Use of cloudy IASI radiances, an intercomparison over the Southern polar region.

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3 EUMETSAT, 4 NOAA, 5 CMC, 6 JMA, 7 UKMO, 8 LMD

Outline

- 1. Introduction
- 2. Cloud retrieval methods
- 3. Cloud intercomparisons over the globe and over Antarctica
- 4. summary and future work

Introduction

Infrared signal affected by the presence of clouds.

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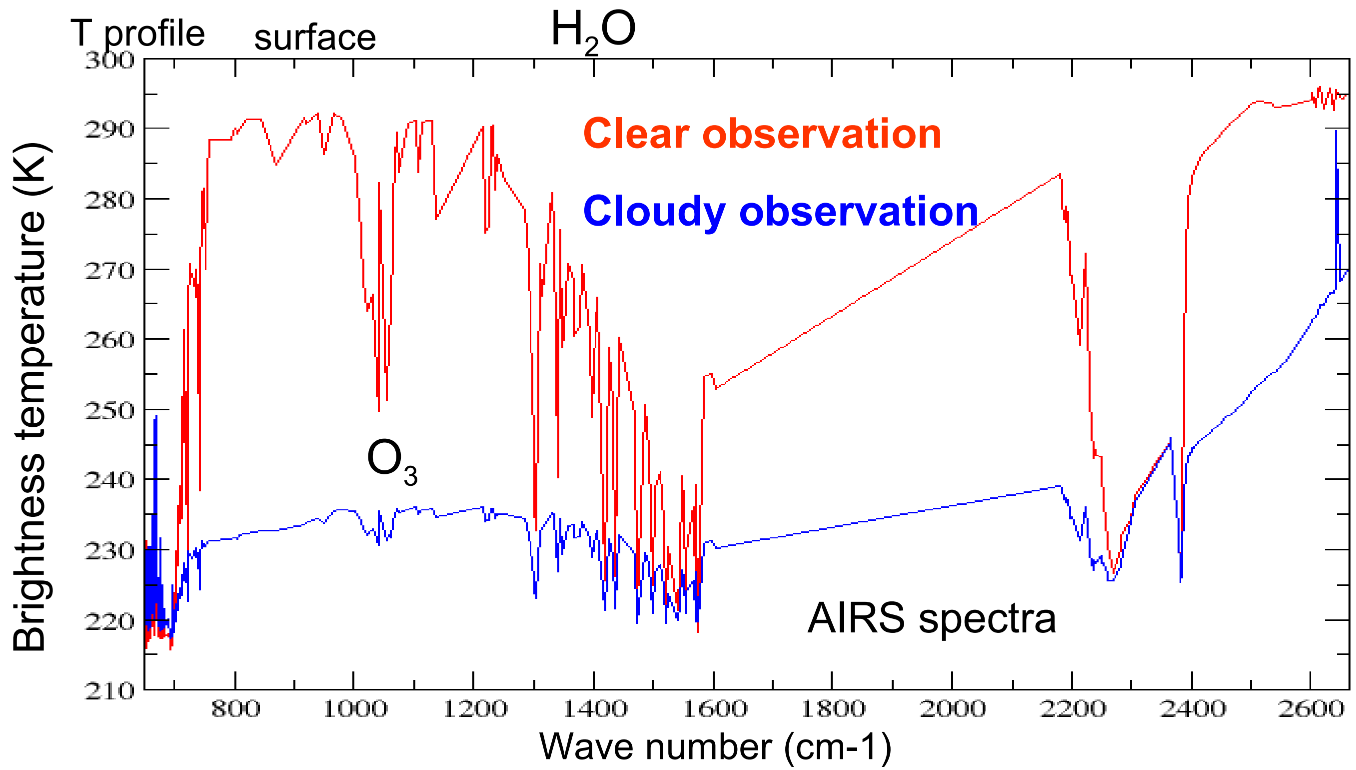
Introduction



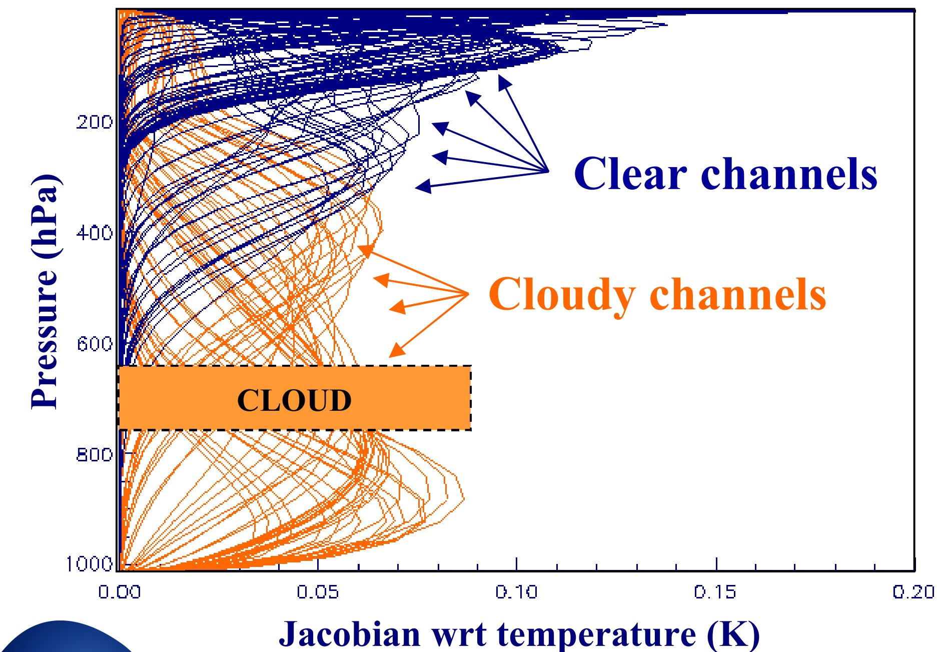
Infrared signal affected by the presence of clouds.

