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Bottom stress estimation based on Radar Observed Currents

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In this investigation, we introduce a method to estimate the bottom stress in a tide dominated area, basing on radar observation of the sea surface current field. This method, merged with echo sounding data, results in a geo-coded map of the current induced impulse flux. We calculated the bottom shear stress with model based on the presumptions of a completely mixed water column (Van Rijn, 1993) and hydro dynamical rough flow over the bottom (Shapiro, 2004) recently developed at GKSS. [2]

The used data sets have been acquired during a campaign in May 2006 within the tidal channel "Lister Tief" north the German island Sylt. For the radar data acquisition a new developed system, the Radar Doppler Current Profiler (RDCP) was used. The product of this instrument is a horizontal profile of the surface current field. The ship based RDCP consists of two synchronized Doppler-radar systems with fixed perpendicular orientated antennas. Within a stripe of about 500m width this provides the full current vector of the surface current, as calculated by the Doppler shift due to the current. The resolution of the grid cells is 15m x 15m.

For the estimation of the bottom shear stress as input the bathymetry, the grain size and the terrain slope, as results of the multi beam echo sounding survey are needed; their spatial resolution is 2m x 2m. The grain size was divided into five different sediment types, from coarse gravel to silt.

The bottom shear stress is calculated with a combined equation taken from Soulsby (1998) and Harris (2003).

The above mentioned parameters are the additional input to the model. The model filters out the erroneous current values and assembles the different data sets into one grid based on common Gauss-Krüger coordinates.

The results of the process are maps of area-wide bottom shear stress; therefore the location of areas with high erosion potential is accomplished.

In the shear stress maps the coarse bottom structures are visible. The impact of the sand dunes at the calculated shear stress is significant during the ebb tide; due to the fact that the main sand dunes in this area are flood orientated.

The prospective investigation includes the impact of more hydrodynamic processes, such as wave and wave breaking events, for the wider approach of the phenomenon.

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