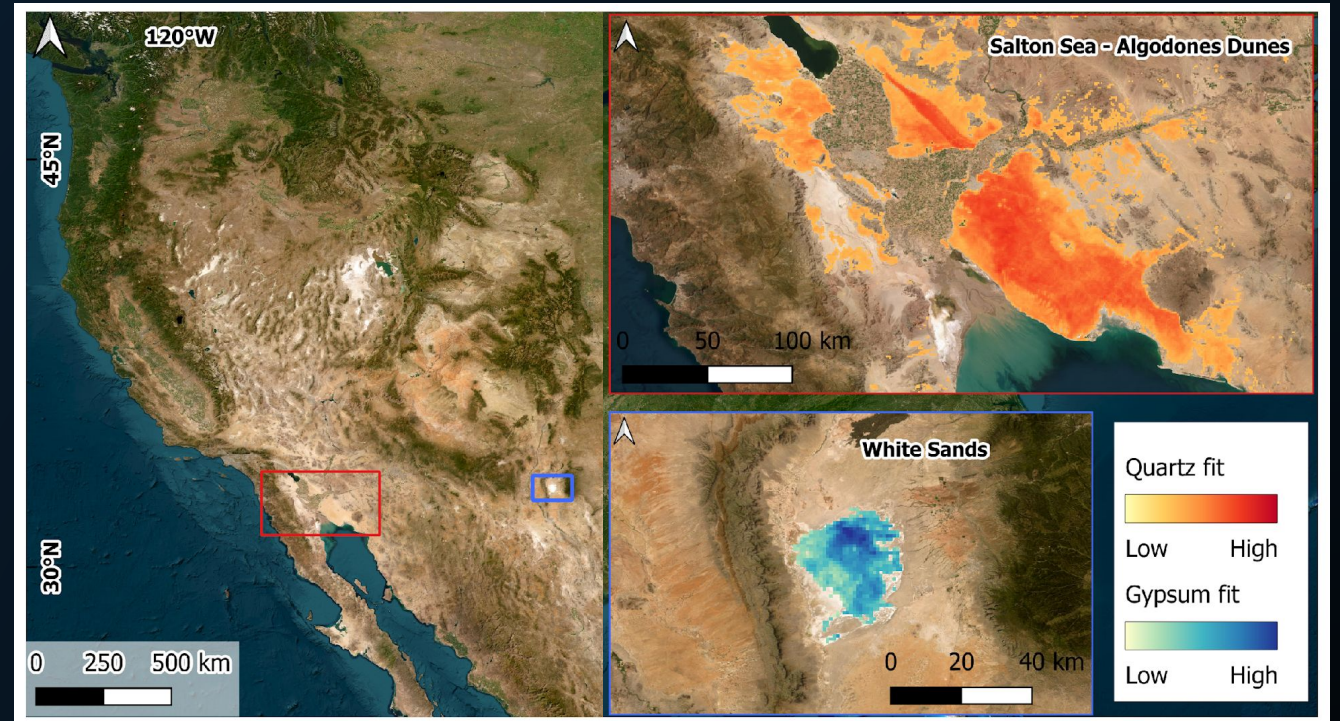


Critical Mineral Resource Detection

Silicates make up approximately 90% of the Earth's crust and are a host for rare earth minerals that are essential for many high-tech devices such as cell phones and electric cars. ECOSTRESS can be used to estimate the abundances of silicates based on the distinct spectral features exhibited in the thermal infrared.

ECOSTRESS can be used to detect other mineral classes such as sulfates, which presence along with other minerals could indicate hydrothermal features with potential for relevant mineral deposits (e.g. porphyry copper deposits, epithermal gold deposits) and energy generation



