CENTRE NATIONAL D'ÉTUDES SPATIALES

Overview of plans and methods for AIRS / IASI intercalibration

At CNES and LMD

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- **Intercomparison LEO/LEO started at GSICS/GCC in 2007 (AIRS/IASI, etc.)**
  - **SNO (Simultaneous Nadir Observations)**
  - **Use of broadband pseudo-channels (boxcar)**
  - **Results accessible through "Science pages" link**

- **CNES proposal (D.Renaut) at the 3rd GSICS Executive Panel (Nov.2007)**
  - **Activity 1 : In-depth routine IASI performance monitoring and regular reports to GSICS**
    - *IASI TEC*
    - *NRT monitoring performed at the EUMETSAT processing center*
  - **Activity 2 : Regular comparison between AIRS and IASI**
    - *following controls already performed during IASI Cal/Val*
    - *in cooperation with LMD*
    - *in parallel with the operational monitoring performed at GSICS GCC*
      - *regular activity. Not systematic.*
    - *participation to the definition of a reference comparison algorithm*

- **1. How to compare high spectral resolution spectra like AIRS / IASI measurements ?**
  - **Use of broadband pseudo-channels**
    - *proven : IASI Cal/Val, current GSICS/GCC comparison algorithm*
    - *takes care of*
      - *Differences in the spectral response functions of AIRS and IASI*
      - *Missing AIRS channels*
    - *provides synthetic results*
  - **Spectrally high resolution comparisons**
    - *Selection of AIRS/IASI "companion channels" → LMD approach*
    - *Computation of "AIRS like" channels from the IASI measurements → CNES approach*
      - *from the more spectrally resolved instrument to the less resolved one.*
      - *Use of algorithms derived from the ones used in IASI Level 1 processing*
- **In both cases the scene must be very uniform (spatially) to account for unavoidable differences in the footprint of the 2 instruments**
  - *Most sensitive for atmospheric window channels*

LEO / LEO intercalibration of IASI : LMD approach

- **A IASI / AIRS "channel to channel" approach**
- **Data : space/time colocated IASI / AIRS**
- **This presentation is based on the following tools**
  - *4A-OP forward model (Brightness Temperatures and Jacobians)*
  - *IASI, AIRS TIGR datasets*

A « Channel to Channel » Metop+Aqua approach

IASI (a 421 channel subset) vs AIRS (a 324 channel subset)

Statistics on IASI and AIRS Brightness Temperatures (BTs) are from the IASI and AIRS TIGR datasets

TIGR Polar 1 (104 Atmospheric situations)

61	IASI/AIRS companion channels found within a **0.1K** stdv value
122	IASI/AIRS companion channels found within a **0.2K** stdv value
162	IASI/AIRS companion channels found within a **0.3K** stdv value

