On the characteristic tilt of boreal summer intraseasonal oscillation(BSISO)

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- BSISO is one of the most important modes of Tropical ISO
- It is active during Boreal Summer , has the timescale of 30-60 days,similar to MJO
- It is known to greatly influence Indian Summer monsoon rainfall pattern and active break cycle.
- Yasunari(1979) , Sikka and Gadgil(1980) identified BSISO.

Sikka and Gadgil(1980)

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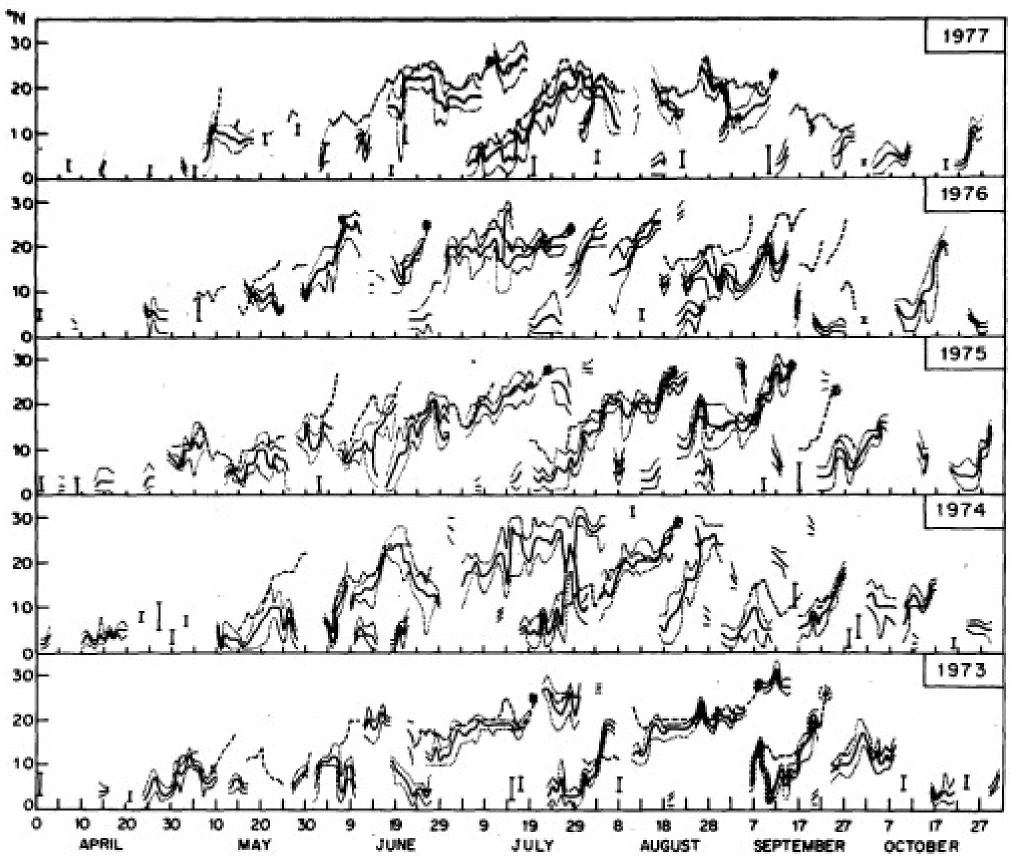


FIG. 4. Daily variation of the latitude of the axis of the MCZ (solid line); northern and southern limits (dotted line) of the MCZ; and the location of the 700 mb trough (dashed line) at 90°E during 1973–77.

Lawrence and Webster(2001)

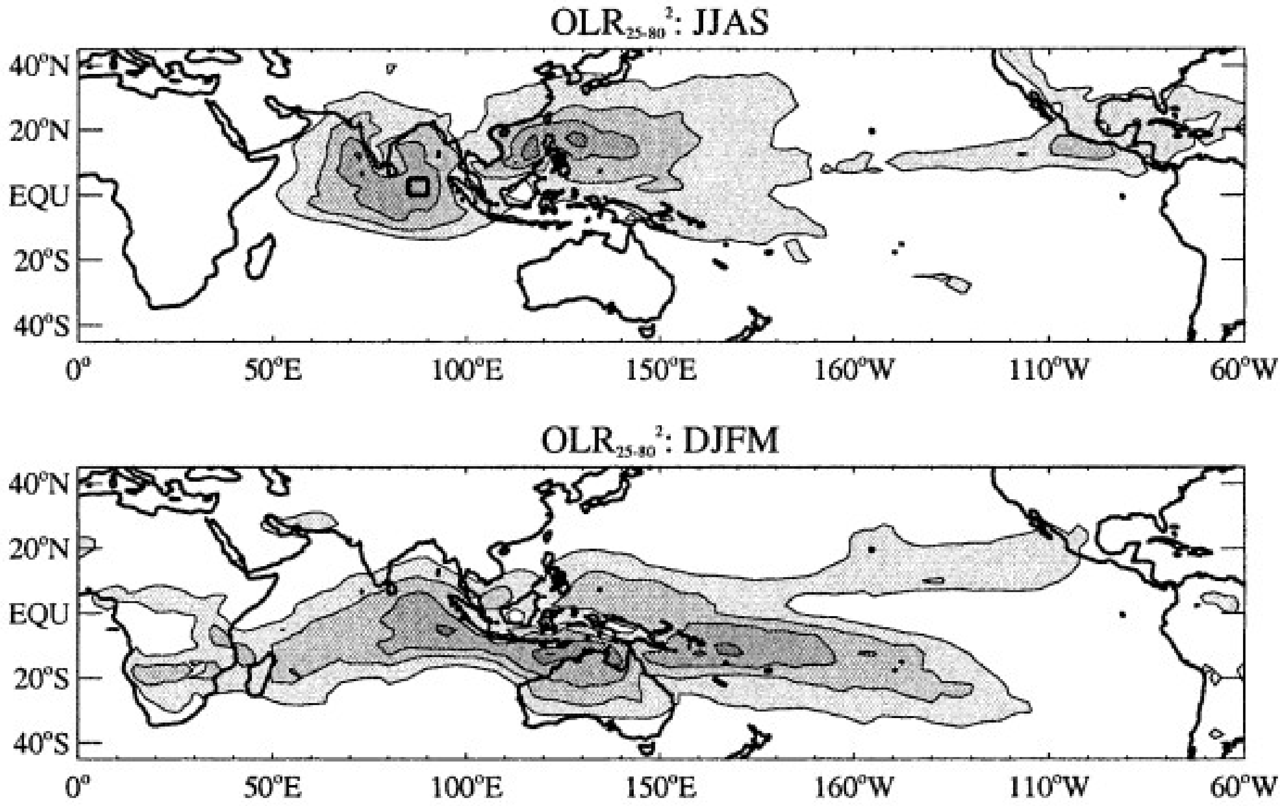


FIG. 3. JJAS and DJFM climatological mean variance maps of 25–80-day bandpass-filtered OLR, contour levels every 100 $W^2\ m^{-4}$.

