

The impact of topography on the initial error growth associated with moist convection

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Rapidly developing moist convection such as afternoon thunderstorms could bring sudden heavy rainfall and lead to disasters like river overflow and flood. It has been shown that the predictability of moist convection is limited in a few hours since the error grows quickly upscale through the process of moist convection. While many studies have investigated the error growth and predictability related to moist convection, literature focus on the impact of topography is still limited. How does topography affect the initial error growth rate associated with rapidly developing moist convection? Understanding the effects of topography on the predictability of moist convection is expected to help us provide a better numerical weather prediction system over the mountainous area.

In this study, identical twin experiments with and without topography are conducted with the WRF model idealized configuration to investigate the impact of topography on the initial error growth associated with moist convection. In the experiment with topography, a Gaussian shape mountain with the peak height of 993.1268 m and about 50-km width is embedded in the southwestern quadrant of the domain. Both experiments consist of a control and a perturbed simulation. The difference between the two simulations is regarded as the error, and its variation over time is used to evaluate the initial error growth. A metric called moist different total energy (moist DTE) is used to estimate the differences between the two simulations. The horizontal distribution, time series, and power spectra of moist DTE suggest that the error growth is greatly dominated by the development of moist convection for both experiments with and without topography. The moist DTE is also calculated over the individual cloud areas at different times. The scatter plot of the size to the moist DTE of the cloud areas suggests that when the convection size is larger, the error could reach a larger value. In addition, for the convection with similar size, those developing over the mountain area have smaller moist DTE.

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