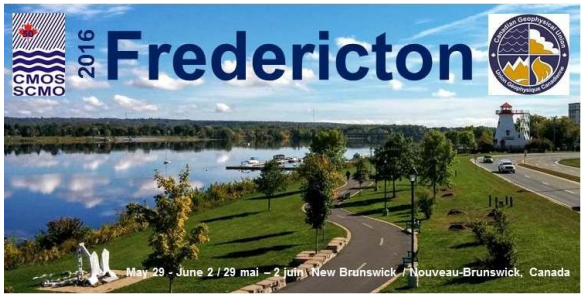

Greenland meltwater into the Labrador Sea in numerical simulations with CORE-II and CGRF forcing

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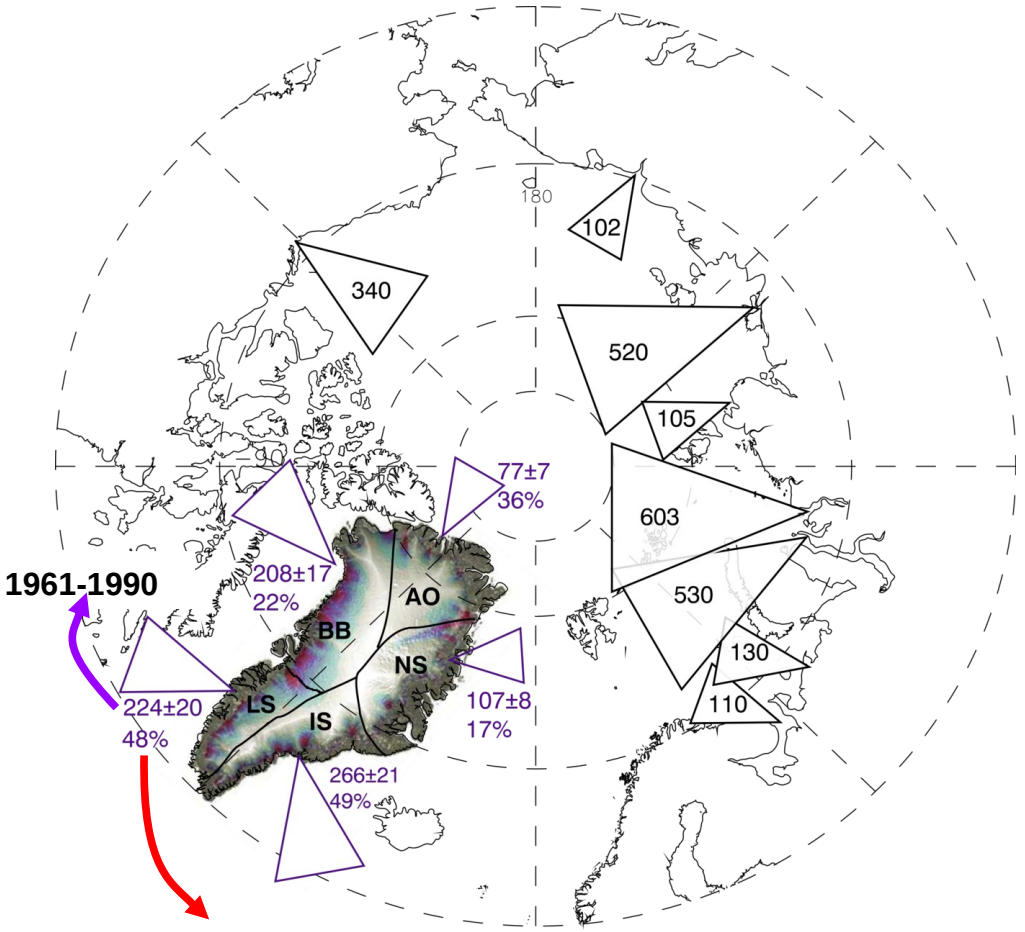
Department of Earth and Atmosphere Sciences
University of Alberta

CMOS2016 Fredericton, NB, May 30, 2016

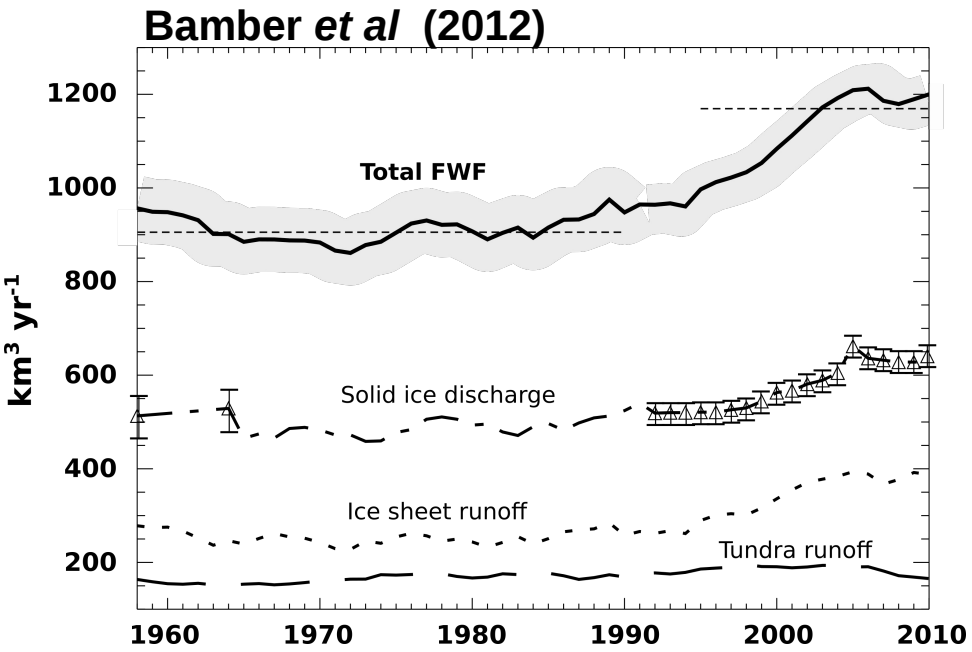
Outline

- **Background**
- **Model configuration and experiment setup**
- **Results**
  - Distribution of Greenland meltwater in Labrador Sea
  - Lateral exchange of Greenland meltwater into deep basin
  - Impact of Greenland meltwater on deep convection
- **Summary and future work**

Increasing Greenland Melt



relative increase over 1992-2010



- **NOT negligible**
- **increasing quickly since the early 1990s**
- **surface runoff counts ~46%**

