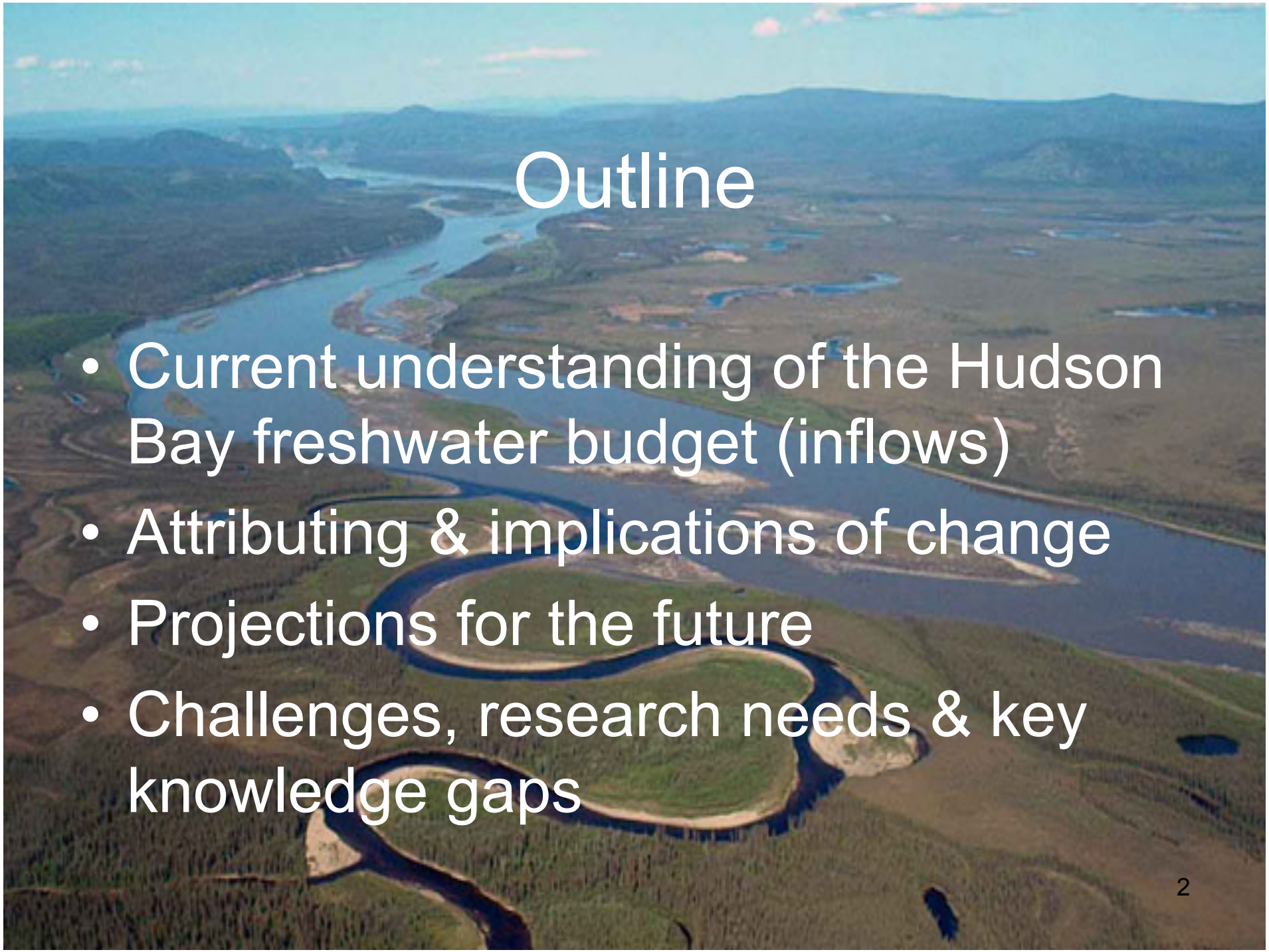
Fresh-water

Stephen Déry



Outline

- Current understanding of the Hudson Bay freshwater budget (inflows)
- Attributing & implications of change
- Projections for the future
- Challenges, research needs & key knowledge gaps

The Hudson Bay Drainage

Basin area = 3.7×10^6 km^2

Déry et al. (2011)

Pan-Arctic domain

Complex Systems Research Center
Institute for the Study of Earth, Oceans and Space
University of New Hampshire
Durham, New Hampshire

Ecosystems Center
Marine Biological Laboratory
Woods Hole, Massachusetts

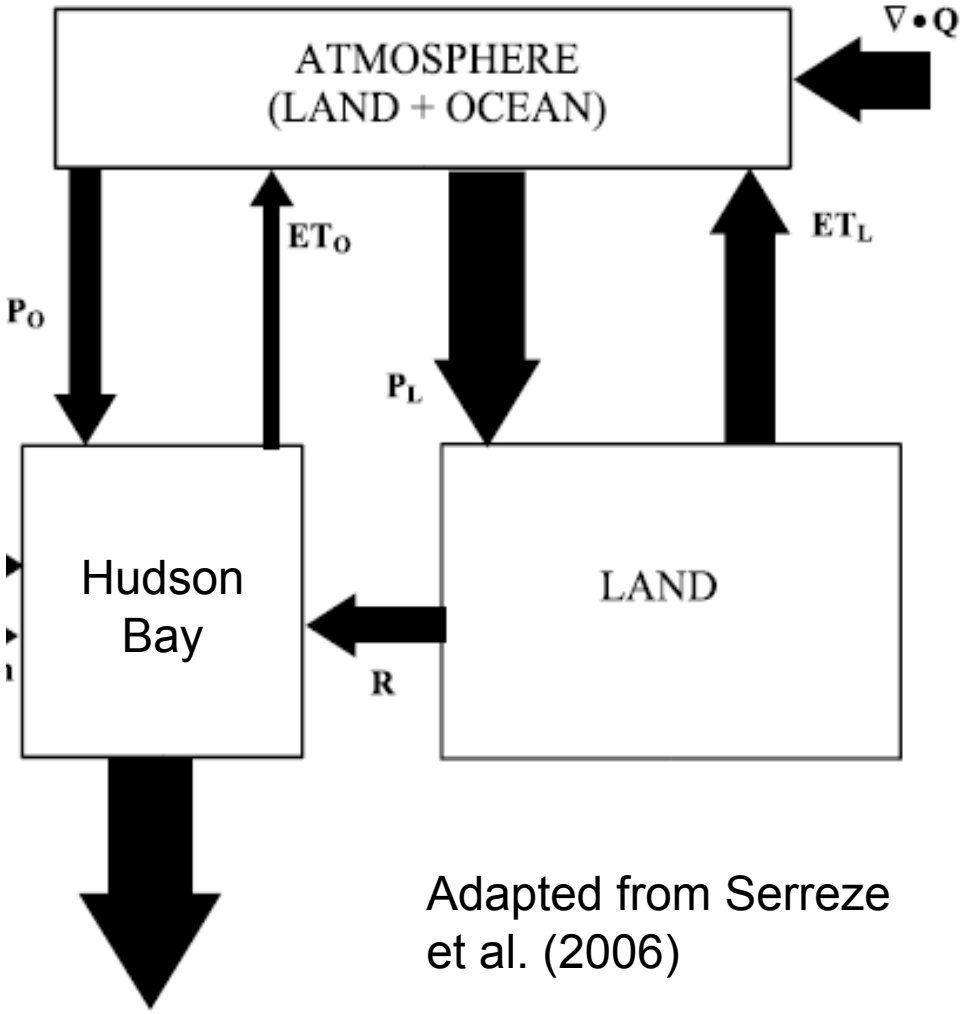
Global Hydrological Archive and Analysis System

Lammers et al. (2001) &
McClelland et al. (2006)

River Basin	Discharge ($km^3\ yr^{-1}$)
Lena	532
Yenisey	630
Ob	530
Yukon	205
Mackenzie	309
Hudson Bay	760
Pan-Arctic	~5250

Hudson Bay freshwater budget

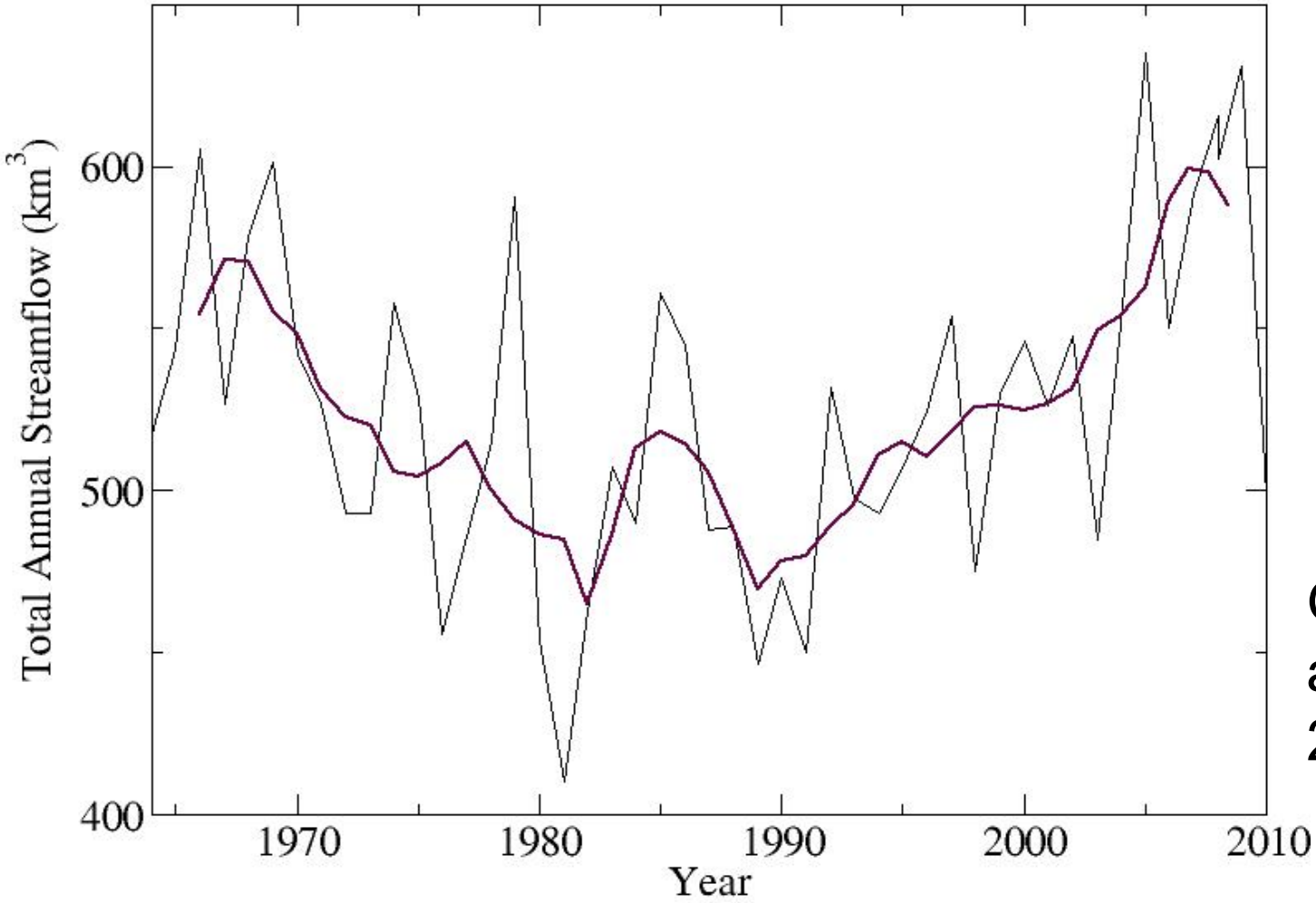
Budget term	Input ($km^3\ yr^{-1}$)
Net precip.	222 (30%)
River discharge	607 (81%)
Ice growth & melt	-80 (-11%)
Net input + residual	743+6 (100%)



