Land / cryosphere breakout

Summary on land discussion

Ivan Csiszar
NOAA/NESDIS/STAR

see individual credits on select slides
Principal questions

• Is transition to enterprise processing on track?
  – science, format, dependencies
  – transition to “true” enterprise products
    • GOES-R, non-NOAA / foreign satellites

• Are we ready for reprocessing?
  – product-specific requirements

• Are the products ready to use? Are they used?
  – true operational applications
    • process for implementing operational use
    • demonstrated potential and impacts
0830 – 0850  *Introduction and welcome*  
Ivan Csiszar

0850 – 0910  *Surface reflectance*  
Eric Vermote

0910 – 0930  *Terrestrial biophysical product suite*  
Marco Vargas

0930 – 0950  *Land surface albedo*  
Yunyue (Bob) Yu

0950 – 1010  *Land surface temperature*  
Yunyue (Bob) Yu

1010 – 1030  *Break*

1030 – 1050  *Active fire*  
Ivan Csiszar

1050 – 1110  *Surface type*  
Xiwu (Jerry) Zhan

1110 – 1130  *Binary snow cover and snow fraction*  
Peter Romanov

1130 – 1150  *Sea ice surface temperature*  
Mark Tschudi

1150 – 1210  *Sea ice concentration*  
Jeff Key

1210 – 1230  *Sea ice characterization and thickness*  
Jeff Key
Agenda (pm)

1330 - 1350 *Enterprise system status*  
Ivan Csizsar

1350 – 1410 *Suomi NPP reprocessing status*  
Jason Choi

1410 – 1430 *NASA Science Team*  
Miguel Román

1430 – 1450 *CEOS Land Product Validation*  
Miguel Román

1450 – 1510 *Land product characterization system*  
Gregory Stensaaas

1510 – 1530 *Break / poster session*

1530 – 1550 *Vegetation Health Applications*  
Wei Guo

1550 – 1610 *NCEP Land Applications*  
Mike Ek

1610 – 1630 *National Ice Center Applications*  
Pablo C. Colón

1630 – 1650 *Open discussion and wrap-up*
A Land Climate Data Record
Multi instrument/Multi sensor Science Quality Data Records used to quantify trends and changes

Emphasis on data consistency – characterization rather than degrading/smoothing the data

E. Vermote, NASA
NDE S-NPP VIIRS GVF Validation (1/3)

Data Sources:
- VIIRS
- AVHRR
- VIIRS-AVHRR

Data Sets:
- GVF
- Surface Type
- Climatology

Compositing:
- Daily Rolling Weekly

Analysis:
- Availability Tables
- Maps

Date:
- dd
- mm
- yyyy

M. Vargas, STAR

http://www.star.nesdis.noaa.gov/smcd/viirs_vi/gvf/gvf.htm
NDE S-NPP VIIRS GVF Validation (2/3)

GVF Time Series and Correlative Analysis Between VIIRS and AVHRR

GVF Temporal Trajectories
VIIRS vs. AVHRR
Konza Validation Site

GVF Comparison by Surface Type
VIIRS vs. AVHRR

Global GVF Temporal Trajectories
VIIRS vs. AVHRR

M. Vargas, STAR
GVF Time Series Inter-Comparison Using In Situ Networks

Comparison Between VIIRS GVF and Google Earth GVF

Konza

Google Earth GVF = 0.44
VIIRS GVF = 0.55

Harvard Forest

Google Earth GVF = 0.26
VIIRS GVF = 0.34

Park Falls

Google Earth GVF = 0.38
VIIRS GVF = 0.36

M. Vargas, STAR
Land surface albedo summary

• Land surface albedo is the ratio between outgoing and incoming shortwave radiation at the Earth surface. It is an essential component of the Earth’s surface radiation budget. LSA is part of VIIRS Surface Albedo Environmental Data Record (EDR).

• After three updates of LUTs of regression coefficients since launch, quality of LSA retrievals have been significantly improved.

• Accuracy of the current non-snow LSA retrievals are smaller than the L1RD threshold. The performance of snow LSA is also comparable (slightly better) than the existing albedo product, although RMSE of current snow retrievals are greater than the precision requirement.

• Current IDPS product contains data gaps/missing values due to cloud coverage. Meanwhile, the albedo retrieved from a single observation may contain some levels of random noises. Daily noise-reduced, no-gap albedo product is required by user.

• An improved enterprise albedo algorithm is currently under development to address these issues.
Albedo product performance

VIIRS Surface albedo EDR is a full resolution granule instantaneous product. LSA is only generated for clear-sky land pixels.

<table>
<thead>
<tr>
<th>Product</th>
<th>L1RDS APU Thresholds</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIIRS LSA</td>
<td>Precision: 0.05</td>
<td>RMSE: 0.05</td>
</tr>
<tr>
<td>VIIRS LSA</td>
<td>Accuracy: 0.08</td>
<td>Bias: 0.01</td>
</tr>
</tbody>
</table>

- Comprehensive evaluation was conducted using field measurements and high-resolution LSA reference maps
- The current LSA data can well meet the requirements for snow-free cases.

