



PRESENTED BOREAS-FIFE REUNION

**Long-Term Influence of BOREAS on Carbon
Cycle and Ecosystem
Research in Canada**

Hank Margolis

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Quebec City, Canada**

**Program Manager
NASA Terrestrial Ecology Program**



MY BOREAS VOYAGE

Studied Forest Ecophysiology



Met Diane Wickland, Piers Sellers & Forrest Hall



Director, Canadian University Participation – BOREAS
(1992-1997)



Collaborator, NASA Goddard (1995-2015)



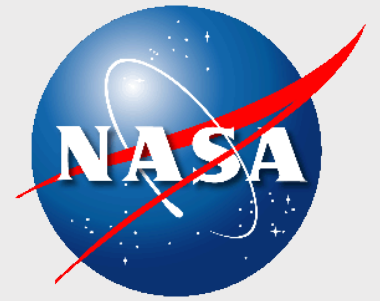
Program Leader, Fluxnet-Canada (2002-2007)



Program Leader, Canadian Carbon Program (2007-2011)



Program Manager, Terrestrial Ecology Program,
NASA Headquarters (September 2015-now)



Big Shoes To Fill



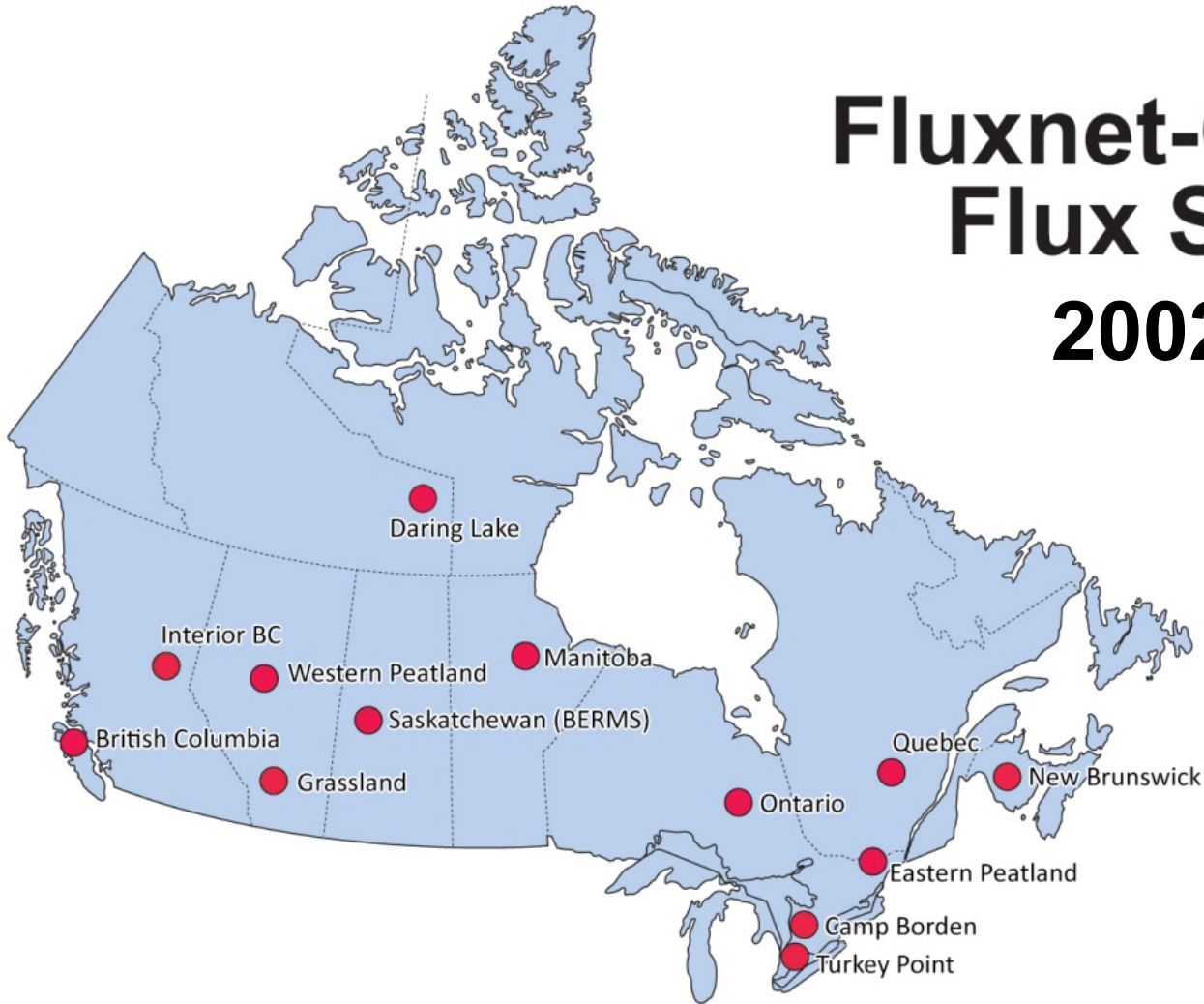
Diane Wickland's Shoes???



Canada's land mass is:

- 45% of North America
- Size similar to US & Europe (10M km² each)
- Contains 10% of the world's forests.

Fluxnet-Canada Flux Stations 2002-2011



13 Flux Stations
~34 Flux Towers

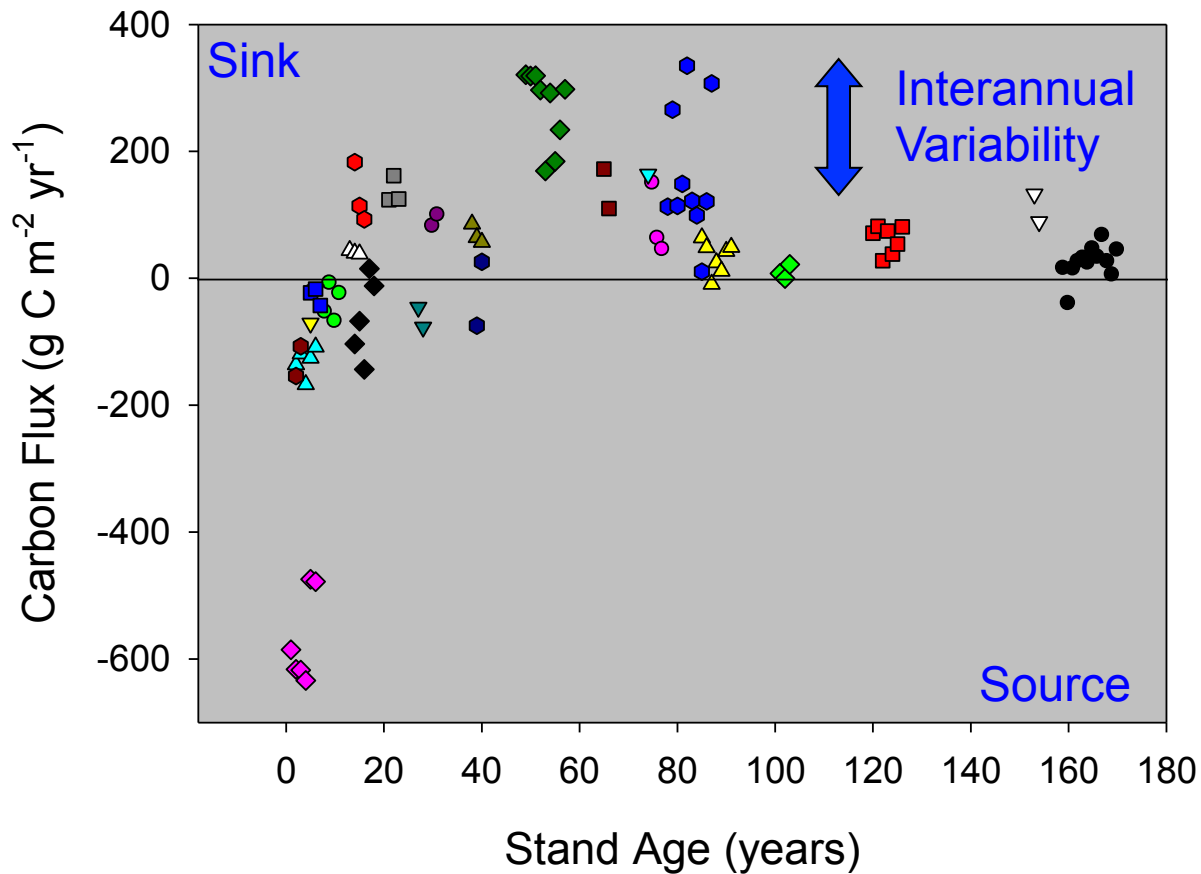
WHAT DID FLUXNET-CANADA DO?