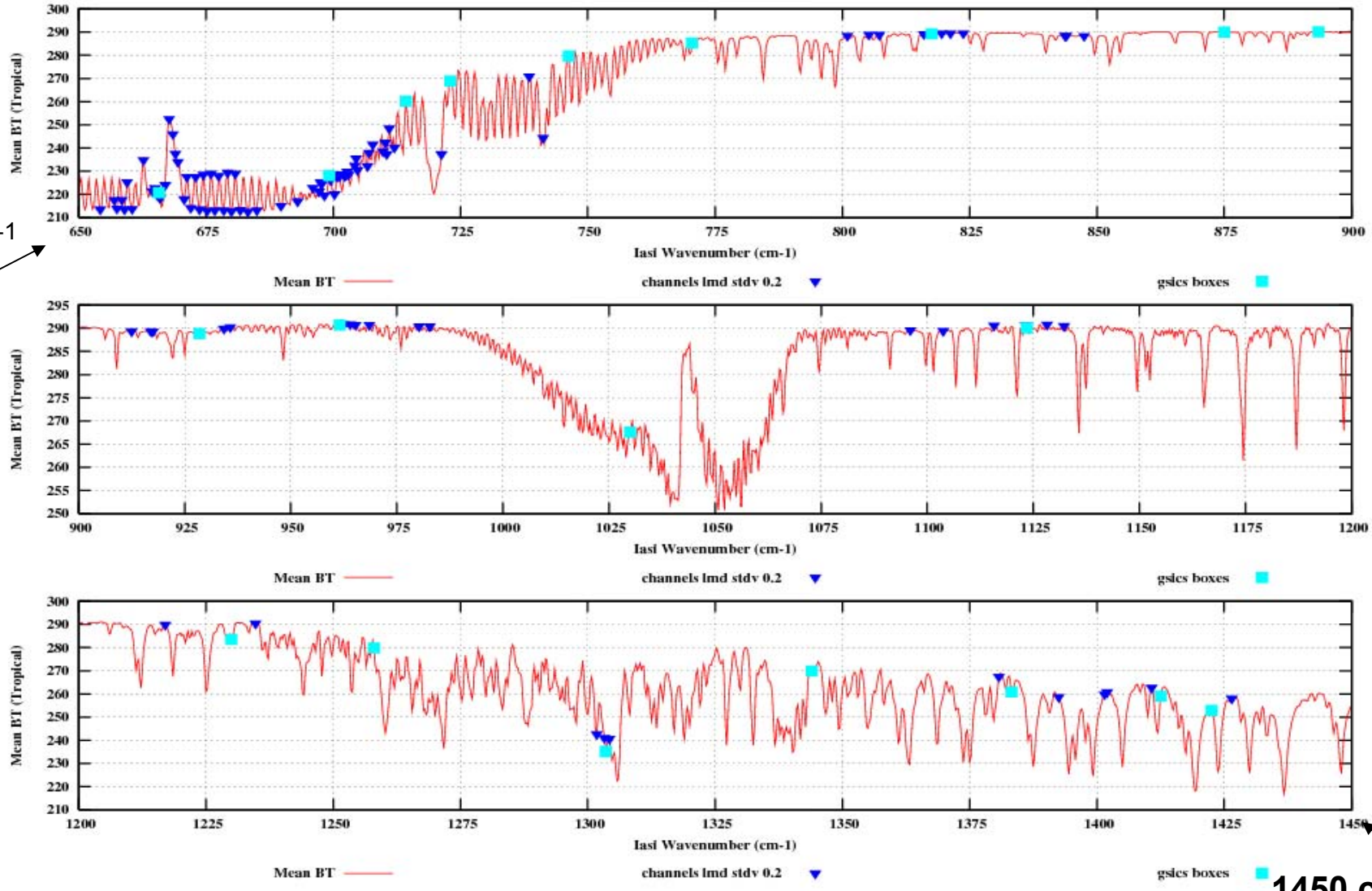
TIGR Polar 2 (593 Atmospheric situations)

51	ASI/AIRS companion channels found within a **0.1K** stdv value
91	IASI/AIRS companion channels found within a **0.2K** stdv value
128	IASI/AIRS companion channels found within a **0.3K** stdv value

TIGR Tropical (872 Atmospheric situations)

72	IASI/AIRS companion channels found within a **0.1K** stdv value
127	IASI/AIRS companion channels found within a **0.2K** stdv value
155	IASI/AIRS companion channels found within a **0.3K** stdv value

IASI and AIRS companion channels : stdv < 0.2K (from LMD)
IASI channels and AIRS broadband boxes (from GSICS web site)



