DUAL IASI-A AND IASI-B AUTOMATIC MONITORING FOR THE LEVEL 1 AND LEVEL 2

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Abstract

Two Infrared Atmospheric Sounding Interferometer (IASI) are currently flying since October 2006 on Metop-A and since September 2012 on Metop-B. Since the reception of the first calibrated spectra, IASI L1 NRT monitoring is done at EUMETSAT , based on the comparison of measured and modelled IASI L1C spectra generated by the radiative transfer model RTTOV v9.3, and on comparison between the co-located measurements of IASI and HIRS flying on the same platform. With the arrival of MetOp-B, IASI L1 radiance monitoring will be done in parallel for the two instruments, providing a self-consistency checks and interesting inter-comparisons.

Moreover, the IASI L2 automatic monitoring is also done on a regular basis, mostly based on comparison with temperature, humidity and ozone profiles taken from 3-hour ECWMF forecast data by selecting the nearest neighbour. Only co-locations within 1 h time difference are considered. Statistics and time series checks are providing for the temperature and humidity profiles, surface temperature as well as ozone total column and cloud detection. This is done for both instruments.

A presentation of the current tools and observations available will be presented. The analysis of the past months of IASI L1 and L2 product quality will be shown as well as the inter-comparison between MetOp-A and MetOp-B, in a global and regional scale, for IASI L1 radiance and L2 products monitoring.

INTRODUCTION

The Infrared Atmospheric Sounding Interferometer (IASI) is currently flying on Metop-A since October 2006. Since the reception of the first calibrated spectra, IASI L1 NRT radiance monitoring is done at EUMETSAT, based on the comparison of measured and modelled IASI L1C spectra generated by the radiative transfer model RTTOV v9.3 using ECMWF forecast files. Since August 2011, the monitoring of IASI L2 products (temperature, humidity, ozone...) is performed as well on a daily basis in comparison with ECMWF files. With the launch of Metop-B in September 2012, both monitoring are done in parallel for the two instruments, providing self-consistency checks and interesting inter-comparisons, using double differences or direct comparisons done on a large number of spectra.

IASI LEVEL 1 PRODUCTS MONITORING

The radiance monitoring, generated every day at EUMETSAT, allows a quick overview on IASI on-board and on-ground processing and IASI products quality. It gives a daily check of instrument (like the temperature of different part of the instrument), the level 0 and level 1 data quality using the different flags available in the products and in the telemetry. It gives times series of instrument temperatures, of the processing parameters like the spectral shift and its quality, the optical axis position, the quality of the correlation between IASI and its imager, the over/underflows, the radiometric and spectral calibration status. Moreover, a radiance monitoring is performed comparing the IASI measurements to simulated radiances fed by co-located ECMWF profiles of temperature, humidity and ozone. Only clear-sky conditions at night over sea are used.

Larger statistics give more information on the noise, and also consistency between the 4 IASI pixels. This is done in parallel for both Metops. The two figures show an example of differences between the Mean (4 pixels) – each pixel (pix1, pix2, pix3, pix4) for Metop-A (right) and Metop-B (left), for the period from 1st of July to 15th of August 2013.

