Studies on the assimilation of AIRS/IASI near surface channels in the French global NWP model

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Introduction

- Up to now, major efforts on cloud detection and assimilation of cloud-affected radiances for AIRS/IASI
- Operations: assimilation of stratospheric/tropospheric channels for AIRS/IASI
- Research work on surface emissivity

- <u>Outline</u>
  - Computation of spectral surface emissivity
    - From spectral libraries
    - Directly from AIRS observations
  - Sensitivity studies to surface emissivity and surface temperature over Antarctica
  - Assimilation of 4 IASI surface channels over sea
  - Conclusion and future works

The atlas of spectral surface emissivity (SSE) climatology for AIRS/IASI

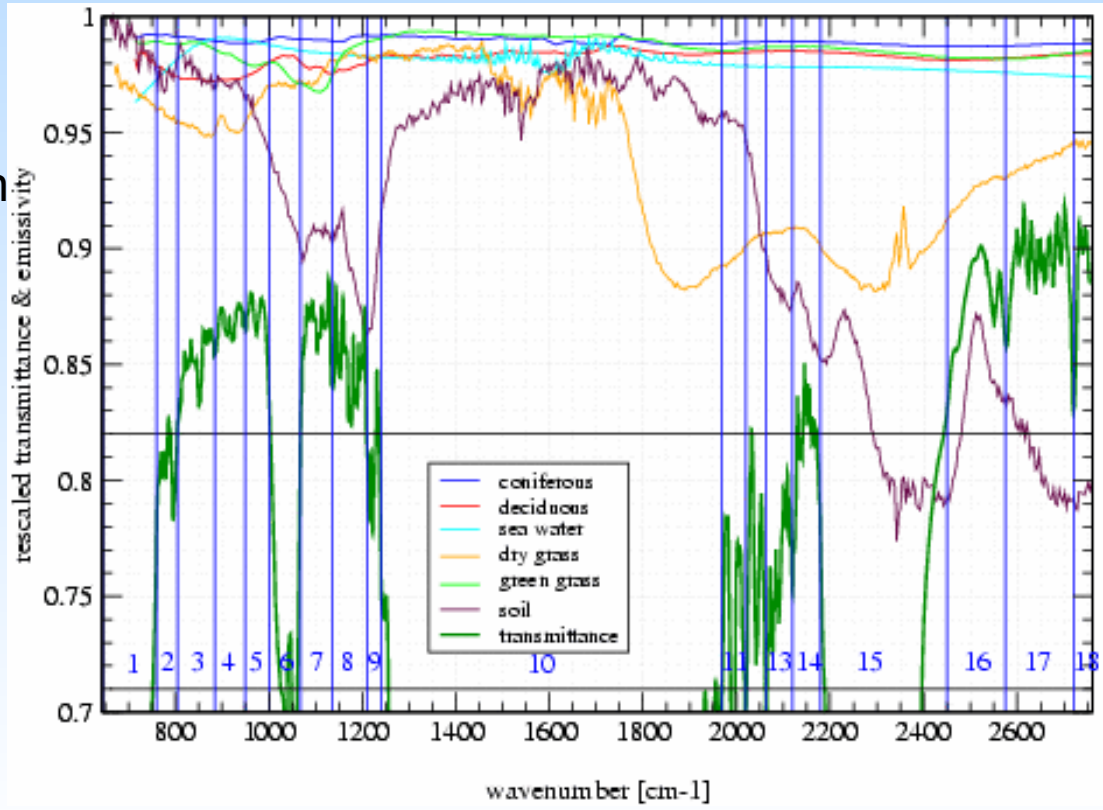
Sczcech-Gajewska and Rabier 2003

- Emissivity spectra from spectral libraries (MODIS, ASTER and JPL) compiled with the ones by Snyder et al 1998.
- A complete surface parameter global dataset Ecoclimap (Masson 2003) used for land surface description

