OSM Presentation: Role of tidally-induced mixing in the Ross Sea

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Nov 12-13, 2013

PRISM-RS Project Meeting

Outline

- Tides vs. No tides model comparison
- Ross Bank

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- Tides vs. No tides model comparison
- Ross Bank
- 1.5km model status
- Conclusion

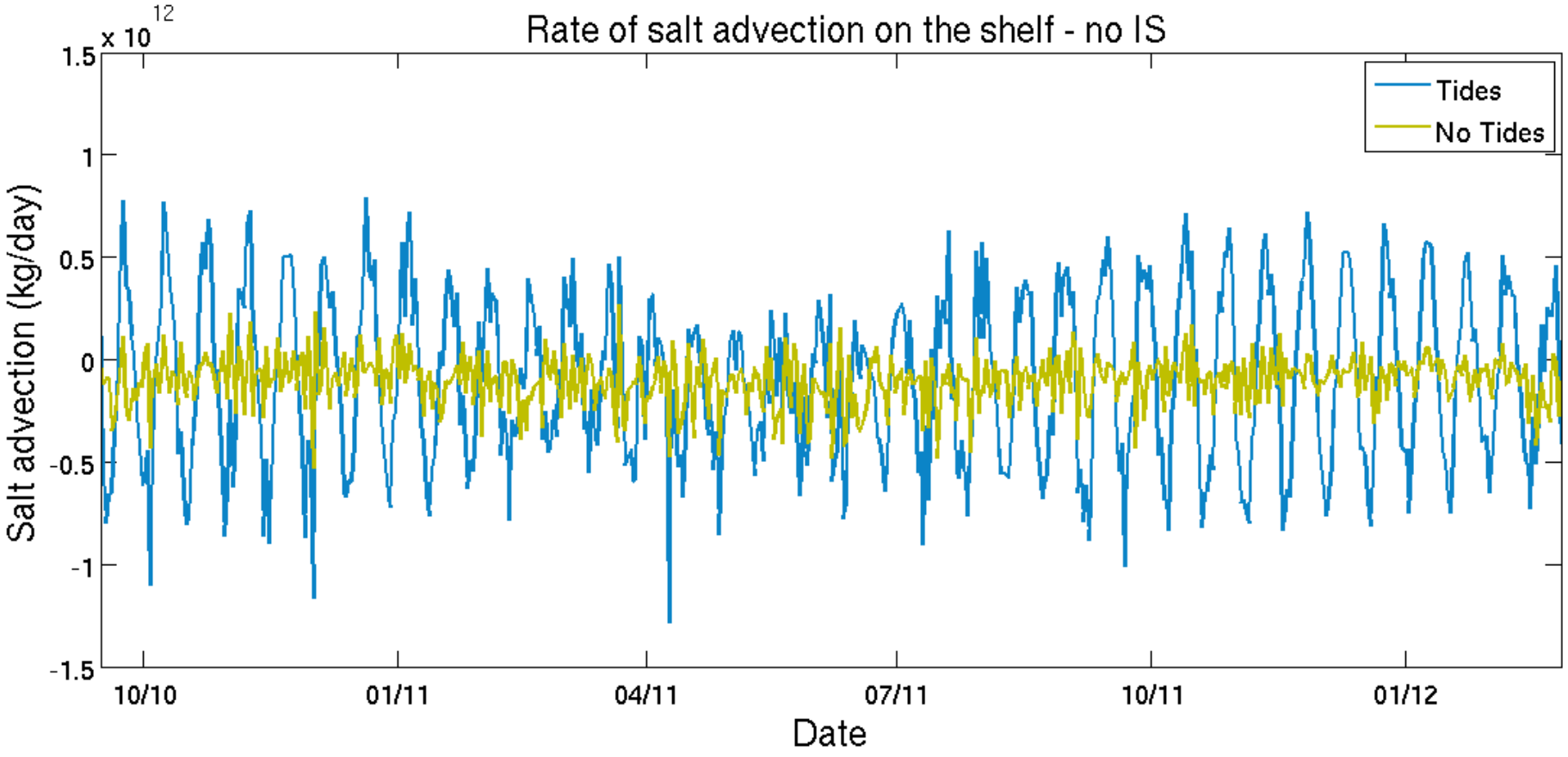
Model Review

- Ross Sea from 15 Sept 2010 - 29 Feb 2012
- 5km grid
  - Tides, no tides, Tides & BBL
  - Daily output, add in 4-hrly over PRISM time
- 1.5km grid
  - In progress, tides

