GC13B-1085: Targeting the right input data to improve crop modeling at global level

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General Information | Discussion

Designed for location-specific simulations, the use of crop models at a global level raises important questions. Crop models are originally premised on small unit areas where environmental conditions and management practices are considered homogeneous. Specific information describing soils, climate, management, and crop characteristics are used in the calibration process. However, when scaling up for global application, we rely on information derived from geographical information systems and weather generators. To run crop models at broad, we use a modeling platform that assumes a uniformly generated grid cell as a unit area. Specific weather, specific soil and specific management practices for each crop are represented for each of the cell grids. Studies on the impacts of the uncertainties of weather information and climate change on crop yield at a global level have been carried out (Osborne et al, 2007, Nelson et al., 2010, van Bussel et al, 2011). Detailed information on soils and management practices at global level are very scarce but recognized to be of critical importance (Reidsma et al., 2009). Few attempts to assess the impact of their uncertainties on cropping systems performances can be found. The objectives of this study are (i) to determine sensitivities of a crop model to soil and management practices, inputs most relevant to low input rainfed cropping systems, and (ii) to define hotspots of sensitivity according to the input data. We ran DSSAT v4.5 globally (CERES-CROPSIM) to simulate wheat yields at 45arc-minute resolution. Cultivar parameters were calibrated and validated for different mega-environments (results not shown). The model was run for nitrogen-limited production systems. This setting was chosen as the most representative to simulate actual yield (especially for low-input rainfed agricultural systems) and assumes crop growth to be free of any pest and diseases damages. We conducted a sensitivity analysis on contrasting management practices, initial soil conditions, and soil characteristics information. Management practices were represented by planting date and the amount of fertilizer, initial conditions estimates for initial nitrogen, soil water, and stable soil carbon, and soil information is based on a simplified version of the WISE database, characterized by soil organic matter, texture and soil depth. We considered these factors as the most important determinants of nutrient supply to crops during their growing season. Our first global results demonstrate that the model is most sensitive to the initial conditions in terms of soil carbon and nitrogen (CN): wheat yields decreased by 45% when soil CN is null and increase by 15% when twice the soil CN content of the

reference run is used. The yields did not appear to be very sensitive to initial soil water conditions, varying from 0% yield increase when initial soil water is set to wilting point to 6% yield increase when it was set to field capacity. They are slightly sensitive to nitrogen application: 8% yield decrease when no N is applied to 9% yield increase when 150 kg.ha-1 is applied. However, with closer examination of results, the model is more sensitive to nitrogen application than to initial soil CN content in Vietnam, Thailand and Japan compared to the rest of the world. More analyses per region and results on the planting dates and soil properties will be presented.

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