IASI Level 2 Product Processing

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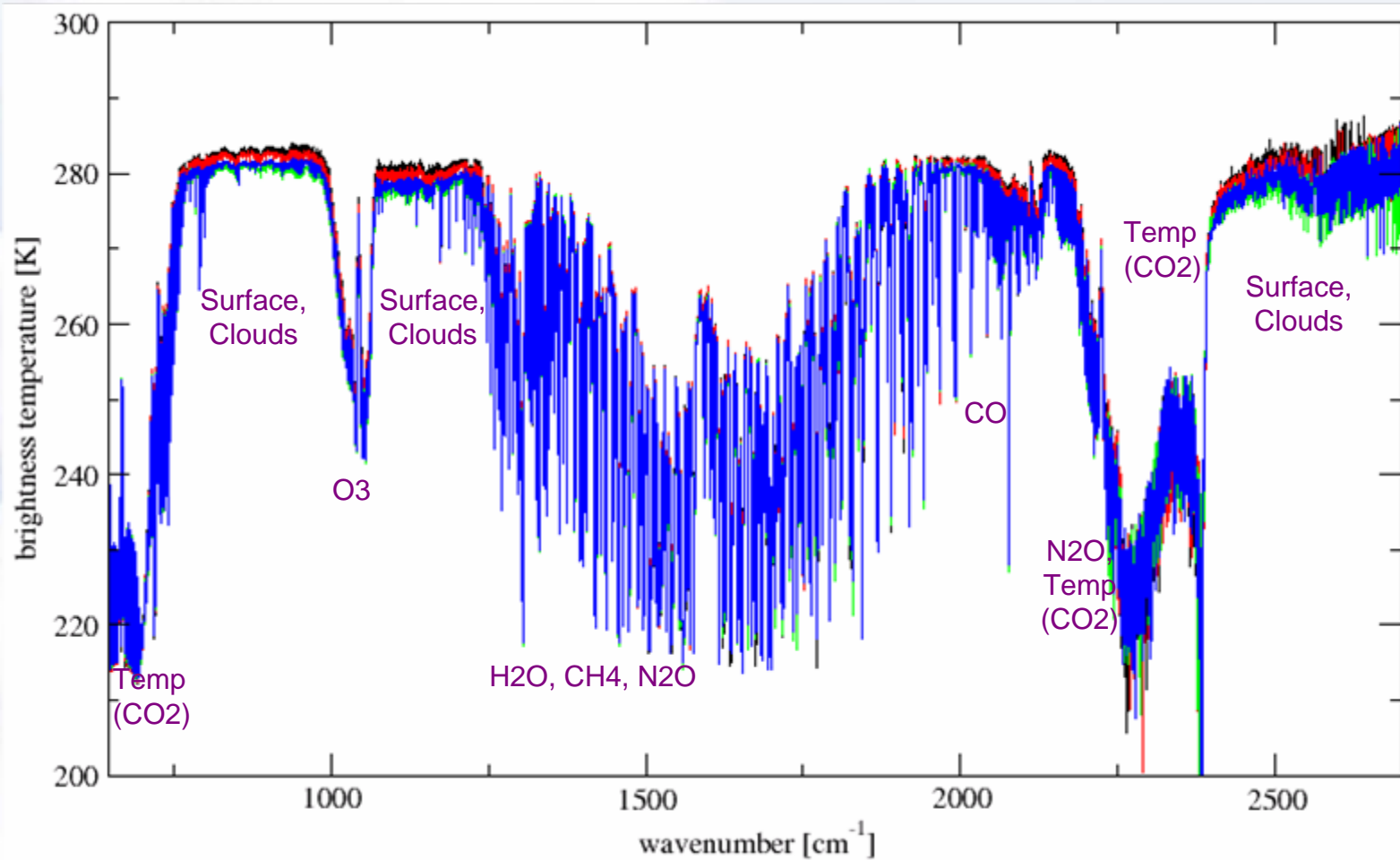ITSC-16, 7-13 May 2008, Angra dos Reis, Brezil

Infrared Atmospheric Sounding Interferometer (IASI)
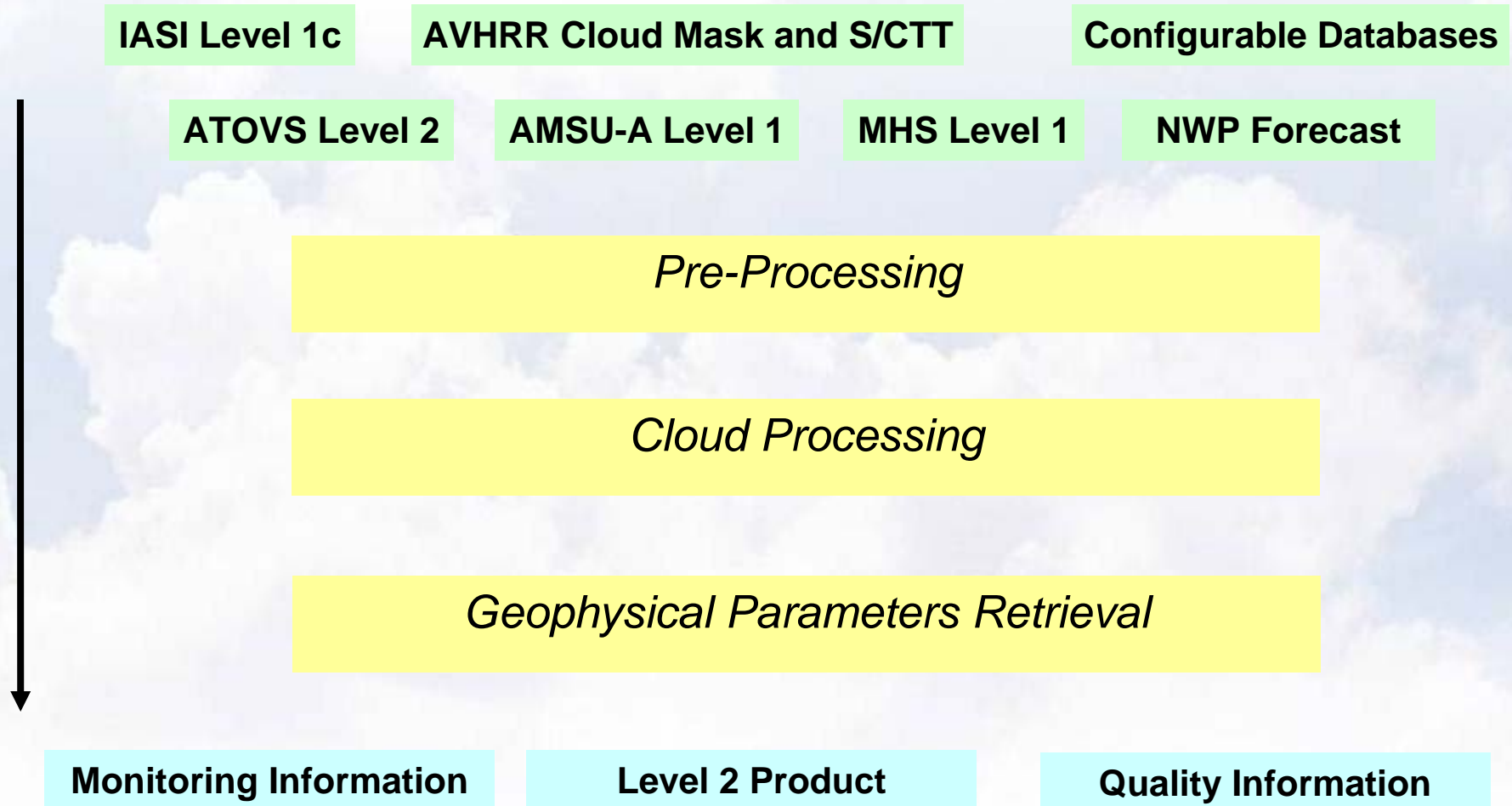
- Michelson-Interferometer   8461 spectral samples
- IFOV diameter   12 km (nadir)
- Scan interval (horiz.)   25 km (nadir)
- Swath width $\pm$48.33° (2200 km)
- Spectral domain   645 - 2760 cm^{-1} (3.6 – 15.5 µm)
- Spectral resolution   0.5 cm^{-1}
- Radiometric resolution   0.07 - 0.7 K (bands 1, 2)
- Absolute calibration   < 0.3 K
- Data rate   1.5 Mbit/s
- Internal imager   10-12 µm
- Temperature- and humidity profiles, O_3, CO, CO_2, CH_4, N_2O, ...

First IASI spectra on 29 November 2006
# L1 Products operational since 29 May 2007

IASI level 2 product generation

IASI Level 1c   AVHRR Cloud Mask and S/CTT   Configurable Databases

ATOVS Level 2   AMSU-A Level 1   MHS Level 1   NWP Forecast

Pre-Processing

Cloud Processing

Geophysical Parameters Retrieval

Monitoring Information   Level 2 Product   Quality Information

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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

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Mapping of AVHRR in IASI-IFOVs

