U.S. Climate Reference Network Observes the Great American Eclipse

Over 100 U.S. Climate Reference Network stations recorded the meteorological impacts of the 2017 Great American Eclipse

The Great American Eclipse crossed the country from Oregon to South Carolina on August 21, 2017. Millions gathered in the approximately 70-mile-wide path of totality—where the moon completely blocked the sun—to witness the marvelous few minutes when day became night. NOAA's unique network of climate observation stations witnessed this extraordinary astronomical event right alongside them.

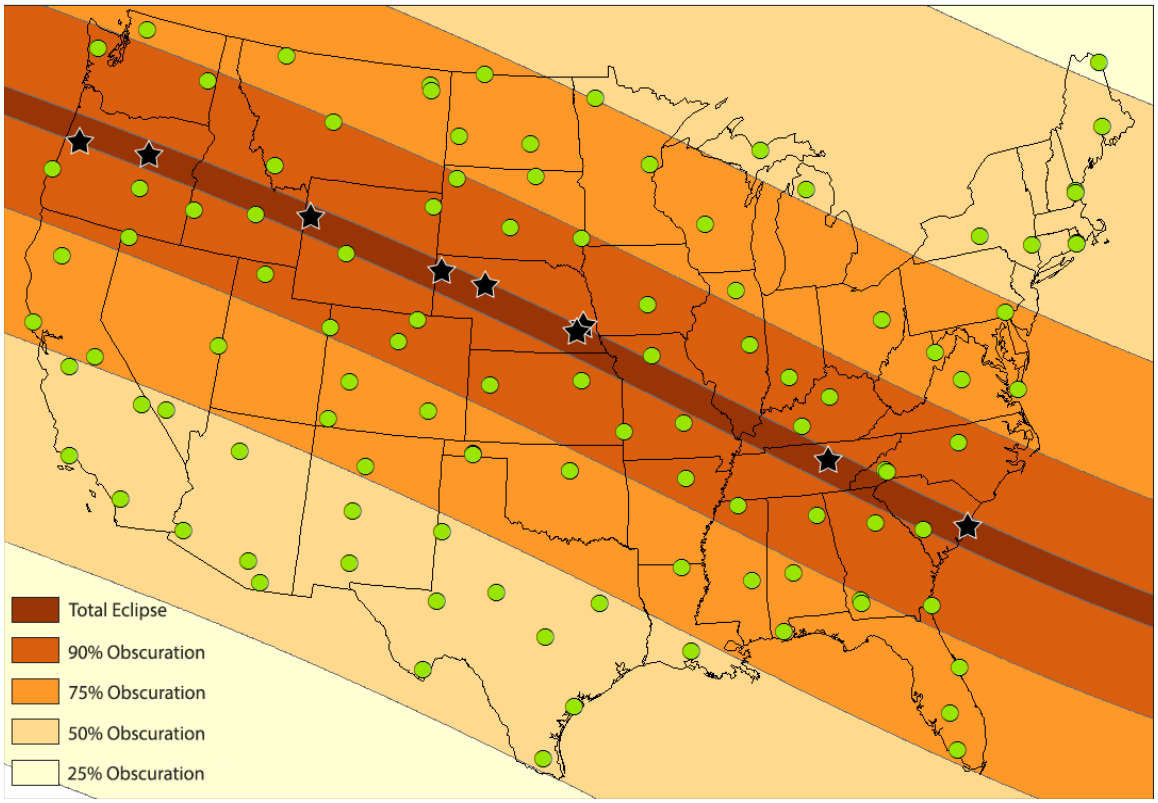
More than 100 U.S. Climate Reference Network, or USCRN, stations across the country observed the meteorological impacts caused by the solar eclipse. Of these stations spanning the Lower 48, nine were located right in the eclipse's path of totality—and six were in totality for over two minutes.

What is the U.S. Climate Reference Network?

Since 2002, NCEI and NOAA's Atmospheric Turbulence and Diffusion Division have together managed and operated the U.S. Climate Reference Network. The network's mission is to monitor the climate across the United States in pristine locations for the next 50 years and provide user-driven information products based on these measurements.

The USCRN consists of a systematic and sustained network of stations with sites across the contiguous United States, Alaska, and Hawaii. These stations use high-quality instruments to measure air temperature, surface temperature, solar radiation, relative humidity, precipitation, soil conditions, and more. Each of these stations used high-quality instruments to measure temperature, solar radiation, and relative humidity before, during, and after the eclipse. The stations take observations in 5-minute increments, and is now available to look at and examine the impacts of the eclipse on the weather that day.

U.S. Climate Reference Network Stations in the Path of the August 21, 2017, Solar Eclipse



This document discusses the meteorological measurements made at the nine stations within the path of totality. A graph displays for each station the 5-minute air temperature, solar radiation, and relative humidity measurements over a period bridging the entire eclipse event. While some stations' eclipse signatures were complicated by partial overcast conditions, all indicate lowering of solar radiation and air temperature as totality is reached. Besides this report, a record of this event will be kept at the Atmospheric Turbulence and Diffusion Division's website. This link is a great resource for information after the eclipse. It provides access to a variety of data and information from NOAA, NASA, and other sources. The USCRN data will also be available on the site.

U.S. Climate Reference Network Stations Within the Path of Totality.

Location	Elevation (feet)	Length of Totality (minutes : seconds)
Corvallis, Oregon	312	1:00.1
John Day, Oregon	2,245	2:07.2
Moose, Wyoming	6,466	2:20.6
Harrison, Nebraska	4,406	2:23.7
Whitman, Nebraska	3,740	1:52.7
Lincoln, Nebraska	1,372	2:13.3
Lincoln, Nebraska	1,189	0:31.5
Crossville, Tennessee	1,913	2:33.2
McClellanville, South Carolina	9	2:28.9

