German Contribution to the international ACSYS Project

A project funded by the Federal Ministry of Education and Research : Bundesministerium für Bildung und Forschung bmb+f

The Arctic Precipitation Data Archive APDA - status quo and outlook

Hermann Mächel and Bruno Rudolf

German Weather Service, Global Precipitation Climatology Centre (GPCC), Postfach 100465, 63004 Offenbach a.M.
Email: bruno.rudolf@dwd.de

APDA (Arctic Precipitation Data Archive) is a subproject of the German ACSYS contribution and will provide a precipitation climatology (rain and snow, 1950-2000) for the hydrological regime of the Arctic drainage system in a 100 x 100 km EASE grid. It can serve as a basis to investigate the energy and water cycle of the arctic climate system and to validate satellite and model data in this region. To guarantee a high accuracy of the gridded data a quality control and correction of the systematic error will be applied to the precipitation data. The systematic error is very important (for snow the error can reaches up to 50% of the total amount). This error is primarily caused by wind, the phase of the precipitation and the used instruments. Therefore the systematic error is different for each country and month.

The gridded data will be available at the beginning of the year 2004 on the GPCC web site: http://gpcc.dwd.de under menu item APDA.

1. Status quo

The previous work includes the acquisition of precipitation data for the arctic drainage basin (for a detailed list see the poster "**Available data at the Arctic Precipitation Data Archive APDA**" or our web site) and the conversion in a standardized format. A comparison of the obtained data was necessary because the data originate from different sources (GDCN, CRU, FAO and national weather services) which partly contain the same stations. Some preliminary work for correcting the systematic error and for interpolating the data on a equal area grid has also been carried out.

An overview of the available data is shown in the following figures. The temporal evolution of the number of stations (**a** for the grid and **b** for the arctic basin) shows only since the 1950 a sufficient station density. Since the 1990 the number of stations decreases due to station closings and outstanding updates. The spatial distribution of the stations (**c**) shows a clear decrease of the station density to the north.

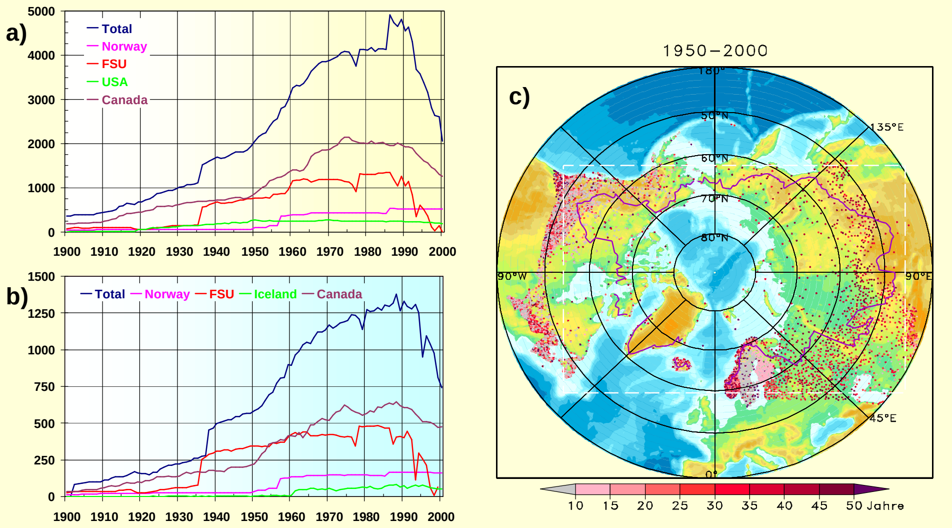

Fig. 1: Temporal evolution of the number of stations for the grid area (**a**, white rectangle in c) and the arctic drainage basin (**b**, magenta line in c) as well as their spatial distribution (**c**).

2. Quality controlling

Before correcting and interpolating the station values a careful quality control is necessary. Currently there are 8520 stations in our archive, with only 4000 simultaneous measuring stations between 1970 and 1990 (fig. 1 a, b). This amount of data can only be checked automatically. The meta data of the stations (for their exact identification, e.g.: station name, coordinates, station elevation) from the different sources must be checked against those from national weather services and the WMO-station catalogue.

To check one station against others (for outliers and inhomogeneities) one need to find areas with similar precipitation variability. Therefore longer time series are regionalized with a principal component analysis. The orthogonal rotated components for Norway (243 stations) for the period 1957-2000 is shown in figure 2. The search for outliers and inhomogeneities can thus be restricted to mangeable areas.

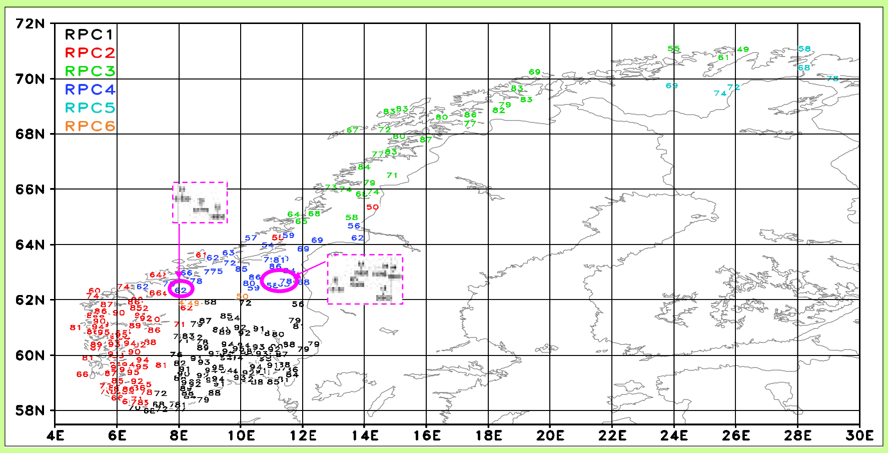

Fig. 2: Correlation coefficients (*100) between the rotated principal components (RPCs) and the station values for all month of the period 1957-2000

