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Supporting Information for

Influence of glacial influx on the hydrodynamics of Admiralty Bay, Antarctica - a case study based on combined hydrographic measurements and numerical modeling

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Introduction

The study methodology is further clarified, and its results and conclusions are corroborated by the five supporting figures and one table.

Fig. S1 displays the recorded salinity and temperature values at specific sites along the external transect. This figure aids in explaining the relatively low average salinity values seen in this transect, as depicted in Fig. 2. Moreover, it functions to substantiate the existence of AB cyclonic circulation. Fig. S2 displays the data extracted from Dotto et al. (2021) and utilized for the determination of open boundary conditions in the model. As was noted in the main text, in the model, only data from the spring and summer seasons was utilized and subsequently interpolated across time in order to generate a continuous time series of water parameter values. However, the little variations seen in values across different seasons indicate that the model configuration effectively captures the AB water variability throughout the entire year. Fig. S3 displays the absolute values of FWT, pycnocline depth, and depth-averaged velocities in test scenarios H0, H2, S0 and S2. It further demonstrates the limited significance of the initial velocity and vertical location of glacial discharges within the broader context of AB hydrodynamics. Fig. S4 displays the standard deviations of FWT at each grid point of the model throughout the course of one lunar cycle in various glacial influx scenarios. As a result, it is a representation of the stability of glacial freshwater distribution in AB at various tidal phases. Its overall values increase as the glacial influx rises. However, in cases where glacial influx volumes are within reasonable limits (see Section 5), these values tend to be modest, particularly in

the northeastern portion of AB where absolute FWT values are highest (Fig. 6). This is evidence of the relative stability of the pattern of freshwater transport in AB during the tidal cycle. Figure S5 presents data about the proportion of glacial freshwater within the overall water budget of AB in 14 model scenarios. It was calculated by taking the average of monthly mean FWT values divided by depth across all grid points.

Additional model setup details used to configure the AB model are provided in Table S1. The model variables that were not explicitly addressed in the main text or in Table S1 were kept consistent with the configuration suggested by Deltares (2020).

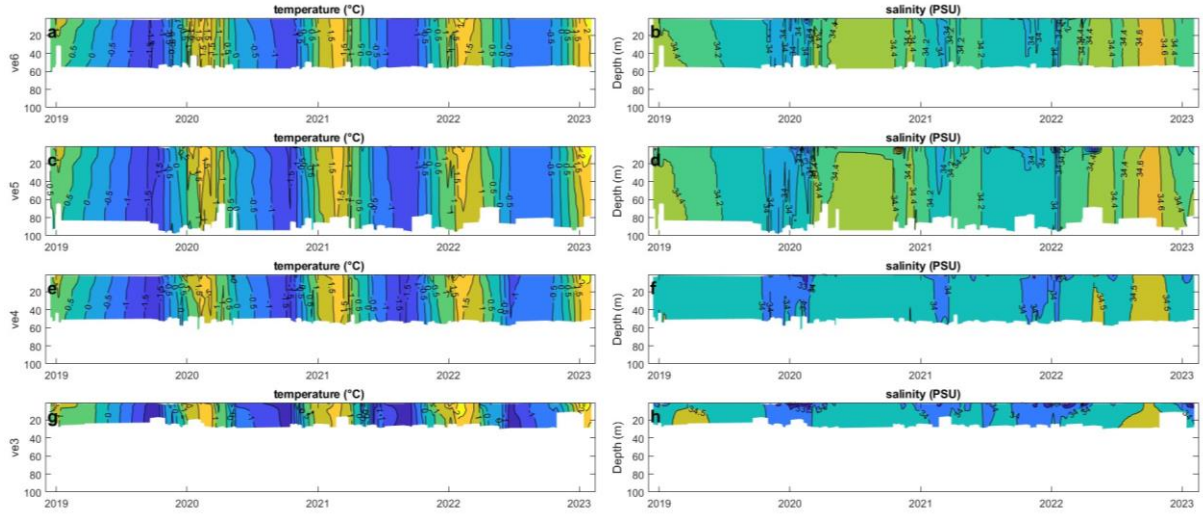

Figure S1. Temperature and salinity measured at *external transect* sites. **a,c,e** and **g** temperature (˚C) and **b,d,f** and **h** salinity (PSU); **a-d** records from ve5 and ve6 sites located on the western/inflow region of AB; **e-h** records from ve3 and ve4 sites located in the eastern/outflow region of AB

