

3D Gas Concentration Mapping of Active Volcanoes using Mass Spectrometry

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An improved portable mass spectrometer system designed for either aircraft, car and ground operation was used for mapping volcanic plumes and fumarole sites in active Costa Rica volcanoes. The Airborne Volcanic Emissions Mass Spectrometer (AVEMS) System developed by NASA-Kennedy Space Center was deployed as part of the second CARTA (Costa Rica Airborne Research and Technology Application) mission conducted in March 2005.

The CARTA 2005 mission, involving multiple sensors and agencies, consisted of three different planes collecting data over all of Costa Rica. The WB-57F from NASA collected ground data with a digital camera, an analog photogrammetric camera (RC-30), a multispectral scanner (MASTER) and a hyperspectral sensor (HYMAP). The second aircraft, a King Air 200 from DoE, mounted with a LIDAR based instrument, targeted topography mapping and forest density measurements. A smaller third aircraft, a Navajo from Costa Rica, integrated with the AVEMS instrument and designed for real-time measurements of air pollutants from both natural and anthropogenic sources, was flown over the volcanoes.

The in-situ gas data in this work, consisting of helium, carbon dioxide, sulfur dioxide and acetone, was acquired in conjunction of GPS data which was plotted with the ground imagery, topography and remote sensing data collected by the other instruments, allowing the 3 dimensional visualization of the volcanic plume and the mapping of gas concentration at the crater. The modeling of possible scenarios of volcanic activity and its direct impact on urban areas is now possible with the combined set of data.