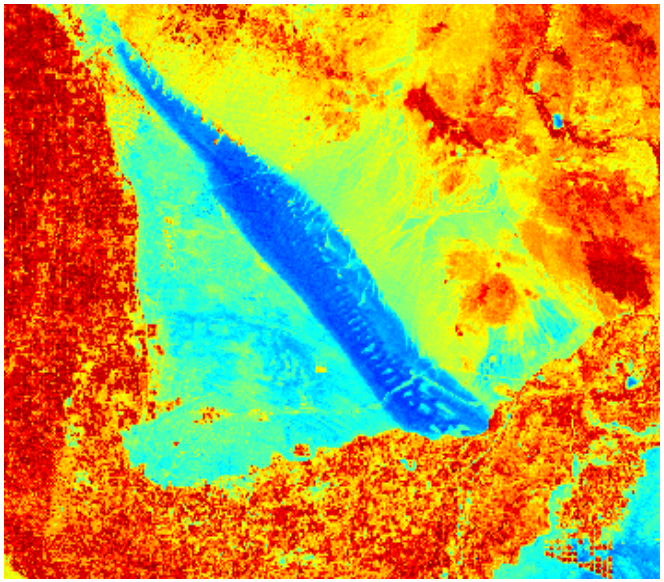
Update on Continental-scale ASTER Emissivity Maps



Glynn Hulley, Simon Hook

Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA

(c) 2011 California Institute of Technology. Government sponsorship acknowledged.

ASTER Science Team Meeting, Tokyo, Japan, 6-9 June 2011

NAALSED v3.0

- North America (22-71º N, 169-55° W) Summertime Product completed: (Jul- Aug) 2000-2010

- Winter (Jan-Mar) Product on hold due to cloud/snow issue after loss of SWIR

- Released for download at: http://emissivity.jpl.nasa.gov

- Products:
  - Emissivity (5 bands)
  - Surface Temperature
  - NDVI
  - Land-water map
  - DEM
  - Lat/Lon
  - Observation count

NAALSED v3.0	
Temporal coverage	2000-2010
Total ASTER Summertime Scenes	64,149
Usable Scenes (Cloud <80%)	39,848
Cloud mask	v3.0 - Improved snow/cloud filter - Elevation dependent brightness temperature thresholding (GTOPO30) - Improved cirrus filter
Atmospheric Profiles	MODIS (MOD07) - 5 km Coincident Obs - MOD07 ozone
Atmospheric Correction	Water Vapor Scaling (Tonooka, 2005) MODTRAN 5.0
TES algorithm	Standard TES (Gillespie, 1998)

http://emissivity.jpl.nasa.gov

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North American Land Surface Emissivity Project

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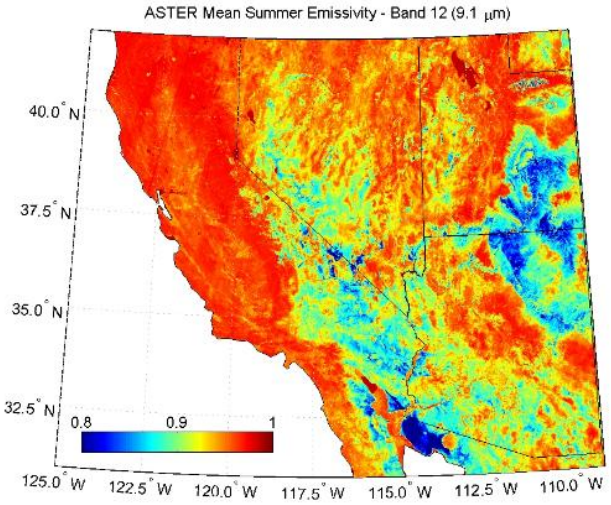
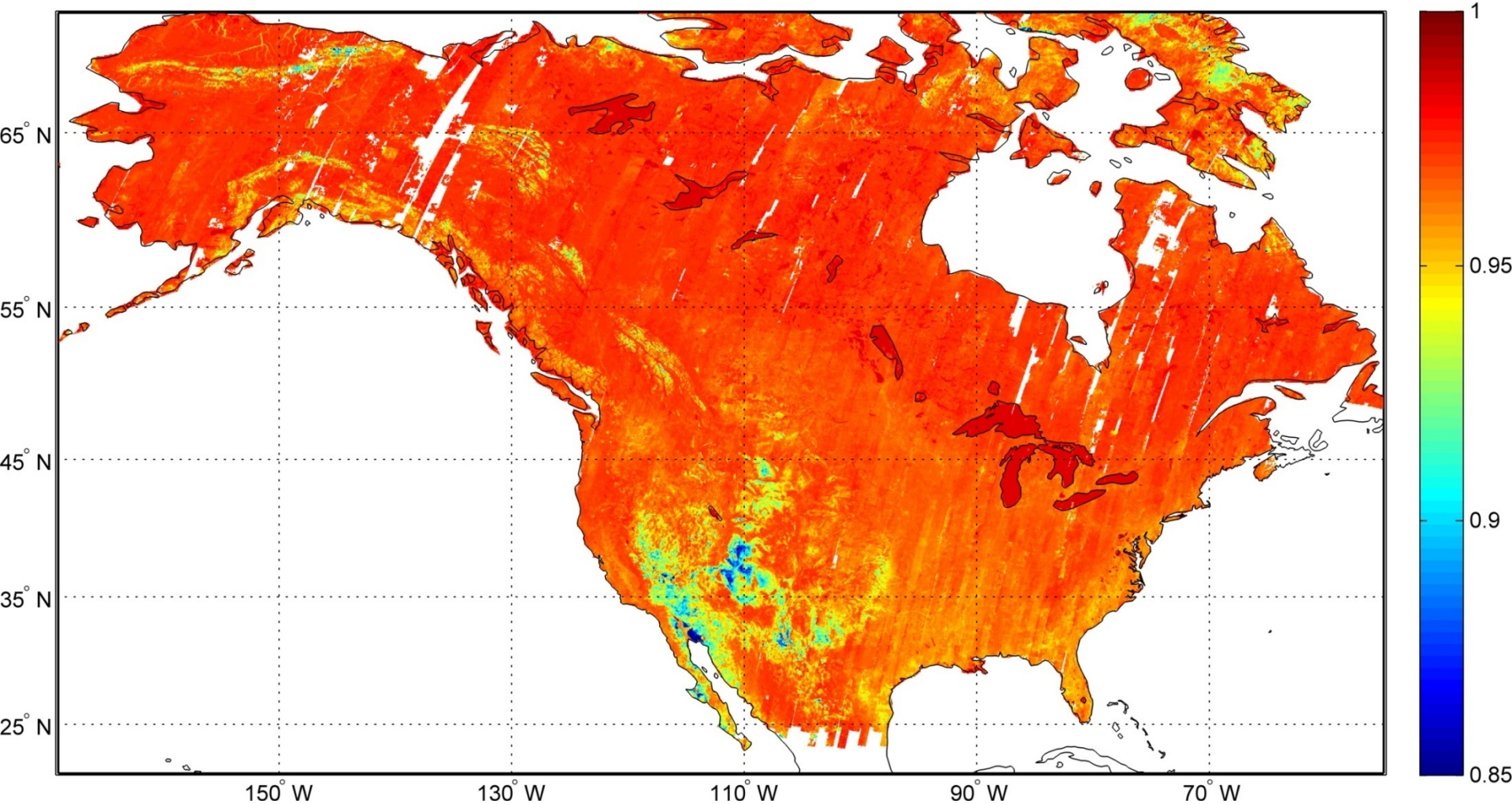
North American Land Surface Emissivity Project

