X-651-70-265

PREPRINT

NASA TM X- 63987

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SUMMARY

Infrared analyses from measurements aboard the Nimbus II satellite showed a complex pattern of temperatures near the Somali Coast where upwelling appears during the Southwest monsoon. The patchiness of higher and lower temperatures may be explained by cyclonic and anticyclonic water movements. This statement is confirmed by ship observations.

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The temperature patterns discussed in this paper were obtained from Nimbus II High Resolution Infrared Radiometer (HRIR) observations on two orbits passing over the general area near the Northeast Coast of Africa. A detailed analysis of these temperatures has revealed a very complicated temperature distribution along the Somali Coast. A previous investigation has shown that the standard deviation of the difference between ship observations and satellite equivalent blackbody temperature recordings was 1.29°C (K.-H. Szekielda, 1970). Therefore the analysis of infrared data over cloud free regions has a very high significance for thermal structure of the ocean's surface, especially in regions with upwelling.

Four orbits from Nimbus II were available between 2 and 6 July for a temperature analysis in the upwelling region along the Somali Coast. These four sets of synoptic temperature data gave an insight into the possible rapid change of sea surface temperature over a great area, and into the dynamical processes at the surface of a region with upwelled water.

The infrared data from Nimbus II on July 3 covered a large region near the Somali Coast and the neighboring sea (Figure 1). An analysis of these data allows one to conclude that an anticyclonic water movement exists along the Somali Coast, accumulating warm water (temperatures higher than 26°C) in the inner part of the gyre. This anticyclonic water movement was first described by A. G. Findlay (1866) and was more recently investigated by J. G. Bruce (1968). In

Findlay's chart an anticyclonic gyre is also reported for the Gulf of Aden and thereby helps to confirm the existence of the anticyclonic motion inferred by the distribution of sea surface temperature observed from Nimbus II in this same area. Northeast off Socotra temperatures lower than 24.0°C were observed which are probably in the center of a cyclonic water movement. An isolated warm area at 56°E and 11°N suggests another anticyclonic water movement.

The diameter of the detected whirls ranges between 100 and 150 kilometers; however, a photograph taken aboard a manned spacecraft showed that in this region eddies with smaller diameters can appear (see Figure 2). A temperature gradient at the eastern edge of the Gulf of Aden is always present during the fully developed upwelling along the Somali Coast. Its strength has not necessarily coincided with the strength of the movement in the inner part of the Gulf because the temperature effect upon the density can be somewhat compensated by a different salinity.

The recorded temperature on July 4 shows a similar distribution pattern as recorded on July 3 along the Somali Coast, but a stronger cooling than before was observed over the entire area (Figure 3). In the southern core of the upwelling a temperature decrease of 2°C over a small area appeared while greater regions show only a decrease of temperature of one degree.

For a comparison of the temperature patchiness as recorded by the satellite HRIR, only a few ship measurements were available. Table 1 gives the sea surface temperature observations made aboard the S/S "Wabasha" during 7-9 July 1966. These measurements largely confirmed the spatial variations in sea

surface temperature the results observed by the Nimbus II HRIR. The S/S "Wabasha" crossed the cyclonic gyre near North Latitude 13°24' as can be seen by temperatures lower than 25°C. At 9°48'N, 54°24'E the transportation of the cold water away from the Coast is seen with the ship measurements (22.2°C), south of which an increase of sea surface temperatures to 27.8°C was observed. Farther to the south, temperatures were lower than 26°C.

Although the satellite data and the ship measurements were not made at the same time, they both showed the same patchiness in sea surface temperature.

REFERENCES

Bruce, J. G., 1968: Comparison of near surface dynamic topography during the two monsoons in the western Indian Ocean, Deep-Sea Res., 15, 655

Findlay, A. G., 1866: A directory for the navigation of the Indian Ocean, Richard Holmes Laurie, London, 1062 pp.

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Table 1

Sea Surface Temperatures Observed By S/S "Wabasha", Panama, R.R.

