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Atmospheric Chemistry and Physics Discussions
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Interactive comment on "Using Eddy Covariance to Measure the Dependence of Air-Sea CO_2 Exchange Rate on Friction Velocity" *by* Sebastian Landwehr et al.

Anonymous Referee #1

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The paper is well written with a clear structure. The methodology is well described and the results are interesting. To summarize; the paper is in good shape and will make an interesting contribution to the Atmospheric Chemistry and Physics Discussions.

In order to further improve the paper, e.g., the following could be elaborated:

Section 2.2. and related sections Ship motions are generally described by the six degrees of freedom that a ship can experience, while the ship in the large eddy simulation (Popinet et al., 2004) is stationary. The large eddy simulation uses numerical dissipation instead of a sub-grid scale turbulence model. An uniform inflow velocity is applied at the inlet boundary. These three aspects influence the results of the large eddy sim-

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ulation and therefore in turn the calculation of the uplift. Please elaborate how these aspects are accounted for in the correlations?

Section 2.5. Page 10 (9-13): It is here suggested that it may be that small-scale turbulence adjusts to the new orientation of the tilted stream lines. Small-scale turbulence is typically more iso-tropic than large-scale turbulence. It is therefore counter intuitive that it rather is the small-scale than the large-scale turbulence that is adjusted to the tilted stream lines. It may, however, be that the magnitude of the small-scale turbulence is increased in areas of increased shear as a result of a tilted air flow. It may also be that since the small-scale turbulence is more iso-tropic than large-scale, it is not so influenced by the tilted air flow. Please clarify what is meant by the word adjust in this discussion. Page 11 (9-22) This description does not belong to this section. Please consider moving it to another section or make it an own section.

Section 2.8. Page 16 (12-13): The transition of n is discussed in terms of smooth and rough due to increasing wind speed. n is also to a large degree dependent on surfactants, especially during low wind conditions, e.g., [Frew et al., 2004; McKenna and McGillis, 2004; Zhang et al., 2013]. Please add some references regarding this phenomenon.

Section 3.3 Page 23 (2) wind stress definition should be with squared friction velocity.

Section 4.1. Page 30 (15-16) This section discusses how the gas transfer velocity relates to the friction velocity and that buoyancy-driven processes may contribute significantly at lower wind speeds. E.g., [Fredriksson et al., 2016] discuss the transition between a gas transfer velocity mainly driven by buoyancy processes to a gas transfer velocity mainly driven by shear stress processes via the Richardson number (relates the buoyancy flux to the friction velocity). This paper can be used in the discussion regarding the range of friction velocity, where the gas transfer velocity as a function of friction velocity is valid.

Fredriksson, S. T., L. Arneborg, H. Nilsson, and R. A. Handler (2016), Surface shear stress dependence of gas transfer velocity parameterizations using DNS, Journal of Geophysical Research: Oceans, n/a-n/a,10.1002/2016JC011852. Frew, N. M., et al. (2004), Air-sea gas transfer: Its dependence on wind stress, small-scale roughness, and surface films, J Geophys Res-Oceans, 109(C8),Artn C08s17,Doi 10.1029/2003jc002131. McKenna, S. P., and W. R. McGillis (2004), The role of free-surface turbulence and surfactants in air-water gas transfer, Int J Heat Mass Tran, 47(3), 539-553,DOI 10.1016/j.ijheatmasstransfer.2003.06.001. Zhang, Q., R. A. Handler, and S. T. Fredriksson (2013), Direct numerical simulation of turbulent free convection in the presence of a surfactant, Int J Heat Mass Tran, 61, 82-93,DOI 10.1016/j.ijheatmasstransfer.2013.01.031.

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