

FIRST INTERNATIONAL IASI CONFERENCE

Thierry PHULPIN (1), Dieter KLAES (2) and Peter SCHLUESSEL (2),

(1) : Centre National d'Etudes Spatiales (Toulouse), (2) : EUMETSAT

Abstract : The First international IASI conference, organized by CNES and EUMETSAT, took place in Anglet (France) from 13 to 16 November 2007, only one year after the successful launch of the IASI instrument on the Metop-A platform. The main topics of the conference were: the performance of IASI, the impact of IASI on NWP, the clouds and surface parameters, climate and atmospheric chemistry. The performance of IASI was assessed by the IASI Technical Center in CNES and validated against NWP model output and airborne and balloon coincidence flights. The results showed that the radiometric performance of IASI is better than 0.5K, likely between (0 and 0.2 K). ECMWF was the first to assimilate IASI data and demonstrated already a significant impact of IASI on NWP – the largest single impact of any instrument despite coming on top of existing systems. The high spectral resolution of IASI is already showing benefits with several users describing techniques to use this information to retrieve surface and cloud properties – paving the way for even more beneficial use of IASI data in NWP. Other sessions during the conference concentrated on retrieval of cloud and aerosol properties and on the growing number of trace gases that can be detected in IASI data. This highlights another critical role of IASI in the monitoring of the Earth's climate over a long time period. The IASI Sounding Science Working Group is called to maintain a coordination on the development of IASI products and will assist CNES and EUMETSAT to organize a 2nd IASI conference in 2009.

Objectives of the first IASI Conference

Only 1 year after launch, 10 months after first data reception, and less than 6 months after the start of data distribution!!!

The objectives of the conference are:

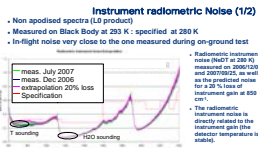
- to give the results on the instrument performances,
- to show initial results of assimilation of IASI in numerical weather prediction models,
- to present the results of the validation campaigns,
- to review the validity and consistency of the IASI products and get the feedback from the users,
- to provide an error estimation of the Level 1 and Level 2 products, to recommend further level 2 algorithm developments where needed,
- after the conference, some level 2 algorithm development and validation will continue under the coordination of EUMETSAT and CNES,
- to promote IASI,
- and broaden users community and applications.



IASI Instrument performances

Main contributions by :

D. Simonei (TAS), D. Blumstein, B. Tournier, T. Phulpin, D. Klaes, P. Schlüssel, R. Fjortoft, I. Gaudel, F. Girod



- Principal Components**
- Treat all bands together, no advantage to use granule eigenectors
 - Treat global number of granules (computationally efficient)
 - 150 Eigenectors sufficient to represent IASI spectrum
 - Static eigenectors work
 - Fast retrievals
 - Select partly cloudy/clear cases
 - Assimilation tests
 - PC Analysis of IASI spectra
 - Not uniform cosine LS effects
 - Small near FOV spectral calibration differences - through single PCs
 - Inter FOV spectral calibration, small differences, shows how well the instrument is working
 - How quantify PCA corrections ?
 - Robustness and accuracy under investigation
 - Collaboration is of interest
 - Application of corrected data to retrievals to see impact of correction

IASI Preprocessing

Main contributions by :

M. Goldberg, Borming Huang, D. Tobin, W. Wolf, N. Atkinson, P. Brunel

Compression

- Lossless compression
- PCA based
- Many different methods tested
- Factor 4.7 losses reachable (Predictive Partitioned Vector Quantisation PPVQ) (compared to JPEG2000, which is 4x)
- Hardware solutions intended: Compression on-board
- Work towards implementation
- CMSIS looking for partnerships
- IASI raw counts needed for testing

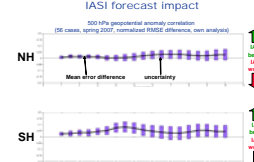
Global/Local

- AAPP (ATOVS and AVHRR Processing Package)
- Maintained by EUMETSAT NWP SAF
- ATOVS(AVHRR)IASI
- Selection of subsets
- Collocation with companion instruments
- Reconstruction schemes can be used to monitor instrument noise
- Local sw cannot necessarily deliver the same results as global because of different context files in the global granule processing
- Most data good enough for NWP

NWP assimilation and Monitoring

Main contributions by :

A. Collard, L. Fiedler, V. Guidard, F. Hilton, L. Garand, R. Randriamampianina, B. Ruston



Issues raised from NWP topic

- EUMETSAT / CNES must monitor and if necessary resolve "overflow" issues over extreme (but common) scenes
- NWP centres must seek to extend the use of IASI in other bands - in particular the water vapour bands
- NWP centres must investigate robust approaches to incorporating more IASI channels in the assimilation (e.g. PCA / L2)
- NWP centres must investigate approaches to extending the use of IASI (and others) over cloudy scenes and land / ice surfaces

