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Global hotspots of nitrous oxide mitigation potentials in croplands

Feng Zhou and Xiaoqing Cui
Peking University, China (zhouf@pku.edu.cn)

Mitigating soil nitrous oxide (N_2O) emissions is essential for staying below a 2°C warming threshold. However, accurate assessments of mitigation potential are limited by uncertainty and variability in direct emission factors (EFs). To assess where and why EFs differ, we create high-resolution maps of crop-specific EFs based on 1,507 georeferenced field observations. Here, using a data-driven approach, we show that EFs vary by two orders of magnitude over space. At global and regional scales, such variation is primarily driven by climatic and edaphic factors rather than the well-recognized management practices. Combining spatially explicit EFs with N surplus information, we conclude that global mitigation potential without compromising crop production is 30% [95% CI: 17-53%] of direct soil emissions of N_2O, equivalent to the entire direct soil emissions of China and the United States combined. Two thirds (65%) of mitigation potential could be achieved on one fifth of global harvested area, mainly located in humid subtropical climate and across gleysols and acrisols. These findings highlight the value of a targeted policy approach on global hotspots that could deliver large N_2O mitigation as well as environmental and food co-benefits.