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Bank storage buffers rivers from saline regional groundwater: an example from the Avon River Australia

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Groundwater-surface water interactions are often conceptually and numerically modeled as a two component system: a groundwater system connected to a stream, river or lake. However, transient storage zones such as hyporheic exchange, bank storage, parafluvial flow and flood plain storage complicate the two component model by delaying the release of flood water from the catchment.

Bank storage occurs when high river levels associated with flood water reverses the hydraulic gradient between surface water and groundwater. River water flows into the riparian zone, where it is stored until the flood water recede. The water held in the banks then drains back into the river over time scales ranging from days to months as the hydraulic gradient returns to pre-flood levels. If the frequency and amplitude of flood events is high enough, water held in bank storage can potentially perpetually remain between the regional groundwater system and the river.

In this work we focus on the role of bank storage in buffering river salinity levels against saline regional groundwater on lowland sections of the Avon River, Victoria, Australia. We hypothesize that the frequency and magnitude of floods will strongly influence the salinity of the stream water as banks fill and drain. A bore transect (5 bores) was installed perpendicular to the river and were instrumented with head and electrical conductivity loggers measuring for two years. We also installed a continuous 222Rn system in one bore. This data was augmented with long-term monthly EC from the river. During high rainfall events very fresh flood waters from the headwaters infiltrated into the gravel river banks leading to a dilution in EC and 222Rn in the bores. Following the events the fresh water drained back into the river as head gradients reversed. However the bank water salinities remained ∼10x lower than regional groundwater levels during most of the time series, and only slightly above river water. During 2012 SE Australia experienced a prolonged summer drought. A significant increase in EC was observed in the bores towards the end of the summer, which suggest that the lack of bank recharge from the river resulted in draining of the banks and connection between the regional groundwater and the river. The long-term river salinity dataset showed that when flow events are infrequent and of low magnitude (i.e. drought conditions), salinities increase significantly. Similarly this is thought to be due to draining of the banks and connection with the regional groundwater system. Thus an increase in extended dry periods is expected to result in higher salinities in Australian waterways as the climate changes.