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EARTH SYSTEM MONITOR

A guide to NOAA's data and information services

INSIDE

Bedford Institute of Oceanography provides ocean data

Physical oceanographic data made available to the scientific community

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For many years, the Ocean Science Division (OSD) of the Bedford Institute of Oceanography has maintained large databases of physical oceanographic data for use by research programs within the Canadian Federal Department of Fisheries and Oceans (DFO). Due to the widespread usefulness of these databases, OSD has recently undertaken an ambitious program to provide open access to these data for use by the wider science community. There are three databases which share a common user interface and WWW/database technology (Figure 1), with a single entry point at: *http://www. maritimes.dfo.ca/science/ocean/database/data_query.html.*

Climate Database

The Climate Database is an assembly of all available hydrographic (temperature and salinity) data for the area 35°- 80° N, and 42° - 100° W (Figure 2). The source of the data is the Marine Environmental Data Service (MEDS), the Canadian oceanographic data center for DFO. Through international data exchange agreements, data from other national data centers within the target area are also included. Near real-time data are obtained by MEDS as IGOSS Bathy/Tesac messages from the Global Telecommunications System. The database is updated monthly and contains over 525,000 profiles with 15 million individual observations from 1910 to the present. The data come from a number of instruments including CTD casts, hydrographic bottles, and a variety of bathythermographs.

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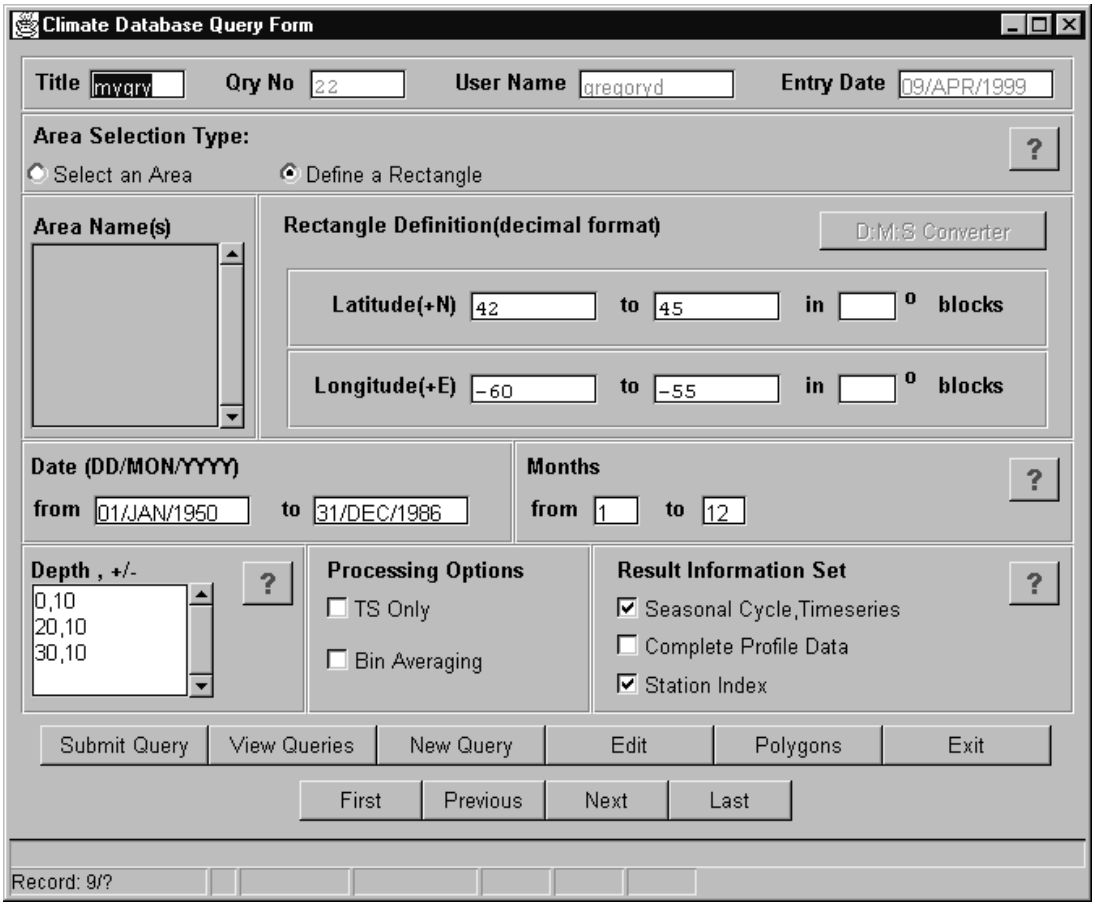

▲ **Figure 1.** Climate Query Form. SST and ODI applications share a similar form for their queries.

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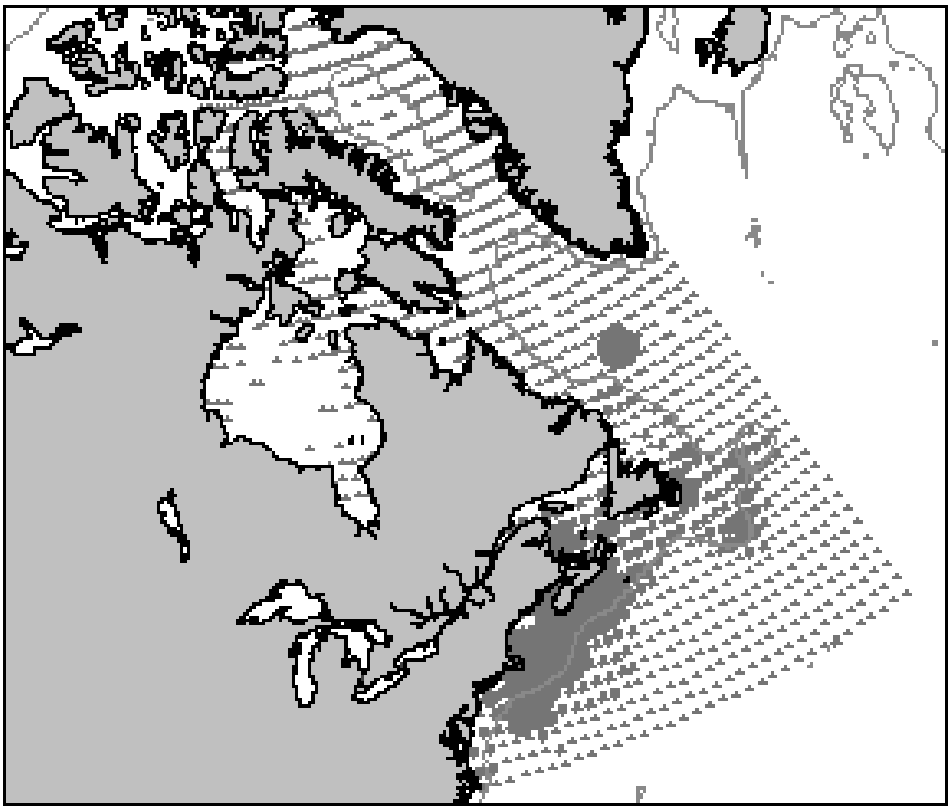

▲ **Figure 2.** Distribution of TS profiles within 10 boxes from the Climate database. Boxes with less than 10 stations have been omitted. Half the boxes shown contain 100 profiles or more.

