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Soil respiration partition and its components in the total agro-ecosystem respiration

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Close to 15% of the Earth's terrestrial surface is used for cropland. In the context of global warming, and acknowledged by the Kyoto Protocol, agricultural soils could be a significant sink for atmospheric CO_2. Understanding the factors influencing carbon fluxes of agricultural soils is essential for implementing efficient mitigation practices.
Most of the soil respiration modeling studies was carried out in forest ecosystems, but only a few was carried out in agricultural ecosystems. In the study, we evaluated simple formalisms to model soil respiration using wheat data from four contrasting geographical mi-latitude regions. Soil respiration were measured in three winter wheat fields at Lamasquère (43°49'N, 01°23'E, 2007) and Auradé (43°54'N, 01°10'E, 2008), South-West France and Lonzée (50°33'N, 4°44'E, 2007), Belgium, and in a spring wheat field at Ottawa (45°22'N, 75°43'W, 2007, 2011), Ontario, Canada. Manual closed chambers were used in the French sites. The Belgium and Canadian sites were equipped with automated closed chamber systems, which continuously collected 30-min soil respiration exchanges. All the sites were also equipped with eddy flux towers. When eddy flux data were collected over bare soil, the net ecosystem exchange (NEE) was equal to soil respiration exchange. These NEE data were used to validate the model.
Different biotic and abiotic descriptors were used to model daily soil respiration and its heterotrophic and autotrophic components: soil temperature, soil relative humidity, Gross Primary Productivity (GPP), shoot biomass, crop height, with different formalisms. It was interesting to conclude that using biotic descriptors did not improve the performances of the model. In fact, a combination of abiotic descriptors (soil humidity and soil temperature) allowed significant model formalism to model soil respiration.
The simple soil respiration model was used to calculate the heterotrophic and autotrophic source contributions to overall soil respiration and to estimate the soil respiration contribution to NEE measured at field scale. These different results have been compared and discussed for the wheat in four different conditions of soil and climate and the results showed that soil respiration consistently represented $\sim$50% of the total ecosystem respiration. A significant portion of the heterotrophic soil respiration was influenced by the location and by the organic carbon content of the soils.