Welcome to the website for the North American Land Surface Emissivity Project. The goal of the project is to create a seamless database of emissivity from standard ASTER emissivity products for use in climate research. The Earth emits energy at wavelengths we cannot normally see, that energy is a function of the temperature and the emissivity of the surface. The surface emissivity primarily depends on the composition of the surface. Thus as the surface composition changes through, for example, land cover land use change, so does the surface emissivity. The land surface emissivity is measured by several instruments mounted on satellites and aircraft. Some of the most well known satellite sensors are AIRS, ASTER and MODIS.

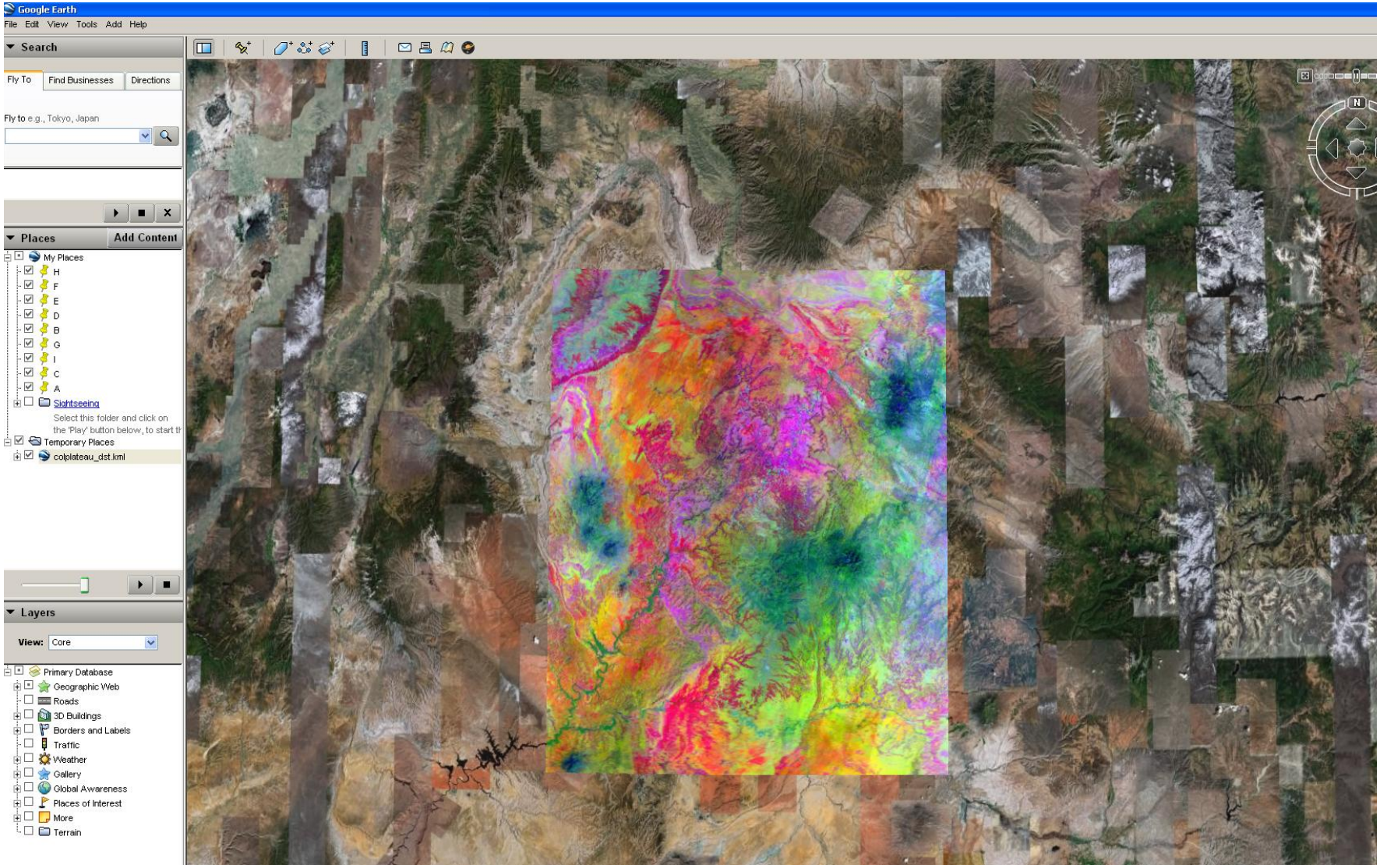
Of these three satellite sensors, ASTER provides the most detailed emissivtiy images with a pixel spatial resolution of 90m. The image below was created by merging together all the ASTER emissivity data ever acquired over California, Nevada, Arizona and Utah under clear skies from 2000-2008 for the months July, August and September.