Validation campaigns -Radiances

Main contributions by :

C. Camy Peyret, A. Larar, S. Newman, J. Remedios, F. Best, H. Revercomb, L. Strow, J. Taylor

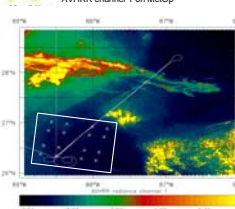
- Approaches:**
- Comparison with ground based instruments (D-RES, NASTL, ARES) - JMWV campaign, Texas, U.S.
 - Comparison with balloon based instruments (SIS Balloon) - Esrange, Kiruna
 - Comparison with simulated spectra using radiometers and other in situ measurements and/or NWP model facts as input for RTM.
- Results - spectral accuracy:**
- Based on comparison with modelled spectra, specification of 2×10^{-4} seems to be in general achieved.
 - However, some also presented by B. Tournier et al. Under Topic 5 regarding "radiance variability at short wavelengths (spectral radiance) - midwave IR"
 - More accurate characterization of true spectral accuracy (beyond spec) may be limited by applied methods.
- Results - radiometric accuracy:**
- Specification of 0.5 K for absolute calibration achieved
 - Assessment against highly accurate airborne radiometers (± 0.05 K) shows that total accuracy must better be 0.2 K. These balloons measurements affected by problems during campaign
 - IASI and ARES have comparable biases (0.1 - 0.2 K)
 - Some similar radiometric observations may reveal that instrument consistency of ± 0.2 K - in-flight characterization of biases to be confirmed.
 - The ARES science team has found "toxic days" to be very valuable.
 - The ability to reproduce on these toxic days has proven to be valuable for checking the radiometric accuracy and the consistency of radiometers.
 - As developer's algorithms become more robust the assessment of "shift" with temperature and moisture should include a discussion of averaging kernels and internal error estimates.

Validation campaigns -Products, properties

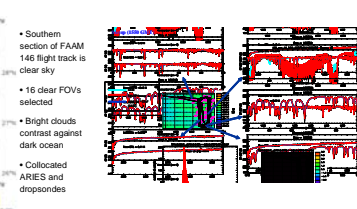
Main contributions by :

M. Kruglanski, F. Montagner, F. Rabier

Gulf of Mexico, 30 April 2007
AVHRR channel 1 on MetOp



NAST-1 vs IASI spectra



Temperature Water Vapour retrieval

Main contributions by :

R. Knuteson, L. Lavanant, Jun Li, Xu Liu, C. Serio, Jon Taylor, R. Armante, G. Grieco, A. Gambacorta

- Main Issues**
- It might be a good idea to have validation datasets coordinated by the IASI program.
 - To ensure all ancillary information is available.
 - Archive these datasets for future generations.
 - Uniformity of datasets to encourage reuse.
 - For early datasets: provide a representation of L1c with most recent updates.
 - Consider the use of data from other campaigns that are available and pointing to high resolution of cloud providers.
 - Developers of retrieval algorithms should be encouraged to test their methods on these validation datasets.
 - IASI and ARES have comparable biases (0.1 - 0.2 K)
 - Some similar radiometric observations may reveal that instrument consistency of ± 0.2 K - in-flight characterization of biases to be confirmed.
 - The ARES science team has found "toxic days" to be very valuable.
 - The ability to reproduce on these toxic days has proven to be valuable for checking the radiometric accuracy and the consistency of radiometers.
 - As developer's algorithms become more robust the assessment of "shift" with temperature and moisture should include a discussion of averaging kernels and internal error estimates.

- Some ideas to make IASI better**
- IASI has great potential for climate applications and recording the state of the atmosphere for future generations.
 - For weather applications the bias of 2% of the spectra is irrelevant, but for climate any systematic bias is an issue that needs to be removed entirely.
 - What is the process to make climate concerns have a high priority?
 - An example: Observation that some of the radiances that are archived had to be correlated with cloud top.
 - When L1c to radiances is flagged bad (CloudFlagQual < 0 or otherwise set to zero) would be useful to have more information in L1c file.
 - For example, could the cause of the flag be added to the L1c file.
 - On-orbit issues
 - Alternatively, can these spectra be made available with changes to the calibration.

