

Appendix

DEPARTMENT OF DEFENSE



Principal Areas of Focus

The Department of Defense—while not supporting dedicated global change research—continues a history of participation in the Climate Change Science Program 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 2006

Satellite Sensors and Observations

As part of National Polar-orbiting Operational Environmental Satellite System (NPOESS) operations, DOD will fund 50% of the satellite and environmental sensor suites as a result of the convergence of national remote-sensing programs. NPOESS will monitor global environmental conditions, and collect and disseminate data related to weather, atmosphere, oceans, land, and near-space environment. The NPOESS program is managed by the tri-agency Integrated Program Office run by DOC, DOD, and NASA.

Global Observations and Models

The Navy is a principal member of the National Oceanographic Partnership Program (NOPP). Key elements within NOPP are the Integrated Ocean Observing System Data Management and Communications (DMAC) program, the Global Ocean Observation System (GOOS), the Global Ocean Data Assimilation Experiment (GODAE), and the National Federation of Regional Associations (NFRA). Within NOPP, a broad partnership of institutions is collaborating on developing and demonstrating integrated ocean observations systems, data management systems, and eddy-resolving real-time global- and basin-scale ocean prediction systems. The HYbrid Coordinate Ocean Model (HYCOM) is part of the GODAE program. The systems will run efficiently on a variety of massively parallel computers, and will include sophisticated techniques for assimilation of satellite altimeter sea-surface height and sea-surface temperature data, as well as *in situ* temperature, salinity, and float displacement. The goal of this project is to develop and implement a comprehensive data management and distribution strategy that allows easy and efficient access to HYCOM-based ocean prediction system outputs to coastal and regional modeling sites; to the wider oceanographic and scientific community, including climate and ecosystem researchers; and to the general public, especially students in intermediate and high schools. This is to be accomplished through a data-sharing system using existing open source software packages to distribute data via the internet. The HYCOM Data Sharing System is built upon two existing software components: the Open Project for a Network Data Access Protocol (OPeNDAP) and the Live Access Server (LAS). OPeNDAP is the middleware that provides uniform binary-level access to scientific data on the internet.

Polar Regions Research

The *CCSP Strategic Plan* places priority on the polar and subpolar regions, which have exhibited more rapid changes than the lower latitudes. The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) responds to the needs of the military, but much of the research also benefits the civilian sector and is funded by non-military customers such as NSF, NOAA, NASA, DOE, and State governments. DOD research has examined impacts of climate change on retreating Arctic sea ice to help define requirements for U.S. Coast Guard ice-breaking ships over the next 30 years. Satellite data show that the extent of Arctic sea ice has decreased by about 10%, and the sonar data collected by U.S. Navy submarines in the Arctic between 1957 and 2000 show the average ice thickness has decreased between 33 and 42%.

CRREL and the University of Alaska are developing an internet-accessible Alaska Engineering Design Information System (AEDIS)—an analytic toolkit for engineers that presents a broad array of geospatial terrestrial, oceanic, and atmospheric environmental data in a Geographic Information System (GIS). CRREL, in partnership with NSF and DOT has established a National Geotechnical Experimentation Site (NGES) as a long-term study area for research on permafrost properties and its responses to human and natural disturbances.

In response to the observations of the rapid pace of environmental change in the Arctic, DOD scientists participate in the interagency Study of Arctic Environmental Change (SEARCH). CRREL scientists have instrumented ice-observing buoys in the Arctic ice pack to monitor changes in ice thickness and snow cover throughout the year. These buoys have also been incorporated into the NSF-sponsored North Pole Environmental Observatory in the central Arctic, and are an integral part of the International Arctic Buoy Program (IABP), which has provided fundamental knowledge of the variations in Arctic climate and circulation patterns over the last 25 years.

DOD scientists participated in the *Arctic Climate Impact Assessment (ACIA)* to assess the ongoing and future changes in Arctic climate and its impacts on people, ecosystems, and infrastructure. Monitoring changes in the state of the ground continues to be of collective interest to DOD, NOAA, and USGS. The Cold Land Processes Experiment (CLPX) uses airborne instruments to retrieve snow pack, frozen ground and water, and vegetation properties for monitoring water resources and hazards. NASA, DOD, and NOAA are developing the 2010 HYDROS satellite mission to measure global soil moisture and freeze-thaw cycles. Improved satellite remote-sensing techniques to monitor changes in the Arctic ice pack are being developed by collaborative teams of agency researchers.

Scientists from CRREL and other institutions examined the seasonal evolution of albedo and the snow and ice mass balance north of Barrow, Alaska, and determined that the observed rates of sea-ice surface melting are typically at least twice as high as rates observed in the pack ice during the Surface Heat Budget of the Arctic (SHEBA) project referenced in the FY 2004-2005 edition of *Our Changing Planet*.

Techniques for high-resolution sea-ice model simulations have also been developed to understand the formation of leads and ridges in Arctic ice cover and its relationship to atmosphere and ocean circulation.

Appendix

Related Research

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, CRREL, and the various services' operational oceanographic and meteorological computational centers—will continue to provide data and services useful to the CCSP.