

# Characteristics of the South Asian High Variability Revealed by 200hPa Geopotential Height

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Conference on Weather Analysis and Forecasting

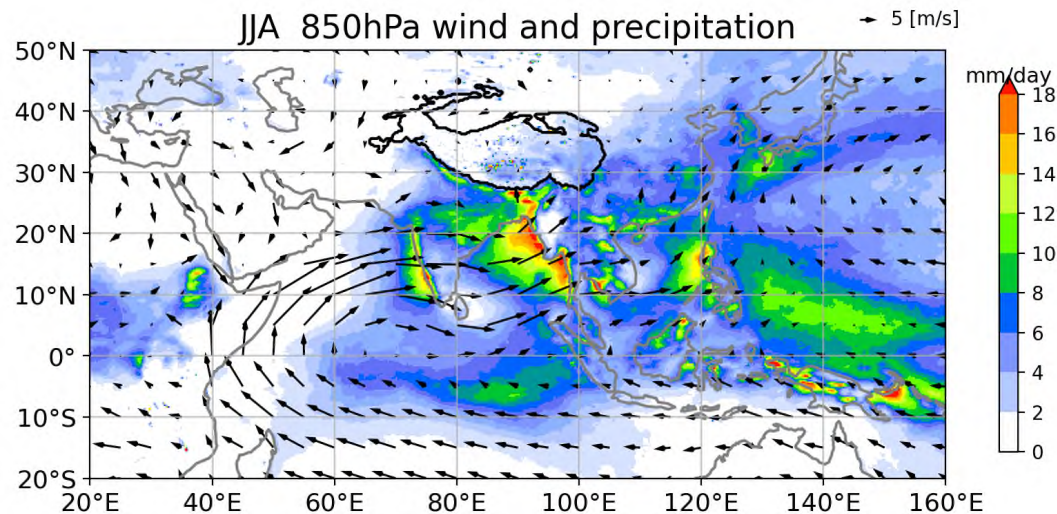
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# Introduction: the South Asia High and Asian Summer Monsoon

The South Asian High (SAH) is the most important upper tropospheric summer system over Asia.

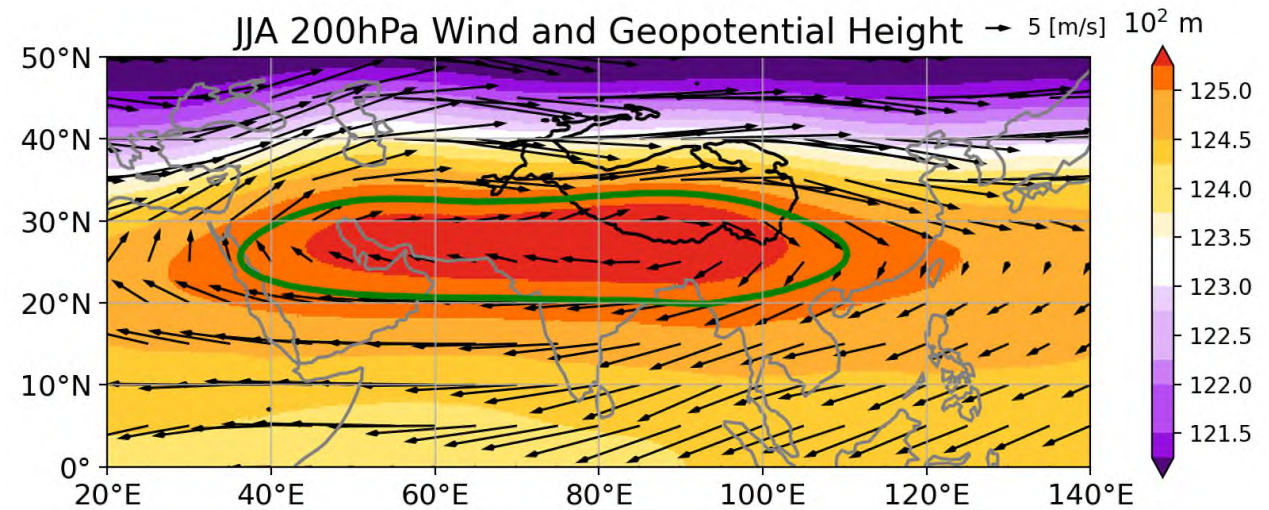
## Lower Troposphere

Shaded: Precipitation  
Vector: 850hPa wind



## Upper Troposphere

Shaded: 200hPa Geopotential Height  
Vector: 200hPa wind  
Contour: 200hPa Geopotential Height  
(12520 m)



# Variability of the SAH

Zhang et al. 2002

- Zhang et al. (2002) found the major centers of the SAH are over Iranian Plateau (west location) and Tibetan Plateau (east location).
- Many studies have examined the bimodal characteristics of the two SAH centers, and tried to understand the variability of the east and west centers on both intraseasonal and interannual timescale (Wei et al. 2015; Yang and Li 2016; Wei et al. 2019b; Zhang et al. 2002).