Related Links

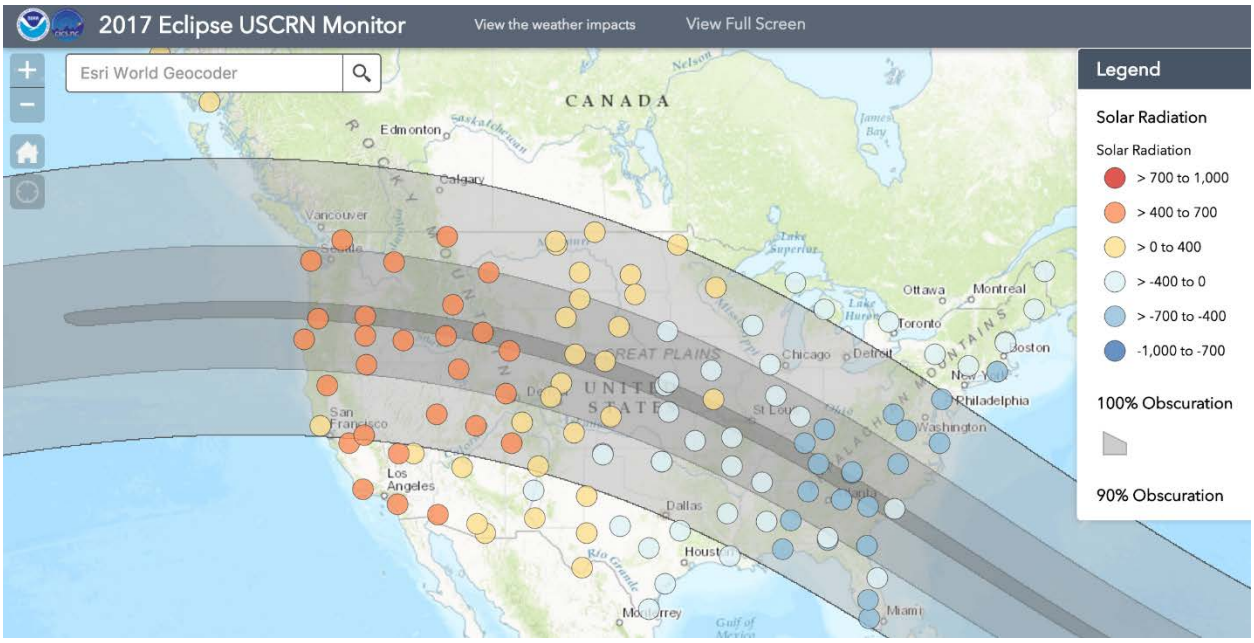
- Near Real Time: USCRN Eclipse Weather Impacts
- How to View the 2017 Solar Eclipse Safely
- Eclipse Weather
- U.S. Climate Reference Network
- Ready, Set, Eclipse: Our Cloudiness Map May Improve Your Experience
- A Solar Eclipse for the Ages: Looking Back at 1900
- Eclipse Will Have Atmospheric Impact
- More Eclipse History from NASA

Total Eclipse Image taken by NASA in Oregon.

Temperature and Relative Humidity Deltas at USCRN Totality Locations.

Location	Totality	Temp Del (°F)	Lag (min)	RH Del (%)	Surface IR Temp Del (°F)	Sky
OR_Corvallis	1m 00.1s	-5.0	12	7	-23.0	Clear
OR_John_Day	2m 07.2s	-4.9	13	7	-25.6	Clear
WY_Moose	2m 20.6s	-8.3	20	20	-22.5	Clear
NE_Harrison	2m 23.7s	-5.8	17	6	-26.8	Clear
NE_Whitman	1m 52.7s	-4.7	3	4	-22.0	Mostly Cloudy
NE_Lincoln_11_SW	2m 13.3s	-6.1	13	12	-16.2	Partly Cloudy
NE_Lincoln_8_ENE	0m 31.5s	-5.8	12	13	-12.1	Partly Cloudy
TN_Crossville	2m 33.2s	-7.4	9	28	-18.9	Mostly Cloudy
SC_McClellanville	2m 28.9s	-4.3	4	13	-14.8	Mostly Cloudy

The dark area centered on Wyoming is the shadow of the eclipse as seen by GOES-16.

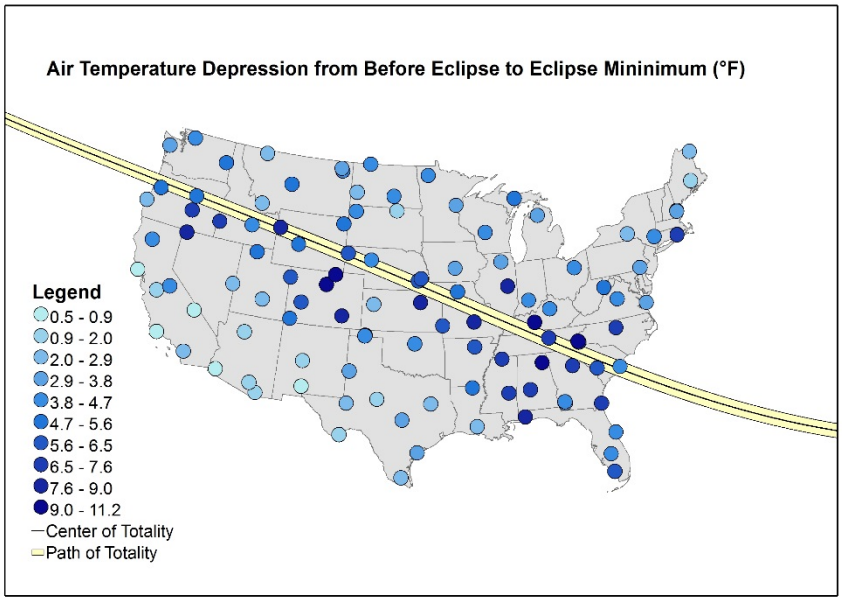


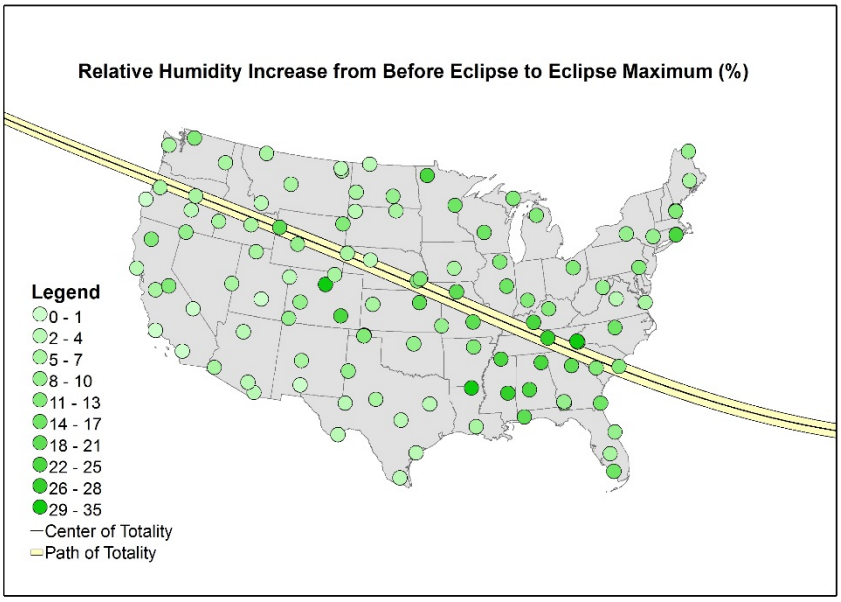
This map shows the effect of the moon's shadow moving over the USCRN stations in the conterminous U.S. At the time of this image, the stations in the west were showing a large increase in solar radiation from one hour to the next (Orange), stations in the central region were at low solar radiation levels for both hours with the eclipse nearby, and stations in the east were showing a large decrease in solar radiation from one hour to the next as the eclipse approached (Blue). Courtesy Ronald Leeper, NCSU Cooperative Institute for Climate and Satellites.

