

Bottom water properties in the Australian-Antarctic Basin: A perspective from the Deep-Argo pilot array

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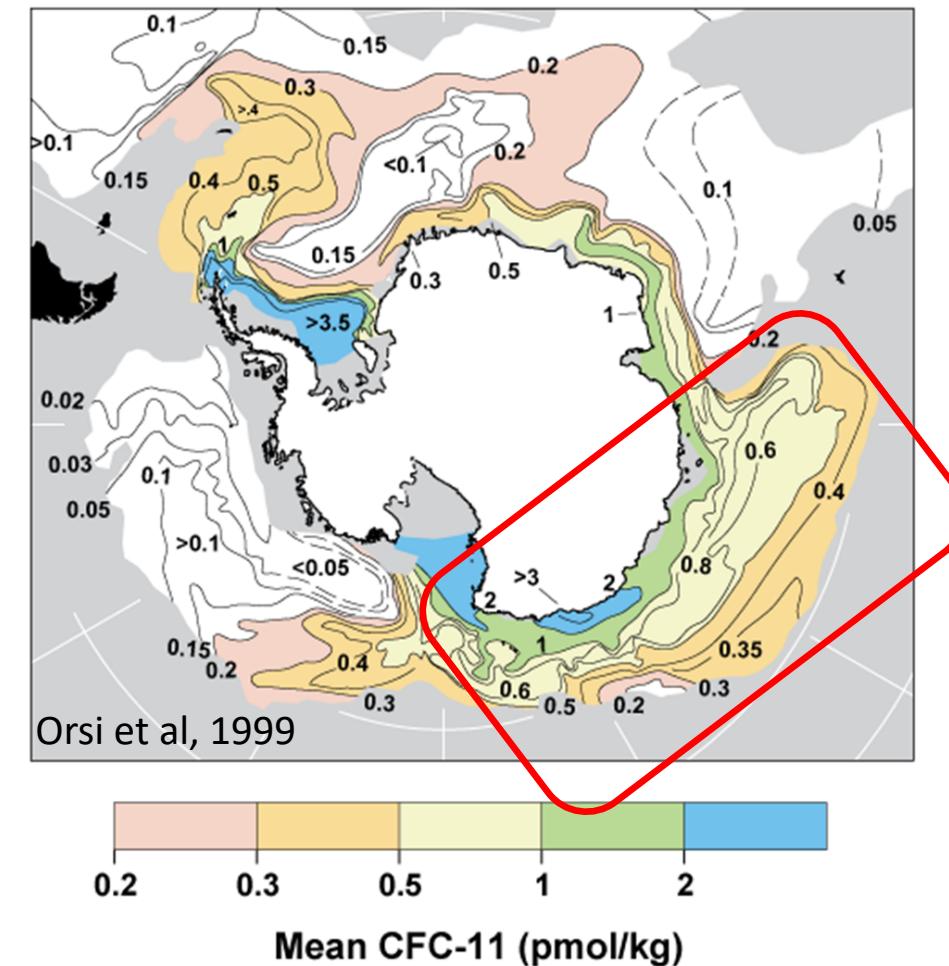
UNSW
SYDNEY

UNIVERSITY of
TASMANIA



Bottom Water in the Australian-Antarctic Basin (AAB)...

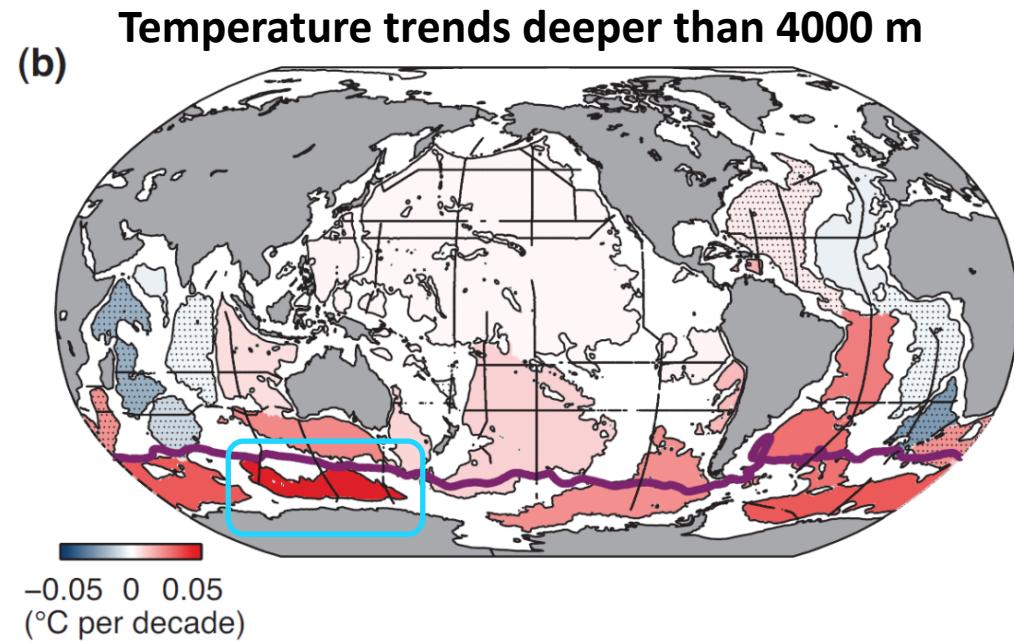
...is actively ventilated from two source regions.



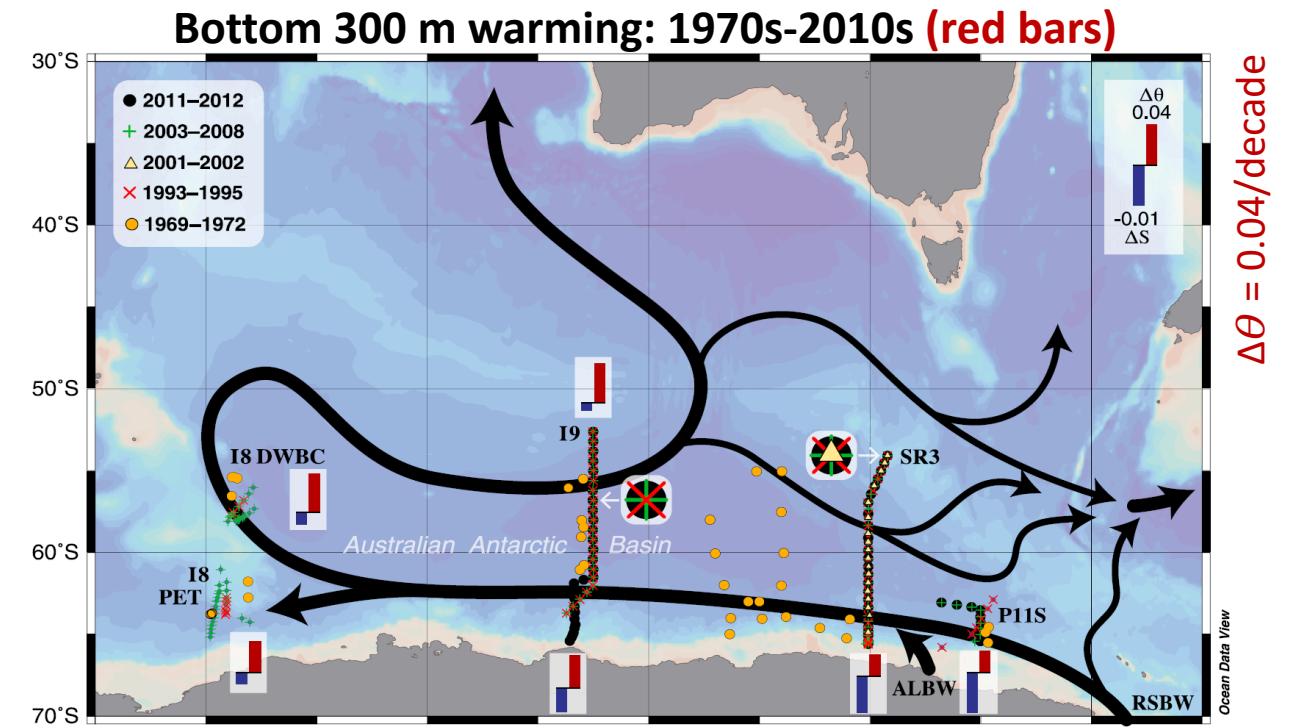
Bottom Water in the Australian-Antarctic Basin (AAB)...

