



Integrated Modelling for Prediction and Management of Change in Canada's Major River Basins (IMPC)

Saman Razavi

Second Annual General Meeting, June 12-13, 2019



UNIVERSITY OF SASKATCHEWAN
Global Institute for
Water Security
USASK.CA/WATER



Integrated Modelling
Program for Canada
Global Water Futures



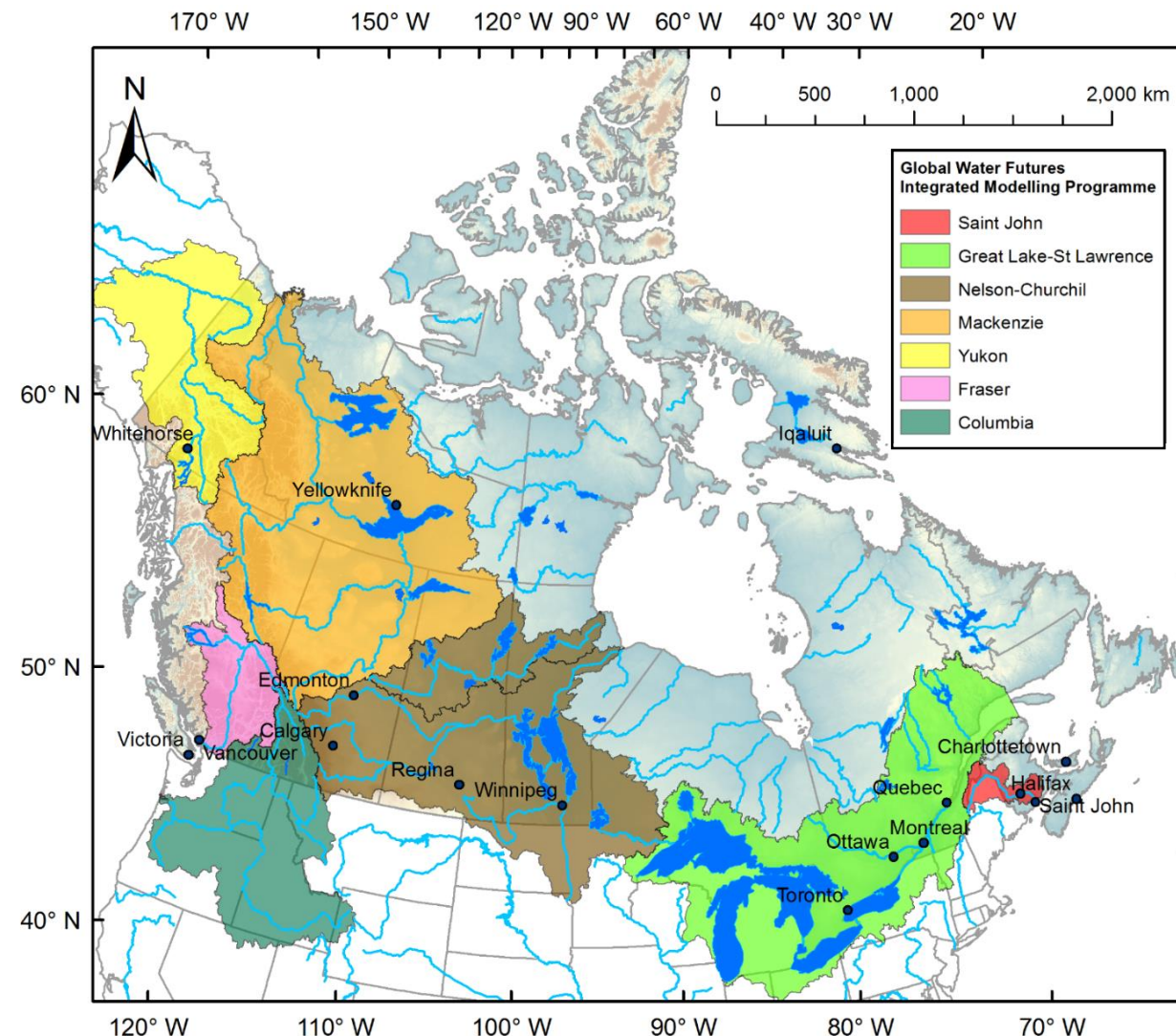
Overarching Challenges

- (I) **Failure to link important features** of climate, hydrology, water quality, ecosystem, and water management systems. Important positive and negative feedback loops, tipping points, and dynamical behaviour of these human-natural systems are not included in current modelling schemes.
- (II) **Fragmentation** in operations, management, and governance of Canadian water resources systems leads to piecemeal science, policy, and modelling. Our research transcends artificial boundaries (international, provincial, and local) and provides information at scales appropriate for decision-making.
- (III) Current practice assumes stationarity, the idea that the past empirical record is a basis for understanding the present and future conditions. We now know that **stationarity is dead** and that our environmental systems are in the throes of unprecedented climate and environment change.

