

# Assessment of the assimilating Metop combined retrieval L2 product in AROME-France

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Eumetsat study EUM/CO/17/4600001975/TA

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# Outline

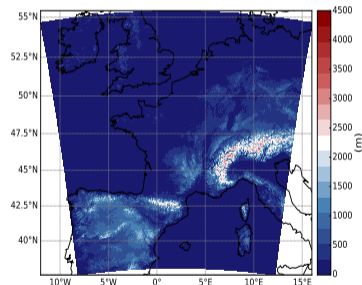
- 1 Introduction
- 2 Evaluation of the Metop combined retrieval L2 product
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  - Experiments setups
  - Impact on the statistics of the other assimilated observations
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- 4 Closing Remarks

# Applications of Research to Operations at MEsoscale

## 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



Brousseau et al. (2016) and Seity et al. (2011)

# Metop combined retrieval L2 Products

L2 products are statistical retrieval (piece-wise linear regression) products, which combine information 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 v6.3: 07/2017 to 02/2018  
Period v6.4: 05/15/2018 to 09/2018.

# Objectives

**Main Objective:** The main objective of this study was to evaluate the potential benefits of assimilating Metop L2 products in replacement of L1 products (radiances) from IASI, AMSU-A and MHS into the AROME-France data assimilation system.

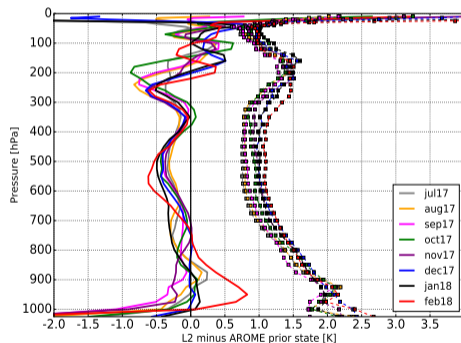
**Secondary Objective:** To contribute to the exploration of new applications for the current operational products from EPS, and to gaining understanding of their utilization also in view of the new hyperspectral missions IASI-NG and MTG-IRS.

# L2 product (v6.3) X AROME - Monthly Variation

## Temperature Profiles

### Mean Bias and Standard Deviation:

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



Solid lines - Mean differences

Dashed lines with squares - standard deviations

# L2 product (v6.3) X AROME - Monthly Variation

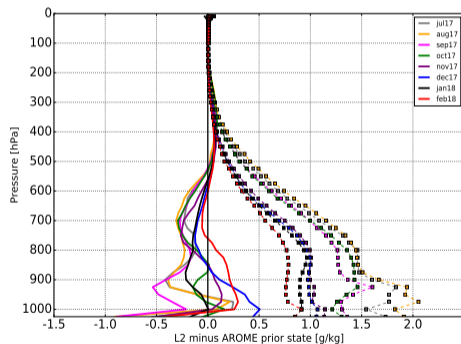
## Specific Humidity Profiles

### - Mean Bias:

- It is negative near surface in most cases (except in December).

### - Standard Deviation:

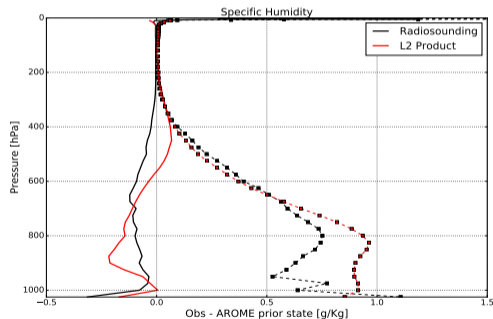
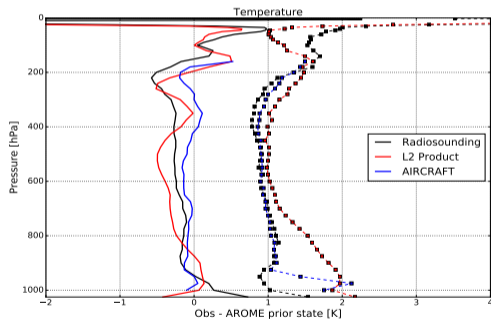
- Absolute differences varying with seasons (actual moisture content)



Solid lines - Mean differences

Dashed lines with squares - standard deviations

# Define the observation error: L2, radiosondes and aircraft X AROME (January/2018)



## L2 observation error

Temperature (L2) observation error  $\Rightarrow 1.2$  \* radiosonde observation error

Humidity (L2) observation error  $\Rightarrow 1.25$  \* radiosonde observation error



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# Experiments Configuration

Period 1 (Summer): Jul 15th, 2017 to Sep 15th, 2017 (63 days)

