FLOODNET THEME 3-1:
Evaluation of Flood Forecasting and Warning Systems Across Canada

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In Memoriam

Dr. Peter Rasmussen
(University of Manitoba)

"Quietly, in the peacefulness of his home, surrounded by his family, Peter Funder Rasmussen left this world on January 2, 2017 at the age of 54 after a courageous fight with cancer."

The work he loved the most was working with our students.

Contributions to the Peter Funder Rasmussen Fellowship in Civil Engineering for the "best and kindest graduate students" can be made at https://give.umanitoba.ca/

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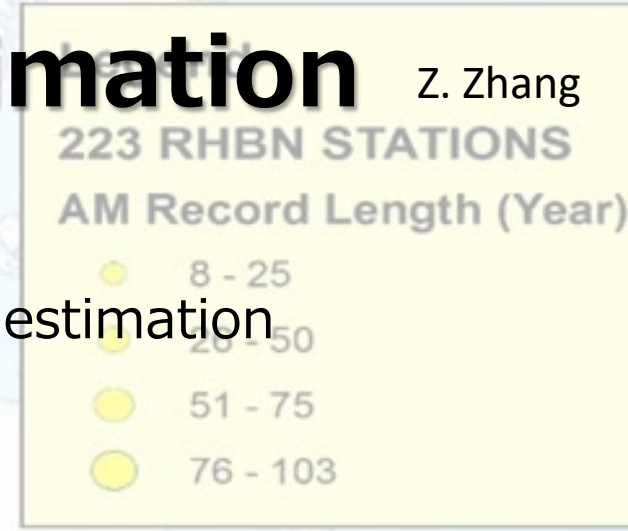
OUTLINE

- Theme 1-6: Flood frequency manual
  - Flood frequency estimation in Canadian Climates (Z. Zhang)
- Theme 3-1: Advancing flood forecasting & warning systems
  - Survey & evaluation of flood forecasting and warning systems across Canada
  - Bias correction of precipitation
  - Improve solid precipitation data
  - Improve hydrologic models on the Canadian Prairies

Theme 1.6: Flood Frequency Estimation

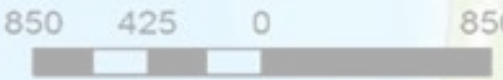
Z. Zhang



1. Investigate the best fit statistical distribution for flood frequency estimation
   - Compare GEV, GLO, PE3, and log10 PE3 distributions
   - Found GEV is better than others, primarily because of robustness

2. Investigate techniques for regional flood frequency analysis
   - Develop homogeneous pooling groups to extend flood frequency records and group “like” stations
   - Groupings use various types of climate & basin characteristics
   - Revision process for heterogeneous pooling groups a key component of this process

