# Climate-Related Precipitation Extremes project

Dhouha Ouali[1], Ronald Stewart[2] and Francis Zwiers[1]

Pillar 3

## Introduction

- Focus is on climatic aspects of water-related extremes (drought, intense precipitation events, freezing rain, snow…) to provide new insights into their future occurrence
- Work closely with a wide range of users in multiple sectors
- Use and develop observed and simulated data for the analysis of extremes

**Agriculture:**

Agriculture and Agri-Food Canada

CCME Canadian Council of Ministers of the Environment / Le Conseil canadien des ministres de l'environnement

**Engineering design:**

National Research Council Canada

Environment and Climate Change Canada

British Columbia Ministry of Transportation and Infrastructure

**Health**

Health Canada

**Insurance:**

CatIQ™ www.catIQ.com

Institute for Catastrophic Loss Reduction

Canadian Institute of Actuaries / Institut canadien des actuaires

**Electrical utilities:**

Manitoba Hydro

BC Hydro

Énergie NB Power

IBC Insurance Bureau of Canada

**Data and climate modelling resources:**

- Observational data (satellite ,radar, …)
- Canadian global and regional models based on the Coupled Model Inter-comparison Project - Phase 5 (CMIP5)
- Weather Research and Forecasting (WRF) model

## Objectives

•Support planning for and adapting to the environmental, health and economic **impacts** of climate-related precipitation extremes

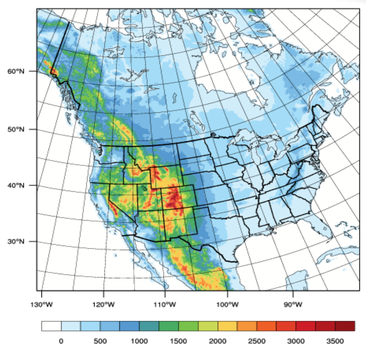
•Provide users with in-depth insights into climate and climate modelling issues

## Project progress

- The project helps users better understand precipitation related extremes that affect them, contributing to the **GWF goal to** improve disaster warning, predict water futures and adapt and manage risks

### A. Implementation and evaluation of a very high spatial resolution climate model in Canada: Weather Research and Forecasting (WRF)

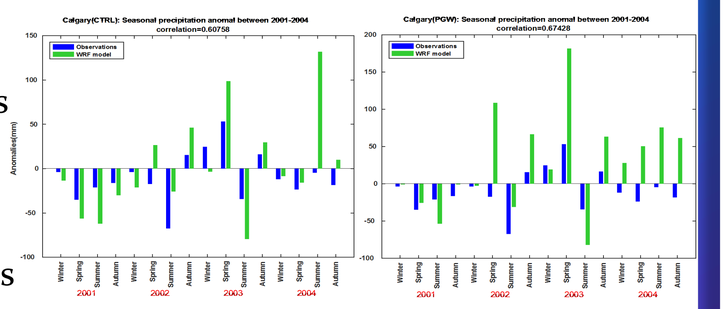
- The WRF model -Version 3.4.1.
- Domain: configured to cover the North American domain, up to 76 °N (CONUS II Domain)
- Historical period simulation: 1995-2015
- Future period simulation: 2080-2100
- Modules within the model are being tested, runs will start shortly




WRF CONUS II Domain

### B. WRF model evaluation during 2001-2004 Canadian Prairie Drought

- Assess WRF ability to simulate seasonal precipitation anomalies during the drought
- The WRF CTRL and PGW simulations are compared with seasonally-averaged observations

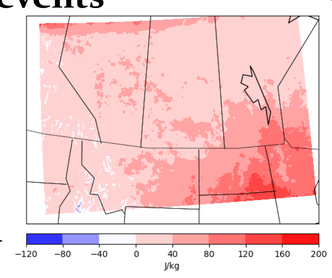



- CTRL runs: the period of reduced precipitation (winter 2001-summer 2002) was overall well simulated although magnitudes did not necessarily agree
- PGW runs : higher precipitation amounts especially in 2003 and 2004, although it still showing negative precipitation anomalies in 2001 and 2002

