A stable isotope perspective on the sources and sinks of nitrate from the catchment to coast continuum

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Dual isotopic composition of nitrate (NO_3^-) at natural abundance level have proven to be useful tools in delineating the sources and fate of NO_3^- in aquatic environment. In this study, we measured the $\delta^{15}N$ and $\delta^{18}O$ of NO_3^- in surface waters from areas of different agricultural land use intensities, sewage, groundwater and estuarine waters (Werribee Estuary) in SE Australia to provide insights into sources, transformation and fate of nitrogen across the land coastal continuum.

For surface stream waters, $\delta^{15}N$ was strongly correlated with the percentage fertilization area (r^2=0.85), with a maximum $\delta^{15}N$ value of ~+13‰, at highest agricultural intensity suggesting that $\delta^{15}N$ is an effective indicator of land use. Consistent with this, the $\delta^{15}N$ of NO_3^- in groundwater below horticultural areas were ~+14‰ .

Nitrogen discharge to the Werribee Estuary was dominated by groundwater through two hotspots, one adjacent to the sewage treatment plant, and the other adjacent to agriculturual areas. $\delta^{15}N$- NO_3^- values at each of these hot spots were consistent with the NO_3^- being derived from these adjacent sources (+14‰ for agriculture, and +30‰ for sewage). A combination of $\delta^{15}N$-NO_3^- and $\delta^{18}O$-NO_3^- values in the estuary showed that agricultural sources of NO_3^- dominated inputs to the estuary. As NO_3^- was tranported down the estuary, there was a further enrichment in $\delta^{15}N$, most likely as a consequence of assimilation by phytoplankton.