Use of cloudy radiances for NWP and retrieval of cloud parameters from IASI over Antarctica

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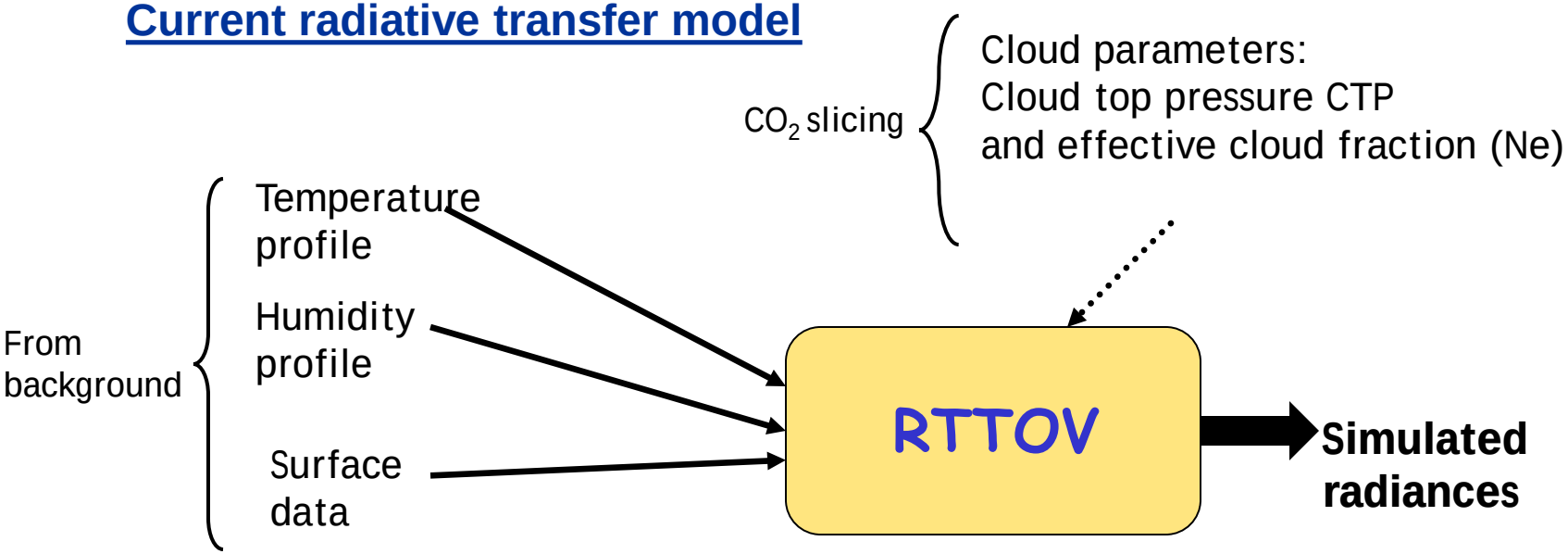
Outline

- In operations : towards the Assimilation of IASI cloudy radiances
- Evaluation of cloud in the CONCORDIASI project
- Conclusions and future works

Introduction

- Start with AIRS data, then with IASI data

Current radiative transfer model

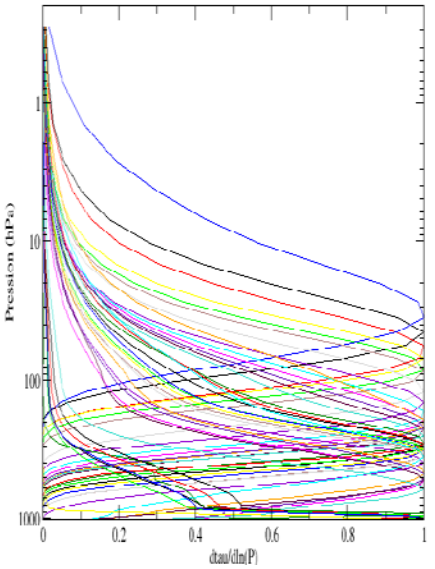


CTP and Ne retrieved with CO_2 slicing
Limitations of CO2 slicing method: detection of low-level clouds and cirrus.
Limitation of RTTOV: simplified cloud modelisation : one single opaque cloud layer

