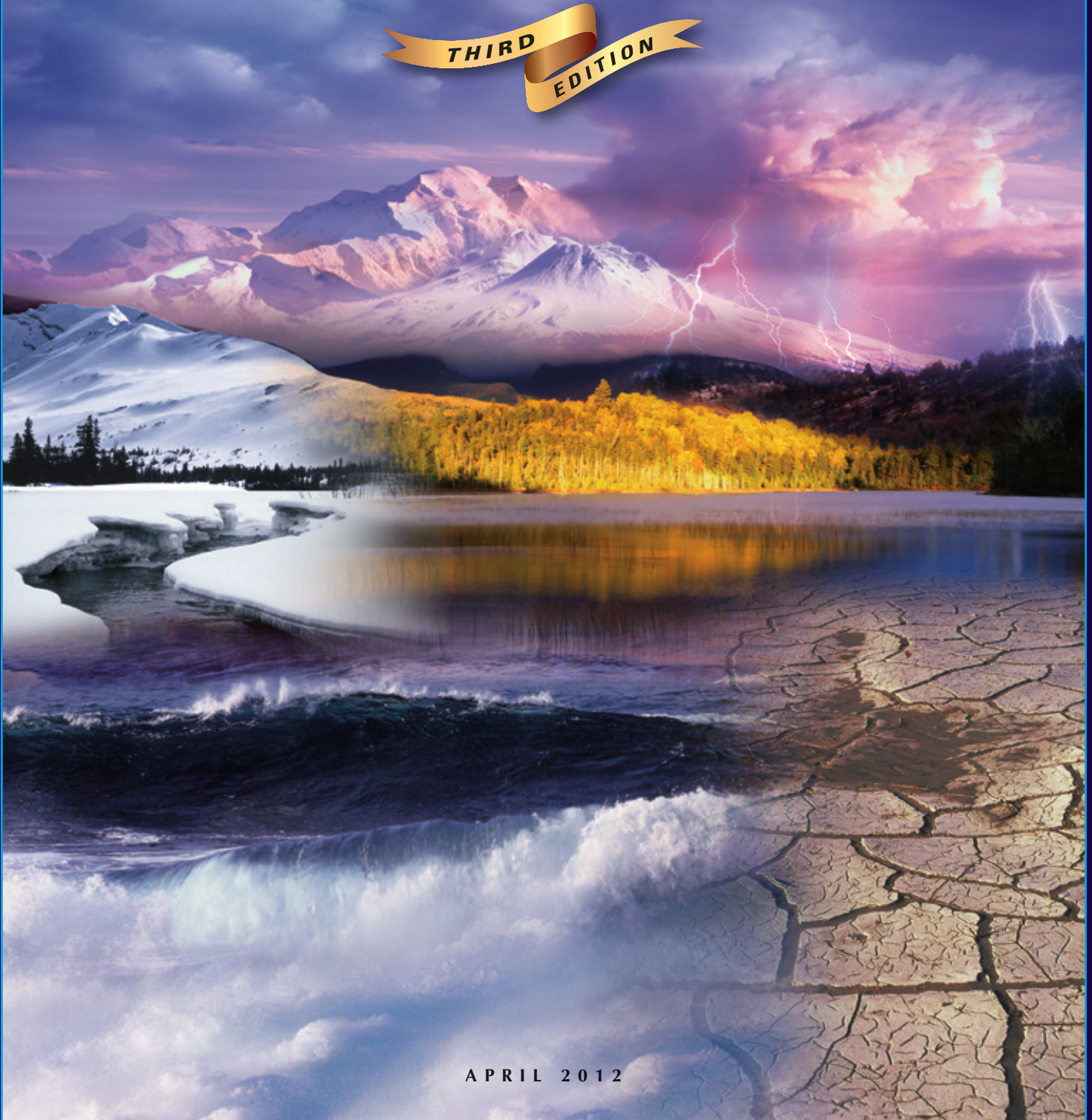


NWS Regional and Local Climate Services Delivery OPERATIONS DOCUMENT

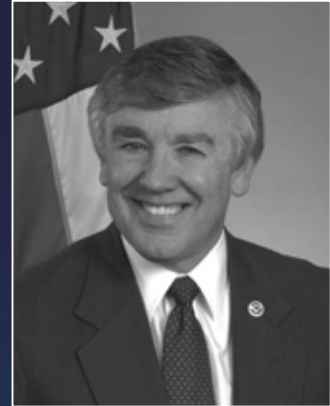
**THIRD
EDITION**



APRIL 2012

Letter from NWS Director

In August 2003, we formally adopted the National Weather Service Regional and Local Climate Services Implementation Plan. We followed that in 2005 with the publication of the first edition of the National Weather Service Regional and Local Climate Services Delivery Operations Document which provided detailed guidelines on how best to accomplish the tasks outlined in the plan. The update in 2007 reflected new products and services that integrated emerging science, technology, and methodologies.



Building on nearly 10 years of experience at the local level and recognizing changes within the National Weather Service, NOAA, and the Department of Commerce, we are issuing the third edition. This edition includes a sampling of local studies and outreach, excellent examples of the ambitious endeavors by our Climate Services Focal Points at our local offices.

I urge you to follow the guidelines in this document to maximize the effectiveness of our regional and field climate services. Your role in this endeavor is critical to maintaining our position at the forefront of climate services delivery to this Nation, and to achieve NOAA's mission goals.

A handwritten signature in blue ink, appearing to read "Jack Hayes". The signature is stylized and fluid.

Jack Hayes

Director, National Weather Service, NOAA





Table of Contents

Introduction	2
Purpose	2
Historical Perspective	2
NWS Climate Services	3
NWS Climate Services: Local Offices	5
Local Office Management Team	5
Local Office Climate Services Focal Point (CSFP)	6
1. Serve as a primary user interface for NOAA climate information and services	7
2. Serve as the steward and conscience for the integrity of the historical climate record	10
3. Participate in NWS climate analysis, monitoring, and prediction activities	12
4. Training	15
5. Local Office Workload	16
NWS Climate Services: Regional Headquarters Offices	17
Regional Director	17
Climate Services Program Manager (CSPM)	17
Appendix A: NWS Climate Services Organizational Structure	20
Appendix B: The Roles and Responsibilities of the CSD	24
Appendix C: CPC Official Product List	26
Appendix D: NOWData (NOAA Online Weather Data)	29
Appendix E: xmACIS	30
Appendix F: Resources	31
Appendix G: Global Climate Observing System: Climate Monitoring Principles	33
Appendix H: Acronyms	35
Appendix I: Glossary of Selected Terms	36
Appendix J: Team Members	37





INTRODUCTION

PURPOSE

The purpose of this document is to provide details of the National Weather Service (NWS) climate services program, including the roles, duties, and responsibilities of climate services representatives in the national, regional, and local offices.

THE ROLE OF THE NWS IN THE PROVISION OF CLIMATE SERVICES

In response to increasing demand for climate information, NWS works with other offices within its parent organization, the National Oceanic and Atmospheric Administration (NOAA), and with partners to develop more effective products and services and to capitalize on research advances. NWS will continue its mission-delivery activities and enhance its capabilities to monitor, predict, and assess the state of the climate, and improve decision support.



Figure 1: Historical US Weather Bureau Cooperative Observer Program Station (NOAA Library)

NWS VISION

A Weather-Ready Nation: Society is Prepared for and Responds to Weather-Dependent Events

Goal 3: Enhance climate services to help communities, businesses, and governments understand and adapt to climate-related risks

NWS Climate Services Program will:

- ◆ Serve as an unbiased broker of climate science and services
- ◆ Provide relevant, accurate, and timely end-to-end climate products and services: from observations and assessments to predictions and projections
- ◆ Develop effective partnerships to accelerate understanding of weather, water, and climate linkages ensuring NWS climate products and services remain relevant
- ◆ Capitalize on modern infrastructure systems and standards to meet the growing needs of the American public for climate data and information
- ◆ Sustain processes for climate research-to-operations and operations-to-research to ensure advances are incorporated efficiently into NWS models and products

HISTORICAL PERSPECTIVE

NWS has been providing the nation with climate services since the late 1800s. At that time, the Weather Bureau (the predecessor to the NWS) was still expanding the Cooperative Observer Program (COOP) network as mandated by the Organic Act of 1890. The nation continues to rely on NWS and NOAA as the *neutral brokers* of observations as we assess long-term temperature trends.

The Dust Bowl years of the 1930s led to the first legitimate effort in long-range prediction. The first experimental monthly prediction was issued by the Weather Bureau in 1947, followed by



Figure 2: Dust Bowl of 1930s (NOAA Library)

seasonal predictions 35 years later. The passage of the National Climate Program Act in the mid-1970s led to the formation of the Climate Analysis Center (CAC) in the NWS in 1979, presently called Climate Prediction Center (CPC), which provides national and global operational climate prediction, monitoring, and assessment products for timescales from weeks to years. Further advances in extended and long-range prediction occurred over the next 30 years as the prediction process gradually evolved from a largely subjective procedure to one which employs a more objective use of specific tools. The first results from operational modeling that coupled the atmosphere and the ocean became available in 1995.

To enhance and improve NWS climate services capabilities in the regional and local offices, the Climate Services Division (CSD) was established at NWS Headquarters in 2000. In 2003, each NWS regional headquarters appointed a Climate Services Program Manager (CSPM); in addition, each local office appointed a Climate Services Focal Point (CSFP), whose function in most instances has been distributed among several staff members. Together with CPC, regional and local offices deliver climate services to the Nation.

Over the past few decades climate-related phenomena and their impacts have been capturing national attention. From the devastating El Niño of 1982-83 to the more recent discourse concerning long-term global change, climate is a high-visibility topic in the public consciousness. Recognizing this growing

importance and the national engagement on this issue, NOAA has enhanced its efforts to deliver a broad array of climate services. A vital component of this enhancement will be the extensive array of climate services offered by the NWS, including observing systems, analyses, assessments, monitoring, predictions, information, and the delivery system to reach users. NWS has already established trust and credibility in providing scientific information to local users, and its continued engagement with the public is a touchstone for continued success from the local to the national level.

NWS CLIMATE SERVICES

NWS climate services are distributed across the organization: national headquarters, regional offices, and field offices. While the majority of service delivery exists at the field office level, program management resides within the Office of Climate, Water, and Weather Services (OCWWS) Climate Services Division.

OCWWS establishes national policy and requirements, secures and allocates resources, and acts as the national coordinator for climate, water and weather services, training and outreach. OCWWS is also responsible for the promotion of the NWS climate services program with national users and partners.

CSD provides the strategic vision for climate services at NWS and oversees the climate services program. It facilitates the development of consistent messaging, common understanding, and coordinated release of information on climate and weather linkages for decision support. The division also collects requirements and sets NWS field policies and procedures for climate prediction products, defines service and mission needs, solicits user feedback to evaluate new products and services, ensures availability of training in climate services for field personnel and technical user groups, seeks resources, and approves final product design. CSD maintains NWS local standard climate web sites disseminating local climate products and services, as well as facilitates development of local climate tools and products. The division coordinates local and regional climate projects across NWS offices, including Office of Science and Technology, Office of Hydrologic Development, and National



NWS CLIMATE SERVICES: INTRODUCTION

Centers for Environmental Prediction. The climate services program maintains strong ties across NOAA lines, specifically through the NOAA Climate Program Office, as well as with federal agencies, the university community, the private sector, and other countries. It also encourages collaborative arrangements among the Regional Climate Centers (RCCs), Regional Integrated Science Assessments (RISAs); State Climatologists (SCs), NWS field offices, and NWS regional headquarters to provide local context to regional and national climate forecasts. Significant support is provided by many other NWS offices described in Appendix A. The specific roles and responsibilities of CSD are listed in Appendix B.

