Integrated Modelling Program for Canada
Global Water Futures

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

Monthly meeting - July 8th, 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

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Agenda

1. Discussion on challenges in setting up Nelson-MiP models
2. Presentation of hydrologic models used at Manitoba Infrastructure
3. Presentation of MESH configuration and input (Fuad - USask)
4. Deliverables for next meeting & follow-up

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Challenges in setting-up Nelson MiP models

- Handling of Feb. 29 (in leap year) in WFDEI-GEM-CaPA meteorological data product which follows a 365-day calendar:

- repeating values of Feb. 28 for Feb. 29 in leap year ???
- averaging Feb. 28 and March 1 and assigning the new values to Feb. 29 of the leap year (one day before and after)?
- averaging Feb. 27, Feb. 28, March 1 and March 2, and assigning the new values to Feb. 29 of the leap year (two days before and after)?

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Presentation of the hydrologic models used at Manitoba Infrastructure

(WATFLOOD-MI & HBV-EC)

By:

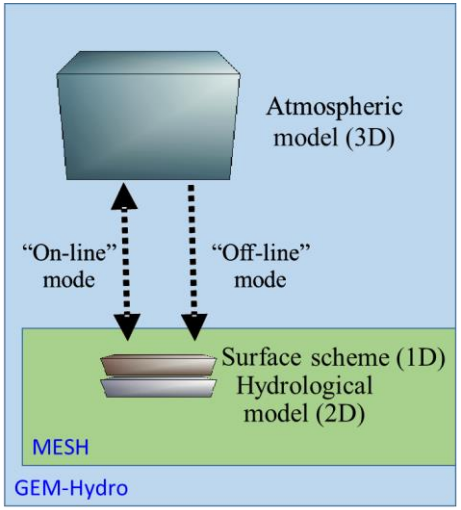
Fisaha Unduche & Habtamu Tolossa

(Manitoba Infrastructure)

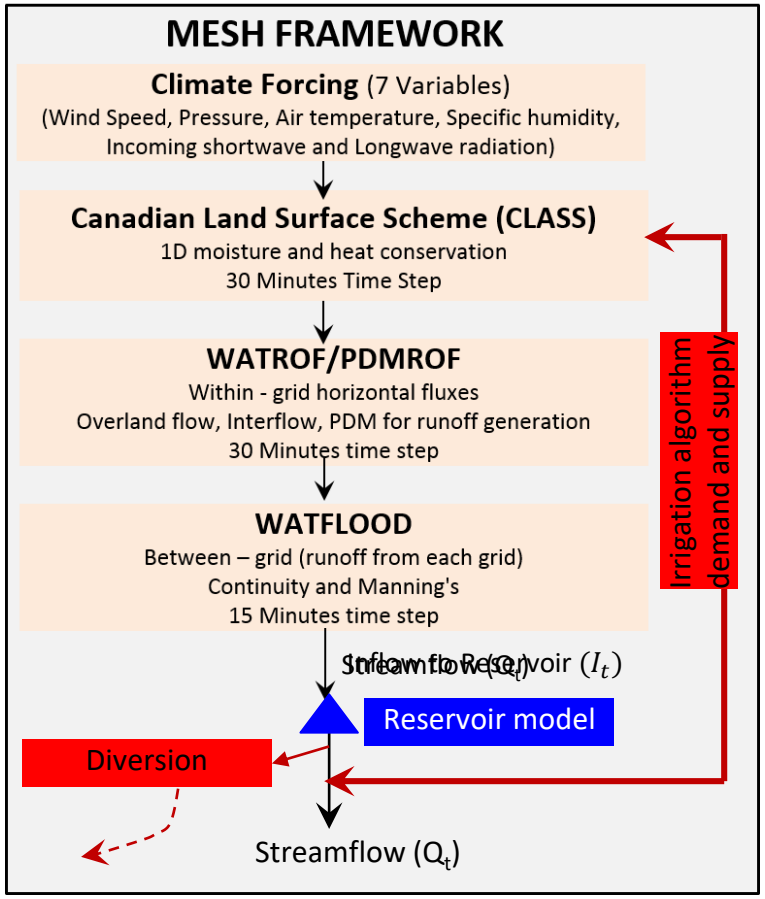
MESH Model Configuration: Nelson Model Intercomparison Project