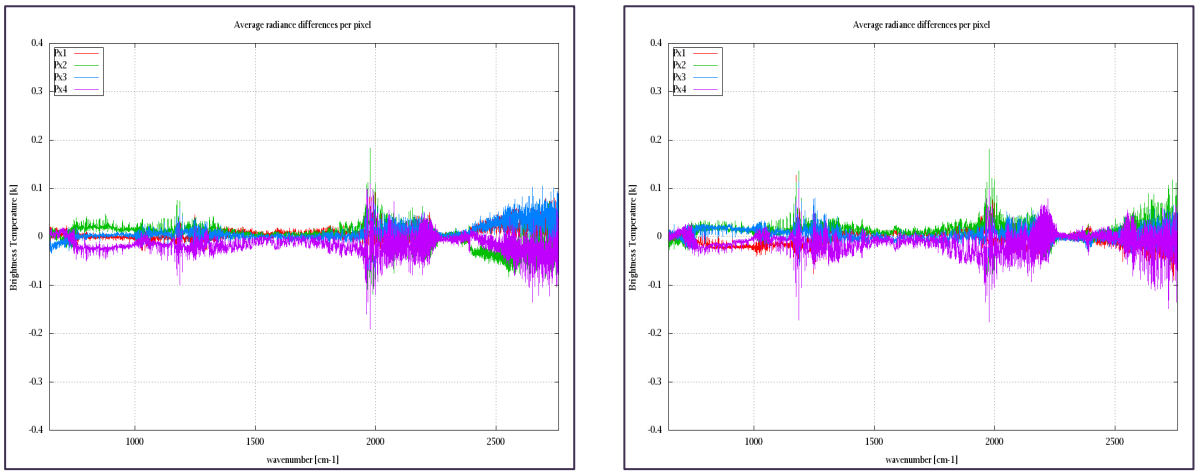

Figure 1: **Radiance differences per Pixel: Mean(PXi $_{(i = 1 \text{ to } 4)}$) - PXi $_{(i = 1 \text{ to } 4)}$ for Metop-A (left) and Metop-B (right).**

Despite the good consistency between the 4 pixels, it shows a different behaviour of the two IASI, not only between pixels but also in the inter-bands: the first inter-bands is for instance larger for Metop-B than for Metop-A.

IASI-A / IASI-B LEVEL 1 INTERCOMPARISON

Taking advantage of dual Metops, the monitoring has been extended to produce inter-comparisons between the two IASI, using double differences between IASI-A (Obs-Cal) and IASI-B (Obs-Cal). The figure 2 shows these differences for several period of times, from the end of commissioning of Metop-B (end of April 2013) to October 2013. All spectra used have been taken by night, over sea, excluding the polar regions. The differences shown on the figure 2 are provided in NedT at 280K and generally remain between ± 10^{-1} K (the specification for Obs-Cal is 0.1K at 280K), which shows a good radiometric consistency between the two IASI.

This inter-comparison has been developed during IASI-B commissioning and is now part of the long term monitoring of the two IASI, providing self-consistency checks. This is done regularly when there is a major update in one or both instruments. It is also envisaged to include this inter-comparison in the weekly report available on *http://www.eumetsat.int/Home/Main/ServiceStatus/index.htm?l=en*.

The operational intercomparison between IASI-A and IASI-B has been done regularly since end of April, 15 days per month: Beginning of May (1st to 14th), End of May (16th to 31st), 15 days in July (1 to 15th), 15 days in August (1st to 15th), 15 days in September and 15 days in October (1st to 15th).

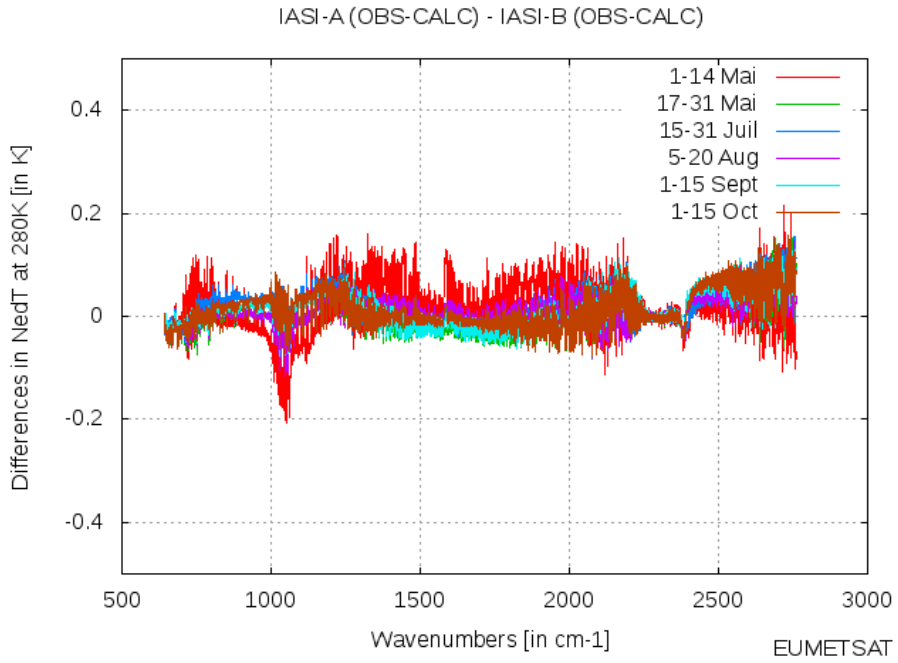

Figure 2: **Differences between IASI-A (OBS-CALC) and IASI-B (OBS-CALC) in NedT at 280K for different periods of time since the end of IASI-B commissioning.**

The main change observed before and after 15th of May 2013 corresponds to a major configuration update for both instruments as extracted on the figure 3 (Red shows before the update, and green after). This concerned the tuning of the IASI pixels and an update on the spectral calibration.

