LEDAPS Update

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Outline

• Bug Fix to LEDAPS SR Code

• Topographic Illumination Correction

• Angular Effects in Landsat Timeseries
Surface pressure bug fix

• LEDAPS/6S uses both NCEP surface pressure (2.5deg) and DEM (1km) to calculate Rayleigh scattering

• September 2010 – team discovered that DEM was not being referenced correctly – no topographic adjustment

• Problem fixed (mostly)... next slides indicate magnitude of effect
P15r34 (VA)
Diff _red
(without dem – with dem)
(-0.20% to +0.20%)
All in absolute SR value
P15r34 (VA)
Diff _NIR
(without dem – with dem)
(-0.20% to +0.20%)
All in absolute SR value
P34r33
(CO)
6/21/2010

Indsr (432)
with DEM data
SRTM DEM
p34r33
(stretch range: 1000-4000m)
Diff _red
(without dem – with dem)
(-0.20% to +0.20%)
All in absolute SR values.
Diff _NIR
(without dem –
With dem)

(-0.20% to +0.20%)
SRTM DEM
p43r33
(stretch range: 0-3500m)
Diff _red (without dem – with dem) (-0.50% to +0.50%)
Diff _NIR
(without dem – withdem)

(-1.00% to +1.00%)
Mapping Forest Changes in Mountain Area

Path 46, Row 32

SVM Result

1989-09-03

2002-10-01

Deforest
Regrowth
Forest
Non
Forest
Illumination Condition (IL)

\[ IL = \cos Z \cdot \cos S + \sin Z \cdot \sin S \cdot \cos(\phi_z - \phi_s) \]

Z: the solar zenith angle,
\( \Phi_z \): the solar azimuth angle,
S: the slope angle,
\( \Phi_s \): is the aspect angle of the incline surface.

Special Case:

Flat area: \( IL = \cos Z \)

Slope face to Sun: \( IL = 1 \)
Traditional Illumination Correction Models

• Cosine model

\[ L_H = L_i \left( \frac{\cos Z}{IL} \right) \]

• C model

\[ L_H(\lambda) = L_i(\lambda) \frac{\cos Z + c}{IL + c} \]

Where \( c = a/b \), \( a \) and \( b \) is from regression \( L_i(\lambda) = a \cdot IL + b \)

Rotation Model

Rotation Model: \[ L_H(\lambda) = L_i(\lambda) - (a \times IL + b) \]

Where \( a \) and \( b \) is from regression \( L_i(\lambda) = a \times IL + b \)
IL vs. TOC Reflectance

\[ Y = 0.04 \times X - 0.0359 \]
\[ R^2 = 0.08 \]

\[ Y = 0.4325 \times X - 0.0227 \]
\[ R^2 = 0.418 \]

Note: Only non-shadow forest pixels are used in this study.
IL vs. TOC Reflectance

Note: Only non-shadow forest pixels are used in this study.
Homogeneity After Correction

### Relative Standard Deviation of TOA

<table>
<thead>
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<th>Original</th>
<th>Cosine Model</th>
<th>C Model</th>
<th>Rotation Model</th>
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### Relative Standard Deviation of TOC

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<td>15.9%</td>
<td>7.0%</td>
<td>7.0%</td>
</tr>
</tbody>
</table>

Relative Standard Deviation = Standard Deviation / Mean
Corrected TOC Reflectance

Original Landsat

Cosine Model

C Model

Rotation Model
3. Influence of Angular Effects on Landsat Surface Reflectance Time Series

Issues associated with assembling per-pixel timeseries of Landsat SR:

• Within-scene (view angle) BRDF effect caused by the changes of viewing geometries (~+-7.5 degrees)
• Seasonal (solar angle) effects
• MLT Drift (solar angle) effects

How much variability can we expect from each of these?
Approach

• Use empirical data (ASAS, Parabola) to derive BRDF kernel for land cover types
• Simulate effect of view, solar angle variations associated with each effect
**View Angle Effects** Within Landsat Scene: Up to 2% abs SR variation

Bidirectional Reflectance for Landsat View Angles (+-7.5) at Principal Plane using in-situ measurement
Seasonal Solar Angle Effect: Up to ~8% abs SR variation (but more like <3% when within single season)

Reflectance varying from different acquisition dates (fixed BRDF parameters were used across whole year)
Effects by Orbit Drift (L5 example)

Up to 1% abs SR

Landsat 5
WRS-2 row 29 (44.6 degree North) (1984 to current)