

Potential benefits of assimilating MetOp combined retrieval L2 products in AROME-France

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Eumetsat study EUM/CO/17/4600001975/TA



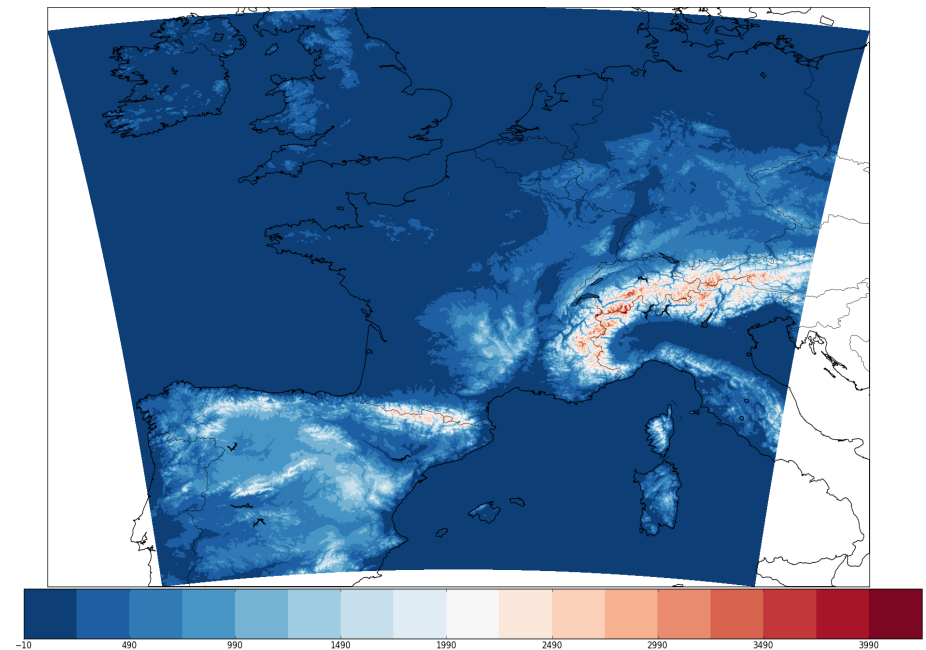
Outline

- Introduction
- Evaluation of the MetOp combined retrieval L2 product
- First results of the assimilation experiments
- Closing Remarks

Applications of Research to Operations at MEscale

- Characteristics:
 - Horizontal Resolution $\Rightarrow$ 1.3 km;
 - Vertical Resolution $\Rightarrow$ 90 levels (10 hPa top);
- Assimilation Scheme $\Rightarrow$ 3D-Var (1 hour assimilation cycle and 1 hour window);
- Boundary conditions $\Rightarrow$ ARPEGE
- Forecast lead time $\Rightarrow$ 48 hours
- Observations assimilated: radar measurements, surface stations, buoys, ship, aircrafts, wind profilers, radiosondes and satellite observations.

