Inventory of Met-Ocean Data Sources for the United States

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A Task Deliverable for the US Department of Energy Project:

National Offshore Wind Energy Resource and Design Data Campaign – Analysis and Collaboration

DOE Contract No: DE-EE0005372

Prepared for the US Department of Energy by:

AWS Truepower, LLC

Albany, NY

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Introduction

On behalf of the US Department of Energy (DOE) under contract number DE-EE0005372, AWS Truepower (AWST) is conducting a 3-year project entitled *National Offshore Wind Energy Resource and Design Data Campaign—Analysis and Collaboration* (hereafter, the Project). The objective of the Project is to supplement, facilitate, and enhance on-going multi-agency efforts to develop an integrated national offshore wind energy data network via sustained public-private sector collaboration. Specific goals of this initiative are to:

- Assess the quality of existing meteorological and oceanographic (met-ocean) data sets, observation networks, and modeling efforts;
- Identify gaps in data and research needed to facilitate project and industry development;
- Support the enhancement of measurement and modeling programs to better describe the physical processes governing the met-ocean environment;
- Recommend offshore met-ocean assessment protocols for atmospheric, ocean surface, and sub-surface measurements;
- Provide the industry with the basis for modifying existing guidance for the siting, design, operation, and maintenance of offshore wind turbines and associated infrastructure; and
- Establish sustainable public-private sector collaboration on addressing offshore resource assessment, design condition, and operational industry needs.

The results of this effort will produce a comprehensive definition of relevant met-ocean resource assets and needs, accepted modeling approaches, and design standards, together with recommended pathways for meeting offshore wind energy industry data and design certification requirements.

The initial task for the Project is to create a comprehensive and web-accessible inventory of relevant coastal and offshore met-ocean data sources and associated metadata for the United States, including the Great Lakes. Although met-ocean information can be obtained from varied sources, there is no centralized clearinghouse tailored to offshore wind energy interests. The purpose of this task, therefore, is to develop the definitive reference web portal for offshore wind-related programs. A first step toward fulfilling this task is to compile a preliminary listing of national met-ocean data sources. This document comprises this preliminary listing, which is now available for review by DOE and other stakeholders.

Scope and Methods

The inventory of met-ocean data sources and metadata is planned to be a living resource, with updates provided over the duration of the Project as new data become available, additional historic data sources are identified, or other sources are contributed. Although no actual measurement data will be archived on the planned website, the website will function as a quick and efficient search portal for all interested parties, including government, academia, offshore wind developers, wind turbine manufacturers, offshore construction and engineering firms, utilities, and other permitting and approval authorities.

Broad criteria for the met-ocean data sources were defined to initiate inventory development and to frame the bounds of the database. These initial parameters were intentionally chosen to be inclusive such that the subsequent Project tasks could effectively assess and screen the available data. Following are the basic search criteria utilized for this task:

- **Geographic Extents**: All US waters from the coast to the Outer Continental Shelf, including Alaska, Hawaii and the Great Lakes[1];
- **Physical Extents**: Ocean (or lake) bottom surface up through the atmospheric boundary layer[2]
- **Source Types**: Existing observational data sets (both directly and remotely sensed), model output, or analyses[3] available for free or purchase;
- **Atmospheric Parameters**: Wind speed and direction, temperature, pressure, humidity, precipitation, solar radiation, lightning, visibility, and related parameters, including relevant statistical analyses, extremes, transient events, and spatial and temporal variations;
- **Ocean (Lake) Parameters**: Bathymetry, current speeds and directions, wave heights, directions and periods, tides, temperature, salinity, density, ice conditions, and related parameters, including relevant statistical analyses, extremes, transient events, and spatial and temporal variations.

Data sources are categorized into six categories: Federal government, State government, Regional Alliances, Universities and Private Research Organizations, Commercial Providers and Development Projects, and International Resources.

The resources were identified mainly through web-based searches (with the assistance of the National Renewable Energy Laboratory, a member of the Project team), and will be supplemented as the Project progresses by personal communications with relevant authorities and input from identified stakeholder groups. The data sources and datasets will be indexed and organized into a searchable database and made available through the Project website, which is currently under development.

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[1] Inland data sources were not considered, but were not excluded if contained with relevant coastal or offshore sources
[2] This includes bathymetric information and bottom soil type, but does not extend to sub-bottom and geotechnical conditions
[3] Future data sets (planned or proposed) and data collection or modeling services were not considered

Data Inventory

<u>National Oceanic & Atmospheric Administration (NOAA)</u>

Climate Forecast System, Climate Prediction Center
Data products include current and archived seasonal climate anomalies from the NCEP coupled forecast system model (CFS) versions 1 and 2.
Link: http://cfs.ncep.noaa.gov/

Comprehensive Large Array-Data Stewardship System (CLASS)
CLASS is NOAA's premiere on-line facility for the distribution of NOAA and US Department of Defense (DoD) Polar-orbiting Operational Environmental Satellite (POES) data, NOAA's Geostationary Operational Environmental Satellite (GOES) data, and derived data.
Link: http://www.class.ngdc.noaa.gov/saa/products/welcome

Coastal and Marine Spatial Planning
The purpose of this website is to provide users with coastal and marine spatial planning information related to national level policies, and to advance the implementation of this data in real-world settings. The CMSP project website provides access to many data sources where coastal and marine spatial planning information can be found.
Link: http://www.msp.noaa.gov/data-tools/index.html

Digital Coast, Coastal Services Center
Digital Coast is a clearinghouse website for geospatial data related to the coastal environment and its natural resources. The content here is contributed by various federal, state, county, nongovernmental, private and academic organizations. Digital Coast provides access to data types such as: benthic, bathymetric, georegulatory, hydrographic, and topographic. Many online mapping tools from public and private sources are also made available through this website.

Comments: Of note is the Digital Coast Offshore Renewable Energy Planning section, which provides a variety of tools and information useful for those involved in finding the best location for offshore renewable energy projects.
Link: http://www.csc.noaa.gov/digitalcoast/

Earth System Research Laboratory (ESRL)
ESRL supports the deployment and operation of environmental observatories and observational networks to provide high-resolution datasets for analysis. These data provide a critical, long-term history of the Earth system necessary for the assessment of global trends. ESRL also operates observational networks to improve our understanding of regional weather, water and climate processes, and to advance the development of new sensor techniques. ESRL conducts and participates in field programs which allow researchers to intensively study an aspect of the Earth system which applies to improving weather and air quality forecasting, and understanding climate processes and trends
Link: http://www.esrl.noaa.gov/

> **The High-Resolution Rapid Refresh (HRRR), ESRL**
> The HRRR is a 3-km resolution, hourly updated, cloud-resolving atmospheric model, initialized by DFI-fields from the 13km radar-enhanced Rapid Refresh model.
> Link: http://ruc.noaa.gov/hrrr/

Meteorological Assimilation Data Ingest System (MADIS), ESRL

MADIS leverages partnerships with international agencies to integrate observations from their stations with those of NOAA to provide a finer density, higher frequency observational database for use by the greater meteorological community.

Highlights include:
- Observed: meteorological surface, radiosonde, NOAA profiler network, satellite wind and others.
- Modeled: Rapid Update Cycle (RUC) Surface Assimilation System (RSAS) Surface Analysis Grids
- Information about obtaining ACARS (commercial aircraft) data

Link: http://www-sdd.fsl.noaa.gov/MADIS/index.html

Physical Sciences Division, ESRL

PSD's scientific goal is to provide the observation, analysis, and diagnosis of weather and climate physical processes necessary to increase understanding of Earth's physical environment, including the atmosphere, ocean, cryosphere, and land, and to enable improved weather and climate predictions on global-to-local scales. PSD archives a wide range of data ranging from gridded climate datasets extending hundreds of years to real-time wind profiler data at a single location. The data or products derived from this data, organized by type, are available to scientists and the general public.
Link: http://www.esrl.noaa.gov/psd/

Great Lakes Environmental Research Laboratory (GLERL)

NOAA's Great Lakes Environmental Research Laboratory addresses a wide range of environmental issues pertaining to the Great Lakes and coastal areas. Data available through their site spans a variety of categories, including: meteorology, geology and oceanography. Of particular note is the Great Lakes Ice Atlas. This atlas contains composite ice charts from a variety of in-situ and remotely sensed sources.
Great Lakes Ice Atlas link: http://www.glerl.noaa.gov/data/ice/atlas/
Link: http://www.glerl.noaa.gov/

International Comprehensive Ocean-Atmosphere Data Set (IOCADS)

ICOADS offers surface marine data spanning the past three centuries, and simple gridded monthly summary products for 2° latitude x 2° longitude boxes back to 1800 (and 1°x1° boxes since 1960)—these data and products are freely distributed worldwide.
Link: http://icoads.noaa.gov/index.shtml

Marine Modeling and Analysis Branch (MMAB)

The MMAB is responsible for the development of improved numerical weather and marine prediction modeling systems within NCEP/NWS. This group provides analysis and real-time forecast guidance (1-16 days) on marine meteorological, oceanographic, and cryospheric parameters over the global oceans and coastal areas of the US.

Highlights include:
- NOAA WAVE WATCH III: NWW3 produces swell period, sea height and sea heading.
- Sea ice forecasting and analysis
- SSM/I and QuickSCAT wind statistics products
- Coastal and open ocean visibility data archive
- MMAB Global Superstructure Ice Accretion Guidance

Link: http://polar.ncep.noaa.gov/mmab/products.shtml

National Climatic Data Center (NCDC)

The NCDC is the world's largest active archive of weather data. Data is received from a wide variety of sources, including: satellites, radars, remote sensing systems, NWS cooperative observers, aircrafts, ships, radiosondes, wind profilers, rocketsondes, solar radiation networks, and NWS Forecast/Warnings/Analyses Products.
Link: http://www.ncdc.noaa.gov/oa/ncdc.html

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Where science delivers performance.

