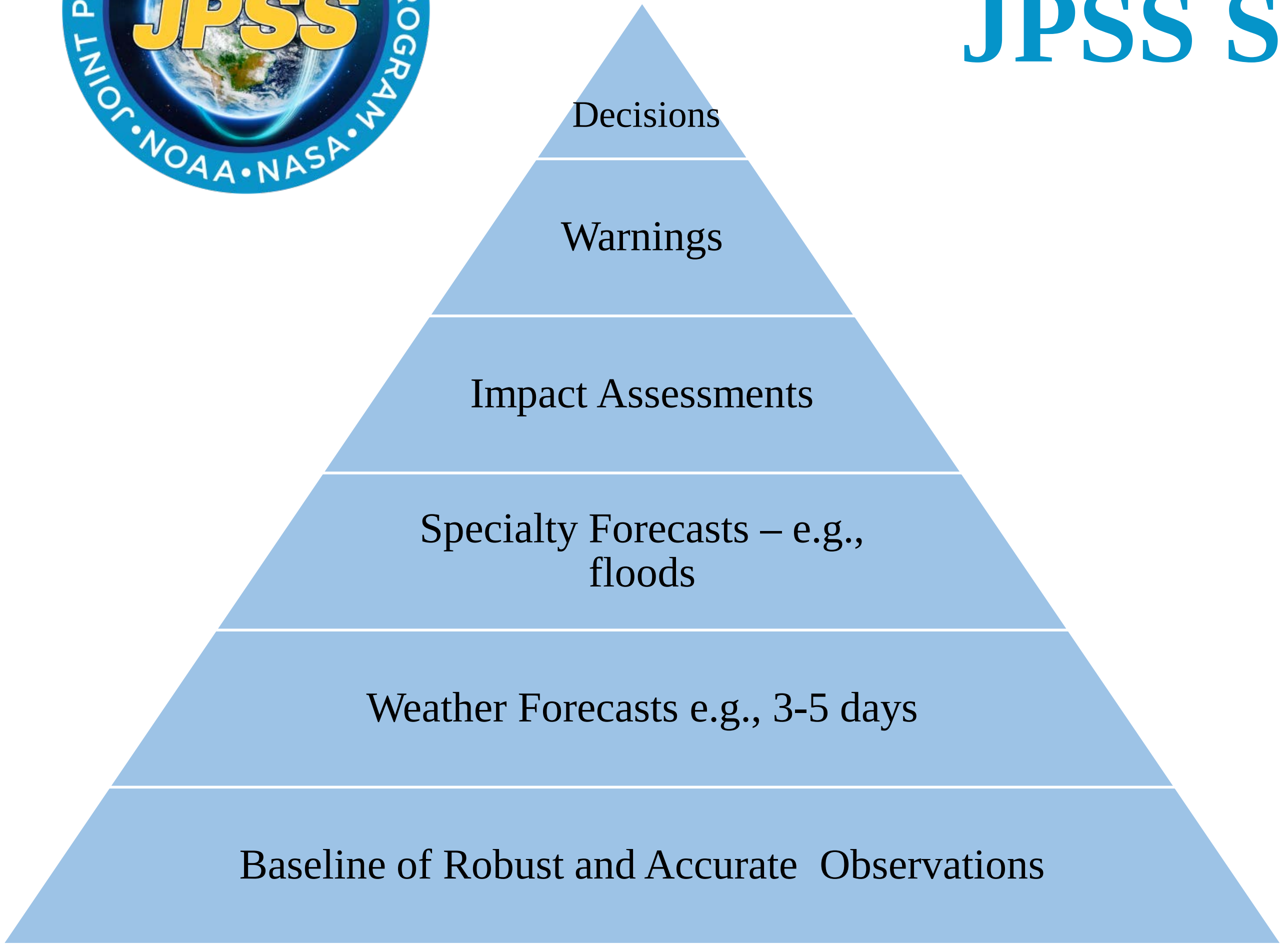
JPSS SENSOR DATA RECORD (SDR) SUMMARY



Fuzhong Weng and Lin Lin

NOAA/NESDIS/STAR

Instrument and SDR Performance

ATMS

- SNPP ATMS has a stable performance in orbit and all the parameters meet the specifications with large margins
- SNPP ATMS striping mitigation algorithm has been updated to further improve the data quality
- SNPP ATMS scan drive main motor current demonstrated large anomaly. Once-per-day scan reversal was implemented on August 24, 2015 and once-per-orbit scan reversal from July 25, 2016
- JPSS-1 ATMS flight unit spacecraft EMI testing shows significantly fluctuation in ch17 gain
- ATMS full radiance calibration was approved for implementation into IDPS. JPSS-1 ATMS PCT has been updated for operations

CrIS

- SNPP CrIS FSR SDRs are routinely generated and available to the public on the STAR FTP site
- SNPP CrIS instrument and SDR performances are very stable: no significant change in noise and gain
- J1 CrIS team has successfully completed S/C Electromagnetic Interference (EMI) test and is ready for Thermal Vacuum (TVAC) testing; the science team is ready to support instrument performance evaluation
- SDR algorithm/software is ready for operation to J1 CrIS

VIIRS

- All SNPP VIIRS SDRs meet or exceed requirement
- J1 VIIRS test program was completed successfully and provides high quality data to assess sensor performance
- J1 VIIRS SDR team has completed waiver studies
- Geolocation software code/LUTs are ready for operation to J1 VIIRS

OMPS

- SNPP earth view SDR and Geo-SDR for both SNPP OMPS NM and NP meet the requirement and are well defined for representative conditions
- SDR algorithms and their LUTs have been modified for J1 OMPS SDR processing
- J1 OMPS algorithms are tested for IDPS B2.0 and will be fully tested with JCT 3.5 and TVAC data

Major Risks/Issues and Mitigation

	Risk/Issues	Impact	Mitigation
ATMS	SNPP scan profile changes related to SD motor current anomaly	Missing data due to increasing the scan reversals	New SDR software for processing reversal scan data
	J1 1.4 GHz interference at channel 17/21	Data quality degradation	Radio Frequency Interference (RFI) mitigation algorithm
	J1 channel 17 gain fluctuation	Data quality degradation	Under investigation, synthetic ch17 from ch18/16.
CrIS	CrIS Fringe Count Error (FCE) correction module does not meet IDPS latency requirement and therefore is turned off	No impact if FCE does not occur: – Not a single FCE event has occurred so far for SNPP – The instrument is designed to avoid FCE and the J1 CrIS is expect not to have the FCE If FCE occurs, the affected SDRs will fail without the correction module in operation	IDPS should increase the processing power.
	Smaller FOV size and full spectrum coverage are not on the vendor's agenda for J3/J4 sensors	The smaller FOV size and full spectrum capability (no spectral gaps) will improve NWP and cross sensor calibrations	JPSS program should make decisions soon before it is too late for making hardware changes.
VIIRS	New moon and VIIRS Recommended Operating Procedure (VROP) 702&705 have to occur between L+50 & L+60 in order for J1 VIIRS Day/Night Band (DNB) to reach provisional maturity at L+90	J1 VIIRS/DNB will not reach provisional maturity without straylight correction (major artifacts in DNB imagery)	Request to schedule the VROPs within L+50&L+60 with new moon. Request fast track DNB straylight light and other LUTs delivery (1-2 week lead time).
	VIIRS SDR team computing and storage	Inadequate computing resources to perform intensive Cal/Val for J1 VIIRS, and other Cal/Val analysis for SNPP	The program needs to provide adequate computer servers and storage to the VIIRS SDR team to do the work.
	SNPP star trackers degrading (noise floor is increasing)	S/C attitude error > 1 degree that results in geolocation error > 14 km lately. Out of attitude knowledge specification on a daily basis.	The Attitude system (HW & SW) needs urgent maintenance (e.g. cool down trackers, give less weight to trackers in attitude solution). Prototyping approach to use gyro data to improved geolocation accuracy in these situations.
	Ocean Color (OC) team requires 0.1 to 0.2% Reflective Solar Band (RSB) calibration accuracy. If not, OC Near-Real-Time (NRT) product will not meet requirements	NRT ocean color users not using operational VIIRS SDR	Test OC F&H LUT and compare with operational and NASA versions. Resolve differences.
OMPS	SNPP NP wavelength seasonal variation	NP Ozone data accuracy	The sensor requirement was waived. But it will be fixed in SDR in further.

Milestones and Deliverables

	Milestones	Deliverables
ATMS	SNPP ATMS antenna emission correction J1 RFI correction software J1 ATMS Provisional Maturity	Source codes for IDPS implementation PCA software for IDPS implementation Products to be delivered on L+90 days
CrIS	J1 CrIS Beta SDR	Products to be delivered on L+68 days
	J1 CrIS Provisional SDR	Products to be delivered on L+90 days
	J1 Validated SDR	Products to be delivered on L+270 days
	CrIS mounting matrix final version	PCT files to be delivered by the end of 2016
VIIRS	J1 VIIRS test program was completed successfully as scheduled	Extensive amount of high quality data to assess sensor performance
	J1 DNB Aggregation Mode code change	J1 SDR software including DNB Option21 mitigation approach
	J1 VIIRS LUTs needed for on-orbit calibration	Delivered LUTs for J1 VIIRS
	All 15 J1 VIIRS waivers were approved by NASA/NOAA review board	Report and mitigation plan
	Water vapor band trade study	Water vapor band trade study report
	Geolocation CPM transition web and DBMS interface	Online system for monitoring VIIRS geolocation performance
	DNB VROP (702 + 705) calibration reanalysis	LUTs, code and report for DNB calibration
	Solar diffuser surface roughness induced degradation model	Model and paper on SRRS model for spectral dependent SD degradation
	VIIRS Remote Sensing Special issue	28 journal papers
OMPS	J1 OMPS Provisional SDR	Products to be delivered in 2017 Post Launch Test (PLT) to Intensive Cal/Val (ICV) phase
	J1 OMPS Validated SDR	Products to be delivered in 2018 ICV to Long Term Monitoring (LTM) phase

Future Plans/Improvements

ATMS

- SNPP ATMS reflector emission correction algorithm will be tested and submitted for operational implementation. Study ATMS scan reversal operations and its impacts on SDR data quality
- For the J1 mission, the team will update PCT with new coefficients, carry out additional testing data analysis, investigate SRF pass band imbalance mitigation
- The team will support post-launch Cal/Val activities for J1 ATMS to reach provisional and continue afterwards

CrIS

- For the J1 mission, the team will analyze the S/C TVAC data, support validation of the operational SDR software, execute post-launch Cal/Val plan and provide the Beta, Provisional and Validated SDR products on schedule
- The team will continue working to address the issues of Finite Impulse Response (FIR) convolution correction, LW FOV5 cold scene anomaly, polarization, and FCE latency
- SNPP CrIS observation approaches 5 years; the team will analyze the history of the data and continue monitoring its performance and SDR health

VIIRS

- The team will support post-launch Cal/Val for J1 VIIRS to reach provisional and continue afterwards
- The team will support J1-J4 preparation (will finalize the list of J1 lessons learned, and Hardware/Software Improvements to be implemented for future builds, e.g, J2-4)
- VIIRS Cal/Val improvements include: RSB solar calibration with lunar correction and test/compare F-LUT from OC group for re-processing/operation; DNB Calibration with onboard and VROP 702-705; Calibration algorithm update for Thermal Emissivity Bands (TEBs) to resolve Warm-Up and Cool-Down (WUCD) deviations and cold-bias for M15; Maintenance on attitude system of SNPP with additional gyro data due to the degradation of Star tracker

OMPS

- The team will support post-launch Cal/Val for J1 OMPS to reach provisional and continue afterwards
- The team will support the OMPS Limb Profiler SDR algorithm preparation for J2 and beyond
- OMPS Cal/Val improvements include: completion of SDR data reprocessing the up-to-dated calibration LUTs and algorithm in OMPS SDR life-cycle with upgraded IDPS system B2.0, correction of SNPP NP wavelength thermal sensitivity, and production of SNPP high spatial resolution data

VIIRS Ocean Color Breakout Highlights

Menghua Wang &
NOAA Ocean Color Team

NOAA/NESDIS Center for Satellite Applications and Research (STAR)

STAR JPSS 2016 Annual Science Team Meeting
NCWCP, College Park, Maryland, August 8-12, 2016

Website for VIIRS ocean color images and Cal/Val:
http://www.star.nesdis.noaa.gov/sod/mecb/color/

Website for VIIRS ocean color data:
http://coastwatch.noaa.gov/cwn/cw_products_ocLOM.html

Acknowledgements: This work has been supported by JPSS/VIIRS funding. We thank MOBY team for in situ optics data, VIIRS Cal/Val PIs and their collaborators in support of VIIRS Cal/Val activities.

VIIRS Ocean Color Breakout Highlights

22 Presentations; several posters (Wed. session)
About 50+ attendees throughout the day

STAR Ocean Color team covered overview;
- OC improved sensor calibration;
- Vicarious calibration with MOBY data;
- Implementing OCI chlorophyll algorithm (experimental);
- OCView monitoring tool;
- DINEOF gap-filling technique

OSPO – OC into production at OKEANOS

VIIRS Cal/Val team (external members):
- VIIRS dedicated cruise results;
- AERONET-OC results;
- apparent and inherent optical properties;
- using VIIRS overlap data for temporal changes;
- NIST traceability

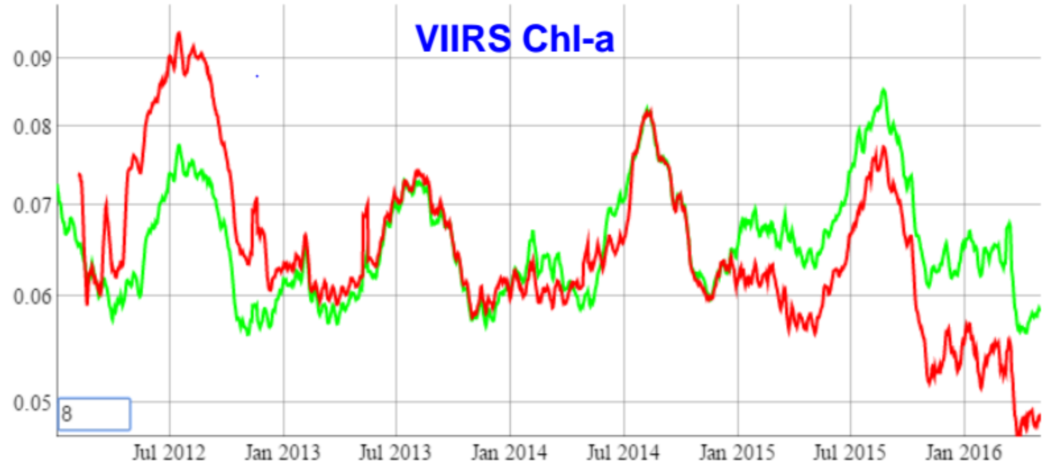
Users, New Applications
- Using ocean color for water-quality monitoring of coral reefs
- Using ocean color for in models: biogeochemical and heating, hydrodynamics
- Harmful algae algorithm
- Science of BRDF effect

Prominent Themes/Discussions

- Improvements of Science Quality data
- Satellite data discovery, version naming, citing, DOI, archiving
- Data distribution, CoastWatch, NCEI
- Plans for J-1 (compare, contrast with SNPP – plans for data productions)
- Bringing IOP products into standard product suite, i.e. a_{ph}; desire for products vs. rigorous validation
- Interest in Sentinel 3 (and other sensors) data
- Usefulness of 745 nm band ; Developing algorithms to exploit 450 nm band
- Potential biases in gap-filled data (using only cloud free pixels)
- Ocean color in models – pros and cons NPZD, encoda, Hycom, GODAS, etc.
- Work to be done on coastal retrievals
- Overall, much progress in VIIRS OC over the 5 years since launch

Cal/Val Team Discussions (Thur. session)
- In situ data analysis and discussion
- Measurement protocol discussion
- Lessons learned from past two VIIRS Cal/Val cruises
- Preparing for the upcoming cruise in Oct. 2016
- In situ data archive (format, etc.)
- Documentation (preparing for papers)

Data improvement through OC reprocessing



Red: VIIRS **IDPS-SDR** **Near-real-time data**

Green: VIIRS **OC-SDR** **Science quality data**

Both data are reprocessed using the same MSL12!

