Retrieved L2 products from TANSO-FTS2 spectra in the thermal infrared over the Arctic Ocean and comparison with TANSO-FTS

Sébastien Payan[(1)], Claude Camy-Peyret[(2)], and Jérôme Bureau[(1)]

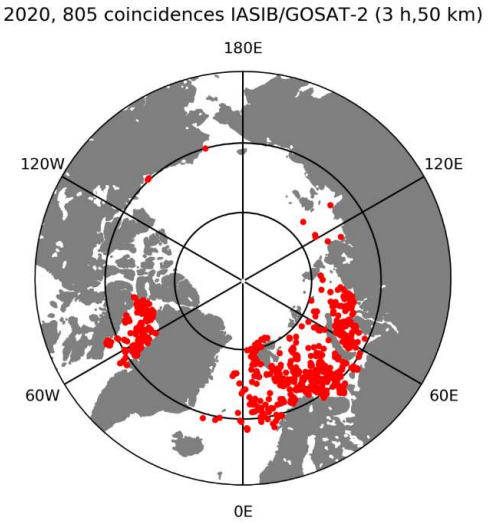
[(1)] LATMOS/IPSL/CNRS/Sorbonne Université, Paris, France [(2)] IPSL (Sorbonne Université/UVSQ) Paris, France

Correspondence to: sebastien.payan@Sorbonne-universite.fr>

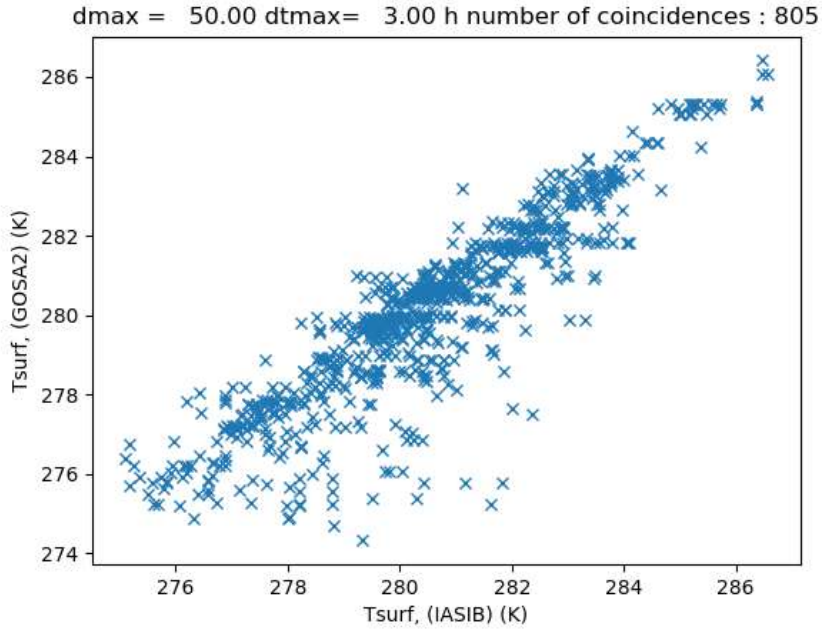
Rationale and TANSO-FTS2 L1b versions

As a contribution to the calibration/validation activities for GOSAT, we were wanting to use the TIR spectra of TANSO-FTS2 to compare our retrieved L2 GOSAT products with similar L2 IASI products obtained using IASI L1C spectra with exactly the same «home made» inversion configuration (LARA algorithm)

We planned to quantify the differences between versions and to contribute to the assessment of the quality of the successive versions



Example of data selection of IASI-B/GODAT2 coinicident measurements in July-August 2020

