UNIVERSITY - NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

UNOLS FLEET IMPROVEMENT COMMITTEE

MEETING REPORT

June 20-21, 1996

Crittenton Hall
Old Dominion University
Norfolk, VA

Meeting Report
UNOLS
FLEET IMPROVEMENT COMMITTEE

Crittenton Hall
Old Dominion University
Norfolk, VA
20-21 June 1996

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OPENING REMARKS - The FIC Committee met at Crittenton Hall, Commonwealth Center for Coastal Physical Oceanography of Old Dominion College in Norfolk, Virginia on 20-21 June 1996. The meeting opened at 0900 with brief remarks from the Chair, Chris Mooers who expressed gratitude to Don Heinrichs, Pat Dennis and Marty Mulhern (*in absentia*) for providing written summaries of their report in advance that improved the efficiency of the meeting. A list of participants of the meeting is included as ***Appendix I.*** The Agenda, ***Appendix II***, was followed except as indicated in these minutes.

UNOLS CHAIR REPORT - Ken Johnson, UNOLS Chair, opened with remarks on the activities of UNOLS. Ken informed the committee of the recent ABC new report on the USCG's HEALY and the NSF Arctic Research Vessel. The report strongly criticized the Coast Guard for the cost of HEALY vis-à-vis the ARV and challenged its science capability. Ken further explained that UNOLS was presently setting up a committee to work with the Coast Guard to enhance the interaction of science aboard the icebreaker fleet. The committee would be called the Arctic Icebreaker Coordinating Committee (AICC) and would be chaired by Jim Swift. The full committee has yet to be named. The committee would deal with only Arctic issues as they relate to scientific work from icebreakers. The FIC may be able to assist the AICC on issues of mission requirements.

Ken reported that the CORE Ocean Partnership Act initiative was working its way through Congress. The bill could provide $30M for the partnership activities with $7.5M for UNOLS ship operations. Diana Josephson of NOAA testified to Congress that NOAA would be providing UNOLS $2.6M annually. These two potential new sources of money could go a long way to alleviate some of the shortfalls in the UNOLS Fleet.

UNOLS is presently engaged in discussions with NOAA on integration plans in the event the NOAA Corps is disbanded. Jim Baker set up this committee with Alan Thomas and Ken the co-chairs. The charge of the committee, which has met once, is to investigate and evaluate all possible ways to cooperate and integrate the UNOLS/NOAA Fleet. A subcommittee was formed and has met to probe the possible options.

Ken reported that the 1997 DOD budget has a bill that would authorizes $45M for a Navy owned, academic institution operated, SWATH vessel. Because of the unplanned nature of this potential ship in the UNOLS Fleet, Ken wrote a dear Colleague letter, ***Appendix III***, to express his views on the matter.

As a final comment Ken quoted from two early UNOLS publications of 1972 and 1974 which projected the fleet into the 90's. Ken noted that the Fleet today is very close to that projection.

AGENCY REPORTS

NSF - Don Heinrichs provided the agency report for NSF. Don's report is included as ***Appendix IV***. The report included personnel changes and assignments at NSF. Don indicated that he would be the NSF liaison for the new UNOLS AICC. A budget summary is part of the report. Also included is the NSF Directorate for Geosciences (GEO) Long-Range Plan FY 1997-2001.

NAVY - Pat Dennis gave the Committee the report for the ONR, OON/CNMOC and NAVOCEANO. This report is attached as ***Appendix V***. It includes the status of the UNOLS Navy owned vessels as well as the fleet of NAVO ships. RADM Gaffney is slated to relieve as Chief of Naval Research and will be dual hatted until a replacement can be named for his CNMOC position. ONR will be the new Chair of FOFCC.

NOAA - Captain Martin Mulhern was not present, however, forwarded a report for NOAA. This report is included as ***Appendix VI***.

BRIEFING ON AUVs AND RPVs

Tom Curtin of ONR provided a comprehensive briefing on a program he is working on with Autonomous Underwater Vehicles (AUVs). His view graphs are included as ***Appendix VII***. The project is developing an Autonomous Ocean Sampling Network. The network includes both fixed (moorings) and mobile nodes (AUVs and ships). These nodes provide multiple sensors that are linked by communications, navigation, energy and software creating a potential for real-time oceanography. The entire complex is connected via satellite to virtually any point in the world. The concept is to use inexpensive off-the-shelf technology where possible.

Bob Bluth, also of ONR, followed with a presentation on Remotely Piloted Vehicles (RPVs). His presentation view graphs are included as ***Appendix VIII***. Bob works with the Center for Interdisciplinary Remotely-Piloted Aircraft System. His program is complementary with the Autonomous Ocean Sampling Network by providing an efficient and cost effective method of collecting atmospheric samples through various low cost remotely piloted vehicles.

FIRST DISCUSSION OF DRAFT 1996 INTERIM FLEET IMPROVEMENT (IFIP) PLAN - Chris Mooers tasked the committee to grapple with the IFIP by laying out a strawman plan. The

Committee is to develop fleet size options for a series of funding scenarios. These range from very optimistic, optimistic, pessimistic/realistic, and very pessimistic. The report, "Projections for UNOLS' Future - Substantial Financial Challenges", was used as a project point which said that the Fleet, as presently configured with new ships coming on line, would have an $18M shortfall by the year 2000. This viewpoint was considered as the pessimistic/realistic scenario. Chris's work provided the committee ideas to ponder for the second day's activity.

The Committee adjourned for the evening.

The Committee reconvened at 0830 on 21 June to continue the meeting.

FIC SUBCOMMITTEE REPORTS

UNOLS Fleet as Real-Time Data Platforms: Eric Firing started this report with a discussion of Shipboard Technical Upgrades. He divided them into the categories of 1) Navigation, 2) External Communications, 3) Sampling Monitoring, 4) Winches, Wire & Rigging and 5) External Networking Computing. Eric plans to broaden his questioning of ship users for more detail. The work remains in progress and will result in a paper with recommendations by late summer (in time for presentation at the September UNOLS Council Meeting).

Rich Findley followed with a report of RVTEC issues on real-time data acquisition and telecommunications. He discussed shipboard data links using MSAT (Mobile Satellite). He also included a discussion on the status of INMARSAT B and SeaNet. RVTEC will be examining fiber optic cables, both steel and KEVLAR. They see a potential for "virtual instrumentation" where the computing power is at the end of the cable. Rich continues to push for NETCDF as a fleet wide standard but the process is moving slowly.

Post Cruise Assessment Reports: Peter Betzer agreed to review the current progress of the Post Cruise Assessment Reports. The UNOLS Office will send Peter a copy of the latest version of the draft assessment report being worked on by Mike Prince and the RVOC along with the current reports for his evaluation.

MG&G Platforms for NAVO and MG&G Needs: Bob Detricks provided the Committee with three point papers relating to MG&G. These are included as ***Appendix IX***. The first paper deals with the UNOLS Fleet as MG&G platforms for NAVO; the second, MG&G Science Program Prospects and the third, Shipboard Technology Upgrades.

Science Program Prospects: Bess Ward, Tom Weingartner and Chris Mooers provided the committee with their assessment of program prospects. Bess covered JGOFS indicating there were no long range major programs on the books. Tom informed the committee of the SHEBA experiment which is beginning in the Arctic, the Shelf Basin Interaction is developing a science plan, and the Canadian Basin Section which will require an icebreaker. Tom suggested that small groups of PIs are planning process-oriented science programs. Chris addressed Coastal Ocean science prospects stating there were plans for coastal work in the Great Lakes requiring an intermediate vessel for several months in the next few years. Otherwise there is a severe shortage of special planning information. He expressed a need for the committee to discuss platform needs for the coastal oceans. This information will be expanded for the Fleet Improvement Plan.

OUTLINE FOR UNOLS-FLEET IMPROVEMENT PLAN 1998 - The committee reviewed the outline for the next FIP (see ***Appendix X***). Tasking assignments were made for writing the plan. These were as follows:

Tom Weingartner:	II B, H, I
Bess Ward:	II D
Eric Firing:	II C, III L
Larry Atkinson:	II A
Bob Detrick:	II F
Chris Mooers:	II L
All:	II K
Jack Bash:	III B, C, F
DESSC:	III H, I, J

Further assignments will follow.

INTERIM FLEET IMPROVEMENT PLAN - The remainder of the meeting was a discussion on the scenarios for the Interim Fleet Improvement Plan. Chris provided four scenarios for the committee to work with. These were "Very Optimistic", "Optimistic", "Pessimistic/Realistic" and "Very Pessimistic". The committee spent considerable time estimating the year 2000 dollars that would be available under each of these scenarios. Consensus was reached by assigning (from highest to lowest) $80M; $60M; $50M and $30M. Units were assigned to ships using the following formula: $5M/Class I (Global) equals one unit; $2.5M/Class III (Regional) equals two units; and $.7M/Class IV (Coastal) equals seven units. No attempt was made to name a ship in the process but only classes of ships. The above numbers would be aggravated even more if a new ship were introduced in Hawaii.

SCENARIO I. All ships remain in the Fleet as presently configured with even the possibility of a new ship added.

II. Two Global ships are removed or one Global and two Regional ships are removed or one Global, one Regional and two/three Coastal ships are lost.

III. Two Global/four Regional/and six local ships are lost or four Global/two Regional/three Coastal ships are lost or three Global/three Regional/and four/five Coastal ships are lost.

IV. A similar spread as III. above except these would be the ships remaining versus lost.

Pros and Cons to all of the options were discussed. Further e-mail exchanges are expected so that a plan can be presented to the UNOLS Council at their 25-26 July meeting in Orlando, FL.

APPENDIX I

FIC Meeting Participants - June 20-21, 1996

Name	Organization	Telephone/Fax/E-mail
Larry Atkinson	ODU	(804) 683-4926/(804) 683-5550/atkinson@ccpo.odu.edu
Jack Bash	UNOLS	(401) 874-6825/(401) 874-6486/unols@gso.uri.edu
Peter Betzer	U of So Florida	(813) 553-3940/(813) 553-3968/prb@marine.usf.edu
Bob Bluth	ONR	(703) 696-4721/(703) 696-8423/bluthr@onrhq.onr.navy.mil
Joe Coburn	WHOI	(508) 289-2624/(508) 540-8675/jcoburn@whoi.edu
Tom Curtin	ONR	(703) 696-4119/(703) 696-2710/curtin@onrhq.onr.navy.mil
Patrick Dennis	USN Support (ONR/N096)	(703) 696-2161/(703) 696-2007/dennisp@onrhq.onr.navy.mil
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Ken Johnson	MLML	(408) 755-8657/(408) 753-2826/johnson@mlml.calstate.edu
Chris Mooers	RSMAS	(305) 361-4088/(305) 361-4701/cmooers@rsmas.miami.edu
Suzanne Strom	WWU	(360) 293-2188/(360) 293-1083/stroms@henson.cc.wwu.edu
Bess Ward	UCSC	(408) 459-3171/(408) 459-4882/bbw@cats.ucsc.edu
Tom Weingartner	U of Alaska	(907) 474-7993/(907) 474-7204/weingart@ims.alaska.edu

APPENDIX II

FIC Meeting Agenda

20 - 21 June 1996
Old Dominion University
Norfolk, VA

Thursday, 20 June 1996

0830 UNOLS Chair Report - Ken Johnson

0900 Agency representatives reports

1000 Coffee Break

1030 FIC Subcommittee reports

1130 First discussion of draft 1996 IFP - Chris Mooers

1200 Lunch

1300 Briefings on new autonomous observing system technologies sponsored by ONR
- Tom Curtin, ONR on AUVs
Bob Bluth, ONR on RPVs

1500 Coffee Break

1530 Continue Discussion of Draft 1996 IFP - Chris Mooers

1730 Adjourn

1830 Dinner cruise

Friday, 21 June 1996

0830 Continue discussion of draft 1996 IFP - Chris Mooers

1000 Coffee Break

1030 Discuss POA for 1998 FIP, especially assignment of homework - Chris Mooers

1200 Lunch

1300 Discuss carry over (from Thursday AM) homework items - Various

1500 Coffee Break

1530 Summarize action items/tasks - Chris Mooers

APPENDIX III

UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

An association of institutions for the coordination and support of university oceanographic facilities.