Adapted from Serreze et al. (2006)

August 2003 to August 2004
Data from St-Laurent et al. (2011)

Annual (gauged) River Discharge into Hudson Bay



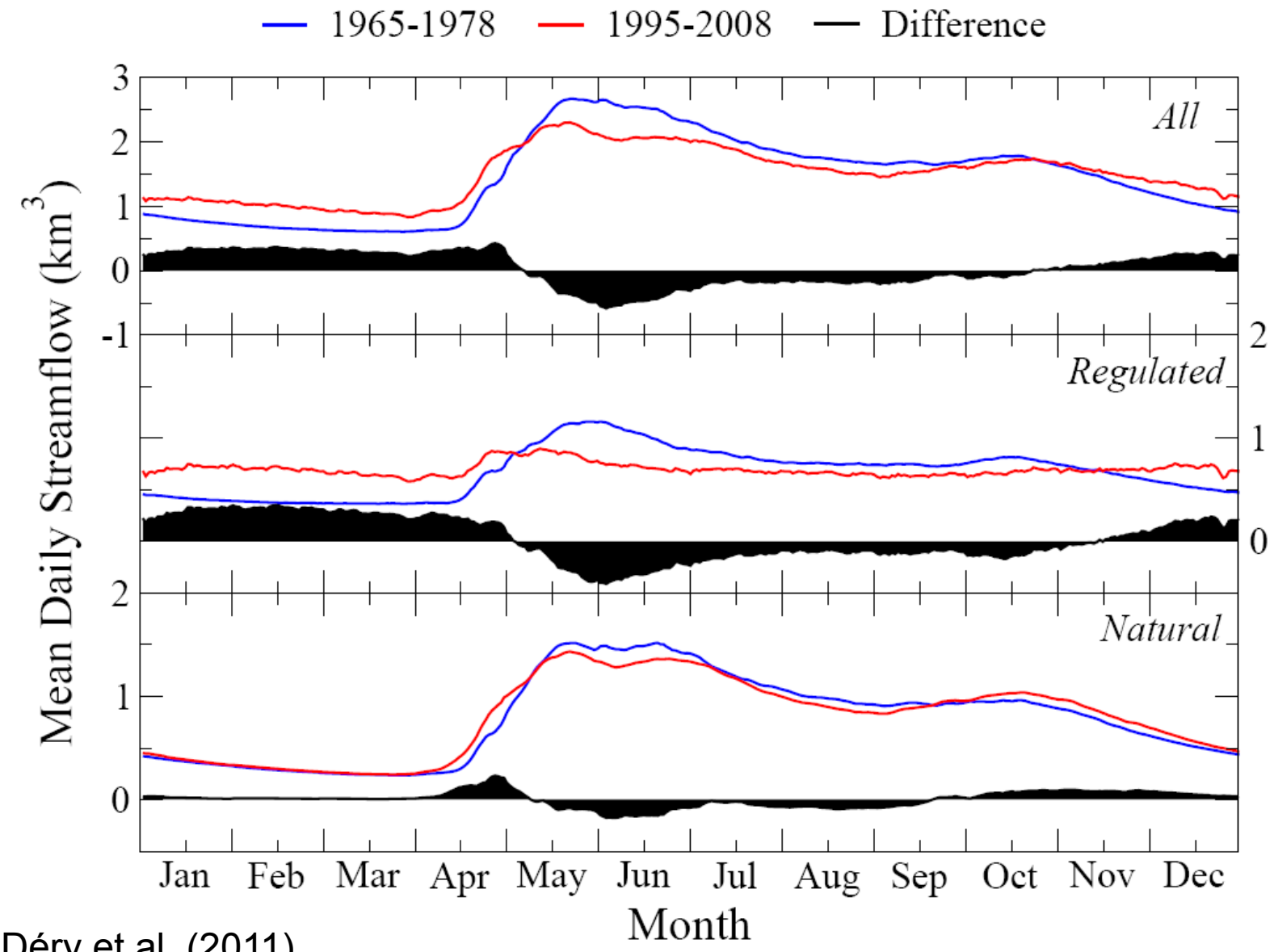
Mean = 525.7 km^3 yr^{-1}

S.D. = 51.4 km^3 yr^{-1}

Gauged area = 2.5×10^6 km^2

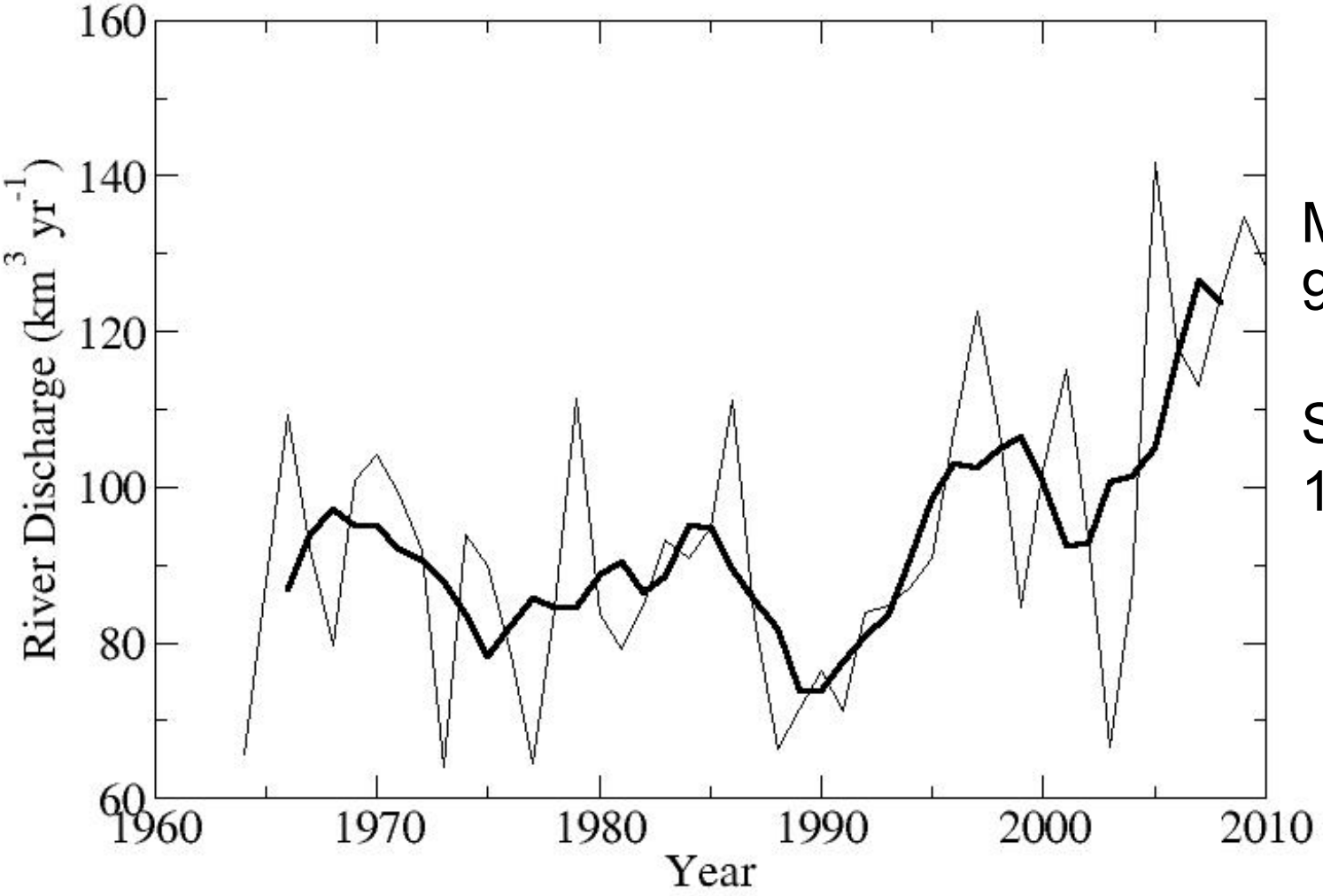
Updated from Déry et al. (2011)

Annual Cycle of River Discharge



Déry et al. (2011)

