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Benthic oxygen flux in permeable sediments of the German Bight calculated with the eddy covariance technique

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Permeable sediments in coastal zones are highly biologically active, contributing to tight recycling of carbon and nutrients between sediments and overlying water. A growing body of literature demonstrates that oxygen flux in these sediments responds dynamically to changes in current velocities and turbulent kinetic energy. As currents interact with bedforms, pressure gradients are created that drive exchange across the sediment-water interface, displacing oxygen-depleted porewaters into surface waters.

We used the eddy covariance technique to quantify oxygen flux at three stations in the German Bight. Station 1 (24 m depth) was composed of medium sands with 1-2 cm bedforms and approximately 100 polychaete worms per square meter. Station 2 (24 m depth) was composed of coarse sands with 3-5 cm bedforms and few worms. Station 3 (38 m depth) and was similar to Station 1 but with intermediate worm densities.

In each of the sands advection appeared to drive the displacement of hypoxic or anoxic porewater into surface waters, generating net oxygen consumption. The correspondence between the water velocity and oxygen flux was high, with oscillations in tidal currents yielding similar oscillations in benthic oxygen consumption. The tidal current was very similar across sites (mean of 16.5 - 18 cm s-1 measured 30 cm off of the bed). Oxygen consumption was greatest (45 $\pm$ 15 mmol m-2 d-1) in Station 1, the medium-grained shallow site with high polychaete worm densities. It was close to equivalent at the other two sites (27 $\pm$ 12 mmol m-2 d-1 and 28 $\pm$ 10 mmol m-2 d 1). The implications for scaling these rates up will be examined.