Ocean-Atmosphere Mechanisms Related to Strong Rainfall Episodes on the Eastern Northeast of Brazil

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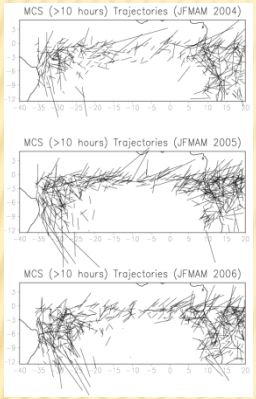
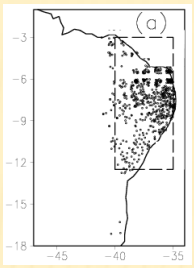
The relationship between simultaneous occurrences of distinctive atmospheric easterly waves (AEWs) signatures that crossed the south tropical Atlantic, intense mesoscale convective systems (MCSs), large sea surface temperature (SST) anomalies over the tropical Atlantic, heat content anomaly (HCA) in the oceanic mixing layer and subsequent strong rainfall anomaly episodes (> 10 mm/day) over the eastern Northeast Brazil (*Nordeste*) is investigated. A simple diagnostic technique allowed us to relate AEW signatures in the 700 hPa vorticity to the strong rainfall anomalies in the *Nordeste*. Twelve cases are selected and documented during the first semesters of 2004, 2005, 2006. An analyse of a set of atmospheric and oceanic variables during the periods allowed to note that the convection over the ocean, which is transported westward from the ocean to the American continent, sustains the dynamical instability and is coupled with strong rainfall episodes in the *Nordeste*. A better understanding of that ocean-atmosphere relationship could help in the forecasting of such dramatic episodes.



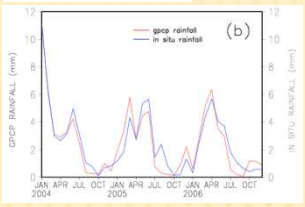
MCS (> 10 Hours) westward "linear" trajectories in the area 35°W-20°E / 5°N-12.5°S during Jan-May in 2004, 2005 and 2006. MCSs are essentially spreading according to three regions. Two first regions have a larger density and a larger meridional extension (5°N-20°S): one on the West African continent, with a westward extension up to 5°E, and another one at west of 20°W which reaches the South American continent.

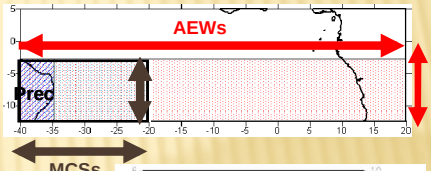
The third region, with a weaker density, is trapped along a zonal band between Equator and 5°S, from 5°E to 20°W



(a) 682 rainfall stations on ENEB (40°W-35°W / 2.5°S-12.5°S).

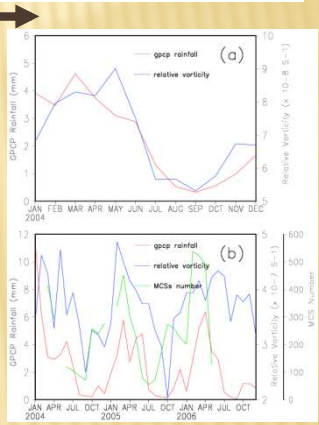
(b) 2004-2006 *in-situ* and GPCP monthly rainfall (mm.day^{-1}) averaged on ENEB.