June 7, 1996

Dear Colleague:

Enclosed is a statement from the UNOLS Chair, developed after consultation with the UNOLS Council, on the proposed University of Hawaii SWATH vessel. The statement recognizes the need for a research vessel operating in the central Pacific. It also recognizes that a research vessel services a broad spectrum of the community and it must be capable of meeting the needs of a diverse group of ocean scientists. The oceanographic community must be widely involved in the design process. In this light, the proposal to replace the MOANA WAVE with a SWATH vessel is a high risk choice. There has not been a careful assessment of community requirements. Most of the ongoing programs in the central Pacific involve servicing deep-sea moorings. This requires a vessel with a large payload, a characteristic inherently absent from the SWATH design.

Although the Navy will give up ownership of the MOANA WAVE in 1997, there are no explicit barriers to transfer of ownership to the University of Hawaii and its continued operation for the next decade. There is no imperative to rush into a new vessel design. UNOLS therefore proposes that the following courses of action be undertaken. The community should immediately begin an assessment of the Science Mission Requirements for a central Pacific research vessel. Planning for replacement of the KNORR and MELVILLE should also begin as these ships may have only about ten years of effective operational life remaining. Simultaneous planning with the central Pacific effort may result in a commonality of design that could serve the community well in the future.

In addition, UNOLS should encourage the transfer of the MOANA WAVE ownership to the University of Hawaii. This should be done to serve central Pacific science. It will maintain a UNOLS presence in Hawaii and it will assist the University of Hawaii in retaining the operational base at Sand Island, which is plays an important role in supporting other UNOLS vessels in transit. Continued operation of the MOANA WAVE will demonstrate whether there is sufficient science need in the future to justify a ship in the central Pacific, particularly in light of the changes at NOAA.

We should not rush to accept a SWATH design for our next generation of research vessels. Their inherent limitations may not be of general service to the oceanographic community.

Sincerely yours,

Kenneth S. Johnson
UNOLS Chair

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UNOLS Statement on the Proposed University of Hawaii SWATH Vessel

One of the strengths of UNOLS is the ability to coordinate existing assets and to ensure that they are available to the entire oceanographic community. In this regard, UNOLS is obliged to ensure that new vessels are able to meet the great spectrum of community needs. In the past decade, UNOLS has seen several attempts to develop large research vessels that have failed because the community was not widely involved in the process. Substantial investments of private and Federal funds in these vessels have been lost, which represents a significant blow to the oceanographic community. The UNOLS Council is, therefore, committed to following an orderly planning procedure for introduction of new ships into the Fleet.

The UNOLS Council recognizes that there is a strong scientific rationale for a UNOLS vessel to operate in the central Pacific region in support of programs such as the Hawaii ocean Time Series, the NOAA TAO array work, and research cruises to the central and western Pacific. The MOANA WAVE, which is currently supporting oceanographic science in the central Pacific, is now only 22 years old and should be able to operate efficiently for eight to ten years. Although, the U.S. Navy will remove the vessel from their fleet of five Navy-owned, University-operated research vessels, they are also willing to transfer it to private ownership. They have done so with other Navy-owned, University-operated vessels. There is no explicit barrier to the MOANA WAVE continuing to operate in the central Pacific in support of academic and Federal oceanographic research during the next decade.

The University of Hawaii now proposes to replace the MOANA WAVE with a large SWATH vessel. However, there has been no community planning for this vessel. The science programs that now exist in the central Pacific might not be well served by a ship of this design. In particular, the NOAA TAO work will use one year of research vessel time in the equatorial Pacific on a continuing basis. This work requires a vessel that can carry large payloads, a role not well suited to the SWATH design. There have been no studies which suggest that ongoing science programs exist in the region which require the special, but limited, capabilities of a SWATH vessel. Thus, construction of a SWATH could be a very high risk operation.

Furthermore, there has been a real shortfall in funds for Fleet operations, with Class II and Class III vessels bearing the brunt of this loss. The funding for science has also been down. As a result, there have not been sufficient requests to operate the MOANA WAVE at more than about 50% of a full schedule. In light of these problems, UNOLS has been very cautious about advocating the addition of new ships and even the replacement of existing ships with more capable, but more expensive, vessels. Finally, the MOANA WAVE has a sufficiently long lifetime remaining that it would be imprudent to rush a design forward in light of the funding crisis facing the UNOLS Fleet.

It is possible that the funding situation will improve in the future. In particular, as NOAA and, perhaps, the U.S. Naval Oceanographic office use more UNOLS time for their sea-going work, Fleet schedules should improve. These changes may improve the schedule for the MOANA WAVE and the remainder of the Fleet. However, the projected Fleet funding deficit in the year 2000 is equivalent to more than three large ship years. This projection is based on assumptions that do not have the MOANA WAVE or a replacement vessel operating after 1997. The projected usage of UNOLS vessels by NOAA and NAVO is only about one half

this level. Addition of a new vessel to the Fleet, or retention of an existing vessel, without a corresponding retirement will only exacerbate an already bad situation.

One factor that could mitigate the replacement of the MOANA WAVE is even greater usage of UNOLS time by NOAA than they now foresee. NOAA uses about one year of ship time to service their TAO equatorial mooring array. R/V DISCOVERER, which now does the TAO work, is scheduled to retire in October. NOAA proposes to use the converted TAGOS vessel KA'IMIMOANA (KA) to conduct this work. However, the KA suffers a number of severe shortcomings for this long-transit work. It is capable of only a ten knot maximum speed, which will add about six days of transit time to each 30 day cruise. This will cost NOAA nearly $1M for each KA operating year above the cost of using a vessel with the transit speed of the typical UNOLS Class II/III. In addition, the KA can only carry 12 scientists and, because of a lack of winches, laboratory space and insufficient stability to carry vans, it has no capability for general purpose work. It is likely that NOAA scientists will rapidly realize these shortcomings and move this work to more effective UNOLS vessels. If so, the TAO array work could represent a significant enhancement for the base schedule of a UNOLS vessel in the Hawaii region. If a large portion of the TAO work were done from UNOLS vessels, it would represent a new source of work and it could serve as justification to retain the MOANA WAVE.

UNOLS, therefore, supports the following courses of action:

1) The Navy is willing to turn the MOANA WAVE over to the University of Hawaii to operate in the general UNOLS Fleet. This should be done to serve central Pacific science. It will maintain a UNOLS presence in Hawaii and it will assist the University of Hawaii in retaining the operational base at Sand Island, which is plays an important role in supporting other UNOLS vessels in transit. Continued operation of the MOANA WAVE will demonstrate whether there is sufficient science need in the future to justify a ship in the central Pacific, particularly in light of the changes at NOAA.

2) The UNOLS community, including the University of Hawaii, should begin assessing the Science Mission Requirements for a modern, general purpose vessel that could serve the needs of ocean science programs that are focused on the central and western Pacific regions. To ensure community support, the design of the vessel should reflect input from the spectrum of potential science users. The effort to assess the Science Mission Requirements for a central Pacific vessel should begin immediately.

Finally, this statement underscores the need to begin planning for replacement of the KNORR and MELVILLE, as well as the MOANA WAVE. These ships may have only about ten years of effective operational life remaining. Now is the time to begin to assess effective designs and funding mechanisms for their replacement. Simultaneous planning with the central Pacific effort may result in a commonality of design that could serve the community well in the future.

APPENDIX IV

NSF Ocean Sciences Division

Ocean Sciences

- Budget estimate is $193.7 Million
- Increase of $0.9 Million or .5%

	FY 1994	FY 1995	FY 1996
Ocean Sciences Research	$100.0 M	$102.6M	$104.9M
Oceanographic Centers & Facilities	50.3M	50.4M	48.9M
Ocean Drilling Program	38.7M	39.8M	39.9M
	$189.0M	$192.8M	$193.7M

- Major Research Initiatives

	FY 1994	FY 1995	FY 1996
Global Change Programs	$53.7M	$57.7M	$57.6M
Biotechnology	4.0M	3.6M	3.0M
High Performance Computing	0.4M	0.8M	0.8M
Environmental Research	7.3M	7.7M	7.3M
SMETE (EHR)	2.1M	2.9M	3.1M
	$67.5M	$72.7M	$71.8M

- Other Research Activities $121.5M $120.6M $121.9M

(June 1996)

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	FY 1994	FY 1995	FY 1996
Ocean Sciences Research	$100.0 M	$102.6M	$104.9M
Oceanographic Centers & Facilities	50.3M	50.4M	48.9M
Ocean Drilling Program	38.7M	39.8M	39.9M
	$189.0M	$192.8M	$193.7M

Oceanographic Facilities Detail

Operations			
Ship Operations*	$32.2M	$35.1M	$31.1M
ALVIN, Aircraft, etc.	2.2M	2.1M	2.4M
Marine Techs	4.2M	4.4M	3.8M
	$38.6M	$41.6M	$37.3M
Infrastructure			
Science Instruments	2.5M	1.9M	1.9M
Shipboard Equipment	2.1M	1.1M	1.6M
Ships, Upgrades	2.1M	0.2M	1.5M
UNOLS, Misc.	0.5M	0.5M	0.3M
	$7.2M	$3.7M	$5.3M
Centers and Reserves			
AMS	1.2M	1.0M	1.4M
IAI	1.3M	2.0M	1.9M
Cross Directorate/Reserves	2.0M	2.1M	3.0M
	$4.5M	$5.1M	$6.3M

*Plus $1.6M from ODP (1994), $1.8M (1995), $2.1M (1996)

(June 1996)

HOUSE APPROPRIATIONS SUBCOMMITTEE
NSF FY1997 – DRAFT LANGUAGE

ACADEMIC RESEARCH FLEET

- Concern with possibility of adding new Navy-owned, university-operated, Class I Oceanographic Research vessel to academic fleet.
- No existing academic plan for new vessel at this time.
- Health of oceanography threatened by new ships without corresponding increases in ship operations and research funds.
- Support NSF efforts to work with other agencies to broaden usage of academic fleet.
- NSF to report on impact of possible Class I ship addition – fiscal and otherwise, balance between research and ship operations funding.

⇒ Report to Committee by August 30, 1996

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Oceanographic Centers & Facilities

- Staff Change
  * Lisa Rom, Instrumentation and Technical Services (ITS)
    - one year leave. August 1996-August 1997
  * Sandy Shor, ITS Program Director
    - IPA, University of Hawaii, August 1996-August 1997

- Program Addition
  * Interamerican Institute (IAI)
  * Line budget in OCFS ($1.6M)
  * OCE "center" management
  * Global Change Program

- UNOLS Liaisons

  Unols Council - Don Heinrichs

  RVOC
  Ship scheduling — Dolly Dieter
  DESSC

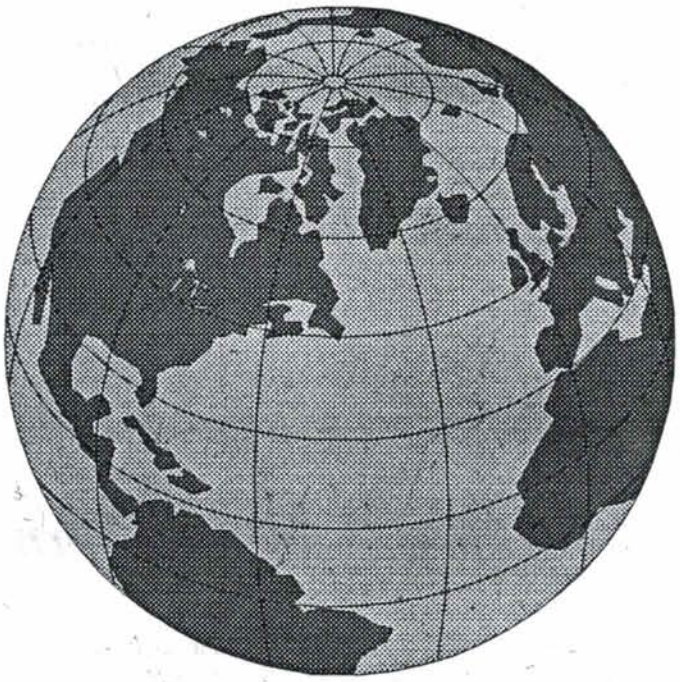
  RVTEC - Lisa Rom/Sandy Shor

  FIC - Richard West

ACADEMIC RESEARCH FLEET

The Committee is concerned with the possibility of new Navy-owned, university-operated, Class I Oceanographic Research vessel being added to the academic fleet. There is no existing academic fleet planning to incorporate a new vessel at this time. The addition of new ships without corresponding increases in ship operations funding and in the funding for research programs that require ship time threatens the health of oceanography. NSF is directed to report to the Committee by August 30, 1996, the ramifications, fiscal and otherwise, of such an addition, with particular attention to the overall balance between research funding and ship operations funding. The Committee is concerned about a funding shortfall for the operations of the academic fleet and supports NSF's efforts to work with other agencies to broaden usage of the fleet.