IASI Conference: 7- Trace Gas Retrieval & Chemistry

- CO₂**
- The challenge here is to achieve precision better than 1% that MAY provide a thermal IR contribution to carbon budget studies
 - Multi-spectral techniques will be investigated to determine temperature and CO₂ signal dependencies using AIRS/A or at the shortwave region of the IASI spectrum - perhaps with IR noise reduction?
- Validation:**
- In general, initial validation looks good
 - A comprehensive validation approach is essential: this will be cross-scale and involve comparison with other satellite instruments, data taken during aircraft field campaigns (e.g. POLARCAT) and monitoring programs (e.g. MOZAIC), and surface remote sensing and monitoring

IASI Conference: 7- Trace Gas Retrieval & Chemistry

- Retrieval:**
- Early experience is already indicating where future improvements would be beneficial to address, for example, optimal estimation forward model speed, surface characterization, view angle dependency, other species retrievals?
 - Chemistry and transport studies:
 - Work has already started and there is potential for future studies looking at correlations between IASI species (e.g. CO, CO₂, C₂H₆, C₂H₄) or IASI in combination with other instrument retrievals (e.g. GOMEZ, IASI CO₂, active and reservoir nitrogen - GOMEZ, NO₂, IASI H₂O, lower and upper tropospheric transport - IASI COMILS CO, diurnal transport - IASI COVARS CO)
 - Applications:
 - Potential for a major impact on air quality forecast skill with assimilation of IASI data (CO₂, CO₂) into global and regional chemistry transport models.
 - The excellent IASI geographical coverage of chemical fields will aid field campaign flight planning and data analysis

Radiative Transfer and Spectroscopy

Main contributions by :

A. Perrin, N. Jacquinet, M. Matricardi, L. Strow

Theme 4: Radiative transfer and spectroscopy

- Spectroscopy**
- Where we are
- GEISA/AD: Dedicated database for IASI (16 molecules, 14 cross sections and optical properties for retrieval)
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- Open issues
- Identify possible deficiencies in databases (e.g. in RTM related activities of participants)
 - How can the database be improved with the recent IASi studies?
 - How can the database be improved with the recent IASi studies?
- Steps forward
- Share findings/progress in RTM to improve on level 2 products
 - Spectral emission channels to be delivered in operational level 2?

Theme 4: Radiative transfer and spectroscopy

- Radiative transfer models**
- Where we are
- Several radiative transfer models have been shown, each with its own cross sections and optical properties for retrieval
 - Several radiative transfer models have been shown, each with its own cross sections and optical properties for retrieval
- Open issues
- Impact of the spectroscopy in the RTM for the different IASi applications (line mixing in CO₂, linearity in CO₂, line shape problem (e.g. NDOP) formation of the order correlation function (OCF) effect)
 - Implementing spectral similarity features (day/night) in RTM
 - Impact of aerosols?
- Steps forward
- Share findings/progress in RTM to improve on level 2 products
 - Spectral emission channels to be delivered in operational level 2?

Clouds and aerosols

Main contributions by :

X. Cabet, JP Chaboureaud, Allen Huang, L. Strow

Clouds and aerosols- issues and future activities

- Recognises the importance of the IASI L1c AVHRR clusters (thanks to CNES and F. Cayli)**
- Need of a cloud detection as a pre-processing step before further processing (profile retrievals, trace gases retrievals, ...)
 - Users are not necessary experts in cloudless detection
 - simple cloudless mask package (with and without external NWP information)
 - additional cloud information (flag, cloud parameters, ...) inside IASI A day/2 files (IASI/12 ?)
 - IASI cloud-related reference scene values (IASI/11 ?)
 - Importance of spectral shift correction for heterogeneous scenes for retrieval in partly-cloudy conditions
- Recognises the importance of field campaigns to validate retrieval cloudless products for their use in NWP applications**

Perspective

The early outcome of good results with IASI is analyzed as the result of a good preparation thanks to the ISSWG. The potential of IASI is so high that the area still open to scientific development is very broad. A coordination of the scientific activities around IASI will permit to incorporate the innovative development into the IASI products and take the largest benefit for all the community. The exchange of information remains very essential. Therefore, after the success of this conference, CNES and EUMETSAT decided to organize regular conferences (every 1.5-2 years) in coordination with ITSC. A ISSWG-2 will be set up it will have to update the Science Plan to detail the work to further exploit the IASI mission, assist EUMETSAT and CNES in the selection of advanced/new methods to be applied in the EPS Ground Segment (and IASI TEC), advise EUMETSAT and CNES on requirements and methods for instrument calibration and validation, advise EUMETSAT and CNES on new applications and products from IASI and co-passenger instruments, provide recommendations for further studies. Participate in the co-ordination of the IASI scientific activities in their field, participate in technical reviews of the IASI project to advise on implications for mission and scientific objectives, generate scientific reports and publications in the framework of the ISSWG activities, advise EUMETSAT and CNES on new scientific developments necessary to maximize the benefit of IASI. It will also help to help in the organization of the conference

More

More information on : <http://smc.cnes.fr/>
<http://ether.ipsl.jussieu.fr>