

Doc # 103

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Department of the Navy
DON/AA DRMD
Date: <u>2014-11-17</u> Authority: EO 13526
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Reason: _____
MDR <u>2014</u> -M- <u>0136</u>

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3 FEB 1977

MEMORANDUM FOR MR. REGINALD BARTHOLOMEW, DEPUTY DIRECTOR, BUREAU OF POLITICO MILITARY AFFAIRS, DEPARTMENT OF STATE

SUBJECT: SEASAT-A Study/Options Paper

~~(SNT)~~ In the current draft paper, a reference is made to the systematic assessment being accomplished by the Navy to determine the military value of the SEASAT-A data. A summary paragraph concerning the assessment has been prepared for inclusion in the Study/Options paper (copy attached). I recommend that it be placed as the third paragraph in the portion dealing with the Synergy Question. A copy of the entire Navy plan is also attached to be used as an Appendix.

(U) The plan should be recognized as an internal DoD document and it is not being submitted for comment. Rather, it provides clarity and further definition to the Study/Options paper. I hope this will be of assistance to you.

ROSS N. WILLIAMS
RADM, U.S. NAVY
Ross N. Williams
Rear Admiral, U.S. Navy
Military Assistant
Strategic & Space Systems

Attachments

1. Summary Paragraph
2. Navy Plan

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Summary Paragraph (U)

~~(S/NF)~~ The Navy has undertaken a detailed systematic study to understand the military value and the national security concerns of the SEASAT-A sensor complement. The study will establish limits at which the data output becomes a matter of military concern. The timeliness and spatial distribution of the various observations will be analyzed to establish the point where military usefulness of the data diminishes. Specific experiments, including underflights and shipborne measurements, will be designed to calibrate and evaluate sensor performance. The synergistic effects will be carefully considered to fully understand the possibility of SEASAT-A in conjunction with other sources (such as other satellites, ships, buoys, etc.) yielding data of value to military operations. The study will continue beyond the launch of SEASAT to use actual data. The Navy plan is included as Appendix ____.

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ASSESSMENT OF THE MILITARY VALUE OF SEASAT AND ITS FOLLOW-ONS

I. INTRODUCTION

SEASAT is a proof-of-concept satellite experiment designed to measure ocean surface parameters. The sensor complement is: Radar Altimeter (ALT), Scanning Multifrequency Microwave Radiometer (SMMR), Radar Scatterometer (SCAT), Synthetic Aperture Radar (SAR), and Visible/ IR Scanner (V/IR). The planned launch date is May 1978. Measurement objectives are: marine surface topography, surface wind speed and direction, significant wave height, directional ocean wave spectra, sea surface spectra, coastal region images, undulations associated with gravimetric anomalies, and detection of icebergs. Concerns have arisen regarding risks to national security as a consequence of unrestricted release of data from SEASAT and projected Earth observation programs and experiments.

Although the requirements of the civilian program of Earth observations from space are quite different from military objectives, a continuous improvement in resolution, coverage, data processing, etc. of various sensors developed by NASA and NOAA are expected to conflict with national security interests. This stems from the fact that there is no restriction on the distribution of the data produced, participation of foreign investigators in such programs, and potential of direct reception of raw observational data at foreign sites. Clearly, performance of these systems will reach a point at which the observations will contain information of considerable military value. Less apparent is a distinct possibility that while the information produced by a single instrument may not contain anything of military interest per se, when combined with cleverly processed outputs of other instruments on the same or other satellites, the results become militarily valuable.

The beginnings of a conflict between civilian space activity and national security interests arose in the GEOS-C program and are now surfacing in the SEASAT project. The area of concern in both cases has been high precision altimetry which affects the definition of the geoid, which in turn has SLBM targeting implications. Of additional concern with SEASAT is the possibility that data from the various sensors could be utilized in combinations (the synergistic effect) which might provide unexpected detection capabilities.

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It is the purpose of the subsequent discussion to outline a program to assess the military value of SEASAT-derived information and that of subsequent operational versions. Further, the possibility of synergistic results, when data from two or more SEASAT sensors are combined or when SEASAT-generated information is combined with that produced by other NASA, NOAA and conceivably unfriendly observational programs, will be assessed.

II. ISSUES TO BE RESOLVED

A list of issues to be considered is given with minimum discussion. The list, not claimed to be exhaustive, is divided into technical and management categories.

A. Technical Issues

1. Sensor Resolution, Precision, Coverage

The problem is to establish values at which the data output becomes of military concern. Consideration of SEASAT performance and projected follow-on improvements will be assessed in terms of all environmental parameters measured, and in terms of secondary-performance objectives.