18 km   18 km

18 km

12 km   12 km   12 km   12 km

50 km   50 km

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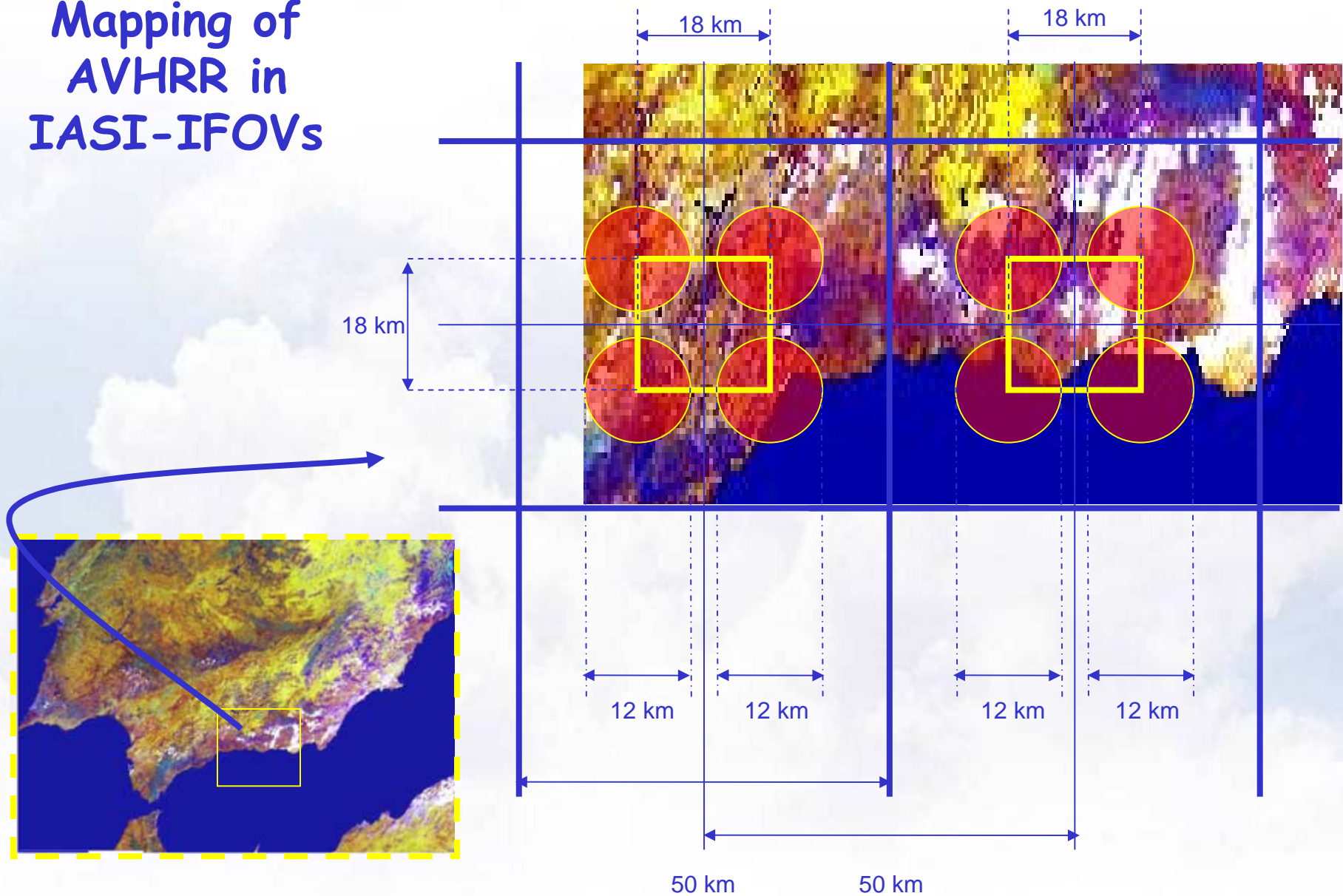
Properties of the
Operational IASI L2 Processor (2/3)

- 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_2O, 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

ΔT_B (OBS–MOD) mean and stddev
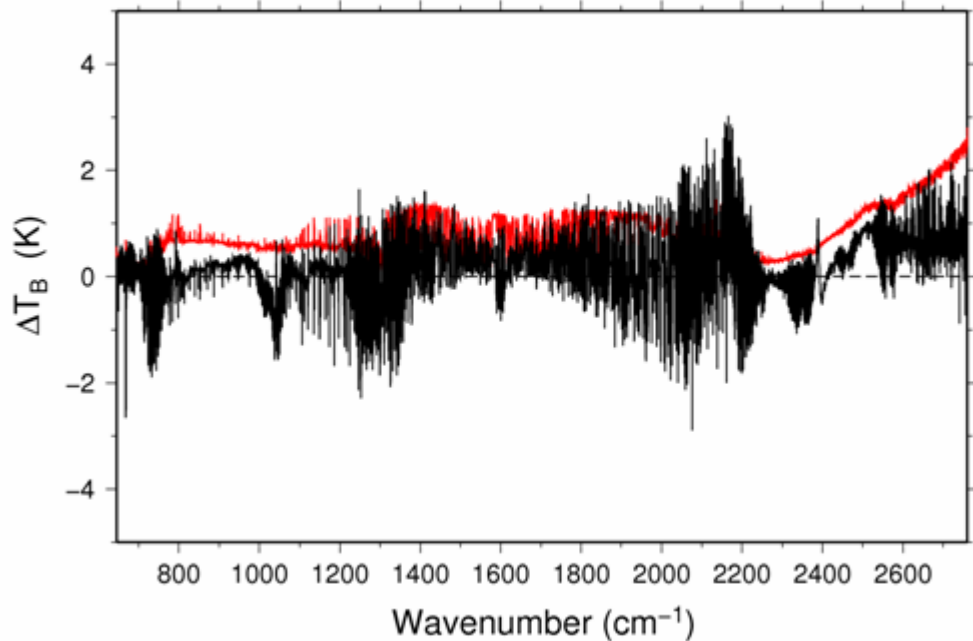
- All retrieval and assimilation schemes use radiative transfer calculations as basis
- Prerequisite for the functionality of the retrieval or assimilation is a good representativity of the measurements by simulated radiances
- Systematic errors:
  - Approxmations necessary for fast calculations
  - Insufficient knowledge of spectroscopic data
  - Erroneous input data
- Systematic fit of models to IASI measurements

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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

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AVHRR/0.6, cold front, all CFR, IASI 20070418124454Z
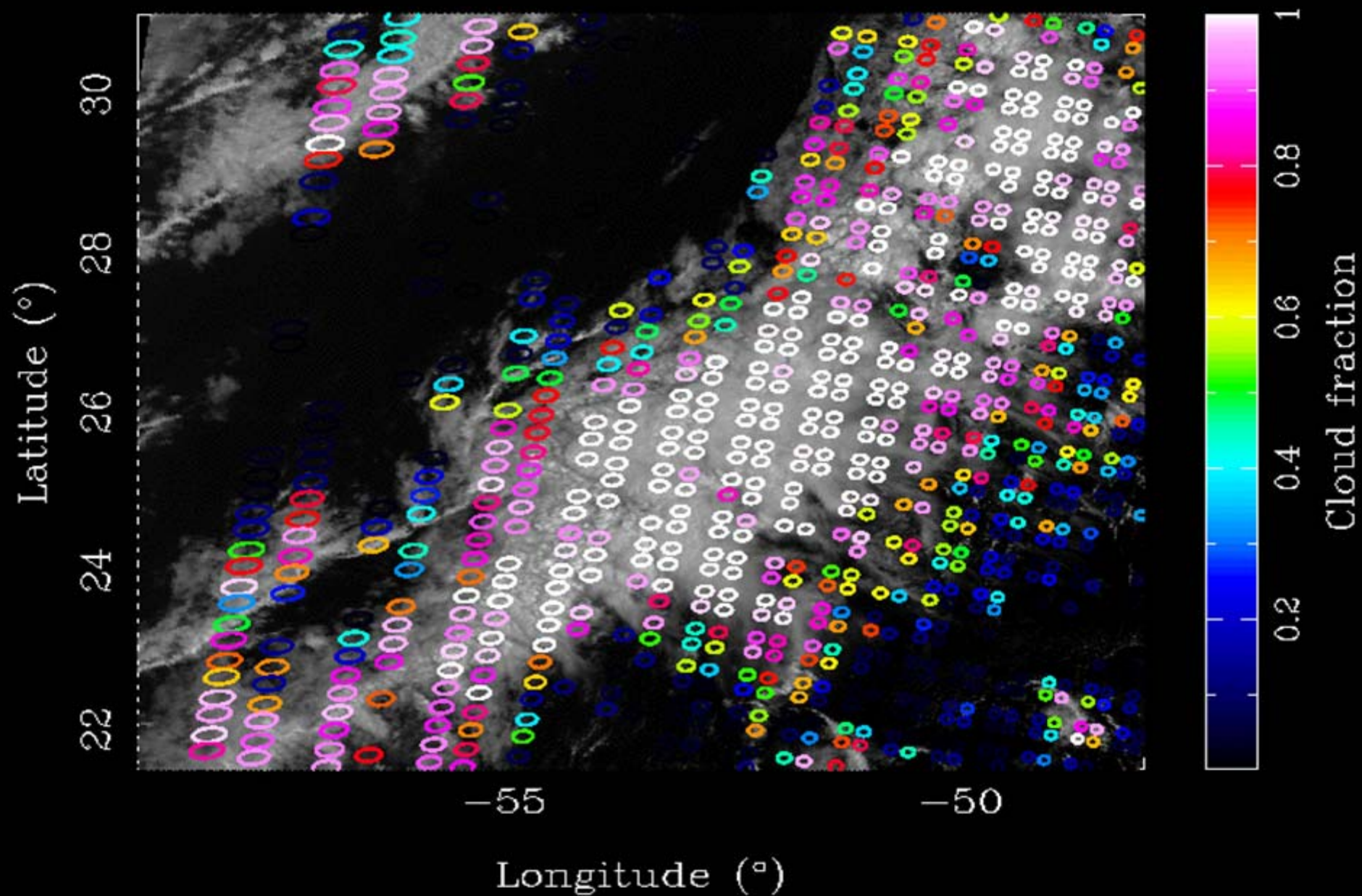
Cloud parameters retrieval
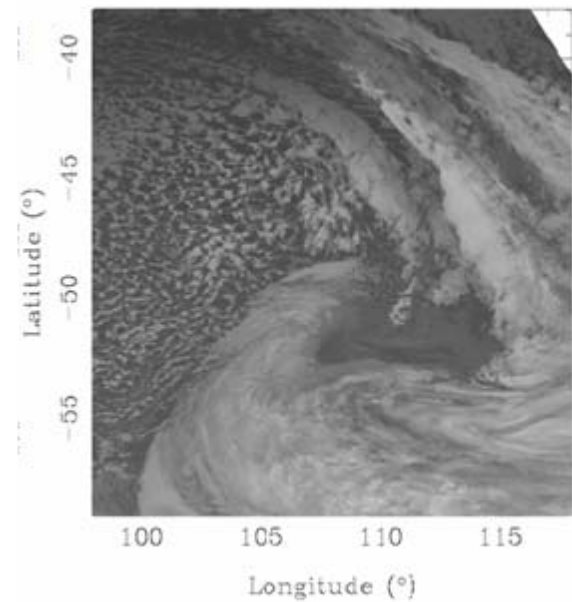
AVHRR: 10.8 μm
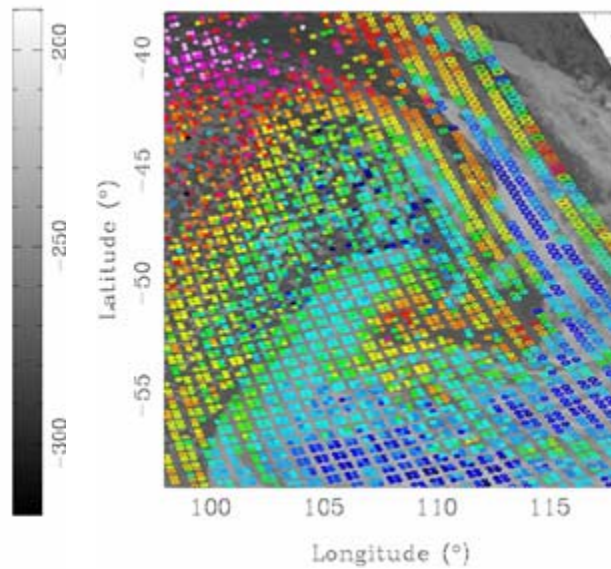
IASI:

