



TQ1: Volcanoes and Earthquakes

NASA Decadal Survey HypsIRI Mission

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TQ1: Volcanoes and Earthquakes



Overarching Question:

How can we help predict and mitigate earthquake and volcanic hazards through detection of transient thermal phenomena?

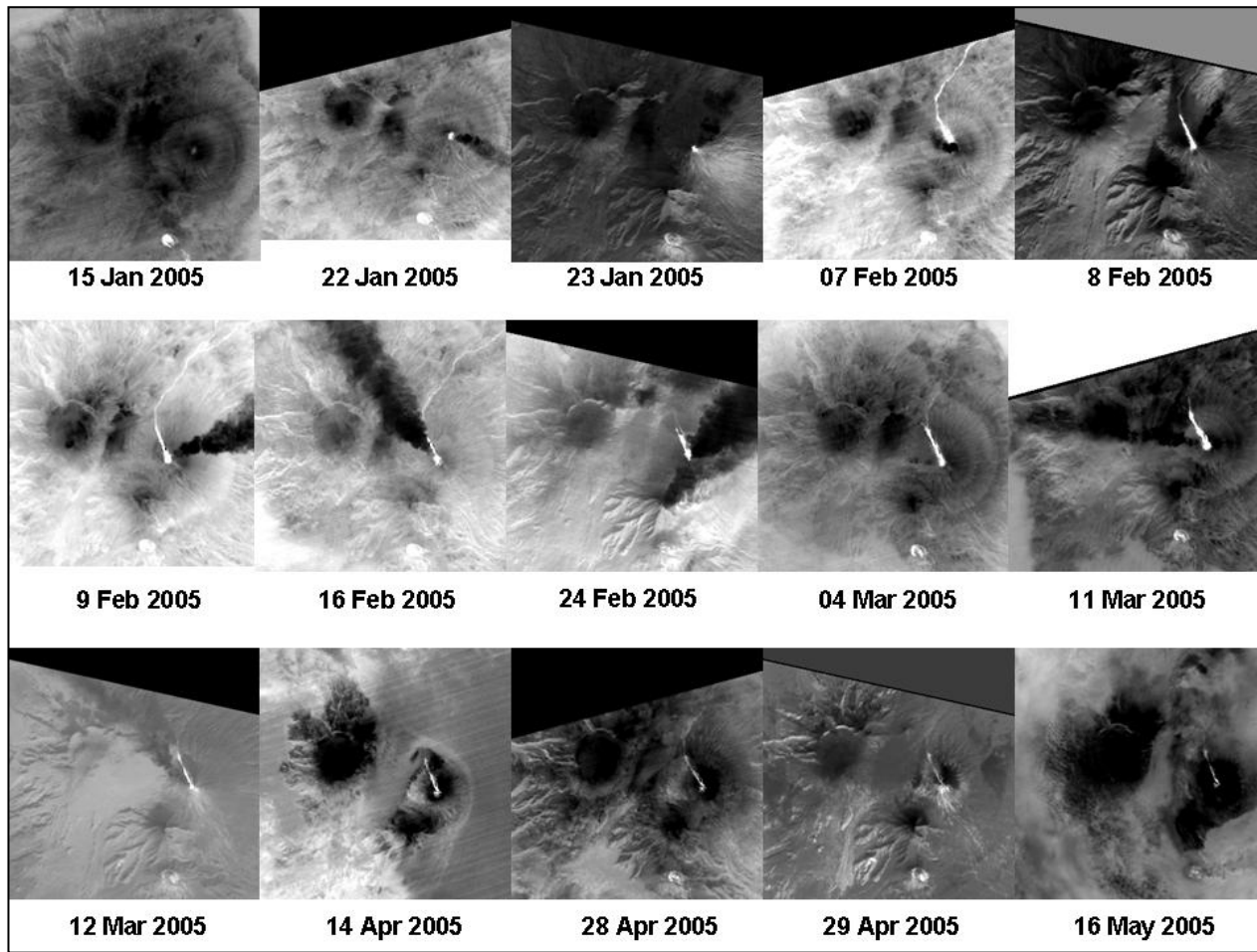




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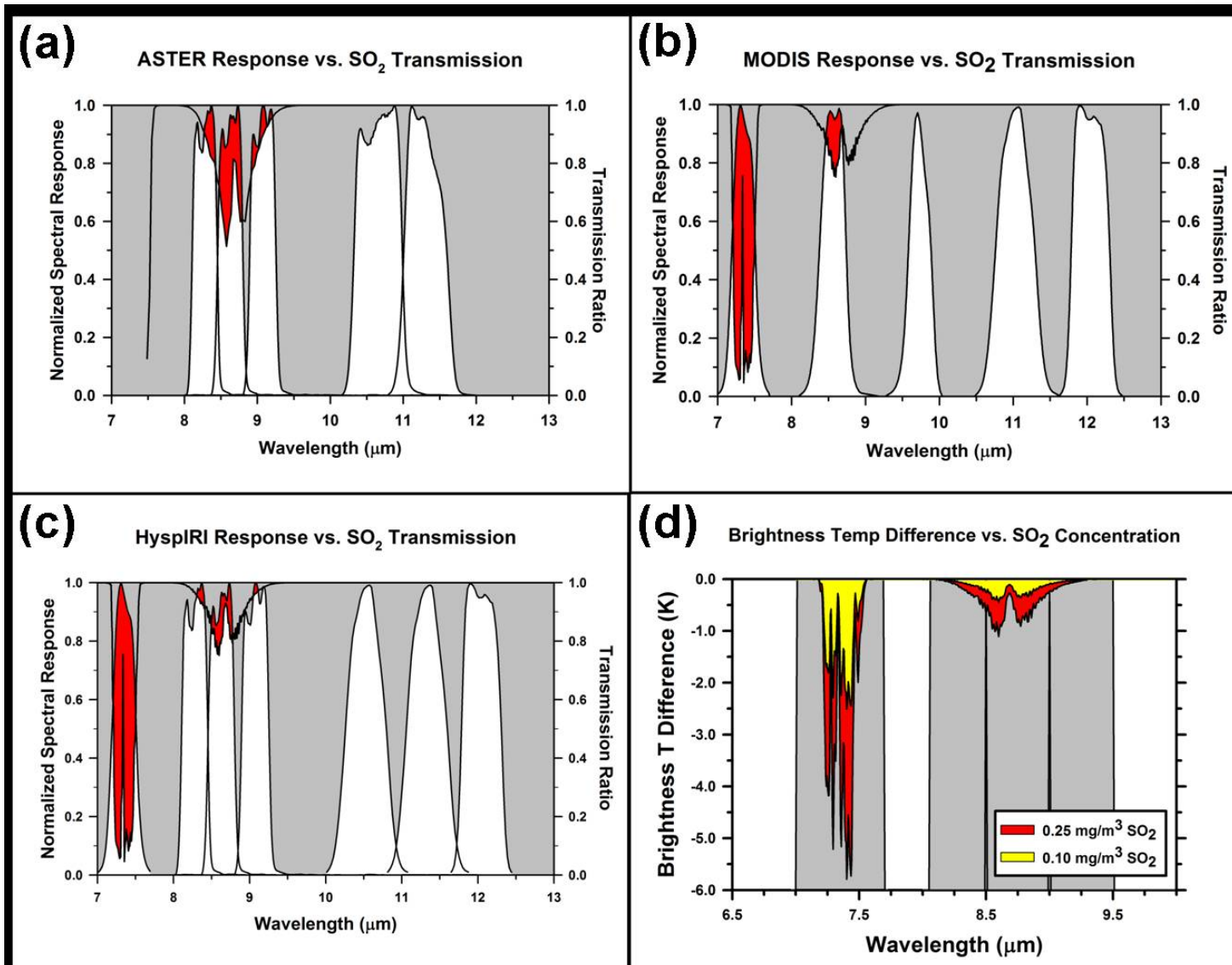
Do volcanoes signal impending eruptions through changes in surface temperature or gas emission rates and are such changes unique to specific types of eruptions?
[DS 227]



Kliuchevskoy and Bezymianny volcanoes in Siberia, observed by ASTER. 15 clear-sky nighttime observations in 5 months show changes in thermal behavior of summit domes, development of lava flows and pyroclastic flows, and presence of ash and SO₂ plumes.



