NPP VIIRS Land Product Status

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Several fundamental land surface data products - surface reflectance, vegetation index, surface albedo, land surface temperature, surface type and active fires - are generated from the NPP Visible Infrared Imager Radiometer Suite (VIIRS) on the Suomi National Polar-orbiting Partnership (NPP) satellite. Current operational algorithms build on heritage algorithms, including those for the NASA EOS Moderate Resolution Imaging Spectroradiometer (MODIS). Development and maintenance of the operational land products has transitioned to government-led Algorithm Teams supported by the JPSS program. These activities, together with the refinement and execution of the previously established Land Product Validation program, are carried out in close coordination with and active participation by the NASA NPP Land Science Team and Land PEATE (Product Evaluation and Test Element). Pre-launch preparatory activities include detailed algorithm assessments, adoption and development of algorithm testing and evaluation systems, and the refinement and rehearsal of product validation during the post-launch intensive calibration and validation period. This poster includes updates on the status of each NPP VIIRS land product, proposed enhancements and algorithm updates to improve product performance for real-time and long-term monitoring, and initial results from the immediate post-launch evaluation of surface reflectance.

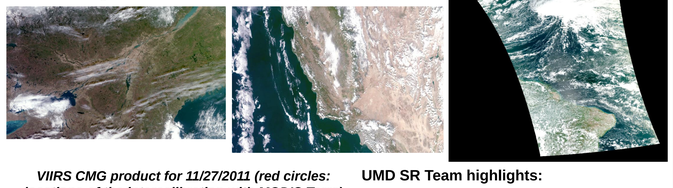
JPSS Land EDR Team Membership

Role or Product Focus	Name	Organization
Product Lead, Fire algorithm & val.	Ivan Csiszar	STAR
S. Reflectance; VCM & SDR Liaison	Eric Vermote	UMD
Surface Reflectance	Alex Lyapustin	GSFC
Albedo algorithm	Bob Yu / Shunlin Liang	STAR / UMD
Albedo validation	Crystal Schaaf	Univ. Mass / Boston
LST algorithm	Bob Yu	STAR
Validation Lead, LST validation	Jeff Privette / Pierre Guillevic	NOAA/NCDC
Vegetation Index algorithm	Marco Vargas	STAR
Vegetation Index validation	Tomoaki Miura/ Alfredo Huete	U. of Hawaii / Arizona
NASA Land Discipline Team lead	Chris Justice	UMD
NASA Coordination & Validation	Miguel Román	NASA/GSFC
Surface Type algorithm	Jerry Zhan	STAR
Surface Type validation	Mark Friedl	Boston Univ.

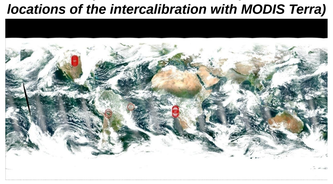
All JPSS Land Team members and their support personnel contributed to this poster.

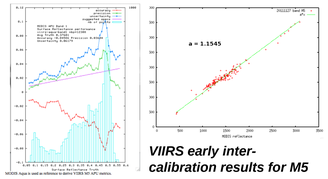
SURFACE REFLECTANCE

First light surface reflectance imagery (11/21/2011)



VIIRS CMG product for 11/27/2011 (red circles: locations of the intercalibration with MODIS Terra)





VIIRS early inter-calibration results for M5

UMD SR Team highlights:

•Development of products and tools (Climate Modeling Grid, APU comparison tools, display tools for IDPS product)

• ADL like versions of the Aerosol, VCM, SR and climate modeling grid generator run at the SCF

•Work with NASA Land PEATE on proposed product improvement (processing over clouds and other exceptions)

•Development of tools to restore data from bow tie deletion process

•Interaction with VCM team to evaluate change in the VCM LUT

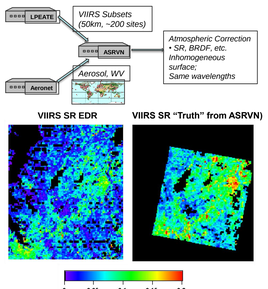
•Generation of corrected reflectance CMG