Left: Comparison of snow free albedo with SURFRAD measurements.
Right: Validating snow-free and snow albedo using Landsat albedo maps.
SNPP LST performance

- The SNPP LST marginally meets the mission requirements based on the validation results obtained from:
  - Ground based validations (CONUS, Europe, Greenland, Australia, China)
  - Radiance based validations over global and four seasons
  - Cross satellite comparisons with MODIS, AATSR, SEVIRI etc.
- Validation tools are run regularly for routing monitoring and web info update
- Working with EMC/NCEP for the model verification
- Suspicious High LSTs observed in Australia in Summer time; lack of in-situ data available for deep-dive validation
- Cloud contamination is still the issue for accurate validation.

Enterprise LST algorithm progress

- Emissivity explicit algorithm developed and tested
- Emissivity estimation algorithm is developed and tested
- NDE LST production system is in development

Reprocessing status

- A reprocessing plan is proposed
- Enterprise algorithm will be used for the reprocessing for LST consistency

JPSS-1 readiness

- All the validation tools and simulation tools/database are ready for the J-1 mission
- J-1 LST production in NDE will be based on the Enterprise Algorithm
- The J-1 Cal/Val plan has been submitted, with the schedule and milestones consistent to the mission’s plan
Active fire data anomalies during the early period of the Suomi NPP data record

Suomi NPP VIIRS - IDPS Active Fires

15 May 2012

Candidate granules for testing for SDR reprocessing

I. Csiszar, STAR
While the overall classification accuracy (~78%) of the new map is similar to 2012 delivery, some accuracy improvements are observed, such as croplands. The images shown left demonstrate two examples of the improved cropland mapping results, where the old version presented wrong type labels. Google images verified the mapping results.
The biome scheme surface type map was generated using a IGBP-biome LUT plus a second SVM classification to further separate cereal crops and broadleaf crops. Validation in progress. The two images shown left is an example of crop mapping result in IGBP and biome legends. Cereal and broadleaf croplands are further separated in biome ST map.
Rapid surface changes can be caused by many events:
- Flooding, severe drought, snow storm, fire, large scale deforestation

These changes cannot be captured by the annual GST product

A suite of daily products or change indicator products are needed to capture such rapid changes
- Can build on the original ST-EDR concept
- Where available, use existing VIIRS products (e.g., Snow, Fire, vegetation cover)
  - Better temporal consistency needed to allow change detection
  - For fire, post fire surface type information needs to be derived
- Some changes require new products, e.g.:
  - Daily surface inundation needed to capture surface changes due to flooding and flood receding
  - Sub-annual tree cover data needed to capture deforestation

X. Zhan, STAR; C. Huang, UMD
### NASA Land SIPS: Code Delivery and Integration Status

<table>
<thead>
<tr>
<th>Land SIPS Products</th>
<th>Algorithms Delivered to Land SIPS</th>
<th>Product Integration and Testing</th>
<th>Draft ATBD Delivery</th>
<th>Delivery of User’s Guide</th>
<th>Products Delivered to assigned DAAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Reflectance</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Summer, 2016</td>
</tr>
<tr>
<td>LAI/FPAR</td>
<td>Underway</td>
<td>Underway</td>
<td>Summer, 2016</td>
<td>Summer, 2016</td>
<td>Fall, 2016</td>
</tr>
<tr>
<td>Snow Products</td>
<td>Underway</td>
<td>Underway</td>
<td>✓</td>
<td>Fall, 2016</td>
<td>Fall, 2016</td>
</tr>
<tr>
<td>MAIAC</td>
<td>Summer, 2016</td>
<td>Pending</td>
<td>Fall, 2016</td>
<td>Fall, 2016</td>
<td>Fall, 2016</td>
</tr>
<tr>
<td>BRDF/Albedo</td>
<td>Underway</td>
<td>Underway</td>
<td>✓</td>
<td>Summer, 2016</td>
<td>Fall, 2016</td>
</tr>
<tr>
<td>Burned Area</td>
<td>Fall, 2016</td>
<td>Pending</td>
<td>Spring, 2017</td>
<td>Spring, 2017</td>
<td>Spring, 2017</td>
</tr>
<tr>
<td>Active Fires</td>
<td>Underway</td>
<td>Underway</td>
<td>Spring, 2016</td>
<td>Fall, 2016</td>
<td>Fall, 2016</td>
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<tr>
<td>Vegetation Index</td>
<td>✓</td>
<td>Pending</td>
<td>Summer, 2016</td>
<td>Summer, 2016</td>
<td>Fall, 2016</td>
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<tr>
<td>LST&amp;E</td>
<td>Underway</td>
<td>Pending</td>
<td>✓</td>
<td>Fall, 2016</td>
<td>Fall, 2016</td>
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<tr>
<td>Ice Products</td>
<td>Fall, 2016</td>
<td>Pending</td>
<td>✓</td>
<td>Fall, 2016</td>
<td>Fall, 2016</td>
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<tr>
<td>Phenology</td>
<td>Fall, 2016</td>
<td>Pending</td>
<td>Fall, 2016</td>
<td>Fall, 2016</td>
<td>Spring, 2017</td>
</tr>
<tr>
<td>Day/Night Band</td>
<td>✓</td>
<td>Underway</td>
<td>Fall, 2016</td>
<td>Fall, 2016</td>
<td>Spring, 2017</td>
</tr>
</tbody>
</table>

