CS8 - Time series information

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Background

Datasets including long time series of meteorological variables form the basis for infrastructural design and studies into climate change and its effects. Unfortunately those datasets are scarce. This especially holds when one is interested in extremes because these require high quality data. The Netherlands is one of the few countries for which data of sufficient length and spatial and temporal resolution are available. However, a large proportion of the data is only available as hard copy and therefore not readily available to researchers and the wider public. The CS8 project aims to rectify this situation. In CS8 four data sources have been digitized, checked for quality and, where necessary, homogenized. For some sources, relevant statistical parameters are also determined and used to describe the present climate, including extremes.

Daily precipitation 1850-1950

KNMI measures daily precipitation since about 1850. In the 1850-1950 period, the network gradually increased to its present density of about 325 rain gauges. The measurements are taken by voluntary observers every morning at 8:00 UTC. Within the CS8 project, all pre-1951 precipitation were digitized and quality controlled.

The new dataset extends the post-1950 data a hundred years back in time with about 12300 station years (4.5 million measurements). Special attention is given to the homogenization and analysis of this dataset. The dataset can serve several purposes, such as: the calculation of design standards for dikes, canals and drainage systems; the calculation of a base-line climate in climate impact studies; the validation of (regional) climate models; and the assessment of precipitation trends and variability and their areal distribution.

High-resolution precipitation from rainfall strip charts

Self-recording rain gauges (Figure 1) have been applied for continuous rainfall measurements at a selected set of KNMI stations since the end of the 19th century. At first, rainfall was recorded on daily (Figure 2) and sometimes weekly rainfall strip charts. Thereafter, from about 1980 through 1993, paper rolls were used containing the rainfall registration for about 10-20 days. Finally, from 1994 onwards rainfall measurements are transferred electronically and operationally stored at 10-minutes resolution. Until now, the strip charts and paper rolls have been used mostly for extracting hourly values. In infrastructural design (e.g. sewer systems, tunnel drainage) there is, however, a need for long high-resolution rainfall series with resolutions much higher than 1 hour.

Figure 1. Example of a self-recording rain gauge (without lid).

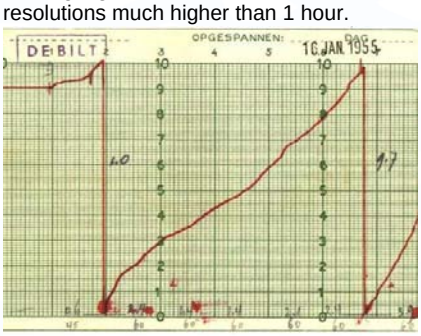

Figure 2. Part of the daily rainfall strip chart of De Bilt of 16 January 1955.

In CS8 we created a dataset with 321 station years of 5-minute precipitation from the 20th century rainfall strip charts and paper rolls of the following stations: De Bilt, Eelde, Den Helder/De Kooy, Vlissingen, Beek and Amsterdam.

Because of the labor-intensive extraction work, we developed an automatic curve extraction (ACE) algorithm for processing bulk quantities of rainfall strip charts and rolls. The framework largely automates the processing of rainfall curves on the strip charts and paper rolls and can be applied to other elements as well.

Pre-1850 meteorological measurements

CS8 also digitized part of the old pre-1850 measurements in the Netherlands. For the reconstruction of the pre-1850 climate, it is important to have as many as possible parallel time series available. The digitization of this kind of data is labor-intensive because of the mostly hand-written base material and the non-standard way of observing like the use of old units and standards, irregular observation times and (sometimes) the use of Latin as writing language (see Figure 3 for an example).

Data files have been created with (sub)daily meteorological measurements/ observations (corrected for typing errors) of 13 stations in the Netherlands in the pre-1850 period. In total it concerns about 150 station years and 110.000 measurements. The digital images of the hardcopy source material enable the user of the data to go back to the original data source.

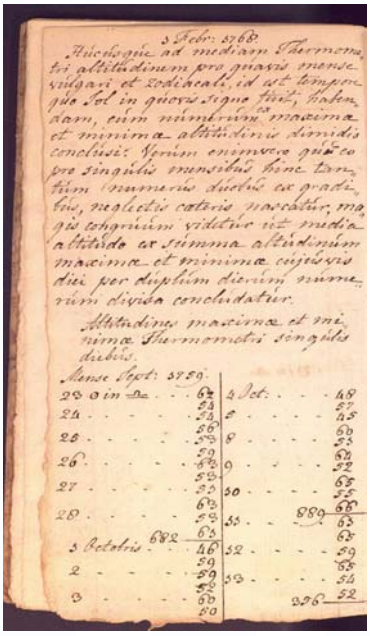

Figure 3. Example page from the weather diary of Jan Carel van der Muelen. The weather observations (partly in Latin) and measurements are taken partly in Utrecht and partly in Driebergen and cover the period 1759–1810.

Hourly observations of Batavia/Jakarta (1866-1970)

CS8 digitized the hourly temperature measurements of Batavia/Jakarta in Indonesia in the 1866-1980 period. Indonesia is situated in a data-sparse area where long time series are scarce. These series are, however, needed to validate climate models for that area, to construct a baseline climate and to develop climate scenarios. The KNMI archives contain a large amount of hardcopy meteorological observations and measurements for Indonesia for the 1850-1980 period. The larger part of the data is being digitized within in a cooperation between KNMI and the Indonesian meteorological office BMKG (see www.didah.org).

The dataset delivered by CS8 contains the hourly air temperature measurements of Batavia/Jakarta for the 1866-1980 period (about 102 station years, 894.120 measurements). The digitized data show a warming trend of about 1.5°C in the 1866-1980 period, which is much larger than the global warming trend in that period. A comparison of the mean diurnal cycles in non-overlapping 30-periods show that the warming is mainly visible in the daytime temperatures.

The data of this area is also being collected in the Southeast Asian Climate Assessment & Dataset (SACA&D), which enables extreme event analysis in the region (see http://saca-bmkg.knmi.nl).