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December 10, 2002
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Climate Reference Network (CRN)

Demonstration Phase Evaluation Plan

December 2002

Prepared by:

U.S. Department of Commerce
National Oceanic and Atmospheric Administration (NOAA)
National Environmental Satellite, Data, and Information Service (NESDIS)

Climate Reference Network (CRN)

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COMMENTS: This DCN 0 package consists of the initial NOAA/NESDIS baseline publication of this document.

NOTE:

*EXAMPLES: *"Insert change pages 6.2-6 through 6.2-9 following page 6.2-5"*
"Replace pages 3.4-1 through 3.4-10 with change pages 3.4-1 through 3.4-10b"
"Replace pages 4.5-24 with change page 4.5-24; delete pages 4.5-25 through 4.5-30"

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Preface

This document comprises the National Oceanic and Atmospheric Administration (NOAA)/ National Environmental Satellite, Data, and Information Service (NESDIS) initial baseline publication of the *Climate Reference Network (CRN) Demonstration Phase Evaluation Plan* (version DCN 0, December 10, 2002, publication). The document number is NOAA-CRN/OSD-2002-0003R0UD0.

The purpose of this demonstration phase evaluation is to verify that the United States Climate Reference Network (USCRN) Program is positioned to proceed with installation and operation of the balance of the nationally deployed systems. The demonstration phase evaluation will support validating strategies and approaches recommended prior to the incremental nationwide implementation.

The publication of this baseline document closes the following Document Configuration Change Request:

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NOAA/NESDIS acknowledges the efforts of the NOAA/NESDIS National Climatic Data Center (NCDC) and Short and Associates, Inc., for their preparation of the material in this document.

Future updates and revisions to this document will be produced and controlled by NOAA/NESDIS.

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Acronyms and Abbreviations

ATDD	Atmospheric Turbulence and Diffusion Division
ATS	Anomaly Tracking System
bps	bits per second
CRN	Climate Reference Network
CSC	Computer Sciences Corporation
DCN	Document Change Notice
DCP	Data Collection Platform
DR	Deficiency Report
DT&E	Demonstration Test and Evaluation
FRD	Functional Requirements Document
GPS	Global Positioning System
GOES	Geostationary Operational Environmental Satellite
HDR	High Data Rate
ID	identifier
mm	millimeter(s)
MTBF	Mean Time Between Failure
MTTR	Mean Time To Restore
NCAR	National Center for Atmospheric Research
NCDC	National Climatic Data Center
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OOS	Office of Operational Services
OSD	Office of Systems Development
QC	Quality Control
RCC	Regional Climate Center
S & A	Short and Associates
SRDC	Sterline Research and Development Center
USCRN	U.S. Climate Reference Network
VDR	Version Description Record
WMO	World Meteorological Organization

Section 1. Purpose

The purpose of the demonstration phase evaluation is to verify that the United States Climate Reference Network (USCRN) Program is positioned to proceed with installation and operation of the balance of the nationally deployed systems. Since the demonstration phase is, in essence, the USCRN implementation program on a smaller scale, it offers to the opportunity to minimize risk in the final system implementation by**:** 1) providing early exposure to data and products derived from USCRN prototype systems to the user community; 2) providing prototype systems in different climatic regimes; and 3) gaining useful experience with the "end-to-end" activities including performance of site surveys, site acquisition, installation, operation, maintenance, and communications management; and 4) providing data analysis of existing deployed sites to assess the validity of current instrumentation for final configuration and developing a life cycle model. The demonstration phase evaluation will support validating strategies and approaches recommended prior to the incremental nationwide implementation.