Oceanographic databases, *from page 1*

All data, regardless of source, are initially validated by MEDS. The primary validation procedures at MEDS are described in the IOC publication GTSPP Real Time Quality Control Manual (UNESCO, 1990). At BIO, the data are subjected to a further set of tests before being incorporated into the database.

One of the primary functions of the BIO tests is the determination and elimination of duplicate profiles. For climatological purposes, a duplicate is defined as any profile that is within 0.02° of latitude and 0.03° of longitude (roughly 3 km) and 30 minutes time of another profile. Determining which duplicate to include in the database is based on a data type hierarchy. A CTD down cast is at the highest level, down through bottle casts, the various BT types, and finally the low resolution IGOSS Tesac and Bathy messages. Bathy and Tesac messages are replaced with the higher resolution CTD or XBT data as they become available, a process that may take a number of years. In addition to the standard quality control, the entire database is subjected to various statistical tests to improve the overall confidence in the data.

The spatial temporal criteria allow queries with user defined polygons, multiple depth ranges, and time windowing options. Processing options include the ability to select only those records that contain both temperature and salinity observations and an option to average the values within a profile according to the depth specification. This reduces the resolution of highly sampled data to more closely resemble observations sampled much less frequently.

— continued on page 4

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EARTH SYSTEM MONITOR

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NGDC to study urban sprawl

A proposal to NASA titled "Development Sprawl Impacts on the Terrestrial Carbon Dynamics of the United States," submitted by Chris Elvidge of the National Geophysical Data Center (NGDC), has been selected for funding by NASA's Office of Earth Science. Under this three-year project NGDC will produce a 1-kilometer resolution map depicting the surface density of manmade materials (buildings, roads, parking lots, etc.) using Defense Meteorological Satellite Program (DMSP) nighttime lights.

The product will be calibrated using Landsat Thematic Mapper data and transects of high-resolution aerial photography. The NGDC product will be used to test the hypotesis that urban sprawl has reduced the capacity of the United States land surface to absorb carbon dioxide from the atmosphere. Project co-investigators include Ramakrishna Nemani, School of Forestry, University of Montana, and James E. Vogelmann of the U.S. Geological Survey. As principal investigator, Dr. Elvidge will join the NASA Land Cover-Land Use Change Science Team.

Elephant seals

The National Geophysical Data Center is establishing a collaboration with the Government of Argentina (Centro Nacional Patagonico) and the British Antarctic Survey to analyze the distribution of satellite-tagged elephant seals and albatross species foraging on the Patagonian Shelf, and the location of squid fishing boats visible in nighttime Defense Meteorological Satellite Program (DMSP) data. During recent years, large increases in the fishing activity have raised questions regarding impacts on the elephant seals and marine bird species. NGDC will be providing a georeferenced time series on nighttime DMSP data back to 1992 for use by the Argentine and British scientists. The tagging program begain in the early-to-mid 1990s, corresponding with the DMSP archive.

The long-term agenda of the collaboration is to set up a conservation program on the Patagonian shelf with the objective of minimizing the impact of fisheries on wildlife. A meeting to discuss this concept is being organized at the New York Zoological Society over the next several months.

News briefs

NSIDC DAAC working group

The National Snow and Ice Data Center (NSIDC) Distributed Active Archive Center (DAAC) user working group met at NSIDC February 7-8. The group reviewed current NSIDC DAAC status for ingest and distribution of Moderate Resolution Imaging Spectrometer (MODIS) data from the *Terra* satellite later this year. Also discussed was the future status for processing of the ice, clouds and land Elevation Satellite laser altimetry data from the Geoscience Laser Altimeter and passive microwave data from the Advanced Microwave Scanning Radiometers on the Advanced Earth Observing System, and the next Earth Observing System platforms. No major issues were raised by the user working group although several actions will be taken to clarify MODIS sea, ice, and snow cover products, and the disposition of NSIDC DAAC processing of Special Sensor Microwave Imager Sounder data.

Annual climate wrap-up online

NCDC's final version of *The 1999 Global Climate* has been placed online. The annual summary also includes a brief summary of December's climate. The annual summary confirmed the preliminary conclusions for 1999 published in mid-December. December's warmth in the United States solidified 1999's rank as the second warmest year in the U.S. since 1900, following last year's record warmth. Twenty-five states, in 1999, ranked in the top 10 warmest for the period of record. Drought development in the Ohio Valley and Southeast was noted with Georgia and Kentucky experiencing their sixth and tenth driest year, respectively.

Globally, the combined ocean/land temperatures were the fifth warmest since 1880. An interesting find was that most of the cooling from 1998's record value was confined to the tropical latitudes of 20 N - 20 S. Both hemispheres in the 20 - 90 degree latitude band experienced only minor cooling from 1998.

For December in the U.S., record warmth continued in the northern Rockies and Plains with Montana experiencing its warmest December on record. December was exceptionally dry in the southwest with Arizona reporting its driest December on record, Nevada its second driest, and California its third driest.

Adriatic Sea cold water formation

The National Climatic Data Center (NCDC) is assisting a group of Italian oceanographers in determining which satellite data sets would be most useful in their research to prove a cold water flow theory in the Adriatic Sea. This cold water formation phenomenon occurs in cold winters, with strong bora-wind episodes in the northern Adriatic. The cold water sinks and spreads southward to the Jabuka Pit, then further south to the Palagruza Sill. The current theory predicates that the cooling phenomenon occurs in only a few days, but the sinking and spreading south takes months. AVHRR (Advanced Very High Resolution Radiometer) level 1B data from NOAA-14 and 15 and/or SST Global data will be provided to the oceanographers.

First half of 19th Century records found

Eighty-five (85) additional ships' log books that are a part of the Maury collection have been discovered in Germany. Apparently, these records were transported to Europe during the U.S. Civil War in an effort to raise funding and were left behind when personnel returned to the United States. One of the log books will be forwarded to the National Climatic Data Center to obtain an estimate on keying of the SST (Sea Surface Temperature) and meteorological observations.

Bathymetry extraction from aerial photography

The National Geophysical Data Center (NGDC) staff is testing a new software module designed to extract bathymetry from stereo pairs of aerial photographs. The capability to perform this analys relies on the visibility of bottom features and has been known for decades. However, no commercial package for performing this analysis could be found. NGDC contracted with BAE Systems to implement a set of algorithms published in the *Manual of of Remote Sensing*. NGDC is currently testing and evaluating results using color aerial photography acquired of coral reef areas in the U.S. Virgin Islands by the National Ocean Service.

