IASI-A End Of Life super-sampled and limb acquisitions tests: processing challenges and scientific interests

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CONTEXT

After 15 years of operational lifetime, Metop-A End Of Life (EOL) tests followed by deorbiting operations started from the 6th of September 2021 to the 27th of November. IASI-A L1 processing chain has been fully operational even after METOP-A orbit started drifting in 2017. In order to fully exploit IASI-A exceptional performances and stability over time and prepare future missions, the End Of Life tests campaigns addressed both instrumental and technical aspects as well as various scientific interests.

The EOL test 15, which took place from 16th September to 14th October, aimed at performing a local improvement of spatial sampling by dividing by a factor of 8 the spacing between 2 consecutive IASI views. This increase of the number of soundings over an area of interest, will allow scientists to monitor atmospheric chemistry conditions and instrument engineers to analyse the possibilities of ground processing for overlapping acquisitions (super-mode). This test have been performed in operational configuration. It was then critical that the L1 processing chain, especially the images processing chain, works properly and gives the exact geolocation during the test.

The last test (EOL-17), which took place just before the passivation of the satellite (27/11/2021), consists of performing limb acquisitions (up to 100 km of altitude) during the platform backflip manoeuvre. Potentially, this test has a strong scientific interests, as this kind of acquisitions, using these instrumental characteristics has never been done before. However, the adaptation of the L1 processing chain to such specific acquisitions can be challenging too.

EOL-15 : reduction of swath and increase of the spatial sampling

❖ **Objectives:**
⇒ Modification of the scanning law parameters: dividing by 8 the spacing between two views (from 58.178 mrad to 7.3 mrad)

Satellite velocity

6 km

P3 P3   P2 P2
P4 P4   P1 P1

Pixel diameter : 12 km
Distance between two FORs:
~6 km (nominal: ~48 km)

Start	≈ 16/09/2021
Duration	≈ 29 days
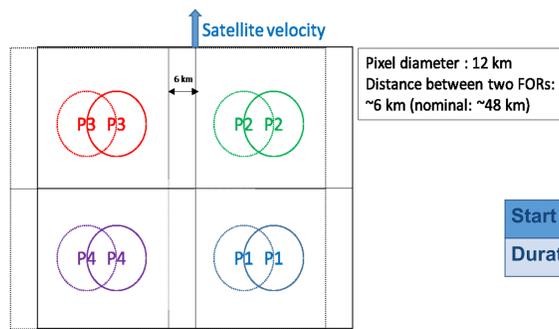
❖ **Test simulation (using CNES numerical performance model):**

OffsetIISAvhrr1

GEUMAvhrr1BCldFrac(1)

GGeoSondLoc(1,1)

Current scan / New scan

IAC: IIS-AVHRR co-registration → CCS: radiance classification and AVHRR cloud in sounder FOV → GEO: geolocation of IASI products
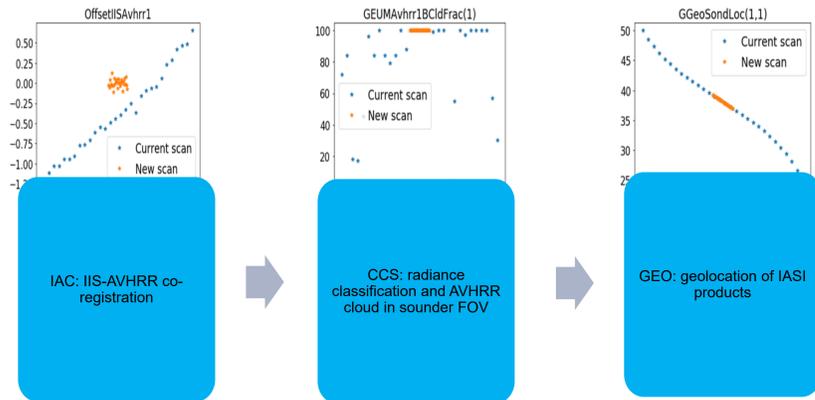
Image pocessing chain (part of l1a processing)

⇒ Identification of ground configuration parameters to be updated (scan angles, OffsetGuess, deltaAvhrrColLeft…)
⇒ Performance assessment

❖ **Scientific interests**

Consecutive FOR standard deviation of differences over pixel 1

IASI 1C noise / Nominal / EOL 15
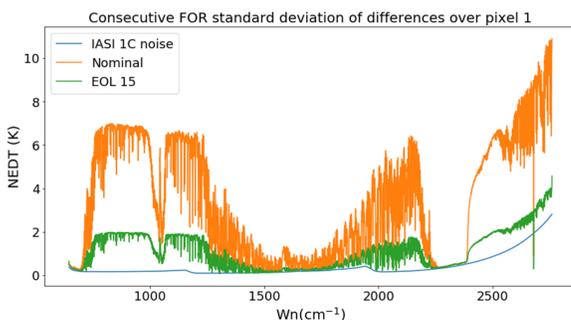
Standard deviation of differences between the consecutive Field of Regards (FOR) for PN1.

