MultiVariate PNA (MVP)

A new index for identifying MJO impacts over North America

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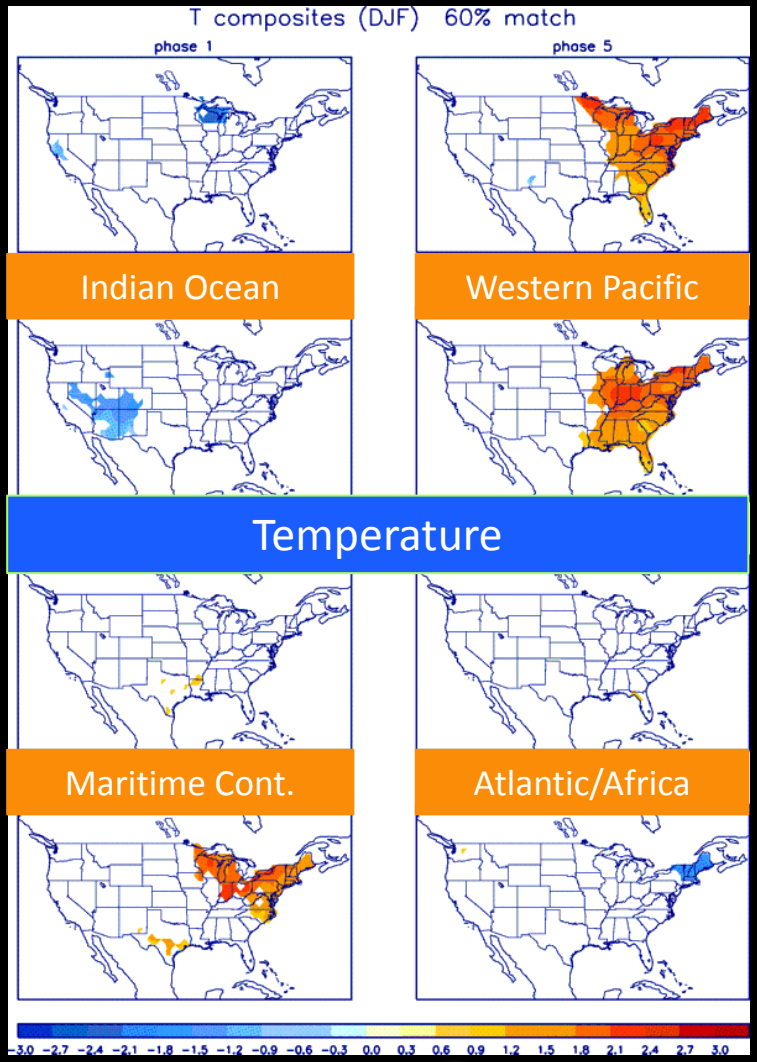
Outline

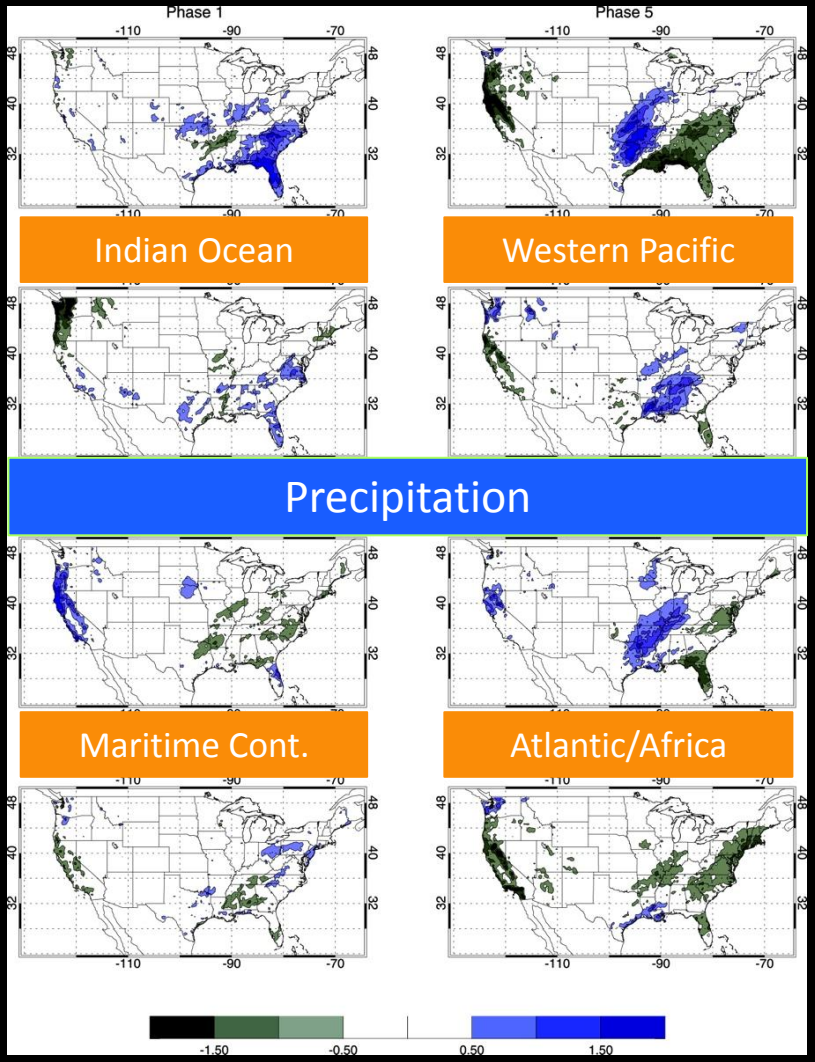
- What do we know about the MJO and Temperatures in the U.S.?
- How was the new index developed?
- How does it relate to the PNA?
- How does it connect the MJO to U.S. Temperatures?

MJO Impacts in the United States

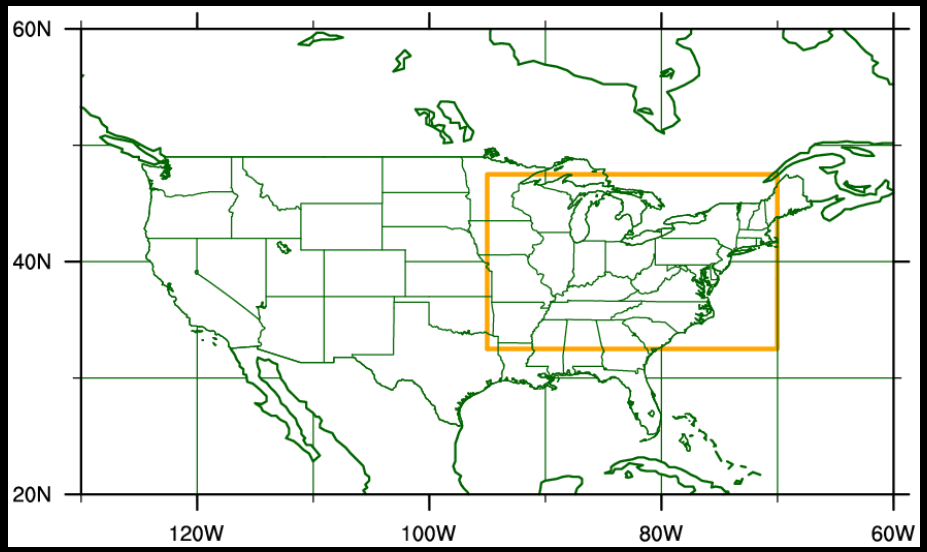
Zhou et al. (2011, Clim. Dyn.)

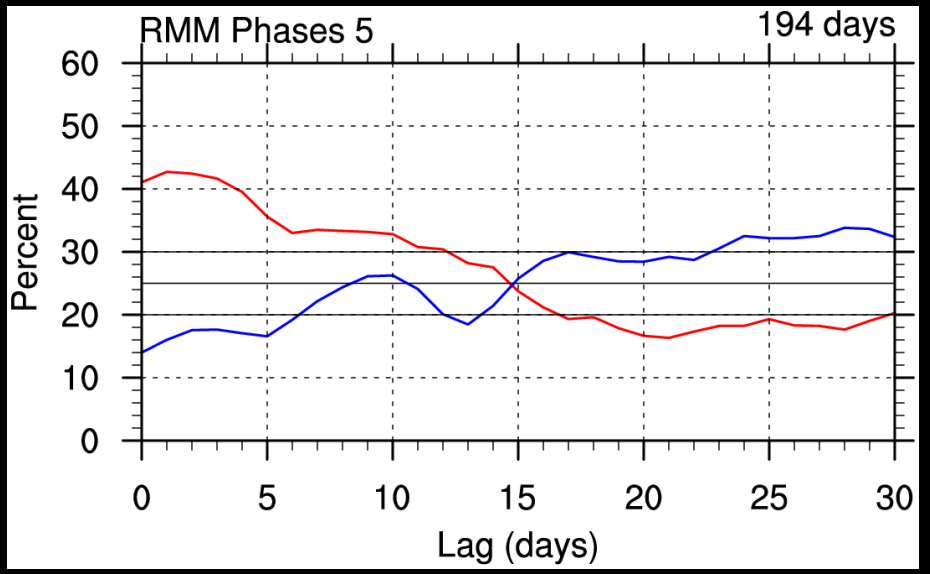


Becker et al. (2012, J. Climate)



Midwest-East (MWE)

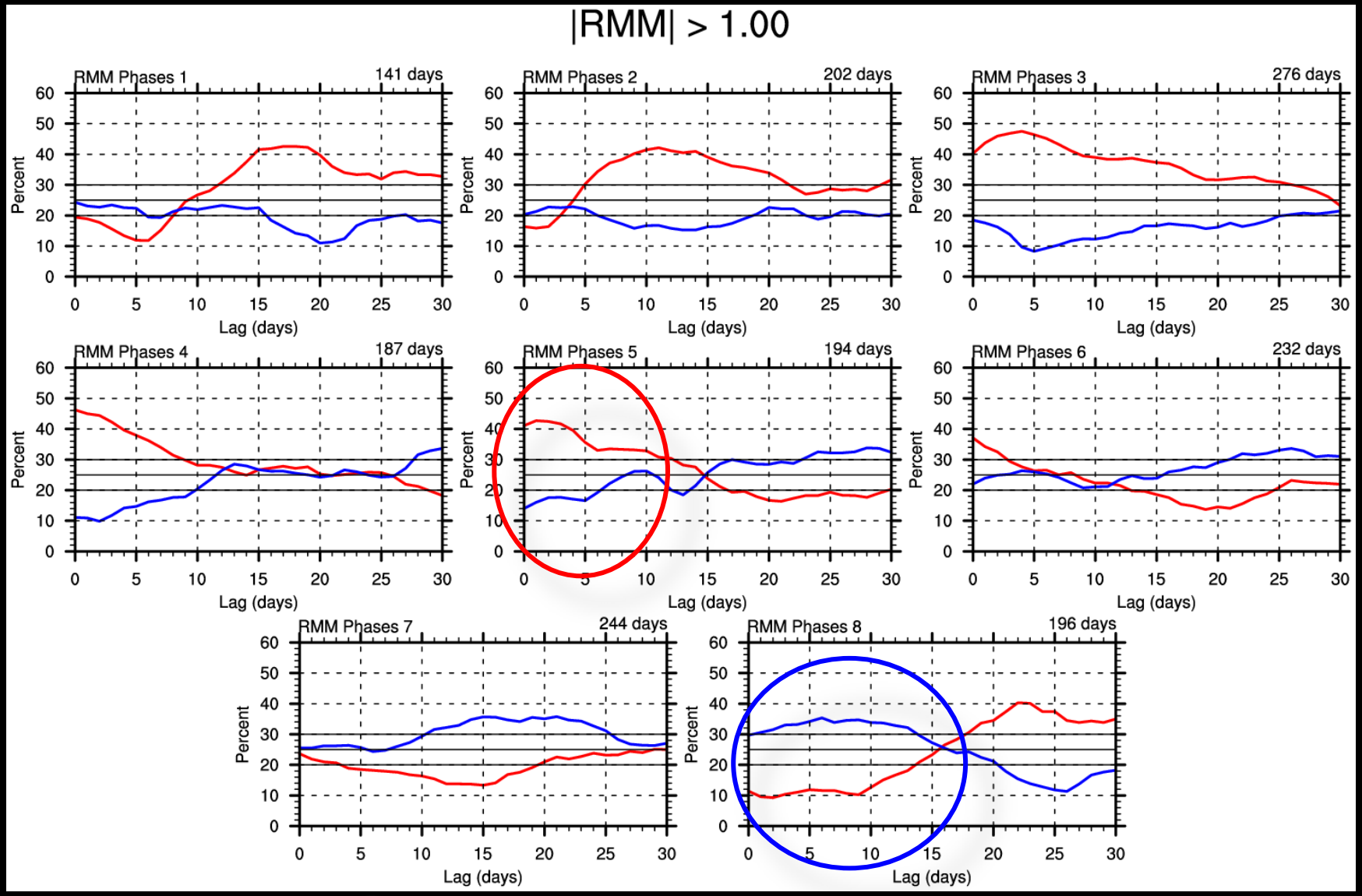




- 5-day running average of 2-m Temperature anomalies from NCEP–NCAR reanalysis
- Average anomalies over MWE region
- Focused on December–February

