Development of a high-resolution cloud-resolving model over complex topography (TaiwanVVM)

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Abstract

In this study, we present a high-resolution (500 m in the horizontal) vorticity equation based cloud resolving model covering the whole Taiwan area with the following features:
Representation of surface topography in the vector vorticity equation model (VVM) is updated with a partial step approach using the immersed boundary method (Chien and Wu, 2016). Compared with the full step approach, the partial step approach provides additional topography forcing to represent micro mountains while preserving the same grid structure by interpolating from adjacent grid points. It maintains the characteristics of dynamics and physics of VVM and improves the representation of gentle slope topography without increasing vertical resolution. Representation of land surface processes is updated with the Noah land surface model (LSM) using the surface properties in 500 m horizontal resolution in Taiwan (Wu et al. 2018). This approach produces reasonable diurnal cycle evolution of the boundary layer and local circulation which is crucial in the development of local afternoon thunderstorms. Representation of microphysical processes is updated with the Predicted Particle Properties scheme (P3, Morrison and Milbrandt, 2014). Idealized experiments are performed to evaluate the aerosol effects on precipitation hotspots of afternoon thunderstorms over Taiwan. Preliminary results show that under a dirty environment, the timing of precipitation over Taiwan is delayed with enhanced diurnal precipitation peak compared with a clean environment. In the future, the model will be used to investigate changes with precipitation hotspots associated with local circulation under pseudo global warming.

References:

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