IndoPacific summer monsoon rainfall and atmospheric stability

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We study large scale coherent structures in rainfall, air temperature and humidity during the IndoPacific monsoon season using daily Tropical Rainfall Measuring Mission (TRMM) and Atmospheric Infrared Sounder (AIRS) satellite observations. Simple maps of rainfall (R) and rate of change of rainfall (dR/dt) reveal the spatial patterns and time evolution of organized convection. We create composite maps using all heavy rainfall days in five summer seasons over selected 10^0x5^0 boxes in north Indian ocean and west Pacific. We find that monsoon rainfall is organized in narrow bands with large spatial scale in the zonal direction, which have a northwestsoutheast tilt. The dR/dt composites show that growth and decay of rainfall has two time scales – a fast scale of westward movement and a slow scale of northward movement.

In order to understand the growth and decay of rainfall, we estimate Convective Available Potential Energy (CAPE) from AIRS three dimensional temperature and humidity fields. We find that there is a reasonable correspondence between atmospheric stability and the slow evolution of monsoon rainbands, as revealed by 7day smoothed patterns of dR/dt and CAPE anomaly (i.e. departure from the seasonal cycle; Fig 1).

Fig1 shows that five days before the rainfall is highest in the central Bay of Bengal, a tilted band of positive dR/dt (contours) and CAPE anomaly (shades) extend from the Bay of Bengal to the west Pacific. Both dR/dt and CAPE anomaly are negative over the equatorial Indian ocean. Northward propagation of the summer monsoon rainband [1,2] is determined by atmospheric stability.

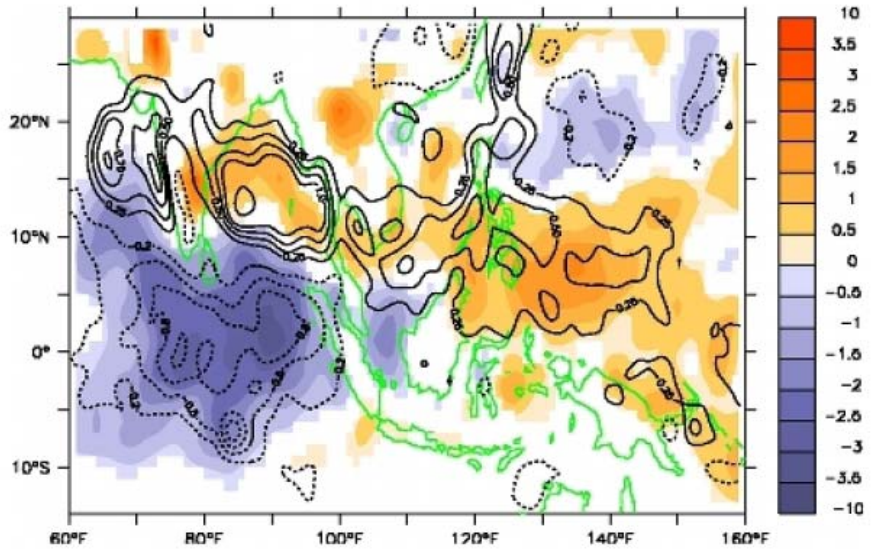

Fig 1: Central Bay composite of dR/dt (contour, mm/day2) and CAPE anomaly (shaded, (J/Kg)/100), both smoothed with a 7day running mean. These composite patterns are seen five days before the rainfall peaks in the central Bay.

References

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[2] Waliser, D. E., 2006: Intraseasonal Variations. The Asian Monsoon, B. Wang, Ed., Springer, 787 pp.