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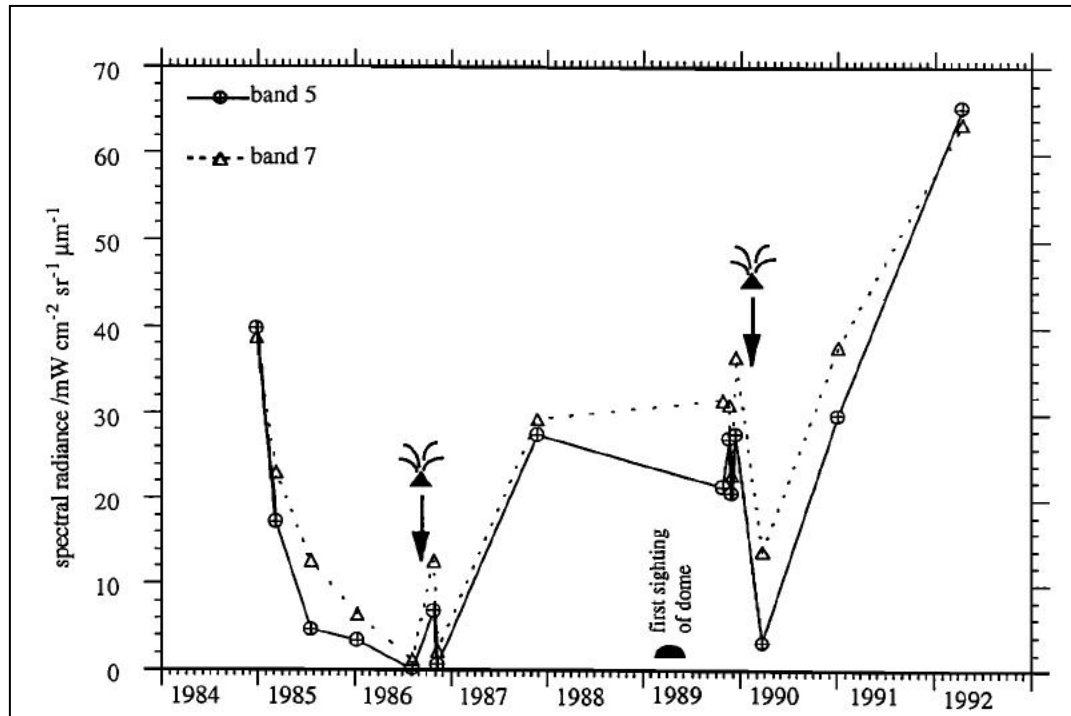




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Can the energy released by the periodic recharge of magma chambers be used to predict future eruptions? [DS 227]

