Increasing complexity of NEMO for climate applications by explicitly simulating the large sub-ice shelf seas

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 898058

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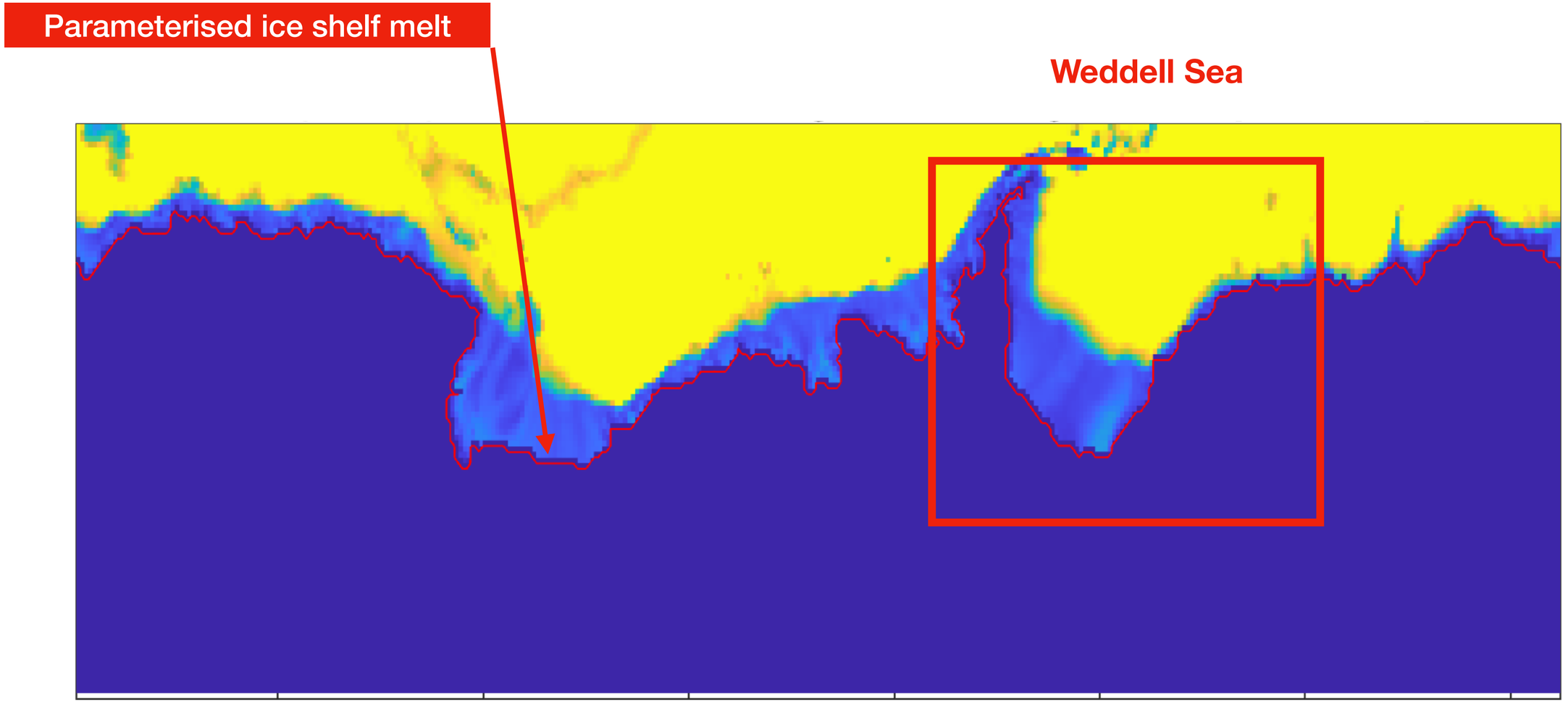
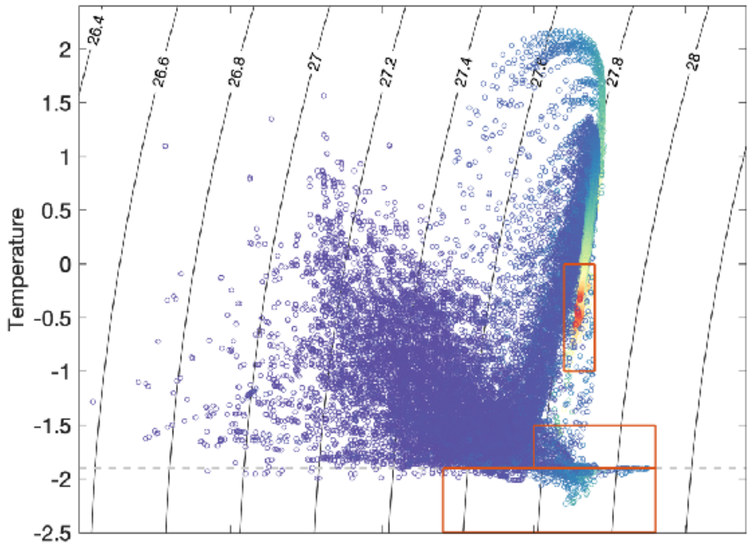
Bathymetry of ORCA1

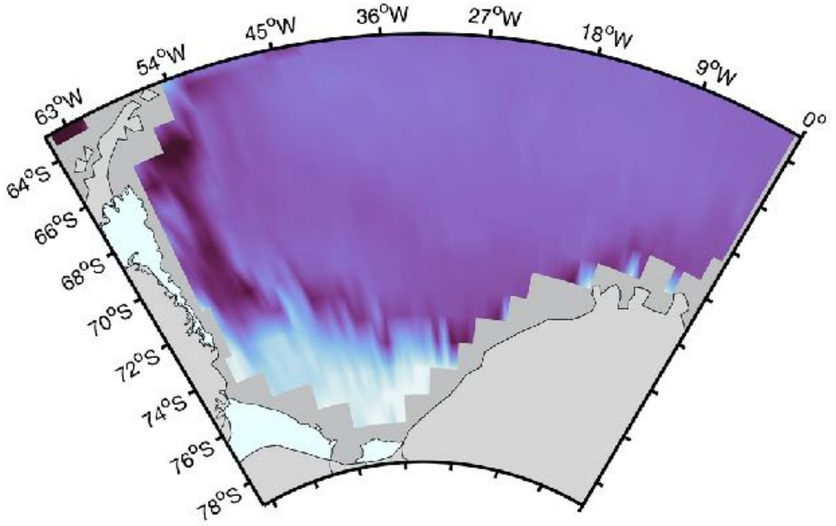


For the same results but pertaining to Ross Ice shelf, please checkout the extra slides of the presentation pdf

