Vol. 10, No. 2 ● December 1999

EARTH SYSTEM MONITOR

NOAA National Data Center Climate Data Online

Customer support system for research, applications, and education

A guide to NOAA's data and information services

INSIDE

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During 1998-1999, the National Climatic Data Center developed the NOAA National Data Center Climate Data Online (NNDC CDO) System to a) provide fast, easy online access to a variety of climatic datasets; b) provide the climatic support and backbone for the NNDC Server (in development); and c) facilitate migration from a Unisys mainframe customer support environment to an open systems Unix environment.

The system includes both recent and historical data, useful for studies of particular weather events, and for historical analysis of data for statistical and other research purposes. The types of data currently included in the system, which continues to be populated, are surface daily and monthly data, hourly precipitation data, and 15-minute precipitation data. The data are primarily for the United States, although there are two monthly datasets, one of which includes global stations. The system will be greatly expanded during 2000, with global surface hourly and global upper air data added to the system. The URL is: *http://www5.ncdc.noaa.gov:7777/plclimprod/plsql/poemain.poe*.

The NNDC CDO backbone is an Oracle relational database system, using structured query language and other programming languages to retrieve data. Data are accessible and selectable by region, country, state (U.S.), climate division (U.S.), county (U.S.), and station, and by time period (year, month, day, hour). The data are available free of charge to NOAA users and to educational institutions (.edu), with charges applied for other users. However, charges are greatly reduced as compared to traditional off-line delivery of climatic data.

Climatic data currently accessible

1. Daily (primarily U.S.) for full period of digital record, typically 1948 to present, over 19,000 stations historically, over 8000 currently active.
2. Monthly (primarily U.S.) for full period of digital record, typically 1948 to present, over 18,000 stations historically, over 8000 currently active.
3. Global monthly for 1987 to present, over 3000 stations historically, over 1000 currently active.
4. Hourly precipitation (primarily U.S.) for full period of digital record, typically 1948 to present, over 6000 stations historically, over 2000 currently active.
5. 15-minute precipitation (primarily U.S.) for full period of digital record, typically 1971 to the

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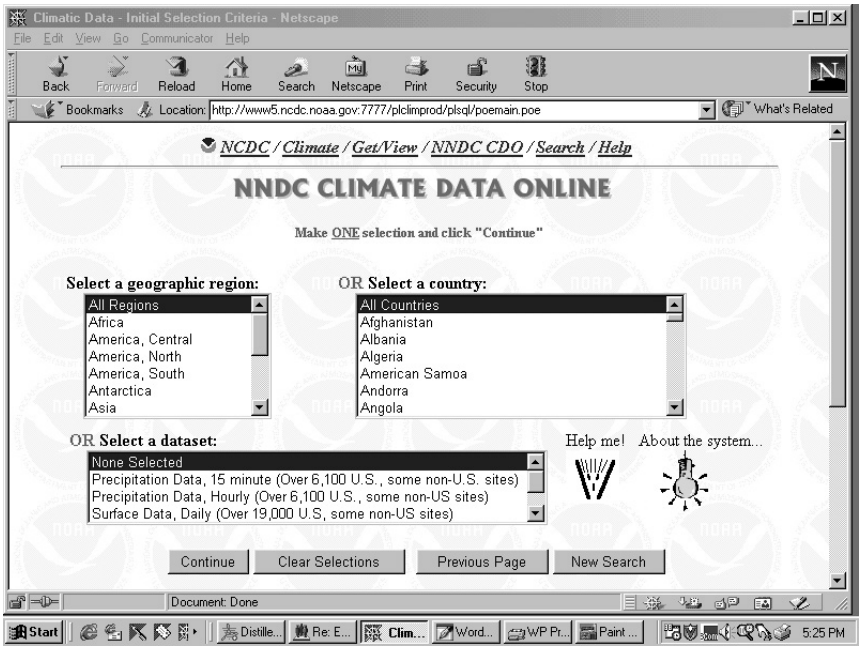

▲ **Figure 1.** The main user interface, allowing initial selection by region, by country, or by data type.

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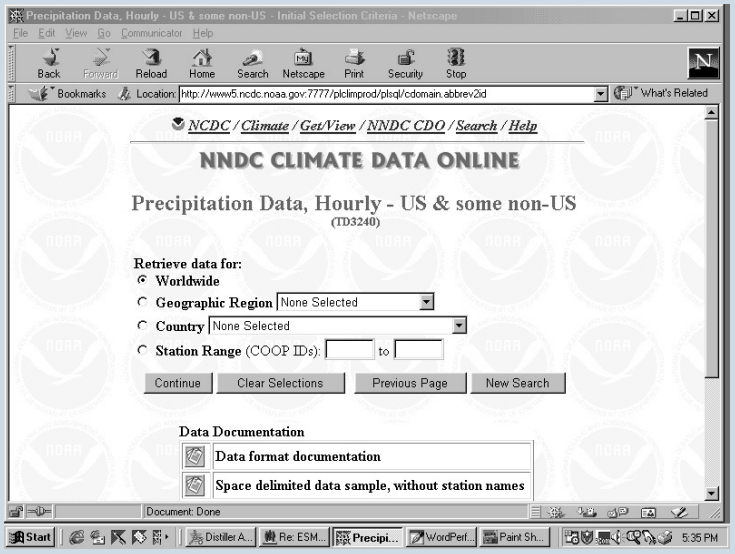

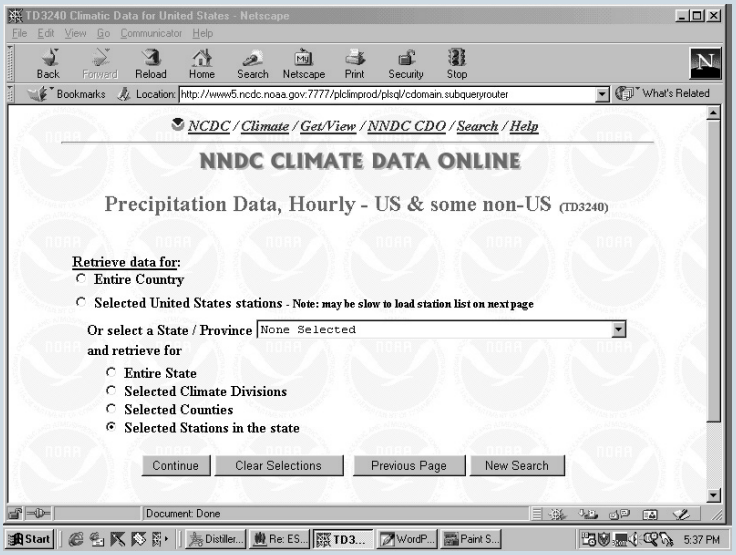

▲ **Figures 2 and 3.** At top, the next page allows selection of the entire dataset (worldwide); selecting the United States as the country shows the next interface (below), allowing further selections by entire state, climate division, county or individual station(s).

Climate Data Online, *from page 1*

present, over 6000 stations historically, over 2000 currently active.

The main user interface (Figure 1) allows initial selection by region, by country, or by data type. You can select, for example, one country to see what types of data are available for that country. Conversely, one data type can be selected to see what countries and stations have data available for that type of data.

The next "page" (Figure 2) allows selection of the entire dataset (worldwide), selection by region, by country, or by station number range. Selection of United States as the country then leads to an interface (Figure 3) allowing selection by entire state, climate division, county, or individual station(s). This is quite flexible in that you can select, for example, all stations in a county, or just pick selected stations from a particular state.

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EARTH SYSTEM MONITOR

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Studying freezing lakes and soil in Alaska

National Snow and Ice Data Center's Tingjun Zhang is collaborating with investigators at the International Arctic Research Center and the Geophysical Institute, University of Alaska Fairbanks to study lake ice. Synthetic aperture radar data can be used to detect whether lakes on Alaska's North Slope are partially frozen or frozen to the bottom, and a time series of such data can be used to estimate ice thickness and growth rate. Results have implications for heat flux and the local surface energy balance. Zhang also participated in the NASA Land Surface Hydrological Program investigation team meeting at Washington, D.C., November 2-4, and presented the paper "Detecting surface soil freeze/thaw status over snowfree land surface using passive microwave satellite remote sensing data."

NOAA research on past El Niño and Asian monsoons

The NGDC's Dave Anderson teamed up with university scientists Don Rodbell (Union College) and Chris Moy (Syracuse University), to analyze lake records of El Niño during the past several thousand years. The team used a recent technological innovation available at Columbia University that provides non-destructive measurements of sediment core properties to analyze climate changes in sediments at unprecedented detail. Using these detailed sampling methodologies, paleoclimatologists are able to sample at an order of magnitude finer resolution than has previously been possible, producing data on interannual and decadal scale climate variability.

Data communications improved

The 1.5 Mbps T1 Wide Area Network (WAN) connection between the National Geophysical Data Center in Boulder, Colorado, and the National Imagery and Mapping Agency in Bethesda, Maryland, has been reconfigured to more fully use the available bandwidth. The link previously was used only for the Hydrographic Source and Assessment System (HYDRAS) program, but now is being split to include data exchange for the Defense Meteorological Satellite Program (DMSP) Night Time Lights programs. Both HYSAS and DMSP are configured to utilize a dedicated portion of this WAN circuit.

News briefs

Major 20th Century weather/ climate events

The National Climatic Data Center (NCDC) is collaborating with the National Weather Service to establish a NOAA list of the most important weather/climate events that have occurred during the twentieth century. The magazine *Weatherwise* has already published such a list in its November/December 1999 issue, including such events as the Dust Bowl Drought of the 1930s and the Super Tornado Outbreak of April 1974.

