UNIVERSITY OF SASKATCHEWAN

A6: Improving floodplain mapping

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The beginning

- Early stage of the research !
- HQP familiarizing himself with the prairies
- Connection with the FloodNet …. Good start !

- What is it that we want to do here?

We want to

- OBJECTIVE: Estimation of flood quantiles & allowing for flood mapping at gauged & ungauged sites in the prairies.

- Because of engineering (design) consideration
  - Evidence-based …. (stat. Dist. based on observations)

Challenges: Change (climate, land-use,….); ungauged sites

The Research Question

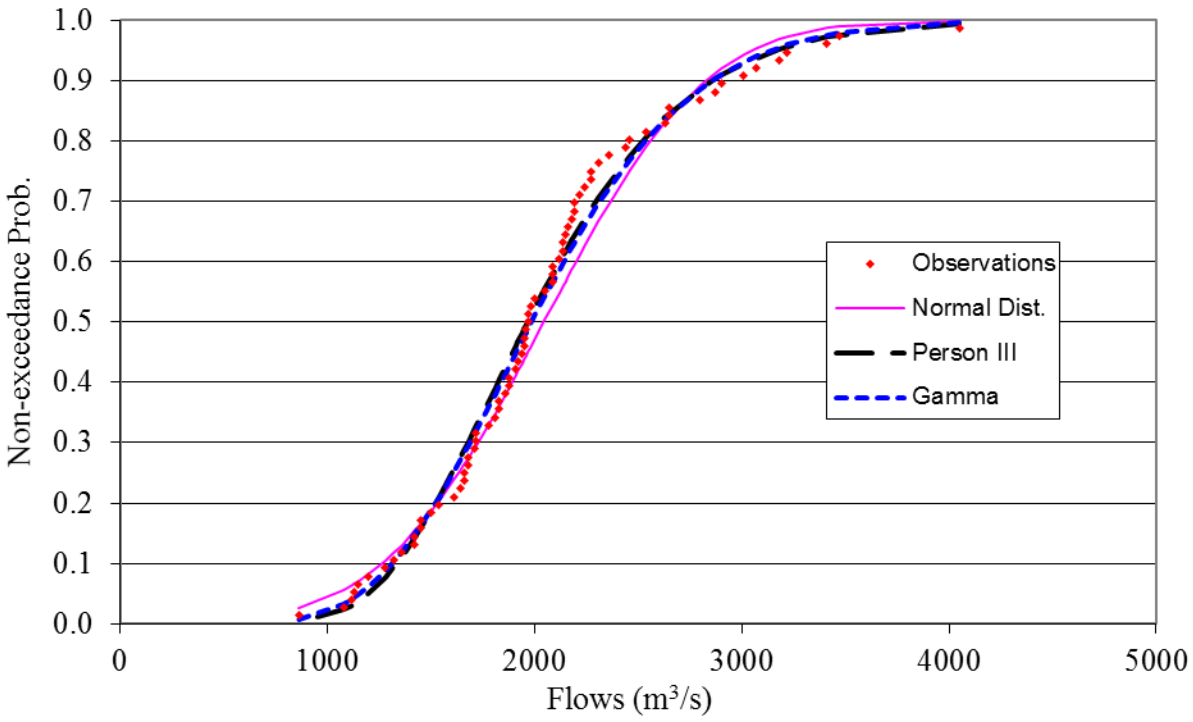
Q: What is the suitable flood estimation framework/method/tool in the prairies?

a) Under climate change

b) Ungauged ba

c) Land-use cha

- We need to unc and the pathwa *Chart* (Freq. Dis



This requires

- Flood modeling;
  - Capturing peak flows well !
  - Preserving the variance !
- Flood-triggering mechanisms
  - Pre-freezing soil moisture and ponding conditions
  - Snow accumulation
  - Snow melting rate and progression
  - Rain over snow
  - Summer rain
  - ……..
- Synthetic climate scenarios (realizations)
  - Generate datasets

