Impact of non-conventional and targeted observations on short-range forecast during HyMeX-SOP1 using HARMONIE in AEMET

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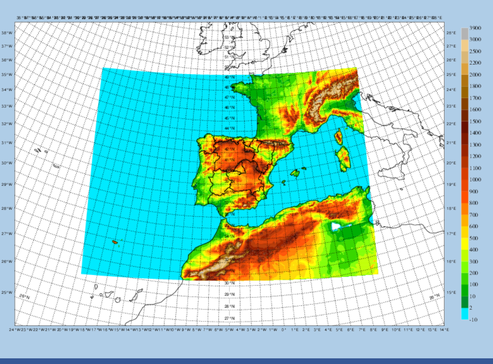
Abstract

In this work we assess the impact on forecast skill due to the assimilation of different data sources and/or targeted observations for some heavy precipitation events produced during the first period of HyMeX-SOP1 (11-24 September 2012).

We carry out a set of observing system experiments based on the non-hydrostatic data assimilation and forecast system HARMONIE, developed thanks to the collaboration between ALADIN and HIRLAM NWP Consortia. HARMONIE is run operationally by AEMET. We test the impact on the analyses and forecasts of assimilating non-conventional observations, as ATOVS radiances and GNSS zenith total delays, or targeted observations from additional radiosoundings performed in the framework of the Data targeting System (DTS) deployed during SOP1 of HyMeX.

HARMONIE Set-up

- Convection permitting, non-hydrostatic dynamics and AROME physics (Seity et al., 2011)
- Surface processes by SURFEX (http://www.cnrm.meteo.fr/surfex)
- Boundaries: ECMWF forecasts
- 3D-VAR upper-air data assimilation with 3 h cycling
- OI surface analysis using CANARI
- Version 38h1.2
- 2.5 km horizontal resolution and 65 vertical levels



Experiments

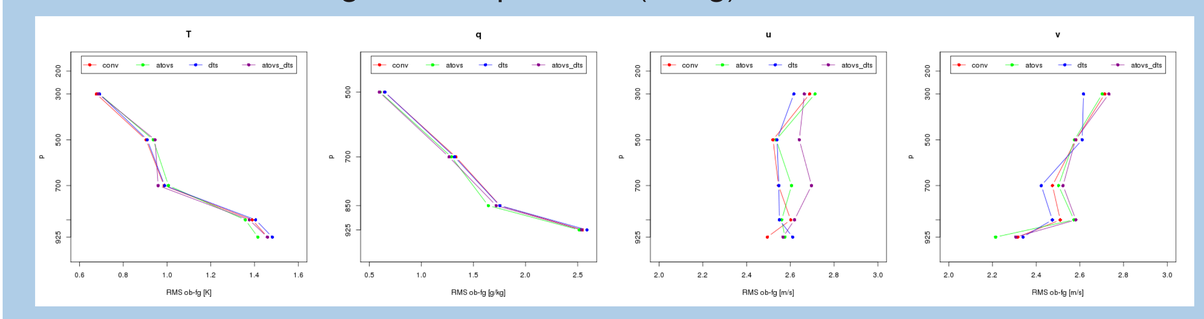
Forecast: 11 to 24 September 2012
Spin-up period: 1 to 10 Sepetember 2012

38h12IB_xl_conv : conventional observations = baseline
38h12IB_xl_atovs : baseline + ATOVS data
38h12IB_xl_dts : baseline + extra RS at 06/18 UTC
38h12IB_xl_atovs_dts : baseline + ATOVS data + extra RS

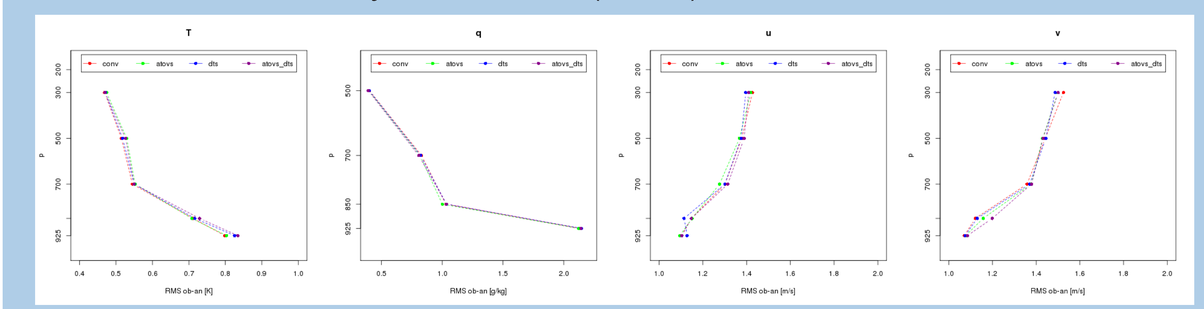
Analysis diagnostics

RMS of background departures and analysis residuals at 00 and 12UTC are calculated for a set of radiosondes over the Iberian Peninsula and the Balearics (located in sensitive areas).

Background departures (ob-fg) for radiosondes



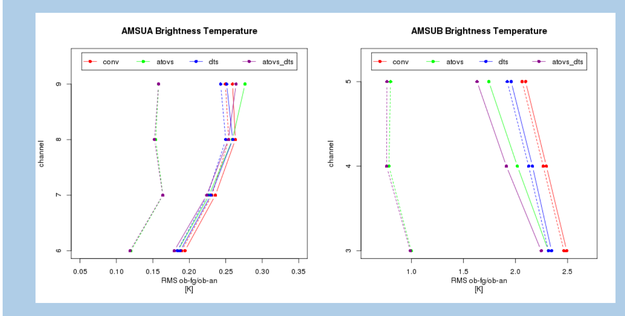
Analysis residuals (ob-an) for radiosondes



Wind background departures are decreased/increased when extra radiosondes/ATOVS are added to the baseline

The assimilation of ATOVS reduces mainly specific humidity (q) innovations.

