Global Water Futures: Solutions to Water Threats in an Era of Global Change

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Global Water Futures
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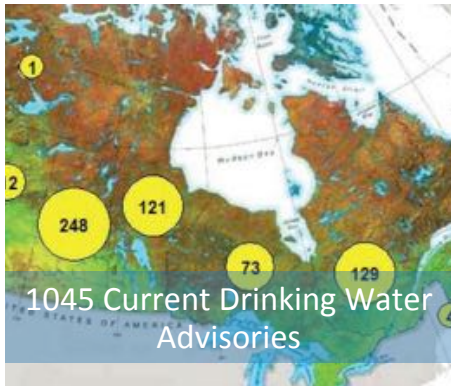
Water is the basis for life, ecosystems and economy

Canadian Water is at Risk


Declining Source Water Quality

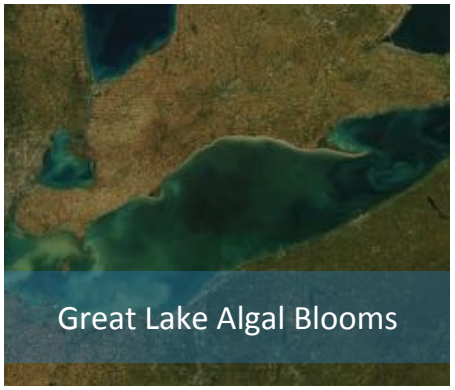

Toronto Flood (2013)


Legacy Mine Waste



1045 Current Drinking Water Advisories

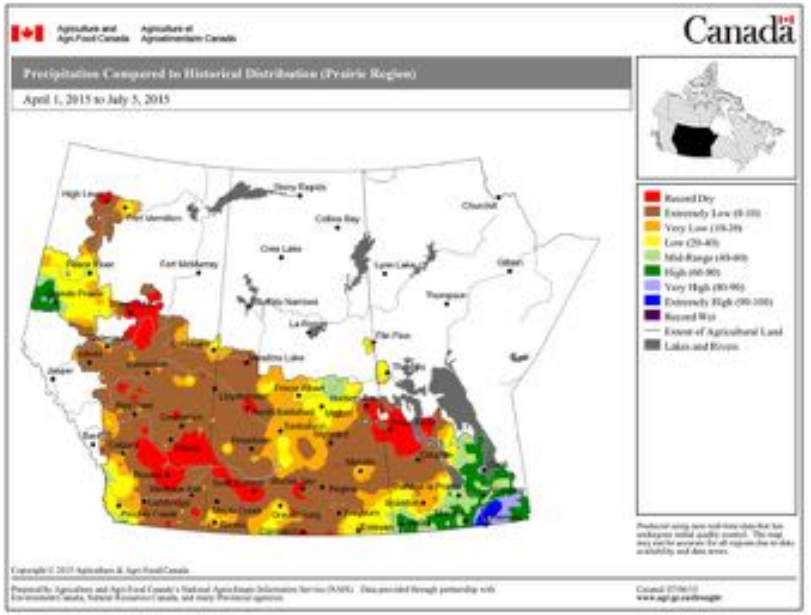

Calgary Flood (2013)


Great Lake Algal Blooms


Drought: Prairies (1999-2004)

Recent Droughts, Fires and Floods

- 1999-2004 Prairie Drought - $6B economic damage
- 2013 Mountain Flood in Alberta & BC - >$6B structural damages
- 2013 Toronto Flood $1B damage
- 2014 Prairie Summer Flooding in Saskatchewan & Manitoba - $1.5B damage
- 2015-2016 Record winter/spring warming, drought – low snowpacks, low streamflows, extensive forest fires
  - Fort McMurray $8.9 Billion
- 2017 Record floods and all-time high water levels in Great Lakes – Saint Lawrence Valley
- 2017-2018 Record drought, summer heat in Prairies and fires in BC and Alberta
- 2018 Record rain-on-snowmelt flooding in New Brunswick and snowmelt flooding in the Kootenays, BC.



