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Change in the periodicity of the energy potential of watershed runoff from climate, land use and energy policy

Anders Wörman (1), Andrea Bottacin-Busolin (1), and Göran Lindström (2)

(1) The Royal Institute of Technology, Land and Water Resources, Stockholm, Sweden (worman@kth.se), (2) The Swedish Meteorological and Hydrological Institute, Norrköping, Sweden

Recent investigations show that landuse changes and hydropower regulation has caused significant changes in the runoff statistics in Swedish rivers during the 20th century. These changes are found to be more pronounced than the corresponding change that has occurred due to climatic changes and have implications to frequency of floods as well as the effectiveness of hydropower regulation. Because of the change towards a sustainable energy system with more intermittent energy sources, like windpower, the stress on the water availability will come from several climatic, technical and management factors. Here we use the coherence spectrum in river discharge to derive information on the variability in the energy potential over different periods (annually and monthly) and estimate the energy potential associated with the different terrestrial part of the hydrological cycle, such as land potential, stream flow potential and groundwater circulation potential. The overall stream flow potential in Sweden is estimated to be 145 TWh per year, but there is a significant variation in this potential over the land surface as well as temporally. The coherence spectrum between northern and southern rivers in Sweden approaches asymptotically about 20 – 25 % for long-term variations. This means that the coefficient of variation of the in annual discharge for the entire country is enhanced in comparison the coefficient of variation of the annual discharge from individual rivers. Tentative analyses of feasible hydropower potential indicate that the coherence of discharge is a significant factor for coordination and utilization of the water availability.