



*Geophysical Research Letters*

Supporting Information for

**Atmospheric River Life Cycle Responses to the Madden Julian Oscillation**

Yang Zhou<sup>1\*</sup>, Hyemi Kim<sup>2</sup>, and Duane E. Waliser<sup>3</sup>

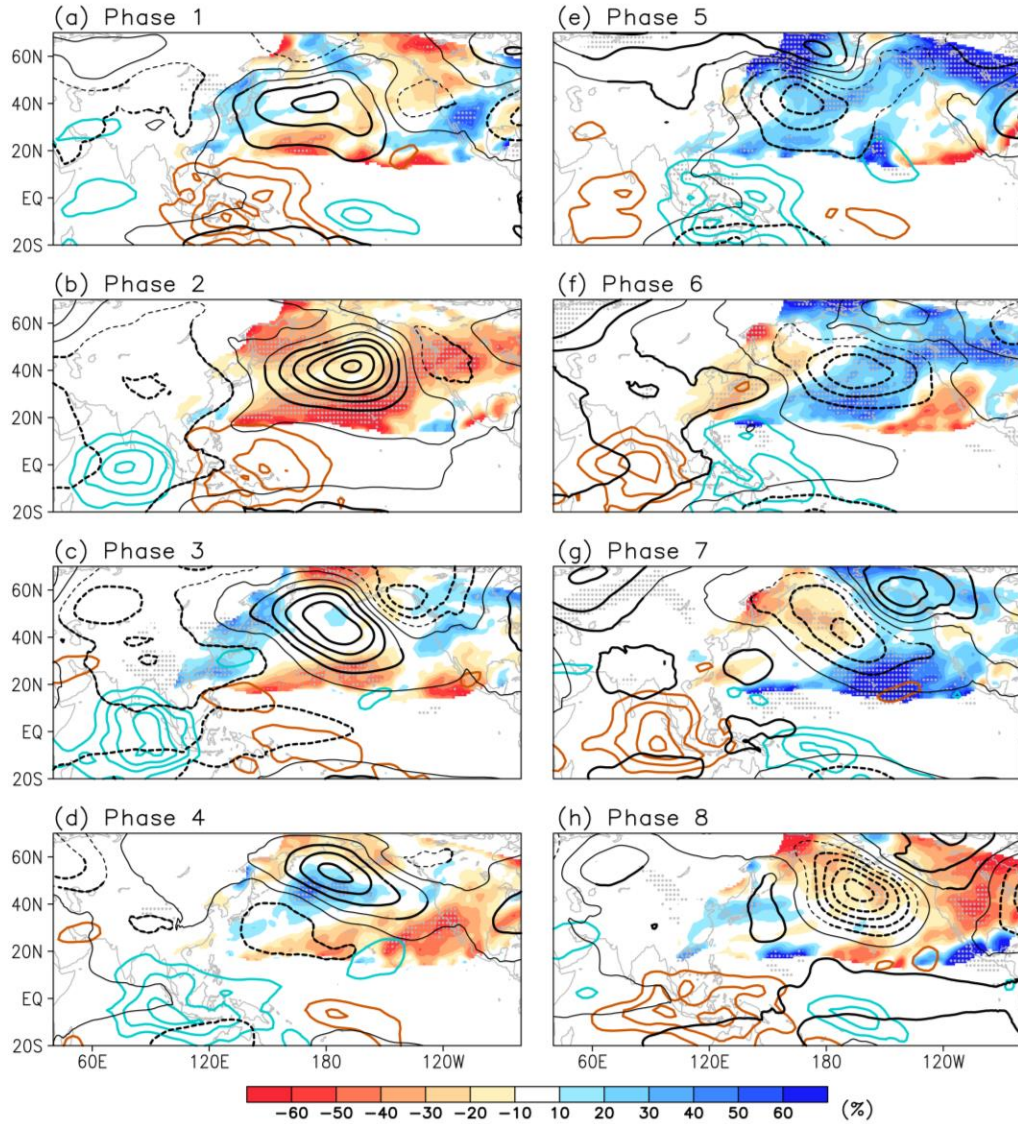
<sup>1</sup>Lawrence Berkeley National Laboratory, Berkeley, CA, 94720

