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Supplement of

Assessment of the Finite-VolumE Sea ice–Ocean Model (FESOM2.0) – Part 2: Partial bottom cells, embedded sea ice and vertical mixing library CVMix

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Supplementary:

- partial cells:

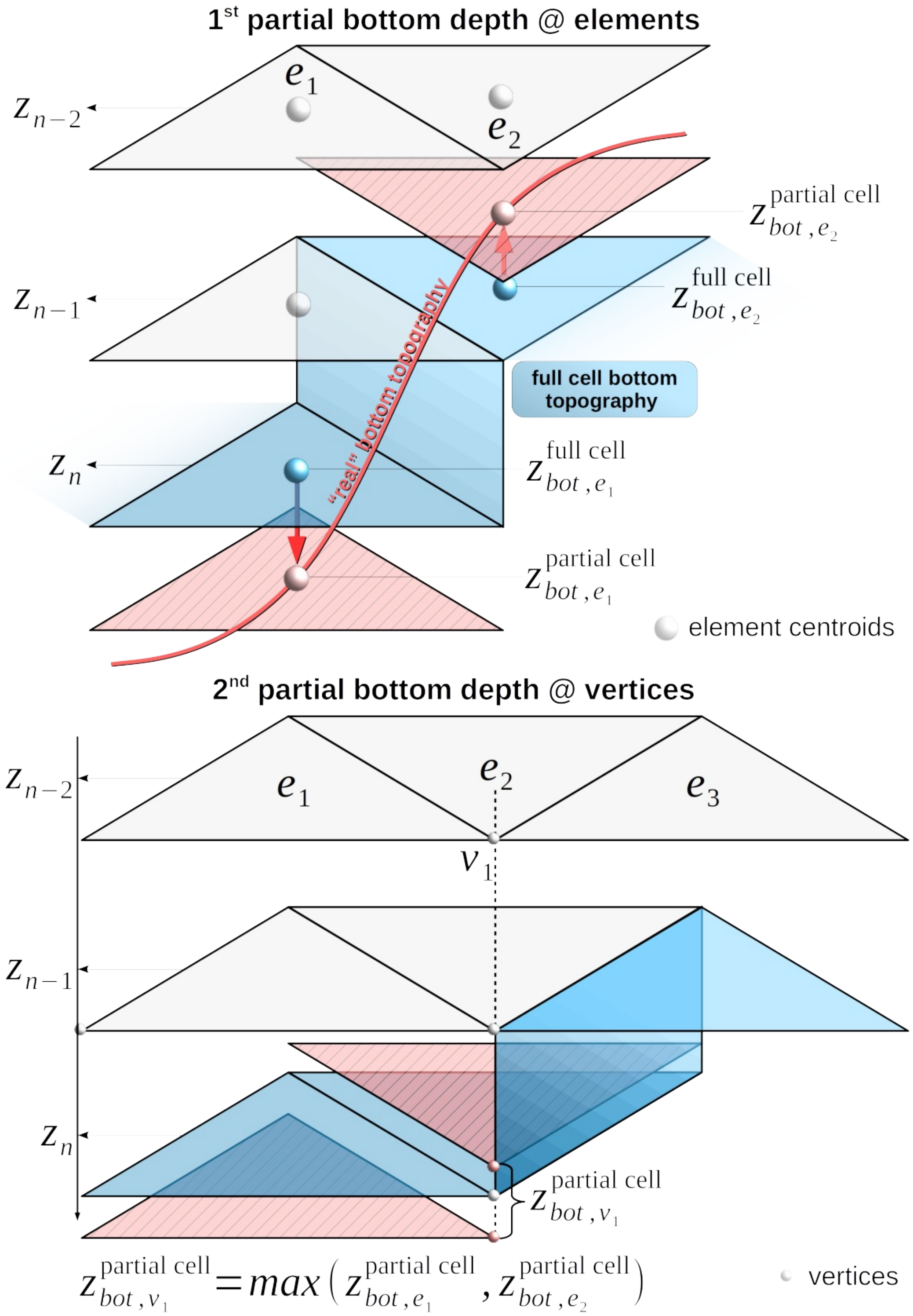

Figure. S1 Schematic representation of partial bottom cell implementation in FESOM2.0 at elements and vertices.