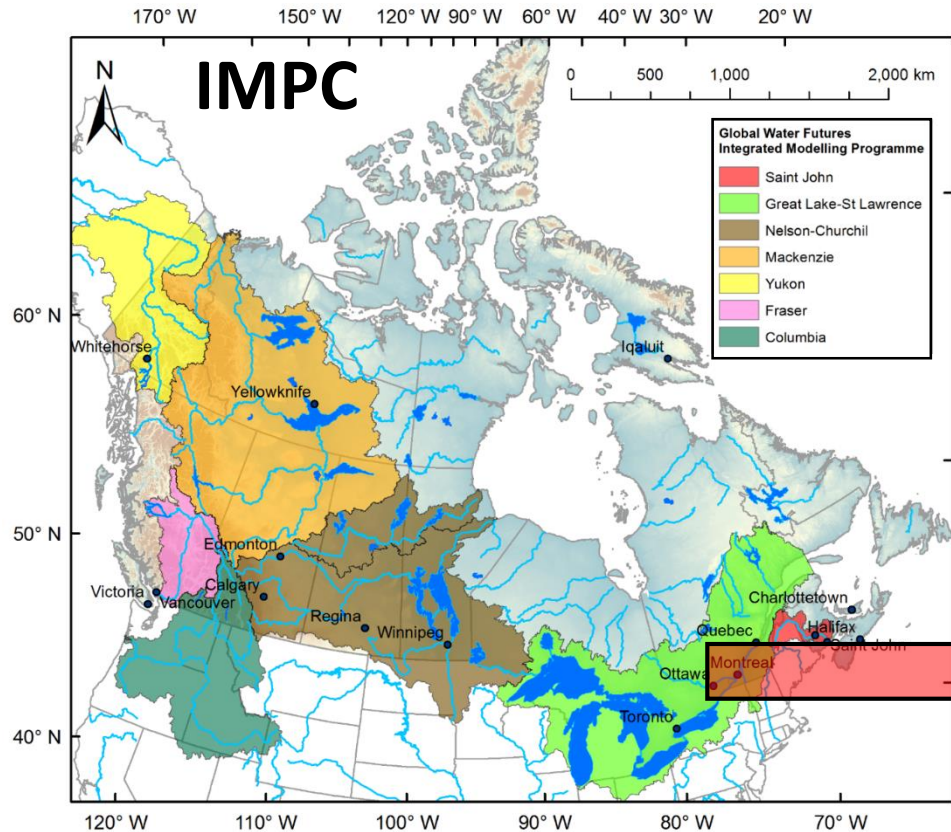


Overarching Objective

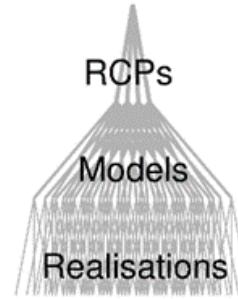
*“This program aims to develop a pan-Canadian **integrated modelling platform** to diagnose, simulate, and predict interactions amongst natural and human-driven water-resource components of the changing Earth and environmental systems, and to deliver **robust decision making tools and solutions** for uncertain future water resources, considering the range of stakeholder needs in Canada’s major river basins.”*



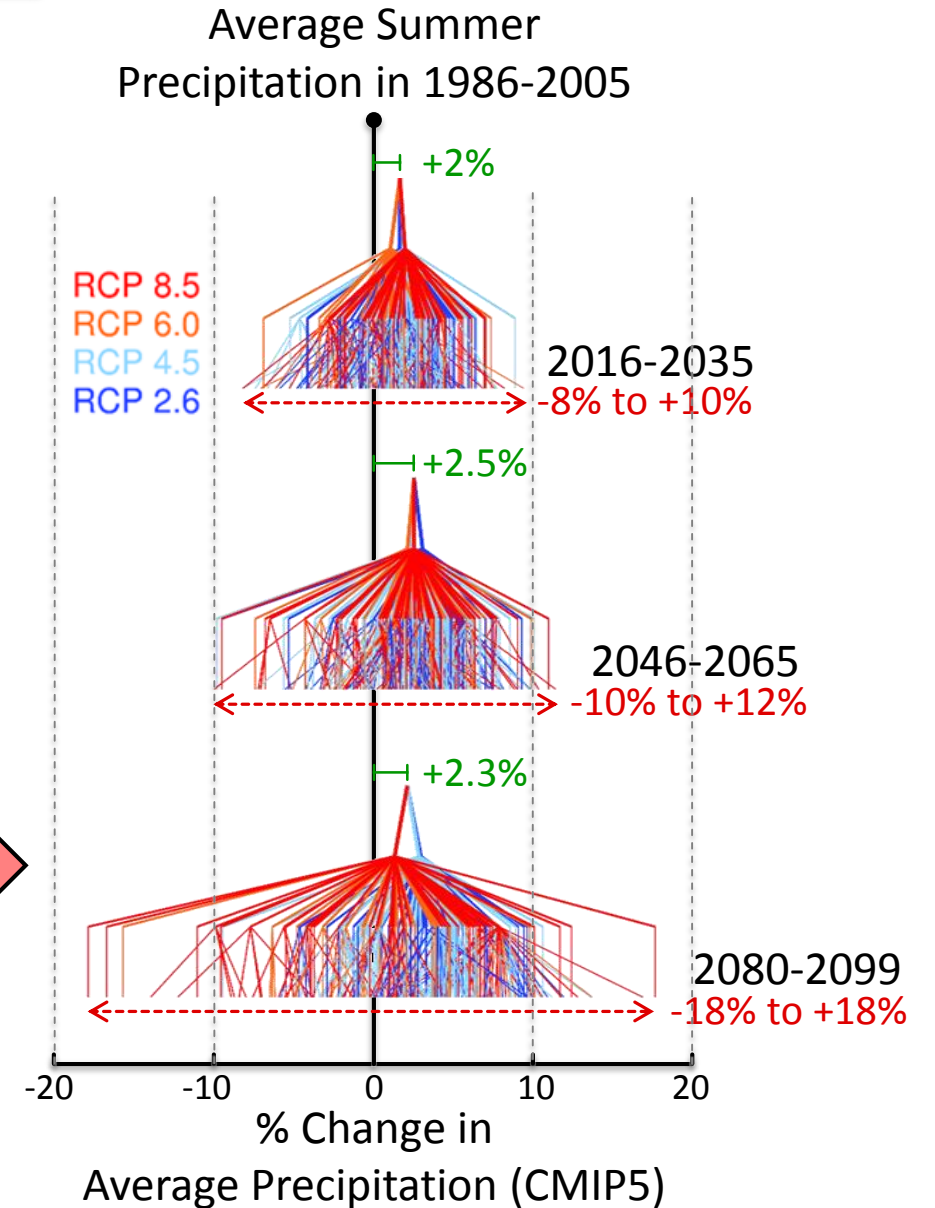
LOOKING INTO THE FUTURE SCENARIO DISCOVERY



Cascade of Uncertainty (CMIP5)