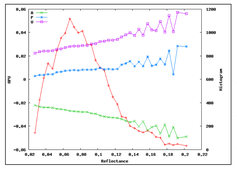
•Evaluated VIIRS calibration and communicated with the calibration team

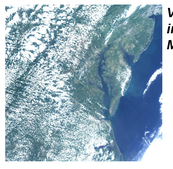
NASA SR Team highlights:

•Evaluation of VIIRS Using AERONET Surface Reflectance Validation Network (ASRVN)

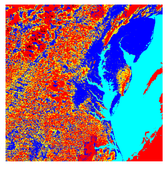
•Prototyping the use of the Multiangle implementation of atmospheric correction (MAIAC) algorithm for analysis of VIIRS VCM, Aerosol and SR products





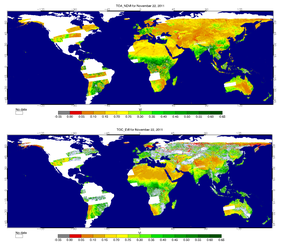


VIIRS proxy image from MODIS



MAIAC VCM

VEGETATION INDEX



Global maps of VIIRS VI and EVI

VI Team highlights:

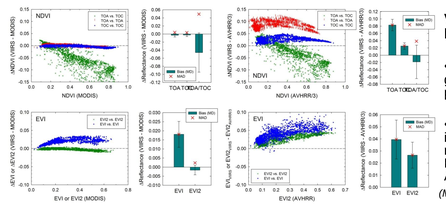
•VI algorithm and product evaluation using ADL

•preparation for top-of-canopy NDVI

• VIIRS-MODIS-AVHRR spectral compatibility analysis using hyperspectral data for EVI and EVI2

•prototyping of ASRVN analysis protocols using MODIS

•development of a scaling methodology for using tower-based reflectance to validate VIIRS VI EDR



VIIRS VI validation with MODIS:

•~40 Hyperion scenes over global AERONET sites processed

•Providing baseline information on the relationships of VIIRS VI EDR with MODIS and AVHRR

(Miura, Huete, & Turner, 2011)

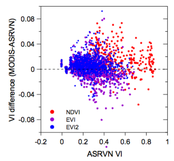
VIIRS VI Validation with ASRVN:

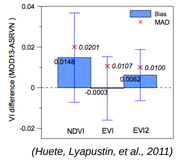
•Accurate atmospheric correction with AERONET

•Avoiding a complicated spatial scaling problem

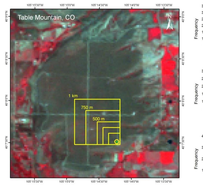
•Global assessment

•Prototyping at 40 sites





(Huete, Lyapustin, et al., 2011)



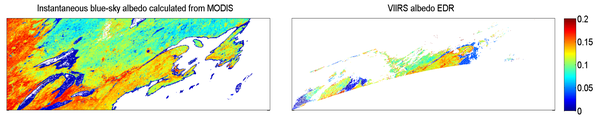
VIIRS VI EDR Validation with Tower Reflectance:

•Spatial Representative Analysis for Table Mountain Site Using Landsat TM

•Ground (non-satellite) based radiometers (BSRN, PEN, etc) used to anchor VI data to the ground

(Miura, Connor, et al., 2012)

SURFACE ALBEDO



Map of instantaneous blue-sky albedo from MODIS and VIIRS proxy, acquired on September 6, 2002. The MODIS map was mosaiced from 8 MODIS tiles and calculated from MODIS white-sky albedo and black-sky albedo. The VIIRS data was re-projected from one albedo EDR swath.

