

<sup>1</sup>Samudra Jit Boruah, <sup>1,2</sup>Ravi S. Nanjundiah & <sup>1,2</sup>Arindam Chakraborty

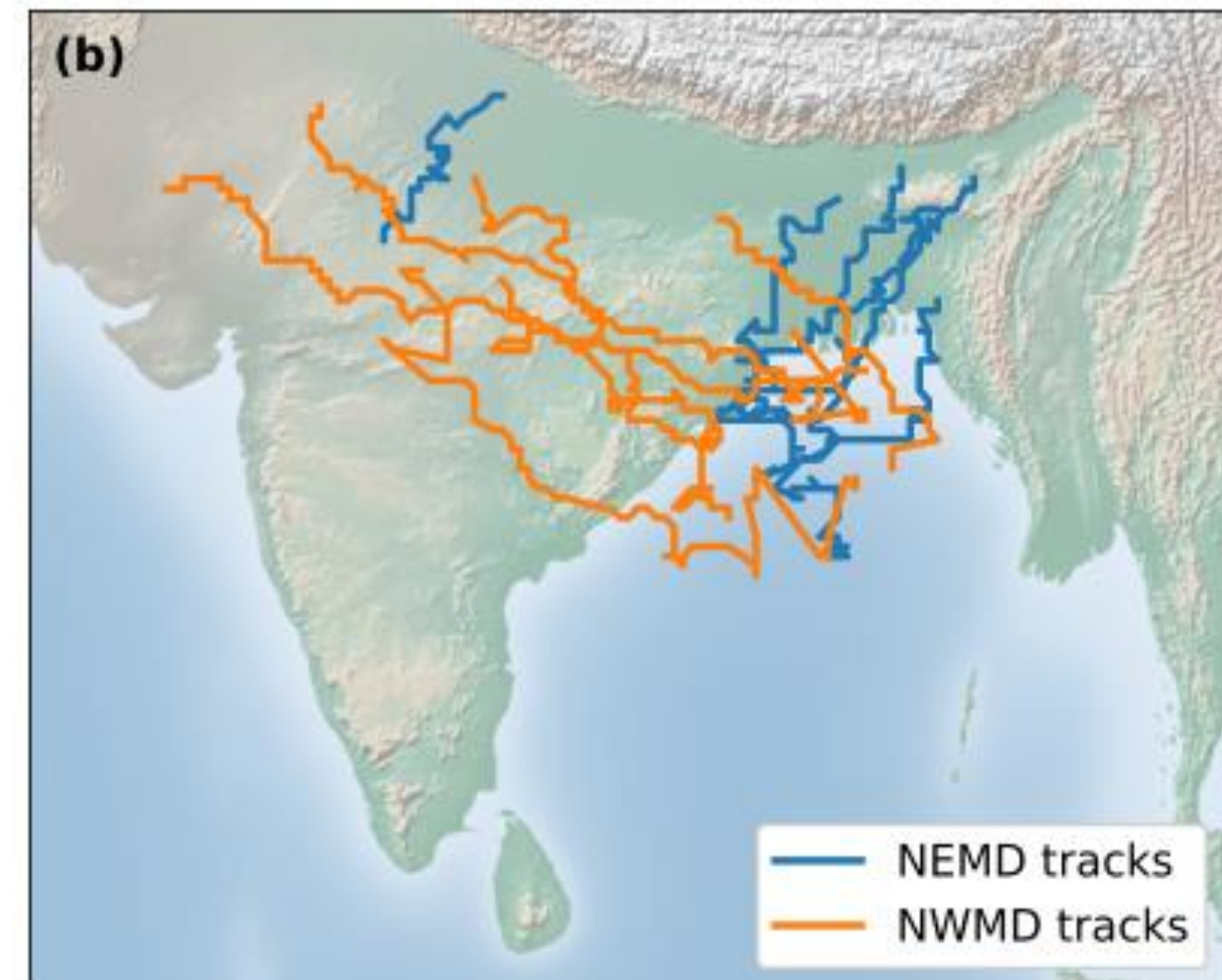
<sup>1</sup>Centre for Atmospheric and Oceanic Sciences, IISc, Bangalore, India, <sup>2</sup>Divecha Centre for Climate Change, IISc, Bangalore, India

- **Monsoon Depressions (MDs)** are generally characterized by a northwestward propagation during their lifetime.
- Track Variability of MDs, which are primarily observed during June and September, have not been studied so far. We aim to identify and understand these anomalous cases.