NAALSED v3.0 Emissivity (Jul-Aug-Sep 2000-2010), Band 12 (9.1 μm)



NAALSED overlays in Google Earth - Colorado Plateau
Useful for geological mapping, resource exploration
Each color represents different rock types (eg. Red = quartz)



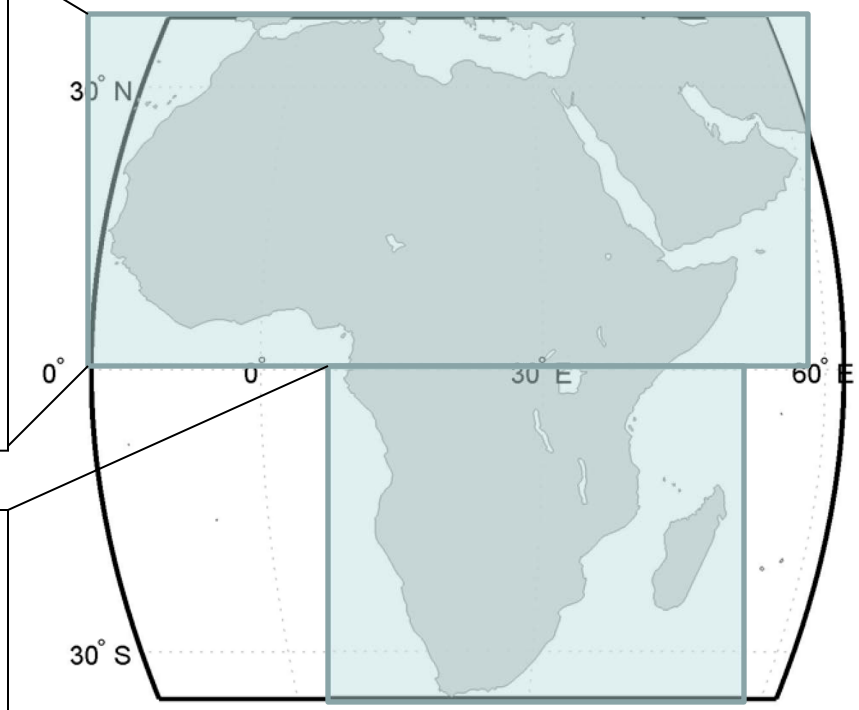
African ASTER Land Surface Emissivity Database (Afr-ALSED)

North Africa/Arabian Peninsula
- 134,662 ASTER scenes
- 49,977 MOD07 scenes

Progress:
- ✓ All scenes delivered to JPL
- ✓ Cloud masking completed
- ✓ TES currently running…

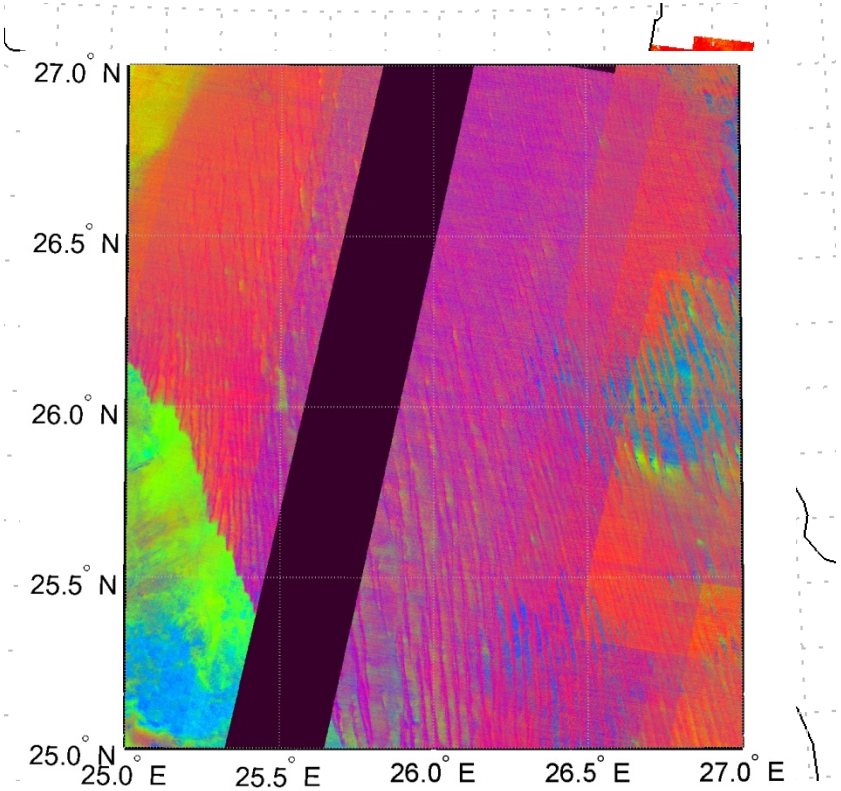
Southern Africa
- ~70,000 ASTER scenes
- ? MOD07 scenes

Progress:
- ✓ Data about to be delivered from EROS



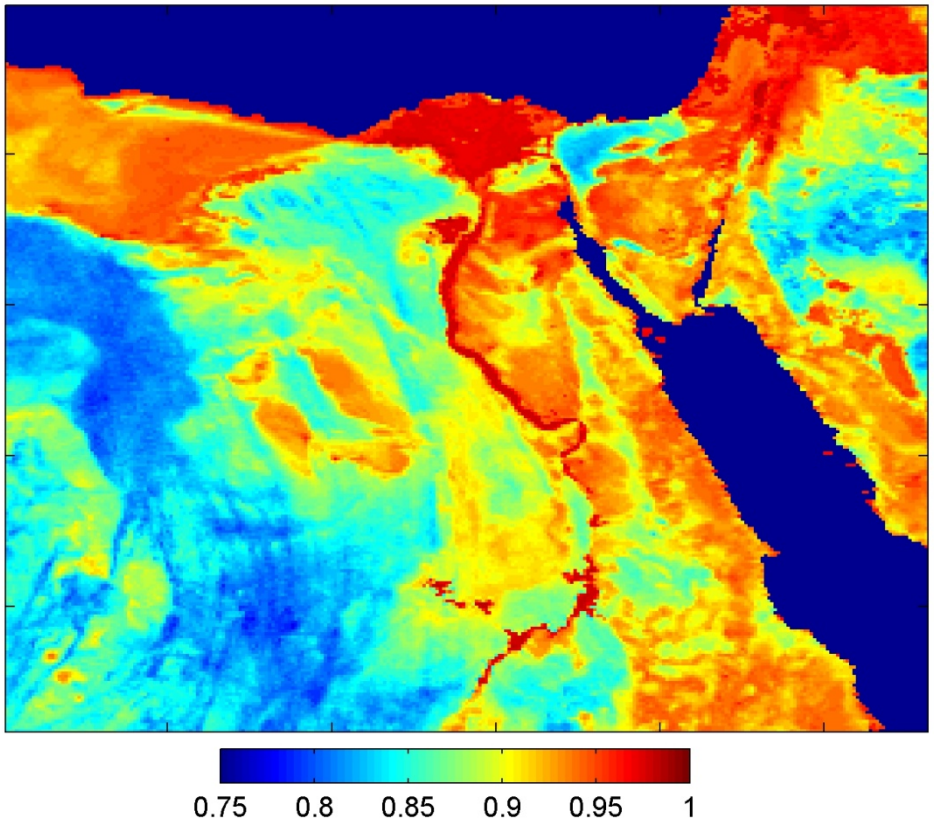
Egypt Test Area

ASTER Band 11 (8.6 μm), 2000-2009 (4,888 scenes)



