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Supplement of

A global monthly climatology of total alkalinity: a neural network approach

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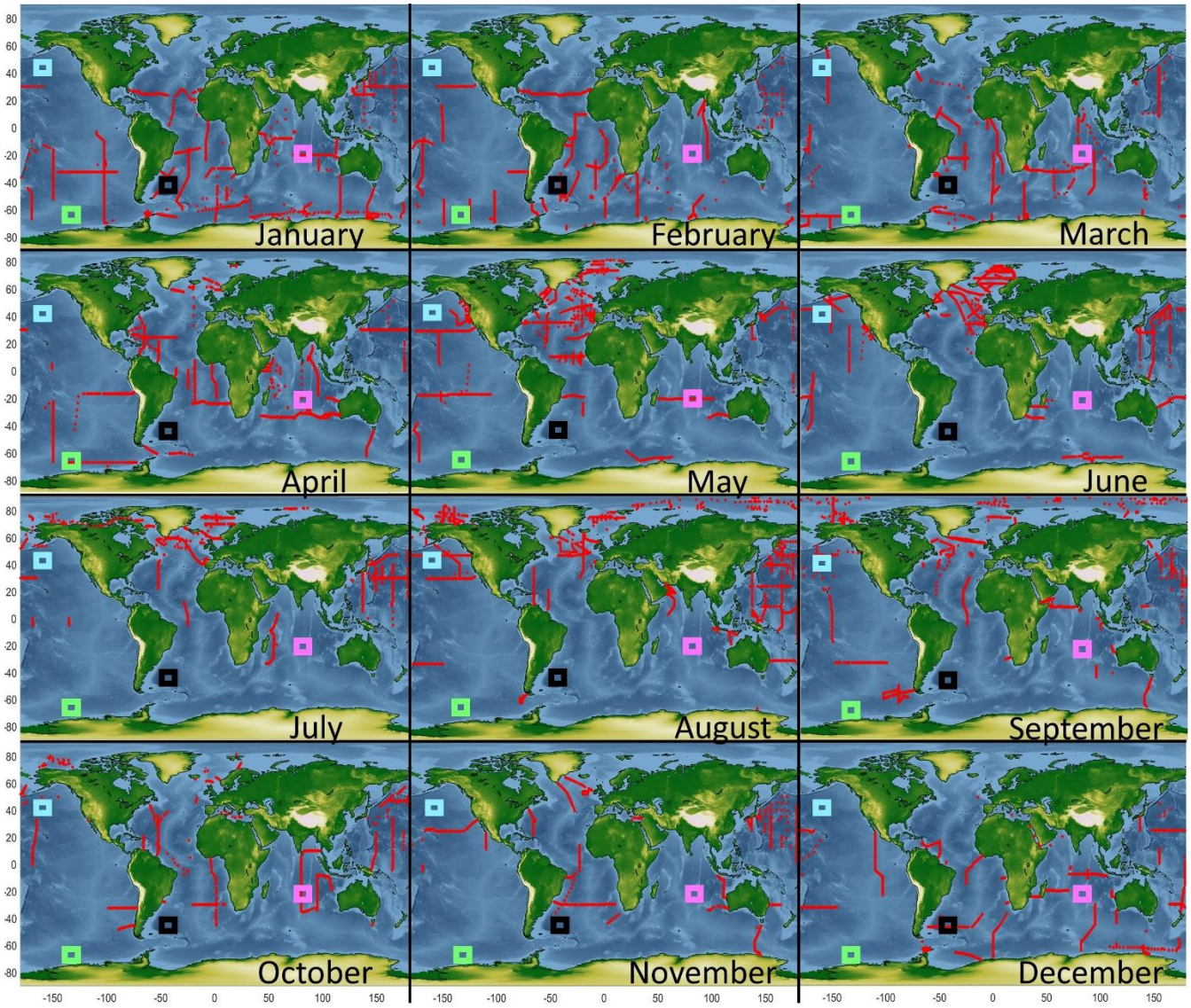

Figure S1. Locations of GLODAPv2 data used in this study presented by month of observation (red dots). Areas where subsurface layer hypothesis was evaluated are shown as coloured squares.