VIIRS Land Surface Albedo Team highlights:

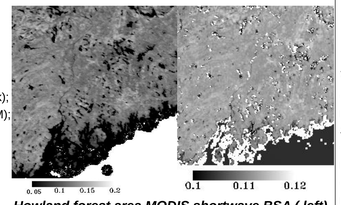
•Algorithm testing and evaluation using ADL 3.1

•Validation using in-situ data:

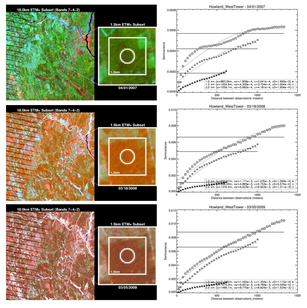
- •Baseline Surface Radiation Network (BSRN);
- •NOAA SURFRAD (SURFace RADiation Network);
- •DOE Atmospheric Radiation Measurement (ARM);
- •flux towers (e.g. Ameriflux, CarboEurope);
- •international long term ecological research sites (ILTER);
- •meteorological towers (Climate Reference Network)

•assessment protocol (Román et al., 2009; 2010) that relies on a geostatistical model that predicts the overall variability, spatial extent, structure, and strength of surface albedo patterns

- •utilizes periodically retrieved multispectral high-resolution imagery as an intermediate between ground and satellite retrievals

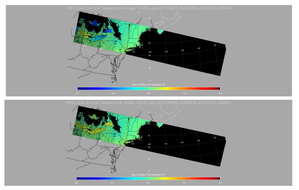


Howland forest area MODIS shortwave BSA (left) and VIIRS shortwave albedo (right)



Top-of-Atmosphere shortwave reflectance composite (ETM+ Bands 7-4-2) and corresponding semivariogram functions, variogram estimator (points), spherical model (dotted curves), and sample variance (solid straight lines) using regions of 1.0 km (asterisks), 1.5 km (diamonds), and 2.0 km (squares), centered over Howland west on 04/01/2007 (top), 03/18/2008 (middle), and on 03/05/2009 (bottom). The circle stands for the tower footprint (30m) and the black stripes are caused by SLC-off.

LAND SURFACE TEMPERATURE



LST proxy images for granule at 0636 on 20020906. Top: dual window; bottom: split-window algorithm.

LST_VIIRS (Dual)	LST_VIIRS (Split)	VIIRS Proxy data	LST_CRN (Int.)	LST_CRN (No Int.)
284.18	284.21	284.18	284.46	284.95
285.07	285.10	285.07	282.86	282.45
284.64	284.58	284.64	283.01	284.45
284.72	284.74	284.72	280.02	280.85

Examples of the comparison of proxy VIIRS LST and CRN data for above granule.

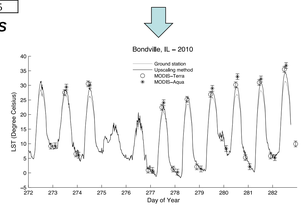
VIIRS Land Surface Temperature Team highlights:

•Algorithm testing and evaluation using ADL 3.1

•LST validation against ground measurements from CRN. The LST results are from runs in ADL using the dual window algorithm and split window algorithm. (Proxy data were solely used for the development and testing of validation tools.)

•Development of a method to scale-up point tower measurements to satellite pixel areas

- •Addresses subpixel heterogeneity with a physical-based method
- •Driven by near-real time meteorological field data Inexpensive: uses NOAA's ~130+ operational field sites
- •Used at CRN and SURFRAD sites
- •Works for homogeneous and heterogeneous sites



Example of scaling field data to MODIS. Precision without scaling was > 3K. With scaling it decreased to ~2K

SURFACE TYPE

VIIRS Land Surface Type Team highlights:

•Transition NGST/Raytheon code to new JPSS team:

- •Surface Type IP and EDR algorithm (C5.0 Decision Tree) implemented at UMD SCF.
- •Legacy and newly developed training data sets ingested at UMD from MODIS LC team.

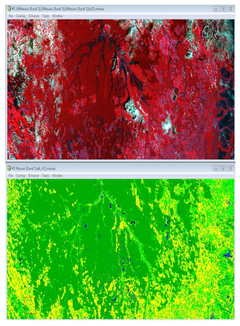
•Continued development of site database to be used for VIIRS ST QST IP and ST EDR validation.

•The newer Support Vector Machine (SVM) algorithm is identified as potential new algorithm for the QST IP.

