Summary of the sessions

Prepared by the chairpersons and the Scientific Committee

Overall sessions

- IASI instrument and ground segment status
- Intercalibration
- Numerical weather prediction
- Radiative transfer and spectroscopy
- Clouds and aerosols
- Atmospheric composition
- Climate
- Surface applications
- Retrieval techniques
- Other infrared sounders
- IASI-NG

IASI instrument and ground segment status

- IASI is a major contributor to the success of the EUMETSAT Polar System (EPS) thanks to the cooperation with CNES and Industry
- It is important to continue and to improve in the areas of :
  - weather forecasting
  - knowledge of atmosphere composition.
  - climate monitoring.
- Long term plans are in place

IASI instrument and ground segment status

- After more than 6 years in orbit, the 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
- Initial comparisons demonstrate a radiometric consistency between IASI-B and IASI-A in the 0.1 K range

Intercalibration

- Two IASI instruments on two MetOp platforms on the same orbit with 50 mn time difference
- Simultaneous nadir observations (SNO) with IASI-A and IASI-B not directly possible, but several intercomparison techniques (same IFOV and nadir angle within 50 min difference, double differences, transfer by another reference sounder) demonstrate consistency and interpixel differences in the 0.1 K range
- In addition to AIRS and IASI-A/IASI-B, CrIS is now usable for intercalibration with some indications of differences in the beginning of LW band (650 cm^{-1}) with the 3 other sounders
- A first Cal/Val campaign a kind similar to JAIVEX is planned
- Validated data bases of independent atmospheric profiles are key to continue monitoring of the radiometry of the IR sounders. They should be more widely used to improve forward radiative transfer models. Additional efforts should be given to their inter-comparison and availability in connection to a selected set of IASI-A/B spectra.
- IASI/A is now the reference for IR instruments for GSICS. IASI/B will certainly get the same status.

Numerical weather prediction

- Global models not only use clear IFOVs but use all selected channels down to the cloud top, but proper use of cloudy IFOVs is still a challenge
- But IASI has the potential to provide information on cloud microphysics as demonstrated by several presentations on the subject
- Principal components (PC) assimilation systems have been developed and tested. The tools are there (PC-RTTOVS) in two NWP centres but more tests and optimization of the covariances matrices are needed. But interesting approaches were presented for describing the correlation between errors
- The mid-term strategy for assimilation of PC scores is still to be defined (clear pixels only?)
- Some NWP centres using IASI data were not represented during this conference
- But overall NWP centres have made large efforts to use IASI data at best with a lot of work put in tuning the models to use cloudy IFOVs and increase the impact of the assimilated IASI radiances

Numerical weather prediction

- IASI is the main contributor among all satellite instruments. A larger number of presentations could have illustrated better the role of IASI in global NWP.
- But progress is constant with more and more channels and IFOVs being assimilated
- Only a few NWP centres do use IASI for regional/mesoscale forecasts despite its demonstrated interest
- The state of the art (80 km resolution and 1 pixel out of 2) have demonstrated the positive IASI impact for forecasting precipitations

Radiative transfer and spectroscopy

- The spectroscopy of HNO_3 (a species contributing in 3 IASI spectral domains) has illustrated the importance of constant improvement in the line-by-line parameters databases (GEISA and HITRAN)
- LBL parameters and cross-section are still to be improved for trace species. HCOOH was a good example when comparison is attempted with emission fluxes (based on inventories or surface measurements)
- The number of trace species “seen” by IASI (more than 20 species including isotopomers) is widely exceeding the most optimistic estimations when IASI was designed and launched
- Progress is needed in the parameterization of aerosol and cloud optical properties: at present IASI data is often providing the only real “nature run” for coarse aerosol (ash, dust). More laboratory/ground based measurements of the corresponding IR properties would be needed (microphysics of ice particles and the corresponding optimized channel selection)
- RTTOV is available provided the input parameters are proper (real and imaginary indices and their spectral dependence)

Clouds and aerosols

- The information contained in IASI spectra on clouds and aerosols is impressive and their characterization is making large progress
- Several presentations and posters demonstrated these advances. Nevertheless methods are based on specific spectral windows without using the spectral information on cloud/aerosol with the T/H_2O profiles retrieved from the same spectra. More attention should be given to the fact that geophysics is coupling thermodynamics and microphysics of IR active particles.

