

## DEPARTMENT OF DEFENSE

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### Principal Areas of Focus

The Department of Defense does not support dedicated global change research, but continues a history of participation in the CCSP through sponsored research that concurrently satisfies national security requirements and stated goals of the CCSP. All data and research results are routinely made available to the civil science community. DOD science and technology investments are coordinated and reviewed through the Defense Reliance process and published annually in the *Defense Science and Technology Strategy*, the *Basic Research Plan*, the *Defense Technology Area Research Plan*, and the *Joint Warfighting Science and Technology Plan*.

### Program Highlights for FY 2004 and FY 2005

#### *Atmospheric Composition*

Analysis and prediction of worldwide aerosol concentrations—including desert dust, biomass smoke, marine and anthropogenic aerosols, and a radiative transfer algorithm yielding atmospheric transmission coefficients—is generated by the Navy Aerosol Analysis and Prediction System.

DOD areas of interest and science and technology investment for the continental boundary layer are transport and diffusion, and clouds and obscurations. For the marine boundary layer issues include maritime and coastal meteorology; major storms, worldwide, with particular emphasis on tropical cyclones; and synoptic to mesoscale prediction. Common interest areas are coherent structures, subgrid-scale parameterization, large eddy simulation, nested models of all scales, surface energy balance, cloud formation and processes, and data assimilation. For example, the Naval Research Laboratory's Special Sensor Ultraviolet Limb Imager, launched in late 2001, provides long-term baseline data for investigations of global change in the upper atmosphere.

#### *Climate Variability and Change*

Completed analysis of sea ice mass balance during the Surface Heat Budget of the Arctic (SHEBA) project has determined that there was a net loss of sea ice. Coordination and data management of the International Arctic Buoy Programme filled the "data void" of the Arctic Ocean with buoy data. These data have permitted quantification of the changes in circulation, temperature, and ice motion in the Arctic. The data suggest a 2°C per decade warming in surface air temperature over the eastern Arctic Ocean, as well as a lengthening of the melt season of the sea ice from 1979-1997. These variations in surface air temperature are related to the Arctic Oscillation, which accounts for more than 50% of the trends in surface air temperature over much of the Arctic region.

Recent Arctic research has included a decade-long set of time series measurements of flow through the Bering Strait and its variable water properties, and submarine-based acoustic doppler current profiler measurements of the upper Arctic Ocean. This provided significant advances in understanding the evolution of temperature change in the core of Atlantic water in the Arctic Ocean between 1991 and 2001, with implications concerning mechanisms for decadal changes in the Arctic Ocean. Further, analysis of the first acoustic thermometry time series record in the Arctic (from October 1998 to December 1999) indicates that the warming of the Atlantic intermediate water continues from the early 1990s and a wide frontal zone propagated into the Nansen Basin beginning in late 1999.

The Defense Modeling and Simulation Office sponsors the Master Environmental Library (MEL) to provide direct and timely access to natural environment information, data, and products wherever they may reside. This includes non-geospatial data such as models, algorithms, and documents, as well as basic environmental data. MEL is currently focused on DOD modeling and simulation users, but is accessible to other DOD, Federal, commercial, and academic communities as well. The Master Oceanographic Observation Data Set and the Generalized Digital Environmental Model are in the public domain and are available through the National Oceanographic Data Center and NAVOCEANO, respectively.

The Ocean Acoustic Observatory Federation involves government and private research organizations to exploit data from active and retired Navy Sound Surveillance System stations for ocean acoustic tomography and thermometry measurements in the eastern Pacific Ocean. Another National Oceanographic Partnership Program (NOPP) research effort—working with academic and private sector economists in major U.S. coastal regions—is conducting a set of coordinated regional studies to assess the expected economic benefits of sustained, improved coastal ocean observing systems. The Multidisciplinary Ocean Sensors for Environmental Analyses and Networks (MOSEAN) project addresses the need for increased observations that are essential for solving a set of diverse interdisciplinary problems of societal importance. These include biogeochemical cycling, climate change effects, ocean pollution, harmful algal blooms, ocean ecology, and underwater visibility.

The DOD High-Performance Computing Challenge is sponsoring two relevant projects: a high-resolution coupled atmosphere-ocean-ice model, the Coupled Environmental Model Prediction (CEMP) system; and a 1/32-degree global ocean nowcast/forecast model. The Distributed Ocean Data System (DODS) is another NOPP-sponsored effort to facilitate data access by providing a transparent interface to recognize and process data in various formats. The DODS plug-and-play feature simplifies access via the Internet. DODS software is free. Data and model output fields are available from the Global Ocean Data Assimilation Experiment (GODAE) server at the Fleet Numerical Meteorological and Oceanographic Center. Further information on research programs is also available at the Office of Naval Research, the U.S. Army Cold Regions Research and Engineering Lab, and the NOPP web sites.

### *Global Water Cycle*

WindSat was launched 6 January 2003, on the Space Test Program Coriolis Mission to demonstrate multiple naval remote-sensing requirements, including measuring ocean wind speed and direction. WindSat will illustrate the viability of using polarimetry to measure wind speed and direction from space and provide operationally usable tactical information directly to Navy units and other military and national users. The payload provides risk reduction data and developmental technology that the National Polar-Orbiting Operational Environmental Satellite System program office will use in the development of the Conical Microwave Imager Sounder (CMIS).

### *Ecosystems*

DOD science and technology investments include physical, chemical, biological, optical modeling, and prediction for the marine environment. In addition, several research efforts are coordinated under the NOPP umbrella. For example, the Ocean Biological Information System is a public-private partnership and a new component of the Global Biodiversity Information Facility. Navy is directly investing in the development of new, in-water instruments capable of measuring biological and chemical properties of the sea associated with the fine structure of biological and chemical dynamics via the Thin Layers

## Appendix

(Critical Scales) Program. The Strategic Environmental Research and Development Program is supporting related research to develop long-lived miniaturized sensors to measure terrestrial and marine ecosystem parameters.

### **Related Research and Infrastructure**

Other DOD-sponsored research and supporting infrastructure, not described above, also contribute to observing, understanding, and predicting environmental processes related to global change. Associated research programs include theoretical studies and observations of solar phenomena, monitoring and modeling of unique features in the middle and upper atmosphere, terrestrial and marine environmental quality research, and energy conservation measures. DOD's continued investment in environmental infrastructure—such as the Oceanographic Research Vessel Fleet, the Cold Regions Research and Engineering Laboratory, and the various services' operational oceanographic and meteorological computational centers—will continue to provide data and services useful to the CCSP.