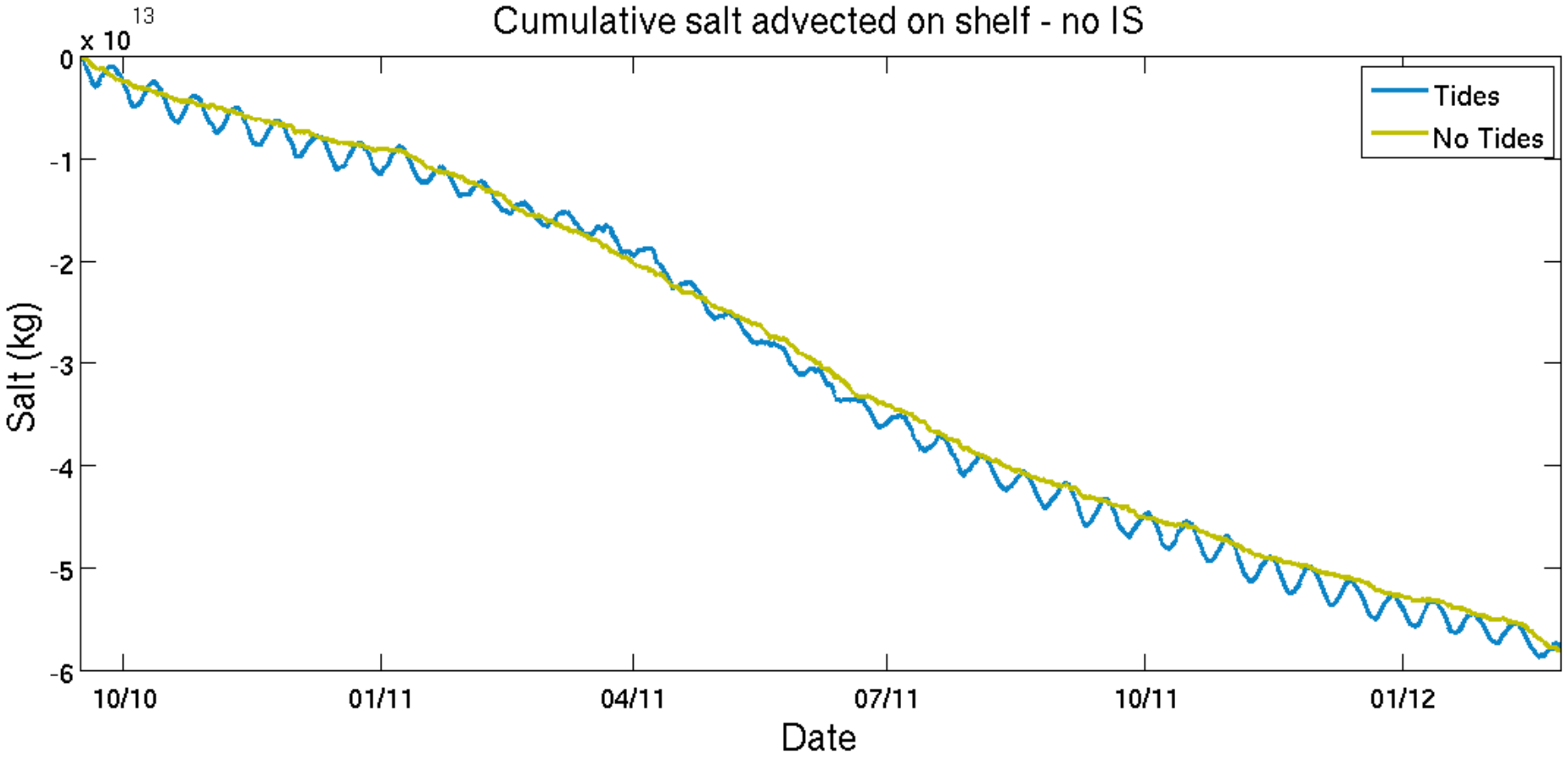
Tides vs. No Tides

- Compare water mass volumes & properties
  - Salt content (changes) on shelf
  - CDW intruding on shelf
  - AABW formed
  - HSSW on shelf
  - Etc…
- Compare to Orsi climatologies
- Calculate model error/drift

