Direct measurement of turbulent fluxes at sea-air interface by micrometeorological technique

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Accurate parameterizations of sea–air momentum, sensible and latent heats, trace gases (e.g. greenhouse gases including CO_2 and CH_4), and aerosol fluxes are important in sea–air interaction. Coupled ocean–atmosphere global climate models require high accuracy of the net surface heat flux for the prediction of climate change, and process–based understanding of particle formation from bubble bursting to realistically predict the climate effect of marine aerosols. Precise measurements of the CO_2 gas transfer across the air–sea interface provide a better understanding of the global carbon cycle. The eddy covariance technique is the definitive method to directly determine these sea–air fluxes, but it requires measurements of the vertical and downwind components of air velocity, air temperature, humidity, trace gases, and aerosol over a sufficiently long averaging period (> 30 min) and with sufficient frequency response (< 10 Hz). One of the greatest difficulties in measuring sea–air flux by the eddy covariance technique over the open ocean is the apparent wind velocity caused by the wave–induced platform motion. As a result, the uncorrected eddy covariance results are all strongly biased, and especially represent unrealistic momentum fluxes. Improved ship motion correction scheme with Kalman filter results in a significant reduction in both the bias and the scatter of momentum fluxes. Previous studies over the oceans have shown that the eddy covariance CO_2 flux was larger than the bulk CO_2 flux estimated by the mass balance technique. Our results suggest that the density correction due to the air pressure fluctuation, which is assumed to be negligible in the WPL correction, is required to evaluate the accurate eddy covariance CO_2 flux over the ocean.

Keywords: air-sea flux, air-sea interaction, eddy covariance technique

