

S1 Supplementary figures

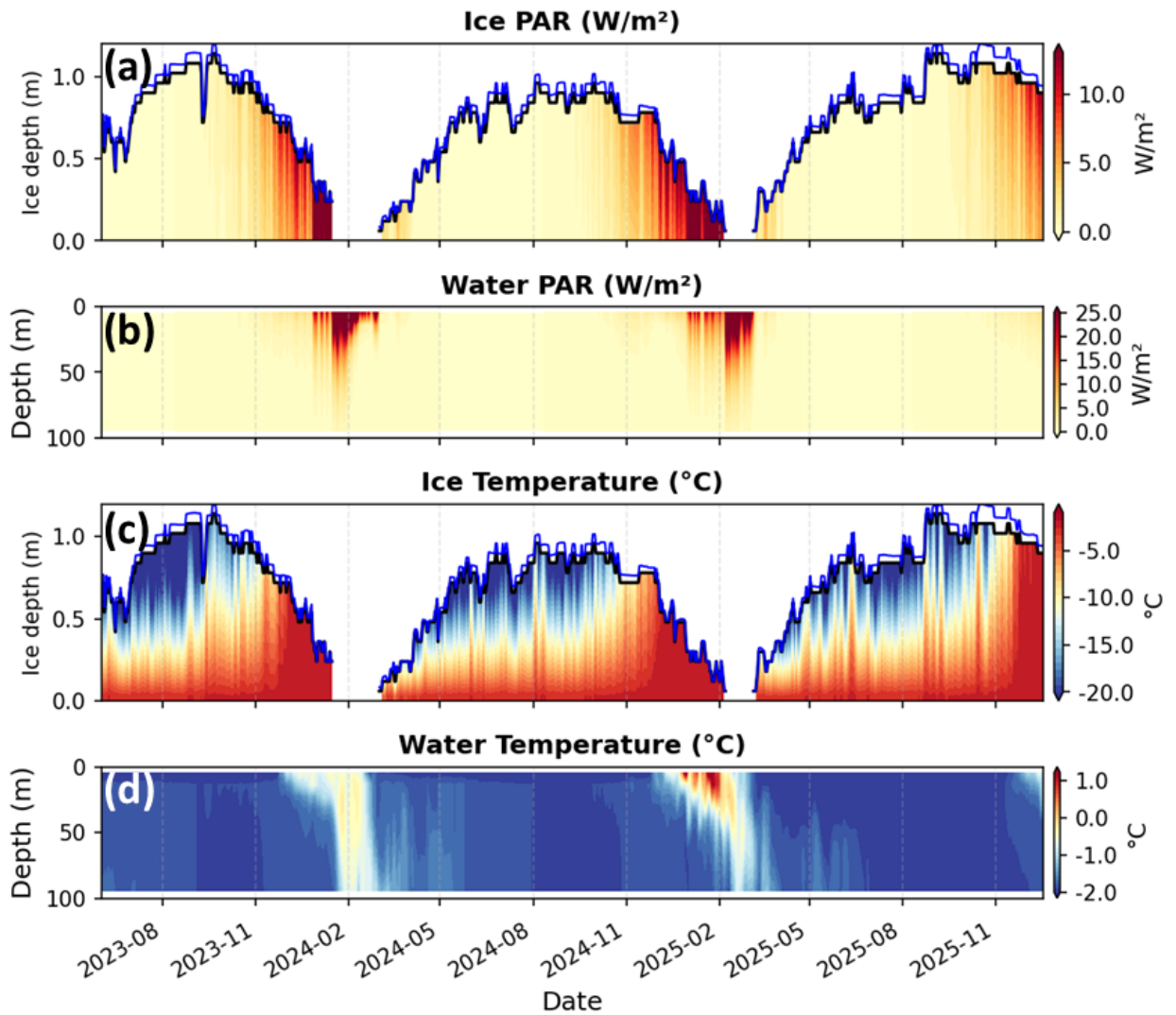


Figure S1. Seasonal evolution of the physical environment at Terra Nova Bay (TNB) over the simulation period (1 June 2023–18 December 2025). Panels show (a) sea-ice and snow thickness, (b) irradiance within the sea ice and entering the upper water column, (c) sea-ice temperature, and (d) water-column temperature in the upper 100 m.

