

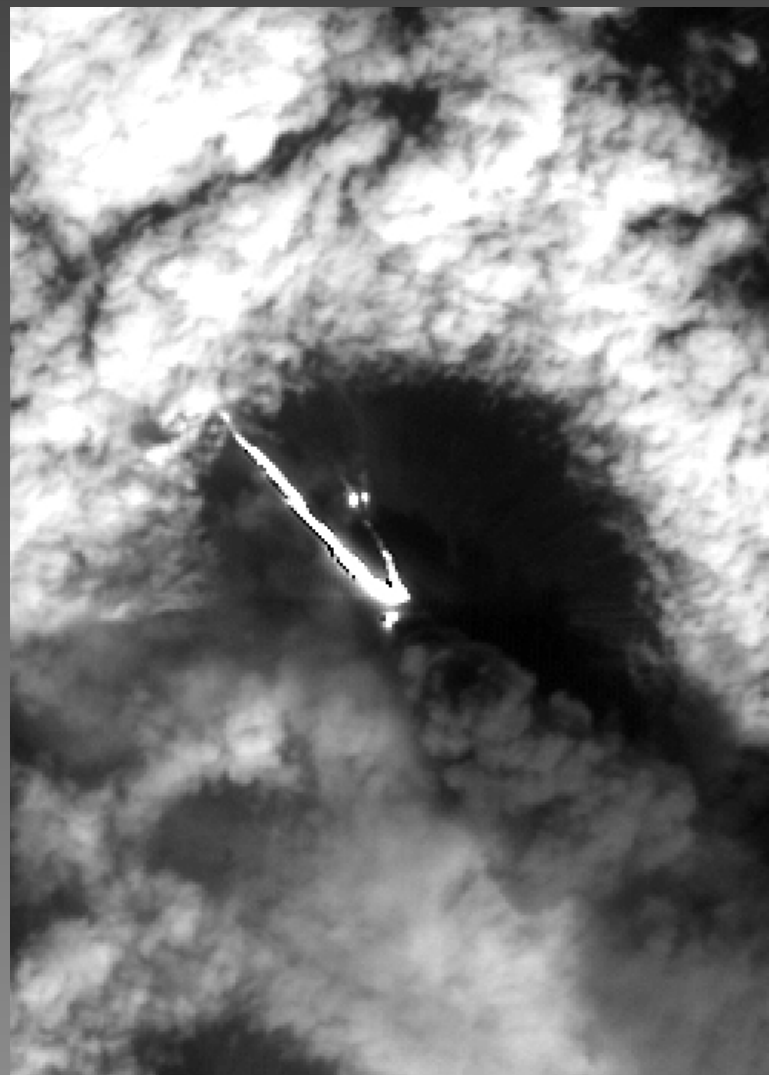


Results of increased spatial, spectral & temporal observations of volcanic activity: Implications for HyspIRI TIR data

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Kliuchevskoi volcano (ASTER-URP data): 28 May 07





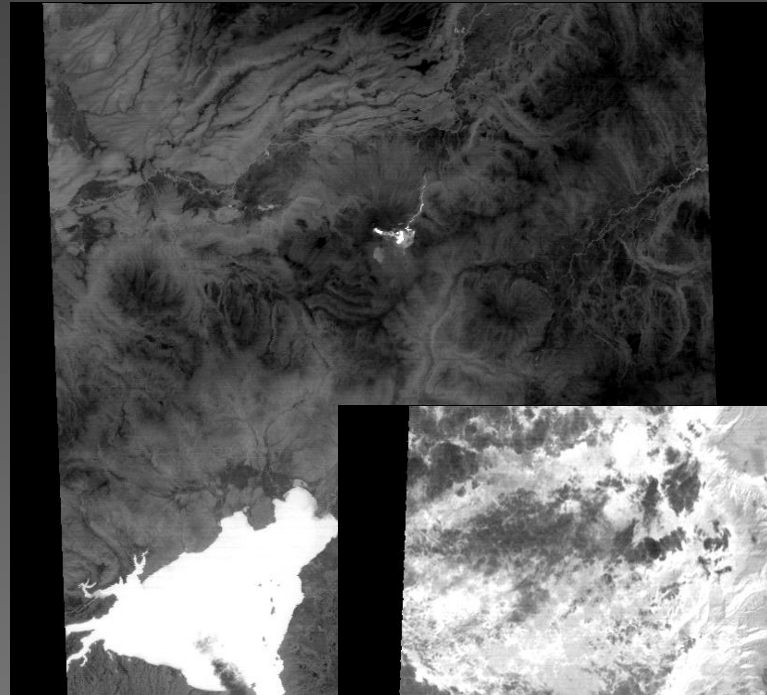
Overview

Kizimen volcano (ASTER-URP data): March 2011

- **Spatial Resolution**

- volcano science returned from multispectral TIR data

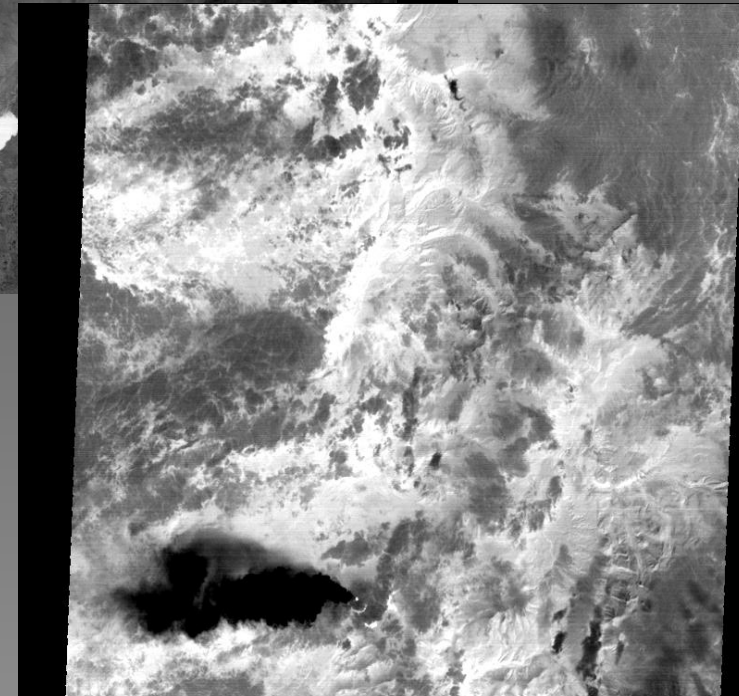
- the ASTER URP Program
 - 8 year archive
 - cloud vs. anomaly statistics for volcanoes



