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Short-term variations of methane concentrations and methanotrophic activity in a coastal inlet (Eckernförde Bay, Germany)

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Large quantities of methane are produced in anoxic sediments of continental margins and may be liberated into the overlying water column and, potentially, into the atmosphere. However, a sequence of microbially mediated methane oxidation pathways in sediments and the water column mitigate the contribution of oceans to the atmospheric methane budget. Of particular importance are methanotrophic bacteria in the water column that mediate the aerobic oxidation of methane (MOx), and represent the final sink for methane before its release to the atmosphere where it acts as a potent greenhouse gas. However methane cycling in (aerobic) marine waters is not well constrained. Particularly little is known about spatiotemporal aspects of MOx activity and the underlying key physical, chemical and biological factors. Here we show results from our investigations on methane dynamics on very short time scales of hours to days in the Eckernförde Bay (E-Bay), a costal inlet of the Baltic Sea in northern Germany featuring seasonal bottom water hypoxia/anoxia. In autumn 2014, we observed highly spatiotemporal variations in water column methane contents and MOx activity: Anoxic bottom waters in a trough in the northern part of the bay contained extremely high methane concentrations of up to 800 nM, which sharply declined at the midwater redox interface (methane remained supersaturated with respect to the atmospheric equilibrium throughout the water column at all times). The methane decrease at the redox interface was related to highly active MOx communities consuming methane under microoxic conditions at rates of up 40 nM/d. About 12 hours later, the methane content and the extend of bottom water anoxia was much lower and MOx activity was highly reduced in the northern part but strongly elevated in the southern part of the bay. A few days later, bottom water anoxia, methane loading and MOx activity was partially re-established. In this contribution, we will discuss potential forcing mechanisms leading to the observed dynamics, eg. partial mixing and re-stratification related to storms and (tidal) currents.