Salt advection on shelf

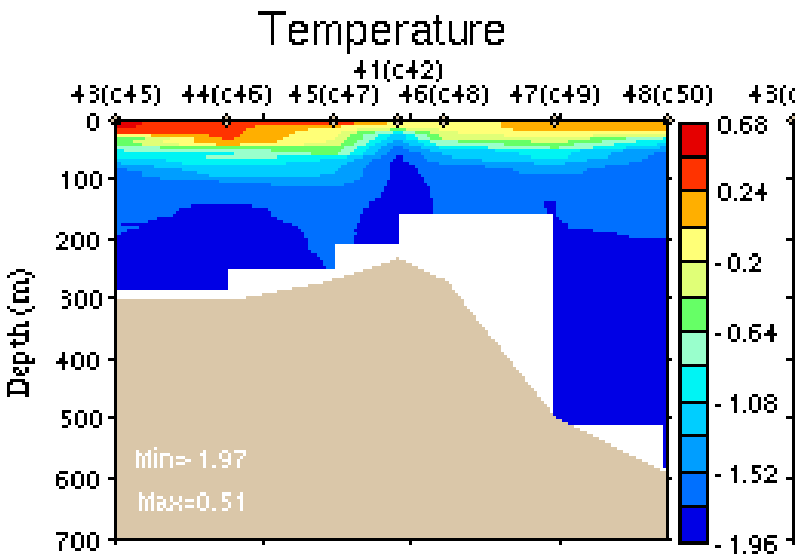


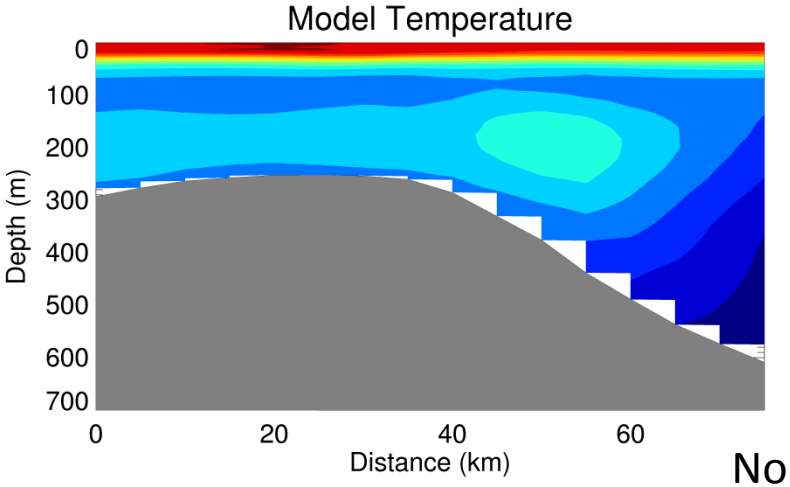
Salt advection on shelf



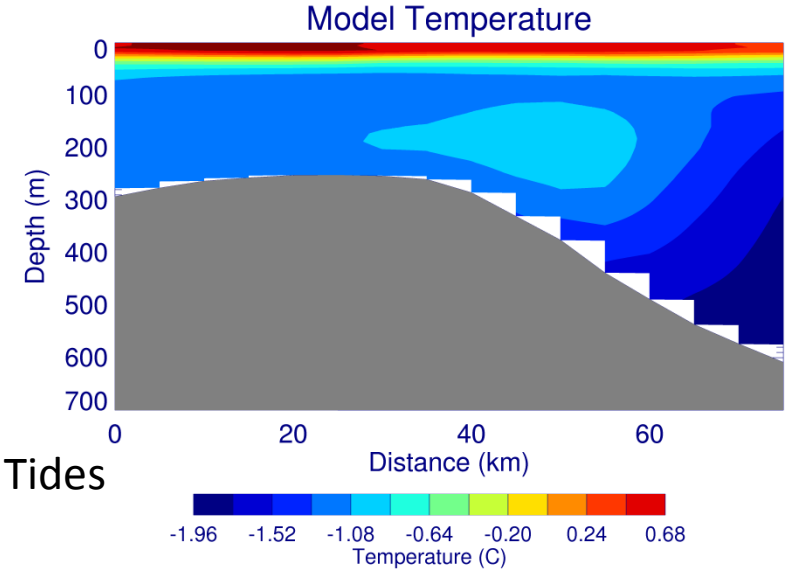
Ross Bank

N/S Section

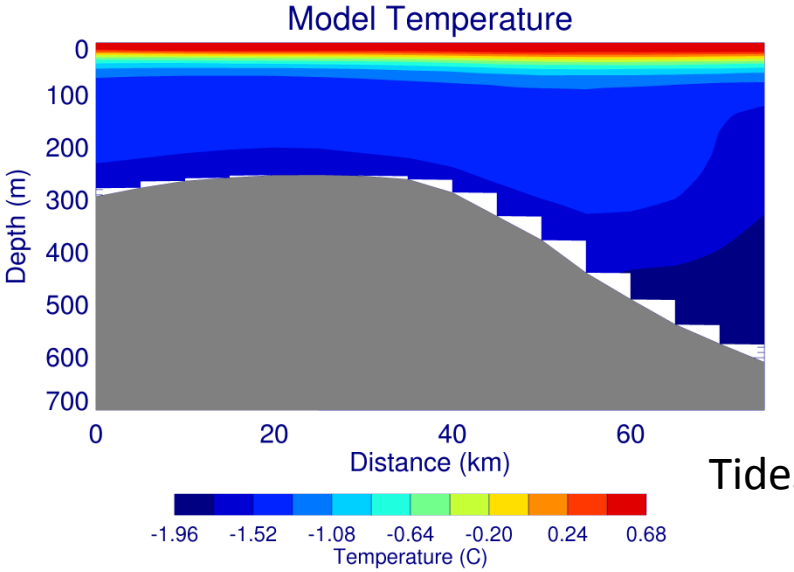




No tides



Tides



Tides + BBL

Ross Bank

- Compare different model runs + data
  - Tides, No Tides, Tides + BBL
- To be presented by Mike
- Focus mainly on model results & not overlap with Blair's presentation

1.5km Model Update

- Currently running tests on timing – can we run it here, or use Yellowstone?
- Need to update bathymetry
- Probably will not be ready in time to include preliminary data in OSM presentation