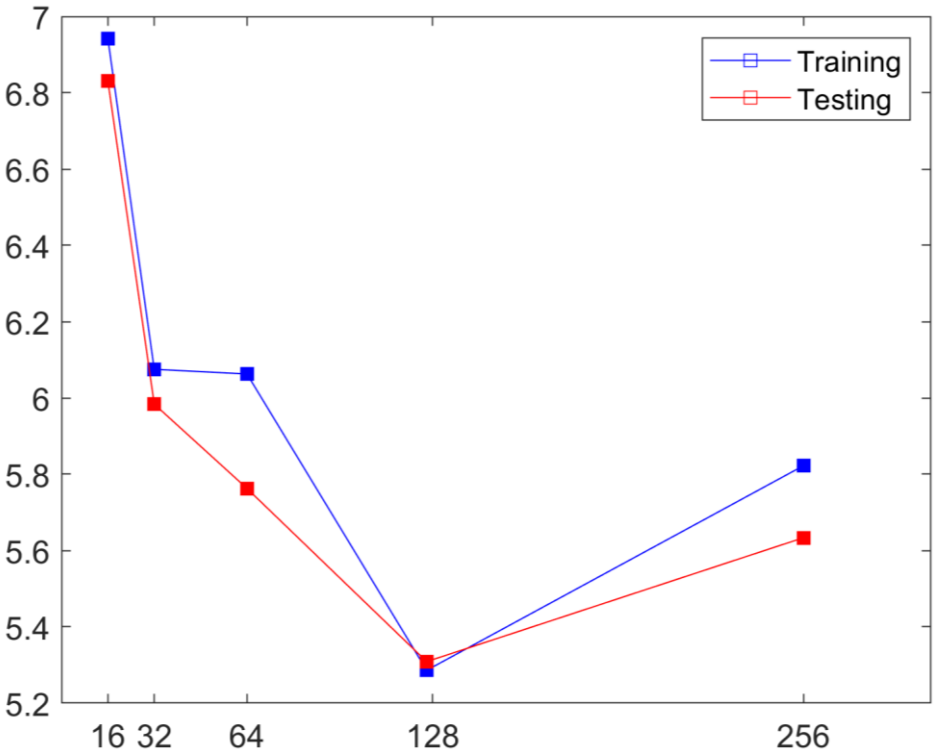

Figure S2. RMSE variation with the number of neurons of the network for the lm algorithm and the NNGv2. Similar results were obtained for br algorithm. Training data contain the data in the first level training set (see Fig. 2). Testing data contain the data in the first level test set (see Fig. 2).

