IASI mission implementation and status

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ABSTRACT

IASI (Infrared Atmospheric Sounding Interferometer) is a programme developed by CNES in partnership with EUMETSAT, to make a step forward in weather forecast, atmospheric chemistry and climate evolution studies. Two instruments are currently operational and have been flying on-board Metop-A (since October 2006) and Metop B (since September 2012) satellites of EUMETSAT.

The principles of the in-space implementation of the mission will be recalled from the physics of the measurement, down to the retrieval of the information. A description of the instrument, how it operates and how data are acquired on-board Metop satellites, will be given. The way the data processing is distributed between the on-board and the on-ground will be described too.

Finally, the global status of the IASI system and of first level data and the outlook of the programme will be given as a conclusion.

Status of IASI instruments onboard Metop-A and Metop-B satellites

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ABSTRACT

IASI is dedicated to atmospheric sounding in the infrared spectral domain. It provides data to a wide community of users, from meteorological agencies for operational numerical weather prediction, to scientific users for atmospheric chemistry and climate monitoring.

The first IASI instrument (FM2 model) on Metop-A satellite was launched in 2006. IASI FM2 mission has been extended, after successful completion of its nominal lifetime of 5 years, and is now in its tenth year of exploitation. It still exhibits very good and very stable performances, and maintains also a very good availability.

The second model IASI PFM-R on Metop-B satellite was launched in 2012. After 3 years of exploitation, its performances are very similar to IASI-A and very stable also.

A good health status of both instruments will be briefly presented, along with a summary of the configuration changes performed onboard since the previous IASI conference: stop of Compensation Device mechanism for both instruments, and switch to redundant side of the instrument for IASI-A. Then an overview of proposed activities on IASI-A for Metop-A end-of-life operations (foreseen in 2019) will be given.

The operational IASI L2 v6 products at EUMETSAT:

Status, applications and evolutions

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ABSTRACT

The IASI level 2 (L2) processor version 6 (v6) [August et Hultberg, ITSC-19] is operational since 30 September 2014 and implements a number of innovations which allow unprecedented sounding capabilities at the IASI single footprint resolution. The measurements of the microwave companion instruments AMSU and MHS are for instance used in synergy with the IASI spectra as inputs to a quasi all-sky statistical first-guess retrieval of temperature and water-vapour, referred to as PWLR for piece-wise linear regression. The subsequent step is an optimal estimation method (OEM) retrieval, so far still solely attempted in clear-sky and with IASI measurements only. It uses the PWLR as variable prior information; where a static global climatology was used until v5. Another decisive innovation deals with the use of reconstructed radiances in a new channel selection by application of principle component analyses which optimises the spectral information exploited by the OEM [Hultberg et August, ITSC-18]. As a result, useful temperature and water-vapour soundings are enabled in about 85% of the IASI pixels, with a typical precision of about 1K for temperature, below 1k in clear-sky and in the mid troposphere and of about 1-1.2g/kg for water-vapour depending on the actual moisture content.

We present here the status and recent evolutions of these products one and a half year after their operational release. We provide an overview of the applications where these IASI L2 v6 are showing new potentials due to the improved atmospheric sounding and surface characterisation capabilities, like nowcasting where plans exist to improve timeliness to the users; the climate and the ocean monitoring. We also introduce with this paper the most recent directions of development, for instance exploiting the horizontal correlation in the measurements in adjacent pixels or the land surface emissivity. In the latter case, the objective is to include it as a variable parameter of the OEM to enable successful convergence over deserts and improve the low tropospheric sounding in general. A pre-requisite for this is a more accurate first-guess land surface emissivity for which non-linear methods are studied to improve on the linear statistical method or static databases still currently employed in operations. We show that the IASI observations are better fitted with PWLR- retrieved land surface emissivities. The assessment of the improvements is also seen through the realisation of the subsequent OEM retrieval step.

The ultimate step in the IASI L2 processing sequence is the atmospheric composition module. It is fed with the atmospheric temperature and humidity profiles, the surface parameters and the cloud information retrieved in the previous steps. The version 6 includes the FORLI [Hurtmans et al, JQSRT 2012] and BRESCIA [Clarisse, AMT 2012] libraries developed at ULB/LATMOS. The CO was the first product of a series to be integrated in IASI L2 v6 with these libraries. It is routinely generated and consists of profiles and averaging kernels, while v5 only provided the total column. We give here an update of the status of its qualification and the plans for the upcoming SO_2, O_3 and HNO_3 atmospheric composition products.

