

STAR JPSS 4TH ANNUAL SCIENCE TEAM MEETING, AUGUST 14TH – 18TH, 2017

JPSS-STAR (JSTAR) Program Updates



PRESENTED BY LIHANG ZHOU
JPSS AMP DEPUTY FOR SCIENCE & JPSS STAR PROGRAM MANAGER
NOAA/NESDIS/CENTER FOR SATELLITE APPLICATIONS AND RESEARCH (STAR)

CONTRIBUTIONS FROM MURTY DIVAKARLA, XINGPIN LIU, TOM ATKINS, TESS VALENZUELA
MEMBERS OF JPSS STAR SCIENCE TEAMS
JPSS PROGRAM SCIENCE
JPSS ALGORITHM MANAGEMENT PROJECT (AMP)
ARE THANKFULLY ACKNOWLEDGED





Highlights of JSTAR FY17 Accomplishments

JPSS-1 Readiness:

- Updated/Delivered of JPSS-1 Cal/Val Plan for all SDR/EDR products: Dec-16
- Developed, tested, and delivered J1 algorithms/LUTs for ATMS, CrIS, VIIRS, OMPS SDRs, and BUFR toolkit
- Critical Design Review (CDR) for updates to NDE/ESPC EDR algorithms for JPSS-1: Oct-16
- Support JPSS Ground Project Block 2.0 Testing/Build Deploy checkout
 - » SDRs, ICVS, Imagery, JPSS-EPS, NUCAPS, MiRS, VPW, etc.
 - » Post-LG2, NDE 2.0 Science Product Evaluation, Block 1 vs Block 2 Comparison, JCT5, 8-day data flow

S-NPP Maintenance/Updates/Operational Cal Val Support/User support:

- VIIRS Global Surface Type (GST) Annual update: GST-2015 available on STAR web: Sep-16
- BUFR toolkit update (V8Pro, V8TOz, CrIS-2211, CrIS-431, ACSPO SST): Apr-17
- OMPS TC/NP weekly Dark & NP bi-weekly wavelength & solar flux LUT update; VIIRS monthly straylight and DNB LUT updates
- S-NPP and GCOM-W1 Maintenance Delivered Algorithm Packages (DAPs) Deliveries (NUCAPS, GAAPS, etc.)
- Imagery of the month delivered by the Imagery EDR team to the program

Cal/Val Maturity & SDR/EDR Reprocessing:

- Validated Maturity Review for NUP products (VPW, GVF, VH, NUCAPS, MiRS, GCOM): Oct-16, Apr-17
- Cal/Val Maturity ReadMe update for all JPSS products: Dec-16
- Completed SDR Reprocessing (ATMS, CrIS, OMPS): Dec-16
- Completed OMPS EDR reprocessing (V8Pro & V8TOz, for 2012-01-26 to 2017-05-31): Jul-17

Integrated Calibration/Validation System (ICVS) Long Term Monitoring:

- ICVS: Updated package to GRAVITE to support operation; Upgraded for J1
- EDR Long Term Monitoring Phase II: requirements comparison

Work with Program Science and coordinate reviews of requirements; waivers; and future improvements for users' applications



JPSS-1 Readiness: Codes/LUTs Deliveries

Milestone	Delivery Date
Re-delivery of ATMS PCT (using PSAT 26)	02/16/17
Delivery of ATMS PCT update (ADR8456)	08/07/17
CrIS engineering packet update (v37, ADR8397/CCR3425), uploaded on 06/07/17	
CrIS DAP (ADR8444 - CrIS full spectral resolution PCT & XML update to use all the CrIS extended interferogram data points; for S-NPP & JPSS-1)	06/29/17
Re-delivery of CrIS PCT update DAP (ADR8444, using Mx3 ADL)	07/06/17
Delivery of CrIS DAPs (ADR8361 - Control generation frequency of CrIS-<FS>-SDR-ENGPCT-BACKUP-AUX using checksum field from ENG PKT APID 1290; ADR8445 - CrIS Full spectral resolution SDR longwave band radiance anomaly in IDPS Block2.0)	08/09/17
CrIS DAP (ADR8013 - CrIS Interferogram spikes not detected) to ASSISTT	07/27/17
J1 VIIRS prelaunch LUTs update DAP (ADR8417, 4 LUTs: VIIRS-SDR-DNB-DN0-LUT, VIIRS-SDR-RELATIVE-SPECTRAL-RESPONSE-LUT, VIIRS-RSBAUTOCAL-BRDF-SCREEN-TRANSMISSION-PRODUCT-RTA-VIEW-LUT, VIIRS-SDR-RADIOMETRIC-PARAM-V3)	05/31/17
VIIRS DAP (ADR8393 – VIIRS SDR code update (checkLimits.cpp) to fix incorrect assignment of M6 reflectance values for pixels with the "out-of-range" radiance)	06/15/17
VIIRS DAP (ADR8281 – code update to fix offset & scaling factor applying order in RSBautocal)	07/12/2017
OMPS DAP (ADR 8283 - Bias correction for 17 km xtrack TC data)	02/23/17
Re-delivery of ADR8283 DAP (using Mx 2.0 ADL)	06/15/17
OMPS SDR J1 Launch-ready LUTs (version 3, for both NP & TC)	03/09/17
Re-delivery of OMPS SDR J1 Launch-ready LUTs (version 3, with updated documentation/name change)	03/28/17
OMPS NP SDR Wavelength & Solar Flux LUTs DAP (wavelength Annual Pattern Correction, 1 st delivery, then bi-weekly update)	03/29/17
OMPS LUT update (ADR8419 - J1 OMPS-NP-OSOL-LUT Update; ADR8396 - J1 OMPS NP CALCONST LUT Update)	07/10/17



