Monitoring of harbor dredging using remote sensing and optical in situ data.

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Each year thousands of tons of materials are dredged in Estonian harbour areas. Dredging operations in coastal waters affect water quality through an increase in suspended matter concentrations. The release of suspended matter into a water column usually takes place over a very limited area, while the local hydrodynamic regime results in the spreading and dispersion of particulate matter over a much larger sea area. An adequate knowledge of the distribution of suspended matter is essential for the environmental impact assessment of dredging operations and for takeing preventive measures against any possible reduction in water quality below acceptable levels. If dredging operations are performed in sea area with an intensive hydrodynamic regime and close to biologically sensitive areas, then monitoring of suspended matter distribution with fine temporal and spatial resolution is required. Higher turbidity decreases the water transparency and less light penetrates to marine biota and photosynthesis activity in euphotic zone goes down. In Baltic Sea higher turbidity can be caused by several natural factors as well, such as resuspension of bottom sediments, phytoplankton blooms, especially by surface accumulations of cynobacterial blooms that frequently occur in July and August in Baltic Sea.
The aim of the current study was to investigate the possibilities of distinguishing between the turbidity caused by dredged sediments from the natural suspended matter using in situ measurements and remote sensing.

In July 2008 the dredging operations started in Paldiski South harbor, Pakri Bay, Gulf of Finland, Baltic Sea. During the July and August also the cyanobacterial blooms were detected on the water surface in several occasions. The field measurements of optical properties together with taking water samples were performed in July 25, 2008. The profiles of attenuation and absorption coefficient of water were measured by Wetlabs ac-s instrument and the corresponding scattering coefficient was calculated from the measurement data. The suspended matter concentration was determined from the water samples using the dry weight method and Chlorophyll a concentration was determined by the Lorenzen (1965) method. The suspended matter concentration varied from 3-6 mg/L and the chlorophyll a content varied from 2-11µg/L. The spectral shape of scattering coefficient differed significantly between the stations indicating that the suspended particles in water column were from different origin.

MODIS (Moderate Resolution Imaging Spectrometer) Terra and Aqua images with 250 meter resolution and 500 meter spatial resolution were downloaded and analyzed for detection of water turbidity over the dredging area. MODIS band 1 (620-670 nm) images with the spatial resolution of 250 meter gave the best general overview of water turbidity over the studied area but insufficient spectral information and therefore it was not possible to distinguish the sediment origin.

For conclusion our results showed that the in situ measured spectra of scattering coefficient enabled to determine between the turbidity caused by cyanobacterial boom from dredged material. The scattering coefficient spectra of cyanobacteria had a sharp slope at 668 nm. On MODIS images the area with higher turbidity was detected but we could not distinguish between turbidity caused by dredged sediments from cyanobacterial bloom.