In support of regional climate services, NOAA established a National Climatic Data Center (NCDC) Regional Climate Services Director (RCSD) at each of the NWS regional headquarters. The RCSD has responsibility for coordinating the development of an integrated NOAA program of climate services on a regional scale that responds to the needs of stakeholders and draws upon agency-wide assets and capabilities. In this capacity, the RCSD works closely with the corresponding regional NWS program.





NWS CLIMATE SERVICES: LOCAL OFFICES

The core of the NWS climate services program resides at the local offices as they are a primary public interface for NOAA. The local offices have three primary climate services functions, to which all activities can be tied:

- ◆ Serve as a primary user interface for NOAA climate information and services
- ◆ Serve as the steward and conscience for the integrity of the historical climate record
- ◆ Participate in NWS climate analysis, monitoring, and prediction activities

LOCAL OFFICE CLIMATE SERVICES TEAM: MANAGEMENT

The provision of climate services at each local office is a team effort. Significant contributions are provided by members of the local office management team:

- ◆ Meteorologist-in-Charge (MIC)
- ◆ Hydrologist-in-Charge (HIC)
- ◆ Science and Operations Officer (SOO)
- ◆ Development and Operations Hydrologist (DOH)
- ◆ Warning Coordination Meteorologist (WCM)
- ◆ Service Coordination Hydrologist (SCH)
- ◆ Observing Program Leader (OPL)
- ◆ Data Acquisition Program Manager (DAPM)

MIC / HIC

The primary role of the MIC and HIC is to ensure local office personnel support NWS's and NOAA's missions to deliver climate services.

- ◆ Identify and support the CSFP function
- ◆ Include climate program development in local office goals
- ◆ Promote education and training for CSFP and local staff in climate services
- ◆ Ensure resources are allocated for climate services at the local level, including travel and outreach intended

for participation in climate-related conferences and workshops

- ◆ Support local office participation in developing and using climate analysis tools
- ◆ Ensure proper siting, relocation, installation, maintenance, and use of equipment at climate-observing sites
- ◆ Support local office data-stewardship practices
- ◆ Support local office participation in RCSD activities

SOO / DOH

The SOO and DOH, in coordination with the CSFP, provide guidance in technical areas (e.g., the use of technologies and tools in local studies), ensure scientific rigor is maintained, and safeguard data integrity in the conduct of office activities.

- ◆ Provide applied science, tools, and training to support local office climate products
- ◆ Offer guidance and assistance to the CSFP on local climate studies
- ◆ Support development of techniques for the local office to use in generating local conditional climatologies and assist in beta-testing of new climate products and services
- ◆ Maintain professional competency through NWS training in climate services

WCM / SCH

The WCM and SCH contribute to the climate services mission through their extensive familiarity with the local community the office serves in its day-to-day operational weather responsibility. Their experience in local outreach can be applied as they collaborate with the CSFP in reaching climate users.

- ◆ Conduct climate-related outreach activities including public awareness of local climate impacts
- ◆ Educate local users on science of climate variability and change
- ◆ Participate in NOAA climate communication activities
- ◆ Support the CSFP in coordinating, integrating, and delivering NWS climate products

OPL / DAPM

The DAPM or OPL oversee the operations and maintenance of data collection for the climate record. The CSFP and the OPL or DAPM, maintain a close working relationship and coordinate on all issues related to climate data.

- ◆ Ensure climate observations and related metadata, data continuity, and data quality-control activities are fully coordinated with partners and conform to NWS policy and needs
- ◆ Routinely communicate with users, climate services partners, and their regional CSPM on issues related to ensuring the integrity of the climate record and user requirements

LOCAL OFFICE CLIMATE SERVICES TEAM: CLIMATE SERVICES FOCAL POINT (CSFP)

Local NWS offices are the most common points of entry for users requesting information, and the CSFP is the staff member who would most often respond to climate-related requests. However, the provision of climate services is a team effort, often requiring participation of several members of the office. This distribution of duties among employees is the ultimate responsibility of the MIC/HIC.

The duties of the climate services team include the delivery of outlooks, analyses, and observations, and providing local interpretation of CPC products. They ensure the integrity of observations, serve as experts for local, state, and tribal decision-makers, and act as local liaisons between NWS and NOAA partners.

- ◆ Deliver products and services, including decision support at the local level
- ◆ Contribute to development of national and regional analysis, monitoring, prediction, and assessment products
- ◆ Remain up-to-date on new NOAA climate products and services
- ◆ Promote NOAA products, services, and education and outreach activities at the local level
- ◆ Conduct local climate studies utilizing nationally-provided analysis tools
- ◆ Be familiar with content, use, and location of CPC products (see Appendix C)
- ◆ Serve as data stewards in the collection, quality control, and dissemination of climate data
- ◆ Provide expertise for climate data continuity studies

1. SERVE AS A PRIMARY INTERFACE FOR USERS OF NOAA CLIMATE INFORMATION AND SERVICES

Decision Support Services (DSS)

- ◆ Provide climate data interpretation to local office staff and users
- ◆ Provide climate variability and change insights into developing extreme weather and water conditions in local area of responsibility

Monitor, assess, and communicate the state of the climate, including variability and change, and potential local impacts

CSFPs monitor large- and global-scale conditions and changes on at least a weekly basis to assess the onset of and changes to large-scale weather and climate events with support from the CSPM and RCSD. Some of these activities include:

- ◆ Assess global domain satellite imagery
- ◆ Monitor the global-scale circulation and other associated features (e.g., North Atlantic Oscillation (NAO), Arctic Oscillation (AO), Pacific-North American pattern (PNA), Madden-Julian Oscillation (MJO), or El Niño Southern Oscillation (ENSO))
- ◆ Review other source material from national centers, including forecasts and outlooks, discussions, bulletins, and updates

Monitor the status of drought or excessive rainfall, temperature anomalies, and other parameters (e.g., evapo-transpiration)

During periods of insufficient or excessive precipitation, extreme temperature anomalies or other unusual climate situations, operational personnel maintain up-to-date information regarding the status of the specific event and provide local insights with the CSPMs and National Centers. This information may be used in national products (such as the Drought Monitor) or in local information releases such as a Public Information Statement.

Heat Index

Heat is an underrated danger, responsible for the deaths of around 175 people each year in the U.S. The heat index is a way to assess the threat from the combined effects of the air temperature and humidity. A review of historical summer (June through August) observations for 192 locations showed a propensity for dangerous heat across the Northern and Central Plains into the Mid- and Upper-Mississippi River Valley. The figure below depicts frequency of occurrence for heat indices above 95°F. The geographic and climatic location, along with proximity to the Gulf of Mexico, makes these areas prone to very warm temperatures, and in some cases, high humidity, resulting in more frequent and higher heat indices. A local office study looks at the physiological response to heat, including a review of how heat acclimatization affects the human body's biology. For more information, go to: http://www.crh.noaa.gov/crh/ssd/pdf/tsp_17.pdf

Submitted by Todd Rieck (WFO La Crosse)

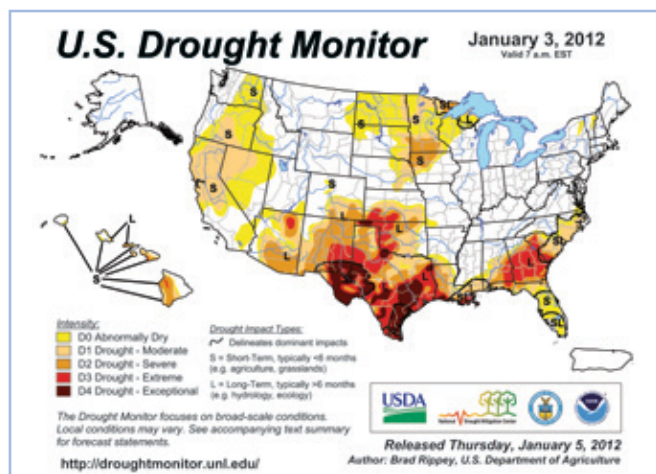
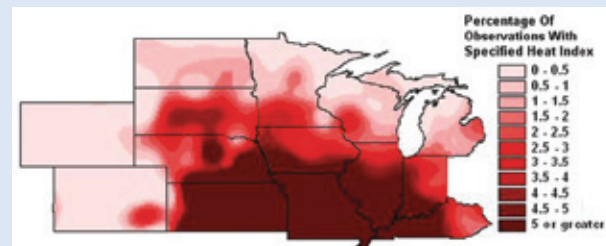


Figure 3: US Drought Monitor. A collaboration of NOAA, USDA, NDMC and others

For drought periods, the Drought Information Statement is used to convey relevant information on current water resources.

Respond to partner/customer requests for DSS and coordinate the request with the regional CSPM and RCSD

Many climate-related events that require the application of DSS often transcend the established boundaries of a single WFO. In such cases, where several WFOs are affected, a response on the regional scale may be more appropriate. Enlisting regional coordination through the CSPM and RCSD would ensure a team-led consistent response.

Partnerships

- ◆ Engage local partners in the development and delivery of climate services and identify opportunities for joint activities
- ◆ Promote NWS climate products, services, and outreach activities to the local climate community

Partners Exchange Program

CSD has encouraged partnerships by establishing a Partners Exchange Program (PEP). Internal and external partners visit NOAA Headquarters Offices and Centers to become familiar with climate services available through NOAA. In



return, NOAA climate staff members visit partners to become acquainted with their climate activities, concerns, and needs. Visitors can take part in several activities at their host partner such as meeting with staff, working on a collaborative project, and joining host events such as map briefings and forecast preparations. Participants also provide an introductory briefing to the host office during the visit, focusing on his/her background, climate-related projects, climate concerns and needs, and ideas for potential collaborations. To apply for the program, please visit: <https://ocwww.weather.gov/pep>

Local office staff members are encouraged to develop close working relationships with their local NOAA counterparts and familiarize themselves with existing and new climate services at NOAA centers and laboratories. Other members of the climate community in the local area, including RISAs, SCs, RCCs, local universities, and state and local agencies can also be valuable resources.

Communication

- ◆ Communicate regularly with the CSPM to remain current on emerging NWS climate services initiatives and promote local-level climate priorities and needs
- ◆ Identify and request resources required to respond to local user needs from local office management or regional CSPMs
- ◆ Inform local NOAA and external climate services partners on emerging climate projects, products, and initiatives
- ◆ Follow the existing policy for communicating requirements and feedback as per NWSI 10-102, "New and Enhanced Products and Services" (available at <http://www.nws.noaa.gov/directives>)
- ◆ Subscribe to the climate services listserv
- ◆ Join the US Drought Monitor listserv

Maintain local office CSFP reference guide

To maintain local office climate services continuity and ease the transition for newly appointed CSFPs, each CSFP should maintain a local office CSFP reference guide containing useful documents.