...is actively ventilated from two source regions.

...has been warming rapidly (especially downstream of source regions).



IPCC AR6, data from Purkey & Johnson, 2010



Van Wijk and Rintoul, 2014

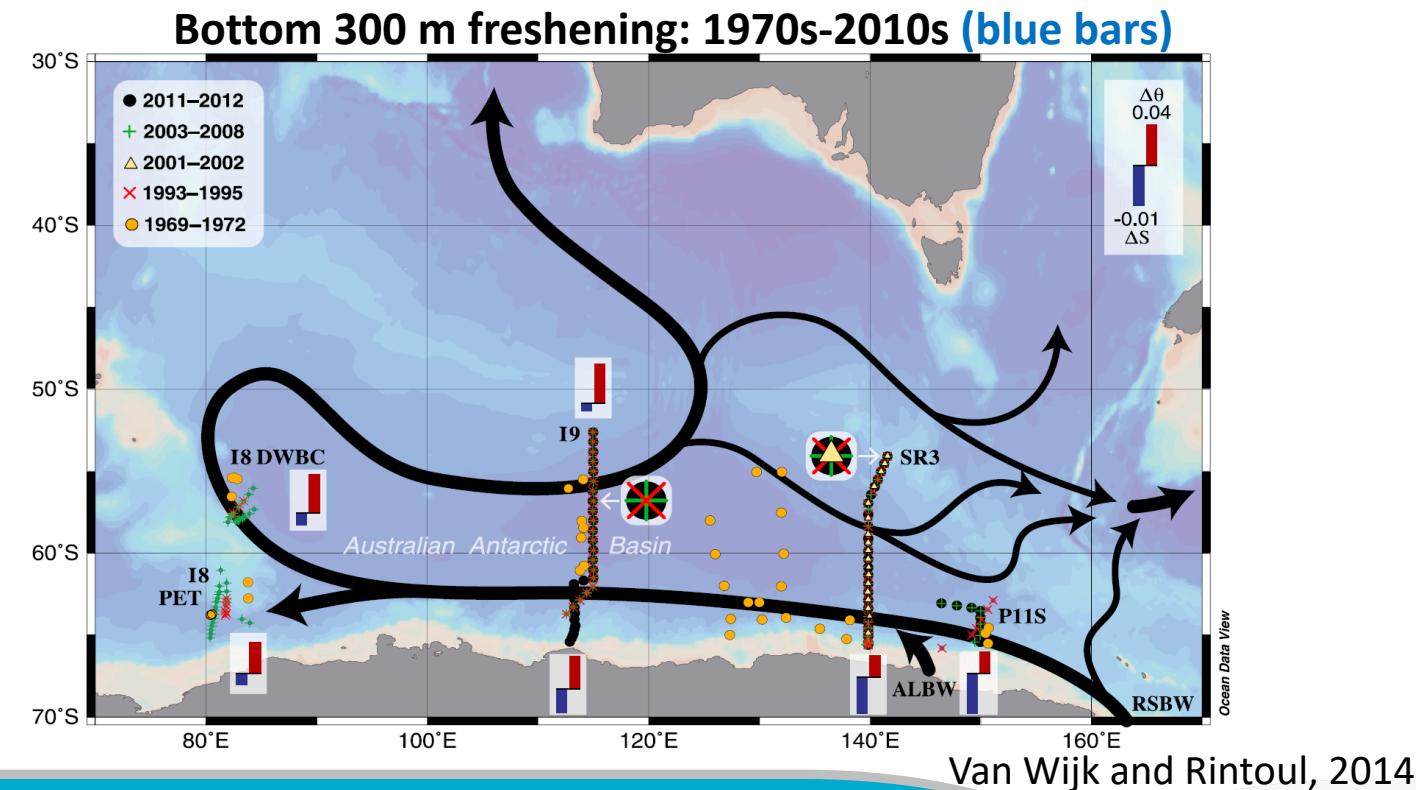
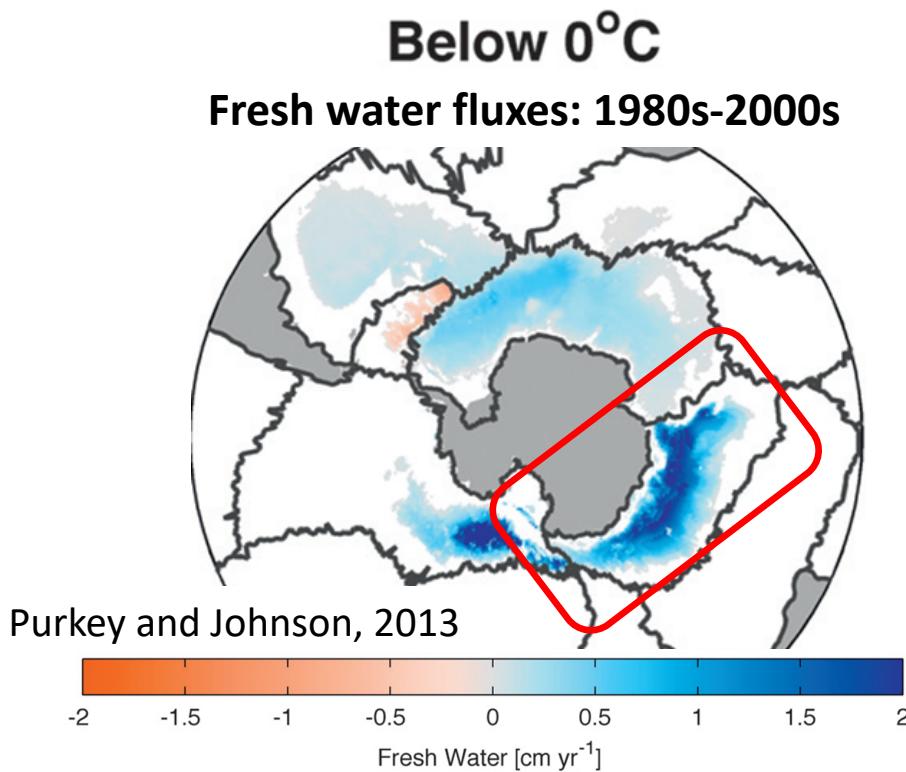


Bottom Water in the Australian-Antarctic Basin (AAB)...

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...has been freshening rapidly (especially near source regions).