  $\rightarrow$14 land cover types

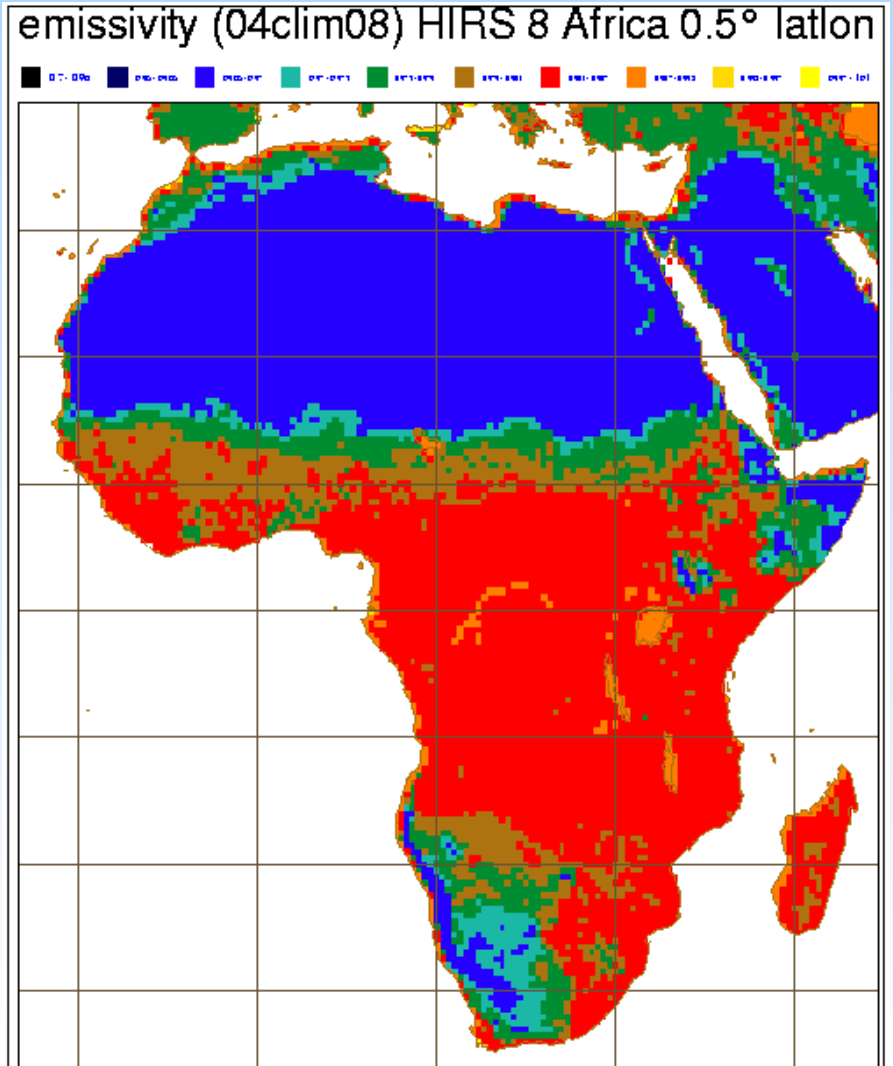
- New emissivity maps for 18 wavebands (IR) and for each month

Transmittance and spectral emissivity for various land cover types.



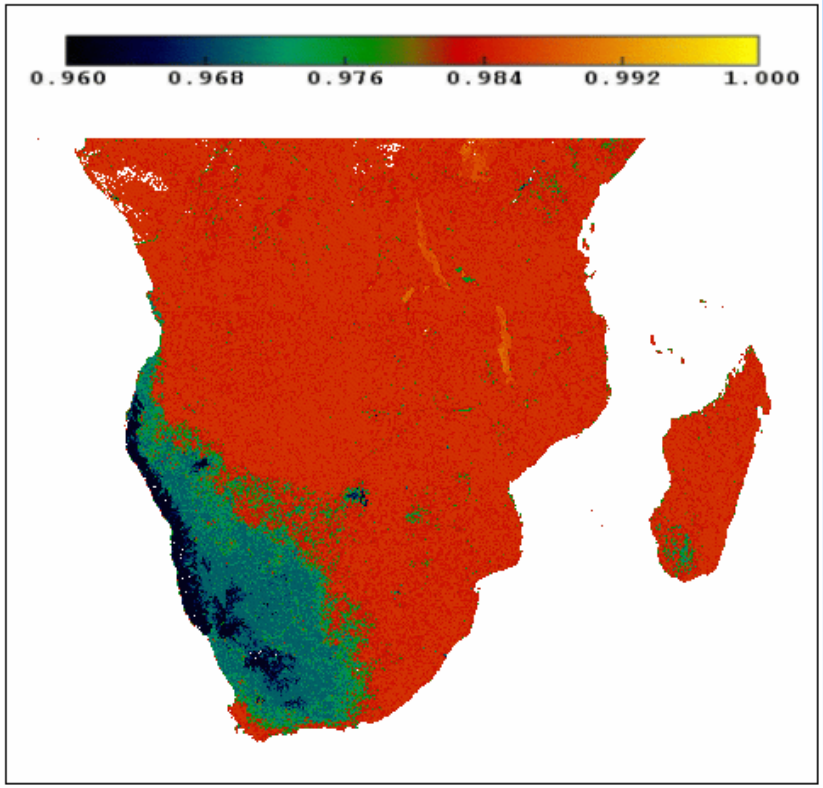
Evaluation of the atlas of spectral surface emissivity climatology

Climatological map of SSE (august)



