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In situ evaluation of air-sea CO_2 gas transfer velocity in an inner estuary using eddy covariance - with a special focus on the importance of using reliable CO_2-fluxes

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The air-sea exchange of CO_2 or CO_2 flux is driven by the difference in the partial pressure of CO_2 in the water and the atmosphere (ΔpCO_2), the solubility of CO_2 (K0) and the gas transfer velocity (k) (Wanninkhof et al., 2009;Weiss, 1974) .
ΔpCO_2 and K0 are determined with relatively high precision and it is estimated that the biggest uncertainty when modelling the air-sea flux is the parameterization of k. As an example; the estimated global air-sea flux increases by 70 % when using the parameterization by Wanninkhof and McGillis (1999) instead of Wanninkhof (1992) (Rutgersson et al., 2008). In coastal areas the uncertainty is even higher and only few studies have focused on determining transfer velocity for the coastal waters and even fewer on estuaries (Borges et al., 2004;Rutgersson et al., 2008).
The transfer velocity (k600) of CO_2 in the inner estuary of Roskilde Fjord, Denmark was investigated using eddy covariance CO_2 fluxes (ECM) and directly measured ΔpCO_2 during May and June 2010. The data was strictly sorted to heighten the certainty of the results and the outcome was; DS1; using only ECM, and DS2; including the inertial dissipation method (IDM).
The inner part of Roskilde Fjord showed to be a very biological active CO_2 sink and preliminary results showed that the average k600 was more than 10 times higher than transfer velocities from similar studies of other coastal areas. The much higher transfer velocities were estimated to be caused by the greater fetch and shallower water in Roskilde Fjord, which indicated that turbulence in both air and water influence k600.
The wind speed parameterization of k600 using DS1 showed some scatter but when including IDM the r2 of DS2 reached 0.93 with an exponential parameterization, where U10 was based on the Businger-Dyer relationships using friction velocity and atmospheric stability. This indicates that some of the uncertainties coupled with CO_2 fluxes calculated by the ECM are removed when including the IDM.

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