Some results of the Data Assimilation in WRF

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Outlines

the main goal of the most projects is to improve the capability of Numerical model to predict the severe weather using the new measurements

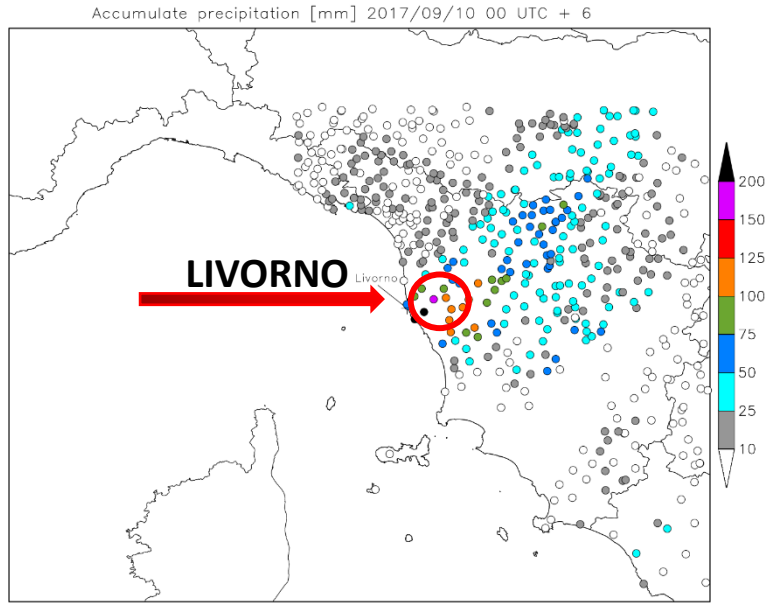
- ✓ **A short description of a selected case study**
- ✓ **The warm updating configuration of WRF using 3DVar**
- ✓ **The Assimilation of GNSS in WRF (COSMEMOS/PROFUMO projects) with an OSSE (Observation System Simulation Experiment)**
- ✓ **Some results**

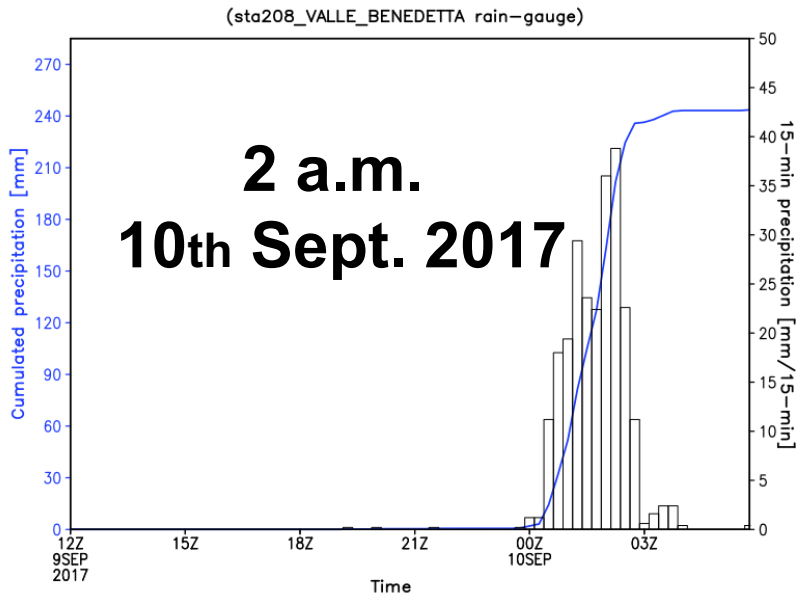
Warm Updating Configuration of WRF using 3DVar: case study

