The Combined Influence of the MJO and East Coast Lows on Rainfall in Eastern Australia

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As a single event, the MJO and East Coast Lows (ECL) enhance daily rainfall over several parts of eastern Australia. What if these climate modes occur together?

Introduction

- The probability of daily rainfall and extreme rainfall is significantly increased during the active MJO phases 5–7 (Dao et al., 2023)
- ECL contributes to over 30% of the total rainfall across the east coast of Australia (Pepler and Dowdy, 2021)
- **However,** the interaction between the MJO and ECL in influencing rainfall over eastern Australia remains unknown

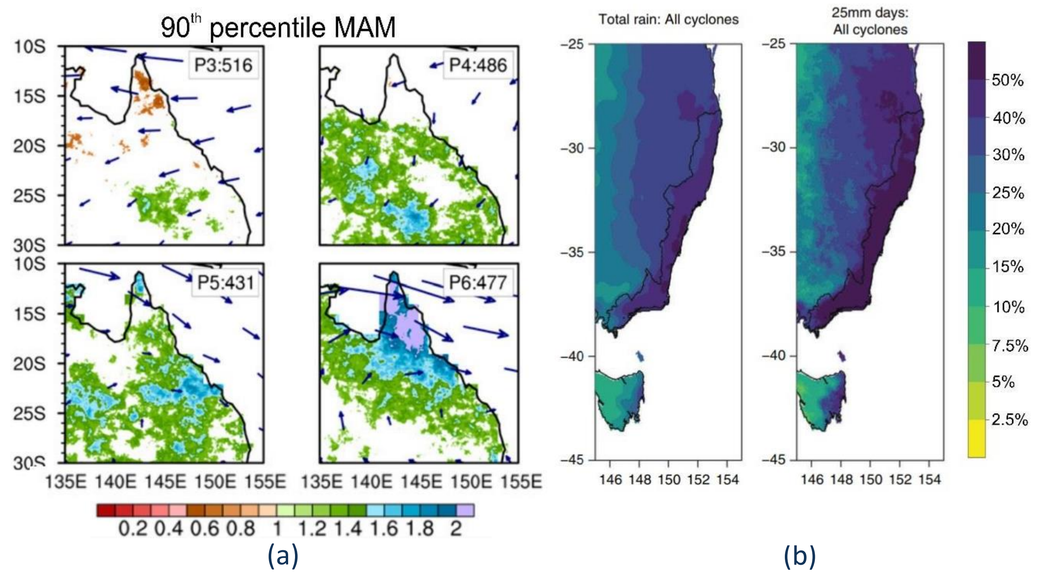

Figure 1. a) Composite of daily rainfall probabilities exceeding the 90th percentile and 850 hPa wind anomalies during MJO phases 3–6 in MAM from 1959 to 2022 (Dao et al., 2023). b) Annual rainfall percentage and the percentage of rainfall exceeding 25 mm on ECL days from 1979 to 2019 (Pepler & Dowdy, 2021)

Data and Method

Data

- The six-hourly BARRA-1 dataset from January 1990 to February 2019
- The RMM index obtained from the Bureau of Meteorology (BoM)
- The daily rainfall from Australian Gridded Climate Data (AGCD)

ECL Identification

- Laplacian-based metric with 82.5th percentile is applied using Mean Sea Level Pressure (MSLP)
- ECL is identified when the maximum laplacian of MSLP is located along 1° latitude and longitude from the minimum of MSLP.

Rainfall Analysis

- The conditional probability is calculated to examine the changes in rainfall during the concurrent events of the MJO and ECL
- The conditional probability is defined as the probability of daily rainfall exceeding the rainfall threshold of 67th and 90th divided by the baseline probability (Ghelani et al., 2017)

