

Monthly Rehabilitated Gridded Canadian Historical Air Temperature and Precipitation Database

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The rehabilitated gridded Canadian historical air temperature and precipitation database is the result of several years of research at the Climate Research Branch, Meteorological Service of Canada. This is a brief review of the technical details and the final database product that is available to researchers.

Air Temperature

A database of homogenized and long-term temperature time series has been specifically designed for climate change analyses in Canada (Vincent, 1998; Vincent and Gullett, 1999). The data consist of monthly maximum, minimum and mean temperatures for 210 locations across the country. Series extend back to 1895 where possible; however, data availability over most of the Canadian Arctic is restricted to the mid-1940s to present. The original data includes monthly station temperatures extracted from the National Climate Data Archive, from which annual and seasonal averages were calculated. Missing values were estimated using highly correlated neighbouring stations. It was necessary in some cases to join short-term station segments to create long-term series. Using a recently developed technique based on regression models (Vincent, 1998), annual maximum and minimum temperature series were tested for "relative homogeneity" with respect to surrounding stations. The methodology involves the identification of inhomogeneities in the temperature series, which are often non-climatic steps due to station alterations including changes in site exposure, location, instrumentation, observer, observing program, or a combination of the above. Monthly adjustment factors were derived from the regression models, and adjustments were applied to bring each homogeneous segment into agreement with the most recent homogenous part of the series (Vincent and Gullett, 1999). Whenever possible, the main causes of the identified inhomogeneities were retrieved through historical evidence such as the inspector reports.

Precipitation

Similarly to air temperature, long-term and homogenized precipitation datasets have been prepared for climate change analyses in Canada (Mekis and Hogg, 1999). A total of 495 locations, most with data covering the period 1900-present were used. Data availability in much of the Canadian Arctic was restricted to 1948-present. For precipitation the

Canadian network density is insufficient to allow widespread use of surrounding station data to identify and adjust inhomogeneities. Instead, the primary goal was to correct daily rain and snow measurements for all known inhomogeneities. Adjustments were applied on the daily level for rain and snow separately. For each rain gauge type, corrections to account for wind undercatch and evaporation were implemented. Gauge specific wetting loss corrections were also applied for each rainfall event. For snowfall, ruler measurements were used throughout the time series, to minimize potential discontinuities introduced by the adoption of Nipher shielded snow gauge measurements in the mid-1960's. Density corrections based upon coincident ruler and Nipher measurements were mapped for Canada and applied to all ruler measurements. The trace adjustment is very important in Canada especially in the northern part of the country, where precipitation amounts are relatively low and many trace events are recorded. In these conditions, the sum of all trace amounts becomes a significant fraction of the total precipitation. Great care was taken to properly account for the trace measurement in the present rehabilitation technique. Where necessary, records from neighboring stations were joined employing a technique based on a simple ratio of observations. Overlapping periods were used to minimize possible inhomogeneities.

CANGRID

These high quality station datasets were used in a statistical optimal interpolation procedure to generate monthly grids of temperature and precipitation anomalies (departures from the 1961-1990 normals). The anomalies have been combined with the gridded output from multiple regression models for normal maximum and minimum temperature and total precipitation, to generate grids of monthly temperature and precipitation from 1900 to 1998. The anomalies were interpolated using the Gandin Optimal Interpolation technique. The departures from the 1961-1990 were first calculated at individual stations. For precipitation, they were further normalized by dividing by the 1961-1990 average. These anomalies were then interpolated to the grid using the statistical interpolation technique. The normals were mapped or gridded using a multiple regression model utilizing a variety of physiographic parameters (elevation, aspect, distance to water, etc.) as predictors (Soulis et al., 1994).

The grid covers Canada with a 50 km resolution on a polar stereographic projection (Figure 1). The CANGRID grid is a 125 (columns) by 95 (rows) matrix. The SW corner (0,0) is at 40.044857 degrees north latitude and 129.85321 degrees west longitude. The projection is true at 60.0 degrees north and centred on 110.0 degrees west. Further details are described by Zhang et al., (2000) and in Seglenieks and Soulis (2000). The dataset is very much a research dataset and will continue to evolve and be modified as additional data are included and improved procedures implemented. Analysis of seasonal and annual gridded temperature data show warming and cooling trends since 1950 (Zhang et al., 2000). While there has been cooling in some regions, the warming trend in western and northwestern Canada over the last 50 years has occurred mostly in winter and spring. The gridded data also show increases in precipitation since 1950 in northern latitudes, similar to what GCM projections have identified. The ratio of snowfall to rainfall has also

changed substantially in spring, especially over the prairies, with a substantial increase in rainfall, mainly in spring.

Monthly maximum, minimum and mean temperatures and monthly rainfall, snowfall and total precipitation are available on a web site at <http://ccrp.tor.ec.gc.ca/HCCD2/>. The gridded data set (monthly maximum, minimum and mean temperatures and monthly total precipitation) are not available on a website, but are available on CD-ROM from the Climate Research Branch (CCRM), Meteorological Service of Canada, 4905 Dufferin Street, Toronto, Ontario, M3H 5T4.

References

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Figure 1. 50 km CANGRID