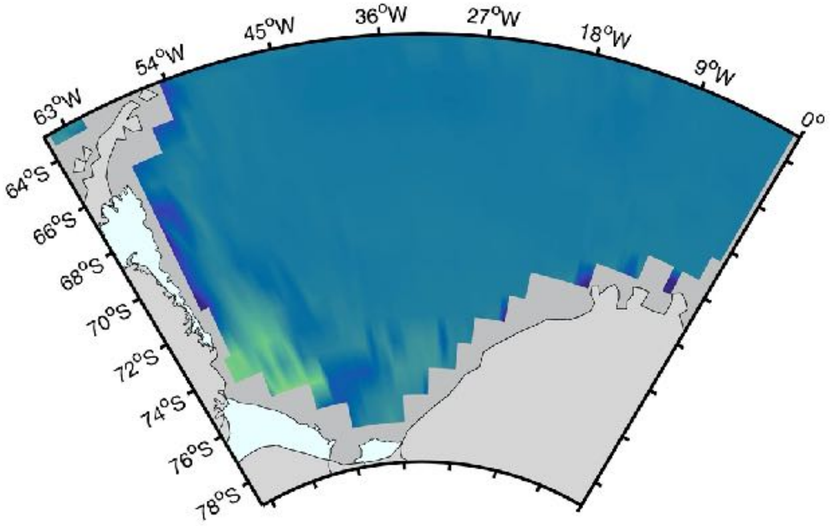
WOA T-S Weddell



WOA Bottom Temp Weddell



WOA Bottom Salt Weddell

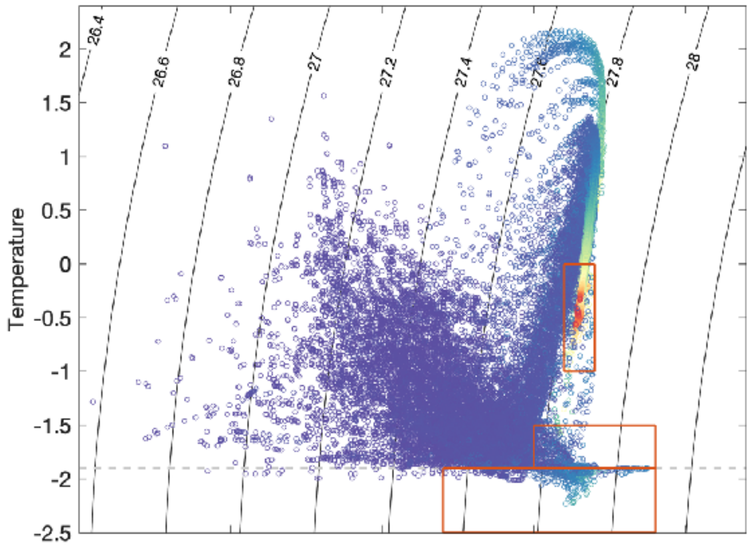


NEMO 4.2 T-S Weddell

NEMO 4.2 Bottom Temp Weddell

NEMO 4.2 Bottom Salt Weddell

WOA T-S Weddell



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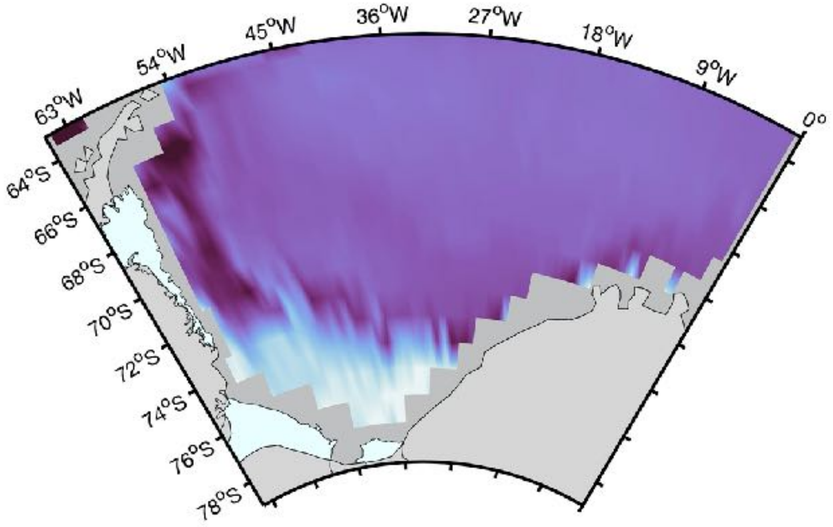
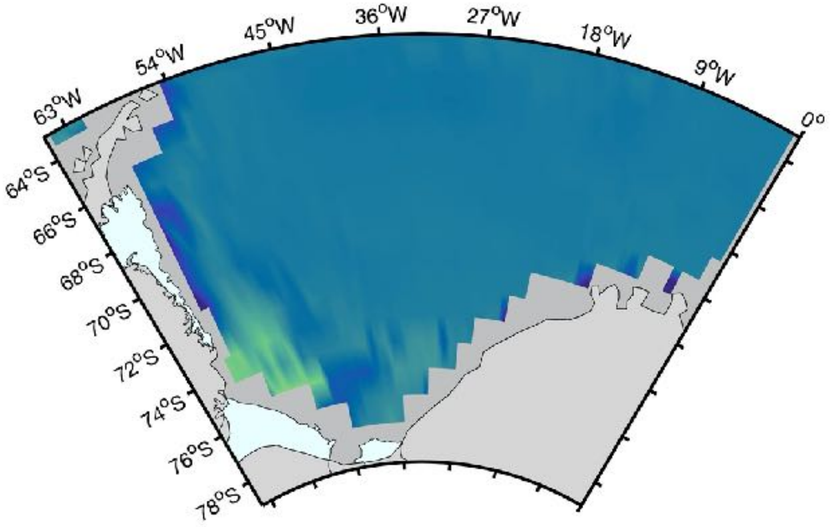


WOA Bottom Salt Weddell



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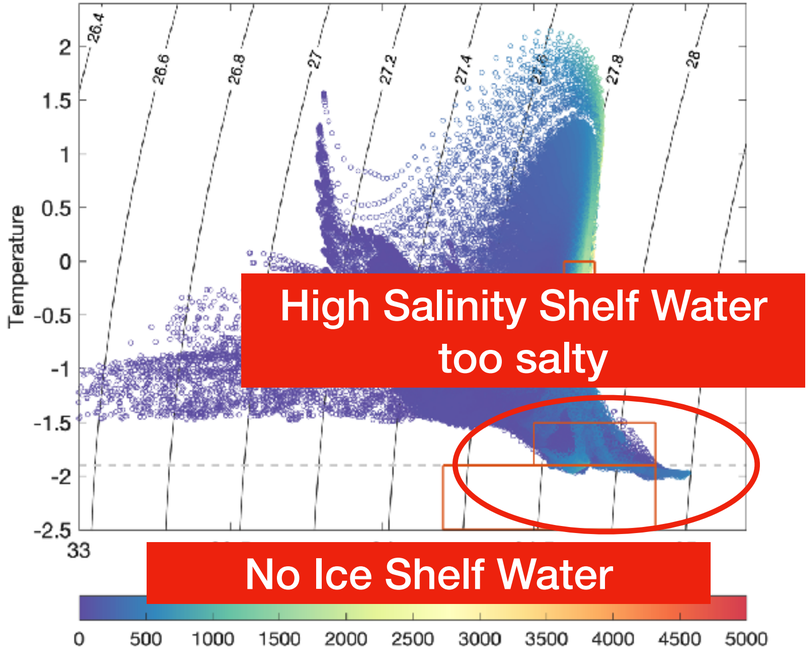
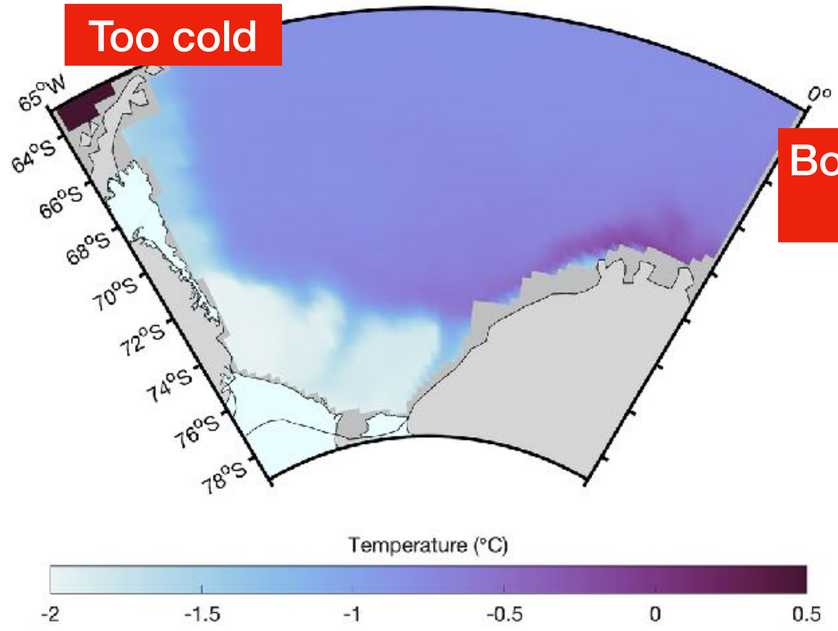