2. Timeliness and Spatial Distribution of Observations

This is an important item. If an aircraft carrier is detected, information regarding its location loses value if the information transmission is delayed. This information is perishable. On the other hand, local details of the geoid remain valid over indefinite spans of time, and have enduring value for military applications. The spectrum of perishability will require considerable thought and trade-off analysis.

3. Ground Truth Evaluation

Underflights and shipborne measurements will be conducted jointly with SEASAT to calibrate and evaluate sensor performance. The surface measurements will be carried out with an advanced sensor complement and results extrapolated to assess performance levels expected of SEASAT follow-ons.

4. Synergistic Effects

Current experience has shown that, in some cases, information extractable from various NASA and NOAA programs exceeds design estimates. Combinations of instruments such as a 30-meter resolution mapper with a 10-meter resolution pointable imager provide a great deal more information than each one separately. Data from several sources (other satellites, ship, buoys) may be used in an interactive way to yield data of high value to military operations.

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5. Orbit Precision

Geodetic accuracy is dependent on satellite altimeter data which in turn are dependent upon tracking precision. In addition, position translation (tying geodetic nets together) is dependent on precise orbital determination. Therefore, high-precision tracking data, because of its impact upon the utility of sensed data, are of military value in their own right.

B. MANAGEMENT ISSUES

SEASAT is scheduled for launch in May 1978. Important decisions are now being implemented. DOD considerations should be factored in as soon as possible before the NASA actions become irreversible.

Recommendations for Navy Policy decisions should be made by the Naval Environmental Remote Sensing Coordinating and Advisory Committee (NERSCAC) (with support by OP-60, OP-955, OP-21 and PME-106) based upon military requirements and technical information resulting from this study. Interface with NASA and NOAA shall be through the DOD/NASA/NOAA Group recently established by Dr. Currie and Dr. Fletcher. Issues to be resolved at the Management Policy level include:

1. Liaison with Program Planning Offices and Civilian Agencies

It is important to establish what problems are of concern to operational activities and what is being planned by NASA and NOAA.

2. Management Responsibility

Establish focus for

- a. Security matters
- b. Policy for data distribution and/or release to non-DOD users.
- c. Funding responsibilities for data collection, processing and distribution.

3. Tracking Network

GEOS-C is basically tracked by the TRANET and the raw data are not supplied to NASA. With Polar orbiters, NASA is likely to expand the network and the data could no longer be

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controlled easily. A policy decision is required for management of the tracking networks and for release of tracking data. The Global Positioning System (GPS) is a potential area of concern.

4. Archiving of Sensitive Data

Data will fall into four general categories of sensitivity: unrestricted data of no military concern; data releasable after a stipulated time interval; data temporarily restricted pending performance evaluation and sensitivity review; and data not releasable because of national security concerns. Decisions are required regarding the amount, format, duration, and location of restricted data that must be archived. A formal review procedure must be established to purge the restricted archive.

III. TENTATIVE PLAN (Task Definition)

Four task areas are essential to a meaningful evaluation of the military worth of space sensors. Tasks A and B are analytical in nature, Task C is experimental, and Task D analysis. These tasks are technical investigations that provide factual basis for management policy decisions. This responsibility includes a technical review of proposed policy decisions, and recommendations based on technical considerations, but does not include a responsibility for policy decision making or for interagency liaison.

TASK A: Evaluation Prior to Launch of SEASAT

1. Catalog spectral region, resolution, sensitivity, and frequency of observation for candidate sensors to be utilized in study (SEASAT, LANDSAT, TIROS, NIMBUS, DMSP, NOAA).
2. List applications areas for evaluation of potential sensing applications (terrain signatures; ASW/Acoustic frontal systems; location and measurement of shear current boundaries; bathymetric information; target detection, location and classification; weather system measurements).
3. Assess military impact of remote sensing measurements as function of stringency of measurements. Prioritize sequence of applications evaluations.
4. Identify sources, format, and mechanisms for data flow to sustain evaluation study.
5. Identify potential research experiments and military operational exercises for candidate sensor evaluations.

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- 6. Define test plan for post-launch sensor evaluation study.
- 7. Provide technical data for DOD policy review of combined NASA, NOAA, DOD plans for SEASAT experiments, data processing, management of data flow, data distribution, and data archiving. This task objective must be completed in sufficient time to permit impacting SEASAT-A prior to launch.

