Estimation of near-surface turbulence and CO₂ transfer velocity from satellite data

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The interfacial gas transfer velocity can be linked to the dissipation of turbulent kinetic energy (TKE) [Kitaigorodskii and Donelan, 1984] and its patchiness [Woolf, 1995] in the near-surface layer of the ocean. In this work, we explore the possibility of estimating the parameters of near-surface turbulence and the air-sea gas transfer velocity from satellite data. A model of near-surface turbulence provides estimates of the dissipation rate of TKE from wind-wave conditions and air-sea heat/buoyancy flux. The model has been validated with the extended near-surface turbulence data set obtained during the TOGA Coupled Ocean-Atmosphere Response Experiment by Soloviev and Lukas (2003). Preliminary tests have also been done in the RSMAS Air-Sea Interaction Saltwater Tank Facility (ASIST). The model uses the TOPEX POSEIDON wind speed and significant wave height data as input to produce a global distribution of the near-surface turbulence dissipation rate and interfacial component of the CO₂ transfer velocity. An advancement of remote sensing algorithm is possible with the incorporation of directional wind/wave data being available from QUIKSCAT and a now-cast wave model. The satellite data on brightness temperature (SSMI and SAR imagery) provides fractional whitecap coverage, which can be combined with parameterization for the bubble-mediated component of the air-sea gas flux. Due to the high solubility of CO₂, bubble mediated transfer velocity is presumed important only at relatively high wind speeds, which reduce potential errors associated with uncertainties in bubble parameterizations.

REFERENCES