N 73 - 4

Paper E 10

MONITORING OCEAN DUMPING WITH ERTS-1 DATA

C. T. Wezernak and N. Roller, *Environmental Research Institute of Michigan, Ann Arbor, Michigan*

ABSTRACT

Large volumes of municipal and industrial wastes are disposed of by means of dumping at sea. Disposal of wastes by barge dumping frequently produces surface films and waste fields whose fate and effects are not adequately defined. Frequently very large areas of the marine environment are affected.

Described in this paper are the results of an analysis of ERTS-1 data for the New York Bight collected on 16 August 1972. Results are presented which show acid-iron wastes, sewage sludge, suspended solids, and major water mass boundary features in the study area. The potential of satellite remote sensing for monitoring large scale events such as ocean dumping is discussed.

1. INTRODUCTION

The volume of waste disposed of by ocean dumping is increasing rapidly. Generally, ocean dumping is viewed as a convenient mechanism for the disposal of the more objectionable waste products of contemporary society, substances which are not readily amenable to treatment by means of existing techniques, or substances which are judged to be "too expensive" to treat. In the majority of cases, waste disposal takes place not in the deep ocean but rather in nearby coastal waters. Because of numerous environmental implications associated with the practice, ocean disposal of wastes has become a matter of national and international concern.

An important element in present and future programs for managing ocean disposal of wastes is the availability of a monitoring system (or systems) which will (a) document authorized discharges to verify compliance in terms of discharge location, (b) detect unauthorized dumps or accidental discharges, and (c) provide data regarding the movement of wastes. Monitoring systems are required not only for the detection of small spills and discharges but also for monitoring large scale events. The present report is one example of current efforts to define the potential of satellite remote sensing for large scale environmental monitoring.

2. STUDY AREA

The coastal waters adjacent to the New York Metropolitan Region are the repository for substantial quantities of sewage sludge, industrial acid-waste, construction debris, and dredge spoils [1,2].

Sewage sludge is disposed of at a location approximately 19 km. south of Long Island. At the present time, approximately 9,500 cu. m. per day are dumped at this location. In addition to nutrient enrichment of the overlying waters, the introduction of heavy metals, etc. at the immediate dump location, the practice also results in the formation of extensive surface films [3,4].

Acid-iron wastes are disposed of at a location approximately 20 km. east of New Jersey and 24 km. south of Long Island. The waste solution contains approximately 8.5% H_2SO_4, 10% $FeSO_4$, and small quantities of various metallic elements [4,5]. The wastes are dispersed by barge over a hairpin-shaped course of approximately 8 km. in length. The subsequent oxidation of the iron from the ferrous to the ferric state produces a suspension which tends to remain in a distinct pattern for long periods after dispersal.

In addition to the above substances, dredging spoils from the New York metropolitan harbor area and construction debris are dumped in the New York Bight.

3. RESULTS

Multispectral aircraft missions are included in the program in order to provide corrobative evidence for use in the analysis and interpretation of space data. The study area is large and includes low contrast phenomena of varying size and distribution. Hence aircraft data is utilized to identify features of interest in the study area and to evaluate ERTS-1 data.

A support mission was carried out by the ERIM aircraft on 16 August 1972 at a time coincident with the satellite pass over the study area. Twelve channels of data were collected over the spectral range 0.32 to 11.7 μm. A two channel display of aircraft data is shown in Figure 1. The lower spectral band (0.62-0.70 μm) corresponds to MSS 5 (0.6-0.7 μm) in the ERTS data.

