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CR-133579

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ENVIRONMENTAL RESEARCH LABORATORIES

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August 20, 1973

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Greenbelt, Maryland

Received in ERN
AUG 27 1973

(E73-10922) REMOTE DETECTION OF OCEANIC EDDIES IN THE LESSER ANTILLES USING ERTS-1 DATA Progress Report (National Oceanic and Atmospheric Administration) 7 p HC $3.00 CSCL 08C G3/13 N73-29271 Unclas 00922

Reference: Type I Progress Report
Title: Remote Detection of Oceanic Eddies in the Lesser Antilles Using ERTS-1 Data
Task No.: 432-641-14-05-10
Proposal No.: 107
Principal Investigator: Dr. Kirby J. Hanson
GSFC ID: CO-005

Dear Sir:

In our Interim Report, delivered in June 1973, we presented evidence suggesting that photo density differences seen in the lee of the Lesser Antilles Islands are a result of changes in sea state due to the sheltering effect of the islands. Upper air wind observations from four stations in the area (St. Maarteen, Guadeloupe, Barbados, and Trinidad) correlated highly with the direction of the ocean features to the west of the islands which are visible in the ERTS pictures.

During the two month report period just concluded, all available winds from upper air, surface, and ship stations for the periods of the ERTS photos were collected and analyzed to further test the preliminary results of the Interim Report. Figures 1-3 of this report show the relationship of the wind data to the features seen in the mosaiced negative prints of ERTS-1 data. On 26 September 1972, (fig. 1) the features in the ERTS-1 print extend to the southwest from Dominica and Martinique. The direction of surface winds, recorded by ships in the vicinity of Martinique, Grenada and St. Lucia, correlate very well with the direction of these features. In fact, the wind arrow to the west of Martinique falls between the two features in the ERTS-1 print and is parallel with them. Figures 2 and 3 show that when winds flow to the west and northwest, the features in the lee of the islands also develop similar directional components. For example, in figure 2 the wind to the east of Tobago is in the same direction as the feature extending from that island and the 1000mb and 850mb winds at Barbados indicate the same flow seen in the very bright feature to the west of St. Vincent. Also, in figure 3 winds to the east of St. Vincent have directions very similar to features to the west of the island. The wind

Original photography may be purchased from:
EROS Data Center
10th and Dakota Avenue
Sioux Falls, SD 57198

7 pp

analysis in these three figures substantially support the theory that the density differences in these ERTS-1 data are wind induced features on the ocean surface.

There does not seem to be a direct relationship between the speed of the wind and the intensity of the photo density changes. The sharpest contrasts in photo density can be seen in the 13-14 October ERTS-1 data (fig. 2), and the wind speeds are 5 to 15 knots. The winds on 26 September also range from 5 to 15 knots, but the features are much less distinct than in figure 2. On 19 November the winds to the east of St. Lucia and St. Vincent are much stronger (25 to 30 knots) than the previous two examples, yet, the features seen in the ERTS-1 images are barely distinguishable. The brighter features in the ERTS-1 mosaics indicate areas of less backscattered energy because they are negative prints. It might be assumed, therefore, that stronger winds, and thus larger waves, would produce a greater contrast in backscattered energy between protected and unprotected areas (i.e. in the wind shadow of the islands and in areas not sheltered by the islands). However, when winds are strong (19 Nov.) the contrast in backscattered energy is much less than that observed during periods when winds are weaker (13-14 Oct.). One possible explanation is that the islands may block the air flow most efficiently when the wind speed is below 20 knots. Higher wind speeds may reduce the size of the wind shadow on the lee side of the island.

The topography of each island influences its ability to alter the surface air flow. High mountains at the northern end of Martinique cause a larger wind shadow than the relatively lower land at the southern end of the island. Thus, the direction of the wind might also determine the island's effectiveness to block the air flow. This offers a possible explanation for the smaller contrast in photo density between the 26 September and 13-14 October figures. Daily changes in atmospheric conditions, such as the amount of particles in the atmosphere, and the size and direction of sea swell and smaller waves in the lee of the islands, are some of the factors influencing the amount of backscattered energy in the lee of the islands. Because of these factors which change from day to day, and the methods involved in transferring the data to various photographic products, conclusions about a relationship between wind speed and photo density contrasts in the final product may not be meaningful.

The most important result of our study is that the wind direction and the direction of the surface features seen in the ERTS-1 images are highly correlated.