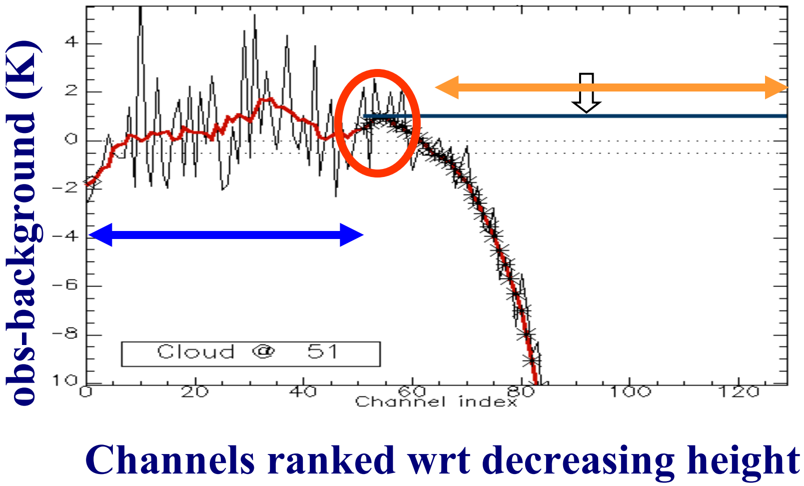
Simulation of channel affected by clouds required (between 75 and 90% of the observations).

Cloud parameters (cloud top and cloud cover) required by operational Radiative Transfer models

In Numerical Weather Prediction data assimilation

- Clear soudings (all channels) have been first assimilated in NWP.
- Clear channels : i.e. Cloud detection scheme of McNally and Watts, 2003: study of the difference between the observation (possibly cloudy) and the simulation from the background computed for clear sky for a subset of channels ranked vertically.





Figures from McNally and Watts 2003

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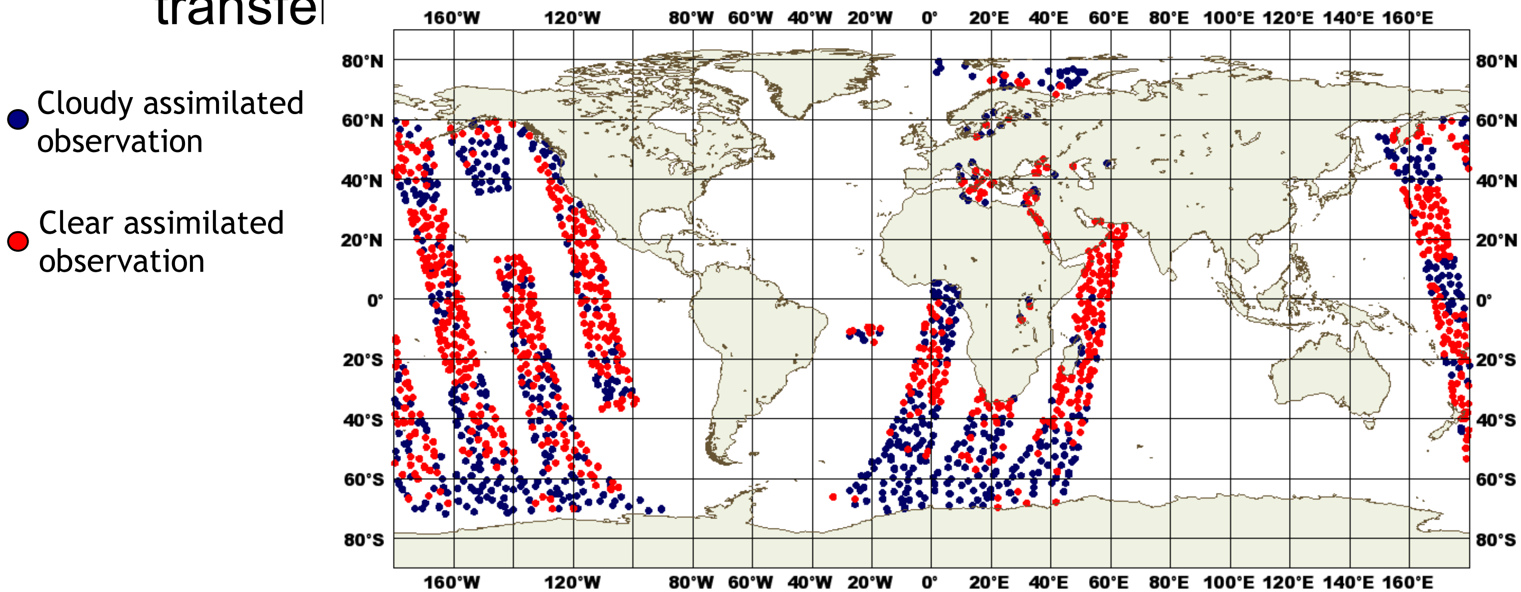
In Numerical Weather Prediction data assimilation

- Cloudy observations are now assimilated in operations since 2008 for UKMO, 2009 for MF and ECMWF : cloud parameters (cloud top pressure and cloud fraction) are provided as inputs of the radiative transfe



Example of AIRS clear and cloudy observations assimilated in the french global model for the 26 March 2009 at 00UTC.