Use of the cloud cover from the imager for the assimilation of cloudy IASI radiances

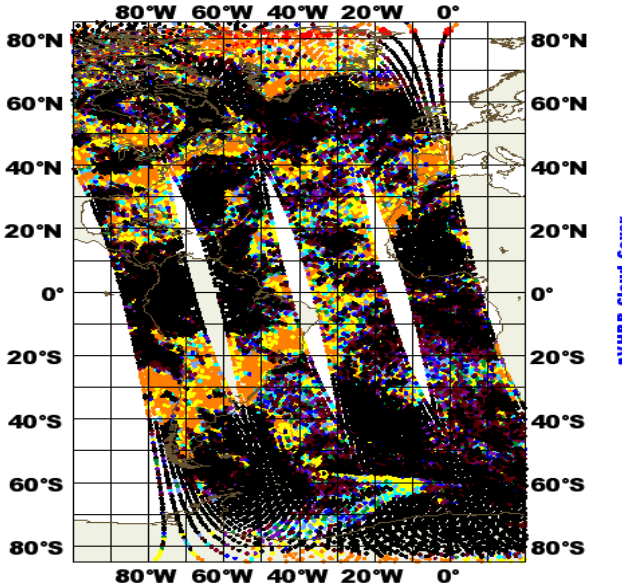
- Same methodology applied for IASI as the one used for AIRS
- Cloud parameters determined with 36 channels
- Retrieval of cloud top pressure and cloud fraction only if cloudcover(AVHRR)=100% to favour the pixel homogeneity (but not sufficient)

