Current Status of the Terrestrial Environmental Data Products from the Suomi NPP Satellite

Ivan Csiszar (NOAA/NESDIS/STAR)
Jeff Privette (NOAA/National Climatic Data Center)
Miguel Román, Eric Vermote (NASA/GSFC)
Chris Justice (University of Maryland)
NOAA JPSS Land Calibration and Validation Team
NASA SNPP VIIRS Land Discipline Team
## NOAA JPSS SNPP VIIRS Land Products and Team Principals

<table>
<thead>
<tr>
<th>Role or Product Focus</th>
<th>Name (+ et al.)</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOAA Product Team Lead, <strong>Fire</strong></td>
<td>Ivan Csiszar / Wilfrid Schroeder</td>
<td>NOAA / UMD</td>
</tr>
<tr>
<td>NASA Coordination, Validation co-lead</td>
<td>Miguel Román, Chris Justice</td>
<td>NASA / UMD</td>
</tr>
<tr>
<td><strong>Surface Reflectance</strong>, VCM, calibration</td>
<td>Eric Vermote</td>
<td>NASA</td>
</tr>
<tr>
<td>Surface Reflectance</td>
<td>Alex Lyapustin</td>
<td>NASA</td>
</tr>
<tr>
<td><strong>Vegetation Index</strong></td>
<td>Marco Vargas</td>
<td>NOAA</td>
</tr>
<tr>
<td>Vegetation Index</td>
<td>Tomoaki Miura/ Alfredo Huete</td>
<td>Univ. of Hawaii / Arizona</td>
</tr>
<tr>
<td><strong>Albedo</strong></td>
<td>Yunyue <em>(Bob)</em> Yu / Shunlin Liang</td>
<td>NOAA / UMD</td>
</tr>
<tr>
<td>Albedo</td>
<td>Crystal Schaaf</td>
<td>Univ. Mass.</td>
</tr>
<tr>
<td><strong>Land Surface Temperature</strong></td>
<td>Bob Yu</td>
<td>NOAA</td>
</tr>
<tr>
<td>NOAA CDR coordination, LST</td>
<td>Jeff Privette / Pierre Guillevic</td>
<td>NOAA / NASA JPL</td>
</tr>
<tr>
<td><strong>Surface Type</strong></td>
<td>Jerry Zhan</td>
<td>NOAA</td>
</tr>
<tr>
<td>Surface Type</td>
<td>Mark Friedl</td>
<td>Boston Univ.</td>
</tr>
<tr>
<td>STAR AIT Land</td>
<td>Walter Wolf, Youhua Tang</td>
<td>NOAA</td>
</tr>
<tr>
<td>NASA LandPEATE, <strong>gridding/granulation</strong></td>
<td>Robert Wolfe, Sadashiva Devadiga</td>
<td>NASA</td>
</tr>
<tr>
<td>Northrop Grumman</td>
<td>Alain Sei, Justin Ip</td>
<td>NGAS</td>
</tr>
<tr>
<td>Raytheon</td>
<td>Daniel Cumpton</td>
<td>Raytheon</td>
</tr>
<tr>
<td>JPSS Algorithm Manager</td>
<td>Leslie Belsma</td>
<td>Aerospace</td>
</tr>
</tbody>
</table>
Land Model Requirements

To provide these proper boundary conditions, land model must have:

- **Atmospheric forcing** to drive land model,
- Appropriate **physics** to represent land-surface processes,
- Proper **initial land states**, such as snow & soil moisture (analogous to initial atmospheric conditions, though land states may carry more “memory”, especially deep soil moisture, similar to ocean SSTs),
- **Land data sets**, e.g. land use/land cover (vegetation type), soil type, surface albedo, and associated parameters, e.g. surface roughness, soil and vegetation properties.
VIIRS vs. MODIS for land monitoring

• What can **VIIRS** do better than **MODIS**?
  – Better coverage and scanning geometry, including higher resolution of “M” bands
    • Improved fire detections (25% higher VIIRS fire counts than MODIS in the three-pixel VIIRS aggregation zone)
    • No gaps at low latitudes, more consistent data for temporal compositing

• What can **VIIRS** do that **MODIS** cannot?
  – VIIRS Day/Night Band: VIIRS can directly assess a variety of phenomenon associated with human settlements (e.g., population, socio-economic activity, the built environment, and urbanization).

