Interactive Comment on "Improvements to the PhytoDOAS method for identification of major phytoplankton groups using hyper-spectral satellite data" A. Sadeghi, et al:

PrincipalCriteria	**Excellent** (1)	**Good** (2)	**Fair** (3)	**Poor** (4)
Scientific Significance: Does the manuscript represent a substantial contribution to scientific progress within the scope of Ocean Science (substantial new concepts, ideas, methods, or data)?		x		
Scientific Quality: Are the scientific approach and applied methods valid? Are the results discussed in an appropriate and balanced way (consideration of related work, including appropriate references)?			x	
Presentation Quality: Are the scientific results and conclusions presented in a clear, concise, and well-structured way (number and quality of figures/tables, appropriate use of English language)?		x		

Short summary:

The presented paper is dealing with the identification of phytoplankton taxonomic groups in case I waters with hyperspectral satellite-borne SCIAMACHY data, by an improvement of the PhytoDOASmethod, as introduced by Bracher et al (2009). The taxonomic groups presented by Bracher et al (2009), diatoms and cyanobacteria, are extended here by coccolithophores and dinoflagellates. The presented approach, a multi-target fit, assigns the measured absorption spectra of algal taxonomic groups to the calculated spectra of natural algal assemblages, while enhancing characteristics of the spectra by means of the fourth derivative method. Validation of coccolithophore and diatom abundances is based on model outcomes of the Nasa Ocean Biochemical model and MODIS (on Aqua) level 3 products. There is no validation for dinoflagellate occurrence. Cyanobacteria are not included in the presented approach.

General comments

The paper addresses the use of hyperspectral satellite-borne data for the delineation of algal taxonomic groups based on absorption spectra. This topic is quite up-to date, and of high relevance for an increased understanding and modeling of ocean biogeochemistry. Further, the use of SCIAMACHY hyperspectral data for phytoplankton retrieval is promoted.The paper presents an improvement of the novel method PhytoDOAS (Bracher et al 2009). The authors give credit to this publication and clearly indicate their own contribution to PhytoDOAS (even though some of the theoretical introduction on DOAS and

PhytoDOASmay be shortened here without scientific loss). The improvement with respect to the Bracher publication (aiming at diatoms and cyanobacteria) is mainly the inclusion of two additional taxonomic groups- coccolithophores and dinoflagellates- in a multi-target fit approach. The objectives of the paper are clearly stated and themethodology is well presented. While the authors present some promising results on coccolithophore, dinoflagellate, and diatom retrieval, they do not provide in situ data for validation and, instead, rely on other satellite-borne data and models. Cyanobacteria are not considered at all. The quality of the results is therefore, as also critically reviewed by the authors, to some extend improvable, and the authors are encouraged to do so in future publications.

The paper is appropriately titled and the abstract provides a concise and complete summary of the work. The paper is generally well written and structured, and overall presented well. Figures, formulae, and tables are appropriate and the number and quality of references with few exceptions well chosen.

Specific comments:

Page 2272, line 3- starting with the abstract, you use the term phytoplankton functional types (PFT) while citing (page 2274, line 3) Nair et al 2008. The concept of PFTs as outlined by Nair et al 2008, however, groups algae with respect to theirrole in the biogeochemical cycle of the ocean, which often does not comply with taxonomic grouping. You refer to taxonomic groups instead and do not use the term PFT correctly. If you would like to keep the term PFT, please explain from the start (abstract and introduction) how your taxonomic groups can be grouped into PFTs. As an example: in Nair et al 2008, diatoms are grouped in both, nitrogen-fixers and silicifiers. *E. huxleyi* is acalcifier and a DMS producer.

Page 2273, line 25 – “chl-a is a common pigment among all phytoplankton species”- yes, all butprochlorophytes.