High Salinity Shelf Water too salty

No Ice Shelf Water

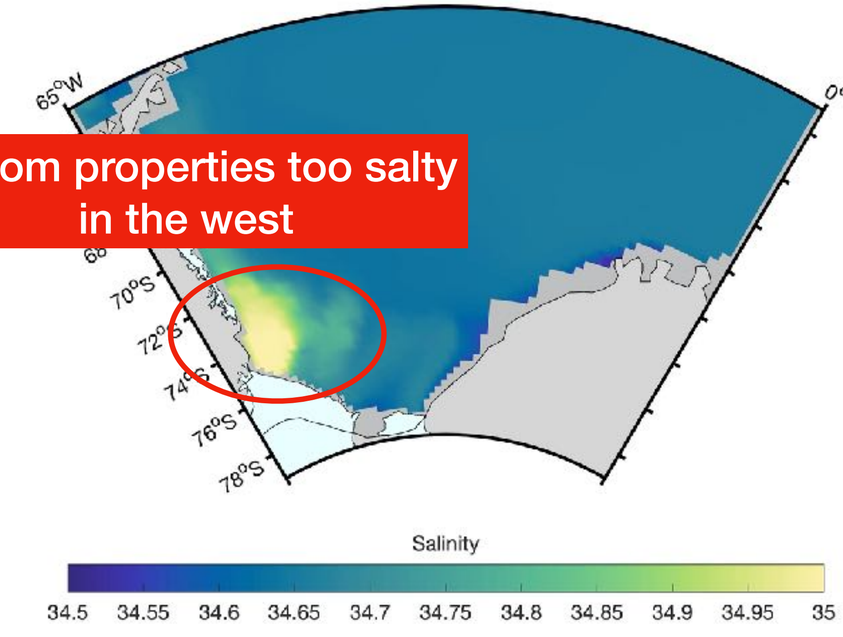
NEMO 4.2 Bottom Temp Weddell

Too cold



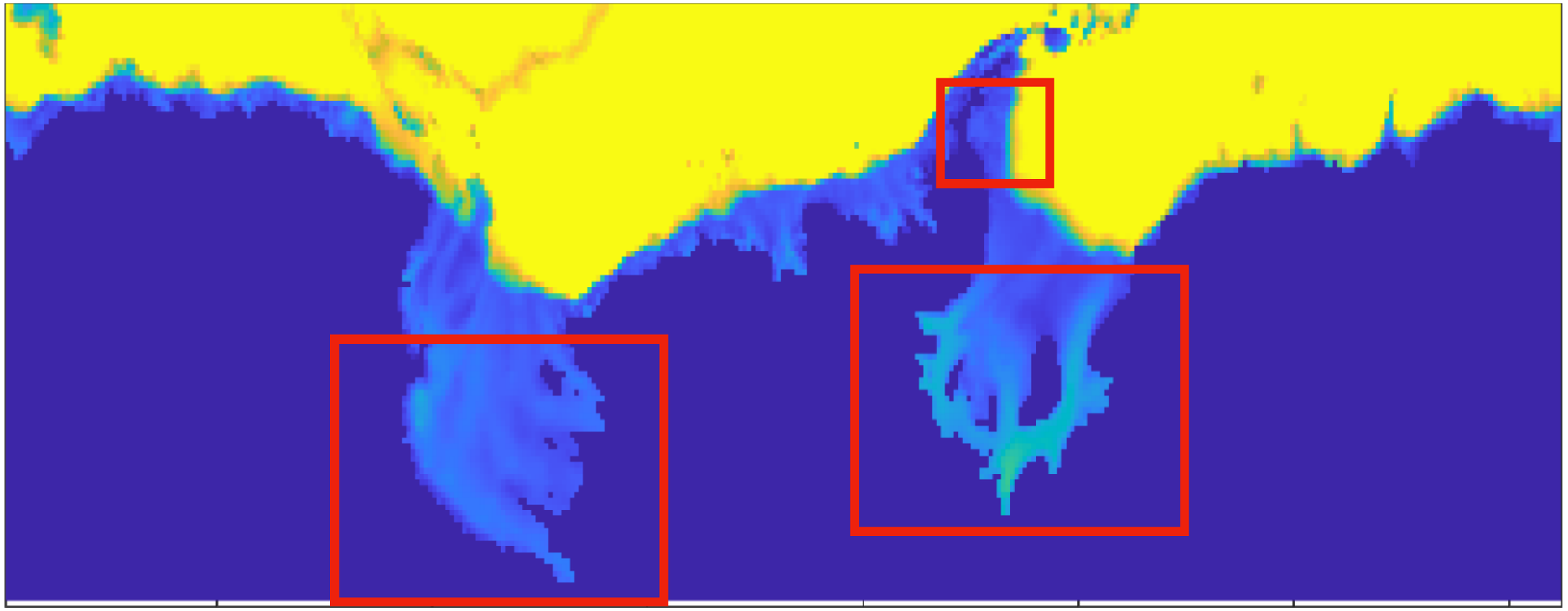
NEMO 4.2 Bottom Salt Weddell

Bottom properties too salty in the west

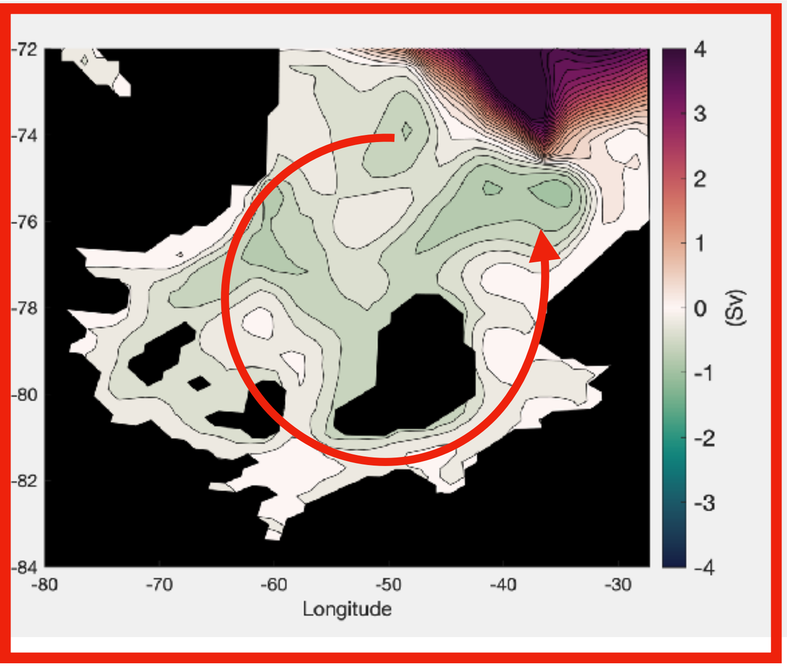


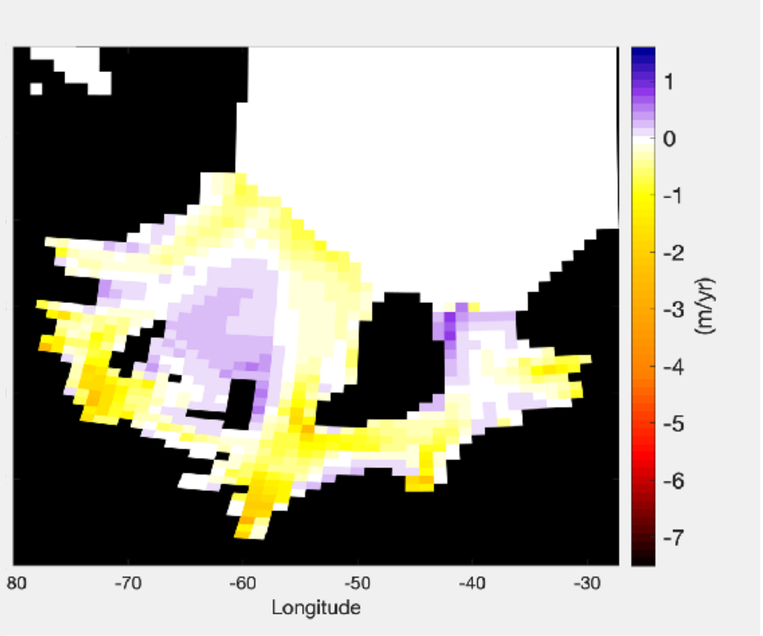
Bathymetry of eORCA1

Now we open the large cold Antarctic sub-ice shelf cavities in eORCA1 NEMO 4.2

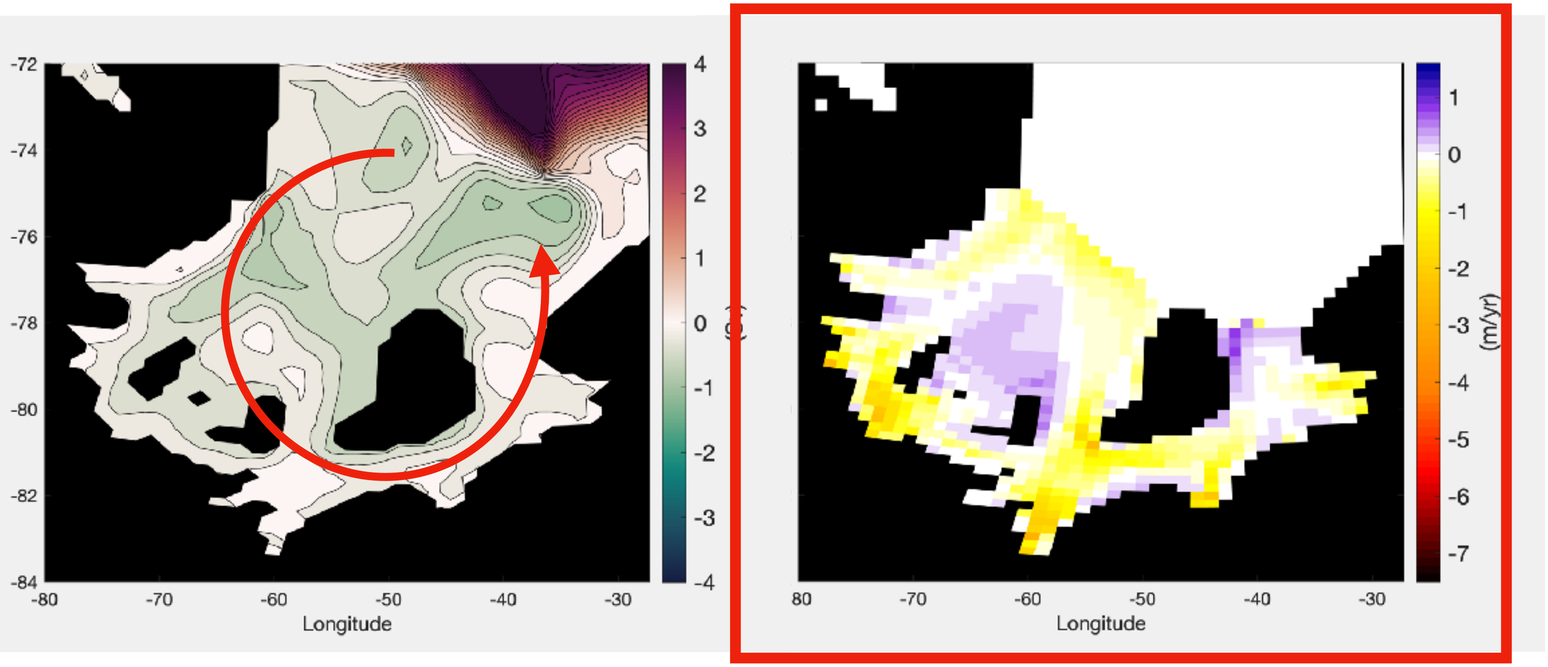


Only open FRIS, Ross & LCIS





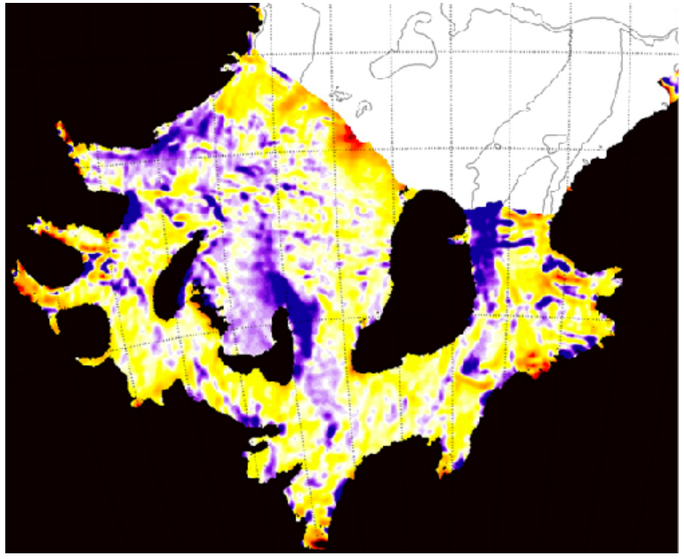
FRIS	Net Melt (Gt/yr)
eORCA1 2 cycles 1995-2009	117
Depoorter 1995-2009	50
Adsumilli 1994-2018	81
eORCA1 2 cycles 2003-2008	104
Rignot 2003-2008	155
eORCA1 last 5 yr forcing	95
Hausmann 1/12 NEMO last 5yr forcing	159