Credit: Federico Rabuffi

Uncovering Precious Minerals: NASA and USGS's Mapping Efforts from Above



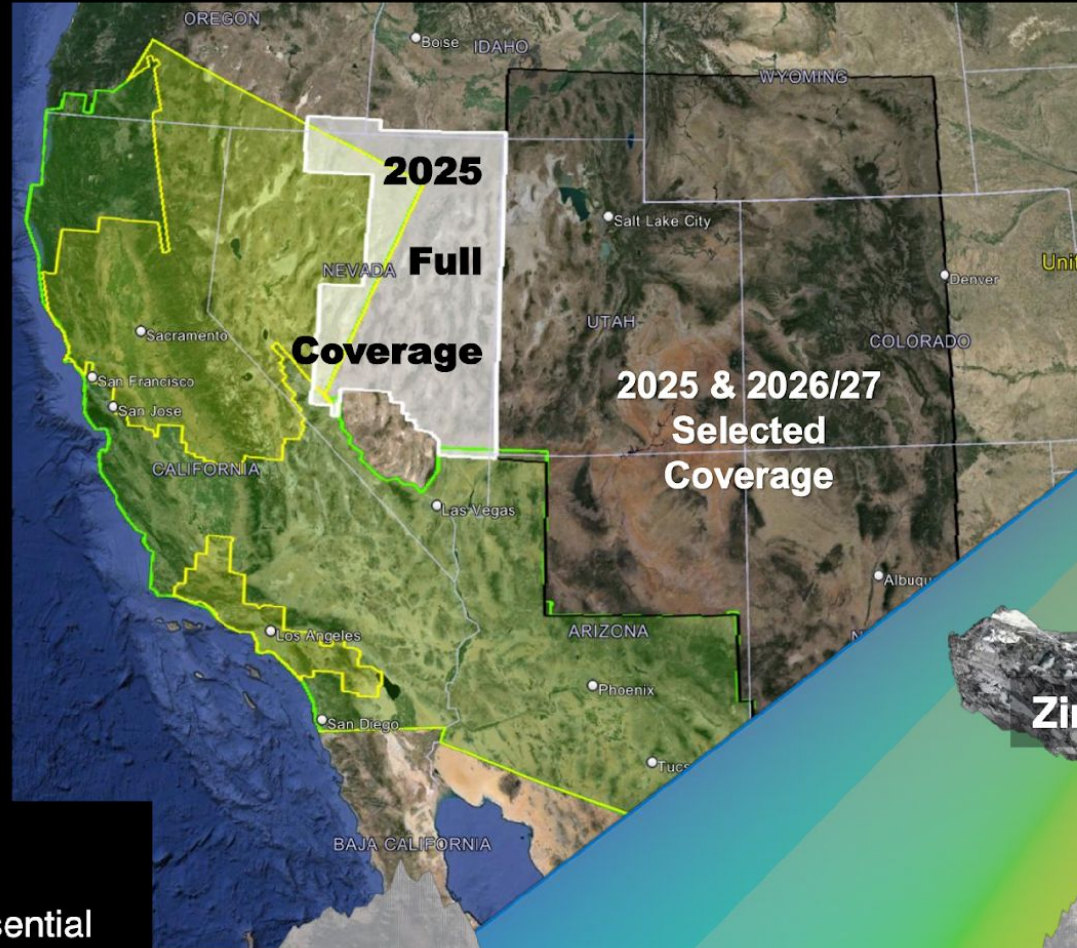
Critical minerals are essential for America's security and prosperity.

NASA and the USGS have embarked on a multi-year survey, called the **GEMx campaign**, to map some of these minerals in the **Western US**.

NASA's advanced instruments AVIRIS and MASTER onboard NASA's near-space ER-2 aircraft use spectral information to find mineral deposits that otherwise would be missed, given the vast area to search.

Key Takeaway:

NASA is facilitating the identification of essential minerals within the U.S., bolstering both security and prosperity while decreasing reliance on foreign sources.