- **Spectral Resolution**

- trade studies of spectral resolution and band positions

- MAGI and SEBASS airborne data



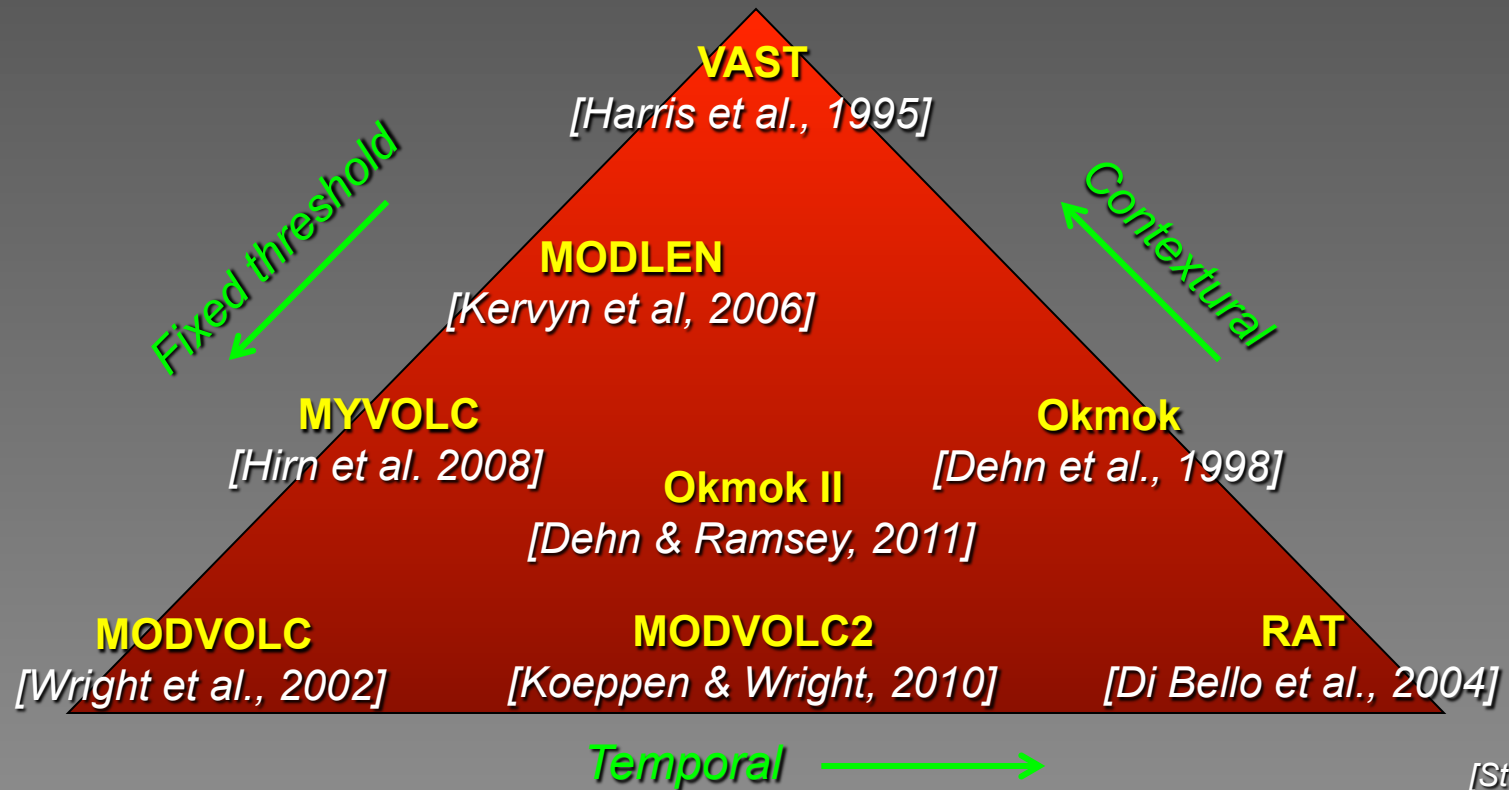


Thermal Anomaly Detection

- **Operational Algorithms**

- used for routine thermal anomaly detection

- based on three end-member algorithms:



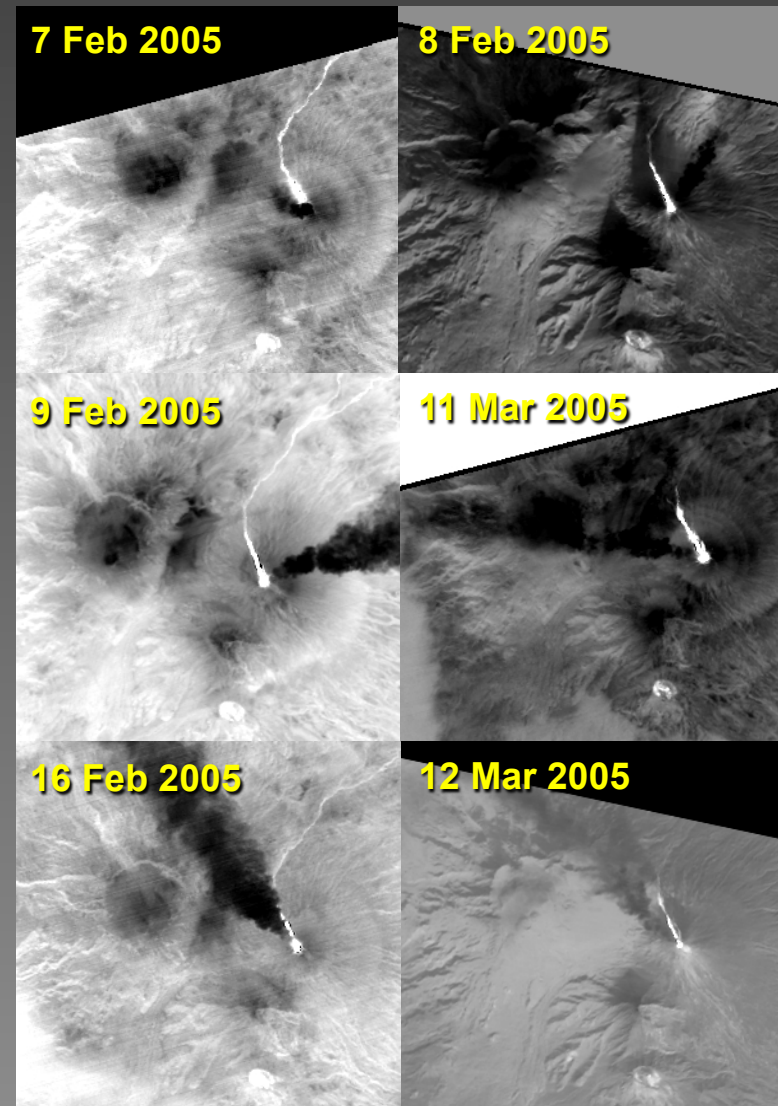
[Steffke, 2009]



