Pr.6a.5

A convectively coupled Kelvin wave's impact on African easterly wave activity

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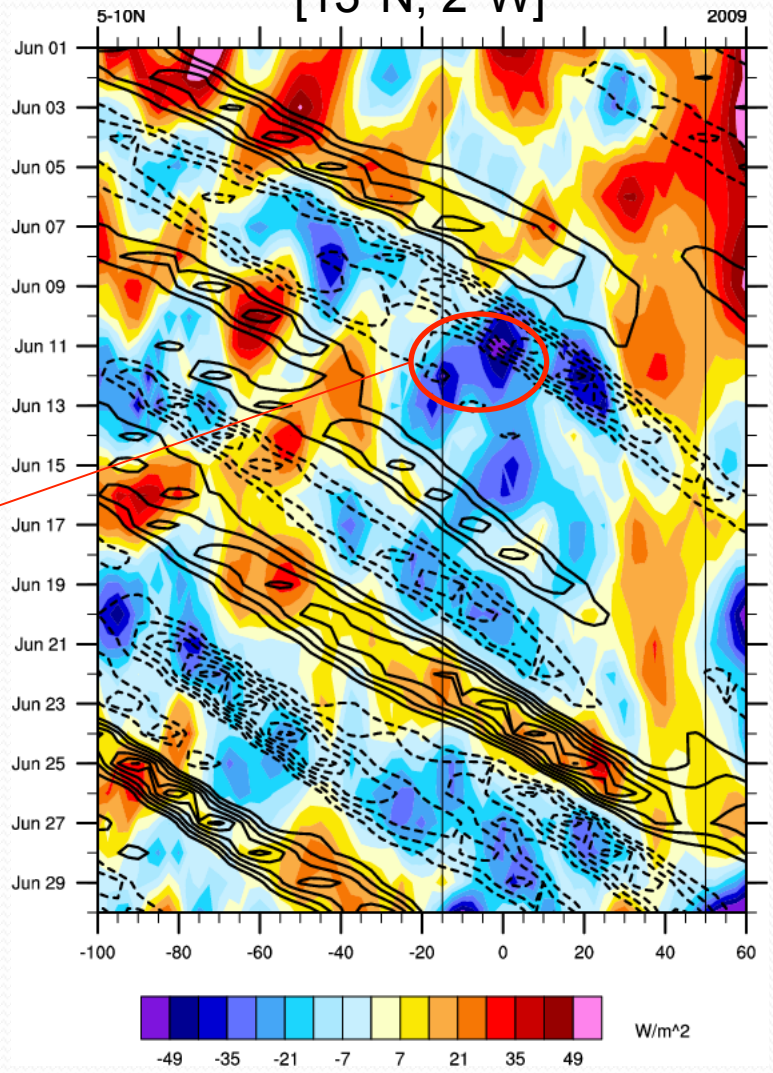
Motivation

Burkina Faso

June 2009 Flood: Burkina Faso
[13°N, 2°W]



Unfiltered OLR anomalies (shaded)
Kelvin filtered OLR anomalies (contoured)

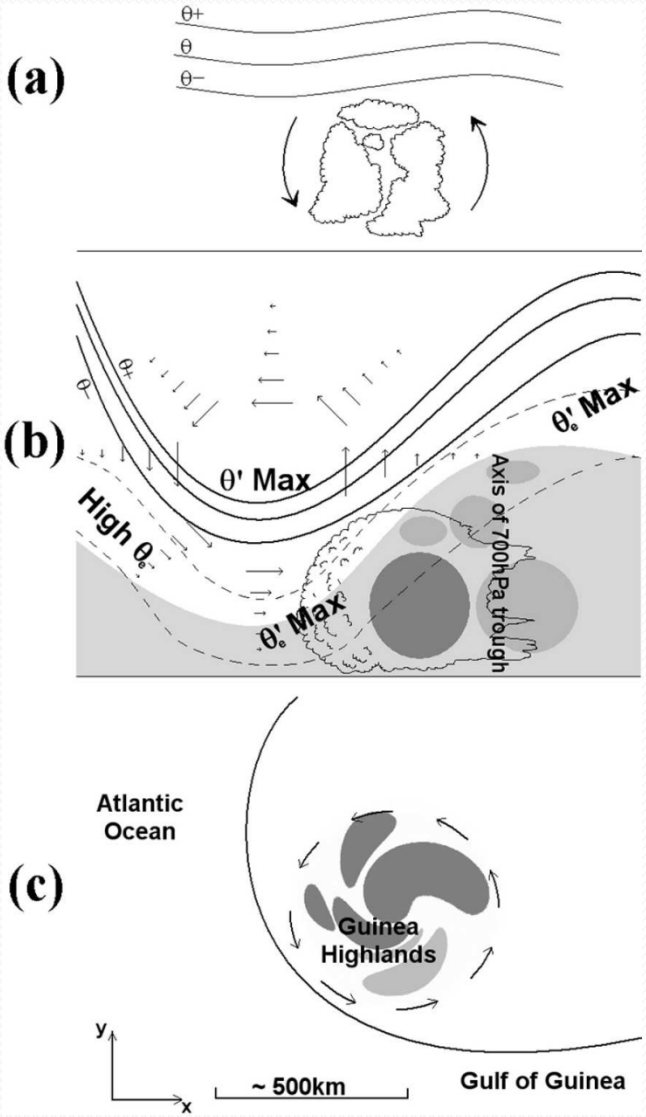
African Easterly Waves (AEWs)

3 Stages:

(a) Initiation

(b) Baroclinic Development

(c) West Coast Developments



Berry and Thorncroft (2005)

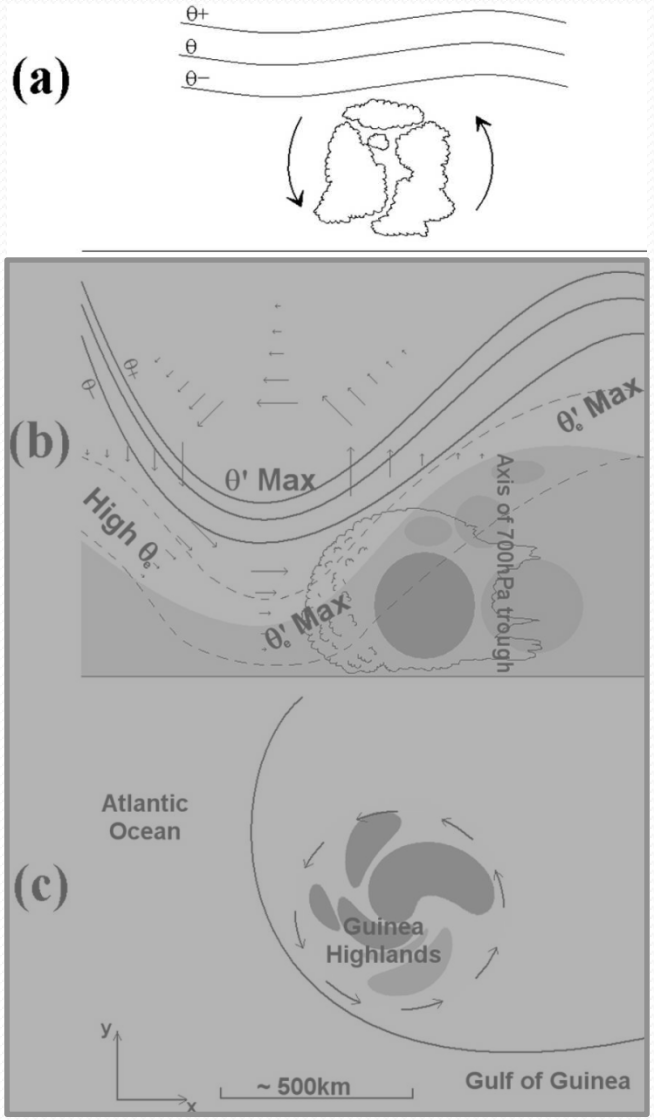
African Easterly Waves (AEWs)

3 Stages:

(a) Initiation

(b) Baroclinic Development

(c) West Coast Developments



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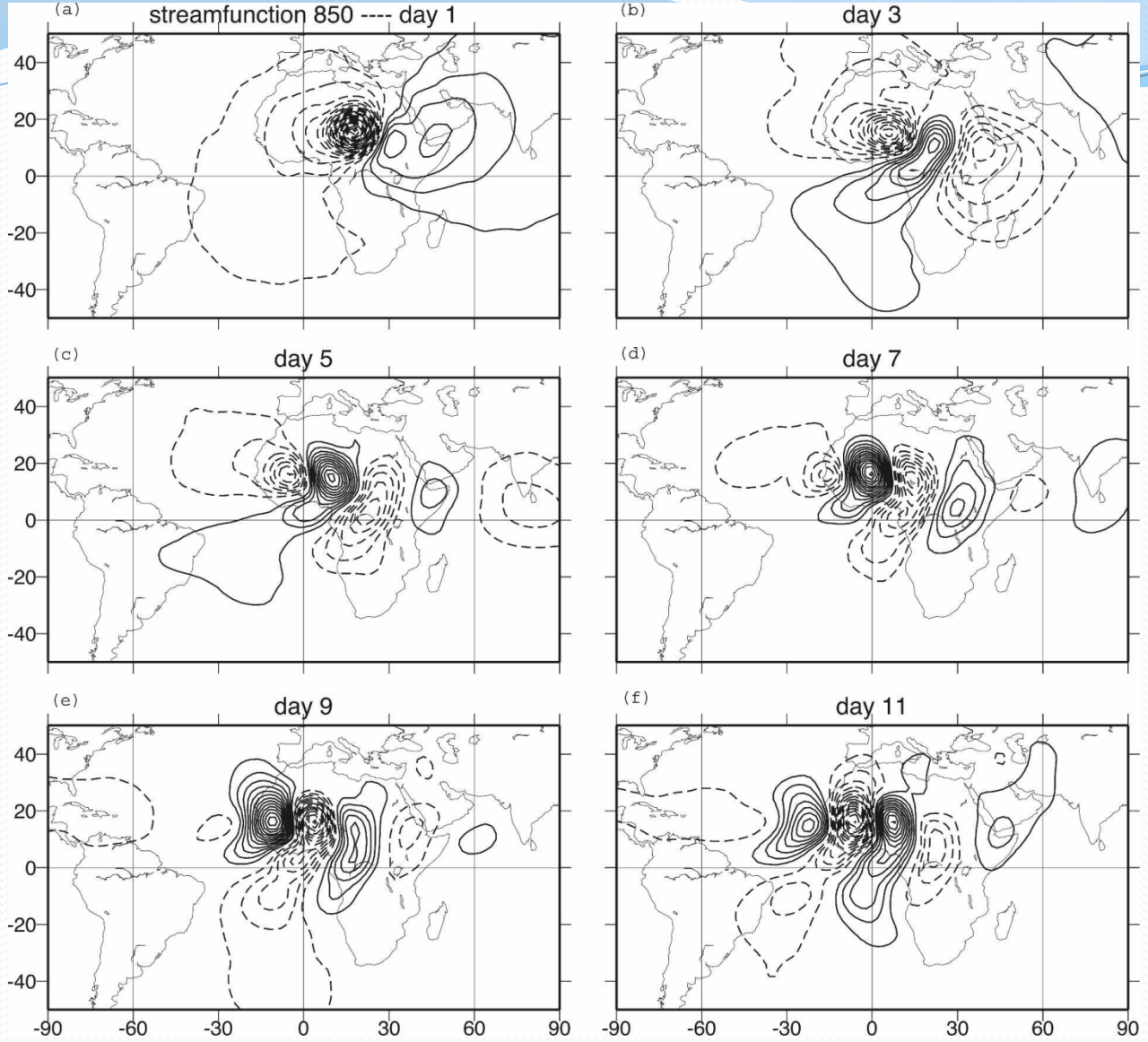

From Thorncroft et al. (2008). Streamfunction at σ = 0.85 for days 1, 3, 5, 7, 9, and 11 for the response to a deep convective anomaly at 15°N, 20°E. Contours are every 105 m^2/s; negative contours are dashed and zero is omitted.

Pre-Alberto AEW (2000)

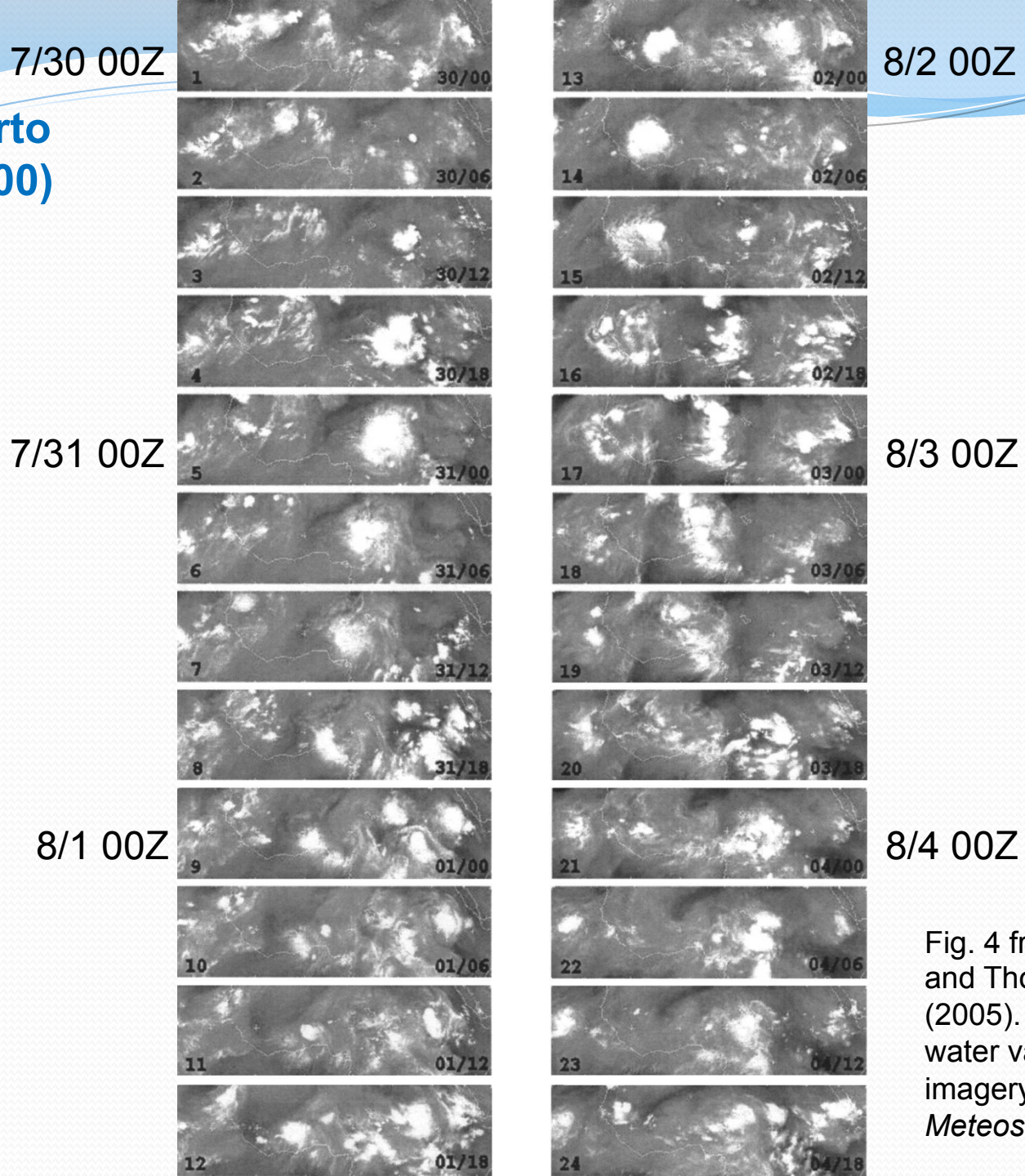

Fig. 4 from Berry and Thorncroft (2005). Mosaic of water vapor imagery from *Meteosat-7*.

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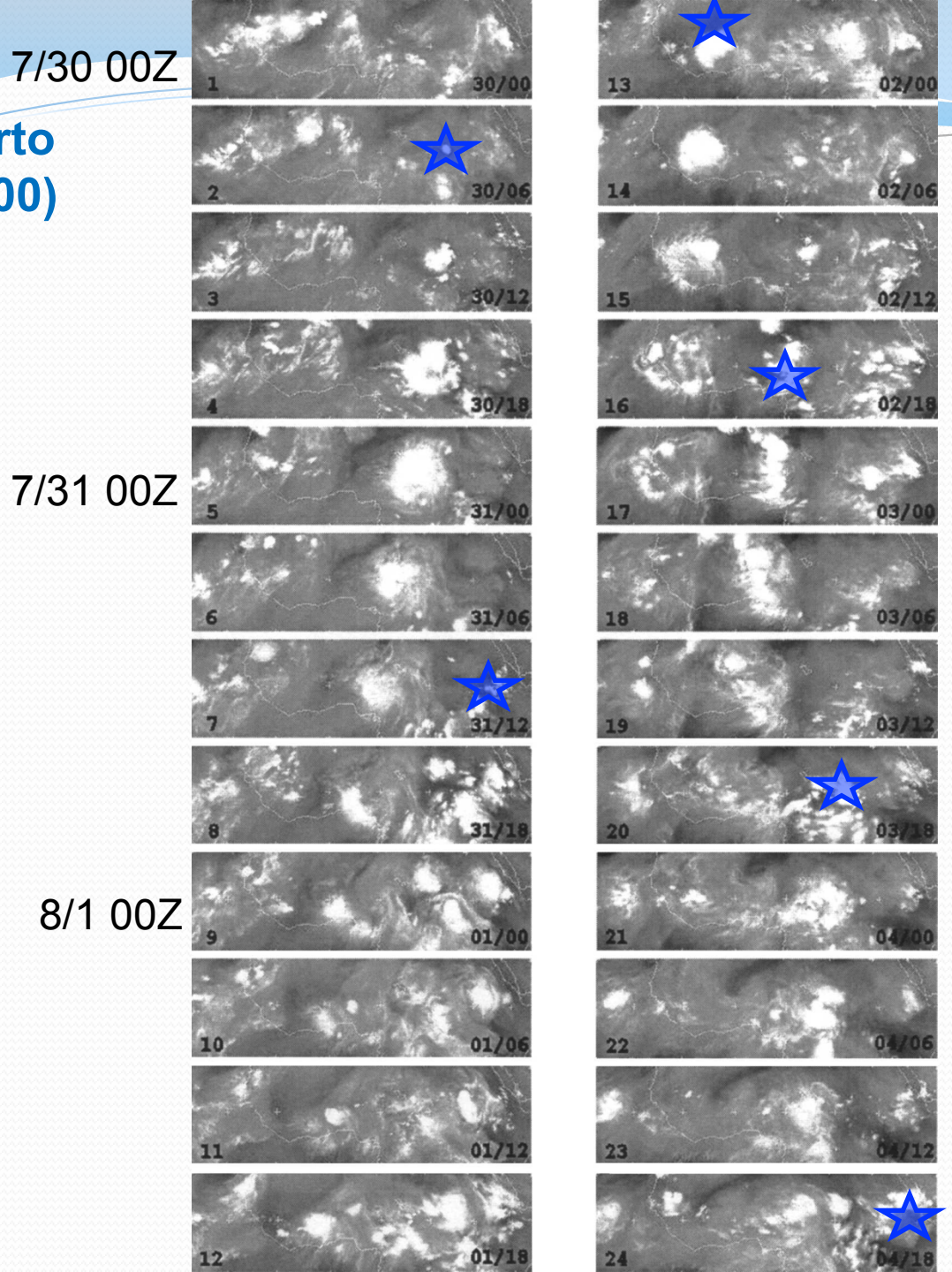

