Suomi NPP/JPSS Land Cryosphere EDR Overview

Products, Applications and J1 Readiness

Ivan Csiszar, Jeff Key

NOAA/NESDIS/STAR

and the NOAA JPSS Land and Cryosphere Teams
General Framework for Land Enterprise System

Pixel level Aeros, CM → Pixel level SDR → Pixel level SR → Pixel level LST, LSA, Snow/Ice binary map, SF

- NN mapping, Sin projection, multiple layers (observations from different orbits; keep pixel CM, Aeros)
- Compositing:
  - apply selection criteria (SAVI, max/min)
  - apply time window
  - apply QC (Aeros, CM)
- Sin -> Lat/Lon
- Either gridding or product algorithm responsibility

1, 7, 8 days composite:
- SDR
- SR

32 days composite:
- SR
- SR/BT/VI monthly
- AST, AST-LWM
- Daily ST
- Sin -> Lat/Lon

Product algorithm responsibility

Product algorithm responsibility

Gridding algorithm responsibility

Pixel level Active Fire

- Fire, Snow, Burned area
- Consistency check

M. Tsidulko, IMSG
VIIRS Surface Reflectance: NDE algorithm performance

IDPS version

NASA C1.1

NDE, NASA Version 1

Improvement is clearly visible from IDPS to current NDE version

Algorithm in transition to operations
Surface Reflectance Algorithm Overview

IDPS: (HDF5)  
GMTCO geolocation file

Preprocessor

NDE Framework: (NetCDF4)  
NDE Aerosol Model  
Enterprise Cloud Mask  
NDE Cloud Height  
GFS Data

Main Algorithm

VNP09.*.h5 (HDF5)

PERL Global Attribute Conversion

VNP09.*.h5 (HDF5)  
plus list of NDE global attributes

Postprocessor

SR_v1-0-8_npp.*.nc (NetCDF4)  
Contains Surface Reflectance for:  
I1, I2, I3, M1, M2, M3, M4, M5, M7, M8, M10, M11  
Contains QC values.

Legend

From IDPS  
From NDE Framework  
Static Files / LUTs  
Executable PERL/C++

Algorithm in transition to operations

M. Wilson, STAR ASSIST

 Algorithm in transition to operations

Intermediate files within the VIIRS GVF processing system
Vegetation Index Daily Global Products (4 km res)

Algorithm in transition to operations

Daily products generated with the Enterprise Surface Reflectance granule data in NetCDF format
Some issues with upstream products and associated QA

Algorithm in transition to operations
Vegetation Index Weekly Global Products

Global weekly products generated from Surface Reflectance granule Data in HDF5 format (from the IDPS)

Some issues with upstream products and associated QA

Algorithm in transition to operations
Vegetation Index Bi-Weekly Global Products

Global Bi-weekly products generated from Surface Reflectance granule Data in HDF5 format (from the IDPS)

Some issues with upstream products and associated QA

Algorithm in transition to operations
Vegetation Health

1. NDVI & BT
2. N-B Climatology

Algorithm reaching readiness for operational transition

F. Kogan, STAR
Enterprise land surface albedo
Gap-filled, noise-reduced, gridded LSA

- New gridded VIIRS LSA product
  - All gaps are filled.
  - Noises are reduced.
- Validation suggested higher accuracy than original VIIRS product and other existing products

Example of global map of gap-filled and noise-reduced VIIRS gridded albedo on Jul 17th, 2015

Granule-based algorithm in transition to operations

Example of time series of one year VIIRS albedo at Fort Peck
Enterprise Land Surface Temperature

Gridded LST Product Development

1km Gridded VIIRS Land Surface Temperature for daytime (top) and nighttime (bottom)

4 × 2 tiles for globe

Granule-based algorithm in transition to operations
**VIIRS Active Fire**

- The JPSS VIIRS active fire products provide high quality information
  - 750m M-band product in operations since March 15, 2016
  - 375m I-band algorithm evaluated for operational implementation
  - both products deliver fire mask and fire radiative power (FRP)
  - FRP used in air quality, and smoke analysis and prediction systems
  - FRP is incorporated into AWIPS-II

*Updated M-band algorithm in delivery to NDE.*

*Fire masks from the M-band (top and left) and I-band (bottom and right) algorithms on 6/18/2017 02:04 UTC.*

I. Csiszar, STAR; M. Tsidulko, IMSG@STAR, W. Schroeder, UMD
Towards a VIIRS Surface Type Change product

S-NPP VIIRS RGB images (M11-M7-M5) acquired on July 28th and August 30th, 2015

Burned areas of the Rocky Creek, CA fires in July 2015 detected with the change vector method using S-NPP VIIRS images shown above

Algorithm in testing and demonstration mode

X. Zhan, STAR; Chengquan Huang, Rui Zhang, Panshi Wang, UMD
Summary

- Finalizing Enterprise algorithm development
  - Algorithms are ready and some are in the process of operational transition
  - Further refinements expected
  - Feedback on upstream Enterprise EDRs (primarily cloud mask)
  - New algorithms in testing and demonstration mode

- Reprocessing needs a coordinated effort
  - SDR is becoming available now

- Consistency between different geophysical products
  - e.g. signal from all products should indicate vegetated vs. clear land etc.

