



Supplement of

Long-term variations in pH in coastal waters along the Korean Peninsula

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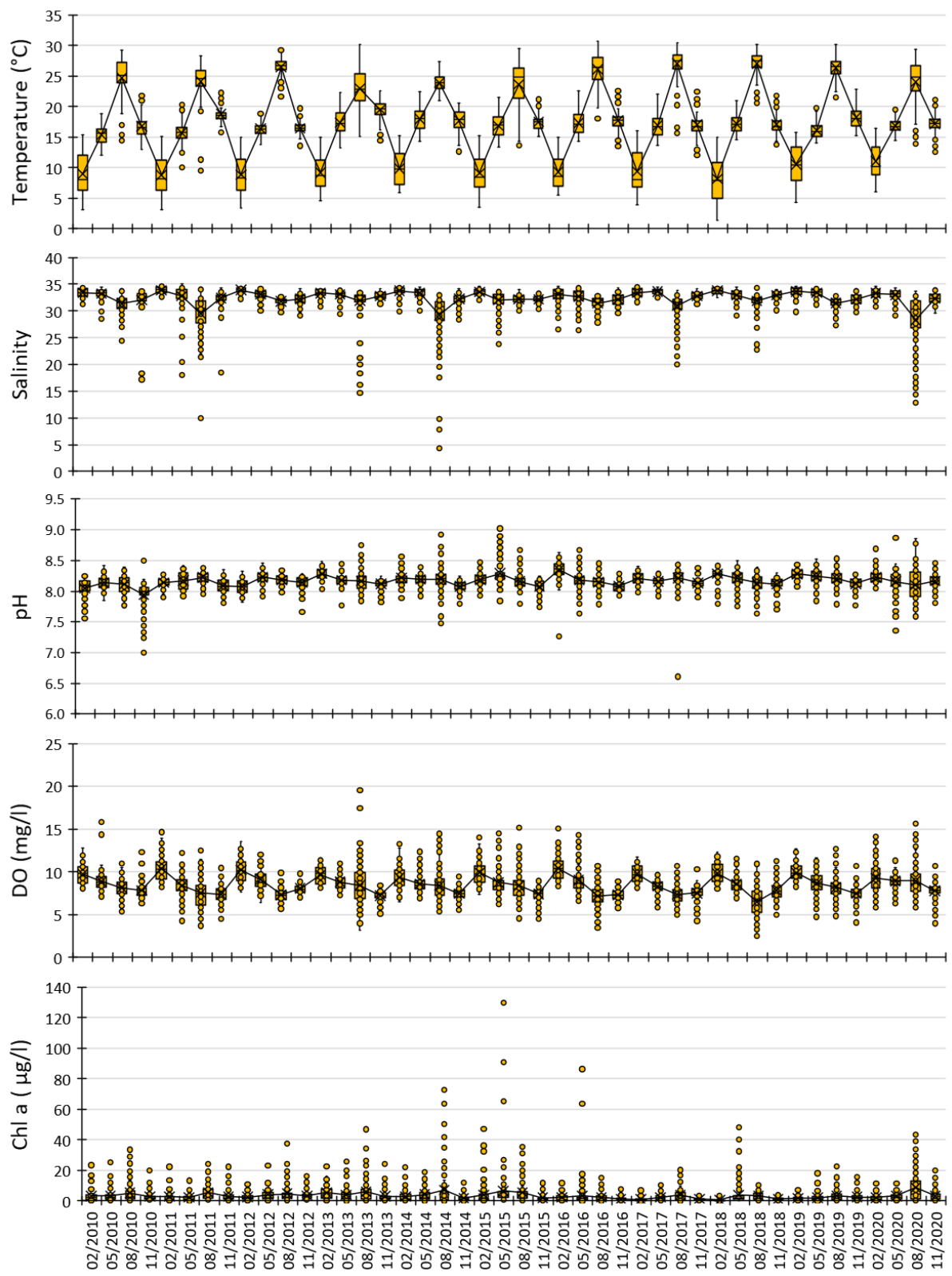


Figure S1. Variations in parameters of surface waters along the southern coast of Korea.