≈ Mackenzie River discharge

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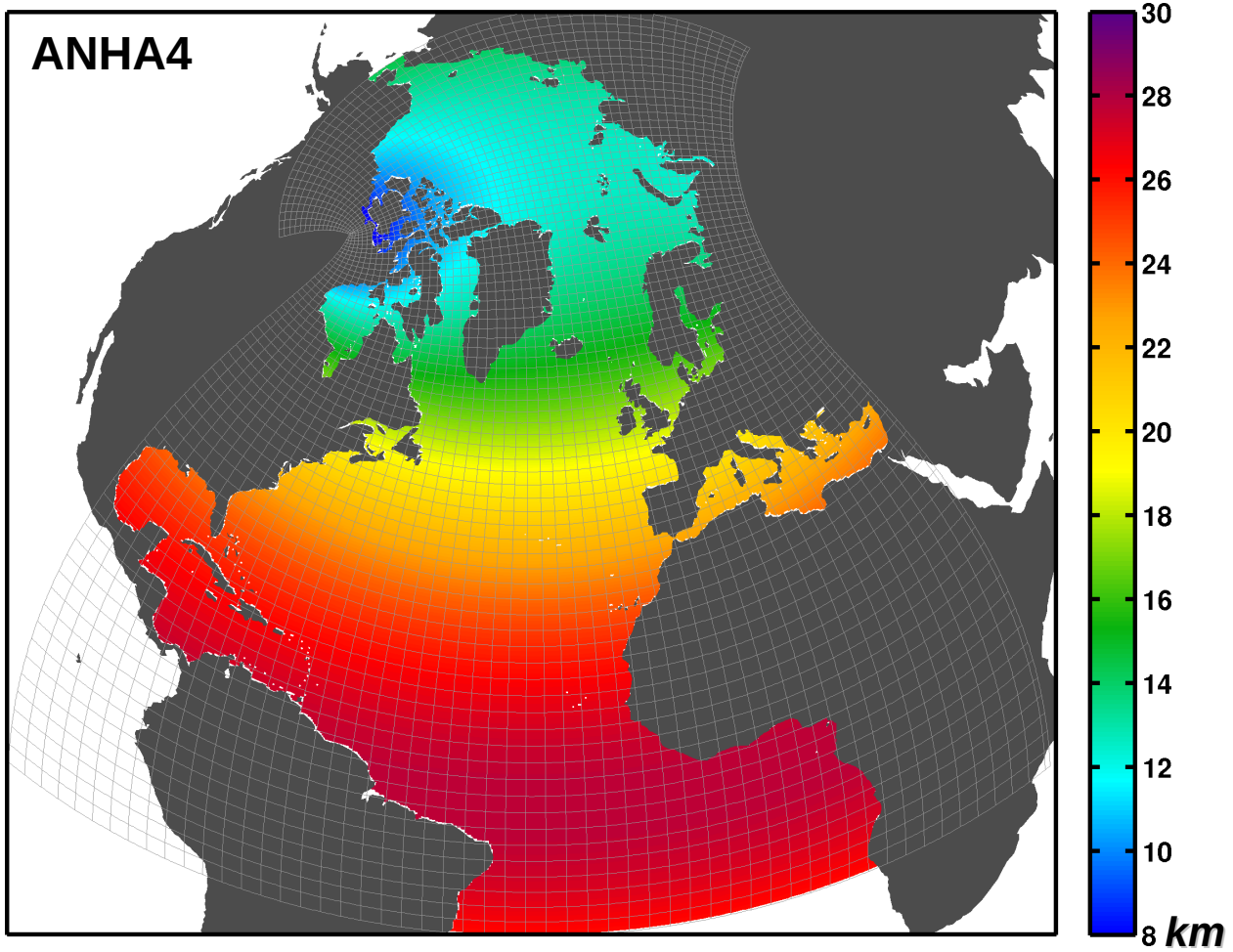
Model Configuration



Model : NEMO 3.4
LIM2 + EVP

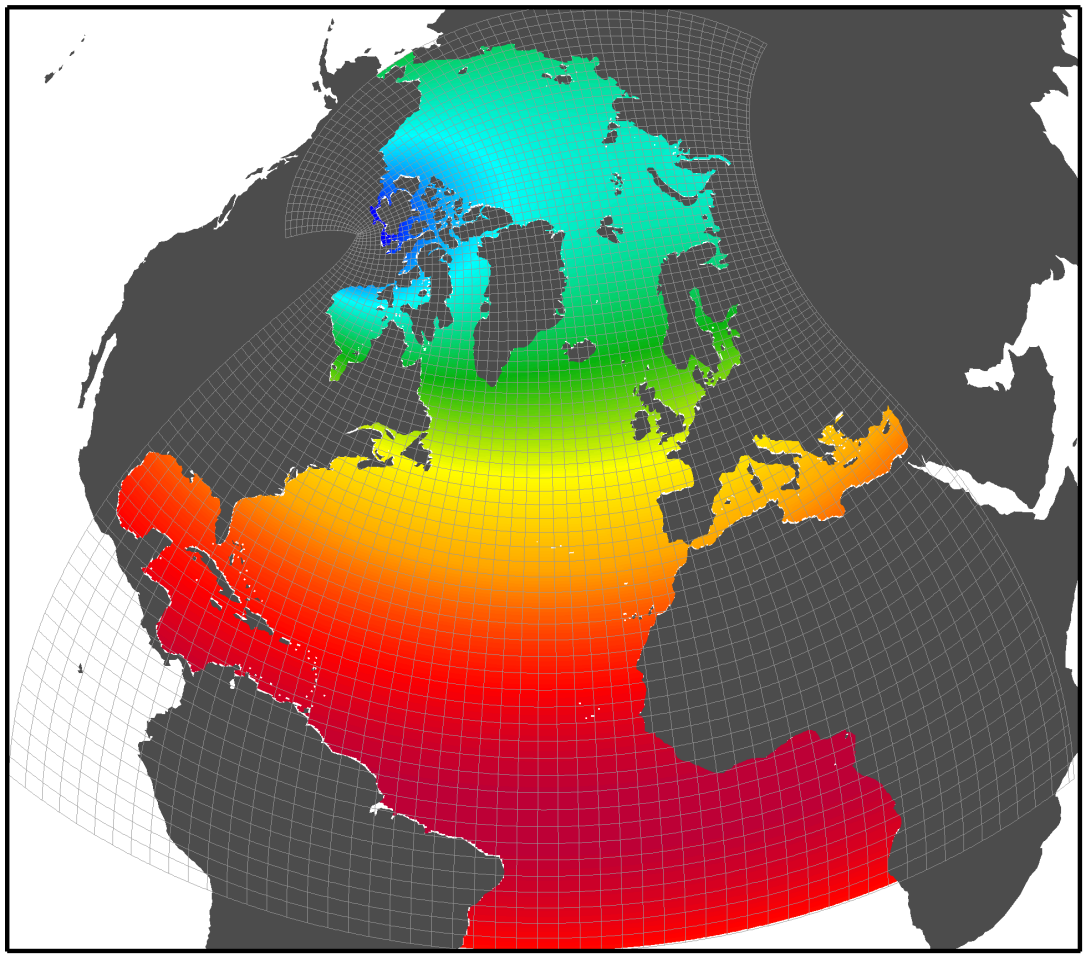
Resolution : 1/4 degree

Mesh : 544 x 800

50 levels

ANHA: Arctic and Northern Hemisphere Atlantic

Experiment Setup



Initialization:

3D T, S, U and V (GLORYS2v3, Jan02)
SSH and seaice

Atmospheric forcing (CGRF, hourly):

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

Runoff:

Inter-annual Dai and Trenberth's runoff
\+ **Jonathan Bamber's Greenland melt**

OBC:

U, V, T and S (GLORYS2v3)

