1   Supplementary Material

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3   **Variable contribution of wastewater treatment plant effluents to N_2O emission**
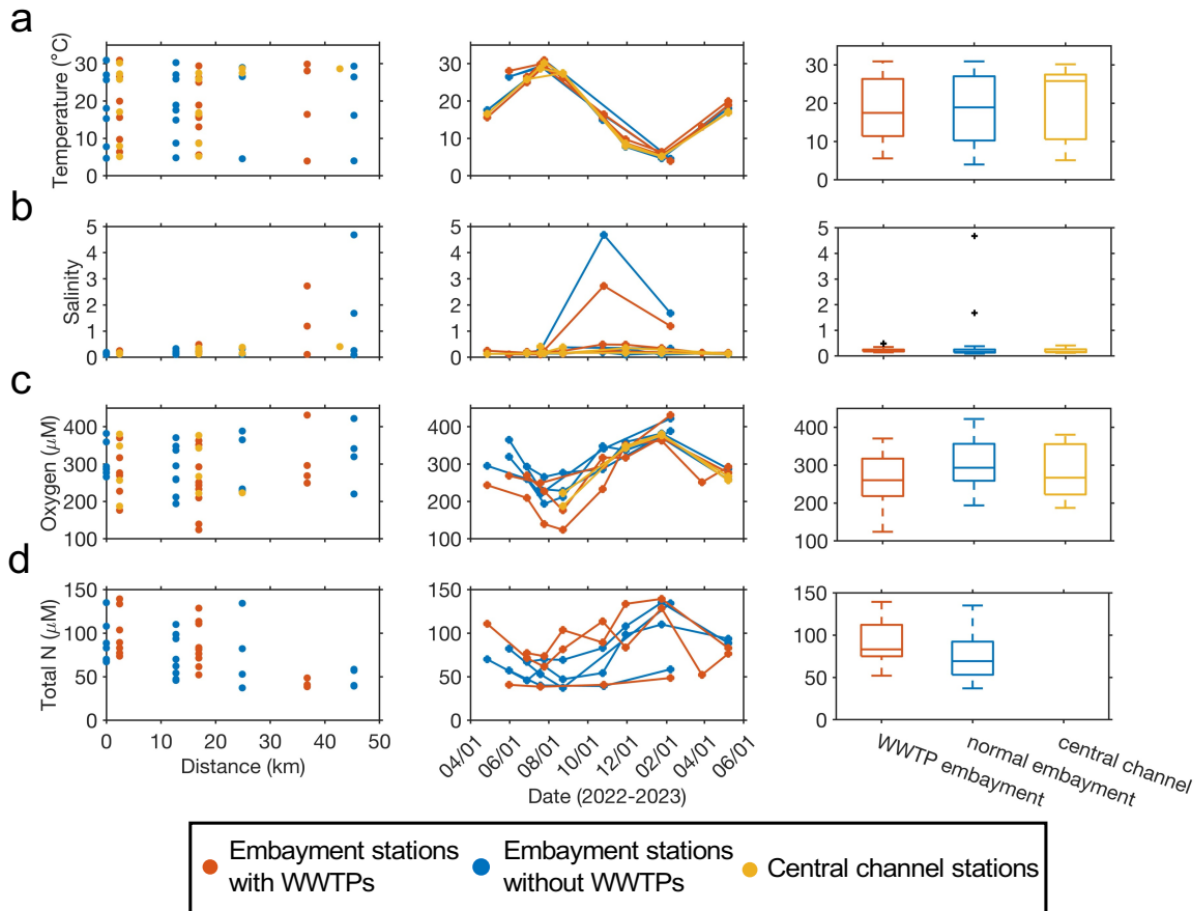
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Supplementary Figure 1. Spatial and temporal variations of temperature (a), salinity (b), oxygen (c) and total nitrogen concentration (d). The distance shows from upstream to downstream stations in the Potomac River. Embayment stations associated with wastewater treatment plants (WWTPs, red circles and lines) and without WWTPs (blue circles and lines), and central channel stations (yellow