The primary foci of the United States Climate Reference Network are to do the following:

1. Develop, implement, and maintain a high quality climate (meteorological) measurement system that is well documented in terms of data quality and accuracy, metadata (site characteristics and instrument changes), system and instrument biases, and representativeness of the meteorological parameters being measured.
2. Determine the optimum U.S. geographical spatial distribution that captures the major representative climate regions of the U.S.
3. Provide near-real-time quality control and dissemination of all USCRN measured parameters.
    - Air temperature
    - Precipitation (liquid and frozen)
    - Solar radiation (solar energy at the surface of the earth)
    - Wind speed
    - Surface temperature (radiated ground temperature)
4. Invite the science community to review, analyze, and use the USCRN data in a broad range of activities that help define past climate trends and forecast future trends and potential impacts of these trends. Promote scientific research based on USCRN data that can be used with a high degree of confidence by government and business decision policy makers.
5. Maintain an ongoing and robust research program that examines new and existing instruments and techniques to better measure meteorological parameters and to ensure data continuity and quality are maintained when new instruments are deployed.

1.1 Scope

The USCRN Demonstration Phase Evaluation includes review of the installation of and the procedures for operation of the initial 40 USCRN systems being sited throughout the United States under different climate regimes. The USCRN system is now in pre-operational use to provide early user feedback, identify network and dataset transfer functions, calculate inter-network and paired-site transfer functions, begin early applied science studies, and undertake sensor suite tuning. The specific purposes of the USCRN Demonstration Phase are to do the following:

- Provide initial user system exposure
- Aid in validating user needs (e.g., optimizing web presentation and other outreach functions)
- Support analysis of performance measures related to site selection**,** and acquisition,
- Develop end-to-end communications data flow, data ingest, and quality control procedures within the National Climatic Data Center (NCDC)
- Evaluate sensor performance in different and harsh operating environments
- Provide initial system operations and maintenance experience
- Establish data integrity and science applicability (NCDC)
- Develop archival procedures and data product formats

1.2 Evaluation Methodology

The USCRN evaluation will be managed by OSD working with NCDC and ATDD personnel. Specific activities will cover all aspects of the USCRN Program and will focus on evaluation of field sensors; central processing capabilities at NCDC; site selection and installation activities; operations; quality control; communications capacity**,** modes and alternatives**;** maintenance; and configuration management. An important aspect is also assuring the cost-effective expandability and supportability of the full USCRN nationwide program for the long term.

The formal evaluation will cover designated deployed and to-be installed field sites during the period January through June 2003. Performance of the USCRN system will be measured against requirements established in the USCRN Functional Requirements Document – November 2002. The specific number of future field sites will be determined based on a readiness review planned for December 2002. Monthly assessment reports will be collected from designated evaluation team members in the various evaluation areas. Interim and final reports of collected performance evaluations (primarily quantitative but in some areas qualitative), with analysis and recommendations for national deployment will be documented. Whenever appropriate, the reports will include recommendations for corrective actions or alternative approaches required to support and sustain the installation of the remaining USCRN field units presently scheduled to begin in October 2003. The principle milestones are indicated in Figure 1 (Demonstration Schedule).

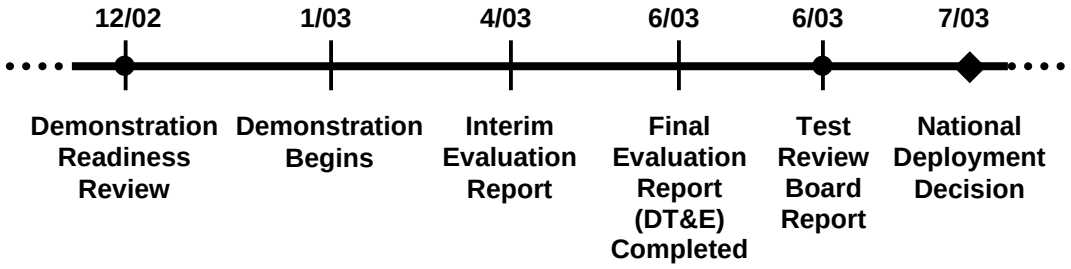

Figure 1-1. Demonstration Schedule

The major steps are the following:

