The NOAA/NESDIS/STAR IASI
Near Real-Time Product
Processing and Distribution
System

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Outline

• Background

• IASI Processing System

• Monitoring and Validation

• Next Steps

• Summary
Background
IJPS

- IJPS -- Initial Joint Polar-Orbiting Operational Satellite System
  - Mission: It is a cooperative effort between NOAA and EUMETSAT to provide and improve the operational meteorological and environmental forecasting and global climate monitoring services worldwide.

- IJPS started with NOAA N, covers the MetOp series, and continues with NPP and the NPOESS series.
MetOp-A Instruments

- IASI: IR Fourier Transform Spectrometer
  » Spectral Coverage: 8461 channels (3.4 - 15.5 μm) in 3 bands
  » Spatial Resolution: 12 km at nadir (120 FOVs/scan)

- AMSU-A: Microwave sounder (synchronized to IASI scans)
  » Spectral coverage: 15 channels (15-90 GHz).
  » Spatial resolution: 48 km at nadir (30 FOVs/scan).

- MHS: Microwave sounder (synchronized to IASI scans)
  » Spectral Coverage: 5 channel (89 – 190 GHz)
  » Spatial Resolution: 15km at nadir (90 FOVs/scan)

- AVHRR: Visible and near infrared imager
  » Spectral Coverage: 5 channels (0.58-12.5 μm)
  » Spatial Resolution: 1km at nadir (2048 FOV/scan)
IASI Products to Distribute

- IASI Level 1C Radiance
  - Full resolution
  - Spatially and Spectrally Subset
  - Principal Component Analysis
  - Reconstructed Radiances
  - Gridded Datasets

- EUMETSAT IASI Level 2 Products
  - Full Resolution

- NOAA Unique IASI Level 2 Products
  - Cloud Cleared Radiances
  - Trace Gas Products
  - Gridded Datasets
Customers

- NCEP (National Center for Environmental Prediction, NOAA)
- GMAO (Global Modeling and Assimilation Office, NASA)
- NRL (Naval Research Lab)
- FNMOC (Fleet Numerical Meteorology and Oceanography Center)
- AFWA (Air Force Weather Agency)
- CLASS (Comprehensive Large Array-data Stewardship System)
System Development
AIRS Processing System

- Instruments
  - AIRS
  - AMSU
  - HSB

- Products
  - Spatially and Spectrally Subset L1B Radiances
  - Spatially and Spectrally Subset Reconstructed Radiances
  - Level 2 cloud cleared radiances
  - Temperature and Water vapor profiles
  - Trace gas profiles

- Products are distributed to the global NWP community.
AIRS/IASI/CrIS Comparison

- AIRS Granules contain 6 minutes of data
  - 240 Granules per day
  - 35 GB per day
    » 9 FOV
    » 2378 channels

- IASI Granules contain ≈ 3 minutes of data
  - 480 Granules per day
  - 30 GB per day
    » 4 FOV
    » 8461 channels

- CrIS Granules contain ≈ 6 minutes of data
  - ≈ 240 Granules per day
  - 30 GB per day
    » 9 FOV
    » 1305 channels

- IASI system design was based on that developed for AIRS
- The same design is being used to develop the CrIS/ATMS system for NPP/NPOESS
Development of IASI Products at NOAA: Pre-Launch

- Began IASI development in August 2004
- Started simulating IASI data in February 2005
- Worked with Simon Elliott of EUMETSAT on reviewing the IASI BUFR format during the spring of 2005.
- Started distributing simulated IASI L1C BUFR files on the AIRS data server to the global NWP centers in October 2005.
- Started producing IASI profiles and cloud cleared radiance products in NetCDF format in August 2006
Development of IASI Products at NOAA: Post Launch