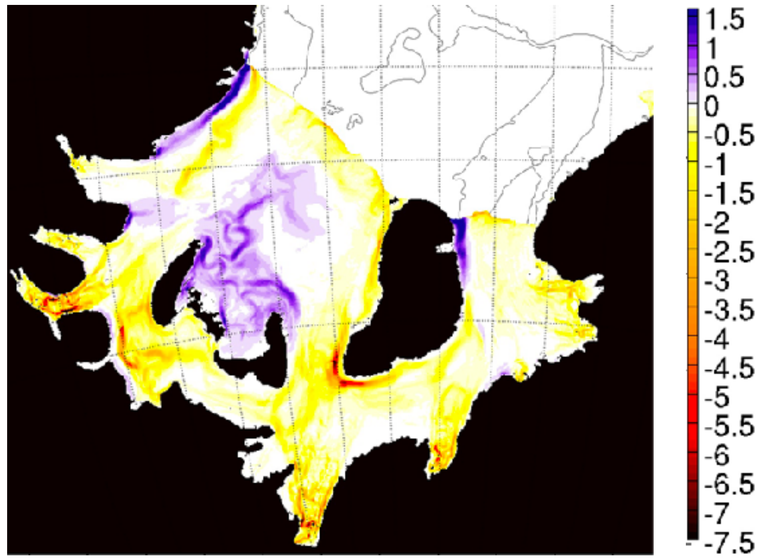
FRIS	Net Melt (Gt/yr)
eORCA1 2 cycles 1995-2009	117 ↑
Depoorter 1995-2009	50
Adsumilli 1994-2018	81
eORCA1 2 cycles 2003-2008	104 ↓
Rignot 2003-2008	155
eORCA1 last 5 yr forcing	95 ↓
Hausmann 1/12 NEMO last 5yr forcing	159

From Hausmann et al., 2020

Rignot et al., 2013 (**Satellite Obs**)

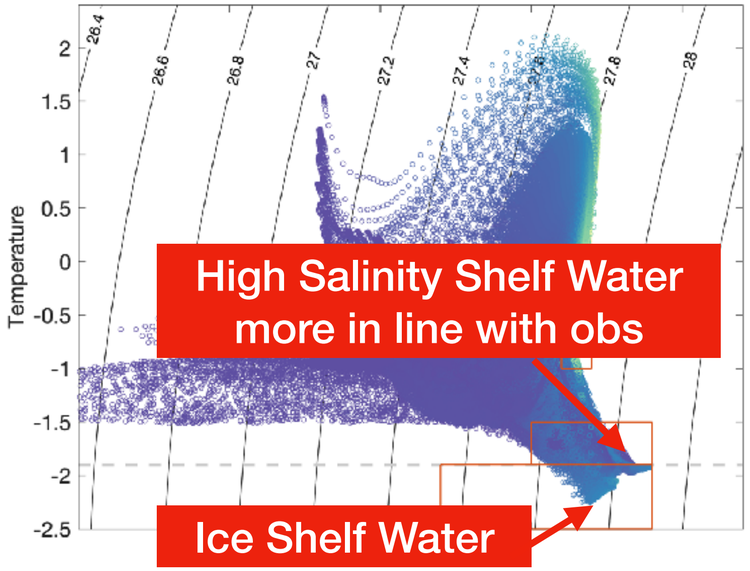


Hausmann et al., 2020 (**NEMO regional 1/12°**)

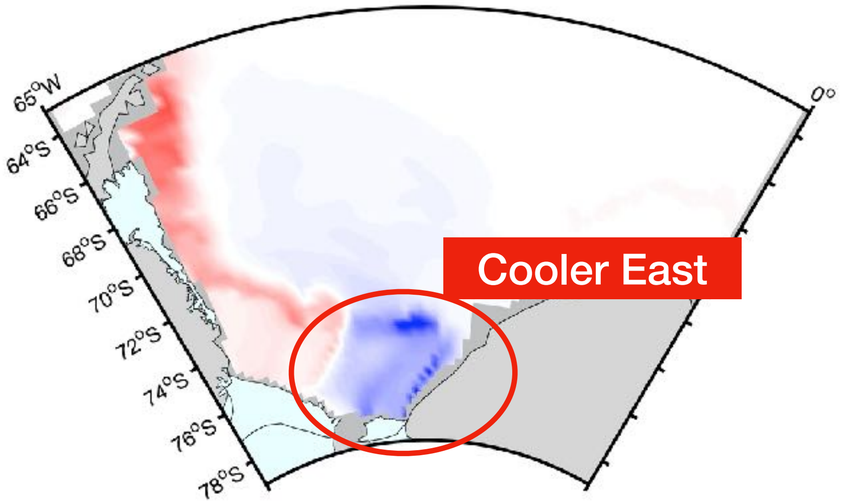


Pattern of melt compares well with satellite observations and high resolution regional model