Ghard Abu Muharik dune field
Decorrelation stretch

MODIS Band 29 (8.55 μm), MOD11C3, 5km



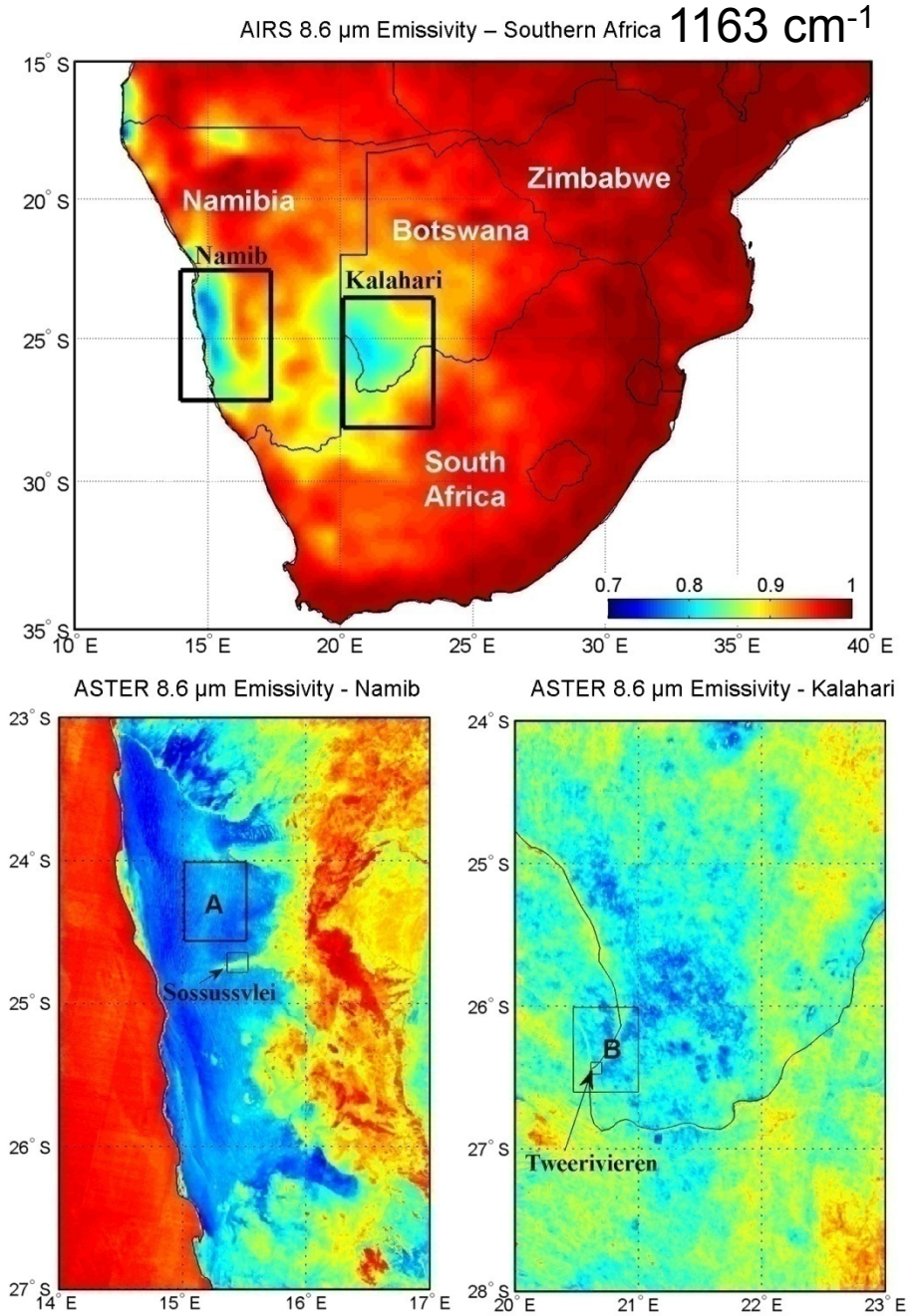
AIRS v5 Land Surface Emissivity Validation

Validation Targets:

- Namib Desert (desert)
- Kalahari Desert (semi-arid)

AIRS emissivity validation requires large, homogeneous sites with known composition.

AIRS Emissivity was accurate to within **2.5%** at the two sites, using lab measurements of sand collected at both sites, combined with ASTER data (90 m).

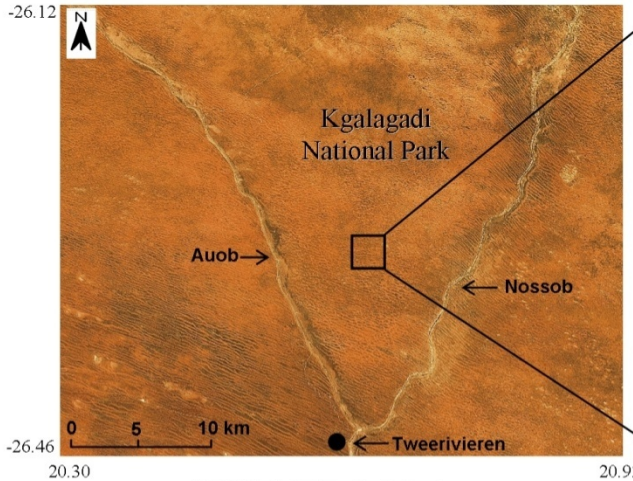


Hulley, G.C., S.J. Hook, E. Manning, S. Lee, E. Fetzer, 2009, Validation of the Atmospheric Infrared Sounder (AIRS) Version 5 Land Surface Emissivity Product over the Namib and Kalahari Desert, *Journal of Geophysical Research Atmospheres*, VOL. 114, D19104, doi:10.1029/2009JD012351