Cloud top temperature
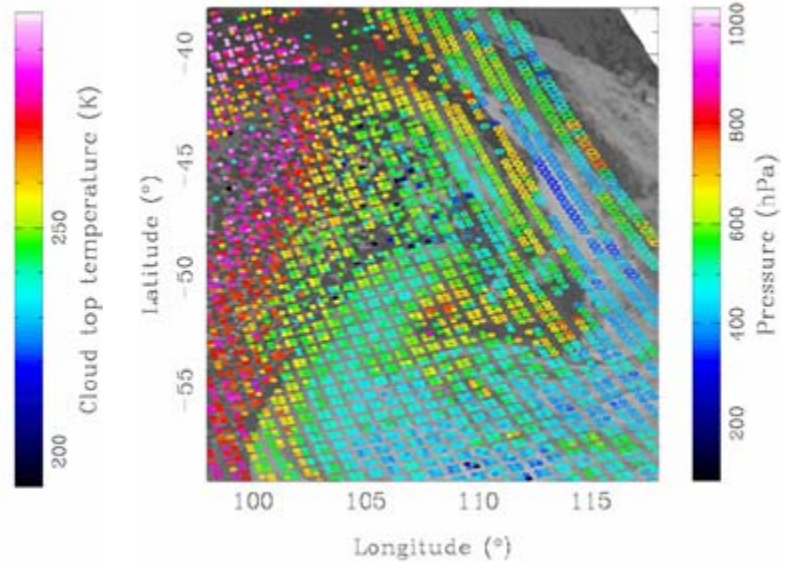
IASI:

Cloud top pressure

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Discrimination of ice and water clouds

Legend:
Clear (red)
Water cloud (green)
Ice cloud (blue)

Axes: T_B (K) versus Wavenumber (cm^{-1})

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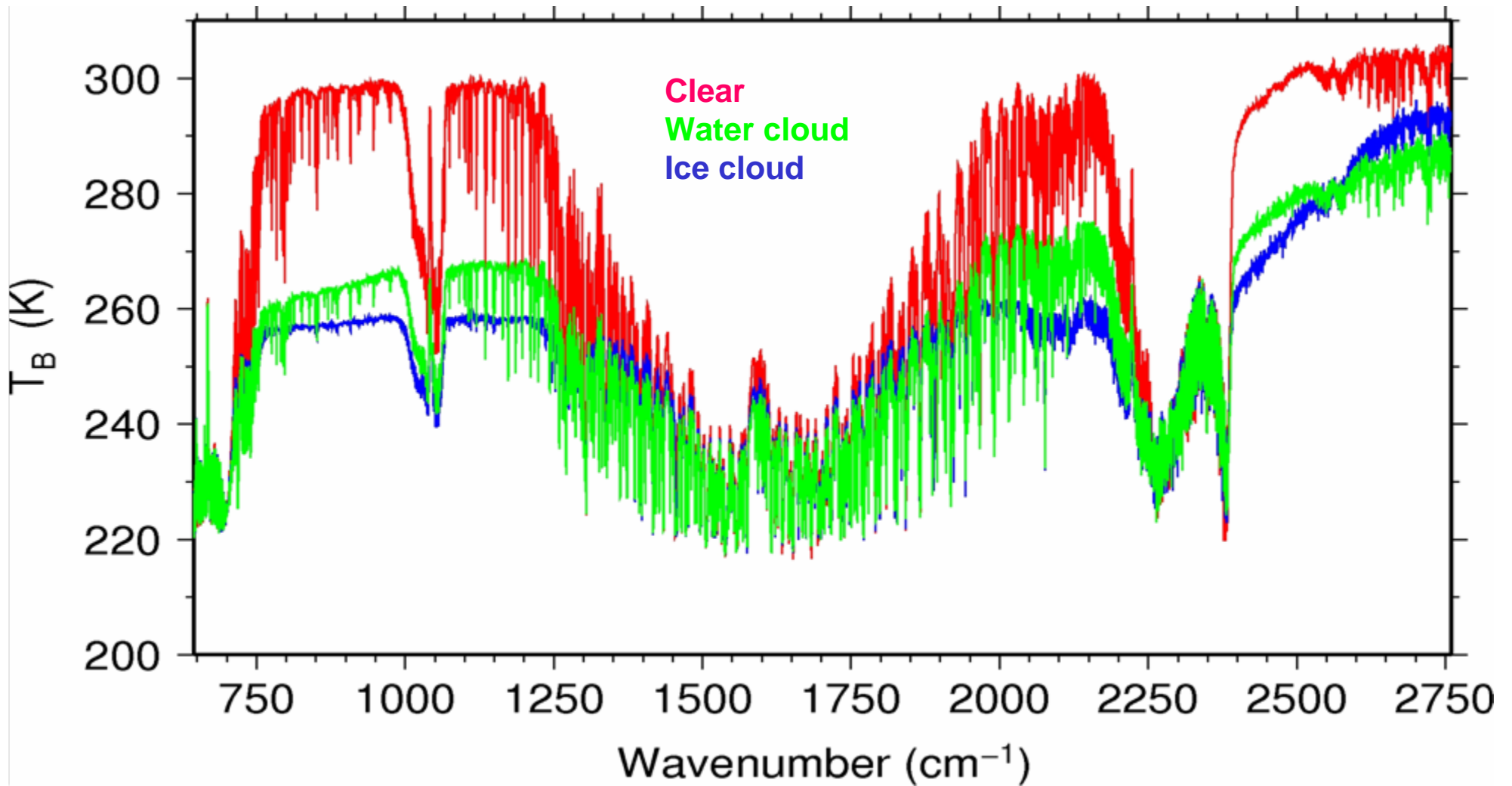
Cloud Cover – 16 October 2007
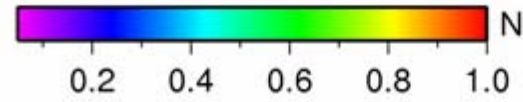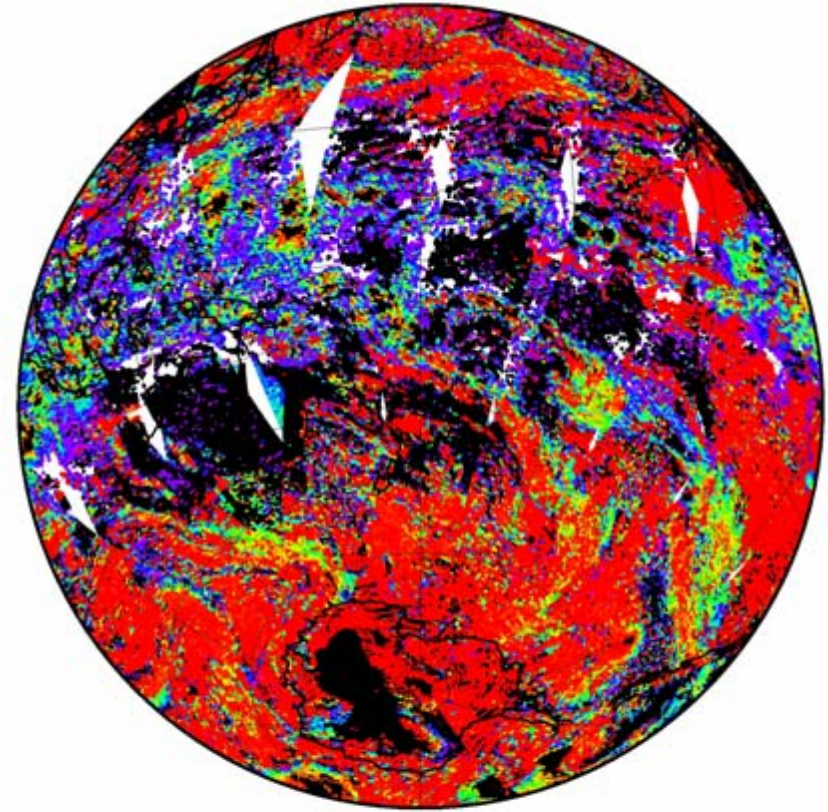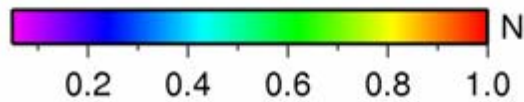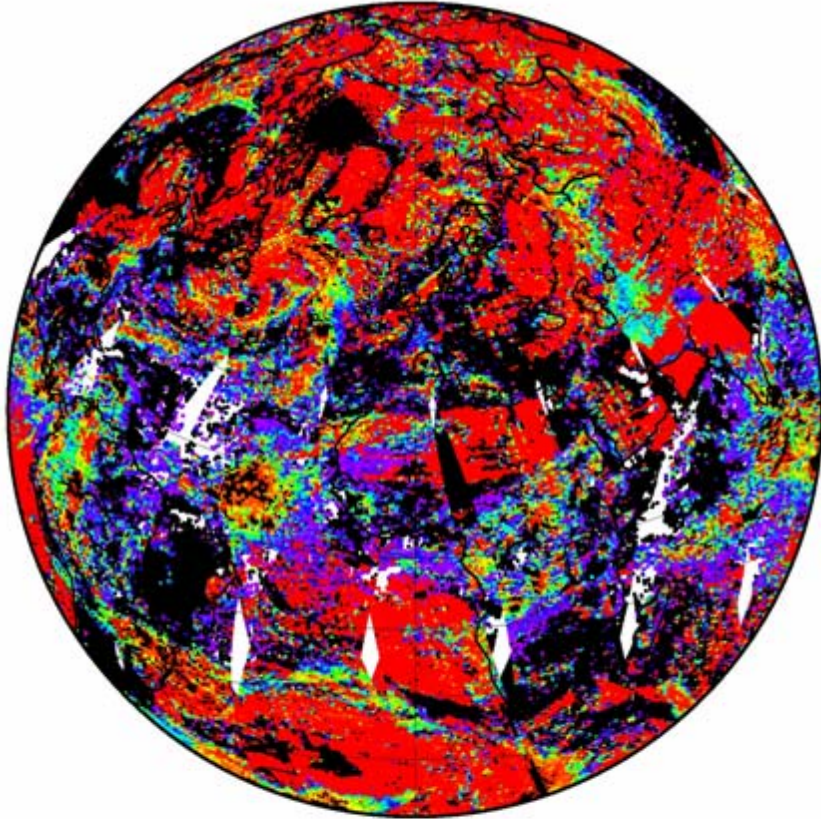
Number of Soundings in Global Datasets

