Global Water Futures: new opportunities for national and international modelling and prediction

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Global Water Futures
GWF.USASK.CA

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

GWF Today

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Awarded
$ 77.84 M

over 7 years
7 2016 - 2023

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

GWF supports
4 Global Programs

futureearth research for global sustainability

WCRP World Climate Research Programme

UNESCO

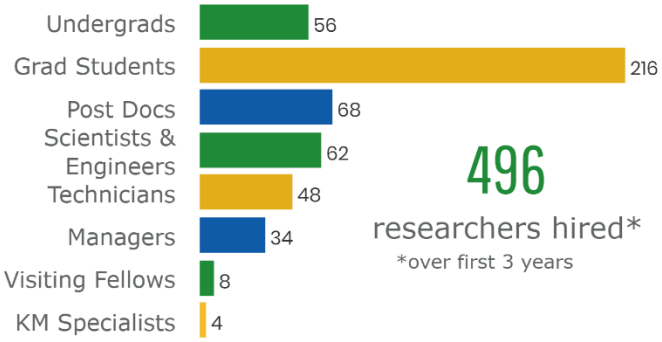
WORLD METEOROLOGICAL ORGANIZATION

39 projects
funded across Canada

15
universities

60
observatories

162
faculty investigators



335
partners

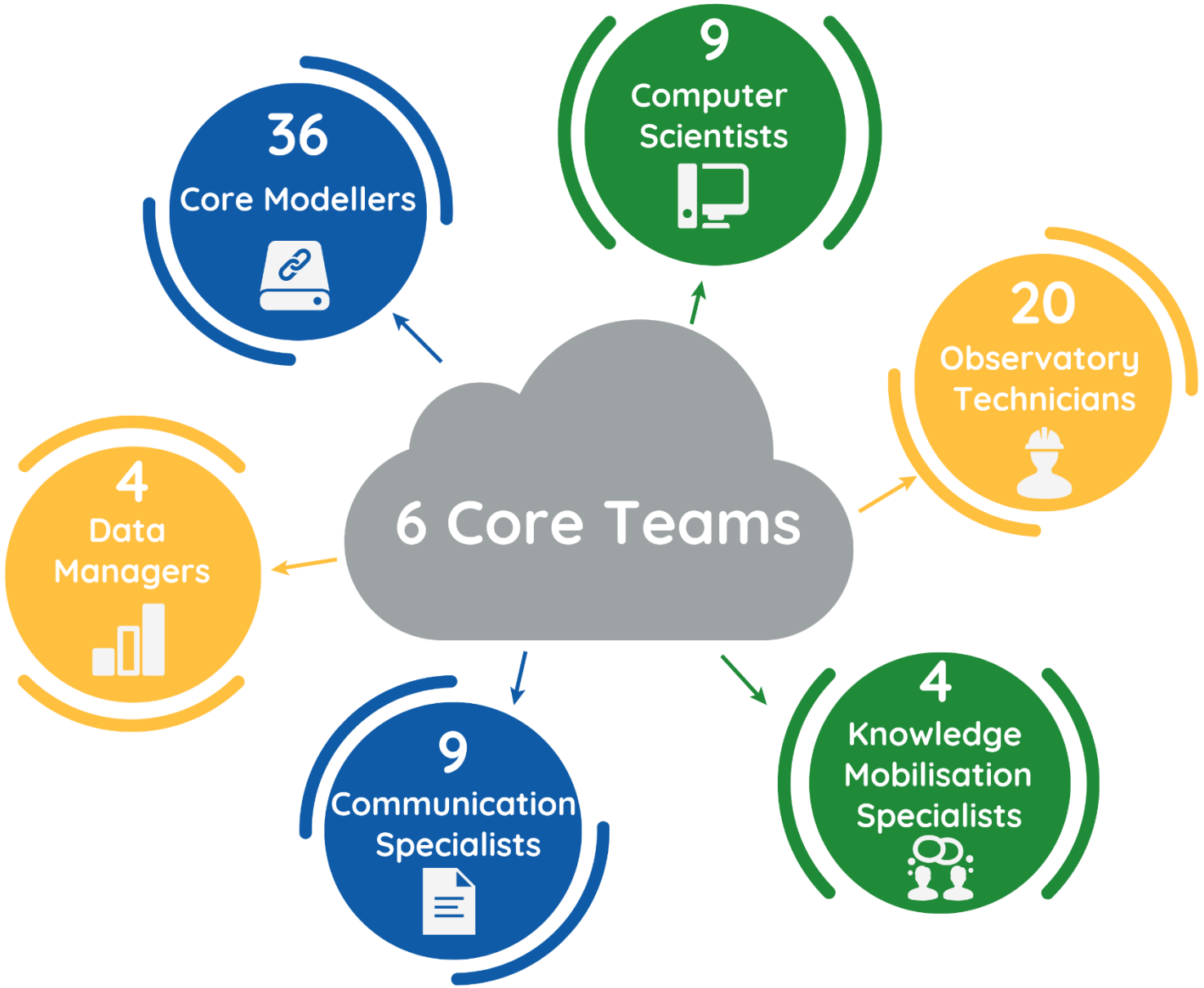
496
researchers hired*
*over first 3 years

