A daily homogenized temperature and precipitation data set for Norway

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Abstract
Homogeneity is important when analyzing climatic long-term time series. This is to ensure that the variability in the time series is not affected by changes such as station relocations, instrumentation changes and changes in the surroundings. The objective for this study is to establish methods to homogenize daily temperatures and precipitation in Norway. The motivation for this study was an interest from the largest Norwegian energy company, Statkraft.

One major concern of climate change is the possible rise of temperature extreme events, in terms of occurrence and intensity. To study this phenomenon, reliable daily series are required, for instance to compute daily-based indices such as high-order quantiles and annual extremes. Because observed series are likely to be affected by changes in the measurement conditions, e.g. change of temperature sensors from MITEF to Milos, then adapted homogenization procedures are required (Mestre et al, 2011).

Time series of precipitation and temperature from 1930 to date forms the basis for all long-term modeling of hydrological inflow to Statkrafts hydropower system. These time series forms the basis for the calibration of hydrological models, and are applied to calculate climatologies applied in long term inflow forecasting and climate analysis. Homogeneous and spatially consistent precipitation, temperature and inflow based on best available data will strengthen Statkraft’s energy optimization and energy trading.

The objective of this project was to establish and facilitate homogeneous daily series of temperature and precipitation to be applied in Statkraft’s hydrological model system:
- Develop methodology to establish "homogenized" daily values of precipitation and temperature for arbitrary locations / catchment.
- Establish and ensure the quality tools to identify and adjust for homogeneity violations.
- Produce homogenized daily values of temperature and precipitation for a number of long climatic series for selected locations in Norway. Locations in Norway relevant for Statkraft were selected. The consumption temperature is very important for the energy production and prize setting in energy demand; therefore it selects areas with the greatest population. This again would say the biggest cities in Norway. 5 locations are used in the daily homogenization of temperature analysis: Oslo, Bergen, Kristiansand, Trondheim and Tromsø. For precipitation also 5 locations were chosen. They represent areas with high precipitation and the greatest energy production for Statkraft and areas which has big errors in the precipitation forecasts. These places are used in the analysis: Sauda, Takle, Fokstugu, Mo i Rana and Bardufoss. Currently only a few statistical methods exist to help homogenize daily climate data for temperature and precipitation. Homogenization methods on a daily basis are scarce and often disregard uncertainties accompanying the break adjustment. We have tested three different methods: SPLIDHOM, MASH, RHTEST in the project with Statkraft for two parameters (Precipitation and temperature). The study proposes to apply SPLIDHOM to homogenize daily temperature series in Norway. This method relies on an indirect nonlinear regression method. Estimation of the regression functions is performed by cubic smoothing splines. It is able to adjust the mean of the series as well as high-order quantiles and moments of the series (Mestre et al, 2011). In general, the mean over the temperature dependent adjustments of all stations show a temperature reduction partly due to the absence of extreme temperatures. For precipitation we suggest to apply RHTest_dlyPrcp which is specifically designed for homogenization of daily precipitation time series. Since daily precipitation is not a continuous process, discontinuities in the occurrence frequency of precipitation might exist and should be dealt with first to avoid complicating the homogenization of daily precipitation data time series (Wang et al., 2009). The discussion around and the results of the analysis will be presented.