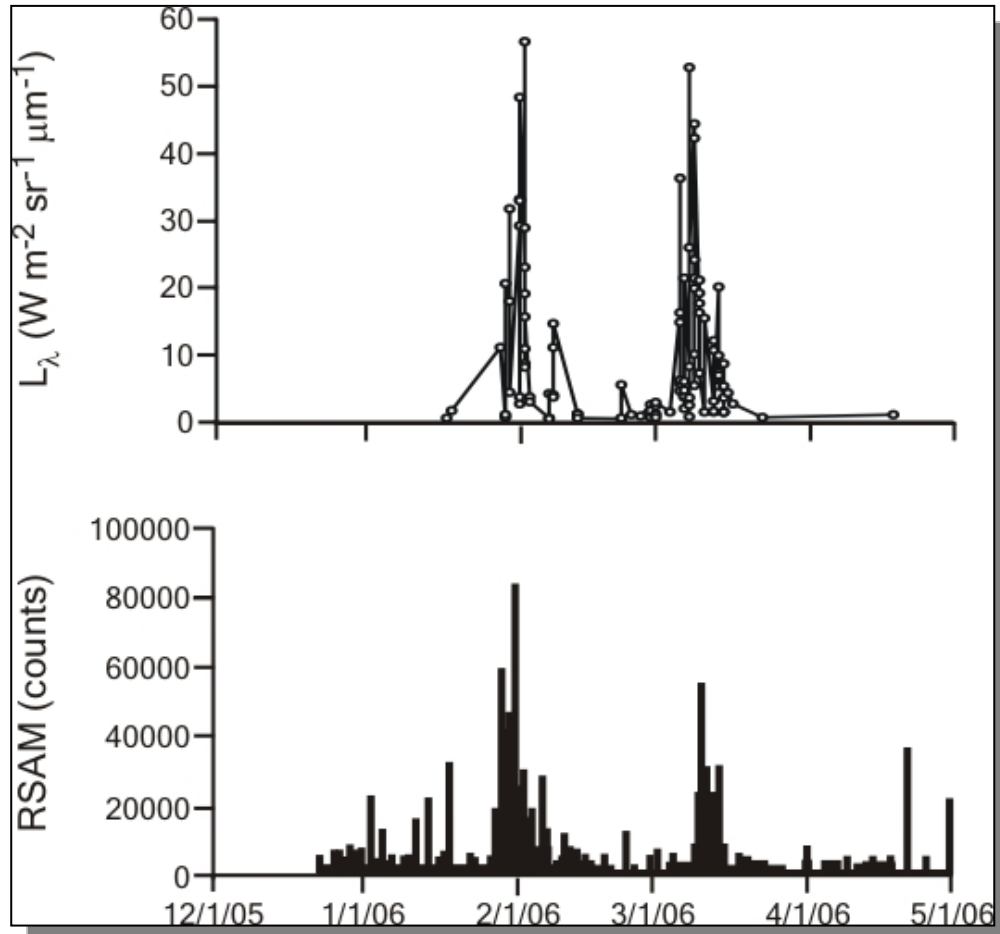


Landsat Thematic Mapper spectral radiance through time for Lascar volcano, Chile. Volcano symbols mark Sept. 16, 1986 and Feb. 20, 1990 eruptions. Activity has been characterized by periods of dome growth punctuated by explosive eruptions with tall ash columns.





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Real-Time Seismic-Amplitude Measurement System vs. satellite measured flux for Augustine volcano eruptions. Note near perfect correlation of 2 different geophysical measurements. RSAM measures volcano-tectonic earthquakes, and is related to magma movement in sub-surface. Thermal integrated radiance seems to be an excellent proxy, and thus can be used to infer behavior at depth.



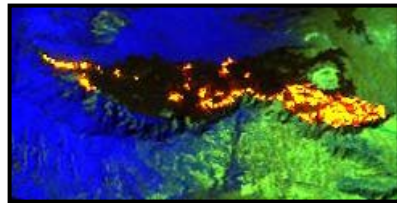
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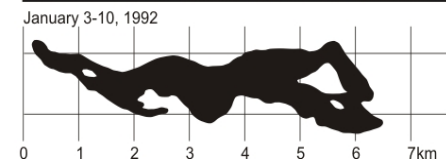
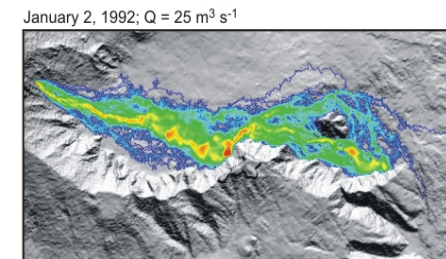
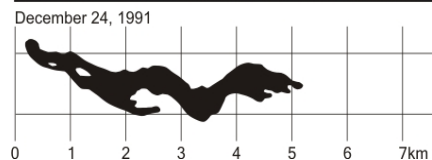
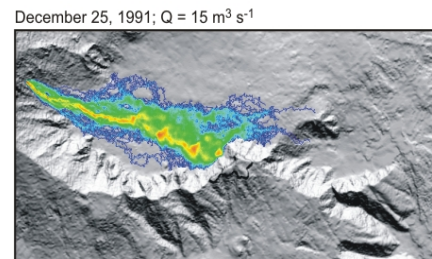
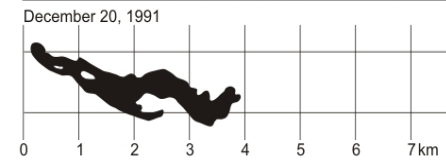
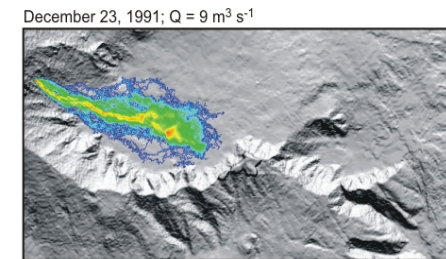
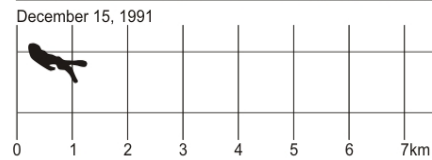
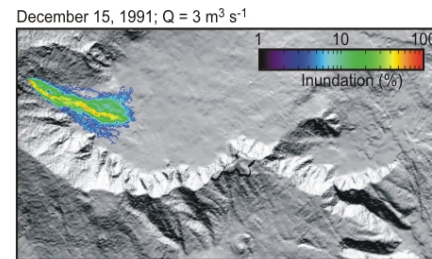
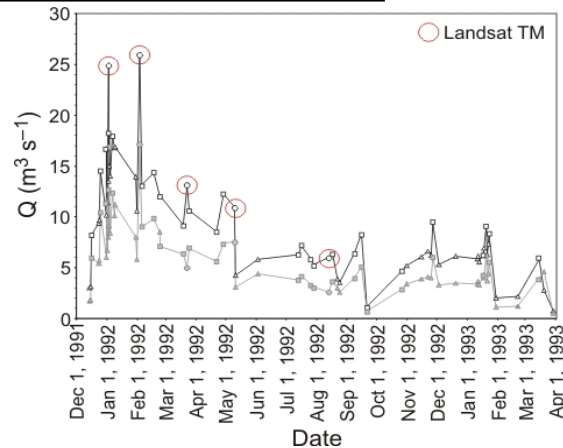
What do changes in the rate of lava effusion tell us about the maximum lengths that lava flows can attain, and the likely duration of lava flow-forming eruptions? [DS 226]