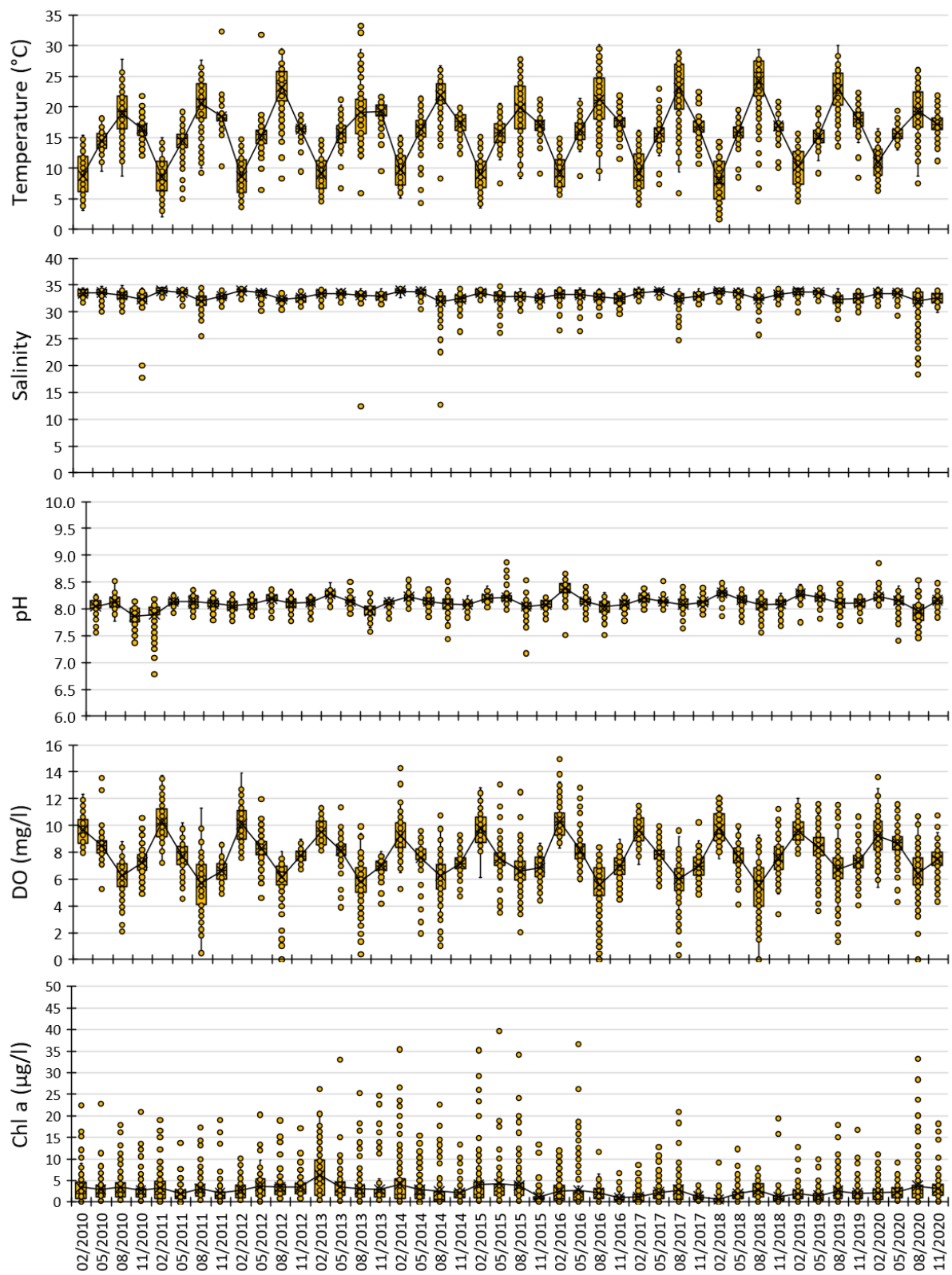


Figure S2. Variations of parameters of bottom waters along the southern coast of Korea.

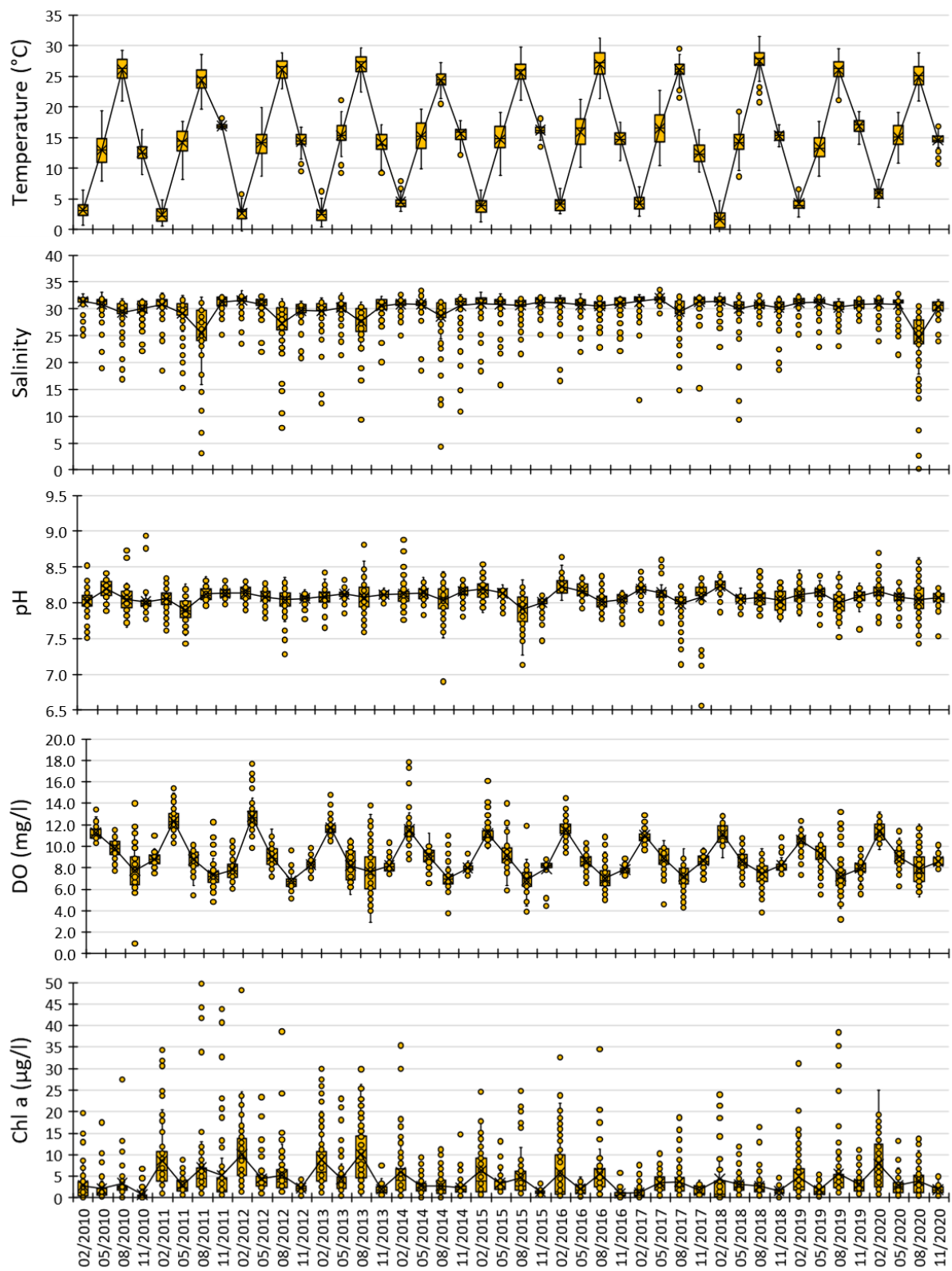


Figure S3. Variations of parameters of surface waters along the western coast of Korea.

