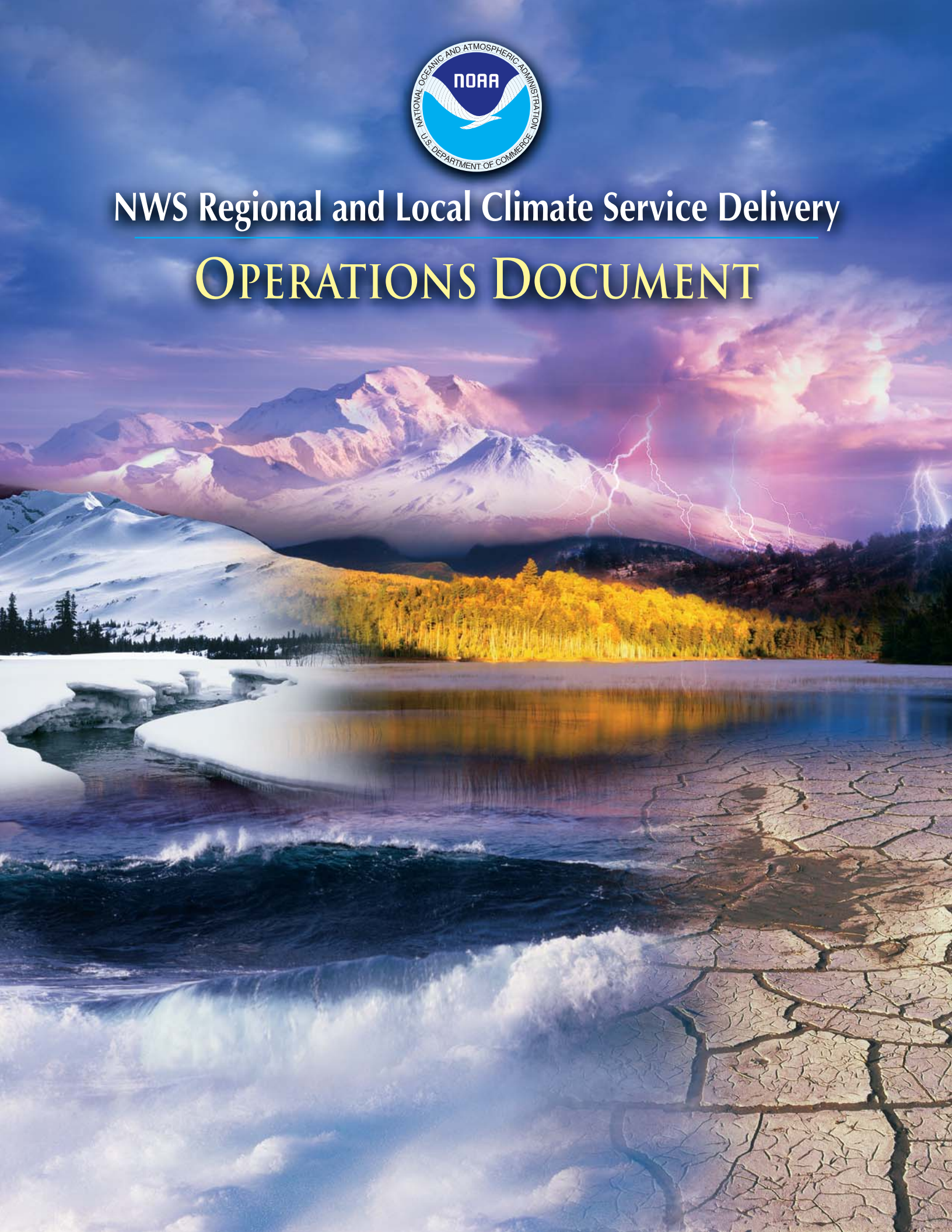


NWS Regional and Local Climate Service Delivery

Operations Document

Letter from NWS Director

In August 2003, we formally adopted the National Weather Service Regional and Local Climate Services Implementation Plan. The plan is a blueprint for mobilizing the regions and field for formal delivery of climate services, building on the successes we have already achieved, and demonstrating our awareness of customers' demands for more climate information and services.

The National Weather Service Regional and Local Climate Service Delivery Operations Document provides detailed guidelines on how best to accomplish the tasks outlined in the plan. It is a living document, reflecting the ever changing state of the growing discipline of climate service delivery nationwide, and it will be updated as new science, technology, and methodologies can be integrated into our services. I will continue to seek new resources so our regions and field have the tools they need to keep up with this expanding field, and with the increased demands of our customers.

I encourage you to use the document as a guide to maximize our efficiency for required regional and field climate services. Your role in this endeavor is critical to placing NWS at the forefront of climate service delivery to this Nation, and to facilitate our leadership role in achieving NOAA's mission goal for national climate services.

David L. Johnson

Director, National Weather Service

Table of Contents

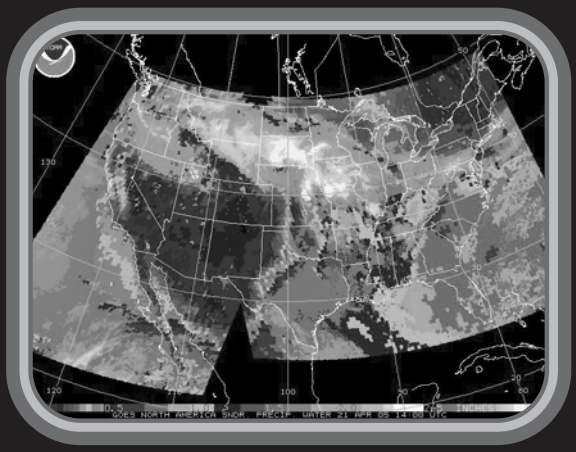
1 Introduction

In August 2003, the National Weather Service (NWS)[1] Office of Climate, Water, and Weather Services (OCWWS), Climate Services Division (CSD) developed a NWS Climate Services Implementation Plan to outline the process for developing the expanded capability at the local, regional, and national level for delivery of climate services. Responsibilities at these levels are continuously evolving to maximize innovation, resources and effectiveness.

At the national level, OCWWS sets policy and requirements, secures and allocates resources, and acts as the national coordinator for regional and local climate services. The Climate Prediction Center (CPC) will continue to fulfill its responsibilities for applied science, technique and prototype development, and central monitoring and prediction.

Regional Headquarters offices design, implement, and expand climate services using allocated resources to provide applied science, technologies, tools, communications, and training to support the local offices' products. They also initiate, coordinate, and nurture regional partnerships and climate service activities.

Local offices (Weather Forecast Offices (WFO) and River Forecast Centers (RFC)) deliver products and services to local customers, including outlooks, advisories, forecasts, analyses, observations, education and outreach. They implement technologies and scientific strategies to deliver climate information to customers at the local level. They extend CPC analyses and predictions locally, ensure integrity of observations and reporting of metadata[2], and develop partnerships for local services. They also serve as the local experts for local, state, and regional decision makers.