9-10 September 2017

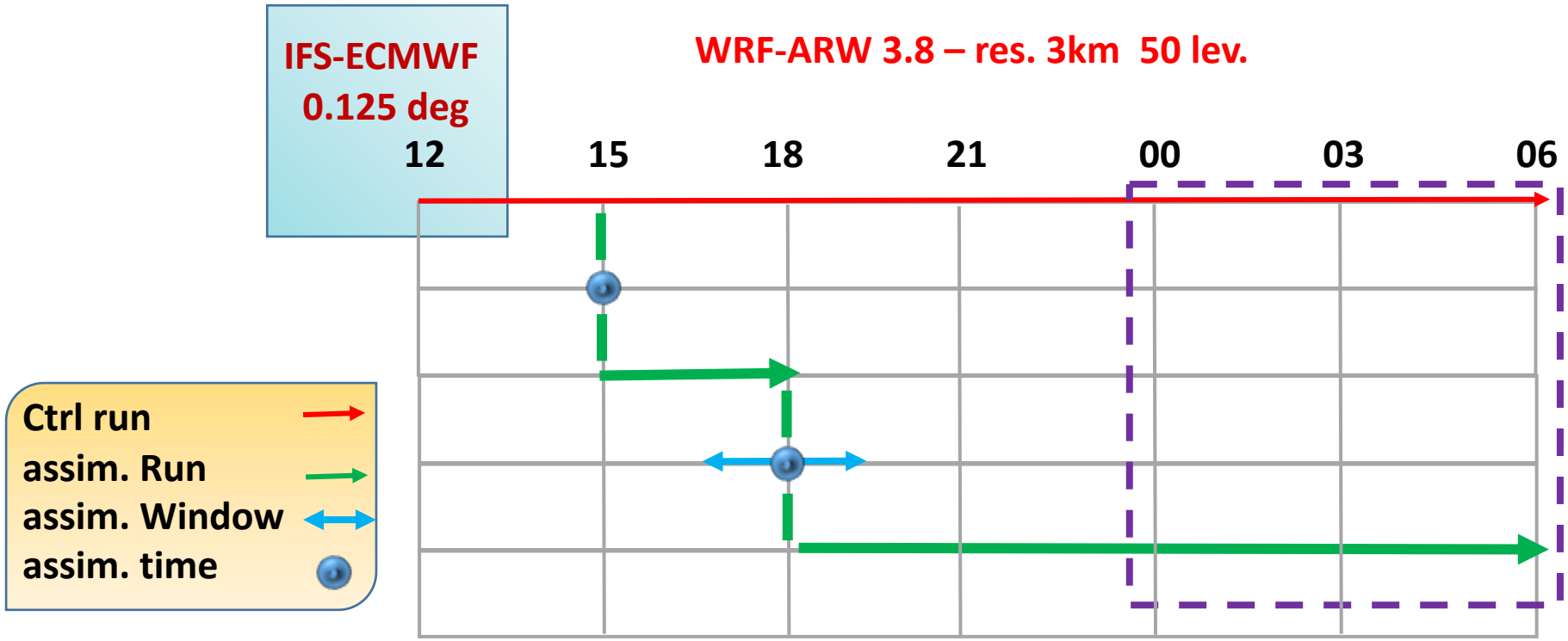
10 Sept

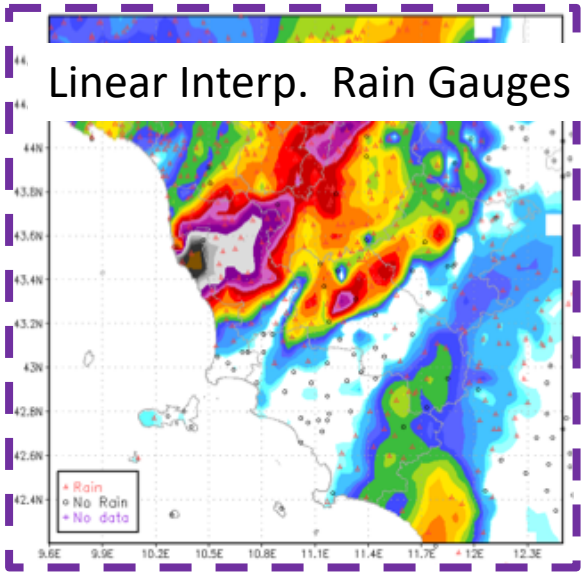
00 03 06





Warm Updating Configuration of WRF using 3DVar: system Architecture





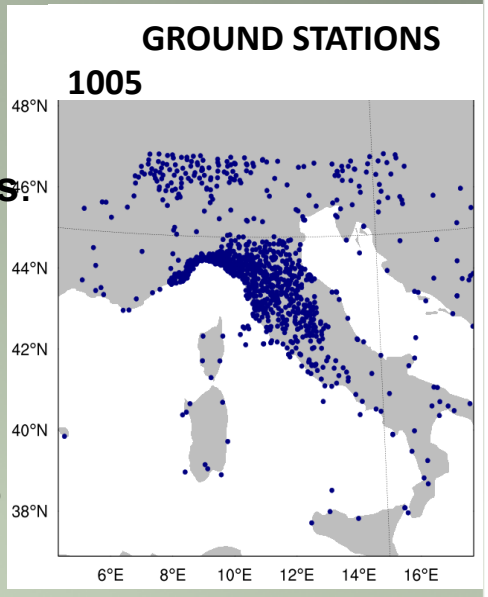
The goal is the 6 hours cumulated precipitation at 6 a.m. of the 10th SEP. 2017

