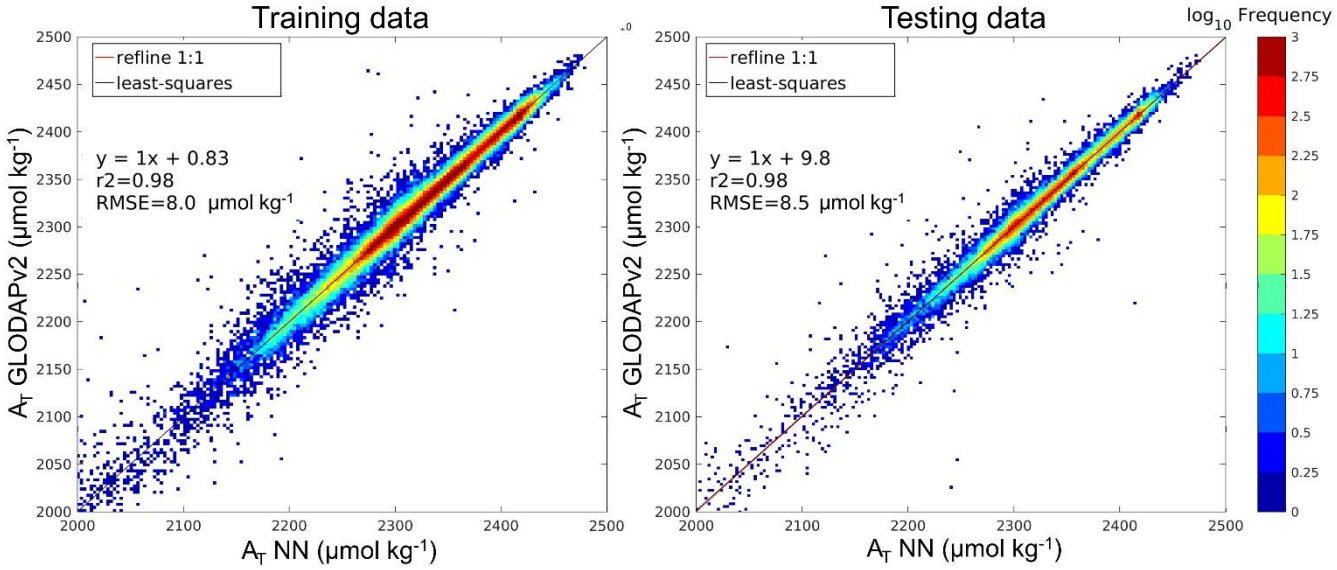

Figure S1: Regression between A_T computed with NN and A_T from GLODAPv2. The graph is divided in pixels. The color of each pixel is determined by the number of points inside it. Note the logarithmic scale to account for the large amount of data. Training data chart contains the training set and the validation set from the initial training set, that is, 76.5% of the GLODAPv2 dataset used in this study. Testing data chart contain the test set from the initial training set and the initial test set, that is, 23.5% of the GLODAPv2 dataset used in this study. The range 2000-2500 µmol kg^{-1} is shown but the statistics are from the whole range.

