State of the Practice, USDA-FAS Perspective

Agenda

1) USDA Foreign Agricultural Service, Office of Global Analysis, *International Production Assessment Division (IPAD)*
   - Introduction and decision-making process

2) IPAD’s use of Earth Observation products
   - State of the practice and EO product transition

3) Products in a decision-support portfolio
   - arranged by ARL and product type
USDA’s Economic Information System, Official U.S. government estimates of World Agricultural Production

- 18 Commodities, 166 Countries,
- 1,209 Country-Crop Pairs (e.g. Australia-Wheat)
- Crop Analysis:
  - Where is the crop grown?
  - When is the crop harvested?
  - How is the crop doing?
  - How big is the crop? (area, yield, & production)
- What does it mean to food supply?
- What does it mean to agricultural prices?
In FY2017, FAS Office of Global Analysis reviewed the business process for USDA’s Interagency Commodity Estimates Committee (ICEC).
Product Example: MODIS NDVI 8-day for Soybean-Producing Areas of Rio Grande do Sul, Brazil

**Northern Rio Grande do Sul**  
(14% of Brazil soybean production)

NDVI indicates crop growth is delayed and vegetation condition is **below** last year.

**Southern Rio Grande do Sul**  
(2% of Brazil soybean production)

- NDVI indicates crop growth is delayed and vegetation condition is **below** last year.
- Crops planted in Nov/Dec had poor germination/low soil moisture. Development was slow and plants had low vigor (PR SEAB-DERAL). Rain at the end of January was beneficial.

Source: MODIS NDVI 8-day & SPAM-IIASA 2005 Soybean Mask, NASA/GSFC/GIMMS, USDA/FAS/IPAD
Earth Observation Products function when they are in context of other products. This example incorporates several support products including:
- crop statistics
- crop distribution maps
- croplands mask
- precipitation & soil moisture

Crop condition product (EO NDVI) includes several contextual elements including:
- NDVI for this year & last year
- minimum, maximum & mean NDVI
- count of observations vs. expected

Critical: Crop analyst’s input and experience
IPAD Products: World Agricultural Production—production briefs, Commodity Intelligence Reports, Lockup presentations to World Agricultural Outlook Board

Analysis Focus of USDA FAS IPAD
(Sum of Products FY2015 to FY2017)

IPAD Products per Country
- 1 - 6
- 7 - 15
- 16 - 30
- 31 - 50
- 51 - 78
- Outside IPAD domain

Commodities
- Barley
- Rapeseed
- Corn
- Rice
- Cotton
- Sorghum
- Palm Oil
- Soybeans
- Peanuts
- Sunseed
- Wheat

IPAD Products by Commodity
(Sum = 590 for FY2015 to FY2017)
- Soybeans 12%
- Cotton 11%
- Rapeseed 6%
- Rice 9%
- Sunseed 3%
- Palm Oil 2%
- Barley 2%
- Sorghum 1%
- Peanuts 1%
- Wheat 29%
- Corn 24%
State of the Practice, USDA-FAS Perspective

Research to operations—from an operational user’s perspective

Four issues to be managed during transition

1. Identify / implement funding source
   ✓ Transition from research funds to operational funds

2. Identify / implement IT systems responsibility
   ✓ Identify who is responsible for data generation, ingest and visualization (RACI: Responsible, Accountable, Consulted, Informed)

3. Product review / Training
   ✓ Blend of scientific review of observations to product latency to confidence in the product.

4. Data continuity (future satellites)
### Transition to full integration and repeated use (ARL 9.0) requires identified budget, IT systems, and product review (including training)

<table>
<thead>
<tr>
<th>Table 1 Short Term Horizon</th>
<th>NASA GIMMS MODIS NDVI</th>
<th>Soil Moisture Palmer Model SMOS @50km</th>
<th>G-REALM</th>
<th>GDA Yield Forecaster (MODIS NDVI@250) croplands mask</th>
<th>SSM/I Yield Forecaster</th>
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</thead>
<tbody>
<tr>
<td><strong>Budget</strong></td>
<td>FAS-IPAD</td>
<td>FAS-IPAD</td>
<td>FAS-IPAD &amp; NASA-ROSES</td>
<td>FAS-IPAD</td>
<td>FAS-IPAD</td>
</tr>
<tr>
<td><strong>IT System</strong></td>
<td>2 external websites; managed by NASA-GIMMS</td>
<td>ftp managed by NASA-GIMMS; ingest/visualization managed by Inuteq/ASRC</td>
<td>ftp managed by ESSIC/SGT; ingest/visualization managed by Inuteq/ASRC</td>
<td>External website; managed by GDA</td>
<td>ftp managed by WeatherPredict; ingest/visualization managed by Inuteq/ASRC</td>
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<tr>
<td><strong>Product Review</strong></td>
<td>DONE</td>
<td>DONE</td>
<td>DONE</td>
<td>DONE</td>
<td>DONE</td>
</tr>
<tr>
<td><strong>Training</strong></td>
<td>DONE</td>
<td>To increase use</td>
<td>NEEDS</td>
<td>To increase use</td>
<td>To increase use</td>
</tr>
<tr>
<td><strong>Data Continuity</strong></td>
<td>MODIS&gt;&gt; NPP/VIIRS</td>
<td>SMOS&gt;&gt; SMAP</td>
<td>JASON-3&gt;&gt; Sentinel 3a</td>
<td>MODIS&gt;&gt; NPP/VIIRS</td>
<td>SSMI&gt;&gt; tbd</td>
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<tr>
<td><strong>ARL</strong></td>
<td>9.0</td>
<td>8.5</td>
<td>8.0</td>
<td>7.5</td>
<td>7.5</td>
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### Table 2  Medium Horizon

