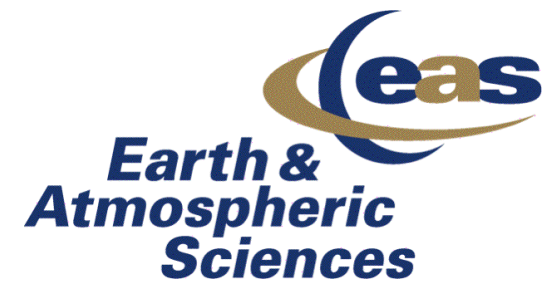




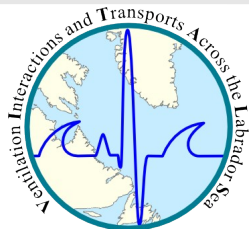
UNIVERSITY OF
ALBERTA



NEMO Simulation in UA

Xianmin Hu (xianmin@ualberta.ca)

UBC, Vancouver, BC, Jan 23th, 2015

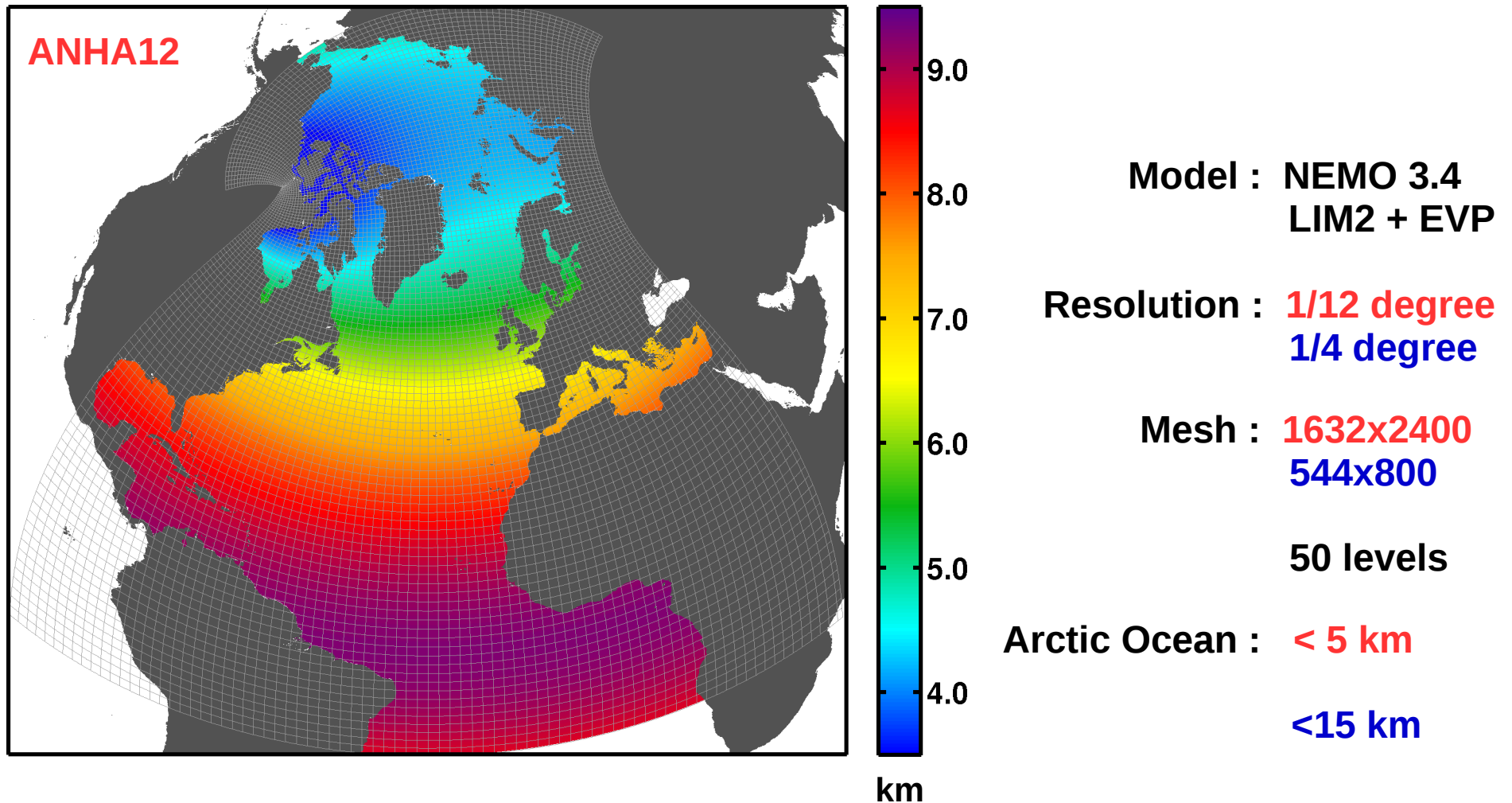


People. Discovery. Innovation.

NEMO Simulation in UA

- **ANHA configuration**
- **Validation of simulated ice thickness**
- **Updates in the forcing fields & simulation plan**

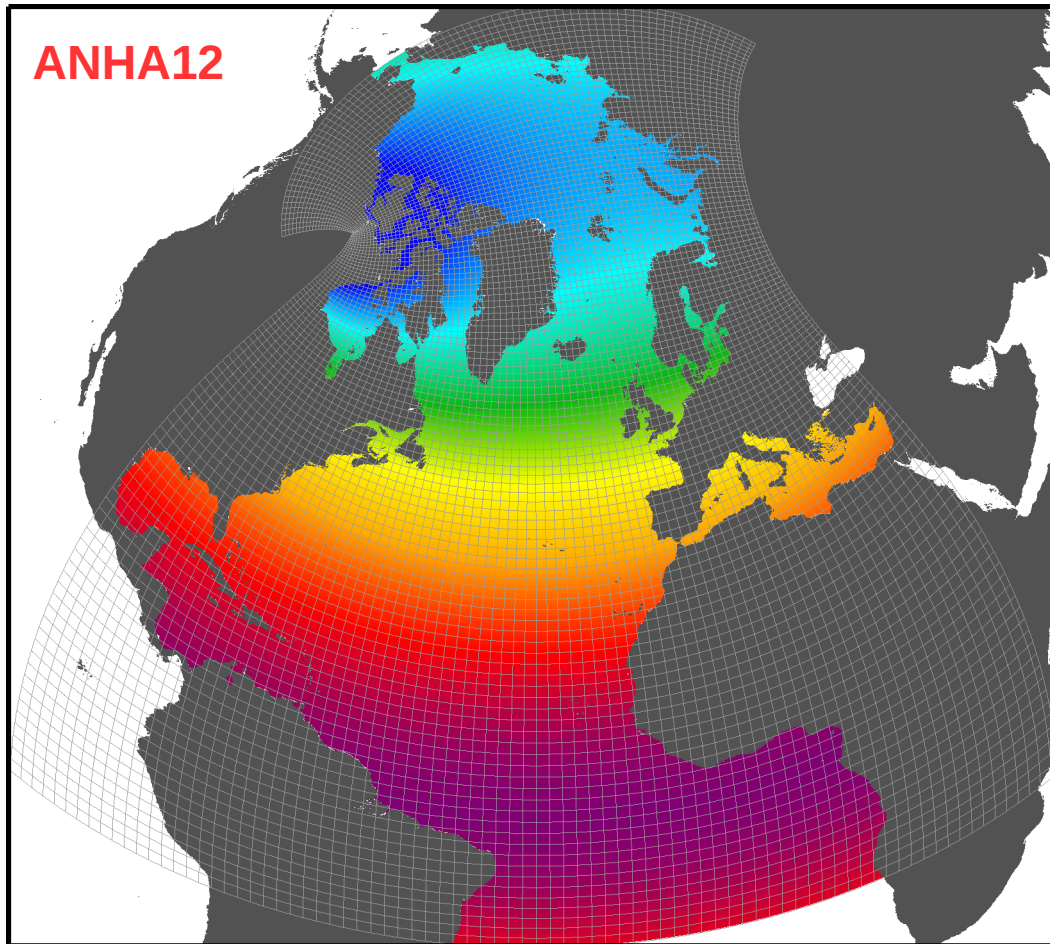
Model Configuration



ANHA: Arctic and Northern Hemisphere Atlantic

ANHA12 & ANHA4

Experiment Setup



Initialization:

3D T, S, U and V (GLORYS1v1, Jan02)
Sea Ice

Atmospheric forcing:

T2, Q2, U10, V10
Precipitation
Radiation (SW & LW)

CGRF
hourly
33km

Snow: CORE2 (IA)

Runoff: Dai and Trenberth climatology

OBC:

U, V, T and S (GLORYS1v1)