Background departures and analysis residuals for ATOVS



The assimilation of ATOVS is able to significantly reduce the background departures for AMSU-B/MHS, and slightly for AMSU-A.

The closest fit of ATOVS radiances to the first guess is reached when both extra RS and ATOVS are added to the baseline.

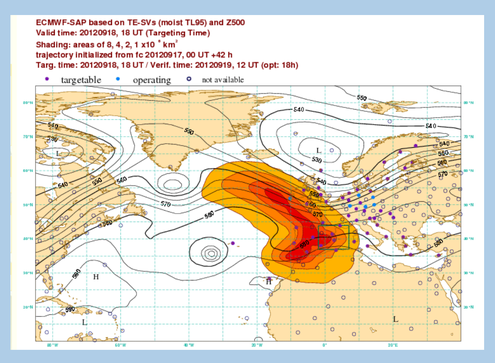
When only extra radionsondes are assimilated ATOVS radiances innovations slightly decrease.

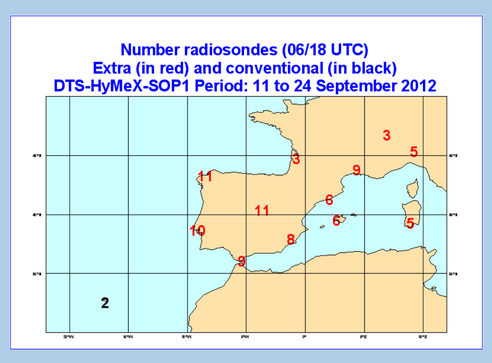
Conventional, non-conventional and targeted observations

- Conventional: SYNOP/SHIP, Aircraft, Buoys, PILOT and TEMP
- Non-conventional: ATOVS (AMSU-A and AMSU-B/MHS)
- Targeted: extra TEMP (06/18 UTC) from Data Targeting System

ATOVS: NOAA-15, NOAA-16, NOAA-18, NOAA-19 and METOP_A
AMSU-A: Channels 6-9 AMSU-B/MHS: Channels 3-5
VARBC, tunning and blacklisting

From 5 to 22 Setember 2012, the Atlantic ridge weather pattern dominated over the Euro-Atlantic region.

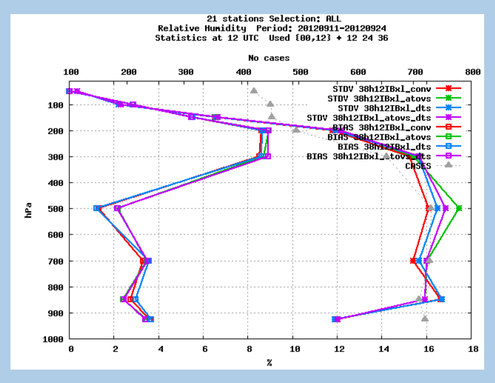


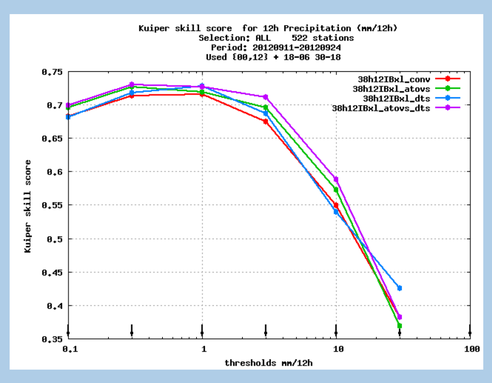


Sensitive Area Prediction (SAP) in this period shows that the assimilation of targeted observations over the Iberian Peninsula and North Atlantic may have a significant impact on the forecast over the Targeted Area (green box).

Forecast impact

Verification against radiosondes shows almost no impact of the additional observations in temperature, geopotential or wind. Relative humidity slightly improves at 850h Pa when satellite data are assimilated,but it deteriorates at upper levels with the addition of observations to the baseline.



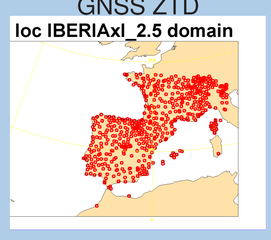


For 12h accumulated precipitation, ATOVS data has a positive impact on the forecast, specially if extra radiosondes are also assimilated.

Summary and future work

- The influence of different sources of observations on short range forecasts of high impact events over the HYMEX SOP1 is being studied with the NH Harmonie system.
- Preliminary results for the first period of HYMEX SOP1 shows an impact of DTS RS and ATOVS radiances on both analyses and forecasts:
  - The fit of first guess to wind/humidity observations is closer when extra radiosondes/satellite data are assimilated.
  - Satellite data produce slightly larger wind innovations.
  - Precipitation forecasts are improved the most when extra radiosondes and ATOVS radiances are added to the baseline (38h12IBxl_atovs_dts).
- We plan to extend this study for the whole HyMeX-SOP1.
- We will carry out further experimentation with ATOVS data and GNSS observations (Global Navigation Satellite System) as additional humidity data source over land.

GNSS ZTD
loc IBERIAxl_2.5 domain



References

- Y. Seity, P. Brousseau, S. Malardel, G. Hello, P. Benard, F. Bouttier, C. Lac, and V. Masson, 2011, The AROME-France Convective-Scale Operational Model, MWR, 139, 976-991.

- SURFEX (http://www.cnrm.meteo.fr/surfex).

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