Lawrence and Webster (2001)

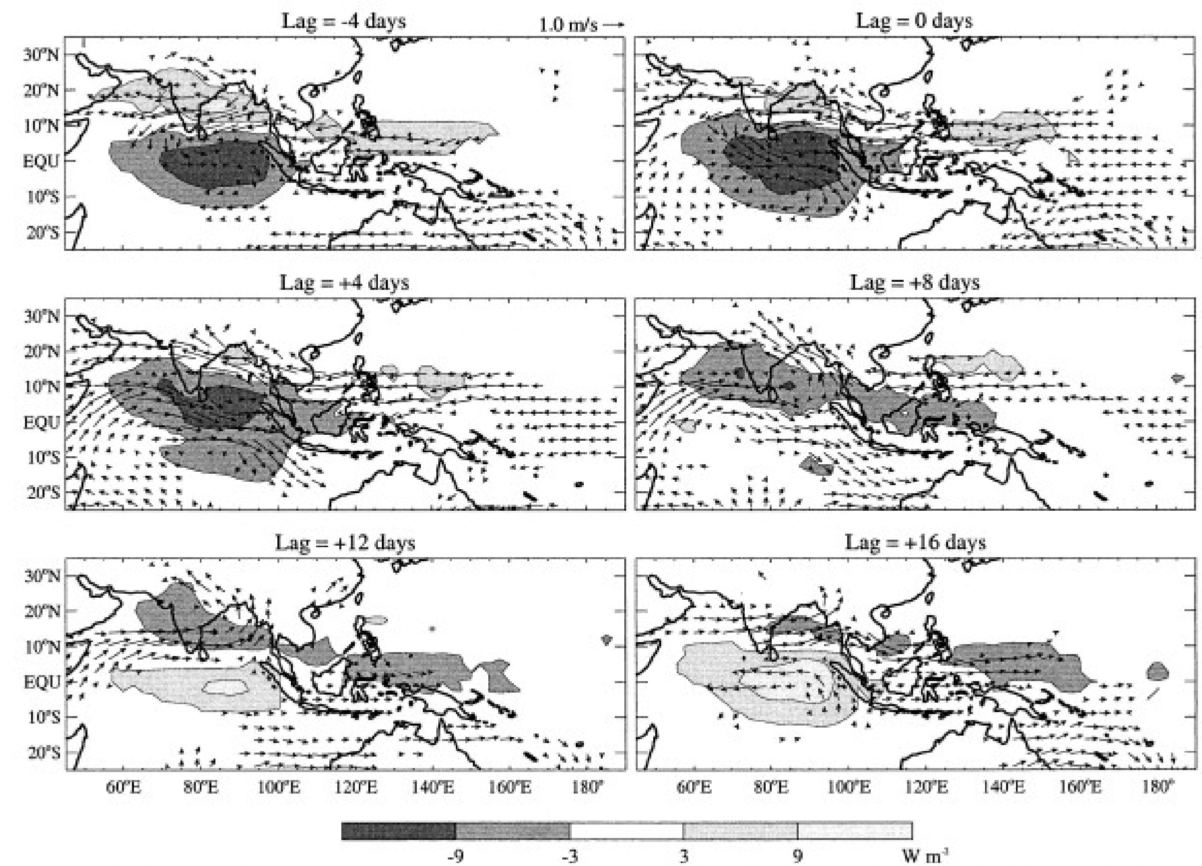


FIG. 4. Lagged regression maps of OLR (shaded) and 850-mb wind (vectors) perturbations relative to a −1 std dev in JJAS OLR_{25-80} in the base region; 0°–5°N, 85°–90°E. All data are bandpass-filtered to retain periods of 25–80 days prior to forming the regressions. Only locally significant OLR anomalies and wind vectors are plotted.

Mechanism

- Shukla and Goswami(1984) ,Jiang Li Wang(2004),Bellon and Sobel(2008)
- Jiang Li Wang(2004) proposed the importance of vertical easterly shear ofthe background monsoon flow

- Northwestward tilt is a characteristic feature of this mode
- In other words , during the Northward propagation , it has different speed over Arabian Sea and Bay of Bengal.

Karmakar and Misra(2019)