Weighting functions of the 36 IASI channels

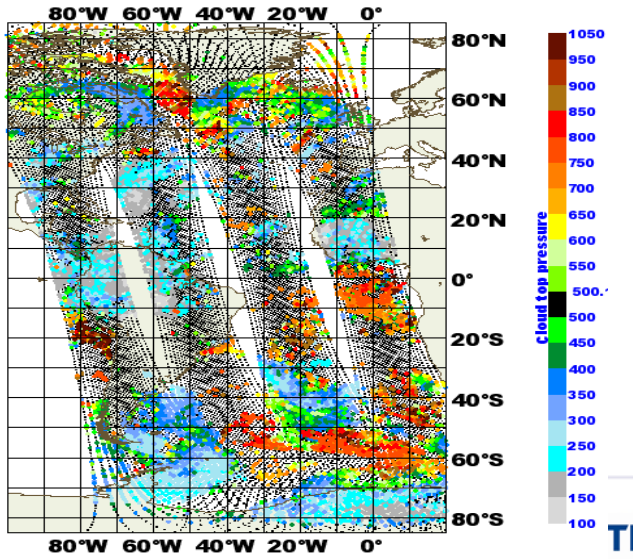


Example for the 19th of september 2010 at 00 UTC

AVHRR cloud cover



IASI Cloud top pressure

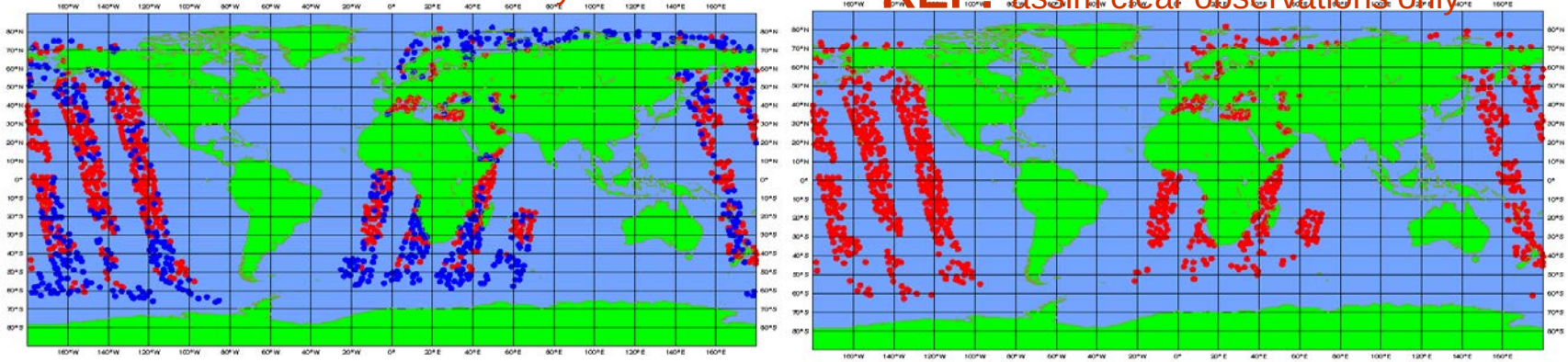


Assimilation of AIRS/IASI cloudy radiances:
data selection

- Cloud parameters (cloud top pressure and effective cloud fraction) used as input of radiative transfer model for the simulation of cloudy radiance
- Assimilation of cloud affected channels if cloud top pressure included in the range 650-900 hPa on top of clear channels for overcast observations

EXP: assim clear + AIRS cloudy observations

REF: assim clear observations only



Geographical coverage of assimilated observations for the channel 239 (478 hPa:mid-troposphere). 01/09/06 à 00UTC

Cloudy obs assimilated

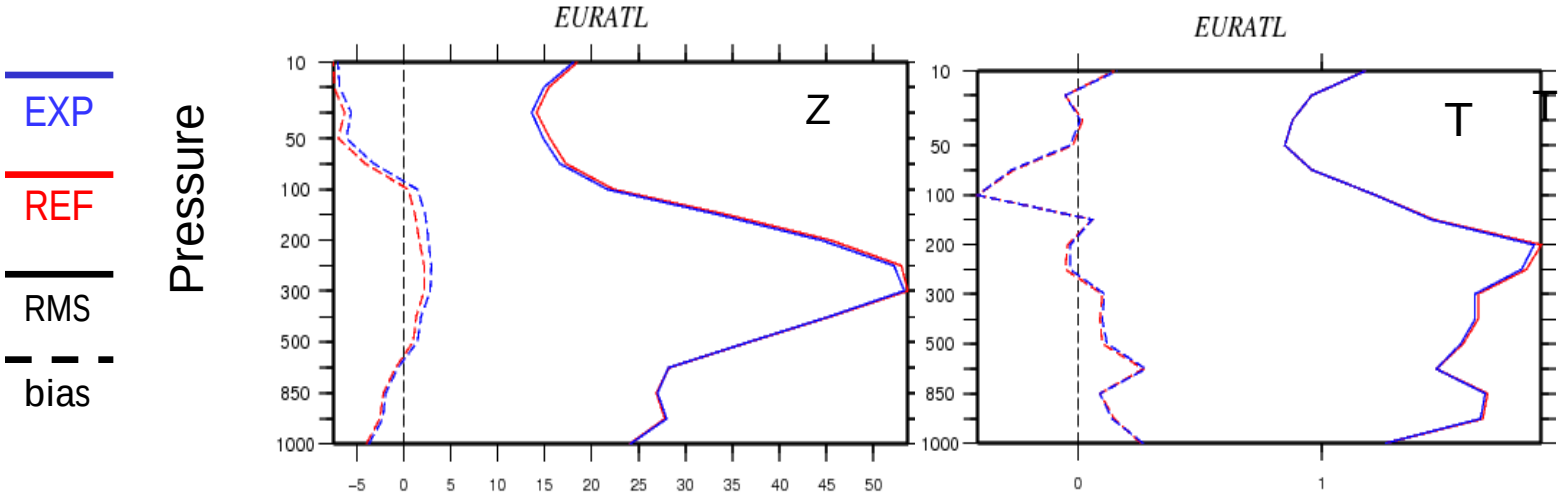
Clear obs assimilated

- About 2 % cloudy observations assimilated among the global IASI dataset, 0.2%-0.3% additional IASI observations in the minimisation