Non linearity correction of IASI on board MetOp-A and MetOp-B

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ABSTRACT

The Infrared Atmospheric Sounding Interferometer (IASI) is a very accurate Fourier Transform Spectrometer dedicated to atmospheric sounding that provides radiance spectra in the infrared spectral domain. The two flight models on board the MetOp-A and MetOp-B satellite are in routine operation phase since July 2007 and April 2013 respectively.

The inter-comparison between IASI-A and IASI-B shows a radiometric residual bias lower or equal to 0.1 K in band 1. A residual default of the low-frequency non-linearity correction of at least one instrument is considered as a possible explanation of this bias.

The low-frequency non-linearity of the IASI detectors is a non-linear function of the entrance photon flux on the detector, due to detector imperfections. This effect, known to be dependent on detector temperature, is corrected on the IASI interferograms by the on-board processing (DPS) with correction tables loaded on board the instrument, only for band 1 because of the detector technology used.

This talk presents the results of our study of the IASI low-frequency non-linearity correction algorithm, the determined new correction and the expected effect of this correction update on the radiometric calibration of the two IASI models in flight and on their inter calibration.

Performance status of IASI on-board Metop-A and Metop-B

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ABSTRACT

In-flight performance monitoring of the IASI level 0 (L0) and level 1(L1) processing is essential to guarantee the users that the data keep the required quality along the mission life time. Monitoring is also needed to detect and anticipate any evolution, and prepare corrections when possible. It is one of the main responsibilities of the IASI Center of Expertise (ICE) set-up and operated in CNES Toulouse.

In this talk, the different missions of the ICE center and resources involved to fulfill these missions are first presented. Then we focus on the IASI performances in terms of instrument and processing monitoring. This includes L0 and L1 data overall quality and the main spectral, radiometric and geometric performances. We explain why and how this monitoring is performed.

The performances of the two IASI instruments on-board Metop-A and Metop-B after respectively 9 years and 3 years of operation are also presented. This covers the status of the performances after IASI-A switch over its IMS redundant side in April 2015. We show that the IASI performances are very satisfactory and very stable thanks to regular updates of on-board and L1 ground configuration files and thanks to specific operations. This allows to take into account and to compensate for the instrument evolution and aging, and to maintain the high level of performances.

IRMA: IASI Radiance Monitoring Assistant
Operational Monitoring of IASI radiances at EUMETSAT

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Monitoring of the products from the Infrared Atmospheric Sounding Interferometer (IASI) instruments currently flying on the two Metop platforms is performed routinely at EUMETSAT using a variety of methods. The time consistency of the Level 1 radiances is evaluated by comparison of the measurements with synthetic spectra generated by the radiative transfer model RTTOV v9.3 fed with ECMWF forecast files. Comparisons with other instruments such as HIRS and AVHRR on the same platform as well as with CrIS on Suomi/NPP are also carried out.

Furthermore, we have used the unique opportunity that the two IASI are flying on the same orbit, overflying the same area with 50 minutes delay to perform inter-comparisons between both instruments using double differences or direct comparisons done on large spectra averages.

We will present an overview of 9 years of IASI-A radiance monitoring as well as 3 years of dual Metop operations. Such a monitoring, besides giving us confidence that the two IASI are very well radiometrically and spectrally intercalibrated, provides a way to trace changes in the configuration of the instruments and to detect the possible differences between them. Comparisons with other instruments are also available with instruments on the same platforms and with other instruments, on polar and geostationary orbits.

IASI performance assessment after permanent cube corner compensation device stop

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ABSTRACT

This poster is related to the performance assessment when the cube corner compensation device (CD) is stopped.

The cube corner CD was destined to compensate the perturbations created by the Cube Corner Functional Device (CCFD) motion on the satellite AOCS, in the case that IASI would be operated with passive dampers (LFD) released, which is not the case. In nominal configuration (both CCFD and CD activated), the impact of the CD activated is a parasitic line ("ghost") in IASI Instrument Spectral Response Function (ISRF). It is due to the excitation of the interferometer beam splitter by micro-vibrations coming from the CD, transmitted by the optical bench structure.

The ghost impact on the spectral and radiometric performances is routinely monitored in flight for IASI-A and IASI-B and has been evidenced independently by some users of IASI data. Some tests in flight between November 2014 and January 2015 on the two IASI have shown that the ghost effect disappears when the CD is switched off; it was thus decided to stop the CD permanently since October 7th 2015. This poster presents the performance assessment related to this CD stop.