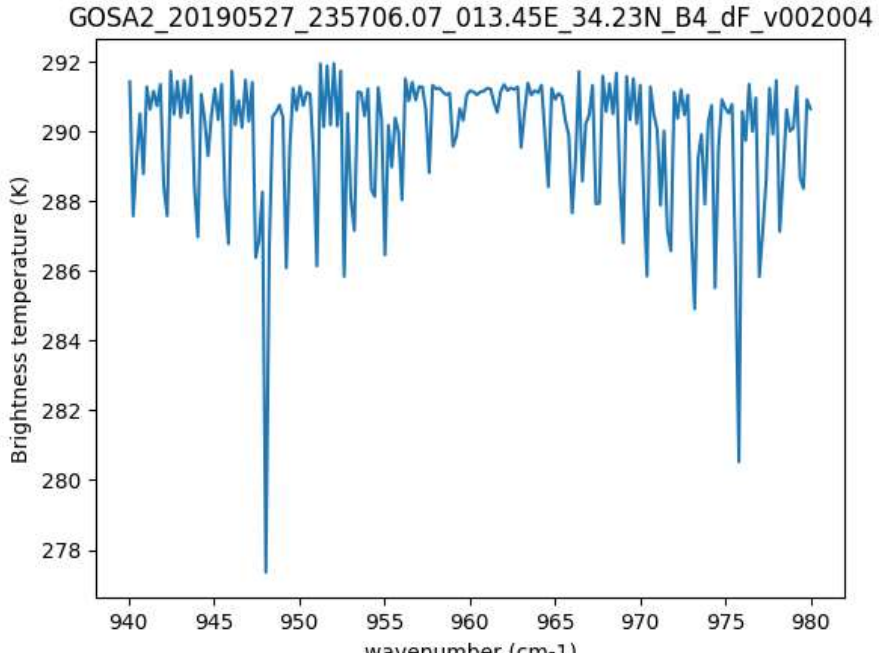


Monthly climatology of T_{surf} and XCO_2 With Tanso-FTS2 in the 3 summer months

- Based on our experience on quasi-coincidences IASI/GOSAT at high latitude, perform Cal/Val comparisons (in the commissioning phase) of GOSAT-2 with IASI
- Contribute to the radiometric (and spectral) calibration of the two TIR bands of TANSO-FTS-2 spectra.
- It is very important to confirm the absolute radiometric calibration of TANSO-FTS2 in the TIR for providing series of “climate quality variables” for T_{surf} and possibly CO_2 in the not so well documented Arctic Ocean region not covered by the SWIR/NIR bands

Retrieval scheme in the TIR for the 10.4 µm window for spectra collected by GOSAT and GOSAT-2 over the ice free Arctic Ocean in summer

- Inter-calibration of the L1B spectra B5 (600-1200 cm^{-1}) and B4 (1180-1800 cm^{-1}) bands of GOSAT-2
- Check of the instrument line shape (ILS) in the two TIR bands
- Check of the impact of forward/backward scan of the OPD
- Search for quasi-coincident footprints of GOSAT and GOSAT-2, as well as for GOSAT-2 and IASI (A, B and C)
- Retrieval of T_{surf} and XCO_2 for coincident measurements (GOSAT-2/GOSAT and GOSAT-2/IASI)
- Comparison of the TIR L2 retrieved products
- In addition, perform XSF_6 retrievals



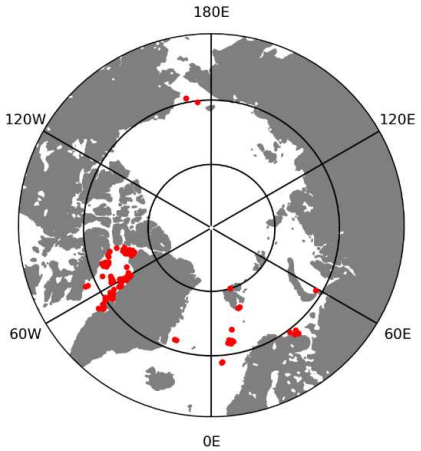
Retrieval scheme :