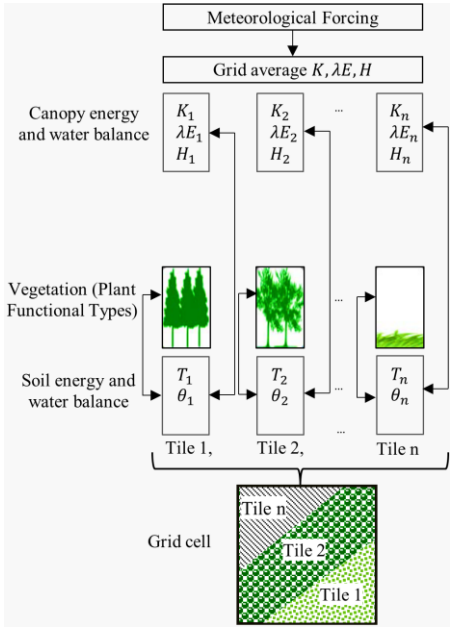
Fuad Yassin
University of Saskatchewan

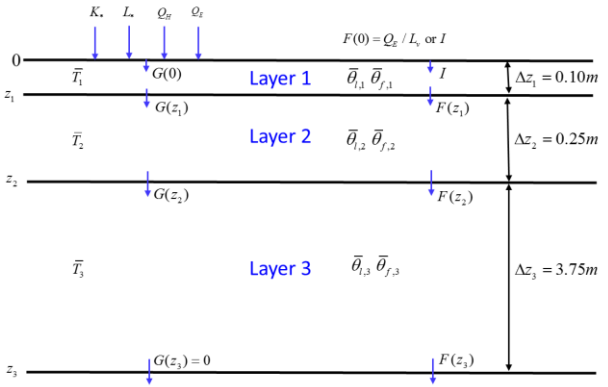
MESH as LSM platform



(**Glaciers, blowing snow, frozen soil infiltration, slope/aspect, physical based phase change**) to evaluate the necessary cold regions processes







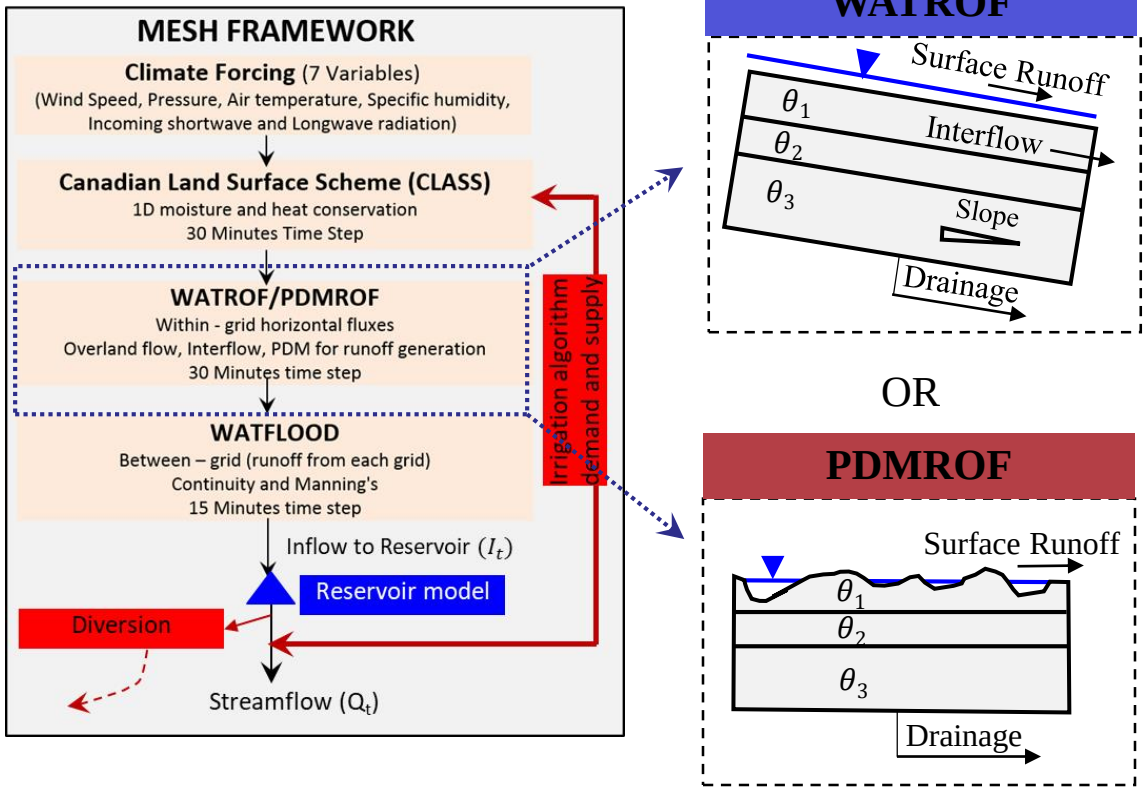
Hydrol. Earth Syst. Sci., 11, 1279–1294, 2007
www.hydrol-earth-syst-sci.net/11/1279/2007/

