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Temporal disaggregation of meteorological data – exploiting daily measurements for (sub-) hourly process-based hydrological models

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While data scarcity is mostly related to a low spatial density of meteorological stations or short record lengths, challenges in hydrological studies sometimes also arise from a too low temporal resolution of input data. This holds especially true in case of processes that are subjected to high dynamics at sub-daily temporal scales. Typical examples include flooding in catchments with a short time of concentration or the energy balance of snow which strongly depends on the sub-daily variability of several meteorological quantities. However, the availability of sub-daily meteorological data is generally lower compared to daily time series, especially prior to the standardization of automatic weather stations in the last two decades. In this presentation we show what we can learn from data obtained within this relatively short period of time covered by automatic weather stations and – based on that – how we can better exploit the information content included in multi-decadal long-term daily observations for hydrological simulations at a sub-daily temporal resolution. We present an updated version of the open-source MEteoroLOgical observation time series DISaggregation Tool (MELODIST) which is written in Python (https://github.com/kristianfoerster/melodist). It is capable of disaggregating daily time series of (i) temperature, (ii) precipitation, (iii) relative humidity, (iv) wind speed, and (v) radiation in order to derive respective hourly time series. For each meteorological quantity different options exist including deterministic, statistical or stochastic approaches. While the first version of MELODIST (0.1.0) was already presented at EGU2016, a lot of practical requirements have led to the development of new methods which are now included in the most recent version (0.1.3). Most of the new features are outcomes of applications in hydrological modelling that emerged under data scarcity in terms of temporal resolution. New disaggregation methods include a better “learning” from highly resolved short time series to better exploit long-term daily series and refining precipitation time series in order to achieve a time step of 5 minutes. This presentation gives an overview about the software and case studies in hydrological modelling with emphasis on different applications in glaciology and urban hydrology.