- Demonstration Readiness Review – The formal review to establish the actual evaluation baseline, (i.e., number of sites, deficiencies if any). The review will establish the readiness to proceed into the evaluation activities.
- Start Evaluation
- Interim Evaluation Report – The report will contain material gathered through March on hardware availability (maintenance); precipitation and temperature sensor accuracy; QC activities; site selection, acquisition and installation activities; and communications adequacy and will address questions raised in evaluation areas listed below.
- Final Evaluation Report – The final report will address the same issues as above and will provide recommendations for continued deployment of USCRN sites and subsequent data processing.
- Test Review Board Report – An independent review by the USCRN Test Review Board (see Appendix B) of test and evaluation methodology and findings, the basis of the findings and identified risks, and proposed corrective actions, etc., with recommendation to the USCRN Executive Board for the national deployment decision.
- National Deployment Decision – The decision by the Executive Board on the course of action to follow regarding the incremental out-year deployment.

1.3 Related Work in Progress

Although the demonstration evaluation is an important activity of the USCRN program, a number of other significant tasks will be in progress before and during and after the evaluation period and the result of these activities will be considered along with the final evaluation findings. Wherever applicable, results of these other activities may be introduced into the demonstration and its subsequent evaluation in a documented manner. Examples of these activities are the following:

- Precipitation gauge qualification testing (Winter Test)
- Communications studies and analyses
- Windscreen study
- Three transducer analysis from the initial windscreen/precipitation gauge study conducted at the National Center for Atmospheric Research (NCAR)
- Any additional sensor research that may be applicable to this evaluation
- Initial maintenance analysis

Section 2. Technical Evaluations

To verify compliance with the USCRN Functional Requirements Document and the "Ten Climate Monitoring Principles" developed by Karl et al. (1995, "Critical Issues for Climate Monitoring"). The following functions, activities, and procedures will be evaluated. Evaluation criteria are listed below.

2.1 USCRN Field Equipment

Evaluation of the USCRN system's individual sensor, processing, and communications components is intended to satisfy Climate Monitoring Principles #3 – Metadata documentation will be accessable, #4 Data Quality and Continuity, and #8 Climate Requirements**.**

2.1.1 Temperature Sensors

The temperature sensors used by the USCRN are platinum resistance thermometers manufactured by Thermometrics Corporation. Three sensors are used at each site to provide redundancy and internal consistency checks and assure accurate temperature readings

Temperature sensor performance must meet requirements defined in FRD section 3.2.4.

The accuracy and reliability of the temperature sensors is described below.

Accuracy

1. Accuracy is determined by developing a transfer function between the fundamental transducer output and converting to engineering units using a NIST traceable temperature calibration system in the USCRN Calibration Laboratory located at the Atmospheric Turbulence and Diffusion Division in Oak Ridge, TN. The transfer function will be developed using calibration points in 2 degree increments from -60 deg C to -50 deg C and +50 deg C to + 60 deg C and in 5 degree increments for -50 deg C to +50 deg C. All temperature sensors utilized in the CRN Network will be tested for the aforementioned accuracy.
    - Range -60 to +60C
    - Resolution .03C
    - Accuracy ± 0.3 C for -50C to +50C and ± 0.06C for -60C to -50C and +50C to +60C.
2. Time Constant: Must be a value short enough that the time required to attain 5 time constants in air does not exceed the minimum averaging time used in any scalar computation.
3. Sampling Rate: 2 seconds, the higher the better since averaging eliminates random measurement errors and produces average values more accurate than measured values.

4. Computations:
    a. 2 second samples averaged to 5 minutes
    b. The 12 five-minute averages are used to compute hourly average and standard deviation
    c. Find maximum and minimum value during the hour from the 12 five minute averages
5. Storage:
    a. Hourly averages
    b. Standard deviation for the hour
    c. Minimum 5 minute value and its time
    d. Maximum 5 minute value and its time
    e. Last 5-minute average from that hour

Reliability

Using the Anomaly Tracking System or similar tool, provide Mean Time Between Failure (MTBF) and Mean Time To Restore (MTTR) statistics during six month test period to verify site temperature sensor availability as defined in the USCRN Functional Requirements Document (FRD) Section 6.1.1, i.e., 95% of data stored at NCDC within one hour and 99.9 % with in one month.