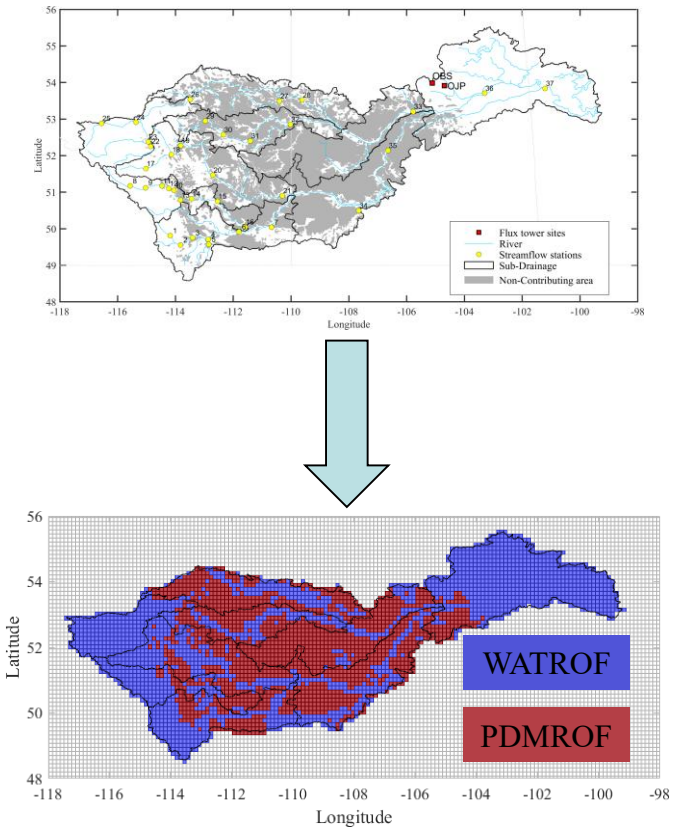
Hydrology and Earth System Sciences

Development of the MESH modelling system for hydrological ensemble forecasting of the Laurentian Great Lakes at the regional scale

A. Pietroniro[1], V. Fortin[2], N. Kouwen[3], C. Neal[4], R. Turcotte[5], B. Davison[6], D. Verseghy[7], E. D. Soulis[3], R. Caldwell[8], N. Evora[9], and P. Pellerin[2]

Lateral flow representation



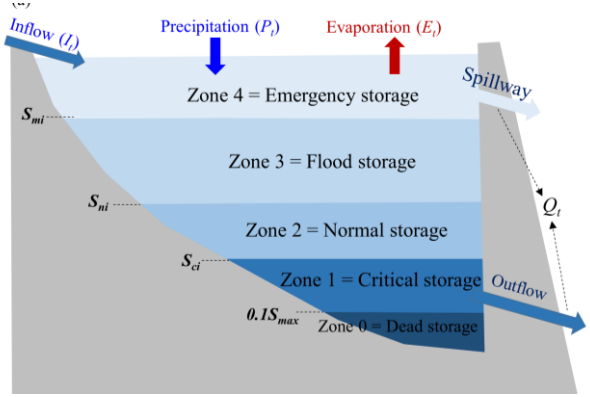


WATROF - Soulis et al. (2000)
PDMROF - Mekonnen et al. (2014).

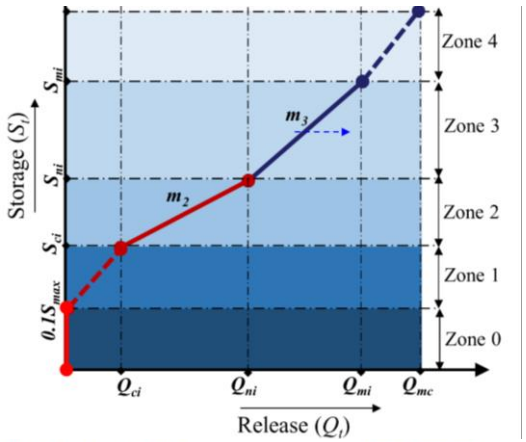
Non-contributing areas map (Godwin and Martin, 1975) Prairie Farm Rehabilitation Administration (PFRA, Hydrology Division, 1983).

Reservoir and Irrigation model

Reservoir zoning



Piecewise linear reservoir release function



Hydrol. Earth Syst. Sci., 23, 3735-3764, 2019
https://doi.org/10.5194/hess-23-3735-2019

Hydrology and Earth System Sciences

Representation and improved parameterization of reservoir operation in hydrological and land-surface models

Fuad Yassin[1], Saman Razavi[1], Mohamed Elshamy[1], Bruce Davison[2], Gonzalo Sapriza-Azuri[3], and Howard Wheater[1]

Soil moisture deficit Irrigation

Check irrigation GRU

Check SM < 50% of FC

Irrigation Demand

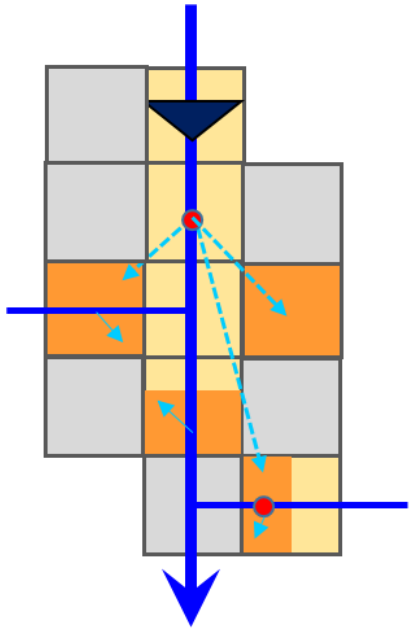
$$IR = \frac{\rho_w}{\Delta t}\sum_{k=1}^{n}\{\max[(\theta_T - \theta_k), 0] * D_k\}$$