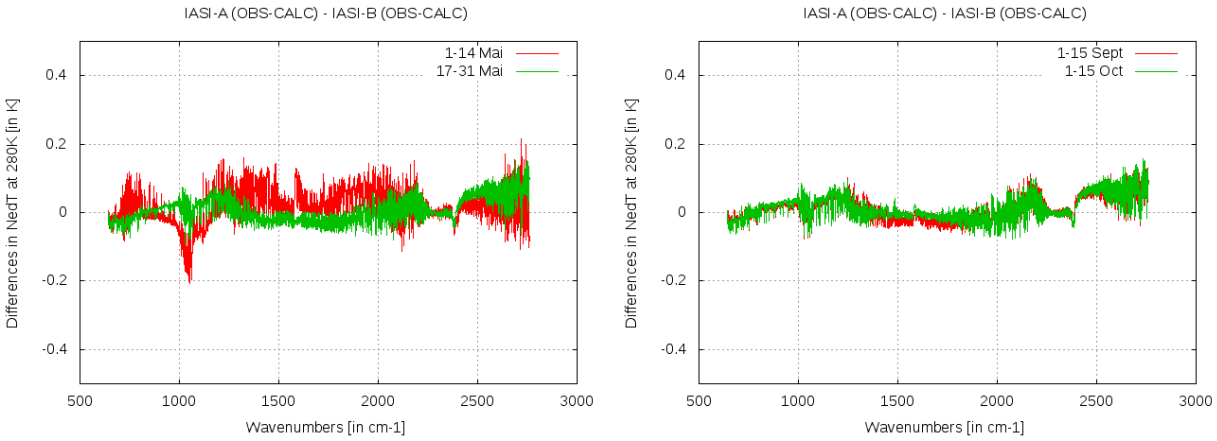

Figure 3: **On-ground updates for the IASI level 1 processing for both IASI, in May on the left and in September on the right. Before the update is shown in red, and after in green.**

For the other period of time, there was no major change except in mid-September (16th for IASI-A and 26th for IASI-B) when there were an update of scan reflectivity for IASI-A and some thresholds adjustment for IASI-B. The result seems to have an effect particularly in band 2.

Not only IASI level 0 and level 1 products are monitored, we are also monitoring the IASI level 2 products as presented in the following section.

IASI LEVEL 2 PRODUCTS MONITORING

The IASI L2 automatic monitoring tool, similar to what has been implemented for the near-real time (NRT) L0/L1 monitoring, allows to routinely control the quality of the IASI L2 products, mostly in comparison with the 3-hour ECMWF forecast files.
The IASI level 2 products encompass a large range of atmospheric and surface parameters, including temperature and humidity profiles, the surface skin temperature and emissivity as well as chemistry product (O3, CO, CH4, N2O and CO2 columnar amounts) and the cloud detection and characterisation. They are directly compared to a single forecast profile if the time difference does not exceed 1h. This ensures accurate temporal coincidences of the retrieval with the reference data but has the disadvantage to limit the area covered by the validation. The statistics are derived for the nine geolocation/surface type configurations, without any distinction between day and night. They are recalled in the following table 1 and figure 4:

[Line:Col]	Label	Surface Type	altitude
[1:1]	North Pole	Land/Sea	> 60°
[1:2]	North Sea	Sea	[30°:60°]
[1:3]	North Land	Land	[30°:60°]
[2:1]	High Elevation	Land	[-60°:60°]
[2:2]	Intertropic Sea	Sea	[-30°:30°]
[2:3]	Intertropic Land	Land	[-30°:30°]
[3:1]	South Pole	Land/Sea	< 60°
[3:2]	South Sea	Sea	[-60°:-30°]
[3:3]	South Land	Land	[-60°:-30°]

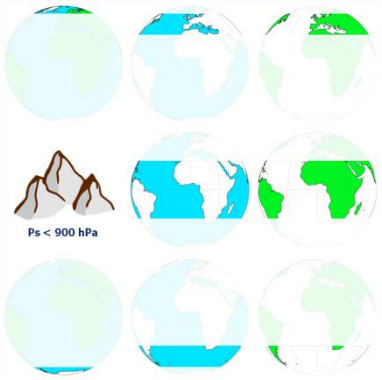

Table 1 and Figure 4: **Characteristics and figures of the nice geolocation/surface type configurations.**

To check the IASI level 2 products, which encompass a large range of atmospheric and surface parameters, the monitoring provides time series of surface temperatures and temperatures at 200 HPa, 500 HPa, 800 HPA and 980 HPa. This is also done for the humidity at the same levels of the atmosphere. The figure 5 below shows an example of a time series of the temperature at 500 HPa, from mid-February to end of May 2013.