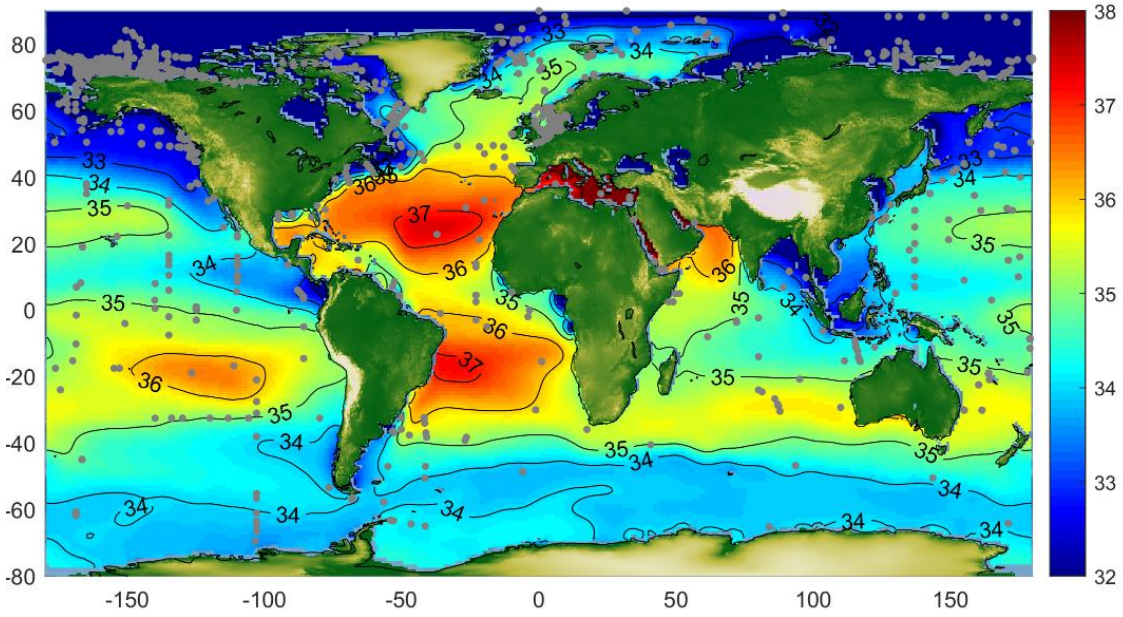

Figure S2: Location of the GLODAPv2 samples with A_T computed by NN beyond ±3RMSE. The annual mean of surface salinity from WOA13 is shown. Areas of low surface salinity contain most of these samples.