Zinc



Lithium

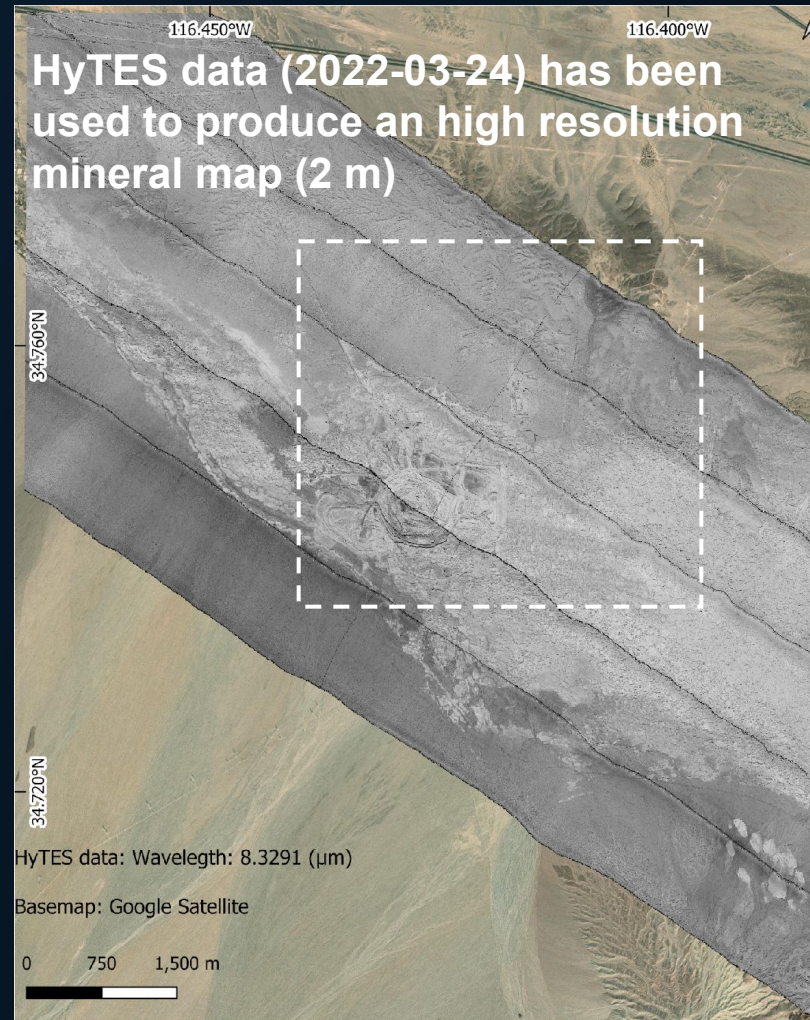
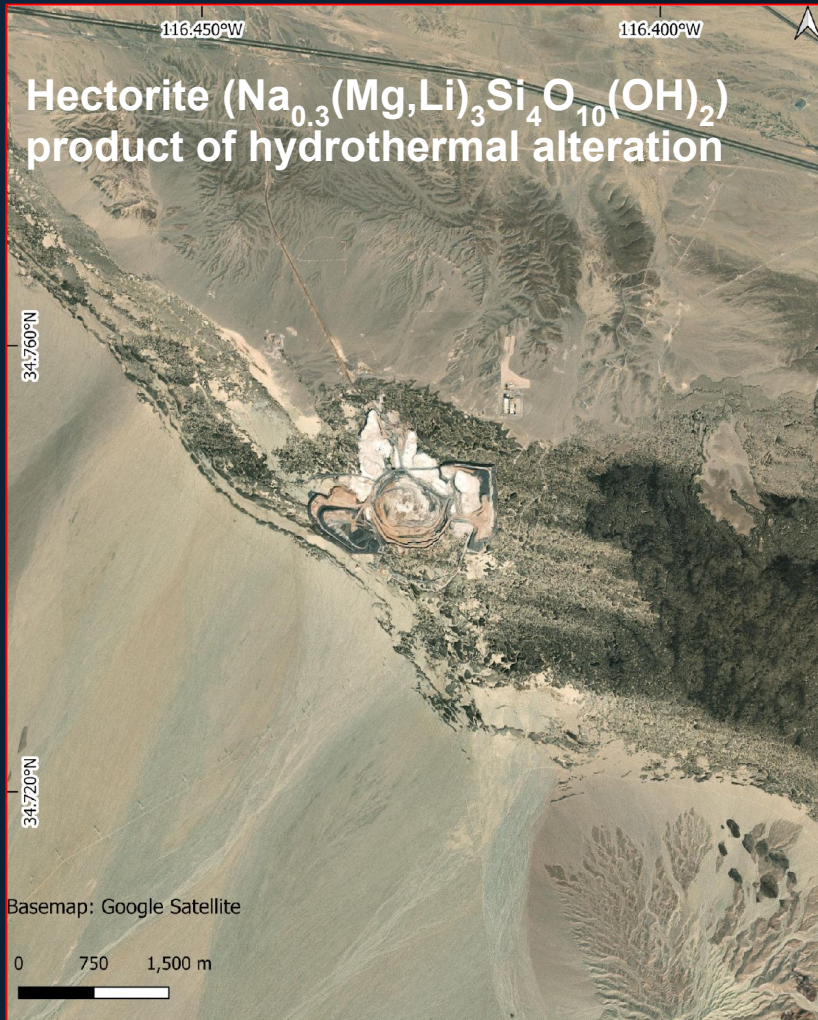


Aluminum

Contacts:
Raymond Kokaly (USGS)
Robert Green (NASA-JPL)

Mapping Hectorite in the Thermal Infrared using the airborne Hyperspectral Thermal Emission Spectrometer (HyTES)

(J.T. Kloprogge et al. 1999)



