Status of IASI instruments onboard MetOp-A and MetOp-B

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[(2)] *TAS*
[(3)] *EUMETSAT*

IASI Conference 2013

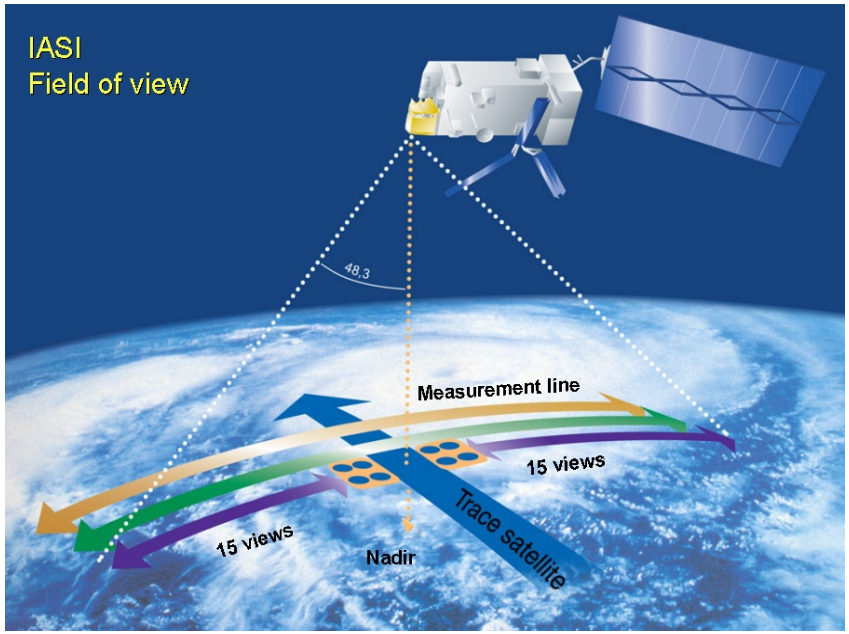
OUTLINE

- IASI PFM-R / MetOp-B SIOV results
- Functional status of IASI FM2 / MetOp-A and IASI PFM-R / MetOp-B

IASI Instrument Overview

- IASI sounder is an infrared Fourier Transform spectrometer based on a Michelson interferometer
- Sounder spectral range 3.7 µm – 15.5 µm
  - continuous spectral coverage with 3 spectral bands (3 focal planes)
  - 8461 spectral channels, spectral sampling from 12 to 0.66 nm
- 4 sounding pixels (12 km diameter), 25 km spatial sampling
- Integrated imager 10.3 µm – 12.5 µm

- Nominal lifetime 5 years in orbit
- Reliability > 0.8 over 5 years
- Availability > 97.5% over lifetime
- Data rate 1.5 Mbit/s
- Mass < 250 kg
- Power < 240 W



IASI PFM-R / MetOp-B In-Orbit Validation phase

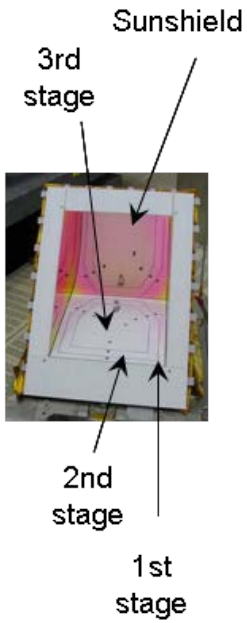
- MetOp-B satellite was successfully launched on 17th of September 2012
- The first 6 weeks of operation were dedicated to SIOV (Satellite In-Orbit Validation)

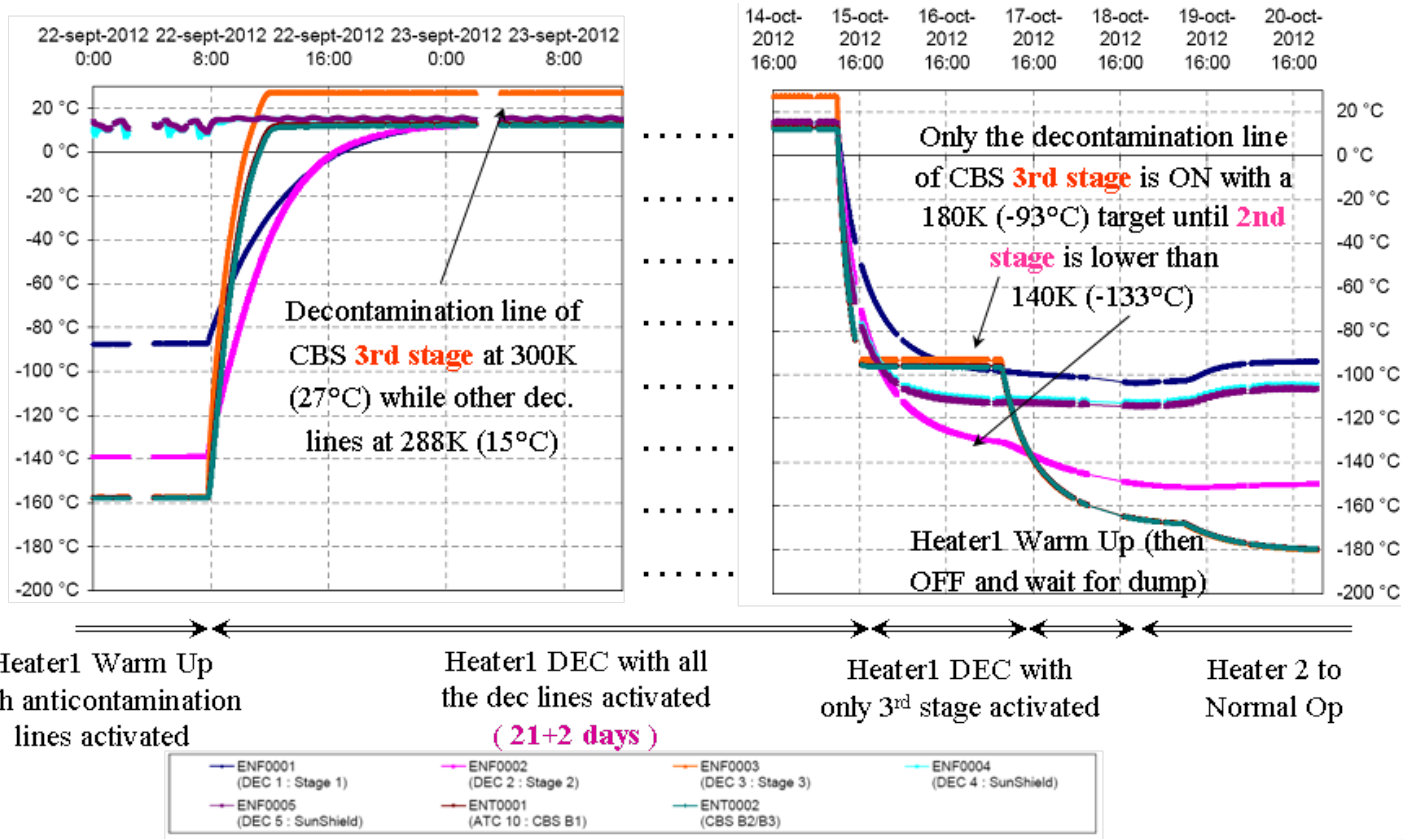
- Main objectives for IASI on MetOp-B IOV are
  - ✦ to bring the instrument to its operational state
  - ✦ to verify the instrument at functional level

- IASI IOV milestones
  - ✦ *Phase 1* : *switch-on and outgassing*
    - » instrument first switch-on — 21/09/2012
    - » 21 days (minimum) in 300 K decontamination — 22/09 – 17/10/2012
  - ✦ *Phase 2* : *configuration*
    - » corner cube mechanisms release — 17/10/2012
    - » upload of new IMS software — 18/10/2012
    - » equipments first switch-on — 19/10/2012
    - » detectors cooling down — 19/10 – 23/10/2012
  - ✦ *Phase 3* : *operational mode preparation*
    - » activation of mechanisms, first operation of interferometer and detection chain — 23/10/2012
    - » activation of on-board data processing — 24/10/2012