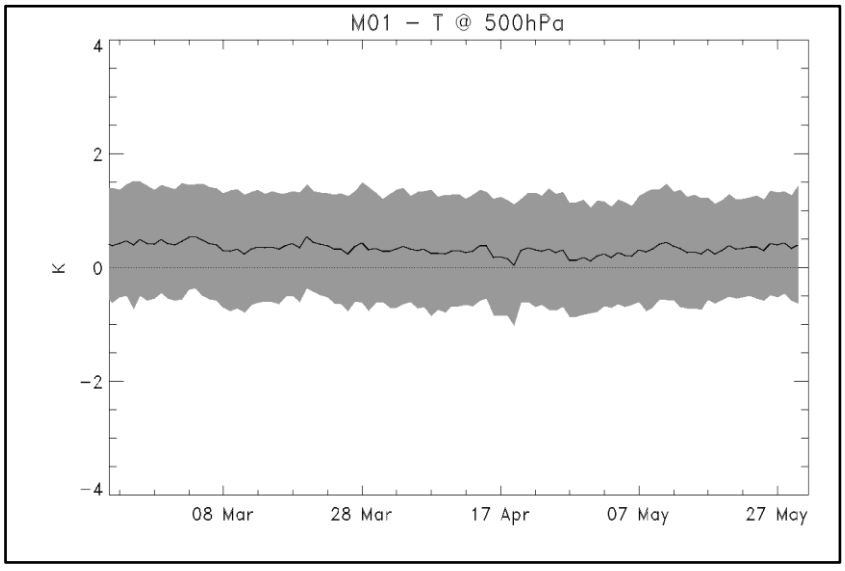

Figure 5: **Time series of the temperature difference at 500 HPa between IASI L2 and ECMWF forecast file, during 3 months.**

We are doing also daily statistics on the temperature and humidity profiles for the 9 geolocations and surfaces conditions recalled on the figure 4.