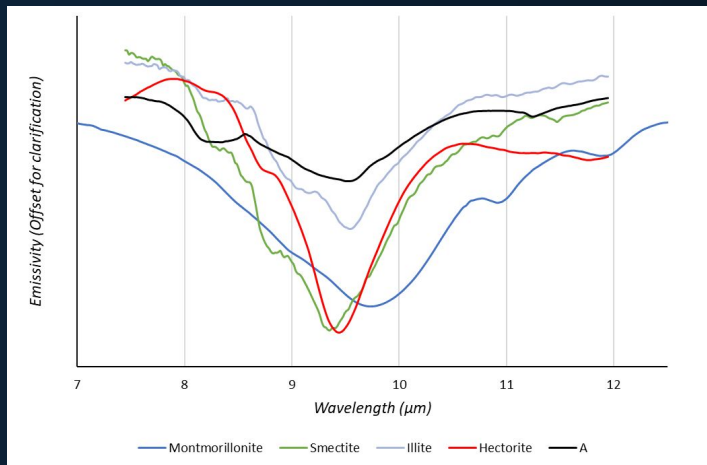
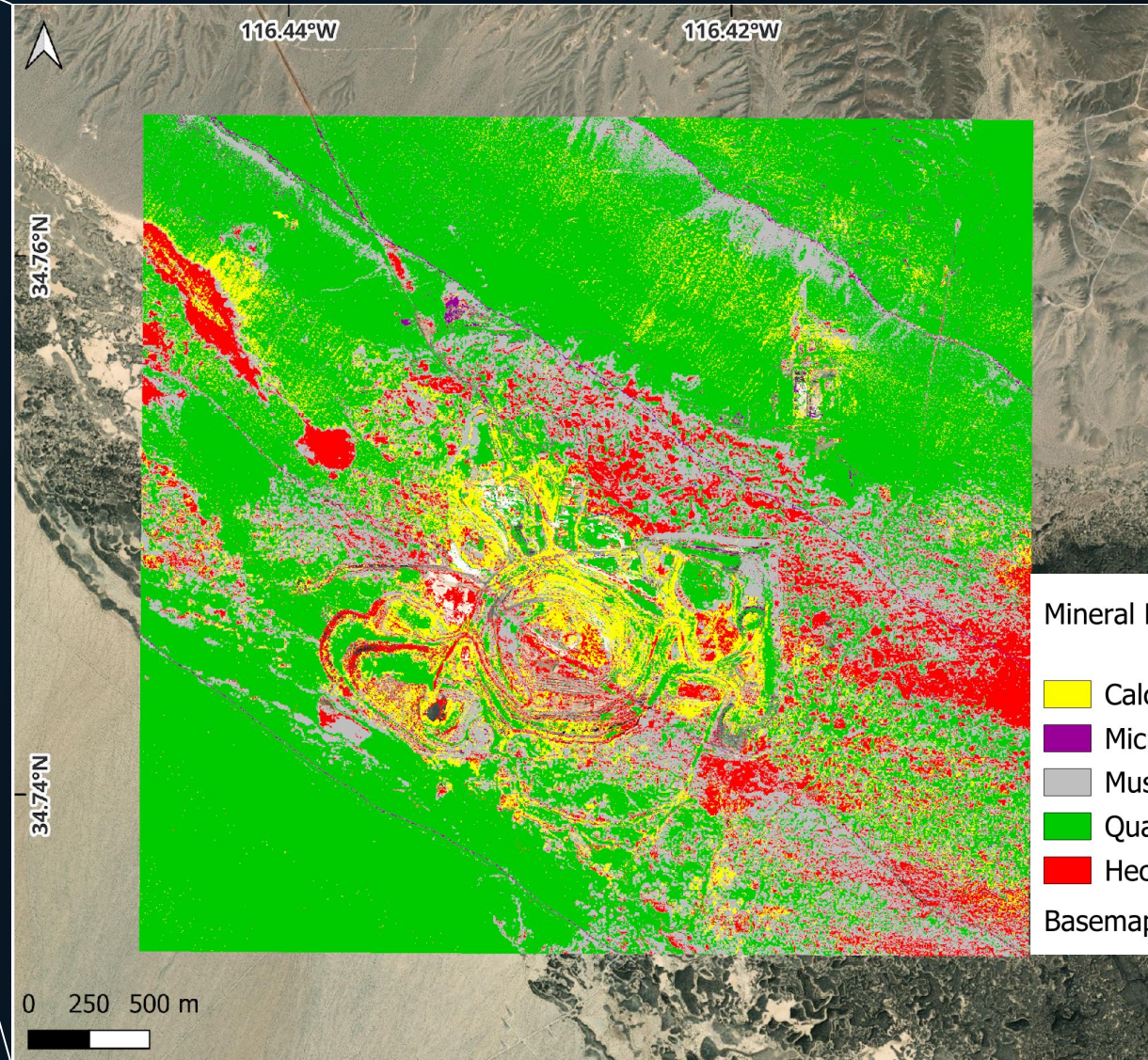
Hectorite

- Naturally occurring mineral with varied industrial applications and source of lithium

Chemical analyses (%) of the standard hectorite samples [4,30]

	SHCa-1	API No. 34
SiO ₂	34.7	55.86
Al ₂ O ₃	0.69	0.13
TiO ₂	0.038	–
Fe ₂ O ₃	0.02	0.03
FeO	0.25	–
MnO	0.008	–
MgO	15.3	25.03
CaO	23.4	Trace
Na ₂ O	1.26	2.68
K ₂ O	0.13	0.10
Li ₂ O	2.18	1.05
F	2.60	5.96
H ₂ O	20.6	9.90
Total	101.18	100.74

