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NASA Contractor Report 156852

A Survey of Potential Users of the High Altitude Powered Platform (HAPP) in the Ocean/Coastal Zone Community

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March 1979

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AC 804 824-3411

SUMMARY

This report contains the results of a survey of the ocean/coastal zone community conducted by Computer Sciences Corporation (CSC) for the National Aeronautics and Space Administration (NASA) Wallops Flight Center to determine potential applications of a High Altitude Powered Platform (HAPP). Such a platform would be capable of stationkeeping for periods up to a year over a given location and could make frequent and repeated high-resolution observations over a given region or serve as a high-altitude regional communications link. The HAPP would combine desirable characteristics of both geostationary satellites (wide-area coverage, frequent observations) and aircraft (high resolution).

Users were surveyed in person and via a questionnaire to determine the desirability of the HAPP within the ocean/coastal zone community. More than 50 responses from users were obtained through personal interviews and responses to the questionnaire mailed out to more than 200 persons. The results of the CSC survey indicate that there is strong interest in all areas of the user community (research and development, operational agencies, private industry) in having NASA develop the HAPP. Many remote sensing and communications requirements are not currently being satisfied by means of satellites or aircraft. Although their interest was strong, potential users stressed that the initial costs for a HAPP research and development program should be borne by NASA. User interest was stronger within the research and development community than among private industry and operational government agencies; the latter group wanted specific proof of the HAPP's superiority over currently implemented platforms. After proof of concept, most users thought a HAPP should be jointly operated in a timeshared mode by several users or agencies. Several respondents also felt that because the most likely HAPP concept would be an airship, it might be viewed in some quarters as "old technology."

In the course of the survey, more than 40 potential HAPP remote sensing and communications applications were identified; these were grouped into 3 categories: operations, survey, and scientific research. Operations such as monitoring offshore oil port activities would require a HAPP continuously. Surveys such as the collection of wave statistics for oil rig construction might use a HAPP for 1 to 2 years. Scientific research activities would generally require a HAPP for periods of weeks to months. Some of the most promising potential HAPP applications identified are

- Communications (e.g., providing improved helicopter communications and navigation in the Gulf of Mexico)
- Regional data collection (e.g., collecting data for use in the preparation of environmental impact statements)
- Operational uses (e.g., monitoring Louisiana Offshore Oil Port (LOOP) activities)
- Research and development (e.g., serving as a platform for remote sensor and antenna development)
- Navigational aids (e.g., monitoring ice in the Great Lakes, United States rivers, and North Slope waters, especially during summer resupply periods)

An attempt was made to identify the requirements for instruments that might be carried onboard the HAPP. An imager of some type is required; because day-night coverage is required, a radar device is suggested. Many users felt that NASA would have to fully understand the user's objectives for a specific HAPP mission before an instrument could be designed to meet those objectives. A common attitude was that users should specify the objectives and requirements of a mission and NASA provide the instrumentation and data gathering facilities to meet these objectives. Most users felt that the remote sensing instruments should provide 24-hour coverage and the capability to see through clouds.

During the course of the survey, several persons noted that a HAPP system would have many of the same characteristics as a geostationary satellite system. Because of this, CSC recommends that NASA present the HAPP concept to the user community as an experimental low-altitude geostationary satellite for mesoscale observations. The same techniques used by NASA to develop and operate its geostationary satellites could, with modifications, be applied to a HAPP system; this is especially true in the command, control, and communications areas. Also, by portraying the HAPP as a low-altitude satellite, NASA may overcome some of the prejudice against airships as old technology. Finally, CSC believes that emphasis by NASA on its ability to provide onboard instrumentation to meet user needs and on the low cost of a HAPP in comparison with a geostationary satellite will convince many organizations to use the HAPP.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

LIST OF TABLES

Table

SECTION 1 - INTRODUCTION

The National Aeronautics and Space Administration (NASA) is investigating the concept of a High Altitude Powered Platform (HAPP), or, as one of its possible configurations is called, an Aerostat. The platform, either a balloon or an airplane, would be designed to stationkeep at an altitude of approximately 21 kilometers (70,000 feet), a region of minimum wind and above storms. Two possible uses of such a platform are communications and remote sensing; both are needs in the ocean/coastal zone community as well as in other applications areas such as meteorology, Earth resources, and environmental quality. Before proceeding with the development of the HAPP, NASA wants to determine whether sufficient interest exists within the user community for such a concept. To ascertain user interest and identify potential HAPP applications, NASA is funding user surveys in various applications areas. At the request of Wallops Flight Center, Computer Sciences Corporation (CSC) has surveyed the ocean/coastal zone community.

The major objectives of the CSC HAPP ocean/coastal zone user survey were as follows:

1. Identify requirements to be met by instruments onboard a HAPP in the coastal region
2. Identify ocean/coastal zone user requirements
3. Inform the ocean/coastal zone community of the NASA HAPP concept
4. Identify potential HAPP applications

This document contains the findings and conclusions of the survey. Section 2 contains background information. Section 3 presents the findings and recommendations of the survey. These are based on the results of personal interviews described in detail in Section 4 and on the responses to a questionnaire described in Section 5 and Appendix A.

SECTION 2 - HAPP BACKGROUND

A feasibility study for providing a high-altitude platform for communications and Earth observations over a given location for long durations was conducted for NASA headquarters (Reference 1). On the basis of that study, two platform concepts are considered the most promising. The first concept involves a lighter-than-air platform that would fly into the wind. The second concept is an airplane that would stationkeep by flying in a tight circle. Both of these platforms would be free flying and would receive their energy for stationkeeping via a microwave beam directed up from the ground. Figure 2-1 shows the two HAPP concepts. Microwave energy from a phased-array antenna on the ground would be beamed to the HAPP at safe energy densities. An onboard antenna would convert the microwave energy into electrical energy to drive electric motors onboard the balloon or airplane. These motors would provide the necessary propulsive power for stationkeeping and could power any remote sensors or communications equipment onboard the HAPP. Table 2-1 shows the nominal characteristics of each concept. Missions 1 and 2 are representative communications payloads corresponding to the Japanese and Applications Technology Satellite-F (ATS-F) communications satellites, respectively.

According to the study, both HAPP concepts appear feasible, although a significant amount of development must be carried out on both the microwave power system and the two proposed vehicles. The costs of developing and operating a system of HAPPs are very uncertain at this time. Nevertheless, several potentially cost-effective applications have been identified (Reference 2), including forest fire detection, ice mapping on the Great Lakes, and monitoring in the 200-mile fisheries zone.

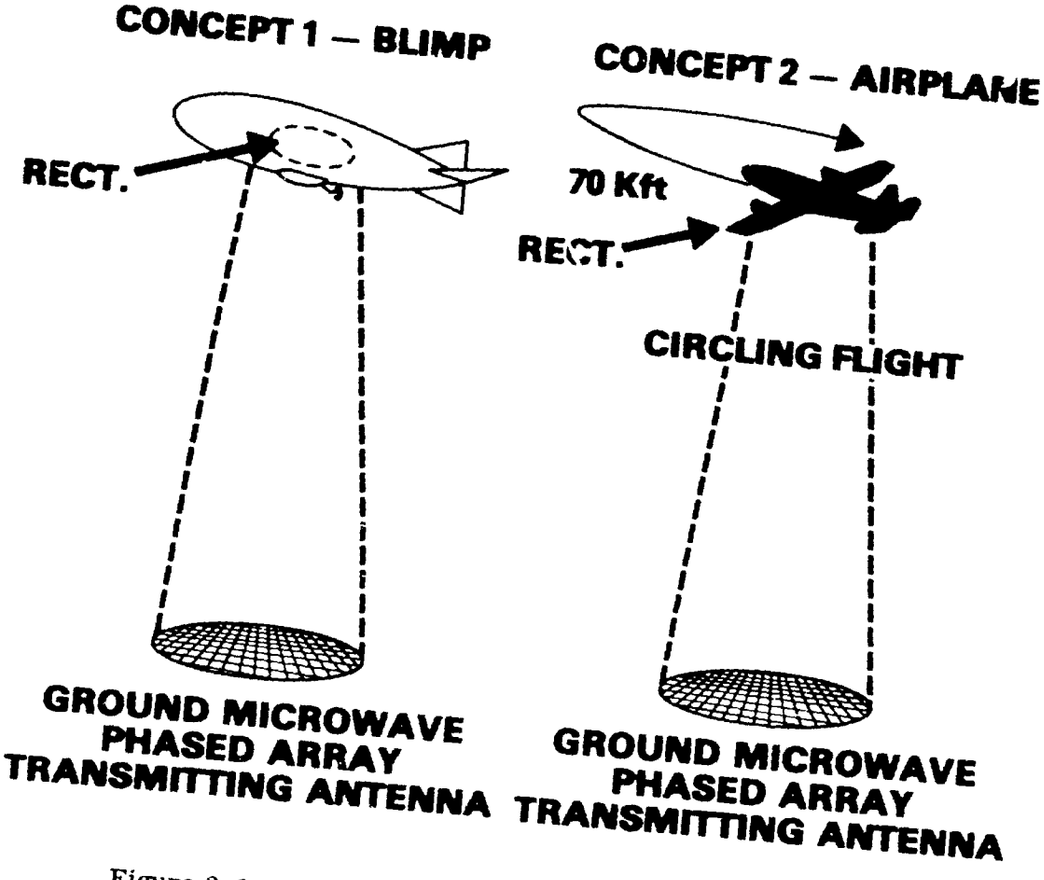

Figure 2-1. High Altitude Powered Platform Concepts

Table 2-1. Proposed Platform Characteristics

	BLIMP		AIRPLANE	
	MISSION 1	MISSION 2	MISSION 1	MISSION 2
1. TOTAL WEIGHT (LBS)	1,900	4,800	1,800	4,500
2. WING SPAN (FT)			100	100
O R				
VOLUME (FT^3)	0.5×10^6	1.3×10^6		
3. PAYLOAD (LBS)	300	1,600	300	1,600
4. NOMINAL ALTITUDE (FT)	70,000	70,000	70,000	70,000
5. AVAILABLE POWER (KW)	FEW KW	FEW KW	—	—
6. MISSION DURATION (YR)	1	1	1	1
7. ANNUAL COST ($)	420,000	550,000	470,000	790,000