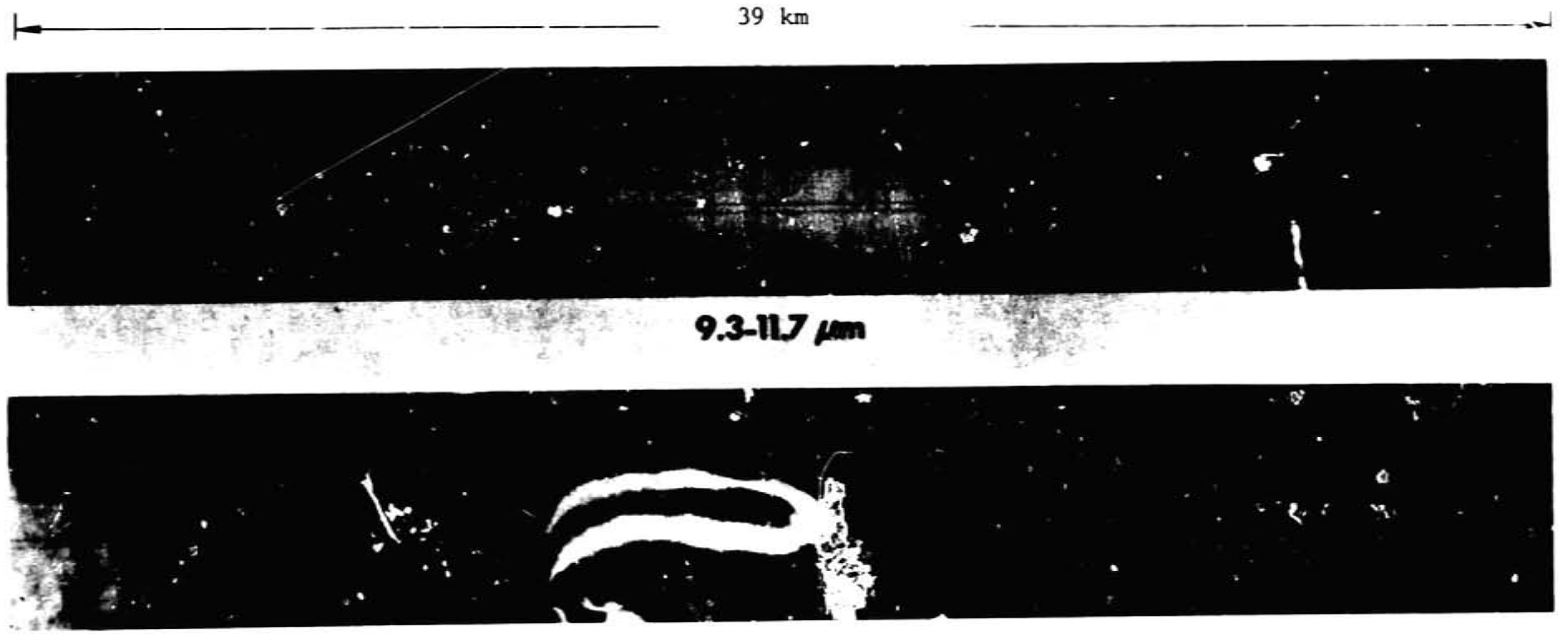
An analysis of aircraft data indicates a number of large features in the area. In addition to the acid waste (which has a reflectance peak in the 0.62-0.70 μm band), surface films, suspended solids, and water mass boundaries are evident. The latter were detectable in this case on the basis of thermal properties and on the basis of other spectral characteristics. Analysis of aircraft data was limited to those features which are within the scope of the ERTS investigation.

Figure 2 illustrates the kind of information which is obtainable by direct analysis of ERTS imagery. Clearly evident in Figure 2 (MSS 5) is the acid-waste, the sewage sludge dump area, and the suspended sediment input from the Lower Bay area. Inspection of Figure 3 (MSS 6) provides additional information regarding the area, most notably the water mass boundaries. Furthermore, an observation regarding the relative depth of the sewage sludge can be made from an inspection of Figures 2 and 3. Of the two spectral bands MSS 5 and MSS 6, greater depth detail can be expected in MSS 5 due to differences in the attenuation coefficient of the two spectral bands. As a result, in Figure 3 only that portion of the sludge which is at or very near the surface is evident, whereas the entire mass is visible in Figure 2. Finally the shape of the sediment plume, the acid-waste, and the water mass boundaries provide information regarding surface circulation patterns at the time of observation.

Shown in Figure 2A is a digital map of the acid waste. The two density levels shown represent concentration differences. The dimensions of the waste are 9.4 km. from pt. A to pt. B and 6.16 km. from pt. C to pt. D. The surface area of the waste is 1,250 hectares. The distance from the nearest point of the plume to the New Jersey coast was found to be 16.25 kilometers. This is somewhat closer to the coast than the designated acid-dump area. The sewage sludge dump is shown in Figure 2B. The center of the dump was found to be 20 km. ± south of Long Island and 20 km ± east of Sandy Hook.

4. CONCLUSIONS

An analysis of spacecraft data collected on 16 August 1972 (ERTS image ID E-1024-15071) clearly shows the distribution of an acid-waste discharge, sewage sludge dump, and major suspended sediment inputs into the study area. Additionally the data analysis provides information regarding the surface movement of the wastes and the location of major water mass boundaries. Synoptic coverage of the type available from satellite



