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The effects of experimental uncertainty in parameterizing air-sea gas exchange using tracer experiment data

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Abstract. It is not practical to measure air-sea gas fluxes in the open ocean for all conditions and areas of interest. Therefore, in many cases fluxes are estimated from measurements of air-phase and water-phase gas concentrations, a measured environmental forcing function such as wind speed, and a parameterization of the air-sea transfer velocity in terms of the environmental forcing function. One problem with this approach is that when direct measurements of the transfer velocity are plotted versus the most commonly used forcing function, wind speed, there is considerable scatter, leading to a relatively large uncertainty in the flux. Because it is known that multiple processes can affect gas transfer, it is commonly assumed that this scatter is caused by single-forcing function parameterizations being incomplete in a physical sense. However, scatter in the experimental data can also result from experimental uncertainty (i.e., measurement error). Here, results from field and laboratory results are used to estimate how experimental uncertainty contributes to the observed scatter in the measured fluxes and transfer velocities as a function of environmental forcing. The results show that experimental uncertainty could explain half of the observed scatter in field and laboratory measurements of air-sea gas transfer velocity.

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