The composition and characteristics of suspended particulate matter in marine coastal areas

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The seasonal dynamics of Suspended Particulate Matter (SPM) along the cross-shore gradient, from the coastal zone to the offshore has attracted considerable attention in recent years (e.g. Maerz *et al*., 2016; Li *et al*., 2017; Fettweis & Lee, 2017; Shen *et al*., 2018). Retrieving spatio-temporal information from satellite ocean colour measurements is desirable, in particular if data (proxies) can be derived that go beyond Chlorophyll-a concentration (Chl-a) and SPM concentration (SPMC). SPM incorporates inorganic minerals of physico-chemical and of biogenic origin and it embeds living and non-living organic matter (OM). The increase of the OM content of the SPM with decreasing SPMC (see Figure 1) and to a first order with distance from the coast is a well-known general feature (Schartau et al., 2019). Based on water sample Loss-on-Ignition (LoI) and SPMC data from the German Bight, Schartau et al. (2019) have devised an analytical model for estimating fractions of inorganic and two types of OM as a function of SPMC. Applied to satellite SPMC, the model provided insights into temporal and spatial variations in SPM and OM features across the German Bight. However, the model does not resolve how the OM is composed of preserved or refractory and labile portions. Their ratios vary due to the seasonal formation and decay of fresh organic matter by algae bloom and bacterial activity (Ittekkot, 1988; Keil *et al*., 1994). The labile fraction is one control of the SPM transport features as it is linked with the occurrence of transparent exopolymeric particles (TEP) (e.g. Alldredge *et al*., 1993). TEPs may act as biological glue increasing particle stickiness during aggregation, thereby enhancing the formation of larger flocs with larger settling velocities (e.g. Fettweis et al., 2014). As an example, nearshore data from the Belgium coast show that Chl-a is high between March and September with the prominent algae bloom in spring and with a secondary peak in summer and low during winter (Figure 2a). The particulate organic carbon (POC) content in the SPM shows little variation over the whole year, except during the spring bloom when the POC content also increases. The POC here includes some persistent fraction of OM. This fraction remains unvalued by Chl-a data that may act only as a proxy for the labile fraction of the OM. The labile fraction is subject to seasonal build-up and decay of fresh OM, e.g. during algal growth or during degradation by bacteria. The "freshness" of the OM, as indicated by the Phaeophytine /Chl-a ratio, is lower in winter compared to the rest of the year, Phaeophytine being associated with decaying Chl-a (Figure 2b).
The aim of the present study is twofold. Firstly, we want to validate the Schartau *et al*. model with LoI and POC data from other areas. Secondly, we want to investigate how the labile fraction of the OM, as calculated by the model, is correlated with CHL-a and the concentrations of Phaeophytine and TEP to allow model refinements and to generate improved data sets, resolving spatio-temporal characteristics of those OM components that are relevant for the near-shore SPM dynamics and element cycling.

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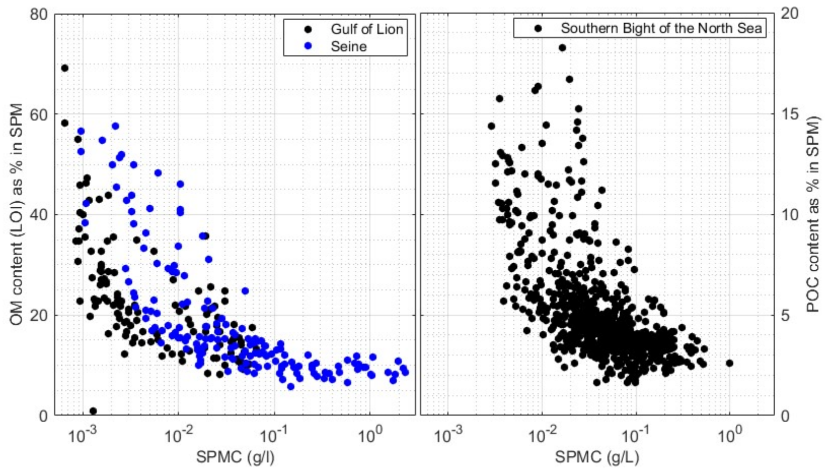

Fig. 1. Organic matter content in the SPM from determined through LoI (left) and element analysis (right). Both data set show that largest variation in organic matter content occurs at low SPMC.

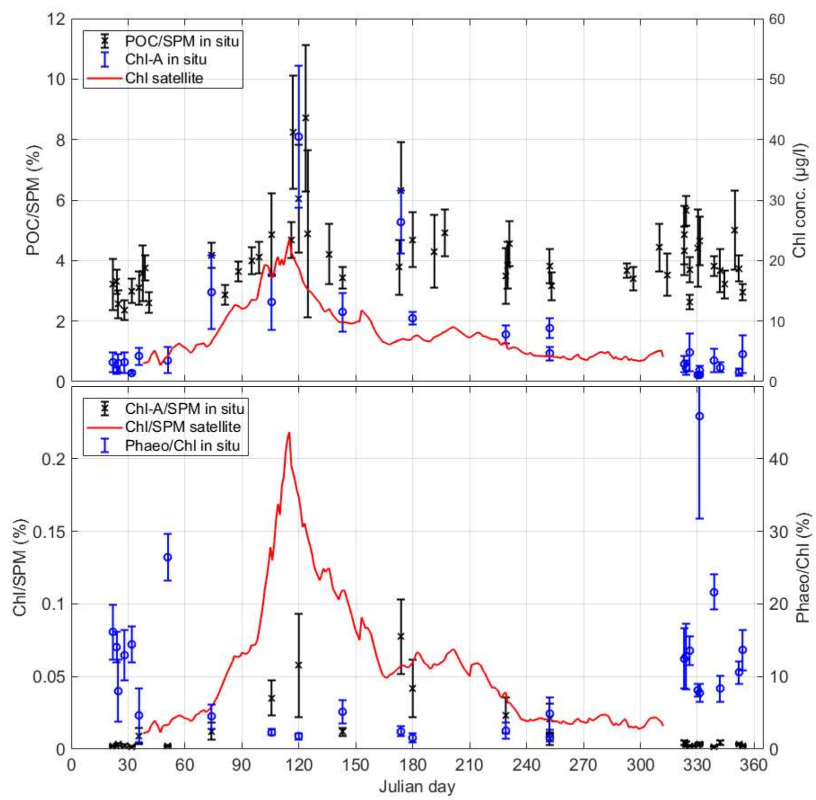

Fig. 2. Seasonal variation of the OM (above) and the Chl and Phaeophytine content of the SPM (below) derived from water samples taken in the Belgian nearshore in 2000-2018. Each dot and errorbar represents the mean and standard deviation of 13 samples taken during a tidal cycle. The solid line is the surface Chl concentration derived from MERIS satellite over the period 2002-2012.