

A New Method for Identification of Madden-Julian Events

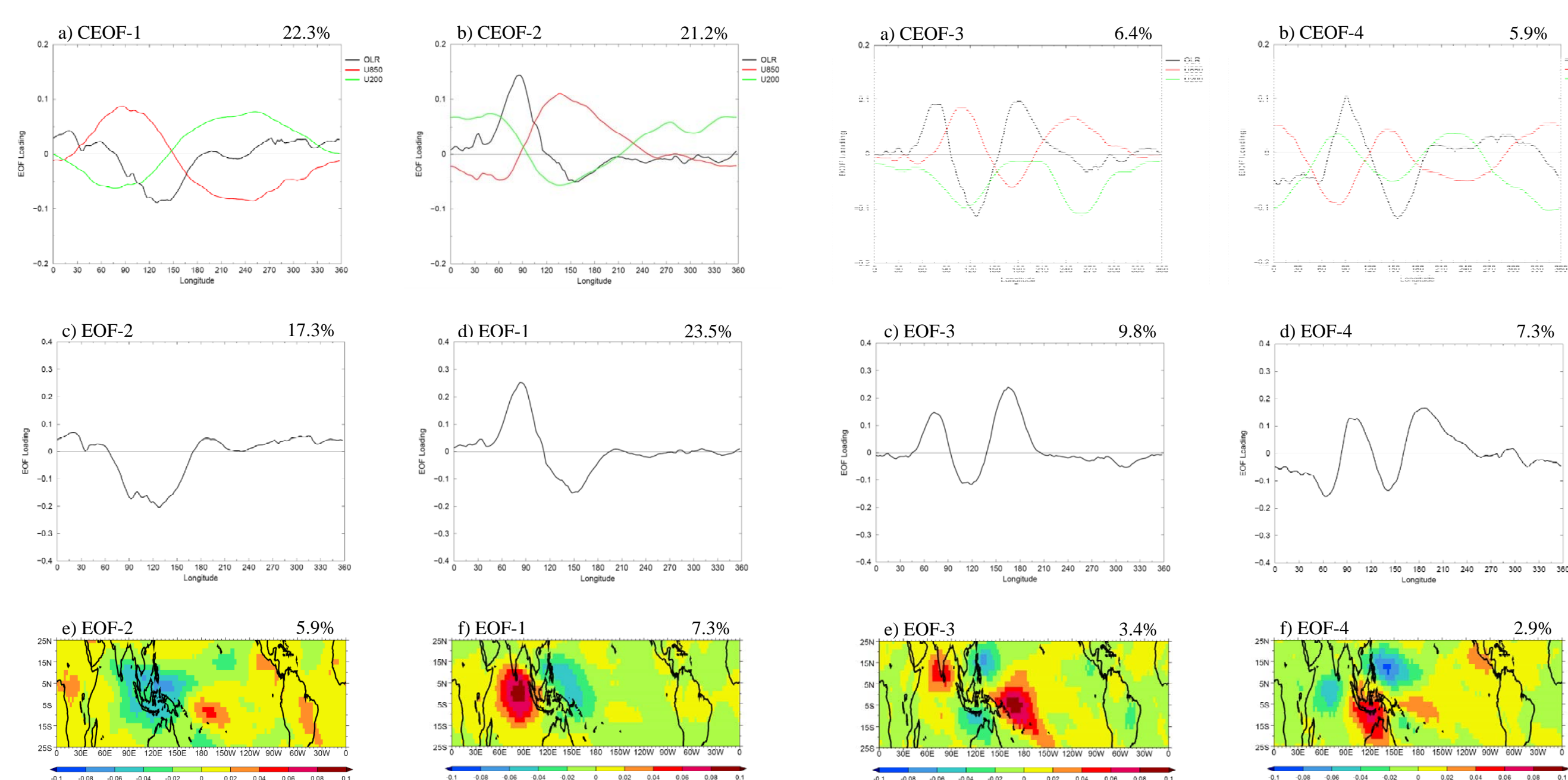
Kenneth R. Sperber, Lawrence Livermore National Laboratory, USA (E-mail: sperber1@llnl.gov)

Goal

- Objective identification of individual Madden-Julian events is investigated using 4 different EOF diagnostics on 20-100 day bandpass filtered data for 1979-2007
 - Combined EOF analysis of 15°N-15°S averaged AVHRR OLR, u_{850} , and u_{200}
 - AVHRR OLR-only from the CEOF analysis
 - 15°N-15°S averaged AVHRR OLR
 - 25°N-25°S maps of AVHRR OLR