M. Román, NASA
CEOS-LPV 5-Year Roadmap

**Vision**

- **All missions support validation & validation is on-going**
- Uncertainty information determined through standard practices & protocols
- Algorithms are iteratively improved based on validation results

**Operational Validation Framework:**
- Land Product Characterization System (Lead Agencies: USGS/NOAA)

**Protocols & Experiments:**
- Biomass Protocol (Lead Agencies: NASA/ESA)
- Phenology, ET, & Soil Moisture Protocols (Lead Agency: NASA)
- Albedo, Burned Area, & LST Protocols
- CEOS Carbon Actions 7/8 (NASA CMS Program)
- WGCV Atmospheric Correction Intercomparison Exercise (Lead Agency: ESA)
- Atmospheric Correction and VI Protocols (Lead Agencies: ESA/NOAA)
- ECV protocols and procedures for Snow ECV (Lead Agency: ESA)

**Field Campaigns and IOPs:**
- BOREE
- neona
- TERN
- ICOS
- JECAM

**New Missions:**
- SMAP
- ICESat-2
- ECOSTRESS
- GEDI
- NISAR

**Sustained Missions:**
- Terra/Aqua/S-NPP
- Landsat 8
- JPSS-1
- JPSS-2
- HyspIRI
- Landsat 9

M. Román, NASA
The MALIBU instrument design includes two Tetracam optical units matching the optical Land channels of key Land sensors such as Landsat-8 OLI, Sentinel-2 MSI, Sentinel 3-OLCI, Terra/Aqua MODIS, Terra MISR, and Suomi-NPP/JPSS VIIRS.
What is LPCS

A web-based system designed for comparative analysis of global satellite higher-level land products.

- Inventory & order data
- Advanced processing
- Basic analysis
- Output charts, images, & tables

K. Gallo, STAR; G. Stensaas, USGS
Using map tiles technology to present 1km VH data through web pages

Users access the country and province maps by clicking the web page.

F. Kogan, STAR; W. Guo, IMSG
Land Data Sets (GFS and CFS, GLDAS)

Vegetation Type (1-deg, UMD)

Soil Type (1-deg, Zobler)

Max.-Snow Albedo (1-deg, Robinson)

Green Vegetation Fraction (monthly, 1/8-deg, NESDIS/AVHRR)

Snow-Free Albedo (seasonal, 1-deg, Matthews)

M. Ek, EMC; Y. Wu, IMSG
Land Data Sets (NAM, NLDAS)

Vegetation Type  
(1-km, MODIS)

Soil Type  
(1-km, STATSGO/FAO)

Snow-Free Albedo  
(1-km, MODIS)

Green Vegetation Fraction  
(1/8-deg, new NESDIS/AVHRR)

Max.-Snow Albedo  
(5-km, MODIS)

M. Ek, EMC; Y. Wu, IMSG
Overarching issues (2/1)

• Enterprise product suite
  – Evolving science and evolving user needs -> requirements
    • I-band / hybrid VIIRS fire product
    • CCR on global gridded products to meet user needs
  – ensure seamless transition to NDE, including dependencies
  – Enterprise Cloud Mask testing
    • science
    • code interface
  – “soft” vs. “strict” definition of Enterprise
    • VIIRS-only in NDE vs. true common algorithm base for multiple sensors

• Reprocessing
  – ensure testing and evaluation
    • define needs and requirements
      – beyond calibration LUTs
    • explicitly test “problem” granules
  – broad interaction to meet all teams’ needs
Overarching issues (2/2)

• Validation
  – further coordination on field campaigns
    • GOES-R, MALIBU
  – increasing involvement of NOAA JPSS (and GOES-R) Science Team members in CEOS LPV
    • product teams
    • Land Product Characterization System (with USGS)

• Interagency / international coordination and collaboration
  – science algorithms / products
  – validation
  – multi-satellite observing systems
    • Mid-morning measurements from polar platforms
Many thanks go to

All presenters and attendees

Science Team members

JPSS and STAR Management

SPARKS interns

Christie Best and Stephanie Moore for taking notes

STAR and NCWCP personnel for logistical support