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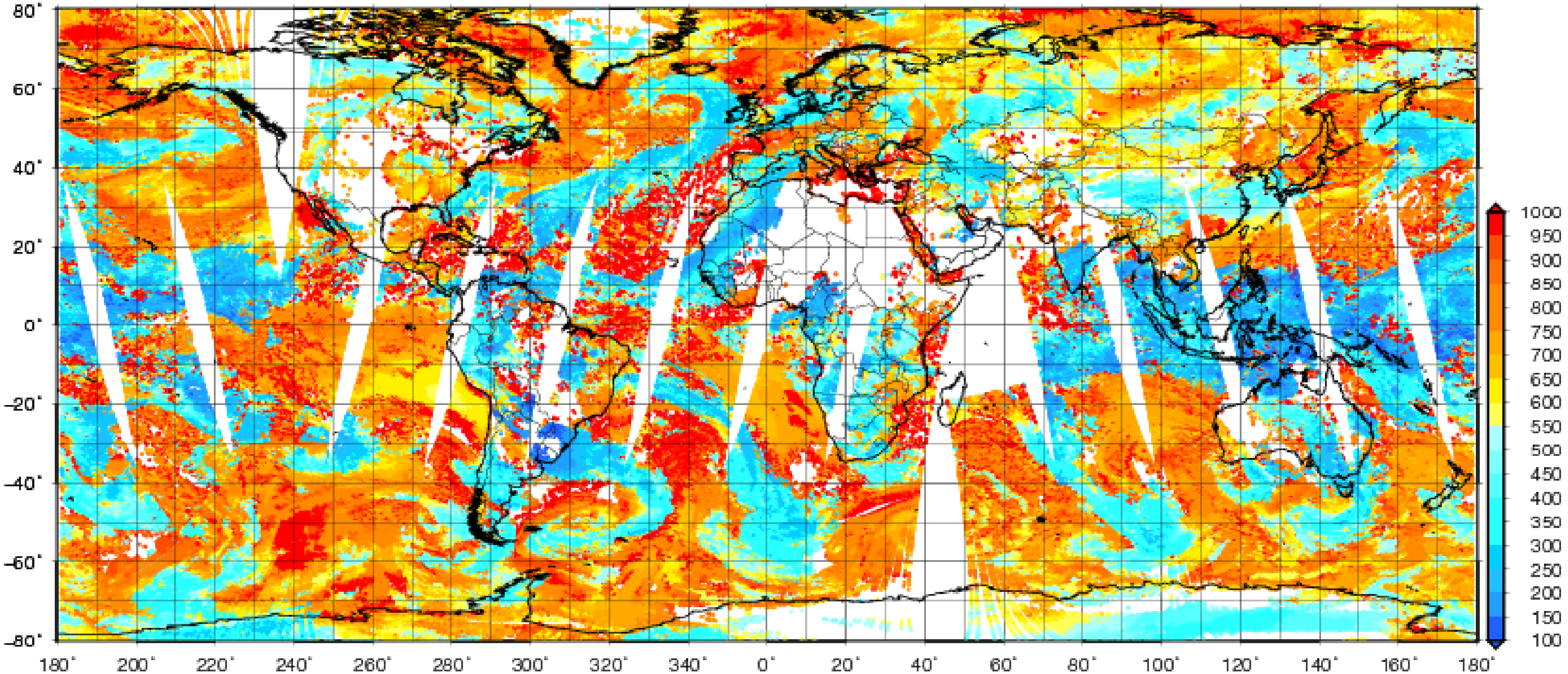
Intercomparison of cloud products from IASI

- **IASI Sounding Science Working Group:**
  - recommendation for an intercomparison of clouds products within IASI footprints.
  - Goal is to estimate the impact of the cloud processing on the accuracy of retrieved profiles from IASI spectra when affected by clouds.
  - Detection and characterization of clouds.
  - Coordinators of the intercomparison: Lydie Lavanant and Thierry Phulpin.
- Study endorsed by WMO Working Group on Numerical Experimentation to compare cloudy radiance assimilation

Cloud intercomparison exercise

- 9 centres collaborate (NOAA, EUMETSAT, LMD, MF/CMS, MF/CNRM, MetOff, JMA, CMC, NRL).
- Chosen period: 12 hours of data 18 november 2009 between 6 and 18UTC