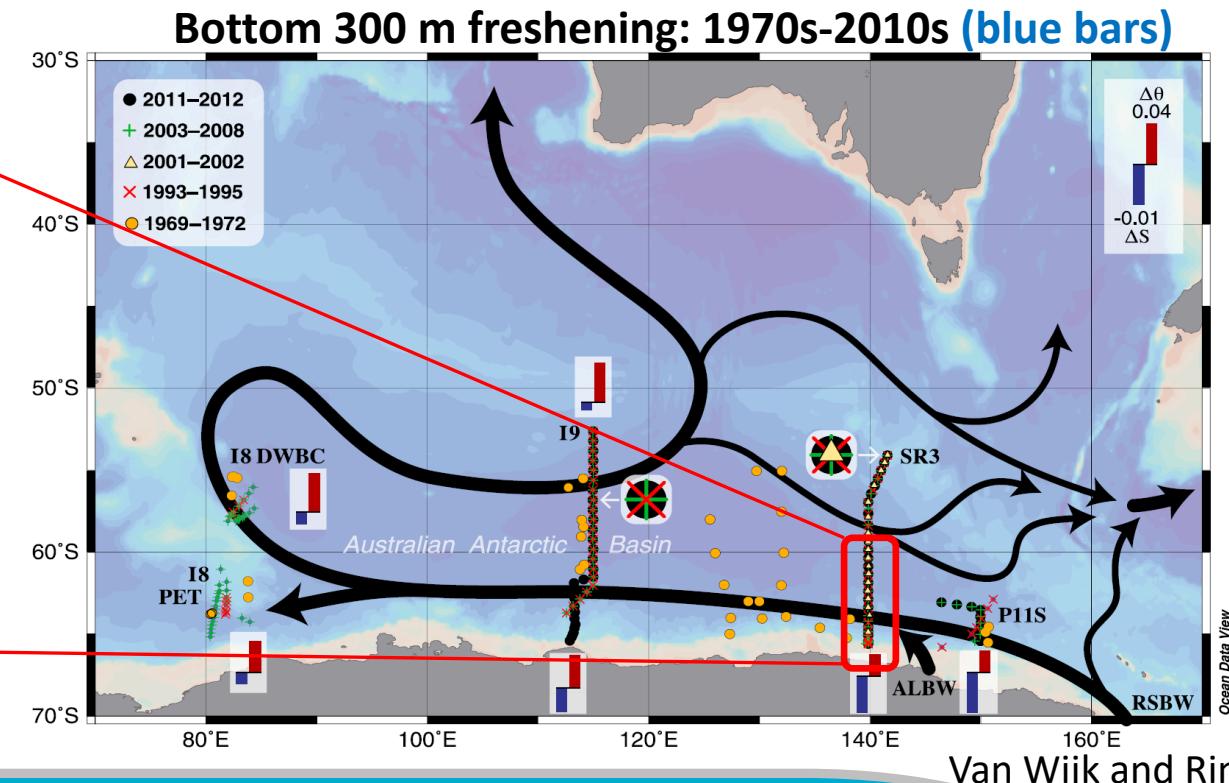
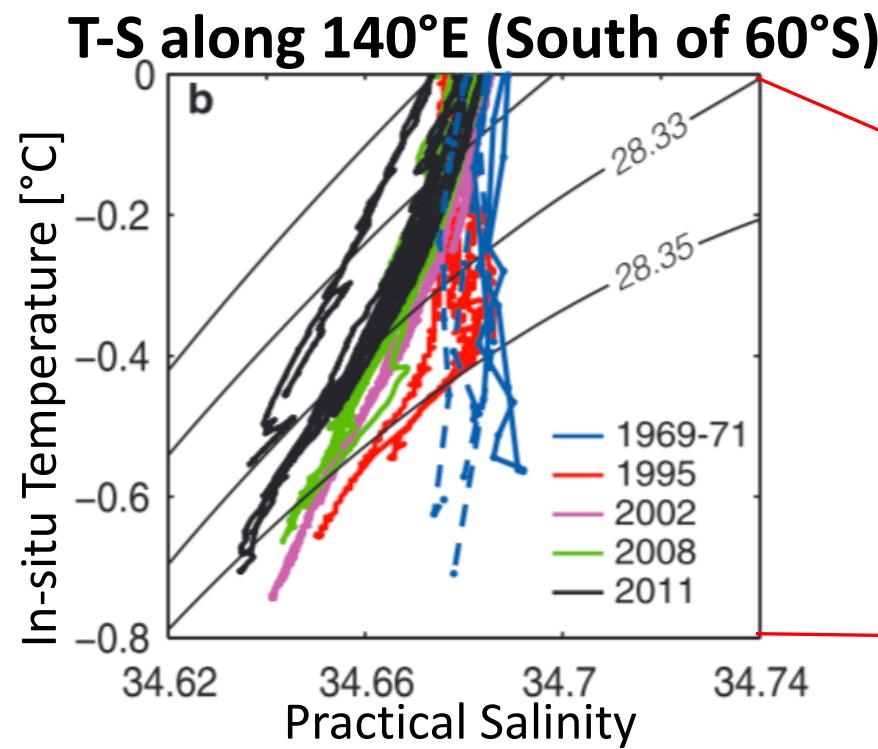


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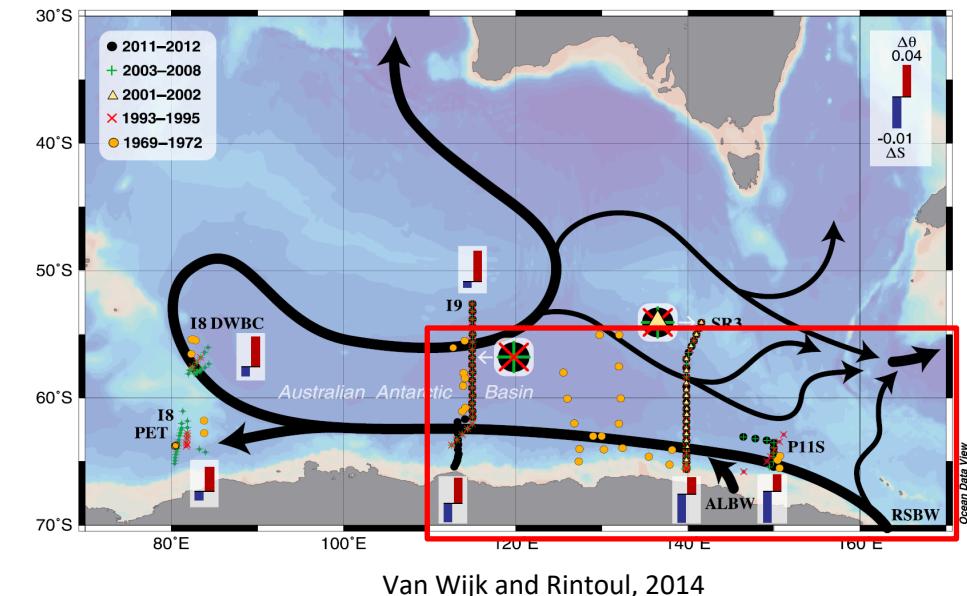
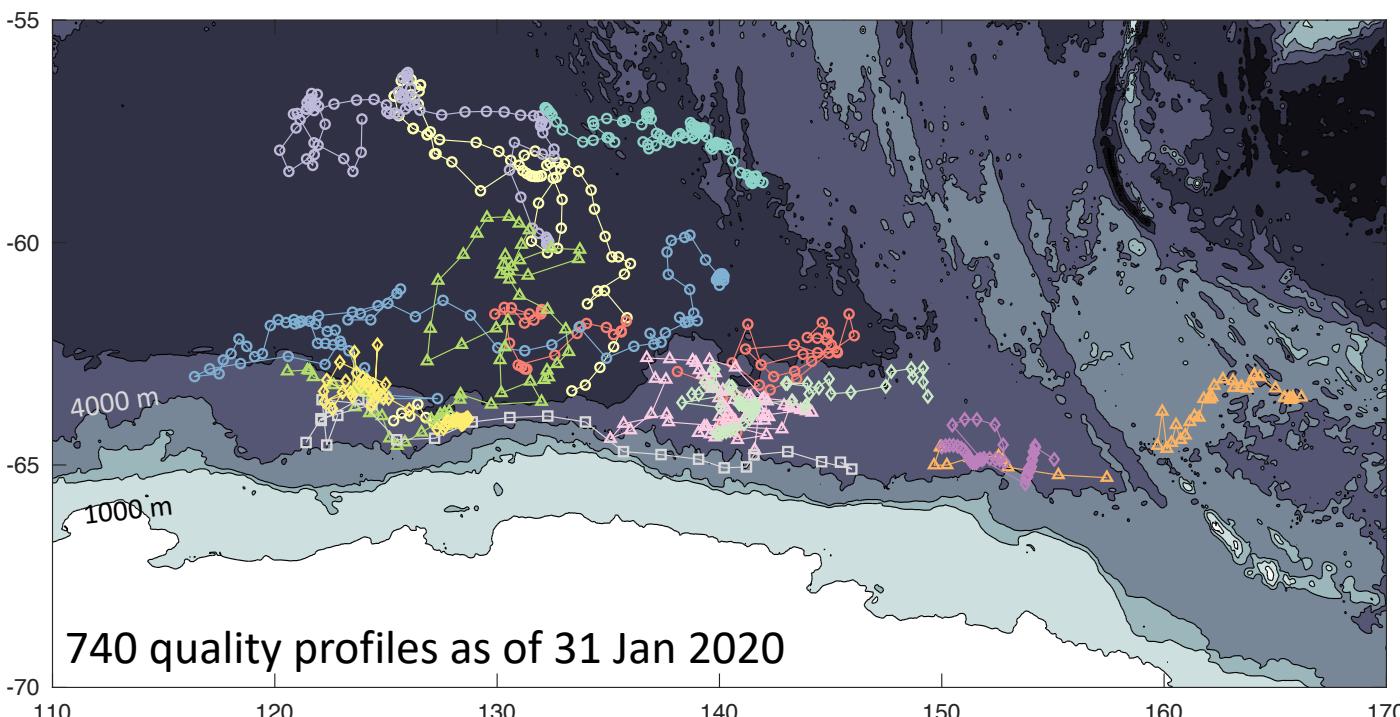
How does the observed variability along repeat hydrographic sections compare to that in the AAB?