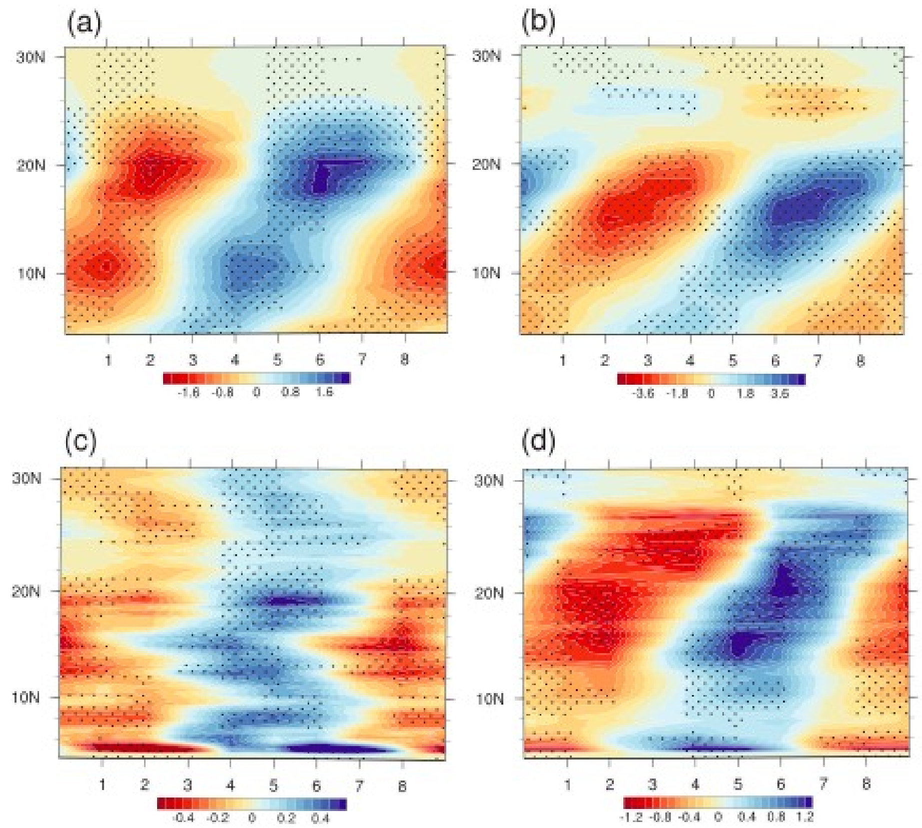


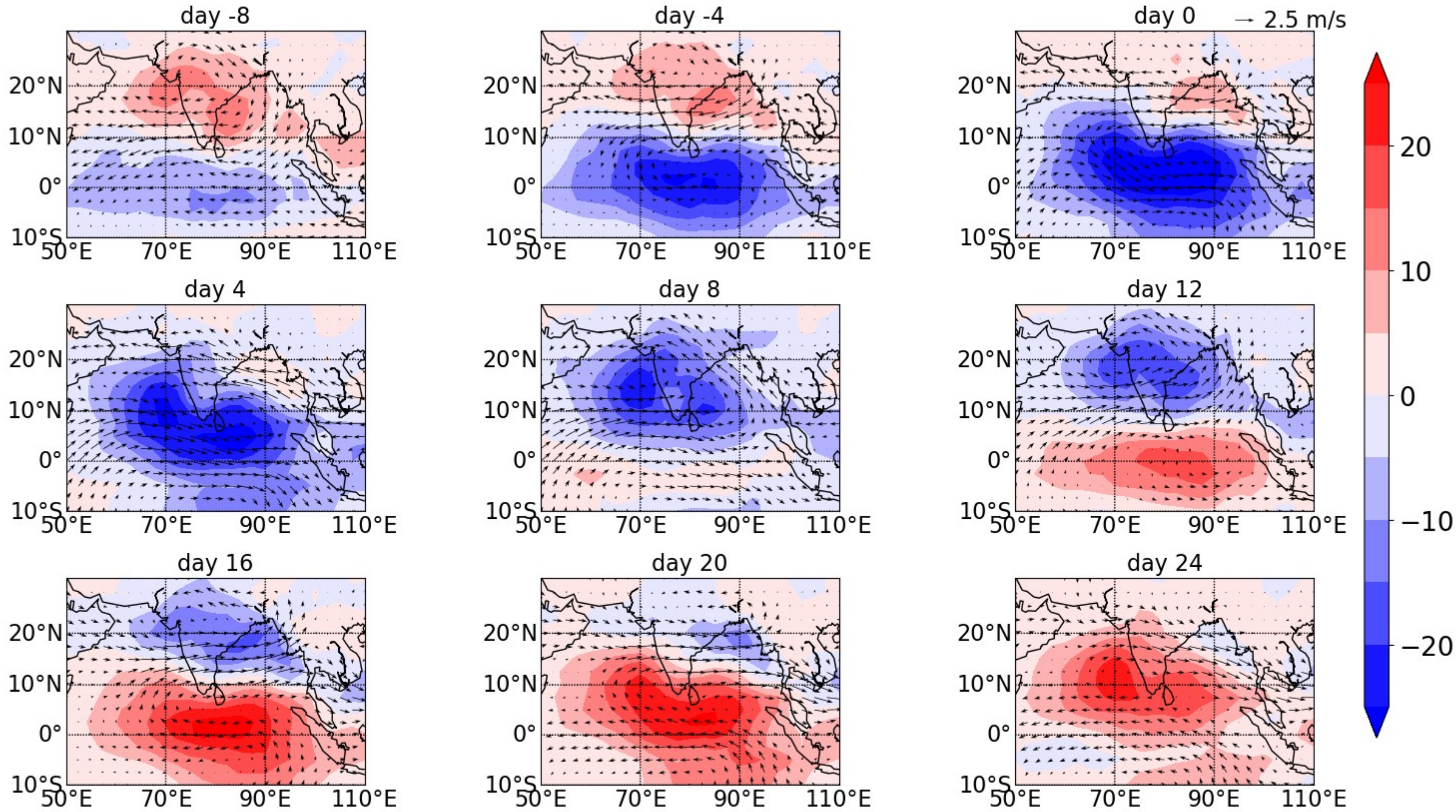
Figure 2. (a) Phase-latitude diagrams of ISO-filtered rainfall averaged over AS longitudes (63–73° N) during May–October 1998–2014. (b) Same as (a) but for BoB longitudes (75–85° N). (c) Same as (a) but for 10 years of model simulation. (d) Same as (c) but for BoB longitudes. Unit of rainfall is mm/day. Stippled regions indicate mean is significant at 5% level using a randomization test. Note that different scales in colorbars are used in different panels.

Data

- NCEP-NCAR reanalysis1
- NOAA interpolated OLR
- May-October data used

Methods

- Lanczos filtering
- Composite analysis
- Moisture budget



Day 0 is defined as the Day when OLR is lowest in the box 0-5N,70-85S

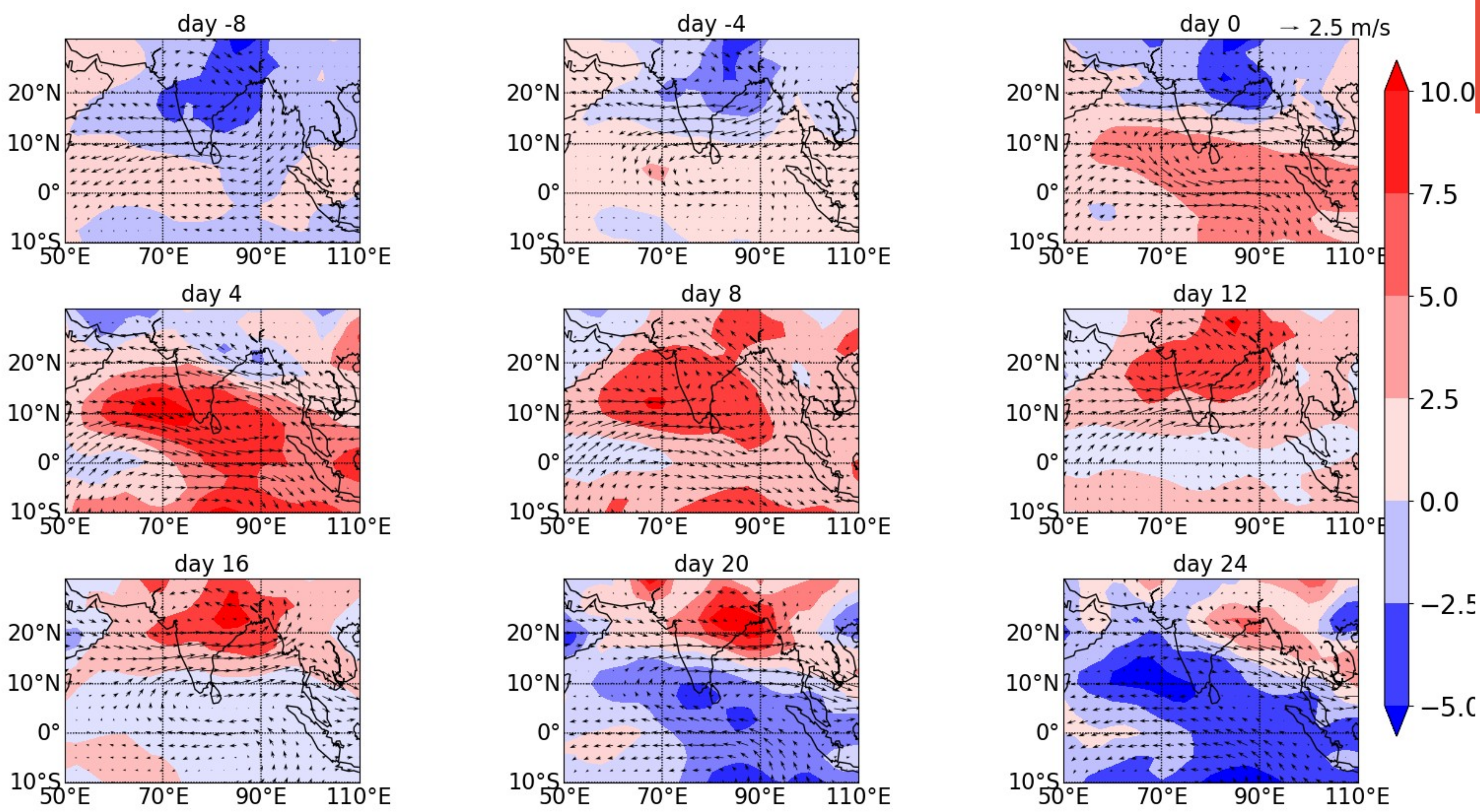
OLR anomaly(W/ m^{-2}), 850 hPa wind anomaly

- In recent years , moisture mode framework has shown some promise in understanding the characteristics of BSISO
- Jiang et al. (2018) have used this framework to understand the northward propagation mechanism.