The NCDC's page documenting occurrences of billion dollar weather disasters from 1980-1999 was featured on the Department of Commerce's home page. The page is currently being updated to include a map depicting the locations of each disaster and the dollar damage numbers will be adjusted for both inflation and a wealth index that takes into account the increase in goods available to the domestic and commercial sectors.

NASA examining land cover changes in Africa

National Aeronautics and Space Administration (NASA) scientists, under the Biospherics Branch at the Goddard Space Flight Center, are nearing completion of a long-term historical archive of National Oceanic and Atmospheric Administration (NOAA) Advanced Very High Resolution Radiometer (AVHRR) data over the African continent. The data will be used extensively for the ongoing Global Inventory, Mapping and Monitoring System (GIMMS) project.

One example of the project's goals is to assess environmental conditions which led up to the infamous Rift Valley Fever epidemics in Kenya. Analysis of past events along with records of Pacific and Indian Ocean sea surface temperature anomalies, coupled with AVHRR-derived satellite normalized difference vegetation index (NDVI) data, show that prediction of Rift Valley fever outbreaks may be made up to five months in advance in East Africa. The NCDC is providing approximately 1000 AVHrr data sets for the year 1980 to help with the GIMMS project.

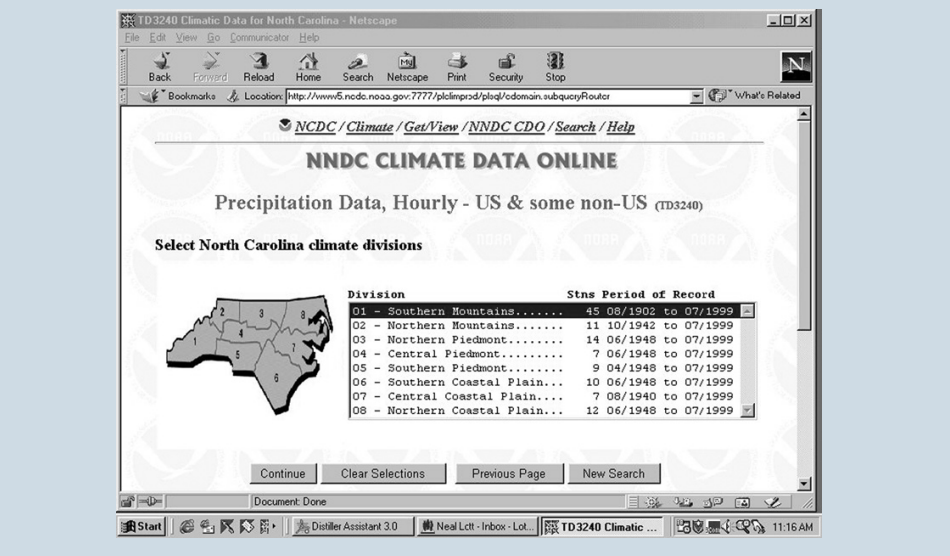
Satellite monitoring of squid fisheries

Dr. Paul Rodhouse of the British Antarctic Survey (BAS) visited the NGDC to discuss ongoing collaborations on the monitoring of squid fisheries in the Southern Atlantic Ocean, off the coast of Peru and surrounding New Zealand. These fisheries are exploited using boats equipped with large banks of lights, which attract the squid to the sea surface. These lights can be detected using nighttime Defense Meteorological Satellite Program-Operational Linescan System (OLS) data. Squid and other cephalopods are short-lived ecological opportunists and there is evidence that as finfish stocks have collapsed through overfishing, in some parts of the world there have been increases in cephalopod stocks as they have, at least partly, filled the vacant niche.

Cephalopods are an important food resource for many higher predators fo the oceanic food chain, including seabirds, seals and whales. Therefore, understanding the interactions between the squid stocks, oceanographic variability, predator populations and commercial fisheries is of fundamental importance in the management of marine ecosystems, especially in the southern hemisphere. Dr. Rodhouse is using nighttime OLS data from NGDC to investigate the feasibility for routine monitoring of the squid populations, which fluctuate substantially from year to year.

Climate atlas evaluation

The National Climatic Data Center has developed a method to evaluate the map products generated for the new U.S. Climate Atlas by Oregon State University (OSU). PRISM (Parameter Regressions on Independent Slopes Model) was used by OSU to generate the 4 x 4 km grid files. The PRISM grid file is imported into ArcView and the value of the grid points which correspond to the station locations are computed. The difference between the observed station value and the modeled value is computed and mapped. ArcView is then used to query the differences, and stations with questionable data are reviewed. OSU has provided preliminary grid files for nearly 200 of the expected 350 maps for NCDC to review. The remaining maps were due by the end of 1999.



▲ **Figure 4.** If "climate division" is selected the next page will show a map of the divisions for that particular state.

Climate Data Online, *from page 2*

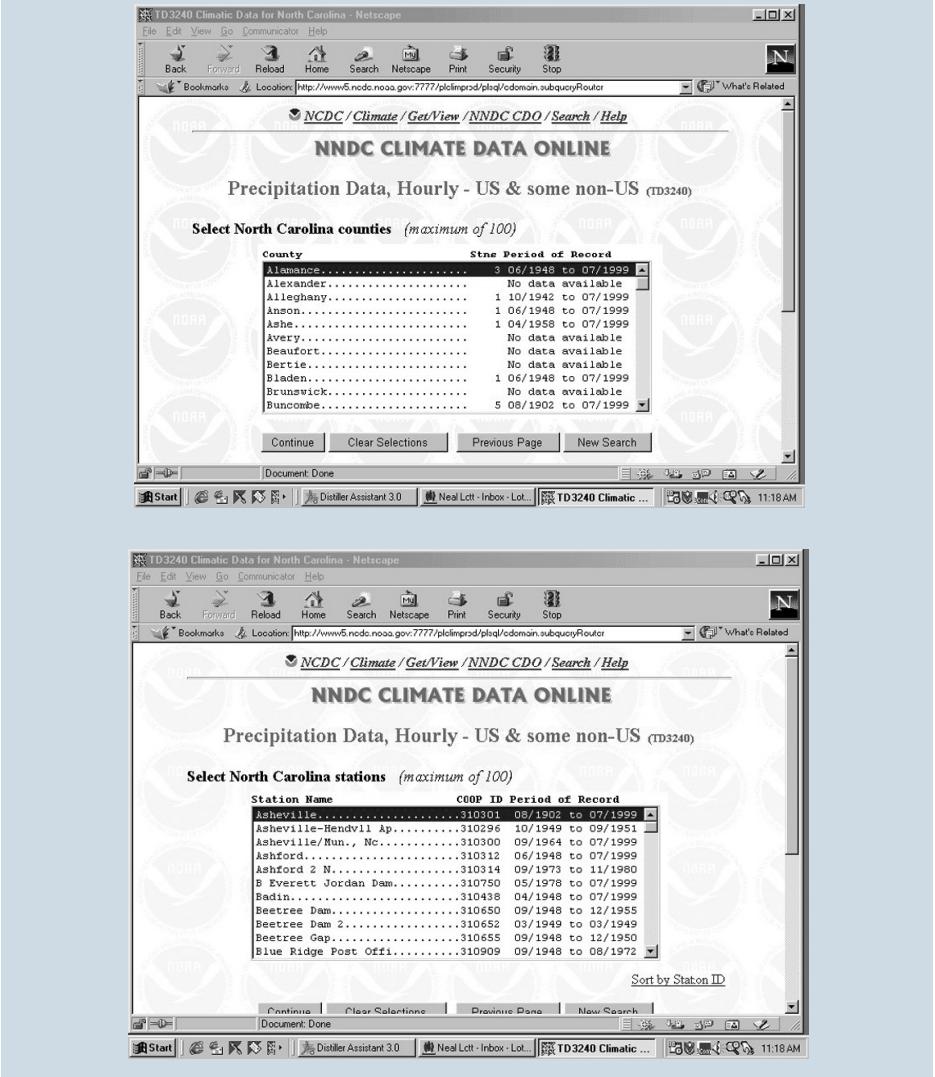
The next "page" will vary depending on what has been selected so far. For example, if "climate division" has been selected, a map of the divisions for that state (Figure 4) will be displayed. If "county" is chosen, a list of counties will be displayed (Figure 5). If station is chosen, a full list of stations for the state (Figure 6) will be displayed.

The next "page" (Figure 7) then provides for selection of the period/dates that are required and the output format desired. Also, some datasets (e.g., daily, monthly) provide element selection capability on this page, so that just the desired weather elements (e.g., precipitation, temperature) may be selected. Our basic format options (for most datasets) are:

1. Space-delimited with station name in each data record
2. Space-delimited without station name
3. Comma-delimited with station name in each data record
4. Comma-delimited without station name
5. The standard (archive) variable length format for that particular dataset
6. The standard fixed length format for that particular dataset

Most users prefer one of the delimited formats. Comma-delimited is often better for import into a spreadsheet. Space-delimited is easier on the eyes and easy to write a program for, such as with Fortran or C++. The standard dataset formats are often required by users with application programs previously written for those specific NCDC formats.

The next "page" will provide a summary of the request and will then direct you into our online store, unless you have free access as mentioned above. The online store then requests payment information, with a similar interface as would be seen for other online systems. At present, payment by credit card is the only option, but we plan to add a subscription option, whereby users will be able to subscribe to the system for a year at a fixed price.



▲ **Figures 5 and 6.** At top, when "county" is chosen, a list of counties is displayed; if station is chosen, at bottom, a full list of stations is seen for the state.

Finally, you're directed to an html address with a list of files that have been produced, or are being produced. Your data file may already be available, so the file may be clicked on to see if it is there. If not, just bookmark the page for future reference. Also, you are "double-covered" in that we send you an email with directions to your data when your order has finished processing. You'll have access to the data file, an inventory for your selection, a station list, and data format documentation. Most small orders (e.g, a few mb) complete processing in a few minutes. However, some larger orders require a few hours to process, so keep that in mind after placing your order. Of course, if our system is quite busy, run times will be longer; and if the internet "lines" in your path to NCDC are busy, your time required to ftp the data files will be longer.

