Comparison of high- and low-resolution regional models' performances over complex terrain during the 2010 Vancouver Winter Olympic and Paralympic Games

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Abstract

Nowcasting and very short-range weather forecast models have been an important topic of study in recent years. And the nowcasting products have been an important source of information in serving many socioeconomic activities. But due to local topographic effects, meteorological conditions exhibit dramatic spatial variation, therefore, it is extremely difficult to have accurate weather prediction. While, verification is an important step to select an optimal model for nowcasting.

The skills of 1-km LAM (Limited-Area version of GEM, Global Environmental Multiscale model), 2.5-km LAM, 15-km REG (Regional version of GEM model) and 15-km GRAPES, (Global/Regional Assimilation Prediction System) that provided mesoscale forecasts for venues at Vancouver during the 2010 Winter Olympic and Paralympic Games are compared in this study. Four surface parameters 2-m temperature, relative humidity, 10-m wind speed and its direction, are verified in terms of bias error (BE) and mean absolute error (MAE). The purpose of the study is to compare how

different low-resolution (15km) and high-resolution (1-3km) models perform over complex terrain regions like Vancouver.

The prediction performance among the models varies with locations and variables. Here is a summary of the study. (1) Generally speaking, all the four models have a certain degree of capability to predict the four selected near surface parameters over complex terrain regions. As a result, mesoscale numerical weather predictions played a key role for the 2010 Vancouver Winter Olympic and Paralympic Games. (2) The improvement in forecasts from 15km to 1-2.5km resolution models is apparent. For example, the 1km and 2.5km LAM were significantly better than the REG (15km) and GRAPES (15km) for the all four surface parameters especially the temperature, wind speed and wind direction. (3) Besides the higher accuracy, the performance of high-resolution models is generally more consistent and less affected by locations and variables over complex terrain region, which obviously demonstrates the value of high-resolution models. (4) However, the comparison between 1km and 2.5km runs may suggest that further increasing a model's spatial resolution beyond 5km (such as 2.5km to 1km in this case) might not necessarily further improve forecast, which poses a challenging task for cloud-resolving storm-scale modeling. In other words, the value of very high-resolution (such as <3km) modeling is still questionable. (5) The large bias possessed by the models suggests that bias correction is a necessary step to improve a forecast from current models. (6) It is also discussed that the difference between model terrain and real terrain heights may have limited the forecast accuracy of low-resolution models especially over complex terrain regions, that is to say, the more accurate topographic feature in model, the better performance of model over complex terrain. Downscaling of raw forecasts from a low-resolution model could be an effective way to overcome this problem. In the future, more statistical and dynamical techniques should be combined to produce more accurate numerical weather forecasts.