U.S. NAVY ACTIVITIES IN MARINE GEODESY

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Abstract

The U.S. Navy relies on a wide variety of marine geodetic data, much of which are integral parts of advanced weapon systems. A sizable Navy effort is devoted to collecting and analyzing this information. This paper briefly discusses the Navy's program in marine geodesy now and through the decade of the 1980's.

Introduction

Navy activities in marine geodesy are on an upbeat. I'm delighted to give a positive report, both for now and in the future.

The program today contains some real thought provoking topics. I will present a more generalized overview of where the Navy is and where its heading in marine geodesy. I need to define what I mean by "marine geodesy" as it means different things to different people. The Navy treats as marine geodesy all those sciences dealing with determining precise position at sea; the configuration of the seabed - that is bathymetry and hydrography; ocean surface topography; gravitational anomalies; geomagnetics; and ocean plate tectonics. Each of these subjects has, of course, many subdivisions and components.

The Navy's interest in marine geodesy, aside from building a technical foundation, is that marine geodesy is a vital part of many weapons systems and platforms. Notice I said part of, not just supporting. The distinction is important. The submarine launched ballistic missile, the submarine navigation system, the cruise missile, all have as components what could be called "geodetic black boxes." Other operational Navy interests in marine geodesy include safe navigation of ships and submarines; ocean dynamics - particularly for ASW applications, and precise positioning. Research interests also include marine geology, tectonics and tsunamies.

Program

Navy's marine geodesy requirements and programs are coordinated with other Defense activities, principally the Defense Mapping Agency, and, through the Joint Chiefs of Staff, the other military services. We have extensive coordination and cooperation with civil agencies as well; the National Science Foundation and the National Ocean Survey of NOAA in particular. I would like to summarize for you some of the most important Navy activities associated with marine geodesy.

BATHYMETRY

First, our program in deep ocean bathymetry operates four fully dedicated survey ships, each equipped with the most sophisticated swath sounding systems available. Additionally, Navy ships collect sounding data of lesser quality while in transit, and our oceanographic survey ships routinely collect bathymetry while conducting their operations.

COASTAL HYDROGRAPHY

Our efforts in coastal hydrography are multifaceted. We have been surveying jointly with the Indonesians in the deep water routes through the Makassar Strait. Although our surveys have been temporarily suspended with the unfortunate grounding of our survey ship CHAUVENET, it is our intention to complete the deep water surveys. Our second major coastal survey ship, USNS HARKNESS is nearing the completion of surveys of ports, approaches and coastal routes in Haiti. Other areas recently surveyed by this unit include Navassa Island approaches, Windward Passage and Yucatan Strait trade routes. Navy has begun significant augmentation by contracting full-scale survey operations. More than 20,000 miles of data have been collected thus far, and we have great hopes for far more. Supplementing and supporting these programs are: 1) periodic surveys by the National Ocean Survey and the UK Hydrographic Office on behalf of the Navy (we defray the expenses for these operations while maximizing the return for the taxpayers dollar), 2) the Hydrographic Survey Assistance Program (HYSAP), offering bilateral technical assistance to a dozen countries, and 3) a modern educational program in

hydrography offered through the auspices of the Oceanographer and the Naval Postgraduate School.

MARINE GRAVITY

Navy is active in the study, acquisition and application of marine gravity data. Gravimeters are continuously at sea on our deep ocean and oceanographic survey ships. We have been studying the application of satellite altimetry for determining the oceanic gravity field. Data sets from GEOS and SEASAT appear useful to this end.

OCEAN TIDES

Ocean tides have received considerable attention by the Navy. Tidal data is collected in consonance with coastal surveys; while deep ocean tides are measured, with sea floor instruments and predicted, with sophisticated modeling techniques. Deep ocean tides are studied as part of our support of remote sensing and weapon systems programs.

POSITIONING

While rarely engaged in cadastral matters, precise positioning of objects in and on the sea is of vital interest to the Navy. We operate a Navigation Aids Support Unit, trained and equipped to establish geodetic control anywhere. We can and do deploy arrays of acoustic transponders to provide precise relative positioning in the deep ocean. Considerable Navy effort has gone into studying and compensating for the effects of gravity anomalies on inertial reference systems, aboard ships, aircraft, submarines and within individual weapons. And, I need only remind us of the Navy's role as manager of the Navy Navigational Satellite System - known as TRANSIT or NAVSAT - with more than 10,000 users worldwide. Navy is also an active partner in developing TRANSIT's successor, the NAVSTAR Global Positioning System (GPS).