SECTION 3 - SURVEY RESULTS

3.1 INTRODUCTION

This section contains major survey findings and recommendations with respect to the application of a HAPP in the ocean/coastal zone. It also contains, in easy-to-use tabular form, a list of potential ocean/coastal zone applications. For each application the following information is provided: user and identifier of application, geographic region of interest, spatial resolution, and frequency of coverage required. For the majority of cases, the numbers given are the best estimates of the persons interviewed. No attempt by CSC has been made to rank the applications as to desirability or to determine whether a particular measurement would be cost effective. Although it is not yet clear whether a single application can be satisfied cost effectively, the consensus of the user community is that several user requirements may be satisfied in a cost-effective manner if several users timeshare instrumentation onboard a HAPP.

At the end of this section, questions, suggestions, and observations of interviewees are provided that should be of value to NASA in reaching an overall assessment of user interest in the HAPP.

3.2 FINDINGS AND RECOMMENDATIONS

Two major findings have resulted from the CSC user survey of the ocean/coastal zone community:

1. User interest in the development of a platform such as the HAPP is strong.

2. Although it is not certain whether a single ocean/coastal zone surveillance application can be cost-effectively satisfied by a HAPP, several user requirements may be satisfied by having users timeshare instrumentation onboard a HAPP.

These observations lead to the recommendation by CSC that the HAPP be developed by NASA as a low-altitude geostationary satellite for regional or meso-scale observations and that a group of users combine their resources and operate it in a timeshared mode. Such a platform could be operated in a mode analogous to that currently being used with other unmanned geostationary satellites. For example, data from the platform could be telemetered back to a control center (e.g., a microwave power station or other designated location) and then processed by a computer and distributed to the users. Many of the concepts being developed under the NASA end-end data system would be directly applicable to the HAPP. In short, as Jack Sherman of the National Environmental Satellite Service (NESS) recommends, NASA should "develop a scenario for its [HAPP] operational application and cost out the entire program so that potential "buyers" will know what they are getting involved in." This should be fairly easy to do if the HAPP is viewed by NASA as another applications satellite.

During the course of the survey, particular attention was paid to user comments concerning possible instrumentation to be carried onboard the HAPP. Users were questioned concerning variables to be measured as well as repetition rates, accuracy desired, and other ancillary information required to specify needed data. Also, existing instruments were described that might satisfy user needs. In general, the members of the ocean/coastal zone community contacted were familiar only with the instruments with which they were presently working. They considered the development of better instruments for a HAPP or a satellite to be a problem that should be solved by NASA. They also felt that as a first step in solving this problem, NASA should became familiar with their needs and requirements and then design instruments to meet these needs.

General characteristics of the instrumentation most desired by users were as follows:

1. The instruments should be able to see through clouds. Several users noted that ground-based equipment usually has no difficulty collecting data on cloudy days.

2. The instruments should be able to provide 24-hour coverage. This is especially important in the operational environment but somewhat less so in the research and development environment.

3. The instruments should be able to provide both coarse resolution with a wide field of view and high resolution of sites of particular interest. A television camera with a zoom lens was mentioned as a possible prototype instrument.

4. A permanent record of the data should be kept for user review.

5. There should be minimal time delays in data retrieval. The user should be able to see the processed data immediately (especially in an operational environment).

6. For communications, every effort should be made to ensure that the present radio and television receivers can receive HAPP-relayed signals. In addition, the cost of ground-based transmitters that will send signals to the HAPP should be kept as low in cost and as light in weight as possible. This may require that more expensive communications relay equipment be launched on the HAPP.

7. The instruments should be cost effective in an operational environment.

Because of the potentially lower cost of the HAPP in comparison with satellites and because of its ability to provide regional coverage on a frequent basis, potential users were intrigued by the idea that the HAPP might fit many of their regional needs. Also, because a HAPP would normally be brought to the ground yearly (Reference 1), users would have an opportunity to calibrate and maintain their instruments as well as replace them with newer devices.

The persons contacted were also extensively questioned concerning coastal zone regions in which a HAPP could be effectively used. Several areas were identified, including the Gulf of Mexico, the Southern California bight, the Northeast Pacific, and the New York bight. Multiagency observations are being conducted in all these regions. Of the regions identified, the Gulf of Mexico in the vicinity of the Louisiana Offshore Oil Port (LOOP), near Grand Isle, Louisiana, seems to be the best candidate. This area is of interest to several agencies located jointly at the National Space Technology Laboratories in Bay St. Louis, Mississippi (e.g., National Marine Fisheries Service, United States Fish and Wildlife Service, National Data Buoy Office, Louisiana State Office of Science and Technology, National Park Service, United States Geological Service, NASA, and United States Coast Guard). Planning and managing HAPP operations would be greatly facilitated due to the proximity and existing work relationships of these groups. In addition, these groups are already remote sensor oriented.

3.3 OCEAN/COASTAL ZONE APPLICATIONS

Tables 3-1 and 3-2 contain 44 ocean/coastal zone remote sensing and communications requirements, identified during the course of the user survey. Many of these are potentially satisfiable with the aid of a HAPP. Table 3-1 specifies the requirement, the user agency and the person identifying the requirement, the geographical region of interest, and best estimates of the required ground resolution and frequency of coverage. The remote sensing requirements are grouped into continuous operations, survey, and research. Table 3-2 provides

Table 3-1. Ocean/Coastal Zone Remote Sensing Requirements (1 of 3)

REQUIREMENT	IDENTIFIER	REGION	RESOLUTION	FREQUENCY OF COVERAGE
		OPERATIONS		
1 MEASUREMENT OF IMPACT OF OIL SPILL ON WILDLIFE	TAIT (SECTION 4.3)	CHESAPEAKE BAY, PRINCE WILLIAM SOUND	10 METERS	FEW/DAY
2 MEASUREMENT OF IMPACT OF DREDGING ON WILDLIFE	TAIT (SECTION 4 3)	TAMPA BAY, SAN FRANCISCO BAY	10 METERS	< 1/DAY
3 MONITORING OF OFFSHORE OIL PORT (LOOP) ACTIVITY	HANNAH (SECTION 4 4)	GRAND ISLE, LOUISIANA	10 METERS	FEW/DAY
4. NATIONAL PARK TRAFFIC CONTROL	NOE (SECTION 4 7)	CAPE HATTERAS	INDIVIDUAL CARS	CONTINUOUS, REAL-TIME DISPLAY
5 PROVISION OF OCEAN/ ATMOSPHERIC DATA (e g , SEA SURFACE TEMPERATURE, SEA STATE, WINDS, OCEAN FRONTS)	STANLEY (SEA USE COUNCIL)	BRISTOL BAY TO CALIFORNIA/ OREGON BORDER	EQUAL TO OR BETTER THAN SEASAT-A	DAILY
	MILLER (INTER-AMERICAN TROPICAL TUNA COMMISSION)	EASTERN TROPICAL PACIFIC	100 METERS	1–2/DAY
	WOLFF (OCEAN DATA SYSTEMS)	WORLDWIDE	1 KILOMETER (COASTAL)	48/DAY
	STRAUB (AMERICAN SCIENCE AND ENGINEERING)	TEXAS/LOUISIANA COAST		1–2/DAY
6 SMUGGLING DETECTION	BEATTY (SECTION 4 7), VAETH (SECTION 4 9), OVERTON (SECTION 4 11), DALY (SECTION 4 15)	U S COASTAL (EMPHASIS ON FLORIDA GULF)	1 METER	REAL TIME
7 DETECTION OF OIL AND HAZARDOUS MATERIALS	VOYIK (SECTION 4 9)	U S WATERS	10–30 METERS	REAL TIME
8 DETECTION OF ILLEGAL BILGE CLEANING	VOYIK (SECTION 4 9)	U S WATERS	10- 30 METERS	REAL TIME
9 FISHING ENFORCEMENT	OVERTON (SECTION 4 11), DALY (SECTION 4 12), MILTON (SECTION 4 15)	U S WATERS	1–3 METERS	REAL TIME
10 SEARCH AND RESCUE	MILTON (SECTION 4 12), WILLIAMS (SECTION 4 13)	U S WATERS	UP TO 1 METER	REAL TIME
11 ALASKA ICE MONITORING	MILTON (SECTION 4 12), STANLEY (SEA USE COUNCIL)	WATERS LEADING TO NORTH SLOPE	10 METERS	1 -2/DAY IN SUMMER

Table 3-1. Ocean/Coastal Zone Remote Sensing Requirements (2 of 3)