Kalahari Desert

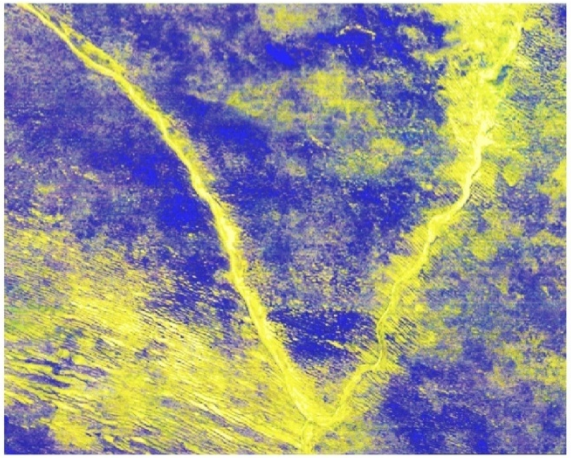
- 20 sand samples collected at Kgalagadi National Park (17-21 November 2008)
- Sampling areas included dune crests, troughs, dry riverbeds

ASTER false-color visible image

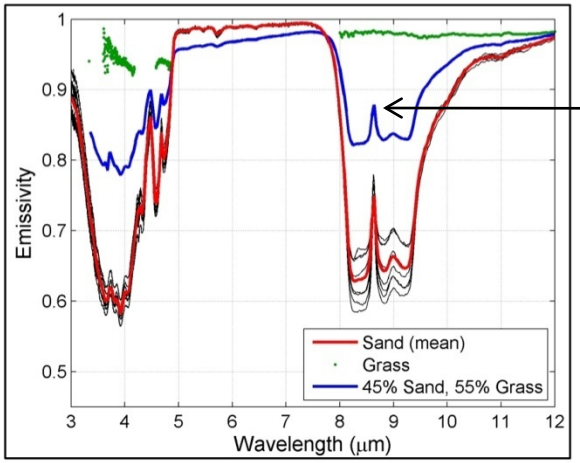


Major: Quartz
Minor: Hematite

ASTER RGB Emissivity image



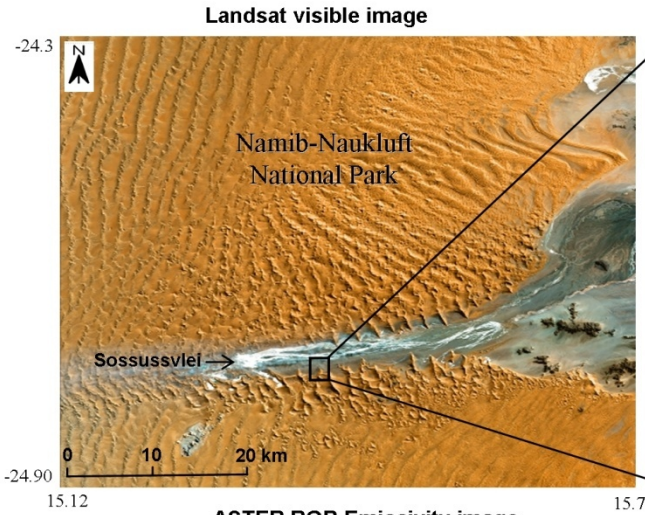
Laboratory Emissivity Spectra



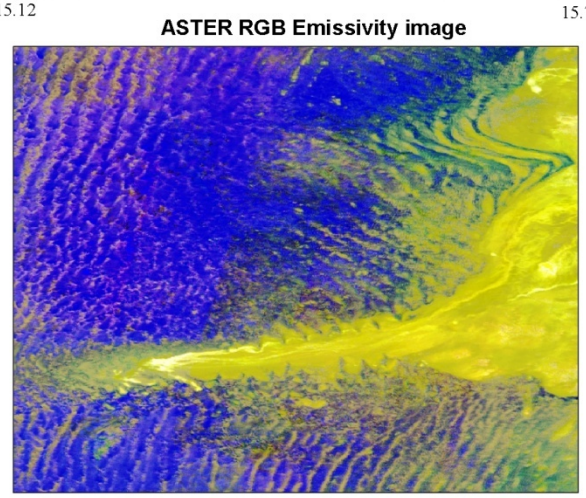
SAFARI 2000
Kalahari transects
- 55% Vegetation
- 45% Sand

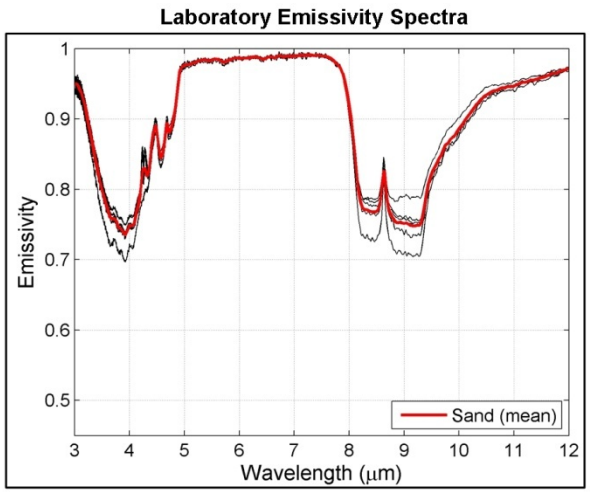
Namib Desert

- Sand samples collected at Sossussvlei in Namib-Naukluft park
- 10 samples from a dune crest and interdune area



