Evaluation of the High-Resolution Rapid Refresh (HRRR) Model Using Near-Surface Meteorological and Flux Observations

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Motivation

Mesoscale models must properly simulate exchanges of heat, moisture, and momentum between the land surface and atmosphere to produce reliable and accurate weather forecasts. Here we evaluate one of these models (i.e., the High-Resolution Rapid Refresh (HRRR) model) over the Southeast US.

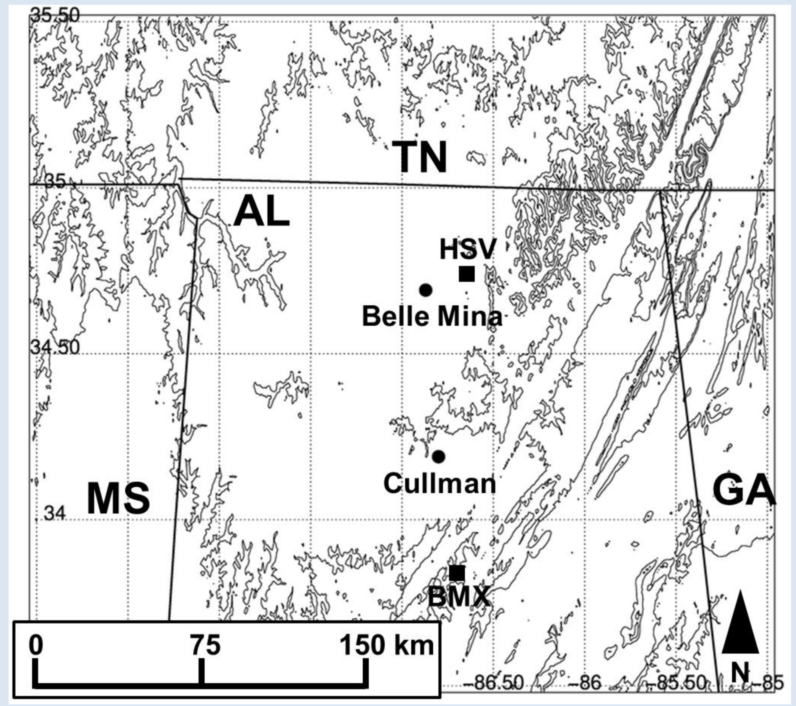
HRRR Model

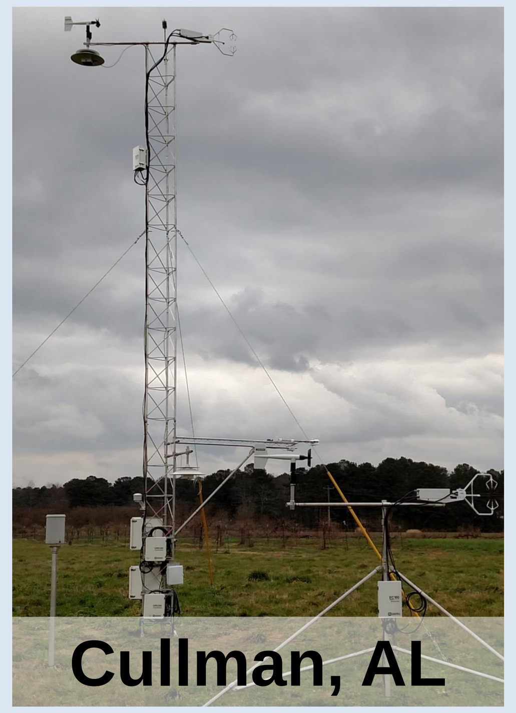
Version 2, 3-km horizontal resolution, RUC land surface model, MYNN PBL scheme, RRTMG radiation scheme