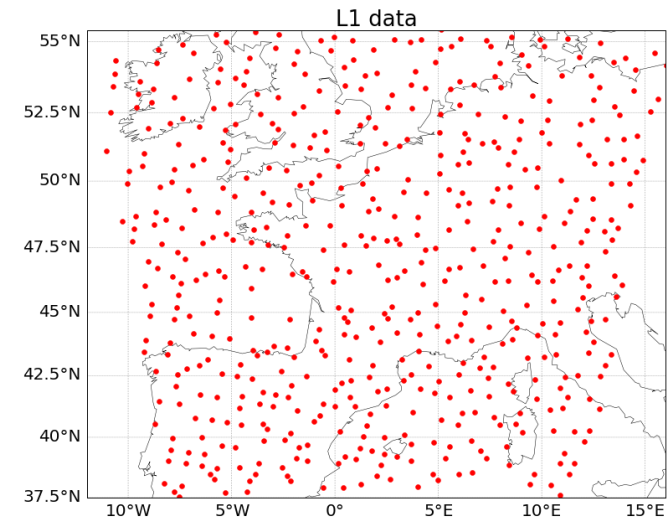
AROME domain and orography



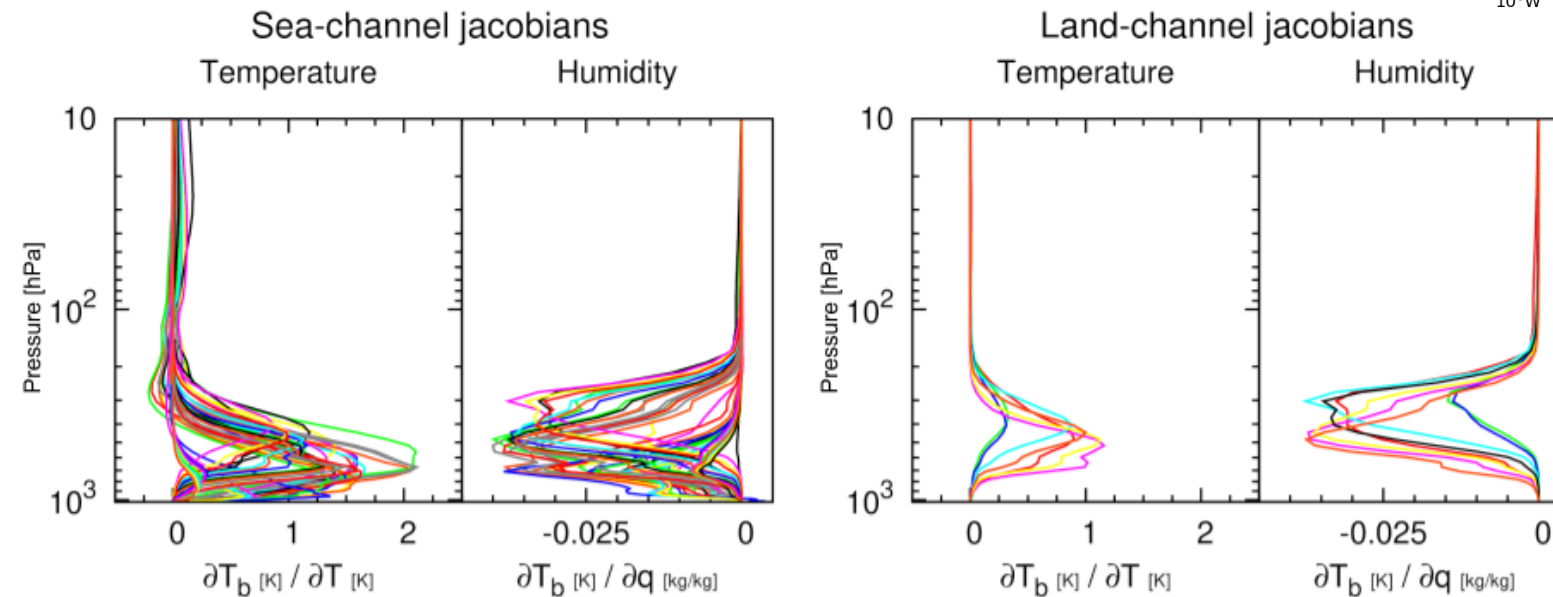
IASI L1 product assimilated by AROME-France

- 20 temperature channels, 20 water vapour channels and 4 surface channels
- Vertical Resolution

Horizontal resolution



80 km thinning



MetOp combined retrieval L2 Product

- It is a statistical retrieval product, which combines products from IASI and microwave sensors (AMSU-A and MHS).
- Information Used:
 - Temperature profiles;
 - Water vapour mixing ratio profiles;
 - Pressure levels;
 - Surface mean elevation in the pixel;
 - Quality control indicator (QCI)
- Only L2 from locally received observations in Lannion. No MetOp-A in the evening.
- Vertical Resolution: 109 levels below 10 hPa.
- Period : 08/2017 to 02/2018.