Period 2 (Winter): Jan, 2018 and Feb, 2018 (59 days)

**Period 3 (Spring): May 15th, 2018 to Jun 26th, 2018 (43 days)**

Experiment	Configuration
Baseline	No IASI, AMSU-A and MHS data
Control	Baseline + IASI, AMSU-A and MHS L1 product
L2 Experiment	Baseline + L2 product

IASI - 44 channels over sea and 8 channels over land

AMSU-A - 4 channels

MHS - 3 channels

# L2 data setup

## Filters Applied:

Region	Filter
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

## Thinning:

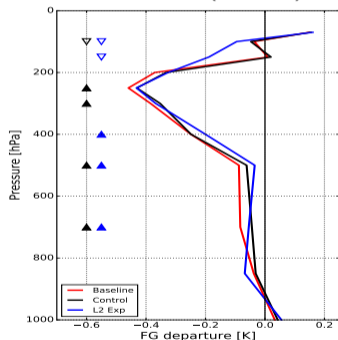
- Horizontal: select one profile over a 160 x 160 km ("best" QCI)
- Vertical: 1 level every 3 levels

# Outline

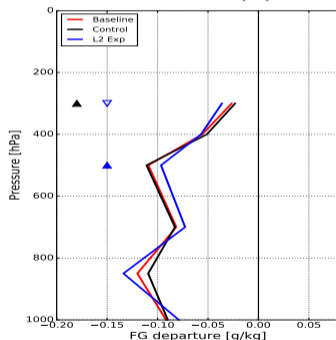
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# Observation Minus First Guess (OMF) - Spring

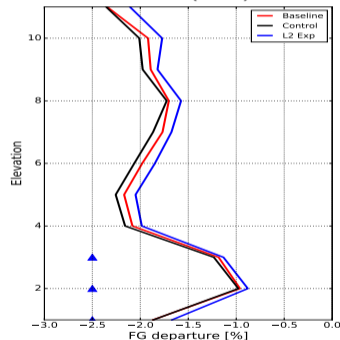
## Radiosonde (Temp)



## Radiosonde (q)



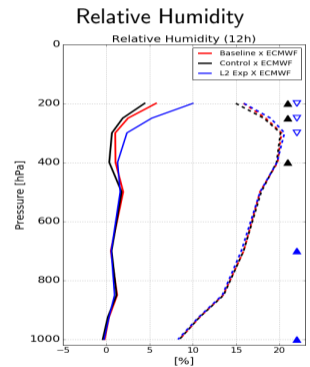
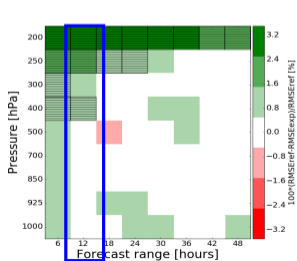
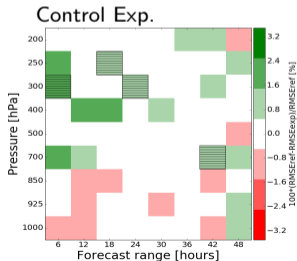
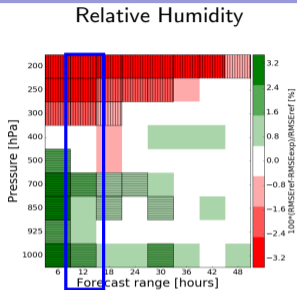
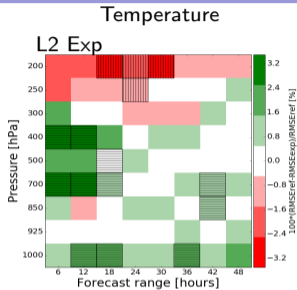
## Radar (RH)



- ▲ L2 Experiment is better than the baseline with 95 % of confidence (t-student)
- ▲ Control Experiment is better than the baseline with 95 % of confidence (t-student)
- ▽ Baseline is better than the L2 Experiment with 95 % of confidence (t-student)
- ▽ Baseline is better than the Control Experiment with 95 % of confidence (t-student)

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Relative Difference of RMSE (%) against ECMWF analyses

Improvement with 95 % of confidence

Degradation with 95 % of confidence

## Main Conclusions:

- The L2 product is suitable to assimilate in the NWP models.
- The L2 experiment helped to decrease the first guess and the analysis departure of the other observations.
- Forecast Scores:
  - The Control experiment improves the upper-troposphere forecast skill for humidity.
  - The L2 experiment helped to improve the humidity skill scores in the middle-lower troposphere and it also degraded the scores above 300 hPa for the temperature (not all periods) and humidity.



Thank you for your attention!!!