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Validation of satellite SO_2 observations in northern Finland during the Icelandic Holuhraun fissure eruption

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This paper shows the validation results of the satellite SO_2 observations from OMI (Ozone Monitoring Instrument) and OMPS (Ozone Mapping Profiler Suite) during the Icelandic Holuhraun fissure eruption in September 2014. The volcanic plume reached Finland on several days during the month of September. The SO_2 total columns from the Brewer direct sun (DS) measurements in Sodankylä (67.42°N, 26.59°E), northern Finland, are compared to the satellite data.

Challenging retrieval conditions at high latitudes (like large solar zenith angle, SZA) are considered in the comparison. The results show that the best agreement can be found for small SZAs, close-to-nadir satellite pixels, cloud fraction below 0.3 and small distance between the station and the centre of the pixel. Under good retrieval conditions, the difference between satellite data and Brewer measurements remains mostly below the uncertainty on the satellite SO_2 retrievals (up to about 2 DU at high latitudes).

The satellite products assuming a priori profile with SO_2 predominantly in the planetary boundary layer give total column values close to the ground-based data, suggesting that the volcanic SO_2 plume was located at particularly low altitudes. This is connected to the fact that this was a fissure eruption and most of the SO_2 was emitted into the troposphere.

The analysis of the SO_2 surface concentrations at four air quality stations in northern Finland supports the hypothesis that the volcanic plume coming from Iceland was located very close to the surface. The time evolution of the SO_2 concentrations peaks during the same days when large SO_2 total column values are measured by the Brewer in Sodankylä and enhanced SO_2 signal is visible over northern Finland from the satellite maps. This is an exceptional case because the SO_2 volcanic emission directly affect the air quality levels at surface in an otherwise pristine environment like northern Finland.

OMI and OMPS SO_2 retrievals from direct-broadcast measurements are validated for the first time in this paper.