

Exploring Mechanisms for Westerly Wind Anomalies

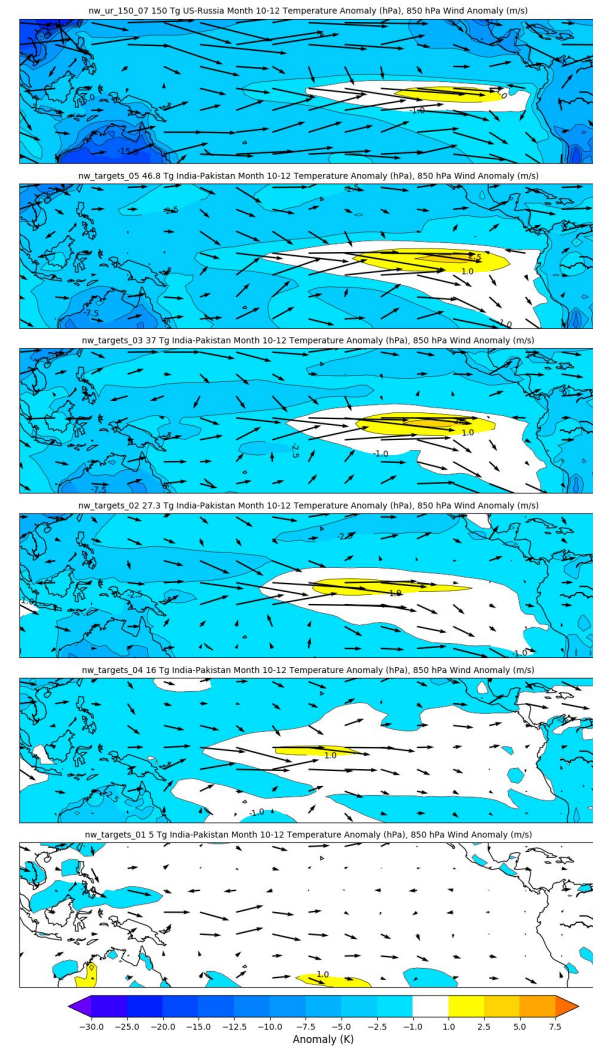
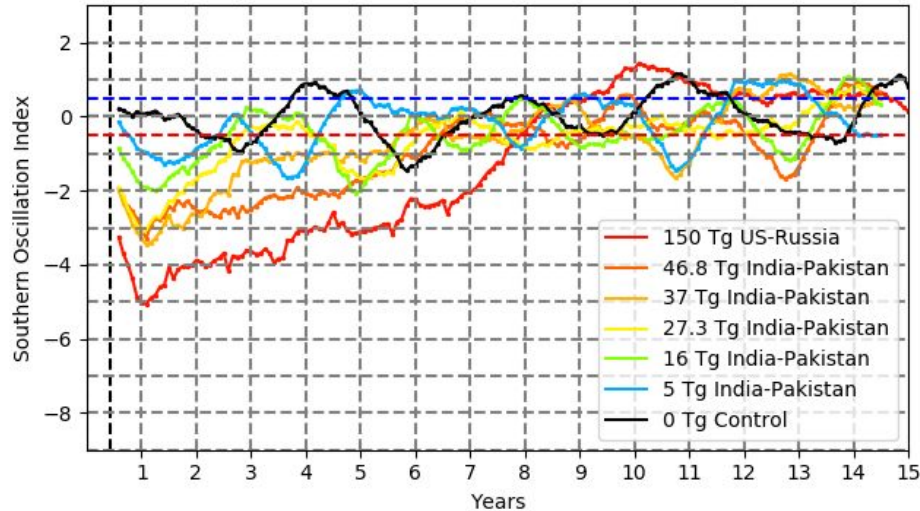
Joshua Coupe

1/29/19

Goals:

1. Understand mechanism driving westerly wind anomalies in the western Pacific within months of the injection of soot.
2. Understand how the westerly wind anomaly scales with amount of soot injected.

12-Month Running Mean SOI Index During 6 Nuclear War Scenarios in WACCM



Previous idea:

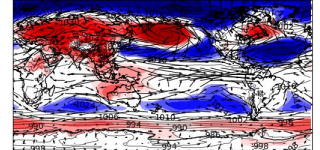
Large-scale land-sea pressure gradient over southeast Asia and Pacific Ocean drives wind anomaly.

Why? Higher MSLP observed over entirety of eastern Asia as cooling continent causes shift in convection over oceans.

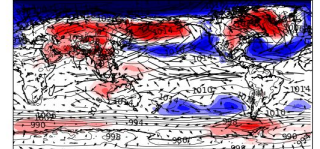
* drives flow from land to ocean in Pacific and Indian Ocean

[Link to all of these plots by month here.](#)

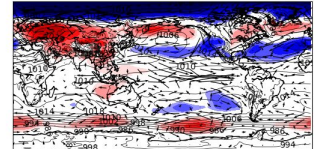
nw_ur_150_07 150 Tg US-Russia Month 12-14 MSLP Anomaly (hPa), 850 hPa Wind Anomaly (m/s)



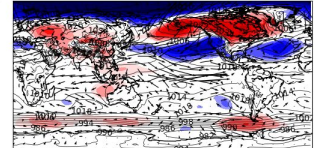
nw_targets_05 46.8 Tg India-Pakistan Month 12-14 MSLP Anomaly (hPa), 850 hPa Wind Anomaly (m/s)



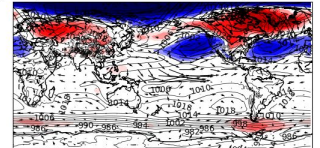
nw_targets_03 37 Tg India-Pakistan Month 12-14 MSLP Anomaly (hPa), 850 hPa Wind Anomaly (m/s)



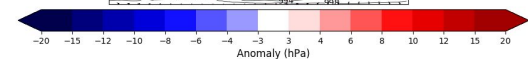
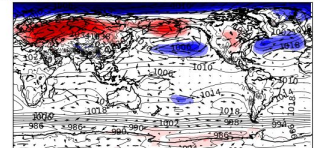
nw_targets_02 27.3 Tg India-Pakistan Month 12-14 MSLP Anomaly (hPa), 850 hPa Wind Anomaly (m/s)



nw_targets_04 16 Tg India-Pakistan Month 12-14 MSLP Anomaly (hPa), 850 hPa Wind Anomaly (m/s)



nw_targets_01 5 Tg India-Pakistan Month 12-14 MSLP Anomaly (hPa), 850 hPa Wind Anomaly (m/s)



