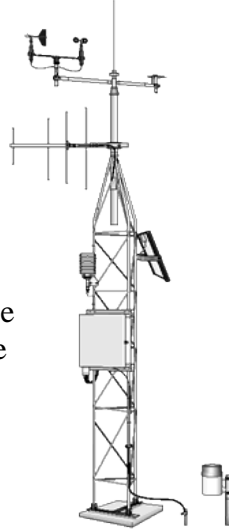


USDA ARS RRSR Unit Research Sites Meteorological Stations

The RRSRU automated meteorological stations were deployed in May of 2003. One station is located at the Central Plain Experimental Research Station (CPER) Nunn, CO and one at the High Plains Grassland Research Station (HPGRS), Cheyenne, WY. Stations measure: Temperature, Relative Humidity, Wind Speed, Wind Direction, Solar Radiation, Precipitation, Evaporation, Soil Temperature, Soil Moisture and Barometric Pressure.

People responsible for the stations and the data are:

| | | | |
|----------------|-----------|--|------------------------|
| Justin Derner | RL | Justin.Derner@ars.usda.gov | (307)772-2433 ext. 113 |
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| David Smith | Technical | David.Smith@ars.usda.gov | (970)492-7124 |



Instrumentation purchased from Campbell Scientific. Both stations are solar powered and use IP modems for connectivity. Station configurations are identical at each research site with the exception of the added CNR1 radiometer at the CPER site. The CPER site meteorological station is part of the Long Term Agroecosystem Research Network (LTAR) and data is streamed to the National Agricultural Library. Near real-time 15 minute data for the CPER station can be found here:

[CPER near real-time meteorological data NAL](#)

Sensors

Temperature and Relative Humidity

- ✓ Model: Vaisala HMP45C Probe
- ✓ Sensor Height: 2 meter
- ✓ Temperature Specs:
 - Temperature Measurement Range: -39.2° to $+60^{\circ}$ C
- ✓ Relative Humidity Specs:
 - RH Measurement Range: 0.8 to 100% non-condensing
 - RH Accuracy (at 20° C): $\pm 2\%$ RH ($0-90\%$ RH); $\pm 3\%$ ($90\%-100\%$ RH)
 - Temperature Dependence of RH Measurement: $\pm 0.05\%$ RH/ $^{\circ}$ C



Wind Speed and Direction

- ✓ Model: RM Young 05103 Wind Monitor
- ✓ Sensor Height: 3 meters
- ✓ Wind Speed Specs:
 - Range: 0-134 mph (0-60 m/s)
 - Starting threshold: 2.2 mph (1.0 m/s)
 - Distance Constant (63% recovery): 2.7 meters
 - Gust survival: 220 mph (100 m/s)
 - Accuracy: ± 0.6 mph (± 0.3 m/s)
- ✓ Wind Direction Specs:
 - Range: $0-360^{\circ}$ mechanical, 355° electrical (5° open)
 - Starting threshold:
 - 10° displacement - 2.0 mph (0.9 m/s)
 - 5° displacement - 2.9 mph (1.3 m/s)
- ✓ Accuracy: $\pm 3^{\circ}$



Solar Radiation

- ✦ Model:
 - LI-COR LI190SB Quantum Sensor
 - LI-COR LI200X Silicon Pyranometer
 - Kipp and Zonen CNR1 net radiometer (CPER)
- ✦ Specs Quantum sensor:
 - Sensor height: 2.5M
 - Sensitivity: 5 μA per 1000 $\mu\text{moles s}^{-1} \text{m}^{-2}$
 - Linearity: Maximum deviation of 1% up to 10,000 $\mu\text{moles s}^{-1} \text{m}^{-2}$
 - Light Spectrum Waveband: 400 to 700 nm
- ✦ Specs Pyranometer:
 - Sensor height: 3 M
 - Sensitivity: 02.kW $\text{m}^{-2} \text{mV}^{-1}$
 - Linearity: Maximum deviation of 1% up to 3000 W m^{-2}
 - Light Spectrum Waveband: 400 to 1100 nm
 - Accuracy: Absolute error in natural daylight is $\pm 5\%$ maximum; $\pm 3\%$ typical
- ✦ Specs CNR1 radiometer:
 - Sensor height: 2 M
 - Pyranometer Spectral Response 305 to 2800 nm
 - Pyrometer Spectral Response 5000 to 50,000 nm
 - Response Time 18 s
 - Sensitivity Range 7 to 15 $\mu\text{V W}^{-1} \text{m}^2$