Cloud top pressure (hPa) from IASI, CMS/MF

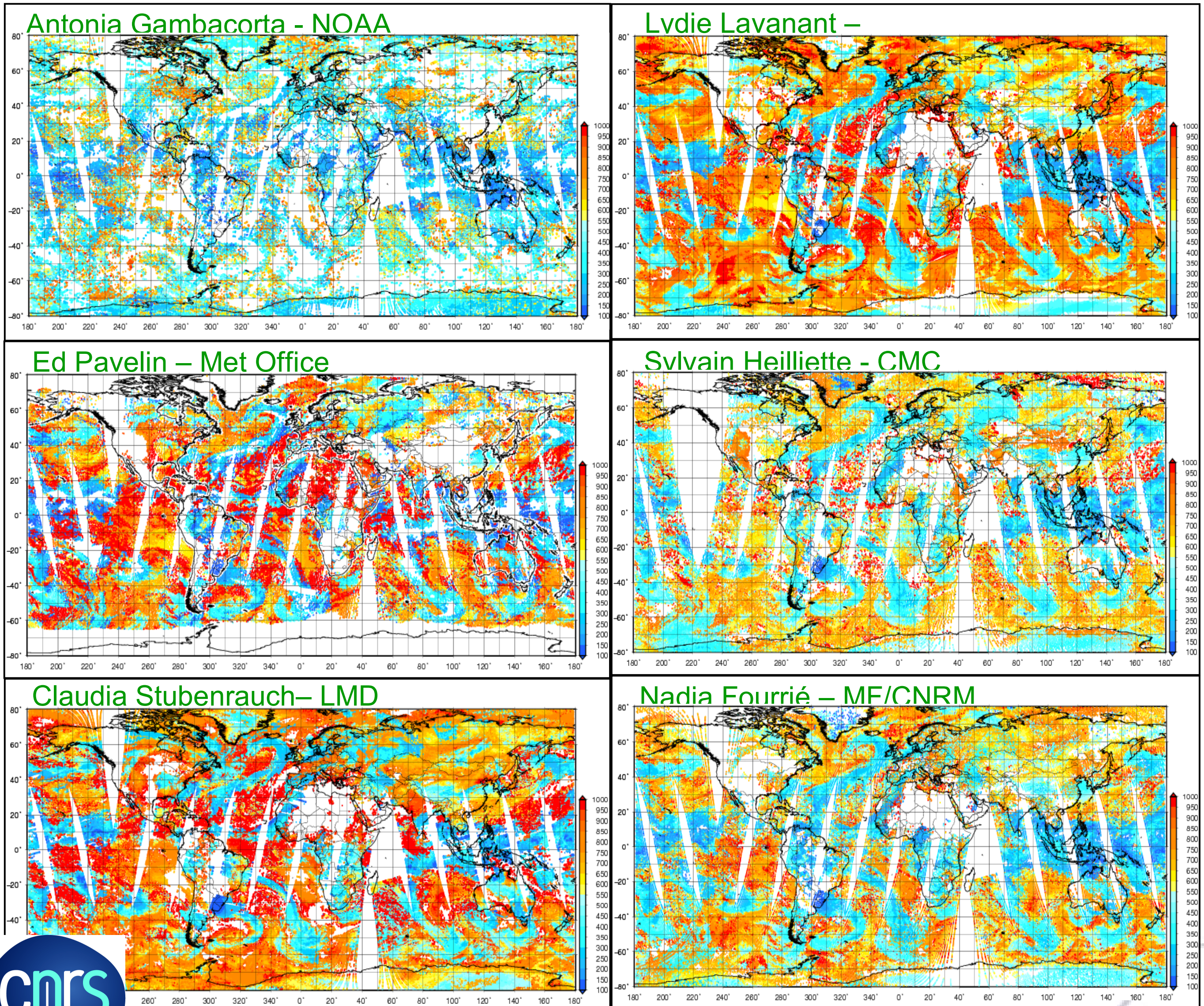
Cloud characterization schemes

- 8 cloud schemes : (NOAA, EUMETSAT, LMD, MF/CMS, MF/CNRM, MetOff, JMA, CMC), 3 schemes operational in NWP data assimilation system, 3 schemes operational for IASI retrievals and 2 research models.
- **Various methods of detection and characterization**:
  - Cloud clearing
  - Comparison with AVHRR and IASI test
  - 1D-Var
  - CO2-slicing (5 schemes)
  - Weighted χ^2 methods
  - ***Up to 3 retrieved cloud layers***

- Number of channels used varies between 8 to 92.
- RT models: RTTOV, RTIASI, SARTA and 4A.
- A priori : NWP forecast or climatology

First results over the globe

cloud top pressure (hPa)



Cloud detection ability is coherent for all the schemes.

The main meteorological structures have been retrieved by all the schemes but the cloud heights can be very different.