Actual IR Demand = $\max_{\Delta t}[(IR - P), 0]$

Aggregate each district AIR

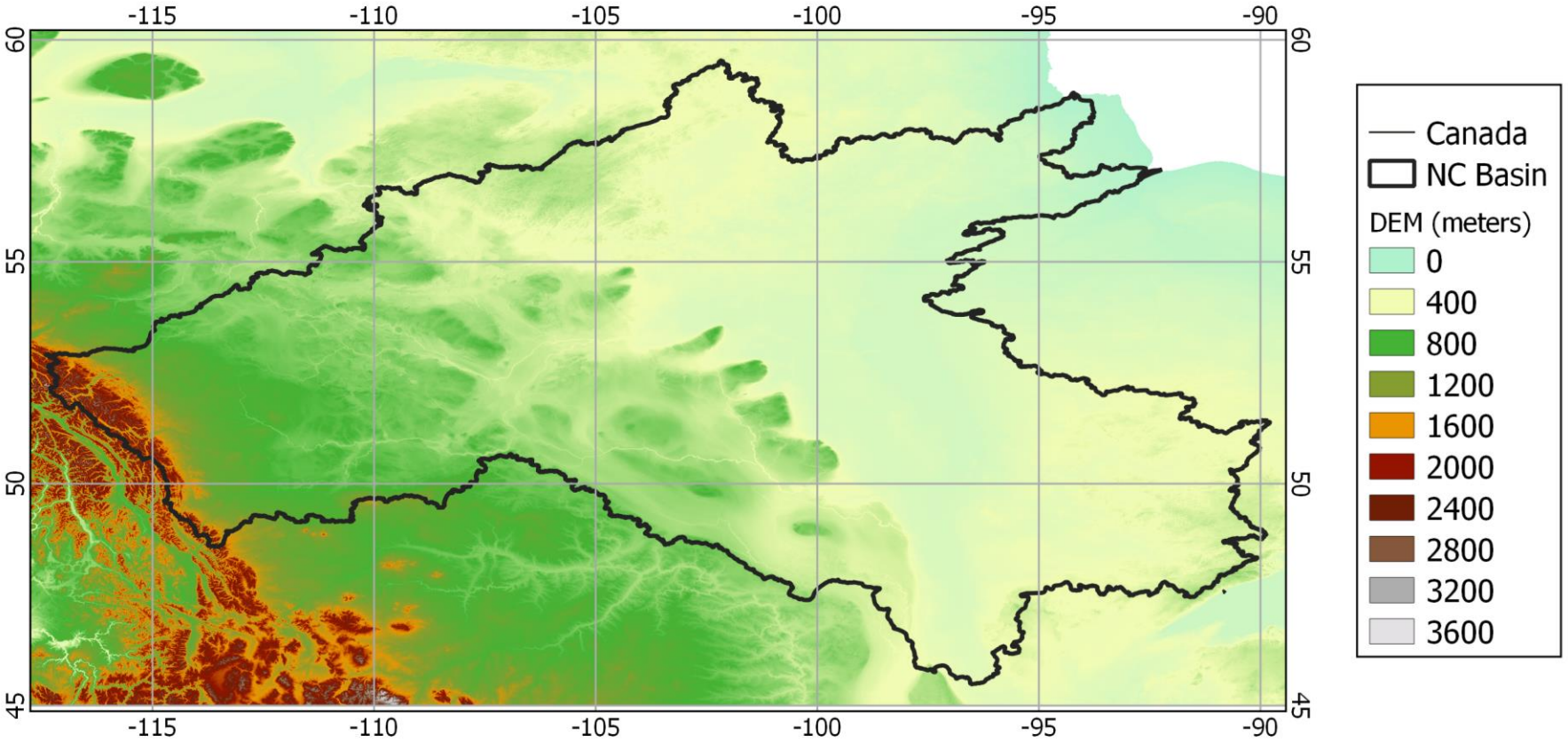
Abstraction: availability in channel storage