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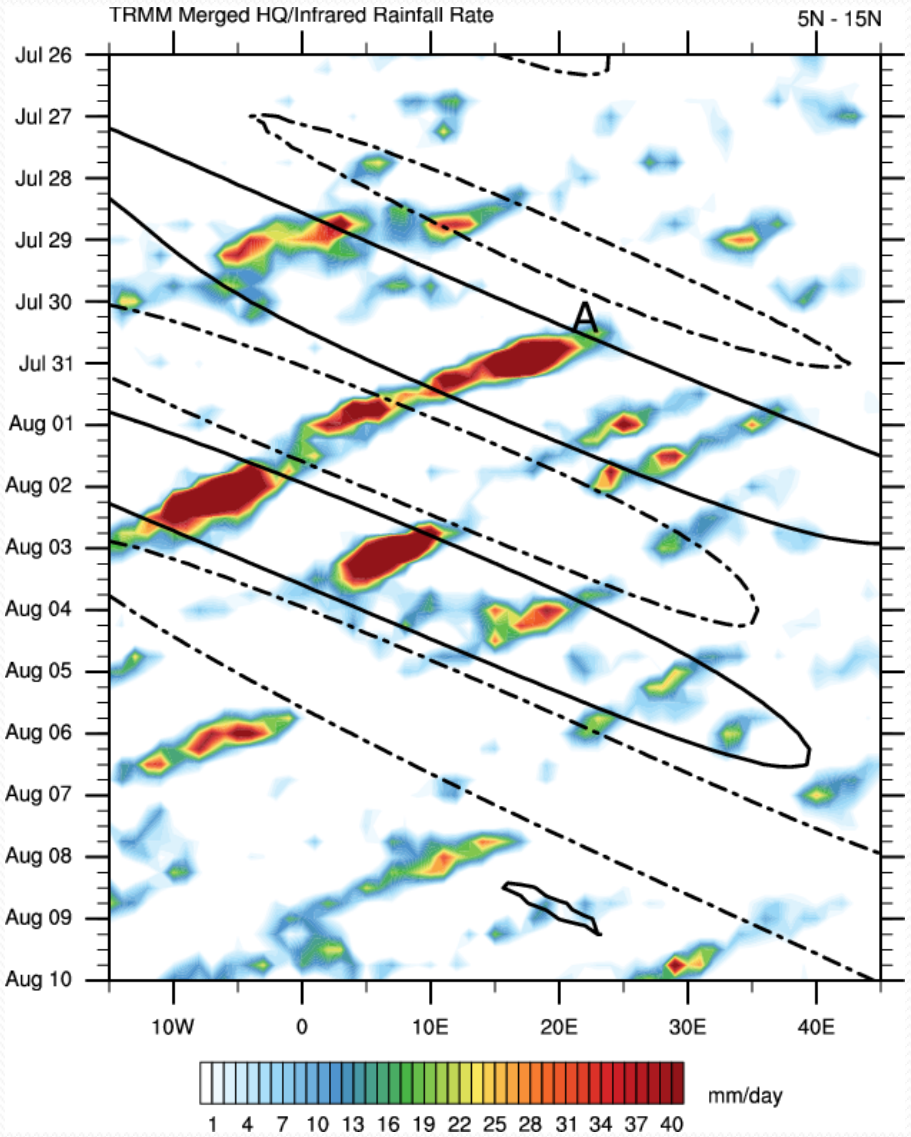

Shading: Unfiltered TRMM rain rate anomalies (positive only)

Black contours: KW filtered TRMM anomalies (dashed contour represents the convectively suppressed phase of the KW)

The +/- 2 mm day^{-1} Kelvin filtered TRMM anomaly is only contoured

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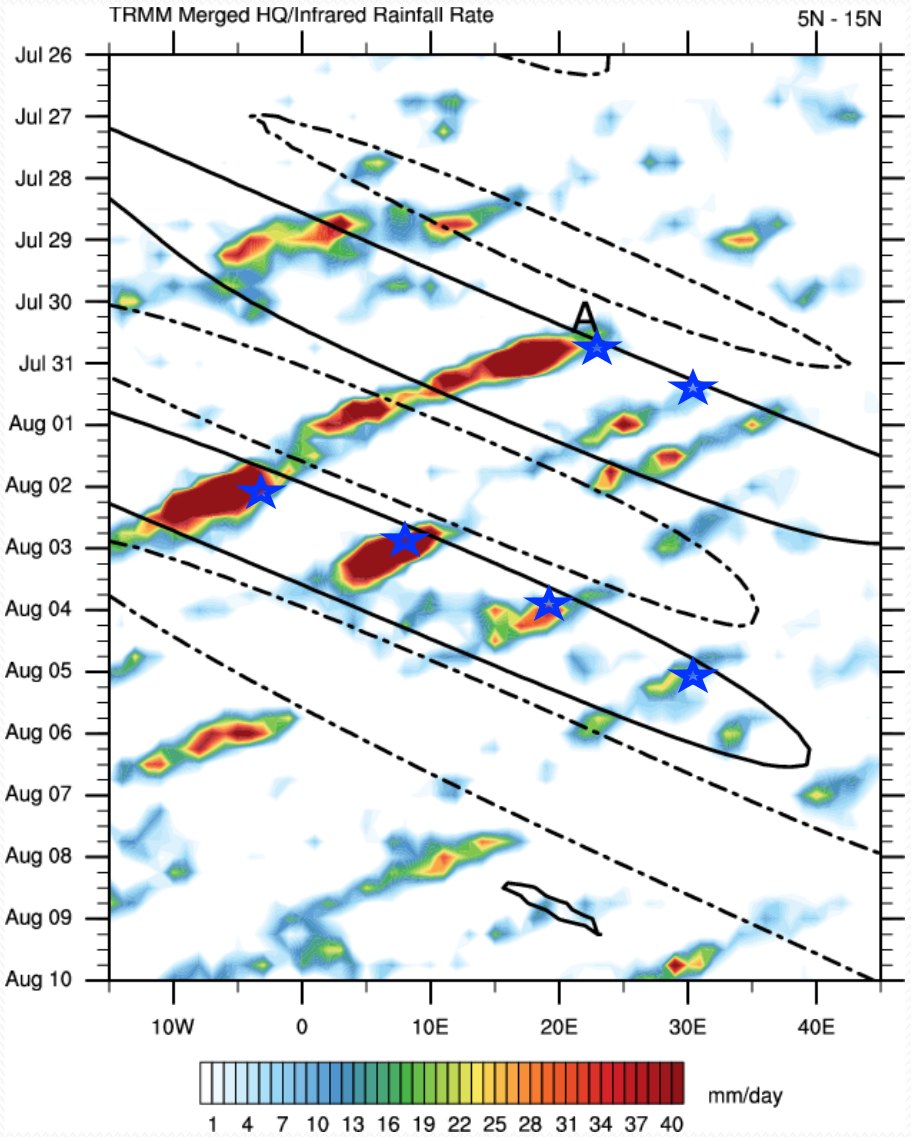

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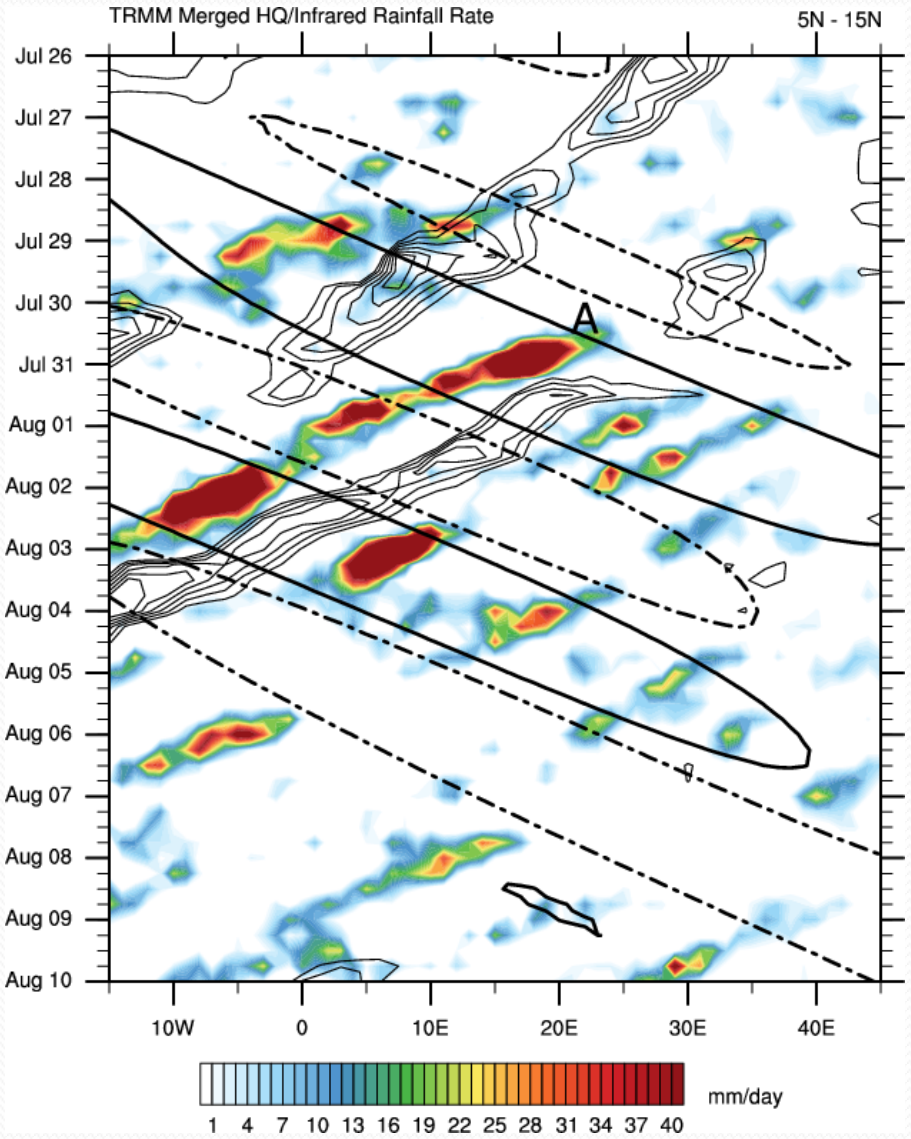

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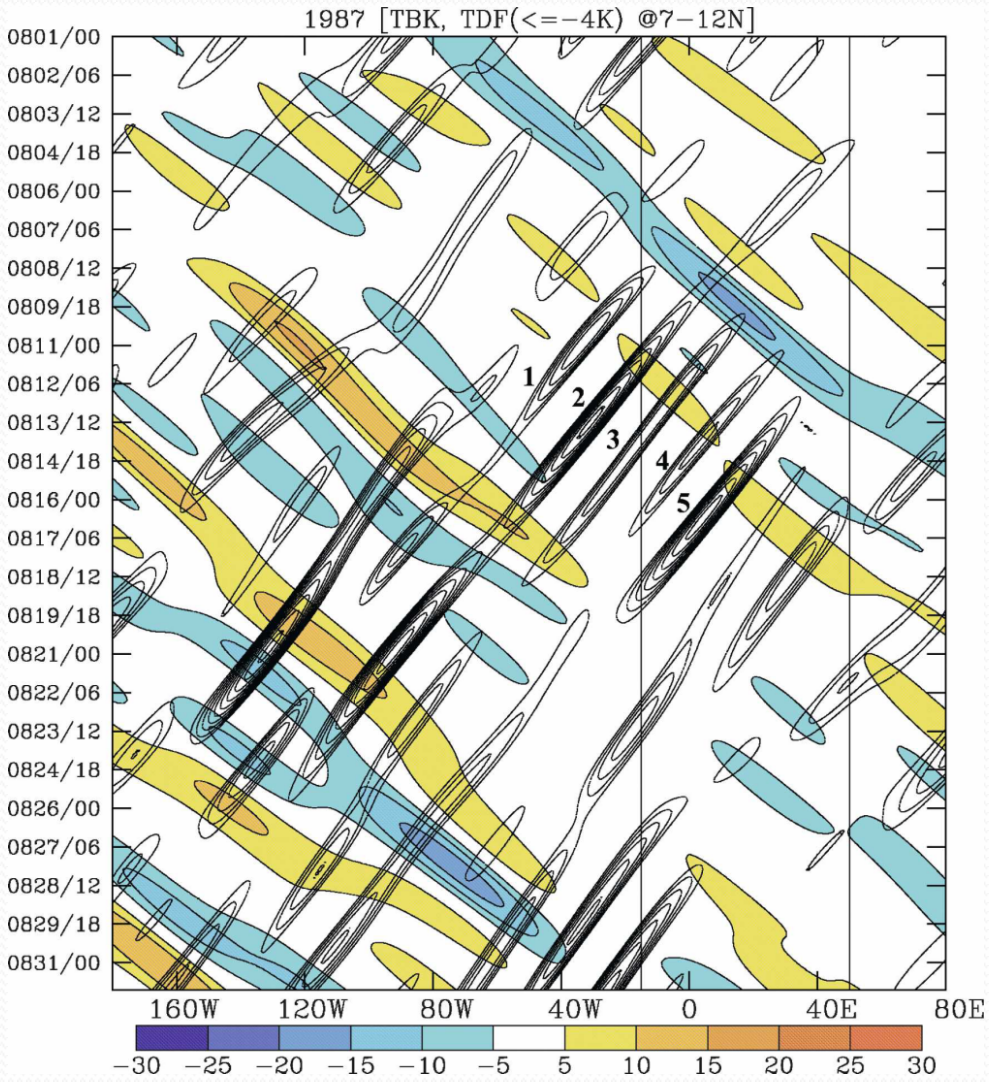
700 hPa southerly winds (grey contours)

Mekonnen et al. (2008)



Shading: Kelvin filtered brightness temperature (Tb) anomalies
Contours: Tropical Depression type wave filtered Tb anomalies

Data Sources & Methodology

ECMWF-Interim Dataset (1.5 degree resolution)

NOAA's Daily Average OLR Dataset

- Wheeler and Kiladis (1999) for Kelvin wave filtering
  [period of 2.5-20 days; eastward wavenumbers 1-14]
  JJAS Kelvin Waves

Composite Approach

Developed a time-series using Kelvin filtered OLR anomalies.

- Selected all dates when the minimum negative Kelvin filtered OLR anomaly was a located over 10°N, 15°W (**DAY 0**)
- Used a lag-approach
- Threshold was -1.5 standard deviations
- 142 CCKWs identified
- All anomalies are tested with a bootstrap significance test with 1000 iterations

Outline

1) 925-700 hPa Vertical Wind Shear

2) 700 hPa Zonal Wind Anomalies

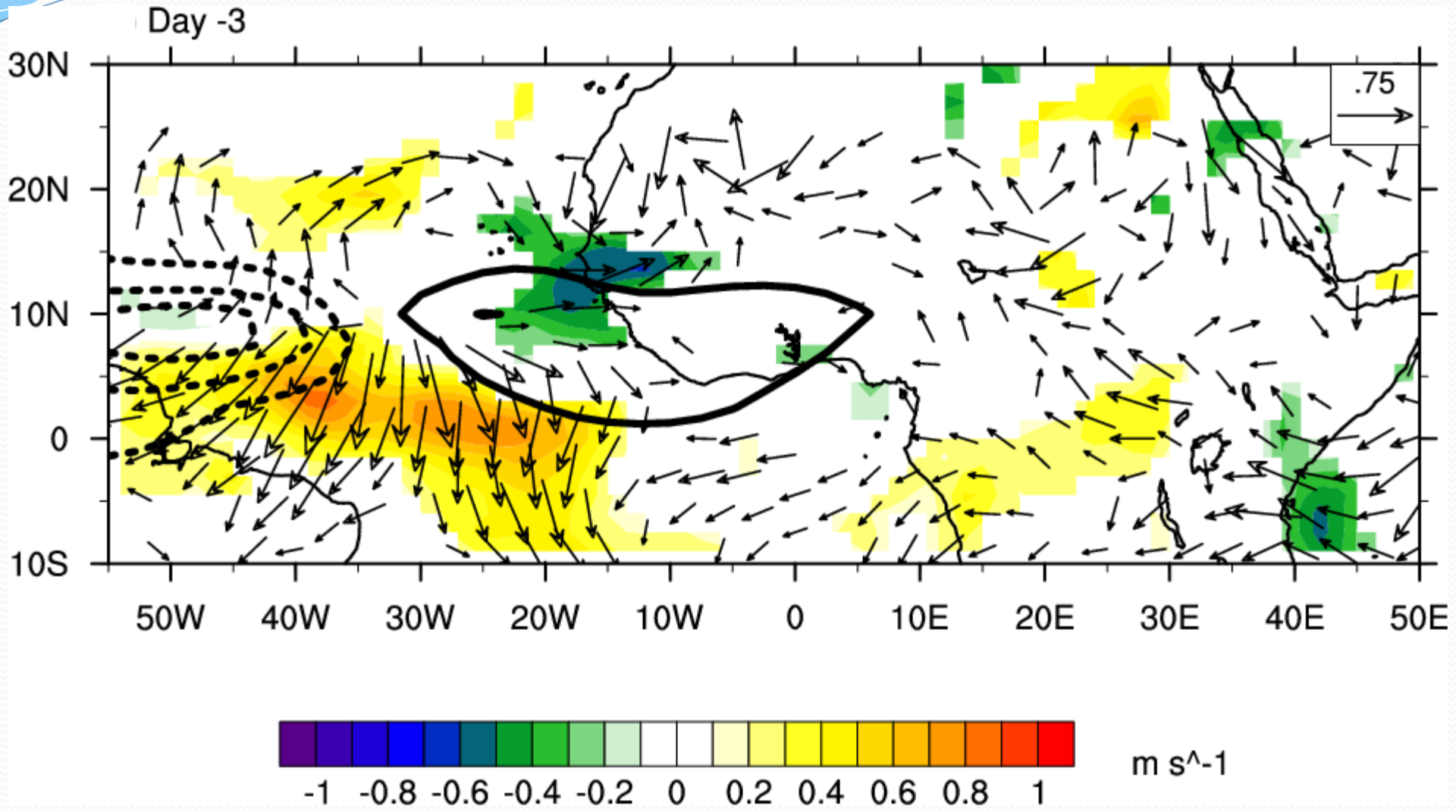
3) 700 hPa Eddy Kinetic Energy (EKE)