$292.6 M
in GWF project & core team funding

$115.8 M
In-kind

$176.8 M
Cash

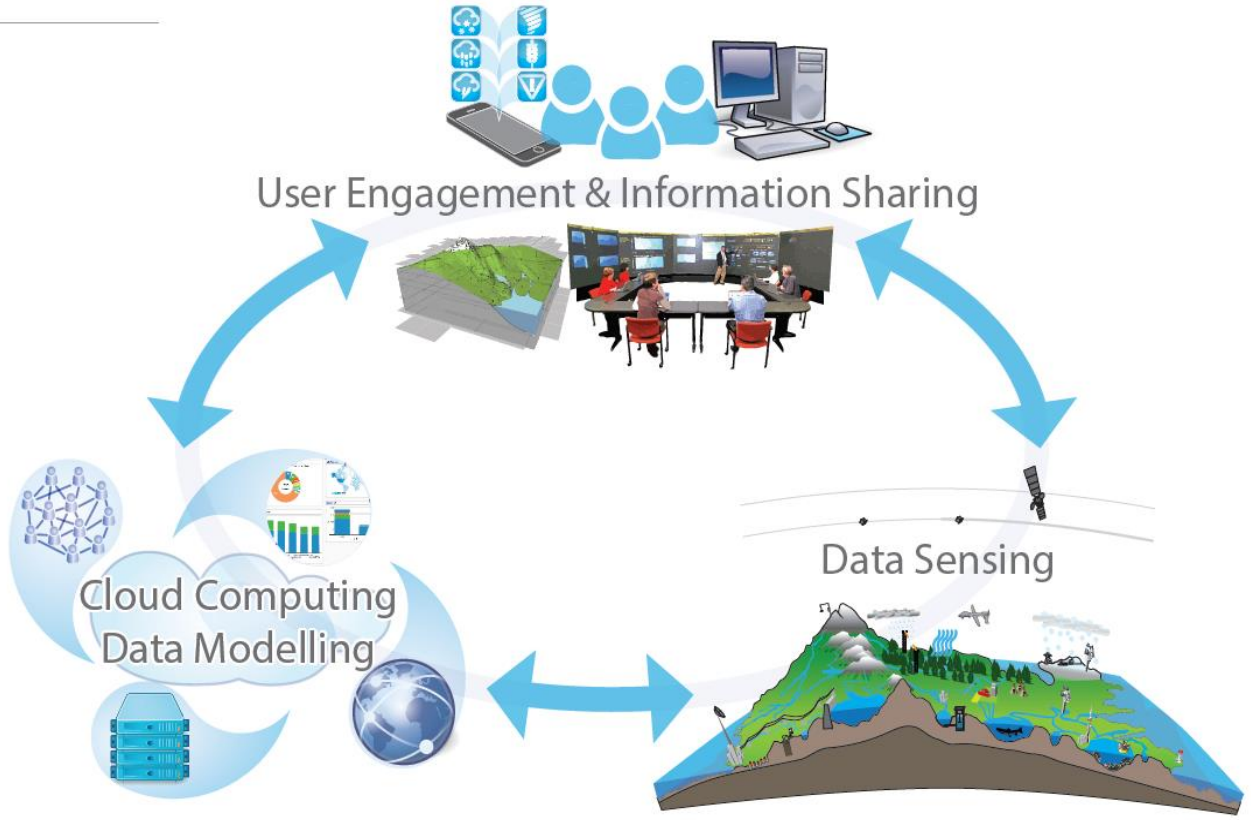
GWF Core Teams



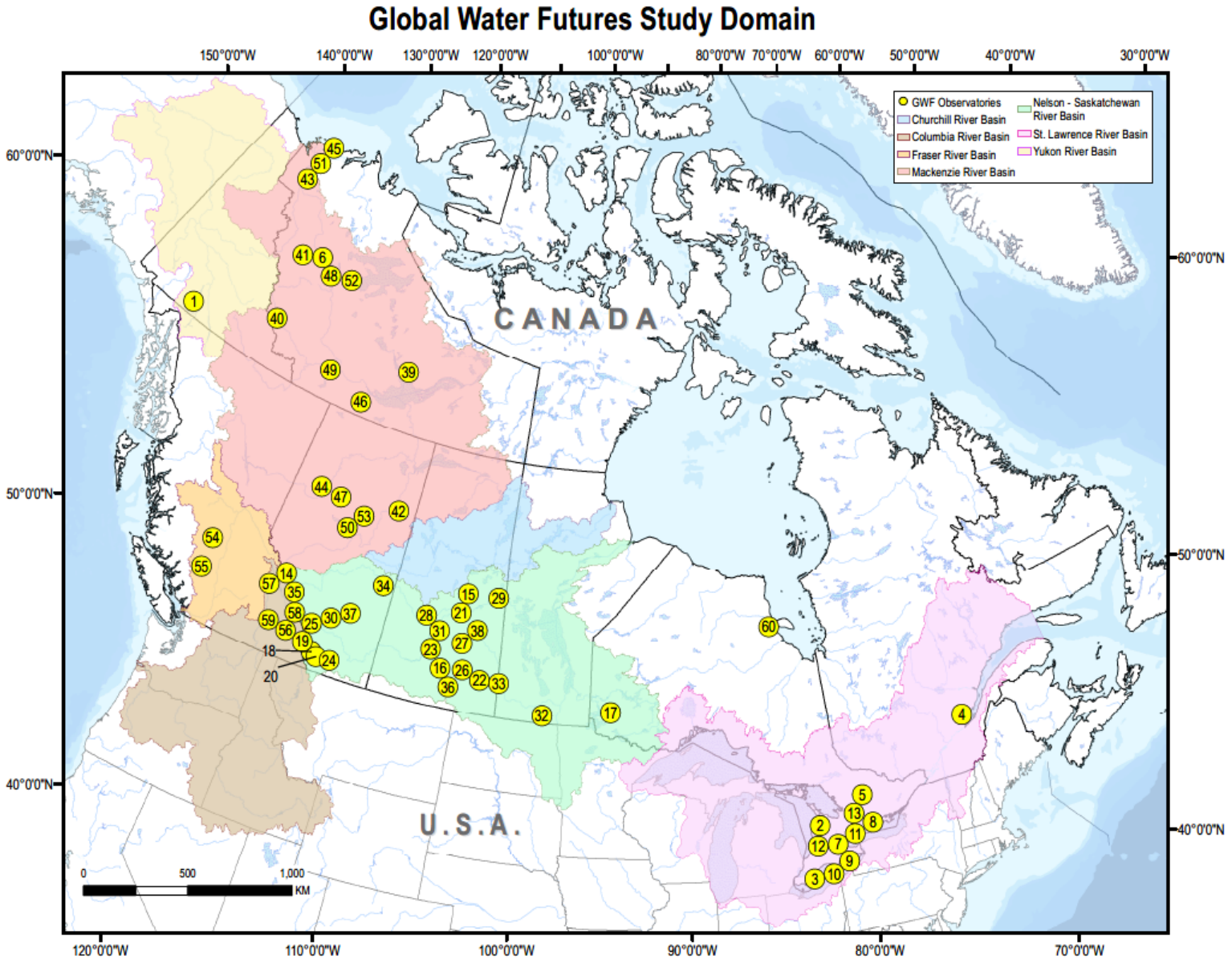
GWF National Water Observation, Prediction and Knowledge Mobilisation Strategy

