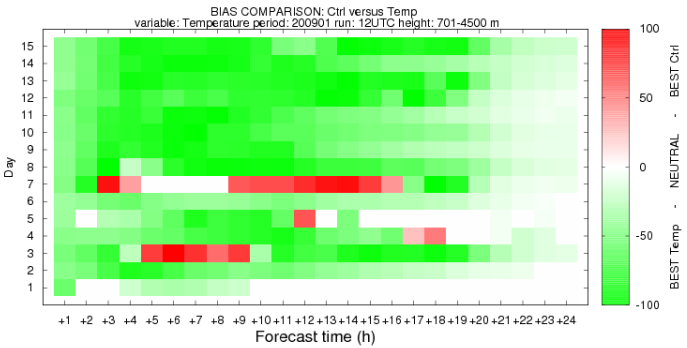










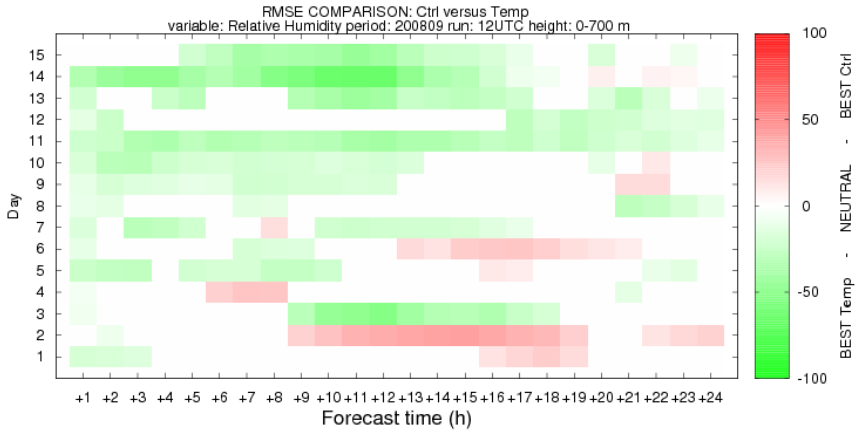


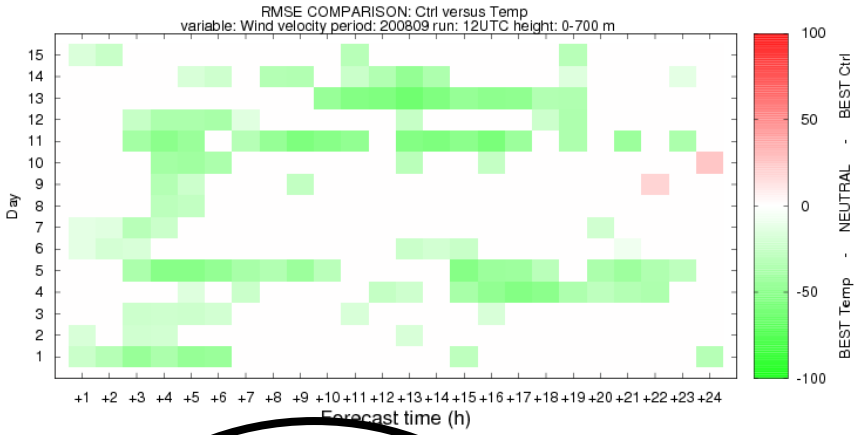
Ctrl vs. **Temp**

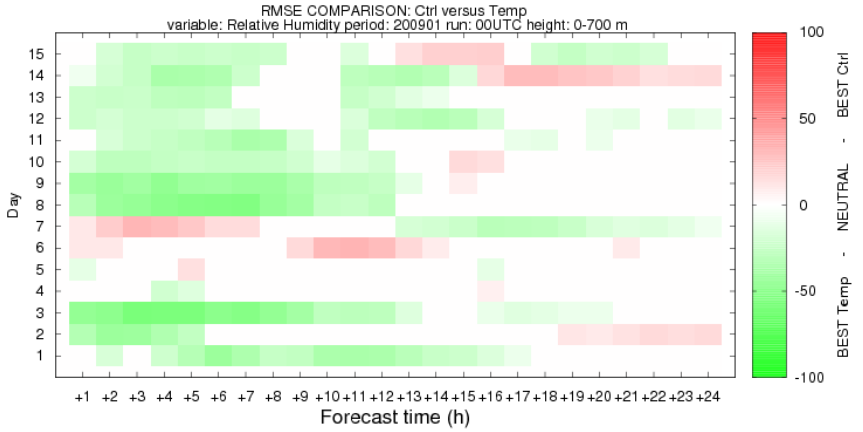