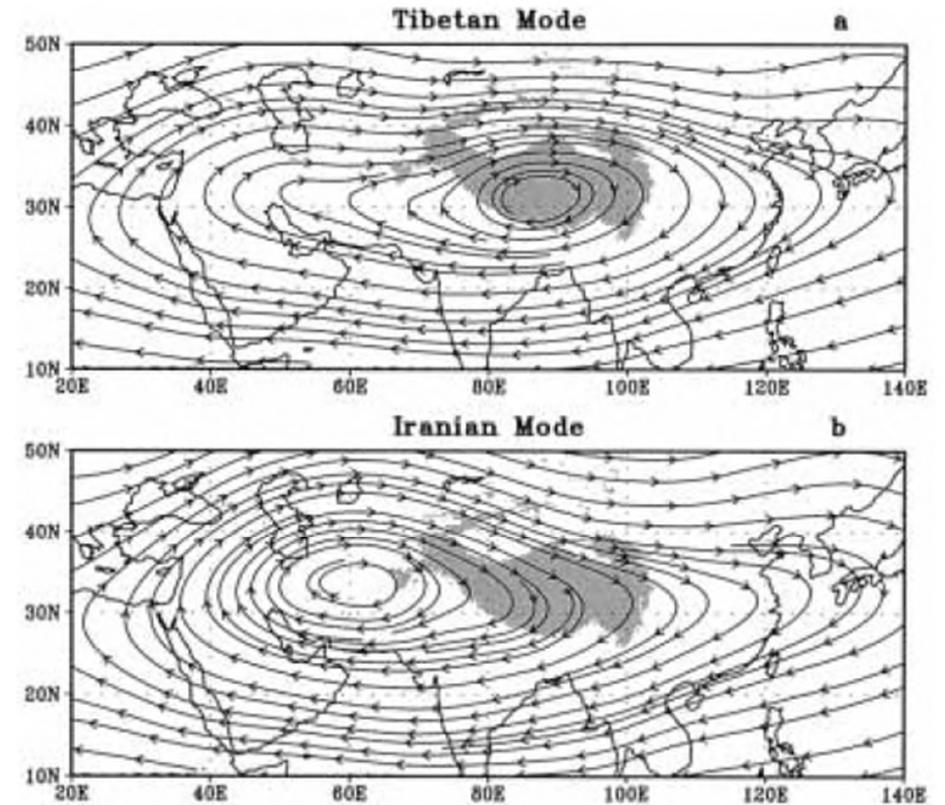
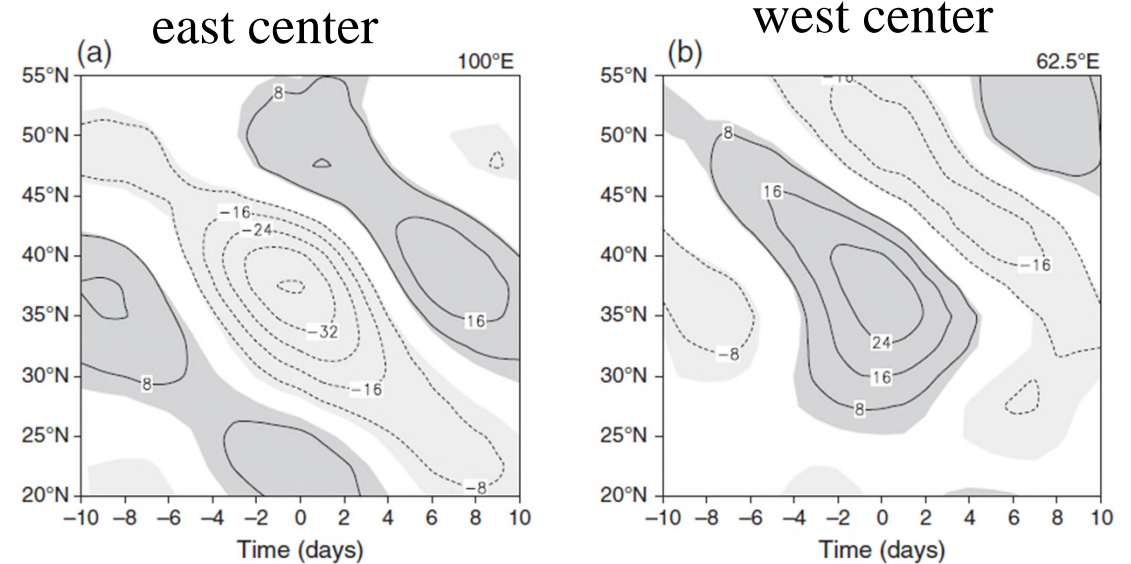


Fig. 3. The 100 hPa streamline composite corresponding to the TM (a) and the IM (b). 77 TM cases, and 62 IM cases are included in 1980–1994 July–August pentads.

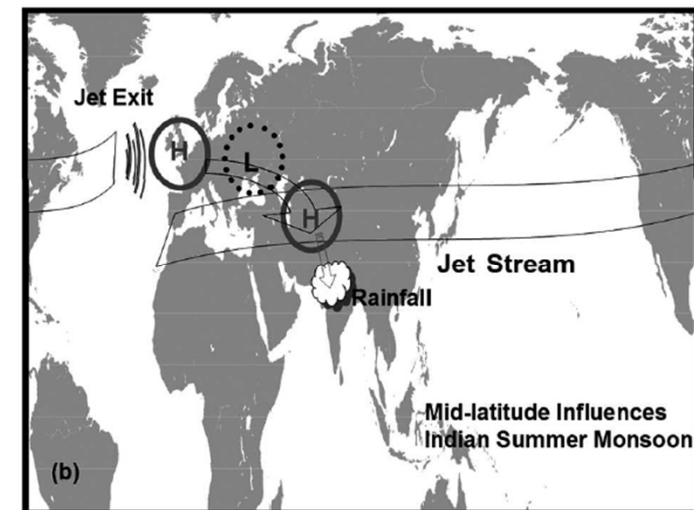
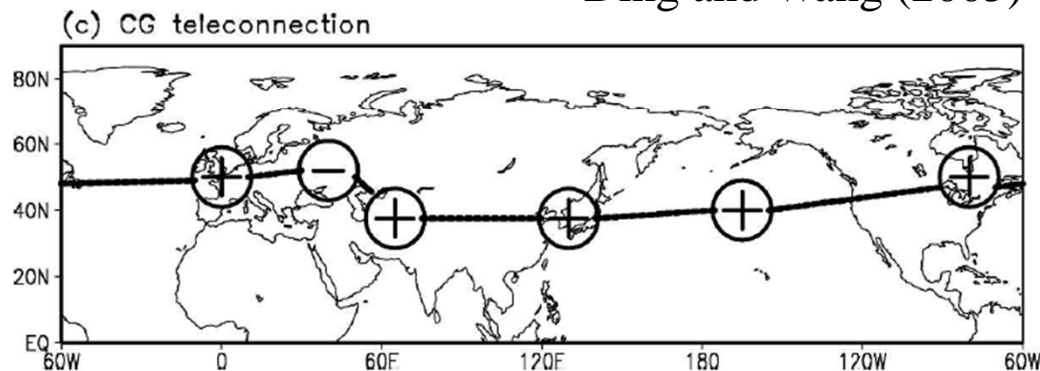
# Mid-latitude influence

- Yang and Li (2016) demonstrated that southward propagation of mid-latitude perturbations have influence on the intraseasonal variability of over the eastern and western centers of the SAH.
- Ding and Wang (2005) demonstrated that the presence of the circumglobal teleconnection. A wave train, excited in the jet exit region of the North Atlantic, may impact the high-pressure center in west-central Asia.

Yang and Li (2016)



Ding and Wang (2005)



# Objective

1. Understand the spatial and temporal characteristics of SAH using geopotential height at 200hPa.
2. Use EOF analysis to obtain the leading modes of the SAH.
3. Investigate the associated large-scale circulations with the variability of the SAH.