REQUIREMENT	IDENTIFIER	REGION	RESOLUTION	FREQUENCY OF COVERAGE
12. DETECTION OF RIVER AND LAKE ICE	MILTON (SECTION 4.12), LOMBARD (SECTION 4.16)	GREAT LAKES, MAJOR RIVERS	10 METERS	1–2/DAY IN WINTER
13. MONITORING OF GULF STREAM BOUNDARIES	MILTON (SECTION 4.12)	U. S. EAST COAST	100 METERS	DAILY
14. DETECTION OF OCEAN DUMPING	KOUTSANDREAS (SECTION 4.14), DEMING (SECTION 4.11), JOHNSON (NASA LANGLEY)	DUMP SITES	–	CONTINUOUS FOR SEVERAL HOURS
15. ENFORCEMENT OF PORT SAFETY VIA SHIP LOCATION MONITORING	VERPLANK (SECTION 4.16)	MAJOR U. S. PORTS	+25-METER POSITION	REAL TIME
16. ICEBERG PATH PREDICTION (CURRENTS, WIND, SATELLITE-TO-SATELLITE TRACKING)	BACON (U. S. COAST GUARD)	ATLANTIC (40^{o}-52^{o}N, 39^{o}-57^{o}W)	5 KILOMETERS	2–4/DAY
17. COLUMBIA GLACIER ICEBERG DETECTION	RYAN (SECTION 4.16)	VALDEZ, ALASKA, SHIPPING LANES	2 METERS	1/DAY IN SUMMER
18 MEASUREMENT OF ABUNDANCE AND DISTRIBUTION OF FISH	SQUIRE (NOAA/SOUTHWEST FISHERIES)	SOUTHERN CALIFORNIA BIGHT	100 METERS	4/DAY (DAY AND NIGHT)
SURVEY				
19. MEASUREMENT OF NONPOINT SOURCE POLLUTION OF RIVERS AND LAKES	KOUTSANDREAS (SECTION 4.14)	500 KILOMETERS BY 500 KILOMETERS	25 METERS	< 1/DAY
20. PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS	KOUTSANDREAS (SECTION 4.14)	COASTAL WATERS, RIVERS, LAKES	2–10 METERS	1–4/DAY 1 WEEK/SEASON
21 ENVIRONMENTAL CONTROL FOLLOW-UP	KOUTSANDREAS (SECTION 4.14)	COASTAL WATERS, RIVERS, LAKES	2–10 METERS	1–4/DAY 1 WEEK/DAY
22 MEASUREMENT OF WAVE DIRECTIONAL SPECTRA	STANLEY (SEA USE COUNCIL)	NORTHEAST PACIFIC OCEAN	6–1000 METERS	SEVERAL/DAY
23. MEASUREMENT OF NEAR-SHORE ICE DYNAMICS, ICEBERGS, AND COASTAL CURRENTS	MURPHY (U. S. COAST GUARD)	WESTERN NORTH ATLANTIC; ALASKA COAST	–	24 CURRENTS/DAY FOR SEVERAL WEEKS; 1/DAY FOR SEVERAL MONTHS

Table 3-1. Ocean/Coastal Zone Remote Sensing Requirements (3 of 3)

REQUIREMENT	IDENTIFIER	REGION	RESOLUTION	FREQUENCY OF COVERAGE
24 HYDRODYNAMIC SURVEYS	BYRNE (NOAA/PACIFIC MARINE ENVIRONMENTAL LABORATORY)	GULF STREAM MEANDER REGION, KUROSHI CURRENT	–	14–27 DAYS TO 144/DAY FOR UP TO 2 YEARS
25 DEEP OCEAN MINERAL EXPLORATION (MARINE ENVIRONMENTAL DATA)	SIAPNO (DEEPSEA VENTURES INC.)	EASTERN/NORTHERN PACIFIC	–	NEAR-REAL TIME
26. OIL SITE SURVEY (OCEAN ENVIRONMENTAL DATA)	MORGAN (CHEVRON GEOPHYSICAL CO.)	WORLDWIDE	–	DAILY
		RESEARCH		
27 MONITORING OF COASTAL ZONE ECOLOGY	WHITLOCK (NASA LANGLEY), BUTERA (NASA NATIONAL SPACE TECHNOLOGY LABORATORY)	U. S. EAST COAST, GULF OF MEXICO	10 METERS	SEVERAL/DAY TO CONTINUOUS TIMELY SENSOR ACTIVATION
28. MEASUREMENT OF SURFACE TURBIDITY AND TEMPERATURE ANOMALIES	BYRNE (UNIVERSITY OF SOUTH FLORIDA)	WEST FLORIDA, CONTINENTAL SHELF	BETTER THAN SATELLITES	2/DAY (ALL SENSORS)
29. SEA GRASSES STUDIES	TAIT (SECTION 4.3)	ST. JOSEPH BAY, FLORIDA	10 METERS	INTENSIVE COVERAGE FOR RESEARCH
30 MEASUREMENT OF SURFACE SALINITY AND TEMPERATURE IN OYSTER AND SHRIMP BEDS	HANNAH (SECTION 4.4)	LOUISIANA ESTUARIES		≤ 1/DAY
31 PARK WETLAND, HYDROLOGY STUDIES	DINKEL (SECTION 4.7)	EVERGLADES	10 METERS	< 1/DAY
32 SHRIMP, MENHADEN LIFE CYCLE STUDIES	BROOKS (SECTION 4.1)	GULF ESTUARIES	10–20 METERS	≤ 1/DAY
33 MEASUREMENT OF NEARSHORE CIRCULATION AND DYNAMICS	BROOKS (SECTION 4.1)	GULF OF MEXICO	10–20 METERS	< 1/DAY
	HIRE (UNIVERSITY OF NORTH CAROLINA)	NORTH CAROLINA BAHAMAS		SEASONAL
	LOVORN (LOCKHEED)	SOUTHERN CALIFORNIA BIGHT		≤ 2/DAY
	PIETRAFESA (NORTH CAROLINA STATE UNIVERSITY)	CAPE HATTERAS (CHARLESTON, SOUTH CAROLINA)		72/DAY
34 SENSOR DEVELOPMENT	BLUME (NASA LANGLEY), LEVINE (NASA GSFC)	IN VIEW OF SURFACE TRUTH		FEW HOURS/DAY

Table 3-2. Ocean/Coastal Zone Communications Requirements

REQUIREMENTS	IDENTIFIER	REGION	COMMENTS
1. LOCATION AND TRACKING OF DRIFTING BUOYS	SHEPARD (SECTION 4.2), MILTON (SECTION 4.12)	UP TO 250 MILES OFFSHORE	CAPABILITY: ±3 KILOMETERS; REQUIREMENT: ±10 TO 30 METERS
2. TSUNAMI WARNING	SHEPARD (SECTION 4.2)	U.S. SHORES	DATA RATE REQUIREMENT: 5 MEGABITS PER SECOND
3. MARINE ANIMAL TRACKING	TAIT (SECTION 4.2)	–	MAY REQUIRE EXTENSIVE AREA COVERAGE
4. GULF OF MEXICO HELICOPTER VOICE COMMUNICATIONS AND NAVIGATION	HANNAH (SECTION 4.2), SARELS (SECTION 4.5)	GULF OF MEXICO	POSSIBLE APPLICATION: RELAYING MEDICAL AND OTHER INFORMATION FROM OFFSHORE OIL RIGS
5. TESTBEDDING OF LARGE ANTENNAS	HOPKINS (SECTION 4.6)	–	–
6. COASTAL RESEARCH AND RESCUE AND DATA RELAY	HOPKINS (SECTION 4.6), MILTON (SECTION 4.12), WILLIAMS (SECTION 4.13), DALY (SECTION 4.15)	U.S. COASTAL WATERS	–
7. NATIONAL PARK SEARCH AND RESCUE	NOE (SECTION 4.7)	U.S. NATIONAL PARKS	LINE-OF-SIGHT COMMUNICATIONS NOT POSSIBLE IN MANY PARKS BECAUSE OF TERRAIN
8. CONTINUOUS SHIP TRACKING	MILTON (SECTION 4.12), DALY (SECTION 4.15)	U.S. COASTAL WATERS	NOT SEEN BY OPERATIONS PERSONNEL AS A REQUIREMENT
9. ENVIRONMENTAL DATA RELAY	WILLIAMS (SECTION 4.13), STANLEY (SEA USE COUNCIL)	U.S. COASTAL WATERS, NORTHEAST PACIFIC	POSSIBLE APPLICATION: DISTRIBUTING WEATHER ADVISORIES
10. CB RELAY	DALY (SECTION 4.15)	U.S.COASTAL WATERS	–

similar information, except that ground resolution is not a parameter of interest and frequency of observation gives way to continuous real-time operation. Although the users interviewed felt that no single requirement listed in the tables would justify the HAPP, most felt that a timeshared platform could readily overcome this problem. Also, most of the respondents felt that a HAPP should be developed because it would provide operational capabilities not currently available from satellite and aircraft platforms. Many felt that a need exists for frequent and repeated high-resolution observations over a given locale for periods up to a year. Although geostationary satellites can give frequent coverage, high resolution (e.g., 10 meters) is not currently possible. Aircraft can provide high-resolution observations but are impractical for long duration and frequent observations. The HAPP would be ideal for such missions.

3.4 QUESTIONS AND CONCERNS OF POTENTIAL USERS

During the course of the CSC user survey, several questions concerning the HAPP were raised. Also, certain attitudes and impressions toward the HAPP concept were detected by CSC personnel. These are described below for consideration by NASA in determining what form the final HAPP concept will take.