2.1.2 Precipitation Sensors

USCRN precipitation gauges provided by Geonor (model T-200) are weighing-type gauges which incorporate three independent load sensors which provide redundancy and are intended to assure continuous operation at remote sites.

An important component of the overall evaluation, the Winter Precipitation Gauge Test will begin in October 2002 and conclude in March 2003. The testing will be conducted at the NWS's Sterling, VA (Sterling Research and Development Center (SRDC) and Johnstown, PA test facilities. Test results will be incorporated into the overall evaluation report. The test requirements must be consistent with the requirements contained in the USCRN Functional Requirements Document Section 3.2.5.

Test data analysis including comparative performance between Geonor and OTT precipitation gauges as well as assessment of readiness of both gauges must be included. For precipitation amount sensors, these tests will require candidate sensors to undergo chamber and calibration testing to meet USCRN needs, plus extended field testing. Because of the varied types of precipitation (liquid, freezing, solid, and mixed), the effect of ambient wind speed on gauge catch, and the probability of having to heat the precipitation sensors, tests must be conducted at a number of varied climates sites through the U.S. To assess these data, clinical observations must be taken, and sensor data must be available at the observing site in real time

Precipitation gauge performance must meet requirements defined on FRD Section 3.2.5, which can be found in Table 1. Summary of Precipitation Sensor Specifications.

Table 1. Summary of Precipitation Sensor Specifications

Attribute	Value
Accuracy	± 0.25mm or ± 2% of the reported values, whichever is greater
Minimum Capacity	600mm
Minimum Required Precipitation Measurement Rate	30 mm per minute
Minimum Reporting Resolution	0.25 mm
Reported Values for Each Sensor	Precipitation accumulation value for each 15 minute period

Reliability

Using the Anomaly Tracking System or similar tool, provide MTBF and MTTR statistics during six month test period to verify site precipitation gauge sensor availability as defined in FRD Section 6.1.1, i.e., 95% of data stored at NCDC within one hour and 99.9% within one month.

Products and Schedule

The products and schedule for the precipitation sensors are listed below.

- Winter Test Plan for Precipitation Gauges 10/02
- Winter Test Plan for Wind Screens 10/02
- Test Analysis, monthly reports and reviews, starting 10/02
- Intermediate test reports Monthly
- Test Report 4/03

Sensor Evaluation Team Members

The sensor evaluation team members are listed below.

- Jim Bradley (Lead) (OSD/S&A)
- Bruce Baker (NCDC)
- Tilden Myers (ATDD)
- Mark Hall (ATDD)
- Doug Gifford (NWS OOS)
- Richard Lewis (NWS OSS)
- Nolan Miller (OSD/S&A)

2.1.3 Site Data Processor (Data Logger)

The data logger, manufactured by Campbell Scientific, (Model CR23X) provides compatibility with all USCRN sensors, the GOES data transmitter, and cell phone or land line modems.

The team will verify that all FRD requirements from Section 3.3.2-9 and Section 4.2 covering data processing, power failure recovery, local (perhaps remote) programming, site monitoring, data storage and retrieval are satisfied and remain functional over the six month period.

Reliability

Using Anomaly Tracking System or similar tool, provide MTBF and MTTR statistics during six month test period to verify site data logger availability defined in FRD Section 6.1.1, i.e., 95% of data stored at NCDC within one hour and 99.9% within one month.

2.1.4 Site Communications Equipment

The team will verify that the transmitter:

a. Complies with High Data Rate (HDR) specifications
b. Is NESDIS certified for low and high data rates including 100, 300, and 1200 bps
c. Contains a Global Positioning System (GPS) controlled clock
d. Diagnostic and status information can be sampled by the data logger and transmitted as part of the data stream
e. Contains non-volatile setups configured with Windows-based software

Reliability

Using the Anomaly Tracking System or similar tool, provide MTBF and MTTR statistics during six month test period to verify site communications equipment availability as defined in FRD section 6.1.1, i.e., 95% of data stored at NCDC within one hour and 99.9% within one month.

