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Long range correlations in daily atmospheric temperature time series in the Canadian Arctic: regional vs. local effects

C. Suteanu (1) and M. Mandea (2)

(1) Saint Mary's University, Geography Dpt. & Environmental Science Program, Halifax, Canada (cristian.suteanu@smu.ca), (2) Centre National d'Etudes Spatiales, Paris, France

Numerous studies concerning the temporal variability in surface air temperature patterns have identified long-range correlations with exponents typically indicating persistence. While relations between exponent values and various location-dependent factors are sometimes found, the extent of the importance of local effects has not been clearly established. In this paper we analyze homogenized minimum and maximum daily temperature time series from 9 weather stations in the Canadian Arctic, for which daily recordings are available for at least 60 years. We investigate scaling properties and their dependence on time and location, using detrended fluctuation analysis (DFA). When the whole available temperature record is analyzed, robust scaling is found in all cases, for intervals of 1-2 months to 5-8 years. Minimum temperature records are generally characterized by higher persistence than maximum temperature patterns. Most of the exponents produced by DFA with polynomials of degrees 1 to 5 are included in the interval 0.70 ± 0.05. Exceptions refer to a location well-known for its high temperature variability (Inuvik, low persistence), the area being subject to strong seasonal changes in net radiation, and two locations in the extreme north (Alert and Eureka, high persistence); the latter are known for their particularly low variability in the summer, related to phase change processes at snow-ice surfaces. To check the scaling behaviour of the patterns in time, we also apply the analysis to subsequent non-overlapping windows with a width of 1 to 5 years. The results show that patterns of temporal change emphasize common aspects among certain locations, in spite of the large distances that separate them and their diverse geographical circumstances. Our study indicates therefore that although a scaling signature can be consistently found in surface air temperature time series, for the studied time scales the change in persistence occurs on a regional scale; in other words, local factors do not play a dominant role regarding changes in pattern scaling. In particular, two groups of stations can be identified, which exhibit common characteristics of change in time. Defining regions characterized by similar patterns of change may therefore be possible; however, such a classification should not be expected to be invariable, since region boundaries may shift over time.