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

Global Water Futures – Inception Meeting

Saman Razavi, January 22, 2018

Integrated Modelling Program for Canada

Global Water Futures

Overarching Challenges

Integrated Modelling Program for Canada
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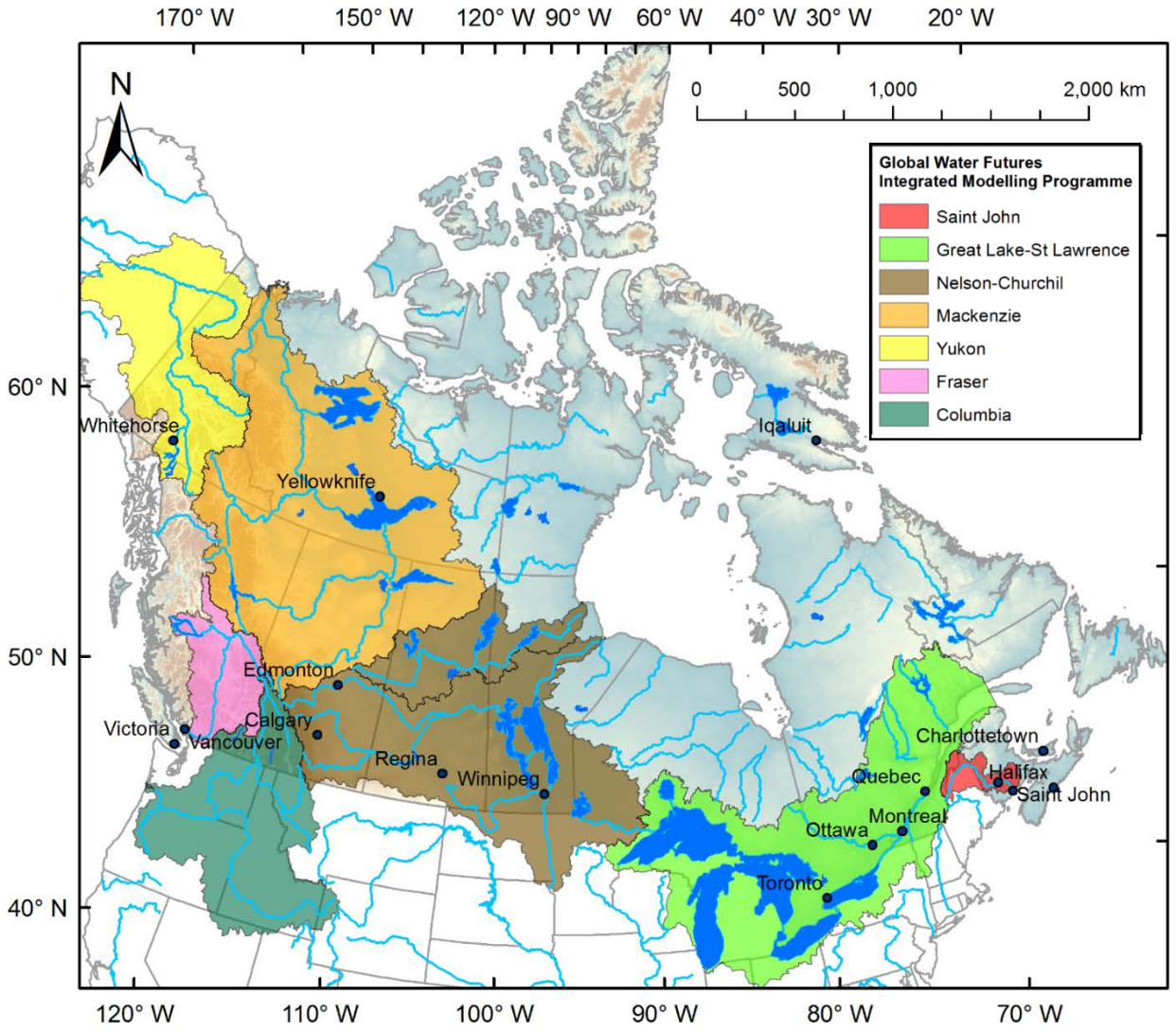
(I) **Failure to link important features** of climate, hydrology, water quality, ecosystem, and water management systems. Important positive and negative feedback loops, tipping points, and dynamical behaviour of these human-natural systems are not included in current modelling schemes.