Difficulties with high orography, ice surfaces

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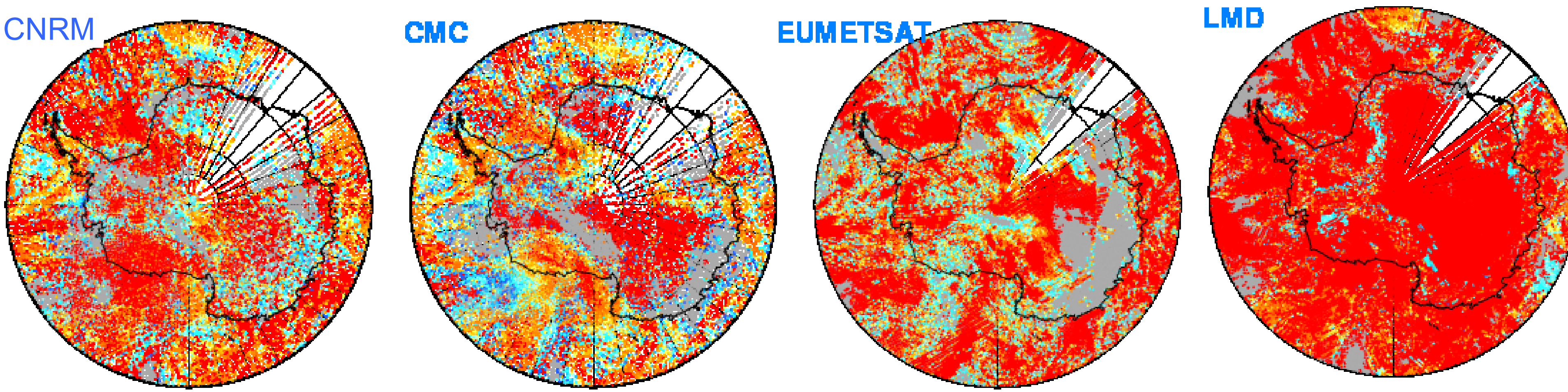
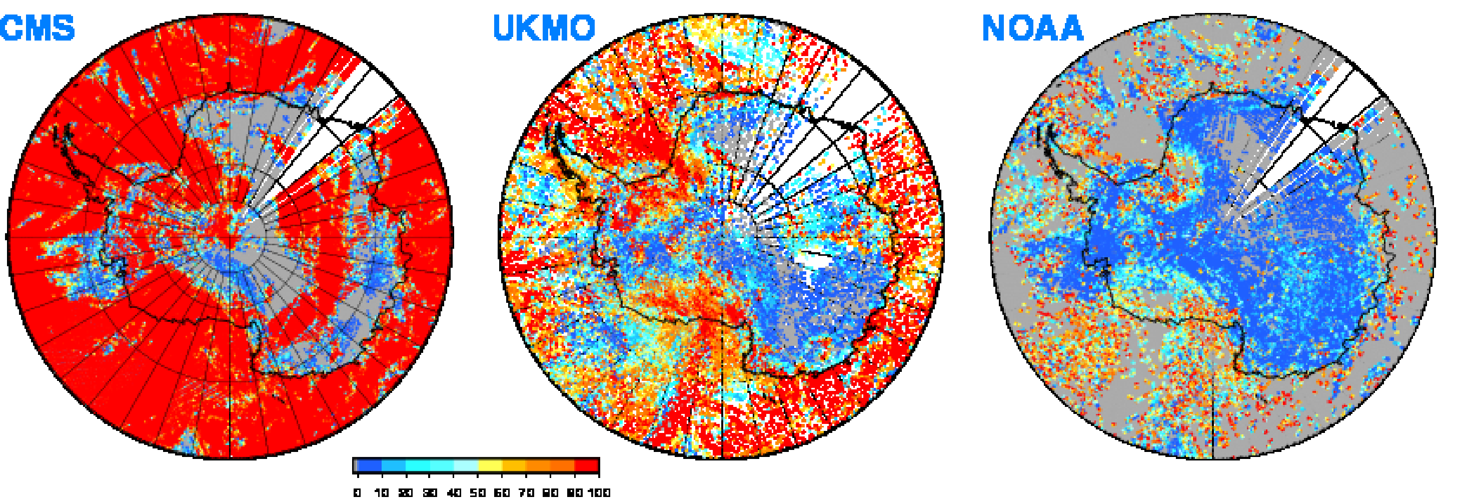
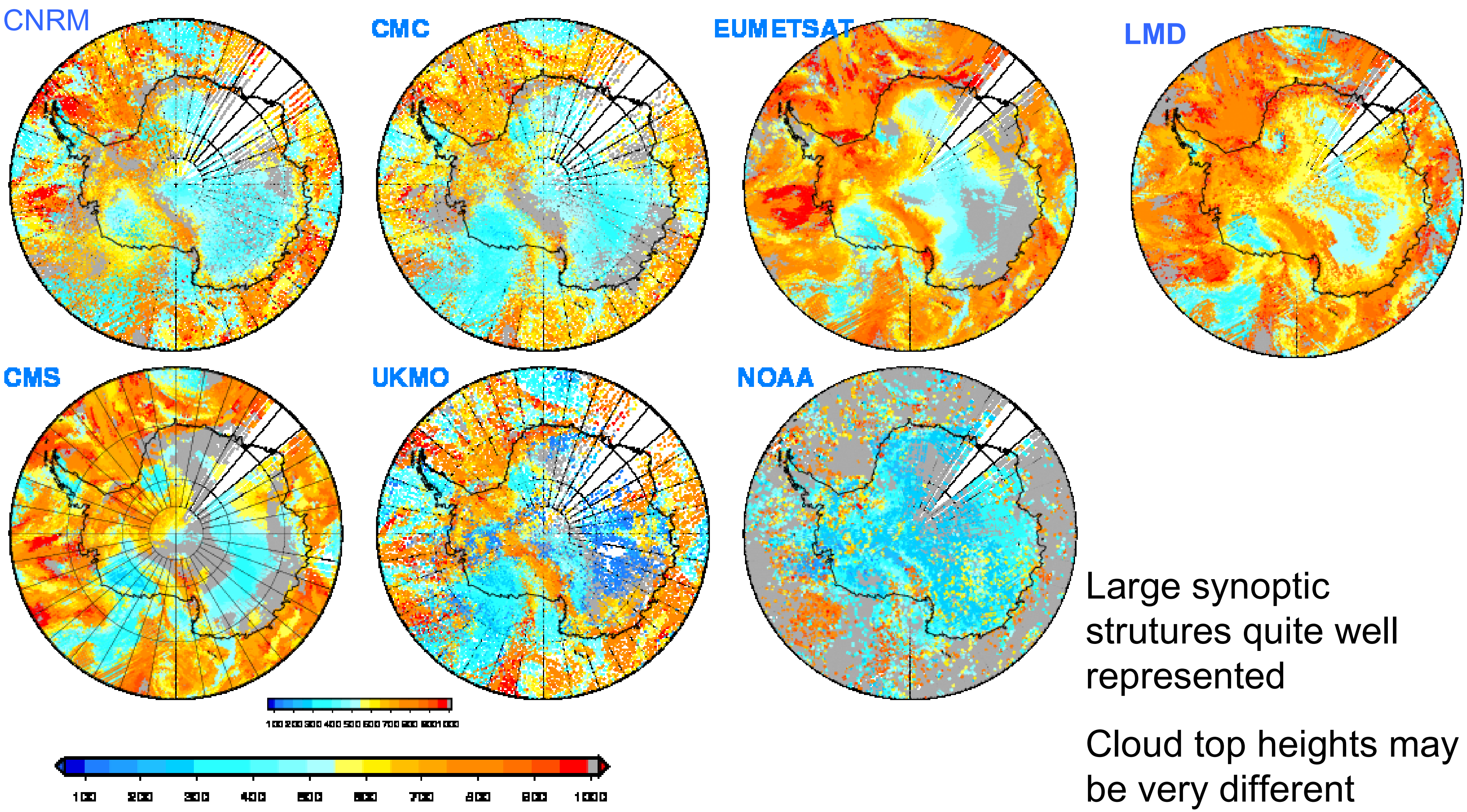
Cloud cover over Antarctica





