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Signals of climate change and variability in the Icelandic discharge records

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In this paper the long term variability of discharge in Icelandic rivers is analysed, in particular with respect to trend. The study is part of a Nordic cooperative research project, Climate and Energy (CE), where the statistical analysis of long time series of hydrological variables 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 analysed. The stations were selected as the gauging stations with the longest records of discharge data and at the same time being of good quality as well as giving a reasonable geographical distribution around the country and representing rivers of varying characteristics. The long term variability is studied using spectral analysis and also by observing Gauss-filtered moving averages of discharge. 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 fifteen to twenty years in the variability of discharge in the mainly groundwater-fed rivers in the southern and western part of Iceland, but there also appears to be a seven year period in some of the glacial rivers.

For a trend analysis of discharge, 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, only two of the twenty time series can be used for the period 1941-2002 and for the period 1961-2000 there are only eleven time series. An eventual trend in the discharge is analysed using the Mann-Kendall test. The test is applied to the direct discharge data, both annual and seasonal values, and also to the timing of the maximum daily discharge in spring and

autumn, respectively. The general conclusion from the shorter period is that the summer discharge has been increasing for the past 40 years, however the annual values of discharge do not show clear trends. For the longer period the two stations analysed show significant but opposite trends, at the 95% confidence level, towards an increasing and decreasing discharge. As for the timing of the spring maximum daily discharge, most 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 only three stations show a trend towards an earlier flood and one towards a later flood. Trends in the magnitude of floods have not been studied yet.

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 the Nordic countries, where this framework of analysis is applied to data from other regions. The results of this study are also being used as a basis for the analysis of the trends and variability in the discharge 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.