...tistics of VIIRS Data vs. In Situ (MOBY)

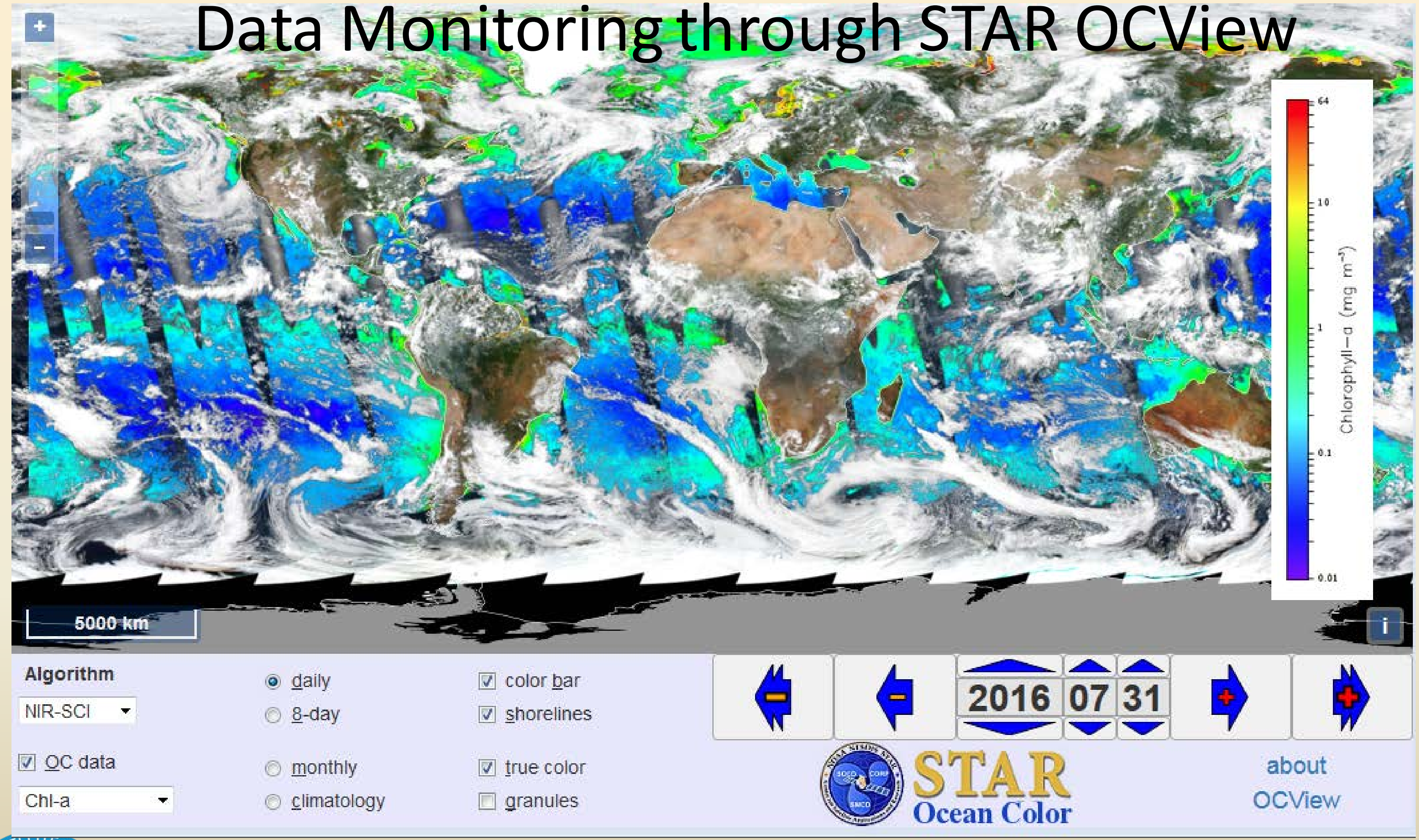
(2012-01-01 ~ 2016-04-27)

	...PS-SDR MSL12 (ver. 1.10) (Near-Real-Time Data)				OC-SDR MSL12 (ver. 1.10) (Science Quality Data)			
	...VG	MED	STD	No	AVG	MED	STD	No
	...083	1.0065	0.0961	463	**1.0164**	1.0157	0.0956	509
	...191	1.0005	0.1733	475	**1.0083**	1.0062	0.0899	509
	...258	0.9991	0.1861	475	**1.0110**	1.0103	0.0846	509
	...604	0.9809	0.4910	475	**1.0148**	1.0004	0.1338	509
$nL_w(671)$	**1.3366**	1.0059	2.1345	487	**1.1762**	1.1053	0.5393	505
Chl-a	**1.0508**	0.9764	0.4254	468	**1.0141**	1.0041	0.1647	509
$K_d(490)$	**1.0135**	0.9826	0.2437	471	**0.9842**	0.9760	0.1007	505

MOBY

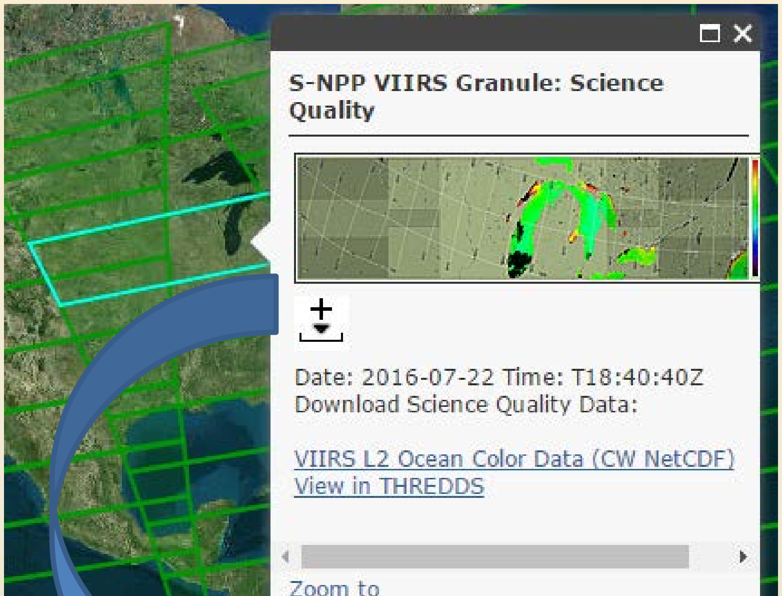
NIR Gain 8 = [0.979954, 0.974892, 0.974685, 0.965832, 0.979042, 0.982065, 1.00000, 1.01812, 0.994676, 1.20252]

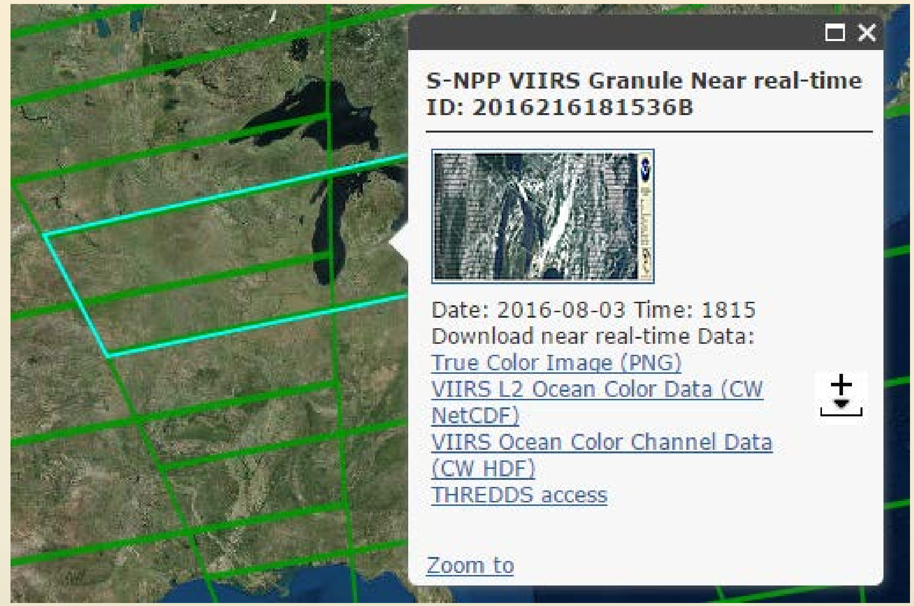
Data Monitoring through STAR OCView

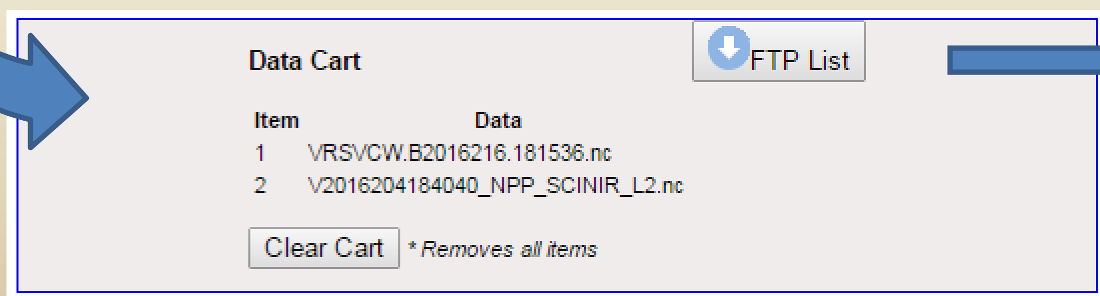


http://www.star.nesdis.noaa.gov/sod/mecb/color/

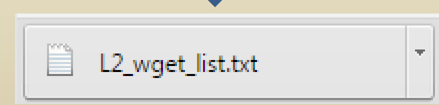
Data Distribution through NOAA CoastWatch/OceanWatch





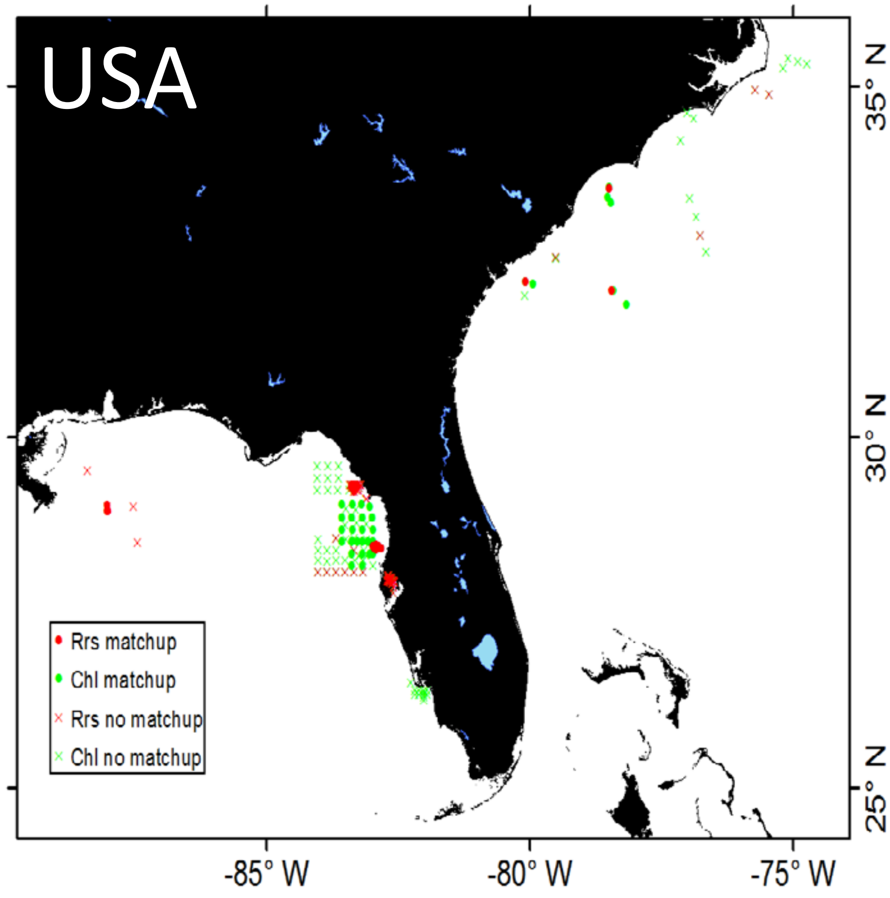


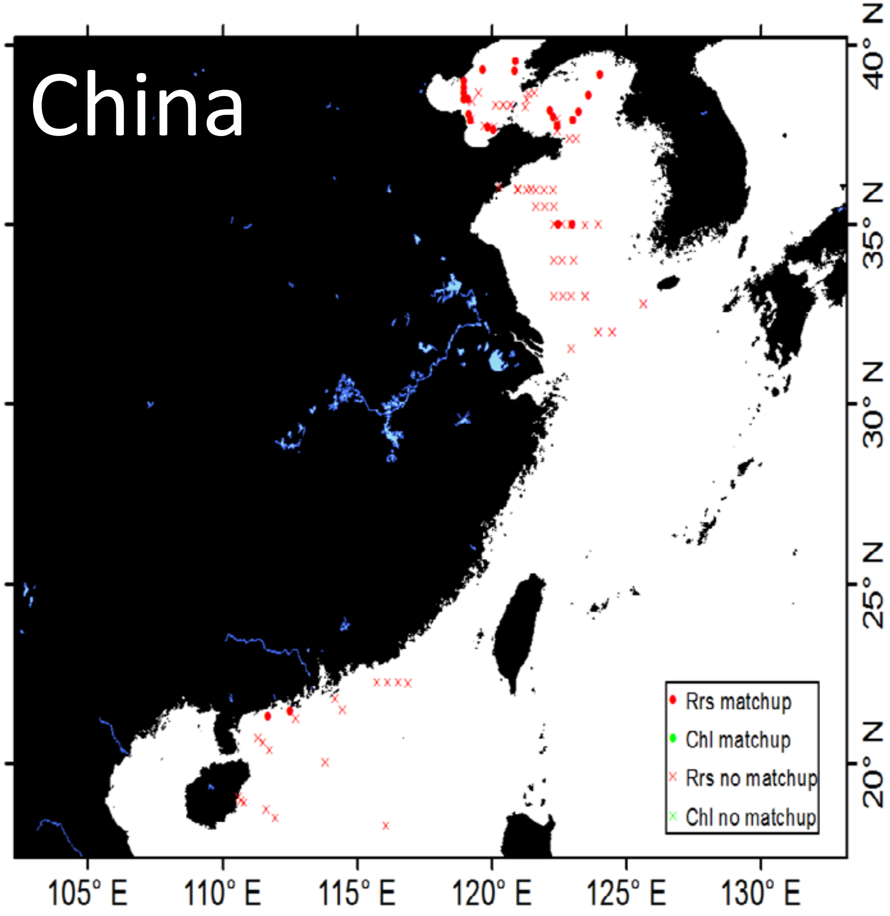
For batch download



New Validation (MSL12 processing)

VIIRS data downloaded from NOAA/NESDIS ftp site in July 2016
Field data collected between 2012 and 2015 from different cruises



