

*Hand to  
Account*

E72-10004-170  
CR-127554

Bimonthly Report: 5/4/72 - 7/4/72

ERTS Proposal No. 108

*Pass  
Malloy*

Remote Sensing of Ocean Currents

George A. Maul, Principle Investigator, GSFC ID-C0315

OBJECT

The object of this investigation is to locate ocean current boundaries by sensing the color change associated with the cyclonic edge of the zone of maximum horizontal velocity shear. The test site is the eastern Gulf of Mexico where the strongly baroclinic flow from the Yucatan Straits forms into the Loop Current. The research will attempt to use ERTS data in the investigation of ocean color sensing from simultaneous observations by ship and satellite.

FIELD DATA COLLECTION

The field data collection plans have been modified from the original proposal. A time-series of the Loop Current will be obtained by occupying the suborbital track of ERTS that passes into the Yucatan Straits every 36 days for at least one year (see attachment). The research vessel will be on the suborbital track on the day of satellite transit collecting continuous chlorophyll-a, volume scattering, and radiometric temperature (in conjunction with the NOAA-2 IR sensors); hourly (15 km interval) expendable bathythermograph (XBT), surface bucket temperature and salinity samples will be obtained. During daylight, spectra of upwelling and downwelling radiance (400-800 nm) will be measured with a 1/4 meter Ebert scanning spectroradiometer. Upon reaching the Yucatan Straits a temperature/salinity/depth (STD) transect of nine stations will be made in order to determine the geostrophic current and transport fields. After the STD transect the surface boundary of the Loop Current will be tracked using the same measurements outlined for the subsatellite track; a hypothetical track from Campeche to Dry Tortugas is shown on the attachment.

Made available under NASA sponsorship in the interest of early and wide dissemination of Earth Resources Survey Program information and without liability for any use made thereof.

NASA SPON

N72-28312

Unclas  
00004

63/13

(E72-10004) - REMOTE SENSING OF OCEAN CURRENTS Bimonthly Report, 4 May - 4 Jul. 1972 G.A. Maul (Atlantic Oceanographic and Meteorological) - 1 Aug. 1972 8 p CSCL 08C

The field data collection program will provide the basic measurements to understand the spectral reflectance at the sea surface as well as answering certain basic questions about the oceanic circulation in this region. Further, the ground truth for a proper analysis of ERTS imagery will be obtained over a time scale of bio/physical significance (biological oceanographers have been invited to partake in the cruises). Equipment purchase and debugging for these measurements is complete and one training cruise has been made as part of a C-130 overflight by MSC.

#### WORK SUMMARY

As mentioned above the required equipment for the field data has been purchased with NOAA funds. An overflight by the NASA/MSO C-130 was made across the boundary layer of the Florida Current south of Dry Tortugas on 28 June. All aspects of the planned experiment were successfully accomplished; the cruise report is appended hereto. Discrete sampling techniques were used with this experiment whereas continuous methods will be used routinely in the future. The chemical analysis of the samples is underway and is about half complete. A cursory examination of the spectra showed the expected increase in energy in the green wavelengths when in the slope waters outside of the current; the boundary was clearly visible to the eye from both the ship and the aircraft. Processing of the aircraft data has been started by MSC.

#### WORK PLANS

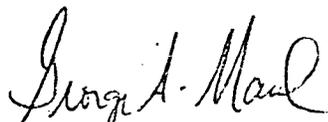
The first cruise is planned for August assuming a July launch date; the exact dates will depend on the ephemeris after final orbital adjustments. Computer software development is lagging because of cruise planning and preparation but is expected to move along with the recent receipt of magnetic tapes containing dummy MSS data. Equipment for the optical scanning of film strips has arrived but is not set up due to an impending move of the laboratory to new quarters; the I<sup>2</sup>S density slicer recently purchased by NOAA National Hurricane Center is set up and is available to the project. Because of the increased scope of the oceanographic part of the project, additional scientists from this laboratory are being assigned and training has commenced.

## DISCUSSION

The work on phase I is proceeding according to schedule to the principle investigator's satisfaction with the exception of the software as noted. The field experiments are proceeding in an orderly manner as far as personnel and equipment are concerned. Data processing will speed up when continuous flow measurements are made at sea. Backup sampling techniques have been established with the recent cruise so that reliability in the continuity of ground truth measurements is assured.

At this writing the funding for the project is adequate, but an administrative error was made when overhead was not included in the proposal. This has cut deeply into the funding for the project which may or may not be covered by redirected NOAA funds. The problem is not resolvable at this writing, but will be reported on as the information becomes available.

