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Teleconnection of atmospheric and oceanic climate anomalies with Australian weather patterns: a review of data availability

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Abstract

The quality and quantity of observed and reanalysed data influence the direction and accuracy of scientific research. This paper reviews the data available for the study of climate and weather patterns in Australia. A list of global reanalysis and satellite data is provided, along with a more detailed review of available in situ (weather station) data in Australia. Regularly updated climate indices are identified that have previously been linked to Australian climate and weather events. Observation of Australian weather is severely hampered by the continents' vastness and remoteness, as evidenced by heavy bias of in situ measurements that are generally clustered in the coastal high-population centres (mainly southeast of Australia), with central and northern regions often having to rely on remote sensing and reanalysis data. Data sparsity can introduce significant uncertainty in terms of extreme weather and climate change management, as variables such as rainfall exhibit high spatial and temporal variability. Several areas for future research are identified, including investigation into the impact of Australian aerosol levels, the connection between soil moisture and flooding potential, and teleconnection between Atlantic sea surface temperature and Australian climate. While this study focusses on data availability to investigate Australian climate patterns, findings are applicable at a global scale.

Keywords

data availability; Australia; climate indices; extreme weather events; satellites; reanalysis; weather stations

1 Introduction

Numerous remote climate patterns influence the climate and weather of Australia. These patterns range from daily to multi-decadal timescales (Micevski et al., 2006; Vance et al., 2015; Verdon et al., 2004a; Verdon et al., 2004b; Wheeler and Hendon, 2004), with extensive interaction between the various oceanic and atmospheric climate features (Cai et al., 2011; Meyers et al., 2007; Power et al., 1999; Risbey et al., 2009b). This high degree of interaction confounds the primary drivers of climate variation. Variability in sea surface temperature (SST), mean sea level pressure (MSLP) and wind have all been associated with distinct, region-specific climate responses in Australia (e.g. Risbey et al., 2009b). Numerous indices have been extracted from in situ and reanalysis datasets to describe and predict climate and meteorological conditions on global (Schubert et al., 2016), national (Meyers et al., 2007) and regional scales (Ummenhofer et al., 2009a). These indices often represent patterns affected by irregular periodicity, varying in timescale from multi-decadal, inter- and intra-annual to daily (Gallant et al., 2012).

Data availability for the study of climate and weather phenomena has augmented significantly since the advent of satellite surveillance in the mid-1970s and the coincident increase in computing capabilities. The emergence of satellite-based datasets, in conjunction with global in situ databases and reanalysis products, aided the identification of climate indices associated with primary climate and weather drivers and their teleconnection (e.g. Henley et al., 2015; Mantua et al., 1997; Wheeler

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