Integrated Modelling Program for Canada
Global Water Futures

Multi-model Intercomparison Project on the Saskatchewan-Nelson-Churchill River Basin (Nelson-MiP project)

Monthly meeting - June 10th, 2020

Environment and Climate Change Canada
Environnement et Changement climatique Canada

STRATEGIC COMMUNITY CONSULTING

Western University · Canada

University of Saskatchewan

Alberta Environment and Parks

Manitoba Infrastructure

Water Security Agency

UNBC University of Northern British Columbia

University of Waterloo

TransAlta

Manitoba Hydro

University of Alberta

University of Manitoba

University of Calgary

Agenda

1. Presentation on lake and river routing support for the Nelson-MiP (Bryan - UWaterloo)
2. Presentation of HEC-HMS configuration and input (Scott – Strategic Consulting)
3. Presentation of SWAT-GWF configuration and input (Pouya - UAlberta)
4. Comparison of ERA5 and WFDEI-GEM-CaPA (Scott - Strategic Consulting)
5. Deliverables for next meeting & follow-up

Integrated Modelling Program for Canada
Global Water Futures

Lake and river routing support for the Nelson-MiP

By:

Bryan Tolson

(University of Waterloo – btolson@uwaterloo.ca)

HEC-HMS

By:

Scott Pokorny

(Strategic Consulting)

1. Study Area

Integrated Modelling Program for Canada
Global Water Futures

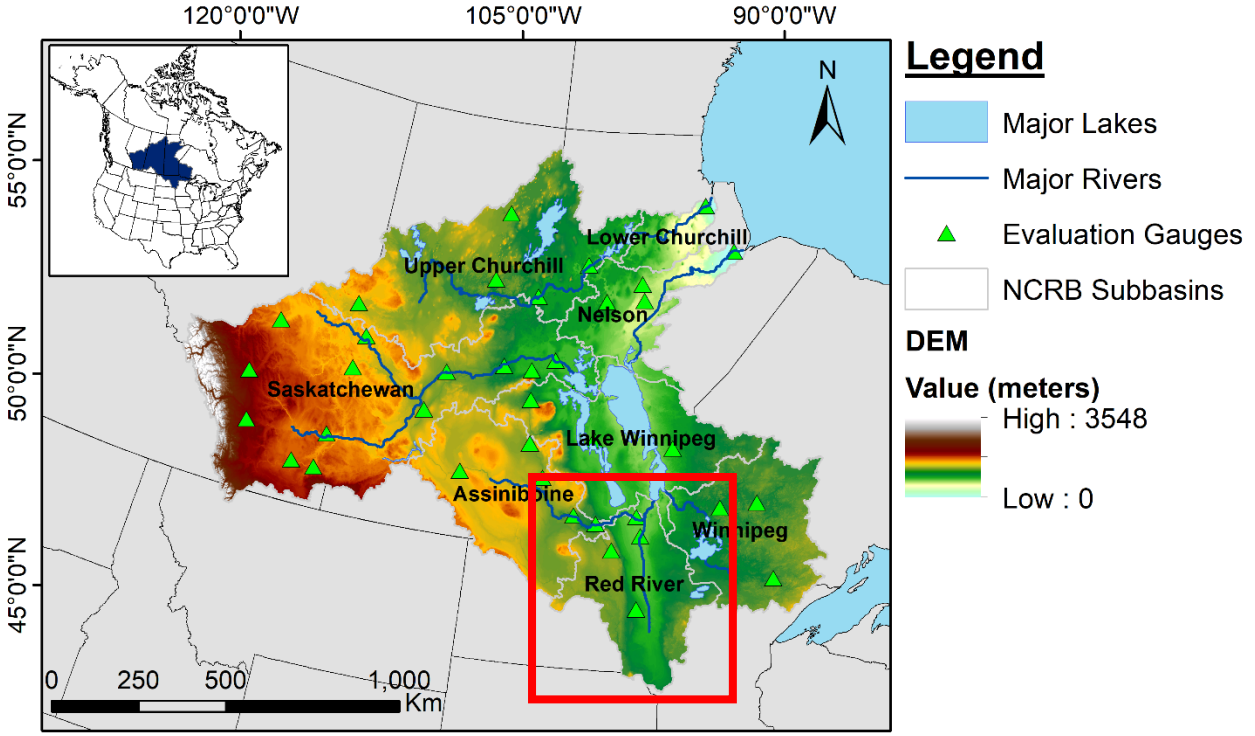


Figure 1 Red River basin in relation to the rest of the Nelson Churchill watershed

