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An application to model traffic intensity of agricultural machinery at field scale

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Several soil-pressure-models deal with the impact of agricultural machines on soils. In many cases, these models were used for single spots and consider a static machine configuration. Therefore, a statement about the spatial distribution of soil compaction risk for entire working processes is limited. The aim of the study is the development of an application for the spatial modelling of traffic lanes from agricultural vehicles including wheel load, ground pressure and wheel passages at the field scale.

The application is based on Open Source software, application and data formats, using python programming language. Minimum input parameters are GPS-positions, vehicles and tires (producer and model) and the tire inflation pressure. Five working processes were distinguished: soil tillage, manuring, plant protection, sowing and harvest. Currently, two different models (Diserens 2009, Rücknagel et al. 2015) were implemented to calculate the soil pressure.

The application was tested at a study site in Lower Saxony, Germany. Since 2015, field traffic were recorded by RTK-GPS and used machine set ups were noted. Using these input information the traffic lanes, wheel load and soil pressure were calculated for all working processes. For instance, the maize harvest in 2016 with a crop chopper and one transport vehicle crossed about 55 % of the total field area. At some places the machines rolled over up to 46 times. Approximately 35 % of the total area was affected by wheel loads over 7 tons and soil pressures between 163 and 193 kPa.

With the information about the spatial distribution of wheel passages, wheel load and soil pressure it is possible to identify hot spots of intensive field traffic. Additionally, the use of the application enables the analysis of soil compaction risk induced by agricultural machines for long- and short-term periods.