- Probability of an extreme (hot or cold) over MWE
  - Extremes are the top and bottom quartiles
- Probabilities near 20–30% are noise

MJO Only


|RMM| > 1.00
RMM Phases 1
141 days
RMM Phases 2
202 days
RMM Phases 3
276 days
RMM Phases 4
187 days
RMM Phases 5
194 days
RMM Phases 6
232 days
RMM Phases 7
244 days
RMM Phases 8
196 days
Percent
Lag (days)

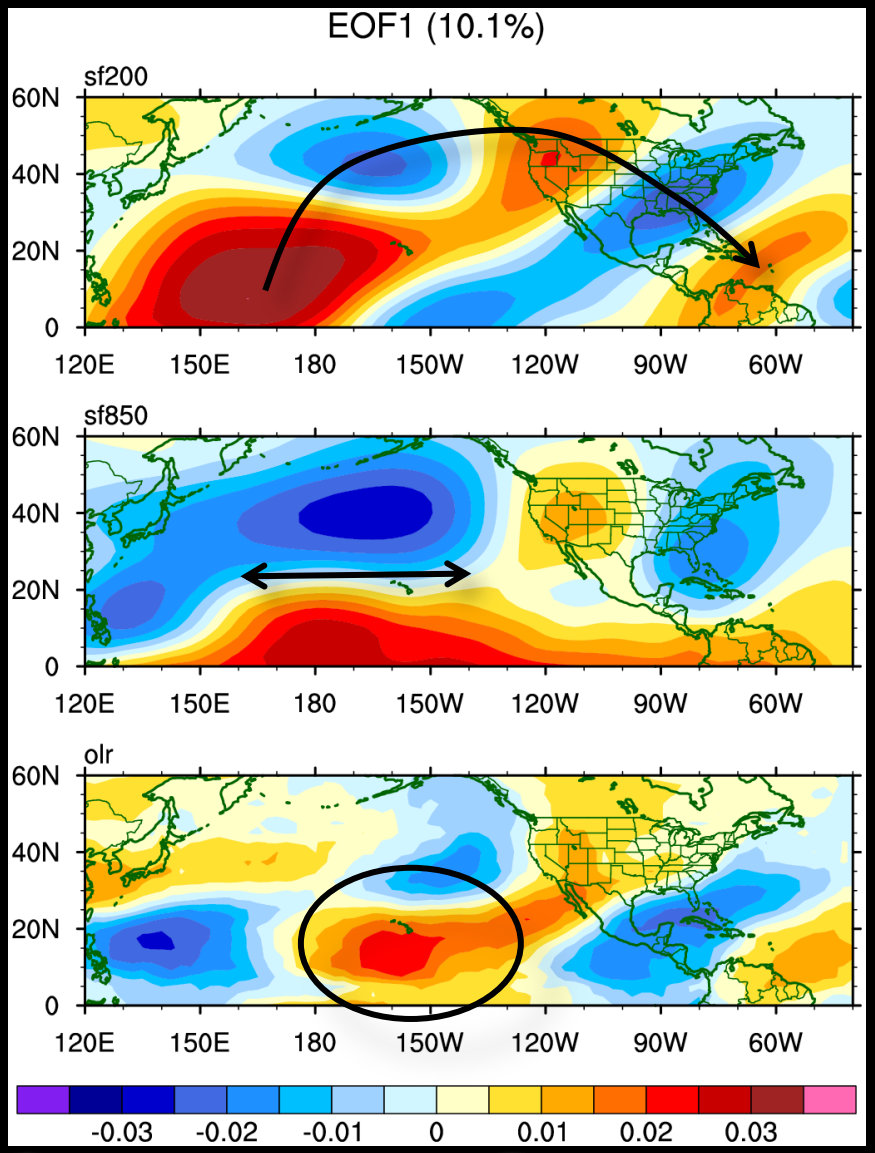
Key Problem

Can we distinguish MJO events that affect U.S. Temperatures from those that don't?

Strategy

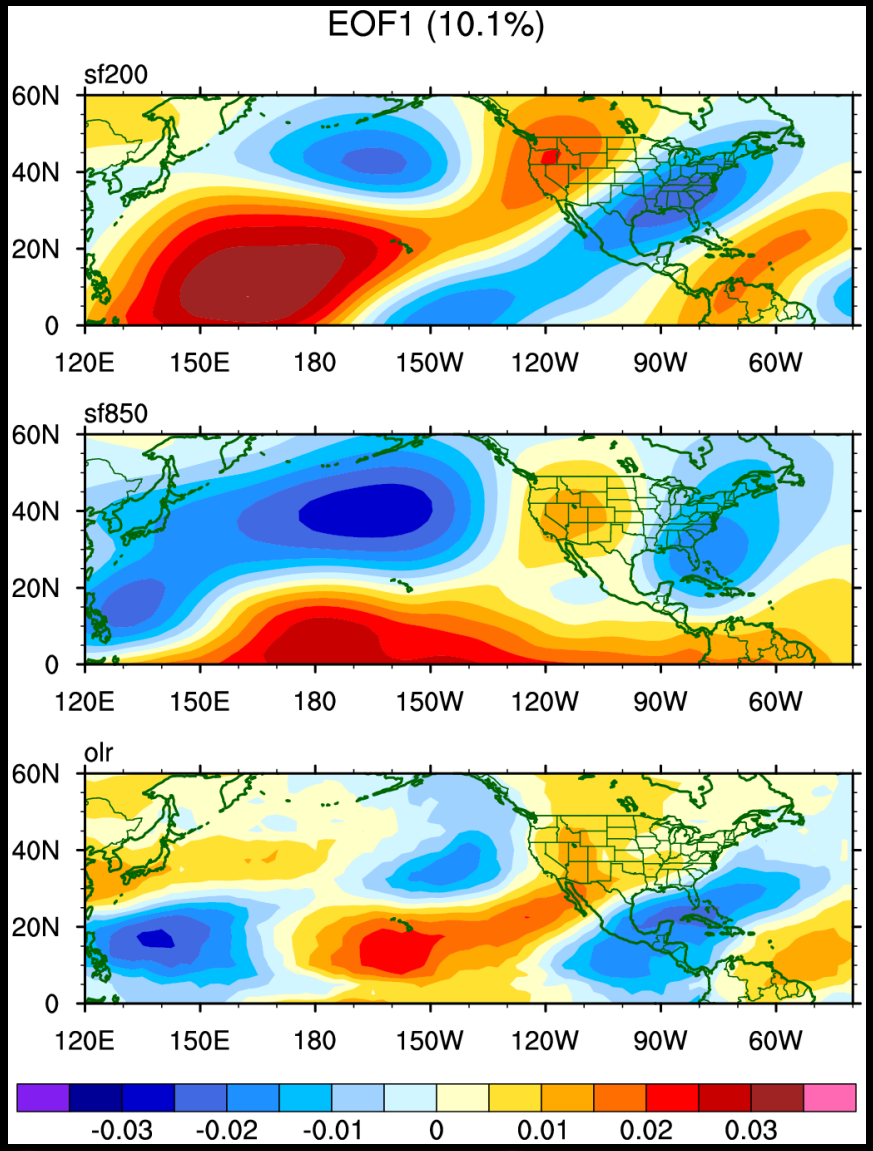
- Multivariate EOF approach
  - Like Wheeler–Hendon, but no latitude averaging
  - Focus on the North Pacific
  - Using OLR/SF850/SF200 instead of OLR/U850/U200
- Pre-filter data for 20–100 days
  - Project EOFs onto unfiltered data for real-time applications
  - No ENSO removal

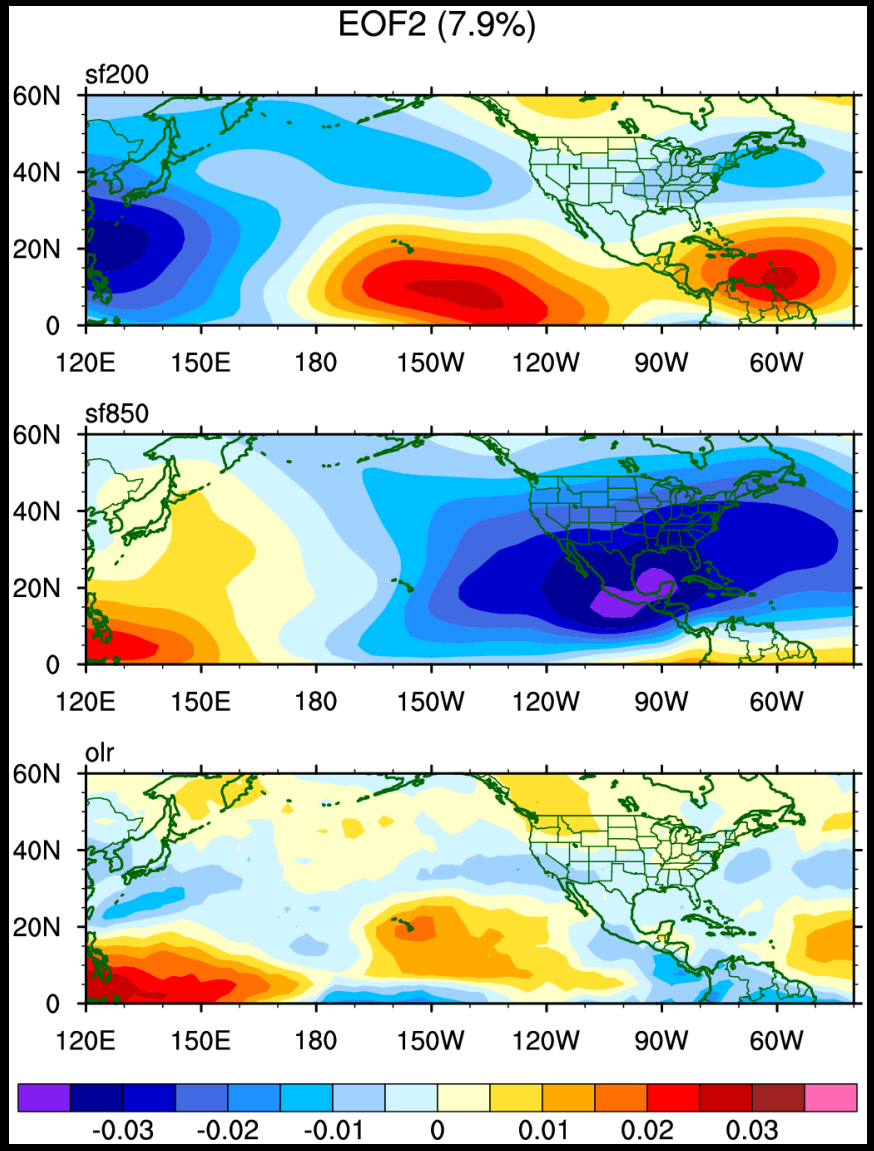
MultiVariate PNA (MVP) Index



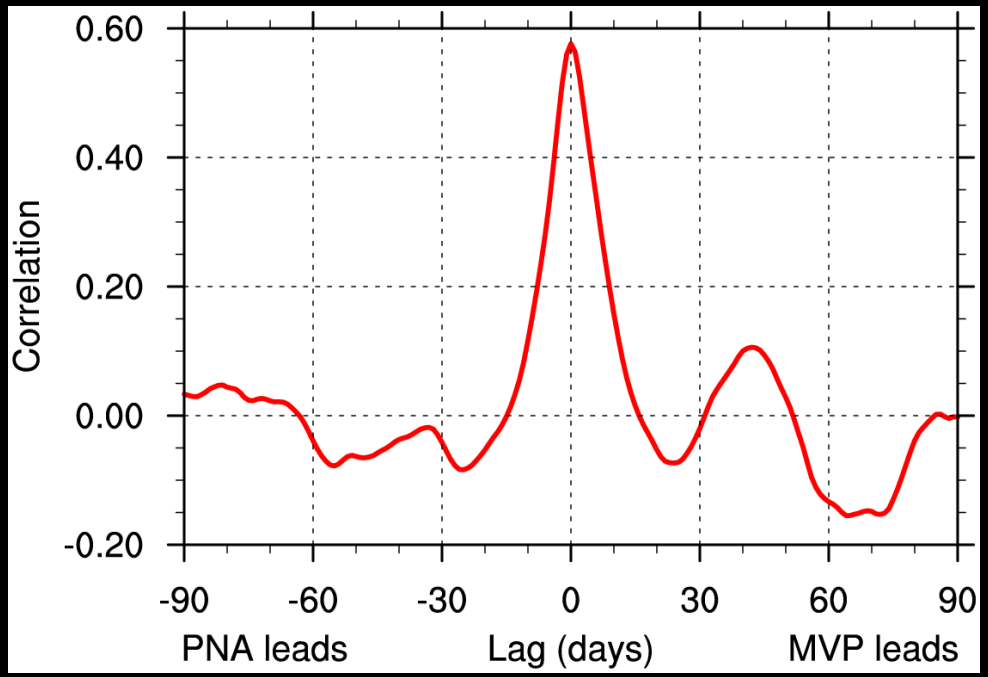
- 200-hPa Wave train over the Pacific and North America
- Anomalous 850-hPa zonal winds near Hawaii
- Convective anomaly south of Hawaii

