2.044 Exploring the direct impacts of particulate matter and surface ozone on global crop production.

Early Career Scientist

Presenting Author:
Luke Schiferl, MIT, Dept of Civil and Environmenal Engineering, Cambridge, MA, USA, schiferl@mit.edu

Co-Authors:
Colette Heald, MIT, Depts of Civil and Environmenal Engineering and Earth, Atmospheric and Planetary Sciences, Cambridge, MA, USA

Abstract:

The current era of rising food demand to feed an increasing population along with expansion of industrialization throughout the globe has been accompanied by deteriorating air quality and an enhancement in agricultural activity. Both air quality and the food supply are vitally important to sustaining human enterprise, and understanding the effects air quality may have on agricultural production is critical. Particulate matter (PM) in the atmosphere decreases the total photosynthetically available radiation (PAR) available to crops through the scattering and absorption of radiation while also increasing the diffuse fraction (DF) of this PAR. Since plants respond positively to a higher DF through the more even distribution of photons to all leaves, the net effect of PM on crop production depends on the magnitudes of these values and the response mechanisms of a specific crop. In contrast, atmospheric ozone always acts to decrease crop production through its phytotoxic properties. While the relationships between ozone and crop production have been readily studied, the effects of PM on crop production and their relative importance compared to ozone is much more uncertain. This study uses the GEOS-Chem chemical transport model linked to the RRTMG radiative transfer model and the DSSAT crop model to explore the impacts of PM and ozone on the globally distributed production of maize, rice, wheat and soybeans. First, we examine how air quality differentially affects total seasonal production by crop and region. Second, we investigate the dependence of simulated production on air quality over different timescales and under varying cloud conditions.