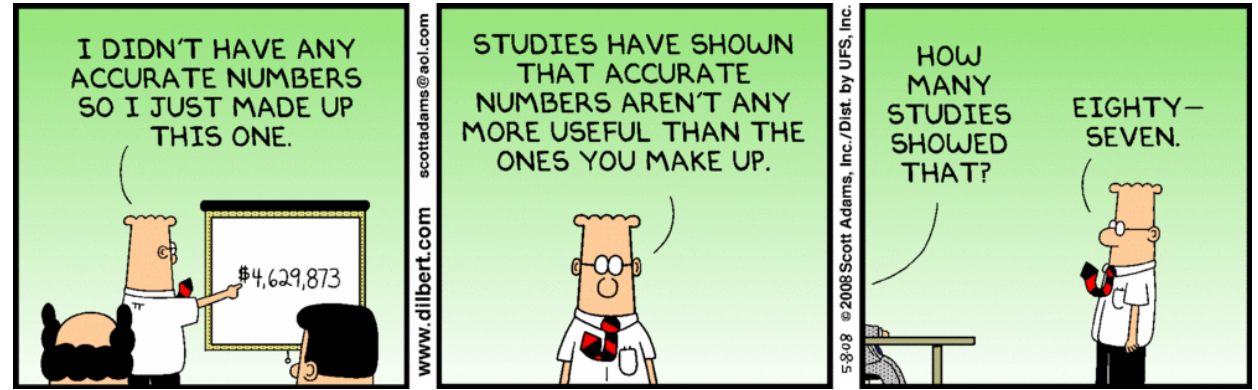
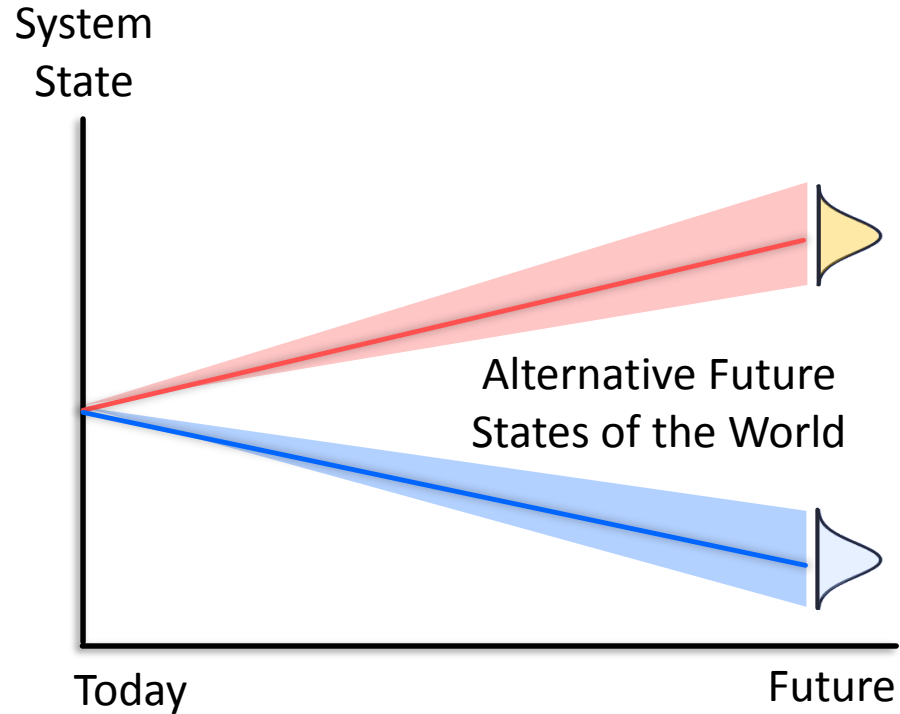


Great-Lakes Basin



Asong Z. E., Hawkins, E., Razavi, S., et al. Climate change projections for scenario-led hydrological impacts assessment: Rethinking how we interpret the cascade of uncertainty for effective adaptation. In Prep.

LIVING WITH “DEEP” UNCERTAINTY?



- Is the “*predict-then-plan*” paradigm obsolete? (Top-Down Decision Making)
- How can we minimize vulnerability when the future deviates from our assumptions about it?
(Bottom-Up, “Robust” Decision Making: “Scenario Discovery” and “Building Resilience”)

BUILDING RESILIENCE

“Resilience” is the capacity to buffer and adapt to major changes and shocks and therefore to maintain function.

I THOUGHT I WAS
INTERESTED IN UNCERTAINTY
BUT NOW I'M NOT SO SURE



Identify alternative future states of the world
(including development and policy scenarios)

Simulate the coupled human-natural system
under the full range of scenarios

Identify and address vulnerabilities

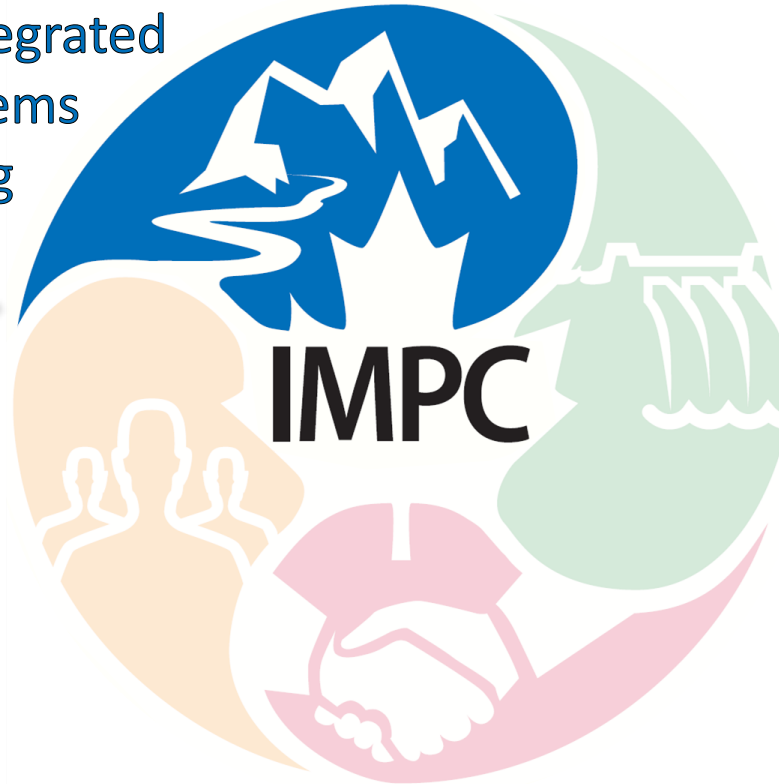
Research Themes



**Integrated Modelling
Program for Canada**
Global Water Futures

A1: Atmospheric Modelling
A2: Hydrologic Modelling
A3: Water Quality Modelling
A4: River Ice Modelling
A5: Model Intercomparison
A6: Floodplain Mapping
A7: Uncertainty Characterization