Objectives

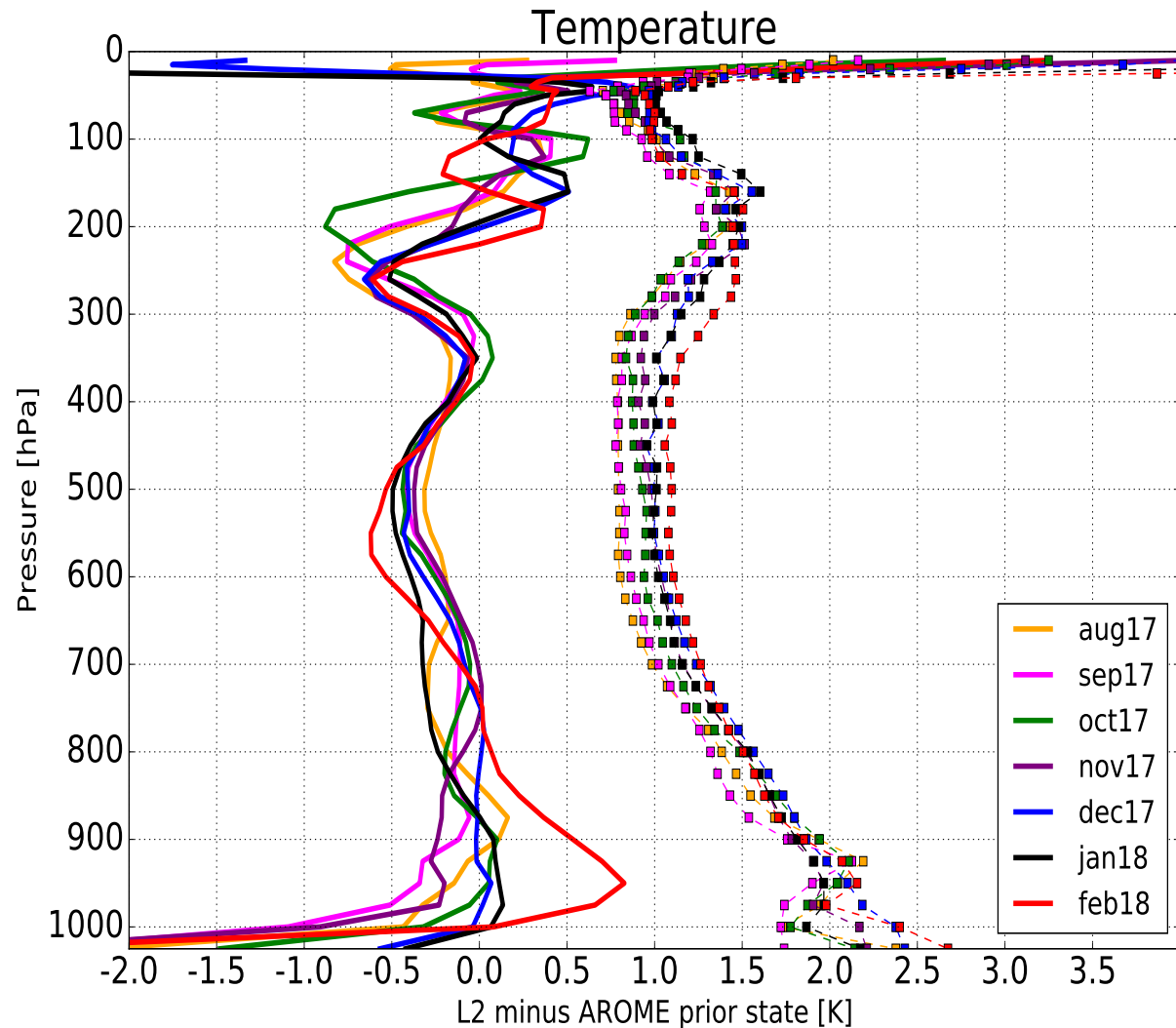
- Can we get advantage from L2 product in our regional model for which it is hard to well simulate radiances ?
- Evaluation of the MetOp combined retrieval L2 product compared to AROME-France short-range forecast and observations;
- Perform the assimilation experiment with MetOp combined retrieval L2 product (define setups);
- Evaluation of the assimilation experiments using objective scores.

