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Interactive comment on "Total suspended matter derived from MERIS data as indicator for coastal processes in the Baltic Sea" *by* D. Kyryliuk and S. Kratzer

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Thank you for your comments!

Yes, we agree that this is a rather descriptive article. The advantage of using satellite-derived TSM to define the extent of the coastal zone is that we can look at the whole Baltic Sea basin synoptically and visually compare the different coastal areas. But the work is not merely descriptive. We base our transect analysis also on theory developed by Kratzer and Tett (2009, see Box 1). Using bio-optical data from the NW Baltic Sea the authors showed how one case use bio-optical data to define the extent of the coastal zone (Figure 7).

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Discussion paper

In this current paper we used Kratzer and Tett (2009) as a basis of our analysis, but we use basin-wide remote sensing data instead to define the extent of coastal processes. We decided to talk here about the 'extent of coastal processes' rather than the extent of the coastal zone as we feel that SPM is more of an indicator of the processes influenced by the coast rather than an exact indicator of the coastal zone.

Our hypothesis is quite clearly defined in the introduction section and then three main objectives are stated at the end of the introduction:

Hypothesis: Total suspended matter derived from MERIS data can be used as an indicator of costal processes.

Objectives: Derive mean estimates of total suspended matter for the Baltic Sea and its sub-basins (please see Figure 12, page 27 and Table 2, page 17)

In section 3.1 the logic behind why we only used the early June images for the analysis is explained. Basically, we wanted to exclude the effect of cyanobacteria as we want to focus on the influence of coastal processes (page 6, Lines 17-22). Further, the TSM composites are compared to chlorophyll-a composites for the same dates illustrating different patterns and de-coupling of the two parameters (i.e. chl-a and TSM), indicating that the TSM values in the composite is presumably of inorganic origin (page 6, Lines 26-30) and followed by illustration (Figure 9).

Investigate if MERIS data can be used to evaluate the extent of coastal processes using bio-optical model derived from in situ measurements (that are essential for validation of satellite products) (please see page 24-26, Figure 10a, 11a & 11b)

Here, it needs to be explained that total suspended matter (TSM) which is also termed suspended particulate matter (SPM) can be divide into an organic and an inorganic fraction as described (page 5, Line 16-17). Kratzer and Tett (2009) used inorganic suspended matter to identify the break between coastal and open sea using a threshold of 0.05 ãĂŰgmãĂŮˆ(-3) which was reached at a distance of about 10-20 km from the

coast. As MERIS provides us with the total suspended matter as a standard product we had to estimate how 0.05 ãĂŰgmãĂůˆ(-3) of inorganic matter translates into TSM. Using the bio-optical data described in Kratzer and Tett (2009; figures 4a, 7a&d) we could conclude that this threshold corresponds to 0.8 (+/- 0.3) ãĂŰgmãĂůˆ(-3) TSM (now including both the organic and inorganic matter).

However, after a statistical analysis of a composite image from June 2011 for different coastal areas in the Baltic Sea we found that the overall threshold is closer to about 0.6 ãĂŰgmãĂůˆ(-3) for total suspended matter (TSM). We found that this threshold is overall more representative for the Baltic Sea, but the values vary slightly dependent on the basin (see page 20-21, Figure 5 & 6). In the end we decided to use the respective local threshold between coastal and open sea waters to define the extent of the coastal in our trend analysis. The local threshold is then applied to the chosen transects for each area (see page 25-26, Figure 11a & 11b).

The extent of coastal processes is compared (synoptically) to the water body classification defined by SMHI (see section 3.2, page 7, Lines 5-31 this for how objective was described and page 24-25, Figure 11a & 1b achieved)

The reviewer was very right to point out that the errors in deriving TSM using the FUB algorithm is actually higher (about 27%) than when using the standard algorithm MEGS (about 10%, see Beltran-Abaunza et al. (2014). We have now corrected this in the revised paper. FUB is not the standard MERIS processor; but it has shown to be overall best for the retrieval of water products.

However, we feel that it is important to mention that the TSM concentration derived by MEGS (the standard processor) were associated with significant noise, whilst the FUB images showed much less noise. Additionally, FUB has a more consistent off-set over the reflectance spectrum (Beltran et al, 2014). FUB is also more accurate in the chlorophyll retrieval that gives us a degree of certainty that what we see in early June composite 2011 is suspended matter of inorganic origin, which is associated with river

run-off and coastal processes, which once again shows that the extent of coastal processes is way beyond earlier assumed scales (e.g. as commonly defined by the SMHI method). And as final remark, the choice of whether using FUB or MEGS for retrieval of TSM in a given area must take into account local conditions and ranges of in situ retrieved values. We have described the relative errors (RMS) and systematic (MNB) errors already in a previous study (Beltran-Abaunza et al., 2014), and even though the transect data do include these errors we still can extract the relative difference between coastal and open sea waters.

Additionally, we set approximate values (number in km) of how far the suspended matter reaches off-shore that is within similar ranges of values as the in situ based bio-optical model described. Here, satellite images allowed to extend the coastal transect further off-shore than the usual measurements from research vessel that generally, do not reach so far off-shore and are also rather sparsely distributed. The MERIS images indicated that the extent of coastal processes is substantially further than 1 nautical mile (as defined by the WFD). Coastal processes also extend somewhat further than the distance defined by in situ bio-optical model described in Kratzer and Tett (2009), especially if one includes Bråviken (in the west, NW2) in the analysis, where there is a much higher gradient of SPM than in the Himmerfjärden area. Our method based on satellite data also shows that coastal processes do extend further than the coastal waters defined by the water body classification developed by SMHI.

Our results demonstrate the advantage of using remote sensing data complementary to conventional monitoring methods, allowing us to rethink how to define the extent of coastal processes and potentially not only from national, economical, geographical but as well from an ecological perspective. This is extremely relevant for such a complex water body as the Baltic Sea with significant anthropogenic load and surrounded by a large number of countries.

Final reviewer's comment: "Finally, the authors have provided illustrations of the seabed sediment (Fig. 13) and bathymetry (Fig 14) in order to illustrate points in the

discussion. However, this information is not new and was not used in the methodology and result section."

We used already existing information (i.e. seabed sediment and bathymetry) to support our points in the discussion. This information was not produced by the authors and therefore was not new and on purpose was not included as part of methodology or results. We still considered it valuable data for our discussion.

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