Adaptation to change and threat mitigation requires

- **New science** to understand the changing Earth system
- **New modelling tools** to capture interconnected forces and their societal implications
- **New monitoring systems** to warn of critical environmental changes
- **More effective mechanisms to translate new scientific knowledge into societal action** e.g. computer apps, games, visualization tools

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CANADA FIRST RESEARCH EXCELLENCE FUND | APOGÉE CANADA FONDS D'EXCELLENCE EN RECHERCHE

University of Saskatchewan | University of Waterloo | McMaster University | Laurier – Inspiring Lives.

University of Guelph

University of British Columbia

University of Northern British Columbia

University of Calgary

University of Laval

McGill University

University of Quebec at Montreal

University of Alberta

University de Montreal

University of Manitoba

University of Victoria

Brock University

Canadian Rivers Institute (University of New Brunswick & University of Prince Edward Island)

Yukon College

Global Water Futures: Solutions to Water Threats in an Era of Global Change

GWF aims:

a) to **place Canada as a global leader in water science for cold regions**,

b) to **address the strategic needs of the Canadian economy** in adapting to change and managing the risks of uncertain water futures and extreme events.

Global Water Futures - Mission

- **Improve disaster warning** – develop:
  - scientific knowledge, monitoring and modelling technologies,
  - national forecasting capacity to predict the risk and severity of extreme events
- **Predict water futures** –
  - use Big Data to make informed decisions,
  - Develop better models to assess change in human/natural land and water systems
- **Inform adaptation to change and risk management** – to reduce the risk of water threats, design adaptive strategies, and enhance economic opportunities, propose
  - governance mechanisms,
  - management strategies,
  - policy tools

Transdisciplinary Science Pillars

- **Pillar 1** - Diagnosing and Predicting Change in Cold Regions
- **Pillar 2** - Developing Big Data and Decision Support Systems
- **Pillar 3** - Designing User Solutions