L2 product X AROME - Monthly Variation

Temperature difference Profiles

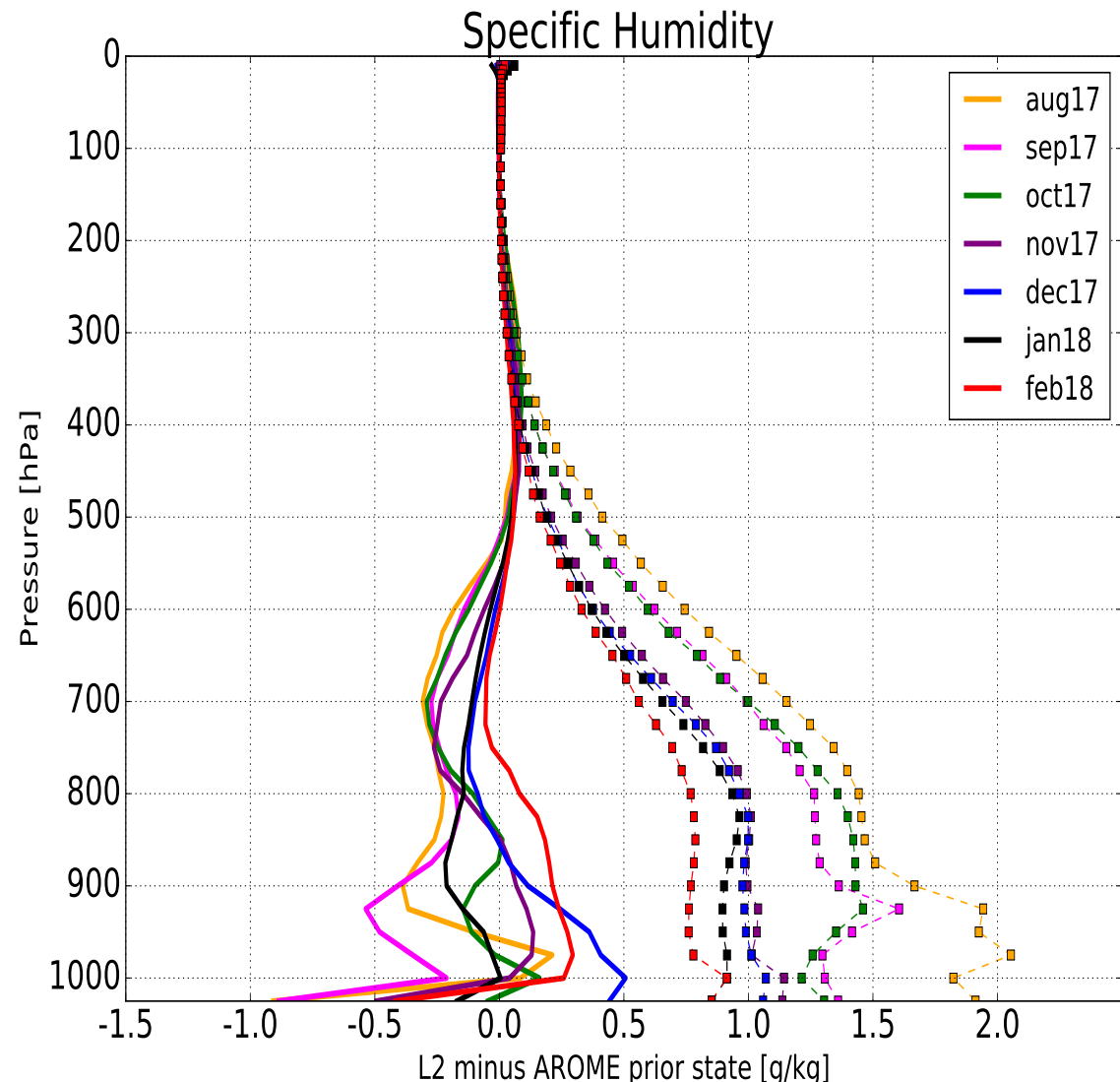
Mean Bias and Standard Deviation:

- Agreement below 1 K in the mid-troposphere.
- Larger differences near surface and between 200-300 hPa.



