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EARTH SYSTEM MONITOR

A guide to NOAA's data and information services

INSIDE

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

SPIDR on the Web

NGDC's online space physics data resource and analysis tool

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The National Geophysical Data Center's innovative Space Physics Interactive Data Resource (SPIDR) is a multi-disciplinary online system to search, browse, and access space weather and environmental datasets over the Internet. SPIDR is a tool for the online user to select data or imagery by date and geographical location, and to deliver an image to the user over the World Wide Web (Figure 1).

Currently, Defense Meteorological Satellite Program (DMSP) satellite imagery, geomagnetic variations, and ionospheric vertical incidence databases can be accessed by the Space Physics Interactive Data Resource. DMSP imagery displays aurora, city lights, fires, lightning strikes, and cloud coverage. Ionospheric and geomagnetic data can be plotted from interactive menus. The Web user selects the month and year from pull-down menus and clicks the worldwide map in the region of interest. Worldwide contour maps of maximum electron density can also be generated from a global model of the ionosphere.

SPIDR was designed to use current technology to meet both internal and external user requirements. Internally, the National Geophysical Data Center (NGDC) needed flexibility in the management of the national archives to conduct data analysis, to assess the quality of the archives, and to extract and manipulate instrumental data for input into physical models.

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The SPIDR research and analysis tool gives NGDC this capability.

NGDC also needed an easy-to-use mechanism to inventory, catalog, and search the archives. A database management system was selected to achieve the required flexibility. Finally, this capability to search NGDC data sets, to create a data display "on the fly," to browse the archives, and to conduct interdisciplinary analysis on the Internet was opened up for everyone to use.

External users

To meet external user requirements NGDC needed to provide access to the archives in a variety of ways to satisfy customer requests and to provide data products and services. Using today's technology on the World Wide Web (WWW), NGDC is able to provide this capability to the external user in an easy-to-use online format.

NGDC decided to provide plots and imagery as well as data to customers utilizing commercial off-the-shelf software to create GIF images "on the fly." Selected for this purpose was the Interactive Data Language (IDL) set of software tools to create and display imagery. The SPIDR system retrieves the requested data from a relational

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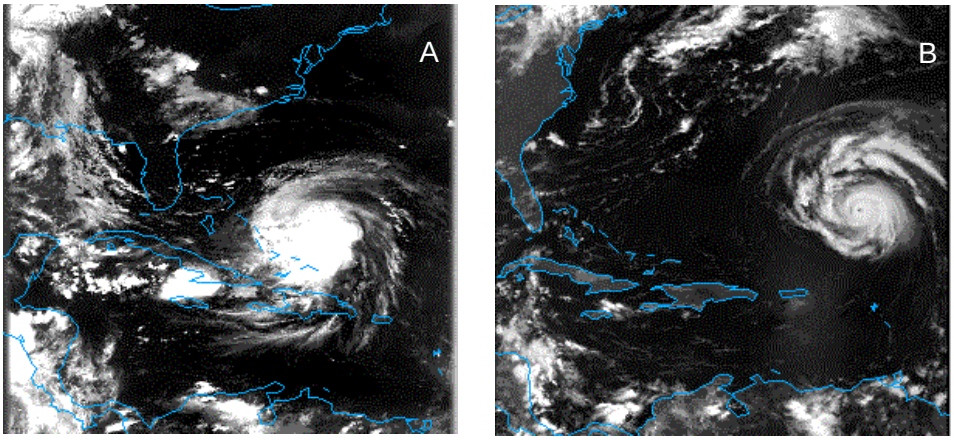
▲ **Figure 1.** NGDC's Space Physics Interactive Data Resource (SPIDR) logo, overlaying a DMSP satellite image of Hurricane Alison. Through SPIDR, users can select data and/or imagery such as this by date and geographic location, and ionospheric and geomagnetic data can be plotted from interactive menus.



▲ **Figure 2.** DMSP images of Hurricanes Erin (A) and Felix (B). Satelite images such as these are readily accessible through SPIDR.

SPIDR, *from page 1*

database management system, generates a plot, prepares a GIF image of the plot, and sends the image to the user over the World Wide Web.

An online research tool

SPIDR is a tool designed to make accessing data and conducting research easier. Navigating the relational database with SPIDR will assist scientists and researchers in analyzing space weather and environmental data. At NGDC, SPIDR is used as a tool for data management, analysis, and investigations of space environment effects on man's technology in space and on Earth.

The average user is in the SPIDR system for a full hour browsing, retrieving, and manipulating images and plots. Users may capture and download images (Figure 2) for later use or request digital values using E-mail. SPIDR is being used for atmospheric physical sciences homework assignments in the classroom from elementary through graduate levels.

Space physics effects seen in the ionosphere can be analyzed in a multidisciplinary environment through the online manipulation of the database management tool. The database management system will enable global quality control both by comparing data and providing input from the database management system to physical models and comparing the model output with the observed values.

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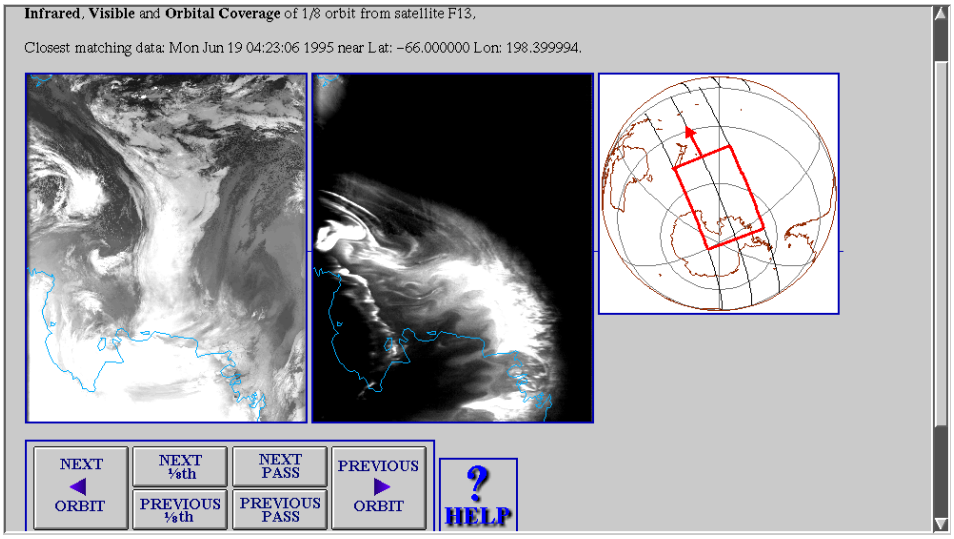

▲ **Figure 3.** DMSP satellites collect visible and thermal infrared imagery in global coverage along a 3000-mile swath with the Operational Linescan System (OLS.) Users within SPIDR can select DMSP imagery by date and geographical position anywhere on earth. DMSP images are then returned along with the satellite path and a button tool for navigating the database, i.e., by 'flying' the satellite about the globe.

EARTH SYSTEM MONITOR

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NODC completes move to NOAA Silver Spring complex

As part of NOAA's consolidation effort, the National Oceanographic Data Center (NODC) completed its relocation to the NOAA Silver Spring Metro Center complex this January. All data and information requests should now be directed to NODC's User Services group at:
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Davidson to direct newly renamed Coastal Services Center

Margaret A. Davidson has been named Director of NOAA's Coastal Services Center (CSC) in Charleston, South Carolina, which was formerly the Center for Coastal Ecosystem Health (CCEH.) Davidson has worked with the South Carolina Sea Grant Consortium for the past 15 years and has served as the executive director since 1983. She also holds a faculty appointment at the University of Charleston and serves on the adjunct faculties of Clemson University and the University of South Carolina.

The CSC was established by NOAA in 1994 at the Charleston Navy Base. The recent name change better reflects the emphasis the CSC is placing on functioning as a service provider to the coastal management community. The Center is dedicated to linking those living and working in the coastal environment to the information and technology that can help them make informed decisions and better integrate environmental and economic considerations. The CSC WWW site can be accessed at URL: *http://www.csc.noaa.gov*.

Eco-Informa '96 announcement and call for papers

Eco-Informa '96 is the fourth major international conference in a unique series that focuses on worldwide communications for environmental applications. The comprehensive multidisciplinary forum is designed to foster the interaction and exchange of global environmental technology between scientific, governmental, and commercial communities. Eco-Informa '96 will be held for the first time in the United States from November 4-7, 1996, at Epcot Science and Technology, Lake Buena Vista, Florida.

Conference topics include: environmental information management and decision support systems, resource management, pollution monitoring and control, legislation, regulation and compliance, and new and future environmental applications, issues, and developments. Interested contributors should submit a proposal form with a 250-word summary on or before April 1, 1996. More information can be obtained from:
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P.O. Box 134001
Ann Arbor, MI 48113-4001
Phone: 313-994-1200 ext. 3234
Fax: 313-994-5123
E-mail: *wallman@erim.org*
Internet: *http://www.erim.org/CONF/conf.html*

News briefs

IWC holds symposium on the effect of climate change on cetaceans

NOAA's National Marine Fisheries Service, Southwest Fisheries Science Center is hosting the International Whaling Commission (IWC) Symposium on the Effects of Climate Change on Cetaceans on March 25-26, 1996. This is the second in a series of meetings convened by the IWC on the potential environmental effects on cetacean populations. The symposium will focus on the processes related to global climate change and how these processes may effect cetacean populations. It will also address current views on what changes have been detected and are most likely to occur, followed by a consideration of what trophic or direct processes would link these changes to the distribution and abundance of cetaceans.

