Project title: Carbon and nitrogen dynamics and retention in an agricultural ecosystem under elevated atmospheric carbon dioxide and ozone

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Project Abstract:

Project objectives:
Soybean and corn plots will be exposed to ambient (control), enriched CO_2, elevated O_3, and simultaneously elevated CO_2 and O_3, using free-air gas concentration enrichment, with 4 to 8 replicates per treatment. Crop residue quantity and quality, decomposition and C and N release from residue, hydrological and gaseous C and N losses, as well as soil C and N mineralization and nitrification will be quantified. Additionally, a ^{15}N pulse-chase ecosystem-scale experiment will be executed.

Project location:
The research will be conducted at the SoyFACE facility at the University of Illinois.

List of hypotheses:
We hypothesize that effects of elevated CO_2 and O_3 on C and N cycling in corn/soybean agro-ecosystems will be mediated by changes in plant traits which will subsequently affect below-ground processes.

Experimental approach:
In this proposal, we are requesting funds to study the effects of elevated atmospheric CO_2 and O_3 on C and N dynamics in a corn/soybean ecosystem. Using a free-air gas concentration enrichment facility, twenty-four 20 m diameter plots will be exposed to ambient, elevated CO_2 (550 ppm), elevated O_3 (80 ppb), or simultaneous CO_2 and O_3. The effects of changes in atmospheric chemistry on plant traits will be evaluated by quantifying crop residue quantity and quality, N_2 fixation, labile C inputs to the soil, photosynthesis, transpiration, and stomatal conductance. Mediation of ecosystem C and N dynamics by changes in plant traits will be assessed by determining the rates of decomposition of crop residues, soil respiration, microbially mediated soil N fluxes, as well as hydrological and gaseous losses of C and N. A ^{15}N pulse-chase experiment will be performed to track the fate of fertilizer N under varying conditions of atmospheric CO_2 and O_3. This study will provide the first field-scale evaluation of the effects of atmospheric CO_2 and O_3 on N retention and loss in agricultural ecosystems of the midwestern US.

Intended accomplishments:
Deliverables will include a database of soil and plant C and N variables, and (2) manuscripts published in peer-reviewed scientific journals.