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Ocean Science Discussions

Interactive comment on "Variability of air-sea gas transfer velocities in the Baltic Sea" *by* Leila Nagel et al.

Anonymous Referee #3

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The paper presents results from three field campaigns in the Baltic Sea where the ACFT approach were used to study heat transfer velocities. These velocities could subsequently be scaled to gas transfer velocities by using previous work from a laboratory study in the Aelotron facility. Additionally, the Schmidt number exponent where allowed to vary depending on actual environmental conditions which is a more physical approach compared to only using a fixed exponent.

General

The main results highlight that wave age might be an important parameter to take into account when parameterizing the gas transfer velocity. This might perhaps be the reason why commonly used parameterizations for lakes differ from ocean measurements (e.g. Cole and Caraco , 1998; Podgrajsek et al. 2015)? For lakes the wind speed

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dependence seems less pronounced, whereas other processes such as water side convection likely is more important compared to oceans.

Additionally, the results also highlight that surface active material might be very important to consider when parameterizing k. This is a very interesting finding and is in line with other recent findings. As such I think this study is highly motivated with relevant results.

Major comments

My only major comment is the heavy focus on comparing with the dual tracer technique. The ACFT approach has a completely different 'time constant' relating k to more or less instantaneous wind with a footprint of a few square meters, whereas the dual tracer technique is quite the opposite. I think a more proper comparison would be with eddy covariance based results.

Minor comments

Page 2. Line 12: Waterside convection is also a process which might influence the transfer velocity

Page 2, paragraph starting at line 25, the recent paper by Pereira et al. 2018, would also be good to include here.

Page 5, figure 1: how sensitive are your calculated transfer velocities to the variation Sc?

Page 6, lines 25-26: how long averaging period did you use?

Page 6, line 27, I think section 4.2 suits better before the current 4.1 section.

Page 8, figure 3: I would suggest comparing with an EC based parameterization instead. Additionally, Ho et al. use a 10-min mean wind speed, what averaging period are you using for your wind speeds?

Page 8-9, line 1: please specify what you mean by “the response time of the system is very high”, what is meant by “high” here, how long time is this?

Page 9, line 3: similar comment, please specify what the typical response time of the water surface you refer to

Page 9, line 5: again, how long are the residence times estimated from the IR images.

Page 12, line 10: The Aelotron has already been introduced in the text, no need for a second introduction here.

References

Cole, J. J., and N. F. Caraco (1998), Atmospheric exchange of carbon dioxide in a lowâĂŘwind oligotrophic lake measured by the addition of SF6, Limnol. Oceanogr., 43(4), 647–656.

Podgrajsek, E., E. Sahlée, and A. Rutgersson (2015), Diel cycle of lake-air CO2 flux from a shallow lake and the impact of waterside convection on the transfer velocity, J. Geophys. Res. Biogeosci.,120,29–38

Pereira, R., I. Ashton, B. Sabbaghzadeh, J .D. Shutler, R. C. Upstill-Goddard (2018), Reduced air-sea CO2 exchange in the Atlantic Ocean due to biological surfactants, Nature Geoscience, 11, 492-496

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