GIF of SOI / equatorial Pacific SSTAs





ARTICLE

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OPEN

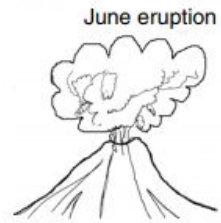
Corrected: Publisher correction; Author correction

Tropical explosive volcanic eruptions can trigger El Niño by cooling tropical Africa

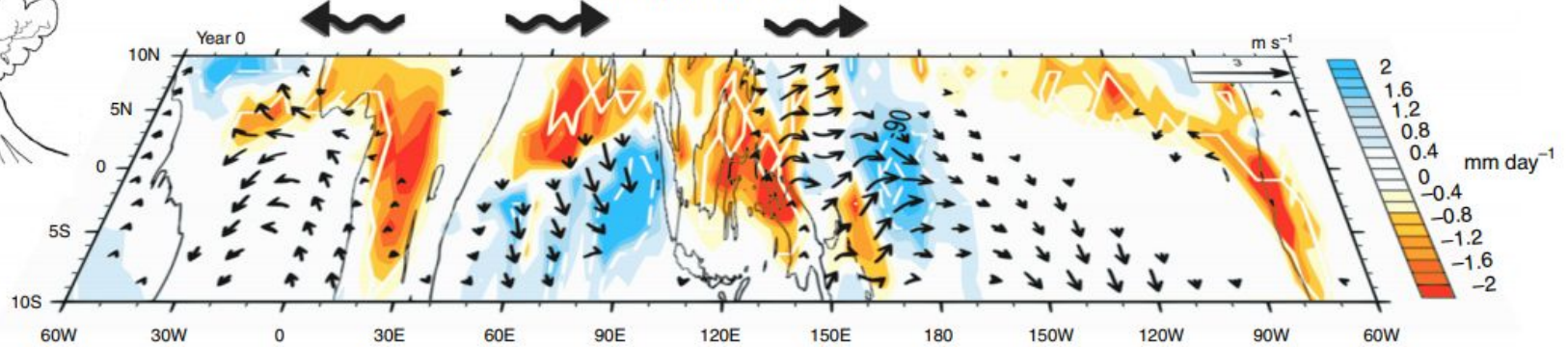
Myriam Khodri ¹, Takeshi Izumo ^{1,2}, Jérôme Vialard ¹, Serge Janicot ¹, Christophe Cassou³,
Matthieu Lengaigne ^{1,2}, Juliette Mignot ¹, Guillaume Gastineau ¹, Eric Guilyardi ^{1,4}, Nicolas Lebas¹,
Alan Robock ⁵ & Michael J. McPhaden⁶

Khodri et al., 2017

a

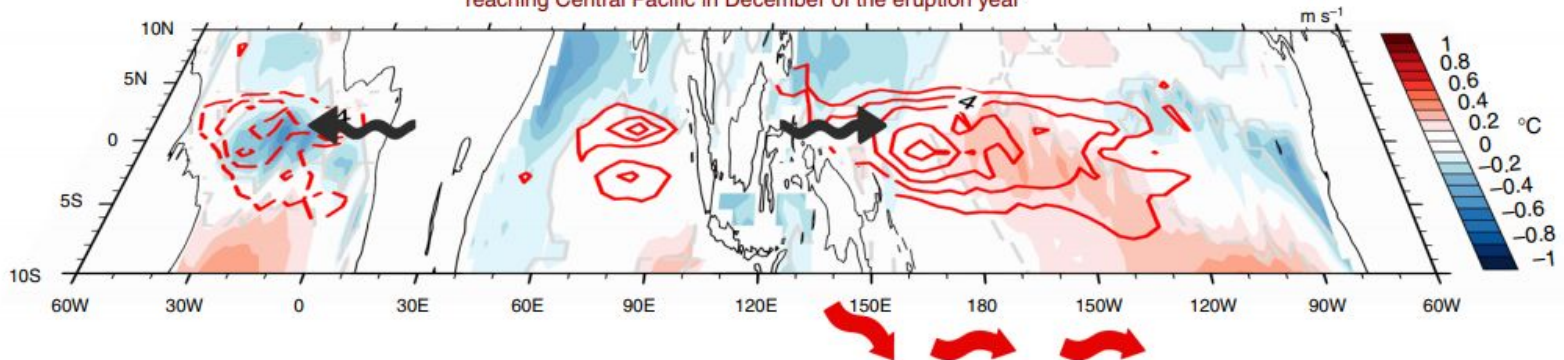


Reduced tropical precipitation in particular over West Africa favours anomalous atmospheric Rossby and Kelvin waves in August–November



b

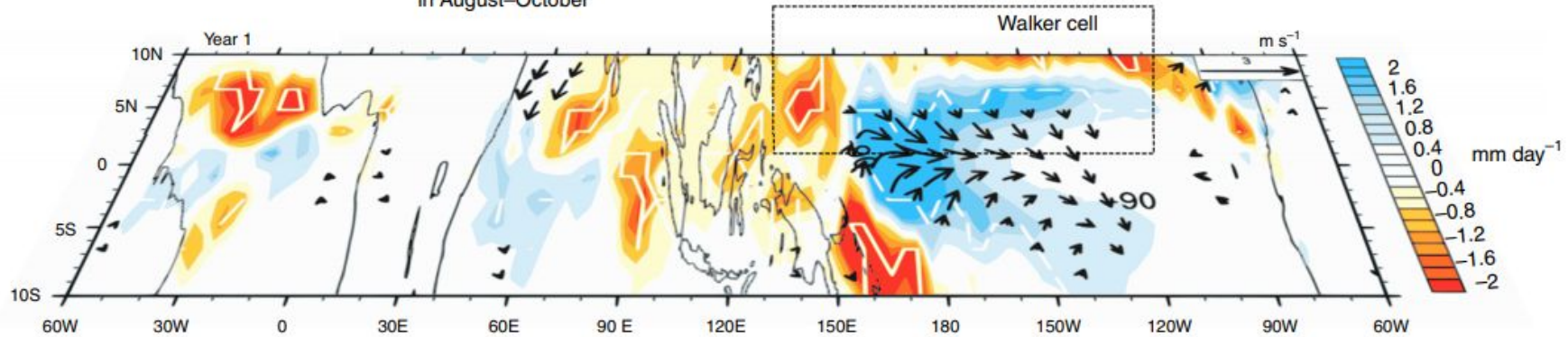
Which shallow the Atlantic Ocean thermocline and initiate anomalous westward oceanic downwelling Kelvin waves reaching Central Pacific in December of the eruption year