- 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%
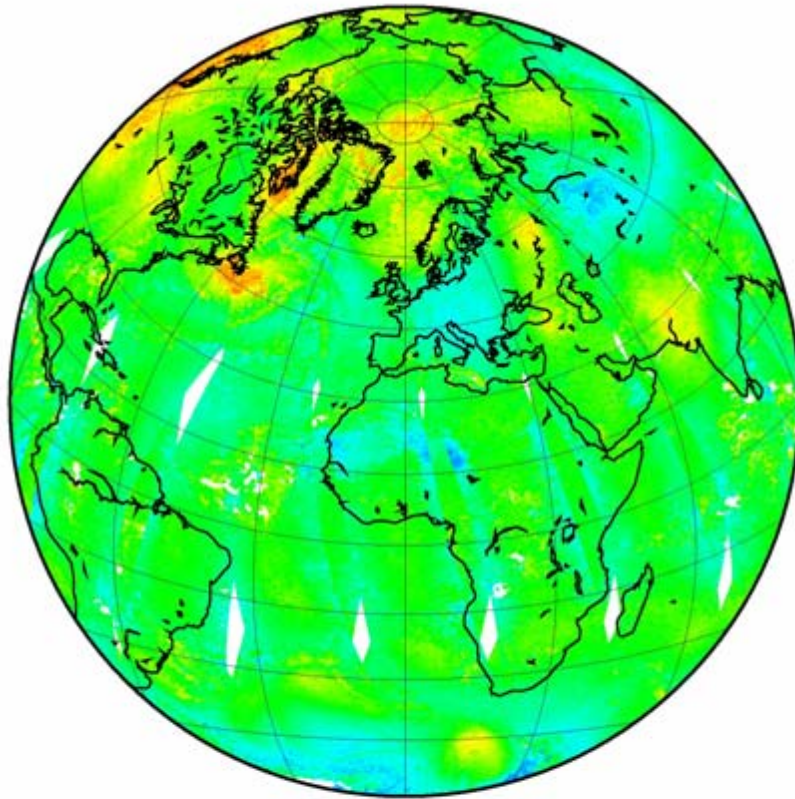 - 700 hPa: 54%
  - 500 hPa: 62%
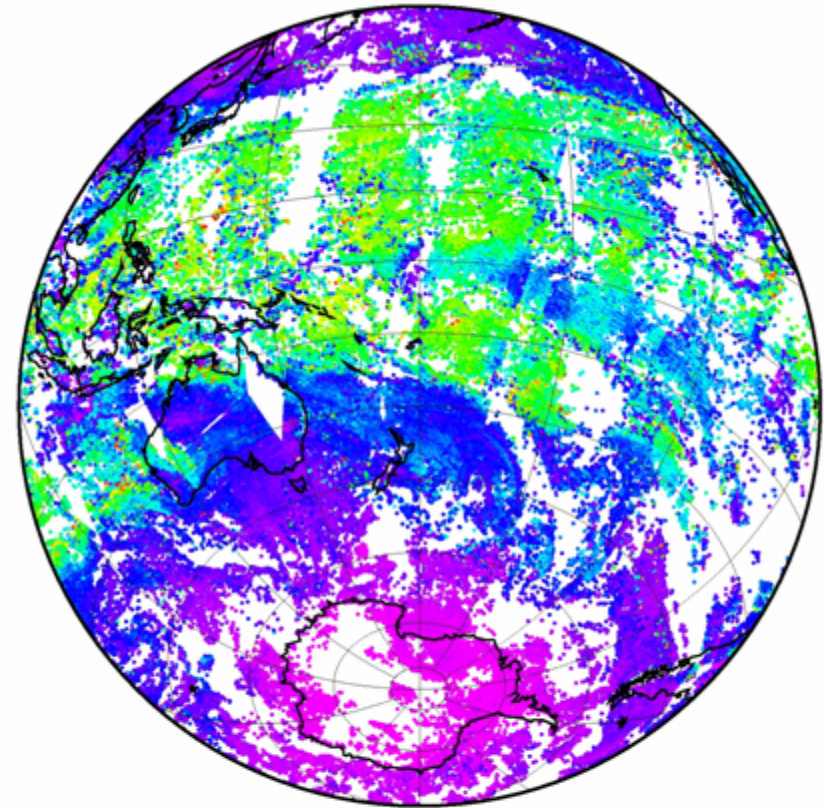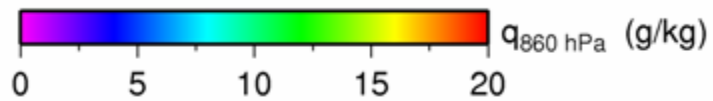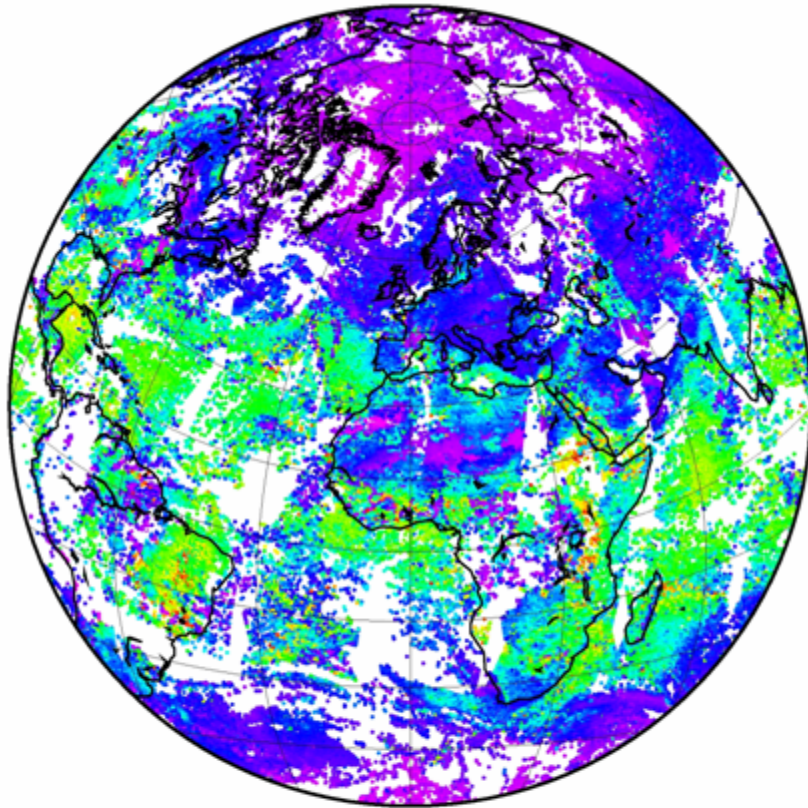 - 300 hPa: 90%
  - 200 hPa: 95%