circles and lines). Total N concentration was not measured at central channel stations. For the boxplots, the red line in each box is the median. The bottom and top of each box are the 25th and 75th percentiles of the observations, respectively. The error bars represent 1.5 times the interquartile range away from the bottom or top of the box, with red + signs showing outliers beyond that range.
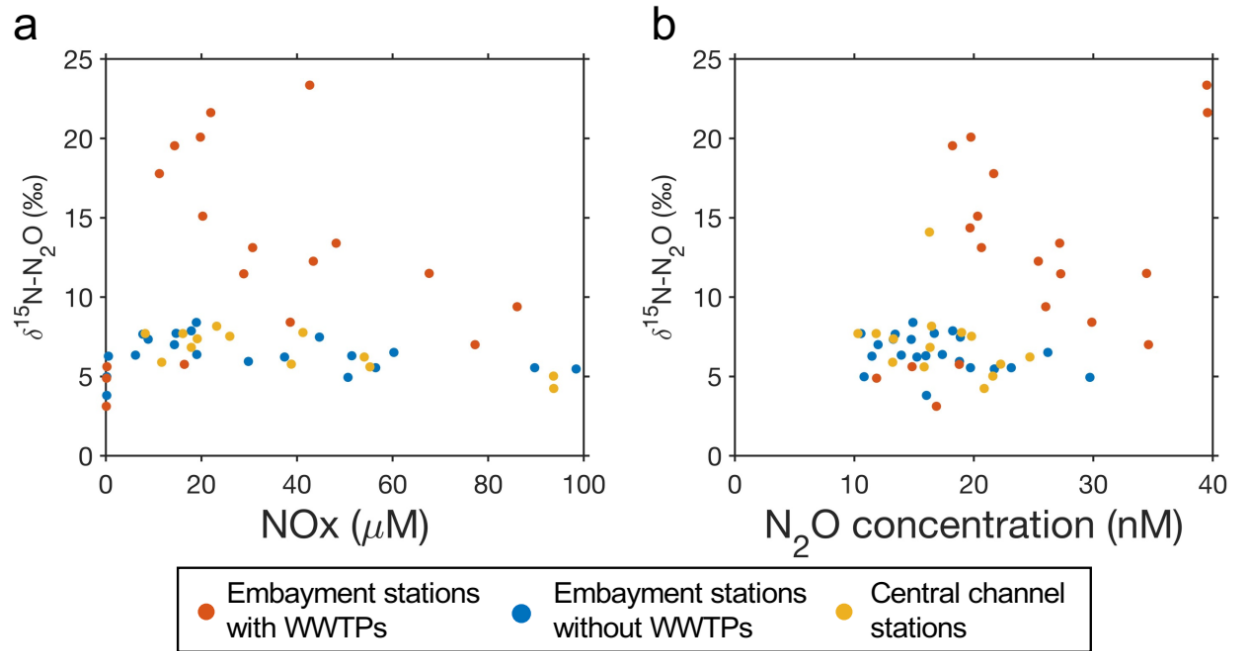
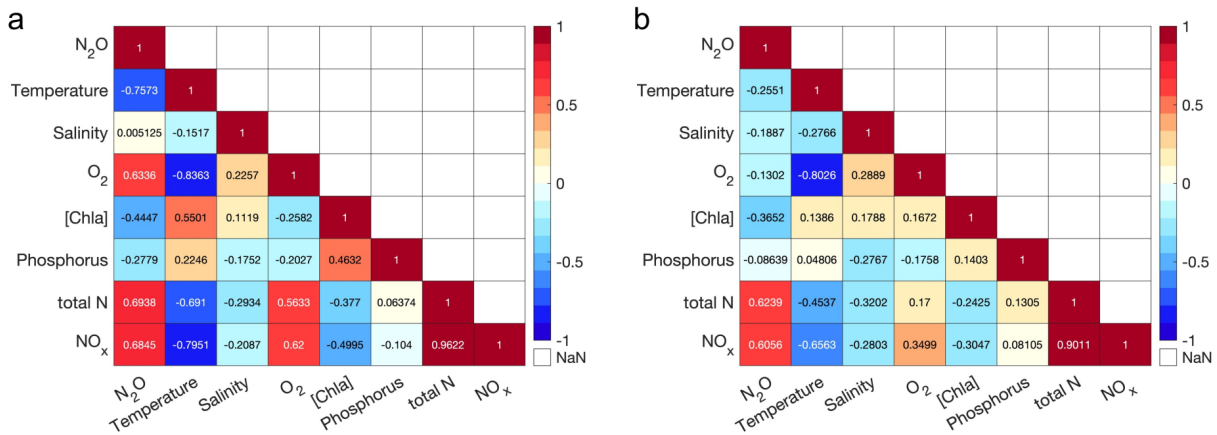Supplementary Figure 2. The relationship between $\delta^{15}N$ of N_2O and NO_x concentration (a) and N_2O concentration (b).
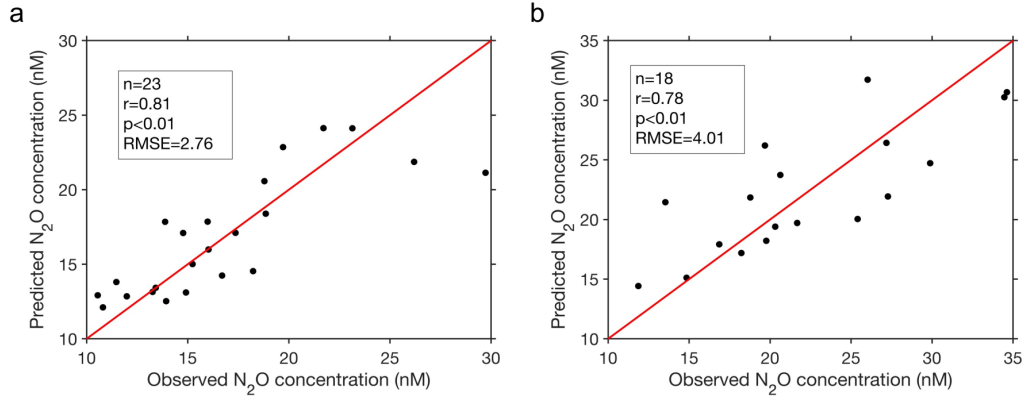

