



Supplement of

Documenting the 2015–2017 freshening of the eastern Eurasian Basin of the Arctic Ocean and evaluating its drivers and consequences

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Supplementary Materials

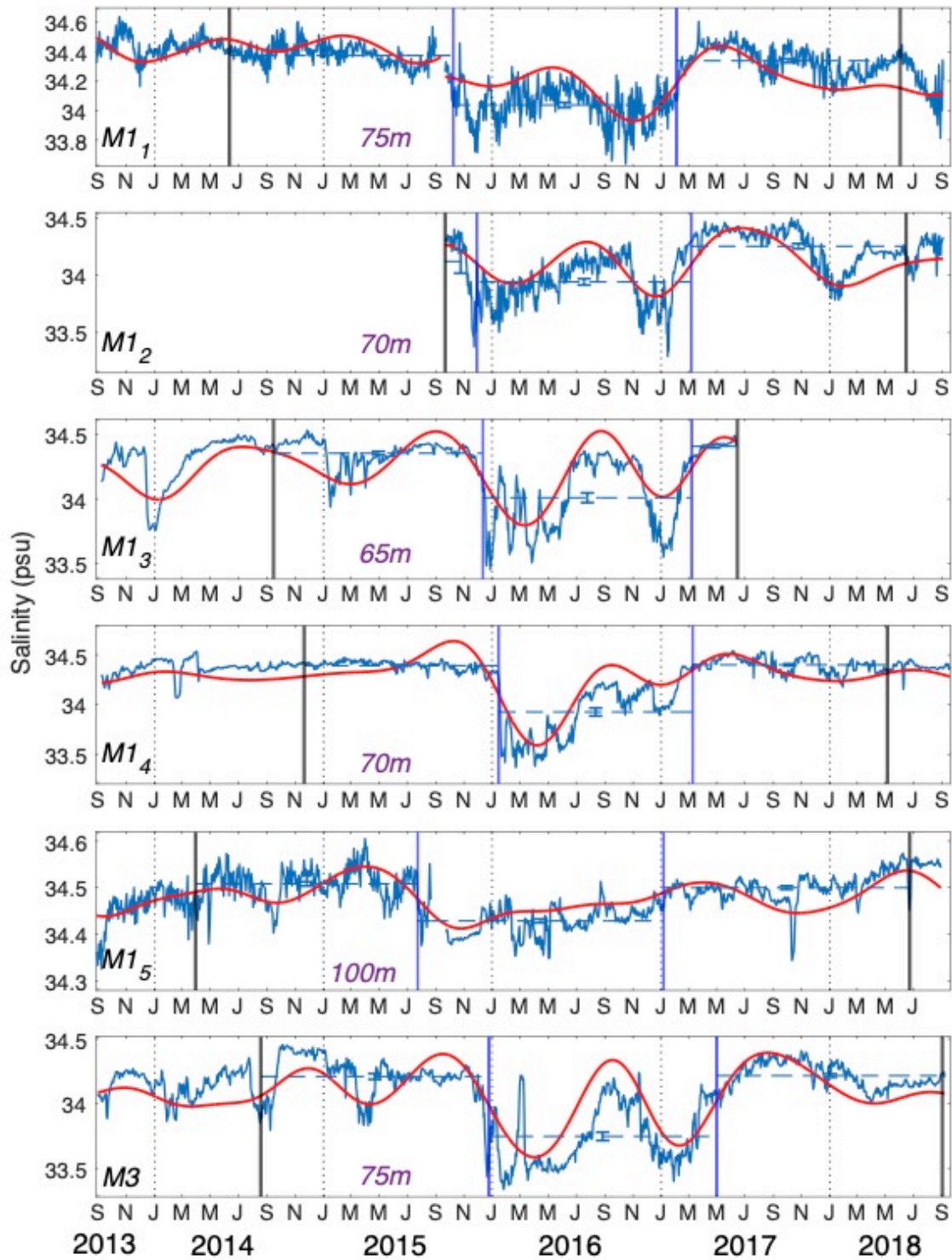


Figure S1: Daily salinity time series (blue lines) with seasonal signals (red line) derived from wavelet analysis for six mooring locations in the eastern Eurasian Basin. Vertical dark blue lines indicate the period of the freshening event; the vertical black lines mark the periods for pre- and post-event.

