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Diurnal variation in respiratory CO_2 flux in an arid ecosystem

Hella van Asperen (1), Thorsten Warneke (1), Simone Sabbatini (2), Martin Höpker (3), Tommaso Chiti (2), Giacomo Nicolini (2,4), Dario Papale (2), Michael Böhm (3), and Justus Notholt (1)

(1) University of Bremen, Institute of Environmental Physics, Remote Sensing, Bremen, Germany (v_asperen@iup.physik.uni-bremen.de), (2) Department for Innovation in Biological, Agro-food and Forest Systems (DIBAF), University of Tuscia, via S. Camillo de Lellis s.n.c., 01100 Viterbo, Italy, (3) Center for Industrial Mathematics, University of Bremen, Bibliothekstrasse 1, 28359 Bremen, Germany, (4) Euro Mediterranean Centre on Climate Change (CMCC) Impacts on Agriculture, Forests and Ecosystem Services (IAFES), via A. Pacinotti 5, 01100 Viterbo, Italy

The application of stable isotopes to study ecosystem processes is increasingly used. However, continuous in-situ observation of CO_2 concentrations, CO_2 fluxes, and their isotopic components are still sparse. In this study, we present results from an arid grassland in Italy, in which continuous measurements of $\delta 13CO_2$ and CO_2 were performed by means of an in-situ Fourier Transform Infrared Spectrometer connected to a concentration-tower set up and to soil flux chambers. By use of Keeling plots, daily nighttime Keeling plot-intercepts and hourly flux chamber Keeling plot-intercepts could be derived. The flux chambers solely showed CO_2 emission, with respiration peaks during the day. Keeling plot intercepts from the tower, overlooking the arid grassland, showed more enriched $\delta 13CO_2$ values than Keeling plot intercepts derived from chamber measurements, indicating different dominating respiratory sources in their footprint. Flux chamber respiratory $\delta 13CO_2$ values showed a daily pattern with on average 3.5‰ more depleted $\delta 13CO_2$ fluxes during the night. It is hypothesized that the observed diurnal variation in respiratory $\delta 13CO_2$ is a consequence of the physical process of diffusive fractionation taking place during the nocturnal boundary layer build up.