Warm Updating Configuration of WRF using 3DVar: data

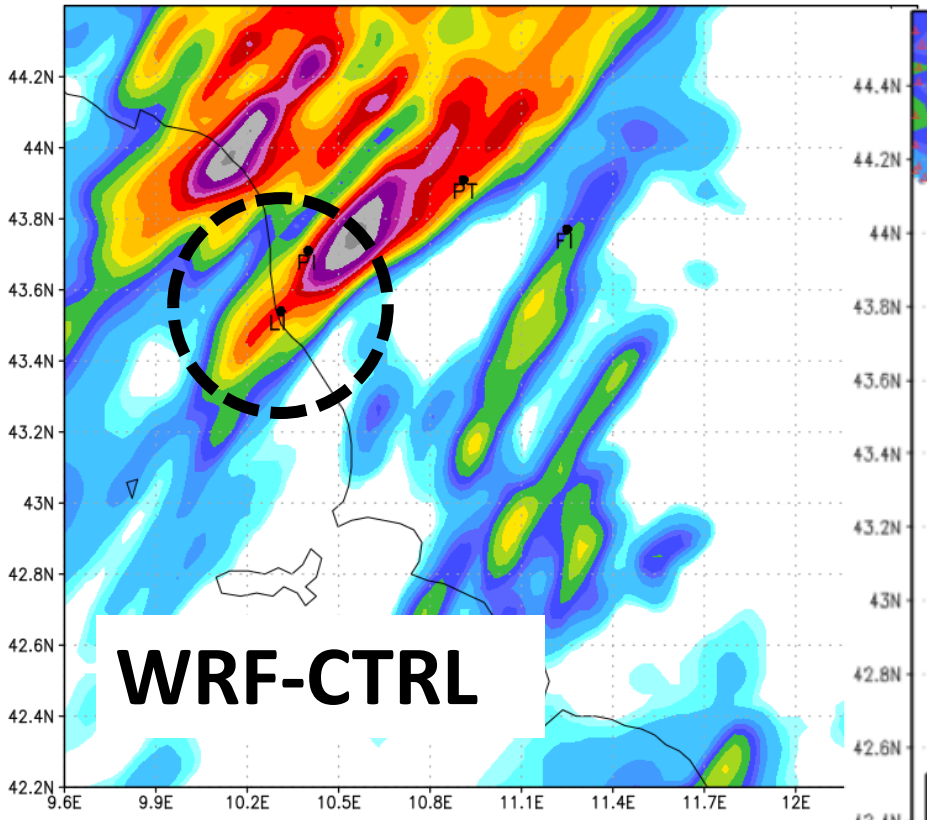
Aleria :S band radar measuring doppler and reflectivity values
Time res.15'
Spatial res.1 km.
Polar volumes are collected in real time with 5 different elevations.

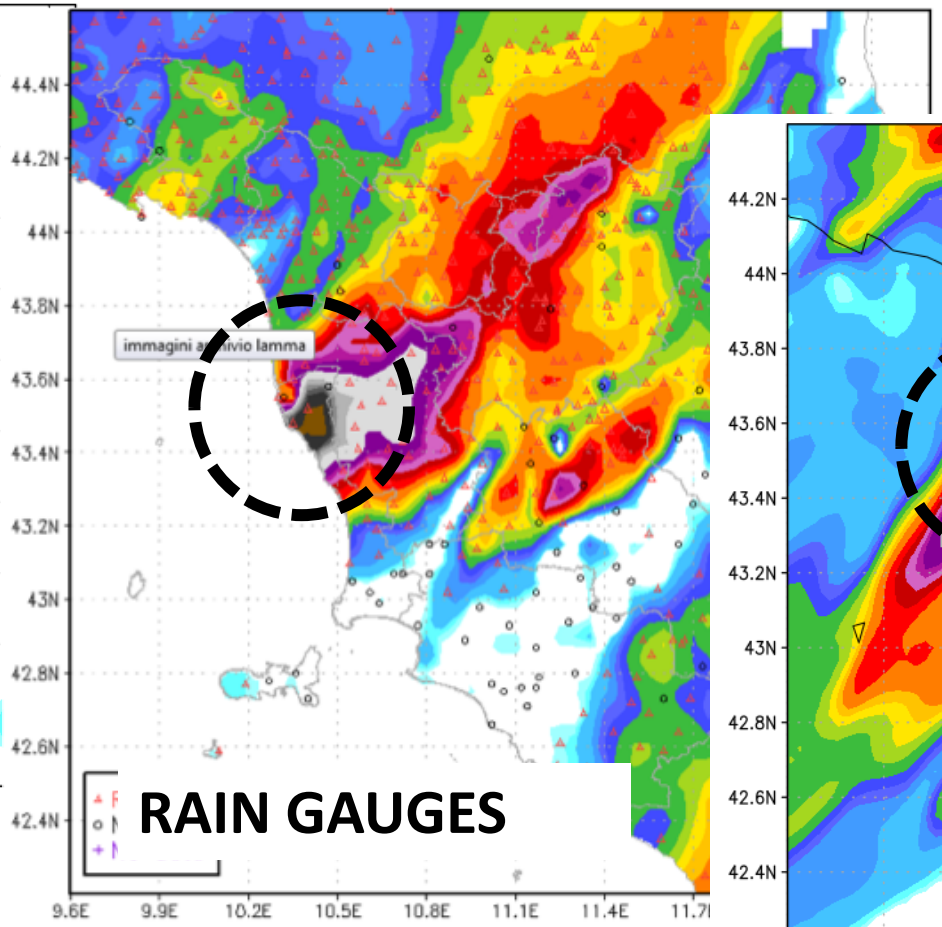
Livorno:X band radar measuring reflectivity values
Time res.15'
Spatial res.450 m
Polar volumes are collected in real time with 4 different elevations.

