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Soil degradation by soil compaction: a new integrative modelling approach

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Soil compaction by field traffic is one of the main threats to all agricultural soils worldwide. For instance, compacted soils have a reduced hydraulic conductivity, which leads to an increased surface runoff and thus to an increased flood risk. To mitigate further soil degradation by field traffic, it is important to know where, when and to what extent soil compaction may occur.

This study demonstrates a new approach to model the soil compaction risk at regional scale. The developed model is called “SaSCiA” (Spatially explicit Soil Compaction risk Assessment). SaSCiA generates daily maps of soil compaction risk by integrating (i) spatial soil and crop type information, (ii) crop type depended machinery information, (iii) daily weather information, (iv) an agro-ecosystem model (MONICA) to compute daily soil moisture information and (v) different approaches to calculate the soil strength and soil stress. By integrating soil moisture calculations and the present crop type which is derived from satellite data (Landsat 8, Sentinel-2A), SaSCiA enables a spatially and temporal highly resolved analyses of soil degradation by soil compaction exceeding all available approaches.

To demonstrate the applicability of the model, SaSCiA was applied to two regions in northern Germany. The results show that soil compaction risk varies strongly in space and time throughout the year. Applying the SaSCiA-model enables a detailed spatio-temporal analysis of the soil compaction risk and thus the identification of areas, which are exposed to soil degradation by soil compaction. Furthermore, SaSCiA may support farmers, stakeholders and consultants in their decision-making for a more sustainable soil management.