Global Water Futures 2021 Operations Team Meeting – Project Reporting Template

Project Name:	Climate related precipitation extremes

Our major accomplishments to date are:

- Identified meteorological factors associated with a severe freezing rain storm that caused major power outages over NB in January 2017
- Illustrated the role of topography in shaping the occurrence and intensity of freezing precipitation in current and historical climate conditions over Manitoba and NB
- Analyzed HAILCAST output, forced with CONUS I CTRL and PGW data, which has been used to estimate future changes in the occurrence and severity of hail over the Canadian Prairies and United States Northern Plains and to illustrate some projected reductions in future hail occurrence through enhanced melting aloft
- Used CONUS I CTRL to calibrate the BCCAQv2 statistical downscaling scheme for downscaling CanRCM4 simulated precipitation over the southern part of British Columbia
- Evaluated the downscaling performance for both the CTRL and PGW periods, focusing on extremes, and whether the downscaling scheme calibration determined for the historical period remains valid for the future period.
- Applied object-based tracking of precipitation systems in western Canada and determined the temporal resolution of source data required to establish the statistical characteristics of MCSs
- Assessed water budget over western Canada in the current and future climate using convection permitting WRF simulations

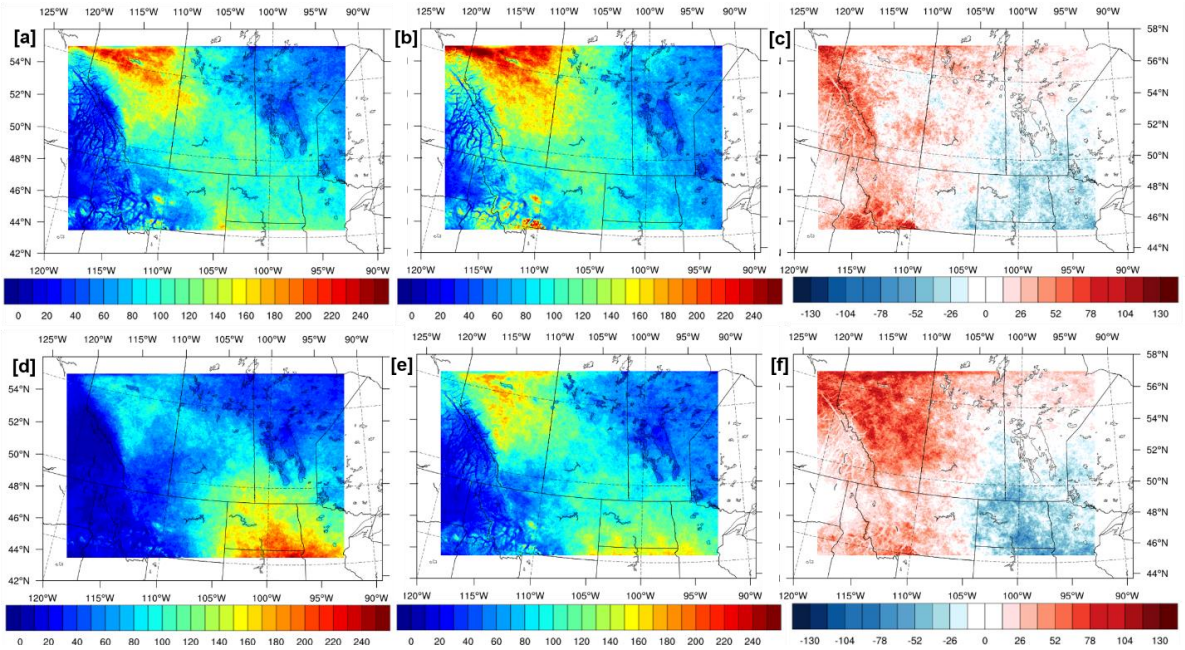
Our current activities are:

- Completing the study of the meteorological factors that led to the devastating Manitoba October 2019 snowstorm
- Utilizing hourly CONUS I and II historical information to determine the occurrence of near 0°C temperatures and associated hazardous precipitation in Manitoba and NB
- Assessing statistical significance of changes in several hailstone-related metrics and associated meteorological features between CONUS I CTRL and PGW simulations
- Developing a method for evaluating downscaling performance that accounts for differences between the warming prescribed in CONUS I PGW and those simulated in CanRCM4. Analyses will be extended to CONUS II when both present and future runs are available.
- Examining the impacts of changing winter warm spells on snow ablation in the mountains of western North America

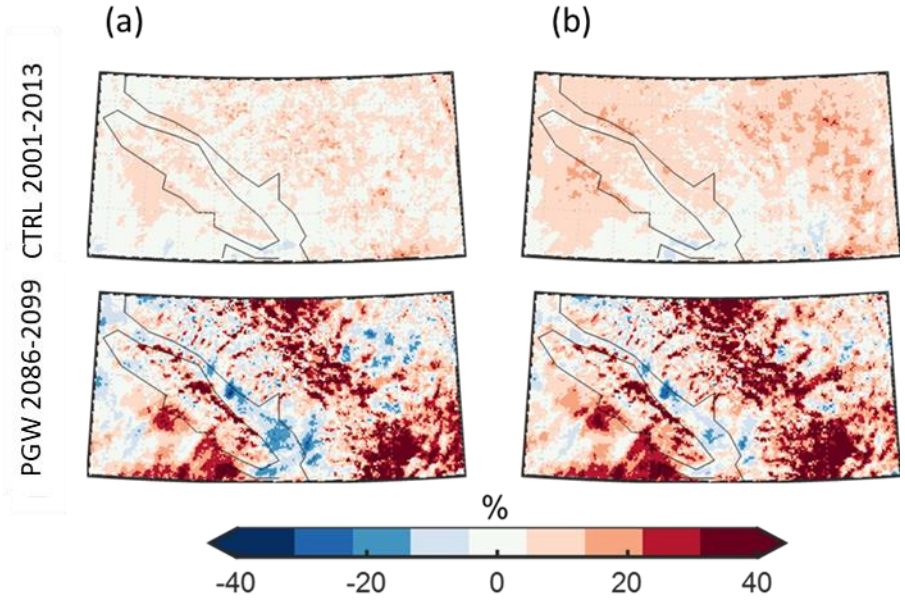
The main accomplishments expected by the end of the project are:

- Analysis of changes in the occurrence of severe snow accretion events in Manitoba and NB using CONUS II historical and future simulations
- Analysis of factors affecting hail formation using CONUS I in the present and future climate including local terrain's effects on wind shear as well as synoptic and mesoscale processes
- Evaluation of whether statistical downscaling schemes such as BCCAQv2 can be used to leverage high cost, and thus limited availability, convection permitting simulations as training data for downscaling lower cost, more plentiful, climate change simulations with conventionally parameterized climate models.
- Examination of Canadian Prairies warm season extreme precipitation events and their associated atmospheric circulations in the current and future climate

Here is a key visual from the project (figure, photo, table, graph, etc.)



Occurrences of hail (number over the 13-year CONUS I period) with diameters of 0.5-2 cm (top row) and > 2 cm (bottom row) using HAILCAST for CTRL (left column), PGW (middle column), and their difference (right column).



Biases (%) in downscaled annual maximum precipitation amounts from the 50 downscaled precipitation series for both the CONUS I CTRL and PGW periods using: (a) 50 CanRCM4 members considered in the calibration process, and (b) 50 other CanRCM4 members not considered in the calibration process. Large biases occur in the future period in part because of differences between the warming prescribed in CONUS I PGW and the warming simulated in CanRCM4.