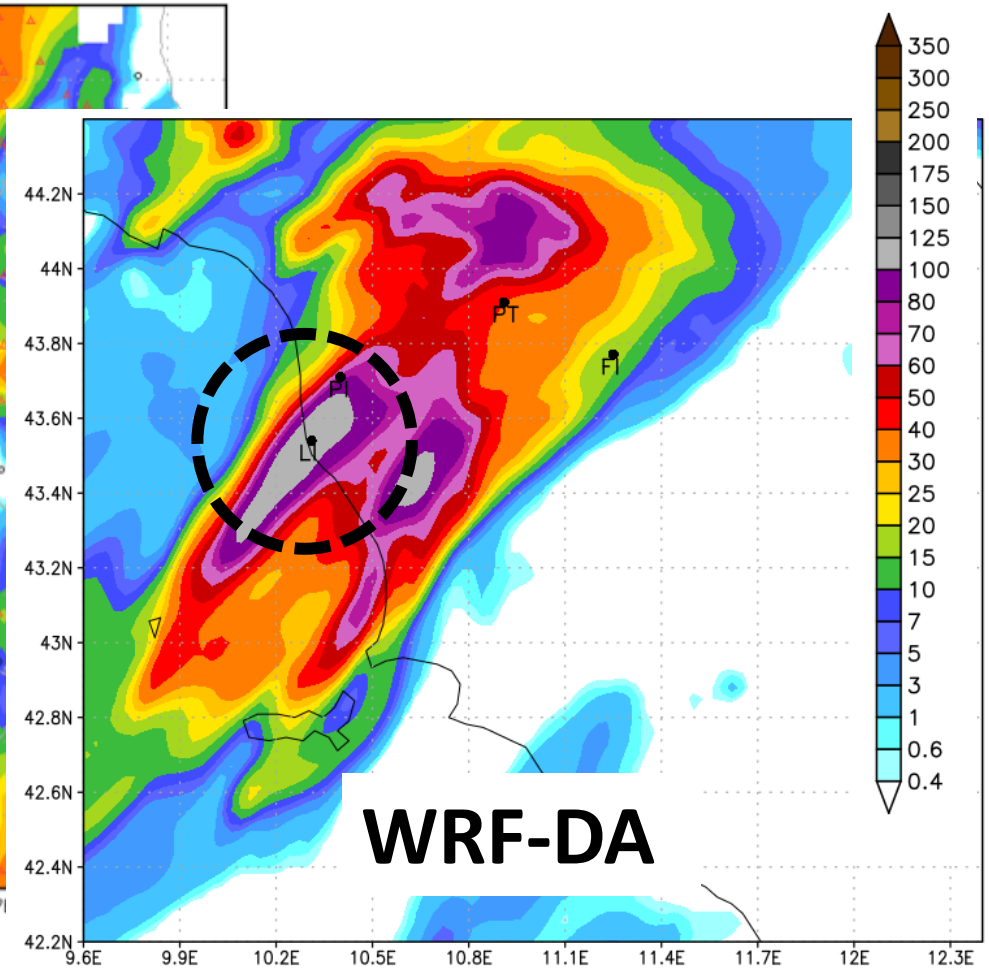
Over 1000 ground stations
collected by regionals networks and GTS
(P,T,RH Wind Speed and Direction)