National Science Foundation
Directorate for Geosciences



GEO

Long-Range Plan

FY 1997-2001

NSF 96-95

National Science Foundation

The National Science Foundation (NSF) provides awards for research in the sciences and engineering. The awardee is wholly responsible for the conduct of such research and preparation of the results for publication. NSF therefore does not assume responsibility for the research findings or their interpretation.

NSF welcomes proposals from all qualified scientists and engineers and strongly encourages women, minorities, and persons with disabilities to compete fully in any of its research- and education-related programs. In accordance with federal statutes, regulations, and NSF policies, no person on grounds of race, color, age, sex, national origin, or disability shall be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving financial assistance from the National Science Foundation.

Facilitation Awards for Scientists and Engineers with Disabilities (FASED) provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on NSF projects. See the program announcement or contact the program coordinator at (703) 306-1636.

The National Science Foundation has TDD (Telephonic Device for the Deaf) capability, which enables individuals with hearing impairment to communicate with NSF about programs, employment, or general information. To access NSF TDD, dial (703) 306-0090; for FIRS, dial 1-800-877-8339.

GEO LONG-RANGE PLAN, FY 1997-2001

I. THE CONTEXT AND PROCESS OF GEO LONG-RANGE PLANNING

Since its establishment in 1950, the National Science Foundation (NSF) has been dedicated to supporting and strengthening the United States' capacity to excel in science. Although the challenges facing the National Science Foundation have changed over the decades, NSF's core purpose remains substantially the same. As stated in its 1995 strategic plan, *NSF in a Changing World*:

> *The National Science Foundation is a catalyst for progress through investment in science, mathematics, and engineering. Guided by its long-standing commitment to the highest standards of excellence in the support of discovery and learning, NSF pledges to provide the stewardship necessary to sustain and strengthen the Nation's science, mathematics, and engineering capabilities and to promote the use of those capabilities in service to society.*

The Directorate for Geosciences (GEO) shares the broader vision of NSF. Working in concert with other units of NSF, with other federal agencies, with international partners, and with numerous other organizations, including professional associations and private-sector firms, GEO seeks to make the strongest possible contribution to the advancement of the geosciences in the U.S. and the rest of the world. Accompanying the main text of this document are examples of activities supported by GEO that have resulted in major contributions to knowledge about Earth. These examples demonstrate the considerable benefits of support for fundamental research, for facilities, and for education in the geosciences, and they offer glimpses of the kinds of benefits that are expected to result from GEO investments in the future.

GEO's long-range planning process builds on its vision by seeking to identify the most effective ways that GEO can target its investments and activities in order to fulfill its mission, which is to advance scientific knowledge about solid earth, freshwater, oceanic, atmospheric, and geospace components of the integrated Earth system through support for high-quality research, through sustenance and strengthening of scientific capabilities, and through improved geoscience education.

Benefits of GEO Investments

Improved Weather Forecasting

GEO's support for basic research has contributed to fundamental understanding of severe weather events that has led to development of detection techniques of hazardous weather and improved predictions of a wide range of atmospheric phenomena. GEO was instrumental in supporting studies that determined the fundamental structure of severe wind events, known as microbursts, which have been responsible for several aircraft disasters. This research contributed directly to changes in emergency flight procedures and to the creation of a national wind shear detection network. Knowledge gained during a study of East Coast snowstorms in the mid-1980s contributed to fundamental refinements in computer forecast models that led to highly accurate predictions of storms like the January 1996 blizzard. At universities and at the GEO-sponsored Center for Analysis and Prediction of Storms (CAPS), research is continuing on the dynamics and causes of tornadic storms. In the near future, it is anticipated that forecasts of the timing and location of potential tornadoes will become more specific and accurate.

In order to fulfill its mission, GEO strives to attain a set of strategic goals:

- **Advancement of fundamental knowledge about the Earth system.** This goal requires GEO to maintain strong bases of support across all geoscience fields in order to have the flexibility to respond to the highest-quality research opportunities identified by investigators while also identifying opportunities where more focused support can play an especially strong catalytic role in advancing scientific progress.
- **Enhancement of the infrastructure for the conduct of geoscience research.** This goal requires GEO to identify and make investments in facilities and instruments that will be used by a large number of geoscientists. It also calls for GEO to facilitate interdisciplinary and international collaborations necessary to accomplish the highest-quality scientific projects, and it requires GEO to pursue productive partnerships with other parts of NSF, with other federal agencies, with organizations outside the federal government, and with international partners.
- **Improvement in the quality of education and training.** This goal calls for GEO to advance education and training for current geoscientists, to facilitate the best education and training for future generations of geoscientists drawn from all segments of the population, and to improve knowledge about the integrated components of the Earth system by all people.

Benefits of GEO Investments

Earthquake Hazard Reduction

GEO's support for Fundamental Earthquake Studies, a component of the National Earthquake Hazard Reduction Program (NEHRP), has led to an enhanced understanding of the processes operating prior to, during, and immediately after earthquakes. Studies of regional tectonic frameworks and the sequence and geometry of stress accumulation around pending focal zones provide the basis for identifying and interpreting earthquake probabilities. Knowledge of the rupture process, particularly the effects of local geology, provides the basis for estimating local ground motion. Such understanding is critical to progress in earthquake forecasting and in hazard mitigation. Although much of the GEO-sponsored earthquake research is conducted by individual investigators or small teams of researchers, GEO also funds the Southern California Earthquake Center, which encourages collaborative and complementary work of scholars in that tectonically active, densely populated area.

GEO's capabilities to advance fundamental knowledge in the geosciences expanded considerably over the last few decades. For the foreseeable future, however, GEO expects to function at budget levels roughly comparable to those of Fiscal Years 1995 and 1996. This situation contrasts sharply with trends over recent decades, when budgetary growth permitted ready consideration of new opportunities. Looking toward the next decade, the constraints of "flat-line" budgetary assumptions are compounded by possible reductions in support for the geosciences provided by other federal agencies. If these reductions are realized, requests for NSF to sponsor activities previously supported by federal partners may further intensify pressures on GEO.

This new situation makes it more important than ever for GEO to establish priorities regarding the use of limited funds. This plan highlights those activities that GEO judges to be of high priority from FY 1997 to FY 2001. Some of those activities are planned efforts that only need sufficient support for completion of stated objectives. Others are on-going activities that must maintain adequate levels of support but do not require increased levels of funding. Still others are new and recently initiated activities for which additional funding may be needed during the planning period. In addition to identifying those higher-priority activities, this long-range plan also identifies activities for which funding may be reduced.

The changing conditions in which it now operates require that GEO develop even stronger partnerships with other units in NSF and with other organizations both within and outside the federal government, including international organizations. GEO commits itself to implement partnerships based on shared goals and the development of mechanisms for working together that enable more progress to be made than would have been possible had the partners operated independently.

GEO undertakes its long-range planning in the same way it conducts its ongoing business -- through partnerships with those engaged in geoscience research and education and with those who benefit from advanced knowledge in the geosciences. Among those with whom GEO interacts most frequently are the individuals and groups who conduct research and education projects and who operate facilities in the geosciences. GEO also seeks to meet the needs of those in the private and public sector who use new advanced knowledge in a variety of ways. GEO has relied on regular consultation with those it serves and its many partners in the development of this long-range plan. During 1993 and 1994, each of GEO's three divisions (Atmospheric Sciences, Earth Sciences, and Ocean Sciences) supported groups of leading scientists and educators who outlined special opportunities for their respective fields. The reports prepared by those groups played central roles in the development of this directorate-wide plan. Long-range planning also has been considered by the Advisory Committee for Geosciences, which consists of leading researchers and educators from the broad range of geoscience disciplines and a variety of institutional settings, including academia, government, and the private sector.

II. HIGH-PRIORITY RESEARCH ACTIVITIES

The set of research activities identified as being in the high-priority category for support include existing activities that should be completed as planned, on-going activities that should be sustained at relatively stable levels, and both new and on-going activities that require increasing levels of support.

Fundamental research supported by standing programs

Previous GEO long-range plans have highlighted a broad range of special activities for which enhanced use of GEO resources might be especially valuable. For the period from FY 1997 to FY 2001, one of the highest priorities is the maintenance of support for fundamental geoscience research through the standing programs of the three divisions. This renewed emphasis on the base program activities is being made because continued strength in investigator-initiated fundamental research across all geoscience disciplines is essential for the health and vitality of the geosciences in the nation. Broadly based fundamental research has been the foundation upon which special initiatives within disciplines, as well as wider-ranging interdisciplinary initiatives have been undertaken. In order to sustain the strength of research across all major disciplinary groups, base budget levels will be maintained.

Major field and modeling programs for global change research

GEO has been an active participant for more than a decade in interagency efforts to conduct integrated research on dynamic Earth systems. These efforts have been formally coordinated since 1989 through the U.S. Global Change Research Program (US/GCRP). GEO's focused

global change programs are coordinated with other agencies and with international partners through the World Climate Research Programme (WCRP) and the International Geosphere-Biosphere Programme (IGBP). For the period from FY 1997 to FY 2001, GEO will continue to give high priority to the support of global change research programs that facilitate the most significant fundamental research and that complement the efforts of national and international partners, although the changing character of the overall set of activities supported will require slightly lower levels of support.

Support will be provided for the planned completion of major international global change field campaigns, such as the World Ocean Circulation Experiment (WOCE) and the Joint Global Ocean Flux Study (JGOFS). The levels of support for these activities will decrease somewhat over the planning period in accordance with the planned phase-down of these programs. Two focused global change programs, Earth System History (ESH) and Global Ocean Ecosystem Dynamics (GLOBEC), are targeted for modest increases over the planning period. Following recent enhancements in support, funding for the Climate Modeling and Prediction (CMAP) Program and the Global Tropospheric Chemistry Program (GTCP) will be maintained at approximately their FY 1995 levels. Increased support will be given to the Climate Variability and Predictability (CLIVAR) Program of the WCRP, which will extend the domain and time scales of research on climate variability to the global oceans and to periods ranging up to centuries. This new program will build on the success of the decade-long Tropical Ocean-Global Atmosphere (TOGA) Program and generally will use funds released as TOGA's final analyses are completed.

Special emphasis areas in the geosciences

As geoscience research evolves, opportunities emerge within and across the base programs for the development of new topics and techniques for which focused attention will yield especially beneficial results. Working in concert with members of relevant scientific communities, special emphasis areas have been developed to foster increased interdisciplinary research or to promote important new lines of inquiry. Funding levels will be maintained as needed for the Ocean Drilling Program and the International Continental Drilling Program. Special emphasis areas at an early stage of maturity for which increased funding will be provided include Environmental Geochemistry and Biogeochemistry (EGB), Coastal Ocean Processes (CoOP), Cooperative Studies of the Earth's Deep Interior (CSEDI), and Active Tectonics research. Special emphasis areas that GEO expects to initiate between FY 1997 and FY 2001 are an expansion of the Ridge Interdisciplinary Global Experiments (RIDGE) to establish ocean-floor observatories and Continental Margins research (MARGINS). Increased levels of support for on-going and new initiatives will come from funds made available through planned phase-downs and reductions in some of the global change programs and other initiatives.