Evaluated March 2016 – Apr 2017

Study Domain

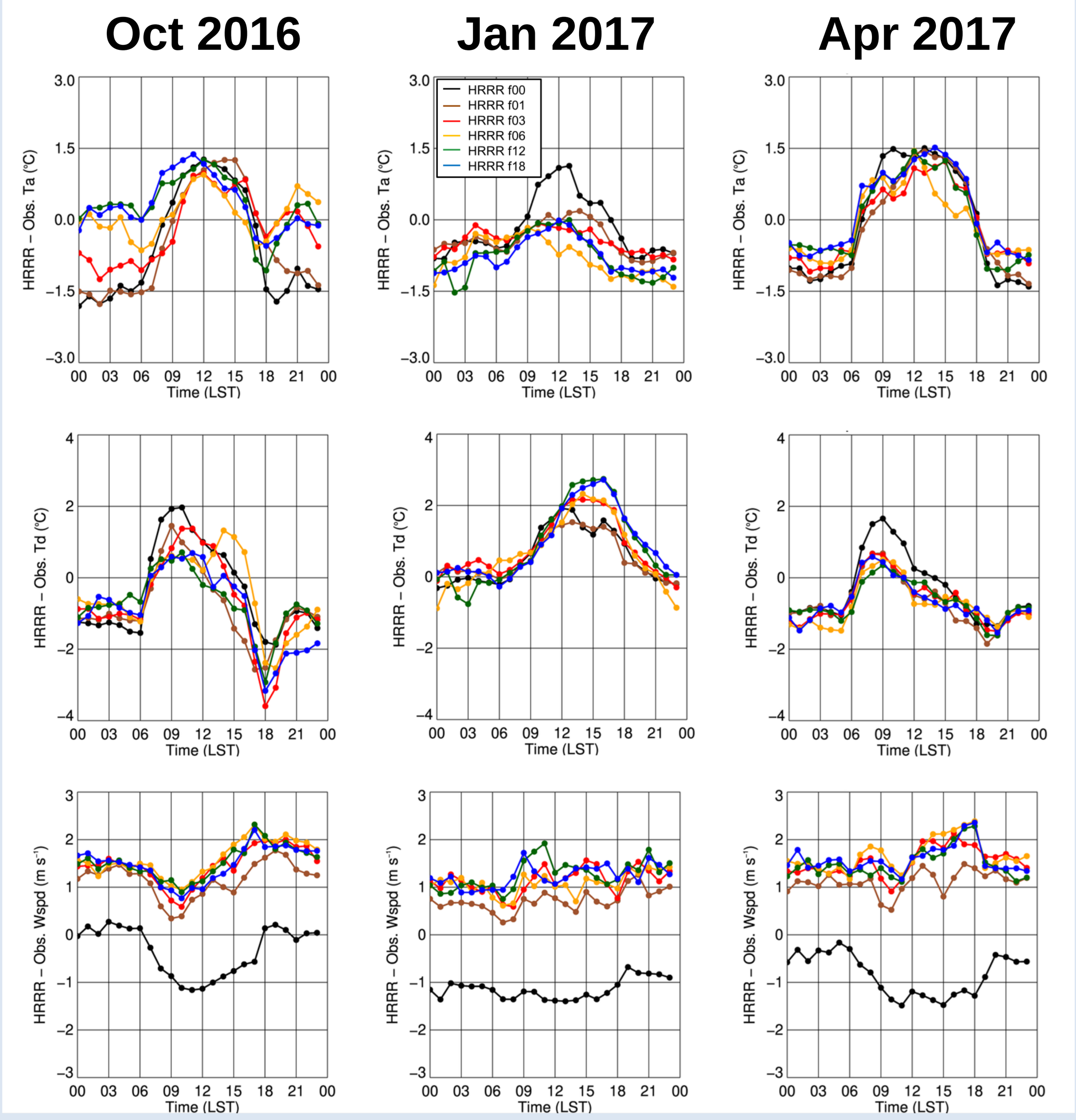
2 10-m flux towers in N. AL (only results from Belle Mina presented)





