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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Intensification of tropical cyclones in the GFS model" *by* J. C. Marín et al.

K. Emanuel (Referee)

emanuel@texmex.mit.edu

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This paper demonstrates and imaginative approach to diagnosing the physical causes for the intensity changes of tropical cyclones, in this case, cyclone simulated by a numerical weather prediction model, the GPS. The physics governing the behavior of phenomena simulate by models of great complexity, such as the GFS, are as hard to understand as those governing the real phenomena, but at least there is little or no measurement problem when using model output and so it provides both a test of new diagnostics and the potential to understand at least the model's renditions of the phenomenon in question. The paper describes an approach to diagnosing two important components of hurricane physics: the entropy and angular momentum budgets. The latter appears to be comparatively simple: The spin-up of the storm represents the net result of inward radial flow, which tends to increase the tangential winds, and frictional torque with the lower boundary, which tends to diminish it. The present study

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shows that these two effects are nearly in balance, as expected, but the residual is too small to be reliably estimated using this technique applied to the available model output. In my view, the more important and significant result pertains to the diagnosis of the entropy budget. Here, energetic considerations lead one to expect that the main balance is between the surface enthalpy flux, which tends to increase entropy, particularly in the core of the system, and export, which diminishes it; storms intensify when the surface flux exceeds the export. While there is nothing controversial about this, it has long been speculated that this whole process can be rather easily disrupted by environmental wind shear, which can serve, through processes that are not currently well understood, to import low entropy air into the core and lead to loss if intensity. The present study is the first, to my knowledge, to quantify the eddy flux of entropy into the core, and it indeed suggests that storms are inhibited by such a process.

An obvious next step would be to try to relate the diagnosed eddy entropy flux to larger-scale features of the environment, particularly wind shear. This would be an important step in truly understanding the physical mechanisms by which low entropy air can enter the core and would also help us to design models that simulate this process with better fidelity.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 17803, 2008.