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Biogeosciences Discussions

Interactive comment on "Remote sensing of coccolithophore blooms in selected oceanic regions using the PhytoDOAS method applied to hyper-spectral satellite data" *by* A. Sadeghi et al.

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Dear Referee #2,

We thank you greatly for your positive feedbacks and appreciate your valuable comments. We found your suggestions very constructive and tried to implement them in the manuscript. You will ïňĄnd our responses, as a supplementary ïňĄle in pdf.

Please note that this ïňĄle contains two parts, separating our answers to the both reviewers.

[A numbering order has been implemented for referring to the comments of each re-

viewer. In this way, your comments have been sorted (in the second part) from C21 to C340, and our responses from R21 to R34, respectively.]

Many thanks again for your contribution!

Kind regards, Alireza Sadeghi (on behalf of the co-authors)

P.S. The revised manuscript has been attached as a pdf file (instead of Figure 1)

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/8/C6170/2012/bgd-8-C6170-2012-supplement.pdf

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Interactive comment on Biogeosciences Discuss., 8, 11725, 2011.

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Remote sensing of coccolithophore blooms in selected oceanic regions using the PhytoDOAS method applied to hyper-spectral satellite data

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Abstract. In this study temporal variations of coccolithophore blooms are investigated using satellite data. Eight years, from 2003 to 2010, of data of SCIAMACHY, a hyper-spectral satellite sensor on-board ENVISAT, were processed by the PhytoDOAS method to monitor the biomass of coccolithophores in three selected regions. These regions are characterized by frequent occurrence of large coccolithophore blooms. The retrieval results, shown as monthly mean time-series, were compared to related satellite products, including the total surface phytoplankton, i.e., total chlorophyll-a (from GlobColour merged data) and the particulate inorganic carbon (from MODIS-Aqua). The inter-annual variations of the phytoplankton bloom cycles and their maximum monthly mean values have been compared in the three selected regions to the variations of the geophysical parameters: sea-surface temperature (SST), mixed-layer depth (MLD) and surface wind speed, which are known to affect phytoplankton dynamics. For each region the anomalies and linear trends of the monitored parameters over the period of this study have been computed. The patterns of total phytoplankton biomass and specific dynamics of coccolithophore chlorophyll-a in the selected regions are discussed in relation to other studies. The PhytoDOAS results are consistent with the two other ocean color products and support the reported dependencies of coccolithophore biomass' dynamics to the compared geophysical variables. This suggests, that PhytoDOAS is a valid method for retrieving coccolithophore biomass and for monitoring its bloom developments in the global oceans. Future applications of time-series studies using the PhytoDOAS data set are proposed, also using the new upcoming generations of hyper-spectral satellite sensors with improved spatial resolution.

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1 Introduction

1.1 Importance of coccolithophores

Phytoplankton play crucial roles in the marine food-web and in the global carbon cycle. Sensitive responses of phytoplankton to the environmental and ecological impacts make them reliable indicators of the variations in climate factors. Coccolithophores are an abundant taxonomic group of phytoplankton with a wide range of effects on the oceanic biogeochemical cycles (*Rost and Riebesell*, 2004) and a significant influence on the optical features of surface water (*Tyrrell et al.*, 1999). Coccolithophores also affect the atmosphere and climate by emitting dimethylsulfide (DMS) into the atmosphere (*Tyrrell and Merico*, 2004; *Andreae*, 1990), where it is converted to the sulfur aerosols and cloud condensation nuclei (CCN) and influence the climate and the Earth's energy budget (*Charlson et al.*, 1987; *Andreae*, 1990). Among different phytoplankton blooms, coccolithophore blooms are very important due to their wide coverage and frequent occurrence (*Holligan et al.*, 1983), as well as their unique biooptical and biogeochemical properties (*Brown and Podesta*, 1997; *Balch*, 2004). Coccolithophores are the main planktonic calcifiers in the ocean characterized by building up calcium carbonate ($CaCO_3$) plates, called coccoliths (*Westbroek et al.*, 1985). Through building and releasing coccoliths, coccolithophores make a major contribution to the total content of Particulate Inorganic Carbon (PIC or suspended $CaCO_3$) in the open oceans (*Milliman*, 1993; *Ackleson et al.*, 1994). PIC represents about 1/4 of all marine sediments (*Broecker and Peng*, 1982) and is regarded as a major oceanic sink for atmospheric CO_2 and by this interacting with the rate of ocean acidification (*Balch and Utgoff*, 2009). In the same context, increased oceanic CO_2, which is a response to the increase in atmospheric CO_2 (anthropogenic contribution), affects the rate of calcification by coccolithophores by reducing the supersaturation state of

Fig. 1.