During 1966 Along The Somali Coast

Date	Position		°C
	Latitude	Longitude	
7 July	14.6°	56.5°	27.8
8 July	13.4°	55.9°	24.4
	12.2°	55.5°	26.7
	11.0°	54.9°	25.6
	9.8°	54.4°	22.2
9 July	8.6°	53.8°	26.1
	7.2°	53.5°	26.7
	5.9°	53.0°	27.8
	4.7°	52.3°	25.6

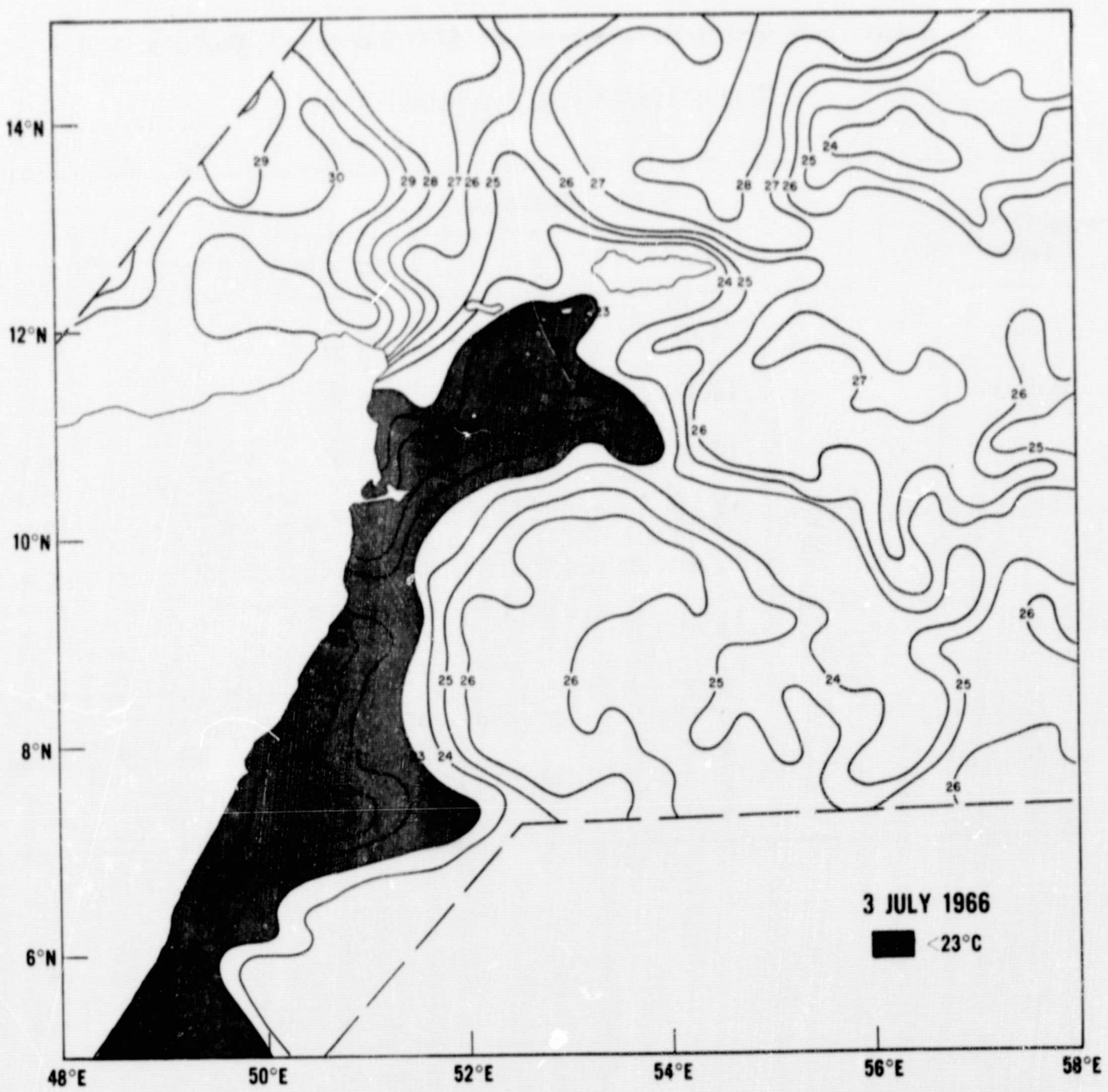

Figure 1. Equivalent Black Body Temperature Distribution in °C as Recorded by Nimbus II Along the Somali Coast During 3 July 1966

