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Can flooding events increase the inorganic fertilizer contributions into watersheds?

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Nitrate pollution from anthropogenic sources is a worldwide concern with environmental and economic implications. Anthropogenic nitrogen inputs over the past century (e.g. from intensive agro-fertilizer applications) have negatively impacted aquatic biogeochemical cycles, water resources and human health. Therefore, well-supported outcomes to determine the origin of these contaminants can help management strategies to reduce this pollution. Specifically, the N inputs from watershed sources into Lake Winnipeg, Canada, have increased during the last decades, and this pattern over time has contributed to an extensive eutrophication of the lake, which has brought several environmental concerns. These nutrient nitrogen inputs include loadings from agricultural inorganic fertilizer and animal manure and discharge from wastewater treatment plants. Stable nitrogen and oxygen isotopic compositions (δ^{15}N, δ^{18}O) of nitrate were used to identify nitrate sources in water. For this purpose, we used the bacterial denitrification method to convert the nitrate from water into N_2O gas by cultures of *Pseudomonas aureofaciens*, which lack N_2O-reductase activity. The resultant N_2O was extracted from sample vial and injected in an isotopic N_2O laser analyzer employing cavity enhanced laser absorption spectroscopy (OA-ICOS) for accurate and precise isotope measurements. We evaluated the sources and seasonal patterns of dissolved nitrates in two major contributors to Lake Winnipeg; the Assiniboine and Red rivers. The relative contribution of nitrate sources was estimated using Bayesian isotope mixing models incorporating δ^{15}N and δ^{18}O values of dissolved nitrate. Our models showed variable spatial and temporal contribution of nitrate sources. Results indicated that nitrate in the Assiniboine River originated up to 62% from waste or municipal sources (i.e. manure and/or waste water discharge), whereas ca. 40% of nitrate in the Red River originated predominantly from inorganic agricultural fertilizers. A decrease in fertilizer loading over time following spring snowmelt was also found. We highlight that flooding events produced higher proportions of inorganic fertilizers in the Assiniboine River watershed. This study has direct implications for water nutrient management in the watershed.