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Atmospheric Measurement Techniques Discussions

Interactive comment on "Chlorophyll fluorescence remote sensing from space in scattering atmospheres: implications for its retrieval and interferences with atmospheric CO_2 retrievals" *by* C. Frankenberg et al.

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We wish to thank this anonymous reviewer for his/her supportive remarks. In the meantime, we addressed almost all of the other comments and will also add a more detailed discussion on the usability of the Fs signal derived at 755nm. We also removed most references to the FLEX missions (but those which might have been seen to critical). Time will tell in the long run what concepts are feasible and how fluorescence can best be retrieved from space. In the absence of more detailed studies encompassing the

entire FLEX spectral range, we thus refrain from too direct statements even though we stick to our opinion that Fraunhofer lines (though more demanding for the instrument) would provide the most robust (and fast!) retrieval method.

In the following, we will respond to the reviewers comments, which needed text changes:

Full physics retrievals:

–> We added an introduction: The term *full-physics* algorithm is commonly used in the atmospheric remote sensing community for retrievals based on the full modeling of the radiative transfer instead of parameterizations or a decoupling of the retrieval of trace gas slant column densities and radiative transfer modeling.

Modeling of fluorescence in the simulation:

–> Yes, in the modeling, Fs is fully implemented in the radiative transfer scheme. We added the following sentence at the end of the section: "To conclude, we implemented the chorophyll fluorescence emission into an orbit simulator, fully modeling the propagation of the signal through a scattering atmosphere, also including multiple scattering effects. "

–> put s in italics

aerosol height

–> We added " (note: in our setup, aerosol height is defined as the peak height of a Gaussian aerosol profile). "

Figure 11

–> removed "true"

TOA vs. surface discussion

–> If we ignore scattering, we in fact retrieve TOA Fs, not surface Fs. We added the fol-

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lowing statement: "In the retrieval as outlined before and also in the Fraunhofer line focussed retrieval, we ignore atmospheric scattering. Hence, the retrieved fluorescence signal accurately represents the true signal at TOA (see Fig. **??**) but not necessarily the surface emission."

Related to this: My understanding is that the "true ïňĆuorescence signal at TOA" is given by Eq. (2) and is computed using the true surface (TOC) ïňĆuorescence. Is this correct ?

–> Yes, this is correct

My understanding is that the retrieved ïňĆuorescence is the one at the surface (or TOC). Please explain "retrieved ïňĆuorescence signal at TOA" ? Is it computed using Eq. (4) with Fsurf on the right hand side being the retrieved (surface) ïňĆuorescence ?

–> The way we set up the fluorescence retrievals was not by using Eq. 2 but the simplified method outlined in eq. 4. Outside of the O2 lines, Fs at TOA and at the surface are thus identical. Within a line, these values differ largely. The reviewer is right that the state vector element is Fsurf (at 755nm + its slope) but that the simple setup in the retrieval is in principle more indicative of $F_TOAasscatteringisignore, espbecausewedefinedtheretrievedparameterat755nm.$

Section 5.1, page 2502, and Fig. 12: Similar as previous item related to TOA and TOC ïňĆuorescence: Please explain how the discussed quantity used for the y-axis of Fig. 12 has been obtained.

–> This has been derived from the simulations, where scattering and aerosol extinction is included. We added the following in brackets: " (calculated from the simulated fluorescence signal at TOA propagated through the scattering atmosphere)"

Please also explain the difference between the red and light red points.

–> Are you referring to Fig 11? All red points have the same color (though there is transparency, so it may look differently if they overlap).

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Section 5.1, page 2503, and Figs. 13: Please explain how the TOA chlorophyll ïňĆuorescence has been obtained (see also previous items) ? Is it the TOC ïňĆuorescence multiplied with transmission obtained using AERONET AOD ? Or the other way around ? Aparently the latter as the ïňĄgure caption suggests that the TOC ïňĆuorescence is obtained from the TOA ïňĆuorescence. This appears to be in contraction to the previous descriptions stating that the retrieved ïňĆuorescence is the one at TOC, not at TOA. Please clarify

–> TOA Fs was also derived using full radiative transfer simulations given a surface Fs. The main message here is that TOA and surface Fs are almost identical, even at high AODs (unlike EVI or LAI would respond(. Hence, measured Fs at TOA (what we do with the Fraunhofer lines) is a very good measure of Fs at TOC. We added (scattering + absorption) in the caption to clarify that we fully modeled the Fs propagation to the sensor.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 2487, 2012.