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Elevated HONO emissions in agricultural system: model simulation by the improved DNDC model (DNDC-HONO)

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Nitrous acid (HONO) is a key reactive nitrogen species in the atmosphere regulating the atmospheric oxidative capacity and nitrogen cycling. Biogenic HONO emission from soil has been suggested as an important source. Soil HONO emission has been mostly characterized through laboratory experiments. The laboratory results, however, is not directly applicable for field applications. A quantitative understanding of the emission intensity requires knowledge about soil properties and processes as well as the exchange between soil and atmosphere. Here we develop a DNDC-HONO model for the simulation of soil HONO production and emissions. The Denitrification–Decomposition (DNDC) model is a process-based biogeochemical model that simulates carbon and nitrogen dynamics and trace gas emissions for agricultural system. Our model implements the HONO relevant processes into the model to be able to predict the soil processes and HONO emissions with considering soil properties, meteorological conditions, and agricultural activities. The new model is capable of demonstrating a significant influence of pH, soil moisture and nitrogen fertilizer application on HONO emission. Fertilized soils with PH=8 appear to be particularly strong sources of HONO. Besides, emitted HONO is comparable with emissions of nitric oxide (NO). Ultimately, the prediction of HONO emission using DNDC-HONO enhances the ability to accurately model N cycling and predict overall N loss from agro-ecosystems. To further refine HONO emission predictions, we recommend DNDC-HONO developments focus on HONO exchange between soil and atmosphere based on enough site measurement data.