TASK B: Laboratory Investigations

- 1. Obtain sample satellite data format from candidate sources (LANDSAT, TIROS, NIMBUS, SEASAT, DMSP, NOAA) to establish data handling procedures, data enhancement algorithms, and data analysis software for application to evaluation tests.
- 2. Conduct preliminary performance evaluations using existing data (satellite, NRL aircraft measurements) to synthesize predicted SEASAT and follow-on measurement capabilities.
- 3. Evaluate single- and multiple-sensor (synergistic) measurement capabilities derived from synthesized data in terms of predicted value for military applications.
- 4. Monitor aircraft flights of SEASAT instrument simulators to confirm measurement capabilities and evaluate data analysis algorithms.
- 5. Participate in, and verify, SEASAT sensor certification and acceptance test data and integration tests to verify sensor engineering parameters used in data reduction algorithms.
- 6. Analysis of data compiled and results obtained from previous DMA and Naval Surface Weapons Center studies, of the SLBM targeting improvements through use of SEASAT-A altimetry.

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 Date: JUN 09 2015

TASK C: Ground Truth Verification

- 1. Conduct aircraft underflights under controlled experimental conditions (as defined in test plan) to verify engineering performance, data transmission, and geophysical measurement capability of SEASAT sensors. (SEASAT sensor calibration and evaluation of data reduction algorithms.)
- 2. Following post-launch calibration and evaluation (90-day period), conduct periodic ground truth verification tests using aircraft calibration platforms to monitor performance of SEASAT sensors as function of experiment life and to extend performance validation over wide range of experimental conditions (high seas, storms, temporal variability).

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TASK D: Post-flight Evaluation of SEASAT Data

1. Use data from single- and multiple-sensors from SEASAT and other platforms to evaluate (synergistic) impact on military operations. Aircraft underflight data to be acquired over designated test sites (terrestrial, coastal, mid-ocean, and arctic) and in conjunction with research experiments and military exercises to support operational evaluation of candidate (SEASAT and follow-on) sensor performance. The specific objectives of the analyses which will be considered are:

- a. Determine the quality of signatures possible with each SEASAT sensor and their interpretation.
- b. Establish the limits and thresholds for target identification and detection.
- c. Assess the existing and potential capability for image processing to enhance specific features with collated data from several sensors simultaneously viewing the same scene.
- d. Hypothesize the resolution achievable by the synergistic effect of future sensors.

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Date: JUN 09 2015

IV. SCHEDULE/MILESTONES

See Figure 1.

V. FUNDING

See Figure 2.

Comments:

- a) Indicated funding for Tasks A-D covers technical activities only.
- b) Tasks C and D above assume that data are provided as specified in the test plan. If this is not the case, additional funding for data acquisition, processing and archiving will be required.
- c) Analysis, evaluation and synergistic impact efforts will be a continuing program from FY 77-80 in order to provide information necessary for decision making. Therefore the man-years reflected in Figure 1 appear high because, in addition to in house effort, the following is necessary:

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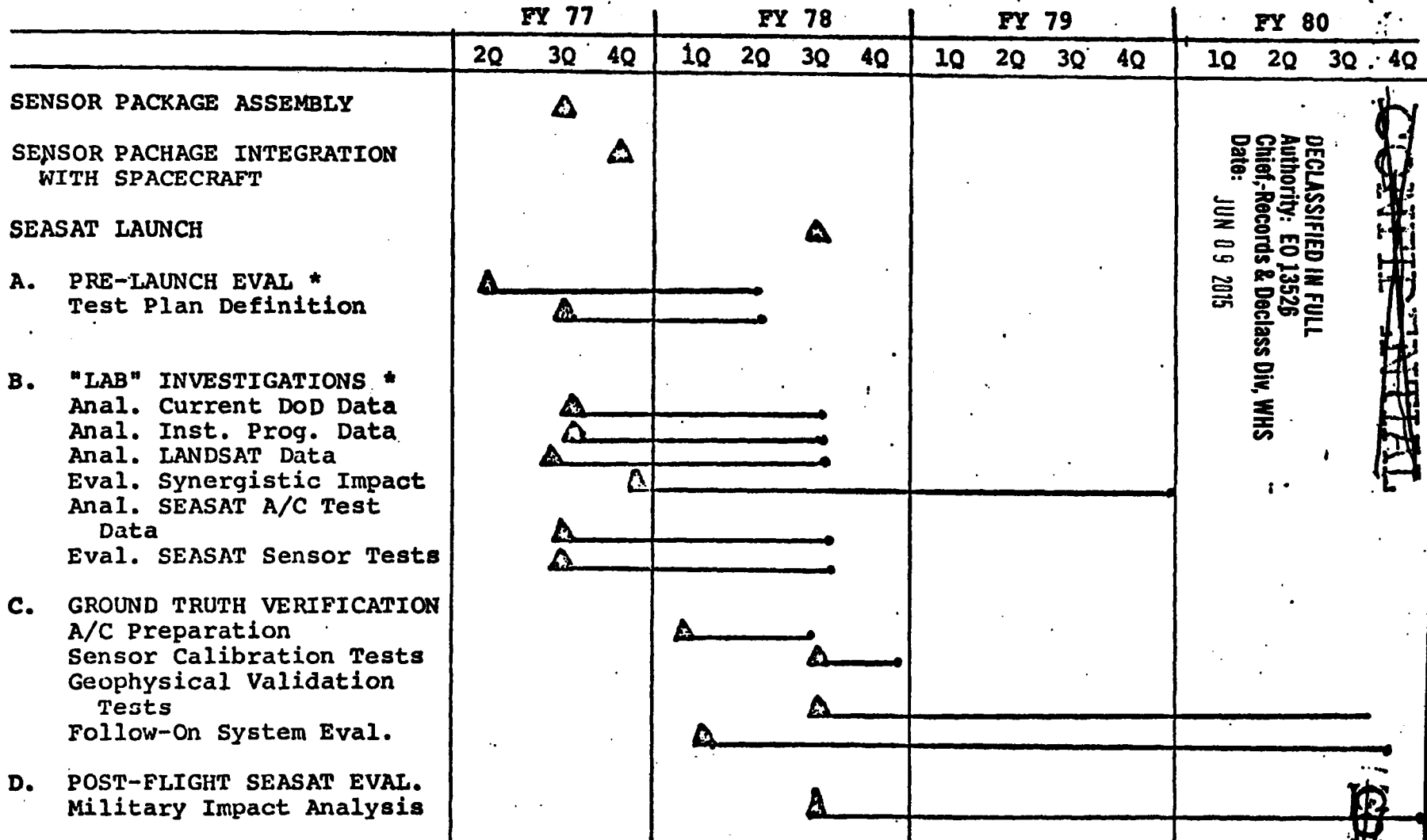
1. Consultation
Jet Propulsion Laboratory
Scripps Institute of Oceanography
Woods Hole
NASA Goddard
NOAA
UCLA
Ohio State University
Draper Labs
NUC San Diego
NUSC Newport
NRL Washington, D.C.
NORDA Bay St. Louis
NCSL Panama City
NSWC Dahlgren

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Date: JUN 09 2015

2. Workshops and information exchanges
Principal Investigators
DOD Users
3. Travel
In house
Consultants

d) The large funding estimate for Task C is for the conduct of operational tests to verify results of SEASAT-A sensor analysis and obtain ground truth measurements upon which to establish synergistic effects of sensor derived data (SEASAT sensors collectively and with other systems), and appraise the potential of future military exploitation of such information. An example of the latter is that, with the existence of a target established by ground truth measurements, novel processing techniques may expose the previously undetected target. Concomitantly, a ground truth picture will facilitate establishment of false alarm probabilities in data interpretation. The ultimate goal of Task C is, through extrapolation of results, to establish a reliable basis for predicting the degree of susceptibility of future systems to military exploitation.

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* Although Tasks A and B are projected for commencement in 3rd QTR FY 77, because of funding limitations, these tasks must in fact commence as soon as possible and must produce data which can be used as a basis for national policy decisions regarding National Security aspects of SEASAT utilization. These data are required as soon as possible to support decisions which must be made prior to SEASAT launch. Decisions which will impact on SEASAT-A configuration should be made prior to integration of the sensor package aboard the spacecraft (Aug 1977).

FIGURE 1

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		FY 77			FY 78				FY 79				FY 80				
		2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	
FUNDING (Incl: Computer, Travel, Consultants)																	
TASK	A	1 MY 90K			1 MY 90K												
	B	3/4 MY 60K			1-1/4 MY 90K				1 MY 75K								
	C				5 MY 650K				5 MY 600K				3 MY 350K				
	D				1/2 MY 50K				2-1/2 MY 200K				3 MY 275K				
	ACFT SUPPORT				180K				144K				108K				
	TEST SUPPORT	25K			50K				50K				50K				
		1-3/4 MY			7-3/4 MY 1110K				8-1/2 MY 1069K				6 MY 783K				
		175K											24 MY \$3137K				

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FIGURE 2

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