

◆ Science questions that motivate us

- How well do Cloud-Precipitation Hybrid Regimes identify tropical convective systems?
- Can we examine the life cycle of convective systems using the hybrid regimes?
- What are the effects of MJO on the evolution of convective systems?

◆ Data

- **Cloud:**
 - MODIS C6.1 daily, 1°×1°, Terra and Aqua data, 2014.06–2019.05 (5 years)
 - 2D Joint histogram of Cloud Optical Thickness (COT) and Cloud Top Pressure (CTP)
- **Precipitation:**
 - The Integrated Multi-satellite Retrievals for GPM (IMERG) V06B Final Run
 - 2014.06-2020.05 (6 years) 30-minutely, 0.1°×0.1°

– MJO index:

- The OLR MJO Index (OMI; Kiladis et al. 2014, Mon. Wea. Rev.)

– Out-going Longwave Radiation (OLR):

- NOAA Climate Data Record(CDR) dataset(doi:10.7289/V5SJ1HH2)

◆ Methodology

– Tropical Cloud-Precipitation (hybrid) Regime (TCPR):

- 100 precipitation values in MODIS-matched 1° grid cell are transformed to 6-bin histogram (Fig. 1)
- The precipitation histogram is concatenated to MODIS cloud histogram with weight number 7
- i.e., cloud 42-bin + precip 6-bin × 7 = total 84 bins (equal weight between cloud and precipitation)
- k-means clustering method derives TCPRs using both Terra and Aqua in 15°S–15°N
- TCPR1, 2, 3, and 4 are selected to represent convective systems (Fig. 2)

– Projection to IMERG domain:

- It is found that the TCPRs having significant precipitations can be **WELL** predicted by precipitation histogram only (Fig. 3)
- This means that the hybrid regimes can be extended to seamless 30-minute IMERG domain (Jin et al. 2020, Submitted to JAMC).
- Data is available at <https://data.nasa.gov/Earth-Science/MODIS-Cloud-Regimes-and-Cloud-Precipitation-Hybrid/68sc-yhe3>

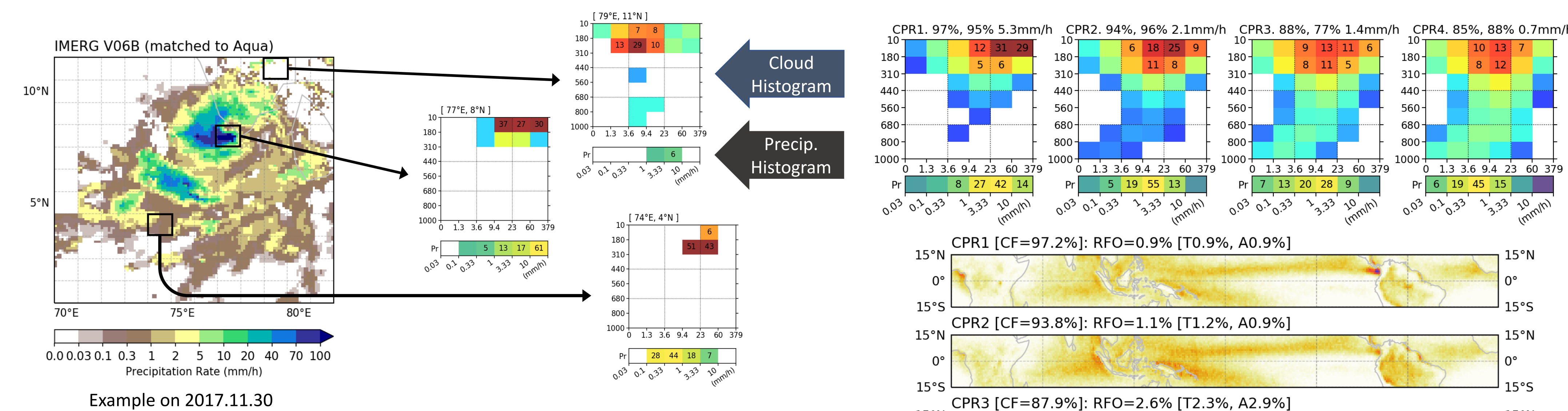
– Identification of horizontal aggregates:

- A TCPR1234 aggregate is defined as an area composed of adjacent 1° grid cells with TCPR1, TCPR2, TCPR3, or TCR4 occurrence
- Diagonal connection is allowed.
- If the center of the smaller aggregate is within the nominal radius of the bigger aggregate, then they are merged.

