

# Supporting Information for “The observed spatiotemporal variability of Antarctic Winter Water”

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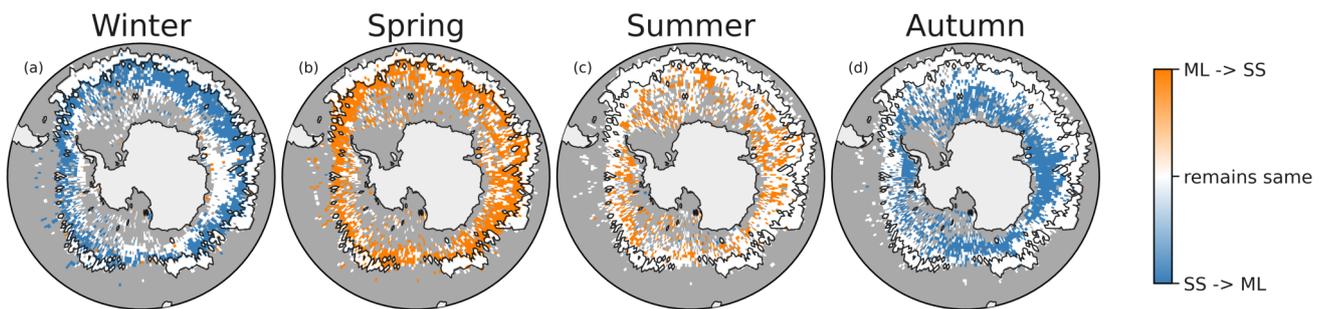
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1. Figures S1 to Sx

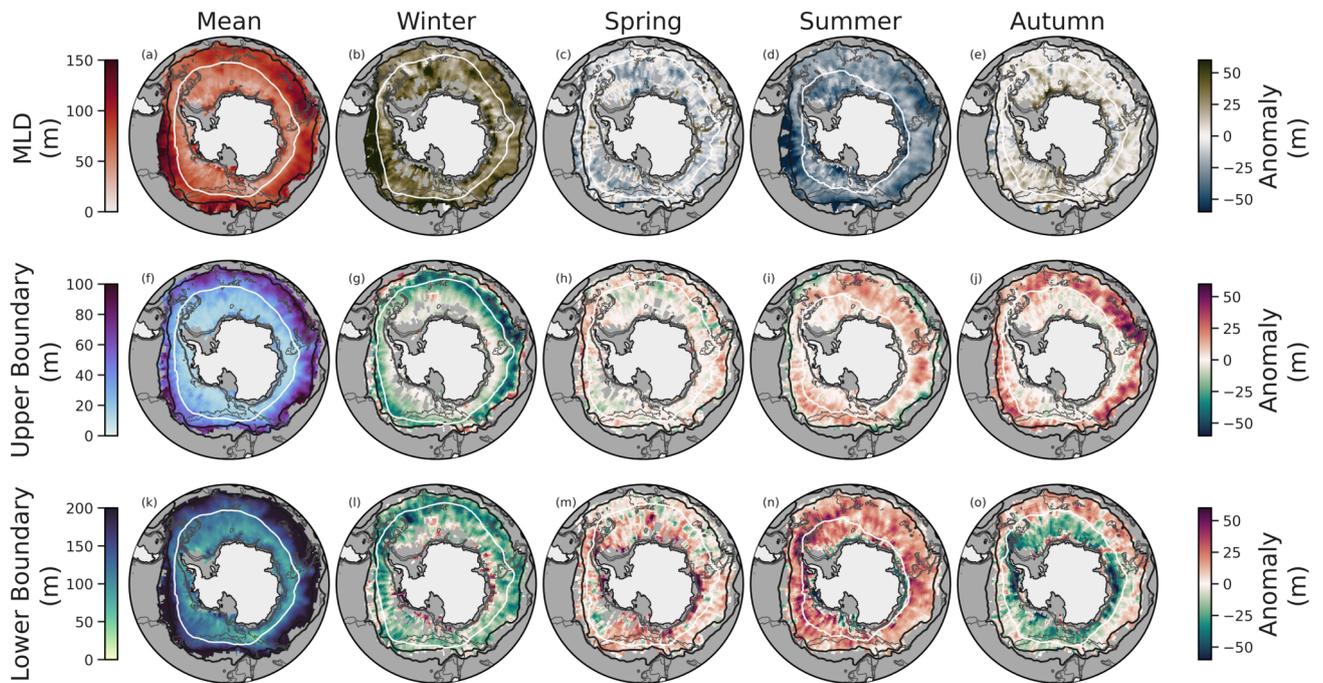
**Introduction** Supporting Information contains 4 additional figures that provide further details on the seasonal cycle of AAWW. Figure S1 shows the seasonal change of WW classification. Figure S2 shows an alternative approach from anomaly plots, as shown in Figures 4 and 6 in main text, to show seasonal temperature change (ie,  $d/dt(\text{var})$ ), which provides further nuances to the seasonal cycle. We provide component-wise information to thickness variability by presenting the upper and lower bound depths as well as the MLD in S3. Lastly, we present all the component terms of the heat budget equation (Equation 1 in main) in S4.