North Atlantic (-80<lon<5, 35<lat<70)	STD (respect to WOA18)		RMSE (respect to WOA18)	
	pc:0	pc:1	pc:0	pc:1
0-250m	1.42	1.35	1.27	1.19
250-500m	1.31	1.28	1.18	1.12
500-1000m	0.84	0.82	0.75	0.71
1000-2000m	0.59	0.61	0.53	0.56
2000-4000m	0.48	0.50	0.48	0.49

Table S1 Table with regional (North Atlantic) mean Standard Deviation (STD) and Root Mean Square Error (RMSE) with respect to WOA18 temperatures, with (pc:1) and without (pc:0) partial cell. It shows that partial cells help to improve the biases especially in the upper and intermediate ocean, while the deep depth ranges indicate a marginal increase in the biases when using partial cells.

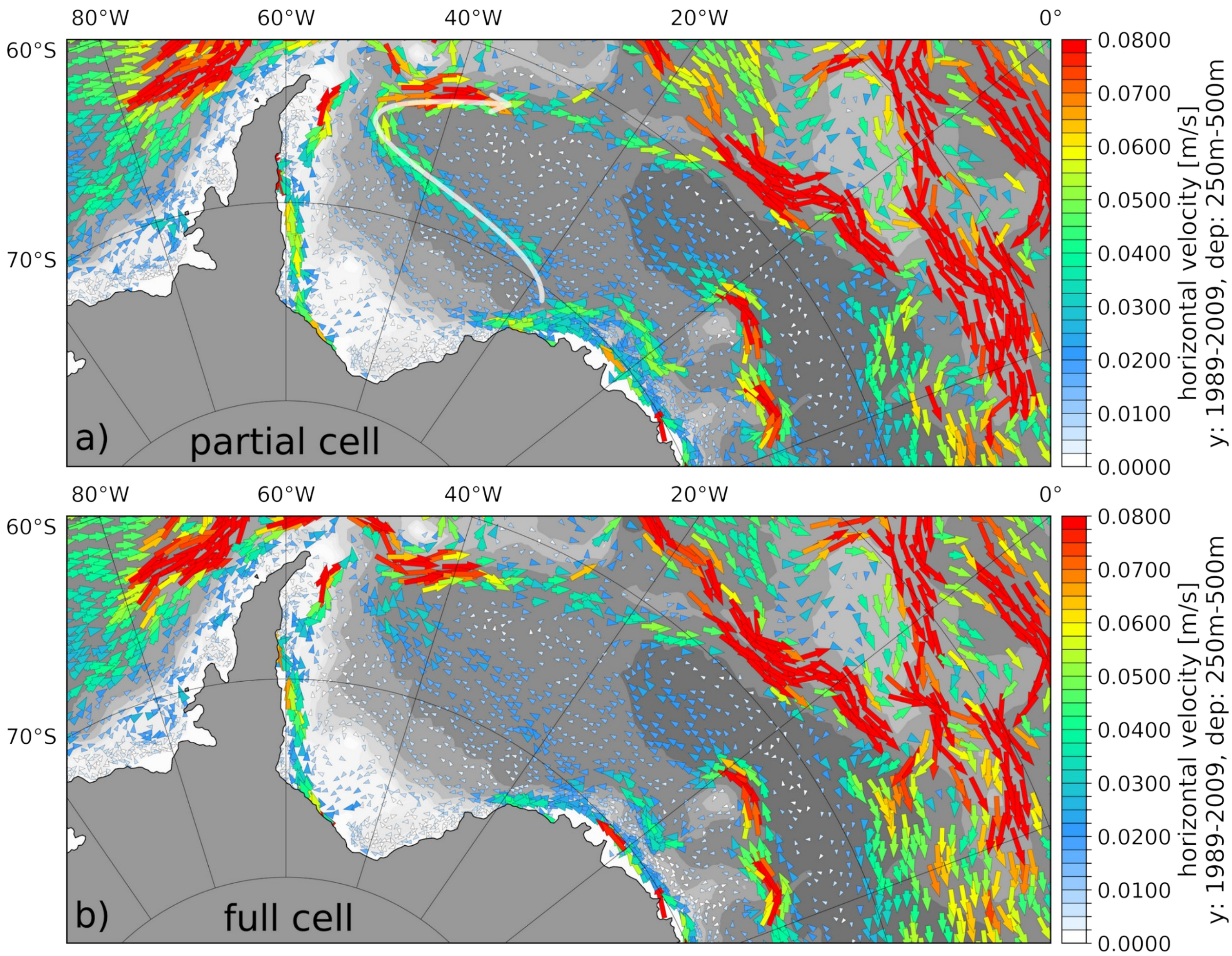

Figure S2 Horizontal ocean circulation in the Weddell Sea for partial cell (a) and full cell (b), vertically averaged for the depth range 250-500 m and averaged for the period 1989 to 2009. The white arrow marks the enhanced warm deep water current when using partial cells.

