

Interactive comment on “Chlorophyll fluorescence remote sensing from space in scattering atmospheres: implications for its retrieval and interferences with atmospheric CO₂ retrievals” by C. Frankenberg et al.

Anonymous Referee #2

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Interactive comment on the manuscript “Chlorophyll fluorescence remote sensing from space in scattering atmospheres: Implications for its retrieval and interferences with atmospheric CO₂ retrievals” by C. Frankenberg et al.

The manuscript “Chlorophyll fluorescence remote sensing from space in scattering atmospheres: Implications for its retrieval and interferences with atmospheric CO₂ retrievals” contains important new material and it covers the topics appropriate for Atmos. Meas. Tech. It is well structured and written. The abstract clearly summarizes the pa-

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per and main results. I am pleased to note that my minor comments (clarification of the definitions and misprint corrections) relating to the previous version of the manuscript are fully taken into account in its current version. The authors have provided timely and comprehensive answers to all interactive comments. I definitely recommend the manuscript publication provided some minor comments would be considered. The submitted manuscript deals with retrievals of chlorophyll fluorescence radiance from high-resolution spectra in O₂ A-band. Two main aspects are considered: 1) fluorescence as primary target of the retrievals from GOSAT observations (as well as recommendations for future satellite missions); and 2) fluorescence as interfering factor affecting accuracy of GOSAT XCO₂ retrievals. Joint consideration of these issues in one paper has certain advantages providing integrated approaches to GOSAT data processing and stimulating inter-team cooperation. However, some terminology adopted in one community might be unusual for another, e. g. “full-physics based” retrieval algorithm. I agree that this term should be putted in quotes in this paper. Additional explanation might be useful, i.e. definition “full-physics” is used to distinguish the method from the simpler approaches, which account for atmospheric light scattering approximately (such “proxy-based” or “differential optical absorption spectroscopy (DOAS) -based). First aspect of the problem (i.e. fluorescence as primary target of the remote sensing) has been already comprehensively discussed in interactive comments/replies; therefore I will focus on the second issue. In the manuscript “Chlorophyll fluorescence remote sensing from...” the authors provided detailed analysis of potential XCO₂ errors due to neglecting fluorescence effects. It is mostly based on the sensitivity studies performed by the numerical simulations using ACOS OCO-2 retrieval algorithm. Important issue of A-band zero-level offset recently discovered by the authors is also considered. Although, the numerical results of the section 4 (the estimated errors and error reduction efficiency) are rather algorithm-specific, presented trends are of interest for CO₂ remote sensing community. In particular, in the community there is no consensus regarding inclusion of surface pressure into state vector. To my opinion presented results seem to support exclusion of surface pressure from the state vector. Author opinion

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regarding this issue would be of interest (at least in the interactive comments). The authors concluded that adding fluorescence to the retrieval state vector reduces bias in XCO₂. However this algorithm modification results in additional scatter in the retrieved XCO₂. Also this approach leads to sub-optimal fit of fluorescence signal itself making Fraunhofer-lines-only approach more prospective alternative for fluorescence as primary target from GOSAT observations. It would be interesting to discuss combination of these approaches: using fluorescence retrievals from Fraunhofer-lines-only in XCO₂ retrievals (either without further fluorescence adjustment or with further adjustment under strong constraints) As was mentioned above, all minor comments (clarification of the definition and misprint corrections) relating to the previous version of the manuscript have been taken into account. The only additional minor comment refers to the caption to Figure 2: "... Positions of Fraunhofer lines most suitable for fluorescence retrievals in the GOSAT spectral range are indicated by green lines". However green lines are not seen in this figure.

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