MultiVariate PNA (MVP) Index



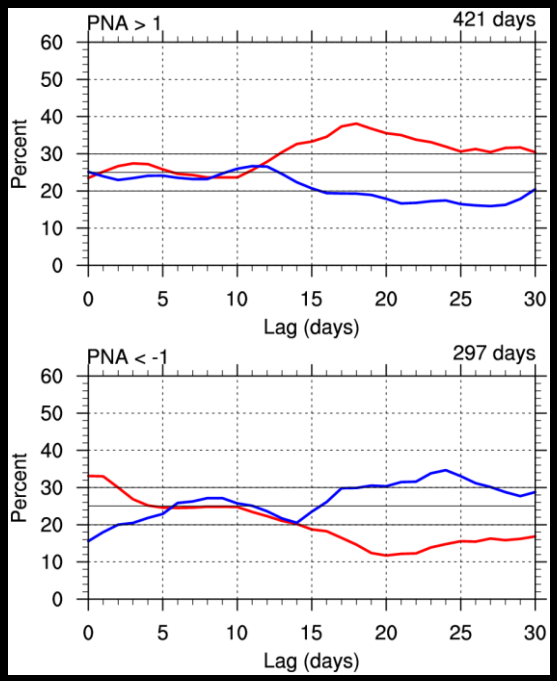


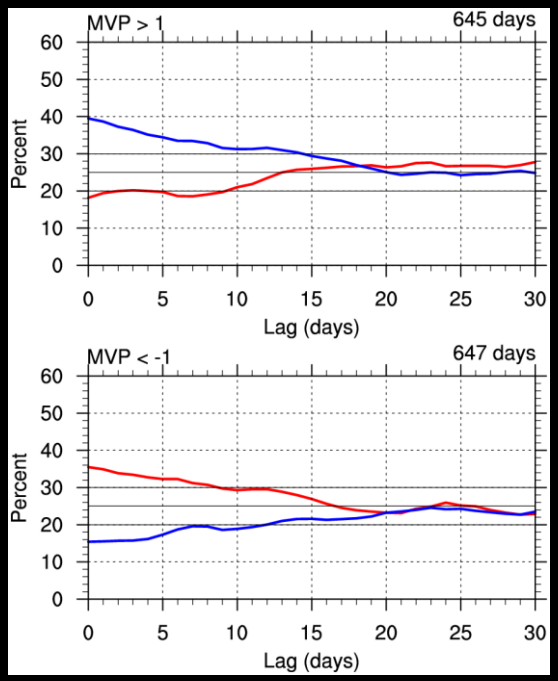
Correlation between MVP and PNA



- Daily PNA downloaded from CPC
- Positive correlation of 0.57 at Day 0

MWE Temperature Signals





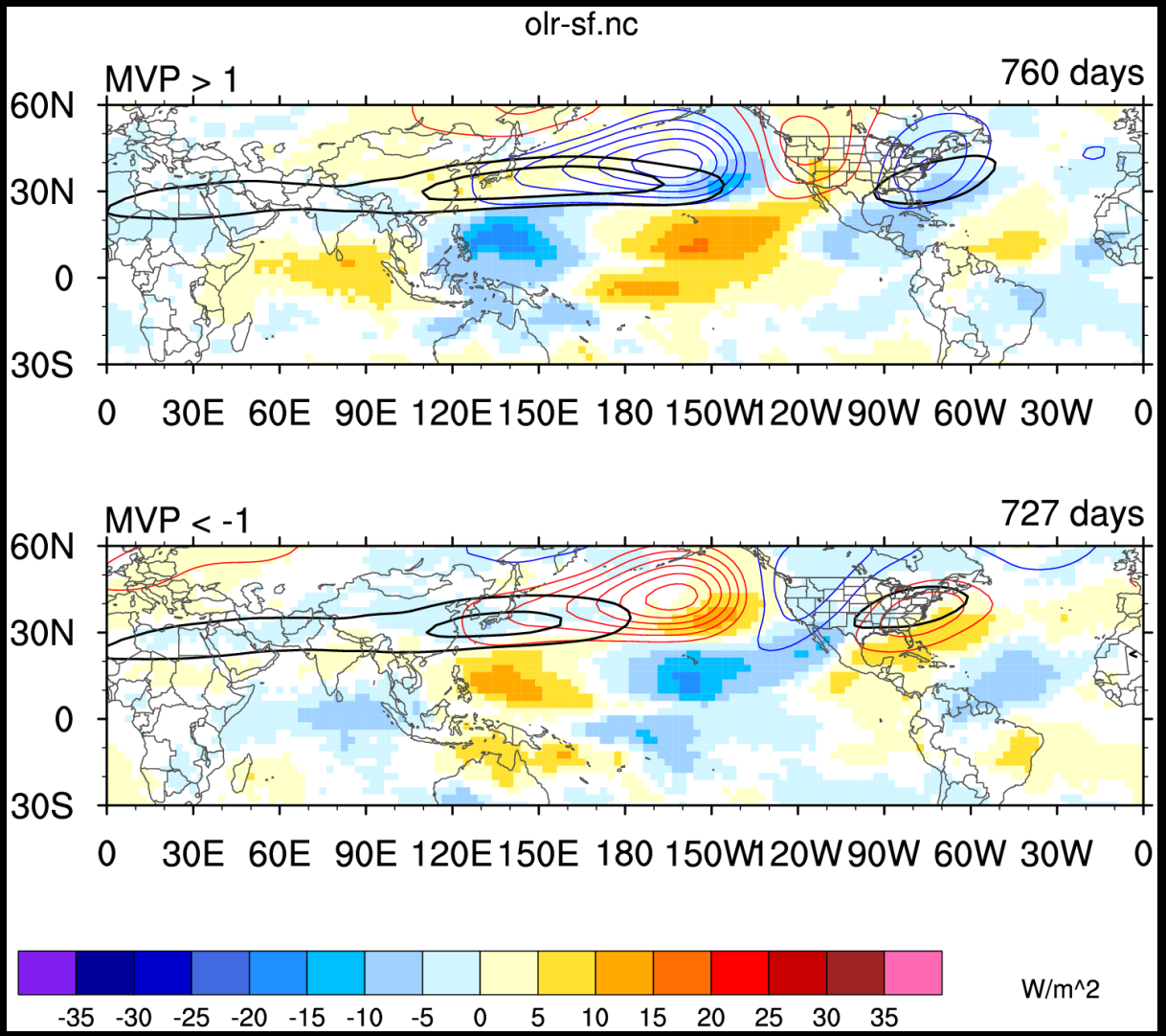
- PNA's temperature signal is surprisingly weak

- MVP has a stronger initial temperature signal
- Dissipates after 10 days or so

Global Composites

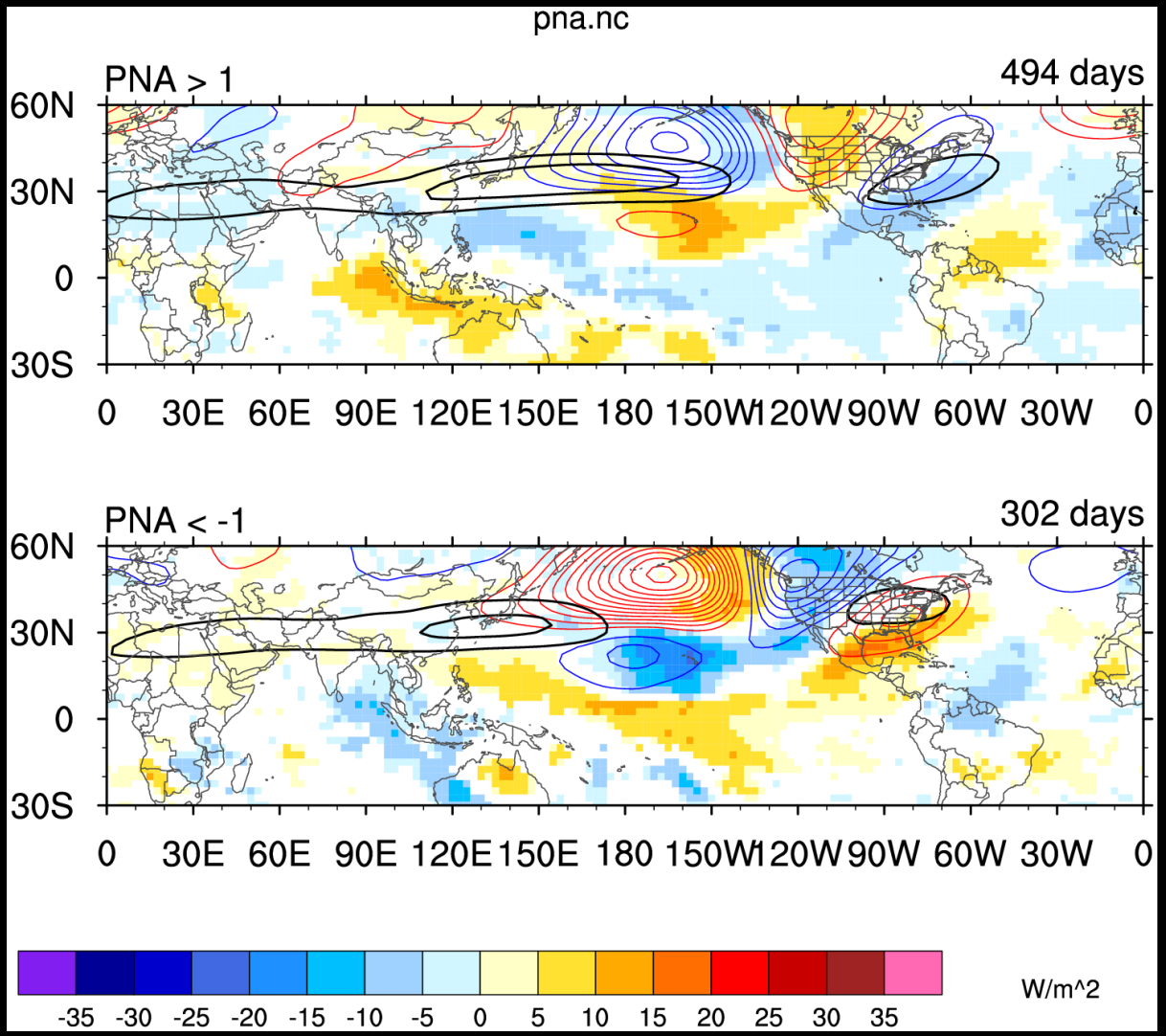
- Positive MVP:
  - Convection in Western Pacific
  - Elongated Jet
  - Trough-Ridge-Trough
- Negative MVP:
  - Convection in Central Pacific and Indian Ocean
  - Retracted Jet
  - Ridge-Trough-Ridge

OLR anomalies are shaded.
500-hPa Height Anomalies are contoured.
Black contours show Total 200-hPa Zonal Wind.



Global Composites

- Equatorial convection has northwest/southeast tilt
- Wave trains are farther north
- Negative PNA suggests blocking



