Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 9, 529-541, 2009
www.atmos-chem-phys.net/9/529/2009/

The impact of diurnal variability in sea surface temperature on the central Atlantic air-sea CO_2 flux

H. Kettle[1], C. J. Merchant[1], C. D. Jeffery[2], M. J. Filipiak[1], and C. L. Gentemann[3]
[1]School of GeoSciences, The University of Edinburgh, UK
[2]National Oceanography Centre, Southampton, UK
[3]Remote Sensing Systems, Santa Rosa, CA, USA

Abstract. The effect of diurnal variations in sea surface temperature (SST) on the air-sea flux of CO_2 over the central Atlantic ocean and Mediterranean Sea (60 S–60 N, 60 W–45 E) is evaluated for 2005–2006. We use high spatial resolution hourly satellite ocean skin temperature data to determine the diurnal warming (ΔSST). The CO_2 flux is then computed using three different temperature fields – a foundation temperature (T_f, measured at a depth where there is no diurnal variation), T_f, plus the hourly ΔSST and T_f, plus the monthly average of the ΔSSTs. This is done in conjunction with a physically-based parameterisation for the gas transfer velocity (NOAA-COARE). The differences between the fluxes evaluated for these three different temperature fields quantify the effects of both diurnal warming and diurnal covariations. We find that including diurnal warming increases the CO_2 flux out of this region of the Atlantic for 2005–2006 from 9.6 Tg C a^{-1} to 30.4 Tg C a^{-1} (hourly ΔSST) and 31.2 Tg C a^{-1} (monthly average of ΔSST measurements). Diurnal warming in this region, therefore, has a large impact on the annual net CO_2 flux but diurnal covariations are negligible. However, in this region of the Atlantic the uptake and outgassing of CO_2 is approximately balanced over the annual cycle, so although we find diurnal warming has a very large effect here, the Atlantic as a whole is a very strong carbon sink (e.g. −920 Tg C a^{-1} Takahashi et al., 2002) making this is a small contribution to the Atlantic carbon budget.

Final Revised Paper (PDF, 1241 KB) Discussion Paper (ACPD)

Citation: Kettle, H., Merchant, C. J., Jeffery, C. D., Filipiak, M. J., and Gentemann, C. L.: The impact of diurnal variability in sea surface temperature on the central Atlantic air-sea CO_2 flux, Atmos. Chem. Phys., 9, 529-541, 2009. Bibtex EndNote Reference Manager