Oceanographic data, *from page 2*
The information returned optionally includes:

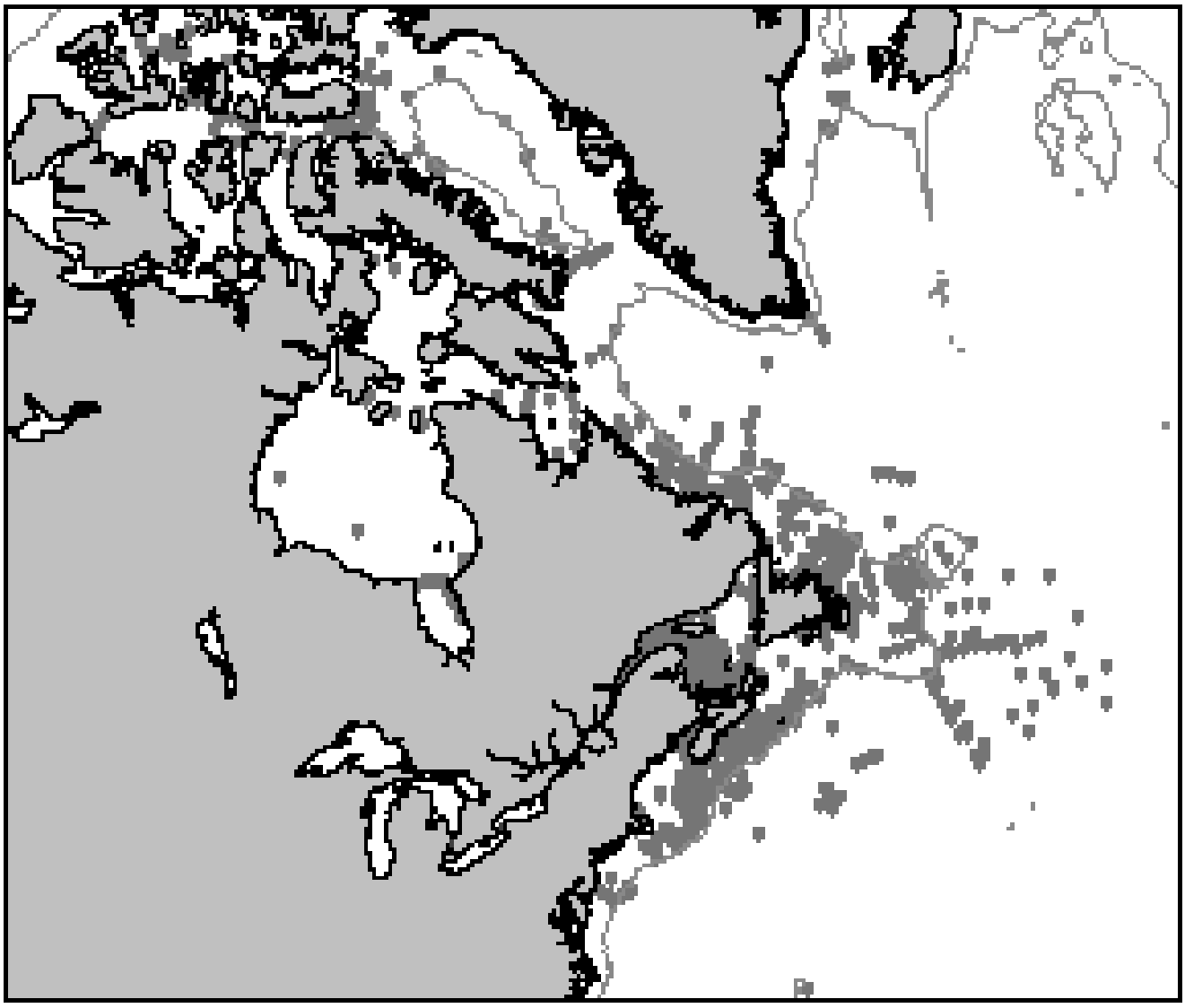
1) a monthly times series of the average, minimum, maximum and count of observations for each year, month and depth level for which there are data
2) a seasonal cycle based on an unweighted average over all months from the time series statistics
3) individual observations of temperature and salinity referenced to depth, latitude, longitude and date. These files can be very large.
4) a station index of latitude, longitude and date/time for each profile selected.

Sea-surface Temperature Database

SST is based on the Jet Propulsion Laboratory (JPL) multichannel sea-surface temperature (MCSST) 18km dataset. The product, distributed by the JPL Physical Oceanography Archive Center, consists of weekly global 18 kilometer gridded temperatures derived from the daytime NOAA Advance Very High Resolution Radiometer (AVHRR). The data and a document describing the JPL MCSST sea-surface temperature dataset can be downloaded from a JPL ftp site *http://podaac-www.jpl.nasa.gov/mcsst*.

In creating the SST database, data are geo-referenced and stored as discrete data for the area 35° - 67° N and 35° - 77° W. The database consists of over 4 million individual observations from 1981 to the present. Updates are made as the data become available from JPL, typically every few months.

The application permits spatial and temporal queries in an identical fashion to the Climate database. The database will be extended in the next few months to include chlorophyll data from SeaWifs as biweekly composites on a 9 km. grid. A review of the Pathfinder dataset is also in progress with a view to eventually replacing MCSST. The information returned is very similar to Climate. Options include a monthly time series, a seasonal cycle, or individual observations.



▲ **Figure 3.** Distribution of current meter and thermograph moorings contained in the ODI database.

Table 1. Common Features of all three databases

Single entry point at http://www.maritimes.dfo.ca/science/ocean/database/data_query.html

User Interface (Navigation) — Similar query form (common set of buttons to create, edit, view and submit queries and to create new areas (polygons).
Registration is required; user name and assigned password can be used for any application

Oracle plug-in (Jinitiator) required to run applications

Off-line queries, with e-mail notification when query completed; results downloaded as ASCII files.
Since queries are assigned a unique number and saved under the user name, they can be rerun or edited and submitted as new queries.
User defined areas (polygons) can be created and saved for subsequent queries. Areas can be created in any of the applications and accessed by the others.

Geographical search areas can be defined in three ways:
1) Choose from a list of predefined polygons
2) Provide a polygon definition by latitude/longitude coordinates
3) Define a rectange by latitude/longitude coordinates; rectangles can be subdivided into x and y blocks to produce a set of subqueries within the rectangle

A time window may be specified by a continuous period and/or by months.

Ocean Data Inventory (ODI)

ODI is an inventory of current meter and thermograph time series data held by the Bedford Institute (Figure 3). A substantial amount of the data has originated from sources other than research programs at BIO and includes data from Canadian and U.S. agencies and universities as well as the private sector. There are approximately 8000 time series in total, half of which are current meter deployments. Geographic coverage is for the area 35° - 80° N, and 40° - 100° W, however the overwhelming majority of the data are from the continental shelf. Temporal coverage is from 1960 to present.