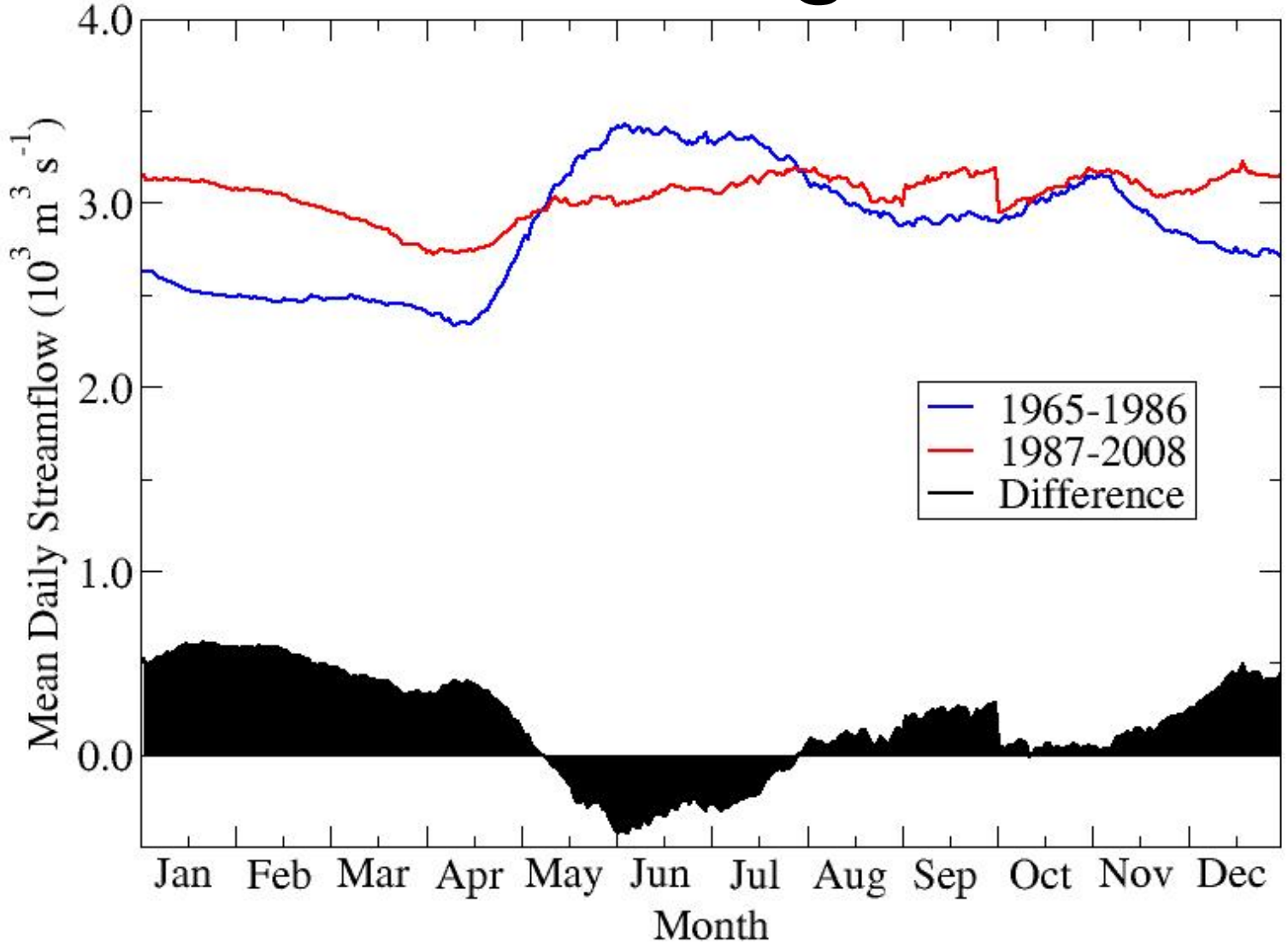
Annual Nelson River Discharge

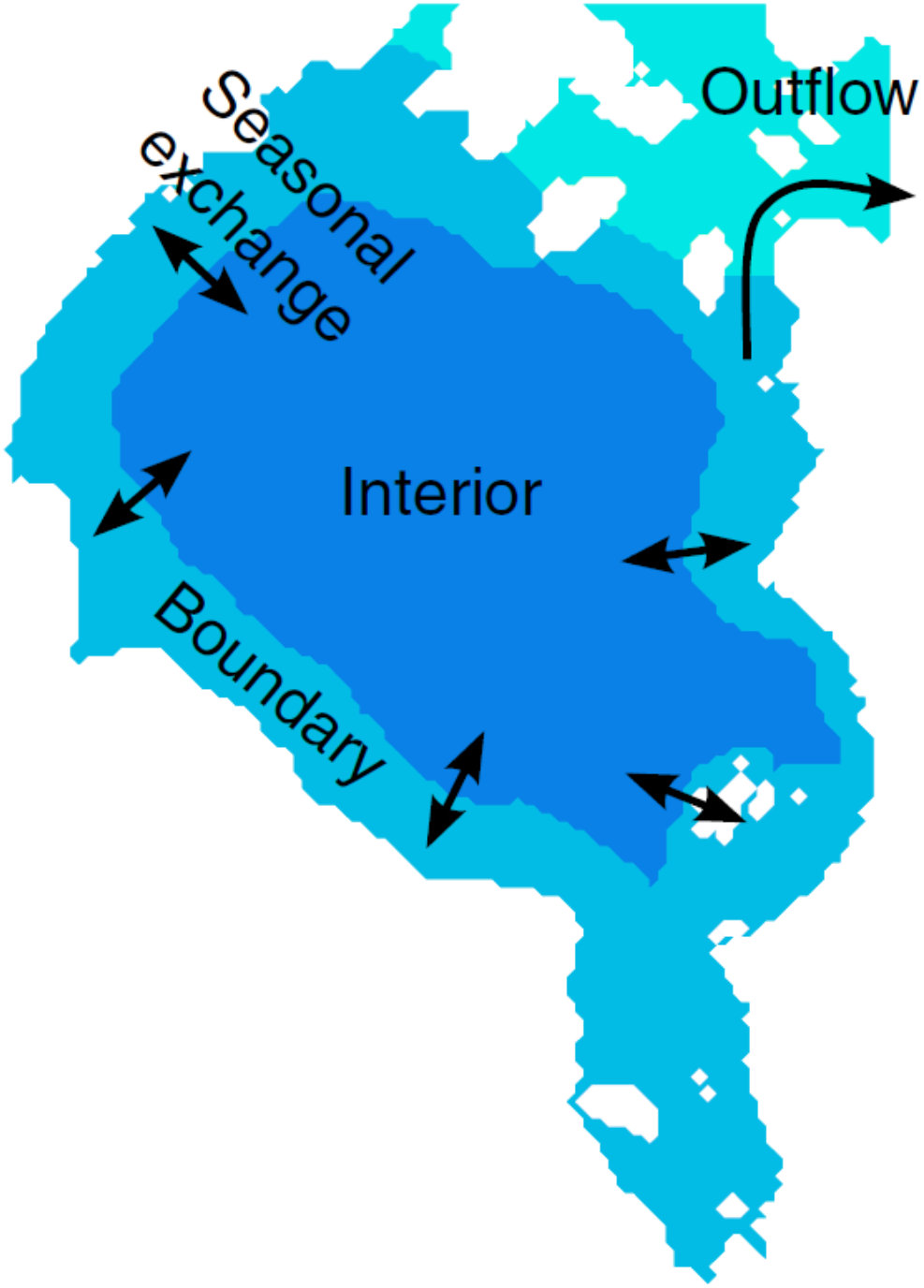


Mean =
92.0 km^3 yr^{-1}

S.D. =
19.0 km^3 yr^{-1}

Annual cycle of Nelson River Discharge



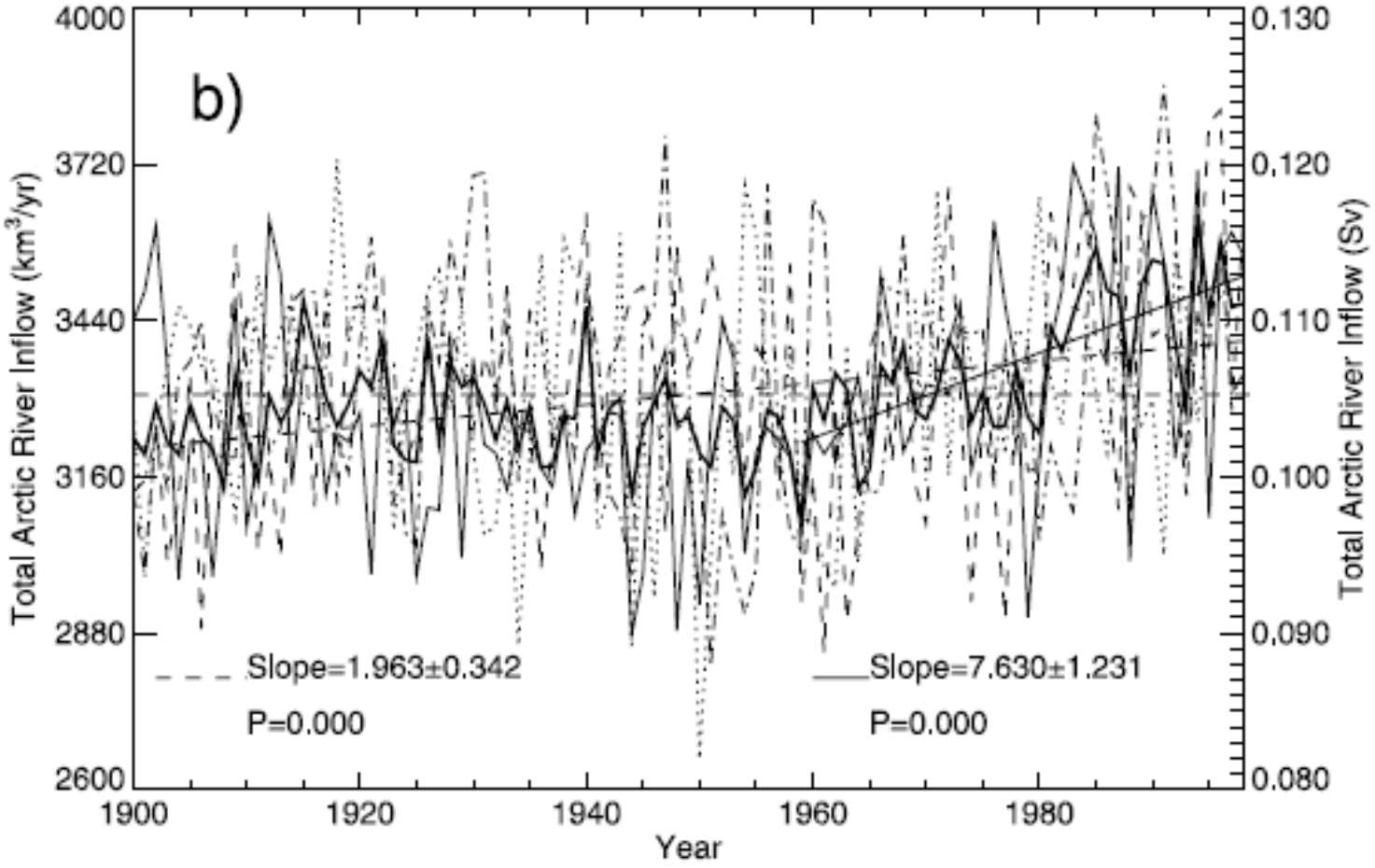


The fate of the river waters of Hudson Bay

St-Laurent et al. 2011