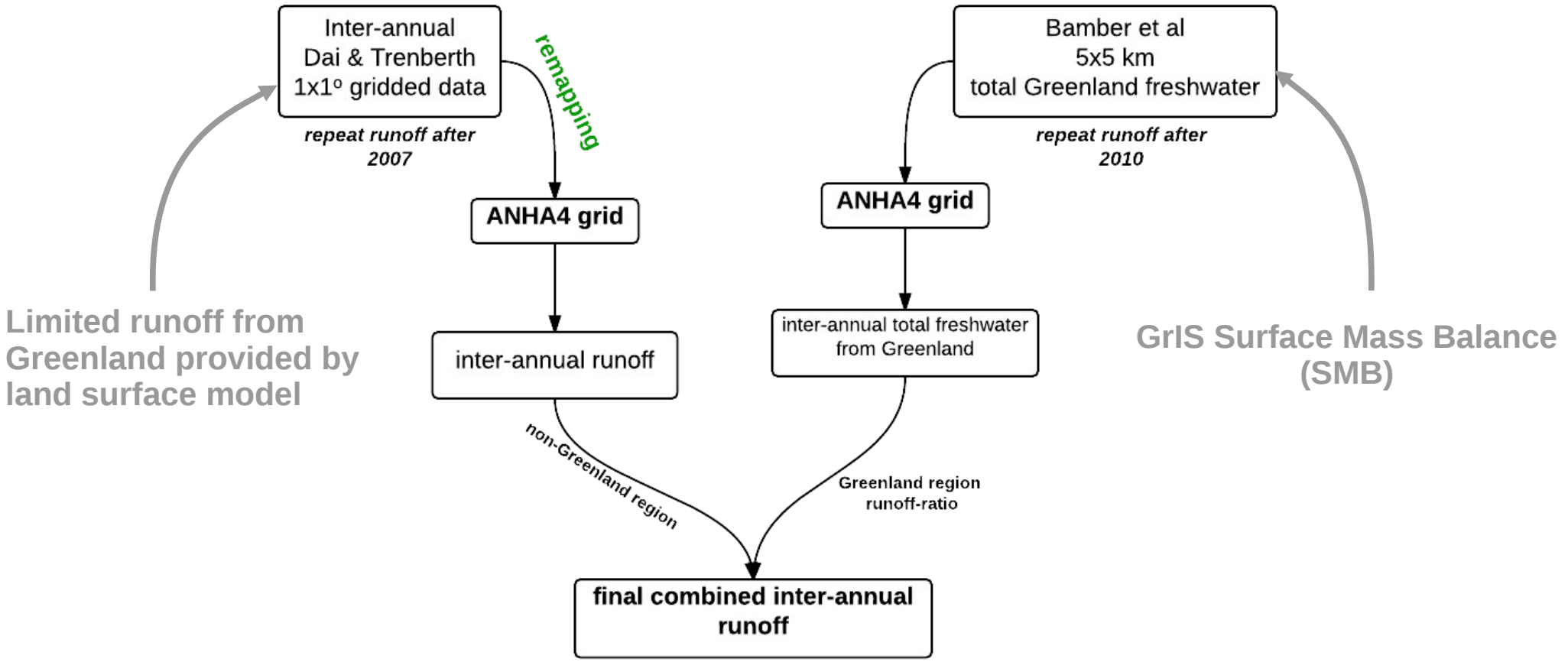
NO temperature & salinity restoring

CORE-II: Jan 2002 – Dec 2009
CGRF: Jan 2002 – Dec 2013

CGRF: CMC GDPS reforecasts
GDPS: Global Deterministic Prediction System

CMC: Canadian Meteorological Centre
GLORYS: GLobal Ocean ReanalYses and Simulations

How to Create the Runoff Data

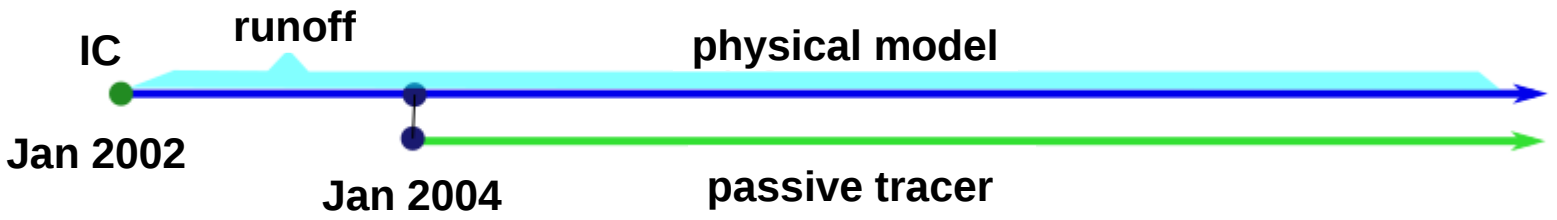


How to Add the Passive Tracers

- **a single passive tracer**
- **proportional to the amount of runoff**
- **start adding tracers in Jan 2004**

$$\Delta c = \frac{\Delta t}{\rho_o \cdot e3t_1} \cdot rnf$$

$$\frac{s}{\frac{kg}{m^3} \cdot m} \cdot \frac{kg}{m^2 \cdot s} = unitless$$



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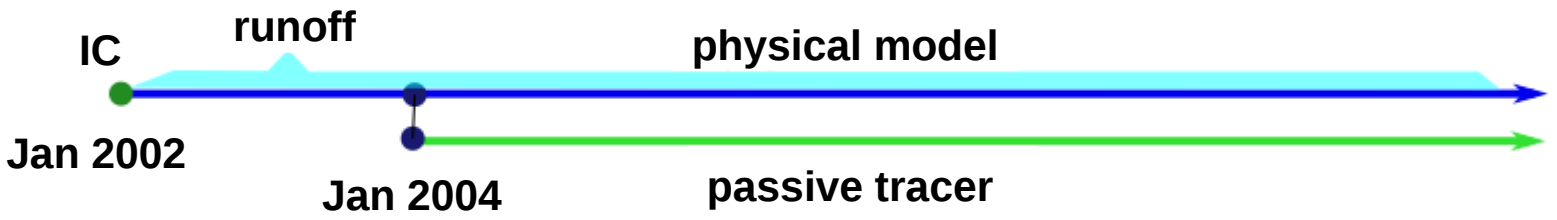