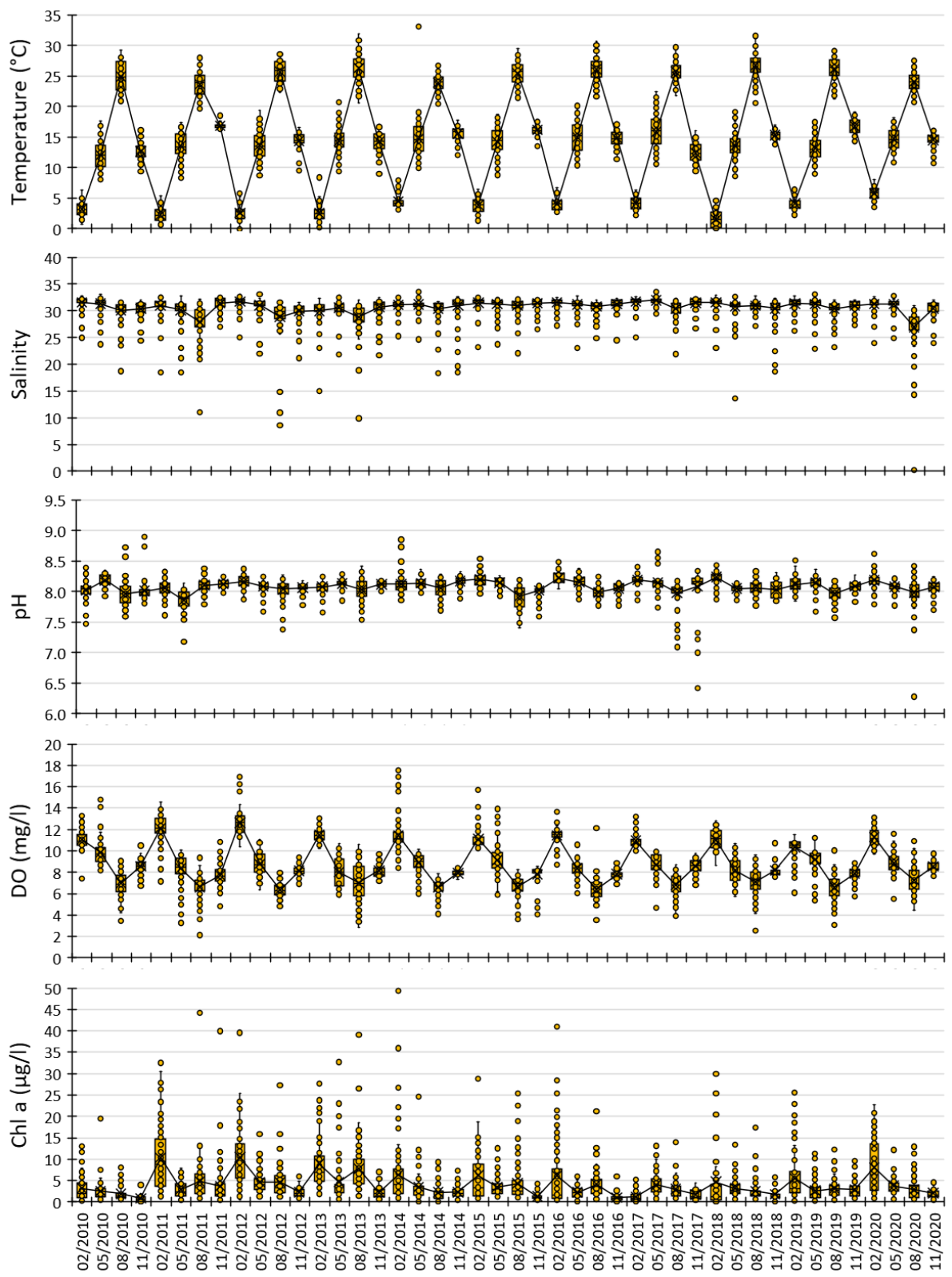


Figure S4. Variations of parameters of bottom waters along the western coast of Korea.

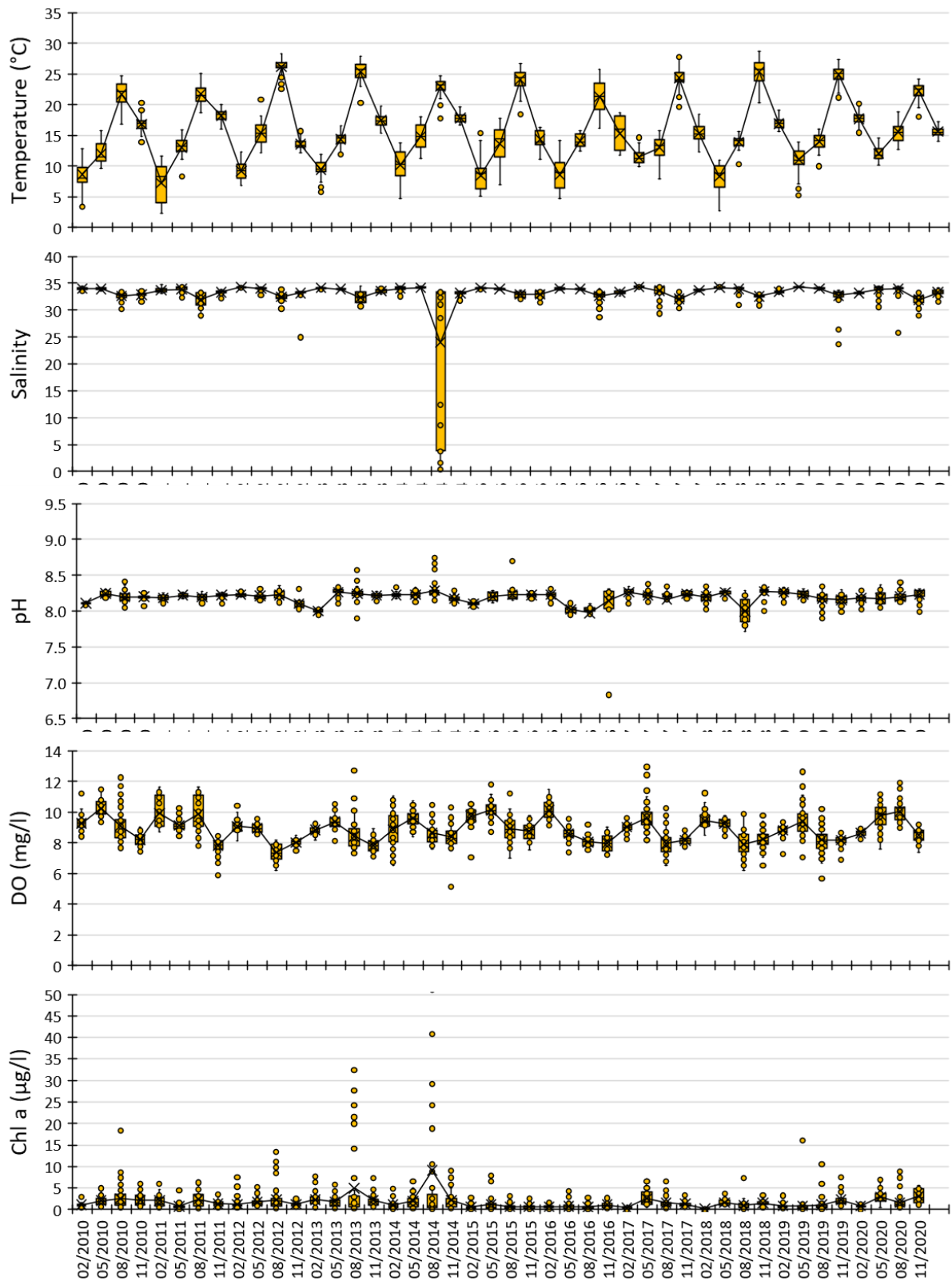


Figure S5. Variations of parameters of surface waters along the eastern coast of Korea.