Assimilation of AIRS/IASI cloudy radiances:
impact on forecast

- **AIRS data**: Small positive impact on the forecast skill. (Pangaud et al, 2009, *MWR*).
- In operations since February 2009 for the global model and since april 2010 for the mesoscale model AROME.
- **IASI data**: Forecast scores neutral to slightly positive (evaluation over monthly periods against ECMWF analyses and radiosondes).

96-hour Forecast RMSE wrt ECMWF analyses



- IASI cloudy radiances In the current e-suite
- Some results can be found in Guidard et al, 2011, *QJRMS*

CONCORDIASI

International project

Main goal: to improve the assimilation of satellite data over Antarctica

See Poster 4.46 by Vincent Guidard

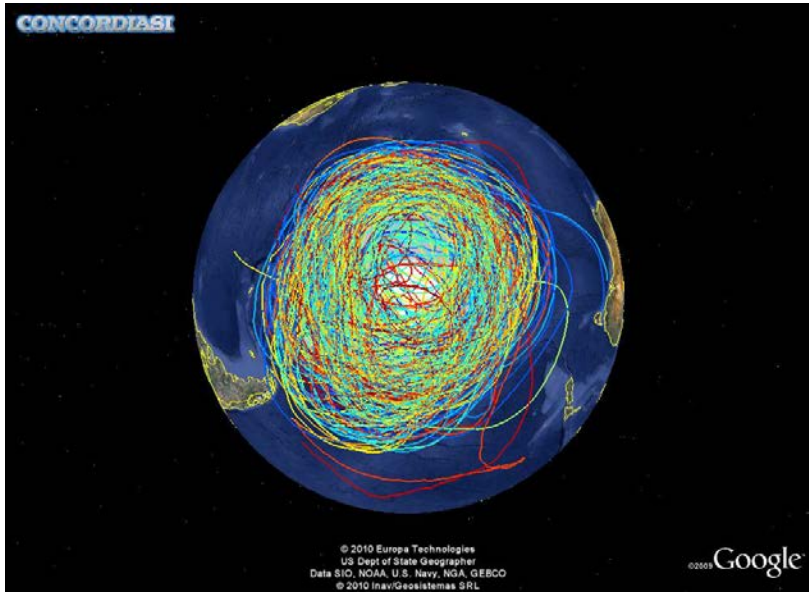
13 driftsondes launched out of 19 Super-pressure balloons in total

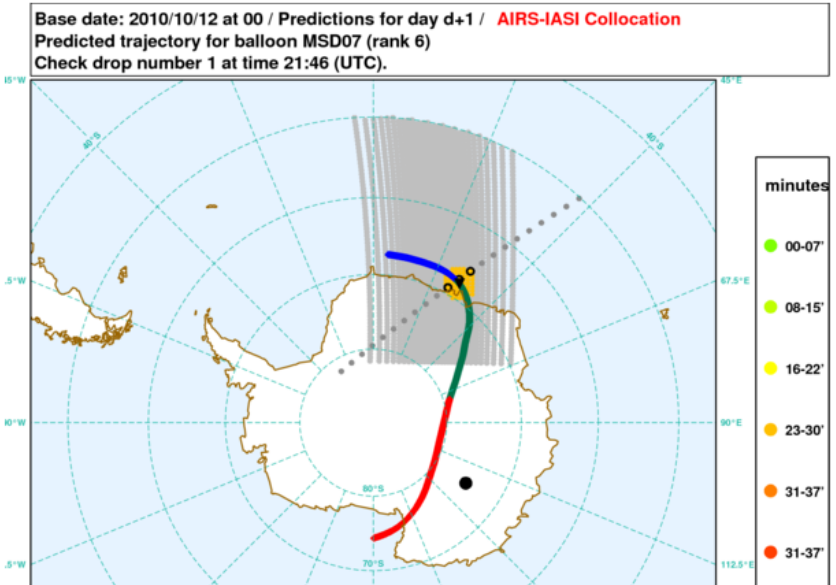
Most of the sondes were dropped when coinciding MetOp overpasses + A-train

