General final comment

Dear Editor,

We have now revised our manuscript amtd-7-12173-2014 "A linear method for the retrieval of sun-induced chlorophyll fluorescence from GOME-2 and SCIAMACHY data". We would like to thank the referees for their thoughtful and comprehensive reviews, which have helped us to improve the manuscript substantially. We acknowledge that the initial manuscript was not clear enough to justify our approach in an appropriate manner and have therefore revised the relevant parts, rearranged the structure of the text and included several new results and figures. We believe that all of the reviewers' concerns and comments have been addressed in the revised version of the manuscript and the response letters.

In addition to the modifications based on the reviewers' feedback, we have been able to process the entire time series of SCIAMACHY L1B data from August 2002 to March 2012 (only three months worth of data were presented in the former version) and included the results in the revised manuscript. Our SCIAMACHY fluorescence retrievals in the 740nm spectral region are the first ones in the literature to the best of our knowledge. The availability of the complete time series has allowed us to carry out a more robust analysis of the retrieval performance. We trust that this achievement represents an important milestone in the field and suggests the potential impact of our manuscript in the fluorescence remote sensing community.

A summary of the significant modifications performed on the manuscript is included below. We hope that it now meets the quality and innovation requirements for publication in AMT. Many thanks for your consideration in advance.

Sincerly,

Philipp Köhler on behalf of the authors

Main changes in the methodology section:

1) Derivation of the forward model starting from the most simplistic formulation of the TOA signal.

2) Modified argumentation to remain consistent with respect to the equations.

3) All necessary equations moved to methodology section (including revised labels and subscripts).

4) Discussion of arising implications from the linearization including the new Fig. 4, which shows by means of simulated TOA radiance that the error due to an in-filling of atmospheric absorption lines is negligible.

5) Clarification of the unique contribution of our approach (automated determination of required PCs/coefficients).

6) Stating clearly the differences to the algorithm from Joiner et al. (2013).

7) Extended description of the backward elimination algorithm

8) Disentangle theory, application to simulated data (moved to sensitivity analysis) and application to real satellite data (moved to results).

Main changes in the Sensitivity Analysis section:

1) New Fig. 6 (bias in dependency of illumination angles, water vapour contents and aerosol optical thicknesses) to enhance confidence and to prove that systematic effects can be excluded.

2) Revised Fig. 7 shows the dependency on the number of PCs used and explains the advantages of the backward elimination. In particular, this figure shows selected PCs/coefficients, bias, standard deviation and BIC. The other plots have been removed in order to make the manuscript more concise.

3) New Table 1 shows core results from different fitting windows.

4) New Fig. 8 (correlation error matrix of a sample retrieval) serves as evidence that the reference fluorescence emission spectrum (hf) has no significant correlation to selected PCs and that the PCs with the largest explained variance are selected.

5) Information/justification about/of selected retrieval window has been merged here (previously scattered throughout the manuscript).

Main changes in the results section:

1) Application of the approach to real satellite data has been summarized here (sampling the training and test set, cloud fraction in the presence of snow, number of selected PCs).

2) Removed NDVI comparison (former Fig. 7).

3) New Fig. 10 shows GOME-2 vs SCIAMACHY long-term averages for TOA reflectance, cloud fractions and retrieved SIF.

4) New Fig. 11 shows the temporal consistency of our retrieval results.

5) Revised citations with respect to V25 results (retrieval is presented in Joiner et al., 2013, V25 data set is described in Joiner et al., 2014)

6) Former Fig. 9 (V25 GOME-2 vs GOME-2, July 2011, vegetated areas only...too much restrictions) has been replaced by a comparison of V25 GOME-2 vs GOME-2 long-term averages (new Fig. 13).

7) Former Fig. 10 has been removed (informative value is covered by new Fig. 13).

8) SAA center has been marked in former Fig. 11 (now Fig.15).

9) New Fig. 14 compares long-term averages of GOME-2, V25 GOME-2 and SCIAMACHY SIF with GOSAT SIF.

10) Extended analysis of north-south bias in training set (two tested sampling methods) in order to investigate if this bias is really related to an instrumental issue. Therefore, former Fig. 12 (now Fig. 16) has been revised.

And last but not least, we substantially revised the conclusions according to the numerous modifications above.