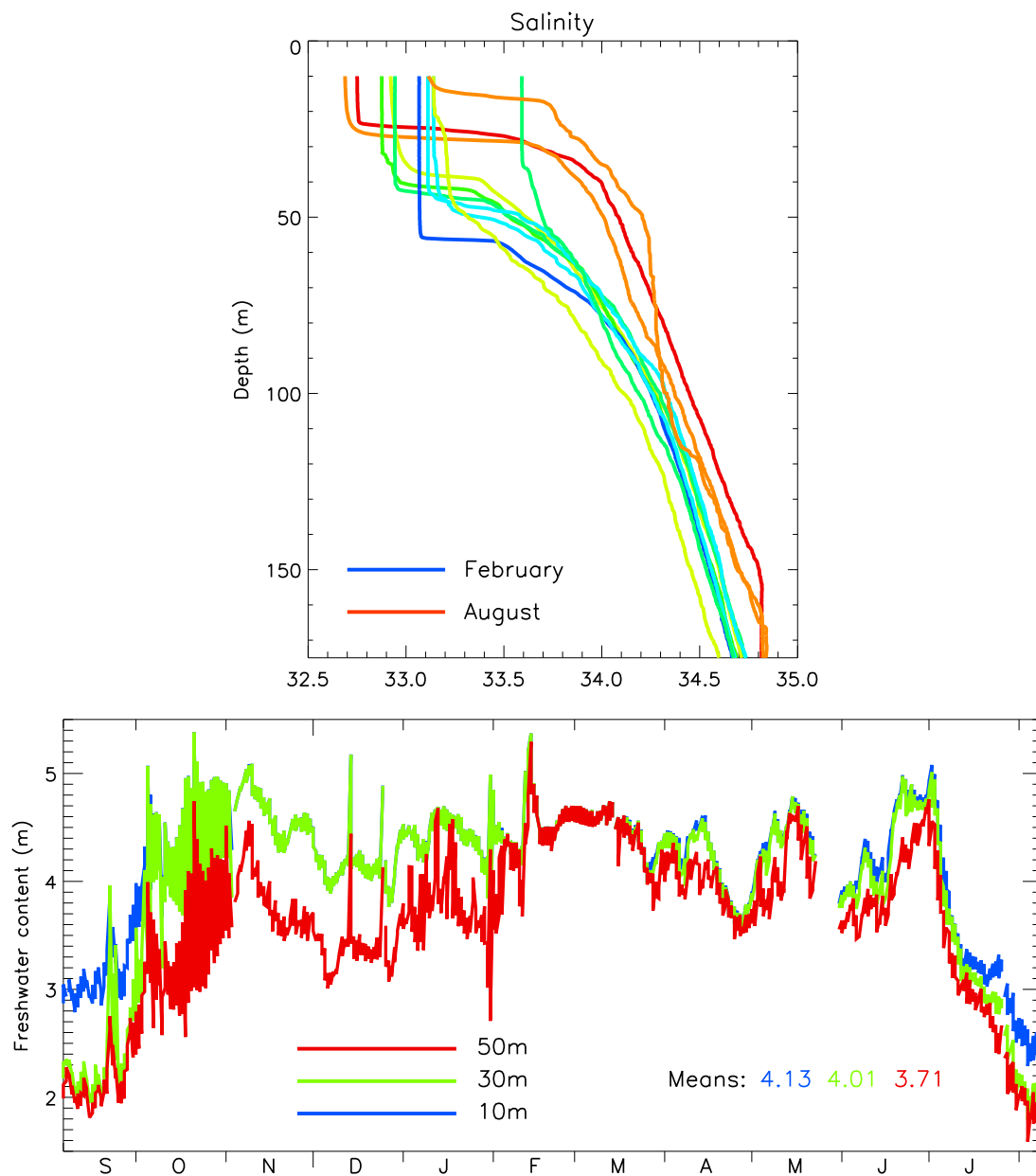


Figure S2: (Top) Salinity profiles from Ice-Tethered Profiler ITP-37 in the eastern Eurasian Basin (2009–2010), starting on August 30 and repeated at 30-day intervals over one year. Color transitions from red (August) to blue (February) and back to red. (Bottom) Time series of freshwater content (FWC) from the ITP-37 record. The blue line shows FWC calculated over the 10–175 m depth range. The green and red lines show FWC estimates in which values above 30 m and 50 m, respectively, are replaced by values at those depths, simulating missing near-surface data. Mean values (shown in corresponding colors) indicate that the absence of observations in the upper layer has a limited impact on FWC estimates used in this study.