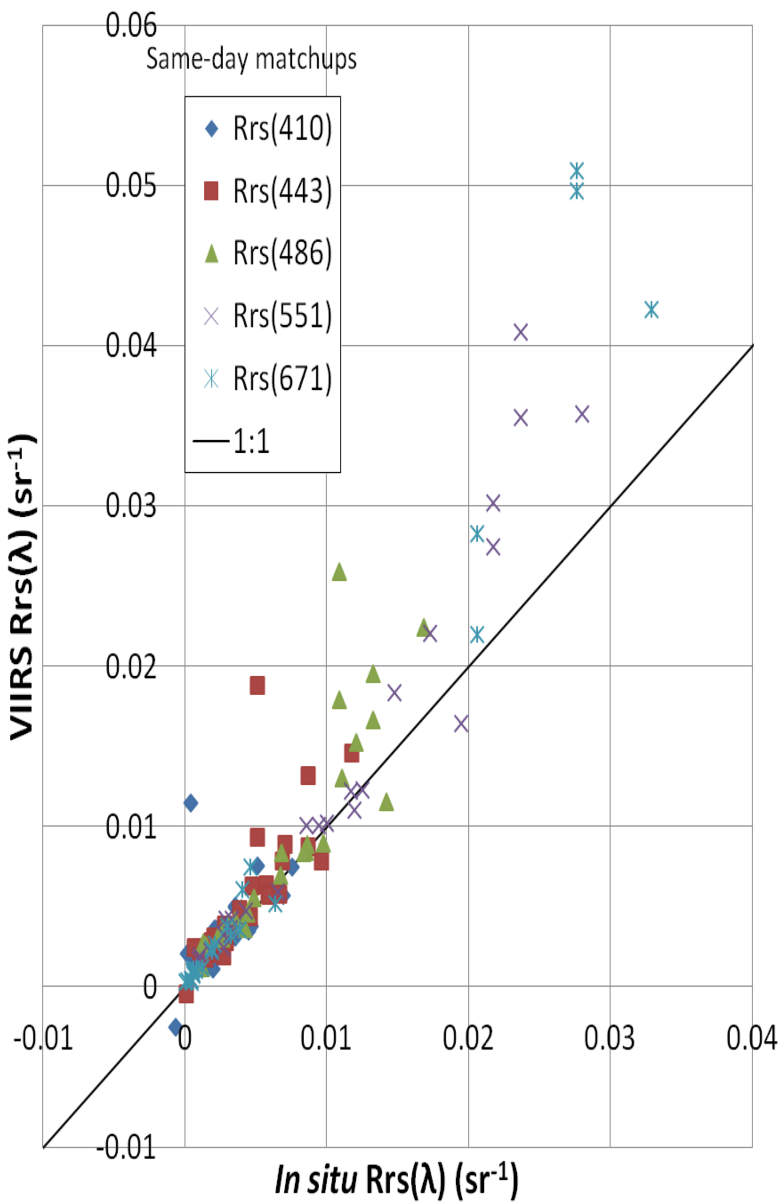


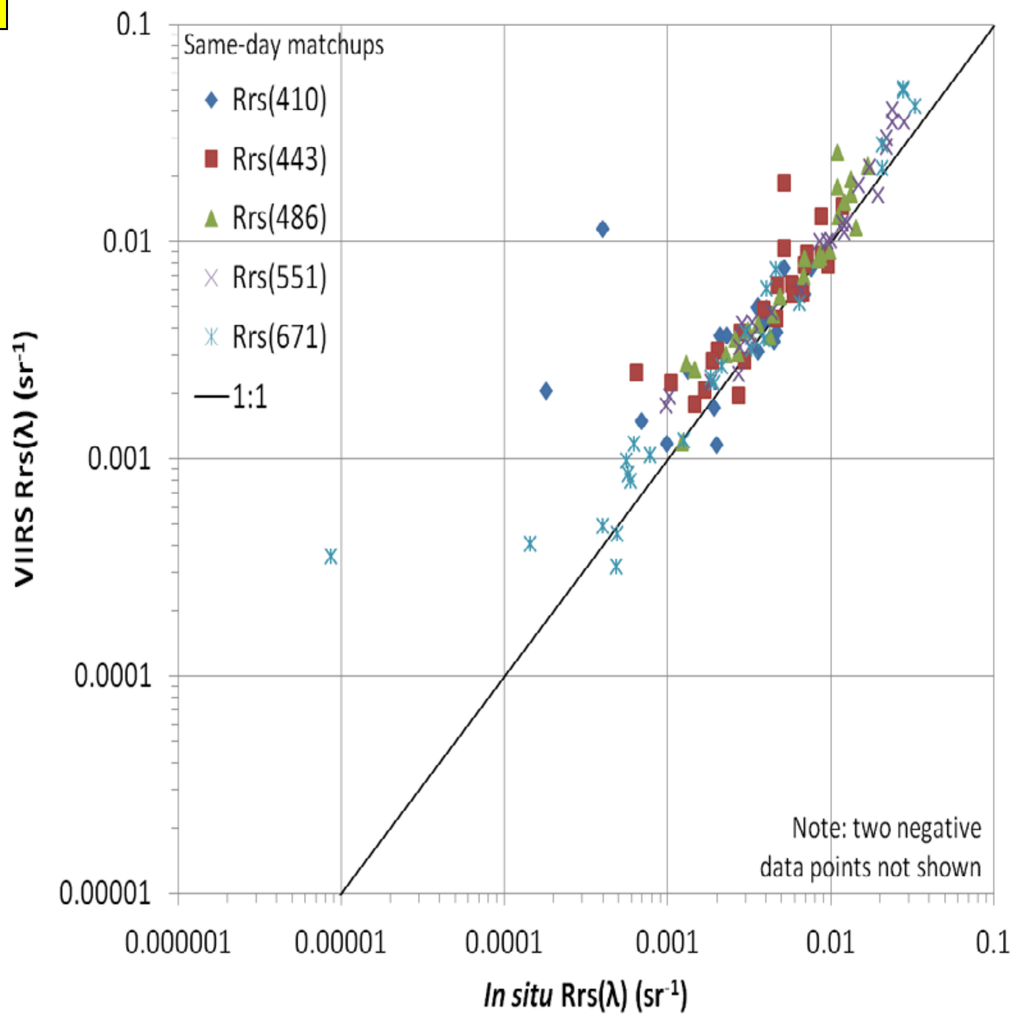
Hu et al. (USF)

NOAA VIIRS

Hu et al. (USF)

China only





	UPD (%)	MAD (sr^{-1})	N
Rrs(410)	35.6	0.00144	22
Rrs(443)	19.1	0.00171	25
Rrs(486)	23.8	0.00224	25
Rrs(551)	21.7	0.00293	25
Rrs(671)	38.5	0.00301	25

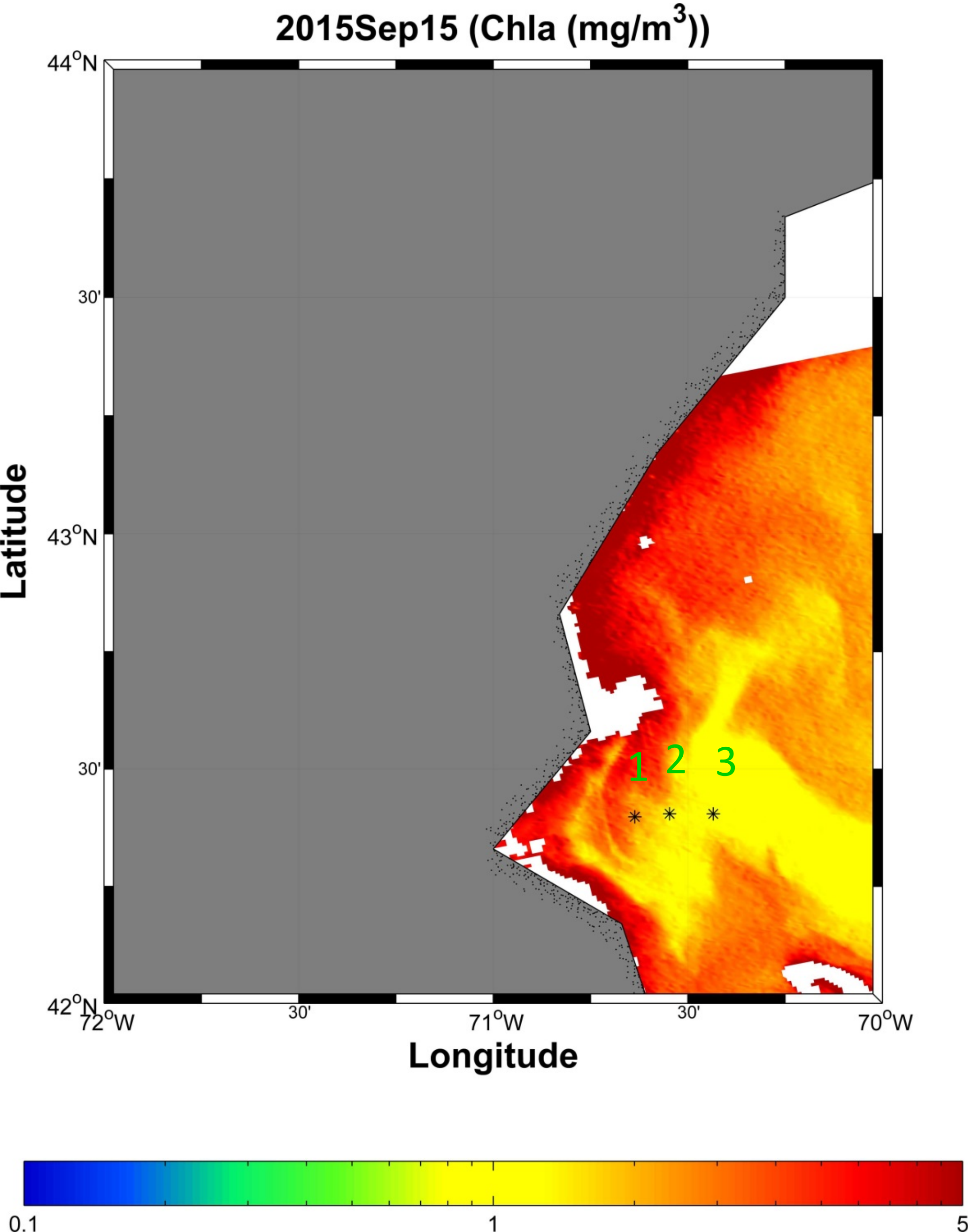
Hu et al. (USF)

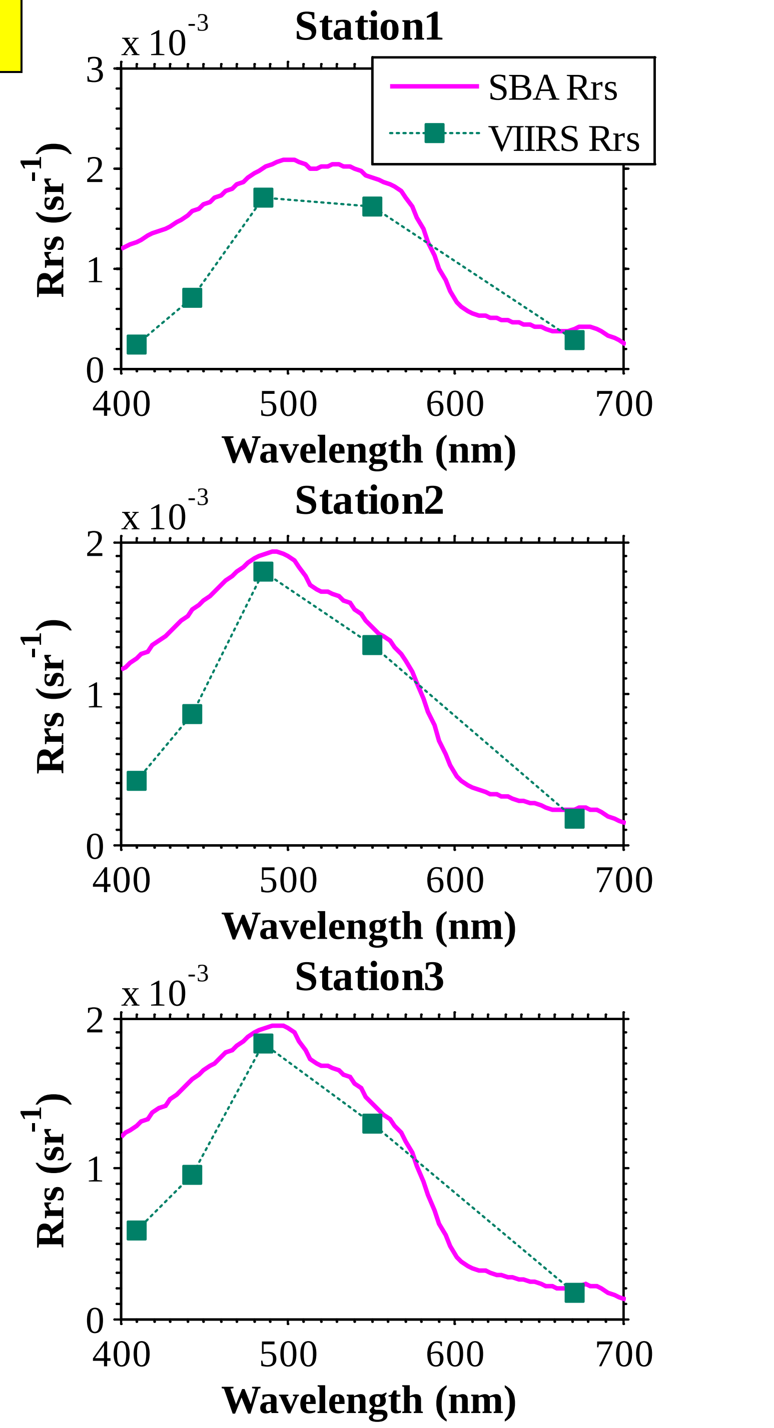
Conclusions from validation results

- MSL12 Rrs performance generally satisfactory in coastal waters (comparable to published MODIS results)
- Bio-optical inversion algorithms still need improvements
- MSL12 Rrs slightly better than L2gen Rrs for the same pixels
- MSL12 shows more retrievals than L2gen

MassBay, September 15, 2015

Lee et al. (UMB)





Conclusions

- We have completed VIIRS mission-long science quality ocean color data **reprocessing** (including **SDR** and **EDR**), and the data stream is now going forward. **Two data streams have been routinely produced: near-real-time and science quality ocean color data.**
- We have developed VIIRS instrument calibration capability, and with new calibration LUTs, VIIRS ocean color products are significantly improved.
- VIIRS ocean color products have been significantly improved (**over global high altitude lakes**) after the implementation of some important updates, new algorithms, and with vicarious calibrations using MOBY data.
- In general, VIIRS **normalize water-leaving radiance** spectra show reasonable agreements with in situ measurements at MOBY, AERONET-OC sites, and various other ocean regions.
- The new NIR ocean reflectance correction algorithm (**BMW**) improves ocean color data over coastal and inland waters.
- VIIRS global ocean color products have been routinely produced using the **NIR**, **SWIR**, and **NIR-SWIR** atmospheric correction algorithms, providing necessary satellite data for various applications in coastal and inland waters, as well as for further improving data quality.
- Our evaluation results show that **VIIRS-SNPP is now capable of providing high quality global ocean color products in support of science research and operational applications.**
- Have been/will be working on **VIIRS-JPSS-1**, **OLCI-Sentinel-3**, **GOCI**, **SGLI-GCOM-C**.

