Geophysical Research Abstracts
Vol. 21, EGU2019-9193, 2019
EGU General Assembly 2019

A precipitation and temperature stochastic weather generator: application to streamflow simulation

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Anticipating both energy consumption and renewable energy productions requires long time series of consistent evolution of different climate variables, including temperature and precipitation. Indeed, temperature is a key variable when it comes to modeling electricity consumption while precipitation is a key variable for modeling hydroelectric production. A bivariate generator of daily temperature and rainfall has been developed in collaboration with Paris-Sud University in the framework of a PhD thesis. Based on hidden Markov models, it is able to produce arbitrarily long daily temperature and rainfall simulations which reasonably well reproduce different features of observed time series at a single site. At this stage of development, the use of a hydrological model has proved useful for the following two reasons: on the one hand streamflow modeling is an essential step towards the modeling of hydroelectric production. On the other hand, the hydrological model makes it possible to challenge the quality of the bivariate generator. Indeed, many hydrological processes depend on the good temporal structure of the input data (good intermittence of precipitation, good cross-correlation between precipitation and temperature, etc.). The model was applied to two catchments in the French Alps. First, it was fitted using the historical data of precipitation and temperature. Then, the synthetic times series of temperature and precipitations produced by the weather generator were used as inputs of a hydrological model which then outputs simulations of snow cover and streamflow. This methodology provides realistic simulations for these two variables at different times scales. To go further, the modelling framework can be adapted to the addition of other key variables for energy production such as wind and solar radiation.