• What can **MODIS** do better than **VIIRS**?
  – **MODIS can ‘see’ the Amazon better**: TERRA-MODIS was designed to cross the equator at a time when cloud cover is at its daily minimum (10:30AM, descending).

• What can **VIIRS** do that is currently missing?
  – VIIRS can/should be used to measure the Earth's Biosphere: (i.e., not just daily VI and Surface Type, but also LAI/FPAR, NPP/GPP, Burned Area, Phenology, etc.)
  – Multiple threads of VIIRS product development and generation: IDPS, NOAA JPSS (NDE), Proving Ground, NASA Science Team and Applied Science etc.
Surface Reflectance

2013-04-15 (GranuleID – NPP000467286982)

**DR4488**: ADL test result over one VIIRS granule showing retrieval under all conditions except night and ocean (showing RGB composite of Bands: M5, M4 and M3 respectively)

**Before**

**After**

ADL TEST RESULT  

*E. Vermote, NASA GSFC*
• **VI Product:** TOA-NDVI and TOC- EVI

• **Maturity Status:** Provisional

• **Archive:** CLASS

• **Validation 1 maturity:** scheduled for Summer 2014

• **Product Improvements:** Additional Quality Flags, VIIRS VI EVI Backup Algorithm

• **J1:** Add top-of-canopy NDVI

*M. Vargas, NOAA/STAR*
Validation of the VI product includes comparison with heritage products (MODIS and AVHRR), Aeronet match-up analysis, time series analysis, biome analysis, and validation using in situ tower reflectance data (FLUXNET).
Correlation between VIIRS and AVHRR (TOA)

Correlation of AVHRR & VIIRS NDVI, for the week June 4-12, 2012; CC=0.943
Area 40 S - 60 N & 180 W - 180 E

VIIRS NDVI is ~30% higher than AVHRR. In order to apply VIIRS NDVI to continue 34-year AVHRR’s NDVI data records & analysis of changes in land cover, drought, climate etc we need to convert NDVI from VIIRS to AVHRR

F. Kogan, NOAA/STAR
Green Vegetation on Our Planet

http://www.nnvl.noaa.gov/green.php

April 2012 – April 2013
500 m grid; NDVI weekly composite / gap filled

F. Kogan, NOAA/STAR
D. Pisut, NOAA Visualization Laboratory
Green Vegetation Fraction

- Climatology vs. near real-time GVF
- Ingested into NCEP models where near real-time GVF leads to better partition between surface heating & evaporation --> impacts surface energy budget, PBL evolution, clouds & convection.

AVHRR 5-year Climatology
Note: VIIRS GVF in Midwestern US much lower than AVHRR GVF Climatology.

M. Vargas, NOAA/STAR
Maps of 16-day mean albedo

An LUT update for the VIIRS provisional albedo (BPSA – Bright Pixel Surface Albedo) is in testing . . .


*Top:* the VIIRS BPSA albedo
*Bottom:* the MODIS albedo

Y. Yu, STAR
Evaluation of the VIIRS Dark Pixel Surface Albedo EDR (New England 2013183)

--- VIIRS DPSA albedo is uses the daily gridded surface reflectance IP as input and only few observations meet the reflectance overall quality for albedo retrieval.

-- Current criteria for DPSA full inversion are limited. A crucial parameter, the WODs (weights of determination), which describes the angular sampling status of the input reflectances, are not even considered.

Zhuosen Wang, Yan Liu, and Crystal Schaaf (UMASS Boston)
Land Surface Temperature: VIIRS vs. MODIS

Calibrated Provisional VIIRS LSTs (Mx8.x) compared to MODIS LSTs (C6)

See posters 683 (Yu et al.) and 678 (Biard et al.)

