Development of a GOES-Based Verification and Forecaster Guidance System for the High-Resolution Rapid Refresh (HRRR) Model

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Motivation

We are developing a near real-time GOES satellite-based verification system for the High Resolution Rapid Refresh (HRRR) model that will provide forecasters objective tools to quickly determine the accuracy of the many overlapping HRRR model forecasts. This system has the potential to greatly increase the efficiency and effectiveness of forecaster evaluations of the HRRR model output by allowing forecasters to quickly identify which forecast cycle is most accurate at the current time (which may not be the most recent forecast cycle due to initialization errors or the sensitivity of the model to small perturbations in the initial state) and then use the remaining portion of that forecast cycle to prepare or update their short-range forecasts.

Methodology

Simulated GOES infrared brightness temperatures for the 6.7 μm water vapor and 11 μm window bands are generated at the Earth Systems Research Laboratory (ESRL) for each HRRR model forecast cycle using the Community Radiative Transfer Model (CRTM) implemented in the Unified Post Processor (UPP). The cloud effective particle diameters used by the CRTM are computed for each hydrometeor species using assumptions made by the Thompson microphysics scheme and realistically vary in both space and time.

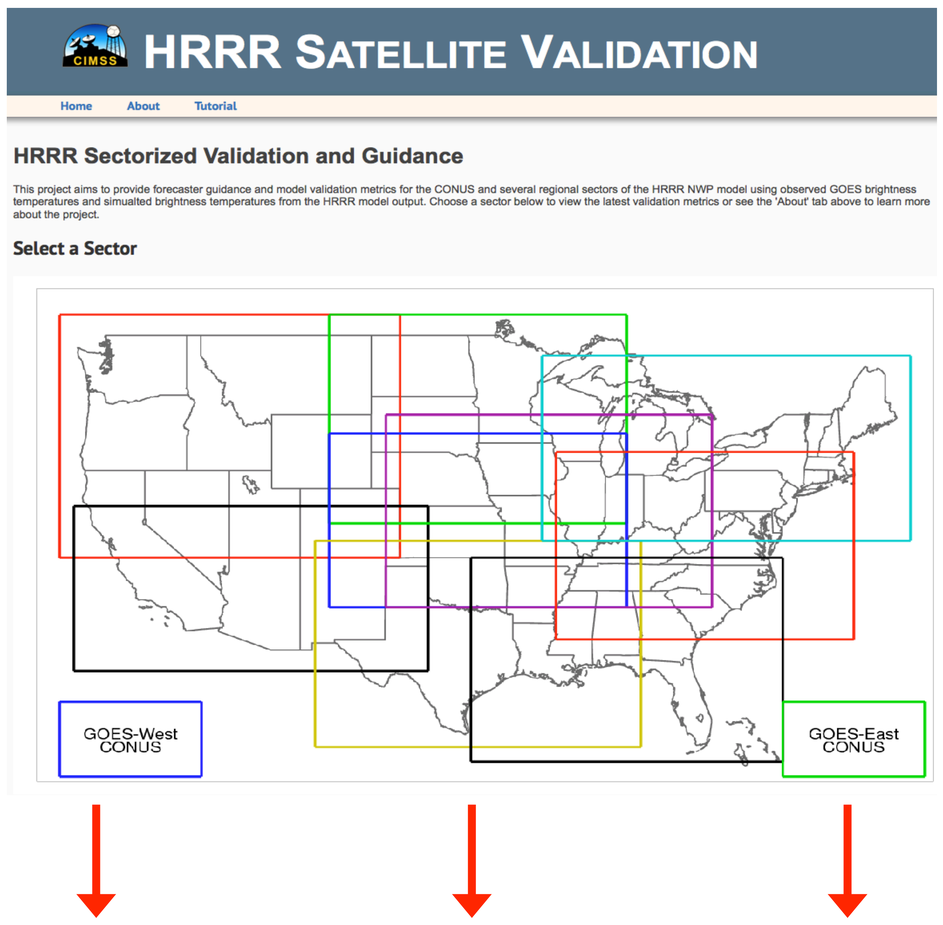
Statistical Analysis

Grid point statistics, including root mean square error, bias, and mean absolute error, are computed each hour for each GOES band to assess the accuracy of the simulated cloud and water vapor fields. The simulated satellite observations are remapped to the GOES satellite projection prior to computing the statistics. These statistics are computed for the entire model domain and also for smaller sectors mimicking the Storm Prediction Center's mesoscale analysis page in order to allow forecasters to zoom into specific regions of interest (see image to the right).