- **Core support teams to deliver national modelling capability, advanced computer science, new observational science and knowledge mobilization**

- **Technical Team (20)**: Observatories & Observations
- **Data Management (4)**
- **Computer Science (9)**
  Human-computer Interface, Data & Re-engineering Codes
- **Modelling Core Team (38)**
  - Hydrological & Water Quality Forecasting
  - Climate Change, Diagnostic Hydrological & Water Quality Modeling
  - Water Resources Modelling
- **Knowledge Mobilization (4)**
- **Communications (9)**



GWF's 60 Observatories



GWF National Water Prediction Strategy

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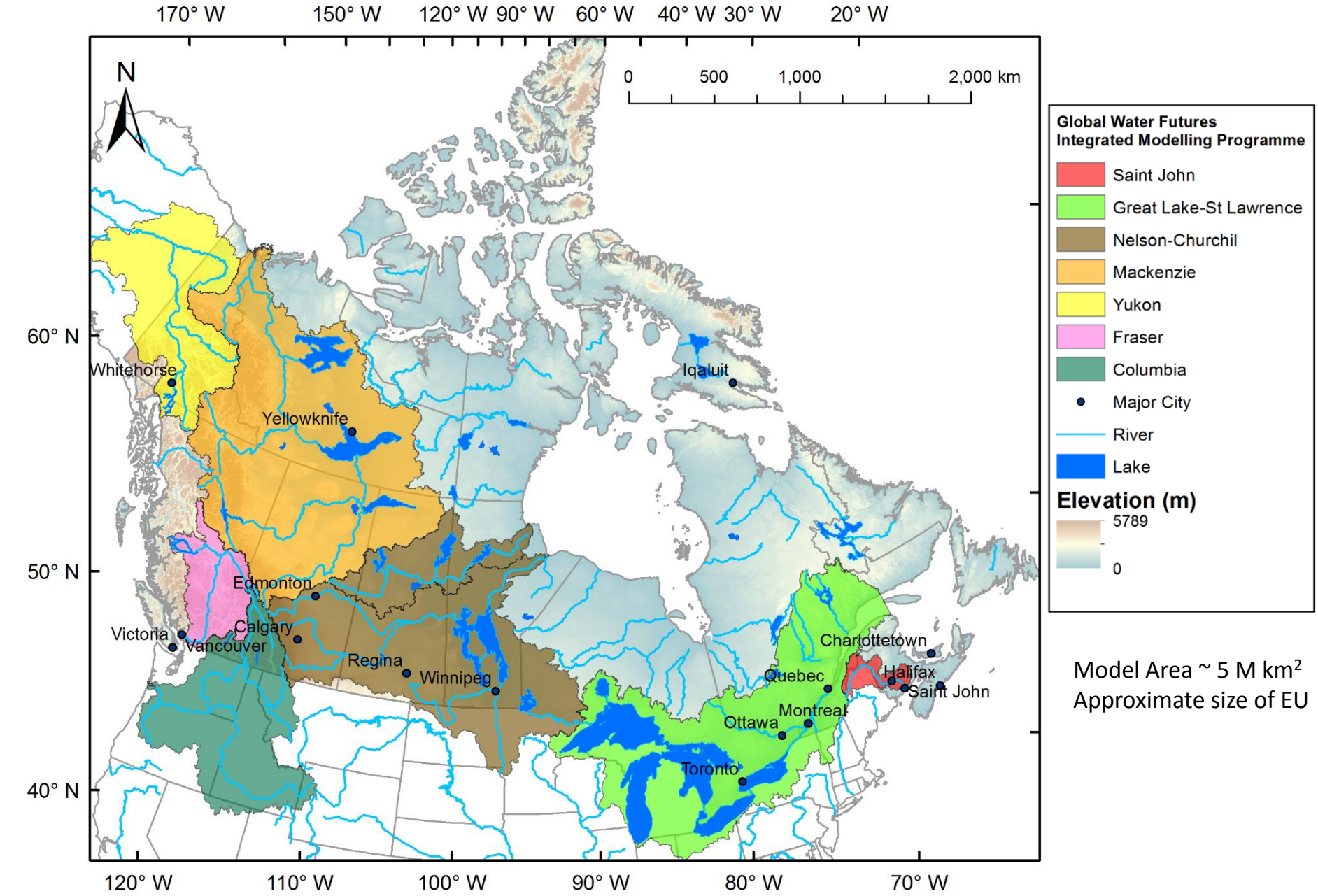