The deadline for registration and fees is March 1, 1996, or as space permits. A workshop which will be limited to 35 participants will follow on March 27-30, 1996, with preference given to symposium speakers and scientists active in relevant fields. For more information, contact Dr. Stephen B. Reilly, Chairman, IWC Scientific Committee via e-mail at: *steve@caliban. ucsd.edu* or contact:
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NGDC scientists participate in NSF paleoclimate workshop

National Geophysical Data Center (NGDC) paleoclimatologists Jonathan Overpeck and Robert Webb attended the National Science Foundation (NSF) Paleoclimates of Arctic Lakes and Estuaries (PALE) Principal Investigators Workshop on February 11-13, 1996 at Boulder, Colorado. The workshop focussed on synthesizing available evidence for environmental change across Beringia and the northwestern Atlantic, in order to evaluate whether coherent spatial and temporal variations exist.

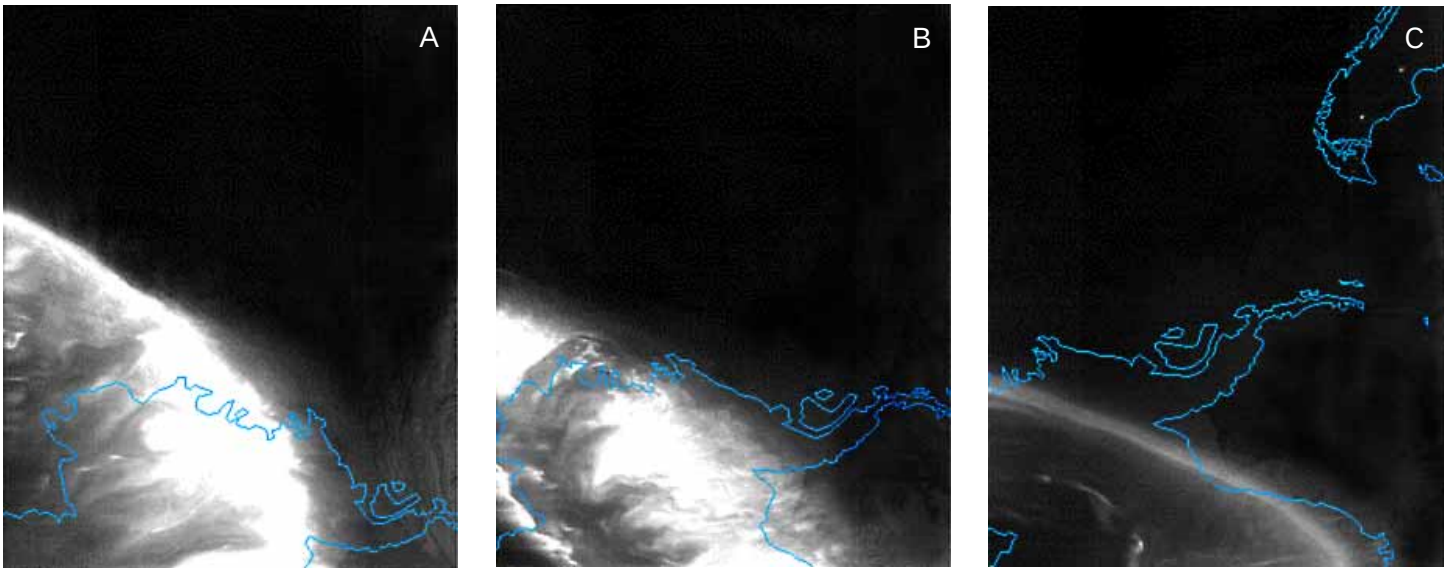
Dr. Overpeck led the working group on "Climate variability of the last 1000 years." The goal of this group is to produce a high-profile scientific paper summarizing the state-of-the-art understanding of Arctic climate change leading to this century. Paleoclimatic data already show that one of the most dramatic circum-Arctic warmings on record took place between 1850 and 1920 (before the period of widespread instrumental coverage in this region.) This end of the "Little Ice Age" must have begun as a naturally-forced change, but may have been accelerated by anthropogenic (trace-gas) forcing in this century.

Fourth POES Users' Symposium

NOAA's Polar-orbiting Operational Satellite (POES), the current series of TIROS satellites, is the third generation polar-orbiting spacecraft system operated by NOAA. Circling the Earth in sun-synchronous orbit, these satellites support large-scale, long-range weather forecasts and numerous secondary missions.

The themes of the Fourth POES Users' Symposium are to inform users of current and future plans of U.S. and international polar satellite systems, and to discuss the changes taking place with NOAA's newest series of polar-orbiting satellites (NOAA-K, L, and M.)

The symposium will be held in Annapolis, MD, from June 10-12, 1996. For registration or exhibit information, contact:
Phone: 301-345-2000, ext. 135 or 120
Fax: 301-441-1771
E-mail: *poesuser@infrmtcs.com*
Internet: *http://infrmtcs.com/~poesuser/*



▲ **Figure 4.** This series (A-F) of polar auroral images illustrate a 'flight' of a DMSP satellite around the South Pole region.

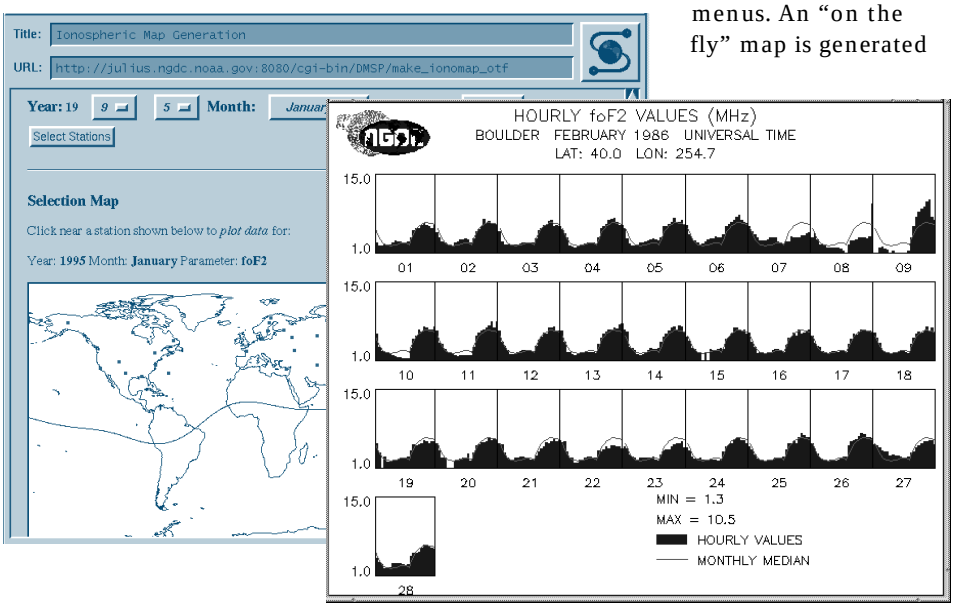
***SPIDR**, from page 2*

DMSP satellite imagery

Defense Meteorological Satellite Program (DMSP) polar orbiting satellites collect visible and thermal infrared imagery in global coverage along a 3000-km-wide swath with the Operational Linescan System (OLS). Internet users may select imagery by date and geographical position anywhere on the Earth. DMSP visible and infrared images are returned along with a map of the satellite path and a button tool for navigating through the database of world-wide satellite coverage (Figure 3). The button tool allows users to "fly" one of four DMSP satellites about the globe (Figure 4.)

Ionospheric vertical sounding database

Users can plot ionospheric vertical sounding data from four full solar cycles of data (1950 through 1996) from a global network of up to 101 different ionosonde stations, including near-real-time data from the NOAA Space Environment Laboratory Data Acquisition and Display System (SELDADS). The Web user chooses the month and year from the pull-down menus. An "on the fly" map is generated with the stations containing data for the period selected. The user clicks the map in the region of interest and the closest station with data available is automatically plotted (Figure 5.) Currently maximum electron density (foF2) plots are generated with monthly medians plotted as a red line overlaying the daily values. Other scaled and derived parameters including the true height of maximum density (hmF2) are planned for future SPIDR developments.

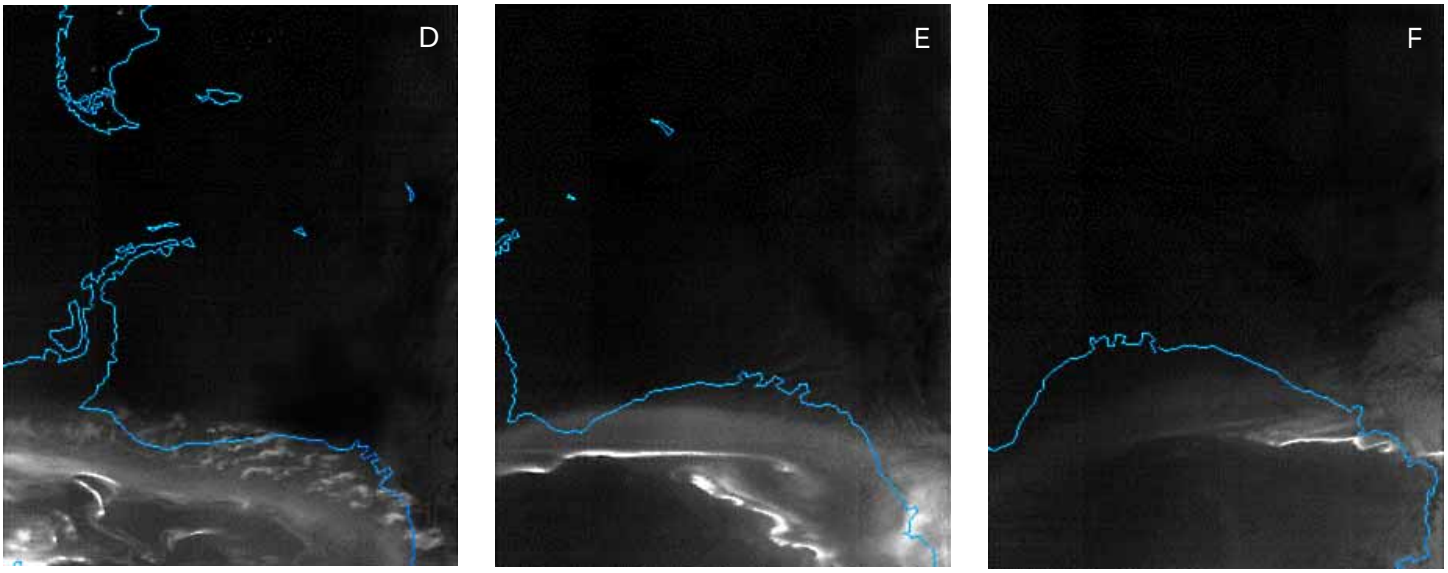


▲ **Figure 5.** Ionospheric maximum electron density data plot for Boulder during the February 1986 storm. The gray line indicates median values for the month. Users can select from four solar cycles of ionospheric data by global location.