NO temperature & salinity restoring

Jan 2002 – 2010

CGRF: CMC GDPS reforecasts

GDPS: Global Deterministic Prediction System

CMC: Canadian Meteorological Centre

GLORYS: GLObal Ocean ReanalYses and Simulations

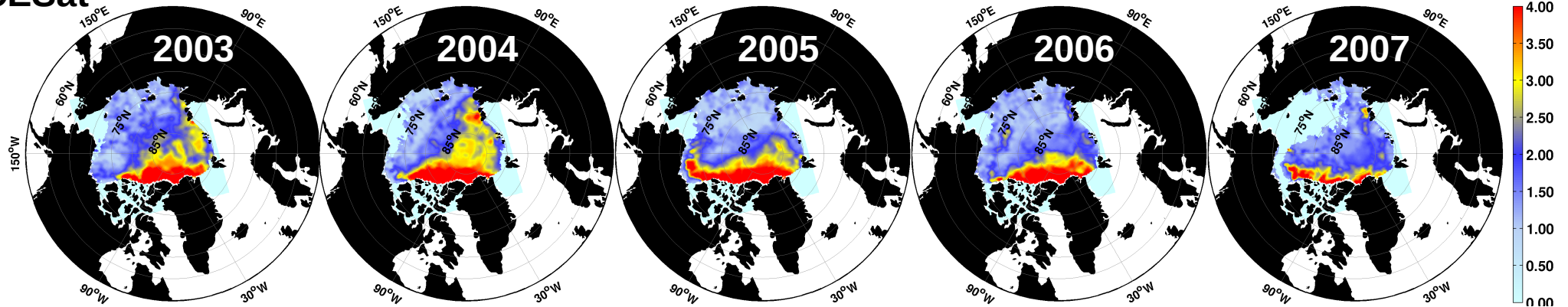
NEMO Simulation in UA

ANHA configuration

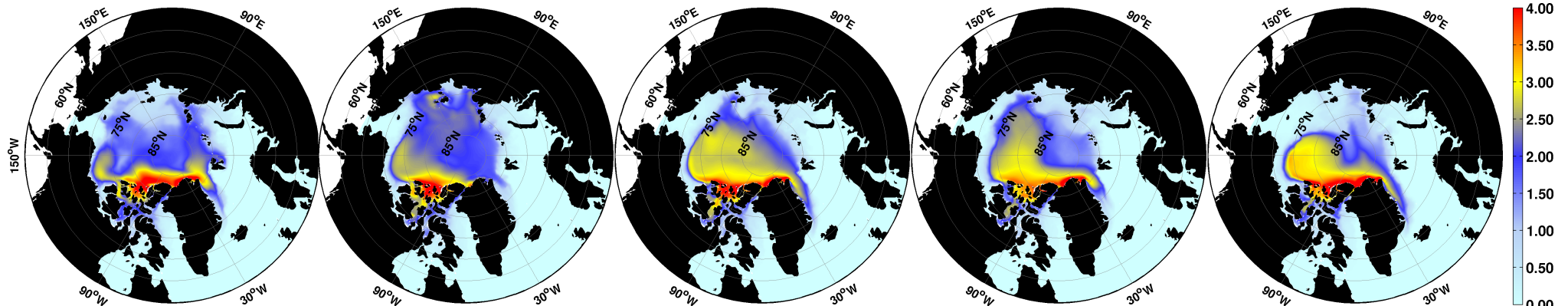
- **Validation of simulated ice thickness**
- Updates in the forcing fields & simulation plan

Autumn (Oct -- Nov) Ice Thickness

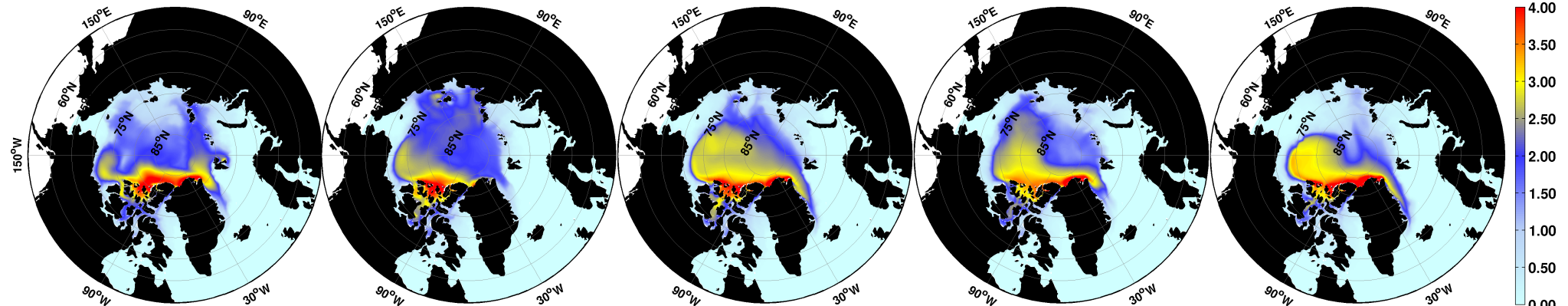
ICESat



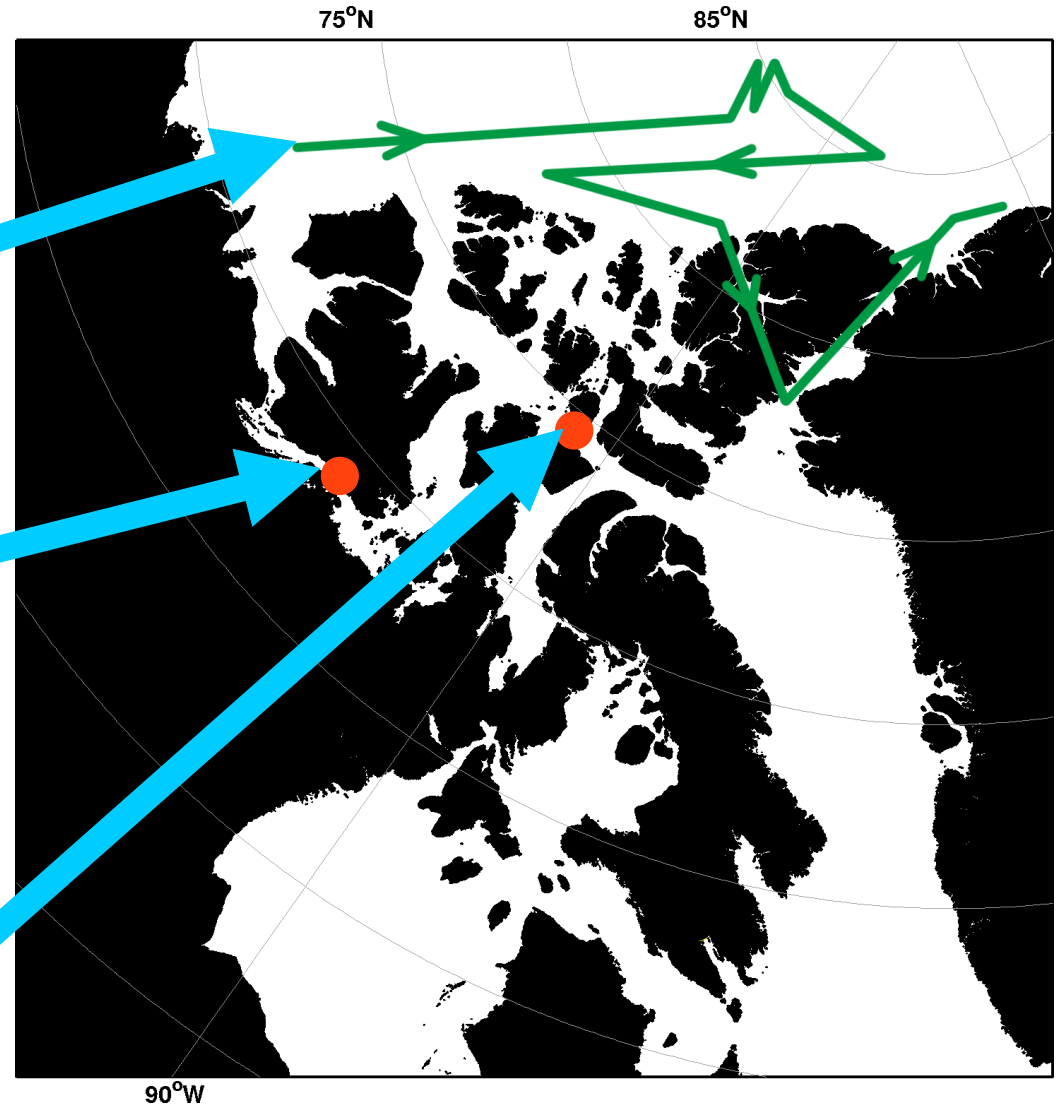
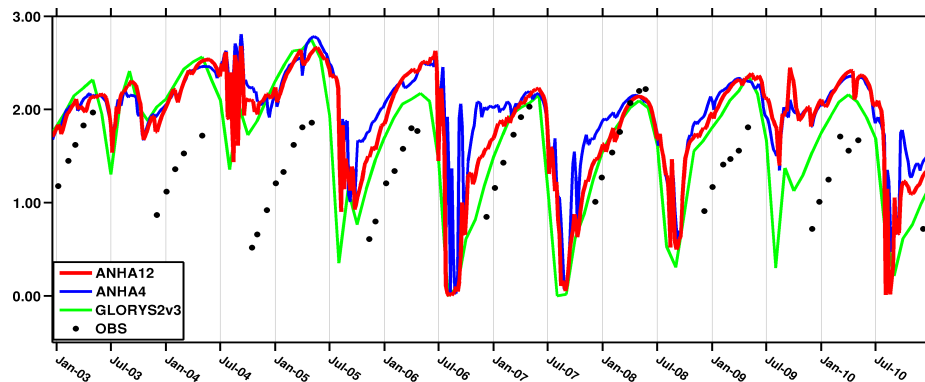
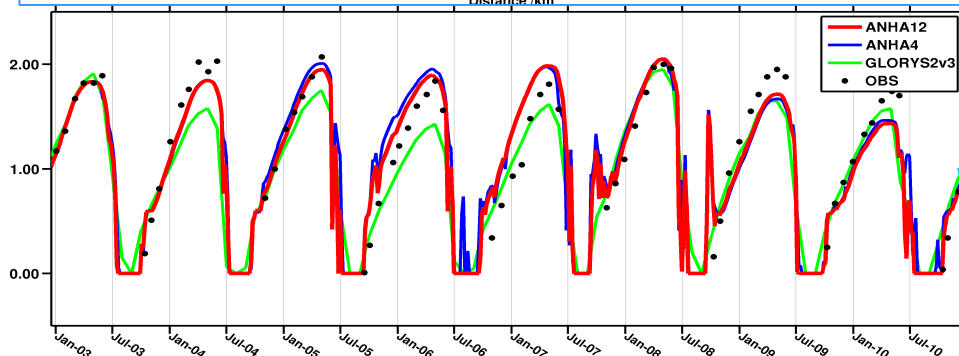
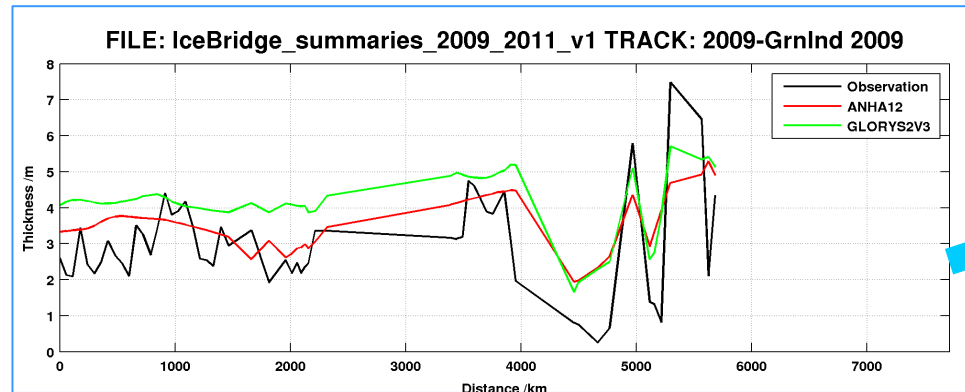
ANHA12



