Geophysical Research Abstracts,
Vol. 11, EGU2009-10493, 2009
EGU General Assembly 2009

Effectiveness of the Radar Doppler Current Profiler for the validation of coastal models

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In this paper comparisons between current velocities obtained from Radar Doppler Current Profiler (RDCP) and a two-dimensional depth integrated flow model are presented. The investigation area is located in a tidal channel, north the Island Sylt in the North Sea, Germany. The water depths in the area are up to 35 m. The tide is semi-diurnal and the tidal ranges reach approximately 2m, which causes cross shore transport through the channels between the islands. The long shore transport along the western coast is mainly wave-induced. The mean current velocities are about 1-1.5m/s. Due to the limited water depth along the inlet, the effect of the wind is found to be relevant.

In this study observations of two measuring campaigns carried out in spring 2006 and 2007 using a RDCP deployed from a moving vessel were analyzed. The RDCP is a new ship based remote sensing method recently developed by the Institute for Coastal Research of the GKSS that has been used to scan the surface current velocity field horizontally. The current detection method is based on the Doppler Effect to the signal, similar as using ADCP. It comprises of two radar systems looking with an angle of 90° to each other to acquire both components of the current vector during the passing of the ship. The vessel mounted device enables cross sectional measurements with orientation known from a differential GPS. For each radial bin of 15m length the radial velocities are calculated by the Doppler basic formula from the backscattered radar signal. The main advantage of the method is the area coverage. Whereas ADCP measurements from moving vessels are restricted to a single transect, RDCP measurements provide much higher area coverage. To facilitate comparisons with model results, the resulting spatial datasets from the RDCP and the multi beam echo sounder were re-gridded.

The ship surveys in 2006 and 2007 comprised of oceanographic, meteorological and geological data acquisition. Measurements were carried out along the tidal inlet between the Sylt and Rømø islands. In addition to the RDCP, measurements using an Acoustic Doppler Current Profiler (ADCP), multibeam echo sounder and sediment samples were carried out. Moreover wave data from a wave rider within the study area, water level measurements at two gauge stations and wind data was made available by the German authorities.

A two-dimensional depth integrated model covering the area of investigations was developed on the basis of Delft3D by WL Delft Hydraulics, the Netherlands. The model covers an area of about 510.552km2. A curvilinear grid with grid spacing from 90 to 130m was developed. The model bathymetry is based on measurements taken in 1994 by the German and Danish authorities. The model is driven by tidal forcing at the open sea boundaries and by time-dependant observed wind. Sensitivities studies to several physical parameters were carried out in order to identify those to be taken for calibration of the numerical model. The sensitivity studies for the grid and the time step do not show significant differences between the simulations. In the other hand, the open boundaries have an important role in the model.
Comparisons between measured and computed current velocities for a 15 days period in May 2007 were done to check the model accuracy. The comparison is done by checking the same areas in the model that the RDCP measurements cover. Good agreement resulted proving the adequacy of the method for model development.