January 2009 simulations showing the RMSE and the BIAS of the 00 and 12UTC runs for stations below and above 700 m.

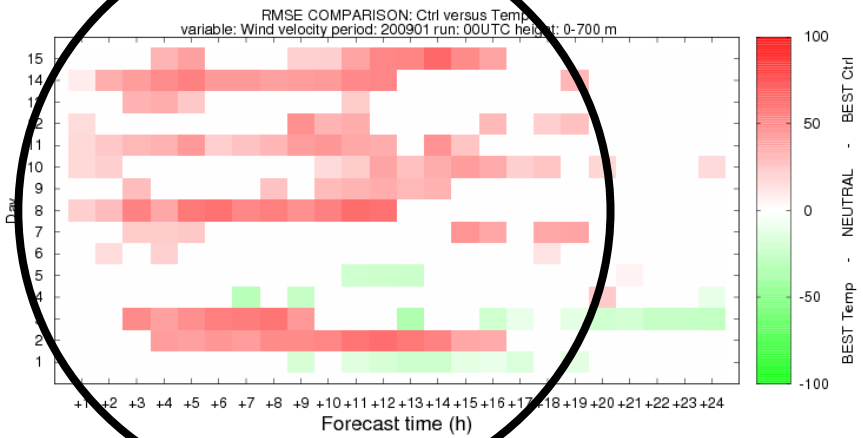
Day (y-axis) vs. forecast time (x-axis).