Note the new address below.



George A. Maul  
NOAA/Atlantic Oceanographic & Meteorological Laboratories  
15 Rickenbacker Causeway  
Virginia Key  
Miami, Florida 33149

August 1, 1972



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION  
ATLANTIC OCEANOGRAPHIC AND METEOROLOGICAL LABORATORIES  
PHYSICAL OCEANOGRAPHIC LABORATORY  
NASA/MSC/ERS  
STATE UNIVERSITY SYSTEM INSTITUTE OF OCEANOGRAPHY

CRUISE REPORT

B-7205 R/V BELLOWS (SUS-7205)

26 - 29 June 1972

I. OBJECTIVES

A. As part of the Earth Resources Programs of the United States, and specifically the Earth Resources Technology Satellite Program, this NOAA/NASA cooperative cruise was performed in the Eastern Gulf of Mexico. The R/V Bellows occupied a track with the same azimuth as the ground track of the ERTS while NASA's C-130 instrumented aircraft observed certain features of the ocean in several regions of the electro-magnetic spectrum. The purpose of the experiment was to:

1. Use remote sensing techniques to locate the surface manifestation of that part of the Gulf Stream system known as the Loop Current.
2. To obtain by ship optical, physical and biological observations of the surface waters in the boundary layer region.
3. To obtain by aircraft, photographic, multispectral scanner, and infrared data over the ship at several altitudes at the same time as the ship observations.
4. To cross correlate the data and attempt to develop techniques for routinely locating these baroclinic features of the ocean from remote platforms.

II. ACTUAL SCHEDULE

<u>Date</u>	<u>Time</u>	<u>Activity</u>
June 25	2100	Depart Tarpon Springs
27	0500	Arrive Dry Tortugas
	0800	Depart Dry Tortugas; commence XBT transect to locate Loop Current.
	1100	Complete transect; commence hydro/ spectral stations.
	1730	Complete stations; secured alongside Dry Tortugas
28	0730	Depart Dry Tortugas; commence

<u>Date</u>	<u>Time</u>	<u>Activity</u>
28 (Cont'd)		XBT transect to locate Loop Current
	1015	NASA air craft contact; commence simultaneous observations
	1215	complete experiment
	1300	Arrive Dry Tortugas
	2000	Complete processing samples; depart for Tarpon Springs.
29	2230	Arrive Tarpon Springs

### III. STATION POSITIONS

The stations were run on a 195 course in a line SSW from Dry Tortugas.

<u>Course</u>	<u>Sta. No.</u>	<u>Date</u>	<u>Time</u>	<u>XBT</u>	<u>Hydro</u>	<u>Sfc. Temp.</u>	<u>Optics</u>	<u>Chl a</u>
	001	27	0900	X		X		
	002		0930	X (failed)		X		
	003		0932	X		X		
	004		1000	X		X		
	005		1030	X		X		
015°	006		1130	X	001	X	X	X
	007		1230	X	002	X	X	X
	008		1400	X	003	X	X	X
	009		1500	X	004	X	X	X
	010		1600	X	005	X	X	X
195°	011	28	0845	X		X		
	012		0915	X		X		
	013		0945	X		X		
015°	014		1015	X		X	X	X
	015		1020	X		X	X	X
	016		1025	X		X	X	X
	017		1030	X		X	X	X
	018		1035	X		X	X	X
	019		1040	X		X	X	X
	020		1045	X		X	X	X
	021		1050	X		X	X	X
	022		1055	X		X	X	X
	023		1100	X		X	X	X
	024		1105	X		X	X	X
	025		1110	X		X	X	X
	026		1115	X		X	X	X
	027		1120	X		X	X	X
	028		1125	X		X	X	X
	029		1130	X		X	X	X

<u>Course</u>	<u>Sta. No.</u>	<u>Date</u>	<u>Time</u>	<u>XBT</u>	<u>Hydro</u>	<u>Sfc. Temp.</u>	<u>Optics</u>	<u>Chl a</u>
	030		1135	X		X	X	X
	031		1140	X		X	X	X
	032		1145	X		X	X	X
	033		1150	X		X	X	X
	034		1155	X		X	X	X
	035		1200	X		X	X	X
	036		1205	X		X	X	X

