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On improving the quality of precipitation data for Canada

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Precipitation is a key variable for specifying the state of the climate system and of high impact potential on the society and environment. It is highly variable in both space and time. In the high latitudes like Canada, precipitation occurs in different forms (e.g., rainfall, snowfall...). Thus, measuring precipitation and quantifying its temporal and spatial distributions are especially challenging. This presentation will focus on our recent and on-going studies towards producing high quality precipitation data sets for Canada. This includes adjusting gauge data to improve its quality, and blending gauge data with satellite precipitation estimates (SPEs) to produce high quality gridded precipitation datasets on monthly and pentad time scales.

Part I of the presentation is about the Adjusted Daily Rainfall and Snowfall (R&S) dataset. This dataset contains all Canadian stations (over 2100 stations) of daily rainfall and snowfall data in the period since 1840. The adjustments includes: (i) conversion of snowfall to its water equivalent using a previously developed snow-water-equivalent (SWE) ratio map for Canada; (ii) corrections for gauge related issues (undercatch and evaporation due to wind effects, gauge-specific wetting loss), and for trace precipitation amounts using previously developed procedures for Canada. Various data flags (e.g., accumulation flags) were also treated. The results show that the trace correction adds 5-20% of precipitation in northern Canada, but less than 5% in southern Canada. The gauge related corrections do not show an organized spatial pattern but add in 10-15% in a large number of stations across Canada. In total, the unadjusted/raw total precipitation data underestimate more than 25% of the total precipitation in northeastern Canada, and about 10%-15% in most of southern Canada. Such large underestimation makes the raw data unsuitable for water availability/balance studies or for numerical model validation, among many other applications. The use of the default/assumed 10:1 SWE ratio for the archived raw data is the primary cause of the underestimation, which is most severe in northeastern Canada, and least severe in British Columbia.

Part II of the presentation is about the first blended pentad precipitation data set for the period 1997-2007 for Canada (CanBP5dV1). This dataset was developed in a recent study, which proposed an algorithm for constructing pentad precipitation fields by integrating the popularly-used Global Precipitation Climatology Project (GPCP) daily precipitation data set, GPCP1dd v1.2 (a dataset of SPEs), with the gauge precipitation data derived from the Adjusted Daily R&S dataset described above. Unlike the algorithm used for the Canadian Blended Precipitation dataset version 0 (CanBPv0), this algorithm considers the differences between snowfall and rainfall, in addition to the gauge density. Its skill was evaluated for three networks of sparse to medium gauge density, with the evaluation data set being much larger than the training data set. The results show that the algorithm produces better representation of pentad precipitation fields than the GPCP precipitation estimates or the analysis using the gauge data alone; it has smaller root mean square errors and higher correlation skill scores. The CanBP5dV1 is also briefly compared with other existing gridded datasets (e.g., the dataset produced using ANUSPLIN and the GPCP Pentad Data Set...).