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Providing daily updated weather data for online risk assessment

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Daily weather data are an important constraint for diverse applications in ecosystem research. In particular, temperature and precipitation are the main drivers for forest ecosystem productivity. Mechanistic modeling theory heavily relies on daily values for minimum and maximum temperatures, precipitation, incident solar radiation and vapor pressure. These data are usually provided by interpolation techniques using measured values from surrounding stations or weather generators based on monthly mean values. One well-known and frequently used software packages is DAYMET which was adapted and validated for Austrian purposes. The calculation includes the interpolation of maximum and minimum temperature and precipitation based on near-by measurements and the subsequent extrapolation of incident solar radiation and vapor pressure deficit based on the temperature and precipitation values. The Austrian version of DAYMET uses daily weather data from more than 400 measuring stations all over Austria from 1960 to 2005.

Due to internal procedures of DAYMET daily values for a whole year are estimated together; thus, the update of the database may only be done with full year records. Whether this approach convenient for retrospective modeling studies risk assessment (e.g. drought stress, forest fire, insect outbreaks) needs a higher update frequency than a full year. At best the measurements would be available immediately after they are taken. In practice the update frequency is limited by the operational provision of daily weather data.

The aim of this study is to implement a concept for providing daily updated weather data as it could be used for continuous risk assessment. First we built a new climate database containing all available daily measurements. It is based on a well-established Relational Database Management System (RDBMS) and may be accessed and extended using the Standard Query Language (SQL). Secondly, we re-implemented the interpolation logic for temperature and precipitation. Incident solar radiation and vapor pressure deficit were calculated with the same procedure as used in DAYMET adjusted to the new data handling. Cross validation is used to obtain optimal parameters but also for rough accuracy estimation of the generated daily weather data. A validation including detailed residual analyses is done using a set of 23 independent climate stations. The results are comparable with the original procedure and allow an online calculation of the needed parameters.