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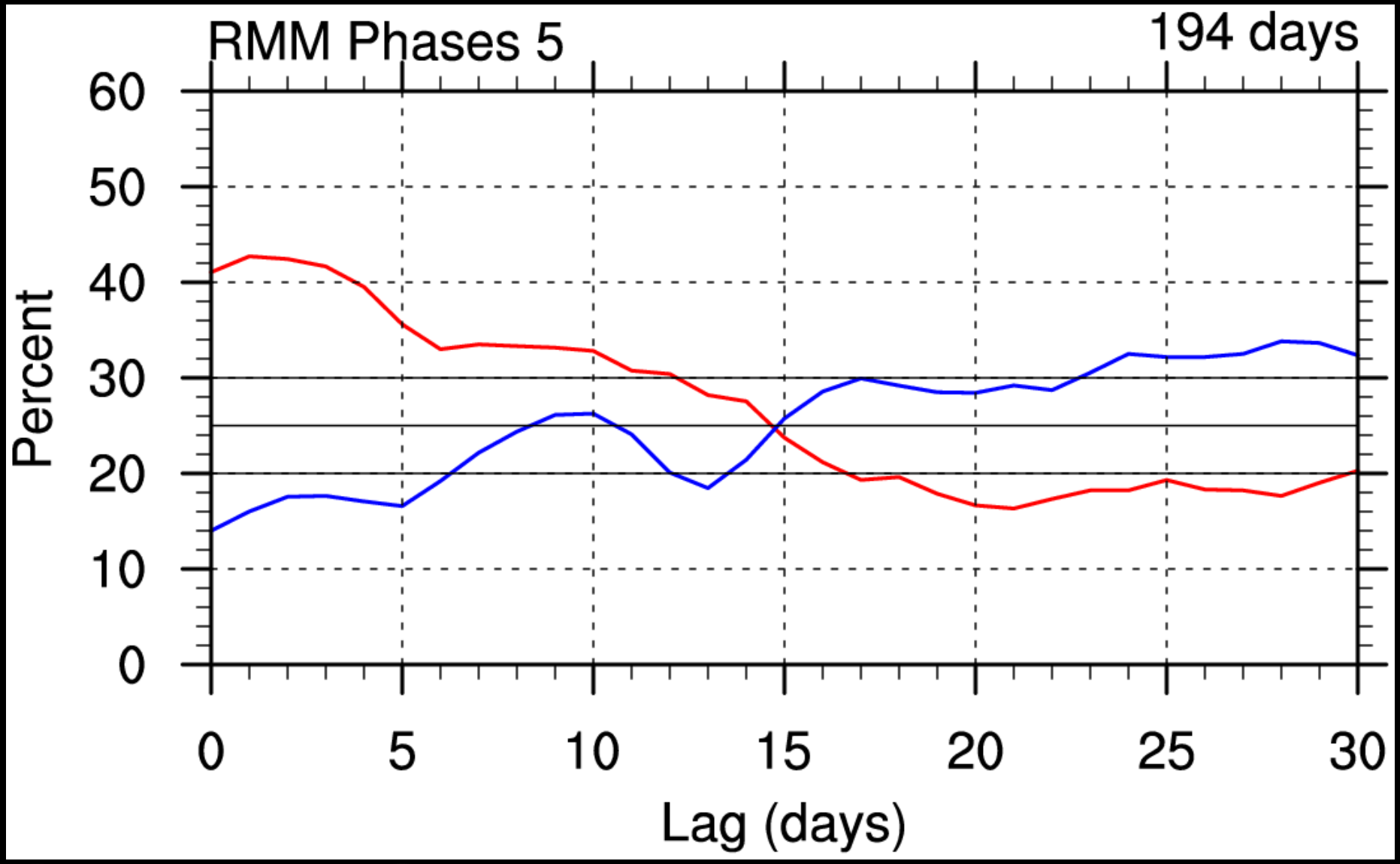
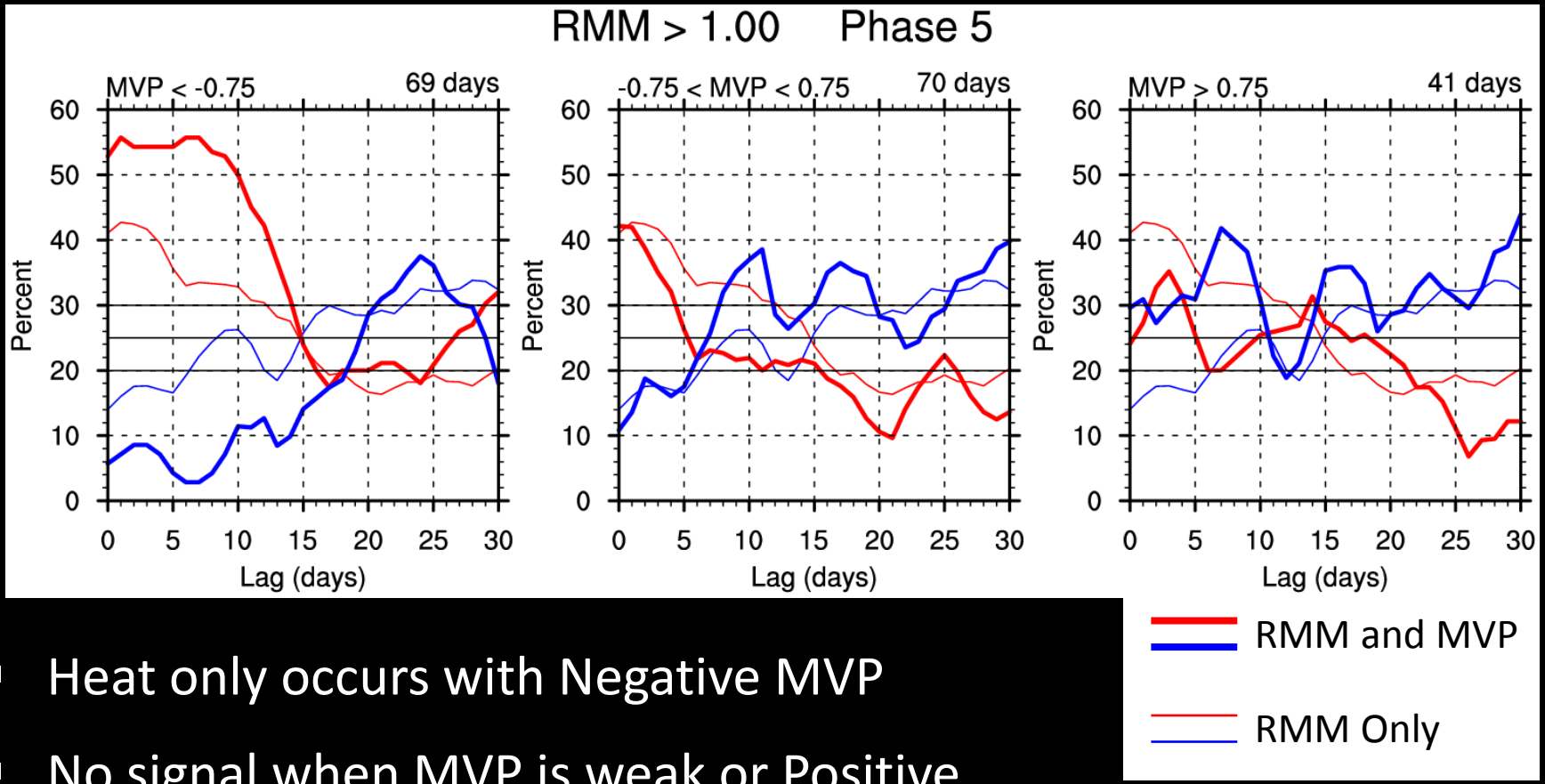
Heat in Phase 5

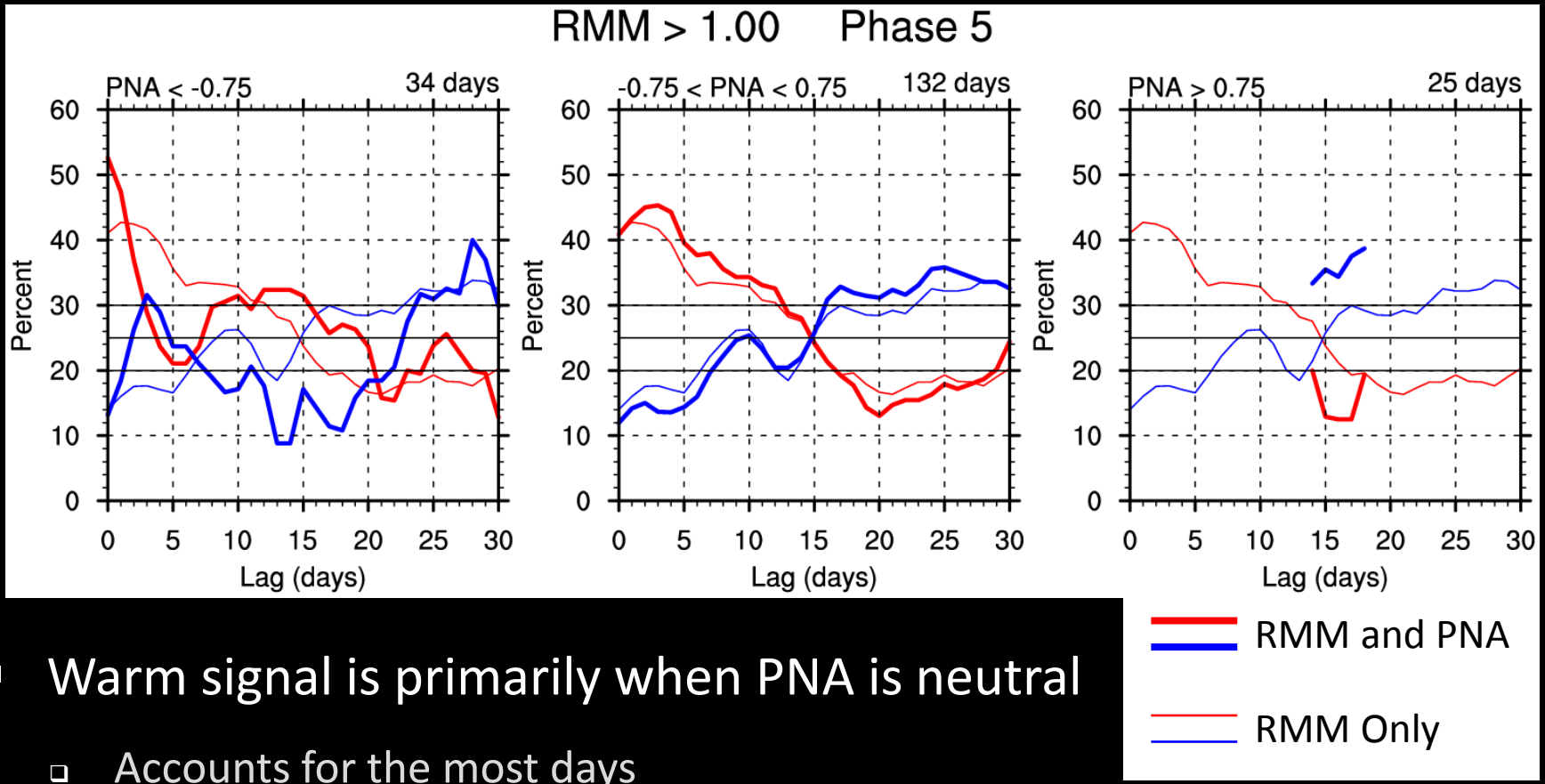


Heat in Phase 5



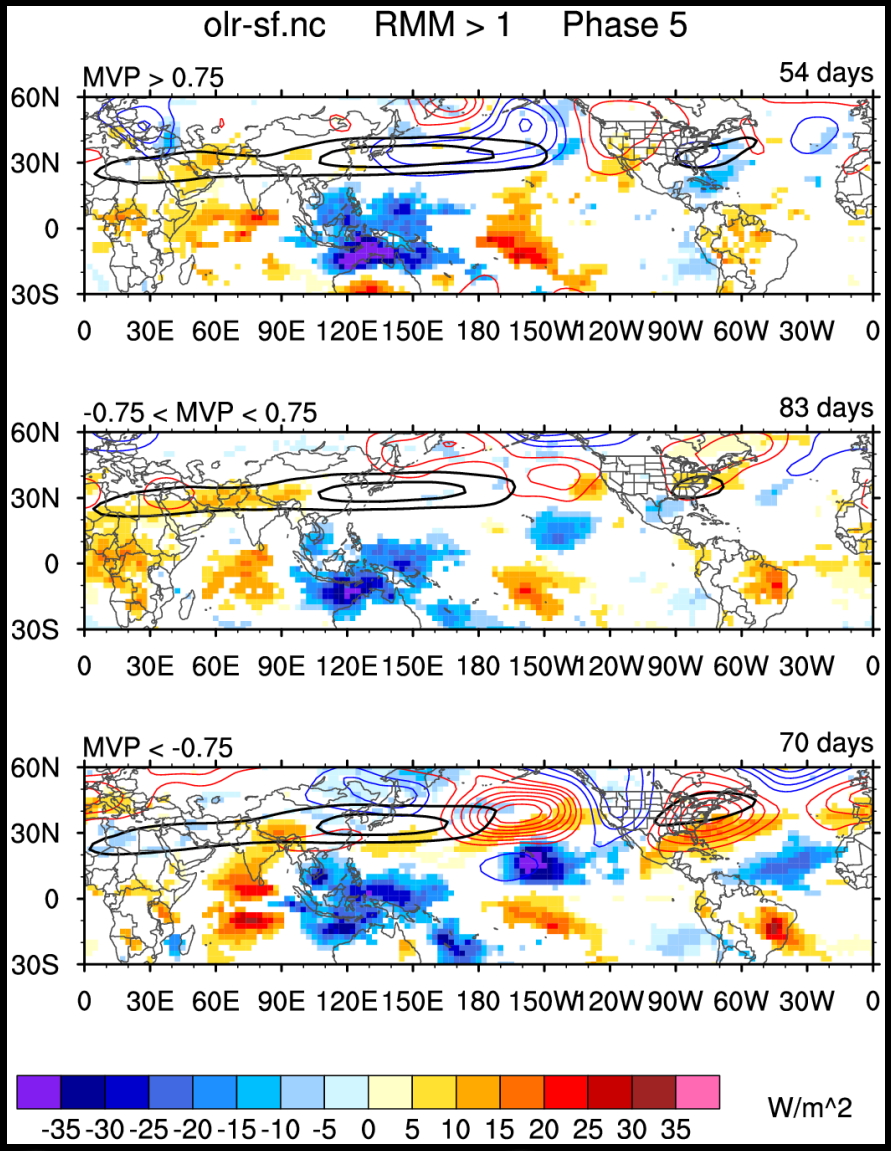
- Heat only occurs with Negative MVP
- No signal when MVP is weak or Positive
  - Good distribution of days between the three categories

Heat in Phase 5



- Warm signal is primarily when PNA is neutral
  - Accounts for the most days
  - Not enough days for Positive PNA

Heat in Phase 5



- Elongated Jet in positive MVP
- Enhanced convection near Hawaii leads to ridging in negative MVP

