Gas Concentration Mapping of Arenal Volcano using AVEMS

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The Airborne Volcanic Emissions Mass Spectrometer (AVEMS) System developed by NASA-Kennedy Space Center and deployed in collaboration with the National Center for Advanced Technology (CENAT) and the University of Costa Rica was used for mapping the volcanic plume of Arenal Volcano, the most active volcano in Costa Rica. The measurements were conducted 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 photogrametric 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 improved AVEMS system is designed for deployment via aircraft, car or hand-transport. The 85 pound system employs a 200 Da quadrupole mass analyzer, has a volume of 92,000 cm^3, requires 350 W of power at steady state, can operate up to an altitude of 41,000 feet above sea level (–65°C; 50 torr). The system uses on-board gas bottles on-site calibration and is capable of monitoring and quantifying up to 16 gases simultaneously.

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 at Arenal Volcano.

The modeling of possible scenarios of Arenal's activity and its direct impact on the surrounding populated areas in now possible with the combined set of data, linking in-situ data with remote sensing data. The study also helps in the understanding of pyroclastic flow behavior in case of a major eruption.