Summary of IASI IOV results : phase 1

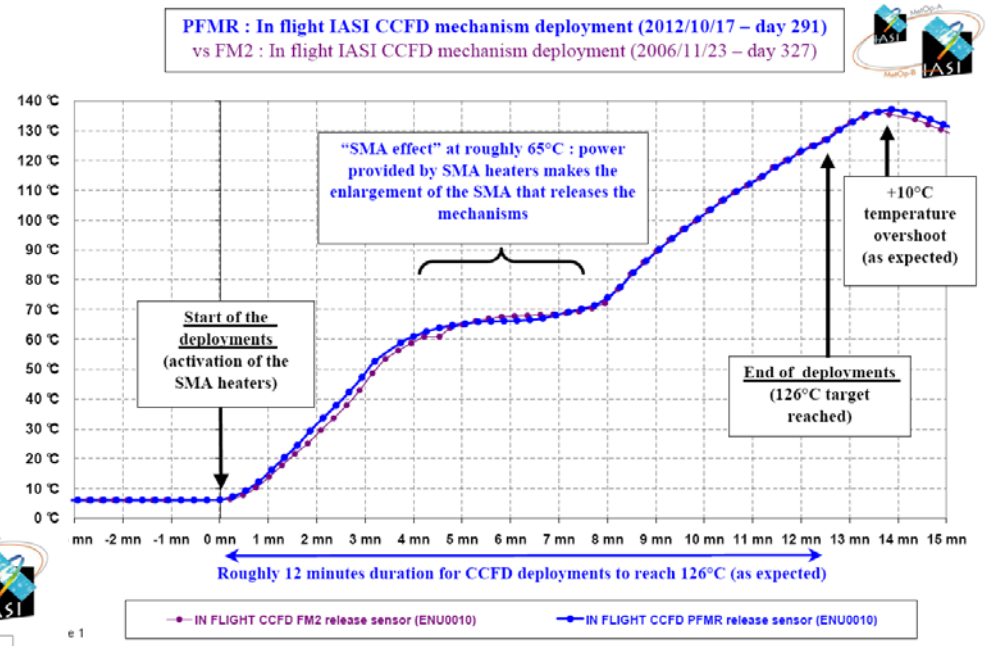
- 300 K decontamination
  - 23 consecutive days in 300 K decontamination
  - Thermal behaviour as expected

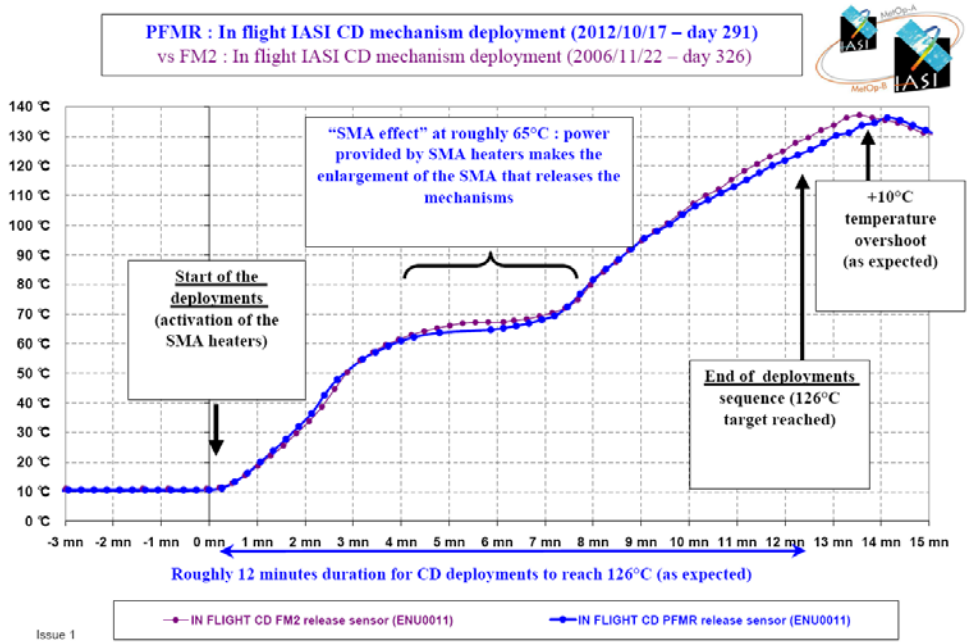




Summary of IASI IOV results : phase 2

- Corner cube mechanisms release
  - ✦ Successfully done for CD and CCFD.
  - ✦ Operation performed in parallel of the first part of CBS cooling down.

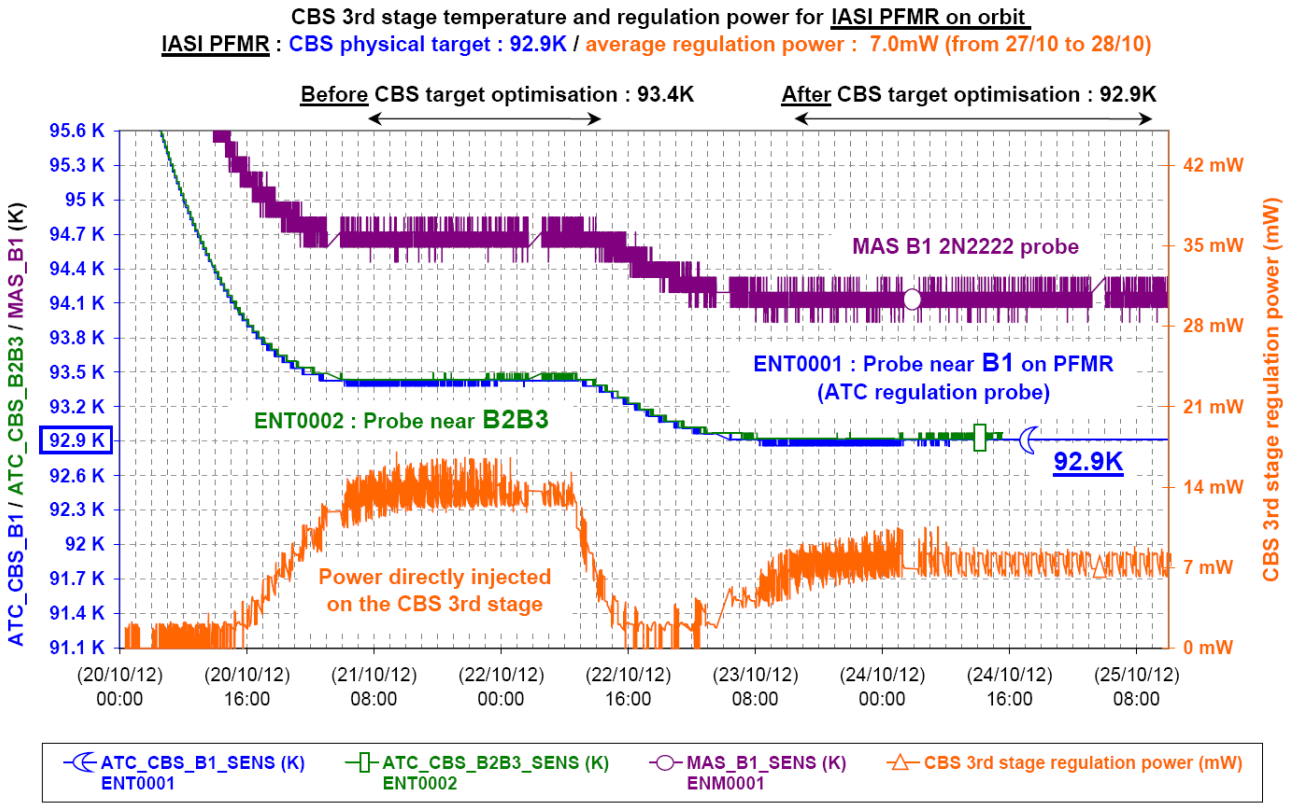




✦ Temperature profile as expected and similar to MetOp-A and to ground data.