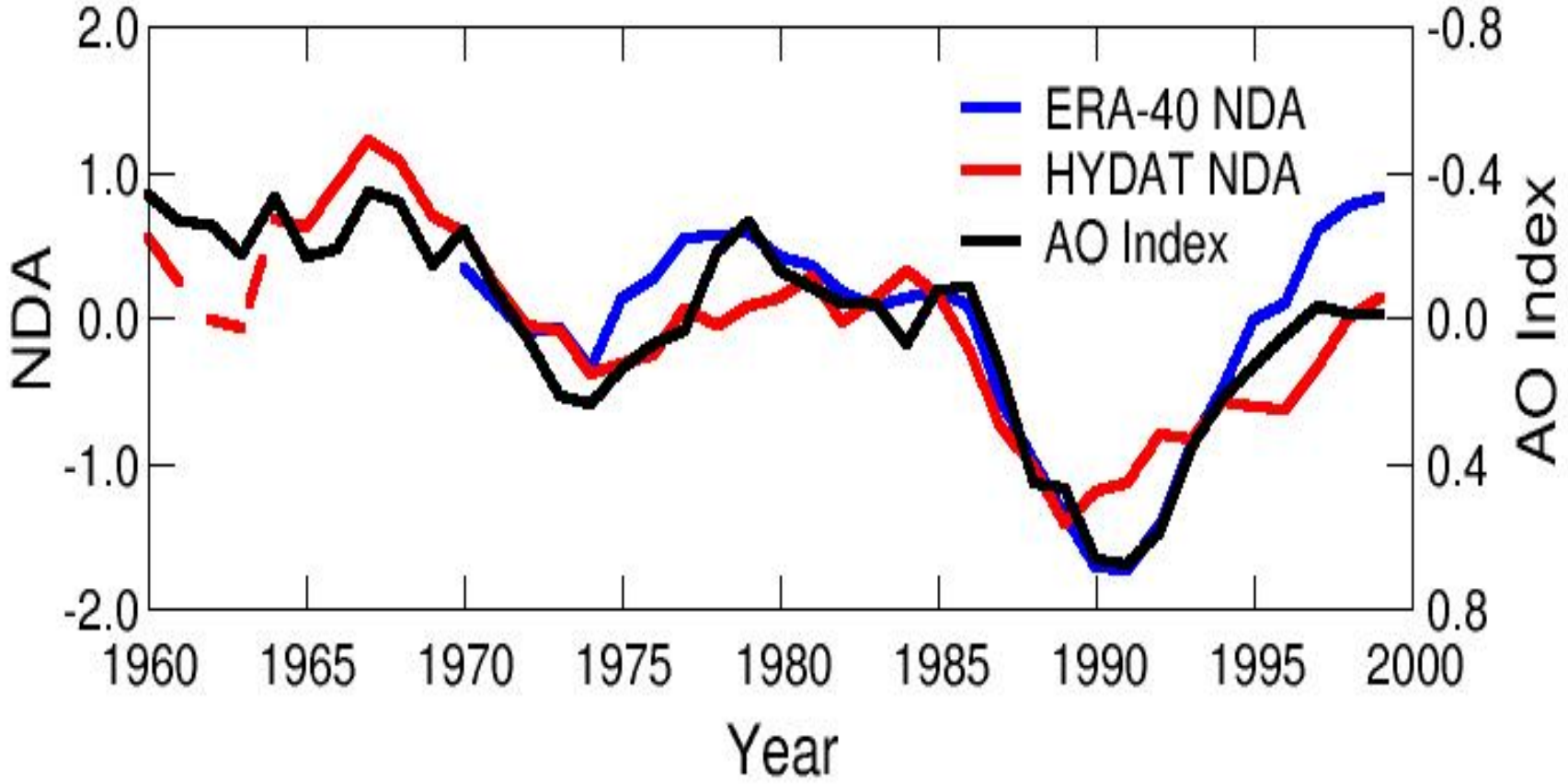
Attributing & Implications of Change

Anthropogenic influences



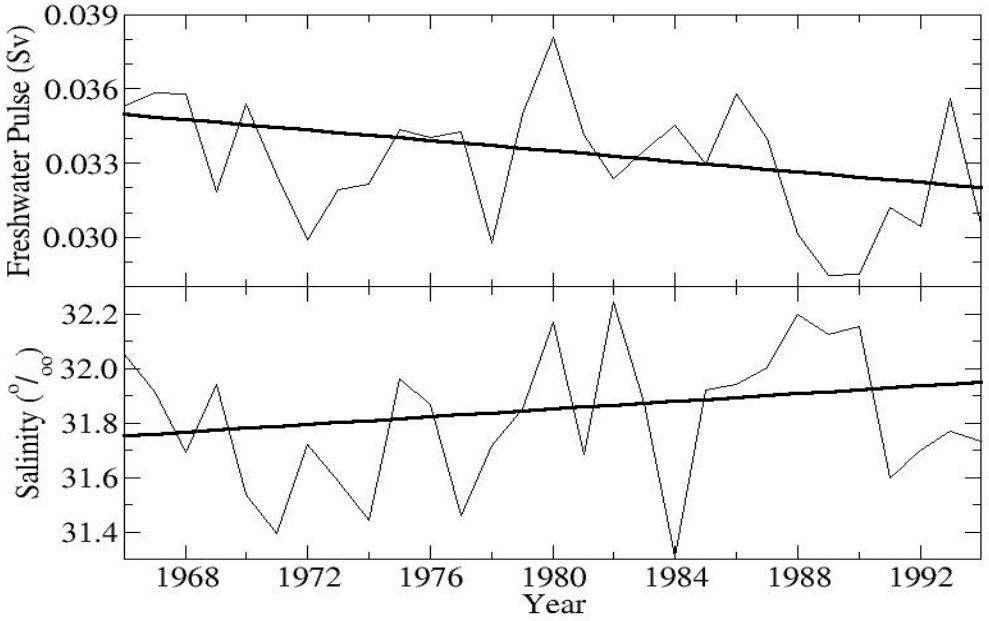
Source: Wu et al. (2005), GRL.

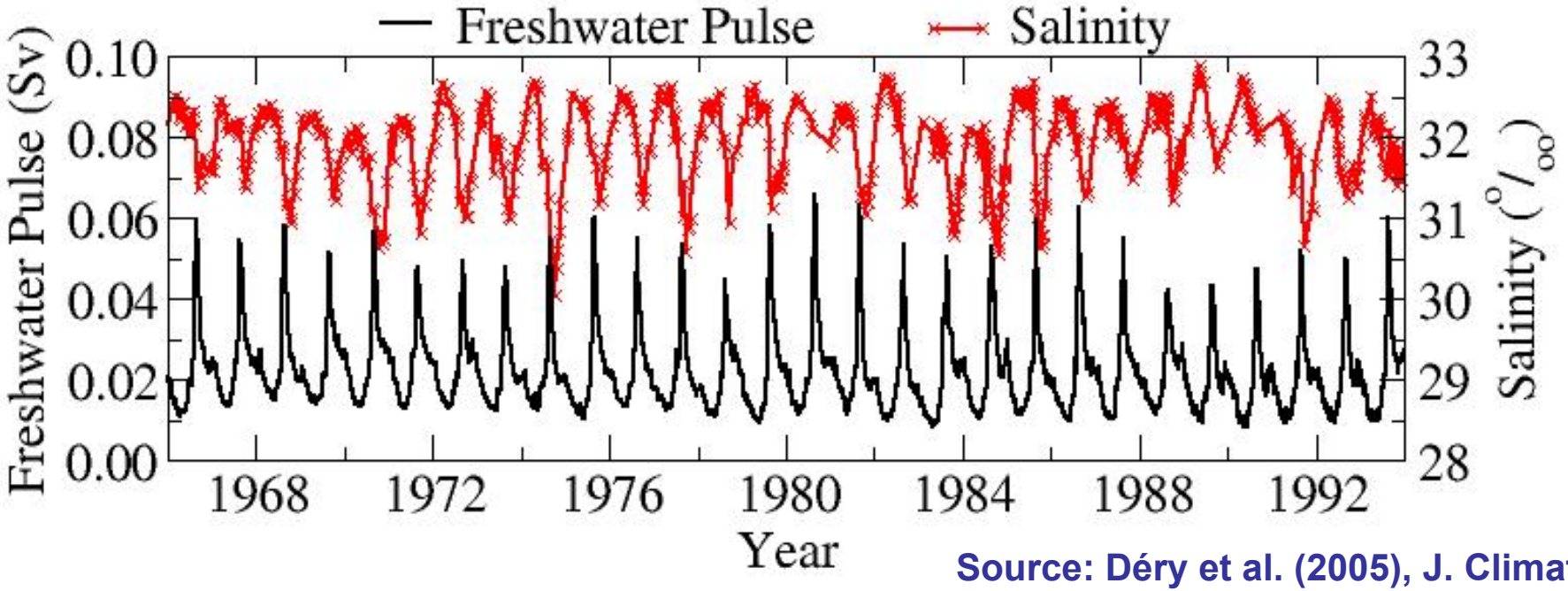
Teleconnection between the Arctic Oscillation & HJUB river discharge



Source: Déry and Wood (2004), GRL.