Supplementary Figure 3. Correlation coefficients among different environmental factors and N_2O concentration for stations without (a) or with (b) the influence by WWTPs.

Supplementary Figure 4. Predicted versus observed N$_2$O concentration based on a multiple linear regression model for stations without (a) or with (b) the influence by WWTPs. The number of data points (n), correlation coefficient (r), p value and root mean square error (RMSE) are presented in the legend.
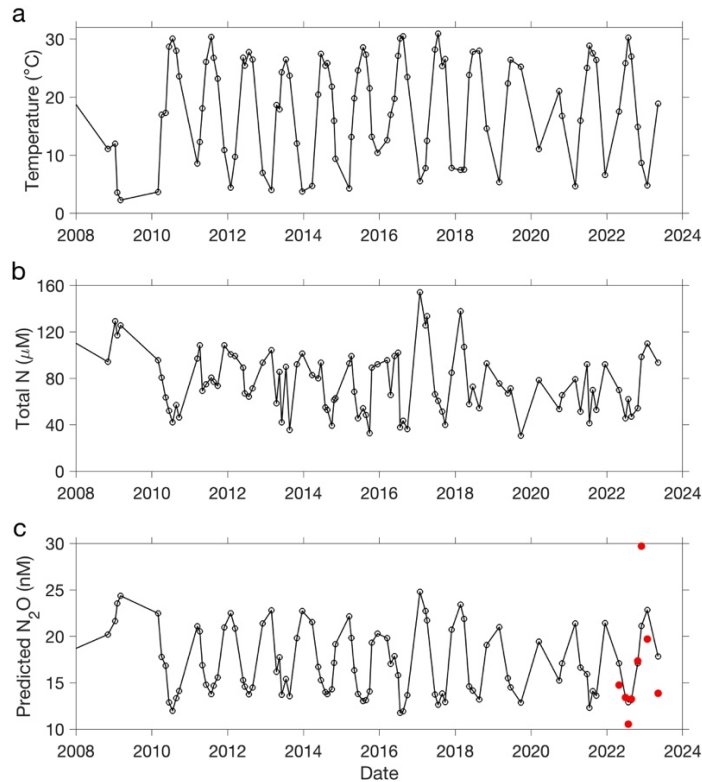
Supplementary Figure 5. Historical measurements of temperature (a) and N concentration (b) at the Occoquan Bay sampling station. N$_2$O concentration (c) is predicted based on a multiple linear regression model developed for stations without the influence from WWTPs. The red points are the observed N$_2$O concentration.

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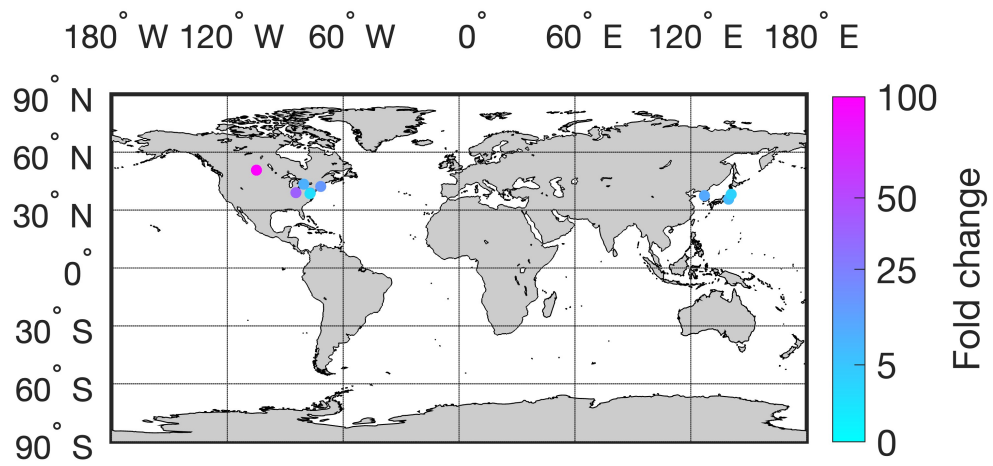
Supplementary Figure 6. N$_2$O observations associated with WWTPs globally, color-coded by the fold change in N$_2$O concentration, saturation or flux comparing downstream and upstream of WWTPs (see Table 1 for details).

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