HyTES mapping of hectorite - MICA

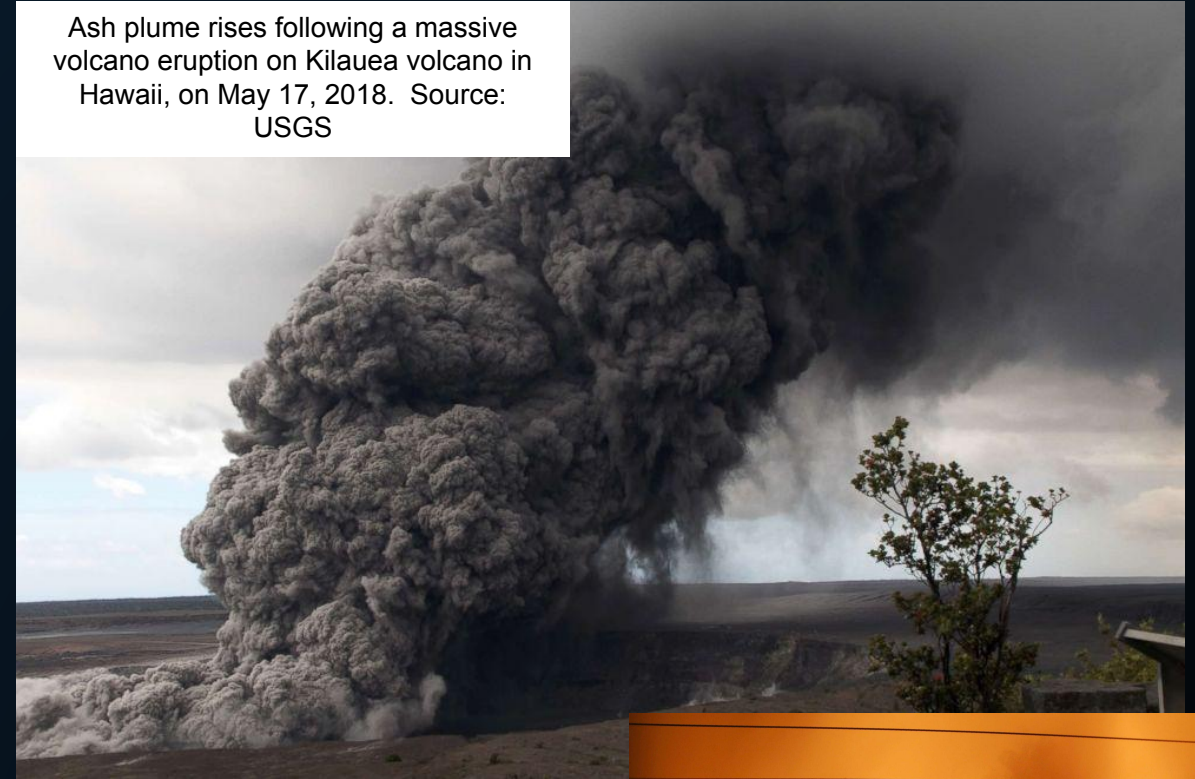
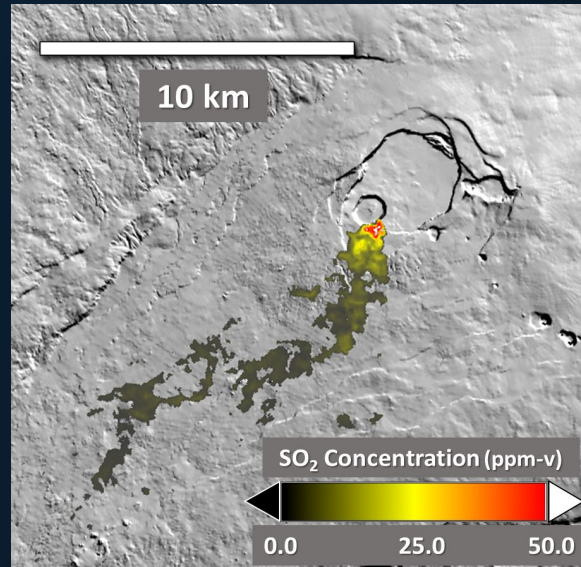
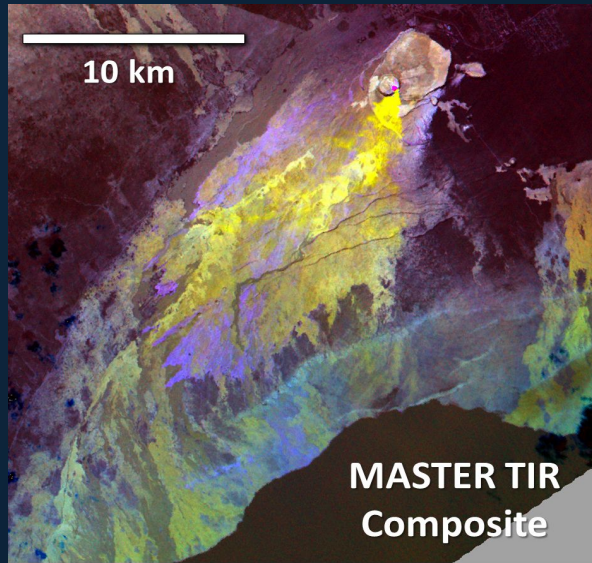


