Lessons Learned:
Integrating Field-Level Biophysical Metrics
Derived from Landsat Science Products into a
National Agricultural Data Warehouse

Jim Hipple, PhD
Physical Scientist / Remote Sensing Specialist

Business Analytics Division
Office of Compliance
Risk Management Agency
Proposed Applications Approach

**Inputs**
- Earth Science Models/Derived Satellite Parameters
  - Land
  - Atmosphere
  - Vegetation

**Data**
- Earth Observations
  - Satellite and
  - *in situ*

**Observations Of Conditions**

**Identification of Crop Condition (temporal profile)**

**Decision Support Tools**
- Vegetative Health: Crops Damage, Yield Prediction, Weather

**Outputs**

**Outcomes**

**Impacts**
- Improved Federal Crop Insurance Program Integrity with National Impact

**Financial Benefits**
- $ Cost Savings
- Improved = USDA Program Integrity
- Reduced Error Rate
- Routine Use for Crop Insurance Adjustment
- Regional/National Assessments
- Individual Crop Policy Assessment
- Pay Claim

**Usda Program Integrity**

**National**
LST Proposal: Landsat Integration

• Technology
  – preprocessing: surface reflectance (LEDAPS-like) for L5, L7 & L8
    • new data on demand
    • batch historic data
  – output 30-120 meter data consisting of:
    • Surface Reflectance bands Landsat bands (30m)
    • Masks layers (cloud, sensor, etc.)
    • Indices
      – (NDVI, LSWI, NDWI, etc)
  – generating a single DOY grid for US contiguous

• Application
  – Enhance data mining applications and products, including Spot check List (SCL) for enhancing program integrity of Federal Crop Insurance
Where we were last year ... and this year.

**CY2016 Efforts**

- Re-scope ‘mapping’ system
  - How do we deliver results to users in a meaningful manner?
  - Combining USDA FSA (farm program) data and USDA RMA (crop insurance) at the field level (the WHERE)
    - CLU (common land unit) => FSA
      » crop, practice, plant date, acreage
    - UNIT (crop unit - basic, optional, enterprise) => RMA
      » Coverage and losses are determined at a unit level
      » crop, loss date, cause of loss, reported yield, etc.

**CY2016 Efforts, continued ..**

- Technology ‘refresh’
  - Updated hardware/software
- User training

**Programmatic data challenges:**

“location data was not necessarily collected by Agency in a format that was conducive to identifying location”

- Not a lot of ‘sexy’ remote sensing going on => a lot of work on background
  - Mapping core re-engineered
  - Geospatial Enterprise Architecture (completed by RMA CIO)
  - Data integration
Operational Agency Issues

• Keeping up a image processing ‘framework’ for ingestion into Crop Insurance Compliance Data Warehouse is challenging
  – Processing implementation challenges taken away from programmatic analysis responsibilities
  – Evolution of Landsat products (Tier 1, …)

• Security
  – Systems in Agency running primarily MS based OS
  – Most of RS image processing (LEDAPS, etc.) in Linux OS
  – Active Directory / USDA.net

• IT refresh & Data Center Consolidation

• How about a Reorg (or 2 …)?

Best news in 2017
USGS EROS Analysis Ready Data (ARD)

Analysis Ready Data (ARD)
- Data processed to a level that enables direct use in applications
  - Allows geospatial, multi-spectral, and multi-temporal manipulations for the purposes of data reduction, analysis, and interpretation
  - Consistent radiometric processing scaled to TOA and surface reflectance
  - Consistent geometry including spatial coverage and cartographic projection — e.g., pixels align through time
  - Metadata of sufficient detail on data provenance, geographic extent, scaling coefficients, and data type

Initial ARD production is focused on the TM through OLI record (1982 – present) for the U.S., but to eventually back through MSS (1972) and global scale

Some ARD Details
- Based on Level-1 Collection 1 Tier 1 Albers input
- Level-2 surface reflectance based on:
  - LEDAPS 3.1.1 (Landsat 4-7)
  - LaSRC 1.0 (Landsat 8)
- Tiling based on Roy et. al Web-enabled Landsat Data (WELD) specifications (5000 x 5000 pixels)
- Operational processing for CONUS, Alaska, Hawaii started May 12, 2017
- Completion by late-summer