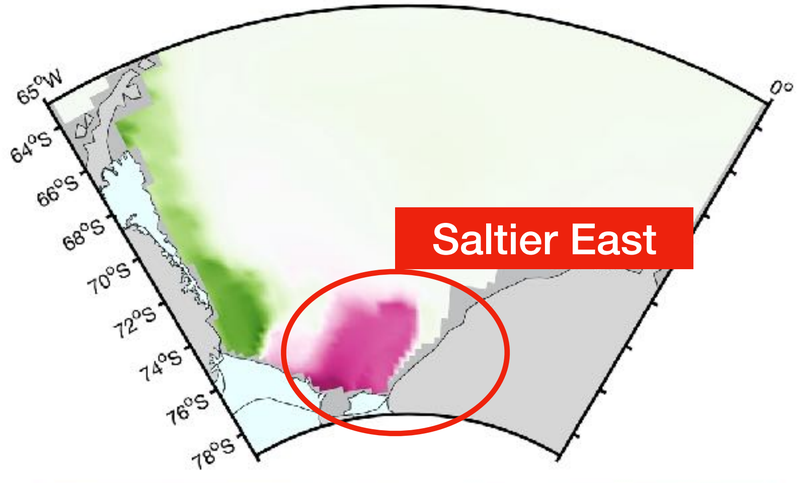
OPEN CAV T-S Weddell

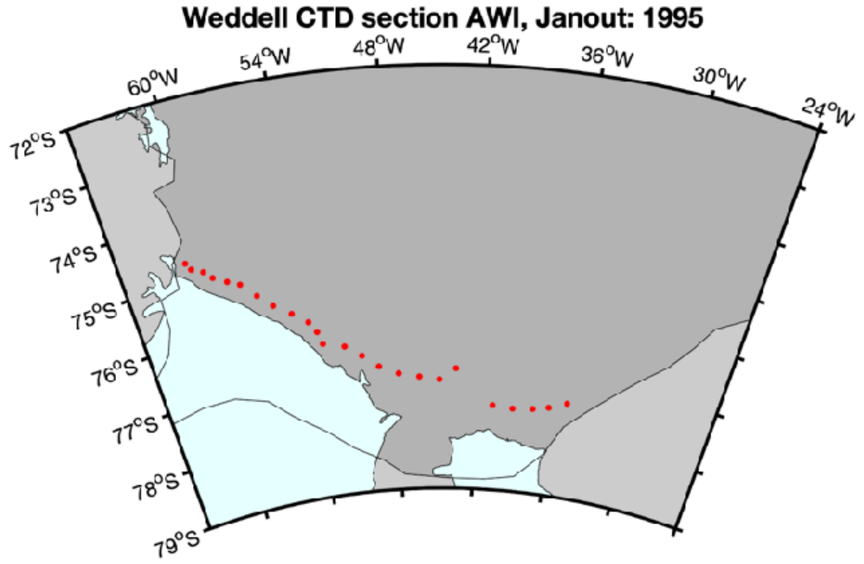


OPEN - CLOSED Bottom Temp Weddell



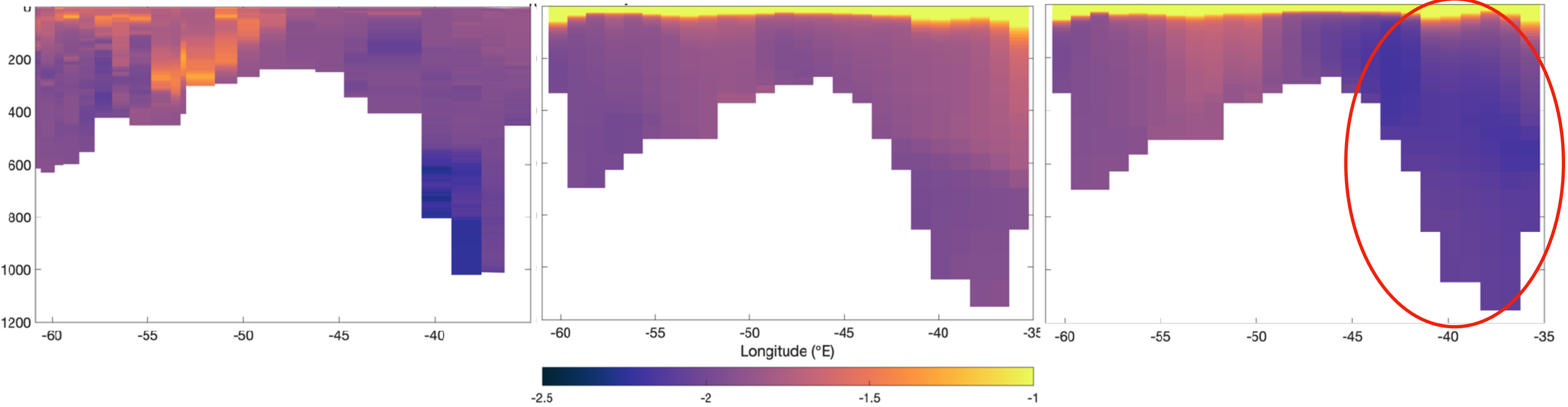
OPEN - CLOSED Bottom Salt Weddell

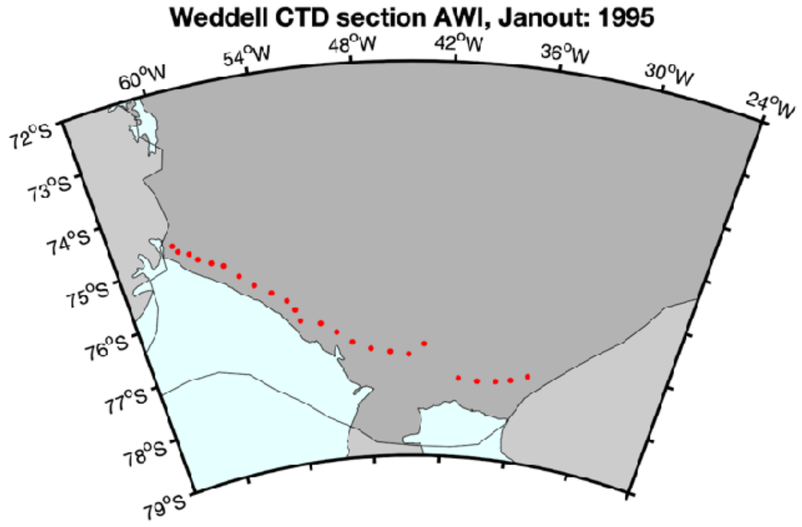




See presence of outflowing ISW within Filchner Trough

CTDs | CLOSED isf cavity | OPEN isf cavity



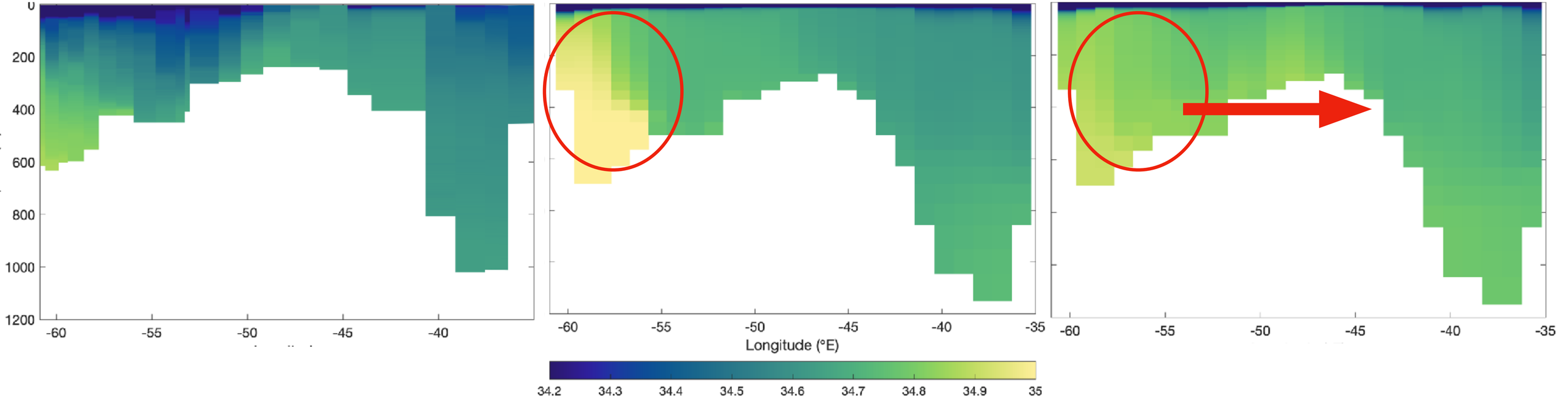


HSSW focused the west now speed out over continental shelf

CTDs

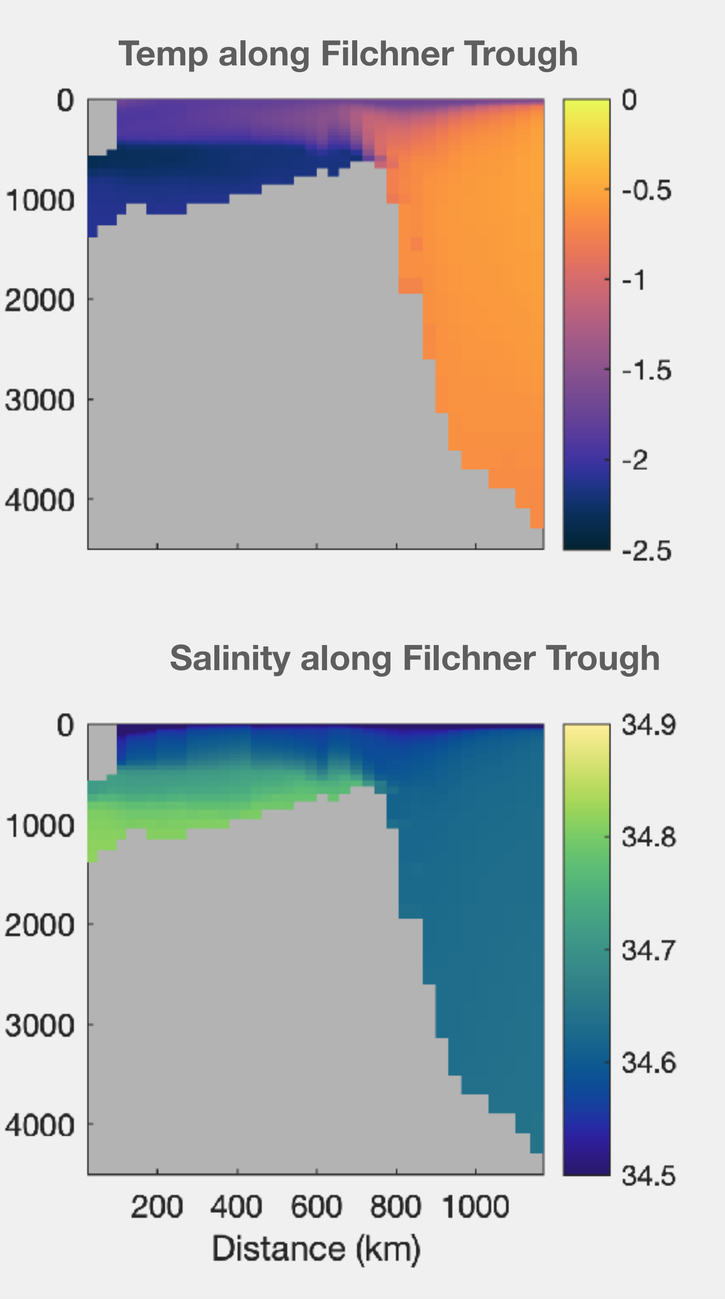
CLOSED isf cavity

OPEN isf cavity



Summary

