

Monitoring of Water Quality in High Turbid Waters Using Coupled Atmospheric-hydro-optical Models and Remote Sensing

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Abstract: Mapping Total Suspended Matters (TSM) from satellite data is hampered by the optical complexity and often extreme turbidity. Extremely high concentrations of Suspended Particulate Matters (SPM), chlorophyll-a (Chla) and Coloured Dissolved Organic Matters (CDOM), local differences, seasonal and tidal variations, and resuspension are important factors that may lead to lack of efficiency in the application of simple hydro-optical models in highly turbid waters. On the other hand atmospheric correction over turbid waters can be problematic if atmospheric haze is spatially variable. In this case, the retrieval of water quality is hampered by the fact that haze variations could be partly mistaken for variations in SPM. In this study, a coupled atmospheric radiative transfer model was used to investigate the seasonal and annual variation of water parameters concentration in the extremely turbid Wadden Sea for one decade. In this research, 150 MEdium Resolution Imaging Spectrometer (MERIS LI B) images which are captured in 2000-2010 over the Wadden Sea were used to provide top of atmosphere (TOA) radiance, atmospheric and geometric parameters. MODerate resolution atmospheric TRANsmission model (MODTRAN 5.2) was applied to implement atmospheric correction. We set several atmospheric conditions as input for MODTRAN simulations and calculated three atmospheric correction parameters for each atmospheric scheme. Then we applied these three parameters to MERIS data and derived water leaving reflectance (R_{rs}) per pixel in different images. Simultaneously, the 2SeaColor forward model was utilized to simulate R_{rs} by setting up a series of Chla, SPM, and a_{CDOM} concentration. Then these two R_{rs} (one was from MODTRAN atmospheric correction, and the other one was from 2SeaColor forward model simulation) were combined to find out the best case of atmospheric state and the corresponding R_{rs} from all the R_{rs} images which were generated by MODTRAN. At the same time, water parameters concentration could be retrieved from the look-up table created by the 2SeaColor model when the R_{rs} was definite. With the Chl-a, SPM, a_{CDOM} maps from different times, simple analyses on the spatial dynamics and the diurnal cycle of these parameters were done based on some statistical methods. The result showed the same pattern in the variation of water parameters concentration in the Wadden Sea in comparison with the ground measurements estimation analysis in this case study. Also, validation over 150 matches up points showed a lot of improvement when compared with results from the work of other researches.

Keywords: MODTRAN, 2SeaColour, Total suspended matters, remote sensing, spatiotemporal dynamics, high turbid waters.