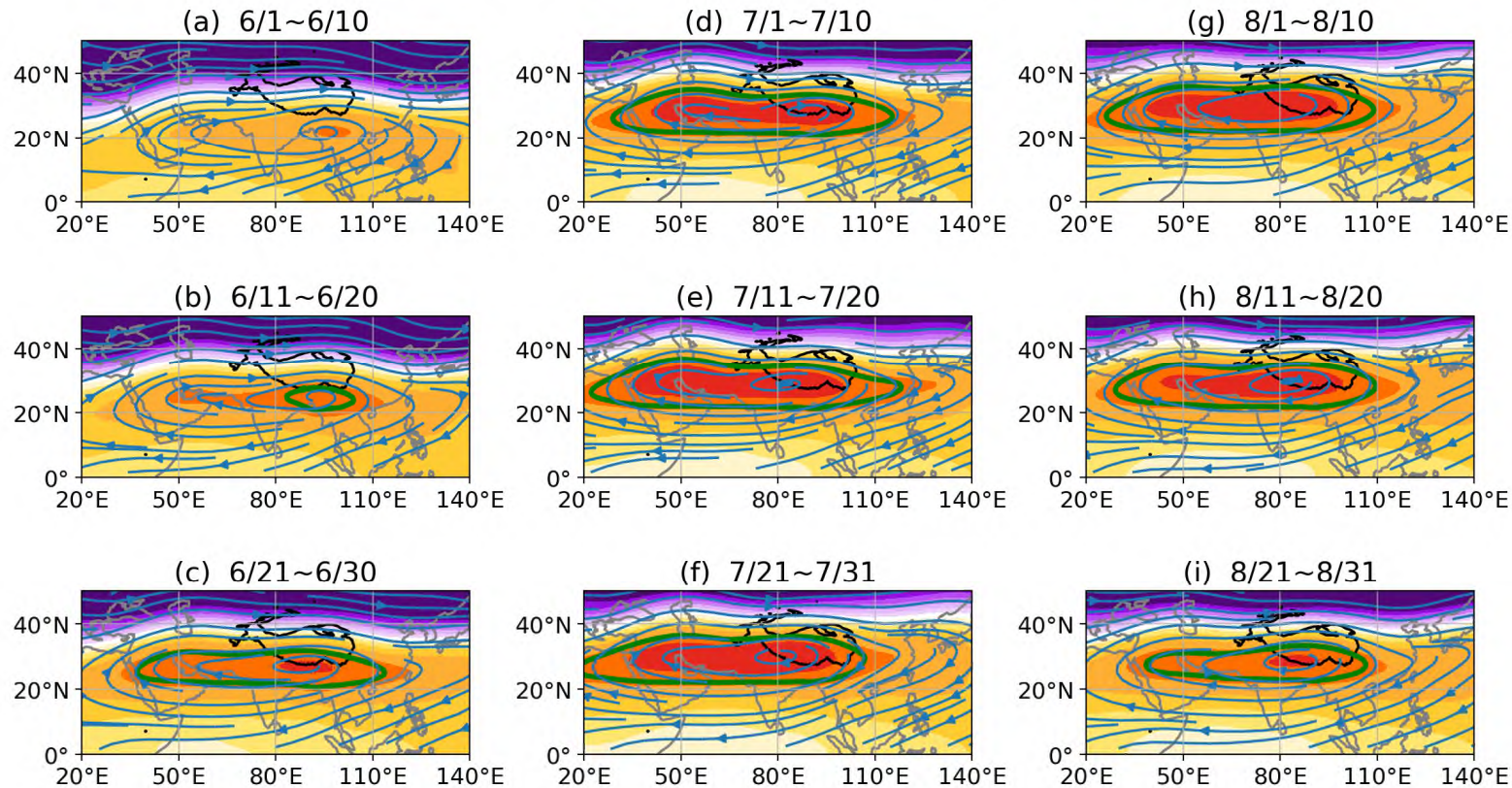
# Data and Method

Data	Time	Variable	Resolution
ECMWF Reanalysis (ERA5)	1979-2020 (JJA)	u, v, z	0.25*0.25/daily
CMORPH Precipitation	1998-2020 (JJA)	Precipitation	0.25*0.25/daily
OLR (NOAA)	1979-2020 (JJA)		1*1/daily

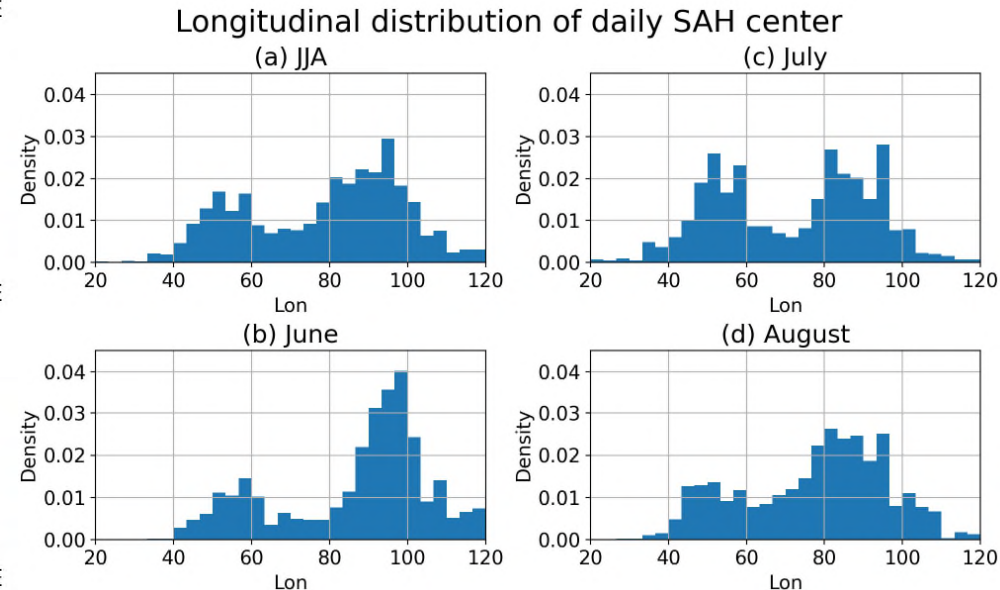
Method	Purpose
EOF analysis	Capturing the dominant modes of the SAH variability
Spectrum analysis using wavelet Lanczos filtering	Investigating the dominant periods of the SAH variability

