Analysis of Real-Time Canadian Prairie Drought Monitoring and Forecasting System

Lei Wen[a*], Charles A. Lin[a,b], Zhiyong Wu[c], Guihua Lu[c], John Pomeroy[d], Yufei Zhu[e]

[a]*Department of Atmospheric and Oceanic Sciences, and Global Environmental and Climate Change Centre, McGill University, Montréal, Canada*
[b]*Atmospheric Science and Technology Directorate, Environment Canada, Montréal, Canada*
[c]*State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering, Hohai University, Nanjing, China*
[d]*Department of Geography, University of Saskatchewan, Saskatoon, Saskatchewan, Canada*
[e]*Canadian Meteorological Centre, Environment Canada, Canada*
[*]*Corresponding author address: Dr. Lei Wen, Department of Atmospheric and Oceanic Sciences, McGill University, 805 Sherbrooke Street West, Montreal, Quebec, Canada, H3A 2K6; Tel: (514) 398-1035; E-mail: lei.wen@mcgill.ca*

A real time drought monitoring and forecasting system was developed, tested and implemented over the Canadian Prairies (1,964,000 km^2). The system uses the VIC (Variable Infiltration Capacity) model to simulate daily soil moisture values starting from 1 January, 1950, and continually running through present into the future with a lead time up to 35 days. VIC is driven by daily maximum and minimum air temperature and precipitation from 1,167 meteorological stations for reconstructing and monitoring runs up to the present, and by the operational Canadian GEM (Global Environmental Multiscale) model forecast (0 to 6 days), the operational 40-number super ensemble forecast of Canadian Meteorological Center (CMC; 7 to 15 days), and the operational CMC ensemble seasonal forecast (16 to 35 days) for the forecasting runs. The novel feature of our methodology is the use of both gauge and model data to drive VIC for real time drought forecasting.

The simulated soil moisture values are used to calculate the Soil Moisture Anomaly Percentage Index (SMAPI) as an indicator for measuring the severity of agricultural and hydrological droughts. The SMAPI is qualitatively compared with three independent drought datasets, which are the North American Drought Monitor (NADM), the Palmer Drought Index (PDI) of Agriculture and Agri-Food Canada, and the Environment Canada Palmer Drought Severity Index. The result indicates that the SMAPI compares favorably with these datasets.

Our VIC prairie soil moisture simulation is updated daily, and the SMAPI results with different temporal scales of daily, monthly, seasonal and annual are publicly accessible online (http://www.meteo.mcgill.ca/~leiwen/vic/prairies/). In contrast to many other real time hydrological modeling, our drought reconstructing, monitoring and forecasting system emphasizes on the idea of maintaining consistency between the real time and long term soil moisture simulations. The examination and interpolation of current model conditions in the context of the model's historical climatology can thus be legitimized through the introduction of SMAPI.