- Window: 940 - 980 cm^{-1}, "CO_2 laser band region"
- State vector: x=(T_{surf}, coeff_CO_2, 2 coeff_H_2O, coeff_O_3)
- Diagonal covariance matrix S_y (L1B unapodised spectra)
- No *a priori* for T_{surf} and XCO_2 constant mixing ratio profile
- T(z) extracted from ECMWF ERA5 analyses
- H2O(z) and 03 profile scaled from ECMWF ERA5
- SF6 fixed (surface values, Barrow Observatory) or retrieved
- CFC12 fixed (surface values, Barrow Observatory)
- We have checked the retrieval sensitivity to the shape of the actual T(z) profile
- Retrieval results are considered as reliable only for normal (negative) lapse rate profiles among the 3 classes of profiles: normal lapse rate, isothermal, temperature inversion → pre-filterin

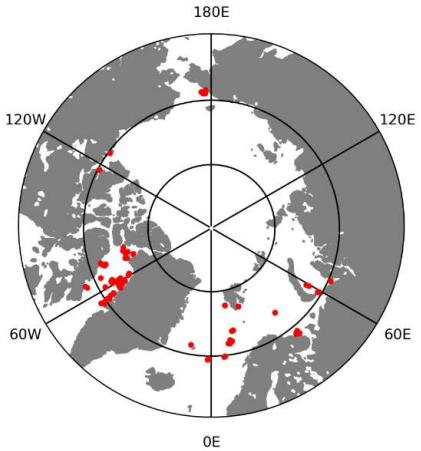
Data selection

Plot of the footprint position of selected coincident IASI-A, B & C, and TANSO-FTS2 "clear, sea, normal lapse rate, good line contrast" for year 2019 and 2020

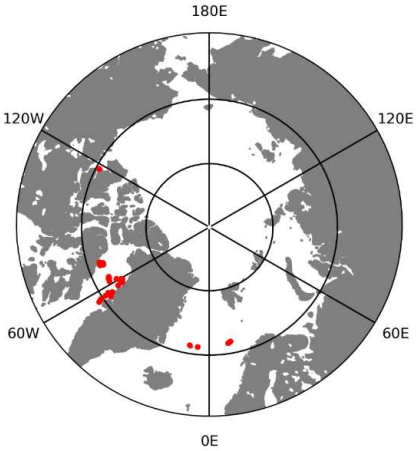
2019, 133 coincidences IASIA/GOSAT-2 (3 h,50 km)



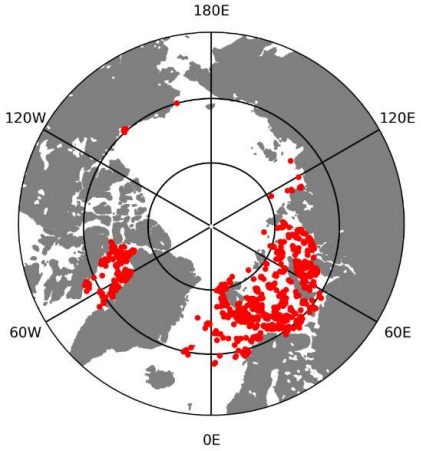
2019, 107 coincidences IASIB/GOSAT-2 (3 h,50 km)



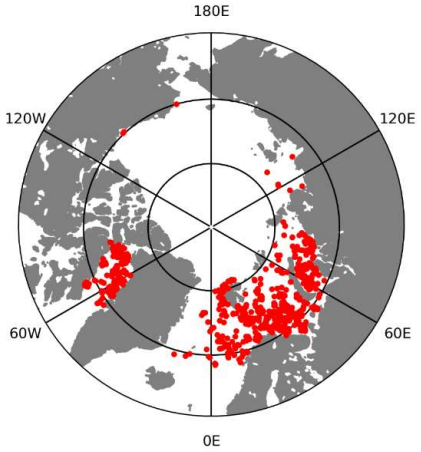
2019, 39 coincidences IASIC/GOSAT-2 (3 h,50 km)