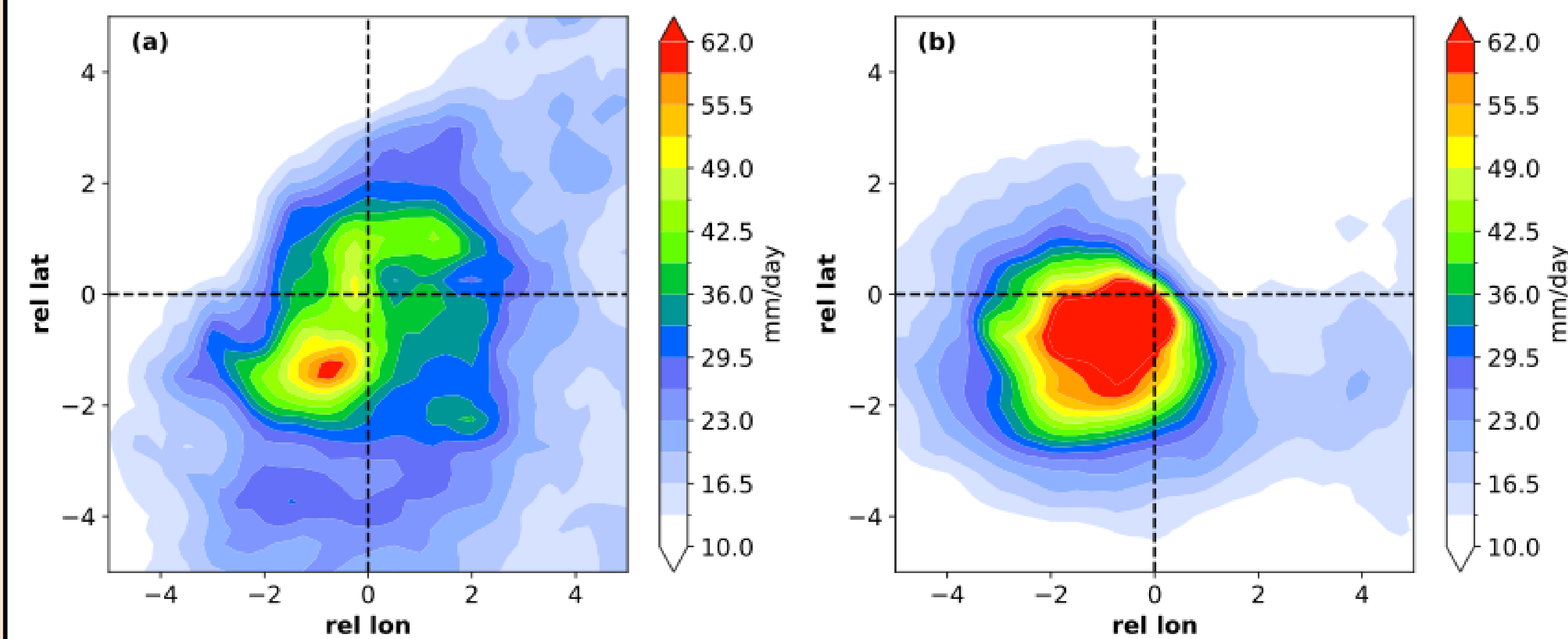
## NOMENCLATURE

**NEMD:** MD moving in northeastward direction for at least 60% of their lifetime.

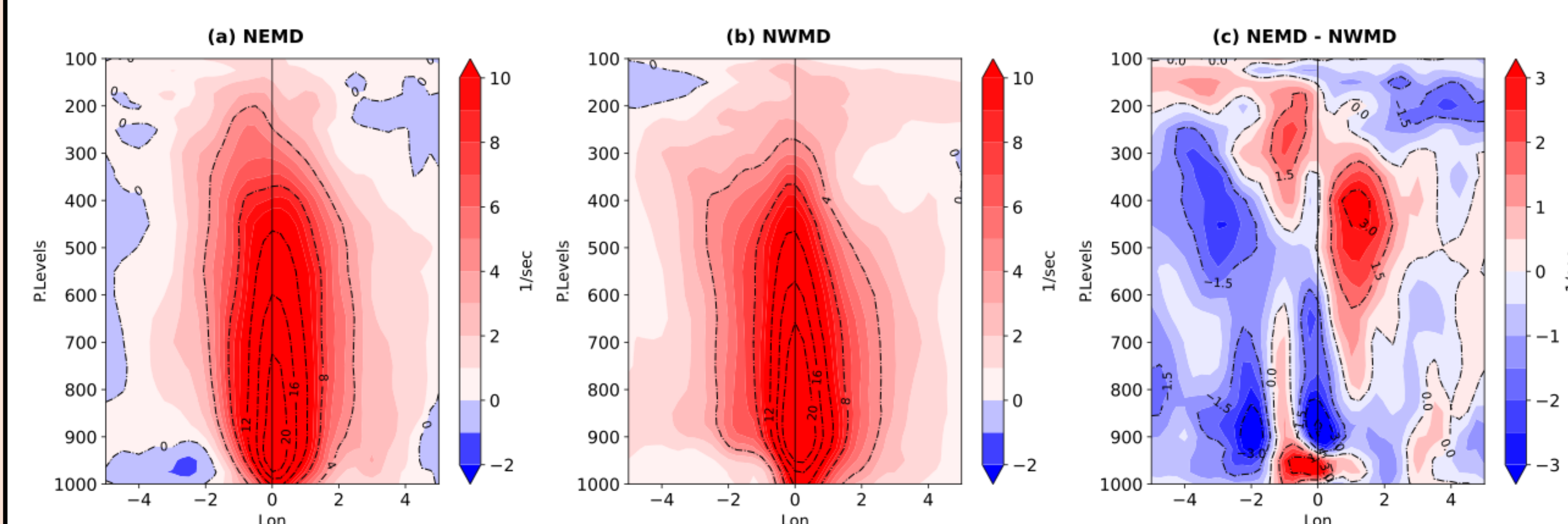
**NWMD:** MD moving in northwestward direction for at least 60% of their lifetime.