<sup>2</sup>Stony Brook University, Stony Brook, NY, 11794

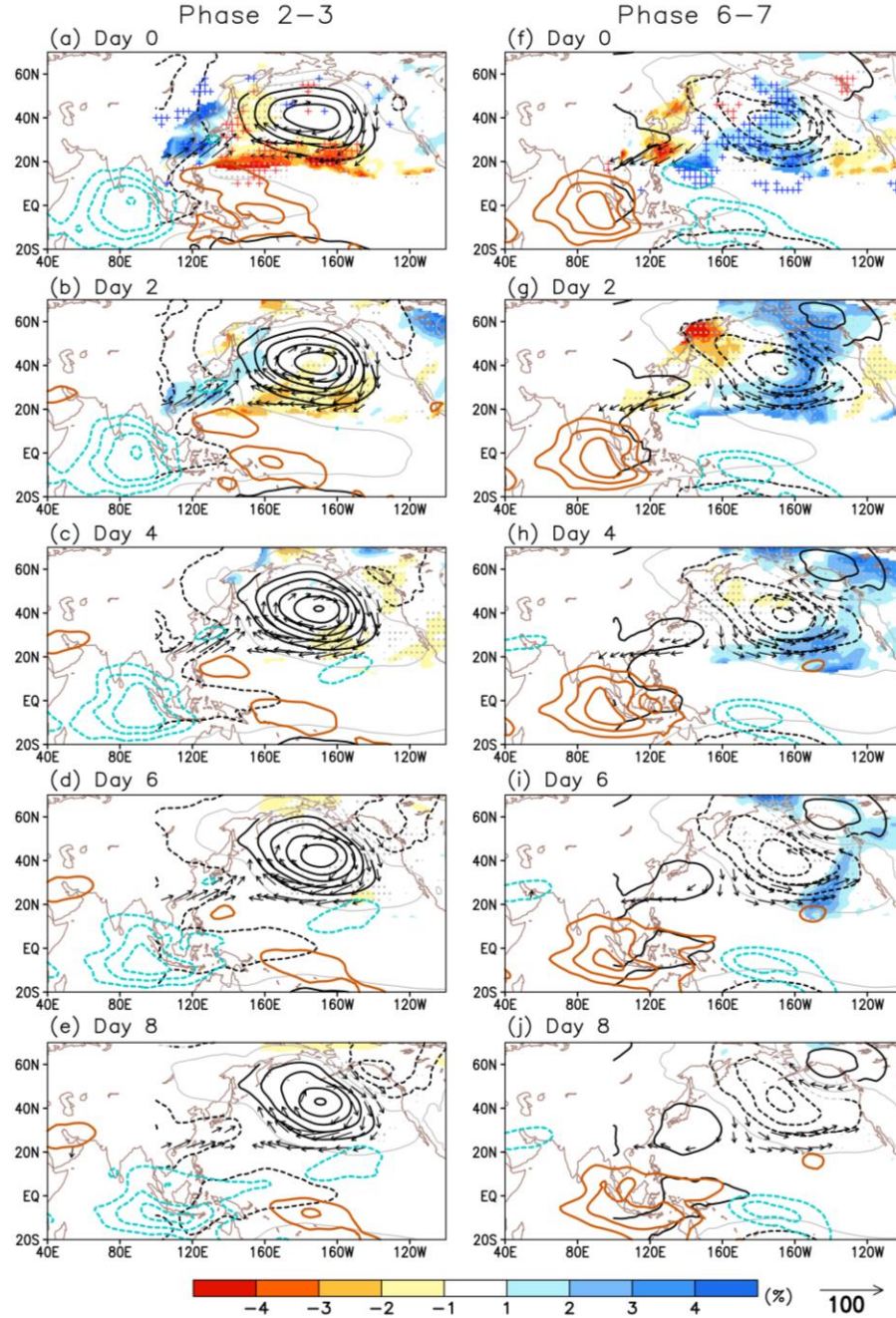
<sup>3</sup>Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, 91109