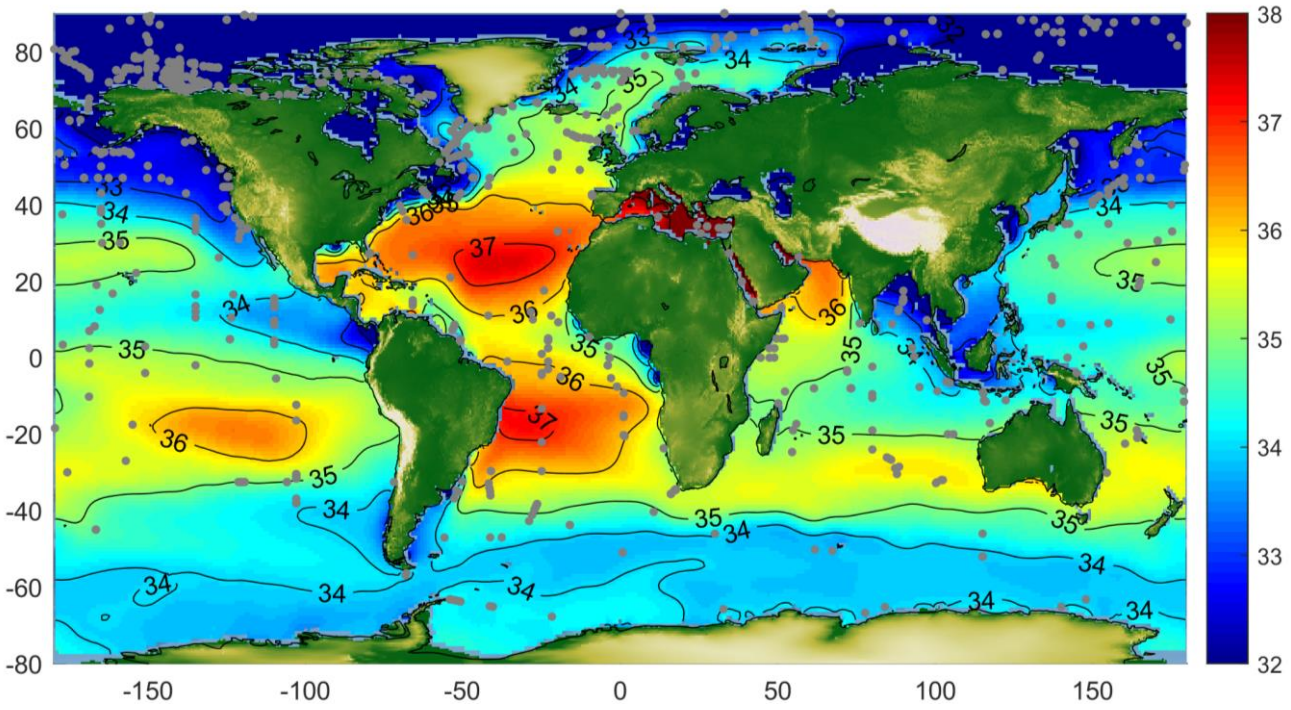

Figure S3: Location of the GLODAPv2 samples with A_T computed by NNGv2 with an error beyond ±3RMSE. The annual mean of surface salinity from WOA13 is shown. Areas of low surface salinity contain most of these samples.

