

Interactive comment on “Global monitoring of terrestrial chlorophyll fluorescence from moderate spectral resolution near-infrared satellite measurements: methodology, simulations, and application to GOME-2” by J. Joiner et al.

P. Stammes (Referee)

stammes@knmi.nl

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This interesting paper fits well into AMT. It describes a relatively simple retrieval algorithm of chlorophyll fluorescence emission based on principal component analysis; a similar approach has been published before. What makes this paper important is the application of the algorithm to GOME-2 data, and thereby providing global, well-sampled maps of chlorophyll fluorescence as observed from space. The results are much smoother and show more detail than fluorescence maps retrieved from GOSAT.

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The application of fluorescence retrieval to GOME-2 type of spectrometers is very promising for future instruments, as mentioned by the authors, but also to past instruments, especially SCIAMACHY on Envisat and GOME on ERS-2. The paper is very complete, but some clarification is needed.

If the comments are well addressed, the paper can be accepted.

Main comments

- The fluorescence retrieval algorithm is not very clearly presented in Sect. 3. Please clearly present all the steps in the algorithm, e.g. in a flow diagram; the best place would be in Sect. 3.4 or 3.5.
- A first error estimate is needed, although the authors state that it is difficult to assess because of the nature of their algorithm.

Specific comments

Abstract:

Please shorten the introductory text (lines 1-14), do not emphasize the O2 A-band, and instead add specific and quantitative results from the paper. Mention that the algorithm is based on a simplified radiative transfer model, applied to a wide spectral range, and that the PCA approach to solve for atmospheric absorption is an empirical approach.

p. 3889:

- l. 8/9: add: . . . , on Metop-B launched . . .
- l. 18-19: remove the word ‘flux’

p. 3890:

- l. 1: remove: “In the absence of atmospheric scattering or”, since in the NIR spectral range there is always atmospheric scattering (Rayleigh).
- l. 19: remove “and scattering”, since the assumption was to neglect scattering. These three terms are in line with p. 3891, l. 6.

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p. 3894:

- l. 17 ff: The DOAS approach does not hold for the deep parts of the O₂ A-band, where many lines are optically thick. So why include this absorption band if DOAS does not apply? What would happen if the O₂ A-band would be skipped? What is the resulting error if it is included?
- l. 25: remove "as well as the effects of RRS", since neglecting RRS was addressed earlier.

p. 3895:

- l. 27 ff: Please try to explain the differences in behaviour of PCs 2, 3 and 4 between the simulations (Fig. 5 and 7) and the GOME-2 measurements (Fig. 6 and 8). It seems that some PC's are reordered in number and/or inverted in sign between simulations and data. A possible related question is: do the simulations represent the same conditions as the GOME-2 data, namely bright scenes: snow/ice, Sahara, clouds?

p. 3897:

- l. 3-9: please shorten this too long sentence. What is the conclusion of this paragraph? What is the resulting error in the fluorescence retrievals?

p. 3898:

- Sect. 4.1: please give the relation of this subsection with the model scenarios described in Sect. 3.2.

p. 3900:

- l. 16: why is the resolution 0.3 nm relevant? Why not another resolution, e.g. 0.1 nm? What would be the expected effect of a higher resolution? Is it to better resolve the Fraunhofer line filling-in of fluorescence?

p. 3901:

- l. 10: What could be the reason of these large residuals? Are they due to the simplified radiative transfer model?

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p. 3902:

- l. 2: please clarify: "referenced to 737 nm"?

p. 3903:

- l. 7: times > time

p. 3904:

- l. 10: singal: signal
- l. 12: SSA > SAA

p. 3905:

- l. 11-12: ... derived from data free of fluorescence ...: what is meant? Please clarify this part of the algorithm in the paper's main text; in the conclusions it causes confusion.
- Please add to the Conclusions an estimate of the error in the retrieved fluorescence.

p. 3906: TROPOspheric

p. 3911: O'Dell paper belongs before the P papers

Table 1: Please specify all the quantities tabulated in the header or in table footnotes. Clarify the differences (sign), and specify which quantities are fluorescence quantities.

Fig. 4: Which spectral resolution is used here? Please give a color bar for the water vapour variation.

Fig. 12, caption:

- the testing
- fit > fitted (2x)
- l in italics

Fig. 16:

- which grid cell size was used for binning?
- betwen > between