

Global estimates of N₂O emissions associated with plant- and animal-based food production

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Abstract

Food production is a major contributor to climate change and land-use change. Current estimates of greenhouse gas (GHG) emissions from the food system are mostly based on “top-down” approaches and restricted to agriculture and land use sectors. Here we use a fully coupled land surface model Integrated Science Assessment Model (ISAM) to simulate vegetation and soil carbon dynamics, as well as N₂O emissions in agricultural land based on detailed biogeochemical processes. Then we establish a life cycle assessment framework including material manufacturing, transportation, machinery, food and feed processing, and byproduct allocation to connect the plant- and animal-based food production systems. We use this framework associated with the ISAM simulations to evaluate N₂O emissions from ~140 plant-based foods and ~10 animal-based foods at 0.5 x 0.5 spatial resolution in the base year of 2010. The results show that rice has emitted the most GHG among all plant-based foods, while beef is the most significant contributor among all animal-based foods. Changing the dietary from more animal-based to more plant-based is an efficient solution for GHG mitigation. We further analyze the N₂O reduction amount under different mitigation scenarios.

Keywords: N₂O emissions, Plant-Based, Animal Based