2.2 Central Facility Equipment – Operational Data Ingest and Quality Control

Evaluation of the USCRN system's central processing equipment will satisfy Climate Monitoring Principles #3 – Metadata, #4 – Data Quality and Continuity, and #9 – Continuity of Purpose.

The team will establish and verify technical requirements for data ingest and quality control functions to include all requirements defined in FRD Sections 5.2-4. These tests which cover ingest, processing, quality control, storage, data access, and the initiation of maintenance actions will verify these activities are initialized and remain functional over the six month test period.

Reliability

Using the Anomaly Tracking System or similar tool, provide MTBF and MTTR statistics during six month test period to verify central processing equipment availability as defined in FRD Section 6.1.1, i.e., 95% of data stored at NCDC within one hour and accessible by the user community with an operational availability of 95% (FRD Section 6.2).

Evaluation Topics

The evaluation topics for Central Facility Equipment – Operational Data Ingest and Quality Control section can be found in the following list.

1. Is there a process to commission a site to ensure that it is fully functional, maintainable, and documented?
2. What is the acceptable overall and site availability? What is considered acceptable data loss?
3. Are fault recognition standards defined and documented?
4. Are quality control procedures and standards defined and documented?
5. What event tracking mechanism(s) is/are used?
6. How are faults corrected?
7. Are fault correction procedures documented?
8. Are resources sufficient to expand coverage for national deployment?

Products and Schedule

The products and schedule for Central Facility Equipment – Operational Data Ingest and Quality Control are listed below.

- Configuration Management system for QC place 10/02
- Hardware Performance tracking system in place 10/02
- Prototype performance data, monthly reports 10/02
- Lessons learned report on ingest and QC 04/03

Operations and Quality Control Team Members

The operations and quality control team members for Central Facility Equipment – Operational Data Ingest and Quality Control are listed below.

- Debra Braun (Lead) (NCDC)
- Jim Bradley (OSD/S&A)
- Ed Hiner (OSD/S&A)
- Grant Goodge (NCDC)
- Ed May (OSD/S&A)
- Bruce Baker (NCDC)

Section 3. Documentation/Configuration Management

To verify that further deployment of USCRN equipment and subsequent management of the USCRN system is sustainable, numerous activities, from documenting site system configuration to maintaining site metadata, must be thoroughly documented. The experience gained during the deployment of the first 40 USCRN field systems and the establishment of the central processing facility must be documented such that site acquisition and installation standards are established and repeatable, site and central processing algorithms are defined, and site metadata is recorded and maintained under strict configuration management standards (Climate Monitoring Principle #3). Documentation of the policies, procedures, and standards for the following evaluation areas must be developed and reviewed by appropriate team members such that satisfactory standards are achieved and documented for the user community.

The Documentation/Configuration Management Team will establish standards and procedures for maintenance of all site level and system level documentation, system changes, and site metadata.

Evaluation Topics

The evaluation topics for documentation/configuration management are listed below.

1. Are configuration management standards and procedures defined and documented?
2. Is there a repository for documentation under configuration management?
3. Does the user community have access to the documentation?
4. Are there sufficient resources available to support national deployment?

Products and Schedule

The products and schedule for documentation/configuration management are listed below.

- CM and Deficiency Report (DR) systems in operation 10/02
- Prototype performance data, monthly reports (NCDC) starting 10/02
- Maintain site metadata documentation 10/03

Documentation and Configuration Management Team Members

The operations and quality control team members for documentation/configuration management are listed below.

- Robert Embleton (Lead) (OSD/S&A)
- Debra Braun (NCDC)
- John Hughes (NCDC)
- Tilden Meyers (ATDD)
- Dave Easterling (NCDC)
- Liz Smith (OSD/CSC)

Section 4. Site Selection

The Team's initial responsibility is to organize all stages of the site acquisition process from the adoption of Network Requirements (e.g., number of sites, geographic distribution) to the formal completion of Site Lease Agreements, in order to meet site readiness for USCRN system installation.