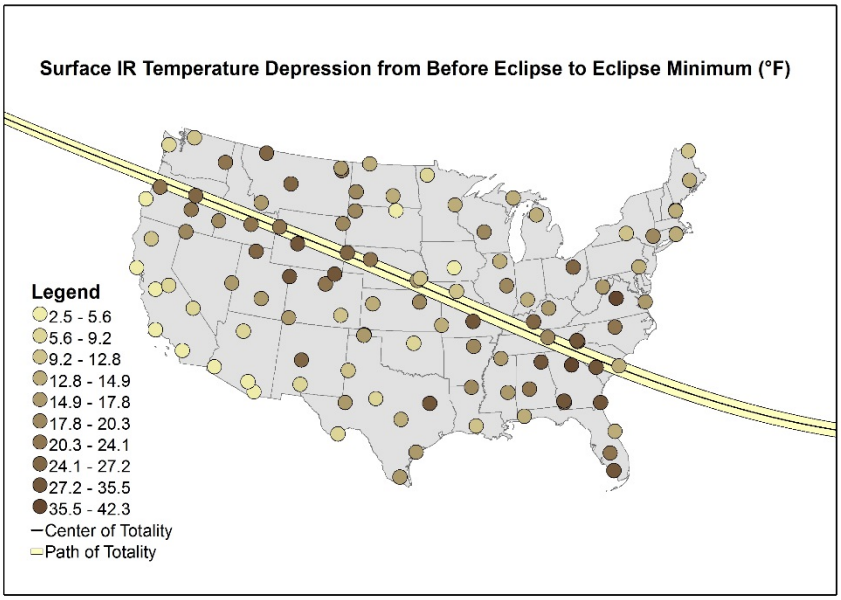
Change in Air Temperature, Relative Humidity, and Surface Infrared Temperature in the USCRN Network during the Eclipse of August 21, 2017

The climate impacts of the eclipse detected by stations in the U.S. Climate Reference Network (USCRN) depended on several factors: distance to eclipse totality center line; air mass characteristics of air temperature and relative humidity; surface vegetation cover; and cloudiness. Only one factor resulted in an eclipse response not being seen: rain or dampness prior to the eclipse maximum in four cases prevented morning warming that would then allow for detection of eclipse cooling. Otherwise, this eclipse occurred during an ideal season and time of day to detect potential impacts on surface conditions. During this event, 110 sites of 114 detected a clear signal of decrease in air temperature, 109 of 113 sites observed a decrease in surface infrared temperature, and 106 sites of 114 showed an increase in relative humidity. A general pattern is evident in the maps of eclipse impacts below, with largest impacts typically found along the center line of the eclipse from Oregon to South Carolina. In each figure, the darker dots experienced the most change between conditions before the eclipse and near the eclipse maximum. Even places furthest from the center line near the southwest and northeast U.S. borders observed distinct temperature effects, although humidity effects were quite minimal in far southern California and Arizona.

Interestingly, the largest air temperature cooling occurred not at a place of eclipse totality, but at the highest altitude station in the network in the mountains west of Boulder, Colorado. Air temperature decreased 11.2°F at an altitude of 9828 feet under mostly clear skies. Large decreases in surface infrared temperature were also somewhat site dependent, with some stations detecting especially large changes due to local effects of vegetation cover and/or instrument sensitivity raising the pre-eclipse surface infrared temperatures to very high levels. Finally, relative humidity change maxima were generally largest in the central and southeast U.S. where some cloudiness was already present, or where a large air temperature decrease caused a large relative humidity increase in drier locations.



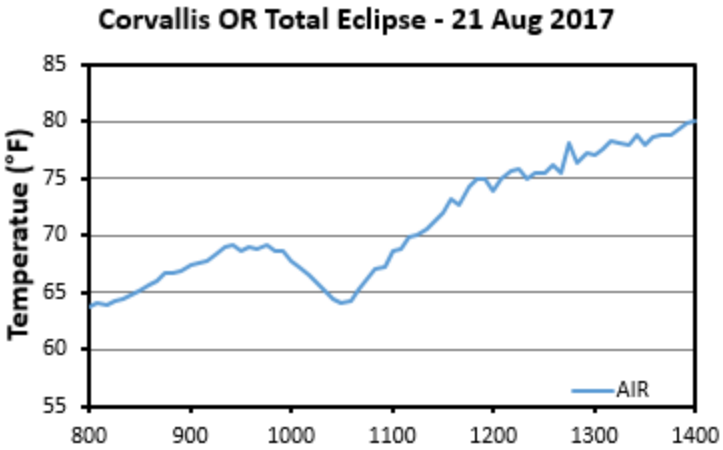




Station Specific Graphs of the Eclipse Totality and Its Climate Effects

On the following pages, each USCRN Totality Station is shown in its environment and a set of three graphs show the Air Temperature (°F), Solar Radiation (Watts per meter squared) and Relative Humidity (%) for the time period around totality, using 5-minute observations. All stations have a decrease in air temperature and an increase in relative humidity during the eclipse totality, although the amounts and time lags vary.

Corvallis, Oregon

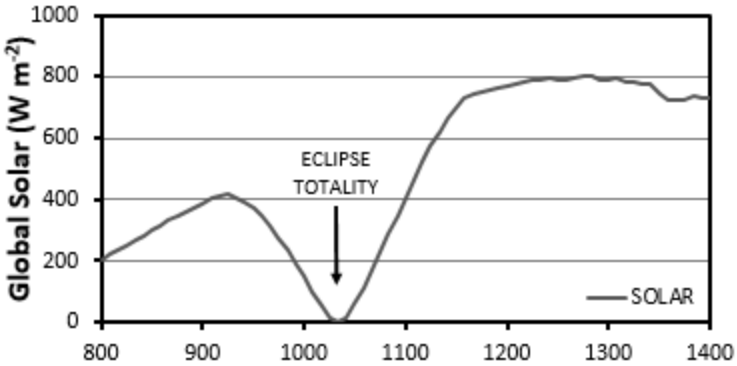


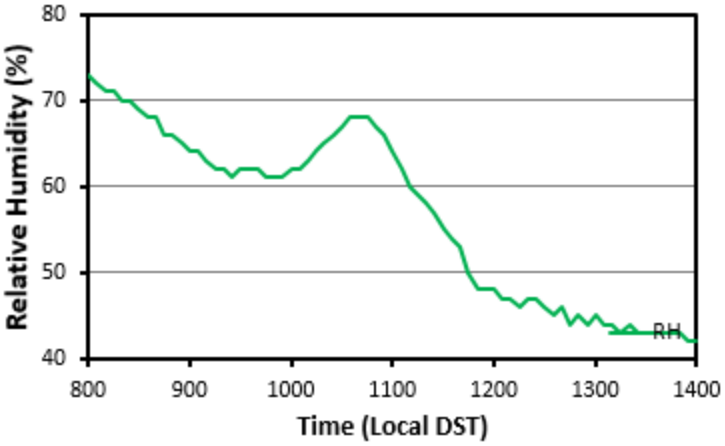
OR Corvallis 10 SSW in
William L Finley NWR