- The domain is extended to 25°S–25°N

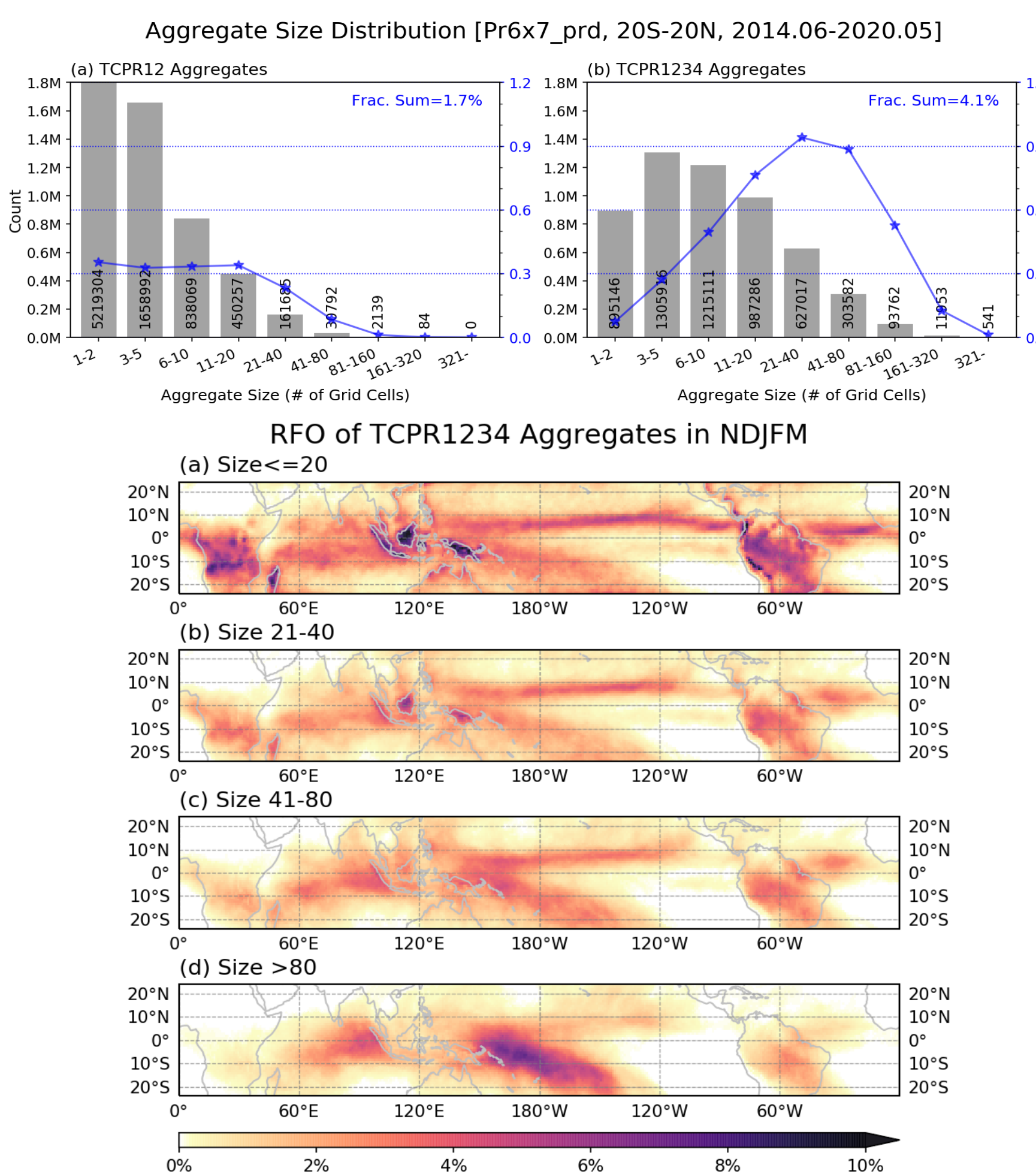
– Tracking the aggregates:

- For a big enough aggregate (e.g., larger than 40 grid cells), trace forward and backward each time step until the size of the aggregate becomes too small (e.g., less than 6 grid cells).
- For two aggregates in adjacent time steps, the overlapped area should be larger than half of either of the two aggregates.
- If multiple aggregates satisfy the “half-overlap” rule, trace the biggest one.

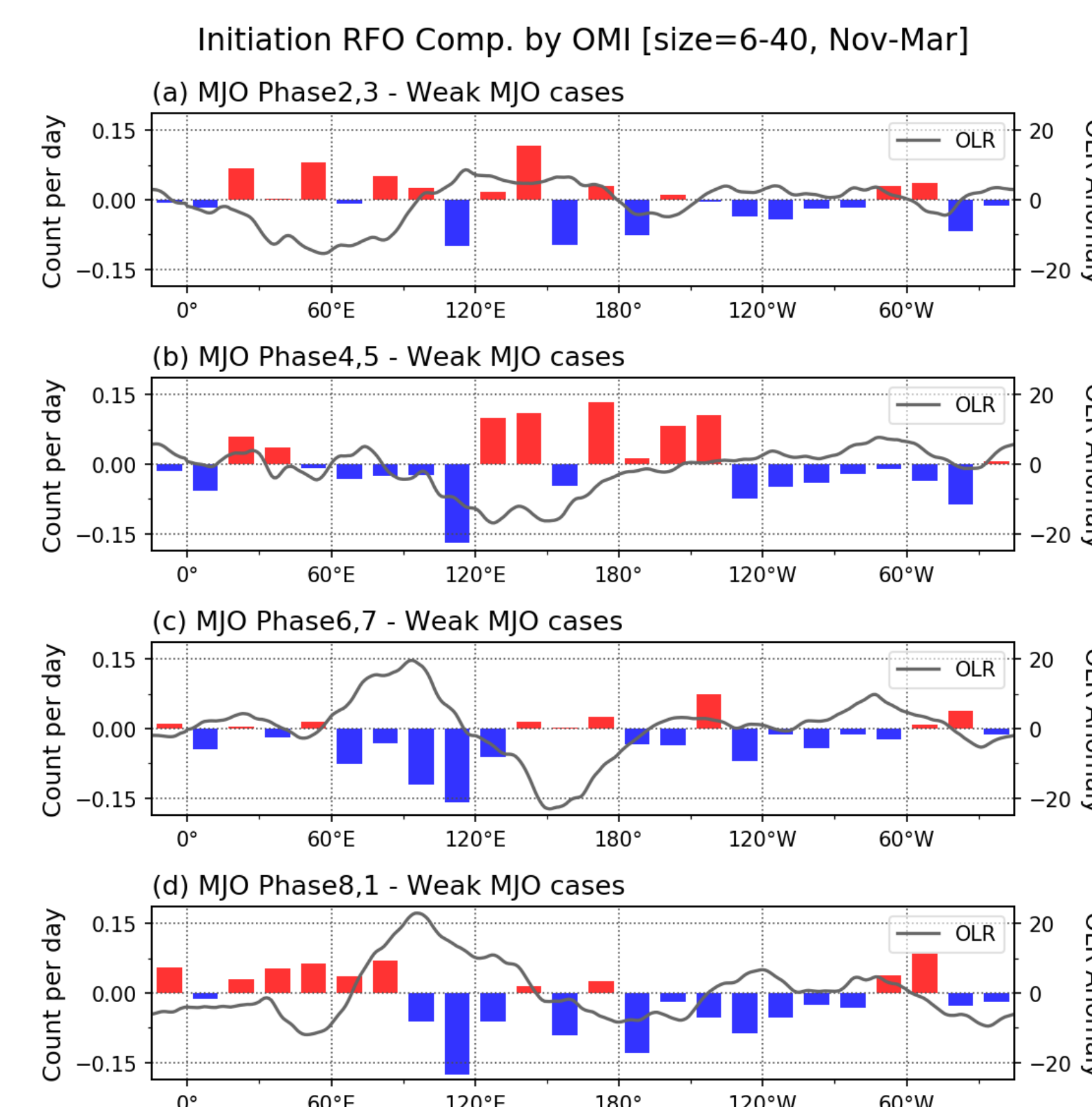


↑ Fig. 1: An example of coincident cloud and precipitation histograms

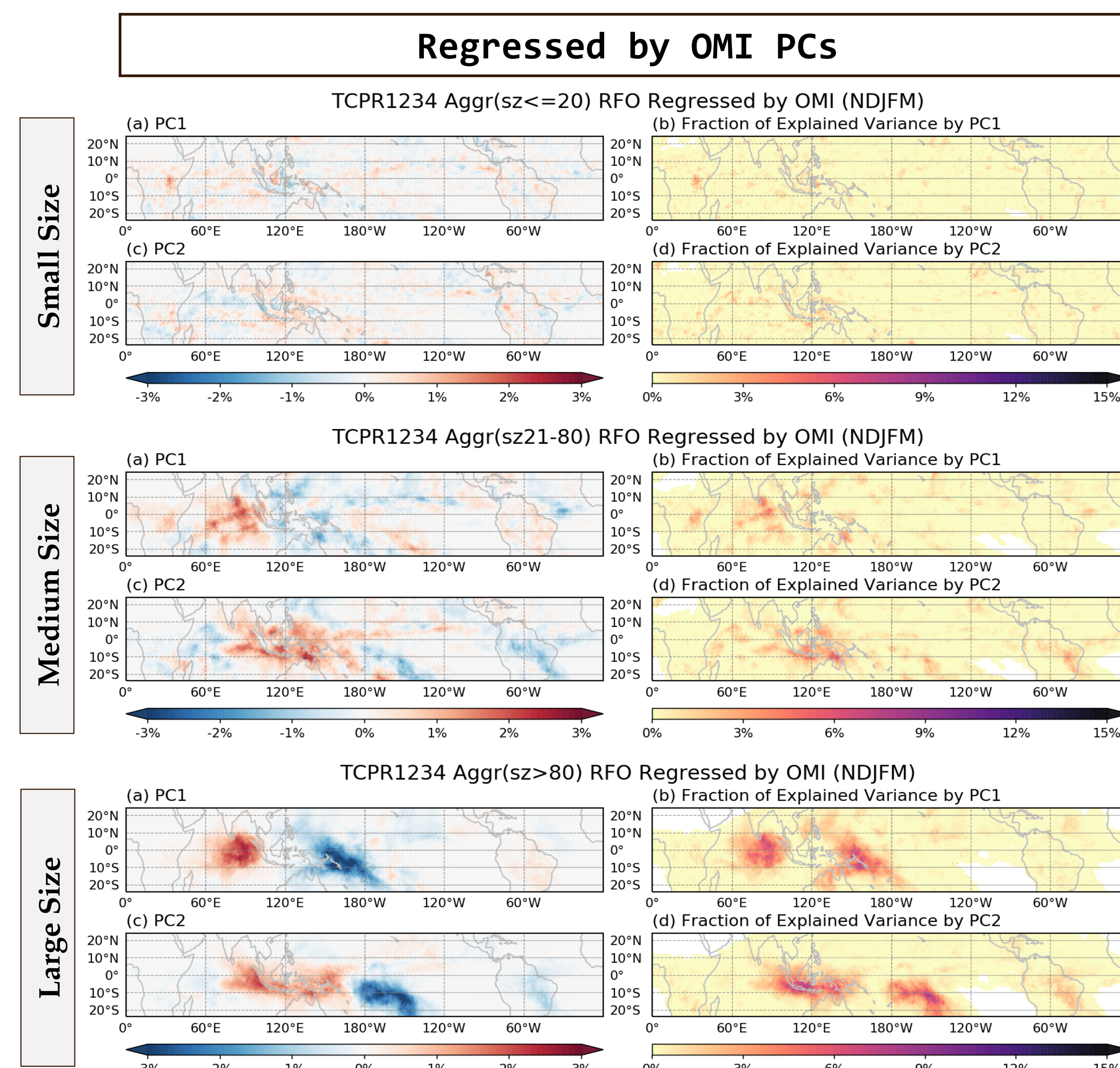
❖ Precipitation and clouds are closely related, but with large variability.