Part of the dropsondes were deployed in sensitive areas

Calibration/validation of IASI assimilation, including cloudy cases

Flights overview Sept 2010-Jan 2011





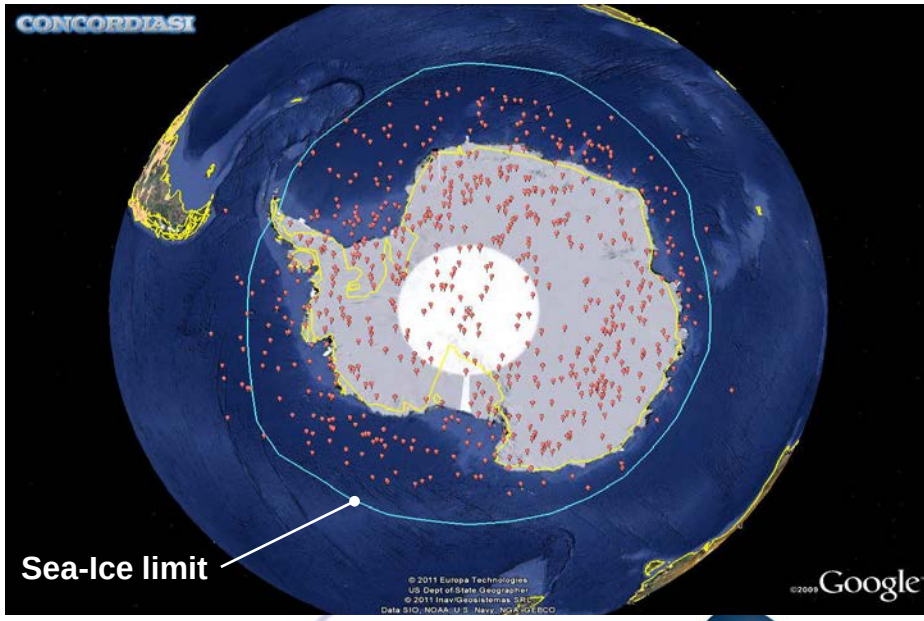
Sensitivity of the cloud parameter retrieval in Antarctica

- **Evaluation of the cloud parameter retrieval from IASI (Tuuli Perttula, FMI)**
  - Evaluation with dropsondes and cloud parameter from CALIOP and CPR from the A-Train
  - Colocations provided by L. Lavanant
  - 120 IASI observations selected, over 11 days (oct-nov 2010)
  - 40 cloudy observations « seen » by CPR or Caliop
  - Only 8 cloudy observations with CPR and Caliop!
  - For clear CPR/Caliop observations, often cloud cover from AVHRR = 100%

- Hard to know where the truth lies!