Global Observing Systems Information Center (GOSIC), NCDC
The GOSIC Portal provides access to data and information identified by the Global Climate Observing System (GCOS), Global Ocean Observing System (GOOS) and Global Terrestrial Observing System (GTOS), in addition to their partner programs e.g. Global Atmosphere Watch (GAW) and GOOS Regional Alliances (GRA).
Link: http://gosic.org/default.htm

National Operational Model Archive & Distribution System (NOMADS), NCDC
The NOAA National Operational Model Archive and Distribution System (NOMADS) provides both real-time and retrospective format independent access to climate and weather model data.
Link: http://nomads.ncdc.noaa.gov/

Products & Services Guide, NCDC
The Products & Services Guide provides a comprehensive overview of the data products offered by the National Climatic Data Center. Product highlights include worldwide surface observations, in addition to satellite, model and radar data.
Link: http://www1.ncdc.noaa.gov/pub/data/inventories/2011psguide.pdf

National Data Buoy Center (NDBC)
The National Data Buoy Center (NDBC) manages the development, operations, and maintenance of the national data buoy network. It serves as the NOAA focal point for data buoy and associated meteorological and environmental monitoring technology. It provides high quality meteorological/environmental data in real time from automated observing systems that include buoys and a Coastal-Marine Automated Network (C-MAN) in the open ocean and coastal zone surrounding the United States. It provides engineering support, including applications development, and manages data buoy deployment and operations, and installation and operation of automated observing systems installed on fixed platforms. It manages the Volunteer Observing Ship (VOS) program to acquire additional meteorological and oceanographic observations supporting NWS mission requirements. It operates the NWS test center for all surface sensor systems. It maintains the capability to support operational and research programs of NOAA and other national and international organizations.
Observations search link: http://www.ndbc.noaa.gov/

National Geophysical Data Center (NGDC)
The NGDC provides products and services for geophysical data describing the solid earth, marine, and solar-terrestrial environment, as well as earth observations from space.
Link: http://www.ngdc.noaa.gov/ngdc.html

Marine Geology & Geophysics, NGDC
The Marine Geology and Geophysics Division of NGDC provides long-term scientific stewardship for global geophysical and digital elevation data, marine geological and geophysical data, and natural hazards data.

Highlights include:
- Bathymetry & Global Relief: This webpage provides access to NGDC bathymetric and topographic datasets including: gridded global relief data and images, multibeam data, hydrographic survey data, satellite-derived data and trackline data.
- NOAA Tsunami Inundation Digital Elevation Models: NOAA's National Geophysical Data Center is building high-resolution digital elevation models (DEMs) of select U.S. coastal regions incorporating bathymetric, topographic, and shoreline data provided by federal, state, and local government agencies, academic institutions, and private companies.
- U.S. Coastal Relief Model: NGDC's 3 arc-second U.S. Coastal Relief Model (CRM) provides the first comprehensive view of the U.S. coastal zone, integrating offshore bathymetry with land topography into a seamless representation of the coast. The CRM spans the U.S. East and West

Coasts, the northern coast of the Gulf of Mexico, Puerto Rico, and Hawaii, reaching out to, and in places even beyond, the continental slope.
Link: http://www.ngdc.noaa.gov/mgg

National Oceanographic Data Center (NODC)
The NODC manages the world's largest collection of publicly available oceanographic data. NODC holdings include in-situ and remotely sensed physical, chemical, and biological oceanographic data from coastal and deep ocean areas.
Link: http://www.nodc.noaa.gov/

Interactive Data Access and Retrieval System (IDARS), NODC
IDARS is being developed to provide a graphical user interface-based tool that will allow visual browsing of data managed by the Operational Oceanography Group of the National Oceanographic Data Center (NODC).
Link: http://www.nodc.noaa.gov/dsdt/

National Coastal Data Development Center (NCDDC), NODC
The NCDDC is dedicated to building the long-term coastal data record to support environmental prediction, scientific analysis, and formulation of public policy.
Link: http://www.ncddc.noaa.gov/

OceanNOMADS, NCDDC
NOAA NCDDC, with partners including National Weather Service, National Centers for Environmental Prediction (NCEP) and the Northern Gulf Institute, has created this NOMADS node for ocean-model access. This site, OceanNOMADS, provides retrospective access to long time series of output from mature ocean modeling and prediction systems, including models from the National Weather Service and the U.S. Navy.

Highlights include:
- Global NCOM (NAVT Coastal Ocean Model)
- RTOFS (Real Time Ocean Forecast System)
- CFSR (Climate Forecast System Reanalysis)

Link: http://www.ncddc.noaa.gov/ocean-nomads/

Satellite Oceanography Group, NODC
The primary goal of the NODC satellite group is to provide scientific stewardship of satellite-derived oceanographic datasets and analyses. The group focuses on three of the key functions of satellite data stewardship: (1) Generating authoritative long-term records through satellite data reprocessing efforts; (2) Using those climate data records to place the current state of the environment in its proper historical perspective; and (3) Insuring the data are properly archived and easily accessed by a wide range of users.
Link: http://www.nodc.noaa.gov/SatelliteData/

Ocean Climate Laboratory, NODC
The Ocean Climate Laboratory (OCL) is a division of the National Oceanographic Data Center (NODC). The primary objectives of the OCL are to: (1) improve the quality of the NODC's oceanographic data archives by using the data to perform scientific analyses and (2) build scientifically, quality-controlled global oceanographic databases.
Link: http://www.nodc.noaa.gov/OC5/

NOS Data Explorer, National Ocean Service (NOS)
NOS Data Explorer offers access to many products, including: bathymetry, coastal maps, environmental sensitivity index maps, aerial photographs, and more.
Link: http://oceanservice.noaa.gov/dataexplorer/

Center for Operational Oceanographic Products and Services (CO-OPS), NOS
Provides access to met-ocean data such as tidal, current and meteorological observations from various entities, including:
- Texas Coastal Ocean Observation Network (TCOON)
- Carolinas Regional Coastal Ocean Observing System (Carolinas RCOOS)
- Northeast Regional Association for Coastal and Ocean Observing (NERACOOS)
- The National Water Level Program
- The National Water Level Observation Network

Link: http://tidesandcurrents.noaa.gov/index.shtml

Centralized Data Management Office (CDMO), National Estuarine Research Reserve System, Office of Ocean and Coastal Resource Management, NOS
The National Estuarine Research Reserve System (NERRS) is a NOAA-state partnership that oversees 28 research reserves which have been established for the purpose of research, education and coastal stewardship.

The CDMO website provides various marine, oceanographic and meteorological observations from National Estuarine Research Reserve (NERR) within U.S. coastal states.
Link: http://cdmo.baruch.sc.edu/

National Marine Protected Area Center, NOS
The Marine Protected Areas Inventory (MPA Inventory) is a comprehensive geospatial database designed to catalog and classify marine protected areas within US waters. This inventory contains information on over 1,600 sites and is the only such comprehensive dataset in the nation. The database has various applications for marine management and conservation, but its primary purpose is to maintain baseline information on MPAs to the assist in the development of the National System of MPAs.
Link: http://www.mpa.gov/

NOAA Central Library
The NOAA Central Library provides information and research support to NOAA staff and the public. The library also networks with over 30 NOAA libraries across the nation. Disciplines covered include: weather and atmospheric sciences, oceanography, ocean engineering, nautical charting, marine ecology, marine resources, ecosystems, coastal studies, aeronomy, geodesy, cartography, mathematics and statistics.
Link: http://www.lib.noaa.gov/

NWS Telecommunication Gateway
The Gateway operates web servers and file servers. The web and file servers store all nationally-generated forecast products and globally received observational data. The web service provides browser access to retrieve data and forecasts. The file servers provide a file transfer service for retrieval of operational model forecasts and observational data.
Link: http://www.nws.noaa.gov/tg/index.html

Observing System Visualization
This visualization tool presents critical aspects of the NOAA Observing System, including: owning agency, type of system (buoy, satellite, etc.), intended use, lifecycle phase, and environmental parameters measured.
Link: https://www.nosc.noaa.gov/OSC/sor.php

Physical Oceanographic Real-Time System (PORTS®)
PORTS® is a decision support tool that improves the safety and efficiency of maritime commerce and coastal resource management through the integration of real-time environmental observations, forecasts and other geospatial information. PORTS® measures and disseminates observations and predictions of water levels, currents, salinity, and meteorological parameters (e.g., winds, atmospheric pressure, air and water temperatures) that mariners need to navigate safely.
PORTS® link: http://tidesandcurrents.noaa.gov/ports.html

The Physical Oceanography Division (PhOD)
The Physical Oceanography Division carries out interdisciplinary scientific investigations on the physics of ocean currents and water properties, and on the role of the ocean in climate, weather, and ecosystems. The tools used include: sensors on deep ocean moorings and vessels, and satellite-based instruments.

