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Signals of climate change and variability in the Icelandic discharge records

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In the study reported in this paper the long term variability of streamflow in Icelandic rivers is analyzed, in particular with respect to trend. The study is part of a nordic project, Climate and Energy (CE), where the statistical analysis of long time series for hydrological characteristics affected by climate play an important role. The object is to detect variability and trend in the time series and relate these changes to climatic variability.

As a first step, time series from twenty gauging station in Iceland were analyzed. The stations were selected as the gauging stations with the longest records of streamflow data and at the same time being of good quality as well as giving a reasonable geographical distrubution around the country.

In this paper two periods are considered in accordance with the CE-project, the period 1941-2002 and the period 1961-2000. As systematic hydrometric measurements only started in Iceland as late as 1947, there are not many very long time series of streamflow in the data base. For the period 1941-2002 only two of the twenty time series can be used and for the period 1961-2000 we have only eleven time series.

The long term variability is studied using spectral analysis and also observing Gauss-filtered averages of streamflow, with the parameter σ = 3 years. From this analysis it is apparent that there is a periodic variation in the discharge at many stations. In particular one observes a period of approximately twenty years in the variability of streamflow in the mainly spring-fed rivers in the southern and western part of Iceland, but there appears to be also a seven year period in some of the other rivers that are either mainly direct run-off rivers or glacial rivers.

An eventual trend in the streamflow is analyzed using the Mann-Kendall test. The test is applied to the direct streamflow data, both annual and seasonal values, and also to the timing of spring and autumn maximum daily discharge.The result of the trend analysis is that there is not a significant trend, on the 95% confidence level, towards increasing or decreasing streamflow for most of the stations. In fact only two stations show a significant trend in the annual values, wheras one shows a significant decrease. For the seasonal discharge values, the results are similar with four stations showing significant trend. As for the timing of the spring maximum daily discharge there is only one time series that shows significant change towards a later date but eight series show a trend at the 70% confidence level towards a later date and only one series towards an earlier date. For the autumn floods there is no station showing significant trend in the timing of the maximum flood and only three time series show a trend at the 70% confidence level, one towards a later date and two towards an earlier date.

The hope is that this study will be of importance for the further study of the effects of climate change in northern Europe, in particular in the Nordic countries, where this analysis will be used on data from other regions. It is also important to analyze the trends and variability in the streamflow data in relation to meteorological measurements of precipitation and temperature as well as to other climatic indicators such as the North Atlantic Oscillation (NAO) index.