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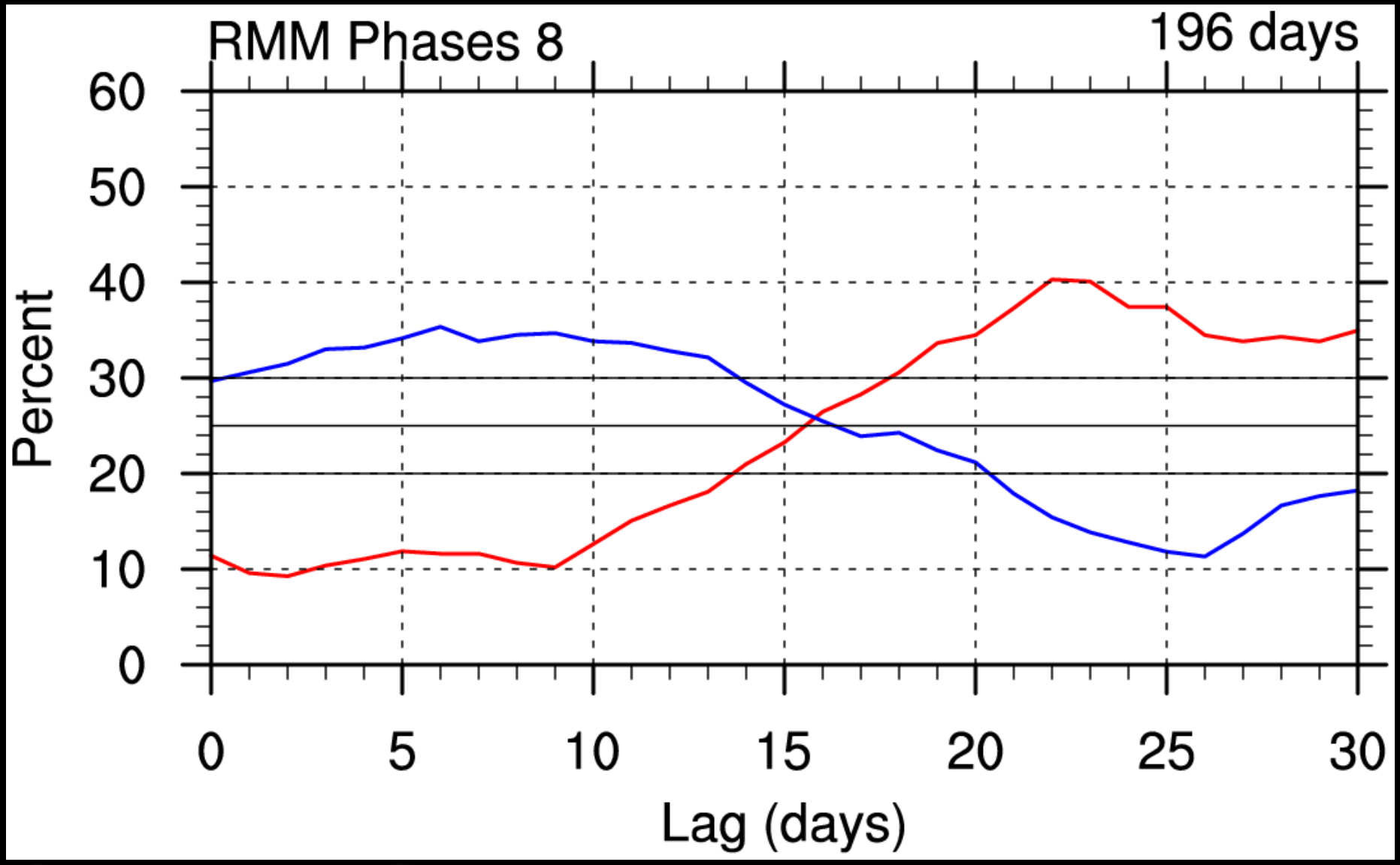
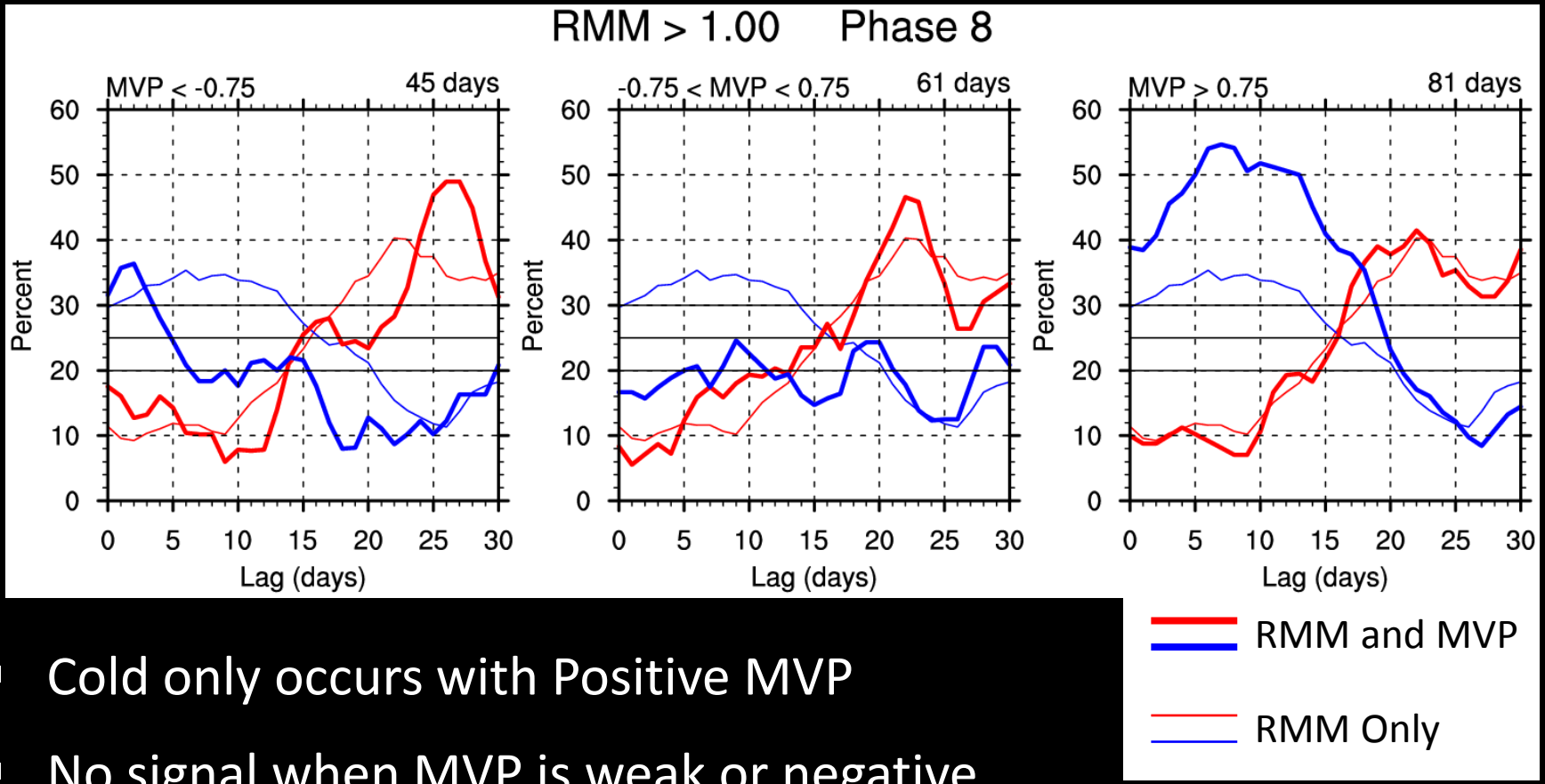
Black contours show Total 200-hPa Zonal Wind.

Cold in Phase 8

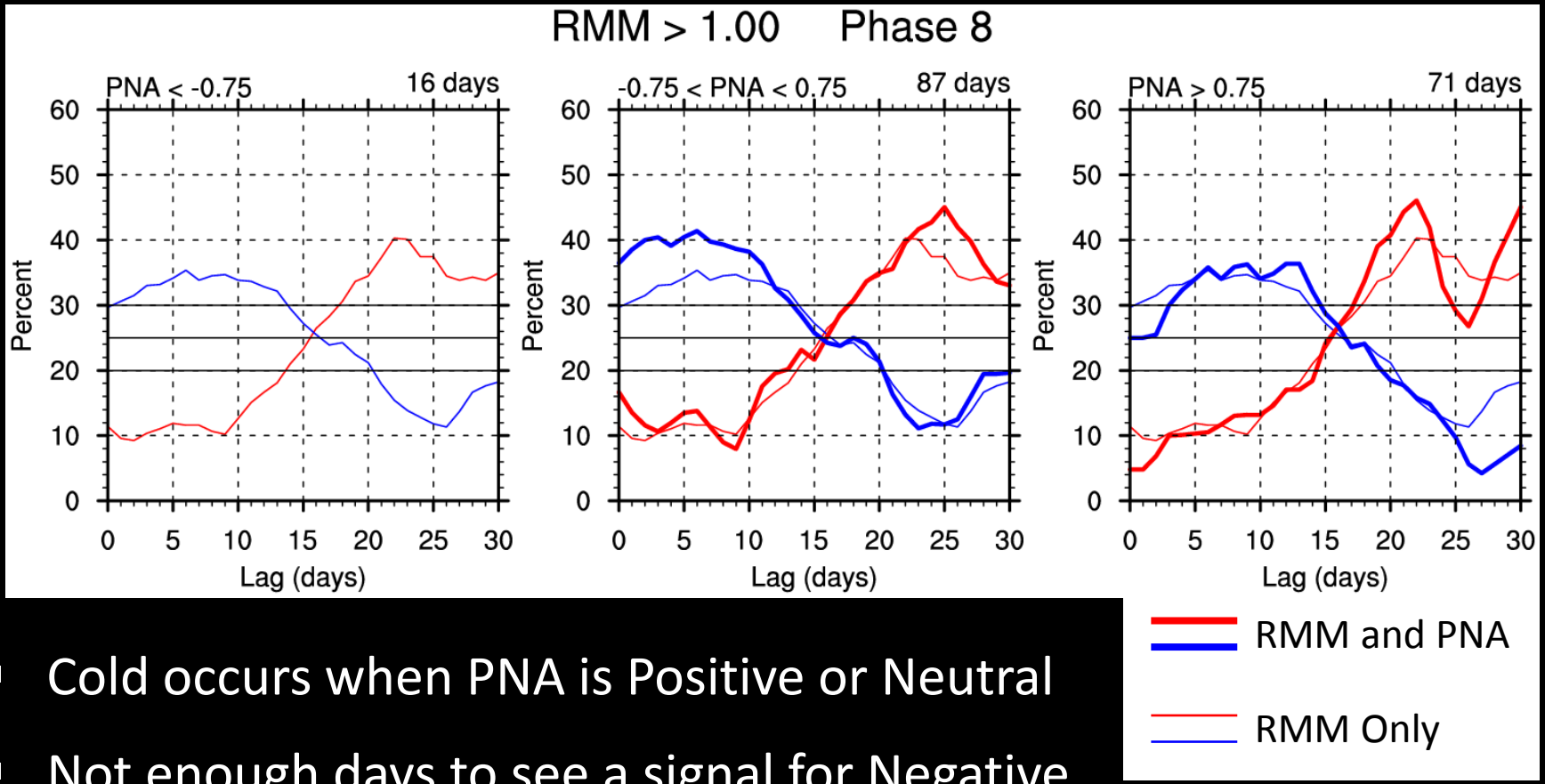


Cold in Phase 8



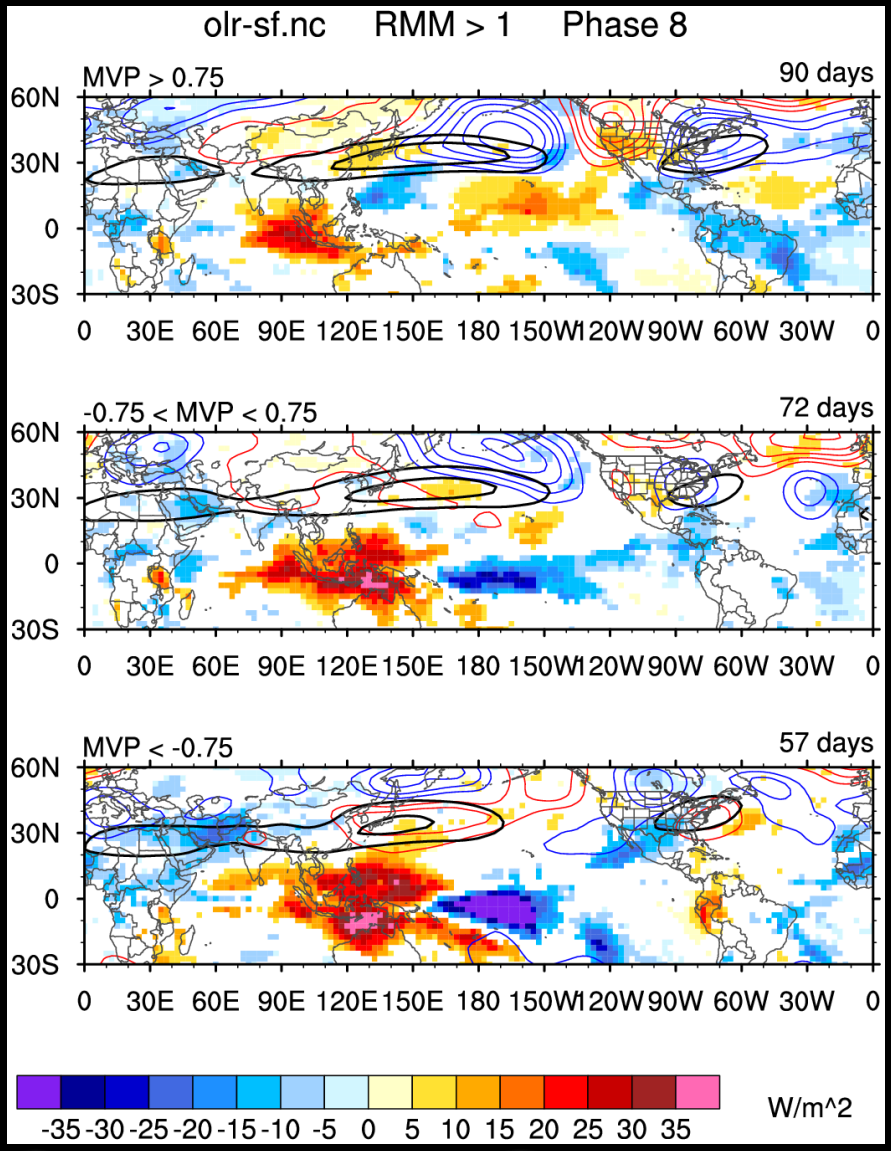
- Cold only occurs with Positive MVP
- No signal when MVP is weak or negative

