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Air-sea gas transfer for gases of varying solubility

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CombiCombination of surface water cooling and a deep ocean mixed layer generates convective eddies scaling with the depth of a mixed layer that enhances the efficiency of the air-sea gas transfer. This enhancement is explained by the convective eddies disturbing the molecular diffusion layer and inducing increased turbulent mixing in the water (Rutgersson et al 2011). The enhancement can be introduced into existing formulations for calculating the air-sea exchange of gases by using an additional resistance, due to large-scale convection acting in parallel with other processes. The additional resistance is expressed by the convective velocity scale of the water and the friction velocity and characterizes the relative role of surface shear and buoyancy forces.

We use direct flux measurements by the Eddy-Covariance method (EC), we use gases of varying solubility (carbon dioxide, methane and water vapor). New methodology allows also to introduce EC measurements of oxygen (Andersson et al., 2014).

Water-side convection is of particular interest for the low to moderate wind-speed regime, when spray and bubbles have less dominance of the efficiency of the transfer. It is also possible that gases of different solubility shows a different response to various forcing mechanisms. Lake data of methane fluxes exhibits a stronger diurnal cycle than CO_2 as a response to the strong diurnal cycle of water-side convection (Podgrajsek et al., 2014).

Calculated fluxes from the Baltic Sea basin shows an altered diurnal cycle when introducing the convection. The potential need of taking processes into account generating turbulence of a larger scale, such as water-side convection or Langmuir circulation introduced larger requirements on the remote sensing products used for air-sea gas flux climatologies.

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