



# ***NASA Land SIPS: Production and QA***

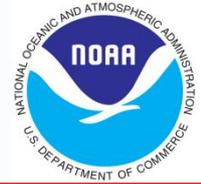
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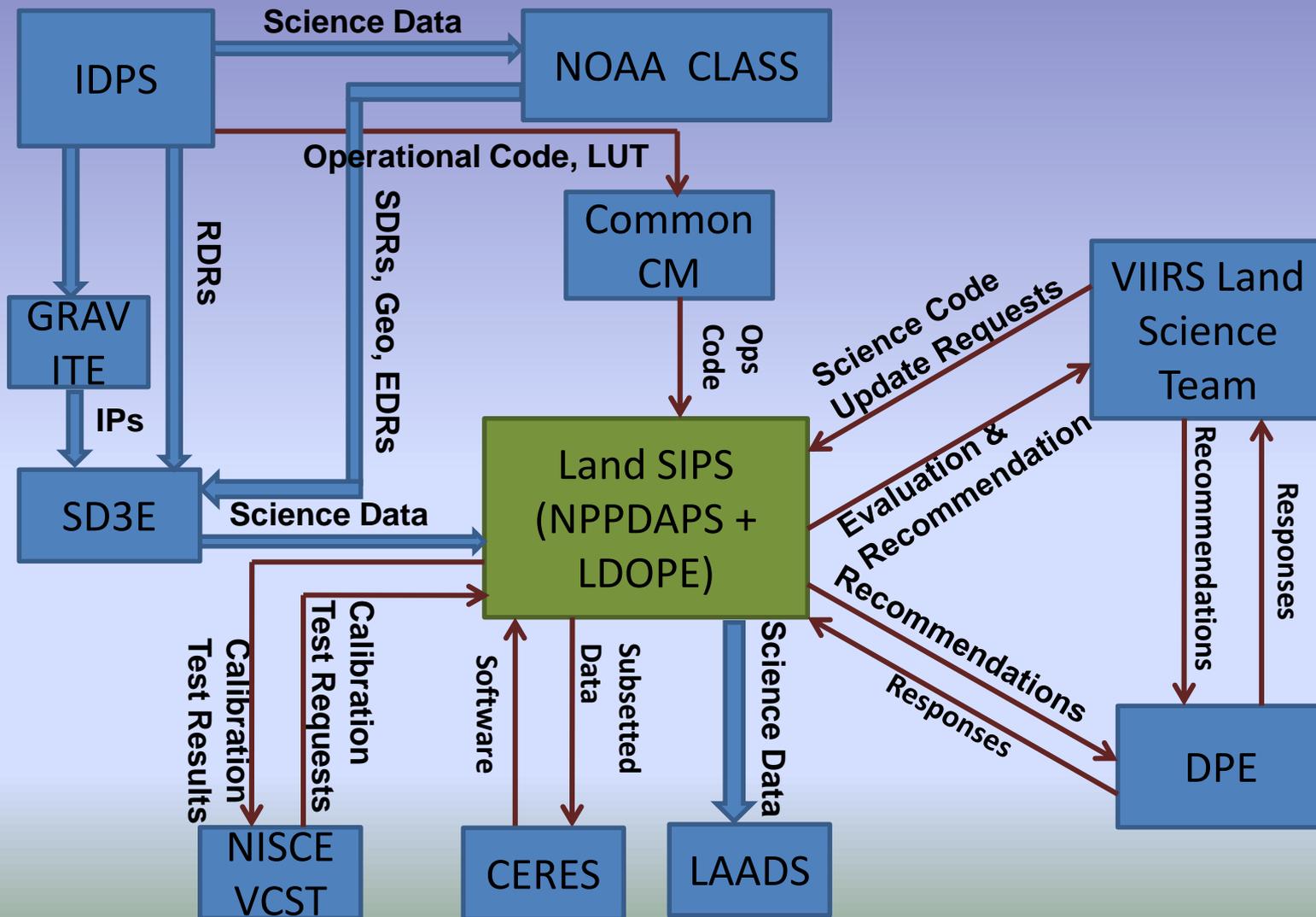
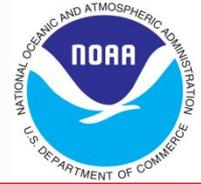
# Land Science Investigator-led Processing System



- **Objective is to generate high quality land products from the VIIRS on-board S-NPP**
  - Extend the Earth System Data Records (ESDRs) developed from NASA's heritage Earth Observing System (EOS) Moderate Resolution Imaging Spectroradiometer (MODIS) onboard the EOS Terra and Aqua satellites.
  - Generate land products using NASA science team delivered algorithms (beginning in December 2015) in combination with science algorithms currently in operation. Majority of NASA science algorithms will be in operation by December 2016.
  - Reprocess land data records from S-NPP mission as desired and recommended by the NASA science team using mature science algorithms provided by the NASA science team
  - Quality assessment performed at the Land Data Operational Product Evaluation (LDOPE) facility adopting the best-practices and tools used to assess the quality of heritage EOS-MODIS products generated at the MODIS Adaptive Processing System (MODAPS).



# Land SIPS: Current Interface





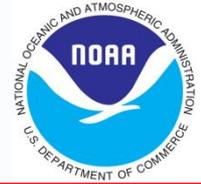
# Land SIPS - Forward Processing Status



- Land SIPS continues to receive and process VIIRS data. Data products are in HDF4 format, archived and distributed from LAADS  
<http://ladsweb.nascom.nasa.gov>
  - **IDPS (LAADS AS 3000):** Aggregate IDPS generated SDRs, Geolocation, EDRs and IPs from one global day (Saturday) every week. Data used to verify the accuracy of products produced in AS 3001. Build version in operation at IDPS is Mx8.10.
  - **Land SIPS (LAADS AS 3001):** Process RDRs using IDPS OPS PGEs integrated to Land SIPS processing system.
    - Leading edge is at current data day.
    - Cloud mask uses IDPS generated 17-day rolling tiles for RNDVI. GMAI based daily snow-ice tiles not ingested, instead tiles are generated in-house using daily NISE data.
    - Products match to aggregate IDPS products in AS 3000 except for minor differences in cloud mask and occasional differences from out of sync algorithm build versions and 17-day RNDVI roll up, ancillaries, and LUTs. Build version in operation is Mx8.10.
  - **LPA (LAADS AS 3002):** Process RDRs using Land SIPS adjusted version of IDPS OPS PGEs.
  - Science team developed algorithms, Diagnostic Data Records (MODIS size gridded tiled products with VIIRS inputs) are generated from all three processing streams.
- Subsets are being generated from AS 3001 and 3002.