Cold in Phase 8



- Cold occurs when PNA is Positive or Neutral
- Not enough days to see a signal for Negative PNA

Cold in Phase 8



- Suppressed convection and troughing in positive MVP
- Unusual convective pattern near Maritime Continent

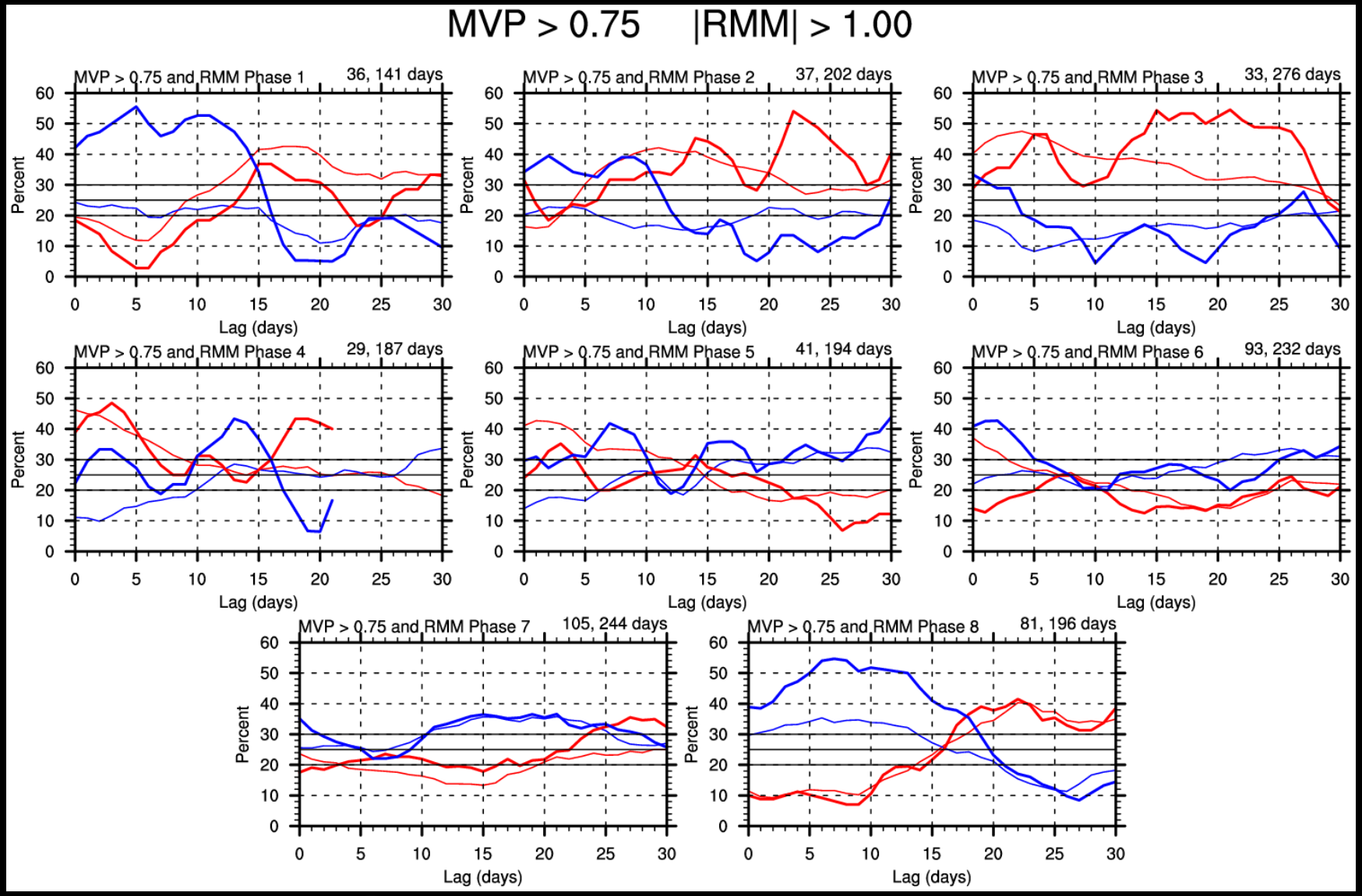
OLR anomalies are shaded.
500-hPa Height Anomalies are contoured.
Black contours show Total 200-hPa Zonal Wind.

Summary

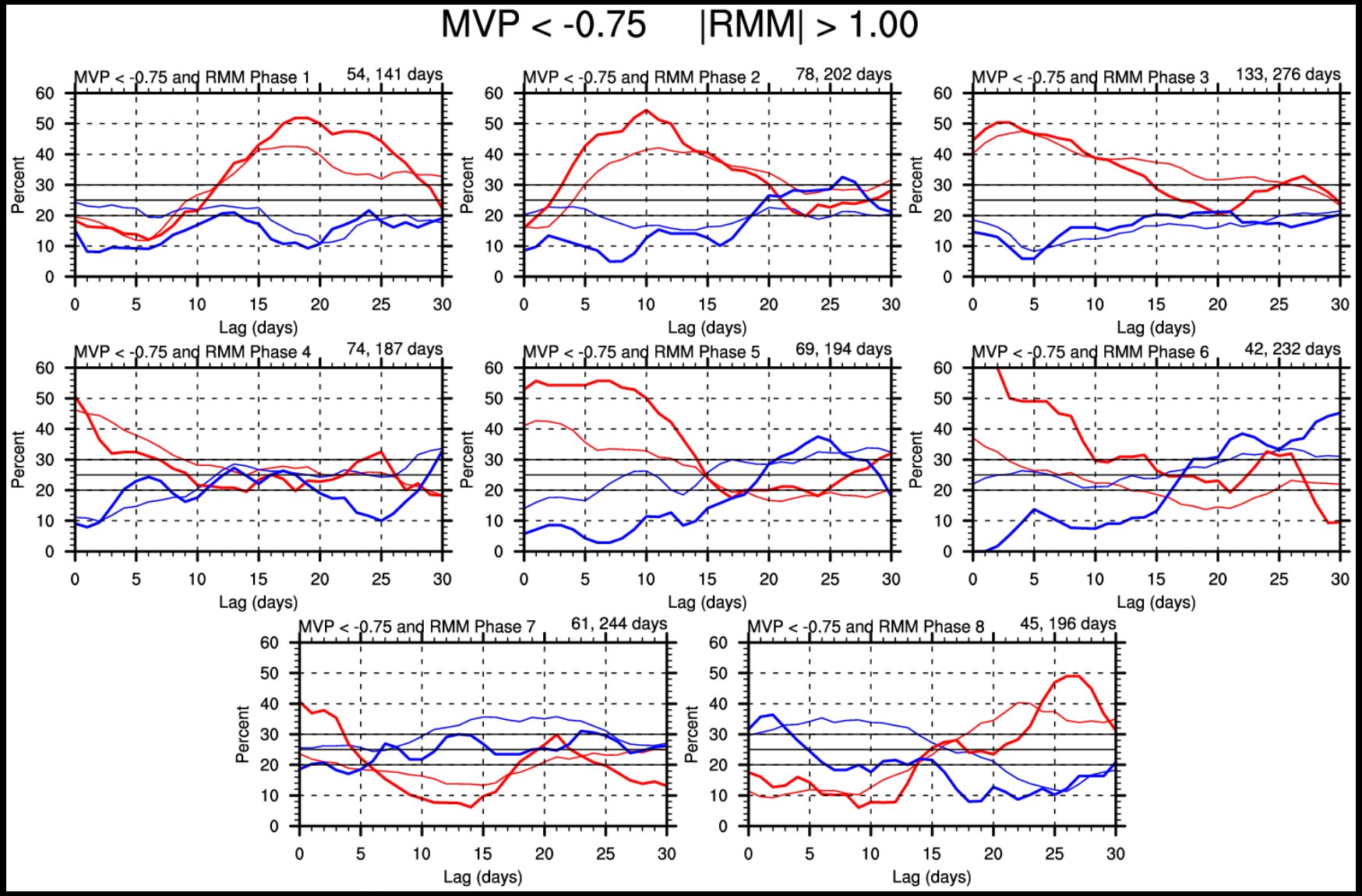
- New Index identifies MJO events that impact North American temperatures
- Combined EOF of OLR and 850/200 hPa Streamfunction over North Pacific
- Key differences from PNA:
  - Southward shift in wave guide
  - Stronger MWE temperature signals
  - More null cases for RMM
- North American Temperatures respond more to convection in the Western Hemisphere than the Eastern Hemisphere

