VOLCANIC ERUPTION DETECTION WITH TOMS

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The Nimbus 7 Total Ozone Mapping Spectrometer (TOMS) is designed for mapping of the atmospheric ozone distribution although absorption by sulfur dioxide at the same ultraviolet spectral wavelengths makes it possible to observe and resolve the size of volcanic clouds. The sulfur dioxide absorption is discriminated from ozone and water clouds in the data processing by their spectral signatures. Thus, the sulfur dioxide can serve as a tracer which appears in volcanic eruption clouds but is not present in other clouds.

The TOMS instrument has been able to detect many eruptions, such as those of El Chichon and Galunggung in 1982, Una Una, Indonesia in 1983, Mauna Loa, Hawaii in 1984 and Ruiz in 1986. Other eruptions, which are difficult of detect in the visible and infrared, have been found with TOMS. An example of this is the eruption of Fernandina in the Galapagos Islands on April 1, 1984 which was only detected by its sulfur dioxide content. The detection limit with TOMS is close to the theoretical limit due to telemetry signal quantization of 1000 metric tons (5-sigma threshold) within the instrument field of view (50 x 50 km near the nadir).

This satellite-based remote sensing capability is important to aerospace operations because of a unique ability to detect and discriminate eruption clouds from weather clouds, and to quantify the sizes of the eruptions. The TOMS technique is passive and, similar to the visible light channels on the NOAA AVHRR instrument, requires sunlight for its operation. The present system on a polar orbiting satellite observes the entire earth from a sun-synchronous, local noon orbit. This provides an excellent means for surveying the earth with a single instrument. However, this limits the observations to the single time of the overpass and, therefore, to the size and location of the cloud at this instant of time. This capability is satisfactory for a survey of global volcanic activity and for verification of eruption reports. To detect eruptions as they occur, and to track the plume as it drifts with the winds, as required for an aviation hazard warning system, it is necessary to place the instruments on geostationary satellites.

Table 1. ERUPTIONS DETECTED WITH TOMS

VOLCANO	ERUPTION DATE	CLOUD TRACK
SIERRA NEGRA	13 NOVEMBER, 1979	3 DAYS
ST. HELENS	19 MAY, 1980	4+ DAYS
ALAID	27 APRIL, 1981	22 DAYS
AMBRYM	8 MAY, 1981	2 DAYS
PAGAN	15 MAY, 1981	2 DAYS
"MYSTERY"	26 DECEMBER, 1981	12+ DAYS
EL CHICHON	29 MARCH, 1982	64+ DAYS
GALUNGGUNG	5 APRIL, 1982	1 DAY
	25 JUNE, 1982	1 DAY
	14 JULY, 1982	2 DAYS
SOPUTAN	27 AUGUST, 1982	1 DAY
COLO., UNAUNA	24 JULY, 1983	1 DAY
MAUNA LOA	25 MARCH, 1984	1 DAY
FERNANDINA	31 MARCH, 1984	11 DAYS
SOPUTAN	25 MAY, 1984	2 DAYS
KRAFLA	5 SEPTEMBER, 1984	3 DAYS
	10 SEPTEMBER, 1984	1 DAY
	18 SEPTEMBER, 1984	1 DAY
RUIZ	12 SEPTEMBER, 1985	1 DAY
	13 NOVEMBER, 1985	7 DAYS
AUGUSTINE	27 MARCH, 1986	
	31 MARCH, 1986	

MAUNA LOA ERUPTION CLOUD SEQUENCE

MARCH 25 -- APRIL 5, 1984

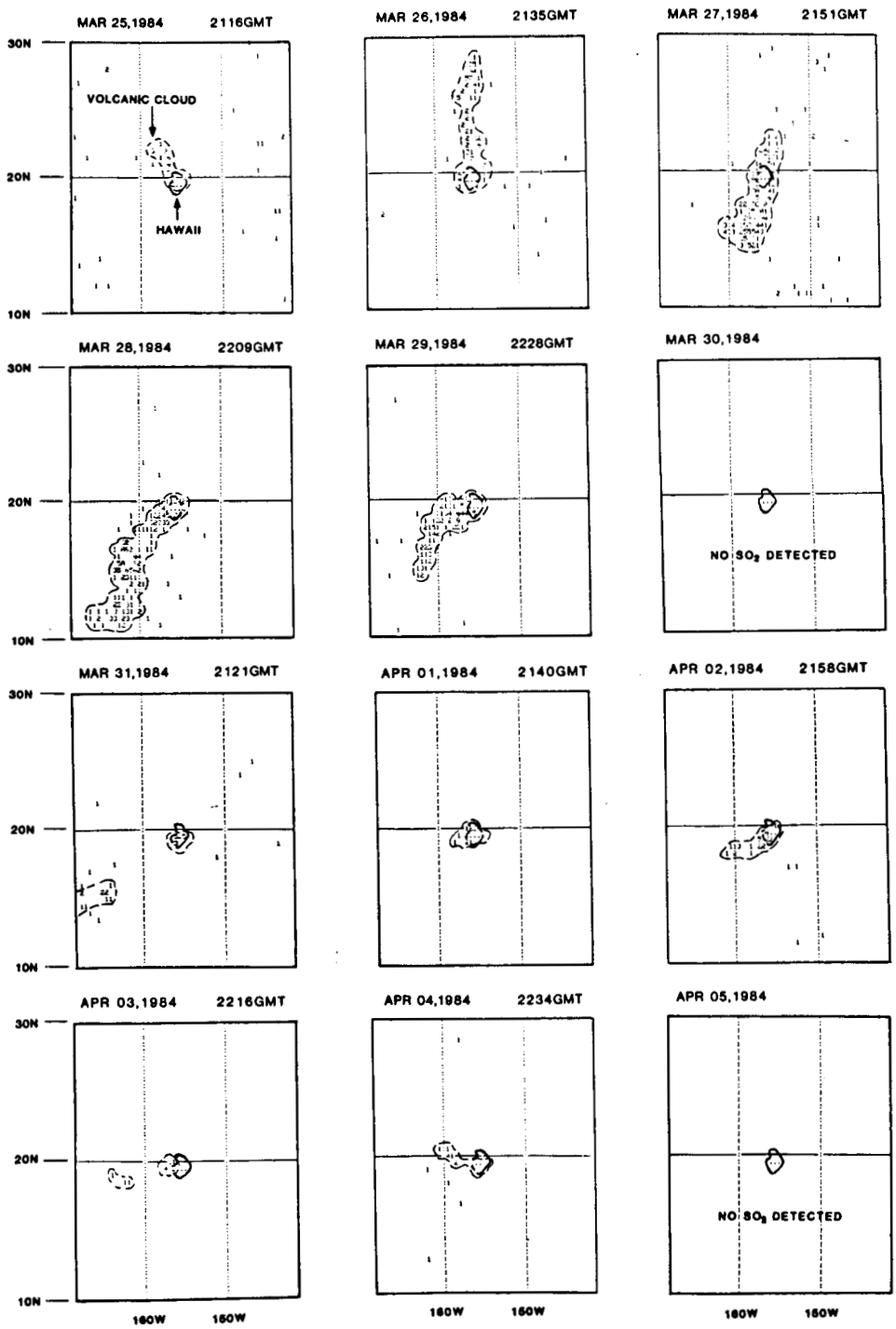

Figure 1.