- Opening the large, cold sub-ice shelf cavities in eORCA1 gives realistic circulation and melt rate patterns.
- The properties on the continental shelf are more in line with observations and the changes observed are in agreement with regional high res model results.
- A challenge remains to transport the dense shelf water down the continental slope and offshore to impact the properties of Bottom Water.



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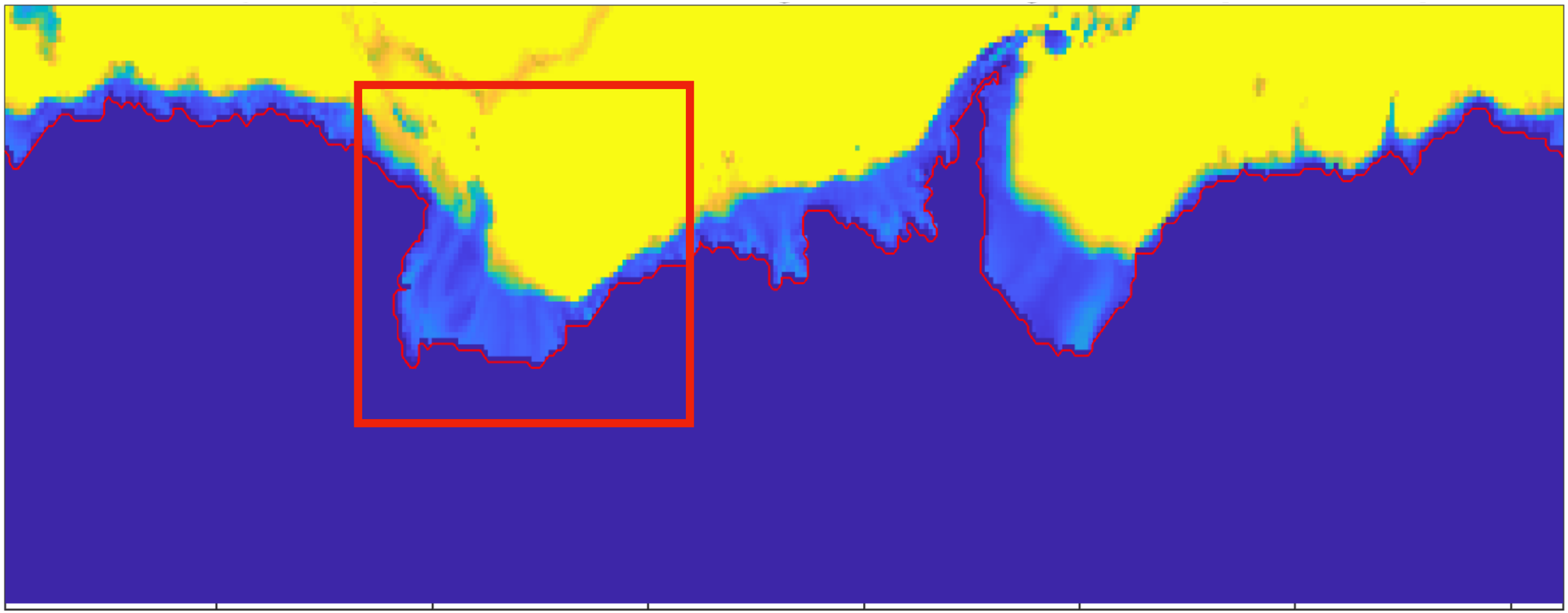
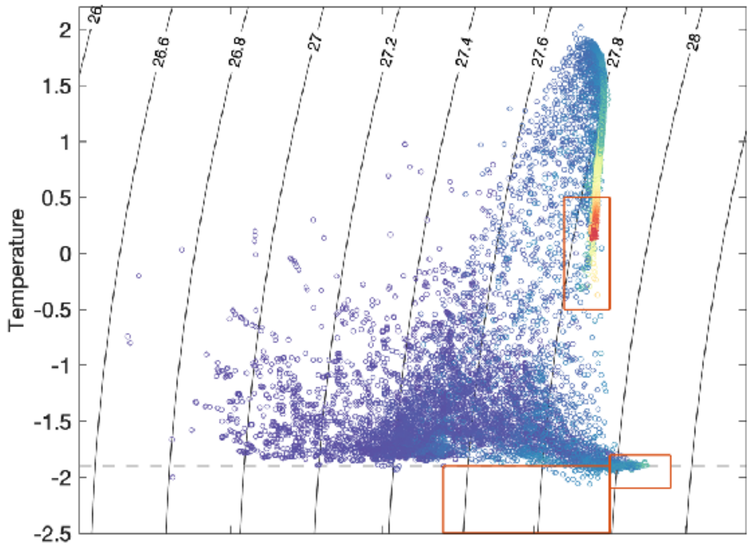
Slides for Ross Sea and Ice Shelf…