Mineral Map

- Calcite
- Microcline
- Muscovite
- Quartz
- Hectorite

Basemap: ESRI Satellite

Volcanic Emissions in the Earth System: Kīlauea Volcano



Credit: Vince Realmuto/JPL

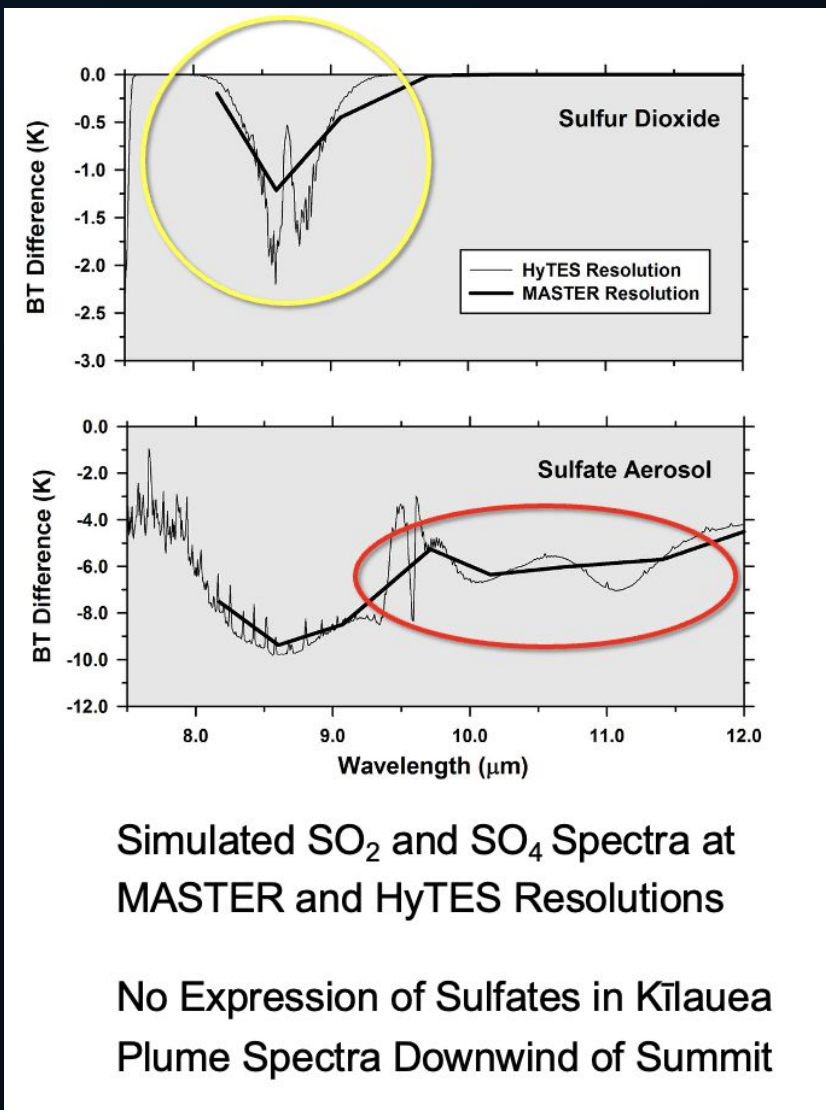
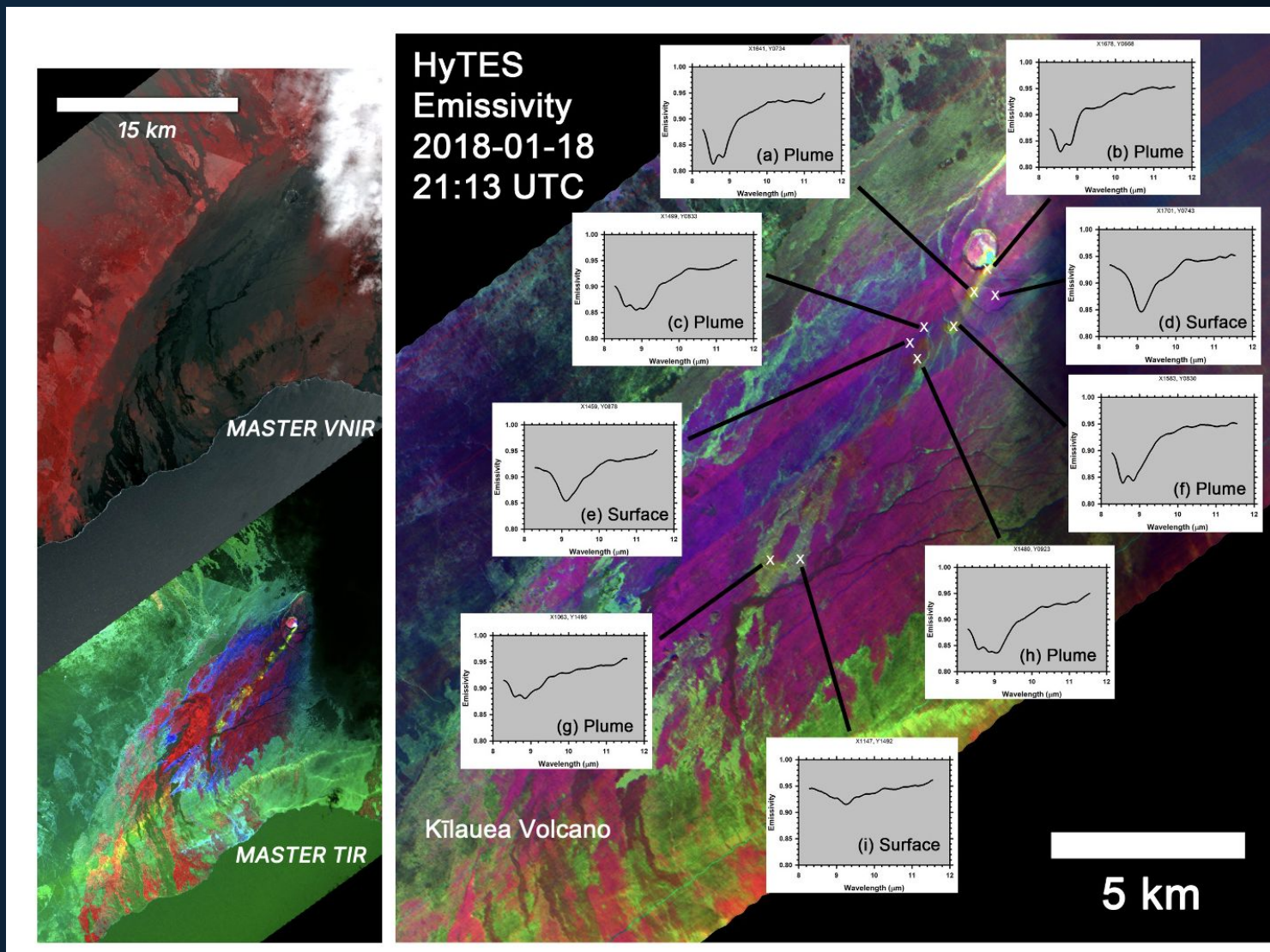
SO₂ emissions from volcanoes can cause acid rain and air pollution, leading to respiratory distress in humans, that can persist long term.