- ◆ Latest version of this document
- ◆ Climate services policy directives
- ◆ Information on local climate services tools (e.g., Datzilla, xmACIS, Local Climate Analysis Tool (LCAT), and others)
- ◆ List of climate contact points
- ◆ Factsheets and brochures
- ◆ Directory of useful web links
- ◆ Reference to useful presentations and publications



NWS Climate Services Listserv

In the fall of 2011, the NWS launched the climate services program listserv. The new e-mail listserv provides an internal forum to coordinate and communicate climate-related information, questions, and announcements. Individuals can sign up easily, send and receive posts automatically, and begin searching through previous archived conversation threads. Examples of posts could include meeting announcements, training opportunities, new research / papers on climate, and general questions (and answers) about climate. Join the **nws_climate** listserv at: <http://www.nws.noaa.gov/ndm/joinlist.html>

NOAA Global Monitoring Exhibit

The NOAA Global Monitoring exhibit is located at the NWS Los Angeles WFO, in Oxnard, California. This exhibit is a very popular resource for the NWS office education and outreach efforts. The exhibit depicts weather monitoring equipment from five service areas (aviation, marine, climate, fire weather, and hydrology), along with interpretive signs explaining the various programs and their purpose. The goals of the exhibit are to engage and educate as well as provide outreach to the public to help serve the NWS Vision of "A Weather-Ready Nation: Society is Prepared for and Responds to Weather-Dependent Events."

Submitted by Dessa Emch (WFO Oxnard)



Outreach

- ◆ Respond to climate inquiries from local users
- ◆ Provide information to users on new climate products and services
- ◆ Know where to refer customers for additional information on complex climate questions
- ◆ At the request of CSD or the CSPM, participate on regional and national climate teams as expert on local perspective

Conduct outreach and education in the local area of responsibility on climate products, data, and information

As the climate program expands, education and outreach responsibilities for climate information will grow in the local offices. These additional responsibilities should be coordinated with the respective CSPM and RCSD. For the local office outreach program, the WCM and the CSFP will ensure climate information is included in any outreach materials and/or activities. Packaging climate information with the meteorological and hydrological outreach programs is a natural fit and should be encouraged. Activities such as school talks and meetings with local constituent groups are excellent entry-level outreach and education efforts.

Collect user requirements

- ◆ Local offices should monitor customer feedback when making product and service enhancements
- ◆ Report user needs and assess requirements at local level via NWS Climate User Directory (<https://ocwws.weather.gov/intranet/climate/directory.php>)
- ◆ Integrate climate partners' information on local user needs
- ◆ Solicit feedback from customers to improve existing climate services and products and for the design of new ones

Ensure local web pages are routinely updated

The CSFP, information technology staff, and webmaster should ensure implementation of a standardized local climate web page, including the Local Data/Records section.

Organize climate awareness events in support of local communities

Climate events, such as El Niño and La Niña, may significantly impact local climate. To ensure local, state, and tribal governments and businesses are informed about such events and equipped to mitigate the impacts, CSFPs should conduct climate awareness outreach activities.

Participate in other outreach activities

Additional outreach activities include supplying climate fact sheets (see Appendix F) to the public and discussing local applications. Such discussions may include how drought impacts the area, the current seasonal hurricane outlooks, and the effect of ENSO and other modes of climate variability on local weather patterns. Offices should include climate topics when conducting workshops targeted to local audiences (media, agriculture, energy, emergency managers, etc.) to inform users on the potential uses and availability of climate resources and to gather feedback on products and services.

Education

- ◆ Conduct activities at the request of educators in the local area of responsibility in coordination with the WCM
- ◆ Support local educator participation in the National Ocean Service (NOS) Climate Stewards Program

2. SERVE AS THE STEWARD AND CONSCIENCE FOR THE INTEGRITY OF THE HISTORICAL CLIMATE RECORD

Local offices are the stewards for the data that are used to construct the Nation's climate record. The MIC or HIC has overall responsibility for the successful collection of accurate climate data and takes action when necessary to ensure the integrity of the climate record. However, on a day-to-day basis, this critical climate function should be shared by the CSFP and the OPL or DAPM. The OPL or DAPM oversees the operations and maintenance of data collection for the climate record. The CSFP and the OPL or DAPM, with the support of the local office (in this section referred to as "team"), must maintain a close working relationship and coordinate on all issues related to climate data. The team ensures climate observations and related metadata, data continuity, and data quality control activities are fully coordinated with partners and conform to NWS policy and needs. It routinely communicates with customers, climate services partners, and the regional CSPM on issues related to ensuring the integrity of the climate record and customer requirements.

Local Climate Data Experts

- ◆ Serve as data stewards in the gathering and quality control of climate data that meet national standards for dissemination
- ◆ Respond to customer inquiries regarding the collection and interpretation of climate data and products
- ◆ Act as the local expert on complementary data (e.g., local mesonet data) and understand details on mesonet data accuracy (instrumentation, exposure, and maintenance)

To help provide data summaries in response to local user inquiries, the CSFP may utilize data records available through NOWData and xmACIS (see Appendices D and E).



Climate Observing Requirements and Policy

- ◆ Understand NWS Climate Data Services policy and Climate Records policy (NDS 10-1003 and NDS 10-1004 respectively, both available at <http://www.nws.noaa.gov/directives/010/010.htm>) and the “Global Climate Observing System: Climate Monitoring Principles” (see Appendix G)
- ◆ Ensure compliance with NWS web policy with respect to climate information (NDS 10-1003, available at <http://www.nws.noaa.gov/directives>) including the labeling of NWS data as “preliminary” and restricting free redistribution of NCDC value-added and official data products
- ◆ Provide weather observers with proper tools and training required to ensure the collection of accurate, consistent climate data at all sites in compliance with NWS observation policies and the needs of customers

The CSFP coordinates with the OPL or DAPM to ensure data quality from the point of observation through the point of delivery. This includes site support for COOP stations and training for observers, as well as the collection, quality control, archiving, and dissemination of secure and accurate observations.

Climate Data Quality

- ◆ Ensure integrity of data record by following quality control policies
- ◆ In coordination with the CSPM, serve as the liaison between local office-specific quality control activities and NCDC, the RCC, and SCs, and ensure problems are identified and solutions implemented
- ◆ Leverage Quality Assurance/Quality Control (QA/QC) tools provided by partners, for example, Health of the Networks (HoN: <http://www.ncdc.noaa.gov/oa/hofn>) and the data correction tracking system, Datzilla (<http://datzilla.srcc.lsu.edu/datzilla>) to report erroneous records
- ◆ Coordinate with CSD and NCDC on creating ThreadEx to provide for a longer period of record for data extremes

Climate Data Continuity

- ◆ Serve as the focal point for data continuity issues
- ◆ Monitor and oversee changes to observing systems supporting the climate record, including coordinating changes with climate partners

As the data continuity liaison, the team may be requested to participate in the development of plans for conducting overlapping observations with other climate services partners. The team also ensures that customers are advised of pending changes at LCD stations that can introduce data discontinuities (e.g., station moves, instrument changes, etc.). The team ensures (1) impacts of proposed changes are understood and options considered before implementation; (2) requirements for overlapping observations are addressed; (3) any changes (planned, accidental or natural) are adequately and appropriately documented in metadata; and (4) customers are advised in a timely fashion of pending and completed changes.

Future Observing System Issues and Initiatives

Support OPL or DAPM in following areas:

- ◆ Cooperative Observer Program (COOP) and U.S. Regional Climate Reference Network (USRCRN)-related activities
- ◆ Plans for COOP modernization
- ◆ Paperless transmission of COOP data, including training observers and encouraging them to switch to the paperless communication environment

3. PARTICIPATE IN NWS CLIMATE ANALYSIS, MONITORING, AND PREDICTION ACTIVITIES

Products

- ◆ Remain current with changes in NWS climate products and services
- ◆ Participate in NWS climate analysis, monitoring, and prediction activities (e.g., CPC seasonal outlooks and hazards assessment, Drought Monitor, and others)

Deliver the Local 3-Month Temperature Outlook

The Local Three-Month Temperature Outlook (L3MTO) products are extended from CPC’s Three-Month Temperature Outlook (3MTO) to the local scale using a downscaling technique (<http://www.weather.gov/climate/l3mto.php>). CPC produces the L3MTO for over a thousand stations across the country with the capability to expand to 4000. NCDC provides the local datasets used in

the downscaling methodology on an operational schedule. CSD disseminates the L3MTO via NWS local climate web sites. Local office maintains the list of sites, where L3MTO products are available, performs quality control, adds local value, and delivers the products to local users. The CSFPs should ensure that the L3MTO is interpreted correctly and referred to appropriately in local climate forecast statements. CSFPs provide local users with explanations of the L3MTO methodology and guidance on product interpretation, benefits, and limitations.

Perform quality control

CSFPs should perform monthly quality control functions utilizing the Analysis Resource Center (ARC) (<https://ocwwws.weather.gov/intranet/climate/L3MTO/ARC>) to ensure (1) consistency in the product and the web display; (2) correspondence between the L3MTO and 3MTO; and (3) correct display of the local climatology.

Participate in national activities for local testing of new products and services

When products become available for local beta-testing, the national offices coordinate with CSD to include CSFPs in the process. CSFPs are responsible for summarizing findings of the climate product beta-testing at the local level. Testing procedures and scheduling are provided in advance and are specific for each activity.



Figure 4: L3MTO Product Suite for San Antonio, TX

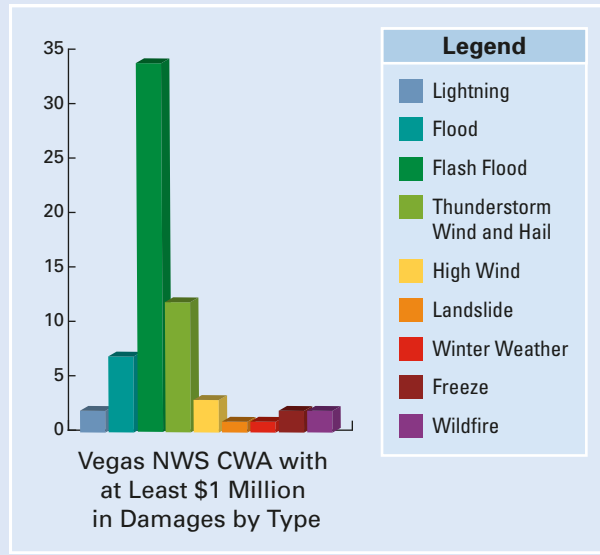
Examples of Relevant Climate Studies for the Local Area

- ◆ Rate of local long-term climate change
- ◆ Historical frequencies of extreme or severe weather events
- ◆ Probabilities of weather-induced phenomena (such as rip currents or storm surges)
- ◆ Probabilities of extremes (e.g., heavy snow events), weather events (e.g., tornados, ice storms), weather-related impacts dependent on the phase or state of different modes of climate variability, such as the NAO, PNA, MJO and ENSO

Costliest Events Climatology for Las Vegas

With the increasing emphasis in NWS on societal impacts, Las Vegas WFO compiled a climatology of the costliest weather events in the current Las Vegas, NV County Warning Area (CWA). Events were largely obtained from Storm Data and Unusual Weather Phenomena from both the web database available from NCDC and from paper copies for years and months that were not in the web database back to 1959. A minimum threshold of \$1 million was used to determine the costliest events across the NWS Las Vegas CWA. See more results at: <http://www.wrh.noaa.gov/vef/projects/CostliestEvents.pdf>