For Results: see Ziyang’s poster



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Theme 3.1: HFC Survey

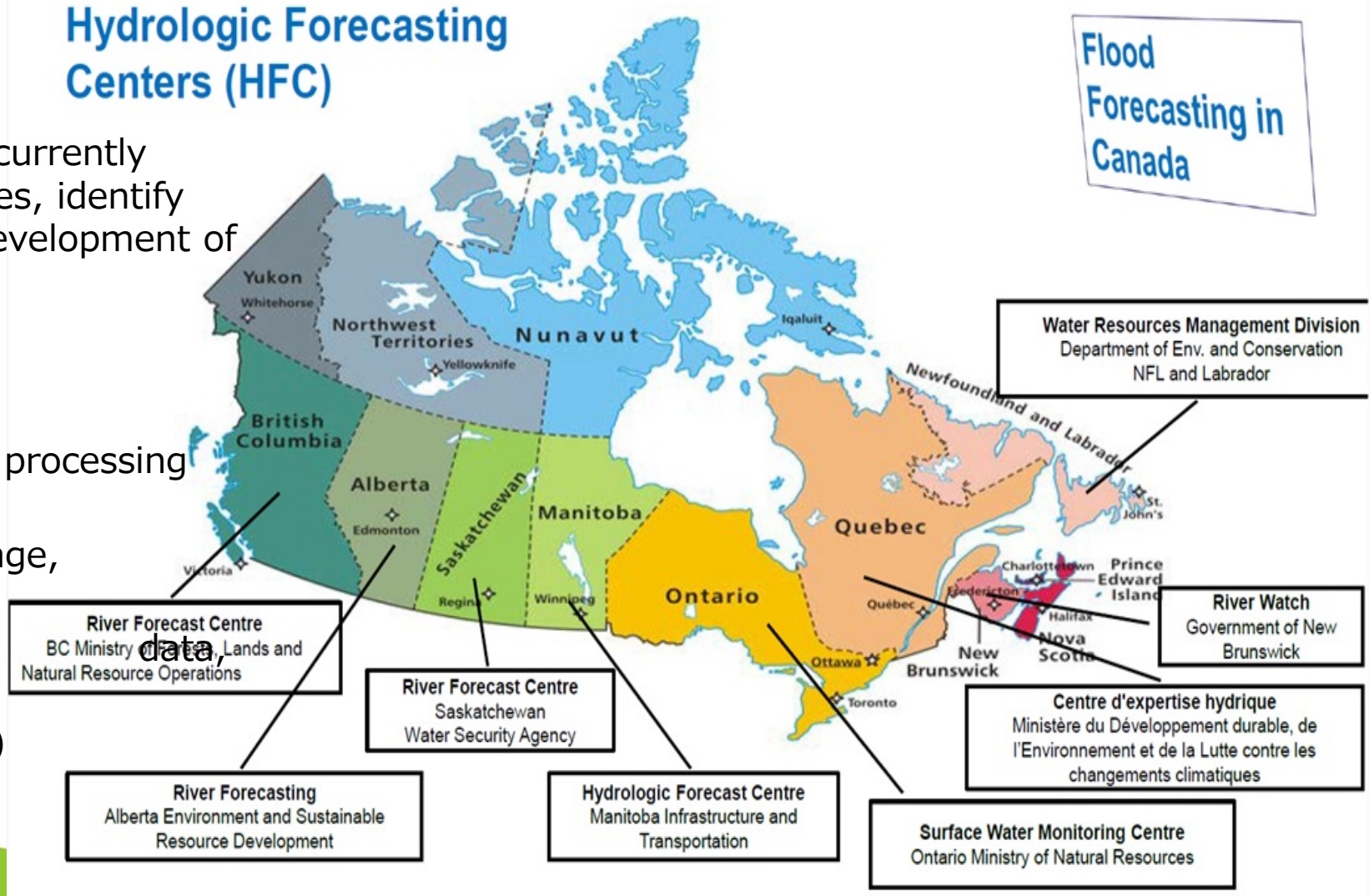
Z. Zahmatkesh & S. Jha

Objective

- Review flood forecasting systems currently implemented by Canadian Provinces, identify limitations/challenges to inform development of adequate solutions

Survey Focus Points

- Methods (hydrologic models, data processing tools, etc.)
- Data and sources (collection, storage, management, etc.)
- Challenges (physical, techniques, gaps, etc.)
- Communication (internal/external)



Theme 3.1: HFC Identified Needs

Z. Zahmatkesh & S. Jha

- Access to more accurate precipitation/snowfall estimation and forecasts
- Up-to-date soil moisture products for use in forecasting
- Improved modelling tools; modelling of more watersheds; tools and approaches for ensemble forecasting
- Support tools to more effectively communicate results of forecasts, risk, and uncertainty
- Data & modelling standards for continuous modelling based approaches
- Data management systems
- More seamless integration of the steps involved in the production of forecasts
- Better online reporting tools
- “Standards of Practice” in the flood forecast community
- More staff