JPSS SST Report Back

Sasha Ignatov, Paul DiGiacomo

NOAA Center for Satellite Applications and Research (STAR)

Three Major Themes

- VIIRS **L2/L3 Data Producers**-8: STAR(5), NAVO(2), U. Miami(1)
  - NOAA ACSPO product continues history of solid performance
  - Reduced-size ACSPO L3U widely used & improved
  - New ACSPO error characterization improves SST performance
  - U. Miami and NAVO continue improving their VIIRS SST products
- ACSPO **Holdings/Archives**-2: STAR(1), NCEI/Silver Spring(1)
  - ACSPO L2P/L3U Products are fully archived at PO.DAAC and NCEI
  - STAR is exploring supplemental product access via CoastWatch
- ACSPO **Users**-10: UKMO(1), ABoM(2), JMA(1), NOAA CRW(1) and Geo-Polar Blend(1), JPL(1), NCEI(1), NOS(1)
  - Sustained 2 major users: CMC and NOAA Geo-Polar-Blended
  - 2 new users: **Met Office (OSTIA)** and NOAA CRW
  - 5 emerging users: ABoM, JMA, JPL, NOS, NCE/Asheville

Improvements to UKMO OSTIA L4 SST Analysis from: (1) Assimilating VIIRS; (2) Replacing Ref to VIIRS

Met Office

Region (CMEMS definitions)	RMS diff to Argo Floats (K)		
	Control	+VIIRS+AMSR2	+VIIRS_Ref
	Operational before 15 Mar 2016	Operational after 15 Mar 2016 – pr	Operational after 20 Sep 2016
Global	**0.50**	**0.44**	**0.40**
North Atlantic	0.59	0.53	0.42
Tropical Atlantic	0.30	0.28	0.24
South Atlantic	0.56	0.50	0.44
North Pacific	0.50	0.45	0.45
Tropical Pacific	0.33	0.29	0.22
South Pacific	0.39	0.36	0.30
Indian Ocean	0.34	0.30	0.28
Southern Ocean	0.52	0.47	0.42

Assimilating VIIRS and using it as REF significantly improves its relative ranking compared to other L4 analyses

Comparison to other SST analyses

Assimilating VIIRS (and REMSS AMSR2) substantially improves the accuracy of the OSTIA analysis compared to other L4 SST analyses.

The effect of using VIIRS as a reference dataset for OSTIA instead of MetOp-A AVHRR continues this improvement.

Statistics for 9 December 2015 to 11 January 2016, from the GMPE (GHRSST Multi-Product Ensemble) system

Analysis Name	Global RMS Diff to independent Argo (K)
OSTIA +VIIRS, AMSR2, and VIIRS bias correction	0.40
CMC	0.42
GMPE Median	0.43
OSTIA +VIIRS, AMSR2	0.44
NRL FNMOC	0.48
NAVO K10_SST	0.52
UKMO OSTIA (original)	0.53
RSS mw	0.53
ABoM GAMSSA	0.54
JMA MGDSST	0.57
NCEI Reynolds	0.59
NCEP RTG	0.69
RSS mw_ir	0.82

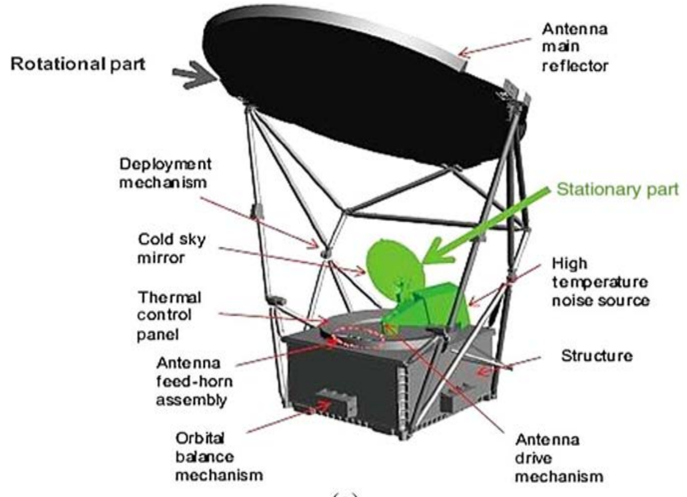
STAR GCOM-W1/AMSR2 PROJECT SUMMARY

STAR GCOM-W1 Project Team
Presented by Ralph Ferraro

Paul Chang, Ralph Ferraro, Zorana Jelenak, Suleiman Alsweiss, Patrick Meyers, Qi Zhu, Mark Romer, Xiwu Zhan, Jicheng Liu, Eileen Maturi, Fuzhong Weng, Andy Harris, Jeff Key, Cezar Kongoli, Walt Meier, Yong-Keun Lee, Walter Wolf, Tom King, Letitia Soullaird, Peter Keehn, Mike Wilson …

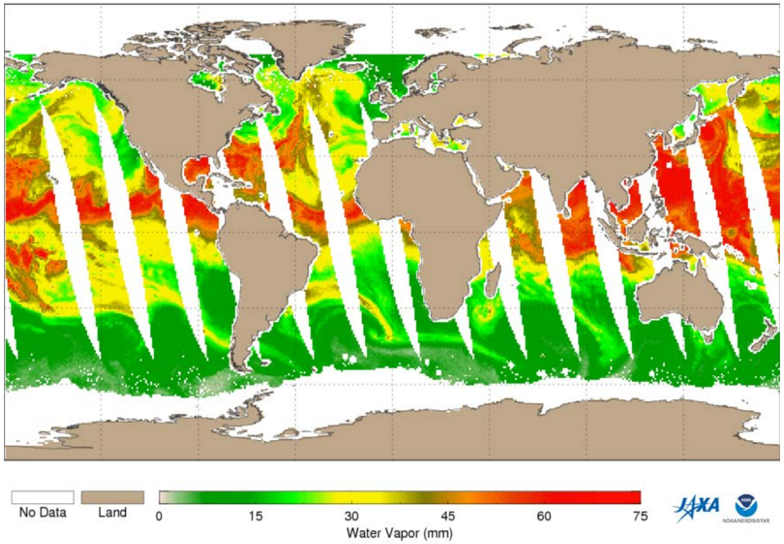
Summary (1/2)

- JAXA's GCOM-W1/AMSR-2 has been providing useful data for weather forecasting and applications at NOAA
  - Sensor performing well (aside from a few short-lived anomalies consistent with previous type sensors)
  - Fills is void for MW imager applications
- NESDIS operational AMSR-2 Products
  - Day-1 products (TB's, TPW, OSW, SST, CLW, RR/type) operational since 11/4/15
    - Research products since Nov. 2013
  - Product updates delivered, awaiting ORR (impacted by NDE upgrade/schedule – hope by end of 2016)
    - Improved ocean EDR's
    - Day-2 – SWE/SD, SIC, SM
  - Products meeting spec's
- Continue to build our relationship with JAXA
  - Sensor calibration/updates
  - Making the case for follow on mission



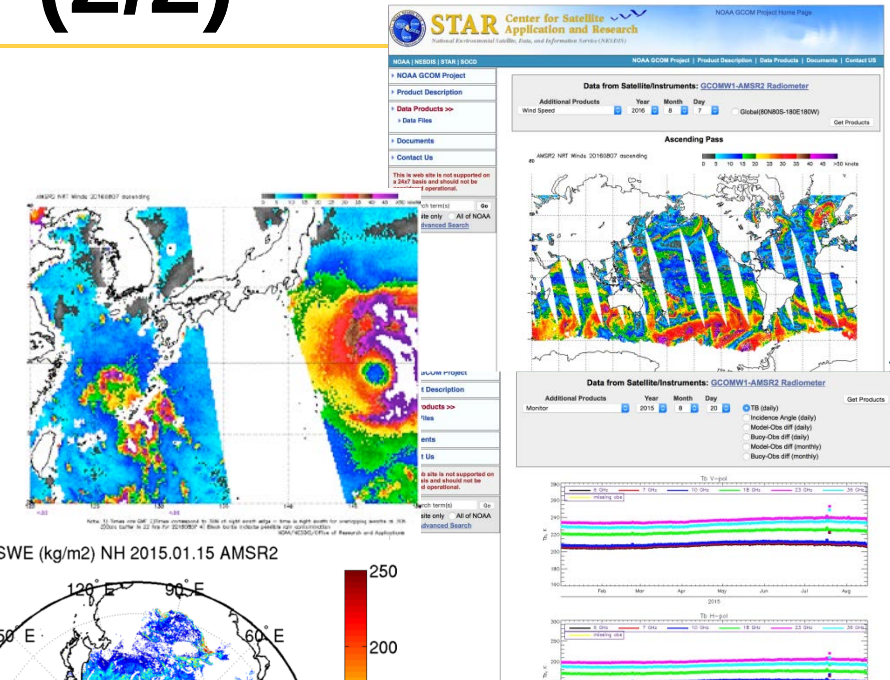
(a)

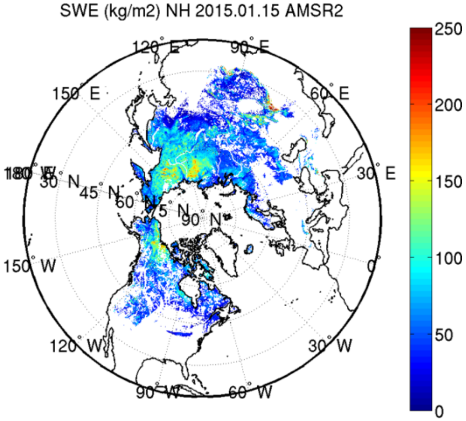
GCOM-W1 AMSR2 Total Precipitable Water - Ascending
9 Aug 2016

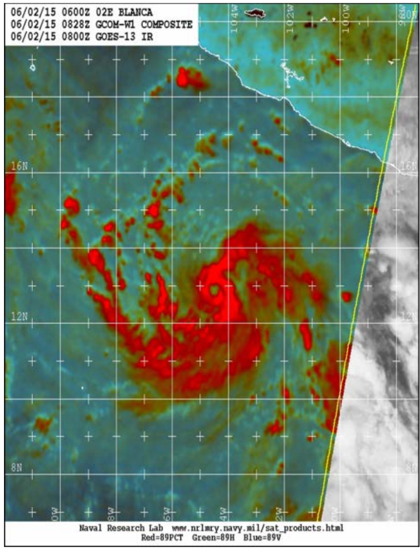


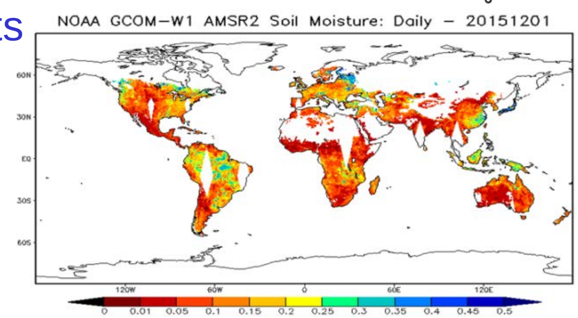
Summary (2/2)

- Ongoing product quality monitoring continues through STAR based web pages and off-line analysis
  - Includes use of CRTM, comparisons with in-situ, etc. - http://manati.star.nesdis.noaa.gov/gcom/
- STAR AMSR2 EDR quick look products
  - http://www.star.nesdis.noaa.gov/jpss/EDRs/products_gcom.php
- Continue to work with users to expand utility and develop new applications
  - Tropical Cyclones – NHC, JTWC
  - Marine forecasts – OPC
  - Hydrology – WPC, NWC
  - Day 2 products – NIC, NWC, etc.
  - Will lead to future product improvements vis R2O and O2R









Land / cryosphere breakout
Summary on land discussion

Ivan Csiszar
NOAA/NESDIS/STAR

see individual credits on select slides

Principal questions

- Is transition to enterprise processing on track?
  - science, format, dependencies
  - transition to “true” enterprise products
    - GOES-R, non-NOAA / foreign satellites
- Are we ready for reprocessing?
  - product-specific requirements
- Are the products ready to use? Are they used?
  - true operational applications
    - process for implementing operational use
    - demonstrated potential and impacts

Agenda (am)

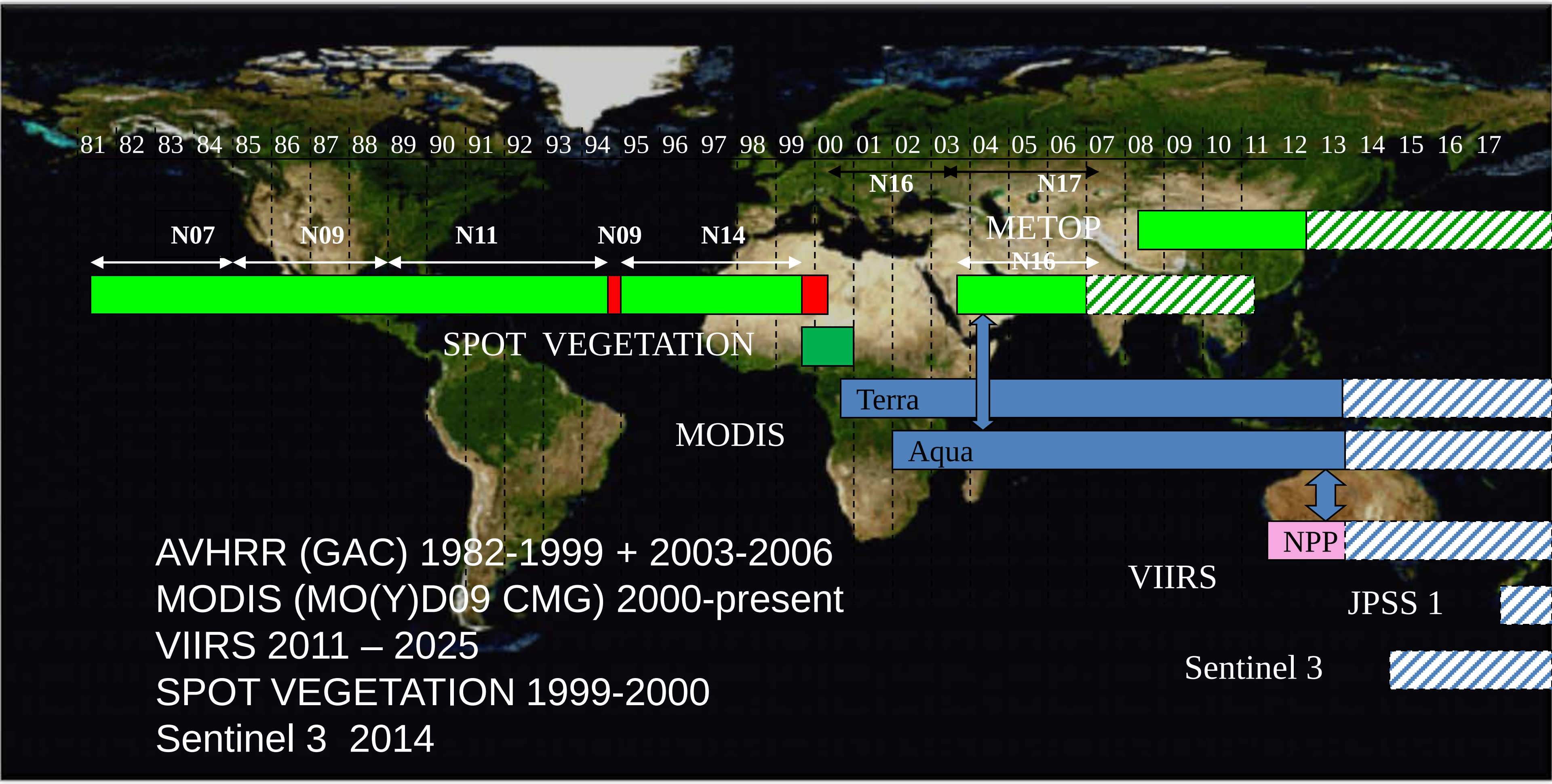
0830 – 0850	***Introduction and welcome***	Ivan Csiszar
0850 – 0910	***Surface reflectance***	Eric Vermote
0910 – 0930	***Terrestrial biophysical product suite***	Marco Vargas
0930 – 0950	***Land surface albedo***	Yunyue (Bob) Yu
0950 – 1010	***Land surface temperature***	Yunyue (Bob) Yu
1010 – 1030	***Break***	
1030 – 1050	***Active fire***	Ivan Csiszar
1050 – 1110	***Surface type***	Xiwu (Jerry) Zhan
1110 – 1130	***Binary snow cover and snow fraction***	Peter Romanov
1130 – 1150	***Sea ice surface temperature***	Mark Tschudi
1150 – 1210	***Sea ice concentration***	Jeff Key
1210 – 1230	***Sea ice characterization and thickness***	Jeff Key

