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Systematic errors in global air-sea CO_2 flux caused by temporal averaging of sea-level pressure

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Abstract. Long-term temporal averaging of meteorological data, such as wind speed and air pressure, can cause large errors in air-sea carbon flux estimates. Other researchers have already shown that time averaging of wind speed data creates large errors in flux due to the non-linear dependence of the gas transfer velocity on wind speed (Bates and Merlivat, 2001). However, in general, wind speed is negatively correlated with air pressure, and a given fractional change in the pressure of dry air produces an equivalent fractional change in the atmospheric partial pressure of carbon dioxide (pCO_{2air}). Thus low pressure systems cause a drop in pCO_{2air}, which together with the associated high winds, promotes outgassing/reduces uptake of CO_2 from the ocean. Here we quantify the errors in global carbon flux estimates caused by using monthly or climatological pressure data to calculate pCO_{2air} (and thus ignoring the covariance of wind and pressure) over the period 1990-1999, using two common parameterisations for gas transfer velocity. Results show that on average, compared with estimates made using 6 hourly pressure data, the global oceanic sink is systematically overestimated by 7% (W92) and 10% (WM99) when monthly mean pressure is used, and 9% (W92) and 12% (WM99) when climatological pressure is used.

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