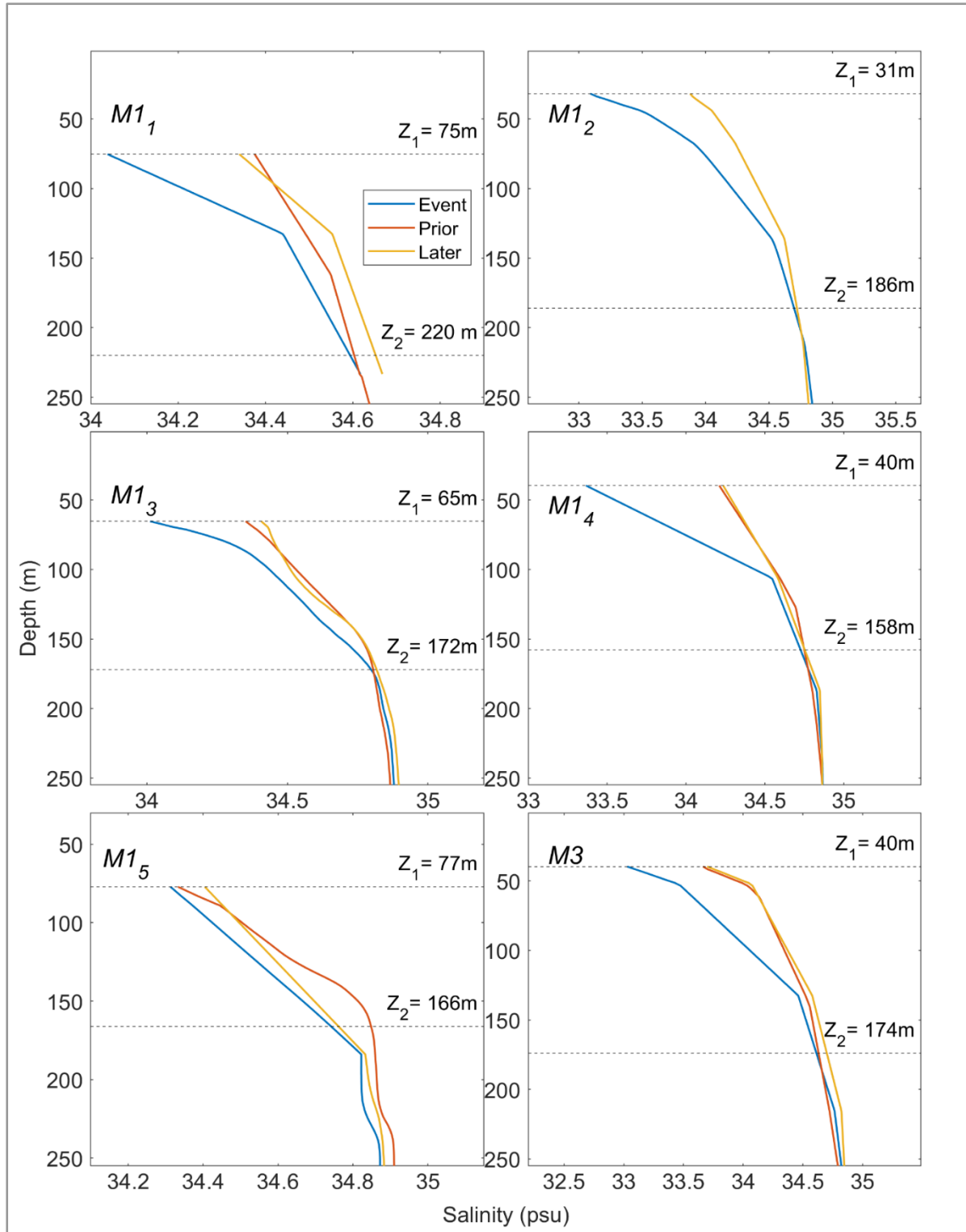


Figure S3: Salinity profiles averaged over the periods before (orange; pre-event), during (blue; Event), and after (yellow; post-event) the freshening event for six mooring locations in the eastern Eurasian Basin. Horizontal grey dashed lines mark freshening depth extent from z_1 (shallowest available salinity) and z_2 (determined by salinity anomaly threshold; see Methods for details).