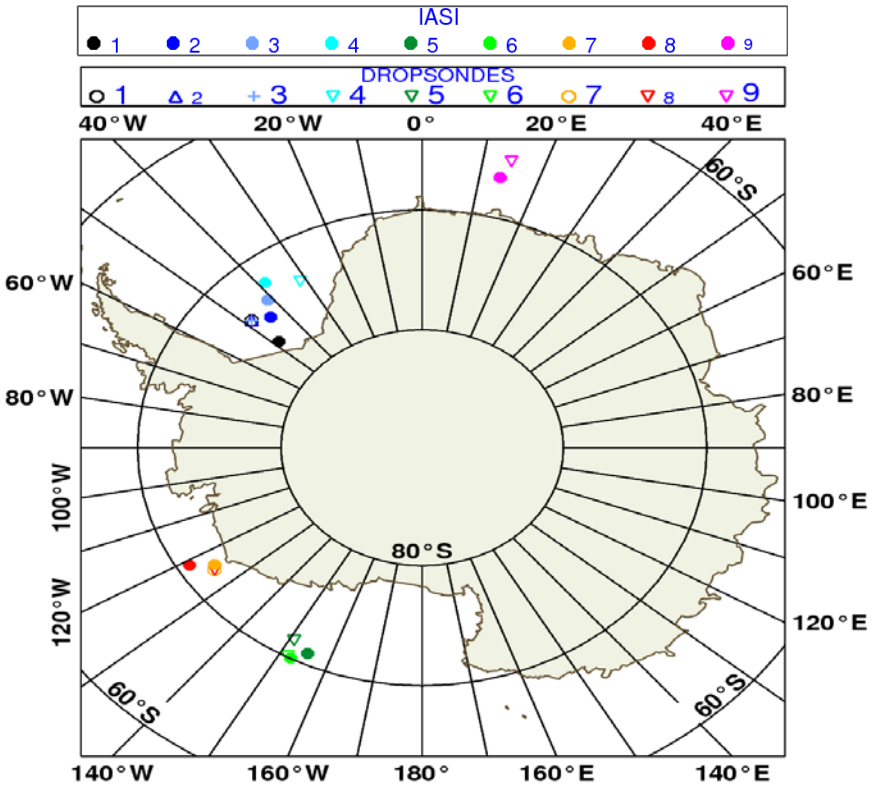
- Modification of the atmospheric profile with dropsonde data but surface data (T2m, Hu2m and Ts) from model

