



Variability of temperature-derived climate indices in the Arctic – Observation and Regional Climate Model

Heidrun Matthes, Annette Rinke, and Klaus Dethloff

Alfred Wegener Institut, Atmospheric Circulation, Germany (heidrun.matthes@awi.de)

The Arctic has now generally been accepted as an area very sensitive to climate change. This includes changes in climate extremes. As extreme climate events directly impact on the residents, their investigation is important to understand ecological and societal changes. In this study, the focus is on understanding of the climate variability of extremes on a regional level.

The work presented here aims at providing results for temperature-based climate indices over the Arctic. On one hand, it is based on the ERA40 reanalysis data from ECMWF and Russian station data from the “Global Summary of the Day” data set provided by NCDC. On the other hand, output from the regional climate model (RCM) HIRHAM, applied over the Arctic domain, was used. The period 1958-2008 was analyzed. The detailed regional analysis for the Russian Arctic has its background in the EU project CARBO-North (<http://www.carbonorth.net/>) which aims at quantifying the carbon budget in Northern Russia.

Various climate indices were calculated from the data described above. Frost days and growing degree days are presented here, as examples of the analysis. The spatial analysis of frost days over the Arctic domain derived from ERA40 data clearly signs to a warming along the sea ice boundaries in both transition seasons. Over land, few areas with increasing frost days were found. Frost days show a high inter-annual variability; therefore only few significant trends could be calculated. Distinct regional differences in the variability as well as in the amount of frost days are discussed in the comparison of eastern and western Russian stations. The analysis of frost days calculated from HIRHAM output shows that the model captures both the spatial patterns and the year-to-year variability from the observations, though it overestimates their numbers over most of the model domain. The simulated trends are in adequate agreement with those from the observations.

The growing degree days as calculated from ERA40 data reflect the north-south temperature gradient in the Arctic and distinguishes the high mountain ranges in Alaska and eastern Siberia. Positive trends were calculated over most parts of the Arctic and are significant in some areas like northern Alaska and northeastern Canada. This is confirmed by the regional, station based analysis over Russia, though some of the calculated trends are not significant. Growing degree days are systematically underestimated by HIRHAM over the Arctic domain. However, the calculated spatial patterns as well as the trends and decadal-scale variability in the time series are well reproduced.