URP Summary

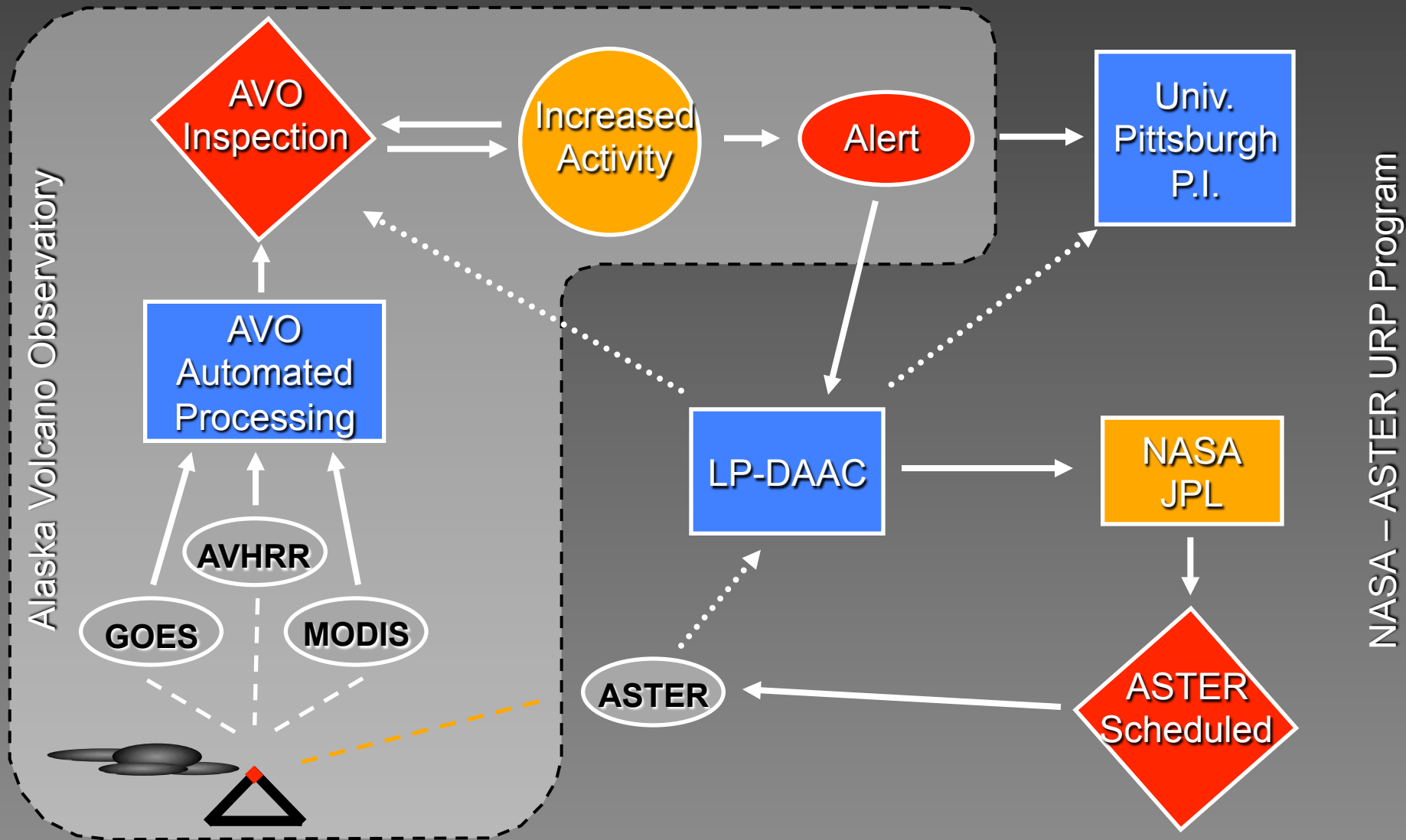
Kluichevskoi time series

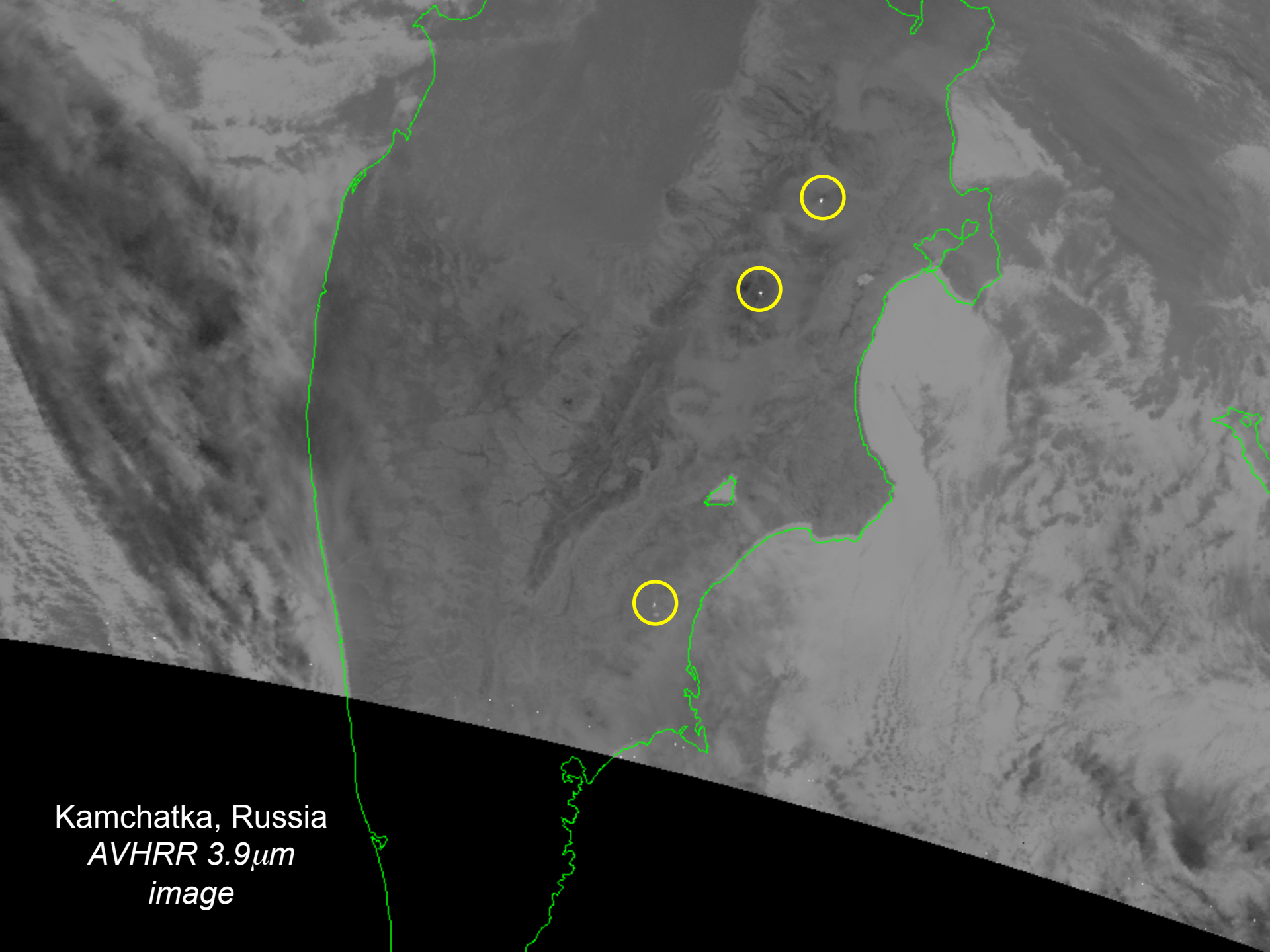
- **ASTER Urgent Request Protocol (URP) Program**
 - integrates Alaska Volcano Observatory monitoring into the ASTER Urgent Request stream
 - focused on the northern Pacific volcanic arc
 - trigger automated ASTER requests → sent to the LP DAAC → ASTER scheduled
 - 1 – 5 day repeat times
 - several thousand high spatial, high temporal scenes in the URP archive
 - now integrated with MODVOLC





