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A comparative approach to surface air temperature patterns and pattern change

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Studies concerning temporal changes in patterns of daily surface air temperature apply a range of different methods and arrive at conclusions that are often difficult to reconcile. This paper addresses the challenges of assessing different aspects of pattern change and arrives at the conclusion that diagrams based on a set of characterization methods can be more useful for the task of monitoring pattern change over time, compared to the application of different methods in isolation. Statistical moments are calculated, and fluctuation analysis methods are applied to entire available temperature records as well as to successive segments thereof. Detrended fluctuation analysis is used with polynomial degrees 1 to 5, and the resulting Hurst exponent H together with the 95% confidence interval is represented for successive segments of the time series. The results show that H can significantly change over time. The application of Haar wavelets analysis leads to qualitatively similar results; however, their uncertainty intervals are typically lower than in the case of detrended fluctuations analysis. Since, at the same time, the Haar wavelet method also better supports the interpretation of results, we choose it over detrended fluctuations analysis. Consequently, we generate diagrams to reflect (i) trends over different time intervals, (ii) statistical moments, and (iii) H exponents identified using Haar wavelets. In this context we compare daily surface air temperature records from meteorological stations in Canada and Europe, and show that the proposed context supports a more effective comparison of pattern changes occurring over time in different locations.