Apply actual demand as precipitation over irrigation area



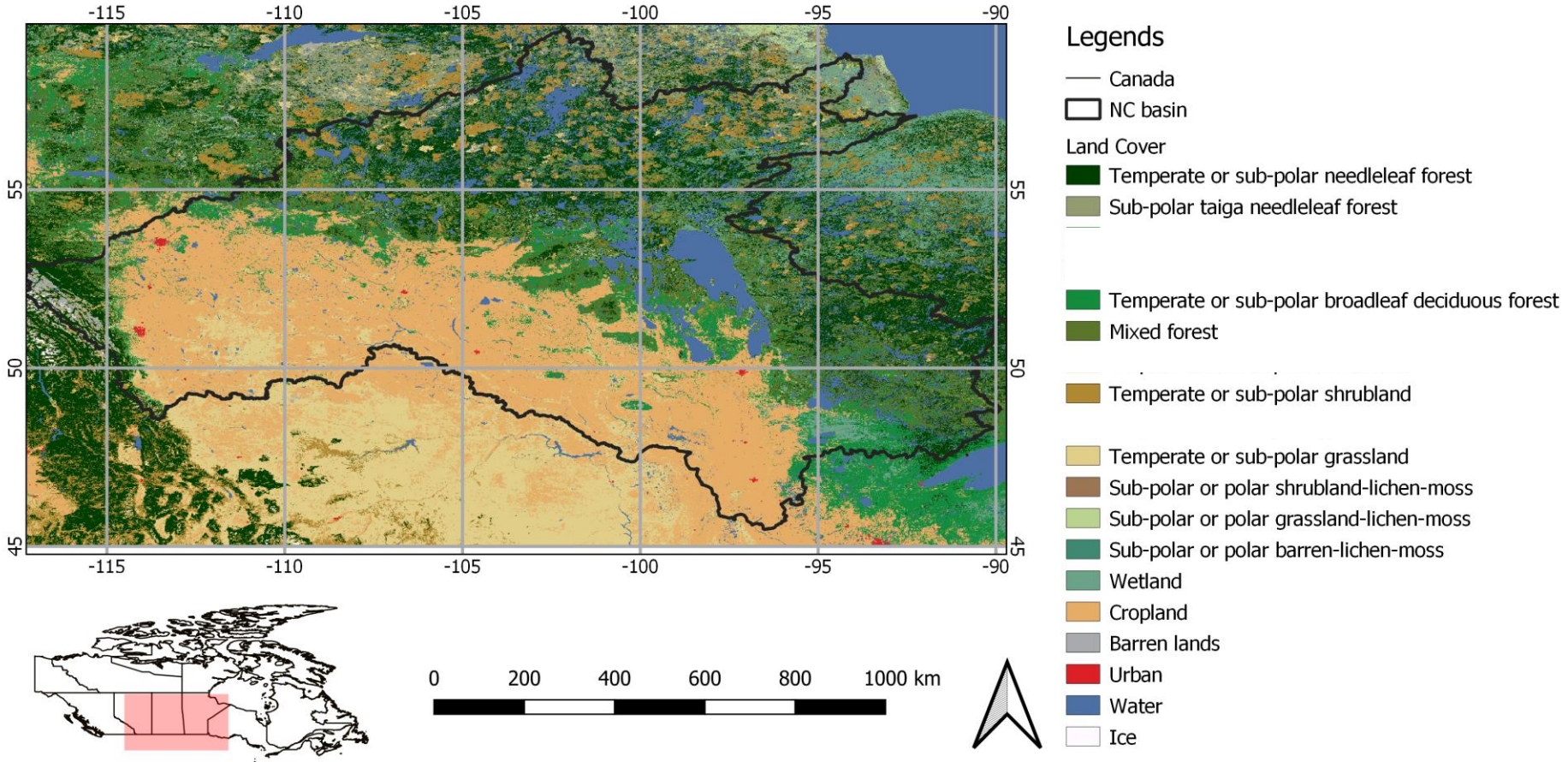
Non-irrigated part of grid cell
Irrigated part of grid cell
Dam
River
Water withdrawal point
Water withdrawn from reservoir
Water withdrawn from local river

DEM