Data that can be obtained here include that from the:
- AOML South Florida Program
- Global Ocean Observing System (GOOS)
- CoastWatch Program
- ARRGO Center
- Global Drifter Program

Link: http://www.aoml.noaa.gov/

World Data Center for Meteorology, Asheville
The WDC for Meteorology, Asheville is maintained by the U.S. Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA) and is collocated and operated by the National Climatic Data Center (NCDC) in Asheville, NC, USA, and is proud to have been accepted as a full member of the new WDS as of September 2011. In accordance with the principles set forth by ICSU, WDC for Meteorology, Asheville acquires, catalogues, and archives data and makes them available to requesters in the international scientific community. Data are exchanged with counterparts, WDC for Meteorology, Obninsk and WDC for Meteorology, Beijing as necessary to improve access to climate and weather data. All data and special data sets contributed to the WDC are available to scientific investigators without restriction. The WDC for Meteorology, Asheville, also works closely with the U.S. Global Climate Observing System (GCOS) program, and strives to work closely with entities involved in all aspects of climate observing and related data management efforts, including the operation of the Global Observing Systems Information Center (GOSIC).
Link: http://www.ncdc.noaa.gov/oa/wdc/index.php

DEPARTMENT OF DEFENSE

ARMY

Coastal & Hydraulics Laboratory, U.S. Army Corps of Engineers: Engineer Research & Development Center
The U.S. Army Engineer Research and Development Center's Coastal & Hydraulics Laboratory (CHL) performs ocean, estuarine, riverine, and watershed regional scale systems analyses research support work for the U.S. Army Corps of Engineers and the DoD Task Force in support of the Ocean Commission. Research projects range from design guidance to three-dimensional numerical models. Focus is placed on inland and coastal navigation, military logistics over the shore, dredging, flood control, storm and erosion protection, waterway restoration, fish passage, hydro-environmental modeling, water/land management, and other water and sediment-related issues facing the nation.
Link: http://chl.erdc.usace.army.mil

CHL Field Research Facility, U.S. Army Corps of Engineers: Engineer Research & Development Center
The Field Research Facility (FRF) is an internationally recognized coastal observatory. Instruments at the facility record the changing waves, winds, tides, and currents.
Link: http://www.frf.usace.army.mil/frf.shtml

Wave Information Studies (WIS), Coastal Field Data Collection Program, U.S. Army Corps of Engineers: Engineer Research & Development Center
The Wave Information Studies is a US Army Corps of Engineers sponsored project that generates consistent, hourly, long-term (20+ years) wave climatologies along all US coastlines, including the Great Lakes and US island territories.
Link: http://wis.usace.army.mil/wis.shtml

Defense Agencies

National Geospatial-Intelligence Agency (NGA)
The National Geospatial-Intelligence Agency explores and analyses imagery and geospatial information to describe, assess, and visually depict physical features and geographically referenced activities on the Earth. NGA does not sell or perform services directly for the public. Those products and services that are available to the public can be obtained from the sources listed on the NGA website, under "How to get NGA Products".
Link: https://www1.nga.mil/Pages/default.aspx

Navy

Global Ocean Data Assimilation Experiment (GODAE), Marine Meteorology Division, Naval Research Laboratory
A comprehensive database containing a wide array of geophysical data, including those that are remotely sensed, observed in-situ and modeled.
USGODAE Data Catalog link: http://www.usgodae.org/cgi-bin/datalist.pl?generate=summary

Navy Coastal Ocean Model (NCOM), Oceanography Division, Naval Research Laboratory
NCOM is a 1/8 degree resolution model that serves as the Navy's operational global Nowcast/Forecast system. NCOM is based on the Princeton Ocean Model (POM). The surface boundary conditions for the NCOM model, including wind stress, heat flux, and salt flux are provided by the Navy Operational Global Atmospheric Prediction System (NOGAPS). The Navy Modular Ocean Data Assimilation System (MODAS) provides the data assimilation for NCOM including SSH and SST.
Link: http://www7320.nrlssc.navy.mil/global_ncom/glb8_3b/html/index.html

Remote Sensing Division, Naval Research Laboratory
The mission of the Naval Research Laboratory Remote Sensing Division is research and development utilizing remotely sensed information or leading to remote sensing systems for applications to the earth's environment in its broadest sense. Because of the Naval Research Laboratory's unique position, this means that it is the Department of Defense's (DoD) center of excellence for remote sensing technology and its applications. Applications to the atmosphere, ocean and land surfaces, and the celestial background include meteorology, background and propagation effects upon systems, increased understanding of ocean and atmospheric processes and their interactions, effects or modulation of the environment by targets, determination of reference frames and other natural environmental phenomena relevant to national security. The effort includes development of environmental sensors, data and signal processing technologies, unique utilization of existing sensors, fundamental investigations in ocean, atmospheric and astrophysical sciences, and modeling and simulation of environmental processes.
Link: http://rsd-www.nrl.navy.mil/7200/

National Marine Renewable Energy Centers (NMREC)

NMREC supports wave and tidal energy development for the United States through testing and deployment of energy technologies, research, and contributing to policy initiatives. NMREC consists of three centers: Hawaii National Marine Renewable Energy Center (HINMREC), Northwest National Marine Renewable Energy Center (NNMREC), and the Southeast National Marine Renewable Energy Center (SNMREC).

> HINMREC link: http://hinmrec.hnei.hawaii.edu/
> NNMREC link: http://depts.washington.edu/nnmrec/
> SNMREC link: http://snmrec.fau.edu/

National Renewable Energy Laboratory (NREL)

Wind Resource Assessment, National Wind Technology Center (NWTC)
The NWTC provides technical assistance in wind resource assessment including the development and validation of high-resolution wind maps. The focus is to provide the wind industry, policy makers, and other stakeholders with applied wind resource data, information products, and technical assistance to effectively evaluate and develop wind potential.

Highlights include:
- U.S. offshore wind resource maps
- Local & International land-based wind resource maps
- Dynamic maps, GIS data & analysis tools

Link: http://www.nrel.gov/wind/resource_assessment.html

Oak Ridge National Laboratory (ORNL)

Mercury Distributed Metadata Management, Data Recovery and Access System
Mercury is a data access system for various ORNL projects on the geophysical and biogeological sciences.
Mercury link: http://mercury.ornl.gov/

Wind ENergy Data and Information (WENDI) Gateway
Office of Energy Efficiency and Renewable Energy (EERE), U.S. DOE Wind & Water Power Program
The WENDI Gateway is an integrated system for the archival, discovery, access, integration, and delivery of wind energy-related data and information. WENDI's WindGIS enables users to browse, query, and display United States wind energy-related spatial data, including maps of wind resource assessment and electrical transmission lines. WENDI's Metadata Clearinghouse allows users to search for datasets, publications, applications, and websites.

Products available through the WENDI Gateway include: maps, data, publications, tools and software from national laboratories (i.e. ORNL, PNNL), government entities (DOE, EPA) and select private sources.
Link: http://windenergy.ornl.gov/node/1

Sandia National Laboratories (SNL)

Energy: Renewable Energy
The Sandia Wind Energy Technologies Group conducts applied research to improve wind turbine technology and supports interconnection/integration studies. Various technical papers and reports are available through their website.
SNL Renewable Energy link: http://energy.sandia.gov/?page_id=270

Savannah River National Laboratory (SRNL)

Atmospheric Technologies Group (ATG)
The SRNL Weather Center provides meteorological monitoring, operational forecasts, and numerical modeling for the SRNL and Savannah River Site (SRS). The weather center is operated by the SRNL's Atmospheric Technologies Group. In addition to their operational mission, the ATG conducts applied research projects including those related to real-time modeling and assessment capabilities, emergency response planning, and the development of custom meteorological data sets for the SRS and a diverse set of other customers.
ATG link: http://www.srs.gov/Weather/

South Carolina Offshore Wind Collaborative
SRNL - and partners Clemson University Restoration Institute (CURI), Santee Cooper, Clemson University's S.C. Institute for Energy Studies, Coastal Carolina University, Center for Hydrogen Research, and the U.S. Coast Guard - are participating in a wind energy assessment project off of the South Carolina Coast utilizing SODAR technology. This is the first use of remote sensing technology to measure winds offshore of the Atlantic seaboard.
Link: http://www.clemson.edu/restoration/focus_areas/renewable_energy/wind/

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Bureau of Ocean Energy Management (BOEM)

Maps and GIS Data
The BOEM website provides information on legal and physical aspects related to the U.S. offshore energy and marine mineral resources e.g. land lease information and existing infrastructure.
BOEM Offshore Mapping and Data link: http://www.boemre.gov/offshore/mapping/index.htm

MarineCadastre.gov
This website is the product of a co-led effort between the Bureau of Ocean Energy Management and the National Oceanic and Atmospheric Administration. The website is an integrated marine information system that provides authoritative and regularly updated ocean information, including offshore boundaries, infrastructure, human use, energy potential, and other data sets. The website is especially useful to those looking to assess suitability for ocean uses, such as energy siting. Data can be viewed in the national viewer or downloaded from its original source.
Link: http://www.marinecadastre.gov

Technology Assessment & Research (TA&R) Program
The TA&R Program is a research element encompassed by the BOEMRE Regulatory Program. The TA&R Program is comprised of three functional research activities: Operational Safety and Engineering Research (OSER), Oil Spill Response Research (OSRR) and Renewable Energy Research (REnR).

Selected projects reports:
- Loads on Structures due to Extreme Wave Crests, Final Report (OTRC Library Number: 6/08A189) by Kuang-An Chang, Hamn-Ching Chen, Kai Yu, Yonguk Ryu, Kusalika Ariyarathne, and Richard Mercier, Texas A&M University, Offshore Technology Research Center, College Station, TX, June 2008
- Seabed Scour Considerations for Offshore Wind Development on the Atlantic OCS, February 2011, by Thomas McNeilan and Kevin R. Smith, Fugro Atlantic, Norfolk, Virginia
- Development of an Integrated Extreme Wind, Wave, Current, and Water Level Climatology to Support Standards-Based Design of Offshore Wind Projects, Estimated: December 2012, by George Hagerman, Virginia Tech Advanced Research Institute, Arlington, Virginia

BOEMRE TA&R link: http://www.boemre.gov/tarphome/

U.S. Geological Survey (USGS)
The USGS hosts various portals and collections containing information about the earth system and life sciences, including:

- **National Geologic Map Database**
  Provides a listing of the major USGS geoscience databases and science programs.
- **Publications Warehouse**
  Reports, maps, datasets, satellite imagery, real-time data, & software.

Link: http://www.usgs.gov/

USGS Woods Hole Coastal and Marine Science Center (WHSC), USGS
The Woods Hole Coastal and Marine Science Center conducts research within the USGS Coastal and Marine Geology Program. They make various map portals and information databases accessible on their website, including:

- **Marine Realms Information Bank (MRIB)**
  MRIB is a distributed geolibrary that provides access to information about oceanic and coastal environments.
- **GIS Information**
  An interactive map server with displays on various information layers from a number of USGS research programs.
- **Geologic Maps of America's Submerged Lands**
  Links to maps of the sea floor, including the digital data, displayed on a map of the U.S. east coast.