$EKE = \frac{1}{2} (u'^2 + v'^2)$

u' = 2-10d filtered u

v' = 2-10d filtered v

925-700 hPa Vertical Wind Shear

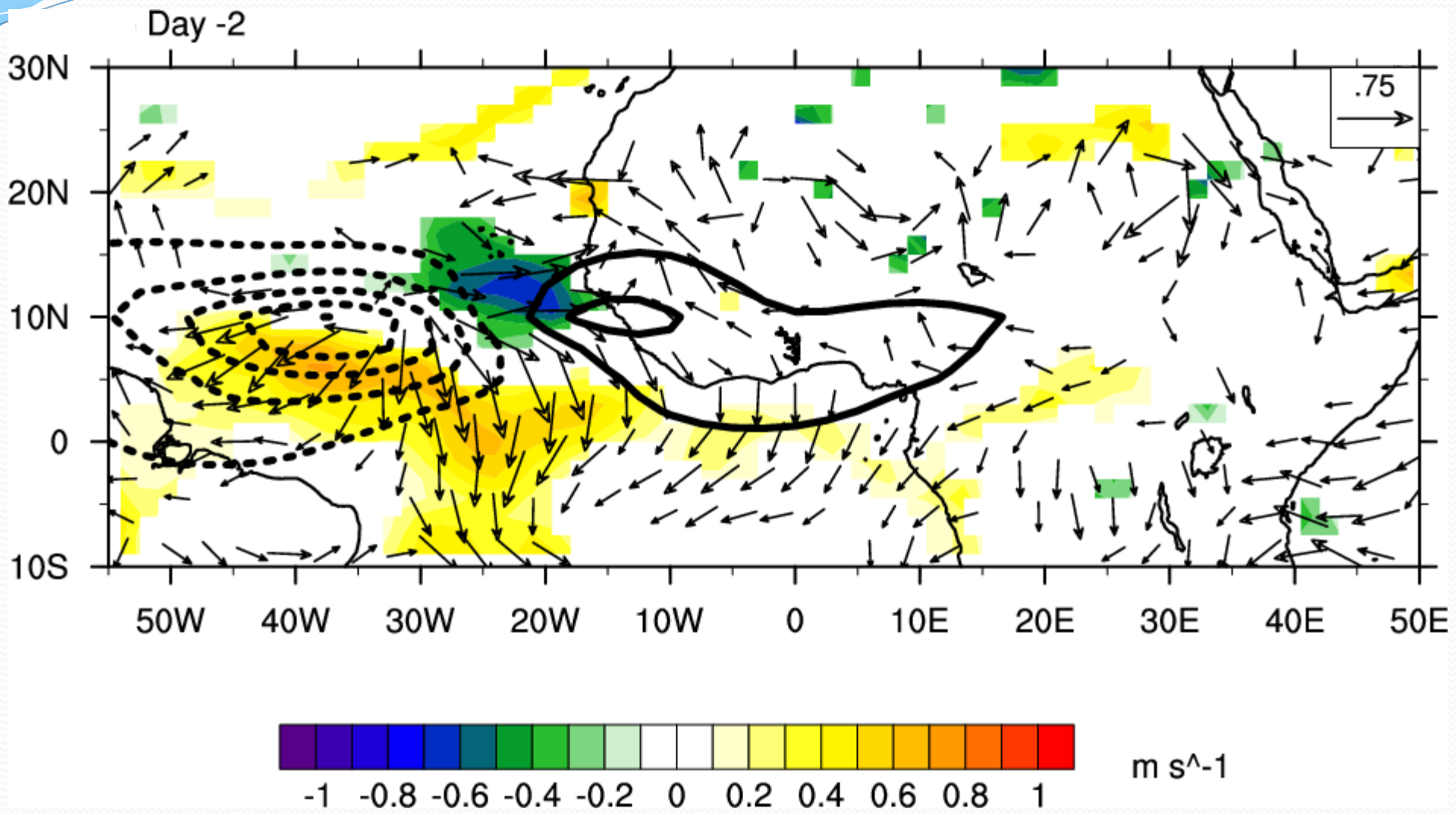


Shading: 925-700 hPa mean absolute vertical wind shear

Contours: Kelvin filtered OLR anomalies are contoured (dashed if negative)

Vectors: Vector (anomaly) difference between 925 and 200 hPa

925-700 hPa Vertical Wind Shear



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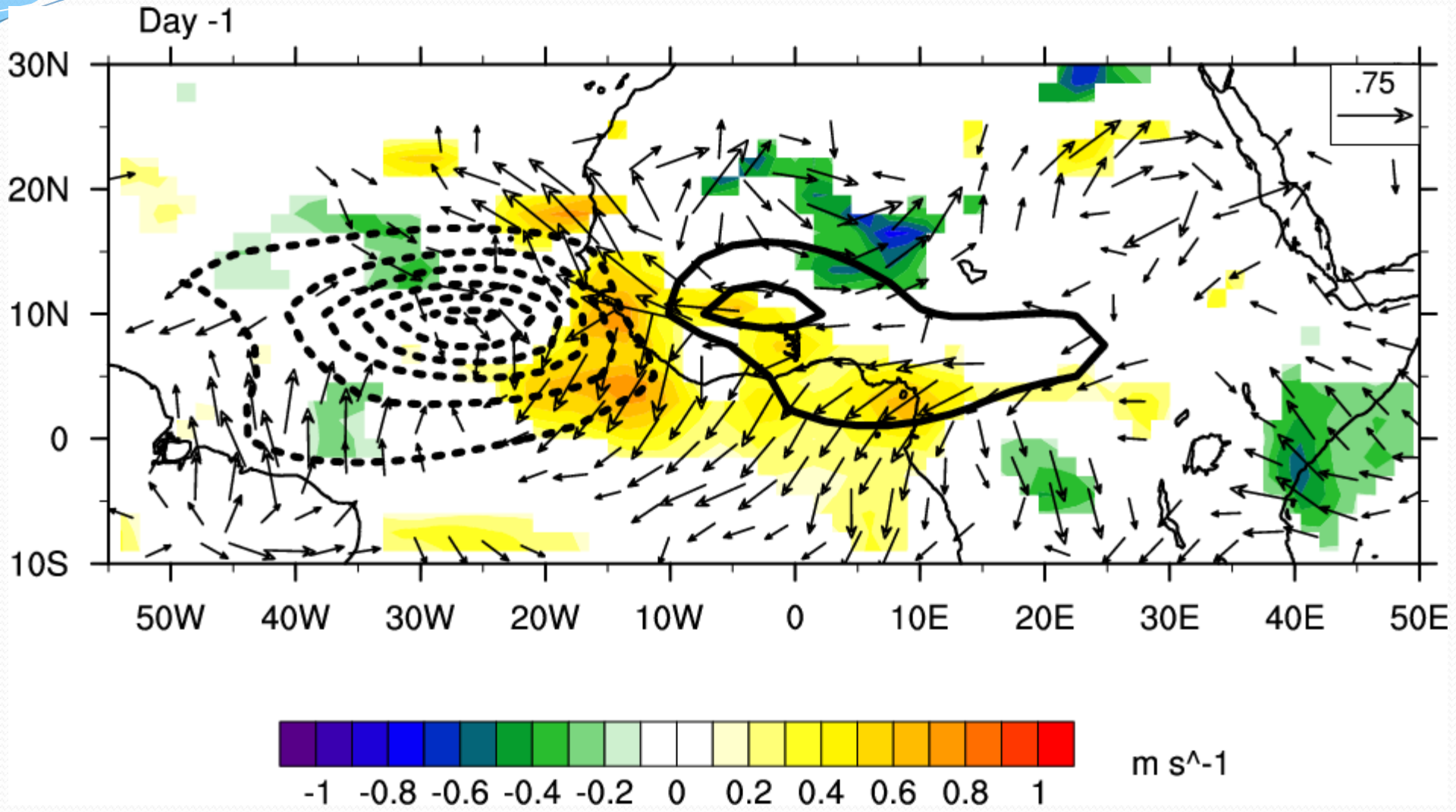

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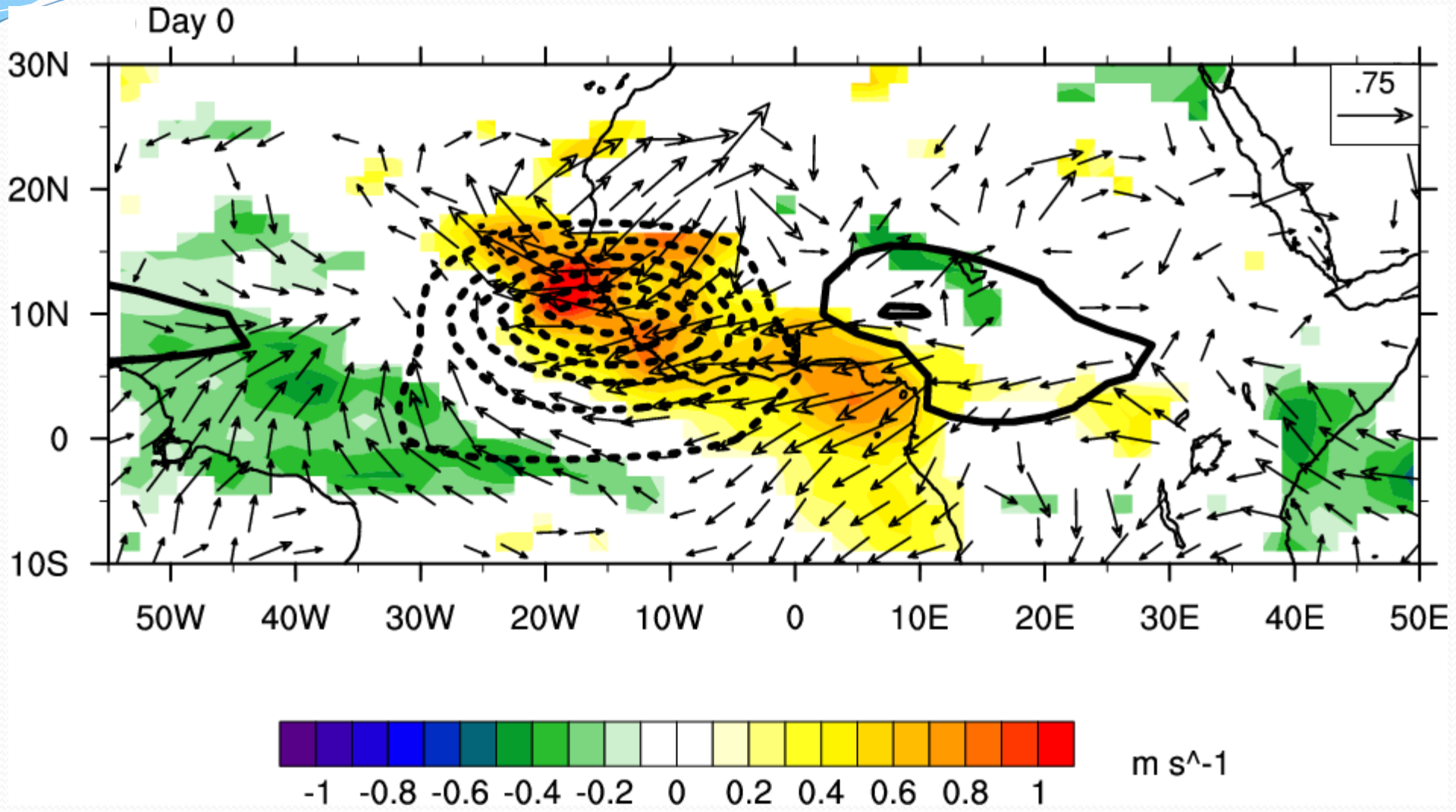

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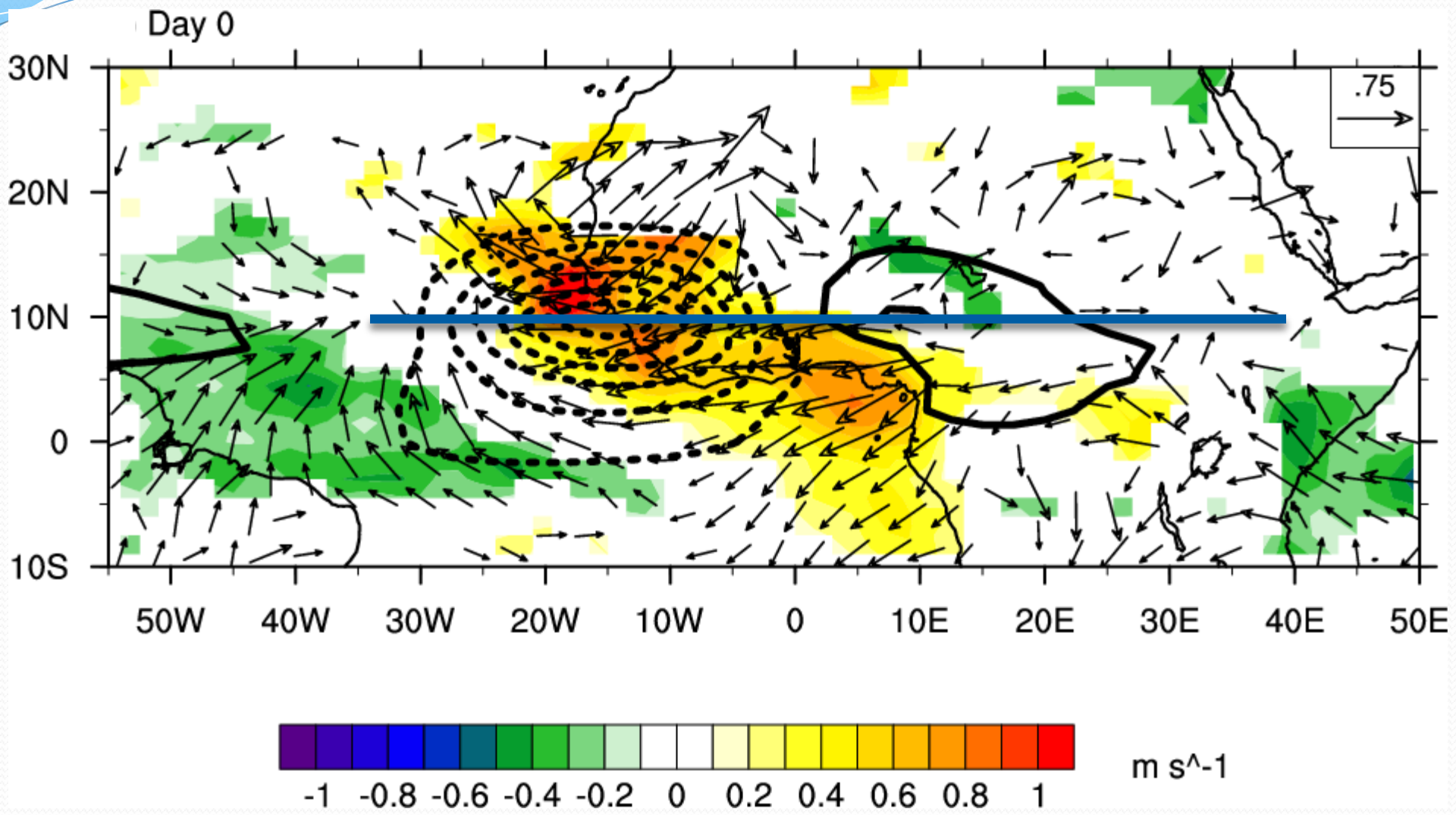

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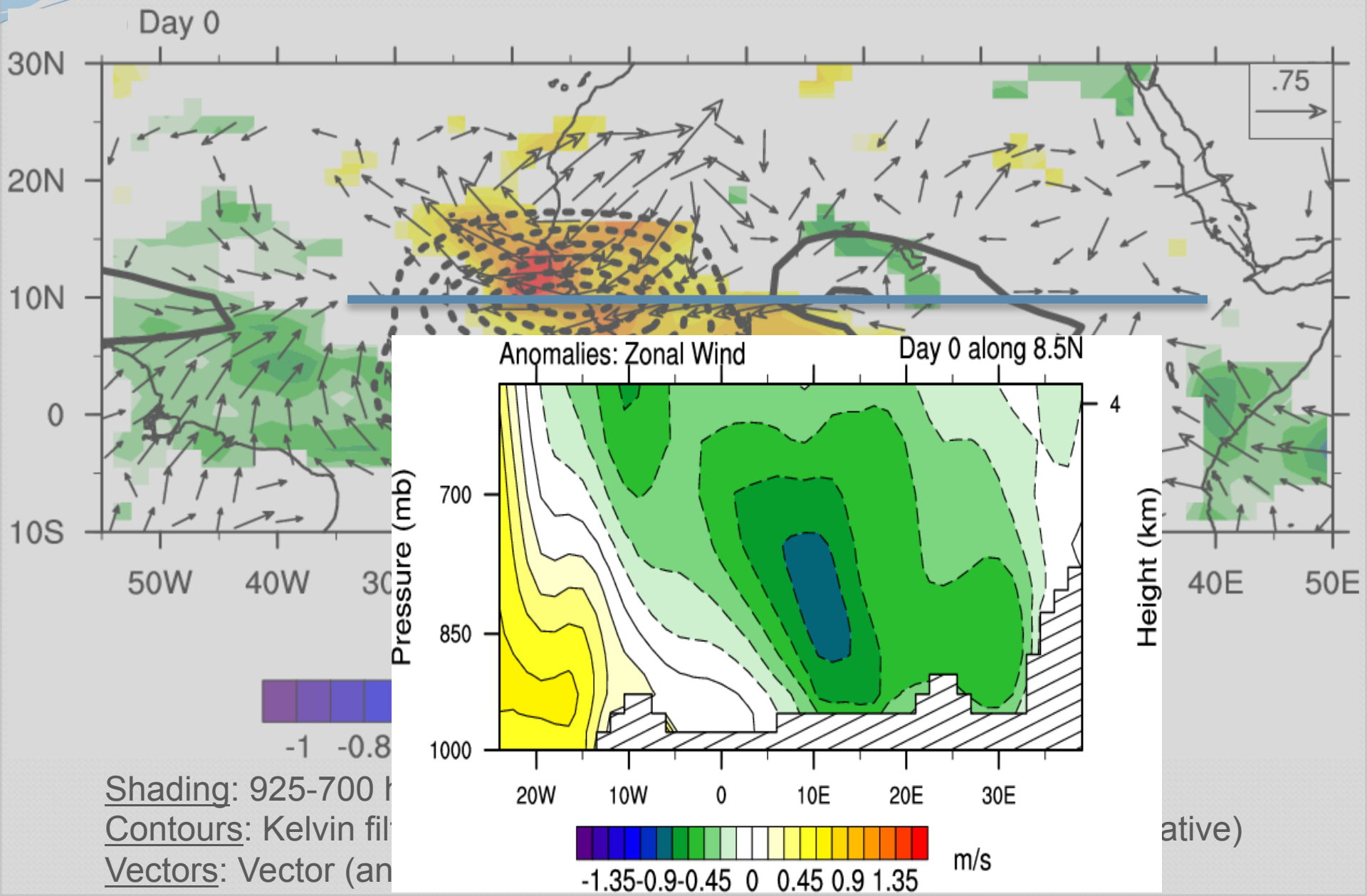