Example of RH2m and W10m



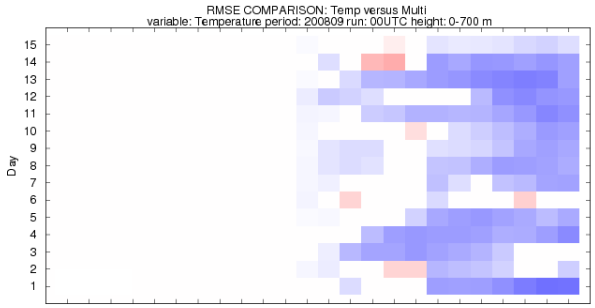


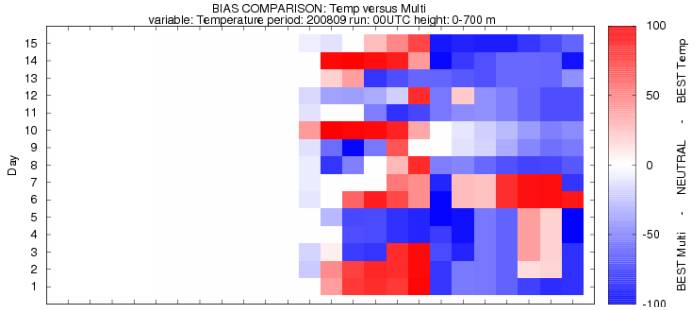


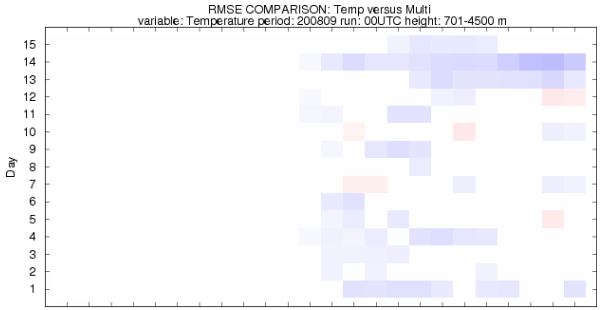


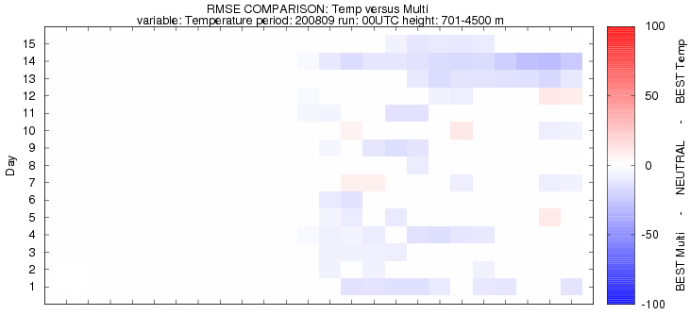
Is it possible to extend in time the validity of the approach ?

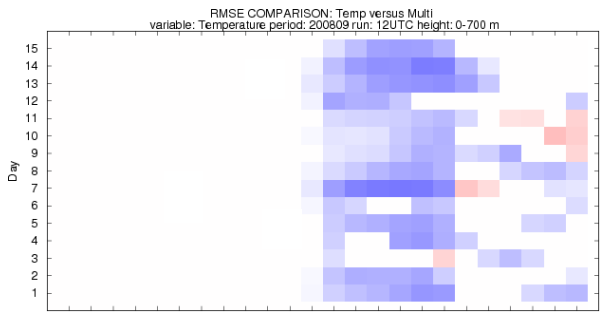
assimilation of T2m **forecasts** given by the Multimodel SuperEnsemble technique (see for instance Krishnamurti, 2000) for all the available stations of the ARPA Piemonte network into the model, as if they were observations (pseudo-observations), from +12h to +24h (**Multi** runs)