Digital data from ionosonde stations around the world are added to the SPIDR database as they are received, processed, and passed through quality control filters. Each month NGDC receives near-real-time data from the SELDADS network for the previous month and places them in the SPIDR database tagged as preliminary data. The Internet user may also choose to generate a Worldwide Contour Plot computed from the Ionospheric conductivity and Electron Density (ICED) global model of the ionosphere. The user completes the selection form and SPIDR then displays a color contour map of maximum electron density (foF2) based on month and sunspot number.

Geomagnetic variations database

Geomagnetic one minute variations data for 1990 through 1996 from up to 61 observatories worldwide reside in a database management system. Users can interactively search the database for the date and location of interest. Geomag-



netic one minute variation data are selected, plotted, and distributed over the Web (Figure 6.) The effect of geomagnetic activity on the aurora can be quickly accessed through links to the DMSP browse imagery (Figure 7.)

Digital hourly values dating back to 1902 from 223 different geomagnetic observatories will be loaded into the SPIDR system in the future. Planned also is the ability to create plots for multiple observatories stacked one above the other for comparison. Geomagnetic indices Ap and Kp are available on SPIDR as well.

Future SPIDR development

The SPIDR system is an actively evolving data access and visualization tool. Input from scientists and other users around the globe has and will continue to shape the development of the SPIDR system. The needs of both external and NGDC users set the priorities for SPIDR, with the goal being to satisfy both external and internal users through a single interface.

In addition to future developments mentioned above, projects in the immediate future include: data delivery for SPIDR datasets, the addition of SSM/I (microwave imager) data from DMSP, stack plots of solar indices such as sunspot number and 10.7 cm flux, and the addition of GOES satellite space environment monitor data. These projects are scheduled to be complete this year. Additional databases and capabilities will be added subsequently including DMSP global daily maps, solar cosmic ray plots, and ionospheric parameter generation and "on the fly" contour maps.

For information about SPIDR and Solar-Terrestrial Physics Division data and products, contact:

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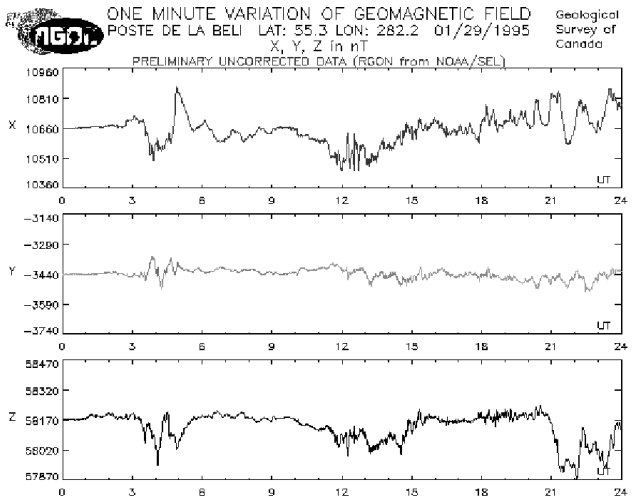
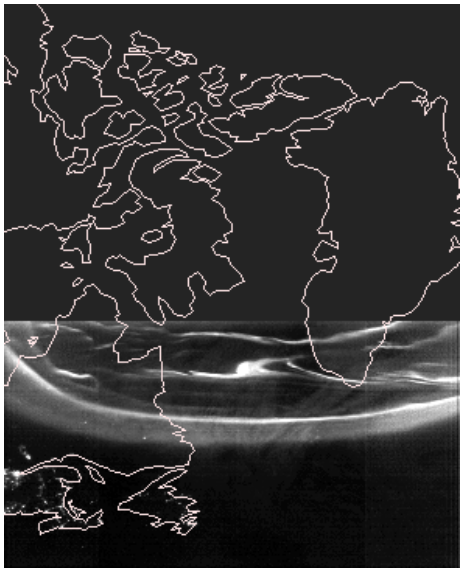
For on-line WWW access to information on National Geophysical Data Center SPIDR and other programs use: *http://www.ngdc.noaa.gov/stp/stp.html.* ■



▲ **Figure 6.** Geomagnetic one-minute variations for 1990 through 1996 reside in a database management system. Selected data are plotted and distributed over the WWW.



▲ **Figure 7.** DMSP visible image, Jan. 29, 1995, showing aurora over Canada and Greenland and city lights in Nova Scotia.

The state of the climate—1996

Summary of the Policymakers' Report of the Intergovernmental Panel on Climate Change

Edited by Robert Quayle
and Thomas Karl
National Climatic Data Center
NOAA/NESDIS

The period from 1990 to 1995 saw major advancements in the field of climatology. In particular, climatologists improved their ability to determine the probable causes of some observed features of the recent climate record. Increases in greenhouse gas concentrations since the mid-1700s have apparently warmed the surface of the Earth, and have likely produced other climate changes. The atmospheric concentrations of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) have continued to increase, largely as a result of human activities, use of fossil fuels, land use changes, and agricultural practices. Recent data indicate that the growth rates in the concentrations of these gases are comparable to the growth rates of the 1980s.

The heat trapping effects caused by increases of the long-lived greenhouse gases (the greenhouse effect) is due primarily to increases in the concentrations of carbon dioxide and methane. Since carbon dioxide remains in the atmosphere for many decades to centuries, its effect is measured in similarly long time scales.

Growth in the concentrations of CFCs and similar ozone-depleting gases has slowed, and the consequent ozone depletion is expected to decrease substantially by the year 2050, largely through the implementation of the Montreal Protocol. Some long-lived greenhouse gases, including a CFC substitute, contribute little to global warming now, but their projected growth could contribute several percent during the 21st century.

If carbon dioxide emissions were maintained at 1994 levels, they would lead to an increase in atmospheric concentrations for at least two centuries, approaching a doubling of pre-industrial levels (from 280 to 500 parts per million volume) by the end of the 21st century. Various computer models indicate that stabilization of atmospheric CO_2 concentrations at 450, 650, or 1000 ppmv could be achieved only if global emissions drop to 1990 levels approximately 40, 140, or 240 years from now, respectively, and then drop substantially below 1990 levels.

Stabilizing CO_2 concentration is governed more by the accumulated anthropogenic CO_2 emissions from now until the time of stabilization than by the way those emissions change over the period. Thus, for a given stabilized concentration value, higher emissions in early decades require lower emissions later on. Among the models run for stabilization at 450, 650, or 1000 ppmv, accumulated anthropogenic emissions over the period 1991 to the year 2100 are 630, 1030, and 1410 billion metric tons of carbon respectively. Stabilization of CH_4 and N_2O concentrations at today's levels would involve reductions in anthropogenic emissions of 8% and more than 50%, respectively.

Recent years have been among the warmest since 1860...despite the cooling effect of the June 1991 Mt. Pinatubo volcanic eruption.

Anthropogenic aerosols (tiny particles such as those that produce smog) tend to produce a net cooling effect on the surface climate. Aerosols in the lower atmosphere resulting from combustion of fossil fuels, biomass burning, and other sources can have continental to hemispherical effects on climate. Locally, the aerosol forcing can be large enough to more than offset the warming due to greenhouse gases. In contrast to the long-lived greenhouse gases, anthropogenic aerosols are very short-lived in the atmosphere. Hence, their effect changes rapidly with increases or decreases in emissions.

Climate change during the 20th century

At any one place, year-to-year variations in weather can be large, but analyses of meteorological and other data over large areas and over periods of decades or more have provided evidence for some important systematic changes. Global mean surface air temperature has increased by between about 0.3 and 0.6 degrees Celsius (about 0.5 and 1.0 degree Fahrenheit) since the late 19th century. This trend has been well publicized for some years and research during the intervening years has tended to reinforce the view that the warming is real, and not an artifice of the data.

Recent years have been among the warmest since 1860, i.e., in the period of instrumental record, despite the cooling effect of the June 1991 Mt. Pinatubo volcanic eruption. Nighttime temperatures over land have generally increased more than daytime temperatures. Regional changes are also evident. For example, the recent warming has been greatest over the mid-latitude continents in winter and spring.

There have also been a few areas of cooling, such as the North Atlantic ocean. Precipitation has increased over land in high latitudes of the Northern Hemisphere, especially during the cold season. Global sea level has risen by between 10 and 25 cm (about five and ten inches) over the past 100 years, and much of this rise may be related to the increase in global mean temperature.

There are inadequate data to determine whether consistent global changes in climate variability or weather extremes have occurred over the 20th century. The mid 1990 to mid-1995 persistent warm-phase of the El Nino-Southern Oscillation (ENSO), which causes droughts and floods in many areas, was unusual in light of the 120-year record of this phenomenon.