↑ Fig. 4: Distribution of aggregates by size (# of grid cells).

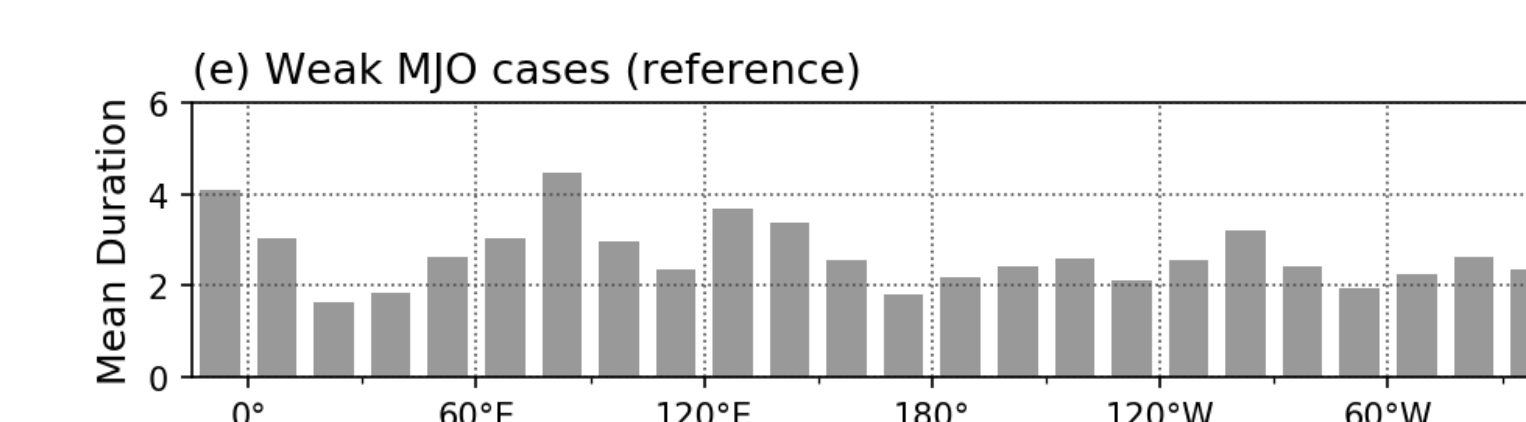


↑ Fig. 7: MJO composite (amplitude>=1) of initiation occurrence of convective systems relative to weak MJO cases (amplitude<0.75)



