Crop production monitoring and Landsat

An update for the Landsat Science Team, EROS meeting, 10/30/2013

Maryland Soybean Field 10/3/2013

Furlough Day # 3

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Geographer

United States Department of Agriculture
National Agricultural Statistics Service
Why is agriculture important to the land cover community?
Collapsed harvested area of major US crops for 2013

- **Corn**
  - Montana

- **Wheat**
  - South Dakota

- **Soybeans**
  - Arizona
**CDL generalities**

- Annual land cover classification targeted to identifying *circa* summer cultivated crops
- Encompasses all of conterminous USA (since 2008, some state prior)
- 56m or 30m resolution
  - Depending on year but now all 30m
- Built with a supervised boosted classification tree methodology
  - Implemented with See 5.0
- Utilizes ground/training data from USDA Farm Service data and ancillary data from National Land Cover Database
- Highly robust for dominant crop types
  - corn, soybeans, wheat, rice, cotton, etc.
- Used internally by NASS to estimate planted acreage amounts
- Derived primarily from
  - Resourcesat-1 AWiFS
  - Landsat-5 TM
  - DMC Deimos-1 and UK-2
  - Landsat-8 OLI and TIRS
DMC Deimos-1/UK-2 Satellite Imagery

**Default**
- 3 Bands – Green, Red, NIR
- Resolution – 22 meters
- CONUS coverage every 15 days

**2011 - 2013**
- Bands for monitoring vegetation
- Upscaled to 30 meters

Windowing:
- Multiple acquisitions per orbit

Full Swath:
- maximum image size : 600 x 600 Km

Along track:
- maximum 16 tiles (1280 Km)
Deimos-1/UK2 Collections

June 27 – July 2, 2011
DMC “hit” map example

DE1 + UK2: April through September, 2011
(1 - 32 bands)
Landsat 8 Collections – late June

L8, 2013, Cycle 6, Jun 18 - Jul 08
Landsat 8 Collections – mid September

Close to 5000 Landsat 8 scenes downloaded so far –

a lot of data for a non supercomputing group
Landsat “hit” map example

Landsat 5: April through September, 2011
(1 - 23 bands)
Landsat 8 usage in the 2013 CDL, mid-season
The above results are as of 10/29/2013 for 25 states:

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<th>Month</th>
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In season CDL 2013 processing runs by state

# of CDLs scheduled

Crop area “acreage” estimates derived for each

### Crops Estimated
- Corn
- Soybeans
- Barley
- Alfalfa
- Rice
- Canola
- Peanuts
- Sugarbeets
- Tobacco
- Dry Beans
- Spring Wheat
- Winter Wheat
- Sorghum
- Potatoes
- Durum Wheat

Crop area “acreage” estimates derived for each

MODIS phenology using CDL as land cover masks

This type of information is directly related to crop yields
Had hoped to provide for this meeting

• An assessment of the usefulness of the individual OLI and TIRS bands on cropland cover classification
  – By summarizing the band usage metadata from all of the classifications
  – And by simplifying the classifications to certain bands to understand the utility of each

• Instead will discuss what might be useful for a future missions and how we can test now
  – Other spectral bands that might be useful for vegetation mapping
  – Implications of a wider swath on land cover classification
Southwest KS

Worldview 2 (NIR, RE, Red)  RapidEye (NIR, RE, Red)

Known field types  DMC (color-infrared)
Northeastern ND

Worldview 2 (NIR, RE, Red)  RapidEye (NIR, RE, Red)

Known field types  DMC (color-infrared)
Path geometry over US

Don’t need to massively widen field of view to give us 8-day data (~60%)

~115 km overlap gap in southern US
AWiFS viewing geometry

- **Soybeans**: With sun, Into sun
- **Woodland**: With sun, Into sun

- **Landsat**: Viewpoint at 24.3° from the sun
- **P6-AWiFS**: Viewpoint at 7.5° from the sun

- **Distances**:
  - 817 km from Soybeans to P6-AWiFS
  - 705 km from Landsat to P6-AWiFS
  - 185 km from P6-AWiFS to Woodland
  - 737 km from P6-AWiFS to Earth
Example four quad, same date/path AWiFS collect

Orbital path (274)
Angle from nadir calculation

Measured swath Width: ~745 km

\[ \Theta = \arctan\left(\frac{\text{opp.}}{\text{adj.}}\right) \]

Orbital path

\( \Theta \) = arctan(opp./adj.)

\( \frac{1}{2} \) swath width

\( +25^\circ \)

\( -25^\circ \)
Inspection of across swath reflectance

Band 2 - Red
Band 3 - Near Infrared
Band 4 - Shortwave Infrared
Across track reflectance

Band 2
Red

Band 3
NIR

Band 4
SWIR

West
Nadir
East
Classification across track study area

31 July 2006
Full swath classification output

Overall Accuracy = 82.5%

Kappa = 0.758
Overall accuracy as a function of viewing angle
Crop accuracy as a function of viewing angle
Should we push for some off-nadir Landsat 8 collects?

• It is a direct way to assess what a wider swath Landsat will look like
  – I would argue yes.

• Will simply waiting for some serendipitous examples due to an disaster/emergency fill the need?
  – Maybe, but I’m not overly confident it will happen.
  – And even if it does it may not be over a relevant area or with decent atmospheric conditions.
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South Dakota Corn Field  10/29/2013