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Possible human influences on climate

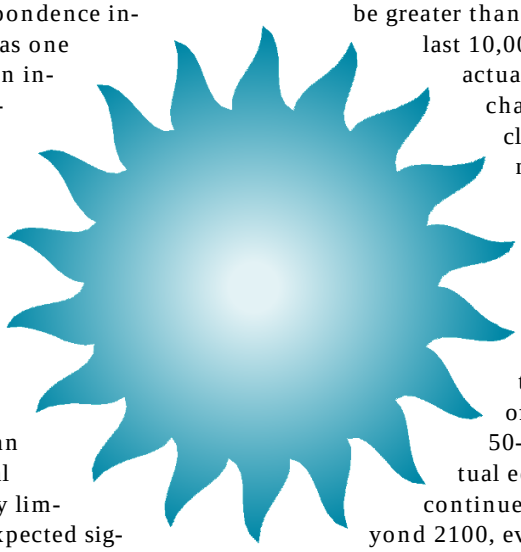
Any human-induced effect on climate will be superimposed on a background of natural climate variability resulting from internal fluctuations and external causes such as solar variability or volcanic eruptions. Detection and attribution studies attempt to distinguish between anthropogenic and natural influences. "Detection of change" is the process of demonstrating that an observed change in climate is highly unusual in a statistical sense, but it does not provide a reason for the change.

"Attribution" is the process of establishing cause-and-effect. During the period from 1990 to 1995, considerable progress was made in distinguishing between natural and human influences on climate. This progress has been achieved by including effects of aerosols in addition to greenhouse gases in climate model simulations of the human-induce climate change 'signal.'

In addition, new simulations with coupled atmosphere-ocean models have provided important information about decade to century time-scale natural climate variability. A further major area of progress is the shift of focus from studies of global-mean changes to comparisons of modelled and observed spatial and temporal patterns of climate change.

The most important results related to the issues of detection and attribution are:

- The limited available evidence from proxy climate indicators suggests that the 20th century global mean temperature is at least as warm as any other century since at least 1400 AD. Data prior to 1400 are too sparse to allow the reliable estimation of global mean temperature.
- Assessments of the statistical significance of the observed global mean surface air temperature trend over the last century have used a variety of new estimates of natural internal and externally-forced variability. These were derived from instrumental data, paleodata, simple and complex climate models, and statistical models fitted to observations. Most of these studies have detected a significant change and show that the observed warming trend is unlikely to be entirely natural in origin.
- Convincing new evidence for the attribution of a human effect on climate is emerging from studies in which the modelled climate is compared with observed patterns of atmospheric temperature change. These studies show that the pattern correspondence increases with time, as one would expect for an increasing anthropogenic signal. Furthermore, the probability is very low that these correlations could occur by chance as a result of natural internal variability alone.



Our ability to quantify the human influence on global climate is currently limited because the expected signal is still emerging from the noise of natural variability, and because there are uncertainties in key factors. These include the magnitude and patterns of long-term natural variability and the time-evolving pattern of forcing by, and response to, changes in the concentrations of greenhouse gases and aerosols, and land surface changes. Nevertheless, the balance of evidence suggests that there is discernible human influence on global climate.

Expected changes in global climate

The Intergovernmental Panel on Climate Change (IPCC) has developed a range of possible future greenhouse gas and aerosol concentrations based on several different assumptions for the period 1990 to 2100. These emissions can then be used to predict the climate. The increasing realism of simulations of current and past climate by coupled atmosphere-ocean climate models has increased our confidence in their use for projection of future climate change. Important uncertainties remain, but these have been taken into account in the full range of projections of global mean temperature and sea level change.

For the mid-range IPCC emission scenario, assuming the "best estimate" values of the variables, models project an increase in global mean surface air temperature relative to 1990 of about 2 degrees Celsius (4 degrees Fahrenheit) by 2100. The lowest IPCC projected increase is about 1 degree Celsius (2 degrees F) by 2100, and the highest gives a warming of about 3.5 degrees Celsius (7 degrees F). In all cases the average rate of warming would probably be greater than any seen in the last 10,000 years, but the actual annual to decadal changes would include considerable natural variability. Regional temperature changes could differ substantially from the global mean value. Because of the thermal inertia of the oceans, only 50-90% of the eventual equilibrium would continue to increase beyond 2100, even if the concentrations of greenhouse gases were stabilized by that time.

Average sea level is expected to rise as a result of thermal expansion of the oceans and melting of glaciers and ice-sheets. The "best estimate" models project an increase in sea level of about 50 cm (20 inches) from the present to 2100. The lowest projected sea level rise is about 15 cm (6 inches), and the highest is projected at about 95 cm (37 inches) from the present to 2100. Sea level would continue to rise at a similar rate beyond 2100, even if concentrations of greenhouse gases were stabilized by that time, and would continue to do so past the time of stabilization of global mean temperature. Regional sea level changes may differ from the global mean value owing to land movement and ocean current changes.

Confidence is higher in the hemispheric-to-continental scale projections of coupled atmosphere-ocean climate models than in the regional projections, where confidence remains low. There is more confidence in temperature projections than hydrological changes.

All model simulations, whether they were forced with increased concentrations of greenhouse gases and aerosols or with increases concentrations of greenhouse gases alone, show: greater surface warming of the land than of the sea in winter; a maximum surface warming in high northern latitudes in winter; little surface warming over the

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New digitized glacier inventory for the former Soviet Union and China

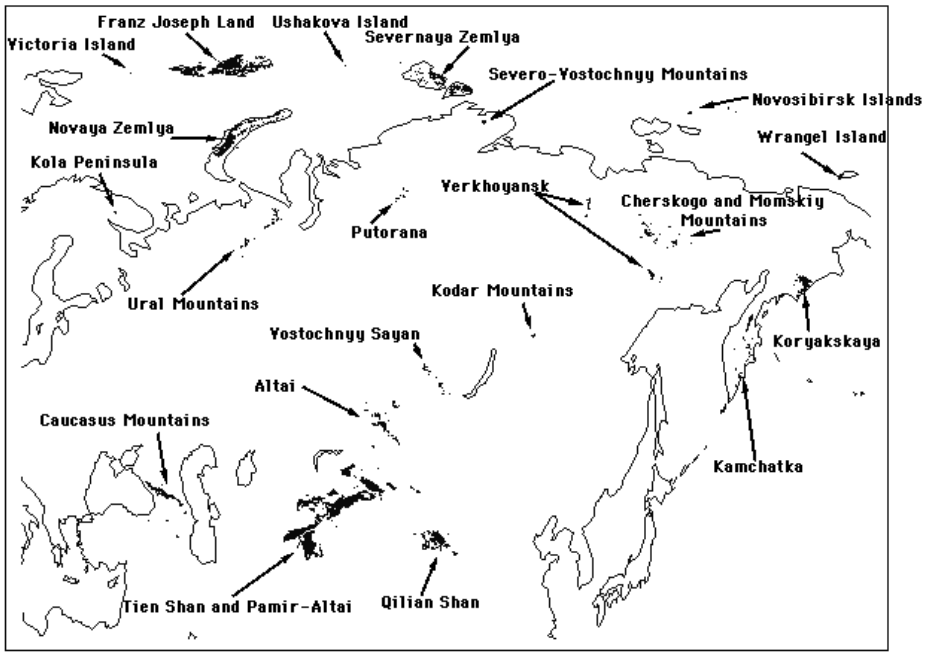
Newly available data makes significant contribution to global environmental change studies

Dan Bedford[1,2] and Chris Haggerty[2]
National Snow and Ice Data Center/
World Data Center-A for Glaciology
NOAA/NESDIS

The link between glaciers and climate is complex, but important for global change detection and for the operating of the global climate system. Climate controls glacier mass through summer melting and winter snowfall; glaciers can influence climate through their high albedos and role as heat sinks; and sea level is affected by glacier recession. Glacier data are important basic tools in attempts to understand this complex two-way relationship. They have become especially significant in recent years, as the need to understand the global climate system has gained a new urgency due to concern over human-induced global climate change.

Glacier data have been used in at least two ways as a part of the study of global climate change. First, they have been used as an early warning system for global and regional warming (see, for example, Oerlemans, 1986; Haeberli and Hoelzle, 1995; Bedford and Barry, 1995b), wherein glacier melting and retreat are used as indicators of a warming trend, often where conventional instrument records are unavailable.

Secondly, they have been used as a medium for estimating possible future sea level rise (Meier, 1990), wherein estimates of global glacier mass loss provide information on one source of mass inputs of water to the oceans. Clearly, for such work to contribute to an understanding or monitoring of the climate system at the global scale, glacier data from the entire globe are required.



▲ **Figure 1.** Locations of glaciers in the former Soviet Union and China. Data on thousands of these glaciers are contained in NSIDC/WDC-A's Eurasian glacial inventory.

Until recently, however, political differences hindered scientific access to glacier data from the former Soviet Union and China. The new availability of such data, through the National Snow and Ice Data Center (NSIDC) and World Data Center A (WDC-A) for Glaciology, makes a significant contribution to the global environmental change community.

Background

The data available through NSIDC/WDC-A's Eurasian glacier inventory consist of records for the former Soviet Union and China. Information for the former Soviet Union is based on material originally published in the *Katalog Lednikov SSSR* (*Glacier Catalog of the USSR*) (USSR Academy of Sciences, 1966 to 1983) in twenty volumes over a period of several years, but which incorporates substantial new information, most notably latitude and longitude coordinates for all glaciers.