Red River Basin

Gross Area

~126k square kilometers

Outlet Elevation

~217m

Extent of model domain still under development

2. Model Description

Integrated Modelling Program for Canada
Global Water Futures

Tentative

Process	HEC-HMS method
Canopy Interception	Simple (Bucket method)
Surface Storage	Simple (Bucket method)
Infiltration	SMA
Overland Translation	Clark Unit Hydrograph
Baseflow	Linear Reservoir
Snowmelt	Temperature Index
Evapotranspiration	Hargreaves
Routing	Muskingum

3. Input Data Used

Integrated Modelling Program for Canada
Global Water Futures

Table 1 Tentative Selection of Input and Calibration Data

Characteristic/ Data type	Information/Product	Source
Topography	USGS: Hydrosheds	https://www.hydrosheds.org/
Soil characteristics	Harmonized World Soil Database V1.2	Nachtergaele et al. (2010)
Land use	ESA CCI LC 2010 v1.4	ESA Climate Change Initiative
Lake and wetland	Global Lake and Wetland Database (GLWD)	Lehner and Doll (2004)
Reservoirs	Global reservoir and Dam database (GRanD) v1.1	Lehner et al. (2011)
Discharge	1. HYDAT, 2. USGS	1. Environment Canada 2. waterdata.usgs.gov/nwis
Meteorological	ERA5/WFDEI-GEM-CaPA	https://www.earth-syst-sci-data-discuss.net/essd-2018-128/
Snow	GlobSnow	www.globsnow.info
Evapotranspiration	FLUXNET	fluxnet.ornl.gov

Integrated Modelling Program for Canada
Global Water Futures

Soil and Water Assessment Tool – Global Water Futures (SWAT-GWF)

By:

Pouya Khalili

(University of Alberta)