ASTER URP Flowchart

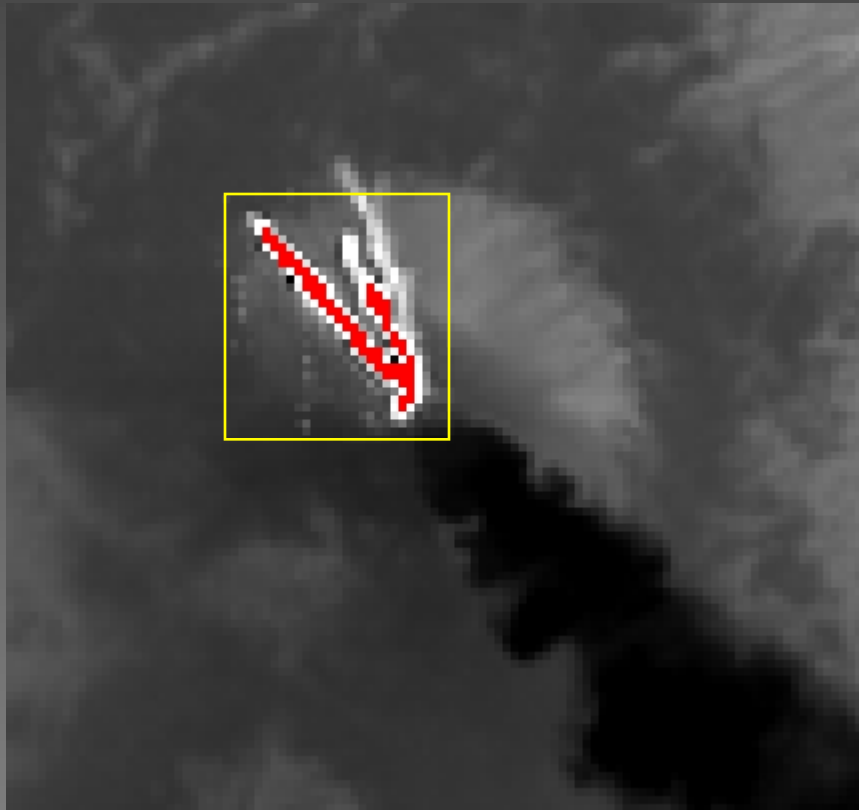




Kamchatka, Russia
AVHRR $3.9\mu m$
image

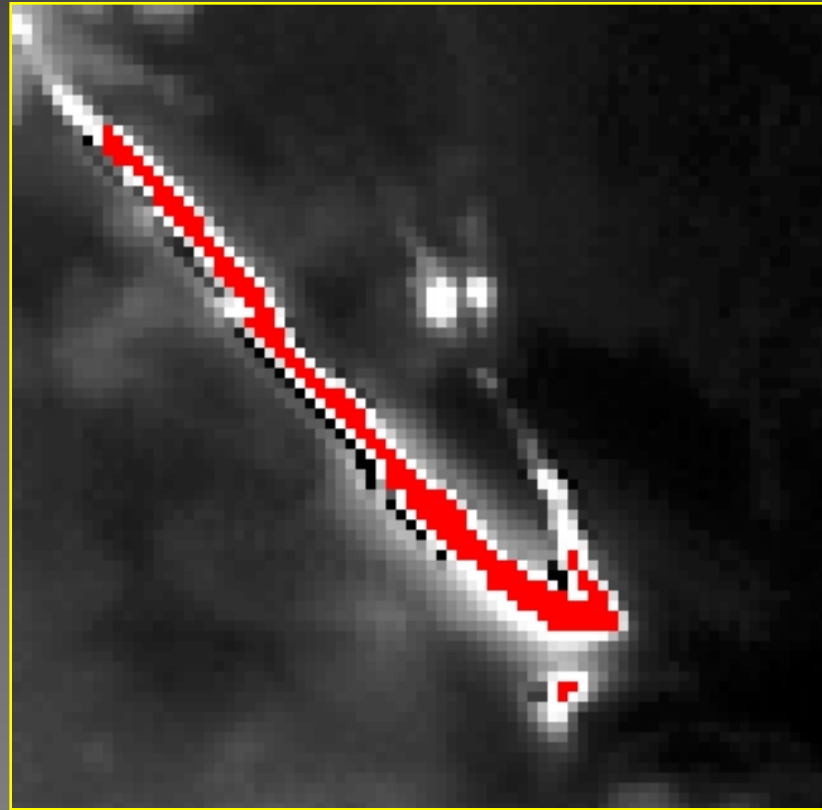


TIR/SWIR UPR Data



TIR temp (90m)

T_{TIR} (max detected) = 100 °C
saturated pixels (red)



Band 4 (LO2 gain) temp (30m)

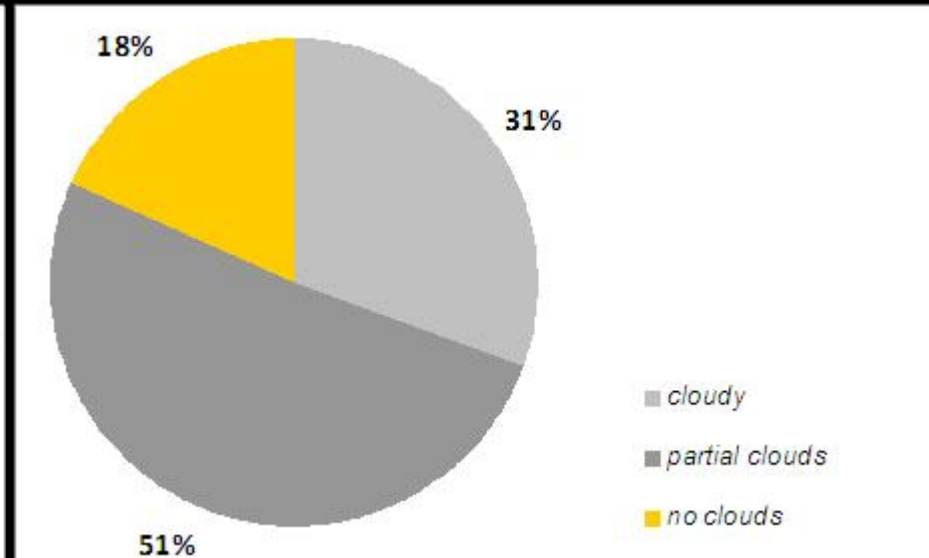
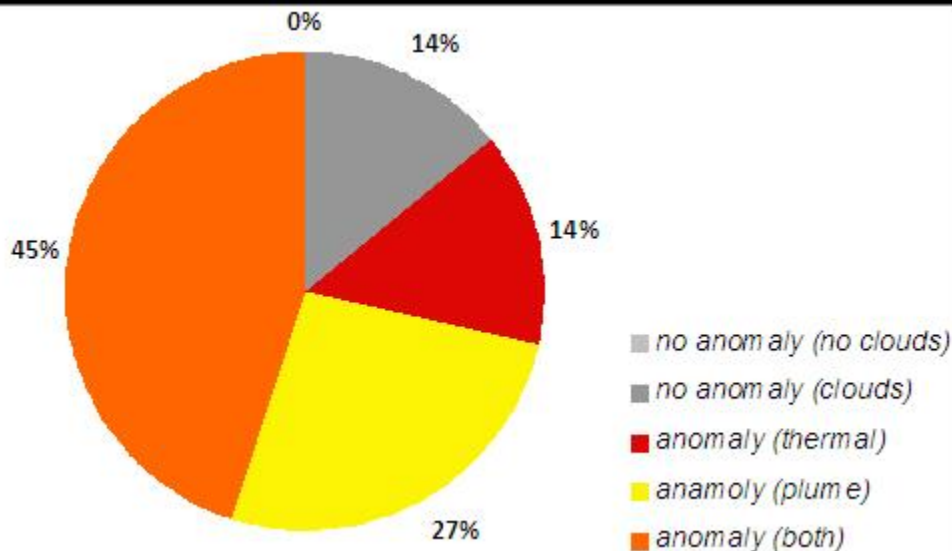
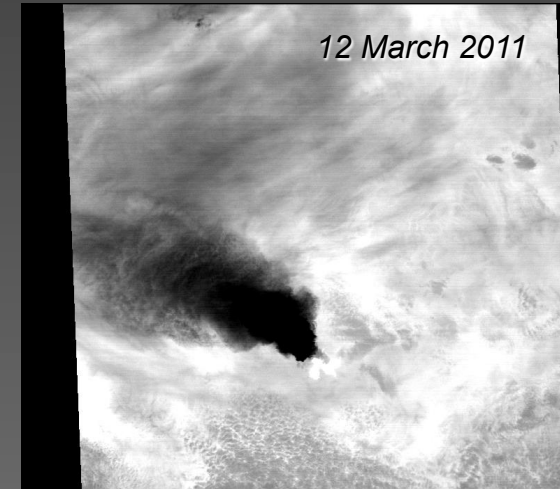
T_{b4} (max detected) = 464 °C
saturated pixels (red)