Digitization was conducted by the Institute of Geography in Moscow, and data transfer to NSIDC/WDC-A was undertaken first by diskette, then electronically via e-mail. The part of the inventory covering China was digitized in part at the World Data Center-D (WDC-D) for Glaciology in Lanzhou, China, and in part by Dr. Chen Xianzhang of WDC-D from microfiche records during a stay at NSIDC/WDC-A as a visiting scholar.

Following acquisition of the digital inventories, steps were taken to develop products from the raw data. These steps included quality control work, and work to reorganize the data into a format suitable for access by the scientific community. Data acquisition and product development have been and continue to be funded by NOAA's Earth System Data and Information Management Program (ESDIM), primarily through the Cooperative Institute for Research in Environmental Sciences (CIRES)—NOAA Cooperative Agreement, NOAA number NA37RJO201.

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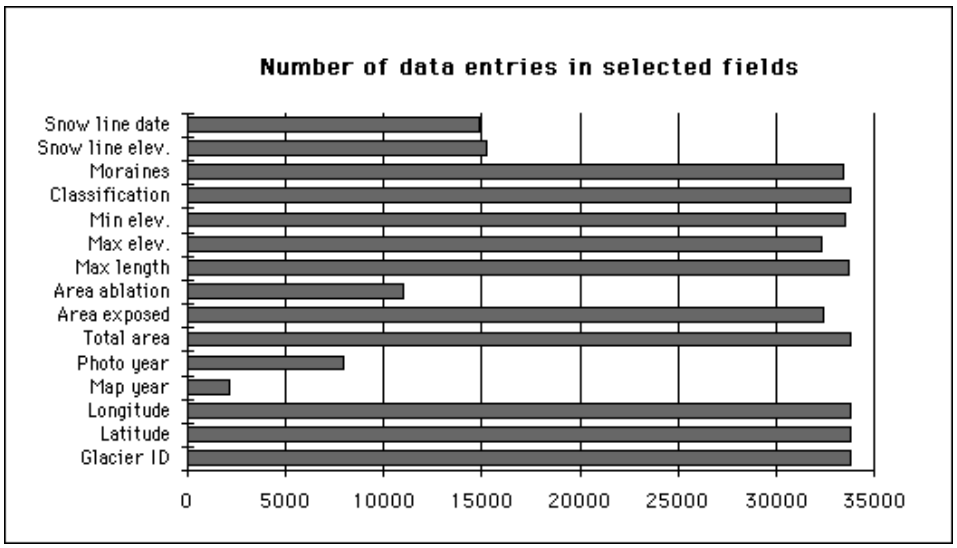
Product development

The glacier inventories contain data for 21,651 glaciers in the former Soviet Union and 12,183 glaciers in China. Locations for these glaciers are shown in Figure 1. Individual glaciers may contain entries in up to 27 data fields, although not all glaciers have entries in every field. Fields describe a range of important physical characteristics, and contain data derived from direct observations as well as from topographic maps and aerial photographs. Examples of the kind of data available, as well as the number of entries in the primary fields, are outlined in Figure 2.

As the data were acquired, they were loaded into a database to facilitate the quality control process. Quality control consisted of a two-tier approach: general checks, which were applied to all fields, and specific checks, which were relevant only to specific individual fields. The general checks were intended to ensure that data were recorded in a consistent manner. For example, dates (such as date of snowline measurement) were found to be recorded as month/day/year in some entries, and day/month/year in others. Such problems were solved simply by correcting all data to a single format.

General checks also identified "false fields," those which appeared with field names in the original data, but contained no actual data. These seem to have occurred when planned measurements were not implemented; the proposed data category remained as a field heading in the inventory, even though no data were collected. False fields were removed from the database.

Specific checks were more complicated, and their nature depended on the field under examination. In general, they were intended to accomplish two things: first, identify the precise meaning of all entries, and second, ensure that impossible entries were removed. The first task was not always easy, since many of the data fields relied on complex code systems, and direct communication with Moscow was often unavailable. However, much of the inventory was consistent with guidelines laid down by the World Glacier Monitoring Service (WGMS) in their 1989 report, which provides descriptions of and keys for many of the codes used in the inventory.



▲ **Figure 2.** Examples of the types of data and numbers of entries in respective fields contained in the new glacial inventory.

Even so, some discrepancies were found. For example, in some cases the inventory uses a slightly different system in the glacier identification number to give the glacier's general location. Where the WGMS system uses the code prefix SU5AZFJ and SU5ANOV to identify glaciers in Franz Joseph Land and Novaya Zemlaya respectively, the inventory uses SU4X and SU4Y. Additionally, the WGMS report provides no key for the interpretation of codes for moraine data, although moraine data are frequently mentioned. This key was eventually located in Muller, Caflisch and Muller (1977), and the data were found to be consistent with these guidelines.

Checking for impossible values typically proceeded by ensuring that the data were internally consistent; that is, ensuring that maximum, mean and minimum values were accurate with respect to each other. This was easily achieved with elevations and areas (where ablation area and area of exposed ice could not exceed total area), and several simple recording errors were discovered where a correct value had been recorded in the wrong field.

Occasionally, however, more puzzling errors would appear, such as the presence of a maximum elevation well over 8000 m in the Tien Shan mountains (where the summits only occasionally exceed the 7000 m mark), or the appearance of orientations indicating that a glacier flowed both north and south. (Other factors made it impossible to interpret this as simply meaning the glacier flowed along a north-south axis.) In these cases, e-mail consultation with Michael Kunakhovitch of the Institute of Geography in Moscow was usually required to solve the problem.

Once quality control work was complete, the data were used to generate a glacier inventory product. This product is available from one of NSIDC/WDC-A's pages on the World Wide Web (WWW). In an effort to allow the user community to access and subset the data within the database easily, a WWW user interface needed to be designed. The Eurasian glacier inventory interface is based upon the General Structured Query Language (GSQL) software developed at the National Center for Supercomputing Applications (NCSA) by Jason Ng. The GSQL-based interface provides the link between standard WWW input forms or clickable image maps to the data base containing the data. Additionally, by modifying a public domain software package, the cost of developing this interface was cut dramatically.

By using several image maps of Eurasia that can be clicked on (supplemented by geographically named links for non-imaged browsers), the user can narrow a query to the river basin or region of interest. The user can also choose which of the 27 data fields to access, minimizing the amount of data downloaded. By giving the user the power to design their own query (through the WWW interface), the Eur-

– continued on page 10

***Glaciers,** from page 9*

asian glacier inventory allows the user to browse the entire data set through the Internet and then subset the data based upon their own research needs. In addition, for users without Web access, the product is available on diskette.

Product applications

The glacier inventory data have numerous applications, as noted earlier. An example of initial work (Bedford and Barry, 1995a) uses various inventory data to estimate accumulation area ratios and equilibrium line altitudes for several glaciers in the former Soviet Union, and to examine their variability over space and time. Elaboration on this kind of work has the potential to provide valuable contributions to the study of climate change through the medium of glacier variability.

Other approaches to the study of global climate change have been explored by Haeberli (1995), and Haeberli and Hoelzle (1995), who utilize basic inventory data to infer glacier responses to climate forcings. Further possible product applications include glacial hydrology work, and estimations of future sea level contributions from glacier melt.

Future work

Besides future scientific work refining the study of accumulation area ratios and equilibrium line altitudes using the glacier inventory data, plans also include broadening the glacier inventory data archived at WDC-A. Data recently received for Norway and for the Alps have been sent from the World Glacier Monitoring Service in Zurich add substantial records to the inventory. Incorporating these data into the inventory and distributing them is a near-term priority. It is hoped that the compilation of a complete global glacier inventory can be achieved through international cooperation by the turn of the century.

The Eurasian glacier inventory can be accessed through the WWW at URL: *http://www-nsidc.colorado.edu/NOAA/Eurasian_glacier_inventory.html.*

Anyone with questions regarding this product is encouraged to consult the NSIDC home page at URL: *http://nsidc.colorado.edu/* (Figure 3) or contact NSIDC User Services at :

NSIDC/WDC-A, Campus Box 449
University of Colorado
Boulder, CO 80309-0449 U.S.A.
Phone: 303-492-6199
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▲ **Figure 3.** This image of the Gilman glacier in Alaska is accessible through the NSIDC WWW site at URL: *http://nsidc.colorado.edu.*

NCDC announces new online products and services

The National Climatic Data Center (NCDC) announces the availability of three new on line services through its World Wide Web (WWW) site (*http://www.ncdc.noaa.gov*):

■ Interactive visualization of global daily data

Located in the Interactive Visualization of Climate Data area, this system previously provided graphical analysis and data plots for U.S. climate divisional data and National Weather Service summary of day data. This has now been expanded to include global summary of day data for approximately 8000 worldwide stations. (Additional stations will be added to the system as time and resources permit.)

This global daily data was previously (and still is) available as ASCII data files for 1994 to present. Now, this new system provides for graphical displays of the most recent 18 months of data, with the latest month normally available 5-6 weeks after the end of the data month (e.g., October '95 accessible in early December). The elements that can be graphed are:

- daily means for temperature,
- dew point,
- sea level pressure,
- station pressure,
- visibility,
- wind speed,
- daily extremes for sustained wind speed,
- wind gust,
- maximum/minimum temperature,
- daily precipitation, and
- snow depth.

The user selects a region of interest from a global map; then selects the country (or countries) needed; and then the desired station(s), element(s), and time period. The system allows for either GIF or Postscript output. For example, you can display: August 1995 mean daily temperature for Vostok, Antarctica; January 1995 mean daily wind speed and temperature for Mount Washington, New Hampshire; Chicago's daily mean dew points for June through August 1995; August 1995 daily rainfall for Baguio and Manila in the Philippines; February 1995 daily snow depth for Valdez, Alaska and Blue Canyon, California; July 1995 daily maximum temperatures for Alert and Eureka, Canada; November-December 1995 daily mean wind speed for London, England.