Unlike Climate and SST, ODI does not contain the individual data observations, but includes monthly statistics for temperature, salinity and currents. For temperature and salinity, the statistics include the mean, maximum, minimum and standard deviation for each month of data. For vector (current) data, the statistics include maximum speed (without regard to direction), mean speed and direction, and the principal axis components for the data as observed, and with the tide removed. The principal axes analysis determines the orientation of the maximum and minimum variance and is a measure of the variability of the current. When used with the vector mean, and making some assumptions about the distribution, (i.e. mean +/- N standard deviations), the current extremes in both the sub-tidal (low frequency) and tidal (mid-frequency) bands can be estimated. Individual time series can be readily identified and a request for complete time series made by email. Requests are usually fulfilled within one day.

In addition to the usual temporal spatial criteria, users may specify which parameters (temperature, salinity, and current) are required. Users are given a parameter count of the number of series identified that meet the selection criteria. This provides an opportunity to change the criteria before proceeding if too few (or too many) time series have been identified.

Information returned includes the station information as well as the scalar and vector statistics. These files can be readily imported into a spreadsheet or database for further analysis. The scalar and vector statistics are also provided as formatted text reports.

Queries

Accessing these databases requires an Oracle plug-in called Jinitiator, which is available on the Ocean Science web site. Registration is required; a user name and password will be assigned and can be used for any application.

Queries are assigned a unique number and saved under the user name. Existing queries can be rerun or edited and submitted as new queries. Queries are run off-line, with users being informed via e-mail when their query has completed. Results are downloaded as ASCII files using a web browser.

For obvious reasons, we have had to put some constraints on the size of the result sets. The constraints are quite generous, and with the exception of requesting individual data values from Climate or SST, the limits should not present a problem. Climate is restricted to 1.5 million observations and SST limited to 1.8 million. If your query exceeds the limits, you will get an e-mail message that your query has returned too many rows and didn't execute. The solution is to break your query up into smaller sub-areas and try again. The web site provides more information to help with taking some of the guesswork out of this process.

Reference

UNESCO, 1990. GTSPP Real-time Quality Control Manual, Intergovernment Oceanographic Commission, Manuals and Guides, No. 22. ■

NODC Coral Reef Website

Developing system provides reef community access to data and information

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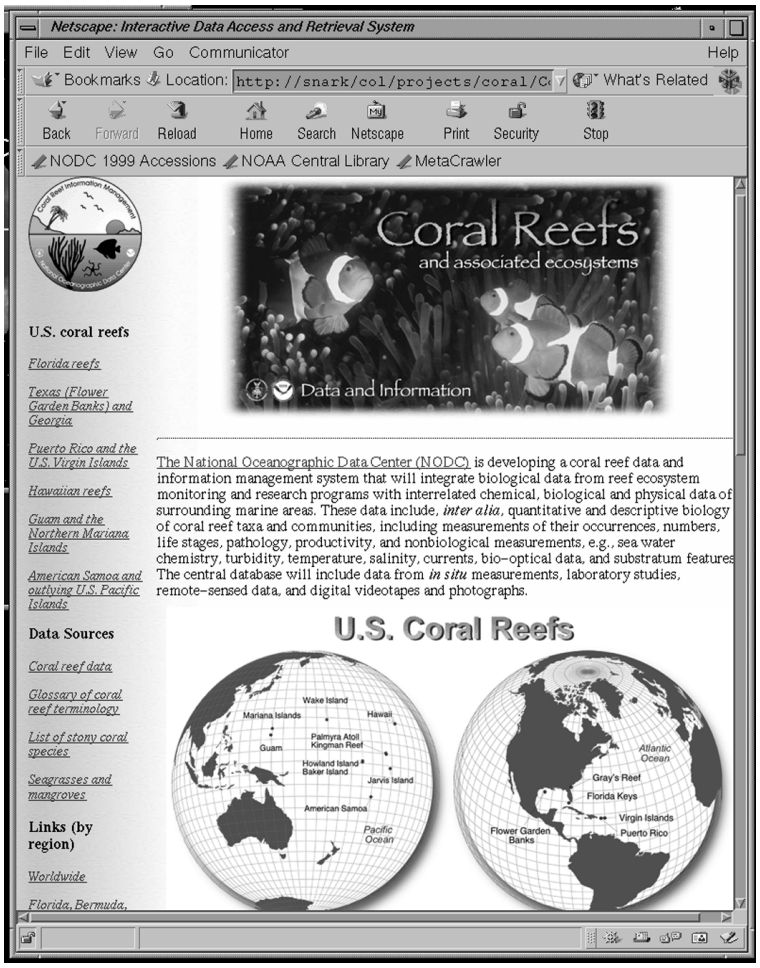
As part of the National Oceanographic Data Center's (NODC) mission to collect, archive, distribute, and preserve marine data, and in support of the 1998 Executive Order for Coral Reef Protection, the NODC is developing a Coral Reef Data and Information Management System that will integrate biological data from reef ecosystem monitoring and research programs with interrelated chemical, biological, and physical data of surrounding marine areas. These data will include, *inter alia*, quantitative and descriptive biology of coral reef communities, including measurements of species occurrences, numbers, life stages, pathology, productivity, and nonbiological measurements, e.g., sea water chemistry, turbidity, temperature, salinity, currents, bio-optical data, and substratum features. Additonally, data from *in situ* measurements, laboratory studies, remote-sensed data, and digital videotapes and photographs will also be archived and made available through the website. This work also supports the goals of the U.S. Coral Reef Task Force National Action Plan; these goals include the mapping of coral reefs, assessment and monitoring, the development and management of Marine Protected Areas, the mitigation of threats to coral reefs, and the dissemination of information and the providing of public education. Critical data collected in support of these goals will be provided with a permanent archive and accession point through which data can be retrieved by future managers and scientists in order to determine the efficacy of U.S. reef conservation, protection, and management efforts.



▲ **Figure 1.** Opening page of the the NODC Coral Reef Website; the site is designed to integrate biological data from reef ecosystem monitoring and research programs into a central location to aid environmental scientists and managers.

