Interactive comment on the manuscript "Using ocean-glint scattered sunlight as a diagnostic tool for satellite remote sensing of greenhouse gases" by A. Butz et al.

The manuscript "Using ocean-glint scattered sunlight as a diagnostic tool for satellite remote sensing of greenhouse gases" contains important new material and it covers the topics appropriate for Atmos. Meas. Tech.

The authors propose and implement new technique to select the set of backscattered sunlight observations that are (mostly) free of errors due to uncertain light path modifications. The technique explores the specificity of optical path modification over ocean with dominated light-path shortening. Such selected set of scans ("upper edge" ensemble) enables analysis of other (than atmospheric light-scattering) uncertainties (e.g. due to incorrect forward model or instrumental drawbacks), which are usually masked by light-scattering effects. The technique was applied to more than three years of TANSO-FTS ocean-glint measurements.

In their previously published paper (Butz et. al, 2011), the authors used similar approach to quantify the inconsistency of spectroscopic parameters in the oxygen (O2) A-band channel. The proposed scaling of (O2) A-band absorption cross-sections is now widely used. In the submitted manuscript the authors developed the approach significantly, including new justified criteria of "error-free" scan selection (based on ad-hoc chosen percentiles); and new applications of the proposed method (tracking of the instrument effects, analysis of the consistency of the spectroscopic parameters in CO2 absorption bands). These results may be helpful in meeting ambitious accuracy/precision requirements for GOSAT/OCO/... observations.

The manuscript is well structured and written; the abstract clearly summarizes the paper and main results. I definitely recommend the manuscript publication provided some minor comments would be considered (at least in the interactive comments).

1. Authors proposed special treatment for the observations of low-altitude optically thick particle layer (e.g. cumulus) which is overlaid by optically thin elevated layer (e.g. cirrus).

- What are the author estimates of the percentage of such situations for actual GOSAT observations?

- Could such observations be revealed by standard screening procedures (e.g. by CAI)?

2. The authors operate with vast set of sun-glint observations. Some of these observations were taken near TCCON sites (e.g., Wollongong TCCON site). Did author consider the possibility to extract “near-TCCON” observations in order to retrieve XCO2 under “non-scattering” conditions and to compare with ground-based observations? These results might be serious argument in support of proposed technique to select observations that are free of “light-scattering” errors.

3. When describing the retrieval method, it is mentioned that (line 189) “Retrieval parameters are the 4-layer partial column profiles of the target absorbers O2 and CO2…” Next, it is stated that “The regularization parameter weighting the side-constraint against the least-squares term is chosen such that each absorber vertical profile gets one degree of freedom. Thus, the inverse method yields absorber profiles with the same shape as the a priori profiles…” Does it mean that in fact the algorithm retrieves scaling factors to a priory profiles and “target gas profiles” are kept in the state vector for the sake of algorithm flexibility? Is it the option for this study or general approach?