Moisture Budget

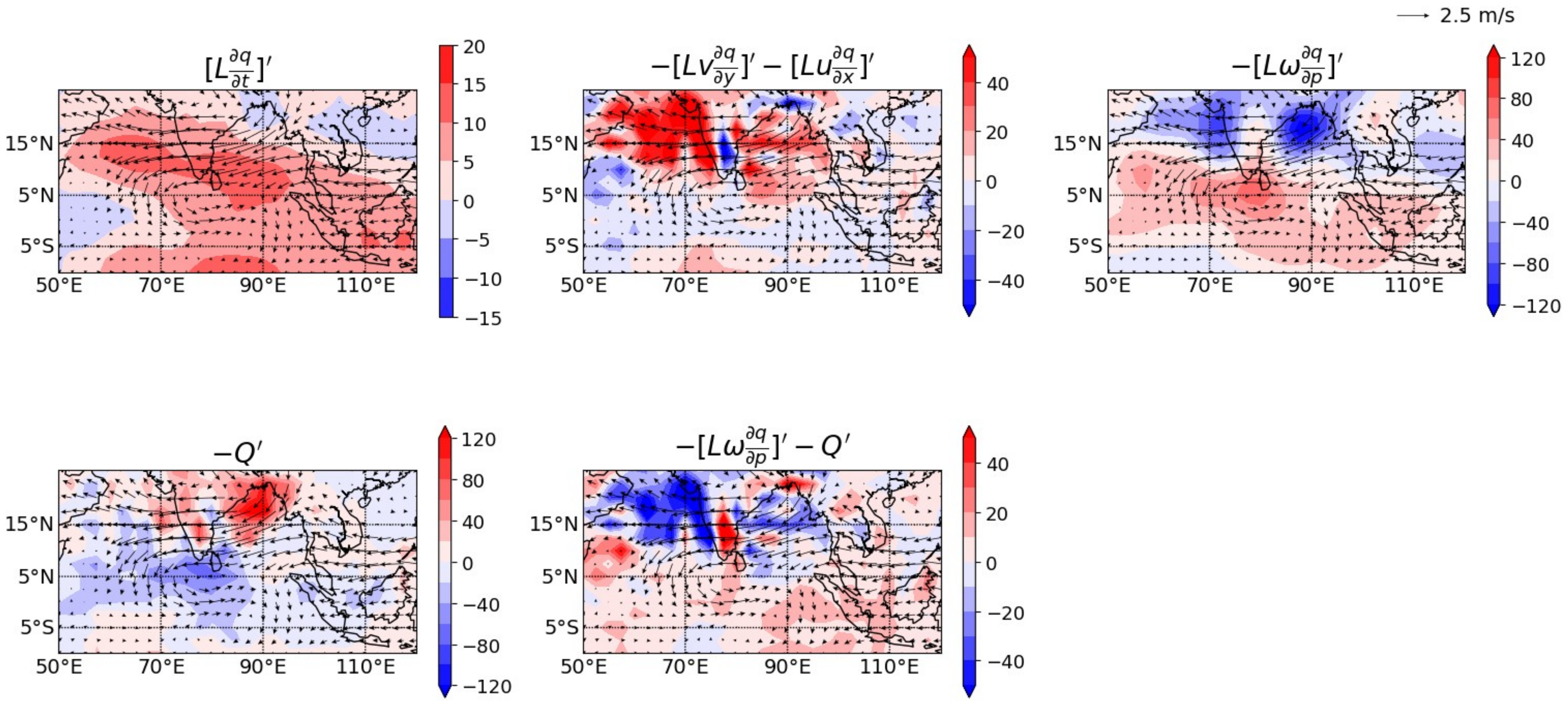
$$[\frac{\partial q'}{\partial t}] = -[(\mathbf{V}.\nabla_h q)]' - [(\omega\frac{\partial q}{\partial p})]' - Q'/L,$$

Square bracket signifies vertical integration from 1000 to 300 hPa , prime signifies 25-80 day filtered data



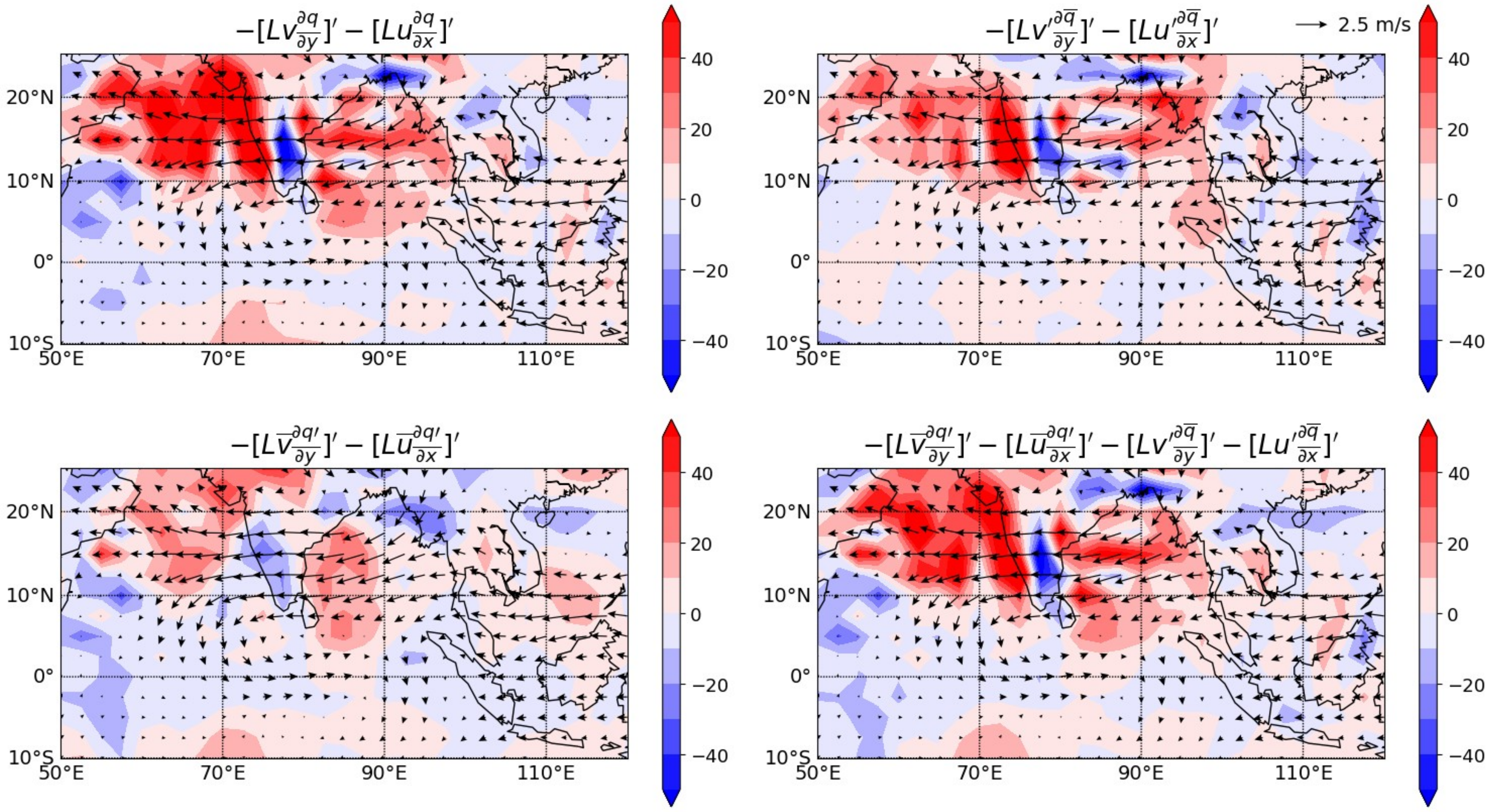
Column-integrated specific humidity(Scaled by L,10^6 J/m2)