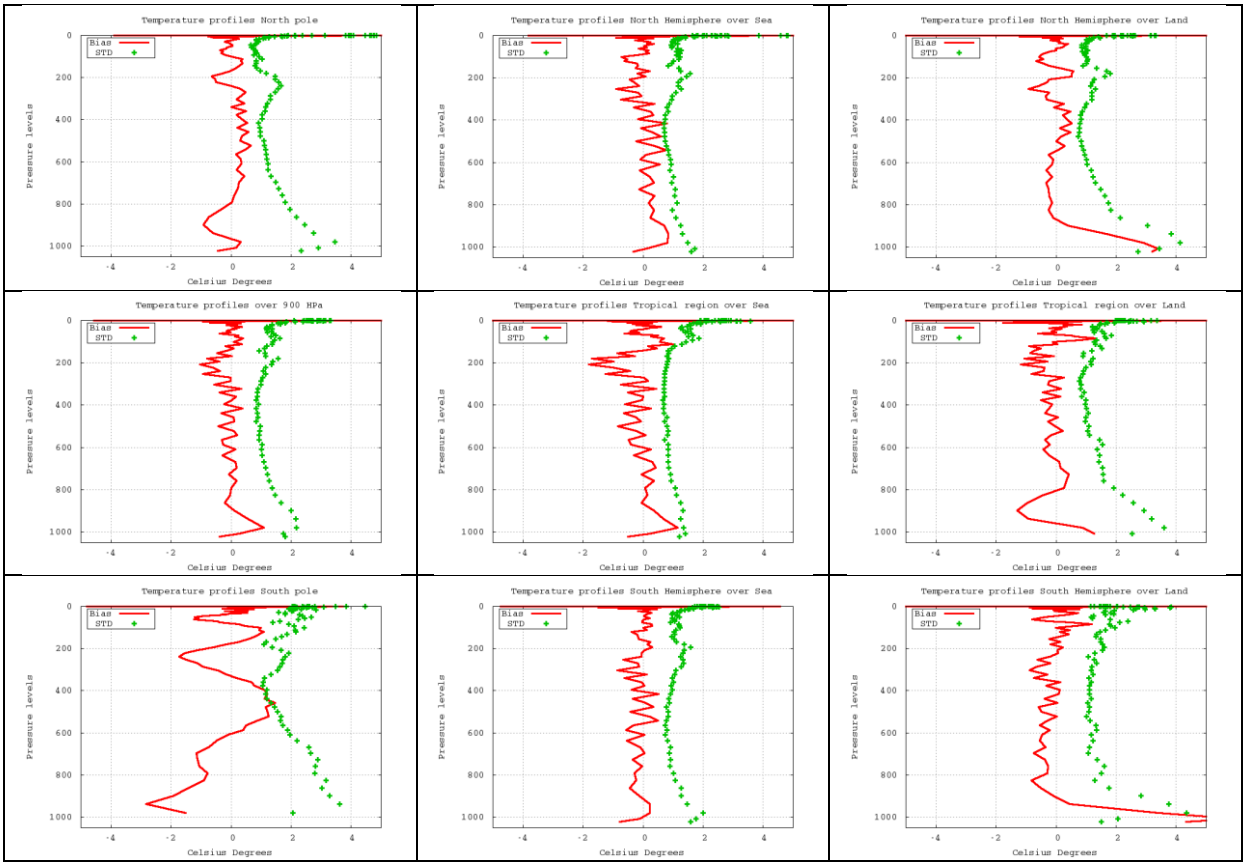

Figure 6: **Daily statistics of the temperature profiles in comparison with ECMWF forecasts.**

For the chemistry products (especially O_3 and it is planned later CO, CH_4, N_2O), the daily monitoring provides histograms of O_3 differences with ECMWF forecast files for the nine geolocation described on the figure 4 and daily, a global map of ozone differences.

With this last monitoring, all IASI products are now monitored and checked operationally every day.

CONCLUSION AND PERSPECTIVES

The comparison between each IASI with modelled radiances computed from ECMWF forecasts provides a good daily consistency check of the IASI measurements. This monitoring is part of the quality checks we are doing every day. The level 2 monitoring, on the other hand, gives an overview of the daily quality of temperature and humidity profiles, surface temperature and ozone, by comparison with the forecasts. These two levels monitoring, focused mainly on the level 1 monitoring, allow routine consistency checks between the two IASI, using double differences which shows, in general, a very good consistency of the 2 instruments. It was part of the IASI-B commissioning check and permitted to see the radiometric impact of each major configuration changes in one or both instruments. This double differences comparison was implemented operationally to provide monthly check between the two instruments and especially when there is an update in the ground IASI level 1 processing. In addition, a direct comparison has been also implemented at EUMETSAT, providing not only a

radiometric analysis but also a spectral consistency check. The outcomes of this monitoring will be available soon.

Furthermore, the global IASI monitoring is supplemented by the comparison with HIRS and AVHRR since 2007, and we have shown that gives interesting feedbacks for the other instrument, especially for those on Metop-B. We are providing intercomparison with CrIS since its dissemination by EUMETSAT in July 2012.

The inter-calibration between CrIS and the two IASI is performed using double differences with the forecasts files. This is done on clear scenes, at night, over ocean. It permits to check the quality of the CrIS products disseminated by EUMETSAT, and also to provide interesting consistency checks bewteen the two instruments. We are also making direct comparison at SOs (Simultaneous Observations) which occurs every seven weeks, allowing punctual checks. The plot on the right shows an example of SOs in the North Pole, with IASI and CrIS mean spectra (top) and the differences in NedT at 280k (bottom). It shows a good consistency between the two instrument.

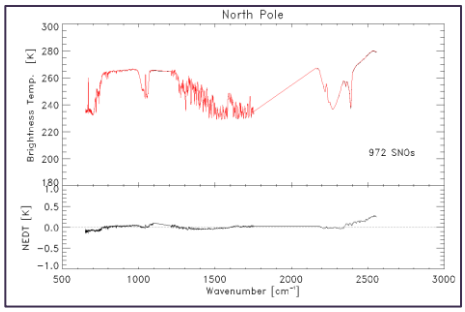

Figure 7: **IASI and CrIS spectra (top), and their difference (bottom) at SOs in north pole.**

Up to now, only the IASI L0/L1 monitoring is available on the official EUMETSAT web site. It will be completed very soon by the cross-comparison between the two IASI, most probably in the weekly report and also later by the IASI L2 daily monitoring.

REFERENCES

The IASI L0 and L1 Daily/Weekly monitoring reports for Metop-A and Metop-B on: *http://www.eumetsat.int/Home/Main/ServiceStatus/index.htm?l=en*.