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Carbon monoxide photoproduction in open ocean waters

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Sunlight initiated photolysis of chromophoric dissolved organic matter (CDOM) is the dominant source of carbon monoxide (CO) in the open ocean. A modelling study was conducted to constrain this source. Spectral solar irradiance was obtained from two models (GCSOLAR and SMARTS2). Water column CDOM and total light absorption were modelled using spectra collected along a Meridional transect of the Atlantic Ocean using a 200 cm pathlength liquid waveguide UV-visible spectrophotometer. Apparent quantum yields for the production of CO (AQY_{CO}) from CDOM were obtained from a parameterisation describing the relationship between CDOM light absorption coefficient and AQY_{CO} and the CDOM spectra collected. The sensitivity of predicted rates to variations in model parameters (solar irradiance, cloud cover, surface water reflectance, CDOM and whole water light absorbance, and AQY_{CO}) was assessed. The model's best estimate of open ocean CO photoproduction was 49 ± 8 Tg CO-C yr^{-1}, with lower and upper limits of 38 and 84 Tg CO-C yr^{-1}, as indicated by sensitivity analysis considering variations in AQYs, CDOM absorbance, and spectral irradiance. These results represent significant constraint of open ocean CO photoproduction at the lower limit of previous estimates. Based on these results, and their extrapolation to total photochemical organic carbon mineralisation, we recommend a downsizing of the role of photochemistry in the open ocean carbon cycle.