# Bimodal distribution of the SAH center

## Climatology of 200hPa Wind and Geopotential Height

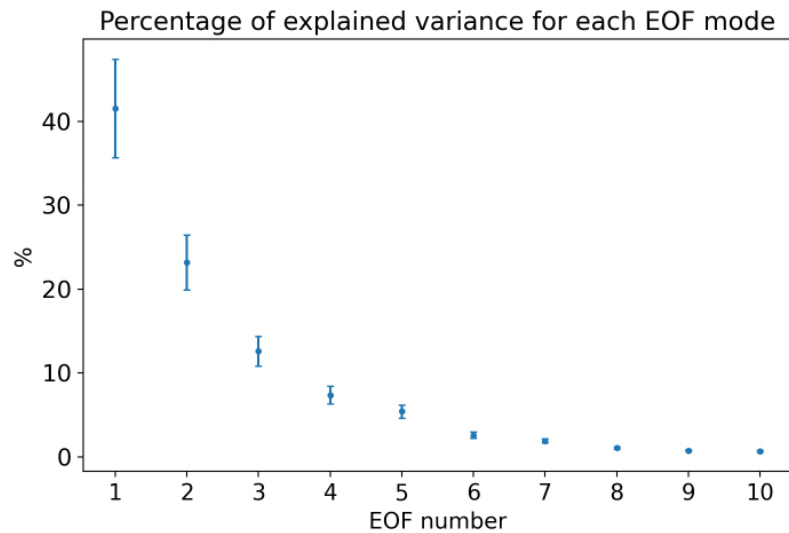
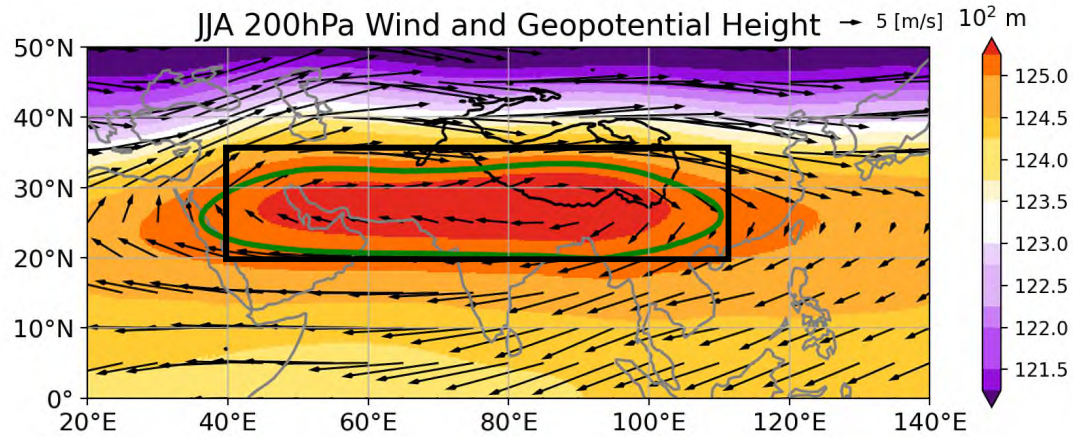


Longitudinal distribution of daily SAH center  
(maximum value of geopotential height at  
200hPa over the 10°-40°N, 20°-120°E)