Thermal data can be used to estimate quantities of SO₂ following volcanic eruptions and the plume extent

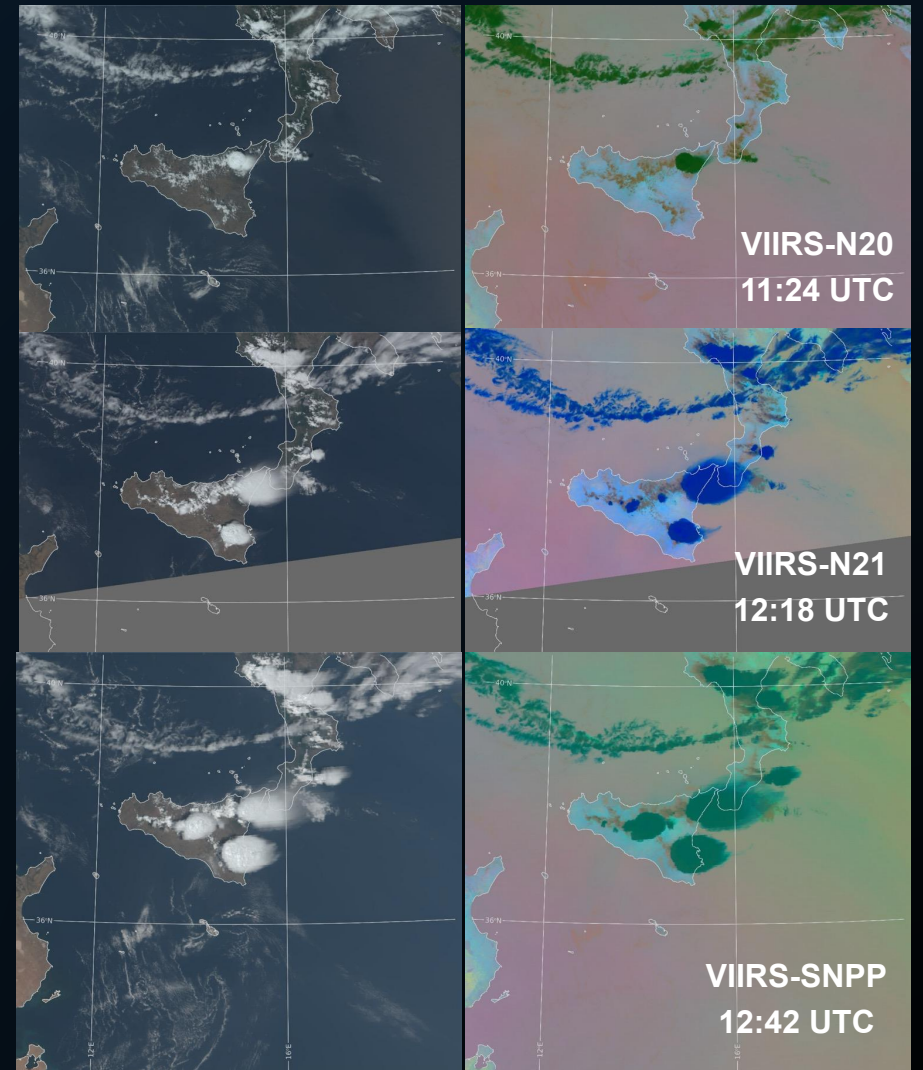
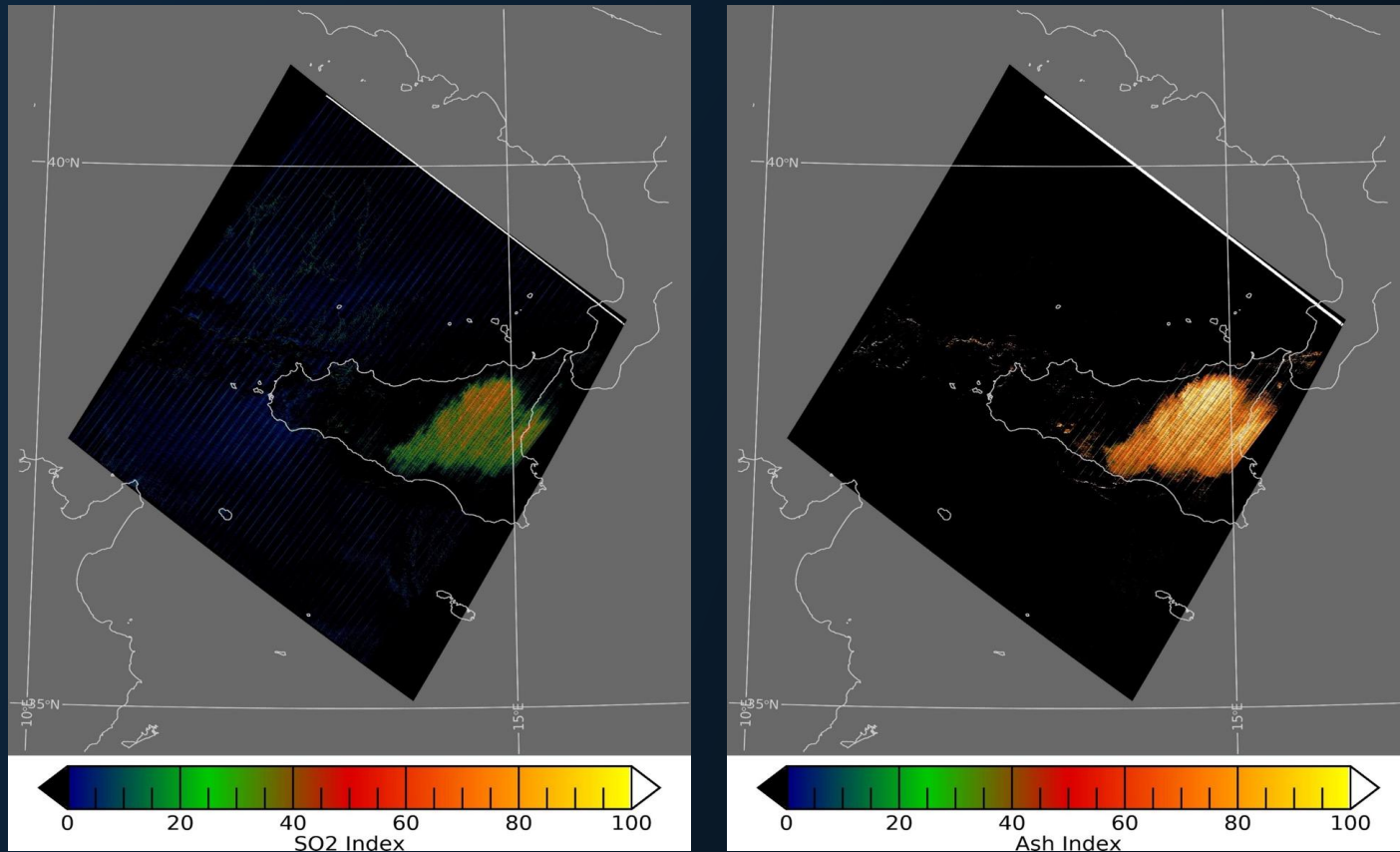


HyTES: Imaging Spectroscopy in the TIR

Kīlauea Plume : 2018-01-18



ECOSTRESS/VIIRS Observations of Mount Etna: 2024-08-05



- ECOSTRESS Data, Acquired at 16:17 UTC, Indicate SO₂ and Ash Were Present in Clouds
- VIIRS Data, Acquired ~4 hr Prior to ECOSTRESS, Indicate That No SO₂ nor Ash Were Present in Cloud
- ECOSTRESS Spatial Resolution (70 m) Finer than VIIRS (750 m) – Resolving Temperature Variations at Cloud Tops?