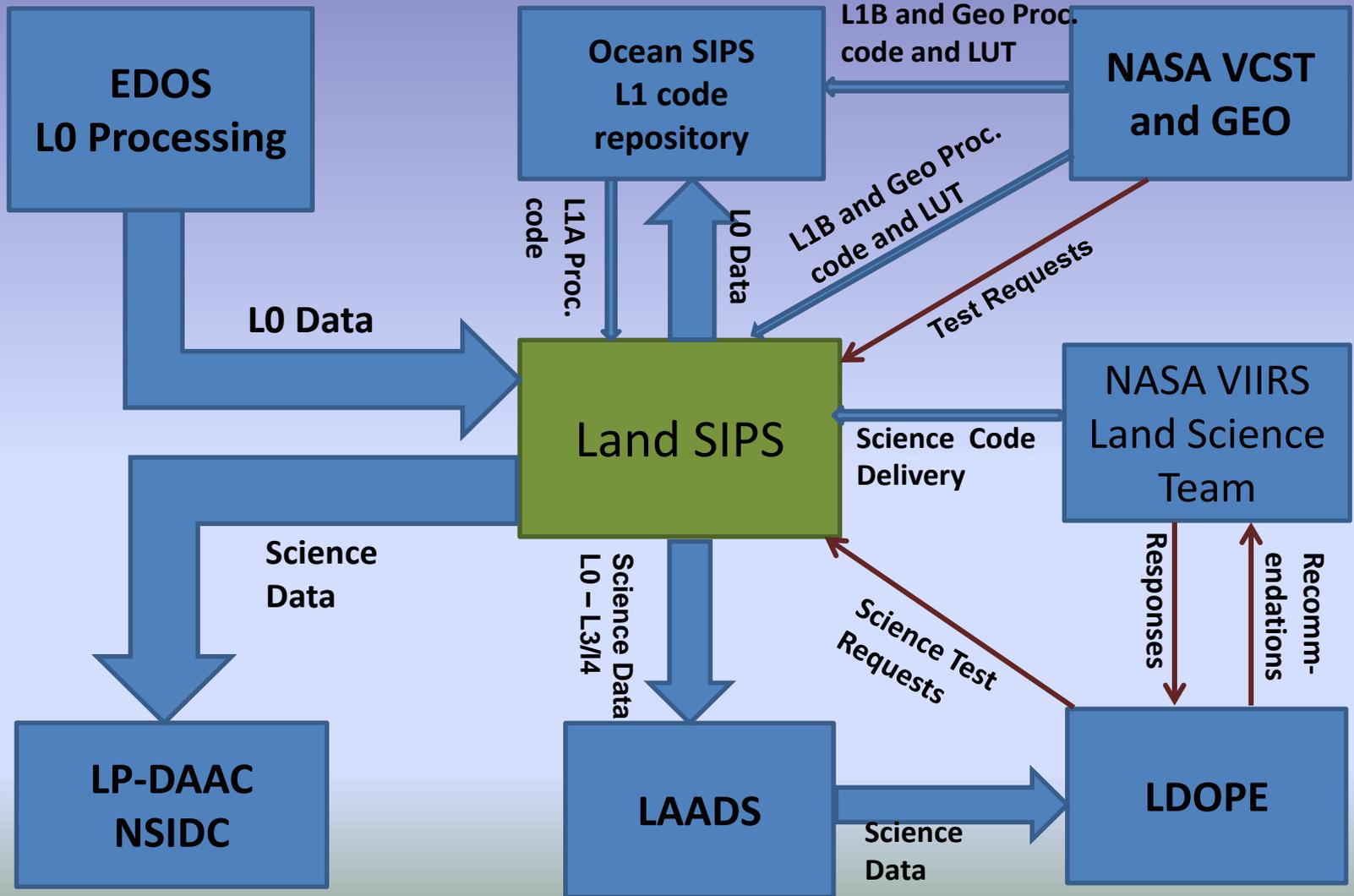
# Land SIPS – C11 Reprocessing Status



- **C11 reprocessing in AS 3110 generates consistent records from the beginning of the mission using the best calibration LUT provided by NASA VCST and best of algorithms available.**
  - **Reprocessing started on 2/26/2014 and completed on July 2014. Records start with the beginning data day 1/19/2012. Processing lags by one month waiting for delivery of LUT by VCST.**
  - **Cloud Mask uses the Climatology 16-day composite NDVI from the 4-years of Aqua MODIS observations and daily snow-ice from NISE data replacing the 17-day rolling tiles of NBAR-NDVI and the monthly/daily snow-ice rolling tiles used in the operational process at IDPS**
  - **DNBs are processed using the LUT for calibration and stray light correction provided by the NASA VCST.**
  - **Processing uses the Land SIPS Adjusted variations of OPS PGEs for TC DNB Geolocation (DNFT), L2 LSR (SR-IP), L2 VI (VRVI) and L2 Aerosols (AOTIP).**
  - **Land SIPS processes the Science DDRs using the latest version of the DDR algorithms based on MODIS C5 operational PGEs and the CERES subsetter.**
  - **This reprocessing does not generate the OPS L2 Land Albedo, Surface Albedo or any GIPs, and does not use rolling tiles.**