User questions concerning the HAPP included the following:

1. For scientific purposes, what will be the relationship between the HAPP, the Space Shuttle, and other NASA programs?
2. Who will manage the operational system? National Oceanic and Atmospheric Administration? Environmental Protection Agency? Private industry?
3. Who will have access to data collected by a HAPP?
4. Would a continuously observing platform be an invasion of privacy?
5. What is the likelihood of a maneuverable HAPP?

6. How does NASA envision HAPP system operation? Will suitable data links be developed?

7. Who will launch the HAPP for the users?

8. Who will maintain the platform?

CSC observations relative to the user survey include the following:

1. The HAPP concept was well received by much of the ocean/coastal zone community. This was especially true of those already involved in remote sensing research and development activities.

2. The HAPP concept will have to compete for many applications with satellites and airplanes. Satellites and airplanes are in vogue, and balloons and airships are viewed as old technology.

3. Industry, while intrigued by the HAPP concept, was primarily interested in how much it will cost and how it can be used profitably.

4. Operational groups within the government, most notably the United States Coast Guard, generally had a "show me" attitude toward the HAPP.

5. Research and development persons were generally enthusiastic.

6. Instruments proposed for use on the HAPP were similar to those currently used onboard aircraft or spacecraft. They included real aperture radar, microwave and infrared radiometers, multispectral scanners, low light level televisions, laser line scanners, and radar altimeters and scatterometers.

SECTION 4 - PERSONAL INTERVIEWS

CSC personnel interviewed numerous persons in federal and state agencies, academic institutions, and private industry to get their impressions of the HAPP concept and to identify user requirements within the ocean/coastal zone community. All but one of the interviews summarized in this section were conducted in person. The material in this section, the responses to the mailed questionnaire, and the material in References 3 through 10 formed the basis of the HAPP user survey.

4.1 DR. JOHN BROOKS, NATIONAL MARINE FISHERIES SERVICE

Dr. John Brooks indicated that a HAPP would be of value in assisting the National Marine Fisheries Service (NMFS) study of the life cycles of gulf shrimp and menhaden. The gulf shrimping industry is the leading seafood industry in the United States, and menhaden, a fish used to make chicken feed, is the leading fish, by volume, caught in the United States. The market value of each is in excess of $100 million per year. Approximately 90 percent of fish larvae grow into fish in the estuaries along the gulf coast. A 2- or 3-year time history of their life in the estuary would be of value in understanding the life cycle of the fish. Although satellite data is of value in the study of estuaries, it is not always available, and users cannot control the data that are collected.

Dr. Brooks indicated that a HAPP would enable him to focus his attention on particular areas of interest. For example, the gulf shrimp located in Vermillion Bay, Louisiana, and Bavatavia Bay are especially interesting. The former area is only about 38 miles wide and could be studied intensively with a HAPP. Dr. Brooks could envision equipping a HAPP with a wind sensor (scatterometer), a temperature sensor (infrared or microwave radiometer), a salinometer (a microwave radiometer being developed by the National Oceanic and Atmospheric Administration's Environmental Research Laboratories (NOAA/ERL)), and an ocean color instrument to study intensively the most productive shrimp areas. Ground truth for the remote sensors could be provided by on-site instruments. The observations from a HAPP could be made year round, with the most intensive studies being conducted in September, October, and November.

Another potential application for the HAPP would be to study the circulation patterns in the Gulf of Mexico, especially those near the shore. Dr. Brooks indicated that he would not need precise measurements of the currents, but rather only the directions in which the water is flowing. These data are of value because fish larvae are often carried from one location to another by such currents before they learn to swim.

NMFS will be using Seasat-A data in its offshore circulation studies. Ground resolution for surface winds will be approximately 50 kilometers. To obtain good near-shore circulation information, much higher resolution data is desirable. In some cases ground resolution on the order of 10 to 20 meters may be required, and Dr. Brooks noted that a HAPP may offer the possibility of obtaining such high-resolution data.

4.2 WILLIAM SHEPARD, NOAA NATIONAL DATA BUOY OFFICE

William Shepard indicated that NOAA's National Data Buoy Office (NDBO), which works with individual users and experimenters to develop specific data collection systems to satisfy specific oceanographic requirements, was not in a position to generate a requirement for the HAPP. He indicated that personnel at the Atlantic Oceanographic and Meteorological Laboratories (AOML) and the Pacific Marine Environmental Laboratories (PMEL) should be contacted to find out their ocean/coastal zone interests. Mr. Shepard felt that if a HAPP were developed and used by NOAA, the group with the expertise to manage such a system would be the National Environmental Satellite Service (NESS). (NESS's Jack Sherman's response to the CSC questionnaire echoes this feeling.) He felt that data buoys could provide surface truth for remote sensors onboard a HAPP, especially during the checkout period.

Mr. Shepard was willing to discuss potential HAPP applications that he could envision based on his experience with buoys. He identified a need to determine the position and track drifting buoys within 250 miles of shore. A HAPP system might be one alternative to the system used in the ARGOS project. Currently buoys can be located to within ±3 kilometers (1.2 miles). Another possible, although probably not cost-effective, application would be to use a HAPP to relay high data rate (5 megabits per second) data such as in a tsunami warning system.

4.3 DR. HOWARD TAIT, UNITED STATES FISH AND WILDLIFE SERVICE

Dr. Howard Tait and others on his staff felt that a HAPP would be of value for many of the studies in which the United States Fish and Wildlife Service (U.S. F&WS) is engaged. They also felt that in some cases, such as oil spills and pollution monitoring, both the Environmental Protection Agency (EPA) and the United States Coast Guard would be interested in studying data from the same areas. Dr. Tait and his staff thus suggested the possibility of joint operation of a HAPP by several different groups. This would enable the cost of a HAPP to be distributed among the various users. It would also eliminate one of the drawbacks of the HAPP, i.e., the need to make frequent observations of a given area in order to make the platform cost effective. These U.S. F&WS personnel indicated that operating a HAPP in a timesharing mode would be most beneficial.

Dr. Tait and his staff identified some of the areas in which U.S. F&WS is working. Many of these would be suitable for a HAPP. Some of the applications mentioned would require a HAPP over land and are thus outside the scope of this survey; however, they are included here to demonstrate user interest in such a platform.

One potential HAPP application is to monitor wildlife areas such as the Chesapeake Bay and Prince William Sound, Alaska, in the event of an oil spill. Daily data on how the oil is dispersing are needed to determine the impact of such a spill on birds that congregate in these areas, especially during migration seasons. In the event of a spill, intensive observations (several per day) with a spatial resolution of 10 meters would be preferred. This is one instance in which a shared platform would be valuable Other possible applications in the marine environment include studying the effect of construction and dredging in bays such as Tampa and San Francisco, tracking marine animals, and monitoring the effect of sea dumping on wildlife. U.S. F&WS is currently working

with NMFS (Andy Kemmerer) to study sea grasses in St. Joseph Bay, Florida, with an airborne, 21-channel, solid-state array spectroradiometer. Observations over land include tracking of migrating birds and monitoring the effect of the Alaska pipeline on Caribou migrating to their calving grounds.

4.4 ROBERT HANNAH, LOUISIANA OFFICE OF SCIENCE AND TECHNOLOGY

Robert Hannah and Tommy Hill of the Louisiana Office of Science and Technology expressed great interest in the HAPP concept. Their office is responsible for coordinating state scientific efforts with federal agencies and facilitating the transfer of federal technology to Louisiana. They, too, felt that a HAPP in the Louisiana coastal zone should be shared jointly with the other federal agencies at the National Space Technology Laboratories, such as U.S. F&WLS, NOAA, the United States Geological Survey (USGS), and the Bureau of Land Management in New Orleans. They thought that the main problem associated with a HAPP would be getting the various groups involved to agree on the type of joint program desired. Once a program was agreed upon, the HAPP could be operated in a timeshared mode.

Hannah and Hill identified numerous potential applications for the platform: monitoring oil and hazardous material spills; studying surface temperature and salinity patterns at frequencies between twice a week to once per day to study the growth of oysters and shrimp; studying turbidity patterns in coastal waters; and counting the number of sport fishing boats visiting oil rigs for fishing.

Two potential applications suggested by Hannah and Hill are particularly attractive. The first is the use of a HAPP to monitor the environmental impact of an offshore port being built in the vicinity of Grand Isle, Louisiana. The port, called the Louisiana Offshore Oil Port (LOOP), will be built by a private group of companies about 60 miles offshore and is scheduled for completion in mid-1980. An oil pipeline from the port to the shore is part of the development. Louisiana has the responsibility of monitoring the environmental impact of the port and detecting any oil spills from the pipeline. A HAPP with high-resolution sensors could aid in this activity.

The second application involves using a HAPP as a communications link between helicopters enroute to offshore rigs and home offices. There are thousands of helicopter transits each day. Presently, communications between helicopters

and the shore are not adequate, and loss of communications with helicopters over the water is a frequent occurrence. This same HAPP can also provide secure communications between the rig and shore facilities and be used to relay medical information to and from the rig. A similar type of operation on land is currently being carried out on an experimental basis using ATS-F (see comments of Larry Hopkins of NASA, Section 4.6).