HJUB Freshwater Pulse and Surface Salinity near St. John's, Newfoundland

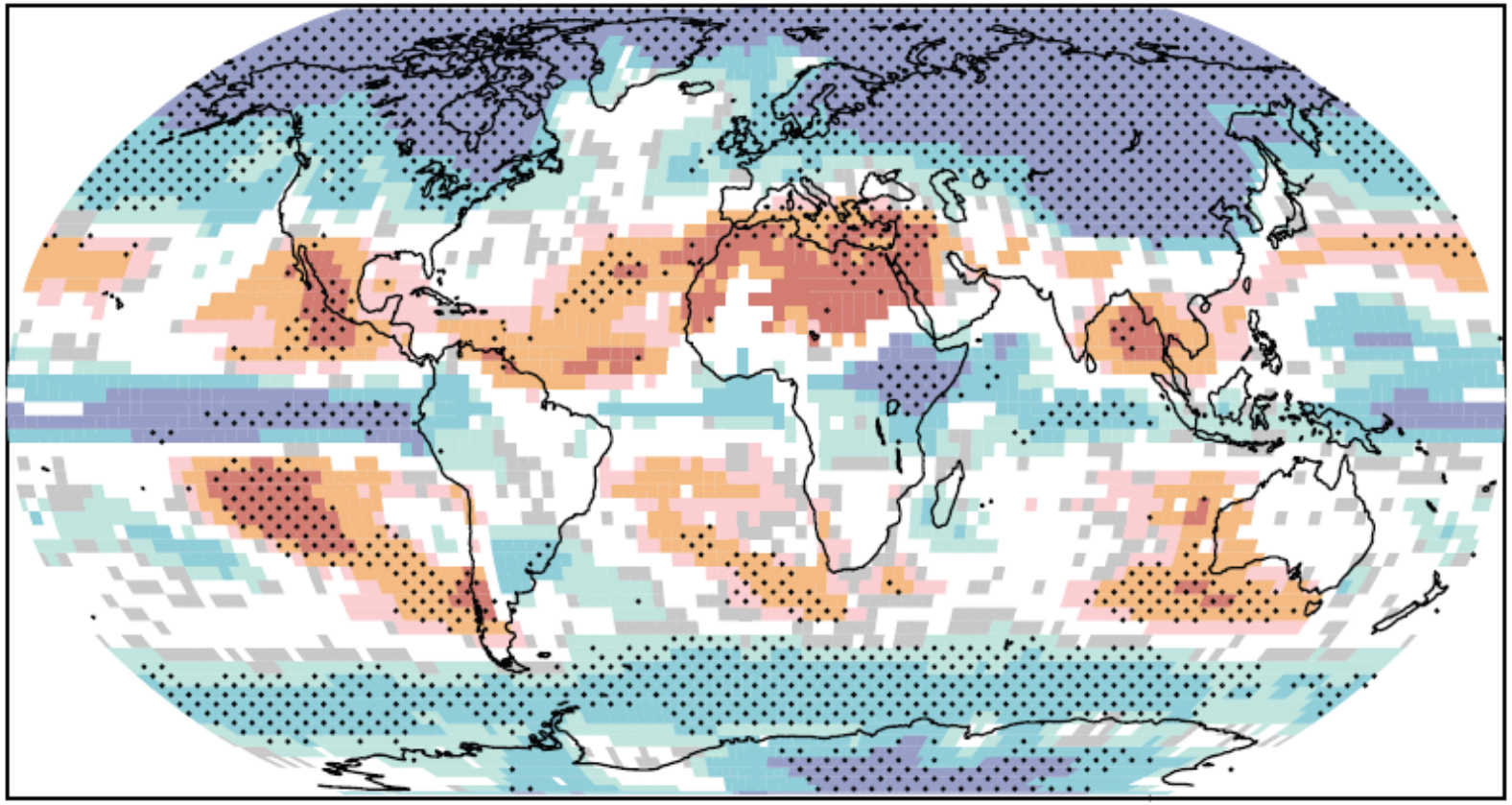


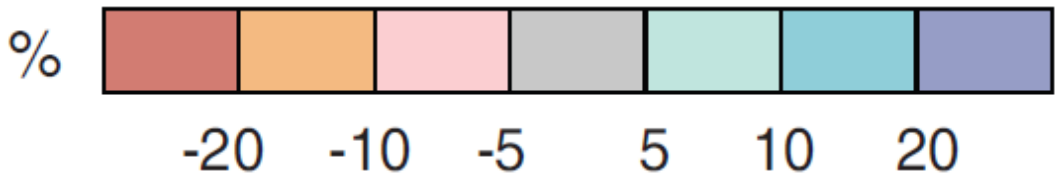


Source: Déry et al. (2005), J. Climate.

Projections for the future

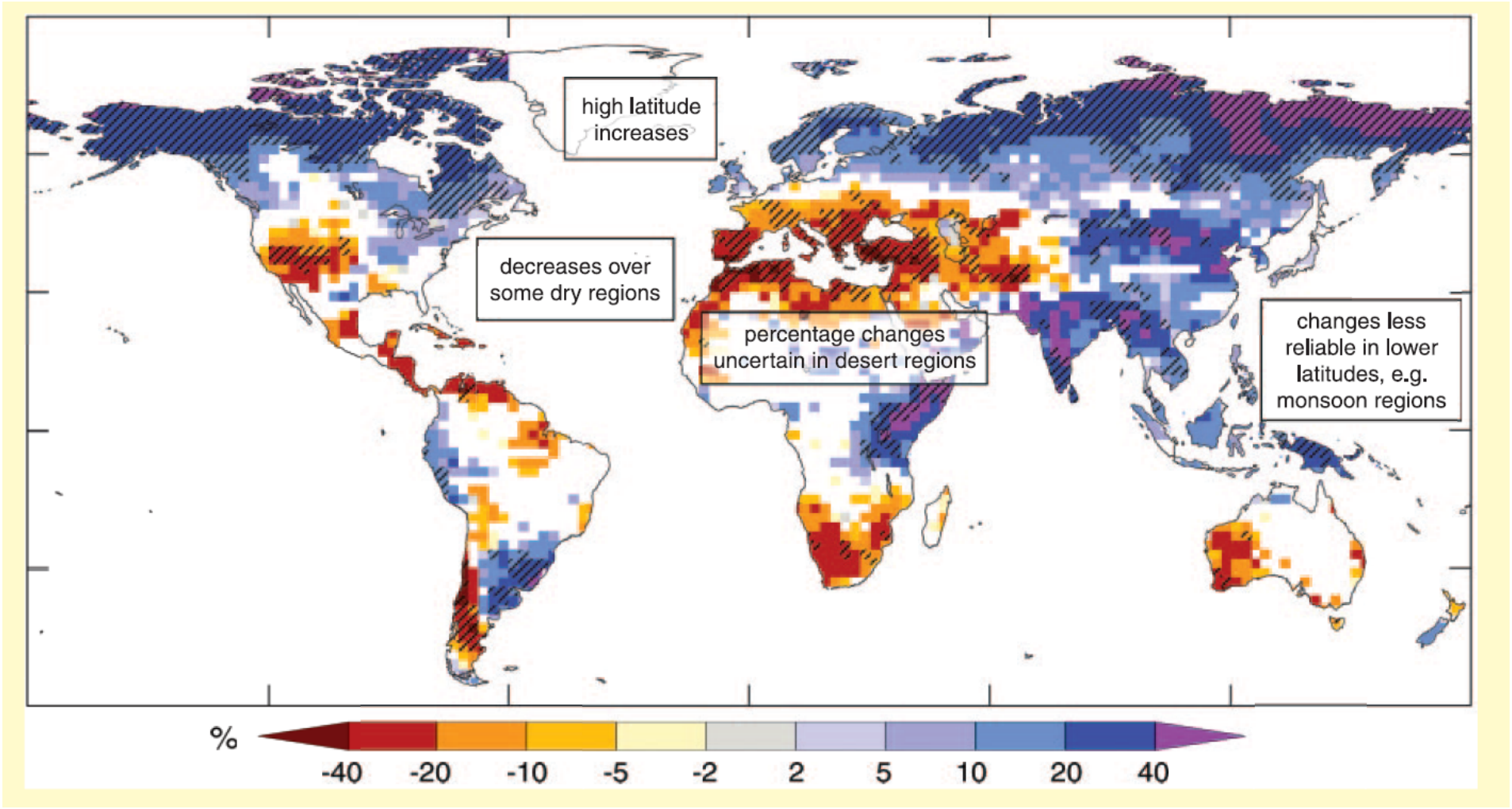
Multimodel projections of changes in DJF precipitation





Multi-model ensemble of A1B scenario, 2090's minus 1980's/1990's (IPCC AR4)

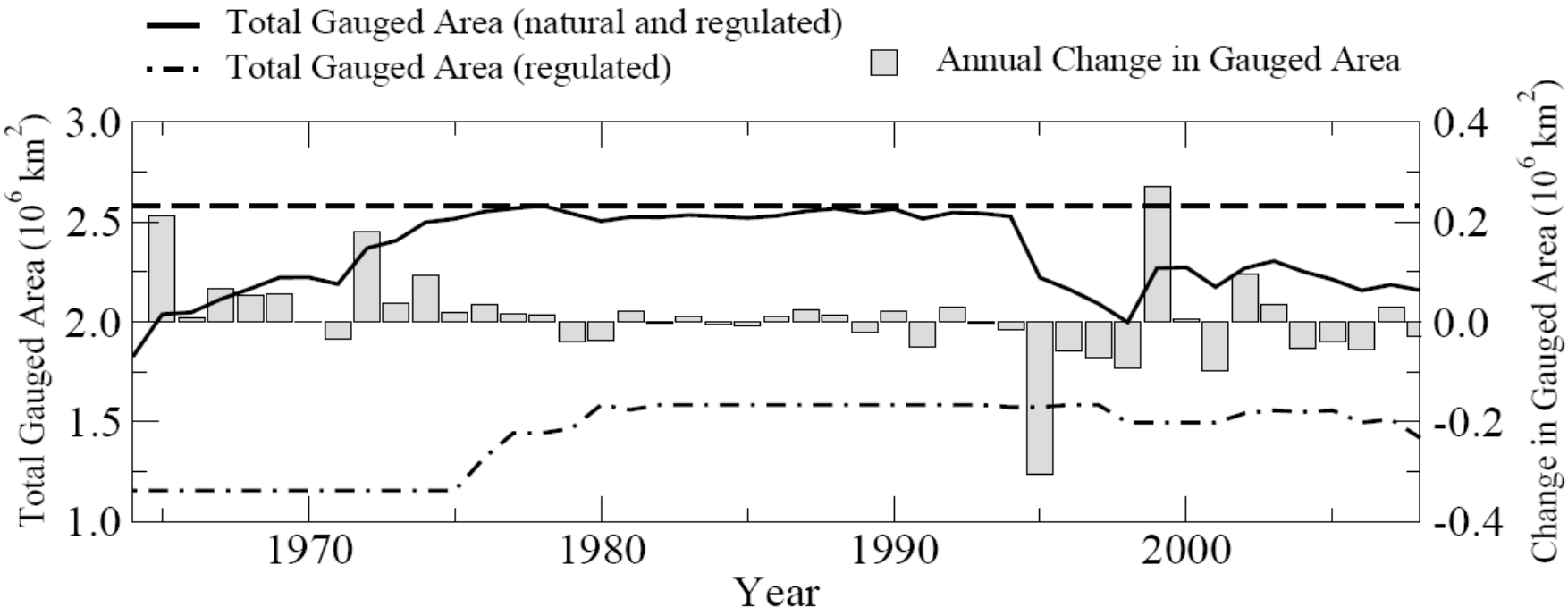
Multimodel projections of changes in annual runoff