Day -4



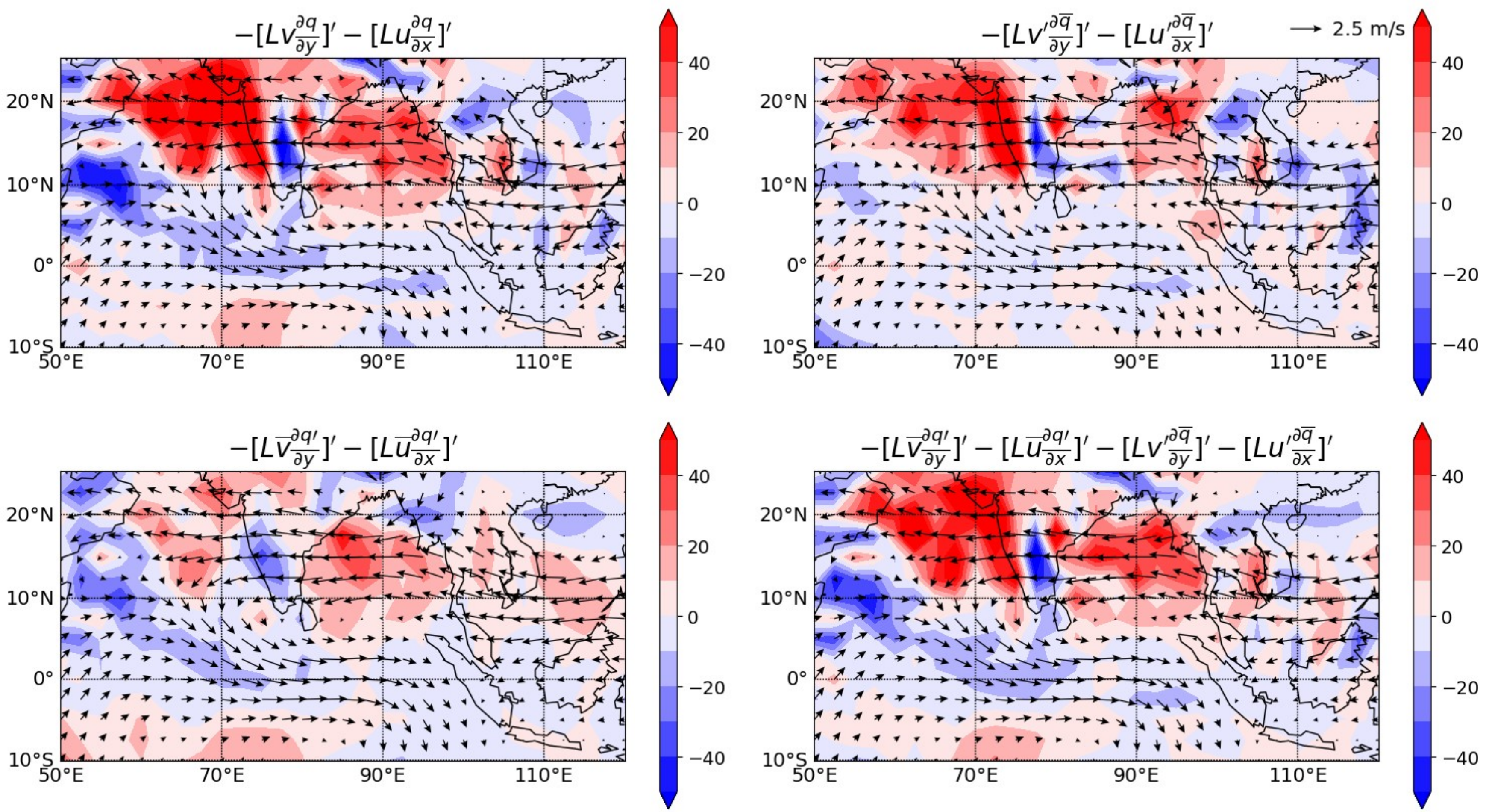
2.5 m/s
$[L\frac{\partial q}{\partial t}]'$
$-[Lv\frac{\partial q}{\partial y}]' - [Lu\frac{\partial q}{\partial x}]'$
$-[L\omega\frac{\partial q}{\partial p}]'$
$-Q'$
$-[L\omega\frac{\partial q}{\partial p}]' - Q'$
15°N
5°N
5°S
50°E
70°E
90°E
110°E
20
15
10
5
0
−5
−10
−15
40
20
0
−20
−40
120
80
40
0
−40
−80
−120

Day -4



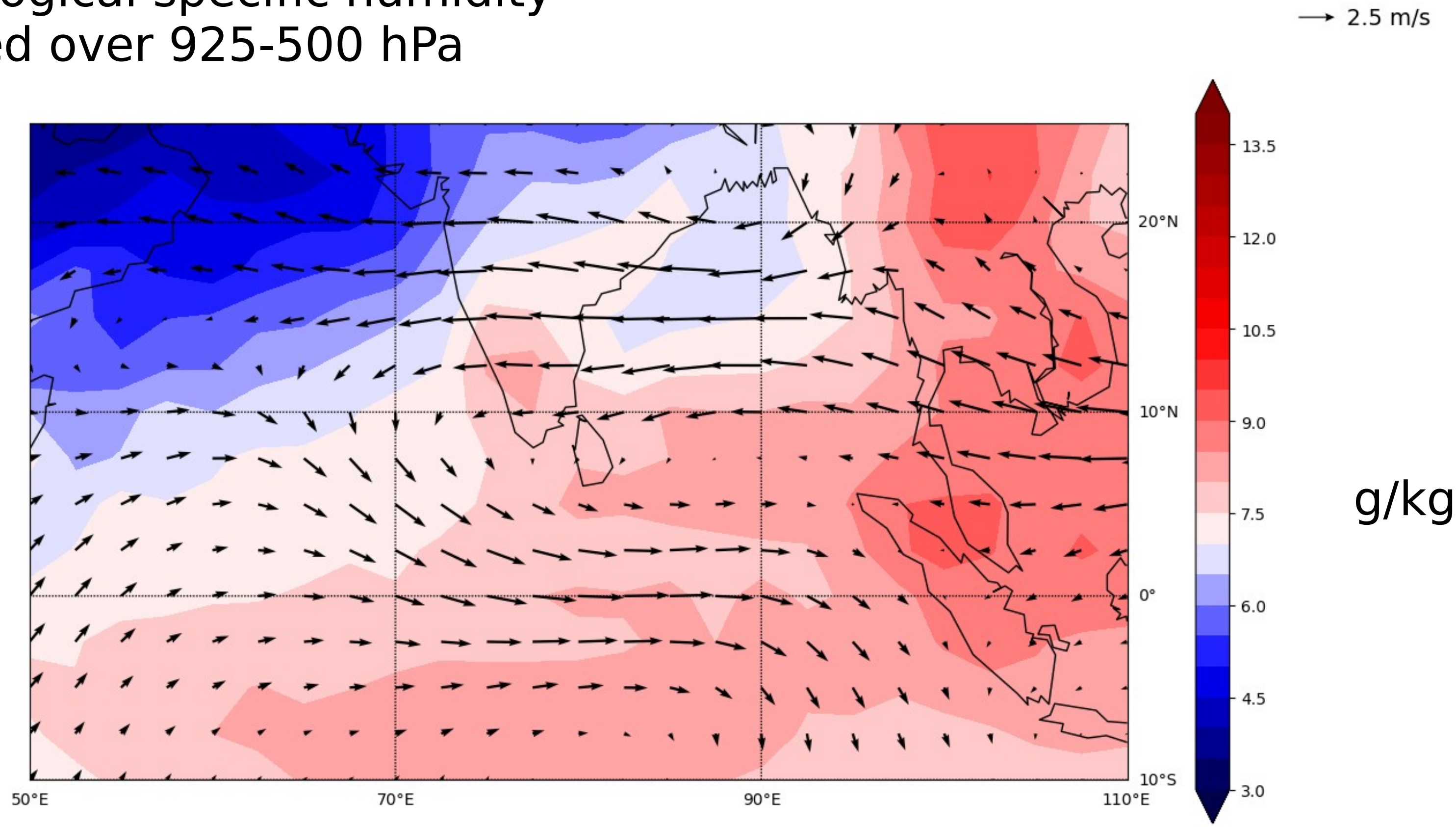
$-[Lv\frac{\partial q}{\partial y}]' - [Lu\frac{\partial q}{\partial x}]'$
$-[Lv'\frac{\partial \bar{q}}{\partial y}]' - [Lu'\frac{\partial \bar{q}}{\partial x}]'$
→ 2.5 m/s
$-[L\bar{v}\frac{\partial q'}{\partial y}]' - [L\bar{u}\frac{\partial q'}{\partial x}]'$
$-[L\bar{v}\frac{\partial q'}{\partial y}]' - [L\bar{u}\frac{\partial q'}{\partial x}]' - [Lv'\frac{\partial \bar{q}}{\partial y}]' - [Lu'\frac{\partial \bar{q}}{\partial x}]'$
20°N
10°N
0°
10°S
50°E
70°E
90°E
110°E
40
20
0
−20
−40

