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Scenarios of organic amendment use to increase soil carbon stocks and nitrogen availability in cropped soils at the territory scale: spatial and temporal simulations with the NCSOIL/CERES-EGC crop model

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The application of Exogenous Organic Matter (EOM) on cropped soils is a promising way to increase soil organic carbon and available nitrogen for crops while recycling organic agricultural and urban wastes. In peri-urban territories where the specialization of agriculture limits the resource in organic amendments since livestock farming is scarce, a better management of EOM land application from all origins at the territory scale could be thought to maximize their benefits. The objective was to predict the effect of various EOM types and uses on C and N fluxes and crop production for each homogeneous spatial unit of the territory, first step for the territorial optimization of EOM land application.
The study area, located 30km west of Paris, covers 221km^2 and is mostly characterized by croplands. The effects of repeated EOM applications were studied using a mechanistic crop model: CERES-EGC accounting for soil characteristics, crop production systems, and climate. The whole territory was divided into homogeneous spatial units, each defined by soil and crop production system characteristics.
Four different soil types were characterized, mapped and parameterized in the model. Kinetics of C and N mineralization during soil incubations were used to optimize soil organic matter characteristics and parameters in the sub-model NCSOIL of CERES-EGC. Crop production systems were defined and spatially inferred using the French land parcel identification system. Climatic data measured on the territory were used to make a 20 year-meteorological scenario. Based on these initial informations, crop yields and C and N fluxes were simulated for the actual crop productions and soil type combinations of the territory. Then, different scenarios of EOM uses were also simulated based on different EOM types, added quantities and frequencies of application within the crop successions respecting the 170kgN/ha/yr legal limit. All the parameters studied, crop yields, N outputs, carbon storage increased with increasing amounts of applied EOM but to different extents depending on added EOM, soil type and crop production system.
Based on all the simulated results obtained, the EOM land application will be optimized to maximize carbon storage, crop production and limit N pollutions at the territory scale, taking into account other constraints such as EOM availability.