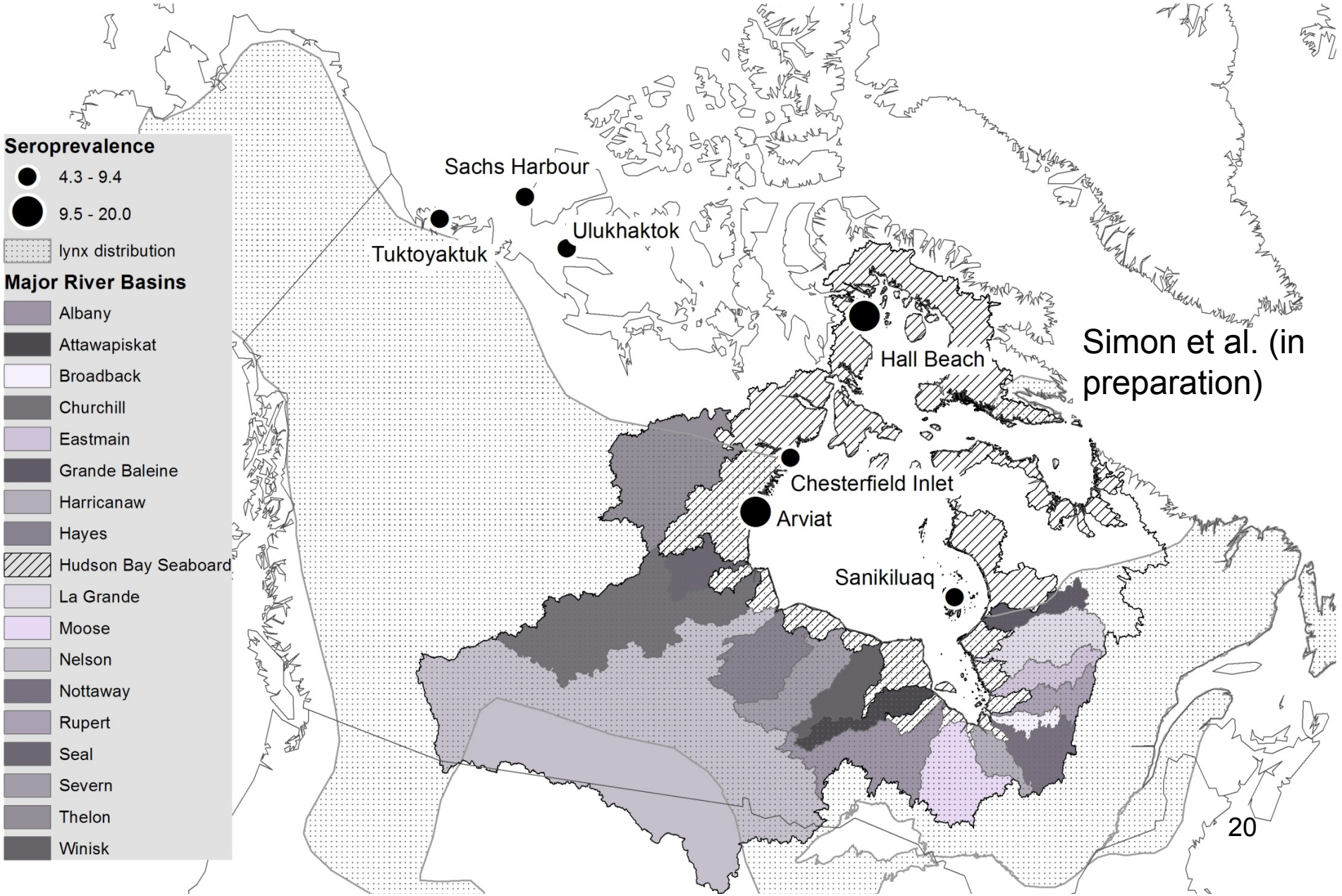
Multi-model ensemble of A1B scenario, 2090's minus 1980's/1990's (IPCC AR4)

Challenges, research needs & key knowledge gaps

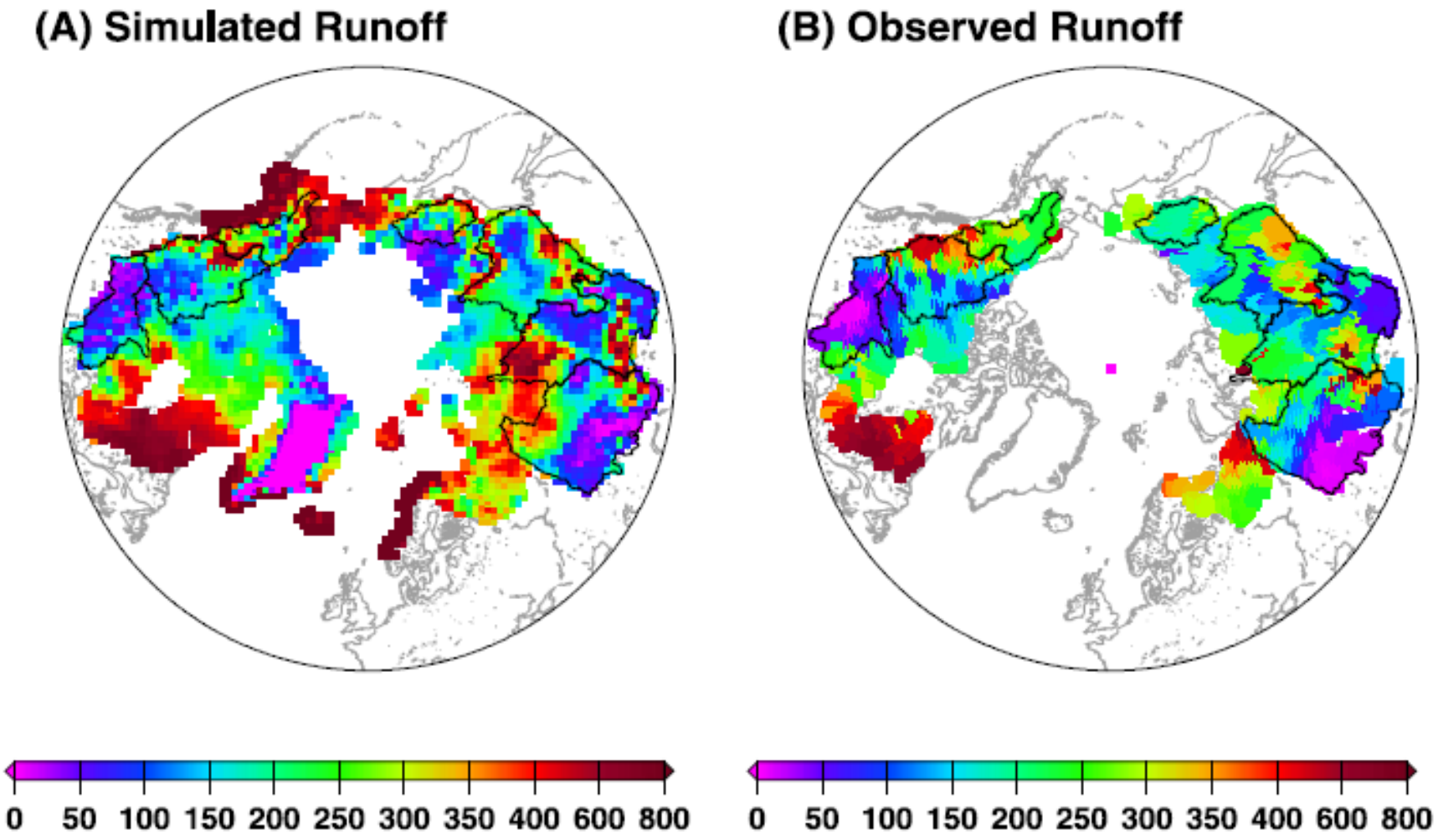
Hydrometric network in decline



Ungauged areas & access to data



Numerical modeling



mm/yr

Source: Su et al. (2005)

mm/yr

Research Needs

- Collecting accurate records of Arctic river discharge, sediment loads, proxy records, chemistry, precipitation, etc.
- Combining remote sensing, numerical modeling & observations to better quantify Hudson Bay streamflow
- Understanding the changing role of pan-Arctic teleconnections.
- Establishing possible physical, biological, ecological & societal impacts of change