Multi-agency science research programs

Two newly established initiatives for the support of atmospheric science research coordinate GEO's efforts with complementary programs in other agencies. Because of the expected synergies resulting from multi-agency coordination, GEO intends to provide expanded support for the U.S. Weather Research Program (USWRP) and the National Space Weather Program (NSWP) during the planning period. The USWRP is a national research and technology-transfer program involving GEO, the National Oceanic and Atmospheric Administration (NOAA), and other agencies that develops the understanding, techniques, and systems necessary to translate basic scientific findings

and new observational data into fundamentally improved short-term weather forecasts. The NSWP involves GEO, the Department of Defense, NOAA, the National Aeronautics and Space Administration (NASA), and the Department of the Interior. Its goal is to support research that will underpin a future predictive warning system for extreme space weather events associated with conditions on the sun and in the solar wind, magnetosphere, ionosphere, and thermosphere. As is true for the special emphasis areas, increased support for these multi-agency research programs will come from planned phase-downs and reductions in some of the global change programs and in other initiatives.

New interdisciplinary methodological efforts linking the geosciences and other disciplines

Because the atmospheric, solid-earth, ocean, and geospace components of the Earth system are linked with biological, human, and other components, GEO works closely with other units in NSF and with other federal agencies to advance methodologies that promote interdisciplinary research. In recognition of the increasingly important role of technologies like the Global Positioning System (GPS) and geographic information systems (GISs), GEO is working with other NSF units to develop a new initiative dealing with Integrated Spatial Information Systems (ISIS). This initiative is expected to bring together individuals and organizations involved in the technical development of GPS, GISs, and other new technologies with geoscientists as well as biological and social scientists whose interests lie primarily in the adaptation of these geospatial technologies to accelerate progress in fundamental research. GEO also expects to initiate support for selected components of the Global Observing System (GOS), especially the Global Ocean Observing System (GOOS) and the Global Climate Observing System (GCOS). These closely related collections of observing systems will make available data that are critical for research on long-term processes related to interactions among ocean and atmospheric systems. GOOS and GCOS are being developed in coordination with other US/GCRP agencies, especially NASA and NOAA, and international partners. Funding for increased support of these special initiatives largely will come from funds redirected out of High-Performance Computing and Communications activities, which are being phased down over the planning period.

III. High-Priority Infrastructural Investments

The nature of geoscience research requires large investments to be made in facilities and instruments. Many of the projects supported by GEO consist of field work for which major capital investments are required in order to study complex, interdependent processes extending over large areas. Decisions regarding GEO's support for science and technology centers, facilities, equipment, instrumentation, and other forms of infrastructure are made in concert with the development of scientific research priorities. They also are made in coordination with other federal agencies, industrial organizations, and international partners.

Solid-earth science facilities

Starting in FY 1997, GEO will assume a larger share of the responsibility for the operation and maintenance of the Global Seismographic Network (GSN). The GSN is the U.S. contribution to an international network of permanent, state-of-the-art digital seismic stations in support of basic research in earthquake studies, imaging of the Earth's internal structure and dynamics, and

nuclear test-ban monitoring. GEO also will maintain support for other activities that facilitate geoscience research. These include the national and international continental scientific drilling programs, the Argonne Advanced Photon Source as a major synchrotron X-ray facility, major national accelerator mass spectrometry (AMS) and ion microprobe facilities, and UNAVCO facilities to support the use of the Global Positioning System in geoscience research.

Atmospheric facilities

Shared-user resources in the atmospheric sciences will be maintained at or near current levels of support during the planning period. The facilities, equipment, and computers at the National Center for Atmospheric Research and the incoherent scatter radar facilities have assumed critical roles in the conduct of a wide range of atmospheric science inquiries, and as a result, support for these facilities will be kept in balance with the support for activities undertaken through research projects. Other atmospheric facilities also will be maintained, with upgrades undertaken as feasible in conjunction with normal maintenance.

Academic research fleet

The U.S. academic research fleet is an integral facet of ocean science research supported by GEO and other federal agencies, often in conjunction with international partners. Support for maintenance and operation of the academic research fleet of more than two dozen vessels will be maintained from FY 1997 to FY 2001 at levels that will enable scientific needs to be met. Through prudent management of the fleet, upgrades and replacement of vessels may be undertaken in conjunction with the possible lay-up of vessels that are not needed during parts of the planning period.

Benefits of GEO Investments

Ocean Drilling Program

GEO's support for the Ocean Drilling Program (ODP) includes funding and management of the internationally financed drilling and logging program using the JOIDES Resolution as well as support for participation of U.S. scientists on drilling cruises and in post-cruise analyses of samples and data. A primary objective of the ODP has been to examine the global history of climate change. Toward this end the program has recovered a vast array of continuous sediment cores from all the world's oceans from which changes in ocean and atmospheric properties can be examined on geologic timescales. Equally important has been the development of new technologies for examining active processes in the ocean crust. At convergent margins, ocean crust is consumed in deep-sea trenches accompanied by large, destructive earthquakes. ODP has focused on examining the role of fluids in this process and has developed and deployed new instrumentation for long-term monitoring of fluid flow and composition. Future emphasis in borehole instrumentation will be to expand the global seismic to the ocean basins by deploying broadband seismometers in ODP holes. Perhaps the most significant legacy of the Ocean Drilling Program will be as a model for the planning and operation of a shared international program. More than 1,500 scientists from 25 nations have participated on drilling cruises which are planned by JOIDES, an international scientific organization representing the 18 countries that support the ODP.

IV. High-Priority Research-Based Educational Activities

Many of GEO's research awards include support for educational activities through the support of both undergraduate and graduate students as well as postdoctoral fellows. Some GEO awards also result in the broader dissemination of research results beyond standard scholarly outlets. In order to facilitate the more effective integration of research and education, GEO intends to

intensify its efforts from now through FY 2001 for these types of activities. Increased attention also will be given to a selected set of special activities that will either help improve general education in the geosciences or facilitate the best education and training for future generations of geoscientists drawn from all segments of the population.

Innovative activities linking geoscience researchers and educators to advance general and undergraduate geoscience education

The geosciences occupy a distinctive place in natural science education. Although studies of the Earth system generally are not taught as independent courses in elementary or secondary school curricula, the atmospheric, ocean, and solid-earth components of the Earth system often are the settings where principles developed in physics, chemistry, and biology are demonstrated. The attention given to geoscience topics in popular media like television shows and museums also attests to the special interest that many people have in the Earth. GEO therefore intends to build on this special role, working closely with geoscientists interested in educational improvement and with professional organizations. Special emphasis will be given to providing students and the general public with opportunities to witness and participate in active research efforts. Based on recent experiences, GEO expects that science and technology centers and research consortiums will play especially critical roles in this process. GEO's enhancement of support in these areas will be undertaken through close coordination with relevant parts of the NSF Directorate for Education and Human Resources (EHR).

Benefits of GEO Investments

SOARS and REU Sites

In coordination with the University Corporation for Atmospheric Research (UCAR) and the National Center for Atmospheric Research (NCAR), GEO is sponsoring an educational program that brings ethnically diverse students into careers in the atmospheric and related sciences. Scientific Opportunities in Atmospheric and Related Sciences (SOARS) students are recruited at the end of their sophomore years from universities and colleges with large enrollments of ethnic minorities. SOARS provides ten-week summer programs at UCAR/NCAR, or other institutions, where students work with scientific mentors on real-world scientific projects. During their participation in SOARS, students maintain a close connection with a UCAR mentor and research program as they complete undergraduate degrees, earn an M.S. while on full scholarship, and then enter either a Ph.D. program or the professional work force. SOARS is only one program sponsored by GEO that advances geoscience education and diversifies the geoscience research and teaching community. Other successful efforts include Research Experiences for Undergraduates (REU) activities in the ocean sciences at Oregon State University geared to Native Americans and a joint REU effort at Harbor Branch Oceanographic Institution and Savannah State College that focuses on African American students.

Focused programs to increase diversity in the geoscience communities

In addition to seeking to improve the quality of education and training for all individuals who are seeking to pursue careers in the geosciences, GEO is committed to helping to broaden the diversity of the geoscience communities, by attracting and assisting individuals from groups that have been underrepresented. In order to accomplish this, GEO will maintain support for special Research Experiences for Undergraduate Site activities that have assisted underrepresented groups. GEO will expand its support for diversity-enhancing activities at science and technology centers, and it will increase its support for focused activities designed to provide students from underrepresented groups with opportunities to learn about and participate in geoscience research. GEO also will

build on its involvement in the Model Institutions for Excellence (MIE) Program, which includes an initial award to the Universidad Metropolitana of Puerto Rico.

V. Activities to be Supported if Additional Funds are Available

The previous three sections of this long-range plan have described those activities that GEO plans to give the high priority for support during the period from FY 1997 to FY 2001, presuming that budgets are kept at or near the levels of FYs 1995 and 1996. The selective character of the activities underscored in these sections should not be interpreted as an indication that these are the only geoscience activities worthy of augmented support during the planning period. Through the GEO long-range planning process, the following activities and infrastructural investments have been identified as meritorious if additional resources become available.

Construction of a polar-cap observatory and upgrades of atmospheric science infrastructure

Advances in atmospheric science research on a number of topics have highlighted the need for expansion of facilities and equipment on which future research activities will rely. A polar-cap observatory has been proposed for a site in far north central Canada to obtain ground-level measurements of the "solar wind," which consists of charged particles that are energized in space and that enter the atmosphere and deposit energy, producing aurora and modifying the composition of the ionosphere and neutral atmosphere. Upgrades and replacements of aircraft that take critical measurements of atmospheric phenomena operating at scales ranging from the local to global are warranted. These kinds of investments have been especially effective in recent years, as GEO funding for these airborne platforms has focused on the marginal costs of upgrading excess military aircraft made available by the Department of Defense. Additional support also would be warranted for further expansion of computational capabilities at NCAR.

Construction or upgrade of vessels in the academic research fleet

Although GEO anticipates that fleet requirements for ocean-based research can be met over the period from FY 1997 to FY 2001 through maintenance of the current budget for the academic fleet, the need for additional support for new vessels and major upgrades will increase throughout the planning period. The dedication of a research vessel providing all-season access to the Arctic region has been identified through some studies as an important research platform. GEO and other units in NSF will continue to work with researchers and with the U.S. Coast Guard and other agencies to determine whether a new vessel is needed or whether research needs in the region can be met by using vessels currently in operation or under construction. Upgrading of the current ocean drill ship or construction of a new vessel for this purpose has been a central point of discussion among the U.S. and the 17 other nations that cooperatively manage the Ocean Drilling Program, and construction of a coastal research vessel has been proposed to provide adequate facilities for the measurements, experiments, and over-the-side operations that currently are not available on ships used for coastal research.

Enhancement of international cooperative research programs

U.S. leadership in major international cooperative research programs, including a number of core projects of the International Geosphere-Biosphere Programme and the World Climate Research Programme, focuses special attention on the need for maintenance or expansion of GEO support for collaborative efforts linking U.S. and foreign scientists. Similarly, the next generation of the Ocean Drilling Program will require expanded and improved capabilities that most likely could be developed only if overall budget levels increase.

This plan was reviewed and approved by the Advisory Committee for Geosciences on March 18, 1996.

NSF 96-95 (Replaces NSF 94-49)

Looking for more information about GEO?

Check us out on the World Wide Web!

For up-to-date information about new developments in GEO, including program announcements, notice of meetings, and other activities, check out the GEO Web Site at:

http://www.geo.nsf.gov

Call us on the phone!

(The area code for all NSF numbers is 703.)

Division of Atmospheric Sciences (ATM) ... 306-1520

Lower Atmosphere Research Section 306-1521
Atmospheric Chemistry Program 306-1522
Climate Dynamics Program 306-1527
Large-Scale Dynamic Meteorology Program 306-1528
Mesoscale Dynamic Meteorology Program .. 306-1526
Paleoclimate Program 306-1527
Physical Meteorology Program 306-1524

Upper Atmosphere Research Section 306-1518
Aeronomy Program 306-1529
Magnetospheric Physics Program 306-1519
Solar Terrestrial Research Program 306-1530
Upper Atmospheric Facilities 306-1531

UCAR and Lower Atmospheric Facilities Oversight Section 306-1521

Division of Earth Sciences (EAR) 306-1550

Research Projects Section 306-1553
Geology and Paleontology Program 306-1554
Hydrologic Sciences Program 306-1549
Petrology and Geochemistry Program 306-1554
Tectonics Program 306-1552

Special Projects Section 306-1553
Continental Dynamics Program 306-1559
Geophysics Program 306-1556
Education and Human Resources 306-1557
Instrumentation and Facilities 306-1558

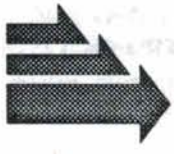
Division of Ocean Sciences (OCE) 306-1580

Ocean Sciences Research Section 306-1582
Biological Oceanography Program 306-1587
Chemical Oceanography Program 306-1589
Physical Oceanography Program 306-1583
Marine Geology and Geophysics Program ... 306-1586
Oceanographic Technology and Interdisciplinary Coordination Program 306-1584

Oceanographic Centers and Facilities Section 306-1576
Ocean Drilling Program 306-1581
Oceanographic Facilities Program 306-1579
Ship Operations Program 306-1577

Office of the Assistant Director for Geosciences 306-1500

Or contact us by e-mail!