Much like BOREAS, we made intensive, high-quality field measurements of biosphere-atmosphere fluxes and combined them with remote sensing to help develop and test predictive models of northern forests and peatlands.

*But we focused on the responses to **inter-annual climate variability and disturbance across Canada***



Annual Carbon Budgets



- NOBS
- ▽ UCI1850
- SOBS
- ◆ EOBS
- ▲ OJP
- OA
- OMW
- ▽ UCI30
- WP39
- ◆ DF49
- ▲ UCI64
- UCI64wet
- HJP75
- ▽ F77
- UCI81
- ◆ HDF88
- △ UCI89
- F89
- HJP94
- ▽ UCI98
- F98
- ◆ HDF00
- ▲ HBS00
- HJP02

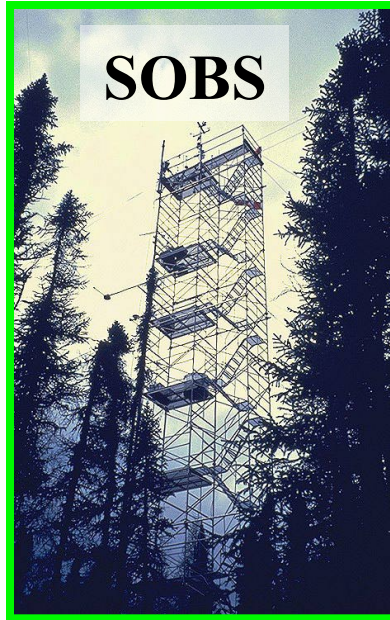
Our Archived Data Set Is One of Our Major Legacies

- 185 site-years of flux data from 34 sites through 2011.
- Basic ecological data for most sites.
- Data through 2011 is archived at the ORNL DAAC.
- 2012-2014 downloads: 932 users from 51 countries.
- Used extensively for regional and global analyses.

FLUXNET-CANADA



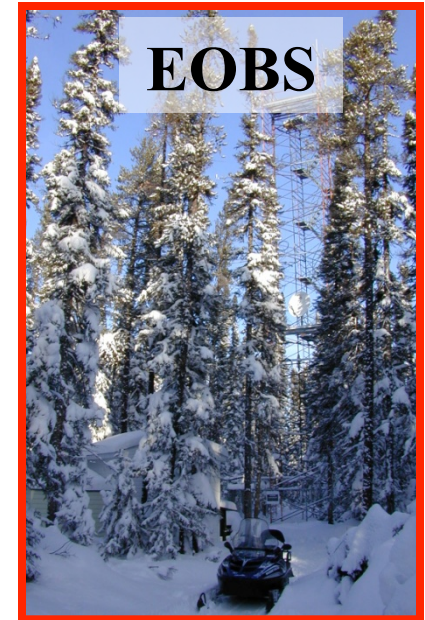
Inter-Regional Comparison of the Same Forest Type – Boreal Black Spruce