## Project progress

### C. Hazardous hail, heavy rain and winter storm events

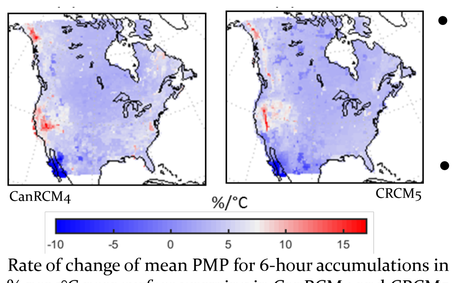
- Information on severe weather events (hail, heavy rain and winter storm events) has been collected.
- All NCAR WRF PGW relevant model output and reanalysis data have been gathered (2001-2013).
- Results show that much of southern Saskatchewan and Manitoba (and northern U.S. Plains) will see increases in maximum convective available potential energy CAPE




Future change (PGW-Historical) in 0000 UTC May $CAPE_{max}$ based on the 2001-2013 NCAR WRF PGW scenario.

### D. Projected changes in probable maximum precipitation (PMP)

- Providing insights on how PMP may evolve in a warming climate

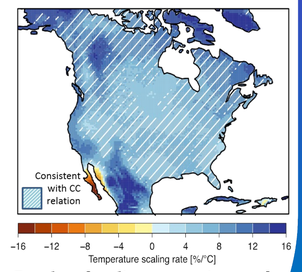



Rate of change of mean PMP for 6-hour accumulations in % per 1°C near surface warming in CanRCM4 and CRCM5

- A non-stationary bivariate extreme value model is adopted to determine the rate of change of PMP per 1°C warming over North America
- Results show that PMP increases at a rate of 4% per 1°C warming, which is somewhat lower than the Clausius-Clapeyron (C-C) rate (7% per 1°C warming)

### E. Projected changes in annual maximum hourly precipitation

- Providing reliable estimates of precipitation intensities in the future for long return periods
- Temperature scaling approach using ensemble of 35 CanRCM4 simulations of hourly precipitation (1951-2100)
- Results show that the temperature scaling relationships are consistent with the C-C rate for the 100-year event




Results of scaling rate estimates for 100-year annual maximum hourly rainfall using CanRCM4 large ensemble

## United Nations SDG

The project's findings help inform the **United Nations Sustainable Development Goals** SDG13 and SDG6

**SDG13: Climate action**

The project outputs (insights into the future occurrence of precipitation extremes under a changing climate) will help in …

- raising **awareness** of the impact of climate change on extreme precipitation
- considering the emerging risks and impacts of climate change in adaptation planning and the implementation of actions to mitigate risks; e.g. inputs in the 2020/2021 national climate change and health vulnerability assessment; help insurers to accurately assess risks associated with changing extreme precipitation events
- the design of **climate resilient infrastructure** (buildings, transportation, electrical, health, hydrological and other infrastructure); e.g. collaborating with ECCC to develop guidance for the civil engineering community;

**SDG6: Clean Water and Sanitation**

- Help users to create adaptive and integrated **water resource management** solutions by investigating future changes in extreme precipitation events; e.g. the management of dams and reservoirs, and hydroelectric generation for the electrical sector

**Affiliations:**
[1] Pacific Climate Impacts Consortium, University of Victoria
[2] University of Manitoba

**Contact information:**
Dhouha Ouali- email: douali@uvic.ca

University of Manitoba · UQÀM Université du Québec à Montréal · Canada First Research Excellence Fund · Apogée Canada Fonds d'excellence en recherche · University of Saskatchewan · University of Waterloo · McMaster University · Laurier Inspiring Lives · Pacific Climate Impacts Consortium · University of Victoria