Latitude: 44.4185 N
Longitude: 123.32576 W
Elevation: 312 feet

Duration: 1m 00.1s

Partial eclipse start: 9:04 AM
Total eclipse: 10:17 – 10:18 AM
Partial eclipse end: 11:37 AM
Pacific Daylight Time



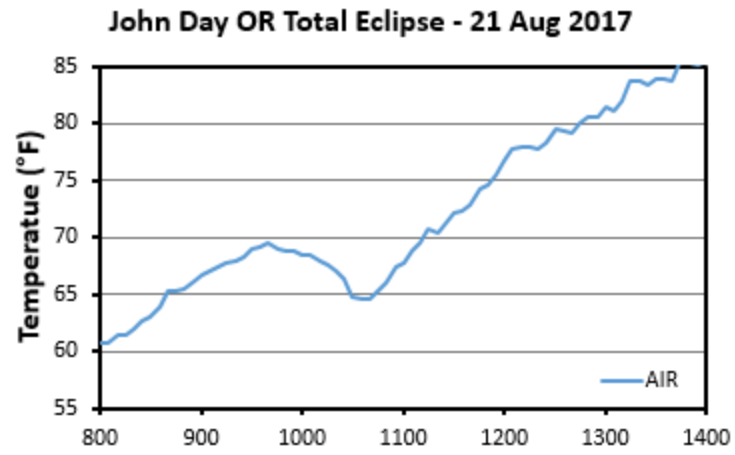


Conditions were clear during the eclipse with light northeast wind minimizing ocean influence.

Due to the eclipse, air temperature decreased 5.0°F, surface IR temperature decreased 23.0°F, and relative humidity increased 7%.

More the 5,000 people attended the eclipse at the Oregon State University stadium.

John Day, Oregon



OR John Day 35 WNW in
John Day Fossil Beds National
Monument

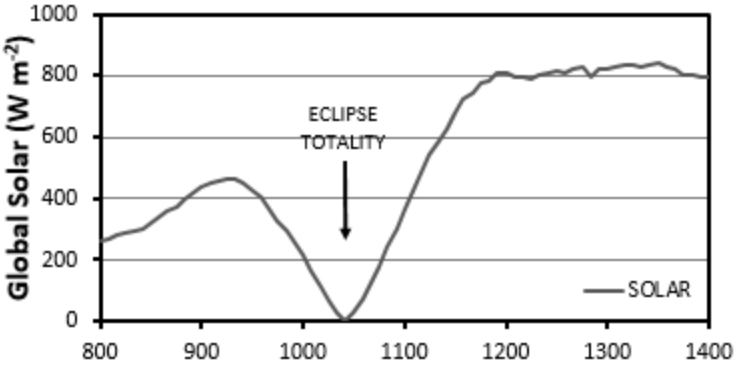
Latitude: 44.5560 N
Longitude: 119.6459 W
Elevation: 2245 feet

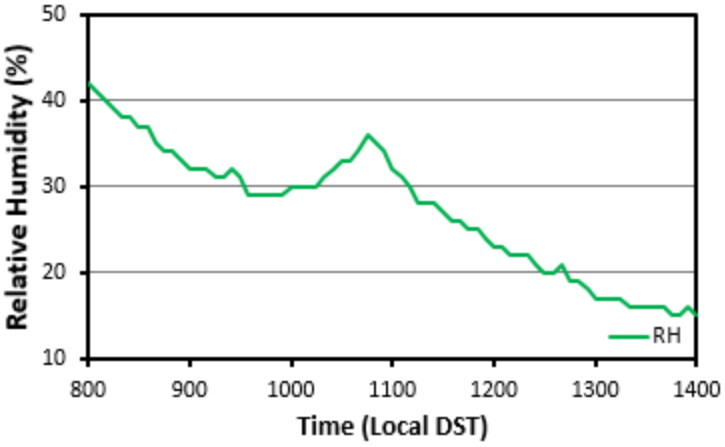
Duration: 2m 07.2s

Partial eclipse start: 9:07 AM
Total eclipse: 10:21 – 10:23 AM
Partial eclipse end: 11:43 AM
Pacific Daylight Time

Conditions were clear during the eclipse with winds becoming calm during the eclipse.

Due to the eclipse, air temperature decreased 4.9°F, surface IR temperature decreased 25.6°F, and relative humidity increased 7%.





The John Day Fossil Beds National Monument was one of many National Park Service units that put in place special procedures to manage larger than normal crowds during this celestial event.