Shading: 925-700 h

Contours: Kelvin fil ative)

Vectors: Vector (an

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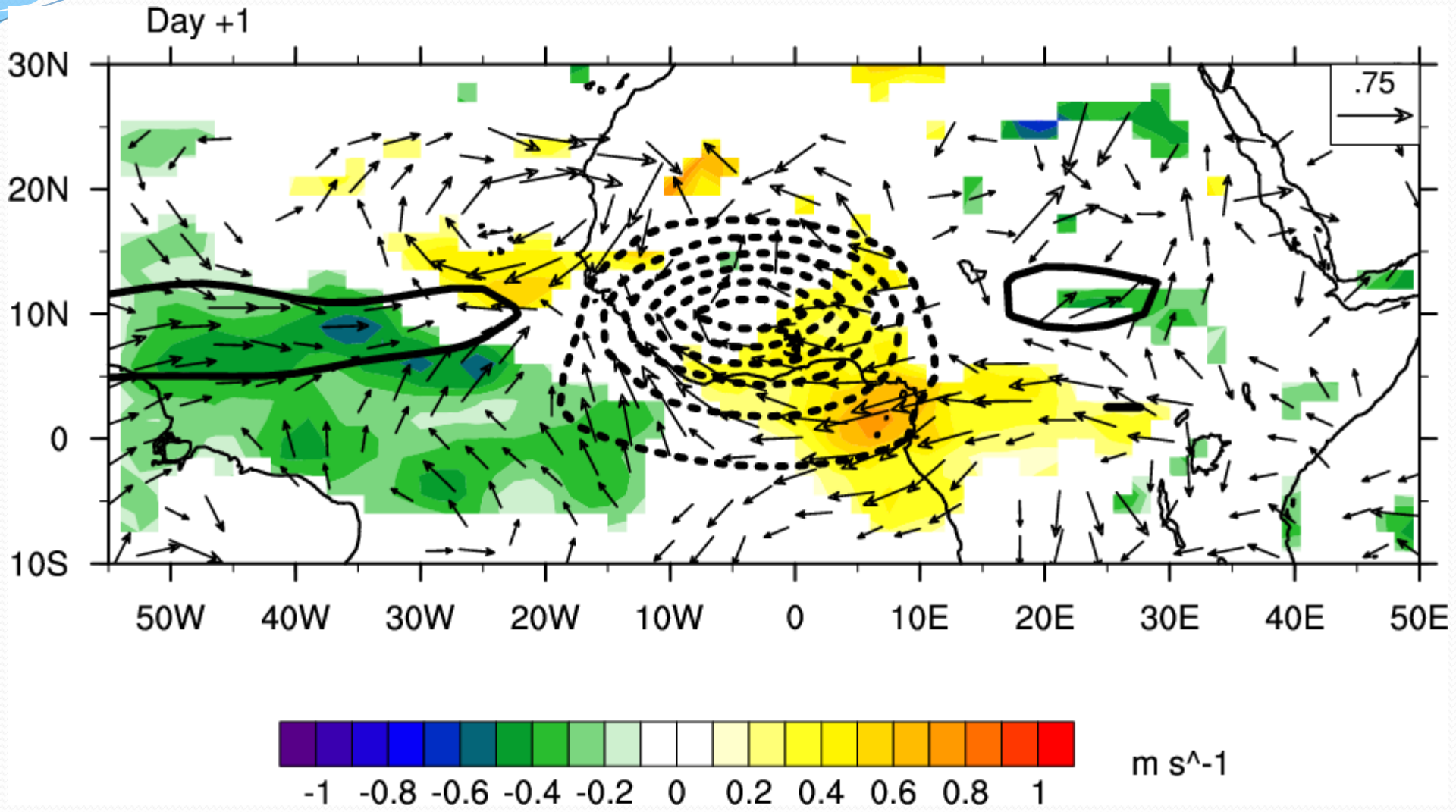

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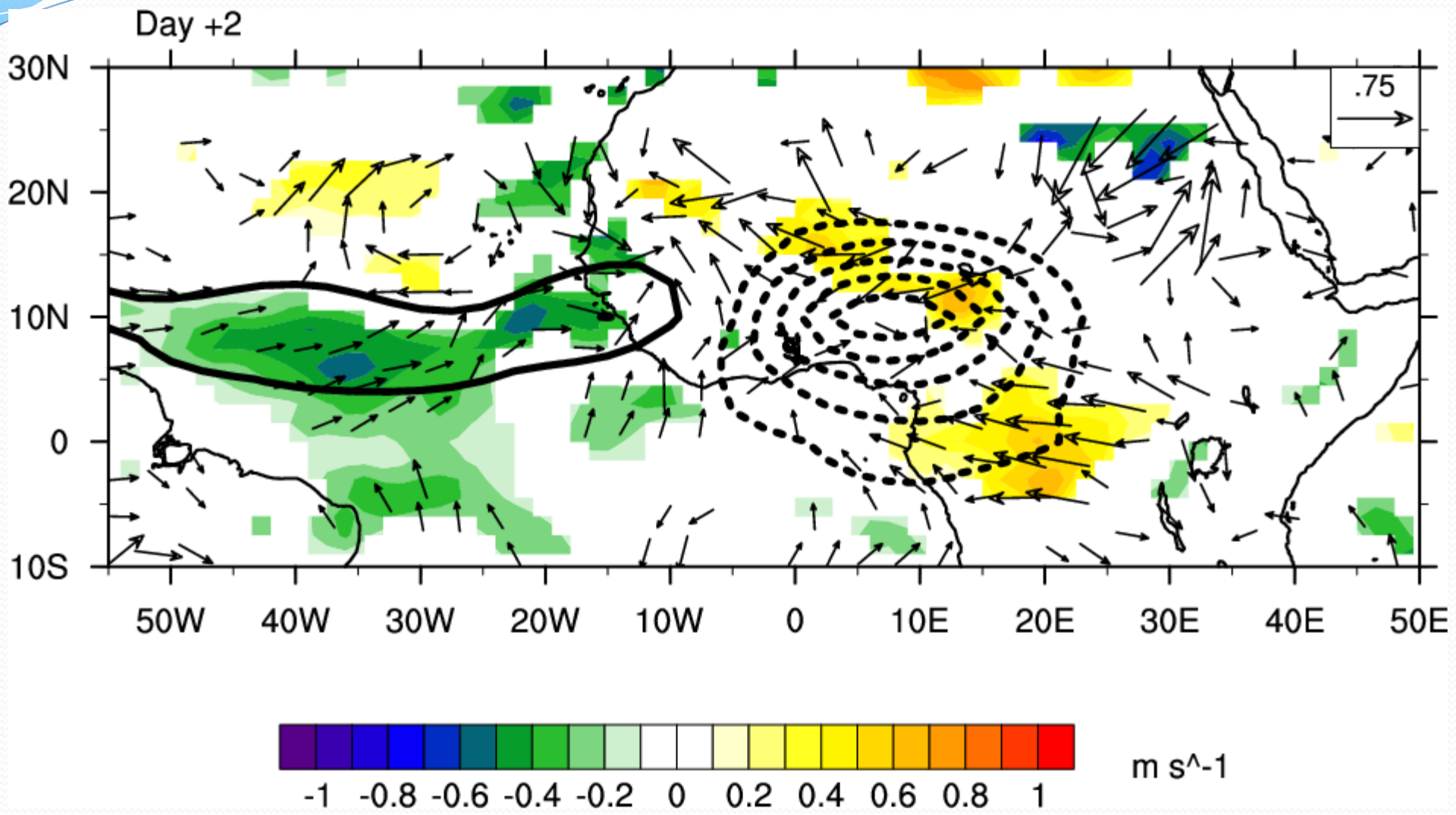

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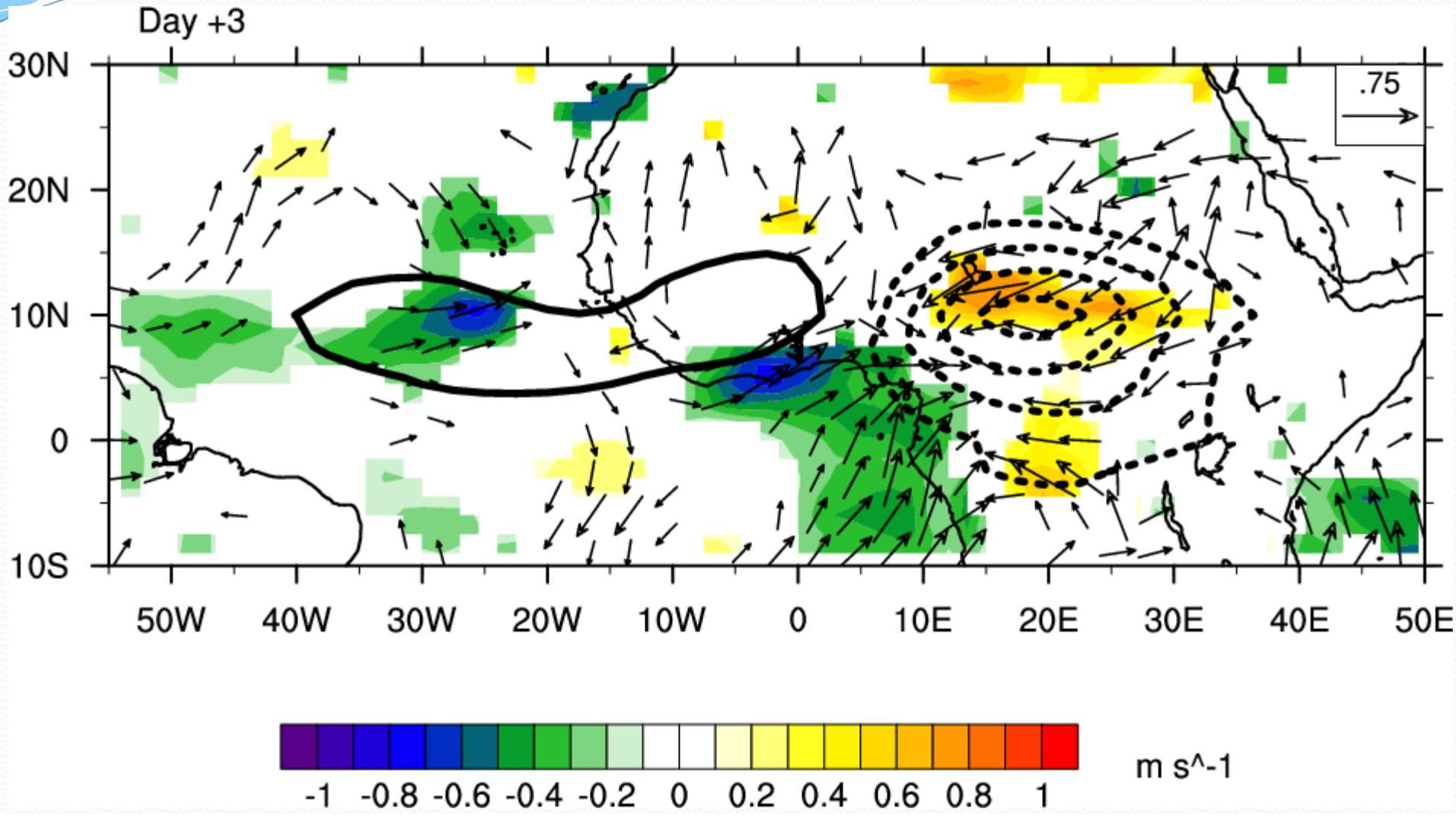

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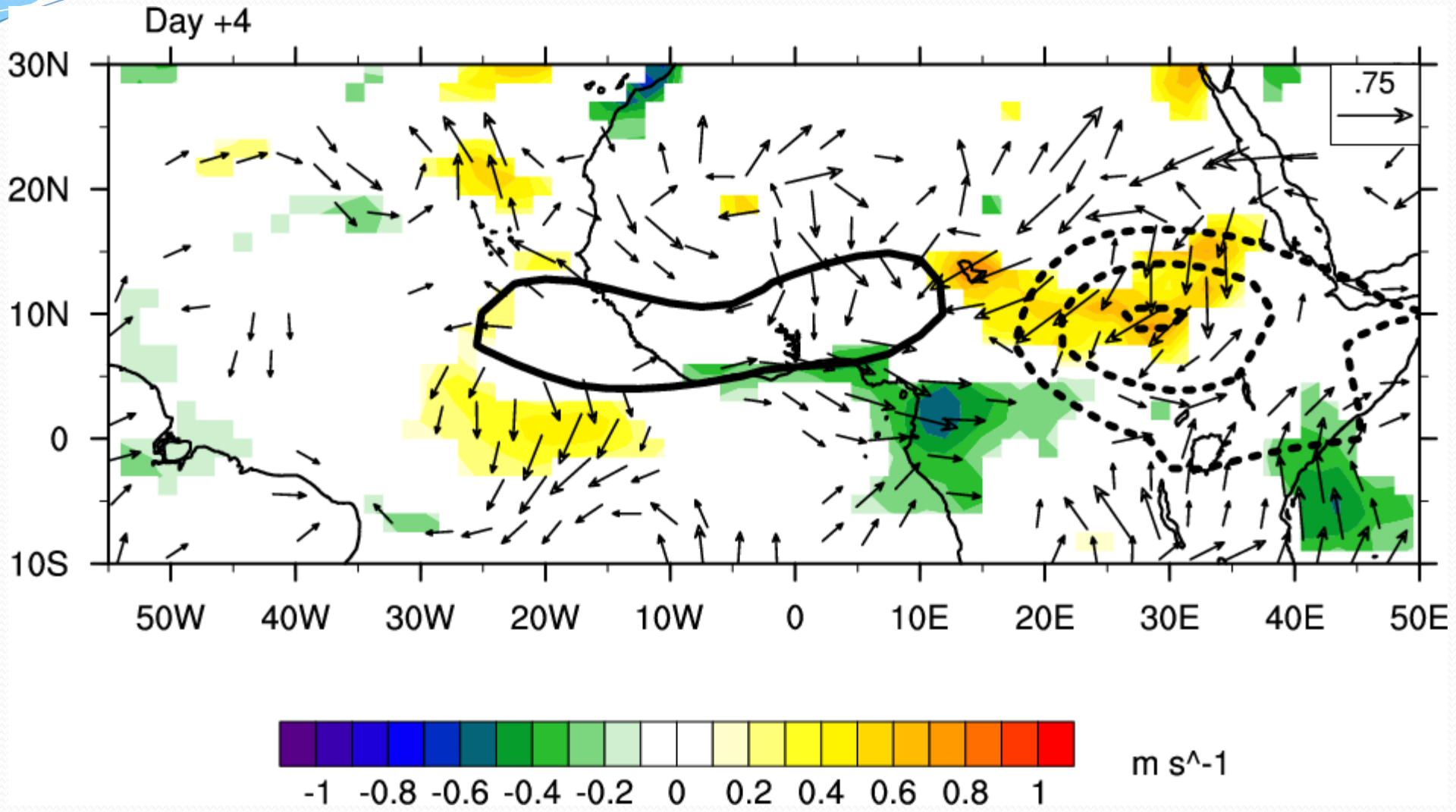

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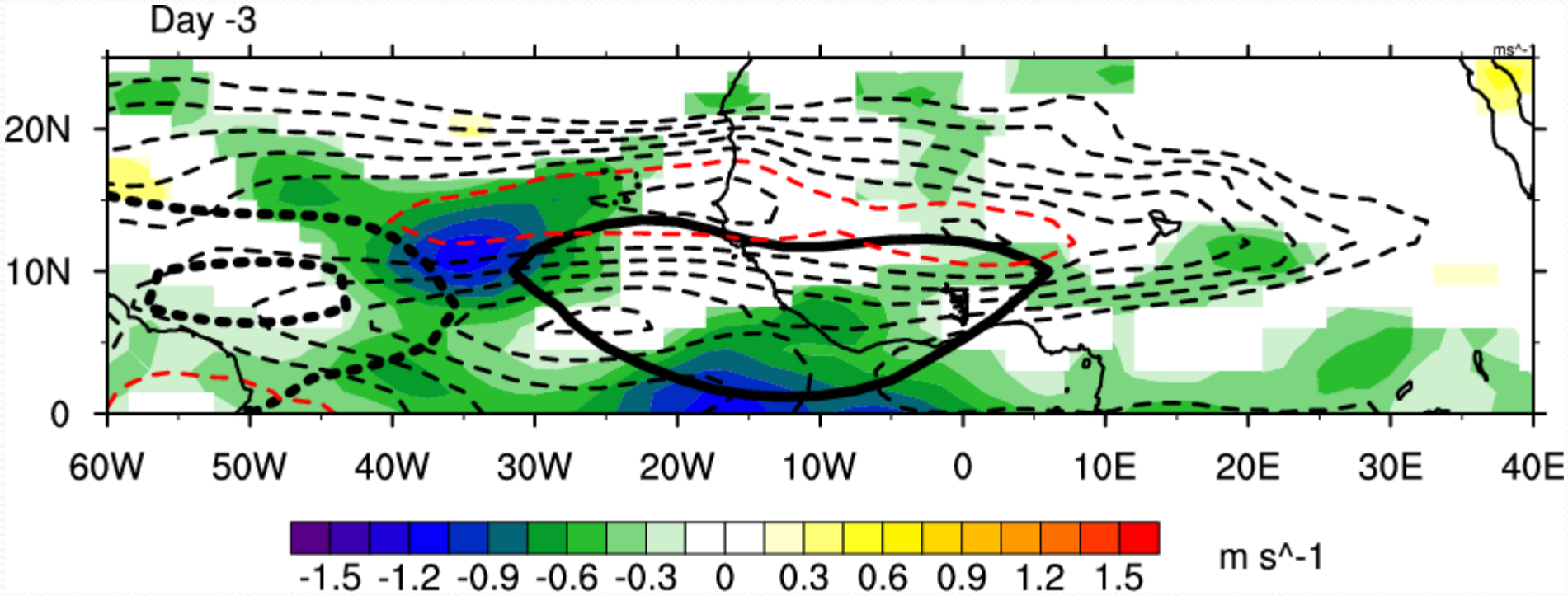
The African Easterly Jet (700 hPa)