645.cm^{-1}

1450.cm^{-1}

IASI and AIRS companion channels : stdv < 0.2K (from LMD)
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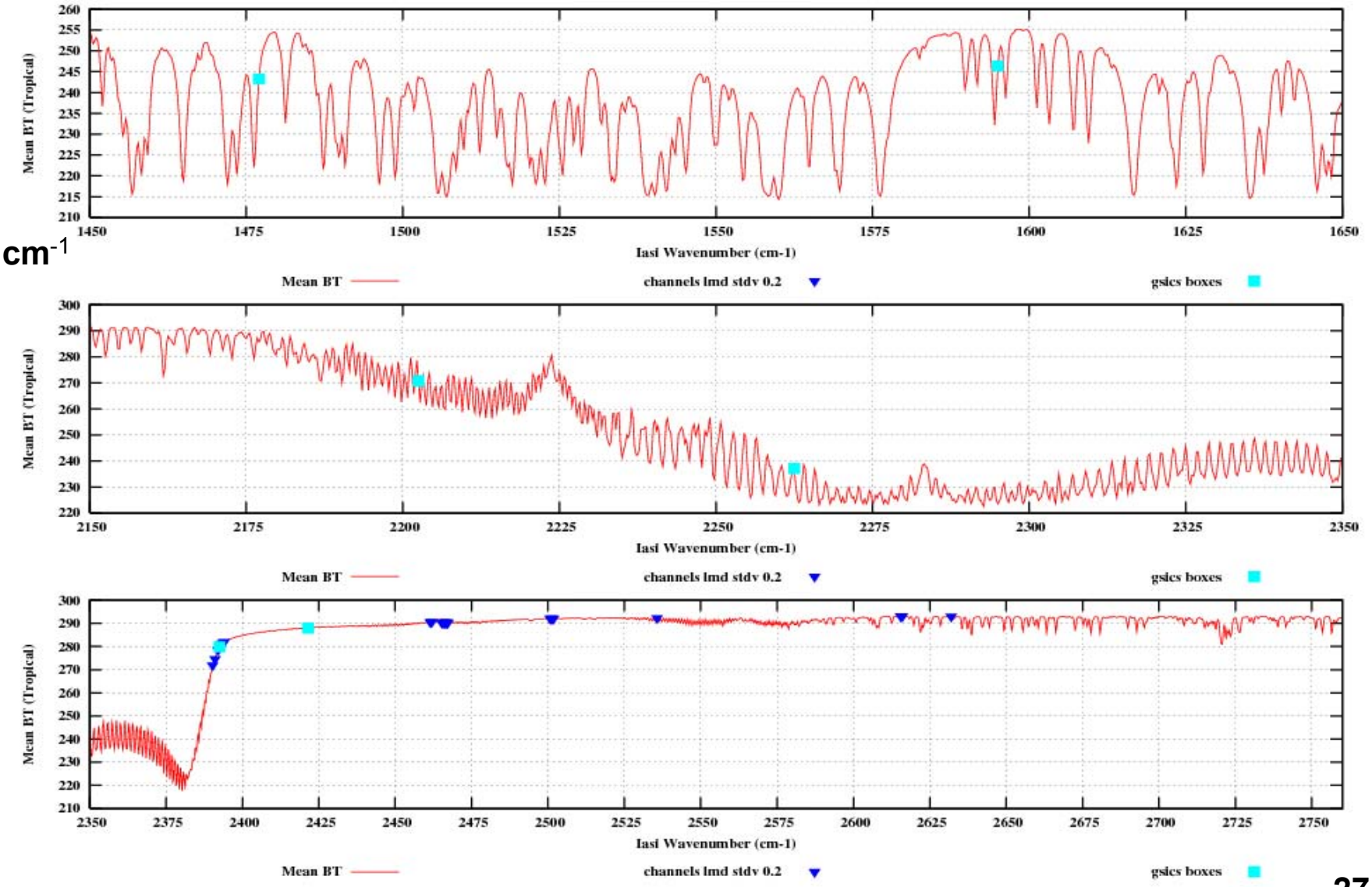