## VORTEX CENTRIC RAINFALL COMPOSITES

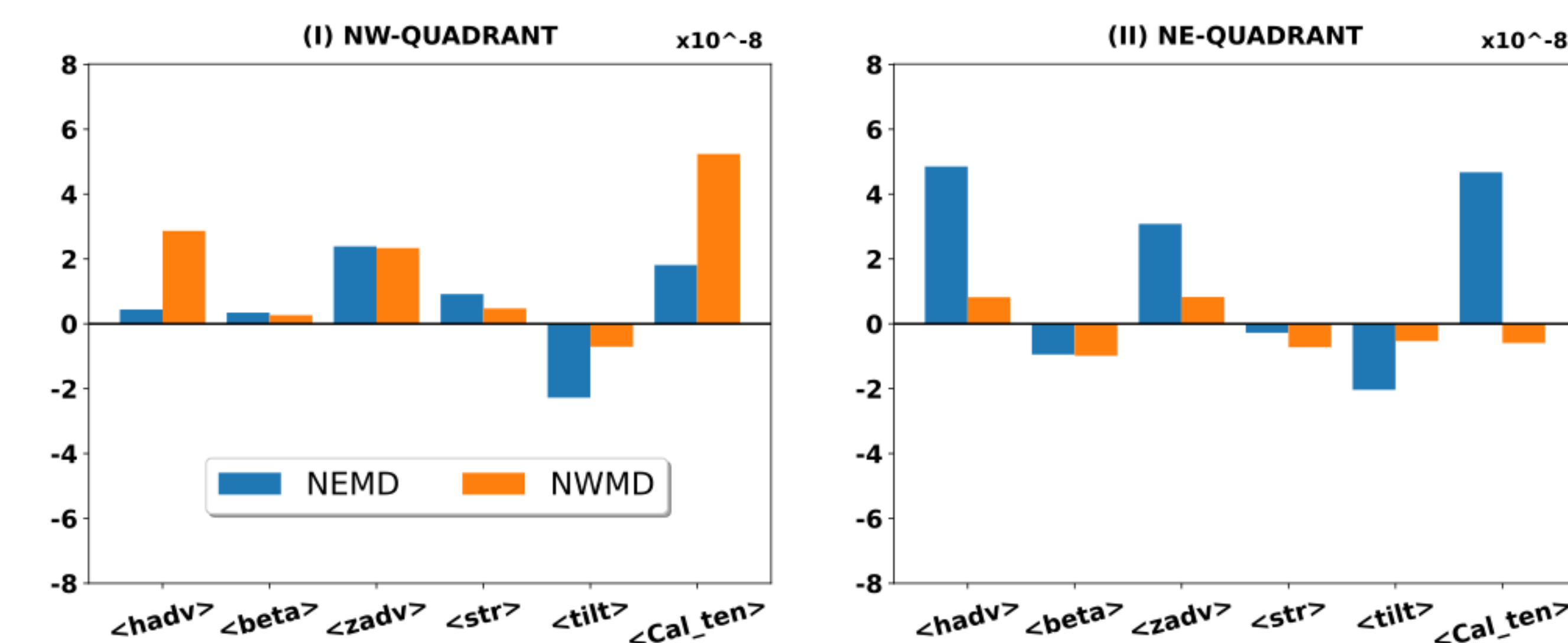


## RELATIVE VORTICITY ANOMALIES



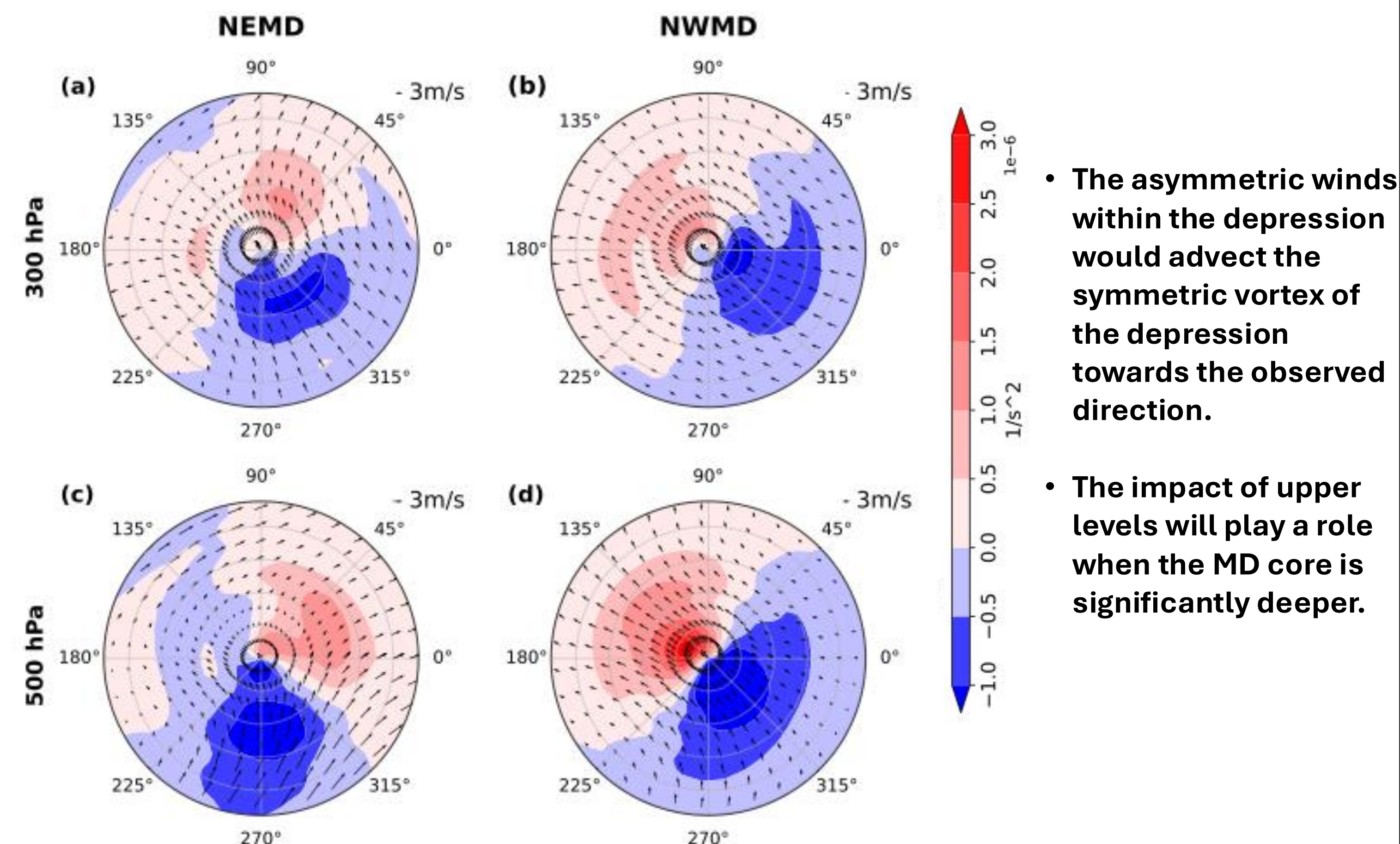
**NEMD** exhibits a **stronger positive anomaly** from mid to upper levels, suggesting a deeper vortex height compared to **NWMD**.

