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Atmospheric Chemistry and Physics Discussions

Interactive comment on "An investigation of how radiation may cause accelerated rates of tropical cyclogenesis and diurnal cycles of convective activity" *by* M. E. Nicholls

Anonymous Referee #2

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General comments: This article examines the influence of radiation to tropical cyclogenesis. It concludes that differential radiative cooling/heating between a relatively cloud-free environment and a developing tropical disturbance may modulate secondary circulations. This circulation may increase relative humidity through adiabatic cooling by the superimposed upward motion in the core at night, which in turn serves as a major factor in enhancing convective activity and accelerates the TC genesis. The manuscript is mostly well written and shall contribute to the understanding to the impact of diurnal cycles on TC genesis. I recommend its acceptance for ACP subject to the following comments, most of which are minor.

Brief comments and questions: 1. The introduction is very thorough, well written, and reads like a review paper on the topic. A few older studies were overlooked that cover the impact of radiation on tropical cyclogenesis using idealized numerical simulations that may be beneficial to the manuscript for completeness.

Sundqvist, H., 1970: Numerical simulation of the development of tropical cyclones with a ten-level model. Part II. Tellus, 22, 504–510.

Hack, J. J., 1980: The role of convective-scale processes in tropical cyclone development. Ph.D. dissertation, Colorado State University, 206 pp.

2. Several of the experiments within the manuscript study the impact of differential radiative heating cooling between the tropical cyclone system and the large-scale environment, with comparisons to the study of Gray and Jacobson (1977). Gray and Jacobson (1977) looked at the difference between the individual cloud clusters and the environment. I find it hard to make a direct comparison between the definition of "differential heating" for cloud clusters and that for tropical cyclones. Can these be so easily separated for a TC?

Comparing the "TC core radiative heating and cooling" versus the "large-scale environment heating and cooling", the large-scale environment simply has a higher relative humidity and as it converges into a forming TC circulation, will help promote convective activity. The author discusses this on PG 6160: LN17-22 and alludes to the fact the main driver may be the radiative cooling of the large-scale environment. I am having a hard time separating "differential radiative heating" and "large-scale cooling" as two mechanisms when looking at a TC as the system of interest.

3. Do the microphysics and radiation schemes in RAMS explicitly interact?

4. Why was the full radiation experiment (Experiment 13) total hydrometeor mass phase shifted for maximum convective activity by 6 hours in the first 48 hours of the experiment compared with Experiment 15/16?

5. The author mentioned that the propagation speeds of two modes are 48 m/s and 24m/s respectively in line 25 of page 6138 which were used to explain "time lag" of "a few days" in line10-16 of page 6153. The distance between storm core and environment should be about 1000 km, so "time lag" is not consistent with the propagation speed.

6. Related to the above comments, could the proposed mechanism on gravity waves be used to explain the outward propagation of tropical cyclone diurnal pulse described by Dunion et al (2014, MWR)?

Formatting, typoes, etc. 1. PG 6136, LN 23: increasing → decrease? 2. Suggest adding experiment numbers to legends in Figures 23 and 25 for reader clarity.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 6125, 2015.