NWS aims to deliver advanced climate services to its customers by enhancing staff training opportunities, equipping offices with emerging technologies and state-of-the-art tools, and providing a comprehensive list of resources to facilitate their climate services mission.

This document, developed by an NWS team[3], describes climate services delivery by NWS regional and local forecast offices, and the actions necessary to expand climate services at each level. It provides guidance to the operational personnel who interact most directly with the customers and are responsible for product delivery. Programmatic roles, responsibilities and other service-related issues are defined to enable operational personnel to carry out their enhanced climate-related mission. Appendices to this document provide additional information, including a list of selected resources not listed within the document. The document itself will be modified as necessary. ■

[1] See Appendix A for list of acronyms used in this document

[2] See Appendix B

[3] See Appendix C

2 CLIMATE SERVICES: Local Offices

Local offices have three primary climate service functions:

- Serve as customer interface
- Be the steward and conscience for continuity/integrity of the historical climate record
- Participate in NWS climate analysis, monitoring and prediction activities

To fulfill these requirements, the local offices have selected a Climate Services Focal Point (CSFP). The individual should have an interest in climate and desire to lead the local office climate program. As the local office climate program lead, the CSFP is the point of contact for regional and national offices, customers, and other members of the climate community, including academia and state and local partners. The CSFP works closely with Data Acquisition Program Manager (DAPM)/Observations Program Leader (OPL) for climate record data issues, the Science and Operations Officers (SOO) to ensure office-wide basic capability in climate services; with the Warning Coordination Meteorologist (WCM) to ensure local office climate services and capabilities are conveyed through outreach; and with local office management to assess and delegate office climate service responsibilities.

2.1 SERVE AS CUSTOMER INTERFACE

NOAA NWS Weather Forecast Offices (WFOs) and River Forecast Centers (RFCs), herein referred to collectively as "local offices," are the most common entry points for customers requesting weather, water, and climate information. Local offices should convey climate information to their customers, both upon request as a customer service and proactively as a part of office outreach activities. In addition, local offices must foster partnerships and working relationships with other members of the climate community at the regional and local level for outreach activities.

2.1.1 PROVIDE SERVICE IN RESPONSE TO CUSTOMER REQUESTS

As with weather, customers contact the local offices seeking information about climate phenomena, data and specific products. One of the primary functions of the CSFP is, therefore, to ensure that the office staff are equipped to respond appropriately to customer requests for climate information.

2.1.1.1 NWS climate outlooks, forecasts, and monitoring products

Local office personnel need to be prepared to answer customer questions regarding both Climate Prediction Center (CPC) and local office climate outlook, forecast, and monitoring products. They need to be familiar with the content, use and location of CPC products, and note when customer feedback is being solicited for a product or service change[4]. Changes may spark questions to the local offices.

Customer feedback received at the local level on CPC products should be forwarded to the region's Climate Services Program Manager (CSPM), who will then forward the information as appropriate to the NWS Climate Services Division (CSD) customer liaison. Local offices should monitor customer feedback

[4] Notification of requests for customer feedback is distributed via the Regional Climate Services Program Manager (CSPM) from NWS Climate Services Division , via standard text product distribution channels, and is found on the product page of the CPC website.

concerning local and CPC products and services for consideration when making product and service enhancements. Local offices may directly contact CPC with outlook and forecast questions not pertaining to customer feedback.

CPC products commonly used by the general public are listed in Appendix D.

2.1.1.2 Climate data

Local offices should follow current NWS policy (NWS Instruction 10-1003: Climate Data Services (*http://www.nws.noaa.gov/directives/010/pd01010003b.pdf*); NWS Instruction 10-501: WFO Statements, Summaries, Tables Products Specification (*http://www.nws.noaa.gov/directives/010/pd01005001c.pdf*)) when responding to customer requests for data. Tools, including xmACIS (see Appendix E), will help answer customer inquiries for climate data. When constrained by time, data volume or NWS policy, local offices should refer customers to partners including State Climate Offices (SCO), Regional Climate Centers (RCC), and the National Climatic Data Center (NCDC) as appropriate.

2.1.1.3 Climate information

Local offices should answer all local climate inquiries as time, expertise, and policy permit. When local offices are unable to respond explicitly to inquiries, they should refer customers to other public sources of climate information as appropriately and as directly as possible. The list of agencies includes, but is not limited to:

- NOAA
  - NWS CPC (*http://www.cpc.noaa.gov/*)
  - NCDC (*http://www.ncdc.noaa.gov/oa/ncdc.html*)
  - OAR Climate Diagnostics Center (CDC) (*http://www.cdc.noaa.gov/*)
  - NOAA Climate Office (Office of Global Programs) (*http://www.climate.noaa.gov/*)
- Non-NOAA/NOAA supported
  - International Research Institute for Climate Prediction (IRI) (*http://iri.ldeo.columbia.edu/*)
  - Regional Climate Centers (RCC) (*http://lwf.ncdc.noaa.gov/oa/climate/regionalclimatecenters.html*)
  - State Climate Offices (SCO) (*http://lwf.ncdc.noaa.gov/oa/climate/stateclimatologists.html*)
  - Regional Integrated Science Assessments (RISAs) programs (*http://www.ogp.noaa.gov/mpe/csi/risa/index.htm*)
  - Pacific ENSO Applications Center (PEAC) (*http://lumahai.soest.hawaii.edu/Enso/index.html*)
  - Universities

Web links to organizations in the climate community, including private providers, can be found at *http://www.nws.noaa.gov/im/dirintro.htm*. The CSFP must provide for local web page links to all applicable climate service partners. **However, specific referrals or recommendations to private providers are not permitted.**

2.1.2 CONDUCT OUTREACH AND EDUCATION IN THE LOCAL AREA OF RESPONSIBILITY ON CLIMATE PRODUCTS, DATA, AND INFORMATION

The WCM and the CSFP will lead efforts to include climate information in the local office outreach program. 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.

Other activities should include promoting the local office web site, supplying climate brochures to the public, and discussing local applications of climate information. Discussions of local applications may include how drought impacts the area, the current seasonal hurricane outlooks, and the effect of the El Niño-Southern Oscillation

(ENSO) on local weather patterns. In drought-sensitive areas, for example, staff can provide information on drought mitigation such as who best to contact for specific information, different types of drought (long-term/hydrological and short-term/agricultural), and drought monitoring indices. Offices should also conduct workshops targeted to local audiences (media, agriculture sector, energy and weather risk management industries, etc.) to educate customers on the potential uses and availability of climate resources and gather feedback on products and services.

Many outreach and customer interface tools are under development and will be available as resources for NWS regional and local offices. In FY05, a series of informational brochures will be produced on themes such as climate information (observations and data), NWS climate products and services, and modes of climate variability.

