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Determination of Phytoplankton Concentrations from Space-borne Spectroscopic Measurements

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The Scanning Imaging Absorption Spectrometer for Atmospheric Cartography (SCIAMACHY) on board of the European environmental satellite Envisat continuously measures transmitted, reflected and scattered solar radiation from 220 - 2380 nm at moderate spectral resolution (0,2 nm - 1,5 nm). Global maps of atmospheric trace gas distributions are derived from these measurements using the Differential Optical Absorption Spectroscopy (DOAS) technique. Although SCIAMACHY is primarily an atmospheric mission, part of the detected solar radiation penetrates the ocean surface and picks up an absorption signal from molecular species in sea water. In the visible part of the measured spectra, spectral features of photosynthetic pigments can clearly be identified. We show that the spectral signature of photosynthetic pigments in SCIAMACHY spectra can be used to infer phytoplankton biomass via chlorophyll concentrations. We present first results obtained in a case study of a phytoplankton bloom event off the West African coast in March 2003 and compare the results with ocean colour measurements of the SeaWifs instrument. While the spatial resolution of the SCIAMACHY instrument (60 x 30 km) is coarse in comparison with ocean colour instruments, we provide evidence that the detected spectral signatures have the potential of discriminating between different phytoplankton groups. Finally, we investigate a method to infer chlorophyll concentration by exploiting the additional information from effective water penetration depth, which is obtained from the DOAS analysis of liquid water absorption. We could also show clear evidence of Vibrational Raman Scattering (VRS) in SCIAMACHY data. The direct relationship of inelastic scattering due to VRS and chlorophyll concentration in oligotrophic waters provides additional information for potential chlorophyll retrievals from SCIAMACHY data.