Project Webpage

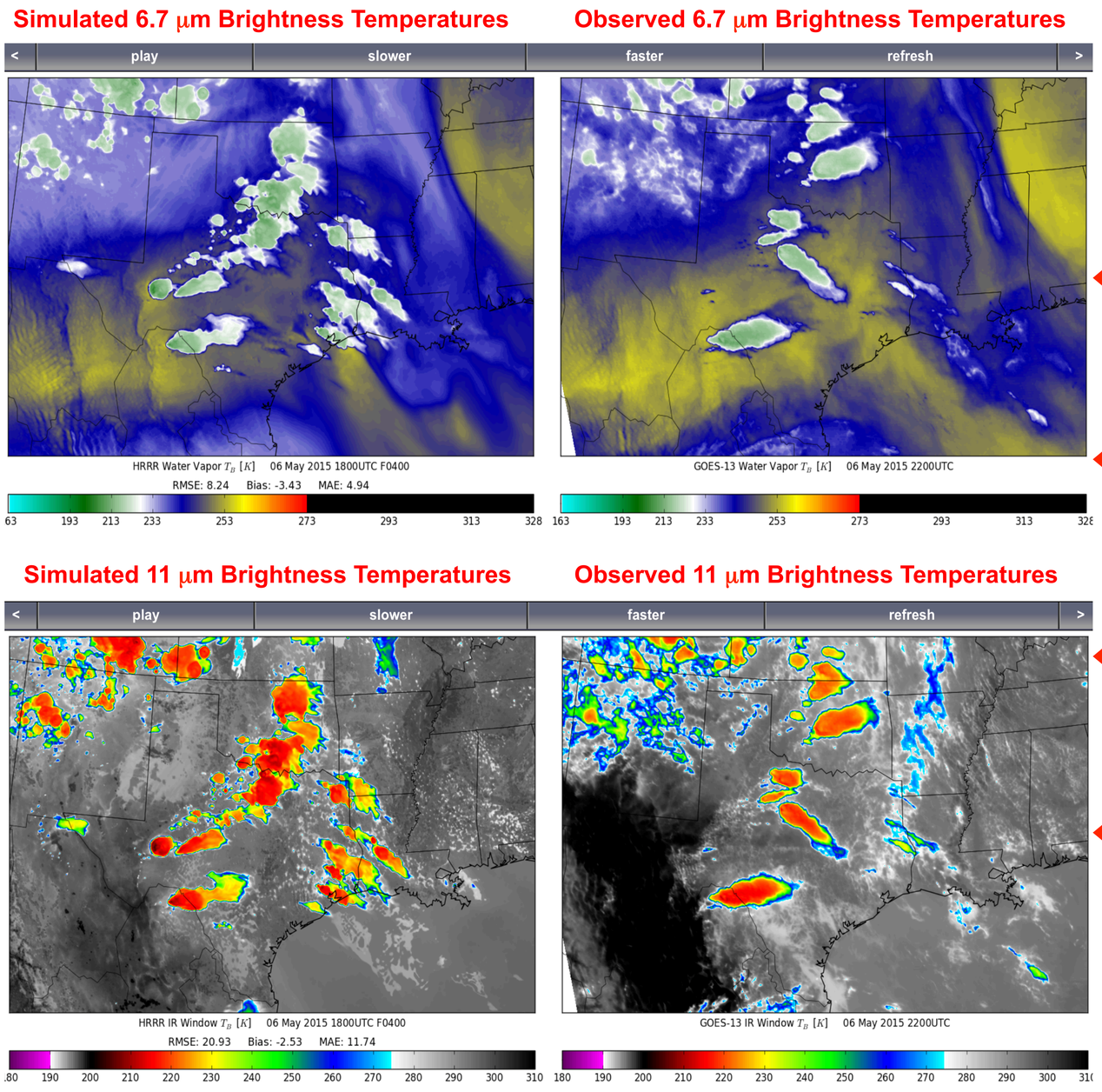
Simulated and observed satellite imagery and the verification statistics from the near real-time system can be seen on our project webpage (http://cimss.ssec.wisc.edu/hrrrval/).