Moose, Wyoming

WY Moose 1 NNE in
Grand Teton National Park

Latitude: 43.6615 N
Longitude: 110.7120 W
Elevation: 6466 feet

Duration: 2m 20.6s

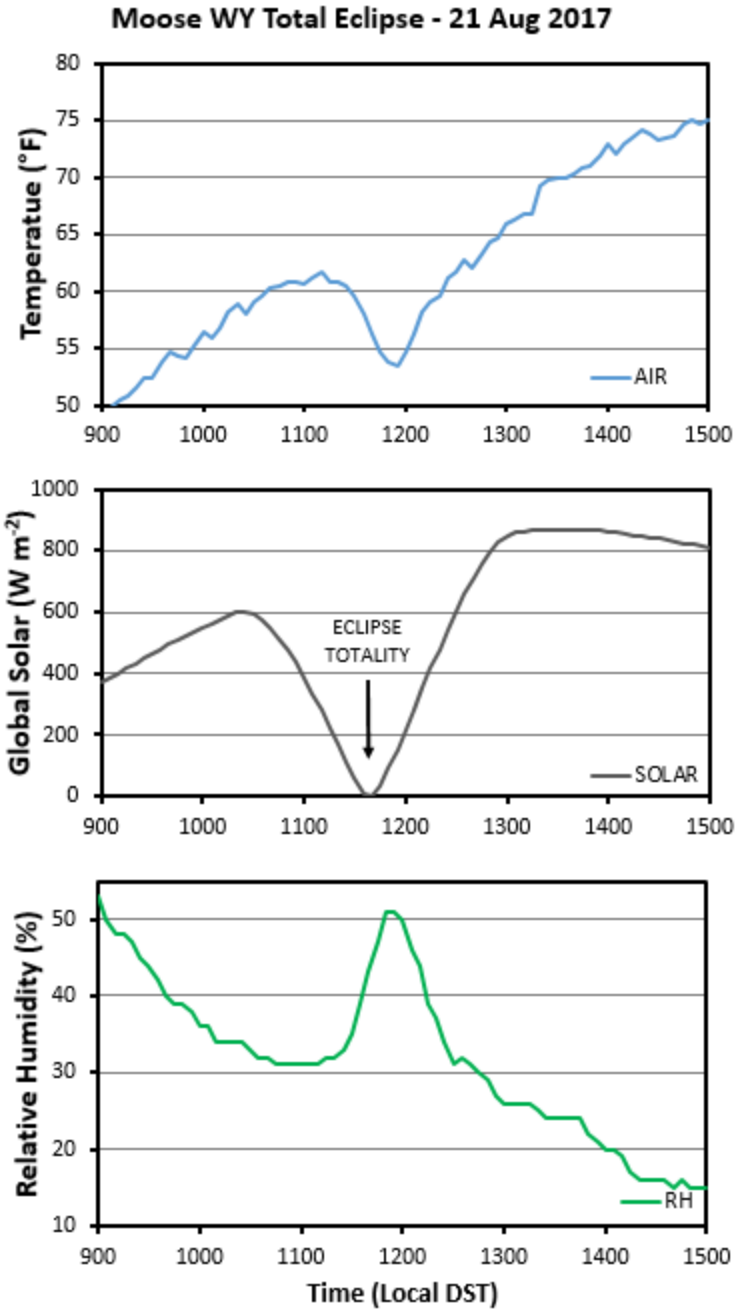
Partial eclipse start: 10:16 AM
Total eclipse: 11:34 – 11:37 AM
Partial eclipse end: 1:00 PM
Mountain Daylight Time

Conditions were clear during the eclipse with winds becoming calm during the eclipse.

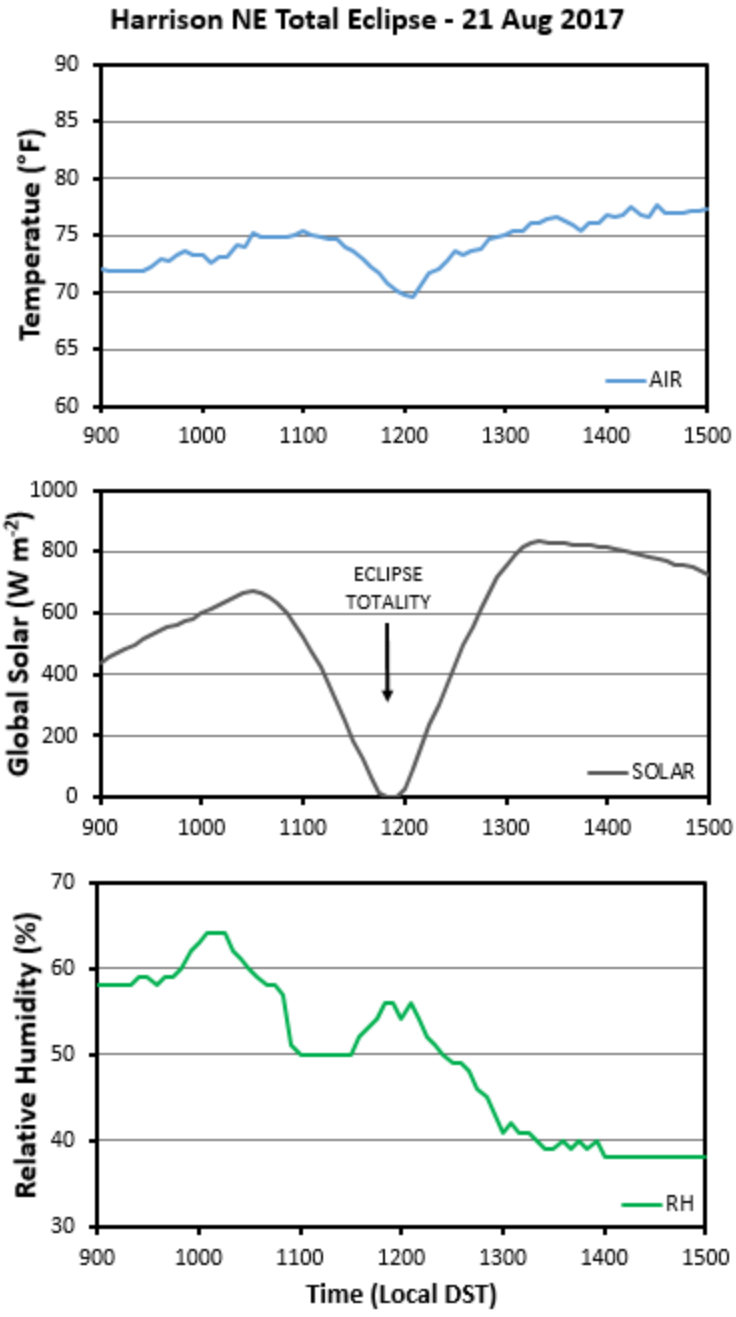
Due to the eclipse, air temperature decreased 8.3°F, surface IR temperature decreased 22.5°F, and relative humidity increased 20%.

Famous peaks at eclipse darkness.

Jackson Hole officials had prepared for two years for this event, and things went very well in town, on the roads, and in the Park. Traffic was up 148% at Moose Junction.



Harrison. Nebraska



NE Harrison 20 SSE in
Agate Fossil Beds National
Monument

Latitude: 42.4247 N
Longitude: 103.7363 W
Elevation: 4406 feet

Duration: 2m 23.7s

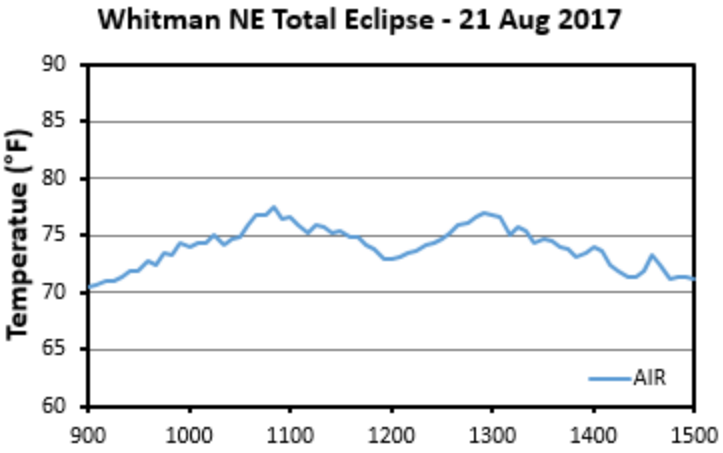
Partial eclipse start: 10:25 AM
Total eclipse: 11:47 – 11:50 AM
Partial eclipse end: 1:14 PM
Mountain Daylight Time

Conditions were clear during the eclipse with a north wind at 12 mph that diminished to 4 mph during the eclipse, but did not become calm.