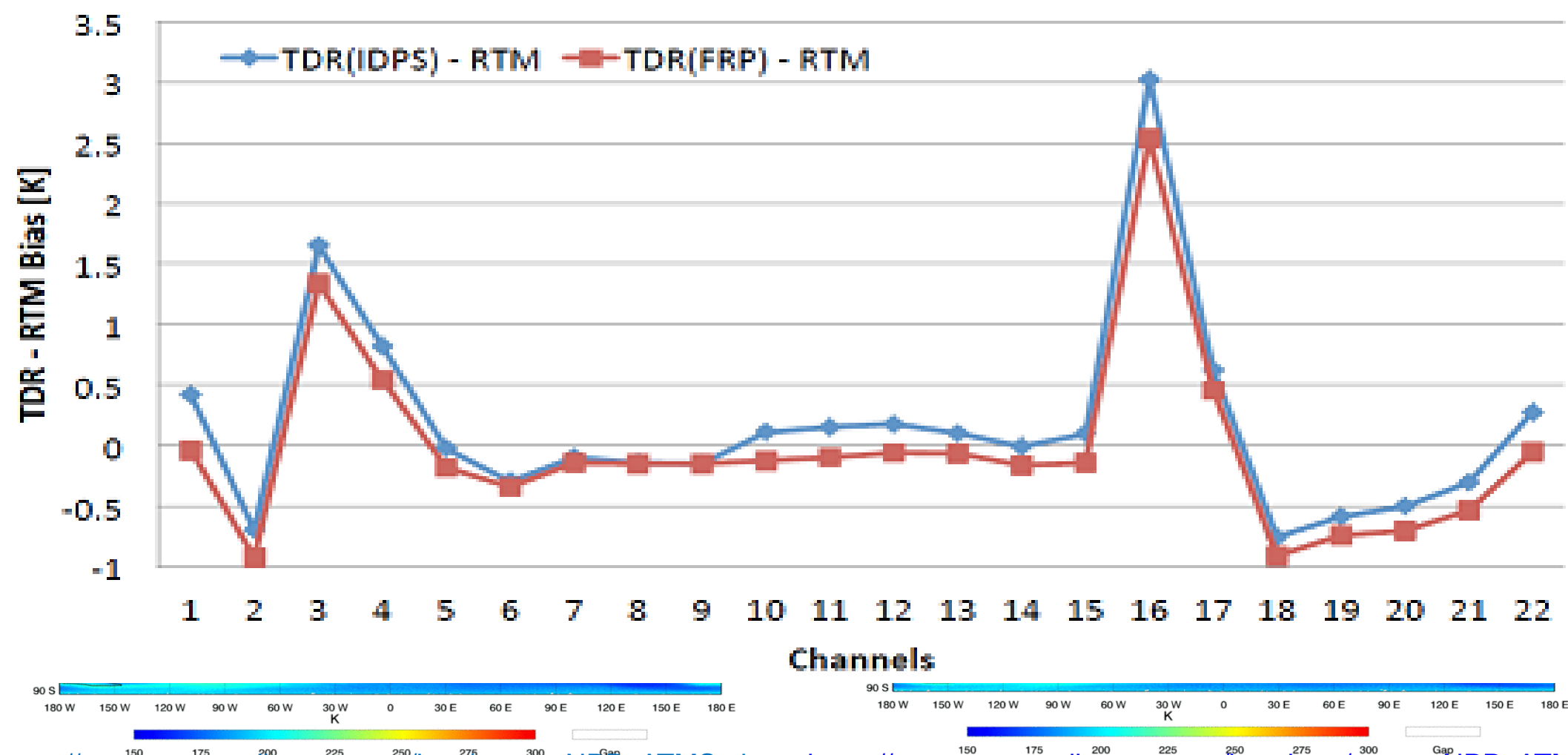
JPSS-1 Readiness: Block 2.0 Testing

STAR ICVS Support on S-NPP Block2.0 Data, Report

Block 1.2 S-NPP

Block 2.0 S-NPP

ATMS TDR-RTM Bias using FRP (Red) and using IDPS OPS (Blue)



https://www.star.nesdis.noaa.gov/icvs/status_NPP_ATMS.php

https://www.star.nesdis.noaa.gov/icvs-beta/status_NPP_ATMS.php

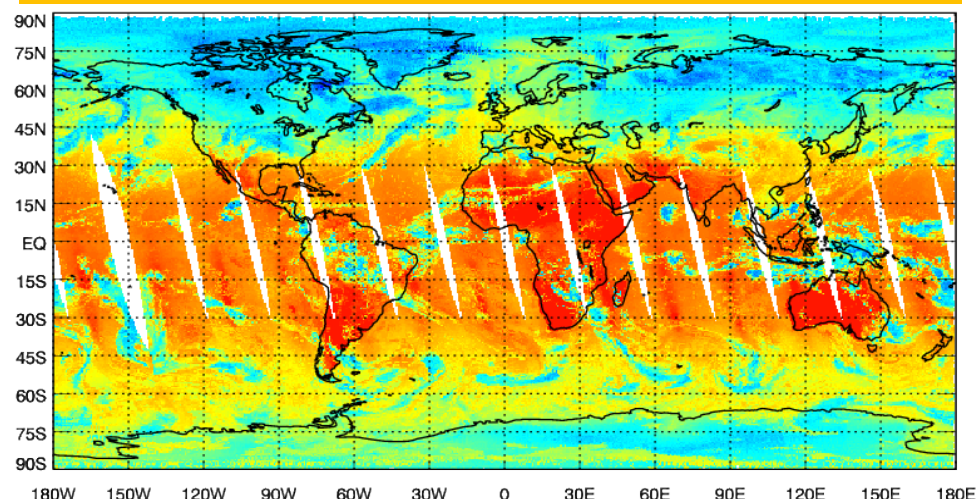
ATMS SDR: Full Radiance Calibration in Operation Since March 8th 2017



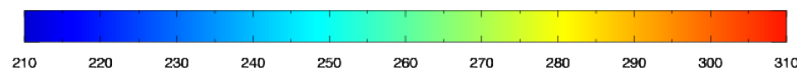
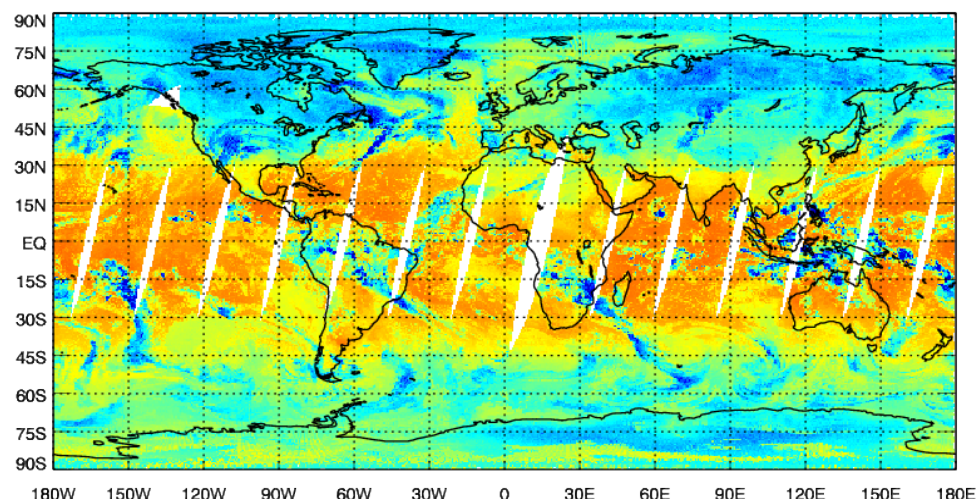
CrIS SDR Updates: Full Spectral Resolution

