Geophysical Research Abstracts
Vol. 14, EGU2012-390, 2012
EGU General Assembly 2012

Episodic estuarine hypoxic events: integrating the biogeochemistry, hydrology and climate on a sub-tropical floodplain, eastern Australia

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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, significant effects on aquatic organisms and ecosystem function, impacting on local communities and economies. This study integrates the biogeochemical, hydrological and climatic processes from four flood events on two sub-tropical floodplains in eastern Australia (Johnston et al. 2003; Wong et al. 2011; Wong et al. 2010).

We found that a key driver of hypoxia was the extensive modification of floodplain surface hydrology through the construction of artificial 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 during flood events, 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.

Drains then transport deoxygenated floodwaters rapidly from backswamp wetlands basins to the main river channel to further consume oxygen. 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. This process effectively displaces the natural carbon metabolism processes from floodplain wetlands 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.

Management options to reduce the impacts of post-flood hypoxia include i) remodifying drainage on the floodplain to promote wetter conditions, thereby shifting vegetation assemblages towards inundation-tolerant species, and ii) strategic retention of floodwaters in the backswamp wetlands to reduce the volume and rate during the critical post-flood recession phase.

References

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