

## ***Interactive comment on “On-orbit radiometric calibration of SWIR bands of TANSO-FTS onboard GOSAT” by Y. Yoshida et al.***

### **Anonymous Referee #1**

Received and published: 30 July 2012

The paper by Yoshida reports on an updated and refined radiometric degradation model for backscatter radiance spectra collected by the Greenhouse Gases Observing Satellite (GOSAT). Using direct solar spectra, degradation coefficients are reevaluated and fed into a time, wavelength, and polarization dependent degradation model. The study is an important contribution to characterizing GOSAT measurements and improving the respective greenhouse gas retrievals. It is suitable for publication in AMT after considering a few comments.

### Comments:

The paper lacks a clear recipe how to apply the proposed degradation correction to GOSAT L1b data. I would recommend providing such a recipe at a prominent place in

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the manuscript. In particular, it is not clear how the spectral dependence of the degradation model is to be implemented in a GOSAT retrieval algorithm since the manuscript only provides numbers at few wavenumber points and a graphical illustration (figure 8). Equation (6) parameterizes the time dependence of the degradation model. In the limit of  $t=0$ , equation (6) reduces to “ $dP/S+eP/S$ ” which is close (but not identical) to 1 when using the numbers in table 3. What is  $t=0$ ? Is it 4 March 2009, which would be different from the previous version of the degradation model? Is there an offset to be considered at  $t=0$  or is this offset already included when using the calibration dataset available from GOSAT support?

p.4715,l.10. . . , figure 3, figure 4: I do not understand why telluric O<sub>2</sub> absorption contaminates the solar spectra for small  $\theta_{SES}$ . Shouldn't the contamination effect become more important the greater  $\theta_{SES}$ . Looking at figure 3, I would conclude that telluric contamination is largest when the sun rises at the satellite ( $\theta_{SES}>105$  deg) causing a long tangent lightpath through the Earth's atmosphere. For smaller  $\theta_{SES}$  the tangent lightpath gets smaller and essentially vanishes for  $\theta_{SES}=90$  deg. On the other hand figure 4 seems to confirm the present rationale in the manuscript. Please clarify.

p.4716, section 4.1, 4.2: Table 1 lists the measurements used to fit an empirical relation of the diffuser reflectivity with incidence angle  $\theta$ . The observation at small  $\theta$  collected on 2009/03/04, ~18:46, seems quite far off the other measurements. In section 4.2, measurements at large  $\theta$  are then excluded from the empirical degradation model because they do not seem to fit well. Did you test if the empirical relationships for the diffuser reflectivity and the degradation model change significantly with/without considering this one data point at small  $\theta$ ?

Figure 9c: The refined degradation model removes the trend from the ratio of the band1 and band2 radiance calibration factors. One would expect that these calibration factors are not needed given a good degradation model. So, are these radiance calibration factors actually close to 1? There is still considerable scatter of the data. Is the scatter

noise driven or is there other contributions?

Minor:

p.4712,l.5: measures short-wavelength infrared (SWIR) spectrum, and its radiometric accuracy ... -> measures the short-wavelength infrared (SWIR) spectrum. Radiometric accuracy ...

p.4712,l.10: parameter -> parameters

p.4712,l.15: evaluated -> found

p.4713,l.6: designated “P” and “S”, as well as thermal radiation ... -> designated “P” and “S”. It further collects thermal radiation ...

p.4713,l.15...: The sentence reads as if accurate radiometric calibration was not required if surface reflectivity did not affect scattering-related lightpath effects. Even if surface reflectivity was not a player or was independent of wavelength, accurate inter-band radiometric calibration would be crucial since particle scattering properties depend on wavelength.

p.4713,l.22: “large deviations” Deviations from what? Do you mean “was found deficient”.

p.4714,l.2...: Define chi2 as used in figure 2 here. This will help clarify what is meant by “residual”.

p.4714,l.6...: The ratio between which radiance adjustment factors changed? Do you refer to ratioing the factors derived from different bands?

p.4714,l.10: What is the meaning of “rough spectra” in this context?

p.4715,l.4...: I suggest adding a comment that the operational (nadir, glint) optical path inside the instrument is the same as for solar calibration except for the solar diffuser.

p.4719,l.2: evaluated -> improved

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Table 1: observing -> observed; the data suitable for the analysis was not available -> no suitable data were available

Table 2: Coefficients a, b, and c of (a) Band 1, (b) 2, and (c) 3 to represent the reflectance of the diffuser plate. -> Coefficients a, b, and c of (a) band 1, (b) band 2, and (c) band 3 to model the diffuser reflectivity as a function of incidence angle.

Fig.2: Mention that the data are ocean-glint scenes.

Fig.4: As for the reference -> For reference

Fig.7: cross -> crosses; square -> squares

Fig.8: Predictions up to mid 2014 seem daring to me. I suggest shortening the prediction period in order to highlight degradation during the past and current mission.

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