2.1.3 DEVELOP PARTNERSHIPS

Local offices are responsible for establishing and maintaining partnerships with other members of the climate community in the local area, including RISAs and universities. Offices should continue to develop and maintain existing partnerships, such as with SCOs and the RCC, as well as develop new partnerships for the purpose of providing more effective outreach and collaboration.

2.1.4 UTILIZE AVAILABLE TOOLS TO PROVIDE A CUSTOMER INTERFACE

An NWS oversight team has developed a standard web interface for climate information at the local office level and will continue to evaluate the needs of customers who use the climate websites. The CSFP ensures the standardized web interface is implemented at their office. Local offices will also be responsible for developing and maintaining data and information in the Local Data/Records area of the standardized climate web page. Future web implementations will include a media toolkit, links to the climate community, and assistance with climate data referrals.

NWS has also developed a Climate Frequently Asked Questions (FAQ) page, which is available at: *http://www.nws.noaa.gov/om/csd/NWSClimate/FAQ/*.

2.2 BE THE STEWARD AND CONSCIENCE FOR CONTINUITY/INTEGRITY OF THE HISTORICAL CLIMATE RECORD

Local offices are the collection centers and stewards for the data that serve as the nation's climate record. The Meteorologist-in-Charge (MIC) or Hydrologist-in-Charge (HIC) has overall responsibility for the successful collection of accurate climate data and takes action when needed 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 Observing OPL (in some cases, this may be the DAPM). The OPL/DAPM oversees the day to day operations and maintenance of data collection for the climate record. The CSFP and the OPL/DAPM (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 in conformance with NWS policy and needs, and it routinely communicates with customers, climate service partners, and the team's CSPM on issues related to ensuring the integrity of the climate record and customer requirements.

2.2.1 THE TEAM'S CLIMATE RECORD DUTIES INCLUDE THE FOLLOWING:

2.2.1.1 Is the local expert for climate data requirements and leads the NOAA climate data observing networks. This includes understanding NWS Climate Data Services policy (*http://www.nws.noaa.gov/directives/010/pd01010003b.pdf*) and the "ten principles of climate monitoring" (see Appendix F).

2.2.1.2 Ensures that the MIC/HIC and the CSPM are advised of issues related to NWS climate observations that cannot be routinely addressed in local day-to-day maintenance of NWS-operated climate observing systems.

2.2.1.3 Acts as the "gatekeeper for climate data quality." The team ensures that NWS data quality control policies are in place. The team, in coordination with the CSPM, serves as the liaison between local office-specific quality control activities and

NCDC, the RCC, and the SCO, and ensures problems are identified and solutions implemented.

2.2.1.4 Is the focal point for data continuity issues. The team monitors and oversees changes to observing systems supporting the climate record, including coordinating changes with climate partners to ensure that:

1. The impact of proposed changes is understood and options considered before implementation. As data continuity liaison, the team may be requested to participate in the development of plans for conducting overlapping observations with other climate service 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.);
2. Requirements for overlapping observations are addressed;
3. Any changes (planned, accidental or natural) are adequately and appropriately documented in metadata;
4. Customers are advised in a timely fashion of pending and completed changes.

2.2.1.5 Responds to customer inquiries regarding the collection and interpretation of climate data and products.

2.2.1.6 Understands and communicates the significance and broad array of applications of *all* climate observations to local staff. The team also ensures that historically significant sites receive priority for maintenance and long-term data continuity considerations. The team ensures that a list of historically significant observing sites that contribute to national (Historical Climate Network, or HCN) or international climate variability and change detection networks (Global Historical Climatology Network (GHCN) and Global Climate Observing System (GCOS)) are available within their County Warning Area (CWA).

2.2.1.7 Ensures compliance with NWS web policy with respect to climate information, including the labeling of NWS data as "preliminary" and restricting the free redistribution of NCDC value-added and official data products.

2.2.1.8 Is the focal point for Cooperative Observer Program (COOP) modernization and legacy related activities. This includes understanding the plan to modernize the COOP and serving on COOP modernization Regional Site Selection Teams and similar activities.

2.2.1.9 Ensures weather observers and their staff have the 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. Communicates the importance of historically significant stations to local staff and the volunteer observers operating those sites and ensures that long-term sites receive priority treatment for maintenance and data continuity related matters.

2.2.1.10 Acts as the local expert on complementary data (mesonet data[5]). The team ensures any mesonet data used in climate products meet NWS policy for accuracy and redistribution. The team understands details on mesonet data accuracy (instrumentation, exposure, and maintenance).

2.3 PARTICIPATE IN NWS CLIMATE ANALYSIS, MONITORING AND PREDICTION ACTIVITIES

2.3.1 CLIMATE ANALYSIS – CONDUCT LOCAL CLIMATE STUDIES

A definition of *Climate* is the statistics (including but not limited to the average) of weather for a given location estimated over a number of years (usually 30). Climatology[6], the scientific study of climate, is primarily a quantitative description of climate through the *analysis* of

5 See Appendix B

6 See Appendix B

weather variables. Analysis of relevant variables is the fundamental step in defining or describing climate, understanding and monitoring climate variability and teleconnections, making climate predictions and, especially at the local level, understanding the link between climate and weather. Climate analyses at scales important to local customers will often reveal important relationships and information unavailable through the Climate Prediction Center (CPC). This information could include probabilities for future weather/climate outcomes or the historical context of a developing weather event to improve public planning or response respectively. Effective local climate analysis involves three activities:

2.3.1.1 Develop expertise in the local climate, its variability and its analysis

The following activities will facilitate developing climate analysis expertise at the local offices:

1. Take advantage of training opportunities, described below (see Training, Section 2.4)
2. Review available literature on regional and local climates
3. Develop and capitalize on relationships with knowledgeable partners
4. Include climate program development in local office goals
5. Implement a team approach involving the MIC, HIC, WCM, SOO, OPL, CSFP and/or local office program leaders in developing local climate analysis expertise
6. Invest travel budget in sending the CSFP to climate-related conferences and workshops to network, learn, and develop and vet ideas
7. Make climate issues a regular part of local office meeting agendas
8. Develop a climate reference library

2.3.1.2 Leverage routine climate analysis information

There is a tremendous amount of climate analysis data and monitoring information already available to the local office on a routine basis ranging from NOAA websites such as CPC, NCDC, CDC, and RCCs, to local databases and programs such as xmACIS (see Appendix E). The CSFP should ensure that these data sets and information sources are identified as local office resources.

2.3.1.3 Identify relevant climate variables for the local area and conduct local studies to meet customer needs.

This guide offers a conceptual approach for local studies. Local offices use (as well as develop) methodologies that are scientifically sound, follow best practices[7], and use approved tools. Training, procedural guidance and software are under development to help local offices with local studies. Studies will often be in consultation with other local offices, CSPMs, and climate community partners. Climate analysis at local offices needs to be effective with a reasonable cost-benefit payoff to staff and customers, and must be prioritized appropriately considering other local office activities and responsibilities.