Link: http://woodshole.er.usgs.gov/pubsearch/index.php

Earth Resources Observation and Science (EROS), USGS
The USGC Center for Earth Resources Observation and Science is a national data reception, processing, archiving, distribution, and research facility for remotely sensed data and other forms of geographic information.
Link: http://eros.usgs.gov/

National Water Information System: Web Interface, USGS
This website provides most of the USGS water data maintained within NWIS, including water-resources data collected at approximately 1.5 million sites in all 50 States, the District of Columbia, and surrounding territories. Data provided on this site are updated by NWIS on a regularly scheduled basis, and real-time data are generally updated upon receipt at local Water Science Centers.
Link: http://waterdata.usgs.gov/nwis

INDEPENDENT/ OTHER AGENCIES

Data.gov Communities

Energy Community
Energy.data.gov is a new open government initiative to increase awareness of, and deepen insights into, our Nation's energy performance. Energy.data.gov brings together high-value datasets, tools, and applications to shed new light on energy use. These free datasets and tools have been gathered from agencies across the Federal government.
Link: http://www.data.gov/communities/energy

Ocean Community
This is the National Ocean Council's portal for data, information, and tools to support people engaged in planning for the future of the ocean, our coasts, and the Great Lakes.
Link: http://www.data.gov/communities/ocean

NASA

Earth Observing System Data and Information System (EODIS)
EOSDIS distributes thousands of Earth system science data products and provides associated services for interdisciplinary studies.

EODIS provides access to earth system data from various EOSDIS data centers, including:
- Alaska Satellite Facility SAR Data Center (ASF SDC)
- Global Hydrology Resource Center (GHRC)
- Goddard Earth Sciences Data and Information Services Center (GES DISC)
- MODIS Level 1 Atmosphere Archive and Distribution System (MODAPS LAADS)
- National Snow and Ice Data Center (NSIDC) DAAC
- Oak Ridge National Laboratory (ORNL) DAAC
- Physical Oceanography Distributed Active Archive Center (PO) DAAC
- Socioeconomic Data and Applications Data Center (SEDAC)

Link: http://earthdata.nasa.gov/data

Goddard Earth Sciences Data and Information Services Center (GES DISC)
The GES DISC is the data archive for the NASA Precipitation and Hydrology and the Atmospheric Composition and Dynamics groups.

Comments: Has A-Train Data Depot and other mission data. The A-Train Data Depot (ATDD) has been developed to process, archive, allow access to, visualize, analyze and correlate distributed atmospheric measurements from A-Train instruments. A-Train Data Depot has retrievals such as: cloud profiles, cloud top temperatures, rain rates, and water vapor content.
Link: http://disc.sci.gsfc.nasa.gov/about-us

Global Change Master Directory (GCMD), NASA
The GCMD is a comprehensive database that contains a listing of geophysical data from various U.S. public and private sources. Browse by data type (e.g. atmosphere, ocean, land surface), observation type (e.g. modeled, in-situ, remotely sensed) and other fields.

Accessible data portals include:
- Physical Oceanography Distributed Active Archive Center (PO.DAAC)
- Earth Observing System Clearinghouse (ECHO)
- Earth Observing System Data and Information System (EOSDIS)
- Fleet Numerical Meteorology and Oceanography Center, U.S. Navy (FNMOC)

Comments: PO.DAAC is the repository for NASA SeaWinds, SSM/I and NSCAT scatterometers. SeaWIFS data available through the GCMD. FNMOC Wave Watch 3 model data are available here.
Link: http://globalchange.nasa.gov/

Reverb | ECHO, NASA
The Reverb is a new, user friendly interface that searches the ECHO metadata clearinghouse. Available datasets are provided by participating NASA agencies and outside organizations.
Link: http://reverb.echo.nasa.gov/reverb/

National Ice Center (NIC)

The NIC is an interagency sea ice analysis and forecasting center comprised of the following components: the Naval Ice Center, NOAA, and the U.S. Coast Guard. The NIC offers many publically available sea ice charts and climatology products through their website.
Link: http://www.natice.noaa.gov/

National Science Foundation

Unidata, University Corporation for Atmospheric Research (UCAR)
Unidata is a diverse community of over 160 institutions vested in the common goal of sharing data and visualization tools. Unidata is a data facilitator, not a data archive center. Unidata provides a mechanism whereby educators and researchers (by participating in the Internet Data Distribution system), may subscribe to streams of current data that interest them. These data consists primarily of: GOES satellite imagery; radar imagery (level II and level III); and model output from the National Centers for Environmental Prediction, the Canadian Meteorological Centre and Fleet Numerical Meteorology and Oceanography Center. Other data available are: WMO observations; land based observations such as profilers, lightning observations; and GPS derived precipitable water content.
Link: http://www.unidata.ucar.edu/

<u>California</u>

California Environmental Resources Evaluation System (CIRES)
The California Environmental Resources Evaluation System (CERES) is a program of the California Resources Agency established to facilitate access to a variety of electronic data describing California's rich and diverse environments. CERES collects and integrates data and information and distributes it.
Link: http://ceres.ca.gov/index.html

<u>Massachusetts</u>

Massachusetts Ocean Resource Information System (MORIS)
MORIS can be used to search and display spatial data pertaining to the Massachusetts coastal zone. Users can interactively view various data layers (e.g., tide gauge stations, marine protected areas, access points, eelgrass beds) over a backdrop of aerial photographs, political boundaries, natural resources, human uses, bathymetry, or other data e.g. Google base maps. Users can quickly create and share maps and download the actual data for use in a Geographic Information System (GIS).
Link: http://www.mass.gov/czm/mapping/index.htm

<u>Rhode Island</u>

Rhode Island Ocean Special Area Management Plan (OceanSAMP)
The Rhode Island Ocean Special Area Management Plan, or Ocean SAMP, serves as a federally recognized coastal management and regulatory tool. Using the best available science, the Ocean SAMP provides a balanced approach to the development and protection of Rhode Island's ocean-based resources.
Home page: http://seagrant.gso.uri.edu/oceansamp/index.html

<u>South Carolina</u>

South Carolina Act 318 of 2008, South Carolina Energy Office (SCEO)
South Carolina Act 318 of 2008 created a committee to review, study, and make recommendations regarding the feasibility of windmill farms in the state including, but not limited to, whether South Carolina is a suitable site for wind production on land or in offshore areas, the economic and environmental impact to the state, and the cost of wind farm installation and operation in the state. The SCEO website provides access to relevant technical papers and reports related to offshore and coastal South Carolina wind energy development.
Link: http://www.energy.sc.gov/

ADCIRC Coastal Circulation and Storm Surge Model
ADCIRC is a system of computer programs for solving time dependent, free surface circulation and transport problems in two and three dimensions. These programs utilize the finite element method in space allowing the use of highly flexible, unstructured grids. Typical ADCIRC applications have included: (i) modeling tides and wind driven circulation, (ii) analysis of hurricane storm surge and flooding, (iii) dredging feasibility and material disposal studies, (iv) larval transport studies, and (v) near shore marine operations.
Link: http://adcirc.org/

Center for Coastal Margin Observation & Prediction (CMOP)
CMOP is a partnership led by Oregon Health & Science University, with Oregon State University and University of Washington as partners. CMOP hosts the SATURN Observation Network, which contributes to NANOOS (a regional association of the U.S. Integrated Ocean Observing System).
Link: http://www.stccmop.org/

CEOS International Directory Network (CEOS IDN)
The CEOS IDN is a comprehensive database containing a listing of geophysical data from international public and private sources. Users can browse by data type (e.g. atmosphere, ocean, land surface), observation type (e.g. modeled, in-situ, remotely sensed) and more.
Link: http://idn.ceos.org/

Earth Observation Portal, Service Support Environment (SSE)
The SSE service directory offers access to a continuously expanding set of basic and complex earth observation and GIS services, including:

- Atmospheric Monitoring
- Coastal and Sea Monitoring
- Satellite Image Processing

Link: http://services.eoportal.org/index.jsp

Eastern Consortium of Coastal Ocean Observatories (ECCOO)
ECCOO is a collaboration of coastal research sites. Observatories included are of two types: "estuary/embayment-coastal" and "nearshore-coastal". Currently, they are the:

- Northeast Regional Association for Coastal and Ocean Observing (NERACOOS)
- Martha's Vineyard Coastal Observatory (MVCO)
- Front-Resolving Ocean Network with Telemetry (FRONT)
- Long Term Environmental Observatory – 15 Meters (LED-15)
- Chesapeake Bay Observing System (CBOS)
- Field Research Facility (DUCK)
- South Atlantic Bight Synoptic Offshore Observatory Network (SABSOON)
- South Florida Ocean Measurement Center (SFOMC)

Link: http://www.whoi.edu/mvco/other_data/ECCOO/index.html

The Global Ocean Surface Underway Data Pilot Project (GOSUD)
A cooperative international program, the GOSUD is seeking the collection, data processing, archiving, and real-time distribution of sea surface salinity and other variables collected by research vessels and ships of opportunity.
Link: http://www.gosud.org/Project-Description/Data-Providers

Global Spatial Data Infrastructure Association
The GSDI Association is an inclusive organization of agencies, firms, and individuals from around the world. The purpose of this organization is to promote international cooperation and collaboration in support of local, national

and international spatial data infrastructure developments that will allow nations to better address social, economic, and environmental issues of pressing importance.
Link: http://www.gsdi.org/

Great Lakes Commission
The Great Lakes Commission is an interstate agency that promotes the development, use and conservation of natural resources surrounding the Great Lakes basin and St. Lawrence River. Its members include the eight Great Lakes states with associate member status for the Canadian provinces of Ontario and Québec. Many environmental monitoring datasets and products related to the Great Lakes are available through their website, in addition to access to other regional monitoring inventories. Of particular note is the Great Lakes Wind Atlas, which is a tool developed for searching and accessing GIS data pertaining to area wind energy development.
Great Lakes Wind Atlas link: http://erie.glin.net/wind/
Link: http://www.glc.org/