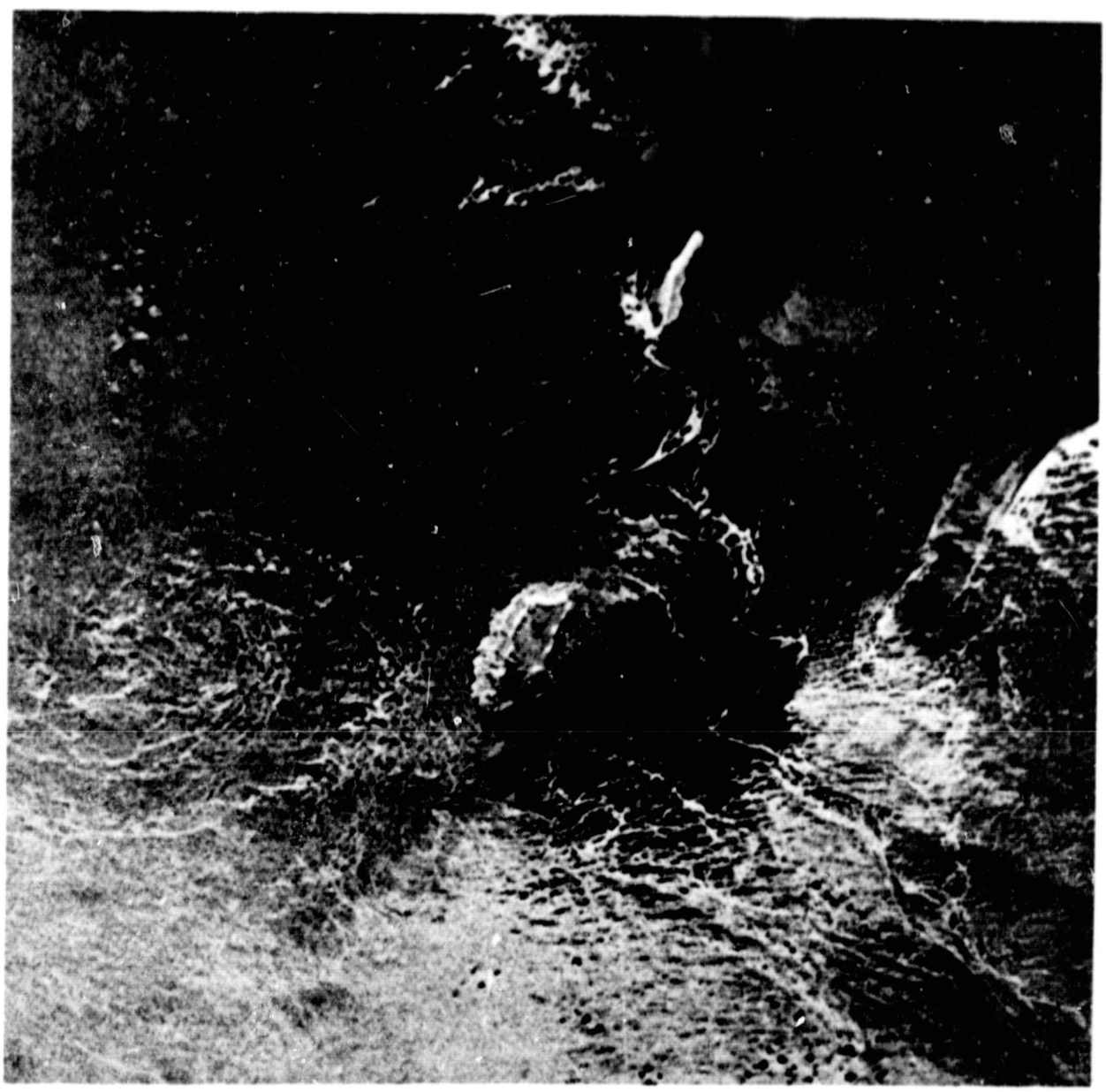

Figure 2. Cyclonic water movement west off Socotra as observed from Apollo 7, October 1967. The photograph is a negative print from a color picture. The visible structure is in the water and not produced by clouds.