NEW YORK BIGHT

16 August 1972

FIGURE 1 AIRCRAFT IMAGERY

Altitude = 3048 meters

FIGURE 2 ERTS-1 IMAGE
MSS 5 0.6–0.7 μm
E 1024-15071

FIGURE 2B

FIGURE 2A

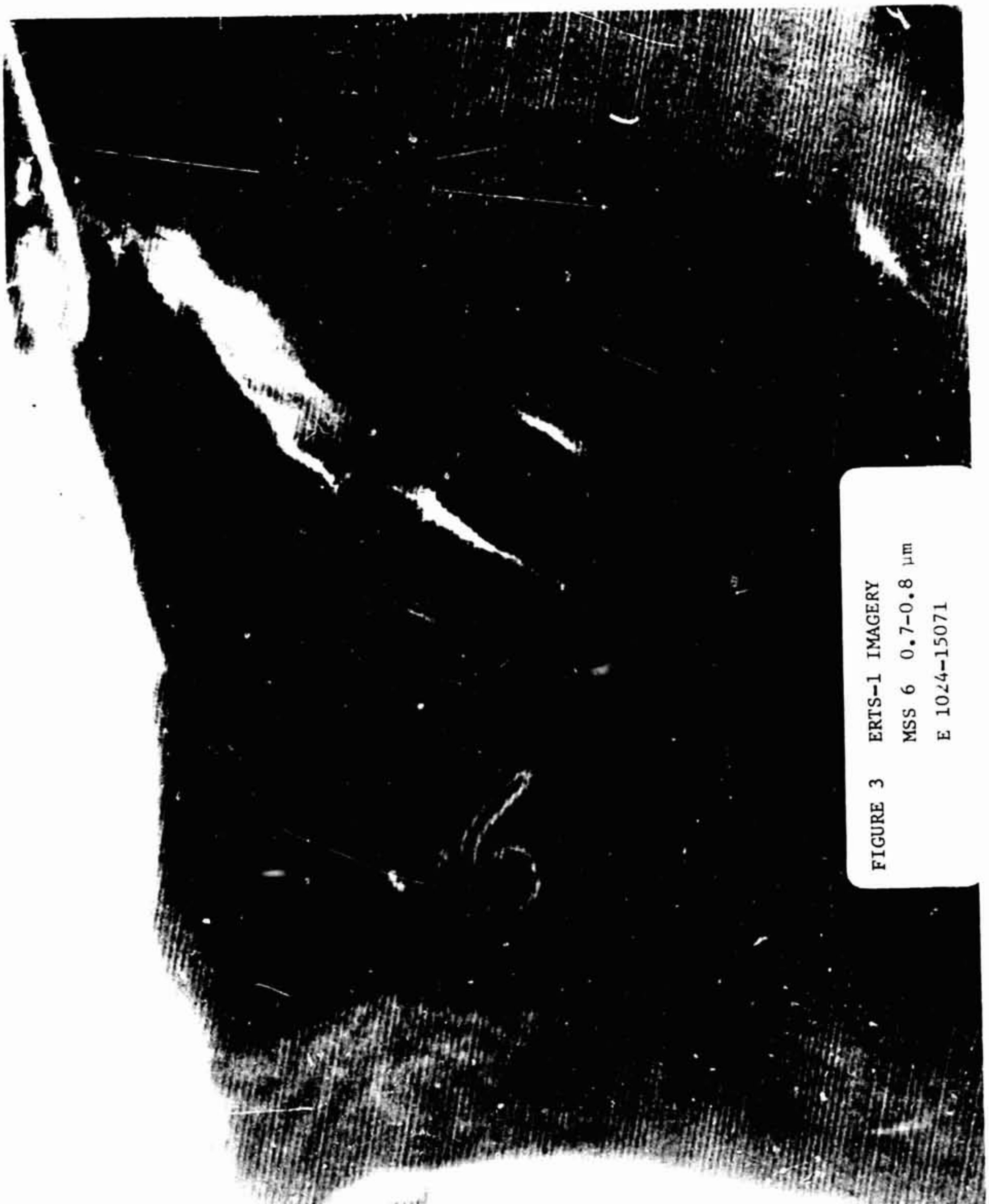


FIGURE 3 ERTS-1 IMAGERY
MSS 6 0.7-0.8 μm
E 1024-15071

altitudes can be expected to contribute towards an understanding of surface circulation patterns in the area.

An attempt was made to differentiate waste fields and water masses using digital ratioing techniques. The results were mixed and indicate the necessity of increasing scanner gain over water areas.

A clear need exists in physical oceanography and marine pollution control for improved monitoring systems capable of providing data over large areas. Remote Sensing from space has the potential for meeting this need. Instrumental improvements in future satellites, including the addition of a high resolution thermal channel, will serve to increase the utility of satellite remote sensing.

5. REFERENCES

1. The Marine Disposal of Sewage Sludge and Dredge Spoil in the Waters of the New York Bight (Technical Memorandum 1-71, Woods Hole Oceanographic Institution, Woods Hole, Mass., Jan. 1971). (Report).

2. Survey of Marine Waste Deposits, New York Metropolitan Region (Technical Report No. 8, Marine Sciences Research Center, State University of New York, Stony Brook, New YOrk, April 1971). (Report).

3. Analyses of Dredged Wastes, Fly Ash, and Waste Chemicals -- New York Metropolitan Region, (Technical Report No. 7, Marine Sciences Research Center, State University of New York, Stony Brook, New York, October 1970). (Report).

4. The Effects of Waste Disposal in the New York Bight (Summary Final Report, National Marine Fisheries Service, Sandy Hook Laboratory, Highlands, New Jersey, April 1972). (Report).

5. R. F. Vaccaro, G. D. Grice, G. T. Rowe, and P. H. Wiebe, Water Research 6, p. 231 (1972) (Journal).