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The Influence of Data Source Characteristics on Calculations of Air-Sea Flux of Carbon Dioxide

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The air-sea gas transfer velocity is commonly parameterised via the wind speed at neutral stratification of the marine atmospheric boundary layer at 10m height. This quantity known as u_{10} is available from a variety of sources, ranging from satellite scatterometers and passive microwave sensors to model re-ananlyses. Furthermore, more recent parameterisations of the gas transfer velocity involve parameters such as friction velocity, significant wave height and small-scale sea surface roughness, also obtainable from satellite measurements. This wealth of data together with publically available climatologies of air-sea concentration difference of carbon dioxide allows a calculation of global CO_2 exchange at daily to monthly intervals.

However, different sampling techniques and integration times of the various instruments or methodologies mean that parameter values, even if these claim to be measuring the same quantity, can disagree quite substantially. When these measurements are then used for calculations on a large scale such as for the determination of global air-sea gas fluxes, relatively small biases of data from different sources can result in large errors on the order of up to 20% in carbon dioxide fluxes. This is particularly true when considering parameterisations of the gas transfer velocity which are based on a squared or cubed function of u_{10}.

In this work we analyse data from a variety of sources and their sampling characteristics. For the calculation of air-sea gas flux we show how the choice of input data defines the uncertainty of the results. Further unknowns such as the parameterisation of gas transfer velocity are discussed. An accurate quantification of these uncertainties is one of the aims of the Centre for the observations of Air-Sea Interaction and fluXes (CASIX) in which this work is carried out.