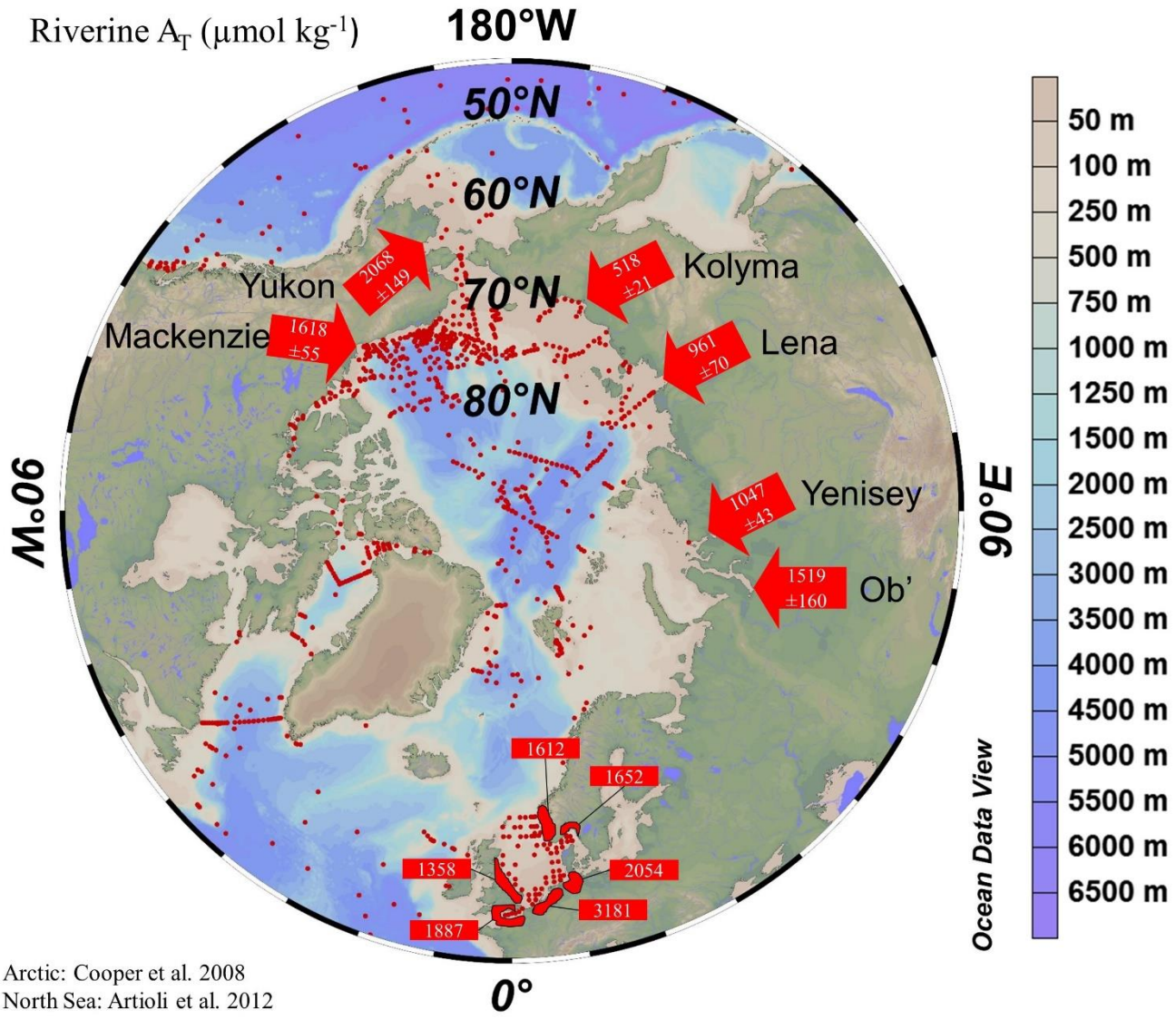

Figure S4: Orthographic (North Polar) projection from 45° N. Red dots: GLODAPv2 (all QC and no QC data) samples with residuals beyond ±3RMSE in the 0-100 m surface layer computed by NNGv2. White values: annual mean riverine A_T in µmol kg^{-1}. This figure was made with Ocean Data View (Schlitzer, 2016).