THEME A: Integrated Earth Systems Modelling



Research Themes

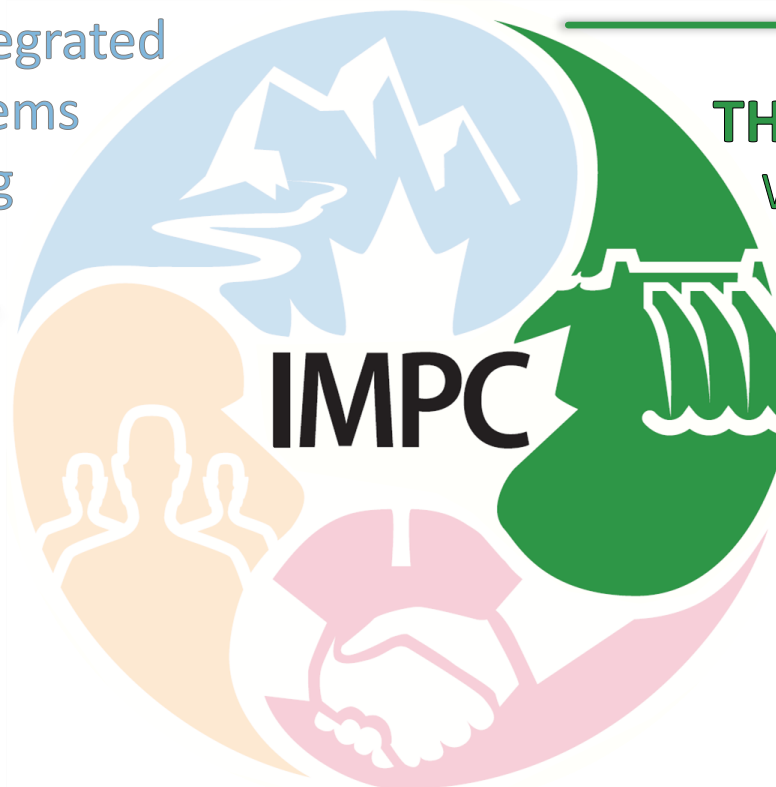


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THEME A:
Integrated
Earth Systems
Modelling



THEME B:
Water Management
Modelling, Coupling
Human-driven and
Natural Systems

B1: Basin-wide Water
Resource Modelling
B2: Environmental Demands
B3: Hydro-economic Modelling

Research Themes



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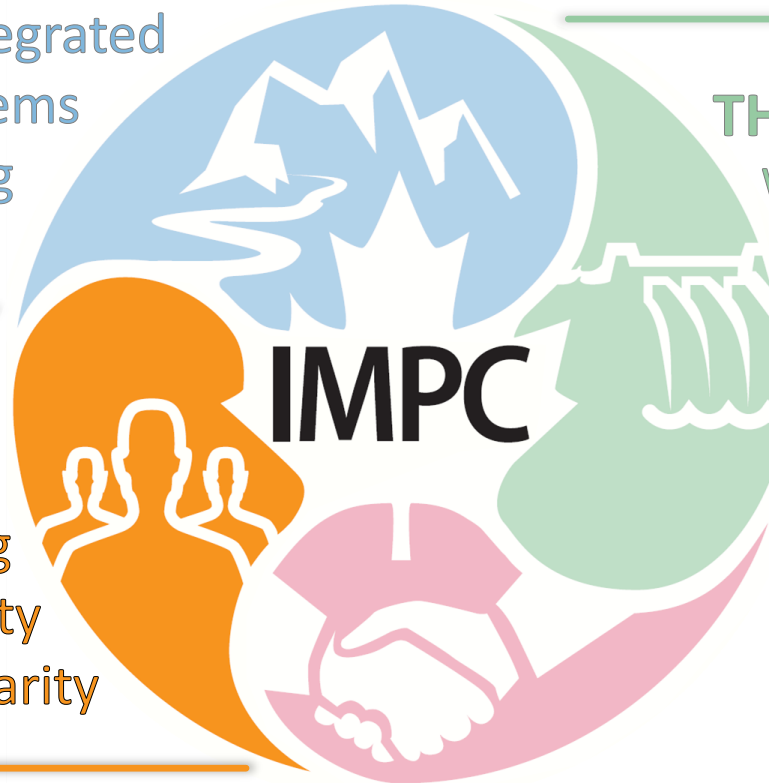
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THEME B:
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Modelling, Coupling
Human-driven and
Natural Systems

THEME C:
Decision Making
under Uncertainty
and Non-stationarity

C1: Future Scenario Generation
C2: Optimization and Multi-
Criteria Decision Analysis



Research Themes



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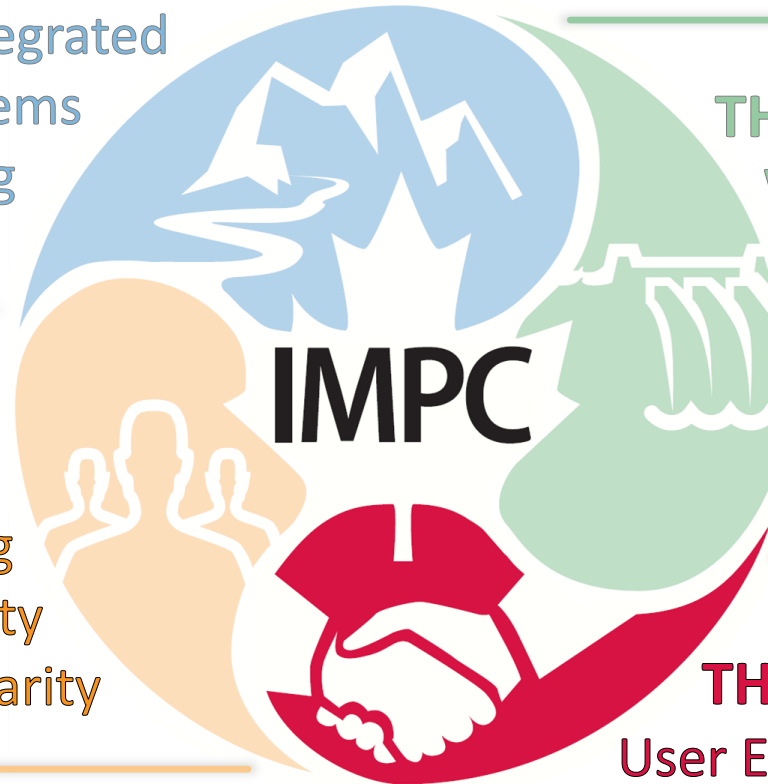
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THEME D:
User Engagement
and Knowledge Mobilization