Extra Slides

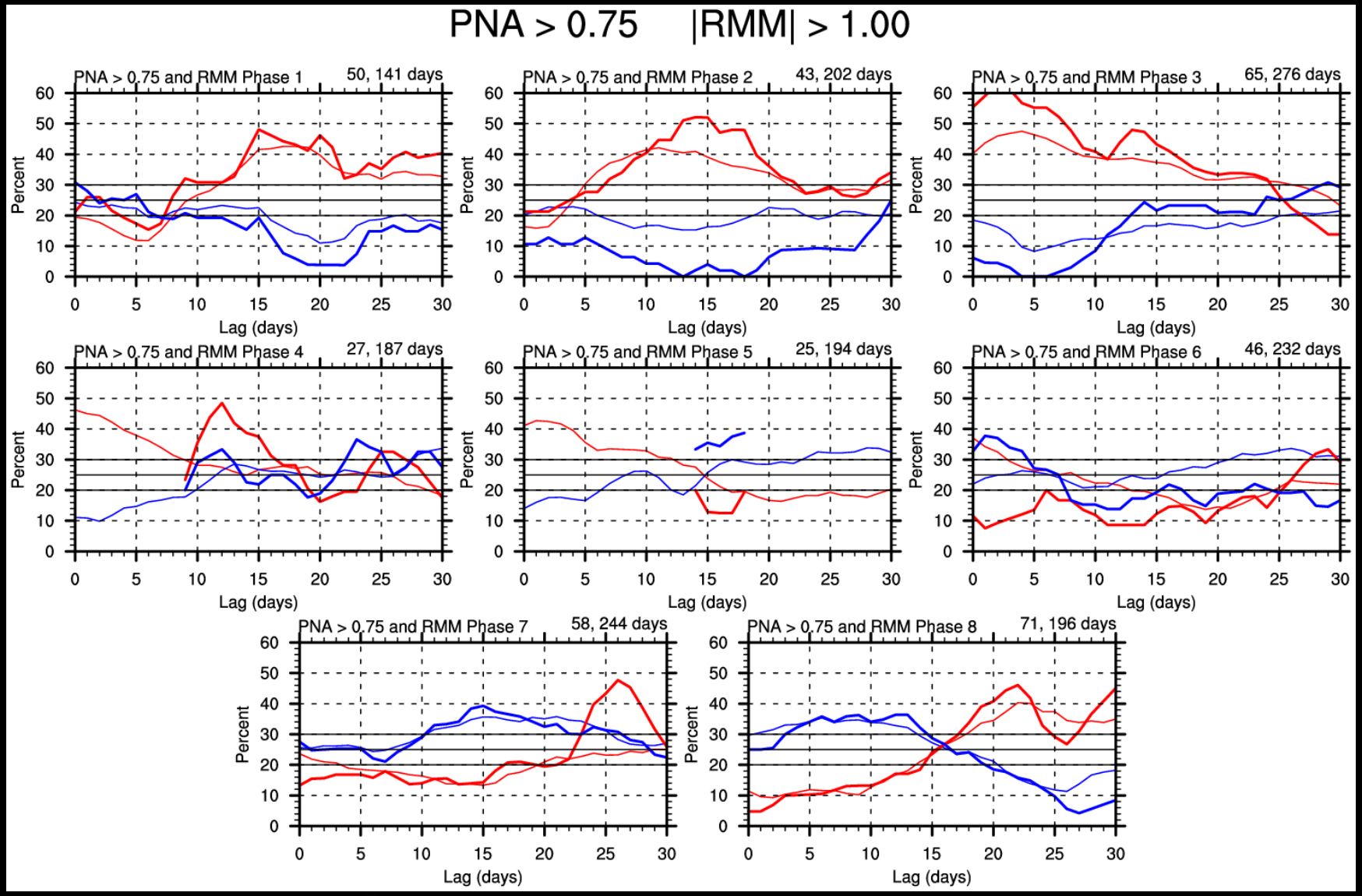
Positive MVP



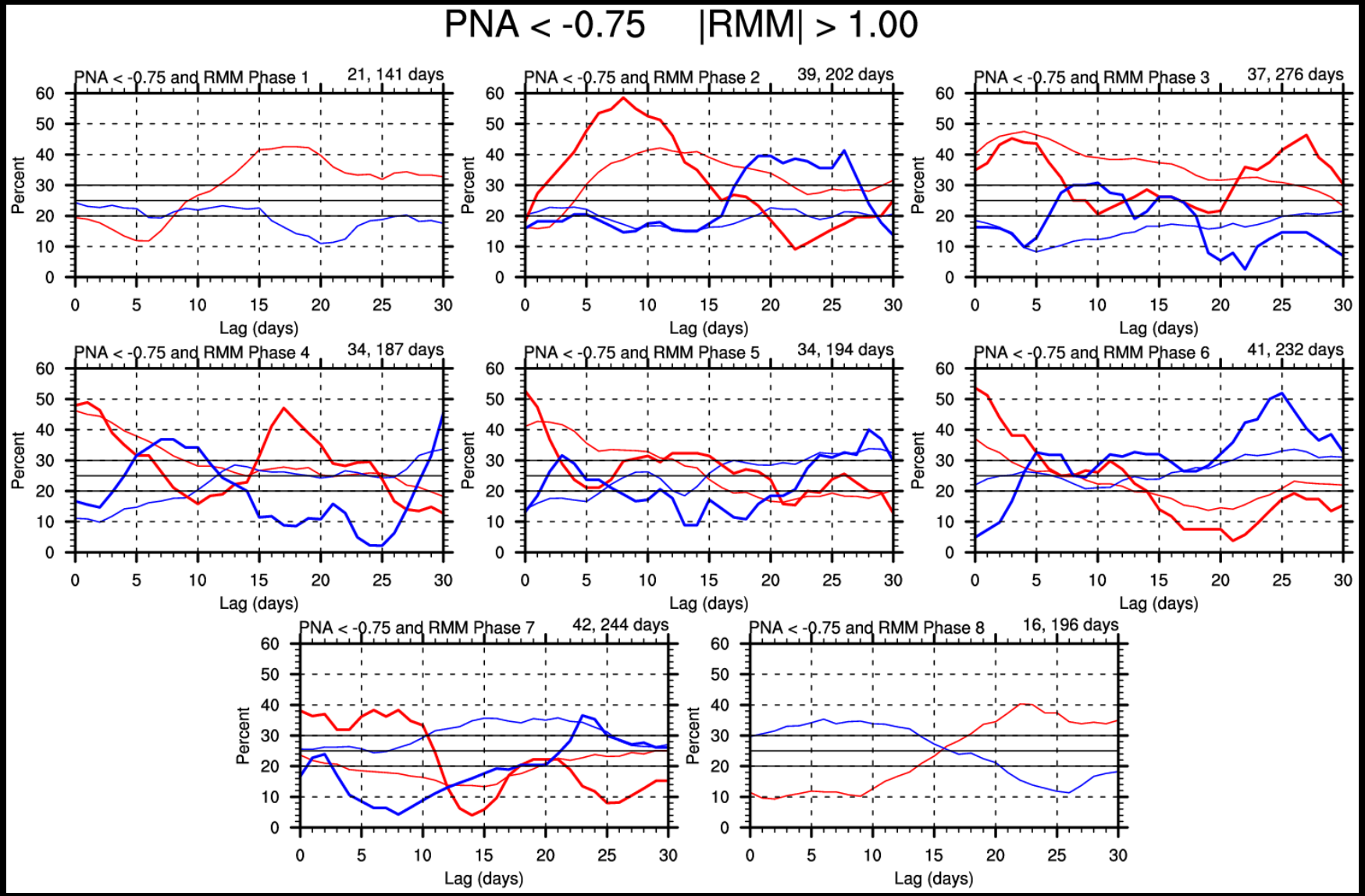
Negative MVP



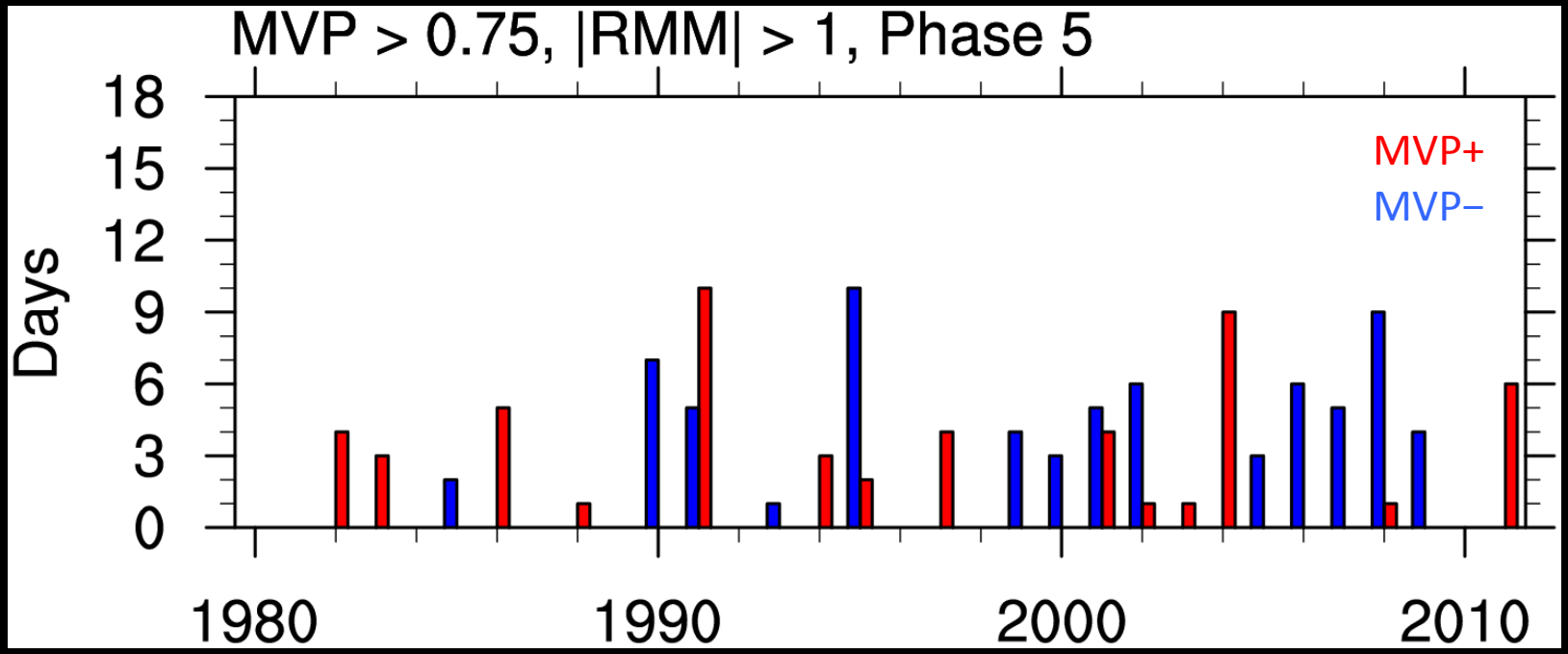
Positive PNA



Negative PNA

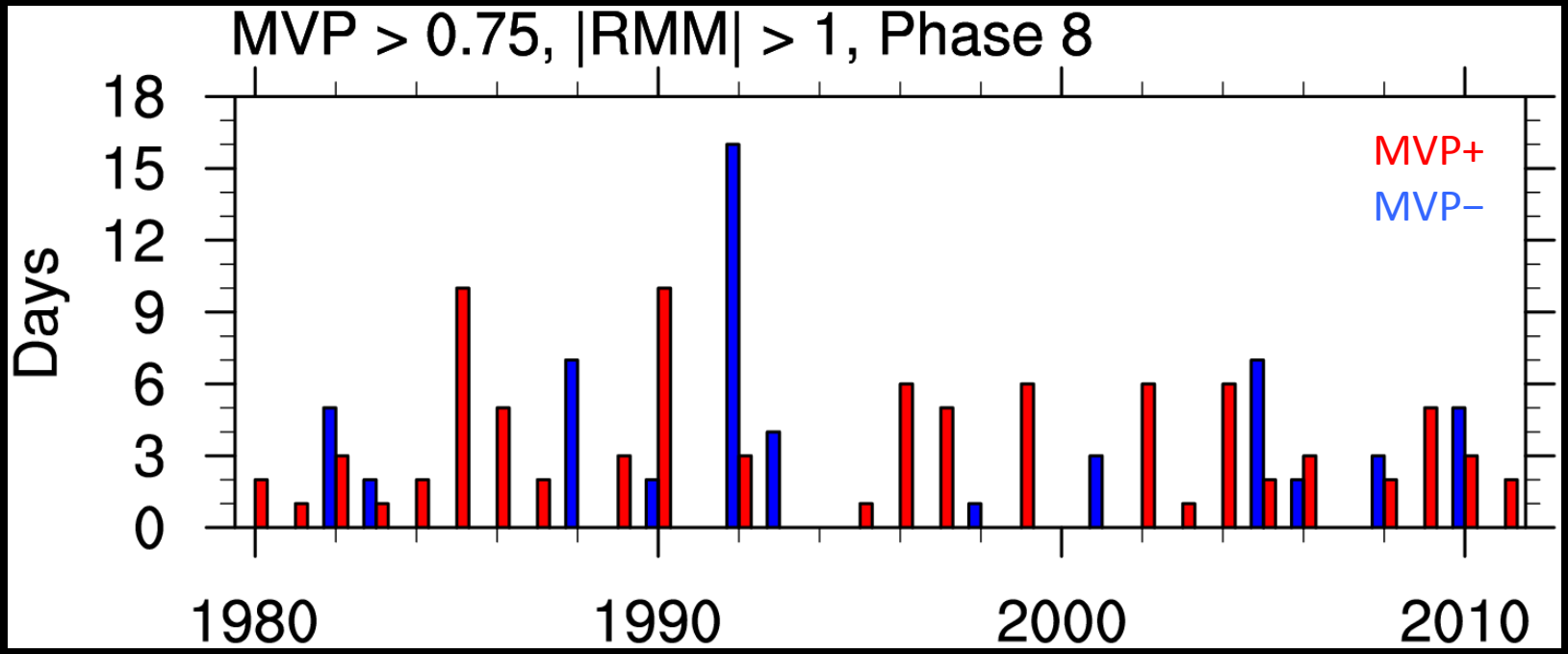


Heat in Phase 5



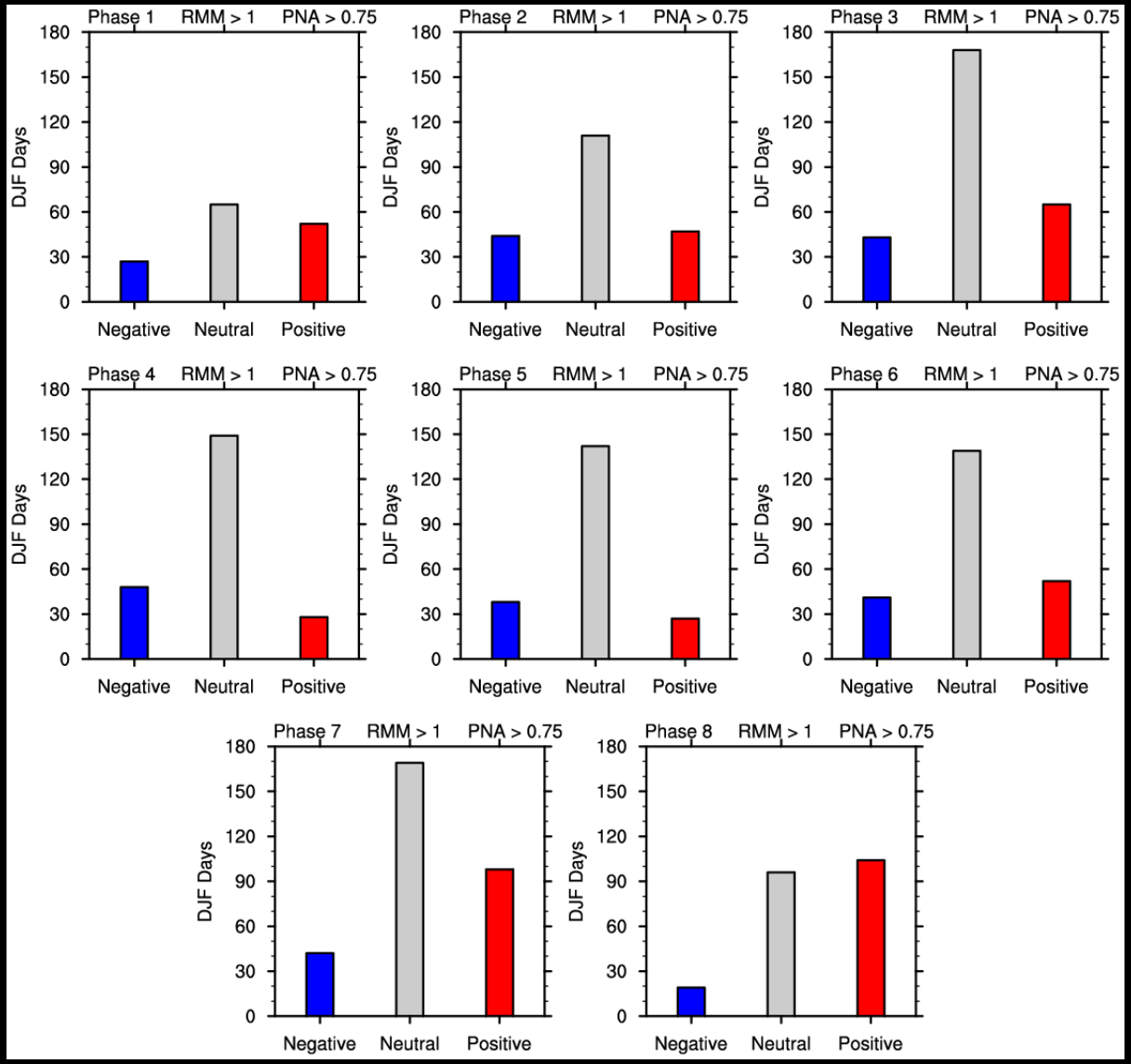
- No clear ENSO signal

Cold in Phase 8

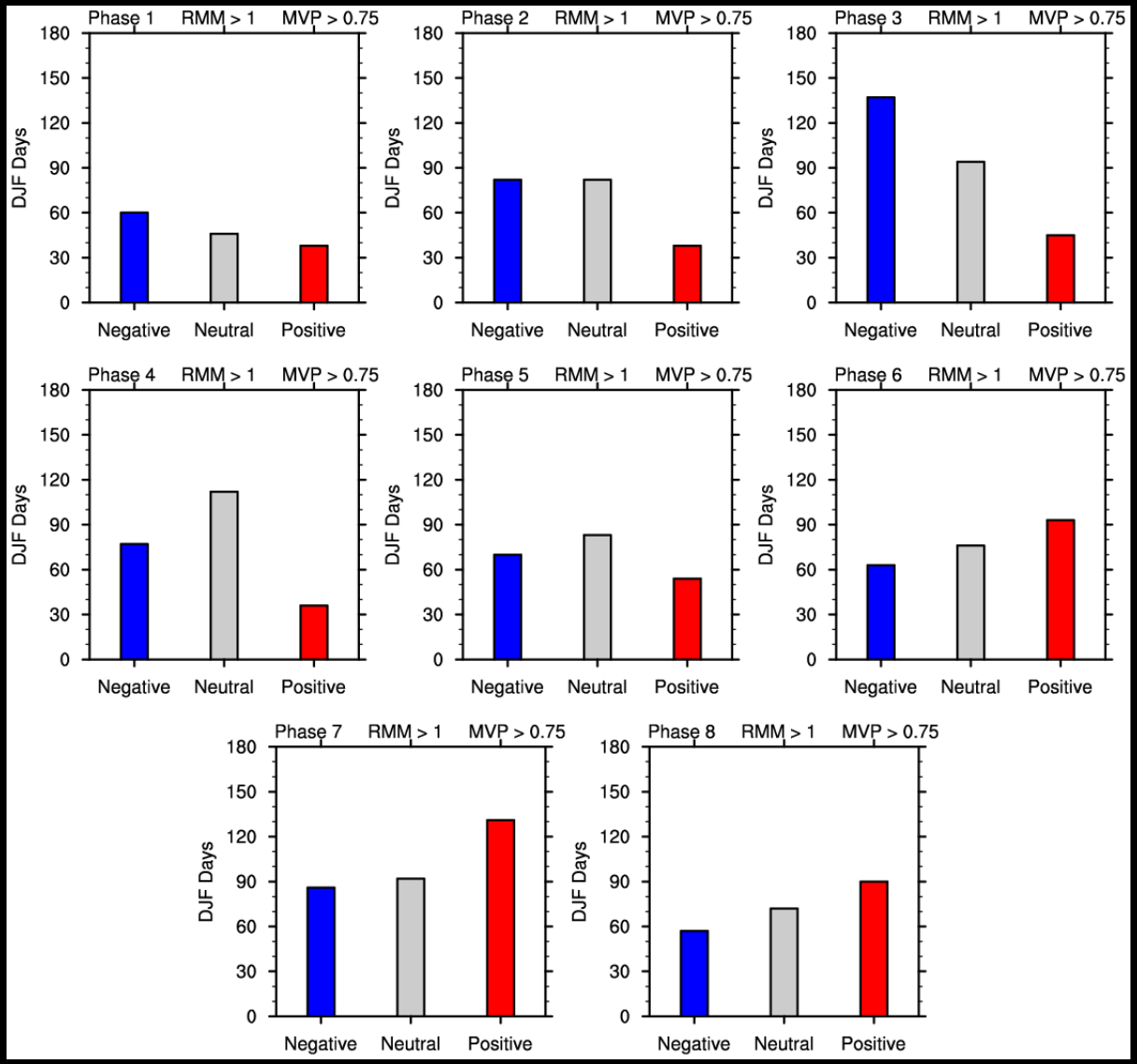


- No clear ENSO signal

PNA Days per RMM Phase



MVP Days per RMM Phase