Shading: Unfiltered 700 hPa Zonal Wind Anomalies
Bold Black Contours: Kelvin filtered OLR anomalies (dashed if negative)
Black-Dashed Contours: Total mean 700 hPa Easterly Winds (begins at -4 m/s)
Red-Dashed Contour: The -9 m/s contour

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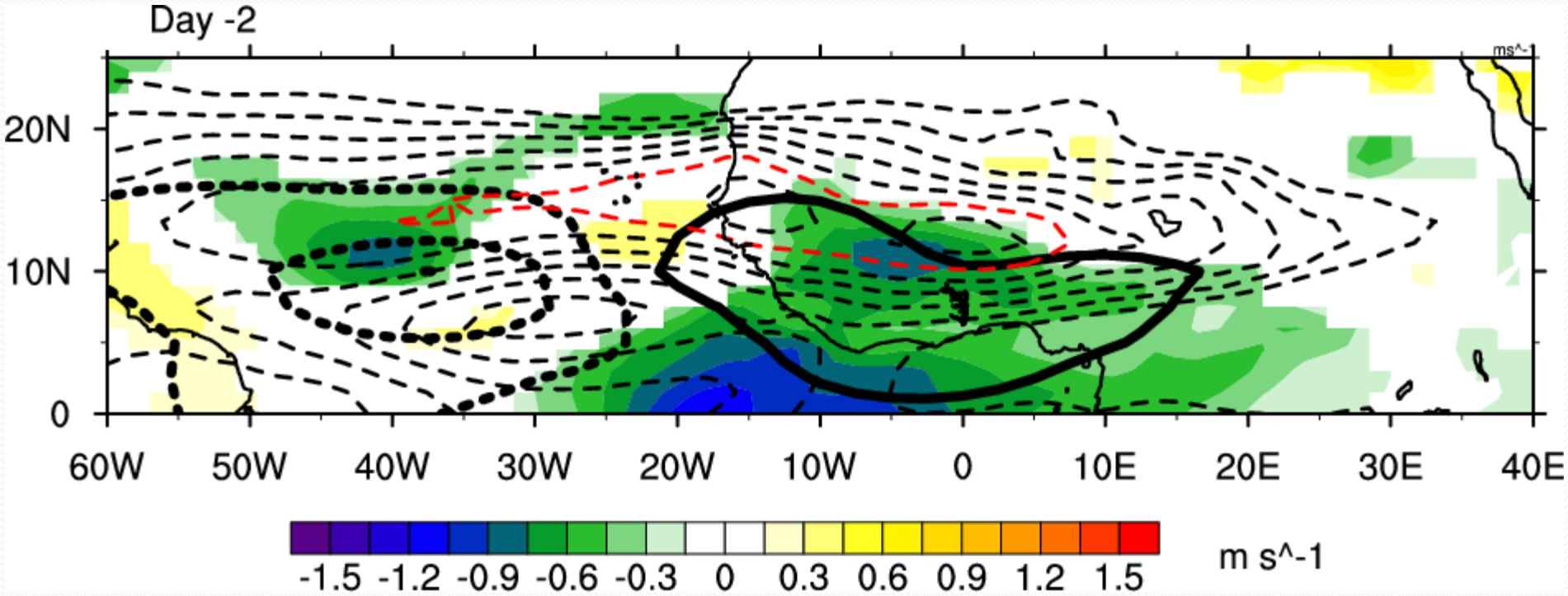

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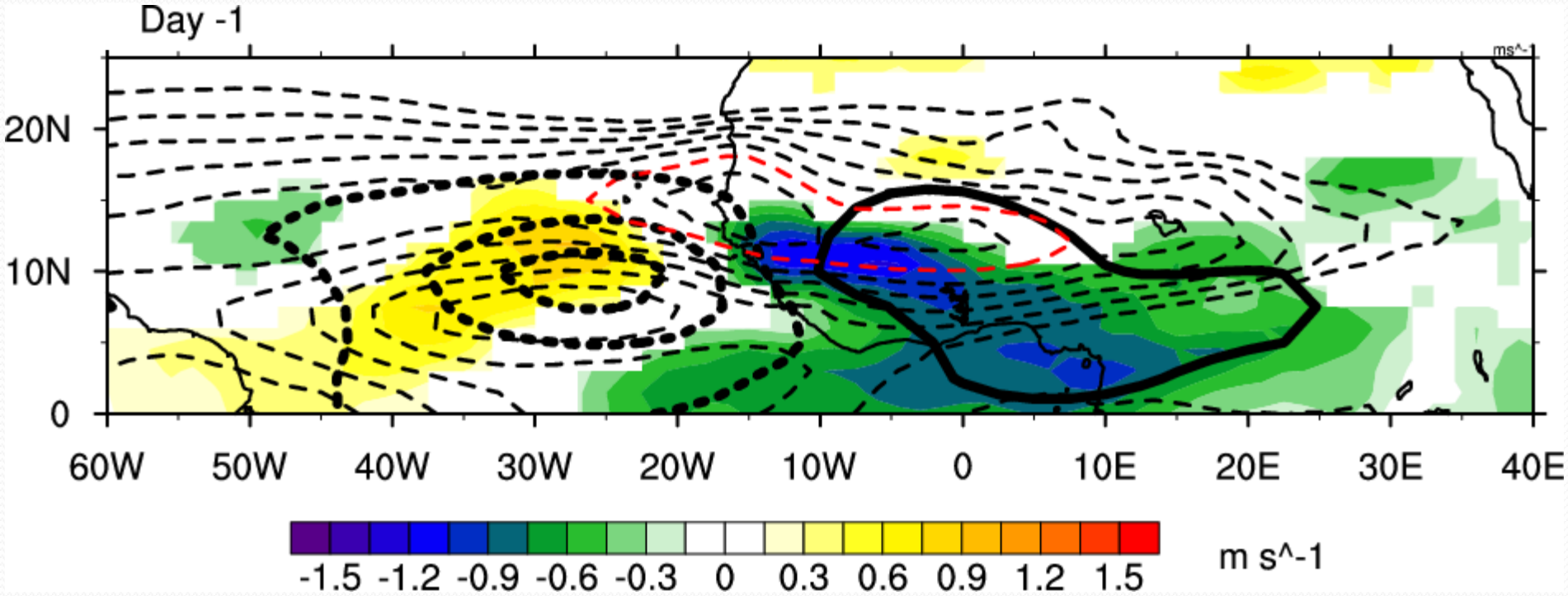

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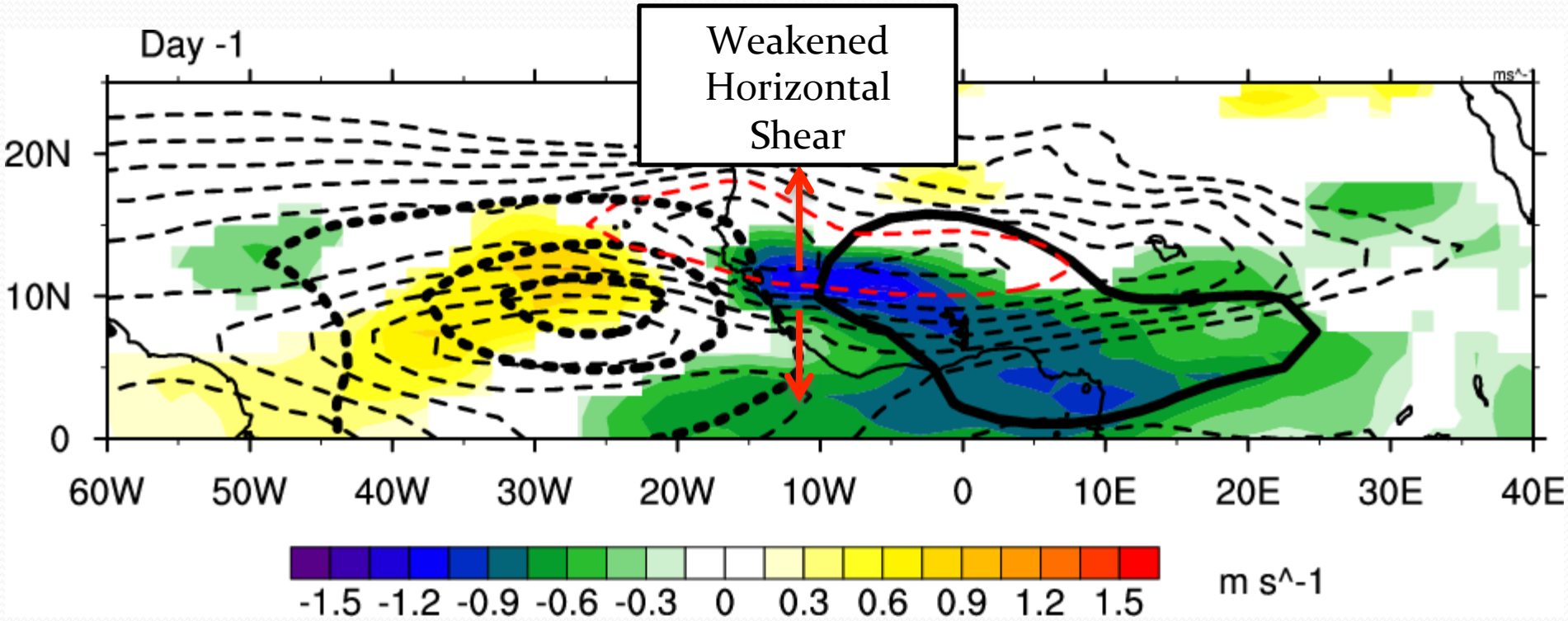

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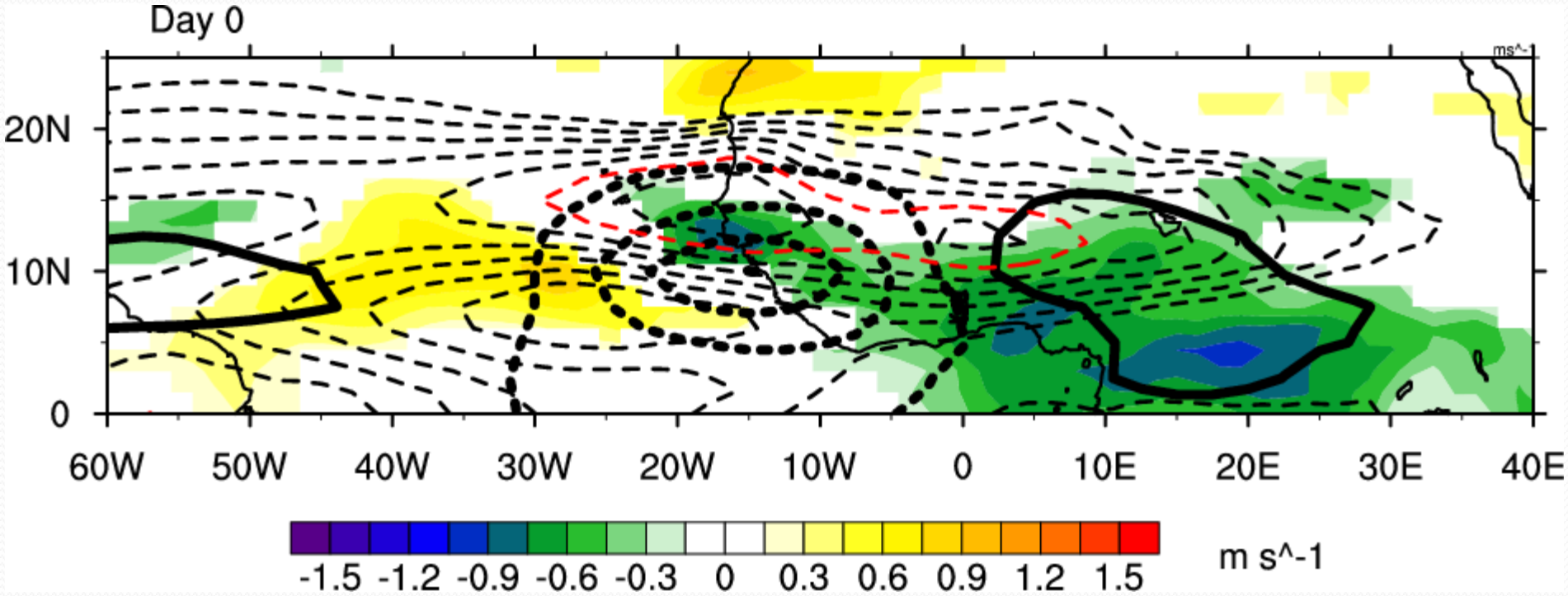

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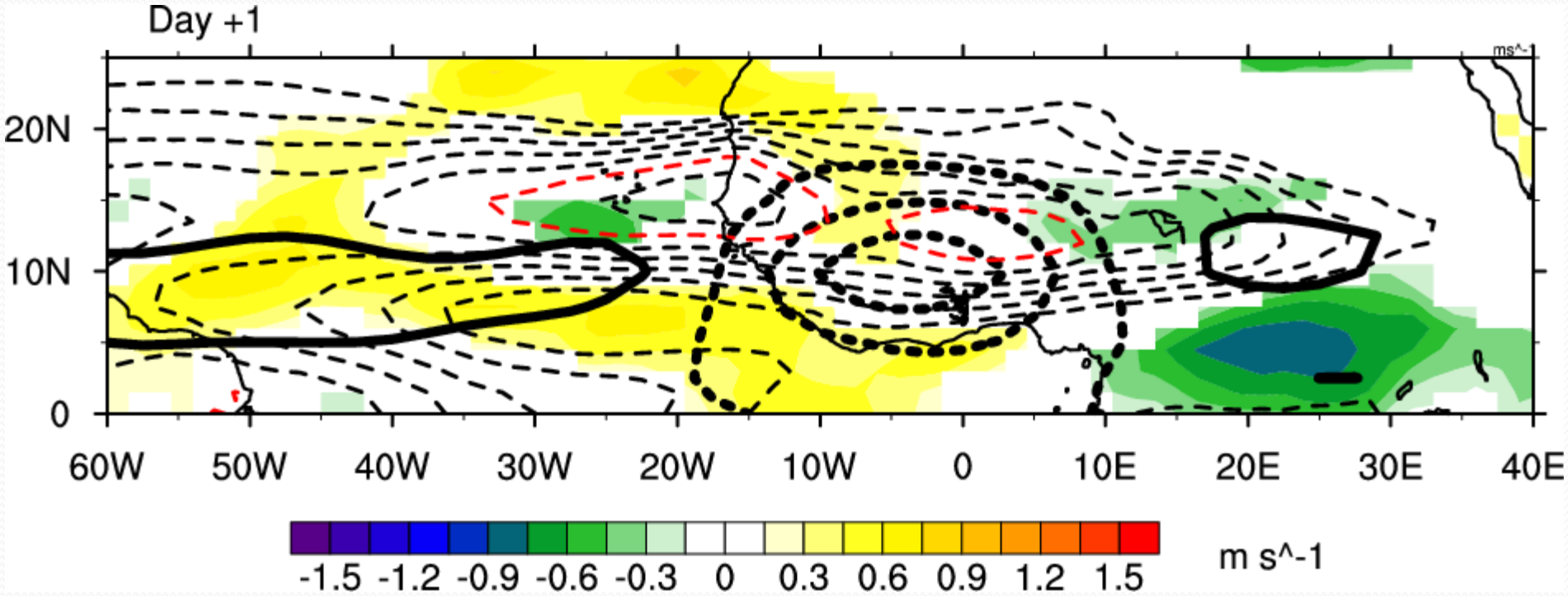

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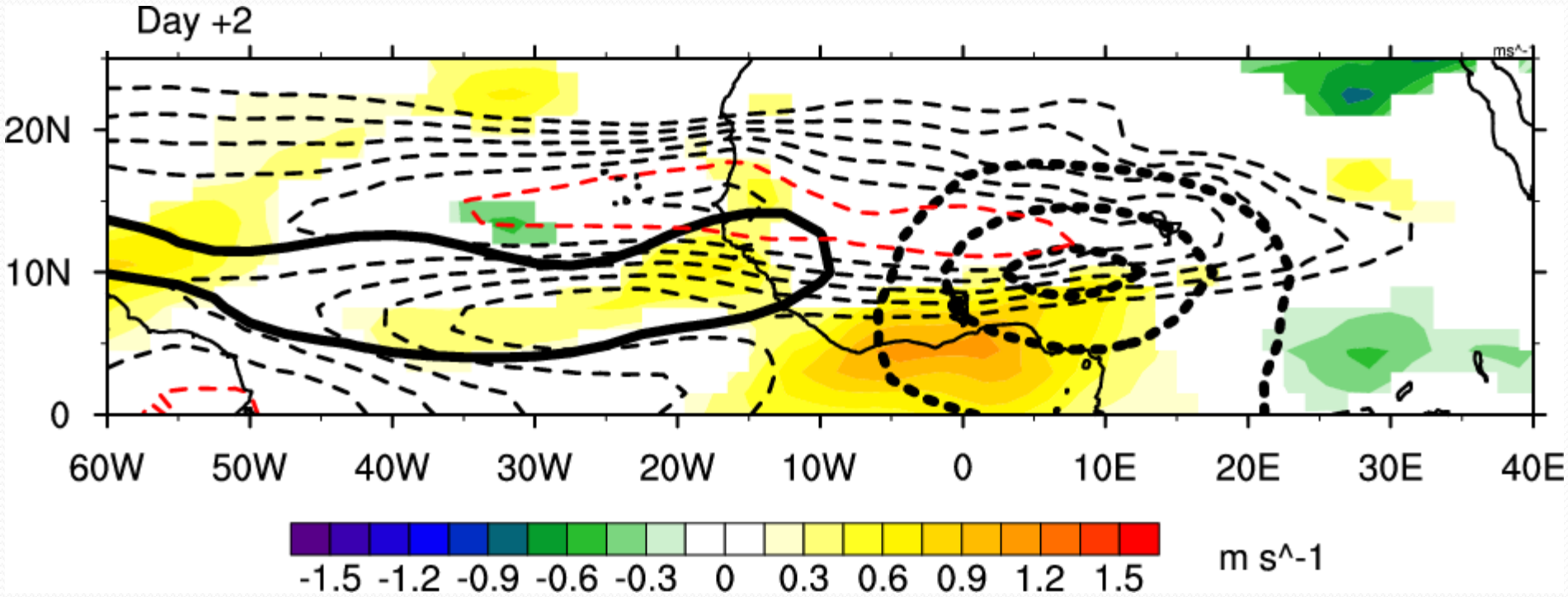