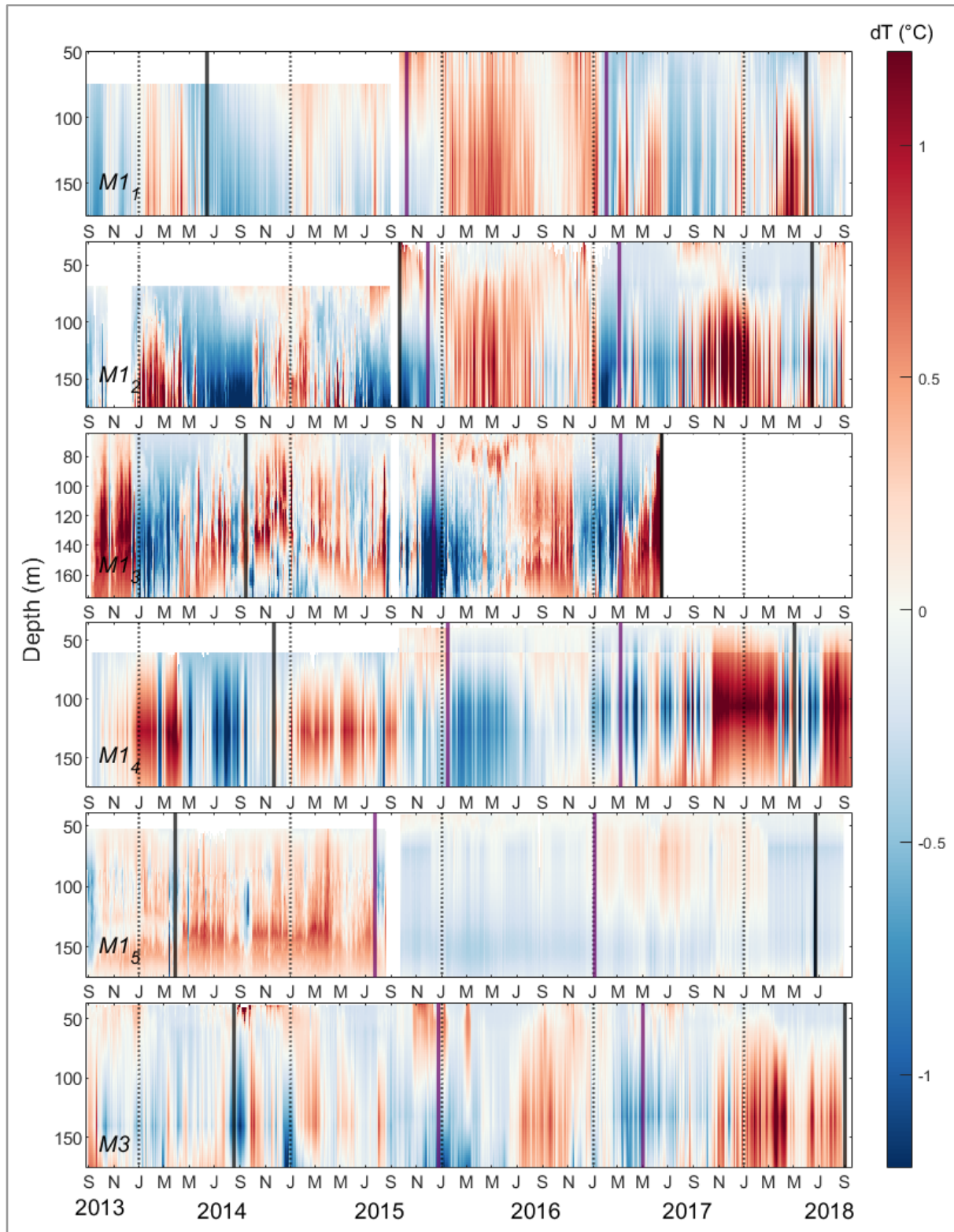


Figure S4: Depth–time distributions of anomalous temperature (relative to the 2013–2018 mean) for six mooring locations in the eastern Eurasian Basin at depths up to 175m (see their locations in Fig. 2.1) from 2013 to 2018. Vertical red dashed lines indicate the freshening event (2015–2017), and solid red lines mark the periods before and after the event, used for comparison. White gaps show missing data.

