

Global, long-term sulphur dioxide measurements from TOVS data: A new tool for studying explosive volcanism and climate

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A new technique for retrieving sulphur dioxide concentrations from TIROS Operational Vertical Sounder (TOVS) data is described and the retrievals are used to study the global effects of SO₂ gas on climate. The retrieval technique relies on absorption of infrared radiation by the anti-symmetric stretch of the SO₂ molecule centred around 7.3 μm . The High-resolution infrared sounder (HIRS) is part of the TOVS package and has a channel that covers this absorption region. The HIRS data are global, span almost 22 years, have a sub-satellite spatial resolution of about 18 km and can be used both day and night.

The retrieval method is described and its accuracy and sources of error discussed. A case study for the August 1991 eruptions of Cerro Hudson is used to illustrate the retrievals and the results are compared with independent SO₂ retrievals from the TOMS instrument.

We will also present retrievals for several large eruptions (including Mt St Helens, El Chichon and Pinatubo) and use a radiative transfer model to estimate the heating rates due to SO₂ gas. The radiative effects of other volcanic constituents (e.g. ash and sulphuric acid) are also considered. These new SO₂ data provide a potentially valuable tool for studying the climatic effects of explosive eruptions. Because the satellite measurements are global, long-term and can simultaneously provide other climate parameters (e.g. Surface temperatures, temperature profiles, humidity profiles, cloudiness, long- and short-wave radiation) they can be used to test and validate volcanically-induced effects in global climate simulations.