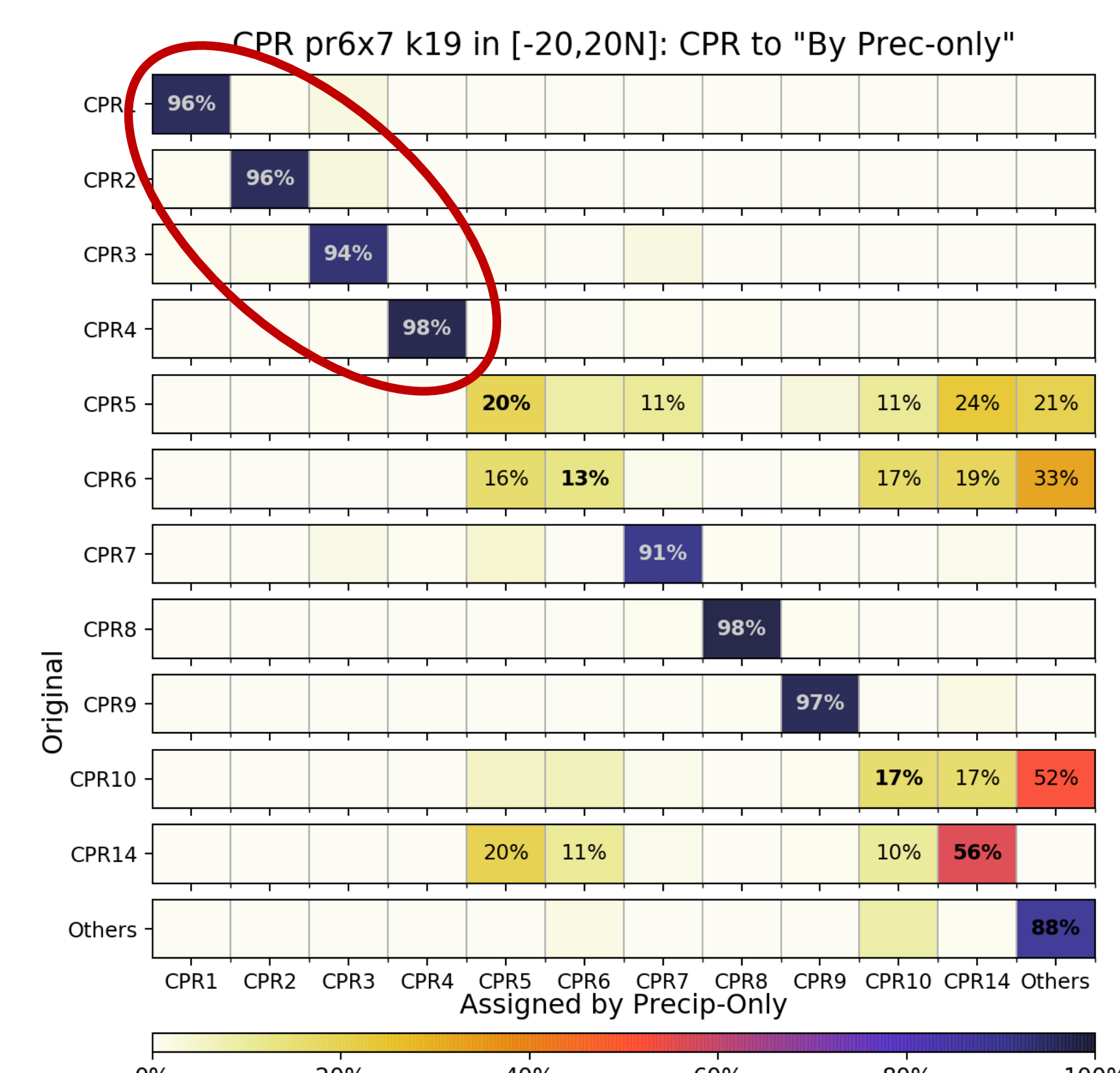
↑ Fig. 6: OMI PCs are regressed onto the daily RFO maps of aggregates by size (<=20, 21-80, or >80 grid cells)

- ❖ Bigger aggregates are **more strongly** associated with MJO (Fig. 6).
- ❖ Strong MJOs tend to promote the initiation of systems, but with regional dependency (Fig. 7)
- ❖ Strong MJOs accompany **long-lived** convective systems (Fig. 8).