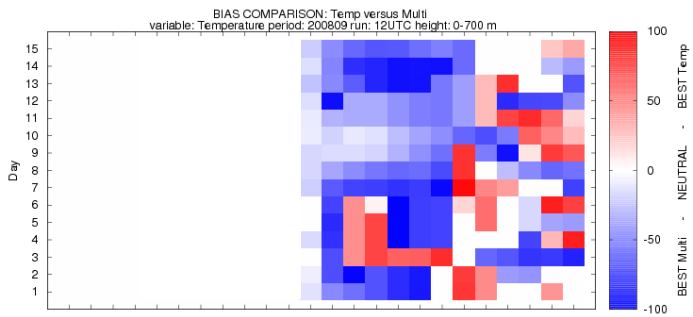


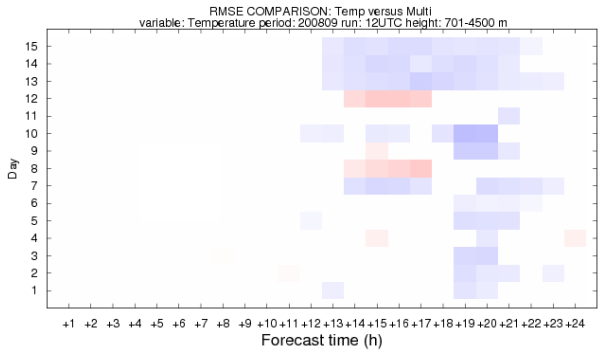


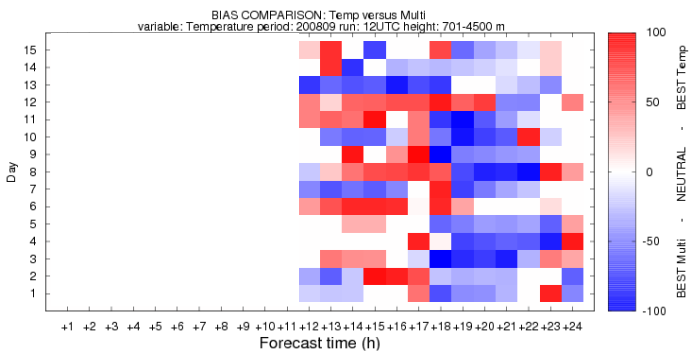












Temp vs. **Multi**

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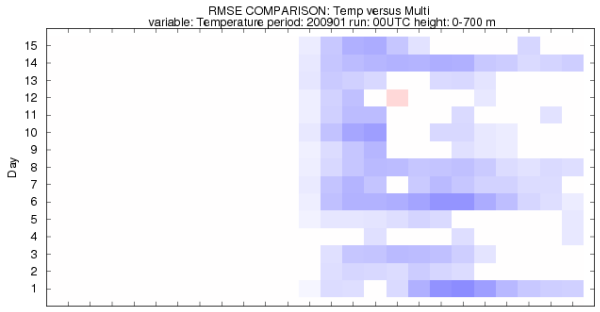