ANHA4



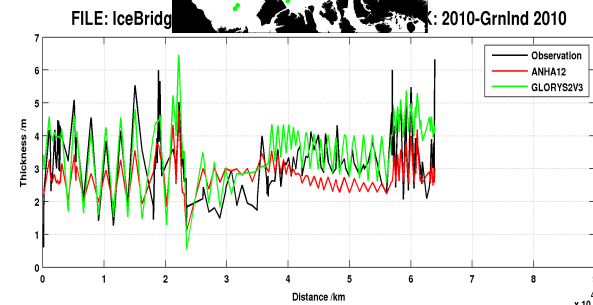
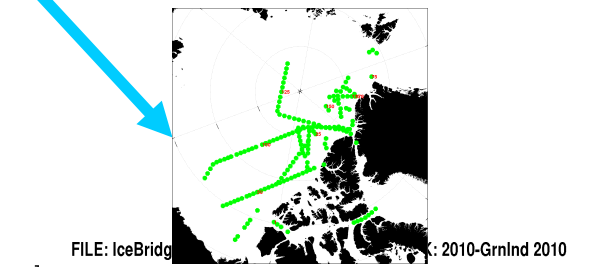
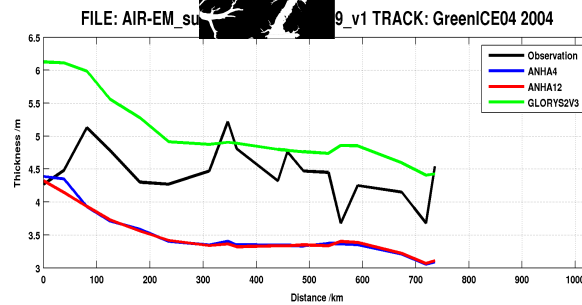
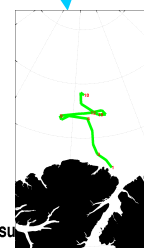
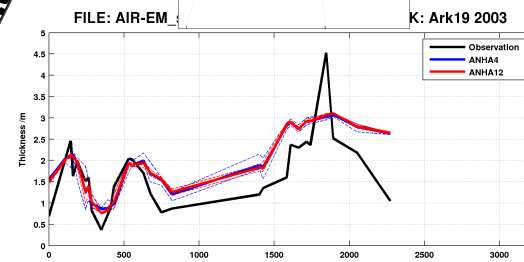
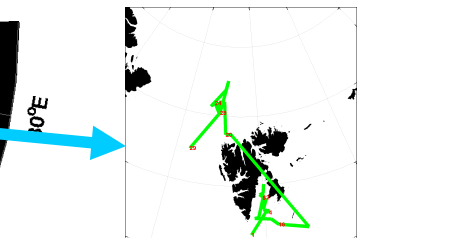
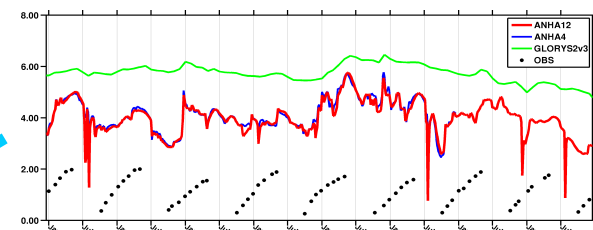
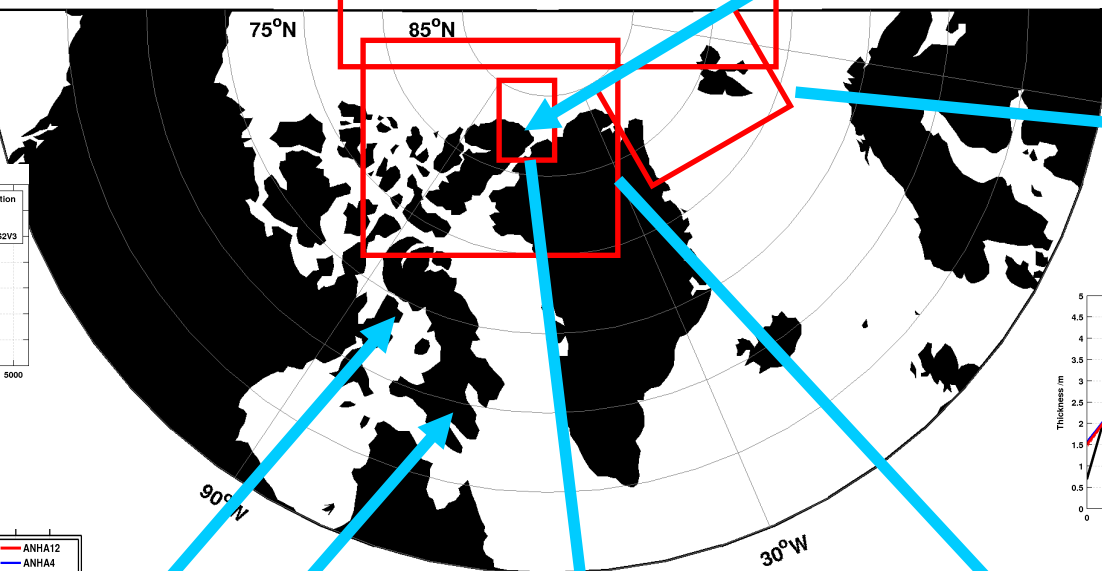
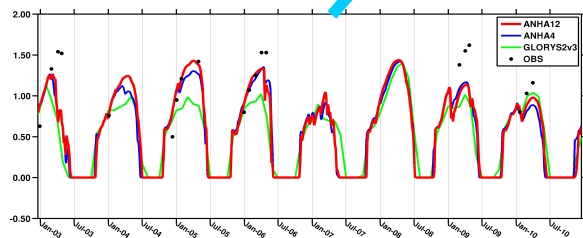
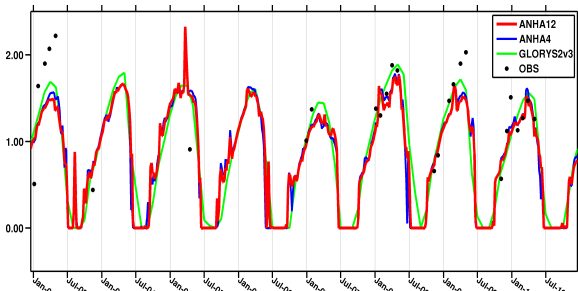
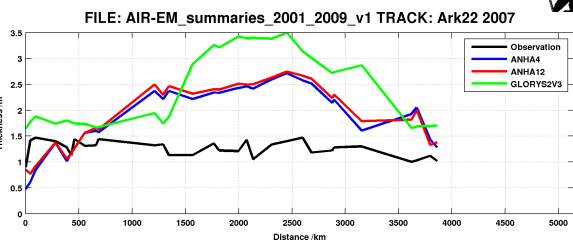
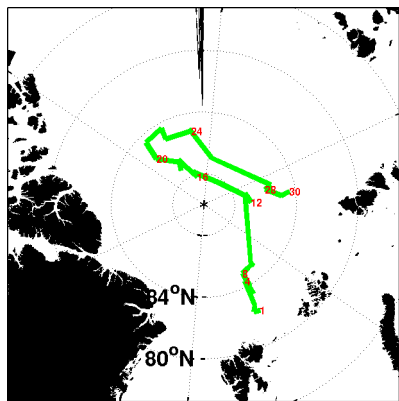
Airborne Electromagnetic & Upward Looking Sonar Data



BLACK: observation

RED: ANHA12

BLUE: ANHA4



BLACK: observation

RED: ANHA12

BLUE: ANHA4

Thermodynamic and Dynamic Ice Thickness Changes

$$\Delta H = \Delta H_{thermal} + \Delta H_{dynamic}$$

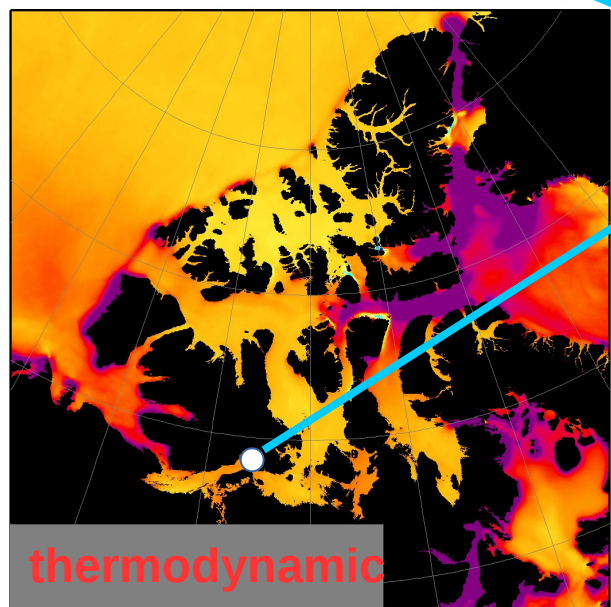
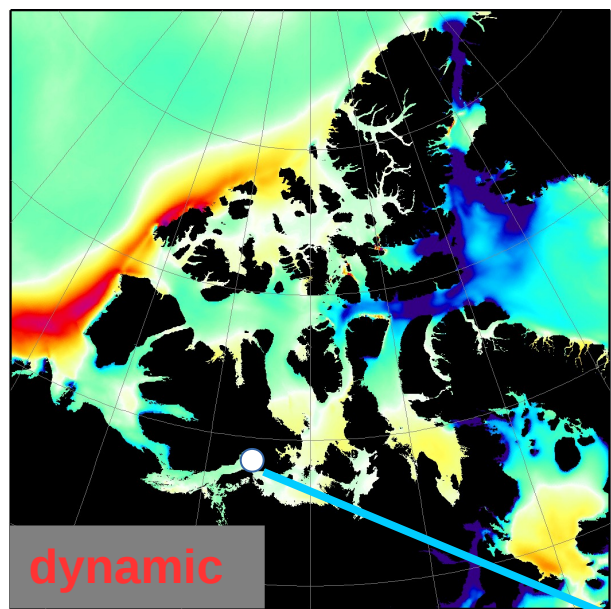
total changes

due to “ice production”
(vertical thermal processes)

remaining part
(lateral processes)