Generated Datasets (Aggregate values corresponding to flood events)

Rainfall	Snowpack	Melt index	Antecedent moisture	Ponding	Streamflow
.....	.....	.....	.....	.....	.....
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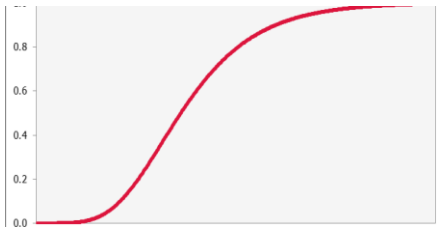
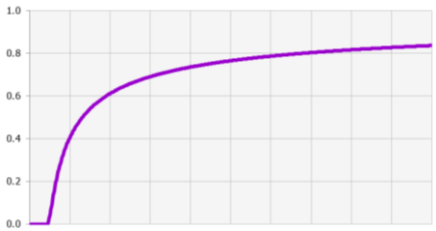
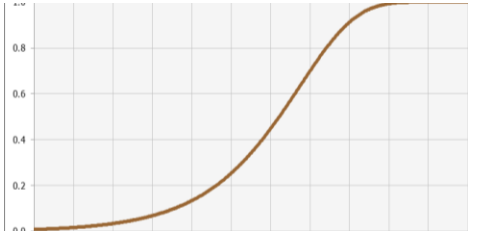
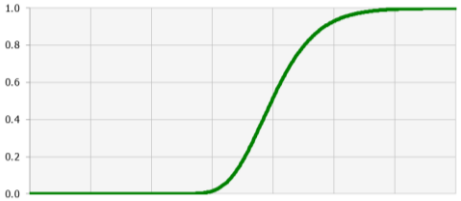
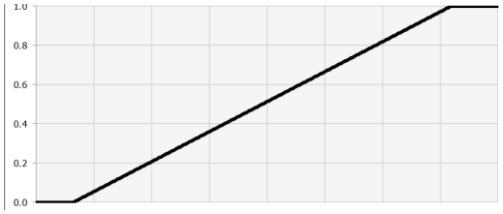