Agenda (pm)

1330 - 1350	***Enterprise system status***	Ivan Csiszar
1350 – 1410	***Suomi NPP reprocessing status***	Jason Choi
1410 – 1430	***NASA Science Team***	Miguel Román
1430 – 1450	***CEOS Land Product Validation***	Miguel Román
1450 – 1510	***Land product characterization system***	Gregory Stensaas
1510 – 1530	***Break / poster session***	
1530 – 1550	***Vegetation Health Applications***	Wei Guo
1550 – 1610	***NCEP Land Applications***	Mike Ek
1610 – 1630	***National Ice Center Applications***	Pablo C. Colón
1630 – 1650	***Open discussion and wrap-up***	

A Land Climate Data Record

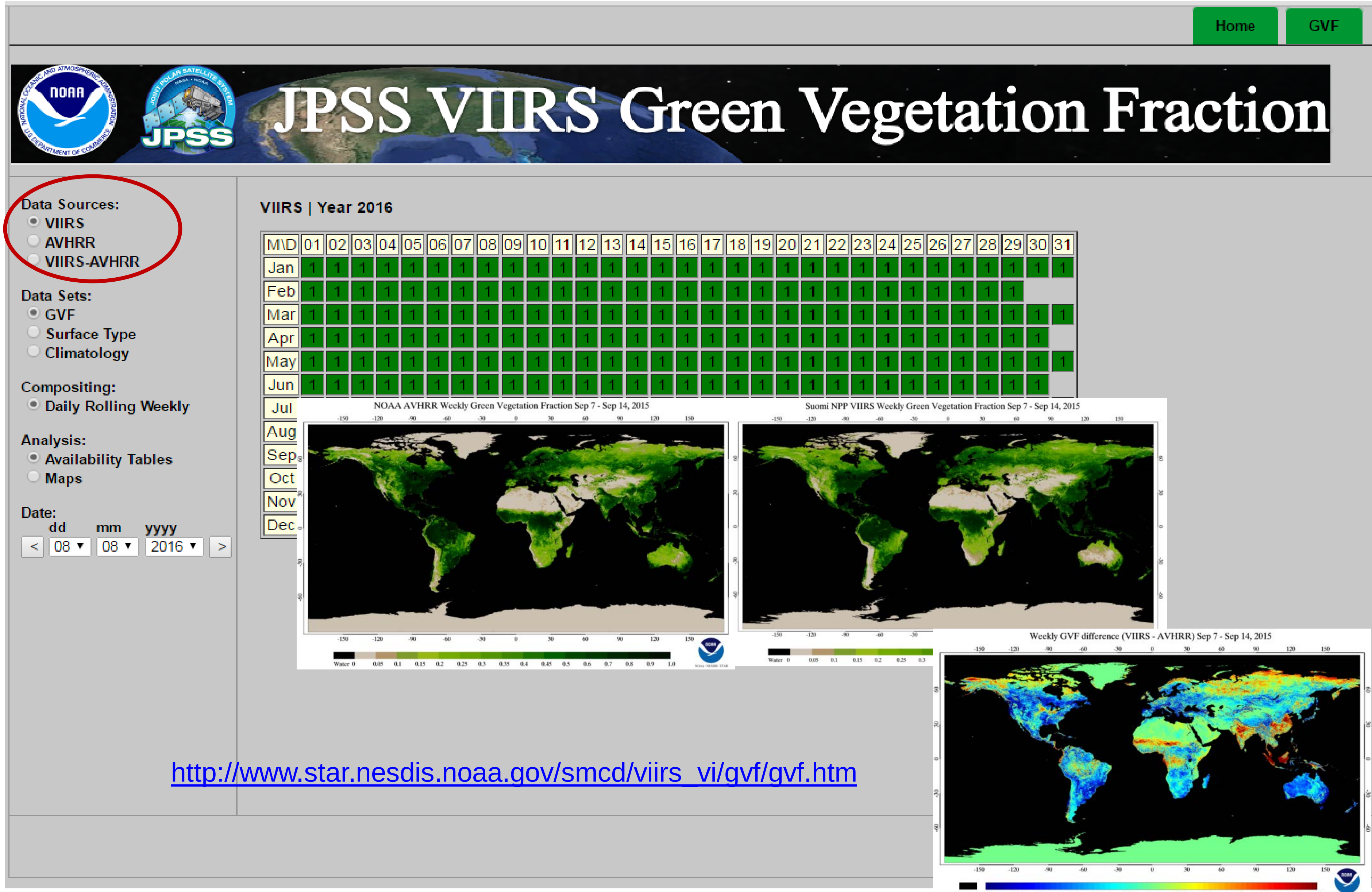
Multi instrument/Multi sensor Science Quality Data Records used to quantify trends and changes



Emphasis on data consistency – characterization rather than degrading/smoothing the data

E. Vermote, NASA

NDE S-NPP VIIRS GVF Validation (1/3)



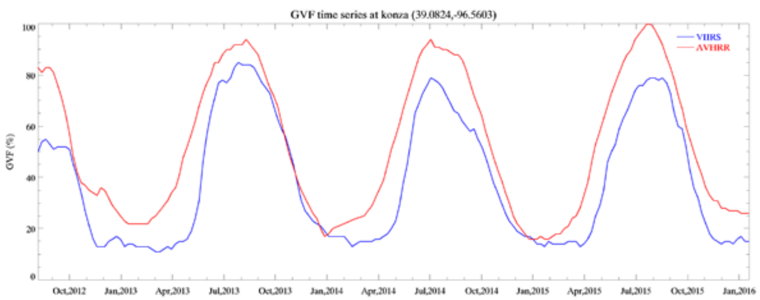
http://www.star.nesdis.noaa.gov/smcd/viirs_vi/gvf/gvf.htm

M. Vargas, STAR

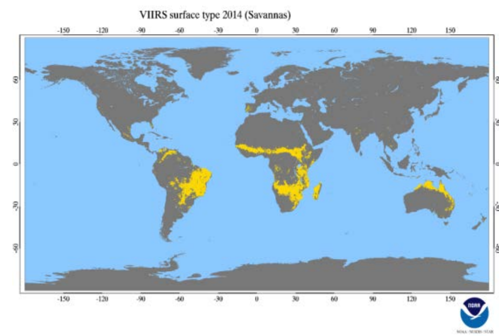
NDE S-NPP VIIRS GVF Validation (2/3)

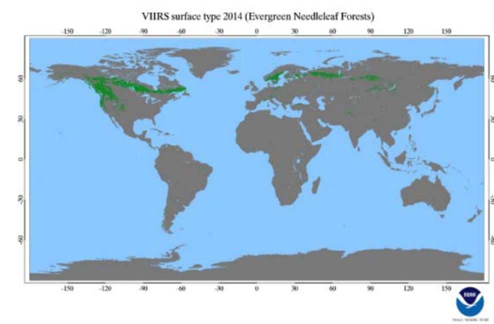
GVF Time Series and Correlative Analysis Between VIIRS and AVHR

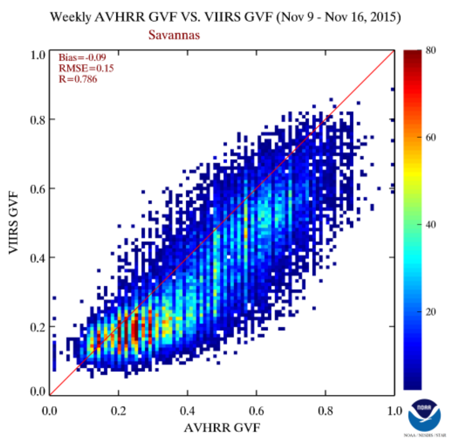
GVF Temporal Trajectories VIIRS vs. AVHRR Konza Validation Site

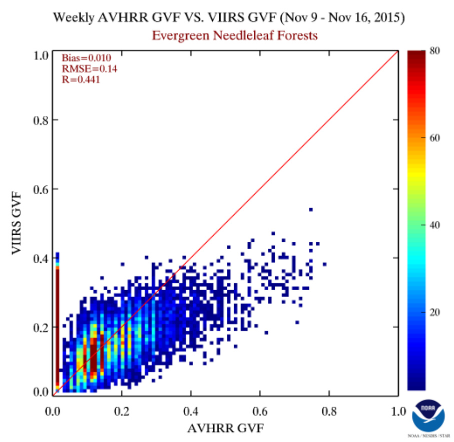


GVF Comparison by Surface Type VIIRS vs. AVHRR

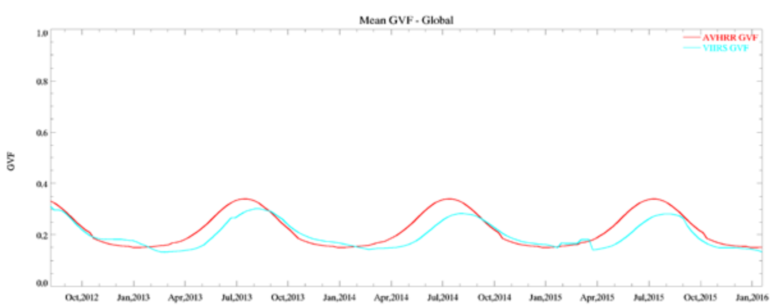








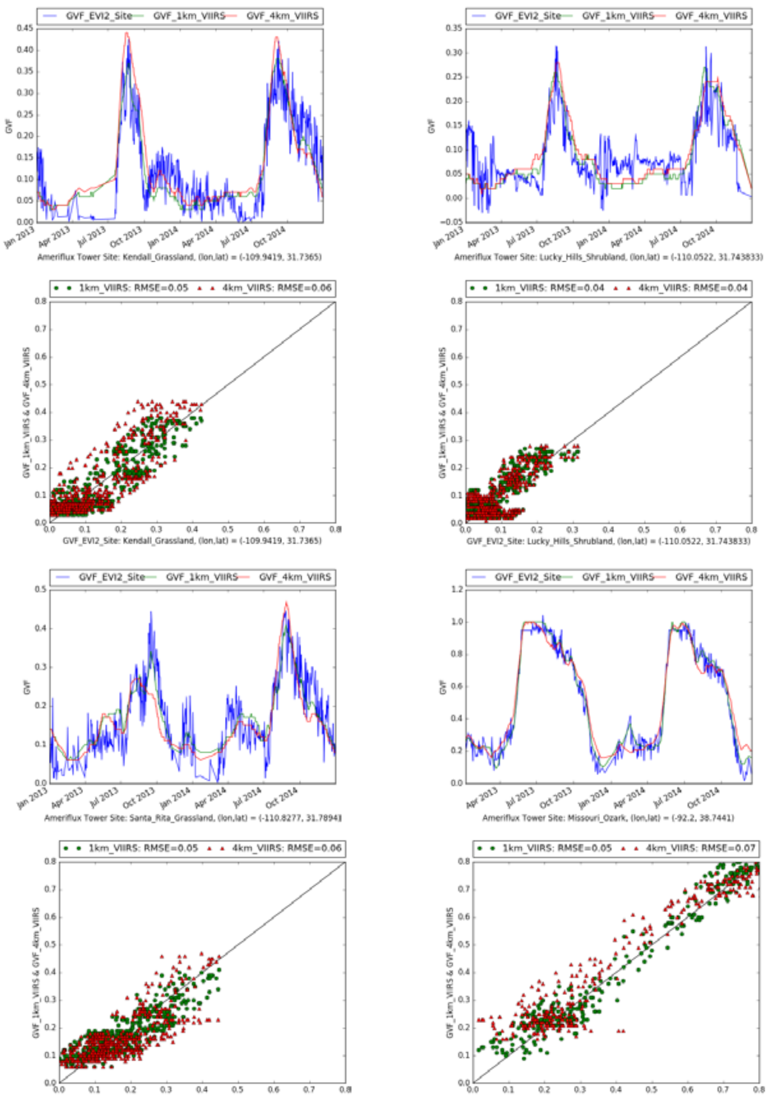
Global GVF Temporal Trajectories VIIRS vs. AVHRR



M. Vargas, STAR

NDE S-NPP VIIRS GVF Validation (3/3)

GVF Time Series Inter-Comparison Using In Situ Networks



Comparison Between VIIRS GVF and Google Earth GVF

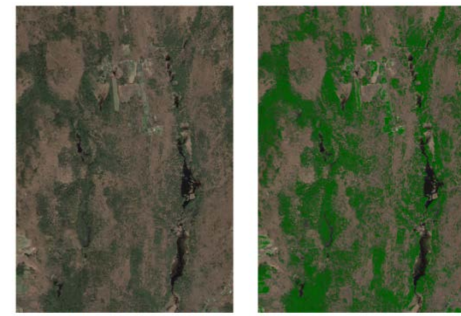
Konza

Google Earth image over a 0.036-degree VIIRS GVF pixel (8/13/2014)

Classified image (green vegetation: green)

Google Earth GVF= 0.44
VIIRS GVF= 0.55

Harvard Forest

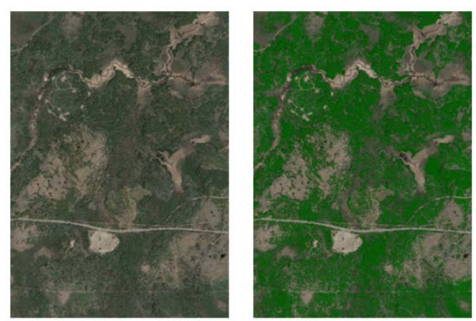


Google Earth image over a 0.036-degree VIIRS GVF pixel (4/27/2016)

Classified image (green vegetation: green)

Google Earth GVF= 0.26
VIIRS GVF= 0.34

Park Falls

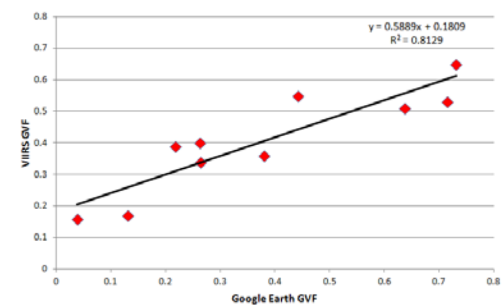


Google Earth image over a 0.036-degree VIIRS GVF pixel (5/10/2013)

Classified image (green vegetation: green)

Google Earth GVF= 0.38
VIIRS GVF= 0.36

Scatter Plot
VIIRS GVF vs. Google Earth GVF



M. Vargas, STAR

Land surface albedo summary

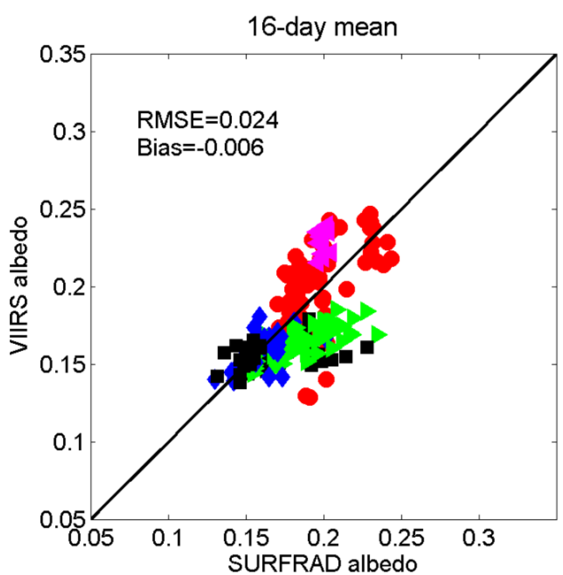
- Land surface albedo is the ratio between outgoing and incoming shortwave radiation at the Earth surface. It is an essential component of the Earth's surface radiation budget. LSA is part of VIIRS Surface Albedo Environmental Data Record (EDR).
- After three updates of LUTs of regression coefficients since launch, **quality of LSA retrievals have been significantly improved**.
- Accuracy of the current non-snow LSA retrievals are smaller than the L1RD threshold. The performance of snow LSA is also comparable (slightly better) than the existing albedo product, although RMSE of current snow retrievals are greater than the precision requirement.
- Current IDPS product contains data gaps/missing values due to cloud coverage. Meanwhile, the albedo retrieved from a single observation may contain some levels of random noises. Daily noise-reduced, no-gap albedo product is required by user.
- **An improved enterprise albedo algorithm is currently under development** to address these issues.