Bathymetry of ORCA1

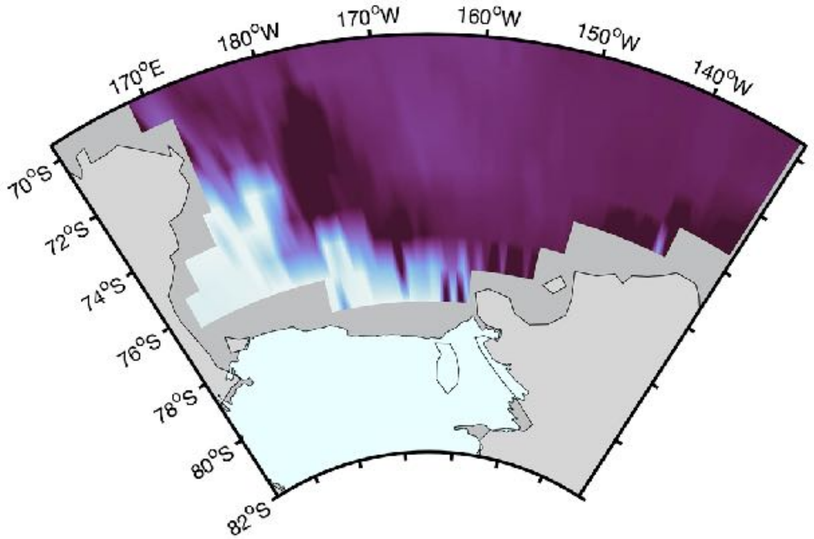
Ross Sea



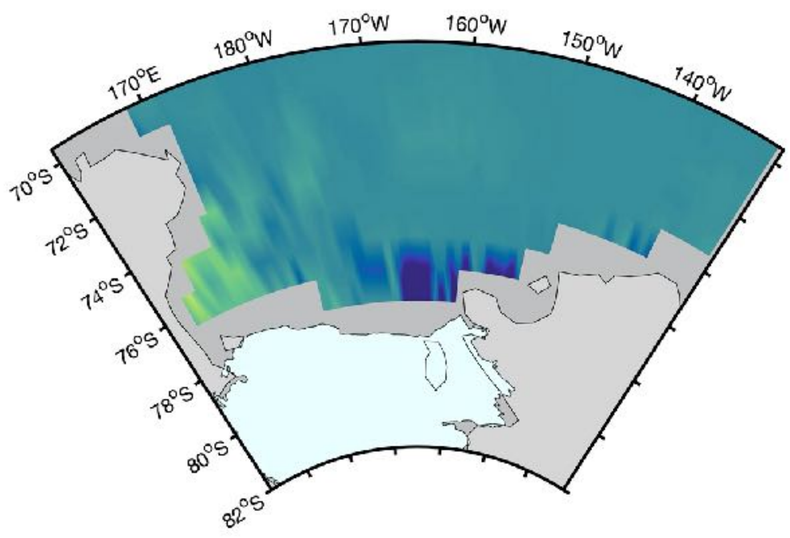
WOA T-S Ross



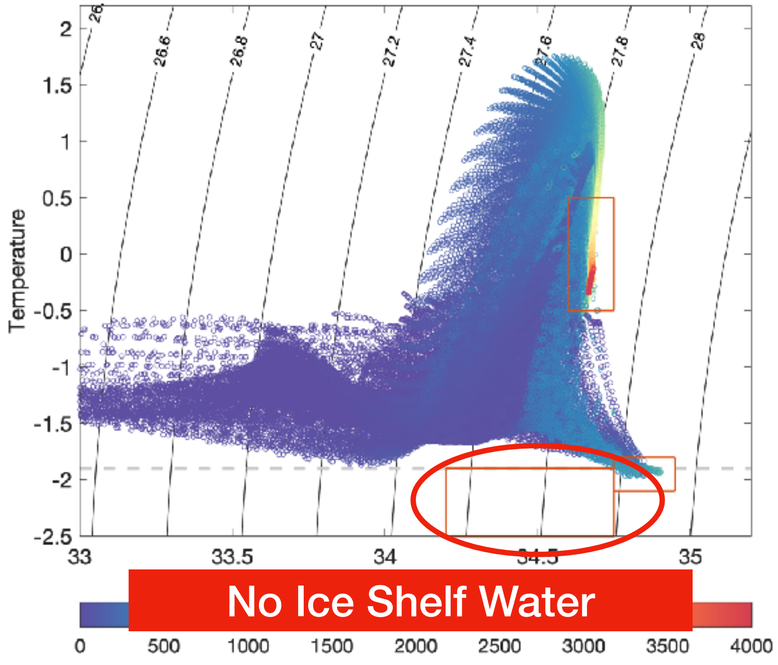
WOA Bottom Temp Ross



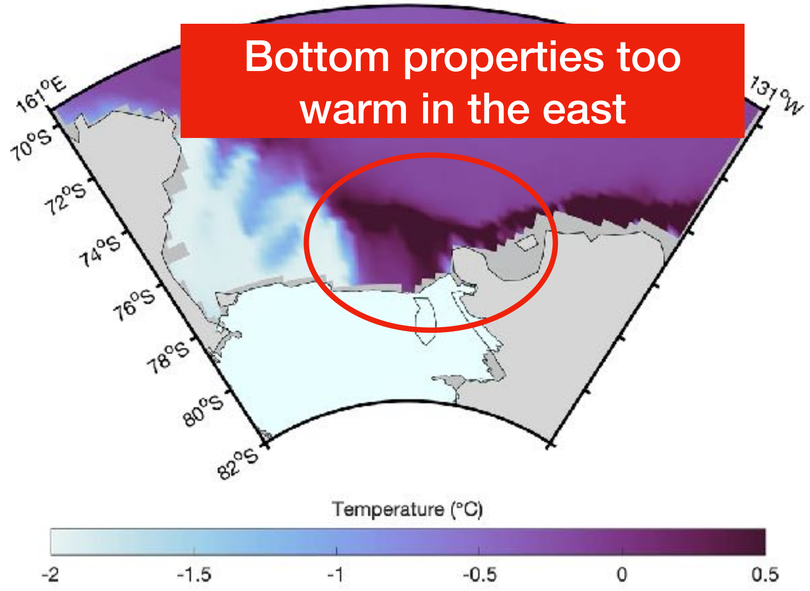
WOA Bottom Salt Ross



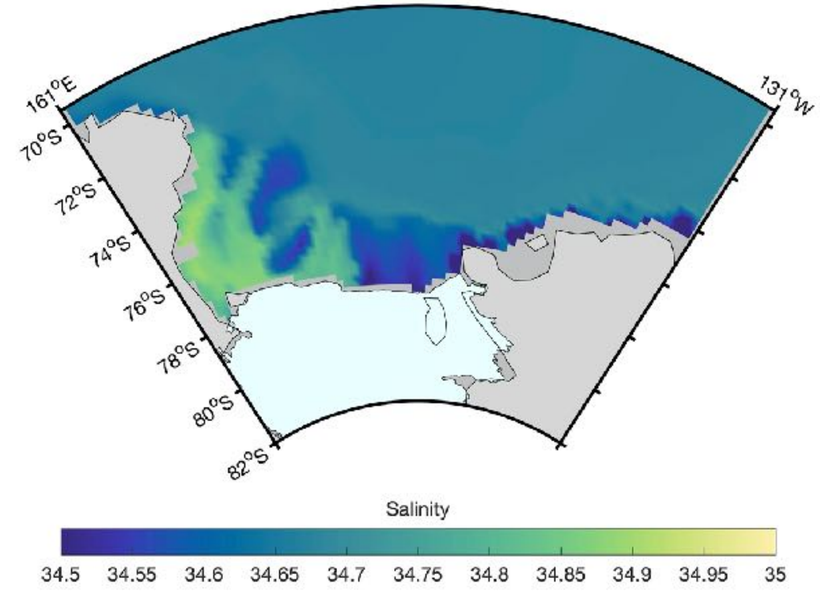
NEMO 4.2 T-S Ross



NEMO 4.2 Bottom Temp Ross

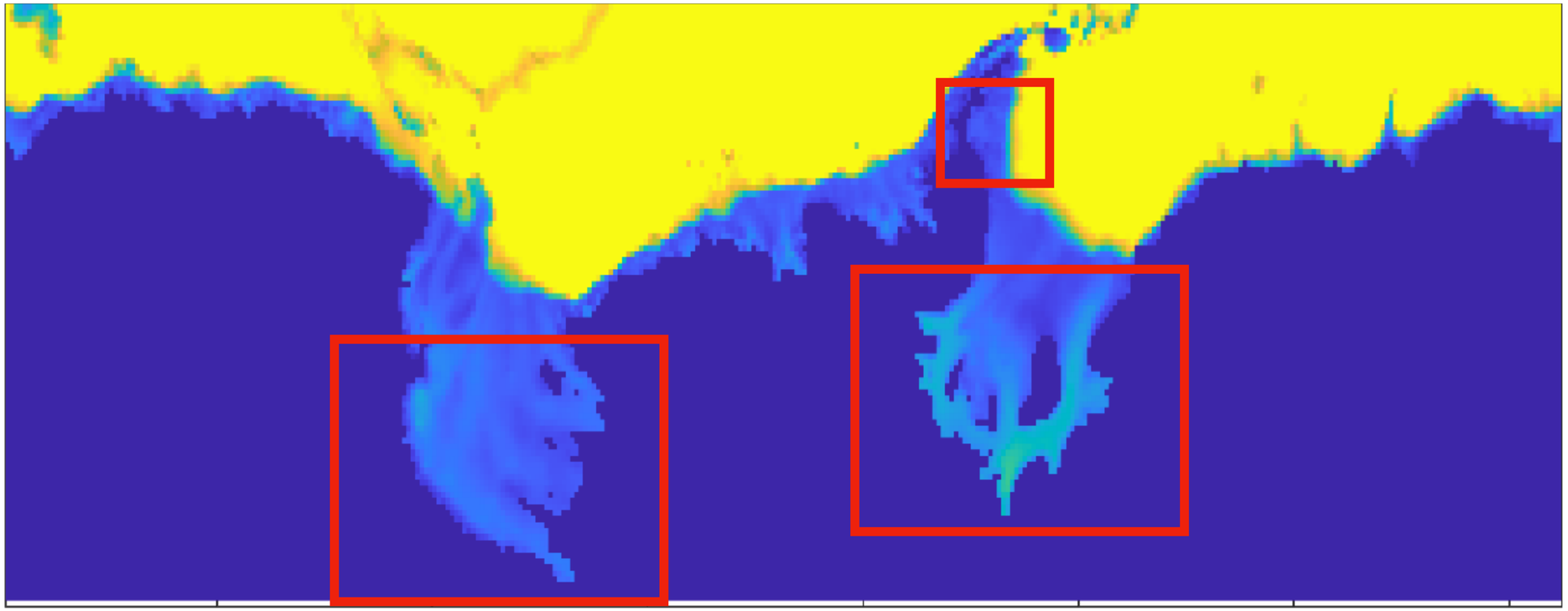


NEMO 4.2 Bottom Salt Ross

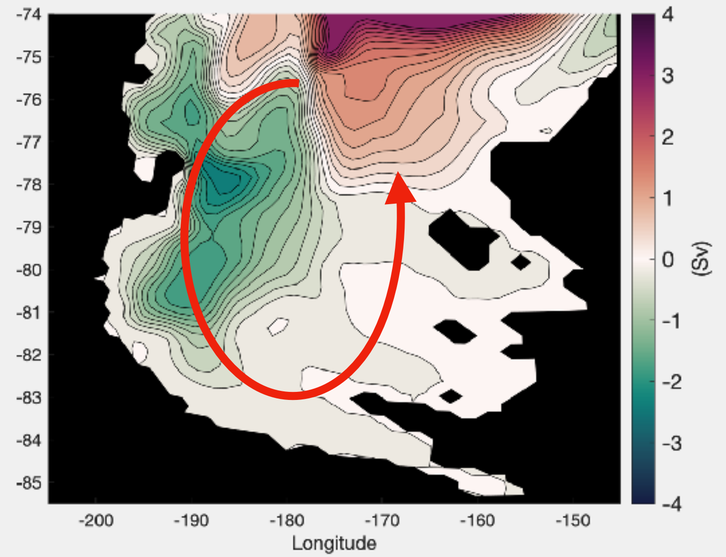


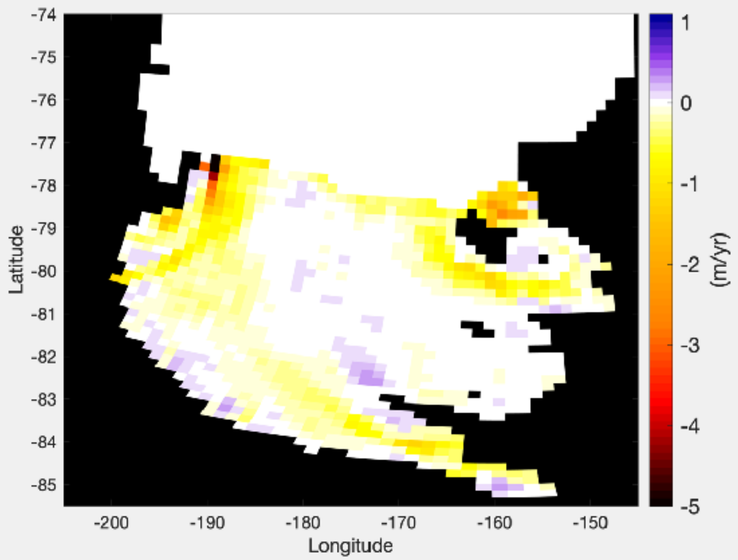
Bathymetry of eORCA1

Now we open the large cold Antarctic sub-ice shelf cavities in eORCA1 NEMO 4.2



Only open FRIS, Ross & LCIS



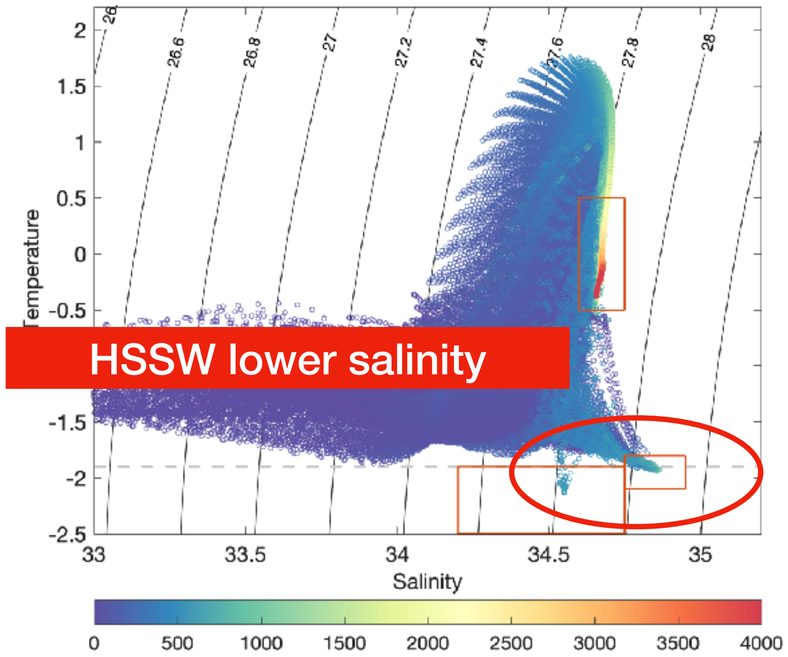


ROSS	Net Melt (Gt/yr)
eORCA1 2 cycles 1995-2009	112
Depoorter 1995-2009	34
Adsumilli 1994-2018	80
eORCA1 2 cycles 2003-2008	131
Rignot 2003-2008	48

