Parent material mapping with ASTER

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Introduction

It is critical to understand the processes that form desert surfaces to develop a model for predicting desert terrain conditions. Remote sensing is an important tool for both understanding these processes as well as provide inputs for predictive geomorphic surface evolution models. These inputs, which describe surface composition / condition, include maps of: 1) rock/soil types, 2) vegetation cover and, 3) surface roughness. These surface characteristics are also important factors in determining trafficability and dust generation from military operations. For this project, we have used both ASTER and MASTER image data. The results from ASTER data are the focus for this presentation.

Bands and spatial resolution of ASTER. ASTER is a 14 band spaceborne imaging system on the Terra satellite. Two measurements are made for band 3; one at nadir and one at 30° off nadir.

Band	Wavelength	Spatial Resolution
1	0.556	15m
2	0.661	15m
3	0.807	15m
4	1.656	30m
5	2.167	30m
6	2.209	30m
7	2.262	30m
8	2.336	30m
9	2.400	30m
10	8.291	90m
11	8.634	90m
12	9.075	90m
13	10.650	90m
14	11.318	90m

Methods

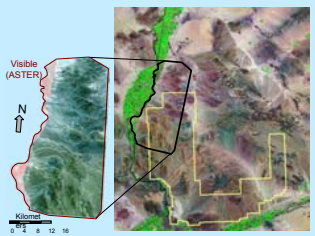
Rock/Soil/Vegetation Mapping: Rock, soil, and vegetation composition can be mapped using passive multispectral visible/near-infrared (VIS/NIR) scanners. Additionally, the thermal infrared (TIR) can be used to map differences in silica and carbonate content in rocks and soils. A variety of methodologies were used to map out different units, including: spectral angle mapping, spectral mixture analysis, and supervised classification techniques. The different units were mapped as layers of the final produced map.

Surface Roughness: Multiple-looks at a scene by an imaging system can be used to map surface roughness. The apparent shadows in a scene will increase on "rougher" surfaces, as opposed to "smoother" surfaces. We have used the two looks of ASTER (nadir and 30°) to map estimates of surface roughness on desert fans.

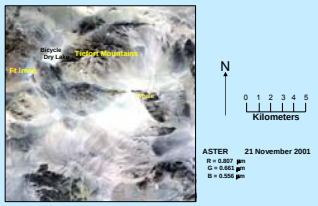
The initial work was done in the Cibola Range of the Yuma Proving grounds. Field work was performed here in May to collect samples for spectral mapping and then again in September of 2005 to evaluate preliminary mapping results. A "blind test" (no field work or ground truthing) was later made for the National Training Center to test our ability to map unvisited (by us) sites.

Test Sites

Yuma Proving Grounds, AZ



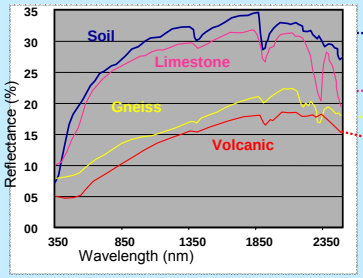
National Training Center, CA

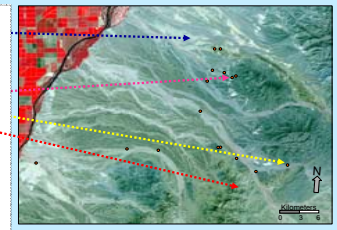


YUMA PROVING GROUNDS

Field Work

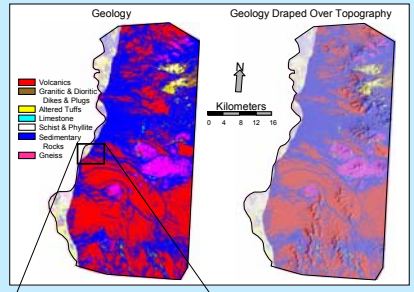
Field work was performed in May of 2005 to collect field samples and find suitable calibration sites. GPS locations were recorded for each collected field sample (46 samples/sites). Spectra of the samples were measured in the laboratory using an ASD spectrometer. These spectra and their locations were used to help train the image analysis. Typical field samples and their spectra are shown below.



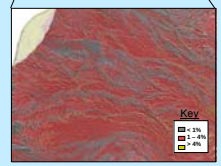


Mapping Results

Geology



Vegetation

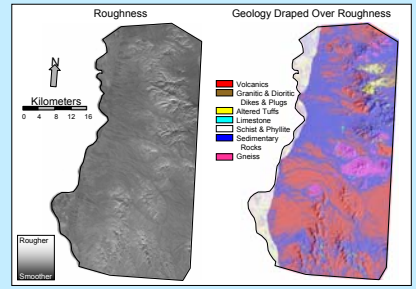


Roughness

Mainly applicable to fans

Not applicable to surface roughness greater than pixel size (15 m)

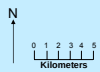
Presently gives relative roughness



NATIONAL TRAINING CENTER (Blind Test)

We produced a geologic map of a portion of the National Training Center (Ft. Erwin), CA in a "blind" test using the ASTER reflectance product (AST07). This map was produced without the aid of field observations / measurements. The units are our "best estimate" of the rock types present. Field observations would greatly improve the unit identifications / boundaries in this map and will be done later this summer.

The ASTER scene was collected on 21 November 2001.



Granitics
- Lighter Granitic
- Darker Granitic
- Other Granitic

- Basalt
- Carbonate
- Volcanics I
- Volcanics II
- Sediments A
- Sediments B
- Dust
- Sed/Meta Rocks

Next Steps

1) Field work to evaluate the "blind test" results at NTC and to determine how we can improve our mapping.

2) Expand the mapping to the entire Yuma Proving Grounds using ASTER data. This will be performed along with mapping the area using MASTER (higher spatial/spectral resolution data for much of the same area (see accompanying poster "Parent Material Mapping Using MASTER").

3) Incorporate soil moisture results for desert playa areas. (See accompanying poster "Remote Sensing for Mapping Near-Surface Playa Moisture").

4) As the parent material maps are completed, they will be converted to GIS friendly versions to be used as a parameter input for the Desert Terrain Model. As they are used in the model, we may find that improvements to the mapping are needed.

Sponsors

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