Albedo product performance

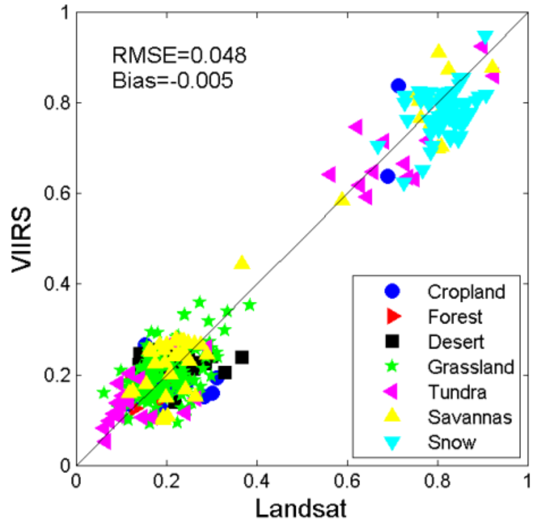
VIIRS Surface albedo EDR is a full resolution granule instantaneous product. LSA is only generated for clear-sky land pixels.

Product	L1RDS APU Thresholds	Performance
VIIRS LSA	Precision: 0.05	RMSE: 0.05
VIIRS LSA	Accuracy: 0.08	Bias: 0.01

- Comprehensive evaluation was conducted using field measurements and high-resolution LSA reference maps
- The current LSA data can well meet the requirements for snow-free cases.



Left: Comparison of snow free albedo with SURFRAD measurements.
Right: Validating snow-free and snow albedo using Landsat albedo maps

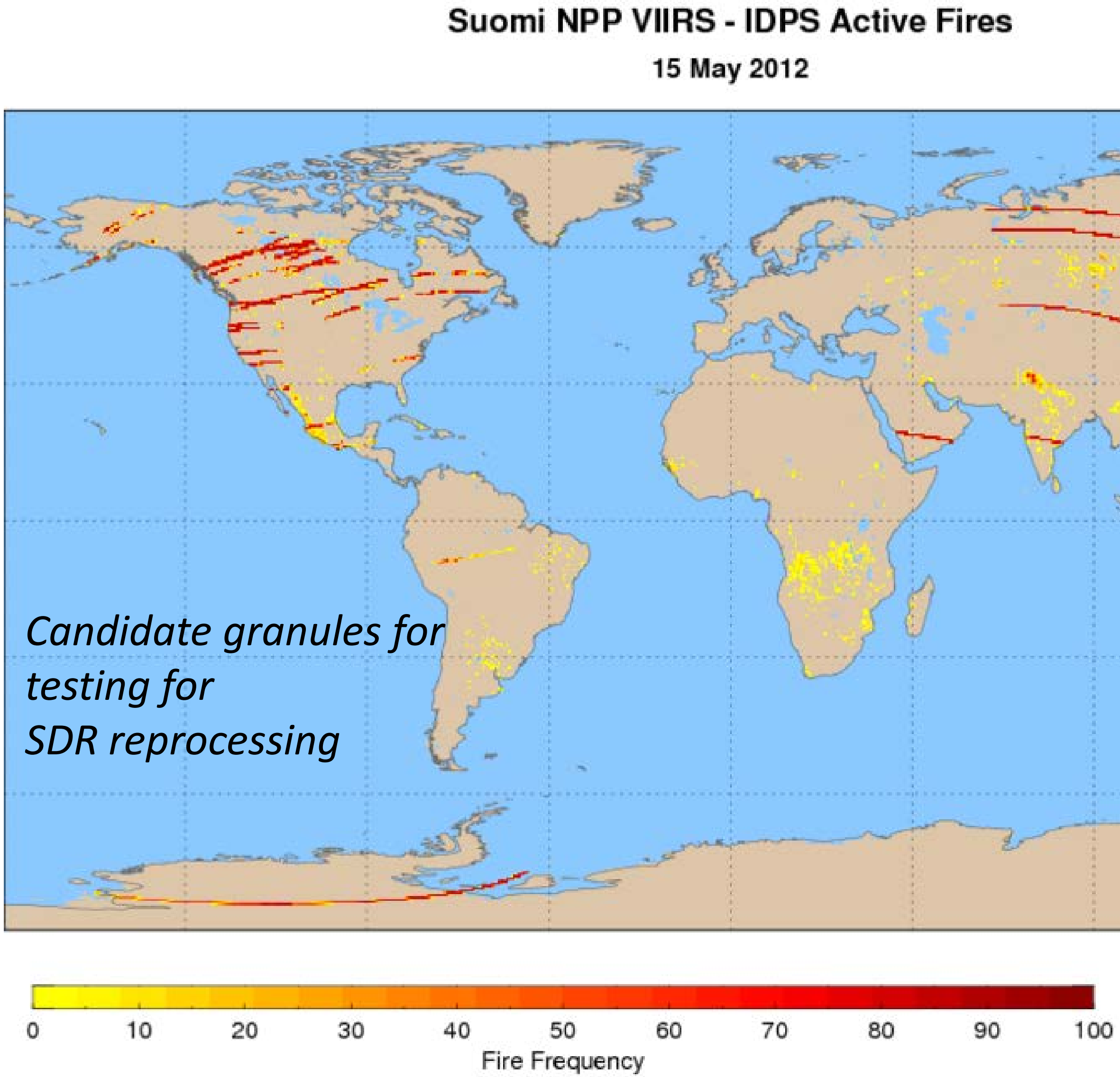


Land surface temperature summary

- SNPP LST performance
  - **The SNPP LST marginally meets the mission requirements** based on the validation result s obtained from
    - Ground based validations(CONUS, Europe, Greenland, Australia, China)
    - Radiance based validations over global and four seasons
    - Cross satellite comparisons with MODIS, AATSR, SEVIRI etc.
  - Validation tools are run regularly for routing monitoring and web info update
  - Working with EMC/NCEP for the model verification
  - Suspicious High LSTs observed in Australia in Summer time; lack of in-situ data available for deep-dive validation
  - Cloud contamination is still the issue for accurate validation .
- Enterprise LST algorithm progress
  - **Emissivity explicit algorithm developed and tested**
  - Emissivity estimation algorithm is developed and tested
  - NDE LST production system is in development
- Reprocessing status
  - A reprocessing plan is proposed
  - **Enterprise algorithm will be used for the reprocessing for LST consistency**
- JPSS-1 readiness
  - All the validation tools and simulation tools/database are ready for the J-1 mission
  - J-1 LST production in NDE will be based on the Enterprise Algorithm
  - The J-1 Cal/Val plan has been submitted, with the schedule and milestones consistent to the mission's plan

Y. Yu, STAR

Active fire data anomalies during the early period of the Suomi NPP data record

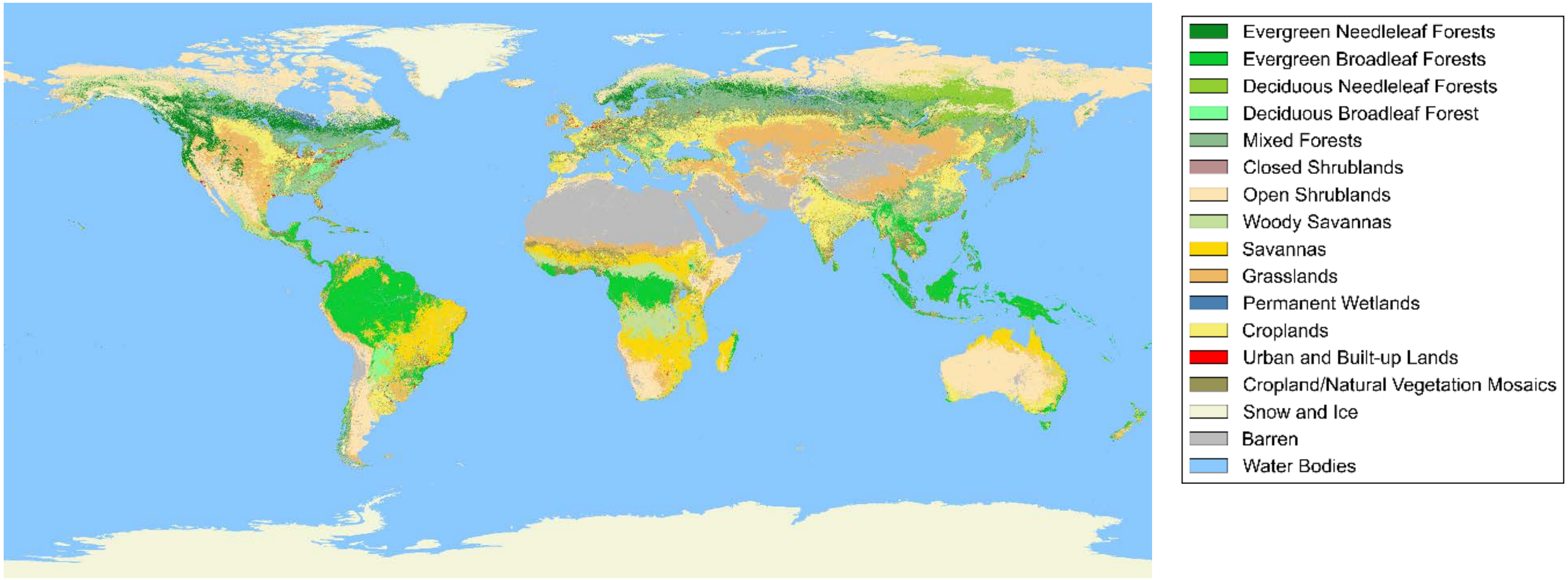


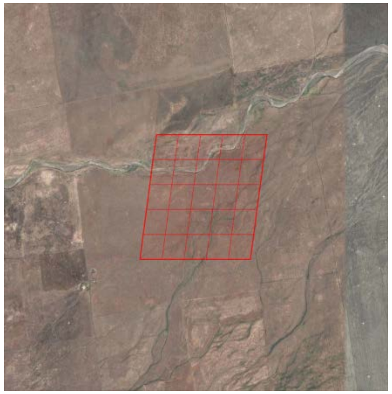
I. Csiszar, STAR

NOAA/NESDIS/STAR

Surface Type Products Overview

- New global surface type map using 2014 VIIRS data was generated.





Eastern Africa

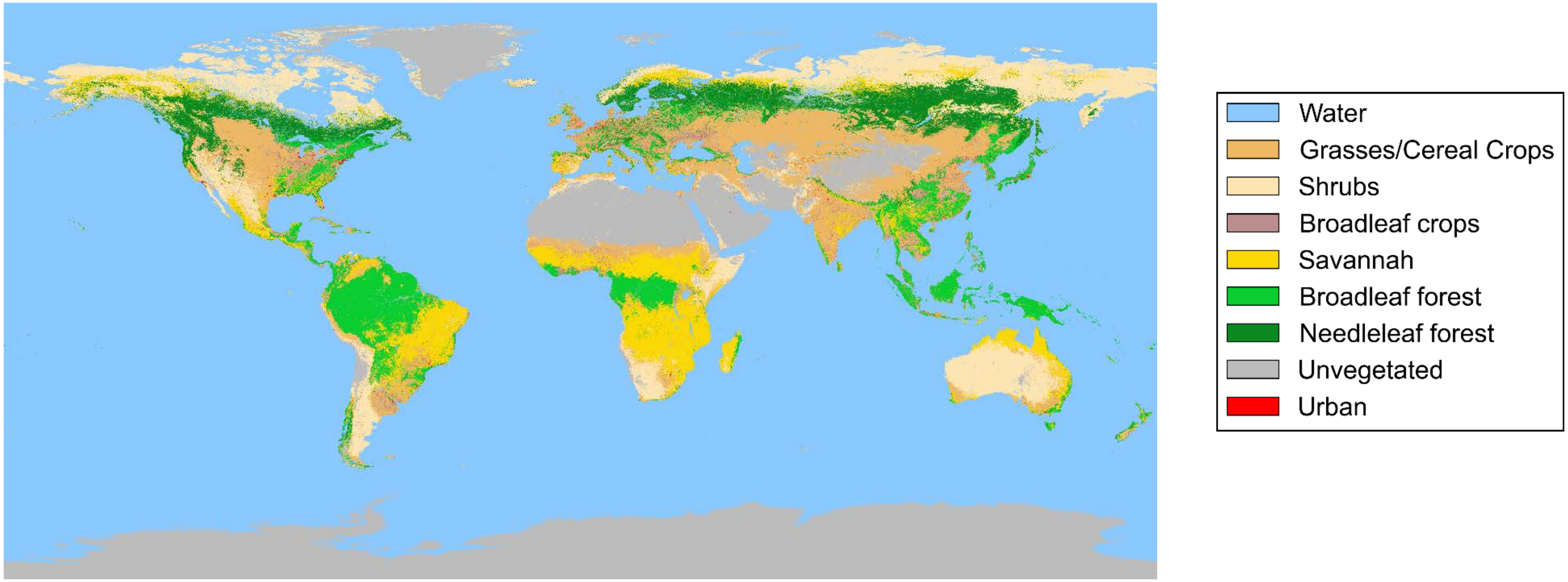
Canada

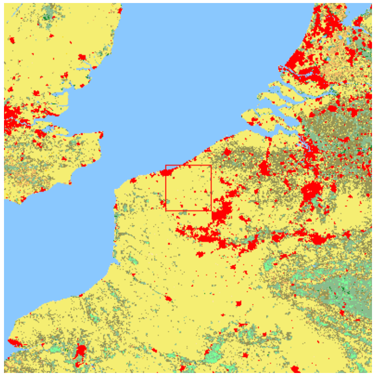
While the overall classification accuracy (~78%) of the new map is similar to 2012 delivery, some accuracy improvements are observed, such as croplands. The images shown left demonstrate two examples of the improved cropland mapping results, where the old version presented wrong type labels. Google images verified the mapping results.

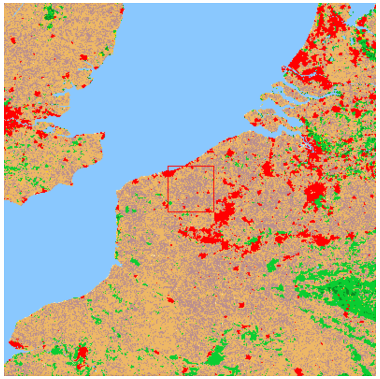
X. Zhan, STAR; C. Huang, UMD

Surface Type Products Overview

New global surface type map in biome classification types to support LAI/FPAR and other studies







Europe

The biome scheme surface type map was generated using a IGBP-biome LUT plus a second SVM classification to further separate cereal crops and broadleaf crops. Validation in progress. The two images shown left is an example of crop mapping result in IGBP and biome legends. Cereal and broadleaf croplands are further separated in biome ST map.

