2.066 Rapidly changing interactions between forests and atmospheric chemistry: contemporary changes in land cover and anthropogenic emissions.

Early Career Scientist

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Abstract:

Forests are well-known to have a large impact on atmospheric chemistry due to reactive biogenic emissions and removal by dry deposition. Few studies have explored decadal-scale changes in forest-atmosphere interactions, despite these timescales being highly relevant to contemporary changes in land cover and anthropogenic emissions. Here we discuss work that combines satellite observations with chemical transport modeling to investigate changes on this time scale and better predict air quality, climate, and ecosystem impacts. First, using global observations of NO_2 from multiple satellite instruments, we constrain estimates of oxidized nitrogen (NO_y) deposition to the world's forests over the past twenty years. For example, we find dramatic decreases in NO_y deposition to forests in the US, supporting other evidence that critical nitrogen loadings across the country are increasingly dominated by reduced nitrogen. Concurrent with changes in anthropogenic emissions are changes in forest cover due to natural and human-driven processes, which we investigate using a custom land cover module coupled to a chemical transport model. For example, we show how projected insect-driven tree mortality in the US over the next 15 years might not only impact the removal of O_3 by deposition, but also lead to shifts in chemical production of O_3 and organic aerosol due to decreases in biogenic emissions. We also use an up-to-date satellite-derived description of land cover in Southeast Asia to explore how conversion of forests to oil palm plantations might be impacting atmospheric chemistry in that region. We find that predictions of regional deposition and air quality can be very sensitive to all these changes in forest-atmosphere interactions. Anthropogenic emissions and land cover changes should both be considered in concert for a better representation of future atmospheric chemistry.