Comments Bernd Jähne, Heidelberg University to the preprint

On physical mechanisms controlling air–sea CO2 exchange

by

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https://doi.org/10.5194/bg-2022-82

1. Empirical correlation instead of analysis of mechanisms

The authors claim in their paper to analyze the physical mechanisms controlling air-sea gas transfer beyond wind speed using a nine year record of continuous eddy covariance measurements taken at the Östergarnsholm tower. Such a long time series is, of course, a treasure, but the title of the paper is misleading in my view. The paper does just list possible other mechanisms than wind wind (or more precisely wind stress at the ocean surface) as the main driving force, but does not discuss at all any possible conceptual model to be checked by the data. All they do are empirical correlations with some other parameters. In addition, even an observed correlation does not mean that another driving force is found, because the investigated parameter might be correlated to another, which is the real driving force.

Therefore a more appropriate title would be “Empirical correlations of the gas transfer velocity with other parameters than wind speed” or a similar wording.

2. The statistical analysis is not convincing

- The authors use a multistep scheme to select only reliable measurements. But they do not specify which fraction is remaining. It is important to know to which extent specific conditions are excluded from the analysis. If the exclusion were large, this may severely bias any averaging and correlations.
- For the averages shown in Fig. 5 all, also negative gas transfer velocities have been used, but not in the following more detailed analysis. This is inconsistent. Either you rely data or not at all.
- The concept of the residual gas transfer velocity and the correlation with a single other parameter seems not to be a good choice. A theoretically more sound approach would be to use a multiparameter space approach with all possible parameters and then perform a principal component analysis or similar approach, as it is standard in pattern recognition and classification. Then it would be possible to identify the most important parameters and the degree of correlation between the parameters quantitatively and whether the results are statistically relevant. The approach of the authors is just qualitatively.

3. Claimed effect of sea spray in enhancing air-sea CO2 fluxes questionable

The authors claim that “sea spray can enhance the transport of CO2 across the interface, as it does with heat and moisture”. This is an oversimplification, because the transport of heat and water vapor is air-side controlled, while the transport of CO2 is water-side controlled. Therefore a much more detailed analysis is required. Droplets may partly be a dead surface for gas transfer in the same way as those bubbles, which come in a much shorter time scale into equilibrium with the surrounding water than their life time. However, the influence of solubility is inverse. Droplets are efficient for highly soluble tracers.