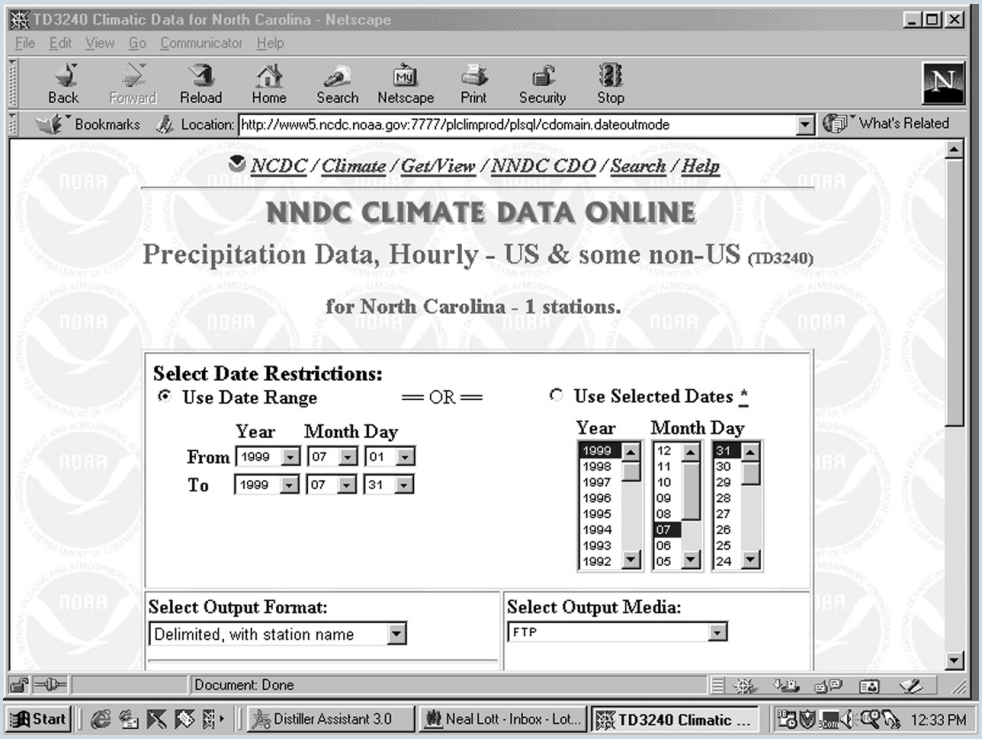
A complete help system is included (*http://www5.ncdc.noaa.gov/cdo/info.html*) with a data price schedule, general system information, detailed system help for diagnosing problems (e.g., inability to connect due to firewall on user end), format documentation, data samples, station lists, utility software, etc.

Although with limited publicity, this system has proven to be quite popular since its online implementation in June 1999. Customers for the available datasets are now frequently using this system rather than placing off-line orders by phone for later delivery by mail. However, when off-line orders are placed, NCDC uses NNDC CDO to fill the order and provide the data on the requested media (e.g., CDROM, zip disk, magnetic tape, ftp delivery). This means we only have to maintain one system for both online and off-line support for these datasets, and future datasets that will be added. That translates into substantial cost savings to the government.

We currently limit the data volume for a specific user-requested file to 40 mb, which is then compressed (gzip) to 5 mb or so. We plan to increase that limit in the near future, as bandwidth improvements allow. Of course, you can place several orders (i.e., for several files) in one web session to retrieve all of the required data. For the immediate future, we suggest that requirements for large data volumes (over approximately 100 mb) be placed as an off-line order by phone (828-271-4800) or email (*orders@ncdc .noaa.gov*).

Again, the system URL is: *http://www5.ncdc.noaa.gov:7777/plclimprod/plsql/poemain.poe*. We encourage you to give it a try and provide feedback to us. We continue to implement enhancements to the system, with user feedback being a key to that process. Our long-term plan is for this system to be NCDC's primary method of delivering *in situ* data to weather and climate data customers.

The NOAA National Data Center Climate Data Online System is a product of the following development team members: Dee Dee Anders, Jeff Arnfield, Steve Fleming, Neal Lott, Doug Ross, Tom Whitehurst, and Vickie Wright. ■



▲ **Figure 7.** This page provides for selection of the required period/dates. Also, some datasets provide element selection capability on this page, so that the desired weather elements can be chosen.

Long-Term Acquisition Plan of Landsat 7

Collecting coral reef data worldwide

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The June 1999 issue of *Earth System Monitor* presented many issues related to coral reef mapping in U.S. waters through the actions headed by the U.S. Coral Reef Task Force (USCRTF). The efforts, in terms of collecting, analyzing and synthesizing cartographic and biological data, focus on the reefs bathed by US waters or by territories under US jurisdiction. However, coral reefs are not only included in US waters. Indeed, despite the uncertainty on the actual surface covered by coral reefs worldwide (~600,000 km^2 according to Smith (1978), ~255,000 km^2 according to Spalding and Grenfell (1997)), US reefs only cover a few percent of the total area, mainly thanks to the contribution of Hawaiian reefs. Therefore, coral reefs are more a global issue than a national issue. In this context, the Long Term Acquisition Plan (LTAP) of the Landsat 7 (L7) program is directing the acquisition of images over most of the reefs worldwide.

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Landsat 7 was launched in April 1999, carrying the Enhanced Thematic Mapper Plus (ETM+) sensor. The characteristics of the L7 ETM+ sensor, together with those of the previous Landsat sensors, are described in Table 1. The general philosophy of L7 is to acquire and periodically refresh an archive of sunlit, substantially cloud-free land scenes. The archive is used to analyze variations in land cover (vegetation, ice, desert, etc.) in the context of global change (Goward et al., 1999). This also includes the study of reefs. The LTAP designates approximately 400-500 scenes worldwide as candidates for acquisition each day. An average of 250 of these are actually scheduled, within the spacecraft and ground resource constraints (e.g., duty cycle, downlink bandwidth, station contacts). After almost three months of on-orbit initialization and verification, routine imaging operations were started in July 1999.

In October 1999, the first Landsat Science Team Meeting after the launch of L7, took place in Goddard Space Flight Center (GSFC) in Maryland. The latest statistics were presented on coverage by L7 of coral reefs, among other "niches" (volcanoes, rainforest, agricultural areas, oceanic islands, calibration sites, sea ice and glacier), Arvidson et al. 1999. There are a total of 8742 reefs covered by 968 scenes in the land database and therefore in the LTAP (Figure 1). This includes all but 21 reefs; these are covered by 19 isolated scenes that have a heavy overhead associated with their acquisition because of isolation.

After a year of operation, the addition of these scenes to the database will be reconsidered. High priority was assigned to 111 scenes containing a total of 604 reefs that are currently at risk, under study, or planned for study in the near future.

Potential research sites are slated for acquisition twice each year, at the peak of coral bleaching in the late local summer and six months later, and existing research sites are acquired on a quarterly basis. In reality, many scenes containing reefs are acquired much more frequently because they are

Table 1. Characteristics of Landsat sensors

Satellite	Sensor	Bandwidths	Resolution
LANDSATs 1-2	RBV	(1) 0.48 to 0.57	80
		(2) 0.58 to 0.68	80
		(3) 0.70 to 0.83	80
	MSS	(4) 0.5 to 0.6	79
		(5) 0.6 to 0.7	79
		(6) 0.7 to 0.8	79
		(7) 0.8 to 1.1	79
LANDSAT 3	RBV	(1) 0.505 to 0.75	40
	MSS	(4) 0.5 to 0.6	79
		(5) 0.6 to 0.7	79
		(6) 0.7 to 0.8	79
		(7) 0.8 to 1.1	79
		(8) 10.4 to 12.6	240
LANDSATs 4-5	MSS	(4) 0.5 to 0.6	82
		(5) 0.6 to 0.7	82
		(6) 0.7 to 0.8	82
		(7) 0.8 to 1.1	82
	TM	(1) 0.45 to 0.52	30
		(2) 0.52 to 0.60	30
		(3) 0.63 to 0.69	30
		(4) 0.76 to 0.90	30
		(5) 1.55 to 1.75	30
		(6) 10.4 to 12.5	120
		(7) 2.08 to 2.35	30
LANDSAT 7	ETM	(1) 0.45 to 0.52	30
		(2) 0.52 to 0.60	30
		(3) 0.63 to 0.69	30
		(4) 0.76 to 0.90	30
		(5) 1.55 to 1.75	30
		(6) 10.4 to 12.5	150
		(7) 2.08 to 2.35	30
		PAN 0.50 to 0.90	15

driven by the land content of the scene, not the reef content: 70% of the reefs have acquisition rates twice a year or better, 65% have acquisition rates of 4 times a year or better, and 33% have rates indicating they are to be acquired at every opportunity. Of the 604 high priority reefs, 0.8% have acquisition rates of twice yearly, 6 months apart; 45.5% have acquisition rates of quaterly and 53.7 % have rates of acquisition greater than 12 times a year. Figure 1 shows that since the start of routine operations on July 15, 2051 images covering 96% of all the requested reefs have been acquired as of December 1. Acquisition rates for scenes containing reefs ranged from one to ten times. Some areas covered during the first months of operation still suffer from cloud coverage but the situation will likely be improved in the near future, after the seasonal pattern in cloud coverage changes. Currently the average assessed cloud cover of the reef scenes in the archive is 24.8%, keeping in mind that the range of actual values is 0 to 99).

