Assessing floodplain ecosystem ecohydrological responses in the Murray-Darling Basin using multiple lines of spatial evidence

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Abstract: The Murray–Darling Basin is a vast river basin with more than 500,000 km of rivers and streams draining more than 1,000,000 km^2 of south-eastern Australia. Extensive riverine and floodplain areas support distinct assemblages of water-dependent trees and understorey vegetation that assemble along latitudinal and elevation gradients, largely driven by availability of groundwater, flooding and rainfall. As a result of anthropogenic development, overallocation and diminishing inflows in a warming climate, increasing water stress has triggered ecosystem decline across the Basin over the past two decades. To alleviate water stress, over the past 10 years managed delivery of water for the environment within the constraints of the hydrological delivery system such as levees, locks and weirs, has been used to restore and protect water-dependent ecosystems. However, diversion of consumptive use to the environment requires monitoring and evaluation of the water resource use, prompting development of methods to track the response of water dependent ecosystems to the contribution of environmental water across multiple years. Furthermore, evaluation of ecosystem response and condition is required to enhance management decisions related to when and where environmental water is needed into the future, to inform adaptive management and ensure best use of often scarce water resources. This is a challenging task at local scales which is amplified when trying to understand ecosystem responses across the entire Basin.

Improved satellite and remote sensing technology over recent years has facilitated monitoring of ecosystems across broad scales, often underpinned by robust field measurements and other lines of evidence. We compared Basin scale timeseries of remotely sensed vegetation indices (NDVI, factional cover) and field validated, regression models of Basin specific tree evapotranspiration (AMLETT ET, Doody et al. 2023) to monitor water stress responses at monthly scales. We also aggregated monthly metrics to annual scales to compare water stress responses with the outputs of an annual tree condition model. Here, we report an evaluation framework underpinned by the Australian National Aquatic Ecosystem (ANAE) Classification of the Murray–Darling Basin (Brooks 2021) that enables a pathway to integrate the spatial data to assess ecosystem condition over time and across multiple spatial scales from individual patches to the whole river basin. The ANAE typology classifies floodplain vegetation into groups that are used to define local scale building blocks from which it is possible to quantify ecosystem condition. By applying an area weighted aggregation of building blocks, it is possible to quantify response of water dependent ecosystems at scales that are also meaningful to water managers, to inform adaptive management. Additionally, use of historical satellite imagery enables quantification of antecedent conditions using all spatial data that has been developed and collated, allowing the derivation of some preliminary trajectories of ecosystem change for comparison across the different datasets.

REFERENCES

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