Geophysical Research Abstracts
Vol. 20, EGU2018-9065, 2018
EGU General Assembly 2018

High Resolution Nitrogen Fluxes in Second-order Tributaries of the Rhine (Germany)

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Anthropogenic nitrogen inputs in rivers are mainly comprised of agricultural fertilizers or discharged wastewater in urban areas. This study examined a nitrate and ammonium concentration dataset of exceptionally high sampling resolution, with measurements retrieved every 15 minutes from 2006 to 2016. Sampling took place from sites located near the confluence of two river systems, the Pegnitz and the Regnitz rivers, near Nuremberg Germany. In conjunction with daily discharge values, this data was used to calculate a highly accurate estimate of total annual nitrogen fluxes for a selected time period (2013-2014). This budget revealed local nitrate sources through comparisons between sampling sites along the river.

Large increases in total nitrogen fluxes upstream and downstream of water treatment plants indicated that urban wastewater inputs were a significant source of nitrate in urban areas. Here we determined additional nitrate contributions of up to 9 t N/day provided by 3 sewage treatment plants. Similarly to a study on carbon fluxes (Lee et al., 2017), this study underlines the importance of considering fluxes, rather than concentrations, when tracking water chemistry changes in fluvial systems. When comparing differing sampling frequencies, selected monthly and bi-monthly sampling schemes showed occasionally large magnitudes of error (at times, in excess of 20%). These results indicate that the consideration of sampling frequency should be an important facet of future studies.