10

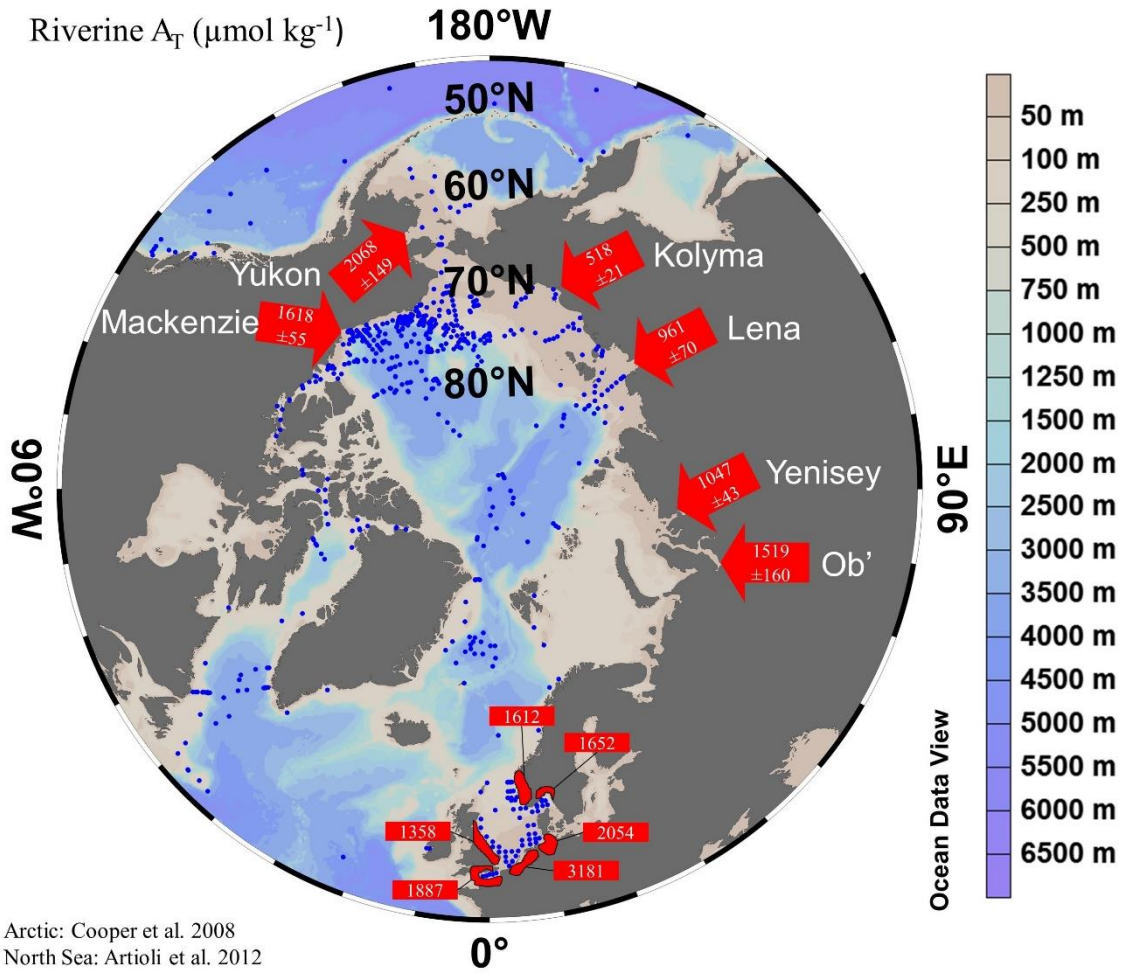

Figure S3: Orthographic (North Polar) projection from 45º N. Blue dots: GLODAPv2 samples with residuals beyond ±3RMSE in the 0-100 m surface layer. White values: annual mean riverine A_T in µmol kg^{-1}. This figure was made with Ocean Data View (Schlitzer, 2016).

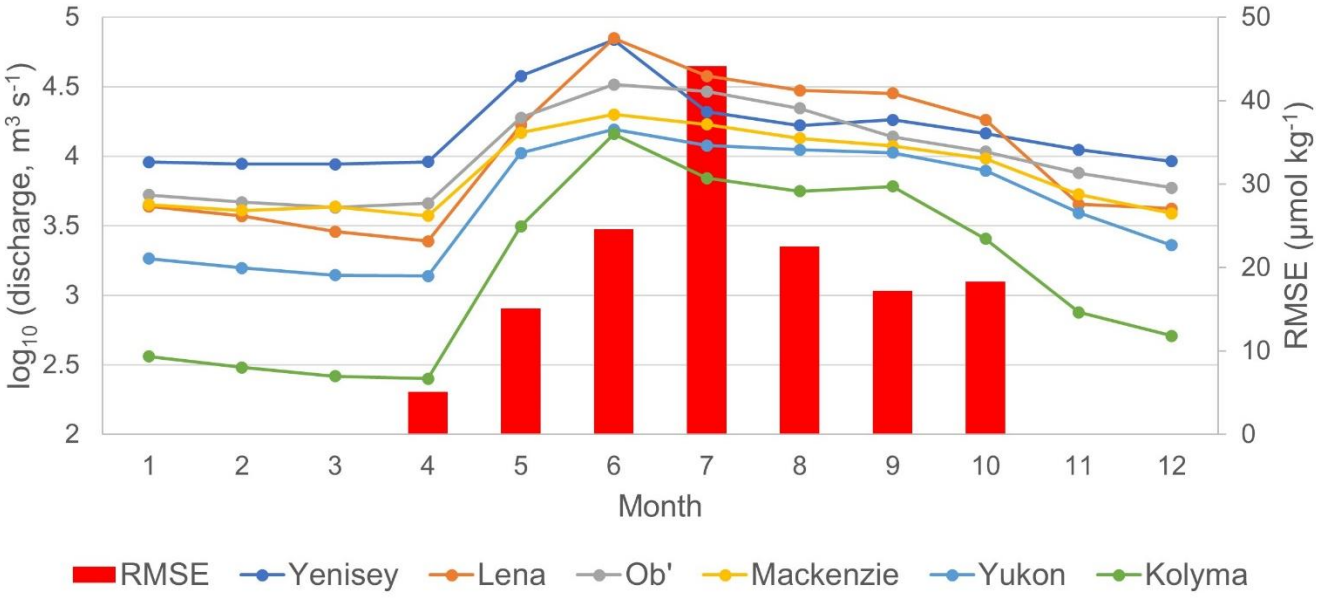

Figure S4: Monthly mean discharge of the main Arctic Rivers (Shiklomanov et al., 2018) and RMSE of A_T computed by NN in GLODAPv2 samples of the Arctic Ocean. There are not enough data to compute RMSE in months with no bars.