- embedded sea ice:

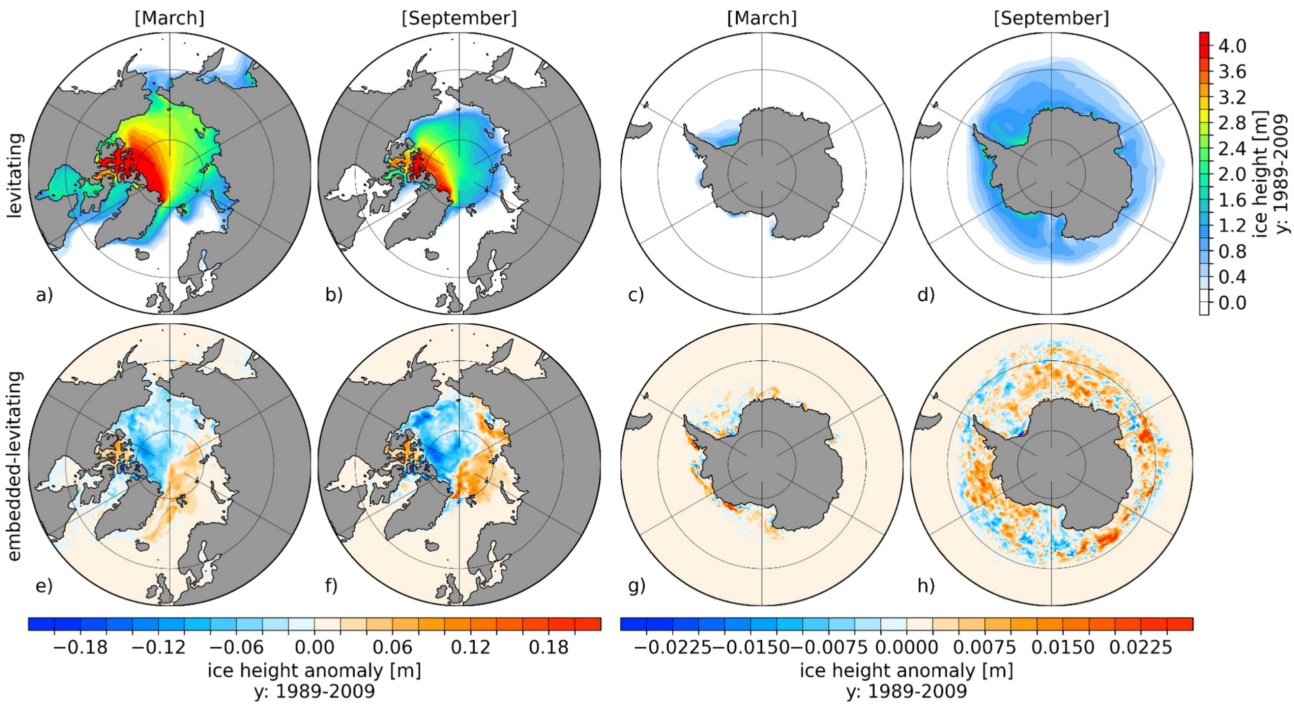

Figure S3 Levitating (upper row) northern and southern hemispheric March (a, c) and September (b, d) sea ice thickness averaged for the period 1989-2009. The lower row shows the corresponding sea ice thickness anomalies between embedded and levitating sea ice (embedded minus levitating) averaged over the same period.