Data and information from associated marine areas that form an integral part of a healthy reef system (seagrass beds, mangrove forests) will also be archived and made available, as well as data from investigations of reef damage (physical, anthropogenic contamination, overfishing, etc.). In order to avoid the development of a redundant website, direct links are provided to other government web pages which have coral reef data holdings. Links to regional, state, academic, and other domestic and foreign organizations are also incorporated; the system is being designed to provide a central "hub" providing direct and immediate access to worldwide coral reef system and associated habitat data. Investigators may submit datasets to the NODC for permanent archival and dissemination. As the system develops, users will be able to download NODC-held biological reef system data in conjunction with data

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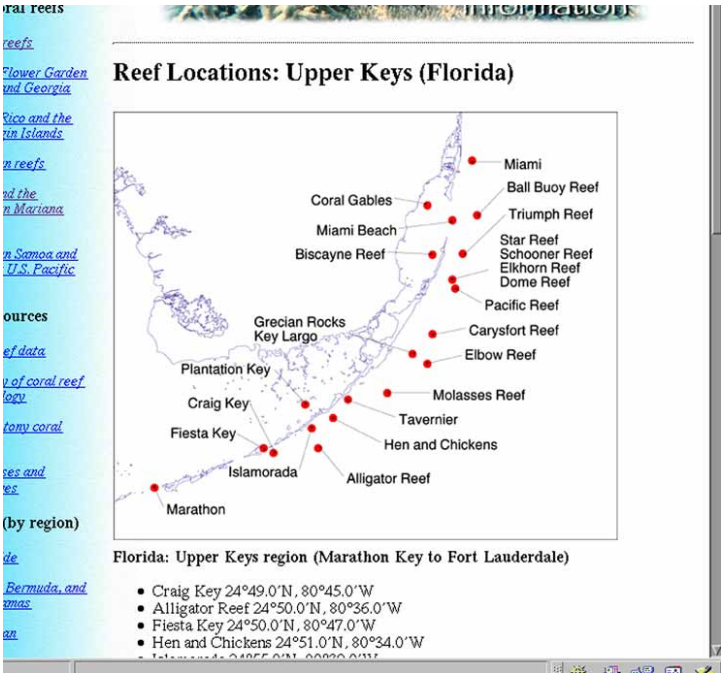


▲ **Figure 2.** "Zoomed" view of location of coral reefs of the upper Florida Keys; maps such as these for all U.S. coral reef regions are included in the NODC Coral Reef Website.

from NODC's large holdings of oceanographic datasets. Long service and experience as the nation's data manager for oceanographic data will support the NODC effort to collect and preserve data permanently for these endangered and fragile ecosystems.

This newly opened website (March 2000; see Figure 1) is accessible through the NODC homepage at *http://www.nodc.noaa.gov*. The website was designed with a basic HTML table format, initially avoiding the use of frames and complex scripts which may prevent the site from being easily accessed worldwide. Additional components will be incorporated based on the needs and requests of users and as data holdings increase. Items are easily accessed from the sidebar on the left of each page. Of note are the U.S. coral reef location maps generated by GIS software and incorporated into the site as .GIF files; the location maps include a clickable overview map of a coral reef region and accompanying close-up views with lists of geographical coordinates of the coral reefs (Figure 2).

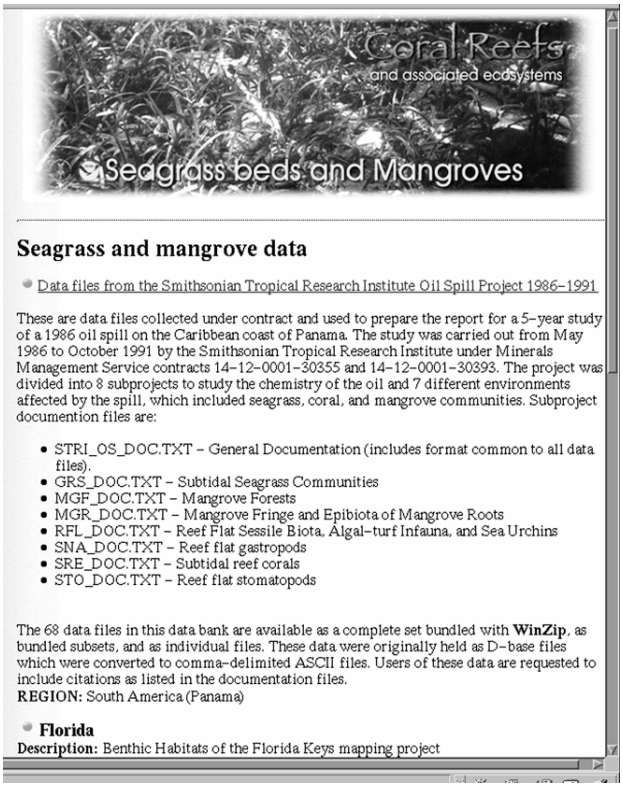
These maps and lists will be modified and added to, as higher-resolution shape files are made available and additional coordinates of coral reef locations are confirmed. The geographic coordinates will later be directly linked to associated datasets. In addition, a direct link on the opening page is provided to the World Conservation Monitoring Centre, which offers world distribution maps of coral reefs and mangrove forests online. Links to coral reef sites worldwide and categorized by regional area are listed on the sidebar in order to aid users in researching for information on a given area; in particular, all links are accompanied by a brief description and the site address to support information search efforts and help users provide the NODC with site feedback.

Downloadable NODC-held data is currently accessible and being added to in the "Data Sources" section along with the links to other organizations with reef data holdings. This section also includes the "List of Extant Stony Corals" (Cairns, et al, 1999), a glossary of reef terminology, and a developing "Seagrasses and Mangroves" section with links (Figure 3).

The NODC encourages researchers globally to submit a copy of their valuable reef data and associated metadata to the NODC for permanent archival and distribution. Data submission procedures may be obtained from the NODC homepage or, alternatively, please contact the NODC Coral Reef Team Lead, Dr. Anthony Picciolo, or other team members through the website for more information. As researchers and coastal managers race to preserve coral reefs, it is particularly desirous to build and maintain a central location for access to data on them. The NODC encourages commentary and feedback on this developing site; we also hope that smaller programs and researchers that lack the funding and/or facilities to permanently manage and store valuable coral reef, seagrass bed, and mangrove forest data will contribute a copy of these data for permanent archival at the NODC.

Reference

Cairns, S.D., Hoeksema, B.W., and Van Der Land, J., Appendix: List of Stony Coral. pp.13-16. In Cairns, S.D. 1999. Species richness of Recent Scleratinia. *Atoll Res. Bull.* 459:1-46. ■

