Comparisons of Model Surface Energy Budgets to WFIP2 Observations

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Wind Forecast Improvement Project II: Motivation and Goals

The Columbia River Gorge hosts one of the world's largest concentrations of wind turbines. Accurate forecasts are crucial for the efficient operation of wind energy. However, boundary layer wind phenomena in complex terrain are often poorly simulated in numerical models. Therefore, the ***goals*** of WFIP2 are:

- Carry out an 18-month field campaign in the Columbia River Gorge region.
- Improve our understanding of regional atmospheric boundary layer processes.
- Develop and improve physical parameterizations in WRF-ARW.
- Transfer numerical model improvements to operational entities.

WFIP2 Instrumentation

- 11 wind profilers
- 17 sodars
- 5 wind profiling lidars
- 4 scanning lidars
- 4 radiometers
- 28 sonic anemometers
- 2 surface flux stations
- and more!

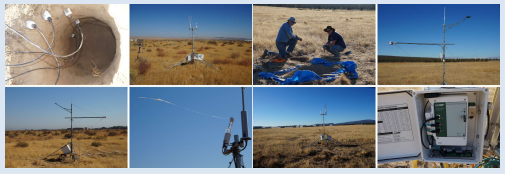
WFIP2 Study Area

Air Resources Laboratory Field Research Division's Surface Flux Stations

The ARLFRD installed two full surface flux stations in Boardman and Prineville, Oregon in late September 2015. These stations consist of the following:

- Sonic Anemometer: Gill in Boardman and RM Young in Prineville
- LI-COR LI-7500A Open Path CO_2/H_2O Gas Analyzer
- Hukseflux 4-Component Net Radiometer
- Hukseflux Heat flux plates
- Soil Thermocouples & Soil Moisture Probe (Campbell Scientific)
- 5 Stevens HydraProbes
  - 5-, 10-, 25-, 50-, 75-cm depths

Boardman | Prineville

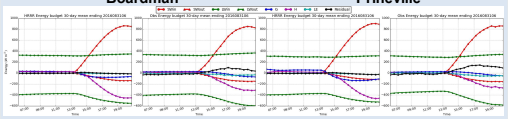


Comparisons

The following figures compare ARLFRD surface flux and ancillary observations to 3-km Experimental High Resolution Rapid Refresh (HRRR) model output. More information on the Experimental HRRR can be found here: https://ruc.noaa.gov/hrrr/. Shown are averages for the month of August, where generally clear skies and minimal precipitation create relatively less complicated conditions. All model runs were initialized at 06z. All 'difference' figures were created by subtracting observations from the model.

