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1 Non conditional and conditional simulations of rain fields: impact on the response of typical Sahelian hydrological landscape

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Assessing the regional impact of climate variability on water resources is an increasing concern of global change science. This is especially true in Sahelian region where climate has shown singular changes since the 1950s that greatly affected the water resources. As in most semiarid regions, Sahelian hydrological systems are indeed highly sensitive to the space and time variability of rainfall. Unfortunately, the understanding of past climate changes and their impacts on such a region is limited by the available rainfall measurements which are not able to provide reliable estimates at small scales. Whereas studying the impacts of future climate change is dependant of the coarse resolution Global Climate Models which are not suitable to the hydrological scales. In order to figure out how past or future climate variability affects the response of Sahelian catchments; the stochastic simulation of rainfields can be used.

In this context a preliminary study is presented here comparing different types of stochastic simulation of rainfields and their impacts on a typical Sahelian hydrological landscape. Four types of simulation are presented on a 60km*60km area in the region of Niamey, Niger, characterized by 227 small endoreic catchments (from 0.05 to 50km^2). The first three types of simulation are based on the turning band method. The first one (NCS) consists of a non conditional simulation of rainfields. The second one (1CS) uses measurements of a raingauge to condition the simulations by one point values. The third one (MCS) uses the entire available raingauge network to condition

the simulations by multiple point values. The last one (DIS) is based on the Gibbs sampling method that allows spatial disaggregation of rain fields conditioned by a mean spatial value. The simulated rainfields are then used to force a hydrological model calibrated for the area studied. The simulations are calibrated using high-resolution rainfall data collected in the region during the period 1990-2002 from which 546 rainfall events are extracted. In order to take into account the dispersion of the stochastic models, 100 realizations are carried out for each event.

The mean characteristics of rainfields are retrieved by each method. However the dispersion of mean annual rainfall largely depends on the conditioning level of the simulations. The non linear rainfall-runoff relation amplifies the dispersion of the runoff responses. In the context of past climate impact studies, the use of a single point to condition the simulations (SC1) allows us to limit significantly the dispersion of the stochastic simulations compared to the NCS. The simulations conditioned by the mean spatial rainfall (DIS) seem to be the most constrained. This confirms their ability to disaggregate available data at coarse resolutions (e.g. satellite) or outputs of climate model output for studying the future climate change impacts.