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Ecosystem-scale carbon monoxide exchange of a Mediterranean Savanna

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Carbon monoxide (CO) is a major player in atmospheric chemistry due to its reduction capacity on OH and its consequential influence on the oxidizing capacity of the lower atmosphere. CO thus indirectly affects the atmospheric lifetime of different greenhouse gases and affects tropospheric ozone levels. All these interactions are complicated, non-linear and exhibit both, positive and negative feedbacks. A complete understanding of the global carbon monoxide budget is thus urgently needed to profoundly predict future concentrations of Methane and other environmentally important gases.

While sources/sinks of CO on land at least partially cancel out each other and their magnitude is very likely lower compared to other sinks and sources, the magnitude of CO sources and sinks is highly uncertain. Thus it may be premature to neglect any direct contributions of land ecosystems to the CO budget. In addition, changes in global climate and resulting changes in global productivity may require re-evaluating older data and assumptions. One major reason for the large uncertainty is a general scarcity of empirical data.

Here we present data on ecosystem scale as well as understory eddy covariance measurements of CO-fluxes in a Mediterranean Savanna. These measurements were accompanied by in situ soil-chamber measurements and lab measurements on soil samples. Based on flux data measured over various biomes in Europe and Asia we hypothesize that CO fluxes from the investigated Savannah are higher during the dry season compared to wet season CO fluxes, mainly due to the higher fraction of aboveground dead plant matter and litter during the dry season.

The Savanna ecosystem acted as a source for CO in any season, with emissions of CO close to zero throughout the night and high(er) emission rates around noon. Results support our hypothesis, with ecosystem scale CO fluxes being roughly twice as high during the dry season compared to the wet season. As shown by the understory EC data the soil surface is the main source for CO in this ecosystem during the dry season. Comparing the dry season fluxes with CO-fluxes measured over other ecosystem types in Europe and Asia they are among the highest measured.

Boosting fits regression ensembles revealed incoming short wave radiation to be the most important predictor for CO fluxes at ecosystem scale. However, the sensitivity of CO fluxes to short wave radiation was multiple times higher during the dry season, compared to the wet season.

Disentangling soil and litter contributions to the overall CO flux by means of in situ soil surface flux measurements and soil flux measurements in the lab showed the soil to act as a slight sink for CO, while the soil surface, including the litter layer, acted as a source for CO. However, the sink strength of the soil samples was reduced when these soil samples were exposed to UV radiation.