D1: Outreach and
User Engagement
D2: Decision Support Systems



Research Themes



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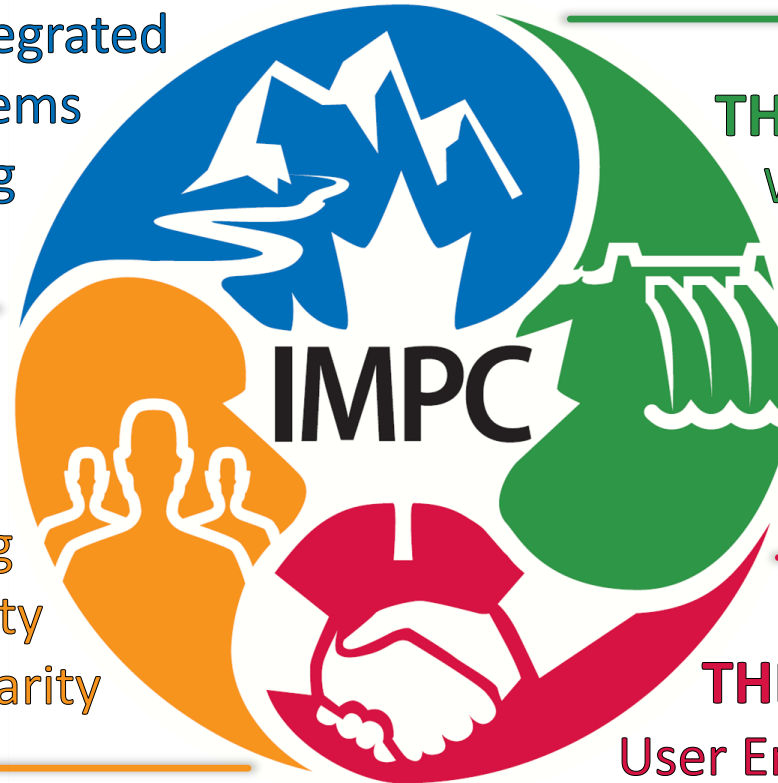
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D2: Decision Support Systems



Lead Investigators



**Integrated Modelling
Program for Canada**

Global Water Futures



Dr. Saman Razavi
Principal Investigator
University of Saskatchewan



Dr. Jay Famiglietti
Canada 150
Research Chair



Dr. Martyn Clark
University of
Saskatchewan



**Dr. Karl-Erich
Lindenschmidt**
University of Saskatchewan



Dr. John Pomeroy
Canada
Research Chair



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University of
Saskatchewan



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University of
Saskatchewan



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University of
Manitoba



Dr. Tim Jardine
University of
Saskatchewan



Dr. Yanping Li
University of
Saskatchewan



Dr. Al Pietroniro
Environment Canada



Dr. Bryan Tolson
University of Waterloo



Dr. Paulin Coulibaly
McMaster's University



Dr. Howard Wheeler
University of
Saskatchewan



Dr. Carl Gutwin
University of
Saskatchewan



Dr. Graham Strickert
University of
Saskatchewan



Dr. Roy Brouwer
University of Waterloo

Progress To Date



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Kick-Off Workshop



Sept 14-15, 2017

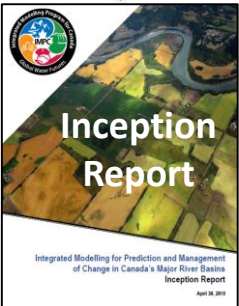
First Annual General Meeting



Jul 18-19, 2018

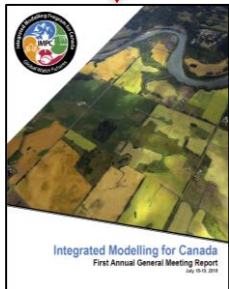
Second Annual
General Meeting
Jun 12-13, 2019

Jul, 2017



First
Annual Report

First
Meeting
Report



Second
Annual Report

Look Into The Future

End of IMPC
(phase 1)
Aug 2020

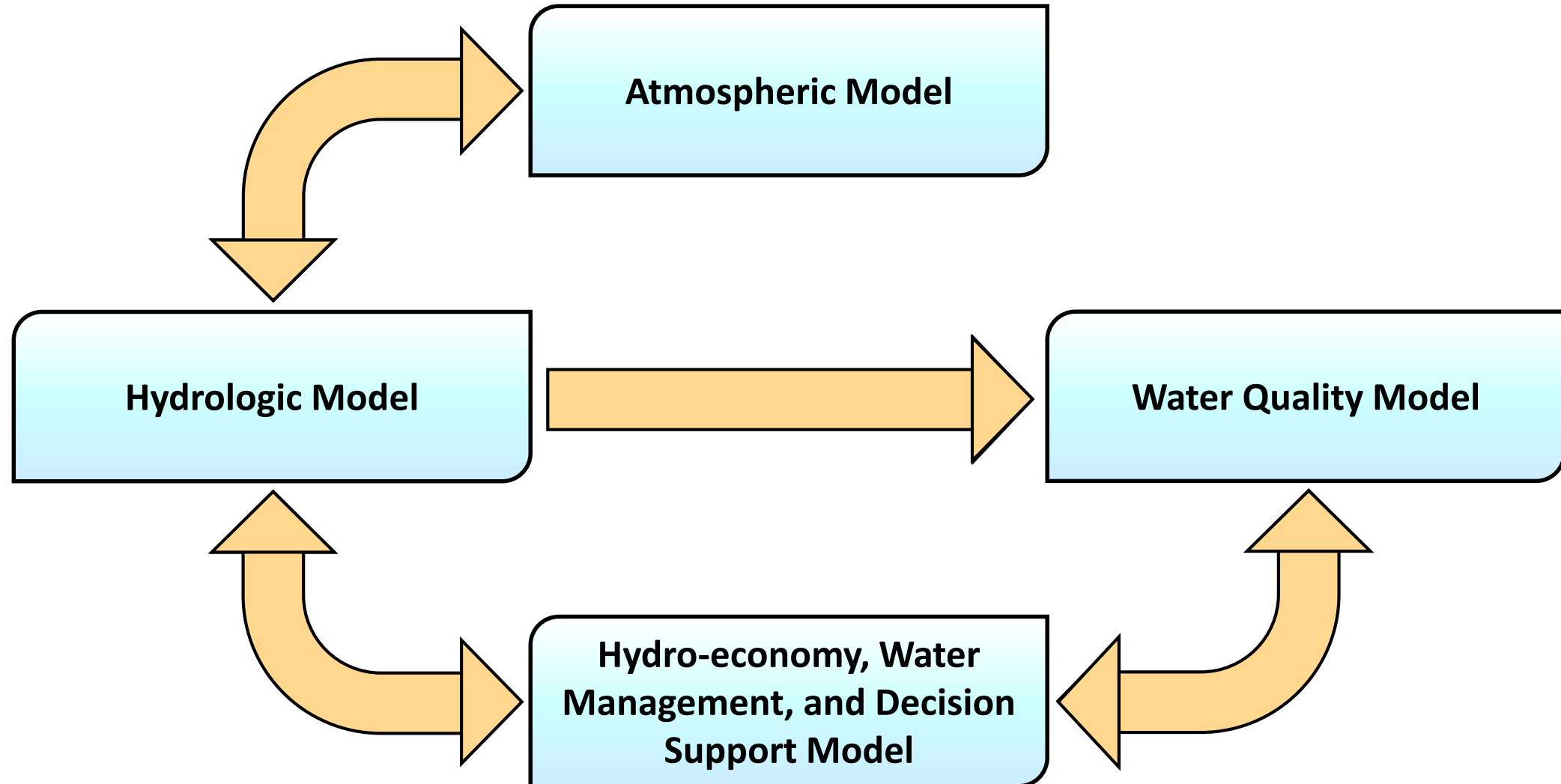
Visions, plans, challenges,...