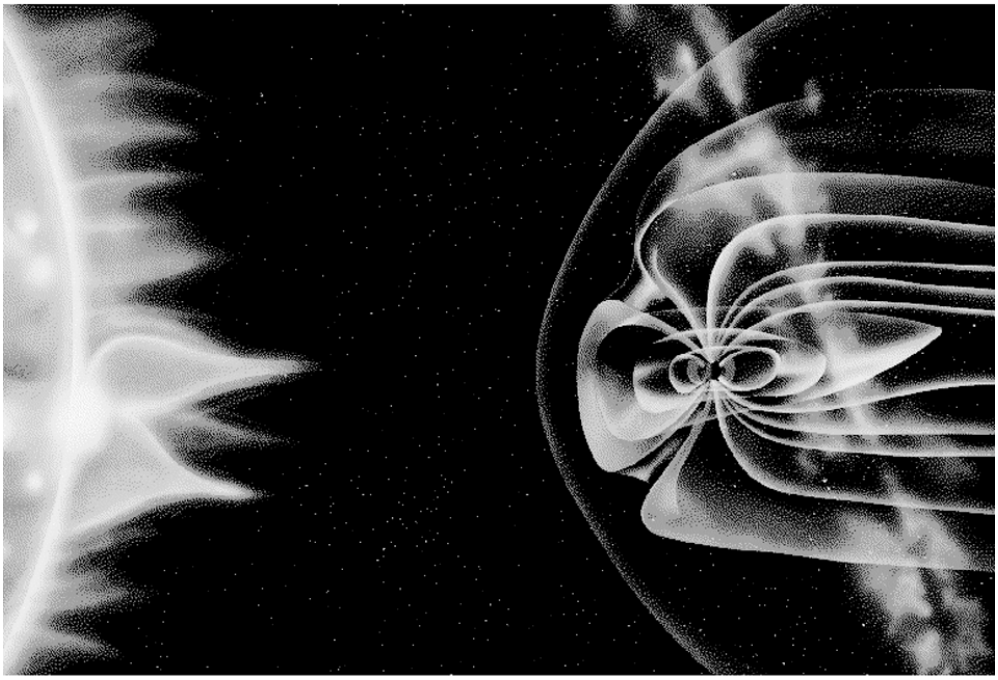


▲ **Figure 3.** New "seagrasses and mangroves" section.

NOAA's Space Environment Center

The nation's official source for space weather alerts and warnings

Barbara McGehan
Space Environment Center
NOAA/OAR



▲ **Figure 1.** The protective magnetic field surrounds the Earth shielding it from many of the harmful effects of the sun.

Each day when you check the weather, you might think that the sun is just a big happy face shining down on Earth, like some huge Nerf ball in the sky. It looks quite calm and makes the day warm and comfortable for us. But in reality, the sun is a smoldering caldron of gases that are constantly exploding, sending streams of solar wind out into space. Sunspots, some of which are larger than Earth, constantly pop up, and sometimes solar flares and Coronal Mass Ejections (CMEs) explode sending billions of tons of plasma into space and occasionally towards the Earth. Really then, between the Earth and the sun, there lies not a void but an area of swirling, turbulent activity that we call space weather.

So space weather refers to the disturbances and storms that swirl through space causing variations of electromagnetic fields (Figure 1) and energetic particle fluxes. And while sunspots have been observed and counted for centuries, not until recently have "weather" conditions in space become a topic of wide-spread interest. As the world becomes increasingly complex and computerized, with new technologies such as satellites, satellite-based communications networks, and the global positioning system, space weather becomes more relevant and interesting for us.

At the annual meeting of the American Association for the Advancement of Science in February, Ernie Hildner, director of NOAA's Space Environment Center, said he expects major effects from the current solar cycle (Figure 2). "The sun is definitely ramping up as we head into the period known as Solar Maximum, and I have no doubt that we will see at least three to four episodes of stormy space weather with some adverse affects on various systems on Earth," he said.

Many activities on the ground including communication and power generation are affected by changing conditions in space. For instance, in 1989, the entire province of Quebec was thrown into darkness when a geomagnetic storm caused an overload on power lines. In space, astronauts face unique hazards when venturing outside the safety of the space shuttle and need to be alerted to the dangers of energetic particle emissions from the sun. This need will increase as teams of astronauts construct the International Space Station. As our use of space increases, so must the ability to predict conditions in space, to safeguard human lives and to protect the nation's investment in these new technologies.

NOAA's Space Environment Center (SEC), located in Boulder, Colo., is the nation's official source of space weather alerts and warnings. It continually monitors and forecasts Earth's space environment 24 hours a day, every day of the year. While space weather has recently become a "hot topic", the Space Environment Center, even before NOAA was formed as an agency, was serving the nation, issuing daily space weather forecasts for the last 35 years. SEC's Forecast Center is jointly operated by NOAA and the U.S. Air Force, providing forecasts, alerts and warnings of geomagnetic storms, particle events and electromagnetic activity to users in the government, industry, and the private sector (Figure 3).

The sun, like the Earth, has its seasons, but its "year" equals eleven of ours. These eleven year cycles have been monitored for centuries and are determined by the number of sunspots observed on the sun (Figure 4). Solar minimum refers to the several Earth

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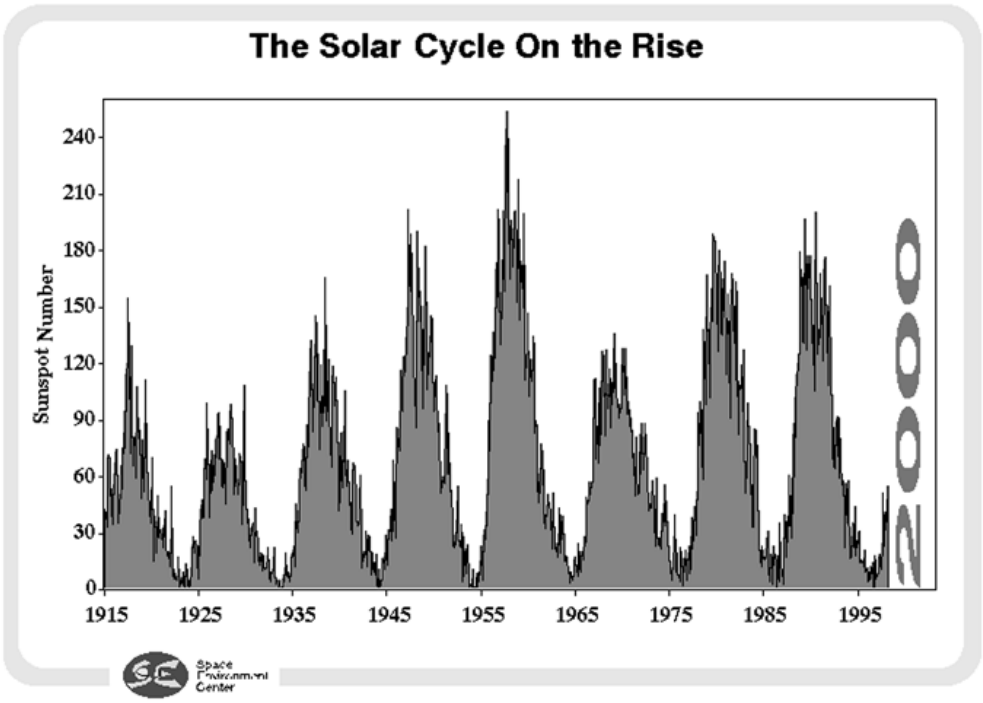

▲ **Figure 2.** The Sunspot Cycle, well documented over the last 300 years, reveals a 10-11 year pattern of solar activity.

To help the public better understand the problems that can occur when the sun waxes and wanes, NOAA recently developed a set of space weather scales, similar to those used for earthquakes, tornadoes and hurricanes. These scales identify the possible effects of space storms on Earth systems.

According to Dr. Hildner, there are three types of storms, each with different effects. "The S-scale describes radiation events. This occurs when the sun erupts in a solar flare and energetic particle levels near Earth increase," said Hildner. "These can cause health effects for high altitude pilots, astronauts, and any of us flying at high altitude and latitude in an aircraft during a solar storm."