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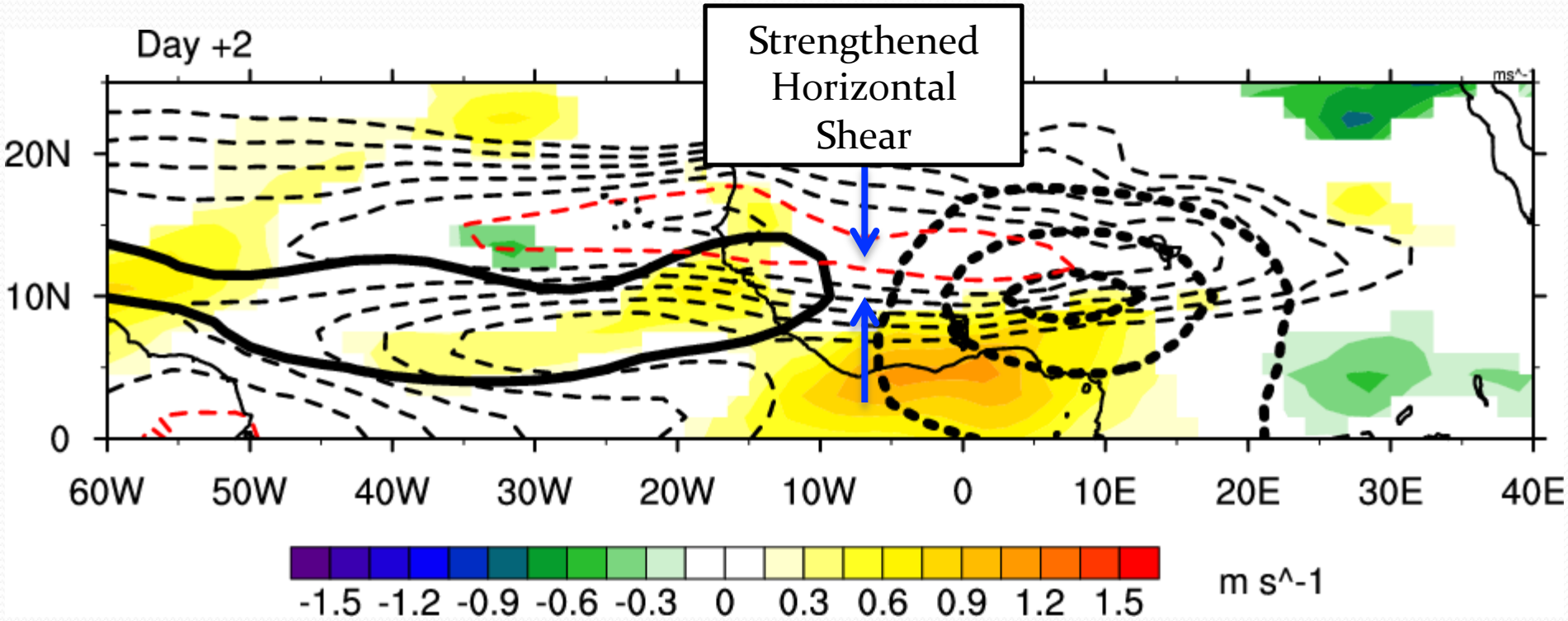

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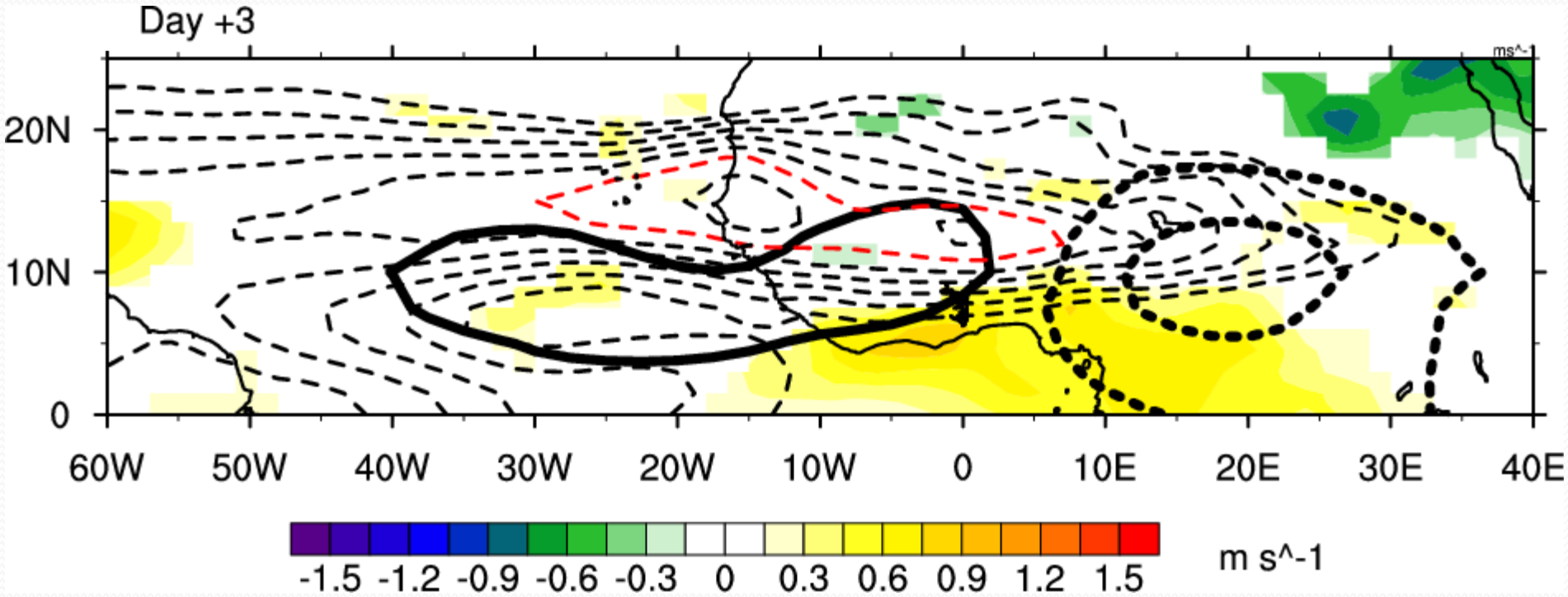

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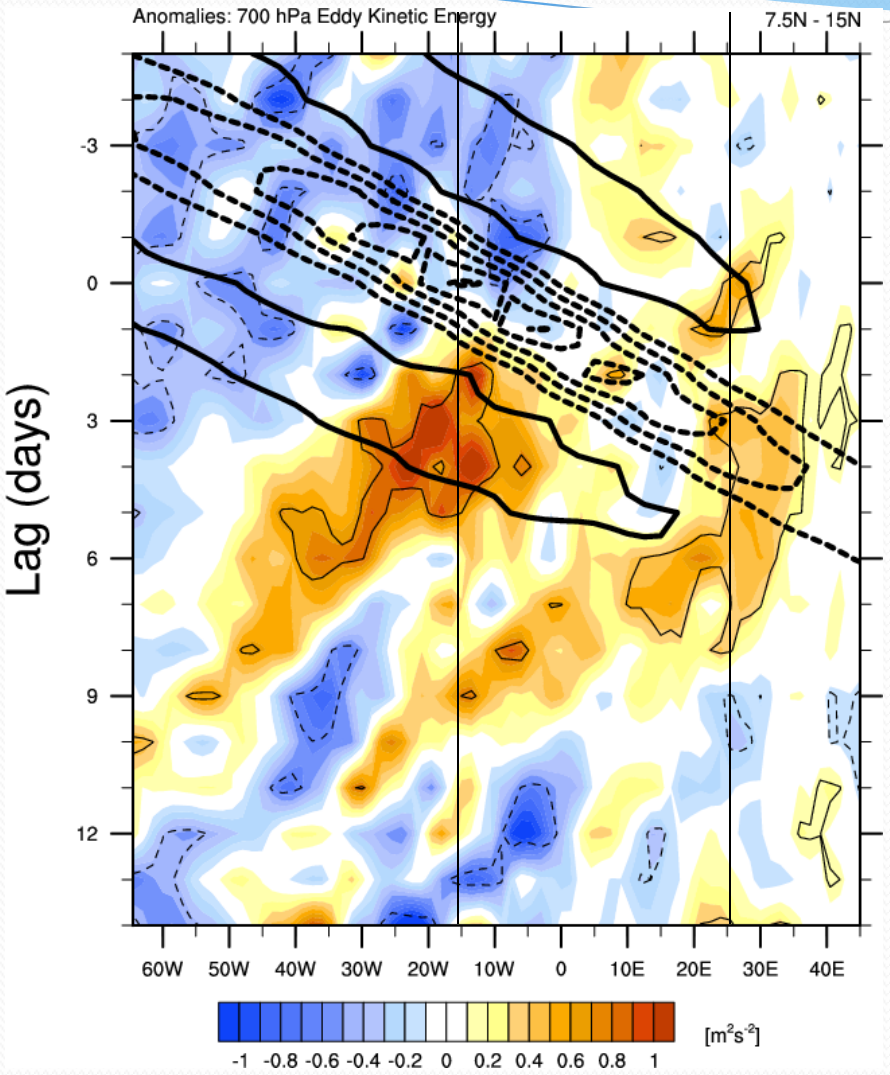
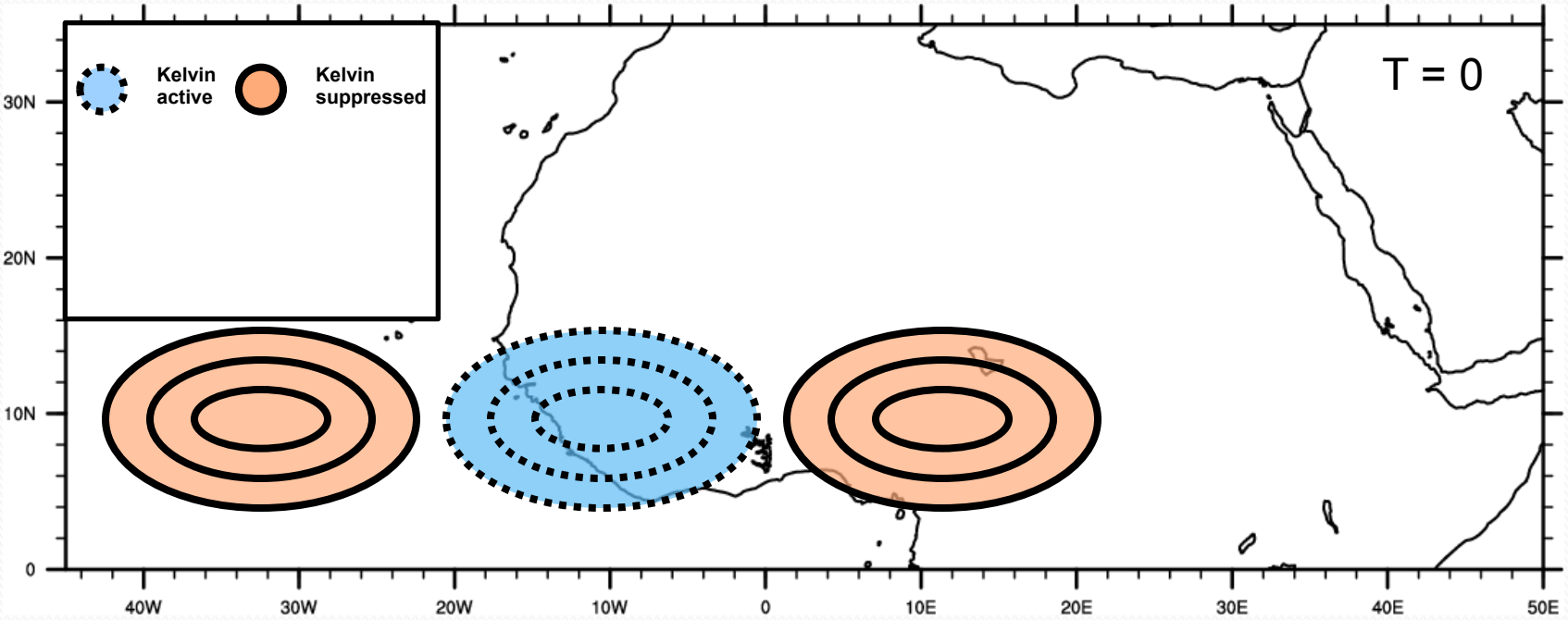
700 hPa Eddy Kinetic Energy Anomalies



Shading: 700 hPa EKE anomalies (contoured if statistically different than zero at the 90% level)

Bold Black Contours: Kelvin filtered OLR anomalies (dashed if negative)

Conclusions



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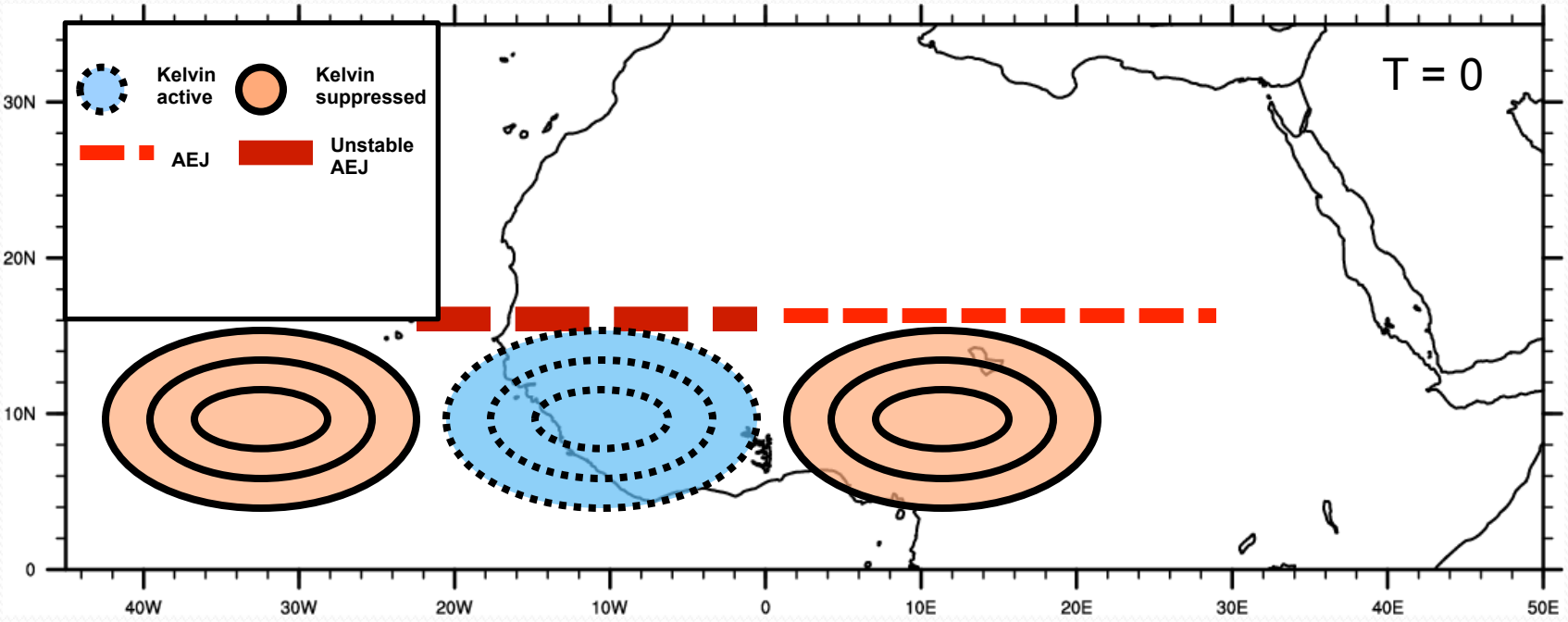
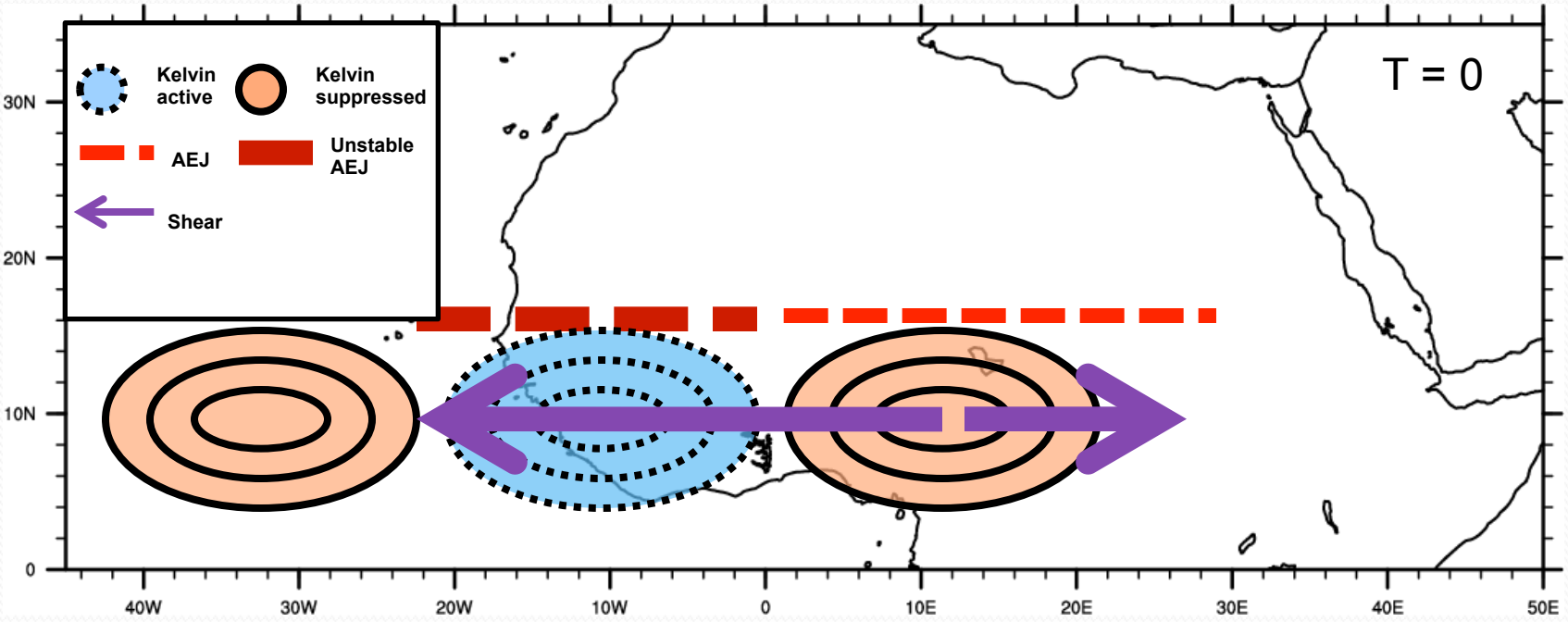