Important lessons learned during site acquisition activities (i.e., locating a site. site survey, licensing) will be documented and reviewed by site acquisition participants (NCDC, RCCs) and OSD. In accordance with the Ten Climate Monitoring Principles (Karl et al., 1995) – item #3 Metadata and #8 Climate Requirements, documentation must provide assurance that the following topics are defined, recorded and maintained such that; 1) site selection procedures are accepted by the climate community and 2) the procedures are repeatable.

Evaluation Topics

The evaluation topics for site selection are listed below.

1. Are site selection standards considered complete yet allow practical regional and field flexibility?
2. Do hosts understand their responsibilities over the duration of the USCRN activity.
3. Is there a repository for documentation of site surveys, acquisition material, and environmental assessments?
4. Do site locations conform to the spatial density study contained in the USCRN Network Plan?
5. Do we have sufficient resources (people and funding) to proceed with deployment of remaining systems?

Products and Schedule

The products and schedule for site selection are listed below.

- Approved Network (Site Location) Plan 11/02
- Approved USCRN Site Acquisition Manual 10/30/02
- Approved USCRN Site Information Handbook 10/30/02

Team Members

The team members for site selection are listed below.

- Mike Helfert (Lead) (NCDC)
- Ed May (OSD/S&A)
- Mike Changery (NCDC)
- Dave Easterling (NCDC) (Network Requirements)
- John Hughes (NCDC)
- RCCs (as appropriate)
- Hal Bogin (OSD/S&A)
- Bruce Baker (NCDC)
- NWS regions (later)

4.1 Site Installation

The demonstration phase will reduce risk with the final system implementation by 1) providing early exposure of quasi-operational prototype systems to the user community, and 2) operating prototype systems in different climatic regimes as sensor test beds. This phase will support proving strategies and approaches prior to the nationwide implementation, (e.g., communications, site selection, site survey, quality control monitoring). Site implementation will be conducted by ATDD, in coordination with NCDC and OSD. This activity needs to be closely coordinated with sensor testing/qualification activities to support that activity.

Evaluation Topics

The evaluation topics for site installation are listed below.

1. Are site installation standards/documentation defined and considered complete?
2. Are site acceptance testing standards and procedures defined?
3. Are site IDs registered with the WMO or Data Collection Platform (DCP) system.
4. Are documentation (Metadata) standards defined and complete?
5. Are copies of metadata documentation provided to host organizations?
6. Do we have sufficient resources (people and funding) to support national deployment?

Products and Schedule

The products and schedule for site installation are listed below.

- Approved USCRN Site Installation Plan 12/02
- Approved site acceptance standards in place 06/03

Team Members

The products and schedule for site installation are listed below.

- Tilden Myers (Lead) (ATDD)
- Mark Hall (ATDD)
- John Hughes (NCDC)
- Grant Goodge (NCDC)
- Nolan Miller (OSD/S&A)
- Mike Young (OSD/S&A)
- Ed May (OSD/S&A)
- Hal Bogin (OSD/S&A)

Section 5. Communications

Evaluation Topics

The evaluation topics for communications can be found in the following list.

1. Is communications design sufficient to support each site and all 40 sites?
2. Are there sufficient DCP reservations available for USCRN use?
3. Can we expand capacity to support full national deployment?
4. Are communications sufficiently direct, redundant, robust, and reliable?

Products and Schedule

The products and schedule for communications are listed below.

- Establish Network Communications Requirements 12/02
- Network Capacity Report 12/02

Team Members

The tem members for communications are listed below.

- Ed Hiner (Lead) (OSD/S&A)
- Debra Braun (NCDC)
- Mark Hall (ATDD)
- Nolan Miller (OSD/S&A)

Section 6. Field Maintenance

The initial scope includes hardware, software, and communications maintenance for the entire USCRN system. This includes all USCRN field sites, the network communications, and the USCRN-unique components of NCDC. The team will establish quantitative maintenance requirements based on both the data availability requirements specified in the FRD, and equipment failure rate statistics. Maintenance planning will include regular preventive maintenance, remedial maintenance, software updates to accommodate new and/or revised algorithms. The maintenance planning team's efforts will conclude with an approved USCRN maintenance plan.

