# Episodic estuarine hypoxic events: Integrating the biogeochemistry, hydrology and climate on a sub-tropical floodplain, Eastern Australia

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Globally, the frequency, magnitude and spatial extent of anthropogenically-induced coastal hypoxic events is increasing [1]. Episodic hypoxia in riverine and estuarine systems can follow high-flow events such as floods or the release of environmental allocations. These events can result in complete deoxygenation of the water column and significant effects on aquatic organisms and ecosystem function. This study integrates the biogeochemical, hydrological and climatic processes from four flood events on two sub-tropical floodplains in eastern Australia [2,3].

We found that a key driver of hypoxia was the extensive modification of floodplain surface hydrology through the construction of drainage networks. Backswamp basins were originally natural storage basins for floodwaters, supporting large areas of wetland vegetation. Drier conditions, due to drainage, has shifted vegetation assemblages from wetland-dominant species to flood-intolerant species. When inundated, senescent vegetation provides a source of labile carbon which rapidly consumes oxygen from the overlying waters, producing anoxic water with high oxygen demand. Carbon metabolism during these events is strongly coupled with microbially-mediated reduction of accumulated Fe and Mn oxides commonly found on coastal floodplains. These redox sensitive species provide a geochemical signature to identify the sources and causes of estuarine hypoxic events. Whilst anoxic floodwaters were previously retained in backswamp wetland basins during the flood recession phase, these waters are now exported rapidly to the main channel.

Post-flood hypoxic events frequently occur in summer, especially when long, dry periods are followed by rapid, intensive rainfall. These events will most likely increase in frequency and magnitude as a result of climate change due to more frequent and hotter summer floods.

[1] Diaz & Rosenberg (2008) *Science* **321**, 926-929. [2] Johnston *et al*. (2003) *Mar. and Fresh. Res*. **54**, 781-795. [3] Wong *et al*. (2010) *Estuar. Coast. Shelf Sci*. **87**, 73-82.

# Stable isotopes ratio in nitrate: A tool to unravel the biogeochemistry of nitrate in an estuarine environment

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Port Philip Bay is a large coastal embayment in temperate south eastern Australia, with a population in excess of 4 million in the local catchment. Like other coastal waters, the bay is typically nitrogen limited and hence there is much interest in identifying sources and sinks of this nutrient within catchments and estuaries surrounding the bay.

This study was carried out in the Werribee estuary, one of the major estuarine systems within Port Philip Bay. Werribee estuary is eutrophic with nitrate concentrations exceeding 1mgN/L during base flow conditions. There are a number of potential sources of nitrogen to the estuary including treated sewage effluent, market gardens, groundwater and the Werribee River. We aimed to distinguish the sources and transformation processes of nitrate in this estuarine environment using a multidisciplinary approach, focussing on stable isotopes and radon measurements.

Monthly sampling of surface water and groundwater was carried out over a 12 month period. Our preliminary results showed that (i) there was a positive correlation between $\delta^{15}N\text{-}NO_3$ and $\delta^{18}O\text{-}NO_3$ with a 2:1 $\delta^{15}N{:}\delta^{18}O$ gradient in both surface and groundwaters suggesting that denitrification was occurring and led to considerable transformation of the isotope signatures from their sources values within groundwater and surface waters. (ii) There was a strong correlation between nitrate and radon concentrations ($R^2$=0.79) at a site in the upper estuary consistent with nitrate derived from groundwater. (iii) The $\delta^{15}N$ and $\delta^{18}O$ of nitrate were +18±4‰ and +11±4‰ respectively when nitrate concentrations in surface waters exceeded 0.2mgN/L, which was consistent with the signatures observed in ground water with high nitrate concentrations (>10mgN/L) beneath the market gardens.