

Observed residual transport of SPM within a coastal turbidity maximum zone

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Introduction

The research presented here has been done to investigate the residual longshore and cross-shore transport of SPM along the Dutch coast borders of the Southern North Sea. This coast is a transport route of SPM in the order of 7-25Mton/yr (Fettweis *et al.*, 2007). The origin of the material is mainly erosion at the Strait of Dover and sources further upstream. Deposition of the SPM occurs in the ecologically important Wadden Sea and further north beyond the German Bight. As the Dutch coast is heavily engineered, it is important to understand where and how the SPM is transported in order to understand the consequences of the interventions. SPM is retained close to the coast due to the River Rhine discharge, which creates the Rhine ROFI with large longshore and cross-shore salinity differences along the Belgian and Dutch coast (Lacroix *et al.*, 2004; De Boer *et al.*, 2009). Recent spatial observations of the SPM distribution in the nearshore inner shelf have identified a near bottom turbidity maximum zone (TMZ) at 1 - 2km from the coastline. The maximum observed concentrations were about 200mg/l (Van der Hout *et al.*, subm.). In the same period a measurement platform was deployed in this TMZ near the village of Egmond amongst others to monitor sediment SPM transport. This time-series will give an estimate of the magnitude of the longshore transport in the TMZ. But also, it will help to identify the longshore and cross-shore processes responsible for the SPM transport.

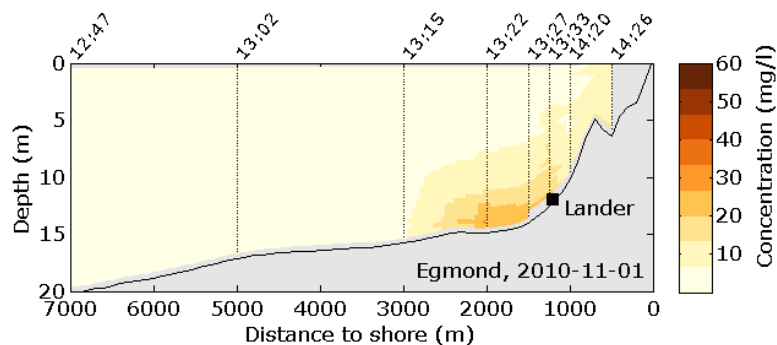


Fig. 1. Location of the lander with reference to one of the spatial observations of the TMZ at the Egmond transect.

Observations

At 1.2 kilometre off the coast of Egmond a bottom lander was placed at a local water depth of 11 metres from March 2011 until November 2012. This location was within the 2.5km wide TMZ, and on the inshore side of the area where a persistent peak concentration of SPM is found (Fig. 1). The lander platform consisted of a triangular aluminium frame, with 2m width and 2m height. Depending on the season, the measurement platform was replaced every three to six weeks and data from the instruments was retrieved. The lander platform was equipped with a series of sensors measuring the following parameters: current velocity, turbulence, temperature, salinity, turbidity (at 4 heights) and fluorescence (at 4 heights). All data was gathered with a frequency interval of 10 minutes. Current velocity was measured at 140cm above the seabed with a Nortek Aquadopp Doppler current meter. At the top of the frame, an upward looking RDI ADCP was placed to measure the current velocity in the upper water column. A Nortek Vektor current meter was mounted at the lander at a height of 30cm above the seabed. The instrument was set to record a burst interval of 2 minutes at 1Hz every 10 minutes. Temperature and salinity were measured with a pumped version of the Seabird SM37 CTD system at 140cm above the seabed. Turbidity and fluorescence were measured optically at four heights above the bottom, i.e. 30, 80, 140 and 200cm, using ALEC Compact-CLW's. All ALEC sensors have been calibrated in the lab over a range of local SPM and chlorophyll-a concentrations.

Results

The SPM concentrations are larger than 1g/l during 1.8% of the time at 0.3 metres above the seabed. At the sensors higher up the water column almost no observations of 1g/l are observed. On average the SPM concentration at 2.0m above the seabed is 2.5 times lower than the SPM concentration at 0.3m above the seabed. The high concentrations occur during storms with TKE larger than 50N/m². A first analysis of the alongshore SPM transport indicates that the transport during storms dominates the residual longshore transport over the tidal residual transport (Fig. 2). This is an effect of both the higher SPM concentrations throughout the water column and the large effect of the storm on the direction of the residual water transport. Most of the time the tidal residual transport is northward, except for northerly storms. Peaks of northward transport are related to southerly and westerly storms. The balance between northerly and southerly/westerly storms during a certain year seems to determine the residual transport of SPM. For the transport in the cross-shore direction, upwelling and downwelling due to wind and tidal straining are possibly important processes (De Boer *et al.*, 2009). The 2-years time-series will be used to identify the upwelling and downwelling events, and their effect on the cross-shore transport. The question is, are these processes in balance at this location, or is there still accumulation of SPM occurring in the TMZ at this distance far from both the SPM source and the River Rhine outflow? In the presentation, we will further examine the role of these processes.

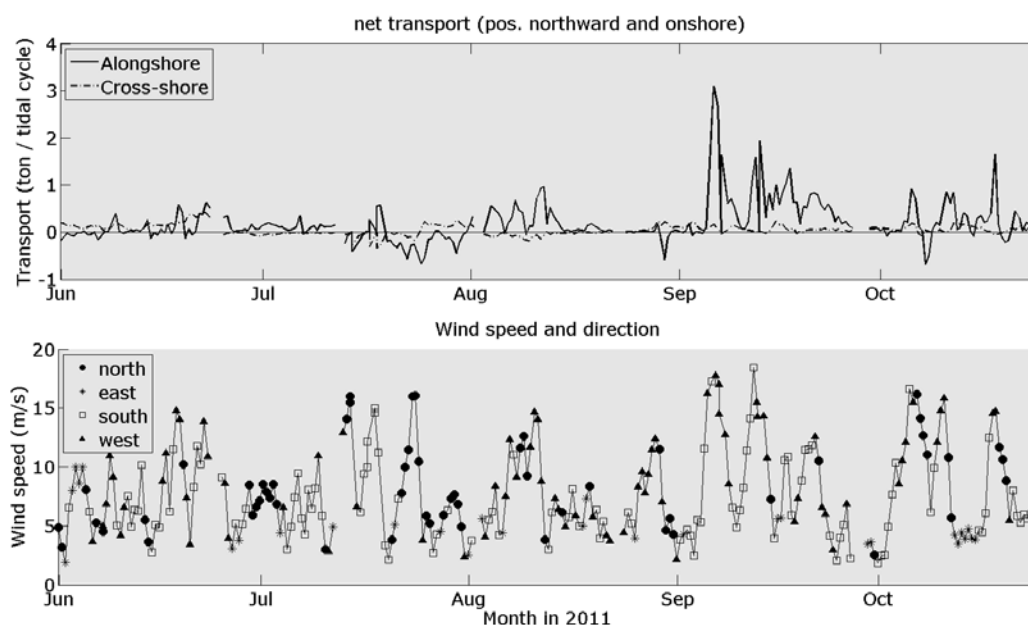


Fig. 2. Top: First results of tidal net longshore and cross-shore transport in the near bed layer at the lander location for a 5-month period. Bottom: Tidally averaged wind speed (vertical axis) and direction (various markers).

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