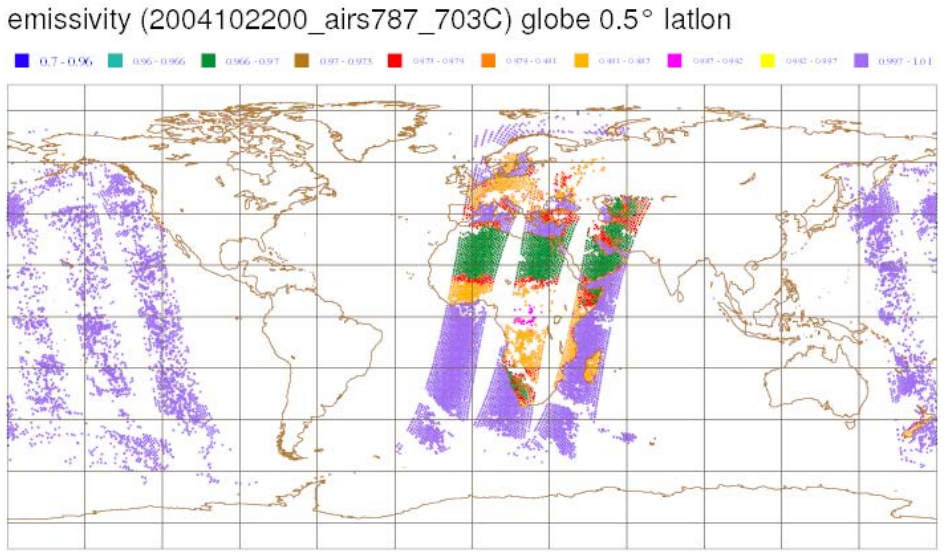
Good agreement between both emissivity fields

SSE composite map retrieved from MODIS band 31 measurements



Assimilation of AIRS over land with SSE atlas

Hua, et al (2006)



Difference of RMSE for geopotential height at 72h forecast range

	Impact of AIRS over land	Impact of SSE
300hPa	0.71	0.26
500hPa	0.51	0.2
850hPa	0.25	0.1

Pre-operational context, 2 weeks

Weak positive impact of assimilation of AIRS over land and of the SSE, not significative

Encouraging results

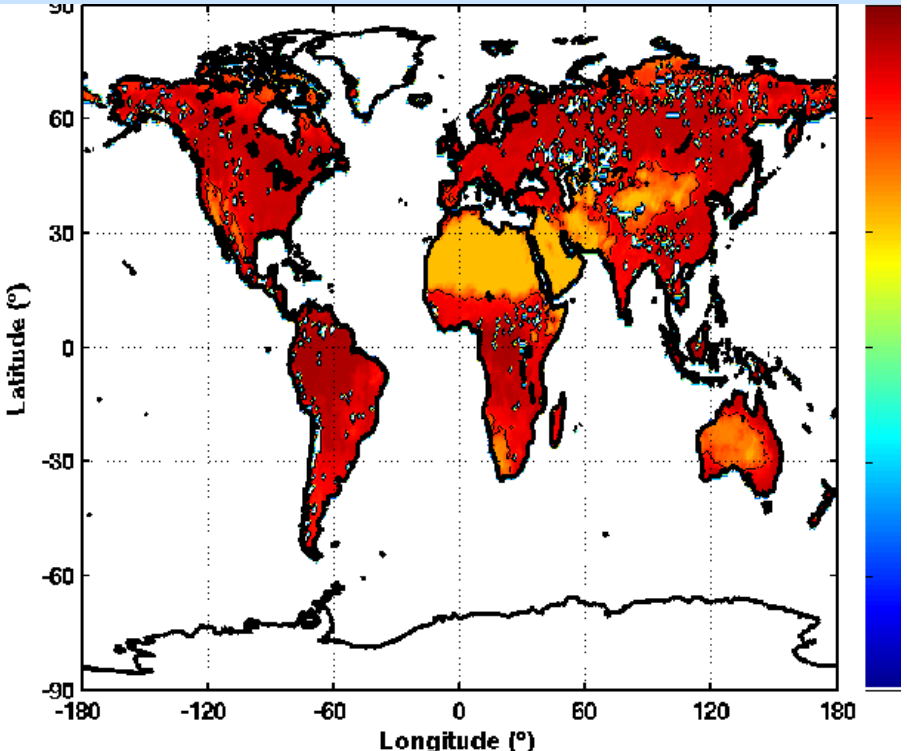
Surface emissivity derived from AIRS channels

