CRN NEWS

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The Climate Reference Network (CRN) Newsletter Issue number 2 was published over three years ago. Final US CRN deployment will be completed in 2008. When the last newsletter was issued in 2004, there were 51 stations located in 27 states. As of the end of September 2007 there are 106 CRN stations in 43 states. At the completion of the network in 2008, there will be 114 stations in the 48 contiguous States. The CRN will provide the benchmark surface observation for climate monitoring.

In addition to the stations in the contiguous United States, seven CRN stations have been installed in extreme environments: Alaska (4), Hawaii (2), and Canada (1). A CRN temperature sensor suite has also been installed on an Andean glacier in Peru. Future deployments include a station on Mount Kilimanjaro in Africa (2008), a pair of stations at the International Polar Year Climate Super-Observatory in the extreme Arctic environment of Tiksi, Russia (2008- 2009), and up to eight additional Andean glacier stations.

Proper maintenance and operation of the CRN remains the top priority. Routine performance monitoring of the observed data and metadata makes it possible to diagnose the health of a station. The objective is to detect and analyze problems and to repair or replace faulty equipment quickly. Problem notification occurs through computer-based tracking systems to determine and document corrective actions. The quality-assurance process includes hourly automatic computer checks as well as daily inspection of flagged values by engineers and by scientists knowledgeable in instrumentation and meteorology.

CRN Station Charlottesville, Virginia

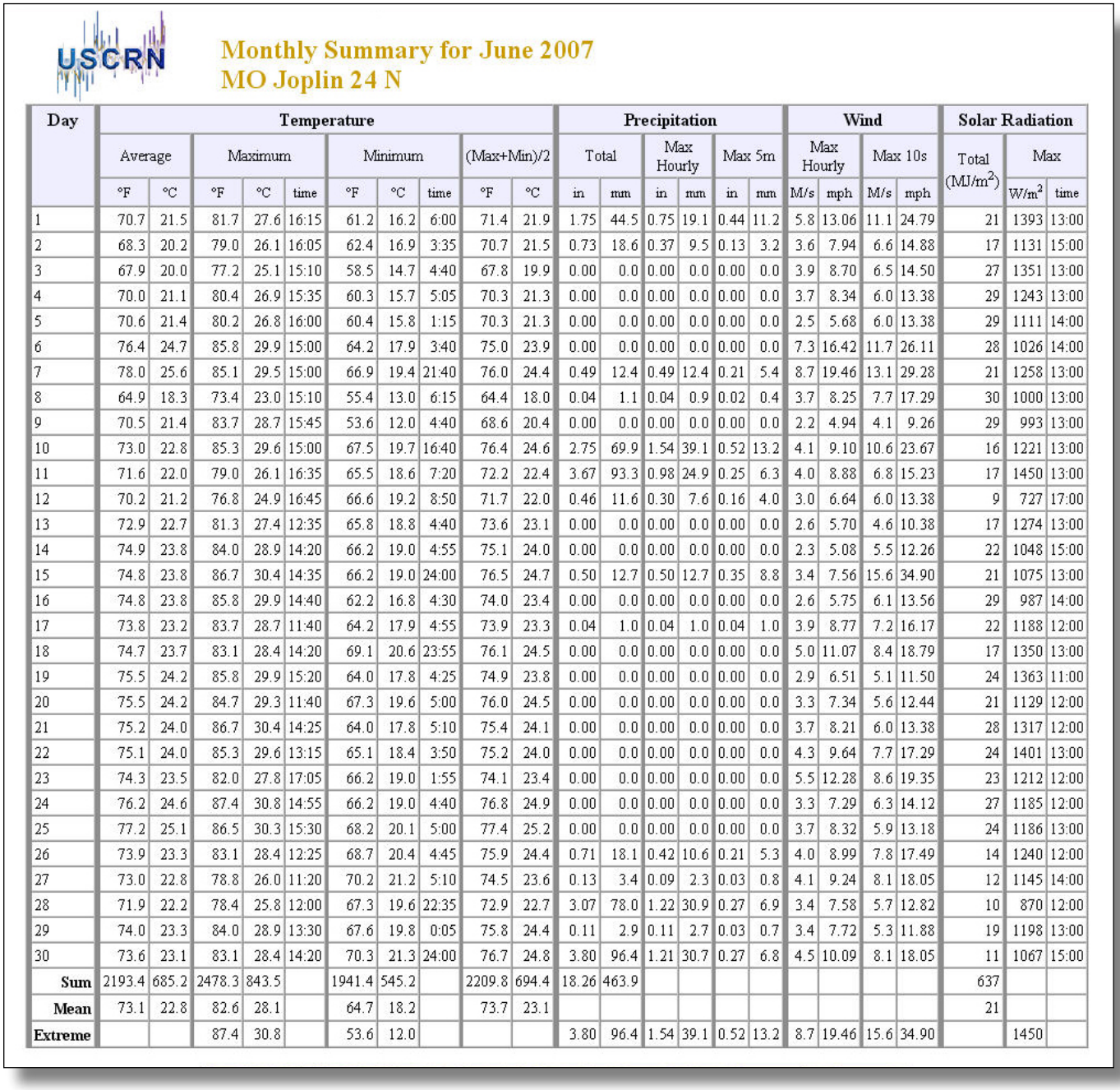
Installed at Thomas Jefferson's Monticello on March 3, 2007.