GWF Today

Awarded
$ 77.84 M

over 7 years
7 2016 - 2023

from
CANADA FIRST RESEARCH EXCELLENCE FUND | APPUYÉE PAR CANADA

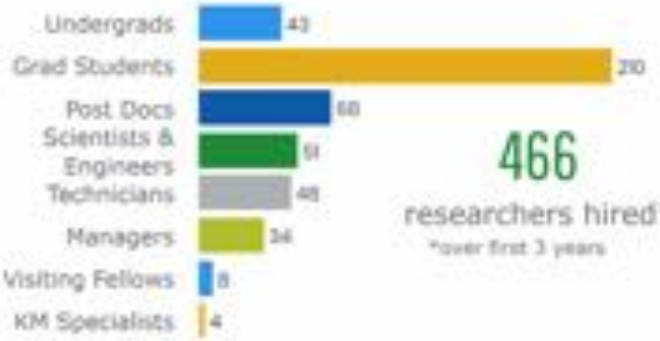
GWF has funded 33 projects

15
universities

157
faculty investigators

335
partners

60
observatories across Canada



466
researchers hired*
*over first 3 years

GWF supports
3 Global Programs

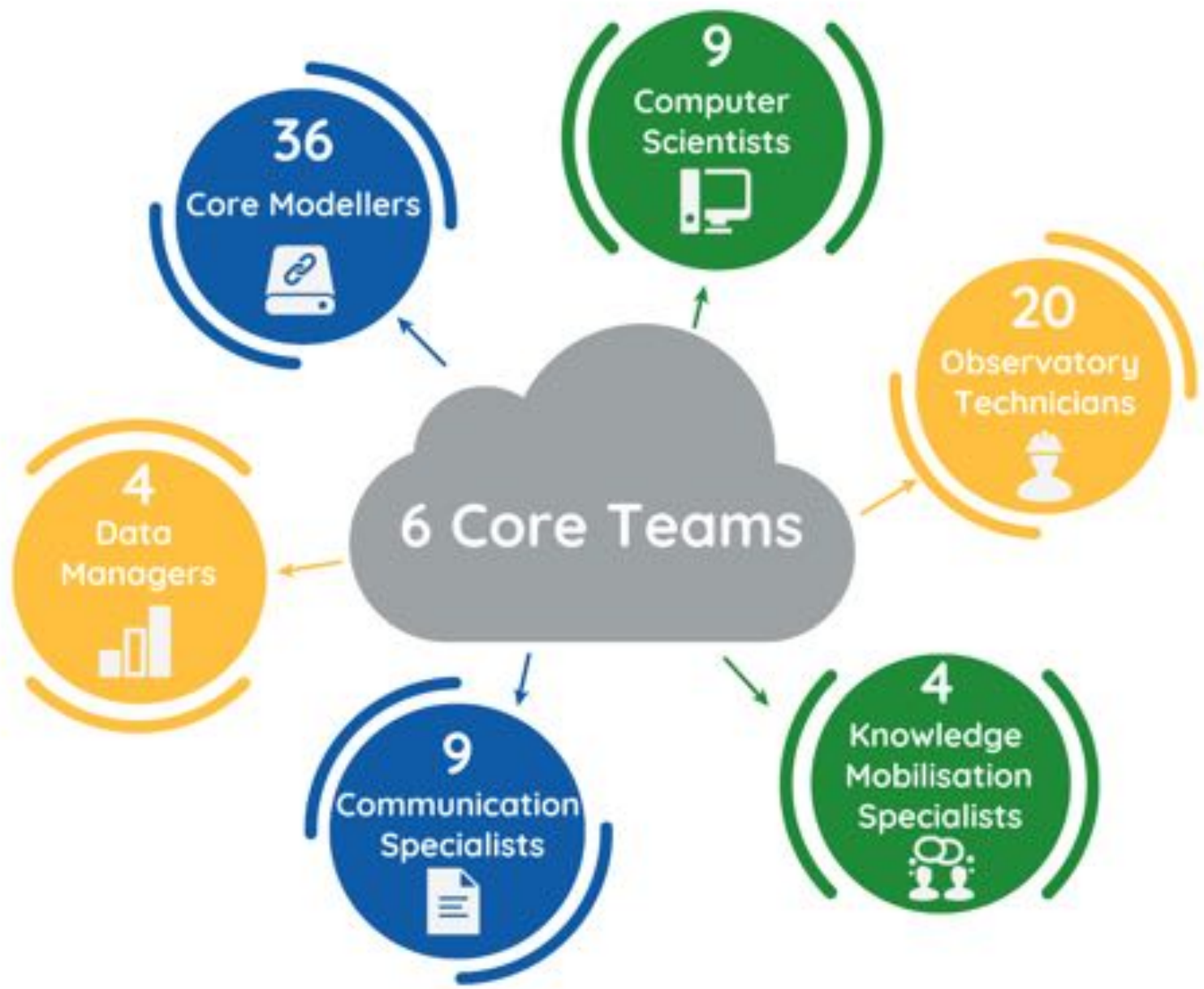
WCRP
World Climate Research Programme

futureearth
research for global sustainability

$292.6 M in GWF project & core team funding

GWF-CFREF (cash)
Institutional Support (cash)
GWF Project Support (cash)
In-Kind Support