-115
-110
-105
-100
-95
-90
60
55
50
45
Canada
NC Basin
DEM (meters)
0
400
800
1200
1600
2000
2400
2800
3200
3600
0
200
400
600
800
1000 km

Land cover

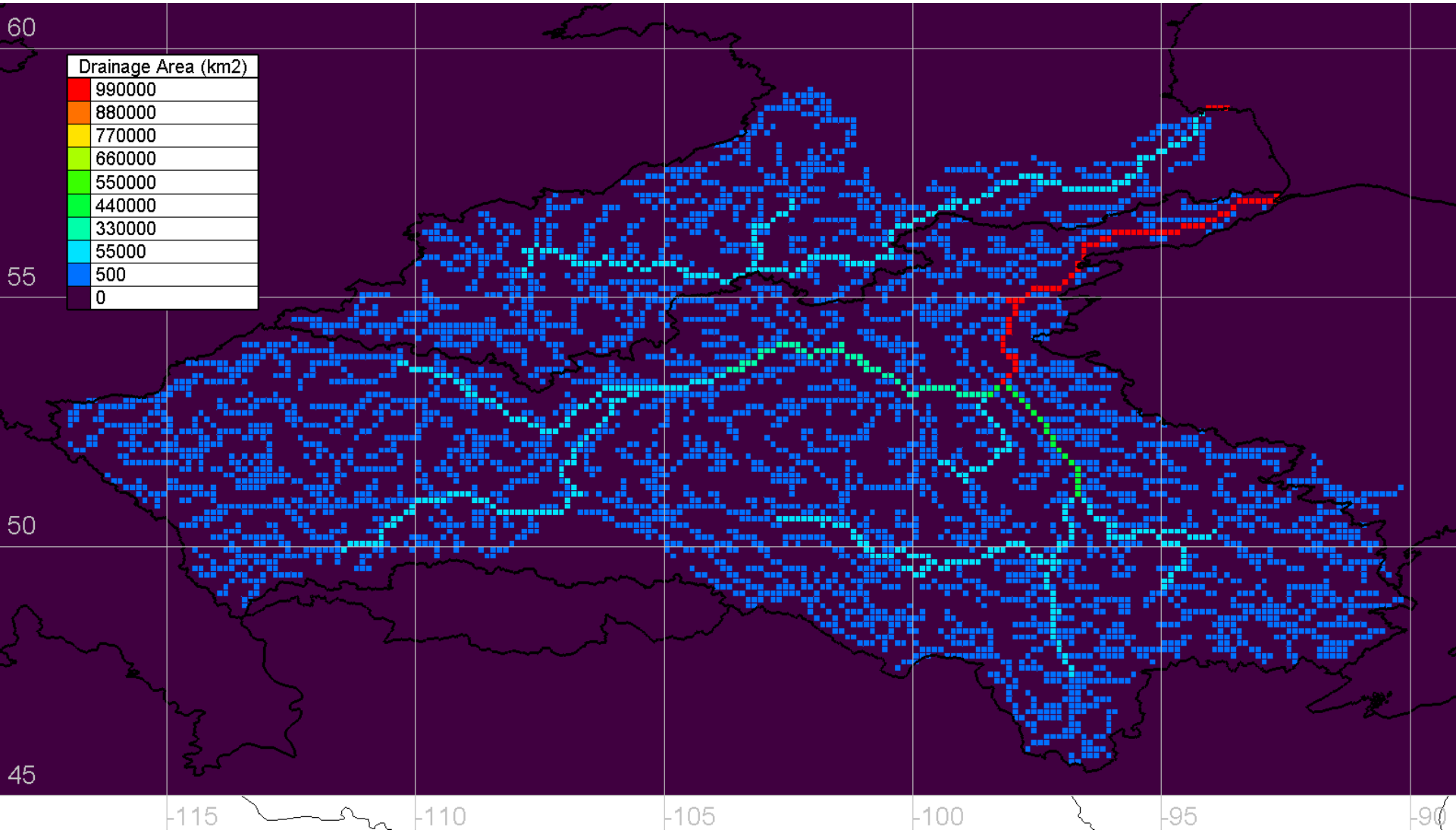
Canada Center for Remote Sensing (CCRS) 2005
Natural Resources Canada