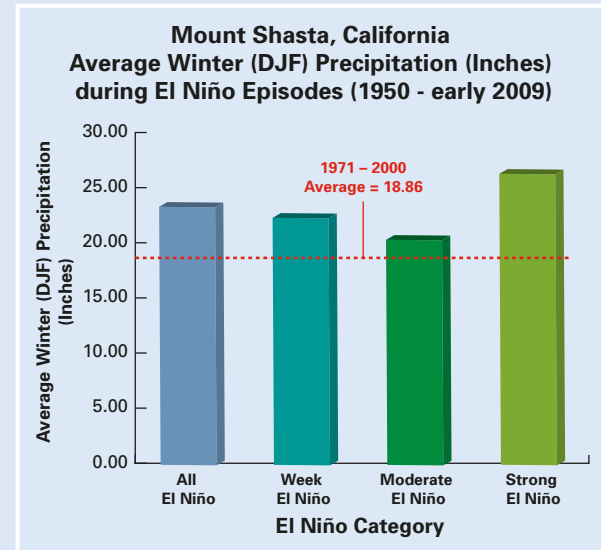
Submitted by Chris Stachelski (WFO Las Vegas)



How El Niño Affects Precipitation in the Medford Forecast Area

This study compares precipitation at two key sites during El Niño events of varying strengths (weak, moderate, and strong). Given that these sites and the forecast area lie in the transition zone of ENSO correlated seasonal climate variance, the premise is that El Niño strength might reveal differences in precipitation impacts. What was discovered is that, likely due to orographic effects related to mean storm tracks, the probability of heavy precipitation episodes (and seasons) increases at Mount Shasta during El Niño events, especially strong episodes, whereas, at Medford (not shown), there is far too much variance to make any concrete conclusions.

Submitted by Brett Lutz and Marc Spilde (WFO Medford)



Local Climate Studies

- ◆ Identify sensitivity of local weather and water conditions to climate variability and change
- ◆ Provide guidance/expertise for climate data continuity studies

Identification of sensitivities often requires additional background study by the CSFP. Climate studies at scales important to NWS local users reveal important relationships and information unavailable through CPC national products. Such information

could include long-term statistics of local climate variables (for example, a climate parameter average, its variability, rate of long-term trends, and others), probabilities for future weather and/or climate events, or the historical climate context of weather events for mitigation and adaptation. Climate studies should be conducted using methodologies consistent with CPC practices, which are available in the Local Climate Analysis Tool (LCAT). LCAT is a tool that can be utilized by local offices to perform local climate analysis studies to respond to user requests and inquiries. LCAT is an online interactive statistical tool that allows local staff

access to recommended data and analysis methods for application at the local level. The LCAT dialog interface allows users to specify data and type of methods for study of local rate of climate change, local climate variability impacts, local drought severity,

and to conduct climate analysis for water resource applications. The CSFP is encouraged to share results of local studies through peer-reviewed papers, regional and national conferences, or as regional technical attachments.

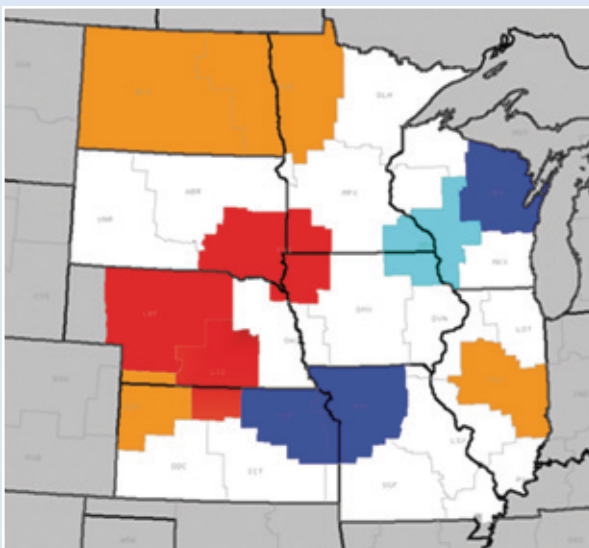
Tornado Climatology

The ENSO cycle can explain at least some of the variability in weather affecting a County Warning Area (CWA). One study has explored the relationship between ENSO phase and tornado activity in the north central U.S., finding significant relationships between ENSO phase and both the number of tornado days and the number of significant tornadoes. In the figure below, CWAs shaded in red colors exhibit a higher than usual chance for increased tornado activity following a La Niña winter, while blue shading indicates a lower than usual chance. For more information, go to:



<http://ams.confex.com/ams/pdfpapers/141973.pdf>

Submitted by Barbara Mayes Boustead (WFO Omaha)



Evaluate user needs and make recommendations for products and services

CSFPs have established trust with their local users through their frequent interaction, and are able to identify local needs for climate information. CSFPs have access to national and local climate data and established methods for climate analysis. They can conduct initial investigations to establish the science-based capacity for responding to specific user needs, and report findings and recommendations to the CSPMs and RCSDs for further review and action.

Develop expertise in local climate variability and change

CSFPs can utilize the extensive formal training and review literature on regional and local climates. Routine participation in climate-related conferences and workshops will allow CSFPs to network, learn, develop ideas, and explore new techniques for communicating climate issues to users more effectively.

Exploit routine climate analysis information to explore linkages between climate phenomena and local weather events

CSFPs should routinely review climate analysis and monitoring information available, including NOAA websites of CPC, NCDC, NOAA's Earth System Research Laboratory (ESRL), and RCCs (see Appendix F). Information such as the ENSO Diagnostic Discussion, sea surface temperatures, and the characteristics of different teleconnection patterns or oscillations (such as the AO, PNA, MJO, and the NAO) can help provide larger scale context for local conditions.

4. TRAINING

- ◆ Ensure personal professional competency in provision of climate services
- ◆ Support capacity building of local staff

Complete online Professional Development Series

NWS operational personnel have access to online training through the Climate Services Professional Development Series (PDS) [<http://www.nws.noaa.gov/om/csd/pds>]. Knowledge of climate phenomena and services acquired through this training should be conveyed to other staff members through local office training by the CSFPs working with the SOO and their CSPM.

The Climate Services PDS comprises six Professional Competency Units that provide targeted training for each of the three primary functions (customer interface, data steward, and participation in analysis, monitoring, and prediction) of the local offices.

- ◆ **PCU 1:** Demonstrate Knowledge of the Infrastructure for Climate Data, Information, and Services
- ◆ **PCU 2:** Demonstrate Understanding of Climate Variability and Change
- ◆ **PCU 3:** Demonstrate Understanding of the Basis and Methodologies of CPC Products
- ◆ **PCU 4:** Interpret and Apply Locally CPC Products
- ◆ **PCU 5:** Respond to User Requests for Historical Climate Data and Information, and Provide Public Outreach
- ◆ **PCU 6:** Demonstrate Knowledge of Timely, Accurate, and Consistent Climate Data Observations and the Broad Range of Their Applications

Attend instructor-led courses

In addition to the online training modules, NWS CSD offers instructor-led courses (residence and virtual). All courses are available for registration at U.S. Department of Commerce Learning Management System (<http://learning.doc.gov>).

- ◆ Operational Climate Services residence training course provides an introduction to NWS local office climate

Function*	Training	Time requirements		
		Online (hours)	Teletraining (hours)	Residence training
1	PCU1	2	-	☆
1,3	PCU2	82	- ±	☆◆
1,3	PCU3	6	3 ±	☆◆
3	PCU4	3	3 ±	☆◆
1,2,3	PCU5	3	1	☆
2	PCU6	3	1	☆
1,2,3	Operational Climate Services Delivery Course	-	-	3 days
1,3	Advanced Climate Variability and Change Course	-	-	3 days
1,2,3	Climate Variability and Change Virtual Course	-	40	

- * 1 Serve as customer interface
- 2 Be the steward and conscience for continuity/integrity of the historical climate record
- 3 Participate in NWS climate analysis, monitoring and prediction activities
- † under development
- ☆ topics included at Operational Climate Services Course
- ± topics included at Climate Variability and Change Virtual Course
- ◆ topics included at Advanced Climate Variability and Change Course

services, familiarity with climate tools, products, and best methods for delivery of NWS climate services

- ◆ Climate Variability and Change Virtual Course (CVCVC) provides scientific knowledge of physical mechanisms, impacts, and predictability of climate variability and change events, and their use in NWS climate products
- ◆ Advanced Climate Variability and Change residence training provides advanced scientific knowledge used in modeling of climate variability and change, climate attribution of severe meteorological and hydrological events, and hands-on knowledge for conducting local climate studies

All courses are offered to other NOAA employees and key partners at cost. The online training is available to anyone, including academia and technical user groups.

5. LOCAL OFFICE WORKLOAD

An extensive array of relevant climate services activities is presented in this document. Some of them are basic and common to all local offices, particularly those related to routine monitoring and data dissemination, prediction and assessment products, and training. Other issues and challenges are not uniform across the country. For example, some areas experience greater impacts from particular climate signals with subsequent socio-economic consequences, whereas others may have very limited climate-related impacts. Some locales have greater populations that require more outreach activities.

The provision of climate services is a team effort, requiring participation of several members of the local office in addition to the CSFP. This distribution of duties among employees is the ultimate responsibility of the MIC/HIC, who also has the authority to determine workload allocation.

The NWS has operated under the guidelines established by the NWS Director in 2003, which mandated that at least 0.5 FTE in each field office be dedicated to perform the activities required to support the NWS climate mission.



NWS CLIMATE SERVICES: REGIONAL HEADQUARTERS OFFICES

Regional headquarters offices serve as the liaisons to national offices, ensuring local compliance to NWS policies, and providing applied science, tools, and training to support local climate programs. Additionally, they initiate, coordinate, and foster regional partnerships and climate services activities.

