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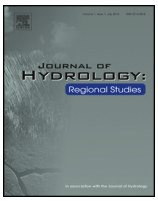

Past and future changes to inflows into Perth (Western Australia) dams

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ABSTRACT

Study region: The city of Perth is located within the region referred to as south-west Western Australia (SWWA) defined as southwest of a line connecting 30° S, 115° E and 35° S, 120° E.
Study focus: SWWA has experienced a prolonged decline in rainfall since the early 1970s accompanied by serious reductions to inflows into the major storage systems. Consequent research questions include: What caused the decline in rainfall? Why have inflows decreased so dramatically? What can be expected over the coming decades? In this study, we consider these questions making use of recent observations and the latest generation of climate model results which attempt to simulate the effects of increased greenhouse gas concentrations.
New hydrological insights for the region under study: Recent observations show a continuation of dry conditions and confirm that a significant change in the relationship between rainfall and inflows appears to have occurred. There is little evidence that increasing local temperatures alone can explain this changed relationship which possibly represents long-term physical changes (e.g. groundwater levels) to the catchments. There is a strong consensus amongst recent model results that rainfall will decline further by the end of the 21st century. While this confirms findings from studies of previous model results, for the purposes of better estimating future changes to inflows it may now be more important to understand the reasons for the changed rainfall/inflows relationship.

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1. Introduction

Perth, located on the west coast of Western Australia (Fig. 1), is Australia's fourth most populous (~2 million people) city and experiences a Mediterranean-type climate, dominated by wet winters and relatively dry summers. Long-term average annual rainfall is about 870 mm with over 85% falling in the 6 months between May and October. Rainfall averaged over the wider southwest region of Western Australia (SWWA) that encompasses Perth and its catchments declined significantly in the early 1970s and has not shown any signs of recovering to the values experienced during most of the 20th century (IOCI, 2002). This decline has been most evident in the early winter period (May to July) and has been linked to a decrease in the number of low pressure troughs and westerly frontal systems combined with a decrease in the amount of rainfall associated with rain bearing systems (Hope et al., 2006a; Raut et al., 2014). These changes have had a serious impact on the total amount of water held in Perth's major dams (Power et al., 2005; Hope and Ganter, 2010) located to the south and east of the city in the nearby Darling escarpment (Fig. 1).

Explaining the observed rainfall decline has been problematic. Many studies have investigated the role of the El Nino Southern Oscillation (e.g. Nicholls, 2009), the Southern Annular Mode (e.g. Meneghini et al., 2007; Hendon et al., 2007; Feng et al., 2010), and Indian Ocean sea surface temperature patterns (e.g. Smith, 1994; Smith et al., 2000; Risbey et al., 2009) without being conclusive. Smith and Timbal (2012) suggested that trends in southern Australia rainfall, including SWWA rainfall, were

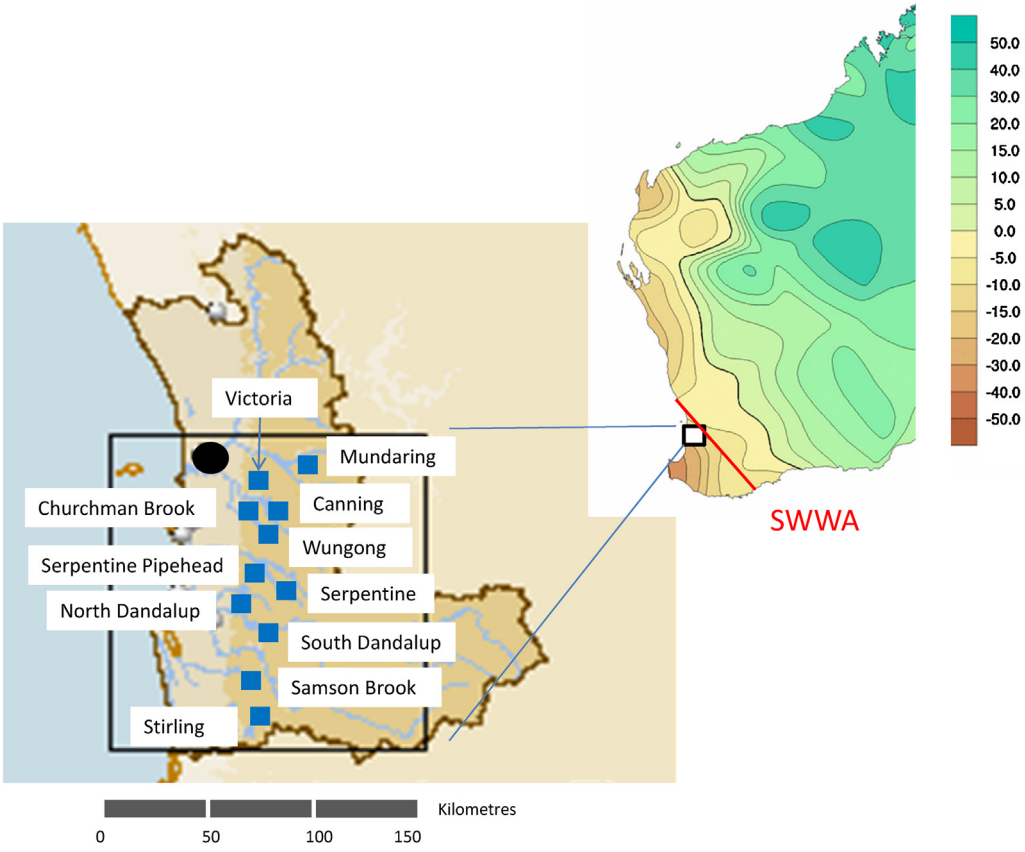

Fig. 1. Location of Perth (filled black circle) and major dams (blue squares). Also shown is a map indicating the region referred to as south-west Western Australia (SWWA) and long-term (1970–2013) trends in annual rainfall (units mm per decade). *Source*: Bureau of Meteorology (http://www.bom.gov.au/climate/change/).