Testing and Verification

The understanding of the data has improved with experience, and data processing evolves to incorporate that experience. CRN analysis utilizes advantages of redundant sensors, and verification of measurement precision, equipment operation, and sensor robustness began in 2000 at test sites at Sterling, Virginia, Johnstown, Pennsylvania, and Lincoln, Nebraska. CRN testing at Lincoln, Nebraska ended in 2003 and testing at Sterling, Virginia is scheduled to end in 2008. A new precipitation test site is planned for Sioux Falls, South Dakota beginning in 2008. The CRN raingauge was selected as a reference at the World Meteorological Organization International rainfall intensity testing facility being built in Vigna de Valle north of Rome, Italy.

Data

Data accuracy and completeness are primary CRN goals. The average data completeness for the network as a whole is more than 99% with some seasonal variation. Understanding how the climate is changing requires high data completeness and accuracy. CRN data which do not reach the archive through normal transmissions are recovered during a station's annual maintenance visit and more often if needed to meet performance measures. The CRN station's datalogger is equipped to hold several months of data in the event that storms, lightning, animal intrusions, communication outages, power problems, or accidents prevent normal hourly data transmission. About 75% of the stations are equipped to store a year of data locally, and the remaining stations are in the process of being upgraded.



Monthly Summary for June 2007
MO Joplin 24 N

Day	Temperature										Precipitation						Wind				Solar Radiation		
	Average		Maximum			Minimum			(Max+Min)/2		Total		Max Hourly		Max 5m		Max Hourly		Max 10s		Total (MJ/m^2)	Max	
	°F	°C	°F	°C	time	°F	°C	time	°F	°C	in	mm	in	mm	in	mm	M/s	mph	M/s	mph		W/m^2	time
1	70.7	21.5	81.7	27.6	16:15	61.2	16.2	6:00	71.4	21.9	1.75	44.5	0.75	19.1	0.44	11.2	5.8	13.06	11.1	24.79	21	1393	13:00
2	68.3	20.2	79.0	26.1	16:05	62.4	16.9	3:35	70.7	21.5	0.73	18.6	0.37	9.5	0.13	3.2	3.6	7.94	6.6	14.88	17	1131	15:00
3	67.9	20.0	77.2	25.1	15:10	58.5	14.7	4:40	67.8	19.9	0.00	0.0	0.00	0.0	0.00	0.0	3.9	8.70	6.5	14.50	27	1351	13:00
4	70.0	21.1	80.4	26.9	15:35	60.3	15.7	5:05	70.3	21.3	0.00	0.0	0.00	0.0	0.00	0.0	3.7	8.34	6.0	13.38	29	1243	13:00
5	70.6	21.4	80.2	26.8	16:00	60.4	15.8	1:15	70.3	21.3	0.00	0.0	0.00	0.0	0.00	0.0	2.5	5.68	6.0	13.38	29	1111	14:00
6	76.4	24.7	85.8	29.9	15:00	64.2	17.9	3:40	75.0	23.9	0.00	0.0	0.00	0.0	0.00	0.0	7.3	16.42	11.7	26.11	28	1026	14:00
7	78.0	25.6	85.1	29.5	15:00	66.9	19.4	21:40	76.0	24.4	0.49	12.4	0.49	12.4	0.21	5.4	8.7	19.46	13.1	29.28	21	1258	13:00
8	64.9	18.3	73.4	23.0	15:10	55.4	13.0	6:15	64.4	18.0	0.04	1.1	0.04	0.9	0.02	0.4	3.7	8.25	7.7	17.29	30	1000	13:00