(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 **optimal decision making tools and solutions** for uncertain future water resources, considering the range of stakeholder needs in Canada's major river basins."*



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

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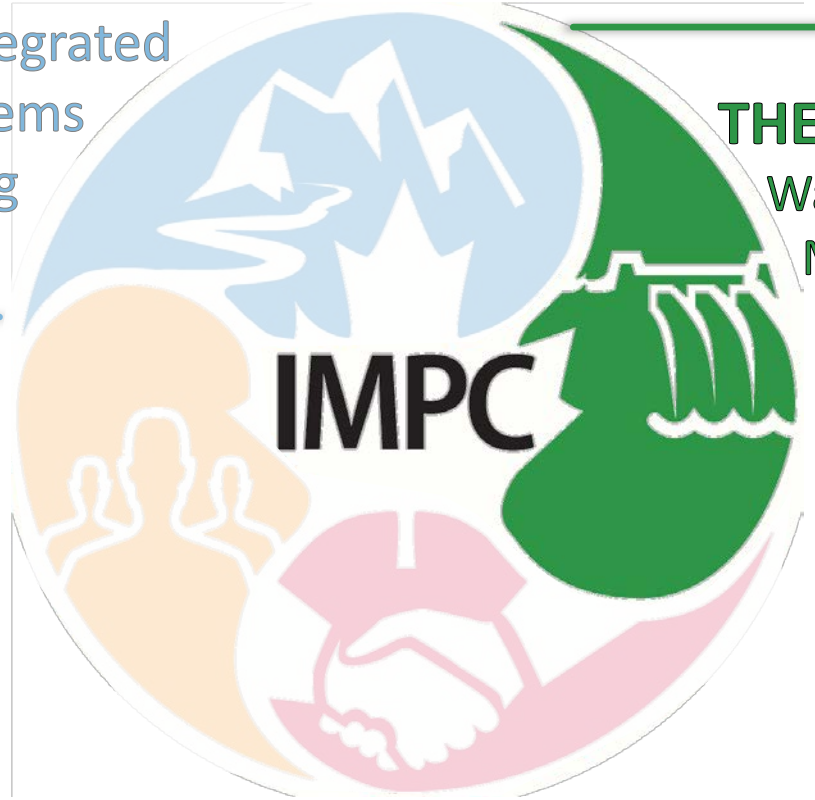
THEME A:
Integrated Earth Systems Modelling



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

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

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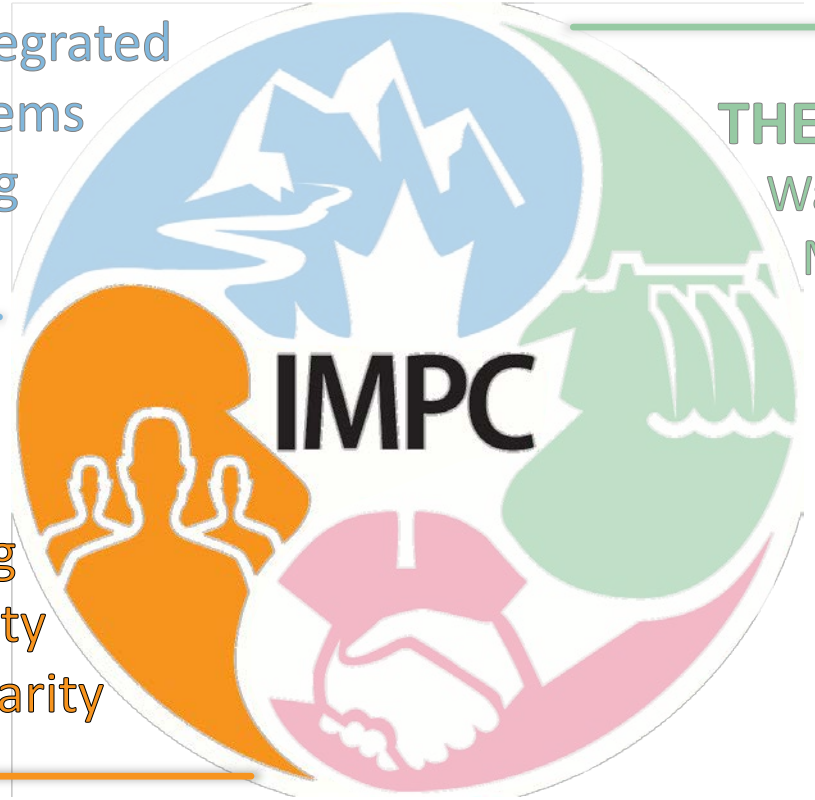