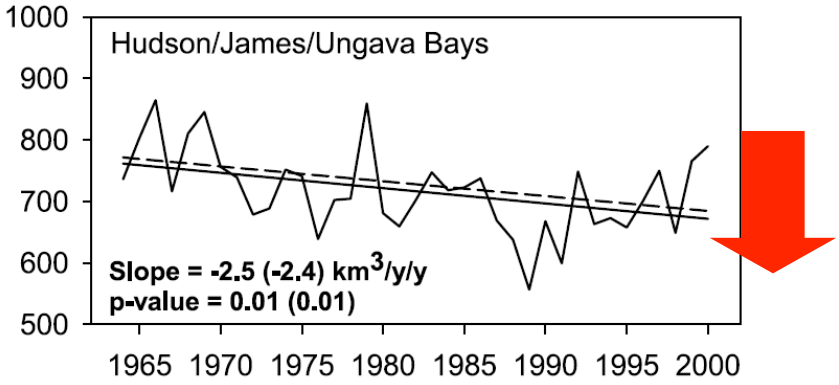
Key knowledge gaps

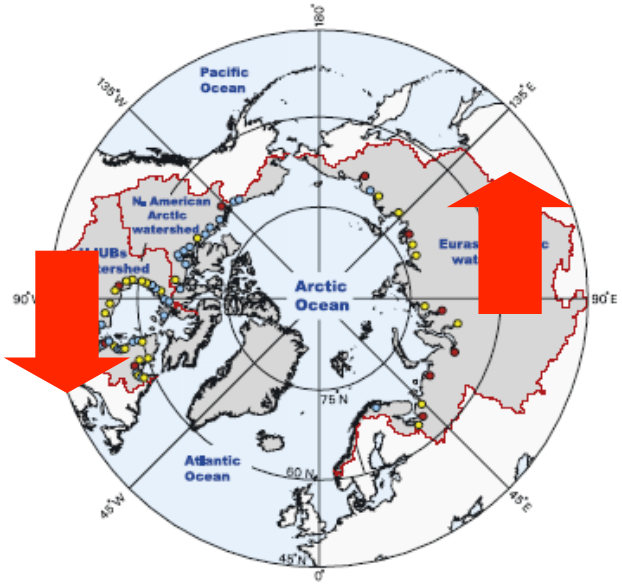
- What are the roles of anthropogenic disturbances & climate on Hudson Bay freshwater fluxes & stocks?
- What are the contributions of ungauged basins to the Hudson Bay freshwater budget?
- What are the prospects for the future?
- What are the regional & global impacts of a changing Hudson Bay freshwater budget?

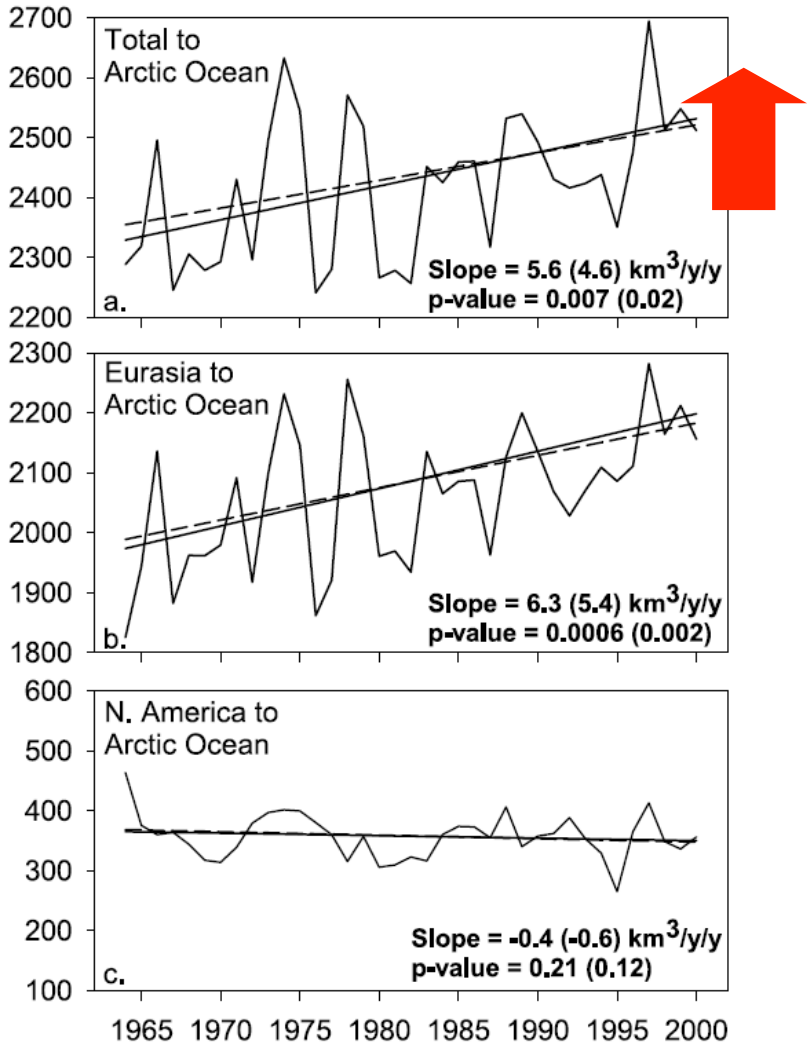
Acknowledgements

- Workshop organizers & participants
- NSERC, UNBC, Environment Canada for funding