Warm Updating Configuration of WRF using 3DVar: comparison

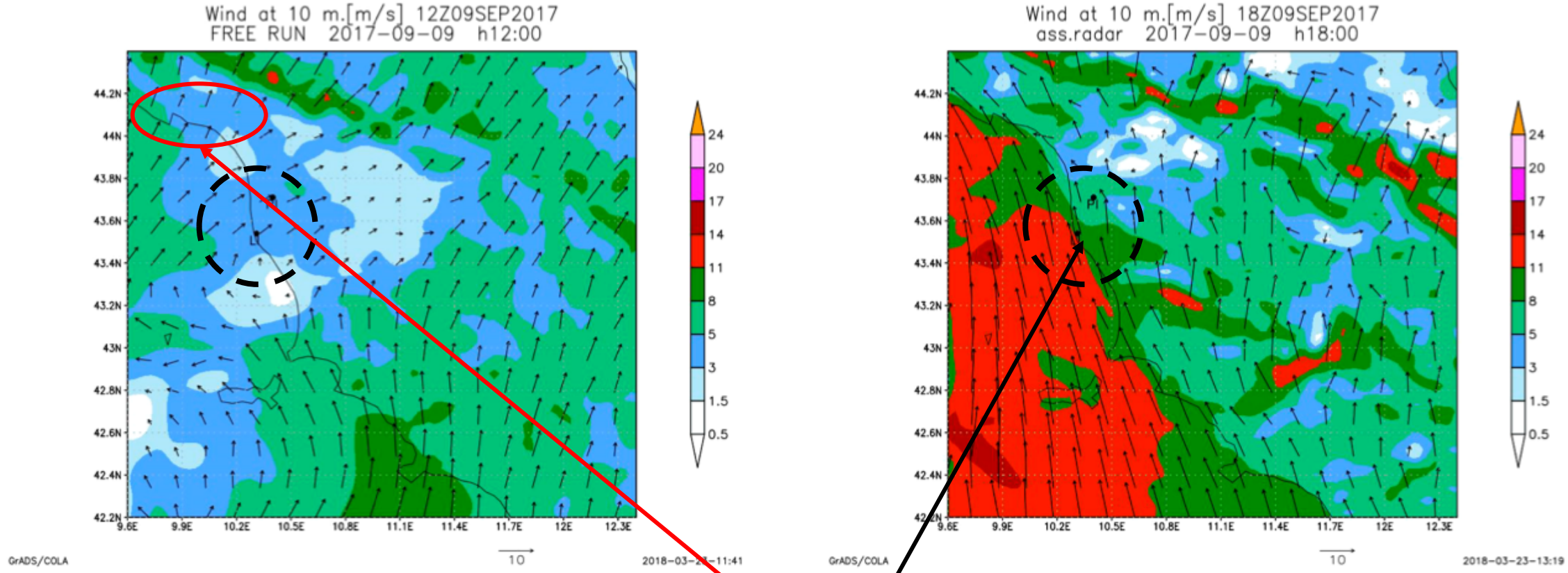






TOTAL PRECIP. CUMULATED ON PREVIOUS 6 HOURS at 6 a.m of 10th SEP. 2017

10 m Wind Comparison



Target area

convergence

Convergence lines about 2 a.m. of 10 th Sept. 2017

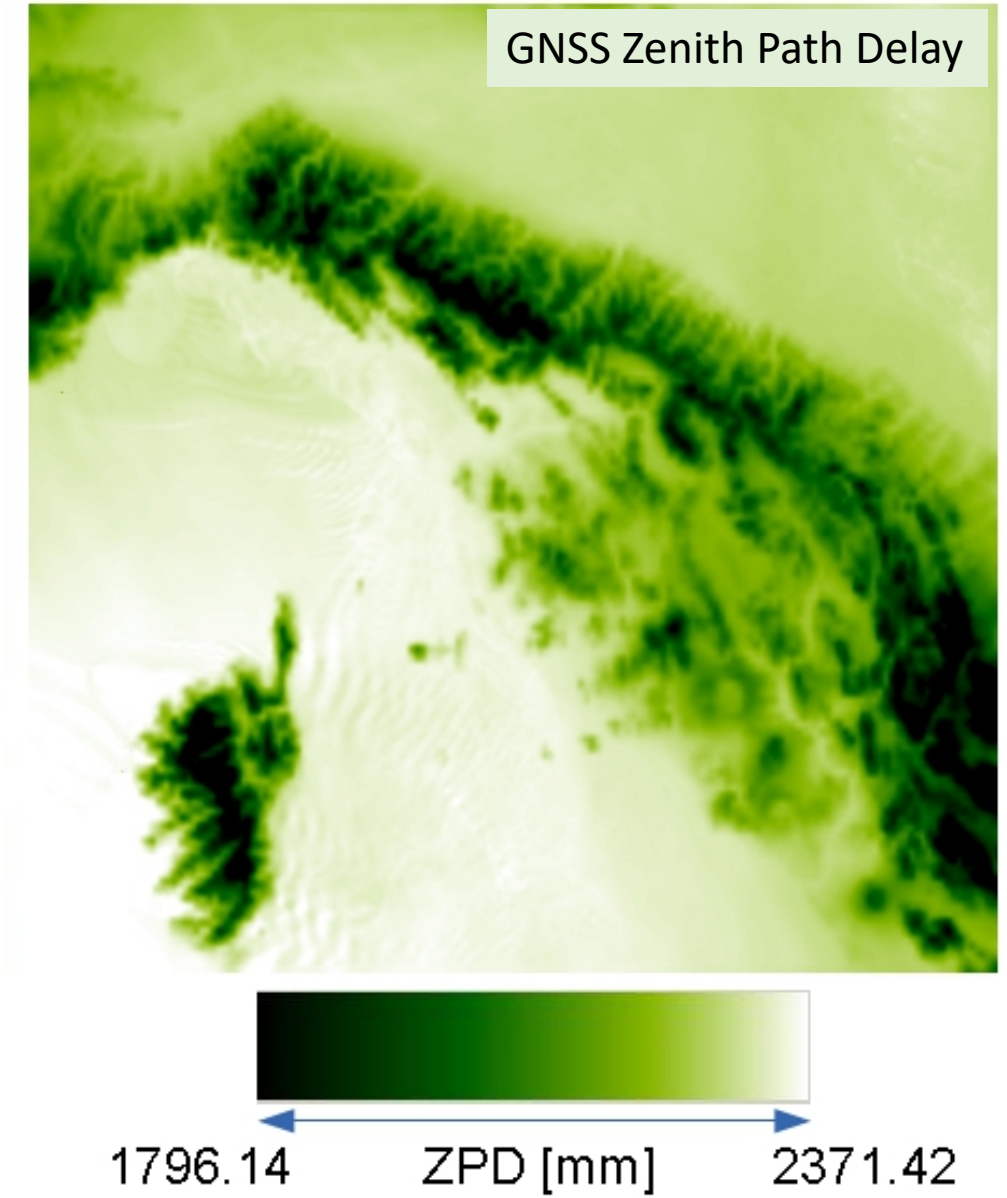
GNSS data assimilation: the COSMEMOS/PROFUMO OSSE