Mount Etna, Sicily
ATSR, 3 January 1992



Mount Etna, Sicily
Landsat TM, 22 March 1992



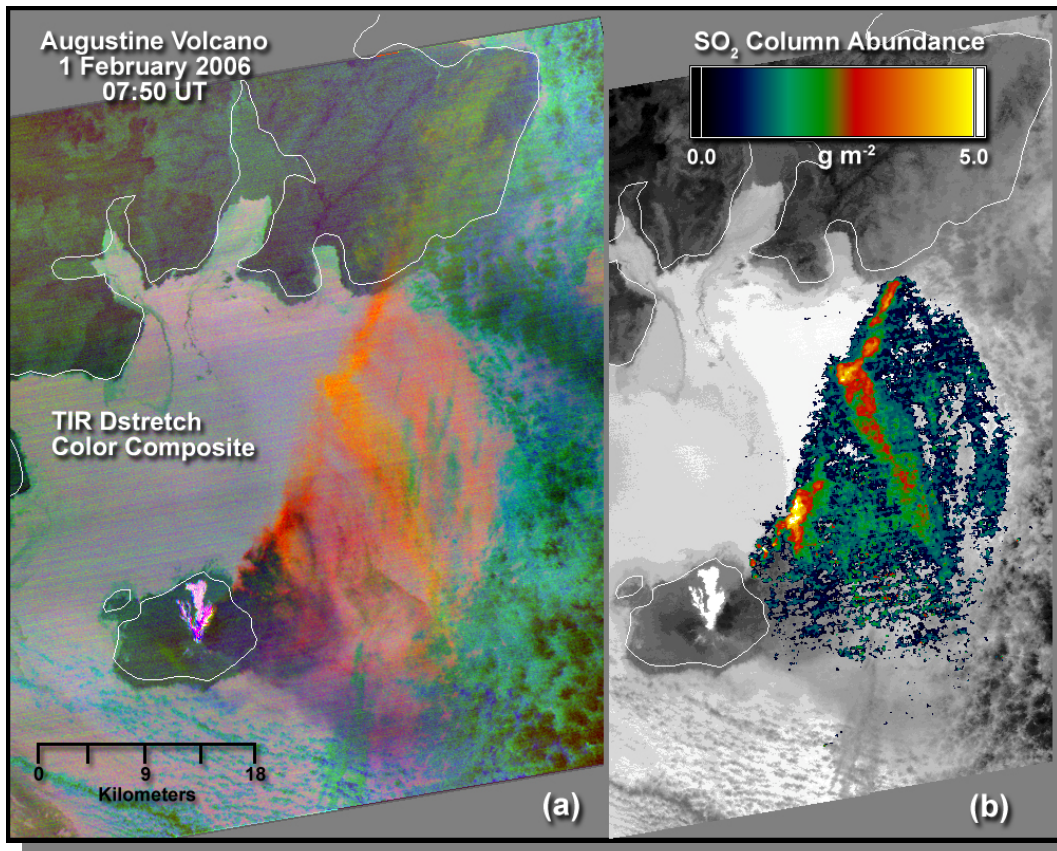
1. The length a lava flow can attain is governed by the effusion rate
2. The thermally active flow area as a function of time is proportional to the effusion rate
3. HypsIRI will allow us to determine the effusion rate twice in each 5 day period