Saskatchewan



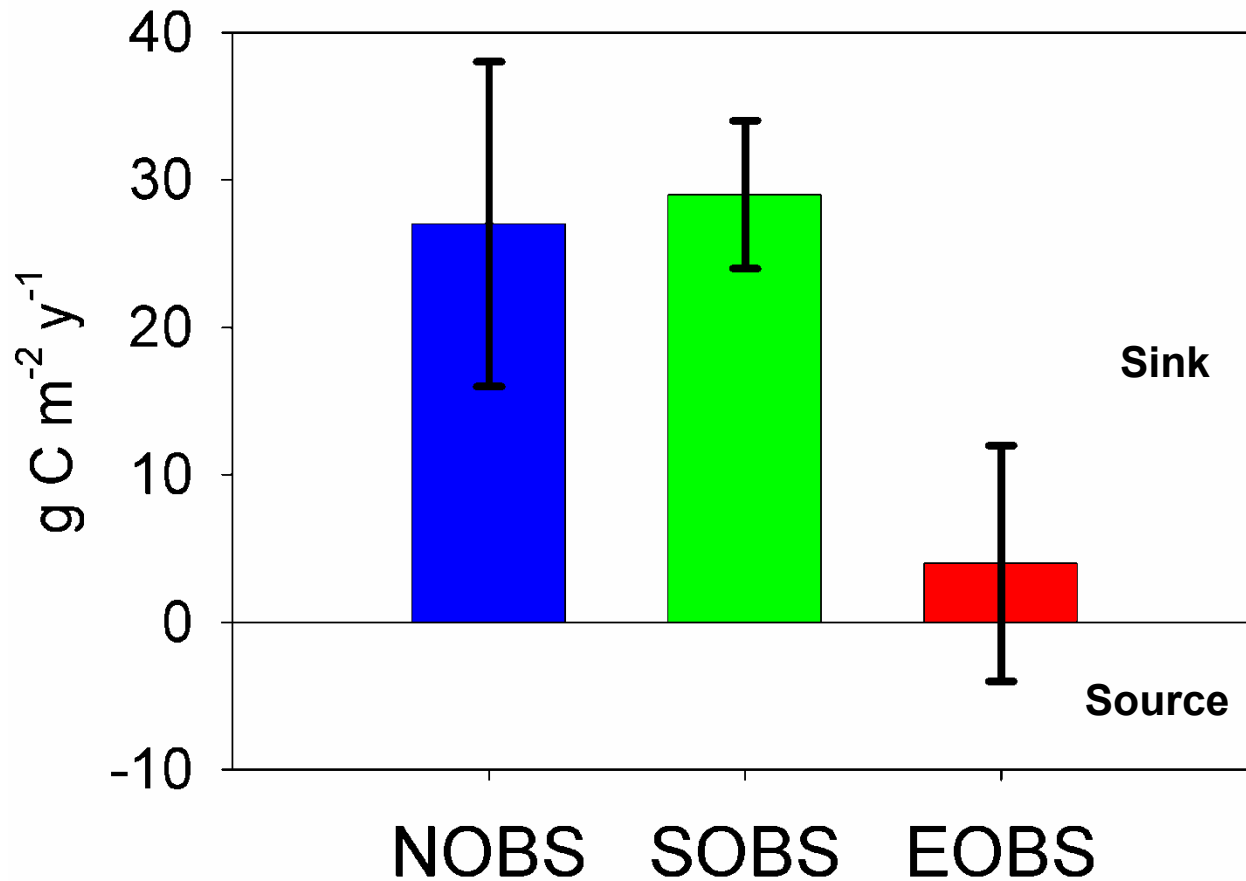
Manitoba



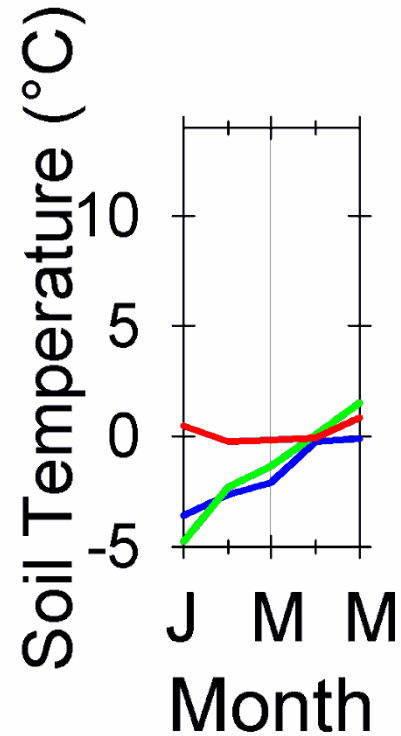
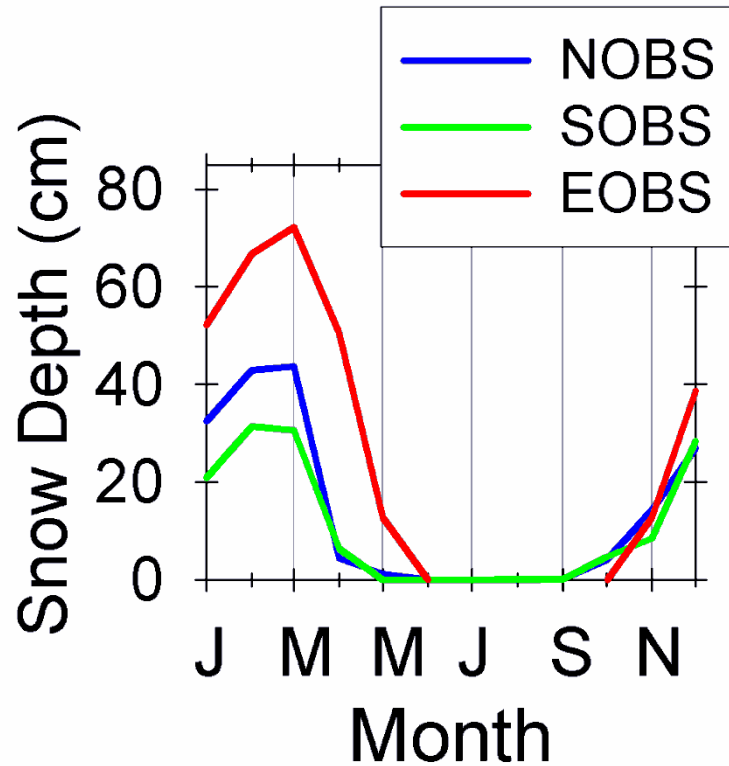
Quebec



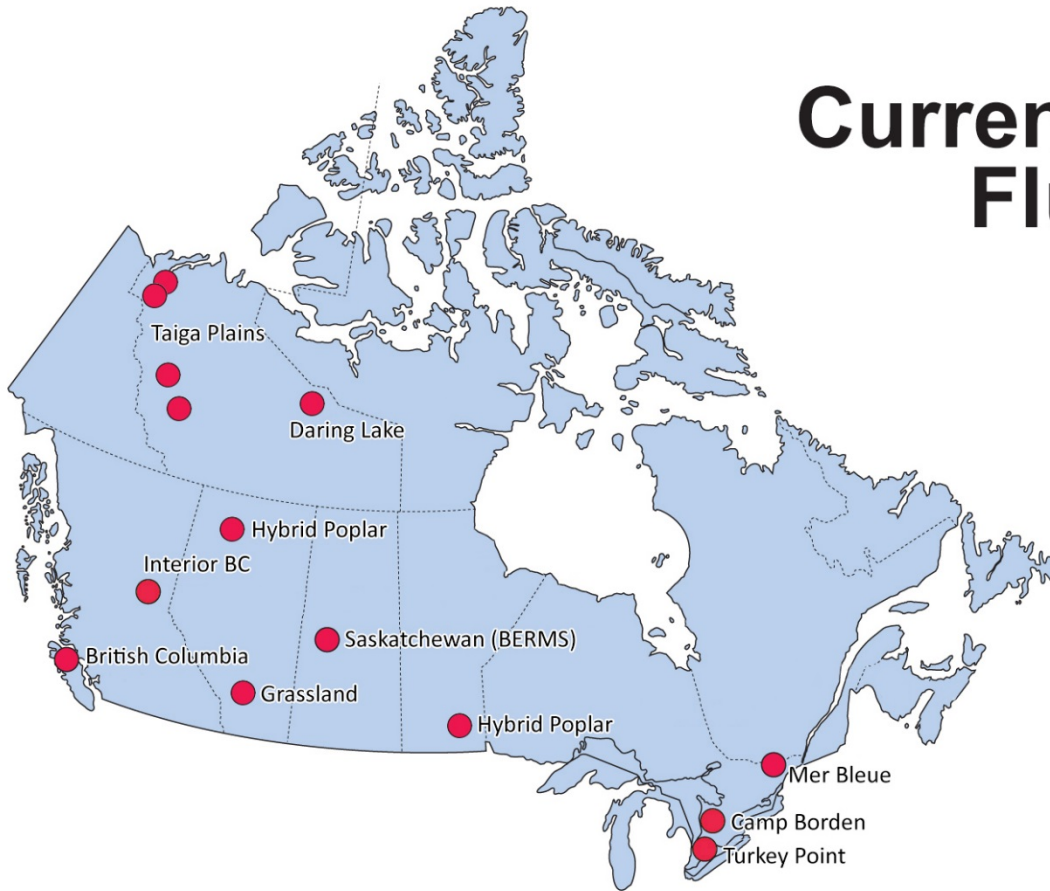
2004 Annual NEP



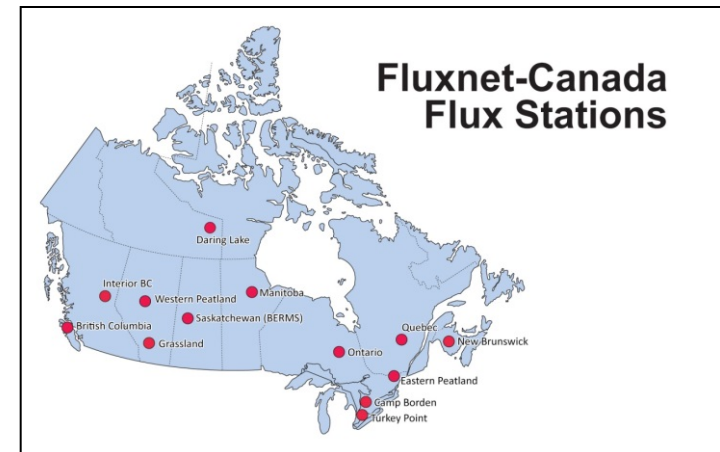
Cross-Spruce Comparison



Current (2015) Flux Sites



11 Flux Stations
25 Flux Towers





... the *in situ* measurements continue

Thanks to:

Alan Barr, Environment Canada

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Altaf Arain, McMaster University

Oliver Sonnetag, Université de Montréal

Elyn Humphreys, Carleton University

Peter Lafleur, Trent University

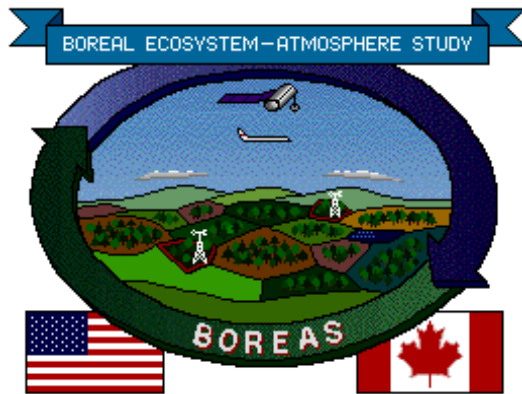
BOREAS Southern Study Area (Boreal Ecosystem Research and Monitoring Sites: BERMS, 1994+)



- southern edge of boreal forest in central Saskatchewan
- forest-grassland ecotone controlled by water balance, sensitive to climate change

Program History

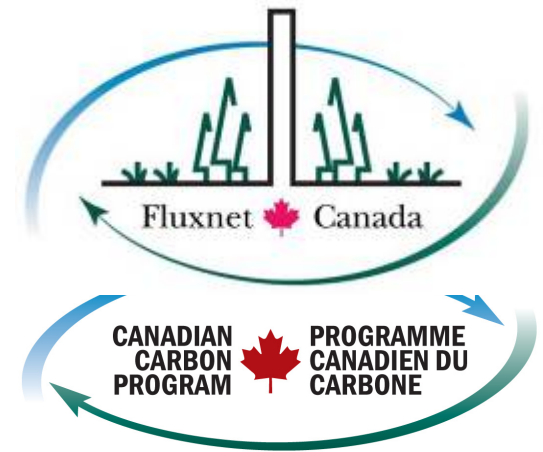
1994-1996



1996-2012



2002-2011



2012+

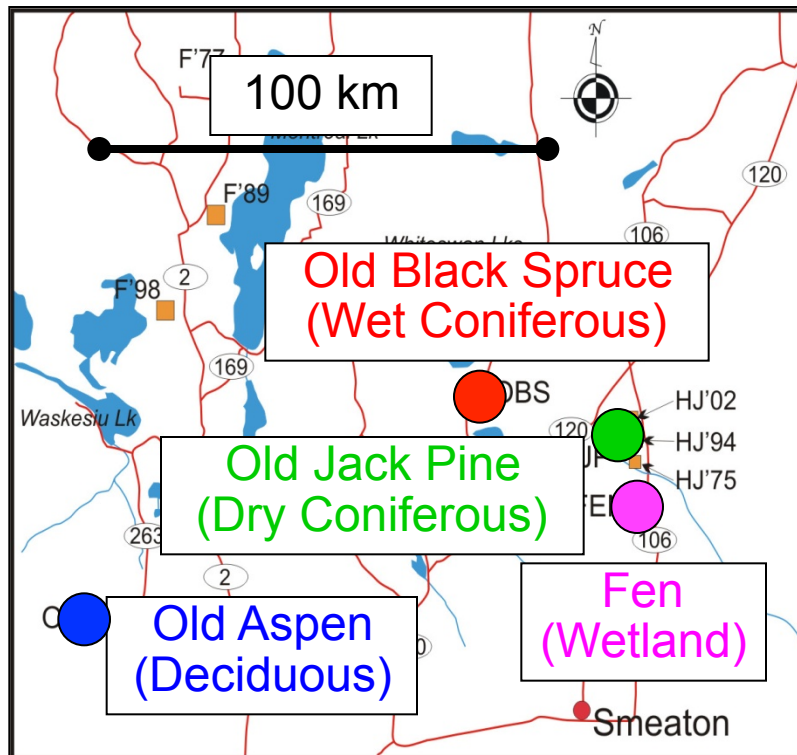
NSERC-funded
Changing Cold Regions Network



UNIVERSITY OF
SASKATCHEWAN

Global Institute for
Water Security

Mature Sites (still in operation)