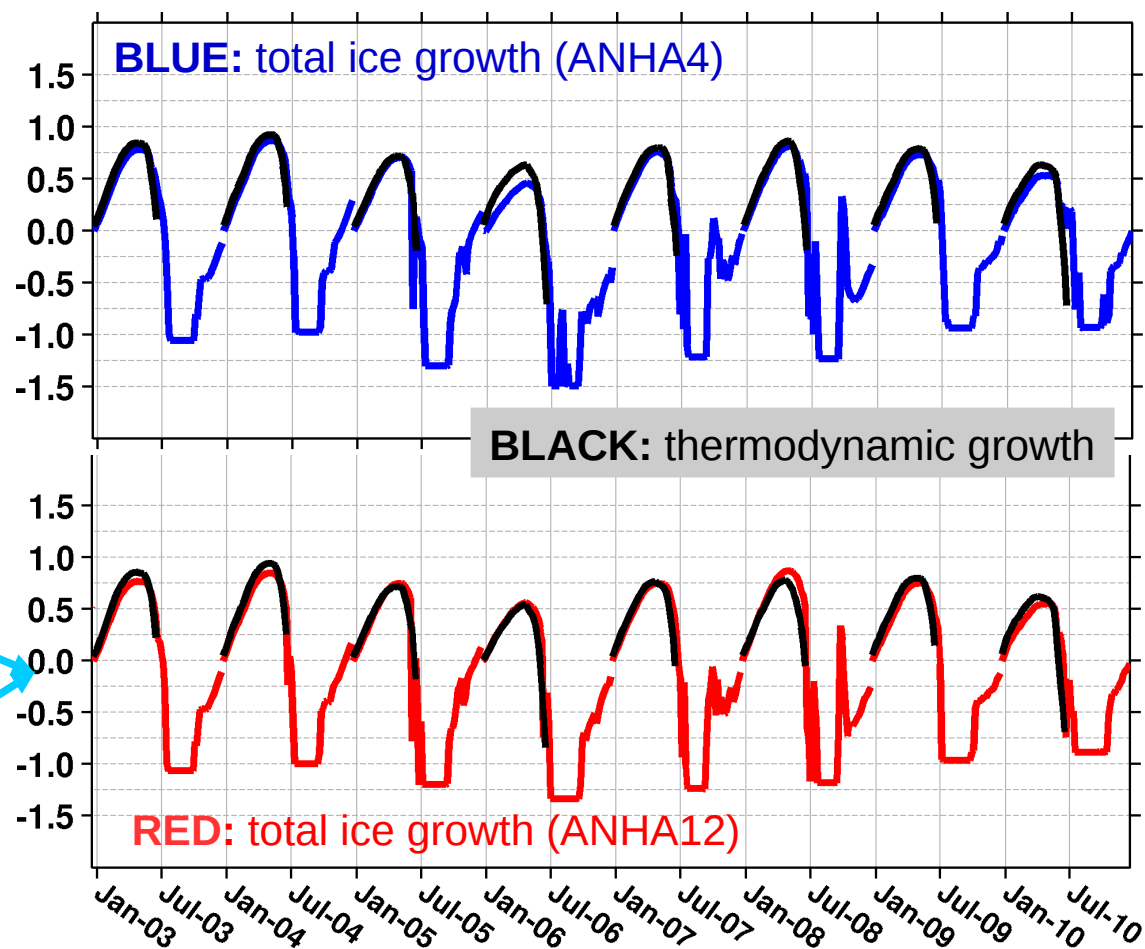
note: they are not actually decoupled

Ice Growth in Cambridge Bay



120°W 110°W 100°W 90°W 80°W

2003-2008 (Jan-Mar, ANHA12)



- mainly thermodynamic (first half year)
- more dynamic in autumn (or just local circulation)

NEMO Simulation in UA

ANHA configuration

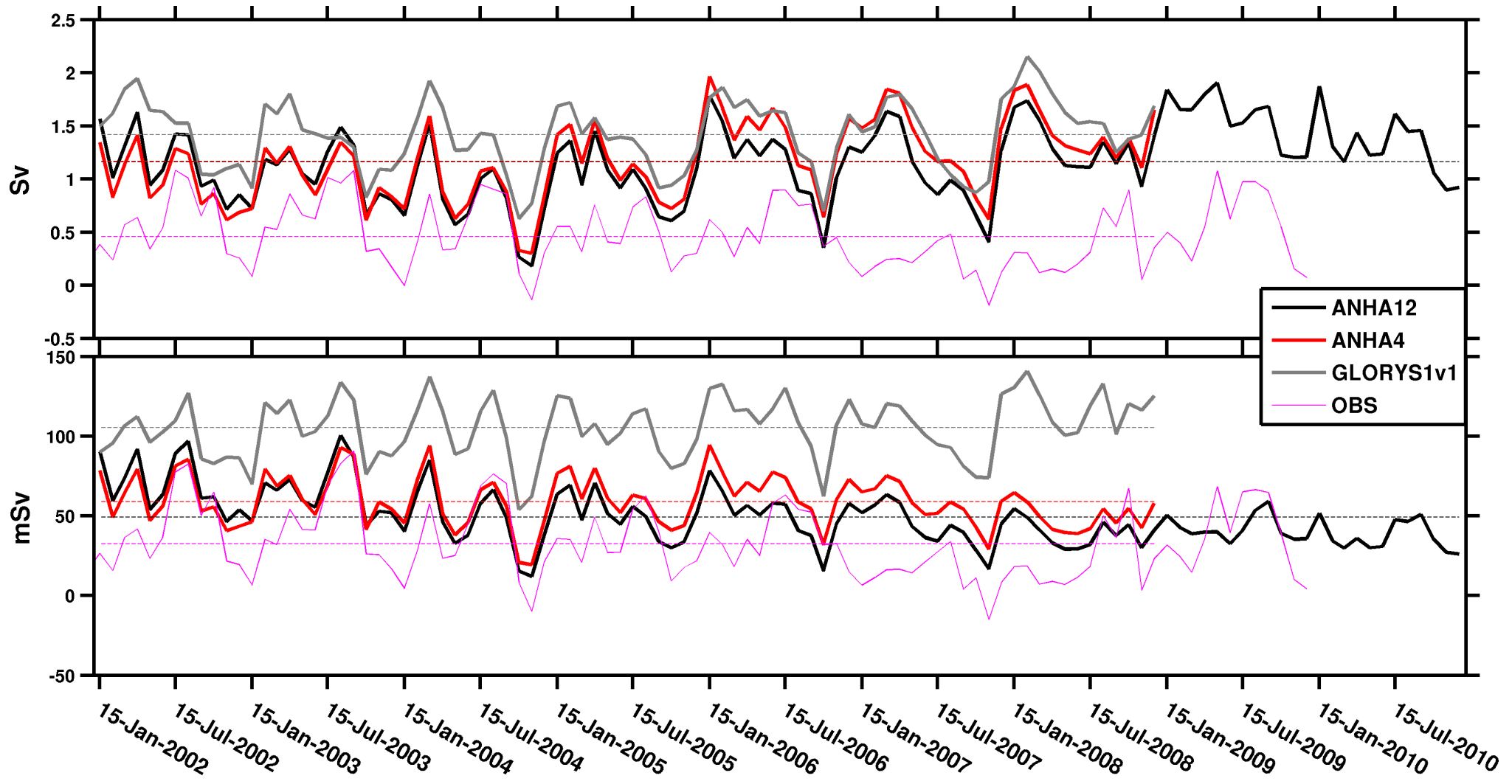
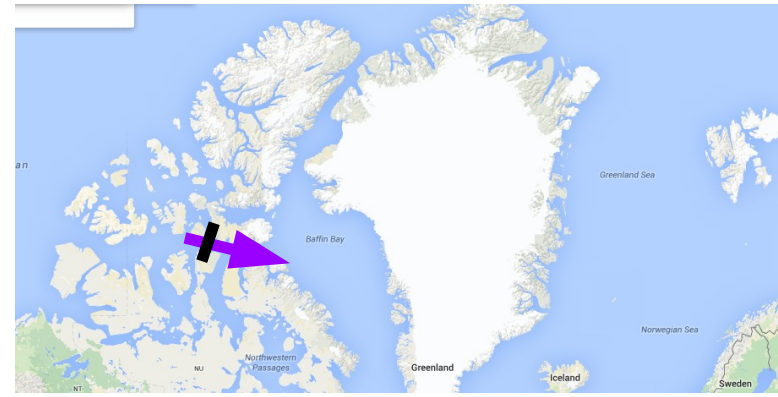
Validation of simulated ice thickness