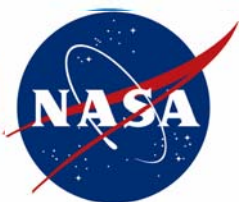
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What are the characteristic dispersal patterns and residence times for volcanic ash clouds and how long do such clouds remain a threat to aviation? [DS 224]



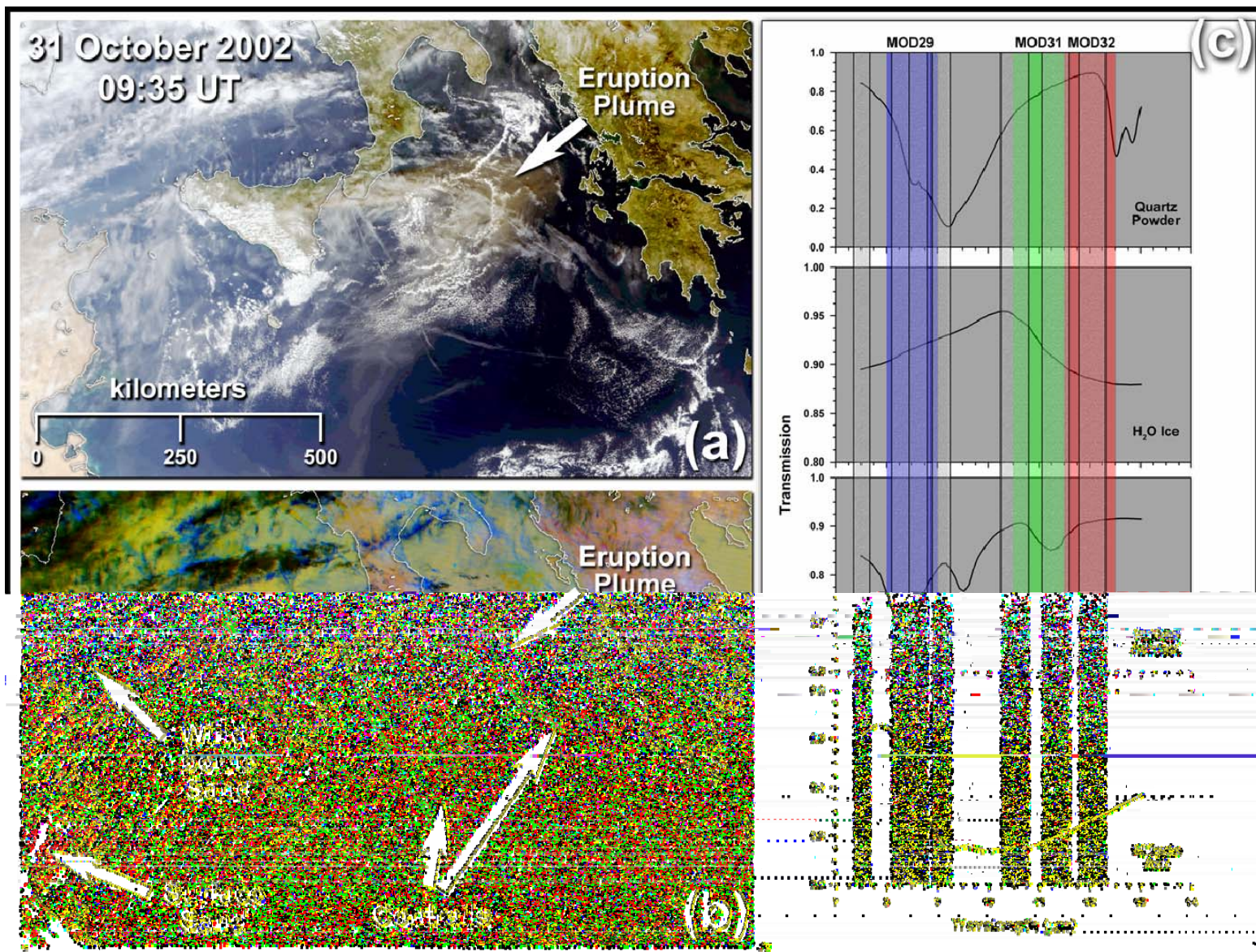
ASTER night-time multispectral TIR image of Augustine Volcano showing eruption plume. (a) Color-composite image showing spectral variations between materials entrained in plume. Magenta display colors indicate mixtures of water droplets (steam) and silicate ash. Red, yellow, and orange display colors indicate mixtures of ash and SO₂. The red and yellow component of the display color increases with relative increase of ash and SO₂, respectively. (b) SO₂ map derived from ASTER TIR data.