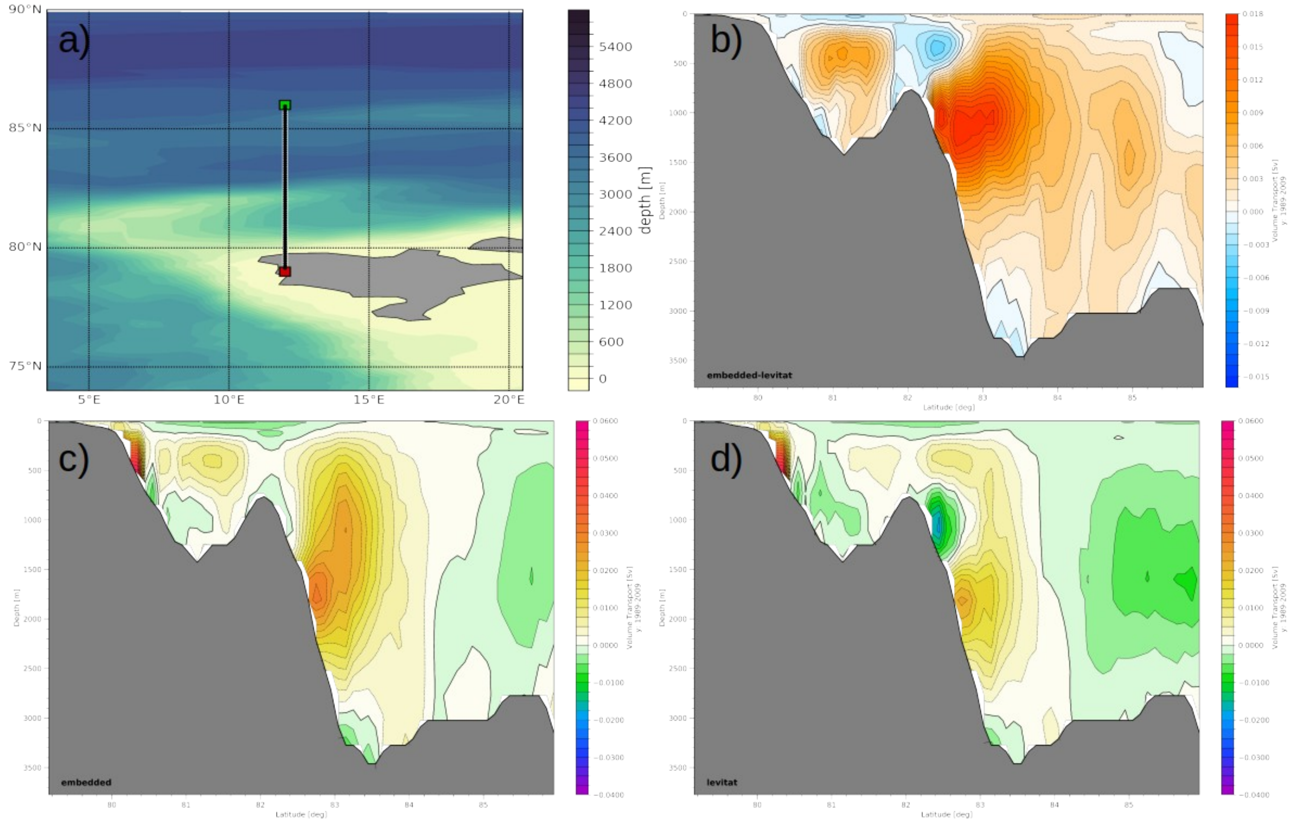

Figure S4 a) Section along Arctic continental slope at 12°E, b) anomalous mean transport in Sv through section (a) for embedded minus levitating sea ice averaged for the period 1989-2009. c) and d): absolute transport for levitating (c) and embedded sea ice (d), where positive values stand for transport to the east.

- vertical mixing:

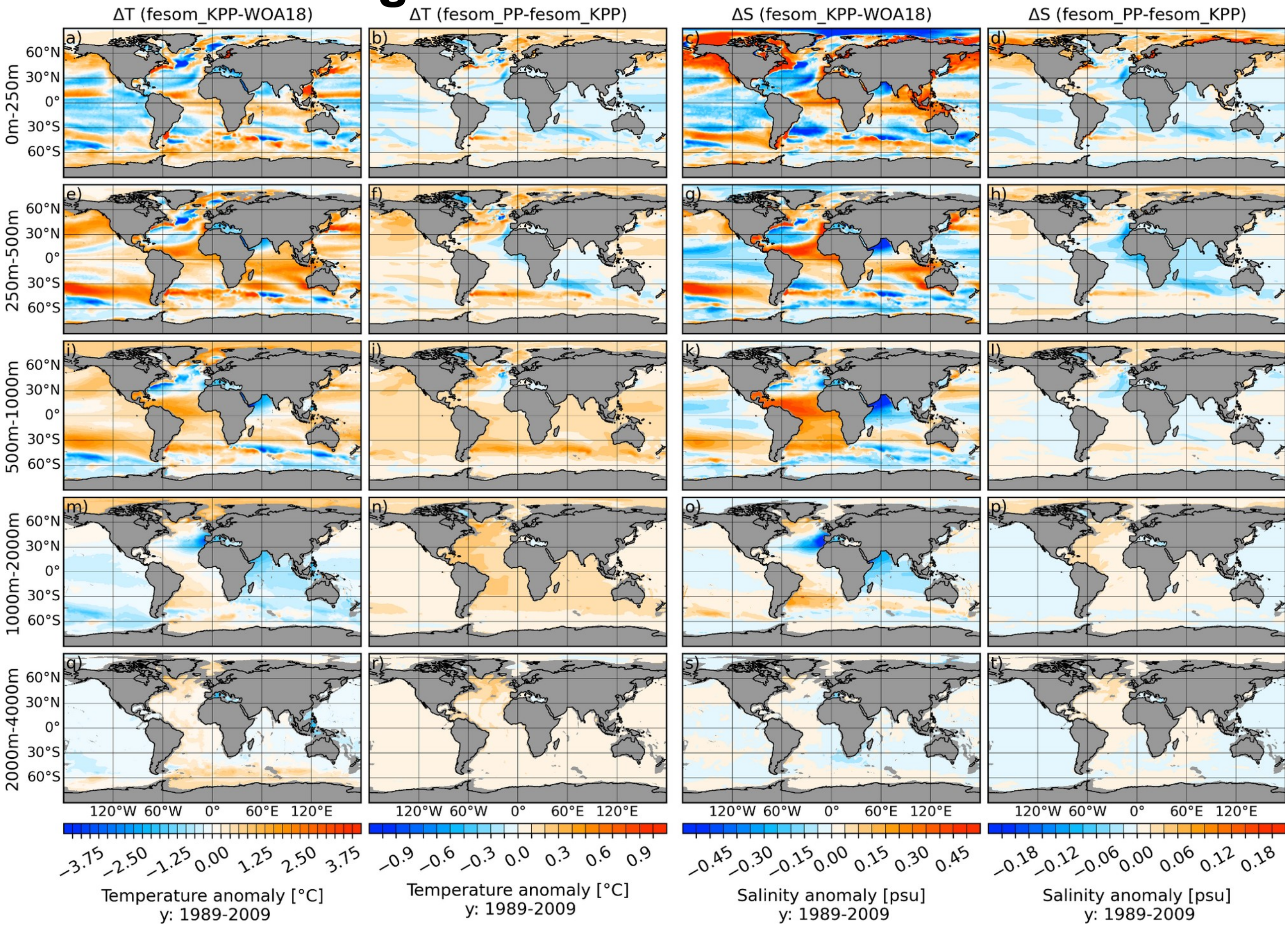

Figure S5 Temperature (1st and 2nd column), salinity (3rd and 4th column) difference between fesom_KPP and WOA18 (1st and 3rd column) as well as between fesom_PP and fesom_KPP (2nd and 4th column) averaged for the period 1989 to 2009. From top to bottom, panels show the vertically averaged fields for the depth ranges of 0-250 m, 250-500 m, 500-1000 m, 1000-2000 m and 2000-4000 m.