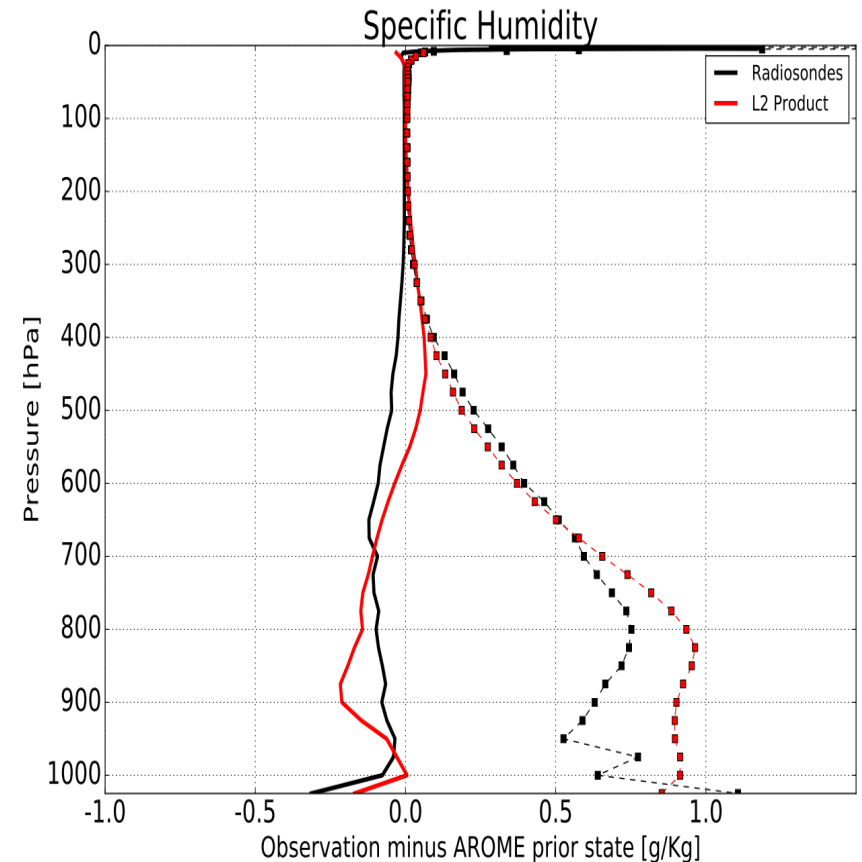
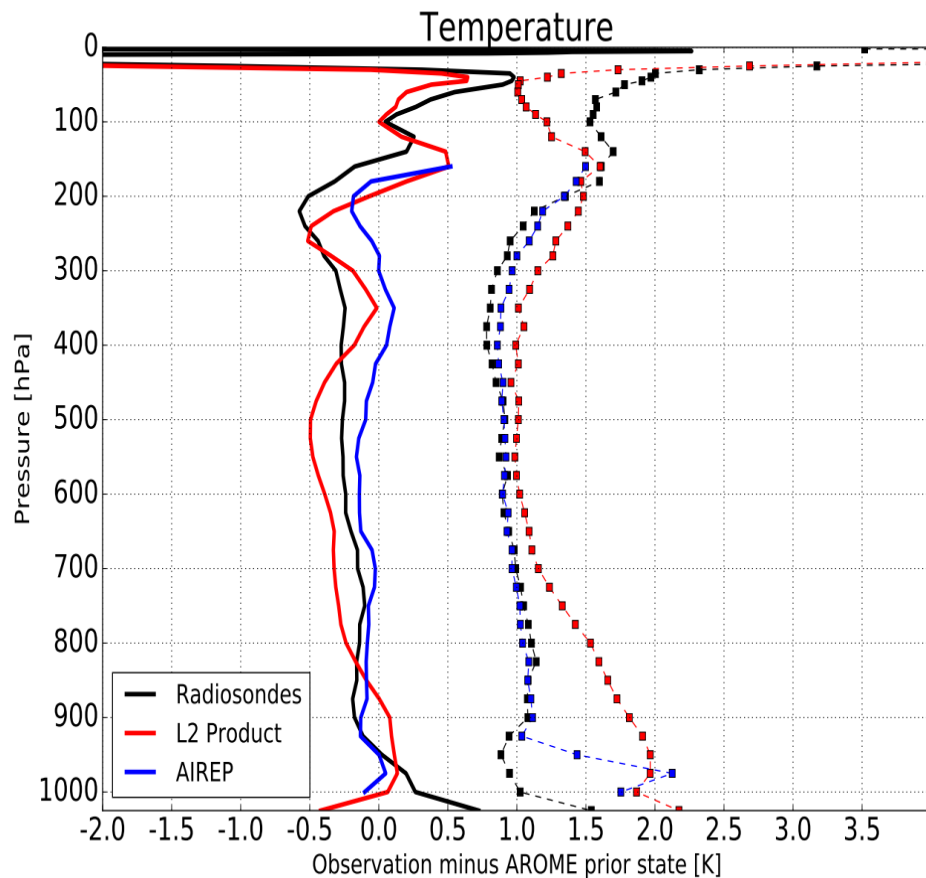
L2 product X AROME - Monthly Variation

- Specific humidity difference profiles
- Mean Bias: Near surface is negative in most cases (except December).
- Standard Deviation: Absolute differences varying with seasons (actual moisture content)



Definition of the observation error: L2, radiosondes and aircraft X AROME

January 2018



L2 observation error:

Temperature observation error $\Rightarrow 1.2 \times$ radiosondes observation error

Humidity observation error $\Rightarrow 1.25 \times$ radiosondes observation error