The number of FOV is different in each plot.

Cloud top pressure over Antarctica

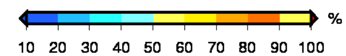


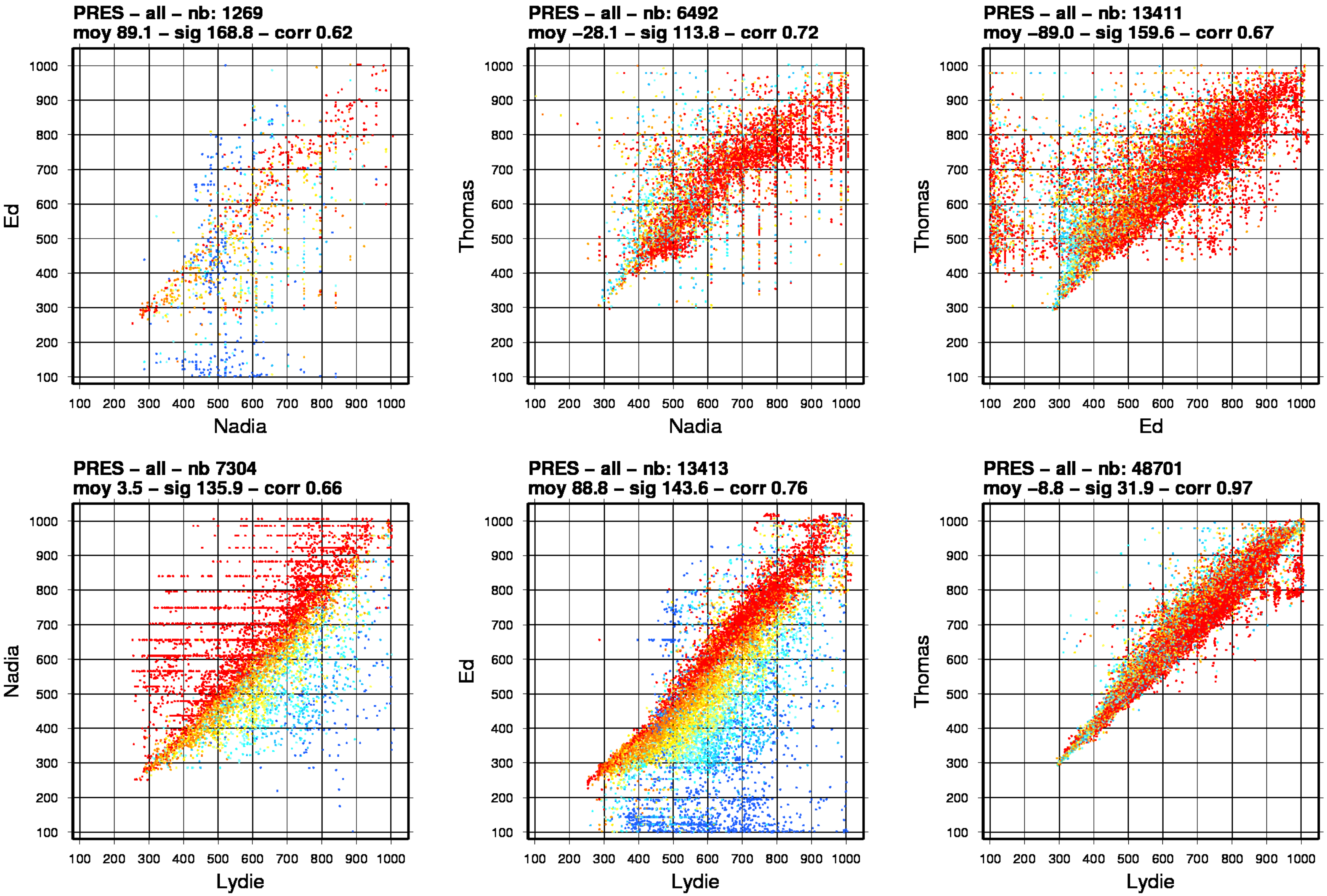
Large synoptic strutures quite well represented