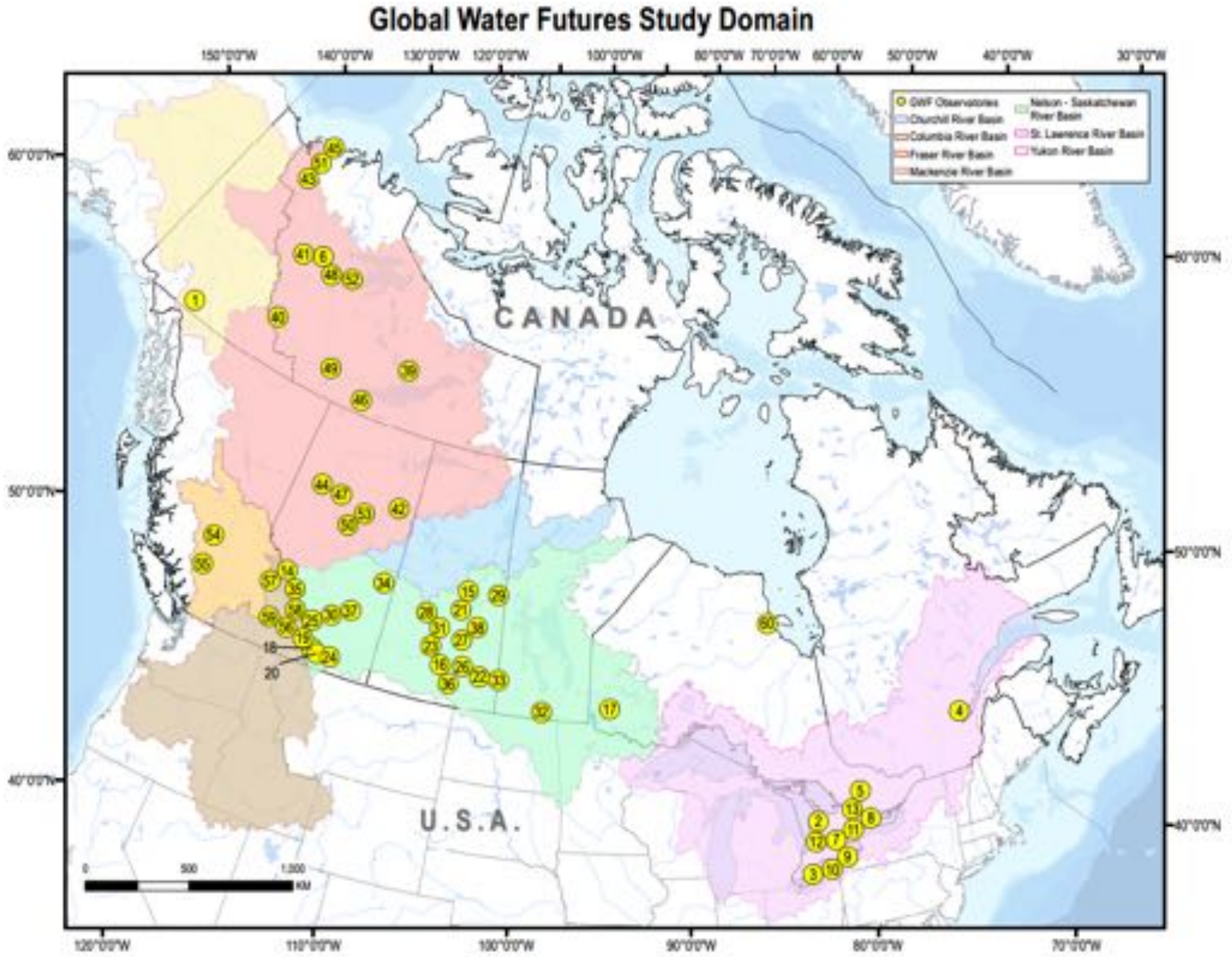
GWF Core Teams



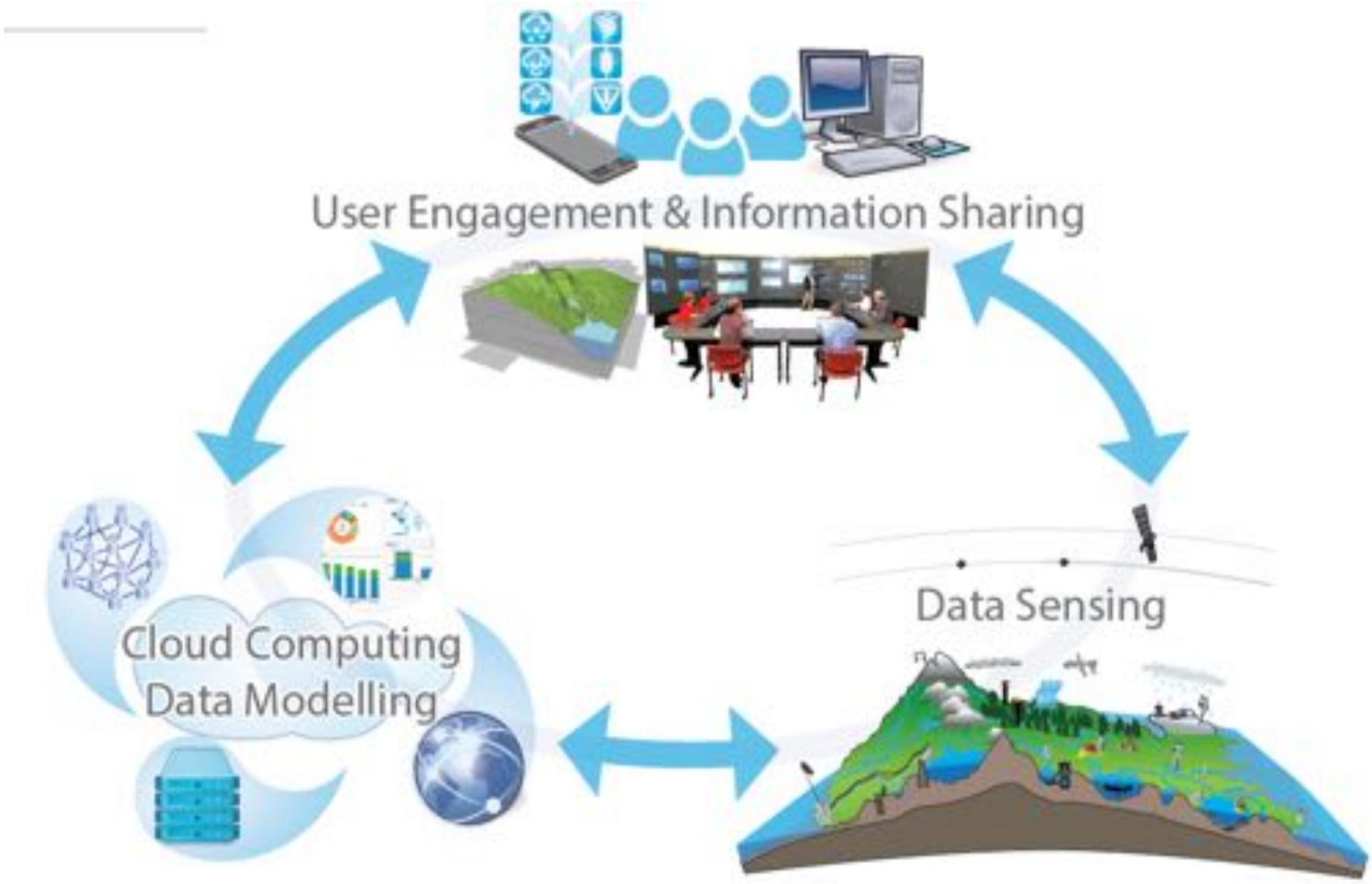

Global Water Futures will position Canada as a:
• Global leader in water science
• Global partner of choice for water research
• Provider to Canada and the world of solutions to water threats
27 UNIVERSITIES, COLLEGES and ACADEMIC INSTITUTIONS
32 INDIGENOUS ORGANIZATIONS and INDIGENOUS COMMUNITIES
80 FEDERAL, PROVINCIAL and CIVIC AGENCIES
61 NON-GOVERNMENTAL ORGANIZATIONS
66 INDUSTRY COLLABORATORS
86
388*
3*
Our Global Team
More than 370 National and International Partners