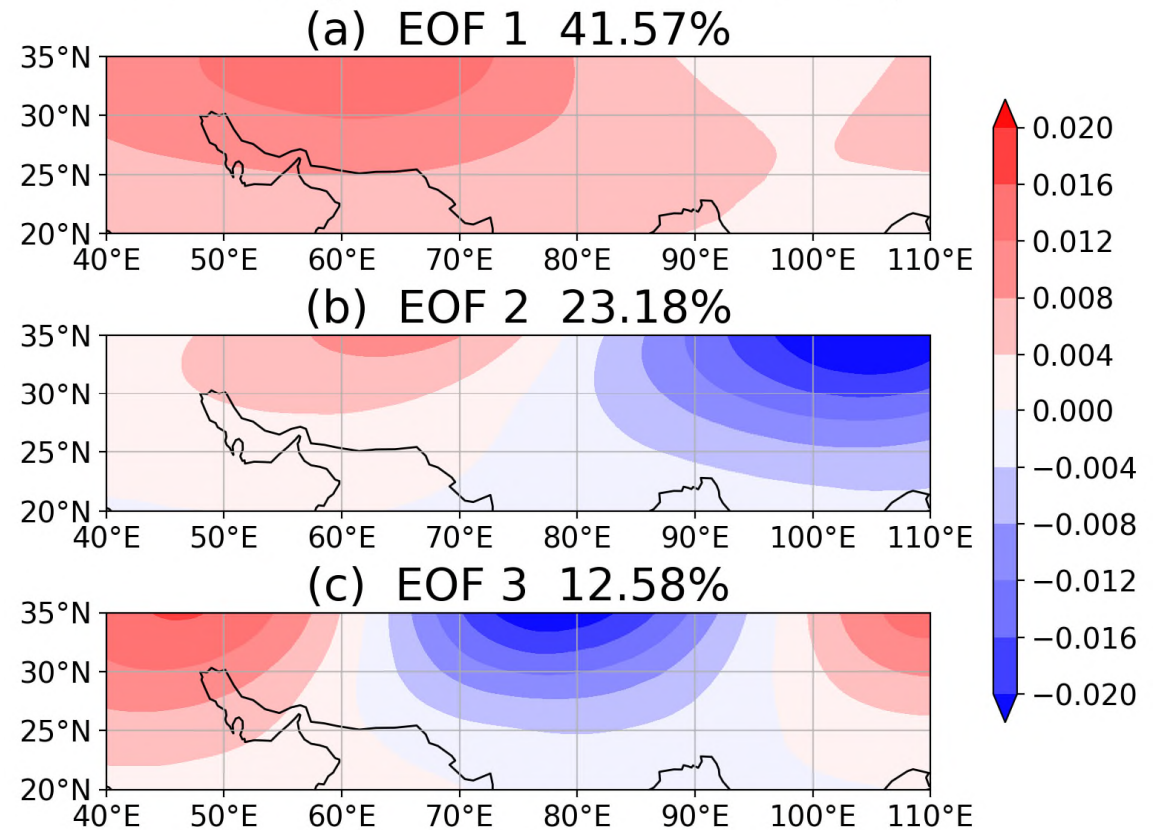


# EOF analysis

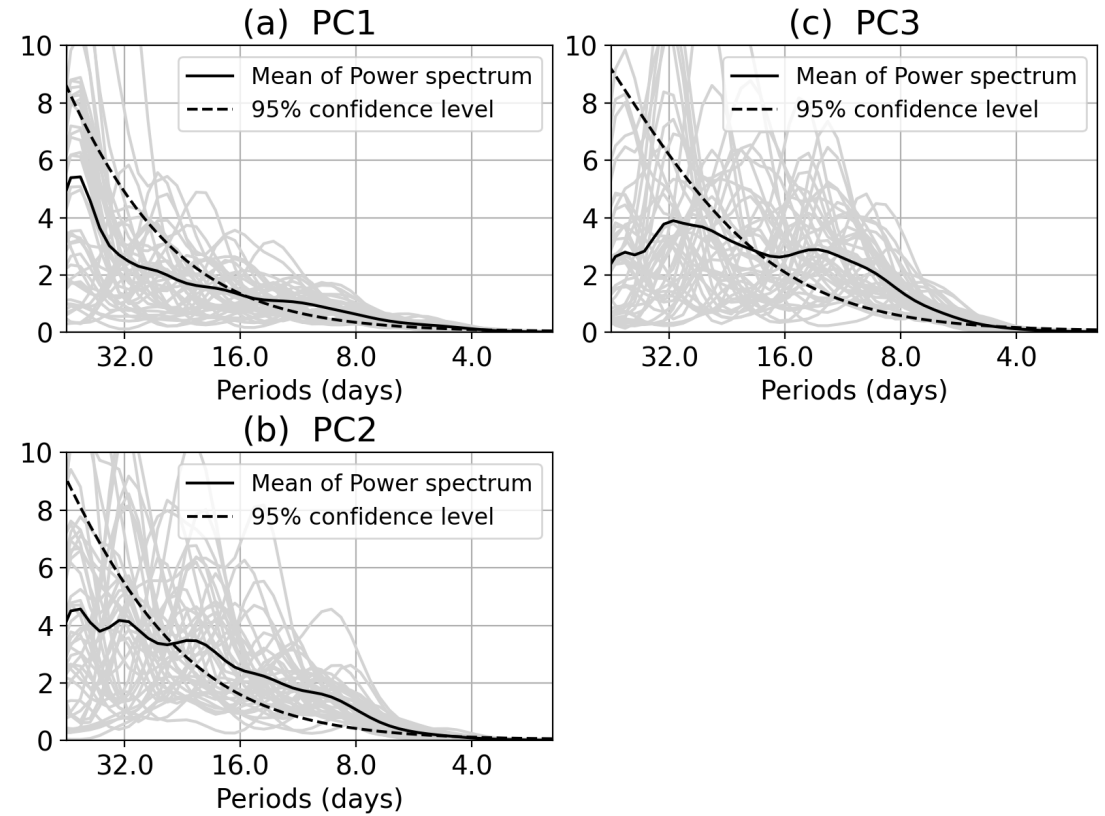
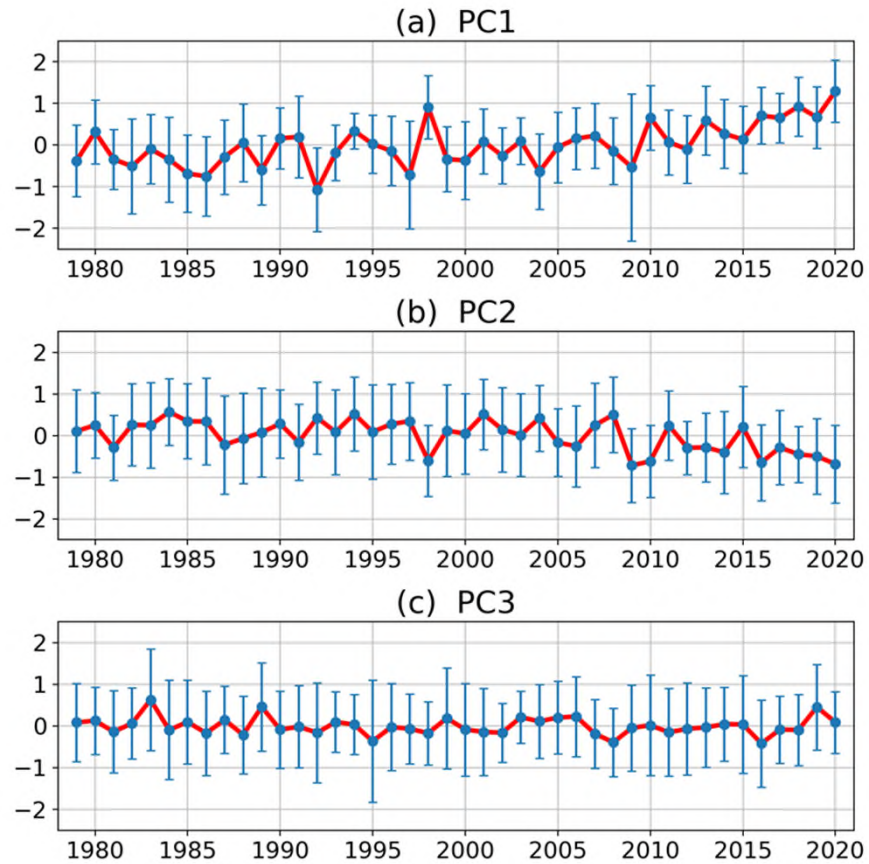
Applying data:  
Z200 daily anomalies (1979-2020 JJA)  
20-35N, 40-110E