STUDY AREA

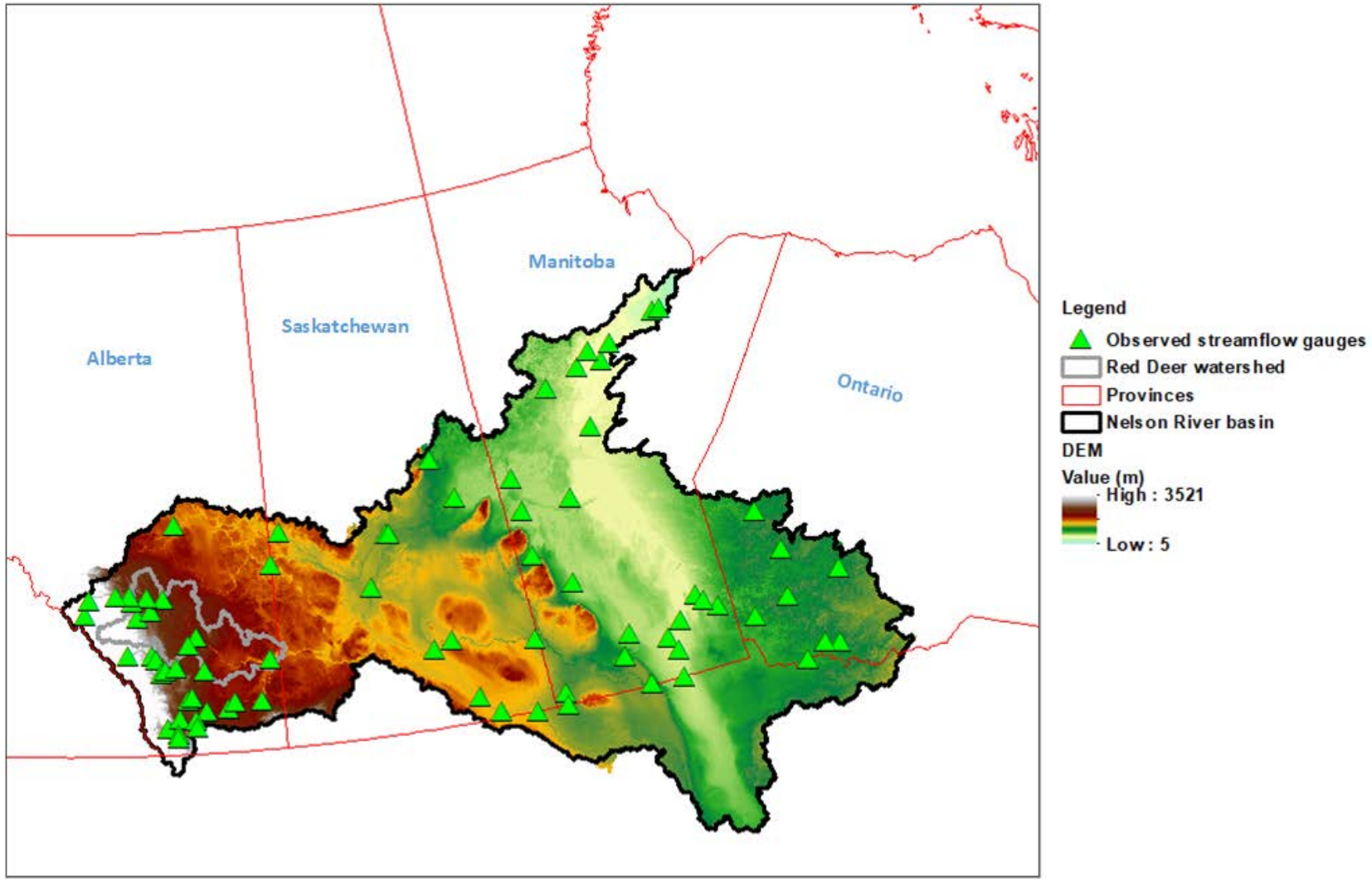


Fig. 1 Map of the study area showing major topographic features and gauging stations

Nelson river basin

Gross Area

~1.2 million square kilometers

Elevation range

Up to 3521 M.S.L

Integrated Modelling Program for Canada
Global Water Futures

NRB Project

My PhD is also a part of a larger project, where two other PDFs and another PhD are/will work on the following objectives:

1) Simulate and assess crop yield response to climate change and different management strategies for understanding water-food nexus in the Nelson watershed

2) Simulate and assess water quality and nutrients in agricultural and natural lands of Nelson watersheds

3) To study spatiotemporal dynamics of blue and green water resources in the Nelson watershed

Model Description

DEM → **Delineation of catchment**

Land Use
Soil
Slope classes → **Defining HRUs**

Meteorological station data:

- Precipitation
- Temperature
- Relative humidity
- Solar radiation
- Wind speed

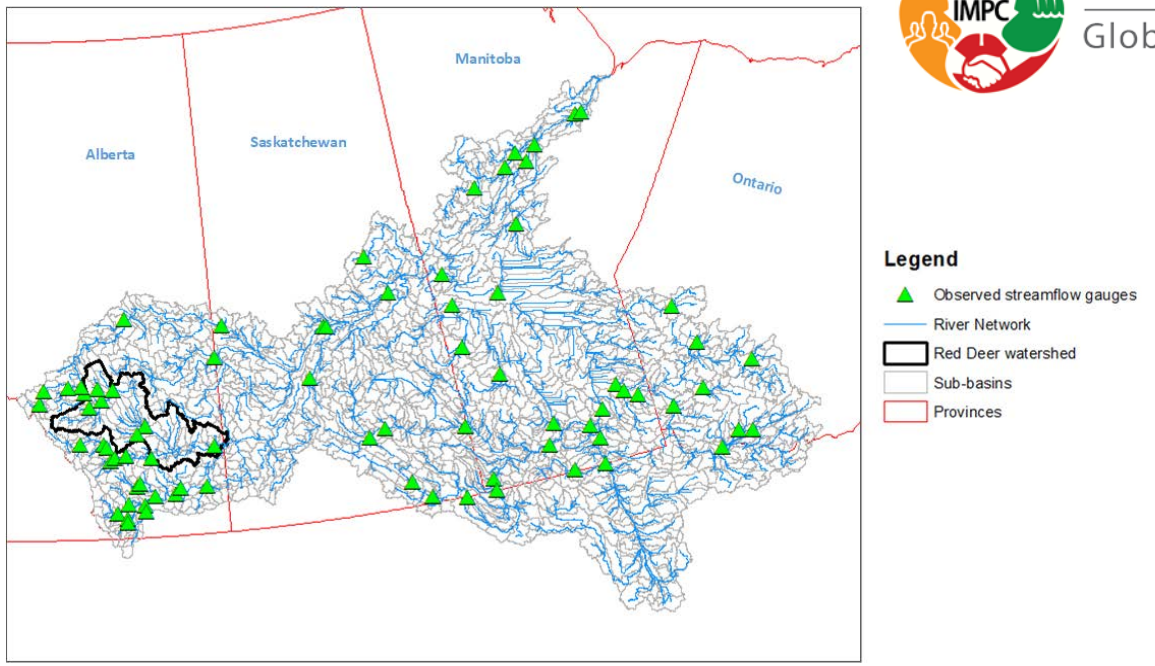


Fig. 2 Sub-basin discretization in SWAT model (1975 sub-basins)

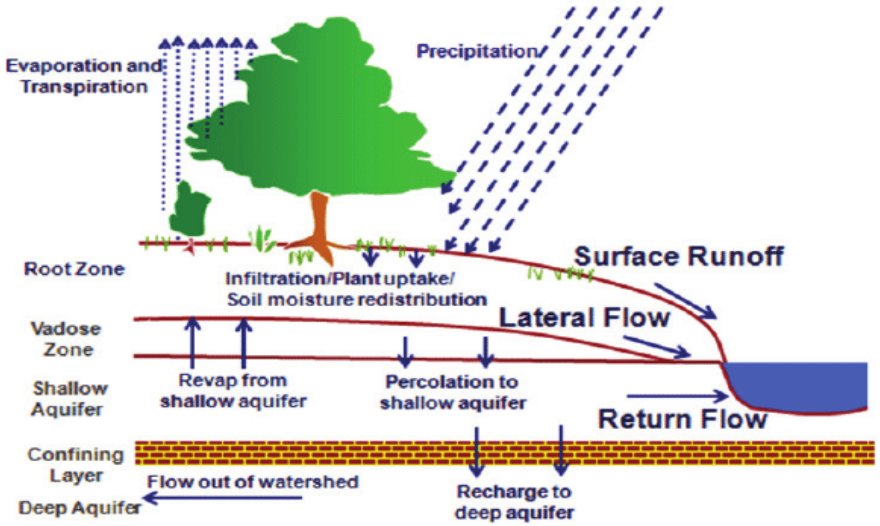


Fig. 3 Schematic of hydrologic processes simulated in SWAT

Table 1 Description of the input data used for the model setup (not finalized yet!)