Day 0



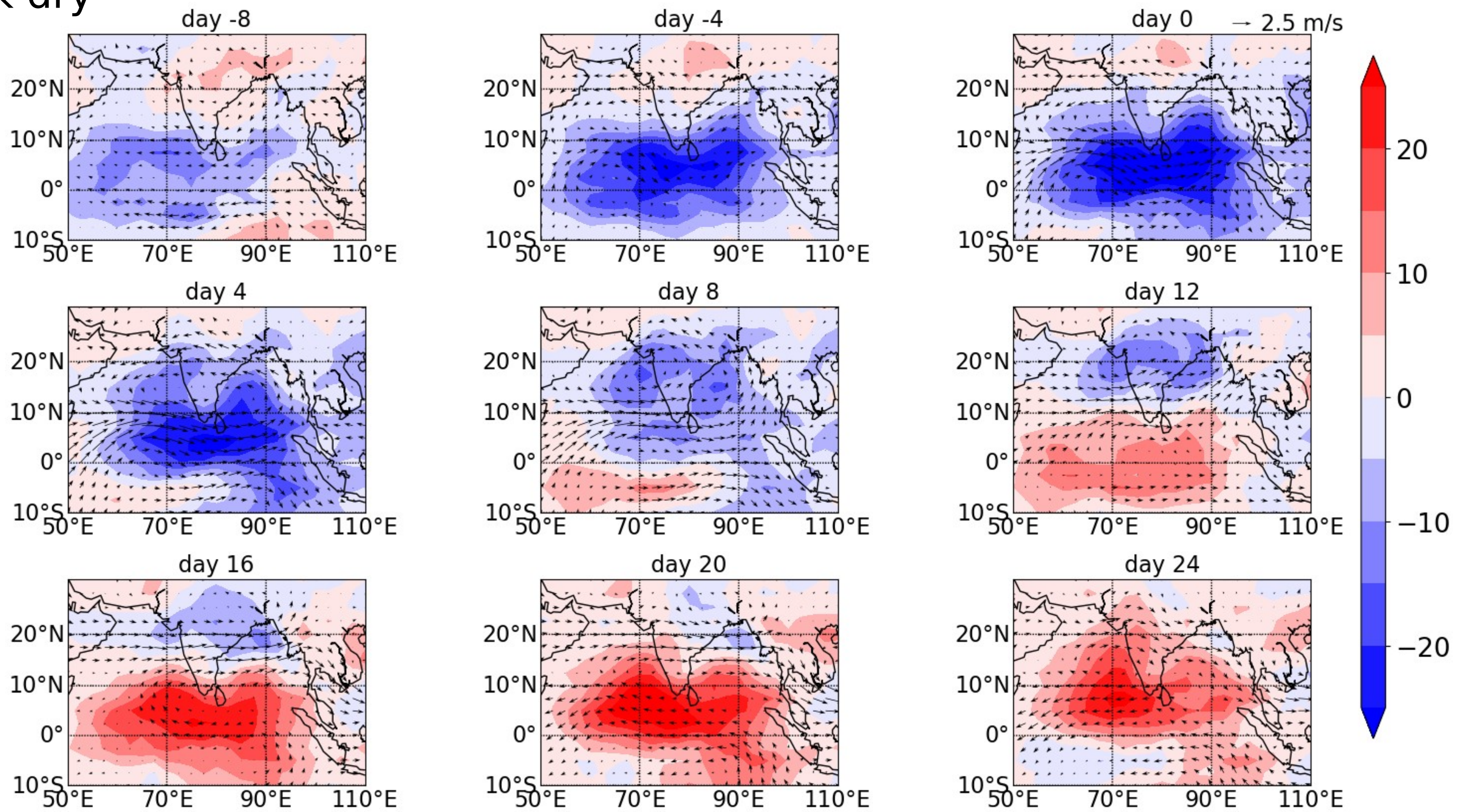
$-[Lv\frac{\partial q}{\partial y}]' - [Lu\frac{\partial q}{\partial x}]'$
$-[Lv'\frac{\partial \bar{q}}{\partial y}]' - [Lu'\frac{\partial \bar{q}}{\partial x}]'$
2.5 m/s
$-[L\bar{v}\frac{\partial q'}{\partial y}]' - [L\bar{u}\frac{\partial q'}{\partial x}]'$
$-[L\bar{v}\frac{\partial q'}{\partial y}]' - [L\bar{u}\frac{\partial q'}{\partial x}]' - [Lv'\frac{\partial \bar{q}}{\partial y}]' - [Lu'\frac{\partial \bar{q}}{\partial x}]'$
20°N
10°N
0°
10°S
50°E
70°E
90°E
110°E
40
20
0
−20
−40

850hPa wind (quiver) at Day 0 and climatological specific humidity averaged over 925-500 hPa