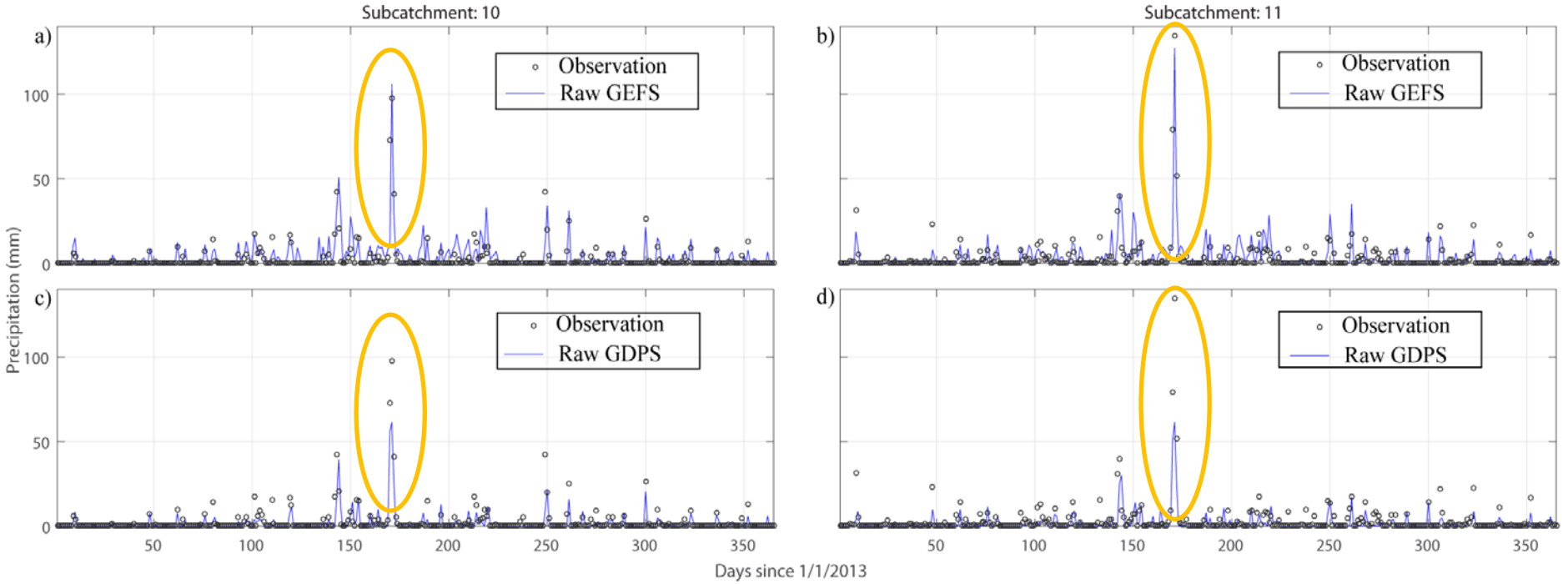
Theme 3.1: On-going Deliverables

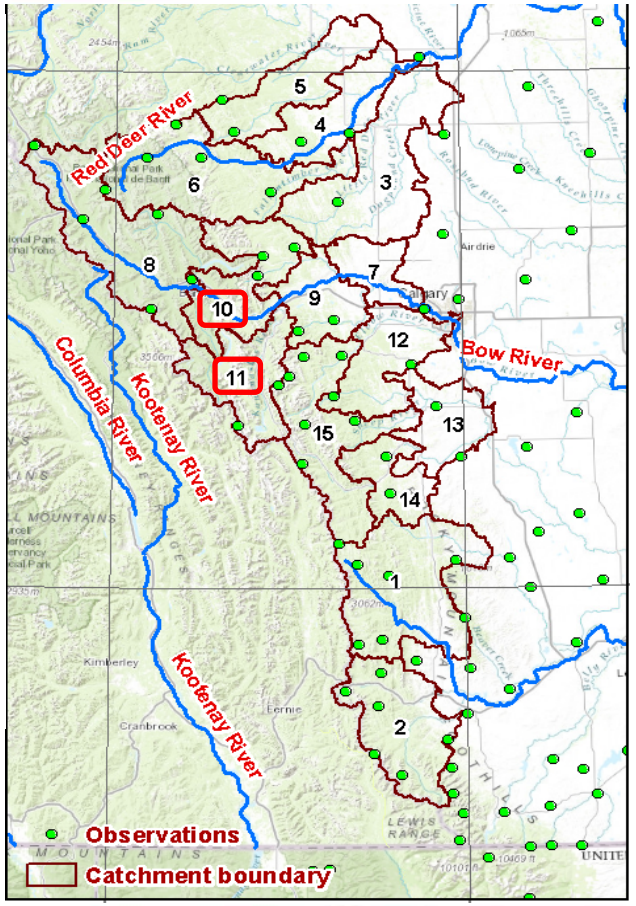
1. Improve precipitation forecasts:
   - Bias correction of precipitation (S. Jha)
   - Estimation of snow-water equivalent (Z. Zahmatkesh)