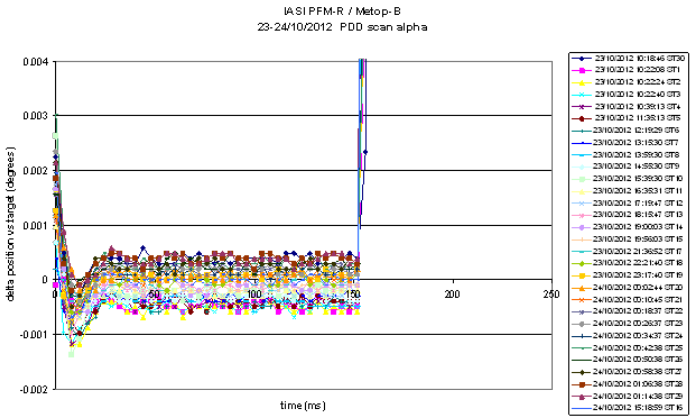
Summary of IASI IOV results : phase 2

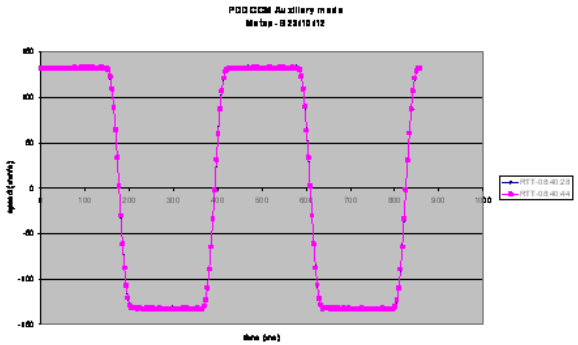
- Detectors cooling down (CBS third stage)
  - First stabilization of temperature showed some margin on the regulation power of CBS third stage. It allowed to decrease the temperature target by 0.5 K.
    - » Reprocessing of non linearity correction tables
  - Third stage is perfectly stable at its new target 92.9 K (-181.2°C). Power is stabilized around 7 mW.



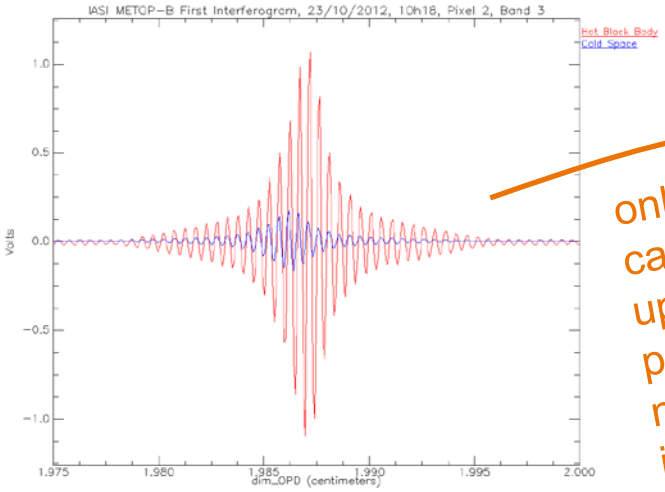
Summary of IASI IOV results : phase 3

- Scan mechanism activation
- Interferometer activation
- Initialization of onboard processing



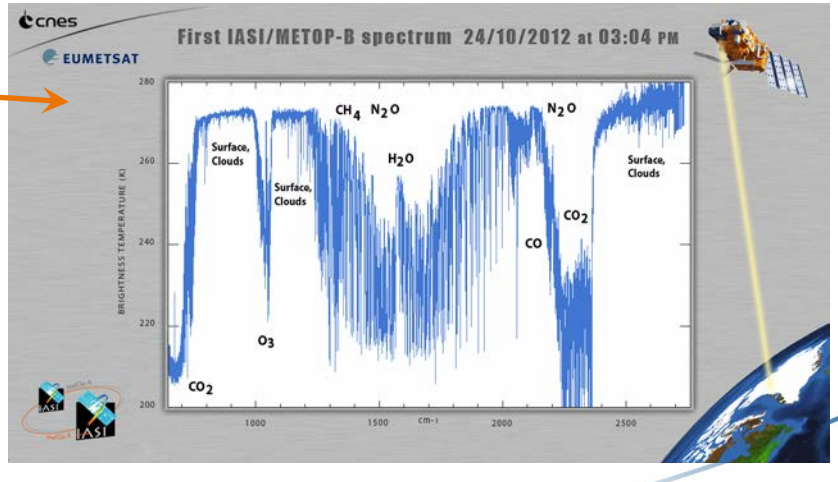


First interferogram was obtained on 23/10/2012



only 1 day for 1st calculation and upload of parameters necessary to initialize onboard processing

First spectrum on 24/10/2012 !



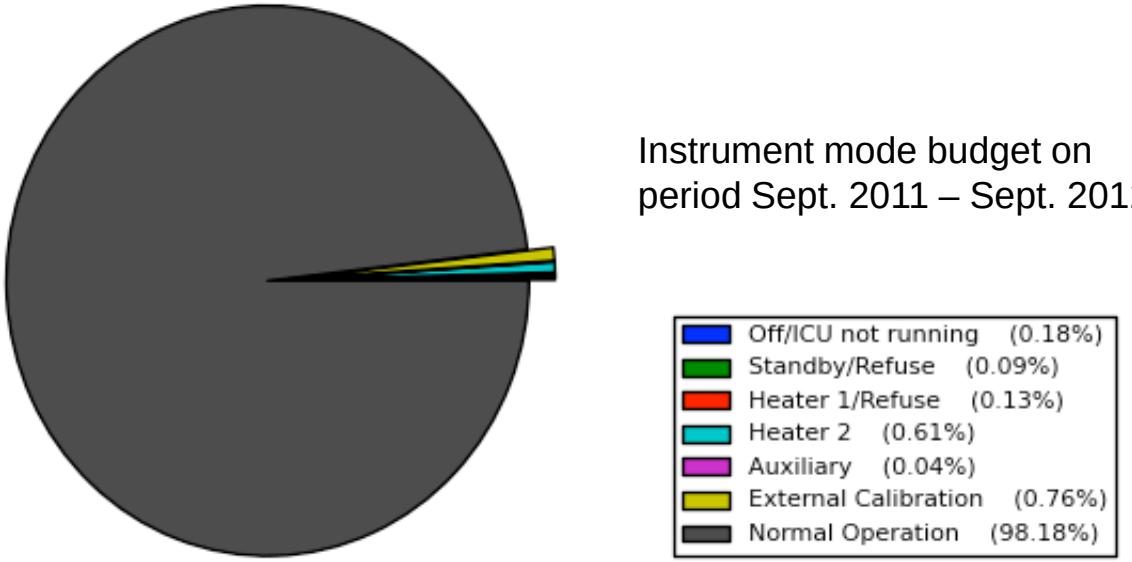
- **IASI PFM-R / MetOp-B SIOV results**

- **Functional status of IASI FM2 / MetOp-A and IASI PFM-R / MetOp-B**

Two IASI instruments in flight

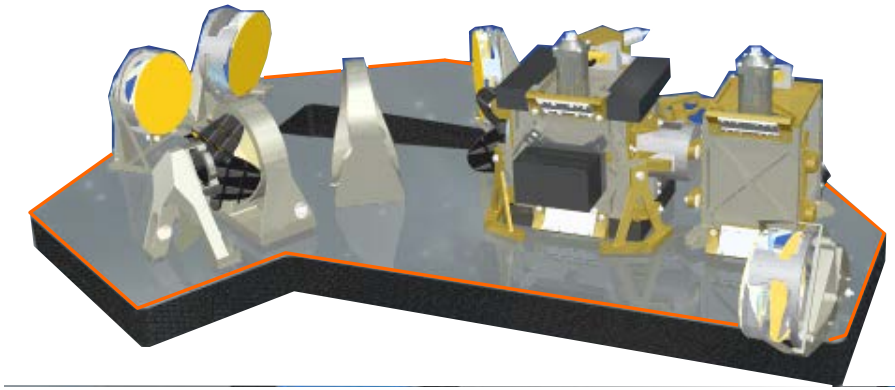
- IASI PFM-R / MetOp-B (IASI-B)
  - Cal/Val phase is ongoing

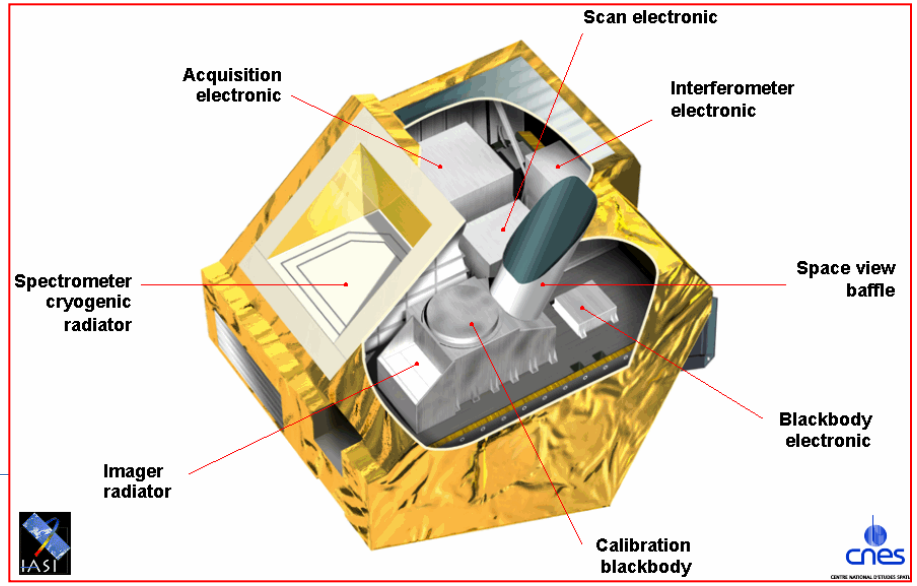
- IASI FM2 / MetOp-A (IASI-A)
  - Instrument is still fully operational after more than 6 years in orbit
  - Over past year, IASI-A was in Normal Operation mode during 98.18% of the time