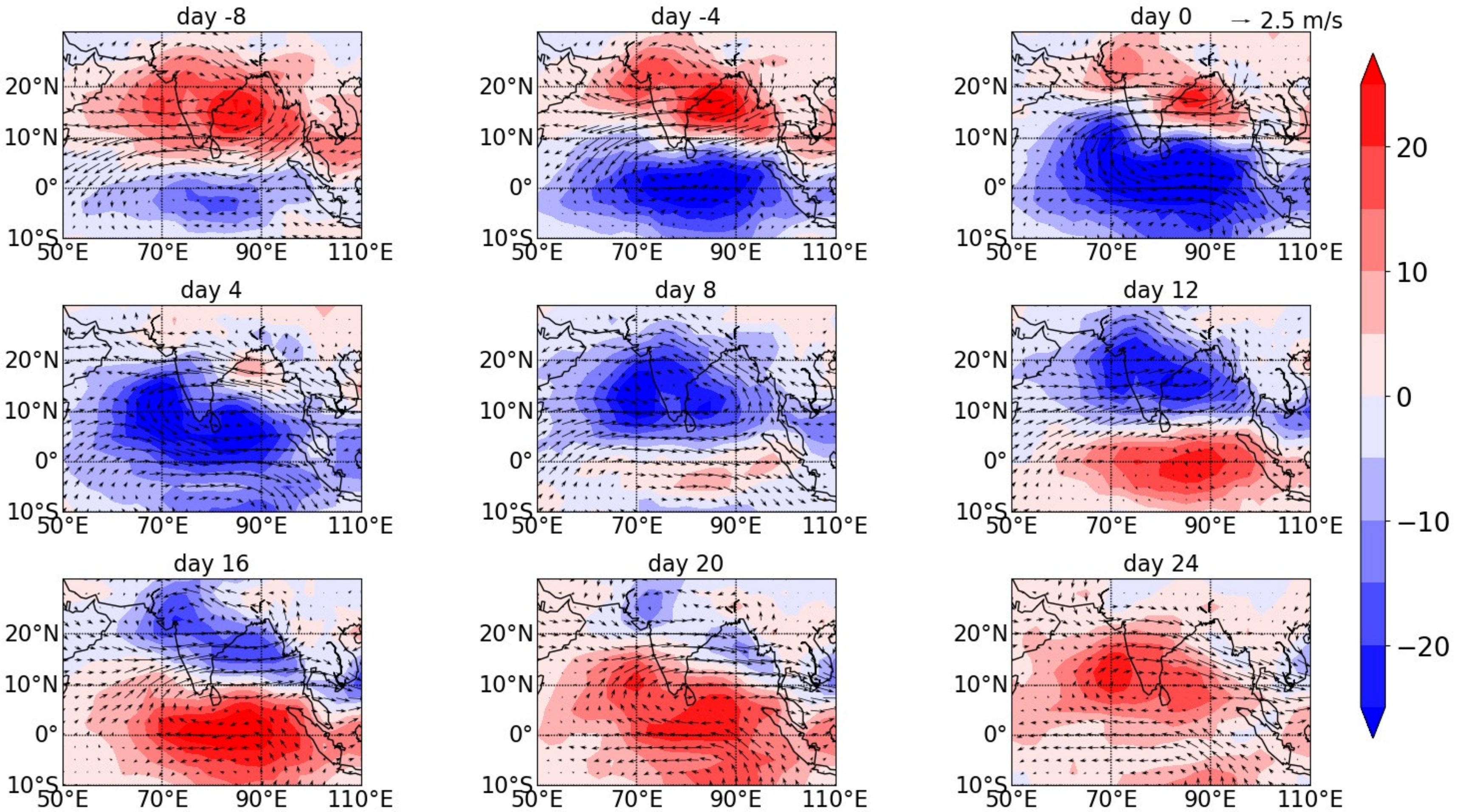


Cases with strong and weak dry lobe in front

Weak dry



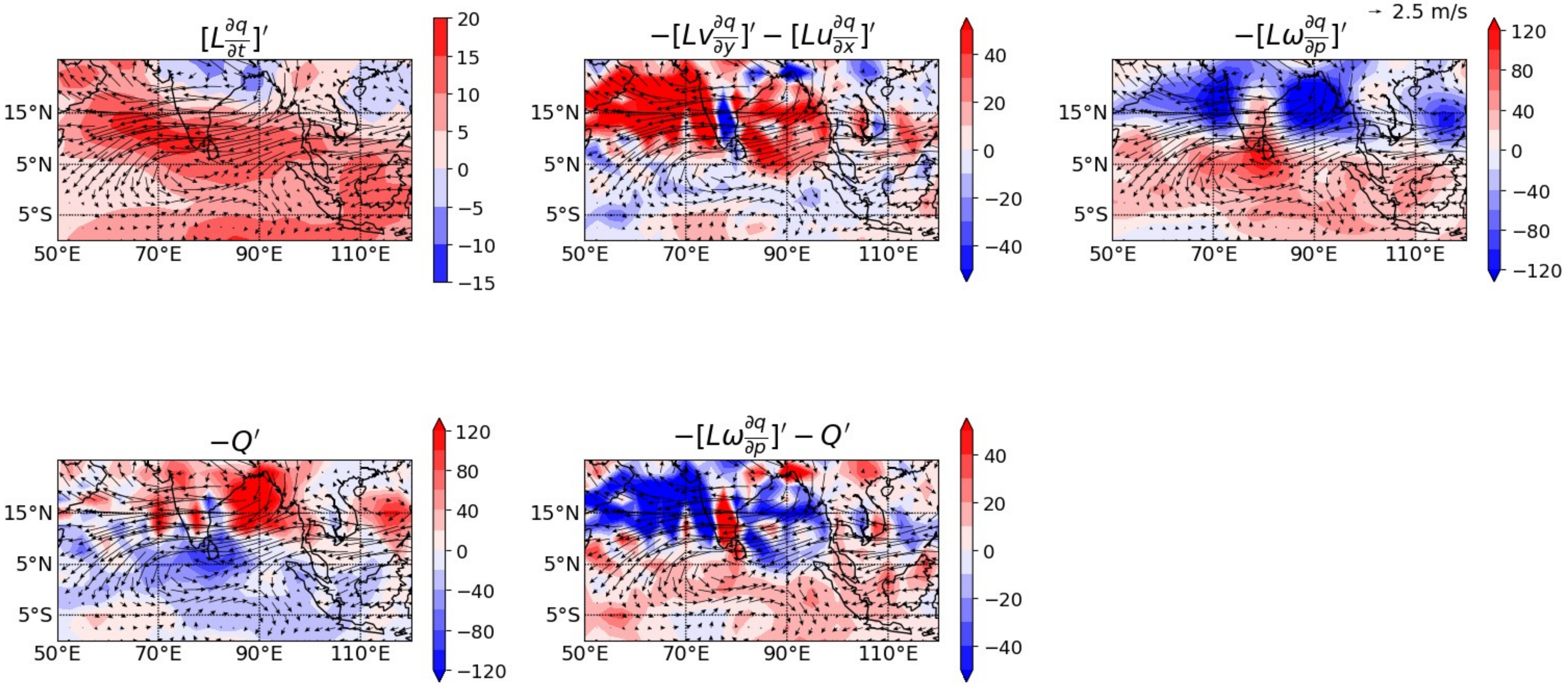
Strong dry



day -8
day -4
day 0
→ 2.5 m/s
day 4
day 8
day 12
day 16
day 20
day 24
20°N
10°N
0°
10°S
50°E
70°E
90°E
110°E
20
10
0
−10
−20