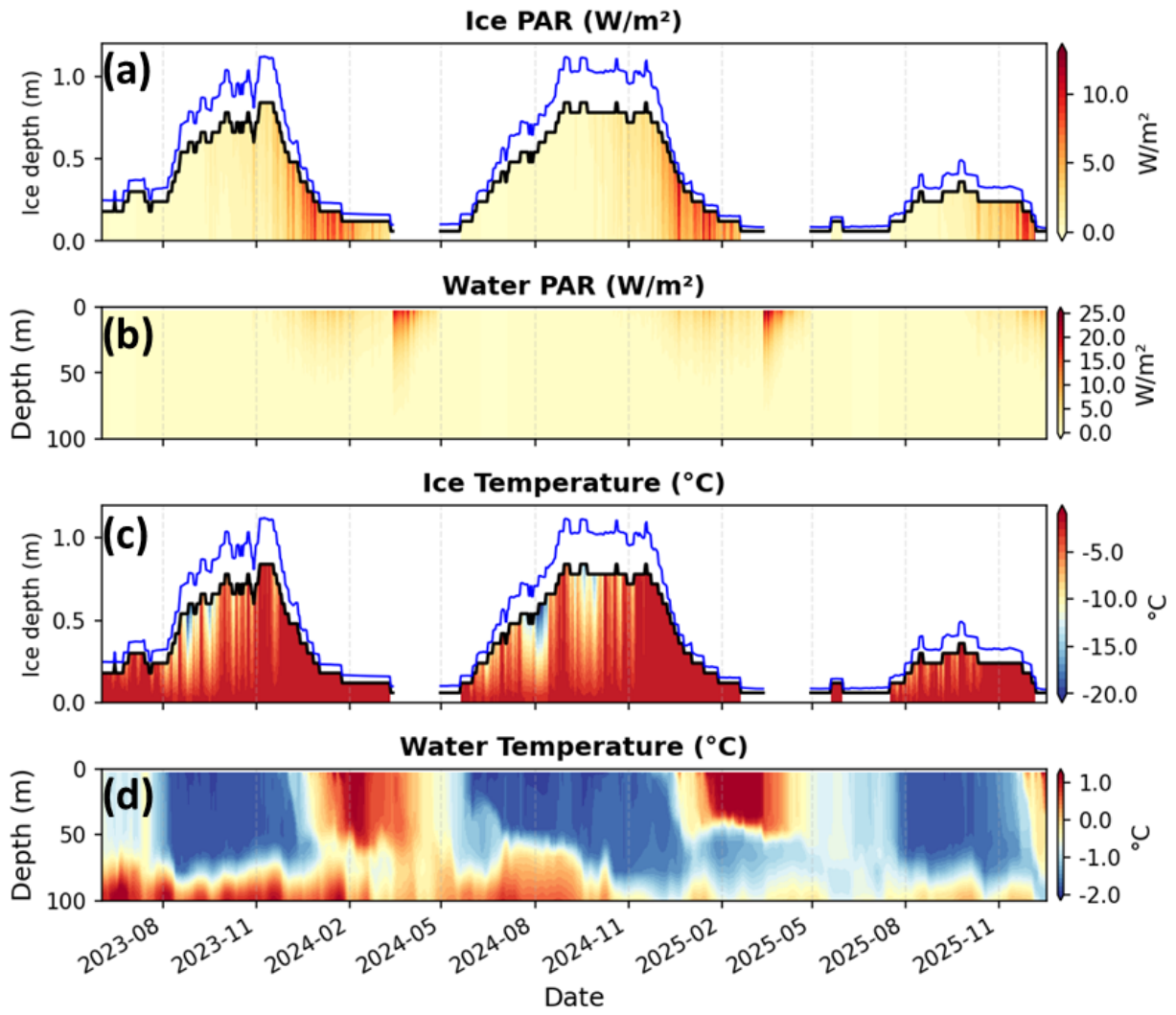


Figure S2. As Fig. S1, but for the western Antarctic Peninsula (WAP).