## VERTICALLY INTEGRATED VORTICITY BUDGET



The beta term is significantly smaller in magnitude compared to the horizontal vorticity advection and subsequently, to the local tendency term.

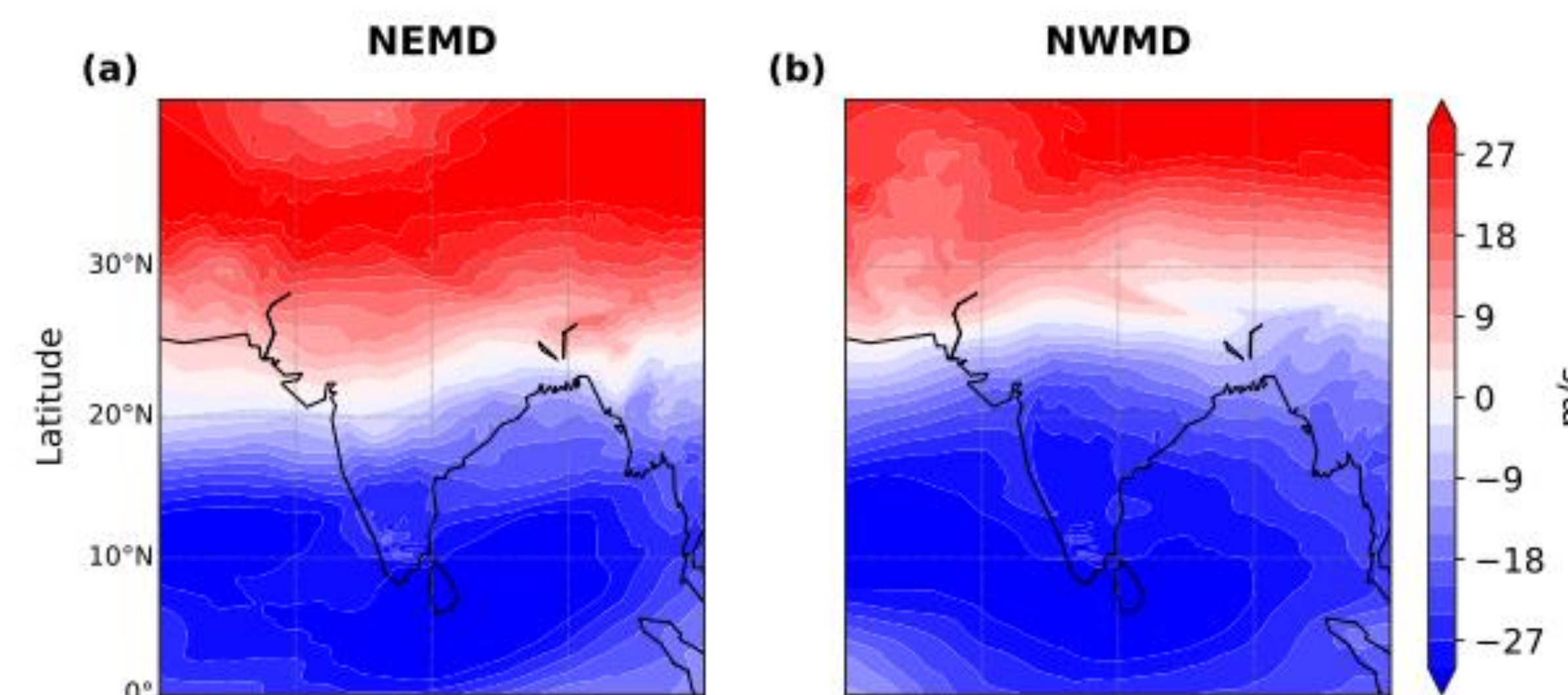