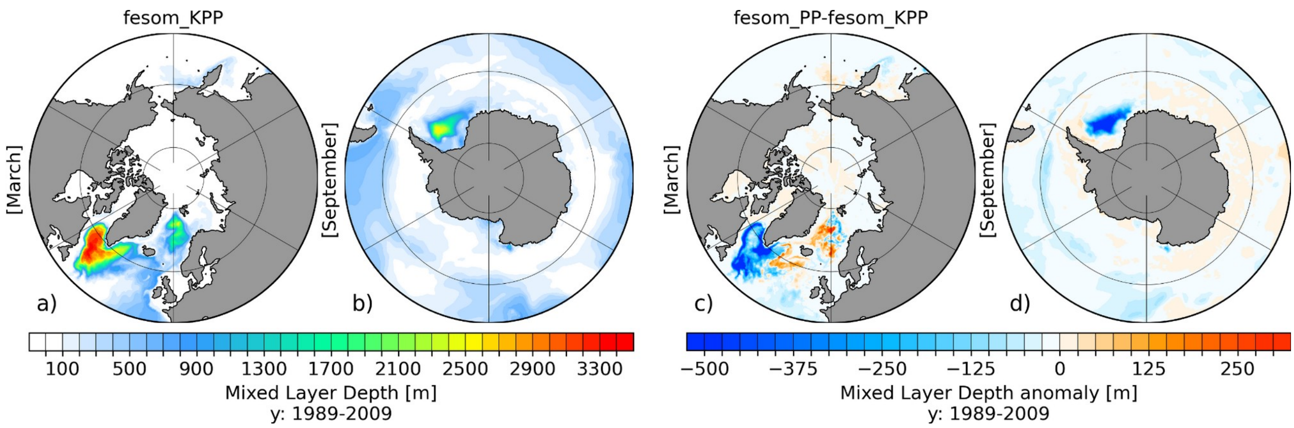

Figure S6 Northern hemispheric March (a) and southern Hemispheric September (b) mixed layer depth (MLD) for fesom_KPP implementation as well as corresponding anomalous MLD between fesom_PP and fesom_KPP implementation (c, d), averaged for the period 1989-2009.

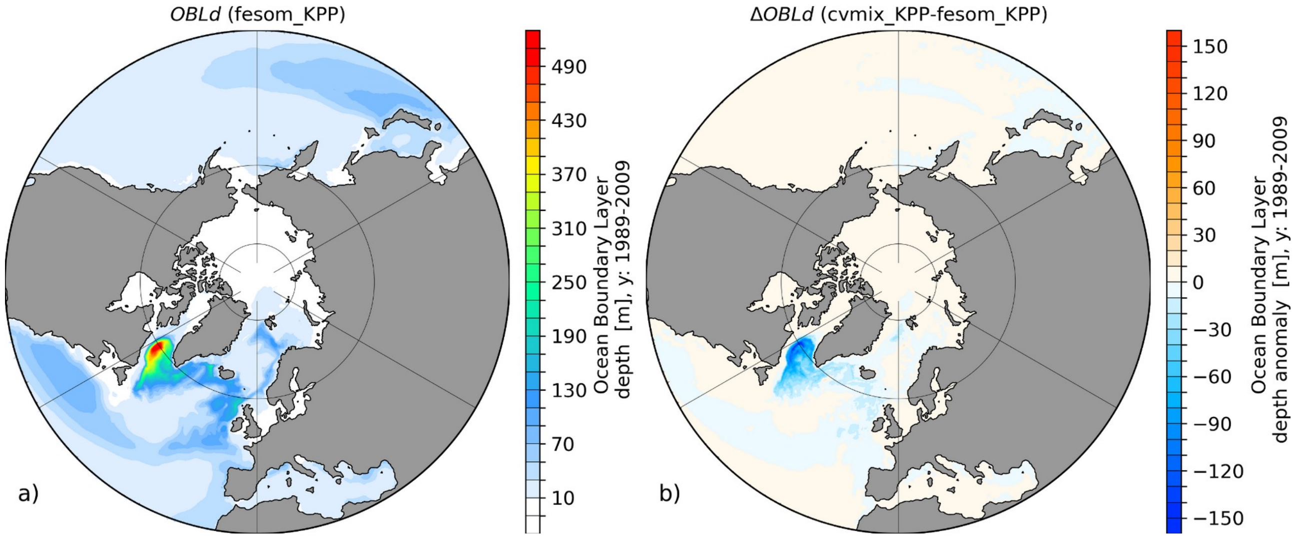

Figure S7 KPP Ocean Boundary Layer depth (OBLd) for fesom_KPP (a) averaged over the period 1989-2009. b) Difference in OBLd between cvmix_KPP and fesom_KPP.