GEOMAGNETICS

Geomagnetics and the Navy are as inseparable as the compass and helmsman. We operate a specially configured and degaussed aircraft-Project MAGNET, to collect geomagnetic data worldwide. Navy now, independently produces models of magnetic variation needed to correct magnetic compasses for land, sea and air navigation. Low level, high resolution magnetic surveys have provided important data for interpreting ocean crustal movements and for use by ASW aircraft. Magnetic data are also routinely collected by the deep ocean and oceanographic survey ships. We operate the DOD Geomagnetic Data Library providing a central repository of data available to all-military, government, industry and academia.

FUTURE PLANS

Some recent Navy program initiatives and developments may be of interest to you as we continue to build upon our present efforts.

BATHYMETRY

The ships we use to survey the deep sea range in age from 17 years to almost 40. As these ships steam many tens of thousands of miles per year, the older ships are physically worn out. We plan to replace them with newer, more efficient merchant hulls converted to this survey mission. The converted ships should be operational in the mid-1980's. The Navy's swath sounding systems, BOTOSS-manufactured by Sperry, and SASS-a General Instrument product, are operating well. A test of the simpler, but far less expensive, SEA BEAM swath sounding system, also made by General Instrument, has shown that SEA BEAM provides repeatable, comparable results - albeit without quite the resolution of the more sophisticated systems. The Navy is also exploring techniques for long range bathymetric reconnaissance of the ocean basins using scattered acoustic energy and radar altimetry. The scattered energy approach hopes to demonstrate an ability to detect and position major bathymetric features at distances of hundreds of kilometers. We expect to do the same using satellite altimetry. Studies of GEOS and SEASAT show that seamounts should be detected in the data. Navy will be launching an altimetric satellite, GEOSAT, about January 1984, to help us classify bathymetric regions, in effect providing reconnaissance for seamounts and other major features, and thus better plan our ship surveys.

COASTAL HYDROGRAPHY

Our activities in coastal hydrography will include continued operation of our two large survey ships HARKNESS and CHAUVENET, including replacement of their old sounding launches with new, more capable craft; and we will provide an automated Hydrographic-Oceanographic Data Acquisition System (HODAS) that should increase the speed, accuracy and reliability of processing survey data. During the 1980's Navy hopes to introduce a Laser sounder and make further use of enhanced LANDSAT imagery provided by the Defense Mapping Agency. Supplementing these efforts will be increased use of commercial contractors and expansion of our highly efficient and popular survey assistance program. We hope, as well, to further our cooperative programs with other agencies, in particular the National Ocean Survey and to a lesser extent the United Kingdom.

MARINE GRAVITY

Marine gravity will continue to receive much attention as we plan to devote more effort to measuring and defining the geoid and gravitational effects on weapon and navigation systems. Navy is upgrading its sensor suites aboard ships and the data processing capabilities ashore. Defining the geoid through Satellite altimetry, begun with GEOS

and SEASAT, is being actively pursued.

OCEAN TIDES

Our ocean tidal prediction capability continues to improve, with accuracies in the single centimeters now possible. This capability permits adjustment of hydrographic data, where local tide gauges are not used, altimetry data and tidal perturbations of the gravity field and weapon system sensors.

POSITIONING

The Navy has a new awareness of precise positioning at sea, both in absolute and relative terms. New weapon systems and tactics require fixing the positions of our platforms and targets in terms of precise geographic references. Our studies of the fine structure of the ocean also require that our oceanographic ships be able to precisely position themselves each time a data set is collected. We strongly favor and support the introduction of the Global Positioning System, which, it is expected, will provide virtually every platform with a continuous, common, and quite accurate positioning capability. Every one of my ships and aircraft, including the sounding launches, are programmed to be outfitted with GPS. We are taking an ever more active role in formulating the Navy's navigation policy, and insodoing, are bringing increased attention on related geodetic issues—for example, recognizing the effects of using regional datums, the need for precise time and the role of celestial observations in defining fundamental coordinate systems.

CONCLUSION

The science of marine geodesy is providing some valuable technology transfer to meet Navy operational needs. Many of the dynamic processes of the oceans, the understanding of which is vital to the Navy mission, fallout of our studies of geodetic parameters. For example, ocean fronts, eddies and currents can be detected in satellite altimetry data.

Recent program decisions reflect the recognition that geodesy, in its broad definition, is an integral part of Navy combat systems. I'm delighted to advise that we can project a reasonable growth in our marine geodesy activities.