Khodri et al., 2017

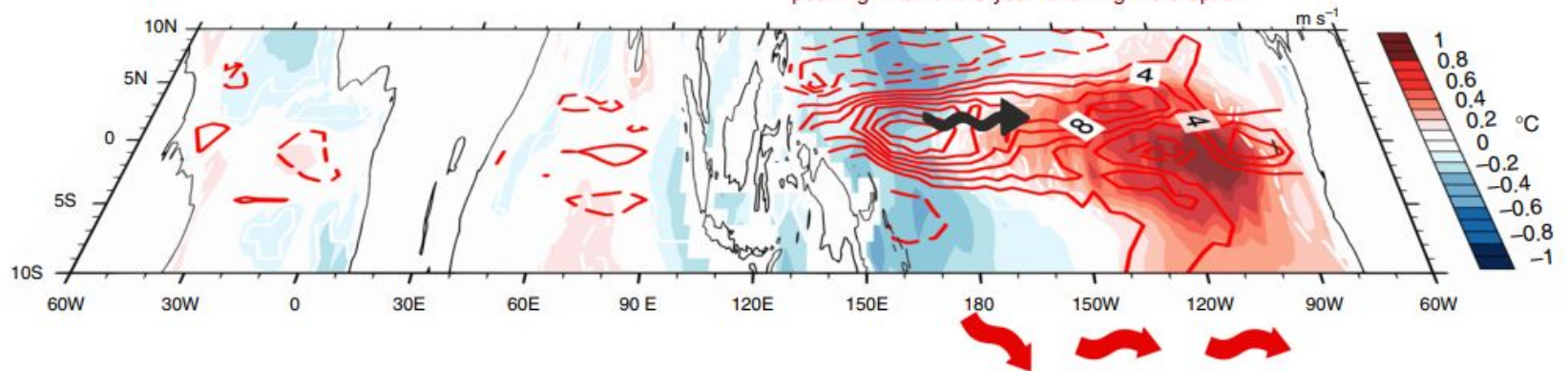
c

Bjerknes feedback and weakened Pacific Walker circulation by tropical land cooling in August–October



d

Initiate anomalous downwelling Kelvin waves leading to an El Niño event peaking in fall of the year following the eruption

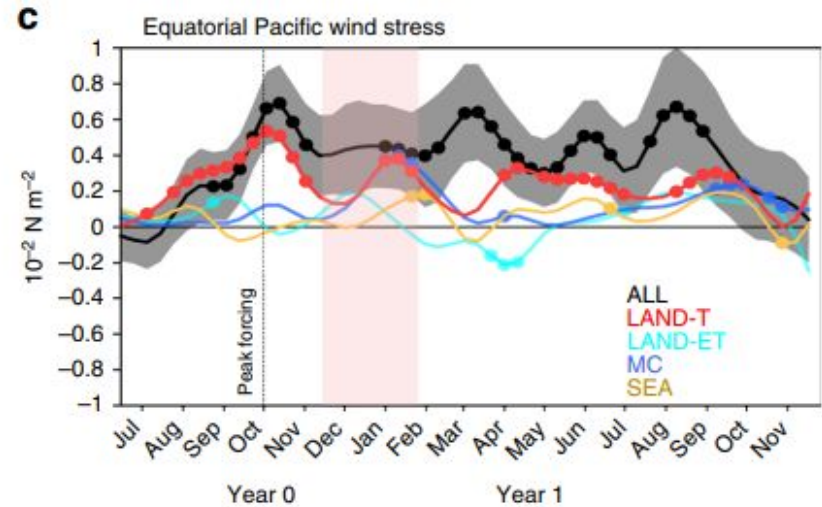
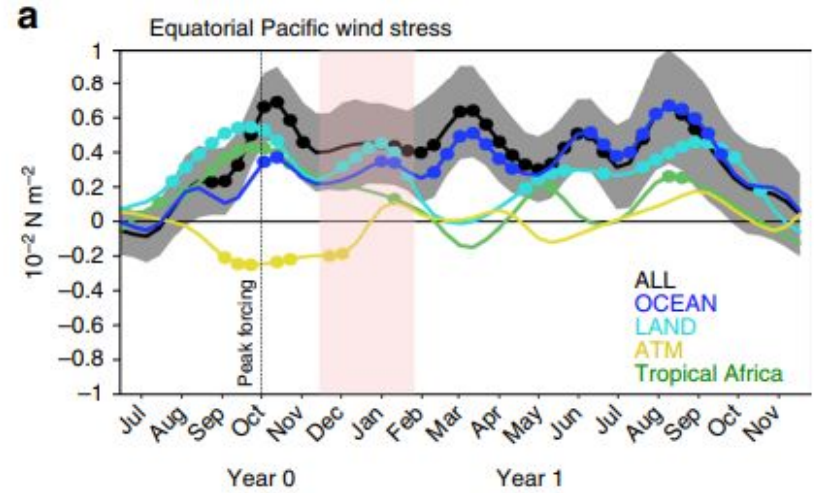


