The characteristics of the organic matter in biomineral flocs

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1. Introduction

Micro-biological processes influence flocculation and thus the transport of the suspended particulate matter (SPM), through the production of polysaccharides such as transparent exopolymer particles (TEP; e.g. Alldredge et al., 1993). The interactions between TEP and SPM have often been studied in open oceans displaying low mineral concentrations, where TEP concentrations are correlated with the rise and decline of phytoplankton blooms (Fukao et al. 2010). In the shallow nearshore areas SPM dynamics and composition is complex due to strong hydrodynamical forces that disturb the bottom sediments and change the floc sizes continuously. However, comprehensive observations are scarce. For the Belgium nearshore and other areas, they show that in winter, when SPM concentration is highest, TEP concentration also has a maximum, while floc sizes are small (e.g. Morelle et al., 2018 and our data). This apparent contradiction indicates that total TEP concentration alone cannot sufficiently explain biophysical flocculation and that a distinction between a more labile or fresh and a more recalcitrant fraction of the OM parameters should be envisaged. The latter fraction is incorporated in the minerals where it is particularly bound to the phyllosilicates (Mayer, 1994), the former one is correlated with phytoplankton blooms. The aim of the study is to discuss the temporal and spatial variation of SPM concentration and floc size in the Belgian part of the North Sea and to relate it to variations of the Particulate Organic Matter (POM) composition and concentration.

2. Methods

The composition of the POM was assessed by analysing particulate organic carbon (POC), nitrogen (PON) and TEP concentration together with SPM concentration from water samples collected in the Belgian nearshore. Time series of floc-sizes were measured with a LISST 100X (Agrawal and Pottsmith, 2000). The differentiation between fresh and mineral-associated POM follows the approach of Schartau et al. (2019), who considered Loss-on-Ignition measurements to describe the POM:SPM ratio as a function of SPM concentration. We applied this model to the concentrations of POC, PON, and TEP and related them to the corresponding SPM concentrations.

3. Results

Based on all data, the statistical model separated the POM into fresh and mineral associated POC, PON and TEP. The model estimates showed that a large part of the POC, PON and TEP is associated with the mineral fractions throughout the year and that mainly in spring and summer fresh TEP, POC and PON is formed. The dominance of fresh TEP over this part of the year corresponds well with the observed seasonal floc-size (Figure 1).

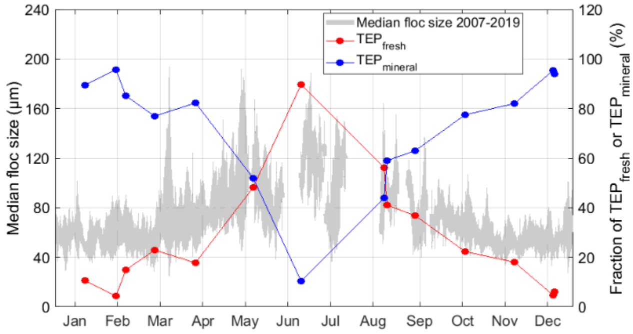

Figure 1: Floc size (grey) and model estimates of the fresh (red) and mineral associated (blue) TEP fractions.

4. Conclusions

The statistical model approach for TEP, POC, PON results in a set of bulk parameters that separate fresh and mineral associated OM fractions. This approach carves out that the median floc size increases when fresh TEP dominates. This is the case in spring and summer. The mineral associated TEP that dominates over the rest of the year seems to have minor influence. This resolves the above mention contradiction and indicates that fresh TEP is one important control of particle settling in coastal waters.

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