Final Technical Report

Quantifying Carbon-Climate Processes at the Regional Scale Using Atmospheric Carbonyl Sulfide

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Atmospheric carbonyl sulfide (COS) analysis has the potentially transformative capability for partitioning the regional carbon flux into respiration and photosynthesis components. This emerging approach is based on the observation that continental atmospheric CO_2 gradients are dominated by net ecosystem fluxes while continental atmospheric COS gradients are dominated by photosynthesis-related plant uptake. Regional flux partitioning represents a critical knowledge gap due to a lack of robust methods for regional-scale flux partitioning and large uncertainties in forecasting carbon-climate feedbacks. Our completed project characterized the relationship between COS and CO_2 surface fluxes using a novel measurement and modeling system in a winter wheat field at the U.S. Department of Energy's Atmospheric and Radiation Measurement program Central Facility (DOE-ARM CF). The scope of this project included canopy flux measurements, soil flux measurements, regional atmospheric modeling, and analysis of COS and CO_2 airborne observations at SGP. Three critical discoveries emerged from this investigation: (1) the new measurement system provided the first field evidence of a robust relationship between COS leaf fluxes and GPP; (2) a previously unknown seasonal soil source of COS was observed and characterized; (3) the regional atmospheric analysis of airborne measurements provided the first COS-based constraints on GPP parameterizations used in earth systems models. Dissemination of these results includes three publications [*Billesbach et al.*, In Press; *Campbell et al.*, In Preparation; *Seibt et al.*, In Review], three presentations at the AGU Fall Meeting (2012), and four invited presentations to department seminars. We have leveraged this foundational project to continue our work on understanding carbon cycle processes at large scales through one funded project (DOE Lab Fee, 2012-2015) and one proposal that is under review (DOE/NASA/USDA/NOAA, 2014-2016).

References

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