Now that data will be available on a regular basis, what are the main scientific and management issues that can be addressed using Landsat 7 images? The kind of studies that may benefit from LTAP imagery are the following:

- assessment of the extent of reef areas worldwide and their contribution to the global biogeochemical cycles
- biodiversity and resource assessment
- chlorophyll assessment and productivity of lagoons
- impact of river run-off
- change detection
- coastal characterization
- baseline mapping by NOAA of all US reefs

The unique opportunity to now have routine imaging of most of the reefs worldwide, combined with an increasing number of monitoring organizations (e.g., *http://www.coral.aoml.noaa.gov/agra/* and *http://coral.aoml.noaa.gov/gcrmn/*) and research institutions involved in coral reef studies, will serve as a consistent basis to improve our knowledge on the functioning of these ecosystems in the next decade.

References

Arvidson T., J. Gasch, S.N. Goward, 1999. Long Term Acquisition Plan: Pleasing all of the people most of the time...Planning Landsat 7 acquisitions for the US archive. Proceedings 14th Pecora Memorial Remote Sensing Conference (6-10 dec. 1999 - Denver Colorado) (in press).

Goward, S.N. et al., 1999, Enhanced Landsat capturing all the Earth's land areas, EOS Trans. AGU 80(26): 289,293.

Smith, S.V., 1978, Coral-reef area and the contributions of reefs to processes and resources of the world's ocean, Nature, 273, 225-226.

Spalding, M.D., and A.M. Grenfell, 1997, New estimates of global and regional coral reef areas, Coral Reefs, 16, 225-230.

Appendix (useful L7 Web sites)

Documentation on Landsat sensors:
http://ltpwww.gsfc.nasa.gov/IAS/handbook/handbook_toc.html

Landsat project:
http://landsat7.usgs.gov/
http://landsat.gsfc.nasa.gov/

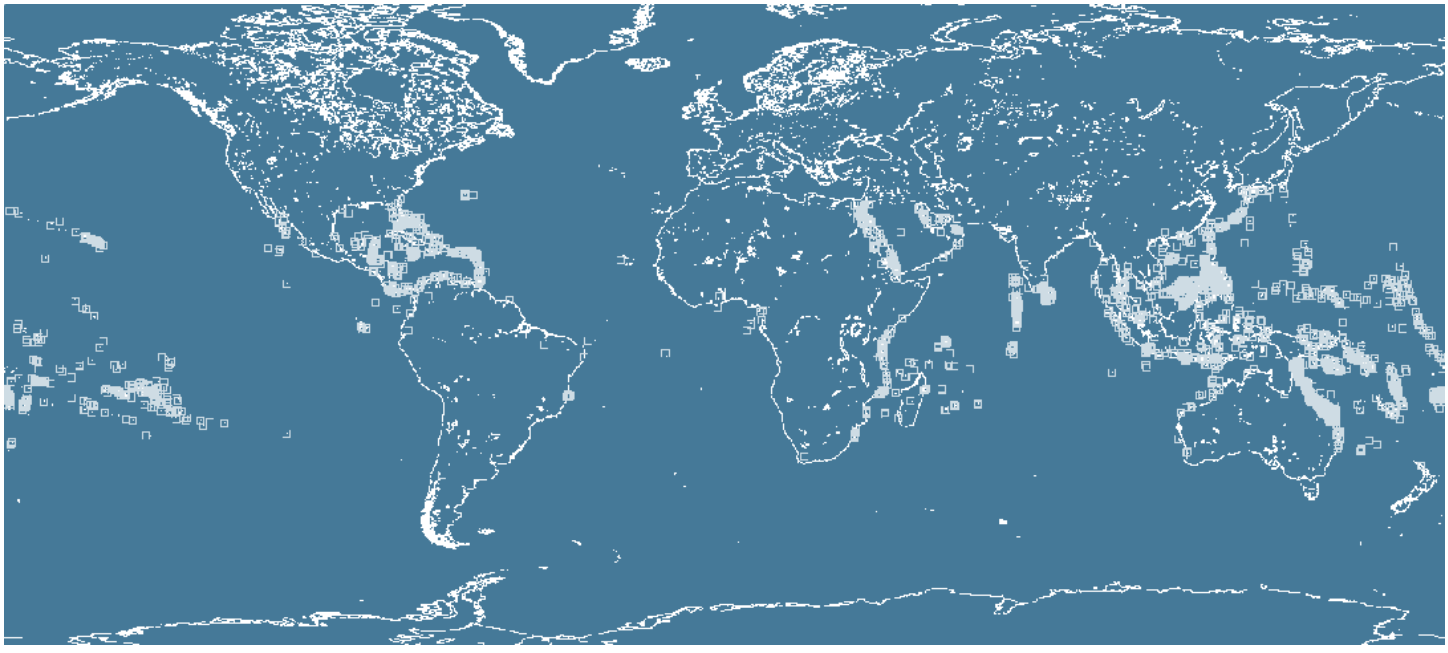
Main Landsat data gateway:
http://edcimswww.cr.usgs.gov/pub/imswelcome/
http://harp.gsfc.nasa.gov/~imswww/pub/imswelcome/plain.html

Other gateways (US and international):
http://harp.gsfc.nasa.gov/~imswww/pub/imswelcome/imswwwsites.html

Current coverage since beginning July 1999:
http://landsat7.usgs.gov/currentcov.html

Landsat software:
http://ltpwww.gsfc.nasa.gov/LANDSAT/CAMPAIGN_DOCS/MAIN/Software.html

Bibliography on coral reefs and remote sensing:
http://paria.marine.usf.edu/ftp/Serge/Biblio ■



▲ **Figure 1.** Current acquisition status of the reefs in the LTAP.

Climate monitoring at the National Climatic Data Center

Products, reports and analyses applicable to the study of earth sciences

Thomas F. Ross, Catherine S. Godfrey, and Richard R. Heim Jr.
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NOAA/NESDIS

The National Climatic Data Center (NCDC) is part of the National Oceanic and Atmospheric Administration (NOAA). NCDC's mission is to manage and disseminate national and global environmental data. The center archives over a half-million magnetic tapes/cartridges, 1.2 million microfiche, and 200 million paper records. The data center has more than 150 years of data on hand and adds 55 gigabytes of information daily.

The center's web page (Fig 1.) is at the following address: *http://www.ncdc.noaa.gov*. The WWW site handles approximately 1.6 million users per year.

The NCDC's Climate Monitoring Branch (CMB) produces operational as well as special-event reports on climate and weather around the globe. These NCDC reports address the climate in historical perspective and are available via the NCDC web site. Highlights include: synopses of global monthly and annual mean temperatures and precipitation and their departures from the long term mean; global and US extreme events; and U.S. and global regional analyses using traditional surface data as well as blended surface and satellite data products. The branch also has the responsibility of monitoring the health of the various network observing systems. For many years NCDC has produced summaries to "describe the climate." Only recently has NCDC taken on the responsibility of "monitoring and assessing the climate," as well.

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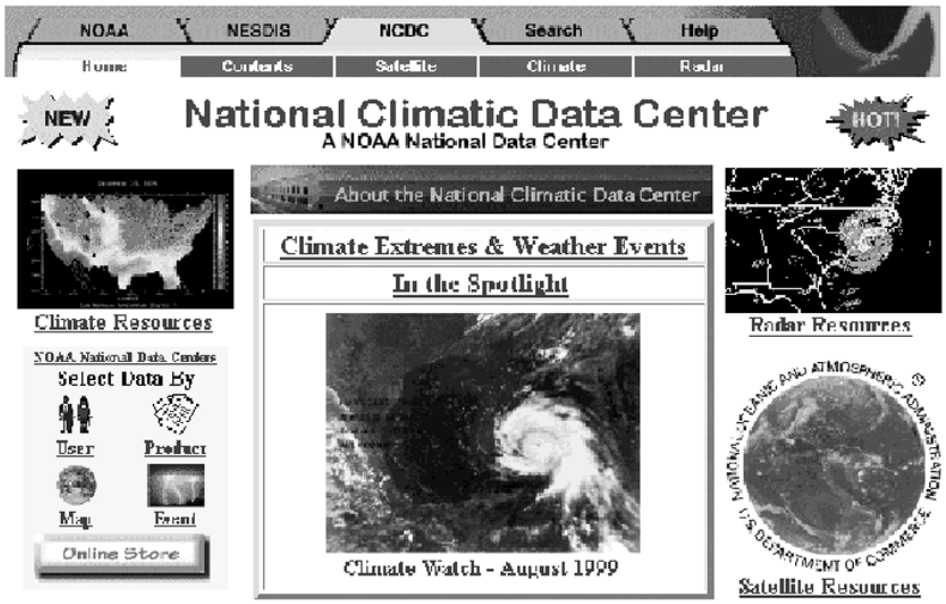
NCDC's mission is to "manage America's resource of global climatological in-situ and remotely sensed data and information to promote global environmental stewardship; to describe, monitor and assess the climate; and to support efforts to predict changes in the Earth's environment." This paper will describe the various products of the Climate Monitoring Branch which enables NCDC to accomplish its mission and highlight some applications useful to the earth science educator and student.