Before the recording system failed near the first of April 1973, ERTS-1 collected data over the Lesser Antilles on two other occasions which we have not yet evaluated. ERTS-1 positive transparencies have been received for 24 and 26 March 1973 and large photo density changes are visible in the lee of some of the islands. Also, the Non-US Standard Catalog (no. 7) lists a data collection over our area of study on 17 February 1973, which we are waiting to receive. During the next report period, these final two sets of ERTS-1 data will be studied and compared with wind observations in the same manner as the data presented in this report.

Sincerely,

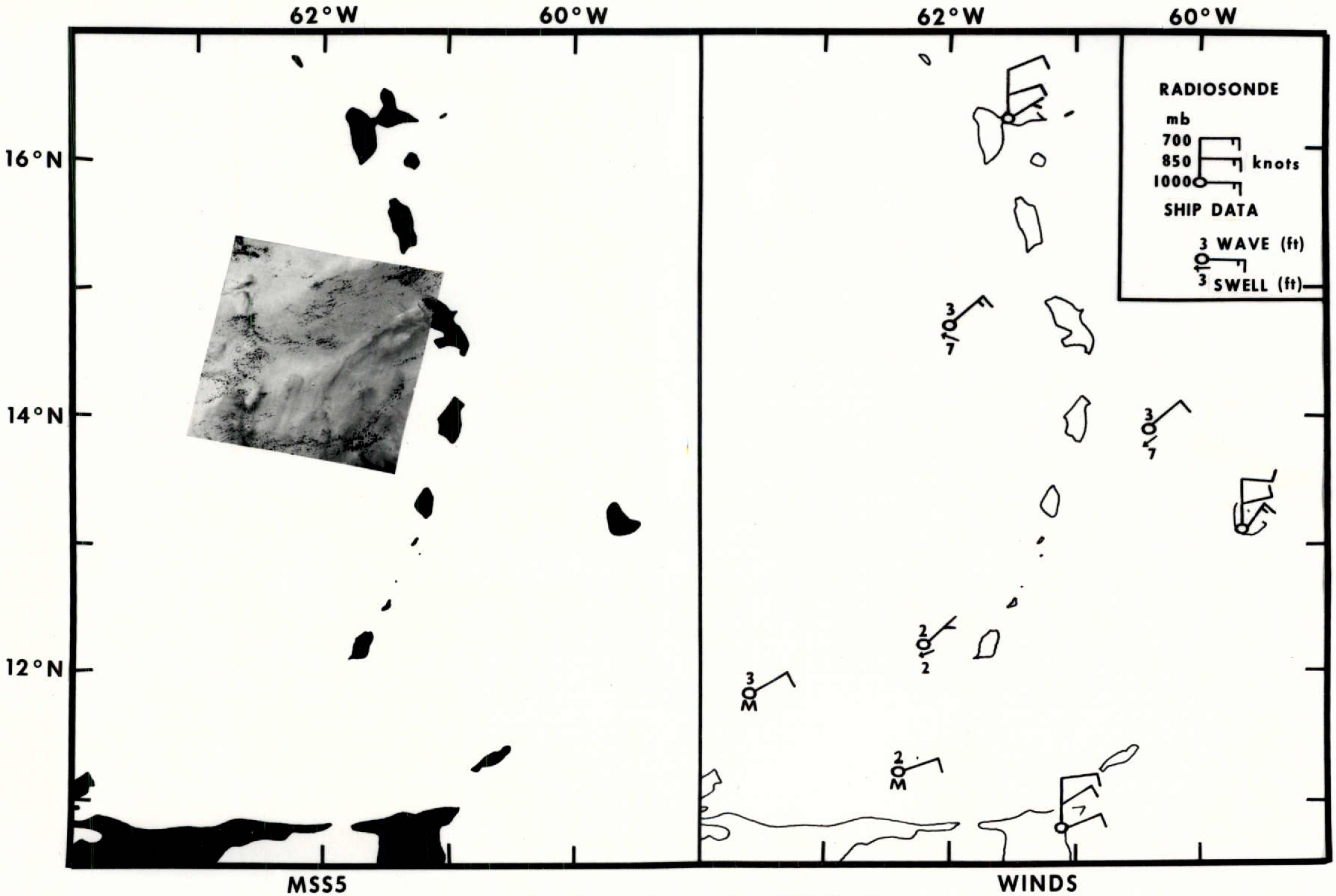
Kirby J. Hanson

cc: Mr. George Ensor, Technical Monitor
Project Scientist, Code 650
Dr. James R. Greaves, Scientific Monitor
ERTS Program Manager