STAR ICVS Support on S-NPP Block2.0 Data, Report

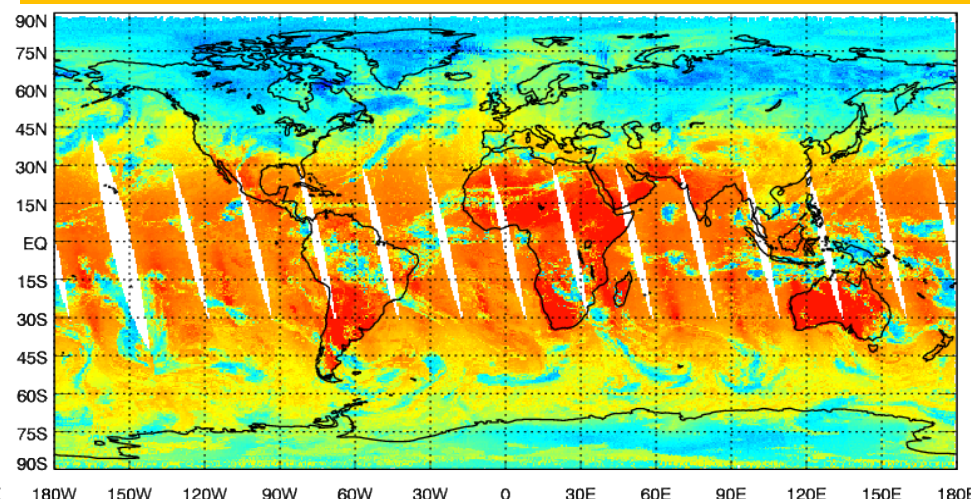
S-NPP – FSR B1.2



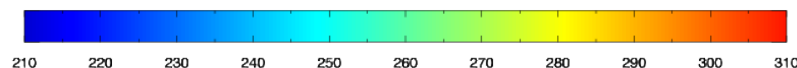
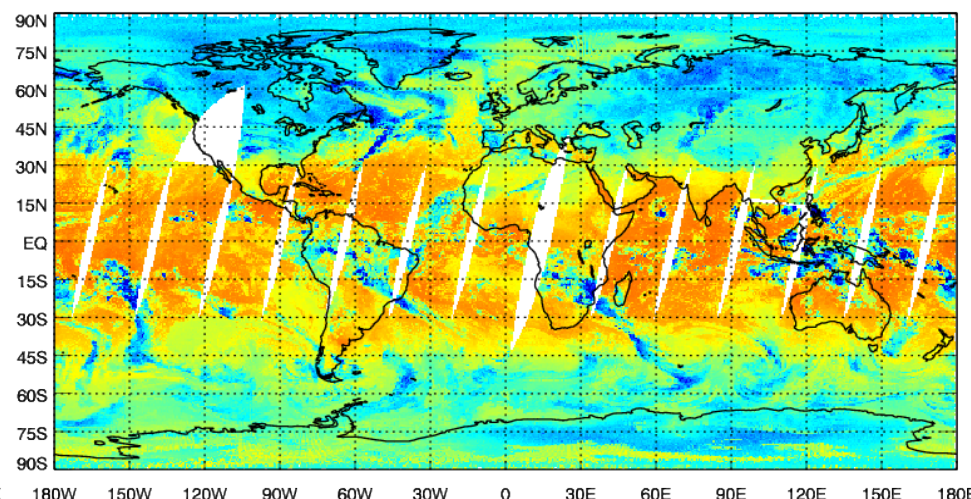
NPP CrIS FSR BT, 4 μm (2500 cm^{-1}), Mapped, Descending, 12/16/2016



S-NPP – FSR B2.0



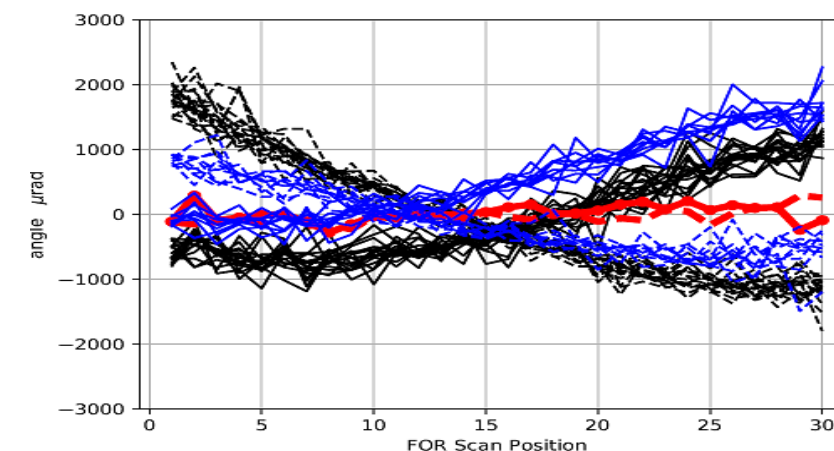
NPP CrIS FSR BT, 4 μm (2500 cm^{-1}), Mapped, Descending, 12/16/2016



- CrIS Full Spectral Resolution SDR: 1305 ->2211ch; Operational March 8, 2017
- CrIS Algorithm Updates (FCE/DQI, A4, and Geo): Operational on April 10, 2017
- CrIS engineering packet update (v37): June 7, 2017
- CrIS PCT Updates: 06/29/17 use all the CrIS extended interferogram data points (for both S-NPP & JPSS-1)

Geolocation performance relative to VIIRS

Blue: Before April 10, 2017; Black: Before ENG v37 uploaded; Red: After ENG v37 uploaded



https://www.star.nesdis.noaa.gov/icvs/status_NPP_CrIS.php

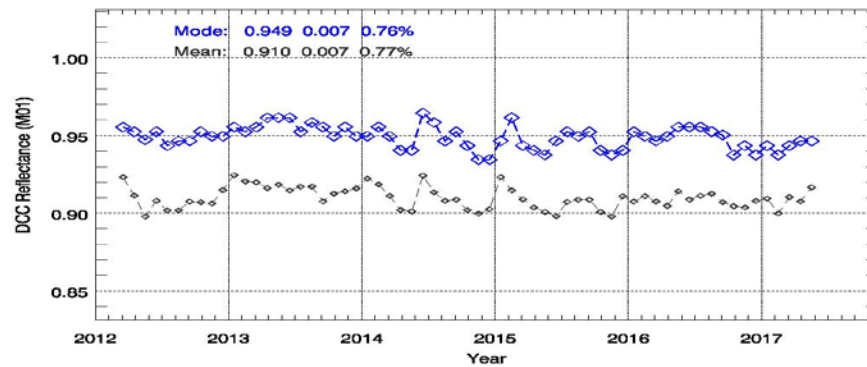
https://www.star.nesdis.noaa.gov/icvs_beta/status_NPP_CrIS.php

Higher spectral resolution; Improved calibration; More accurate geo-location



JPSS-1 VIIRS SDR: Cal/Val Readiness

VIIRS SDR are independently validated with the world-wide validation site radiometric time series



Oct-17
JPSS-1 Launch

Dec-17
Beta Maturity (L+60D)
Verify: Geo Accuracy,
Cal/Earth View Data,
Detector Operability, DNB
Aggregation Mode

Jan-17
Provisional Maturity (L+90D)
Instrument Checkout
Adjust Instrument Setting
LUTs/Coefficients Update

April-18
Validation Maturity (L+6M)
Cross-comparison
Verification
Improve the Calibration
Establish Long-term Monitoring
Algorithm Refinements

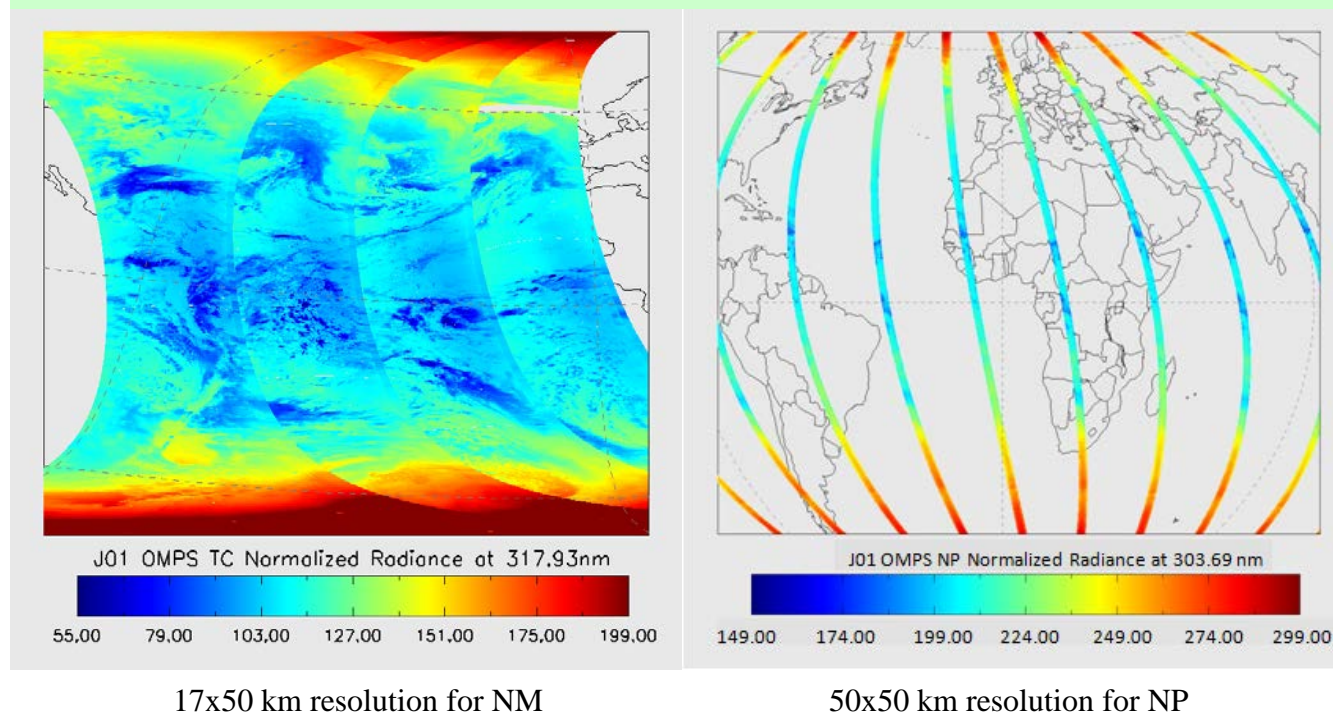
VIIRS SDR Geolocation Accuracy
Monitoring Tool: Error Assessments
automatically generated