Due to the eclipse, air temperature decreased 5.8°F, surface IR temperature decreased 26.8°F, and relative humidity increased 6%.

People came to the Agate Fossil Beds National Monument from all over the world to watch the eclipse, including a group from the Netherlands. Hundreds of people participated in activities of all sorts as they awaited the eclipse. This was a very unusual amount of activity for the isolated northern corner of the Nebraska Panhandle.

Whitman, Nebraska

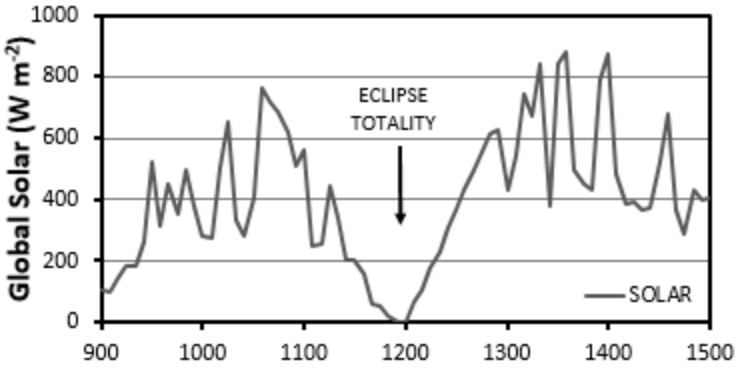


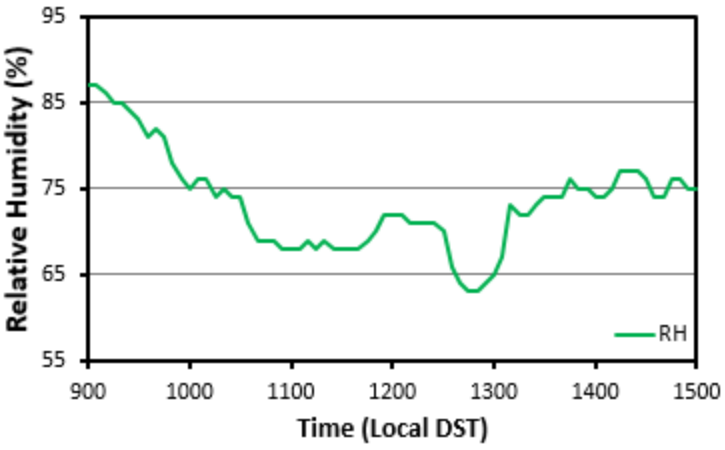
NE Whitman 5 ENE in
Gudmundsen Sandhills Laboratory

Latitude: 42.0680 N
Longitude: 101.4450 W
Elevation: 3740 feet

Duration: 1m 52.7s

Partial eclipse start: 10:29 AM
Total eclipse: 11:52 – 11:54 AM
Partial eclipse end: 1:19 PM
Mountain Daylight Time



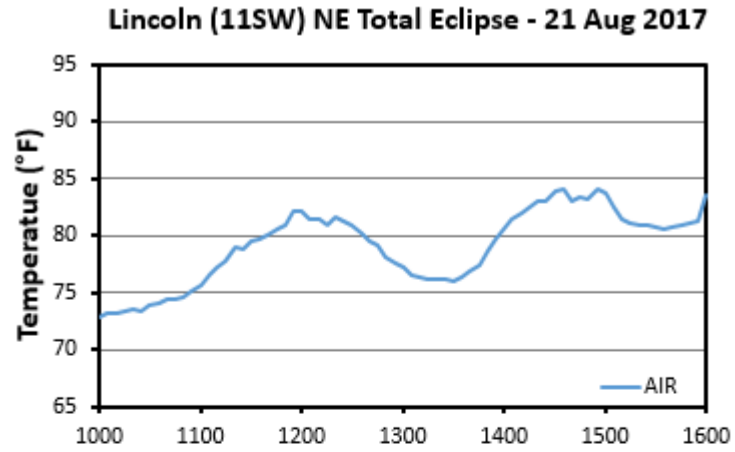


Conditions were mostly cloudy during the eclipse with a north wind at less than 5 mph prior to the eclipse, but that freshened to 10 mph during the eclipse onset and increased further after totality. Cloud density varied frequently during the event.

Due to the eclipse, air temperature decreased 4.7°F, surface IR temperature decreased 22.0°F, and relative humidity increased 4%.

The facility hosting the USCRN station here is part of the University of Nebraska Institute of Agricultural and Natural Resources. The Nebraska Extension assisted in gathering citizen science reports on the impacts of the eclipse as it crossed the state.

Lincoln, Nebraska (11 miles SW)

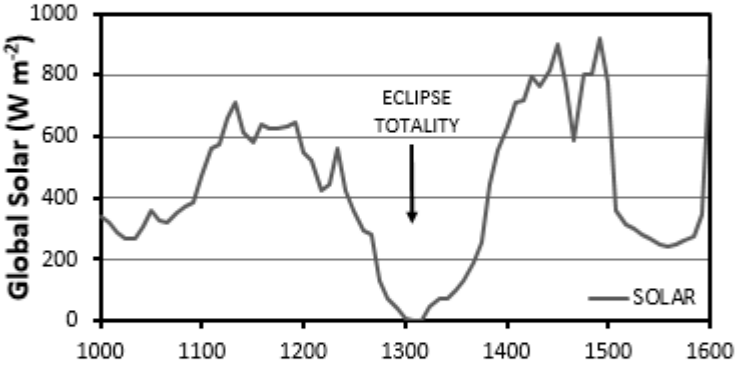


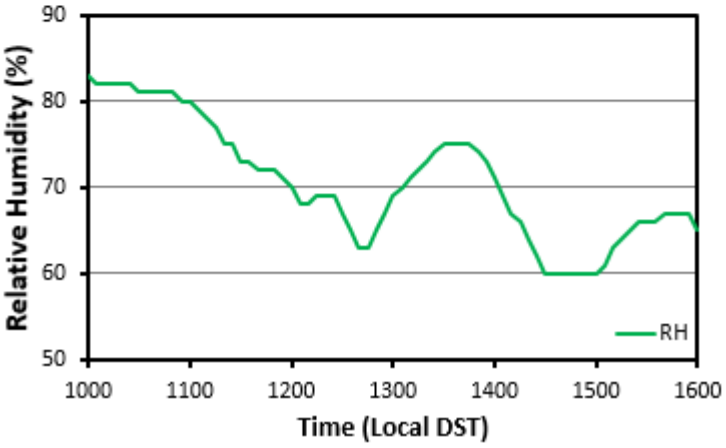
NE Lincoln 11 SW in
Spring Creek Prairie Audubon
Center

Latitude: 40.6954 N
Longitude: 96.8541 W
Elevation: 1372 feet

Duration: 2m 13.3s

Partial eclipse start: 11:36 AM
Total eclipse: 1:01 – 1:04 PM
Partial eclipse end: 2:29 PM
Central Daylight Time





Conditions were variable, with scattered and broken mid-level clouds coming in and out, with winds from the south at 8-10 mph, with only a small decrease at the eclipse time.