Extensive climate analysis is already done on the national, regional, and state scales. The role of the field office is to perform studies at smaller scales on unique variables and to tackle problems that can affect outcomes for decision makers at the local level or are directly related to operational weather and climate issues. These studies can be easily conducted because the datasets are often readily available; the data just need to be "mined" for relevant information and potential links to climate phenomena.

Possible types of local climate studies include development of (1) historical frequencies of extreme or severe weather events, (2) probabilities of weather-induced phenomena (like rip currents or storm surges) conditioned on different weather patterns, and (3) probabilities of extremes (e.g. heavy snow events), weather types (e.g. tornados, ice storms), weather-related impacts, etc.

7 Instructions, training and recommended publications provided by NWS Climate Services (CPC, CSD, Regions)

conditioned on the phase or state of different modes of climate variability, like the North Atlantic Oscillation (NAO), the Pacific/North American pattern (PNA), Madden-Julian Oscillation (MJO), or ENSO[8]. The first of these can provide historical context for emergency managers for major weather events, the second can form the basis for short-range forecast schemes of hazardous conditions, and the third can augment CPC bulletins, press releases, and outlooks for planners and decision makers on expected or associated local impacts.

All field offices may formally participate in study type (3) for ENSO-related impacts (see 2.3.3.2). The experience gained therein as well as the data, techniques, and tools employed can be used for similar studies conditioned instead on phases of NAO, MJO, etc.

The following guidelines are recommended for conducting local office-scale climate analysis:

1. Develop expertise with the tools of climate analysis - statistical spreadsheets, databases, xmACIS[9], SPLUS, etc.
2. Interact and conduct outreach with customers to identify opportunities for local studies and climate service needs (for example, translating a CPC climate outlook press release for the local area)
3. Collaborate with expert academic and/or NOAA partners
4. Discuss ideas with customers, office colleagues, the CSPM, and others
5. Ensure any climate data used for local studies is as reliable and accurate as possible
6. Encourage the participation of Hydro-Meteorological Technicians (HMT), Interns, Student Career Experience Program (SCEP) students, or volunteers in data analysis and studies
7. Ensure climate studies are conducted in physically consistent ways with CPC products (e.g. conformance with definitions of ENSO, NAO, etc.)

2.3.2 CLIMATE MONITORING – MONITOR CLIMATE VARIABILITY AND CHANGE WITHIN THE LOCAL AREA AND SHARE THAT KNOWLEDGE WITH CUSTOMERS

The local office is the primary public interface for NOAA, especially when climate issues have a potential impact in the local area. Operational personnel need to monitor climate variability and change, especially with respect to potential impacts on the local community. They need to be involved in the assessment process, up to date on the situation, and ready to provide clear and lucid responses to customer queries. Specifically, the following activities should be conducted at the local offices:

2.3.2.1 Monitor the large-scale climate state on at least a weekly basis

CSFPs/operational forecasters should assess large and global scale conditions and changes on at least a weekly basis to monitor the onset of and changes to large-scale weather and climate events. A review of global domain satellite imagery and analysis products, indices, discussions, bulletins, updates and outlooks available from the National Centers for Environmental Prediction (NCEP), CDC, NCDC, etc. should be made to assess ongoing and future changes in the climate system.

Following are specific activities that are recommended for CSFPs and/or operational forecasters at least once a week:

1. Assess global domain satellite imagery
2. Monitor the global scale circulation and other associated features (e.g. MJO, NAO, ENSO, PNA)[10]

8 See references to these phenomena in Appendix G

9 See Appendix E for information on this web-based interface

10 See links in Appendix G for information on these phenomena

3 Review other source material (routine or otherwise) from national centers (Hydrological Prediction Center (HPC), NCEP Central Operations, CPC, CDC, NCDC). These include forecasts and outlooks, discussions, bulletins, etc.

The national products and guidance cover time scales ranging from bi-weekly to annual. Field personnel should routinely use the expertise of the national guidance in their downscaled assessments.

2.3.2.2 Monitor the status of drought or excessive rainfall, temperature anomalies or other fields (eg., evapo-transpiration), as applicable

During periods of insufficient or excessive precipitation, extreme temperature anomalies or other unusual climate situations, operational personnel need to maintain up-to-date information regarding the status of the specific event. This information may be used in national products (such as the *Drought Monitor*), for local information releases such as Public Information Statements (PNS), or for use by other sectors (such as agriculture, energy, etc.). Routine monitoring and information dissemination (via standard output format) may be desired at a variety of time scales, such as: 2 weeks, 1 month, 3 months, 6 months, and 1 year.

2.3.2.3 The CSFPs should coordinate with the CSPMs, who in turn coordinate with National Centers (HPC, CPC, NCDC) to provide input on the status of drought (i.e. for the weekly Drought Monitor) or excessive rainfall, temperature anomalies or other fields in the local area when applicable.

2.3.2.4 CSFPs should coordinate with RCCs and SCOs on their monitoring activities.

2.3.3 PREDICTION – ENHANCE AND AUGMENT CPC'S PREDICTION PRODUCTS THROUGH DOWNSCALING AND COMPOSITING COMBINED WITH CONDITIONAL PROBABILITIES

CSFPs and SOOs are responsible for coordinating and integrating local prediction techniques into their local product delivery.

2.3.3.1 Local Downscaling Techniques[11]

Downscaling is the correlation of a CPC climate parameter (e.g. temperature for a mega-climate division) to a specific site based on historical data.

1 CPC produces a suite of seasonal temperature and precipitation outlooks for the 102 mega-climate divisions nationally.

2 The NWS Climate Local Products Specialist (contractor) will prepare downscaled seasonal long-lead temperature forecasts (**Local 3-month Temperature Outlooks**) for stations agreed upon by CSD and the regions, in consultation with the local offices.

3 These products will be run operationally at the NCEP and delivered in a graphical and/or a text format. The exact format of each product will be determined by the NWS Climate Outreach Specialist (contractor) in collaboration with the NWS Local Climate Product Specialist, the NWS Web Specialist (contractor), and the Local Climate Product Development team.

4 The Local 3-month Temperature Outlooks will be made available to the local office for review on or before the day the official product is issued. Local offices will review the product to ensure consistency, and notify their CSPM if any adjustments are required. The CSPM will in turn notify CSD and the supervisor for the Local Climate Product Specialist.

[11] See Appendix B

Due to the short turnaround, if the CSPM is not available, the local office can go directly to CSD (Local Product Team Leader) and notify the CSPM of the action.

5. Field offices should be cognizant of the effect of large-scale climate signals in their CWA, and ensure that the Local 3-month Temperature Outlooks are consistent with that signal.

6. Local offices will add any local value-added text information, serve as the local experts for interpretation, and be the primary point of contact for any local queries.