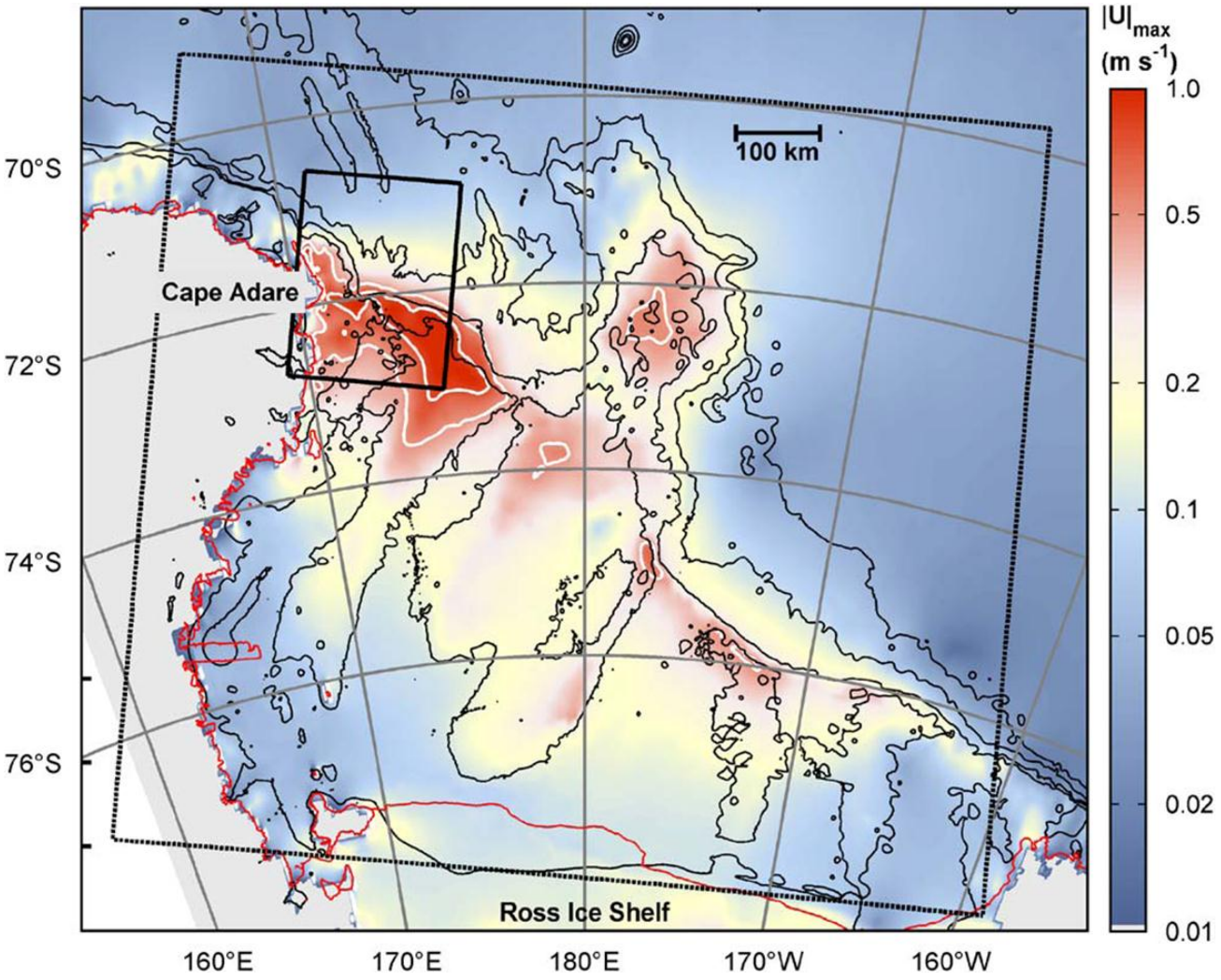
Conclusion

- Overall goal is to quantify the effect of tides on processes that affect water masses in the Ross
  - Namely, mixing
- Keep in touch w/ Blair on Ross Bank
- Model animations are available to pre-order
  - Typically come in animated GIF format
  - 5km, with or without tides
  - Daily snapshots or possibly 4-hrly over PRISM time

Abstract

Tides in the Ross Sea are thought to play an important role in many processes including ice shelf basal melt, sea ice concentration, and bottom water formation. Using a regional ocean model, we compare water mass properties and term balances of heat and salt from simulations with and without tides to determine the magnitude of the tidal contribution to different processes. Specifically, we examine the changes in volume of High Salinity Shelf Water on the continental shelf, the amount of Antarctic Bottom Water formed, and the amount of Circumpolar Deep Water that intrudes onto the shelf. Adding tides also significantly improves agreement between the model and observations over some banks, as shown by a comparison with observations over Ross Bank from the PRISM-RS project. This is important as Ross Bank is a key location for upward mixing of biologically limiting dissolved iron from sediments and the addition of tides improves our estimates of the magnitude of this process.