2. Improve hydrologic modelling:
   - Hydrology of the Prairie region (A. Muhammad)
   - Selection of the appropriate modelling system (A. Muhammad)

Theme 3.1: Bias Correction of Precipitation

S. Jha et al. (submitted)





– Evaluate RPP on Calgary 2013 flood case study

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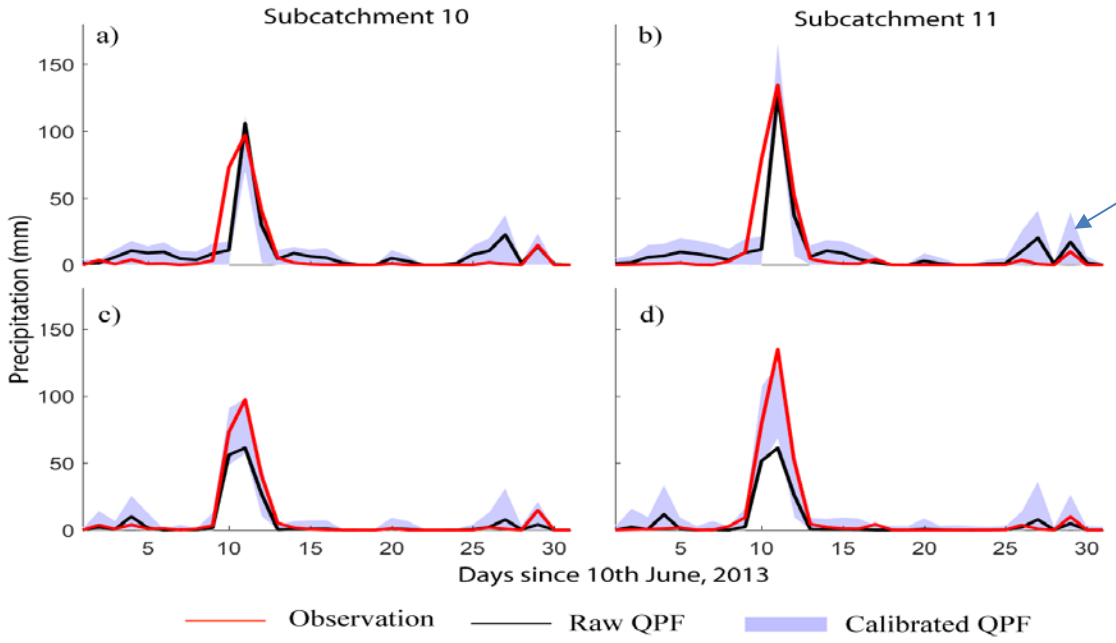
Theme 3.1: Bias Correction of Precipitation

S. Jha et al. (submitted)

- Conclusions:
  - Post-processed forecasts have low bias, and higher accuracy for each lead-time
  - Study covered a range of topographical conditions from mountains to plains
  - Raw forecasts from different sources need to be carefully examined before using in streamflow forecasting



5 and 95% of 1000 ensemble forecasts generated from RPP

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Theme 3.1: Estimation of SWE

Z. Zahmatkesh

- Objectives:
  - Evaluate NWS's SNOw Data Assimilation (SNODAS)
  - Validate snow depth (SD) and snow water equivalent (SWE)