Atmospheric composition

- Progress in the use of IASI data for characterizing tropospheric ozone at the megacity scale has been impressive to understand pollution and air quality (AQ). The impact of stratospheric intrusion is still to be properly modelled or accounted for
- Results with IASI for AQ are convincing. More work should be done to convince AQ agencies to use IASI products.
- The groups involved and present at this conference were from France and Belgium. More advertising on the IASI results and IASI conference could attract the attention of other groups working on this topic elsewhere
- A first real demonstration of the coupling between IASI (IR) and GOME-2 (UV) has been presented
- The generated products (for O_3) are not always Eumetsat L2 products and some harmonization should be attempted in order to reach stable and validated products for lower tropospheric ozone with possibly a better coordination between the partners (SAF, MACC). But several approaches are good to assess the final uncertainty of the corresponding IASI products.

Atmospheric composition

- But the number of original results derived from IASI on atmospheric composition is huge covering a wide variety of processes (fires, pollution events, volcanoes, …)
- Mid to long trends of trace species (CO in particular) derived from IASI (globally) have been presented and demonstrate the consistency between the dedicated sounder MOPITT and the more generic sounder IASI for long time series of the CO pollution tracer
- This confirms the need of homogeneous and consistent data sets for monitoring long term trends
- The impact of clouds on the quality of retrievals of traces species and particles is still an issue that needs more consideration (for the quality insurance of the products)
- Validation of the atmospheric composition products should be continued. In many cases IASI is providing global data that cannot be easily validated. But ground based high resolution FTIR spectrometers have been shown to provide a good correlative set of measurements provided the time/space variability is accounted for

Atmospheric composition

- Chemical process studies are now achievable with IASI and the secondary production of HCOOH in pollution plumes is an example where a satellite IR sounder can document tropospheric chemistry reactions not easily reproduced/understood in the laboratory
- Information on surface emission of trace species is now feasible with IASI data. Very interesting examples of the time dependence of the sources were given both for gases emitted during volcanic eruptions (SO_2) and major wild fires (CO, HCN, HCOOH, C_2H_2, …)
- The impact of IASI in near real time monitoring of volcanic eruptions is major and now IASI is used operationally.
- Several presentations covered the D isotope of water using optimized retrieval methodologies for HDO/H_2O . This ratio can be used as a diagnostic for microphysical processes in the water cycle (condensation/evaporation)
- More isotopomers should be looked in the IASI spectra (CH_3D, ^{13}C compounds, …)
- The new retrieval methods are good examples of what can be done from high quality (resolution, SNR, coverage) infrared spectra

Climate

Initial steps to use IASI radiances in climate study (either based on radiances or on retrieved products)

Probability density functions (pdf) of radiances in some spectral channels gives interesting indications on the trends

Methane in mid troposphere as retrieved from IASI in the tropics has been validated and is now assimilated in MACC. Sensitivity to low levels in some favorable cases. Climatology performed with IASI+AIRS show increase in the very last years

The group strongly recommends that reprocessing of Level 1c IASI-A data is performed shortly by Eumetsat (operational data available from July 2007)

Climate

- Validation of IASI climate products is challenging
- Radiometrically stable and spectrally well calibrated IASI spectra are by more global, consistent and long term as compared to very diverse ground-based measurements far or sondes
- Intercalibration/intercomparison of IR sounders is essential
- Use of IASI climate quality data in ESA CCI and GMES/EU MACC should be enhanced (good examples are the validated CO and CH_4 climatologies based on IASI)

Surface applications

- Emissivity impacts most of atmospheric variables derived from IASI.
- Even if some progress has been made more work remains to be carried out.
- If ground-based validation is not very representative because the difference in spatial scales, cross validation between IR instruments should be encouraged.
- First indication of a possible day/night variation of emissivity (not the same in all channels)
- Very interesting IASI derived emissivity databases developed and available (Eumetsat, LMD)

Retrieval techniques

- IASI retrievals have been generated since 5 years
- Retrievals algorithms have reached maturity and are operational in near real time for many products (Eumetsat and several institutes)
- But progress can still be done in the retrieval algorithms:

  - Optimized state vector variables ln(HDO)-ln(H_2O)

  - better and more physical *a priori* variance/covariance matrices with possibility of adaptative matrices

  - reducing the dimensionality from data space to parameter space (PC, but not only)

Other infrared sounders

- CrIS is now in orbit and will complement the IASI sounders (A and B) on a different orbit (13:30 Equatorial LT)
- Cross-calibration and monitoring of possible IR sounder differences as times goes (long term Joint Polar System)
- GEO sounders are coming up: China and US are actively going into this direction. MTG/IRS Eumetsat/ESA programme is on track
- One new Russian IR sounder to be launched soon

IASI-NG

- The MetOP-SG progamme is on track with the next generation of European instruments including IASI-NG and the synergy with Sentinel 5 (TIR/UV and TIR/SWIR synergies)