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Numerical study of the water exchange in the Western Baltic Sea

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The Baltic Sea is a semi-closed and brackish sea area with the low salinities and the only boundary to the open sea is the transition zone formed with Kattegat and Danish Straits(the Great Belt, the little Belt and the Sound) .The inflow and outflow events through the Danish Straits exchange the high salinity and fresh water between the North sea and Baltic Sea. In this study, a three dimension primitive equation ocean model is used to simulate the physical processes in the Western Baltic Sea. The DMI-BSHcmod was developed in Bundesamy für Seeschifffart und Hydrographie (BSH) in Hamburg, Germany. Then the further development and updating of the model codes has taken place at Danish Meteorological Institute (DMI) . The model is set up with 3nm horizontal resolution of the coarse domain covering the North sea and Baltic sea with 50 vertical layers and 0.5nm of the fine domain in the transition zone with 52 vertical layers. To provied the realistic sea level boundary for the open boundary in the North Sea, the large scale barotropic 2D model (NOAmod) has been setp up in the Northeastern Atlantic . The realistic meteorological filelds and river run-off forcing data are also used in the BSH-DMIcmod. Major inflows from the Kattegat can birng the oxygen to the deepest basins in the Baltic Sea so it has a strong influence on the nutrient situation in the Baltic. As a record, after 16years of the stagnation period in the Baltic, the major inflow happens again at the beginning of January in 1993. Hence, the period of 1992-1994 has been chosen to evaluate the model performance. Comparison with the MARNET observation data , the model results have the similar pattern and the events of the water change can be simulated well particular in the January 1993.
In order to investigate the transport processes from Kattegat to Baltic Sea though the Great Belt and the Sound , the TRACMASS Lagrangian Trajectory Code is applied for calculateing the three dimensional Eulerian current volicities from the DMI-BSHcmod. The 55 water particles have been chosen as the initial position of the surface in the Kattegat . After the event happening, 21 water particles are passing the Great belt and 14 particles through the Sound. However, most particles through the Sound go to the deep layer of the Arkona Basin or even through the Bornholm Belt. In the major inflow in 1993, the contribution of the Sound is also significant.