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Removing Wave Artifacts from Eddy Correlation Data

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The German Wadden Sea is an extensive system of back-barrier tidal basins along the margin of the southern North Sea. Due to their high productivity and the strong retention potential of labile organic carbon high mineralization rates are expected in this system. Since the sediment bed is sandy, the oxygen fluxes across the sediment-water interface (SWI) may be enhanced by strong tidal currents as well as by wind-induced surface waves.

In order to measure oxygen fluxes in-situ without disturbance of the sediment, the Eddy Correlation method (ECM) was introduced to aquatic geoscience by Berg et al. (2003). The method is based on correlating turbulent fluctuations of oxygen concentration and vertical velocity measured at high frequency above the SWI. The method integrates over spatial heterogeneities and allows the observation of total benthic oxygen fluxes in complex systems where other methods like flux chamber deployments and oxygen profile measurements in the sediment fail. Therefore, the method should also reflect effects like the enhancement of oxygen fluxes by porewater advection driven by waves and currents over sandy sediments. Unfortunately the ECM suffers from wave contamination due to stirring sensitivity of the electrodes, spatial separation between the oxygen electrode and the location of velocity measurement as well as by a tilt of the measurement setup at the deployment side.

In order to correct for this wave contamination we tested the method of spectral reconstruction initially introduced by Bricker and Monismith (2007) for the determination of Reynolds-stresses in wave-affected environments. In short, this method attempts to remove the wave signal from the Power spectral densities of oxygen concentration and vertical velocity fluctuations by cutting off the wave peak in these spectra. The wave contribution to the co-spectrum between both quantities is then reconstructed by assuming that the phasing in the wave band is dominated by the waves. Based on the example of the North-Frisian Wadden Sea we will discuss the potentials and limits of this method.

References:

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