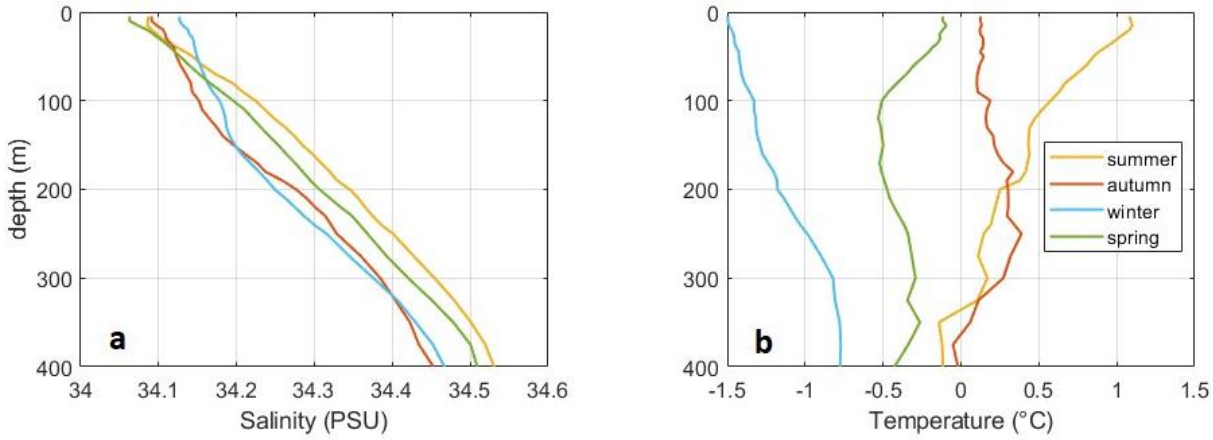

Figure S2. Seasonal salinity (PSU) (**a**) and temperature (˚C) (**b**) reanalysis results from Dotto et al. (2021) used to establish open boundary conditions of AB model; site location -62.18, -58.40 (location in reanalysis grid – m=43 n=49).

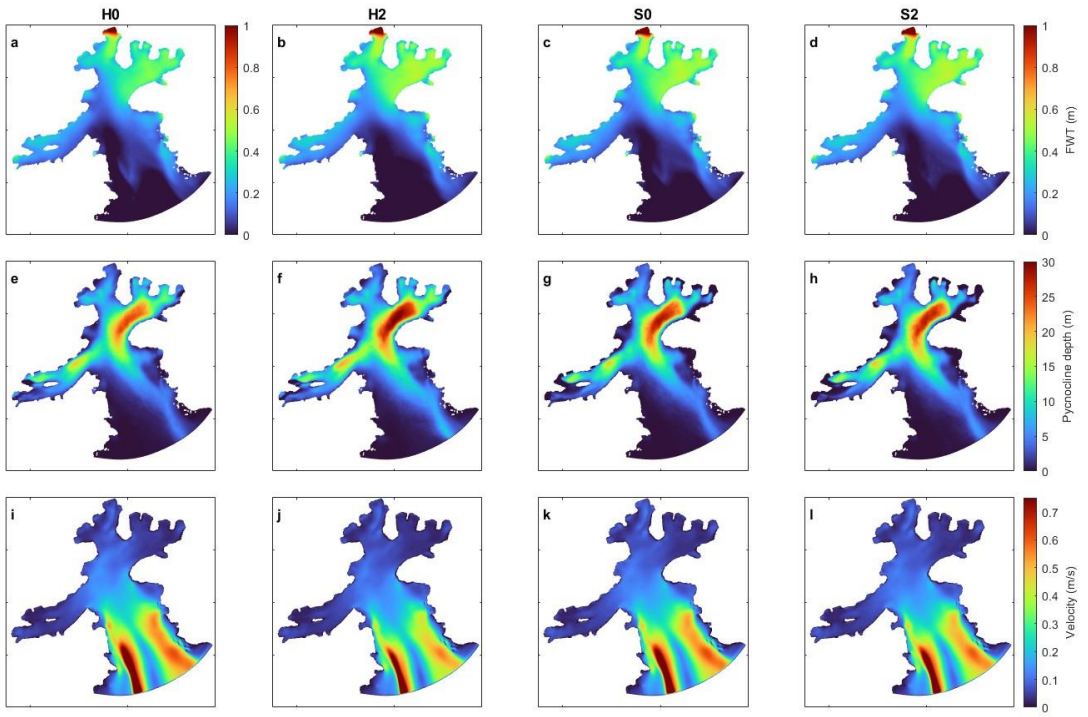

Figure S3. Analogous to Fig.3 in the main text, only presented in absolute values: **a-d** FWT (m) **e-h** Pycnocline depth (m); **i-l** depth averaged velocities in m/s; **a,e** and **i** H0 scenario; **b, f** and **j** H2 scenario; **c,g,** and **k** S0 scenario; **d,h** and **l** S2 scenario. All figures depict mean values from period from 1.01.2022 to 28.01.2022.

