Satellite Data Assimilation over Antarctica : The Concordiasi Field Experiment

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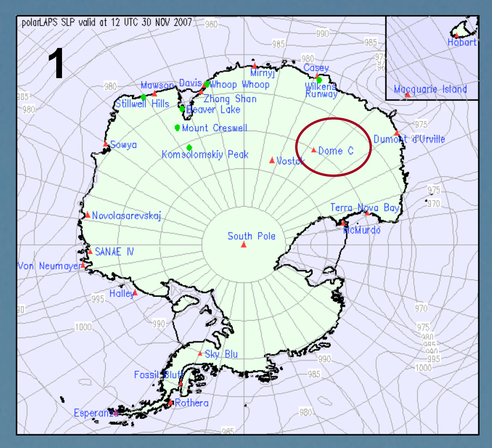
The Concordiasi Project

- Austral Spring 2008/ 2009
- Increase in the number of observations over Antarctica (Fig. 1) :
  - Radiosoundings (Concordia at Dome C, Dumont d'Urville) :
  - Stratospheric Balloons (12 balloons with 50 sondes + 4 balloons for chemical studies)

Objectives : Improve the assimilation of infrared and microwave satellite observations over high latitudes by comparison with in-situ observations (see above)

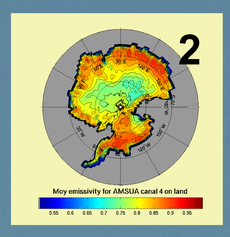
http://www.cnrm.meteo.fr/concordiasi

An international project: Météo-France, CNES, IPEV, PNRA, CNRS/INSU,
NSF, NCAR, Concordia consortium, University of Wyoming, Purdue University. Support from ECMWF.



Meteorological model of Météo France /ECMWF: ARPEGE (Courtier et al, 1994; Rabier et al., 2000)

The assimilation of microwave sensors: AMSUA/AMSUB on NOAA, MetOp

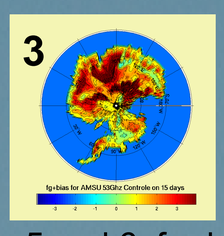


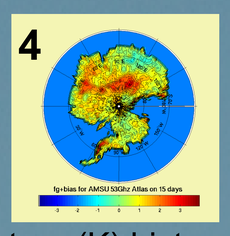
- Dynamical approach for the estimation of the emissivity (Fig. 2) in ARPEGE from satellite observations (Karbou et al. 2006)
  ➔ Emissivities derived from AMSU-A ch 3 and AMSU-B ch 1 are assigned to the temperature & humidity sounding channels respectively.
- This approach will be compared to the operational emissivity scheme (Grody, 1998 or Weng, 2001 depending on the frequency).

Results are presented for the fg-departures (observations – first guess), with no bias correction applied.

• Study over land (Fig. 3, 4, 5 & 6)

Results for AMSU-A ch5: Fig. 3 (with the operational emissivity scheme) and Fig. 4. (with the so-called dynamical approach)





→ A better fit to the observations
→ More observations assimilated
→ In this case, up to +41%

- Fig 5 and 6: fg-departure (K) histograms for AMSU-A and AMSU-B over land.

Fig. 5 :AMSU-A, ch. 4 & 5, 2 weeks, over Antarctica

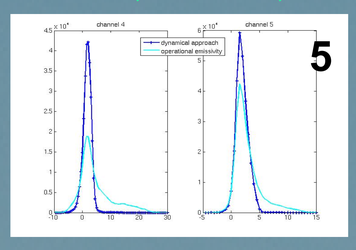
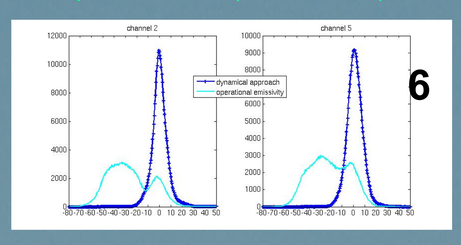


Fig. 6: AMSU-B, Ch. 2 & 5, 2 weeks,over Antarctica



• Study over sea ice (Fig. 7 & 8)

Use of the retrieved satellite emissivities over sea-ice rather than the operational emissivity algorithm: Results are shown for AMSU-A (fig. 7) and AMSU-B (fig. 8)

(fg-departures with no bias correction applied)

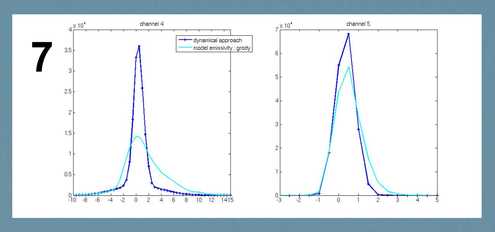
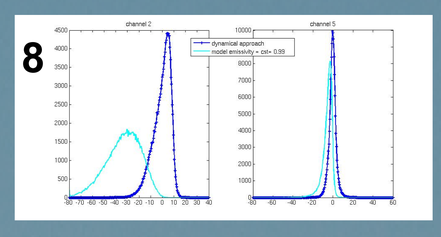