- 9 observations with « close » dropsonde data selected over sea ice and land

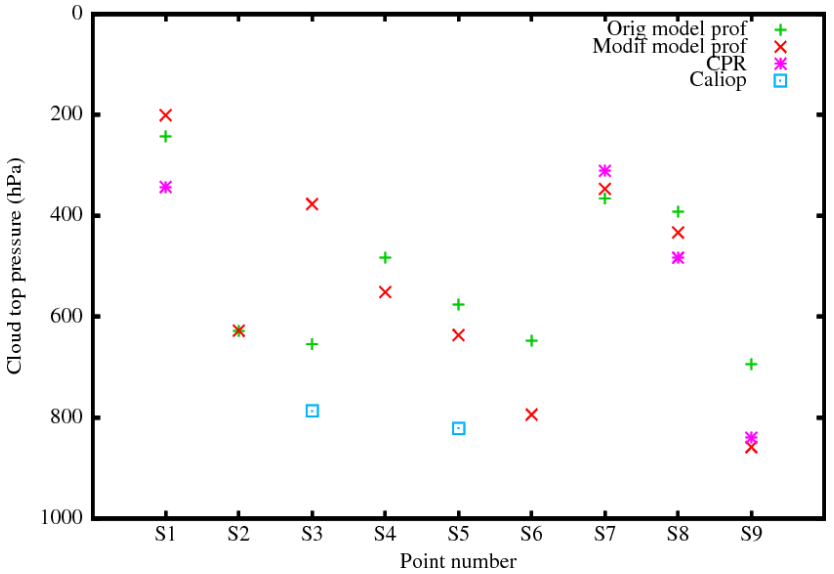


METEO FRANCE Toujours un temps d'avance
cnrs INSU Observer & comprendre

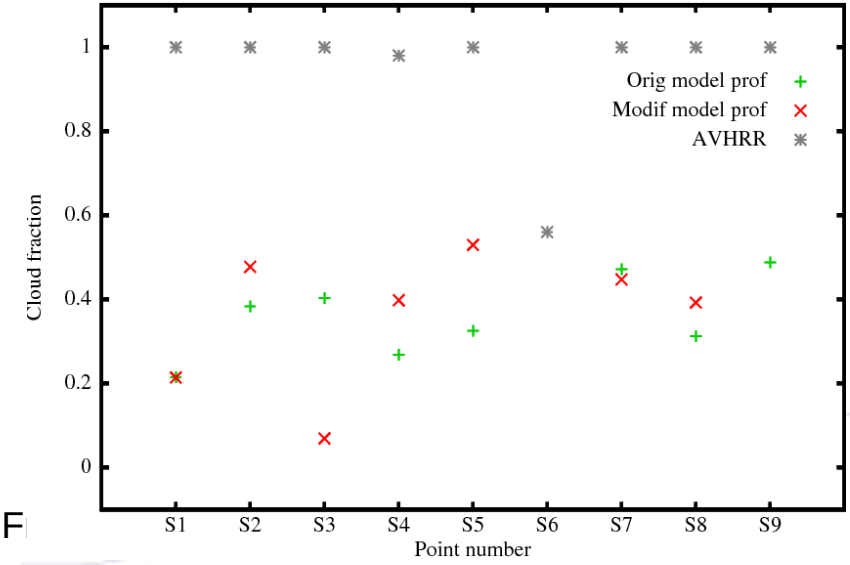
Evaluation over sea ice



Cloud top pressure (hPa)