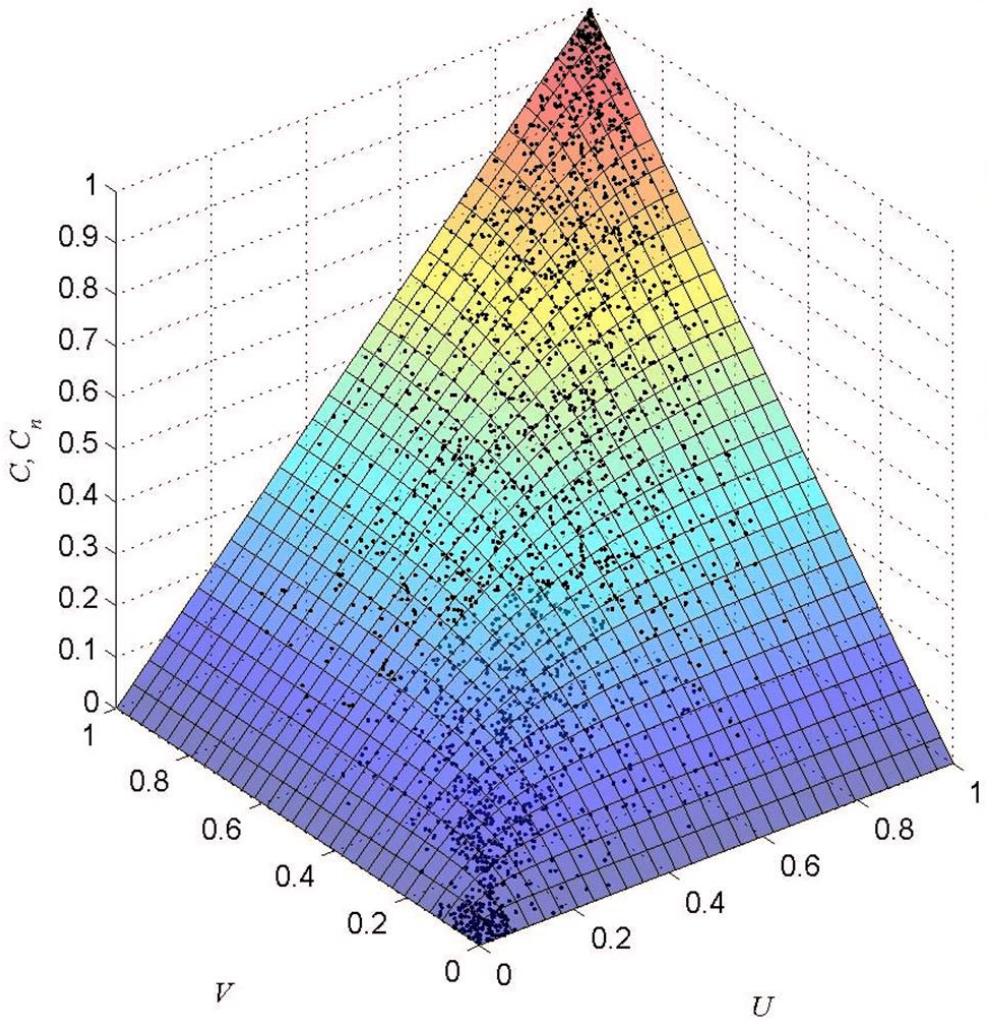


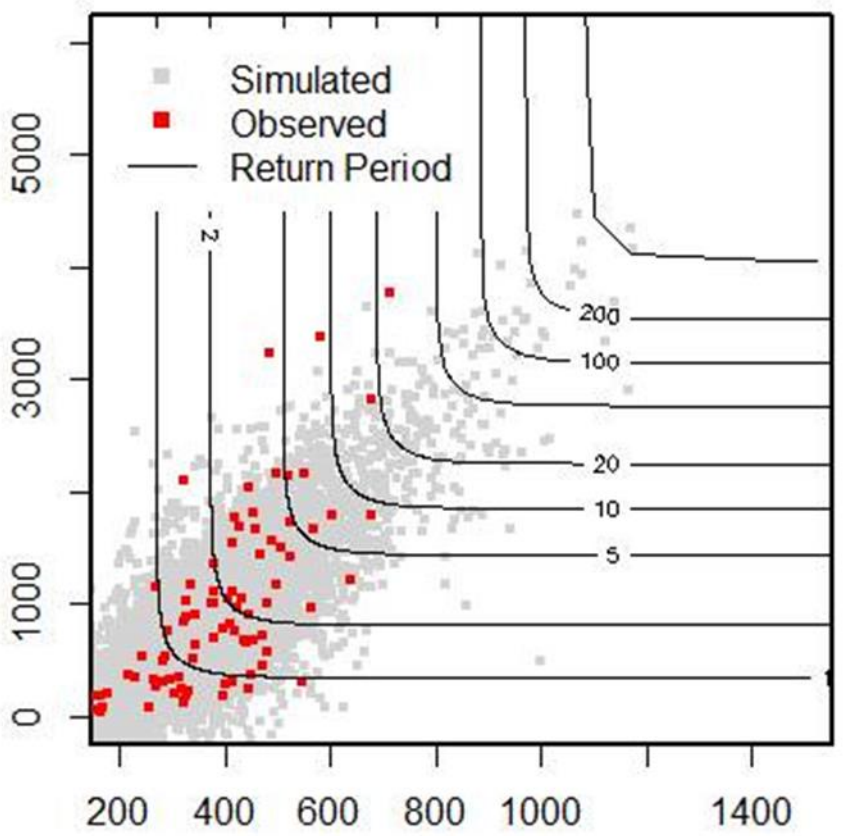




This requires

- Constructing copulas



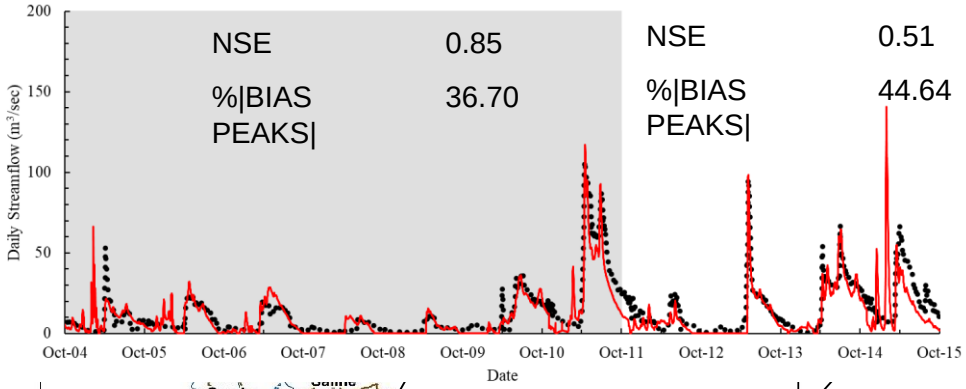


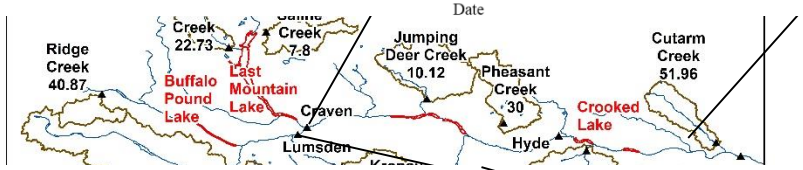
The outcome

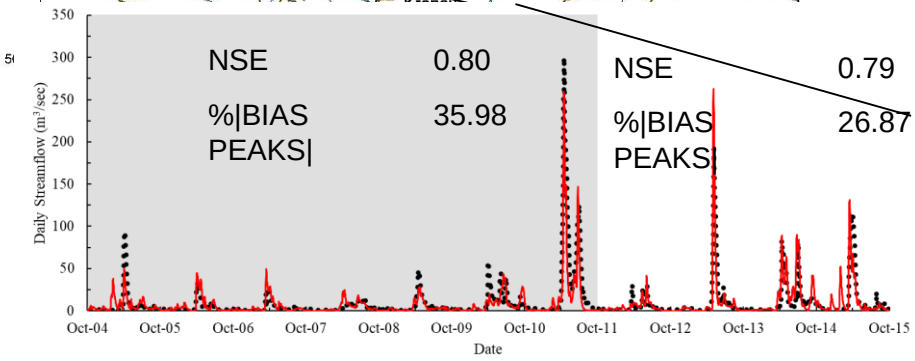
- Copulas
  a) Good for design because they are using evidence-based approach
  b) They provide understanding of flood triggering factors
  c) Supporting data of continuous hydrographs for detailed hydraulic modeling/flood mapping
  d) Can be used for predictive purposes
  e) Can be translated into charts & tables to mimic the existing approach of the SWSA