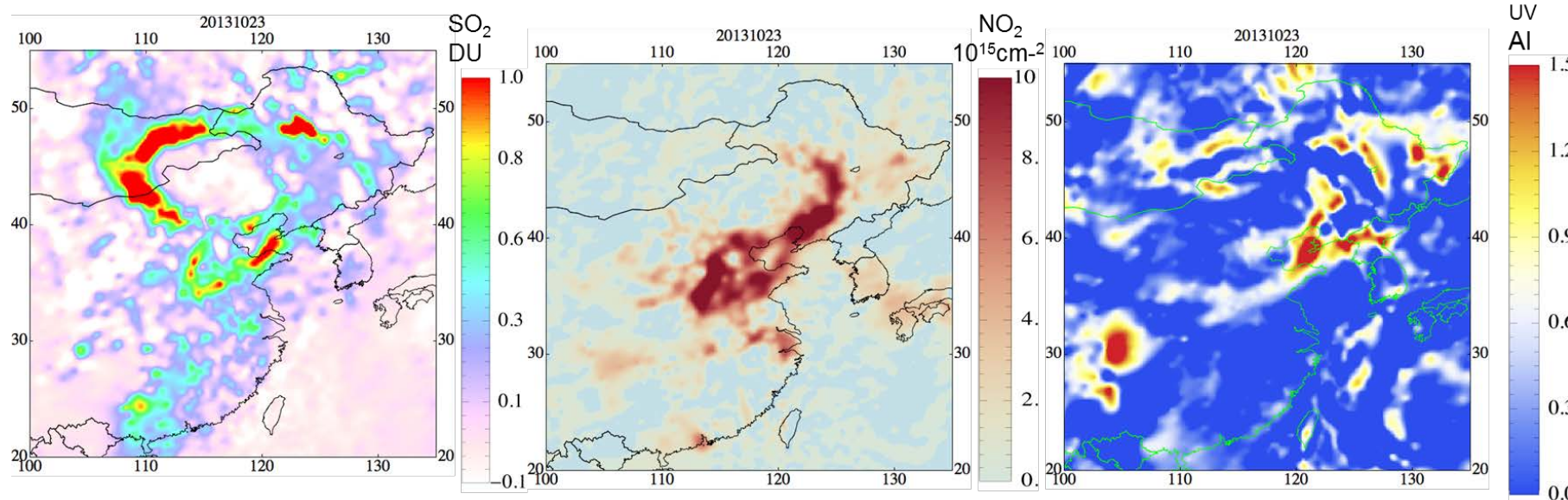
VIIRS SDR has implemented Geo code change to accommodate JPSS-1 DNB aggregation mode change

OMPS Updates (S-NPP), JPSS-1, JPSS-2

Example of Proxy SDR products from JPSS-1 Algorithm



- Total Column Ozone, UV Absorbing Aerosol Index, Total Column SO₂
 - (50x50) 17x17 km² resolution at Nadir
 - Full coverage of the sunlit Earth once per day.
- Nadir Ozone Profile
 - Nadir orbital track at (250x250) 50x250 km² resolution
 - Vertical resolution from 7 to 10 km in the middle and upper stratosphere
- Limb Ozone Profile (Only on S-NPP and JPSS-2)
 - Nadir orbital track with 150 km reporting
 - Vertical resolution of 3 km in the stratosphere
- Future Capabilities
 - OMPS Nadir Mapper total column and tropospheric NO₂
 - OMPS Nadir Profiler daily Mg II Index
 - OMPS Limb Profiler stratospheric aerosol profile



OMPS code update for JPSS-1: Extend spectral range, reduce horizontal cell size



SNPP Data Products Cal Val Maturity Status

Aug2017

JPSS Product Cal Val Maturity Reviews:

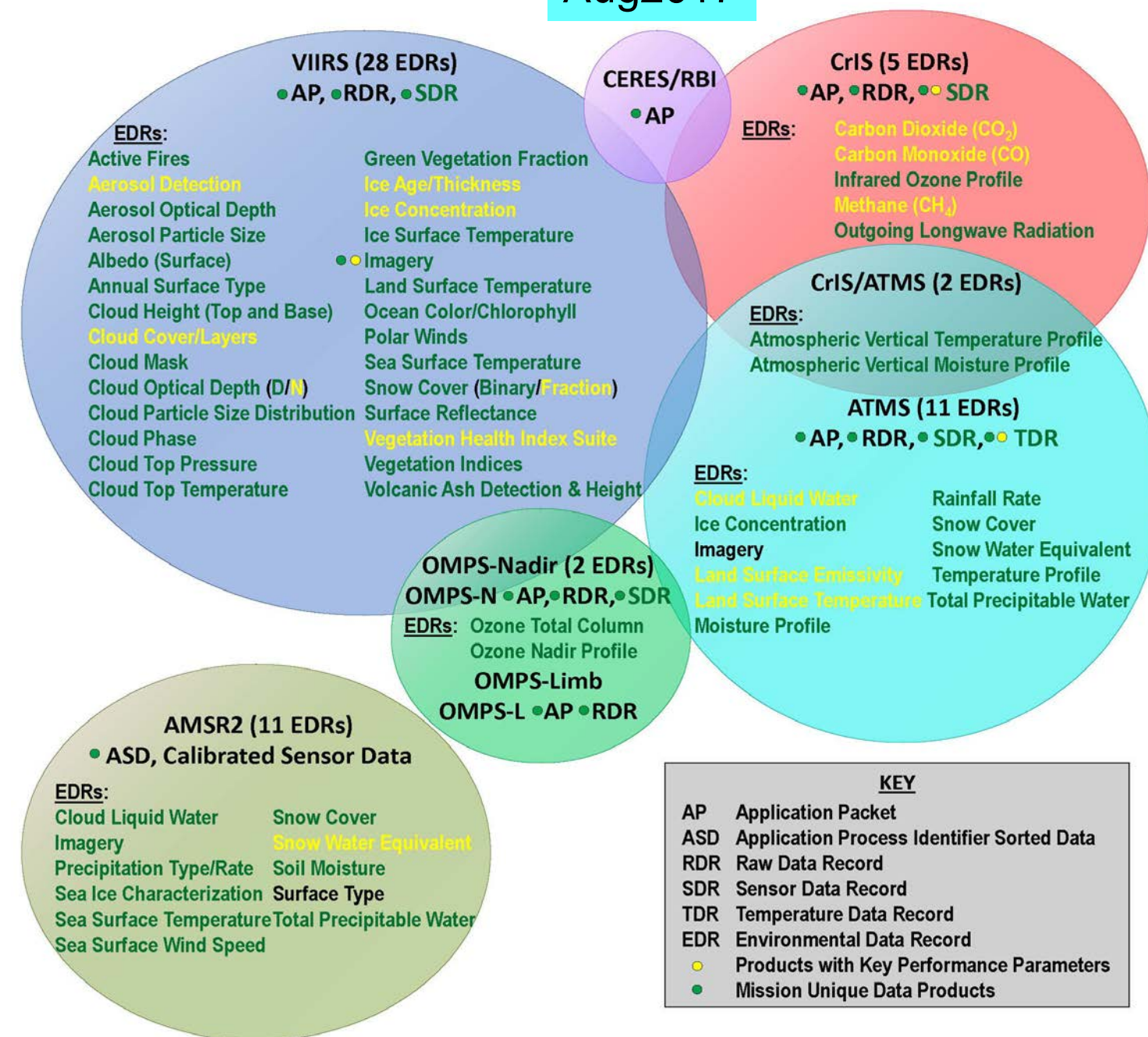
JPSS STAR (JSTAR) validates all Sensor and Environmental Data Records and conducts products validation maturity reviews.