REGIONAL DIRECTOR

The NWS Regional Director

- ◆ Appoints a CSPM
- ◆ Allocates regional resources (i.e. funding, personnel, training, etc) to support climate services
- ◆ Promotes the NWS strategic goal to enhance climate services
- ◆ Promotes the NOAA climate goal at the regional level and supports coordination with RCSD and other NOAA climate stakeholders
- ◆ Ensures CSPM and CSFP professional development in climate science and services
- ◆ Ensures the development, implementation, and revision of a regional climate services plan that is consistent with the national plan
- ◆ Includes climate-related milestones in the annual regional operating plan
- ◆ Ensures that national policies and directives are regionally supplemented
- ◆ Ensures that regional NWS observing systems are managed in accordance with data continuity plans

CLIMATE SERVICES PROGRAM MANAGER (CSPM)

The CSPM supports the local offices as the liaison to national offices, ensuring local compliance to NWS climate services policies, and providing applied science, technologies, tools, communication, and training. The CSPM also initiates, coordinates, and fosters regional partnerships and climate services activities. The CSPM ensures field offices have adequate resources (within fiscal constraints) to fulfill their mission. Specific activities of CSPMs are listed below:

BUDGET / RESOURCES

- ◆ Develop and track regional spending plans and report expenditures to CSD
- ◆ Allocate resources to field offices
- ◆ Conduct field office assessments/program reviews

COMMUNICATION

- ◆ Support exchange of information among field offices, NWS Headquarters, and regional users
- ◆ Communicate with the RCSD on NOAA climate services initiatives and identify opportunities for joint activities
- ◆ Promote partnerships to identify local-level priorities and develop regional products

- ◆ Provide input to NOAA's ClimateWatch Magazine
- ◆ Coordinate regional input for NOAA's Climate Portal
- ◆ Distribute relevant information to the local offices from CPC or CSD such as upcoming local meetings, press releases, and notification that feedback is being sought on products
- ◆ Utilize the climate listserv to communicate routine and relevant climate news, announcements, training opportunities, inquiries, and surveys
- ◆ Solicit local office and regional user input for monthly teleconferences with NWS Headquarters (NWSH) CSD

DECISION SUPPORT SERVICES

- ◆ Enhance and promote decision support services through integration of climate information into other NWS decision support activities
- ◆ Provide data interpretation to regional customers

LOCAL STUDIES

- ◆ Investigate opportunities for regional and local studies by establishing working relationships with local academic communities
- ◆ Provide guidance, expertise, and tools to local offices for conducting studies
- ◆ Support development of techniques for local offices to generate local conditional climatologies
- ◆ Review scientific findings of local climate studies
- ◆ Coordinate local offices' participation as beta-test sites for transition of new climate products and services from research to operations

DATA

- ◆ Coordinate with regional Observing Services Program Manager on data-related activities
- ◆ Ensure local offices serve as data stewards in the gathering, quality control, and dissemination of data, including the application of COOP modernization and data continuity plans
- ◆ Distribute materials on the importance of accurate observations and metadata to field and volunteer observers

OUTREACH

- ◆ Provide materials and tools for regional and local climate services
- ◆ Know where to refer customers for additional information to answer complex climate questions

PARTNERSHIPS

- ◆ Engage regional partners in the development and delivery of climate services
- ◆ Provide regional coordination with RCSDs and external key partners and users such as RCCs, RISAs, and SCs

PLANNING

- ◆ Develop a regional climate services plan in coordination with their respective RCSD and the CSD
- ◆ Implement national climate services policies and directives
- ◆ Set annual goals for regional and local offices for planned activities (face-to-face interactions)

PRODUCTS

- ◆ Collect, synthesize, and convey input from partners and local offices to NWS Headquarters (CSD) on national products such as the Drought Monitor, Drought Outlook, Hazards Assessment, and others
- ◆ Collaborate with national offices on testing new methods at the regional level
- ◆ Recommend improvements for regional and local products and services
- ◆ Ensure regional and local observations and forecast products (e.g., Local 3-Month Temperature Outlook) meet national standards for dissemination

REQUIREMENTS

- ◆ Follow the existing policy for communicating requirements and feedback as per NWSI 10-102, "New and Enhanced Products and Services"
- ◆ Solicit and/or identify feedback from local offices and regional customers for monthly teleconferences with NWS Headquarters (CSD) to improve existing products and to identify requirements for new ones

TRAINING

- ◆ Monitor, coordinate, and manage CSFP professional development in the area of climate science and services
- ◆ Assess field training needs in collaboration with CSD
- ◆ Oversee capacity building of local staff

APPENDIX A: NWS CLIMATE SERVICES ORGANIZATIONAL STRUCTURE

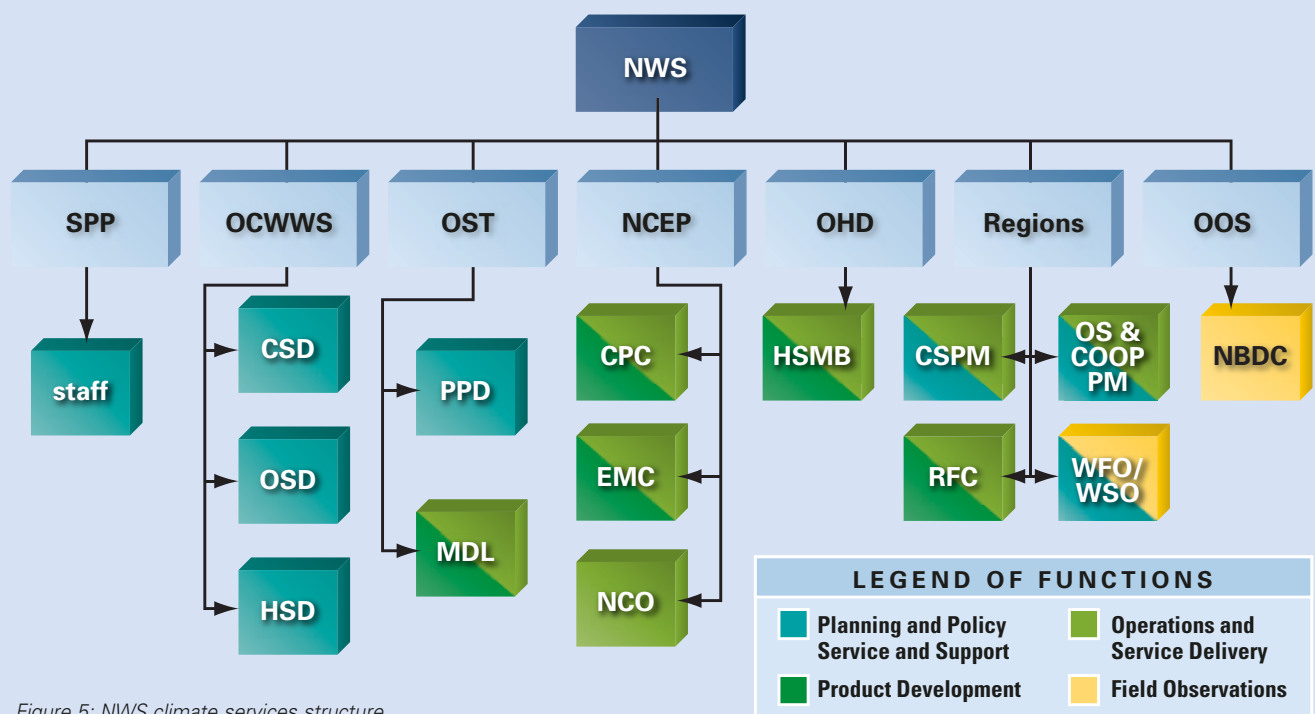


Figure 5: NWS climate services structure

NWS – National Weather Service

SPP – Strategic Planning and Policy Office

OCWWS – Office of Climate, Water, and Weather Services

CSD – Climate Services Division

OSD – Observing Services Division

HSD – Hydrologic Services Division

OST – Office of Science and Technology

PPD – Programs and Plans Division

MDL – Meteorological Development Laboratory

NCEP – National Centers for Environmental Prediction

CPC – Climate Prediction Center

EMC – Environmental Modeling Center

NCO – NCEP Central Operations

OHD – Office of Hydrologic Development

HSMB – Hydrologic Science and Modeling Branch

Regions – NWS Regional Headquarters

CSPM – Climate Services Program Managers

OS&COOP PM – Observing System and COOP Program Managers

RFC – River Forecast Center

WFO/WSO – Weather Forecast Office / Weather Service Office

OOS – Office of Operational Systems

NDBC – National Data Buoy Center



NWS climate services structure is schematically shown in Figure 5. The service is supported by four main functions:

- ◆ Planning and Policy, Service Support: programmatic planning, coordination, developing policies and directives, processing user requirements, training, and facilitating data management
- ◆ Product Development: research and development of operational products and services
- ◆ Operations and Service Delivery: maintenance of service delivery tools and means, delivery of scheduled climate products, outreach and education of NWS climate users
- ◆ Field Observations: collecting climate observation records, ensuring data quality, and transmitting the data to archiving entities

NWS CLIMATE SERVICES: NATIONAL OFFICES AND CENTERS

Office of Strategic Planning and Policy (SPP)

SPP develops NWS-wide policy objectives, and provides guidance and support for the integration of policy, strategy, and long-range planning processes. SPP develops and recommends policy on NWS/NOAA and private sector roles, activities, and relationships; and provides guidance necessary in the formulation of external agreements involving data rights and intellectual property issues.

Office of Climate, Water, and Weather Services (OCWWS)

OCWWS establishes national policy and requirements, secures and allocates resources, and acts as the national coordinator for climate, water, and weather services, training and outreach delivered by NWS field offices. OCWWS is also responsible for outreach efforts to promote the NWS climate services program with national users and partners.

OCWWS Climate Services Division (CSD)

CSD, located at NWSH OCWWS, administers the NWS Climate Services Program, including the policies and requirements for climate prediction products and other services. CSD provides support and guidance (e.g., how to conduct local climate studies) to the NWS field offices; collects and responds to user needs and product requirements for NWS climate operations (i.e., national centers, regional headquarters and local offices); provides stewardship of the climate data record by ensuring adherence to data quality and continuity procedures; develops and executes climate training programs; represents NWS in appropriate NOAA climate services; and supports NWS international activities. CSD maintains the Partners Exchange Program that promotes partnerships, shares best practices, and guides new climate services providers. For details of CSD activities, please see Appendix B.

OCWWS Observing Services Division (OSD)

OSD is responsible for policies and procedures for observing, monitoring, acquisition, and dissemination of data, including standards, in support of climate services (per guidance in NWS Instructions 10-13).

Office of Science and Technology (OST)

OST constructs the NWS science and technology roadmap in climate prediction and other applications for intraseasonal to inter-annual time scales. OST identifies new methodologies for infusion of science into operations. OST’s Meteorological Development Laboratory (MDL) manages the Operations and Services Improvement Process (OSIP) used for documenting, coordinating, and developing new local climate products and services. OST ensures that research, development, and strategic planning, including budgeting needed for climate data continuity studies, are provided.

National Centers for Environmental Prediction (NCEP)

NCEP delivers science-based climate analyses, diagnostics, guidance, forecasts, and warnings to the NWS field offices, the Nation, and the global community. NCEP has nine centers, of which three (described below) provide direct climate support to the field offices.

NCEP Climate Prediction Center (CPC)

CPC develops and delivers centralized numerical and web-interactive climate predictions, monitoring and outlook products, assessments, and discussions. Output is generated for time scales of weeks to years, for NWS field offices, the Nation, and the global community.

CPC coordinates with NWS field operations and CSD to (1) identify and develop user requirements, (2) improve operational climate outlooks and monitoring and assessment products, (3) improve delivery of climate products and services and measure success through a variety of web-interactive and direct outreach mechanisms (meetings, telephone conference calls, and webinars), (4) accelerate the transition of science and technology advances which specifically improve operational climate models and forecasts, (5) take advantage of opportunities to develop collaborative products and services, both within NWS and with users and partners, and (6) enhance climate training and ensure consistency with NOAA and NWS training plans.

CPC manages the NOAA Climate Test Bed (CTB), a facility to improve climate products and facilitate transition from climate research to operations. CPC provides NWS operational climate services consistent with the execution of NWS policy directives.

CPC engages in a broad set of international activities that serve to strengthen partnerships and build capacity for international decision support. CPC provides international expert assessment products, as well as weather and climate information, that are used to assess past, present, and future conditions around the globe. Specific expert assessment products include seasonal

rainfall outlooks using the NCEP Climate Forecast System (CFS), extended range and long-range weather and climate guidance, and global and regional hazards outlooks prepared in coordination with national and international partners, including USAID's Famine Early Warning System (FEWSNET) team. CPC also provides global monsoon monitoring products, including weekly updates for each of the regional monsoon systems (Africa, Asia, North America, and South America).