GWF Canadian RHP River Basins

GWF's Observatories



GWF Water Observation, Prediction and Knowledge Mobilization Strategy



Smart Water Systems Laboratory

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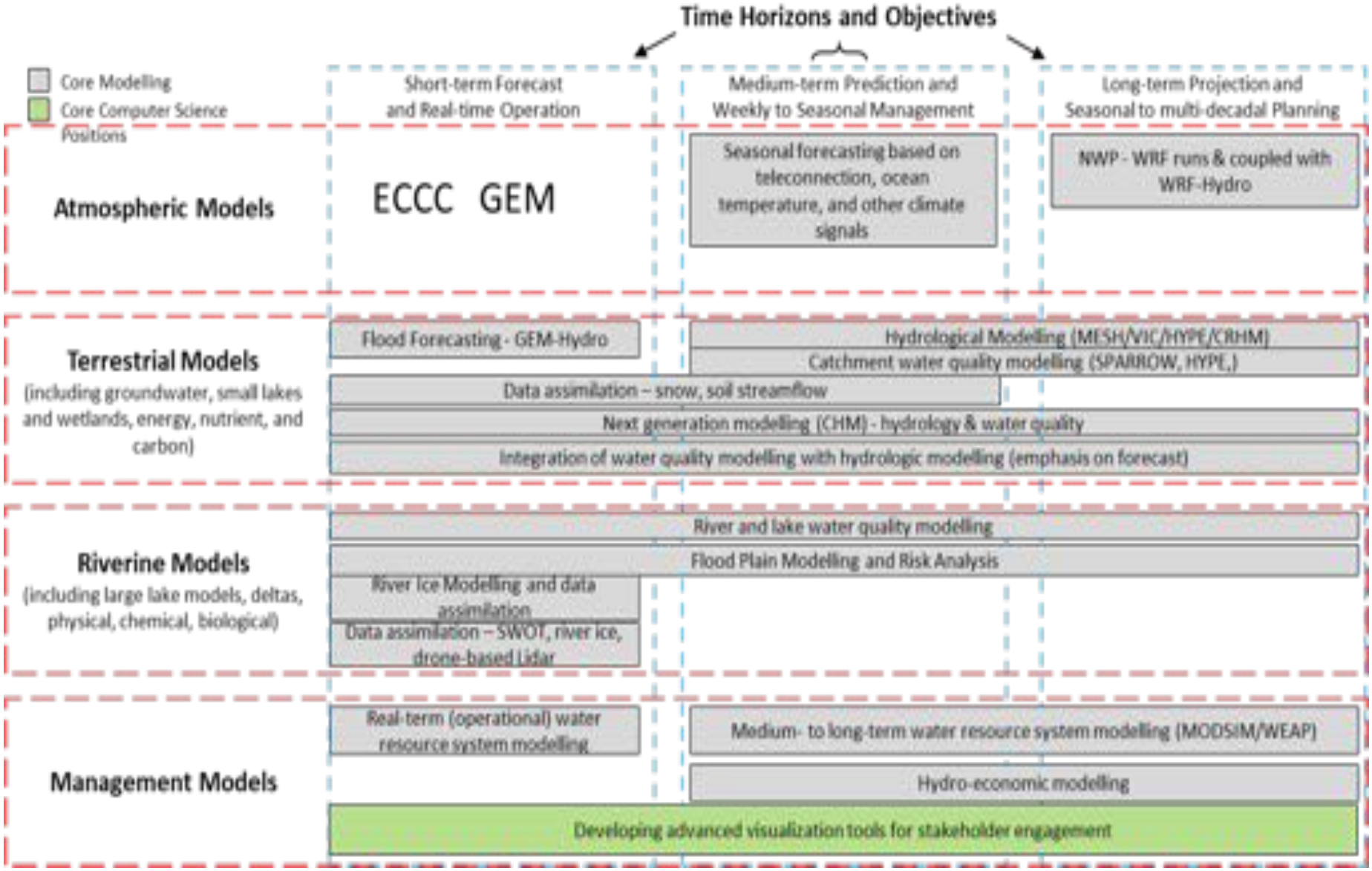
Core Modelling Strategy



GWF Multi-modelling Strategy

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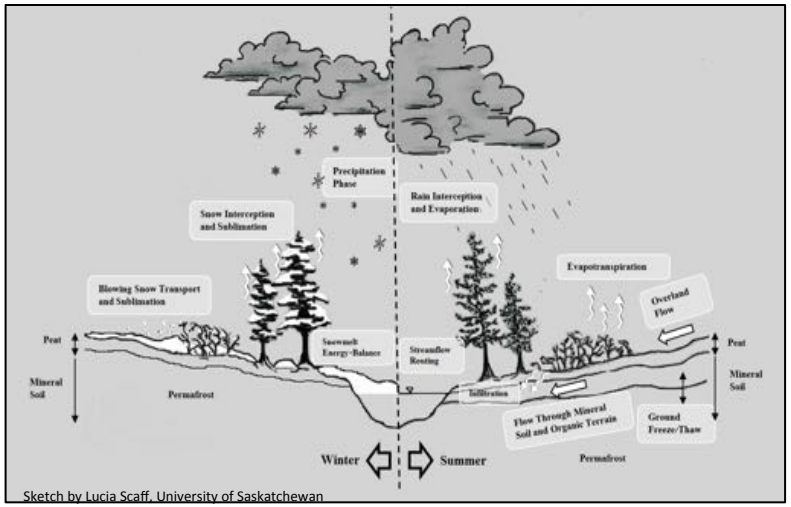
Cold Regions Hydrological Modelling Platform (CRHM)