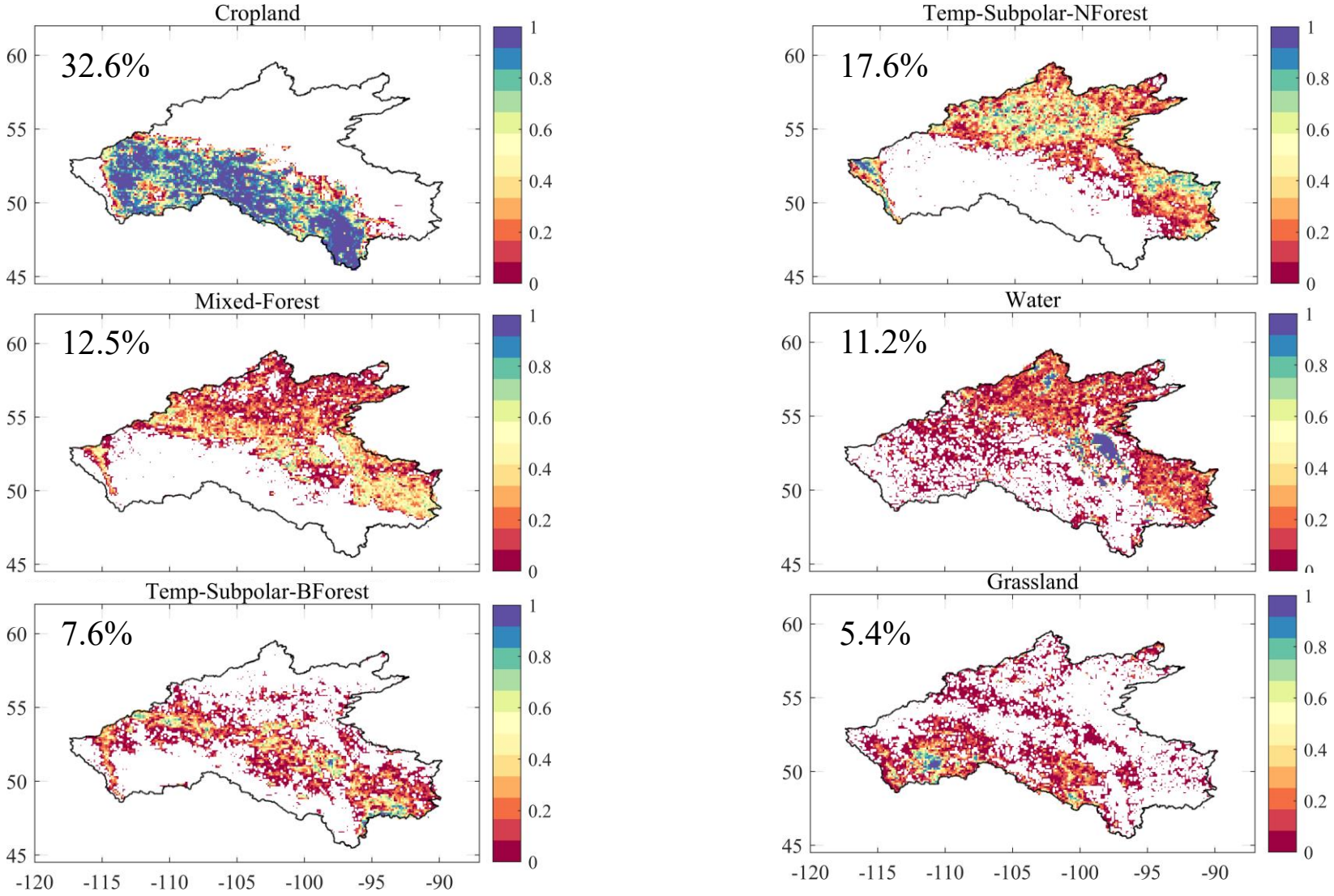
MESH Model Configuration

- Spatial resolution: 0.125°
- 12,626 grid cells, and about 54,000 tiles
- Sub-basin areas/shapes are compared with GreenKenue delineation.
- Suitable streamflow selection (ongoing)
- 15 Grouped Hydrological Response Units(GRUs) (16-17 after splitting for irrigated fraction)
- There are around 53 dams (ongoing-selection based on data availability)
- Distributed Soil Texture & Depth to Bedrock (ongoing)
- Irrigated land fraction estimation (ongoing)

GreenKenue MESH model setup (Drainage Area)

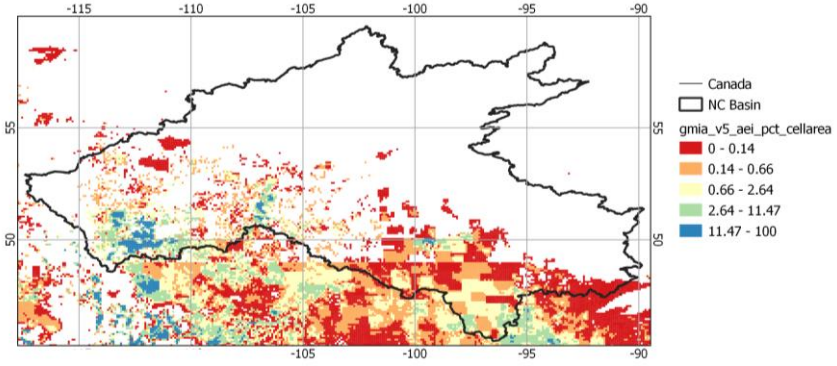


Land cover fraction 0.125° grid scale

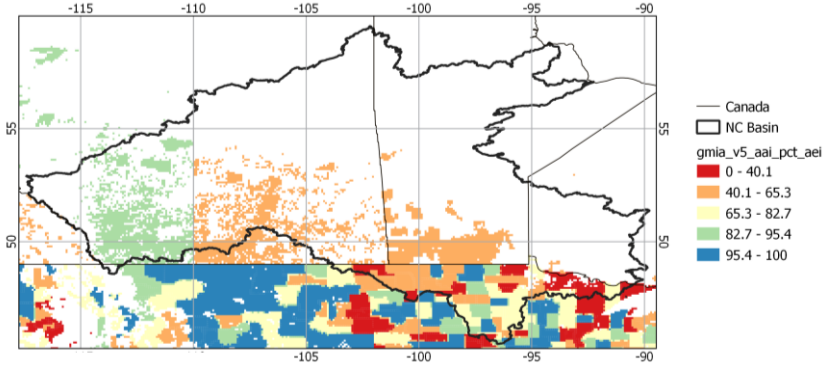


Irrigated area (From: Global Map of Irrigation Areas)

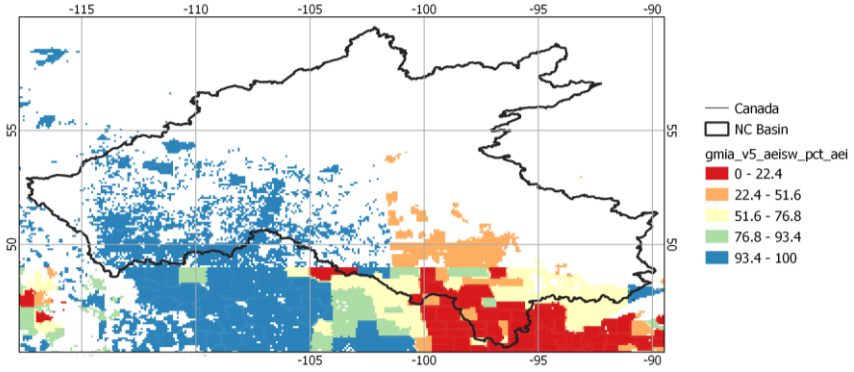
area equipped for irrigation (percentage of total 5 arc-minute grid cell area) (0.0833 decimal degrees resolution)