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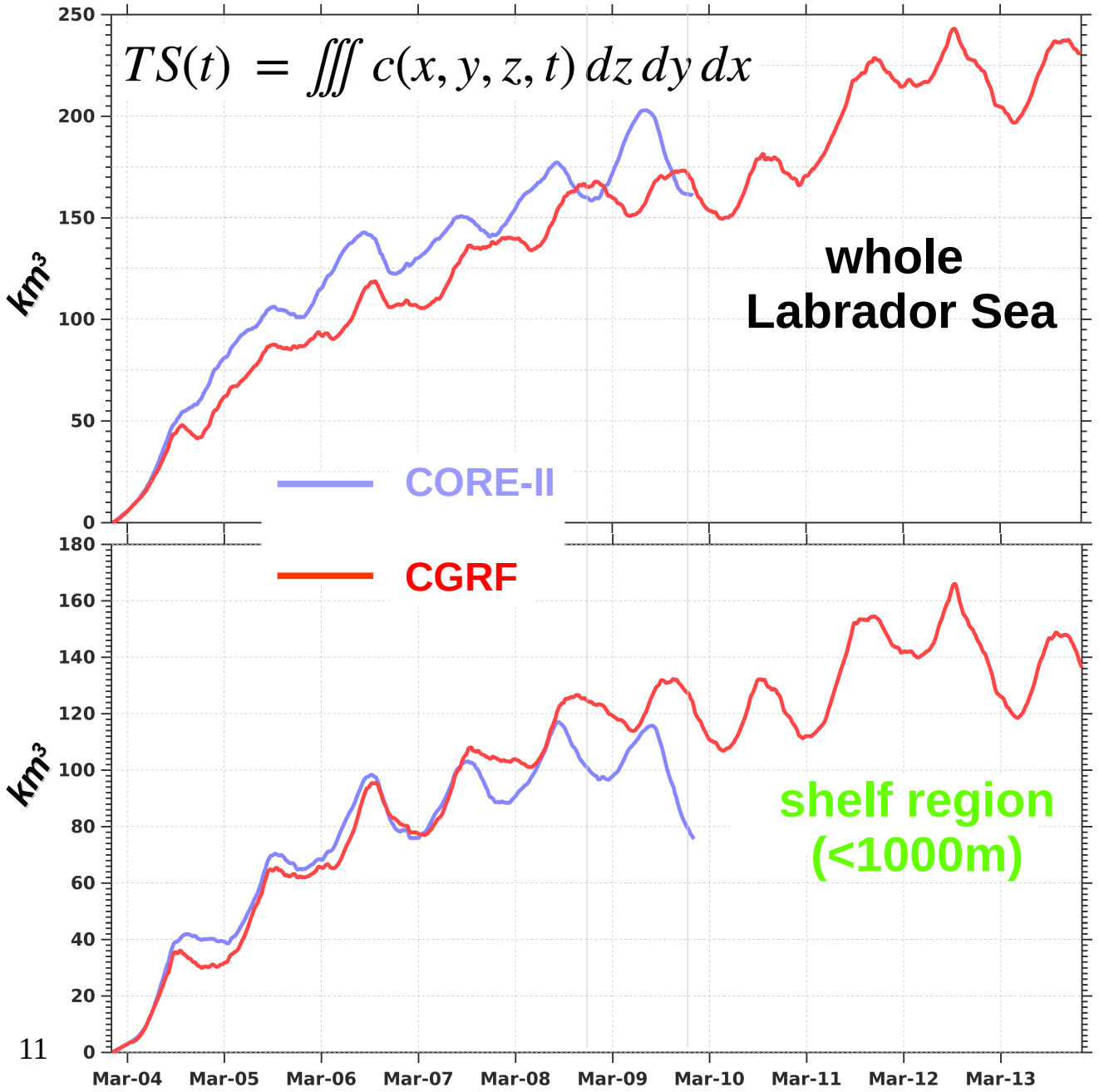
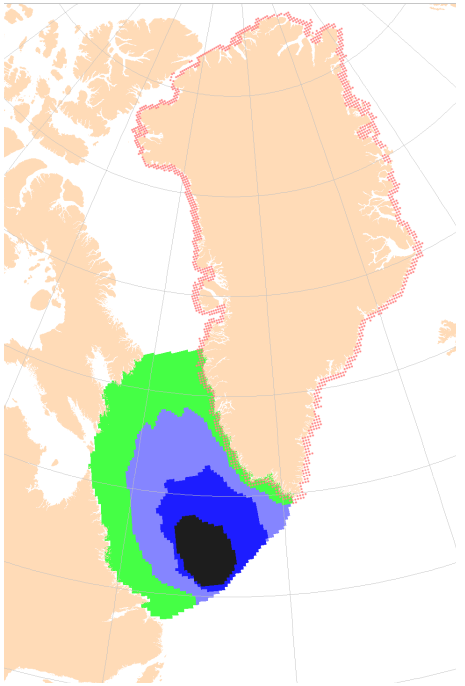
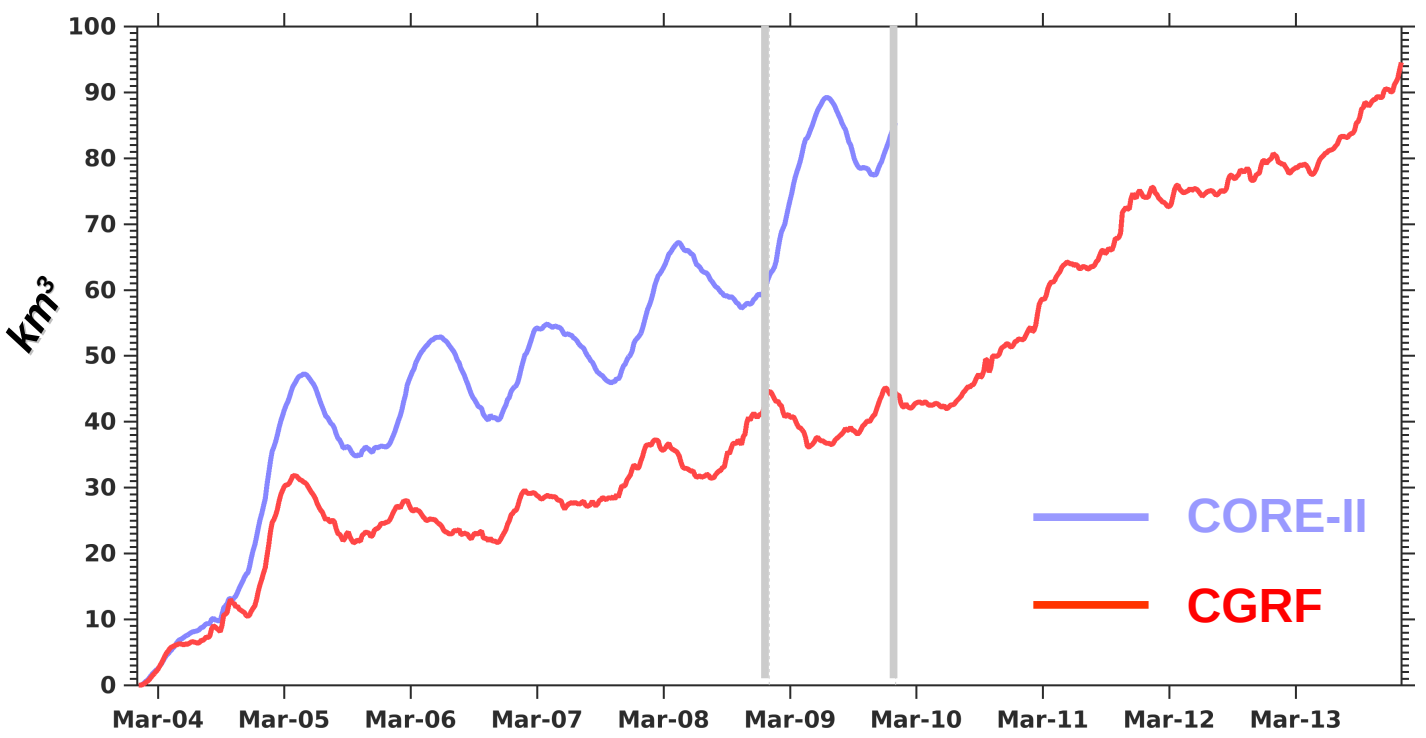
Passive Tracer Storage in Labrador Sea