Variable	Instrument	Sampling Height(s) (m AGL)
Temperature, Dew Point Temperature	Humidity and Temperature Probe	2
Soil Temperature	Soil Temperature Probe	-0.02, -0.05
Wind Speed, Wind Direction	Propeller Anemometer	10
Net Radiation	4-component Net Radiometer	3
Pressure	Barometric Pressure Sensor	1
3-dimensional Wind Components	3-D Sonic Anemometer	3, 10
Water vapor mixing ratio	Closed Path Infrared Gas Analyzer	3, 10

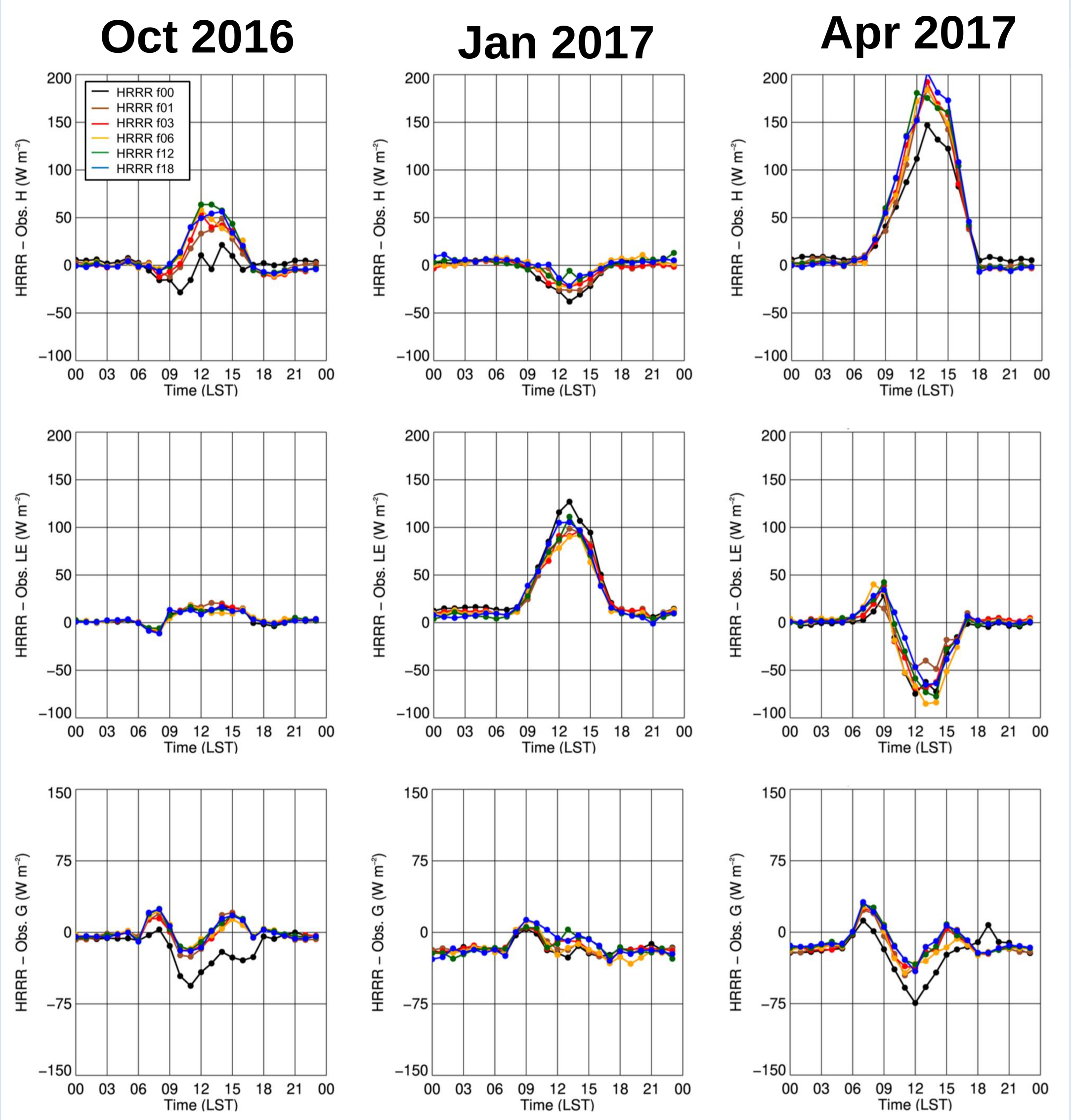
Temperature, Moisture, Wind



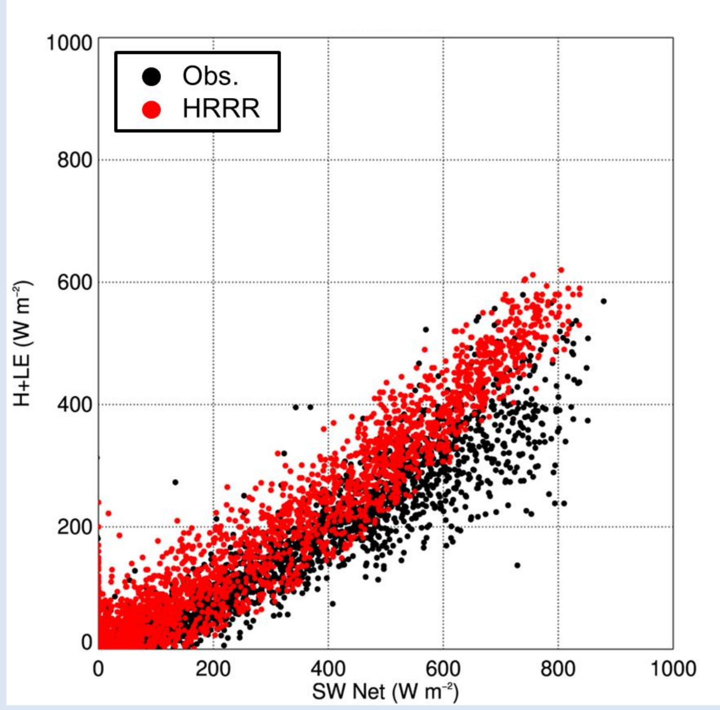
Mean difference between the HRRR forecast and observations of air temperature, dew point (2-m AGL), and wind speed (10-m AGL) from Belle Mina. The black, brown, red, orange, green, and blue lines show the 0-, 1-, 3-, 6-, 12-, and 18-h HRRR forecasts, respectively.

Sensible, Latent, and Ground Flux

Mean difference between the HRRR forecast and observations of sensible, latent, and ground heat flux from Belle Mina. The black, brown, red, orange, green, and blue lines show the 0-, 1-, 3-, 6-, 12-, and 18-h HRRR forecasts, respectively.