Babqiqi 2006

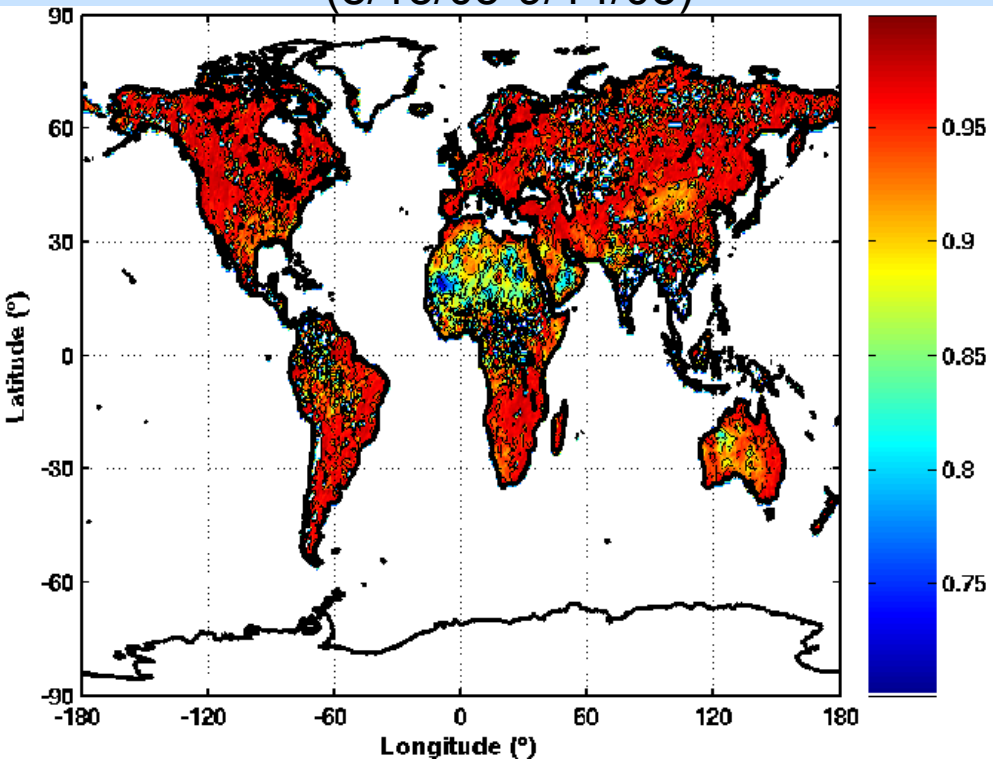
- Atlas of dynamical surface emissivity, according to Karbou et al 2006
- Calculation only for clear sky pixels

Example for channel 1237, 1123 cm^{-1}

Climatological Atlas

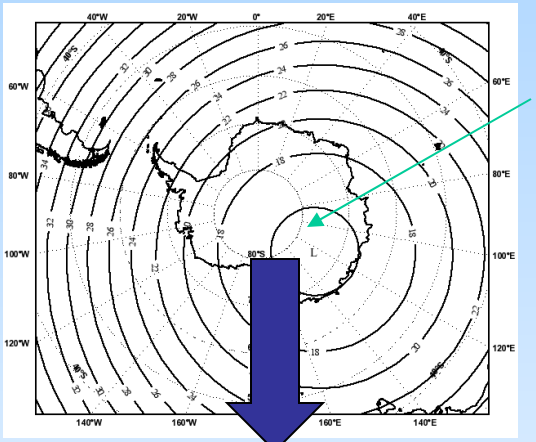


Monthly retrieved surface emissivity (8/15/05-9/14/05)



Sensitivity study over Antarctica

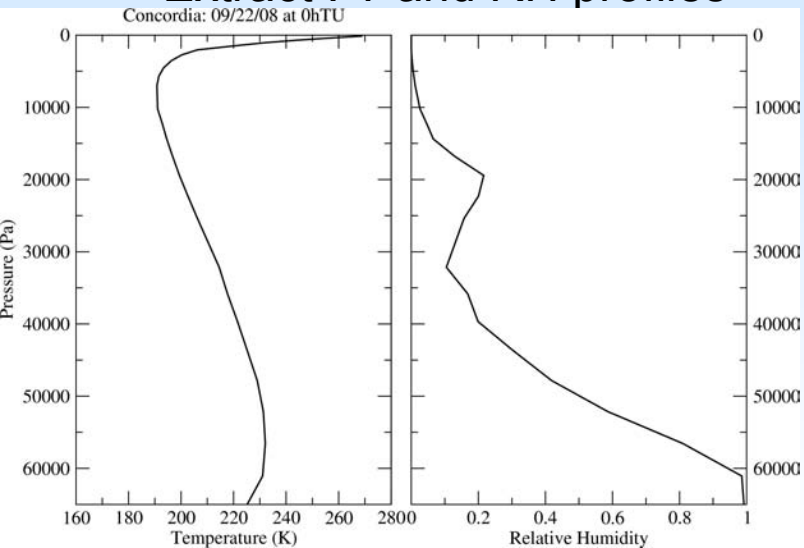
From the tuned model for Antarctica study



Centre : Concordia (75°S;123°E)