- **Updates in the forcing fields & simulation plan**

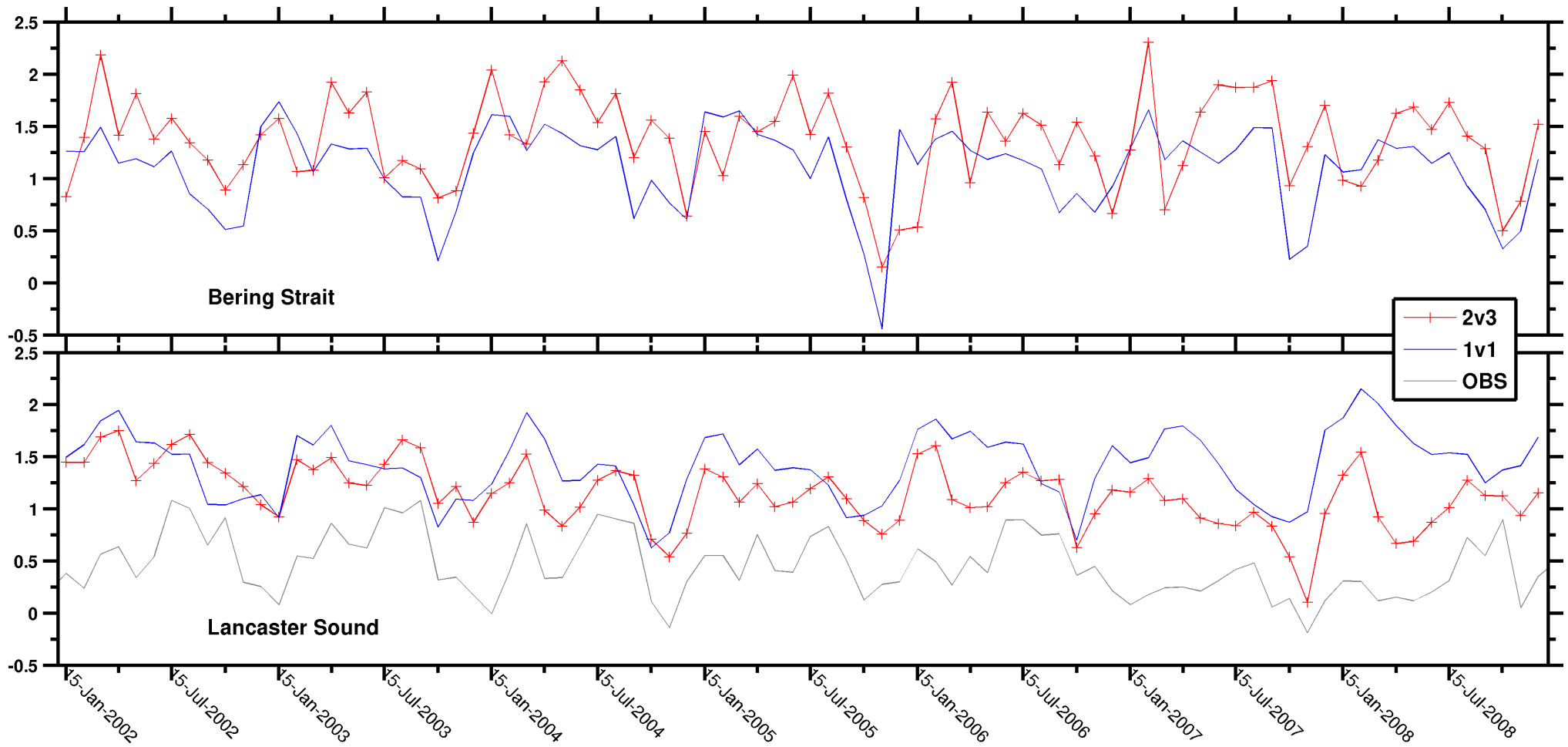
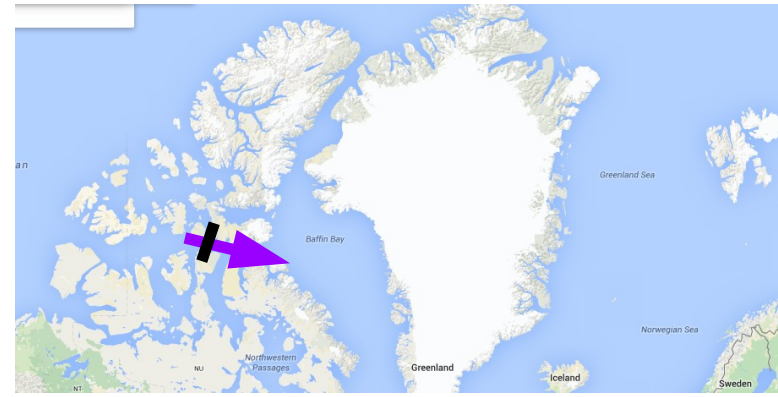
Updates in ANHA Forcings

- Atmospheric forcing
 - CGRF: extended to 2014
 - CORE-II: long hindcast simulation (1958-)
- Initial & open boundary conditions
 - switch GLORYS1-v2 to GLORYS2-v3
- Runoff
 - remap Dai & Trenberth climatology
 - included Greenland runoff from Jonathan Bamber
 - inter-annual runoff (since 1958)

Oceanic Fluxes through Lancaster Sound



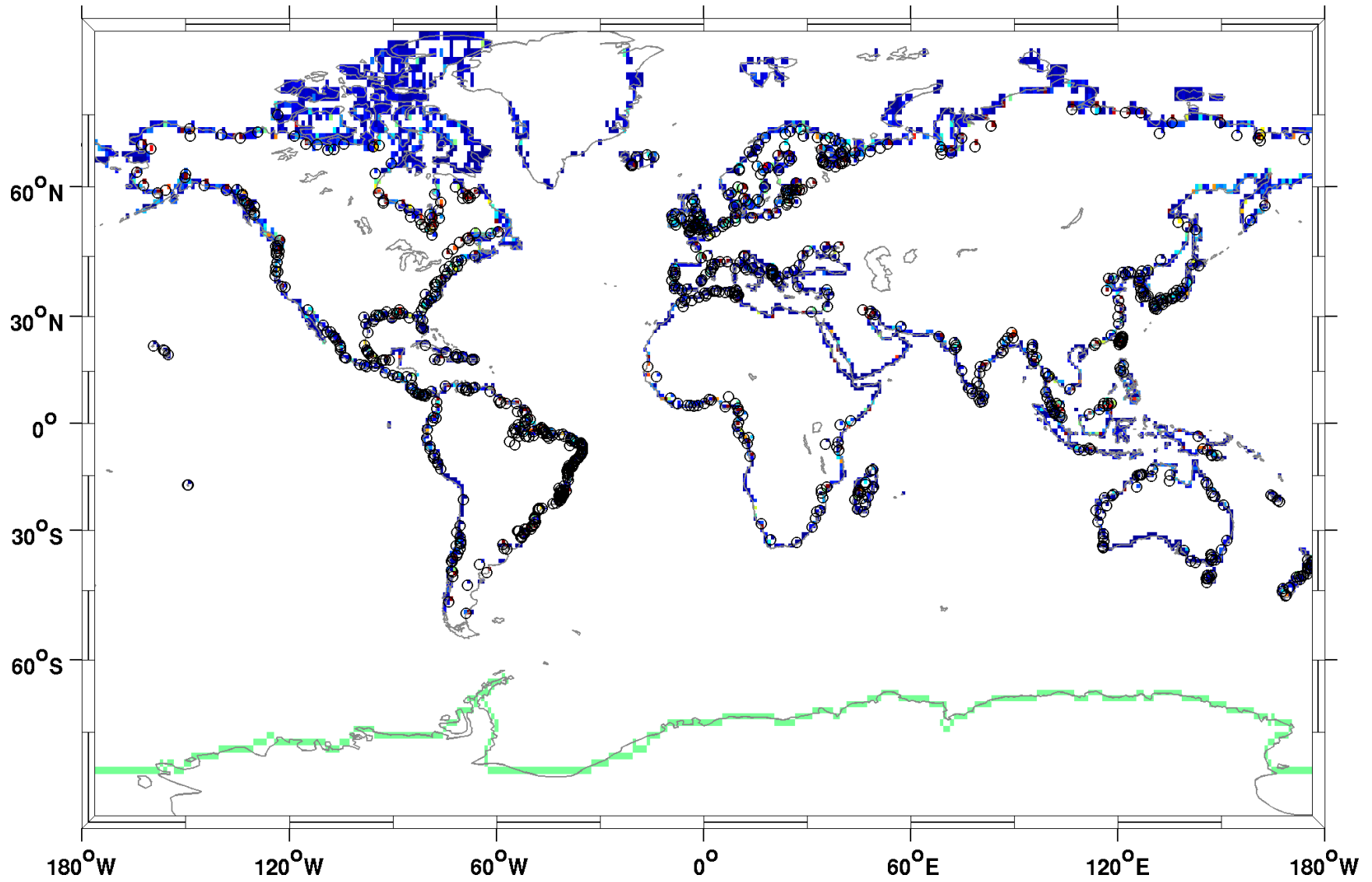
Bering Strait & Lancaster Sound Volume Flux (GLORYS1 vs GLORYS2)



Improvement in Runoff into “ANHA oceans”

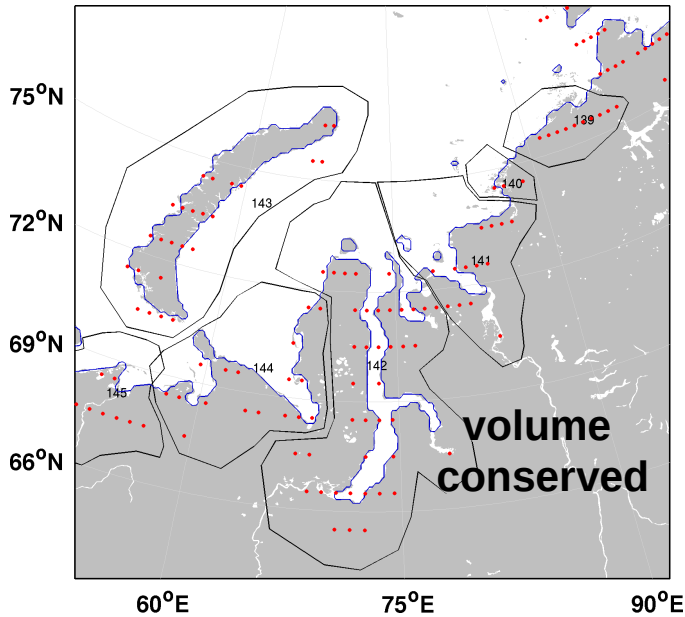
- **Remap low resolution runoff data to high resolution model grid**
- **Runoff from Greenland**
- **Inter-annual variability**