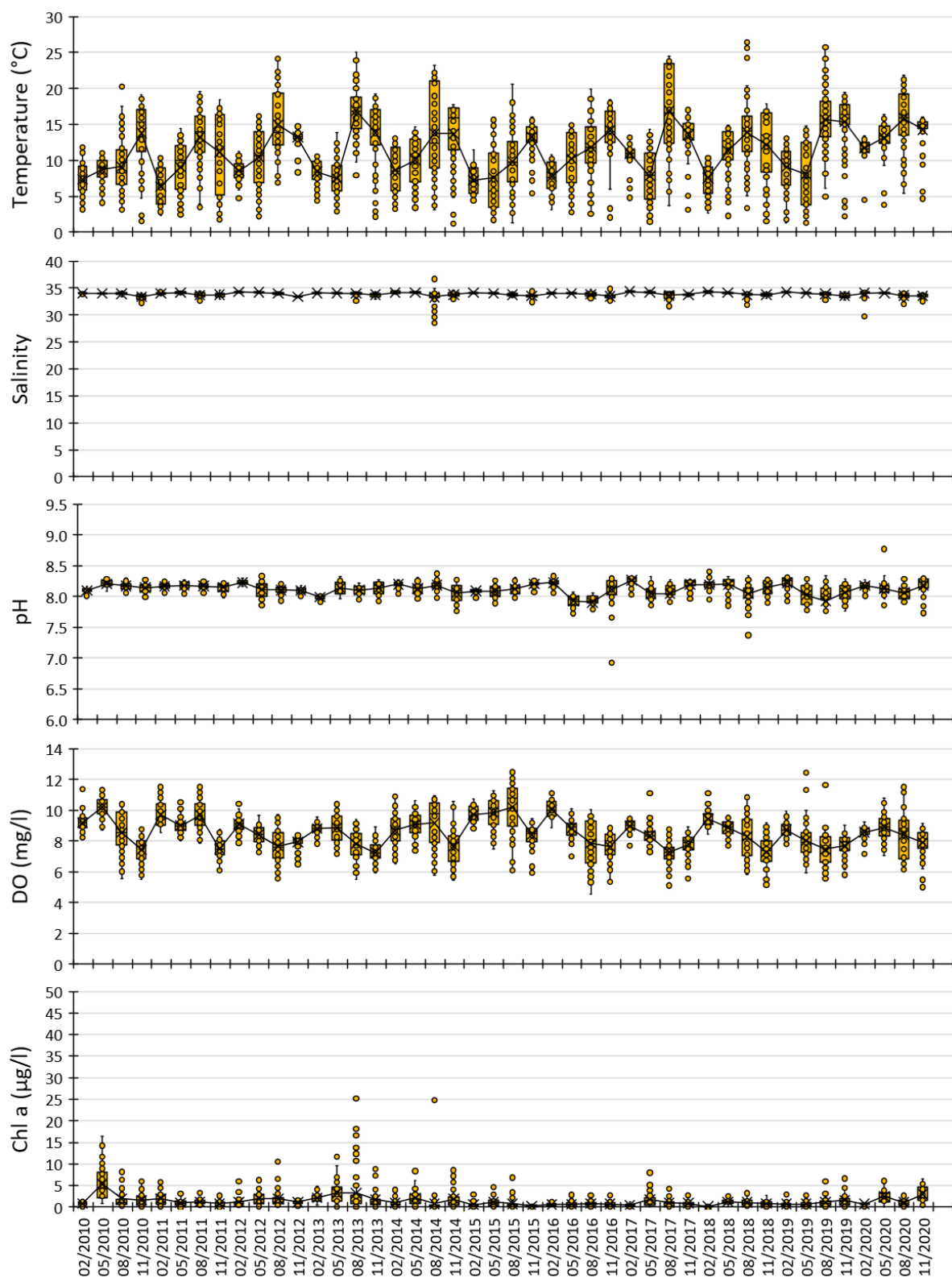


Figure S6. Variations of parameters of bottom waters along the eastern coast of Korea.