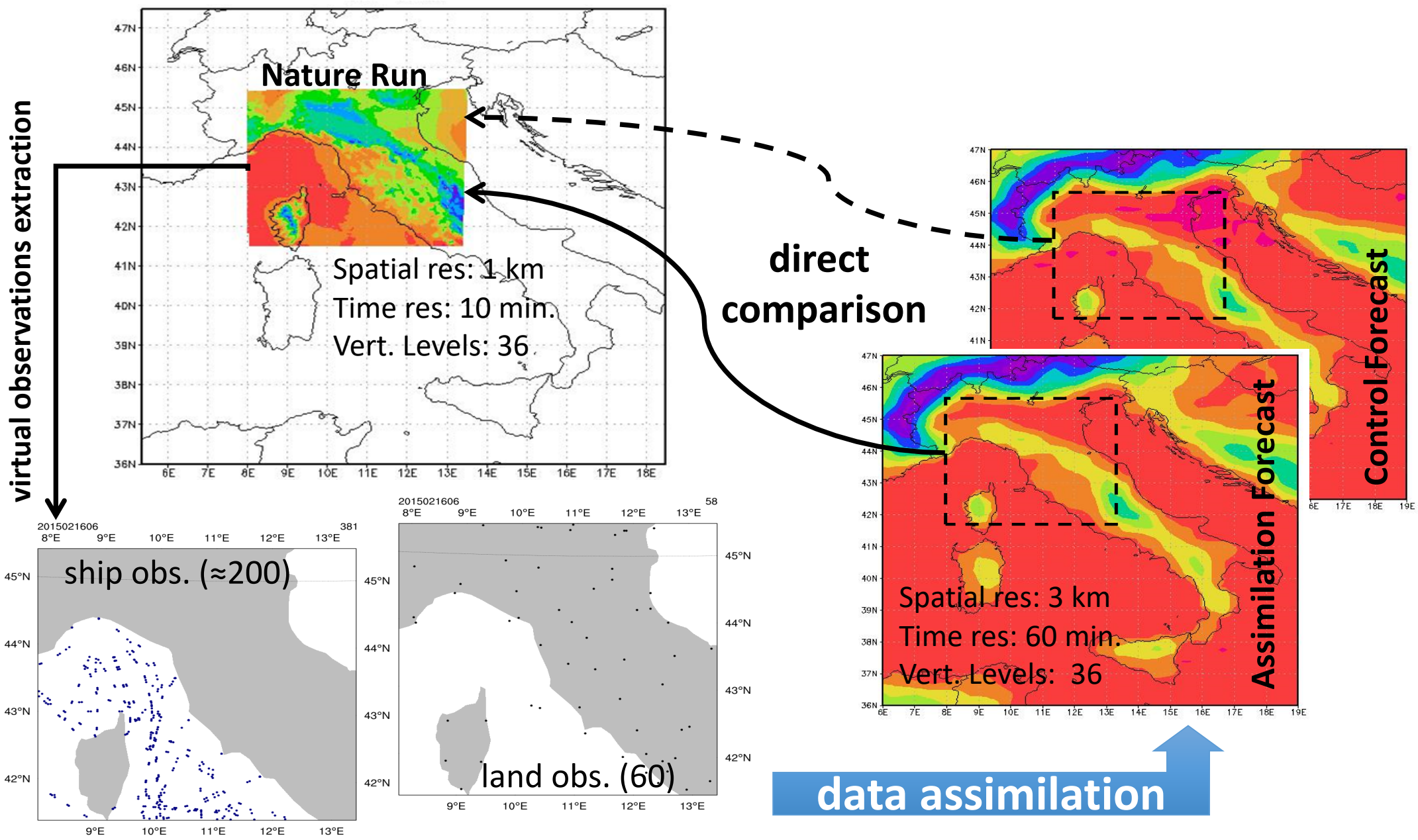
- ZPD field reconstruction from a high resolution (1 Km, 10 min.) ARW numerical simulation ('Nature Run' - NR)