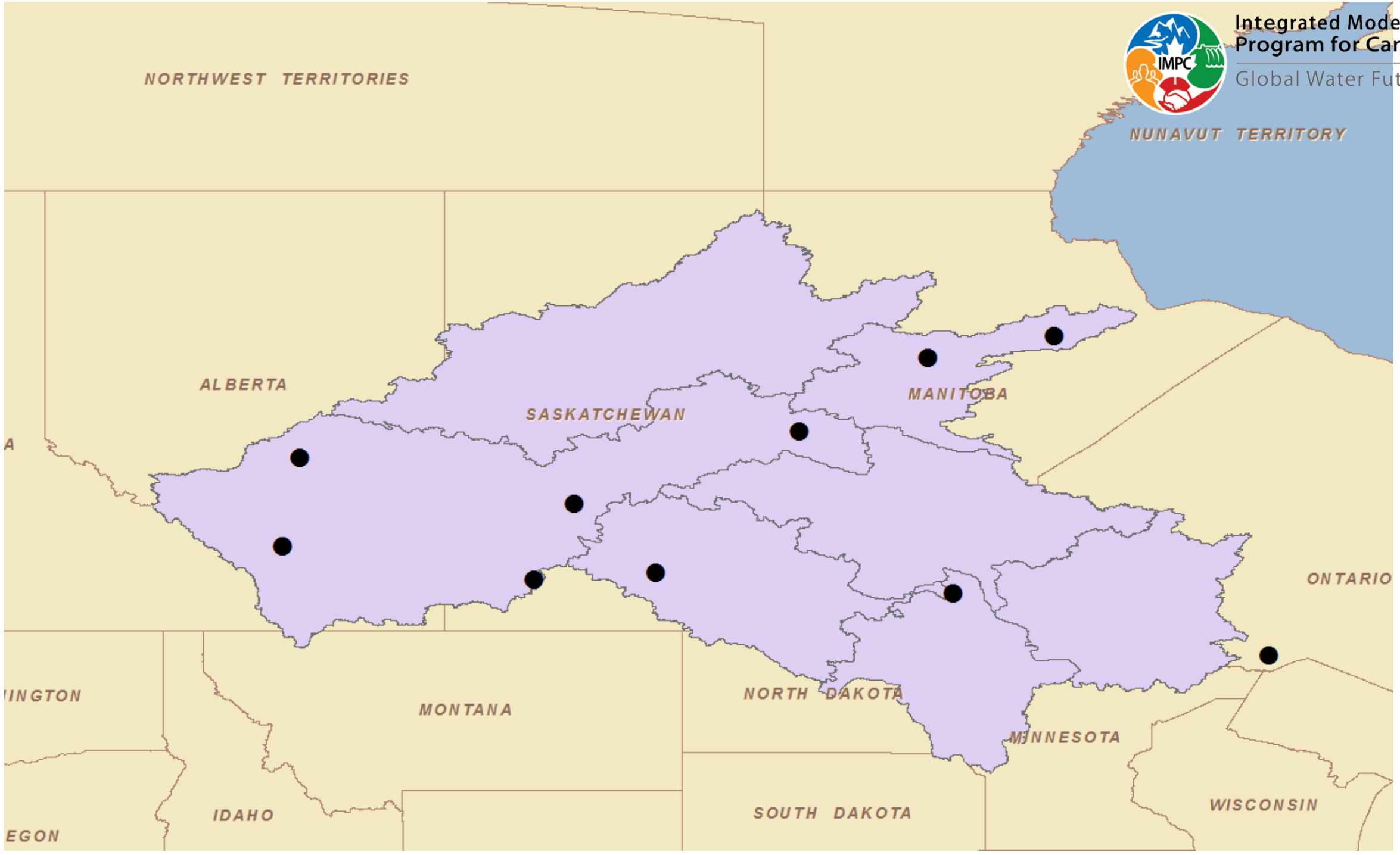
Characteristic	Information	Source
Topography	SRTM	http://srtm.csi.cgiar.org/
Soil characteristics	Soil Landscape of Canada (SLC) + FAO	http://sis.agr.gc.ca/cansis/nsdb/slc/index.html
Land use	2015 Land Cover of Canada	https://open.canada.ca/data/en/dataset/4e615eae-b90c-420b-adee-2ca35896caf6
Discharge	HYDAT	https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey/data-products-services/national-archive-hydat.html
Meteorological	CFSR - WFDEI	https://globalweather.tamu.edu/ http://www.eu-watch.org/
Evapotranspiration	Penman Monteith method	Simulated in SWAT model

Comparison of ERA5 and WFDEI-GEM-CaPA

By:

Scott Pokorny

(Strategic Consulting)