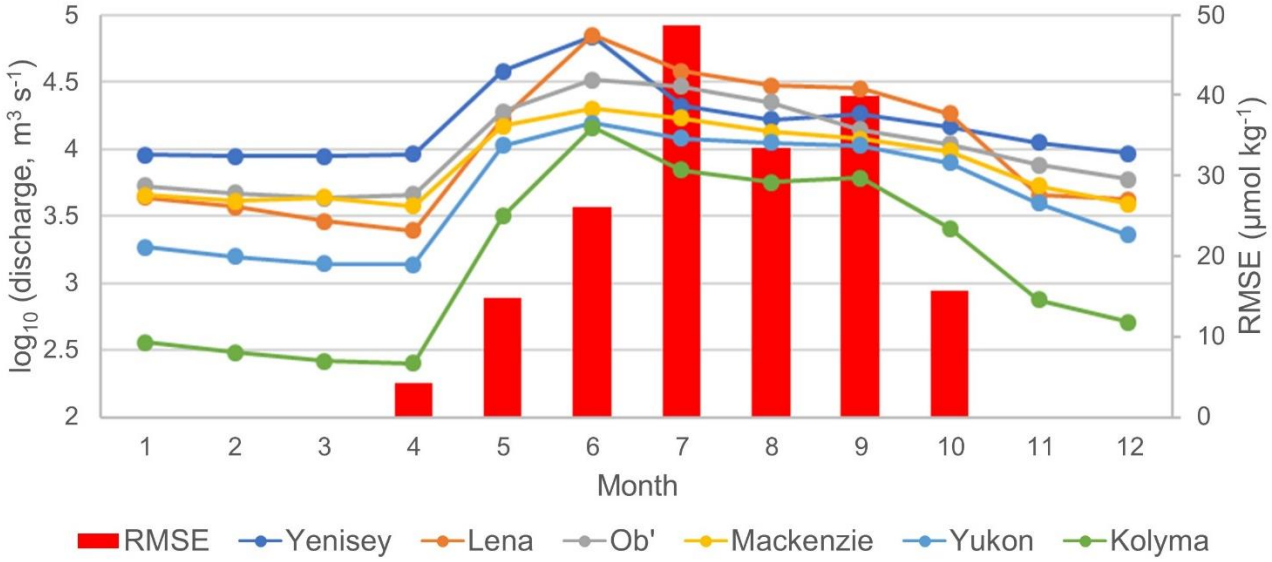

Figure S5: Monthly mean discharge of the main Arctic Rivers (Shiklomanov et al., 2018) and RMSE of A_T computed by NNGv2 in GLODAPv2 samples (QC and no QC) of surface layer (150m) of the Arctic Ocean (latitude>60°N). There are not enough data to compute RMSE in months with no bars.

20

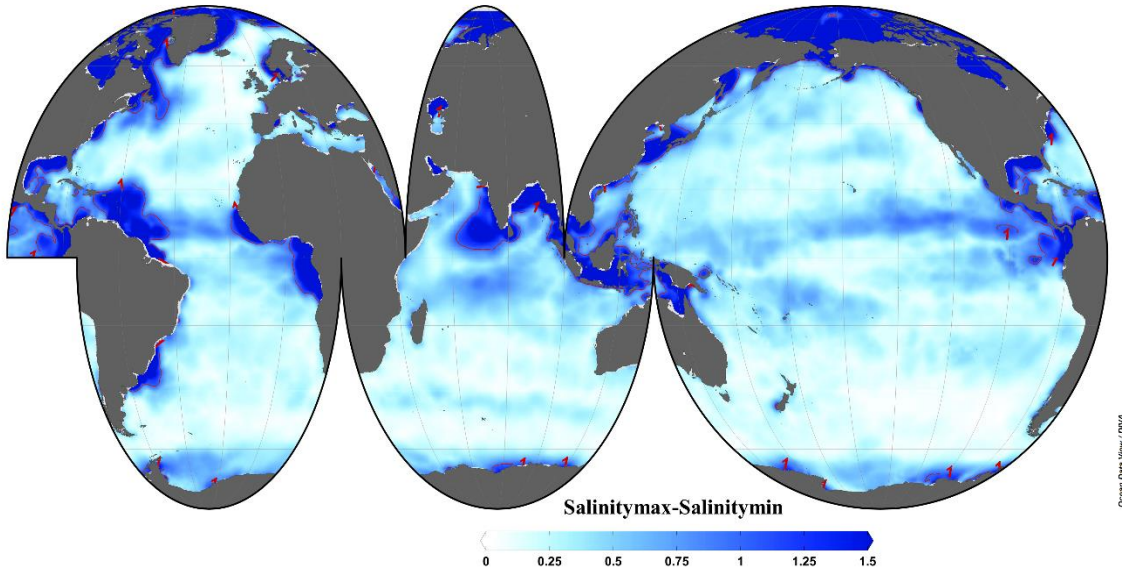

Figure S6: Surface salinity seasonal amplitude. Red line represents the contour of amplitude 1. This figure was made with Ocean Data View (Schlitzer, 2016).