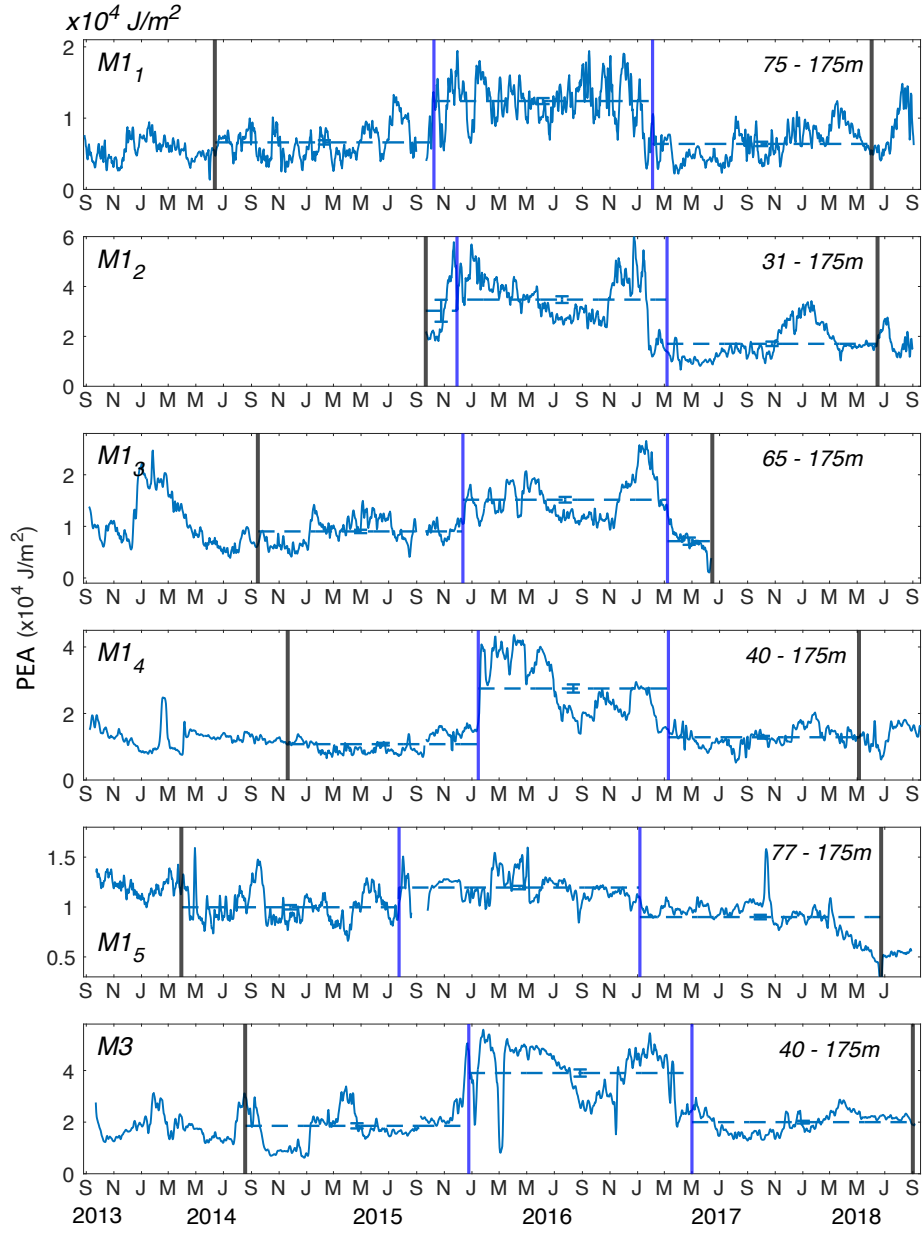


Figure S5: Time series of potential energy anomalies (PEA [J/m^2], blue) for six mooring locations in the eastern Eurasian Basin, averaged over the depth indicated for each mooring individually (top right). Horizontal dashed lines represent the mean PEA, and the error bar denotes ± 3 standard errors. Vertical dark blue lines indicate the period of the freshening event; the vertical black lines mark the periods before and after the event.