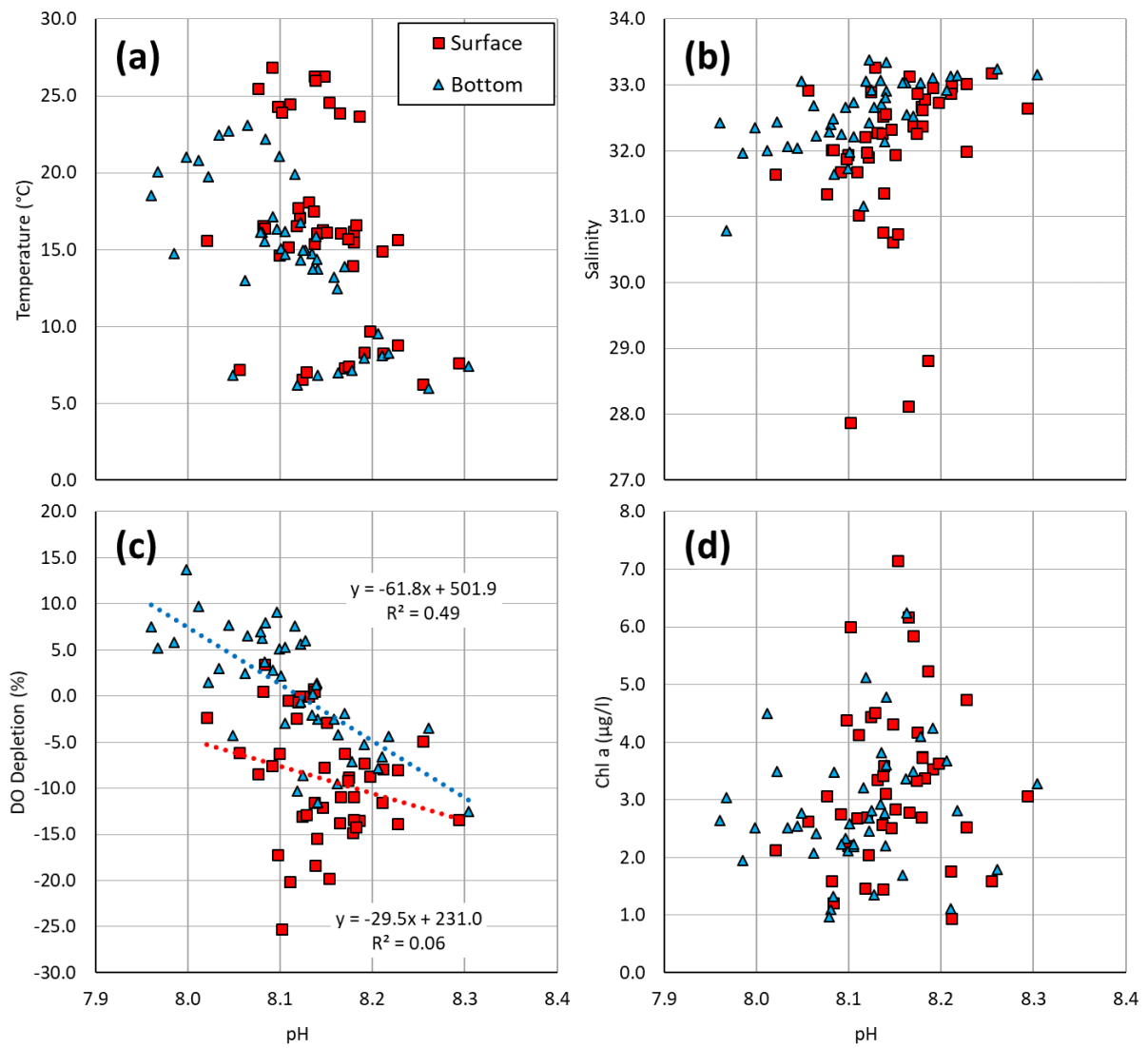


Figure S7. Variations of pH with (a) temperature, (b) salinity, (c) DO depletion, and (d) chlorophyll-a in waters from the entire Korean coast.

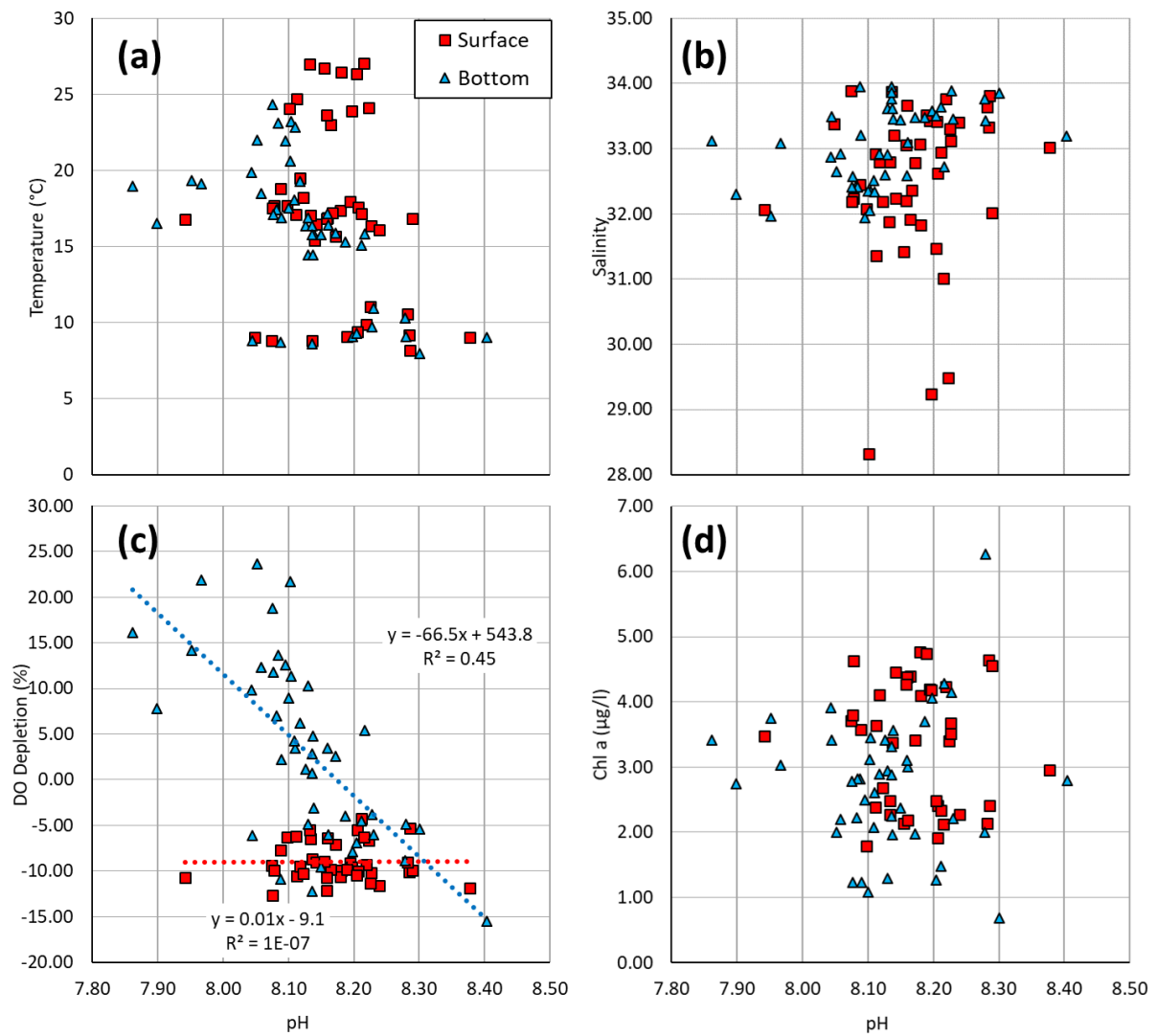


Figure S8. Variations of pH with (a) temperature, (b) salinity, (c) DO depletion, and (d) chlorophyll-a in waters from the south coast of Korea.