Remap Low Resolution Runoff Data to High Resolution Model Grid

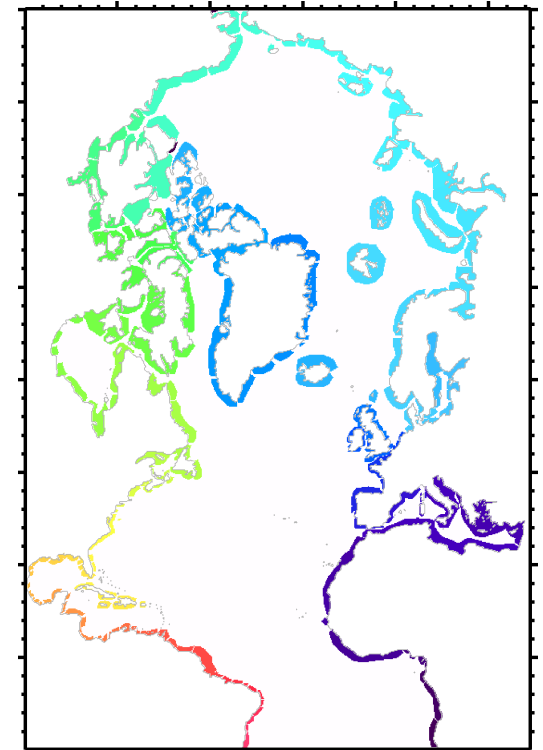
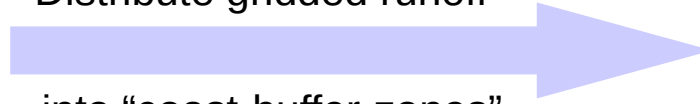


Remap Low Resolution Runoff Data to High Resolution Model Grid

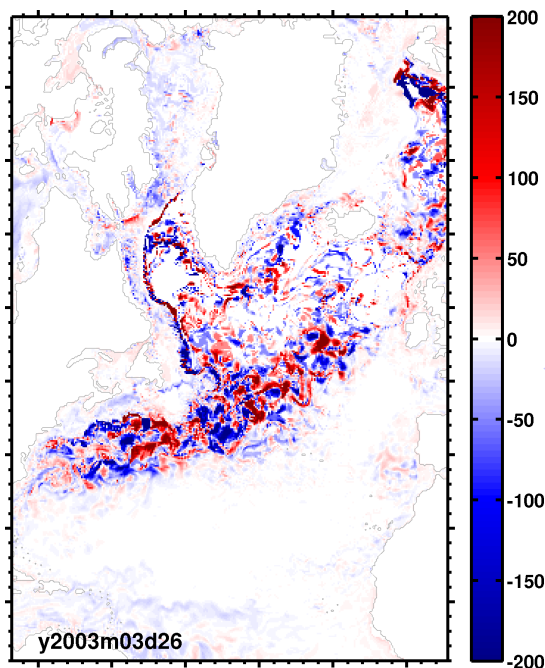
Dai and Trenberth $1^\circ \times 1^\circ$ gridded data



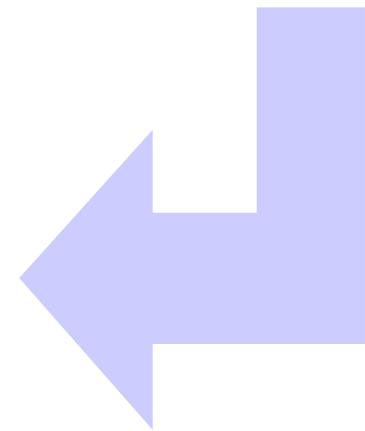
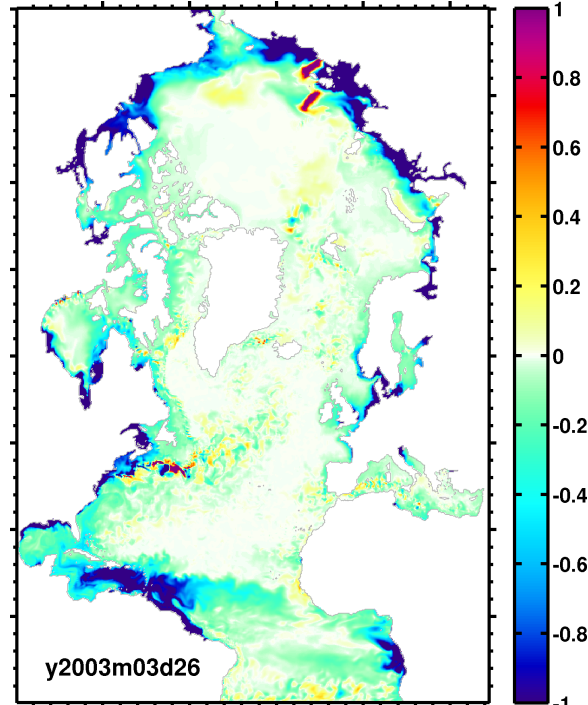
Distribute gridded runoff
into "coast-buffer-zones"

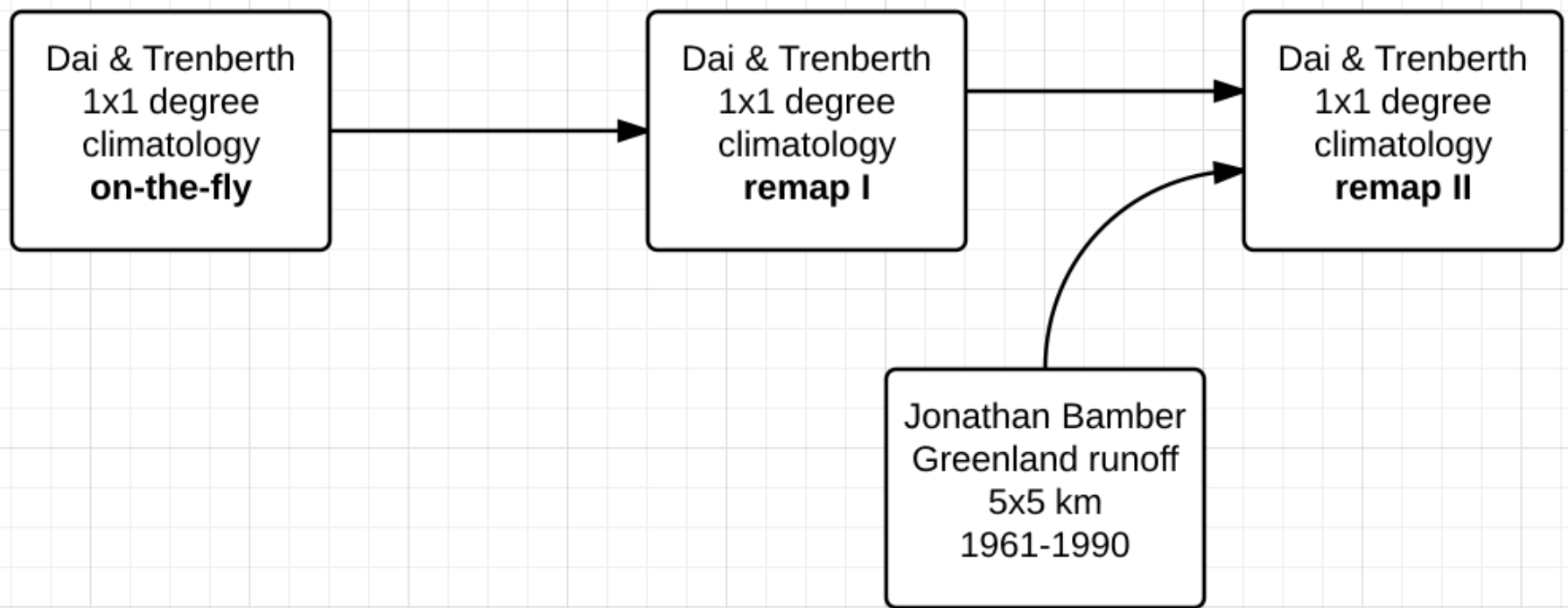


salinity changes in top 50m



MLD
changes





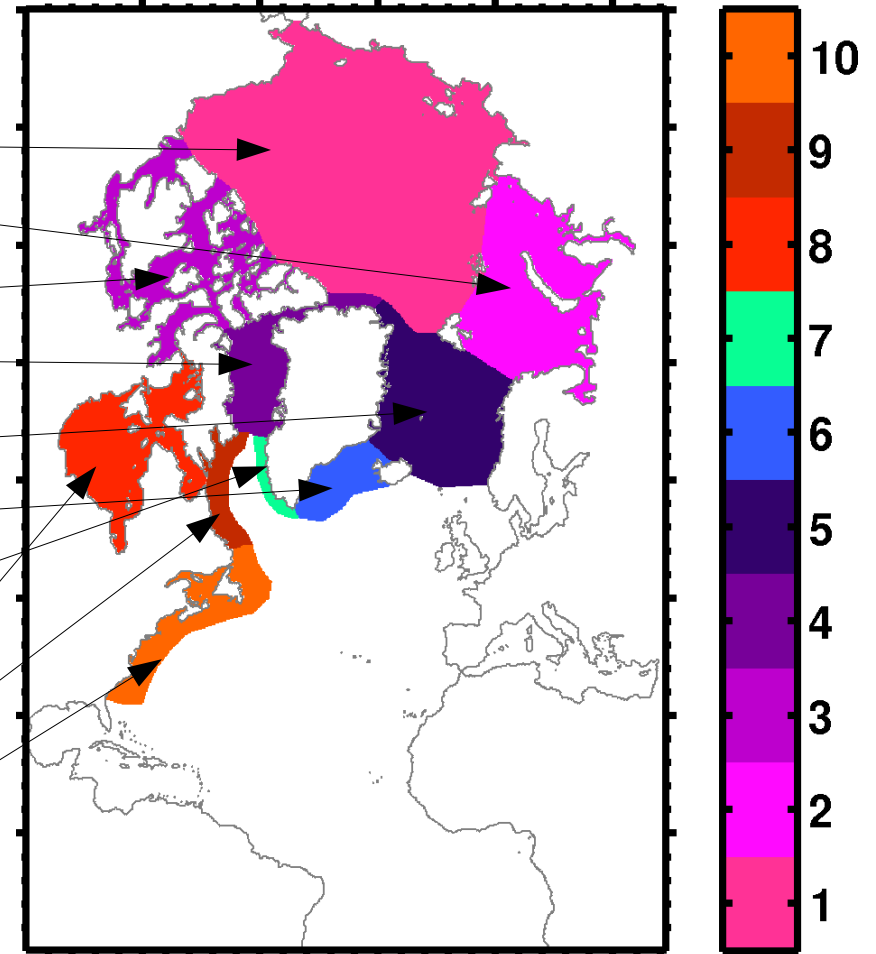
similar procedures for the inter-annual case

