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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The basic mechanism behind the hurricane-free warm tropical ocean" *by* Z. Yuan et al.

Anonymous Referee #1

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The aim of the paper is a worthy one. Namely, to explain why certain tropical basins (the south Atlantic ocean, e.g.) are ordinarily devoid of hurricane activity.

The authors suggest that in a hydrostatically balanced tropical atmosphere, externally forced low-level-equatorial-westerly-wind (LLEWW) 'events' are a crucial ingredient for the formation of hurricanes in an otherwise "hurricane-free" region without tropical easterly waves or other westward propagating disturbances.

In normal meteorological language, the authors are suggesting that westerly wind bursts create favorable conditions for the formation of tropical cyclones in the equatorial region in both the northern and southern Hemisphere. The cyclonic shear supplied by such events has long been known to provide elevated cyclonic vorticity (above the prevailing planetary vorticity for these latitudes) necessary for the birth of such se-

vere tropical storms in otherwise favorable environmental conditions (low vertical shear, warm SST's moist low- to mid-troposphere, etc.). We needn't look too far for illustrative examples of the importance of westerly wind bursts in tropical cyclone formation in the near equatorial region. This past month or so has provided examples in the south Pacific.

The authors use the vertical momentum equation in an unorthodox way for a rotating fluid to attempt to provide a theoretical foundation for their particular argument of embryo formation in the equatorial region. They then examine ERA observations and NOAA OLR data to support their interpretation.

Holton 1979, 1992, 2004 (and others) note that some care is required in order to justify the hydrostatic approximation for a moving fluid under rotational influences. Once the background pressure gradient and gravity forces are subtracted from the vertical force balance there remains a perturbation vertical pressure gradient and buoyancy force defined relative to the resting background in hydrostatic balance. It is generally dangerous to invoke cause and effect arguments in a fluid without accounting for the sign and magnitude of the perturbation pressure and buoyancy forces. In a strictly hydrostatic approximation, in which the perturbation pressure gradient and buoyancy forces are assumed to exactly cancel, THE VERTICAL VELOCITY IS NO LONGER OBTAINED FROM THE VERTICAL MOMENTUM EQUATION. Indeed, the vertical motion is then determined from the mass-continuity equation wherein the horizontal motion field is governed by the horizontal momentum equations. The authors have instead used the RESIDUAL TERMS in the vertical momentum equation to infer conditions favorable for embryo formation without a complete consideration of the horizontal momentum balances. For reasons discussed above, this is inconsistent and generally unwise. All of the subsequent arguments and interpretations in this paper are thus highly suspect.

In addition to this major concern re the validity of the scientific argument, I have other major concerns about the science and presentation. For example, the term embryo is never defined in this paper. Does embryo refer to the pouch as defined in Dunkerton

et. al. 2009, or does it refer to a tropical depression as declared by NHC, JTWC or JMA forecasters? If the former is the intended meaning, how do the authors identify the 'embryo' from the best track data for named systems?

Finally, the writing and more importantly the logic is very difficult if not impossible to follow.

On the basis of the above consideration I cannot recommend acceptance of this mss.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 1957, 2010.