Geophysical Research Abstracts
Vol. 14, EGU2012-3453, 2012
EGU General Assembly 2012

Space-time variability in scaling aspects of surface air temperature records

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Long-range correlations in surface air temperature records reflect interactions among climate components, and their properties have been extensively studied for different regions. Relations between such properties and various geographical factors related to recording station positions have been established. On the other hand, the scaling properties of such temperature data may also significantly vary in time. In this paper, we explore the changes suffered by scaling aspects of surface air temperature patterns on different time scales, and compare the patterns of change for different spatial locations. To this end, we analyse homogenized daily minimum and maximum temperature time series from meteorological stations in two regions remotely located from each other: in North America (Atlantic Canada) and Eastern Europe (Romania). The two regions are geographically very different, and yet they share certain features of atmospheric circulation. Both are dominated by midlatitude westerlies, which reach them after covering a relatively large distance (thousands of kilometres) from the nearest ocean lying to the west. At the same time, they are subject to southerly and south-westerly flows originating over warm waters, as well as to colder northerly winds, while a water body to the east also exerts an influence on their climate (affecting the locations of some stations more than others). We apply detrended fluctuations analysis (DFA) and directed detrended fluctuations analysis (DDFA) to the daily temperature time series from 20 stations (10 for each region), using sliding windows of different sizes. We find that scaling exponents and scaling regimes change in time and vary from one location to the other. The temporal and spatial changes in long-range correlations are significant compared to the 95% certainty intervals for the scaling exponents. However, there are groups of stations characterized by similar changes in terms of scaling exponents. One can thus delimit regions affected by comparable temporal variability, even when the temperature values themselves are very different. By establishing and assessing long-range correlations in temperature variability and their change in space and time, this approach can support studies regarding factors involved in climate dynamics, as well as regional implications of climate change.