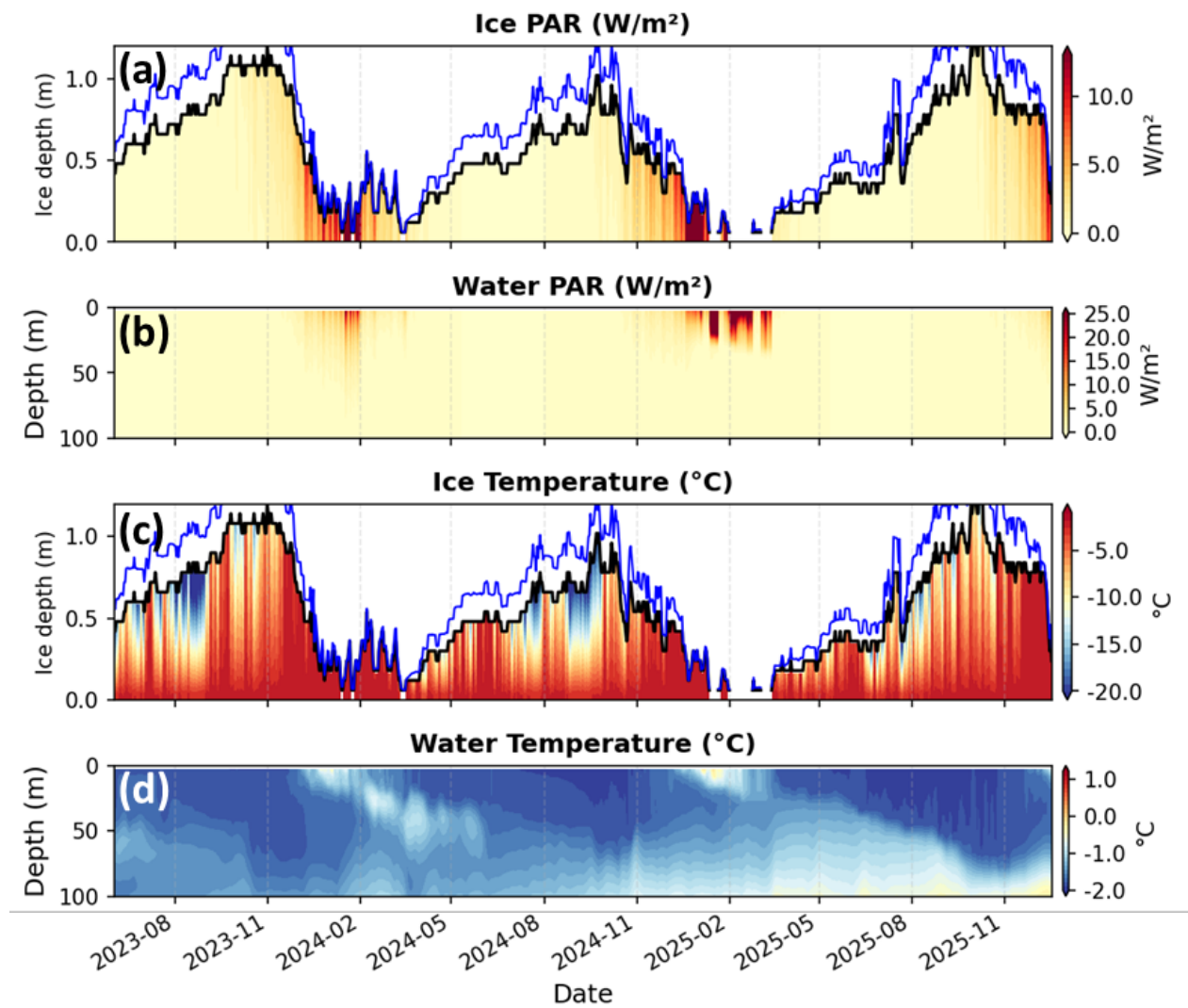


Figure S3. As Fig. S1, but for the Amundsen Sea polynya (ASP).