7. The product will be issued by the local office using the agreed upon graphical and text format.

8. Local offices will be given all necessary training and tools by CSD and the NWS regions.

2.3.3.2 Local Composite-Based Techniques[12]

Compositing is a general technique for identifying impacts associated with different climate states, for example positive or negative phases of the NAO. It can be applied locally to identify conditions associated with particular climate states. This information can then be used to place current conditions in a climate context or, coupled with a CPC forecast of the climate state, as a basis for making local forecasts. At a minimum, local offices will consider both temperature and precipitation for compositing.

Compositing involves the binning or stratification of historical data based on the occurrence or non-occurrence of an event (e.g. an El Niño) to develop conditional probabilities based on the event. Once the data is binned, the historical frequencies (or conditional probabilities) of different meteorological, hydrological or weather conditions can be compared for either the occurrence or non-occurrence of the event or for all cases (the climatological probabilities). An example is the historical frequency of snowfalls in excess of 8" in Baltimore during La Niña winters. The following considerations and responsibilities should be used to develop ENSO composite-based local forecast products:

1. CPC's operational categorization of El Niño, La Niña, and ENSO neutral years (neither El Niño nor La Niña) based on Niño3.4 (an area bound by 120W-170W, 5N-5S) SSTs form the first basis for compositing.

2. Subsequent local compositing should consider other bases than ENSO as peer reviewed research suggests.

3. Local offices will have access to the RCC xmACIS data system (see Appendix E) where they will extract relevant data and "bin" the data based on CPC's ENSO categorization.

4. Local offices will examine hydro-meteorological data to determine whether significant associations can be made based on the state of ENSO. A local office may choose areas and parameters of local need and/or interest as appropriate, and produce composite-based conditional probabilities for specific stations or the CWA based on the ENSO signal. For example, RFCs could use compositing to relate the likelihood for near-normal river flows, low-flow events, or above normal flow for rivers and streams within their Hydrologic Service Area (HSA) to the state of ENSO.

5. The ENSO composite-based conditional probabilities will be adjusted for long-term trends where necessary and tested for statistical significance.

6. Significant conditional probabilities will be used in combination with CPC probabilistic forecasts of Niño3.4 to produce local ENSO composite-based forecasts.

7. These forecasts will be run operationally at the NCEP and delivered in a graphical and/or a text format. The exact format of each product will be determined by the NWS Climate Outreach Specialist (contractor) in collaboration with the NWS Local Climate Product Specialist, the NWS Web Specialist (contractor), and the Local Climate Product Development team.

[12] See Appendix B

8. The forecasts will be made available to the local office for review on or before the day the official products are issued. Local offices will review the products to ensure consistency, and notify their CSPM if any adjustments are required. The CSPM will in turn notify CSD and the supervisor for the Local Climate Product Specialist. Due to the short turnaround, if the CSPM is not available, the local office can go directly to CSD (Local Product Team Leader) and notify the CSPM of the action.

9. Field offices should be cognizant of the effect of large-scale climate signals in their CWA, and ensure that the localized forecasts are consistent with that signal.

10. Local offices will add any local value-added text information, serve as the local experts for interpretation, and be the primary point of contact for any local queries.

11. The product will be issued by the local office using the agreed upon graphical and text format.

12. The Local Climate Products Specialist will work in tandem with CSD and CSPMs to provide standardized methodology and tools for compositing exploration.

13. Local offices will be given all necessary training and tools by CSD and/or the NWS Regions.

2.4 TRAINING

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

The Climate Services PDS is comprised of six Professional Competency Units:

- PCU 1: Infrastructure for Climate Data and Services
- PCU 2: An Overview of Climate Variability
- PCU 3: The Basis and Methodologies of CPC Products
- PCU 4: The Application of CPC Products, Local Climate Studies
- PCU 5: Customer Services and Public Outreach
- PCU 6: Timely, Accurate, and Consistent Climate Data Observations and Their Applications

These PCUs make up targeted training for each of the three primary functions of the local forecast offices. They aim to develop the professional competency of the NWS operational climate services staff.

Each PCU requires online training and in some cases, teletraining. With the exception of PCU6, the PCU online and teletraining is complimented by the 3-day Operational Climate Services Course offered at the National Weather Service Training Center (NWSTC) or other training locations (beginning in 2005). PCU2 is covered at the 4-day residence Climate Variability Symposium in addition to the current online training and the Operational Climate Services Course. However, further development of PCU2 may replace the Climate Variability Symposium.

The table on the following page summarizes the training and time requirements for building NWS climate services competency at the local level. All training in the table is required for the CSFPs. Other staff can participate at the discretion of local office management.

Function*	Training	Time requirements		
		Online (hours)	Teletraining (hours)	Residence training
1	PCU1	2	-	✪
1,3	PCU2	4 (8†)	-	✪✦
1,3	PCU3	4.5	3	✪
3	PCU4	3	2	✪
1,2,3	PCU5	2	1	✪
2	PCU6	2	1	✪
1,2,3	Operational Climate Services Course	-	-	3 days
1,3	Climate Variability Symposium	-	-	4 days

* 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 Symposia

2.5 LOCAL OFFICE WORKLOAD

Field offices have identified focal points (CSFPs) to help lead and spin up their climate program. The climate focal points are assuming these duties in addition to their primary forecast and warning responsibilities, along with other program responsibilities. This poses a workload challenge for the office management team. MICs, HICs and field staff must manage resources and establish priorities. The range of responsibilities associated with climate program requires at least 0.5 FTEs for each local office, which may be distributed to more than one person.

The primary focus of the NWS operational program is to provide outlook, watch, warning, and advisory products and services. It is in this area that the operational staff focus to ensure they have the best possible knowledge and skills to provide potentially life and property-saving information for customers. Primary focus on this core mission must not change.

Every field office needs to inventory existing staff resources to determine how to re-prioritize activities, responsibilities and time allocation within the office. MICs and HICs should apprise CSPMs and Regional Directors of workload issues and potential tradeoffs to ensure the success of a credible and timely climate services delivery program that does not degrade performance in other assigned and/or critical program areas. ■