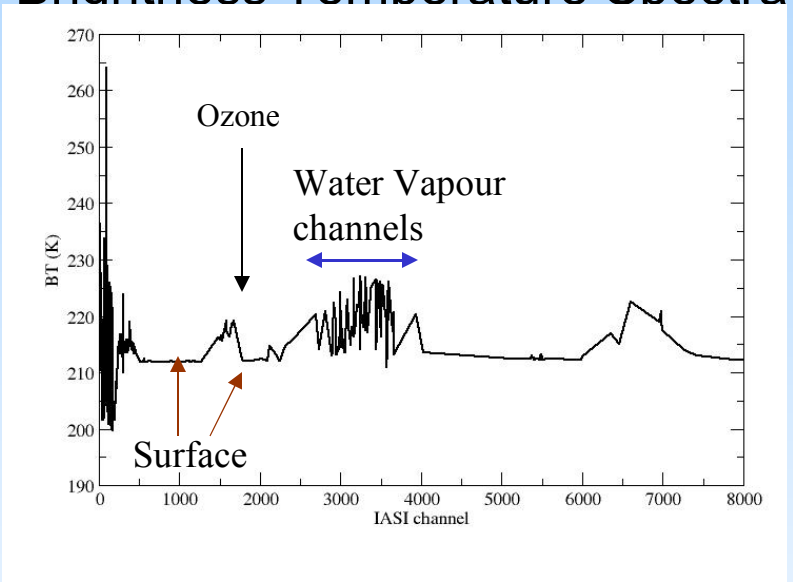
RTTOV Direct

Extract : T and RH profiles



Output : IASI

Brightness Temperature Spectra

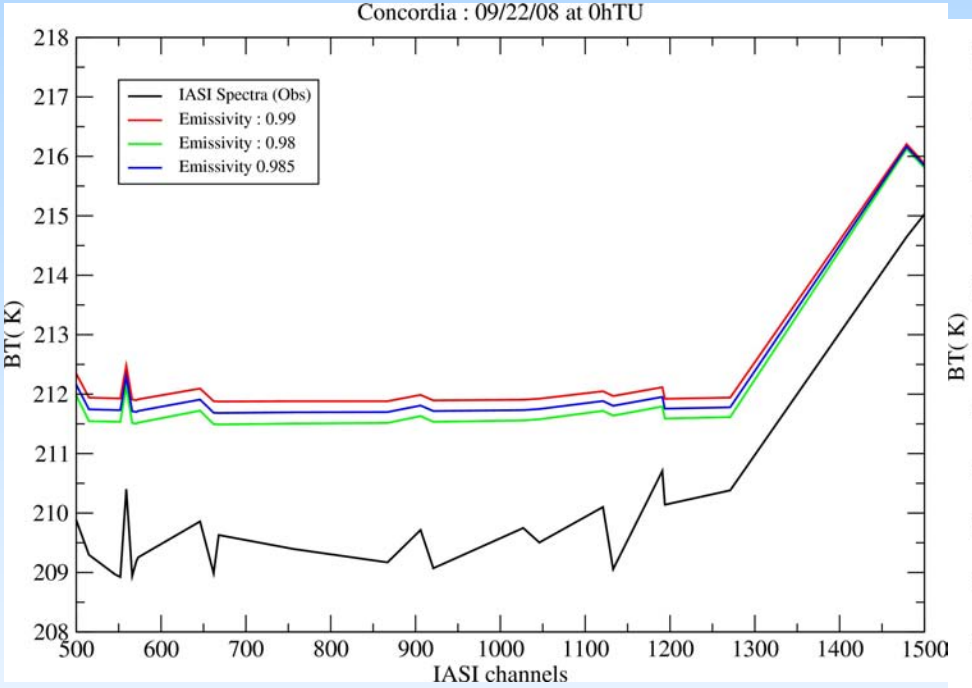


T and HR profile at Concordia the 09/22/08, during the 1st phase of the Concordiasi campaign