Model Area ~ 5 M km^2
Approximate size of EU

GWF National and Policy Initiatives

- Engagement with ECCC – lead water department for Government of Canada
  - Co-hosted 1st National Flood Forecasting Workshop, Vancouver Feb 2019
  - Joint national water prediction strategy
- MOU with NRCan – river basins, remote sensing, groundwater, climate change, glaciers, forestry
  - Co-hosted Water Science Summit, Ottawa, November 2018
- Water, Peace and Security with UN University Institute for Water, Environment and Health (Hamilton) – UN Water Decade
- Water Security for Canadians
  - Strategic Briefing and Discussion, Ottawa, April 2019

Canada Water Security Centre

FUNCTION

A water policy, science and technical centre of excellence to provide centralized observation, creation, collection and dissemination of water information between federal, provincial and territorial agencies, Indigenous governments and organizations, river basin organizations, universities, industries and the public.

GOAL

Predict and respond to water security problems and opportunities.

- Coordinate monitoring
- National water info repository
- Modeling, forecasting and prediction service for streamflows, lake levels, floods, droughts, water quality

GOAL

Integrated river planning and management.

- Collaborative, large scale river basin planning
- Strengthen rivers basin institutions
- Support traditional knowledge collaboration (e.g Guardians program)

National Water Security Commission

FUNCTION

An oversight authority with investigative, adjudicative and enforcement powers that works either independently or together with other orders of government as appropriate to anticipate disputes and facilitate resolutions in support of water management for waters that flow along or across internal or Canadian borders or boundaries.

GOAL

Coordinated federal policies on water.

- Indigenous water rights and policy implementation
- Oversee river basin institutions
- Evolve and implement federal flood and drought risk policies

GOAL

Ensure the ecological integrity of transboundary waters and associated aquatic ecosystems.

- Designate significant waters for protection and restoration
- Set standards for cumulative effects on river basin health
- Dispute resolution

Natural Resources Canada – some interests for collaboration

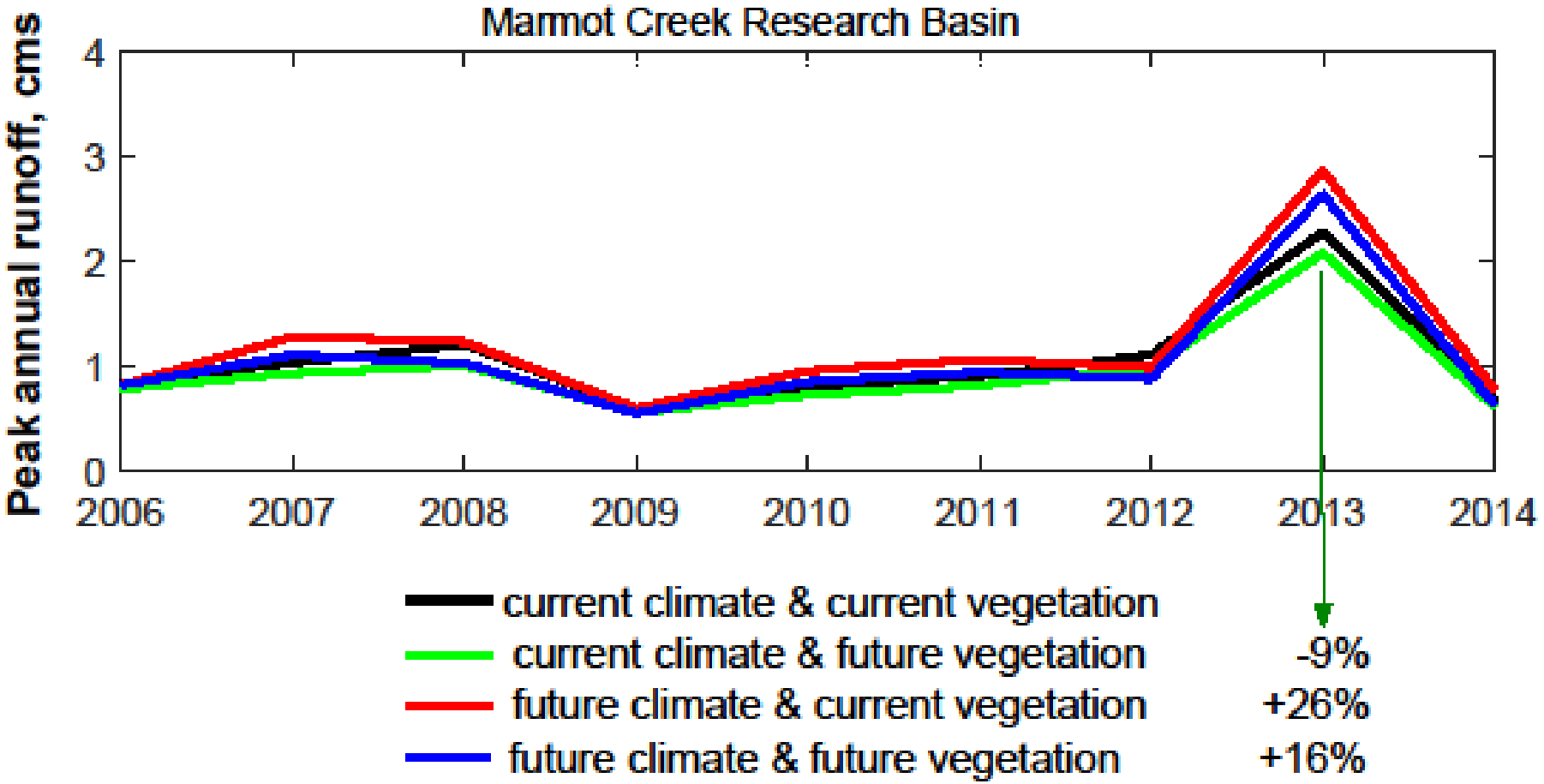
- Topographic Wetness Index for Canada – also deal with permafrost/ice, explore Wetland DEM Ponding Model
- Enhancing and integrating groundwater information into flood modelling
- Standards for exploiting water data – Chyf (affiliate project proposed) and linked data
- Dynamic surface water mapping to update NHN using Earth Observation, Artificial Intelligence, High Performance Computing
- Incorporating Indigenous Knowledge in Floodplain Management guidelines
- Update hydrological and hydraulic procedures for flood hazard delineation to include consideration for future discharges and model outputs for design purposes. MESH

