IASI Level 2 Product Processing

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Infrared Atmospheric Sounding Interferometer (IASI)

• Michelson-Interferometer: 8461 spectral samples
• IFOV diameter: 12 km (nadir)
• Scan interval (horiz.): 25 km (nadir)
• Swath width: ±48.33° (2200 km)
• Spectral domain: 645 - 2760 cm⁻¹ (3.6 – 15.5 µm)
• Spectral resolution: 0.5 cm⁻¹
• Radiometric resolution: 0.07 - 0.7 K (bands 1, 2)
• Absolute calibration: < 0.3 K
• Data rate: 1.5 Mbit/s
• Internal imager: 10-12 µm
• Temperature- and humidity profiles, O₃, CO, CO₂, CH₄, N₂O, ...
First IASI spectra on 29 November 2006
L1 Products operational since 29 May 2007
IASI level 2 product generation

Pre-Processing

Cloud Processing

Geophysical Parameters Retrieval

Monitoring Information

Level 2 Product

Quality Information
Properties of the Operational IASI L2 Processor (1/3)

• For a best use of IASI measurements the level 2 processing combines IASI with concurrent measurements of AVHRR and AMSU-A to detect clouds and to derive cloud parameters.

• IASI stand-alone processing is used for geophysical parameters retrieval.

• Inclusion of NWP forecast:
  — Surface pressure as reference for the profiles to be retrieved.
  — Surface wind speed over sea for the calculation of surface emissivity.
  — Temperature and water-vapour profiles for cloud detection and CO$_2$-slicing.
Mapping of AVHRR in IASI-IFOVs
Properties of the Operational IASI L2 Processor (2/3)

• Processing is steered by configuration settings (80 configurable auxiliary data sets), which allows for optimisation of PPF

• Online quality control supports the choice of best processing options in case of partly unavailable IASI data or corrupt side information (data from other instruments or NWP forecast)

• Besides error covariances a number of flags are generated steering through the processing and giving quality indicators; 40 flags are specified, which are part of the product, a sub-selection directly relevant for the user is disseminated with the product
Properties of the Operational IASI L2 Processor (3/3)

• Different retrieval methods are implemented so that the best configuration can be chosen based on validation results, so far:
  
  — EOF regression retrieval using all spectral samples of bands 1 and 2 for temperature and moisture retrieval, surface temperature, emissivity, and ozone columns
  
  — Iterative retrieval based on 235 spectral samples

• Band 3 has been removed from temperature and humidity sounding
  
  — Insufficient capabilities to include solar radiation (too time consuming)
  
  — NLTE effects not modeled
  
  — Suffers from high noise compared to bands 1 and 2
**Geophysical parameters retrieval:**

**state vector to be retrieved**

- The state vector to be retrieved consists of the following parameters
  - Temperature profile at high vertical resolution
  - Water vapour profile at high vertical resolution
  - Ozone columns in deep layers (0-6km, 0-12 km, 0-16 km, total column)
  - Land or sea surface temperature
  - Surface emissivity at 12 spectral positions
  - Columnar amounts of N$_2$O, CO, CH$_4$, CO$_2$
  - Cloud amount
  - Cloud top temperature and pressure
  - Cloud phase

- In case of clouds and elevated surface the state vector has to be modified
Correction of systematic errors

- All retrieval and assimilation schemes use radiative transfer calculations as basis
- Prerequisite for the functionality of the retrieval or assimilation is a good representativity of the measurements by simulated radiances
- Systematic errors:
  - Approximations necessary for fast calculations
  - Insufficient knowledge of spectroscopic data
  - Erroneous input data
- Systematic fit of models to IASI measurements
Cloud processing

• Cloud detection
  – AVHRR-based cloud detection using Scenes Analysis from AVHRR Level 1 processing
  – Combined IASI / ATOVS cloud detection
  – IASI stand-alone cloud detection

• Cloud parameters retrieval
  – Cloud fraction (CO$_2$-Slicing)
  – Cloud top pressure and temperature (CO$_2$-Slicing)
  – Cloud phase
Cloud parameters retrieval

AVHRR: 10.8 µm

IASI: Cloud top temperature

IASI: Cloud top pressure
Discrimination of ice and water clouds

![Graph showing discrimination between clear sky, water cloud, and ice cloud](image_url)
Cloud Cover – 16 October 2007
Number of Soundings in Global Datasets

• IASI soundings are possible only in clear or nearly clear fields of view

• The fraction of clear or almost clear IASI soundings:
  - N = 0:
  - N < 2%: 15% (varies between 12 and 24% among different orbits)
  - N < 5%: 16%

• Fraction of useful soundings depending on atmospheric level
  - 860 hPa: 52%
  - 700 hPa: 54%
  - 500 hPa: 62%
  - 300 hPa: 90%
  - 200 hPa: 95%
Temperature at 860 hPa: 16 October 2007
Temperature at 500 hPa: 16 October 2007
Temperature at 200 hPa: 16 October 2007
Specific Humidity at 860 hPa: 16 October 2007
Specific Humidity at 700 hPa: 16 October 2007
Surface Skin Temperature: 16 October 2007
10 Day Average SST: 16-25 October 2007
Comparison: ECMWF / IASI

Clear situations
May – June 2007

Land: 1330 match-ups

Ocean: 21810 match-ups
Comparison: ECMWF – IASI L2
Validation Campaigns

- Met Office, airborne campaign, North Sea,
  - 2 February 2007
- JAIVEx, Gulf of Mexico, Oklahoma CART site
  - 18 April – 4 May 2007
- RV Polarstern
  - 12 April – 4 May 2007
  - 26 October – 26 November 2007
- Arctic Observatory Sodankylä, FMI, Finland
  - 4 June – 5 September 2007
- Richard Aßmann Observatory Lindenberg, DWD, Germany
  - 1 June – 31 August 2007
Validation Campaign at FMI Arctic Observatory Sodankylä

- 4 June – 5 September 2007
- Observations:
  - 360 PTU sondes
  - 40 ozone sondes
  - 7 CFH sondes
  - MW radiometry WV column
  - GPS WV column
  - Brewer columnar ozone
  - Aerosol optical depth
  - Surface meteorological observations
- Data have been post-processed and quality controlled by cross-comparison
Validation Campaign at DWD Laboratory Lindenberg

- 1 June – 31 August 2007, to be continued in winter 2007/2008
- Observations:
  - 290 additional PTU sondes
  - 36 ozone sondes
  - 34 reference sondes
  - Raman lidar (WV)
  - MW radiometry
  - GPS WV column
  - Brewer columnar ozone
  - Aerosol optical depth
  - Ka-band cloud radar
  - Ceilometer
  - Surface meteorological observations
- Data have been post-processed and quality controlled by cross-comparison
Dissemination to Users

- The product is broken down into 5 streams:
  - **TWT**: Atmospheric temperature profiles, atmospheric water vapour profiles, surface skin temperature
  - **OZO**: Atmospheric ozone
  - **CLP**: Cloud parameters
  - **TRG**: Atmospheric trace gases CO, CH$_4$, N$_2$O, CO$_2$
  - **EMS**: Land surface emissivity

- IASI level 2 products will be disseminated via EUMETCast and GTS

- The trial dissemination of level 2 products has started on 25 September 2007, including TWT and CLP
Conclusion

• The instrument is stable and provides level 1 data operationally, allowing to derive level 2 products

• Level 2 products are being validated against short-range forecast fields and against data from dedicated field campaigns

• The trial dissemination of level 2 products has started