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Multiscale interactions and non-hydrostatic modeling of the atmosphere

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Improvements in both algorithms and high performance computing resources now permit global atmospheric simulations to be performed at resolutions at which non-hydrostatic effects become significant. As such, we consider HOMME-NH, a variable-resolution, efficient and architecture-aware, non-hydrostatic dynamical core that has been developed under the US DOE's earth system modeling initiative. We study the nonlinear evolution of an unstable baroclinic wave and the attendant dynamical interactions across scales in both the hydrostatic and non-hydrostatic settings and characterize the differences as a function of resolution. In particular, we focus on how linkages between the larger scale balanced modes and smaller scale, imbalanced modes differ when the hydrostatic approximation is made from when the full non-hydrostatic dynamics is considered.