## ASYMMETRIC ADVECTION OF SYMMETRIC VORTICITY



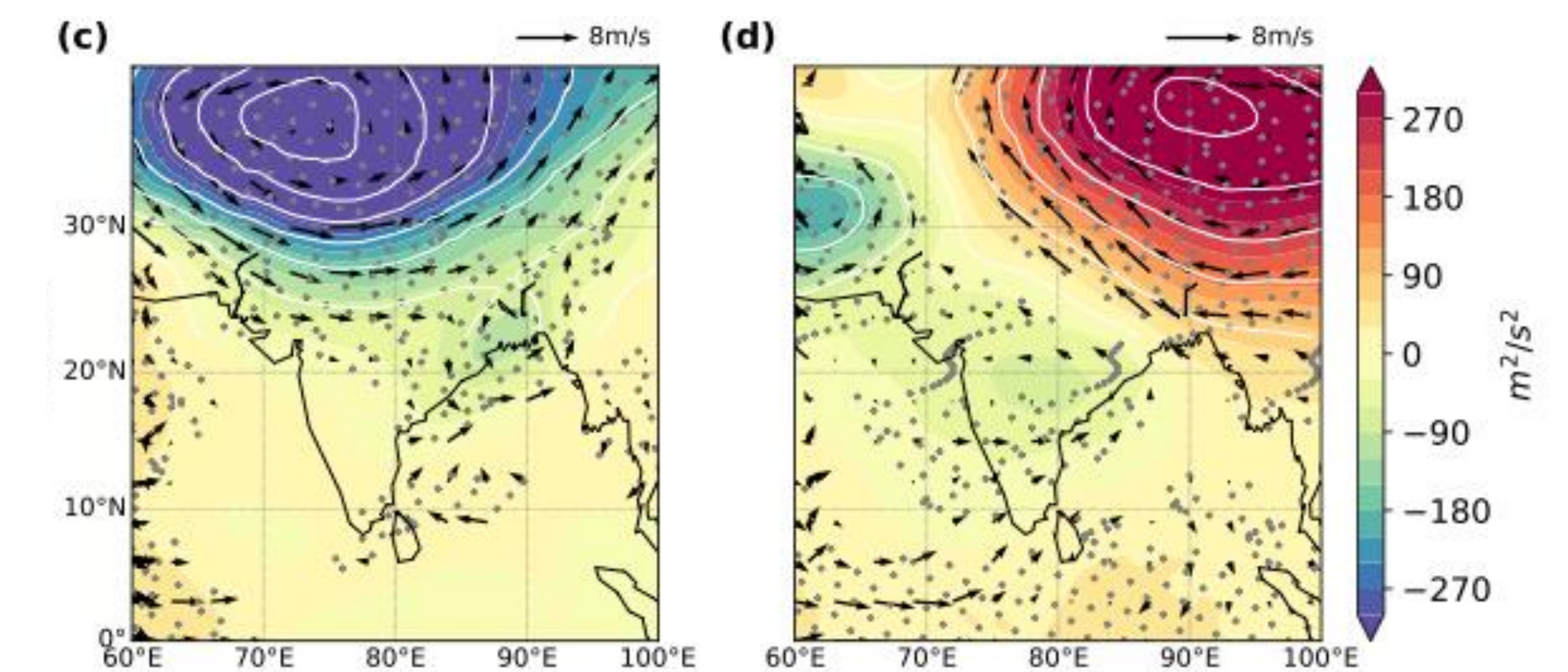
• The asymmetric winds within the depression would advect the symmetric vortex of the depression towards the observed direction.

• The impact of upper levels will play a role when the MD core is significantly deeper.