> **Great Lakes Information Network (GLIN), Great Lakes Commission**
> The Great Lakes Information Network is a partnership project managed by the Great Lakes Commission that provides information related to the binational Great Lakes-St. Lawrence region of North America. Data include regional maps and GIS data spanning a variety of categories, such as: atmospheric and oceanographic, bathymetric, cadastral and more.
> GLIN Maps & GIS link: http://gis.glin.net/

Group on Earth Observations GEO Portal
The GEO portal is a gateway to Global Earth Observation data, information and services developed by the European Space Agency (ESA) as contribution to Global Earth Observation System of Systems (GEOSS).
Link: http://www.geoportal.org/

HYCOM Consortium for Data Assimilative Modeling
The HYCOM consortium is a multi-institutional effort sponsored by the National Ocean Partnership Program (as part of the U. S. Global Ocean Data Assimilation Experiment (GODAE)), to develop and evaluate a data-assimilative hybrid isopycnal-sigma-pressure (generalized) coordinate ocean model (called HYbrid Coordinate Ocean Model or HYCOM). This site provides access to near real time global HYCOM + NCODA (Navy Coupled Ocean Data Assimilation) based ocean prediction system output.
Link: http://hycom.org/

ICSU World Data System
The ICSU World Data System is a portal allowing for data retrieval from participating WDS Members, including:
- WDC for Renewable Resources and Environment
- WDC for Oceanography, Tianjin
- WDC for Oceanography, Silver Spring
- WDC for Meteorology, Asheville
- WDC for Marine Geology and Geophysics, Boulder
- WDC for Climate
- International Oceanographic Data and Information Exchange
Link: http://icsu-wds.org/

IHO Data Centre for Digital Bathymetry (DCDB), International Hydrographic Organization (IHO)
To improve the collective availability of bathymetric data, the IHO has established the IHO Data Centre for Digital Bathymetry (DCDB). The Data Centre collects and quality checks oceanic soundings acquired by hydrographic and oceanographic ships during surveys and while on passage. This also includes soundings collected by other vessels such as warships, fisheries ships and commercial vessels. The DCDB worldwide digital data bank of oceanic soundings is made available for the production of bathymetric products, such as: maps and gridded datasets

produced by the General Bathymetric Charts of the Ocean (GEBCO) Project, the International Bathymetric Chart (IBC) Project and other projects e.g. Google Ocean.
Link: http://www.ngdc.noaa.gov/mgg/bathymetry/iho.html

Intergovernmental Oceanographic Commission (IOC)
The IOC is an autonomous body located within UNESCO. The purpose of the Commission is to promote scientific investigation, with a view toward learning more about the nature and resources of the oceans through the concerted action of its members.

Select IOC Programs:

1. **International Oceanographic Data and Information Exchange (IODE), IOC**
   Ocean data sources developed and maintained by IODE National Oceanographic Data Centres:
   - **IODE Ocean Data Portal**
     The International Oceanographic Data and Information Exchange (IODE) program of the UNESCO Intergovernmental Oceanographic Commission (IOC) was established to enhance marine research, exploitation and development by facilitating the exchange of oceanographic data and information between participating Member States, and by meeting the needs of users for data and information products.
     Link: http://www.oceandataportal.org/
   - **World Ocean Database** (global)
     The World Ocean Database 2009 (WOD09) is a database of selected historical in-situ surface and subsurface oceanographic measurements produced by the Ocean Climate Laboratory (OCL) at the National Oceanographic Data Center (NODC), Silver Spring, Maryland, USA.
     Link: http://www.nodc.noaa.gov/OC5/WOD/pr_wod.html
   - **SeaDataNet data access** (regional)
     The SeaDataNet infrastructure links 40+ national oceanographic data centers and marine data centers from 35+ countries.
     Link: http://www.seadatanet.org/data_access
   - **Published Ocean Data**
     Published Ocean Data is an e-repository setup by IODE as a parallel repository to its OceanDocs system and is targeted at datasets, rather than documents. It was implemented by the IODE to support pilot projects undertaken by a joint IODE/SCOR/MBLWHOI Library working group on data publication and data citation.

2. **GOOS**
   GOOS is the Global Ocean Observing System. GOOS is a permanent global system for observations, modeling and analysis of marine and ocean variables to support operational ocean services worldwide.
   Link: http://www.ioc-goos.org/

3. **JCOMM**
   Worldwide marine meteorological and oceanographic communities are working in partnership under the umbrella of the WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology, in order to respond to interdisciplinary requirements for met-ocean observations, and data management and service products.
   - **Global Sea Level Observing System (GLOSS)**
     GLOSS aims at the establishment of high quality global and regional sea level networks for application to climate, oceanographic and coastal sea level research.
     Link: http://www.gloss-sealevel.org/

IOC link: http://ioc-unesco.org/

IOOS Data Catalog and Asset Viewer, Integrated Ocean Observing System (IOOS)
The Data Catalog and Asset Viewer is an online tool that allows users to find information from all available IOOS partners without having to know in advance what partners operate the actual observing systems and data servers.

IOOS partners include: NOAA and other federal agencies; the IOOS Regional Associations; and other national or international organizations.

IOOS Regions:
- Alaska Ocean Observing System (AOOS) - http://www.aoos.org/
- Caribbean Regional Association (CaRA) - http://cara.uprm.edu/
- Florida Coastal Ocean Observing System (FLCOOS) Consortium- http://www.marine.usf.edu/flcoos/
  Note: Contributes to both SECOORA and GCOOS
- Great Lakes Observing System (GLOS) - http://glos.us/
- Gulf of Mexico Coastal Ocean Observing System (GCOOS) - http://gcoos.tamu.edu/
  - Central Gulf of Mexico Ocean Observing System (CenGOOS)- http://www.cengoos.org/
  - Texas Integrated Ocean Observing System - http://www.tioos.org/
    Note: comprised of the Texas Coastal Ocean Observation Network (TCOON) and Texas Automated Buoy System (TABS)
- Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS) - http://www.maracoos.org/
- Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS) - http://www.neracoos.org/
- Pacific Coast Ocean Observing System (PaCOOS) - http://www.pacoos.org/
  - Northwest Association of Networked Ocean Observing Systems (NANOOS) http://www.nanoos.org
    - Oregon Coastal Ocean Observing System (OrCOOS) - http://agate.coas.oregonstate.edu/
  - Central & Northern California Ocean Observing System (CenCOOS) - http://www.cencoos.org/
    - Bodega Marine Laboratory Bodega Ocean Observing Node (BOON), UC Davis - http://bml.ucdavis.edu/boon/index.html
  - Southern California Coastal Ocean Observing System (SCCOOS) - http://www.sccoos.org/
- Pacific Islands Ocean Observing System (PacIOOS) - http://oos.soest.hawaii.edu/pacioos/index.php
- Southeast Coastal Ocean Observing Regional Association (SECOORA) - http://secoora.org/
  - Carolinas Regional Coastal Ocean Observing System (RCOOS) - http://carolinasrcoos.org
  - Coastal Ocean Research and Monitoring Program (CORMP) - http://cormp.org/index.php
  - The North Carolina Coastal Ocean Observing System (NCCOOS) - http://nccoos.org/

Data link: http://www.ioos.gov/data/welcome.html

The IPCC Data Distribution Centre (DDC)
The DDC provides climate, socio-economic and environmental data, both from the past and also in scenarios projected into the future. Technical guidelines on the selection and use of different types of data and scenarios in research and assessment are also provided.

The DDC provides four main types of data:
- Climate observations, as global mean time series and gridded fields
- Climate model projections and simulations: monthly means and climatologies (decadal and 30-year means),
- Socio-economic data
- Environmental data and scenarios

Link: http://www.ipcc-data.org/

MARCO Mapping and Planning Portal, Mid-Atlantic Regional Council on the Ocean
The MARCO Mapping and Planning Portal is an online tool that allows state, federal, and local decision-makers and the public to visualize, query, map, and analyze ocean and coastal data in the Mid-Atlantic region.
Link: http://www.midatlanticocean.org/map_portal.html

Michigan Great Lake Wind Council

The Great Lakes Wind Council is an advisory body within the Michigan Department of Energy, Labor & Economic Growth that was established to examine and make recommendations on issues related to offshore wind development in Michigan. The council has identified and mapped potential leasing areas for offshore wind energy development, and provides guidance legislation.

The Council provides reports and maps related to the Great Lakes offshore wind energy initiative at their website:
Link: http://michiganglowcouncil.org/index.html

Monterey Bay Research Institute (MBARI) Ocean Observatories

MBARI has various ocean observation systems are under development to provide critical information for research on climate change, biogeochemical cycles, ecosystem assessment, and environmental hazards. Observation system architectures include those that use seafloor cables to distribute power and communications, profiling floats, and sensors attached to large marine predators traversing ocean basins.

The five observations systems within the Monterey Bay hosted by MBARI are the:
- Autonomous Ocean Sampling Network (AOSN)
- Land/Ocean Biological Observatory (LOBO)
- Monterey Accelerated Research System (MARS)
- Monterey Ocean Observing System (MOOS)
- OASIS Moorings

Link: http://www.mbari.org/default.htm

Northeast Ocean Data Portal

The Northeast Ocean Data Portal is a decision support and information system for managers, planners, scientists and project proponents involved in coastal and marine spatial planning in the region from the Gulf of Maine to Long Island Sound. The Portal provides access to data, interactive maps, tools, and other information needed for decision making.

