
Comparing a statistical weather generator and multiple runs of global climate models to characterize hydrological low flows: A case study in the Loire catchment (France)

Ludovic Delabre¹, Alexandre Devers^{*2}, and Joel Gailhard¹

¹EDF - Division Technique Générale – EDF DTG – France

²EDF - Division Technique Générale – EDF DTG – France

Abstract

Understanding and quantifying severe low flows is crucial for the management of hydropower or thermal power plants. Moreover, low flows are strongly related to the climatic regime and will be affected by climate change. However, the strong interannual variability of low flows, combined with the limited length of observational records, hinders robust characterization based solely on historical data. Hydrological modeling offers an alternative to provide long timeseries of pseudo-observation but require long term meteorological inputs such as precipitation and temperature.

This study explores two approaches to generate long meteorological time series: (1) statistical weather generators calibrated on in-situ observations, and (2) ensembles derived from two global climate models, each comprising 50 members following the SMILEs method (Single-Model Initial-condition Large Ensembles). Both climate datasets are used to drive a lumped conceptual hydrological model, MORDOR-SD, to simulate long-term daily discharge series. The analysis focuses on the Loire River catchment in central France over the 1955–2015 period.

The resulting precipitation, temperature, and discharge time series are compared, with particular attention to low-flow characteristics. The comparison emphasizes annual minima (and maxima for temperature) over multi-day periods, with analyses of trends and return period estimations. The study highlights the strengths and limitations of each approach, both in terms of usability and their ability to produce robust estimates of low-flow characteristics for various return periods.

Keywords: weather generators, gcm, hydrological modeling, precipitation, temperature, discharge

^{*}Speaker