Genesis of tropical storm Eugene (2005) from merging vortices associated with ITCZ breakdowns. Part III: Sensitivity to various genesis parameters

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Abstract: In this study, a series of sensitivity simulations is performed to examine the processes leading to the genesis of Tropical Storm Eugene (2005) from merging vortices associated with the breakdowns of the intertropical convergence zone (ITCZ) over the eastern Pacific. This is achieved by removing or modifying one of the two vortices in the model initial conditions or one physical process during the model integration using the results presented in Parts I and II as a control run. Results reveal that while the ITCZ breakdowns and subsequent poleward rollup (through a continuous potential vorticity supply) provide favorable conditions for the genesis of Eugene, the vortex merger is the most effective process in transforming weak tropical disturbances into a tropical storm. The sensitivity experiments confirm the authors' previous conclusions that Eugene would not reach its observed tropical storm intensity in the absence of the merger and would become much shorter lived without the potential vorticity supply from the ITCZ. It is found that the merging process is sensitive not only to larger-scale steering flows but also to the intensity of their associated cyclonic circulations and frictional convergence. When one of the vortices is initialized at a weaker intensity, the two vortices bifurcate in track and fail to merge. The frictional convergence in the boundary layer appears to play an important role in accelerating the mutual attraction of the two vortices leading to their final merger. It is also found from simulations with different storm realizations that the stormscale cyclonic vorticity grows at the fastest rate in the lowest layers, regardless of the merger, because of the important contribution of the convergence associated with the boundary layer friction and latent heating. © 2010 American Meteorological Society.

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