A space-time simulator of daily temperature designed for mountain climatology

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Abstract

We present a space-time stochastic model for the generation of average daily temperature, which is specifically designed for mountainous regions. The proposed generator is applied to the Isère River catchment at Grenoble, in the northern French Alps (5800km^2). The catchment altitude ranges from 200 m in Grenoble to more than 3800 m in the Vanoise national Park. The proposed generator comprises four main steps : fitting the marginal distribution at station location (28 stations in and around the catchment), mapping the subsequent parameters to get marginal temperature distribution at any grid point, transforming the station residual series to Gaussian variates, fitting the space-time correlation in the Gaussian world. The marginal model includes climatic trends, seasonality, and a flexible parametric distribution with the Skewed Generalized Error Distribution for the residuals to the seasonal regime. The subsequent parameters are mapped with Thin Plate Splines with the possibility, when statistically relevant, to add an altitudinal drift. Both the marginal and space-time components of the model are conditioned on a daily classification into three main weather types affecting the region, namely the Atlantic, Mediterranean and unstructured (Anticyclonic) circulations. Furthermore, as the generator is aimed to be used later in conjunction with a precipitation generator to feed an hydrological model, some parameters are conditioned on the fact that days are wet or dry.

The model is validated in a cross-validation framework and some results are highlighted such as the changing probability of hotspells at different altitudes.

Keywords: TEMPSIM, Skewed Generalized Error Distribution, Weather Types

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