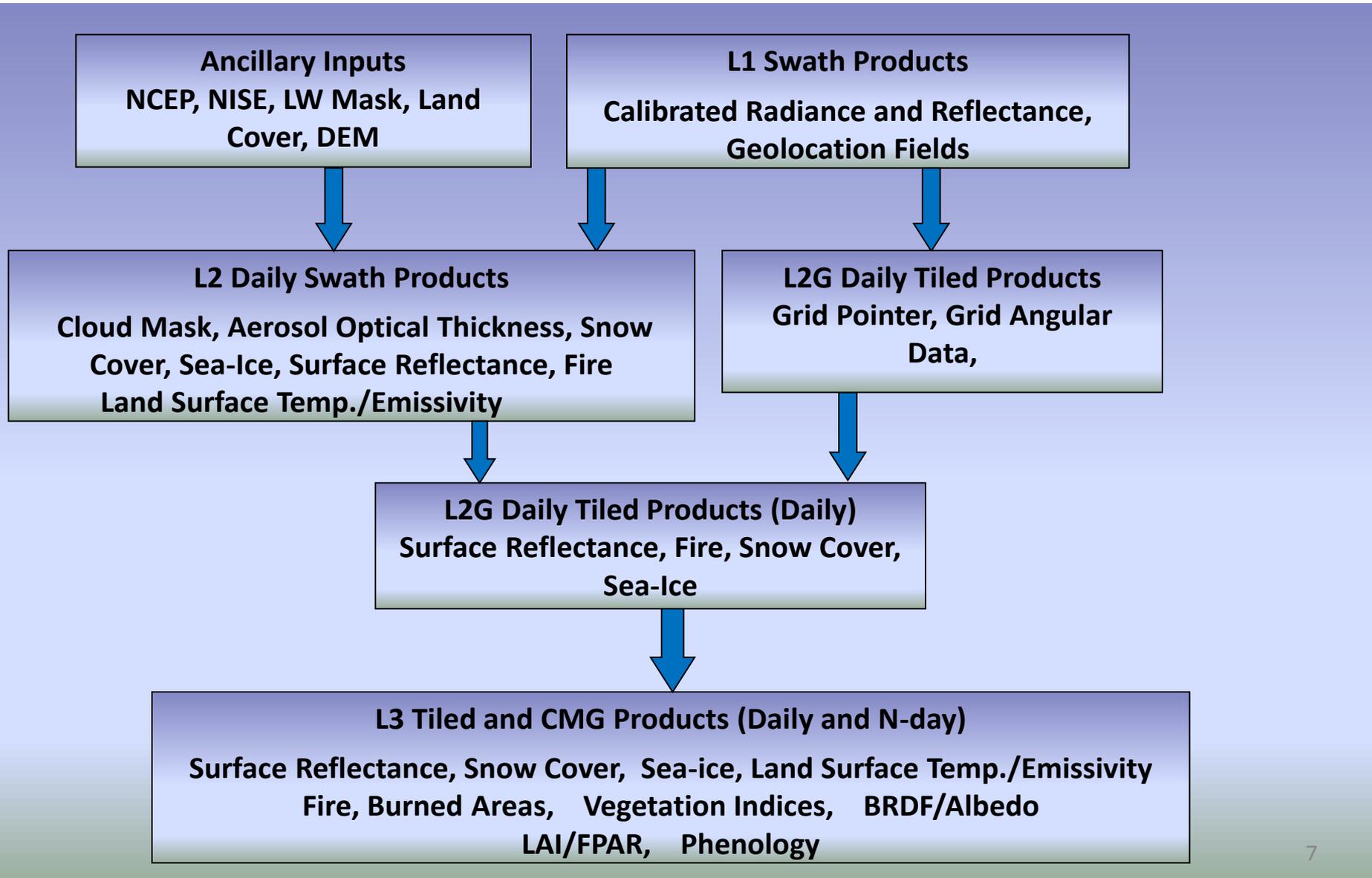
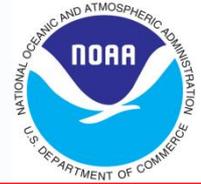


# Land SIPS: Operational Interface





# Land SIPS - VIIRS Data Product Hierarchy





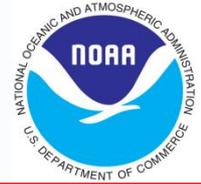
# Land SIPS - VIIRS Data Production



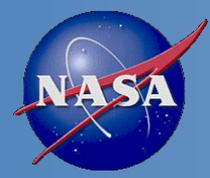
- VIIRS L1 and L2 swath products are generated from processing of the VIIRS data acquired during 6 minutes of the satellite overpass.
- The L2G, L3 and L4 products are produced as adjacent non-overlapping tiles of approximately 10 degrees square, (at the equator)
- L2G product is a data structure storing the L2 observations intersecting the grid cell in a map projection. L2G heavy format stores all observations that meets the threshold criteria for the observation foot print coverage with the grid cell, L2G-lite format stores only one observation from an orbit. First observation is stored in a 2D array and the additional observations from all grid cells are stored in a 1-D array.
- The MODIS land gridded products are produced at 4 resolutions (500m, 1km, and 0.05 degree), and in 3 projections (Sinusoidal, Lambert Azimuthal Equal-Area, and Geographic). The simple Geographic lat/lon projection is only used for the coarsest resolution grid, produced at 0.05 km (~ 5.5 km), which is referred to as the Climate Modeling Grid (CMG). Most of the higher resolution VIIRS land products are produced in the Sinusoidal tile grid, except for the Sea Ice products, which are produced in the polar Lambert Azimuthal Equal-Area tile grids.



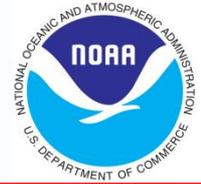
# Land SIPS - Transition



- **The L0 dataflow from EDOS is currently under testing. The Operational Readiness Review (ORR) for EDOS is scheduled for Sept 14, 2015. Expected to be operational by early October.**
- **NASA L1A/L1B/Geo expected to be operational at Land SIPS by early October 2015.**
- **New Land SIPS Processing stream is currently in development. Expected to be operational in December 2015, generating land products using the NASA science team delivered algorithms and “best-of” science algorithms currently in operation.**
  - C11 reprocessing in AS 3110 will continue until NASA ST and SIPS is ready for the next collection reprocessing using the NASA L1B data and NASA Science Team delivered algorithms.
  - AS 3001 and 3002 will be replaced with a single forward processing stream in AS 300X containing best of the algorithms from the two processing streams, using IDPS delivered RDRs through SD3E.
  - In parallel to this forward processing in AS 300X, Land SIPS will develop the new SIPS processing stream (in AS 500x) that would generate the NASA VIIRS land products using the NASA ST delivered algorithms using the NASA L1B as input. This NASA processing stream, when fully functional could replace AS 300X.



