

Overview of infrared radiance assimilation in Météo-France models

N. Fourrié, V. Guidard, N. Boukachaba, O. Coopmann, P. Moll.

CNRM, UMR 3589 Toulouse France.

A large part of assimilated observations in the global model of Météo-France comes from infrared radiances. Since July 2013, radiances from AIRS, IASI on board Metop A and Metop B, and CrIS are assimilated in the global model. The infrared radiances are also used in the mesoscale model AROME. This poster intends to give an overview of the infrared radiance usage in the French models, the latest updates and the status of the current developments.

In the global model ARPEGE

In the mesoscale model AROME

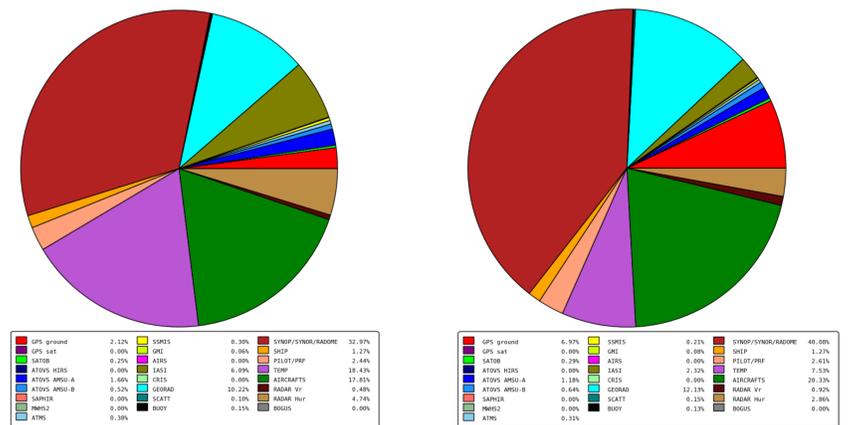
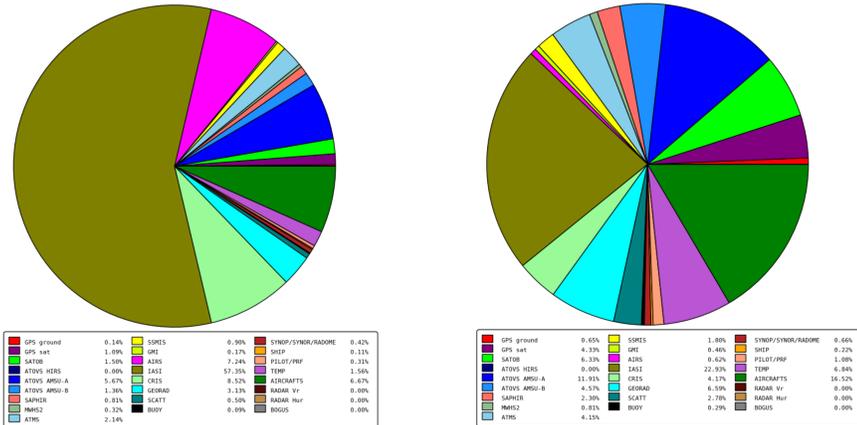


Figure 1: Percentage of assimilated observations in the global model ARPEGE for 19/1/2017.

Figure 2: Percentage of DFS brought by the observations in the global model ARPEGE for 19/1/2017.

Figure 3: Percentage of assimilated observations in the mesoscale model AROME for 26/10/2017 (non rainy day).

Figure 4: Percentage of DFS brought by the observations in the global model ARPEGE for 19/1/2017 (non rainy day).

90% of assimilated data come from satellites in the global model and hyperspectral sounders represent 75% of the total amount.

The amount of assimilated satellite observations is weaker in the mesoscale model AROME. Only data with high frequency such as SEVIRI radiances. The main contributor of satellite data to the DFS is SEVIRI (12%). These results highly depend on the precipitation and in case of rainy situations, very few observation are assimilated and thus have an impact on the analysis.

IASI:

- *Assimilation of 5 ozone channels,
- *Assimilation density now in a (100km)² box.
- *Use of a surface emissivity atlas from the University of Wisconsin and retrieval of the surface temperature with the window channel 1194 (943.25 cm⁻¹) for clear sky and over land in the global model and in the mesoscale model.

CrIS:

- *Assimilation of 5 water vapour channels sensitive to the mid-troposphere (in magenta in Fig. 8).
- *Addition of 21 tropospheric channels over the sea (in blue in Fig. 8).
- *Now 68 Cris channels are assimilated in ARPEGE.

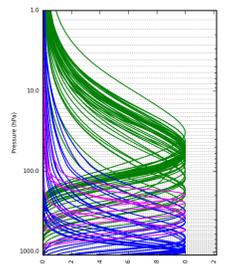


Figure 8: Weighting functions of the CrIS channels assimilated in ARPEGE over the sea. Channels in green are also assimilated over land.