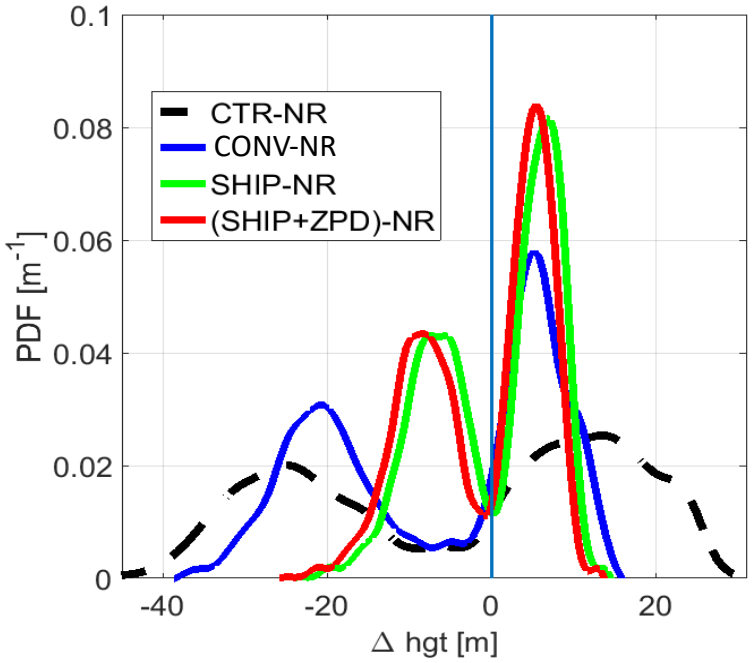
$$ZPD = k_1 \frac{P(z_0)}{\bar{g}} + \int_{z_0}^{z_{TOA}} \left(k_2 + \frac{k_3}{T(z)}\right) \rho_{WV}(z) dz$$

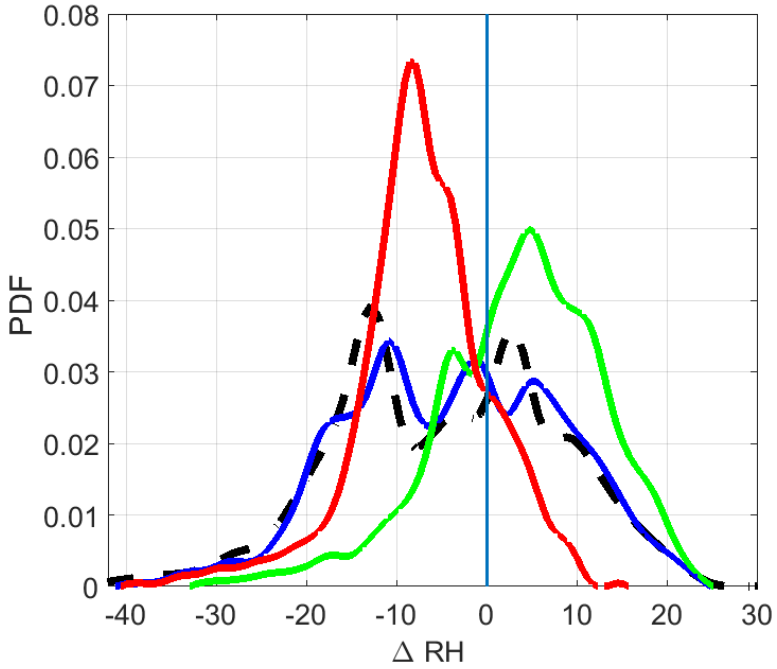
- NR initial and boundary conditions: ECMWF global forecast at 0.125°of resolution;
- NR spatial domain: Tuscany and Ligurian Sea;
- Simulation period: 18 days (february, 2-19 2015);
- Four types of lower resolution (3km, 60 min.) operational-like forecasts on a larger domain (Italy and surrounding seas):
  1. Control (CTRL), without any data assimilation;
  2. Conventional (CONV), with assimilation of conventional data (P, T, RH, wind speed and direction) from 60 existing SYNOP land stations;
  3. SHIP, assimilating also conventional data from a hypothetical collaborative fleet (≈200 vessels);
  4. SHIP+ZPD, as SHIP but including ZPD by dedicated GNSS receviers.