Due to the eclipse, air temperature decreased 6.1°F, surface IR temperature decreased 16.2°F, and relative humidity increased 12%.

The Audubon Center houses a great variety of prairie bird species that must have reacted in interesting ways to the sudden onset of night. A national effort was made to record the natural soundscapes of locations before, during, and after totality, and many noted the change in bird activities at this time: http://eclipsesoundscapes.org/.

Lincoln, Nebraska (8 miles ENE)

NE Lincoln 8 ENE in

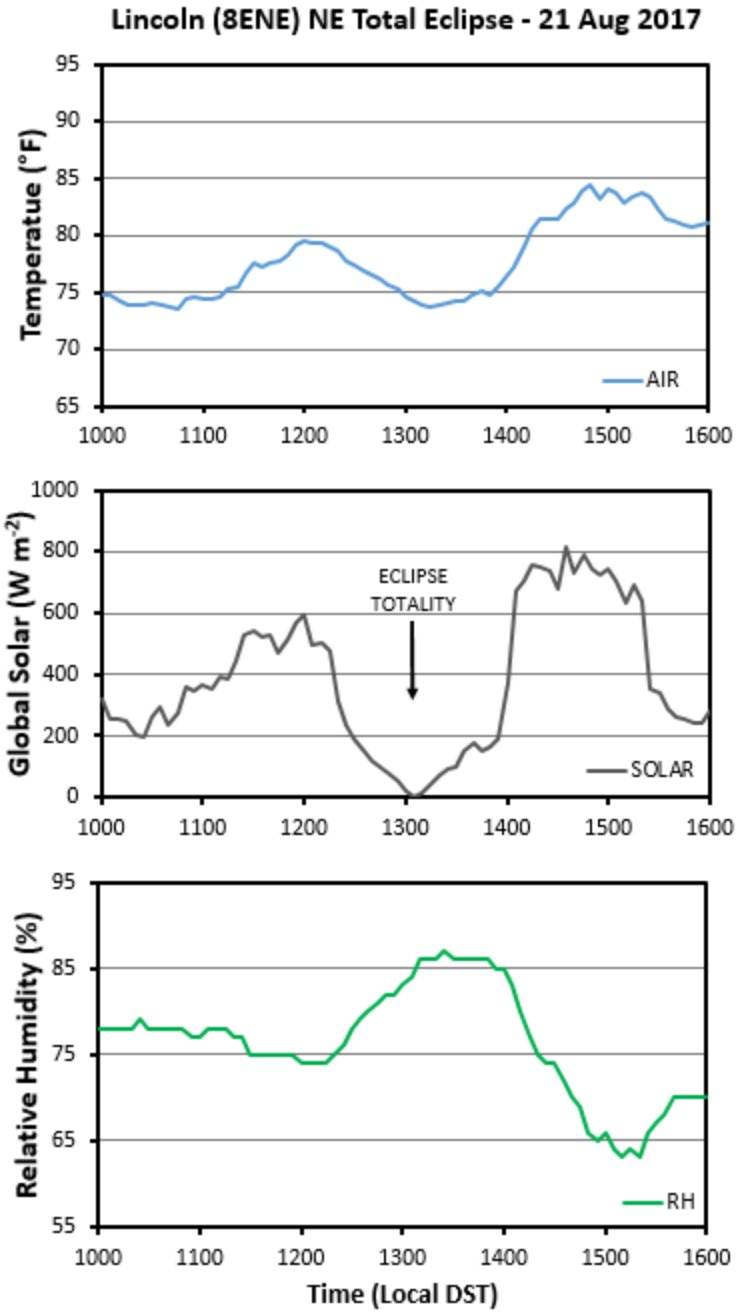
University of Nebraska Prairie Pines

Latitude: 40.8484 N
Longitude: 96.5651 W
Elevation: 1189 feet

Duration: 0m 31.5s

Partial eclipse start: 11:37 AM
Total eclipse: 1:03 – 1:03 PM
Partial eclipse end: 2:29 PM
Central Daylight Time

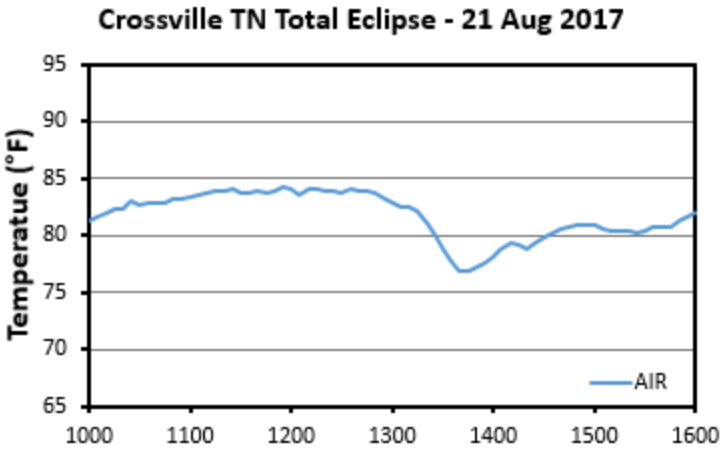
Conditions were variable, with scattered and broken mid-level clouds coming in and out, with winds from the south at 3 mph, with only a small decrease at the eclipse time.



Due to the eclipse, air temperature decreased 5.8°F, surface IR temperature decreased 12.1°F, and relative humidity increased 13%. While in totality for only 31.5 seconds, the climate effects of the eclipse at this location were very similar to those at our twin site across town.

The eclipse occurred on the first day of fall semester classes at the University of Nebraska in Lincoln, and hundreds of free solar viewing glasses were handed out to students, although classes were not technically cancelled. The viewing was quite variable in the area due to clouds.