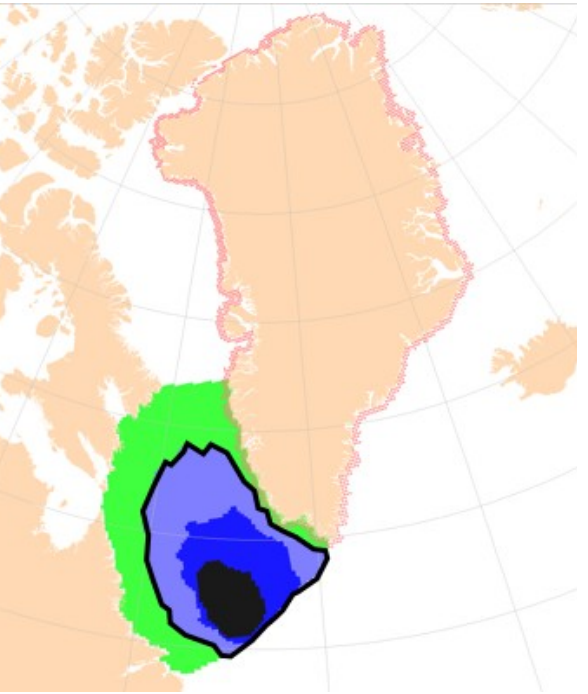




- **total: CORE-II**
- **shelf: CGRF**

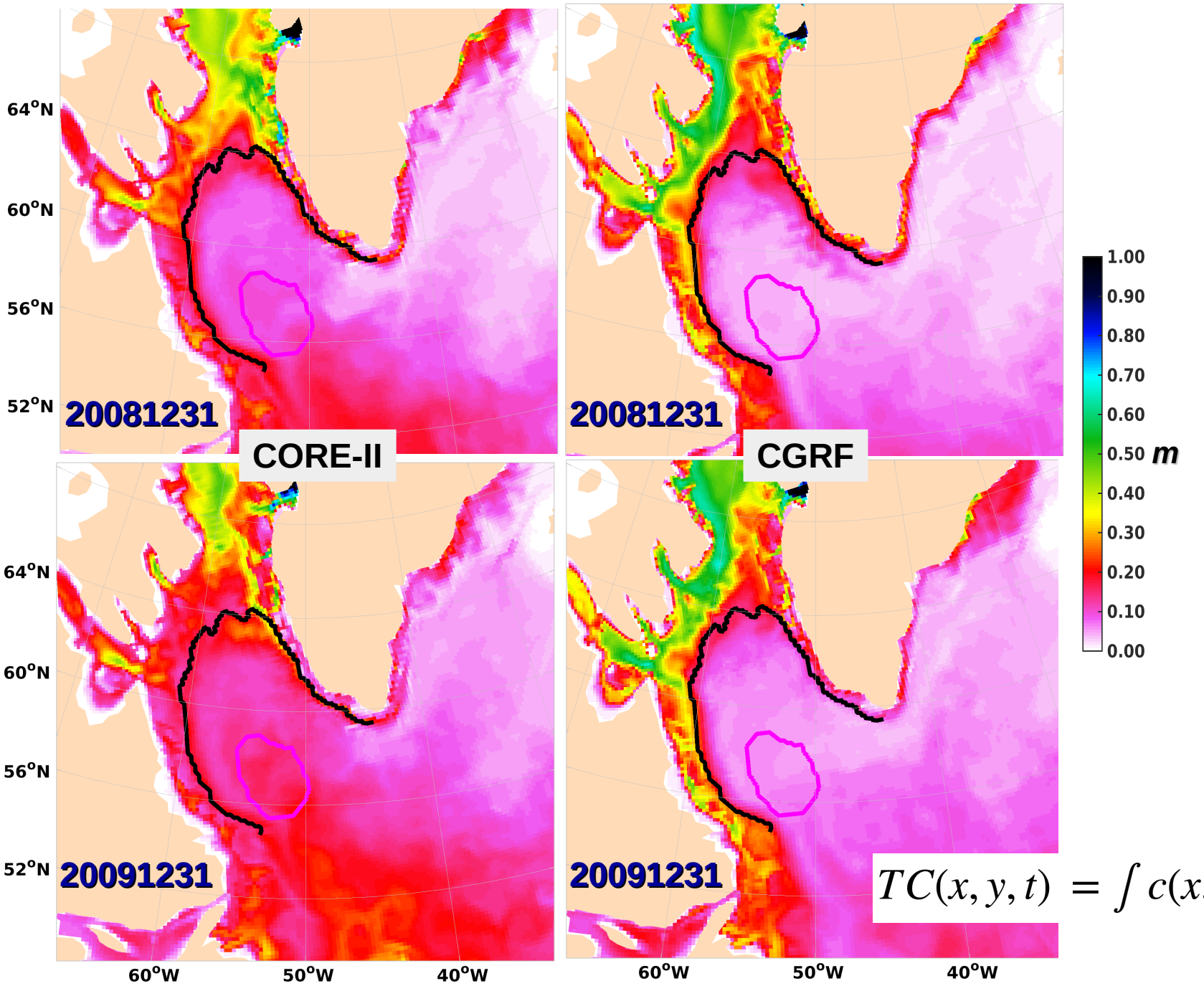
Passive Tracer Storage in Labrador Sea





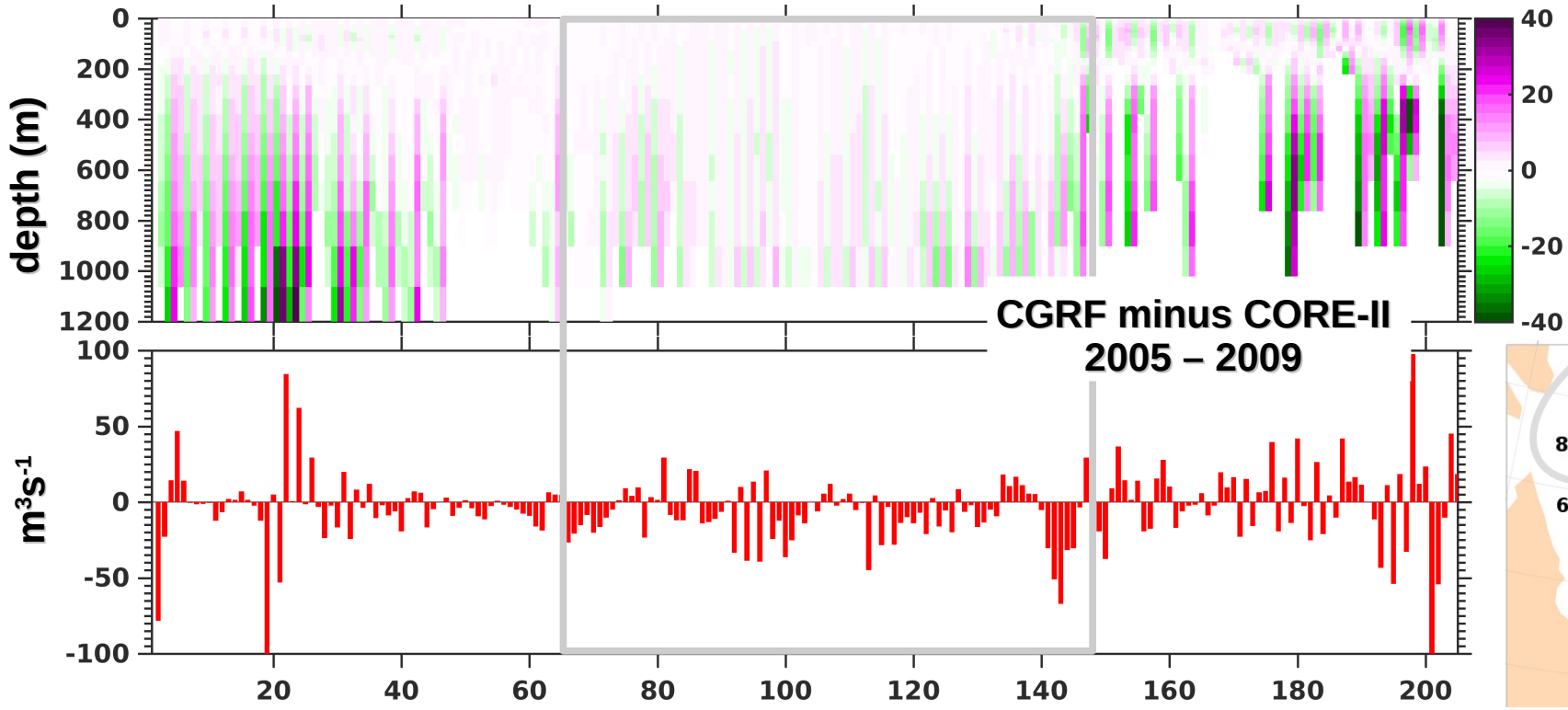
- **deep basin: CORE-II**

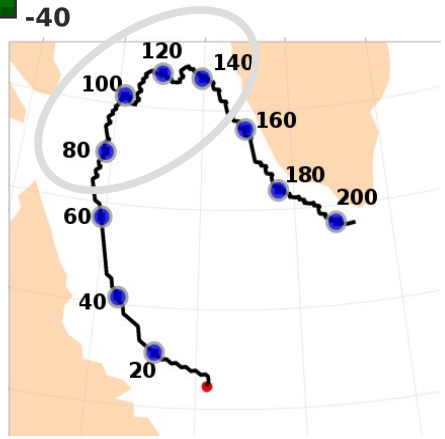
Spatial Distribution of Tracer Content



$$TC(x,y,t) = \int c(x,y,z,t)\,dz$$

Difference in Lateral Exchange of Passive Tracer Flux Into Deep Basin