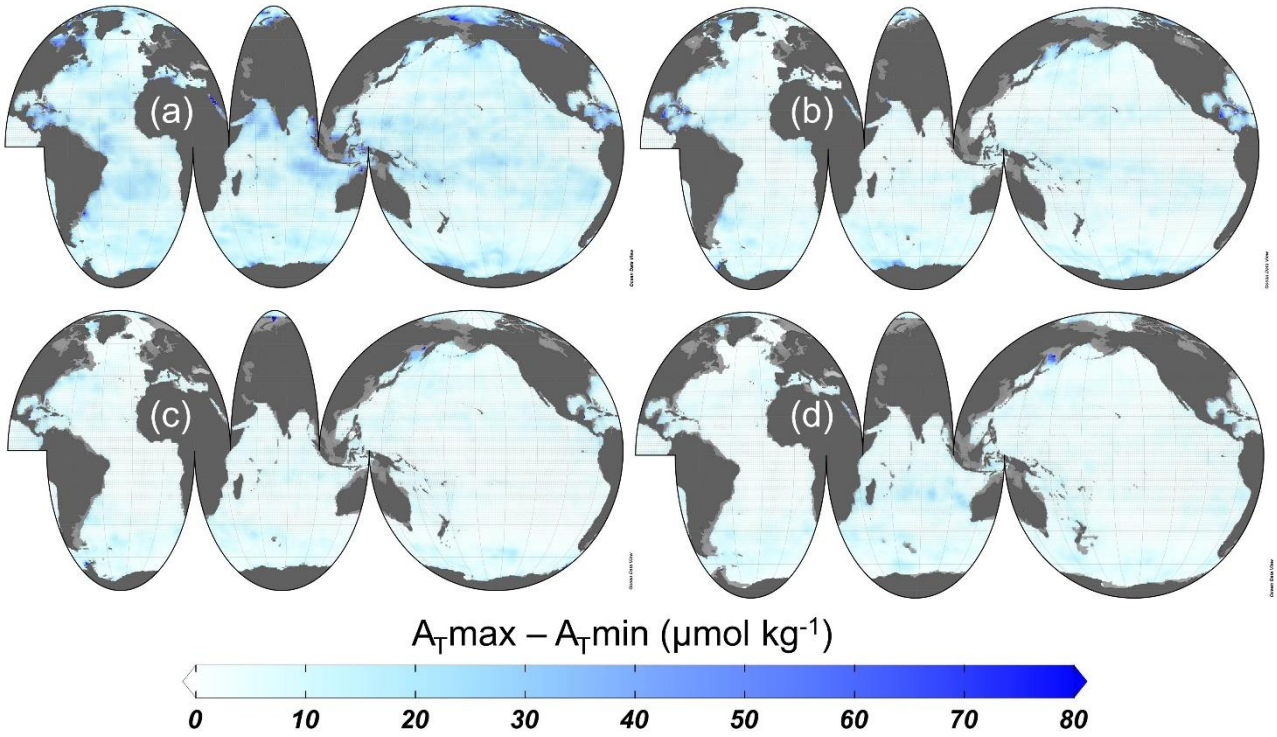

Figure S7: Seasonal amplitude of A_T at (a) 100 m, (b) 250 m, (c) 500 m and (d) 1000 m. This figure was made with Ocean Data View (Schlitzer, 2016).