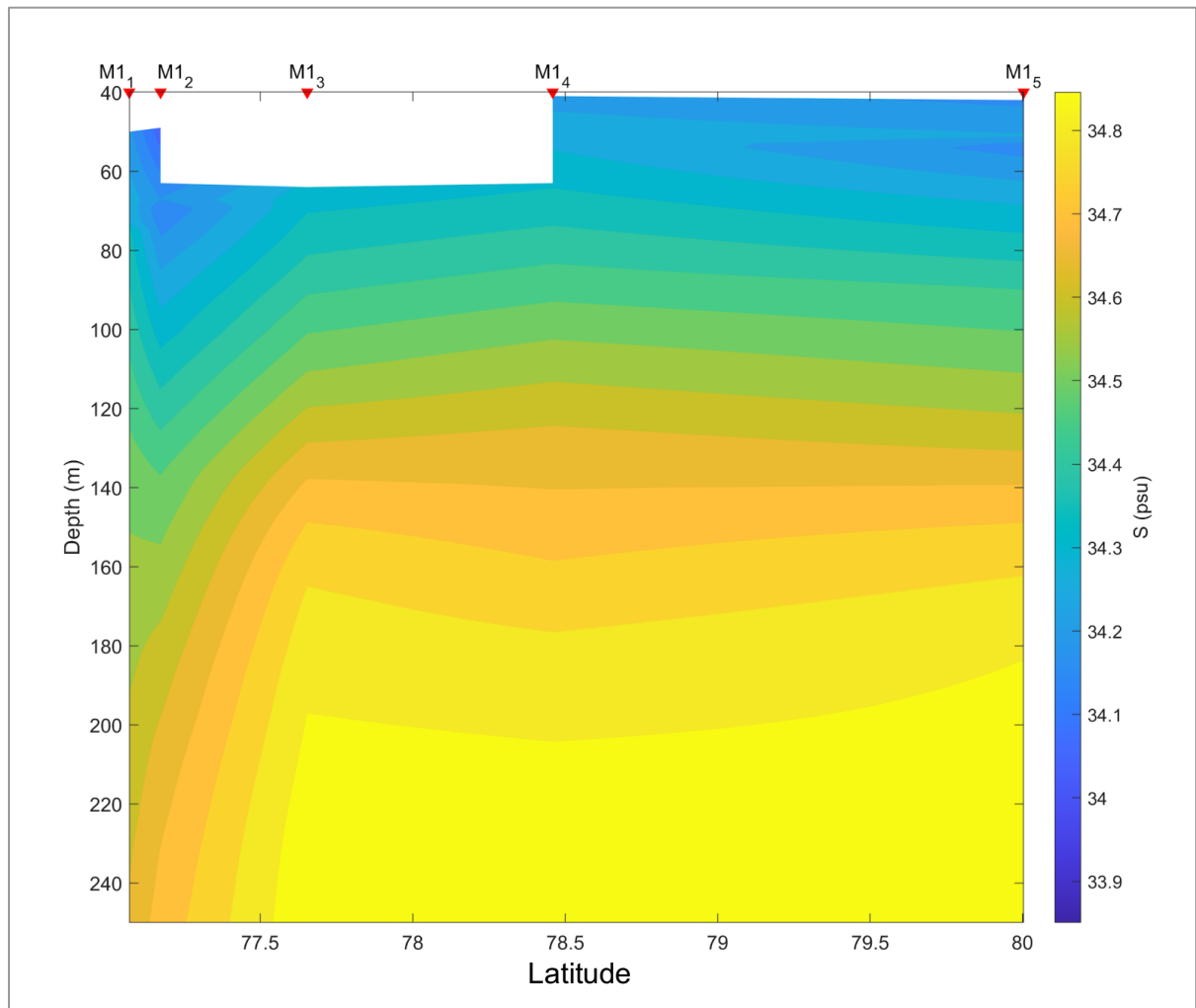


Figure S6: Vertical section of salinity (psu) from 40 to 250 m depth along the mooring array in the eastern Eurasian Basin, averaged from September 2015 to September 2018, excluding the freshening event. Red triangles at the top mark the mooring locations. White areas indicate data gaps.