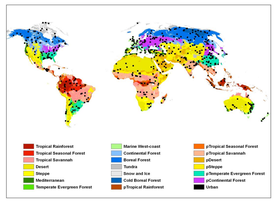
•Acquisition and processing of high resolution imagery at validation site locations identified via stratified random sampling

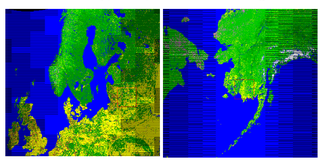
•Development of aggregation methods to VIIRS pixel size

•Development and testing of validation tools



MOD09 2-3-1 color composite (2001/01/01) and Surface Type map from the C5.0 algorithm





NPP VIIRS Surface Type EDR Granules in gridded maps. Left: Northern Europe; right: Alaska.

ACTIVE FIRES

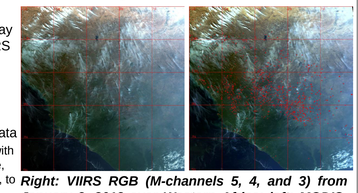
VIIRS Active Fire Team highlights:

•Developed capability to search/ingest/display near-coincident Aqua/MODIS and NPP/VIIRS AF data Cal/Val

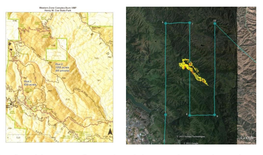
•Refined methodology to simulate VIIRS radiances for fire pixels

•Developed partnerships to acquire high resolution airborne and satellite reference data

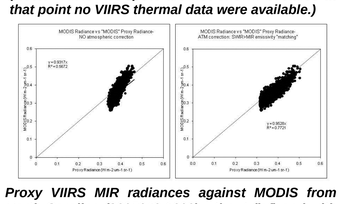
- •The team participated in a field campaign with California Fire (CalFire), U.S. Forest Service, NASA/Ames, and San José State University, to collect ground and airborne reference data during a prescribed burn at Henry Coe State Park, CA on October 18, 2011.



Right: VIIRS RGB (M-channels 5, 4, and 3) from January 3, 2012 over Western Africa; left: MODIS-Aqua near coincident observation of the same region showing with hot spot (MYD14) detections. (Note: VIIRS hot spots are not shown because at that point no VIIRS thermal data were available.)

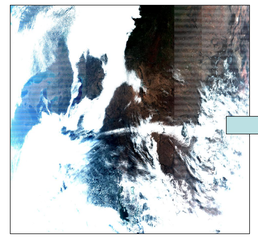


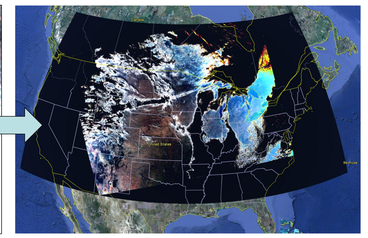
Left: Henry Coe ignition plan showing location of firing teams and instruments; right: Hot spot imagery from Autonomous Modular Sensor (AMS) overpass at 2246 UTC, October 18, 2011, corresponding with Aqua-MODIS overpass. Flight paths for the B200 are shown as blue lines and waypoints.



Proxy VIIRS MIR radiances against MODIS from North Carolina (2005049.1600) without (lef) and with (right) atmospheric correction. Data generated using ASTER kinetic temperature (AST08) and surface reflectance (AST07_XT) products with MODTRAN and NCEP/radiosonde profile data.

NASA LAND PEATE SUPPORT AND COORDINATION





Reprojection of NPP Level-1B SDR Product (DOY 327, 2011, RGB = Band 5,4,3) to MODIS (500m) Sinusoidal Grid

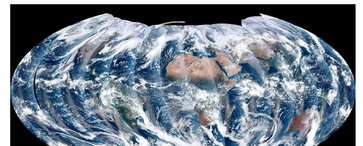
Land-PEATE highlights:

•Development of generic reprojection tools for VIIRS swath products is complete and in test phase.

