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Analysis of volcanic bromine monoxide emissions in the southwestern Pacific region in 2005 based on satellite observations from OMI

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In this study, we analyze the potential of the Ozone Monitoring Instrument (OMI) for the detection and quantification of volcanic bromine monoxide (BrO) from space. Compared to other available UV/VIS satellite sensors with similar trace gas retrieval capability (like GOME-2) OMI has better spatial resolution and global coverage, likely leading to a better detection limit of BrO. In addition, the now more than ten years long OMI data record exceeds others in time and can be exploited for different volcanological applications. We chose the southwestern Pacific as our study region, including the Marianas, Papua New Guinea, and Vanuatu because volcanic activity of different magnitude has been reported in the Global Volcanism Program data base in this area. We analyze measurements acquired during the entire year of 2005. We use the standard level-2 OMI BrO data product available from NASA GES DISC. In addition, we take advantage of coincident OMI SO_2 retrievals as a proxy for the plume extent and to calculate BrO/SO_2 ratios. We explore spatial variations in BrO/SO_2 ratios and interpret these in terms of atmospheric chemical processing. For example, the Anatahan eruption in March 2005 clearly reveals lower BrO/SO_2 values closer to the source that increase downwind before leveling-off at a certain distance from the vent. We also report the first BrO measurements from several volcanoes in the southwestern Pacific, including Anatahan, Manam, and Bagana where the plume BrO vertical column densities (VCD) clearly exceed background values and where plume BrO and SO_2 VCD are highly correlated ($R>0.8$). Finally, our analysis suggests that several volcanoes emitting BrO may have an as-yet unappreciated contribution to global halogen emissions from volcanoes.