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Temporal disaggregation of daily meteorological data to 15-minute intervals for use in hydrological models

R.A. Goler (1,2) and H. Formayer (1)

(1) Institute of Meteorology, University of Natural Resources and Life Sciences, 1190 Vienna, Austria (robert.goler@boku.ac.at), (2) alpS Centre for Climate Change Adaption Technologies, Innsbruck, Austria

The focus of the SeRAC-CC project is on the impact of climate change on the behaviour of the hydrological systems of small alpine catchments (several square km). This will be assessed by modelling three eastern Alpine catchment areas differing in altitude and precipitation regime. Climate scenario data is provided by three regional climate models, which, after bias correction and localization, have a spatial resolution of 1 km. However, the daily time interval of this data is too coarse to adequately examine the short-term run-off response of catchments of this size, especially in case of heavy precipitation produced by convective processes.

Based on physically realistic representations of the daily variations of each variable, temporal disaggregation techniques are used to regenerate the climate data at 15-minute time intervals. Temperature is disaggregated using three piecewise continuous cosine curves based on the available minimum and maximum temperature of each day. A cosine profile is also used to disaggregate wind speed and downwelling shortwave radiation, with both functions peaking at local noon. Precipitation is disaggregated based on the method of fragments and specific heavy precipitation events, and relative humidity is based on calculations of the actual and saturated vapour pressures, which themselves are derived from the temperature distribution.

This resulting data set is shown to compare statistically well with the ten-minute observations from nearby weather stations, and thus provides confidence for their use as input into the hydrological models.