Paula Macleod, Canada Centre for Mapping and Earth Observation

Flood Plain Mapping

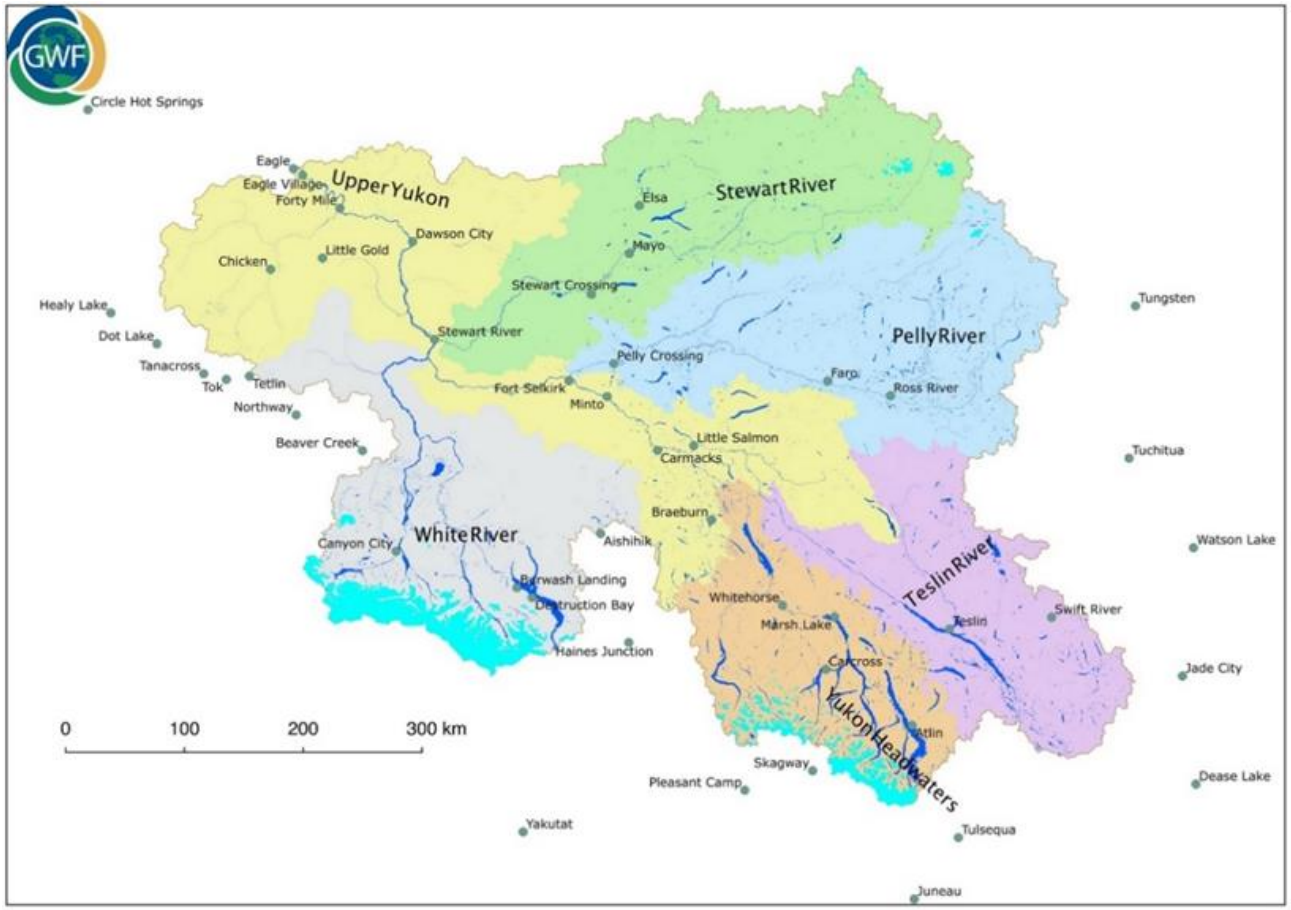
- Strong national need for updated, reliable flood risk calculations and dynamic floodplain mapping.
- Existing national capacity to calculate flood extents using hydrodynamic models
- Can GWF contribute estimates of future discharge probabilities that reflect non-stationary climate, changing land use and water management scenarios?