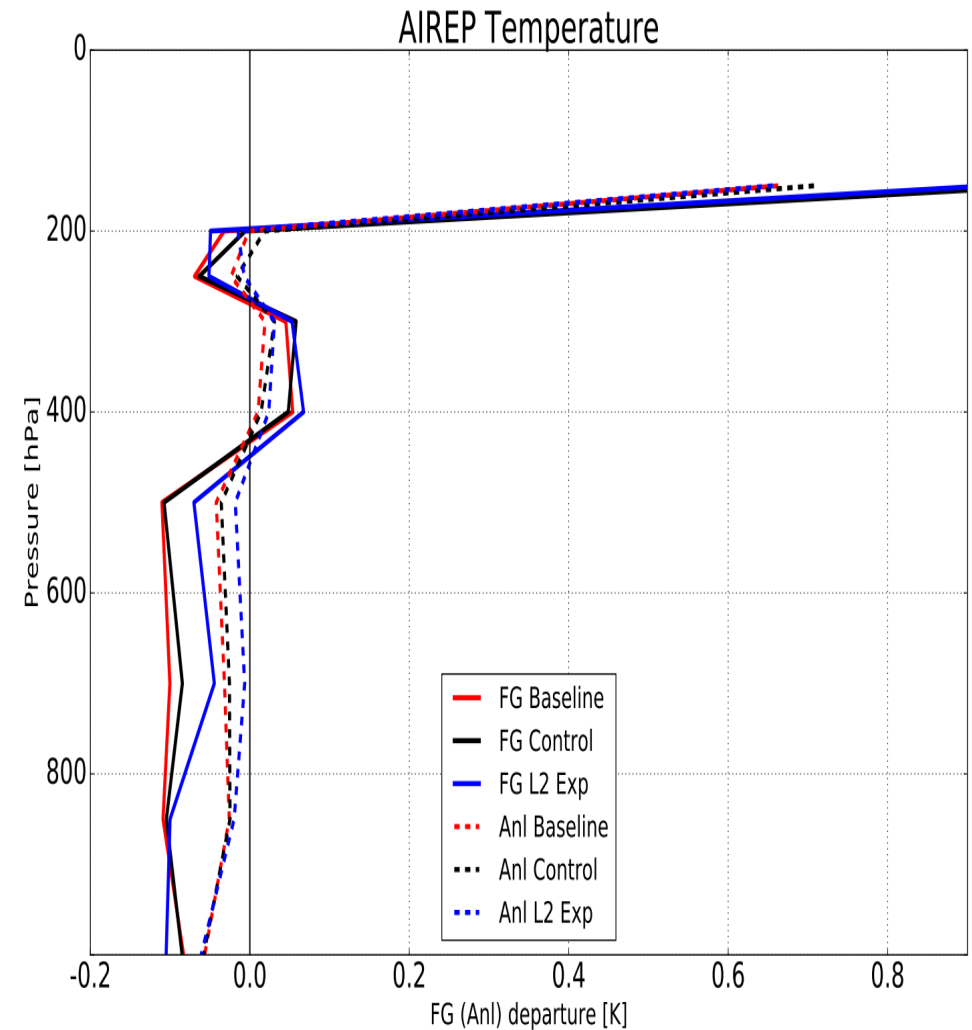
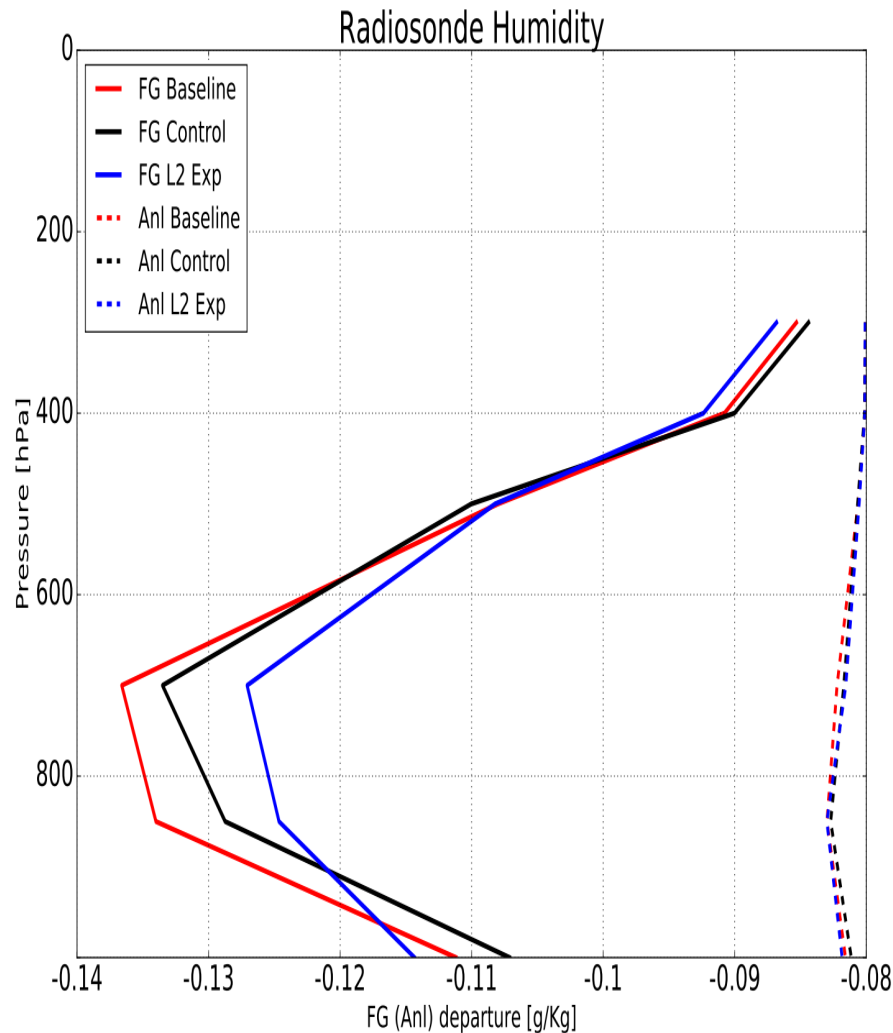
L2 data setup

