A conceptual approach to incorporate management into global models; the example with tillage

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Different agricultural management strategies are being promoted to reduce global greenhouse gas emissions resulting from agricultural practices. Currently, the evaluation of management on GHG emissions is limited, because global ecosystem models, which are typically used to study global biogeochemical fluxes, often do not have management incorporated in sufficient detail. As a result, the evaluation of the impact of agricultural management on global greenhouse gas emissions is hampered. We here develop a conceptual approach to explore whether agricultural management can be incorporated in global ecosystem models using process-based knowledge from detailed (e.g., field-scale or watershed) models. We focus on tillage and nitrous oxide emissions but the conceptual approach can also be employed for other modeling aspects. First, we identify the most important nitrogen processes in agricultural soils and analyze their relation with tillage. In a second step, we explore in a literature review how these processes and interactions with tillage are modeled in detailed models. The review also looks at the data requirements as data are often more limiting at the global scale. We find that in general the repercussion of tillage on nitrous oxide emissions can be modeled at the global scale, because there are modeling approaches available for the most important processes and the basic data requirements can be met at the global scale. A general recommendation on which modeling approaches to choose for the implementation of individual processes cannot be provided as this depends on the current implementation of other processes in the modeling framework to be extended. The new implementation will have to be tested and evaluated in the model-specific and research-question specific context.