End of GWF
Aug 2023

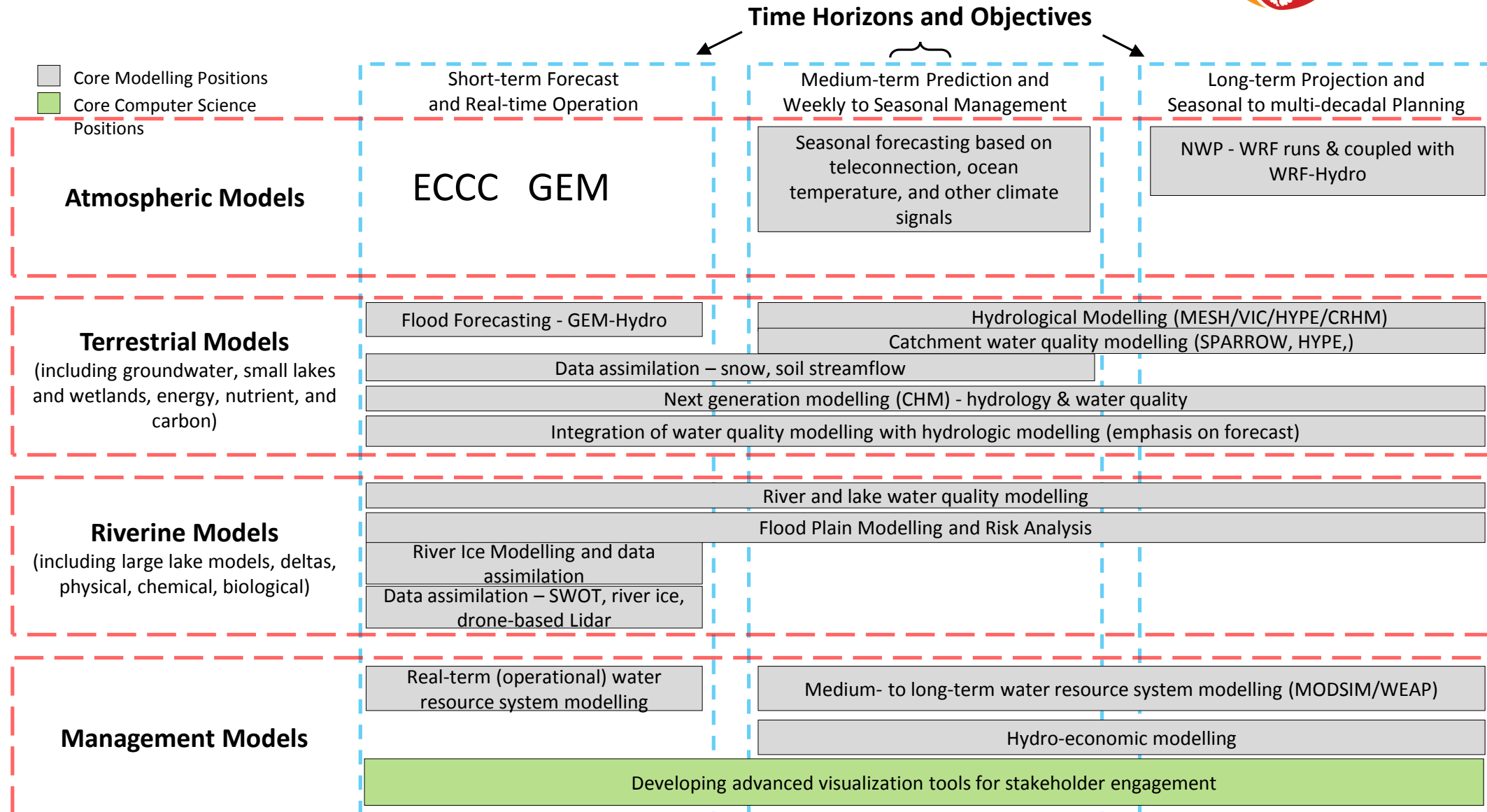
From the inception ...



**Integrated Modelling
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Global Water Futures



From the inception ...



