



## **Tropical Indian Ocean Variability Driving Southeast Australian Droughts**

CC Ummenhofer (1), MH England (1), PC McIntosh (2), GA Meyers (3), MJ Pook (2), JS Risbey (2), A Sen Gupta (1), and AS Taschetto (1)

(1) Climate Change Research Centre, University of New South Wales, Sydney, Australia (c.ummehofer@unsw.edu.au), (2) Centre for Australian Weather and Climate Research, CSIRO Climate Adaptation Flagship, Hobart, Australia, (3) University of Tasmania, Hobart, Australia

Variability in the tropical Indian Ocean has widespread effects on rainfall in surrounding countries, including East Africa, India and Indonesia. The leading mode of tropical Indian Ocean variability, the Indian Ocean Dipole (IOD), is a coupled ocean-atmosphere mode characterized by sea surface temperature (SST) anomalies of opposite sign in the east and west of the basin with an associated large-scale atmospheric re-organisation. Earlier work has often focused on the positive phase of the IOD. However, we show here that the negative IOD phase is an important driver of regional rainfall variability and multi-year droughts. For southeastern Australia, we show that it is actually a lack of the negative IOD phase, rather than the positive IOD phase or Pacific variability, that provides the most robust explanation for recent drought conditions.

Since 1995, a large region of Australia has been gripped by the most severe drought in living memory, the so-called “Big Dry”. The ramifications for affected regions are dire, with acute water shortages for rural and metropolitan areas, record agricultural losses, the drying-out of two of Australia’s major river systems and far-reaching ecosystem damage. Yet the drought’s origins have remained elusive. For Southeast Australia, we show that the “Big Dry” and other iconic 20<sup>th</sup> Century droughts, including the Federation Drought (1895-1902) and World War II drought (1937-1945), are driven by tropical Indian Ocean variability, not Pacific Ocean conditions as traditionally assumed. Specifically, a conspicuous absence of characteristic Indian Ocean temperature conditions that are conducive to enhanced tropical moisture transport has deprived southeastern Australia of its normal rainfall quota. In the case of the “Big Dry”, its unprecedented intensity is also related to recent above-average temperatures. Implications of recent non-uniform warming trends in the Indian Ocean and how that might affect ocean characteristics and climate in Indian Ocean rim countries are also discussed.