To carry out these activities, CPC provides access to a wide range of global prediction and monitoring products in real-time obtained from the NCEP Global Forecast System (GFS) and CFS, and a suite of operational analyses based on in situ and satellite observations (including gridded global precipitation and temperature analyses).

CPC is heavily engaged in professional development training through the African Desk and Monsoon Desk training programs. These desks provide opportunities for professional meteorologists and university scientists in Africa, Asia and elsewhere to train and collaborate at NCEP. Tailored curricula have been developed to meet the needs of participants, improve climate services and enhance capacity building.

NCEP Environmental Modeling Center (EMC)

EMC is responsible for operational CFS development, implementation, and maintenance, including the execution of all necessary reanalyses and reforecasts to meet CPC's operational requirements. EMC works closely with CPC to produce and verify the operational CFS products to meet climate services requirements. EMC works through CTB to accelerate CFS model and data assimilation improvements proposed by the research community which receives a subset of CFS data.

Recent advances in CFS have demonstrated a level of skill in forecasting U.S. surface temperature and precipitation that is comparable to the skill of the statistical methods used by the CPC. This represents a significant improvement over the previous dynamical modeling system. The skill provided by the CFS spatially and temporally complements the skill provided by the



statistical tools. The availability of a dynamical modeling tool with demonstrated skill should result in overall improvement in the operational seasonal forecasts.

NCEP Central Operations (NCO)

NCO sustains and executes the operational suite of the numerical analysis and forecast models and prepares NCEP products for dissemination. It also links all nine of the national Centers together via computer and communications-related services.

Office of Hydrologic Development (OHD)

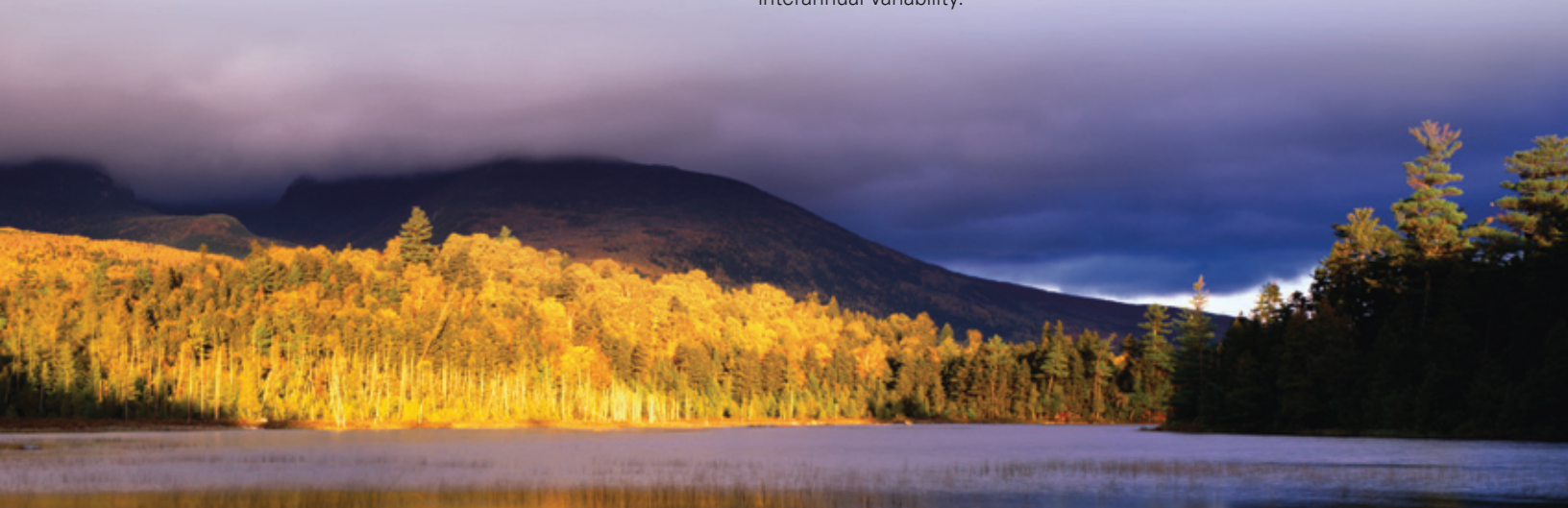
OHD and OCWWS work together to support the provision of climate services as they relate to water resources. OHD, together with the OCWWS Hydrologic Services Division and NWS field offices, provides hydrologic research, development, and operational services ranging from flood warnings to the support of water resources management. OHD develops federal standard climatologies of rainfall used as civil engineering design criteria for the nation's building infrastructure. OHD also makes real-time observations from federal, state, and local agencies using the Geostationary Operational Satellites (GOES) Data Communications System, available to NWS and NOAA operations. CSD and OHD work together to enhance coordination of linkages between water- and climate-related activities such as providing climate context of hydrologic events, and the use of climate information in hydrologic predictions.

Office of Operational Systems (OOS)

OOS provides system engineering, hardware and software management and maintenance, facilities engineering services, communications, and logistics services for operational systems supporting the climate services program. OOS provides resources for climate data continuity studies. It develops policy for implementation, operations, support, and evaluation of operational weather systems.

National Data Buoy Center (NDBC)

NDBC designs, develops, operates, and maintains a network of data-collecting buoys and coastal stations. The buoy data are critical for climate research, monitoring, and predictions. The TAO/TRITON array is a network of deep ocean moorings at 67 sites (55 TAO buoys maintained by the US and 12 TRITON buoys maintained by Japan) in the tropical Pacific Ocean. The array covers one-third the circumference of the globe near the equator and provides a stream of real-time data that are critical for scientific research, real-time monitoring and operational weather and climate forecasting communities around the world. The TAO/TRITON moored buoy array is the cornerstone of the ENSO Observing System because it systematically measures oceanic and atmospheric components that contribute to ENSO and intra-seasonal to interannual predictability. The array provides real-time data to operational weather and climate forecasting centers such as NCEP, ECMWF, etc. for improved prediction and real-time monitoring of El Niño and La Niña and intraseasonal-to-interannual variability.



APPENDIX B: THE ROLES AND RESPONSIBILITIES OF THE CSD

◆ Policy and Planning

- NWS Strategic Plan and Roadmap
- Contribution to Climate and Weather Goals for Strategic Execution and Evaluation
- Maintain Policy Directive series: 10-10, 10-12, and 10-21
- NWS Climate Services Operations Document
- NWS Annual Operating Plan
- Contribution to NOAA Energy Plan
- Participation in NOAA climate services teams

◆ AWIPS Representative for Climate

◆ Budget Planning and Tracking

◆ Data Management and Stewardship

- Process Change Management Requests
- Climate Records (observations to data products on the Web; field support and liaison to NCDC)
- COOP Program Management for climate
- Data continuity assurance
- Data tools – quality control; paperless initiative for reporting; data threading
- Representative for climate portions of the national web page

◆ User Requirements

- Directory of Regional and Local Climate User Needs
- Annual Customer Satisfaction Surveys
- Organization of special climate user events: e.g. CFSv2 , Drought Monitor Forum, etc.

◆ Partnership Development - Liaison roles

- CPC, NCDC, CPO & USGCRP (US Global Change Research Program), ESRL
- Hydrology/Fire Weather/Health
- National Integrated Drought Information System/ Drought
- NOAA Marine Sanctuaries, NOS
- Regional Climate Centers
- American Association of State Climatologists – Executive Board member
- Centers for Disease Control and Prevention
- Department of Energy and institutions of the NOAA Energy Plan
- Intergovernmental climate teams
- Research institutions and academic partnerships

◆ Training development

- Online training – 30 hours
- Residence courses
 - Operational Climate Services Delivery
 - Advanced Climate Variability and Change
- Virtual course
 - Climate Variability and Change Virtual Course (CVCVC)
- Training for technical user groups

◆ **Local Climate Products and Tools**

- Local 3-Month Temperature Outlook (developed and transitioned to CPC; dissemination through local climate web pages supported by CSD)
- Local 3-Month Precipitation Outlook (facilitating development)
- Local Climate Analysis Tool (LCAT) with MDL
- NOAA Online Weather Data (NOWData); xmACIS (for field staff)
- Climate Summaries dissemination via NWS climate web sites

◆ **Outreach**

- Annual Climate Prediction Applications Science Workshop (CPASW)
- Climate Services section at Annual Climate Diagnostics and Prediction Workshop
- Partnership Exchange Program – visitor program to enhance partnership projects
- Development of outreach materials (standard presentations, factsheets, etc.)

◆ **Climate Services for Decision Support**

- Climate.gov
 - Facilitate NWS input to ClimateWatch Magazine, Products and Services, and Education sections
 - Maintain regional and local climate pages that are linked from climate.gov
- Lead the development of Devils lake, ND, Decision Support System <http://www.devilslake.noaa.gov/> and other DSS activities
- Facilitate the development of consistent messaging, common understanding, and coordinated release of information on climate and weather linkages for decision support

◆ **Education**

- NOAA Education Council member
- NOS Climate Stewards Program Leadership team
- Participation in National Science Teachers Association annual conference
- NOAA Education PreK-20 subgroup co-chair
- Development of education materials for elementary level for use by NWS field staff
- NOAA Climate Education working group

◆ **Regional Climate Program Coordination**

- Monthly Climate Services Program Managers (CSPMs) call
- Annual face-to-face meeting
- Listserv development and web site for field support

◆ **International Activities**

- Global Framework for Climate Services Implementation Plan – team member for chapter on research, modeling, and prediction
- Lead for international climate initiatives: Brazil training, North American RCC, CoCoRaHS expansion to the international community



APPENDIX C: CPC OFFICIAL PRODUCT LIST

1 Crop Moisture Index

(http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/cmi.gif) – The Climate Prediction Center’s and U.S. Department of Agriculture’s Joint Agricultural Weather Facility (JAWF) produces the Crop Moisture Index chart. The index indicates short term conditions

2 One-Month Climate Outlook (Contiguous U.S. and Alaska)

(<http://www.cpc.ncep.noaa.gov/products/predictions/30day>) – Probabilistic one-month temperature and precipitation outlook

3 One-Month Outlook Discussion (Contiguous U.S. and Alaska)

(<http://www.cpc.ncep.noaa.gov/products/predictions/30day/fxus07.html>) – Technical discussion of the meteorological and climatological basis for the one-month outlooks

4 Three-Month Climate Outlooks (Contiguous U.S. and Alaska)

(<http://www.cpc.ncep.noaa.gov/products/predictions/90day>) – Series of thirteen probabilistic three-month temperature and precipitation outlooks

5 Three-Month Outlooks Discussion (Contiguous U.S. and Alaska)

(<http://www.cpc.ncep.noaa.gov/products/predictions/90day/fxus05.html>) – Technical discussion of the meteorological and climatological basis for the outlooks

6 Three-month Probability of Exceedence Outlooks

(<http://www.cpc.ncep.noaa.gov/pacdir/NFORdir/HOME3.shtml>) – Series of thirteen three-month probability of exceedence outlooks for temperature, precipitation, and heating and cooling degree days for the conterminous U.S.