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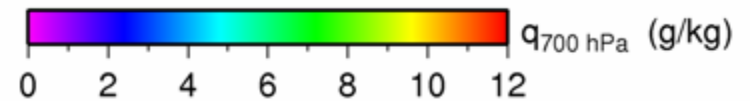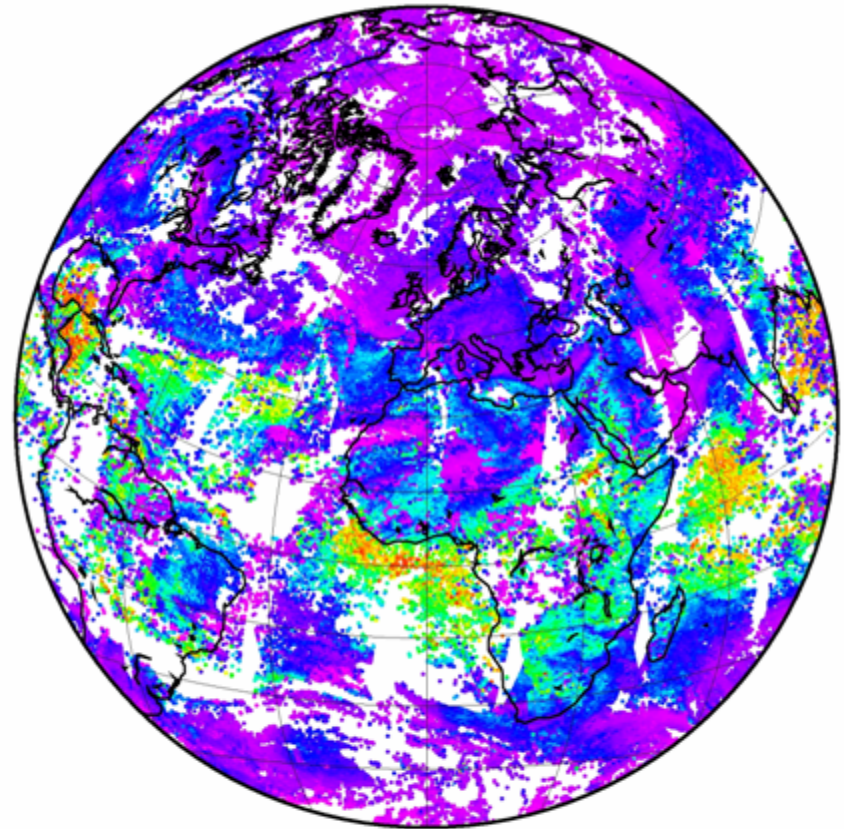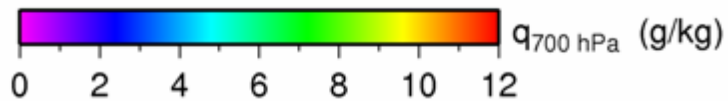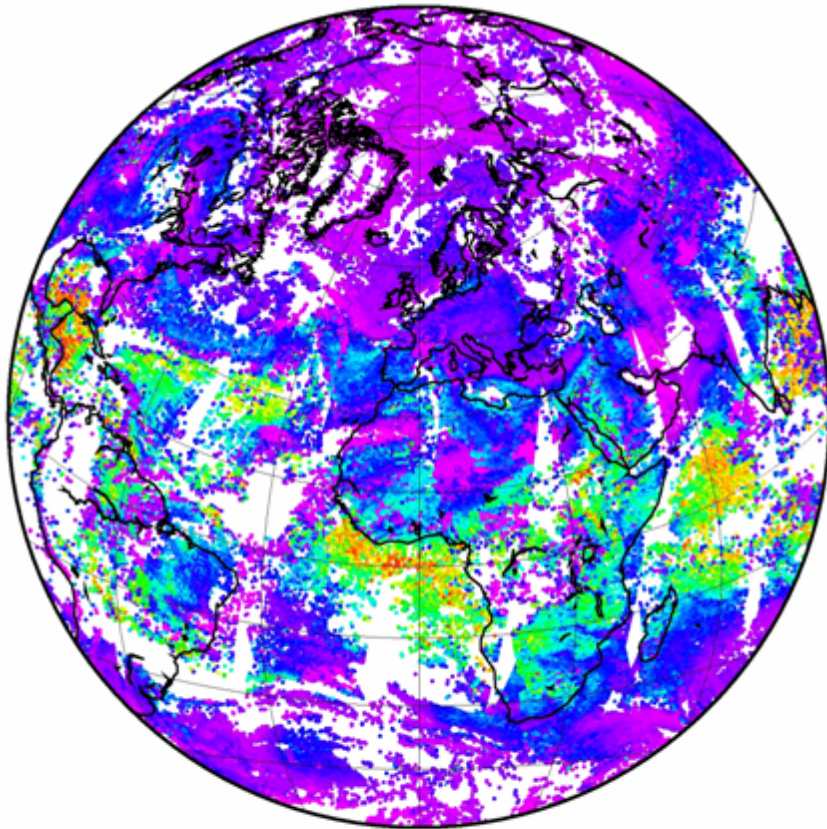# Temperature at 860 hPa: 16 October 2007
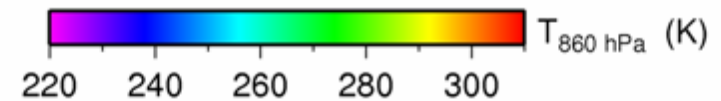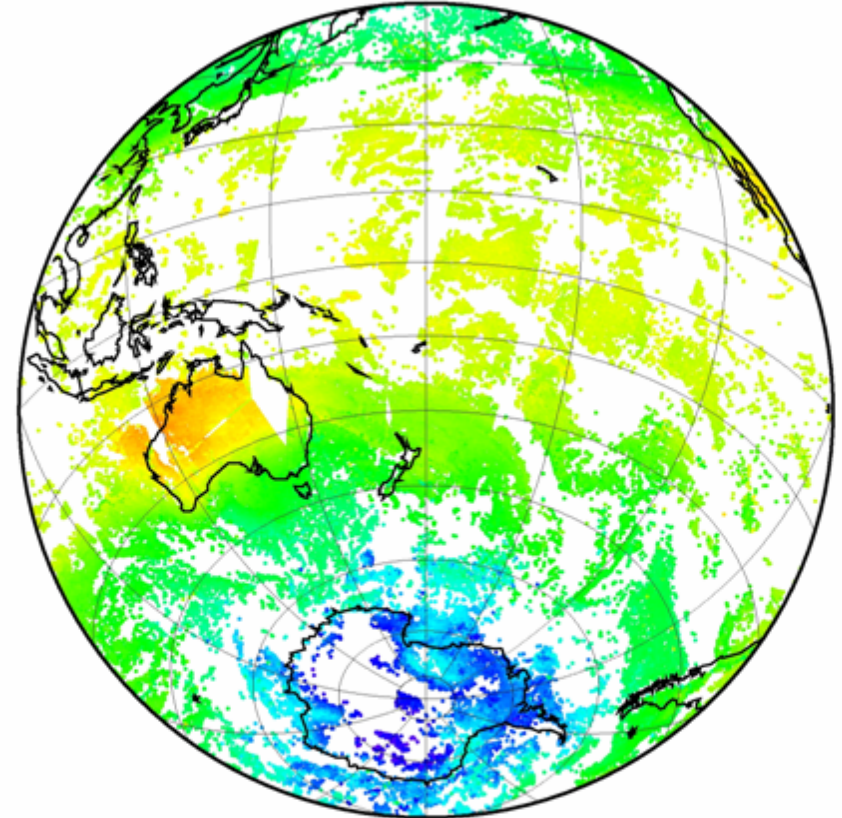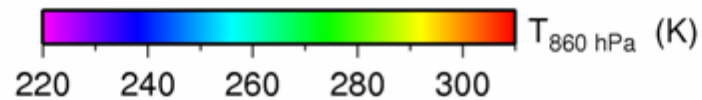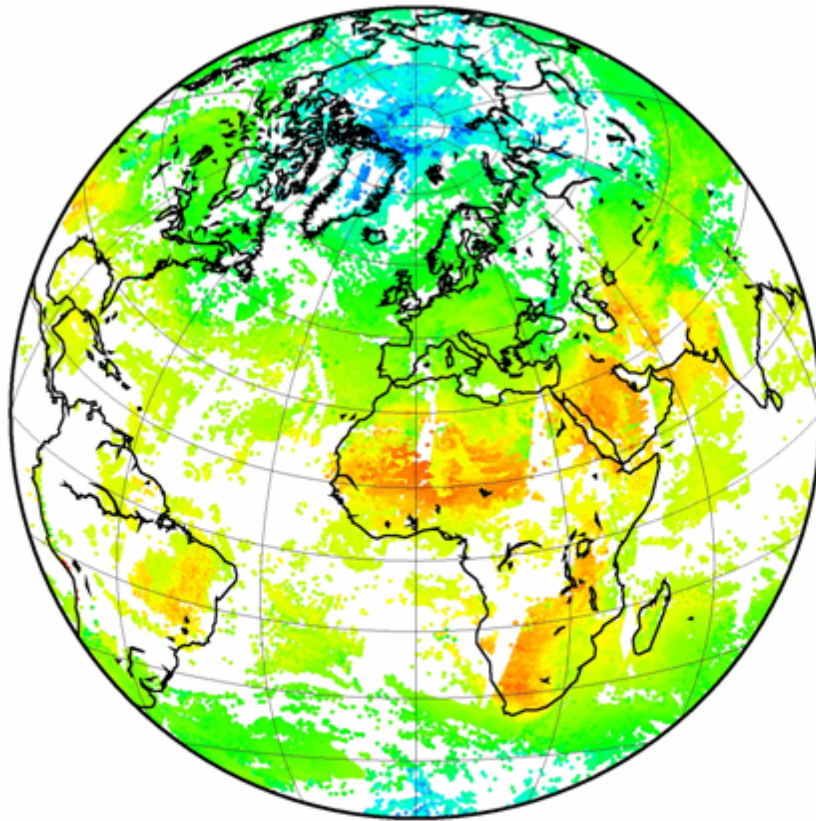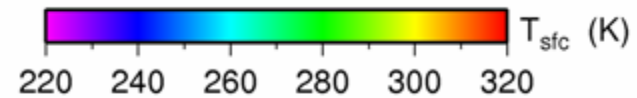
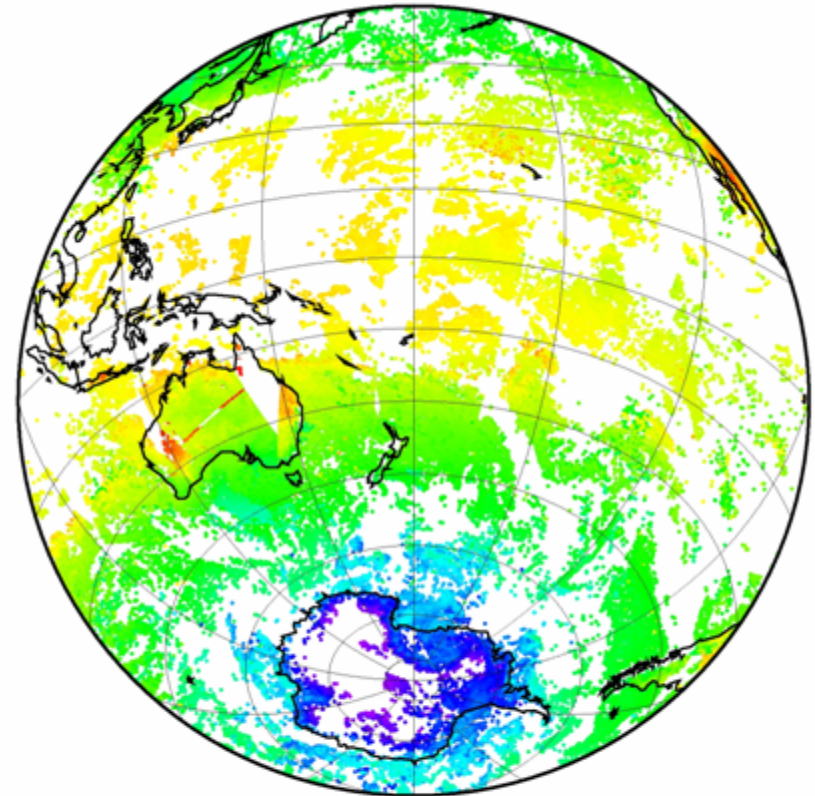# Temperature at 500 hPa: 16 October 2007