Results

Annual Variability of ECL

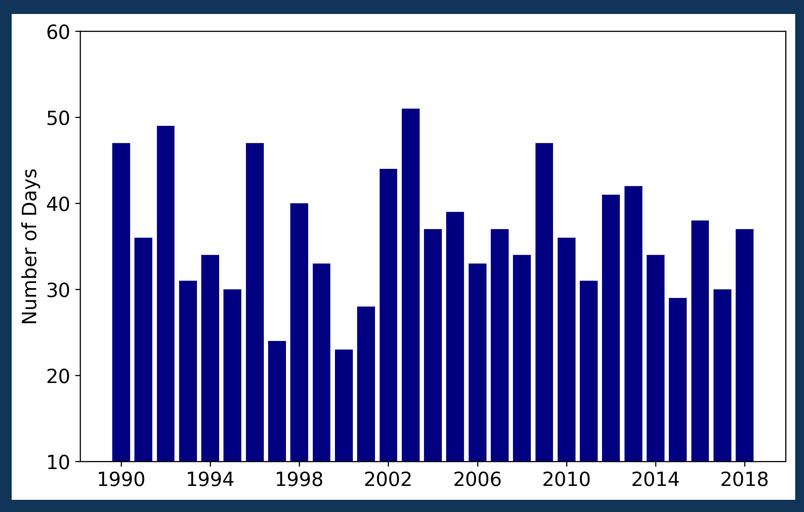

Figure 2. The annual frequency of ECL from 1990 to 2019

ECL Centres

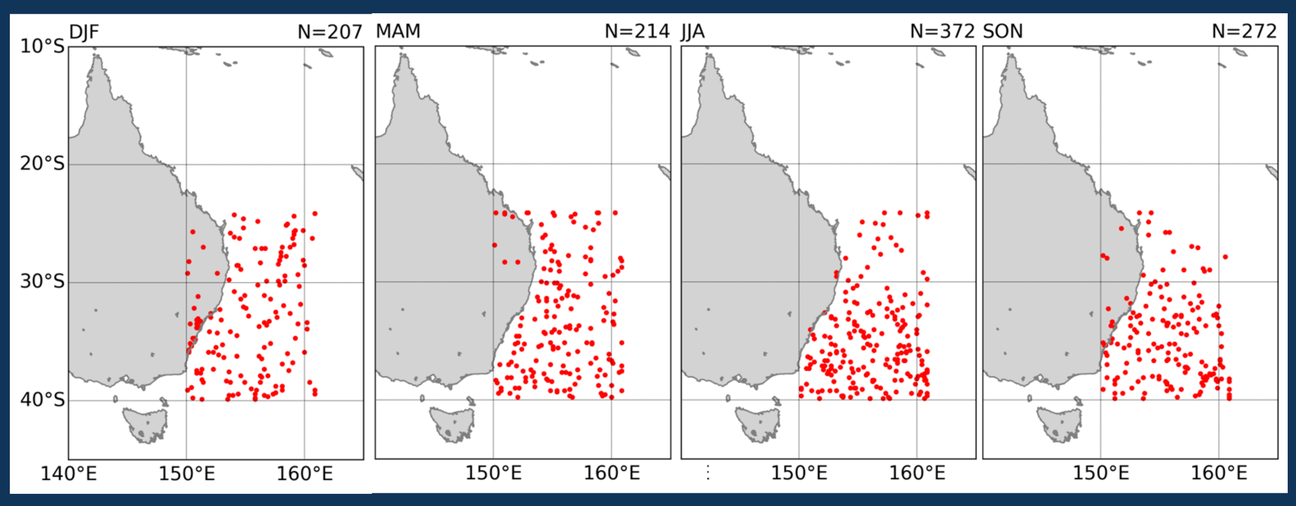

Figure 3. The locations of ECL centre in four different seasons during 1990–2019

The Probability of the MJO and ECL

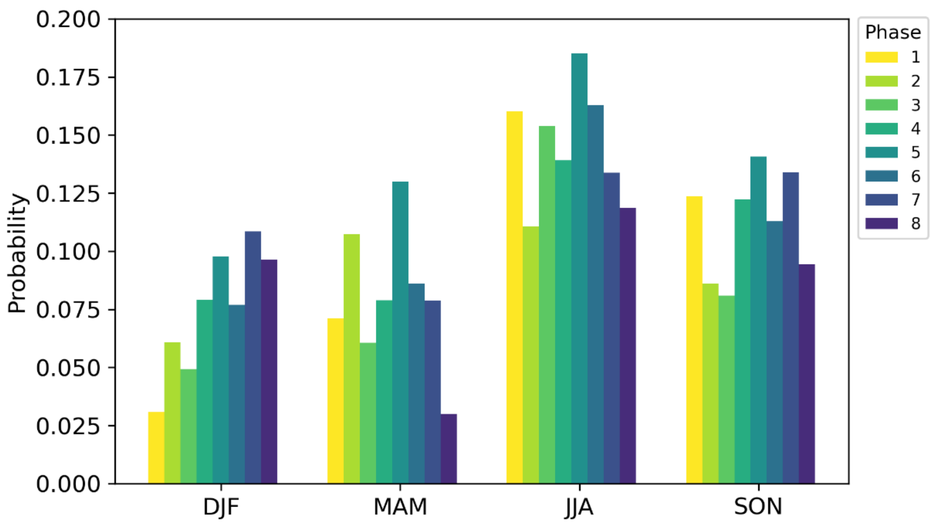

Figure 4. The probability of the ECL occurrences under different active phases of MJO in DJF, MAM, JJA, and SON

Conclusion

- There is relatively significant annual variability in the ECL frequencies, varying from 20 to 55 days per year on average
- The ECL centres are evenly distributed, with JJA being the most common period
- The probability of ECL occurrences during the active MJO phases 5, 6, and 7 in JJA is the highest throughout periods

Future Work

- Examine the rainfall changes during the ECL only and how the MJO influences the ECL rainfall
- Investigate the dynamic process when the MJO and ECLs occur together