- Methods:
  - Evaluate in two contrasting (by land use and elevation) watersheds
    - Don River (80% urbanized)
    - Madawaska River (93% forested)
  - Observations from ECCC global historical climatology network ranging from 8 to 60 years of record

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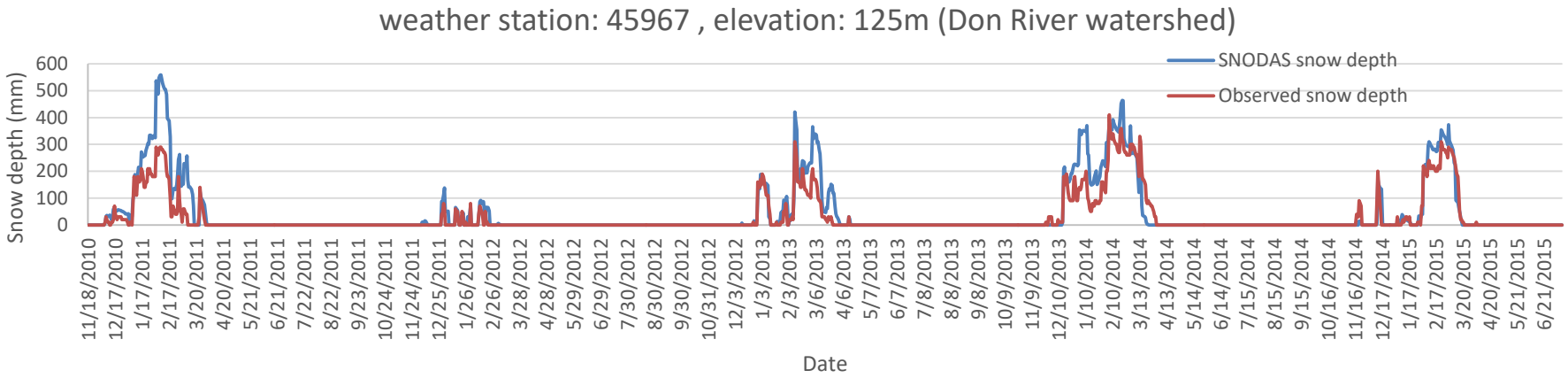
Theme 3.1: Estimation of SWE

Z. Zahmatkesh

- Results:
  - For all stations, strong correlation between SNODAS depth and SWE
  - SNOWDAS over-estimating (relative to observed) both SWE and depth
    - Depth: correlations of 0.53-0.78 (Madawaska R) and 0.7-0.85 (Don R)
    - SWE: correlations of 0.42-0.72 (Madawaska R) and 0.61-0.76 (Don R)
  - SNOWDAS seems to perform best at lower elevation



See Zahra's poster for more details!

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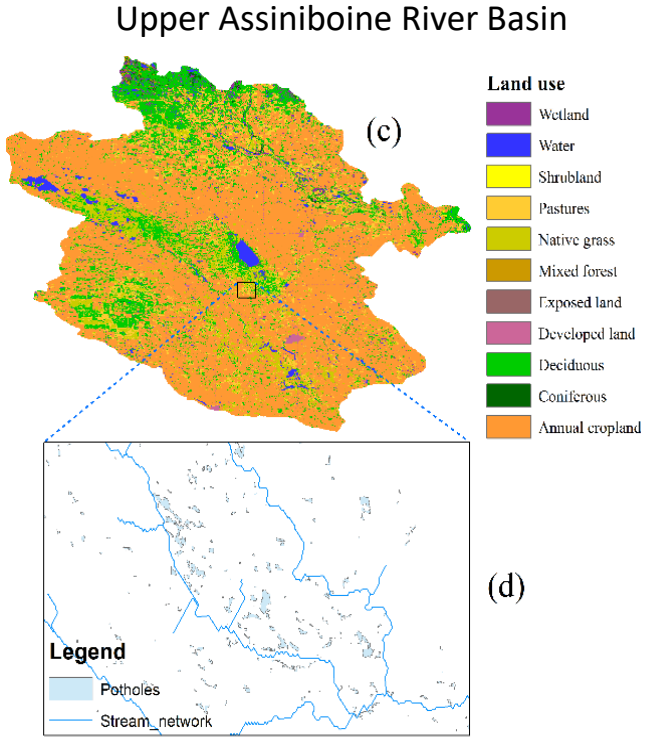
Theme 3.1: Hydrology of the Prairies