Examples of CMB Monthly Products

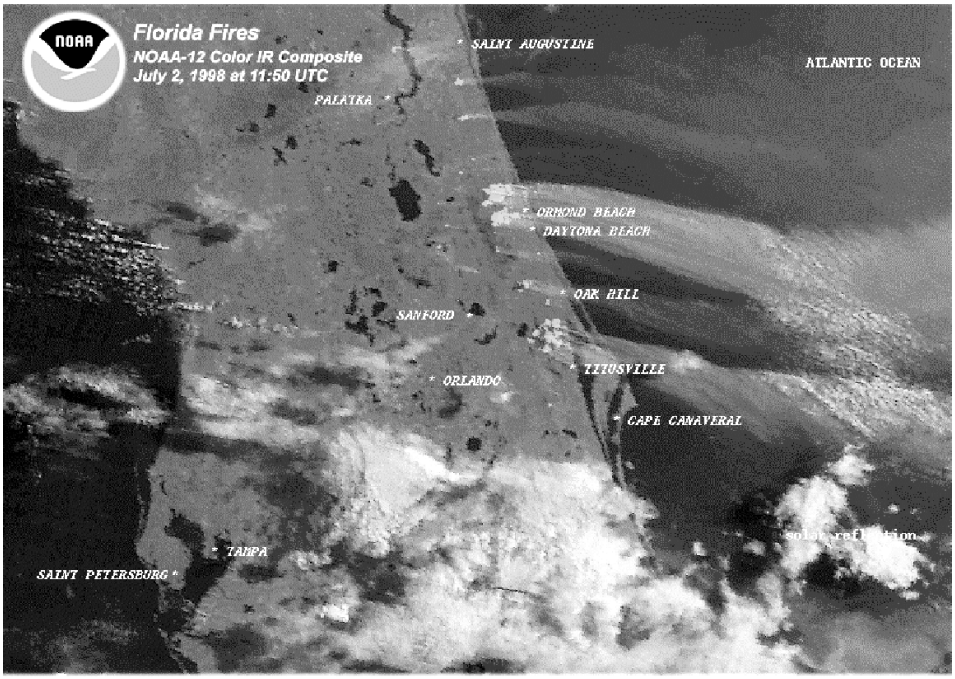
During the unprecedented 16-month episode of record-breaking high global temperatures, NCDC was called upon frequently to provide summaries of global and US temperature and precipitation trends, extremes, and comparisons to history. Many of the reports were required as an accompaniment to a Vice Presidential Press Briefing. The world wide web (WWW) was the venue of choice because of the expedient nature of the reports. The Internet also allowed us to distribute the report freely world wide. In addition to monthly reports, which were becoming routine and expected by the media, special reports were produced to address seasonal changes or special events like specific storms, floods, or droughts (Figure 2).

Global temperatures in 1998 were the warmest in the past 119 years, since reliable instrument records began. The previous record global annual temperature was set in 1997. The global mean temperature in 1998 was 1.2 F (0.66 C) above the long-term average value of 56.9 F (13.8 C). This was the 20th consecutive year with an annual global mean surface temperature that exceeded the long-term average. A persistent El Niño in the first half of the year and the unprecedented warmth of the Indian Ocean contributed to 1998 as being a record warm year.

After the run of record-breaking monthly temperatures was over, the decision was made to produce the monthly web reports operationally. The



▲ **Figure 1.** NCDC Home Page on the web.



▲ **Figure 2.** Florida drought of 1998 caused widespread fires that are clearly shown by the smoke plumes in this image.

original reports were produced by one individual with input from a variety of agencies and individuals. The monthly reports are now created by a team whose repertoire of products and analyses continues to expand and the report includes the following.

1. Anomaly time series

The data that are used in Figure 3 are based on the NCDC's long-term mean temperatures for the globe, which were calculated by processing data from thousands of world-wide observation sites on land and sea for the entire period of record of the data. Many parts of the globe are inaccessible and therefore have no data. The temperature anomaly time series presented was calculated in a way that did not require knowing the actual mean temperature of the Earth in these inaccessible areas such as mountain tops and remote parts of the Sahara Desert where there are no regularly reporting weather stations.

Using the collected data available, the whole Earth long-term mean temperatures were calculated by interpolating over uninhabited deserts, inaccessible Antarctic mountains, etc., in a manner that takes into account factors such as the decrease in temperature with elevation. By adding the long-term monthly mean temperature for the Earth to each anomaly value, one can create a time series that approximates the temperature of the Earth and how it has been changing through time. (Quayle, et al,.1999)

B. Gridded Anomaly Maps

Figure 4 shows a global gridded anomalies map produced using data from the Global Historical Climatology Network (GHCN). The GHCN is a comprehensive global surface baseline climate data set designed for monitoring and detecting climate change. Comprised of surface station observations of temperature, precipitation, and pressure, all GHCN data are on a monthly basis. The products currently use monthly temperature and precipitation data. GHCN homogeneity adjusted data was the primary source for developing the gridded fields. In grid boxes without homogeneity adjusted data, GHCN raw data was used to provide additional coverage when possible. Each month of data consists of 2592 gridded data points produced on a 5 X 5 degree basis for the entire globe (72 longitude x 36 latitude grid boxes). A product is produced for both temperature and precipitation.

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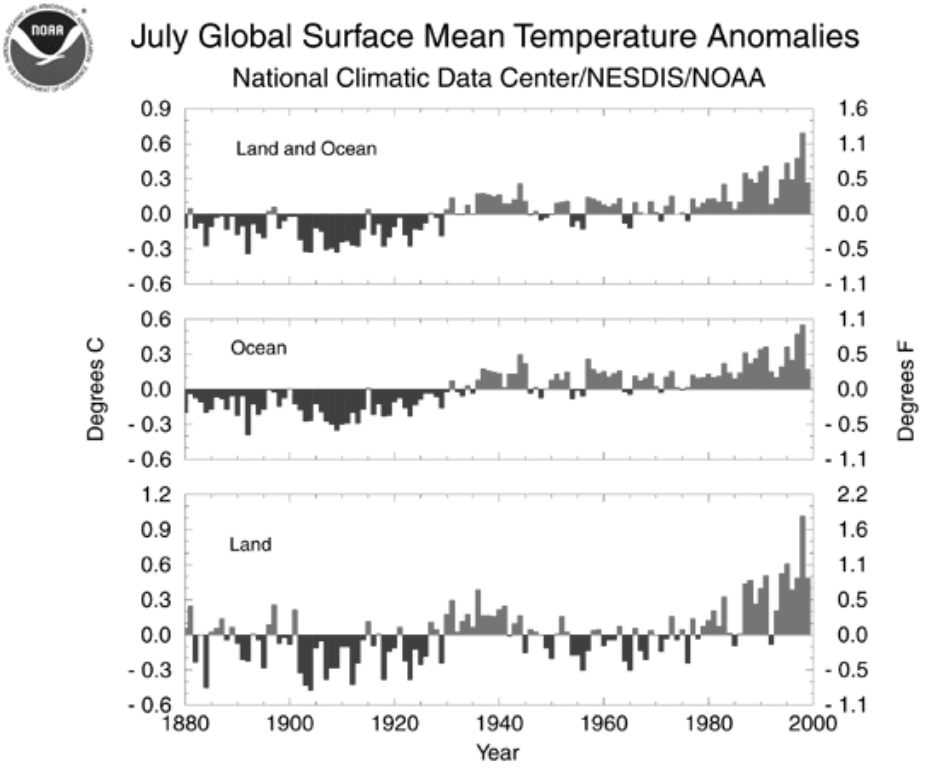
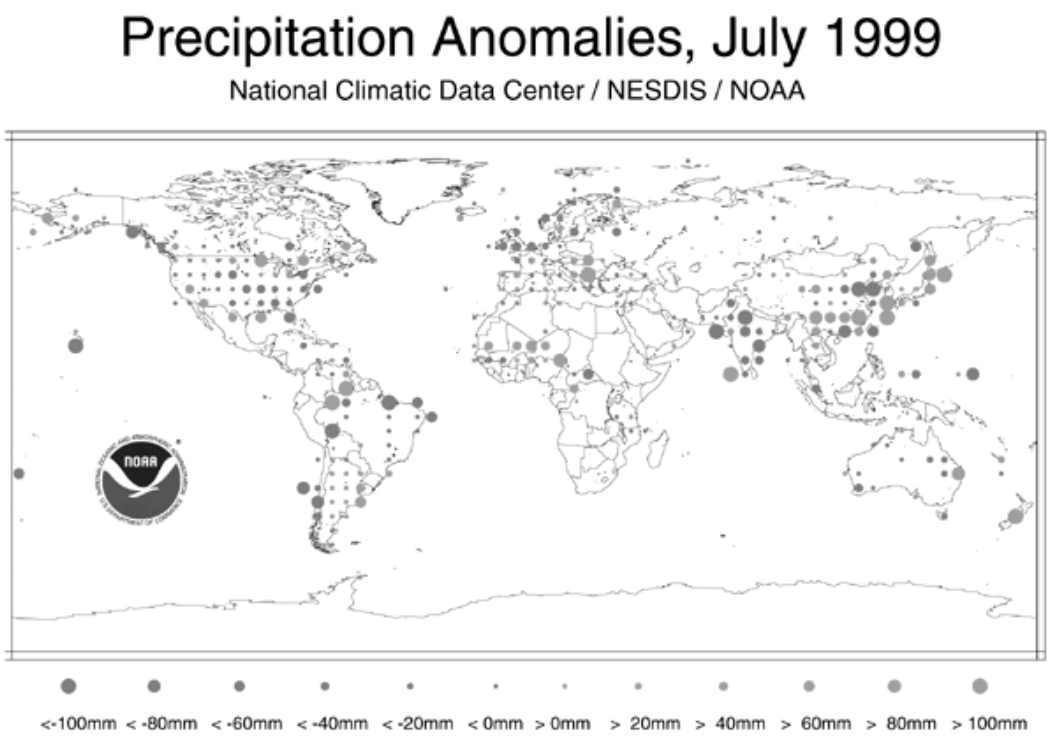
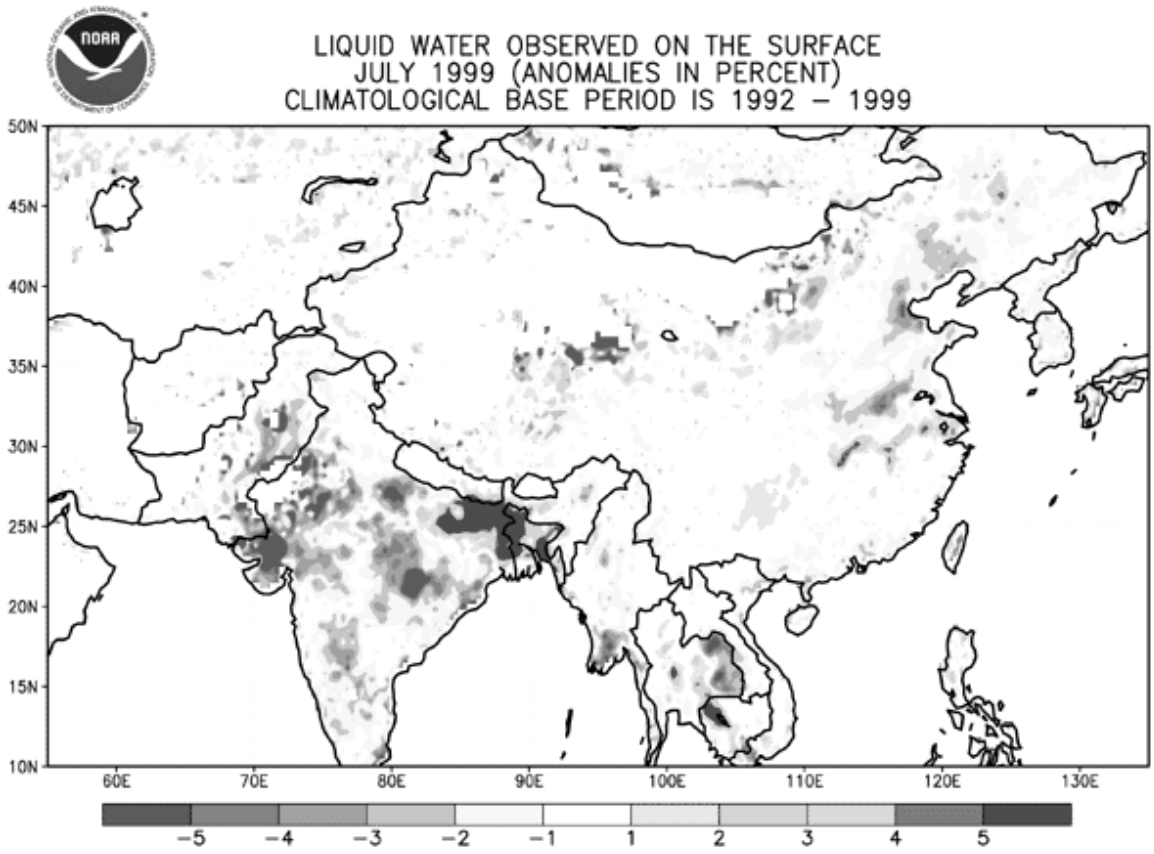