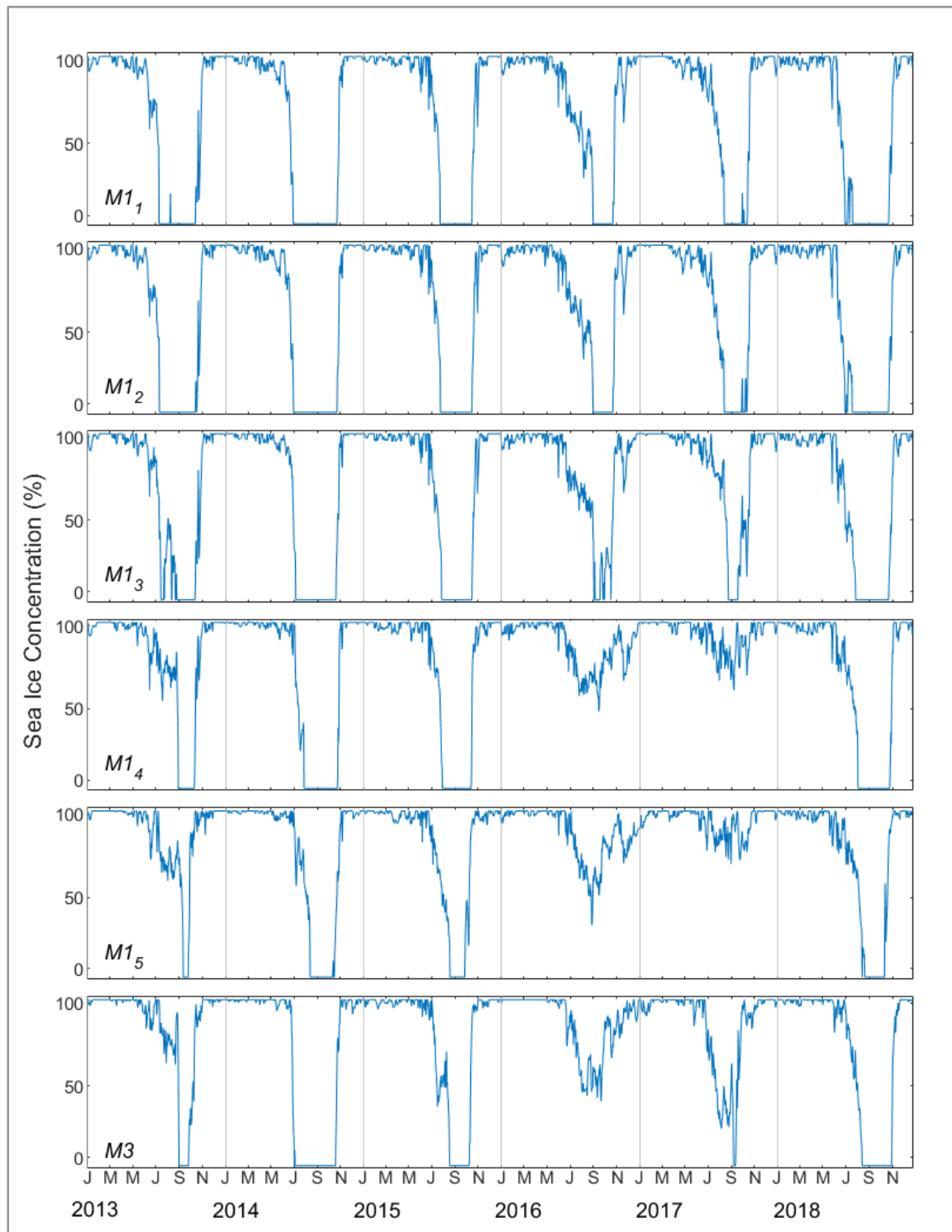


Figure S7: Time series of daily sea ice concentration (%) from 2013 to 2018 for six mooring locations in the eastern Eurasian Basin.

Table S1: Freshening layer limits and freshwater content (FWC) at six mooring locations in the eastern Eurasian Basin. z_1 is the depth of the shallowest salinity record; z_2 and z_2' are the lower bounds of the freshening layer where the mean salinity-anomaly profile falls to $\leq 3\%$ ($\leq 6\%$ for M1₅) of the event salinity magnitude and to $\sim 0\%$ ($\sim 3\%$ for M1₅), respectively. “Mean for z_1-z_2 ” and “Mean for z_1-z_2' ” list the depth-integrated FWC (meters) as the mean $\pm$ 3 SE (standard error) of the time series. The correlation row gives the Pearson coefficient between the two FWC series at each mooring.

Moor	M1₁	M1₂	M1₃	M1₄	M1₅	M3
Z₁ (m)	75	31	65	40	77	40
Z₂ (m)	220	186	172	158	166	174
Z₂' (m)	230	204	174	170	184	186
Mean for Z₁-Z₂	1.26 $\pm$ 0.01	0.89 $\pm$ 0.02	0.58 $\pm$ 0.01	0.75 $\pm$ 0.01	0.69 $\pm$ 0.00	1.95 $\pm$ 0.02