4.5 CAROLL SARELS, PETROLEUM HELICOPTERS, INC.

Subsequent to the Hannah interview, CSC spoke with Caroll Sarels of Petroleum Helicopters, Inc. (PHI), Lafayette, Louisiana. Mr. Sarels verified that a need exists for improved communications and navigation facilities for helicopters operating out to 150 miles in the Gulf of Mexico. Very high frequency (VHF) communications to the shore are not good when helicopters are within about 5 miles of an oil rig and at low altitude. To facilitate continuous communications, four rigs between Venice, Louisiana, and Galveston, Texas, have been instrumented with VHF equipment to relay communications. Mr. Sarels indicated that a HAPP at 70,000 feet would be very cost effective at $500,000 to $1 million per year to provide improved communications and navigation services. He said that as a step toward improved navigation, PHI is installing Long-Range Aid to Navigation (LORAN) equipment for its helicopters. The expected accuracy in the Gulf of Mexico will be to within ±2.5 kilometers (1-1/2 miles). Any HAPP-based system would have to compete with this position accuracy as well as on other factors such as ease of operation, reliability, and cost.

4.6 LARRY HOPKINS, NASA NATIONAL SPACE TECHNOLOGY LABORATORIES

Larry Hopkins of NASA identified several possible communications applications in which a HAPP might be useful; however, a detailed cost analysis in each case would have to be carried out to determine whether the HAPP concept is more cost effective than competing concepts. Mr. Hopkins suggested that a HAPP could be used as a flying testbed to evaluate antenna configurations. Because most platform data collection activities (such as those of the United States Army Corp of Engineers) are regional in nature, the follow-on to the Geostationary Operational Environmental Satellite (GOES) data collection system might make use of a system of regional HAPPs. A coastal search and rescue system might make use of a HAPP network to retransmit LORAN-C data. A HAPP could also be used to relay emergency medical information between an oil rig and shore facilities. Mr. Hopkins is involved in similar activities on land using ATS-F.

4.7 FRANK BEATTY, UNITED STATES GEOLOGICAL SURVEY

Frank Beatty (United States Geological Survey (USGS)), Ted Dinkel (National Park Service (NPS)), and Frank Noe (NPS) were extremely enthusiastic about the possibility of a HAPP. This group, too, felt that a shared platform would be most cost effective. They also raised questions about the possibility of a maneuverable platform.

NPS could use a HAPP to monitor traffic in the inland and coastal ports. Dinkel and Noe envisioned a system employing a television camera or real aperture radar with a video display whereby up-to-date traffic information at such ports as Cape Hatteras (50- to 70-mile roads) or the Great Smoky Mountains National Park (60-by-20-mile road system) would be available to park rangers. More effective traffic control would free many rangers for other more important park activities. Videotapes of the television screen could be made to study traffic patterns and alleviate bottlenecks. The same system could be used to direct traffic from seashore parks when storms cause mass exits.

NPS personnel also envisioned a HAPP in a communications role. Line-of-sight communications in many parks such as the Great Smoky Mountains National Park is not possible due to variations in terrain. A HAPP could provide reliable communications for search and rescue and emergency medical operations and, at the same time, look for forest fires.

USGS and NPS personnel felt that a HAPP equipped with a multispectral scanner would be extremely useful in studies of wetlands, water quality, and hydrology, especially in the Everglades National Park.

Another application that was identified during the conversations was in the area of drug enforcement. USGS had received a letter from a Louisiana sheriff requesting Landsat imagery to enable detection of illegal ships anchored off the United States coast and engaged in smuggling contraband into the United States.

While this is not possible using Landsat, USGS personnel felt that a HAPP equipped with a camera for other applications could be redirected to search out an area in which suspected smuggling might be taking place.

4.8 DANIEL MACY, TEXACO

Daniel Macy indicated that Texaco has few offshore oil activities at the present time. The company will be drilling off Newfoundland in 1979 and will be evaluating Seasat data in that area. Mr. Macy indicated that offshore oil operations are weather sensitive. In most cases, meteorological and oceanographic data are collected for the group of oil companies in the area, often by another service company. Mr. Macy indicated that Texaco is very conservative and cost conscious with respect to any new technology, and he could not envision the company's making use of a HAPP until cost and effectiveness of the platform are certain.

4.9 GORDON VAETH, NOAA NATIONAL ENVIRONMENTAL SATELLITE SERVICE

Gordon Vaeth, who has had a significant amount of experience with manned and unmanned balloons, said that various agencies have been studying lighter-than-air vehicles over the last 25 years. Mr. Vaeth favored the development of manned lighter-than-air vehicles that could be used for both reconnaissance and necessary follow-up actions. For example, if an oil spill were detected, a balloon could deploy chemicals to break up the spill. Also, light two-man French zodiac-type balloons, costing about $75,000 to build, could be used to detect smugglers. (The Drug Enforcement Administration and the Customs Agency are interested in deploying HAPPs in the vicinity of the Rio Grande to carry out various reconnaissance functions.) Mr. Vaeth acknowledged that his advocacy of manned platforms such as airships and seaplanes is a minority viewpoint. However, the ability to maneuver (e.g., follow schools of fish) and take positive actions (e.g., put personnel aboard an illegal fishing boat) open up the number of potential applications for such platforms.

In general, Mr. Vaeth felt that satellites can adequately satisfy many of the potential applications for which HAPPs have been proposed. Other applications can be better satisfied by manned platforms. Mr. Vaeth also made the useful observation that all lighter-than-air vehicles, manned or unmanned, face difficult psychological barriers in that they are viewed by many decisionmakers as old technology.

Mr. Vaeth provided CSC with the names of several persons in the United States Coast Guard, NASA, and the United States Navy who might participate in the HAPP survey.

4.10 LT. GREGORY VOYIK, UNITED STATES COAST GUARD, MARINE ENVIRONMENTAL DIVISION

Lt. G. Voyik and Lt. W. Plage indicated that detection of oil on water and identification of the polluting source are the major requirements of the Surveillance and Monitoring Branch of the Marine Environmental Division. The ideal reconnaissance system should have a day-night, all-weather capability to detect a spill, assess its dimensions, identify its source, and produce a hardcopy documentation of the violation. All this must be done in near-real time. In addition, in the case of large spills, a requirement exists for continuous, all-weather tracking to facilitate containment and cleanup operations.

The Coast Guard must monitor oil spills and illegal cleaning of bilges in the United States coastal area out to 50 nautical miles (prohibited zone). Spills as small as 10 meters in diameter must be detected. The Coast Guard has developed an instrument package called Airborne Oil Surveillance System II (AOSS II) to enable it to carry out its pollution surveillance mission. AOSS II, which became operational onboard an HC-130B aircraft in April 1977, consists of a dual-look (left and right) side-looking radar (SLAR), an infrared/ultraviolet line scanner, a passive microwave imager, a high-resolution reconnaissance camera, and a data recorder. Only one such system is in operation. Plans for the next few years call for the introduction of six improved AOSS systems called AIREYE onboard the new Coast Guard medium range surveillance aircraft (MRSA) now being procured. Under AIREYE the passive microwave images will be replaced by an active gate television system.

Lt. Voyik and Lt. Plage indicated that the active radar is the primary instrument in the package. They did not feel that a HAPP-based system would give them any advantages over AIREYE and that the 1600-pound payload described by Stanford Research Institute (Reference 1) for a Type II mission would not be large enough to accommodate their instrument package. They also stressed a requirement for a near-real-time digital link to make the sensor data quickly

available to enforcement personnel. They felt that a SLAR onboard a HAPP might be of some value for target detection but stressed their needs for identification and documentation of oil pollution violations. While recognizing that a HAPP does offer the possibility of continuous observations, they felt that a system based on deterrent and flying random patterns will enable them to adequately carry out their function. If a HAPP were used for other Coast Guard operations or other government agencies, data from it could be used to complement existing monitoring equipment.

4.11 CAPT. R. H. OVERTON, UNITED STATES COAST GUARD, OCEAN OPERATIONS DIVISION

The Ocean Operations Division of the United States Coast Guard is responsible for marine law enforcement off the coasts of the United States. Its specific responsibilities include fishing enforcement and apprehension of ships involved in illegal activities such as drug traffic. At CSC's meeting the Ocean Operations Division was represented by Capt. R. H. Overton (Commandant) and Comdrs. T. E. Deming and J. E. Streeper. D. Conley and L. Nivert from the Coast Guard Office of Research and Development were also present.

Capt. Overton indicated that in law enforcement it is not sufficient simply to know that a ship is in a particular location. A need exists to both classify (e.g., fishing boat, tanker) and identify (i.e., read the name of) the vessel. This would require sensors with 5- to 10-foot resolution along with a real-time data link. In addition, any surveillance platform used by the Ocean Operations Division must afford the capability to take some kind of action to apprehend the violator. The persons attending the meeting felt that a HAPP could not adequately satisfy either of these requirements. Thus they felt they could not endorse the HAPP concept at this time. They indicated, however, that they would be willing to evaluate a HAPP if it were developed.

The persons from the Office of Research and Development indicated that the Coast Guard is looking at tethered balloon systems to determine whether they might meet Coast Guard requirements in law enforcement, ice monitoring, pollution monitoring, and marine science. They were familiar with the HAPP concept.