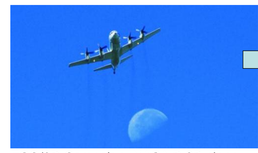
• Working on implementing runs of generic subsetter for VIIRS Level-2 Swath products over targeted field sites (e.g., FLUXNET, AERONET, and NOAA-CRN.)

•Global browse images have been available since VIIRS was turned on to enable synoptic quality assessment.

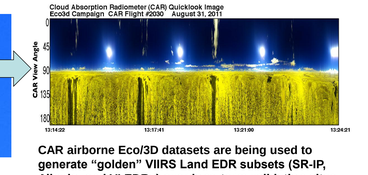
•Coordination of Land CONOPS, Cal/Val Rehearsal & Pre-launch Cal/Val Campaign (ECO/3D).



Global browse image of the VIIRS L1B Moderate input, (DOY 327, 2011, RGB = Band 5,4,3) generated from the coarse 6km version of the products made at Land PEATE.



ECO/3D Campaign: NASA P-3B plane passes over Bartlett Forest, NH
(from: Conway Daily Sun)



CAR airborne Eco/3D datasets are being used to generate "golden" VIIRS Land EDR subsets (SR-IP, Albedo, and VI EDRs) over long-term validation sites.

SUMMARY AND CONCLUSIONS

The JPSS Land Team is ready for post-launch algorithm development, evaluation and validation

•Extensive preparation during pre-launch and immediate post-launch

- •Adoption of corresponding Algorithm Development Library code, along with development of off-line science code
- •Establishment of data acquisition and ingest capabilities
- •Adoption and development of validation tools
- •Coordinated development of validation Operations Concepts

Work with on-orbit shortwave data began immediately after first light

•First light imagery

•Correlative analysis with MODIS

•Initial comparison with *in situ* data

Close coordination between the NOAA/JPSS and NASA Land Discipline teams

•Bi-weekly teleconferences

•Major role of LandPEATE for data access, algorithm testing and evaluation, and Quality Assurance

Continuing advances in algorithm and validation science

•MODIS land heritage, including the latest MODIS algorithm developments

•Improved scaling of point reference data to VIIRS pixels

EDR/IP/ ARP	PI & co.	Access systems and download VIIRS data					Download Val. Data		Access CasaNosa	Visualize / analyze VIIRS proxy	Compare with Val. Data		Alg. change	Access & use ADL	Access & use ADA
		GTP	LPEATE	STAR	NSIPS	CLASS	Field / Hi res Data	MODIS			Field Data.	MODIS			
SR	Alexei Lyapustin Yujie Wang		✓			✓	✓	✓	✓	✓	✓	✓	✓		
	Eric Vermote	✓	✓			✓	✓	✓	✓	✓		✓	✓	✓	
ST	Mark Friedl Damien Sulla-Menashe	✓		✓		✓	✓	✓	✓	✓		✓	✓		
	Xiwu (Jerry) Zhan Chengquan Huang Kuan Song	✓	✓	✓		✓		✓	✓	✓			✓		
VI	Tomoaki Miura Alfredo Huete	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓		
	Marco Vargas Nikolay Shabanov	✓		✓	✓	✓			✓	✓			✓	✓	
Albedo	Crystal Schaaf Zhuosen Wang	✓				✓	✓	✓	✓	✓	✓	✓	✓		
	Yunyue (Bob) Yu Shunlin Liang Dongdong Wang	✓			✓	✓	✓	✓	✓	✓		✓	✓	✓	
AF	Ivan Csiszar Wilfrid Schroeder Louis Giglio Evan Ellicott	✓	✓	✓			✓	✓	✓	✓		✓	✓	✓	
LST	Jeff Privette Pierre Guillevic	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓		
	Yunyue (Bob) Yu Sanmei Li Yuling Liu	✓			✓		✓	✓	✓	✓	✓	✓	✓	✓	

Summary of JPSS Land Algorithm and Validation Team capabilities for data access, reference and correlative data and processing at the conclusion of the pre-launch preparatory activities. Note also NASA LandPEATE's overarching support described above.

ACKNOWLEDGMENT

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