9	70.5	21.4	83.7	28.7	15:45	53.6	12.0	4:40	68.6	20.4	0.00	0.0	0.00	0.0	0.00	0.0	2.2	4.94	4.1	9.26	29	993	13:00
10	73.0	22.8	85.3	29.6	15:00	67.5	19.7	16:40	76.4	24.6	2.75	69.9	1.54	39.1	0.52	13.2	4.1	9.10	10.6	23.67	16	1221	13:00
11	71.6	22.0	79.0	26.1	16:35	65.5	18.6	7:20	72.2	22.4	3.67	93.3	0.98	24.9	0.25	6.3	4.0	8.88	6.8	15.23	17	1450	13:00
12	70.2	21.2	76.8	24.9	16:45	66.6	19.2	8:50	71.7	22.0	0.46	11.6	0.30	7.6	0.16	4.0	3.0	6.64	6.0	13.38	9	727	17:00
13	72.9	22.7	81.3	27.4	12:35	65.8	18.8	4:40	73.6	23.1	0.00	0.0	0.00	0.0	0.00	0.0	2.6	5.70	4.6	10.38	17	1274	13:00
14	74.9	23.8	84.0	28.9	14:20	66.2	19.0	4:55	75.1	24.0	0.00	0.0	0.00	0.0	0.00	0.0	2.3	5.08	5.5	12.26	22	1048	15:00
15	74.8	23.8	86.7	30.4	14:35	66.2	19.0	24:00	76.5	24.7	0.50	12.7	0.50	12.7	0.35	8.8	3.4	7.56	15.6	34.90	21	1075	13:00
16	74.8	23.8	85.8	29.9	14:40	62.2	16.8	4:30	74.0	23.4	0.00	0.0	0.00	0.0	0.00	0.0	2.6	5.75	6.1	13.56	29	987	14:00
17	73.8	23.2	83.7	28.7	11:40	64.2	17.9	4:55	73.9	23.3	0.04	1.0	0.04	1.0	0.04	1.0	3.9	8.77	7.2	16.17	22	1188	12:00
18	74.7	23.7	83.1	28.4	14:20	69.1	20.6	23:55	76.1	24.5	0.00	0.0	0.00	0.0	0.00	0.0	5.0	11.07	8.4	18.79	17	1350	13:00
19	75.5	24.2	85.8	29.9	15:20	64.0	17.8	4:25	74.9	23.8	0.00	0.0	0.00	0.0	0.00	0.0	2.9	6.51	5.1	11.50	24	1363	11:00
20	75.5	24.2	84.7	29.3	11:40	67.3	19.6	5:00	76.0	24.5	0.00	0.0	0.00	0.0	0.00	0.0	3.3	7.34	5.6	12.44	21	1129	12:00
21	75.2	24.0	86.7	30.4	14:25	64.0	17.8	5:10	75.4	24.1	0.00	0.0	0.00	0.0	0.00	0.0	3.7	8.21	6.0	13.38	28	1317	12:00
22	75.1	24.0	85.3	29.6	13:15	65.1	18.4	3:50	75.2	24.0	0.00	0.0	0.00	0.0	0.00	0.0	4.3	9.64	7.7	17.29	24	1401	13:00
23	74.3	23.5	82.0	27.8	17:05	66.2	19.0	1:55	74.1	23.4	0.00	0.0	0.00	0.0	0.00	0.0	5.5	12.28	8.6	19.35	23	1212	12:00
24	76.2	24.6	87.4	30.8	14:55	66.2	19.0	4:40	76.8	24.9	0.00	0.0	0.00	0.0	0.00	0.0	3.3	7.29	6.3	14.12	27	1185	12:00
25	77.2	25.1	86.5	30.3	15:30	68.2	20.1	5:00	77.4	25.2	0.00	0.0	0.00	0.0	0.00	0.0	3.7	8.32	5.9	13.18	24	1186	13:00
26	73.9	23.3	83.1	28.4	12:25	68.7	20.4	4:45	75.9	24.4	0.71	18.1	0.42	10.6	0.21	5.3	4.0	8.99	7.8	17.49	14	1240	12:00
27	73.0	22.8	78.8	26.0	11:20	70.2	21.2	5:10	74.5	23.6	0.13	3.4	0.09	2.3	0.03	0.8	4.1	9.24	8.1	18.05	12	1145	14:00
28	71.9	22.2	78.4	25.8	12:00	67.3	19.6	22:35	72.9	22.7	3.07	78.0	1.22	30.9	0.27	6.9	3.4	7.58	5.7	12.82	10	870	12:00
29	74.0	23.3	84.0	28.9	13:30	67.6	19.8	0:05	75.8	24.4	0.11	2.9	0.11	2.7	0.03	0.7	3.4	7.72	5.3	11.88	19	1198	13:00
30	73.6	23.1	83.1	28.4	14:20	70.3	21.3	24:00	76.7	24.8	3.80	96.4	1.21	30.7	0.27	6.8	4.5	10.09	8.1	18.05	11	1067	15:00
Sum	2193.4	685.2	2478.3	843.5		1941.4	545.2		2209.8	694.4	18.26	463.9									637		
Mean	73.1	22.8	82.6	28.1		64.7	18.2		73.7	23.1											21		
Extreme			87.4	30.8		53.6	12.0				3.80	96.4	1.54	39.1	0.52	13.2	8.7	19.46	15.6	34.90		1450	