■ Images of hurricanes and other storms

Located in the 'online data access' area, this system includes multiple satellite images of all of this year's hurricanes, along with images of significant hurricanes of previous years (e.g., Gilbert, Andrew, Hugo)—over 160 images in all. Several other types of images are also included such as the first GOES-9 IR and visible images, tornadic thunderstorms, Advanced Very High Resolution Radiometer (AVHRR) 'close-ups' of numerous areas, and the March 1993 'storm of the century.'

■ Various 1995-1996 technical reports on weather events

Located in the Products, Publications, and Services area, these include a wide variety of topics such as: the blizzard of '96, billion dollar weather disasters of 1980-1996, the California flooding of last winter, Hurricane Opal, and probabilities for a white Christmas.

The same page provides access to seven reports produced during 1993-1994 covering events such as the March '93 blizzard, the '93 Midwest flooding, the February '94 Southeast ice storm, and July '94 flooding in Georgia. The reports are available as ASCII text with separate GIF images, and as Wordperfect files. They include discussions of the events, climatic data tables, computer-analyzed maps of the affected areas, satellite images, and NEXRAD images.

We encourage users to try these new products and systems, and to contact the NCDC with any comments, suggestions, or problems that may be encountered at:

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NOAA/NESDIS
151 Patton Avenue
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Phone: 704-271-4800
Fax: 704-271-4876
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—Neal Lott
National Climatic Data Center
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151 Patton Ave.
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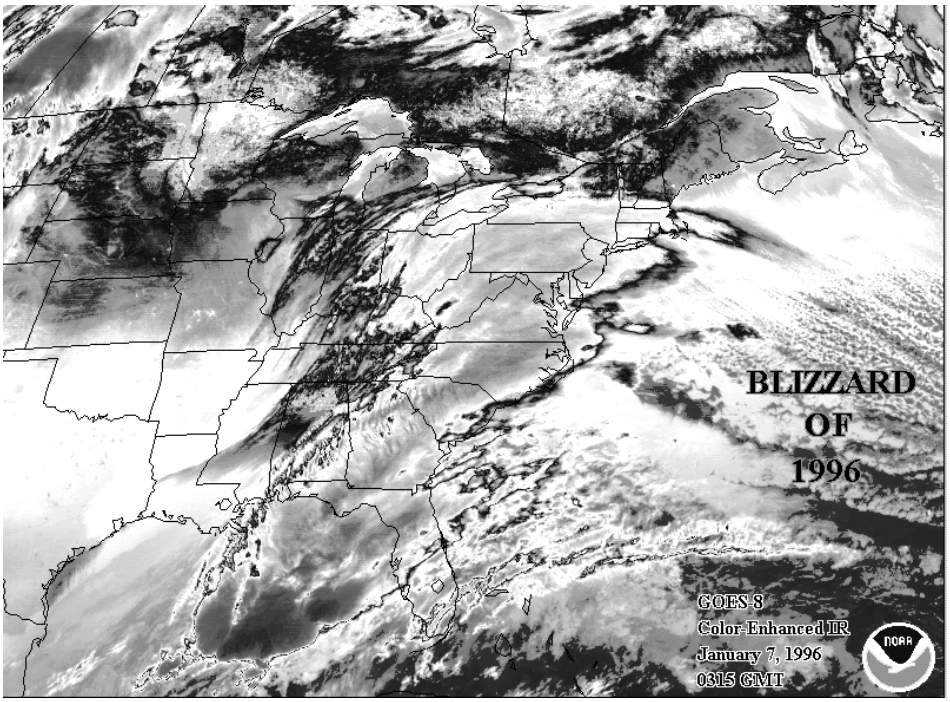
E-mail: nlott@ncdc.noaa.gov ■



▲ **Figure 1.** GOES-8 image of the Blizzard of '96 as presented on the NCDC's World Wide Web site. New online services offered by NCDC include interactive systems for displaying data and access to technical reports and graphics.

The Florida Keys ecosystem monitoring integration project

Utilizing new technologies to collect, analyze, and distribute environmental information

Mitchell Katz
Strategic Environmental Assessments Div.
NOAA/NOS

The National Ocean Service's Office of Ocean Resources Conservation and Assessment (ORCA) is currently conducting a joint effort with the Florida Marine Research Institute (FMRI) of the state's Department of Environmental Protection to develop an integrated monitoring plan for the Florida Keys' ecosystem, including Biscayne and Florida bays and the Florida Keys National Marine Sanctuary. Partial funding is also being provided by the National Fish and Wildlife Federation.

The project is designed to fulfill NOAA's responsibility under the Florida Keys National Marine Sanctuary and Protection Act, which calls for the establishment of a long-term ecological monitoring program and database. As part of this effort, information has been collected about Federal, State and local marine monitoring efforts in the region, including summary descriptive data and site data.

Designing and implementing an integrated monitoring program requires that the entire marine ecosystem, of which the sanctuary is a part, be considered. It is the way that the information about monitoring activities is being collected, processed, and disseminated, as much as its scope, however, that has taken the project in a new direction compared to past assessment efforts.

Conducted as a true partnership, the project involves the use of the Internet to both organize and transmit the information from Florida to ORCA's offices in Silver Spring, MD and to develop methods of displaying it graphically online for use by coastal resource managers and other interested users.

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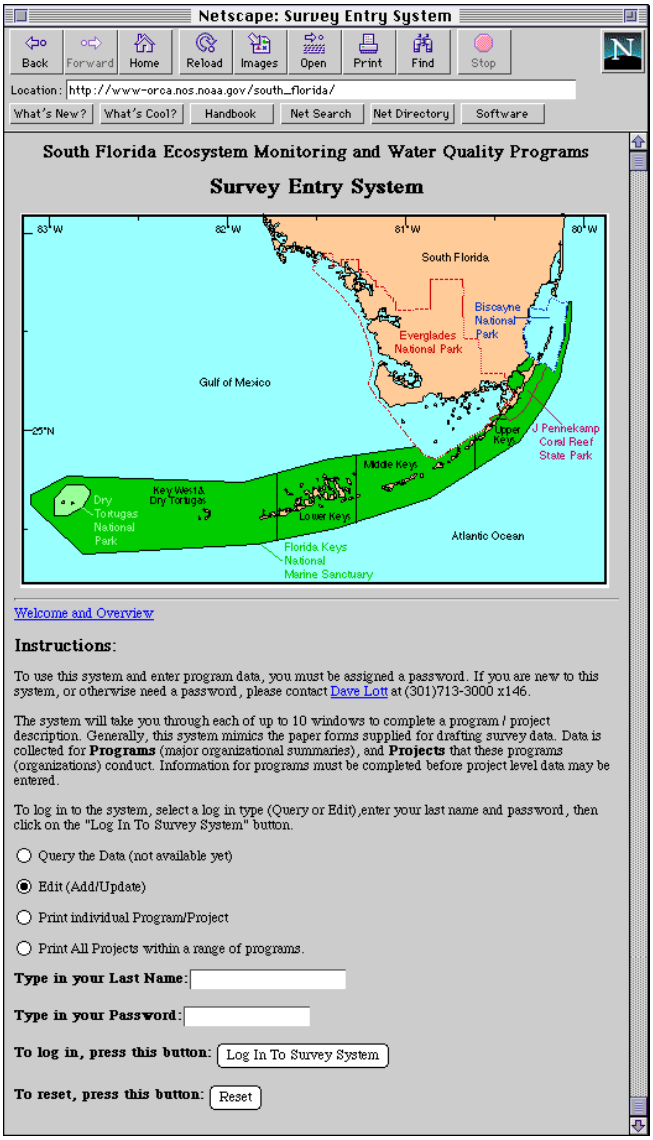
Gathering the data

Many types of environmental monitoring are currently taking place within the Florida Keys marine ecosystem, and these efforts are being conducted by a variety of organizations, including Federal and State government agencies, regional authorities and academic institutions. The range of the monitoring efforts is vast, as well, including monitoring of reef fishes, nutrients, salinity, regional circulation patterns, spiny lobsters, hardbottom communities, seagrasses, algal blooms, and marine mammals and birds.

While efforts have been made in the past to assess the monitoring efforts taking place and to catalog them by theme and geographic subregion, coordination and integration between the Federal, State, academic and local components of these organizations remains problematic. To rectify this problem, ORCA and FMRI staff met in mid-1995 to develop a better method to collect data on and access monitoring programs in the region. The preliminary result was a series of on-site surveys conducted between October and November of 1995 with the principal investigators involved in many of the monitoring projects currently being conducted within the ecosystem.

Initially institutions with well-known monitoring efforts were identified and their project managers interviewed. However, other projects identified as a result of the interviews were also considered, and as of November 1995, the heads of over 225 monitoring projects in the region had been either interviewed or contacted.

Data collected included information on the geographic distribution of monitoring activities within the ecosystem, the types of agencies conducting



▲ **Figure 1.** Gray scale rendition of the opening WWW page from the Florida Keys ecosystem monitoring survey conducted by NOAA and FMRI.

the activities, and the themes and parameters of the monitoring programs (e.g., whether they focused on physical parameters such as algal blooms and water quality or biological resources such as fishes and corals).

Organizing the information

Once the surveys were completed, the information collected had to be entered into a database to ensure that it could be processed and used in a geographic information system (GIS) to allow users to make queries about regional monitoring activities. A new Netscape™ home page was created, and the Internet was used to input the data electronically at FMRI into an Oracle™ database located at ORCA's offices (Figure 1).