Enclosures

ERTS-1 IMAGE IDENTIFICATION

	Observation ID	Center Point Coordinates	MSS Band
Figure 1	1065-14000	14.465N/62.051W	5
Figure 2	1082-13541	15.941N/60.278W	5
	1082-13544	14.492N/60.625W	5
	1082-13550	13.051N/60.973W	5
	1082-13553	11.621N/61.325W	5
	1083-14000	15.908N/61.770W	5
	1083-14002	14.474N/62.135W	5
	1083-14005	13.045N/62.489W	5
	1083-14011	11.605N/62.838W	5
Figure 3	1119-14005	14.478N/62.166W	5
	1119-14012	13.032N/62.520W	5
	1119-14014	11.569N/62.866W	5



26 SEPT 1972 ERTS COVERAGE

Figure 1

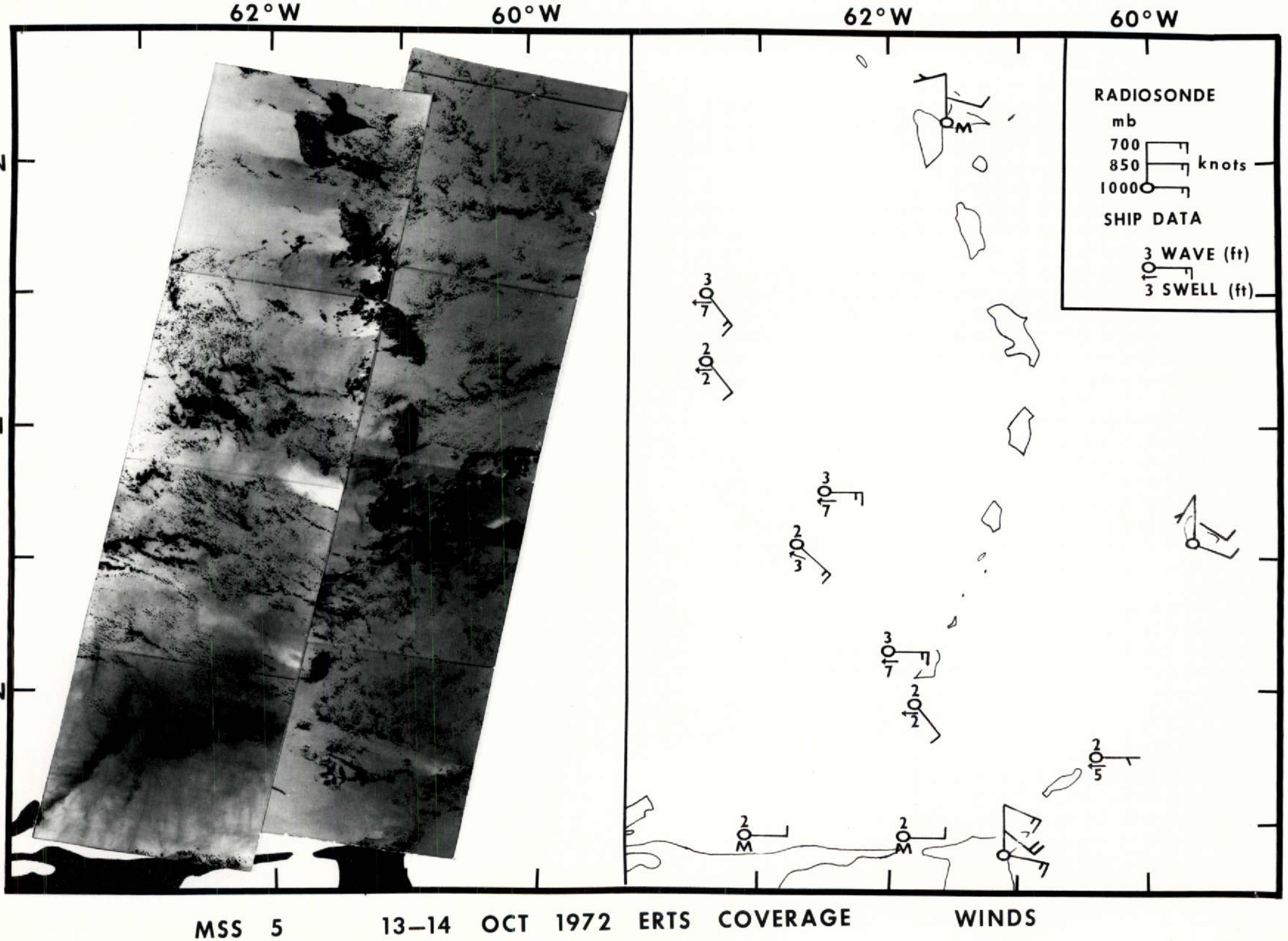
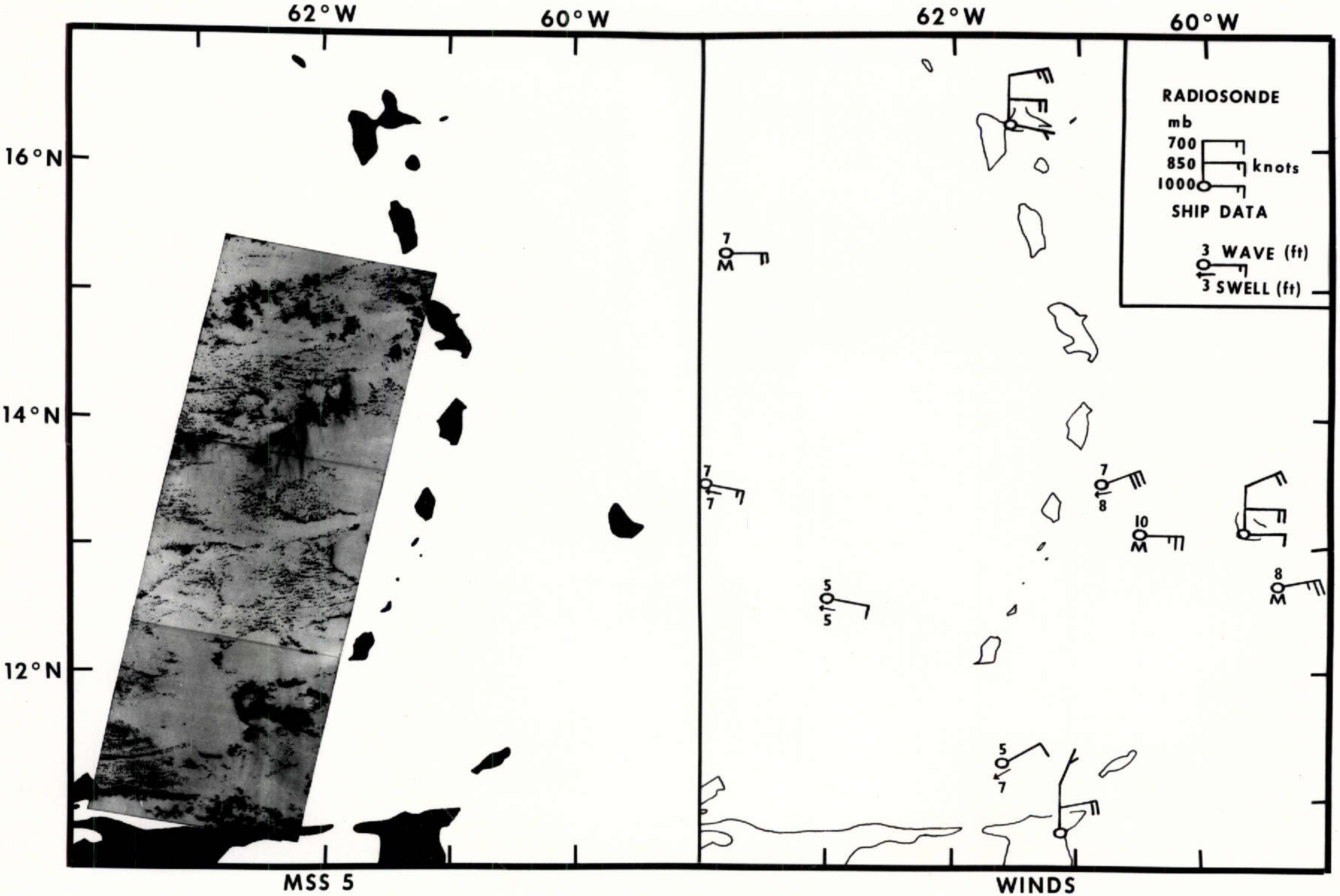

62°W
60°W
16°N
14°N
12°N
RADIOSONDE
mb
700
850
1000
knots
SHIP DATA
3 WAVE (ft)
3 SWELL (ft)
MSS 5
13–14 OCT 1972 ERTS COVERAGE
WINDS

Figure 2



19 NOV 1972 ERTS COVERAGE

Figure 3