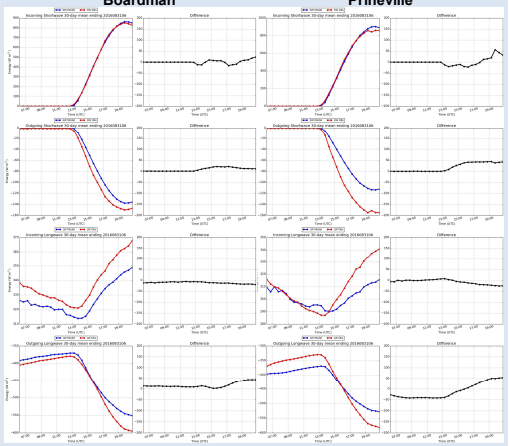
Energy Budget

Boardman | Prineville



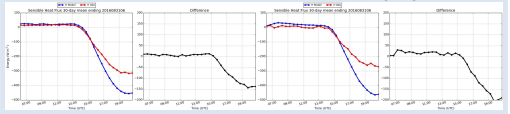
Radiation

Boardman | Prineville



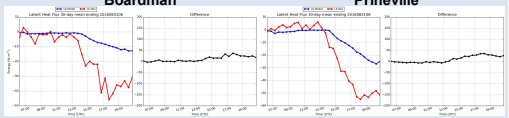
Sensible Heat Flux

Boardman | Prineville



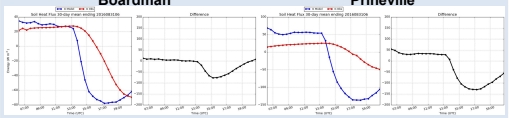
Latent Heat Flux

Boardman | Prineville



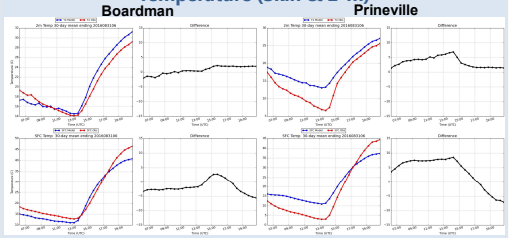
Soil Heat Flux

Boardman | Prineville



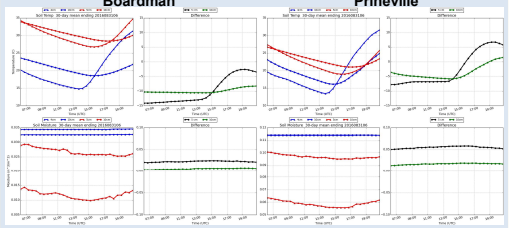
Temperature (Skin & 2-m)

Boardman | Prineville



Soil Temperature & Moisture

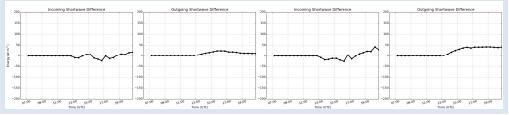
Boardman | Prineville



Does Higher Resolution Help?

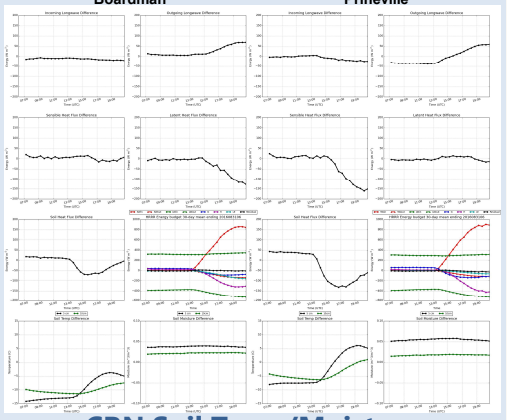
Below are the same comparisons as above, except observations are now compared with the 750-m resolution WFIP-HRRR nest.

Boardman | Prineville



Higher Resolution, continued

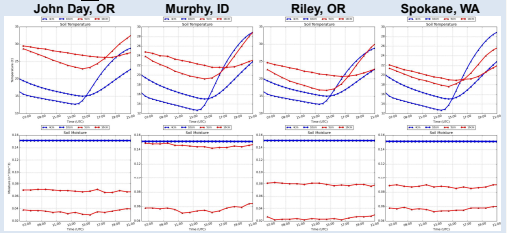
Boardman | Prineville



CRN Soil Temp/Moisture

HRRR archived grids are not currently accessible. Thus, several 15-h WRF runs were completed for Jul & Aug 2016 using the same physics as the HRRR, and driven by the 13-km RAP model. Model output was compared to soil temp/moisture data from the Climate Reference Network to see if differences are similar to earlier results. Below are comparisons for a WRF run initialized 2016082406. Results were similar for **all** runs. Model = blue and Observations = red.

John Day, OR | Murphy, ID | Riley, OR | Spokane, WA



Summary

Large discrepancies exist between the 3-km/750-m WFIP-HRRR and ARLFRD observations for sensible and soil heat flux, and soil temp/moisture. Given similar differences in soil temp/moisture between the WRF model and CRN data, it is likely that there is a cold and moist bias in soil simulated by the RUC LSM used in the HRRR.