## ZONAL VERTICAL WIND SHEAR

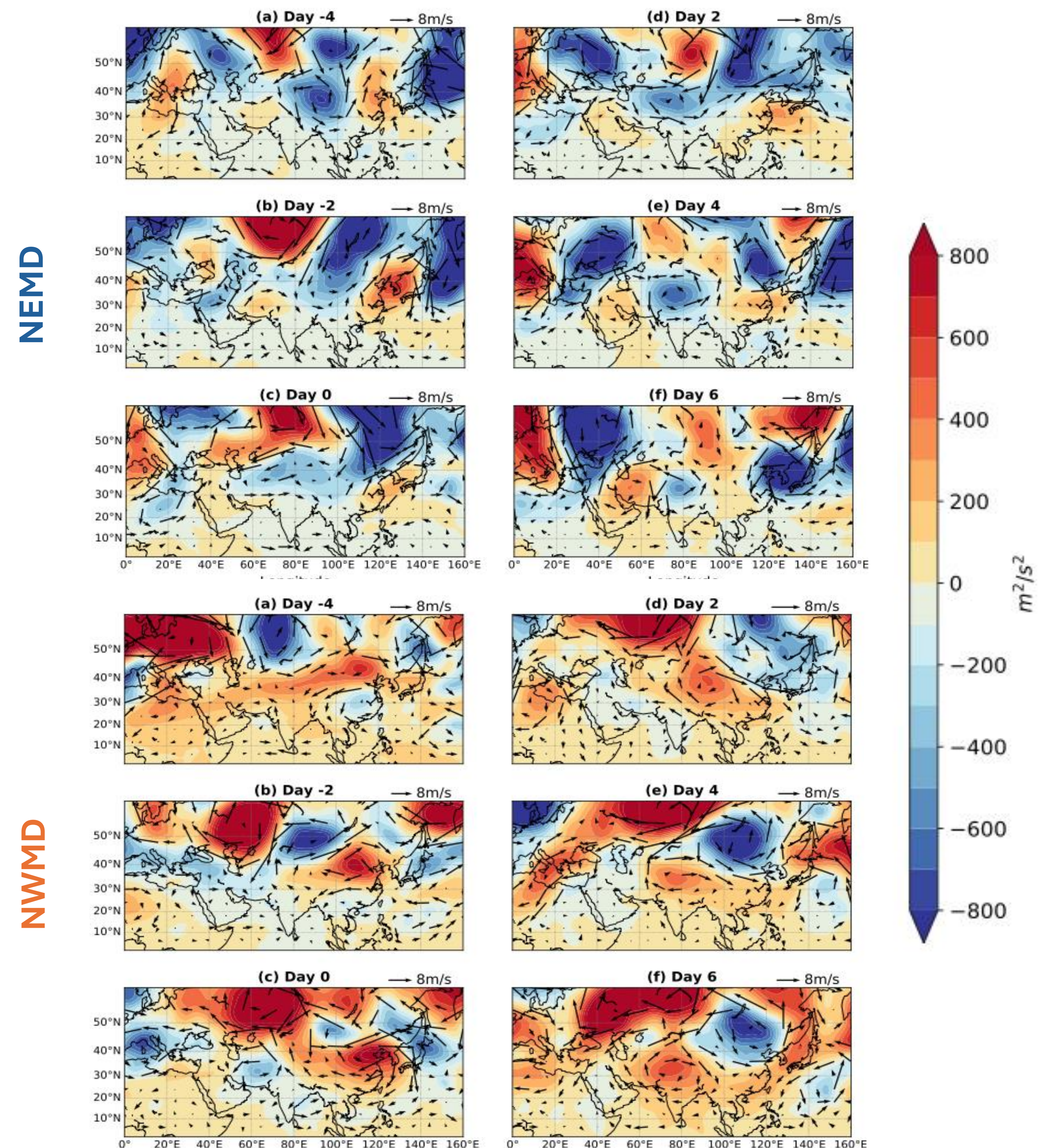


## GEOPOTENTIAL AND WIND ANOMALIES



Strong negative (positive) geopotential anomaly for **NEMD** (**NWMD**), centered at 37N and 72E (90E). Stippled areas represent significant values at 98% confidence.

## LEAD-LAG COMPOSITES OF GEOPOTENTIAL ANOMALIES



## SUMMARY

- **NEMD** are characterized by deeper vortices and comparatively higher rainfall to the east of center.
- Horizontal vorticity advection is the dominant balance in areas of observed propagation in both cases, while the beta term is small.
- MD vortices are advected by asymmetric winds around the center at mid to upper levels.
- Strong geopotential anomalies at 300 hPa can potentially deflect certain MD tracks, recurving them to northeast direction.
- Geopotential anomaly is connected to extra-tropical geopotential structures, showing a possible interaction with sub-tropics.

To connect – [samudrab@iisc.ac.in](mailto:samudrab@iisc.ac.in)