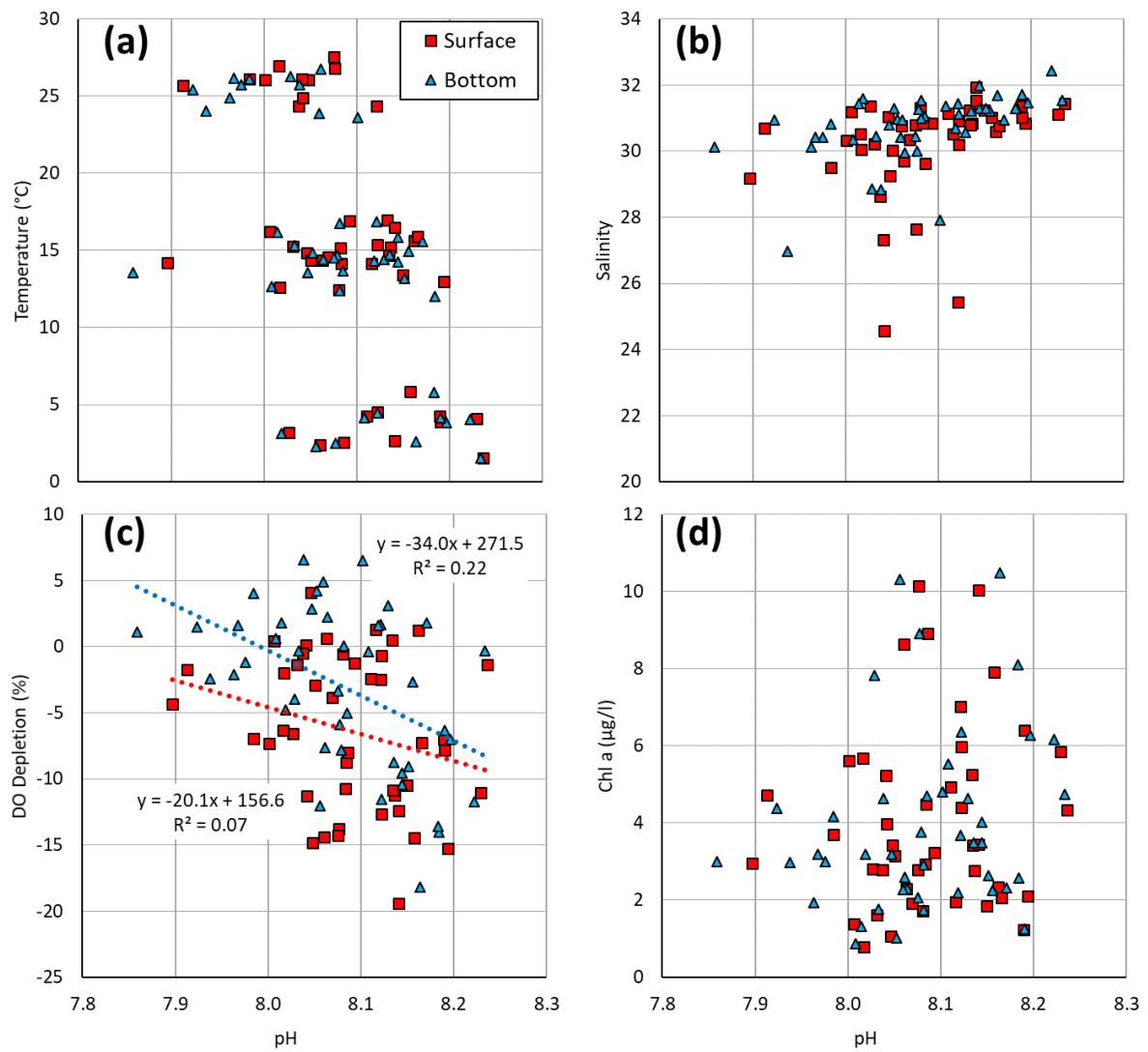


Figure S9. Variations of pH with (a) temperature, (b) salinity, (c) DO depletion, and (d) chlorophyll-a in waters from the west coast of Korea.