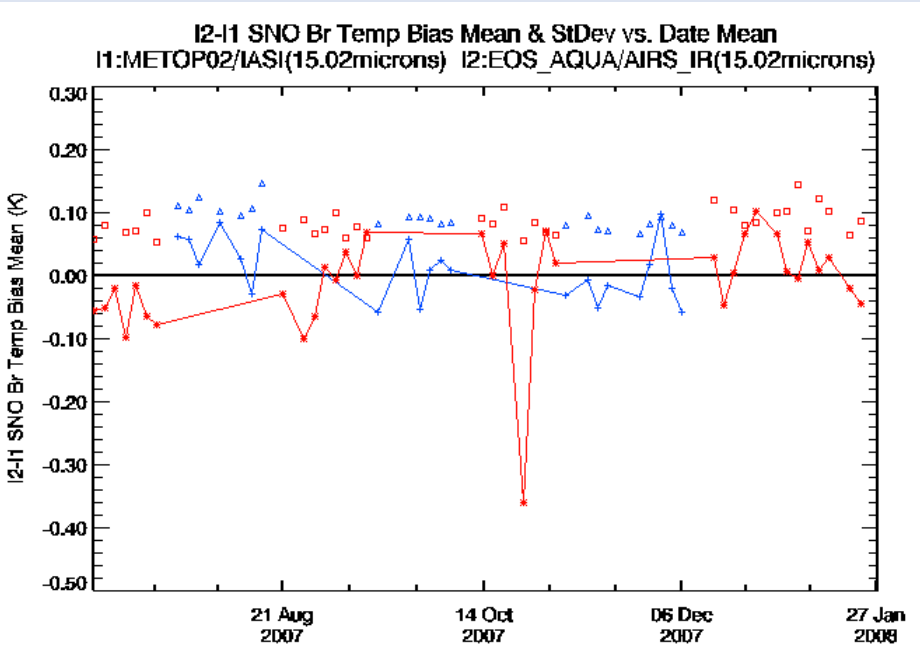
650.cm^{-1}

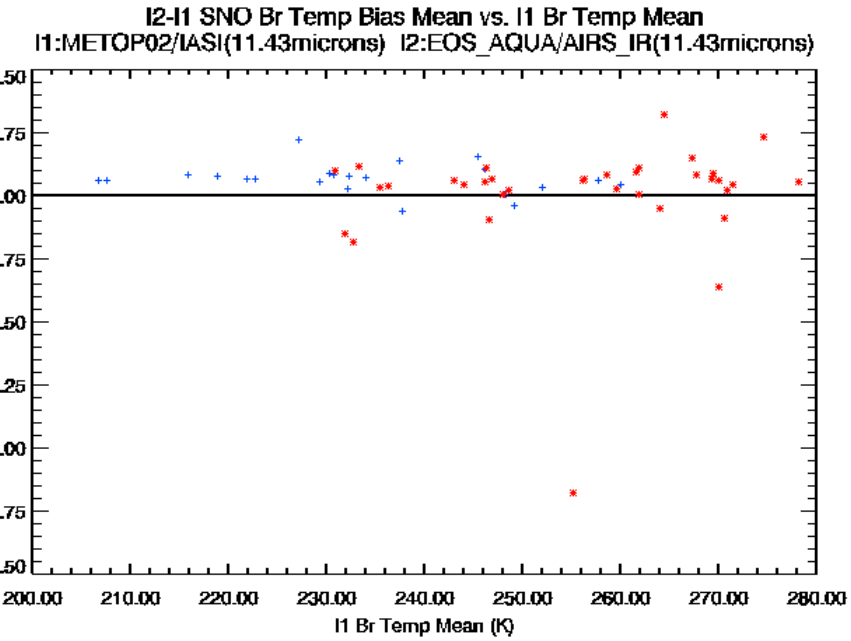
2750 cm

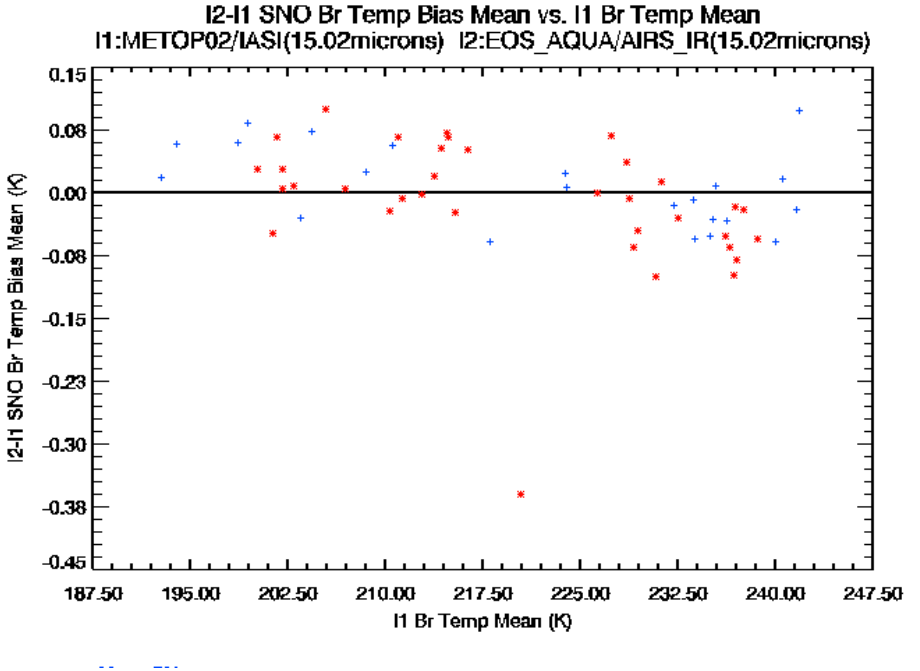
2. What spectra can we compare ?

- **Simultaneous Nadir Observations (SNO)**
  - *current approach in GSICS/GCC comparison algorithm*
  - *allows a direct comparison of radiances (no need for a radiative transfer model)*
  - *limitations*
    - *at high latitude only (73.7 degrees N or S)*
    - *one event in each hemisphere every 2.7 days*
    - *delay between IASI and AIRS pass can reach 75 sec*