Are the long-term trends within or outside the range of seasonal variability in the AAB?

Deep-Argo Pilot Array in the AAB:

12 operational Deep-Argo floats in the AAB:

- Mostly 10-day profiling cycle (after initial testing)
- Deep parking pressures retain (most) floats in basin
- Ice-detection algorithms allow for profiling throughout the year
- Under-ice locations refined with depth & pressure info
- Shipboard CTDs taken on deployment for calibrating salinity

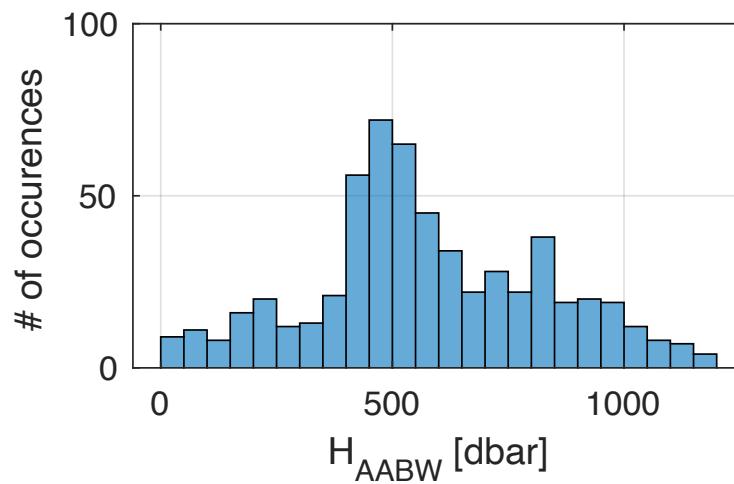
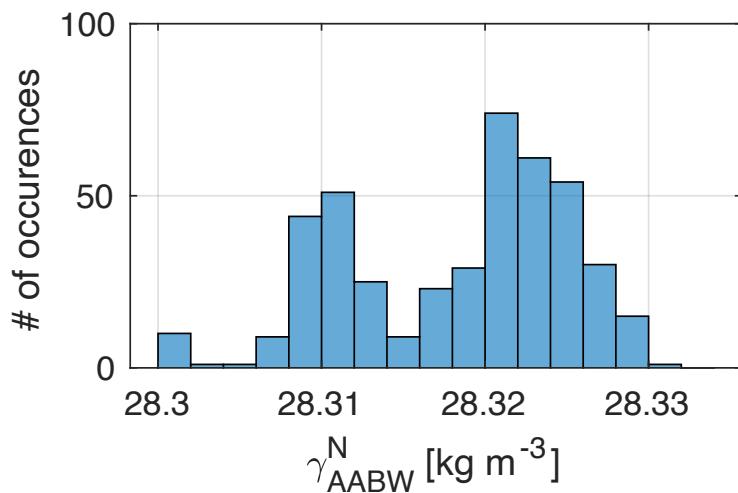
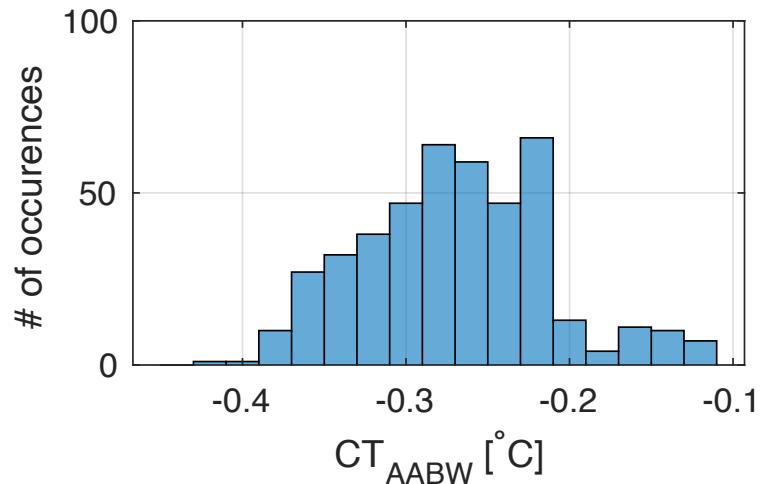
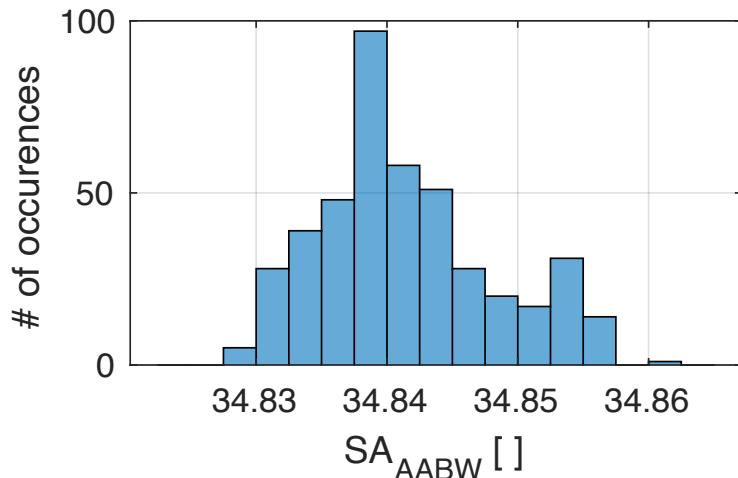


- Scripps SOLOs
(deployed summer 2018; $P_{\max} = 6000$ dbar)
- ARVORs & NINJA
(deployed summer 2018; $P_{\max} = 4000$ dbar)
- CSIRO SOLOs
(deployed summer 2019; $P_{\max} = 6000$ dbar)

