Detecting volcanic CO_2 signals from space

Florian M Schwandner[1], Simon A Carn[2]

[1]Jet Propulsion Laboratory (JPL), California Institute of Technology, Pasadena CA 91109, USA,
[2]Michigan Technological University (MTU), Houghton MI 49931, USA

E-mail: Florian.Schwandner@jpl.nasa.gov

We investigate the feasibility of space-borne detection of volcanic carbon dioxide (CO_2) anomalies. Our goals are: (a) better spatial and temporal coverage of volcano monitoring techniques; (b) improvement of the currently highly uncertain global CO_2 emission inventory for volcanoes, irrespective of mode of emission, and (c) use of volcanic CO_2 emissions for high altitude, strong point source emission and dispersion studies in atmospheric science.

The Japanese GOSAT Fourier-Transform Spectrometer (TANSO-FTS) and Cloud & Aerosol Imager (CAI) aboard the IBUKI satellite have been producing data since January 2009, measuring CO_2 total column concentrations in polar orbit with a repeat cycle of 3 days and a field of view of 10km, at an altitude of 666km amsl. With this geometry, GOSAT has the potential to spatially integrate entire volcanic edifices with one point of measurement in target mode. At the expense of not providing a spatial scanning or mapping capability, it has strong spectral resolving power and can be pointed at targets of interest, in the lowest ppmv contrast of total column CO_2 and boundary layer XCO_2.

However, the detection of strong volcanic point sources of CO_2 from space is hindered by several obstacles, including orographic clouds, unknown dispersion behavior, a high tropospheric CO_2 background, and sparse data coverage from existing satellite sensors. These obstacles can be overcome by a small field of view, enhanced spectral resolving power, by employing repeat target mode observation strategies, and by comparison to continuous ground based sensor network data.

Since summer 2010 we have conducted repeated target mode observations of now almost 30 persistently active global volcanoes including Etna (Italy), Erta Ale (Ethiopia), and Ambrym (Vanuatu), using L2 GOSAT FTS SWIR data. In this presentation we will summarize results from over two years of measurements. Ongoing and new collaboration with country specific observatories and agencies, as well as with the Deep Carbon Observatory and the Smithsonian Institution, enhances the potential for best ground truthing.