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Risk of what, to whom, and when? Soil loss maps are no risk assessments

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Soil erosion “risk” maps are almost exclusively produced by estimating long-term average soil loss rates with USLE-based models, after which at-risk areas are ranked according to poorly justified thresholds. This approach fails to engage with well-established concepts from more mature fields in risk science.

Soil erosion is a natural process and only becomes a hazard once vulnerable systems are exposed to individual or successive erosion events. Hence, meaningful erosion risk assessments require (i) a clear definition of the exposed elements considered to be at risk (e.g. soil itself, farmers, downstream infrastructure and water bodies); (ii) their biophysical and/or socio-economic vulnerability to erosion; (iii) the consequences that erosion may generate (e.g. crop yield losses, increased vulnerability to droughts and floods, off-site pollution); and (iv) the time frame over which these consequences occur. Crucially, meaningful erosion risk assessments must describe erosion in probabilistic terms rather than as deterministic averages.

In this contribution, we outline several steps towards more progressive erosion risk assessments. First, we demonstrate how the probability of occurrence of severe water-erosion events on individual arable fields can be estimated using a simple machine-learning approach and dynamic input factors. This enables the identification of short-term risks of crop or off-site damage and can lead to the development of early warning systems. Second, to address medium- to long-term risks associated with erosion-induced soil change, we propose a dynamic, process-oriented multi-model framework that represents how erosion alters soils and their functioning over time. This framework accommodates different erosion processes and their interactions within a multi-hazard perspective. Our contribution will be presented in an interactive poster format, inviting the soil erosion research community to co-develop a more useful and consequence-oriented erosion risk assessment framework.