OPEN CAV T-S Ross

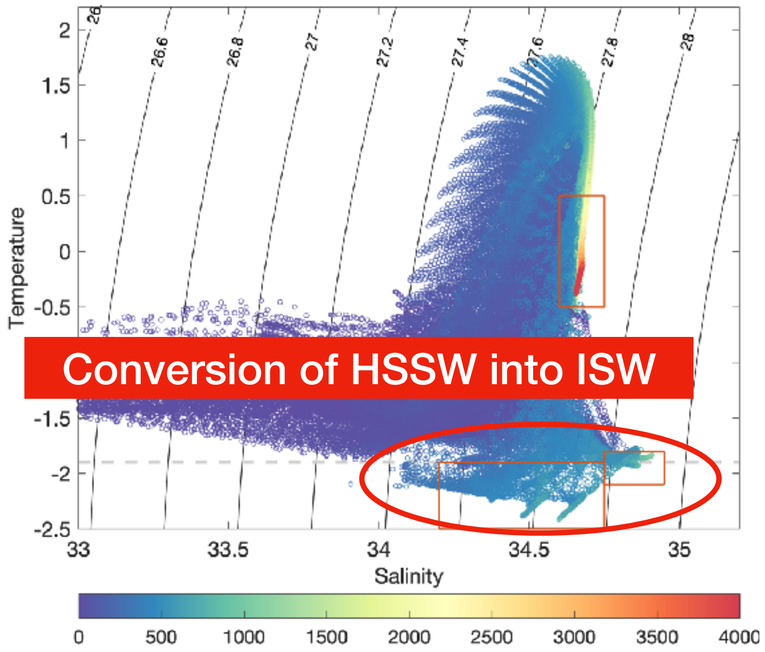
OPEN - CLOSED Bottom Temp Ross

OPEN - CLOSED Bottom Salt Ross

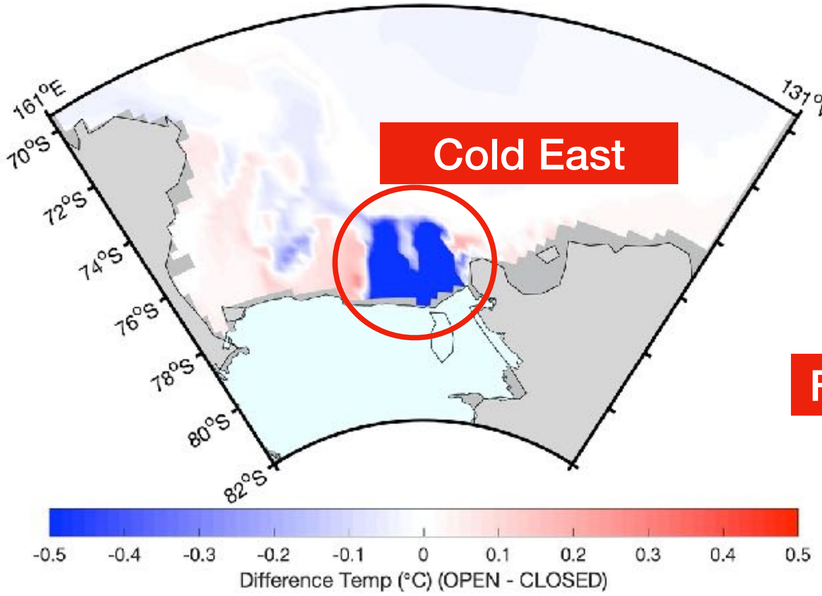


HSSW lower salinity

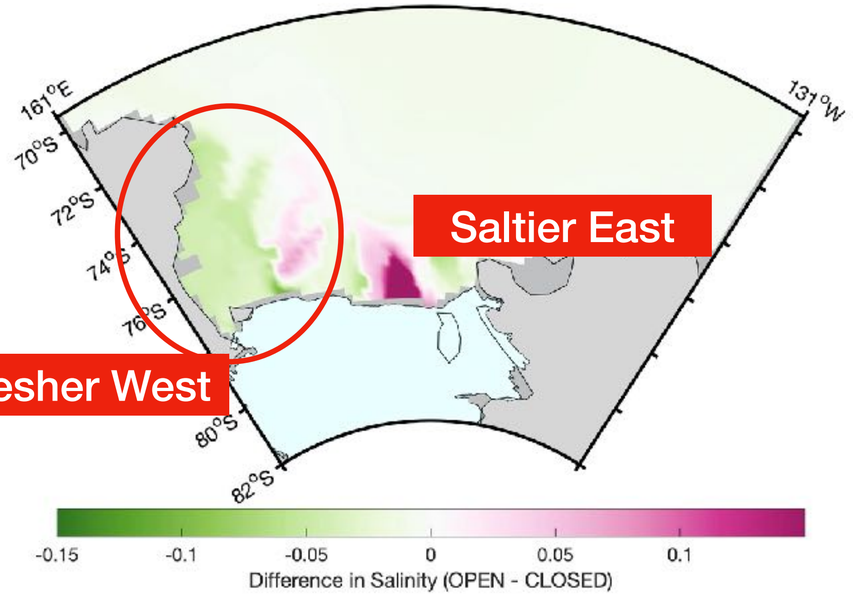
OPEN CAV T-S Ross

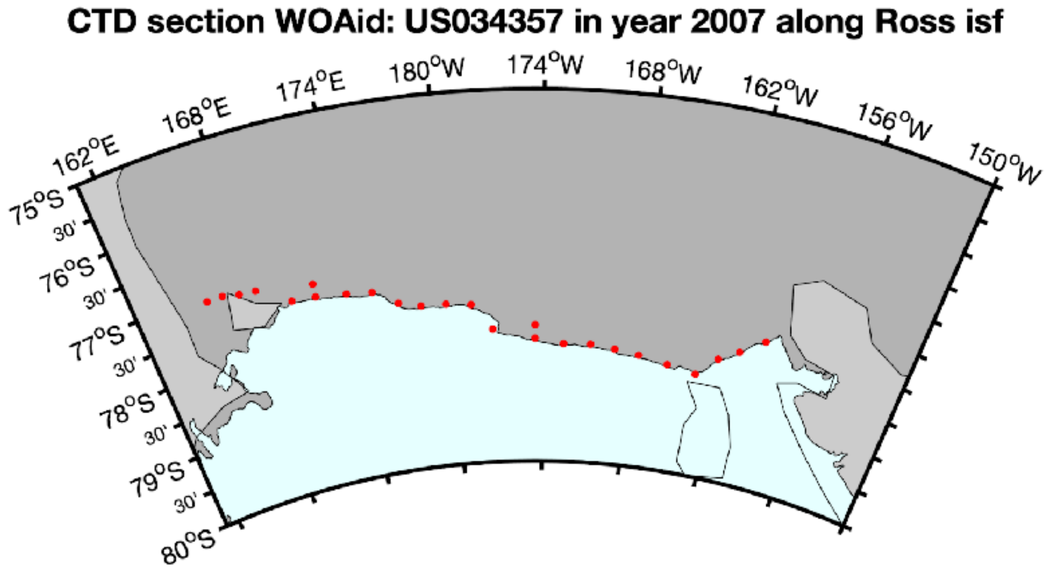


OPEN - CLOSED Bottom Temp Ross



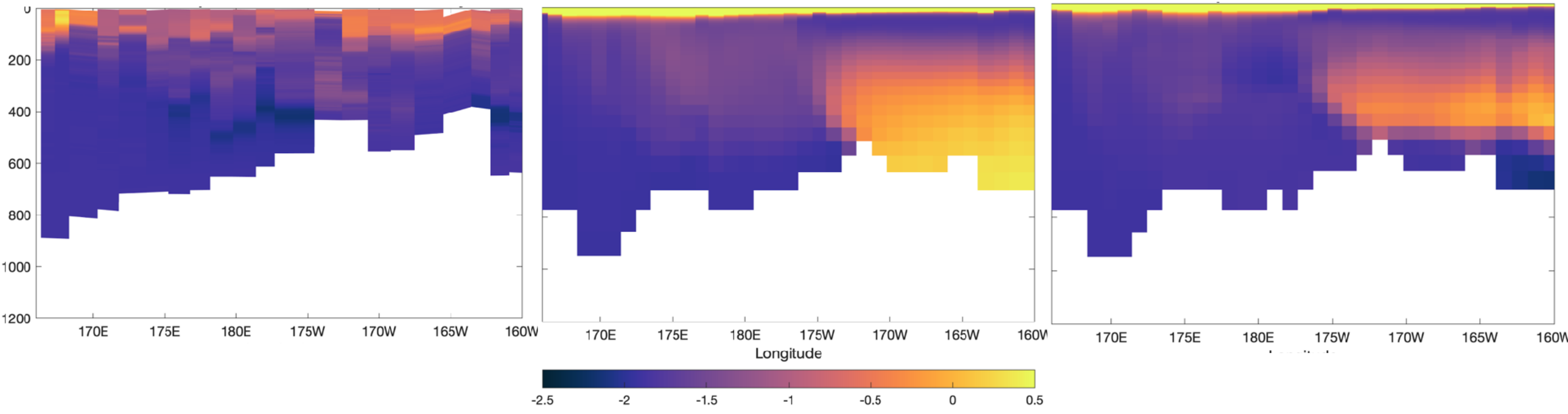
OPEN - CLOSED Bottom Salt Ross

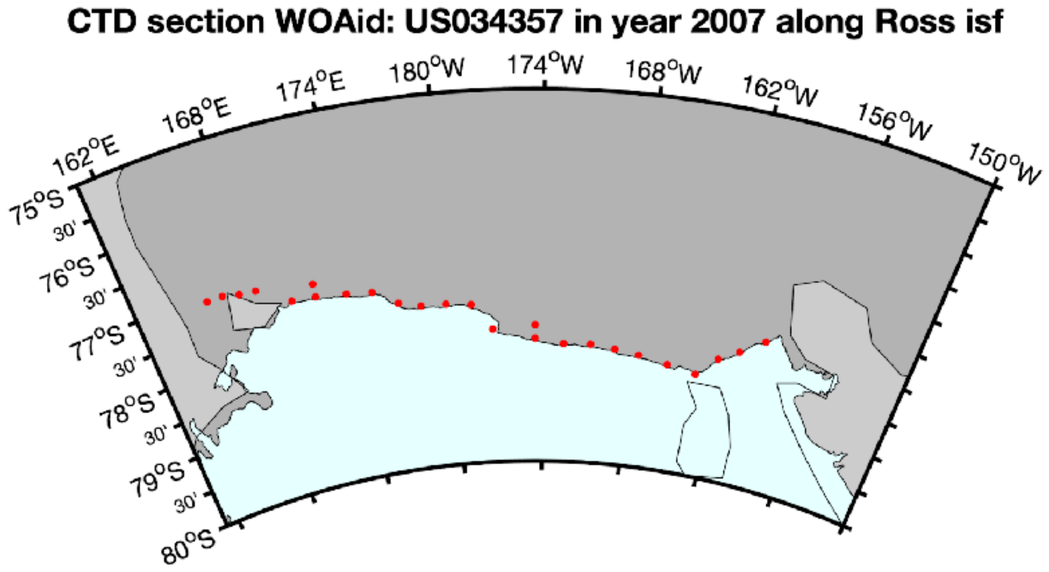




Warm bias to east reduced

CTDs	CLOSED isf cavity	OPEN isf cavity





HSSW more spread out

CTDs	CLOSED isf cavity	OPEN isf cavity