



## **Hurricane genesis: on the breaking African easterly waves and critical layers**

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This study brings new understanding on the decades-old hurricane genesis problem that starts with westward travelling African easterly waves that can evolve into coherent cyclonic vortices depending on their strength and other nonlinear wave breaking processes.

In general, observations indicate that only a small fraction of the African easterly waves that occur in a single hurricane season contribute to tropical cyclogenesis. However, this small fraction includes a large portion of named storms. In addition, a recent study by Dunkerton et al. (2009) has shown that named storms in the Atlantic and eastern Pacific basins are almost all associated with a cyclonic Kelvin “cat’s eye” of a tropical easterly wave typical of critical layers, located equatorward of the easterly jet axis. To better understand the dynamics involved in hurricane genesis, the flow characteristics and the physical and dynamical mechanisms by which easterly waves form cat’s eyes are investigated with the help of atmospheric reanalyses and numerical simulations.

We perform a climatological study of developing easterly waves covering the 1998-2001 hurricane seasons using ERA-Interim 6-hourly reanalysis data. Composite analyses for all named storms show a monotonic potential vorticity (PV) profile with weak meridional PV gradient and a cyclonic (i.e. south of the easterly jet axis) critical line for time periods of several days preceding the cat’s eye formation. In addition, the developing PV anomaly composite shows a statistically significant companion wave-packet of non-developing easterly waves.

A barotropic shallow water model is used to study the initial value and forced problems of disturbances on a parabolic jet and realistic profiles associated with weak basic state meridional PV gradients, leading to Kelvin cat’s eye formation around the jet axis. The results highlight the synergy of the dynamical mechanisms, including wave breaking and PV redistribution within the nonlinear critical layer characterized by weak PV gradients, and the thermodynamical mechanisms such as convectively generated PV anomalies in the cat’s eye formation in tropical cyclogenesis. These findings are consistent with the analytical theory of free and forced disturbances to an easterly parabolic jet (Brunet and Warn, 1990; Brunet and Haynes, 1995; Chobotov et al., 2000).

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