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GOSAT/TANSO-FTS Measurement of Volcanic and Geothermal CO2 Emissions

Florian M. Schwandner (1), Simon A. Carn (2), and Christopher G. Newhall (1)

(1) Earth Observatory of Singapore (EOS), Nanyang Technological University (NTU), Singapore (f.schwandner@ntu.edu.sg), (2) Dept. of Geological and Mining Engineering and Sciences, Michigan Technological University, Houghton, MI, USA

Approximately one tenth of the Earth's human population lives in direct reach of volcanic hazards. Being able to provide sufficiently early and scientifically sound warning is a key to volcanic hazard mitigation. Quantitative time-series monitoring of volcanic CO2 emissions will likely play a key role in such early warning activities in the future. Impending volcanic eruptions or any potentially disastrous activity that involves movement of magma in the subsurface, is often preceded by an early increase of CO2 emissions.

Conventionally, volcanic CO2 monitoring is done either in campaigns of soil emission measurements (grid of one-time measuring points) that are labor intensive and slow, or by ground-based remote FTIR measurements in emission plumes. These methods are not easily available at all sites of potential activity and prohibitively costly to employ on a large number of volcanoes. In addition, both of these ground-based approaches pose a significant risk to the workers conducting these measurements. Some aircraft-based measurements have been conducted as well in the past, however these are limited by the usually meager funding situation of individual observatories, the hazard such flights pose to equipment and crew, and by the inaccessibility of parts of the plume due to ash hazards.

The core motivation for this study is therefore to develop a method for volcanic CO2 monitoring from space that will provide sufficient coverage, resolution, and data quality for an application to quantitative time series monitoring and correlation with other available datasets, from a safe distance and with potentially global reach.

In summary, the purpose of the proposed research is to quantify volcanic CO2 emissions using satellite-borne observations. Quantitative estimates will be useful for warning of impending volcanic eruptions, and assessing the contribution of volcanic CO2 to global GHG. Our approach encompasses method development and testing for the detection of volcanic CO2 anomalies using GOSAT and correlation with Aura/OMI, AIRS, and ASTER determined SO2 fluxes and ground based monitoring of CO2 and other geophysical and geochemical parameters. This will provide the ground work for future higher spatial resolution satellite missions.

This is a joint effort from two GOSAT-IBUKI data application projects: "Satellite-Borne Quantification of Carbon Dioxide Emissions from Volcanoes and Geothermal Areas" (PI Schwandner), and "Application of GOSAT/TANSO-FTS to the Measurement of Volcanic CO2 Emissions" (PI Carn).