Ross Sea Tides



Padman et al, DSRII, 2009

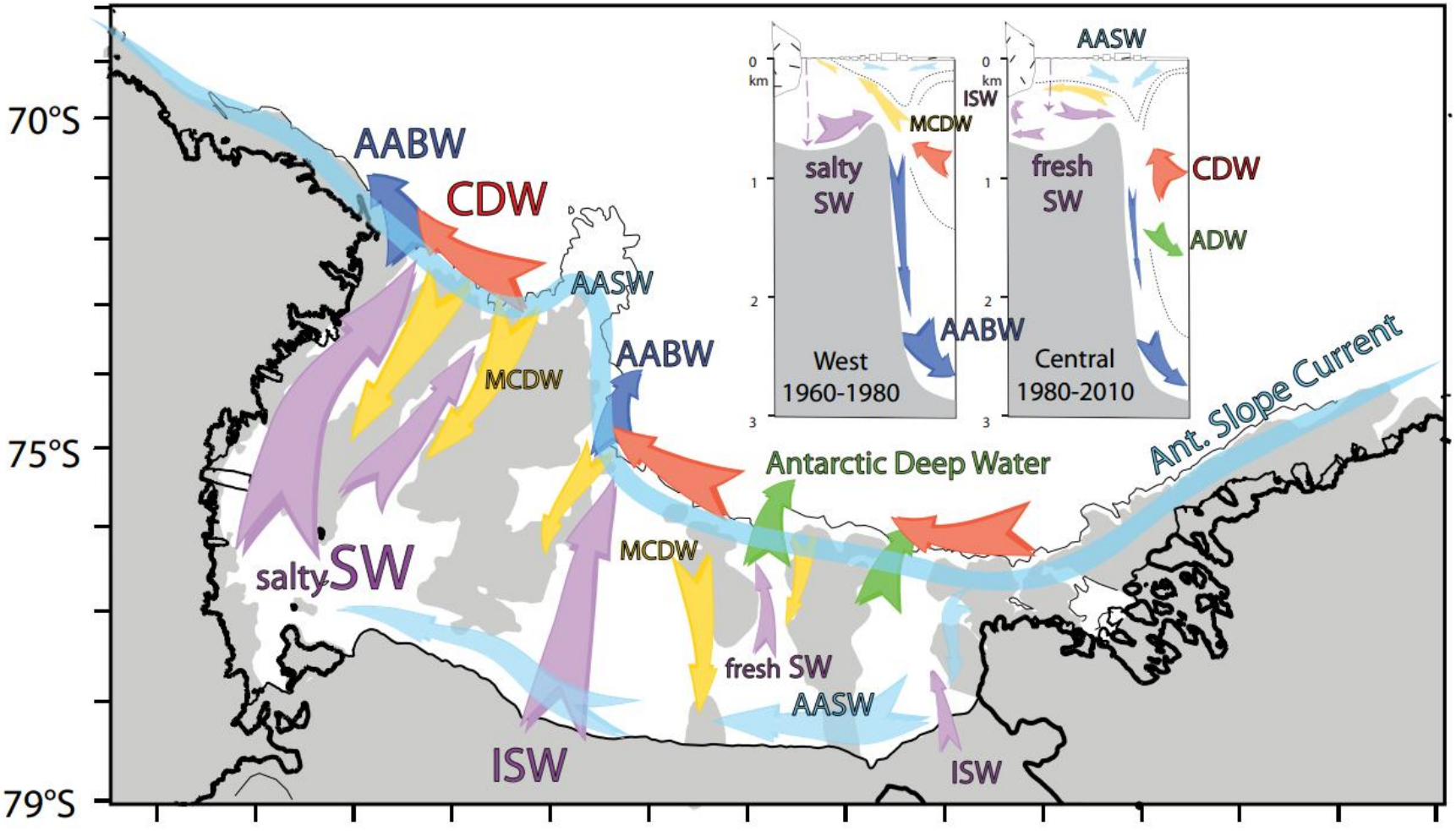
Ross Sea Model

- ROMS: 5 km horizontal resolution, 24 levels
- Ice shelves (mechanical and thermodynamic)
- Dynamic sea-ice
- Different wind forcing, but typically either from Antarctic Mesoscale Prediction System (AMPS) or ERA-Interim
- Lateral boundary conditions from WOA, OCCAM and SSM/I ice concentrations
- Bathymetry from BEDMAP and Davey
- Experiments w/ dye representing CDW

