The BENTO Box: Development and field-testing of a new satellite-linked data collection system for volcano monitoring

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Currently it is impossible to monitor all of Earth's hazardous volcanoes for precursory eruption signals. The primary constraint is the high cost of deploying monitoring instrumentation (e.g., seismometers, gas sensors), which includes the cost of reliable, high-resolution sensors, the cost of maintenance (including periodic travel to remote areas), and the cost/difficulty of developing remote data telemetry. Our goal is to develop an integrated monitoring system and an associated monitoring strategy that will allow identification of restless volcanoes through widespread deployment of robust, lightweight, low-cost, easily deployable monitoring/telemetry systems. Ultimately, we expect that this strategy will lead to more efficient allocation of instrumentation and associated costs.

Towards achieving this goal, we have developed the BENTO (Behar's ENvironmental Telemetry and Observation) box. These portable, autonomous, self-contained data collection systems are designed for long-term operation (up to 12 months) in remote environments. They use low-cost two-way communication through the commercial Iridium satellite network, and, depending on data types, can pre-process raw data onboard to obtain useful summary statistics for transmission through Iridium. BENTO boxes also have the ability to receive commands through Iridium, allowing, for example, remote adjustment of sampling rates, or requests for segments of raw data in cases where only summary statistics are routinely transmitted. Currently, BENTO boxes can measure weather parameters (e.g., windspeed, wind direction, rainfall, humidity, atmospheric pressure) and volcanic gas (CO2 and SO2) concentrations.

In the future, we plan to develop BENTO boxes for seismic, atmospheric pressure/infrasound, other gases (e.g., halogens), tilt, and temperature. We are currently field-testing BENTO boxes equipped with gas and meteorological sensors ('BENTO 1') at Telica Volcano, Nicaragua; and Kilauea Volcano, Hawai'i. We plan to deploy a third gas BENTO prototype at Etna Volcano, Italy in June of 2013. Together, the data from these three BENTO boxes and previously established volcano monitoring instruments are allowing us to test and refine sensor deployment strategy. 'BENTO 2', currently under development, will be compatible with high data rate sensors, including seismic, tilt and infrasound. We expect this prototype development to be complete by mid-2013.