— continued on page 12

years when the sunspot numbers are lowest; Solar Maximum occurs in the years when sunspots are most numerous.

As Dr. Hildner pointed out at the AAAS meeting, we are now in the midst of solar cycle 23 and are approaching Solar Maximum. This means we can expect an increase in the number of geomagnetic storms and other effects on our Earth systems. One of the most spectacular effects is the aurora borealis or northern lights. These spectacular curtains of light can appear as red or greenish yellow bands in the sky.

During the current Solar Maximum, the aurora is expected to appear several times per year over the continental U.S. It may even reach as far south at the Gulf of Mexico at least once during this period.

The electric currents that flow during auroral displays disturb the ionosphere and wreak considerable havoc on long distance radio communications and on satellite to ground connections. And it's possible that at least one electric power system operator will lose some of their power grid and be challenged to avoid triggering a widespreadblackout sometime during solar maximum. When the aurora is visible overhead, it causes earth currents to flow through the ground underneath. The currents leak into power systems, pipelines, and other long metal conductors.

Satellites are also sensitive to the charged particles released by the sun. Since the last solar cycle we have become increasingly dependent on satellites for cell phones, pagers and other communication needs. In the last ten years, more and more satellites have been sent into orbit. In fact, more than 900 communications satellites are slated to be in orbit by 2003. And these satellites with their sensitive electronic wiring are susceptible to the energetic charged particles of the solar wind.

▲ **Figure 3.** Many industries and technologies are affected by solar storms, including satellites, power companies, aviation, navigation, and astronauts.

U.S. Coral Reef Task Force unveils groundbreaking plan to protect 20 percent of reefs by 2010

In a groundbreaking step, the U.S. Coral Reef Task Force today unveiled the first-ever National Action Plan to comprehensively and aggressively address the most pressing challenges facing coral reefs today. As members of the U.S. Coral Reef Task Force, the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce, the U.S. Department of the Interior and other federal agencies are joining with coastal states and territories to launch this cooperative effort to help save the world's remarkable coral reefs.

U.S. Coral Reef Task Force co-chair Secretary of the Interior Bruce Babbitt said, "I commend everyone whose hard work paid off in developing the National Action Plan. We stand at a very critical point for the preservation of vital coral reefs resources. Today's agreement to protect and set aside 20 percent of coral reefs in this nation's waters by 2010 will increase the long-term survival of coral reefs and the vast array of marine species that depend upon them. The action plan, when implemented, will also lead to more robust economies and safer, healthier futures for people and islands protected and sustained by these ancient and magnificent coral reefs."

"Protecting 20 percent of all U.S. reefs and other decisive actions called for in the new plan is crucial because two-thirds of the world's reefs may be dying. If current conditions continue, an alarming 70 percent of the world's reefs may be gone by 2050. This rapid decline represents a serious threat to businesses, consumers, communities, and the environment," said D. James Baker, Task Force co-chair and NOAA administrator.

Driven largely by such human activities as pollution, overfishing and dredging, the coral reef crisis places a multitude of human, natural and economic needs in jeopardy. As the "rain forests of the sea," coral reefs provide services estimated to be worth as much as $375 billion annually, a staggering figure for an ecosystem covering less than one percent of the Earth's surface.

In the U.S. alone, coral reef ecosystems support millions of jobs. They support billions of dollars in tourism each year, over $1.2 billion in the Florida Keys alone. In Hawaii, gross revenues generated from just a single, half square mile coral reef reserve are estimated to exceed $8.6 million each year.

The annual dockside value of commercial U.S. fisheries from coral reefs is over $100 million. The annual value of reef-dependent recreational fisheries probably exceeds $100 million per year. In developing countries, coral reefs contribute about one-quarter of the annual total fish catch, providing food to about one billion people in Asia alone.

Further threatened by the current global reef crisis is the exciting promise of life-saving and other critical pharmaceuticals. Coral reefs are the medicine chests of the 21st century – they are considered to be one of the primary sources of new medicines and biochemicals in the new century. Examples include many pharmaceuticals now being developed as possible cures for cancer, arthritis, viruses, and other diseases.

The new National Action Plan is designed to be the nation's roadmap to more effectively understand coral reef ecosystems and reduce the adverse impacts of human activities. Responding to the urgency of the current situation, the new plan draws on the expertise and commitment of hundreds of public and private stakeholders. The plan calls for:

1) Designating 20 percent of all U.S. coral reefs as no-take ecological reserves by 2010. With the fishing community and a broad range of other stakeholders, the existing network of coral reef protected areas will be expanded to ensure the survival of key sites.

2) Mapping all U.S. coral reefs by 2009. Right now, just five percent of all U.S. reefs have been adequately mapped. To meet critical management needs, the first priority will be to complete ongoing mapping of Caribbean reefs and reefs on the eight main Hawaiian Islands.

3) Monitoring to build an integrated national reef monitoring system that profiles and tracks the healthy of U.S. coral reefs. This monitoring will build on and link existing federal, state and territorial monitoring in addition to implementing new monitoring to, wherever possible, fill in current gaps.

4) An All-Islands Coral Reef Initiative to address the highest priorities of U.S. state and territorial islands. Since 1994, the islands of Hawaii, American Samoa, Guam, Puerto Rico, the U.S. Virgin islands, and the Commonwealth of the Northern Mariana Islands have been working together to protect and sustainably use coral reefs. In FY 2000, NOAA and the Department of the Interior will provide $1.35 million to assist U.S. islands to improve coral reef management and protection, including monitoring, education and designation of marine protected areas.

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Tropical cyclones of the North Atlantic Ocean, 1871-1998

The National Climatic Data Center (NCDC) in partnership with the Tropical Prediction Center/National Hurricane Center has published *Tropical Cyclones of the North Atlantic Ocean, 1871-1998*. The 206 page book, featuring a satellite image of hurricane Mitch near peak intensity on its cover, is divided into two main sections.

The first section is a narrative about topics such as: the characteristics and classification of tropical cyclones, data collection sources, accuracy of the track and intensity classifications, and the frequency of North Atlantic tropical cyclones. Section two is subdivided into a three (3) part track map series. The first grouping of maps displays, on a yearly basis, the tracks of all recorded North Atlantic tropical cyclones for the years 1871- 1998, with 1999 included as an attachment. Tracks are coded by stage of development from 1886 onward. The second and third sets of track maps depict the 1886 to 1998 North Atlantic tropical cyclone activity by inter-seasonal periods first by months, May though December, and then by 10 or 11 day periods from June 1 to November 30.