The standard protocol for e-mail addresses at NSF is to combine the first initial and up to seven characters of the last name followed by @nsf.gov (e.g.: jdoe@nsf.gov). There are exceptions, however, so check on the GEO Web Site or call the appropriate program to confirm the e-mail address.

GETTING NSF INFORMATION AND PUBLICATIONS

The National Science Foundation (NSF) has several ways for the public to receive information and publications. Electronic or printed copies of the NSF telephone directory, abstracts of awards made since 1989, and many NSF publications are available as described below. To access information electronically, there is no cost to you except for possible phone and Internet access charges. Choose the method of access that matches your computer and network tools. For general information about Internet access and Internet tools, please contact your local computer support organization.

WORLD WIDE WEB: NSF HOME PAGE

The World Wide Web (WWW) system makes it possible to view text material as well as graphics, video, and sound. You will need special software (a "web browser") to access the NSF Home Page. The URL (Uniform Resource Locator) is ***http://www.nsf.gov/***.

INTERNET GOPHER

The Internet Gopher provides access to information on NSF's Science and Technology Information System (STIS) through a series of menus. To access the Gopher, you need Gopher client software; the NSF Gopher server is on port 70 of ***stis.nsf.gov***.

ANONYMOUS FTP (FILE TRANSFER PROGRAM)

Internet users who are familiar with FTP can easily transfer NSF documents to their local system for browsing and printing. The best way to access NSF information is to first look at the index (file name: **index.txt**). From the index, you can select the files you need. FTP instructions are:

- FTP to ***stis.nsf.gov***.
- Enter **anonymous** for the user name, and your e-mail address for the password.
- Retrieve the appropriate file (i.e., **filename.ext**).

E-MAIL (ELECTRONIC-MAIL)

To get documents via e-mail, send your request to the Internet address ***stisserve@nsf.gov***. The best way to find NSF information is to request the index. Your e-mail message should read: **get index.txt**. An index with file names will be sent to you. However if you know the file name of the document you want, your e-mail message should read: **get <filename.ext>**.

E-MAIL MAILING LISTS

NSF maintains several mailing lists to keep you automatically informed of new electronic publications. To get descriptions of the mail lists and instructions for subscribing, send your request to: ***stisserve@nsf.gov***. Your message should read: **get stisdirm.txt**.

ON-LINE STIS

NSF's Science and Technology Information System (STIS) is an electronic publications dissemination system available via the Internet (telnet to ***stis.nsf.gov***); you will need a VT100 emulator. The system features a full-text search and retrieval software (TOPIC) to help you locate the documents. Login as **public** and follow the instructions on the screen.

To get an electronic copy of the "STIS USERS GUIDE," NSF 94-10, send an e-mail request to: ***stisserve@nsf.gov***. Your message should read: **get NSF9410.txt**. For a printed copy of the "STIS USERS GUIDE," see instructions "How To Request Printed NSF Publications."

NON-INTERNET ACCESS VIA MODEM

If you do not have an Internet connection, you can use remote login to access NSF publications on NSF's on-line system, STIS. You need a VT100 terminal emulator on your computer and a modem.

- Dial **703-306-0212**,
- choose 1200, 2400, or 9600 baud,
- use settings 7-E-1, and
- login as **public** and follow the on-screen instructions.

NSF 95-64 (Replaces NSF 94-4)

HOW TO REQUEST PRINTED NSF PUBLICATIONS

You may request printed publications in the following ways:

- send e-mail request to: ***pubs@nsf.gov***
- fax request to: **703-644-4278**
- for phone request, call: **703-306-1130** or Telephonic Device for the Deaf (TDD **703-306-0090**)
- send written request to:

  NSF Forms and Publications Unit
  4201 Wilson Boulevard
  Room P-15
  Arlington, VA 22230

When making a request, please include the following information:

- NSF publication number;
- number of copies; and
- your complete mailing address.

QUESTIONS ABOUT NSF PUBLICATIONS, PROGRAMS, ETC.

Contact the NSF Information Center if you have questions about publications, including publication availability, titles, and numbers. The NSF Information Center maintains a supply of many NSF publications for public use. You may:

- visit the NSF Information Center, located on the second floor at 4201 Wilson Blvd., Arlington, Virginia.; or
- call the NSF Information Center at **703-306-1234**; or **703-306-0090** for TDD; or
- send e-mail message to ***info@nsf.gov***.

QUESTIONS ABOUT THE ELECTRONIC SYSTEM

Send specific, system-related questions about NSF electronic publication services that are not answered in this flyer, to ***webmaster@nsf.gov*** or call **703-306-0214** (voice mail).

APPENDIX V

STATUS OF NAVY OCEANOGRAPHIC FLEET
Report to UNOLS FIC
20 June 1996

AGOR (Auxiliary General Oceanographic Research) Ships:

- Navy-owned, University-operated.
- Four ships in service:

Hull No.	Name	Operator	Remarks
AGOR 14	MELVILLE	SIO	Upgraded '92
AGOR 15	KNORR	WHOI	Upgraded '92
AGOR 22	MOANA WAVE	U Hawaii	Deactivate FY '98
AGOR 23	THOMPSON	U Washington	Operational '92

- Two ships under construction:

AGOR 24	REVELLE	SIO	Delivered 11 Jun '96
AGOR 25	ATLANTIS	WHOI	Delivery sked Apr '97

TAGS (T-MSC operated Auxiliary General Survey) Ship:

- Navy-owned, Navy-operated.

- Seven ships in service:

Hull No.	Name	Remarks
TAGS 26	BENT	Deactivate 2000; replaced by TAGS 64
TAGS 27	KANE	Deactivate Sep '97; foreign transfer; replaced by TAGS 62
TAGS 34	WYMAN	Deactivate Sep '98; scrap; replaced by TAGS 63
TAGS 51	MCDONNELL	Operational '91
TAGS 52	LITTLEHALES	Operational '92
TAGS 60	PATHFINDER	Operational '95
TAGS 61	SUMNER	Operational '95

- One ship under conversion:

TAGS 45	WATERS	Intra-Navy transfer Oct '95; ready for ops Feb '97

- Two ships under construction:

TAGS 62	BOWDITCH	Delivery sked Jul '96; Replace KANE
TAGS 63	HENSON	Launch sked Jan '97; delivery sked Feb '98; Replace WYMAN

- One ship in FY97 Congressional actions:

TAGS 64	(unnamed)	Replace BENT

OTHER (Other Things Heard & Expeditiously Reported) Activities:

- Congressional Actions.

Authorization Bills:
+ Senate Armed Services Committee (SASC) authorization language supports acquisition of one new oceanographic research ship, based on a SWATH TAGOS 23 Class, for operation by an unspecified university. SASC increased budget by $45 million for this ship.
+ SASC also authorized $54 million for the acquisition of TAGS 64.
+ House authorized $54 million for TAGS 64. No mention of additional university ship.
+ It is expected that the House-Senate Authorization conference will modify the Senate language regarding the $45 million acquisition but retain the intention to buy.

Appropriations Bills:
+ House Appropriations Committee (HAC) is now in session.
+ Senate Appropriations Committee (SAC) will convene shortly.

- Navy Activity:
AGOR 24 & 25 construction progress on track and nearing completion.
TAGS 63 delivery may occur early (Oct '96 vice Jan '97).
TAGS 64 FY '97 congressional funding very likely.
Deep submersibles, SEA CLIFF and TURTLE, scheduled to be deactivated in early FY '97 and early FY '98 respectively. Future uncertain. FOFCC advised.

APPENDIX VI

Following is an update regarding the NOAA fleet for the UNOLS FIC meeting.

STATUS OF NOAA OCEAN RESEARCH SHIPS:

NOAA Ship RONALD H. BROWN - launched May 30, 1996. Halter Marine is projecting delivery during the week of March 8, 1997.

NOAA Ship KA'IMIMOANA - now in service after completion of the conversion to support the TAO climate array. Has completed a cruise for the ATOC program (for Scripps Institution of Oceanography) during the transit from Seattle to Hawaii, and is about to depart on the first TAO cruise. The conversion met all of the NOAA scientific mission requirements, and all systems operational. KA'IMIMOANA is uniquely configured for efficient buoy/mooring support operations.

NOAA Ships MALCOLM BALDRIGE and DISCOVERER - to be out of service before the end of fiscal year 96.

STUDIES OF THE NOAA CORPS AND FLEET

Several studies are being conducted of the Corps and Fleet, by groups in and out of Department of Commerce. All are in-progress and/or administratively restricted by the Administration at this time.

CHARTER OF UNOLS VESSELS:

This year, NOAA has chartered a significant number of days aboard R/V PELICAN.

NOAA has identified $2.6 M to be utilized annually beginning in FY 97 for charter of UNOLS vessels. Because of the expected delivery date for the RON BROWN and projected sailing schedules, NOAA presently expects the sum for UNOLS charter to be slightly larger during FY 1997.

OAR - UNOLS INITIATIVE

Dr. Alan Thomas, Acting Assistant Administrator for Oceanic and Atmospheric Research, and Dr. Ken Johnson, are co-chairs of a UNOLS - NOAA committee to explore increased collaboration between UNOLS and NOAA research programs. Other agencies are represented.

MISCELLANEOUS OF GENERAL INTEREST

On June 10-11, a Workshop on Maintaining Current and Future Fisheries Resource Survey Capabilities was held, convened by the Atlantic States Marine Fisheries Commission, Gulf States Marine Fisheries Commission, and Pacific States Marine Fisheries Commission. Federal, state, academic, and commercial interests were represented. Findings and recommendations are being developed by the steering committee and are expected to be distributed quickly.