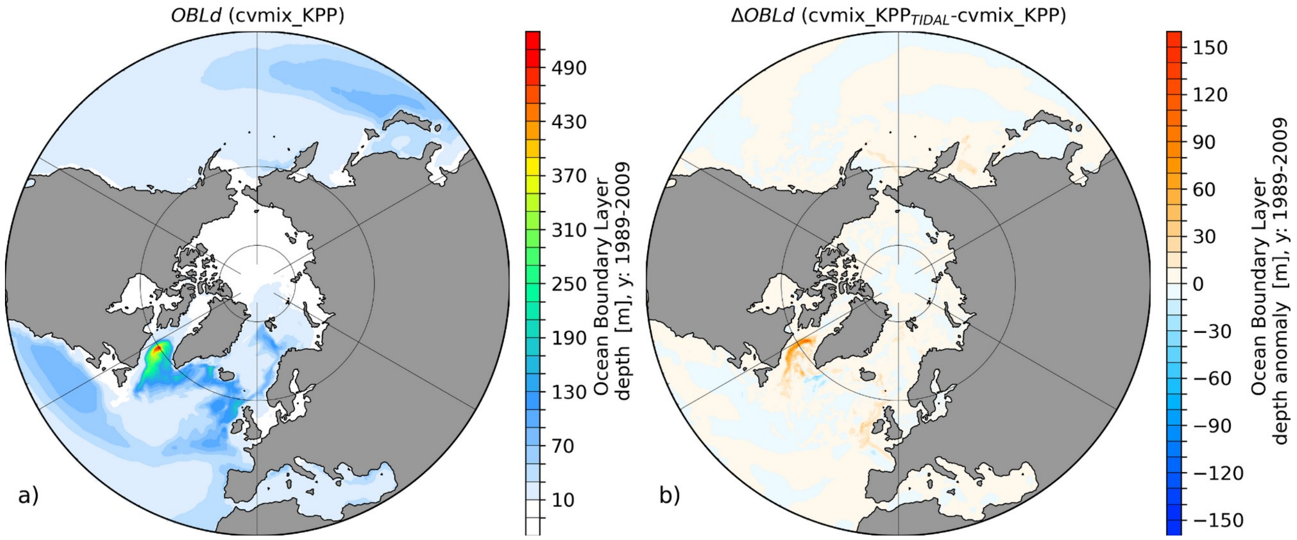

Figure S8 KPP Ocean Boundary Layer depth (OBLd) for cvmix_KPP (a) averaged over the period 1989-2009. b) Difference in OBLd between cvmix_KPP$_{TIDAL}$ and cvmix_KPP.

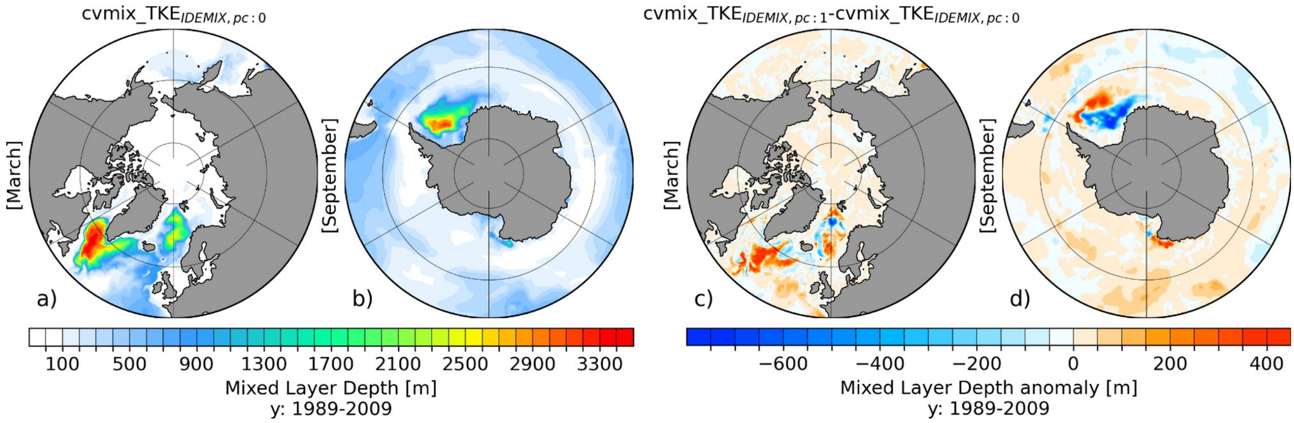

Figure S9 Northern hemispheric March (a) and southern hemispheric September (b) mixed layer depth (MLD) for cvmix_TKE$_{IDEMIX}$ using full cells (pc:0) as well as corresponding anomalous MLD between cvmix_TKE$_{IDEMIX}$ using partial cells (pc:1) minus full cell (pc:0) (c, d), averaged for the period 1989-2009.