**Contents of this file**

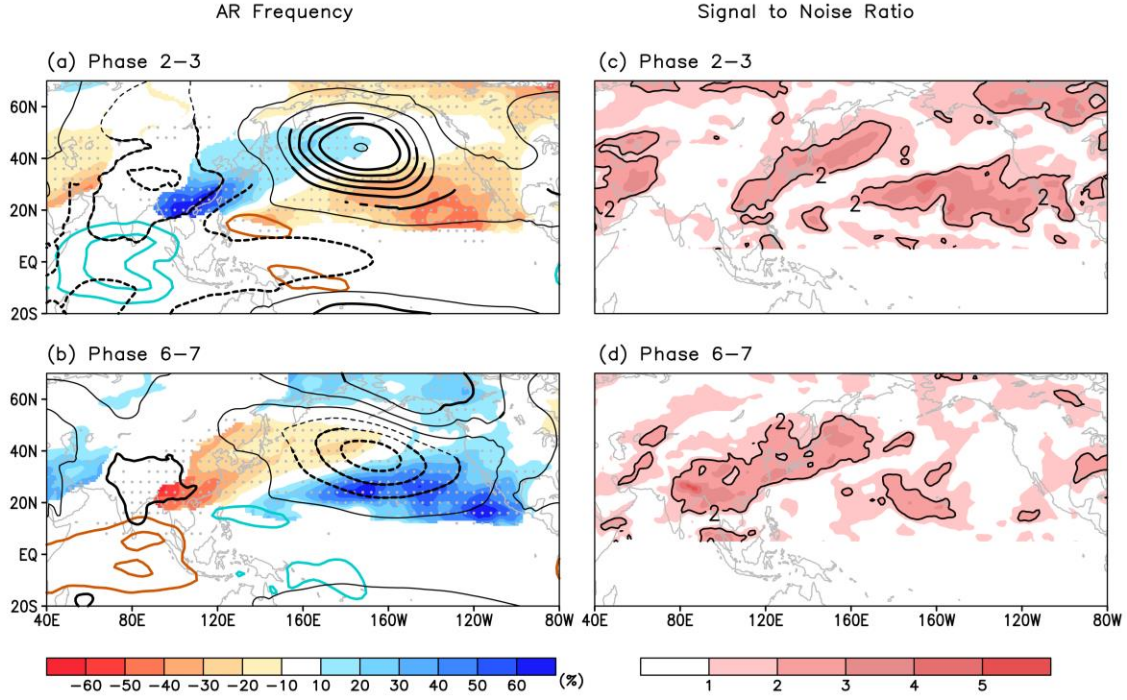
Figures S1-S3



**S1.** Composites of percentage changes in lifecycle frequency (shading), Z850 anomaly (solid/dash contours represent positive/negative values, 5m interval), and OLR anomaly (orange/blue contours represent positive/negative values, 5 W/m<sup>2</sup> interval, zero line is omitted) for **a-h** MJO phase 1-8. Z850 anomaly is 10-day averaged starting from AR origins. The OLR anomaly is concurrent with AR origins. The large (small) grey dots mark AR frequency anomalies that pass the 95% (90%) confidence level of one-sample t-test. Black contours represent values that exceed the 95% confidence level of one-sample t-test.



**S2.** Every-two-day lag composites starting from AR origins in percentage changes of lifecycle frequency (shading), Z850 anomaly (solid/dash contours represent positive/negative values, 5m interval), IVT anomaly (only showing values to the north of 10°N and over 15 kg m<sup>-1</sup> s<sup>-1</sup>), and OLR anomaly (orange/blue contours represent positive/negative values, 5 W/m<sup>2</sup> interval, zero line is omitted) for MJO phases **a-e** 2-3 and **f-j** 6-7. Z850 and OLR anomalies are 20-100-day filtered. The large (small) grey dots mark AR frequency anomalies that pass the 95% (90%) confidence level of one-sample t-test. Black contours and shown vectors represent values that exceed the 95% confidence level of one-sample t-test. The plus sign in **a** and **f** shows anomalous origin frequency which is the same as Figure 3a-b.



**S3. a-b** Composites of percentage changes in lifecycle frequency (shading), Z850 anomaly (solid/dash contours represent positive/negative values, 5m interval), and OLR anomaly (orange/blue contours represent positive/negative values, 5 W/m<sup>2</sup> interval, zero line is omitted) for MJO phases **a** 2-3 and **b** 6-7 using ECMWF-Hist simulations. Z850 anomaly is 10-day averaged starting from AR origins. The OLR anomaly is concurrent with AR origins. The grey dots and black contours represent values that pass the 95% confidence level of one-sample t-test. **c-d** Signal-to-noise ratio calculated by dividing **a-b** with one standard deviation of anomalous lifecycle frequency among 10 ensembles.