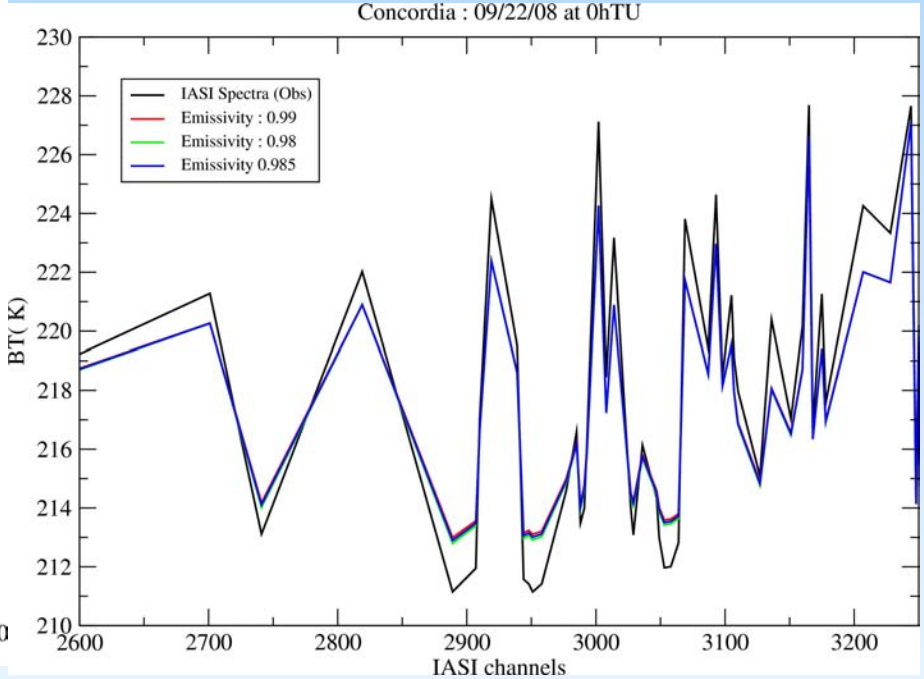
Sensitivity to the surface emissivity

Sensitivity tests on the value of surface emissivity : 0.99, 0.98, 0.985

Case Study : Station Concordia, the 09/22/08 at 0hTU



Impact for Surface Channels



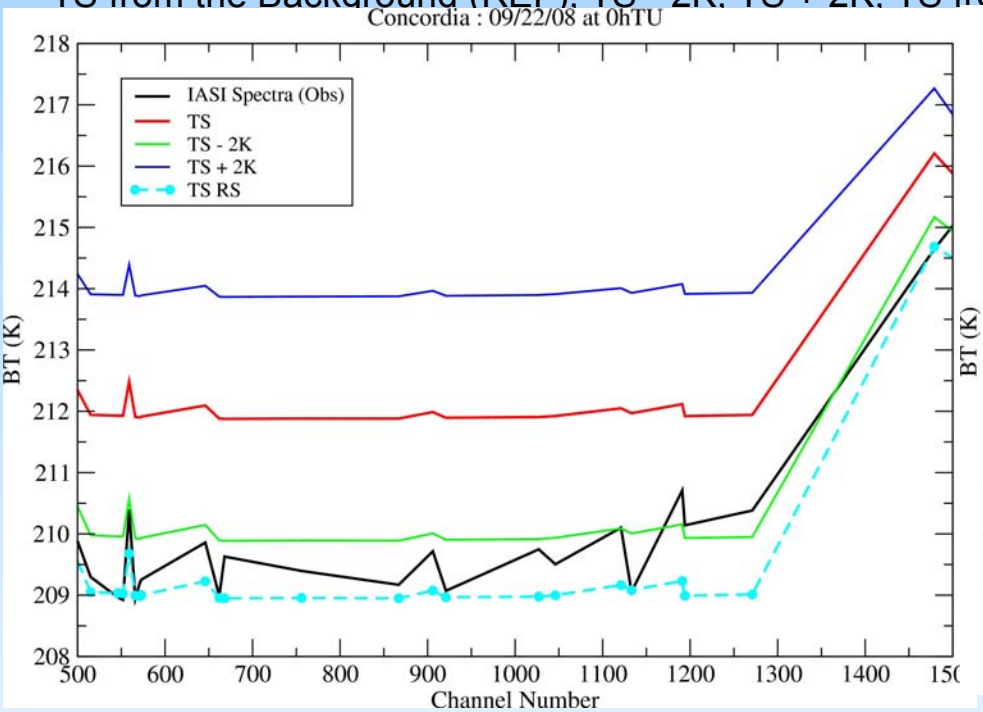
Impact for Water Vapour Channels

At Concordia station, for a variation of 0.005 in emissivity →variation of 0.25K on the BT

