Scale-Dependent Systematic Errors in High-Resolution RAP/HRRR Physics Over Complex Terrain

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The Rapid Refresh (RAP) and High-Resolution Rapid Refresh (HRRR) are NOAA real-time operational hourly updating forecast systems, which provide guidance for convective, aviation, renewable energy, and general weather applications at 13- and 3-km grid spacing, respectively. Both systems use WRF-ARW as the model component of the forecast system. During the second installment of the Wind Forecast Improvement Project (WFIP 2), the HRRR has been targeted for the improvement of low-level wind forecasts in the complex terrain within the Columbia River Basin (CRB), which requires much finer grid spacing to resolve important terrain features in the Cascade Mountains and the CRB. This project provides an opportunity to set up and test a high-resolution nest (Δx = 750 m) within the HRRR over the northwestern U.S. Special effort is made to incorporate scale-aware aspects into the turbulence parameterizations to improve wind forecasts not only for operational-scales, but also for this higher resolution application.

Many wind profiling and scanning instruments have been deployed in the CRB in support the WFIP 2 field project, which began on 01 October 2015 and will finish on 31 March 2017. During the project, several forecast error modes have been identified; the most systematic are the low-bias in the depth of cold pools during the winter and the low-bias in thermal trough-induced gap flows during the summer. Most effort has been focused on developing the Mellor-Yamada-Nakanishi-Niino (MYNN) turbulent mixing scheme to improve upon these biases, but investigating the effects of horizontal mixing has also helped improve the some of the common model biases. This presentation will highlight the testing and development of these model components, showing the improvements over original versions for temperature and wind profiles. Examples of case studies and retrospective periods will be presented to illustrate the improvements.