Characterizing groundwater variability in a highly impacted river system using isotopic and geochemical data

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The San Joaquin River (SJR) is a highly eutrophic river draining large agricultural areas and other land uses in the Central Valley, California. A long-term increase in nitrate concentrations has been observed in the SJR during the past 50 years, and groundwater may be a significant source of additional nitrate, contributing to high algae growth and low dissolved oxygen levels. In order to better understand groundwater variability and groundwater-surface water interactions, water samples were collected from multi-depth monitoring wells along both sides of the river, within the streambed using drive point samplers, and along detailed downstream surface water transects. The nitrate isotopic composition of the samples was used to identify nitrate sources and dominant biological processes controlling nitrate distribution within the SJR. The groundwater samples showed a wide range of nitrate concentrations, isotopic compositions, and redox conditions, suggesting that groundwater –surface water interactions were highly variable along the length of the river. Isotopic mass balance calculations indicated that unmonitored nitrate sources and sinks, including groundwater, were significantly more important than in-stream algal uptake and denitrification for controlling surface water nitrate distributions, except during short periods of time with the highest algal growth.