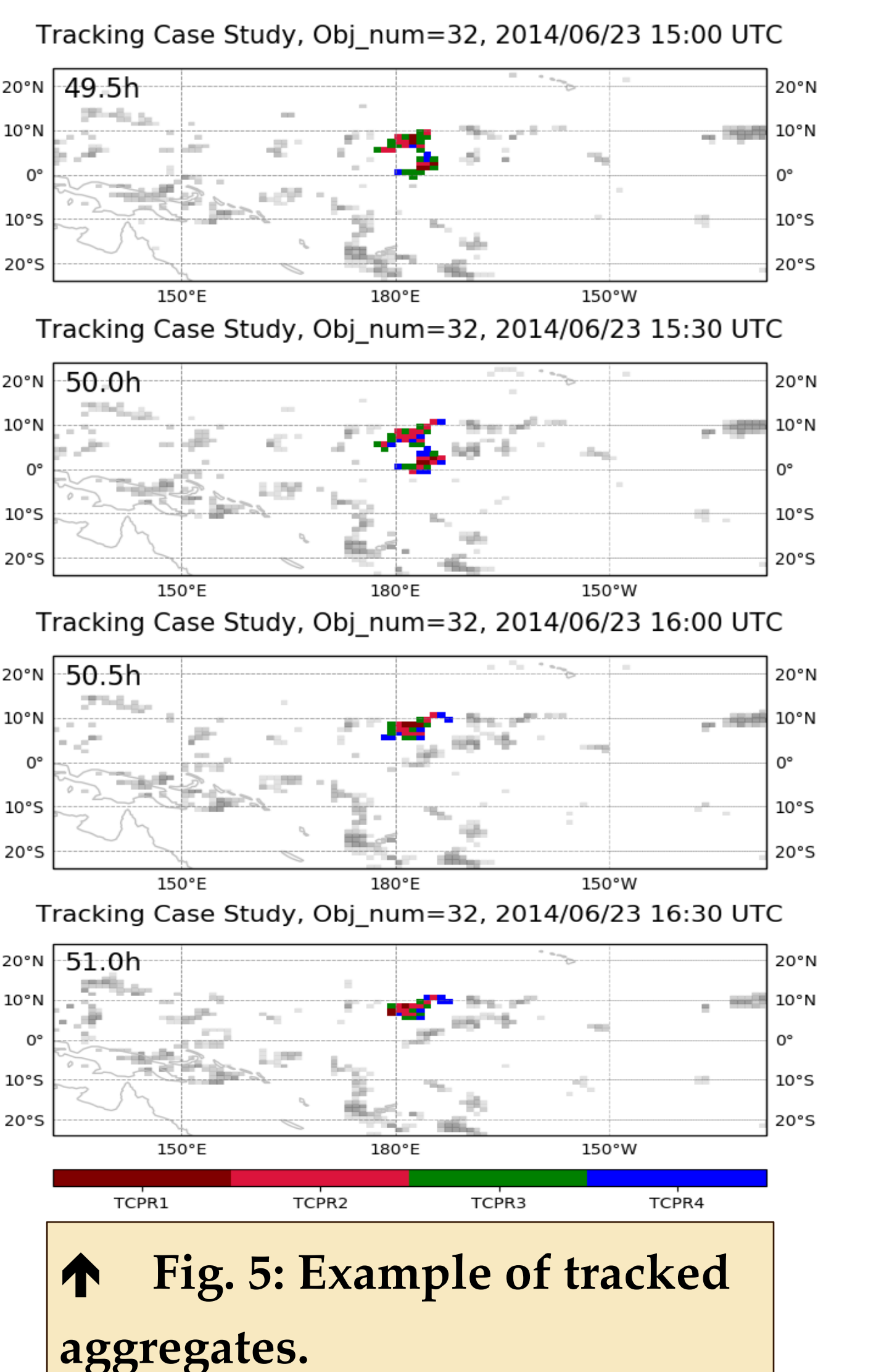


↑ Fig. 8: MJO composite (amplitude>=1) of mean duration of convective systems relative to weak MJO cases (amplitude<0.75)