THEME B:
Water Management Modelling, Coupling Human-driven and Natural Systems

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

THEME C:
Decision Making under Uncertainty and Non-stationarity

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

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Integrated Modelling Program for Canada
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- **A1:** Atmospheric Modelling
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Water Management Modelling, Coupling Human-driven and Natural Systems

- **B1:** Basin-wide Water Resource Modelling
- **B2:** Environmental Demands
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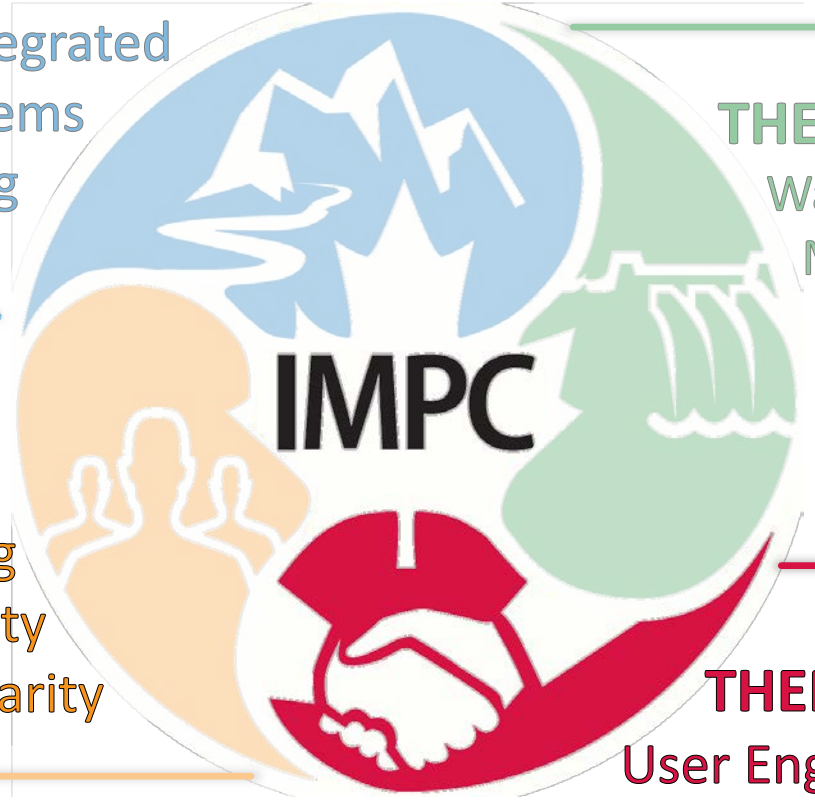