Evaluation Topics

The evaluation topics for field maintenance are listed below.

1. How, how often, and by whom is periodic preventive maintenance performed?
2. How, how often, and by whom is periodic sensor calibration performed?
3. Are unit spares necessary to support real-time maintenance? If yes, where will they be stored?
4. Who provides and installs spare installations?
5. What are the per site average costs?
6. How do we know logistics will be sufficient?
7. Are calibration standards documented?

Products and Schedule

The products and schedule for field maintenance are listed below.

- Identification of Specific Maintenance Areas 11/02
- Draft of Maintenance Requirements and Associated Assumptions 12/02
- Documentation of Failure Modes and Rates for Representative Equipment 03/03
- Identification and Characterization of Potential Providers 04/03
- Draft USCRN Maintenance Plan 04/03
- Identification and Resolution of Maintenance Planning Issues 06/03
- Final USCRN Maintenance Plan 07/03
- Establish field recalibration schedule 07/03

Team Members

The team members for field management can be found in the following list.

- Ed Hiner (Lead) (OSD/S&A)
- John Hughes (NCDC)
- Tilden Myers (ATDD)
- Nolan Miller (OSD/S&A)
- Mike Young (OSD/S&A)
- Dick Reynolds (OSD/S&A)
- Bruce Baker (NCDC)

Appendix A – Ten Climate Principles

1. Management of Network Change: Assess how and the extent to which a proposed change could influence the existing and future climatology obtainable from the system, particularly with respect to climate variability and change. Changes in observing times will adversely affect time series. Without adequate transfer functions, spatial changes and spatially dependent changes will adversely affect the mapping of climate elements.

2. Parallel Testing: Operate the old system simultaneously with the replacement system over a sufficiently long time period to observe the behavior of the two systems over the full range of variation of the climate variable observed. This testing should allow the derivation of a transfer function to convert between climatic data taken before and after the change. When the observing system is of sufficient scope and importance, the results of parallel testing should be documented in peer-reviewed literature.

3. Metadata: Fully document each observing system and its operating procedures. This is particularly important immediately prior to and following any contemplated change. Relevant information includes: instruments, instrument sampling time, calibration, validation, station location, exposure, local environmental conditions, and other platform specifics that could influence the data history. The recording should be a mandatory part of the observing routine and should be archived with the original data. Algorithms used to process observations need proper documentation. Documentation of changes and improvements in the algorithms should be carried along with the data throughout the archiving process.

4. Data Quality and Continuity: Assess data quality and homogeneity as a part of routine operating procedures. This assessment should focus on the requirements for measuring climate variability and change, including routine evaluation of the long-term, high-resolution data capable of revealing and documenting important extreme weather events.

5. Integrated Environmental Assessment: Anticipate the use of the data in the development of environmental assessments, particularly those pertaining to climate variability and change, as part of a climate observing system's strategic plan. National climate assessments and international assessments (e.g., international ozone or IPCC) are critical to evaluating and maintaining overall consistency of climate data sets. A system's participation in an integrated environmental monitoring program can also be quite beneficial for maintaining climate relevancy. Time series of data achieve value only with regular scientific analysis.

6. Historical Significance: Maintain operation of observing systems that have provided homogeneous data sets over a period of many decades to a century or more. Alist of protected sites within each major observing system should be developed, based on their prioritized contribution to documenting the long-term record.

7. Complementary Data: Give the highest priority in the design and implementation of new sites or instruments within an observing system to data-poor regions, poorly observed variables,

regions sensitive to change, and key measurements with inadequate temporal resolution. Data sets archived in non-electronic format should be converted for efficient electronic access.

8. Climate Requirements: Give network designers, operators, and instrument engineers climate monitoring requirements, at the outset of network design. Instruments must have adequate with biases sufficiently small to resolve climate variations and changes of primary interest. Modeling and theoretical studies must identify spatial and temporal resolution requirements.