There are many other cases in which reconstruction using only EOFs 1 and 2 gives a false indication that an MJO is present, or the threshold criterion incorrectly yields sporadic indication of MJO

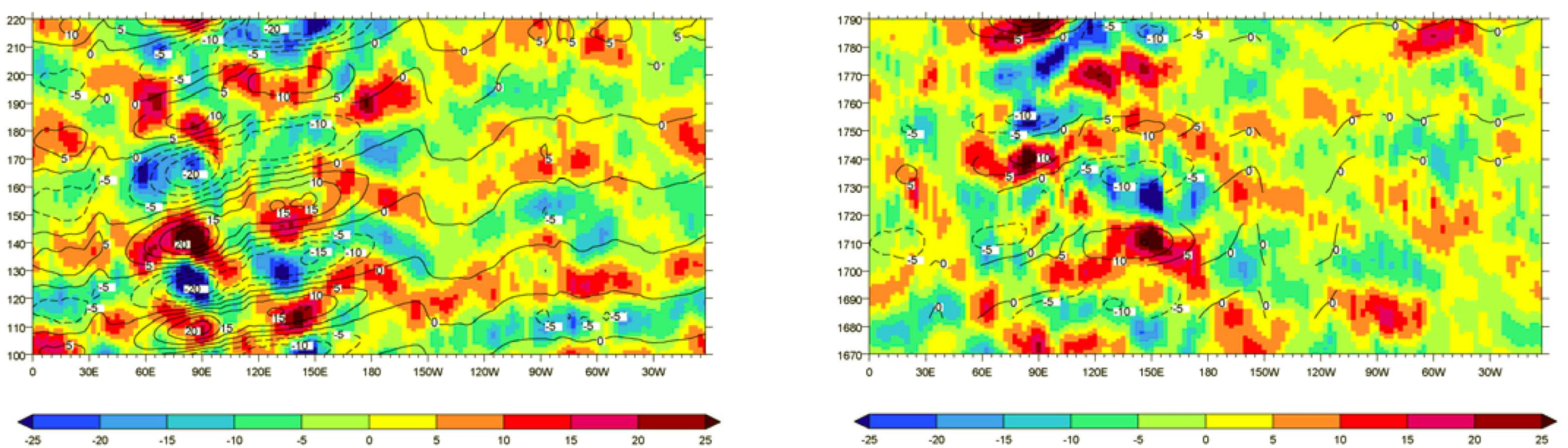
- These cases compromise our ability to composite pure MJO events for improving our understanding of MJO processes
- In forecasting, this would give rise to an increased number of false-positive indications of developing MJO's