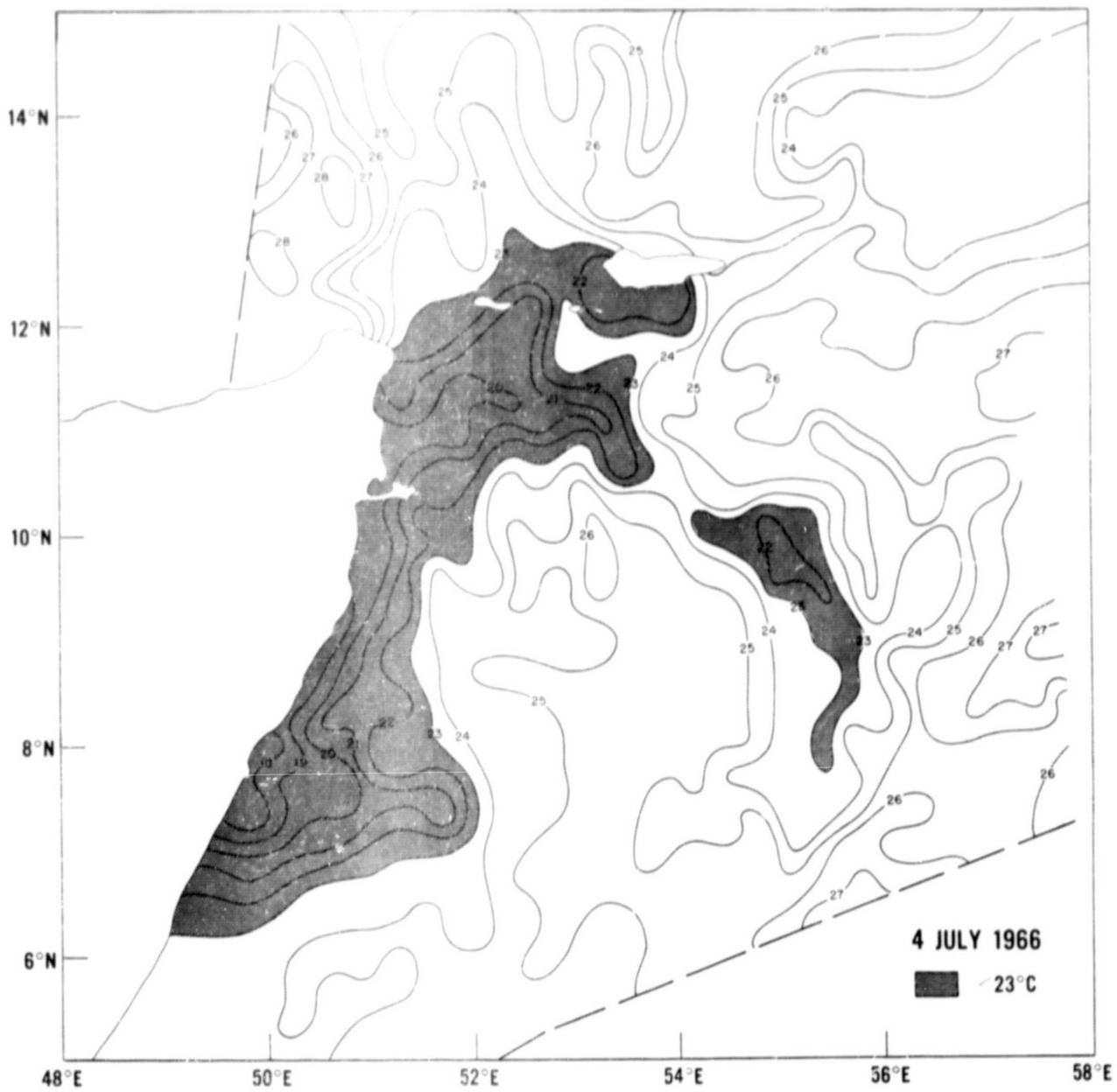

Figure 3. Equivalent Black Body Temperature Distribution in °C as Recorded by Nimbus II Along the Somali Coast During 4 July 1966