4.12 TOM MILTON, UNITED STATES COAST GUARD, ADVANCED TECHNOLOGY BRANCH

Tom Milton, who is responsible for managing research on the lighter-than-air vehicles for the United States Coast Guard, definitely felt that a need exists for research and development of the HAPP concept and expressed hope that NASA will develop such a platform. He indicated that the Coast Guard does not have the resources to carry out the necessary research and development to develop a new concept such as HAPP. To the Coast Guard research and development generally means buying off-the-shelf items and repackaging them for their operational applications. Furthermore, he reiterated that the Coast Guard is conservative in introducing new equipment into its inventory until it is certain that significant improvements over existing capabilities can be demonstrated.

Stressing that he was expressing his personal views and not those of the Coast Guard, Mr. Milton identified several potential Coast Guard applications in which a HAPP might prove useful. He further suggested that CSC speak with John Daly in the Chief of Staff's Office to get the official view of the HAPP concept. Potential HAPP applications mentioned by Mr. Milton, listed according to Coast Guard mission requirements, are as follows:

1. Search and rescue--A HAPP might be used as a relay platform for emergency messages. A special channel could be set aside for use in conjunction with the HAPP. Mr. Milton indicated that current communications in search and rescue operations need improvement. The Coast Guard is currently examining tethered balloons for this application. Another possible search and rescue application is the use of an active radar to vector rescue ships to disabled vessels. An onboard infrared detector could, possibly, locate a disabled vessel or downed aircraft by spotting an emergency flare.

2. Domestic ice breaking--Mr. Milton felt that it might be worthwhile evaluating the use of a HAPP to monitor lake and river ice. Currently these functions are carried out by aircraft. One very important potential application would be to monitor the ice in waters leading to North Slope of Alaska oil fields during a few critical weeks in the summer when resupply by large convoy is taking place. Barge resupply is much cheaper than aircraft, and a HAPP might be cost effective.

3. Marine environmental protection--A need exists to detect and identify sources of oil spills and slicks caused by ships illegally dumping bilge water. Legislation may be drafted in the future requiring ships to carry a transponder in territorial waters of the United States. A HAPP might be used to interrogate the transponder and aid in ship identification. A system of coded transponders is currently being jointly tested by the United States Navy and the Coast Guard.

4. Enforcement of laws and treaties--Enforcement in the 200-mile fishing zone might be aided by a HAPP-activated transponder interrogation system.

The operational personnel involved in activities 3 and 4 could not see a HAPP significantly increasing their capabilities in these areas.

5. Radio navigation aids--A HAPP-based system could possibly improve on existing LORAN-C and Omega-based systems.

6. Short range navigation aids (buoys)--A HAPP-based system might provide the capability to locate buoys, which are frequently blown off location by storms, to within 10 to 33 meters.

7. Marine science--The Coast Guard currently makes aircraft flights to delineate the boundaries of the Gulf Stream. Infrared or microwave radiometers on a HAPP might be able to do the job more efficiently.

8. Port safety and security--Three potential applications are vessel traffic control, detection of smugglers, and communications. The Coast Guard currently has surveillance radars at several ports and is procuring more. An airborne system may offer a better vantage point for vessel traffic control.

9. Recreational boat safety--A HAPP might be used as a broadcast tower for distributing up-to-date weather information to boats.

10. Commercial vessel safety--A HAPP might be used to continuously track ships in United States coastal waters (e.g., Cargo Merchant) to ensure that they do not enter dangerous or restricted waters.

Milton indicated that the Coast Guard is currently investigating existing tethered balloon systems as a means of satisfying some of its requirements. He suggested that certain facets of a HAPP system could first be tested using tethered balloons. The Coast Guard is also investigating manned lighter-than-air vehicles, and Mr. Milton indicated that the French and Japanese have been exploring various lighter-than-air concepts for various oceanographic applications.

4.13 COMDR. J. WILLIAMS, UNITED STATES COAST GUARD, TELECOMMUNICATIONS MANAGEMENT DIVISION

Comdr. J. Williams, Assistant Chief of the Telecommunications Management Division, discussed potential applications with CSC and also circulated the CSC questionnaire to other groups within the Coast Guard that might have an interest in it. Although Comdr. Williams identified several possible communications applications for which a HAPP could be a candidate, he indicated that he did not view HAPP as a serious competitor for these applications or as a replacement for aircraft in other Coast Guard activities. He expressed his willingness to reconsider HAPP if NASA could demonstrate increased capability of the platform. Potential HAPP telecommunications applications identified include relaying meteorological and environmental data collected by ships, cooperative observers, and buoys; relaying distress beacon signals and aiding in locating persons and ships sending the distress signals; and detecting small craft in search and rescue operations.

Comdr. Williams said that he was not aware of any communications problems faced by helicopters traversing the Gulf of Mexico. He indicated that if such a problem exists, two possible alternate approaches to a HAPP are locating relay towers on strategically placed oil rigs or equipping helicopters with transmitters for over-the-horizon communications. The latter approach would be costly for helicopter operations (about $12,000 per transmitter-receiver).

4.14 JOHN KOUTSANDREAS, ENVIRONMENTAL PROTECTION AGENCY

John Koutsandreas is a senior advisor for advanced monitoring in the Office of Monitoring and Technical Support within the Environmental Protection Agency's (EPA's) Office of Research and Development. He indicated that a HAPP would be potentially very useful in several areas in which the EPA is involved, including preparation of environmental impact statements, follow-up monitoring of the impacted region, formation of land quality environmental indices, and monitoring of nonpoint source water pollution and ocean dumping. He expressed confidence that a rationale could be developed to continuously monitor the air, water, and land in the vicinity of major metropolitan areas. A stationary platform such as a HAPP would be ideal for such an application. Such a platform would most likely be operated in conjunction with other federal and state agencies. For all of the aforementioned applications, the area of interest would be less than 300 miles in diameter.

Mr. Koutsandreas felt that a HAPP would be of greatest value in the preparation of Environmental Impact Statements. Federal agencies and others using federal funds are required to prepare an Environmental Impact Statement if a project is likely to significantly alter the environment. In the past Environmental Impact Statements tended to be poorly prepared and to contain an excess amount of verbiage. However, new rules for preparing Environmental Impact Statements have reduced the length to a maximum of 150 pages and directed preparers to write in plain language. Mr. Koutsandreas felt that the inclusion of photography (e.g., multispectral imagery) would greatly simplify the documents and give a much better description of the region involved than many words. He felt that data collected one to four times per day at specified times for 1 week per season could, over the course of a year, form a major portion of the data base upon which an Environmental Impact Statement could be prepared. Average resolution on the order of 5 to 10 meters and a capability to zoom down to a few meters of resolution would be desirable. (Both of these resolutions are

beyond the current or planned capabilities of Landsat.) The imagery collected could be compared with additional imagery in the future to determine the accuracy of the Environmental Impact Statement. Similarly, HAPP-collected imagery could be used by federal and state officials to determine the effectiveness of environmental control measures ordered by these agencies.

Often rivers and estuaries are polluted as a result of the effects of agriculture, feedlots, and mining taking place over an extended area. Mr. Koutsandreas felt that a HAPP-borne complement of sensors could monitor a large area and aid in controlling this form of pollution.

4.15 JOHN DALY, UNITED STATES COAST GUARD, PLANS AND EVALUATION DIVISION

John Daly of the Coast Guard's Plans and Evaluation Division identified several Coast Guard missions in which he felt a HAPP might be of advantage. The agency now is required to monitor CB frequencies, and the HAPP might be of value as a communications relay. In the area of navigation, a HAPP might provide continuous monitoring of ships' positions in United States coastal waters. Mr. Daly indicated that a HAPP might also be useful in locating potential fishing violators. For example, a mother ship often sits offshore while a number of small boats go out to pick up contraband. This type of pattern would be visible with the aid of airborne radar or a television system. Aircraft or ships could then be vectored to investigate suspicious congregations. Finally, a HAPP might be used as an aid in search and rescue. Most search and rescue operation time is spent in trying to locate the ship or person. Ten-meter sensor resolution is required for this application. Mr. Daly felt that any HAPP platform in operation would be timeshared by various groups within the Coast Guard as well as with other federal agencies.

4.16 LT. COMDR. VERPLANCK, UNITED STATES COAST GUARD, PORT SAFETY AND LAW ENFORCEMENT DIVISION

CSC met with Lt. Comdr. VerPlanck, Jim Lombard, and Don Ryan of the Coast Guard Port Safety and Law Enforcement Division, which is responsible for the smooth movement of ships in United States ports and river waters and in the offshore shipping lanes. Comdr. VerPlanck identified a requirement for surveillance in such port areas as New Orleans, San Francisco, Puget Sound, and New York. The ideal system would provide position (±25 meters), speed, type, and size of ships in real time to a Coast Guard traffic control center in a format compatible for computer processing. The area to be covered could be from 25 to 200 miles on a side. The same system might also be used to determine whether ships anchored in a given port are located within their designated anchorages.

Any HAPP-based system would have to improve on the capabilities of current surveillance systems planned or installed in United States ports. Current instrumented sights include Valdez-Prince William Sound, Alaska, Puget Sound (10 radar sites under construction), San Francisco Bay (2 radar sites), New York City (2 radar sites planned, 6 low light level televisions), and Houston/Galveston (1 radar site, 4 low light level televisions planned). The radars can position a 5-square-meter target to within ±10 meters.

Lt. Comdr. VerPlanck concurred with Comdr. Hickey, another questionnaire respondent, that no need exists for continuous surveillance by a HAPP of offshore vessel traffic for ship traffic control. He felt that the primary responsibility for this function should reside with the individual ship captains.