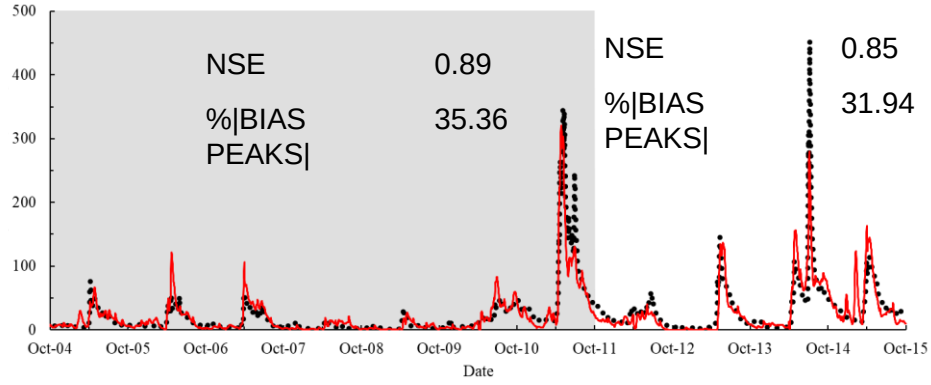
Building on FloodNet

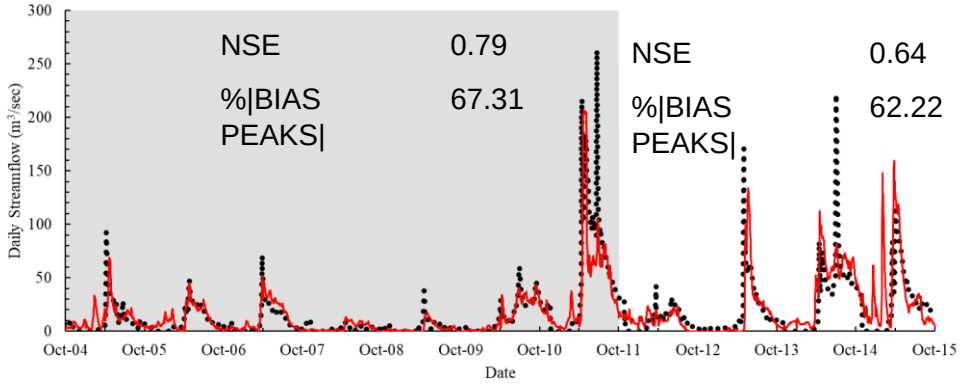
- MESH (and HBV) modeling in the Qu'Appelle River Basin & other watersheds
  - Adapting runoff generation mechanisms to prairies
  - Improving peak flow prediction











Calib period • • • • Observed —— Simulated

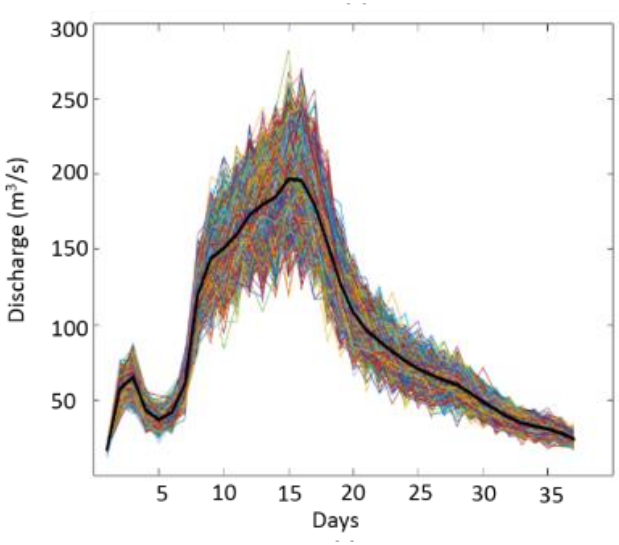
Building on FloodNet

- MESH (and HBV) modeling in the Qu'Appelle River Basin & other watersheds
  - Adapting runoff generation mechanisms to prairies
  - Improving peak flow prediction