7 6- to 10-Day and 8- to 14-Day Mean North American 500 millibar Outlook

(<http://www.cpc.ncep.noaa.gov/products/predictions/610day/500mb.php>) – Product to provide insight into the 6- to 10-day and 8- to 14-day temperature and precipitation outlooks by indicating mean circulation patterns

8 Atlantic Hurricane Season Outlook

(<http://www.cpc.ncep.noaa.gov/products/outlooks/hurricane.shtml>) – Hurricane Outlook for the Atlantic basin

9 Eastern Pacific Hurricane Season Outlook

(http://www.cpc.ncep.noaa.gov/products/Epac_hurr/Epac_hurricane.html) – Hurricane Outlook for the eastern Pacific east of 140° West. CPC issues this outlook in cooperation with the Tropical Prediction Center and NOAA’s Hurricane Research Division

10 CLIMAT Messages

(<http://products.weather.gov/detail.php?selrow=12>) – “CLIMAT” is the program for the international exchange of monthly mean data. The World Data Center for Meteorology, operated by the National Climatic Data Center, collects CLIMAT messages for publication under WMO sponsorship

11 El Niño/Southern Oscillation (ENSO) Diagnostic Discussion

(http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory) – Monthly bulletin to provide insight into climate outlooks by reviewing the potential effects of the ENSO

12 Climate Diagnostics Bulletin

(<http://www.cpc.ncep.noaa.gov/products/CDB>) – Monthly report on the status of the ocean-atmosphere climate system in the tropics and extratropics

13 6- to 10-Day and 8- to 14-day Excessive Heat Outlooks

(http://www.cpc.ncep.noaa.gov/products/predictions/610day/gifs/appt_maps.08.35.a.gif) – 6- to 10-Day and 8- to 14-Day excessive heat outlooks in probabilistic format for the Contiguous U.S. for April through September

14 6- to 10-Day and 8- to 14-Day Wind Chill Index Outlooks

(http://www.cpc.ncep.noaa.gov/products/predictions/short_range/cold/wc_610.php) – The Climate Prediction Center issues 6- to 10-Day and 8- to 14-Day wind chill index outlooks in probabilistic format for the contiguous U.S. for the months of October through March

15 Hawaiian One-Month and Three-Month Outlooks and Discussion

(<http://www.cpc.ncep.noaa.gov/products/predictions/90day/fxhw40.html>) – A one-month and a series of thirteen three-month temperature and precipitation outlooks for selected cities in Hawaii and an accompanying prognostic discussion

16 3- to 14-day Hazards Assessment

(http://www.cpc.ncep.noaa.gov/products/predictions/threats/p_threats.gif) – Product for the contiguous U.S. and Alaska to provide potential hazardous conditions from extreme temperature, high wind, heavy precipitation or lack of precipitation, and dry or moist soils and wildfire risk

17 6- to 10-Day and 8- to 14-day Maximum Heat Index Prediction

(http://www.cpc.ncep.noaa.gov/products/predictions/short_range/heat/hi_610.php) – 6- to 10-Day and 8- to 14-Day Maximum Heat Index Predictions for approximately 200 locations in the Contiguous U.S. for April through September

18 6- to 10-Day and 8- to 14-Day Temperature and Precipitation Outlooks (Contiguous U.S. and Alaska)

(<http://www.cpc.ncep.noaa.gov/products/predictions/610day>) – 6- to 10-Day and 8- to 14-Day outlooks in probabilistic format for the Contiguous U.S. and Alaska

19 6- to 10-Day and 8- to 14-Day Outlook Discussion (Contiguous U.S. and Alaska)

(<http://www.cpc.ncep.noaa.gov/products/predictions/610day/fxus06.html>) – Technical discussion of the meteorological and climatological basis for the outlooks

20 Probability of Exceedence Outlook for Center Probability Distribution (50 percent)

(<http://www.cpc.ncep.noaa.gov/products/predictions/90day/lead01/poep.html>) – Series of thirteen three-month graphical outlooks for the 50 percent probability of exceedence (or center probability distribution) for temperature and precipitation across the contiguous U.S.

21 Tropical Pacific Mean Sea-Surface Temperature (SST) Outlook

(<http://www.cpc.ncep.noaa.gov/products/predictions/90day/SSTs>) – Climate outlook techniques rely significantly upon the slowly varying global SST field and do not have useable accuracy at long lead times. These SST outlooks make tangible the results of research activities by scientists

22 U.S. Drought Outlook Discussion

(http://www.cpc.ncep.noaa.gov/products/expert_assessment/DOD.html) – Drought Outlook discussion for the remaining part of the month of issuance plus the next three months

23 3- to 14-day Hazards Assessment Discussion

(<http://www.cpc.ncep.noaa.gov/products/predictions/threats/threats.php>) – Text discussion for the contiguous U.S. and Alaska with technical insight to further assist in assessing potentially hazardous conditions in the 3-to 14-Day Hazards Assessment

24 U.S. Drought Outlook

(http://www.cpc.ncep.noaa.gov/products/expert_assessment/seasonal_drought.html) – National Drought Outlook for the remaining part of the month of issue plus the next three months

25 National Drought Summary

(<http://drought.unl.edu/dm/monitor.html>) – NOAA's Climate Prediction Center and National Climatic Data center (NCDC), the U.S. Department of Agriculture, and the National Drought Mitigation Center (NDMC) jointly issue this narrative summarizing drought conditions with a look ahead

26 Palmer Drought Severity Index

(http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/palmer.gif) – The Climate Prediction Center's and U.S. Department of Agriculture's Joint Agricultural Weather Facility (JAWF) produces the Palmer Drought Severity Index chart. The index indicates long term conditions

27 Weekly Weather and Crop Bulletin

(<http://www.usda.gov/oce/weather/pubs/Weekly/Wwcb/index.htm>) – The Climate Prediction Center's (CPC) and U.S. Department of Agriculture's Joint Agricultural Weather Facility (JAWF) issue this weekly report containing written summaries of domestic and international agricultural weather conditions

28 Global Tropical Hazards Outlook

(<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>) – The Climate Prediction Center issues an outlook for global hazards for the upcoming Week-1 and Week-2 time periods for areas expecting enhanced or suppressed rainfall integrated over a week and regions where conditions are especially favorable or unfavorable for tropical cyclogenesis



APPENDIX D: NOWDATA *(NOAA Online Weather Data)*

What is NOWData?

NOAA's Online Weather Data (NOWData) is a data query system providing basic climate statistics to the public, using the NOAA RCC Applied Climate Information System (ACIS). Through NOWData, climate statistics are available, on a preliminary basis, for over 3,800 surface observing stations from across the conterminous U.S., Alaska, Hawaii, Puerto Rico, the Virgin Islands, and Guam. Daily and monthly data for temperature, precipitation, snowfall, and heating/cooling/growing degree days are available for the current and previous years. Climate normals are available for the 1971-2000 period and extreme values are available for the full period of record for each station. Data from the 19th Century to yesterday can be found in NOWData.

How to access NOWData?

Click the area of interest on the map at <http://www.weather.gov/climate> to access a local NWS WFO climate page, and then select the NOWData tab on the upper right.

NOWData may also be accessed directly from any local NWS WFO homepage by selecting "Local" under Climate from the list on the left and then the NOWData tab on the upper right of the local climate page.

At the NOWData interface, select a location and one of the nine products available. Then make additional selections from any menus that appear and select "Go." The product will be displayed in a separate screen.

Why NOWData?

The most common question asked of NWS personnel is "What was the weather like on...?" NOWData provides that answer and much more:

- ◆ Unprecedented, user-friendly access to climate information for the general public
- ◆ Convenient "one-stop" tool for more traditional users
- ◆ Integrates climate information across all of NOAA
- ◆ Supports NOAA's commitment to provide data to the public

Who is responsible for NOWData?

NOWData was developed by NOAA as a joint project between NWS, NCDC and the RCCs.

Where to get additional information?

NOWData statistics and information are considered preliminary and subject to revision. Official and certified climatic data can be accessed at NCDC (<http://www.ncdc.noaa.gov/oa/ncdc.html>). NOWData is designed to provide statistical information. Users interested in lengthy data histories for stations should contact NCDC or the RCCs.



APPENDIX E:

XMACIS

XmACIS is a web-based interface that provides interactive access to climatological summary products. The products are based on data from the Regional Climate Centers' constantly-updated climate database (ACIS). To access the system use the address: <http://xmacis.rcc-acis.org>.

Using this address, the user will need to select the office identifier from a drop-down menu. To go directly to the web page incorporating the office's custom station list, use the above address followed by a slash (/) and the office identifier used when the office's station list was created. For example, Boston would use the address: <http://xmacis.rcc-acis.org/BOX>

The custom station lists in xmACIS can be modified upon request. Stations can be added to or removed from the station lists. Some offices may wish to delete stations from their list, for instance, if their list proves to be too long and unwieldy. Requests for changes should be sent to your regional CSPM and are usually incorporated into xmACIS near the middle of each month. When requesting the addition of a station to a list, include both the new station's name and identifier. Note that stations with no data in the ACIS database will not appear on the xmACIS web page. Supplemental Aviation Weather Reporting Stations (SAWRS), for instance, which only have hourly observations (no daily data), are not available in xmACIS.

The xmACIS web page consists of two frames. The frame on the left is used to select program options. When the "Submit" button is selected, the results appear in the right frame. The enter key cannot be used to submit your request - the "Submit" button must be used. The browser's back arrow does not have any functionality in xmACIS and should not be used. A "Help" button in the options frame displays a page containing brief product descriptions. A more complete "xmACIS User's Guide" is available in PDF format via a link on the help page, or at http://xmacis.rcc-acis.org/static/xmACIS_Users_Guide.pdf

Questions regarding ACIS data availability should be routed through the regional CSPMs. The regions can filter these requests and work with the appropriate RCC for resolution. Data that has been key-entered at local offices can be added to the xmACIS database by contacting the Northeast RCC. Ideas for future enhancements to the xmACIS suite of products should also be routed through the regional headquarters.

Questions regarding xmACIS capabilities and problem reports can be sent to xmacis@nrcc.cornell.edu. This address is also available as a link on the xmACIS help page.

xmACIS is for National Weather Service internal use only. The URLs should **not** be given out to anyone outside of NWS. The RCCs have developed NOWData for general public access to the ACIS database.



APPENDIX F: RESOURCES

NWS DIRECTIVES

NDS 10-10 Climate Services

- ◆ 10-1001 Climate Outlooks
- ◆ 10-1002 Climate Monitoring
- ◆ 10-1003 Climate Data Services
- ◆ 10-1004 Climate Records
- ◆ 10-1005 Local Climate Outlooks

NDS 10-12 Drought Services

- ◆ 10-1201 WFO Drought Products Specification
 - WR - Western Region Drought Related Services and Support
- ◆ 10-1202 National Drought Products

NDS 10-21 Intercomparison of Hydrometeorological Instruments and Algorithms

- ◆ 10-2101 General Instructions for Terrestrial-Based In-Situ Instrument and Algorithm Intercomparisons for the Purpose of Climate Data Continuity

WEB-BASED RESOURCES

NWS Climate Services WFO Support Intranet (<https://ocwws.weather.gov/intranet/climate>)

- ◆ Requires login using your NOAA email name and password
- ◆ Provides materials and information for WFO personnel to use in their climate-related outreach efforts.

