Ground-based and satellite measurements of the SO2 plume from the eruption of Raikoke volcano in June 2019

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The eruption of the Raikoke volcano (Kuril Islands) on June 21-22, 2019, created a large plume of sulfur dioxide (SO₂) that reached the upper troposphere and lower stratosphere. The plume persisted in the atmosphere over the middle and high latitudes of the Western Hemisphere for more than a month creating a rare validation opportunity with multiple collocated measurements from ground and space both revealing enhanced SO₂ vertical column densities (VCDs). Moreover, since the plume was often located over high latitudes, multiple orbits per day from the polar orbiting satellites could be utilized. Pandora sunphotometer measurements at Edmonton and Eureka, Canada, and at Fairbanks, Alaska, and Brewer spectrophotometer measurements at seven Canadian sites (Saturna, Edmonton, Churchill, Resolute, Eureka, and Alert) reported SO₂ values up to 15 Dobson Units (DU, where 1 DU = 2.69 × 10¹⁶ molecules/cm²). These measurements were compared with satellite SO₂ VCDs obtained by the Sentinel 5p TROPOspheric Monitoring Instrument (TROPOMI), AURA Ozone Monitoring Instrument (OMI), and Suomi NPP Ozone Mapping Profiling Suite (OMPS). Back-trajectory Lagrangian model analysis and satellite SO₂ profile measurements by the Atmospheric Chemistry Experiment mission Fourier transform spectrometer (ACE/FTS) on board the Canadian satellite SCISAT demonstrated that the volcanic plume was located at 8-25 km. In general, ground-based and satellite measurements show a very good agreement. However, the exact ground-based and satellite viewing geometry should be considered when such measurements are taken near the edge of the plume.

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