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RELATIONSHIPS BETWEEN THE MARITIME CONTINENT HEAT SOURCE AND THE EL-NIŇO – SOUTHERN OSCILLATION PHENOMENON

John L. McBride*, Malcolm R. Haylock and Neville Nicholls
Bureau of Meteorology Research Centre, Melbourne, Australia

The El Niño - Southern Oscillation (ENSO) phenomenon is a major controlling factor of interannual variability of climate over the globe. A fundamental component of this coupled atmosphere ocean phenomenon is the variability of equatorial convective rainfall in the west-central Pacific, at approximately the longitude of the dateline. In recent years there have also been considerable advances in understanding of the relationships between ENSO variations and variations in convective activity associated with the northern hemisphere branch of the Asian monsoon.

The current paper addresses variability of convection and rainfall in a third tropical heat source: in the intervening longitudes of Australia and the maritime continent. The relationship between maritime continent convection and ENSO has been previously studied by Lau and Chan (1983). These authors documented the existence of a dipole in convective variation between the maritime continent and the dateline. Thus during a warm event convection is enhanced over the dateline and depressed over the maritime continent, with the converse happening during a cold event. The association between ENSO and interannual variations in maritime continent convection has the sense that low-pressure is associated with high rainfall. Thus maritime continent rainfall is greater than normal during a cold event when the Jakarta or Darwin pressure anomaly is negative and less than normal in the opposite (warm) phase when Jakarta has a positive pressure anomaly.

It has long been known there is a strong seasonal variation in the association between Australian-Indonesian rainfall and the Southern Oscillation (McBride and Nicholls 1983; Hastenrath 1987). Haylock and McBride (2001) used monthly rainfall from 63 stations across Indonesia to demonstrate that rainfall in the dry and transition seasons is highly correlated with ENSO; whereas in the wet season of December to January there is little or no correlation. They used Empirical Orthogonal Function (EOF) analysis to demonstrate that interannual variations in wet season rainfall exhibit very little spatial coherence. Haylock and McBride hypothesised that predictability of rainfall in a region is dependent on coherence of the rainfall anomalies. On this basis they concluded that maritime continent wet season rainfall is inherently unpredictable.

Corresponding author address: John L. McBride, BMRC, GPO Box 1289K, Melbourne, Australia 3001.
e-mail: J.Mcbride@bom.gov.au

The current note documents further exploration of the seasonal structure of ENSO-monsoon rainfall relationships. The data used in the paper are OLR data for the period 1974 to 2001 (excluding 1978), from the National Oceanic and Atmospheric Administration (NOAA) polar orbiting satellites. Gridded SST data for the period 1949 to 1998 are from the UK Meteorological Office Global Ice and Sea Surface Temperature data set. The index of ENSO activity used is the Southern Oscillation Index (SOI), which is the normalised Tahiti minus Darwin pressure difference.

The main finding is that the phenomenon of the dry season being related to ENSO and the wet season being effectively independent of ENSO is a general result extending beyond the island station network to cover the entire region. Examination of the annual cycle of the west-Pacific SST pattern associated with ENSO reveals the existence of a related phenomenon in SST. Specifically, maritime continent rainfall seems to be controlled by fluctuations in a "boomerang"-shaped SST anomaly pattern of opposite sign to the anomalies in the equatorial eastern Pacific. Considering the relationship between coherence and predictability proposed by Haylock and McBride, the predictable component of monsoon convective activity is not in the major heat source of the planetary monsoon, but rather in the maritime continent region and centred in the winter hemisphere (Fig.1). This has implications for understanding the interactions between ENSO and the planetary monsoon.