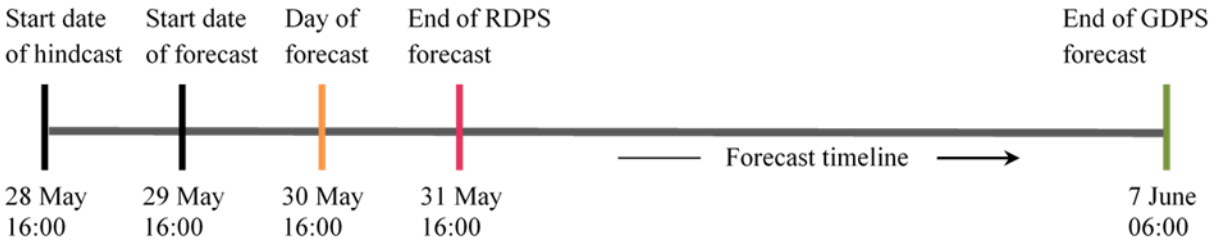
Climate and Forest Change Impacts on Peak Streamflow



Kabir Rasouli

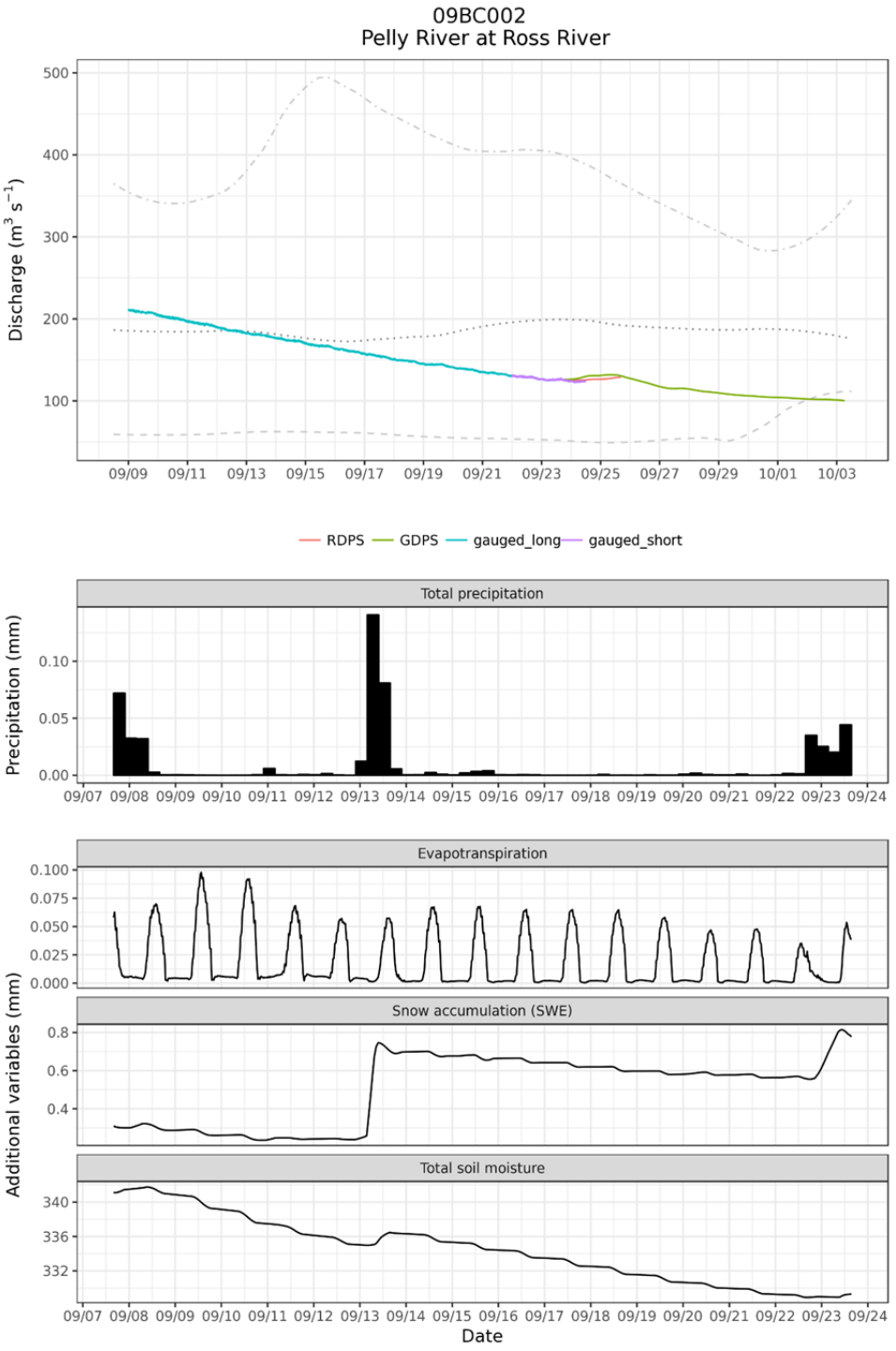
GEM-MESH Forecasting for Yukon





Richard, Pomeroy, Princz, Tesemma, Davison, Loukili, Shook, Elshamy, Pietroniro 2019

