Fine-scale Analysis of the Energy-Land-Water Nexus: Nitrate Leaching Implications of Biomass Co-Firing in the Midwestern U.S.

Objective

Interdisciplinary research into the multisector dynamics involving energy, land and water systems is increasingly crossing policy domains and natural and economic systems that have historically been studied independently. A key methodological question concerns the appropriate scale and scope of analysis. Most studies employ either: 1) a high-level model that resolves multiple systems at relatively coarse scale; or 2) a model or empirical analysis with a finer scale resolution focused on the primary system of interest. However, it may be necessary to bridge these two approaches. Understanding when this is required is a critical research question.

Impact

Scientists confront a critical question of scale for their analysis of linkages between energy, water and land systems. Studies exploring this nexus within a single watershed or an individual power plant can accurately capture local processes. However, when interventions are extrapolated to a regional scale, critical multisector dynamics are missed. We find that forty-six percent of the coal-fired plants in the upper-MISO region stop generating electricity instead of co-firing biomass at the 15% level. Ignoring these interactions leads to overestimation of the demand for biomass. On the other hand, region-wide analysis of this nexus grossly underestimates the impact on water quality in key hotspots of the MISO region.

Approach

This study applies a novel, gridded energy-land-water modeling system to analyze the local environmental impacts of corn residue co-firing of coal power plants across the upper MISO region.



Figure: Coal-fired power plants and biomass supply circles

Sun, Shanxia, Brayam Valqui Ordonez, Mort D. Webster, Jing Liu, Christopher J. Kucharik, and Thomas Hertel. 2020. "Fine-scale Analysis of the Energy-Land-Water Nexus: Water Quality Implications of Biomass Co-Firing in the Midwestern U.S.", Environmental Science and Technology <u>https://doi.org/10.1021/acs.est.9b07458</u>.

