



Stochastic modelling of evaporation based on copulas

Minh Tu Pham (1), Hilde Vernieuwe (2), Bernard De Baets (2), and Niko Verhoest (1)

(1) Ghent University, Laboratory of Hydrology and Water Management, Ghent, Belgium (MinhTu.Pham@UGent.be), (2) Ghent University, Department of Mathematical Modelling, Statistics and Bioinformatics, Ghent, Belgium

Evapotranspiration is an important process in the water cycle that represents a considerable amount of moisture lost through evaporation from the soil surface and transpiration from plants in a watershed. Therefore, an accurate estimate of evapotranspiration rates is necessary, along with precipitation data, for running hydrological models. Often, daily reference evapotranspiration is modelled based on the Penman, Priestley-Taylor or Hargreaves equation. However, each of these models requires extensive input data, such as daily mean temperature, wind speed, relative humidity and solar radiation. Yet, in design studies, such data is unavailable in case stochastically generated time series of precipitation are used to force a hydrologic model. In the latter case, an alternative model approach is needed that allows for generating evapotranspiration data that are consistent with the accompanying precipitation data. This contribution presents such an approach in which the statistical dependence between evapotranspiration, temperature and precipitation is described by three- and four-dimensional vine copulas.

Based on a case study of 72 years of evapotranspiration, temperature and precipitation data, observed in Uccle, Belgium, it was found that canonical vine copulas (C-Vines) in which bivariate Frank copulas are employed perform very well in preserving the dependencies between variables. While 4-dimensional C-Vine copulas performed best in simulating time series of evapotranspiration, a 3-dimensional C-Vine copula (relating evapotranspiration, daily precipitation depth and temperature) still allows for modelling evapotranspiration, though with larger error statistics.