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Plume Detection Based on Multispectral TIR Remote Sensing

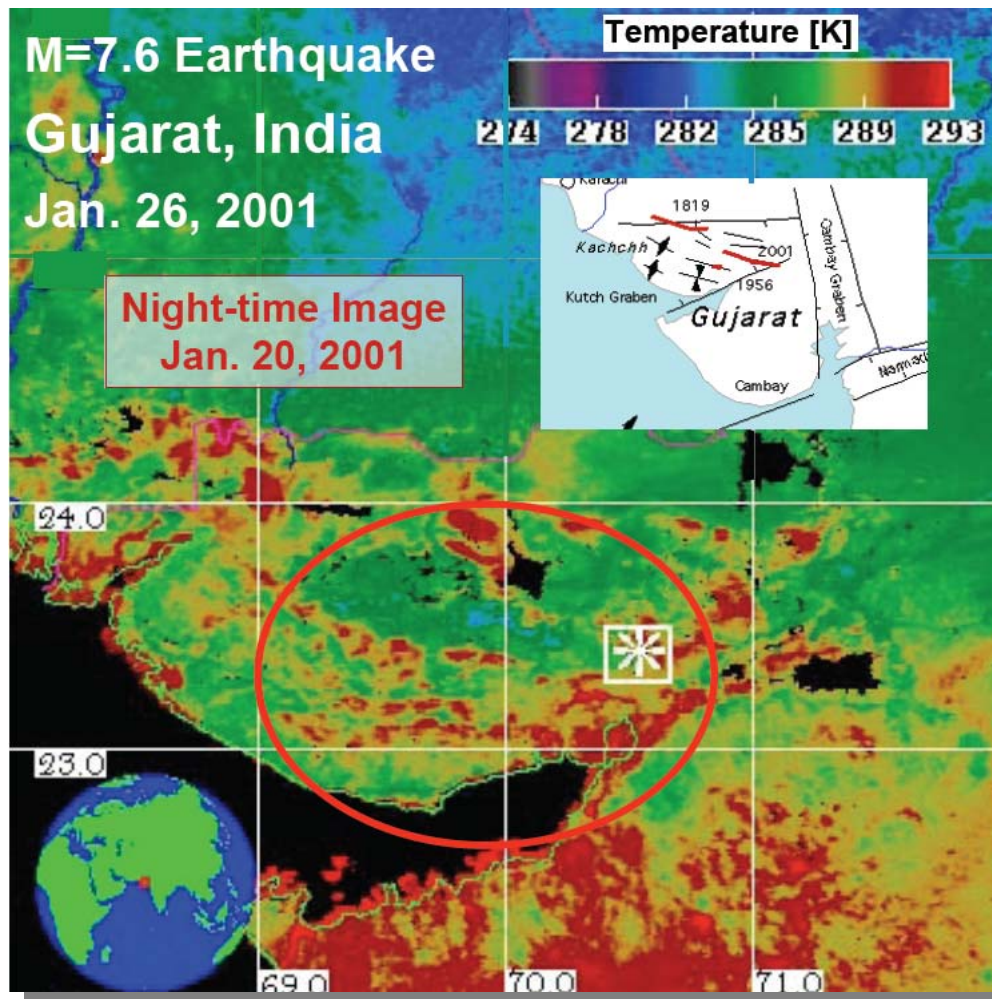




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What do the transient thermal infrared anomalies that may precede earthquakes tell us about changes in the geophysical properties of the crust? [DS 227, 229]



Almost 10 days before this earthquake the known faults in the region showed up in the night-time MODIS images.

(Star = Epicenter)

The intensities fluctuated from night to night.
The effect disappeared after the event.

(Ouzounov & Freund, 2004)



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