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Synergistic Use of Thermal Infrared Field and Satellite Data: Eruption Detection, Monitoring and Science

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The ASTER-based observational success of active volcanic processes early in the Terra mission later gave rise to a funded NASA program designed to both increase the number of ASTER scenes following an eruption and perform the ground-based science needed to validate that data. The urgent request protocol (URP) system for ASTER grew out of this initial study and has now operated in conjunction with and the support of the Alaska Volcano Observatory, the University of Alaska Fairbanks, the University of Hawaii, the USGS Land Processes DAAC, and the ASTER science team. The University of Pittsburgh oversees this rapid response/sensor-web system, which until 2011 had focused solely on the active volcanoes in the North Pacific region. Since that time, it has been expanded to operate globally with AVHRR and MODIS and now ASTER visible and thermal infrared (TIR) data are being acquired at numerous active volcanoes around the world. This program relies on the increased temporal resolution of AVHRR/MODIS midwave infrared data to trigger the next available ASTER observation, which results in ASTER data as frequently as every 2-5 days. For many new targets such as Mt. Etna, the URP has increased the observational frequency by as much 50%. Examples of these datasets will be presented, which have been used for operational response to new eruptions as well as longer-term scientific studies. These studies include emplacement of new lava flows, detection of endogenous dome growth, and interpretation of hazardous dome collapse events. As a means to validate the ASTER TIR data and capture higher-resolution images, a new ground-based sensor has recently been developed that consists of standard FLIR camera modified with wavelength filters similar to the ASTER bands. Data from this instrument have been acquired of the lava lake at Kilauea and reveal differences in emissivity between molten and cooled surfaces confirming prior laboratory results and providing important constraints on lava flow propagation models. In summary, this operational/scientific program utilizing the unique properties of TIR data from ASTER has shown the potential for providing innovative and integrated synoptic measurements of volcanic science, eruptions and eruption-related hazards globally. Now, this long-term archive of volcanic image data is being mined to provide statistics on the expectations of future high-repeat TIR data such as proposed for the NASA HyspIRI mission.