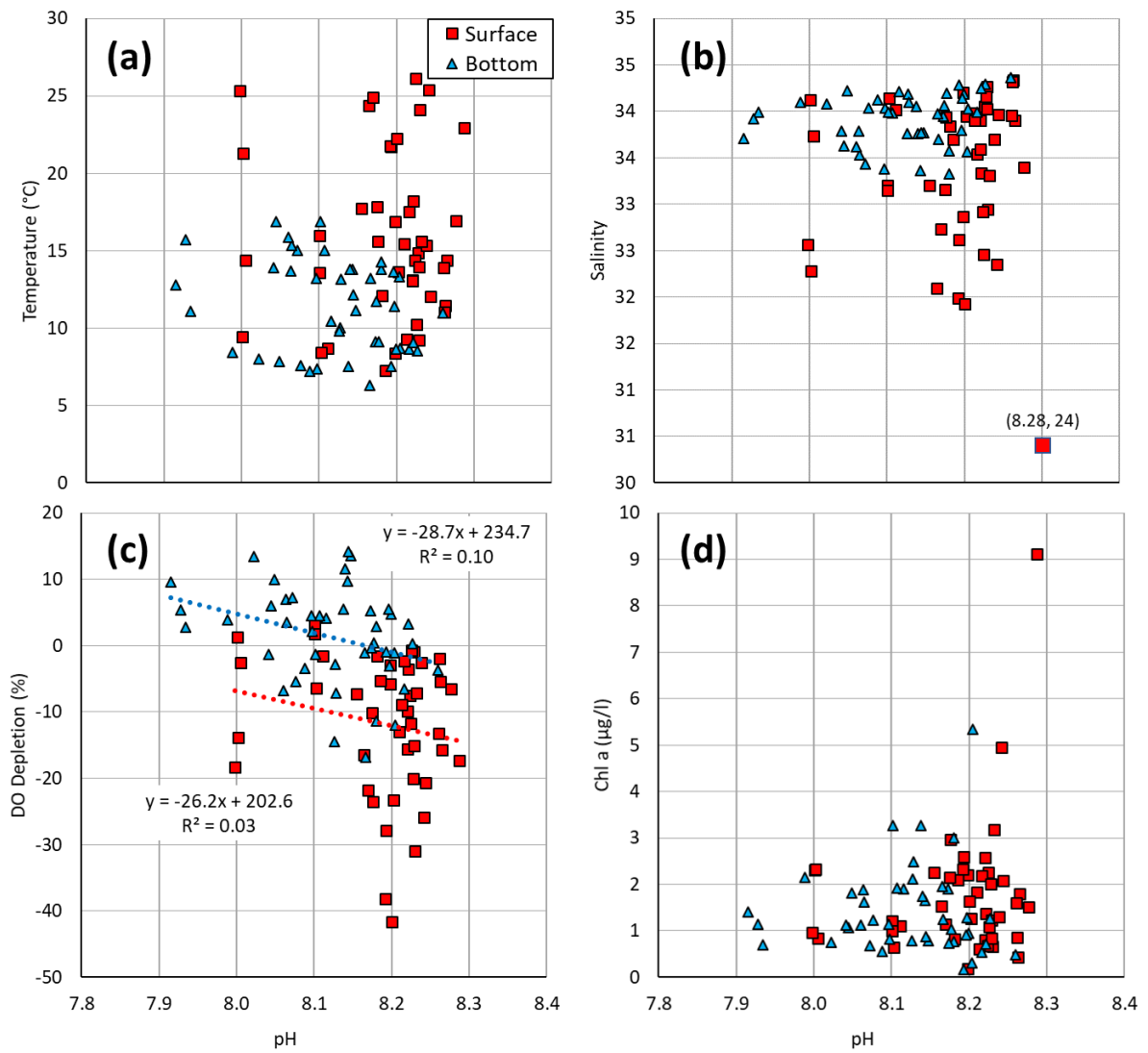


Figure S10. Variations of pH with (a) temperature, (b) salinity, (c) DO depletion, and (d) chlorophyll-a in waters from the east coast of Korea.

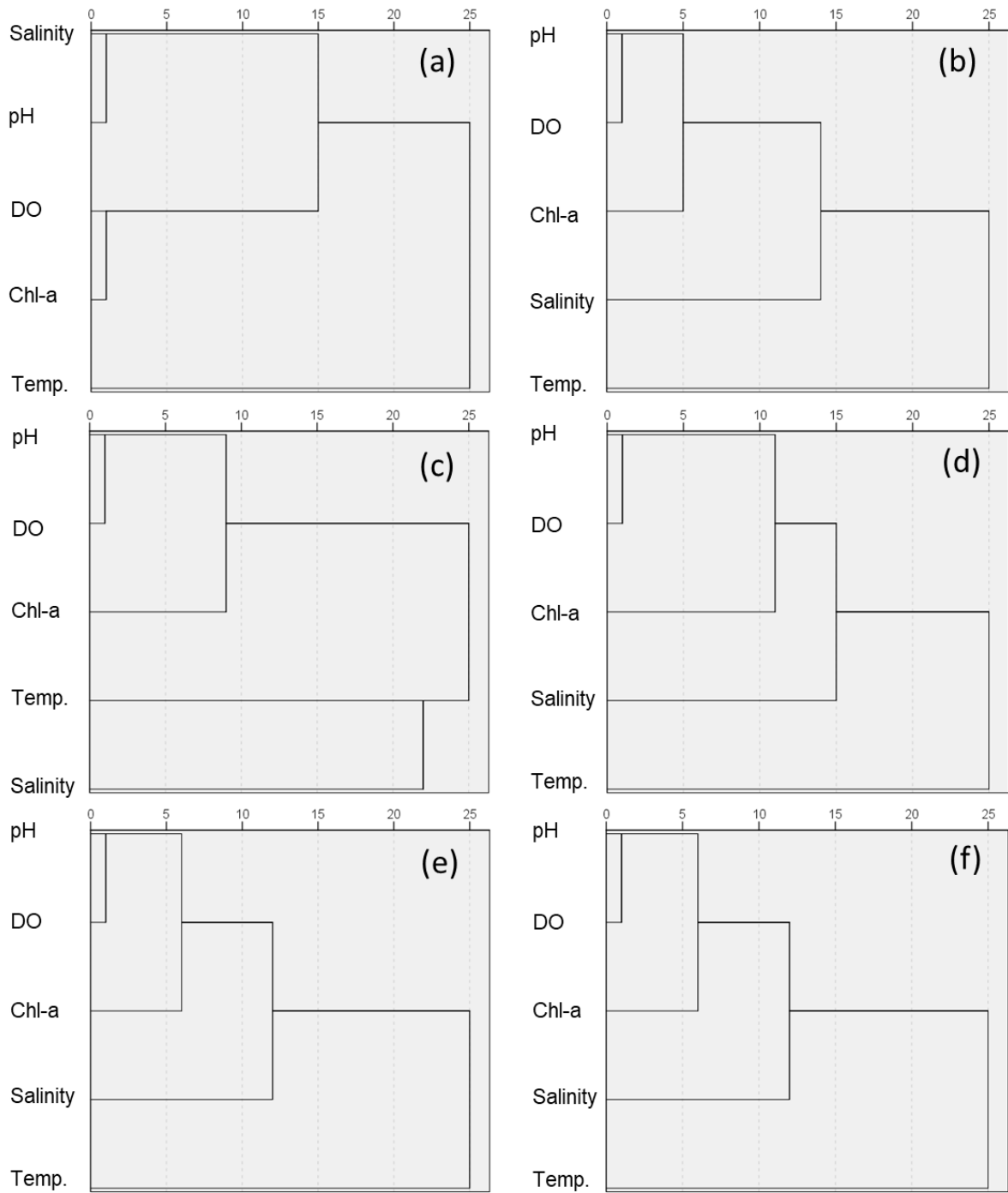


Figure S11. Hierarchical cluster analysis of parameters in coastal waters for: a) and b) the estuary, c) and d) the bay, and e) and f) the river mouth. The left columns (a, c, e) represent surface waters, while the right columns (b, d, f) represent bottom waters.

