IASI AND GOSAT RETRIEVALS IN THE THERMAL INFRARED : CASE STUDY FOR SURFACE TEMPERATURE COMPARISONS

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I – Motivation for retrieval of GOSAT data in B4 band

- Periods of no-observation (sun too low, clouds) hamper the estimation of the annual carbon budget from GOSAT alone
- TIR spectra of TANSO-FTS have not yet been used extensively as compared to SWIR spectra
- Potential of TIR has to be explored, especially in view of the TIR/SWIR synergy
- Diurnal variation (day/night) of XCO2 and XCH4 could be sampled with TIR retrievals
- But the actual data quality and retrieval accuracy of measurements from TIR have to be further investigated

⇒ Compare IASI and GOSAT results in coincidence

II – Method and Strategy

- Both IASI and TANSO-FTS perform measurements in the TIR:
  - B4 [700 – 1800 cm⁻¹] band of GOSAT (de facto only to 1400 cm⁻¹)
  - B1 [645 – 1210 cm⁻¹] and B2 [1210 – 2000 cm⁻¹] bands of IASI
- Not SNO (simultaneous nadir observations) as for IASI/AIRS
- Good coincidences (space and time) near the poles (orbit crossing)
- IASI is considered as a reference for radiometric calibration of other instruments. The radiometric calibration of TANSO-FTS is still to be assessed
- But IASI and TANSO-FTS have different instrumental noise and spectral resolution

⇒ direct comparison of radiances not directly feasible

- Solution: retrieve surface temperature from coincident IASI and GOSAT for comparison

- Window chosen for this study: [940-980] cm⁻¹ window for CO2 (laser band), [1240;1320] cm⁻¹ for CH4, [1140;1200] cm⁻¹ for N2O, and [980;1100] cm⁻¹ for O3

⇒ obtain CO2, O3, N2O and CH4 as a by-product

- 3 Periods/scenarios chosen:
  - April 2010 during a CNES balloon campaign from Esrange/Kiruna (Sweden) i.e. in cold conditions and low sun in Northern Scandinavia (for TANSO-FTS SWIR/SWIR)
  - July and August 2010 with “warmer” ground conditions than for April
  - TANSO-FTS and IASI spectra in coincidence with TCCON sites during year 2010 (768 couples of coincident spectra)

Example of coincidence / fit
- GOSAT: 14:00 UT – 75.385 °N – 21.609 °E
- Date: 2010/04/25
- Distance between IFOV centers: 3.92 km

IASI and GOSAT retrieval using LARA (“home made” radiative transfer and retrieval algorithm for research studies).

P and T profiles from ECMWF, emissivity fixed.

Retrieved parameters: surface temperature, spectral shift, CO2, N2O, CH4, O3 and/or H2O slant column density.

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III – Results

- Retrieved Tsurf from coincident IASI and GOSAT spectra are well correlated

⇒ good for confirming GOSAT B4 radiometry

- Weak dependence of correlation with the distance or time difference criteria

⇒ reasonable statistics achievable

Arctic - April 2010:

⇒ Δt = 30 min
⇒ 121 coincidences
⇒ 91.2% correlation
⇒ [262-280 K] range

July-August 2010

⇒ Δt = 30 min
⇒ ΔD = 5 km
⇒ 310 coincidences
⇒ 84.1% correlation
⇒ [270-290 K] range

TCCON Sites coincidences

- 2010
- Δt = 6 hr
- ΔD = 100 km
- 768 coincidences
- 80.6% correlation
- [285-320 K] range

Conversion of all retrieved surface temperature into radiances:

- Arctic (good space and time coincidences but low surface temperatures).
- Correlation = 98.67 %
- Slope = 0.990 ± 0.005

- Coincidences over TCCON Sites (bad time coincidences, but higher surface temperature compare to Arctic)
- Correlation = 80.60 %
- GOSAT equivalent radiances > IASI = in agreement with orbits of both instrument (GOSAT measurements after IASI and then latter in the day)

IV - Outlook

- Comparisons of IASI and GOSAT xCO2, xCH4 and xN2O retrievals.
- Cloud filtering still to be refined (snow, ice conditions) / better filtering of cloudy, icy or snowy spectra
- Improve statistics by considering coincidences all over the globe during several months.