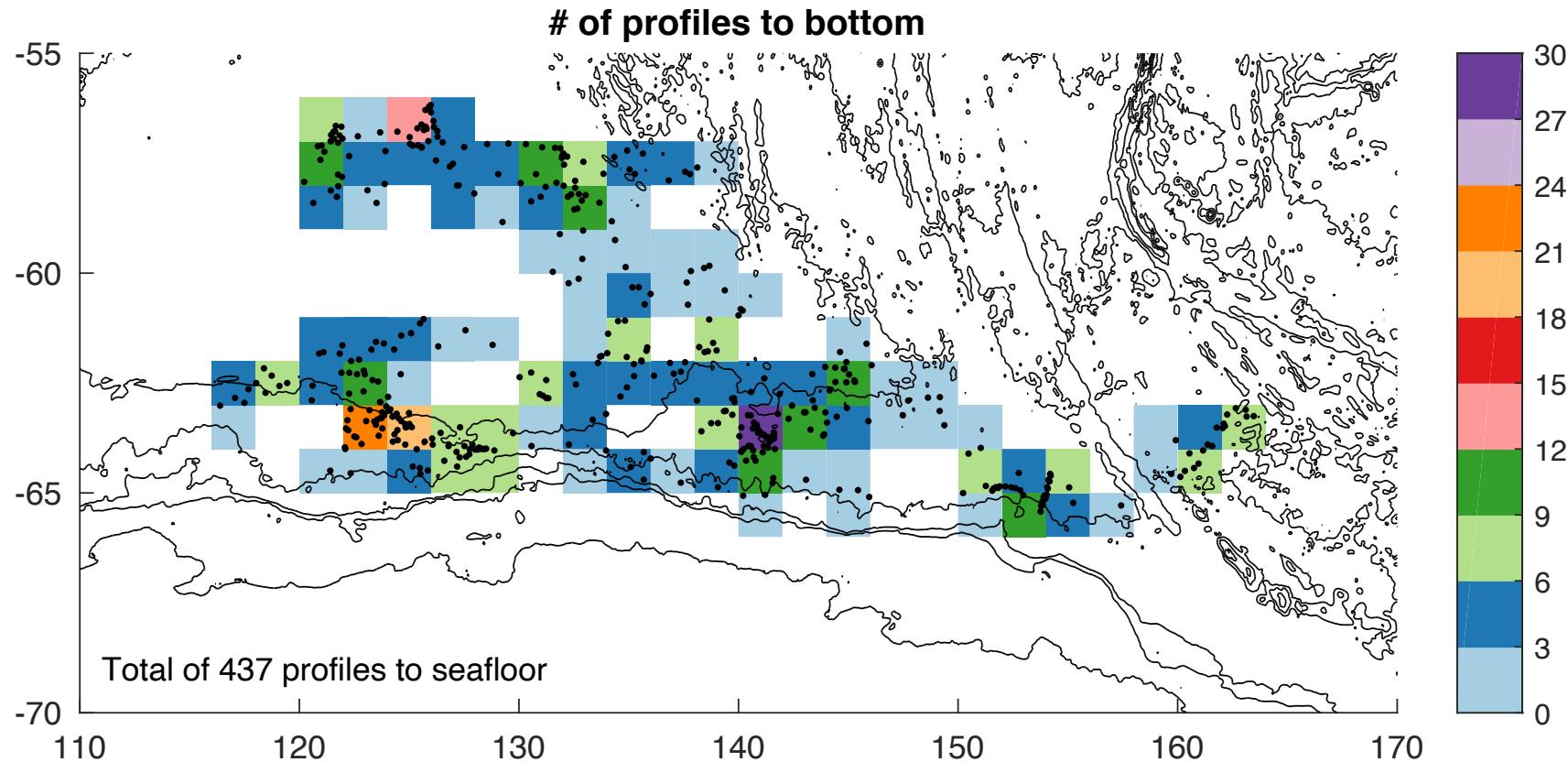
★ Thank you to R/V Investigator (2018) and R/V Kaiyo-Maru (2019) teams for deploying floats! ★

Distribution of AABW properties

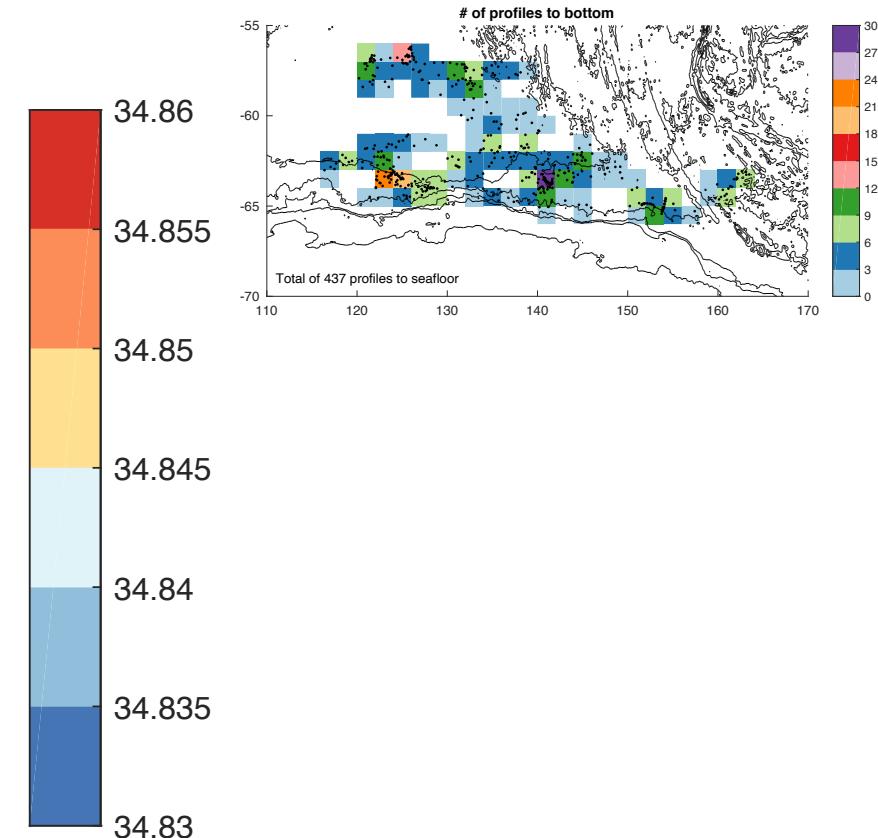
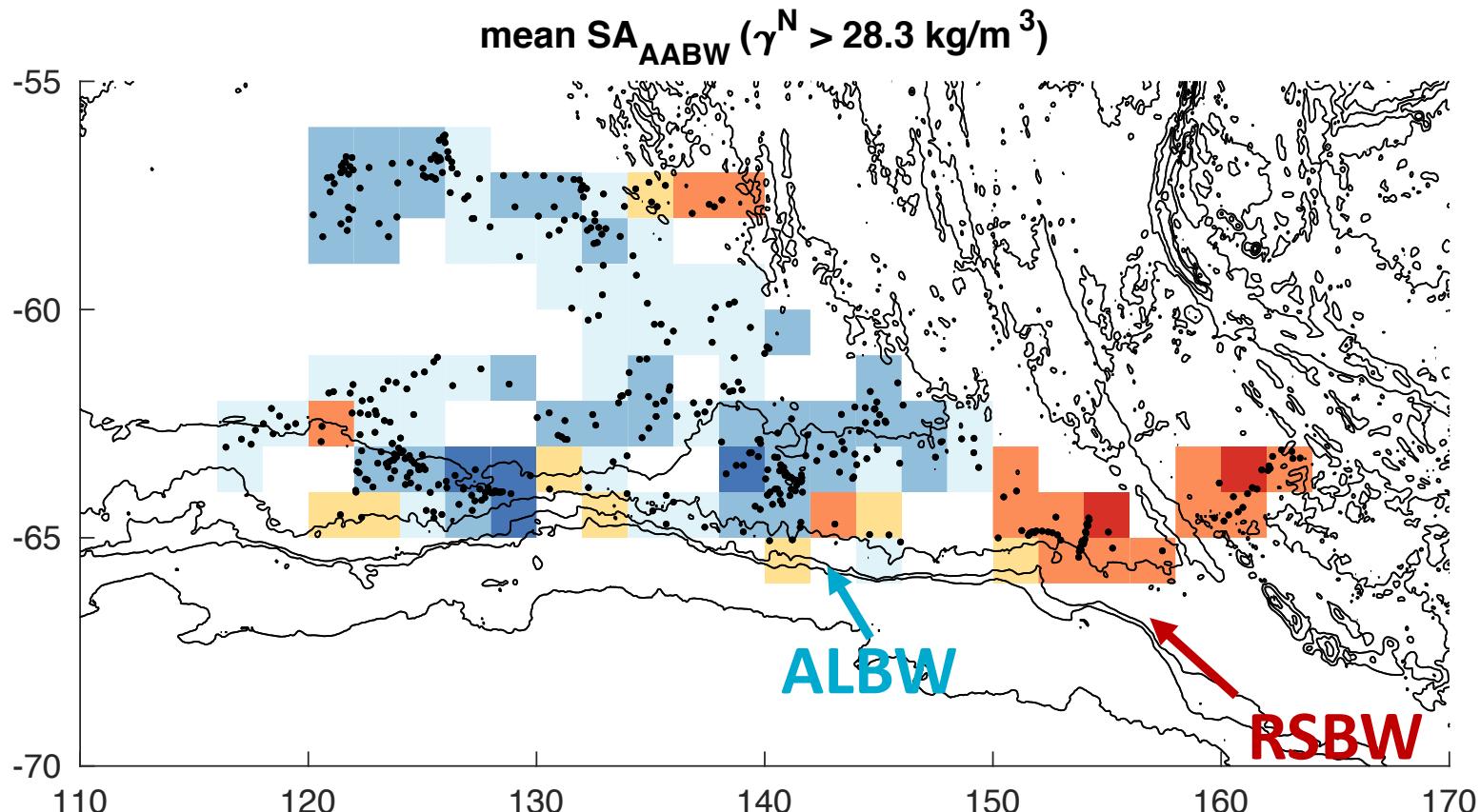
AABW defined as
 $\gamma^N > 28.3 \text{ kg/m}^3$



