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Effects of changing the observing instrument for daily sunshine duration on the homogeneity of time series

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In studies of climate change long time series are required. These time series should include as less changes in the measurement condition as possible. Some changes can not be prevented. At German climate reference stations, parallel measurements are used to analyze the effect of changes in the measurement systems for example from manual to automatic measuring instruments. The aims of the parallel measurements are to identify measurement uncertainties and analyze the comparability of measurement systems to investigate the homogeneity.

In this presentation we will show results for the parameter daily sunshine duration. The daily sunshine duration is measured manually with a Campbell-Stokes sunshine recorder. For automatic measurements the SONI instrument is used. The different measurement principles (glass sphere and photo diode) cause systematic differences between the measurement systems. During summer the manual observations are larger especially in the case of frequent changes between sunny and cloudy conditions. Furthermore the standard deviation of the differences between the two measurement systems is larger during summer because of the seasonal cycle of the day length over the year. To adjust the automatic measurements a linear regression model is used based on parallel measurements from 13 climate reference stations in Germany. To validate the regression coefficients a cross validation was made by leaving out data of single stations. The regression coefficients using different compositions of stations are similar which indicates a trustable dataset to estimate the linear model. With this method we want to prevent breaks in long time series caused by instrumental changes from manual to automatic measurements.