Seasonality in concentration, size and settling velocity of muddy marine snow in the southern North Sea and their effects on the sea bed

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Suspended particulate matter (SPM) concentrations in mid-latitude shelf seas have a typical seasonal signal. Higher values of SPM concentration together with smaller floc sizes occur in the water column in winter and lower SPM concentration and larger floc sizes in summer. This seasonality is mainly caused by the higher biological activity in summer rather than seasonality in weather types and thus wave climate (Fettweis *et al*., 2014). A question that remained unanswered is related to the fate of the SPM throughout a year. How are the near-bed fluxes of SPM influenced by seasons? Is the reduction of the SPM concentration in the water column during summer compensated by a higher near bed concentration and possibly more frequent formation of HCMS, rather than by an export of the fine-grained material out of the measuring area? The research question is not only of scientific interest, but other reasons exists for gaining a better understanding of processes that changes SPM concentration over a long period. The fine-grained sediment dynamics control not only the transport of cohesive sediments, but also of bio-geochemical processes and of the substances that tend to be adsorbed to the fine particles, such as pollutants and nutrients (Friedrichs *et al*., 2008). As such they influence coastal eutrophication, algae blooms, fate of pollutants, ephemeral sealing of the sea-floor by fluffy layers, benthic and pelagic ecosystems and siltation of navigation channels and harbors (Lancelot *et al*., 1998; Lee & Wiberg, 2002; Kirby, 2011). A better understanding of cohesive sediment dynamics allows a better prediction of changes caused by natural as well as anthropogenic influences.

SPM concentration profiles of the lowest 2m of the water column and particle size distribution have been measured in the Belgian coastal turbidity maximum area (southern North Sea) during more than 700 days between 2006 and 2013. The long-term data series of SPM concentration, floc size and settling velocity have been ensemble averaged according to tidal range, alongshore residual flow direction and season, in order to investigate the seasonal SPM dynamics and its relation with physical and biological processes. The data show that the SPM is more concentrated in the near bed layer in summer, whereas in winter the SPM is better mixed throughout the water column. The decrease of the SPM concentration in the water column during summer is compensated by a higher near bed concentration indicating that a significant part of the SPM remains in the area during summer rather than being advected out of it. The opposite seasonality between near-bed layer and water column has to our knowledge not yet been presented in literature. Physical effects such as wave heights, wind climate or storms have a weak correlation with the observed seasonality. The argument to favor microbial activity as main driver of the seasonality lies in the observed variations in floc size and settling velocity. On average the flocs are larger and thus settling velocities higher in summer than winter.

References

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