Geophysical Research Abstracts
Vol. 12, EGU2010-15280-1, 2010
EGU General Assembly 2010

Soil respiration vs. soil CO_2 efflux: the role of CO_2 storage flux in soil respiration models

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Most studies implicitly consider soil surface efflux of CO_2 to be the instantaneous soil respiration, thereby neglecting possible changes in the amount of CO_2 stored in the soil pore-space. For the widely used chamber-based and micro-meteorological measurements, filling or depletion of this CO_2 pool can result in either an under- or overestimation of the soil respiration. Soil temperature and moisture are the major abiotic factors controlling soil respiration, and are used as explanatory variables by most models. However, these two factors also influence soil gas transport, and thus, the amount of stored CO_2. This effect can add undesired noise to soil respiration models or even interfere with the model parameters.

To examine the effect of CO_2 storage flux, we monitored both the soil CO_2 efflux and the CO_2 storage in the soil pore-space of a deep and well-aerated riparian soil. Measurements were carried out from March 2009 to March 2010 using an automated chamber system and CO_2 concentration measurements at various depths (0.05 to 2.1 m) in the soil profile. First results show that the integration of the storage flux can lead to a significant divergence of soil respiration and soil CO_2 efflux, potentially affecting respiration models. It will be discussed whether the integration of the storage flux either changes the overall parameter estimation or is only relevant to improve the understanding of particular meteorological situations.