Measurements of Diurnal Variations and Eddy Covariance (Ec) Fluxes of Glyoxal Over the Tropical Pacific Ocean During the Torero 2012 Field Experiment

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Here we describe a Fast Light Emitting Diode Cavity Enhanced Differential Optical Absorption Spectroscopy (Fast LED-CE-DOAS) instrument to measure diurnal variations and EC fluxes of glyoxal, and inform about its unknown sources. The Fast LED-CE-DOAS is a multispectral sensor that selectively and simultaneously measures glyoxal (CHOCHO), nitrogen dioxide (NO_2), oxygen dimers (O_4) and water vapor (H_2O) with ~2 Hz time resolution. The instrument was deployed during the Tropical Ocean Troposphere Exchange of Reactive Halogens and OVOC (TORERO) field experiment (January to March 2012) on a cruise from Honolulu, Hawaii, USA to Puntarenas, Costa Rica, probing a large portion of the Eastern tropical Pacific Ocean. Glyoxal is the smallest α-dicarbonyl product of hydrocarbon oxidation, and a precursor for secondary organic aerosol (SOA). The unique physical and chemical properties of glyoxal, i.e., high solubility in water (Henry's Law constant, KH = 4.2 $x10^5$ M atm^{-1}) and short atmospheric lifetime (~2 hrs at solar noon) make it a unique indicator species for organic carbon oxidation in the marine atmosphere. Previous reports of elevated glyoxal over oceans remain unexplained by atmospheric models. Eddy covariance (EC) fluxes are a well-established and widely used technique to measure surface-atmosphere gas exchange. The EC flux method provides insight into sources and sinks of atmospheric parameters (physical, chemical state variables) suitable to test our process level understanding. Our findings are discussed in context with measurements of glyoxal from remote sensing (ship-based MAX-DOAS and satellite) and implications for our current understanding of sources and sinks of this tracer gas over the open ocean.