ASTER URP Statistics

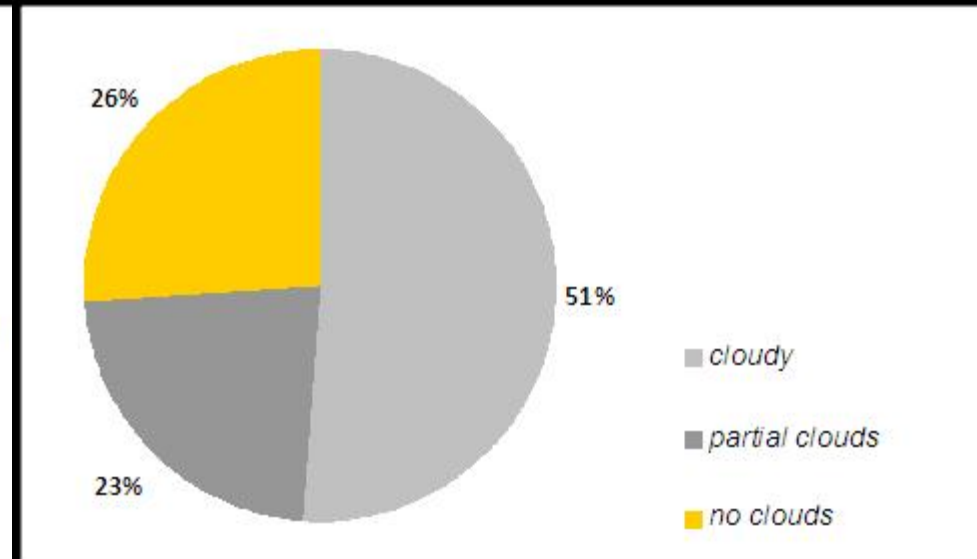
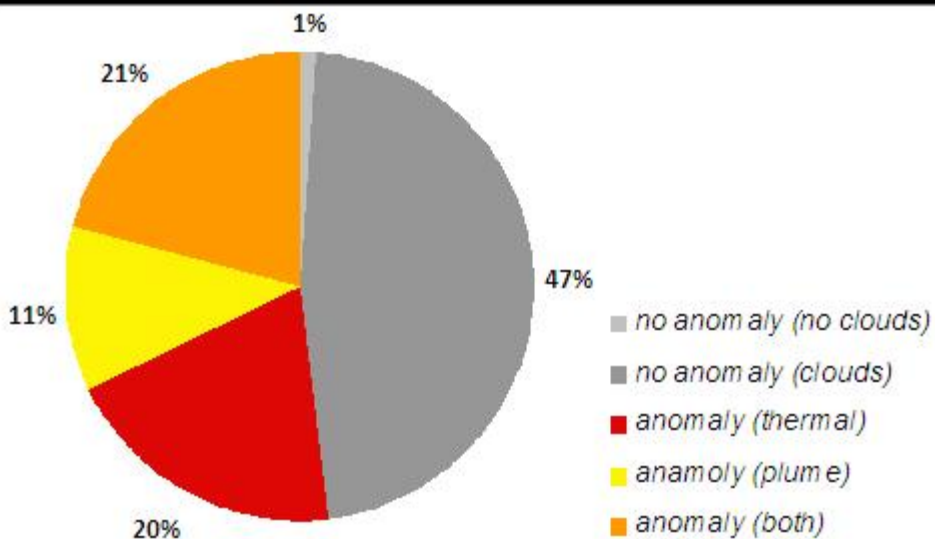
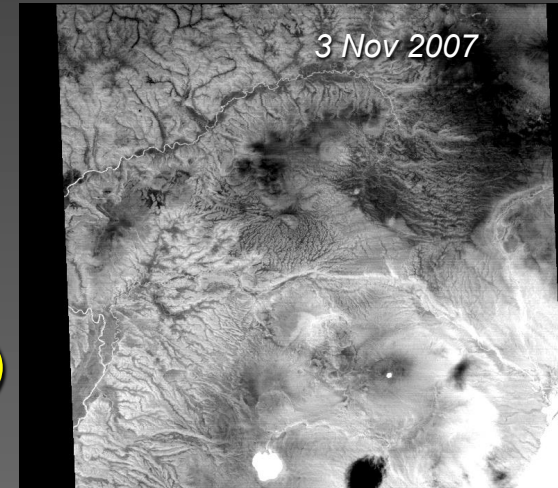
- **Kizimen Volcano (*new eruption*)**
 - 1 Jan 2011 to 30 Apr 2012
 - 49 ASTER observations
 - average: 1 scene / 9 days
 - 40 contained clouds (7 had no anomaly)
 - 7 (*thermal*), 13 (*plume*), 22 (*both*)





ASTER URP Statistics

- **Karymsky Volcano (ongoing eruption)**
 - 1 Jul 2007 to 30 Apr 2012
 - 96 ASTER observations (*not continuous*)
 - average: 1 scene / 18 days (1 / 5 days)
 - 71 contained clouds (45 had no anomaly)
 - 19 (*thermal*), 11 (*plume*), 20 (*both*)





ASTER URP Statistics

- **URP Expansion Now Underway**

- MODVOLC-based targets:

- Cordon Caulle (*Chile*)
 - Erta Ale (*Ethiopia*)
 - Etna (*Italy*)
 - Nyamuragira (*DR Congo*)
 - Nyiragongo (*DR Congo*)
 - Pu' u O' o / Kilauea (*Hawaii, USA*)
 - Reventador (*Ecuador*)
 - Santa Maria (*Guatemala*)
 - Semeru (*Indonesia*)
 - Stromboli (*Italy*)
 - criteria
 - volcanoes with high activity / danger potential
 - globally distributed
 - 10 targets initially chosen to test the scheduling demand
 - will grow based upon capacity of the system



Spectral Analysis

Salton Sea Geothermal Field (SSGF)

- SEBASS data
- MAGI data





Spectral Analysis

- **Salton Sea Geothermal Field (SSGF)**
 - diversity of thermal/compositional targets
 - SEBASS TIR data (*26 Mar 2009 & 6 Apr 2010*)
 - geology validation target for new airborne MAGI instrument
 - funded by the NASA IIP
 - built by Aerospace Corp.
 - 32 TIR channels
 - initial flights: Nov. 2011
 - this study
 - TIR band positions of HyspIRI
 - spectral deconvolution

“sandbar” geothermal site
Salton Sea, CA (6 Apr 2010)