Review Panel is comprised of JPSS Program and Project Scientists, key NOAA users (NWS, NOS, NMFS, OAR), external users, Low-earth Orbiting Working Group (LORWG) advisors, product development managers (NDE and IDPS), the algorithm science manager (STAR).

JPSS Program Scientist is the chair of the review panel.

During the review process we assess **how well the products are meeting specification** and make an overall assessment of each algorithm.

Most **SNPP** Data Products reached **validated**; expect all validated by 2018.



✓ Validated ✓ Provisional



Lessons Learned from S-NPP Cal Val

- Need for **enterprise algorithms** and cost effective solutions for Science Mission Life-Cycle support
 - Optimal and reliable data products from **a fusion of GEO/LEO satellite constellation.**
- Consistent, Long-term product quality performance, achieved through **reprocessing** are crucial to setup a baseline for further advancement of observational data records.
 - Optimize the algorithms and processing systems to achieve the lowest JPSS data uncertainties; Meet the NWP reanalysis users' needs.
- **Common standards & practices** for Cal/Val processes and Maturity Definition of products derived from a variety of satellite platforms.
 - Best Practice and Traceability.



Enterprise EDR Algorithms Progress

- **Enterprise Clouds, Cryosphere, and Aerosol** algorithms updated delivery: 04/14/17
- **ACSP0 SST V2.41** delivery: 03/01/17
- **VIIRS Ocean Color MSL12** Operational Readiness Review (ORR) 11/9/2016
- **VIIRS Polar Winds update (using ECM instead of VCM):** 05/16/17
- **MiRS patch deliveries:**
 - Radiometric bias corrections based on ATMS full radiance SDR: 03/06/17
 - Metadata update (add orbit numbers, production_site and production_environment): 06/07/17
 - Update to fix the file creation time: 06/23/17
- **GCOM patch deliveries:**
 - GCOM Day-2 algorithms update: 02/17/17
 - Update to handle the compressed OISST ancillary data files: 04/18/17
 - Ocean code bug fix; pre-processing the L1B and L1R files separately to help reduce latency: 06/30/17
- **Active Fires** update deliveries:
 - Remove ADL dependence; update quality flags; new metadata for product monitoring: 05/11/17
 - Internal NetCDF file compression: 08/09/17

The Enterprise Processing System (EPS) products became operational in NESDIS on July 5, 2017. The products include **Ice** Concentration and Cover, Ice Surface Temperature, Ice Thickness/Age, Snow Cover, and Fractional Snow Cover; Aerosol Detection, Aerosol Optical Depth, Aerosol Particle Size, Volcanic Ash Mass Loading, Volcanic Ash Height; Cloud Mask, Cloud Top Phase, Cloud Type, Cloud Top Height, Cloud Top Temperature, Cloud Top Pressure, Cloud Optical Depth, Cloud Particle Size Distribution, Cloud Liquid Water, and Cloud Ice Water Path.

In addition to the science improvement gained by the development of the Enterprise (NOAA-unique) products, they also demonstrate NOAA's goal of enterprise solutions by employing same algorithms for POES and GOES satellite systems.

VIIRS Sea Surface Temperature EDR

SST EDR Lead: Alex Ignatov

Algorithm Highlights:

- **Advanced Clear-Sky Processor for Oceans (ACSPO) –NOAA Enterprise SST Algorithm**
 - Day: M15 & M16 (10.8 & 12 μm); M5 & M7 for cloud detection
 - Night : M12 (3.7 μm), M15 & M16
 - Regression trained on global matchups
 - Applies to AVHRR, MODIS, VIIRS, ABI
- Output format: netcdf4. 10 min granule
- Spatial Resolution: 0.74 km at Nadir

Cal Val Maturity:

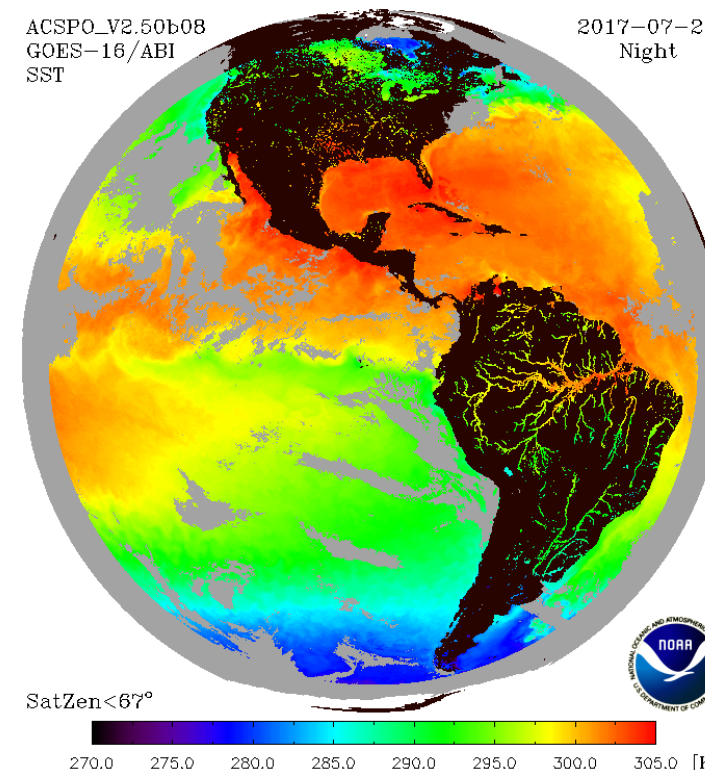
Beta	Provisional	Validated
Feb-2013	Jan-2014	Sep-2014

Performance

Attribute	Requirement	Day ²	Night ²
Accuracy ¹	0.2 K	0.06	0.02
Precision ¹	0.6 K	0.48	0.38