A potential HAPP application identified by Mr. Lombard is the monitoring of ice on the Great Lakes. The Coast Guard currently does this with conventional aircraft. Another interesting HAPP application identified by Mr. Ryan is the monitoring of icebergs that might enter the sea lines from glaciers in the

vicinity of Valdez harbor. Geologists predict that within the next few years receding glaciers will spawn such icebergs. The Coast Guard has a contingency plan to put a submarine net along passages leading into the channel. Mr. Ryan felt that a HAPP could be used in a timesharing mode to monitor icebergs as small as 2 meters in diameter approximately once per day during the summer months.

4.17 LUTHER BIVINS, NOAA OFFICE OF OCEAN ENGINEERING

CSC met with Luther Bivins, Jack Cawley, and Bob Farland of NOAA's Office of Ocean Engineering (OOE). This group is a service organization within NOAA and provides engineering support to NOAA oceanographic investigators. Like its sister group, the National Data Buoy Office, the Office of Ocean Engineering felt that it could provide surface truth for a HAPP. The OOE has limited experience in the area of remote sensing but is currently trying to integrate remote sensors into its ocean monitoring activities.

OOE personnel are currently surveying various platforms (e.g., aircraft, satellites) to determine which could best satisfy requirements of the National Climate Program. A HAPP might be able to satisfy various mesoscale climate requirements.

Several other potential applications were identified during the course of the discussions, including monitoring the breakup of ice on the Great Lakes (especially in places like the St. Mary's River), monitoring 13 offshore ocean dumping sites, and monitoring the el Nino phenomenon and the New York bight.

SECTION 5 - RESPONSES TO SURVEY QUESTIONNAIRE

In order to inform and ascertain the views of the largest number of persons within the ocean/coastal zone community, a questionnaire (Appendix A) was prepared and mailed to over 200 persons in industry, government, and academia. A package of material (Appendix A) was mailed along with the questionnaire to provide the respondent with background information on the HAPP concept. Approximately 15 percent of the persons receiving questionnaires responded. A greater percentage of the respondents were in government and industry. The smallest percentage of responses came from academia. This mirrored CSC's experience with personal contacts. The results of the questionnaire were used along with the information from personal interviews to prepare Tables 3-1 and 3-2 and to reach the conclusions of this survey.

Recognizing that NASA will use the results of this and other user surveys as input in deciding whether or not it wants to proceed with development of the HAPP concept, CSC considers it useful to include actual replies of the questionnaire respondents to the question, "Do you think a high-altitude powered platform could be of value in your ocean/coastal region observations?" The responses are given below.

"Most emphatically. High resolution, high repetition rate data needed for coastal zone work. Most important for practical applications vs. experiments. A better investment than Seasat at current state-of-the-art of microwave sensors....

"Should also be a telemetry link relay system for automatic insitu sensors. This is an excellent idea--when do we start?"

Oscar K. Huh
Louisiana State University

"If instrumented with the proper devices and programmed to provide near real time data, a high altitude platform could prove very valuable."

W. D. Siapno
Deepsea Ventures, Inc.

"I believe that such a system is worthwhile and have supported the idea for about 3 or 4 years.

I don't believe that NESS, per se, would be a user of this type of system, although if it became an operational system, NESS conceivably might manage the system.

"Who pays to use this NASA system, what is its relationship to other NASA programs, etc. (?) I doubt the value of any results you may achieve from another survey of the used [sic] community. My suggestion is that you develop a scenario for its operational application and cost out the entire program so that potential "buyers" will know what they are getting involved in."

Jack Sherman
NOAA/NESS

"Probably so but may be competing with Seasat for some things."

Rear Adm. E. D. Stanley, USN (Ret)
Sea Use Council

"Best application in fisheries--oceanography would be for continuous monitoring of ocean fronts (sea surface temperatures), surface winds and sea state along west coast of U.S. and Baja, California. HAPP data would also provide best data base for checking Seasat data and NOAA VHRR-IR data."

Forrest Miller
Inter-American Tropical Tuna
Commission

"Possibly...many CZ monitoring problems require frequent low cost high resolution coverage--A/C upkeep and maintenance along with flying costs are a problem; current satellites do not have adequate frequency of coverage."

Robert W. Johnson
NASA Langley Research Center

"...most valuable asset possible."

Charles Whitlock
NASA Langley Research Center

"Yes [but] this seems to me a poor method of finding information."

Charles S. Cox
Scripps Institute of Oceanography

"Yes, the balance between coverage and resolution would make a platform at the suggested altitude quite useful for near shore oceanographic measurements."

Donald L. Murphy
United States Coast Guard Research
and Development Center

"The HAPP would be valuable because of its potential for activating the necessary sensor instantaneously over the desired area. Timeliness of the data acquisition and flexibility are at a premium."

M. Kristine Butera
NASA, Slidell, Louisiana

"Yes, if economically feasible.

"...use as close in GOES initially, relay of observations from ocean platforms is essential secondary function."

Paul Wolff
Ocean Data Systems

"No--I don't foresee immediate need except possibly in augmenting other data sources to provide reliable forecasts."

Atle Steen
Kennecott Exploration, Inc.

"Not as I foresee our operations in the next few years."

Michael E. Utt
Union Oil Company Research Center

"The platform information may be useful, but I doubt it would be of enough value to offset the potential cost to the user.

"We would be interested in receiving information on the data if it becomes available through your computer system (CSC Infonet); however, we are not interested in funding any research or development in association with HAPP."

William J. Straub
American Science and
Engineering Co.

"We presently have some evidence, by way of satellite photographs, demonstrating that submarine springs can be located from high altitudes. I think the proposed high altitude platforms have useful advantages over satellite imagery."

Dr. Robert H. Byrne
University of South Florida

"HAPP could be of value in determining sea ice limits and locating icebergs but some of the primary factors to be considered are expedient transmission of data (results of a HAPP overflight must be forwarded on the order of less than six hours for rapid dissemination via the international ice patrol bulletin) and resolution through cloud cover between icebergs and surface vessels. With a passive microwave imager, HAPP might also prove useful in determining sea surface temperature."

Lt. Comdr. Jerry C. Bacon
United States Coast Guard
International Ice Patrol

APPENDIX A - QUESTIONNAIRE

The following cover letter, questionnaire, and information concerning the HAPP concept were sent to over 200 persons in the ocean/coastal zone community. Sample responses are given in Section 5.

COMPUTER SCIENCES CORPORATION
SYSTEM SCIENCES DIVISION
[illegible]

May 30, 1978

Dear Colleague,

NASA is investigating the concept of a High Altitude Powered Platform (HAPP), or as one of its possible configurations is called, an Aerostat. This platform would be designed to station keep at an altitude of approximately 21 km (70,000 ft), a region of minimum wind and above storms. Two of the possible uses of such a platform are communications and surveillance; both of these are needs in the ocean/coastal zone community. As the concept of the HAPP is developed, the specifications for useful missions must be available. That is, the platform must be designed to allow chosen instruments to acquire sufficiently accurate data for the users. The goal of the enclosed questionnaire is to identify potential uses and requirements that instruments for a HAPP in the ocean/coastal region must meet.

We would appreciate it very much if you would take a few minutes to read the enclosed information about the HAPP and answer the questions in this questionnaire, to help us identify potential uses within the ocean coastal zone community. We would also welcome responses from any of your colleagues who are willing to participate in this survey.

Sincerely,

David Escoe

David Escoe (301-589-1345 x625)

COMPUTER SCIENCES CORPORATION

HIGH ALTITUDE POWERED PLATFORM
OCEAN/COASTAL ZONE
QUESTIONNAIRE

PART I

1 NAME _____

2 ORGANIZATION _____

_____

3 ADDRESS _____

_____

_____

4 TELEPHONE _____

PART II

PLEASE DESCRIBE YOUR CURRENT OCEAN/COASTAL ZONE INTERESTS

5 OCEANOGRAPHIC OBSERVATIONS _____

_____

6 DURATION OF OBSERVATION PERIOD _____

7 FREQUENCY OF OBSERVATION _____

8 GEOGRAPHIC LOCATION _____

9 SEASON OR TIME OF DAY _____

10 METEOROLOGICAL CONDITIONS REQUIRED _____

11 ANCILLARY DATA REQUIRED _____

_____

Please return to: David Escoe
Computer Sciences Corporation
8728 Colesville Road
Silver Spring, Maryland 20910

PART III

12 DO YOU THINK A HIGH ALTITUDE POWERED PLATFORM COULD BE OF VALUE IN YOUR OCEAN/COASTAL REGION OBSERVATIONS?

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PART IV

IF YOU HAVE AN EXISTING REMOTE SENSOR, OR CAN ENVISION ONE WHICH COULD OPERATE FROM A HAPP PLEASE ANSWER THE FOLLOWING QUESTIONS