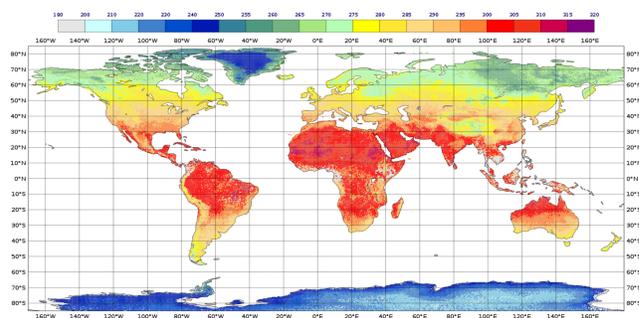


Figure 5: Average LST retrieved from IASI channel 1194 (943.25 cm⁻¹) in the global model over the period between 20 September 2016 – 19 October 2016

A study on the assimilation of surface sensitive channels with retrieved LST in the AROME model Boukachaba et al (2017) has shown an increase of the number of channels assimilated over land (Fig 5). This results in an improvement of forecast scores from 6 h up to 24 h, especially in the mid troposphere as shown by figure 6.

Geostationary satellites:

- *Assimilation of data of 5 geostationary satellites.
- *Assimilation of 3 WV channels for HIMAWARI-8
- *Increase of the assimilation density in (125 km)² boxes for all geostationary satellites.

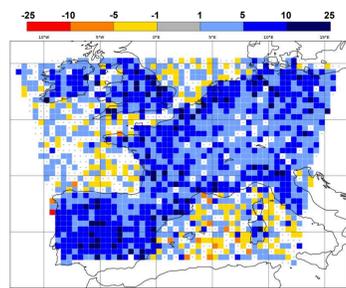


Figure 6: Mean difference of number of assimilated channels per box of 0.5° squared between the reference and an experiment with the retrieval of surface temperature for IASI simulation during daytime from 15th January to 28th February 2015.

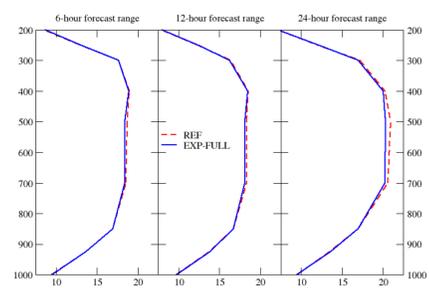


Figure 7: Root Mean Square forecast error at 6h, 12h and 24h for relative humidity wrt ECMWF analyses 15 January 2015-28 February 2015 in the AROME model for the reference (red dashed line) and the experiment with the assimilation of more channels with the retrieved surface temperature from channel 1194.

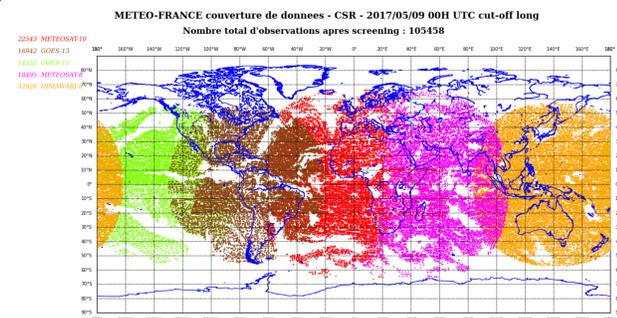


Figure 9: Example of assimilated observation location for the geostationary satellites for 9 May 2017 00UTC.

	Sea	Land
MSG 10	4 T + 2 WV	2 WV
MSG 8	4 T + 2 WV	2 WV
GOES 13	1 WV	1 WV
GOES 15	1 WV	1 WV
HIMAWARI 8	3 WV	3 WV

Table 1: Number of channels assimilated over sea and over land for the Clear Sky radiances of each geostationary sounder in ARPEGE.

AROME	Sea	Land
MSG 10	4 T + 2 WV	3 T + 2 WV

Table 2: Number of channels assimilated over sea and over land for MSG 10 radiances in AROME.

Future developments planned for IR sounders:

- Use of Ts for radiance assimilation in the next e-suite.
- Use of non diagonal R matrix for hyperspectral sounders. As expected, first results are very encouraging.
- Addition of surface channel assimilation for all geostationary sounders and exploration of assimilation over land for these satellites
- Towards an all-sky IR assimilation for IASI (see oral 5.03 by I. Farouk)
- Coupling between chemistry and atmospheric models. (poster 8p.09 by O. Coopman)

Contact : Nadia.Fourrie@meteo.fr

References:

Boukachaba N., Guidard V. and Fourrié N. (2017) : Improved assimilation of IASI land surface temperature over continents in the convective scale AROME France model. In revision Tellus.