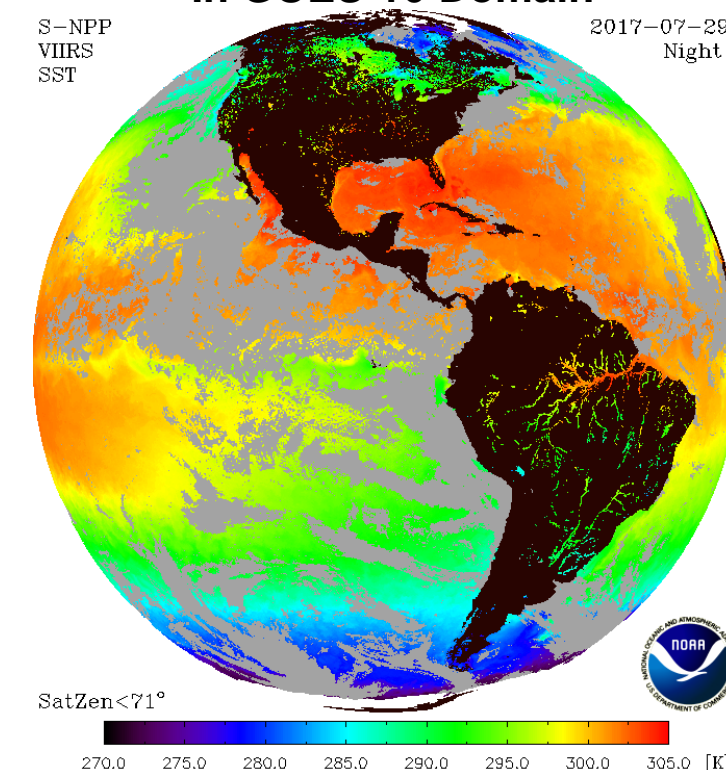
Product	Reproc Algorithm Version	Reprocessed Data Availability		Reprocessing Status
		Start Date	End Date	
VIIRS SST	ACSPO 2.40 RAN1	2/1/2012	12/6/2015	✓ FTP Site
	ACSPO 2.41 RAN2	TBD	TBD	
Data Location	ftp://ftp.star.nesdis.noaa.gov/pub/socd2/coastwatch/sst/ran/viirs/snpp			

GOES-16 Night SST Composite



- Enterprise ACSPO algorithm applied to G16
- ABI composite covers larger domain, due to 15 min refresh rate

VIIRS Night SST Composite In GOES-16 Domain

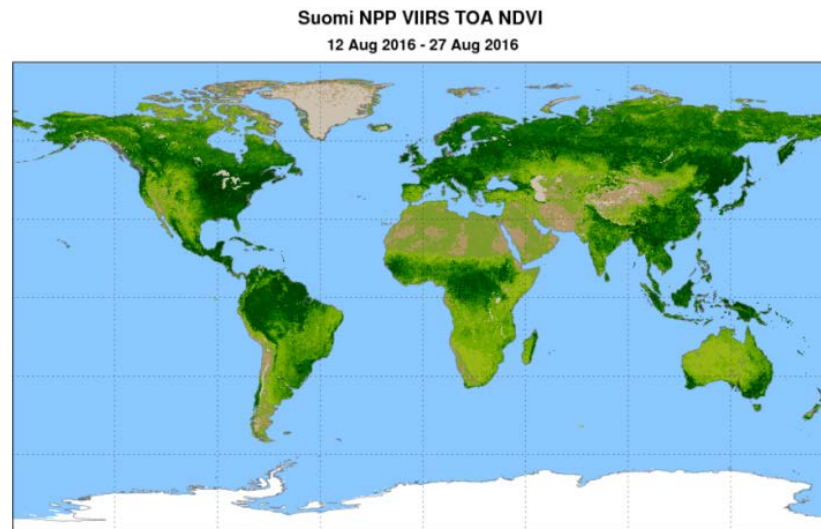


- VIIRS SST composite in G16 domain
- Large areas are cloudy during S-NPP overpass @ 1:30 am

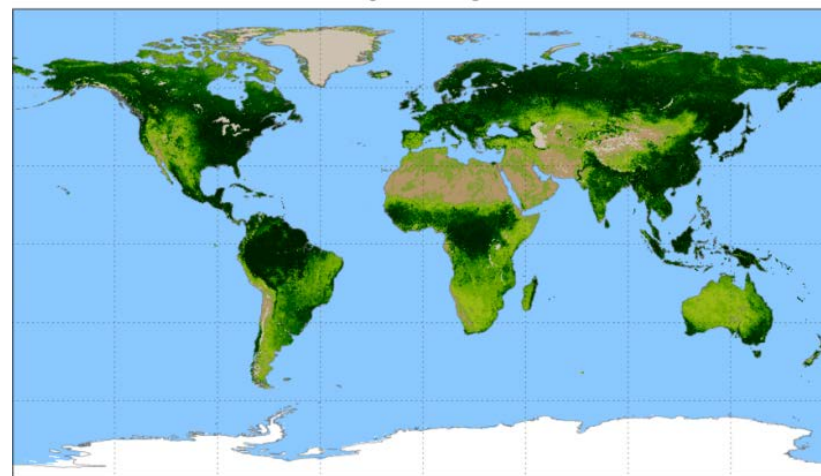


Enterprise Algorithm for Vegetation Products (EAVP)

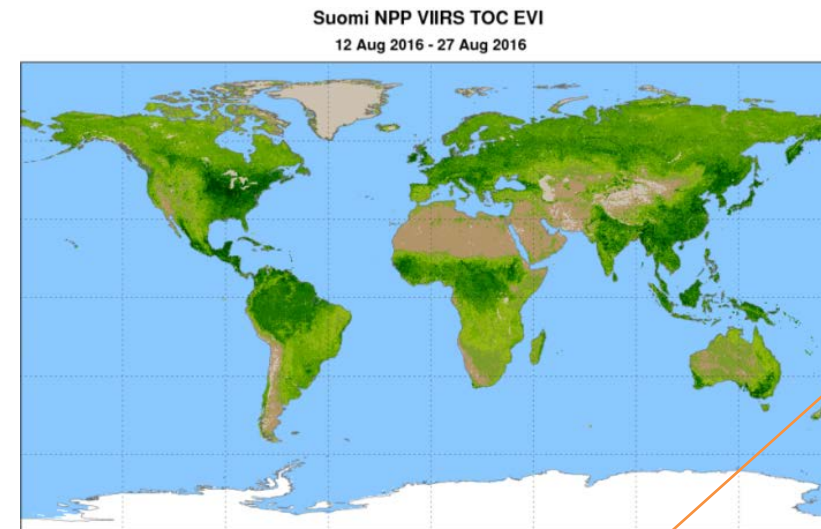
Global gridded products in Lat/Lon projection; Spatial resolution: 1 km (0.009 degree); Temporal resolution: daily, weekly, and bi-weekly; Output File Format: NetCDF4; Ingest the enterprise versions of the VIIRS SDR, CM, SR, and AOT datasets