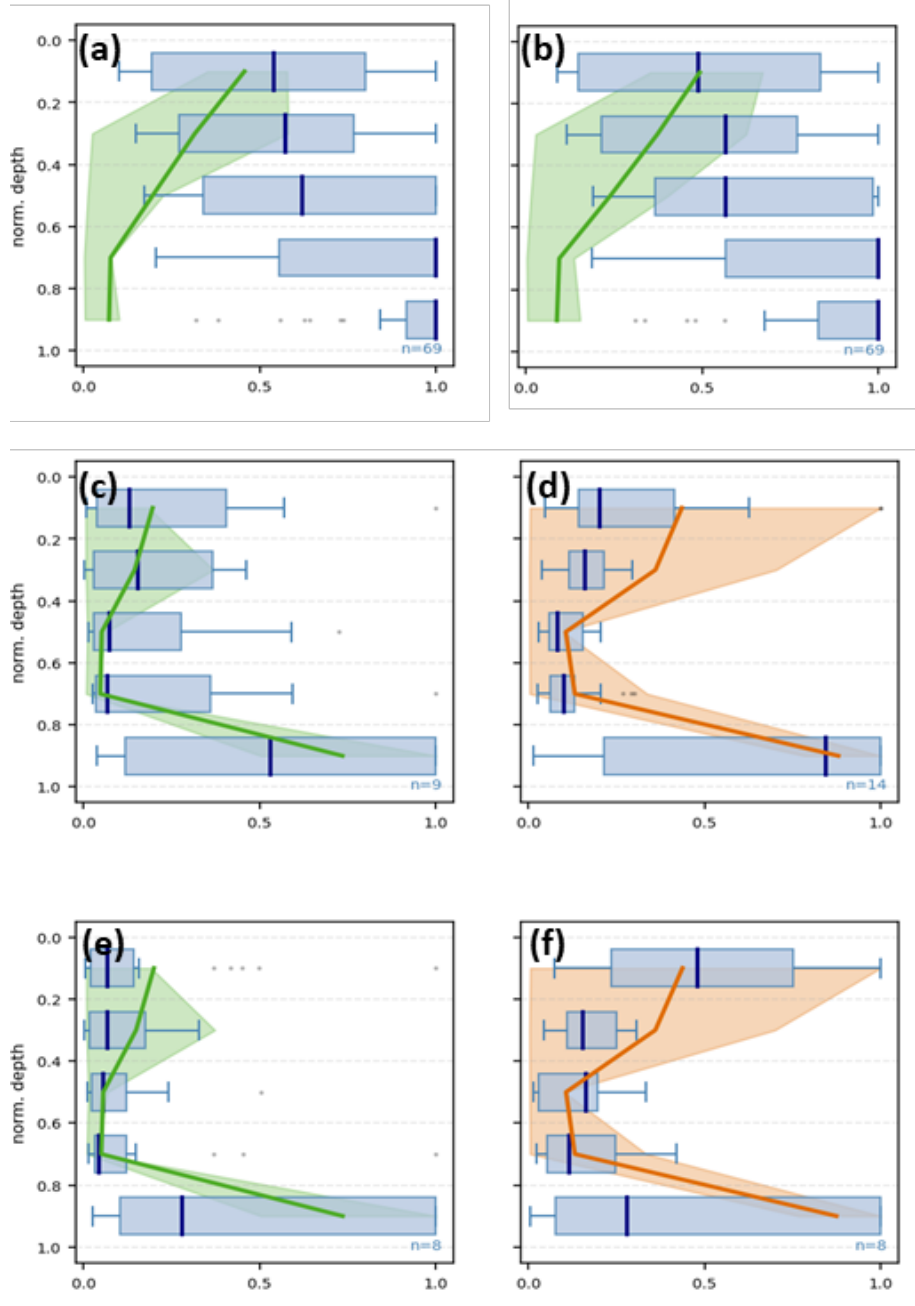


Figure S4. Seasonal vertical profiles of particulate organic carbon (POC) and particulate organic nitrogen (PON) within Antarctic sea ice at TNB and the WAP, comparing SPBM simulations with available ice-core observations. Panels show (a) TNB spring POC, (b) TNB spring PON, (c) WAP spring POC, (d) WAP summer POC, (e) WAP spring PON, and (f) WAP summer PON. Profiles were normalised by the maximum value within each individual ice column and averaged within five equal bins of normalised depth, following the procedure used for Fig. 3. Normalised depth ranges from 0 at the ice–atmosphere interface to 1 at the ice–ocean interface.