Observed 20th century changes in Arctic river discharge

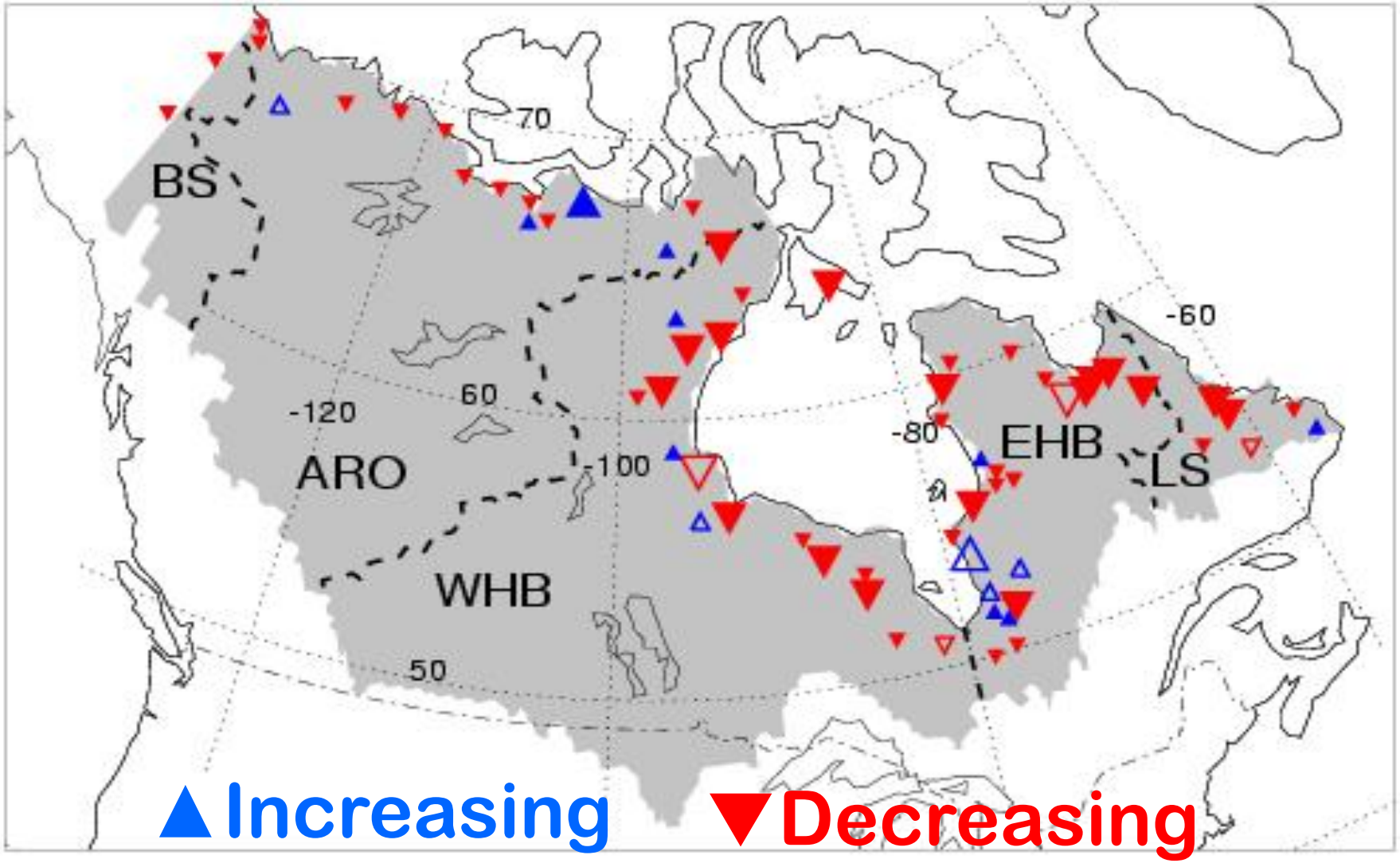






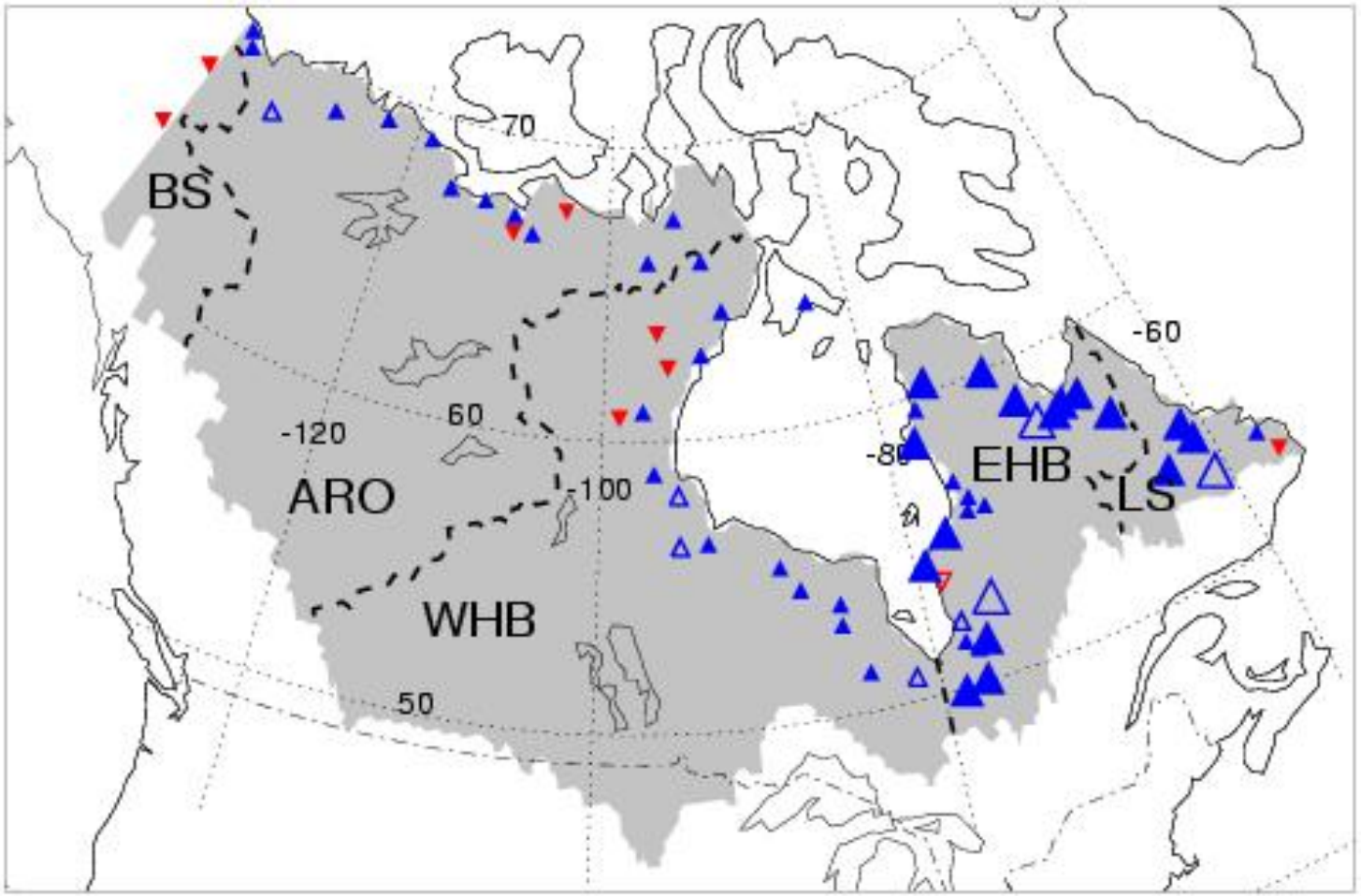
Source: McClelland et al. (2006), GRL.

Decreasing river discharge in northern Canada, 1964-2003



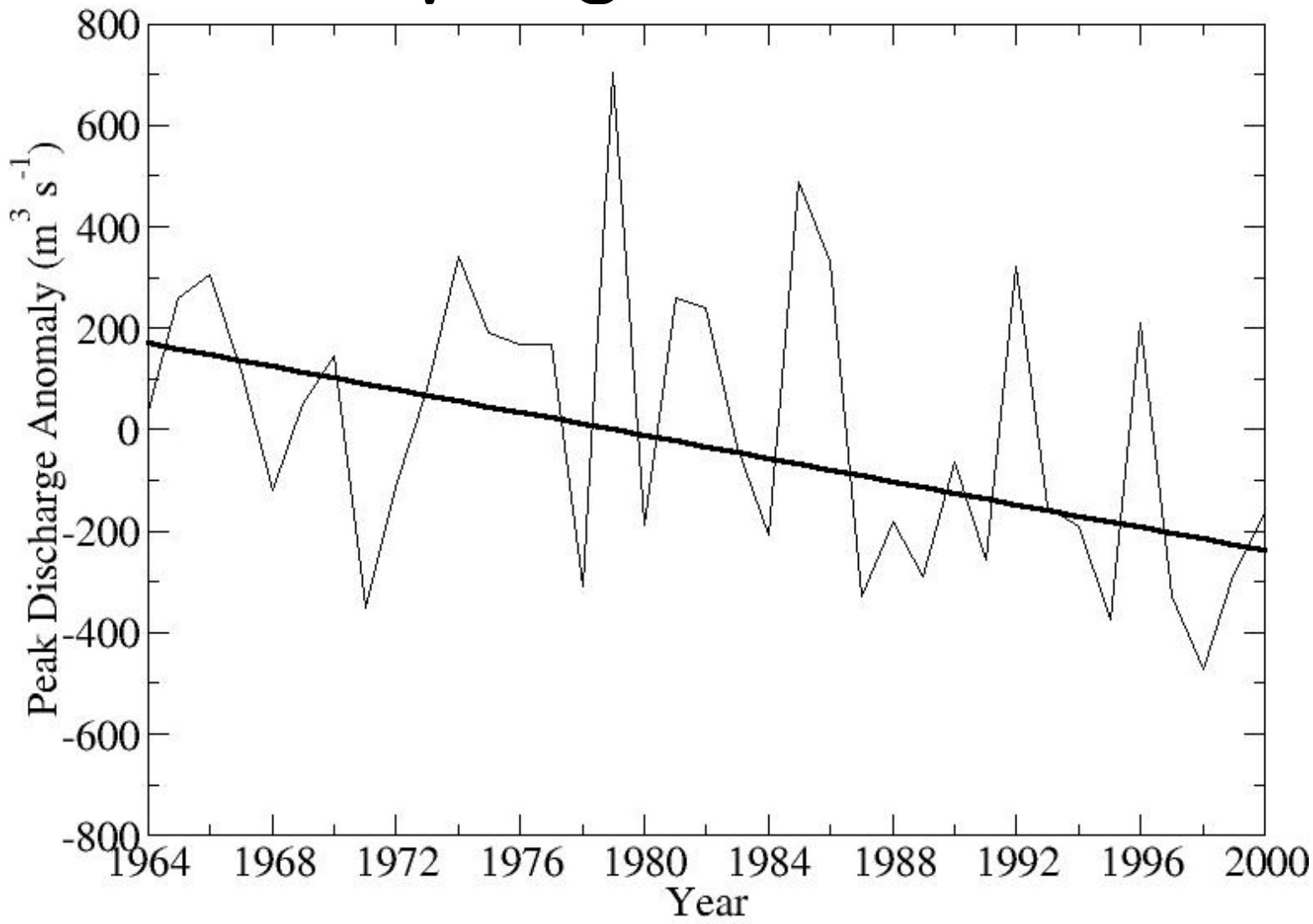
Source: Déry and Wood (2005), GRL.

Teleconnection between Eurasian snowcover extent & river discharge in northern Canada



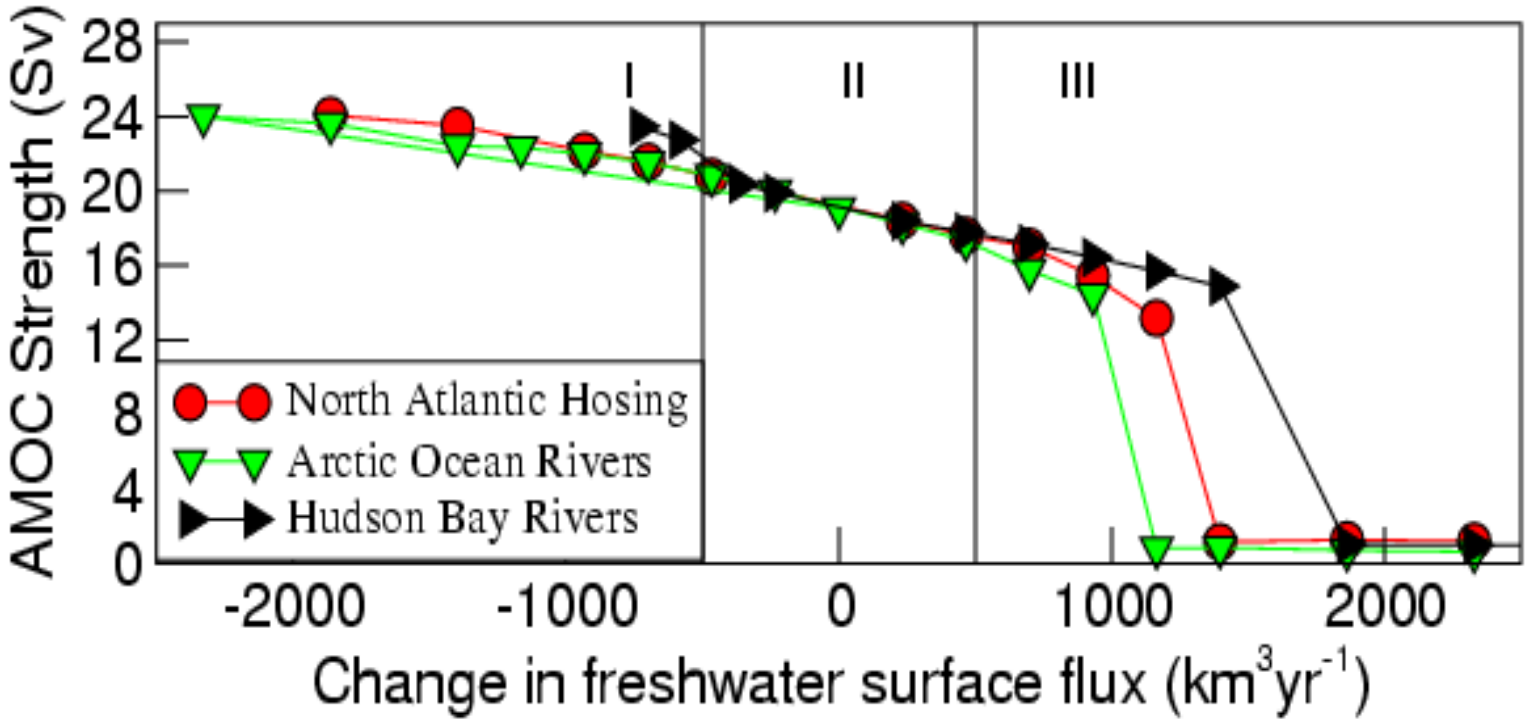
Source: Déry et al. (2005), JGR.

Trends in Date & Intensity of HJUB Spring Freshets



Source: Déry et al. (2005), J. Climate.

Changing Arctic rivers & the Atlantic Meridional Overturning Circulation (AMOC)



Source: Rennermalm et al. (2007), JGR.