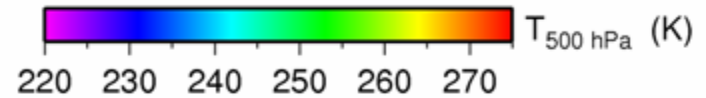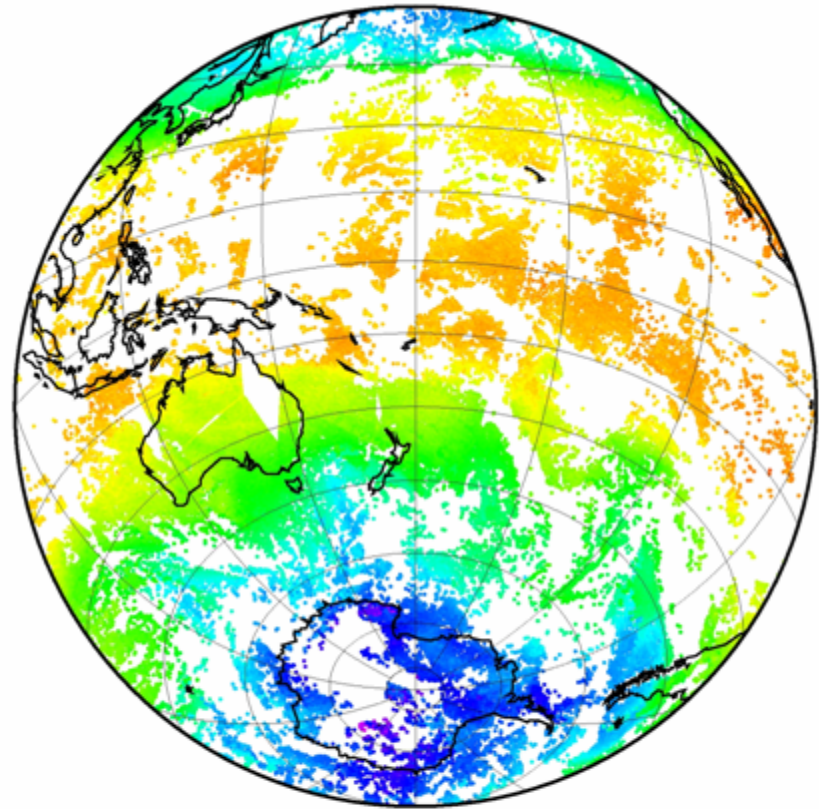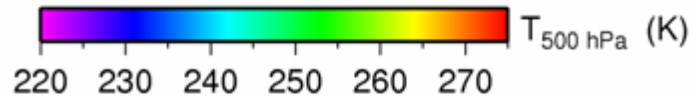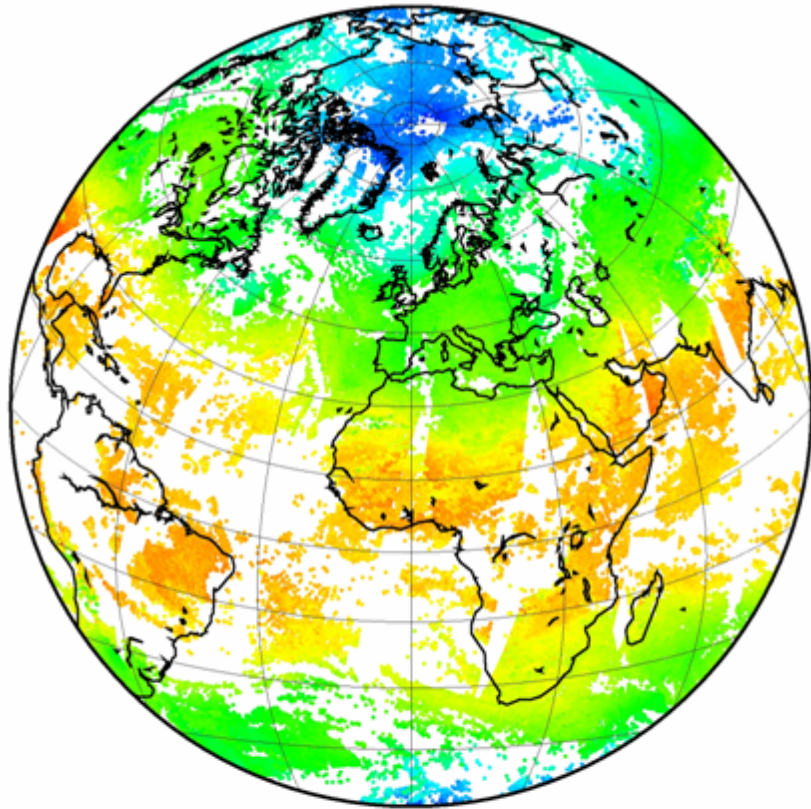
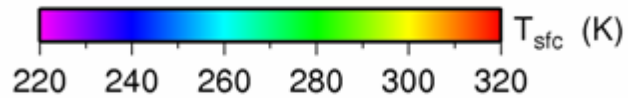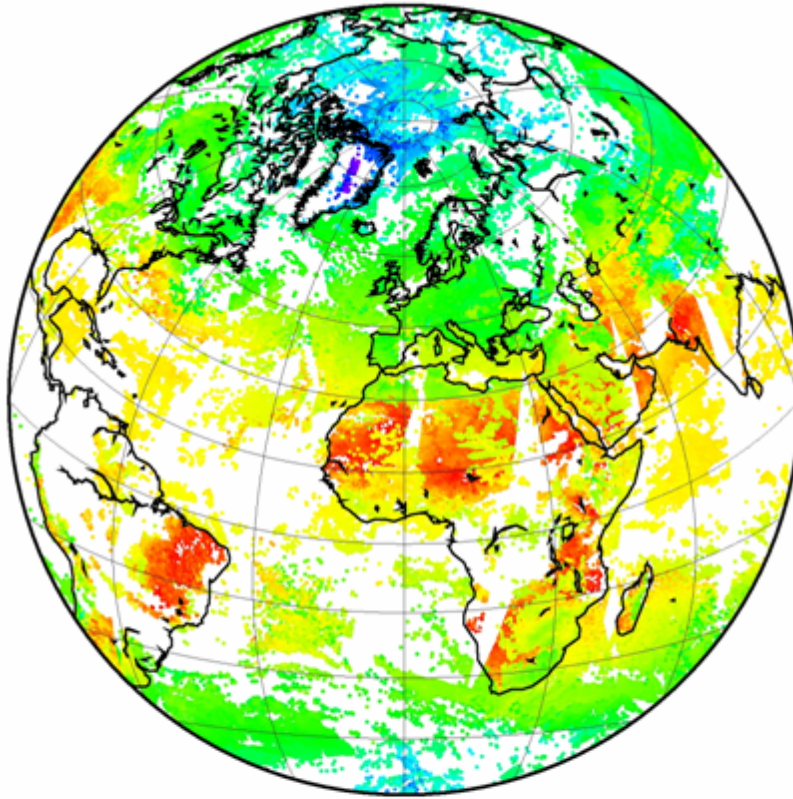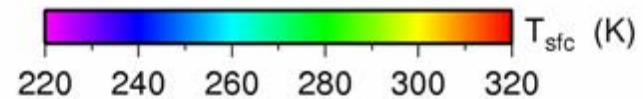# Temperature at 200 hPa: 16 October 2007
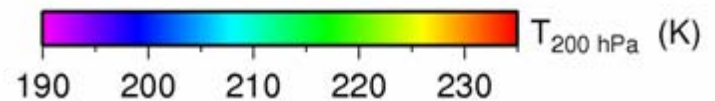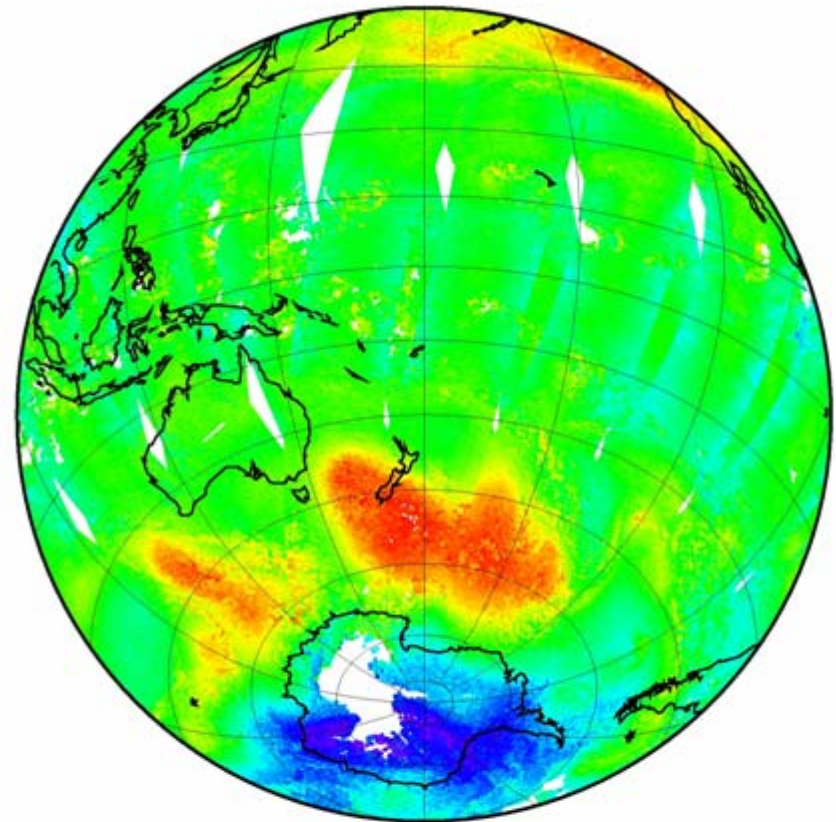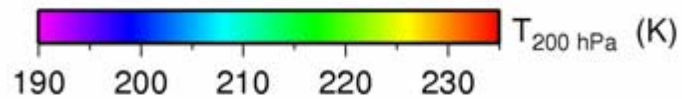
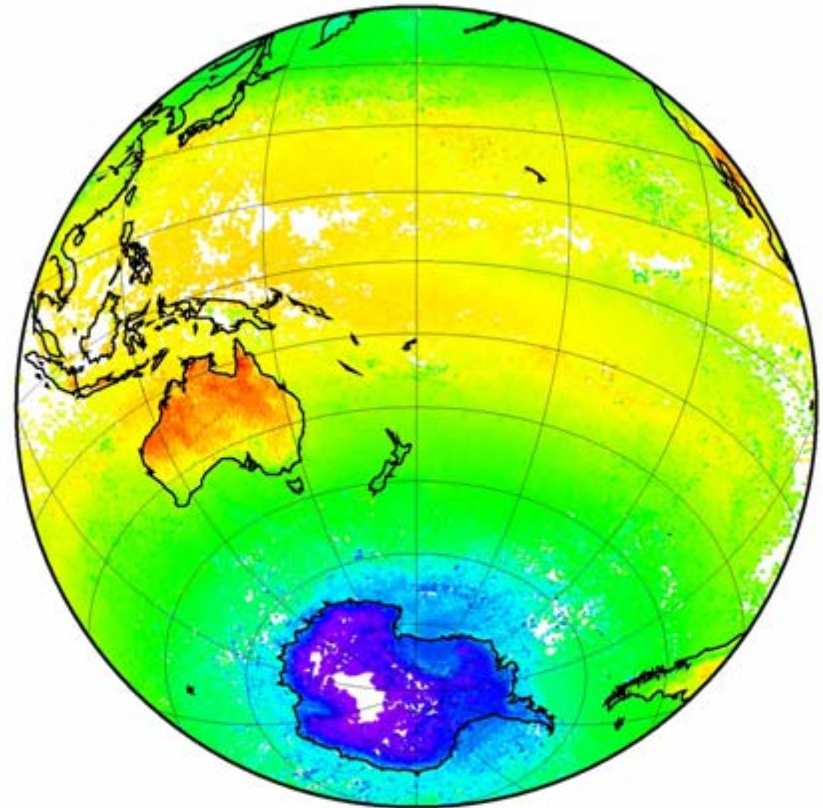# Specific Humidity at 860 hPa: 16 October 2007
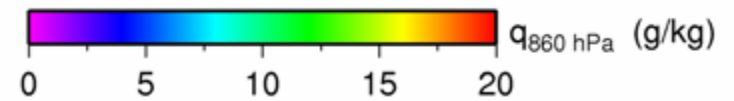
Specific Humidity at 700 hPa: 16 October 2007