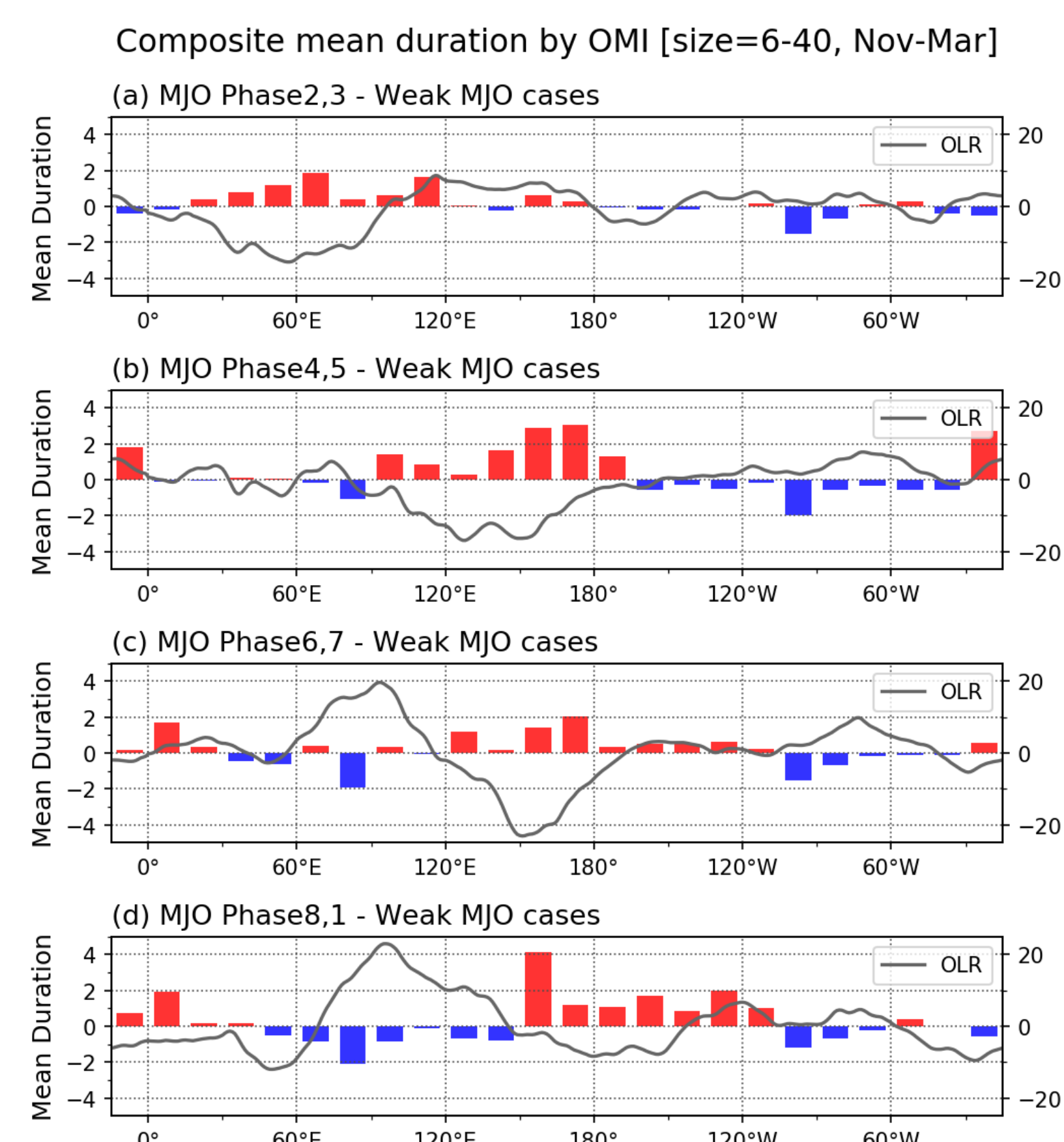
← Fig. 2: Centroids and relative frequency-of-occurrence (RFO) of regimes representing convective systems.



↑ Fig. 3: Regime agreement distribution matrix when assigning by precipitation only.



↑ Fig. 5: Example of tracked aggregates.



❖ The effect of MJO on the “Organization Index” is shown at <https://agu2020fallmeeting-agu.ipostersessions.com/Default.aspx?s=58-23-D4-4B-C3-B5-95-C3-CE-F3-13-9C-56-06-FB-38>