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KEYNOTE

Inundation frequency in the Murray–Darling Basin: Past, present and future

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Abstract: Flooding has been identified as the costliest natural disaster in Australia, causing billions of dollars in damage and losses over the years. However, floods are also crucial for maintaining healthy ecosystems in the Murray–Darling Basin (MDB). Ecosystem functions, such as nutrient cycling and biodiversity, depend on the frequency and extent of inundation. Stakeholders involved in flood risk management and water resources have a keen interest in analysing flood frequency in the MDB. This analysis would help uncover trends and establish connections to current and future climate conditions, providing valuable insights for decision-making. The two-monthly maximum water depth maps of Teng et al. (2023) provide a comprehensive quantitative description of floodplain inundation over the past 34 years (1988–2021). This dataset can be valuable to inform flood risk mitigation plans and water management strategies aimed at preserving the ecological benefits of periodic flooding.

We characterised the 34-year perspective of inundation frequency in comparison to the instrumental historical 122-year period and future projections under climate change informed by CMIP6 GCMs. Inundation is influenced by various flow characteristics, and after exploring several proxies, we found that the 30-day maximum flow was the most suitable for overall comparison. However, to compare the 35-year period with the longer historical period, we had to use modelled runoff data, which does not account for management and flow lags seen in observed flow. Despite this, we found that modelled runoff was well correlated with flow. The analyses showed that the Annual Exceedance Probabilities (AEPs) of modelled runoff in the 35-year period were higher than those of the 122-year period. The inundation frequency over the longer historical period will therefore be lower than the inundation observed in this 35-year dataset.

Hydroclimate projections indicate that the MDB will be hotter and drier under climate change. The mean annual runoff and hence future water resources is projected to decrease by up to 40% under a 2-degree global warming scenario. This projection is supported by several lines of evidence (trend in observed data, hydroclimate projections, expanding Hadley cell pushing the cool season storm tracks further south) from numerous research studies of the region.

Preliminary results show that under climate change, the inundation frequency in the MDB is likely to decrease slightly or remain unchanged, unlike the projected large reduction in water resources availability. This is because high extreme rainfall will become more intense in the future, and as a result the projected decrease in runoff and flow characteristics that drive floodplain inundation will be less than the projected decrease in mean runoff and water resources availability. There is growing concern among stakeholders regarding the management of environmental water for floodplains under the influence of climate change. While it is important to acknowledge these concerns, it is crucial to recognize that the focus should be on "management" rather than attributing all issues to "climate change". Our comprehensive inundation data support the perspective that the impact of climate change on floodplain frequency, is relatively smaller compared to its impact on average water security and reliability. However, there may be differing interpretations due to the inherent complexity of the subject matter.

REFERENCES

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