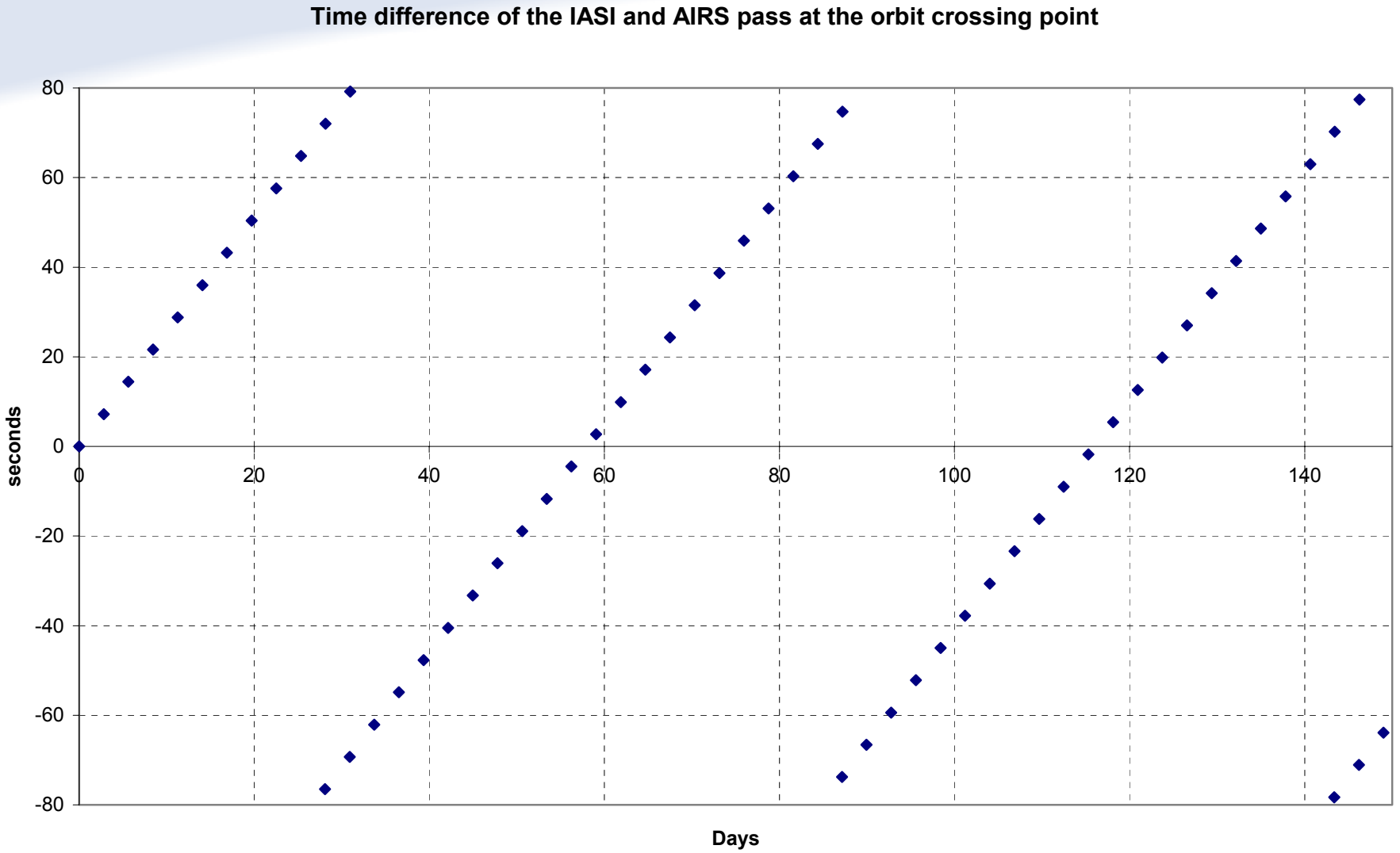
- *Samples from the GSICS Web site*
- *Good stability ... But outliers*
- *No check for spatial uniformity*
- *Large gaps in the data*
  - *e.g. South H 1st Dec – 17th Jan*