This page, which is accessed by an assigned password, allowed the survey data to be entered quickly, checked easily, and printed out directly as the Internet page. The simple point-and-click interface had spaces for a variety of information parameters, including the project title; contact name, phone number, and e-mail address organizational affiliation; and project summary, including attributes such as site locations, sampling dates, methodology, and data use and users (Figure 2). Key words were also listed to enable future searches on the database.

Developing a monitoring GIS

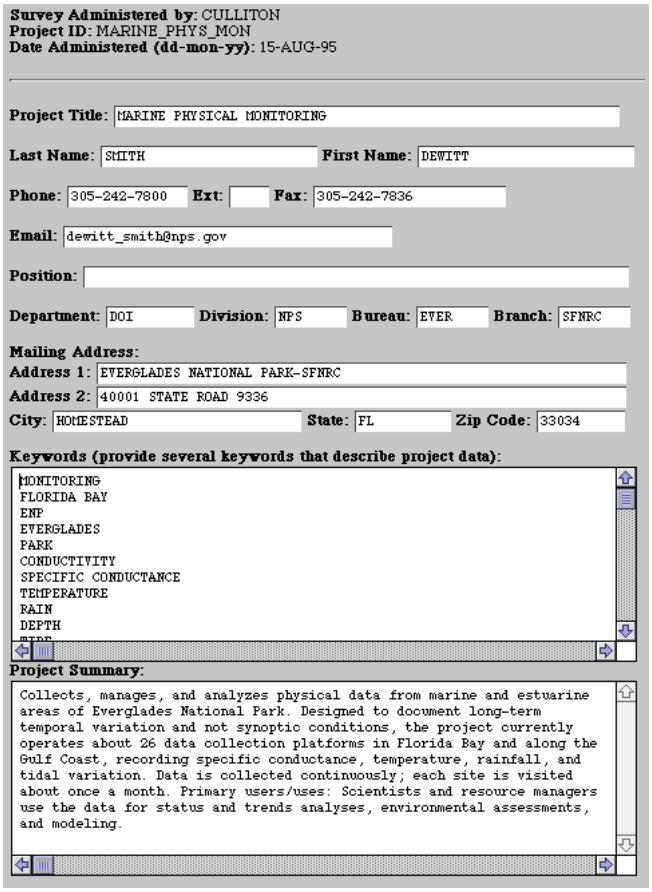
The monitoring sites and temporal and thematic information inventoried are currently being incorporated into an ArcView II mapping and information assessment system. Complete with a query function, the system will allow users to map the data (Figure 3) and view the activities in a variety of ways, including: 1) spatially (i.e., where certain activities are occurring within the region); 2) thematically (i.e., what programs are monitoring for a certain species or parameter); and 3) temporally (i.e., what monitoring programs were occurring over a certain period of time). The system will also enable combinations of these query methods to be mapped and displayed together (e.g., to show all lobster monitoring during the fall seasons between 1989 and 1991), and tabular summaries of the information will also be available that can be either downloaded or printed out for further use. Other capabilities will include overlaying individual data queries on top of one another and zooming to increase the resolution of the mapped information.

The integration process

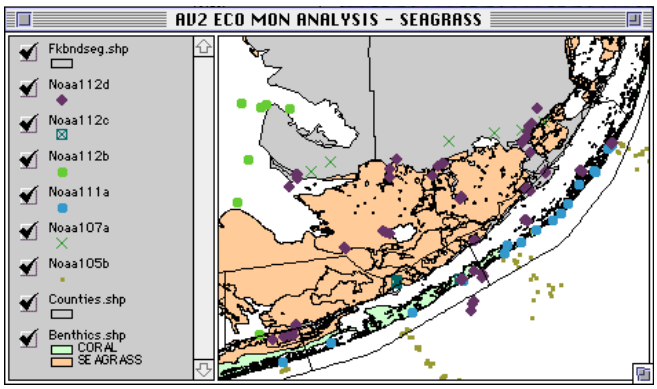
A planning process is now underway to bring together representatives of the major monitoring programs in the region through a series of integration workshops. The objective is to develop consensus on how to best integrate existing monitoring projects to address the environmental problems determined to be of highest priority within the South Florida ecosystem.

The workshops are designed to be driven by the major problems identified by the management and scientific community during both the development of the draft sanctuary management plan and recent Federal and State efforts to address ecosystem restoration problems within the region. Goals of the workshop process, which will include the use of the ArcView II mapping system, include: 1) determining the information needed to identify, assess and ultimately implement priority management strategies and monitor their effectiveness over time; 2) evaluating the extent to which the existing mix of monitoring programs supports these information needs; and 3) determining, based on the information developed and knowledge of local experts, the modifications necessary to existing programs and new programmatic needs.

It is the belief of the partners that this effort represents a unique approach to integrating a diverse and extensive body of monitoring investments by combining the use of the latest information technology—the Internet, a fully relational database management system and GIS capabilities—with the principle of a knowledge-based consensus-building process. It is hoped that by utilizing such technologies, the complex task of integrating the efforts of many programs and projects can be simplified. ■



▲ **Figure 2.** Online project summary from the Florida Keys ecosystem monitoring survey conducted by NOAA and FMRI.



▲ **Figure 3.** Gray scale rendition of an example of a potential ArcView II system map.

Advances from the Shipboard ADCP Archive Center

Shipboard Acoustic Doppler Current Profilers (ADCP) have been an increasingly common configuration on most research vessels over the past decade. In 1994, the National Oceanographic Data Center established the Shipboard ADCP Archive Center (SAC) at the University of Hawaii (UH) (Caldwell, 1995). Through collaboration with scientists and computer specialists at the UH, the SAC continues to fine-tune its management system and provide high-quality data to the scientific community.

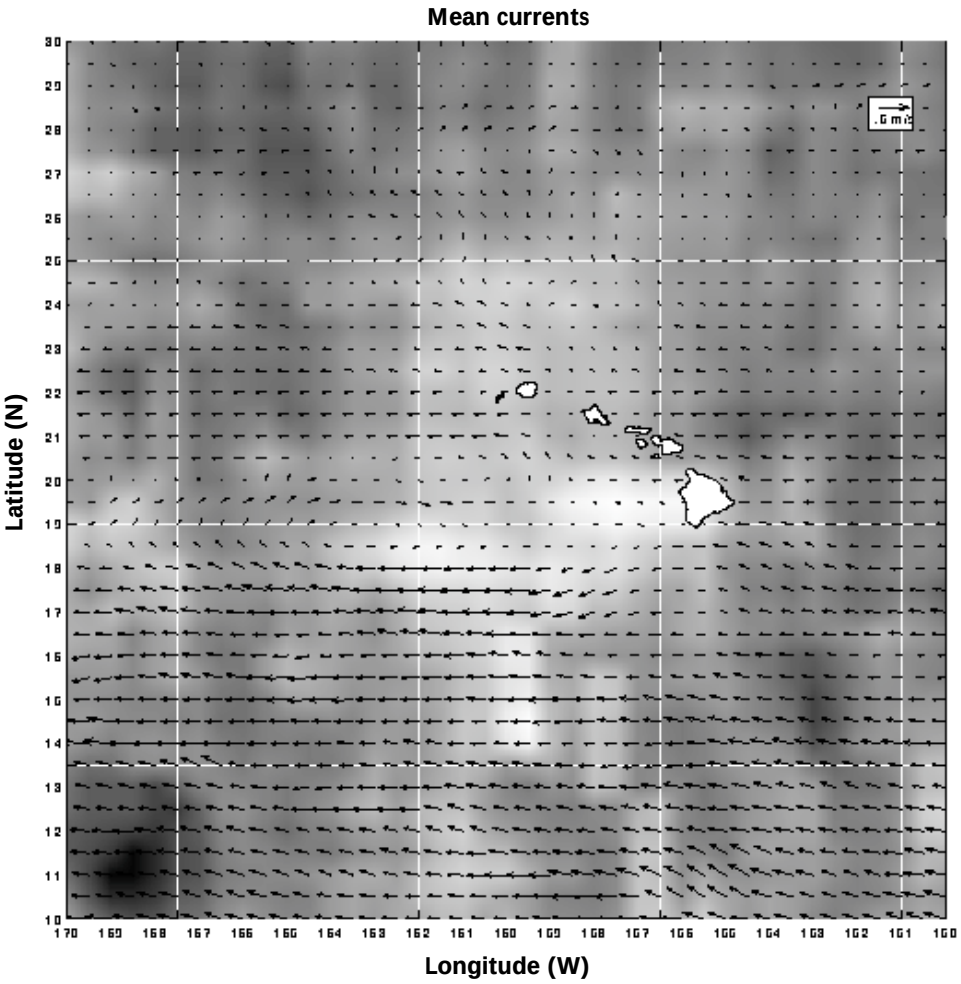
The SAC has a node on the World Wide Web (WWW) (*http://www.soest.-hawaii.edu/caldwell/index.html*) which provides inventories, plots of cruise tracks, cruise summaries, and data products. The primary data product is the ASCII standard subset of current velocity components averaged hourly in time and to 10 m intervals in the vertical. The subset also includes near-surface temperature and ship velocity.

Within the Web page, explicit instructions on obtaining and contributing data are provided. The high-resolution data, which are stored in the Common Oceanographic Data Analysis System (CODAS) at the time and space intervals as collected at sea and processed on shore, are presently not available through the WWW. However, they can be easily transferred upon request using other media, such as FTP through the Internet.

An important technical management advance is the addition of machine signatures within the CODAS data storage system. This allows CODAS block files written on one type of computer to be read automatically by another with a different binary design; for example, CODAS software on an IBM-compatible PC can read CODAS block files created on a SUN. This will greatly facilitate distribution of CODAS data and software on CD-ROM, the medium most suitable for these voluminous sets. The NODC has plans for preparing CD-ROMs of shipboard ADCP in the near future.

