AIRBORNE MULTISPECTRAL IMAGING OF VOLCANIC SULFUR DIOXIDE*

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ABSTRACT

Multispectral thermal infrared imaging offers the potential to map volcanic SO_2 plumes from airborne and spaceborne platforms, thus facilitating the determination of baseline flux levels. To date, the SO_2 mapping procedure has been applied to data acquired over Mount Etna, Sicily, and Kilauea Volcano, Hawaii, with the airborne Thermal Infrared Multispectral Scanner ('l'IMS). These TIMS data represent isolated "snapshots" of the. Etna and Kilauea SO_2 plumes in 1986 and 198S, respectively. Recent deployments of the airborne Multi spectral Infrared and Visible Imaging Spectrometer (M1 VIS) at Mount Etna in July, 1986, and TIMS at Kilauea in September, 199S, have added to the database of plume imagery.

1.0 DISCUSSION

The thermal infrared (TIR) S O_2 intimation procedure is based on the MODTRAN radiative transfer code (Berk et al., 1989), which is used to model the radiance perceived by a sensor as it views the ground through an intervening S 0_2 plume. A thorough description of the estimation procedure was provided by Real muto et al. (1994).

Figure 1 shows the changes in atmospheric transmission that results from the introduction of $S0_2$ to the optical path, superimposed on the spectral response functions of the six TIMS channels. The transmission spectra were calculated for a vertical optical path of 1.9 km through a Hawaiian atmosphere. To create the curve, the transmission of a path containing 0.1 g m^{-3} SO_2 was divided by the transmission of a clear path (containing no $S0_2$). The absorption features of SO_2 span TIMS channels 1 -3, with the maximum absorption centered at 8..5 pm. Channels 4-6 are not affected by $S0_2$ absorption.

Figure 1 also illustrates the fundamentals of the SO_2 estimation procedure. The radiance measured in Channels 4-6 is used to estimate the temperature of the ground beneath the plume. Given this temperature estimate, Channels 1 - 3 are used to estimate the amount of SO_2 required to attenuate the ground radiance to the observed levels, SO_2 estimation is an iterative procedure, requiring six runs of MODTRAN at each pixel.

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The TIMS image data provide virtually instantaneous measurements, or snapshots, of plumes from different vents as well as large portions of individual plumes. Such data are particularly useful in the study of dynamic processes, such as the transport and dispersion of volcanic SO_2. The true benefits of the TIR SO_2 mapping to volcano monitoring programs will not be realized until inexpensive data is available on a repetitive basis. It is anticipated that such data will be provided by ASTER and MODIS, scheduled for launch on the EOS AM- 1 platform in 1998.

2.0 ACKNOWLEDGMENTS

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3.0 REFERENCES

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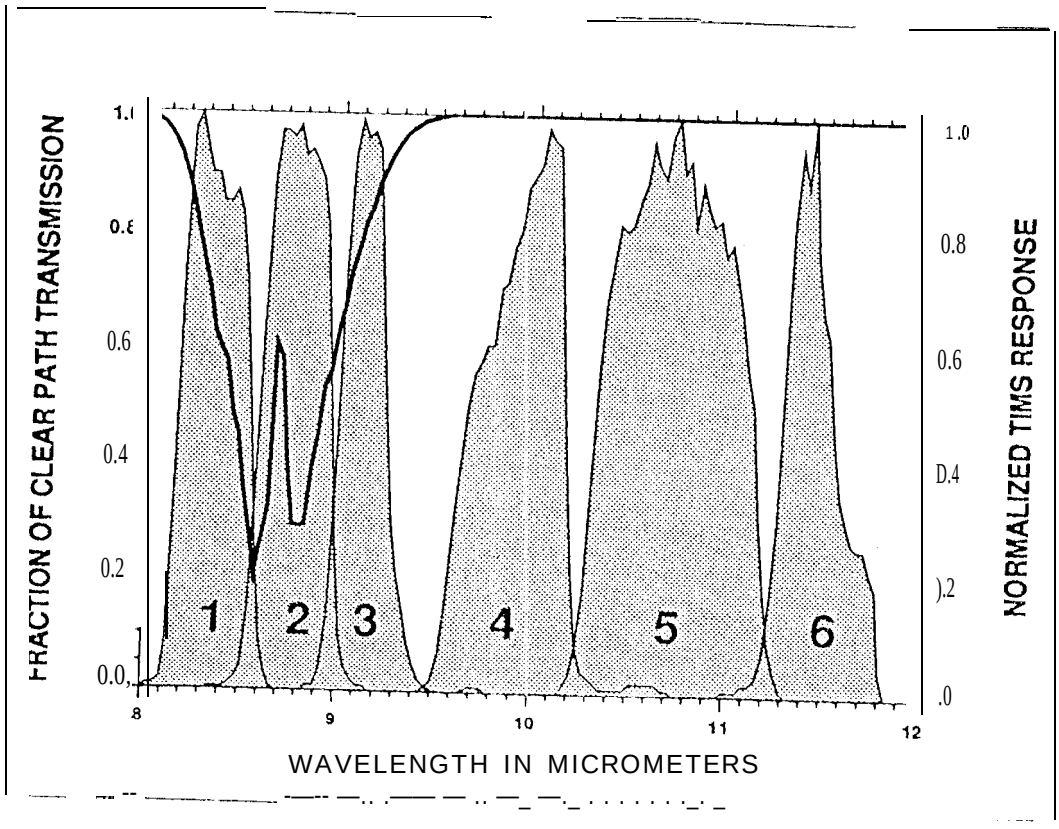

Figure 1. Change in Atmospheric Transmission Caused by Introduction of SO_2