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How can point rainfall data be best used to drive land surface models in the Sahel?

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In semiarid areas such as the Sahel, land surface processes are known to be highly non-linear, in particular with respect to their main driver that is precipitation. Precipitation also represents the forcing variable that is estimated with the highest uncertainty at the scales of interest, using point (ground) data or large scale (satellite or model) information. For all these reasons, the response of a land surface model (LSM) to rainfall uncertainty and to the method of rainfall estimation from gauge measurements was investigated for the AMMA-CATCH meso-site in South-West Niger. The LSM used is the SEtHyS_Savannah model. This model was specially developed to simulate water and energy fluxes over dry savannah landscapes. It was first calibrated/validated at local scale using field observations collected in millet and fallow plots, the two main land cover types of south-west Niger. Meso-scale simulations were then performed at kilometric resolution for the whole monsoon season of 2005 over a ~3000 km² domain, using a combination of ground- and satellite- derived meteorological and ecological forcing data. Rainfields were estimated over this area at a 1-km² x 15-min resolution from high-resolution rain gauges using a conditioned stochastic event generator as well as three deterministic – geometrical or geostatistical – interpolation methods: nearest-neighbor, standard kriging and lagrangian kriging. Propagation through the LSM of uncertainty and of bias, and transformation of unaccounted-for uncertainty into additional bias, are characterized, as well as interaction with land use and other input variables. Sensitivity of the various water and energy cycle variables is highlighted. Some conclusions are drawn with respect to the choice of rainfall estimation method for land surface modeling in the Sahelian environment. This study also provides useful indications with respect to the rainfields that will be used for forcing the LSMs run in the framework of the ALMIP-2 project, on the three AMMA-CATCH mesosites.

Keywords: land surface modelling, rainfall forcing, error propagation, stochastic

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