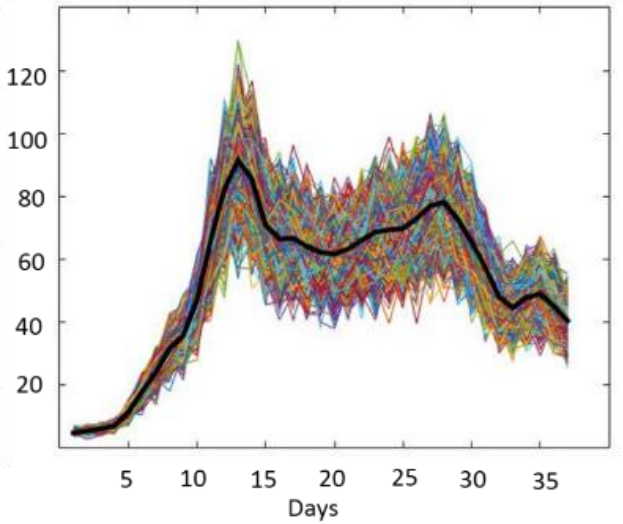
- Hydraulic modeling
  a) HEC-RAS (1D/2D) in the QRB
  b) Probabilistic flood mapping

Uncertainty in hydraulic model parameters and boundary conditions

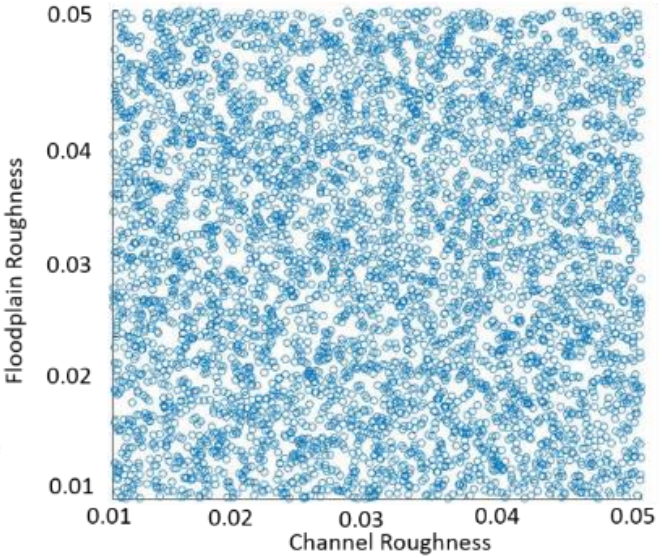
- manning's n (model parameters) , and
- inflow hydrographs (boundary conditions)