Page 2274, line 4- Check citation:You cite Millie et al 1997 for the space-borne detection of algal blooms. Please have a look at this publication! It is not about space-borne detection of algal blooms, but on the use of photopigments and absorption signatures for detection of *Kareniabrevis*(*Gymnodiniumbreve*) in the laboratory,but not from space. There is a lot of appropriate literature for the satellite-borne detection of algal blooms available, please use one of these.

Page 2280, line 1- “scattering of CDOM”? CDOM is dissolved, how does it scatter?

Page 2283, line 24- please include discussion, on how appropriate a pixel size of 30 km x 60 km is for the delineation of algal groups in natural waters (e.g. in comparison to MODIS and MERIS pixel sizes).

Page 2284, line 16- you are planning to validate model data on *E. huxleyi* as an indicator for coccolithophores with a model of PIC as another indicator for coccolithophores. Pleasediscuss how appropriate this is and please also include in situ data to confirm both model outcomes.

Page 2284, line 17- you consider coccolithophores; what about dinoflagellates and diatoms?

Page 2284, line 26,27- “It must be mentioned that as *E. huxleyi* is the dominant species of the coccolithophores, it has been used in this study as the spectral indicator of this PFT target”. Please add a reference for this statement. Further, *E. huxleyi* is both, acalcifier and a DMS producer (two groups in the concept of PFTs, as summarized by Nair et al 2008). To which PFT do you assign the species? As you include in total two more taxonomic groups to PhytoDOAS, coccolithophores and dinoflagellates, please discuss with relevant literature, why the use of a single species as marker species for the delineation of one of these two groupsis appropriate.

Page 2285, line 1- Measurement of the reference absorption spectrum for the two new groups (coccolithophores and dinoflagellates): If I understand you right, you used for the group coccolithophoresonly one culture with one strain of *E. huxleyi*,without paying attention to the physiological state or age of the culture. For dinoflagellates you used only one natural sample, at a bloom situation.And so you proceeded for diatoms. Especially dinoflagellates are quite diverse with respect to pigment content and absorption spectra. These absorption spectra are the backbone of you approach and need to be selected and discussed more carefully! Please compare the derived spectra also with relevant literature.

Page 2285, line 9- was this a monospecific bloom? Is the dinoflagellate species representative? How have other studies solved the problem of dinoflagellate diversity?

Page 2286, line 20- the triple target fit includes *E. huxleyi* together with diatoms and dinoflagellates. Why did you not include cyanobacteria?

Page 2287, line 14-17- The comparison with in situ data is a crucial aspect that deserves more discussion. Are there public datasets available that you can refer to? The question of how to match the large satellite ground pixels to in-situ data needs to be addressed here.

Page 2289 onwards, 3.2- you compare model data with the retrieved coccolithophore and diatom data. What about dinoflagellates?

Page 2291, line 1- “..validity test should be done..”: yes.

Page 2292, line 20, 21- generally yes, phytoplankton blooms could provide you the opportunity to test the retrieval method under realistic conditions. But how many phytoplankton blooms have a spatial dimension which corresponds to 30 km x 60 km?

Page 2293, line 2, 3- why would this method be a better alternative to more accurately retrieve chl-a from satellite data, especially with respect to the not yet included algal taxonomic groups and the large pixel size?

Page 2294, line 4- “challenge to overcome spectral correlation between absorption spectra of target PFTs which arises from their common pigments”- not only from common pigments, but also from similar absorption regions of most other pigments than chl-a.

Figure 11: please include colourbars with both lower panels.

Technical corrections:

Page 2286, line 9- “This approach, called as multi-target fit”- delete “as”

Page 2286, line 13- “targets are ïtted”- fitted

Page 2287, line 22, 25- fourth instead of forth

Page 2291, line 17- these instead of this

Page 2293, line 13, 14- Sentence not complete?

Page 2294, line 6- spectra?

Page 2294, line 21- global for “globla”

Page 2295, line 5- global distribution for “globladisribution”

Page 2295, line 22- lower case: dimethylsulphide instead of “Dimethylsulphide”