Khodri et al., 2017

Performed a number of model experiments

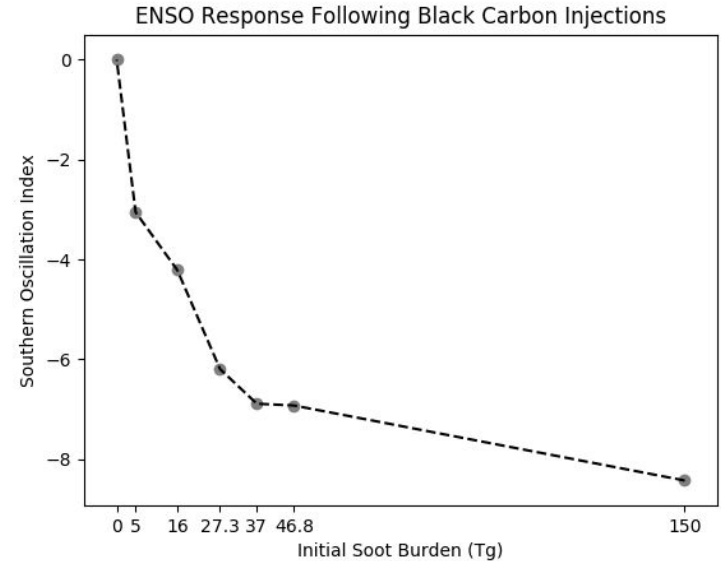
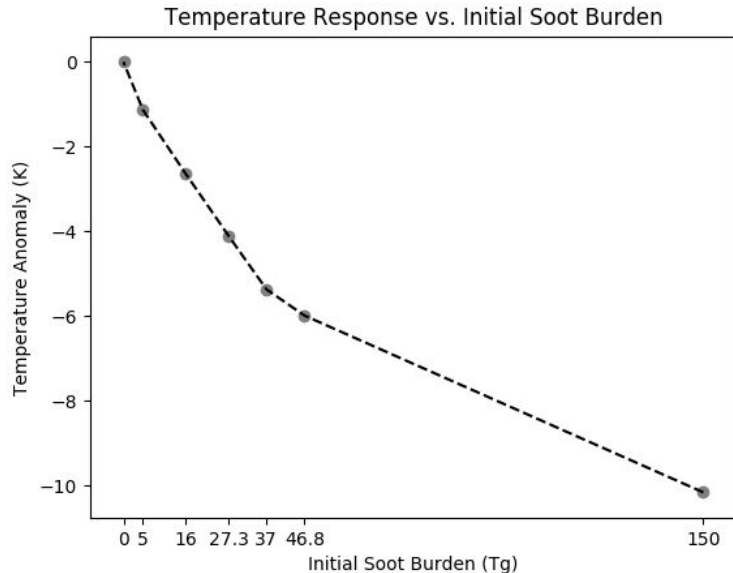
1. ATM - volcanic aerosol forcing but surface albedo of continents modified so they do not cool - simulates change in vertical temperature profile.
2. OCEAN - horizontal SST gradients are changed and atmosphere is allowed to respond
3. LAND - land surface albedo modification enforcing surface cooling
 - a) LAND-T: tropical regions
 - b) LAND-ET: extratropical regions
 - c) LAND-AFRICA: Africa
 - d) LAND-SEA: southeast Asia
 - e) LAND-MC: maritime continent

Khodri et al., 2017

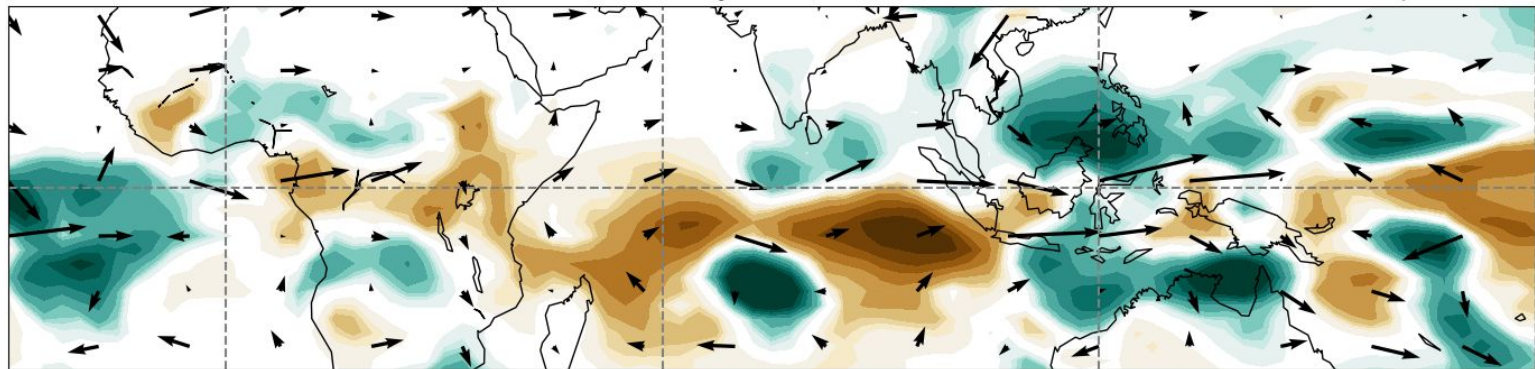


Initial soot vs Climate response

Temperature response vs initial soot burden and lowest SOI vs initial soot burden have similar relationships, good indication that ENSO response directly relate to cooling.

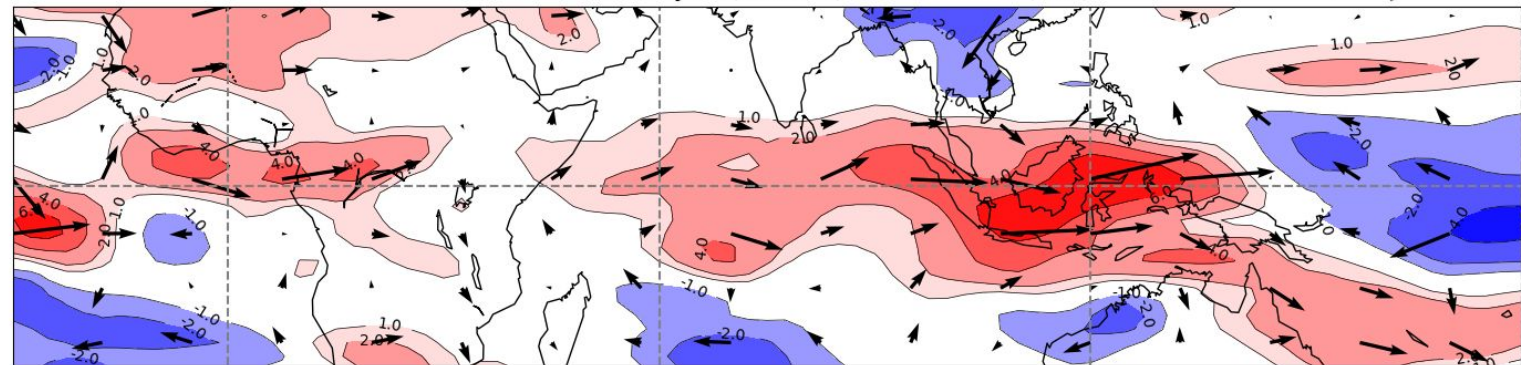


0005-04 PRECIP Anomaly , (contour) 850 hPa wind (m/s)



