Use of Solar Irradiance Measurements to Improve the Physical Parameterizations in the Rapid Refresh and High-Resolution Rapid Refresh Models

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The 13-km Rapid Refresh (RAP) and 3-km High-Resolution Rapid Refresh (HRRR) are hourly-updating models that support short-range weather forecasting interests within the contiguous United States. Experimental versions of these models have shown forecast skill gains over predecessor versions due, in part, to improved parameterizations of turbulent mixing and land-surface processes. Of equal importance, however, is the refined coupling of subgrid-scale cloud information with the radiation parameterization in the RAP and HRRR, which has improved a key numerical pathway by which parameterized clouds may realistically alter the surface energy budseph get, reducing forecast errors in low-level temperature, water vapor, and wind.

To refine this coupling between modeled clouds and radiation, RAP and HRRR developers have increasingly used real-time solar irradiance measurements from the Surface Radiation Budget Network (SURFRAD) and Integrated Surface Irradiance Study (ISIS) datasets provided by the NOAA/GMD. This presentation will describe the role of these irradiance measurements in RAP and HRRR development, recently culminating in the upgraded RAPv3 and HRRRv2, slated for operational status in summer 2015. Additionally, this presentation will summarize how ongoing research, aimed at developing increasingly sophisticated physical parameterizations for the benefit of renewable energy applications, continues to be informed by irradiance measurements as a source of model validation.

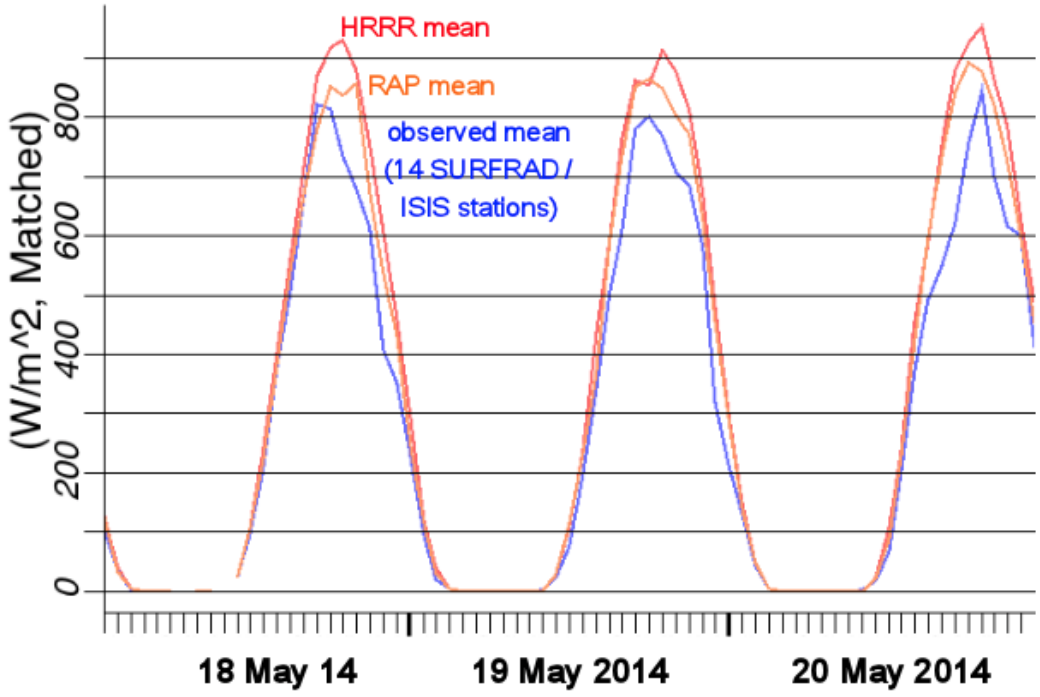

Figure 1. Time series of 12-h RAP (orange curve) and HRRR (red curve) forecasts of downward shortwave flux (W/m^{-2}) at the surface, averaged across 14 SURFRAD and ISIS locations, for three days in May 2014. The corresponding measurements, also averaged, are shown in blue.