- Further progress towards interagency and international coordination
  - NOAA and NASA activities
  - CEOS WGCV and other coordination groups
  - EUMETSAT, bilateral

- Land breakout session: Thursday, August 17
SNOW, ICE, AND POLAR WINDS

Jeff Key
NOAA/NESDIS
608-263-2605, Jeff.Key@noaa.gov
VIIRS Operational Products

Snow Cover (binary)    Ice Surface Temperature    Ice Thickness/Age

Snow Fraction    Ice Concentration    Polar Winds
AMSR2 Operational Products

Snow Cover

Snow Depth

Snow Water Equivalent

Sea Ice Concentration

Sea Ice Type
## Team Members - VIIRS

<table>
<thead>
<tr>
<th>EDR</th>
<th>Name</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead; ice and winds</td>
<td>Jeff Key</td>
<td>NESDIS/STAR</td>
</tr>
<tr>
<td>Winds</td>
<td>Jaime Daniels</td>
<td>NESDIS/STAR</td>
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<tr>
<td><strong>Wisconsin:</strong></td>
<td></td>
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<td>Ice conc., temp.</td>
<td>Yinghui Liu</td>
<td>CIMSS/U. Wisconsin</td>
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<td>Ice thickness</td>
<td>Xuanji Wang</td>
<td>CIMSS/U. Wisconsin</td>
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<td>Ice, winds</td>
<td>Rich Dworak</td>
<td>CIMSS/U. Wisconsin</td>
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<tr>
<td>Ice</td>
<td>Aaron Letterly</td>
<td>CIMSS/U. Wisconsin</td>
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<tr>
<td>Winds</td>
<td>Dave Santek</td>
<td>CIMSS/U. Wisconsin</td>
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<td><strong>Maryland:</strong></td>
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<tr>
<td>Snow cover, fraction</td>
<td>Peter Romanov</td>
<td>CREST/CCNY</td>
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<tr>
<td><strong>Colorado:</strong></td>
<td></td>
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<tr>
<td>Ice temp., conc.</td>
<td>Mark Tschudi</td>
<td>U. Colorado</td>
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<tr>
<td><strong>Other:</strong></td>
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<td>Ice, snow</td>
<td>Sean Helfrich</td>
<td>STAR/NIC (unfunded)</td>
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<tr>
<td>Winds</td>
<td>Wayne Bresky</td>
<td>IMSG</td>
</tr>
<tr>
<td>Winds</td>
<td>Andy Bailey</td>
<td>IMSG</td>
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**Team Members – AMSR2**

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<td><strong>Wisconsin:</strong></td>
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<td>Snow products</td>
<td>Yong-Keun Lee</td>
<td>CIMSS/U. Wisconsin</td>
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<td><strong>Maryland:</strong></td>
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<td></td>
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<tr>
<td>Snow</td>
<td>Cezar Kongoli</td>
<td>CICS</td>
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<td><strong>Colorado:</strong></td>
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<tr>
<td>Sea ice</td>
<td>Walt Meier</td>
<td>NSIDC (formerly NASA GSFC)</td>
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<tr>
<td>Sea ice</td>
<td>Scott Stewart</td>
<td>CU Contractor</td>
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<tr>
<td>Sea ice</td>
<td>Florence Fetterer</td>
<td>NSIDC</td>
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# Product Performance - VIIRS

<table>
<thead>
<tr>
<th>Product</th>
<th>L1RDS APU Thresholds</th>
<th>Performance</th>
<th>Meets Spec?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snow cover (binary)</td>
<td>90% correct typing</td>
<td>96-99%</td>
<td>Y</td>
</tr>
<tr>
<td>Snow fraction</td>
<td>10% uncertainty</td>
<td>10-20%</td>
<td>N*</td>
</tr>
<tr>
<td>Ice surface temperature</td>
<td>1 K uncertainty</td>
<td>0.9 K</td>
<td>Y</td>
</tr>
<tr>
<td>Ice concentration</td>
<td>10% uncertainty</td>
<td>8.9%</td>
<td>Y</td>
</tr>
<tr>
<td>Ice thickness/age</td>
<td>70% correct typing (new/young, other ice);</td>
<td>90% (first-year/other); 0.5 m precision for thickness</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>no thickness requirement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIIRS winds</td>
<td>7.5 m/s accuracy, 3.8 m/s precision (mean vector difference)</td>
<td>6.1/7.0, 3.3/2.7 accuracy, precision (NH/SH)</td>
<td>Y</td>
</tr>
</tbody>
</table>

*The snow fraction requirement is inconsistent with that of other NOAA sensors. A change has been recommended.*
# Product Performance – AMSR2

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<th>L1RDS APU Thresholds</th>
<th>Performance</th>
<th>Meets Spec?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snow cover (binary)</td>
<td>80% correct typing</td>
<td>72-97%</td>
<td>Y</td>
</tr>
<tr>
<td>Snow depth</td>
<td>20 cm uncertainty</td>
<td>15-22 cm</td>
<td>Y (marginal)</td>
</tr>
<tr>
<td>SWE</td>
<td>50-70% uncertainty (shallow to thick snowpacks)</td>
<td>~20-22%</td>
<td>Y</td>
</tr>
<tr>
<td>Ice concentration</td>
<td>10% uncertainty</td>
<td>3.9% NH; 4.4% SH</td>
<td>Y</td>
</tr>
<tr>
<td>Ice type</td>
<td>70% correct typing</td>
<td>80-90%, Arctic winter</td>
<td>Y</td>
</tr>
</tbody>
</table>
Experimental Products

River Ice

Ice Motion

Blended Ice Concentration

Sea Ice Leads
Experimental Products, cont.

Winds from combined S-NPP and JPSS-1

Summary

• VIIRS Products:
  • Snow: Binary snow cover, snow fraction
  • Ice: Ice surface temperature, ice concentration, ice thickness/age
  • Polar winds
• AMSR2 Products:
  • Snow: Snow cover, snow depth, snow water equivalent
  • Ice: Ice concentration, ice type
• VIIRS ice products are being added to PolarWatch.
• All products meet requirements.
• All products are operational.
• Planned improvements for J1 are minor and all are ready.
• Experimental products include river ice, ice motion, blended ice concentration, sea ice leads, polar winds with new bands, winds from tandem satellites.