Apr. 10 – Aug. 8, 1979

CEOF

Jul. 28, – Nov. 25, 1983

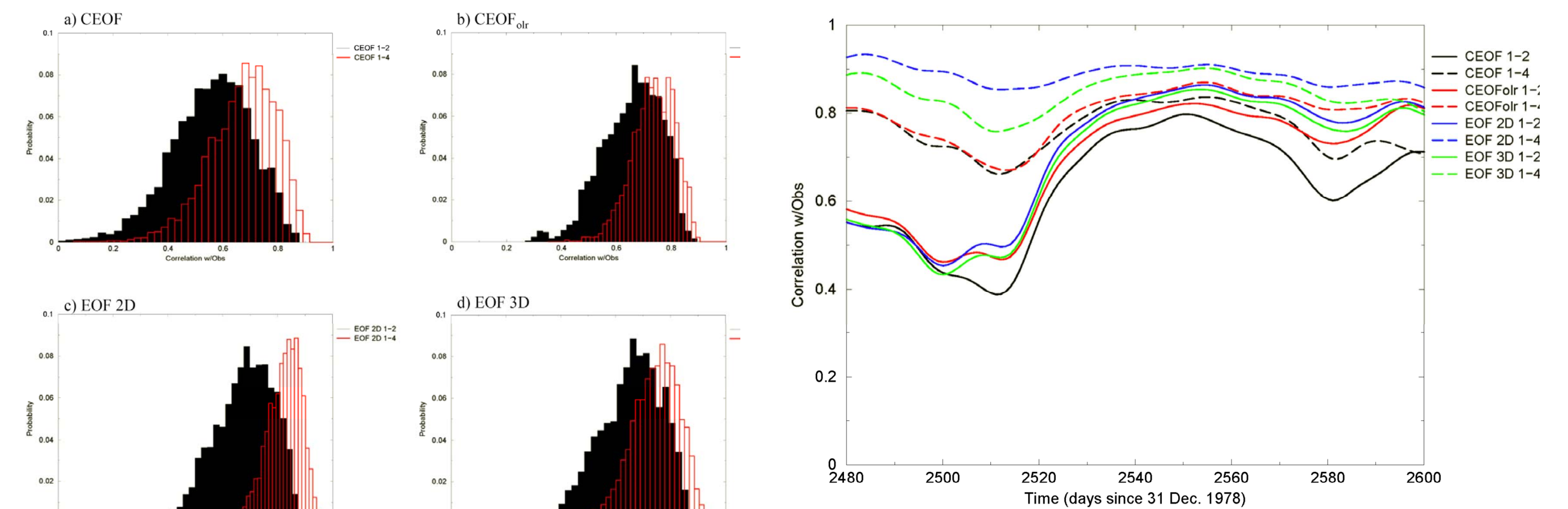
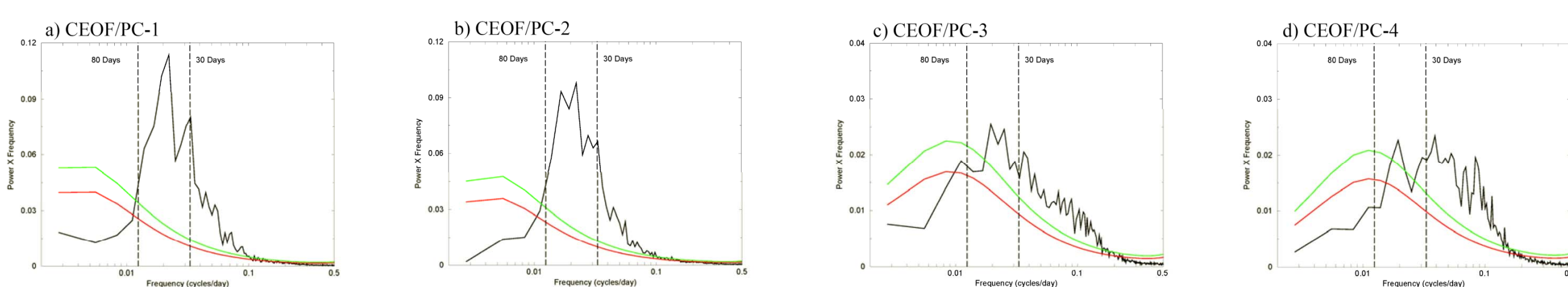


Temporal Characteristics of the PC's

- PC's 1 and 2 are strongly correlated among the different EOF diagnostics
- Though the correlations of PC's 3 and 4 are weaker among the different EOF diagnostics, they are statistically significant at >1% level
- Like PC's 1 and 2, PC's 3 and 4 also have statistically significant power at intraseasonal time scales

The Benefit of Using Modes 1-4

- Premise: Validate the reconstructions against the 20-100 day filtered observations. If the reconstruction using modes 1-4 has similar skill as the reconstruction using modes 1 and 2, then it is likely that an actual MJO is occurring (i.e., modes 3-4 do not contribute to the variability)
 - The skill metric is the pattern correlation, which is calculated in a 40-day moving window relative to observations for each of the reconstructions
 - For each EOF technique, compared to observations, the mode 1-4 reconstruction has a statistically significant larger pattern correlation than does the mode 1-2 reconstruction (left figures)
 - For the Oct. 5, 1985 – Feb. 12, 1986 case, during the early portion of the time period the mode 1-4 reconstruction has much larger skill than the mode 1-2 reconstruction, indicating that the MJO is not the dominant mode of variability during this period (right figure)

