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A high-resolution European dataset for hydrologic modeling

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There is an increasing demand for large scale hydrological models not only in the field of modeling the impact of climate change on water resources but also for disaster risk assessments and flood or drought early warning systems. These large scale models need to be calibrated and verified against large amounts of observations in order to judge their capabilities to predict the future. However, the creation of large scale datasets is challenging for it requires collection, harmonization, and quality checking of large amounts of observations. For this reason, only a limited number of such datasets exist.
In this work, we present a pan European, high-resolution gridded dataset of meteorological observations (EFAS-Meteo) which was designed with the aim to drive a large scale hydrological model. Similar European and global gridded datasets already exist, such as the HadGHCND (Caesar et al., 2006), the JRC MARS-STAT database (van der Goot and Orlandi, 2003) and the E-OBS gridded dataset (Haylock et al., 2008). However, none of those provide similarly high spatial resolution and/or a complete set of variables to force a hydrologic model. EFAS-Meteo contains daily maps of precipitation, surface temperature (mean, minimum and maximum), wind speed and vapour pressure at a spatial grid resolution of 5 x 5 km for the time period 1 January 1990 – 31 December 2011. It furthermore contains calculated radiation, which is calculated by using a staggered approach depending on the availability of sunshine duration, cloud cover and minimum and maximum temperature, and evapotranspiration (potential evapotranspiration, bare soil and open water evapotranspiration). The potential evapotranspiration was calculated using the Penman-Monteith equation with the above-mentioned meteorological variables. The dataset was created as part of the development of the European Flood Awareness System (EFAS) and has been continuously updated throughout the last years. The dataset variables are used as inputs to the hydrological calibration and validation of EFAS as well as for establishing long-term discharge "proxy" climatologies which can then in turn be used for statistical analysis to derive return periods or other time series derivatives. In addition, this dataset will be used to assess climatological trends in Europe.
Unfortunately, to date no baseline dataset at the European scale exists to test the quality of the herein presented data. Hence, a comparison against other existing datasets can therefore only be an indication of data quality. Due to availability, a comparison was made for precipitation and temperature only, arguably the most important meteorological drivers for hydrologic models. A variety of analyses was undertaken at country scale against data reported to EUROSTAT and E-OBS datasets. The comparison revealed that while the datasets showed overall similar temporal and spatial patterns, there were some differences in magnitudes especially for precipitation. It is not straightforward to define the specific cause for these differences. However, in most cases the comparatively low observation station density appears to be the principal reason for the differences in magnitude.