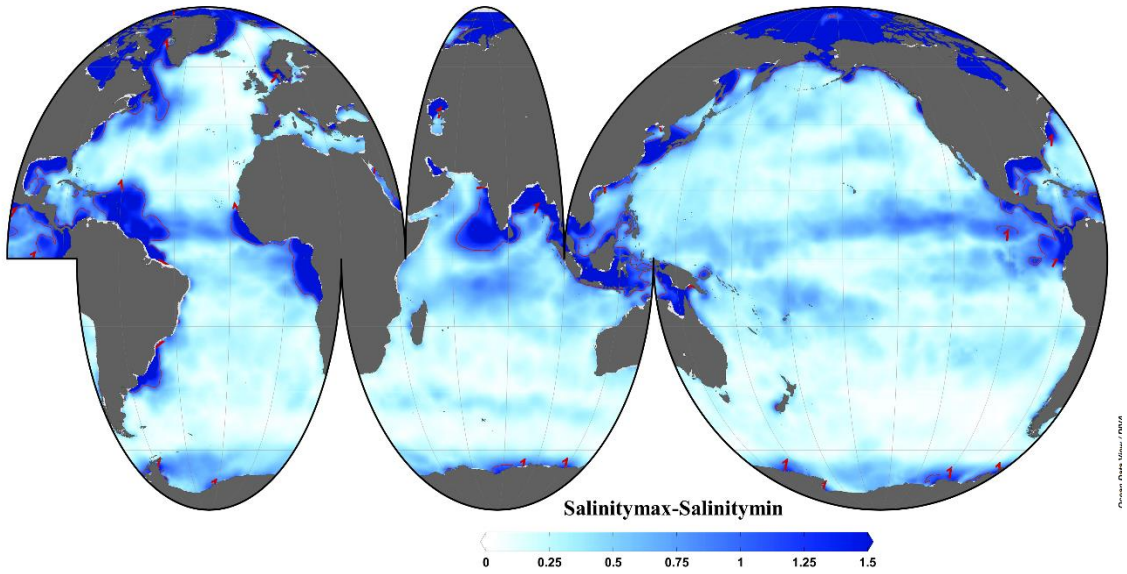

Figure S5: Surface salinity seasonal amplitude. Red line represents the contour of amplitude 1. This figure was made with Ocean Data View (Schlitzer, 2016).