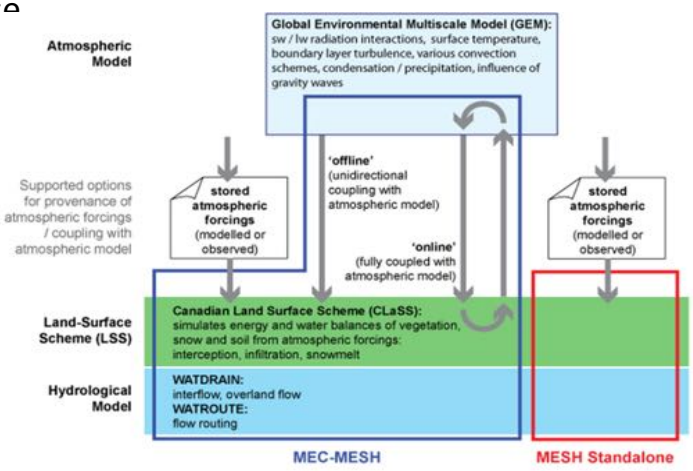
-modular, flexible, object oriented process modelling
-users select modules to create a custom model
-spatial discretization based on hydrological response units
-catchment applications



Sketch by Lucia Scaff, University of Saskatchewan

*Pomeroy et al., 1998; 2007, 2016

-GEM-Hydro – with ECCC
-VIC
-HYPE
-Various water quality models

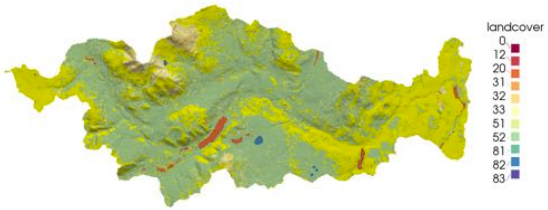


Pietroniro et al., 2007

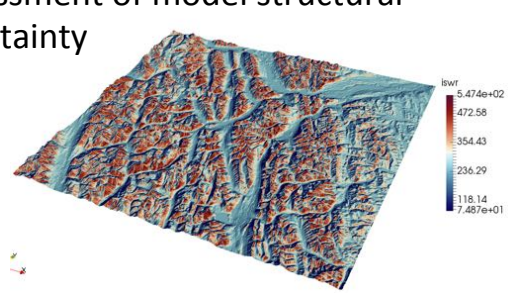
MESH -Coupled land surface hydrological model
-Feedback with atmospheric and groundwater models
-Water management
-Cold regions
-Flexible
-Large river basins

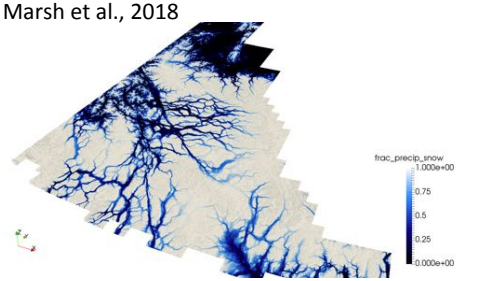
Canadian Hydrological Model (CHM)

Multi-scale, multi-physics, variable complexity and domain model
-Efficient TINS
-Assessment of model structural uncertainty



Marsh et al., 2018





Essential science questions as an RHP

1. How will extreme atmospheric events and other changes to the climate system be translated by the hydrological system into hydrological extremes?
2. How will hydrological storage in lakes, managed reservoirs, glaciers, permafrost, groundwater and wetlands interact with a changing climate and shifting terrestrial ecosystems to create new hydrological regimes?
3. How can humans better manage, mitigate and adapt to this change and conserve ecosystems through water and land management, prediction, and governance?

By 2023, GWF will contribute to

- *Improved scientific foundations* for solving water problems.
- National *water forecasting and prediction* system
- *Predictions of water futures* around the world
- *Water solutions* for food security, energy security, infrastructure, economic development, safe communities, ecosystem conservation, governance.
- *Decolonialization* of Indigenous water management in Canada.
- *Water, peace and security* around the world
- Revitalized *water strategy for Canada*
- Making Canada known as the ***water solutions country***.

GWF UofS Facilities

National Hydrology Research Centre, Saskatoon

Canadian Centre for Water Forecasting & Prediction, Saskatoon

Coldwater Laboratory, Canmore, Alberta

2nd annual GWF science meeting

- Saskatoon, SK, Canada
- 15–17 May, 2019

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