

Operational satellite monitoring of oil spill pollution in the southeastern Baltic Sea

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Shipping activities in the Baltic Sea, including oil transport and oil handled in harbors, have a number of negative impacts on the marine environment and coastal zone. Oil discharges from ships represent a significant threat to marine ecosystems. Oil spills cause the contamination of seawater, shores, and beaches, which may persist for several months and represent a threat to marine resources. One of the main tasks in the ecological monitoring of the Baltic Sea is an operational satellite and aerial detection of oil spillages, determination of their characteristics, establishment of the pollution sources and forecast of probable trajectories of the oil spill transport. Oil pollution monitoring in the Mediterranean, North and Baltic Sea is normally carried out by aircrafts or ships. This is expensive and is constrained by the limited availability of these resources. Aerial surveys over large areas of the seas to check for the presence of oil are limited to the daylight hours in good weather conditions (ESA). Satellite imagery can help greatly identifying probable spills over very large areas and then guiding aerial surveys for precise observation of specific locations. The Synthetic Aperture Radar (SAR) instrument, which can collect data independently of weather and light conditions, is an excellent tool to monitor and detect oil on water surfaces. This instrument offers the most effective means of monitoring oil pollution: oil slicks appear as dark patches on SAR images because of the damping effect of the oil on the backscattered signals from the radar instrument. This type of instrument is currently on board the European Space Agency's ENVISAT and ERS-2 satellites (ESA). Since 1993 there is no regular aerial surveillance of the oil spills in the Russian sector of the southeastern Baltic Sea. In June 2003 LUKOIL-Kaliningradmorneft initiated a pilot project, aimed to the complex monitoring of the southeastern Baltic Sea, in connection with a beginning of oil production at continental shelf of Russia in March 2004. Operational monitoring was performed in June – December 2004 on the base of daily satellite remote sensing (AVHRR NOAA, MODIS, TOPEX/Poseidon, Jason-1, ENVISAT ASAR imagery) of SST, sea level, chlorophyll concentration, mesoscale dynamics, wind and waves, and oil spills. About 50 large oil spills have been detected during this time period. In the report, we present some of the results of a complex approach to the ongoing monitoring of the southeastern Baltic Sea devoted, basically, to the oil spills detection by means of ASAR ENVISAT data and forecast of probable trajectories of the oil spill transport based on the interactive numerical model Seatrack Web. This version of a numerical model on the Internet platform has been developed at SMHI (The Swedish Meteorological and Hydrological Institute) in close co-operation with Danish authorities. The system is based on an operational weather model HIRLAM (HIGH Resolution Limited Area Model, 22 km grid) and circulation model HIROMB (HIGH Resolution Operational Model for the Baltic Sea, 24 layers), which calculates the current field at 3 n.m. grid. The model allows to forecast the oil drift for two days ahead or to make a hind cast (backward calculation) for 10 days in the whole Baltic Sea. When calculating the oil drift, wind and current forecasts are taken from the operational models. An oil spreading calculation is added to the currents, as well as oil evaporation, emulsification, sinking, stranding and dispersion. This powerful system today is in operational use in Sweden, Denmark, Finland, Poland, Estonia, Latvia, Lithuania and Russia (Ambjörn, 2004).