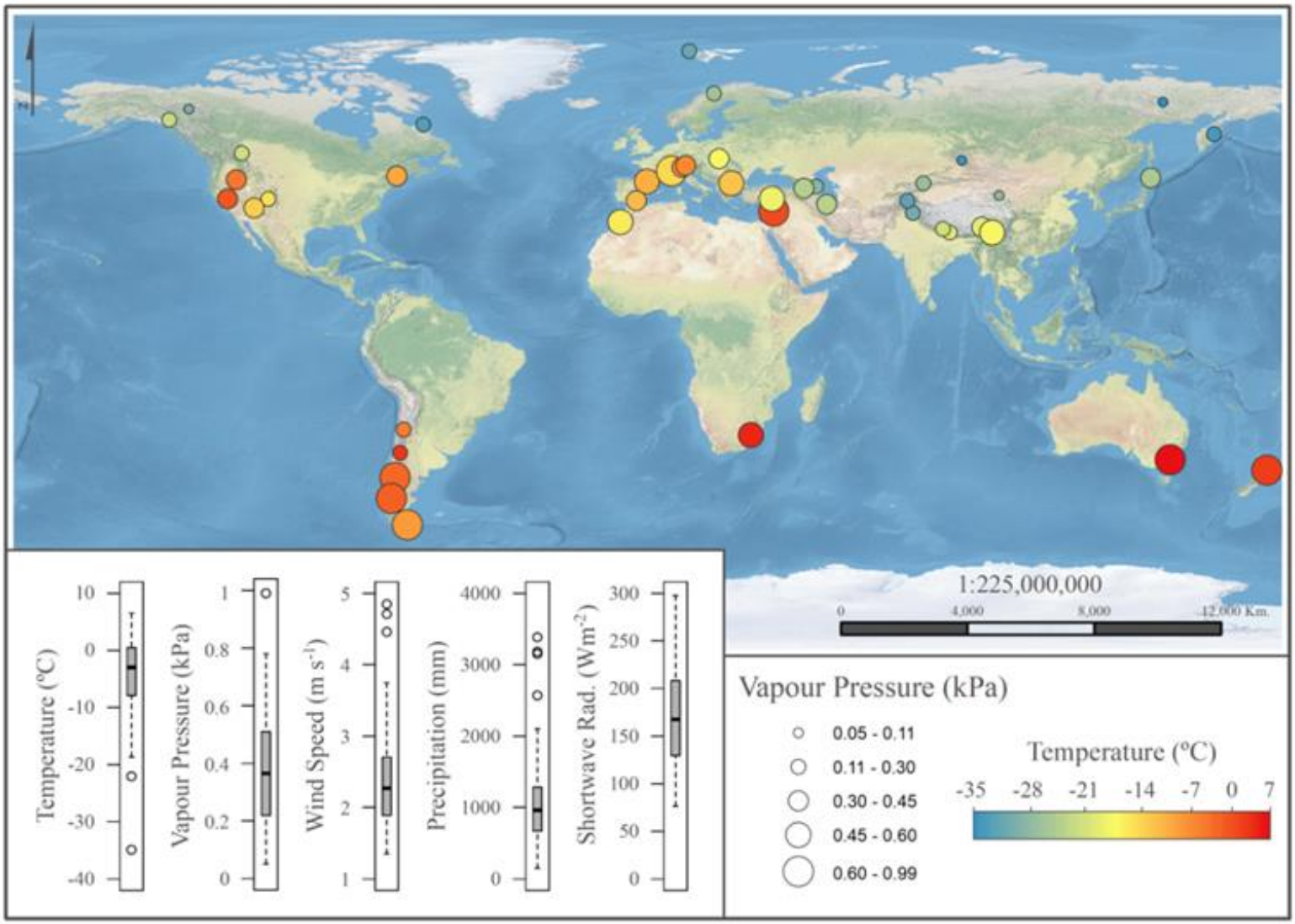
Daily Operational Forecasts

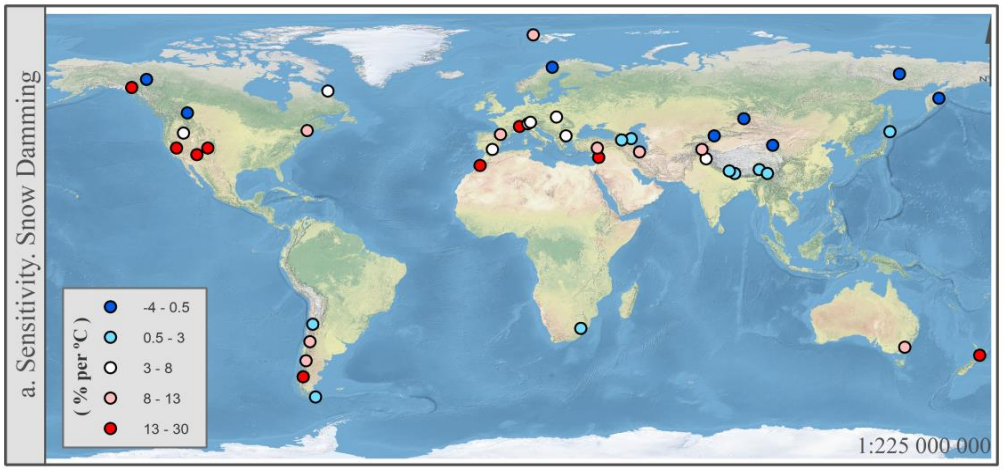


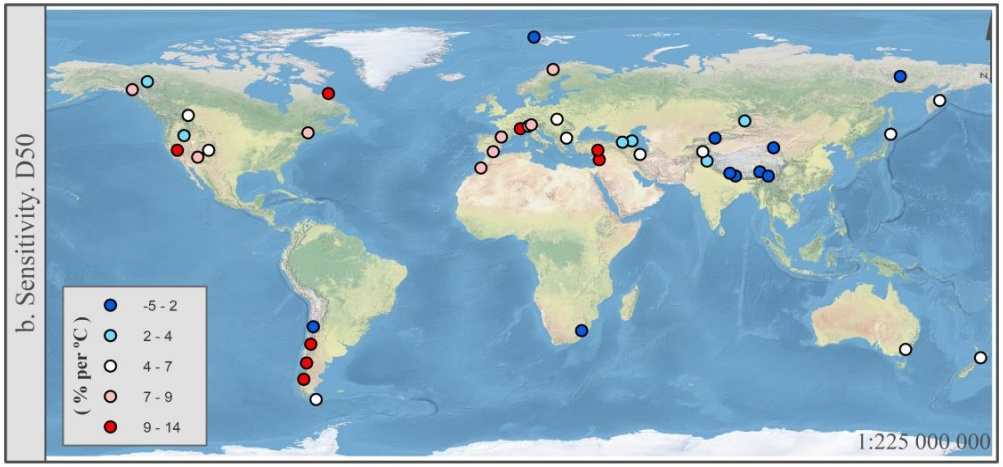
GWF International

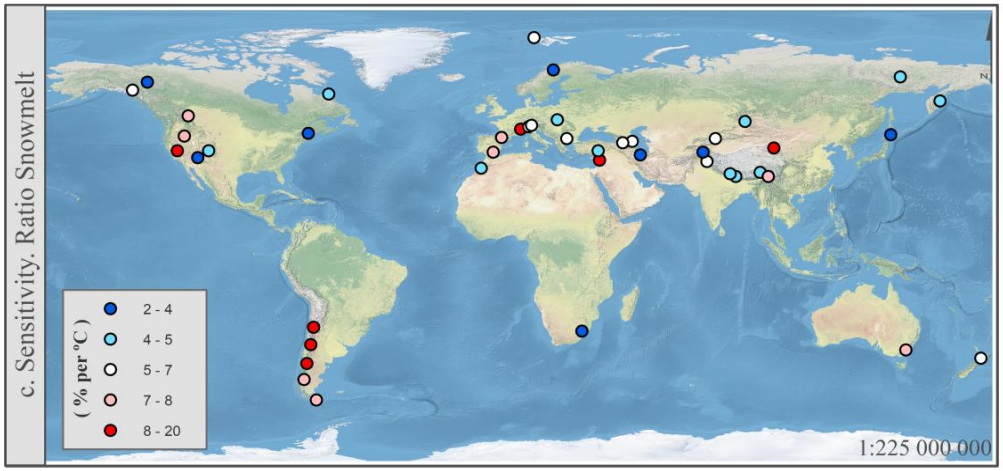
- GEWEX (WCRP project) –
  - GWF is a **Regional Hydroclimate Project**
  - INARCH – mountain hydrometeorology **X-cut Project**
  - Water for the Food Baskets of the World
- UN Water Action Decade
  - Collaboration with UN University
  - *Canada Water* - Strategy and Action Plan
- UNESCO
  - Global Environmental Facility - Central Asian Hydrology Project
  - GWF/UNESCO Joint Presentation to COP25, Santiago, Dec 2019
- Future Earth – Water Futures.
  - Sept. Conference, Bangalore
  - *Climate Impacts on Global Mountain Water Security Working Group*
- WMO – High Mountain Summit in Geneva, Oct 2019