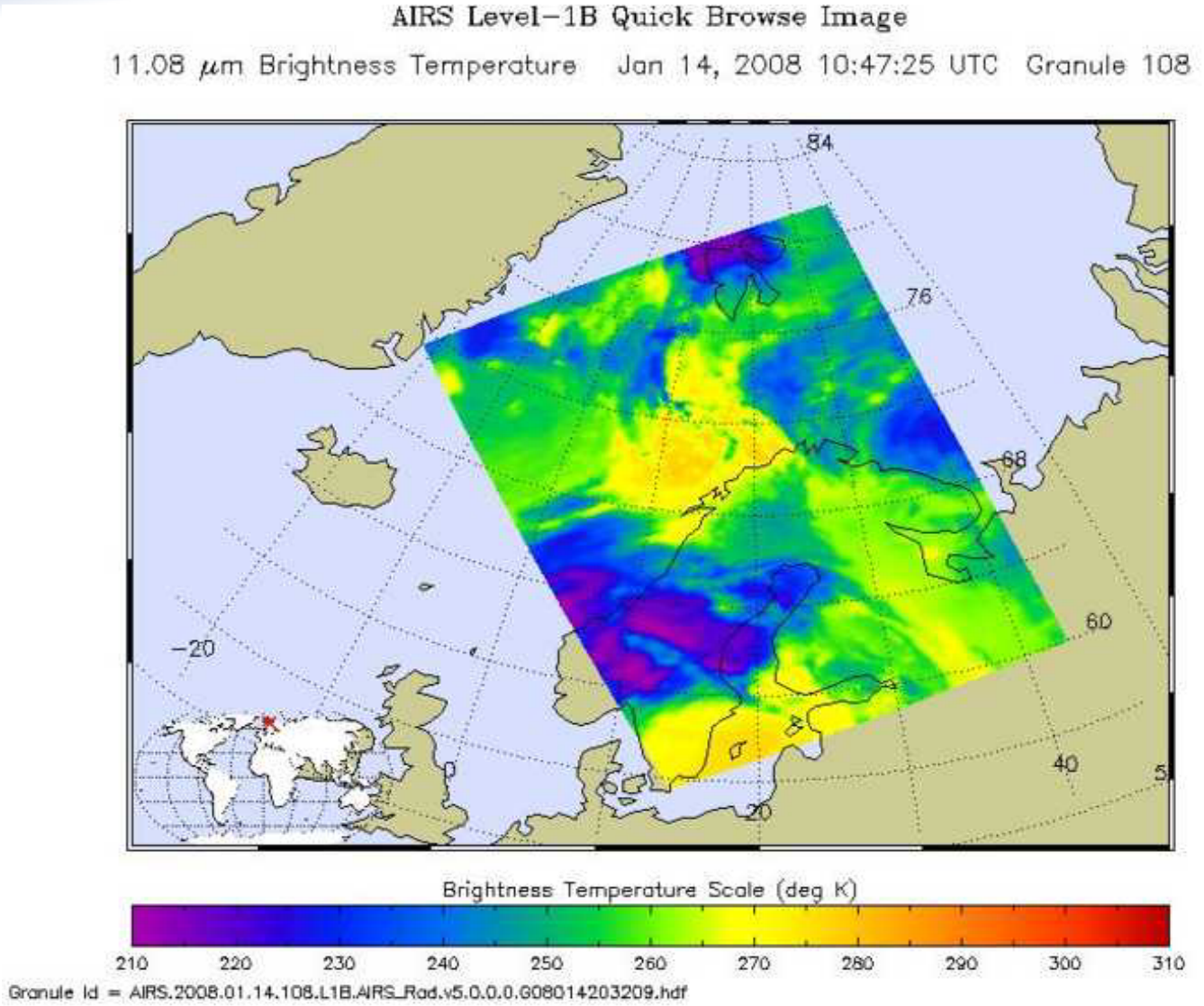
SNO limitations : delta time



- *Colocation time constraint around 80 sec to keep every SNO opportunity.*

Case 14 Jan 2008 –Tscene 270 K

- *"High" BT are observed at high latitudes in winter*
- *Spatial non uniformity is present*
- *Significance of the regression line ? (Slope & Intercept)*