1) AEJ becomes more unstable during the passage of convectively active phase of CCKW

Conclusions



1) AEJ becomes more unstable during the passage of convectively active phase of CCKW
2) Enhanced low-level easterly shear occurs within and ahead of the convectively active phase of the CCKW, with westerly shear ahead of its suppressed phase

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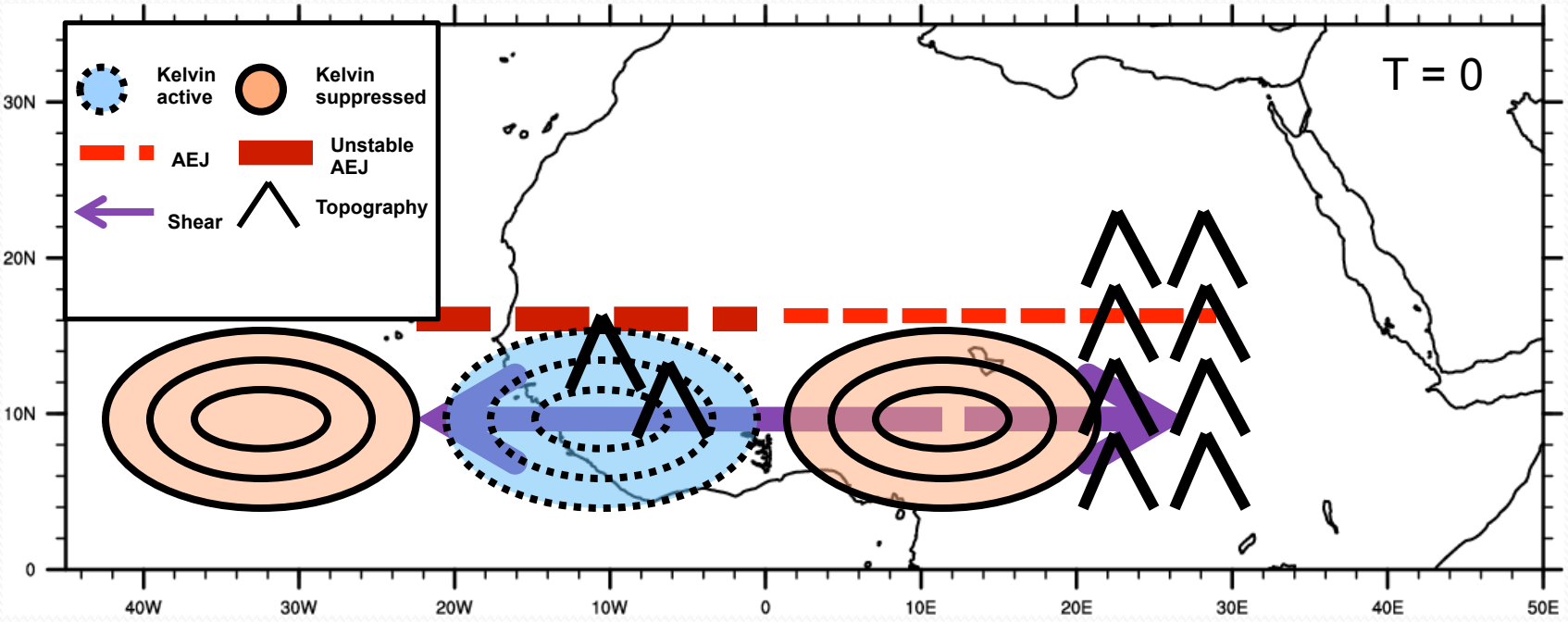

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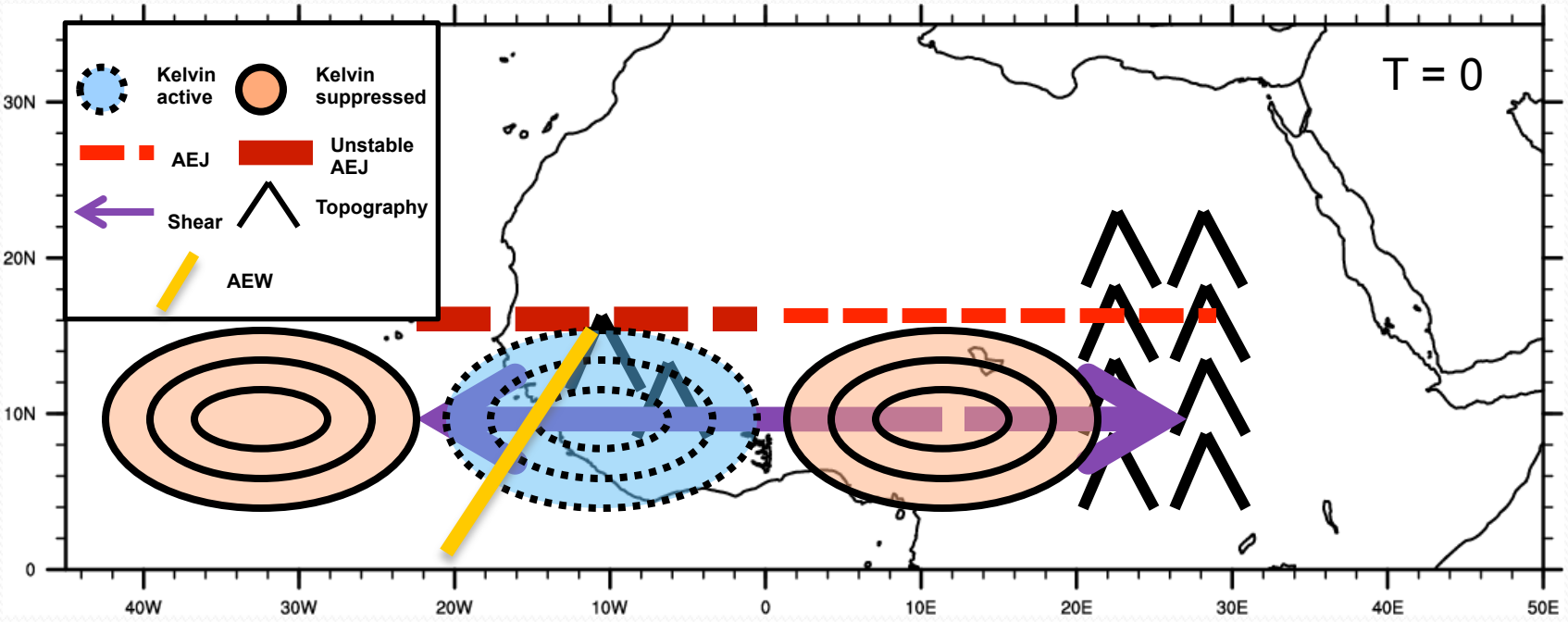
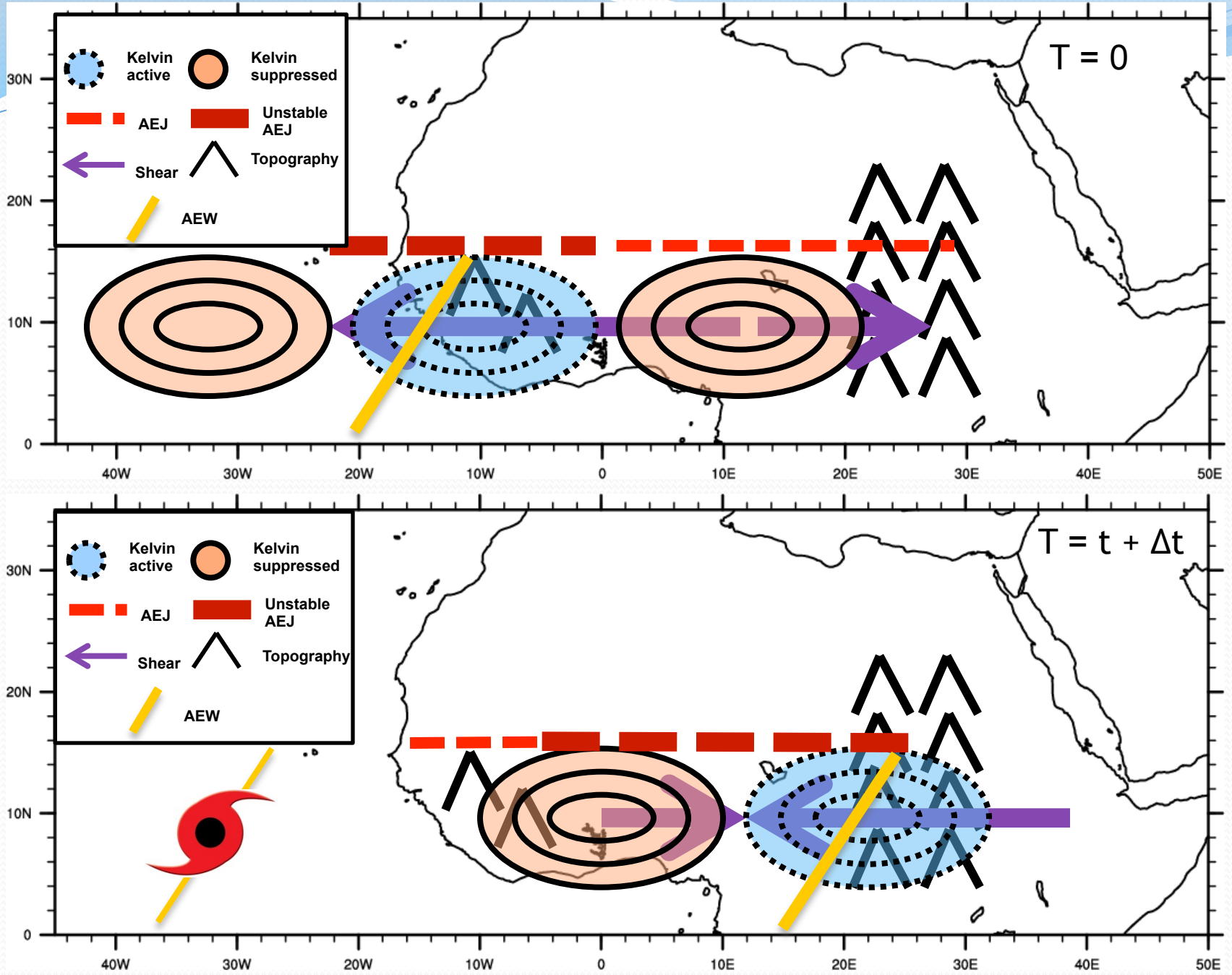


1) AEJ becomes more unstable during the passage of convectively active phase of CCKW
2) Enhanced low-level easterly shear occurs within and ahead of the convectively active phase of the CCKW, with westerly shear ahead of its suppressed phase
3) Enhanced AEW activity develops over western Africa after the passage of the convectively active phase of the CCKW


Kelvin active
Kelvin suppressed
AEJ
Unstable AEJ
Shear
Topography
AEW
T = 0
T = t + Δt
30N
20N
10N
0
40W
30W
20W
10W
0
10E
20E
30E
40E
50E

Happy 4th of July!

Extra Slides

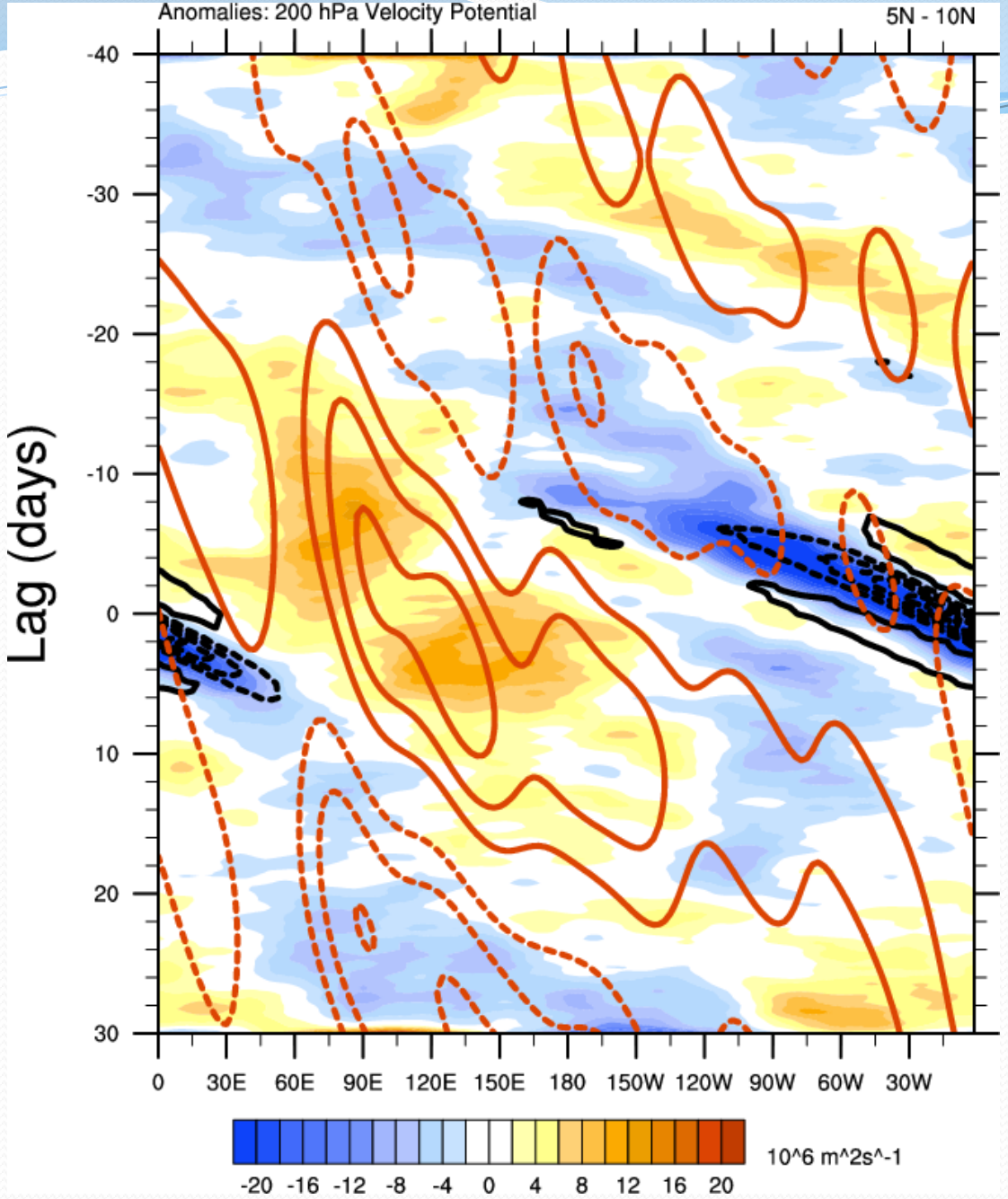
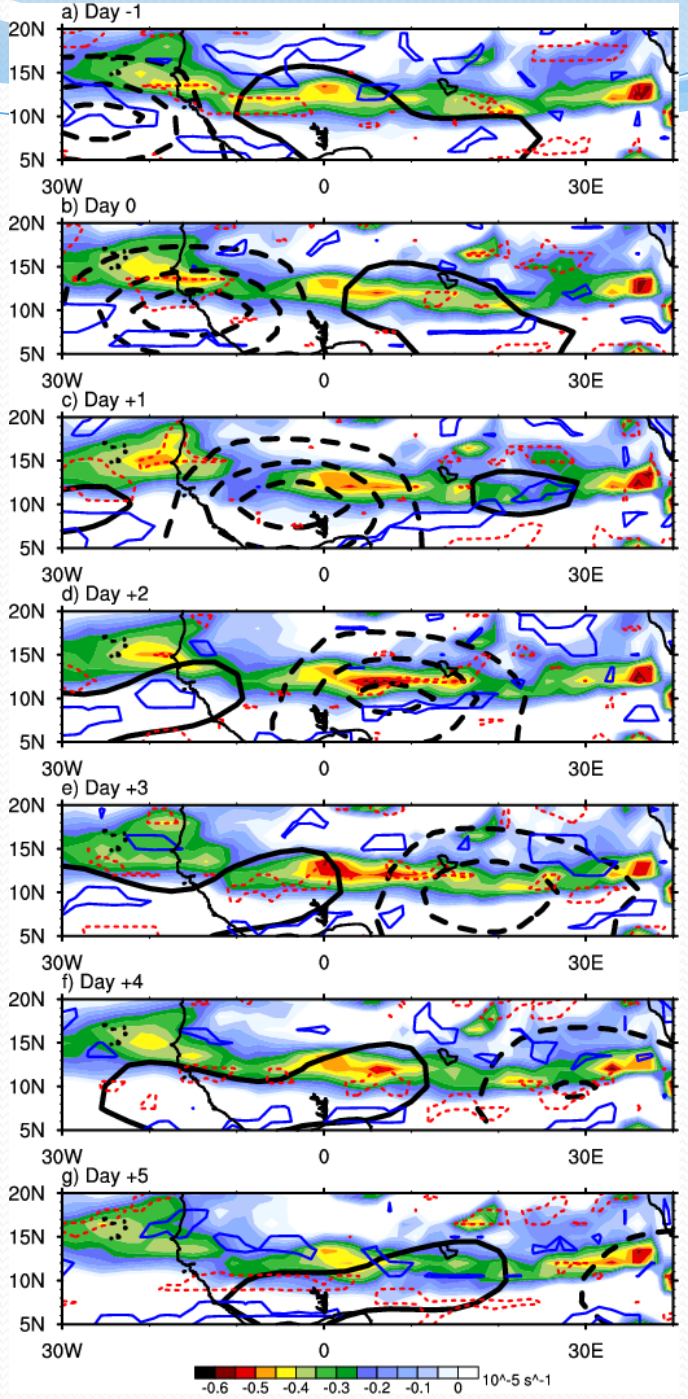
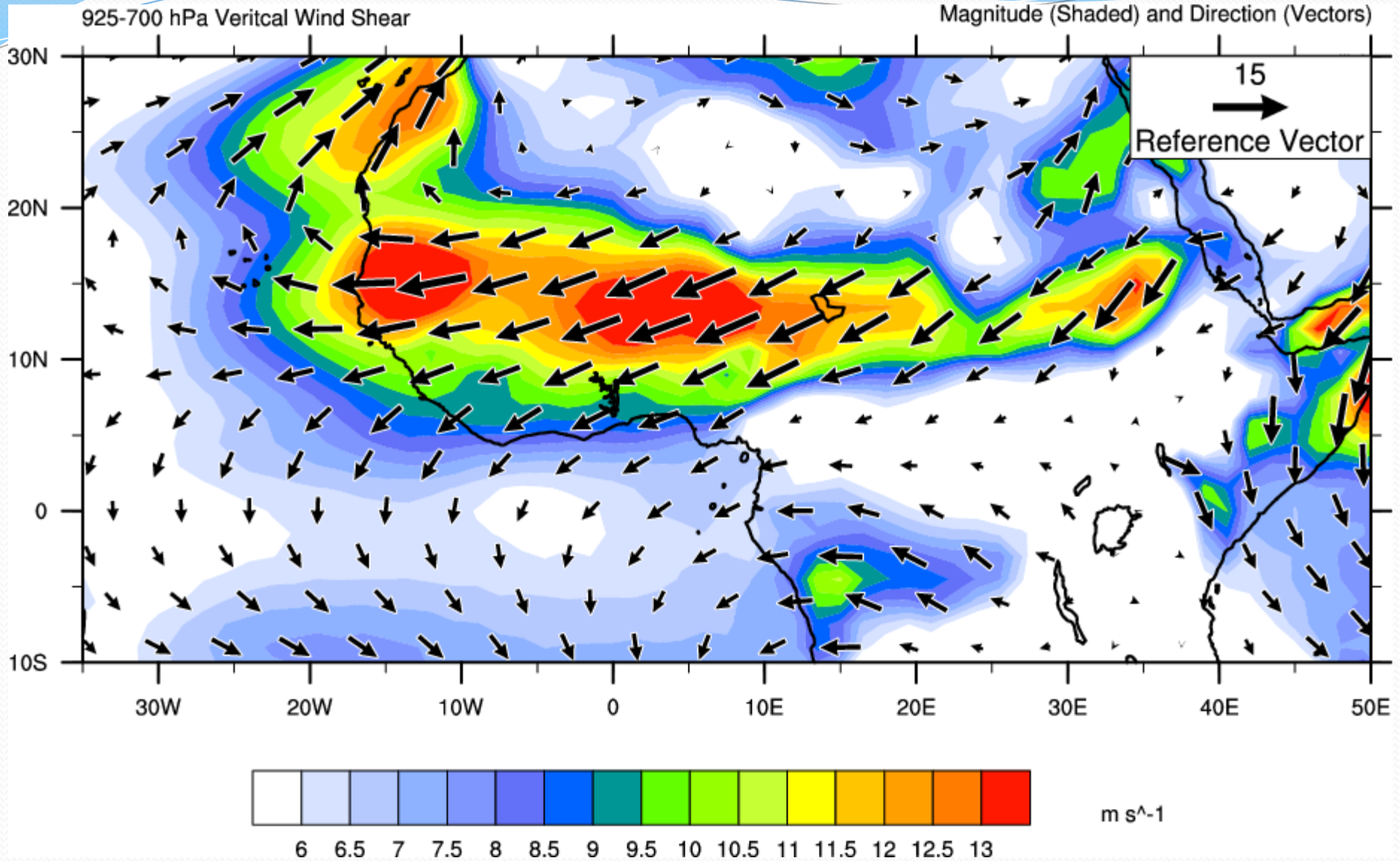