<table>
<thead>
<tr>
<th>Budget</th>
<th>RACI (notional)</th>
<th>IT System (notional)</th>
<th>Product (notional)</th>
<th>Training</th>
<th>Data Continuity</th>
<th>ARL</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAS-IPAD</td>
<td>R: NASA-GIMMS R: Inuteq/ASRC A: IPAD</td>
<td>ftp managed by NASA-GIMMS; ingest/visualization managed by Inuteq/ASRC</td>
<td>NEEDS</td>
<td>NEEDS</td>
<td>SMAP&gt;&gt; tbd</td>
<td>6.0</td>
</tr>
<tr>
<td>FAS-IPAD &amp; tbd</td>
<td>R: NASA-GIMMS A: IPAD</td>
<td>2 external websites; managed by NASA-GIMMS</td>
<td>NEEDS</td>
<td>DONE</td>
<td>NPP/VIIRS&gt;&gt; JPSS/VIIRS</td>
<td>5.0</td>
</tr>
<tr>
<td>USAF 557 WW &amp; FAS-IPAD</td>
<td>R: USAF 557 WW R: Inuteq/ASRC A: IPAD</td>
<td>ingest managed by Inuteq/ASRC; IPAD internal database (CADRE) managed by Inuteq/ASRC</td>
<td>NEEDS</td>
<td>DONE</td>
<td>GPM&gt;&gt; tbd</td>
<td>5.0</td>
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<tr>
<td>NASA</td>
<td>R: NASA-GSFC?</td>
<td>TBD</td>
<td>NEEDS</td>
<td>NEEDS</td>
<td>L-8/ S-2a&amp;b&gt;&gt; Landsat-9 (small satellites?)</td>
<td>4.0</td>
</tr>
</tbody>
</table>

**Select USDA-FAS-IPAD Products, by ARL Level—Medium Horizon**

*Transition from prototype requires external budget, focus on IT systems, and product review (observations>>algorithms>>training)*
• X-Axis: NASA’s ARL, 1.0 to 9.0
• Y-Axis: Product type
  - Crop area and crop yield products (e.g. relative crop yield forecasting, flooded area)
  - Crop condition products (e.g. NDVI, soil moisture, CHIRPS, ESI, HLS)
  - Support products (e.g. crop distribution maps, crop calendar, fieldwork data collection, CropSignal—crop stats, precipitation and temperature)
• Z-Axis: Impact (a qualitative assessment)
  - Crop analysts’ will be surveyed about the products and converted into a quantitative score. Impact score is from 100 to 1,200 with 1,200 indicating that the product has a strong impact on IPAD.
Fifteen products (right side) are currently “state of practice.”
ARL on X-axis; Product type on Y-axis; Impact to program on Z-axis.
State of the Practice, USDA-FAS Perspective

Anticipated products—from an operational user’s perspective

Six products (ARL 1.0 to 3.0)

- GDA yield forecaster using VIIRS @350m
- Flooded area estimation using Sentinel-1 (baseline plus change product)
- Yield forecasting using Harmonized Landsat-Sentinel @30m
- Effective field edge boundaries for a global common land unit, using Sentinel-2a&b @10m (machine learning)
- Relative crop area estimation using Landsat-8 & Sentinel-2a&b (machine learning)
- Soil moisture—corrected 2-layer Palmer model using SMAP @13km
1. **Complete transition of research products to operations**
2. **Understand product interactions**

1. How does 10km precip. data *interact* with soil moisture?
2. How does ESI *interact* with NDVI?
3. How does NDVI @30m *interact* with crop models?
4. How does fieldwork *interact* with soil moisture, CHIRPS and ESI?
5. How does effective field edge identification *interact* with crop area estimation?

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**IPAD products—state of practice (15)**
- **Products in development (12)**