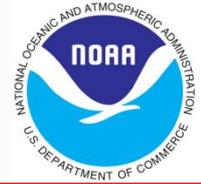
# Land SIPS – IDPS vs SIPS Products



- **L1B and Geo:** Aside from differences in format, when the same LUTs are configured and all data is converted to a common floating point radiance data type, there is no significant difference between the L1B and SDR products.
- **Upstream Products**
  - SIPS will use the **C11 approach to Cloud Mask**. Cloud Mask from Atmosphere SIPS could be also considered if available.
  - SIPS will use the Mx8.10 build of **IDPS for AOTIP** with recommended changes from the NASA SR science team.
- Science Processing algorithm for **Surface Reflectance and Fire** algorithm will be nearly the same as operational IDPS.
  - Code Changes to SR at Land SIPS will be delivered to STAR/AIT for implementation and testing in ADL and delivery to DPE for use in operational processing at IDPS.
- **Land Surface Temperature** will use the IDPS operational algorithm until an emissivity based algorithm is delivered by the NASA science team.



# Land SIPS – VIIRS Land Products



Product Name	VIIRS (S-NPP) ESDTs	MODIS Heritage ESDTs	VIIRS (S-NPP) (Product release date: Tentative)
Land Surface Reflectance	VNP09	MxD09	DEC 2015
MAIAC Product Suite *	VNP19	MCD19	JUL 2016
BRDF/Albedo, NBAR	VNP43	MCD43	MAR 2016
Land Surface Temperature	VNP21	MxD21	DEC 2016
Vegetation Indices (VI)	VNP13	MxD13	JAN 2016
FPAR	VNP15	MxD15	JUN 2016
Fire and Thermal Anomalies	VNP14	MxD14	MAR 2016
Burned Area	VNP64A1	MCD64A1	DEC 2016
Snow Cover	VNP10	MxD10	MAR 2016
Sea Ice Cover	VNP29	MxD29	NOV 2016
Ice Surface Temperature	VNP30	MxD10	NOV 2016
Land Surface Phenology	VNP12Q2	MCD12Q2	APR 2017

\* Includes surface reflectance, BRDF, snow fraction and aerosol retrievals over Land



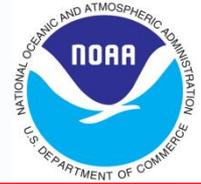
# Land Product Quality Assessment and Algorithm Evaluation



- **Adopts the MODIS Land QA approach to assess quality of VIIRS products.**
  - Global browses, golden tiles browses, animation, time series
  - Visual inspection of browse images and analysis of selected sample data records
- **Verify reproducibility of IDPS products at Land SIPS.**
  - Through comparison of global browse images of Land SIPS generated products to IDPS aggregated products in AS 3000
  - Accuracy, Precision and Uncertainty estimate from comparison of full resolution data records from the two archive sets.
- **Assessment of VIIRS Land Algorithm Changes**
  - PGE specific science test and chain tests run generating global data
  - Baseline and Test data created for comparison of different algorithm versions, LUTs, Seed Files etc.
  - Comparison to heritage MODIS products
- **QA information posted on the QA web page**
  - Results from all QA processes (browses, time series, APU etc.)
  - Known issues from operational product evaluation
  - Algorithm test status and evaluation results
- **QA tools developed and maintained by LDOPE**
  - Generic and transparent to products from different instruments
  - All operational QA processes automated to process data in real time with production and populate result on the QA web page.



# Land SIPS - QA Web Page



National Aeronautics and Space Administration  
Goddard Space Flight Center

## Suomi NPP - Land Science Investigator-led Processing System

# VIIRS Land Product Quality Assessment

Visible Infrared Imaging Radiometer Suite

Home	Browse	Time Series	Land Products	QA Info	Alg Updates/Eval	Links	Early Images
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### Welcome to the NPP VIIRS Land Product Quality Assessment

The objective of the VIIRS (Visible Infrared Imaging Radiometer Suite) Land Product QA is to evaluate and document the science quality of products made from the remotely sensed data acquired using VIIRS. Results of quality assessment of samples of VIIRS Land products made at Land SIPS (Science Investigator Processing System) and IDPS (Interface Data Processing System) and results of evaluation of improvements to the VIIRS Land Science algorithms derived by analyzing the products made at Land SIPS using the new algorithms are placed on the web pages located at this site.

The Suomi NPP (National Polar-orbiting Partnership) satellite was launched on Oct. 28, 2011. Evaluation of products from the IDPS OPS (Operation System) algorithms, and the Land SIPS adjusted version of the IDPS OPS algorithms run at Land SIPS and of the science algorithm improvements are done at LDOPE (Land Data Operational Product Evaluation). Results from LDOPE's evaluation of the pre-launch version of the IDPS algorithms done using simulated or proxy MODIS data and the results from the science test of changes to algorithm done post-launch using on-orbit data are posted on the Algorithm Updates/Evaluation section of this web page. This web page is constantly evolving. For global browse images from immediate post-launch period please click on the Brows menu at the top of this page. Please direct your questions and comments to [Sadashiva Devadiga](#).

For more information about the VIIRS Land products, validation, and product maturity status, visit: <http://viirsland.gsfc.nasa.gov/index.html>

### What's New

- Mx8.10 is now in operation at Land SIPS starting day 08/08/2015 (2015126).** Click [here](#) for NPP version history.
- VIIRS xDR from the operational processing of on-orbit data at Land SIPS using the same algorithm version as IDPS is available from AS 3001 of LAADS and products from science team improved version of algorithms is available from AS 3002. Please see the [Land SIPS data production and retention policy](#) to verify availability of data online.
- SNPP VIIRS Land Records from [C1.1](#) reprocessing using best of Calibration LUTs and science algorithms available from AS 3110. C1.1 reprocessing started 2/26/14. Reprocessing of December, 2014 started 1/20/15 and completed 2/5/15. This reprocessing lags operational processing by a month.
- Data products from the early mission period were labeled as of BETA quality. Many products have now reached [maturity stage](#) of "provisional quality" or "Validation Stage 1".