- Started generating products from the actual EUMETSAT pre-operational IASI data in February 2007
- Began distribution of EUMETSAT PFS to NCDC/CLASS in March 2007
- Began transition to operations in June 2007
- Conducted the System Readiness Review in August 2007
- System was run on the test machine during the final transition phase in September 2007
- IASI L1C thinned and reconstructed radiance products became operationally available in October 30, 2007
Current Status of IASI Products at NOAA

- Products will be made operationally available in three phases
  - IASI L1C thinned and reconstructed radiance products (phase 1)
  - IASI NOAA Unique products (phase 2)
  - AVHRR collocated to IASI footprints (phase 3)

- The product processing system will run at NOAA/OSDPD distributing all products through the NOAA/ESPC Data Distribution Server (DDS)

- Phase 1 is already operational (October 30, 2007)

- Phase 2, IASI NOAA-Unique profiles and cloud cleared products, will be operationally available in March of 2008

- Phase 3, IASI/AVHRR products, will be made available in March 2010
System Information

- IBM P570+ with 16 2.2 GHz CPUs, 2 GB/CPU, 3 TB SAN storage, running AIX 5.3
- Three separate machines for development, test, and production (Operated within NOAA/NSOF)
- All data handling and algorithms are written in C++ and Fortran 90
- All high-level system management is written in Perl and K-shell
System Information

- System limits the number of consumptive processes
- Up to 16 granules may be processed at once
- 12 minutes to produce all L1C subsets and principal components per granule
- 9 minutes for the retrieval to generate profile and reconstructed radiance products
### IASI L1C Archive Products

#### Instrument or Source

<table>
<thead>
<tr>
<th>Instrument</th>
<th>File Type</th>
<th>Contents</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>IASI</td>
<td>EUMETSAT PFS IASI L1C</td>
<td>IASI Radiance</td>
<td>EUMETSAT Binary</td>
</tr>
<tr>
<td>IASI</td>
<td>IASI granule metadata file</td>
<td>IASI metadata (FGDC-RSE)</td>
<td>xml</td>
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</tbody>
</table>

#### Data type

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Data type</th>
<th>Time period</th>
<th>Product type</th>
<th>Resolution</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>IASI</td>
<td>Radiances</td>
<td>Daily</td>
<td>Global grids</td>
<td>3*3</td>
<td>Gridded Binary</td>
</tr>
<tr>
<td>IASI</td>
<td>Metadata</td>
<td>Daily</td>
<td>Global grid metadata</td>
<td>3*3</td>
<td>xml</td>
</tr>
</tbody>
</table>

**IASI L1C Archive Products**
# IASI L1C Products

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Spectral Subset</th>
<th>Data Type</th>
<th>Spatial Subset</th>
<th>Format</th>
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</thead>
<tbody>
<tr>
<td>IASI</td>
<td>616 channels</td>
<td>IASI Radiance</td>
<td>Warmest FOV from every FOR</td>
<td>BUFR NetCDF</td>
</tr>
<tr>
<td>IASI</td>
<td>616 channels</td>
<td>IASI Radiance</td>
<td>First FOV from every FOR</td>
<td>BUFR NetCDF</td>
</tr>
<tr>
<td>IASI</td>
<td>616 channels</td>
<td>IASI Radiance</td>
<td>All 4 FOVs from every FOR</td>
<td>BUFR NetCDF</td>
</tr>
<tr>
<td>IASI</td>
<td>616 channels</td>
<td>IASI Reconstructed Radiance (1 band)</td>
<td>1 FOV from every FOR</td>
<td>BUFR NetCDF</td>
</tr>
<tr>
<td>IASI</td>
<td>616 channels</td>
<td>IASI Reconstructed Radiance (3 bands)</td>
<td>1 FOV from every FOR</td>
<td>BUFR NetCDF</td>
</tr>
<tr>
<td>IASI</td>
<td>616 channels</td>
<td>IASI Reconstructed Radiance (1 band)</td>
<td>4 FOVs from every FOR</td>
<td>BUFR NetCDF</td>
</tr>
<tr>
<td>IASI</td>
<td>616 channels</td>
<td>IASI Reconstructed Radiance (3 bands)</td>
<td>4 FOVs from every FOR</td>
<td>BUFR NetCDF</td>
</tr>
<tr>
<td>IASI</td>
<td>8461 channels</td>
<td>IASI Radiance</td>
<td>4 FOVs from every FOR</td>
<td>NetCDF</td>
</tr>
<tr>
<td>IASI</td>
<td>8461 channels</td>
<td>IASI Radiance</td>
<td>4 FOVs from 2 scans/granule</td>
<td>NetCDF</td>
</tr>
</tbody>
</table>