3 CLIMATE SERVICES:
Regional Headquarters Offices

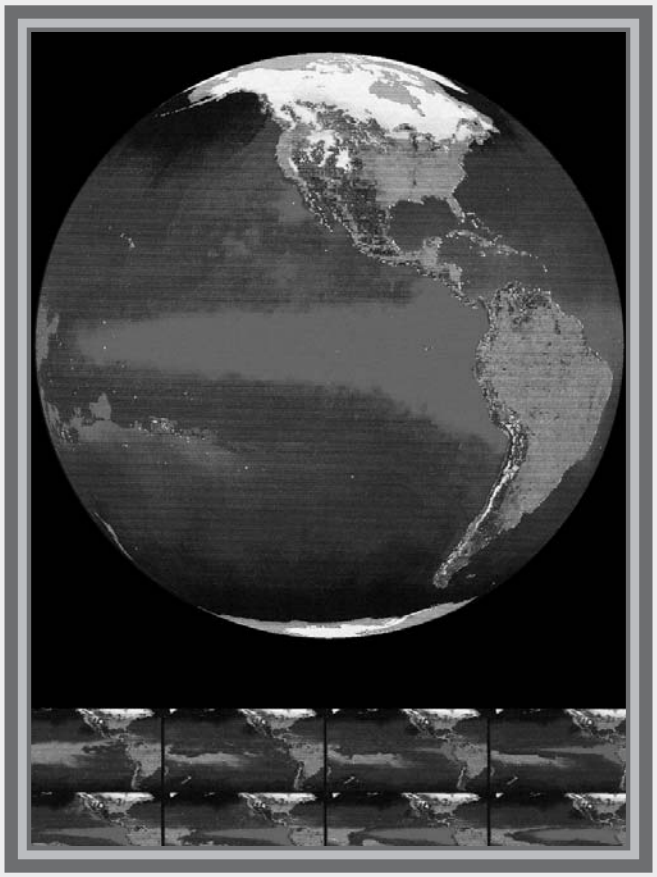
Regional Headquarters offices provide oversight for all climate service delivery activities within the region. Regional offices allocate resources to the field offices and support field office activities; when resources are available, conduct regional scale climate studies, analysis, monitoring, and prediction; provide applied science, technologies, tools, communications, and training to support the local offices' products, including outlooks, advisories, forecasts and observations; and initiate, coordinate, and nurture regional partnerships.

Each Regional Headquarters office has a CSPM who manages the climate program within the region. The CSPMs coordinate team activities, such as participation in CPC El Niño and Drought Monitor discussions, and collate input from the field offices. They should periodically organize or help organize regular partner and customer outreach meetings that include the local offices throughout the region.

The CSPMs distribute relevant information to the local offices from CPC or CSD, such as notification that feedback is being sought on products, upcoming local meetings, applicable press releases, and other information that affects the local office responsibility of delivering climate services.

Regional offices host contractors that develop tools for local climate analysis, monitoring and prediction, and they house testbeds for climate downscaling activities. CSPMs serve on steering committees for NWS Climate Specialist contractors. The offices campaign for resources required by the field to implement climate services.

CSPMs are the liaisons between NWS headquarters (CSD) and the field offices. They ensure field offices have the resources to deliver climate services described in this document. They are also responsible for any activities required to meet the NWS goal for climate service delivery. ■



NOAA'S Satellite Views El Niño - 1997/98

APPENDIX A:
Acronyms

AASC	American Association of State Climatologists
ARSCO	American Association of State Climatologists Recognized State Climate Offices
ASOS	Automated Surface Observing System
CDC	Climate Diagnostics Center
COMET	Cooperative Program for Operational Meteorology, Education and Training
COOP	Cooperative Observer Program
CPC	Climate Prediction Center
CSD	Climate Services Division
CSFP	Climate Services Focal Point (Local offices)
CSPM	Climate Services Program Manager (Regional Headquarters)
CWA	County Warning Area
DAPM	Data Acquisition Program Manager
ENSO	El Niño-Southern Oscillation
FTE	Full-time employee
FY	Fiscal Year
GCOS	Global Climate Observing System
GHCN	Global Historical Climatology Network
HIC	Hydrologist-in-Charge
HMT	Hydro-Meteorological Technician
HPC	Hydrological Prediction Center
IRI	International Research Institute for Climate Prediction
MIC	Meteorologist-in-Charge
MJO	Madden-Julian Oscillation
NAO	North Atlantic Oscillation
NCDC	National Climatic Data Center
NCEP	National Centers for Environmental Prediction
NCO	NOAA Climate Office
NCTP	NOAA Climate Transition Program
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NWR	NOAA Weather Radio
NWS	National Weather Service
NWSH	National Weather Service Headquarters
NWSTC	National Weather Service Training Center
OAR	Office of Oceanic and Atmospheric Research
OCWWS	Office of Climate, Water, and Weather Services
OPL	Observations Program Leader
PCU	Professional Competency Unit
PEAC	Pacific ENSO Applications Center
PDO	Pacific Decadal Oscillation
PDS	Professional Development Series
PNA	Pacific/North American pattern
PNS	Public Information Statement
RFC	River Forecast Center
RISA	Regional Integrated Sciences and Assessments
SCEP	Student Career Experience Program
SCO	State Climate Office
SOO	Science and Operations Officer
WCM	Warning Coordination Meteorologist
WFO	Weather Forecast Office

APPENDIX B:
Glossary of Selected Terms

Climatology - The study of climate variable statistics usually based on 30 years of climate records (currently, 1971-2000 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.

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 setup, instrument changes, changes in the environmental site characteristics, dates of maintenance visits, changes in algorithms for processing and measuring the environment, and type of work performed, etc.

Mesonet - Non NOAA weather/climate observation networks, usually designed to depict mesoscale phenomena.

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

APPENDIX C:
Team Members

Fiona Horsfall, NWS/OCWWS/Climate Services Division (Chair)

Mike Brewer, NWS/OCWWS/Climate Services Division

Walt Drag, Senior Forecaster, Taunton, MA, Eastern Region

Chip Guard, WCM, Guam, Pacific Region

Bart Hagemeyer, MIC, Melbourne, FL, Southern Region

Gary Hufford, Climate Services Program Manager, Alaska Region

Mike Huston, Lead forecaster, Pocatello; WFO Climate Services Steering Committee, Western Region

Judy Koepsell, NWS/OCWWS/Climate Services Division

Bob Leffler, NWS/OCWWS/Climate Services Division

Glenn Lussky, MIC, La Crosse, WI , Central Region

Barb Mayes, NWS/OCWWS/Climate Services Division

Victor Murphy, Climate Services Program Manager, Southern Region

Bob Reeves, NWS/OCWWS/Climate Services Division

APPENDIX D:
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 (CPC) 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/*) - The Climate Prediction Center (CPC) issues a 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*) - A 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/*) - The Climate Prediction Center (CPC) issues a 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*) - The Climate Prediction Center (CPC) provides a 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.html*) - The Climate Prediction Center (CPC) issues a 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.html*) - The Climate Prediction Center (CPC) issues these outlooks 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 Outlook** (*http://www.cpc.ncep.noaa.gov/products/outlooks/hurricane.html*) - The Climate Prediction Center (CPC) issues the Hurricane Outlook for the Atlantic basin. No outlook, however, can give certainty as to whether or not a particular locality will be impacted by a tropical storm or hurricane in any given year.

9. **CLIMAT Messages** (*http://products.weather.gov/detail.php?selrow=12*) - The program for the international exchange of monthly mean data is called the "CLIMAT" program. The World Data Center for Meteorology, operated by the National Climatic Data Center, collects CLIMAT messages for publication under WMO sponsorship.

10. **El Niño/Southern Oscillation (ENSO) Diagnostic Discussion** (*http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/*) - The Climate Prediction Center (CPC) issues this monthly bulletin to provide insight into climate outlooks by reviewing the potential effects of the ENSO.