Total Runoff into Different “Basins” (Climatology)

	on-the-fly	remap-I	remap-II
1	50	1652	1652
2	127	1855	1855
3	133	414	414
4	21	73	181
5	19	81	122
6	15	28	143
7	5.5	5.9	80
8	312	1016	1016
9	0.7	112	112
10	212	1071	1071
domain	2926	22171	22510

unit: km³ per year

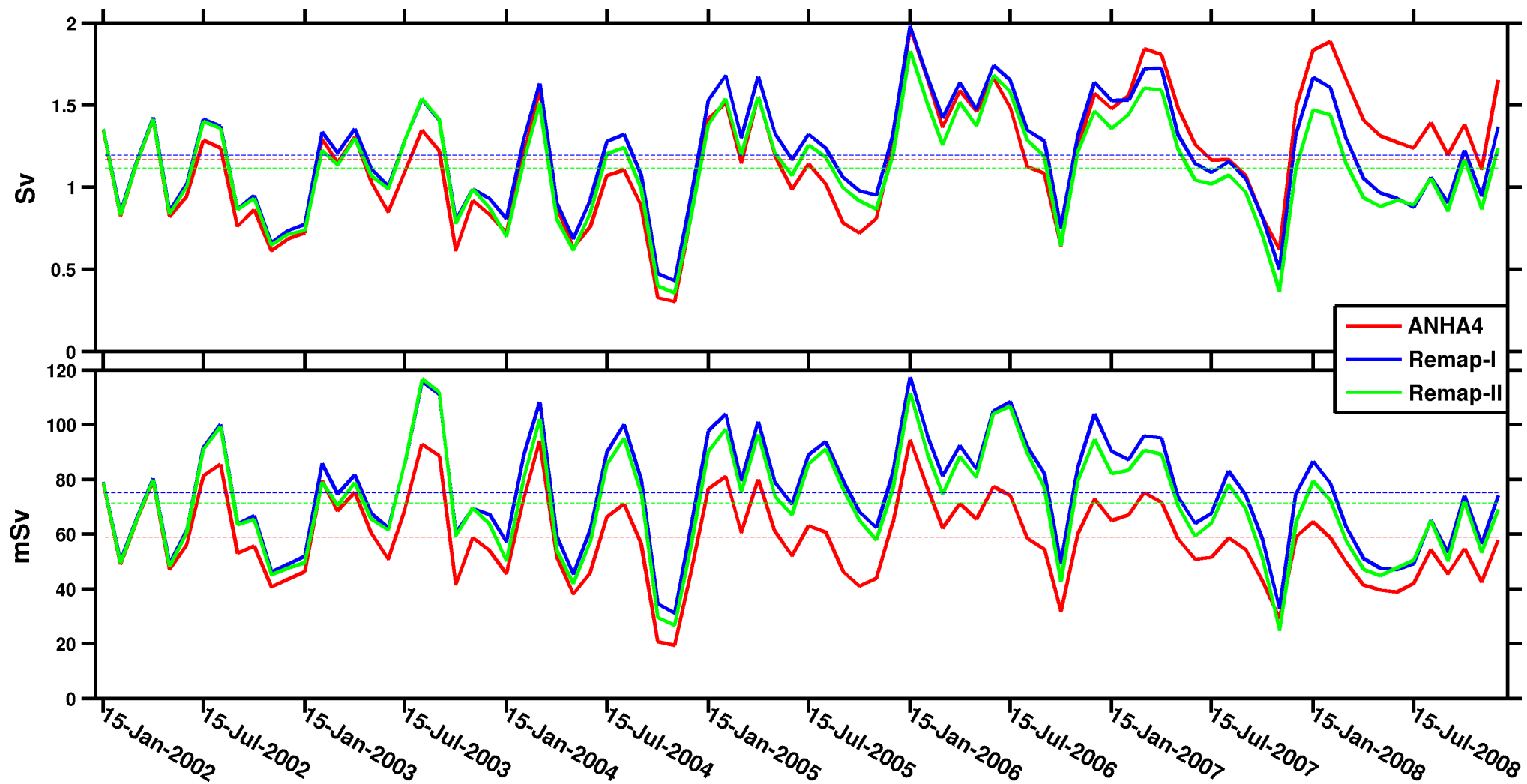
(~0.7Sv)



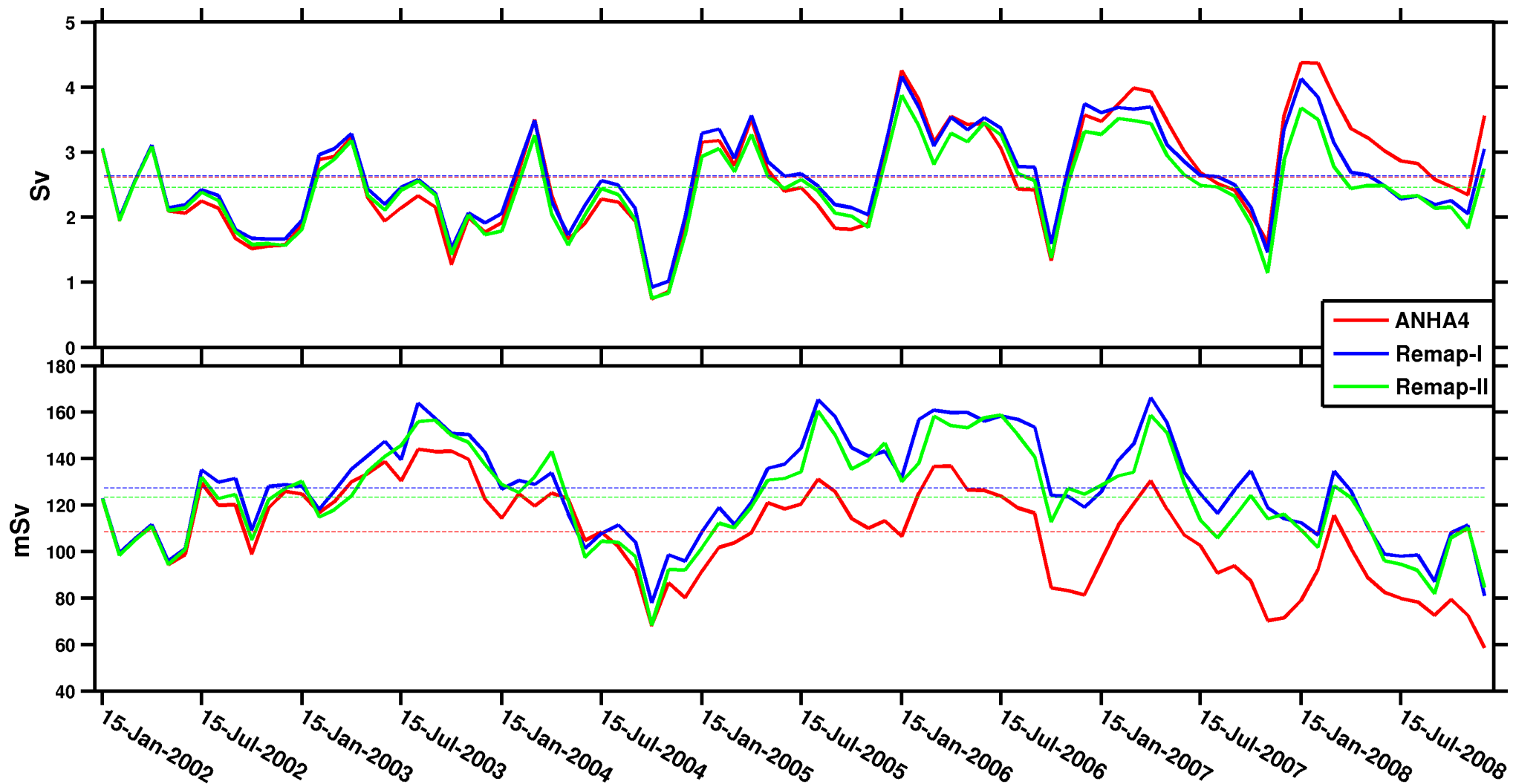
including Greenland runoff from Jonathan Bamber
1961-1990, $r=0.46$

