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Mapping the spatial patterns of field traffic and traffic intensity to predict soil compaction risks at the field scale

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Soil compaction is one of the main threats to cropland soils in present days. In contrast to easily visible phenomena of soil degradation, soil compaction, however, is obscured by other signals such as reduced crop yield, delayed crop growth, and the ponding of water, which makes it difficult to recognize and locate areas impacted by soil compaction directly. Although it is known that trafficking intensity is a key factor for soil compaction, until today only modest work has been concerned with the mapping of the spatially distributed patterns of field traffic and with the visual representation of the loads and pressures applied by farm traffic within single fields.
A promising method for for spatial detection and mapping of soil compaction risks of individual fields is to process dGPS data, collected from vehicle-mounted GPS receivers and to compare the soil stress induced by farm machinery to the load bearing capacity derived from given soil map data. The application of position-based machinery data enables the mapping of vehicle movements over time as well as the assessment of trafficking intensity. It also facilitates the calculation of the trafficked area and the modeling of the loads and pressures applied to soil by individual vehicles.
This paper focuses on the modeling and mapping of the spatial patterns of traffic intensity in silage maize fields during harvest, considering the spatio-temporal changes in wheel load and ground contact pressure along the loading sections. In addition to scenarios calculated for varying mechanical soil strengths, an example for visualizing the three-dimensional stress propagation inside the soil will be given, using the Visualization Toolkit (VTK) to construct 2D or 3D maps supporting to decision making due to sustainable field traffic management.