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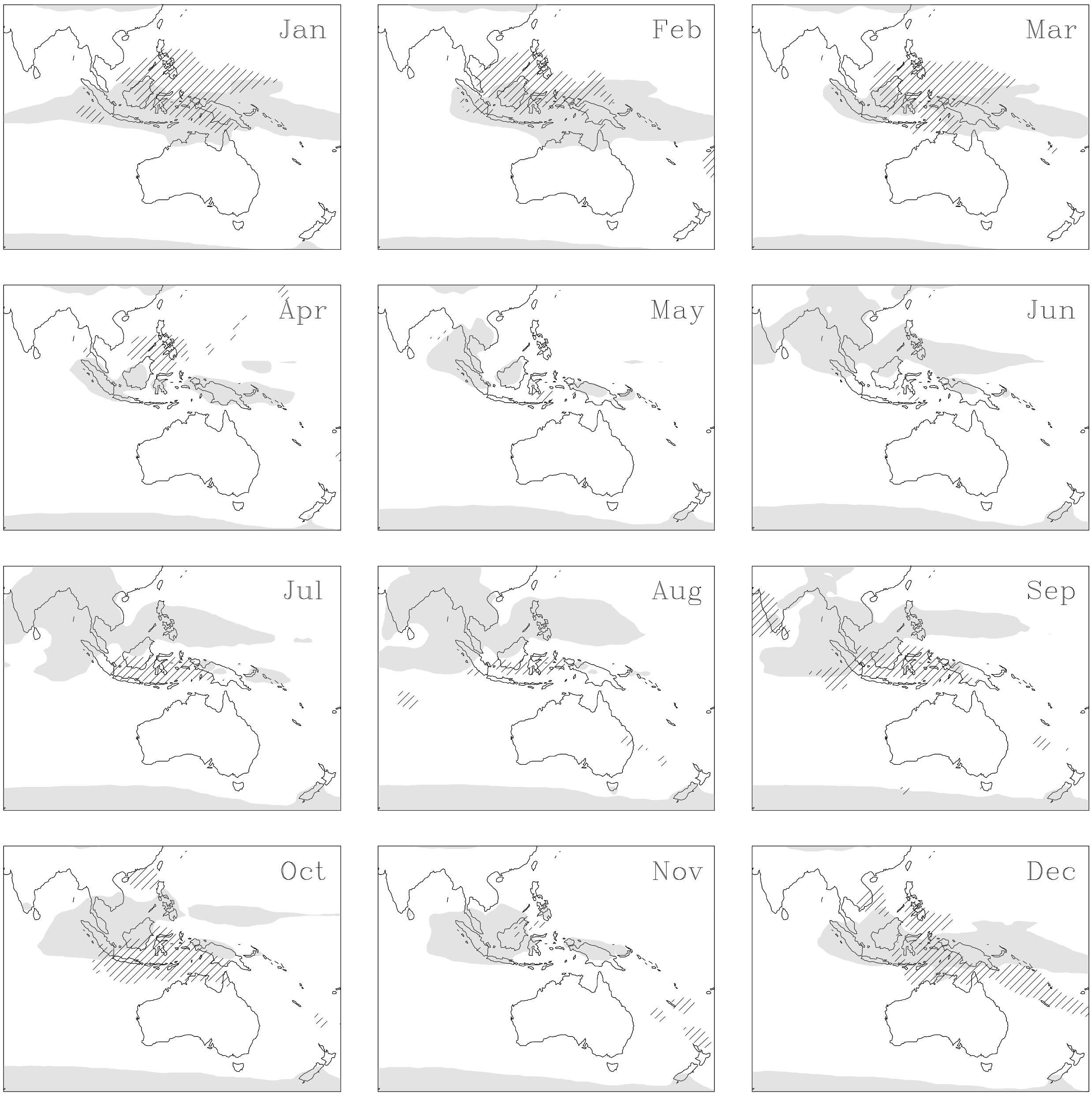

Fig.1 The annual cycle of cold cloud over the maritime continent as represented by the presence of low values of OLR: the shaded area for each month being long-term mean OLR values less than 220 w m-2. Superimposed for each month is the area of OLR that is negatively correlated with the Southern Oscillation Index, with the hatching representing correlations of magnitude greater than 0.6