(1) Agro-C – a process-based model for simulating crop photosynthesis, respiration and other processes involved in crop growth and carbon/nitrogen dynamics in soils

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(3) Available modes for the model runs: Operational

(4) Components & processes: Atmosphere, Biosphere & Physical, Chemical, Biological
-> linking to impact assessment

(5) Brief model description

The Agro-C model is a biogeophysical model that consists of two submodels, Crop-C for simulating crop biomass and Soil-C for computing the soil organic carbon (Huang et al. 2009). The harvestable portion of the biomass, i.e., the yield, is calculated as the product of the biomass and the harvest index (Huang et al. 2007). Crop-C submodel includes two main functional modules that are related to photosynthesis and autotrophic respiration. These modules use the environmental variables of temperature, solar radiation, soil moisture and atmospheric CO_2 concentration as input. The degree of crop N uptake depends on the common constraints of N availability and demand. The availability of N is determined by the mineralization of the soil N pool, synthetic N and manure N, which are assumed to follow first-order kinetics that are modified by the soil texture, temperature and moisture. The demand for N is determined by the crop type and the growing season (Huang et al. 2009). Soil-C submodel simulates soil heterotrophic respiration via the decomposition of both input C (e.g., crop residues, roots and manure) and SOC. Changes in SOC are then determined by balancing the loss of SOC with the gain of input C. The input C is split into two components of labile-C and resistant-C, and the SOC pool is divided into two sub-pools named light-C and heavy-C. The light-C sub-pool is hypothesized to be more biologically reactive, while the heavy-C sub-pool is much more resistant to decomposition. Decomposition of each component and sub-pool is described by four first-order kinetics, respectively. The actual decomposition rate of each component and sub-pool is further modified by soil parameters such as temperature, moisture, texture and pH (Huang et al. 2009). The Agro-C is run with a daily step.

The Agro-C model has been used to simulate and predict the changes in the soil organic carbon stocks of China's croplands (Yu et al. 2012a) and to evaluate the critical carbon input to maintain current soil organic carbon stocks in global crop systems (Wang et al. 2016). It has also been used to evaluate the relative contributions of cultivar improvement, climate and crop management in shaping the past crops productivity in China (Yu et al. 2012b) and to predict the future potential productivity of rice, wheat and maize in China and its spatial variation under future climate change scenario (Zhang et al. 2017).

Key references:

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