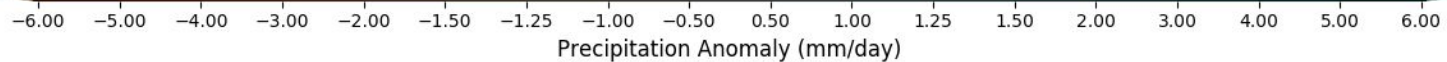
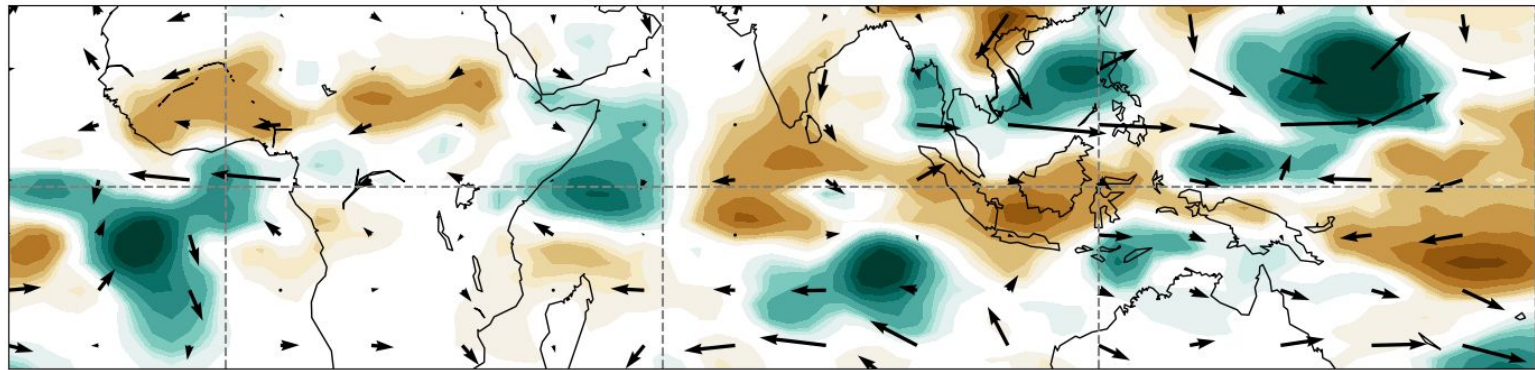
-6.00 -5.00 -4.00 -3.00 -2.00 -1.50 -1.25 -1.00 -0.50 0.50 1.00 1.25 1.50 2.00 3.00 4.00 5.00 6.00
Precipitation Anomaly (mm/day)

0005-04 U Anomaly , U(contour) 850 hPa wind (m/s)

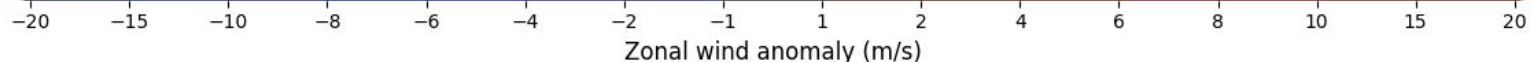
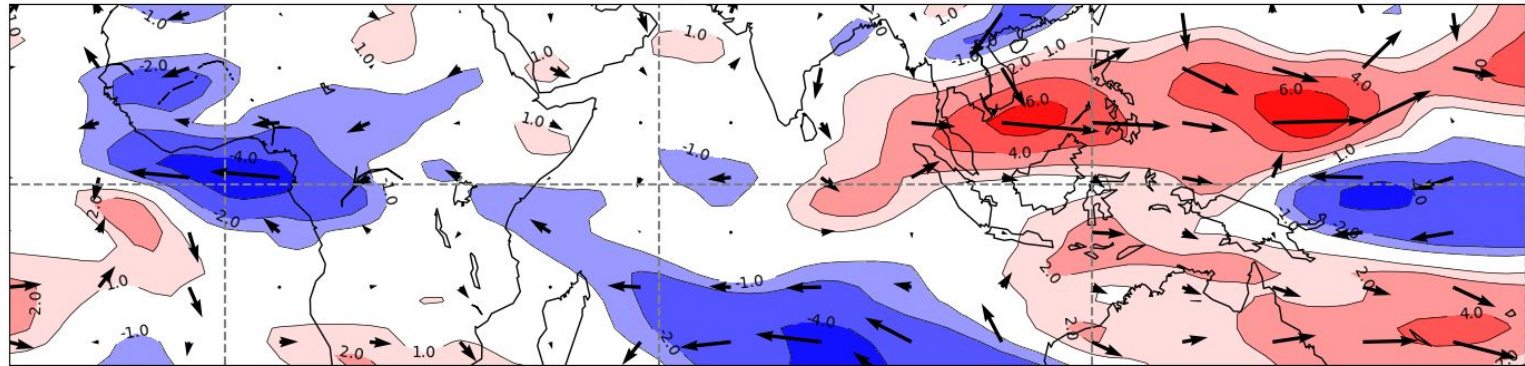


-20 -15 -10 -8 -6 -4 -2 -1 1 2 4 6 8 10 15 20
Zonal wind anomaly (m/s)

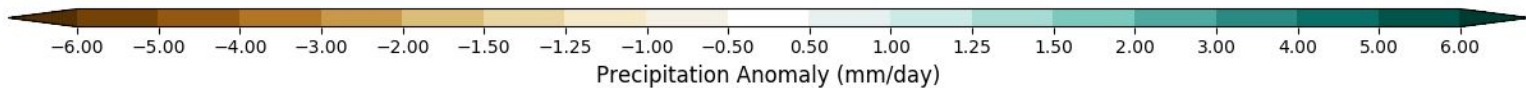
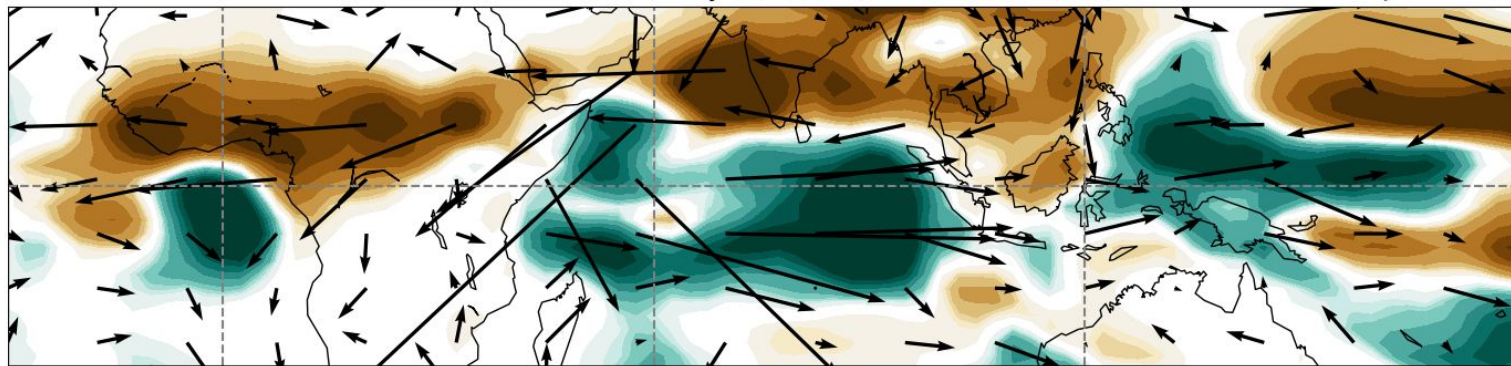
0005-05 PRECIP Anomaly , (contour) 850 hPa wind (m/s)