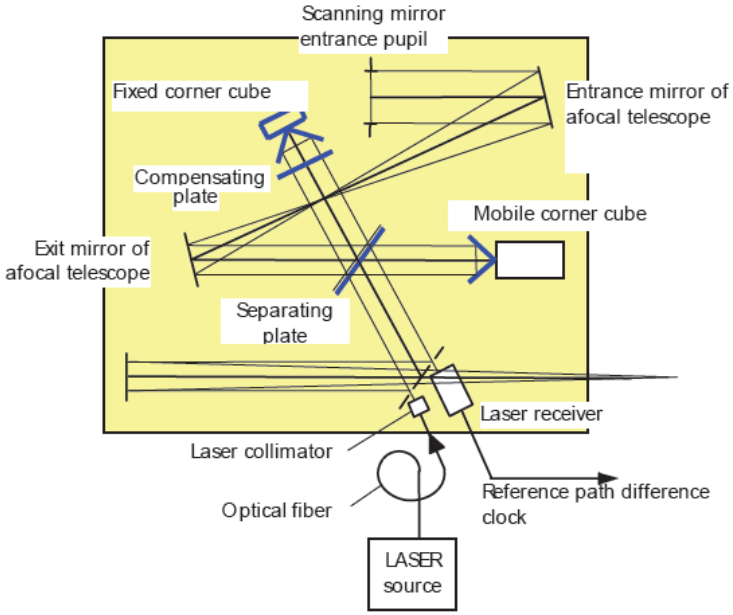
Instrument mode budget on period Sept. 2011 – Sept. 2012

Health status of both IASI's



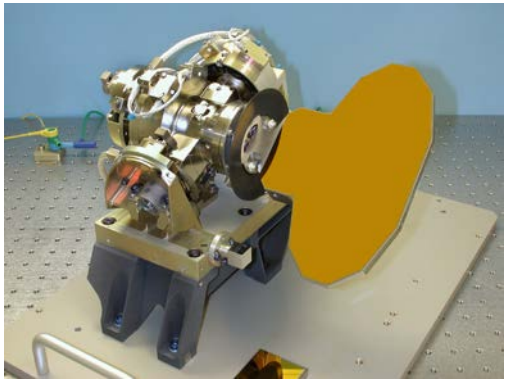


- Scan mechanism
- Interferometer
  - Thermal stability
  - Dimensional stability
  - Corner cube mechanism speed
  - Laser metrology
- BlackBody
- Cold Box
- Imager

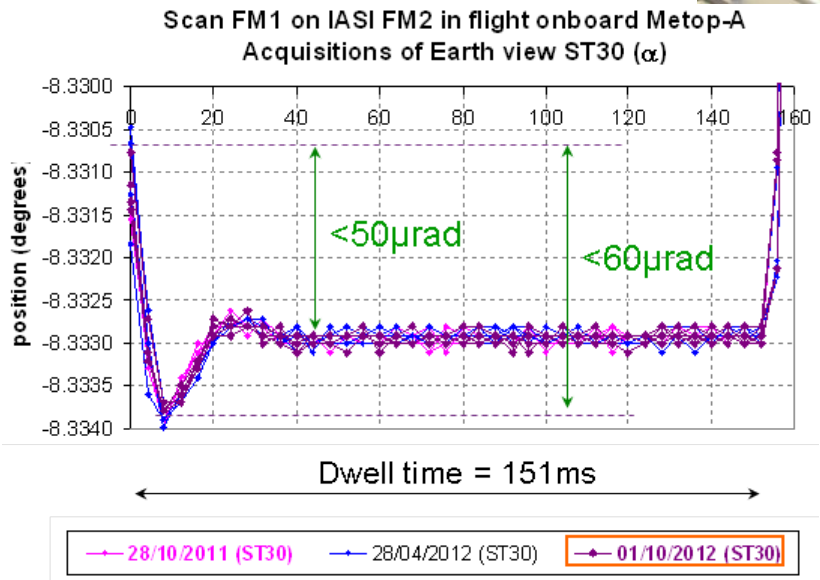


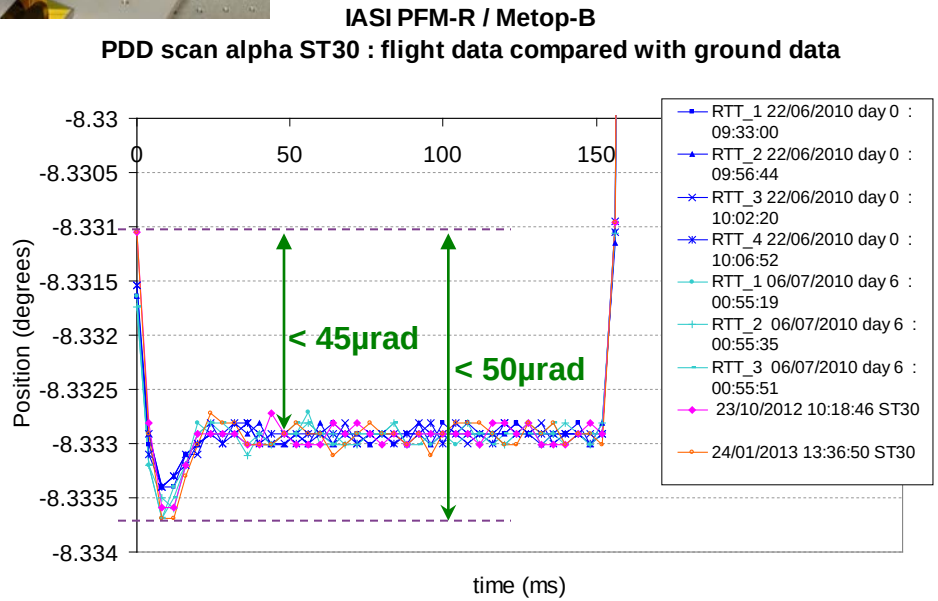
Scan mechanism

IASI-A



IASI-B



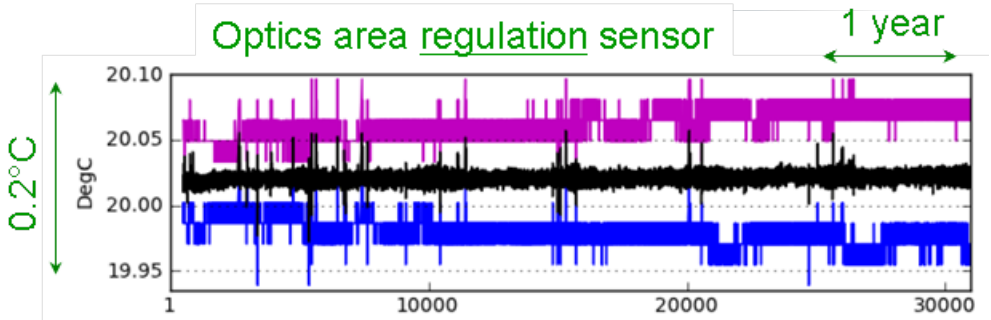


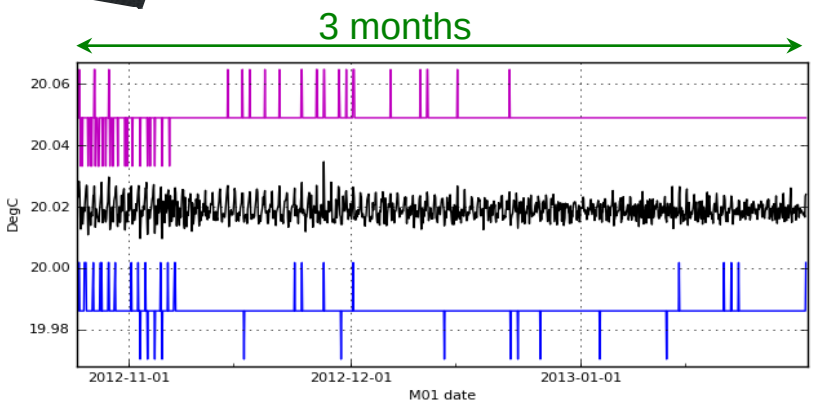
- Very good performance of both scan mechanisms
  - No sign of degradation on IASI-A after 6 years
  - IASI-B is very close to IASI-A and to on-ground test results