Data provided through the portal are provided as GIS database files that contain information on coastal and marine spatial planning, including:
- Geology
- Administrative and Regulatory
- Commercial, Industrial and Military
- Infrastructure
- Physical Oceanography

Link: http://northeastoceandata.org/

Ocean Observatories Initiative (OOI)

The National Science Foundation's Ocean Observatories Initiative (NSF-OOI) will construct a network of instruments, undersea cables, and instrumented moorings that span the Western Hemisphere. The OOI will be one fully integrated system and will measure physical, chemical, geological, and biological phenomena in carefully selected key coastal, regional, and global areas.
Link: http://www.oceanobservatories.org/

Permanent Service for Mean Sea Level (PSMSL)

PSMSL has been responsible for the collection, publication, analysis and interpretation of sea level data from the global network of tide gauges since 1933.
Link: http://www.psmsl.org/

South Atlantic Bight Synoptic Offshore Observational Network (SABSOON), Skidaway Institute of Oceanography (SIO), University of Georgia
The SIO and its partners have developed an observational network along the U.S. southeastern continental shelf. Eight large offshore platforms, currently operated by the U.S. Navy, are being instrumented to provide a range of oceanographic and meteorological observations on a continuous, real-time basis.
Link: http://www.skio.usg.edu/?p=research/phy/sabsoon/sabsoon

Southeast Regional Partnership for Planning and Sustainability (SERPPAS)
The SERPAS webpage provides various GIS maps of the southeast region, including those containing information on military airspace and protected aquatic areas.
Link: http://www.serppas.org/

U.S. Global Ocean Ecosystems Dynamics (GLOBEC)
U.S. GLOBEC researchers are developing and applying computer models of the physics and biology of the seas, based on studies of key marine processes and observational programs. This inter-related sequence of modeling, process-oriented studies, broad scale observations, and retrospective studies is the foundation of the GLOBEC research strategy. These program elements provide essential pieces of information on a broad spectrum of spatial and temporal scales.

Data include meteorological and oceanographic observations from the following regions:
- Georges Bank
- Northeast Pacific
- Northwest Atlantic
- Southern Ocean

Link: http://www.usglobec.org/index.php

US Offshore Wind Collaborative
The US Offshore Wind Collaborative (USOWC) is an interdisciplinary, non-profit organization created to help the United States harness its vast offshore wind resources. The USOWC provides a forum for information-sharing, problem-solving, and capacity-building among government, industry, academia, energy, and environment advocates with the goal of realizing the great potential for coastal and Great Lakes wind to contribute to local clean energy production, climate change mitigation, and jobs-creation.

The USOWC website provides access to relevant technical papers and reports related to U.S. offshore wind energy development.
Link: http://www.usowc.org/index.html

West Coast Observation Project (WCOS)
The West Coast Observation System consists of the following organizations:
- Central and Northern California Ocean Observing System (CeNCOOS) - http://www.cencoos.org
- Channel Islands National Marine Sanctuary (CINMS) - http://channelislands.noaa.gov/
- Coastal Services Center (CSC) - http://www.csc.noaa.gov
- Cordell Bank National Marine Sanctuary (CBNMS) - http://cordellbank.noaa.gov/
- Gulf of Farallones National Marine Sanctuary (GFNMS) - http://farallones.noaa.gov/
- Monterey Bay National Marine Sanctuary (MBNMS) - http://montereybay.noaa.gov/
- National Coastal Data Development Center (NCDDC) - http://www.ncddc.noaa.gov
- National Oceanographic Data Center (NODC) - http://www.nodc.noaa.gov
- NOAA Integrated Ocean Observing System (IOOS) Program Office - http://ioos.noaa.gov/
- Northwest Fisheries Science Center (NWFSC) - http://www.nwfsc.noaa.gov/
- Office of Response and Restoration (OR&R) - http://response.restoration.noaa.gov/index.html
- Olympic Coast National Marine Sanctuary (OCNMS) - http://olympiccoast.noaa.gov/
- Pacific Coastal Observing System (PaCOOS) - http://www.pacoos.org

- Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) - http://www.piscoweb.org
- Sanctuary Integrated Monitoring Network (SIMoN)
- Southwest Fisheries Science Center (SWFSC) - http://swfsc.noaa.gov/
- University of California-Davis, Bodega Marine Laboratory - http://www-bml.ucdavis.edu/boon

Link: http://sanctuarysimon.org/regional_sections/obs/

UNIVERSITIES AND PRIVATE RESEARCH INSTITUTIONS

<u>Alaska</u>

Institute of Marine Science (IMS), University of Alaska Fairbanks
Data sets available include current, tidal and wind observations from various IMS projects in the Alaska region.
Data archive link: http://www.ims.uaf.edu/ims-research/dataarchives.html

<u>California</u>

The Geological Data Center (GDC), Scripps Institution of Oceanography (SIO)
The GDC archives and provides access to marine geological data. Available products include data from SIO cruises and all US academic vessels, and data supporting ocean drilling.
Link: http://gdc.ucsd.edu/index.php?page=0

CLIVAR & Carbon Hydrographic Data Office
The CCHDO's primary mission is to deliver global hydrographic data to users. These data are a product of decades-long observations related to the physical characteristics of ocean waters, carried out during WOCE, CLIVAR and numerous other oceanographic research programs.
Link: http://cchdo.ucsd.edu/

HFRadar Network, Coastal Observing Research and Development Center, Scripps Institution of Oceanography
HFRadar Network is being developed to manage and distribute in near real-time ocean surface currents measured by a distributed network of shore-based HF radar systems. HFRNet provides reliable data telemetry, archiving, and integrated processing for a growing list of near real-time products in a scalable manner for a growing user community supported by the Integrated Ocean Observing System.
Link: http://cordc.ucsd.edu/projects/mapping/

Ocean Surface Currents Mapping Project, UC Santa Barbara
A surface current mapping project with near real-time and archived observations for central and southern coastal California.
Link: http://www.icess.ucsb.edu/iog/realtime/index.php

<u>Colorado</u>

National Snow & Ice Data Center, Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado at Boulder
NSIDC manages and distributes scientific data, creates tools for data access, supports data users, performs scientific research, and educates the public about the cryosphere. NSIDC distributes more than 500 cryospheric data sets for researchers, from both satellite and ground observations.
Link: http://nsidc.org/

<u>Connecticut</u>

Front-Resolving Observational Network with Telemetry (FRONT) Program, University of Connecticut
The FRONT program has several observational components, including a suite of autonomous ocean sensors that measure physical and biological properties throughout the water column (ADCP's, profiling CTD's, and a profiling plankton observatory). Supplementing this underwater array is shore-based HF radar (CODAR) measurements of surface currents.
Link: http://nopp.uconn.edu/

Delaware

Delaware Bay Observing System (DBOS), University of Delaware
The Delaware Bay Observing System (DBOS) consists of a series of lighthouses equipped with oceanographic and meteorological instrumentation to measure the dynamic coupling between the atmospheric and ocean variability in the Delaware Bay.
Link: http://www.udel.edu/dbos/index.html

Delaware Environmental Observing System, University of Delaware
The Delaware Environmental Observing System (DEOS) is a support tool for decision makers involved with emergency management, natural resource monitoring, transportation, and other activities throughout the State of Delaware. The primary goal of this system is to provide state agencies and the citizens of Delaware with immediate information about environmental conditions in and around Delaware. DEOS also archives data for historical environmental studies and research.
Link: http://www.deos.udel.edu/index.html

The Delaware Geological Survey (GDS), University of Delaware
The GDS provides earth science data pertaining to the state of Delaware and its coastal waters.
Link: http://www.dgs.udel.edu/

Research Ship Schedules & Information Project, The Ocean Information Center (OCEANIC) at the University of Delaware's College of Earth, Ocean, and Environment
This project is a focal point for identifying and locating research platforms, their data gathering efforts, and their affiliated efforts worldwide.
Link: http://www.researchvessels.org/index.htm

Florida

Center for Ocean-Atmosphere Prediction Studies (COAPS), Florida State University
COAPS provides a wide range of products focusing on the atmosphere-ocean interface, including:
- FSU winds and flux products
- Scatterometer products
- Research vessel data
Link: http://coaps.fsu.edu/index.shtml

Eastern Florida Shelf High Frequency Radar, Rosenstiel School of Marine and Atmospheric Sciences, University of Miami
The University of Miami/Rosenstiel School of Marine and Atmospheric Sciences operates four WERA High Frequency radars that provide measurement of currents on the ocean's surface over a large area of the ocean off of Miami, FL.
Link: http://iwave.rsmas.miami.edu/wera/

Explorer of the Seas Research Program, Rosenstiel School of Marine and Atmospheric Sciences, University of Miami
This research program is a joint partnership between the University of Miami and Royal Caribbean International. The program began with the launching of its research platform, the Explorer of the Seas cruise ship, on the ship's maiden voyage in October of 2000. This program has produced a large data set of atmospheric and oceanographic measurements along the cruise ship's route throughout the Atlantic Ocean.
Data Access link: http://oceanlab.rsmas.miami.edu/

The Florida Coastal Monitoring Program
The Florida Coastal Monitoring Program (FCMP) is a unique joint venture focusing on full-scale experimental methods to quantify near-surface hurricane wind behavior and the resultant loads on residential structures. The aim is to provide the data necessary to identify methods to cost-effectively reduce hurricane wind damage to residential structures. This work is critical in a state where 85% of the rapidly increasing population resides on or near the 1200 miles of coastline vulnerable to hurricane strike.

Sponsored by the Florida Department of Community Affairs, participants include Clemson University and the University of Florida. The goals of the FCMP include the following:
- Measuring ground level wind velocity
- Measuring building envelope wind forces
- Evaluating the effectiveness of structural retrofits

This project is helping to fill critical gaps in existing data sets. Specifically, this program provides a direct quantification of the complete wind velocity - structural load - damage chain.
Link: http://fcmp.ce.ufl.edu/

Institute for Marine Remote Sensing (IMaRS), University of South Florida
IMaRS research activities focus on the analysis of digital data obtained by satellite and airborne sensors, and on the development of applications of these data at various scales. Emphasis is placed on research of coastal processes of highly variable regions like the Gulf of Mexico, the Caribbean Sea and Cuba using instruments such as AVHRR, CZCS, SeaWiFS, MODIS, and Landsat. Other sensors such as altimeters and scatterometers are used to examine the physical environment in the adjacent deep ocean.
Link: http://imars.usf.edu/HOME/index.html

Ocean Circulation Group, University of South Florida
This observational program includes the use of moored buoys, HF radar and a combination of profilers and gliders. Presently, emphasis is placed on the West Florida Continental Shelf (WFS).
Link: http://ocgweb.marine.usf.edu/

Ocean Modeling and Prediction Laboratory (OMPL), University of South Florida
The Ocean Modeling and Prediction Laboratory research activities focus on the development of numerical models of ocean currents and processes, with regional (Tampa Bay) and global applications. This research work involves combining real-time ocean observations with numerical models of ocean processes to provide hindcasts of past conditions, nowcasts of present conditions or forecasts of future conditions.