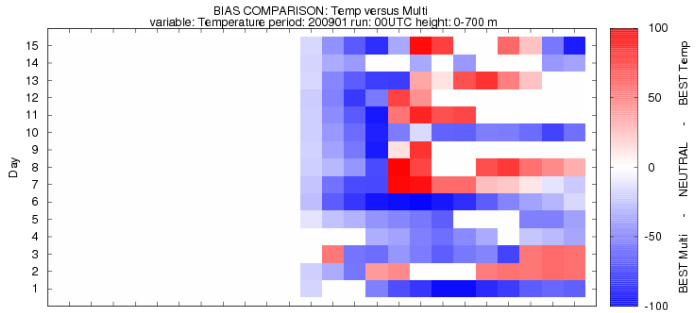

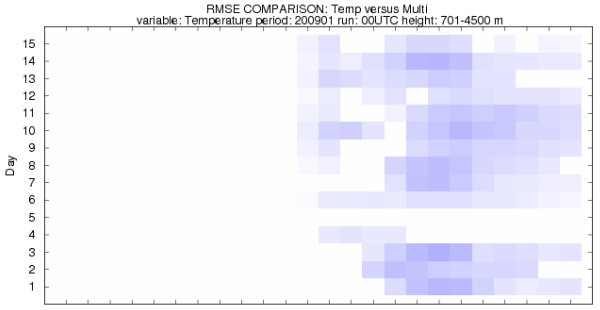

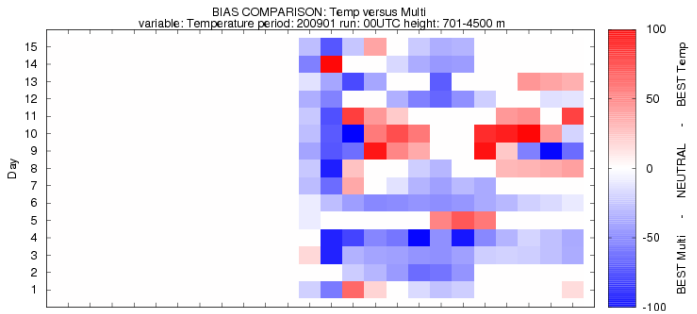

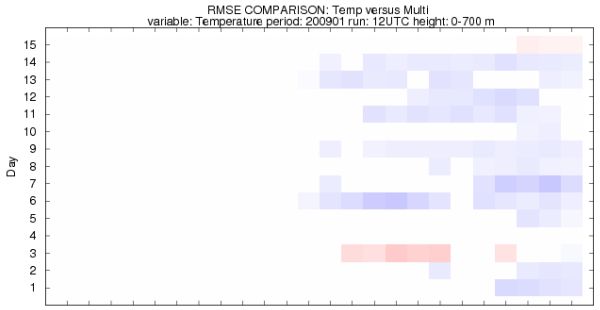

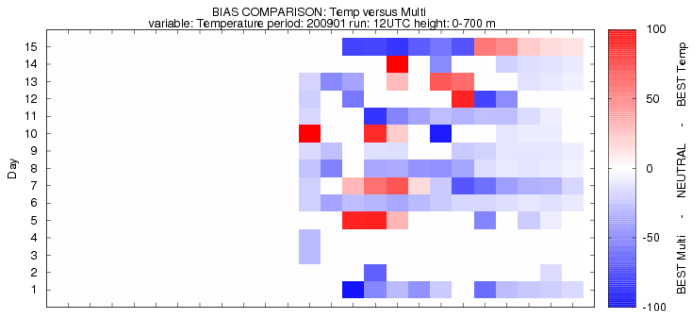

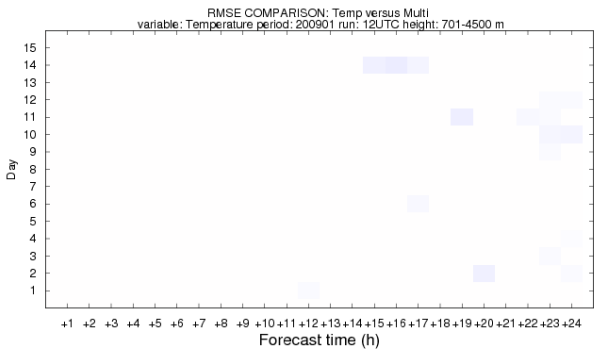

