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Interactive comment on "Interpretation of FRESCO cloud retrievals in case of absorbing aerosol events" *by* P. Wang et al.

Anonymous Referee #3

Received and published: 6 February 2012

The paper from Wang et. al. discusses the results of the FRESCO cloud algorithm together with the aerosol absorbing index. Both data products are established for spectrometers like GOME, GOME-2 and SCIAMACHY. The FRESCO algorithm is part of the official Level-2 data product and has a high importance for the scientific community. An impact of aerosols to the GOME cloud data is plausible and expected with respect to the retrieval methods used. Nevertheless, a detailed study is not yet published and an important task for a scientific paper.

The paper contains some interesting and promising results. In general, I think there are two objectives of these studies which can be a focus of the scientific paper:

1.) The impact of aerosol events to the FRESCO cloud retrieval. 2.) Retrieval of aerosol parameters in addition to cloud parameters

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It is not clear to me, which of these options would be a better focus of the paper. In both cases some studies should be added (see below) and the objective of the paper should be explained more in detail. The conclusions in sect. 5 and the abstract are very optimistic, in particular with respect to the benefit for aviation safety and operations. I think this should be removed or discussed in detail with respect to the points below.

- A meaningful, quantitative interpretation of the FRESCO results as aerosol layer height requires running the algorithm in a different mode using scene albedo and scene pressure. What would be the threshold in the AAI, where FRESCO could switch from the usual retrieval mode to a mode using scene albedo and scene pressure? Are vulcanic ash plums usually / always above this threshold?

- What is the limit in AOD to retrieve reliable values for aerosol pressure using FRESCO? What kind of absorbing aerosols would typically fulfil this limit?

- I think the results could be useful, even if there would be only a limited amount of cases to apply the technique, because the combination of the o2-A-band and the AAI is an interesting approach: The AAI is a function of several aerosol properties, including AOD, SSA and aerosol layer height. Could the AAI be transformed into a more useful value, if the AOD and the layer height is known? If this is not the case, which additional information would be required? Unfortunately this is not really discussed within the paper.

- If the authors would like to discuss the first objective, they should quantify the error in effective cloud fraction and cloud pressure in the case of absorbing aerosol events and should discuss the possibility to improve FRESCO cloud retrievals using the AAI. Maybe it is a good idea to set a flag in the FRESCO product, if the cloud fraction / pressure is influenced by an absorbing aerosol?

- I wonder, why FRESCO should give the aerosol height instead of the cloud height, if the aerosol is above the cloud. The authors have shown in their previous

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papers, that the cloud height retrieved by FRESCO usually represents the center of the cloud. Therefore I would not expect to get the aerosol height, if the aerosol layer is above a cloud. In Fig. 2b.), the scene height is between the aerosol and the cloud except for high sza in the optical thick aerosol case.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 32685, 2011.

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