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Geostatistical analysis of long-term soil temperatures in Canada

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A recent study of long-term measurements of soil temperatures at 30 stations in Canada has shown that summer and spring mean soil temperatures are increasing; winter and annual means did not show the same trend. Studies that followed investigated soil temperature trends in other countries and the impacts of future climate change. In this study long-term measurements of soil temperature taken daily at 0.1, 0.2, 0.5, 1.0, and 1.5 m depths were analyzed using several geostatistical techniques. The main objectives of these analyses were: 1) to compare the geostatistical properties of soil temperatures at three sites having very different climates and 2) to determine if these properties changed over the decades of available data. Data from as early as 1965 to as late as 2000 from three different climatic regions of Canada were obtained from the Meteorological Service of Canada. Analyses conducted on the data included autocorrelation, cross-correlation, and spectral power, coherency, and phase using the daily data measured at the five different depths from each of the three sites. Preliminary results on one site show that correlation length scales of about 60 days are very consistent at the five depths based on 35 years of data. As well, cross-correlations between soil temperatures measured at different depths are strong, and peak cross-correlation lags change with increasing distance between measurement depths. Cross-correlations peak at zero days and about -5 days lag between small and large depth differences, respectively. Spectral powers show peaks at 365 days as expected, but secondary peaks lag behind the expected 730 days. Overall, this study provides new insights into the temporal variability of soil temperatures in northern latitudes.