▲ **Figure 3.** Global Mean Temperature Time Series



▲ **Figure 4.** Global Gridded Precipitation Anomalies



▲ **Figure 5.** SSMI Liquid Water (Wetness) Product

Climate monitoring, *from page 9*

C. Satellite and blended satellite/GHCN/*in situ* derived products

NCDC produces maps of land surface temperature, wetness (Figure 5), snow cover, and their respective anomalies, as well as anomalies for blended surface temperature (Figure 6). These products are derived from the Special Sensor Microwave Imager (SSMI), a polar-orbiting satellite with global coverage. The maps are presented as both global and high resolution North American images. The data are available in near real time by the fifth day of the following month. Anomalies are presently derived from the 1992-1997 base period. The spatial resolution is 1 degree for all three data products.

The blended surface temperature product (Figure 6) is a result of merging several sources of data. The first data source is *in situ* land stations from the GCHN. Anomalies of GHCN time series are interpolated into a 5x5 degree area centered on each station. The second data source is a 1x1 degree surface temperature derived from the (SSMI) satellite instrument. While GHCN mean temperature data were used starting in the late 1800s, the SSMI data used in this analysis begin with January 1992. Therefore the data run from January 1992 to the present. The SSMI derived temperature is weighted to be equal to one *in situ* station, but is not interpolated into surrounding grid boxes.

The final temperature in the grid box is the mean of the in situ and satellite observations. The SSMI temperature derivation does not work over snow-covered grid boxes or over oceans. The ocean data in this data set are the Reynolds' Sea Surface Temperature (SST) from NOAA/National Weather Service (NWS)/National Center for Environmental Prediction (NCEP). These SST data were derived from ship and buoy observations as well as satellite data (but not the SSMI instrument). Data over ice-covered areas are not available. In the case of coastal areas where GHCN surface temperatures were interpolated over the ocean, the SST data replace the GHCN interpolated data. However, if there were a GHCN station in that 1x1 degree grid box, as there are for many small Pacific islands, the GHCN data would not be replaced by SST. In all cases, GHCN, SSMI, and SST, the anomalies are adjusted to be a mean of the base period, 1992 to current. Units are in degrees Centigrade.

More information on the blended surface temperature product, including the data, may be obtained through: *http://www.ncdc.noaa.gov/ol/climate/research/blended/blended.html*.

Other products

Several additional parameters are utilized in CMB's climate monitoring. These include temperature standardized by its mean and standard deviation, precipitation standardized by the gamma distribution, daily temperature variability within the month, days with precipitation, days with temperatures beyond extreme thresholds, and the

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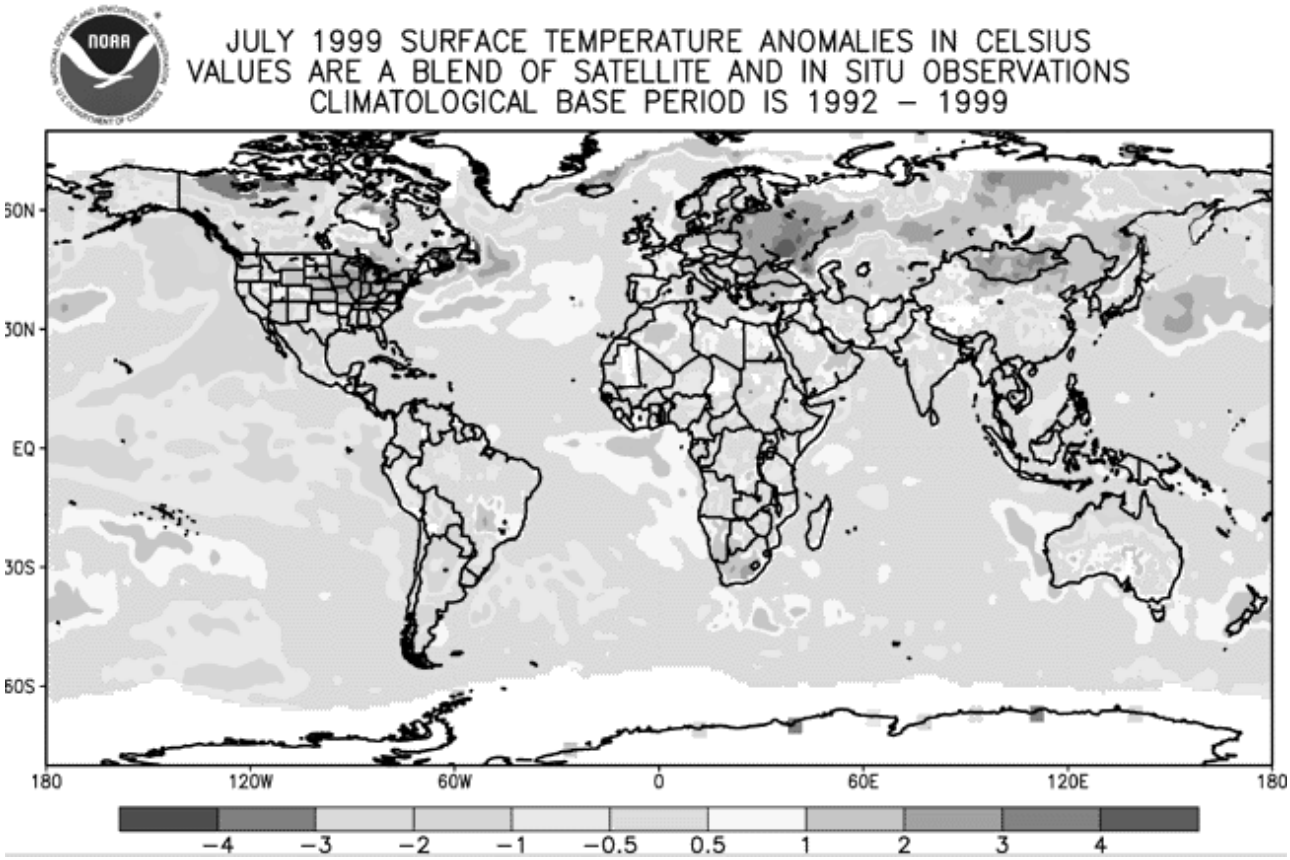


▲ **Figure 6.** SSMI/In Situ Blended Temperature Product

Climate monitoring, *from page 11*
Standardized Precipitation Index (SPI) developed by McKee, et al (1995). Animated maps are used to illustrate the temporal changes in the spatial structure of temperature anomalies, drought indices, upper-air circulation patterns, and satellite-observed snow cover extent.

Climate Watch

As part of the climate monitoring effort, the center produces a timely report called, "Climate Watch". The image shown in Figure 7 is a comparison of the sizes of Hurricane Floyd (1999) with Hurricane Andrew (1992). The report is issued usually within the first ten days of the month and updated several times as warranted. The report contains climatological information, data, satellite images, and analyses of current events for the month. The report also highlights new NWS station records of interest and global extreme events.