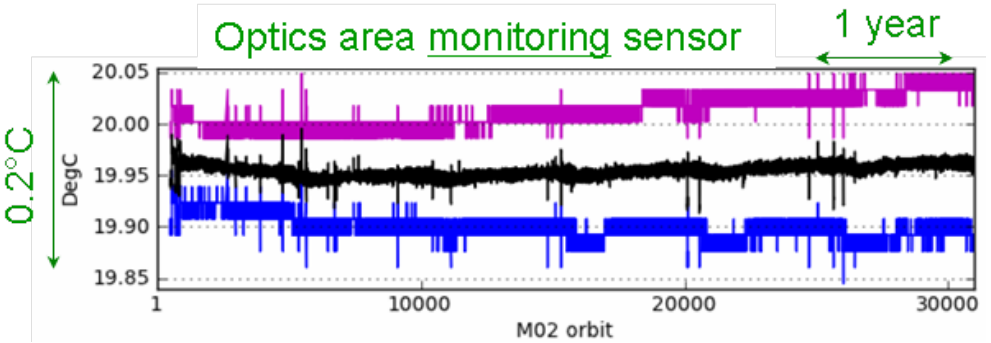
Optical bench thermal stability

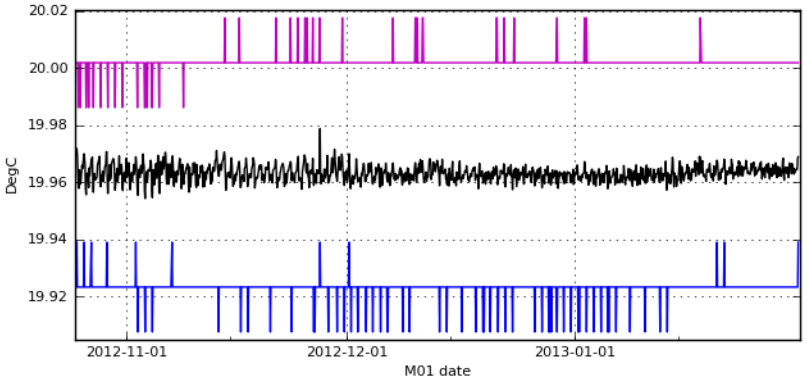
IASI-A

IASI-B





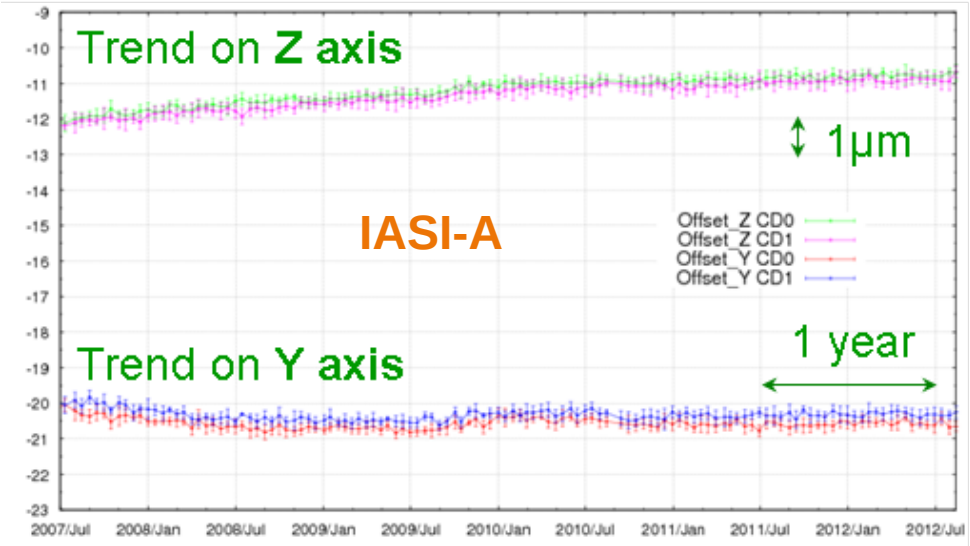




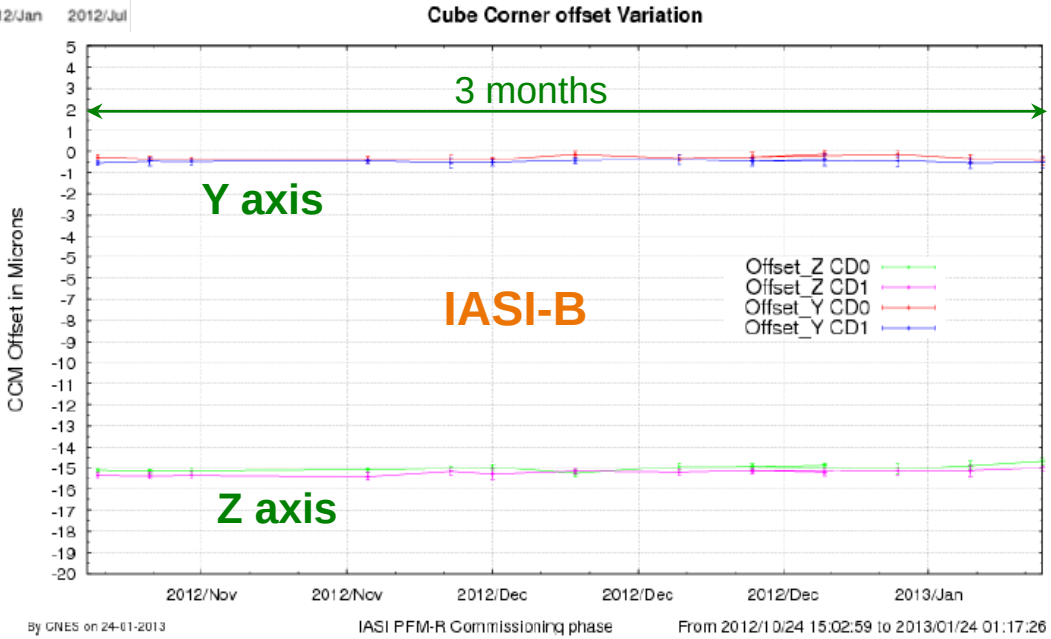
- Optical bench is perfectly regulated in temperature and stable
  - ±0.1°C since launch on monitoring sensor on IASI-A
  - same temperatures on IASI-B

Optical bench dimensional stability

Corner cubes (n°1 / n°2) co-alignment



- Stability of the cube corner co-alignment (constant offset)
  - ✦On IASI-B, results consistent with flight prediction done after optical vacuum test in 2006 (Y = 3 µm ± 4 µm, Z = -15 µm ± 4 µm)

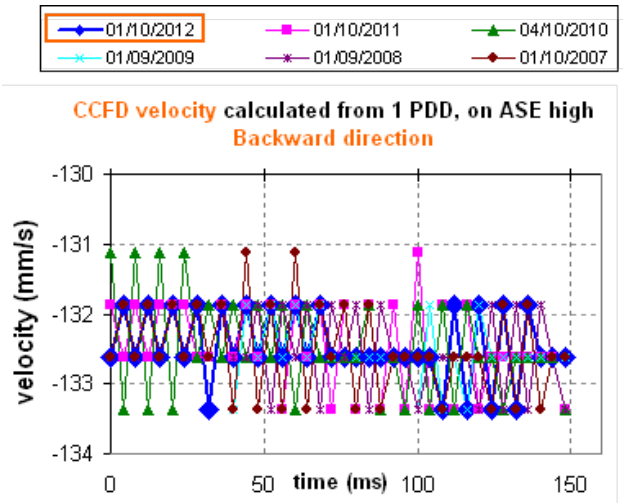


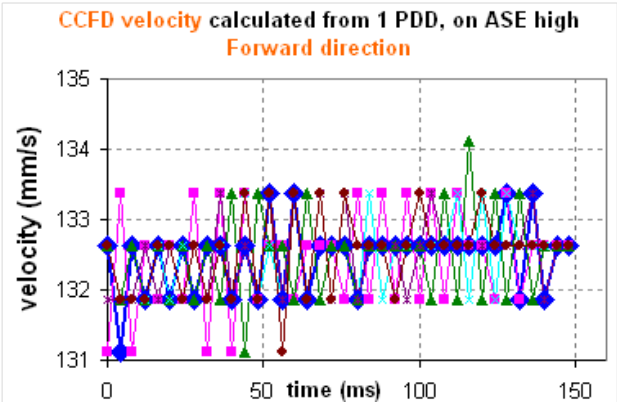
✦Very low drift << 1 µm/year on IASI-A, due to hygroscopic effect of the optical bench (carbon), close to the asymptote

