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Drought propagation across the Murray–Darling Basin

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Abstract: Recurrent droughts are a common environmental feature across Australia. Major droughts such as the millennium drought (1996–2010) have occurred in the past 30 years in large parts of eastern australia, including in the Murray–Darling Basin (MDB). We investigate propagation behaviours, from meteorological (MD) to hydrological droughts (HD), for 122 catchments across the MDB using 48 years of hydroclimatic data from 1971 (Figure 1a). These catchments lie in four of the six major precipitation zones of Australia, with the majority of the catchments from the winter followed by uniform and summer precipitation zones.

We determine drought events based on the run theory using the standardised precipitation index (*SPI*) and standardised streamflow index (*SSI*). Drought propagation is then investigated focusing on lag times from the start of an MD event to the start of its corresponding HD event, and lag of the recovery phase from the end of an MD to the end of the corresponding HD event. The propagation behaviour of droughts with different severity and timescales (1, 3, 6 and 12 months) is considered. The schematic diagram in Figure 1(b) describes the start and end lags assuming SPI < 0 and SSI < 0 as criteria for starting (and ending) the MD and HD, respectively.

Scatterplots (Figure 1c) of start and end lags reveal that for severe droughts (e.g., SPI < -1 and SSI < -1) at a monthly scale, start lags range from 0 to 2.5 months while end lags vary from 1.0 to 5.0 months. The smaller start lags compared to end lags indicate that although catchment storage could buffer the impacts of MD on HD, the effects of MD are propagated quicker at the start than during the recovery phase. For droughts of longer timescales, start lags tend to be more than end lags. For droughts of smaller timescales, the correlation between start and end lags is stronger and is statistically significant, compared to droughts of longer timescales. We also find that as drought timescales increase correlations between start and end lag weaken suggesting a non-uniform lag response of catchments for droughts of larger time scales. This implies that for droughts of shorter time scales, most catchments tend to exhibit similar propagation patterns, however as the length of the drought increases catchments show diverse propagation characteristics.

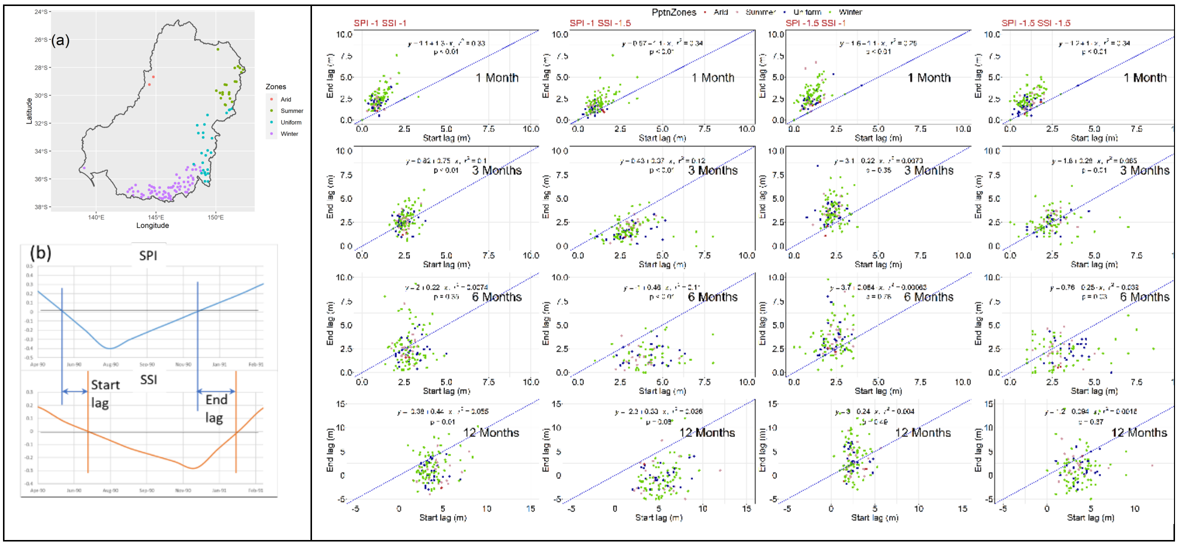

Figure 1. (a) Location of selected catchments across MDB (b) Schematic diagram of start and end lags in drought propagation (c) Scatterplot showing the relationships between start lag and end lag; a higher correlation indicates the uniformity of propagation behaviour among all catchments

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