



*Supplement of*

## **Retrieving monthly and interannual total-scale pH ( $\text{pH}_T$ ) on the East China Sea shelf using an artificial neural network: ANN- $\text{pH}_T\text{-v1}$**

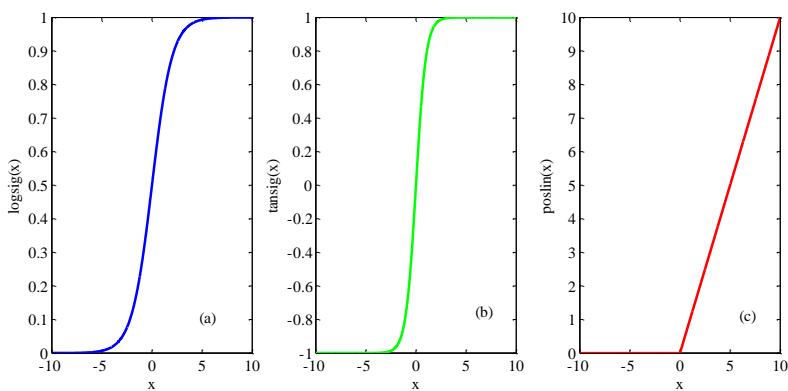
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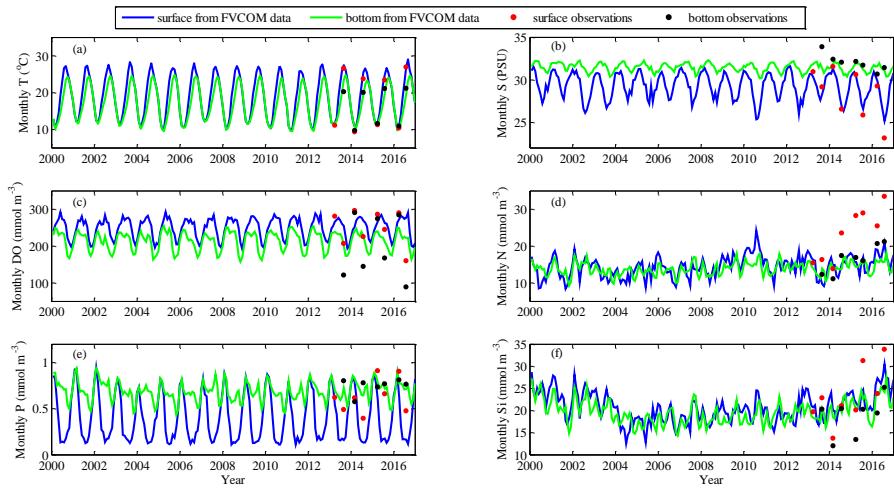
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**Table S1: The performance of different number of neurons for two hidden layers in the training step. Three statistics are the coefficient of determination ( $R^2$ ), the root mean squared error (RMSE), and the mean absolute error (MAE).**

