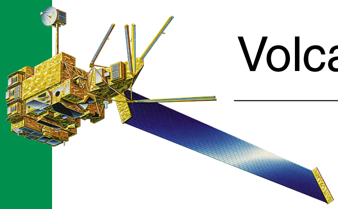

# Volcanic Eruptions Measured from Space with TOMS

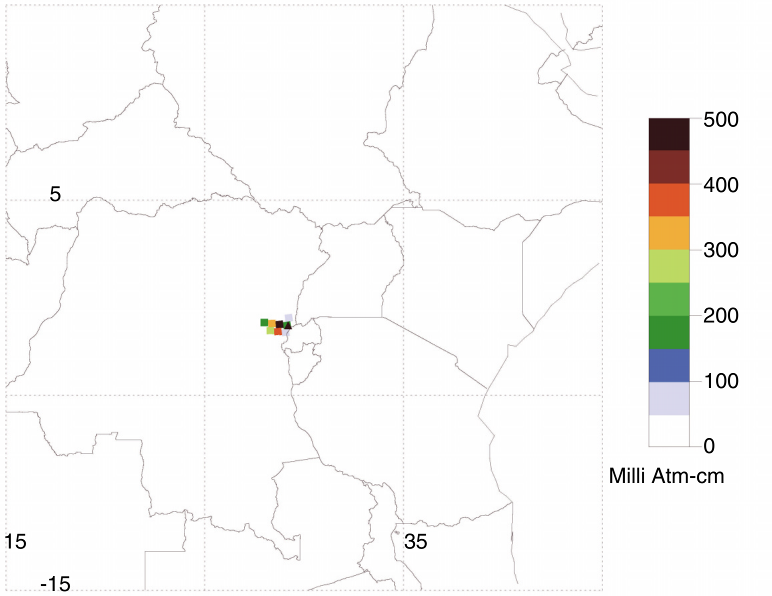


Fig.1 Iterative $SO_2$
ADEOS TOMS
[DEC 1, 1996 Orbit 1516]

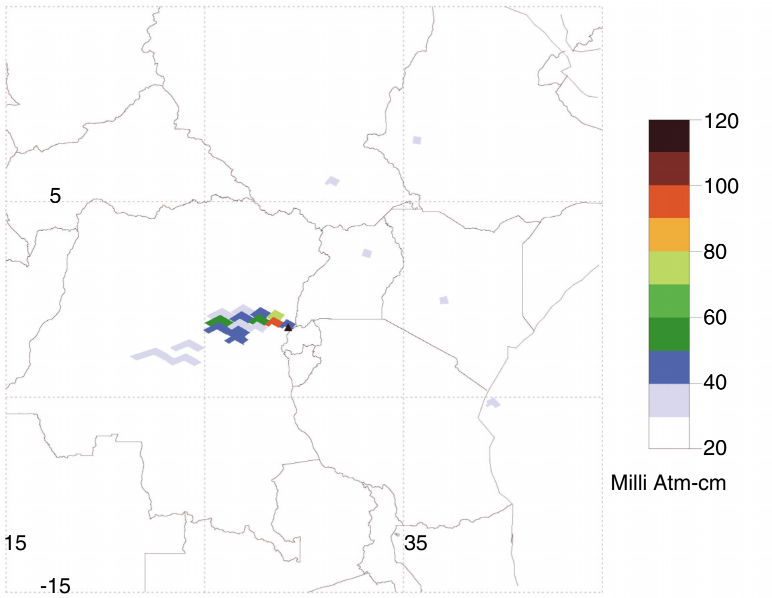


Fig.2 Iterative $SO_2$
ADEOS TOMS
[DEC 2, 1996 Orbit 1530]