Surface Skin Temperature: 16 October 2007

ITSC-16, 7-13 May 2008, Angra dos Reis, Brezil

10 Day Average SST: 16-25 October 2007
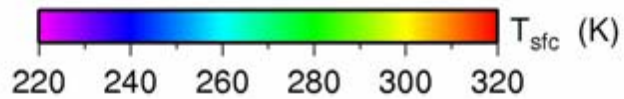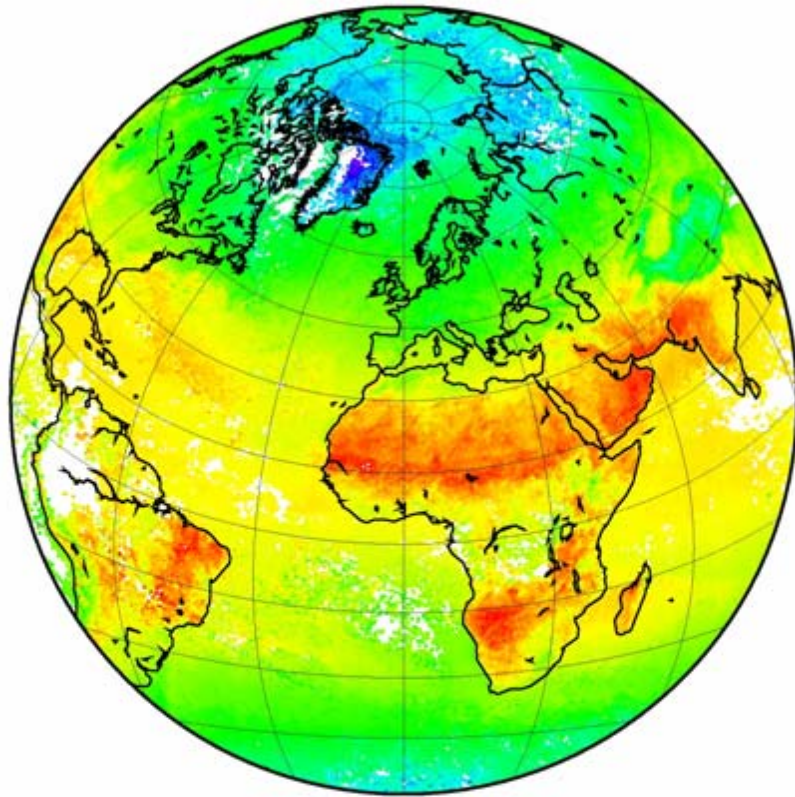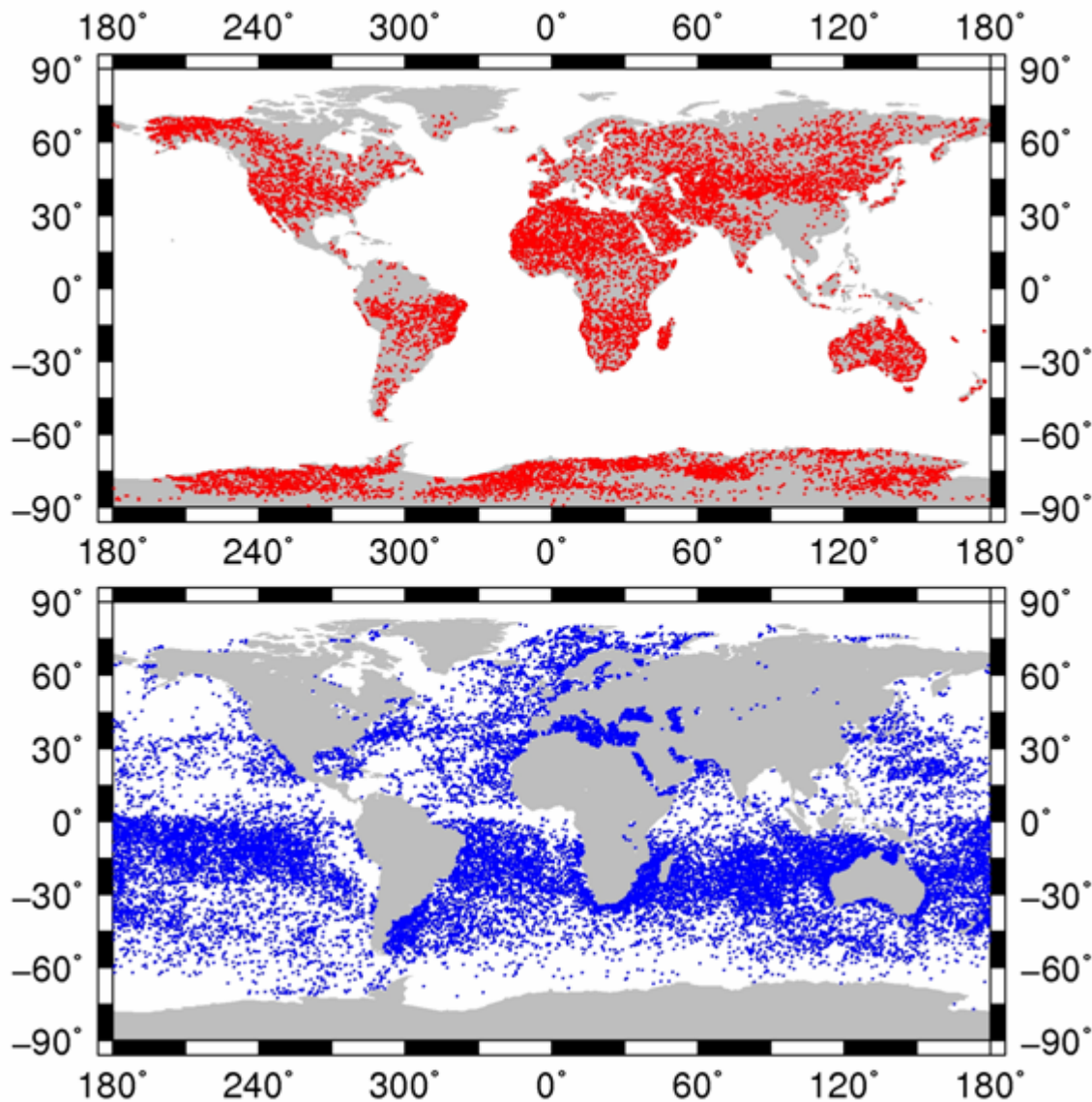
Comparison: ECMWF / IASI

Clear situations
May – June 2007

Land: 1330 match-ups

Ocean: 21810 match-ups

Comparison: ECMWF – IASI L2
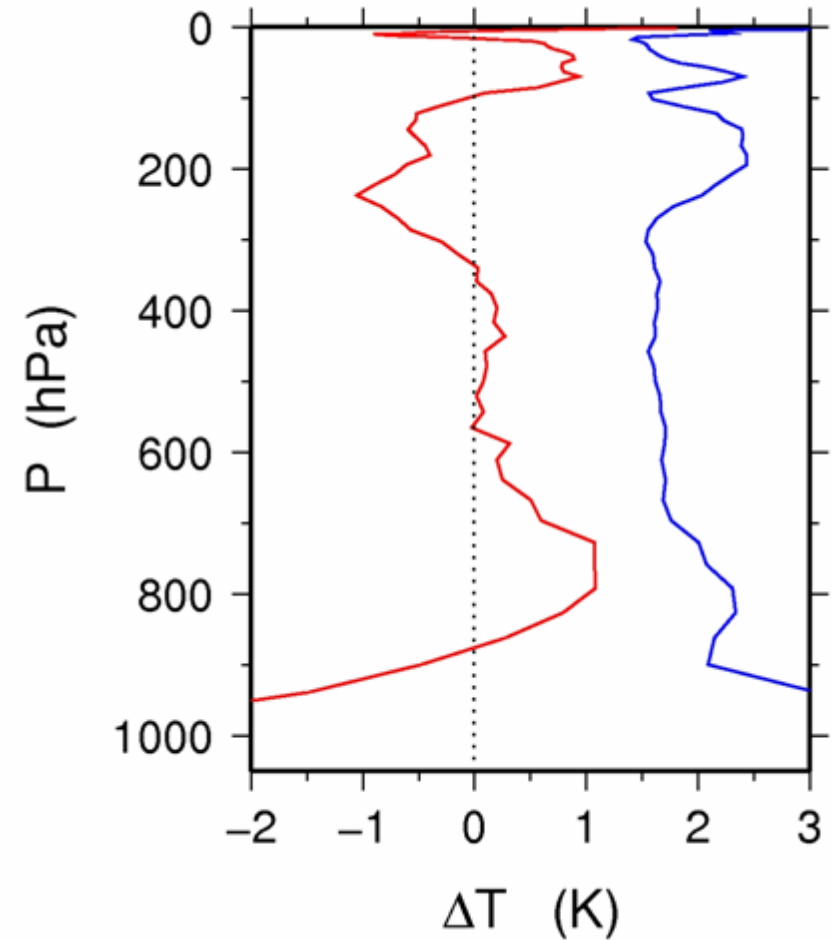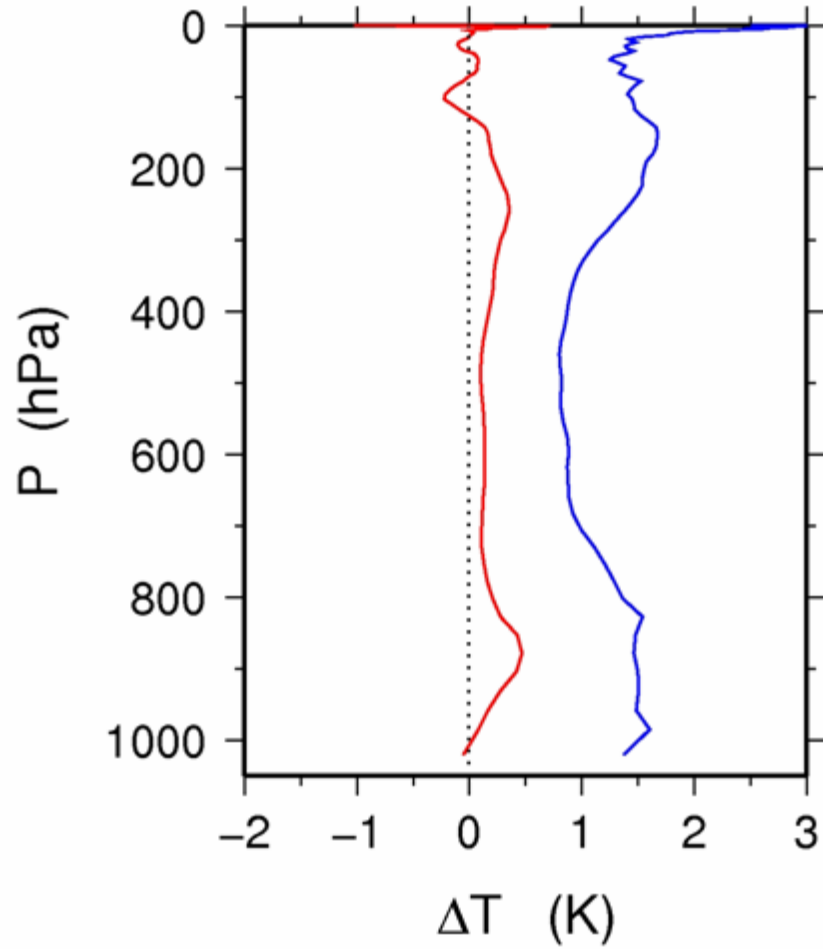
Validation Campaigns

- 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

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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

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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