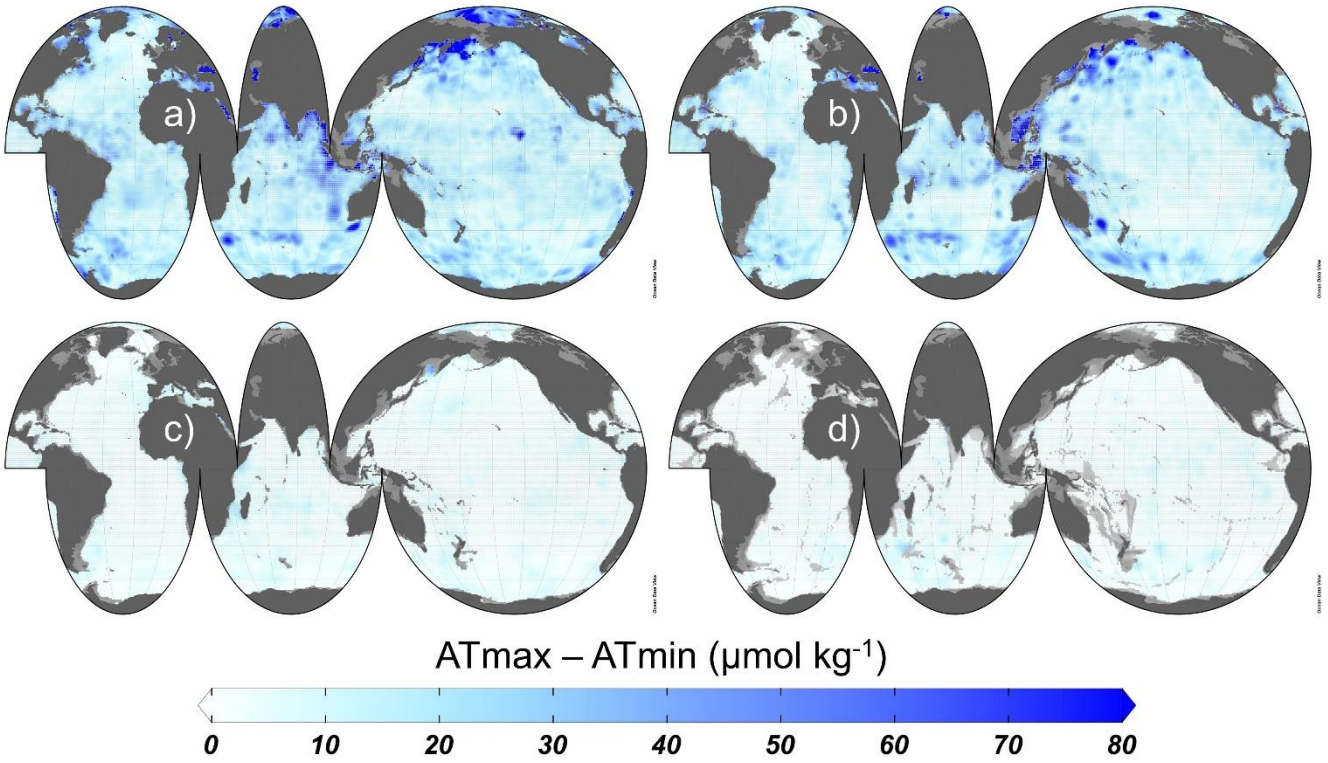

Figure S6: Seasonal amplitude of A_T at a) 100 m, b) 500 m, c) 1000 m and d) 3000 m. This figure was made with Ocean Data View (Schlitzer, 2016).

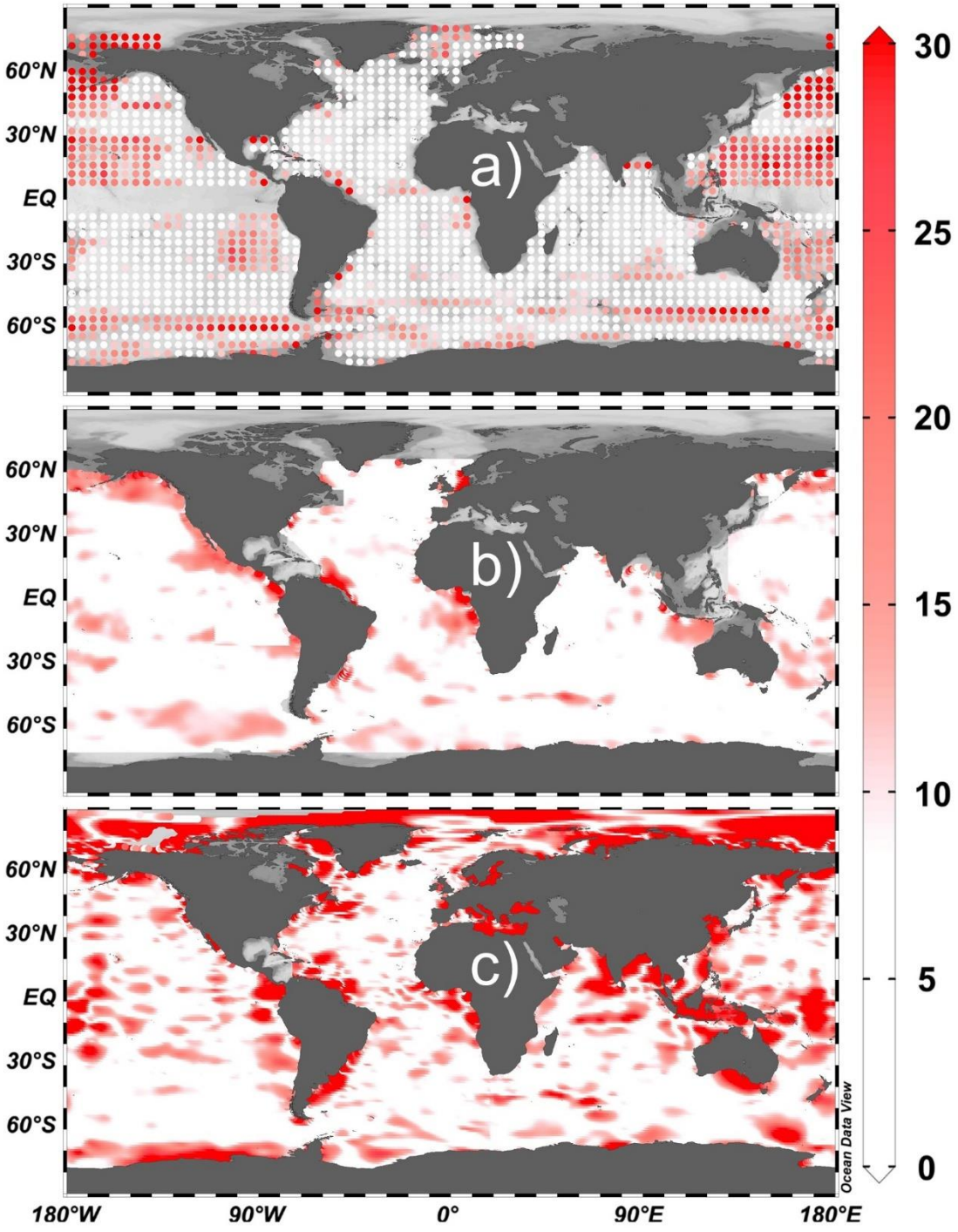
a)
b)
c)
60°N
30°N
EQ
30°S
60°S
180°W
90°W
0°
90°E
180°E
30
25
20
15
10
5
0
Ocean Data View