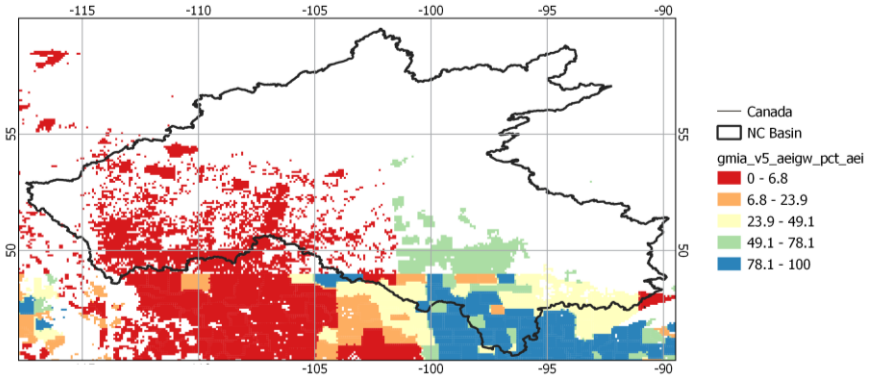
area actually irrigated (percentage of area equipped for irrigation)



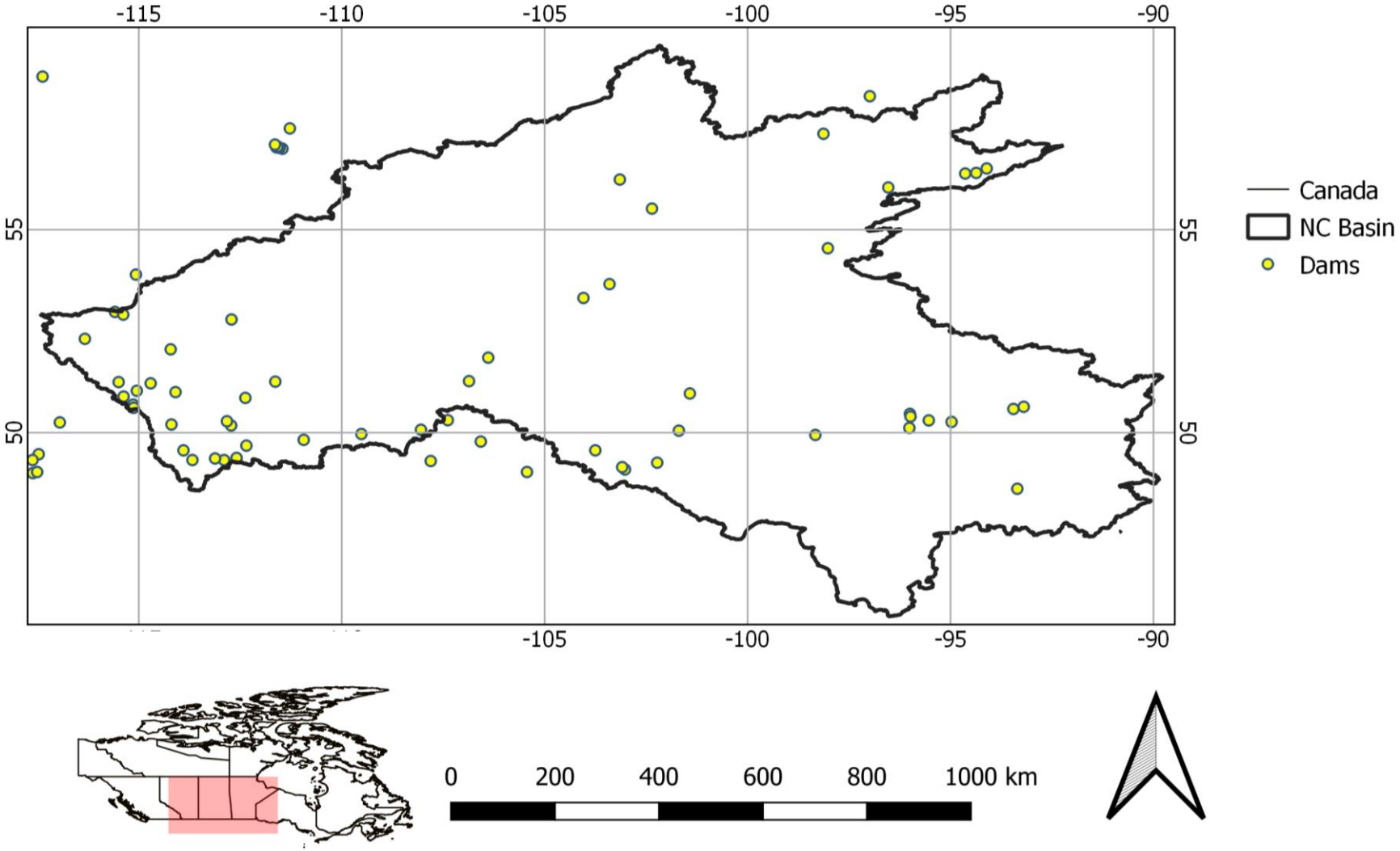
area equipped for irrigation with surface water (percentage of total area equipped for irrigation)



area equipped for irrigation with groundwater (percentage of total area equipped for irrigation)



Dams


-115
-110
-105
-100
-95
-90
55
50
Canada
NC Basin
Dams
0
200
400
600
800
1000 km

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Deliverables & Follow-up

- Modellers will report on the stage of their model set-up and new challenges encountered. We are encouraged to prepare 1 or 2 slides for that.
- We will also discuss on metrics for model calibration/ validation.
- During next meeting Dr Craig will give a presentation on RAVEN.
- Next meeting scheduled for **Wednesday August 12 @ 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