## http://landweb.nascom.nasa.gov/NPP\_QA/

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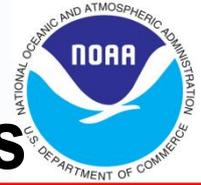
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# Land Product Quality Assessment

## Global Browse Images of Operational Products

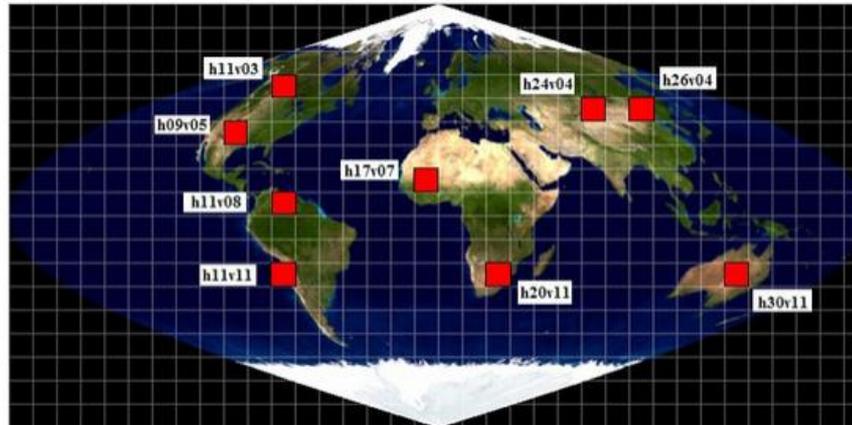


Julian day		NPP_VMAE_L1 L1B Moderate input, Day Band 5,4,3	NPP_VIAE_L1 L1B Imagery input, Day Band 1,2,1	NPP_VDNE_L1 Night Band	NPP_CMIP_L2 Cloud Mask IP Day	NPP_CMIP_L2 Cloud Mask IP Night	NPP_VAOTIP_L2 Aerosol Optical Thickness IP	NPP_SRFLMIP_L2 Surface Refectance IP (Moderate)	NPP_VAFIP_L2 Active Fire IP	NPP_VLST_L2 Land Surface Temperature Daytime
2015 236	Orbiter									
2015 235	Orbiter									
2015 234	Orbiter									
2015 233	Orbiter									
2015 232	Orbiter									
2015 231	Orbiter									
2015 230	Orbiter									
2015 229	Orbiter									
2015 228	Orbiter									
2015 227	Orbiter									
2015 226	Orbiter									
2015 226	Orbiter									

## NPP Time Series

A time series of summary statistics derived from all the gridded NPP Land products at a number of fixed globally distributed locations is maintained and monitored by LDOPE personnel in order to enable synoptic [quality assessment](#) via the internet. Product time series analyses are important because they capture algorithm sensitivity to surface (e.g., vegetation phenology), atmospheric (e.g., aerosol loading) and remote sensing (e.g., sun-surface-sensor geometry) conditions that change temporally, and because they allow changes in the instrument characteristics and calibration to be examined. Time series statistics are extracted at nine NPP Land golden tiles selected over areas that are expected to be representative of the variability of the majority of the NPP Land products. [Golden tile browse images](#) are also available for the most recent month of production. Follow steps to examine time series plots. Click [here](#) for more information.

1. Select a data set:
2. Select a product:
3. Click on a tile:



Plot Options: LPEATE, h09v05, NPP\_D16VIHKM\_L3D -16-day Vegetation Index

Biome	LandCover	Site
<a href="#">biome 1</a>	<a href="#">land_cover 10</a>	<a href="#">site 19</a> <a href="#">site 23</a>
<a href="#">biome 2</a>	<a href="#">land_cover 7</a>	<a href="#">site 6</a> <a href="#">site 7</a> <a href="#">site 10</a>
<a href="#">biome 3</a>	<a href="#">land_cover 12</a>	<a href="#">site 26</a> <a href="#">site 33</a>
<a href="#">biome 4</a>		<a href="#">site 18</a>
<a href="#">biome 6</a>	<a href="#">land_cover 1</a>	
<a href="#">biome 7</a>	<a href="#">land_cover 16</a>	<a href="#">site 40</a> <a href="#">site 41</a> <a href="#">site 42</a>