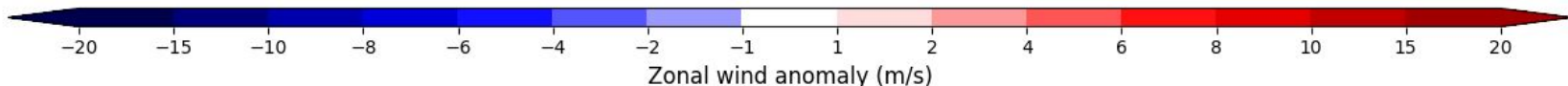
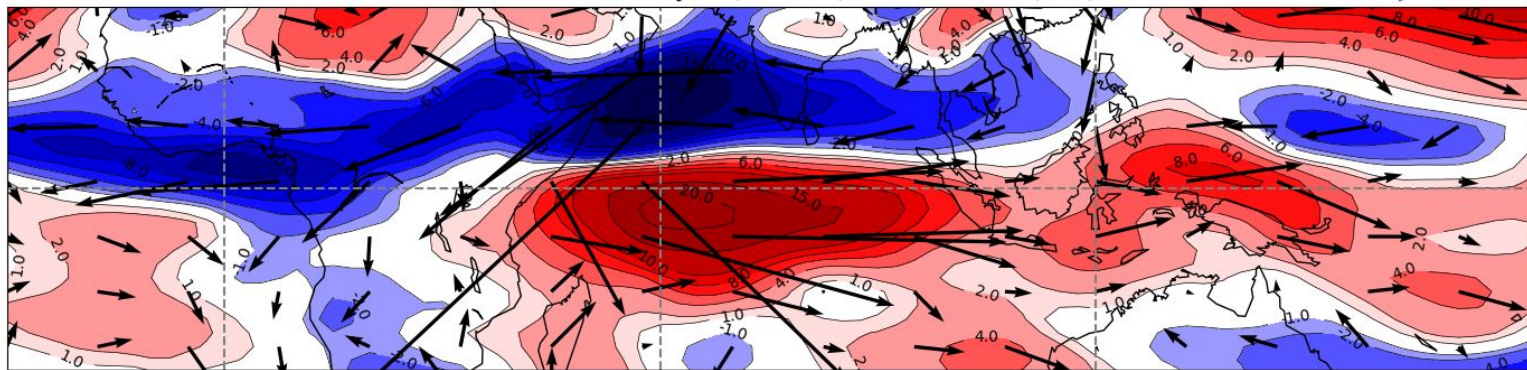
0005-05 U Anomaly , U(contour) 850 hPa wind (m/s)



0005-06 PRECIP Anomaly , (contour) 850 hPa wind (m/s)

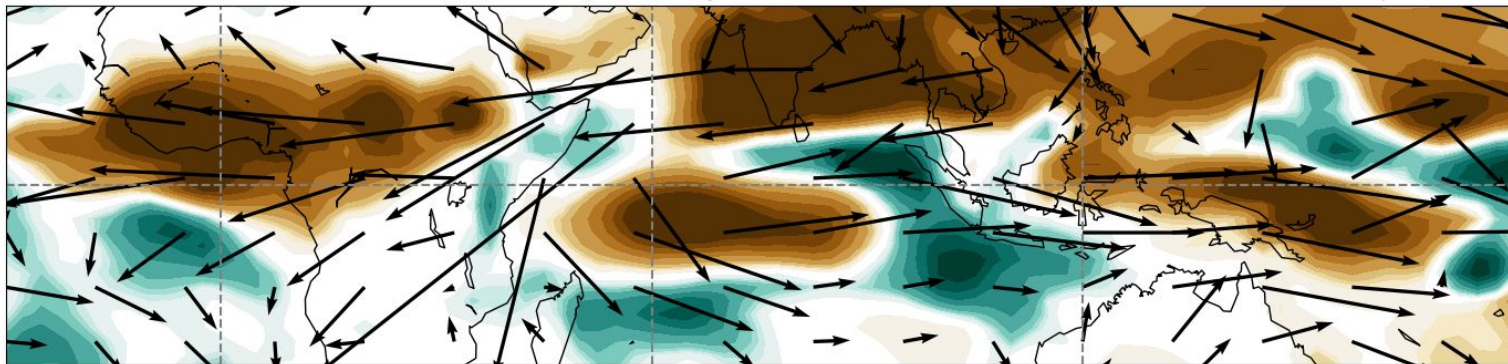


0005-06 U Anomaly , U(contour) 850 hPa wind (m/s)



0005-07 PRECIP Anomaly , (contour) 850 hPa wind (m/s)