13 TYPE OF INSTRUMENT _____

14 WEIGHT _____

15 VOLUME _____

16 OPERATING ENVIRONMENT REQUIRED _____

17 REQUIRED PLATFORM STABILITY _____

18 TIME BETWEEN REFURBISHMENTS _____

19 DESIRED PLATFORM ALTITUDE _____

20 SUPPORTING EQUIPMENT _____

COMMENTS _____

_____

_____

_____

_____

_____

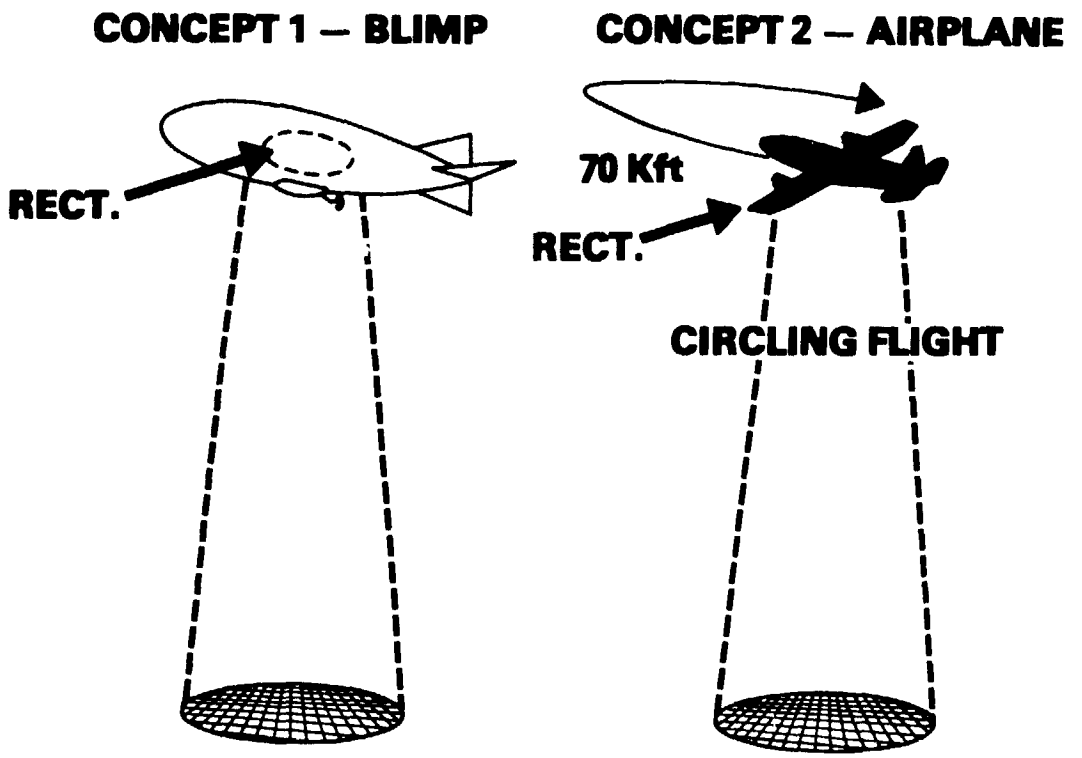
HAPP OCEANOGRAPHY/ COASTAL ZONE SURVEY

- OBJECTIVES
- HIGH ALTITUDE POWERED PLATFORM (HAPP) DESCRIPTION
- POTENTIAL OCEAN/COASTAL ZONE APPLICATIONS
- OCEANOGRAPHIC REMOTE SENSORS

SURVEY OBJECTIVES

1. INFORM OCEAN/COASTAL ZONE COMMUNITY OF NASA HAPP CONCEPT
2. IDENTIFY OCEAN/COASTAL ZONE USER REQUIREMENTS
3. IDENTIFY POTENTIAL HAPP APPLICATIONS
4. IDENTIFY REQUIREMENTS THAT INSTRUMENTS FOR A HAPP IN THE COASTAL REGION MUST SATISFY

HIGH ALTITUDE POWERED PLATFORM CONCEPTS



PROPOSED PLATFORM CHARACTERISTICS

	BLIMP		AIRPLANE	
	MISSION 1	MISSION 2	MISSION 1	MISSION 2
1. TOTAL WEIGHT (LBS)	1,900	4,800	1,800	4,500
2. WING SPAN (FT)			100	100
O R				
VOLUME (FT^3)	0.5×10^6	1.3×10^6		
3. PAYLOAD (LBS)	300	1,600	300	1,600
4. NOMINAL ALTITUDE (FT)	70,000	70,000	70,000	70,000
5. AVAILABLE POWER (KW)	FEW KW	FEW KW	—	—
6. MISSION DURATION (YR)	1	1	1	1
7. ANNUAL COST ($)	420,000	550,000	470,000	790,000

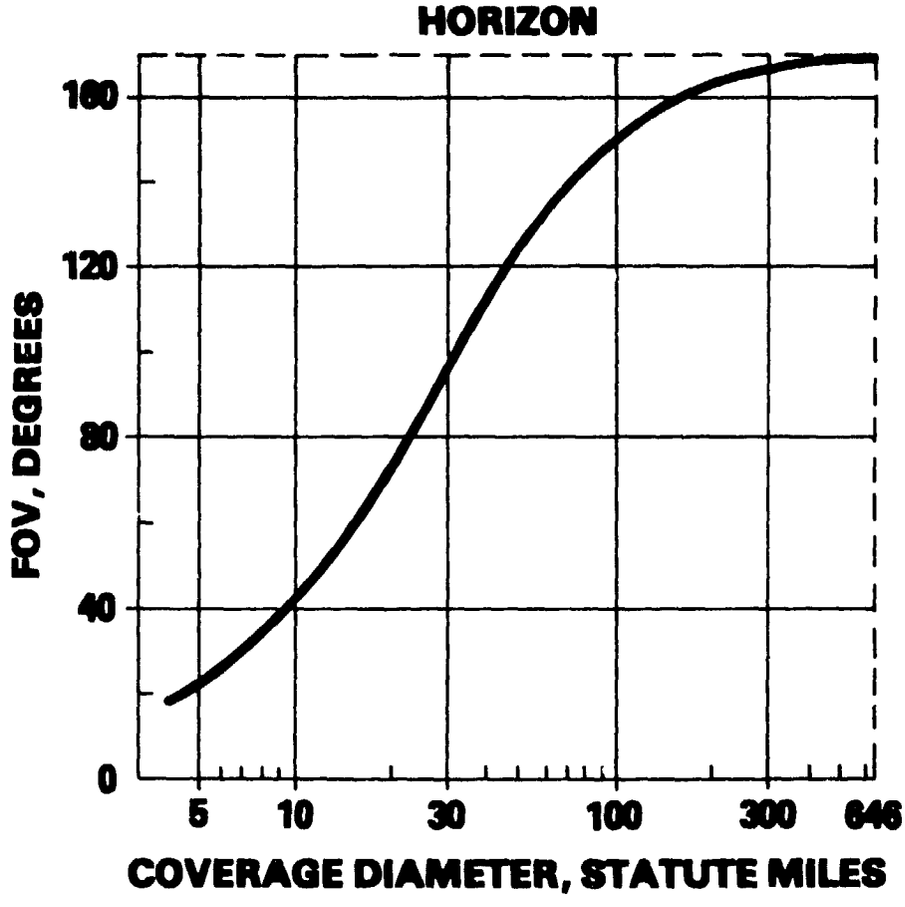
POTENTIAL OCEAN/COASTAL ZONE APPLICATIONS

- CONTINUING OPERATIONS
  - POLICING 200-MILE FISHING ZONE
  - MARINE TRAFFIC CONTROL
  - ICE DETECTION/MAPPING
  - WATER QUALITY/POLLUTION MAPPING
  - REMOTE COMMUNICATIONS LINK
- OCEAN SURVEY
  - OCEANOGRAPHIC/METEOROLOGICAL DATA COLLECTION
  - OIL AND MINING SITE SURVEYS
  - SEA SURFACE TEMPERATURE MAPPING
  - SHALLOW WATER BATHYMMETRY

POTENTIAL OCEAN/COASTAL ZONE APPLICATIONS (CONT'D)

- **SCIENTIFIC**
  - **COASTAL CURRENT STUDIES**
  - **RED TIDE STUDIES**
  - **WET LAND STUDIES**
  - **NEAR SHORE CIRCULATION STUDIES**
  - **INTERNAL WAVES STUDIES**
  - **TEST BED FOR GEOSTATIONARY SATELLITE REMOTE SENSORS**

DIAMETER OF AREA SEEN FROM A HAPP VS. SENSOR ANGULAR FIELD OF VIEW (FOR 70,000-FT. ALTITUDE)



OCEAN/COASTAL ZONE REMOTE SENSORS

SENSOR	OBSERVATION	SPACECRAFT/AIRCRAFT
RADAR ALTIMETER	SEA STATE, CURRENTS, OCEAN TOPOGRAPHY	GEOS-3, SEASAT-A
MICROWAVE RADIOMETER	SURFACE WIND, SEA SURFACE TEMPERATURE, RAIN RATE, SOIL MOISTURE, SEA ICE	NIMBUS, SEASAT-A
MICROWAVE SCATTEROMETER	SURFACE WIND AND DIRECTION	SEASAT-A
INFRARED RADIOMETER	SEA SURFACE TEMPERATURE	NUMEROUS NASA, NOAA SATELLITES AND AIRCRAFT
COASTAL ZONE COLOR SCANNER	OCEAN COLOR, POLLUTION, COASTAL PHENOMENA	NIMBUS-G
SYNTHETIC APERTURE RADAR	SEA ICE, WAVE SPECTRA, ICEBERGS, LEADS, SHOALS, CURRENTS	SEASAT-A
MULTISPECTRAL SCANNER & RETURN BEAM VIDICON CAMERA	MULTISPECTRAL IMAGERY FOR COASTAL ZONE AND WETLAND STUDIES	LANDSAT 1—3

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9. S. H. Melfi, J. D. Koutsandreas, and J. Moran, "Tracking Pollutants From a Distance," Environmental Science and Technology, vol. 11, January 1977

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