APPENDIX VII

Autonomous Ocean Sampling Network

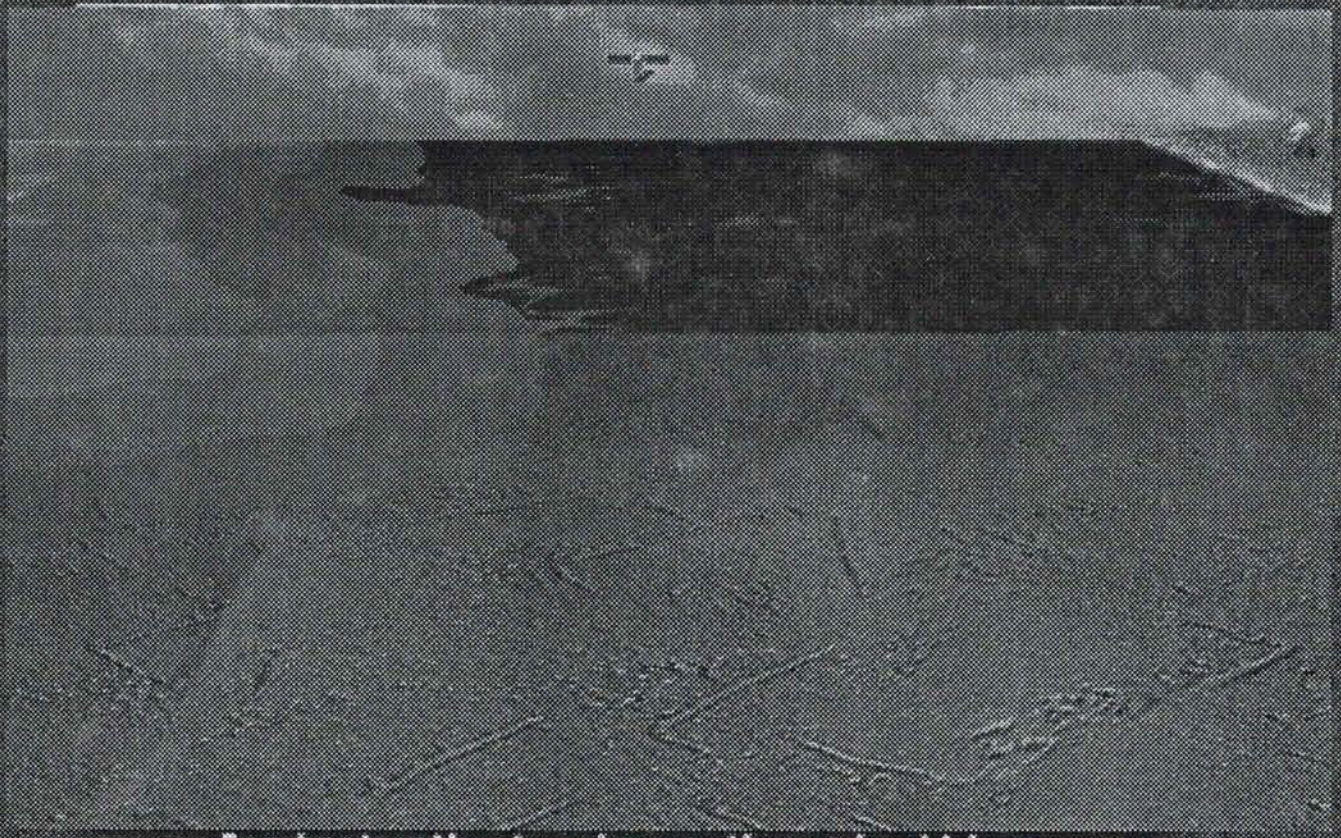
Dr. Thomas B. Curtin
Office of Naval Research


AVHRR


CZCS
AVHRR

3-D Ocean Field Estimation

Numerical Models + Observations (sensors, platforms)

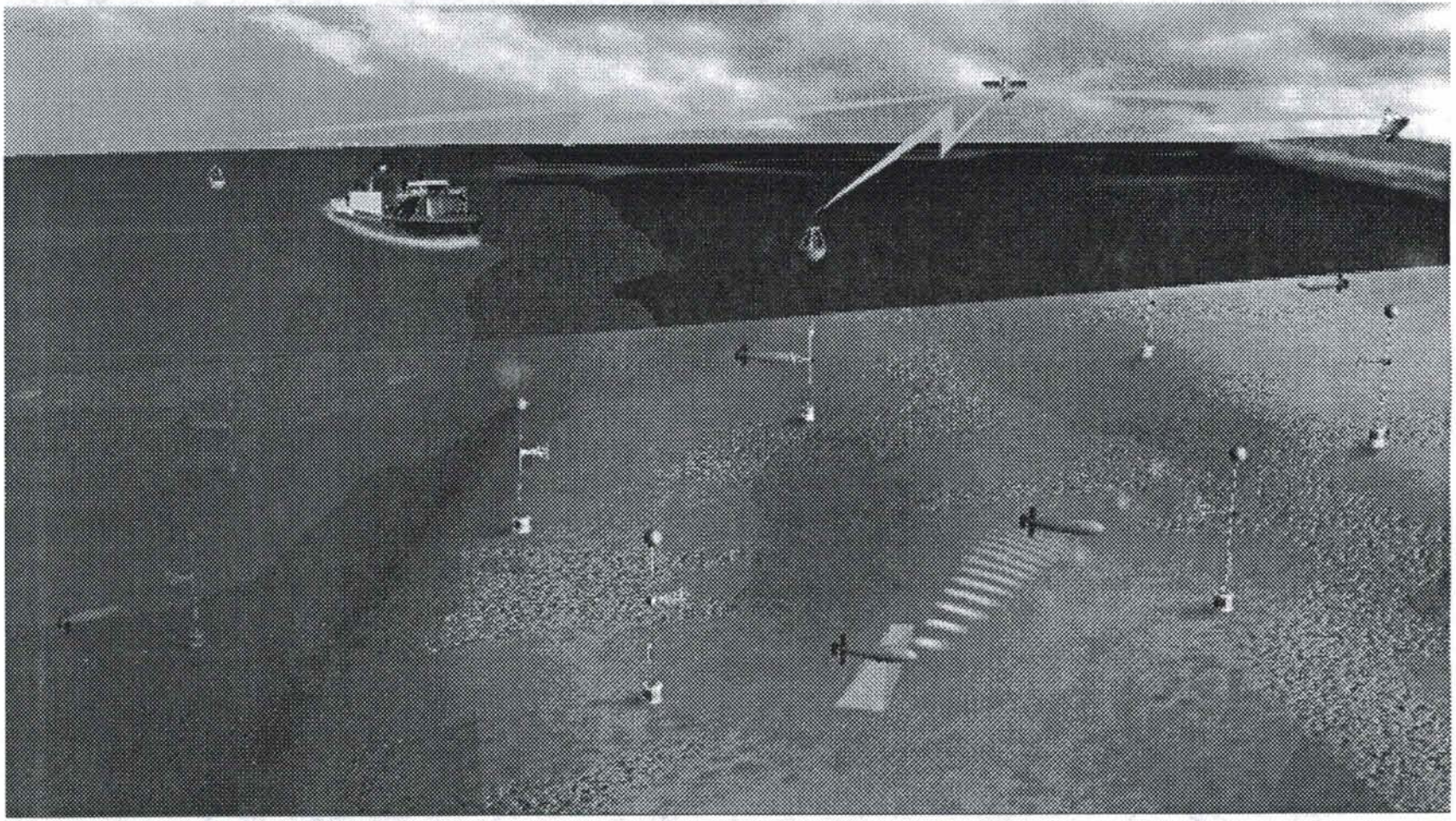


For best estimate, observations should be:

- simultaneous at multiple points (gradient measurement)
- time variable, spatial resolution (adaptive sampling)

Autonomous Ocean Sampling Network

Fixed Nodes + Mobile Nodes



Sampling Approach
(Configuring the Network for a Specific Mission)

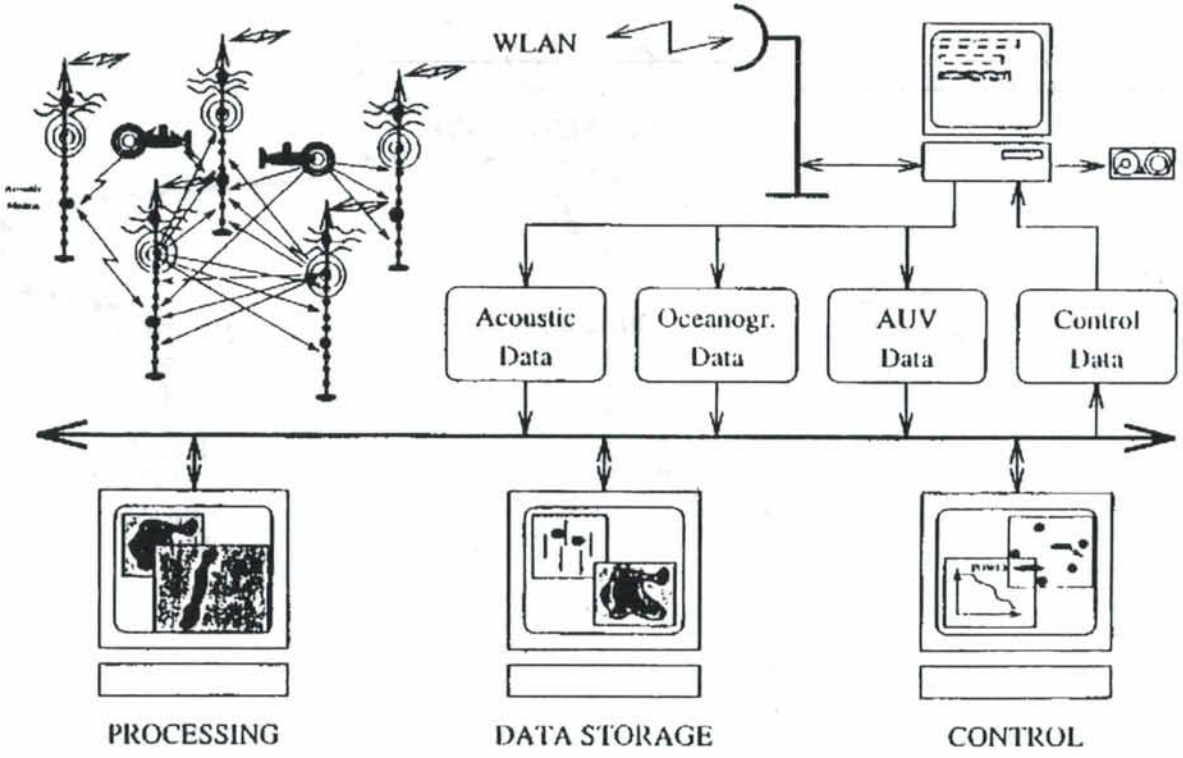
(1) Identify phenomenon of interest
(determine resolution)

(2) Determine ocean volume coverage
(define range)

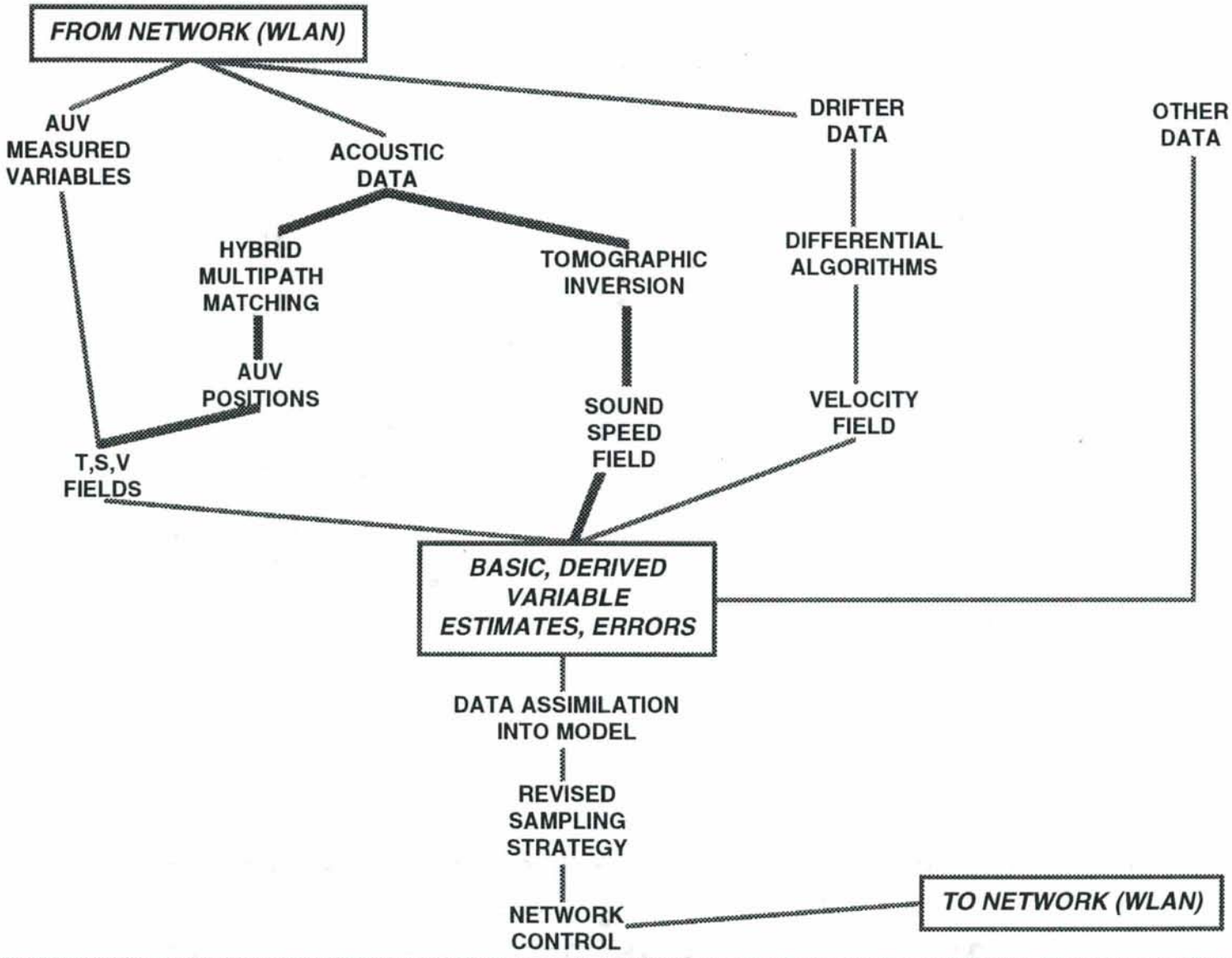
(3) Define acceptable error bounds
(specify precision)