Spectral Analysis

- **Proposed HyspIRI TIR Bands (μm)**

- 3.98, 7.35, 8.28, 8.63, 9.07, 10.53, 11.33, 12.05

- **Suggested Variant (μm)**

- [Ramsey & Rose, 2009]*

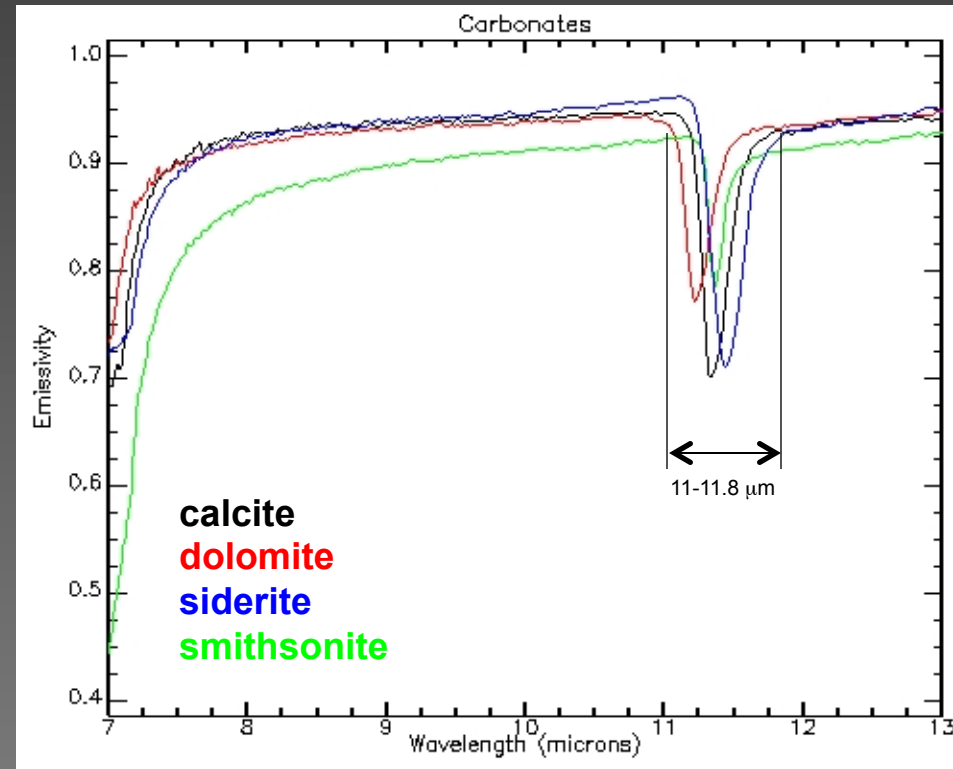
- 3.98, 7.35, 8.28, 8.55, 9.07, 10.05, 11.35, 12.05

- better discrimination of:

- SO_2 (8.55), silicates (10.05), carbonates (11.35)

- **Focus of This Study**

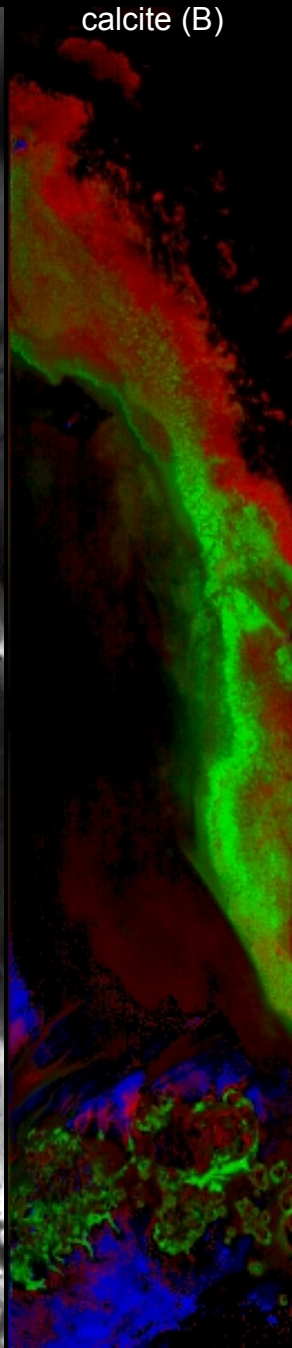
- only varying the 10 μm band (10.18)