Future Products

One of the goals of the CMB is to also monitor the health of the climate network. The group plans on ingesting, analyzing, and producing daily maps and products of anomalous temperature and precipitation events. These products should help to identify suspect data values during the analysis. The CMB is also working on global anomaly time series by hemisphere, additional satellite-enhanced analyses, and additional animations.

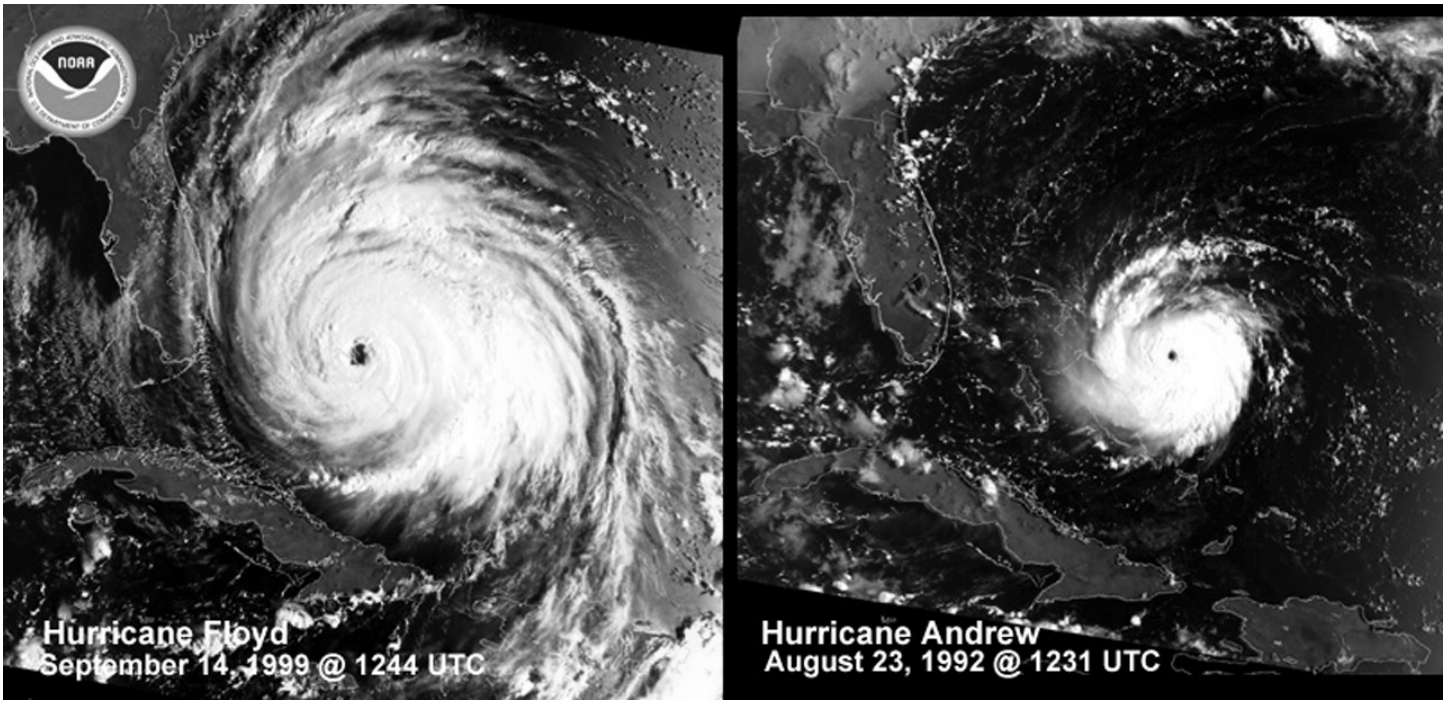
Conclusion

NCDC's Climate Monitoring Branch enables the Center to accomplish its mission of monitoring and assessing the climate of the nation and of the world by producing various products on an operational basis. These products are made available via the internet to the scientific community, educators, news media, policy makers , and others.

References

1. Robert G. Quayle, Thomas C. Peterson, Alan N. Basist, and Catherine S. Godfrey 1999: An Operational Near Real Time Global Temperature Index Geophysical Research Letters, 26, 3, February 1, 1999, 333-335. (Also available at web site: *http://www.ncdc.noaa.gov/ol/climate/research/1998/ anomalies/anomalies.html*) National Climatic Data Center (NCDC), NOAA/NESDIS,Asheville N.C.

2. McKee, T.B., N.J. Doesken, and J. Kleist, 1995: Drought monitoring with multiple time scales. Preprints, Ninth Conference on Applied Climatology, 15-20 January 1995, Dallas, TX, 233-236. ■



▲ **Figure 7.** Climate Watch graphic, comparing the sizes of Hurricane Floyd (1999) with Hurricane Andrew (1992).

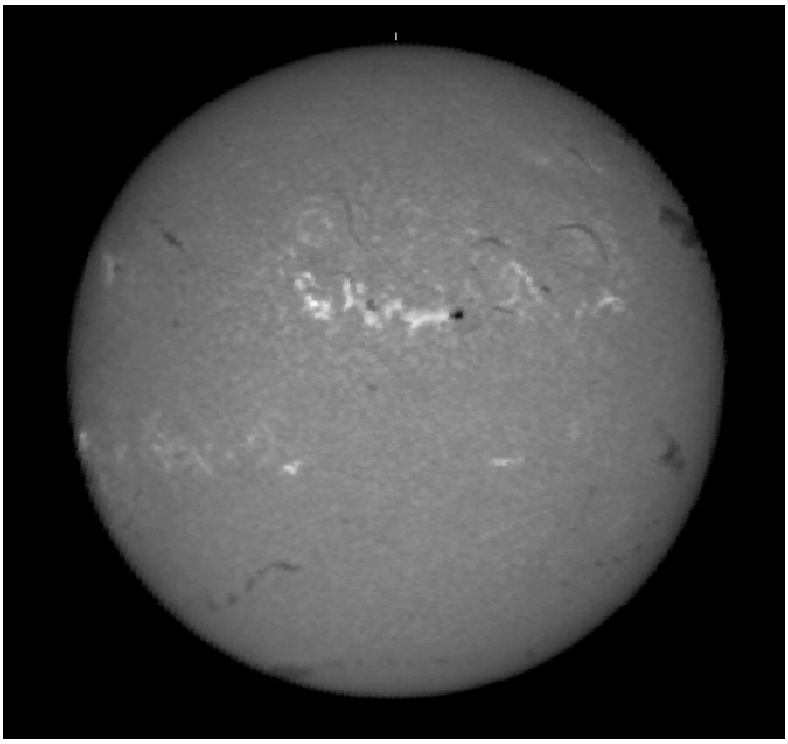
New NOAA space weather scales make Solar Max effects more predictable

As the sun revs up for Solar Max, a time of intense solar activity, we can look forward to increasingly turbulent space weather. In early November, the National Oceanic and Atmospheric Administration introduced the first-ever scales designed to characterize the severity and impact of upcoming solar storms on public safety and services. "NOAA's new scales are the Richter scales of space weather. For the first time, we can predict the impact of solar storms, and these storms may be a real Y2K problem," said Dr. D. James Baker, Undersecretary for Oceans and Atmosphere and NOAA administrator. "When Solar Maximum occurs, the sun bursts at its seams with explosive power, and as it churns there is potential for electrical power outages, radio problems, and the disabling of satellites. This can disrupt communications, including broadcast transmissions and pagers," Baker said.

As the period during the 11-year solar cycle when the sun is most active, Solar Maximum brings an increase in the number and intensity of solar storms and their effects. Space storms, radiation showers, aurora borealis, and affects on power grids and Global Positioning System navigation and other systems are all expected during the upcoming Solar Max period, which is expected to last about three years.

Already there is an increase in solar activity as the world approaches another Solar Maximum. As we get farther into Solar Cycle 23, expectations are that the sun will continue to rev up. Each time there is a solar event, NOAA's National Weather Service includes information on the event in its transmission of weather data.

Working like the Richter scale for earthquakes, NOAA's new space weather scales describe the intensity and frequency of three kinds of solar events: geomagnetic storms, solar radiation storms and radio blackouts. "The scales are a giant step forward in informing the public about the severity of these events and their expected consequences," said Dr. Ernie Hildner, director of NOAA's Space Environment Center in Boulder, Colorado. Hildner said that physical measurements on the scales will help the scientific and operations communities consistently identify the intensity of solar events. Solar storms can vary, with some equivalent to a thunderstorm on Earth, while others may be more severe, with intensity similar to a hurricane or tornado.



▲ **Figure 1.** Full disk H-Alpha image of the sun received on December 9, 1999 from Learmonth, Australia.

Satellite expert David Desrocher, a senior engineer at The Aerospace Corporation in Colorado Springs, Colorado, said that, "NOAA's new space weather scales will significantly aid the space industry in anticipating events, understanding effects, and developing more robust satellite designs and mitigation strategies." John Kappenman, a senior engineer at Metatech in Duluth, Minn., explained that space storms can impact the operational reliability of electrical transmission systems worldwide. "The previous solar cycle demonstrated just how seriously the power industry needs to consider the potential impacts of geomagnetic storms," Kappenman said.

One of the strongest impacts occurred during the last solar cycle in 1989, when the entire Province of Quebec went dark because a geomagnetic storm caused power lines to overload.

NOAA's Space Environment Center in Boulder is responsible for issuing warnings, watches and forecasts of the space environment and potential impacts on Earth. The Center continuously monitors the solar environment with a complex array of ground-based observations and satellites operated by NOAA and its national and international partners.

For more information on the Space Environment Center, check out *http://www.spaceweather.noaa.gov*.

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Wanted: Historical marine and coastal data of the Caribbean!