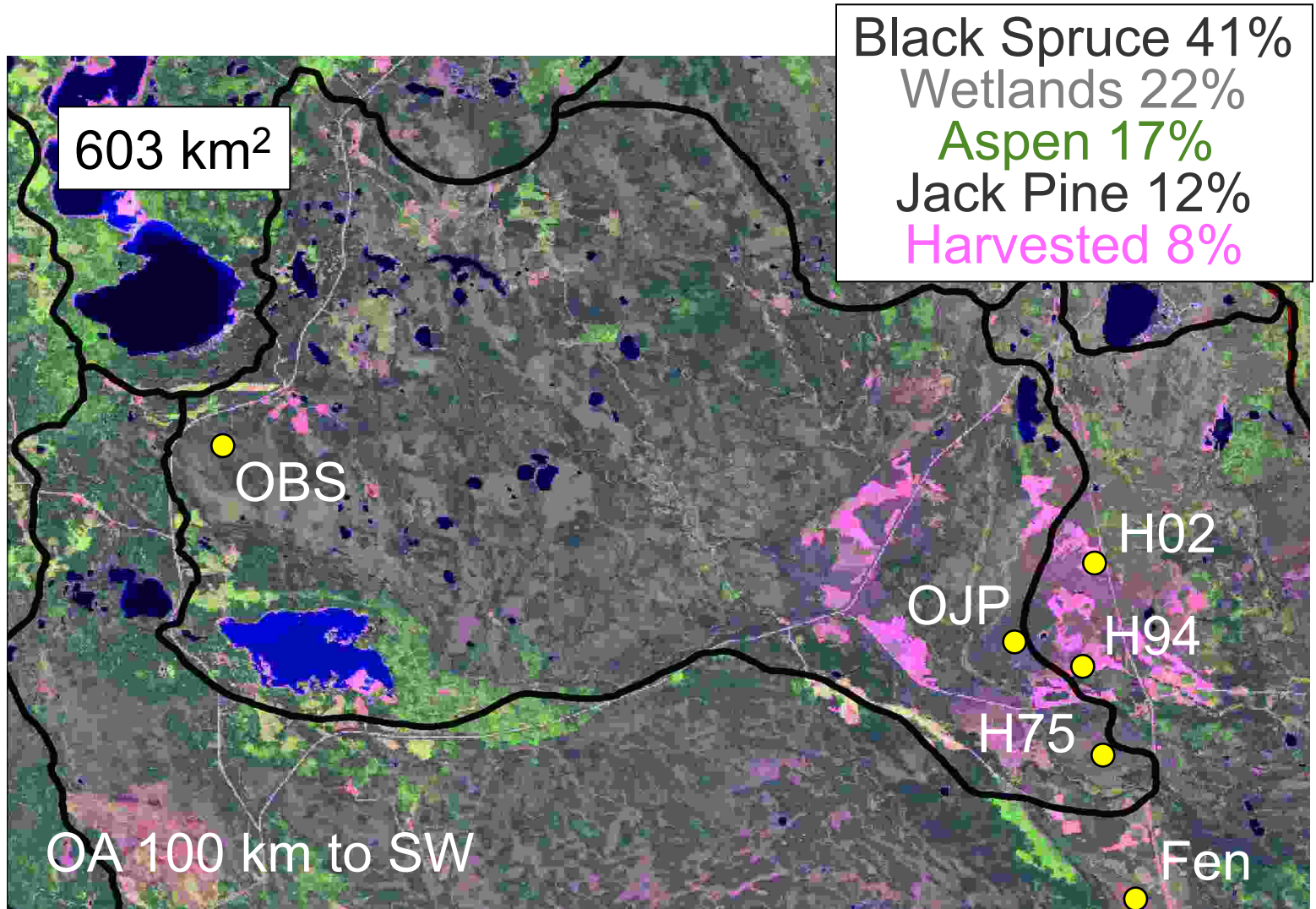


BERMS Research Highlights



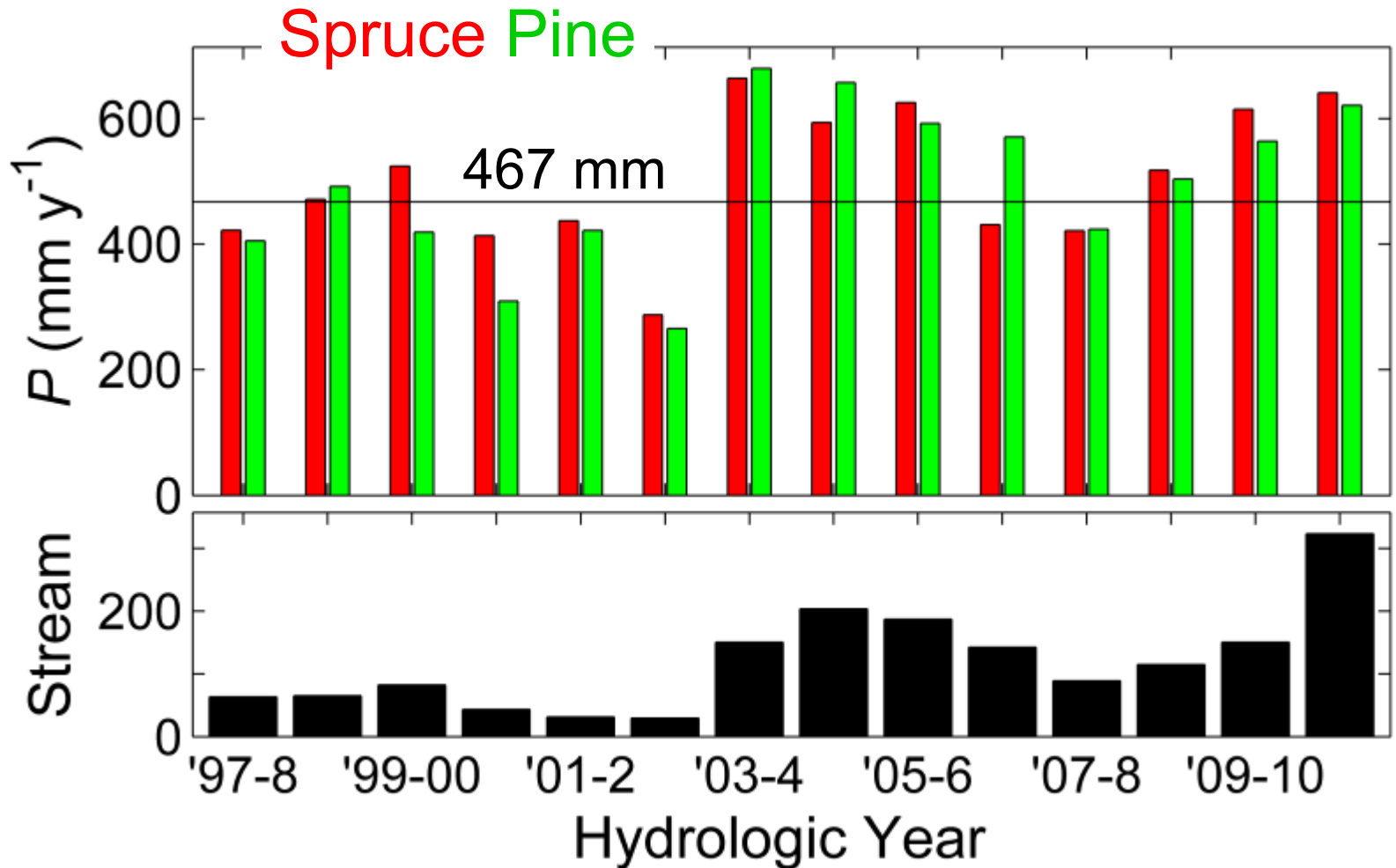
- Water balance at stand, basin, and regional scales

