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APPLICATION OF THE GIBBS SAMPLER TO CONDITIONAL SIMULATION OF SAHELAN RAIN FIELDS

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The drought that struck the Sahelian region of West Africa for almost 30 years, starting at the end of the 60's, has been widely documented using large scale observations as well as local high resolution data obtained from such experiments as HAPEX-Sahel and EPSAT-Niger. While this drought went somewhat abated in the end of the 90's, the fragility of the Sahelian ecosystem and the chronic deficit in water resources require to anticipate possible episodes of similar or harsher drought in the future, whether linked to global climate change or the regional impact of land use modifications.

GCM's are currently the only tool available for obtaining possible rainfall scenarios over the Sahel for the next century. However their coarse resolution imposes to develop models that will provide rainfall fields at a scale more compatible with the requirements of hydrological models. Despite the improving performances of regional atmospheric models, stochastic approaches remain a powerful tool to carry out sensitivity studies regarding the impact of GCM's rainfall scenarios onto regional water resources, mainly because several decades of rain may be simulated in a row. Building on a disaggregation model previously developed for the Sahel, some mathematical problems related to the conditioning of the turning band algorithm (TBM) used in this earlier version are presented here, as well as a technique used to solve them.

The TBM is replaced by a Gibbs sampler, which tackle the conditioning issue by sampling from a multivariate density $\mathbf{f(x)}$ for an n-dimensional random vector $\mathbf{x}$. As a preliminary step, the Gibbs sampler is described mathematically by its iteration kernel. A brief review of the Gibbs algorithm is given, which emphasize the stationary properties, transition probability, conditional distributions and convergence criteria. Subsequently it is shown how the stochastic space-time disaggregation model obtained by replacing the TBM algorithm by the Gibbs sampler provides an elegant and convenient answer to the conditional simulation of meta-gaussian rain fields. In order to explore the efficiency of the model, it is tested on a sample of Sahelian rainfields observed during the EPSAT-Niger experiment. The proposed validation of the model permits to compare observed and simulated rainfield statistics obtained for various space scales.

Submitted by
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Convective wind system with aerosols, named "haboob", Hombori in Mali, West Africa.