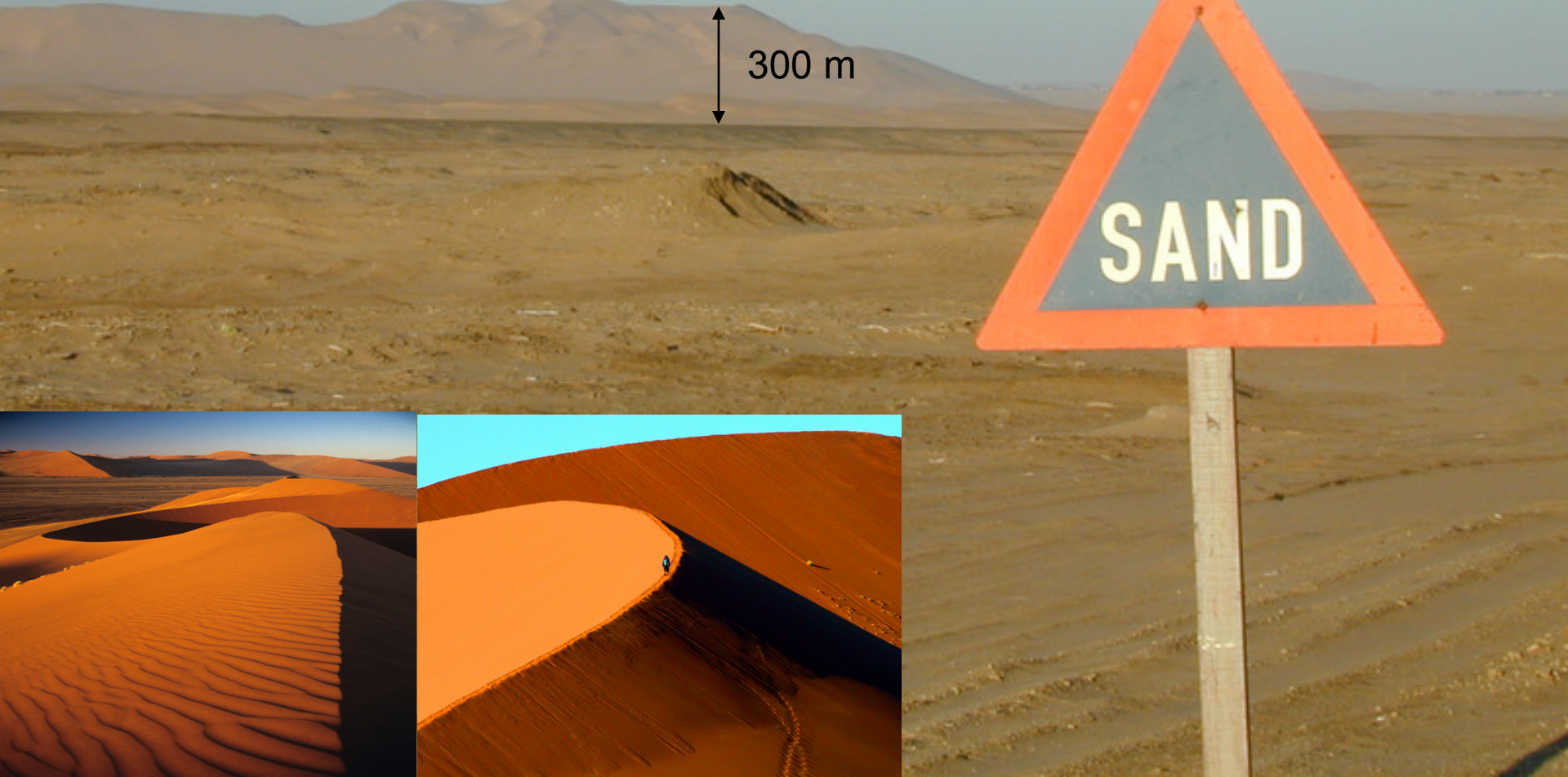
Major: Quartz
Minor: Feldspar, Magnetite

