Science Traceability Guidance

Science Objective: What are the science questions that will be answered?

Measurement Objective: What is measured that addresses the objective or answers the science question?

Measurement Requirement: What is the parameter, spatial, temporal (What?, Where?, When?) domain of the measurement ?

Instrument Requirement: What are the specifications of the instrument to meet these measurement requirements?

- (Spectral, radiometric, spatial, uniformity, etc)

Other Mission Requirements: What are the other requirements, beyond the instrument?

NOTE: There should be redundancy. The Mission will be based on the tightest requirements.

Science Objectives	Measurement Objectives	Measurement Requirements	Instrument Requirements	Other Mission and Measurement Requirements
Volcanoes and Earthquakes: **How can we help predict and mitigate earthquake and volcanic hazards through detection of transient thermal phenomena?**				
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]	Detect, quantify and monitor subtle variations in: 1) surface temperatures 2) sulfur dioxide emissions at low, non-eruptive flux levels. Compilation of long-term baseline data sets.	Temperature measurements in the range -20 to 100 ˚C. TIR radiance measurements at ~8 µm; 5 other TIR bands for use in SO2 retrieval algorithm; 7 day repeat.	7 TIR channels, 7-12 µm Pixel size ≤60 m NEΔT ~0.02 K. >95% abs. radiometric calibration	Nighttime data acquisitions.
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]	Area covered by active lava flows; Lava flow surface temperatures; Radiant flux from lava flow surfaces.	Temperature measurements in the range 0 to 1200 ˚C (active lava), and 0-50 ˚C (ambient background). 5 day repeat.	1 low gain channel at ~4 µm (NEΔT ~ 1-2 K) 2 nominal gain channels at 10-12 µm Pixel size ≤90 m Rapid bright target recovery at 4 µm (<2 pixels), bands saturate at 1200C	Nighttime data acquisitions. NIR/SWIR hyperspectral data is beneficial. Rapid response off nadir pointing capability. Rapid re-tasking for acquisition of targets of opportunity.
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]	Discrimination of volcanic ash clouds from meteorological clouds (both water and ice), in both wet and dry air masses.	Four spectral channels at 8.5, 10, 11, and 12 µm; Nedt of 0.2 K, Max. repeat cycle of 5 days.	4 channels, 8-14 µm. Pixel size ≤90 m >95% abs. radiometric calibration	NIR/SWIR hyperspectral data valuable to assist in recognition of meteorological clouds and estimation of plume height. Night-time data acquisitions to increase the frequency of observation.
What do the transient thermal anomalies that may precede earthquakes tell us about changes in the geophysical properties of the crust? [DS 227, 229]	Detect and monitor increases in surface temperatures along potentially active faults.	Temperature measurements in range 0 to 50C. 5 day repeat (or better)	2 channels in 8-12 um range; pixel size 100m; NEDT ~ 1K	Nighttime data acquisitions extremely necessary
Can the energy released by the periodic recharge of magma chambers be used to predict future eruptions? [DS 227]	Detect and monitor temperature changes of volcanic edifices	Temperature measurements in range of 0-1200C; 5 day repeat	1 low gain channel at ~4 µm (NEΔT ~ 1-2 K) 2 nominal gain channels at 10-12 µm Pixel size ≤90 m	Nighttime data acquisitions.