Computer aided determination of 0:00 to 24:00 local time minimum and maximum temperatures from old time thermograms

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Since 1950 it is common practise in the Netherlands to use 0:00 – 24:00 UTC minimum and maximum temperature in describing a part of the climate. With the modern equipment of today this is an easy job to do. In former days the only equipment available was the mercury thermometer together with a minimum and maximum thermometer. The mercury thermometer was read three times a day during daylight hours. With the first reading of the mercury thermometer also the minimum and maximum thermometer were read and reset afterwards in order to determine the minimum and maximum temperature of the last 24 hours. Since 1906 this scheme was extended to read and reset the minimum and maximum thermometer every time the mercury thermometer was read. Moreover on some meteorological/climatological stations the thermograph was introduced in order to get hourly data. These hourly data and the three times a day readings of the mercury, minimum and maximum thermometer are available in a digital format.

In studies on climate change and variability it is desirable to use data on the same time scale and period throughout the whole era of study. Because of the close vicinity, local time in the Netherlands can be considered sufficient close to the preferential UTC. The calculation of daily average temperatures since 1906 for a recurrent period of 0:00 to 24:00 local time is easy to do, because the necessary hourly data is digital available. The determination of the minimum and maximum temperature for the same recurrent periods is less easy. The thermograms of the five principal climatological stations, still available in the KNMI archive, can be used to do this job. However the reading of all the thermograms for such a long period of time will be time consuming. A more efficient approach could be the use of the available digital data together with a smart computer program.

In the program a method, which will be explained during the presentation, is used to estimate the minimum and maximum temperature between 0:00 and 24:00 local time daily together with a valuation from the available digital data. The valuations are categorized into: certain, almost certain, likely and indeterminate. For the minima and maxima in the last two categories the proper readings are subsequently taken from the thermograms manually. Manual processes are prone to mistakes. Therefore another

computer program is developed for the validation of the manually obtained results. As will be explained during the presentation, the available data makes it possible to determine an upper and lower limit for each daily minimum and maximum temperature. These limits are used to validate the manually obtained results.

The data between 1906 and 1952 of climatological station Maastricht have been processed with the methods described above. 29% of the minima and 6% of the maxima appeared to fall in the categories likely and indeterminate and needed therefore new thermogram readings. These figures proof a tremendous reduction on costly manual labour. Especially for the maxima a giant reduction is feasible. After finishing the thermogram readings only 2% of all estimates for the minimum temperature appeared to need a correction. For the maximum temperature this figured appeared to be 0.3%. Also in this way the computer program seems to be highly efficient. The validation program proofed its usefulness in detecting a few mistakes in the thermogram readings.