X. Zhan, STAR; C. Huang, UMD

Daily Surface Type Product

- Rapid surface changes can be caused by many events:
  - Flooding, severe drought, snow storm, fire, large scale deforestation
- These changes cannot be captured by the annual GST product
- A suite of daily products or change indicator products are needed to capture such rapid changes
  - Can build on the original ST-EDR concept
  - Where available, use existing VIIRS products (e.g., Snow, Fire, vegetation cover)
    - Better temporal consistency needed to allow change detection
    - For fire, post fire surface type information needs to be derived
  - Some changes require new products, e.g.:
    - Daily surface inundation needed to capture surface changes due to flooding and flood receding
    - Sub-annual tree cover data needed to capture deforestation

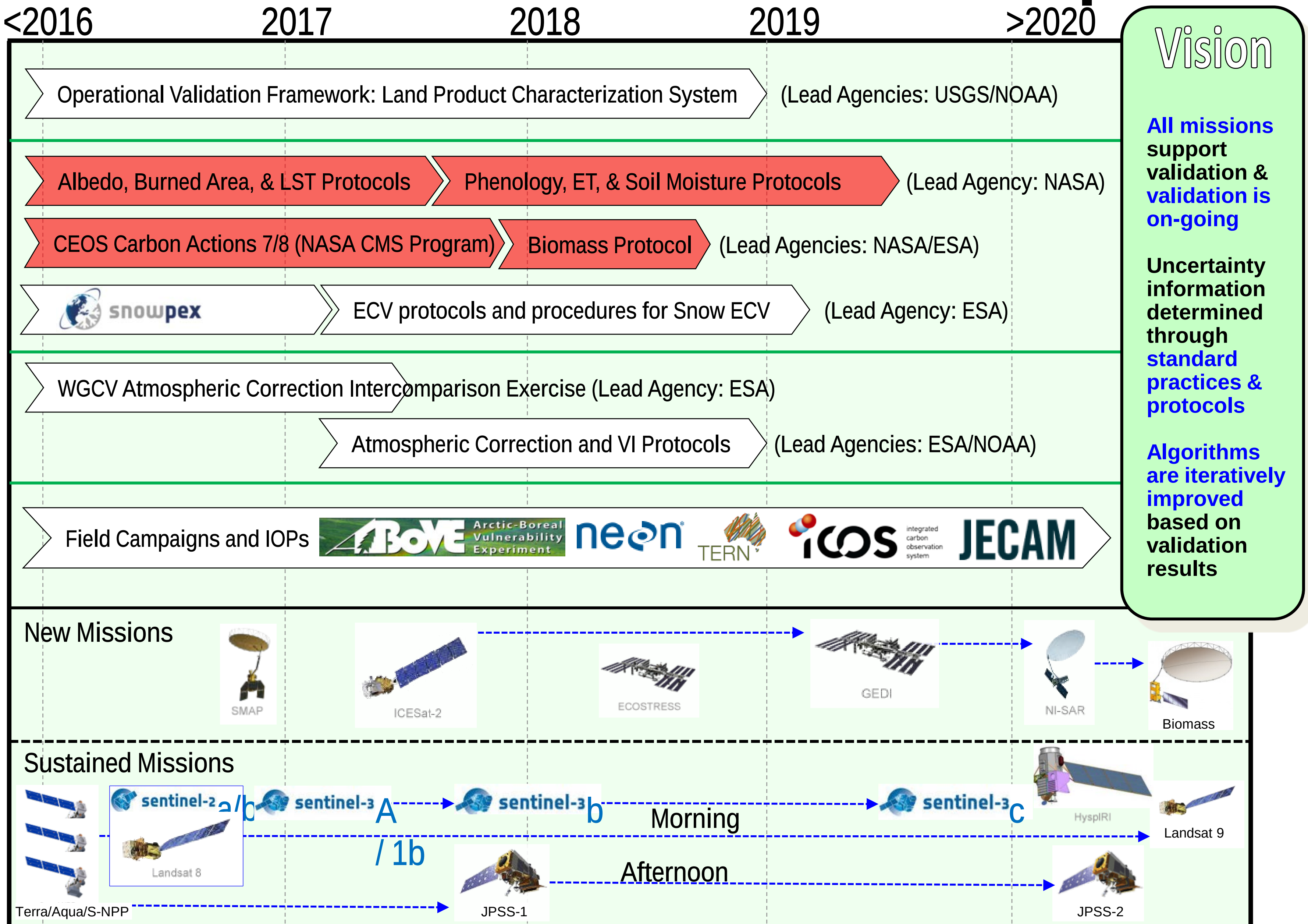
X. Zhan, STAR; C. Huang, UMD

NASA Land SIPS: Code Delivery and Integration Status

Land SIPS Products	Algorithms Delivered to Land SIPS	Product Integration and Testing	Draft ATBD Delivery	Delivery of User's Guide	Products Delivered to assigned DAAC
Surface Reflectance	✓	✓	✓	✓	Summer, 2016
LAI/FPAR	Underway	Underway	Summer, 2016	Summer, 2016	Fall, 2016
Snow Products	Underway	Underway	✓	Fall, 2016	Fall, 2016
MAIAC	Summer, 2016	Pending	Fall, 2016	Fall, 2016	Fall, 2016
BRDF/Albedo	Underway	Underway	✓	Summer, 2016	Fall, 2016
Burned Area	Fall, 2016	Pending	Spring, 2017	Spring, 2017	Spring, 2017
Active Fires	Underway	Underway	Spring, 2016	Fall, 2016	Fall, 2016
Vegetation Index	✓	Pending	Summer, 2016	Summer, 2016	Fall, 2016
LST&E	Underway	Pending	✓	Fall, 2016	Fall, 2016
Ice Products	Fall, 2016	Pending	✓	Fall, 2016	Fall, 2016
Phenology	Fall, 2016	Pending	Fall, 2016	Fall, 2016	Spring, 2017
Day/Night Band	✓	Underway	Fall, 2016	Fall, 2016	Spring, 2017

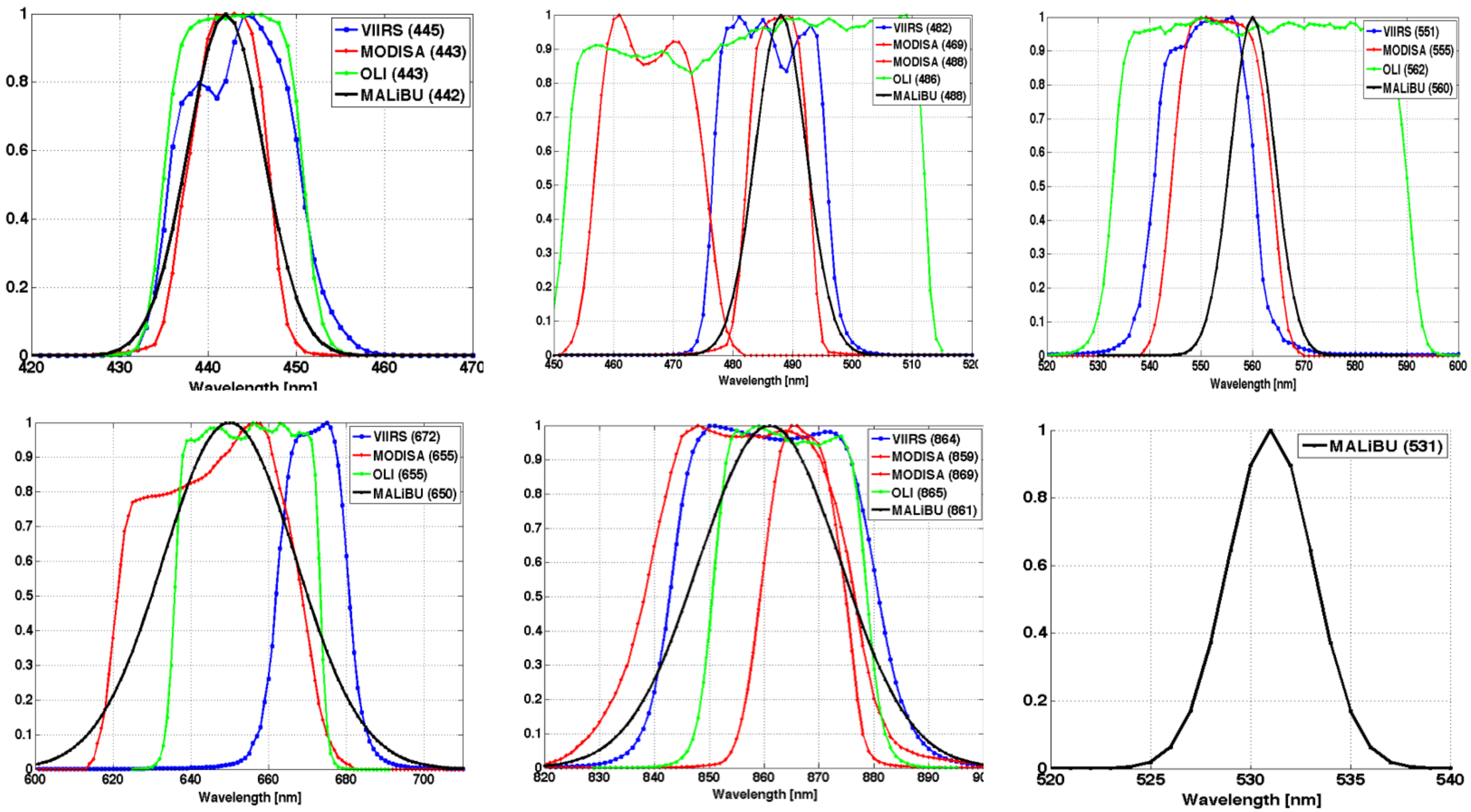
M. Román, NASA

CEOS-LPV 5-Year Roadmap



M. Román, NASA

MALIBU Spectral Response



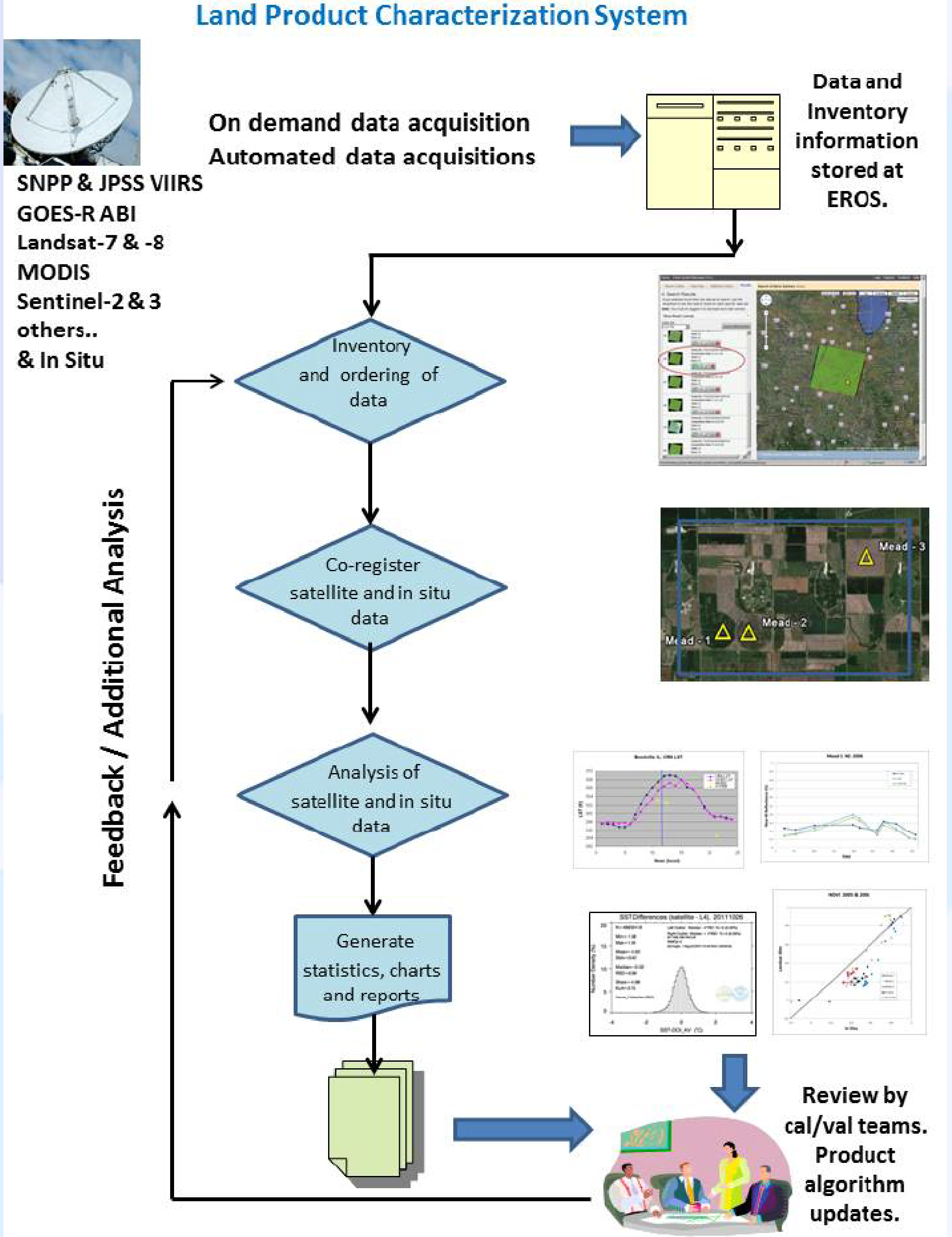
The MALIBU instrument design includes two [Tetracam optical units] matching the optical Land channels of key Land sensors such as Landsat-8 OLI, Sentinel-2 MSI, Sentinel 3-OLCI, Terra/Aqua MODIS, Terra MISR, and Suomi-NPP/JPSS VIIRS.

M. Román, NASA

What is LPCS

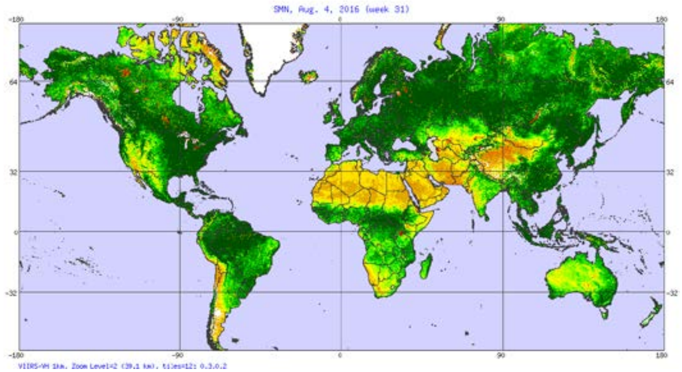
A web-based system designed for comparative analysis of global satellite higher-level land products.