- Data selection procedure:
- Horizontal Thinning: select one profile over a 160 x 160 km box ;
- Vertical Thinning: 1 level every 3 levels
- Filter applied :
 - Sea : Use data only above level 1000 hPa
 - Land, orography below 1 km : Use data only above level 900 hPa
 - Land, orography above 1 km : Use data only above level 700 hPa

Experiments Configuration

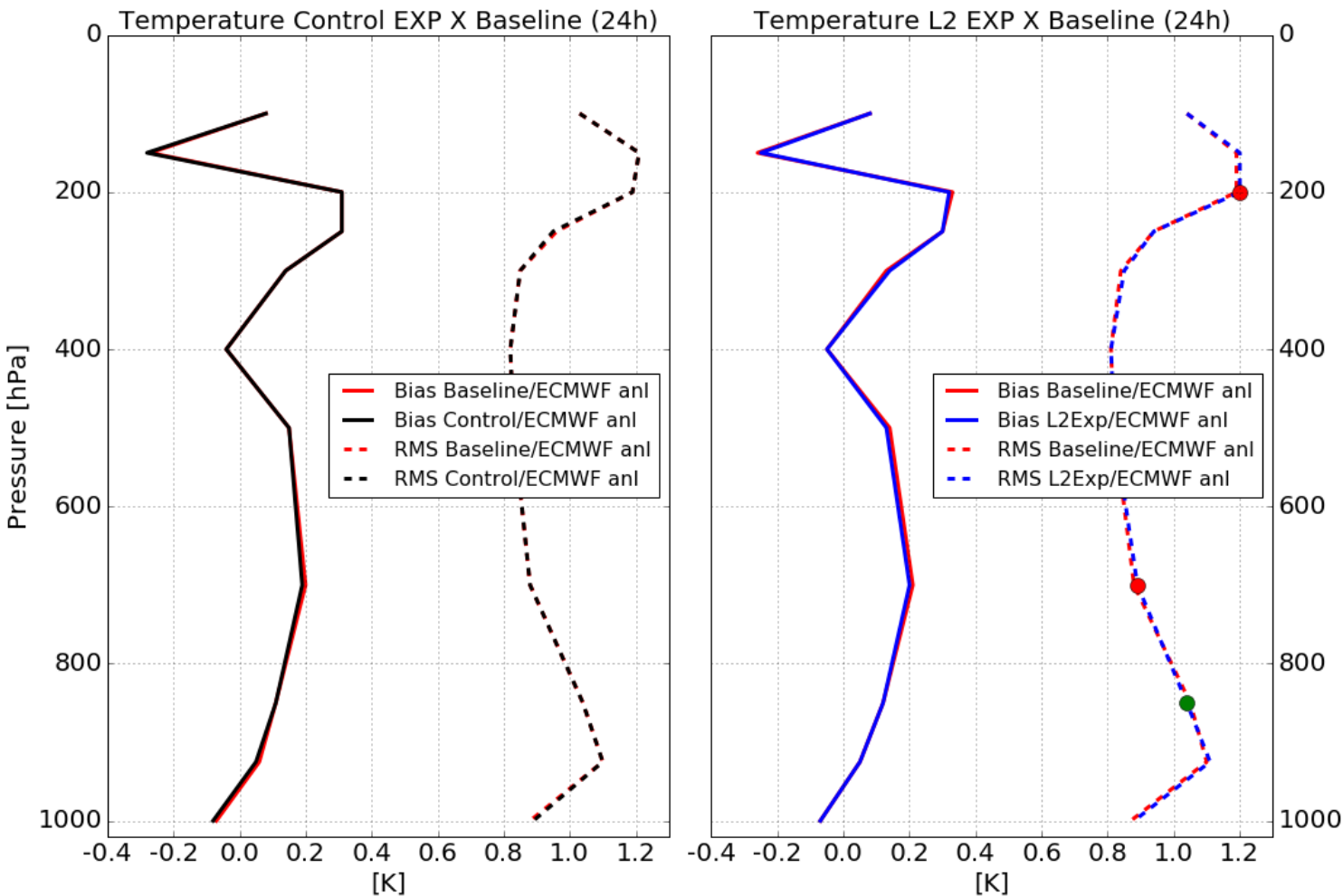
- Experiment period of 35 days : 1 January 2018-4 February 2018
- Observations assimilated : radar measurements (doppler wind and reflectivity), surface stations, buoys, ship, aircrafts (AIREP), wind profilers, radiosondes, ATMS, SSMIS, GMI, SEVIRI, ASCAT and GNSS data from ground-based station
- **Experiment Configuration**
 - Baseline : No IASI, AMSU-A and MHS data
 - Control : Baseline + IASI, AMSU-A and MHS L1 product
 - L2 Experiment : Baseline + L2 product

Impact on other observation simulations



- Reduced bias in the lower troposphere using L2 compared to L1.
- No differences in the standard deviation.