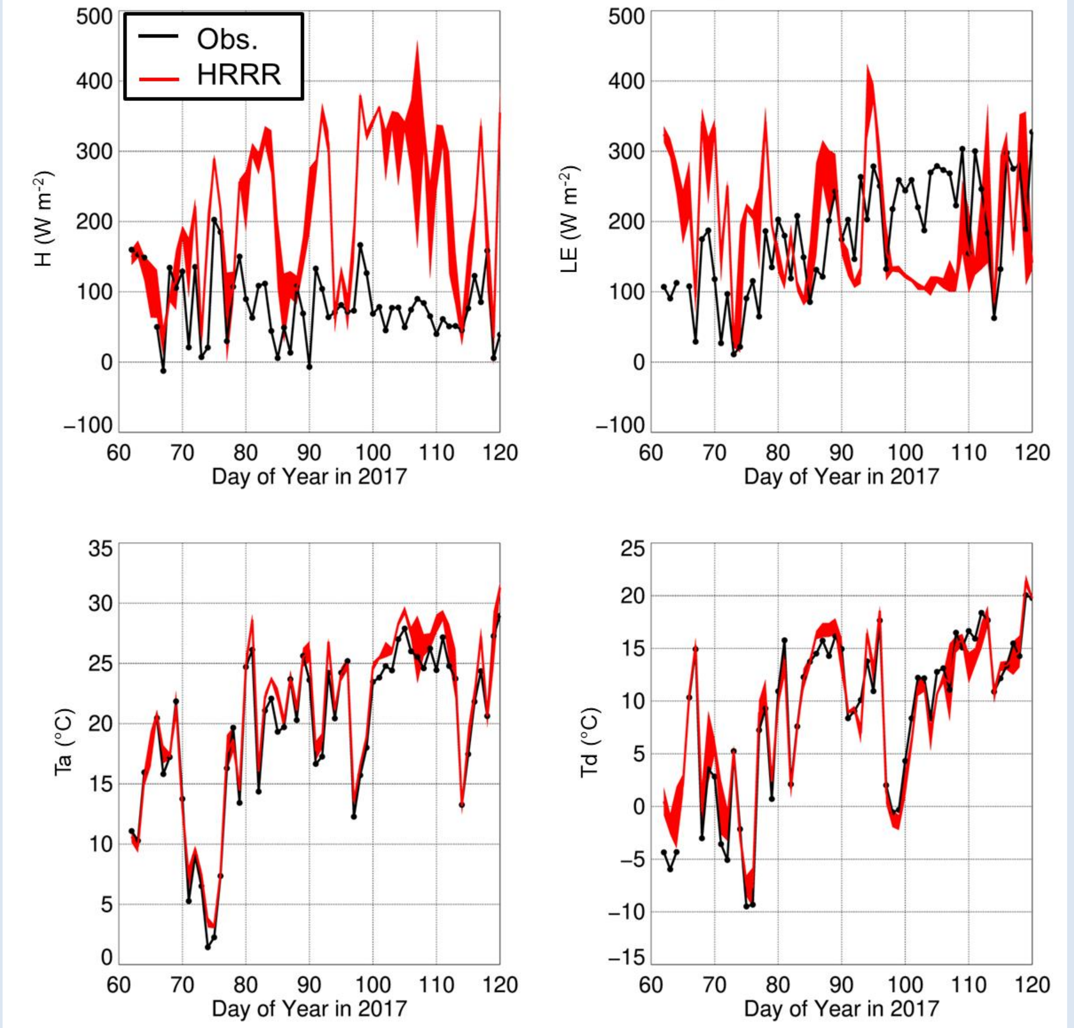
Land-surface Response



The relationship between H + LE and SW_{in} – SW_{out} from Belle Mina shows larger slopes in the model than in the observations, which underscores important time-of-day biases present in the HRRR.

Spring 2017 Case Study

Mean afternoon observed and forecast sensible heat flux, latent heat flux, air temperature, and dew point in March and April 2017 at Belle Mina. The black lines show the obs.; the red shading represents the range among the mean of all HRRR forecasts (i.e., 1-, 3-, 6-, 12-, and 18-h) ± 1 σ.



Key Messages

- ➢ **Reasonable agreement between the HRRR and observed surface met. fields**
- ➢ **Biases in fluxes cannot explain the good agreement between the obs. and HRRR-derived T and T_{dew} fields, motivating the need for additional work on HRRR's LSM**

Interested in more details? See Lee, T. R., M. Buban, D. D. Turner, T. P. Meyers, and C. B. Baker, 2019: Evaluation of the High-Resolution Rapid Refresh (HRRR) model using near-surface meteorological and flux observations from Northern Alabama. *Weather and Forecasting*, 34 (3), 635-663, doi: 10.1175/WAF-D-18-0184.1.