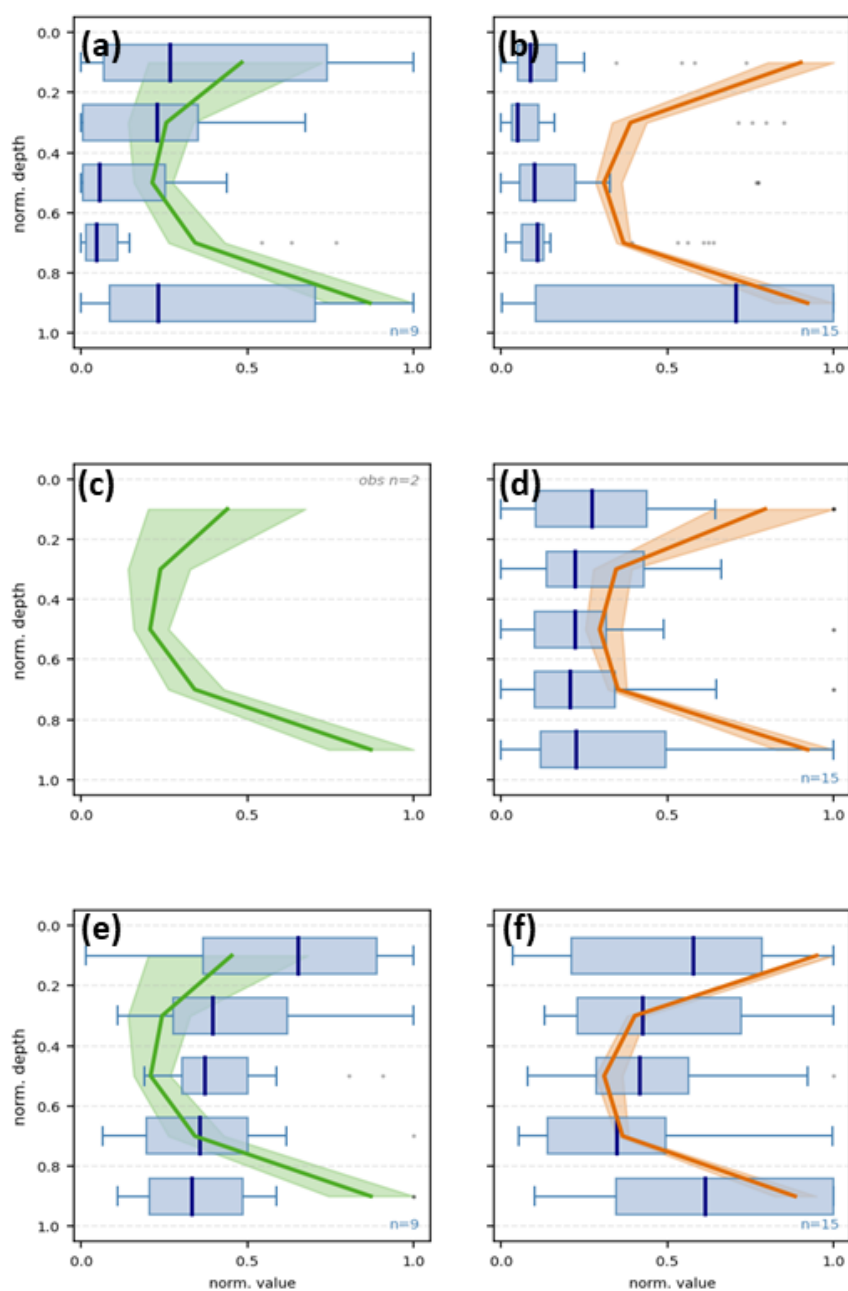


Figure S5. Seasonal vertical profiles of dissolved nitrate (NO_3), phosphate (PO_4), and silicate (Si) within sea ice at the WAP, comparing SPBM simulations with available ice-core observations. Panels show (a) spring NO_3 , (b) summer NO_3 , (c) spring PO_4 , (d) summer PO_4 , (e) spring Si, and (f) summer Si. Only two observational measurements were available for spring PO_4 ; these observations are therefore not shown in panel (c), which displays the model result only.

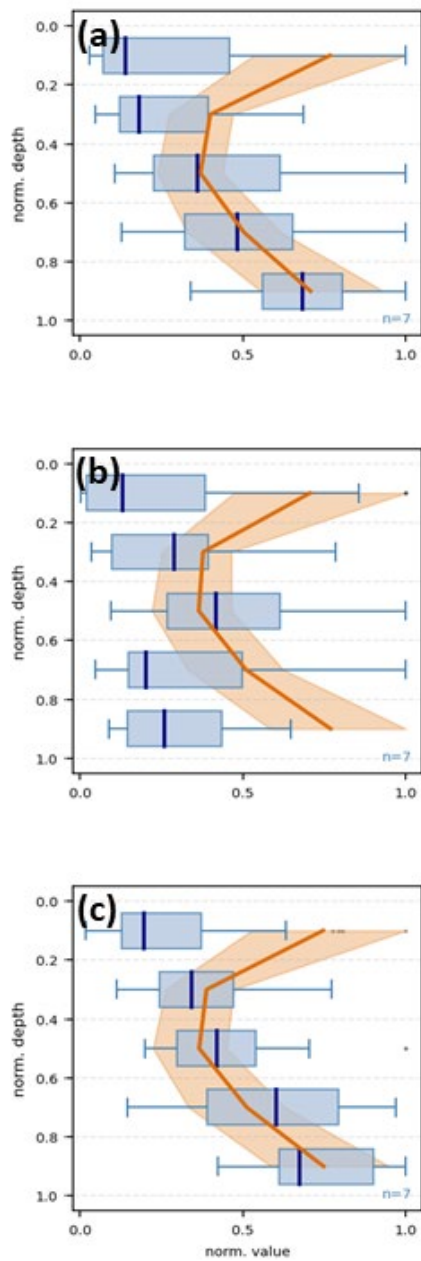


Figure S6. Summer vertical profiles of dissolved nutrients within sea ice at the ASP, comparing SPBM simulations with available ice-core observations. Panels show (a) NO_3 , (b) PO_4 , and (c) Si.