The SAC archive now consists of over 120 cruises. Although the archive continues to grow at a steady pace, the contribution of data from outside the sphere of influence of the UH scientists has been disappointing. The NODC strongly encourages shipboard ADCP data collectors to provide copies of their high-resolution data sets to the SAC.

As the data accumulates, more and more applications will be possible, such as regional climatological charts. Figure 1, for example, shows a plot in which data from all cruises in the Hawaiian region at the 30 m depth level were synthesized with other current data sources (current meters and subsurface drifters) in preparation of an atlas (R. Lumpkin and P. Flament, SOEST, University of Hawaii, from the Ocean Atlas of Hawaii, *http://satftp/atlas/*.)



▲ **Figure 1**. Average surface flow (cm/s), based on 40,000 observations of ship drift, 85,000 satellite-tracked drifting buoys and 8,000 modern current measurements. The shading denotes root-mean-square variability of modern current observations; higher variability is lighter. *(Sources and periods: historical ship drift, 1895-1993, National Ocean Data Center (NODC), NOAA; drifting buoys, 1986-1995: Atlantic Oceanographic and Meteorological Laboratory, NOAA, and Pelagic Fisheries Research Project, University of Hawaii; direct current measurements, 1987 to 1995: Shipboard ADCP Archive Center, University of Hawaii/NODC/NOAA. Source of figure: Hawaiian Ocean Atlas, http://satftp/atlas/.)*

References

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Data products and services

NSIDC presents new edition of DMSP brightness temperatures and sea ice user's guide

The National Snow and Ice Data Center (NSIDC) has reissued *DMSP SSM/I Brightness Temperatures and Sea Ice Concentration Grids for the Polar Regions, User's Guide*. This revised edition updates the *User's Guide* last published in 1989. The new guide contains information on the use of SSM/I polar stereographic products, including brightness temperatures, daily sea ice concentrations, and monthly averaged sea ice concentrations stemming from data collected by both the DMSP F8 and F11 satellites.

The manual accompanies data distributed on CD-ROM and via the Internet. The spiral-bound information may be inserted directly into the three-ringed binder originally issued (which contains information on software that is no longer supported.) For more information on this product, contact NSIDC User Services at:
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The NSIDC also maintains a Web site at URL: *http://nsidc.colorado.edu*.
Contact: NSIDC

NGDC publishes 1994 SAMPEX monthly plots

The National Geophysical Data Center's (NGDC) has received January through December 1994 SAMPEX (NASA's Solar, Anomalous, and Magnetospheric Particle EXplorer satellite) monthly plots for publication in the February 1996 issue of *Solar-Geophysical Data*. SAMPEX is a polar orbiter and has access to interplanetary fluxes of solar energetic particles and galactic cosmic rays over the polar portions of its orbit. The plots contain fluxes of energetic electrons, protons, helium nuclei, and heavy ions. They can be used to identify the occurrence and magnitude of solar and interplanetary particle events.
Contact: NGDC

NODC releases revised Geosat Wind/Wave CD-ROM

The National Oceanographic Data Center (NODC) has issued a revised version of the CD-ROM containing wind/wave data from the U.S. Navy Geodetic Satellite (Geosat). The revised version corrects problems detected by the Geosat data analysis team in 29 of the first 30 days of data and also removes unnecessary end-of-line characters from the end of the data records. The space savings from the latter step made it possible to store all the wind/wave data on the new CD-ROM without compression (the original CD-ROM files were in compressed form.)

These data cover the duration of the Geosat Geodetic Mission (April 1985 - September 1986), and were declassified long before the altimetric height data from that portion of the mission. Significant wave height and radar backscatter strength (sigma-0) are the fundamental measurements included in the data set. In addition, wind speed values, based on several different models, are estimated from the backscatter measurements.

Customers who received the original disc should contact the NODC User Services Branch to receive this replacement (CD-ROM NODC-64). Other Geosat data sets including the 4-disc set of recently declassified global altimeter data from the Geosat Geodetic Mission are also available from the NODC. Further details about the Geosat data products and an online order form for NODC CD-ROMs are available on the NODC Web site at *http://www.nodc.noaa.gov/*.
Contact: NODC

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Fax: 704-271-4876
E-mail: satorder@ncdc.noaa.gov

National Geophysical Data Center (NGDC)
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Fax: 303-497-6513
E-mail: info@ngdc.noaa.gov

National Oceanographic Data Center (NODC)
301-713-3277
Fax: 301-713-3302
E-mail: services@nodc.noaa.gov

NOAA Environmental Services Data Directory
301-713-0572
(Gerry Barton)
Fax: 301-713-1249
E-mail: barton@esdim.noaa.gov

NOAA Central Library
Reference Services:
301-713-2600
Fax: 301-713-4599
E-mail: noaalib@libmail.lib.noaa.gov

NGDC releases new educational slide sets

The National Geophysical Data Center's (NGDC) World Data Center-A for Paleoclimatology presents two new educational slide sets, which are currently available from NGDC. Each set of 20 slides includes vivid photographs of field research conducted around the globe, high-quality graphics of important datasets, and descriptive diagrams, which make these sets ideal instructional aides. Sets also include an accompanying narrative, a bibliography, and a vocabulary list.

The first set is entitled Coral Paleoclimatology—Natural Recorders of Interannual Climatic Variability in the Tropical Oceans and Seas. The second new set is Low-Latitude Ice Cores—High-Resolution Records of Climatic Change and Variability in the Tropics and Subtropics. Please contact the NGDC for current prices and purchase procedures.
Contact: NGDC

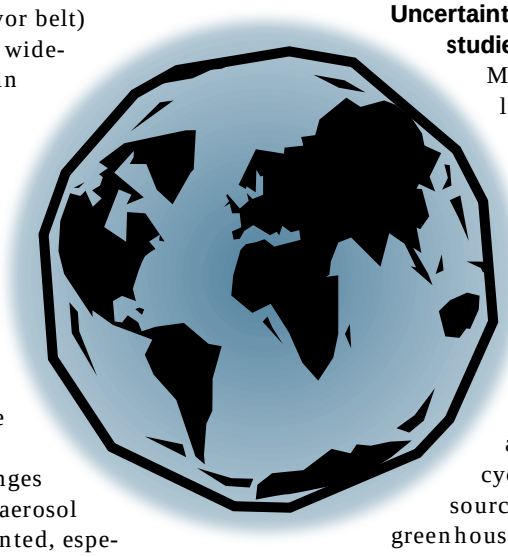
NCDC places images of significant weather events online

The National Climatic Data Center (NCDC) Research Customer Service Group has placed a directory of over 100 GIF format images of significant weather events online. The images can be accessed through the NCDC's World Wide Web (WWW) Home Page at URL: *http://www.ncdc. noaa.gov*.

The directory includes images of most of 1995's hurricanes, previous year's storms such as Gilbert, Hugo, and Andrew, significant events such as the March 1993 blizzard, and Advanced Very High Resolution Radiometer (AVHRR) images of various locations, both of the United States and from overseas. Some Defense Mapping Satellite Program (DMSP) very high resolution images are also included. The directory will continue to be updated regularly.
Contact: NCDC

State of the climate, *from page 7*

Arctic in summer; an enhanced global mean hydrological cycle; and increased precipitation and soil moisture in high latitudes in winter. In addition, most simulations show a reduction in the strength of the north Atlantic thermohaline (conveyor belt) circulation, and a widespread reduction in diurnal range of temperature.



The direct and indirect effects of anthropogenic aerosols have an important effect on the projections. Generally, the magnitudes of the temperature and precipitation changes are smaller when aerosol effects are represented, especially in northern mid-latitudes. The cooling effect of aerosols is not a simple offset to greenhouse warming, but significantly influences some continental scale patterns of climate change (most noticeably in summer.) For example, models that consider only the effects of greenhouse gases generally project an increase in precipitation and soil moisture in the Asian summer monsoon region, whereas models that include aerosols suggest that monsoon precipitation may decrease. The spatial and temporal distribution of aerosols greatly influence regional projections, which are therefore more uncertain.

A general warming is expected to lead to more extremely hot days and less extremely cold days. Warmer temperatures will lead to a more vigorous hydrological cycle, translating into prospects for more severe droughts and/or floods in some places and less severe droughts and/or floods in other places. Several models indicate and increase in precipitation intensity, suggesting more extreme rainfall events. Knowledge is currently insufficient to say whether there will be any changes in the occurrence or geographical influence of severe storms, e.g., tropical cyclones.

Sustained rapid climate change could shift the competitive balance among species and even lead to forest dieback, altering the terrestrial uptake and release of carbon. The magnitude is uncertain, but could be between zero and 200 billion metric tons of carbon over the next one to two centuries, depending on the rate of climate change.

Uncertainties in climate change studies

Many factors currently limit our ability to project and detect future climate change. To reduce uncertainties, further work is needed on the following high priority topics:

- Estimation of future emissions and biogeochemical cycling (including sources and sinks) of greenhouse gases, aerosols and aerosol precursors and projections of future concentrations and radiative properties.
- Representation of climate processes in models, especially feedbacks associated with clouds, oceans, sea ice and vegetation, in order to improve projections of rates and regional patterns of climate change.
- Systematic collection of long-term instrumental and proxy observations of climate system variables for the purposes of model testing, assessment of temporal and regional variability, and for detection and attribution studies.
- Large rapid climate system changes (as have occurred in the past) are very difficult to predict. Future climate changes may well involve surprises. These arise from the nonlinear nature of the climate system. When rapidly forced, nonlinear systems are especially subject to unexpected behavior. Progress can be made by investigating nonlinear processes and subcomponents of the climatic system. Examples of such nonlinear behavior include rapid circulation changes in the North Atlantic and feedbacks associated with terrestrial ecosystem changes. ■