The publication, which contains numerous maps, tables and graphs, is easily read and is intended to be a reference tool for a diverse range of individuals- from the weather enthusiast to the researcher. Copies for NOAA agencies may be ordered at no charge through *orders@ncdc.noaa.gov*, or requested by U.S. mail, fax or telephone to the NCDC. The publication will also be posted to the NCDC home page at *www.ncdc.noaa.gov*. Requesters having the *noaa.gov* domain may access at no charge. For non-*noaa.gov* users, the hard copy publications cost $25.00 each and the electronic version will be available for a one-time charge of $15.00.
Contact: NCDC

Earth System Monitor 1995-2000 now online

The *Earth System Monitor* is now online, using the portable document format (pdf), at NODC. All issues from March 1995 through March 2000 are available at: *http://www/nodc.noaa.gov/General/NODCPubs/*.
Contact: NODC

Data products and services

Earth System History program increases paleoclimate data

After NOAA and the National Science Foundation (NSF) recently reminded scientists participating in the Earth System History (ESH) program to make their published scientific data publicly available, scientists are contributing more data to the NOAA Paleoclimatology Program than ever before. The contributed data sets provide evidence of past variations in climate derived from paleo records such as ice cores, tree rings, and ocean and lake sediments, and are made available via the NOAA Paleoclimatology Program web site (*http: www.ngdc.noaa.gov/paleo*).

NOAA and the NSF both support the ESH program, which is designed to improve our understanding of past climate variability and future climate change, including the effects of altered atmospheric trace gas composition.
Contact: NGDC

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WWW: *http://www.nodc.noaa.gov/*

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

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

January ice storm

The National Climatic Data Center has placed a web page online with details regarding the recent winter storms in the southeast and mid-Atlantic areas. The web page includes narrative information and precipitation data for the January 22-23 ice storm in Georgia and South Carolina, along with information and snowfall data for the January 24-25 snowstorm in the Carolinas, Virginia, and Maryland.

A satellite movie loop of the storm system shows its movements along the southeast coast. Raleigh-Durham, N.C., set a new storm event record with 20.3 inches of snow, breaking the old record set in 1902. An amazing 15 inches of snow fell in four hours. The page also briefly describes global events during the month of January, and touches on the historical cold wave of 15 years ago when state minimum temperature records were set in South Carolina, North Carolina, and Virginia. The page is also located in "The Spotlight" on NCDC's homepage.

The website is: *http://www.ncdc.noaa.gov/o1/climate/extremes/2000/January/extremes0100.html*.
Contact: NCDC

SHEBA reconnaissance imagery

The National Snow and Ice Data Center (NSIDC), affiliated with the National Geophysical Data Center, has made the first of 57 formerly classified images of the SHEBA (Surface Heat Balance of the Arctic) site available via worldwide web. During the yearlong SHEBA experiment, scientists on a Canadian icebreaker made over 300 types of measurements to study heat flux. The high resolution of the reconnaissance images (about 1 m) will allow investigators to characterize surface conditions and their impact on the net radiation balance.
Contact: NGDC

Monterey Bay virtual tour

A cooperative project between the National Geographic Society and NOAA's Monterey Bay National Marine Sanctuary has posted a 3-D "virtual tour" of the Monterey Canyon. The scroll-and -zoom perspective view, rendered by Peter Sloss of NGDC in QuickTimeVR format, can be seen at: *http://sustainableseas.noaa.gov/missions/monterey1/background/virtualtour.html.*
Contact: NGDC

Space Environment Ctr, *from page 9*

The G-scale describes the variation in Earth's magnetic field caused by Coronal Mass Ejections. This occurs when a bubble of material is ejected from the sun whichif it heads directly toward Earth, interacts with our magnetic field causing large electric currents to flow in our atmosphere. The effect of these currents can disrupt electric power grids, and satellites.

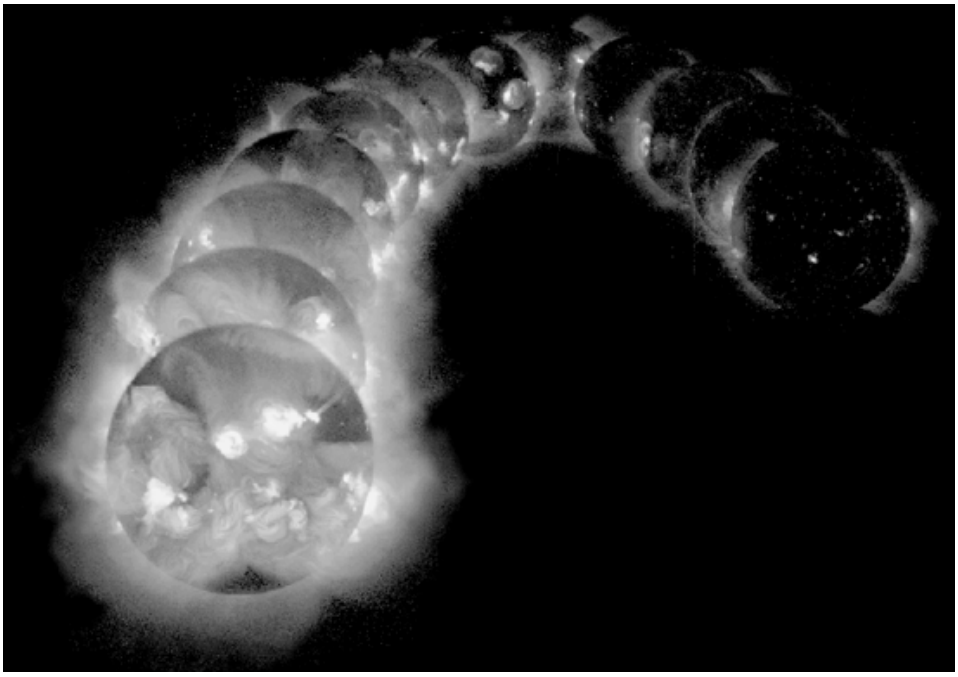
The R-scale reflects the size of solar flares that affect high frequency and shortwave radio propagation. When flares are occurring, radio signals that normally reflect off the ionosphere, an upper layer of Earth's atmosphere, may be lost or absorbed so the intended receivers never get them.

Senior forecaster Gary Heckman says the effects listed on the scale are the "bumps" that are caused by space weather affecting our systems on Earth. "For instance, sometimes solar flares produce very intense bursts of radio static that are so strong that satellite receivers on the ground, cell phones, airplane radios and television ground receivers are able to detect nothing but noise until the radio bursts are finished. This can last from a few minutes to an hour. At other times, a geomagnetic storm can hit a satellite or affect a power grid," he said.

"Even though we may not realize it, the sun is the major driver, not only of Earth's weather, but also of the electromagnetic activity that can affect the technical systems on which society depends," Heckman continued.

NOAA has a program to develop partnerships with industries that are affected by space weather, as well as with other government agencies, to develop more reliable methods of space weather measuring and forecasting so that when the next solar cycle begins to rise, they will be in a position to incorporate space weather storm information into their systems and keep on functioning without costly losses or dangerous failures.

For more information on the Space Environment Center, visit SEC's website at *http://www.sec.noaa.gov*. ■



▲ **Figure 4.** The sun goes through its 10-11 year solar cycle.

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