Cloud fraction

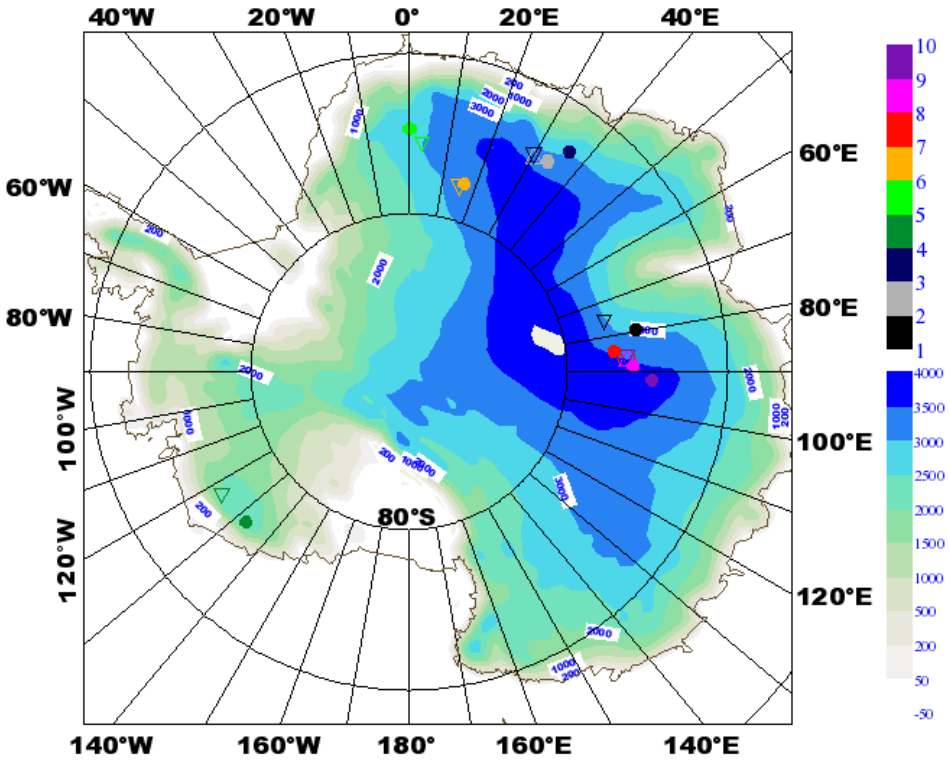


3 clear cases 6 cloudy cases

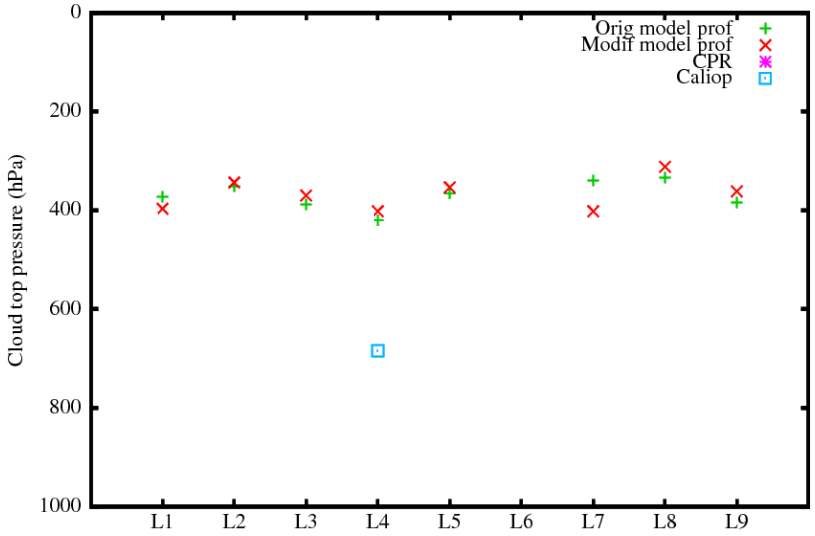
IASI retrieval closer to the CPR clouds

Surface temperature problem in the model over sea ice

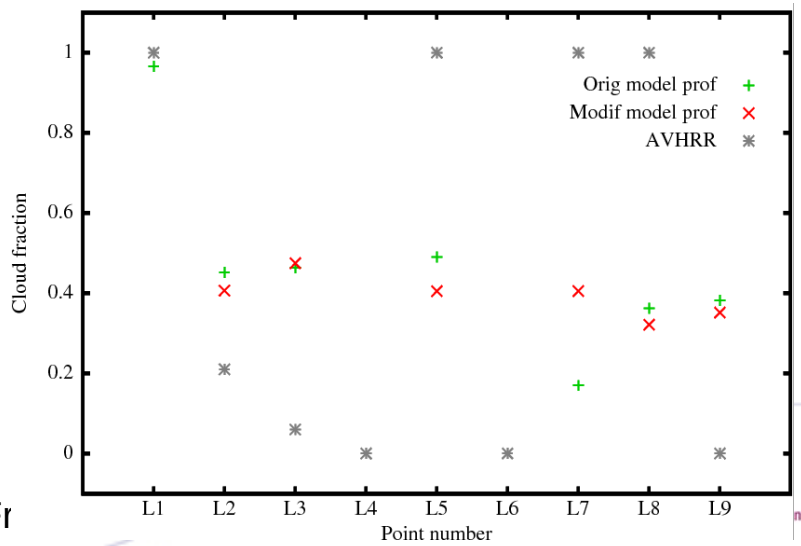
Evaluation over land



Cloud top pressure (hPa)



Cloud fraction



- Altitude above 2000m, high variability of the orography
- Difficulties to detect clear sky
- Benefit from the imager for the cloud detection in some cases

Conclusions and prospects

- Simple cloudy radiance assimilation scheme with one layer opaque cloud. Similar approaches used in other NWP centres.
- IASI cloudy radiance assimilation in the current e-suite
- Same methodology will be applied to CrIS.
- A step further: cloudy radiance assimilation with cloud profiles:
  - Liquid water content and ice water content
  - 1D-Var study (Talk 4.15 by Pauline Martinet)

- Cloud parameter retrieval over Antarctica.
  - Need of cloud product for comparison (Talk 4.18 by François Faijan)
  - Problems of
    - surface temperature in the model over sea ice
    - high elevated orography
    - Presence of strong vertical gradient in temperature near the surface

Thank you very much!