#### IV. PERSONNEL

1. G. A. Maul, Chief Scientist, NOAA - ACML
2. E. B. Murphy, Marine Technician, SUSIO

#### V. DESCRIPTION OF OPERATIONS

Location of the current on the 27th, with XBTs was a transect, run at standard speed, taking measurements half-hourly. When the current was found, and the plans laid for the overflights, three hydro stations with casts to 50 meters were taken, one cast to 30 meters and one cast consisting of a bottle at the surface and at 10 meters were taken in the vicinity of the surface front. The samples were at 0, 10, 20, 30, 40 and 50 meters depth; water samples for chlorophyll-a, scattering and salinity were collected and processed. On each station the upwelling and downwelling spectral irradiance was determined with the scanning spectro-radiometer; the sun was on the starboard beam during measurement. Finally, both thermometric and radiometric sea surface temperature were recorded along with wet bulb, dry bulb, barometric pressure, and wind velocity. All measurements were taken with the sun altitude greater than 30°. Nights were spent in sheltered waters. The overflights began at 1015; the aircraft called on 2182 kh<sub>2</sub> when airborne for initial contact. After rendezvous at several altitudes while the ship collected samples. The transect was about 20 km long with the surface front of the current bisecting the transect. Every five minutes a surface sample was taken, its bucket temperature measured and stored in a plastic container for later processing; an XBT was launched, a surface spectrum measured, and the surface infrared temperature recorded. This took approximately two hours. During the experiment the ship's heading was kept at 350° and its speed constant at 6 knots. Loran A readings from two stations were taken at each sample; plotting was done at a later time.

INTERIM PROCESSING: 1 liter chlorophyll-a samples were filtered and the filter frozen as soon as possible after the experiment. The scattering determinations were made in the same time frame. No further shipboard processing was necessary.

#### VI. RESULTS

The data collection phase of the experiment was a success; both the ship and the aircraft obtained the desired information. The surface

waters of the Loop Current were clearly distinguishable from the inshore waters optically and thermometrically. The aircraft and ship observed a color change across the surface front which is identically correlated with the surface and deeper thermal structure. It remains to be determined if the remote sensors aboard the C130 are capable of detecting these features through increasing air mass.

## VII. LOGS

Chief Scientist's Log  
Deck Log  
Track Chart  
Loran Log (C&GS 722)  
Hydrographic Station Log

## VIII. ACKNOWLEDGMENTS

The splendid cooperation of Captain Frank Davis and Ellen Murphy in preparing for this cruise and implementing its success is gratefully acknowledged. During the actual overflight the entire ship's company; Gene Olson, David Kulwicki, and our guest, Bill Bellows, along with Frank and Ellen, all pitched in for the two most hectic hours in oceanography. They are the spirit that makes SUSIO what it is and which encourages further cooperation with AOML. Finally, I would like to thank the crew of NASA's C130 and especially James Weber for their part in the experiment, certainly without the overflight the project could only have been half a success.

---

Submitted by: George A. Maul

Approved by:

*M. O. Rinkel*  
M. O. Rinkel  
Assistant Director

cc: Director, AOML  
Director, PhOL  
J. Weber, NASA/MSO  
J. Greaves, NASA/GSFC  
F. Davis, R/V BELLOWS  
D. KULWICKI, R/V BELLOWS  
L.R.F. BELLOWS  
BILL BELLOWS

### III COMMANDS

#### BEGIN SEARCH (\) Command

#### FUNCTION

To begin a new search and stop all reference to the previous search.

#### USE

When conducting a search, it is necessary to: (1) Identify yourself so that any output you receive will reach you without delay, (2) clear data entered by the previous search from the computer's memory, (3) select the file that you want to search. The BEGIN SEARCH (\) satisfies all three of these and must be done as the first step in every search.

Command	Operand	Example
BEGIN SEARCH	None	(\)

#### EXPLANATION

To do a BEGIN SEARCH depress the BEGIN SEARCH (\) key, then hit TRANSMIT (henceforth, it will be understood that TRANSMIT must be depressed in order to send any command to the computer). The following display will appear on the screen, one question at a time:

```
SEARCH TITLE
NAME OF PERSON CONDUCTING SEARCH
NAME OF PERSON RECEIVING RESULTS IF DIFFERENT
MAIL ADDRESS
THE FOLLOWING FILES ARE AVAILABLE FOR YOU TO SEARCH:
1--STAR, IAA
2--
3--
```

Answer each question, then depress TRANSMIT and answer the next question. Continue this process until you have chosen a file. As a result, you will receive the following:

```
SEARCH TITLE (your title)
DATE/FILE (today's date/file you have requested)
SEARCH BY (your name)
REQUESTOR (requestor)
ADDRESS (your address)

SET NO. IN (DESCRIPTION)
NO. SET (+=OR, *=AND, -=NOT)
```