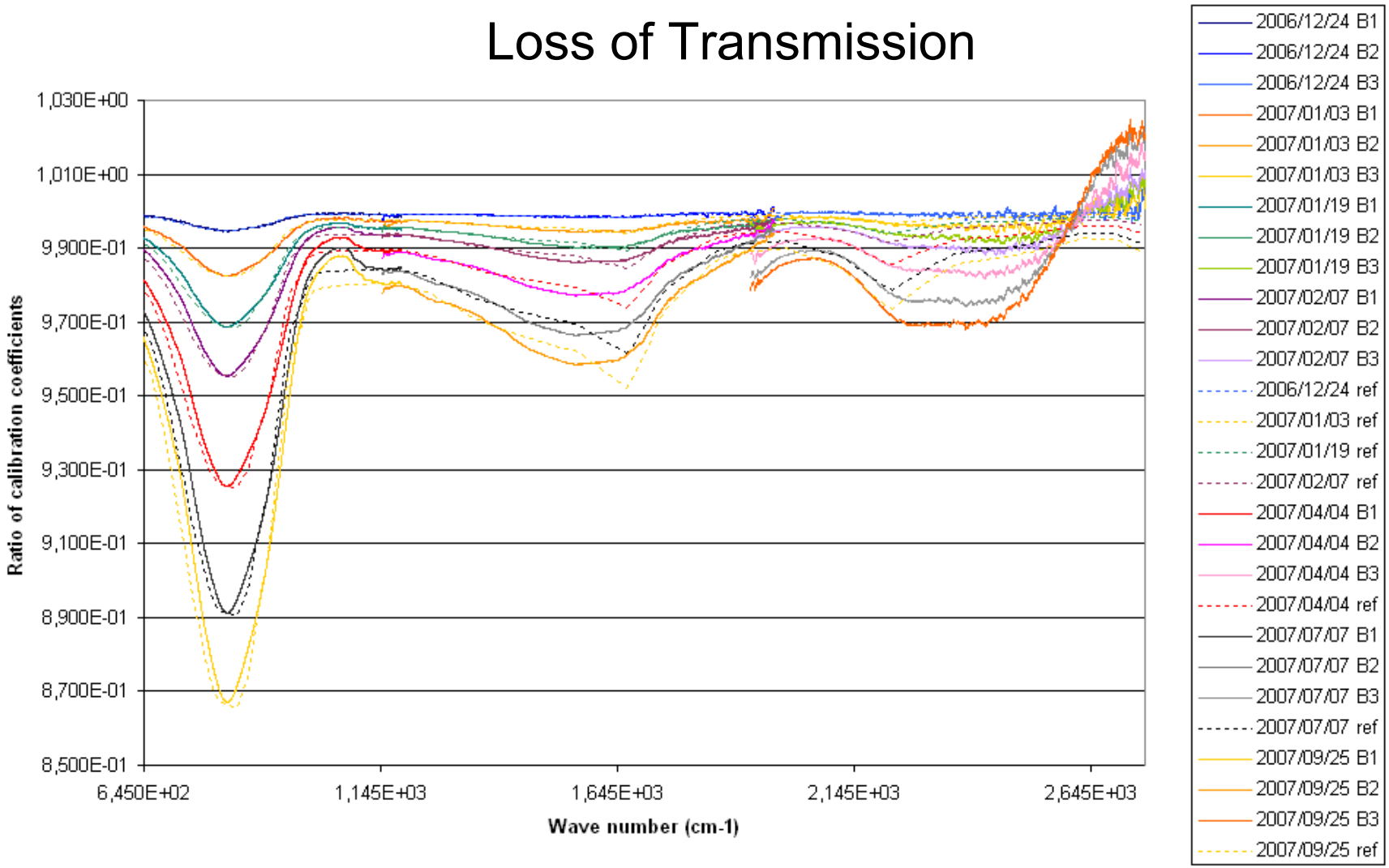
What spectra can we compare (continued) ?

- **Double differences could relax co localization constraints**
  - *[IASI Obs-Calc(x,t1)] – [AIRS Obs-Calc(x,t2)]*
  - *2 different times, 1 single point.*
- **Could provide "Non Simultaneous Nadir Observation (NSNO)"**
  - *Also at mid or low latitude*
- **Accuracy of the method to be evaluated**
  - *Error of the Analysis+ Forward Model : extrapolation + 2 different local times*
  - *Expected improvement by selecting suitable situations (temporal stability)*
    - *Impact on the diversity of observed situations ?*
  - *Accurate detection of clouds and aerosols needed*
  - *Still very good spatial uniformity needed*
- **Can be used with any spectra comparison method**
  - *Broadband pseudo-channels*
  - *AIRS like channels comparisons*
  - *AIRS/IASI companion channels*

- **Step 1 – Breadboard and methods validation**
  - SNO Broadband pseudo-channels
  - SNO Channel to channel intercomparison
    - 2 methods currently evaluated
  - Double differences implementation
  - Inputs by LMD/CNES for the selection of a GSICS reference algorithm for IASI/AIRS intercalibration

- **Step 2 – Operational implementation of selected methods at the CNES IASI TEC**
  - Comparisons performed regularly, not systematically
  - Only a sampling of what can be done more systematically by the GSICS/GCC
  - 1 report every 6 months typically

Water ice contamination effect observed on IASI



- *Mainly loss of transmission for long wave range*
  - *Absorption peak around 850 cm-1, i.e. 11.8 µm*