Flood hydrograph at Moose Jaw

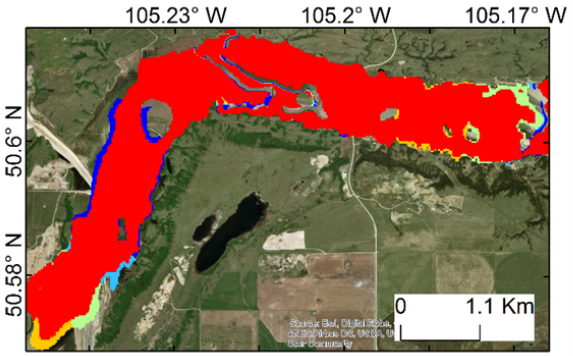


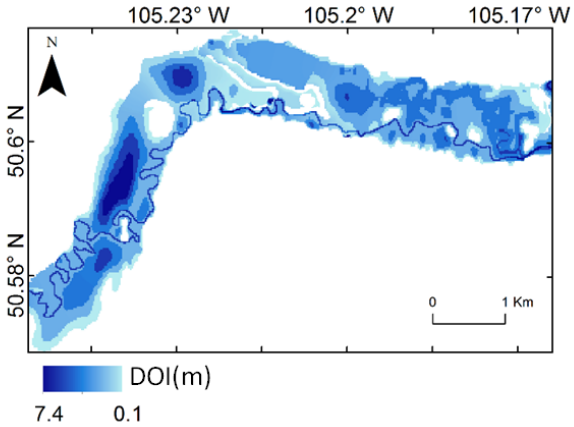
Flood hydrograph in Wascana Creek

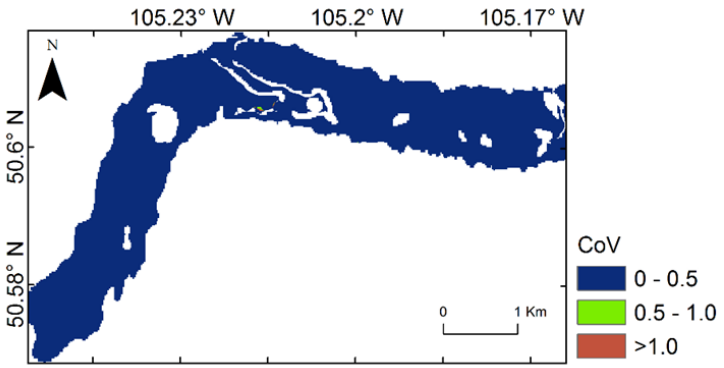


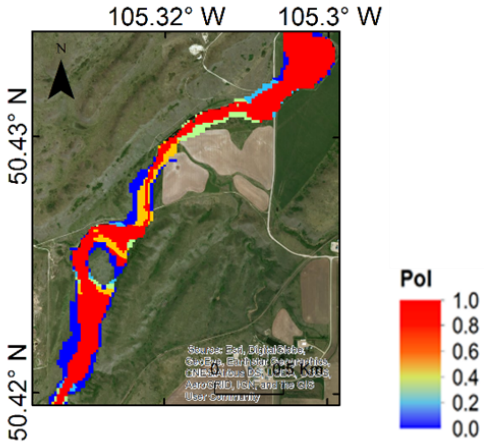
Roughness coefficients

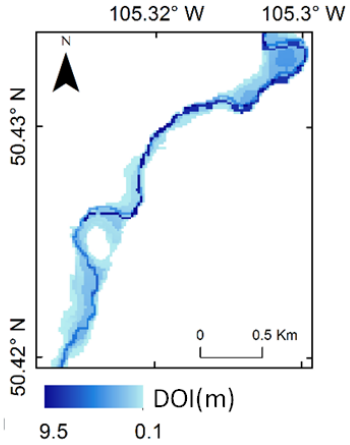
Probabilistic flood mapping

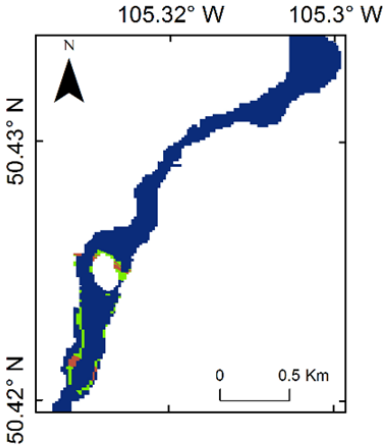












Probability of Inundation

Depth of Inundation

Coefficient of Variation

This requires

- Regionalization analysis
  a) Construct regional marginal distributions of flows
  b) Construct regional copulas in “similar” regions
  c) Use to estimate flood quantiles at ungauged basins

Again building on a lot of univariate regional analysis done within FloodNet, and site classification of rain-driven, snow-driven, …. Etc.

The Magnitude of Work

- A lot of hydrologic modeling;
- Climate model simulations;
- Analysis of flood triggering factors
- Extensive and advanced statistical analysis
- Hydraulic modeling ??

Milestones

- December 2018
  - Watershed models developed for 2 watersheds
- December 2019
  - Climate realizations and Generation of datasets
  - Analysis of flood-triggering mechanisms
- December 2020
  - Statistical analysis & construction of copulas at the sites
  - Proof of concept

Final Thoughts

- Beyond 2020
  - Generating datasets at several sites
  - Regionalization of copulas
  - Estimation of flood quantiles at ungauged basins
  - Hydraulic modeling
  - Probabilistic flood mapping & Risk assessment