RECENT AND FUTURE REGIONAL CLIMATE VARIATIONS IN SWEDEN IN RELATION TO LARGE-SCALE CLIMATE

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ABSTRACT

Weather and climate play a crucial role for life on Earth. They are part of the human's daily perception and people are especially concerned with the climate in their region. The regional climate is determined by interactions of forcings and circulations occurring at a wide range of spatial and temporal scales. Through the Earth's history climate has undergone considerable natural changes. The past decades are characterized by globally increasing surface temperatures, a trend that coincides with rising concentrations of atmospheric green-house gases due to anthropogenic emissions. The question how and to what extent the climate will change in the future is therefore of greatest concern. To date Global Climate Models (GCM) are the primary tool to project future climate changes but their current spatial resolution is too coarse to satisfy the need for regional climate estimates. It is therefore necessary to infer local climate information from GCM output by means of statistical and dynamical downscaling. The overall aim of this thesis is to increase our understanding of the recent and the past regional climate in Sweden and its future changes. Two variables are studied here, precipitation and wind. The Swedish surface climate is largely influenced by the large-scale atmospheric circulation over the North Atlantic/European region. This link is applied in statistical downscaling of precipitation.

Statistical downscaling of a large number of GCMs suggests on average an increase in annual precipitation of 5-8% depending on region, but ranges between -5 to +25% taking the GCM-related uncertainty into account. In addition, statistical downscaling models developed for Scania suggest an increase in precipitation intensity in autumn and winter. Changes in the precipitation climate are generally related to stronger zonal flow, vorticity and increasing atmospheric moisture. Precipitation changes suggested by the dynamical model RCA-1 (Rossby Centre Regional Climate Model) are of the same magnitude as obtained from statistical downscaling. The RCA-1 control simulation was evaluated against observed precipitation in Scania. The model captures the geographical precipitation distribution only partly but improves the amplitude of the seasonal cycle compared to the driving GCMs.

The Swedish surface winds were studied for a two-year period using data from 142 synoptic stations. Monthly mean wind speeds range between 1 to 7 m/s. Speeds decrease quickly with increasing distance from the coast. Surface flow patterns vary with season and region. Their coherence largely depends on wind direction variability, which tends to be larger north of ~58-60°N. The spatial scale of wind was determined by means of pair-wise station correlation and ranges from~350 km for speed to ~500 km for direction based on all available station pairs. Scales for individual stations, however, may strongly deviate from these estimates.

KEYWORDS: statistical and dynamical downscaling, precipitation, surface winds, spatial scale