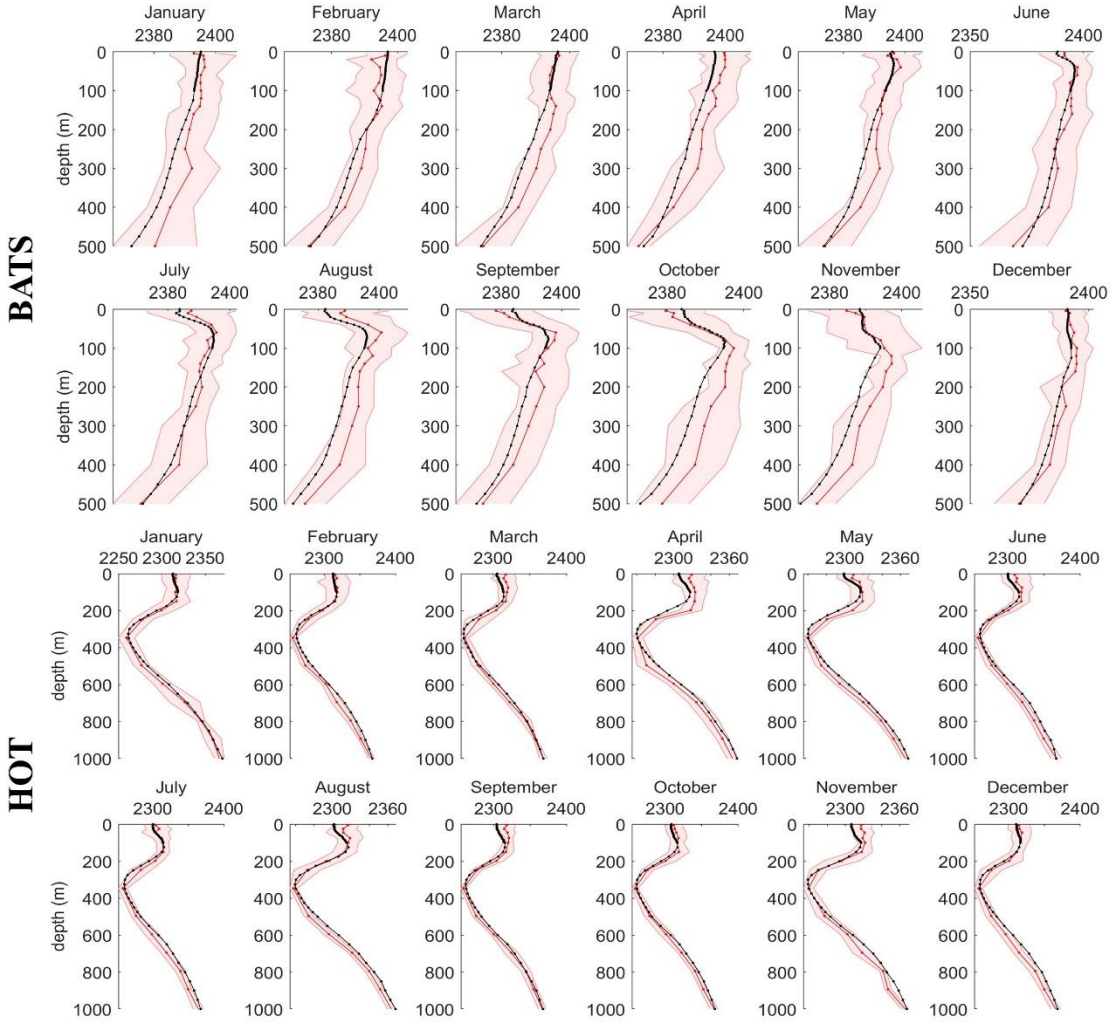

Figure S8: Profiles at BATS and HOT time-series locations of climatological measured data (red line) and the monthly climatology of A_T computed with NNGv2 (black line). The shading represents the standard deviation of the average of the measured data.