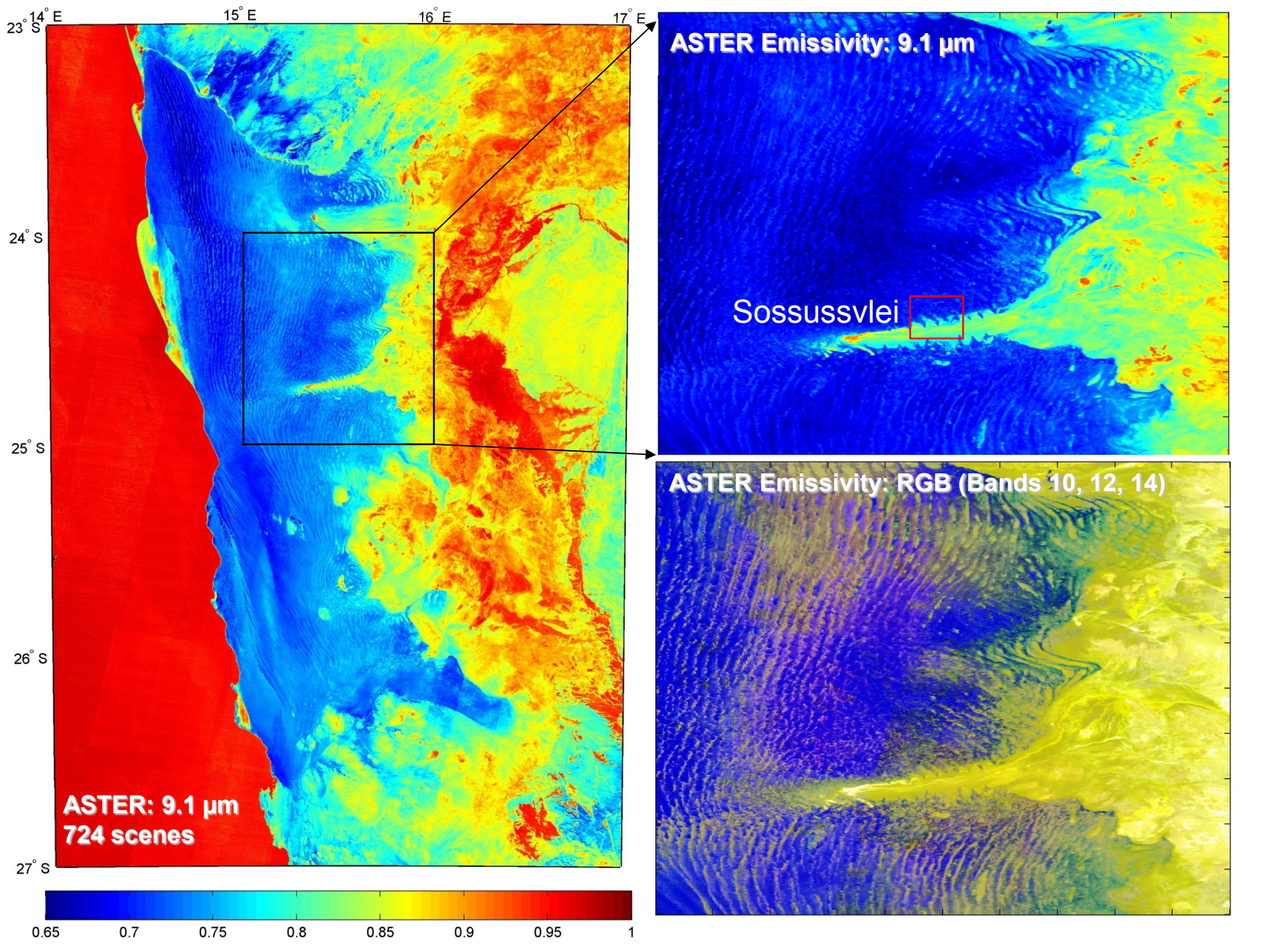




Namib Dunes, Namibia

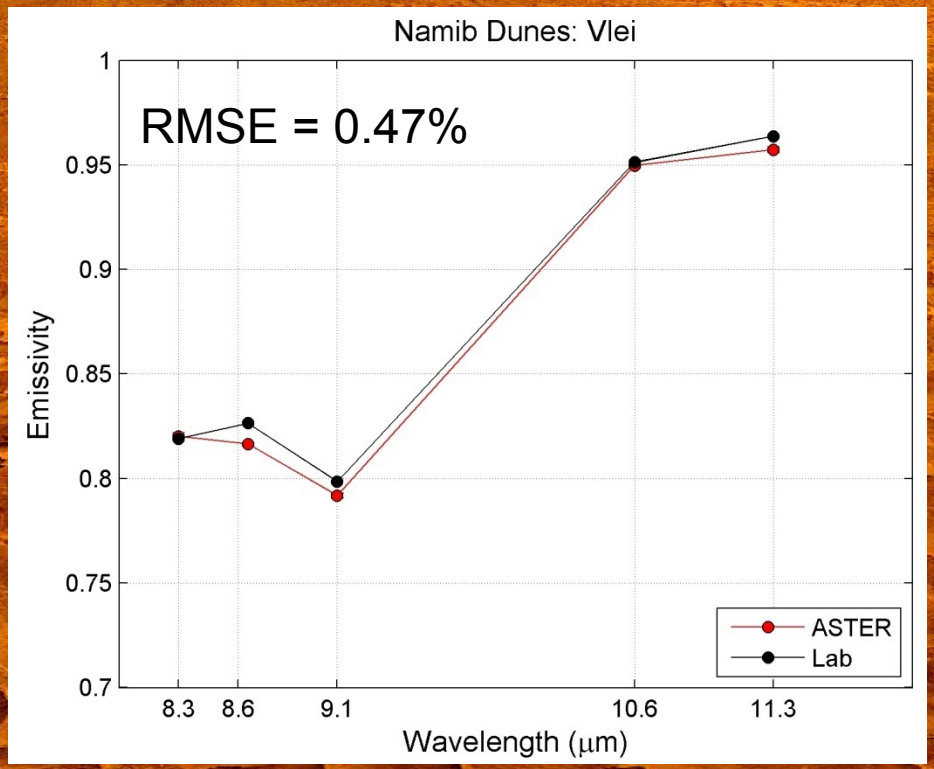
- Oldest (55 million years) and tallest (~300 m) dunes in the world
- Aridity caused by cool Hadley cell and cold Benguela current
- 10-85 mm annual rainfall and almost completely barren
- Occupies 80,900 km² (~1000 x 100 miles)
- Primarily quartz, with hematite (iron mineral)