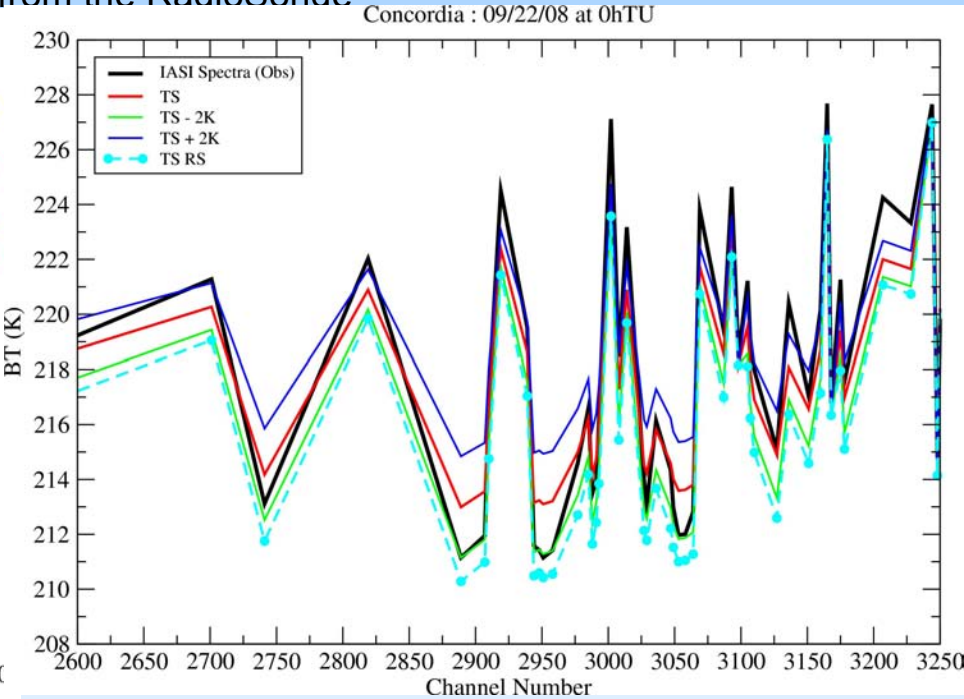
Sensitivity to the surface temperature

Sensitive study on the variation of surface temperature (TS) at Concordia (09/22/08) :

TS from the Background (REF), TS - 2K, TS + 2K, TS from the RadioSonde



Impact for Surface Channels



Impact for Water Vapour Channels

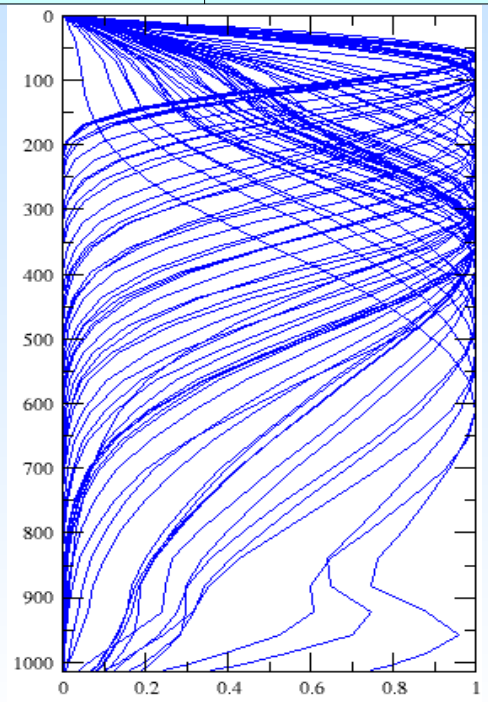
- Impact of the surface temperature predominant
- Similar results obtained for ~ 10 cases.
- TS from RadioSonde usually improved the simulations
- Improvement of the surface temperature necessary

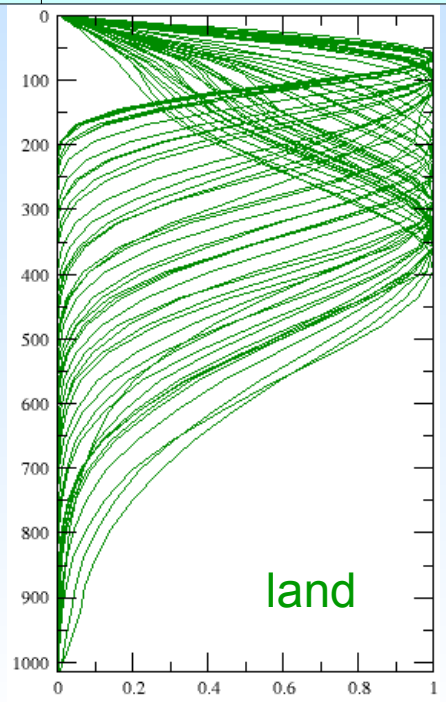
In operations

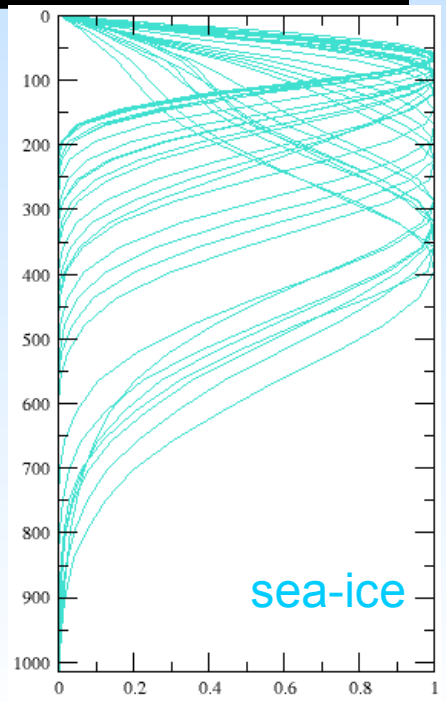
- IASI operationally assimilated in ARPEGE global 4D-VAR and ALADIN limited-area 3D-VAR (~10 km horizontal resolution)
- Only "long wave" temperature channels assimilated, only in clear condition (1 flag/channel, McNally & Watts, 2003):