GODAR initiative for integrated coastal management

Paul Geerders
Project Co-ordinator
IOCARIBE-GODAR

Transparent waters (Figure 1), blinding white beaches and lush palmtrees: that is the image of the Caribbean coasts as it is known worldwide.

Causes

No wonder that a rapidly expanding tourism industry has become an activity of great economic importance for the countries in the region. And there are more economically relevant activities in the coastal environment of the region, such as fisheries and aquaculture, as well as exploration of oil, gas and other non-living resources. As a consequence of these developments a strong increase of the coastal population is observed in most countries, causing a rapid expansion of the coastal cities. However, the impacts of all these trends have not always been positive.

Effects

In many cases, the above mentioned developments have caused detrimental effects on the coastal environment, its ecosystems and biodiversity. Several of these coastal ecosystems are unique and valuable, they require protection and conservation. Only few and limited efforts were made by some countries to ensure that todays natural resources will remain available for future generations (the principle of sustainable development).

Tools and methodologies

Over the last decade the awareness on these problems has strongly increased. As a consequence, the need has arisen to develop and improve tools and methodologies for integrated coastal management of the coastal zone. These include systems for (real time) monitoring, systems for data and information processing and archival, and systems for simulation and decision support. They also include methodologies to assess the characteristics of the coastal zone, determine vulnerability and resilience, and balance the interests of different communities. Such systems and methodologies will first of all support the management of coastal resources, but will also be of great value in dealing with the damaging influences of climate related natural phenomena such as El Niño and hurricanes.

Role of data

Historical marine and coastal data and information can provide a significant contribution to systems for integrated management of the coastal zone in various ways. Historical data serves to build time series of variables, which can be used to detect changes and trends. As such they also form an essential basis for the development of numerical models. Such models, as a part of integrated management systems, would allow the forecast of events and changes, including the option of early warning for potentially dangerous events. They would also give the possibility to simulate the consequences of human intervention. A detailed knowledge of the behaviour of variables in the past allows for better choices of locations and sample frequencies for coastal measurement and monitoring systems. In this way, the efficiency and precision of the national systems, planned to be implemented in the countries of the region as a part of the Global Ocean Observing System, GOOS, can significantly be improved.

— *continued on page 16*

▲ **Figure 1.** Beautiful Caribbean waters harbor fragile ecosystems that need to be monitored for negative impacts.

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AGU geophysical monograph on millenial scale global climate

The National Geophysical Data Center's Robert Webb co-edited with Peter Clark (Oregon State University) and Lloyd Keigwin (Woods Hole Oceanographic Institution) an American Geophysical Union (AGU) Geophysical Monograph (#112) titled "Mechanisms of Global Climate Change at Millennial Times Scales." The monograph is intended to provide the paleoclimatology and climate dynamics communities with a comprehensive overview of current evidence and understanding of climate variability and abrupt climate change between orbital and interannual time scales. Chapters within the monograph focus on the current understanding of abrupt climate variations or events that have occurred at millennial-to-submillennial frequences (100-1000 yr). These abrupt climate variations or events are superimposed on gradual glacial to interglacial climate changes in response to slowly changing orbital forcing. Webb was also a co-author on the summary chapter titled "Making Sense of Millenial-Scale Climate Change."
Contact: NGDC

Hurricane Floyd report

The NCDC Monitoring/Rapid Response Team has placed a detailed report online concerning Hurricane Floyd. The report includes storm impact information, rainfall tables and maps, wind gust data, Next Generation Weather Radar (NEXRAD) images, satellite images/movies, and links to other sources of information and data. Cumulative rainfall data for Hurricanes Dennis and Floyd are also included. The website is: *http://www.ncdc.noaa.gov/ol/climate/extremes/1999/ September/extremes0999.html*.

Additionally, NCDC has placed a "Hurricanes-1999" web page online. The main function of the page is to tie together the various web pages, information, and images the Center has concerning the 1999 hurricanes. Federal employees at the NCDC, in conjunction with other Federal agencies in the Veach-Baley Federal Complex in Asheville, NC, collected non-perishable food items and supplies, pet foods, and monetary donations to assist with the monumental Hurricane Floyd relief effort in North Carolina.
Contact: NCDC

Data products and services

Web systems linked

Two of the National Climatic Data Center's (NCDC) Web systems have been linked to provide improved access to online customers. NCDC's Web Climate Services (WebCliServ) at *http://www.ncdc.noaa. gov/ol/climate/stationlocator.html*, which provides enhanced metadata search capabilities, has been linked to NOAA National Data Centers (NNDC) Climate Data Online (CDO) to provide direct access to online data from the associated metadata. This provides online users the capability to search for weather stations and then retrieve climate data by city or station name, postal zip code, U.S. County, climate division, state, station number, latitude-longitude, and call sign. Climate data has been simplified by providing a single access point to all online data sets available for the selected stations.
Contact: NCDC

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National Oceanographic Data Center (NODC)
301-713-3277
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WWW: *http://www.nodc.noaa.gov*

NOAA Environmental Services Data Directory
301-713-0572
(Gerry Barton)
Fax: 301-713-1249
E-mail: barton@esdim.noaa.gov
WWW: *http://www.esdim.noaa.gov/#data-products*

NOAA Central Library
Reference Services:
301-713-2600
Fax: 301-713-4599
E-mail: *reference@nodc.noaa.gov*
WWW: *http://www.lib.noaa.gov/*

Safer by design: natural hazards toolkit for the 21st Century

Paula Dunbar represented the NGDC at the Sixth Annual Congress of the Institute for Business and Home Safety (IBHS) in Memphis, Tennessee. Over 200 professionals involved in reducing the effects of natural hazards participated in the Congress. The meeting was structured around four basic tools that are necessary to make natural hazard loss reduction a public value: motivation, mitigation, public outreach, and real-time warning. The new IBHS publication, "Is Your Home Protected from Earthquake Disaster? A Homeowner's Guide to Earthquake Retrofit," was distributed at the Congress. A figure showing the location and magnitude of earthquakes in Alaska, Hawaii, and the coterminous United States for the last 100 years in included in this publication. NGDC is credited with providing these plots. This publication will be made available to IBHS members as well as the general public.
Contact: NGDC

NOAAPort

As of November 1, 1999, the NCDC NOAAPort Data Archive and Retrieval System (NDARS) Phase-One is fully functional. The objective of Phase-One is the receipt and identification of the entire NOAAPort data stream. It is one of the few systems that is receiving and ingesting all four channels. The majority of National Weather Service sites only ingest two channels. NCDC now has the capability to archive the entire data stream and distribute raw NOAAPort data to users when funding becomes available to store the data. A formal report is forthcoming in the ESDIM Project 97-295W.
Contact: NCDC

New NGDC digital data flier

A full color flier presenting 'Digital Data on Compact Disc' featuring images and descriptions of all CD-ROMs available from the National Geophysical Data Center is being mailed worldwide to more than 47,700 potential customers. The new center-wide flier format represents a shift away from previous fliers produced by each of the four divisions. The flier will also be posted on NGDC's website to enable customers to download the information.
Contact: NGDC

Caribbean data, *from page 14*

Situation of data

Many institutions and organizations in the Caribbean region hold a wealth of historical ocean and coastal data sets. A part of these was identified at a regional workshop held in October 1996 in Cartagena de Indias, Colombia. This workshop was organized in the framework of the Global Oceanographic Data Archeology and Rescue Project (GODAR) initiated and managed by the Intergovernmental Oceanographic Commission (IOC) of UNESCO.

However, although in principle much data should be available, the practical availability of this data appears quite limited. In many cases, inventories are lacking or incomplete, and very little descriptive metadata on the datasets are available. Furthermore, many of the historical data sets in the region are still in a manuscript form or in some analogue or digital magnetic form of past technologies.

Finally, in many cases, no regular backups are being made. This means that valuable data sets may easily be lost due to deterioration of the carrier or media, to calamities (eg. fires, inundations) or accidental erasure. In several cases it is even doubtful if the required hardware still exists to read some of the older recording media. All this leads to the factual situation that much of the historical data of the region is not really accessible.

Initiative

The increasing importance of research and integrated coastal management in the Caribbean region, and the related need for historical ocean and coastal data, has led to the conclusion that the accessibility of this data needs to be improved. At a meeting of the Caribbean countries in Costa Rica, in April 1999, this conclusion resulted in the initiative for a specific project on this subject. This project would have the following aims:
- to identify historical marine and coastal data sets on the Caribbean,
- to compile and publish an inventory of these data sets on CD-ROM and on a web site,
- to increase the awareness on the importance of proper data management,
- to set priorities for recovery of data sets taking into account current and planned activities in the region,
- to carry out recovery of specific data sets, taking into account the priorities defined, and the availability of funds.

This initiative was very much welcomed by the participants in the Costa Rica meeting and they pledged their support to it. As an important contribution to the project, during the meeting it was suggested that much of the marine and coastal data of the Caribbean actually may be archived outside the region, such as in the United States, Russia, Germany, the Netherlands, France and probably other countries. A search for these sources will certainly be included in the project.

As an integral part of the project, several training and awareness workshops will be held. These will include theoretical and practical training on proper data management procedures. This will help to ensure that today's data will not require a similar effort ten years from now.

Currently a project plan is being developed by a small team of experts. This project plan defines in more detail the Terms of Reference of the project and its Implementation Plan, and also identifies possible funding sources for the various phases of the project.

Impact

An improved access to historical marine and coastal data of the Caribbean will primarily serve coastal research and management in the region. Based upon this data, the countries of the region will be able to develop and improve their mechanisms for management of the coastal zone and its resources, taking into account the needs of future generations. Moreover, the results of the project will be of great importance for the worldwide marine science community. The Caribbean forms an integral part of the Earth System and better understanding of its functioning contributes to an improved understanding of that system as a whole. ■