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Design and performance of an integrated ground and space sensor web for monitoring active volcanoes.

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An interdisciplinary team of computer, earth and space scientists collaborated to develop a sensor web system for rapid deployment at active volcanoes. The primary goals of this Optimized Autonomous Space In situ Sensorweb (OASIS) are to: 1) integrate complementary space and in situ (ground-based) elements into an interactive, autonomous sensor web; 2) advance sensor web power and communication resource management technology; and 3) enable scalability for seamless addition sensors and other satellites into the sensor web. This three-year project began with a rigorous multidisciplinary interchange that resulted in definition of system requirements to guide the design of the OASIS network and to achieve the stated project goals. Based on those guidelines, we have developed fully self-contained in situ nodes that integrate GPS, seismic, infrasonic and lightning (ash) detection sensors. The nodes in the wireless sensor network are linked to the ground control center through a mesh network that is highly optimized for remote geophysical monitoring. OASIS also features an autonomous bidirectional interaction between ground nodes and instruments on the EO-1 space platform through continuous analysis and messaging capabilities at the command and control center. Data from both the in situ sensors and satellite-borne hyperspectral imaging sensors stream into a common database for real-time visualization and analysis by earth scientists. We have successfully completed a field deployment of 15 nodes within the crater and on the flanks of Mount St. Helens, Washington. The demonstration that sensor web technology facilitates rapid network deployments and that we can achieve real-time continuous data acquisition. We are now optimizing component performance and improving user interaction for additional deployments at erupting volcanoes in 2010.