Cloud top heights may be very different

Examples of cloud pressure scatterplots

CLOUD PRESSURE – all sit. Effective Amount:

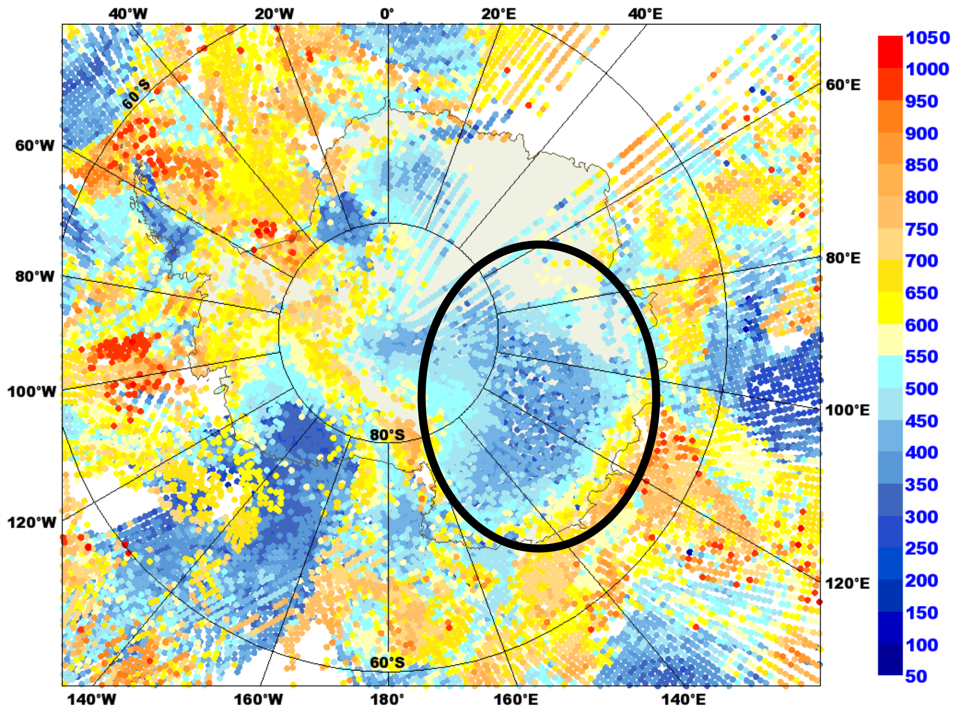


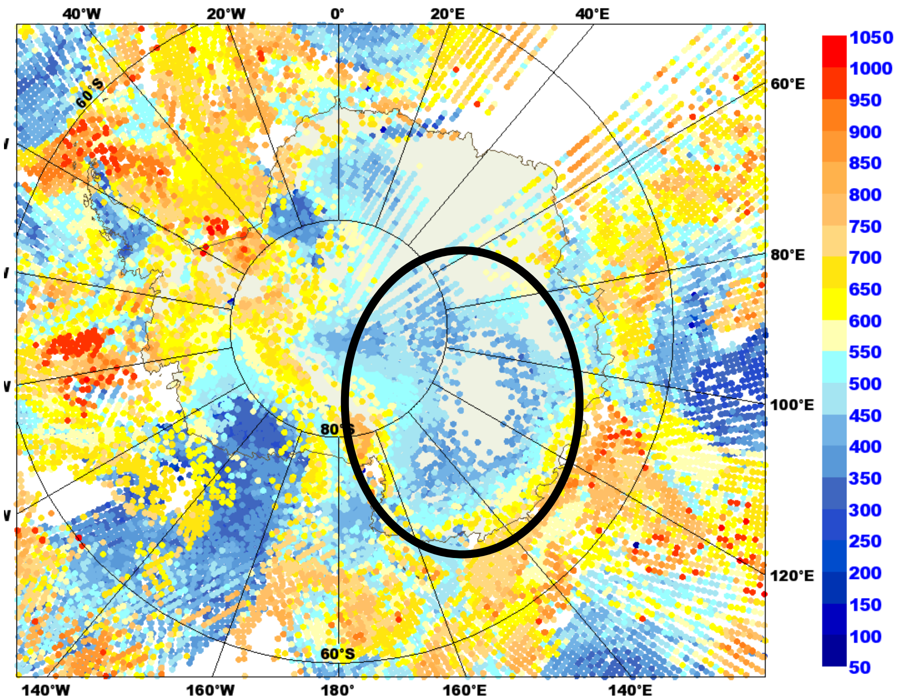


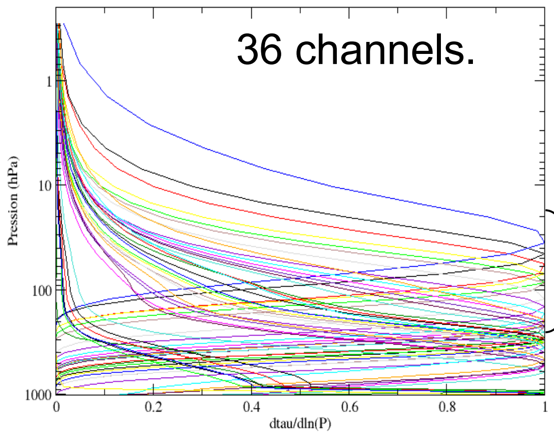
Large discrepancies can be observed

Only UKMO is able to retrieve cloud top pressure above 300 hPa.

Impact of the channel set

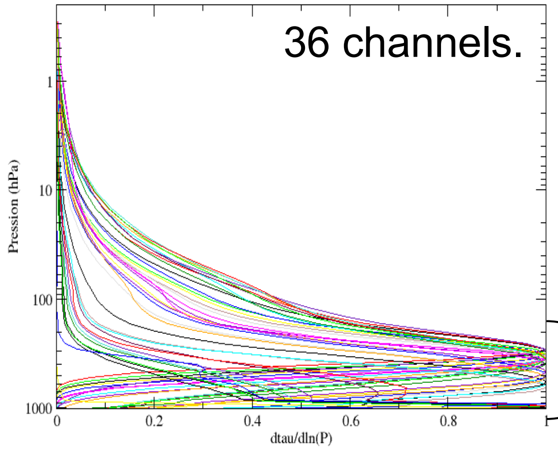






orography

16 stratospheric/ upper-tropos. channels



Only tropospheric channels

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Conclusions and future work

- Overall agreement between « cloud » schemes.
- Antarctica region represents a challenge for the « cloud » detection and the cloud retrieval:
  - Accuracy on Skin temperature and temperature profile in the low levels required.
  - High Orography
  - Retrieval of polar stratospheric clouds may require specific channel sets.

- The retrieved cloud is a radiative cloud that may not be in agreement with a physical cloud.
- The RTTOV radiative transfer model does not calculate cloud microphysical properties and consequently, the poor simulation of the observation for high level cloud layers have a large impact in the capacity of assimilating these situations.

- No access to the truth. Make use of the A-Train data to get a further understanding (North data) or use of a collocated dataset of radiosonde and IASI data
- Intercomparison exercise with in-situ observations from future campaigns (i.e: the ConcordIasi campaign)

Cloud characterization systems

Researcher	Affiliation	Scheme status	Scheme description	IASI Channels	RT	A Priori