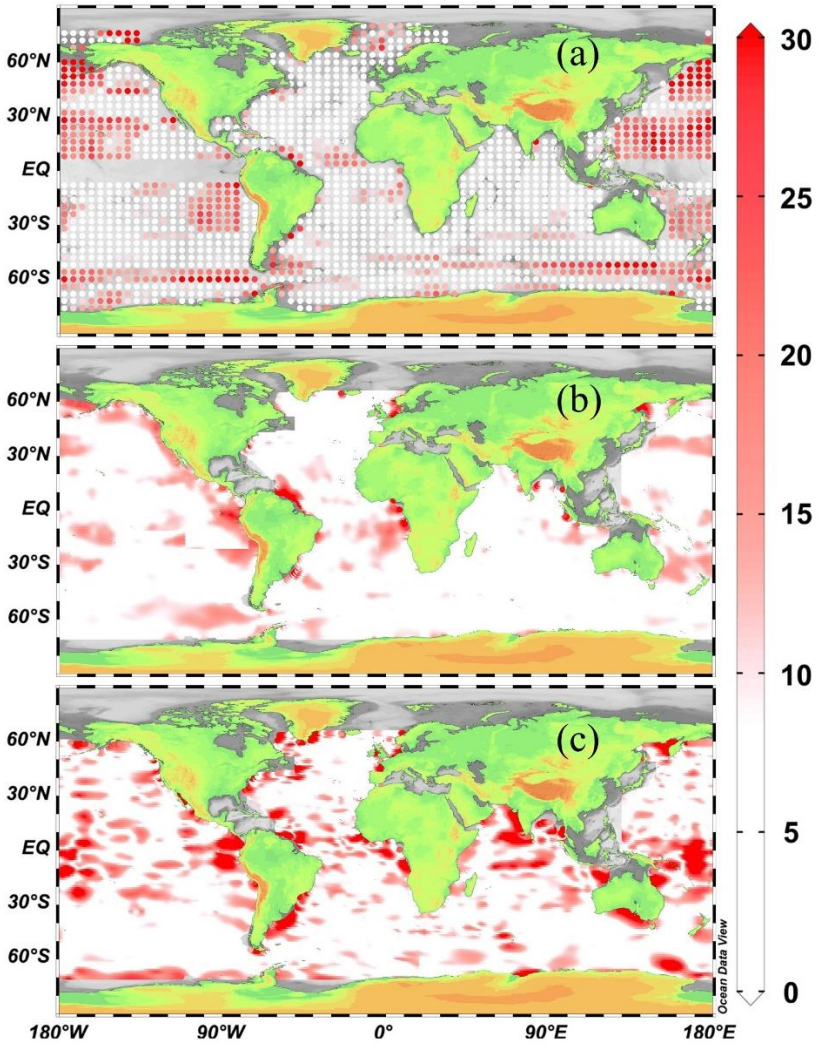

Figure S9: Absolute differences between the annual mean of the surface A_T neural network climatology and a) Takahashi et al. (2014), b) Lee et al. (2006) and c) Lauvset et al. (2016) surface annual mean climatologies in µmol kg^{-1}. The color bar was developed in order to show the highest differences beyond the errors of each method. This figure was made with Ocean Data View (Schlitzer, 2016).

Table S1: Analysis by latitude in samples with A_T residuals beyond ±3RMSE. A_T computed by NNGv2. n*: with A_T residuals beyond ±3RMSE in the specified ranges. n: number of samples available in GLODAPv2 in the specified ranges. Percentages in the third column are computed over the sum of n* in the second column. Percentages in the fifth column are computed from the second and the fourth ones.

Latitude	n*	% over total n*	n	% over n
<0º	679	26%	118459	1%
0º-20º	244	9%	31703	1%

20º-40º	228	9%	43478	1%
40º-50º	173	7%	22983	1%
50º-60º	274	10%	15835	2%
60º-70º	148	6%	4106	4%
>70º	886	34%	15069	6%

Table S2: Depth analysis in samples at latitudes greater than 60º N with residuals beyond ±3RMSE. A_T computed by NNGv2. n^*: with A_T residuals beyond ±3RMSE in the specified ranges. n: number of samples available in GLODAPv2 in the specified ranges. Percentage in the third column is computed over n^* at latitudes greater than 60º N. Percentages in the fifth column are computed from the second and the fourth ones.

	n^*	% over total n^*	n	% over n
depth<100m	771	75%	6036	13%

Table S3: Salinity analysis in samples at depths lower than 100 m with residuals beyond ±3RMSE. A_T computed by NNGv2 n^*: with A_T residuals beyond ±3RMSE in the specified ranges. The difference between the two zones shows how the network specially computed A_T with greater error in the Arctic low salinities due to the presence of high-A_T-discharge rivers than in the rest of the ocean.

Salinity	% over n^* lat>60º N	% over n^* lat<60º N
<34	91%	48%
>34	9%	52%

Table S4: Monthly analysis in samples at depths lower than 100 m and latitudes greater than 60º N with residuals beyond ±3RMSE. A_T computed by NNGv2. n^*: with A_T residuals beyond ±3RMSE in the specified ranges. n: number of samples available in GLODAPv2 in the specified ranges. The greatest removal in the summer months reflects again the influence of the rivers, that is, the highest discharge is in the summer. Percentages in the fifth column are computed from the second and the fourth ones.

Month	n*	% over total n^*	n	% over n
1	0	0%	0	0%
2	0	0%	0	0%
3	0	0%	0	0%
4	1	0%	130	1%
5	66	9%	828	8%
6	15	2%	866	2%
7	136	18%	1098	12%
8	325	42%	1918	17%
9	180	23%	906	20%
10	48	6%	272	18%

11	0	0%	18	0%
12	0	0%	0	0%

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