Laboratory programs include:
- TB-PORTS (Tampa Bay Physical Oceanographic Real-Time System), which provides more accurate water level, current, and meteorological data for Tampa Bay.
- Coastal Ocean Monitoring and Prediction System (COMPS), which consists of an array of instrumentation both along the coast and offshore of the West Florida Shelf.
- Bay Regional Atmospheric Chemistry Experiment (BRACE), which collects meteorological data throughout the Tampa Bay
- West Florida Continental Shelf oceanography measurements by the Ocean Circulation Group provides buoy data from the West Florida Continental Shelf.

Link: http://ompl.marine.usf.edu/

Hawaii

University of Hawaii Sea Level Center (UHSLC)
The UHSLC provides three online databases:
- Joint Archive for Sea Level Research Quality Data Set (JASL RQDS)

- GLOSS/CLIVAR "fast delivery" database
- JCOMM Sea Level Program map database

Link: http://ilikai.soest.hawaii.edu/uhslc/datai.html

<u>Louisiana</u>

Wave-Current-Surge Information System (WAVCIS) for Coastal Louisiana, Coastal Studies Institute, School of the Coast and Environment, Louisiana State University
The objective of WAVCIS is to provide sea state information, including: wave height, period, direction of propagation, water level, surge, near surface current speed and direction, and meteorological conditions on a real time basis around the entire Louisiana coast.
Link: http://wavcis.csi.lsu.edu/index.asp

<u>Maine</u>

Physical Oceanography Group, School of Marine Sciences, University of Maine
The Physical Oceanography Group at the University of Maine is responsible for operating the NERACOOS moored buoys in the Gulf of Maine and the Gulf of Maine CODAR stations. Current and historical data are available for download on their webpage.
Link: http://gyre.umeoce.maine.edu/gomoos.php

<u>Massachusetts</u>

Ocean Observation Laboratory (OCEANOL), School for Marine Science and Technology, University of Massachusetts – Dartmouth
OCEANOL integrates measurements from moorings, CODAR, shipboard surveys, operational satellite imagery and meteorological instruments into studies of various coastal ocean and estuarine domains, including: the Gulf of Maine, Georges Bank, the New England Shelf, and the Buzzards, Narragansett and Mt. Hope Bays.
Link: http://www.smast.umassd.edu/OCEANOL/

Woods Hole Oceanographic Institution (WHOI)
The Woods Hole Oceanographic Institution is dedicated to research and education to advance understanding of the ocean and its interaction with the Earth system, and to communicating this understanding for the benefit of society.

The data center makes data available from:
- Floats
- Local coastal observatories
- Bathymetric studies
- Global surface moorings (met & ocean)
- WHOI ships

WHOI Data Center link: http://www.whoi.edu/data/

> **Martha's Vineyard Coastal Observatory, WHOI**
> Data products include those of the Air-Sea Interaction Tower (ASIT) of the Coupled Boundary Layers and Air-Sea Transfer (CBLAST) program, in addition to other meteorological and oceanographic data.
> Link: http://mvcodata.whoi.edu/cgi-bin/mvco/mvco.cgi

The Unstructured Grid Finite Volume Coastal Ocean Model (FVCOM), School for Marine Science and Technology, University of Massachusetts – Dartmouth
FVCOM is a prognostic, unstructured-grid, finite-volume, free-surface, 3-D primitive equation coastal ocean circulation model developed by UMASSD-WHOI joint efforts. The model consists of momentum, continuity, temperature, salinity and density equations and is closed physically and mathematically using turbulence closure submodels. The horizontal grid is comprised of unstructured triangular cells and the irregular bottom is presented using generalized terrain-following coordinates. FVCOM was originally developed for the estuarine flooding/drying process in estuaries and the tidal-, buoyancy- and wind-driven circulation in the coastal region featured with complex irregular geometry and steep bottom topography. This model has been upgraded to the spherical coordinate system for basin and global applications.
Link: http://fvcom.smast.umassd.edu/index.html

Michigan

Lake Superior Water Monitoring and Information System, Great Lakes Research Center, Michigan Technological University
The Information System provides data access to the Michigan Technological University met-ocean observations taken at Lake Superior. Data provided are from free and moored platforms.
Link: http://www.michigantechlakesuperior.org/

Marine Hydrodynamics Laboratories (MHL), College of Engineering, University of Michigan
The Marine Hydrodynamics Laboratories investigates the areas in which the marine environment affects our world. The laboratories encompass a number of testing facilities and numerical modeling capabilities with which to measure and predict the influence of physical forces on marine systems as well as ocean and coastal structures. The MHL also contains extensive field research capabilities for underwater exploration, nearshore and offshore hydrodynamic investigations and monitoring, sediment and pollution transport measurement and prediction, in-situ sensor technology, renewable energy systems, as well as water quality assessment and coastal monitoring systems.

Comments: Of particular note is the Ocean and Coastal Engineering Laboratory. The capabilities of this field research facility include: oceanographic remote sensing utilizing Synthetic Aperture Radar (SAR), shore based HF radar, acoustic current sensing, directional wave spectra measurement and other varied met-ocean monitorings and modelings.
Link: http://www.engin.umich.edu/dept/name/facilities/mhl/index.html

Michigan Alternative and Renewable Energy Center (MAREC), Grand Valley State University
The MAREC mission is to be an economic development catalyst, business accelerator, as well as research and development center that links business, education and government resources to further alternative and renewable energy development.

Comments: MAREC is responsible for the Lake Michigan Offshore Wind Assessment Project, but the LIDAR buoy data from Lake Michigan is not publicly accessible *yet*.
Link: http://www.gvsu.edu/marec/

New Hampshire

Law of the Sea Mapping Program, Center for Coastal and Ocean Mapping/Joint Hydrographic Center (CCOM/JHC), University of New Hampshire
The University of New Hampshire's Center for Coastal and Ocean Mapping/Joint Hydrographic Center (CCOM/JHC) is collecting multibeam bathymetry and acoustic backscatter data that can be used to support an extended continental shelf under Article 76 of the United Nations Convention of the Law of the Sea (UNCLOS). This extensive

seafloor mapping project grew out of an exhaustive desktop study of the U.S. bathymetry data holdings and identified several regions where new bathymetric surveys are needed.

This website contains images, data and papers regarding bathymetric mapping focus area, including the:
- Atlantic
- Gulf of Mexico
- Gulf of Alaska
- Mendocino Ridge

CCOM/JHC link: http://www.ccom-jhc.unh.edu/index.php?p=2|24|53|54|66|77|58|62&page=home.php

<u>New Jersey</u>

Coastal Ocean Observation Lab, Institute of Marine and Coastal Sciences, Rutgers University
Available data has been collected by these instruments:
- Satellite
- CODAR (Coastal Ocean Dynamics Applications Radar)
- Underwater gliders

COOL Data link: http://rucool.marine.rutgers.edu/index.php/COOL-Data/
COOL CODAR data: http://marine.rutgers.edu/cool/codar.html

The Center for Maritime Systems, Stevens Institute of Technology
Various data products are available through the New York Harbor Observing and Prediction System (NYHOPS) and the New Jersey Coastal Monitoring Network (CMN).
Link: http://www.stevens.edu/ses/cms/

<u>New York</u>

GeoMapApp, Lamont-Doherty Earth Observatory, Columbia University
GeoMapApp is an earth science exploration and visualization application that is continually being expanded as part of the Marine Geoscience Data System (MGDS) at the Lamont-Doherty Earth Observatory of Columbia University. The application provides direct access to: the Global Multi-Resolution Topography data (which hosts 100m resolution multibeam bathymetry data); ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) data; and NED (National Elevation Dataset) topography data.
Link: http://www.geomapapp.org/index.htm

Great South Bay Project, School of Marine and Atmospheric Sciences, Stony Brook University
Data are being collected from eight stations on the Great South Bay (GSB) using SeaCat instruments measuring water temperature and salinity. Meteorological data are being collected from two locations in the Great South Bay: on the south tower of the Smith Point bridge, and at the GSB #1 buoy. The Smith Point observatory data includes temperature and salinity from the Smith Point SeaCat, short and long wave radiation from Eppley pyronometers, and wind speed, wind direction, air temperature, humidity, barometric pressure and rainfall rate from a Vaisala WXT520. The GSB #1 buoy reports wind speed and direction, air temperature and humidity, photosynthetically active radiation, water temperature and salinity, chlorophyll-a fluoresence and turbidity.
Great South Bay Project link: http://www.somas.stonybrook.edu/research/gsb_ecosystem/monitoring/index.html

LIShore, School of Marine and Atmospheric Sciences, Stony Brook University
LIShore is a project of the School of Marine and Atmospheric Sciences at Stony Brook University, in collaboration with the LIShore partners. Data access is provided for meteorological and oceanographic observations at coastal points across Long Island, New York.
Link: http://www.lishore.org/index.html

Sound Science, School of Marine and Atmospheric Sciences, Stony Brook University
The Sound Science is a research program that encompasses meteorological and oceanographic observations from stationary and non-stationary platforms in the Long Island Sound.
Link: http://www.stonybrook.edu/soundscience/main.html