White Gull Creek Watershed



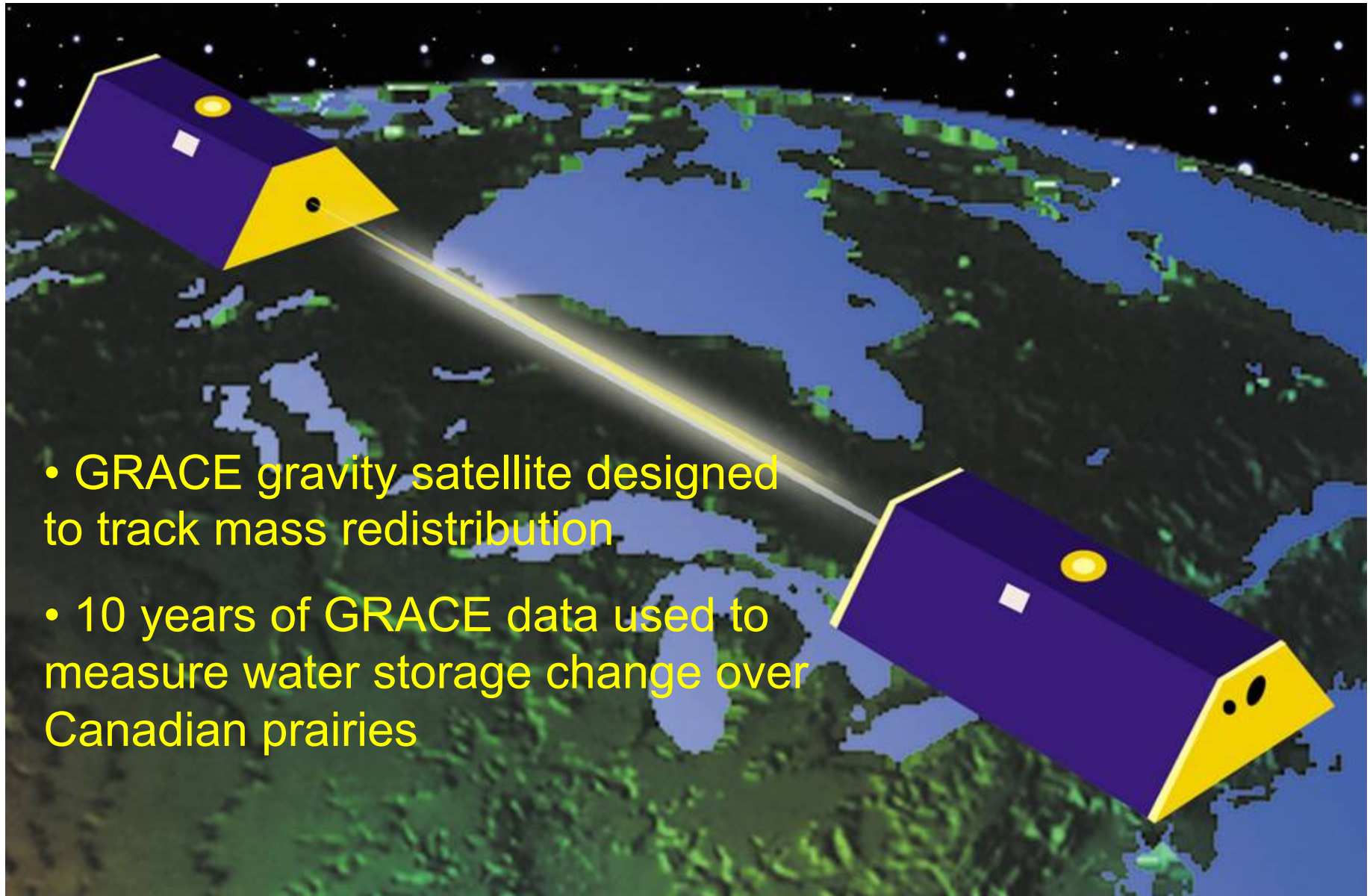
Annual Precipitation and Streamflow

White Gull Creek, Oct-Sept Hydrologic Years 1997-2011



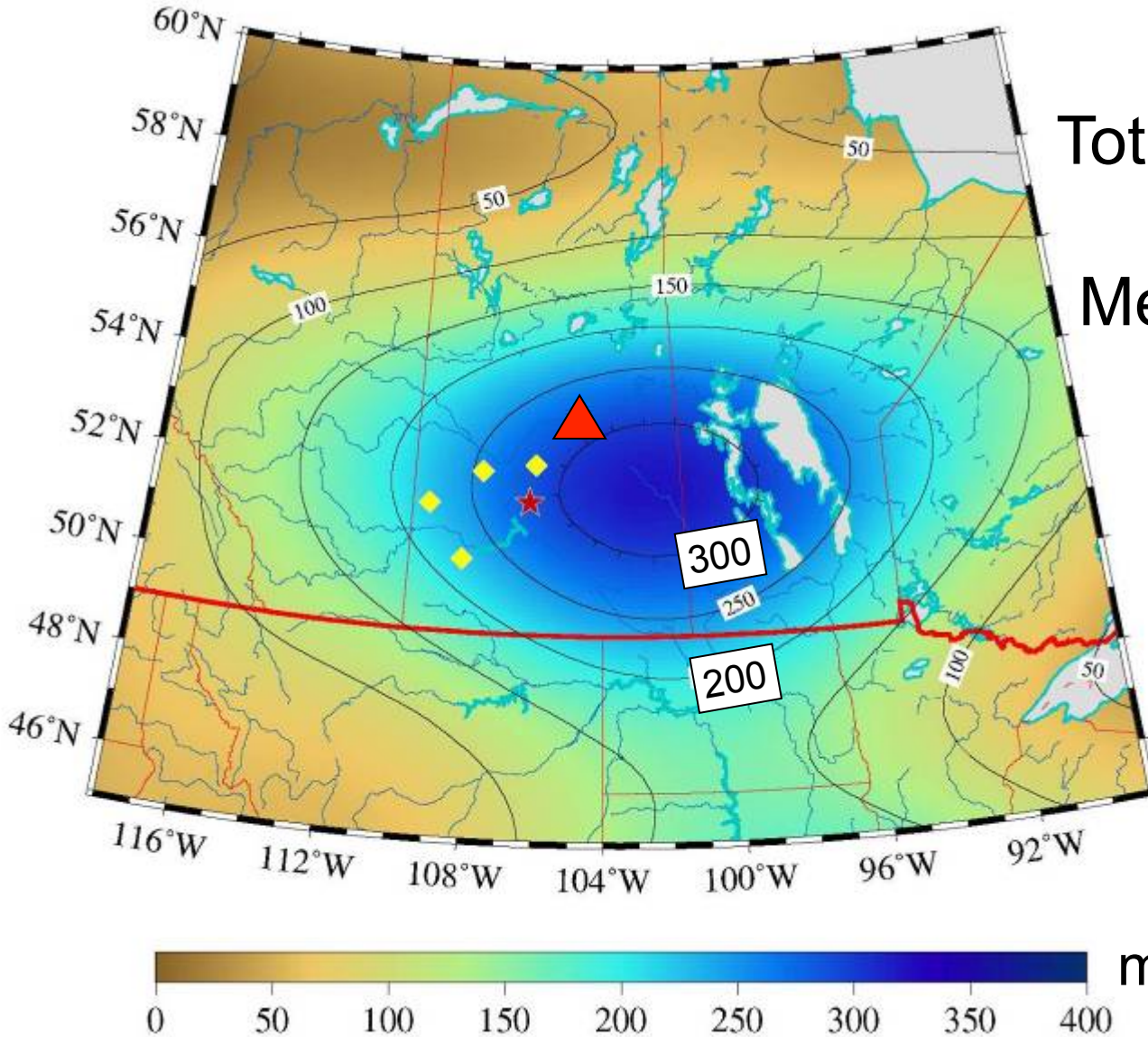
Mass Redistribution Measurement Using GRACE

(slides courtesy of Tony Lambert, NRCCan)



- GRACE gravity satellite designed to track mass redistribution
- 10 years of GRACE data used to measure water storage change over Canadian prairies

Total Water Storage Change from GRACE 2002-2011



Total water storage:

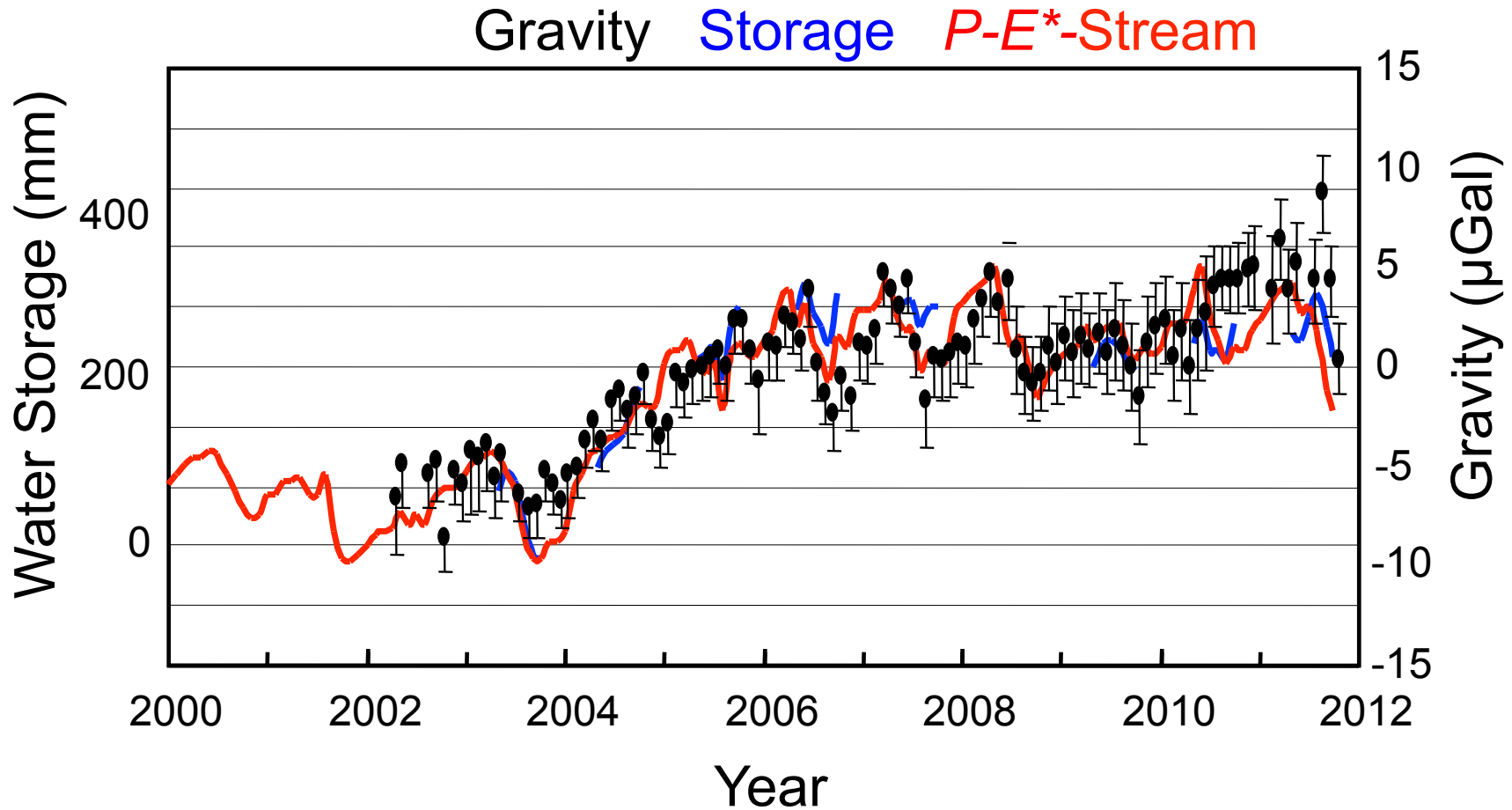
455 ± 38 Gt

Mean annual rate:

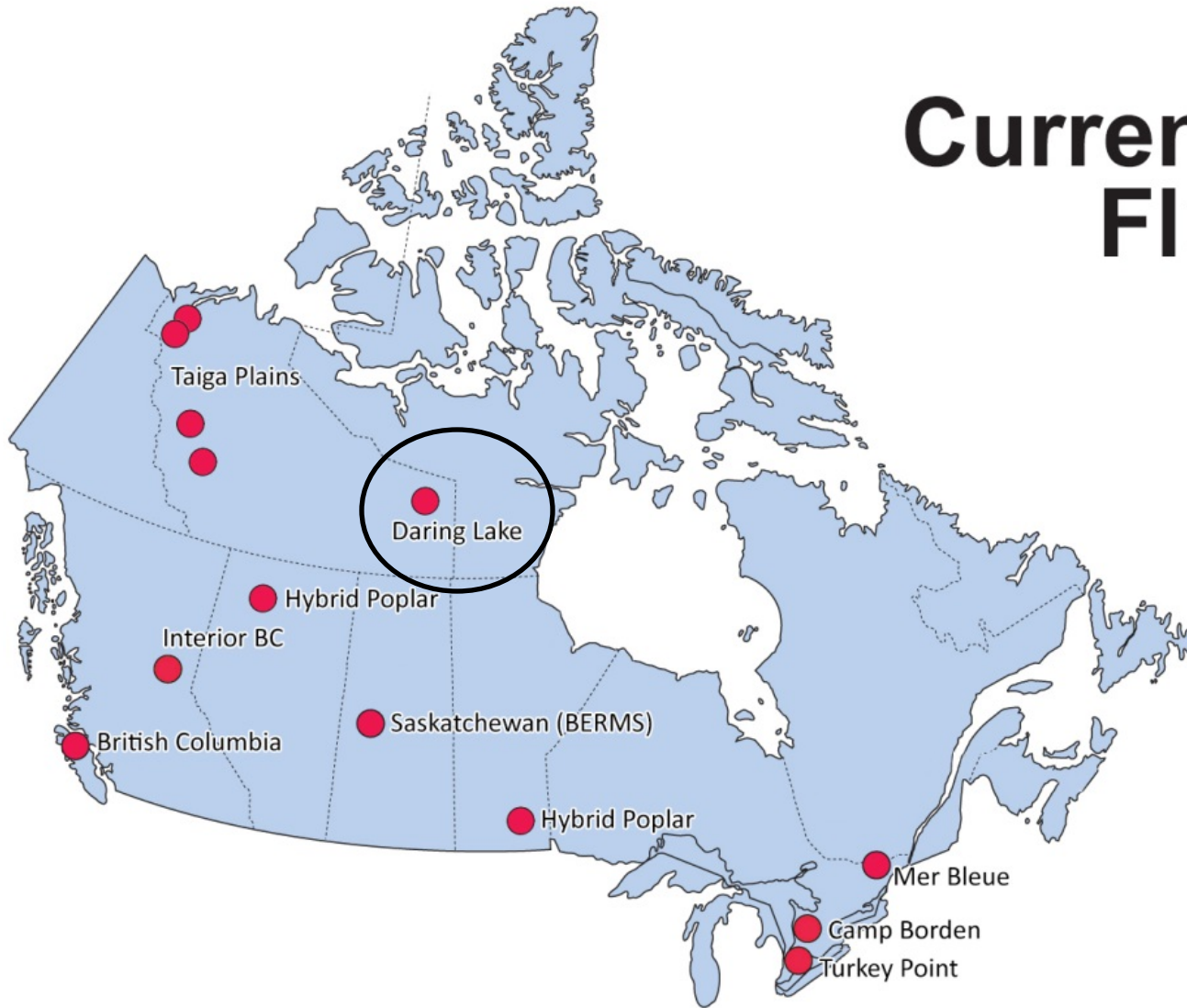
48 ± 4 Gt/yr

Triangle:
White Gull
catchment

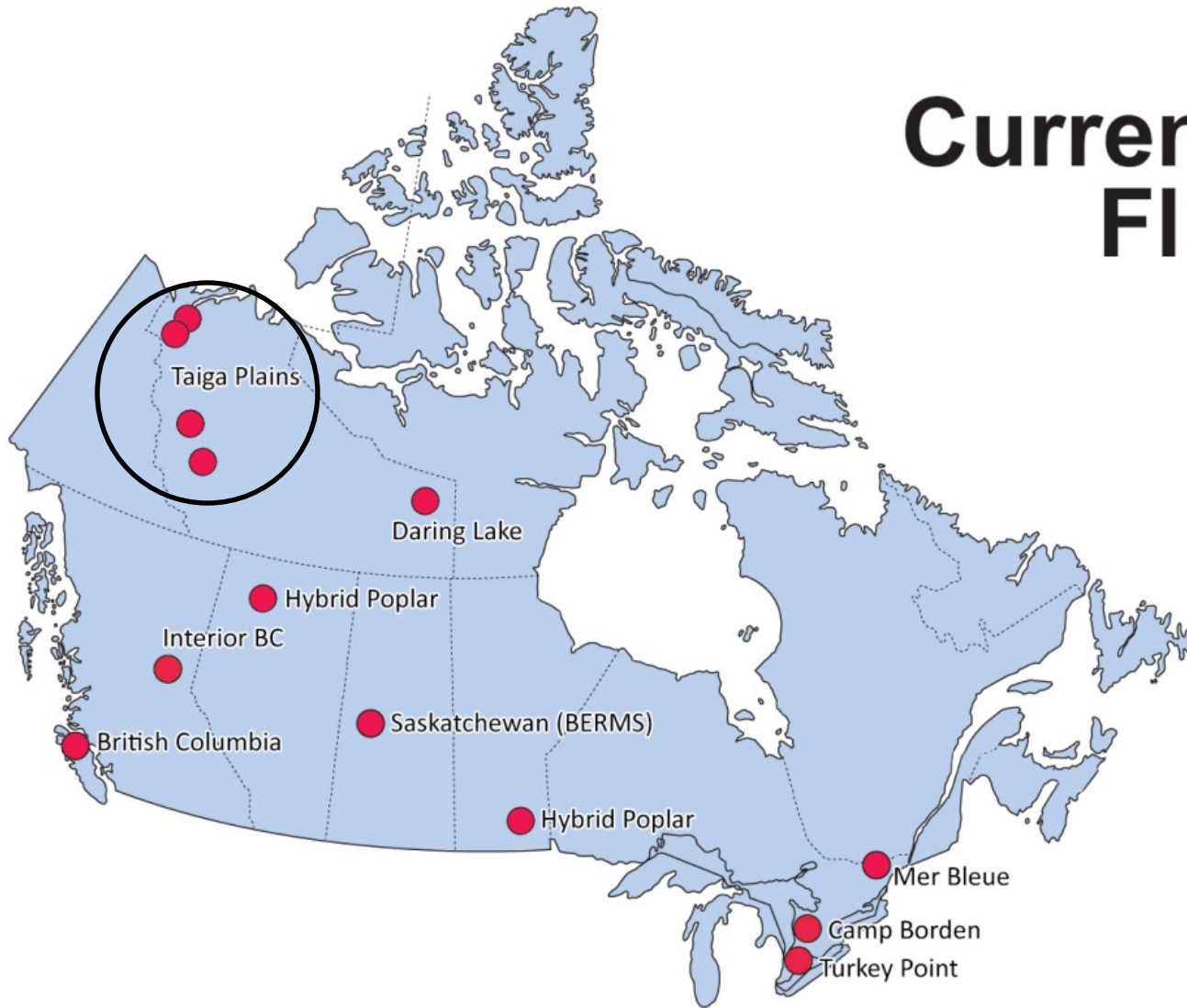
Comparing GRACE Gravity Estimates with BERMS White Gull Basin Water Balance



Current (2015) Flux Sites

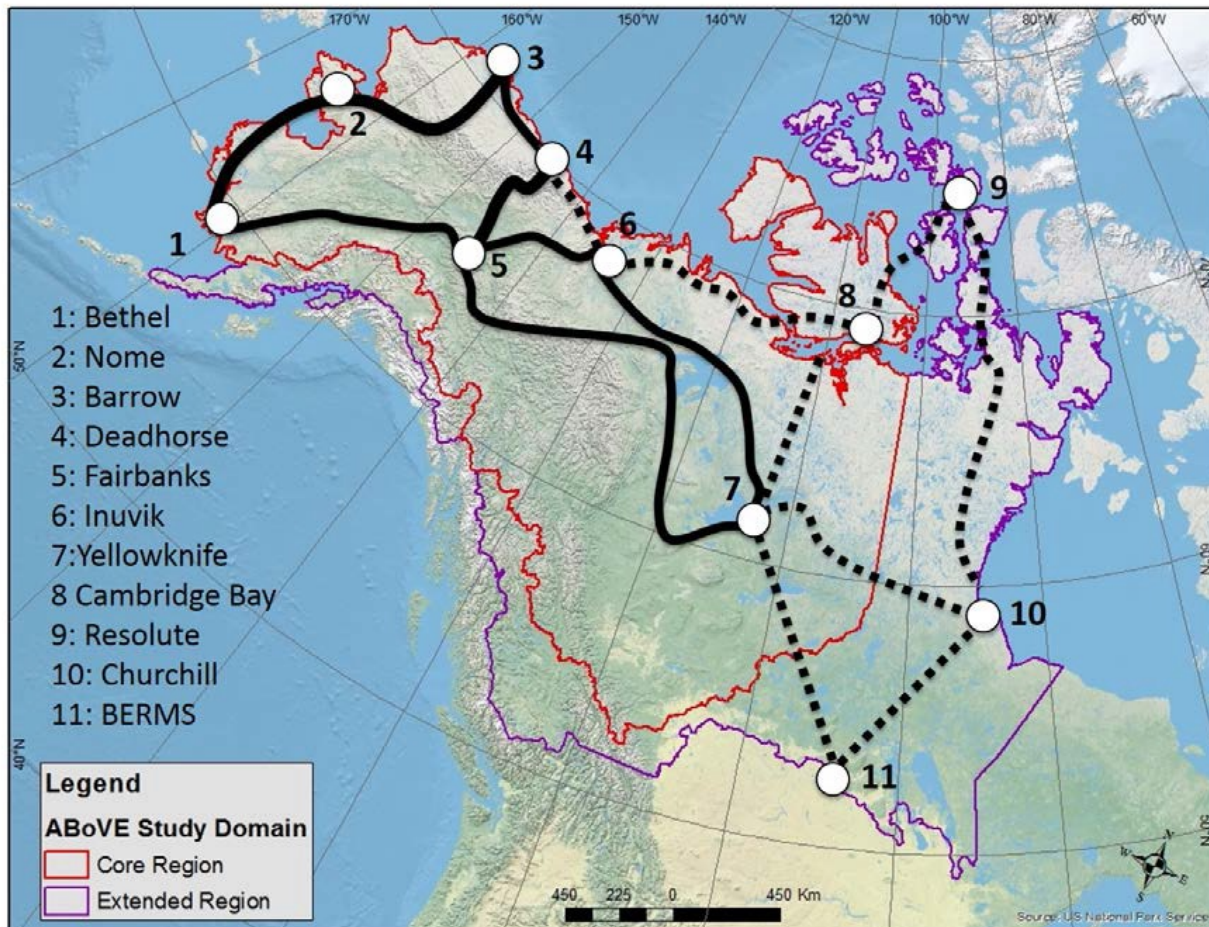


Current (2015) Flux Sites



ABoVE Airborne Campaign

Notional flight lines for ABoVE's Foundational Airborne Measurements. Detailed sampling strategy will be determined by the ABoVE Science Team and NASA HQ following selection.



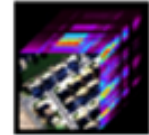
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AVIRIS-NG Campaign for SpaceX Debris at KSC



AVIRIS-NG First Cut Top 14 Anomalous Target Detections



MNF-based anomaly detection image for 14 highest probability detections of anomalous materials on land, neglecting obvious man-made sites and water.