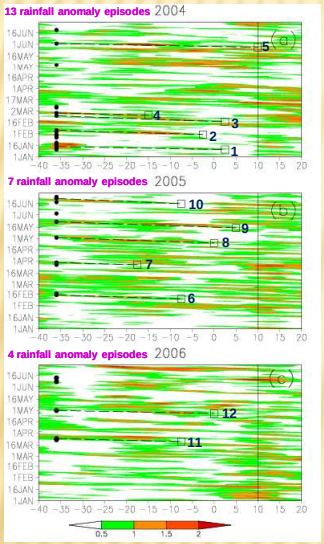


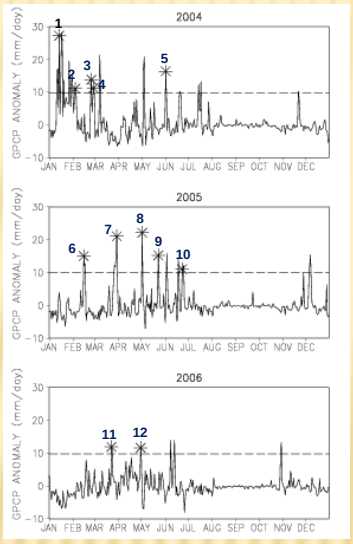


(a)Monthly climatology (1997-2006) of GPCP rainfall (mm.day^{-1}) averaged on ENE, and monthly climatology (1948-2006) of 700 hPa vorticity (10^{-6}s^{-1}) averaged over 40°W-20°E / 2.5°S-12.5°S.

(b) 2004-2006 monthly GPCP rainfall (mm.day^{-1}) averaged on ENEB; 2004-2006 monthly 700 hPa vorticity (10^{-7}s^{-1}) averaged over 40°W-20°E / 2.5°S-12.5°S, and 2004-2006 monthly number of MCSs (lifespan > 2 Hrs) moving westward from 20°W up to ENEB and with a dissipation coordinate between 2.5°S and 12.5°S







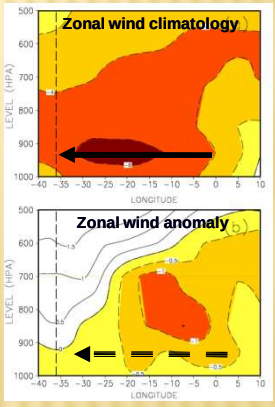
- Black dots: **24** GPCP rainfall anomaly episodes **(> 10 mm.day^{-1})** schematized at 36°W, *i.e.* on the mean eastern longitude of ENEB

- 700 hPa relative vorticity (10-5s^{-1}) in Jan-Jun of 2004, 2005 and 2006 along 40°W-20°E averaged from 2.5°S to 12.5°S

12 EVENTS (Strong Rainfall anomaly episodes + AEWs > 3 days) ARE SELECTED

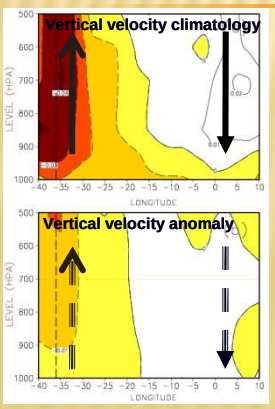
- Squares: Initiation coordinates of selected AEW events

- AEW initiations and related strong rainy occurrences are connected by a dashed line

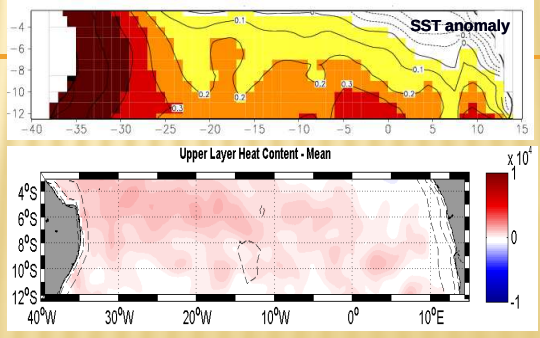


•Negative values of zonal wind, in the direction of the trades, indicate a westwards advection of the moisture from the ocean to the American continent.

• An abnormal acceleration of the trades helps to transport the excess of moisture from the ocean to the American continent, and thus supports a convergence of the moisture when arriving in the vicinity of the ENEB.



Intensification of the upward motion at west of 20°W which corresponds to a region with a larger density of MCSs. That means that during the selected events, evaporation coming from the ocean is transported westward and upward to the atmosphere. The moistened air near the surface converges into the atmospheric circulation and help in releasing the latent heat ascent.



The region of positive upper layer heat content anomalies is coincident to the positive SST anomaly region (> +0.3ºC). This region can be responsible for storing heat in the mixing layer that could be transferred to the atmosphere through air-sea interaction processes which could favour the establishment of deep convective systems and the intensification of AEWs over the Equatorial Atlantic as they propagate westward towards the ENEB.

Conclusion

This works studies some particulars rainfall events during the FMAM of 2004, 2005 and 2006. it shows a good relationship between exceptional rainfall events and oceanic and atmospheric conditions.

References

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