New Model Run for PRISM

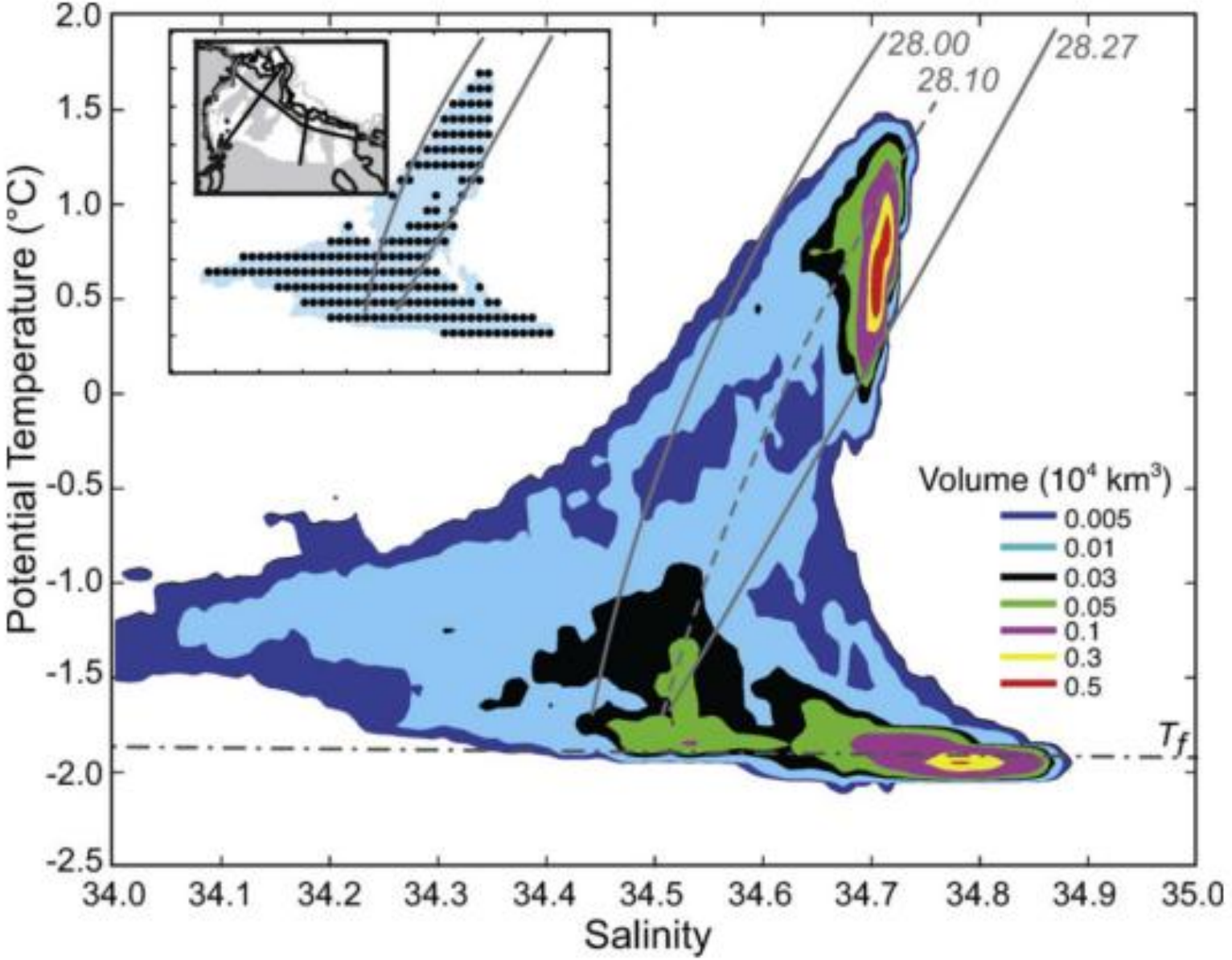
- Sept. 15, 2010 – Feb. 29, 2012
- Model fields saved every 12 hours for entire run
- Forced with 6-hourly winds and air temperatures from the new higher resolution (0.75°) ERA-Interim product
- Had to switch to coarser (25-km) SSMIS sea-ice from AMSR-E (12.5-km)
- Fixed small bug in the sea-ice code
- Two new dye tracers: Ice Shelf meltwater and sea-ice meltwater