- ◆ Available resources include
 - Quick Reference Materials
 - Public Fact Sheets
 - Standard PowerPoint Presentations
 - Posters
 - Climate Change Resources
 - Links to Regional Resources and On-line Training
 - Link for feedback, which WFO personnel are also strongly encouraged to use as it is provided to facilitate direct communications from field staff to both the Climate Services Division and the Climate Prediction Center

Climate Prediction Center (<http://www.cpc.ncep.noaa.gov>)

- ◆ Climate Glossary (<http://www.cpc.ncep.noaa.gov/products/outreach/glossary.shtml>)
- ◆ Historic Archive of North American Teleconnection Indices (<http://www.cpc.ncep.noaa.gov/data/teledoc/telecontents.shtml>)
- ◆ MJO Information (<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml>)
- ◆ Monitoring Weather and Climate (http://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_ao_index/history/history.shtml)
- ◆ Monthly Atmospheric and SST Indices (<http://www.cpc.ncep.noaa.gov/data/indices>)
- ◆ Oceanic and Atmospheric Data (http://www.cpc.ncep.noaa.gov/products/monitoring_and_data/oadata.shtml)

OTHER NWS SITES

- ◆ Analysis Resource Center
(<http://ww2.wrh.noaa.gov/hsd/climate/L3MTO/ARC>)
- ◆ Climate Services Professional Development Series
(<http://www.weather.gov/om/csd/pds>)
- ◆ HPC Daily Weather Maps
(<http://www.hpc.ncep.noaa.gov/dailywxmap>)
- ◆ Storm Prediction Center Climate Data
(<http://www.spc.noaa.gov/climo>)
- ◆ Severe Plot2 from SPC
(<http://www.spc.noaa.gov/software/svrplot2>)
- ◆ NCDC Storm Data
(<http://www4.ncdc.noaa.gov/cgi-win/wwwcgi.dll?wwevent~storms>)
- ◆ Precipitation analysis site
(<http://water.weather.gov>)

NOAA AND NOAA-AFFILIATED SITES

- ◆ NOAA Climate Services
(<http://www.climate.gov>)
- ◆ NOAA National Climatic Data Center
(<http://www.ncdc.noaa.gov/oa/ncdc.html>)
- ◆ NOAA Earth System Research Laboratory
(<http://www.esrl.noaa.gov>)

- ◆ NOAA Climate Program Office
(<http://www.climate.noaa.gov>)
- ◆ Pacific ENSO Applications Center
(<http://www.prh.noaa.gov/peac>)
- ◆ Regional Climate Centers
(<http://lwf.ncdc.noaa.gov/oa/climate/regionalclimatecenters.html>)
- ◆ Regional Integrated Science Assessments (RISAs) programs
(http://www.climate.noaa.gov/cpo_pa/risa)
- ◆ State Climate offices
(<http://www.stateclimate.org>)
- ◆ International Research Institute for Climate and Society
(<http://portal.iri.columbia.edu/portal/server.pt>)

USDA Weekly Weather and Crop Bulletin (<http://www.usda.gov/oce/weather/pubs/Weekly/Wwcb>)

Weickmann and Berry (ESRL) MJO Experimental Forecasts (http://www.cdc.noaa.gov/MJO/Forecasts/climate_discussions.html)

National Academies Press, Communicating Uncertainties in Weather and Climate Information: (2003), 3. Lessons Learned from the Case Studies <http://books.nap.edu/books/0309085403/html/39.html#pagetop>

U.S. Drought Monitor
(<http://droughtmonitor.unl.edu>)



APPENDIX G:

GLOBAL CLIMATE OBSERVING SYSTEM: CLIMATE MONITORING PRINCIPLES

Effective monitoring systems for climate should adhere to the following principles*:

1. The impact of new systems or changes to existing systems should be assessed prior to implementation.
2. A suitable period of overlap for new and old observing systems is required.
3. The details and history of local conditions, instruments, operating procedures, data processing algorithms and other factors pertinent to interpreting data (i.e., metadata) should be documented and treated with the same care as the data themselves.
4. The quality and homogeneity of data should be regularly assessed as a part of routine operations.
5. Consideration of the needs for environmental and climate-monitoring products and assessments, such as IPCC assessments, should be integrated into national, regional and global observing priorities.
6. Operation of historically-uninterrupted stations and observing systems should be maintained.
7. High priority for additional observations should be focused on data-poor regions, poorly- observed parameters, regions sensitive to change, and key measurements with inadequate temporal resolution.
8. Long-term requirements, including appropriate sampling frequencies, should be specified to network designers, operators and instrument engineers at the outset of system design and implementation.
9. The conversion of research observing systems to long-term operations in a carefully-planned manner should be promoted.
10. Data management systems that facilitate access, use and interpretation of data and products should be included as essential elements of climate monitoring systems.

Furthermore, operators of satellite systems for monitoring climate need to:

- (a) Take steps to make radiance calibration, calibration-monitoring and satellite-to-satellite cross-calibration of the full operational constellation a part of the operational satellite system; and
- (a) Take steps to sample the Earth system in such a way that climate-relevant (diurnal, seasonal, and long-term interannual) changes can be resolved.

* The ten basic principles (in paraphrased form) were adopted by the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) through decision 5/CP.5 at COP-5 in November 1999. This complete set of principles was adopted by the Congress of the World Meteorological Organization (WMO) through Resolution 9 (Cg-XIV) in May 2003; agreed by the Committee on Earth Observation Satellites (CEOS) at its 17th Plenary in November 2003; and adopted by COP through decision 11/CP.9 at COP-9 in December 2003.

Thus satellite systems for climate monitoring should adhere to the following specific principles:

- 11.** Constant sampling within the diurnal cycle (minimizing the effects of orbital decay and orbit drift) should be maintained.
- 12.** A suitable period of overlap for new and old satellite systems should be ensured for a period adequate to determine inter-satellite biases and maintain the homogeneity and consistency of time-series observations.
- 13.** Continuity of satellite measurements (i.e. elimination of gaps in the long-term record) through appropriate launch and orbital strategies should be ensured.
- 14.** Rigorous pre-launch instrument characterization and calibration, including radiance confirmation against an international radiance scale provided by a national metrology institute, should be ensured.
- 15.** On-board calibration adequate for climate system observations should be ensured and associated instrument characteristics monitored.
- 16.** Operational production of priority climate products should be sustained and peer-reviewed new products should be introduced as appropriate.
- 17.** Data systems needed to facilitate user access to climate products, metadata and raw data, including key data for delayed-mode analysis, should be established and maintained.
- 18.** Use of functioning baseline instruments that meet the calibration and stability requirements stated above should be maintained for as long as possible, even when these exist on de-commissioned satellites.
- 19.** Complementary in situ baseline observations for satellite measurements should be maintained through appropriate activities and cooperation.
- 20.** Random errors and time-dependent biases in satellite observations and derived products should be identified.

APPENDIX H:

ACRONYMS

AASC	American Association of State Climatologists	NRC	National Research Council
ARC	Analysis Resource Center	NWS	National Weather Service
COMET	Cooperative Program for Operational Meteorology, Education and Training	NWSTC	National Weather Service Training Center
COOP	Cooperative Observer Program	OAR	Office of Oceanic and Atmospheric Research
CPC	Climate Prediction Center	OCWWS	Office of Climate, Water, and Weather Services
CSD	Climate Services Division	OPL	Observing Program Leader
CSFP	Climate Services Focal Point (Local offices)	PCU	Professional Competency Unit
CSPM	Climate Services Program Manager (Regional Headquarters)	PEAC	Pacific ENSO Applications Center
CWA	County Warning Area	PDO	Pacific Decadal Oscillation
DAPM	Data Acquisition Program Manager	PDS	Professional Development Series
DOH	Development and Operations Hydrologist	PNA	Pacific/North American pattern
ENSO	El Niño-Southern Oscillation	PNS	Public Information Statement
ESRL	Earth System Research Laboratory	QA/QC	Quality Assurance/Quality Control
FTE	Full-time employee	RCC	Regional Climate Center
GCOS	Global Climate Observing System	RCSD	Regional Climate Services Director
GHCN	Global Historical Climatology Network	RFC	River Forecast Center
HCN	Historical Climate Network	RISA	Regional Integrated Sciences and Assessments
HIC	Hydrologist-in-Charge	SAWRS	Supplemental Aviation Weather Reporting Station
HMT	Hydro-Meteorological Technician	SC	State Climatologist
HoN	Health of the Network	SCEP	Student Career Experience Program
HPC	Hydrological Prediction Center	SCH	Service Coordination Hydrologist
IRI	International Research Institute for Climate Prediction	SCO	State Climate Office
LCAT	Local Climate Analysis Tool	SEE	Strategic Execution and Evaluation
MIC	Meteorologist-in-Charge	SOO	Science and Operations Officer
MJO	Madden-Julian Oscillation	USGCRP	United States Global Change Research Program
NAO	North Atlantic Oscillation	USRCRN	United States Regional Climate Reference Network
NCDC	National Climatic Data Center	WCM	Warning Coordination Meteorologist
NCEP	National Centers for Environmental Prediction	WFO	Weather Forecast Office
NOAA	National Oceanic and Atmospheric Administration	WSO	Weather Service Offices



APPENDIX I: GLOSSARY OF SELECTED TERMS

Climatology - The study of climate variable statistics usually based on 30 years of climate records (currently, 1981-2010 data are used by NWS).

Composite - A study of the conditional probability of a local climate variable for which the condition is specified by climate variability phenomena that might have an impact on the local climate variable.

Data Types -

- ◆ **Certified Data** - Data that has been legally authenticated by NCDC as existing in its archives. NCDC can certify any data it archives (final or preliminary)
- ◆ **Final Data** - Data that has been subject to all levels of NCDC quality control, and edited if necessary
- ◆ **Preliminary Data** - Data that has not been subject to all levels of NCDC quality control

Downscaled forecast – a local climate forecast that is translated from a national CPC product to a specific site. A downscaled forecast produced for a dense network of specific sites adds spatial resolution/value to the product.

Metadata - Data about data, such as instrument siting, instrument changes, changes in the environmental site characteristics, dates of maintenance visits, changes in algorithms for processing and measuring the environment, type of work performed, etc.

Normal - Official 30-year average (see **Climatology** above).



APPENDIX J: TEAM MEMBERS

3RD EDITION, JANUARY 2012

Fiona Horsfall, Editor, NWS/OCWWS/Climate Services Division

Jenna Meyers, Team Lead, NWS/OCWWS/Climate Services Division

Robert Reeves, Team Lead, NWS/OCWWS/Climate Services Division

Michelle Hawkins, NWS/OCWWS/Climate Services Division

Judy Koepsell, NWS/OCWWS/Climate Services Division

Viviane Silva, NWS/OCWWS/Climate Services Division

Marina Timofeyeva, NWS/OCWWS/Climate Services Division

James Zdrojewski, NWS/OCWWS/Climate Services Division

Shari Dixon, NWS/OCWWS/Climate Services Division

*Copies of this publication can be obtained by contacting the
NWS Climate Services Division, at 301-713-1970 ext 182.*