THEME C:
Decision Making under Uncertainty and Non-stationarity

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

THEME D:
User Engagement and Knowledge Mobilization

- **D1:** Outreach and User Engagement
- **D2:** Decision Support Systems

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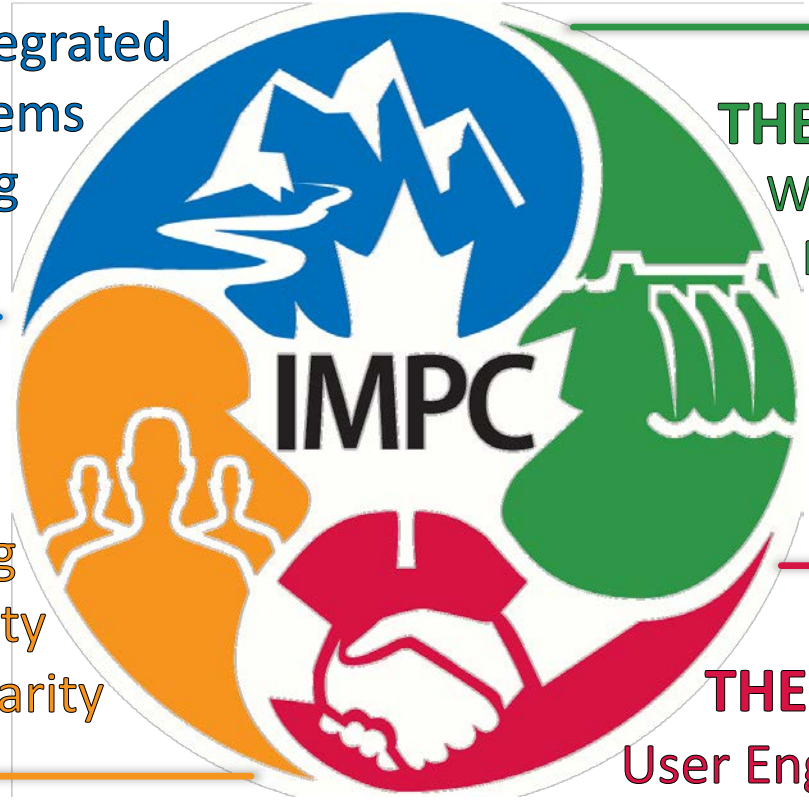

THEME C:
Decision Making under Uncertainty and Non-stationarity

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

THEME D:
User Engagement and Knowledge Mobilization

D1: Outreach and User Engagement
D2: Decision Support Systems

Investigators

Integrated Modelling Program for Canada
Global Water Futures

Dr. Saman Razavi
Primary Investigator
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University of Saskatchewan

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Canadian Research Chair

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University of Saskatchewan

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University of Saskatchewan

Dr. Tricia Stadnyk
University of Manitoba

Dr. Tim Jardine
University of Saskatchewan

Dr. Yanping Li
University of Saskatchewan

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Environment Canada

Dr. Brian Tolson
University of Waterloo

Dr. Paulin Coulibaly
McMaster's University

Dr. Howard Wheater
University of Saskatchewan

Dr. Carl Gutwin
University of Saskatchewan

Dr. Graham Strickert
University of Saskatchewan

Dr. Roy Brouwer
University of Waterloo

Partnership Wheel

Integrated Modelling Program for Canada
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18 Current Partners

- 4 Federal Agencies
- 3 Provincial Governments
- 3 Transboundary Agencies
- 3 Municipalities
- 3 Indigenous Communities
- 1 Industry
- 1 NGO

We’re working with our KM advisory committee to fill the wheel!

Progress To Date

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First Science Committee Meeting
Jul, 2017

IMPC Website

Bi-weekly Theme Meetings Begin

Theme A led by Amin H., Theme B led by Mohamed E. Themes C and D led by Hayley C., Water Quality led by Michael K./Luis M.