Figure S7: 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).

Latitude	n*	%relative over total n*	n (GLODAPv2)	%relative over n
HS	215	8.72%	113277	0.19%
0º-20º	89	3.61%	27879	0.32%
20º-40º	100	4.05%	37213	0.27%
40º-50º	179	7.26%	26899	0.67%
50º-60º	299	12.12%	16738	1.79%
60º-70º	296	12.00%	5531	5.35%
>70º	1289	52.25%	18684	6.90%

Table S1: Analysis by latitude in samples with residuals beyond ±3RMSE. n*: number of samples where the differences between measured and computed A_T are greater than ±3RMSE. n: number of samples available in GLODAPv2. 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.

	n*	%relative over total n*	n (GLODAPv2)	%relative over n
depth<100m	1317	86.81%	9522	14.45%

Table S2: Depth analysis in samples at latitudes greater than 60º N with residuals beyond ±3RMSE. 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.

Salinity	%relative over n* lat>60º N	%relative over n* lat<60º N
<34	94.77%	59.25%
>34	5.23%	40.75%

Table S3: Salinity analysis in samples at depths lower than 100 m with residuals beyond ±3RMSE. 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.

Month	n*	%relative over total n*	n (GLODAPv2)	%relative over n

1	0	0.00%	13	0.00%
2	1	0.07%	59	1.69%
3	0	0.00%	8	0.00%
4	0	0.00%	107	0.00%
5	103	7.49%	1170	8.80%
6	93	6.76%	1190	7.82%
7	264	19.19%	1412	18.70%
8	413	30.01%	2364	17.47%
9	409	29.72%	2670	15.32%
10	82	5.96%	465	17.63%
11	8	0.58%	59	13.56%
12	3	0.22%	5	60.00%

Table S4: Monthly analysis in samples at depths lower than 100 m and latitudes greater than 60º N with residuals beyond ±3RMSE. The greatest removal in the summer months reflects again the influence of the rivers, that is, the highest discharge is in the summer. The high removal percentage in December doesn't have considered because of the low data availability. Percentages in the fifth column are computed from the second and the fourth ones.

References

Shiklomanov, A.I., R.M. Holmes, J.W. McClelland, S.E. Tank, and R.G.M. Spencer. 2018. Arctic Great Rivers Observatory. Discharge Dataset, Version 20180724. https://www.arcticrivers.org/data