	Before 1 Jul. 08	1 Jul. 08 → 4 Feb. 09	Since 4 Feb. 09
Open Sea	Ø	up to **50** channels	up to **64** channels
Land	Ø	Ø	up to **50** channels
Sea-Ice	Ø	Ø	up to **32** channels

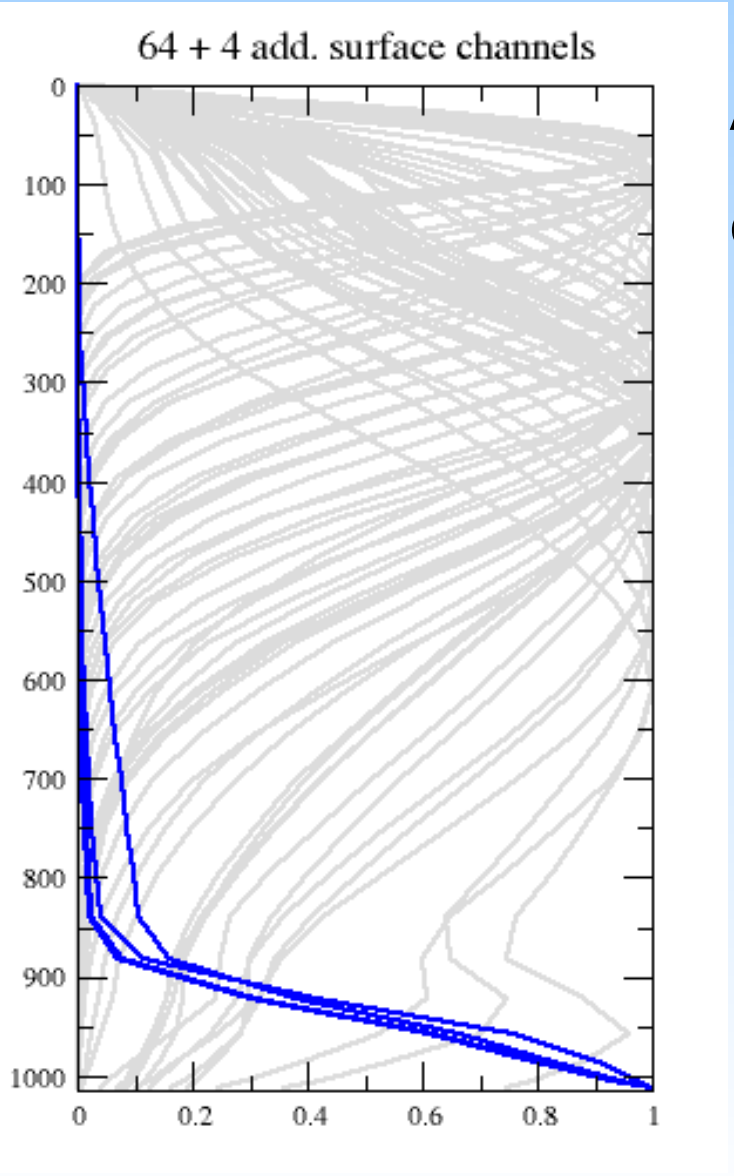
sea







Extension to surface channels



Add 4 surface LW temperature channels

only over sea

Reference = OPER

IASI+surf = Reference
+ 4 surface channels over sea

Neutral impact on the forecast

Conclusions

- **Preliminary studies for the 4D-Var with AIRS before operational assimilation**:
  - use of surface emissivity from atlas (spectral climatology or dynamical computation).
  - The use of spectral surface emissivity atlas for the AIRS channel assimilation over land provided promising results.
- **Sensitivity studies with 1D-Var and IASI over Antartica**
  - Weak sensitivity to surface emissivity
  - Impact of surface temperature predominant
  - Improvement of the surface temperature required
- **Addition of 4 IASI surface channel over sea in the assimilation**$\rightarrow$neutral impact

Future work

- Assimilation
  - AIRS over land and sea-ice
  - Extension to (near) surface channels for AIRS and IASI
- In parallel, characterization of
  - The surface emissivity
    - Spectral variation
    - comparison with other surface emissivity atlases
  - The surface temperature retrieval
- Sensitivity studies over Antarctica to be extended for other radiosonde stations (e.g. Dumont D'Urville) + retrievals