- Modelling – USA, Iran, India, Spain, Kazakhstan, Chile, Argentina, China
- Critical Zone Observatory – China-Siberia
- Third/Three Pole Environment – Chinese Academy of Sciences

Virtual CRHM Basins for Mountains









Sensitivity (% change per °C of warming) of
-Snow Damming: the average correlation between annual and monthly precipitation (snow damming),
-D50 Day: the day when the centre of mass of the hydrograph occurs, and
-Snowmelt Ratio: the ratio of snowmelt to total runoff

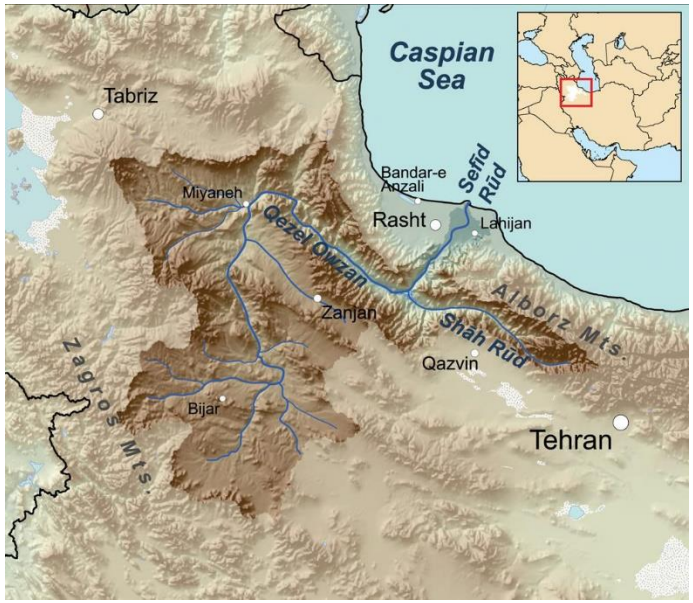
International collaboration – MESH

Columbia

Coello River Basin (1,800 km^2) within the Magdalena Cauaca Basin (273,000 km^2)

Iran

Sefidrud River Basin (65,000 km^2)



France/Luxembourg: Moselle River

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