FIG. 10 in Ventrice et al. (2012b)

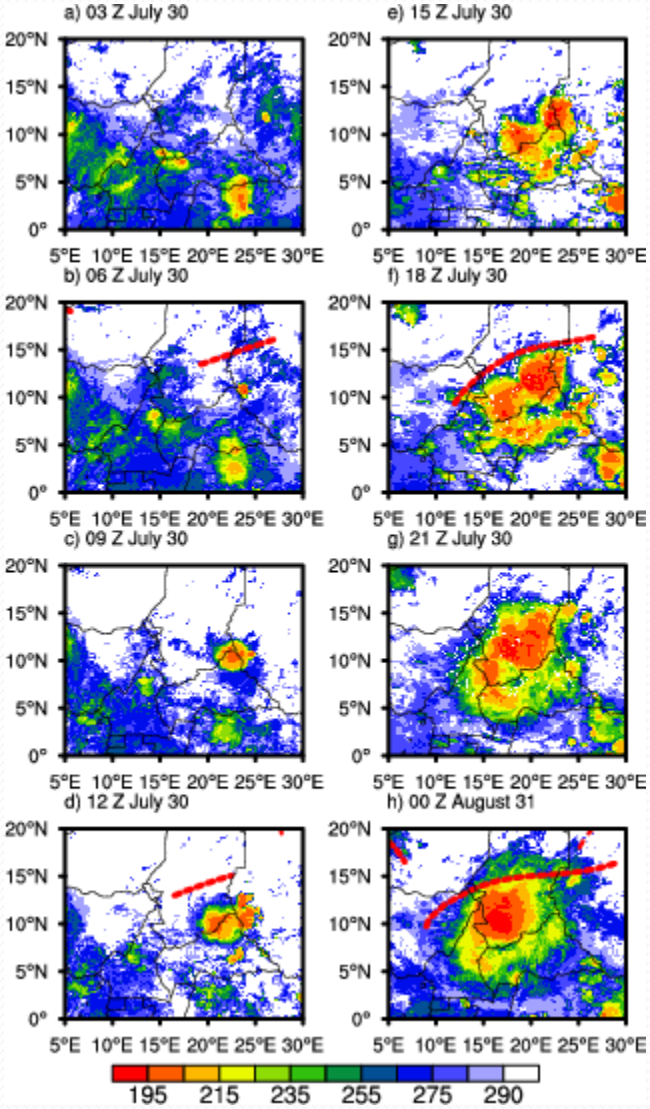
- Gradient becomes more negative during and just after the passage of the convectively active phase of the CCKW
  - Jet becoming more unstable



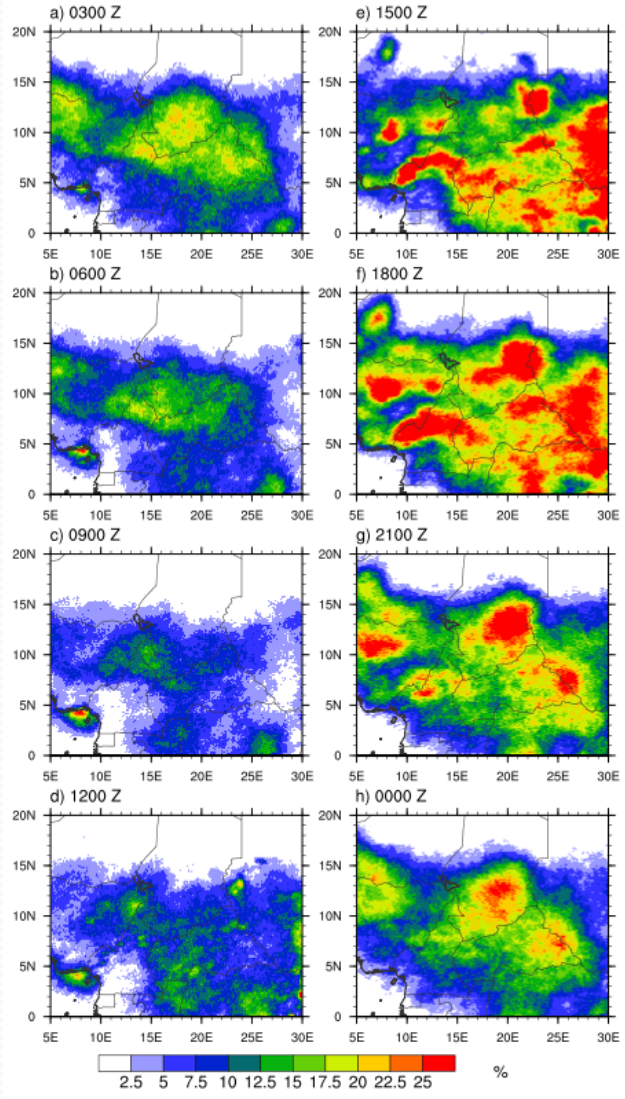
Horizontal gradient of absolute vorticity (negative values only shaded). Statistically significant (90% level) changes are contoured (red-dashed are negative anomalies). Kelvin filtered OLR anomalies are contoured black (dashed if negative)


925-700 hPa Veritcal Wind Shear
Magnitude (Shaded) and Direction (Vectors)
15
Reference Vector
30N
20N
10N
0
10S
30W
20W
10W
0
10E
20E
30E
40E
50E
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
11.5
12
12.5
13
m s^-1

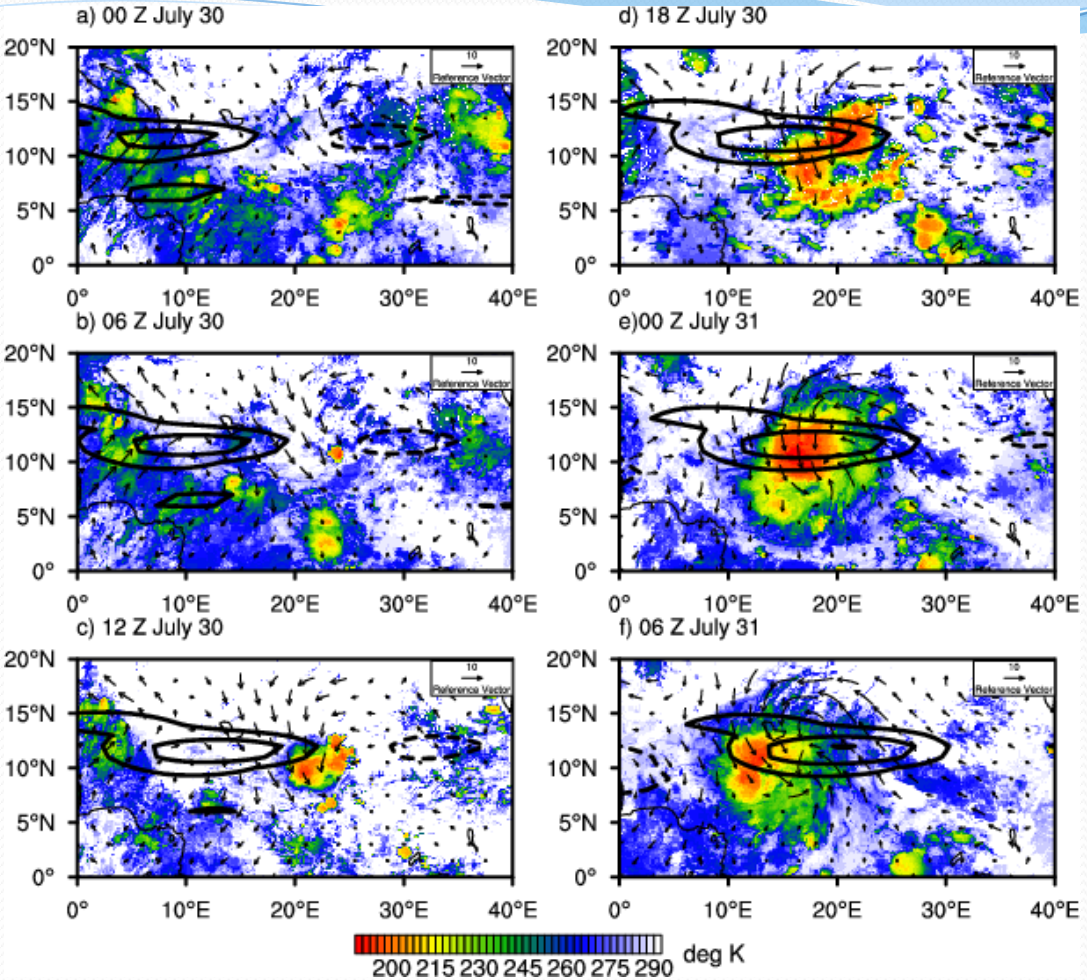
Diurnal Cycle of Convection



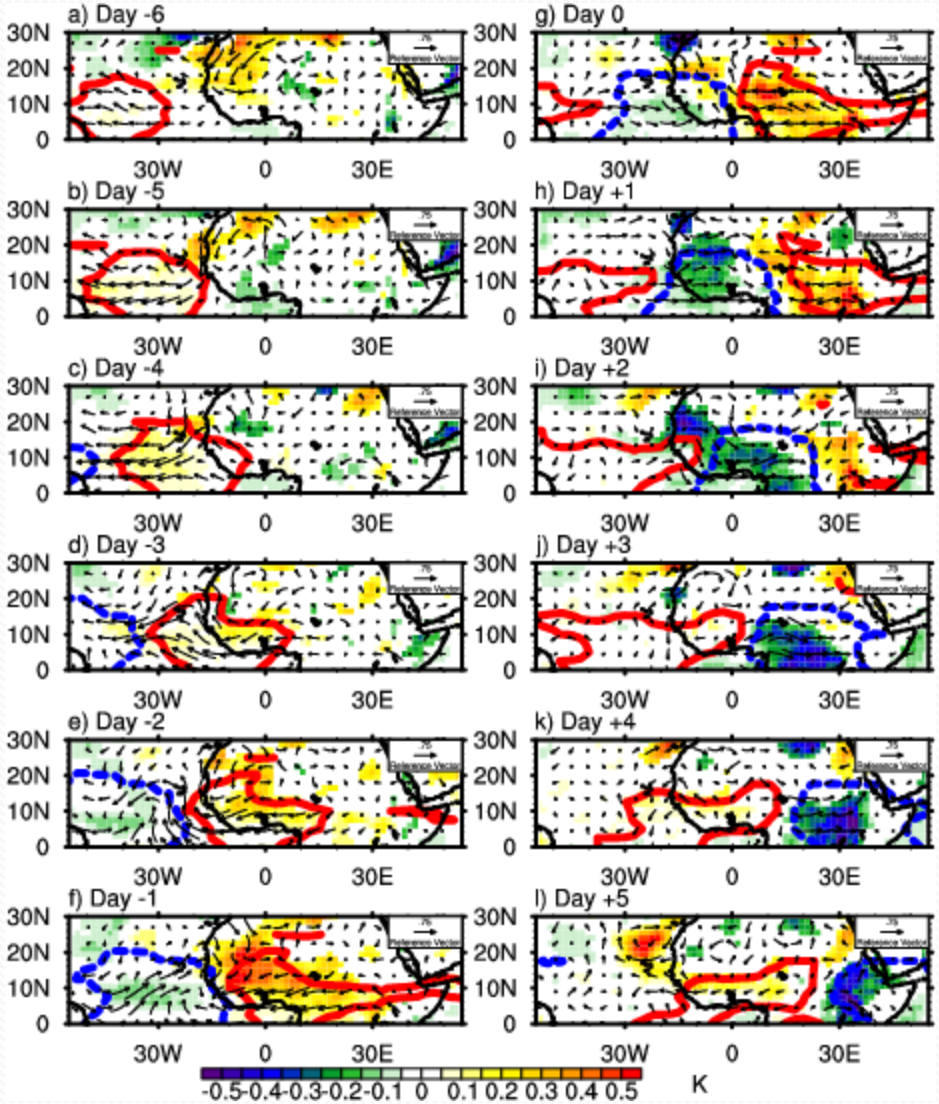
pre-Alberto AEW case



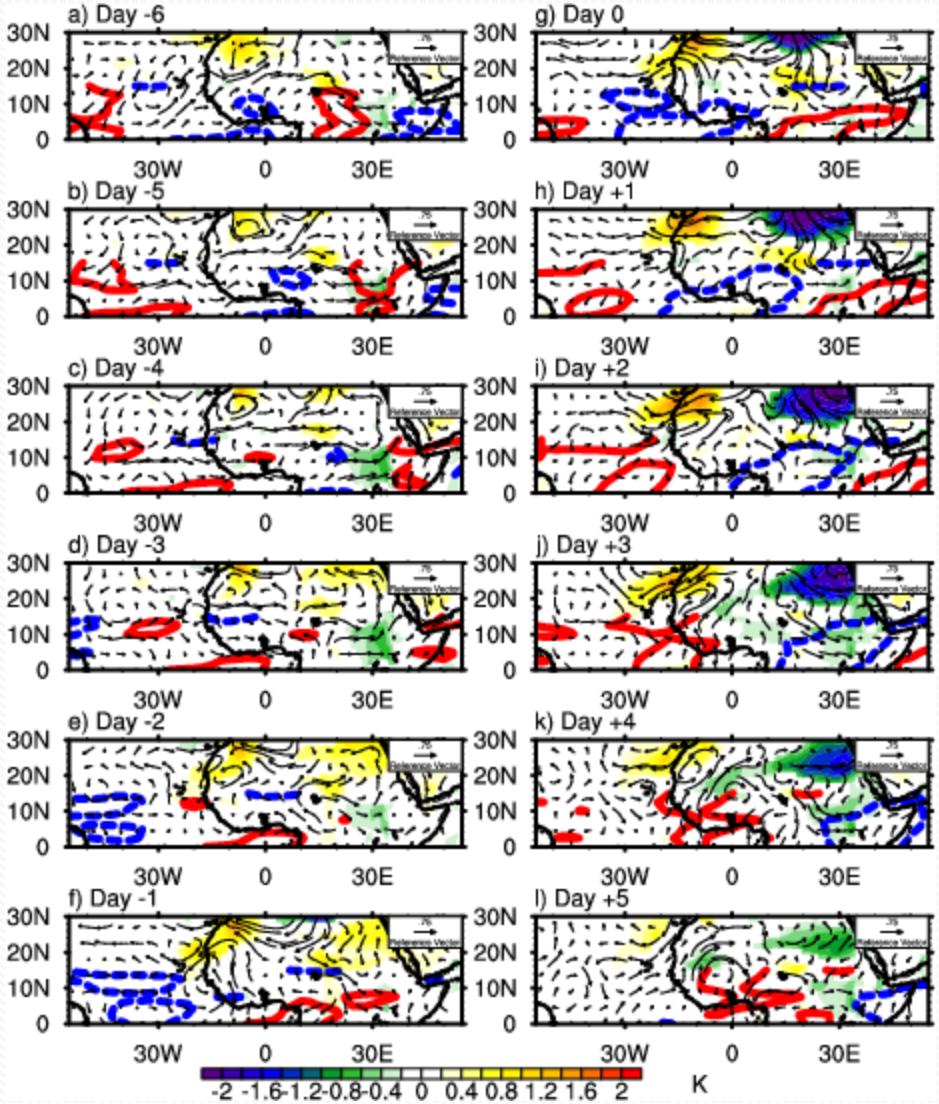
233K Exceedence Freq. Composite



CPC-merged IR (shaded) overlaid with Kelvin filtered TRMM rain rate anomalies (black contours) and ERA-Interim 850 hPa wind anomalies (vectors) for the period beginning at 00Z July 30, 2000 and ending 06Z July 31, 2000. Shade interval is 2.5°K; contours interval is 0.2 mm day^{-1}; reference vector is 10 ms^{-1}.



925 hPa temperature anomalies and 850 hPa zonal wind



Same as previous slide, but using Vizy and Cook (2009) cold air surge dates