Fig. 7: AMSU-A, ch. 4 & 5, 2 weeks, over sea ice

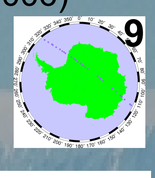
Fig. 8: AMSU-B, ch. 2 & 5, 2 weeks, over sea ice

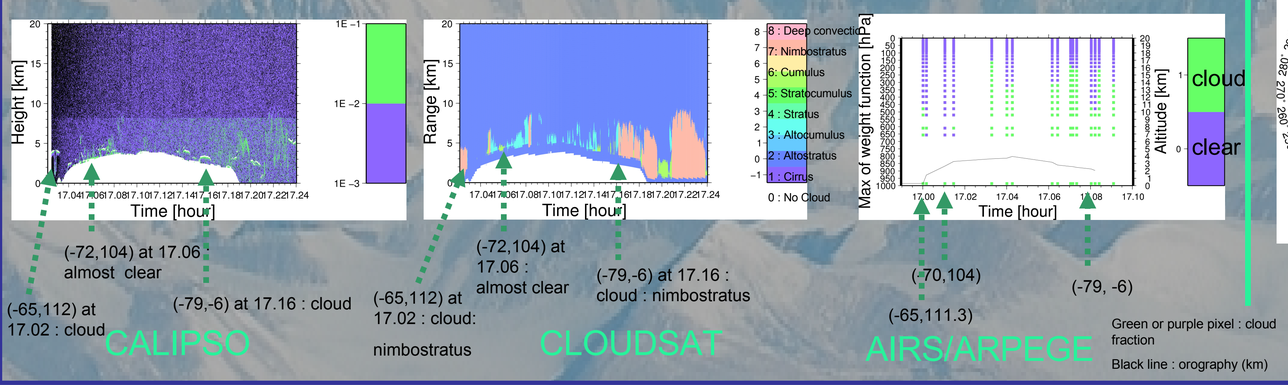


The assimilation of infrared sensor: AIRS/IASI

One major aim of the campaign : assimilation of IASI radiances
For cloud detection: use of Cloud Detect (McNally and Watts, 2003).
At high latitudes
→ Investigate detection of Polar Stratospheric Clouds (McCormick, 2002)
→ Cloud Detection algorithms not so accurate for low clouds (Dahoui, 2006)

Case study 1: along the track of AIRS (fig. 9) the 10/01/2008





Case study 2: 9/01/2008 between 3 and 4 UTC

Comparison between Modis/Aqua (Fig. 10) and IASI/Met0p (Fig. 11)
Comparison between Modis/Aqua (Fig. 10) and AIRS/NOAA (Fig. 13)
Fig. 11 & 13 : Cloud Fraction (orange : cloud/ pink : clear)

Fig. 10: Modis : Cloud Top Pressure (hPa)

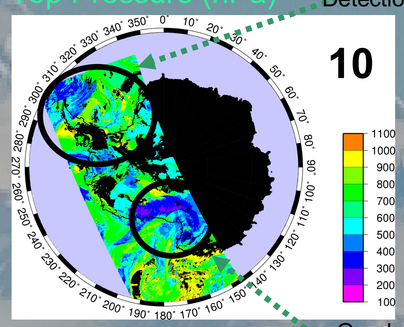


Fig. 11 :IASI, ch., 242 (max weighting function: 286hPa)

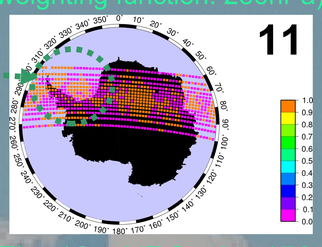


Fig. 12 :IASI, ch., 242 Weighting function

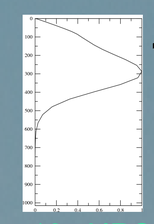


Fig. 12 : AIRS, ch., 173 (max weighting function 321hPa)

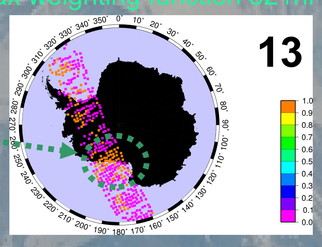
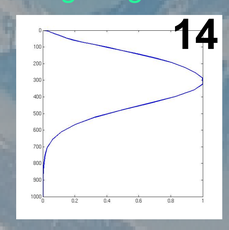


Fig. 13 :AIRS, ch.,173, Weighting function



Future Work

For the microwave

→ Test with a lambertian or semi-lambertian surface rather than specular surface for the emissivity computation

→Improve the assimilation over Antarctica :Modification of thresholds for data use (Orography, TS, estimation of emissivity over sea ice)

For the infrared

→Statistical study and tuning of cloud detection over Antarctica

→Study in 1D-VAR/ comparison with Radiosounding for cloud detection at Concordia station

http://www.lmd.polytechnique.fr/VORCORE/McMurdoE.html

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