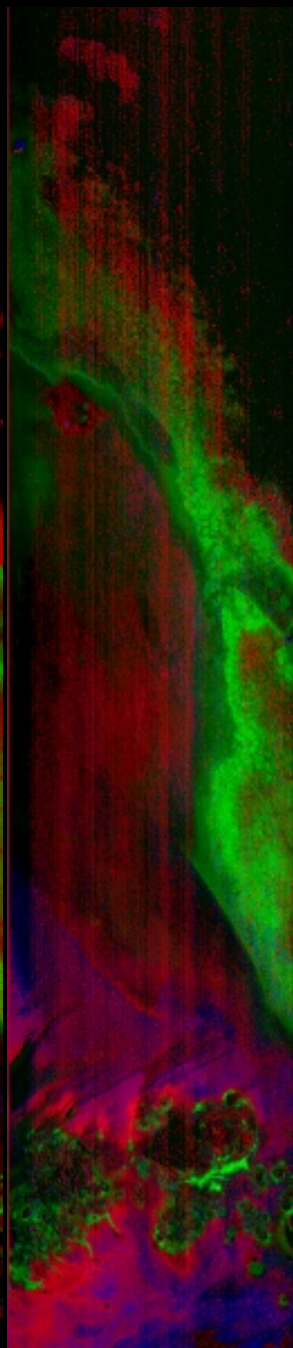
SEBASS 10 μm
radiance



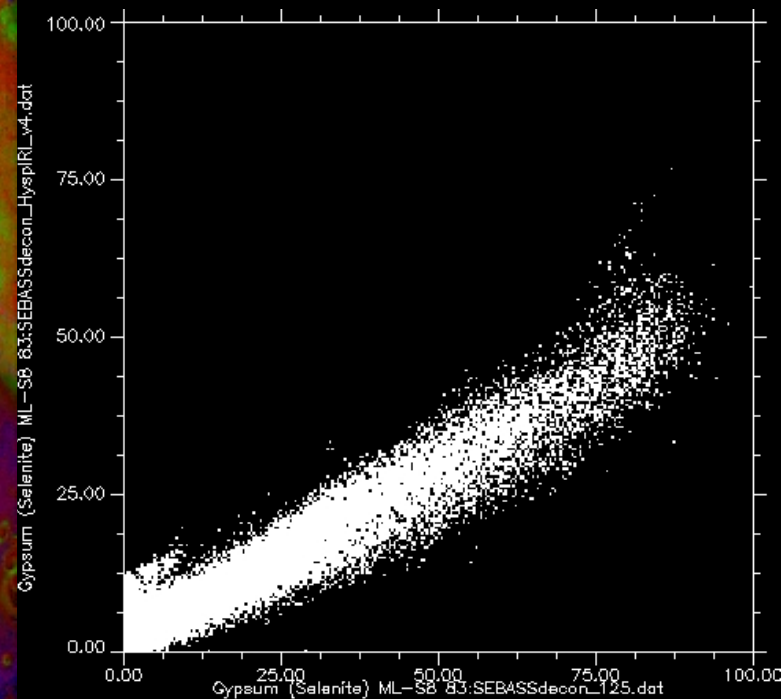
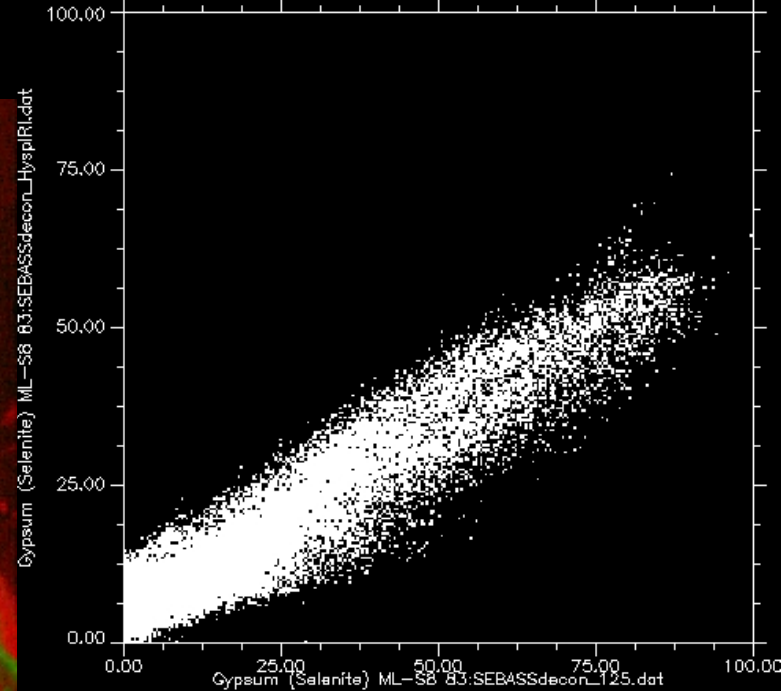
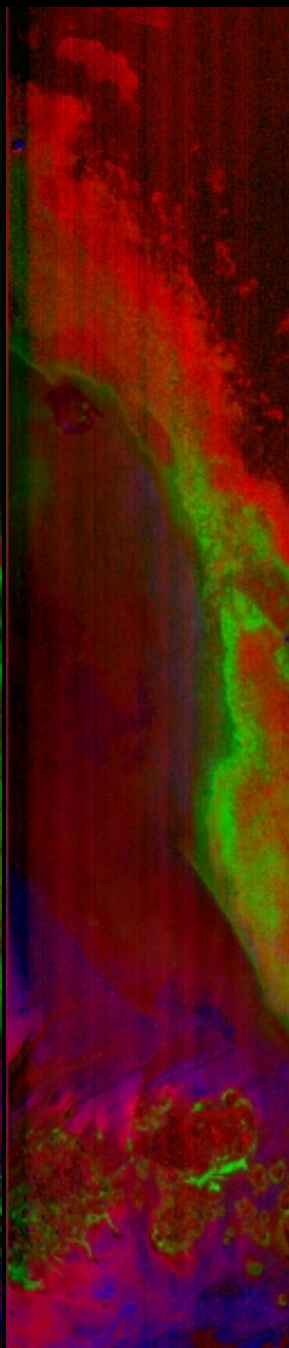
oligoclase (R),
gypsum (G),
calcite (B)



HyspIRI TIR
bands

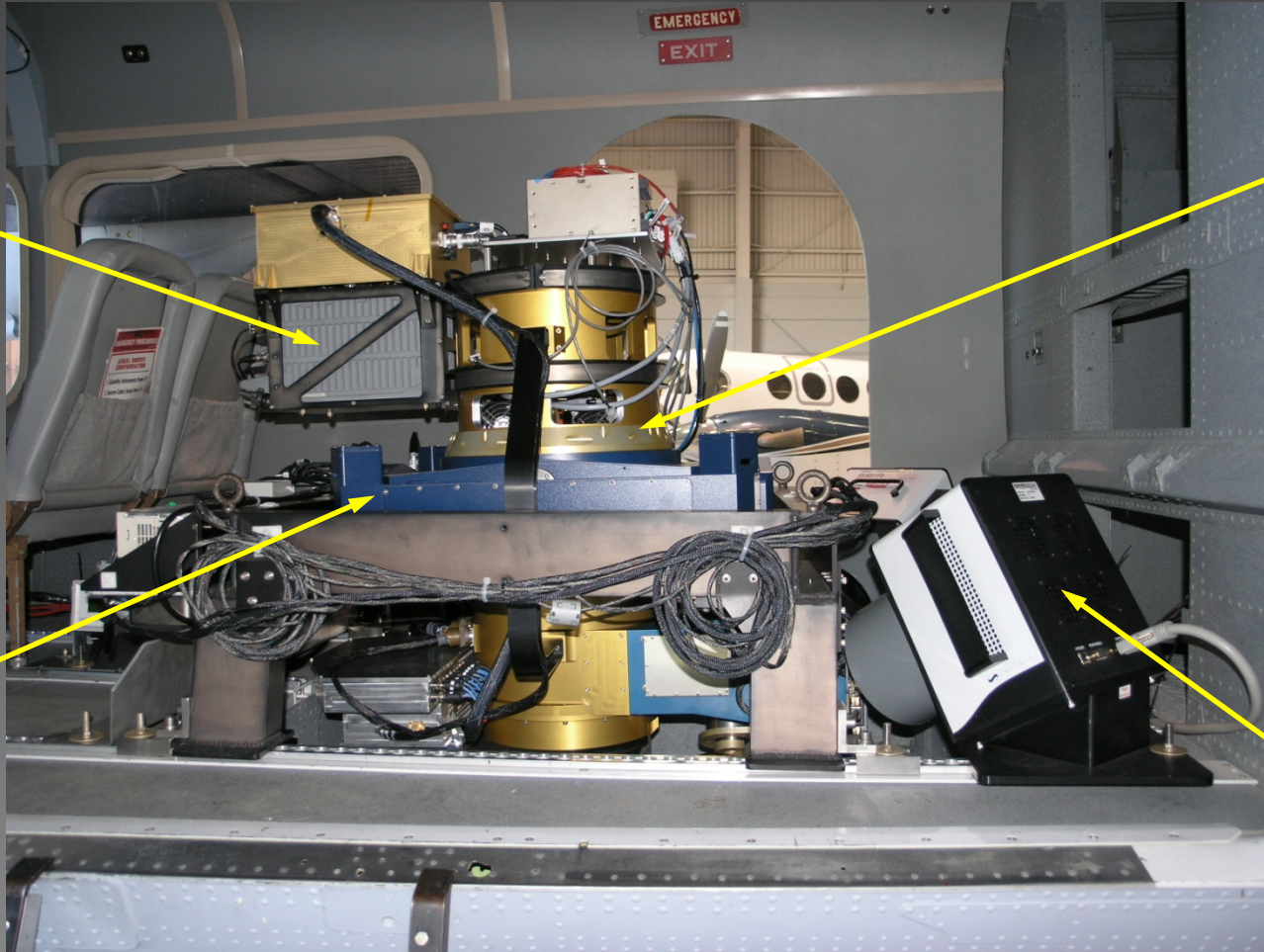


HyspIRI TIR
(band 10 shift)