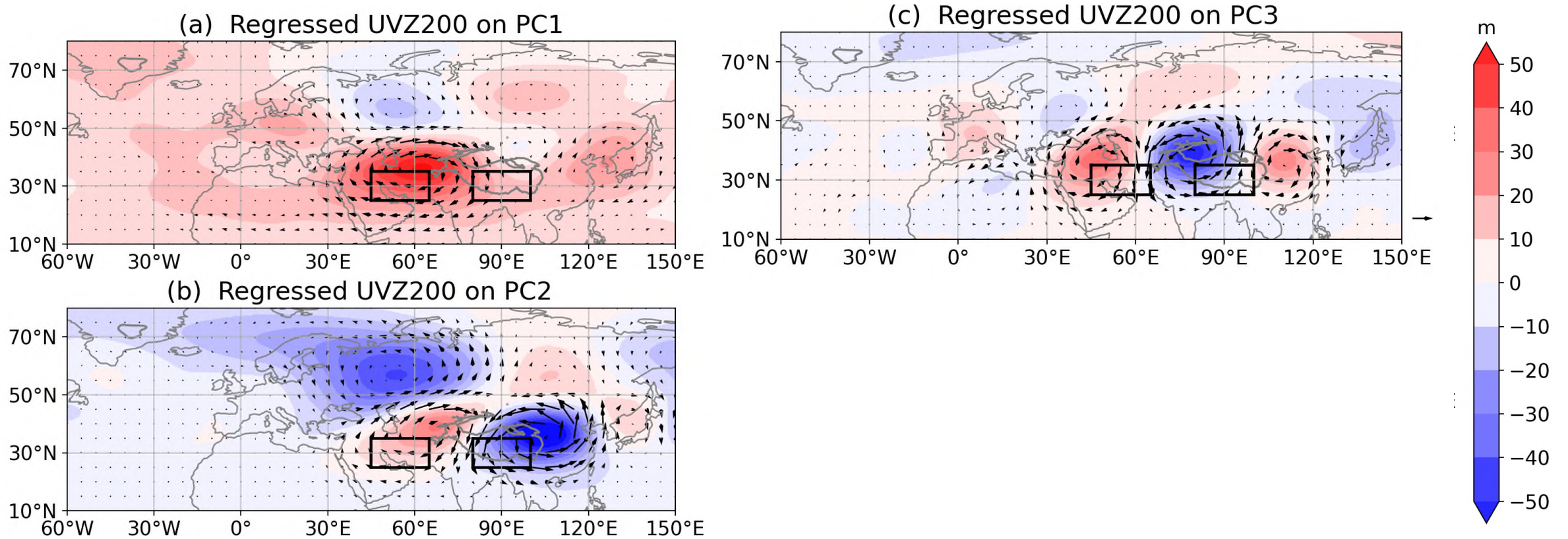
## EOF analysis of 200hPa Z anomaly



# Temporal Characteristics

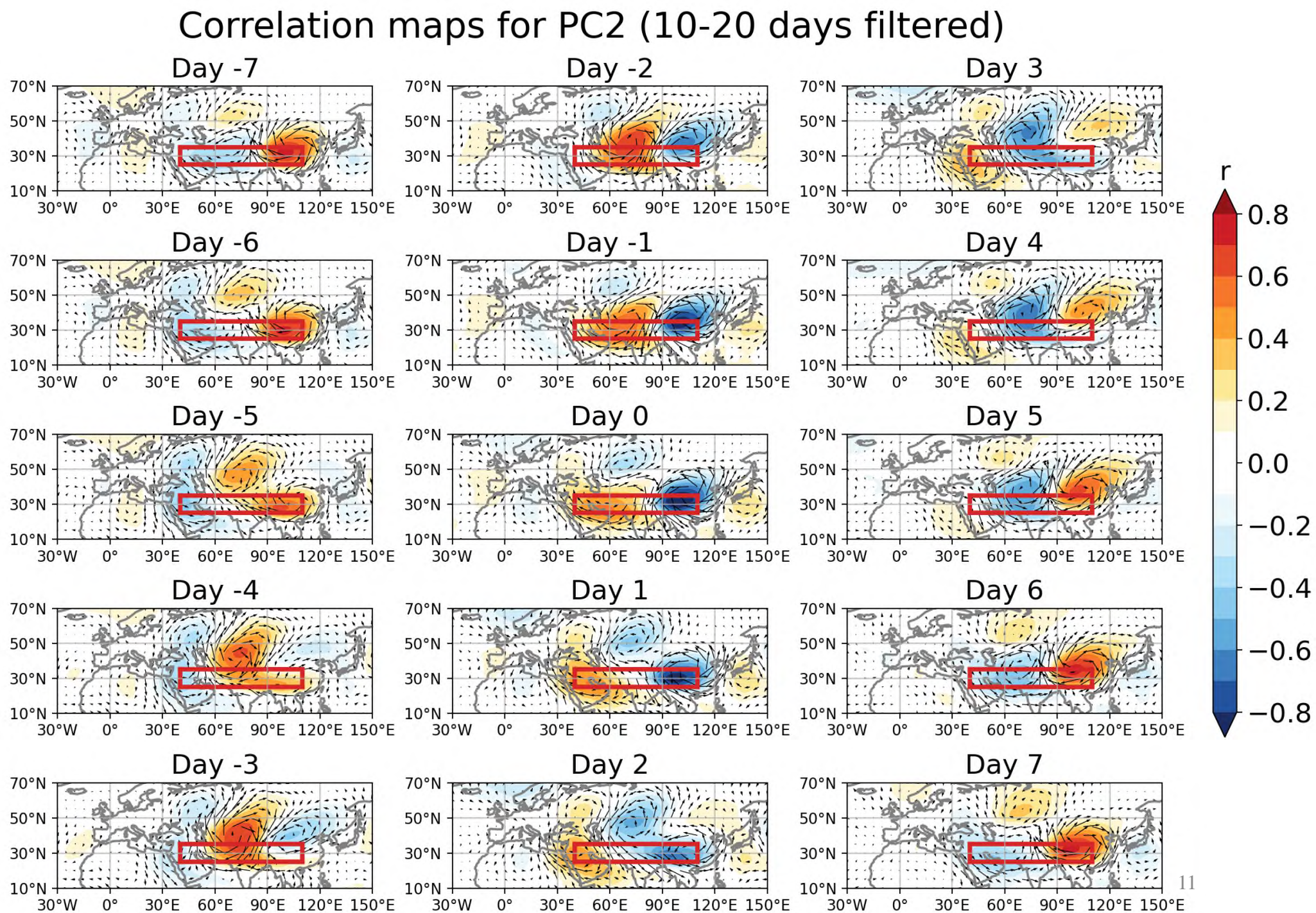


