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Changes in sub-daily rainfall at Melbourne, Australia, 1950-2007: a neglected aspect of climate change with implications for ecohydrology and catchment water yield.

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The implications of global and regional climate change for rainfall have largely been considered in terms of seasonal and annual totals, and in relation to changed occurrence of rainfall extremes. However, ecosystem function on daily timescales is driven by the properties of frequent rain events, which typically have durations measured in hours. Little appears to have been resolved about how the properties of rain events may change, and what the implications might be for ecohydrology.

To better understand changes in catchment water yield and the conversion of rain to functionally available water within ecosystems, the changing properties of sub-daily rainfall in metropolitan Melbourne, Australia, have been explored using 58 years of 6-minute rainfall data. Results show that though median rain day depths have not changed, rain rates have declined from a median of 1.1 mm/h in the 1970s to 0.6 mm/h in 2000-2007. Rainfall intermittency, defined by the number of cessations of rain per day, has declined from a median of 4 cessations in the 1950s to 1 cessation per day in 2000-2007. In the 1950s, the median of the maximum duration of continuous rain during a day was 0.9 h, but by 2000-2007 this had increased to 2.4 h. Rain event depths peaked in the 1970s and 1980s at about 3.0 mm. Since then, event depths have declined, and the years 2000-2007 exhibit the smallest median event depth since the 1970s, 1.4 mm, a decline of > 50%. Thus, the rainfall climate of Melbourne considered at sub-daily timescales has changed in favour of prolonged rain events with lower rain rates and smaller event depths.

Such changes in rain event properties have the potential to exacerbate the effects of declining annual rainfalls. Events with lower rain rates lose a larger fraction of the incident rain to wet canopy evaporation. Smaller rain events are less able to penetrate plant canopies and ground litter to replenish the soil moisture store. Thus, it appears that changes in sub-daily rainfall may be of considerable significance to ecohydrology and to the production of water supply from forested catchments.