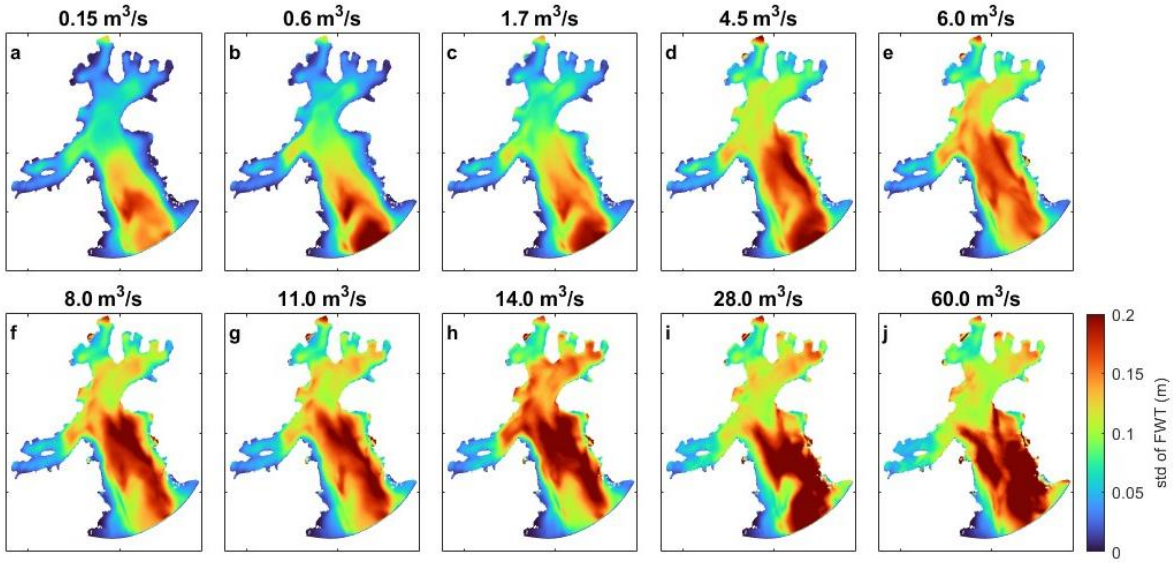

Figure S4. Standard deviation of FWT values in AB during a period from 1.01.2022 to 28.01.2022.

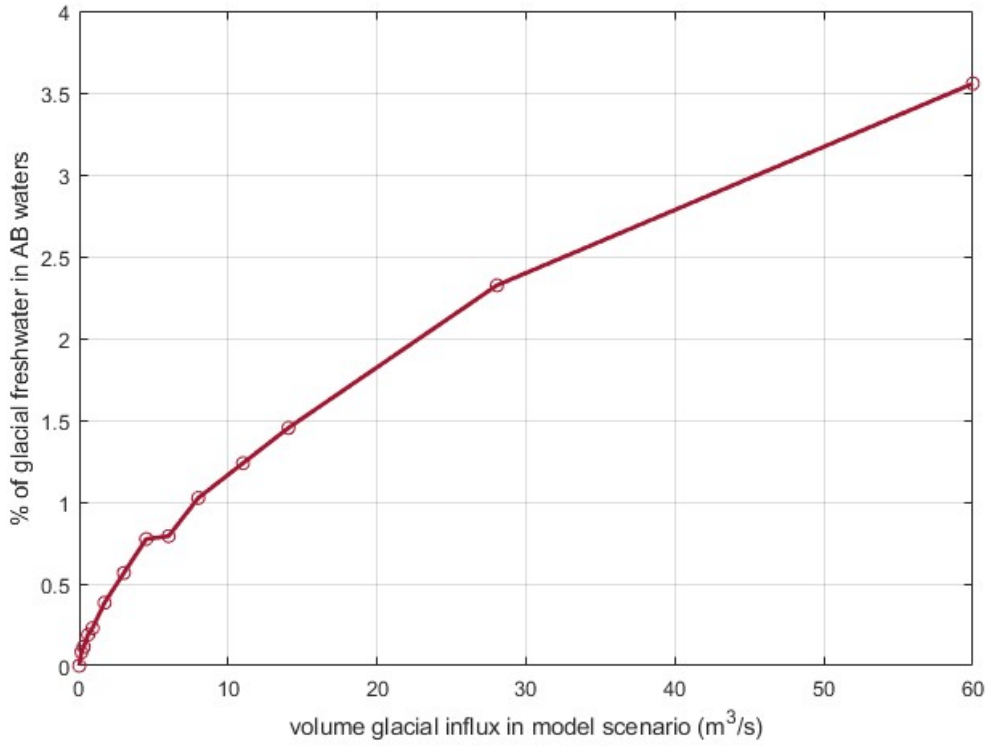

Figure S5. Percentage of glacial freshwater in the total AB water budget over 14 model scenarios

Number of grid cells	**31 619**
Number of layers	**50**
Duration of the modelling	**58 days**
Time step	**0.06 min (3.6 s)**
Initial conditions	**Salinity 34.1 ppt** **Temperature -0.2 ˚C**
Bottom roughness coefficients	**Used formula – 3D Chézy** **Uniform values U, V= 40 $m^{1/2}/s$**
Model for 3D turbulence	**k-ε**

Table S1. Additional details of AB model setup.