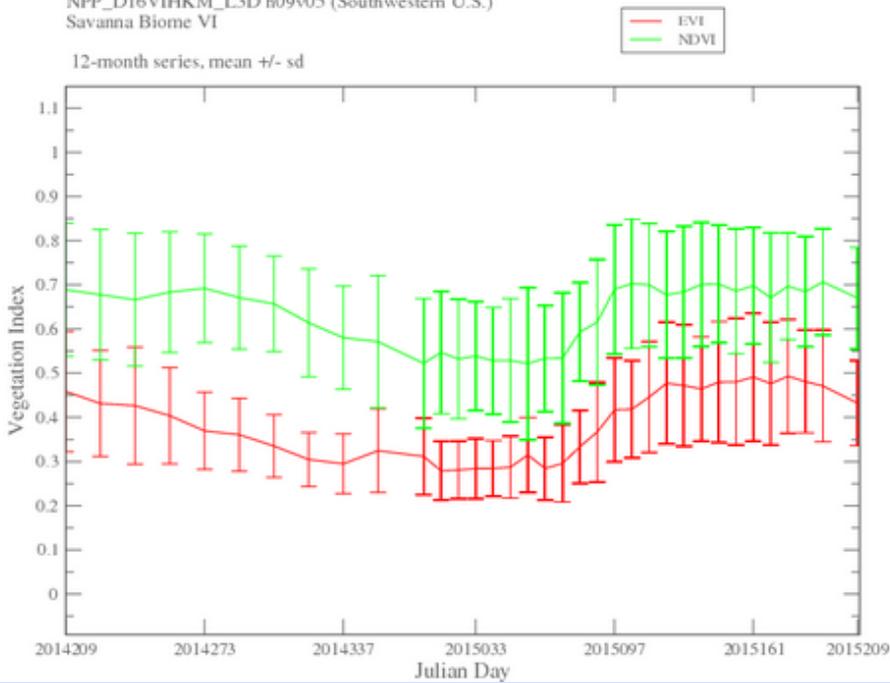
# Land Product Quality Assessment

## Golden Tile Time Series: LST Day



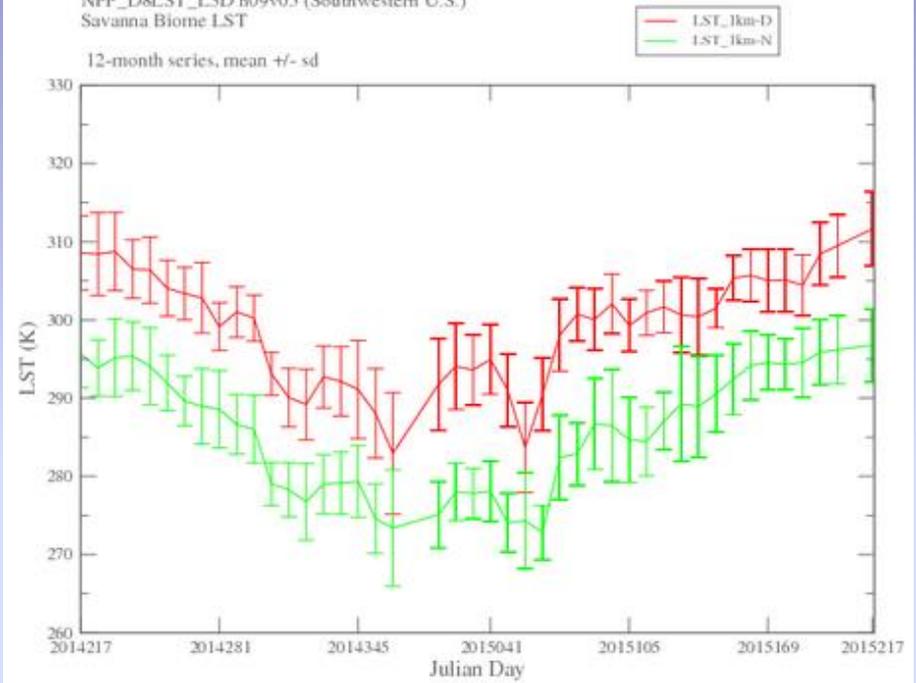
NPP\_D16VIHKM\_L3D h09v05 (Southwestern U.S.)  
Savanna Biome VI

12-month series, mean +/- sd



NPP\_D8LST\_L3D h09v05 (Southwestern U.S.)  
Savanna Biome LST

12-month series, mean +/- sd





# Land Product Quality Assessment

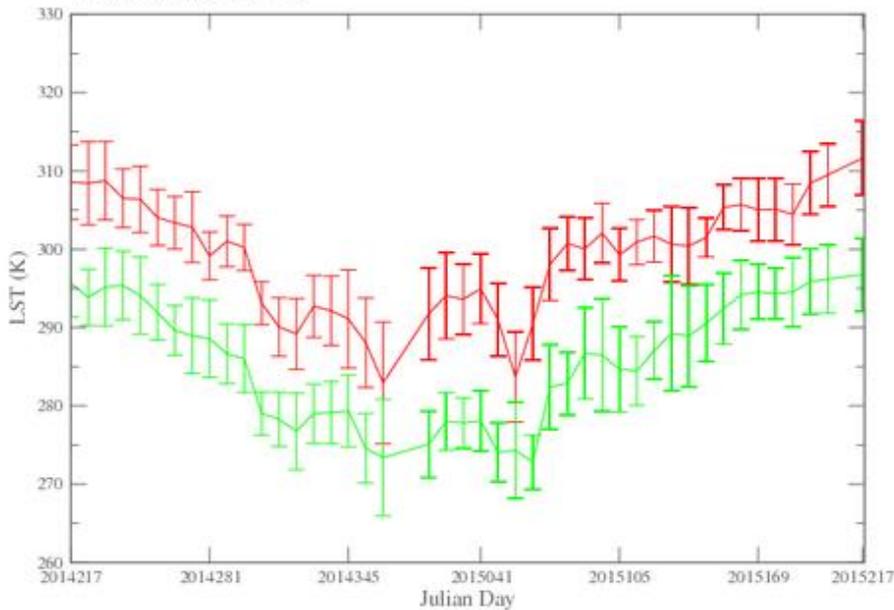
## Golden Tile Time Series, LST: IDPS vs C11