Suomi NPP VIIRS TOC NDVI
12 Aug 2016 - 27 Aug 2016

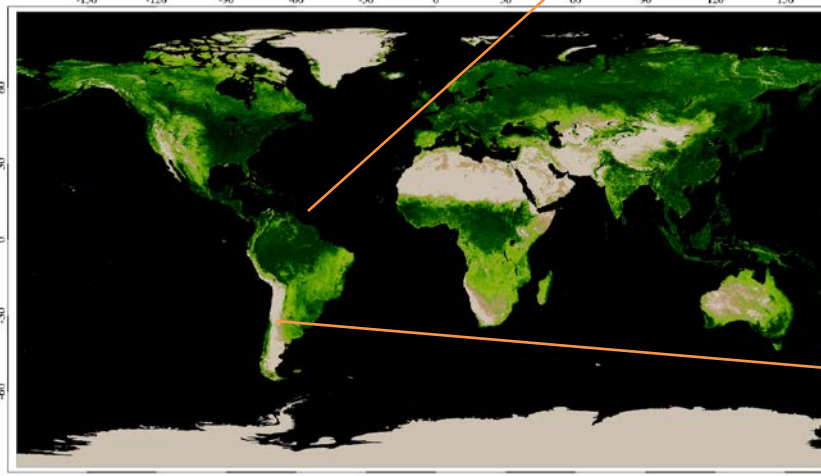


NOAA/NESDIS/STAR

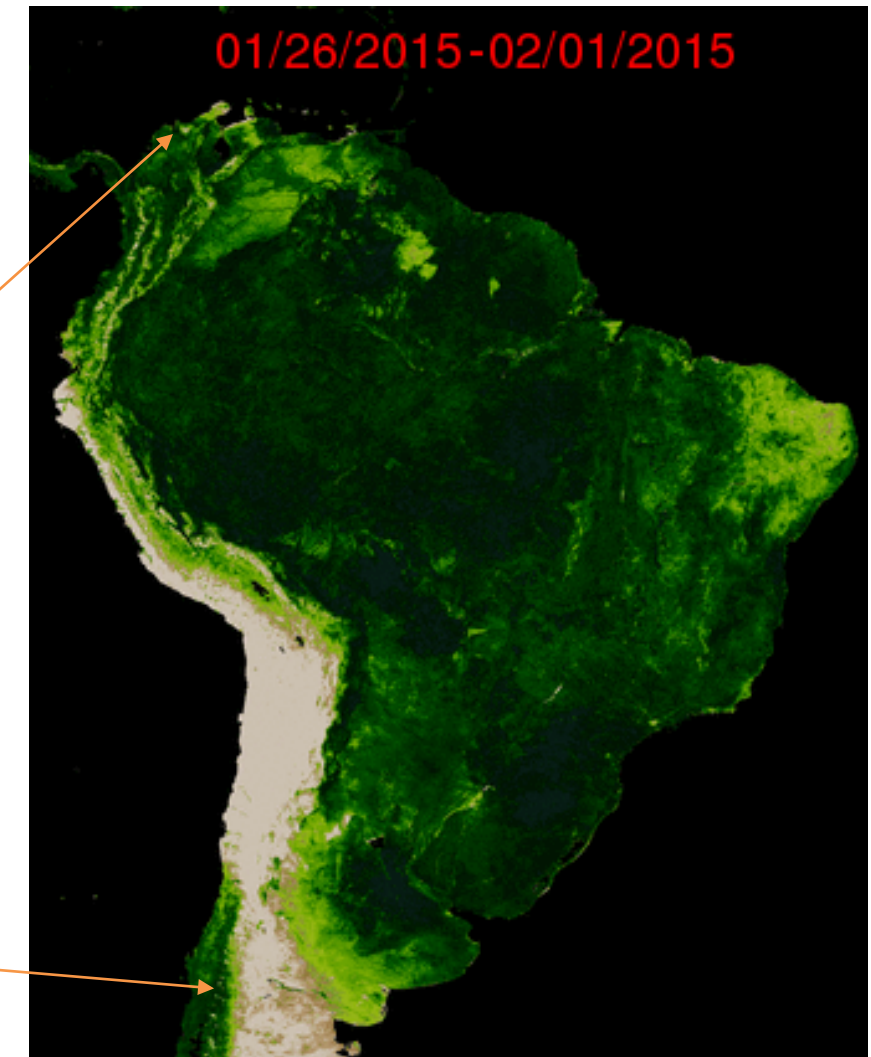


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NOAA/NESDIS/STAR



NOAA/NESDIS/STAR



Plot made by Dr. Zhengyan Jiang



S-NPP Enterprise Data Products (EDRs Only)

Note: Does not include VIIRS Imagery EDRs because they will be processed in IDPS

Enterprise		
Aerosol Detection (VIIRS)	Global Surface Type (VIIRS)*	Rainfall Rate (ATMS)
Active Fires (VIIRS)	Green Vegetation Fraction (VIIRS)	Sea Ice Characterization (AMSR-2)
Aerosol Optical Depth(VIIRS)	Ice Age/Thickness (VIIRS)	Sea Surface Temperature (AMSR-2)
Aerosol Particle Size (VIIRS)	Ice Concentration (VIIRS)	Sea Surface Temperature (VIIRS)
Albedo (Surface) (VIIRS)	Ice Concentration (ATMS)	Sea Surface Wind Speed (AMSR-2)
AMSR Calibrated Sensor Data (AMSR-2)	Ice Surface Temperature (VIIRS)	Snow Cover/Depth (AMSR-2)
Atmospheric Vertical Moisture Profile (CrIS/ATMS)	Imagery (AMSR-2)	Snow Cover (ATMS)
Atmospheric Vertical Temperature Profile (CrIS/ATMS)	Imagery (ATMS)	Snow Cover (VIIRS)
Carbon Dioxide (CO) (CrIS)**	Infrared Ozone Profile (CrIS)	Snow Water Equivalent (ATMS)
Carbon Monoxide (CO2) (CrIS)**	Land Surface Emissivity (ATMS)	Snow Water Equivalent (AMSR-2)
Cloud Cover/Layers (VIIRS)	Land Surface Temperature (VIIRS)	Soil Moisture (AMSR-2)
Cloud Height (Top and Base) (VIIRS)	Land Surface Temperature (ATMS)	Surface Reflectance (VIIRS)
Cloud Liquid Water (AMSR-2)	Methane (CH4) (CrIS)**	Surface Type (AMSR-2)
Cloud Liquid Water (ATMS)	Moisture Profile (ATMS)	Temperature Profile (ATMS)
Cloud Mask (VIIRS)	Ocean Color/Chlorophyll (VIIRS)	Total Precipitable Water (AMSR-2)
Cloud Optical Depth (VIIRS)	Outgoing Longwave Radiation (CrIS)	Total Precipitable Water (ATMS)
Cloud Particle Size Distribution (VIIRS)	Ozone Nadir Profile (OMPS-N)	Vegetation Indices (VIIRS)
Cloud Phase (VIIRS)	Ozone Total Column (OMPS-N)	Vegetation Health Index Suite (VIIRS)
Cloud Top Pressure (VIIRS)	Polar Winds (VIIRS)	Volcanic Ash Detection And Height (VIIRS)
Cloud Top Temperature (VIIRS)	Precipitation (Type/Rate)(AMSR-2)	
Already available in ESPC	Implementation in NDE planned in 2017	

*Global (annual) Surface Type is generated by STAR



S-NPP SDR Reprocessing Status

Product	POC	Reproc Algorithm Version	Data Volume	Processing Speed	Reprocessed Data Availability		Reprocessing Status
					Start Date	End Date	
ATMS SDR	Mark Liu	ATMS/V1.0 ADL 4.2_Mx8.11 with updates	500 GB/year	5 hours/year	11/8/2011	8/31/2016	✓ Ready for MLP
CrIS SDR	Yong Chen	CrIS-TSR/V1.0	16 TB/year	1 day/year	2/20/2012	8/31/2016	✓ Ready for MLP
		CrIS-FSR/V1.0	TBD	TBD	TBD	TBD	✓ Ready /TBD
VIIRS SDR	Changyong Cao	VIIRS/V1.0	200 TB/year	10 days/year	1/1/2012	7/31/2016	✓ Ready /TBD
OMPS SDR	Trevor Beck	OMPS-TC	1 TB/year	1 day/year	1/26/2012	9/9/2015	✓ Ready for MLP
		OMPS-NM	86 GB/year	2.8 hours/year	1/26/2012	9/9/2015	✓ Ready for MLP