(4) Specify sensors, node distribution, initial
sampling strategy (adaptive)

Real-Time Oceanography Network Architecture



Shore Station Operations

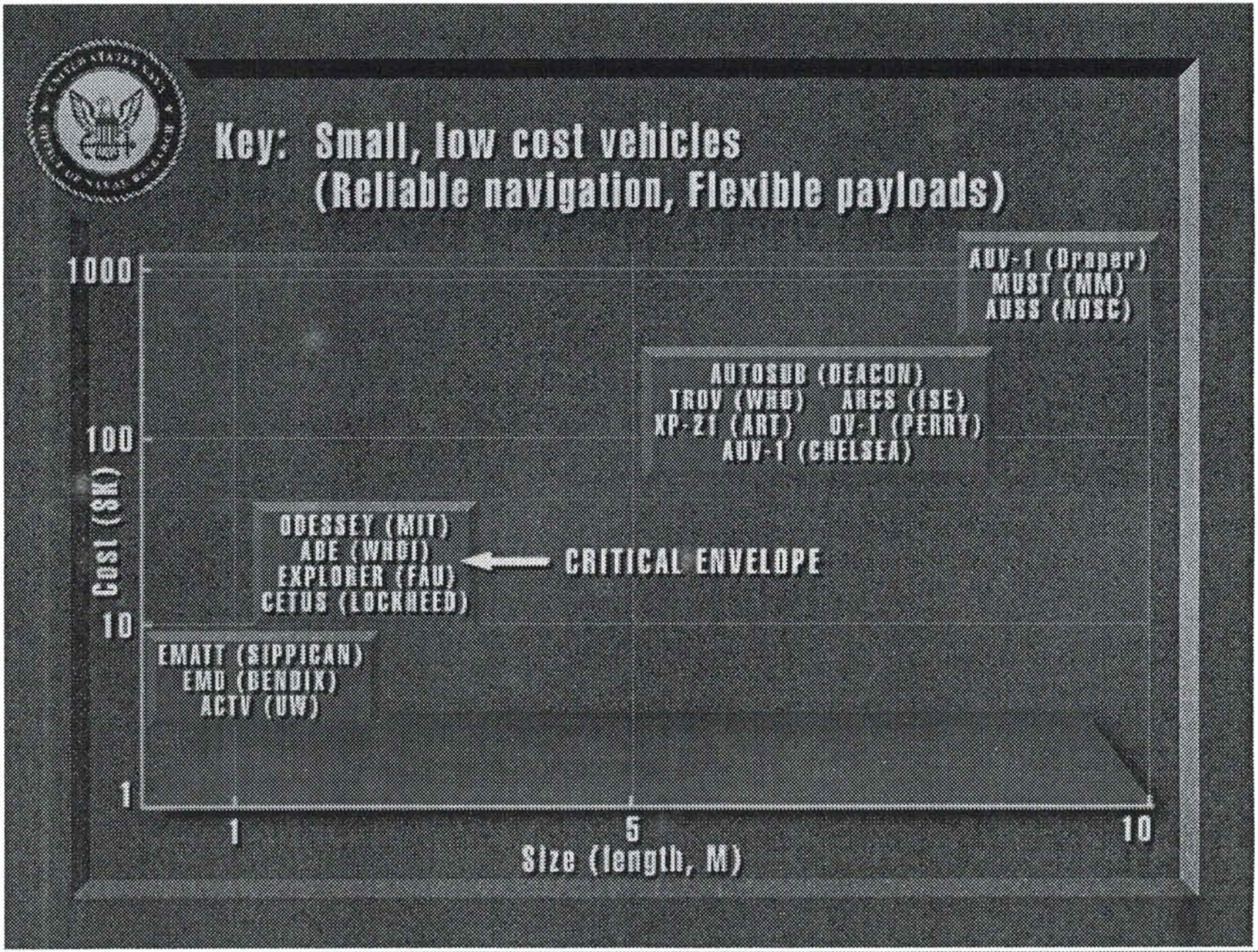


Network Advantages

- Synoptic volume coverage
- Adaptive sampling (global/local knowledge)
- Flexible control options
- Energy limitation management
- Robust to component failure

Network Interoperability (Standards)

- Communication
- Navigation
- Energy
- Software


Key: Small, low cost vehicles
(Reliable navigation, Flexible payloads)
1000
100
10
1
Cost ($K)
AUV-1 (Draper)
MUST (MM)
AUSS (NOSC)
AUTOSUB (DEACON)
TROV (WHO) ARCS (ISE)
XP-21 (ART) OV-1 (PERRY)
AUV-1 (CHELSEA)
ODESSEY (MIT)
ADE (WHOI)
EXPLORER (FAU)
CETUS (LOCKHEED)
CRITICAL ENVELOPE
EMATT (SIPPICAN)
EMD (BENDIX)
ACTV (UW)
1
5
10
Size (length, M)

Technical Issues

Control/Communication/Navigation

- Integration of autonomous mission management and human supervisory control
- Performance predictability of autonomous mission management
- Integrated reliability within an adaptive control environment
- Delayed control through long range acoustic communication links
- Arbitration of behaviors with competing objectives
- Compilers for high level mission description conversion into state table
- Survey, gradient/terrain following, docking, path optimization algorithms

Technical Issues

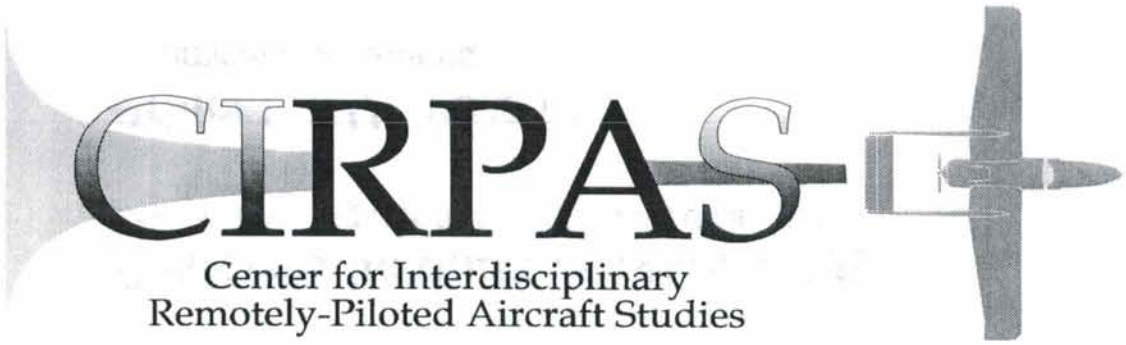
- Collision resolution multiple access (CRMA) acoustic data transfer among multiple vehicles in close proximity
- Integrated undersea/satellite network communication architecture, protocols
- Optimum search strategies related to mission goals, sensors, and communication constraints
- Measure of effectiveness in group performance
- Optimization in group behavior (individual capability versus inter-individual communication limits)
- Convergence of acoustic navigation precision by bootstrap methods
- Optimal initial deployment of multiple vehicles for desired adaptive behavior

Technical Issues

- Sensor
  - MEMS technology for low power, low cost, wide dynamic range mechanical transduction
  - Fiber optic/spectrophotometer technology for optical, chemical biological sensing
  - Inversion of acoustic communication data packets for sound speed field (tomography)
- Propulsion
  - Structure-flow interactive systems
  - Performance optimization over wide speed ranges
  - Propeller, actuator efficiency
- Power
  - High pressure battery charging
  - Efficient underwater non-contact power coupling

APPENDIX VIII

The Center for Interdisciplinary Remotely-Piloted Aircraft Studies



"Safety-Net" for Baseline Operations

- Organization
- CIRPAS Platforms
- The Science & Technology Initiatives
- Cost Model

CIRPAS Organization

Office of Naval Research
Ocean, Atmosphere, and Space Science and Technology Department

Naval Postgraduate School
Meteorology, Oceanography, Physics, Aeronautics and Astronautics, Mechanical Engineering, Electrical and Computer Engineering, Operations Research, Space Systems Academic Group

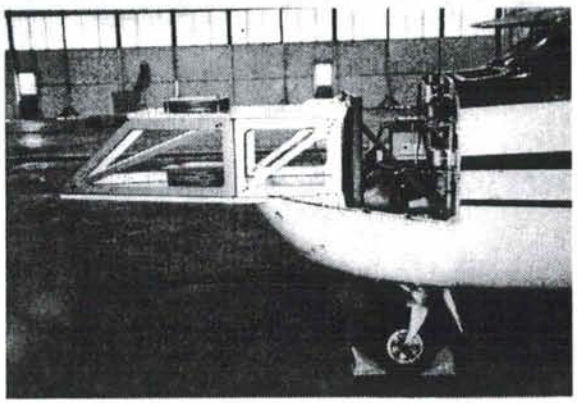
California Institute of Technology
Division of Engineering and Applied Science

Princeton University
Chemical Engineering

Department of Energy
Atmospheric Radiation Measurement Program

Pelican

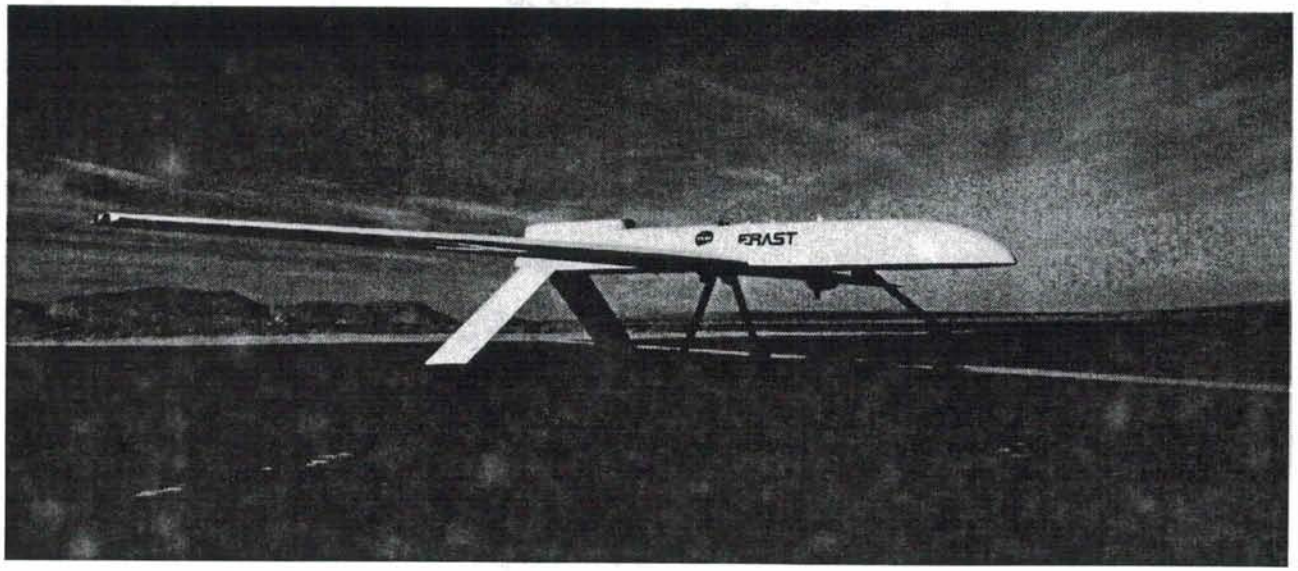
- optional onboard/remote piloting
- distributed real-time data access
- large payload (150kg nose, 50kg wings)
- diverse payload (meteorology, oceanography, chemistry, remote sensing)
- 24 hour missions (remote)
- low altitude (10-20 m minimum)
- slow speed (40 m/s)