Experiments Forecast Skills - Temperature@24h

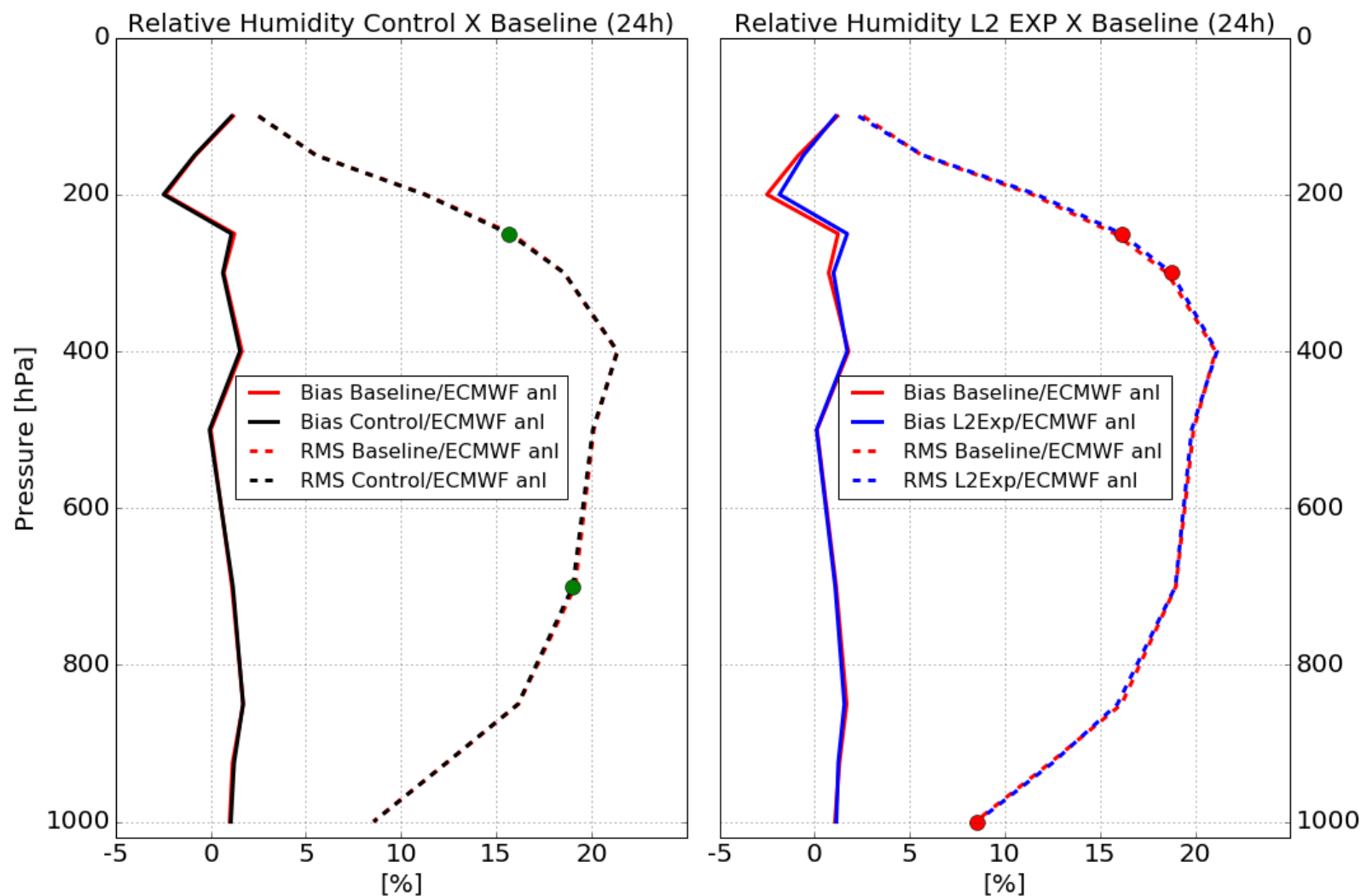


Experiment is better than the reference with 95 % of confidence (t-student)

- Reference is better than the Experiment with 95 % of confidence (t-student)

Very small impact on temperature

Experiments Forecast Skills - Humidity@24h



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- Reference is better than the Experiment with 95 % of confidence (t-student)

Very small impact on humidity

Conclusions and future works

- The L2 product is suitable to assimilation in the NWP models.
- The L2 experiment helped to decrease the first guess and the analysis departure of the other observations.
- L2 experiment has scores comparable with the control experiment (L1 product).
- Next Steps:
 - Perform other periods of the year.
 - Adapt further the experiment settings to optimise L2 impact