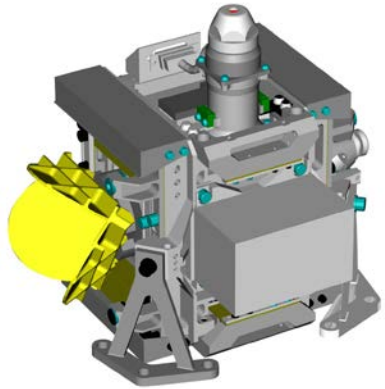
➔ no need to update the spectral database

Corner cube mechanism

IASI-A

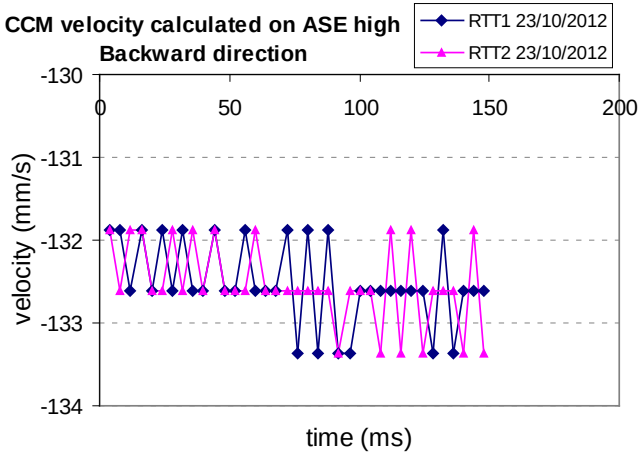


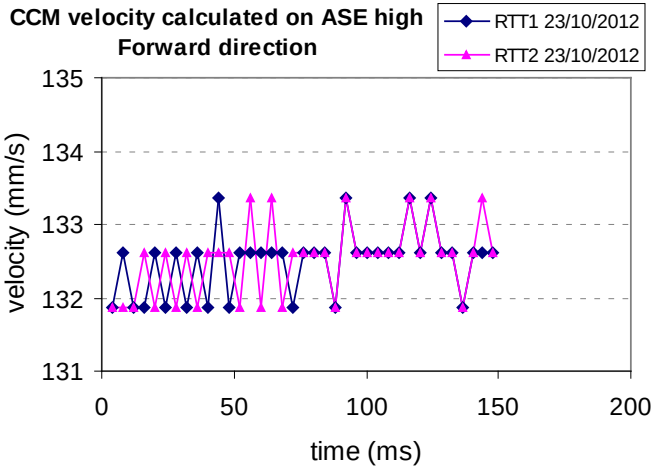




- Cube corner speed stability is very good on both IASI's
  - ✦No evolution over 6 years on IASI-A.
  - ✦Same profile for IASI-B and IASI-A
- Average speed
  - ✦Backward 132.5 mm/s
  - ✦Forward 132.5 mm/s
  - ✦Stability ±1 mm/s