Precipitation

- ✦ Model: Hydrological Services CS700H heated tipping bucket rain gauge
- ✦ Gauge height 1.5M
- ✦ Specs:
 - Accuracy: $\pm 2\%$ @ $< 250 \text{ mm hr}^{-1}$, $\pm 3\%$ @ 250 to 500 mm hr^{-1}
 - Resolution: TB4/CS700/CS700H: 0.01 in

Evaporation

- ✦ Model: Nova Lynx 255-100
- ✦ Specs:
 - Accuracy: 0.25%
 - Linearity: 0.25%
 - Range: 0-10"

Soil Temperature

- ✦ Model: Campbell Scientific 107 temperature probe
- ✦ Depth of Probes: 5, 10, 30, 50 cm
- ✦ Specs:
 - Temperature measurement range: -35° to $+50^{\circ}\text{C}$
 - Polynomial linearization accuracy: Typically $< \pm 0.5^{\circ}\text{C}$ over -38° to $+50^{\circ}\text{C}$ range

Soil Moisture

- ✦ Model: Campbell Scientific CS616-L water content reflectometer
- ✦ Specs:
 - Accuracy: + 2% using calibration for specific soil.
 - Depths: 5, 10, 30, 50 cm



Barometric Pressure

✎ Model: Vaisala CS105

✎ Specs:

➤ Total accuracy:

- ± 0.5 mb @ +20°C
- ± 2 mb @ to 20°C
- ± 4 mb @ -20°C to +45°C
- ± 6 mb @ -40°C to +60°C

✎ Operating temperature: -40°C to +60°C



Data Logger

✎ Campbell Scientific CR3000 Micrologger

✎ Operating Range -25° to +50°C

GPS coordinates:

HPGRS

NAD 27 Conus Zone 13T 509391.00 m E, 4560172.00 m N

Elevation: 1918 m

CPER

NAD 27 Conus Zone 13T 524226.00 m E, 4521295.00 m N

Elevation: 1648 m

CPER and HPGRS Meteorological Stations

| Measurement | Scan interval | Storage interval | Height or Depth |
|-------------------------------------|------------------------|-----------------------------------|------------------------|
| Barometric Pressure | 15 minutes | hourly average | 1 M |
| Volumetric soil water content | hourly | hourly, daily average | |
| Soil Temp. at 4 depths | 10 seconds | hourly average, daily max and min | 5,10,30,50 cm depths |
| Precipitation | as precip. is received | hourly sum, daily sum | 1 M height |
| Incoming Radiation | 10 seconds | hourly average | 3 M |
| Photosynthetically Active Radiation | 10 seconds | hourly average | 2.5 M |
| Air Temp. | 10 seconds | hourly average, daily max and min | 2 M height |
| Relative Humidity | 10 seconds | hourly average | 2 M height |
| Wind Speed | 10 seconds | hourly average, daily max | 3 M height |
| Wind Direction | 10 seconds | hourly average | 3 M height |
| Evaporation | hourly | hourly sum, daily sum | |

| CPER only measurements | Scan interval | Storage interval | Height or Depth |
|-----------------------------------|----------------------|-------------------------|------------------------|
| Incoming Shortwave Radiation | 10 seconds | hourly average | 2 M |
| Outgoing Shortwave Radiation | 10 seconds | hourly average | 2 M |
| Incoming Longwave Radiation | 10 seconds | hourly average | 2 M |
| Outgoing Longwave Radiation | 10 seconds | hourly average | 2 M |
| Incoming Shortwave Radiation | 10 seconds | hourly average | 2 M |
| Net Shortwave Radiation | 10 seconds | hourly average | 2 M |
| Net Longwave Radiation | 10 seconds | hourly average | 2 M |
| Albedo | 10 seconds | hourly average | 2 M |
| Total Incoming Radiation | 10 seconds | hourly average | 2 M |
| Total Outgoing Radiation | 10 seconds | hourly average | 2 M |
| Net Radiation | 10 seconds | hourly average | 2 M |
| Incoming Temp Corrected Shortwave | 10 seconds | hourly average | 2 M |
| Outgoing Temp Corrected Shortwave | 10 seconds | hourly average | 2 M |