CIRPAS
Center for Interdisciplinary Remotely-Piloted Aircraft Studies

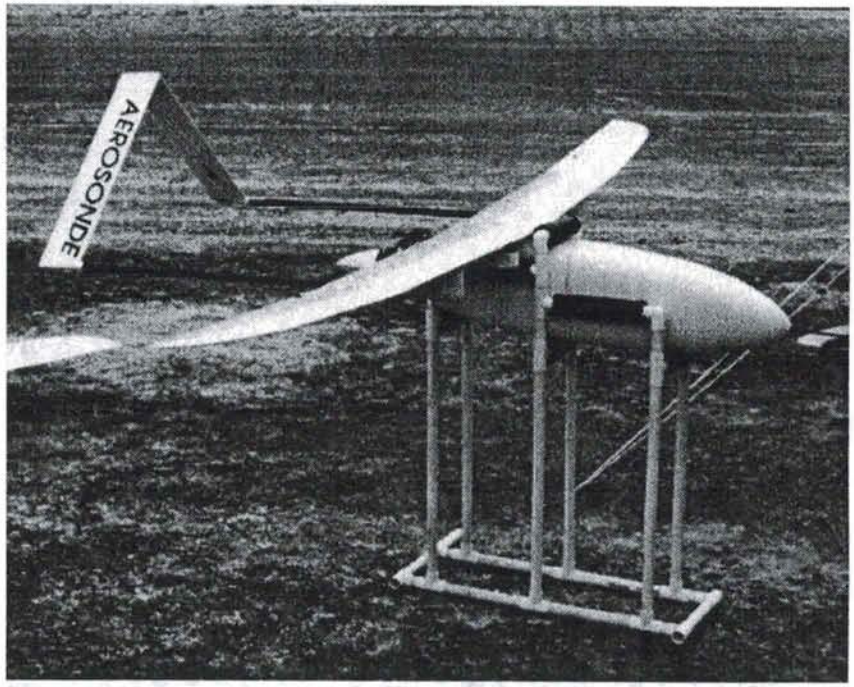
Altus

- General Atomics *Predator* derivative
- 150 kg payload
- Ultimate altitude maximum of 65,000 ft
- Flight duration of 50 hours



Aerosonde

- atmospheric vertical profiles of temperature, humidity, pressure and winds (50 m to 4 km)
- low-cost radiosonde (balloon) alternative
- reusable
- programmable flight profiles (1500 km range)
- ultimately over 12-hour duration



Science & Technology Initiatives

Funded
Proposal
Planning

- **Aerosol Radiative Forcing**
  - TARFOX (Jul 1996) Wallops Is., VA - *Pelican*
    - NASA, ONR
  - ACE-2 (Jun-Jul 1997) NE Atlantic - *Pelican* (first remote mission), *Altus*?, *Aerosonde*?
    - NSF, NASA, ONR
  - ACE-3 (Apr 1999 or 2000) Western Pacific

- **Atmospheric Chemistry**
  - Southern California Ozone Study (Aug-Oct 1997) - *Pelican*
    - CA Air Resources Board

S & T Initiatives (continued)

- **Instrument Development**
  - CCN Spectrometer - size vs supersaturation (0.1% to 2%)
  - Gas Chromatograph - sulfur species, hydrocarbons and halogenated compounds
  - Mass Spectrometer - SO_2,SO_3, CH_3SO_3H, H_2SO_4, NO, NO_2, HNO_2, HNO_3, NH_3, possibly DMS
  - Integrating Nephelometer - scattering at 450, 550, & 700 nm
  - Counter-flow Virtual Impactor - cloud drop residual particles
  - PMS probe modification - weight and power reductions

S & T Initiatives (continued)

- **Meteorology**
  - Coastal Meteorology (Jun, Aug 1996) CA coast - *Pelican*
    - ONR
  - DOE ARM-UAV IOP (Aug 1996) Oklahoma - *Altus*
  - EOPACE (Nov 1996) San Diego coast - *Pelican*
  - Turbulence capability on *Pelican* and *Altus*
  - *Aerosonde* test and evaluation (1997)
  - South China Sea Monsoon Exp. (1998) - *Aerosonde*
  - Large Eddy Simulation Exp. (1998 or 1999) CA coast - *Pelican* and/or *Altus*
- **Oceanography**
  - CalCOFI (Oct 1996) CA coast - *Pelican*
    - ONR, NRL

S & T Initiatives (continued)

- **Remote Sensing**
  - Aerosol optical depth retrieval (TARFOX, ACE-2)
  - Ocean Color (CalCOFI)
  - 94 GHz Radar
  - Lidar
- **Operational System Support**
  - EW Vulnerability Assessment (Sep 1996) Pt. Mugu-*Pelican*
- **Classified Systems**
  - JETEP - Aerosol Retrieval with NTM
  - NTM system test and evaluation (H.Loomis)
  - UAV Sensor Technology (test and development)

CIRPAS Partnerships

- National Science Foundation
- Stockholm University - student/faculty exchange
- UK MRF - technology development
- NASA Environmental Research Aircraft and Sensor Technology (ERAST) Program (Dryden Flight Research Center)
- NASA Ames Research Center - sensor development
- NASA Mission to Planet Earth - RPA Study
- Naval Research Laboratory - Hyperspecral Imager
- Joint Environmental Technology Exchange Program-JETEP
- Numerous University collaborative projects

APPENDIX IX

APPENDIX IX

MG & G Presentation

Date: Fri, 31 May 1996 10:55:03 -0500
To: cmooers@rsmas.miami.edu
From: rdetrick@whoi.edu (Bob Detrick)
Subject: FIC homework

UNOLS Fleet as MG&G Platforms for NAVO

(Point paper by Robert Detrick; information supplied by Commander Jim Trees, NAVOCEANO)

NAVOCEANO is potentially interested in using UNOLS vessels equipped with multibeam sonars, gravimeters and seismic sub-bottom profiling systems for surveys along both the U.S. east and west coasts. These surveys may extend into water depths of less than 100 fathoms (-200 m). This work may be carried out on more than one vessel over several different periods during FY '97 as needed to integrate with existing, scheduled UNOLS academic research work. In FY '97 NAVO has budgeted $4.7M for possible contract work on UNOLS vessels or other commercial survey ships although at this time they do not have a final budget figure for FY '97. It was not clear to me if this $4.7M figure represents just ship time or total project costs of which ship time only represents a portion of the total. However it is clear that the potential is here for NAVOCEANO to utilize a substantial amount of UNOLS ship time in FY '97.

UNOLS vessels equipped with multibeam sonars include the EWING, KNORR, MELVILLE, THOMPSON and REVELLE. The sonar systems on these ships are designed to operate in water depths of 10-10000 m and should be able to satisfy most, if not all, of the NAVO survey requirements. It was unclear from my conversations with Cmdr. Trees whether NAVO required MCS or just SCS sub-bottom seismic profiling. The EWING is the only UNOLS vessel equipped for MCS; any of the multibeam-equipped UNOLS vessels could be equipped for SCS profiling, although only the EWING and MELVILLE routinely collect such data.

Recommendations:

In FY '97 a significant opportunity exists for NAVO utilization of multibeam equipped UNOLS vessels for survey work along the U.S. east and west coasts. The potential of similar survey work for NAVO in 1998 and beyond needs to be explored. FIC should also consider the need for equipping one or more UNOLS vessels with a higher frequency (75 kHz), shallow water (operating range 1-500 m), multibeam mapping system to improve mapping capabilities of the UNOLS Fleet in very shallow water.

MG&G Science Program Prospects

(Point paper by Robert Detrick)

Like the rest of the marine science community, science program prospects within MG&G are very uncertain.

The budget for ODP is expected to remain flat for FY '97. Program renewal for Phase III, which begins in 1998, has yet to be decided although NSF has committed to the program through 2002. The drill ship will move into the Indian Ocean in late 1997 and is expected to work in the Indian Ocean and western Pacific through 1999. There thus may be ODP-related site survey needs on UNOLS vessels in these areas.

The RIDGE program budget is, at best, expected to remain flat for the next few years. With the completion of the initial phase of the RIDGE Indian Ocean program earlier this year, and the third leg of the MELT experiment next year, RIDGE research is expected to focus more on the RIDGE Observatory on the Juan de Fuca Ridge in the northeast Pacific. This work will involve deep submergence (ALVIN, ROV) studies, mapping and sampling, and instrument deployment and recoveries usually involving Class II or III vessels. Other major programs are planned or proposed for the Mid-Atlantic Ridge and East Pacific Rise, as well as an expedition involving the new ATLANTIS to the southern EPR, western Pacific and possibly into the Indian Ocean.

MESH and MARGINS are the other two major MG&G initiatives. MESH UNOLS ship use is relatively modest and is not expected to increase significantly (as far as I know). The MARGINS program is likely to be the next major initiative in MG&G but its future funding prospects are very uncertain. Nevertheless, the MARGINS community has typically conducted one or two major experiments each year (e.g. Aleutians, New Zealand, East Greenland). These experiments usually require the airgun/MCS capabilities of the EWING. This level of activity could increase if the MARGINS program is funded. Other new initiatives within MG&G include BOREHOLE, LIPS, and OSN. Funding prospects for all of these programs are very dependent on the future of the NSF budget. Most involve use of Class II or III vessels, especially the EWING, but also those equipped with multibeam sonars.

Shipboard Technology Upgrades

MG&G Needs:

P-Code GPS - P-code is enormously useful but is not available on all UNOLS vessels. It should be.

The UNOLS Fleet is now well-equipped with deep water multibeam sonars (six ships - the MELVILLE, KNORR, THOMPSON, EWING, REVELLE and ATLANTIS) all have second or third generation deep water sonar systems. However, I don't believe any UNOLS vessel is equipped with a shallow water multibeam system (i.e. for operating in

water depths of <10-100 m). This may be a future need, especially with a greater emphasis on coastal processes.

With the conversion to the new ATLANTIS the deep submergence community in the U.S. is pretty well taken care of for now platform-wise. Upgrades to the ALVIN, in order to keep its capabilities "state-of-the-art", will be needed.

The EWING's MCS streamer, the only such facility available to the U.S. academic community, is in need of replacement. The present streamer is too short, is one of only two in existence making obtaining replacement sections hard, and is in poor condition. A new, six km, industry standard streamer is needed ASAP.

We need at least two UNOLS vessels capable of firing a large (ca. 6000-8000 cu in) airgun array for seismic refraction studies. The EWING is so equipped, but a second airgun-equipped vessel is needed for refraction studies that don't involve MCS. The MELVILLE has some capability in this area but its system needs to be upgraded to match that on the EWING.

APPENDIX X

DRAFT

Outline for UNOLS-Fleet Improvement Plan 1998

Executive Summary

I. Background
- A. FIC
- B. Purpose and objectives of update
- C. UNOLS Fleet
- D. Utilization and cost trends
- E. Support trends

II. Trends in Oceanography and Facility Needs
- A. Coastal Oceanography
- B. Polar Oceanography
- C. Physical Oceanography
- D. Biological Oceanography
- E. Chemical Oceanography
- F. Marine Geology and Geophysics
- G. Marine Meteorology
- H. Ocean Acoustics and Optics
- I. Global Oceanography
- J. Fisheries Oceanography
- K. Impact of new technologies
- L. Agency science plans for big and small science programs
- M. R/V needs for the next five-to-ten years AND beyond
- N. Etc.

III. Trends and Issues Regarding the UNOLS Fleet
- A. Future funding
- B. Future costs
- C. R/V retirement projections
- D. New construction priorities
- E. Interagency cooperation & support
- F. Regional distribution
- G. Modes of operation
- H. Special platforms
- I. Deep submersibles
- J. ROVs, AUVs, etc.
- K. Real-time data acquisition and dissemination
- L. Needed technology upgrades
- M. Etc.

IV. Findings and Recommendations

Appendix I: CZRV analysis, etc.
Appendix II: Regional consortia
Appendix III: Others