IASI-B

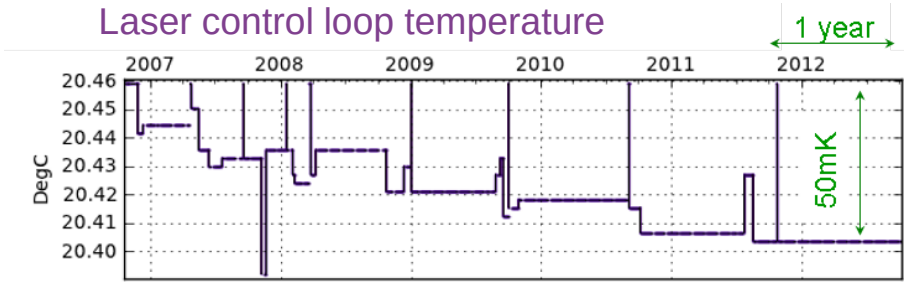




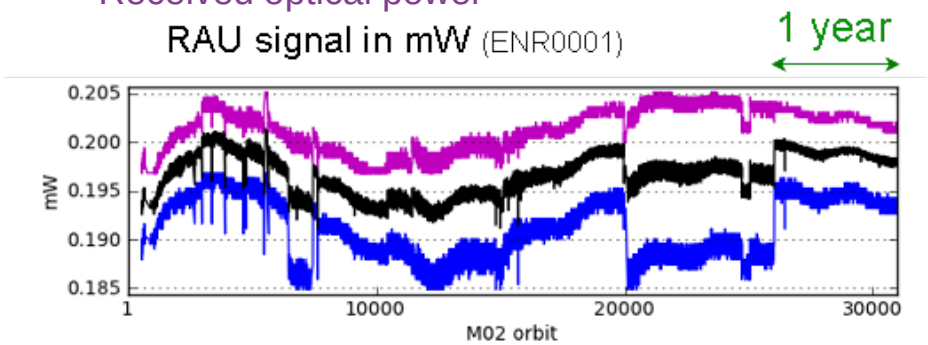
Laser metrology

IASI-A

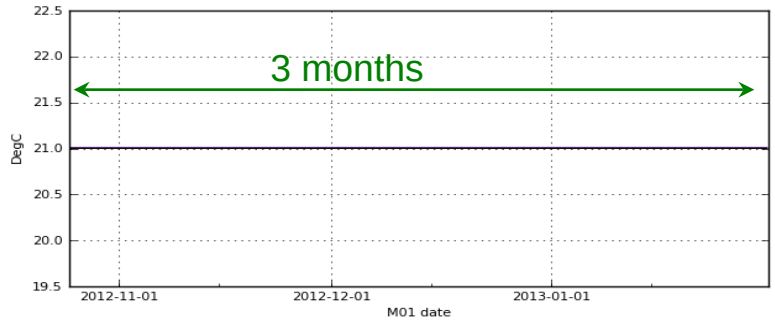
Laser control loop temperature

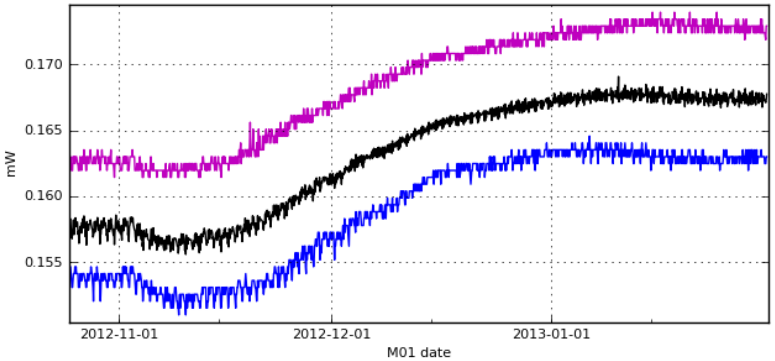


Received optical power



IASI-B

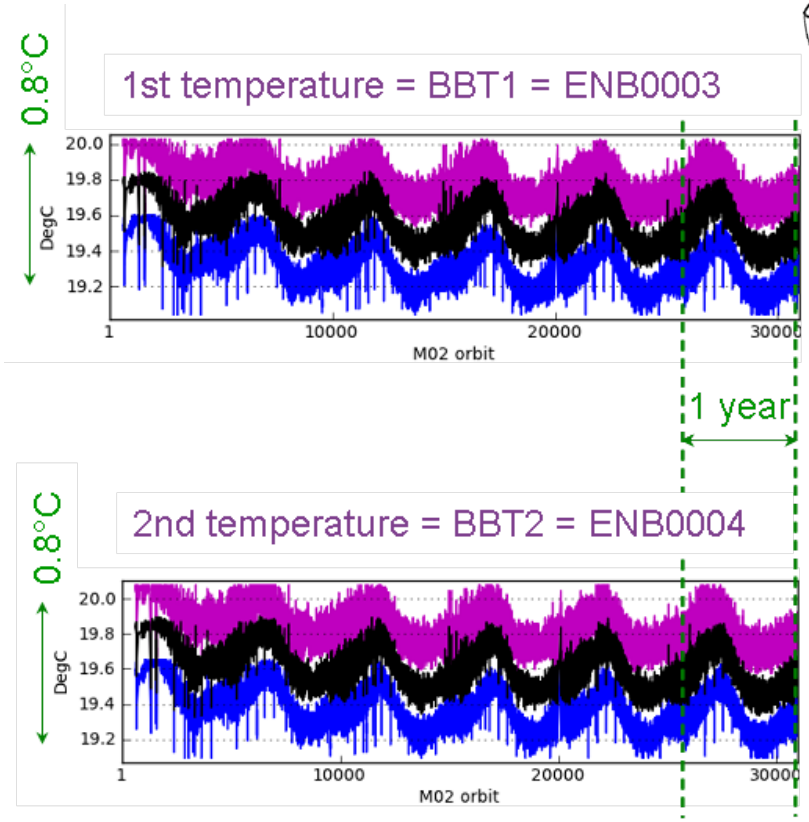


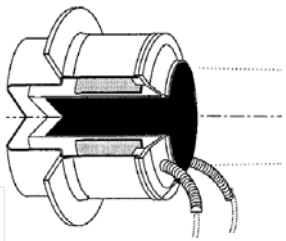


- Good stability of the functioning point of the laser control loop
  - ±50 mK evolution since beginning of life on IASI-A : slight drift of laser diode due to ageing, corrected by the wavelength control loop
- Low variations of RAU received power and good margin w.r.t. minimum functioning value (100 µW)

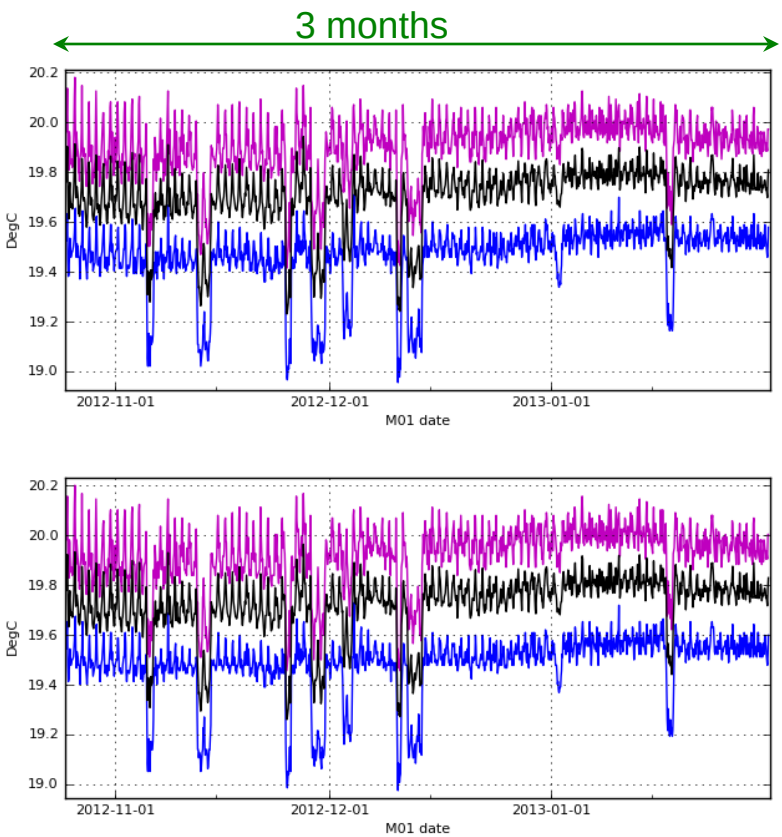
Calibration BlackBody

IASI-A





IASI-B

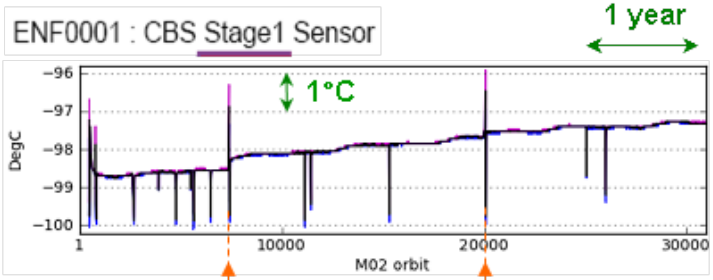


- BB thermal environment temperature very stable

➔ good stability of the radiometric calibration process

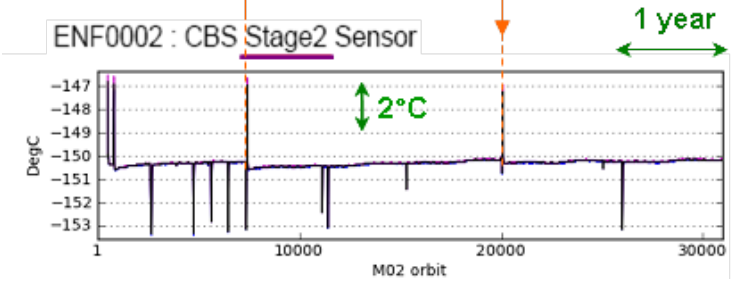
Cold Box Subsystem (1/2)

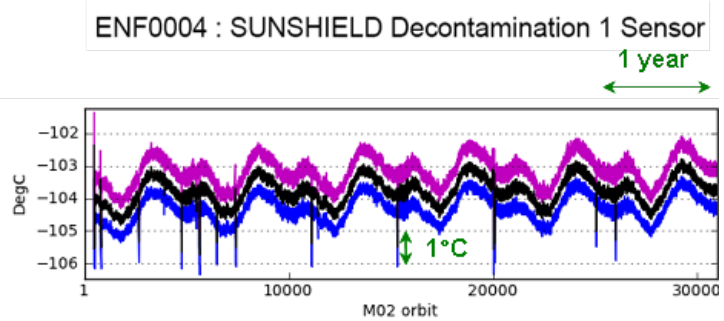
IASI-A

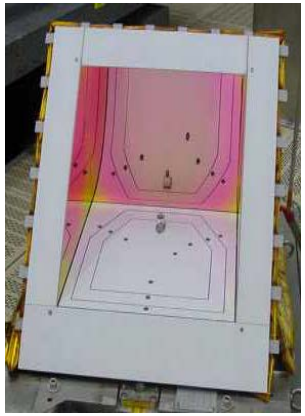


200K decontamination (March 2008)

200K decontamination (August 2010)

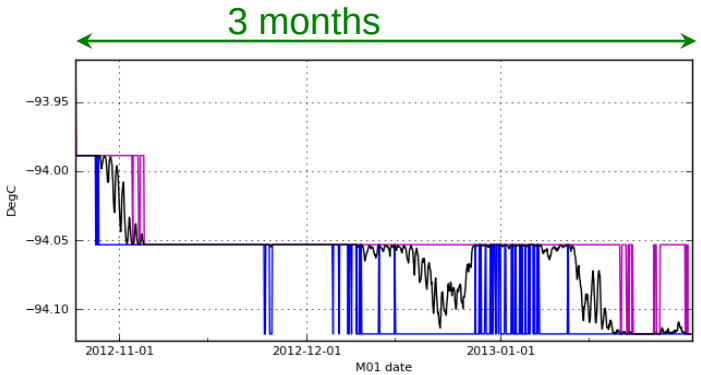


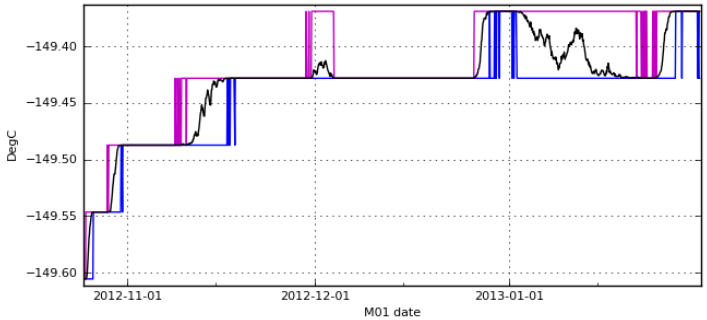


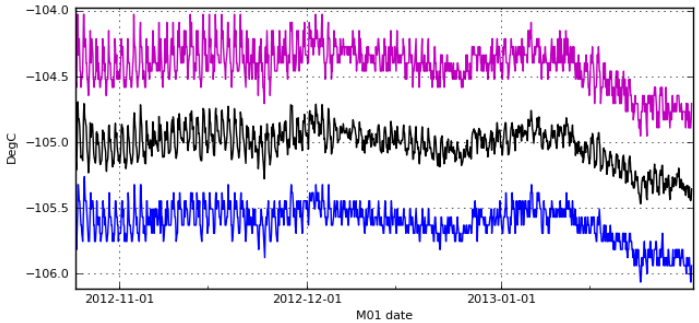


- Good stability of CBS non regulated stages temperature
  - Evolution < +0.2°C/year on IASI-A
  - Sunshield ≈+0.1°C/year : very low ageing of the gold coating
  - similar temperatures on IASI-B

