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An approach for the spatial up-scaling of a dynamic crop model: calibration and sensitivity to rainfall and soil variability

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Dynamic crop models have generally been developed and tested at the scale of a homogeneous plot. However, the increasing motivation for applications related to climate variability demand new approaches allowing to up-scale these tools in a way that can incorporate considerable heterogeneity, in particular that of soils. In this work a model calibration is carried out using SWAP (a crop model) and PEST (a program designed for parameter estimation) to assess the effects exerted on yield patterns by the space-time variability of soil moisture. A major objective has been to develop a probabilistic analysis accounting for response of the calibrated model to (sub-seasonal and inter-annual) rainfall and soil variability, from climate scenarios built with a weather generator. Procedures for fulfilling these purposes were part of a wider project focused to improve predictions of ENSO (El Nino- South Oscillation) phenomenon on sugarcane yields of the Caribbean region. The study site concerned to the sugarcane factory Worthy Park, located on 18^o 08' N 77^o 13' W, around 60 km far from Kingston, the capital of Jamaica. Detailed databases with information of each field as well as daily weather data series from 1990 to 2000 are available. Soil water retention functions were measured in 13 locations (at 2 different soil depths), selected from a stratified sampling. Results show a fairly good agreement between observed and simulated yields, but highlight the limited applicability of soil databases where the spatial resolution of the input information is inadequate with respect to the modeling purposes. Yields under coarse soils show higher sensitivity to anomalies due to ENSO events. The anomalies on January reveal the highest, more linear and more homogeneous impact on sugar cane yields among soils.