Jeonjupo Coast	W	E	6	6	6	6	8	8	8	8	8	8	8
Mokpo Coast	W	R	4	4	4	4	8	8	8	8	8	8	8
Muan Coast	W	E	3	3	3	3	3	3	3	3	3	3	3
Shinan Coast	W	E	2	2	2	2	2	2	2	2	2	2	2
Sihwa Lake	W	E	3	6	6	10	10	10	10	10	10	10	10
Taeon Coast	W	E	5	5	5	5	5	5	5	5	5	5	5
Tongyeong Coast	W	E	4	4	4	4	4	4	4	4	4	4	4
Donghae Coast	E	E	4	4	4	4	4	4	4	4	4	4	4
Gampo Coast	E	E	4	4	4	4	4	4	4	4	4	4	4
Ganggu Coast	E	E	2	2	2	2	2	2	2	2	2	2	2
Gangneung Coast	E	E	7	7	7	7	7	7	7	7	7	7	7
Geojin Coast	E	E	2	2	2	2	2	2	2	2	2	2	2
Guryongpo Coast	E	E	2	2	2	2	2	2	2	2	2	2	2
Hupo Coast	E	E	2	2	2	2	2	2	2	2	2	2	2
Jukbyeon Coast	E	E	6	6	6	6	6	6	6	6	6	6	6
Jumunjin Coast	E	E	5	5	5	5	5	5	5	5	5	5	5
Chuksan coast	E	E	2	2	2	2	2	2	2	2	2	2	2
Onsan Coast	E	E	3	3	3	3	9	9	9	9	9	9	9
Samcheok Coast	E	E	4	4	4	4	4	4	4	4	4	4	4
Sokcho Coast	E	E	4	4	4	4	4	4	4	4	4	4	4
Ulsan coast	E	E	5	5	5	12	12	12	12	12	12	12	12
Wolpo Coast	E	E	2	2	2	2	2	2	2	2	2	2	2
Yangpichun estuary	E	E	-	-	-	-	-	-	-	4	4	4	4
Yangyang Coast	E	E	4	4	4	4	4	4	4	4	4	4	4
Youngil Bay	E	B	12	12	12	12	12	12	12	12	12	12	12
<i>Total (each time)</i>			279	282	282	317	347	347	347	355	355	355	355
<i>Frequency per year</i>			4	4	4	4	4	4	4	4	4	4	4
<i>Total (per year)</i>			1116	1128	1128	1268	1388	1388	1388	1420	1420	1420	1420

* S, W, and E in column "Coast" represent south, west, and east, respectively.

** E, B, and R in column "Type" represent estuary, bay, and river mouth, respectively.

Table S4. Liner regression of the centered moving average against time.

		Surface						Bottom					
		Temperature (°C)	Salinity	pH	DO (mg/l)	DO Dep. (%)	Chl-a (µg/l)	Temperature (°C)	Salinity	pH	DO (mg/l)	DO Dep. (%)	Chl-a (µg/l)
Slope	Entire	0.001	0.0004	0.00003	-0.0003	0.001	-0.001	0.001	0.0002	0.00004	-0.0002	-0.001	-0.001
R ²		0.526	0.212	0.293	0.312	0.018	0.364	0.622	0.164	0.291	0.203	0.037	0.456
Slope	South	0.001	0.0001	0.0001	-0.0002	0.001	-0.001	0.001	-0.0001	0.0001	0.0000	-0.002	-0.001
R ²		0.538	0.017	0.359	0.168	0.014	0.301	0.487	0.028	0.432	0.004	0.143	0.446
Slope	West	0.001	0.001	0.00002	-0.0004	0.0004	-0.002	0.001	0.001	0.00003	-0.0003	-0.001	-0.002
R ²		0.339	0.384	0.110	0.378	0.008	0.296	0.375	0.267	0.102	0.324	0.015	0.325
Slope	East	0.001	0.0003	-0.00001	-0.0002	-0.0001	-0.001	0.002	0.0000	-0.0001	-0.0005	0.002	-0.001
R ²		0.230	0.030	0.019	0.048	0.0001	0.162	0.401	0.013	0.227	0.167	0.029	0.310
Slope	Estuary	0.001	0.0004	0.00002	-0.0002	-0.0003	-0.001	0.001	0.0002	0.00003	-0.0002	-0.002	-0.001
R ²		0.505	0.335	0.246	0.249	0.007	0.355	0.576	0.197	0.249	0.186	0.234	0.386
Slope	Bay	0.001	0.0004	0.00003	-0.0004	0.003	-0.002	0.001	0.0001	0.00005	-0.0002	-0.0004	-0.002
R ²		0.512	0.050	0.173	0.290	0.103	0.233	0.594	0.009	0.242	0.091	0.003	0.498
Slope	River	0.001	0.002	0.0001	-0.0004	0.001	-0.001	0.001	0.001	0.0001	-0.0004	0.002	-0.001
R ²		0.241	0.346	0.345	0.291	0.007	0.167	0.285	0.232	0.269	0.343	0.049	0.217

* The centered moving average (4) generated 40 data points out of 44 averaged data from February 2010 to November 2020.

Table S5. Correlation (R) of pH with temperature (Temp.), salinity, dissolved oxygen concentration (DO, mg/l), DO depletion (dep. %), and chlorophyll a concentration in surface and bottom waters.

<i>Coast</i>		Surface					Bottom					<i>n</i>
		Temp.	Salinity	DO (mg/L)	DO Dep. (%)	Chl-a ($\mu\text{g/L}$)	Temp.	Salinity	DO (mg/L)	DO Dep. (%)	Chl-a ($\mu\text{g/L}$)	
Entire	pH	-0.11	0.16	0.36	-0.39	0.18	-0.19	0.18	0.38	-0.39	0.12	14484
South	pH	-0.12	0.01	0.44	-0.42	0.23	-0.29	0.12	0.55	-0.53	0.15	7368
West	pH	-0.23	0.19	0.39	-0.38	0.22	-0.28	0.24	0.36	-0.32	0.18	4324
East	pH	-0.03	-0.08	0.25	-0.22	0.14	0.13	-0.06	0.23	-0.32	0.09	2792
Estuary	pH	-0.08	0.25	0.25	-0.29	0.08	-0.10	0.18	0.27	-0.30	0.09	9892
Bay	pH	-0.17	-0.01	0.54	-0.51	0.30	-0.38	0.15	0.59	-0.55	0.21	3688
River	pH	-0.12	0.26	0.43	-0.57	0.20	-0.30	0.34	0.39	-0.43	0.04	904