Spatio-temporal patterns of particulate organic matter in coastal oceans

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1. Introduction

A central aspect of coastal biogeochemistry is to determine how nutrients, lithogenic and organic matter are distributed and transformed. So far, organic components of TSM are determined from water samples, which limits spatio-temporal change analyses. Satellite images of surface Chla- and total suspended matter (TSM) concentrations indicate strong, time-variable linkages between intertidal fringes and offshore pelagic regions. We show how a linkage between sample data of total particulate organic matter (POM) and satellite TSM images adds valuable spatio-temporal information content.

2. Methods

We combined satellite images with sample data of TSM, POM, POC and PON from the North Sea using a specifically developed semi-empirical model. It separates refractory, mineral-associated from fresh, labile POM as a function of TSM by parameterising the net accumulation of fresh organic matter (Kpom) and the fraction of resuspended inorganic matter in POM (m_{POM}).

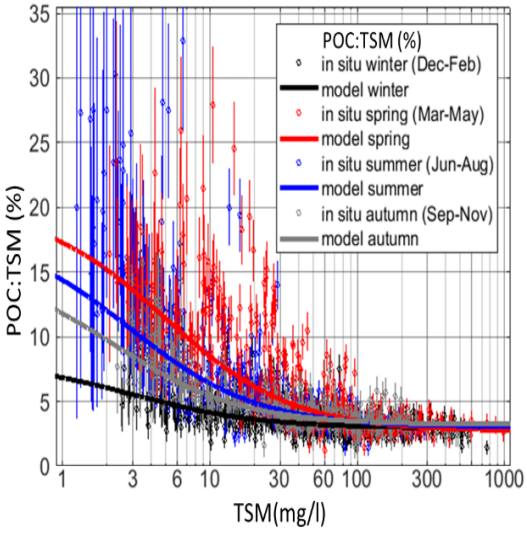

Figure 1: POC content (in %) as a function of TSM (Belgian North Sea, data from 2004 to 2020). Colours indicate seasons, curves show the model fits.

3. Results

Representative for all parameters in TSM dependence, POC:TSM sample data are high at low TSM, e.g. above 20 % in spring, and approach asymptotically a constant plateau around 2.5 % at large TSM (Figure 1). Model fits yield m_{pom} around 0.13 for all seasons. K_{POM} shows clear seasonal variations from 4.9 mg/l in spring, reflecting the phytoplankton blooms, to 2.2 mg/l in winter. Figure 2 displays the difference between fresh and mineral associated POM for the spring in the German Bight. It shows a clear transition zone of equal parts of POM at water depths between 15 and 20m.

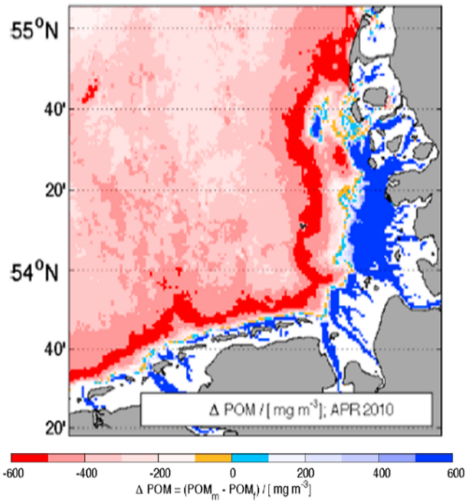

Figure 2: Satellite image of the difference between mineral associated and fresh POM. The POM values are computed by the pixel wise POM:TSM model application to the original TSM image (German Bight, April 2010; MERIS/ENVISAT).

4. Conclusions

The application of our model to satellite images of TSM yields spatio-temporal patterns of the build-up and decay of organic matter and the location of a transition zone between lithogenic and marine dominated suspended matter. When calibrated with samples this model can be applied satellite images or in-situ time series of TSM at any coast.