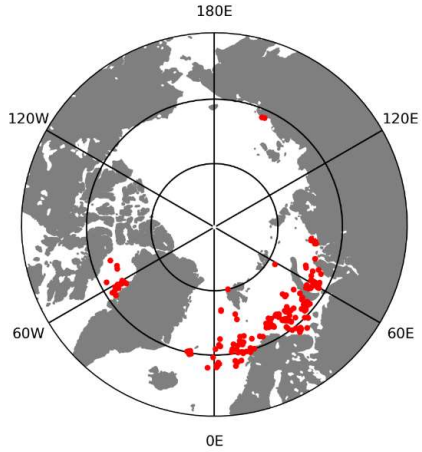
2020, 830 coincidences IASIA/GOSAT-2 (3 h,50 km)



2020, 805 coincidences IASIB/GOSAT-2 (3 h,50 km)



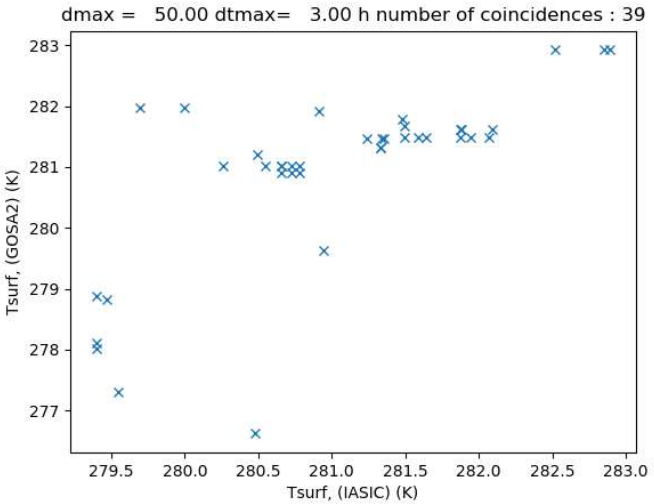
2020, 206 coincidences IASIC/GOSAT-2 (3 h,50 km)

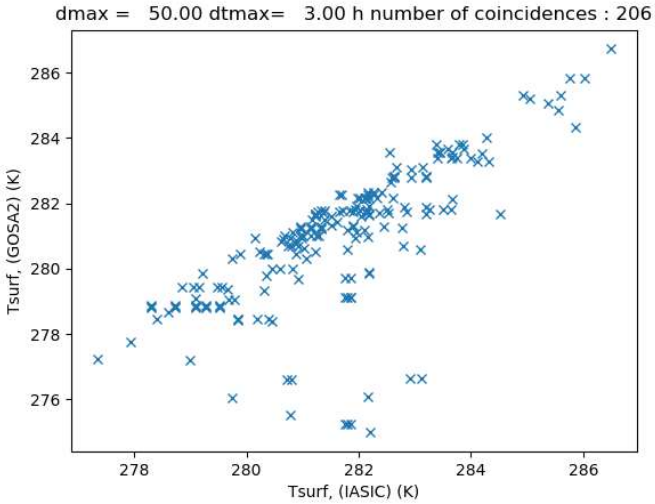


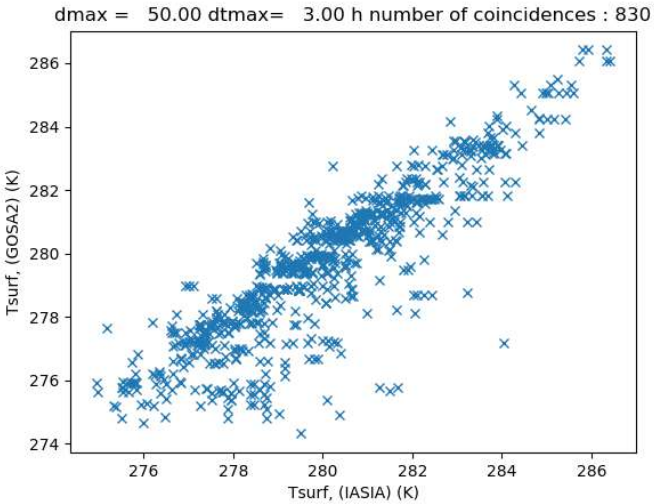
A third filter is applied on the profiles. We first eliminated all saturated ECMWF ERA5I water vapor profiles. We selected then only IFOVs for which the ECMWF/ERA-5 temperature profile (extracted and interpolated in time and space for any particular footprint) was appropriate. Over the Arctic Ocean, different geophysical situations can occur with respect to the temperature profile. We have distributed 29945 profiles ECMWF T(z) profiles into three classes: negative (normal) lapse rate profiles, temperature inversion below 2 km and quasi-isothermal profiles in the 0-1 km layer and others.