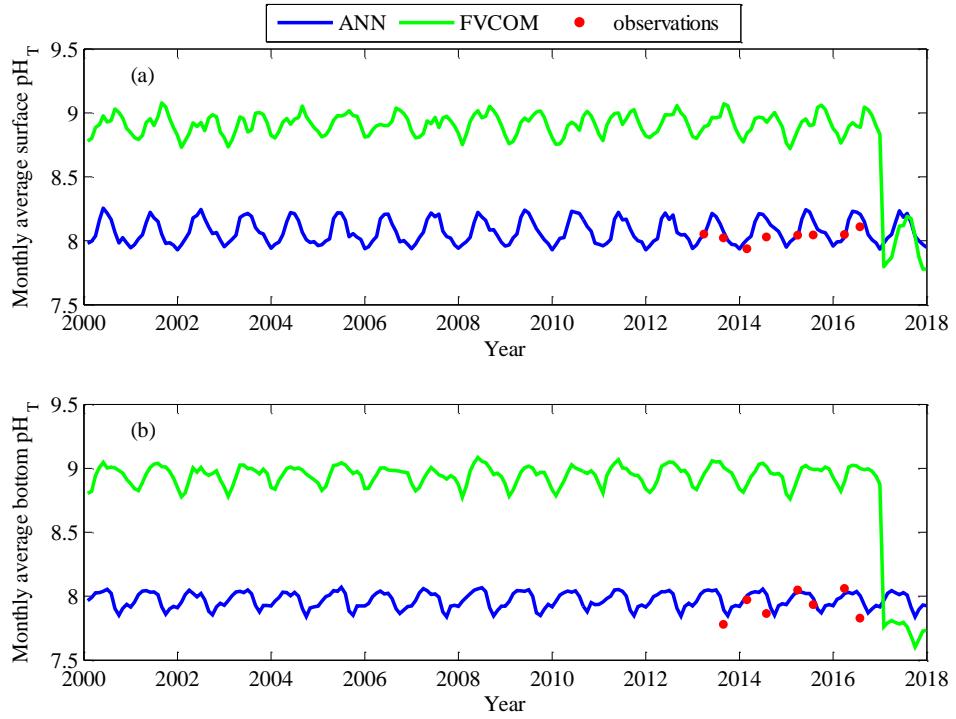
Model	Number of neurons		Training data			Independent validation data		
	first	second	$R^2$	RMSE	MAE	$R^2$	RMSE	MAE
1	4	4	0.68	0.071	0.054	0.67	0.072	0.057
2	8	4	0.70	0.070	0.050	0.67	0.069	0.050
3	16	4	0.76	0.062	0.045	0.76	0.062	0.045
4	32	4	0.74	0.063	0.046	0.79	0.062	0.048
5	40	4	0.76	0.062	0.044	0.76	0.061	0.045
6	64	4	0.79	0.058	0.041	0.78	0.056	0.043
7	128	4	0.76	0.062	0.045	0.74	0.062	0.044
8	8	8	0.73	0.065	0.047	0.73	0.065	0.048
9	16	8	0.78	0.059	0.042	0.78	0.058	0.044
10	32	8	0.78	0.059	0.042	0.83	0.053	0.039
11	40	8	0.79	0.059	0.042	0.77	0.055	0.040
12	64	8	0.77	0.061	0.044	0.76	0.059	0.042
13	128	8	0.77	0.060	0.042	0.79	0.059	0.043
14	16	16	0.79	0.057	0.041	0.85	0.054	0.041
15	32	16	0.80	0.057	0.040	0.69	0.059	0.043
16	40	16	0.82	0.054	0.039	0.81	0.053	0.039
17	64	16	0.79	0.059	0.041	0.76	0.057	0.040
18	128	16	0.79	0.058	0.040	0.78	0.059	0.043
19	32	32	0.78	0.059	0.042	0.75	0.058	0.039
20	40	32	0.79	0.058	0.041	0.79	0.055	0.040
21	64	32	0.78	0.059	0.042	0.83	0.052	0.040
22	128	32	0.79	0.058	0.041	0.79	0.056	0.041
23	40	40	0.77	0.060	0.043	0.77	0.060	0.044
24	64	40	0.79	0.058	0.042	0.75	0.060	0.043
25	128	40	0.80	0.057	0.040	0.78	0.057	0.042
26	64	64	0.78	0.060	0.042	0.78	0.057	0.040
27	128	64	0.72	0.068	0.050	0.65	0.067	0.048
28	128	128	0.72	0.067	0.049	0.65	0.072	0.051



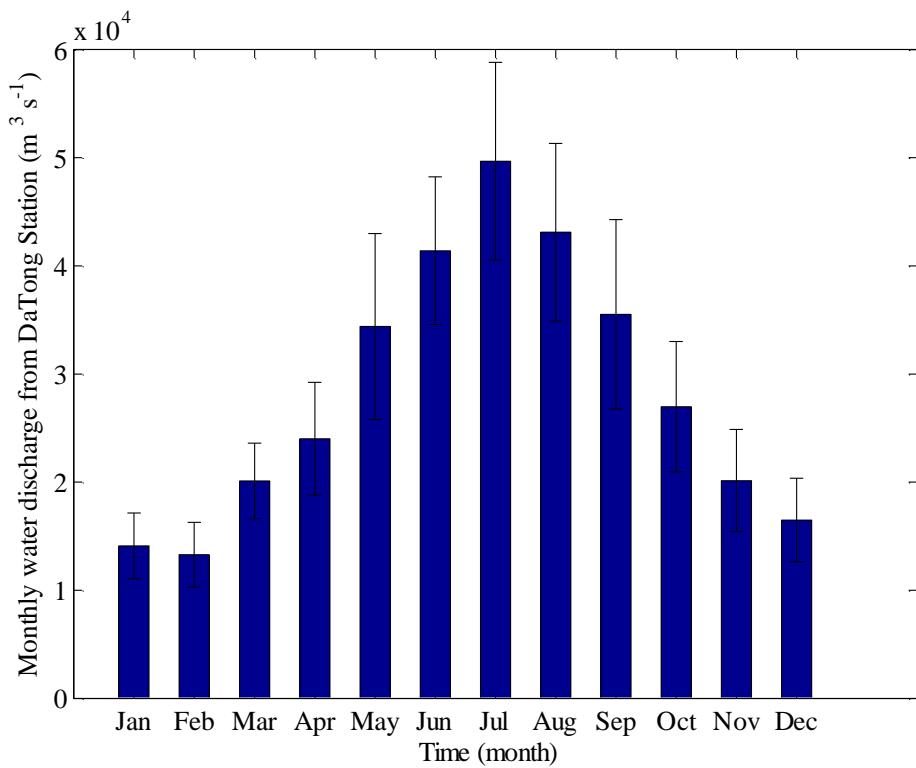
**Figure S1: Comparison of three transfer functions. (a)-Log-sigmoid transfer function (logsig); (b) Hyperbolic tangent sigmoid transfer function (tansig); (c)-Positive linear transfer function (poslin).**