IASI-B



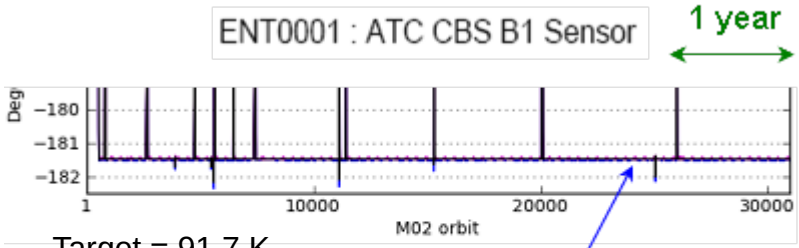




Cold Box Subsystem (2/2)

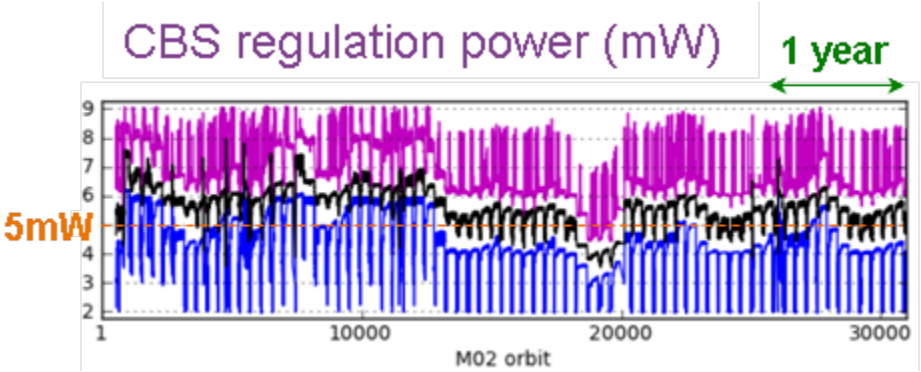
IASI-A

CBS third stage regulated temperature

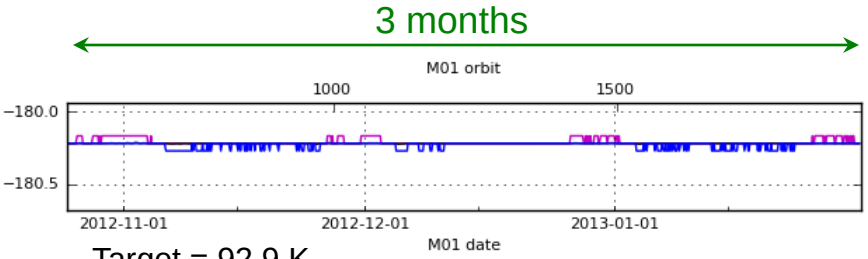


Target = 91.7 K

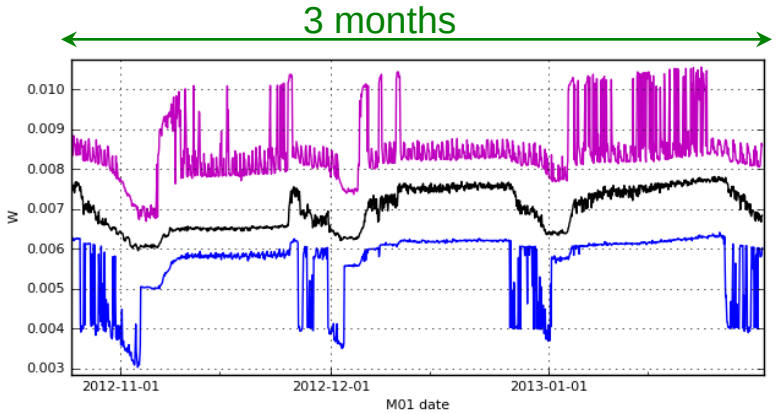
1 LSB accurate
ΔT < 50mK



IASI-B



Target = 92.9 K



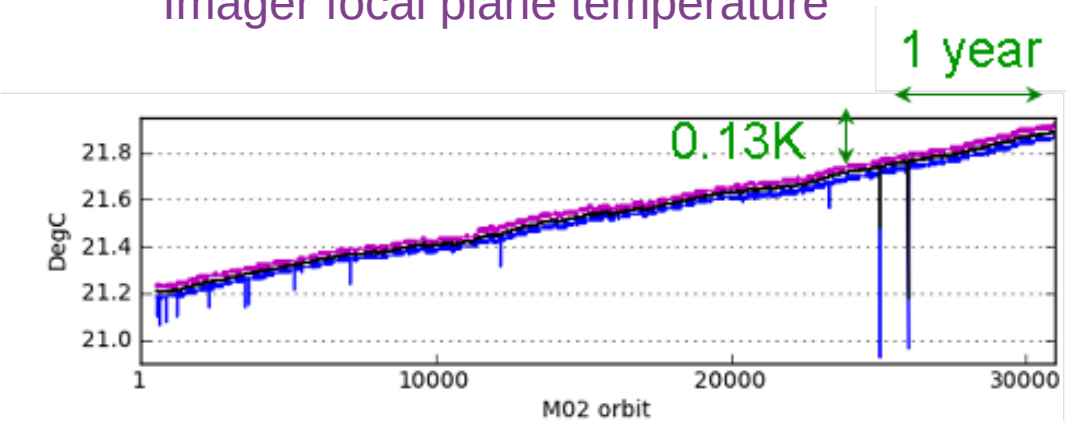
- CBS 3rd stage average regulation power
  - ✦5 mW after 6 years on IASI-A
  - ✦7 mW on IASI-B

  } ➔ no need to increase temperature target

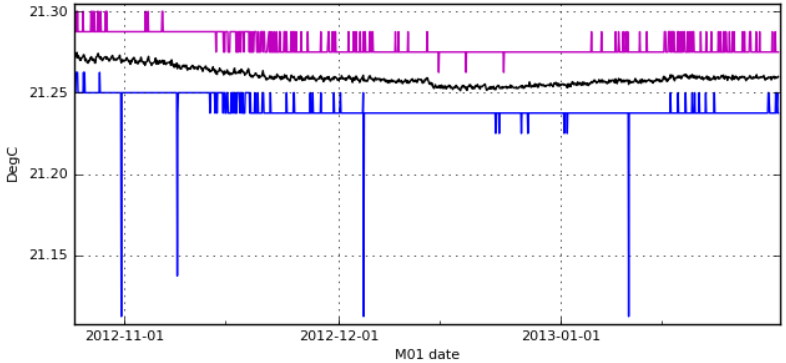
IASI Integrated Imager

IASI-A

Imager focal plane temperature



IASI-B



- Drift of ≈ +0.13 K/year of the bolometer temperature measurement
  - observed on ground between optical vacuum tests and in flight
  - on IASI-A the drift has been linear over 6 years
  - on IASI-B the temperature at beginning of life, compared to last optical vacuum test, is consistent with the same drift
- No impact on imager performance

Conclusion

- After more than 6 years in orbit, IASI-A instrument demonstrates a fully nominal and very stable behaviour, allowing very stable and very good performances

- 4.5 months after launch and 3 months after the start of Cal/Val phase, IASI-B status is also fully nominal
- IASI-B performances will be detailed in the next presentations

- The MetOp-B operations have been conducted in a very good spirit and cooperation between CNES IASI team and EUMETSAT

- Up to now, very positive feedback from IASI-A community of users... We hope it will continue with IASI-B !