Mesoscale Diagnosis for Regional Climate Simulations

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The underlying strategy to use limited area models (LAMs) for regional climate simulations is that "GCMs can provide the response of the global circulation to large-scale forcings, and nested LAMs (or regional climate models) can account for the effects of local, sub-GCM grid scale forcings" (Giorgi and Mearns 1999). Over the past decade considerable progress has been made in the development and applications of regional climate models. Limited-area regional climate models have been shown to be capable of simulating more accurate regional distribution of precipitation (as compared with the global climate models), particularly over regions where precipitation is strongly modulated by local topographic forcing. However, because of the need to prescribe lateral boundary conditions, regional climate models do not possess independently climate prediction capability. To a certain degree, the climate of a limited-area regional climate model is prescribed by its lateral boundary conditions. Moreover, the majority of the applications of regional climate models have emphasized time-averaged results of the simulations (e.g., monthly, seasonal, or annual means). Little attention has been paid to examine the realism of individual weather systems that are simulated by these models.

With increased resolution and sophisticated physics, high-resolution nonhydrostatic mesoscale models have been shown to be capable of realistically simulating the detailed mesoscale structure of weather systems. These models have also demonstrated remarkable skills in real-time weather prediction. With continued advance of computing technology, it is becoming feasible to use high-resolution, nonhydrostatic, mesoscale models for regional climate simulations. This opens up the possibility of more accurate simulation of mesoscale weather systems for regional climate studies. As regional climate simulation and regional weather prediction are different applications of the same (or similar) model, experiences learned from one application will be very useful to the other. In this presentation, we will discuss recent results of diagnostic and verification studies of regional weather prediction models, and their implications to regional climate simulations. We conclude with a suggestion that more emphasis be placed on analyzing (and diagnosing) regional climate model's ability in simulate of mesoscale weather systems. Accurate representation of mesoscale weather systems can help establish the credibility of regional climate models, and improve our understanding of the connection between regional climate and mesoscale weather systems. The example of warm season precipitation will be highlighted.