Y. Yu, STAR
LST evaluation using ground data

MX7

MX8_corrected
● ST EDR product passed science provisional maturity review in Jan 2014.

● First full year VIIRS data were collected from LPEATE for First VIIRS Quarterly Surface Type Intermediate Product creation by Mar 2013.

● First VIIRS QST IP is produced and will be delivered to IDPS soon.

X. Zhan, STAR
Active Fires: VIIRS (M-band) vs. MODIS

M13 Data Aggregation Bug Identified (Feb 2012)

M13 Data Aggregation Revised in Mx5.3 (May 2012)

19 Jan - 13 Feb 2012

11 May - 10 Jun 2012

The overall features of the Aqua MODIS and S-NPP functional dependence on scan angle remained the same a year later and over a longer time period

Feb - Jun 2013

See presentations 9.5 (Csiszar et al.) and J6.2 (Ellicott et al.)
Improved Satellite Mapping of Active Fires Achieved Using VIIRS I-bands

Wildfire in southern Brazil, March/2013

Issues of VIIRS fire detection:
- Anomalous behavior at sensor saturation
- Inconsistent quality flags
- Unknown saturation of native resolution pixels prior to aggregation (single-gain bands)
- South Atlantic Magnetic Anomaly

See presentation J6.3 (Coen et al.)
The Land PEATE: meeting the needs of the NASA Science Team and helping the NOAA IDPS

VIIRS LDOPE QA: [http://landweb.nascom.nasa.gov/NPP_QA/](http://landweb.nascom.nasa.gov/NPP_QA/)

VIIRS Global Browse

VIIRS Level 3 Products
VIIRS Land Science Team Support Activities

Conversion of MODIS code for Daily LAI/FPAR to VIIRS Land Science DDR is complete.

R. Myneni (BU)

Integration and testing of VIIRS Active Fire DDR. New PGE installed to operations.

L. Giglio (UMD)

Level 2 Fire DDR, baseline NPP_VAFIP, 8/12/2012
VIIRS Land Gridding/Granulation - Proposed

DSR GIP

Day 1
DSR GIP
Day 2
DSR GIP
Day ...
DSR GIP
Day 16
DSR GIP

DSR GIP

16-day BRDF/Albedo

Generated every 8-days

Land Albedo GIP

BRDF Archetypal

BRDF Archetypal (updated)

Update once per year (Jan. 1)

Surface Type (offline)

NDVI 5 year climatology

Cloud Mask IP

Global Land/Ocean Albedo EDR

Cloud Mask

Global Albedo EDR

Land Albedo EDR

Grid2gran

Grid2gran

Grid2gran

Grid2gran

QST - LWM

Snow Ice Rolling Tile

S. Devadiga (GSFC/LDOPE)
• S-NPP VIIRS land core IDPS product development and evaluation is progressing well
  – Provisional: Surface Reflectance, LST, Active Fires, Vegetation Index, Surface Type
  – Beta: albedo

• Finish Suomi NPP product evaluation and development
  – Surface albedo to provisional; all products to validated
  – Gridding/granulation
  – Auxiliary data

• Continue interaction with upstream product teams
  – SDR data is good - work is underway to resolve remaining quality flag and sensor performance issues (e.g. Active Fires)
  – VIIRS Cloud Mask – coordination regarding gridding/granulation
Summary and conclusions (2/2)

• Development of data products not in the suite of operational NOAA products (i.e. IDPS or NDE)
  – NOAA JPSS Proving Ground and Risk Reduction
  – NASA SNPP Science Team

• Teams are continuing the development of improved and additional products
  – Green Vegetation Fraction, I-band Active Fires, LAI/FPAR etc.

• Development and operational implementation of products to meet new Level 1 requirements
  – Top-of-canopy vegetation index
  – Full active fire mask and fire radiative power

• Product continuity and reprocessing with latest algorithm

• Publications (JGR SNPP Special Issue and other)