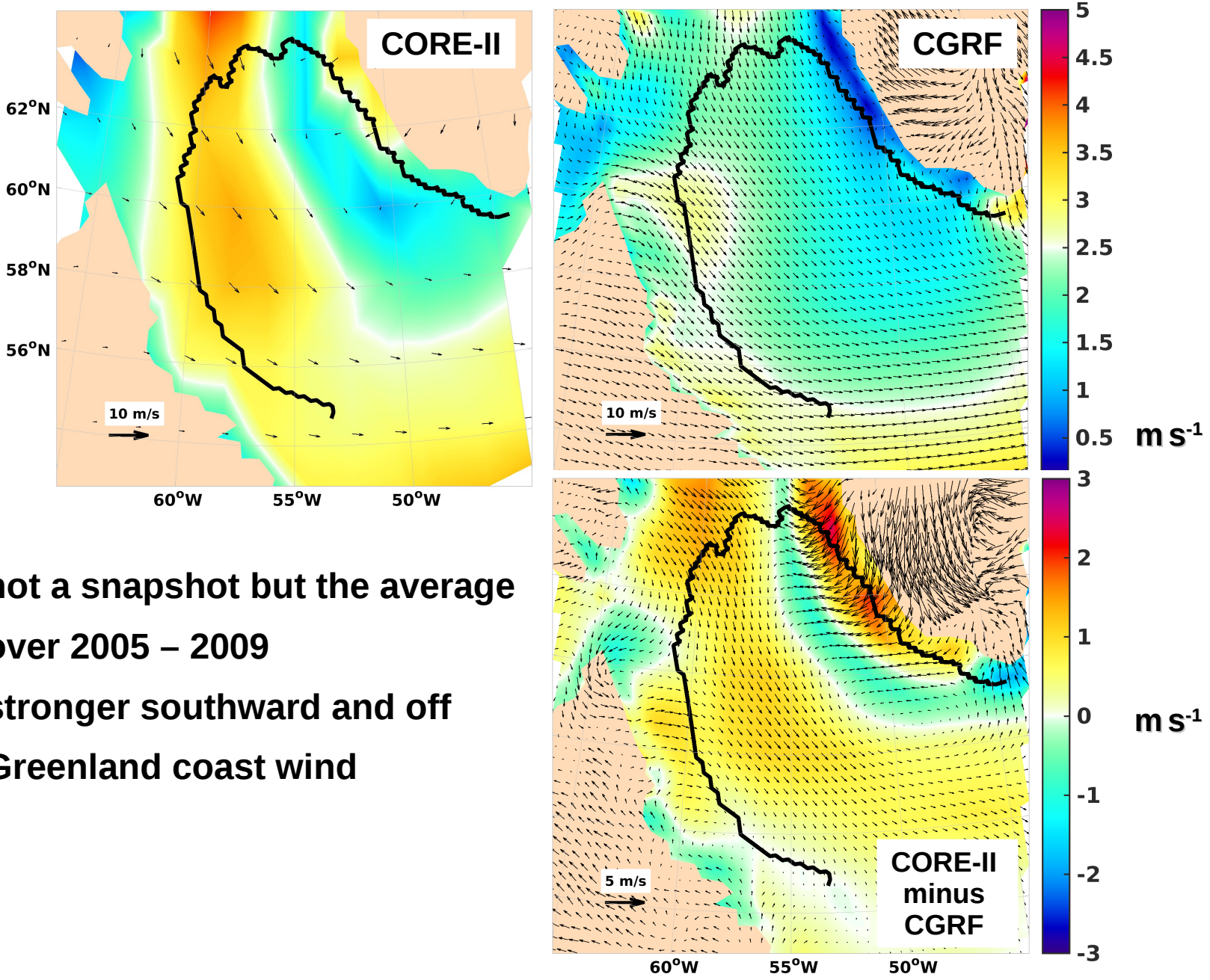




1000m isobath section

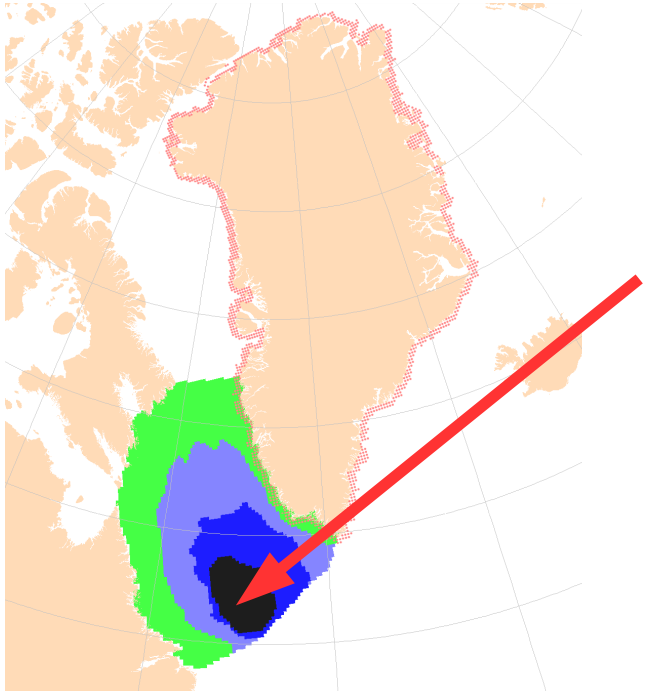
negative: more into deep basin with CORE-II

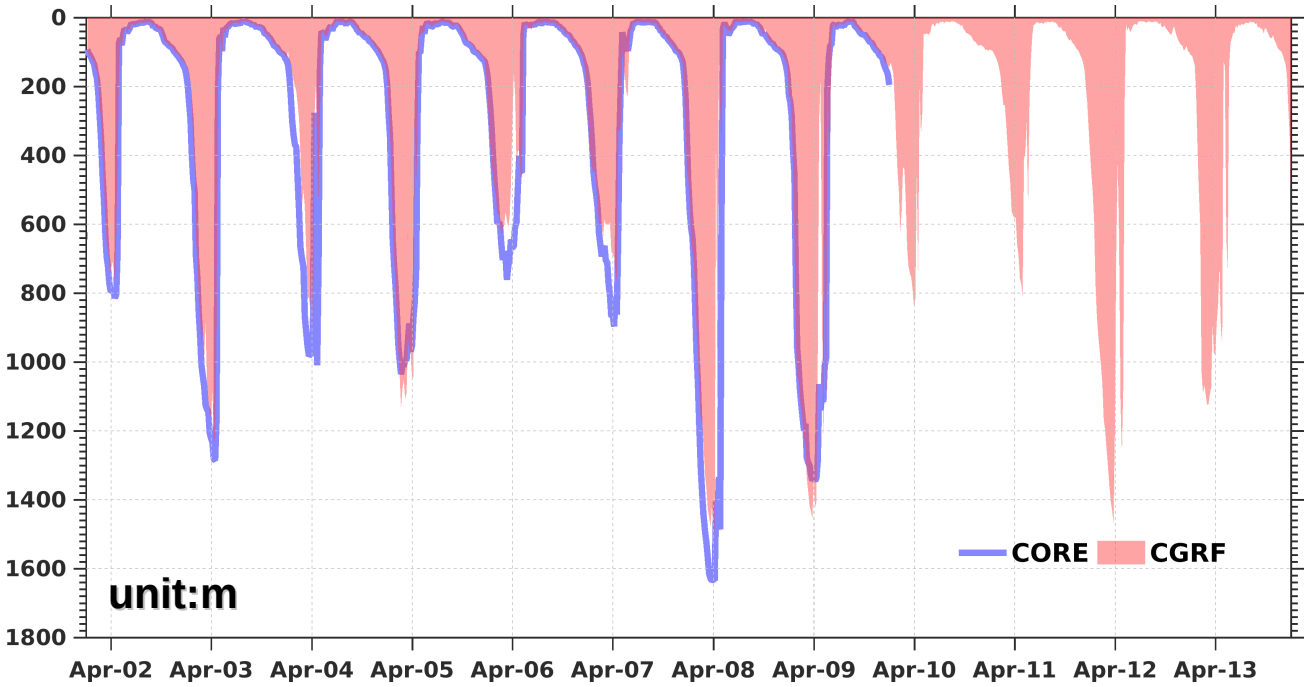
Difference in Surface Wind



- not a snapshot but the average over 2005 – 2009
- stronger southward and off Greenland coast wind

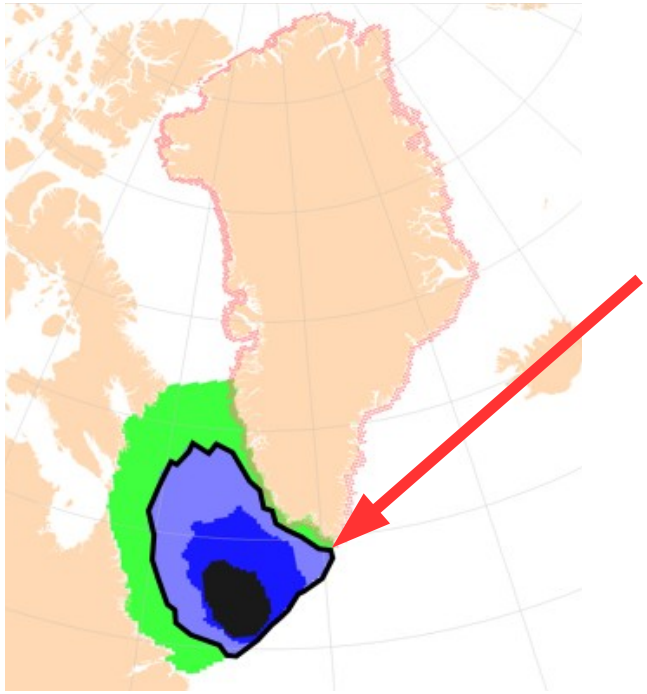
Impact of Greenland Meltwater on Deep Convection