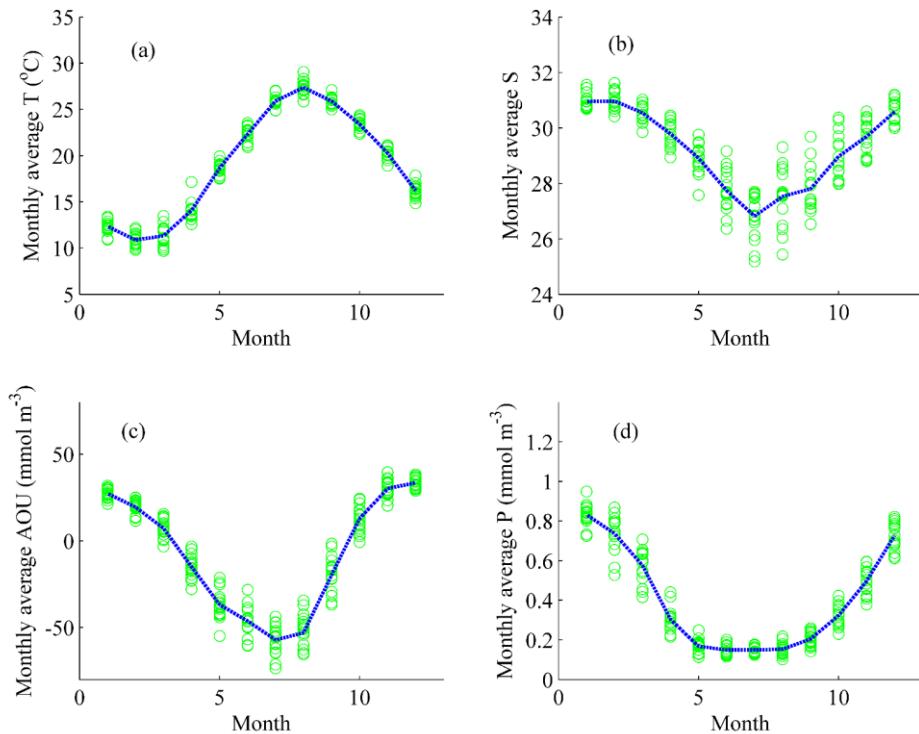
**Figure S2: Comparison of monthly-average environmental variables from the Changjiang Biology FVCOM with the corresponding observations at the surface and bottom on the East China Sea shelf. Blue and green solid lines represent surface and bottom simulated data from the Changjiang Biology FVCOM, respectively; red and black points show surface and bottom observation data from 2013 to 2016, respectively. (a)-temperature; (b)-salinity; (c)-dissolved oxygen; (d)-nitrate; (e)-phosphate; (f)-silicate.**



**Figure S3: Comparison of monthly average  $\text{pH}_T$  on the East China Sea shelf. Blue solid line represents retrieved  $\text{pH}_T$  by the ANN model using Changjiang Biology FVCOM output; green solid line represents simulated  $\text{pH}_T$  by the Changjiang Biology FVCOM; red points show monthly average  $\text{pH}_T$  observations from 2013-2016. (a)-surface; (b)-bottom.**



**Figure S4:** Monthly average water discharge and its standard deviation (DaTong Station, data derived from the Hydrological Information Center of China, <http://www.hydroinfo.gov.cn/>).



**Figure S5: Seasonal cycles of surface T (a), S (b), AOU (c), and P (d) from Changjiang Biology FVCOM output on the East China Sea shelf from 2000-2016. The green circles represent monthly regional average, the blue dashed represents mean value of each month.**