NPP\_D8LST\_L3D h09v05 (Southwestern U.S.)  
Savanna Biome LST

— LST\_1km-D  
— LST\_1km-N

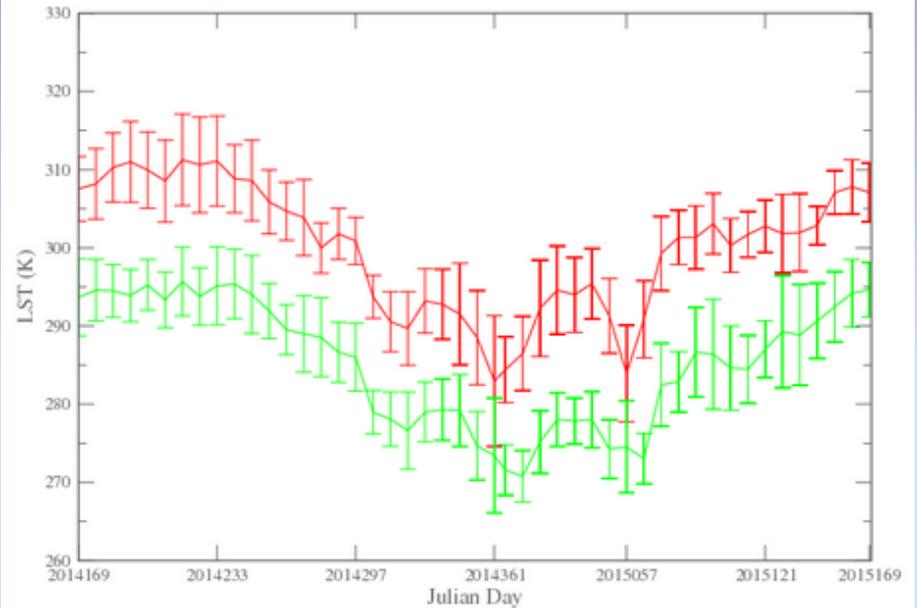
12-month series, mean  $\pm$  sd



NPP\_D8LST\_L3D h09v05 (Southwestern U.S.)  
Savanna Biome LST

— LST\_1km-D  
— LST\_1km-N

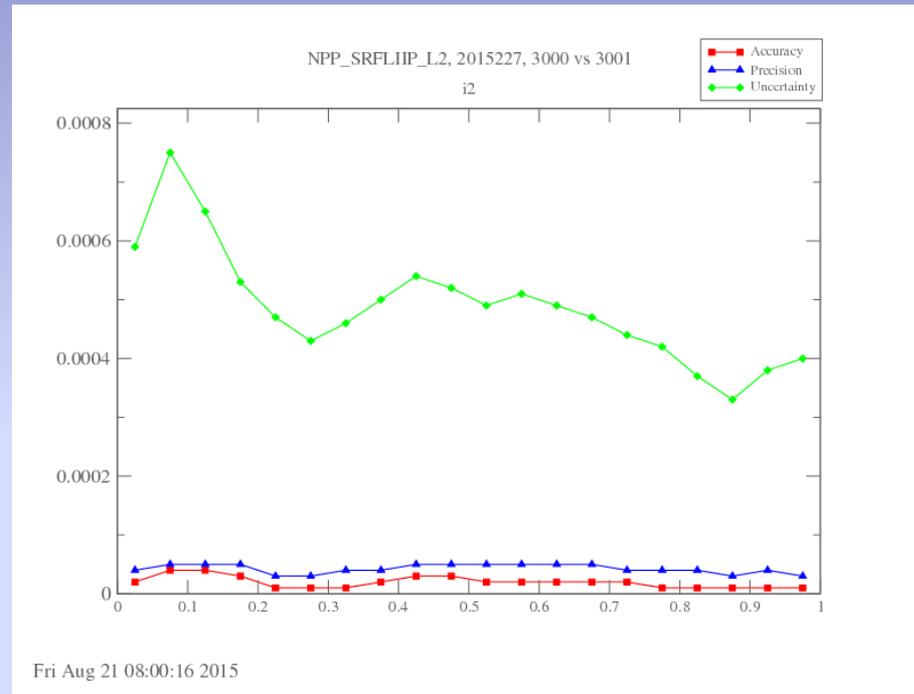
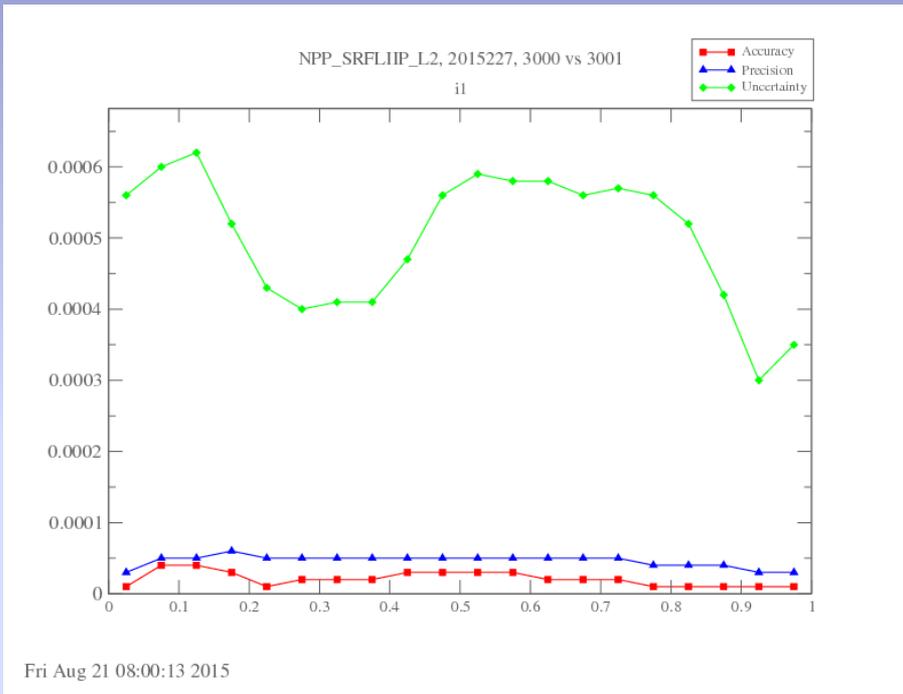
12-month series, mean  $\pm$  sd