MAGI On The Twin Otter



**Inertial
Navigation
System**

Sensor

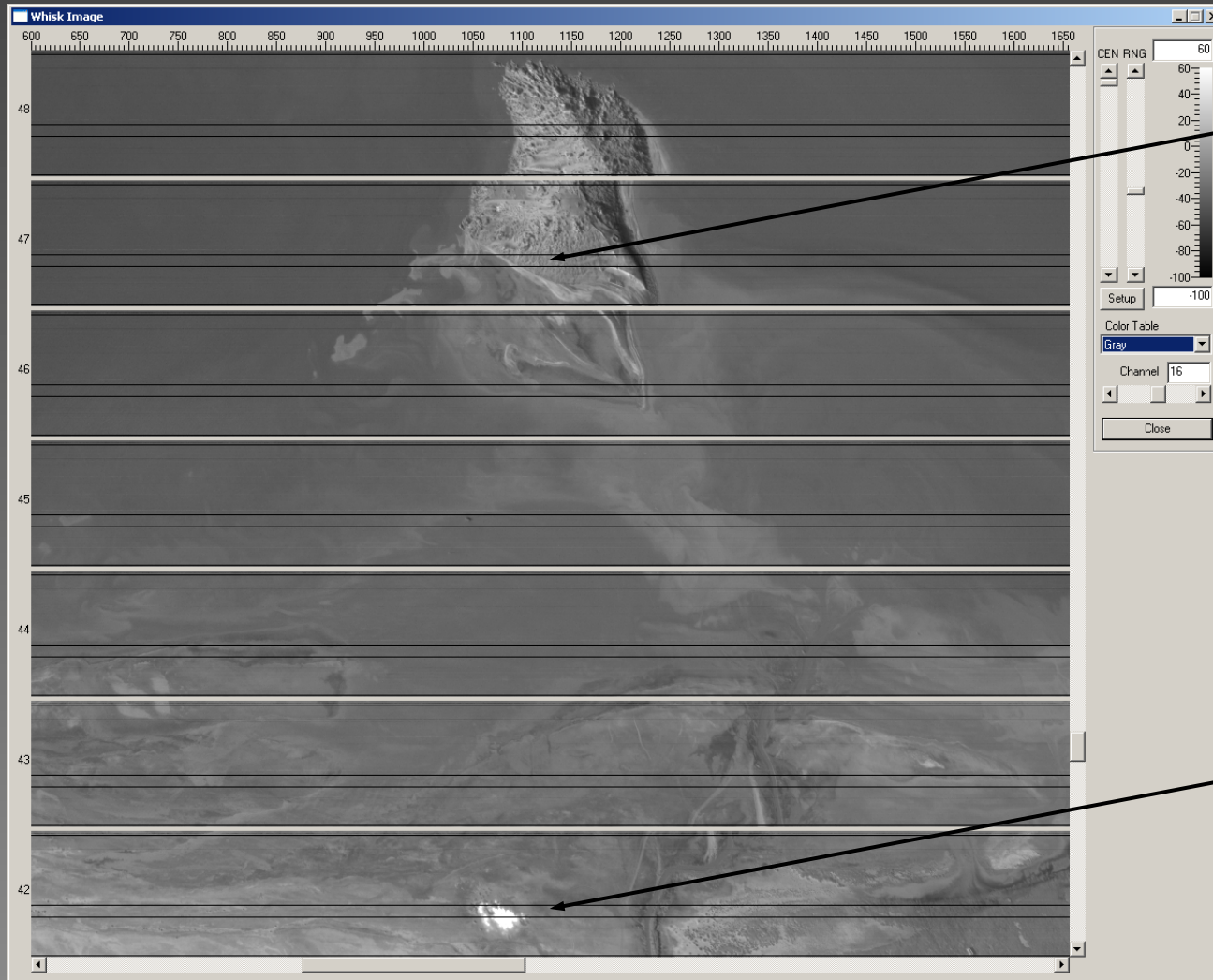
**Commercial
Stabilization
Platform**

**Calibration
Blackbody**



MAGI L0 Data ($10\ \mu\text{m}$ Band)

Salton Sea, CA
(~ 1-meter GSD)



Mullet Island

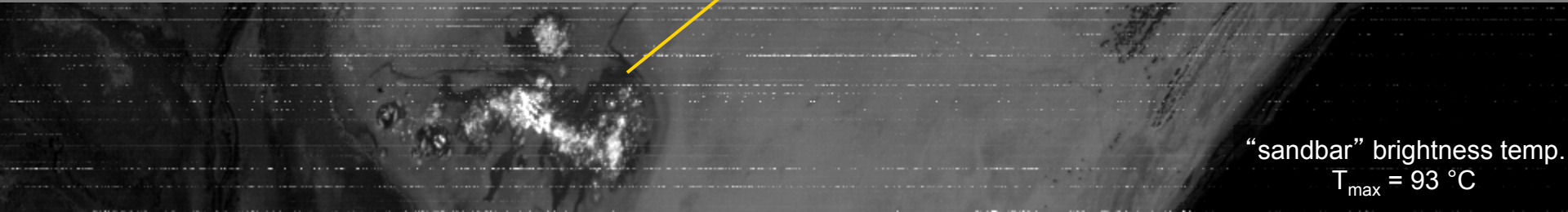
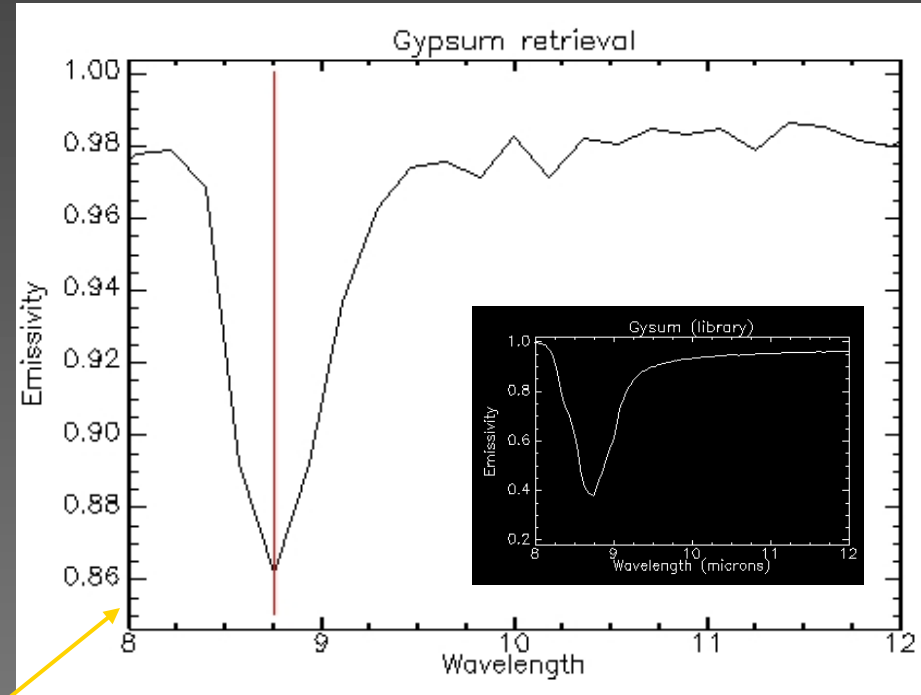
fumarole region



MAGI Analysis

• Initial Analysis

- limited amount of data processed from L1
- some detector line noise
- temperature/emissivity data appear very good
- compositional diversity matches well with SEBASS mineral maps





Conclusions

• TIR Observations of Volcanic Targets

– temporal

- 8 year volcano archive from the URP Program
- several 1000 scenes available for analysis
- TIR observations of numerous volcanic eruptive styles (*nearly identical to HyspIRI spatial/spectral/temporal*)
- clouds are always an issue (74 – 82% of URP scenes)
 - *high repeat time is critical (52 – 86% of scenes show anomalies)*

– spectral

- new instruments/tools to simulate HyspIRI TIR bands
- slight tweaking of band positions needs to be studied
 - greatly improves detection of feldspar silicate minerals
 - carbonates and SO₂ as well