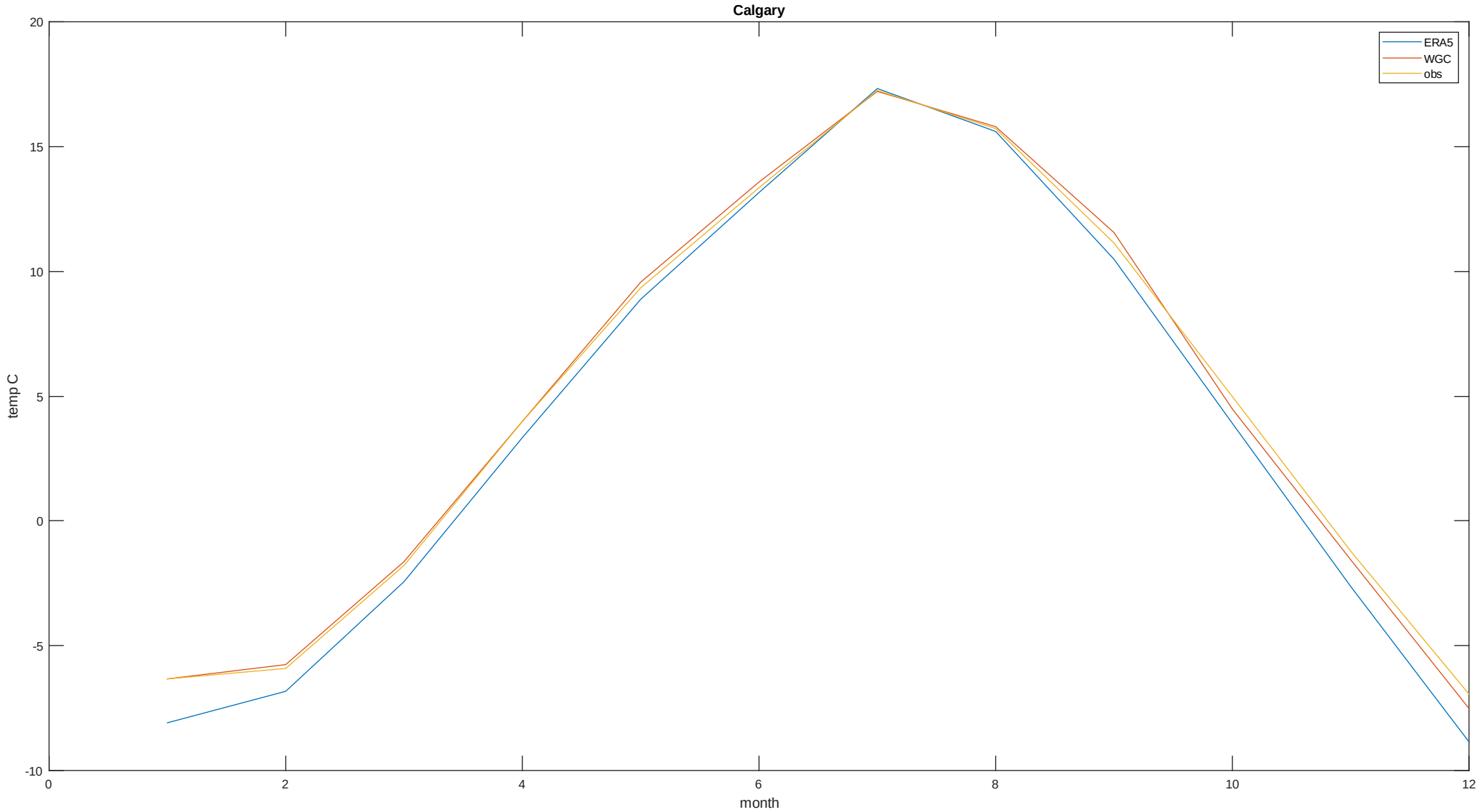


Integrated Modelling Program for Canada

Global Water Futures

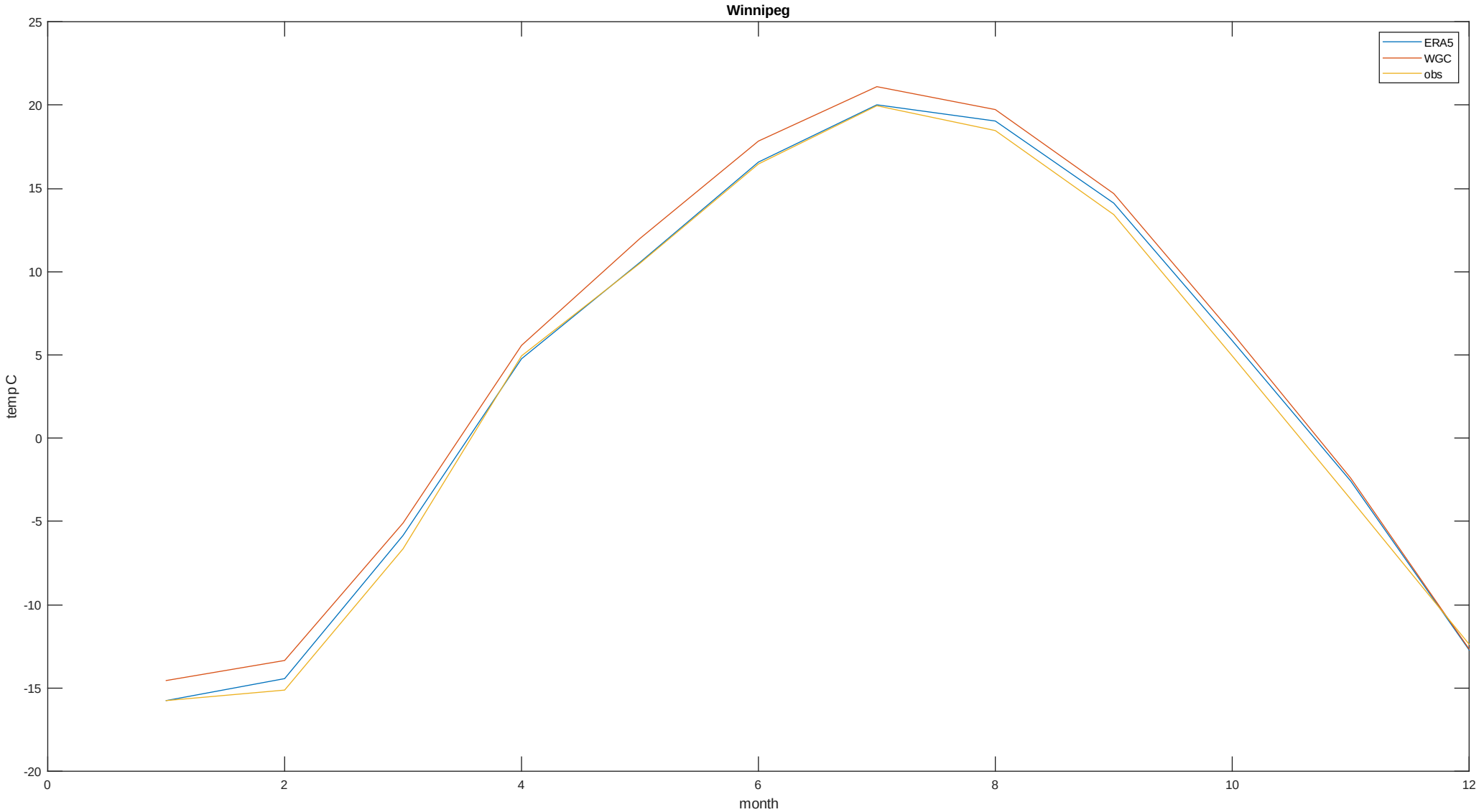
Integrated Modelling Program for Canada

Global Water Futures



Integrated Modelling Program for Canada

Global Water Futures



Integrated Modelling Program for Canada
Global Water Futures

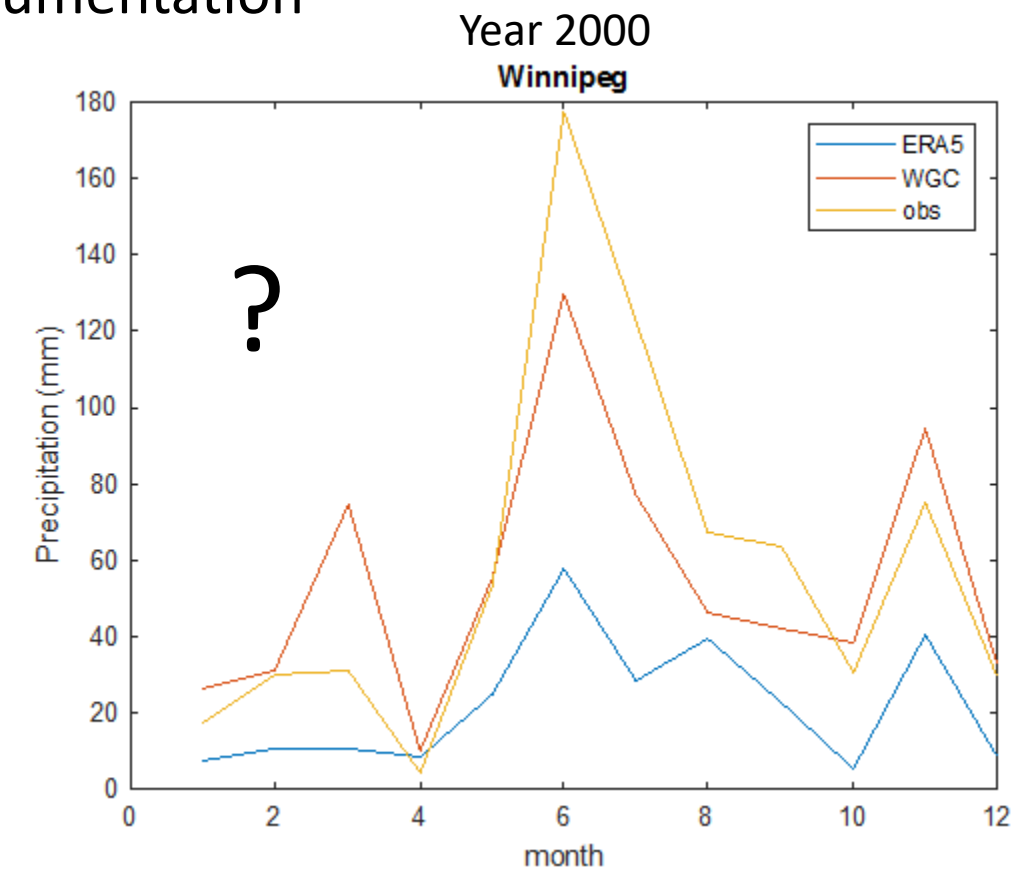
RMSE values (temperature)

RMSE	CALGARY INTL A	EDMONTON INTL A	GILLAM A	REGINA INTL A	SASKATOON DIEFENBAKER INTL A	SWIFT CURRENT CDA	THE PAS A	THOMPSON A	THUNDER BAY A	WINNIPEG RICHARDSON INTL A