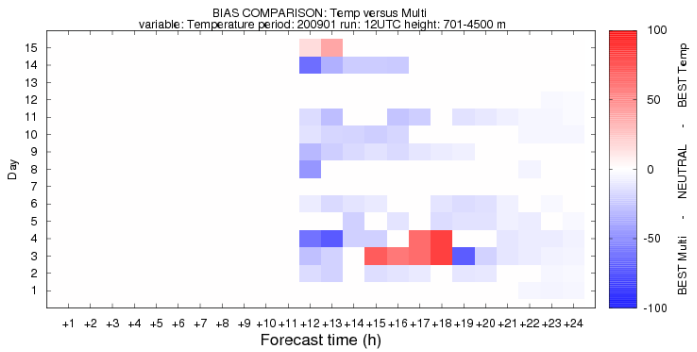

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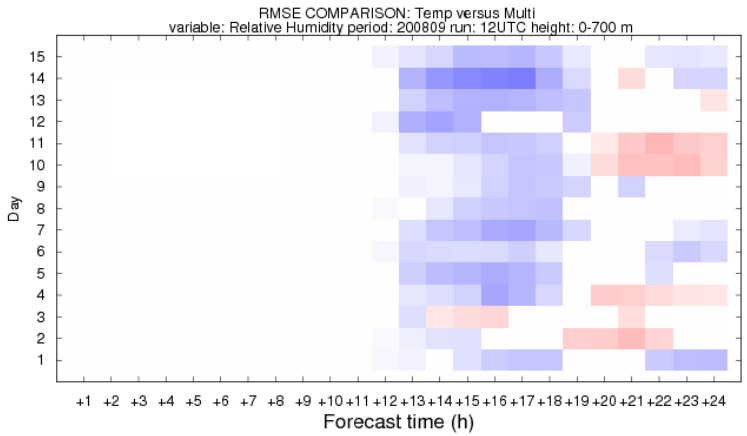
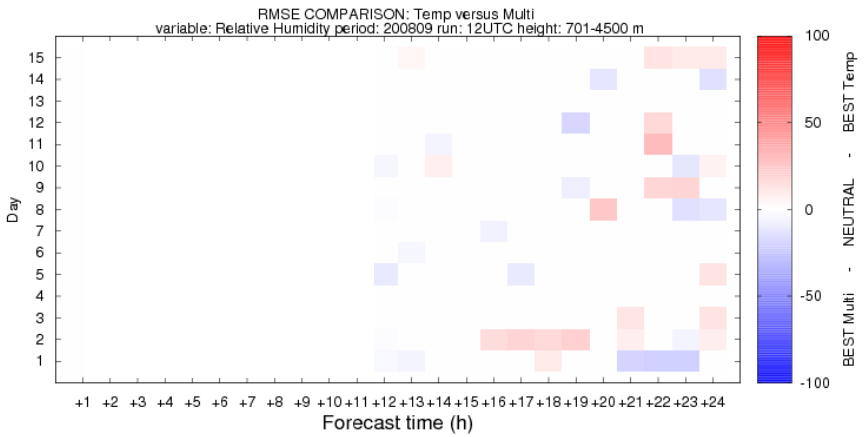
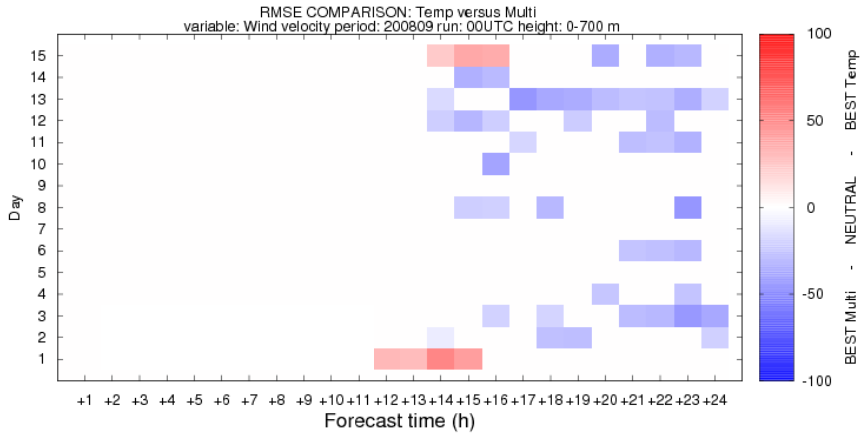
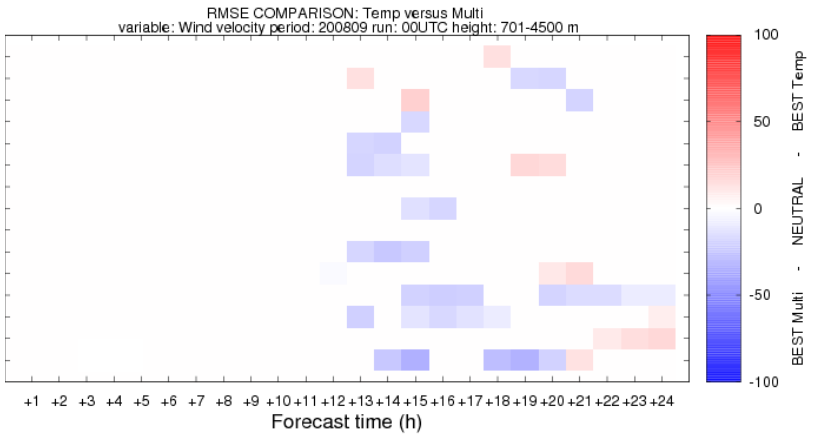