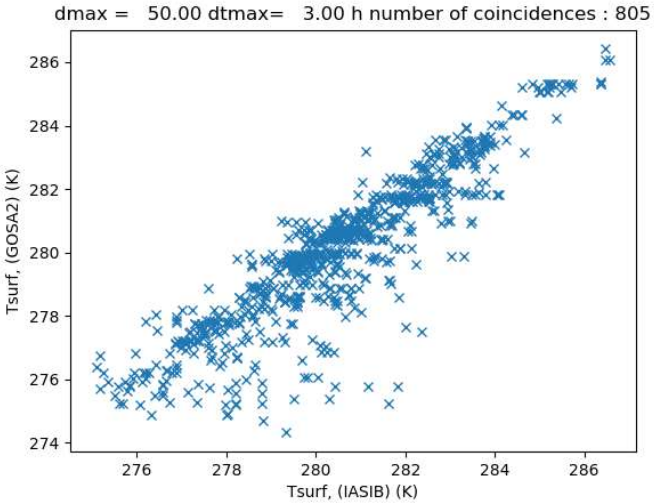
Comparison IASI/GOSAT2

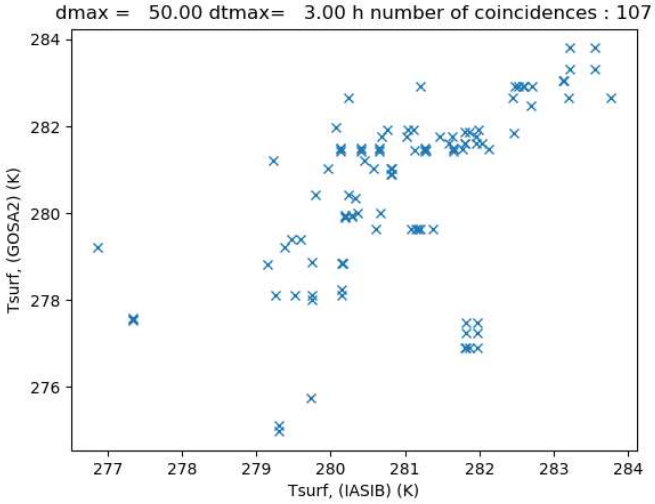
Correlation between T_{surf} derived from TANSO-FTS and IASI-A in July/August 2019-2020