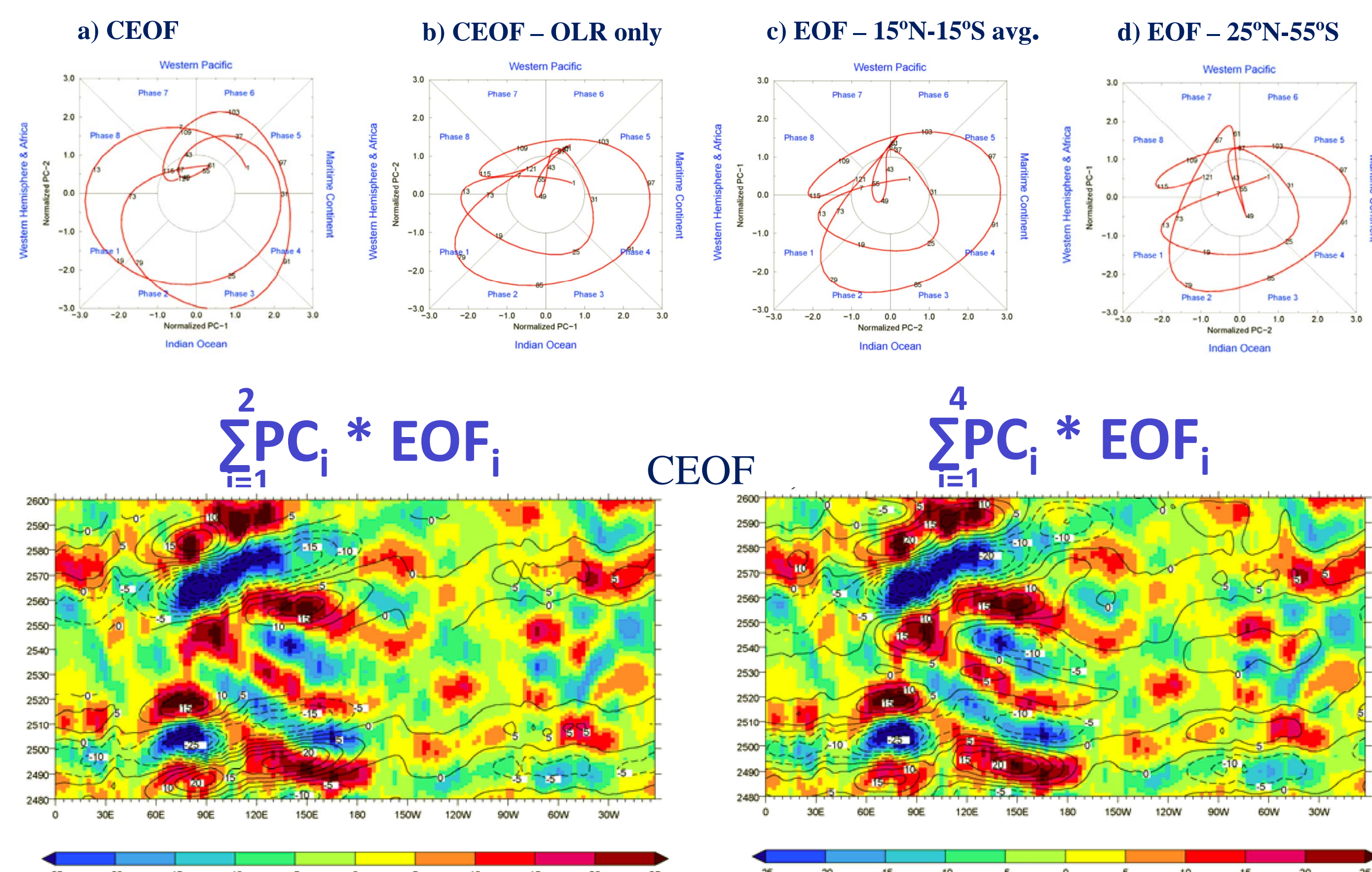


MJO Propagation (Oct. 5, 1985 – Feb. 12, 1986)

- EOF-1 and EOF-2 have been taken to represent the eastward propagation of the MJO
 - $(PC-1^2 + PC-2^2)^{0.5} \geq 1.0$ (Wheeler and Hendon, 2004, *MWR*, 132, 1917-1932)
 - $(PC-1^2 + PC-2^2)^{0.5} \geq 0.4$ (Matthews, 2008, *QJRM*, 134, 439-453)
- Shaded data is 20-100 day bandpass filtered AVHRR OLR anomalies
- Isolines are the OLR anomalies from the EOF reconstructions (plotted when $(PC-1^2 + PC-2^2)^{0.5} \geq 1.0$ in the left figure)
- Using only the 2 leading modes indicates the presence of the MJO when in fact the observed data indicates that westward propagation dominates (lower-left figure)
- Including modes 3 and 4 in the reconstruction gives a more realistic representation of the observed anomalies (lower-right figure)

New Method for Identifying MJO events

- Recipe; On a given day an MJO is present if
 - $(PC-1^2 + PC-2^2)^{0.5} \geq 1.0$
 - Relative to observations the pattern correlation of the mode 1-4 reconstruction \geq mean pattern correlation + 0.5 σ (0.4 σ if an event is already underway)
 - The difference in the pattern correlations between the mode 1-4 and the mode 1-2 reconstructions is <1.1 σ
 - If these 3 criteria are satisfied an MJO is taken to be present on the given day and 39 days thereafter (due to the width of the time window over which the pattern correlations are calculated)



CEOF

EOF 2D