Bottom Water properties in the AAB:

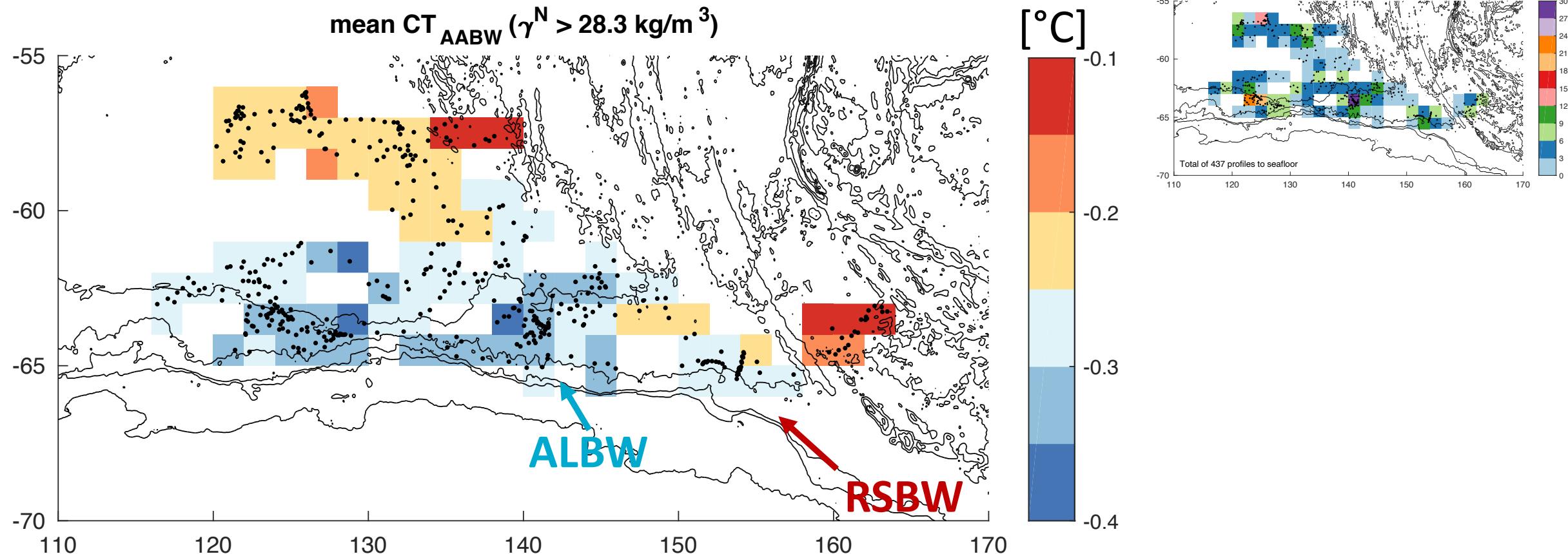


Bottom Water properties in the AAB: Absolute Salinity



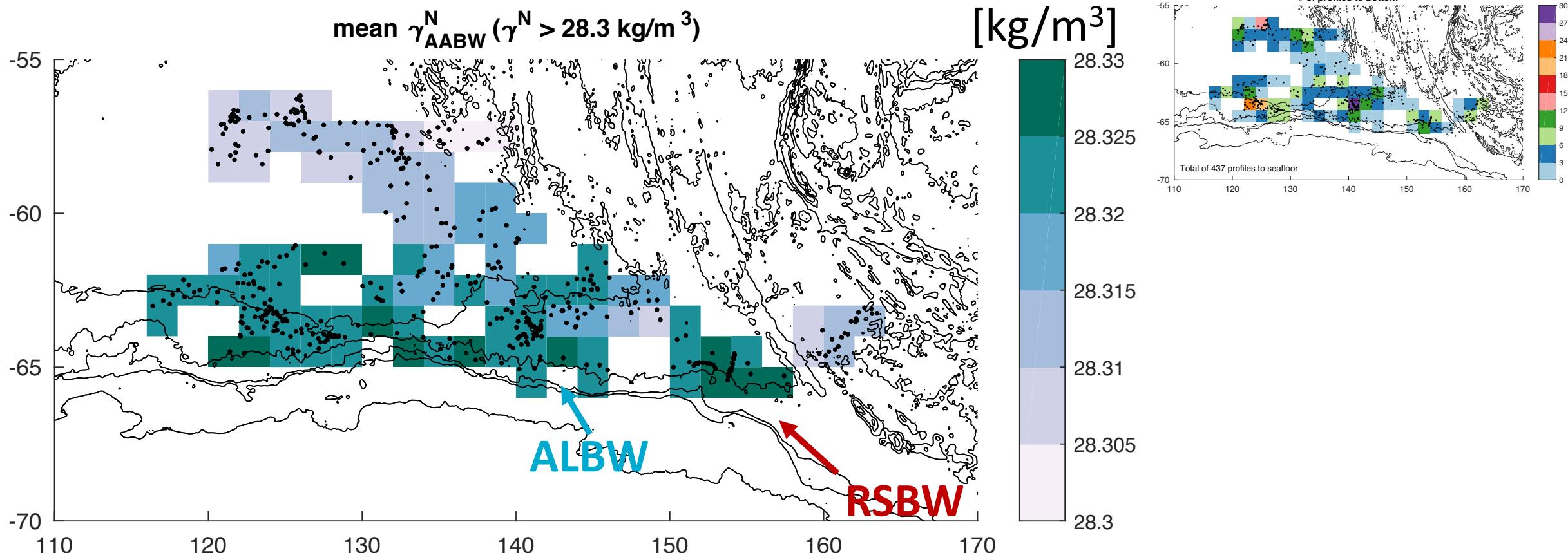
- Ross Sea-sourced AABW **saltier**
- Adelie Land-sourced AABW **fresher**