# Associated Large-scale Circulations



# PC2

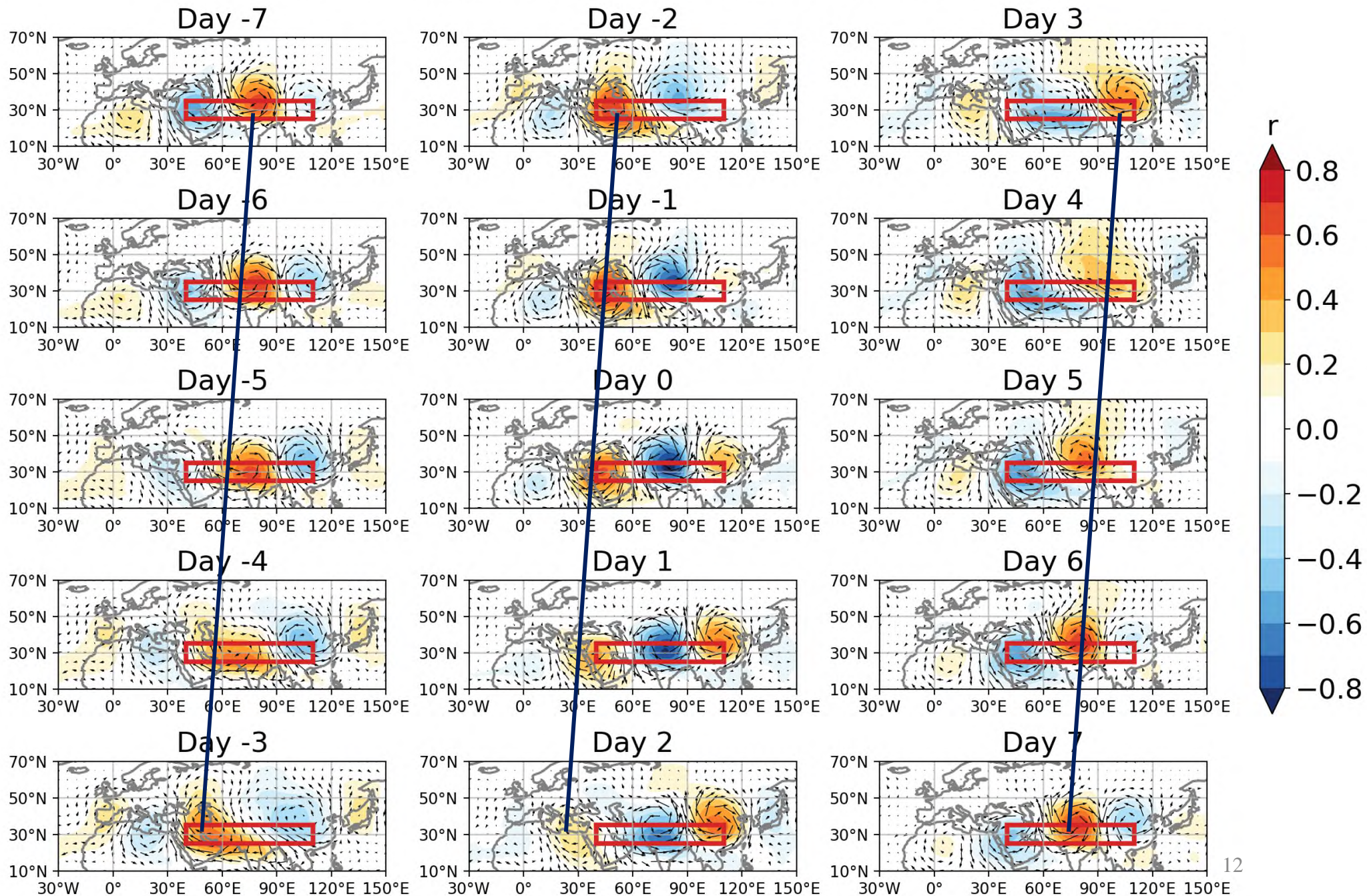
Lead lag correlation maps between the PC2 and UVZ200