Impact on Salinity & the CAA throughflow

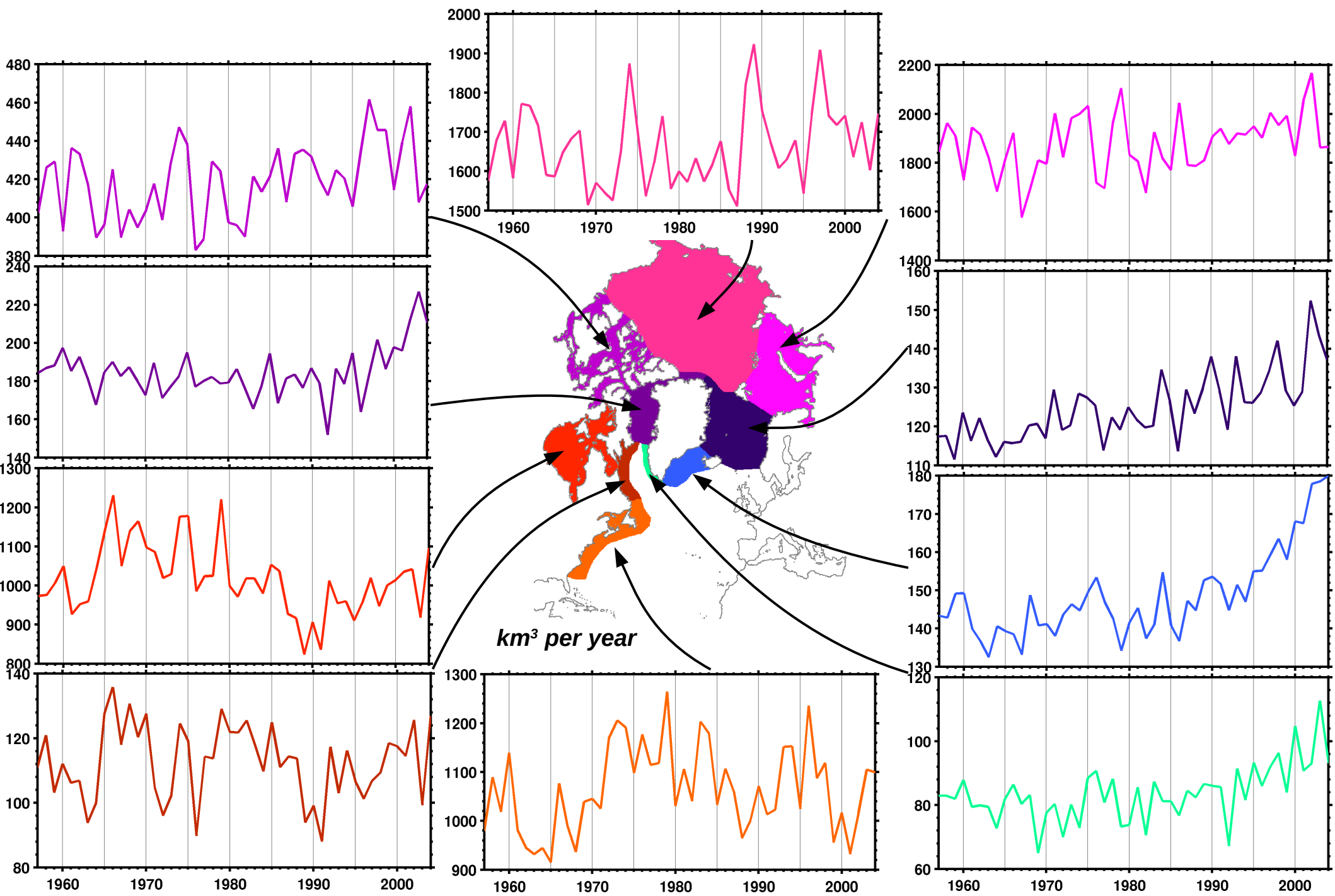
Lancaster Sound



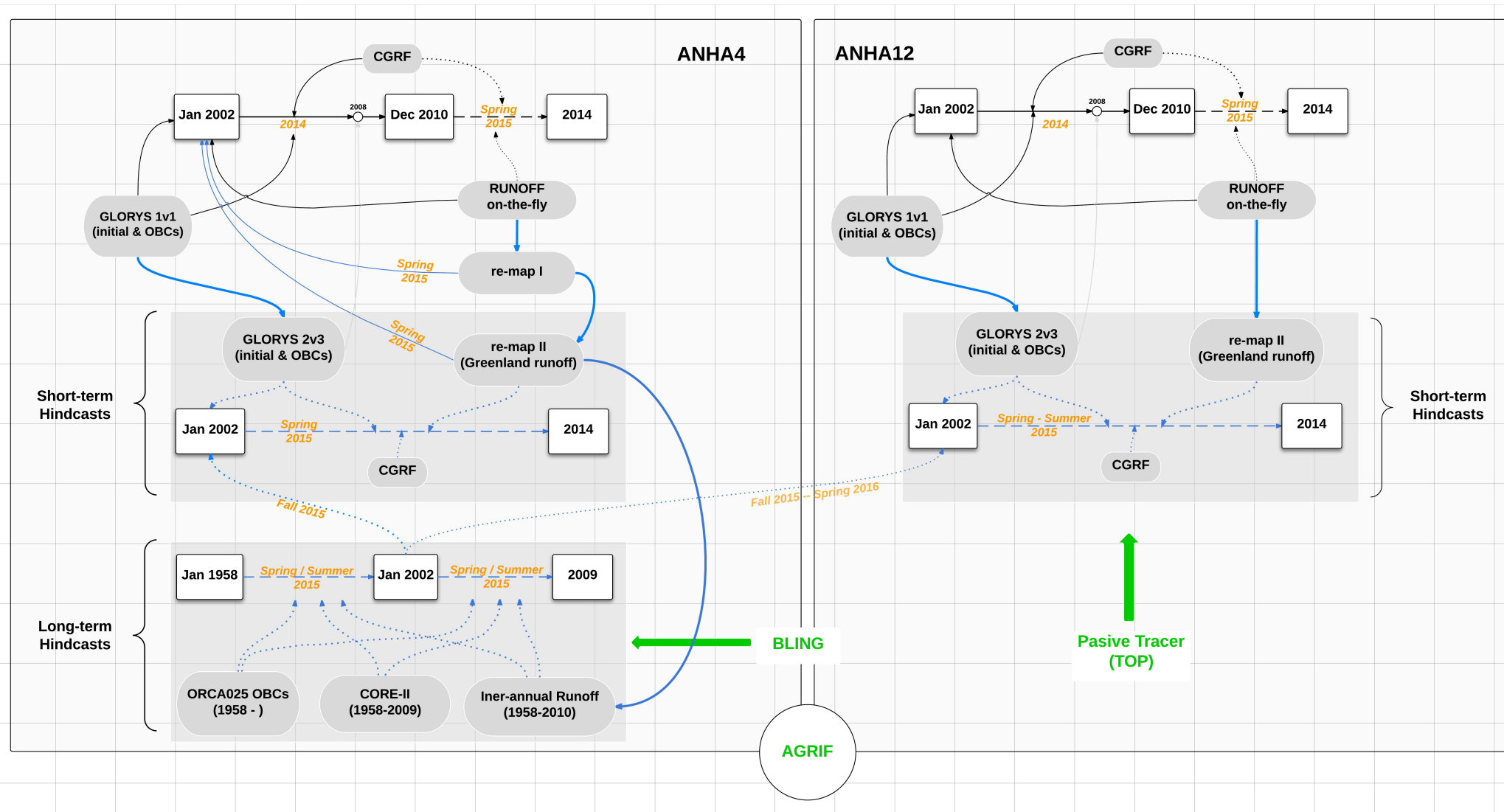
Davis Strait



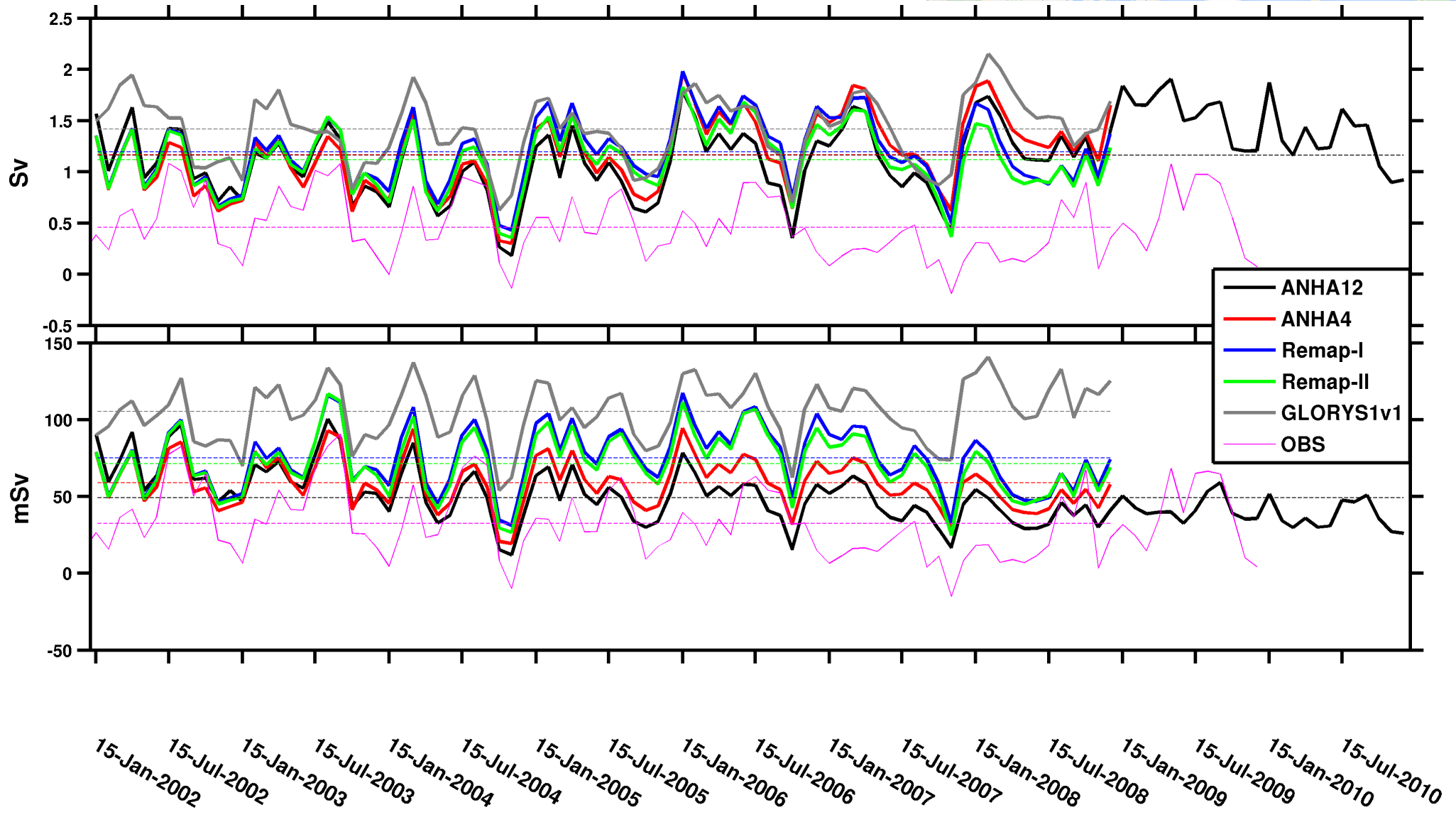
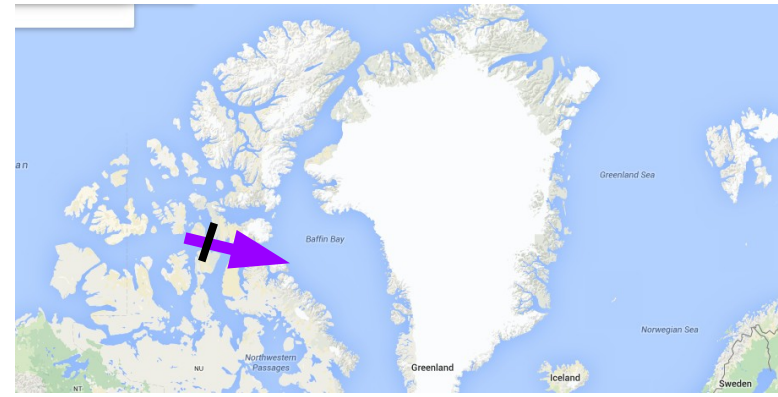
Inter-annual Runoff



Simulation Plan



Lancaster Sound FLuxes



Nares Strait