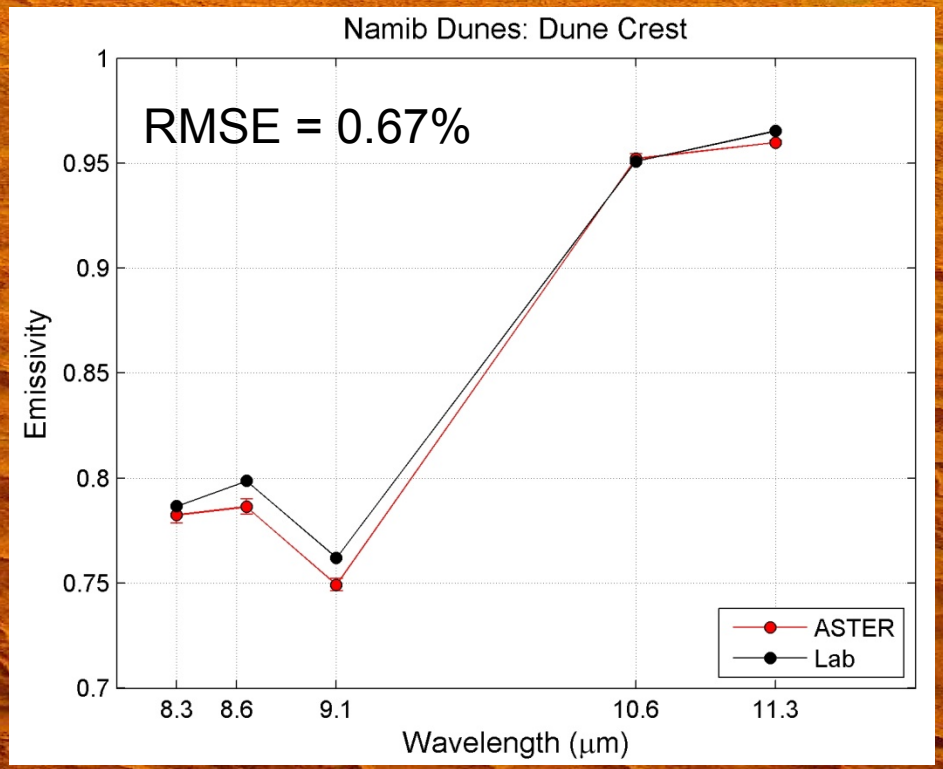


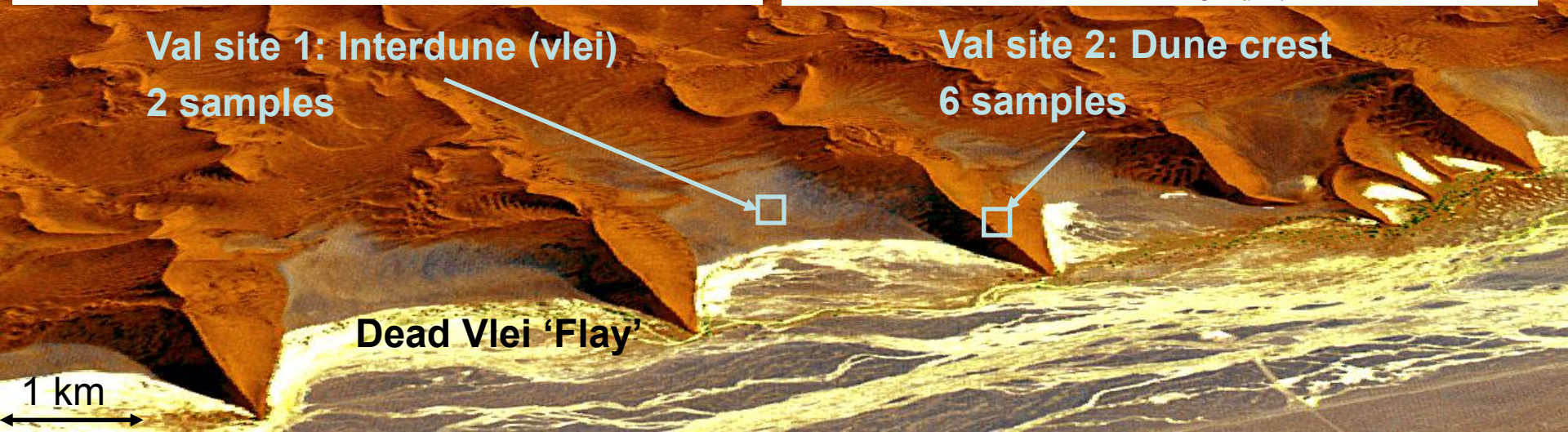

14° E
15° E
16° E
17° E
23° S
24° S
25° S
26° S
27° S
ASTER: 9.1 µm
724 scenes
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
ASTER Emissivity: 9.1 µm
Sossussvlei
ASTER Emissivity: RGB (Bands 10, 12, 14)

Sossussvlei – Namib Naukluft Park

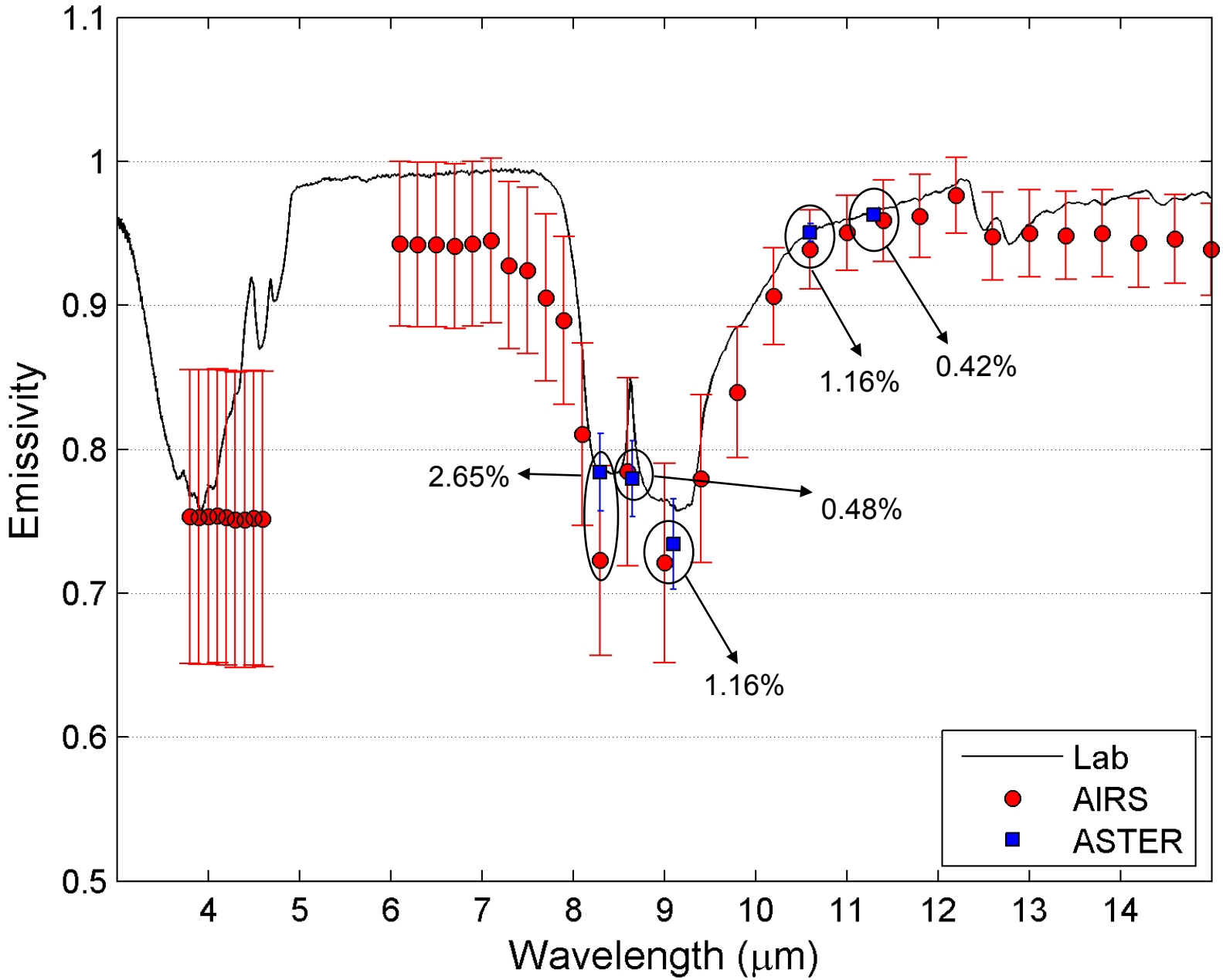
*Credit: ASTER Science Team







ASTER pixels upsampled to AIRS resolution (50 km) at Sossussvlei



Future Work

- Complete Wintertime NAALSED using MODIS cloud mask
- Submit NAALSED Summer STAR to fill gaps (Jul-Sep 2011)
- Complete Africa/Arabian Peninsula by September 2011
- Complete Australia by end of year 2011
- Potential Applications for African ASTER Emissivity Database:
  - Validation of coarser resolution emissivity products (MODIS, AIRS)
  - Generate a more accurate emissivity classification map over barren surfaces for MSG-SEVIRI
  - Sand transport and sand dune mobility studies
  - A Land Surface Temperature product for Landsat

The End

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