North Carolina

Ocean Observing and Modeling Group, Department of Marine, Earth & Atmospheric Sciences, North Carolina State University
Research emphases include:
- coastal and estuarine circulation dynamics
- bio-physical interactions
- air-sea interactions
- numerical modeling and data assimilation
- design and implementation of coastal ocean observing systems

Link: http://omgrhe.meas.ncsu.edu/Group/index.html

Oregon

College of Earth, Ocean and Atmospheric Sciences, Oregon State University
Highlights include:
- **Ocean Observations & Data Products, COAS Physical Oceanography**
  Link: http://www-po.coas.oregonstate.edu/research/data-obs/intro/
- **Cooperative Institute for Oceanographic Satellite Studies**
  Link: http://cioss.coas.oregonstate.edu/CIOSS/index.html

Scatterometer Climatology of Ocean Winds (SCOW), C.M. Risien and D.B. Chelton, Oregon State University
SCOW provides an observationally based atlas of global ocean winds. This climatology is based in 122 months' worth of QuikSCAT satellite measurements. In addition, SCOW now includes a sea surface temperature climatology that is based on 89 months (June 2002 - October 2009) of AMSR-E observations and a SST climatology that is based on 122 months (September 1999 - October 2009) of Version 2 of the NOAA AVHRR-only Optimum Interpolated 1/4 Degree SST fields.
Link: http://cioss.coas.oregonstate.edu/scow/

Mapping Coastal Ocean Currents, College of Oceanic & Atmospheric Sciences, Oregon State University
This website provides access to surface current and buoy observations in three areas:
- The entire Oregon coast
- Near Newport, Oregon
- Near the Columbia River mouth

Link: http://bragg.coas.oregonstate.edu/

Rhode Island

Graduate School of Oceanography (GSO), The University of Rhode Island
Research campaigns at the GSO span a variety of disciplines, including: meteorology, physical oceanography and geology. Data from many research campaigns is available for download through their website.
Link: http://www.gso.uri.edu/

South Carolina
Belle W. Baruch Institute for Marine & Coastal Sciences, University of South Carolina

Baruch Institute has a long history in long- and short-term coastal research from the North Inlet Estuary and nearby coastal systems. Archived at this website is historical data, images, and species lists that have been derived from coastal studies and monitoring programs since the late 1970s. The data archive includes tidal, meteorological and basic water measurements from coastal South Carolina
Coastal Data Archive link: http://links.baruch.sc.edu/Data/CoastalData.html

Texas

Texas Automated Buoy System (TABS), College of Geosciences, Texas A&M University
Texas A&M University Geochemical and Environmental Research Group operates this network of 9 buoys located off of the Texas coast. The network provides hourly observations of met-ocean variables.
Link: http://tabs.gerg.tamu.edu/Tglo/

Virginia:

Surface Current Mapping in the Lower Chesapeake Bay, Center for Coastal Physical Oceanography, Old Dominion University
Surface water currents in the lower Chesapeake Bay are observed with the use of land-based HF RADAR antennas located at four sites: Ocean View Community Beach, the 4th Island of the Chesapeake Bay Bridge Tunnel, Fort Story on Cape Henry and at Sunset Beach Resort on the southwestern tip of the Eastern Shore. This project is part of the HFRadar Network at the Scripps Institution of Oceanography.
Link: http://www.ccpo.odu.edu/currentmapping/

AWS Truepower: Mesoscale modeling and windTrends database

windTrends is a simulated hourly time series of the Mesoscale Atmospheric Simulation System (MASS) model output, beginning in 1997. The windTrends database covers the United States and southern Canada, and associated coastal waters. This is a controlled regional reanalysis dataset developed by AWS Truepower that differs from the conventional reanalysis data because it is computed at a finer resolution (20km) and relies on rawinsonde data. This model output can be interpolated to exact point locations within the domain.
Link: http://www.awstruepower.com/

The Long Island – New York City Offshore Wind Project

The Long Island – New York City Offshore Wind Project is a bold initiative to help New York reach its clean and renewable energy goals. The proposed project would be located in the Atlantic Ocean, approximately 13 nautical miles off the Rockaway Peninsula. It would likely be designed for 350 megawatts (MW) of generation, with the ability to expand it to 700 MW, giving it the potential to be the largest offshore wind project in the country.

The project home page provides project assessment reports, including output from economic feasibility and geo-met-ocean characterization studies.
Link: http://www.linycoffshorewind.com/Default.html

Noble Consultants, Inc.

Noble Consultants, Inc. utilizes numerical models in the analysis and design of projects involved with the water environment. These models include 1-D, 2-D and 3-D hydrology, hydraulic, hydrodynamic, sediment transport and water quality models for Coastal & Ocean projects, Riverine & Estuarine projects, and Waterfront Development & Restoration projects.

Coastal & Ocean Model Applications include:
- Constituent Transport & Water Quality
- Sediment Transport & Coastal Morphology
- Storm Surge & Coastal Flooding
- Tide, Wind & Wave Induced Circulation
- Wave Generation & Propagation

Link: http://www.nobleconsultants.com/

Remote Sensing Systems

Remote Sensing Systems specializes in processing and analyzing microwave data collected by satellite microwave sensors. Emphasis is placed on analysis of data from the SSM/I, SSMIS, TMI, AMSR-E, QuikSCAT, MSU, AMSU and WindSat instruments.
Link: http://www.remss.com/

Oceanweather, Inc.

Oceanweather functions as a specialized consulting firm serving the coastal and ocean engineering communities with its unique capacity to integrate several areas of expertise into the specification of definitive design data on the physical environment. In dedicated studies, the approach and deliverable outputs (wave parameters, wave spectra, extremal analysis, operational data, etc.) are designed around user applications and needs. Oceanweather has performed studies and developed informational databases world wide.
Link: http://www.oceanweather.com/

WeatherFlow

WeatherFlow Inc. is a leader in the private sector weather industry, with over two decades of experience in applying the latest in observational, modeling, and forecasting technology to its clients' most challenging problems. With its proprietary observing network at the heart of the company, WeatherFlow has brought a steady

stream of innovative value-added products and services to market, filling highly specific needs in many sectors, including plume dispersion, emergency management, hazardous weather alerting, hurricane measurements, insurance and financial products, maritime operations, wind energy, the National Mesonet, and others.
Home page: http://www.weatherflow.com/

Vaisala

Vaisala is a global leader in environmental and industrial measurement. Vaisala provides products and solutions to professionals in meteorology, airport operations, defense, road operations, wind energy, cleanrooms and chambers, building automation, and chosen industrial applications as well as in some innovative new business areas where environmental measurement plays a significant role.

Two notable product solutions are listed below:

- **Vaisala Global Lightning Dataset GLD360**
  Vaisala Global Lightning Dataset GLD360 is a service that provides real-time lightning data for accurate and early detection and tracking of severe weather. The data provided is generated by a Vaisala owned and operated world wide network.
- **Vaisala's U.S. National Lightning Detection Network® (NLDN)**
  The NLDN® provides the fastest delivery of high quality lightning data over the continental United States. The NLDN® data can be delivered in real-time (less than 15 seconds latency), near real-time (>1 minute bins) or in archive format (>24 hours).

Product offering link: http://www.vaisala.com/en/products/Pages/default.aspx

Coriolis Operational Oceanography
Coriolis is a French Data Assembly Center that provides access to data useful for operational oceanography. Data provided is gathered by ships, drifters, floats, moorings and satellites. Data spans internationally and includes observations from various networks, including: Argo, OceanSITES and EGO gliders.
Link: http://www.coriolis.eu.org/

ERA-40 Reanalysis Project, ECMWF
ERA-40 will use a variational data assimilation system to make a new synthesis of the in-situ and remotely-sensed measurements made over the period of 1957-2002. ERA-40 will produce analyses with six hourly frequency throughout the period, supplemented by intermediate three-hour forecasts. The products will be of high temporal and spatial resolution, with a grid-spacing close to 125km in the horizontal and with sixty levels in the vertical located between the surface and a height of about 65km. The availability of ERA-40 analyses will also revitalize the use of data from past field experiments in the improvement of climate and weather forecasting models. ERA-40 products will be enhanced by short periods of higher resolution global assimilation. This will enable better exploitation of the observational data from experiments such as GATE (1974), ALPEX (1982) and TOGA-COARE (1992-93).

Comments: ECMWF has begun the ERA-Interim project. This is an 'interim' reanalysis of the period 1989-present in preparation for the next-generation extended reanalysis to replace ERA-40.
ERA Projects link: http://www.ecmwf.int/research/era/do/get/index

EUMETSAT
EUMETSAT operates a system of meteorological satellites monitoring the atmosphere and ocean and land surfaces which deliver weather and climate-related satellite data, images and products – 24 hours a day, 365 days a year. This information is supplied to the National Meteorological Services of the organisation's member and cooperating states in Europe, as well as other users worldwide.
Link: http://www.eumetsat.int/Home/index.htm

General Bathymetric Chart of the Oceans (GEBCO)
GEBCO operates under the joint auspices of the Intergovernmental Oceanographic Commission (IOC) of UNESCO and the International Hydrographic Organization (IHO). GEBO provides a range of bathymetric data sets and products, including global gridded and digital contour format.
Link: http://www.gebco.net/

Integrated Science Data Management (ISDM), Department of Fisheries and Oceans Canada
ISDM manages and archives ocean data collected by the DFO, or acquired through national and international programs conducted in ocean areas adjacent to Canada. Data is provided by various research programs and monitoring campaigns, including:
- Joint WMO IOC Joint Commission on Oceanography and Marine Meteorology (J-COMM)
- Responsible National Oceanographic Data Centre (of the World Data Centres)
- Ship Of Opportunity Programme (SOOP)

Data and Products link: http://www.dfo-mpo.gc.ca/science/data-donnees/index-eng.html

National Climate Data and Information Archive (NCDIA), Environment Canada
The EC NCDIA is a data repository for weather and climate observations throughout Canada. Available data and products include surface observations, climate summaries, radar imagery and energy estimation products.
Link: http://climate.weatheroffice.gc.ca/prods_servs/index_e.html