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Complementary approaches to surface air temperature patterns in Arctic stations

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While it is important to accurately characterize the variability of surface air temperature (SAT) patterns and to assess its temporal change, there is no single best method to be applied for this purpose. SAT patterns involve numerous aspects of variability, and many of the existing methods refer, in fact, to distinct pattern properties. In this paper, we apply three approaches to SAT times series variability evaluation, in order to provide a more realistic and comprehensive picture of patterns and pattern change in the Arctic.

The first two approaches have already been widely applied to time series: L-moments and Haar wavelet analysis. The latter, however, is embedded in a methodology leading to the construction of iso-persistence maps, which support the study of the temporal scale range dependence of pattern variability.

The third approach, transition matrix analysis, is introduced here. It starts with the construction of matrices reflecting the transition probability among all accessible values in the time series, as a function of data resolution. The relationship between the entropy associated with the transition matrices and data resolution leads to the determination of the resolution index.

All three approaches are applied to daily SAT time series from 15 stations located north of 70 degrees northern latitude in Canada, Norway, and the Russian Federation. The results of this study reveal complementary aspects of SAT patterns. We show that spatial and temporal correlations characterizing pattern change can be detected and used in the investigation of climate variability in the studied regions.