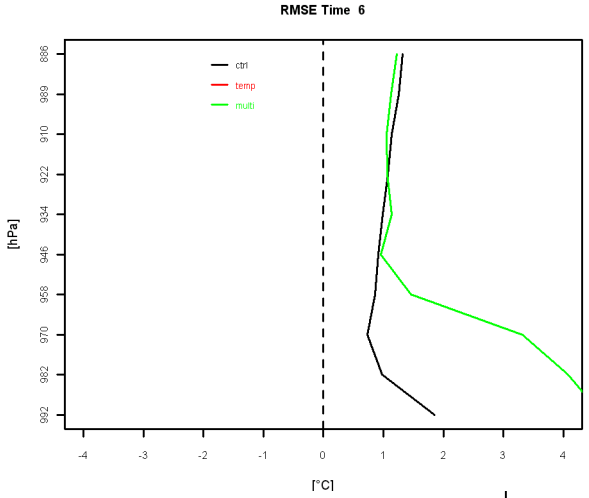


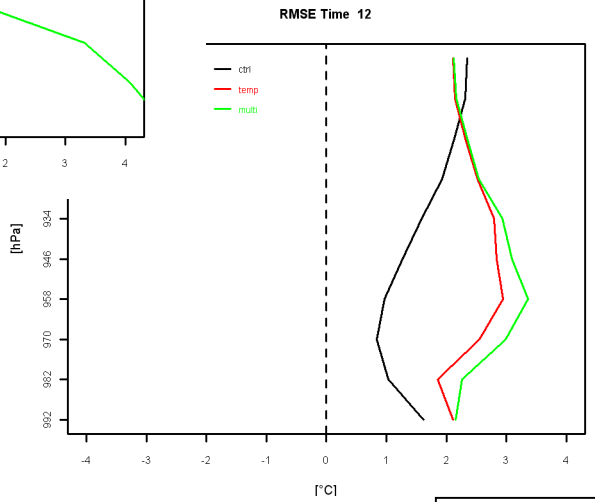


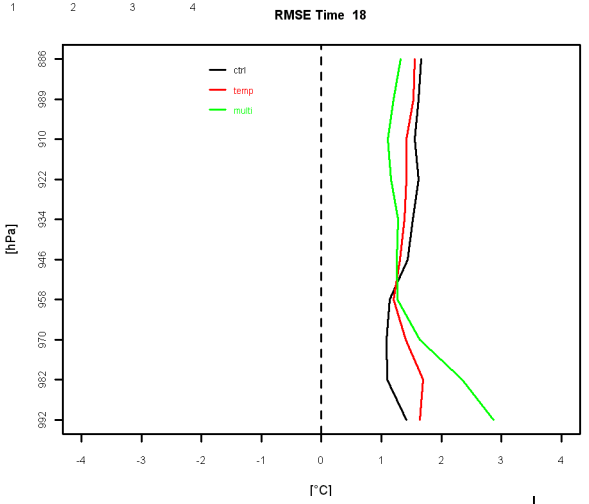


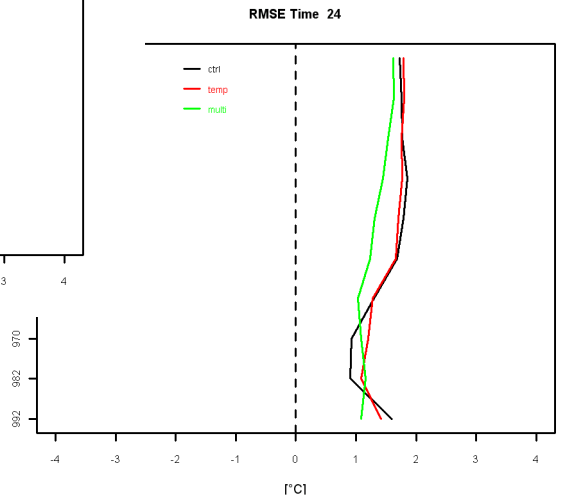
January 2009

00UTC run







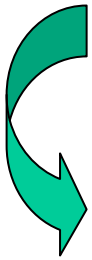


Conclusions

- general positive impact for the 2m temperature during the assimilation cycle
- more neutral (but in general positive) impact for 2m relative humidity and 10m wind intensity
- the effect of the 12h nudging vanishes after 6-8h but we can cure the forecast with the injection of the pseudo-observations
- no need for “revolutions” in the code, only a switch in the namelist
- the dataset of observations and pseudo-observations is, in principle, expandable to the rest of Italy
- no great differences between 00UTC and 12UTC runs and between winter and summer regimes

BUT

- the vertical profiles are still a challenge
- the effect on the precipitation field is not always positive



hydrostatic upper-air correction !

Thank you for your attention !