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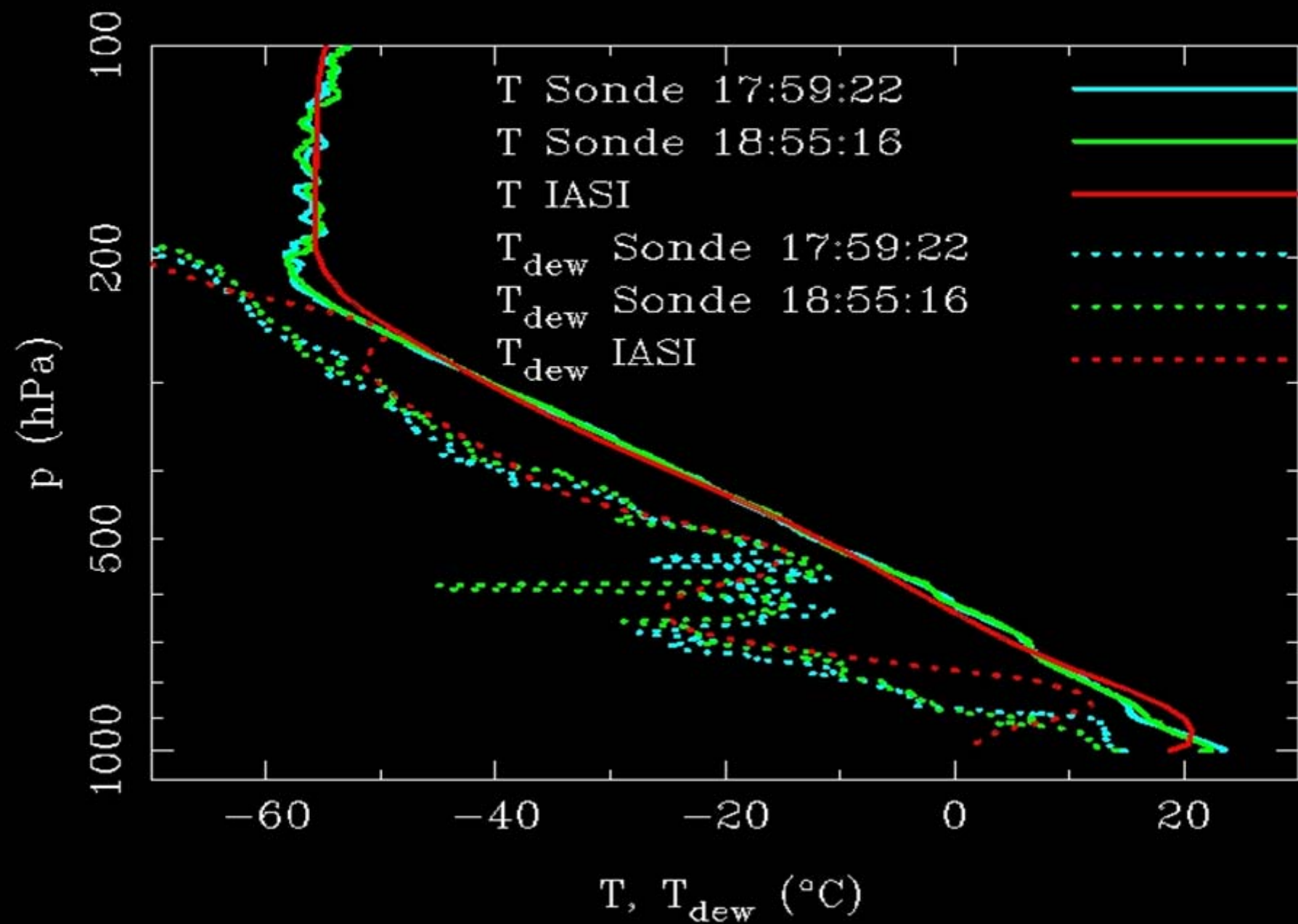
Sodankyla 2007/08/08 18:59:15

Lindenberg 2007/06/08 19:58:01

T Sonde 18:58:00
T Sonde 19:53:00
T IASI
T_{dew} Sonde 18:58:00
T_{dew} Sonde 19:53:00
T_{dew} IASI

p (hPa)

T, T_{dew} (°C)
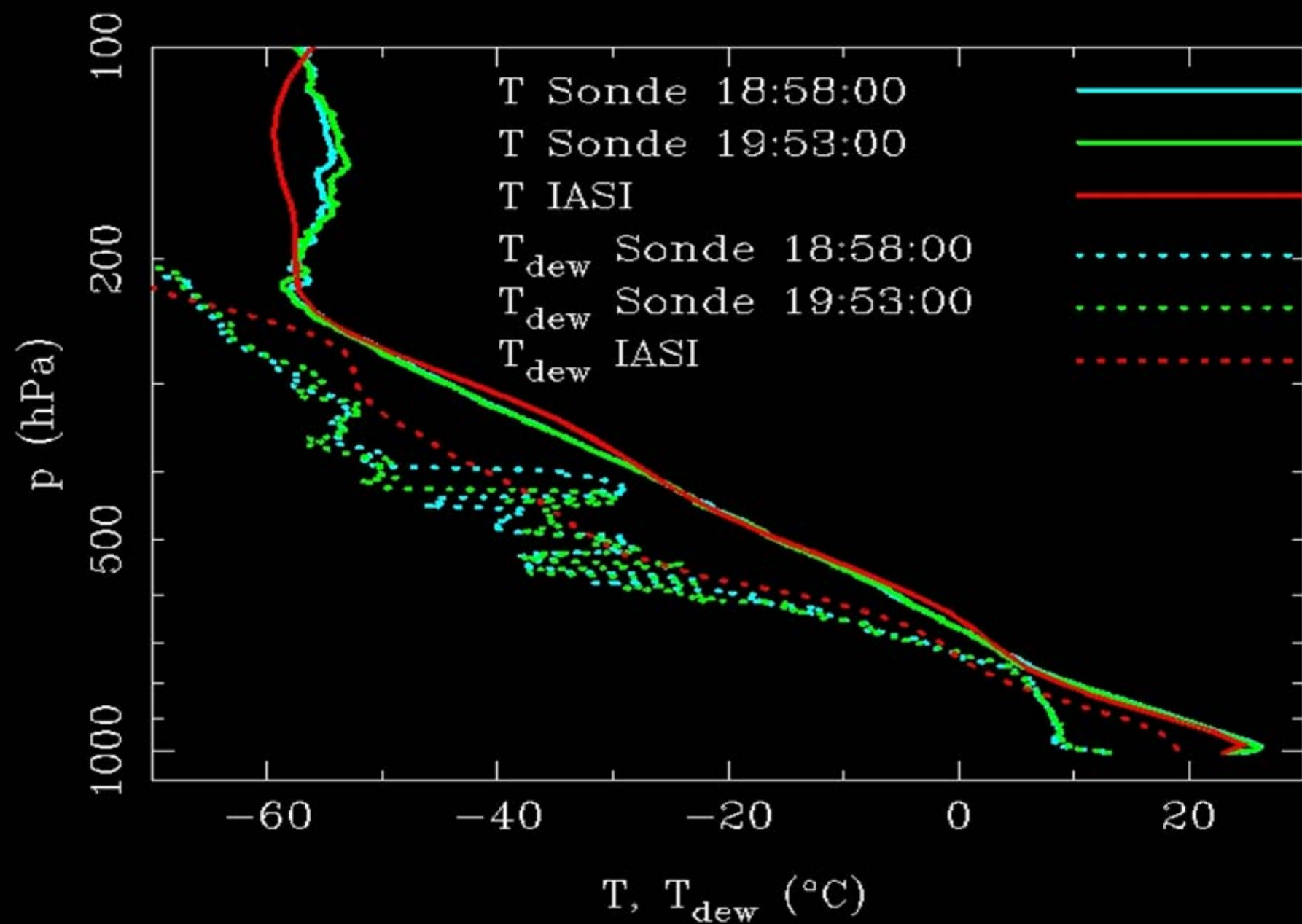
Lindenberg 2007/07/15 09:04:42

T Sonde 08:04:00
T Sonde 08:59:00
T IASI
T_{dew} Sonde 08:04:00
T_{dew} Sonde 08:59:00
T_{dew} IASI

p (hPa)

T, T_{dew} (°C)
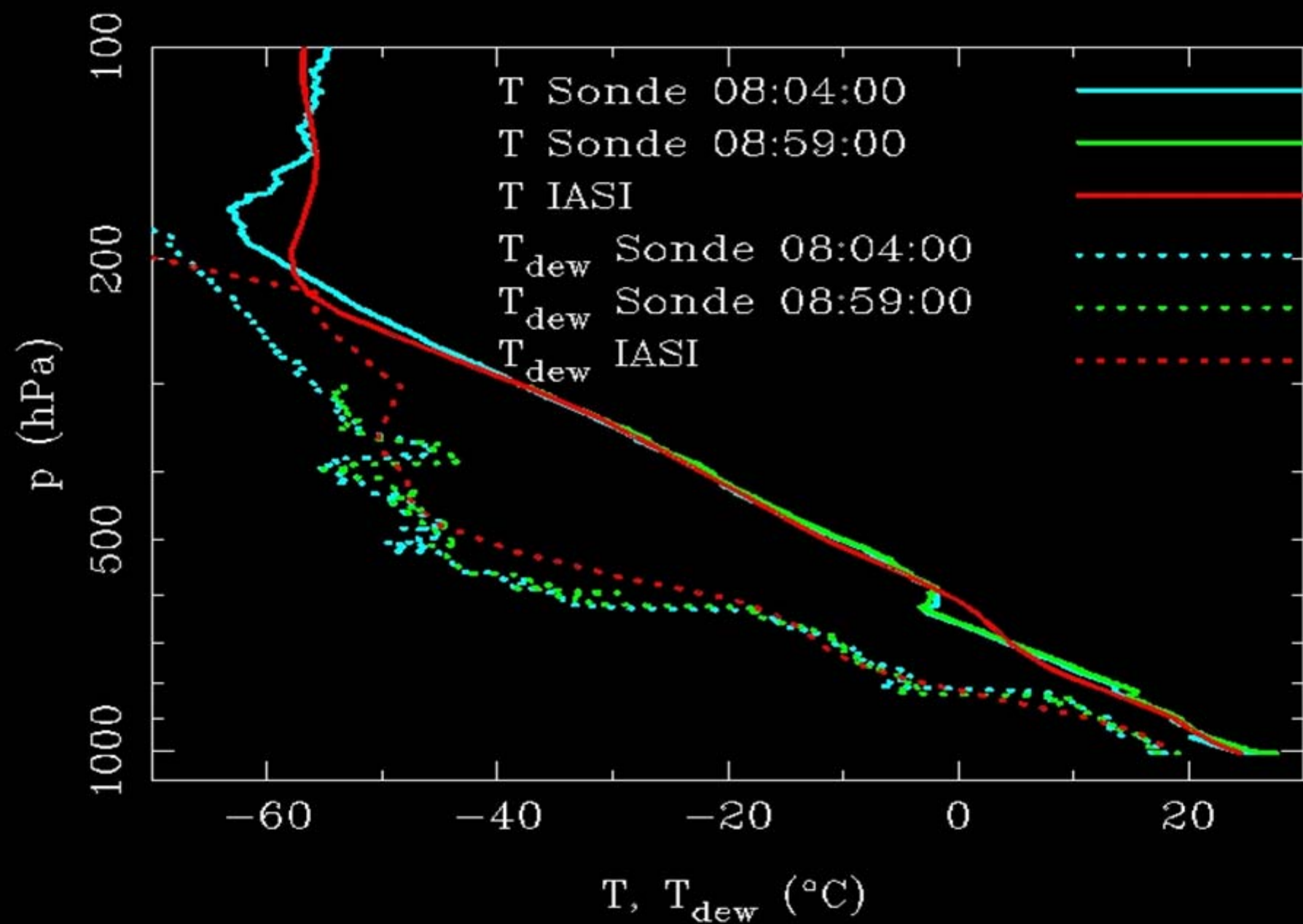
Dissemination to Users

- 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_2O, 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

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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 fiields and against data from dedicated field campaigns

- The trial dissemination of level 2 products has started

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