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Long term water quality trends in Australia's largest river basin

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The Murray-Darling River Basin is the largest drainage system in Australia, and has undergone significant modification to the land surface and hydrological regime since the beginning of European settlement ∼180 years ago. Natural conditions (stream flow and water quality) are difficult to estimate due to a lack of early data, however the few records available suggest a more variable flow regime than present, which is characteristic of most Australian semi-arid to arid rivers [Peel et al., 2001]. An assessment of the natural water quality conditions can only be based on a comparison with other non-regulated streams, catchment characteristics, and current major ion trends. The re-engineering and diversion of tributaries in the catchments, intensive water extraction from the river for agricultural and drinking water, and large scale removal of trees, have all resulted in a profound change to the hydrology of this basin. Alongside this has been the concern over increasing salinity in the Murray River, a trend which in previous studies has been shown to exist independent of any changes in river flow [Cunningham and Morton, 1983; Morton and Cunningham, 1985]. Since this initial work, over 20 years of additional salinity data has been recorded, which provides an ideal opportunity for the stated processes governing salinity trends to be tested and re-assessed. Given the dependence of agriculture and communities upon this basin and its water, it is crucial to determine the scale, and cause of changes in water quality, and the impacts that management schemes are having on this system.

Here, we analyse salinity and flow records extending back to 1938, with the salinity record derived from samples taken 1-2 times per month from 1938 – 1962, and daily from 1962. This salinity record integrates a large number of processes throughout the catchment, and as such can provide a useful indication of basin-wide trends in water quality. However, the influence of each hydrological process on salinity has to be separated. We relate salinity to other historic variables measured in the Murray basin, such as land discharge, rainfall, land use change, and water extraction. We identify cycles at different time scales that provide clues on which variables and processes are related. The comparison between water quality and flow across the transition to the highly regulated river system that is operating today indicates that, for the 1938 – 1980 period, mean salinity levels increased against a trend of decreasing flow, which is in agreement with previous studies. Interestingly though, we find that over the last ∼15 years, mean salinity levels and variability have both decreased. Extraction of river water, its use and evapo-concentration during irrigation, and its subsequent return to the river, has been shown to be the main cause for the conversion to a Na - Cl dominated water quality in the lower reaches of the Murray River [Herczeg et al., 1993]. We test several explanations for these trends in salinity, such as a decrease in the return flow of highly evaporated irrigation waters to the river, following the successful implementation of salt interception schemes. This conclusion is intriguing given the extended period of drought and low flow conditions that have dominated the hydrology of this basin over the same time as water quality has improved. Our findings are an important step in understanding long term trends in water quality, and the impact of agriculture and resultant water management practices on large river basins.

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