Mean for Z₁-Z₂'	1.30 $\pm$ 0.01	0.92 $\pm$ 0.02	0.57 $\pm$ 0.01	0.76 $\pm$ 0.01	0.68 $\pm$ 0.00	2.00 $\pm$ 0.02
Correlation	0.99	0.99	1.00	0.99	0.99	0.99

Table S2: Properties averaged over 50–150 m for five mooring locations. S is mean salinity, dS_{fresh} is the observed salinity anomaly during the freshening event, $\Delta S = S_{\text{north}} - S_{\text{south}}$ is the meridional salinity difference between adjacent moorings, $\bar{V}$ is meridional current velocity averaged over adjacent mooring locations, $F \sim \bar{V} \cdot \Delta S / \Delta x$ is the proxy of advective flux averaged from September 2015 to September 2018 (excluding the freshening event).

Mooring	S (psu)	dS_{fresh} (psu)	ΔS (psu)	$\bar{V}$ (cm/s)	Proxy of flux $F \sim \bar{V} \cdot \Delta S / \Delta x$ (psu/yr)	Divergence of fluxes ΔF (psu/yr)
M1 ₁	34.42	-0.14	-0.10	+3.4	-3.57	
M1 ₂	34.32	-0.12				
			+0.23	+1.1	+1.63	+5.20 ↔ salinification
M1 ₃	34.55	-0.07	-0.03	+0.8	-0.085	-2.48 ↔ freshening
M1 ₄	34.52	-0.16				
			-0.04	+1.1	-0.081	+0.004 ↔ salinification
M1 ₅	34.48	-0.05				