9. Continuity of Purpose: Maintain a stable, long-term commitment to these observations, and develop a clear transition plan from serving research needs to serving operational purposes.

10. Data and Metadata Access: Develop data management systems that facilitate access, use, and interpretation of the data and data products by users. Freedom of access, low cost mechanisms that facilitate use (directories, catalogs, browse capabilities, availability of metadata on station histories, algorithm accessibility and documentation, etc.), and quality control should be an integral part of data management. International cooperation is critical for successful data management.

Appendix B – USCRN Test Review Board

The members of the USCRN Test Review Board are as follows:

Chris Fiebrich – Oklahoma University, Mesonet Manager
Greg Johnson – United States Department of Agriculture, Portland OR)
Ken Kunkel – Illinois State Water Survey

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National Oceanic and Atmospheric Administration (NOAA)				
Library and Floor Locations				
001	NOAA OSD Library	c/o Verna Cauley	FB 4, Room 3307	1
344	NOAA NCDC Library	c/o Debra Braun	FED, Room 514, Asheville, NC	2
OSD				
010	NOAA/OSD3	Richard G. Reynolds	FB 4, Room 3308C	1
345	NOAA/OSD3	Richard Brooks	FB 4, Room 3301D	1
NCDC				
346	NOAA/CC11	Bruce Baker	FED, Room 420, Asheville, NC	1
347	NOAA/CC21	Debra Braun	FED, Room 514, Asheville, NC	1
348	NOAA/CC2	David Easterling	FED, Room 516, Asheville, NC	1
349	NOAA/CC3	Michael Helfert	FED, Room 468, Asheville, NC	1
350	NOAA/CC4	John Hughes	FED, Room 420F, Asheville, NC	1
351	NOAA/CC	Thomas Karl	FED, Room 557C, Asheville, NC	1
352	NOAA/CC	Sharon LeDuc	FED, Room 557A, Asheville, NC	1
OAR				
353	NOAA/ARL1	Ray Hosker	P.O. Box 2456, Oak Ridge, TN	1
354	NOAA/ARL1	Tilden Meyers	P.O. Box 2456, Oak Ridge, TN	1
NWS				
355	NOAA/OST32	Doug Gifford	SSMC2, Room 12110	1
NOAA / Computer Sciences Corporation (CSC)				
094	NOAA/CSC – CMO Copy	Kelly Coleman	FB 4, Room 3317	1
096	NOAA/CSC	Linwood Hegele	FB 4, Room 3313	1
097	NOAA/CSC	Wayne Taylor	FB 4, Room 3311	1
098	NOAA/CSC – DCO Copy	c/o Elizabeth Smith	FB 4, Room 2326	2
101	NOAA/CSC	Pong Yu	FB 4, Room 3315	1
173	NOAA/CSC	Kelly Coleman	FB 4, Room 3317	1
205	NOAA/CSC	Forrest Gray	FB 4, Room 3315A	1
NOAA / Short and Associates (S&A)				
356	S&A	Harold Bogin	FB 4, Room 3010E	1
357	S&A	James Bradley	FB 4, Room 3010E	1
358	S&A	Robert Embleton	FB 4, Room 3010E	1
359	S&A	Edwin Hiner	FB 4, Room 3010E	1
360	S&A	Edwin May	FB 4, Room 3010E	1
363	S&A	Steve Short	FB 4, Room 3010E	1
364	S&A	Michael Young	FB 4, Room 3010E	1
375	S&A (at NCDC)	Marjorie McGuirk	Asheville, NC	1

Loc. No.	Organization	Name	Address	Copies
Regional Climate Centers (RCCs)				
365	Southeastern RCC	Mike Janis	Columbia, SC	1
366	High Plains RCC	Ken Hubbard	Lincoln, NB	1
367	Western RCC	Kelly Redmond	Reno, NV	1
368	Western RCC	Dick Reinhardt	Reno, NV	1
			TOTAL	35