FOV = Field of View; FOR = Field of Regard. The light green refers to internal files.
# IASI Level 2 NOAA Unique Products

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Channels</th>
<th>Data Type</th>
<th>IASI FORs</th>
<th>IASI FOV #</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>IASI</td>
<td>616</td>
<td>CCR from retrieval</td>
<td>All FORs (660/granule)</td>
<td>1</td>
<td>BUFR NetCDF</td>
</tr>
<tr>
<td>IASI</td>
<td>100 levels</td>
<td>L2 (T, H$_2$O, CO$_2$, O$_3$, CH$_4$, CO, HNO$_3$, N$_2$O)</td>
<td>All FORs (660/granule)</td>
<td>NA</td>
<td>BUFR NetCDF</td>
</tr>
<tr>
<td>IASI (using AVHRR)</td>
<td>616</td>
<td>RAD</td>
<td>All FORs (660/granule)</td>
<td>1 (clearest)</td>
<td>BUFR NetCDF</td>
</tr>
<tr>
<td>AVHRR (on IASI FOVs)</td>
<td>5</td>
<td>RAD (clear and cloudy)</td>
<td>All FORs (660/granule)</td>
<td>1,2,3,4</td>
<td>BUFR NetCDF</td>
</tr>
<tr>
<td>IASI (using AVHRR)</td>
<td>616</td>
<td>CCR</td>
<td>All FORs (660/granule)</td>
<td>1</td>
<td>BUFR NetCDF</td>
</tr>
</tbody>
</table>

PCS - Principal Components; RAD - Radiance; RR - Reconstructed Radiance; CCR – Cloud cleared radiances; FOR - Field of Regard; *616 channel set determined through a NOAA/ECMWF collaborative effort.
<table>
<thead>
<tr>
<th>Instrument or Source</th>
<th>Data type</th>
<th>Time period</th>
<th>Product type</th>
<th>Resolution</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>IASI</td>
<td>Radiances</td>
<td>Daily</td>
<td>Global grids</td>
<td>3°*3</td>
<td>Gridded Binary</td>
</tr>
<tr>
<td>IASI</td>
<td>Radiances</td>
<td>Daily</td>
<td>Global grids</td>
<td>0.5°2</td>
<td>Gridded Binary</td>
</tr>
<tr>
<td>IASI</td>
<td>RR/PCS</td>
<td>Daily</td>
<td>Global grids</td>
<td>3°*3</td>
<td>Gridded Binary</td>
</tr>
<tr>
<td>IASI</td>
<td>RR/PCS</td>
<td>Daily</td>
<td>Global grids</td>
<td>0.5°2</td>
<td>Gridded Binary</td>
</tr>
<tr>
<td>IASI GFS</td>
<td>Radiances/Forecast</td>
<td>Daily</td>
<td>Global grids</td>
<td>0.5°2</td>
<td>Gridded Binary</td>
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<tr>
<td>IASI GDAS</td>
<td>Radiances/Forecast</td>
<td>Daily</td>
<td>Global grids</td>
<td>0.5°2</td>
<td>Gridded Binary</td>
</tr>
<tr>
<td>IASI</td>
<td>Radiances</td>
<td>Daily</td>
<td>Global binary</td>
<td>N/A</td>
<td>Binary</td>
</tr>
<tr>
<td>IASI</td>
<td>Radiance locations</td>
<td>Daily</td>
<td>Global binary</td>
<td>N/A</td>
<td>Binary</td>
</tr>
<tr>
<td>IASI</td>
<td>(input for matchups)</td>
<td>Daily</td>
<td>Global binary</td>
<td>N/A</td>
<td>Binary and NetCDF</td>
</tr>
<tr>
<td>IASI</td>
<td>Radiances</td>
<td>Daily</td>
<td>Matchups (Radiosondes)</td>
<td>N/A</td>
<td>Binary and NetCDF</td>
</tr>
<tr>
<td>IASI</td>
<td>Radiances</td>
<td>Daily</td>
<td>Thinned data</td>
<td>2 scans/granule</td>
<td>Binary</td>
</tr>
</tbody>
</table>
Validation and Monitoring
Validation