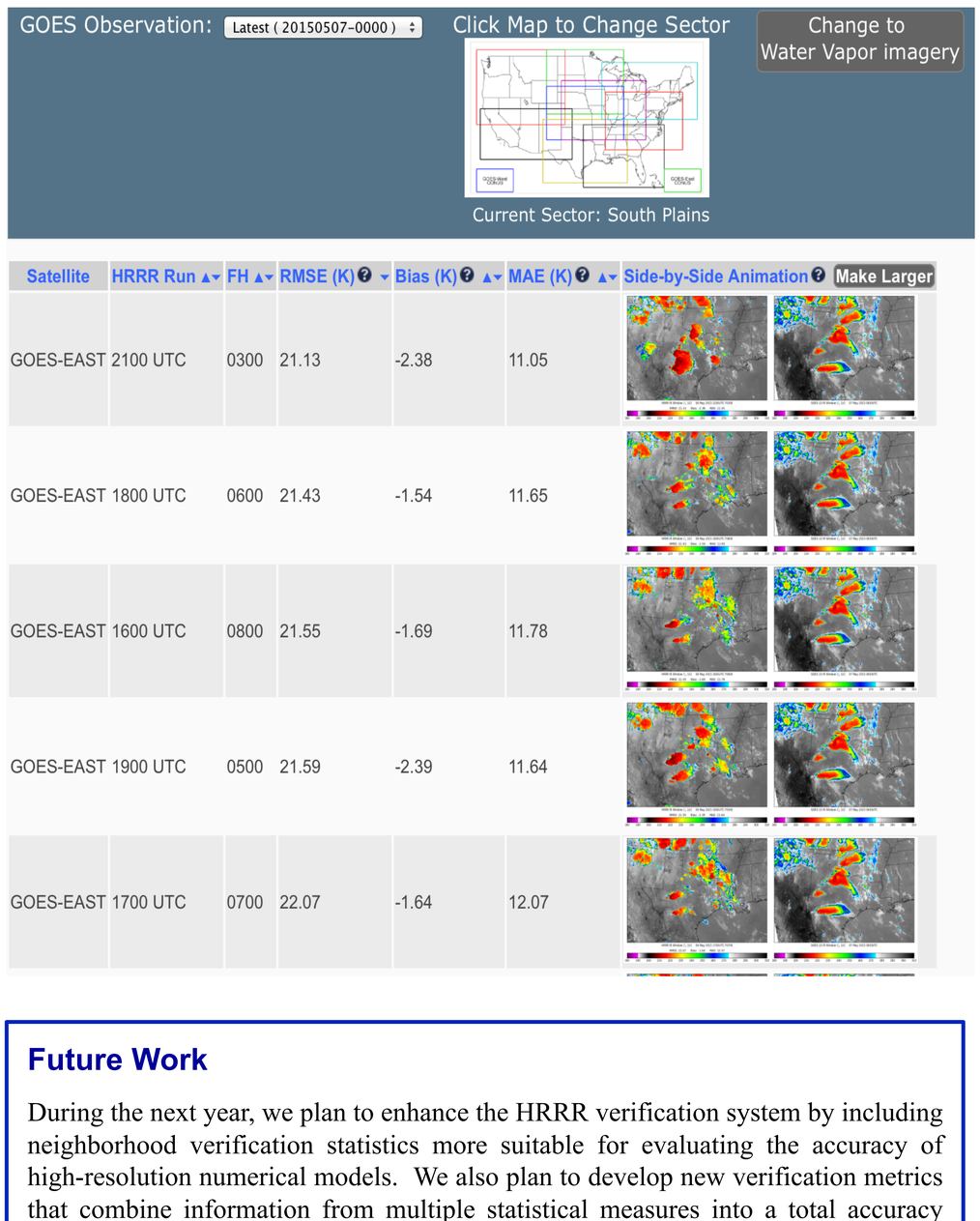
Project Homepage – Forecasters can click on each box to view statistics and satellite imagery for that sector. An online tutorial is also available.



Side-by-Side Animations – Forecasters can view animations of the observed and simulated brightness temperatures for each forecast cycle. The top row shows the 6.7 μm window band and the bottom row shows the 11 μm water vapor band for the south-central U.S. sector at 22 UTC on 06 May 2015 from a 4-hour forecast initialized at 18 UTC. Verification statistics are shown beneath the simulated brightness temperature imagery.

Sector Page – Forecasters can sort the available forecast cycles based on their RMSE, bias, and mean absolute error. The observation time can be chosen in the drop down menu to the right of the domain map. The viewer can toggle between the water vapor and window band statistics by clicking on the icon to the right of the domain map.





Future Work

During the next year, we plan to enhance the HRRR verification system by including neighborhood verification statistics more suitable for evaluating the accuracy of high-resolution numerical models. We also plan to develop new verification metrics that combine information from multiple statistical measures into a total accuracy value. In addition, we will use long-term statistics and additional analysis methods to evaluate the accuracy of the HRRR model forecasts for different regions, seasons, and flow regimes, and also as a function of forecast cycle and forecast hour.

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