ARD (USGS Analysis Ready Data)
- Meets or exceeds programmatic requirements
- Substantively similar to our integration
- Will save time & effort
Our 2017/2018 Goals

- better understand routine remote sensing and geospatial data requirements and analytical needs to work more efficiently (across Agency)
- improve efficiencies by filtering data and providing appropriate analytical products to drive faster and more accurate decision-making
- Projects:
  - High Risk Mapping
    - “Incorporate flood gauge data, elevation, and satellite data to develop a mapping layer to help ROs (Regional Offices) determine the risk of flooding for a particular field. Help the ROs that don’t have the high level mapping skills.”
    - Looking for imagery showing extent of ‘peak flooding’ at specific date
    - Catalog of imagery tied to ‘county’ & tied to peak events going back ~20-years
    - Monetary impacts => Decrease rates producer pays; decrease in workload in ROs (capture these impacts); decreased program payments (cost to Government)
  - Planting Date Study
    - Identify impacts of changing final planting date for crop insurance elegibility
    - Identifying factors that go into ‘yield verification’
Improving Rating Areas

Overlay of 1 ft. Contour and Satellite Flood Imagery of October 20, 2009

satellite imagery to identify historic flooding linking it to high resolution contours to better map risk areas.
Improving Rating Areas

This map shows how written agreements in this area will be affected.

- satellite imagery to identify historic flooding extent

Result: less land in AAA and reducing the number of written agreements
Yield Verification

Yield ‘verification’ vs. yield prediction

All yields are producer reported

‘Verification’ is determining whether reported yield by producer is within reason based upon temp/precip, soils, planting date and growth (NDVI)

Cotton tracks with planting date, but the last ten days costs $40 to $45 million per day

Crop is established before summer gets hot (germination impact)
Crop is mature & harvested before first killing frost
Charts showing probability of success vs. planting date for a county represent the 800-m grid cell at the center (centroid) of the county, not the entire county.
Average field size by selected crops for 6 states. Field sizes are based upon reporting/management.

California
Iowa
Florida
Nevada
North Carolina
South Dakota

IOWA – big Ag state, but small field size

NORTH CAROLINA – diverse & small field size
Approximate Acres Per Pixel BINS

<table>
<thead>
<tr>
<th>Size Range</th>
<th>Description</th>
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<tbody>
<tr>
<td>0 to 0.25</td>
<td>less than 1 Landsat pixel</td>
</tr>
<tr>
<td>0.251 to 1.5</td>
<td>1 Landsat pixel to 6 Landsat pixels</td>
</tr>
<tr>
<td>1.51 to 2.5</td>
<td>6 Landsat pixels to approx. 1 TIRS pixel / 12 Landsat pixels</td>
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<tr>
<td>2.51 to 15.5</td>
<td>to approximately 1 MODIS NDVI pixel</td>
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<tr>
<td>15.51 to 40</td>
<td>To approximately 1 NPP pixel</td>
</tr>
<tr>
<td>40.1 to 247</td>
<td>To approximately 1 AVRR pixel</td>
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</tbody>
</table>

Field Size: All Reported Crops

Sunflower

Tobacco

Corn

Soybeans

Wheat
Summary

• ‘operational agency’, not science/research agency
• Integrating science products have monetary impacts
• oversee crop insurance (quasi-regulatory agency)
  • Approved Insurance Providers (~17 AIPs)
    – sale & service of common crop insurance product
    – every AIP sells exact same policy with same price
    – oversee ‘within season’
      » Agents & Loss Adjusters
  • RMA Insurance Services
    – ‘common (or standard) rate’ determination and exceptions to that
      – within-season
      – DC & Regional Offices (10)
  • RMA Compliance
    – usually after growing season
    – ensure compliance with crop insurance provisions by AIPs
      – DC & Regional Offices (6)
• Agricultural Producer / Farmer / Rancher
  – use crop insurance as part of their risk management tools
  – contribute by paying premium ($) (‘skin in the game’)