Parent material mapping with MASTER

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Introduction

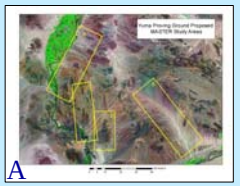
MASTER data was collected over much of the Yuma Proving Grounds to evaluate how high spectral / spatial resolution image data can improve parent material mapping over ASTER. Until now, ASTEr has been the primary remote sensing imaging system used for the Desert Terrain Project. MASTER (MODIS /ASTER airborne simulator) is flown on a DOE KingAir Beachcraft B200 and measures 50 spectral bands in the visible thru the thermal (see table below).

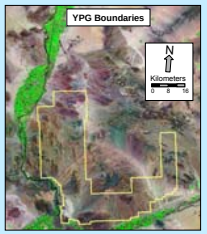
MASTER data was collected over much of the Yuma Proving Grounds (YPG) on the 28th and 29th of September 2005. The data was collected from an altitude of ~2350 meters above mean sea level, yielding ~5 meter pixel resolution. During the overflight, field work was performed to establish calibration sites, document surface cover in key areas for later validation, and collect field spectra. In all, 29 MASTER scenes were collected covering areas of: 1) the Cibola Range, 2) Middle Mountains and west, and 3) King Valley. The Cibola Range was initially of interest as we had earlier produced a parent materials map of this area using ASTER data. (See other poster "Parent Material Mapping Using ASTER".) The focus of this poster is on the preliminary results from five MASTER data strips of this area. The data for the Middle Mountains will be used in future research. Data for the third area, King Valley, will be used to for studying dust distribution and generation.

Comparison: ASTER vs MASTER

	visible/nir bands	swir bands	midwave bands	thermal bands	IFOV (meters)
ASTER	3	6	0	5	15-30-90
MASTER	11	14	15	10	5 to 50

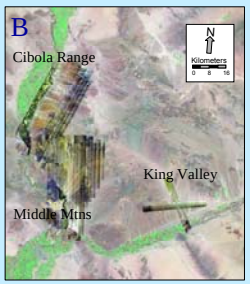
Yuma Proving Grounds (YPG)





YPG Boundaries

Above (A) is the layout of the areas initially requested for the MASTER data collect. The actual data that was collected is shown to the right (B). MASTER 29 flight strips collected on 28-29 September 2005. There is a 25 to 50% overlap of many of the flight strips. Only two data strips were collected over the King Valley area due to test firing on the range. One strip was oriented up the valley floor while the other was made roughly perpendicular to it to catch lithologic variability up the valley walls.



Field Work / MASTER Data Collect

Field work was performed during the overflight in September of 2005 to collect field samples, establish a photographic record of the field conditions during overflight, collect field spectra, and find suitable calibration sites. GPS locations were recorded for all field sample, spectra, and photographic sites. Spectra of the samples were measured in the laboratory using an ASD spectrometer.

MASTER

MASTER Aircraft (KingAir Beachcraft B200)

The MASTER instrument onboard the aircraft

Fire

The summer of 2005 was a unique year at YPG. High rainfall earlier in the year led to unusuallly high grass cover over the lower elevations in the range. Subsequent high summer temperatures dried the grass and making the fire hazard high. During the overflight, a fire was recorded in the NW-SE MASTER strip of King Valley. Field spectra were recorded in both burned and unburned areas. Although this data has yet to be exploited, it does provide a unique opportunity for evaluating fire hazards in desert environments.

Fire burning during overflight.

Burned area in King Valley.

Calibration

The data was calibrated using an Empirical Line approach. Field spectra of three target areas (water, green vegetation, and soil) were measured in the field using an ASD spectrometer and used in conjunction with the DN values from the MASTER data to create gains/offsets to calibrate the MASTER data to reflectance. The calibration coefficients were calculated for the NW-SE flight strip over King Valley as this is where the calibration sites were located. These coefficients were then applied to the other image data. Although the MASTER data was collected over two days, the calibration coefficients appear to work well for all the image data sets in areas where the elevation is equivalent to the calibration sites.

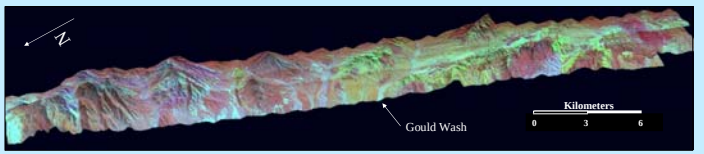
Calibration Sites

A) Soil calibration site: Tower M
ASD spectra taken from the top of Tower M over relatively homogenous soil.

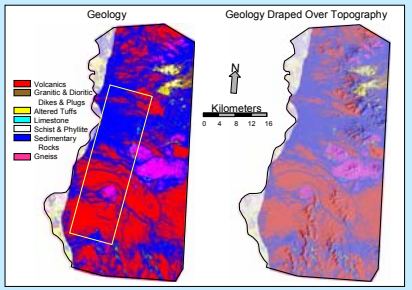
B) Water calibration site: pond

C) Vegetation calibration site: crops

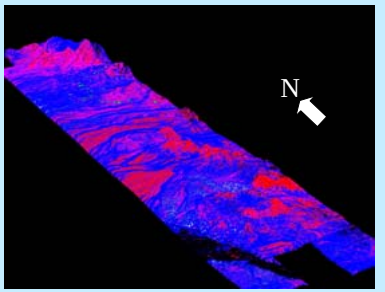
Preliminary Mapping Results



MASTER composite image (3 strips) overlaid on 10 m DEM of the Cibola Range – enlarged Gould Wash area



ASTER Parent Material Map.



MASTER Parent Material Map – using the same classes as used in the ASTER scene. This area is a subset of the scene to the right (outlined in yellow). The MASTER data gave more accurate results in the southern part of this 5 strip composite (excessive volcanics in this area in the ASTER map).

Next Steps

1) Expand the mapping to the Middle Mountains and then to King Valley.

2) MASTER has higher spatial and spectral resolution than ASTER. Therefore, we anticipate that the geological mapping using MASTER has the potential to produce more detained geological maps. In this preliminary work, we applied the mapping approach we used to the ASTER scene to the MASTER image. Future work will focus on refining our methodology for MASTER data.

3) Combine the improved geology results (from 2 above) with roughness image data derived from ASTER data. It is possible that there are a few areas in this MASTER data set where roughness can be derived from the MASTER data alone. This would require: 1) that there is overlap between two subsequent scenes, and 2) that there is sufficient time difference between when the overlapping scenes were collected (several hours). Both of these conditions are met only in a few isolated locations in this data set. Roughness will continue to be primarily derived using ASTER data.

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.

Sponsors
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