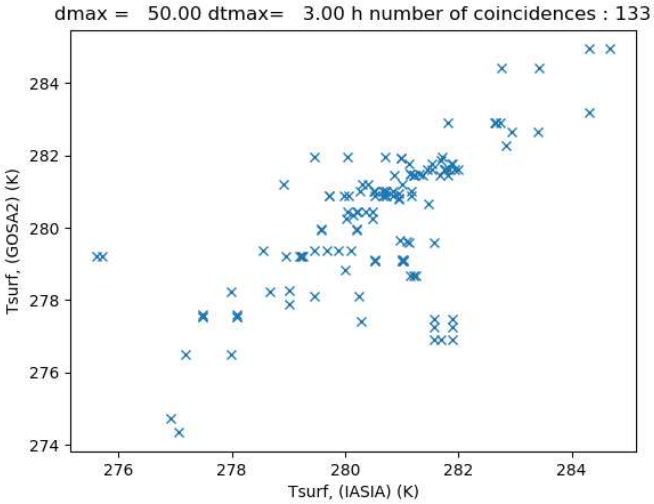










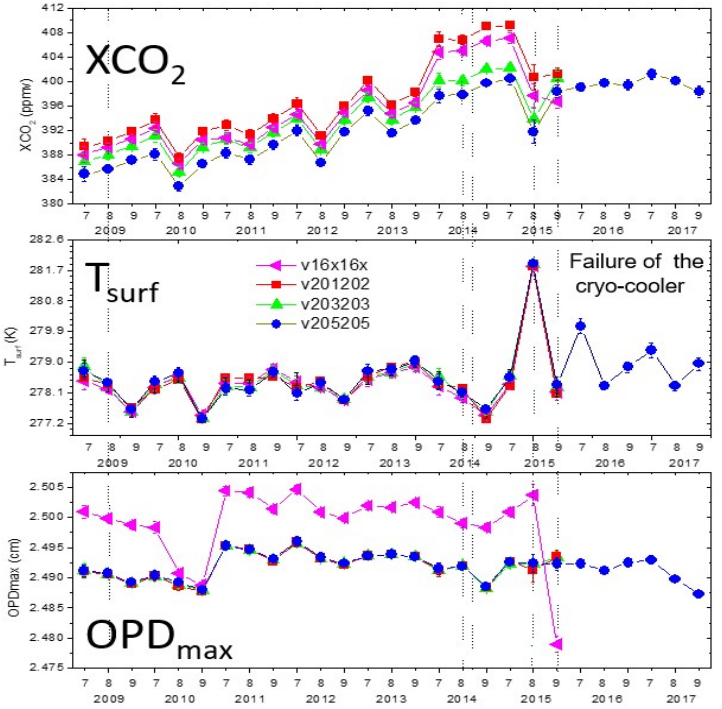


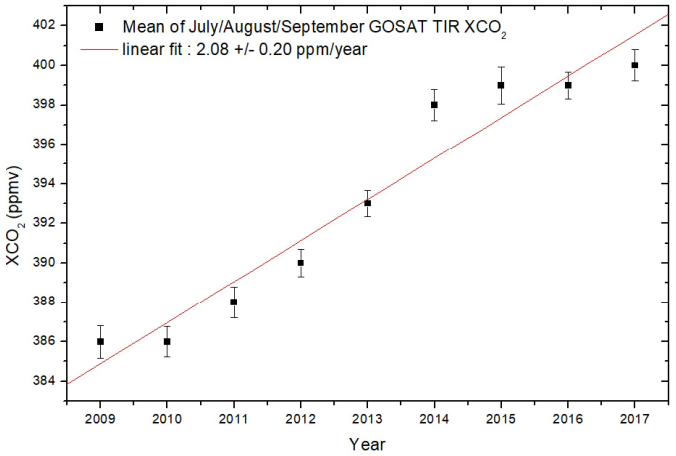
Outlook

Monthly climatology of T_{surf} and XCO_2 from TANSO-FTS2 in the 3 summer months

- Based on our experience on quasi-coincidences IASI/GOSAT at high latitude, we have performed Cal/Val comparisons (in the commissioning phase) of GOSAT-2 with IASI
- We have tried to contribute to the radiometric (and spectral) calibration of the two TIR bands of TANSO-FTS-2 spectra.
- We have performed intercomparisons of GOSAT (TANSO-FTS), GOSAT-2 (TANSO-FTS-2) and IASI-A, B, C retrieved products for nearly coincident footprints.
- It is very important to confirm the absolute radiometric calibration of TANSO-FTS in the TIR for providing series of "climate quality variables" for T_{surf} and possibly CO_2 in the not so well documented Arctic Ocean region not covered by the SWIR/NIR bands
- IASI will is a good reference for checking the new version of TANSO-FTS spectra (V220) in the TIR region (B4) as well as for checking TANSO-FTS-2 in B4 and B5

See Payan et al., Remote sensing 2017





Acknowledgements :

- Support from to LATMOS and IPSL
- Access to GOSAT and GOSAT2 L1b spectra of NIES and JAXA
- French atmospheric data base AERIS and Eumetsat