WGC	2.45	3.05	2.59	2.75	2.50	2.45	2.46	2.78	2.87	2.59
ERA5	2.67	2.36	2.24	2.55	2.30	2.21	2.50	2.47	2.47	2.37

Integrated Modelling Program for Canada
Global Water Futures

Precipitation Comparison

- Precipitation comparison is more challenging
  - ERA5 units are not consistent with the documentation
  - ERA5 had a strong dry bias



Integrated Modelling Program for Canada
Global Water Futures

Deliverables & Follow-up

- **During next meeting we will discuss on the challenges encountered during the setup of our models.** Modellers can prepare a slide to explain the challenges/issues.
- Presentation on MESH model (USask), RAVEN (UWaterloo), HBV-EC & WATFLOOD-MI (Manitoba Infrastructure)

- Next meeting scheduled for **Wednesday July 8 @ 10:00AM MDT**

- SLACK channel to facilitate informal communication for Nelson-MiP

  Channel link: https://uc-hal.slack.com/archives/C011BTG7GL8

  Channel name: #ncrb_mip

- Nelson-MiP data available at: https://uofc-my.sharepoint.com/:f:/g/personal/tricia_stadnyk_ucalgary_ca/EtnMyjMpPopNhU1-qCSgCJ4Bp7LCRZ57_18veRI5ynLmOQ?e=hXO0ip