TN Crossville

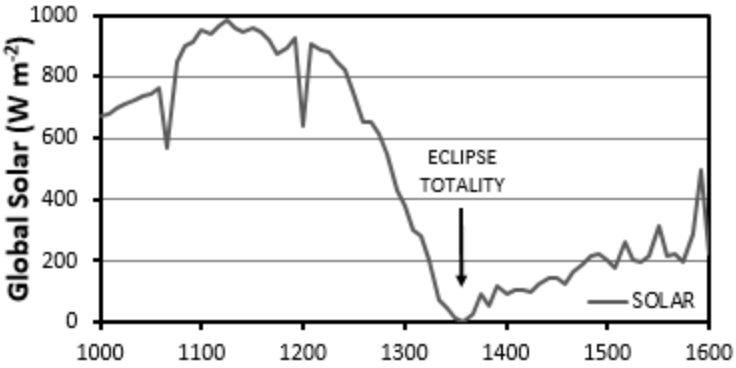


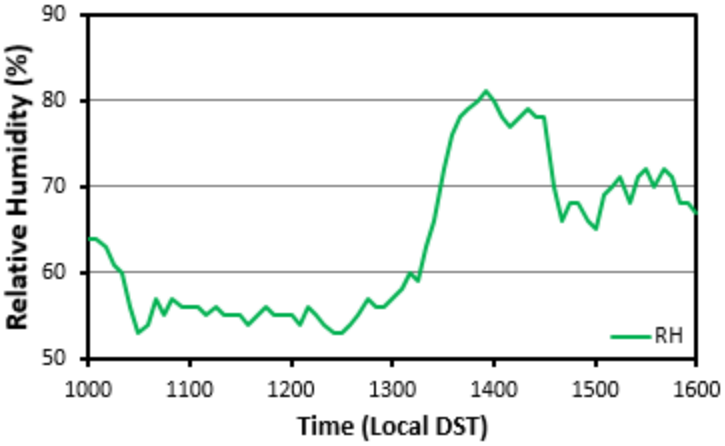
TN Crossville 7 NW
University of Tennessee Plateau
Research and Education Center

Latitude: 36.0138 N
Longitude: 85.1345 W
Elevation: 1913 feet

Duration: 2m 33.2s

Partial eclipse start: 12:02 PM
Total eclipse: 1:30 – 1:33 PM
Partial eclipse end: 2:56 PM
Central Daylight Time



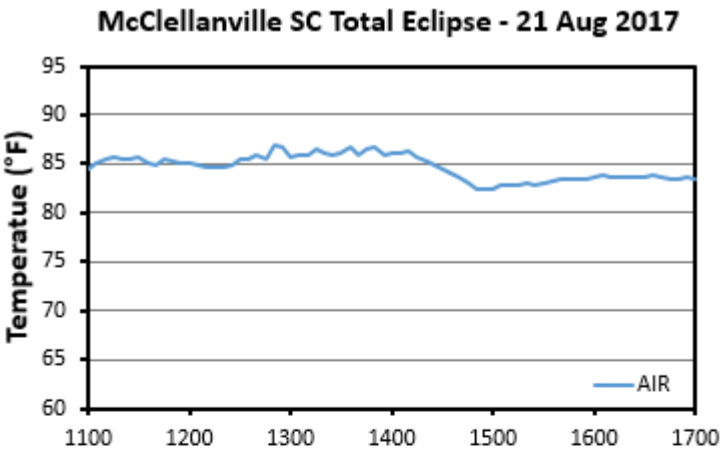


Conditions were only partly cloudy early in the period, but became mostly cloudy during and after the time of totality, with light SW winds becoming calm at eclipse time.

Due to the eclipse, air temperature decreased 7.4°F, surface IR temperature decreased 18.9°F, and relative humidity increased 28%. The large humidity increase was matched by overcast aloft.

Similar eclipse air temperature responses were measured by the NWS in Clarksville (-6°F) and Nashville (-5°F). The only eclipse related fatality noted by the media occurred in nearby Kentucky, where two women standing on a sidewalk watching the eclipse were hit by a car, and one was killed. It is not known if the eclipse affected the driver.

McClellanville, South Carolina

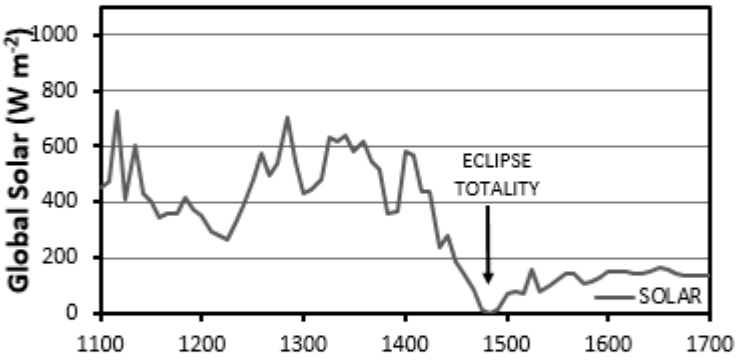


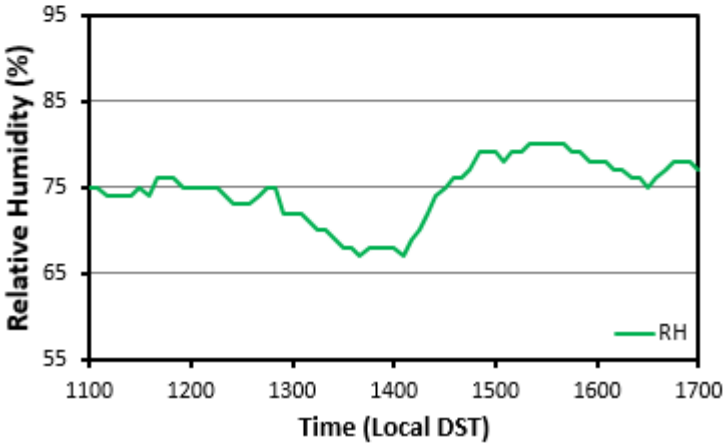
SC McClellanville 7 NE
South Carolina Dept. of Natural Resources Santee Coastal Reserve

Latitude: 33.1532 N
Longitude: 79.3637 W
Elevation: 9 feet

Duration: 2m 28.9s

Partial eclipse start: 1:17 PM
Total eclipse: 2:46 – 2:48 PM
Partial eclipse end: 4:10 PM
Eastern Daylight Time





Conditions were partly cloudy with thunderstorms just inland from the coast along the sea breeze front, with overcast conditions after the eclipse; winds were off the ocean from the southeast at 3 mph.

Due to the eclipse, air temperature decreased 4.3°F, surface IR temperature decreased 14.8°F, and relative humidity increased 13%.

In an interesting celebration of this event, a Royal Caribbean Cruise off the coast but in the path of the totality was organized around the singer Bonnie Tyler singing her 1983 hit “Total Eclipse of the Heart” at the moment of totality.