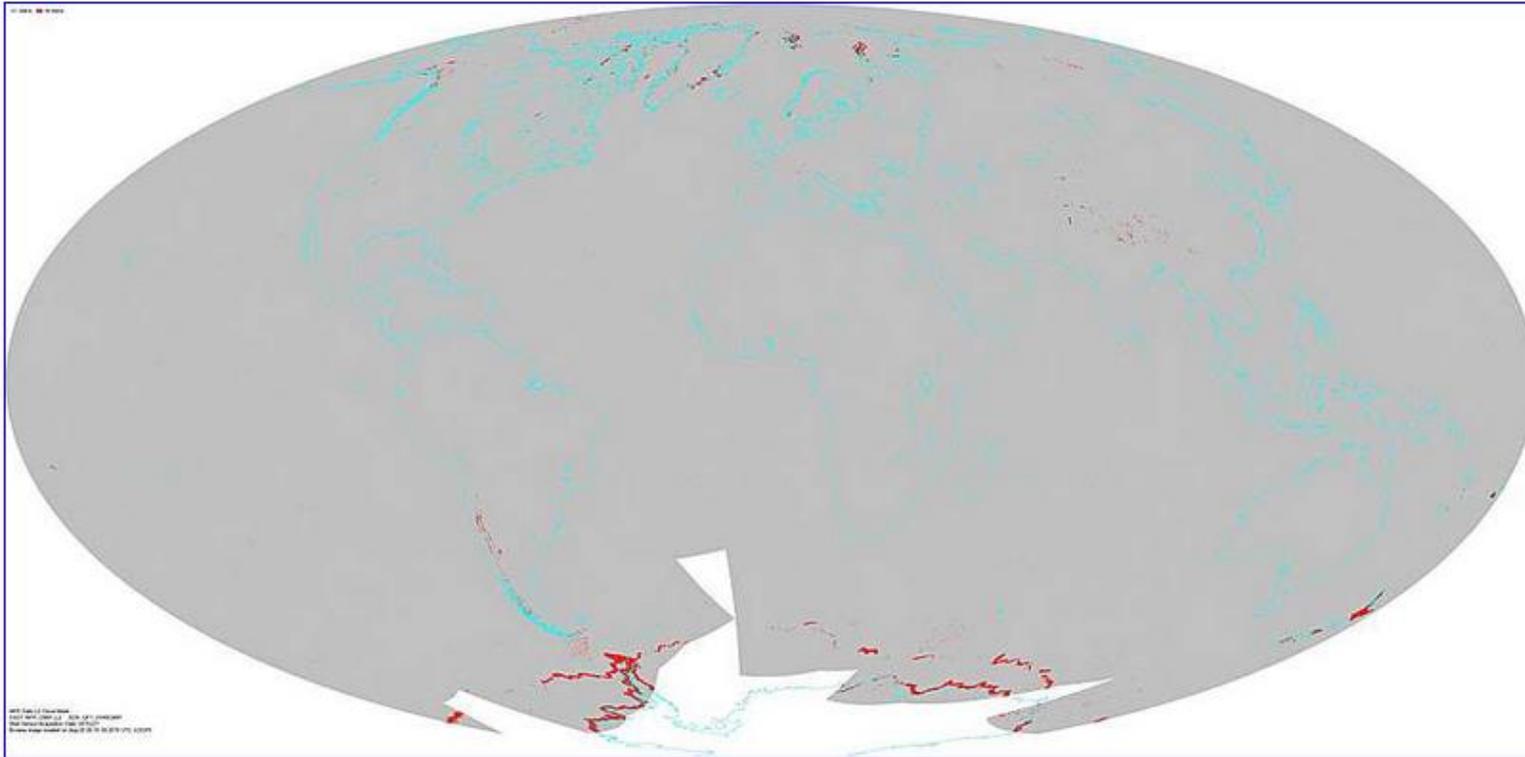
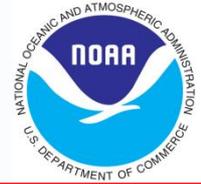
# Land Product Quality Assessment

## APU for Surface Reflectance : IDPS vs LSIPS





# VCM QF1: IDPS diff LPEATE (Day 2015227)



Color Look Up:  Match  No Match

SDS	Total Match	Total Mismatch	Total Counts	Percent Match	Percent Mismatch
QF1_VIIRSCMIP	2410605463	25746301	2436351764	98.943244	1.056756
QF2_VIIRSCMIP	2430076970	6275030	2436352000	99.742442	0.257558
QF3_VIIRSCMIP	2423107005	13244995	2436352000	99.456360	0.543640
QF4_VIIRSCMIP	2426575211	9776789	2436352000	99.598712	0.401288
QF5_VIIRSCMIP	2436352000	0	2436352000	100.000000	0.000000
QF6_VIIRSCMIP	2427333469	9018531	2436352000	99.629835	0.370165



# VCM: IDPS vs LPEATE (Day 2015227)



- Statistics from comparison of cloud confidence in VCM\_IP

GranID		%Cloud	%Cloud_match	%Clear_Match	%Comm_Diff	%Omm_Diff
A2015227.0325	Australia - East	40.38	99.93	99.99	0.02	0.07
A2015227.0455	Antarctica	68.22	99.97	99.98	0.01	0.03
A2015227.0505	Australia - West	13.16	99.87	99.99	0.04	0.13
A2015227.0530	Northern Russia	60.56	99.88	99.84	0.10	0.12
A2015227.0535	Arctic	59.84	99.83	99.40	0.40	0.17
A2015227.0635	Antarctica	71.37	99.92	99.98	0.01	0.08
A2015227.0710	Northern Russia	63.70	99.99	99.98	0.01	0.01
A2015227.0715	Arctic	60.32	99.87	99.22	0.51	0.13
A2015227.1000	Antarctica	40.61	99.90	99.98	0.03	0.10
A2015227.1140	Antarctica	62.77	99.92	99.97	0.02	0.08
A2015227.1155	Africa - equitorial	40.71	99.99	100.00	0.00	0.01
A2015227.1200	Africa - Sahel	27.08	99.99	100.00	0.01	0.01
A2015227.1715	Canada - East	49.27	99.97	99.99	0.01	0.03
A2015227.1720	Canada - North	50.77	99.70	99.31	0.67	0.30
A2015227.1850	NA – Gulf of Mexico	38.26	99.96	99.99	0.02	0.04
A2015227.1855	Central NA	39.78	99.97	100.00	0.01	0.03
A2015227.1900	Canada - North	50.91	99.84	99.75	0.24	0.16

IDPS is used as reference

%Cloud = TotalCloudyPixels/TotalPixels

%CloudMatch = AllMatch/Total\_Ref\_Cloudy

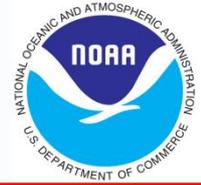
%ClearMatch = AllClear/Total\_Ref\_Clear

%Comm = (TotalNumpixels where C1 is showing cloud and IDPS not)/TotalRefCloudy

%Omm = (TotalNumpixels where C1 is not showing cloud and IDPS is)/TotalRefCloudy



# Conclusion



- Land SIPS will soon generate VIIRS Land records using the NASA VIIRS L0 data.
- Land SIPS forward processing stream will generate high quality land products using NASA science team delivered algorithms or “best of” algorithms in current operations.
- C11 reprocessing will continue until Land SIPS is ready for another reprocessing.
- VIIRS L1 and L2 swath products are generated in 6 minute granules while the L2G, L3 and L4 products are produced as tiles of approximately 10 degrees square
- Products are distributed to public through assigned DAACs