Bottom Water properties in the AAB: Conservative Temp



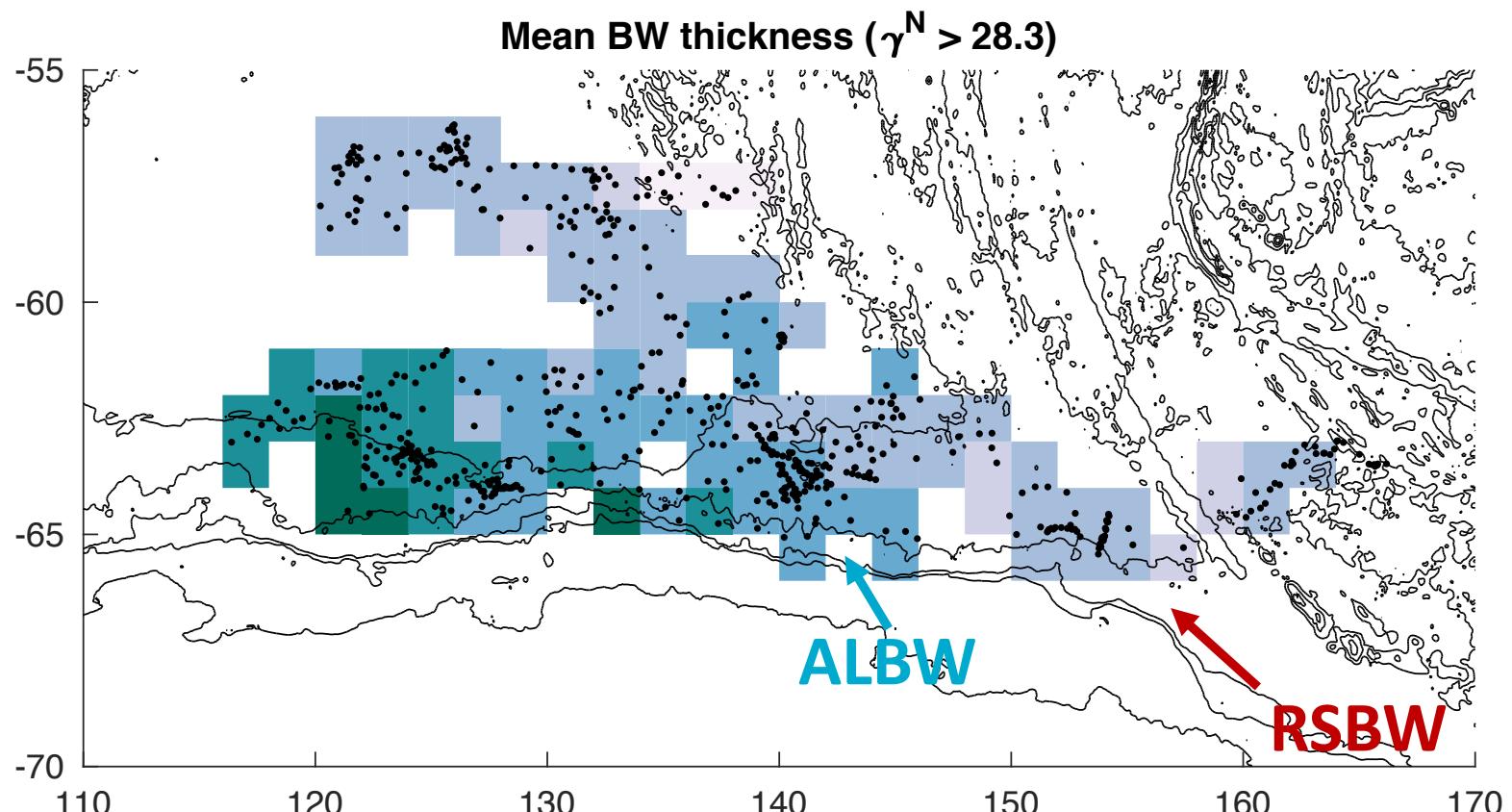
- Ross Sea-sourced AABW **saltier** and **warmer**
- Adelie Land-sourced AABW **fresher** and **colder**

Bottom Water properties in the AAB: Neutral Density

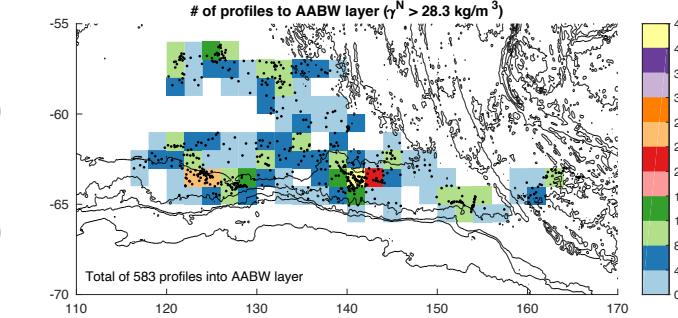


- Ross Sea and Adelie Land-sourced AABW compensated in density
- AABW gets progressively less dense along pathway as it mixes with above waters

Bottom Water properties in the AAB: Thickness of AABW



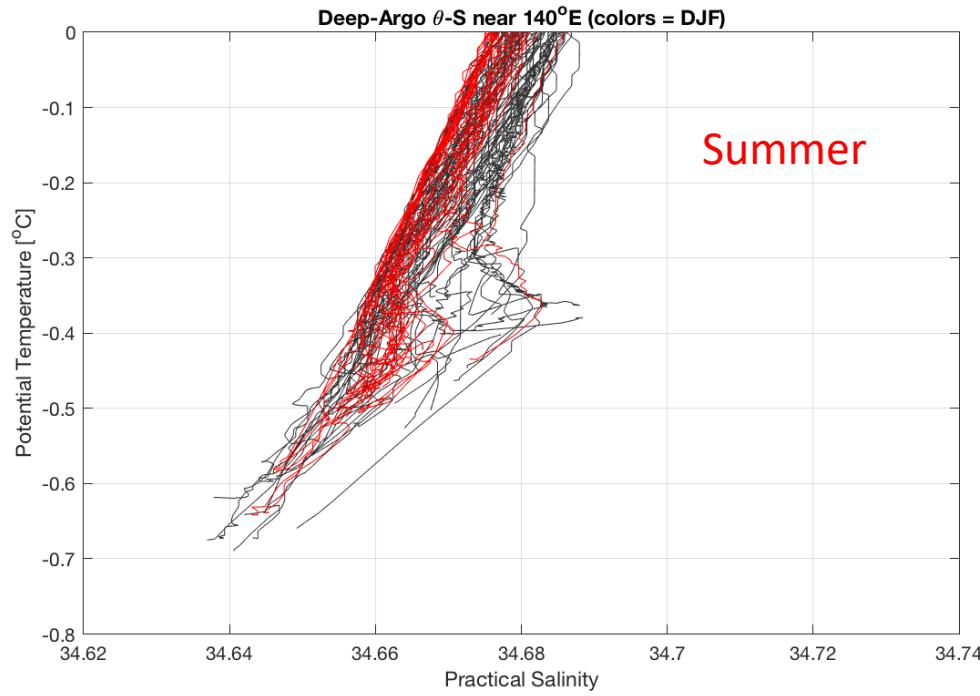
- Thickest AABW to the west of dense shelf water sources
- Thinning of the layer to the north as it spreads and mixes



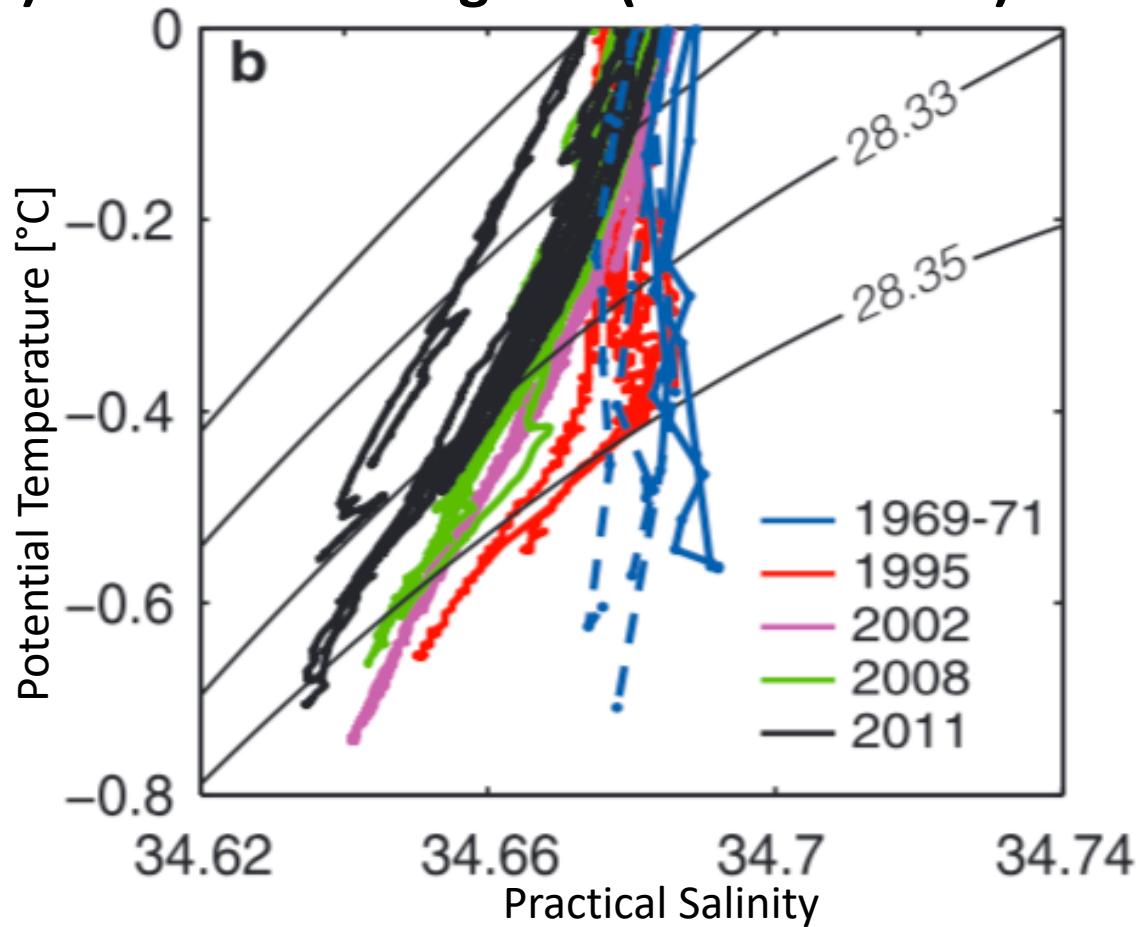
About 150 more profiles reach top of AABW layer than reach seafloor

