Geophysical Research Abstracts
Vol. 16, EGU2014-15406, 2014
EGU General Assembly 2014

Using satellite measurements to improve understanding of estuarine turbidity dynamics

Stefan Talke and Austin Hudson
Civil and Environmental Engineering, Portland State University, United States (s.a.talke@pdx.edu)

In-situ measurements of estuary turbidity maxima (ETMs) often lack spatial resolution (e.g., moored measurements) or are not synoptic (e.g., estuary transects). Satellite-based estimates of turbidity can potentially address these issues, but suffer from a lack of temporal resolution. In this contribution we address the time resolution problem by constructing a 'climatology' of turbidity for several estuaries, using approximately 15 and 12 years of MODIS data from the Terra and Aqua satellites, respectively. In-situ measurements of turbidity from the Columbia River Estuary (USA) and the Ems estuary (Germany) are regressed against atmospherically-corrected estimates of reflectance at a 250m resolution. A linear calibration with R2>0.9 (p-value < 1e-7) is found for low-aerosol conditions in the Columbia River Estuary, despite the relatively low surface turbidity (< 20 NTU). We process approximately 1300 images between 1999 and 2013 and find evidence of two topographically-trapped turbidity maxima in the North and South Channels. By conditionally sampling the data, we find that the magnitudes of these two ETMs and their spatial spread increases with tidal range and river discharge. The ETMs coincide with a sharp gradient in salinity; as the salinity gradient increases with greater river discharge, the turbidity gradient sharpens. A third ETM occurs at the head of salinity intrusion during low-flow conditions far upstream of the topographically trapped ETMs. These observations are further investigated by combining a semi-analytical model of salinity intrusion (MacCready, 2007) with an idealized analytical model of ETM dynamics developed for the Ems Estuary (Talke et al., 2009). Sensitivity experiments demonstrate that bathymetric features such as holes and sills contribute to the topographic trapping of turbidity by altering the tidally averaged circulation and salinity intrusion, particularly via the depth and mixing parameters. The methodology applied in the Columbia River estuary is currently being applied to the Ems and other estuaries. While the highly turbid, semi-diurnal, low flow, and well/partially mixed Ems estuary presents different processing challenges than the sediment poor, high flow, mixed semi-diurnal Columbia River estuary, initial results suggest that the ETM of the Ems is affected similarly by changes in river flow and tides. In particular, the e-folding scale (the 'spread') of the turbidity is highly sensitive to the shape of the salinity distribution and the river flow.