- Global Grids enable quick reprocessing of long term representative data.
- Matchups enable daily comparisons between Level 2 products and radiosondes.
- Online system allows us to have a quick view of the daily products.
STAR IASI Web Page

http://www.orbit2.nesdis.noaa.gov/smcd/spb/iosspdt/iosspdt.php

NESDIS NRT IASI

The Infrared Atmospheric Sounding Interferometer (IASI) is a Fourier Transform Spectrometer based upon a Michelson Interferometer (8401 channels)

- Spectral range: 645 - 2780 cm⁻¹
- NEDT information
- Contains simple spectral interval 0.25cm⁻¹; 3401 channels
- A posteriori spectral resolution: 0.5 cm⁻¹
- Scan Type: Up and Down
- Scan Rate: 8 s
- FOV 3.35 degree
- INGC scope at Nadir 12 km
- Sampling at Water: 256 km
- Pupil Plane: 120
- Swath: ~485 km; ~1025 km
- Data Rate: 1.5 MHz

Imaging channel within the IASI field of regard (64 x 64 pixels)

- Enables characterization of cloudiness inside the spectrometer field of view

IASI will provide temperature and humidity profiles with a vertical accuracy of 1 Kelvin and 3% per 1km layer, respectively

A near-real time system has been running at NOAA/NESDIS/SMCD/SPB/IOSSPDT since November 2003. To get more information about the data, please email us.
Example of Images on STAR IASI Web Page
Indicates which of the 16 available CPU’s are in use.

Indicates the day’s total progress. Arrow buttons allow display of previous day’s status.

Indicates the day’s progress of each processing level.

Buttons to open up the log file and the status file viewing windows.

Indicates the status of each granule:
- not processed
- waiting to start
- one process level complete
- all process levels complete
- error in a process level
- missing data
Next Steps
Future Development of IASI Products at NOAA

- Integrate the use of the IASI calibrated image in the ILS sub-pixel correction algorithm

- Implement handling of grib2 formats in retrieval preprocessing and in the forecast global grid products

- Test latest updates to the retrieval algorithm

- Finalize NOAA-Unique Level 2 products archive agreements with NCDC/CLASS

- Finish implementation of the AVHRR/IASI physical collocation algorithm

- Develop IASI/AVHRR BUFR tables
• Simulated CrIS and ATMS data

• Meeting in late November with Simon Elliott (EUMETSAT) and NCEP to discuss the BUFR table for CrIS

• The simulated CrIS data will be available in March 2008
Summary

• Have been running the AIRS near real-time processing system for five years

• Developed and built the IASI processing system:
  » Based upon AIRS experience
  » Working with EUMETSAT
  » Transitioned Level 1C Subsetting and Distribution System (phase 1) to operations
  » NOAA Unique Level 2 System (phase 2) will transition to operations in March 2008
  » AVHRR collocated to IASI footprints (phase 3) will be transition to operations in March 2010

• CrIS/ATMS development has already begun