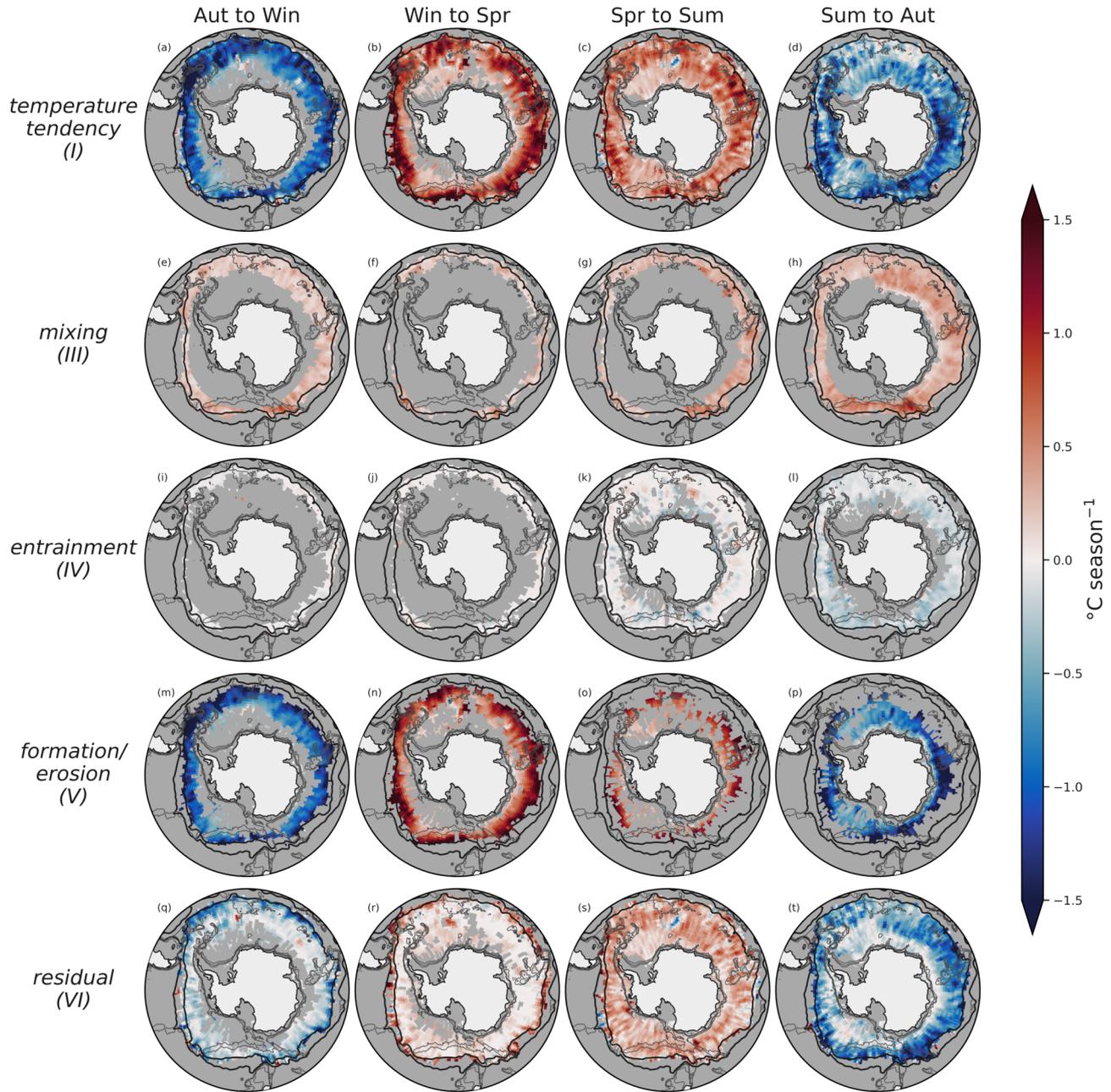
**Figure S1. Seasonal change of WW classification.** Orange indicates a change from  $WW_{ML}$  to  $WW_{SS}$ , white indicates the WW remains the same, blue indicates a change  $WW_{SS}$  to  $WW_{ML}$ , and black contours indicate WW that remains unchanged throughout the entire annual cycle. Black lines indicate the PF and SAF, white lines indicate the mean 15% sea ice concentration for the time period, and gray lines indicate 1km, 2km and 3km isobaths.



**Figure S2. Annual mean and seasonal change of WW:** (a-e) core temperature, (f-j) core salinity, (k-o) core depth, and (f-j) thickness. Positive (negative) indicates an increase (decrease) from the previous season. Black lines indicate the PF and SAF, white lines indicate the mean 15% sea ice concentration for the time period, and grey lines indicate 1km, 2km and 3km isobaths.



**Figure S3.** Annual mean and seasonal change of WW: (a-e) core temperature, (f-j) core salinity, (k-o) core depth, and (f-j) thickness. Positive (negative) indicates an increase (decrease) from the previous season. Black lines indicate the PF and SAF, white lines indicate the mean 15% sea ice concentration for the time period, and grey lines indicate 1km, 2km and 3km isobaths.



**Figure S4.** Full seasonal heat budget of WW<sub>SS</sub>. (a-d) temperature tendency; (e-h) turbulent vertical mixing; (i-l) entrainment/detrainment; (m-p) WW subduction/erosion; (q-t) residual. The Roman numerals on the right hand side represent the term of the row from Equation 1. Black lines indicate the PF and SAF, and gray lines indicate 1km, 2km and 3km isobaths.