11. **Climate Diagnostics Bulletin** (*http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/bulletin/*) - The Climate Prediction Center (CPC) issues this monthly report on the status of the ocean-atmosphere climate system in the tropics and extratropics.

12. **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*) - The Climate Prediction Center (CPC) issues 6- to 10-Day and 8- to 14-Day excessive heat outlooks in probabilistic format for the Contiguous U.S.

13 **Hawaiian One-Month and Three-Month Outlooks and Discussion** (*http://www.cpc.ncep.noaa.gov/products/predictions/90day/fxhw40.html*) - The Climate Prediction Center (CPC) issues a one-month and a series of thirteen three-month temperature and precipitation outlooks for selected cities in Hawaii and an accompanying prognostic discussion.

14 **3- to 14-Day Hazards Assessment** (*http://www.cpc.ncep.noaa.gov/products/predictions/threats/p_threats.gif*) - The Climate Prediction Center issues this 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.

15 **6- to 10-Day and 8- to 14-Day Maximum Heat Index Prediction** (*http://www.cpc.ncep.noaa.gov/products/predictions/hi_610.html*) - The Climate Prediction Center (CPC) issues 6- to 10-Day and 8- to 14-Day Maximum Heat Index Predictions for approximately 200 locations in the Contiguous U.S.

16 **6- to 10-Day and 8- to 14-Day Outlooks (Contiguous U.S. and Alaska)** (*http://www.cpc.ncep.noaa.gov/products/predictions/610day/*) - The Climate Prediction Center (CPC) issues 6- to 10-Day and 8- to 14-Day outlooks in probabilistic format for the Contiguous U.S. and Alaska.

17 **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*) - The Climate Prediction Center (CPC) provides a technical discussion of the meteorological and climatological basis for the outlooks.

18 **Probability of Exceedence Outlook for Center Probability Distribution (50 percent)** (*http://www.cpc.ncep.noaa.gov/products/predictions/90day/lead01/poep.html*) - The Climate Prediction Center (CPC) issues a 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.

19 **Tropical Pacific Mean Sea-Surface Temperature (SST) Outlook** (*http://www.cpc.ncep.noaa.gov/products/predictions/90day/SSTs/*) - The Climate Prediction Center's 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.

20 **U.S. Drought Outlook Discussion** (*http://www.cpc.ncep.noaa.gov/products/expert_assessment/DOD.html*) - The Climate Prediction Center (CPC) issues a Drought Outlook discussion for the remaining part of the month of issuance plus the next three months.

21 **3- to 14-Day Hazards Assessment Discussion** (*http://www.cpc.ncep.noaa.gov/products/predictions/threats/threats.html#SYNOPSIS*) - The Climate Prediction Center (CPC) provides a 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.

22 **U.S. Drought Outlook** (*http://www.cpc.ncep.noaa.gov/products/expert_assessment/seasonal_drought.html*) - CPC issues a national Drought Outlook for the remaining part of the month of issue plus the next three months.

23 **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 issues this narrative summarizing drought conditions with a look ahead.

24 **Palmer Drought Severity Index** (*http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/palmer.gif*) - The Climate Prediction Center's (CPC) 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.

25 **U. S. Drought Monitor** (*http://drought.unl.edu/dm/monitor.html*) - NOAA's Climate Prediction Center (CPC) and National Climatic Data Center (NCDC), the U.S. Department of Agriculture, and the National Drought Mitigation Center (NDMC) jointly issues this graphic summarizing the extent and intensity of drought conditions.

26 **Weekly Weather and Crop Bulletin** (*http://www.usda.gov/oce/waob/jawf/wwcb.html*) - 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.

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. Three servers are currently available with redundant databases and capabilities.

Offices in the NWS Eastern region should use the following server:

Primary: *http://xmacis.nrcc.cornell.edu/*
Backups: *http://xmacis.srcc.lsu.edu/*
http://xmacis.unl.edu/
http://xmacis.sws.uiuc.edu/

The NWS Southern and Pacific regions should use:

Primary: *http://xmacis.srcc.lsu.edu/*
Backups: *http://xmacis.unl.edu/*
http://xmacis.nrcc.cornell.edu/
http://xmacis.sws.uiuc.edu/

The NWS Central and Alaska regions should use:

Primary: *http://xmacis.unl.edu/*
Backups: *http://xmacis.nrcc.cornell.edu/*
http://xmacis.srcc.lsu.edu/
http://xmacis.sws.uiuc.edu/

The NWS Western region should use:

Primary: *http://xmacis.sws.uiuc.edu/*
Backups: *http://xmacis.nrcc.cornell.edu/*
http://xmacis.srcc.lsu.edu/
http://xmacis.unl.edu/

Using the urls listed above, 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 following 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.nrcc.cornell.edu/box/.*

These custom station lists can be modified at any time using the web page - *http://squall.nrcc.cornell.edu/~keith/NWS_station_selection.html*. 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. Changes require manual verification, so your updates will not appear immediately in the xmACIS menu. Allow a day or two for your changes to be incorporated. Note also that stations with no data in the ACIS database will not appear on the xmACIS web page. SAWRS stations, 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.nrcc.cornell.edu/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 Regional Climate Center for resolution. Data that has been key-entered at local offices will be added to the xmACIS database in the future as resources become available. 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 Regional Climate Centers are currently working on an external version of xmACIS that can be incorporated into local NWS web pages for use by the public. This external version of xmACIS is scheduled for release in the future. ■

APPENDIX F:
Ten Principles of Climate Monitoring

United States Climate Reference Network: Climate Monitoring Principles National Climatic Data Center, 10 April 2000.

The National Research Council (NRC 1999) recommended that the following ten climate monitoring principles, proposed by Karl et al. (1995), should be applied to climate monitoring systems:

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 climatic 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 data-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 data in the development of environmental assessments, particularly those pertaining to climate variability and change, as a 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. A list of protected sites within each major observing system should be developed, based on their prioritized contribution to documenting the long-term climate record.