Bottom Water properties in the AAB: Properties near 140°E

Deep-Argo θ -S near 140°E (South of 60°S)



θ -S along SR3 (South of 60°S)

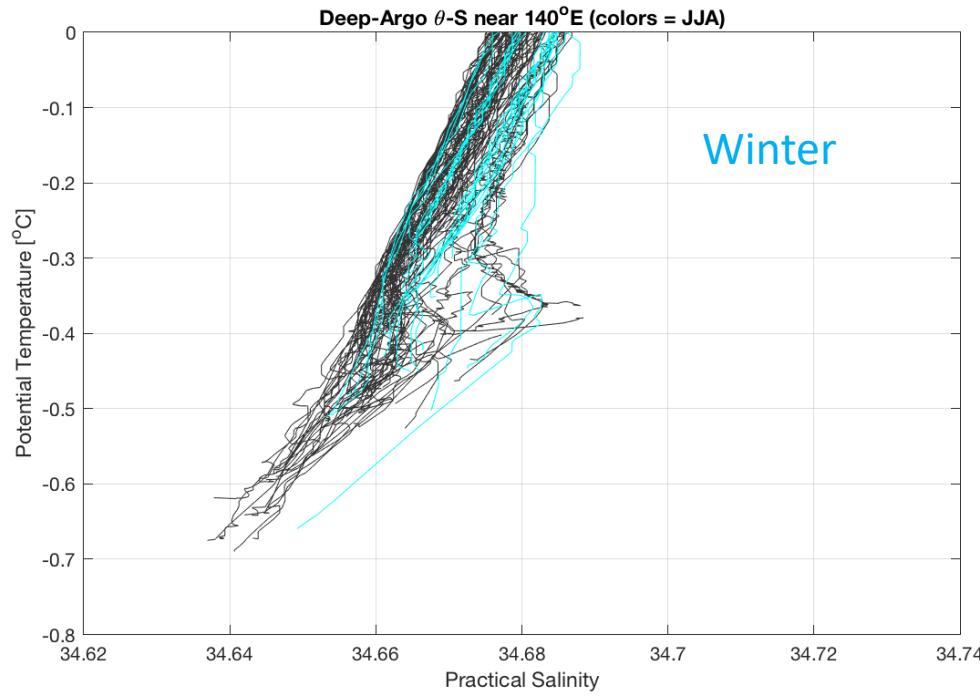


- 1970s values unobserved, 1995-2011 values observed from 2018-2020

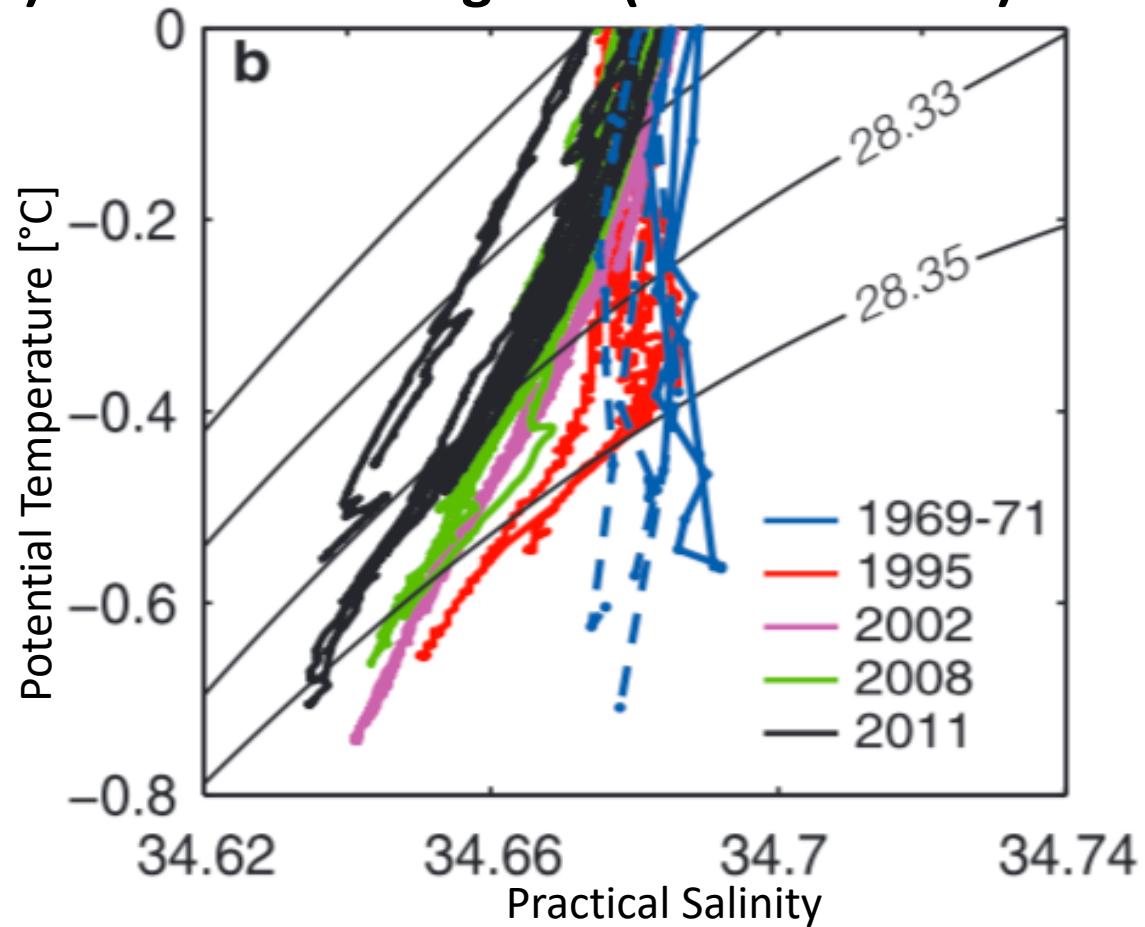
Van Wijk and Rintoul, 2014

Bottom Water properties in the AAB: Properties near 140°E

Deep-Argo θ -S near 140°E (South of 60°S)



θ -S along SR3 (South of 60°S)



- 1970s values unobserved, 1995-2011 values observed from 2018-2020

Van Wijk and Rintoul, 2014

Conclusions:

- Deep-Argo pilot array in the AAB measures **full-depth** (or nearly full-depth) CTD profiles **year-round**, including **under-ice** profiling when necessary
 - 437 profiles to the seafloor as of 31 Jan 2020
 - 583 profiles to top of AABW layer as of 31 Jan 2020
- Properties of AABW ($\gamma^N > 28.3 \text{ kg/m}^3$) show **two distinct sources** of AABW that are compensated in density
 - **colder/fresher ALBW**
 - **warmer/saltier RSBW**
- Historical changes in θ -S along 140°E **since the 1990s** are similar in range to local variability in deep-Argo profiles
 - Freshest in summer, most saline in winter

Questions / Challenges for the COSIMA community:

- How well do the models capture the spatial and temporal variability in AABW properties?
- Do you see a similar seasonal evolution of AABW properties in the models?
- Can we use the models to fill some of the gaps in this Deep-Argo pilot array?

Thank you

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