Sept

Kick-Off Workshop

Sept 14-15

User Engagement Specialist joins team

Oct 1

IMPC B3 Meeting
Nov 1

Nov

Formation of Participatory Working Groups begins

KMOC Meetings Begin
Nov 23, Jan 12, Feb 1

IMPC Twitter

Indigenous Representatives and Issues Workshop

Jan 8

IMPC A5 Meeting
Jan 19

GWF Inception Meeting
Jan 22-23

12/17 HQP's hired

Jan, 2018

First Annual General Meeting
Jul 18-19

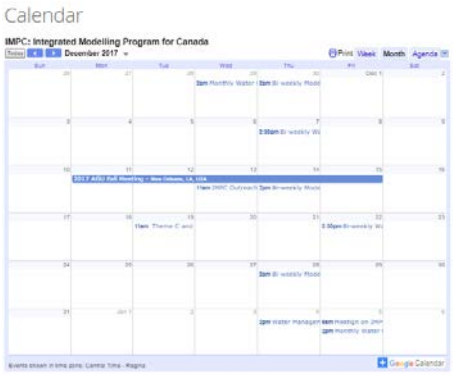
Inception Report V3
WP KM Plans added

Data Policy Document:
Consistency and Reproducibility

Joint IMPC-Core Modelling Meeting
Jan 30

Knowledge Transfer

IMPC Website



Events Calendar

Social Media

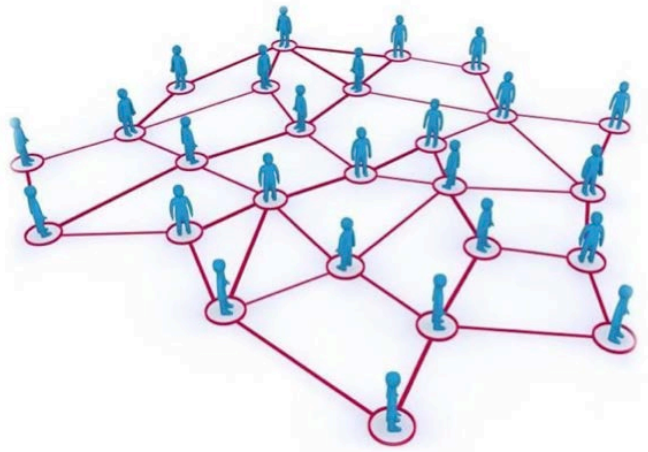
Outreach Materials

Knowledge Exchange and Co-Creation

At the Program level:

Knowledge Mobilization Oversight Committee

At the Work Package level:



Social Science Metrics for Evaluation

- Participatory Working Groups
- Working Package KM Plans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THEME A: Integrated Earth Systems Modelling

A1: Atmospheric Modelling

High resolution atmospheric modelling to represent scenarios of change and land-atmosphere feedbacks

A2: Hydrologic Modelling

Improving hydrologic process representations for cold regions to better simulate snow and glacier and accommodate hyper-resolution modelling

A3: Water Quality Modelling

Integrating land-surface and in-stream water quality processes into hydrologic modelling

A4: River Ice Modelling

Integrating river ice processes into hydrological modelling for operation and flood forecasting

A5: Model Intercomparison

Hydrologic model inter-comparison and multi-model analysis for improved prediction

A6: Floodplain Mapping

Improving floodplain mapping in flood sensitive areas

A7: Characterization and Communication of uncertainty

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

B1: Basin-Wide Water Resources Modelling

Developing a water resources model to simulate different operational policies of existing and future water infrastructure

B2: Environmental Demands

Developing a performance model for aquatic ecosystems based on hydro-ecologic metrics and environmental demands

B3: Hydro-economic Modelling

Developing an integrated hydro-economic model to assess the direct and indirect impacts of policy decisions based on socio-economic water valuation studies

THEME C: Decision Making under Uncertainty and Non-stationarity

C1: Future scenario generation

Future scenario generation for river-basin scale changes in climate, land surface, and water resources

C2: Optimization and Multi-Criteria Decision Analysis

Optimization and multi-criteria decision analysis to optimize policy and decision scenarios and evaluate trade-offs between different competing objectives

THEME D: User Engagement, Knowledge Mobilization, and Decision Support Systems

D1: Outreach and user engagement

Outreach and user engagement to inform model development and output design, inclusion of user community representative on modelling team, and iterative, two-way sharing of information between scientists and users

D2: Decision support systems

Developing decision support systems with advanced visualization tools and expert systems built on research in Themes A-C and linked to the programme data inventories

IMPC Kick-off Workshop

September 14-15th, 2017 National Hydrology Research Centre, Saskatoon

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The aim of the workshop was to plan for large-scale modelling activities for forecasting, prediction, and water resources management and decision support over the next three years, until August 2020.

More than 70 people from academic, regulatory, and industrial sectors attended the workshop in-person or online to present and discuss their objectives, plans, and perspectives for IMPC. These included:

- Environment and Climate Change Canada,
- Agriculture and Agri-Food Canada,
- Prairie Provinces Water Board,
- Saskatchewan Water Security Agency,
- Alberta Environment and Parks,
- City of Calgary,
- Manitoba Infrastructure and Transportation,
- Manitoba Hydro,
- Yukon Department of Environment, and
- EPCOR Water.