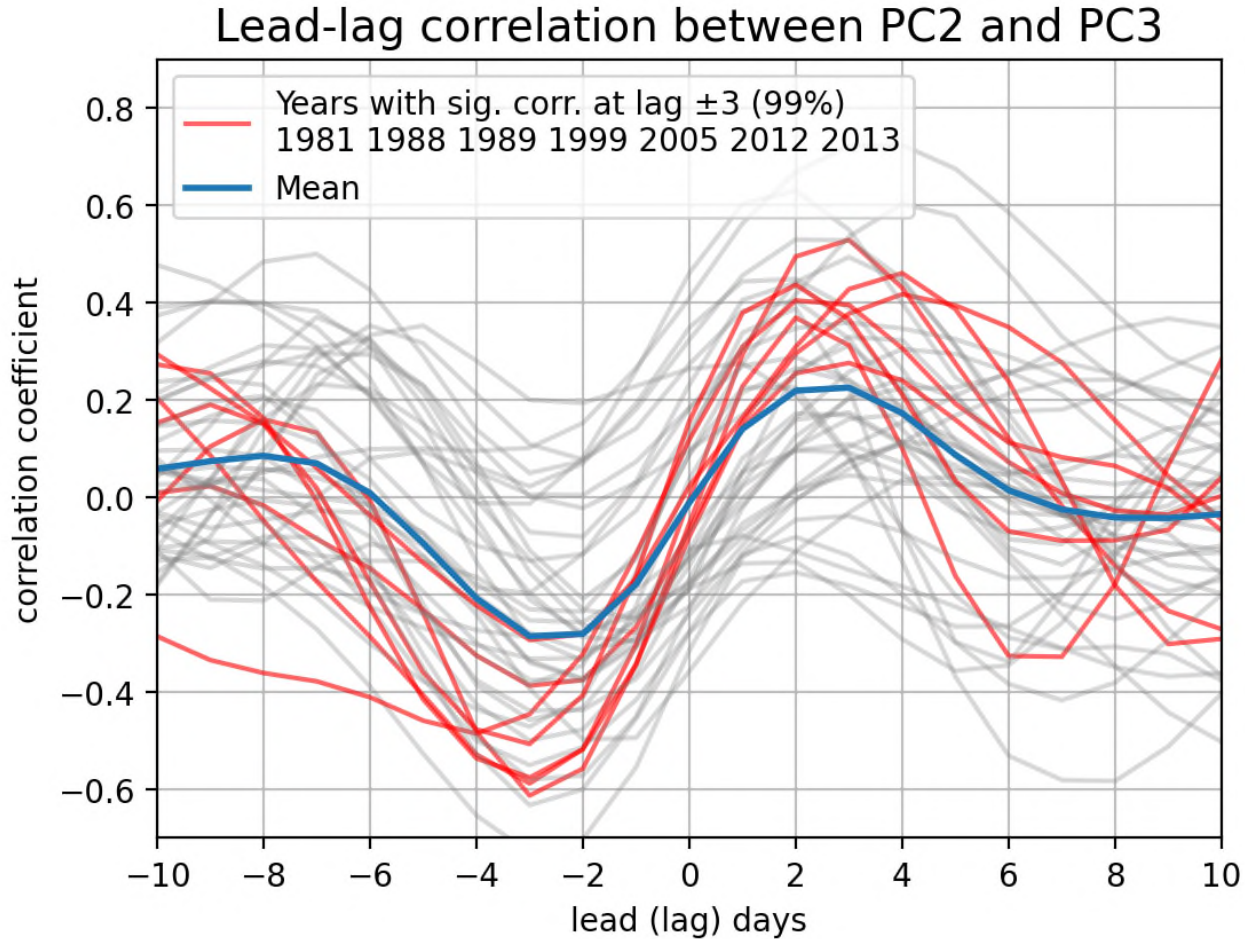
# PC3

Lead lag correlation maps between the PC3 and UVZ200

## Correlation maps for PC3 (10-20 days filtered)

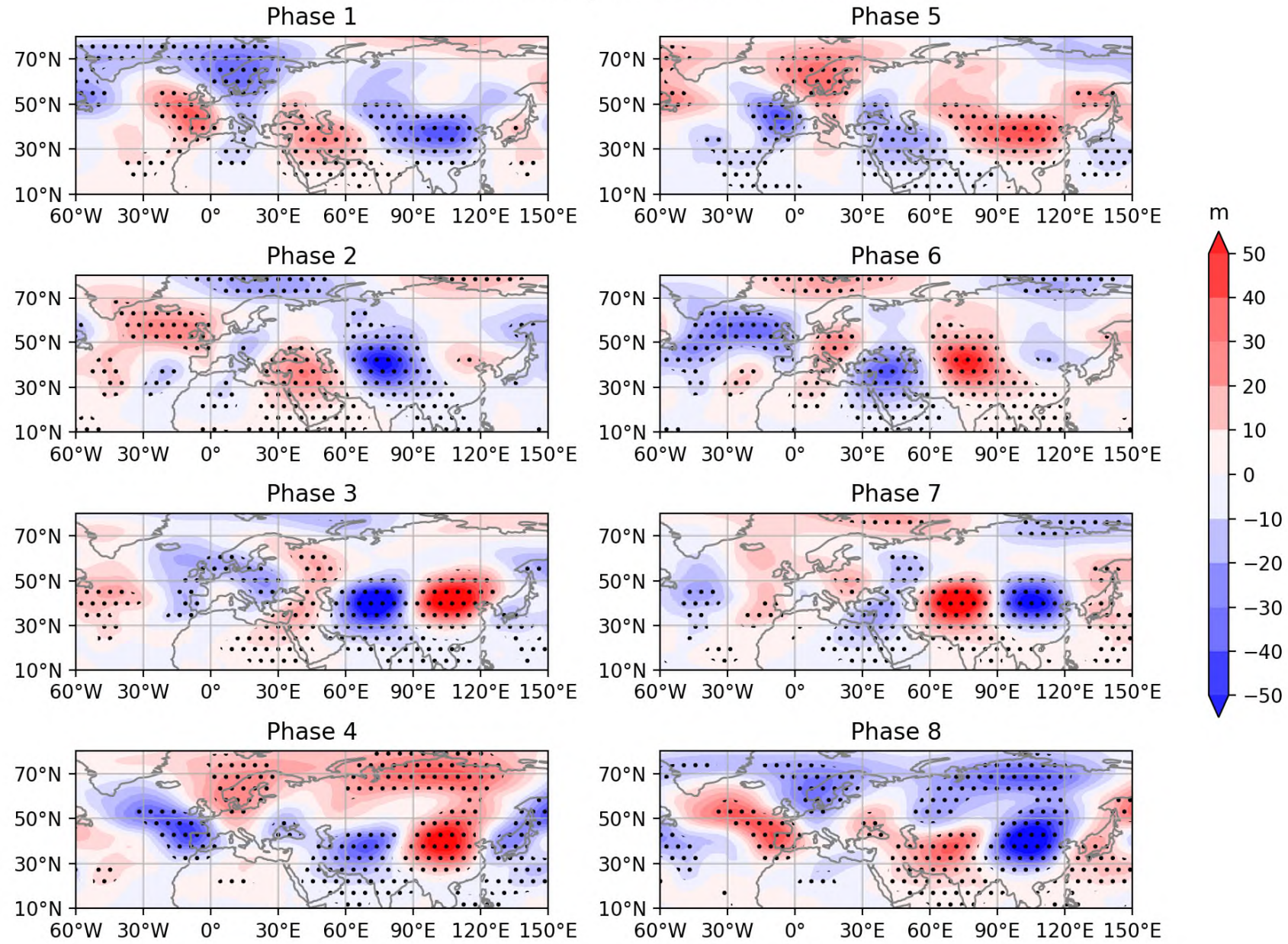
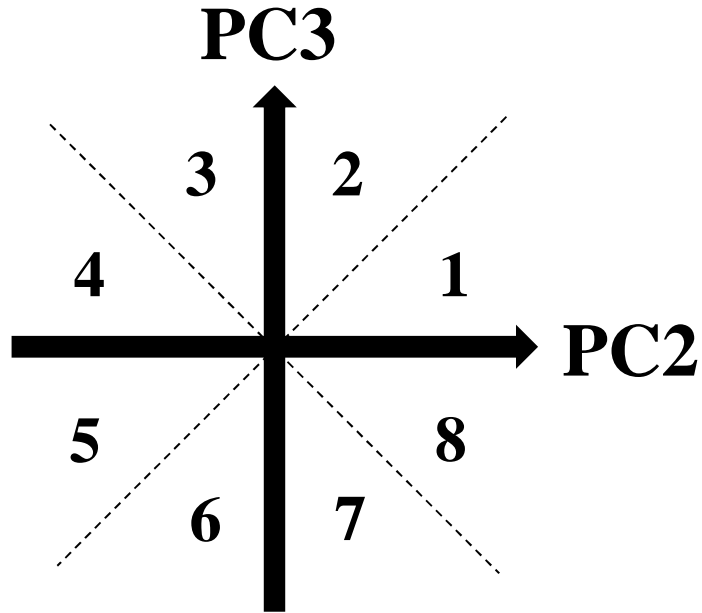


# Lead-lag Correlation Between PC2 and PC3





# Z200 Composite for 8 Phases



Dotted areas indicate  $p < 0.05$  (95% confidence level)

# Summary

1. The SAH center has two preferred locations of the maximum 200 hPa geopotential height ( $Z_{200}$ ) over Iranian Plateau ( $45-65^{\circ}\text{E}$ ) and Tibetan Plateau ( $80-100^{\circ}\text{E}$ ) are identified.
2. Use EOF analysis: The intraseasonal variability of SAH is associated with the southward penetration of mid-latitude waves originating from  $50^{\circ}\text{N}$  or further north and the waveguide trapping effect within the jet stream.
3. Combination of PC2 and PC3: westward-propagating wave train across the South Asian High, and circulations extending from the upstream North Atlantic through Europe into Asia.

# Future Work

1. Analyze the relationship between mid-latitude wave trains, propagating from the North Atlantic through Europe to Asia, and the SAH.
2. Identify specific case studies to better understand this relationship.

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