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SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY

Department of Atmospheric Sciences Seminar Announcement

Mechanisms and Predictability of Wavelike Banded Convection Over Southern China

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You are invited to our weekly online Atmospheric Sciences Spring 2022 seminars via Zoom meeting.
When: March 30, 2022 at 3:30PM HST
Meeting admission: 3:15PM HST

Register in advance for this meeting:
https://hawaii.zoom.us/meeting/register/tJcof--qqjMiEtXX9J8yHV3K8NrAjdJsakyN

After registering, you will receive a confirmation email containing information about joining the meeting.
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Abstract:

The mechanisms and predictability of wavelike banded convection that occurred near the south coast of China on 30 January 2018 are investigated through a series of convection-allowing simulations and ensembles using a nonhydrostatic mesoscale model. The simulations capture reasonably well the observed characteristics of this event. The convective bands are found to be closely related to an episode of mesoscale gravity waves propagating northeastward with a wave speed of around 12 m/s and a primary wavelength of about ~40–50 km. Further analyses and sensitivity experiments reveal that the environment provides a wave duct for these gravity waves, with a thick low-level stable layer below 850 hPa capped by a low-stability reflecting layer with a critical level. The strength and depth of the low-level stable layer determine the intrinsic phase speed and wavelength of the ducted gravity waves. The convective bands collocate and propagate in phase with the peak updraft regions of the gravity waves, suggesting strong interactions of convection and gravity waves, in which the ducted gravity waves can trigger and modulate convection, while latent heating from convection enhances the waves. In essence, both wave ducting and wave-convection interaction are jointly responsible for the banded convective activity.

Although almost all 20-member ensembles can capture the wavelike pattern of convective bands, their wavelength and period vary among the ensembles. The GOOD and POOR runs are further conducted and initialized using the composite of initial conditions from good and poor members selected based on the performance of the simulated wave characteristics. Both the GOOD and POOR runs exhibit wave ducting structures for gravity waves, but the GOOD run tends to have higher precipitable water over the land, which results in a more evident wave pattern of convective bands on land in the GOOD run. Their differences in precipitable water are mainly attributed to the differences in the initial conditions of humidity and temperature at low-middle levels. The practical predictability depends on the correct initial state in terms of thermodynamics, and to a lesser degree on physical parameterizations. To further explore their intrinsic predictability, a series of sensitivity experiments were performed with the linear weighted initial conditions from the GOOD and POOR runs. The pattern of wave-convection coupled bands is generally predictable (forecast lead time <~12 hr) but their phase (the exact location of each band) has an intrinsic predictability barrier even with minute initial perturbations due to the rapid small-scale error growth associated with gravity waves and moist convection.