7. COMPLEMENTARY DATA

Give the highest priority in the design and implementation of new sites or instrumentation 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 accuracy 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 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 G: Resources

WEB BASED RESOURCES

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

1. Climate Glossary (*http://www.cpc.ncep.noaa.gov/products/outreach/glossary.shtml*)
2. Historic Archive of North American Teleconnection Indices (*ftp://ftpprd.ncep.noaa.gov/pub/cpc/wd52dg/data/indices/tele_index.nh*)
3. MJO Information (*http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml*)
4. Monitoring Weather and Climate (*http://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_ao_index/history/history.shtml*) – Archive of Daily Indices
5. Monthly Atmospheric and SST Indices (*http://www.cpc.ncep.noaa.gov/data/indices/index.html*)
6. Oceanic and Atmospheric Data (*http://www.cpc.ncep.noaa.gov/products/monitoring_and_data/oadata.shtml*)

Other NWS sites

1. Climate Services Professional Development Series (*http://www.nws.noaa.gov/om/csd/pds/index.html*)
2. Experimental Forecasting Of Dry Season Storminess over Florida from the ENSO Signal (*http://www.srh.noaa.gov/mlb/enso/14th_global_climate_p5.6.pdf*)
3. HPC Daily Weather Maps (*http://www.hpc.ncep.noaa.gov/dailywxmap/*)
4. Rip Current Safety (*http://www.ripcurrents.noaa.gov/*)
5. Storm Prediction Center Climate Data (*http://www.spc.noaa.gov/climo/*)
6. Severe Plot2 from SPC (*http://www.spc.noaa.gov/software/svrplot2/*)
7. WFO Melbourne ENSO and Experimental Forecast Page (*http://www.srh.noaa.gov/mlb/enso/mlbnino.html*)

NOAA and NOAA-affiliated sites

1. National Climatic Data Center (*http://lwf.ncdc.noaa.gov/oa/ncdc.html*)
2. NOAA Office of Global Programs (*http://www.ogp.noaa.gov/aboutogp/relatedlinks.html*) – links to climate-related sites
3. Pacific ENSO Applications Center (*http://lumahai.soest.hawaii.edu/Enso/index.html*)
4. Pacific ENSO Update (*http://lumahai.soest.hawaii.edu/Enso/subdir/update.dir/update.html*)
5. Regional Climate Centers (*http://lwf.ncdc.noaa.gov/oa/climate/regionalclimatecenters.html*)
6. State Climate Offices (*http://lwf.ncdc.noaa.gov/oa/climate/stateclimatologists.html*)
7. Weickmann and Berry (CDC) MJO Experimental Forecasts (*http://www.cdc.noaa.gov/MJO/Forecasts/climate_discussions.html*)

USDA Weekly Weather and Crop Bulletin (*http://www.usda.gov/oce/waob/jawf/wwcb.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.*

OTHER SELECTED RESOURCES

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Glantz, Michael H., 2001: *Once Burned, Twice Shy?* United Nations University Press, 294 pp.

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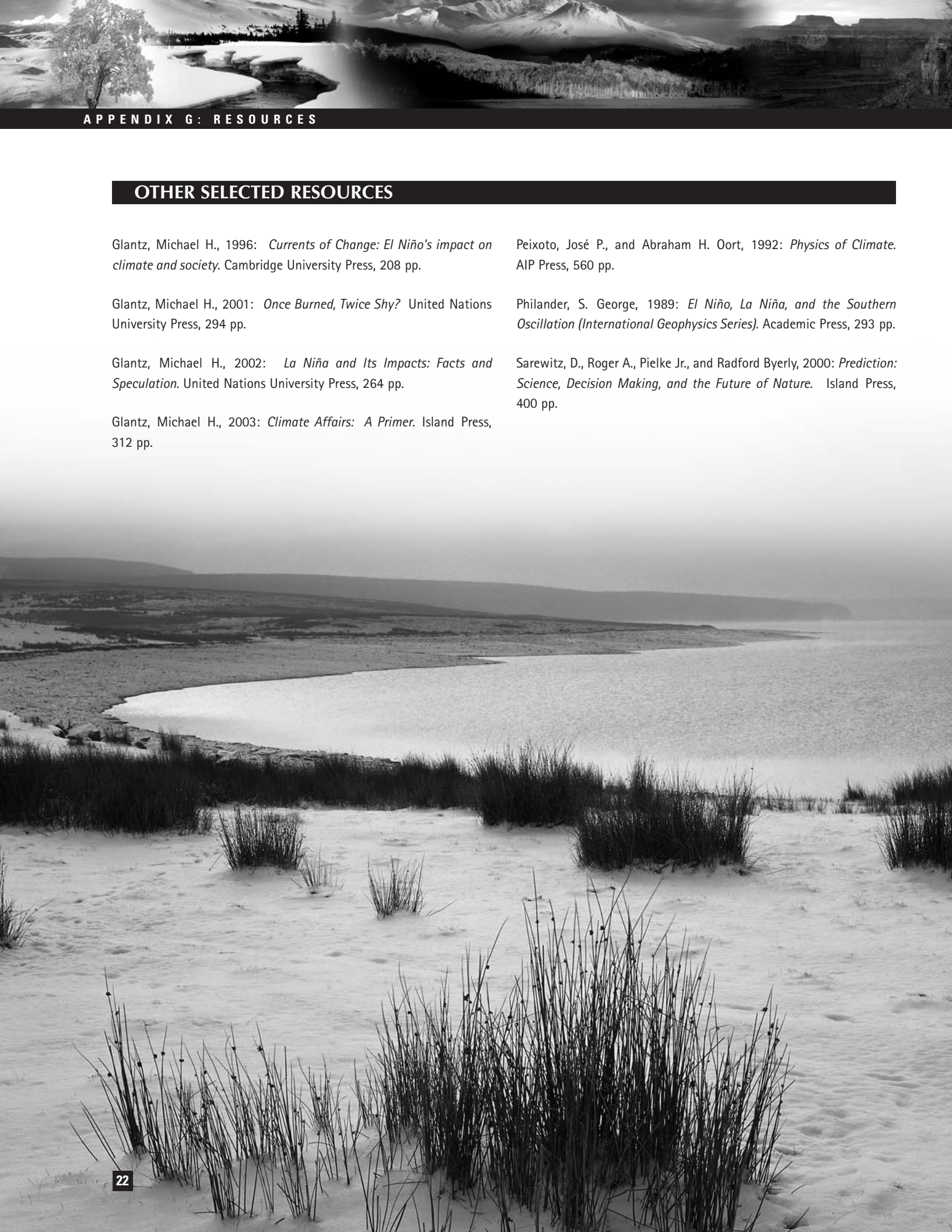
Peixoto, José P., and Abraham H. Oort, 1992: *Physics of Climate*. AIP Press, 560 pp.

Philander, S. George, 1989: *El Niño, La Niña, and the Southern Oscillation (International Geophysics Series)*. Academic Press, 293 pp.

Sarewitz, D., Roger A., Pielke Jr., and Radford Byerly, 2000: *Prediction: Science, Decision Making, and the Future of Nature*. Island Press, 400 pp.



Notes

This document was prepared under the auspices of NWS Climate Services Division. The Climate Services Division at NWS headquarters provides the strategic vision for climate services at NWS and oversees the NWS climate services program. It develops policy and requirements for climate prediction products and other services related to the period of week two out to one year, including seasonal forecasts and threats assessments. The division also 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, seeks resources, and approves final product design. The Climate Services program maintains strong ties with other countries; across NOAA lines, specifically through the NOAA Climate Office; with federal agencies; the university community; and the private sector and encourages collaborative arrangements among the Regional Climate Centers, RISAs, State Climatologists, NWS WFOs, and Regional headquarters to tailor climate forecasts for local users.


DEPARTMENT OF COMMERCE
UNITED STATES OF AMERICA
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
NATIONAL WEATHER SERVICE