VIIRS Daily BRDF, NBAR and Albedo

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Suomi NPP VIIRS Albedo

- Suomi National Polar-orbiting Partnership (NPP)
  - Launched Oct 2011

- VIIRS Albedo algorithm provides only a Single Daily Broadband Albedo
  - In swath, at the time of overpass
  - No BRDF, no NBAR
  - No spectral quantities (no bands or broadband vis or NIR)
  - Minimal Quality Flags
  - No reprocessing
Suomi-NPP VIIRS Albedo

- Two algorithms were originally implemented in code
  - Bright Pixel Surface Albedo (BPSA) uses a TOA LUT approach
    - Liang, 2003; Liang et al., 2010
    - Designated as primary algorithm
    - BPSA is now the ONLY Albedo provided
      - Low quality Beta results currently being output from CLASS
  - Dark Pixel Surface Albedo (DPSA) based on MODIS heritage
    - Spectral BRDF models, coarse NBAR, were supposed to be produced in unreleased IP
    - Discovered after launch that DPSA code had been turned off
    - Subsequent evaluation found the DPSA code poorly implemented
      - Require a major redelivery and redesign of code
      - Decision made in April 2014 not to attempt to correct

- Note at present VIIRS will not provide MODIS continuity
VIIRS Albedo Evaluation

- VIIRS Beta BPSA Albedo extremely unstable
  - Problems with cloud/snow/SR continue

- BPSA **only** algorithm being processed
  - prototype gridded DPSA had to be primarily evaluated at NASA LPEATE and offline

- Monitoring VIIRS
  - versus daily MODIS V006
  - versus tower albedometers
Poor Quality control throughout DPSA process
Insufficient Quality flags assigned to DPSA (and BPSA) output (Thanks to the LPEATE

Differences with ADL code and why it matters

- Read input data
- Reflectance, angles, QFs ...
- Set weight to reflectance data
- Check Outliners
  - Number of reflectance data > 7
    - No Check outliers
      - Without this function, the inversion includes noisy data which is caused by poor data, undetected clouds, and anomalous events. It can make the results quite variable.
    - Check kernel QC, But QC in MINIMIZE_RMSE_HERITAGE does not match with QC check
      - Number of reflectance data > 3
        - Yes
          - Fill value
        - No
          - Magnitude inversion
    - Yes
      - Calculate NBAR, albedo
      - WOD & RMSE > threshold
        - Yes
          - Calculate weight of determination and RMSE
        - No
          - Full inversion
            - Yes
              - Check kernel QC, But QC in MINIMIZE_RMSE_HERITAGE does not match with QC check
            - No
              - Number of reflectance data > 3
                - Yes
                  - Fill value
                - No
                  - Number of reflectance data > 7
                    - Yes
                      - Check Outliners
                    - No
                      - Magnitude inversion
                        - Yes
                          - Calculate NBAR, albedo
        - No
          - Full inversion
a) Current BPSA

BPSA and DPSA of eastern USA as being currently produced by the Mx8.3 I&T in the IDPS (NOTE: BPSA has extensive clouds and DPSA generates very few retrievals)

(b) DPSA (2014-03-06)
Flagged with virtually no full retrievals (NY) and mostly fill

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<th>QA number</th>
<th>Color</th>
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<tr>
<td>0</td>
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<td>N/A</td>
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<tr>
<td>1</td>
<td>Green</td>
<td>full inversion</td>
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<tr>
<td>2</td>
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Offline version of DPSA under development

Suomi-NPP VIIRS Sahara Black Sky Albedo 2014 DOY013

MODIS Version 006 (   VIIRS  Tile H17V06

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<th></th>
<th>R</th>
<th>G</th>
<th>B</th>
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<tbody>
<tr>
<td>VIIRS</td>
<td>662 - 682 nm</td>
<td>545 - 565 nm</td>
<td>478 - 488 nm</td>
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<tr>
<td>MODIS</td>
<td>620 - 670 nm</td>
<td>545 - 565 nm</td>
<td>459 - 479 nm</td>
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Red BSA
R²=0.9988

1.24µm BSA
R²=0.9991
VIIRS offline Daily DPSA vs current BPSA

Albedo over Sahara

DOY 2013

ALBEDO

270 275 280 285 290 295 300 305
True color BSA of tile H12V04 of New England and southeastern Canada, Sept 2013
Suomi NPP VIIRS DPSA offline NBAR (Nadir BRDF Adjusted Reflectance)

Two adjoining Suomi NPP VIIRS surface reflectance swaths over tile h08v05 for Day 278 2013

Resultant NBAR after BRDF correction with offline DPSA algorithm
Validation over Spatially Representative SURFRAD Sites Offline DPSA

Ft Peck MT, 2012
Validation over Spatially Representative SURFRAD Sites Offline DPSA and Current BPSA

Ft Peck MT, 2012
Offline DPSA

Penn State PA, 2012
Summary

• DPSA implemented in IDPS code is irreparably broken
  • Only BPSA will be provided by CLASS

• Inability to obtain, evaluate, and make corrections to the IDPS products is a serious problem – will be for NPP and into the future with JPSS.

• Offline MODIS heritage DPSA code has been produced
  • Difficulties with upstream products continue (currently resulting in fewer high quality retrievals than from MODIS data stream)
  • However offline DPSA results indicate that high quality BRDF, NBAR, and Albedo products are achievable (VIIRS products need to be accompanied by sufficient quality flags to aid the user)