Predictive Soil Mapping in Arizona’s Basin and Range Province

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Outline

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  - Soil pre-mapping
  - Atmospheric correction methods
- Objectives
- Methods
- Results
  - Atmospheric effects
  - Pre-maps
- Conclusions
Introduction

- The National Cooperative Soil Survey is near completion of initial mapping in the contiguous U.S.
- Areas of the West are still without soil information
- Updates planned for older surveys
Soil pre-mapping

- Requires time, energy, money, and experience
- Surface reflectance (e.g., Landsat) is often used for developing pre-maps
  → subject to atmospheric interactions!
- Several methods of correcting for scattering and absorption effects
Assumptions

- **Dark object subtraction (COST)**
  - True dark object
  - Multiple dark objects needed

- **Radiative transfer code approach (6S)**
  - Must know input parameters (AOD)
  - More complex

- **First goal should be to do no harm!**
Objective

- Objectives are to compare two methods of atmospheric correction for a Landsat 7 ETM+ image taken in a semi-arid ecosystem (~160,000 ha, Graham County, AZ).
Methods

- **LS scene from 12 Sept. 2000**
  - Radiometric corrections according to LS 7 Handbook (apparent reflectance)

- **Correction methods**
  - Dark object subtraction method (Chavez, 1996) (COST – Cosine of solar zenith angle)
  - Radiative transfer code approach (6S – Second Simulation of a Satellite Signal in the Solar System)
  - Rayleigh scattering – scattering of light by particles smaller than wavelength
  - Mid-Latitude / Desert atmosphere/aerosol (AERONET – Tucson)
Study Area
Landsat 7 ETM+ Data

http://ls7pm3.gsfc.nasa.gov/mainpage.html
Results - Landsat

Band 3

Band 7
• 36 points
  - Water
  - Vegetation
  - Geology
  - Soil
Results

Band 1

Band 2

Band 3

Band 4
Results

Band 5

Band 7

Surface Reflectance

Apparent Reflectance

- cost
- mid desert
- rayleigh
- Linear (1:1)
Results – Soil Pre-map

1:63,000 Scale

1:24,000 Scale
Summary

- More variation in COST model
- As wavelength increases, COST model overestimates reflectance
- Rayleigh scattering had best relationship with apparent reflectance
- Lack of ground data for the date of scene inhibits correction methods
- No true dark objects
Conclusions

- Application of the surface reflectance will determine the complexity and necessary assumptions of the atmospheric correction needed.

- Available data (atmosphere / aerosol) will also direct correction method.

- For soil survey purposes, a Rayleigh correction is suggested when atmospheric conditions cannot be quantified.
Future Mapping Focus

1:63,000 Scale

1:24,000 Scale
References


- http://modis-sr.ltdri.org/code.html

- http://aeronet.gsfc.nasa.gov/cgi-bin/type_one_station_opera_v2_new?site=Tucson&nachal=2&level=1&place_code=10
Thank You!
## Results

<table>
<thead>
<tr>
<th>Band</th>
<th>Apparent Reflectance</th>
<th>COST</th>
<th>Rayleigh</th>
<th>Mid-lat Desert</th>
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</table>
Results

Band 1

Reflectance vs. Apparent, COST, Desert, Rayleigh

Band 2

Reflectance vs. Apparent, COST, Desert, Rayleigh