Large Scale Circulation

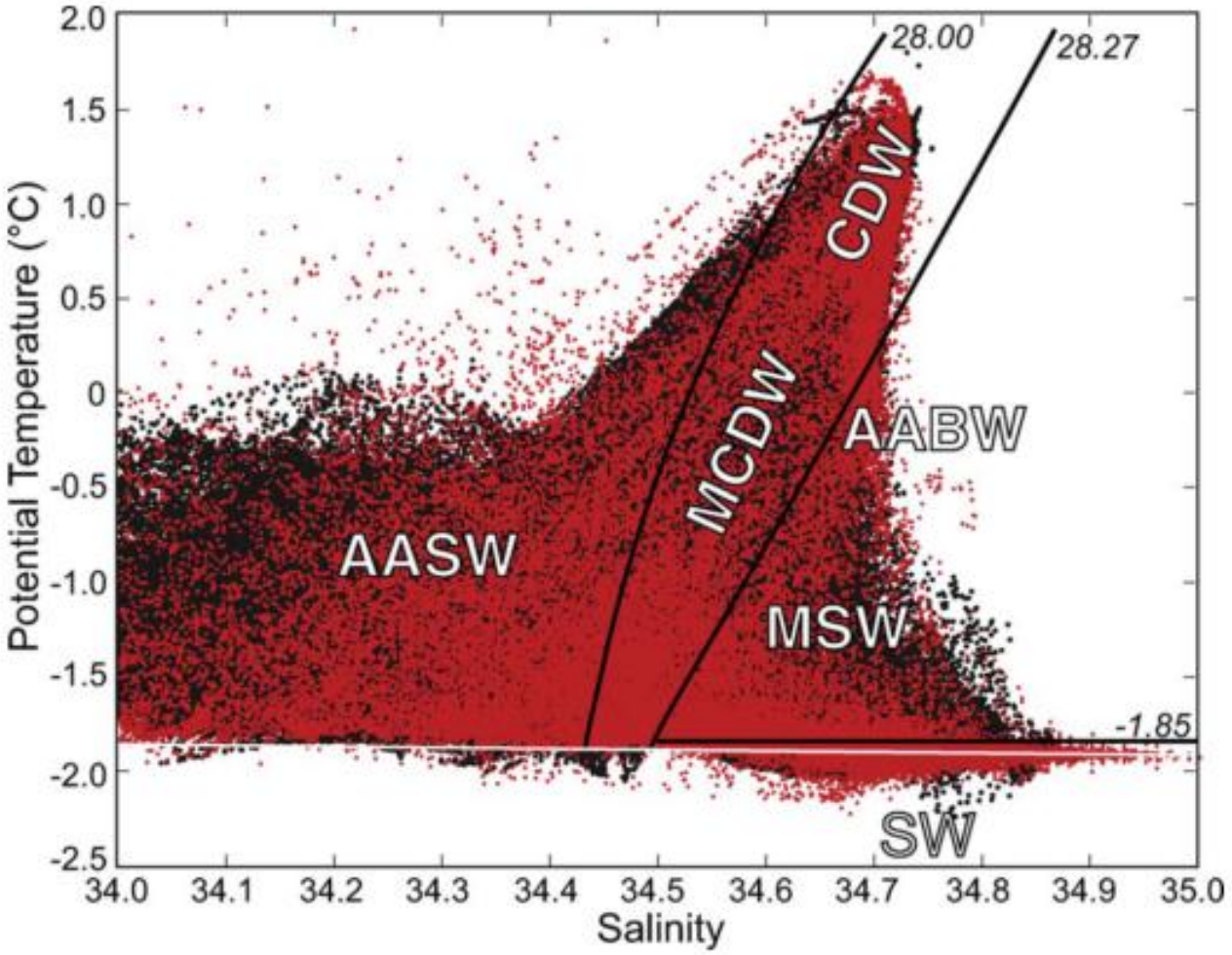


Smith et al, Oceanography, 2012

A.H. Orsi, C.L. Wiederwohl / Deep-Sea Research II 56 (2009) 778–795



Ross Sea Water Masses



Orsi & Wiederwohl, DSRII, 2009

Definitions of water masses

Water Mass	Density	Temperature	Salinity
AASW	<28.0	All	All
(M)CDW	[28, 28.27]	All	All
ISW	>28.27	<-1.95	All
MSW	>28.27	>-1.85	All
SW	>28.27	[-1.95, -1.85]	All
LSSW	>28.27	[-1.95, -1.85]	<34.62
HSSW	>28.27	[-1.95, -1.85]	>34.62

Orsi & Wiederwohl, DSRII, 2009