A. Muhammad

- Objective:
  - Assess the impact that model structure has on the accuracy of streamflow prediction in the Prairies
    - Address Prairie pothole runoff by adding geographically isolated wetlands (GIWs) to SWAT model
- Method:
  - Adapt the SWAT model to include different spatial representations of Prairie potholes
    - Lumped vs. sub-basin lumped vs. discretized
- Results:
  - Stay tuned! (Ameer's presentation is next)



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Theme 3.1: Model Selection & Uncertainty

A. Muhammad

- Objectives:
  1. Assess impact of climate and land use change in the Upper Assiniboine River
  2. Assess uncertainty in streamflow prediction

- Methods:
  1. Evaluate long-term uncertainty in projected streamflow under climate change and altered land use scenarios
  2. Perform multi-model (SWAT, WATFLOOD, HEC-HMS, NAM) comparison to assess uncertainty in model selection & parameterization

- Results: In progress

Our End Goal

"Advance knowledge on flood forecasting systems and enhance flood forecasting in Canada" by:

- Improving input data available to flood forecasters
- Providing enhanced tools for use by flood forecasting agencies
- Providing insight into uncertainty arising from model choice, model structure, and model parameterization

With Thanks to…

Co-PIs
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D. Burn

HQP
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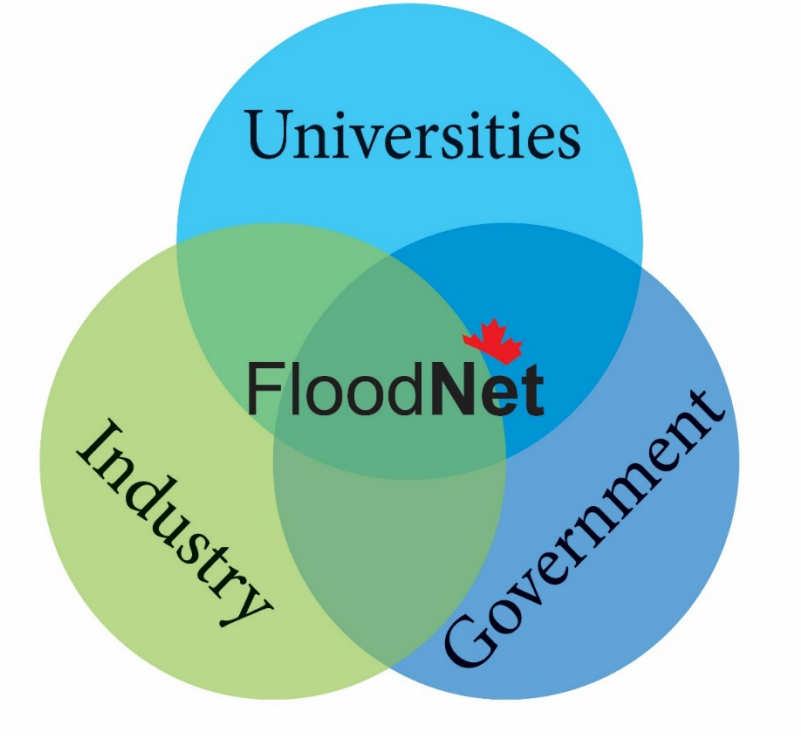
Ameer Muhammad
Zahara Zahmatkesh
Ziyang Zhang

Data Providers & Partners
ECCC
CSIRO
NOAA



Hydrologic Forecasting Centre Personnel
D. Campbell
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Submitted Publication:
Jha, S. K., Shrestha, D. L., Stadnyk, T., and Coulibaly, P. (Submitted). 'Evaluation of ensemble precipitation forecasts generated through postprocessing in a Canadian catchment.' Hydrology and Earth System Sciences (HESS).

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