Visualization Tools

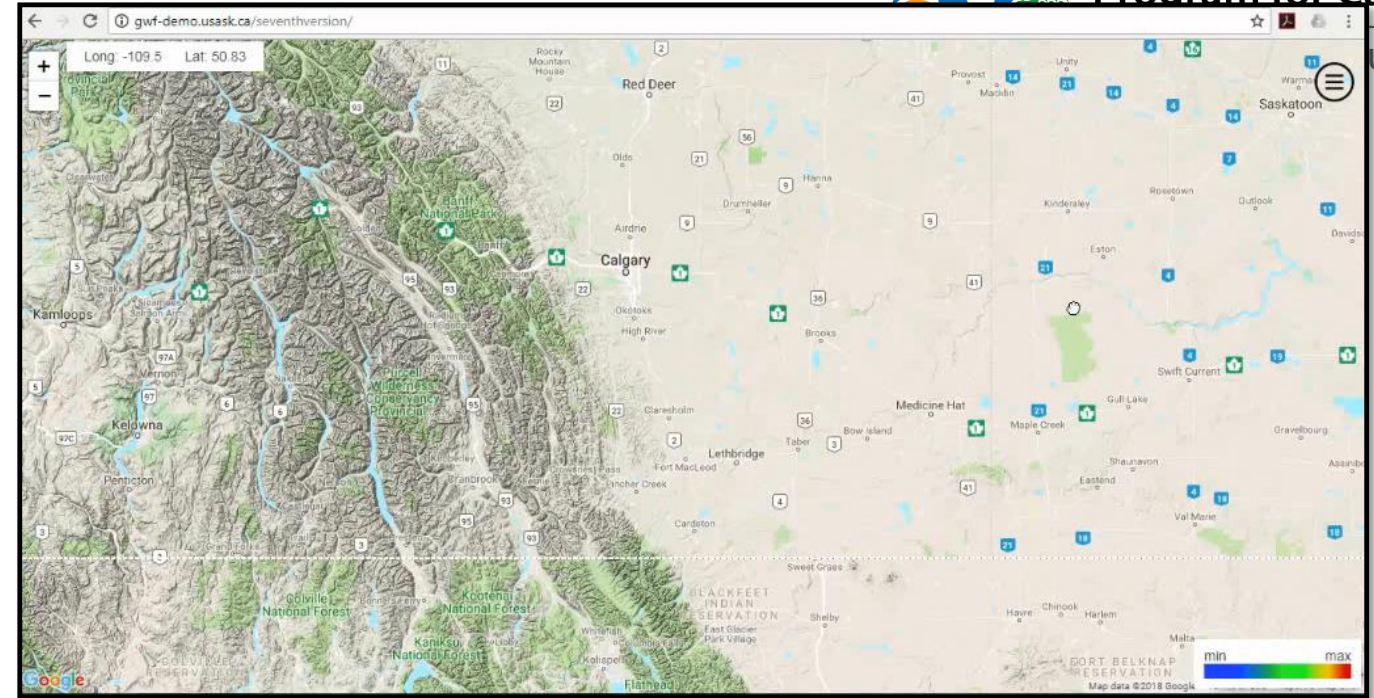
Visit <http://gwf-demo.usask.ca/>
(In Progress)

Streamflows

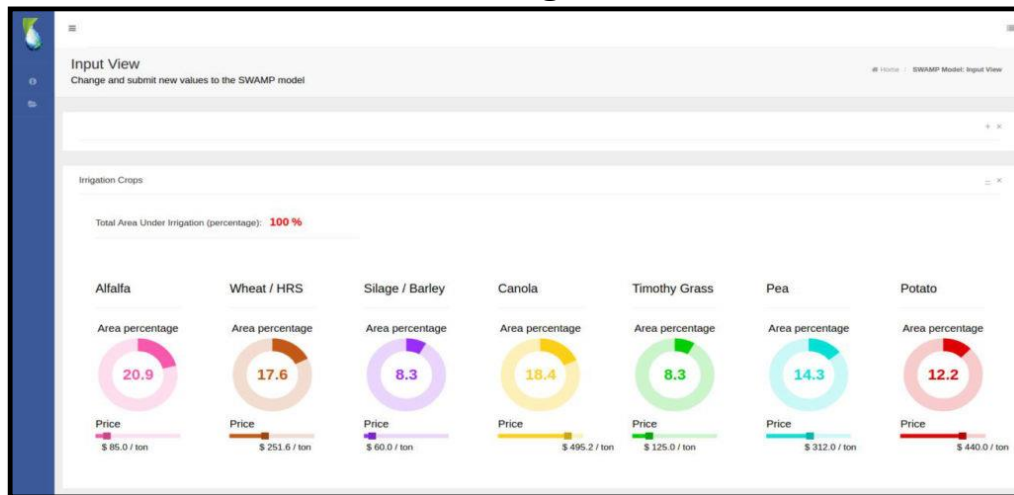


Integrated Modelling
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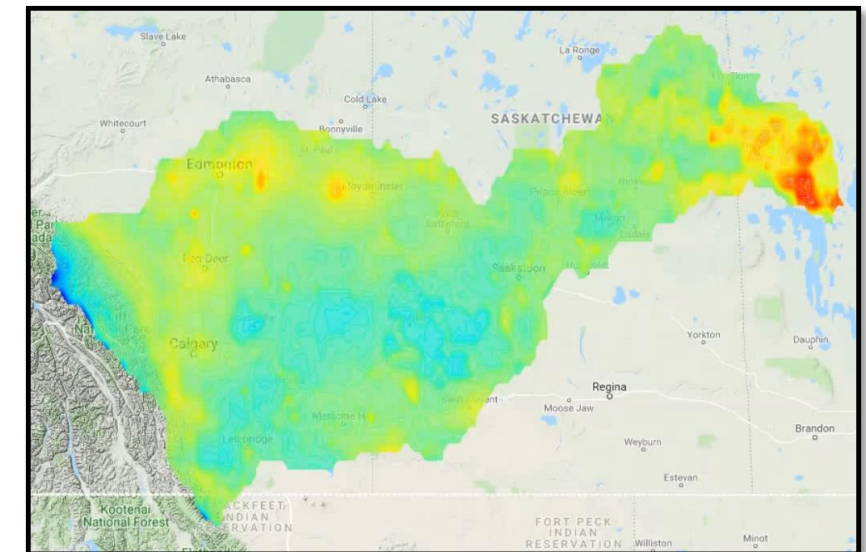
utures



Dashboard for Water Management



Evapotraspiration(mm)