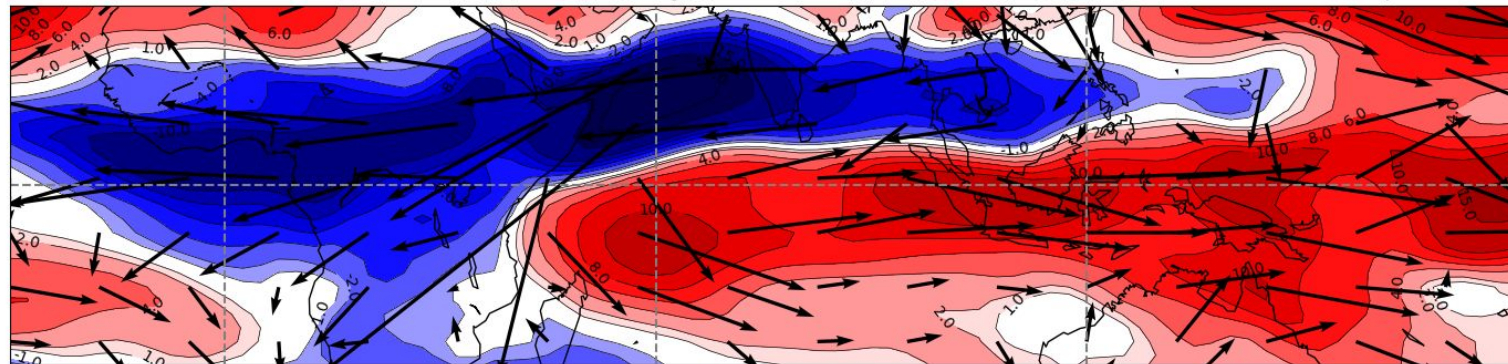
5 m/s



-6.00 -5.00 -4.00 -3.00 -2.00 -1.50 -1.25 -1.00 -0.50 0.50 1.00 1.25 1.50 2.00 3.00 4.00 5.00 6.00
Precipitation Anomaly (mm/day)

0005-07 U Anomaly , U(contour) 850 hPa wind (m/s)

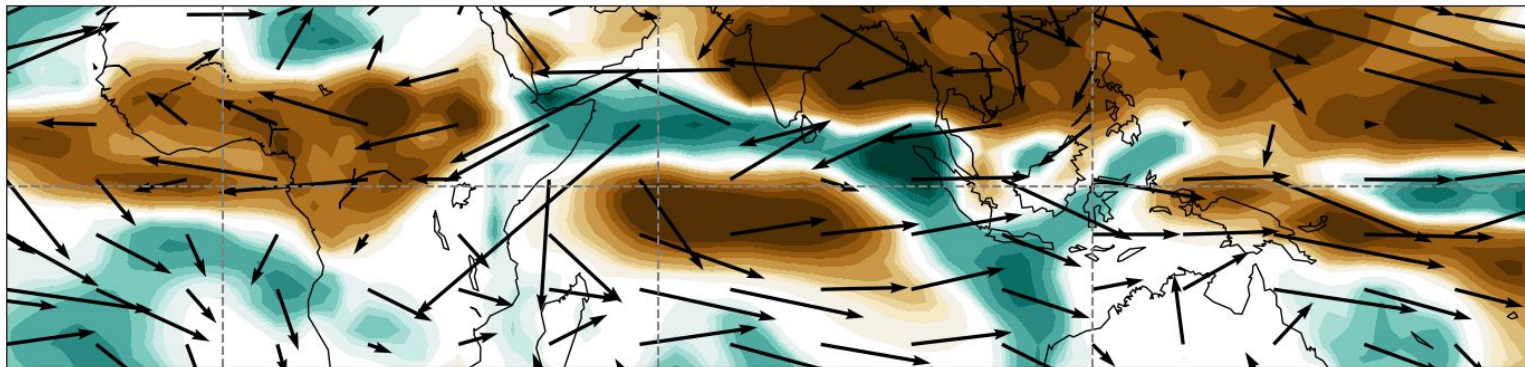
5 m/s



-20 -15 -10 -8 -6 -4 -2 -1 1 2 4 6 8 10 15 20
Zonal wind anomaly (m/s)

0005-08 PRECIP Anomaly , (contour) 850 hPa wind (m/s)

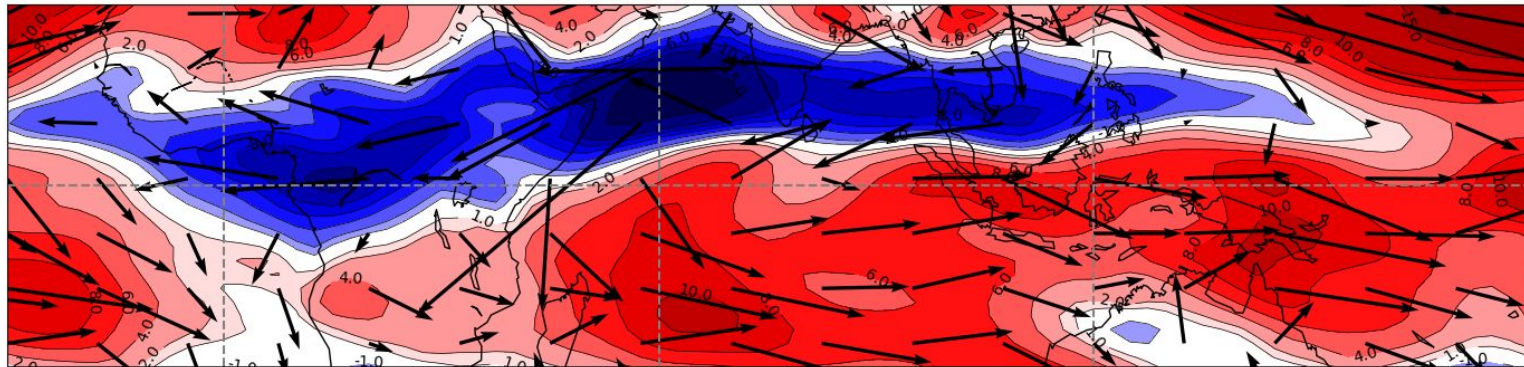
5 m/s



-6.00 -5.00 -4.00 -3.00 -2.00 -1.50 -1.25 -1.00 -0.50 0.50 1.00 1.25 1.50 2.00 3.00 4.00 5.00 6.00
Precipitation Anomaly (mm/day)

0005-08 U Anomaly , U(contour) 850 hPa wind (m/s)