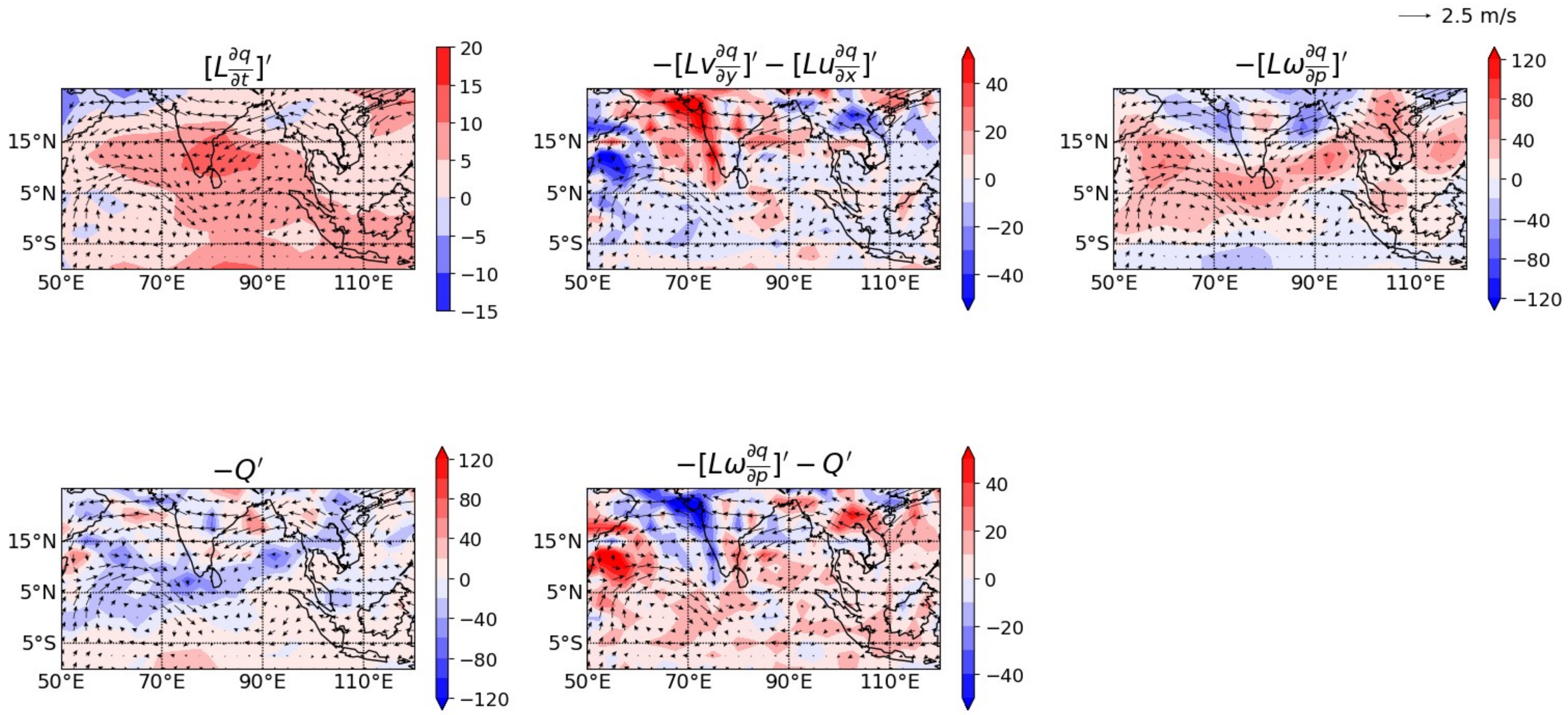
Day-4

Strong dry

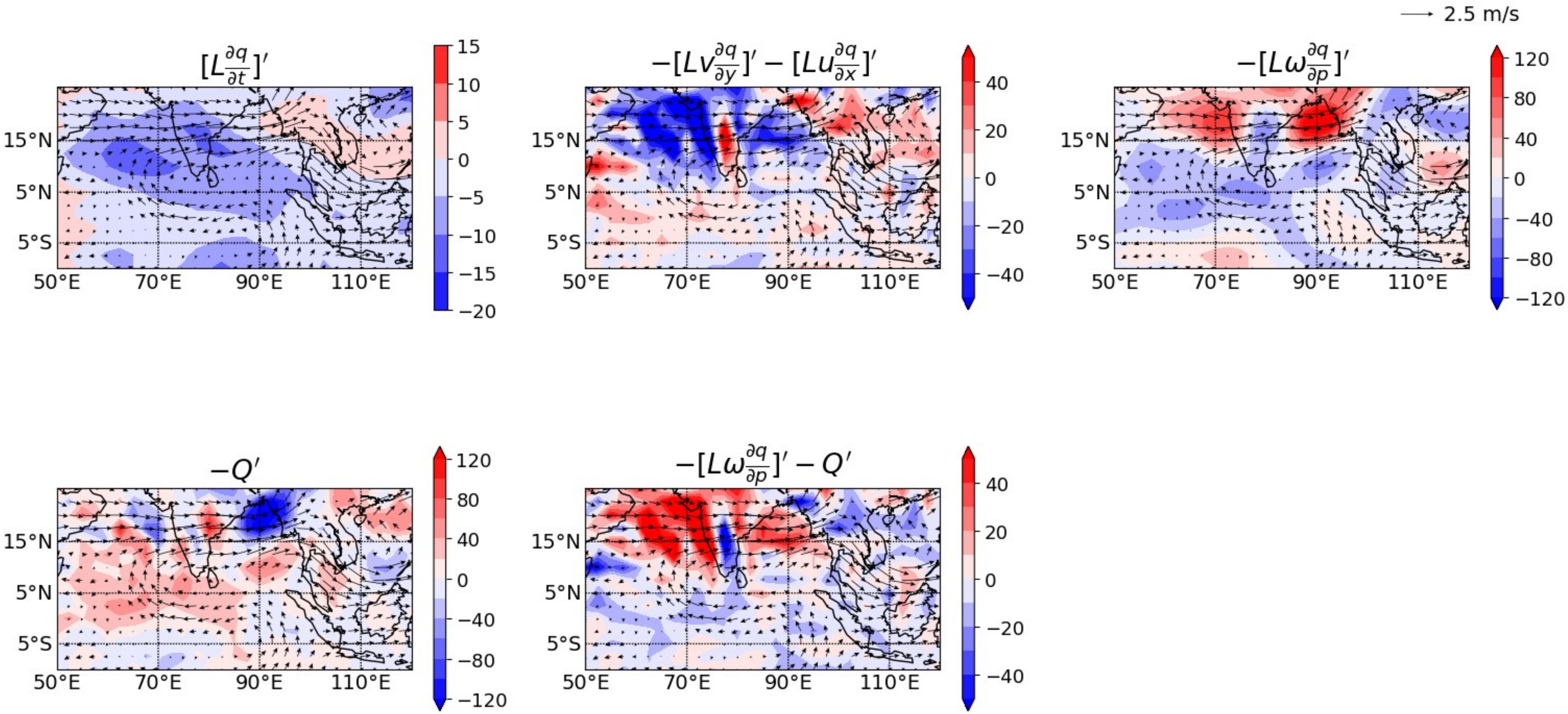


Day-4

Weak dry



day16


2.5 m/s
$[L\frac{\partial q}{\partial t}]'$
$-[Lv\frac{\partial q}{\partial y}]' - [Lu\frac{\partial q}{\partial x}]'$
$-[L\omega\frac{\partial q}{\partial p}]'$
$-Q'$
$-[L\omega\frac{\partial q}{\partial p}]' - Q'$
15°N
5°N
5°S
50°E
70°E
90°E
110°E
15
10
5
0
−5
−10
−15
−20
40
20
−20
−40
120
80
−80
−120

Conclusion

- Distribution of moisture plays the dominant role in determining the tilt.
- Previous dry lobe has a role to play.
- Easterly associated with the previous dry lobe moistens the area far north over the Arabian Sea, whether drying associated with the vertical advection inside the previous lobe in the bay inhibits the propagation.

Thank you