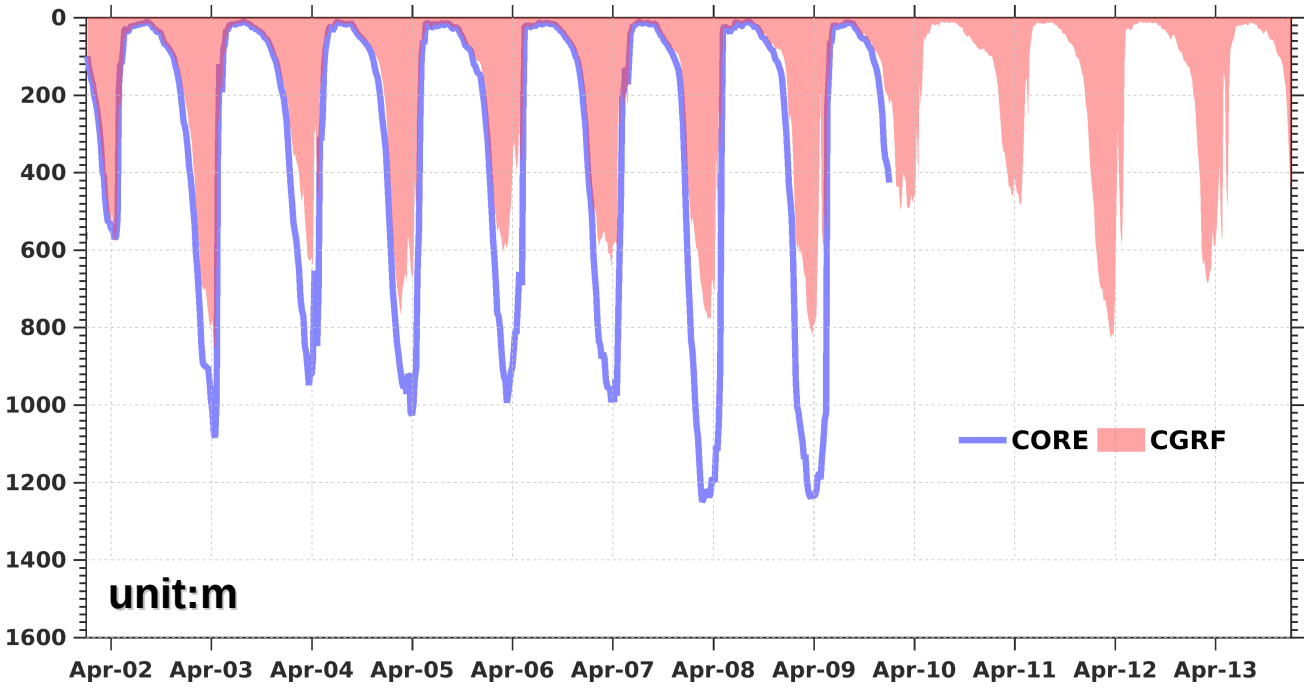




- re-calculated MLD
- not much difference
- good range and inter-annual variability

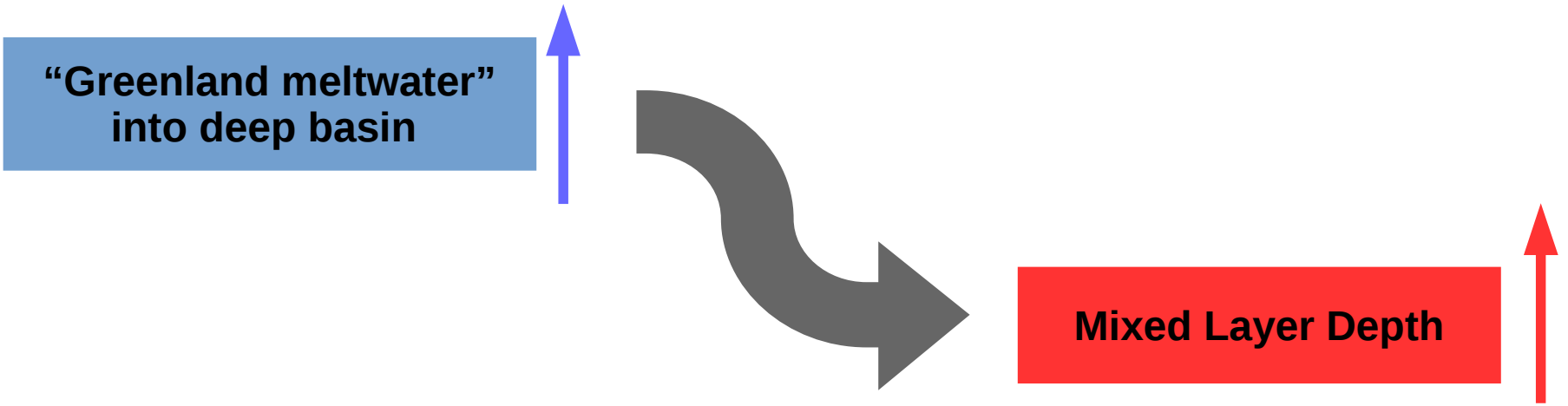
Impact of Greenland Meltwater on Deep Convection





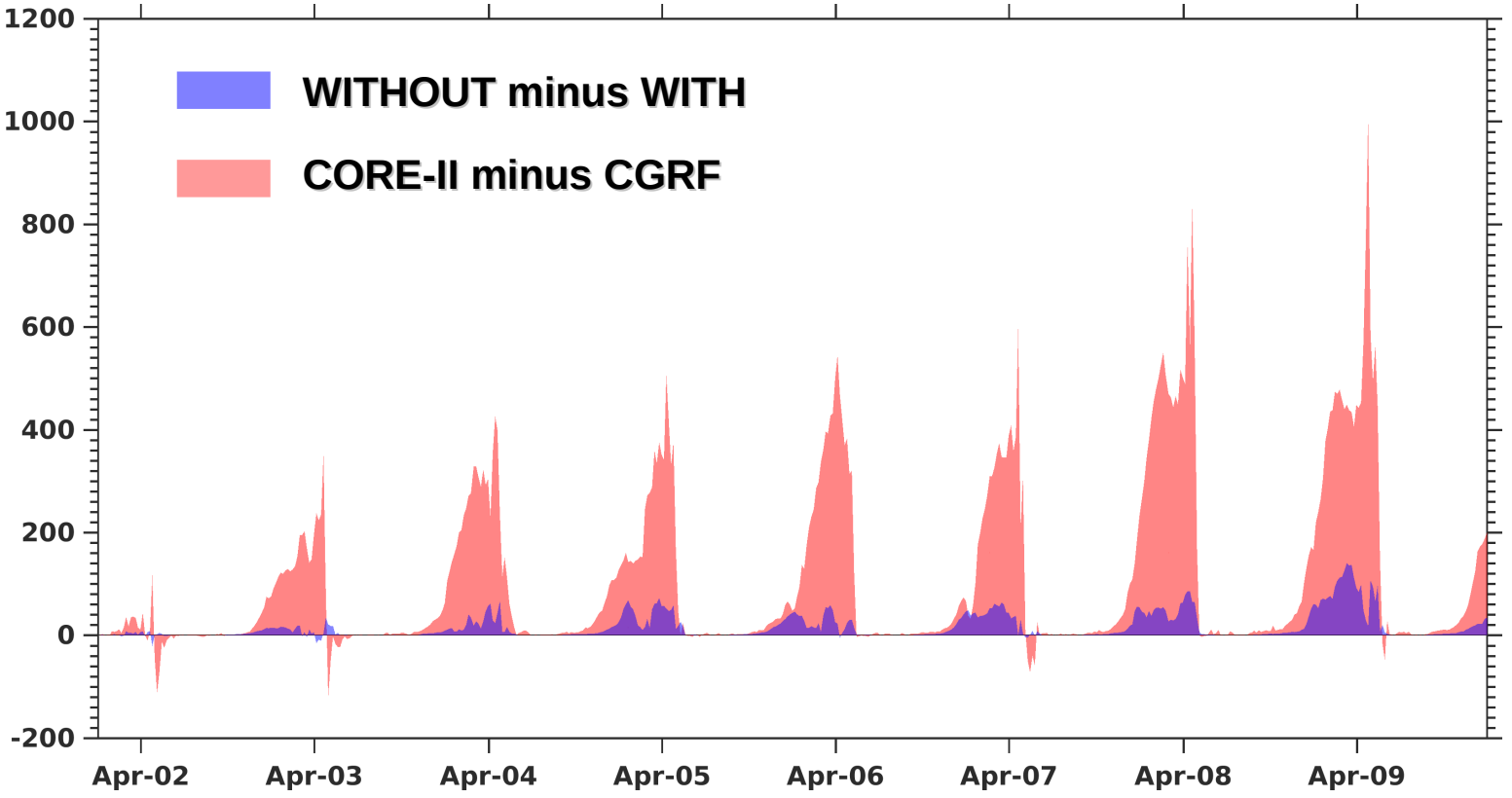
- deeper MLD with CORE-II forcing
- similar inter-annual variability

Impact of Greenland Meltwater on Deep Convection



Make Sense ????

