Sediment dynamics in the Belgian coastal zone observed from space

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For over fifteen years, dedicated space-borne ocean colour sensors such as MODIS, MERIS and SeaWiFS have been routinely used to derive chlorophyll a concentration in the global oceans, and suspended sediment concentration in the coastal zone. These sensors typically provide nearly daily global cover with a moderate spatial resolution of a few hundred metres to a kilometre. Imagery and processing software are provided for free by the space agencies. These sensors and data archives are excellent tools to determine long-term trends, time-series and multi-temporal averages anywhere on the planet. In regions with large tidal variability however, their observations are not representative for the day, and in some regions cloud cover drastically reduces data availability. Moreover, their spatial resolution is often too coarse for coastal zone monitoring, where, especially in Europe, a focus on the first nautical mile is required for the Water Framework Directive.

A multi-sensor, multi-scale approach allows for a more complete monitoring of coastal sediment dynamics. Here we complement the moderate resolution dataset with free data from other satellites that are usually designed for land and weather applications. Processing software was developed in house for retrieving suspended sediment concentration and related parameters such as turbidity and light attenuation. From the imager on Meteosat Second Generation, the Spinning Enhanced Visible and Infrared Imager (SEVIRI), tidal cycles of suspended sediment concentration can be observed due to its extremely high 15-minute temporal resolution. In days with scattered and moving clouds, cloud-free composites can be constructed from SEVIRI observations. On the other end of the spectrum, we use images from the recently launched Landsat-8 (2013), which has a high spatial resolution (30m) and a two week revisit time, allowing the study of small scale sediment patterns in the coastal zone, including in and around ports. On Landsat-8 imagery, human impacts become directly observable: impacts of offshore constructions on sediment transport, resuspension of bottom sediments by large container ships and trawl fisheries, dredging operations and dumping at designated locations.

These free datasets can be supplemented with very high resolution data (several metres or less) from commercial satellites. Images in and around the port of Zeebrugge were acquired in the summer of 2014 from the Pléiades satellite constellation, showing suspended sediment patterns and surface effects at a resolution of less than a metre. This new source of data opens up new applications both in terms of objects and natural processes that can now be resolved. For example waves, wakes, slicks, the larger marine mammals and swarms of jellyfish, ships and offshore constructions can be studied using very high resolution imagery.