Antonia	NOAA	IASI operational Level2	Cloud clearing method using the 2x2 IASI spots in conjunction with AMSU and MHS. Up to 2 cloud layers.	69 channels from the 666 -1200 and 2385 -2600 cm-1 bands	SARTA v10	climatology
Arlindo/ Thomas	EUMETSAT	IASI operational Level 2	Detection: AVHRR + IASI different tests - Characterization: CO_2-Slicing	41 CO2 pairs in 366	RTIASI-4	ECMWF forecast
Claudia	LMD	IASI Level2	Detection: 'a posteriori' test based on coherence of the retrieved cloud spectral emissivities. Characterization: Weighted c^2 method	8 channels in CO2	4A	Atmos. profiles (*at present from AIRS*) + spectral transmissivity profiles + spectral surface emissivities
Ed	Met Office	Operational AIRS assimilation	1D-Var retrieval of cloud parameters together with atmospheric profile	92 channels	RTTOV 7	MetOffice 6h forecast Minimum residual method
Nishihata	JMA	Developping	Detection: AVHRR, comparison with surface temperature - Characterization: CO_2-Slicing	74 channels	RTTOV 9.3	JMA 6h forecast
Lydie	Météo-France	IASI op Level2	Detection: AVHRR - Characterization: AVHRR for opaque clouds, CO_2-Slicing for homogeneoussemi-transparent. Up to 3 cloud layers	40 CO2 pairs in 366	RTTOV 9.3	ECMWF 12h forecast
Nadia	Météo-France	Operational IASI assimilation	Detection: IASI tests, comparison with surface temperature- Characterization: CO_2-Slicing	34 channels	RTTOV 9	Meteo-France 6h forecast
Sylvain	CMC	Operational IASI assimilation	Detection: AVHRR, comparison with surface temperature - Characterization: CO_2-Slicing	13 CO2 pairs	RTTOV 8.7	CMC 6h forecast