Impact of Greenland Meltwater on Deep Convection



WITH Greenland meltwater (≈ 500 km^3 per year)

SHALLOWER MLD in Labrador Sea deep basin!!!

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Summary and Future Work

- Different atmospheric forcing data has an impact on the spatial distribution of Greenland meltwater in the ocean
  - CGRF results in more Greenland meltwater in Baffin Bay and shelf region
  - CORE-II favors more Greenland meltwater in Labrador Sea and the deep ocean region
- Greenland meltwater does have an impact (reducing) on the mixed layer depth in Labrador Sea.
  - this signal is much smaller than the influence due to different atmospheric forcings, i.e., surface non-solar heat flux in CORE-II vs CGRF

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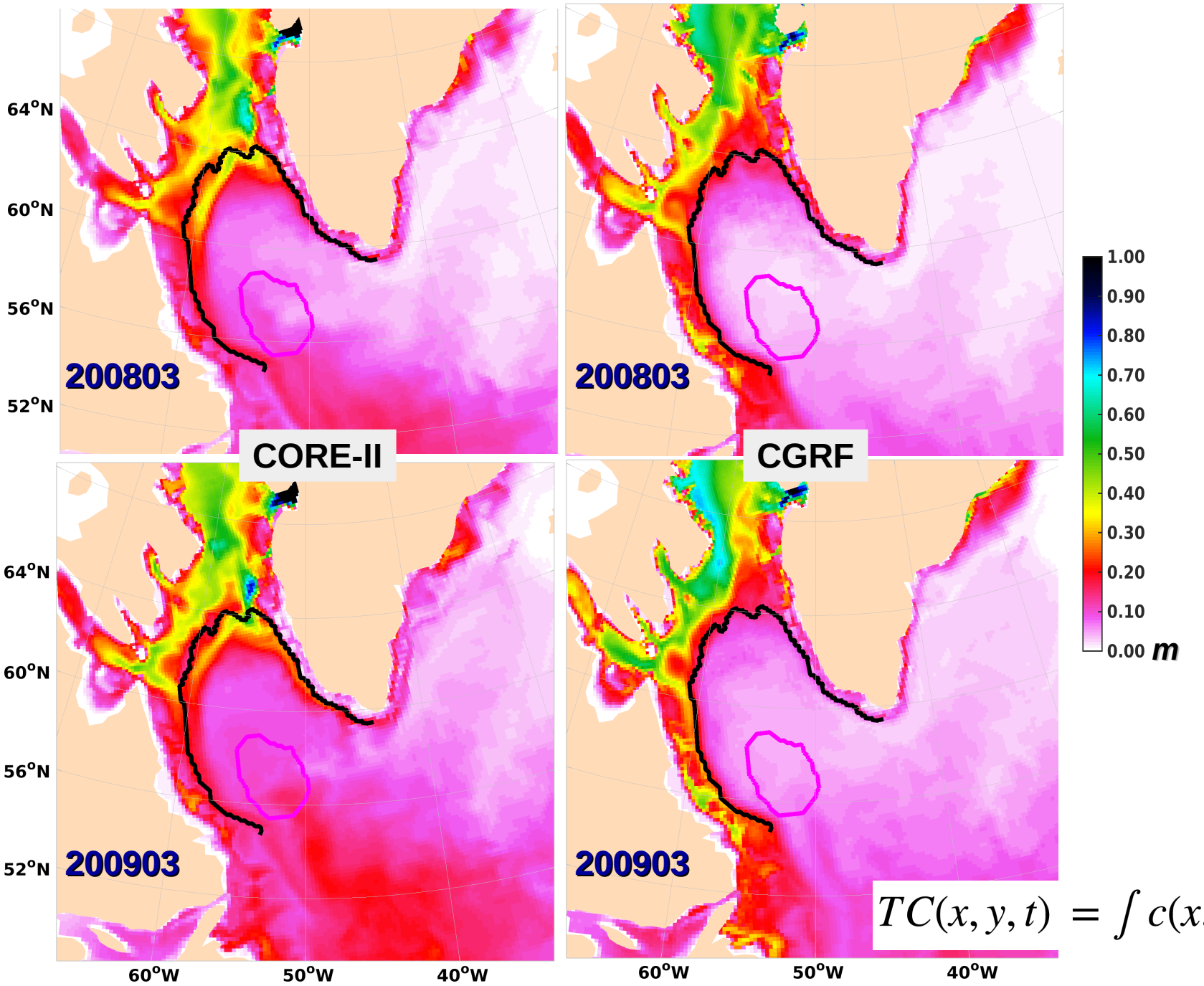

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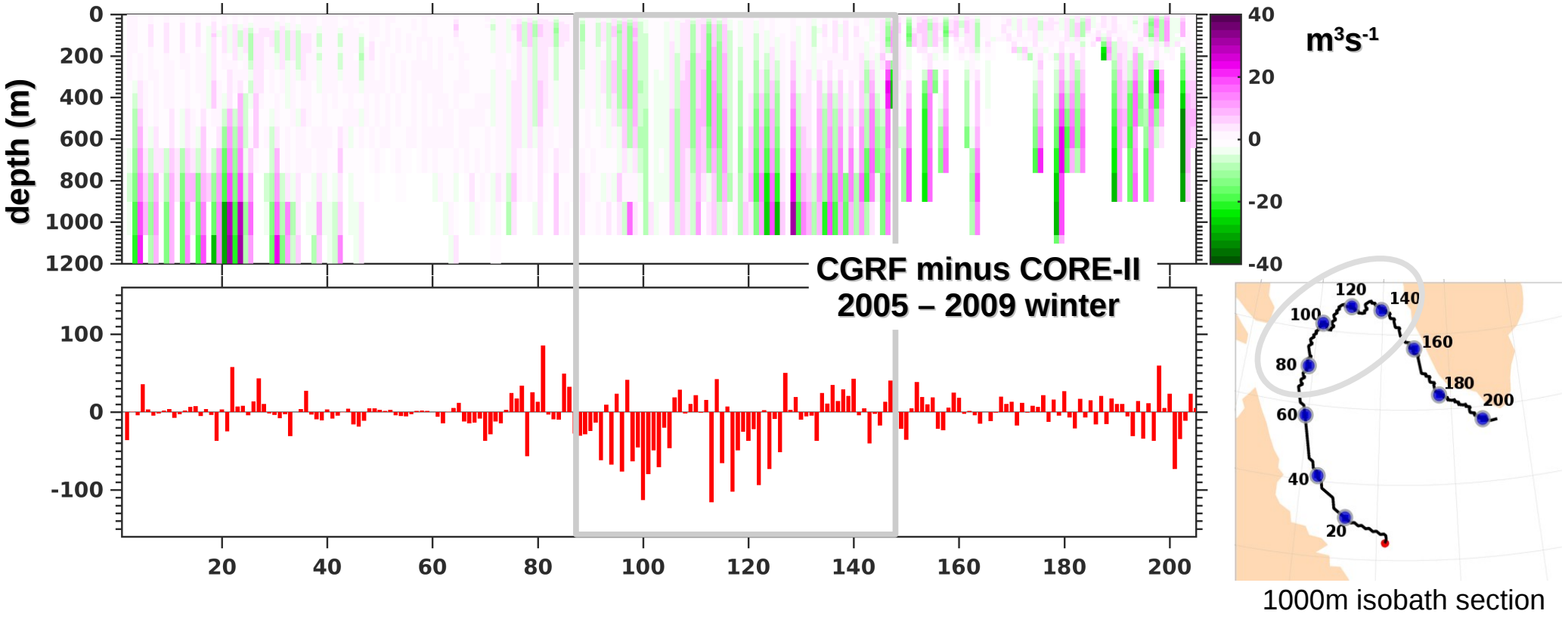

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