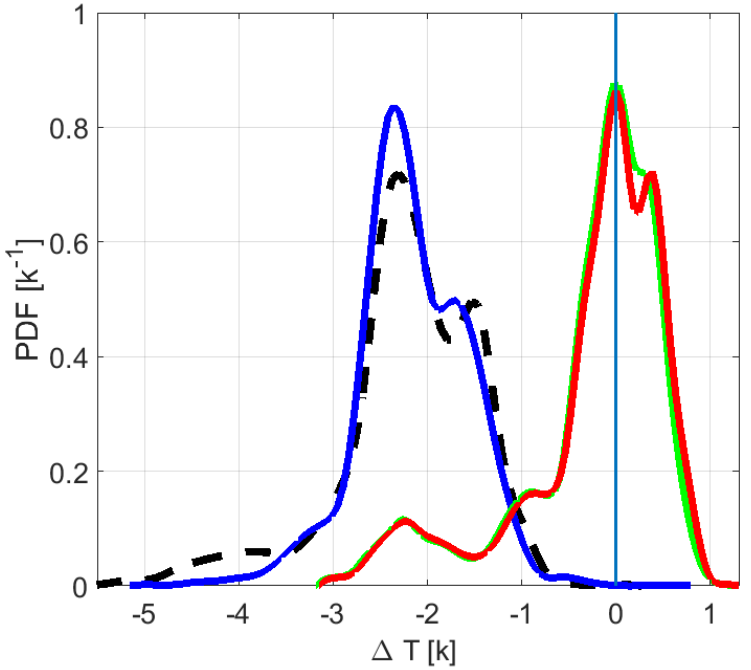
All the forecast fields of main interest for navigation are then directly compared with the NR 'truth'.

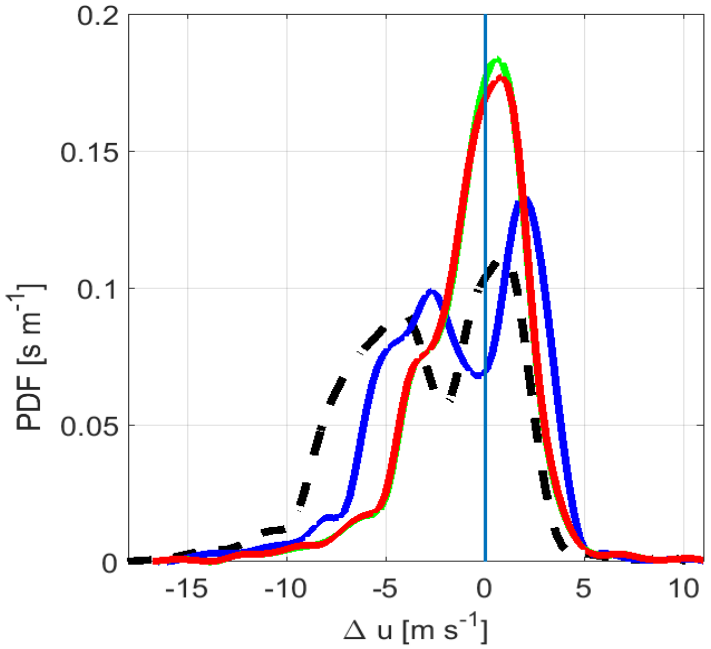


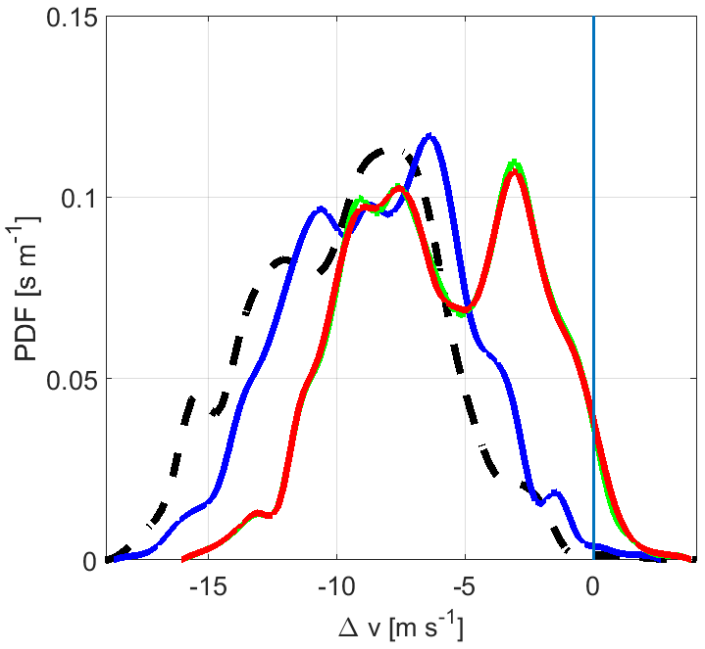

Nature Run
Spatial res: 1 km
Time res: 10 min.
Vert. Levels: 36
virtual observations extraction
direct comparison
Control Forecast
Assimilation Forecast
Spatial res: 3 km
Time res: 60 min.
Vert. Levels: 36
ship obs. (≈200)
land obs. (60)
data assimilation











The examined ground fields (HGT, RH, T and wind speed U and V) show that the effect of DA is in general positive, and the inclusion of ships observations makes the effect stronger, both in terms of bias correction and RMSE decrease.
ZPD assimilation improves the forecast only as concerns RH.
In any case the positive effect is limited to the very first hours of forecast (4-6 h), making the nearly real time data gathering and assimilation mandatory to get at least an improvement of nowcasting predictions.