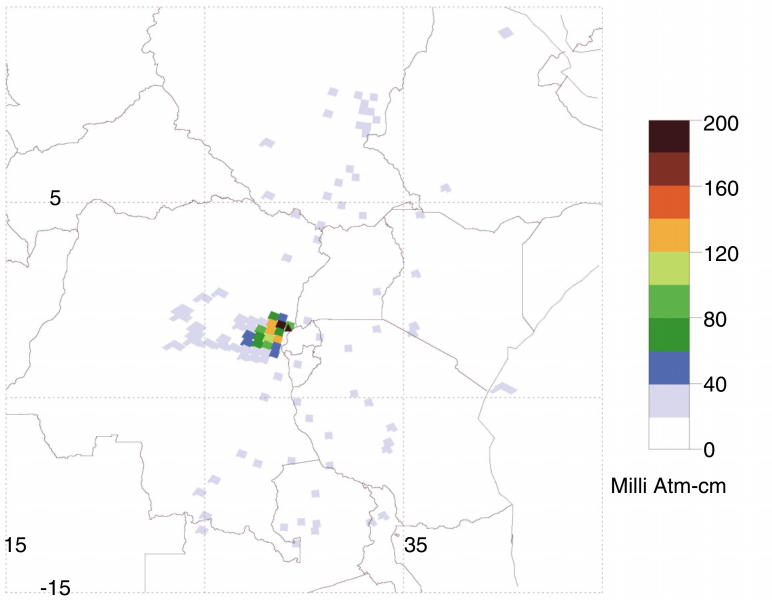


Fig.3 Iterative $SO_2$
ADEOS TOMS
[DEC 9, 1996 Orbit 1630]

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Processed by NASA-GSFC

# Volcanic Eruptions Measured from Space with TOMS

Magmatic volcanic eruptions contain large quantities of sulfur dioxide. This gas absorbs at the same ultraviolet wavelengths used by TOMS for measuring total ozone. Differences in the spectral dependencies are used in the retrievals to discriminate between ozone and sulfur dioxide (Krueger, et al., 1995). In addition, spectral differences between molecular and aerosol scattering are used to discriminate volcanic ash and other absorbing aerosol clouds in the TOMS data (Krotkov, et al., 1997). Thus, it is possible to separately track volcanic gas and ash clouds as they drift with the winds. Some eruption plumes separate into individual gas and ash clouds which follow independent paths.

The images show the sulfur dioxide clouds produced in the eruptions of Nyamuragira Volcano in Zaire as measured with ADEOS/TOMS in December 1996. This is a good example of a volcano that erupts effusively, extruding lava and gases over a 1 or 2 week period of time, as compared with many other volcanoes that erupt explosively in less than a day. Nyamuragira is a very active volcano with eruptive sequences occurring about every 5 years (Krueger, et al., 1996). The latest eruption was captured by TOMS beginning December 1, 1996 and continuing for two weeks. The first image (Fig. 1) on December 1 captured the initial cloud of sulfur dioxide soon after the first eruption of lava. Peak $SO_2$ amounts were near 500 m atm-cm (*1). The location of the volcano is indicated with a red triangle in all the images. No ash clouds are observed because of the effusive nature of the Nyamuragira eruptions. On December 2, (Fig. 2) the sulfur dioxide cloud has spread to a larger plume west of the volcano with peak values of 80 m atm-cm. The eruption rate diminished over the next week but then was renewed on December 9 (Fig. 3) with a fresh plume found again to the west of the volcano.

Because these are effusive eruptions, the sulfur dioxide is emitted to the troposphere where it is rapidly changed to sulfate aerosols. In a prior, larger eruption of Nyamuragira, the conversion time constant was found to be near 5 days (Krueger, et al., 1996).

*1) m atm-cm: A unit of total columnar atmospheric constituent (e. g., ozone or sulfur dioxide) thickness at N.T. P. conditions.
1 m atm-cm = $2.687 \times 10^{20}$ molecules/$m^2$

Literature:

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Krueger, A. J., C. C. Schnetzler, and L. S. Walter, The December 1981 eruption of Nyamuragira Volcano (Zaire), and the origin of the "mystery cloud" of early 1982, J. Geophys. Res., Vol. 101, pp. 15191-15196, 1996.

Krotkov, N. A., A. J. Krueger, and P. K. Bhartia, Ultraviolet optical model of volcanic clouds for remote sensing of ash and sulfur dioxide, J. Geophys. Res., Vol. 102, pp.21891-21904, 1997.