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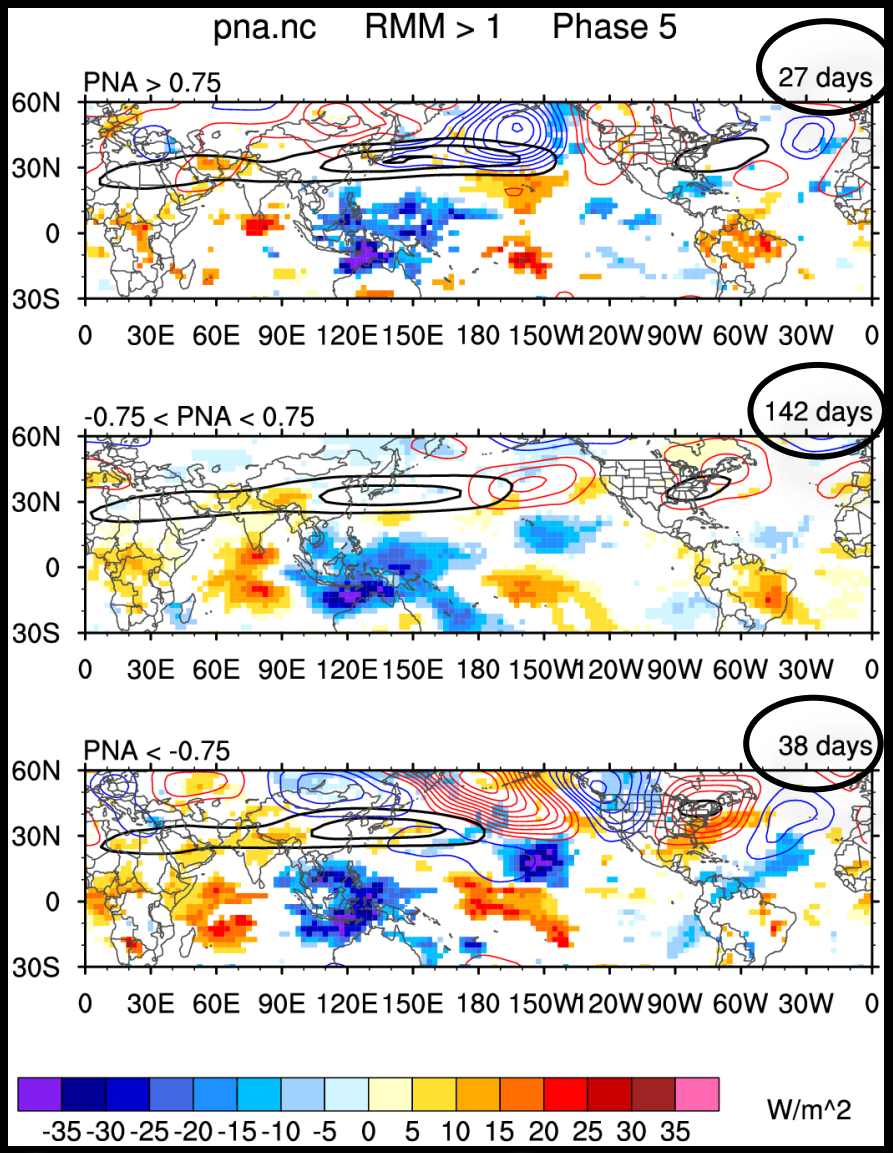

- Similar pattern for PNA–
- Stronger pattern for PNA+
- But not many cases!

OLR anomalies are shaded.
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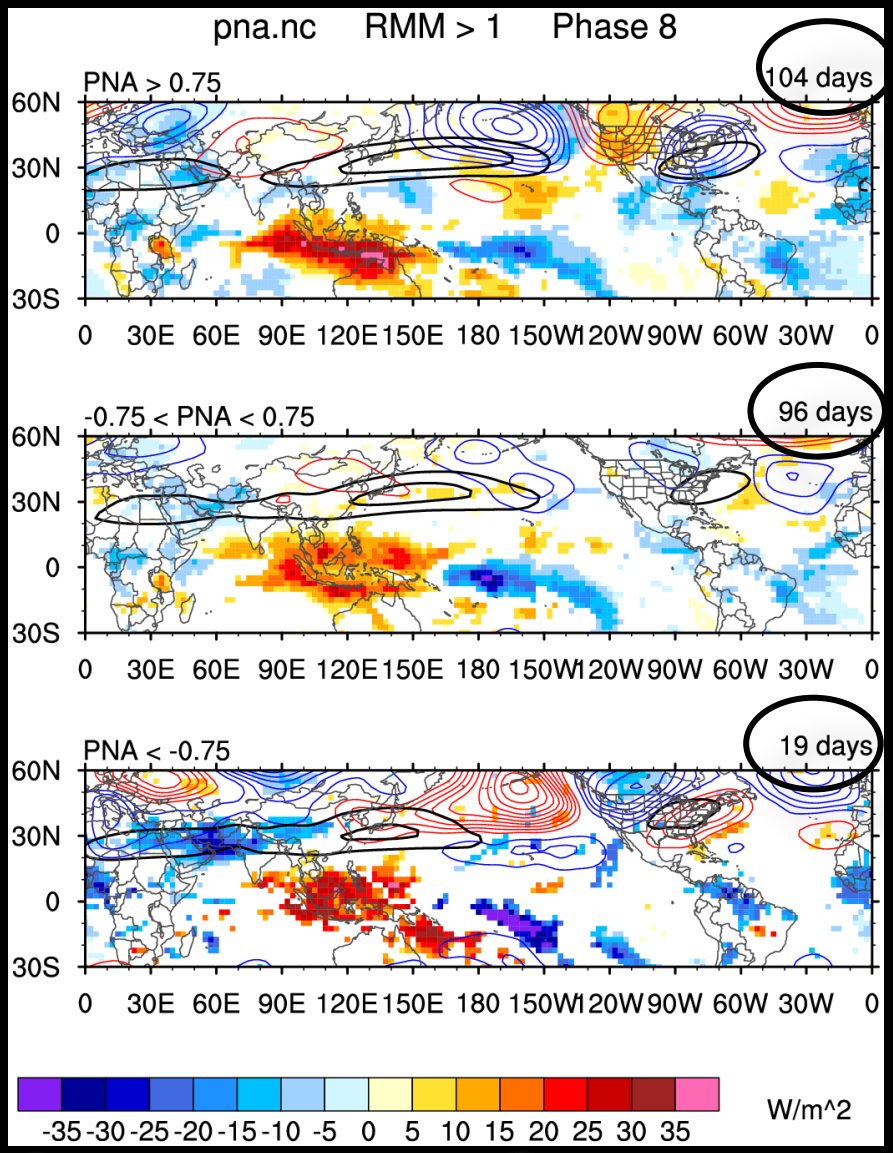
Black contours show Total 200-hPa Zonal Wind.

Cold in Phase 8



- Stronger signal in PNA+
- Still not many events in PNA–

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Black contours show Total 200-hPa Zonal Wind.