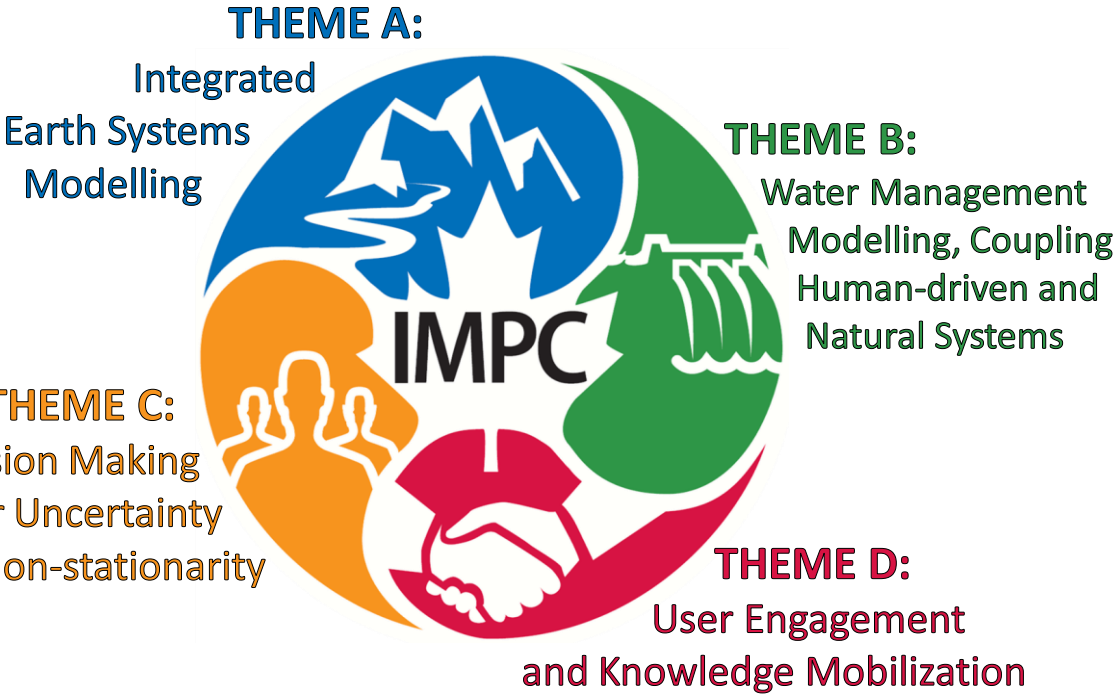
Review of the Meeting Agenda



Integrated Modelling Program for Canada
2nd Annual Meeting
June 12-13th, 2019
Louis' Loft, 93 Campus Drive, University of Saskatchewan, Saskatoon

Objective:
This is the second annual IMPC meeting for the IMPC team to present, evaluate, and discuss their research progress and strategies for knowledge mobilization in the second year of the research program. This will be done in collaboration with the GWF core modelling team. Investigators, HQPs, the GWF core modelling team, collaborators, and representatives of various local, provincial, and national stakeholders/users are invited to attend this meeting.

| Day 1: Wednesday, June 12, 2019 | | |
|--|---|-----------------------------------|
| 8:00-8:30 | Registration and Refreshments | |
| Theme A, Chair: Stadnyk | | |
| 8:30-8:45 | Welcome, IMPC Overview, Meeting Agenda | Razavi |
| 8:45-9:15 | GIWS vision for Integrated Large Scale Modelling | Famiglietti |
| 9:15-9:30 | Global Water Futures: modelling progress, and new opportunities for international modelling and prediction | Pomeroy |
| 9:30-9:45 | GWF Core modelling Team: Progress, Challenges and Opportunities. | Pietroniro/Clark |
| 9:45-10:00 | High-resolution atmospheric modelling (A1) | Li |
| 10:00-10:20 | Progress in model couplings for water quality & river ice modelling (A3 and A4) | Lindenschmidt |
| 10:20-10:35 | Discussion | Stadnyk/Famiglietti (moderator) |
| 10:35-11:00 | Coffee Break | |
| Theme A (Cont'd), Chair: Lindenschmidt | | |
| 11:00-11:15 | Improving large scale models through representation of cold regions processes: advances and next steps (A2) | Pomeroy |
| 11:15-11:30 | Canadian Hydrological Model – status and prospects | Marsh |
| 11:40-11:55 | Progress with HYPE hydrological modelling | Stadnyk/Awoye |
| 11:30-11:40 | Progress with MESH/GEM-Hydro | Princz |
| 11:55-12:05 | Model inter-comparison and multi-model analysis (A5) | Mai/Tolson |
| 12:05-12:15 | Data Management in GWF: Information for Modellers | Peterson |
| 12:15-12:30 | Discussion | Lindenschmidt/Pomeroy (moderator) |

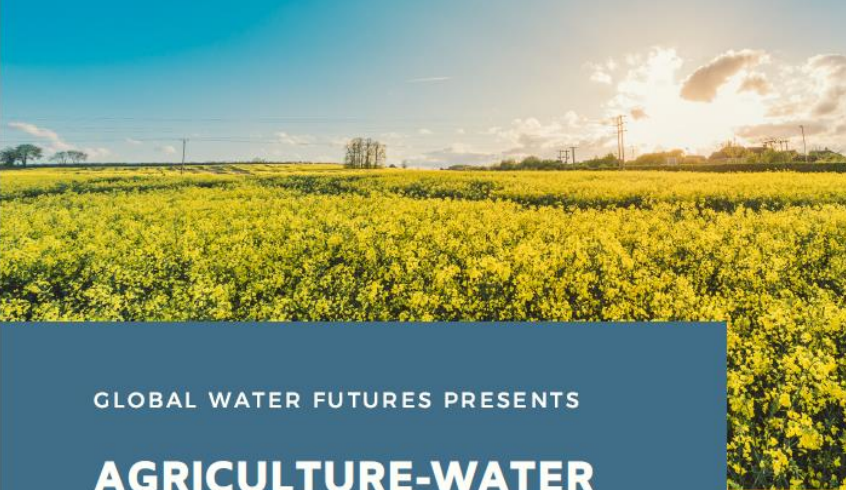


- ## Agenda Highlights:
- Lightning Talks (HQP)
 - Café Table Discussions
 - Modelling Integration Plenary
 - User Panel: Vision and Future Planning

Ag-Water Expo



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GLOBAL WATER FUTURES PRESENTS


AGRICULTURE-WATER RESEARCH EXPO

An interactive workshop to showcase the latest research to help address current and future agricultural water-related challenges in the Prairies

**LOUIS' LOFT, MEMORIAL UNION BUILDING
UNIVERSITY OF SASKATCHEWAN
93 CAMPUS DRIVE, SASKATOON**

JUNE 14, 2019 | FRIDAY | 8:30 AM - 2:30 PM

Visitor parking - Lot 1 (south of Place Riel - see map)



PROGRAM

- 8:30 AM**
Registration
Light refreshments, coffee and tea
- 9:00 AM**
Welcome and Introduction
Overview
Project Presentations
- 9:45 AM**
Self-guided tour of Research Expo
- 11:30 AM**
Lunch
- 12:30 PM**
Practitioner-led Roundtable Discussions
- 2:00 PM**
Conclusion and Wrap-Up
- 2:30 PM**
Workshop close



With attendees from:

- Agriculture & Agri-Food Canada
- Saskatchewan Ministry of Agriculture
- Saskatchewan Water Security Agency
- Saskatchewan Crop Insurance Corporation
- Saskatchewan Association of Rural Municipalities
- Saskatchewan Ministry of Environment
- Saskatchewan Cattlemen's Association
- Mistawasis Nehiyawak
- Muskeg Lake Cree Nation
- Redberry Lake Biosphere Reserve
- South Saskatchewan River Watershed Stewards
- Ducks Unlimited Canada
- North Saskatchewan River Basin Council

And more....



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Exciting Two Days Ahead!