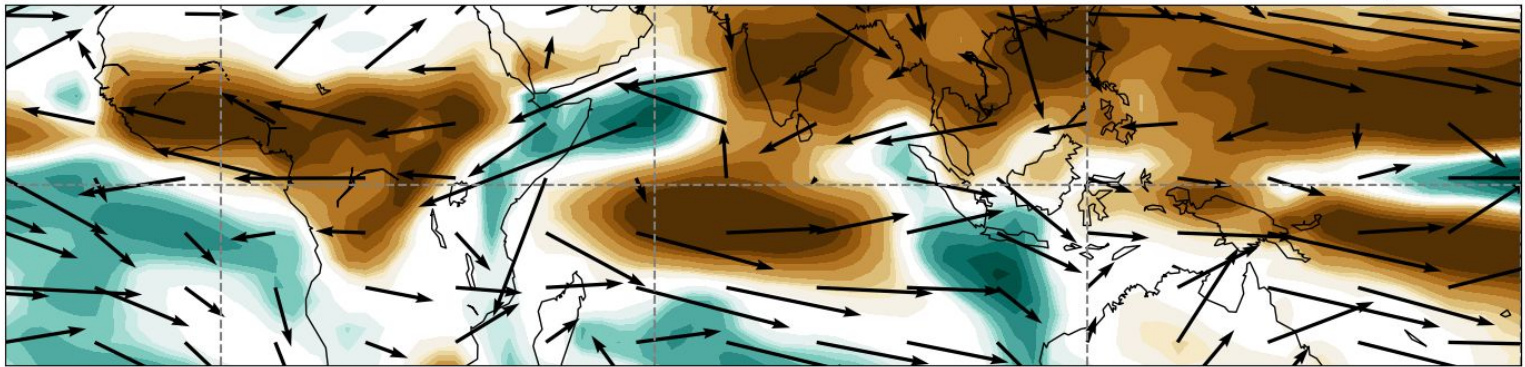
5 m/s



-20 -15 -10 -8 -6 -4 -2 -1 1 2 4 6 8 10 15 20
Zonal wind anomaly (m/s)

0005-09 PRECIP Anomaly , (contour) 850 hPa wind (m/s)

5 m/s

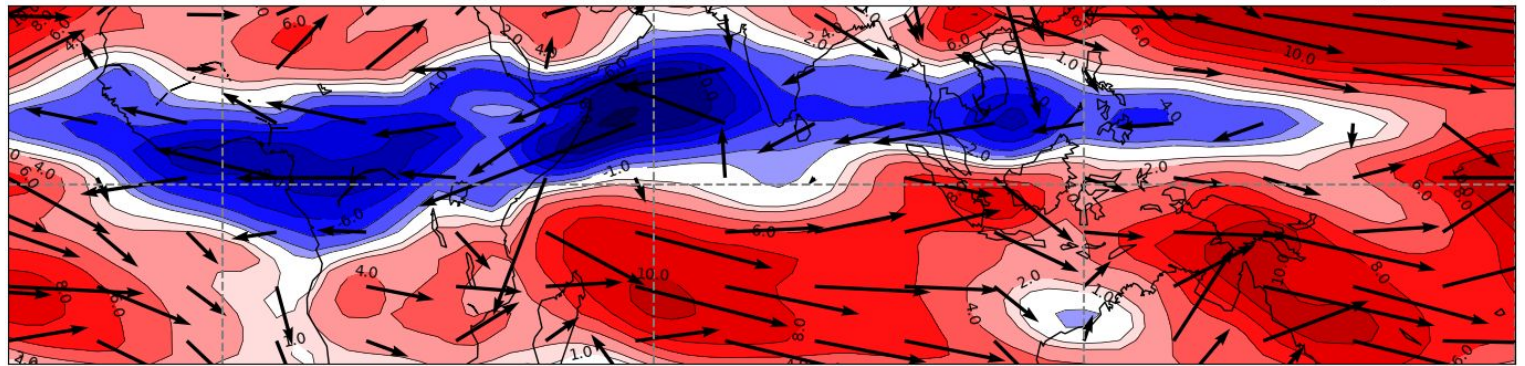


-6.00 -5.00 -4.00 -3.00 -2.00 -1.50 -1.25 -1.00 -0.50 0.50 1.00 1.25 1.50 2.00 3.00 4.00 5.00 6.00

Precipitation Anomaly (mm/day)

0005-09 U Anomaly , U(contour) 850 hPa wind (m/s)

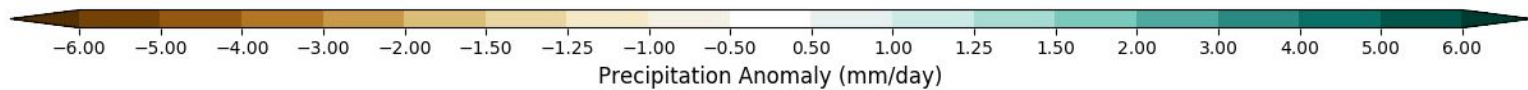
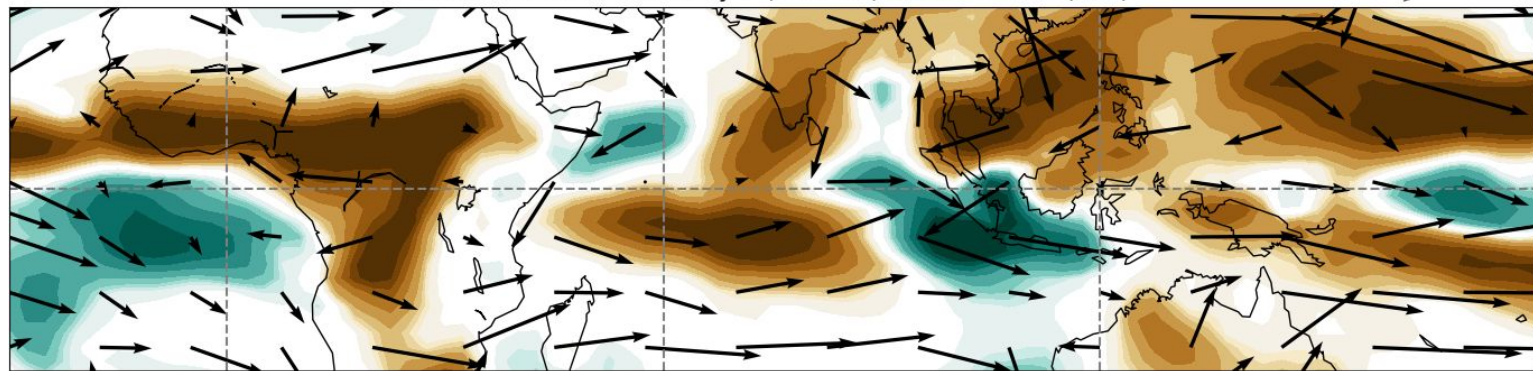
5 m/s



-20 -15 -10 -8 -6 -4 -2 -1 1 2 4 6 8 10 15 20

Zonal wind anomaly (m/s)

0005-10 PRECIP Anomaly , (contour) 850 hPa wind (m/s)



0005-10 U Anomaly , U(contour) 850 hPa wind (m/s)