CRN's Joplin, Missouri station during the June floods affecting Oklahoma, Kansas, and Missouri

CRN data are used by government agencies and researchers to better understand climate change, for intercomparison with satellite information, and to serve as a baseline or reference by other networks. Examples include:

- The state of Alabama modernizing Historical Climatology Network stations
- The National Science Foundation's National Ecological Observatory Network
- The Meteorological Services of Canada co-location at the Canadian National Meteorological Testbed in Egbert, Ontario, with the Canadian Reference Climate Station (RCS) and at the USGS EROS Data Center in Sioux Falls, South Dakota
- CRN surface temperature measurements can be used to validate satellite surface temperatures
- Extremes are measured accurately:

Max surface temperature	06/24/2006	CA Stovepipe Wells	160ºF
Max air temperature	07/05/2007	CA Stovepipe Wells	126ºF
Min air temperature	02/03/2006	AK Barrow	-56ºF
Max 5-minute precipitation	07/07/2006 07/25/2007	FL Titusville WY Lander	0.73 in
Max 60-minute precipitation	07/07/2006	FL Titusville	3.77 in
Max 30-day precipitation	11/01/2006-11/30/2006	WA Quinault	51.35 in

CRN redundant temperature sensors

Site Host Partnerships

CRN has experienced some maintenance problems: equipment failures, power outages, and station modification by polar bears, elk, and wayward lawnmowers. Daily monitoring is used in evaluating potential problems and site hosts are key to cost-effectively maintaining the data completeness and quality necessary for climate analysis. For example, a lawn mower knocked the support arm off of a tower and the problem was correctly analyzed remotely using supplementary measurements and the site host's help. The long-term success of the CRN is dependent on the commitment and cooperation of the site hosts.

CRN site hosts include:

- Universities and agricultural research facilities
- Wildlife foundations, refuges, and reserves
- Arboreta
- Indian reservations
- State Parks and conservation areas
- National Park Service
- U.S. Forest Service
- U.S. Fish and Wildlife Service
- Department of Agriculture
- National Aeronautics and Space Administration
- U.S. Geological Survey
- Department of Energy
- National Oceanic and Atmospheric Administration

The CRN site hosts and partners are vital to the success of this program.

USCRN Network Upon Completion in 2008

(114 operational stations at 107 locations)

Field Measurements

It will take several years before an individual CRN station's data can be used in identifying national trends, but CRN's instrument suite and five-minute data have already allowed the identification of some interesting micro meteorological behavior. One example is the highly variable nighttime air temperatures observed at many sites.

CRN regularly considers new measurement technologies such as those currently being evaluated for rainfall. Should a new technology be selected, its implementation would include comparison of the new intrument's observations with the old instrument's observations to avoid introducing biases into the data.

New to CRN in 2008, soil moisture and soil temperature measurements at the agricultural root zone will be added along with atmospheric relative humidity measurements. These measurements will provide critical information on the water cycle and for drought and frost assessments.

Soil moisture and temperature measurement instruments

The USA National Phenology Network (USA-NPN): A Complementary Network

CRN Station Montrose, Colorado

CRN monitors temperature and precipitation which are determinants in the lifecycle of biological systems. Observations and data on biological systems are more difficult to automate than temperature and precipitation. The USA-NPN has observers who document and report the date of natural events that are climate-connected, such as flower-blooming times, leaf emergence, and other periodic natural events (insect hatchings, return of migratory birds, fruit production). The timing of these events demonstrates local changes and variability in weather and climate. Phenology reporting networks have been in existence for decades around the world; the goal of the USA-NPN is to coordinate existing networks in the United States through the USA-NPN National Coordinating Office, and to foster a better understanding among United States scientists and citizens of how plants and animals are adapting to changing environments. If you or your group wishes to participate, the USA-NPN will provide guidance to help you select and observe appropriate species at your location. The program is identifying a select group of widespread plants to facilitate comparison among sites, as well as a broader set of plants especially suited to each region, all within broad functionally relevant groups (allergens, invasives, crops, hardwoods, conifers). Volunteers are being sought to participate (starting early 2008) by collecting phenological data from one or several plants at any number of sites. Opportunities for education and outreach to citizens, through active participation in data collection and entry, are facilitated by Project Budburst, see http://www.budburst.org. For more information about the USA-NPN, see http://www.usanpn.org or call (520) 626-4696.

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