2.1 Outliers

Because of the high temporal variability of precipitation most of the methods for identifying outliers, e.g. the threshold values ± 3.5 s, are not applicable (fig. 3 top). The precipitation at station Eikesdal (61850, Norway) in July 1983 lies between ± 3.5 s, but differs significantly from their neighboring stations and can be judged as outlier. In contrast to this the value in March 1961 at the station Aursund (10600, fig. 3 bottom) lies outside the 3.5 s threshold value and seems to be at first sight an artifact. By adding a third neighboring station (Vauldalen, 10900 with 96.7 mm/month, purple square), the „outlier" can be rehabilitated.

Outliers can also be detect through the lower correlation coefficients with neighboring stations or principal components.

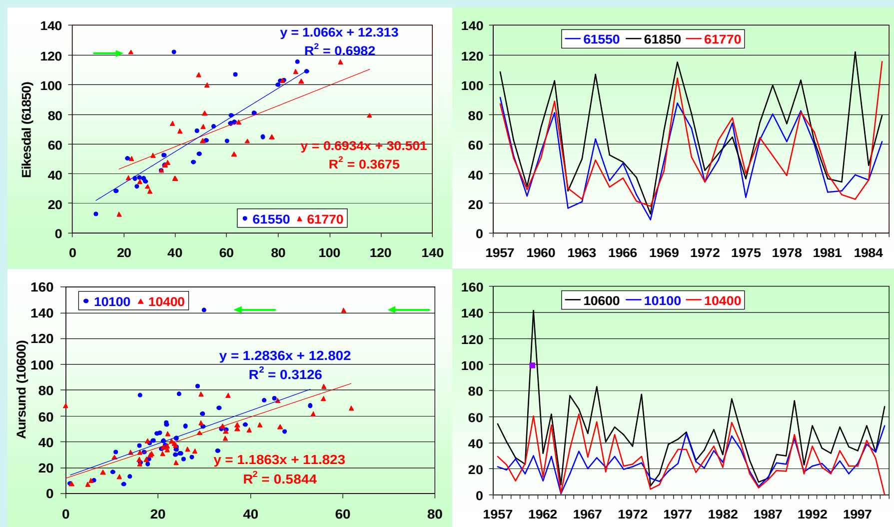

Fig. 3: Examples for identification of outliers; **top**: station Eikesdal (61850, y) in comparison with neighboring stations (x) in July of the period 1957-1985 and **bottom**: station Aursund (10600, y) in comparison with neighboring stations (x) for March of the period 1957-2000. (The spatial distribution of the stations is shown in fig. 2)

2.2 Tests of Homogeneity

Investigations of the hydrological cycle require long and homogeneous precipitation time series. Many stations (fig. 4) are contaminated by non climatic effects e. g. changes in measuring and analysis methods, (coding), observer changes, station relocations, changes in the surrounding area and recently by the automation of the instruments and methods of data archiving (updates in a databank). Therefore homogeneity testing is absolutely necessary. One of the most popular test is the "standard normal homogeneity test" (SNHT) according to Alexandersson (1986, Alexandersson & Moberg, 1997).

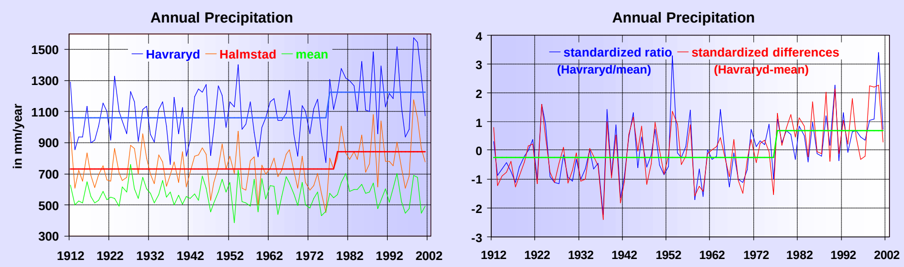

Fig. 4: Examples of inhomogeneous precipitation time series for Sweden (mean = average of 3 neighboring stations). The comparison with a homogeneous series suppresses simultaneous climatic changes and visualizes inhomogeneities.

References

Alexandersson, H., 1986: A homogeneity test applied to precipitation data. *J. Climatol.*, **6,** 661-675.

Alexandersson H., A. Moberg 1997: Homogenization of Swedish temperature data. Part I: Homogeneity test for linear trends. *Int. J. Climatol.*, **17,** 25-34.

Herzog, J., G. Müller-Westermeier 1998: Homogenitätsprüfung und Homogenisierung klimatologischer Meßreihen im Deutschen Wetterdienst. Berichte des Deutschen Wetterdienstes Nr. 202. Selbstverlag des Deutschen Wetterdienstes, Offenbach.