Reprocessing Readiness

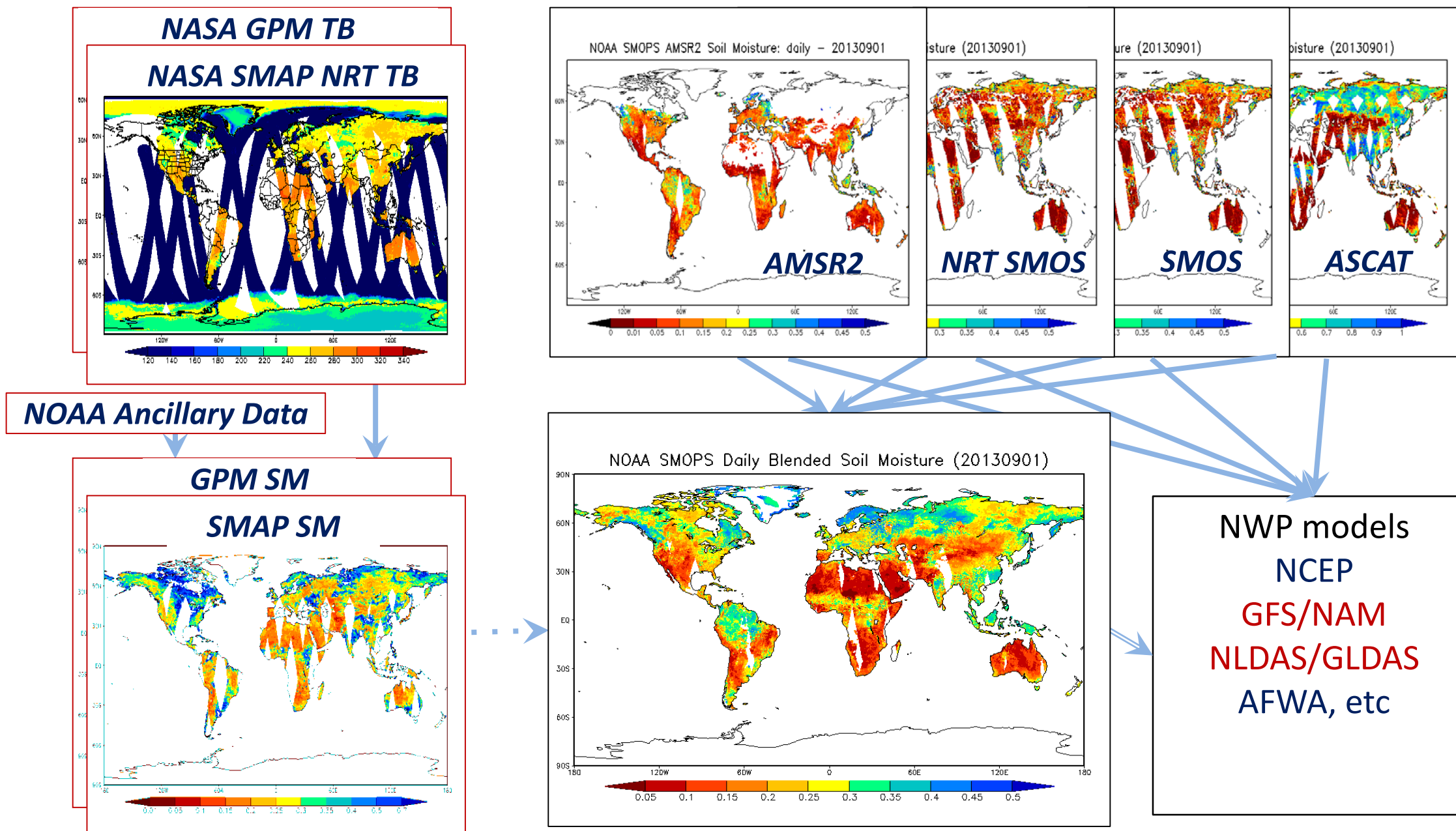
Ready for reprocessing/Reprocessed	Ready for reprocessing/Decision pending	Closely ready for reprocessing with a version. DAP delivered, review process on or IDPS MX Build with fixes	Reprocessing version yet to go through review process	Reprocessing plans to be defined.	N/A
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EDR Re-processing Brown-bag Session: Tuesday 12:30-1:30pm, Aug 15 2017, Conference Center, POC: Dr. Murty Divakarla



Blended Products

NESDIS Soil Moisture Operational Product System (SMOPS)



NESDIS SMOPS ingests operationally soil moisture product from **JPSS/GCOM-W1** and **blend** them with soil moisture retrievals from SMOS, SMAP, GPM, & ASCAT; provides inputs to NWP models



Priorities Moving Forward

- **Ensure Cal/Val Team Readiness for JPSS-1**
 - Ensure the SDR/EDR algorithms and cal val tools are fully tested and characterized with JPSS-1 testing data
 - Proactively preparing for sensor waivers' mitigation
 - Implement code adjustments to meet JPSS-1 requirements
 - Refine and update JPSS-1 Cal Val plans
- **Continue Support for Suomi NPP Mission Objectives**
 - Provide Suomi NPP data products to support NOAA's operational missions.
 - Develop plans for reprocessing mission long data records with validated enterprise algorithms
 - Continue to work with users to optimize the use of JPSS products



Summary

- ✓ Most of the S-NPP data products have reached the Validated maturity level and are in general with accuracy similar (or superior) to existing products.
- ✓ Great progress has been made for replacement and upgrade of current S-NPP algorithms with NOAA enterprise algorithms and planning reprocessing SDRs/EDRs with matured algorithms.
- ✓ Demonstrated pre-operational evaluation of JPSS-1 science data products algorithms mitigating J1 instrument waivers, and new algorithms for JPSS-1 instrument upgrades.
- ✓ Closely engaged with the JPSS-1 launch readiness testing activities, JPSS-1 test data through the SDR and EDR algorithms, as well as ICVS and long term monitoring systems.
- ✓ With improved knowledge of the pre-launch characterization of the J1 instruments and by leveraging the S-NPP Cal/Val experience, the Cal/Val activities for JPSS-1 are expected to be much more accelerated.

	Monday 14 August	Tuesday 15 August	Wednesday 16 August				Thursday 17 August				Friday 18 August
830 - 900		Innovative Science	Innovative Science				Innovative Science				
0915 - 1015	Keynotes + Program Overviews	ATMS	NUCAPS	Ocean Color	Ozone	Clouds	Trace Gases	SST	Land	Aerosols	Transition to Operations
1015 - 1030	Break	Break	Break				Break				Break
1030 - 1200	SDR / EDR Overviews	CrIS	NUCAPS	Ocean Color	Ozone	Clouds	Trace Gases	SST	Land	Aerosols	Blended Products
1200 - 1315	Lunch	Lunch	Lunch				Lunch				
1315 - 1445	Advanced Applications	OMPS	MIRS	Ocean Color		Imagery	Trace Gases	SST	Land	Cryo	
1445 - 1530	Break	Break	Break				Break				
1530 - 1700	VIIRS	Cloud Mask	GCOM	Ocean Color		Imagery	Trace Gases	SST	Land	Cryo	
1700 - 1930		Poster Session / Reception at ESSIC									

Session
Locations:

NCWCP
Auditorium

NCWCP
Conference
Center

ESSIC 4102

NCWCP
Conference
Room 2552-53

ESSIC
3rd Floor

ESSIC is located across the street
from NCWCP in the MSquare Bldg.,
5825 University Research Court



**Thank You and Hope you
Enjoy the Meeting!**