- Consecutive FOR variability exhibit atmospheric structures and exceed noise level ➔ Significant increase of the spatial variability of L1 spectra.
- Scientific areas of interest for oversampling: atmospheric chemistry, pollution
- Impact of overlapping pixel on the retrievals: preparation of MTG-IRS
- Noise reduction (e.g. by averaging L1 data) : preparation of IASI-NG

EOL-17 : Limb acquisitions during the backflip manœuvre

❖ **Objectives:**
⇒ Exploit the Deep Space View Test to acquire measurements in the Earth Limb direction and the measurements

END = T0 + = 50 min

Half-orbite Backflip manoeuvre   NOp

Limb area

Altitude (km)

START= T0

date	27/11/2021 10:09-10:58
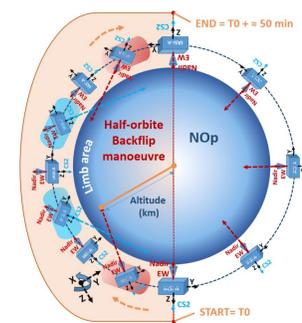
❖ **Test simulations for onboard coding table update**
⇒ Simulation of IASI Limb spectra using 4A/OP and AFGL (Air Force Geophysical Laboratory) atmospheres
⇒ Building and validation of a dedicated onboard coding table.

Tropical

CO_2 O_3 CH_4 H_2O CO CO_2
HNO_3

Tangent heights
020 km
030 km
040 km
050 km
070 km
080 km
090 km
100 km
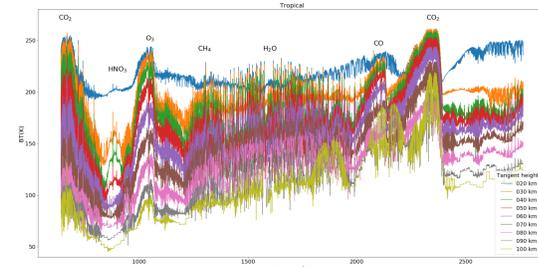
Tropical atmosphere (AFGL 1) IASI Limb viewing spectra simulated with 4A for different tangent heights.

Coding table noise

IASI 1A noise / CTC noise
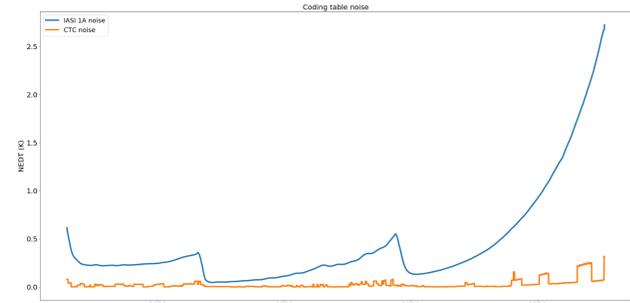
Coding Noise from the Limb viewing coding table. The coding noise has been estimated over 4800 simulated Limb spectra).

❖ **Next steps**
⇒ Performance analyses of the L1C spectra
⇒ Refine (if necessary) the spectral calibration by updating the "reference" spectrum

❖ **Scientific interests**

HNO_3 Q branch ν_2 band HNO_3 Q branch $2\nu_9$ band

O_3

Stratospheric O_3 in emission

BT(01)
BT(02)
BT(03)
BT(04)
BT(05)
BT(06)
BT(07)
BT(08)
BT(09)
BT(10)
BT(11)
BT(12)
BT(13)
GIIRS LW
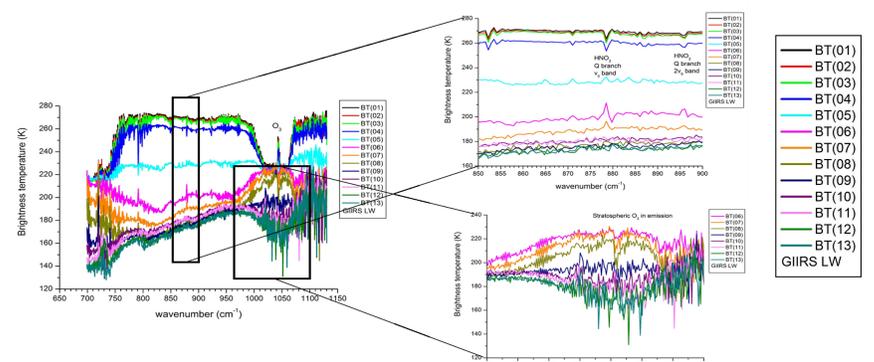
Limb viewing spectra of the GIIRS Fourier transform hyperspectral sounder onboard the geostationary satellite FY-4A (courtesy P. Dussarrat, EUMETSAT and C.Camy-Peyret,IPSL).

⇒ It is expected that the IASI-A limb viewing spectra will be of similar quality

⇒ Detection and analysis of stratospheric chemistry (HNO_3 and O_3)
⇒ Analysis of possible non-local thermodynamical equilibrium (non-LTE) of stratospheric CO ?

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