Geophysical Research Abstracts
Vol. 20, EGU2018-7089, 2018
EGU General Assembly 2018

Diabatic Effects on Baroclinic Development in an Idealised Linear Framework

Kristine Flacké Haualand (1), Thomas Spengler (1), and Michael J. Reeder (2)

(1) Geophysical Institute, University of Bergen and Bjerknes Centre for Climate Research, Bergen, Norway, (2) School of Earth, Atmosphere and Environment, Monash University, Australia

Latent heating influences baroclinic development by changing its structure and intensification rate. It also increases downstream ridging, which can cause forecast errors. The influence of latent heating can be investigated through its effect on the energetics of the instabilities, as well as through the distribution of interacting potential vorticity (PV) anomalies. In addition to latent heating associated with condensation, evaporational effects leading to latent cooling at lower altitudes may be important for the intensification of the development, because it intensifies the positive low-level PV anomaly. Our study aims to clarify the role of the aforementioned diabatic effects on baroclinic development in a paradigmatic linear framework.

To address these questions, we incorporate the effects of latent heating (condensation) and cooling (evaporation) in a linear extension of the Eady model. Unlike several previous studies, we focus on moderate heating intensities rather than the most intense cases. Similar to earlier findings, the most unstable solution, as well as the short wave cutoff, shift toward shorter wavelengths when the heating intensifies. All unstable wave structures tilt westward with height, consistent with the paradigm of developing baroclinic cyclones. Above the latent heating, downstream ridging is intensified due to the negative PV anomaly associated with the vertical gradient of the heating. For moderate latent heating intensity, evaporational cooling barely alters the instabilities, despite the intensification of the low level PV anomalies. For strong heating intensities, however, unstable modes at shorter wavelengths intensify with weak evaporation, but become neutral for intense evaporation. Our findings have implications for the recently emphasised importance of the evaporation on baroclinic development. While our results support the significant role of latent heating on downstream ridging, the inclusion of low-level evaporation appears to not alter the developing cyclone significantly.