Atmos. Chem. Phys. Discuss., 8, S10537–S10539, 2009
www.atmos-chem-phys-discuss.net/8/S10537/2009/

Atmospheric Chemistry and Physics Discussions

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

J. C. Marín et al.

Received and published: 20 January 2009

Reply to referee Kerry Emanuel

We are grateful for Dr. Emanuel's encouraging comments.

The most important results of this paper are obtained from the diagnosis of the moist entropy budget equation. The surface entropy flux and the lateral advection of entropy into the cyclone appear to be the primary factors governing tropical cyclone intensification in the cases simulated by GFS, as quantified in this study. The consistency of the results suggests to extend the described methodology to other numerical models, specifically regional models with higher horizontal resolution, and to observations of actual tropical cyclones to better understand the tropical cyclone behavior. We agree that future studies must be conducted to investigate the relation between the eddy entropy flux and the large-scale environment surrounding the tropical cyclone, and to determine how low entropy air is entrained into the core leading to its decay.

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

Reply to referee Mark DeMaria (MDM)

We are grateful for Dr. DeMaria's encouraging comments.

(MDM): Ventilation in this study refers to low moist entropy air replacing higher entropy air over a fairly large volume around the storm center (surface to tropopause over a 4 by 4 deg lat/lon area). In the original study referenced in this paper (Simpson and Riehl 1958) they were referring to dry (low entropy) air being entrained into the eyewall of tropical cyclones in environments with vertical wind shear, which occurs on much smaller scales and directly involve the convective evolution. This process is not represented very well (if at all) by the global model. The authors may want to elaborate on the difference between what they mean by ventilation and in the original Simpson and Riehl study.

Authors: We agree with the suggestion of the referee and the following paragraph was included in section "2.2.2: Thermodynamic aspects", after the ventilation term was defined, to explain the differences between the ventilation used in this study and that used by Simpson and Riehl (1958):

"In the original work of Simpson and Riehl (1958) the term ventilation referred to the lateral advection of low entropy air from the outside toward the interior of a tropical cyclone under the influence of vertical wind shear. In that case, the ventilation was probably the cause for the temperature decrease in the rain areas near the vortex, thus reducing the efficiency of the primary mass circulation in maintaining the cyclone, a process that occurs on scales of tens of km. Simpson and Riehl suggested that the development and maintenance of a warm core depends on the effect of ventilation compared to the heat input from the sub-cloud layer advected by the primary circulation. In the present study, the effect of ventilation is analyzed over a much larger scale, the study volume (4° x 4° area from the surface to tropopause) enclosing the tropical cyclone, since the GFS model cannot represent accurately the eyewall and rainbands structure, evolution and their interaction with the larger-scale environment."

ACPD

8, S10537–S10539, 2009

Interactive Comment

We agree that a much larger sample of cases must be evaluated to support our confidence on the results obtained in this study. It would be interesting to study the moist entropy and angular momentum budgets in cases that undergo extra-tropical transitions and also in cases of tropical waves or even tropical depressions that do not further intensify. In addition, these results can be extended to other numerical models, specifically regional models with higher horizontal resolution and resolved convection, and to observations of actual tropical cyclones to better understand tropical cyclone evolution.

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

ACPD

8, S10537–S10539, 2009

Interactive Comment