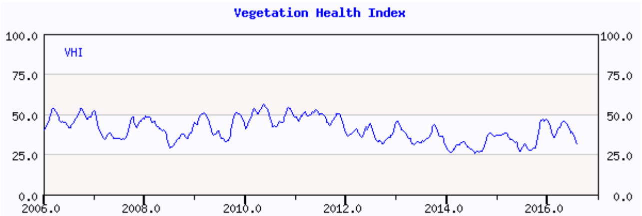
- Inventory & order data
- Advanced processing
- Basic analysis
- Output charts , images, & tables

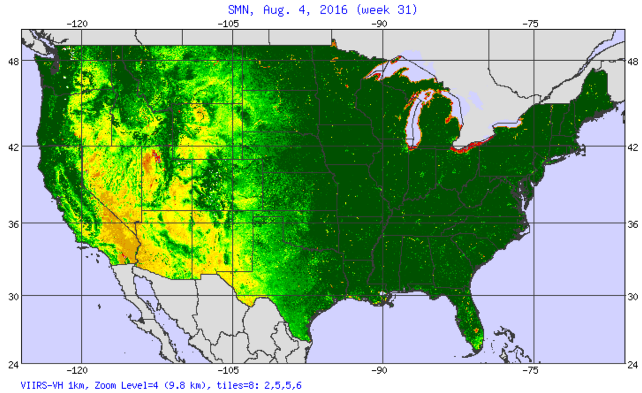


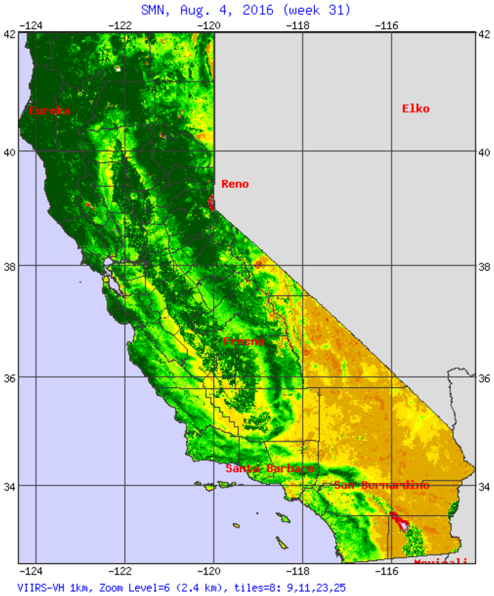
K. Gallo, STAR; G. Stensaas, USGS

Using map tiles technology to present 1km VH data through web pages





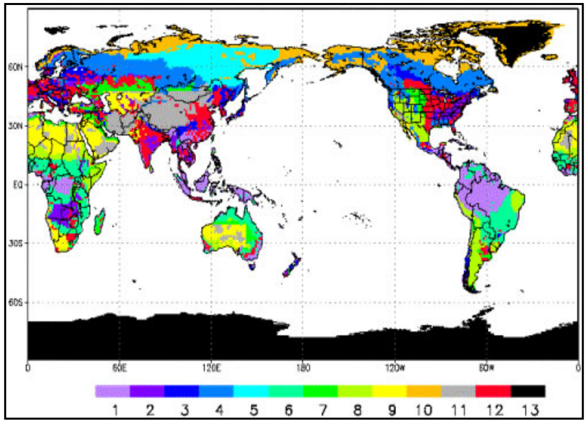




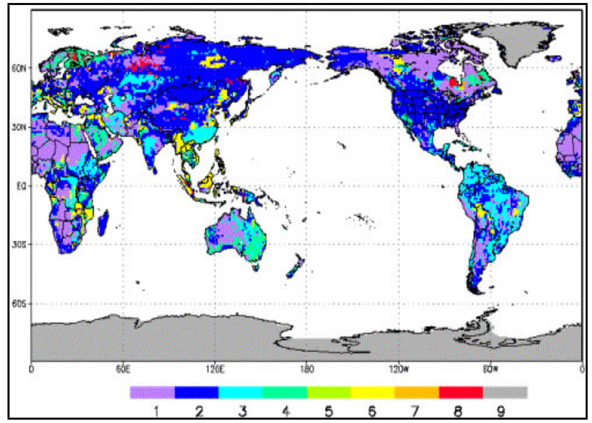
Users access the country and province maps by clicking the web page.

F. Kogan, STAR; W. Guo, IMSG

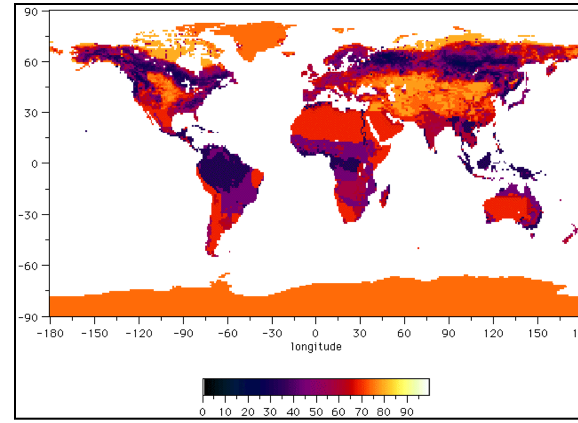
Land Data Sets *(GFS and CFS, GLDAS)*



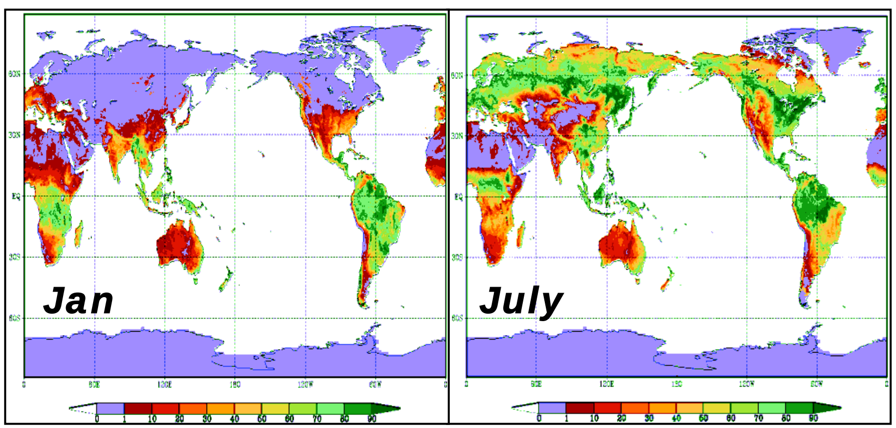
Vegetation Type
(1-deg, UMD)



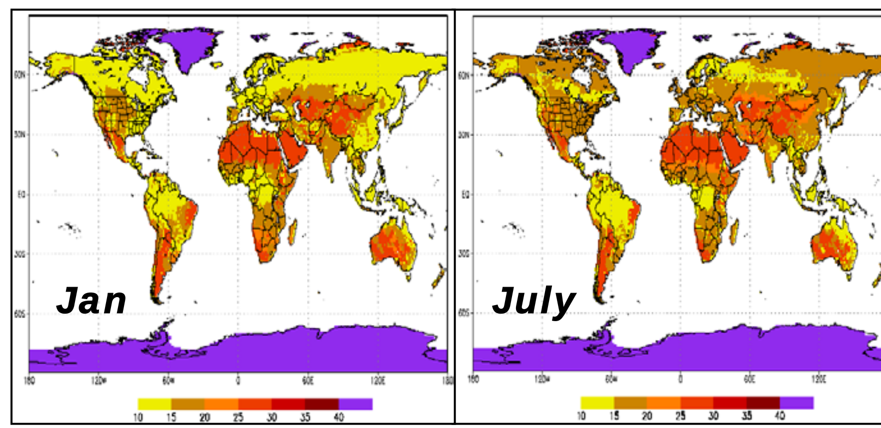
Soil Type
(1-deg, Zobler)



Max.-Snow Albedo
(1-deg, Robinson)



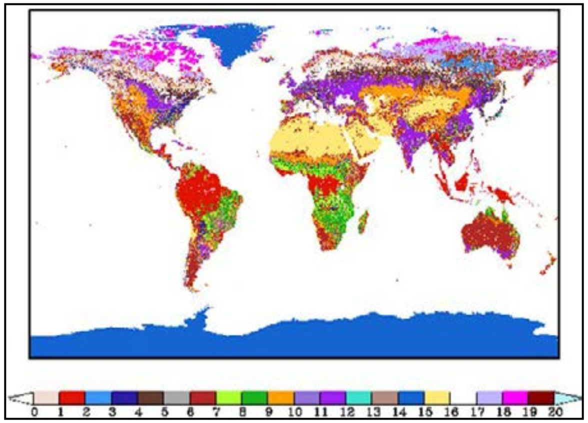
Green Vegetation Fraction
(monthly, 1/8-deg,
NESDIS/AVHRR)



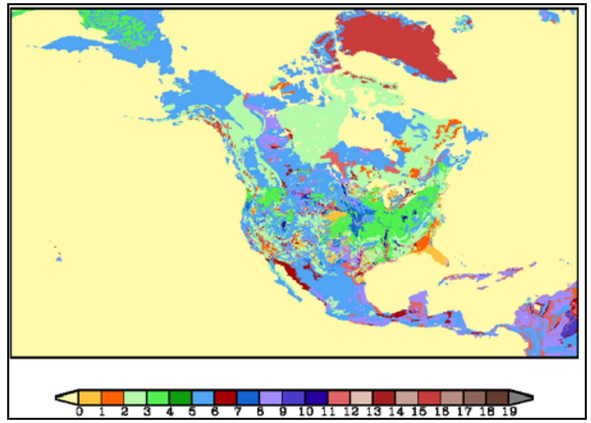
Snow-Free Albedo
(seasonal, 1-deg,
Matthews)

M. Ek, EMC; Y. Wu, IMSG

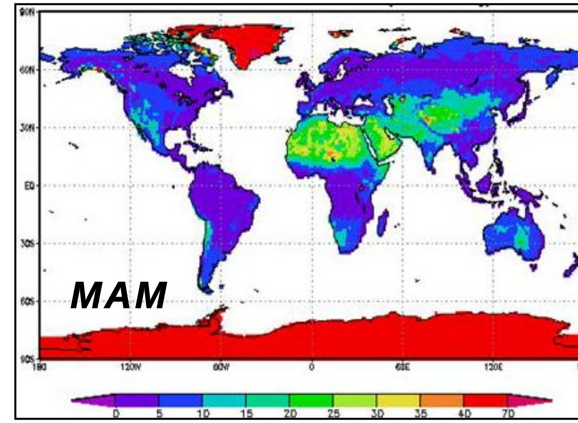
Land Data Sets *(NAM, NLDAS)*



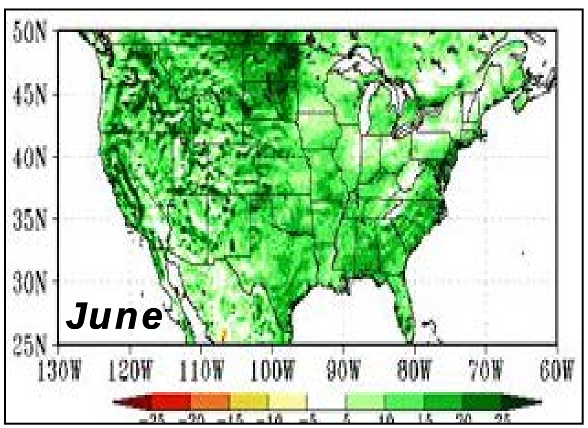
Vegetation Type
(1-km, MODIS)



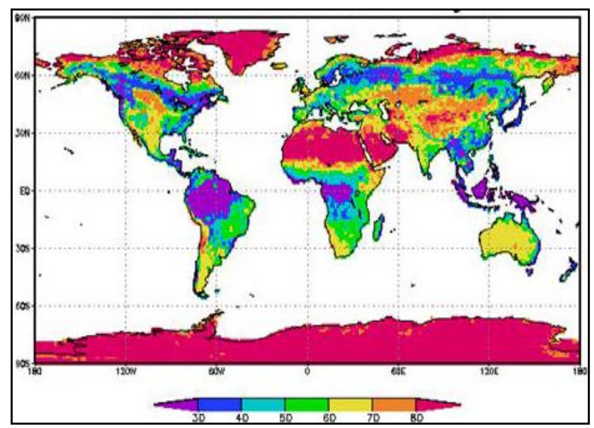
Soil Type
(1-km, STATSGO/FAO)



Snow-Free Albedo
(1-km, MODIS)



Green Vegetation Fraction
(1/8-deg, new NESDIS/AVHRR)



Max.-Snow Albedo
(5-km, MODIS)

M. Ek, EMC; Y. Wu, IMSG

Overarching issues (2/1)

- Enterprise product suite
  - Evolving science and evolving user needs -> requirements
    - I-band / hybrid VIIRS fire product
    - CCR on global gridded products to meet user needs
  - ensure seamless transition to NDE, including dependencies
  - Enterprise Cloud Mask testing
    - science
    - code interface
  - “soft” vs. “strict” definition of Enterprise
    - VIIRS-only in NDE vs. true common algorithm base for multiple sensors
- Reprocessing
  - ensure testing and evaluation
    - define needs and requirements
      - beyond calibration LUTs
    - explicitly test “problem” granules
  - broad interaction to meet all teams’ needs

Overarching issues (2/2)

- Validation
  - further coordination on field campaigns
    - GOES-R, MALIBU
  - increasing involvement of NOAA JPSS (and GOES-R) Science Team members in CEOS LPV
    - product teams
    - Land Product Characterization System (with USGS)
- Interagency / international coordination and collaboration
  - science algorithms / products
  - validation
  - multi-satellite observing systems
    - Mid-morning measurements from polar platforms

Many thanks go to

All presenters and attendees

Science Team members

JPSS and STAR Management

SPARKS interns

Christie Best and Stephanie Moore for taking notes

STAR and NCWCP personnel for logistical support

SNOW, ICE, AND POLAR WINDS

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

Cryo Team: Peter Romanov, Yinghui Liu, Mark Tschudi, Xuanji Wang, Dan Baldwin, Rich Dworak
Polar Winds: Dave Santek, Jaime Daniels

Executive Summary

- Products:
  - Snow: Binary snow cover, snow fraction
  - Ice: Ice surface temperature, ice concentration, ice thickness/age
  - Polar winds
- All products meet requirements (with one qualification)
- All products have better performance than their IDPS counterparts (a few only slightly better; others substantially better)
- Planned improvements for J1 are minor
- All products are ready for J1!

Product Performance

Product	L1RDS APU Thresholds	Performance	Meets Spec?
Snow cover (binary)	90% correct typing	92-94% (daily)	Y
Snow fraction	10% uncertainty	10-20%	N (next slide)
Ice surface temperature	1 K uncertainty	0.9 K	Y
Ice concentration	10% uncertainty	8.9%	Y
Ice thickness/age	70% correct typing (new/young, other ice); no thickness requirement	90% (first-year/other); 0.5 m precision for thickness	Y
VIIRS winds	7.5 m/s accuracy, 3.8 m/s precision (mean vector difference)	6.1/7.0, 3.3/2.7 accuracy, precision (NH/SH)	Y

Major Risks/Issues and Mitigation

Risk/Issues	Impact	Mitigation
Cloud contamination	Impact varies with location and season, generally not large	Use only confidently clear pixels
Snow fraction may not meet requirements	None	Requirement is not consistent with GOES-R (15% accur; 30% prec) and should be changed

Future Plans/Improvements

Binary snow cover:
- No significant changes

Snow fraction:
- Possibly change output to include reflectance-based fraction + NDSI value rather than reflectance-based fraction and NDSI-based fraction

Ice surface temperature:
- Update regression coefficients with newer raob data and J1 VIIRS spectral response functions

Ice concentration:
- Improve tie-point processing
- Evaluate generating an I-band resolution product
- Validation with additional high-res data, e.g., SAR

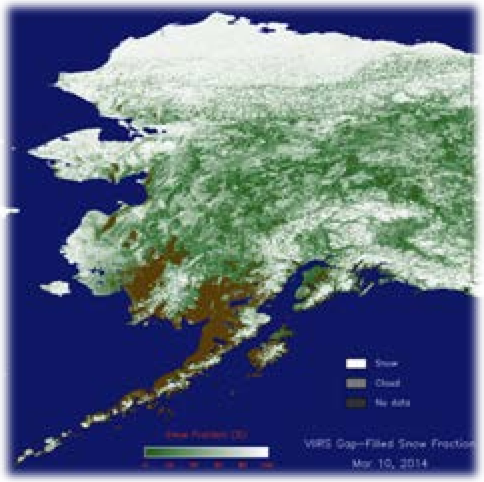
Future Plans/Improvements, cont.

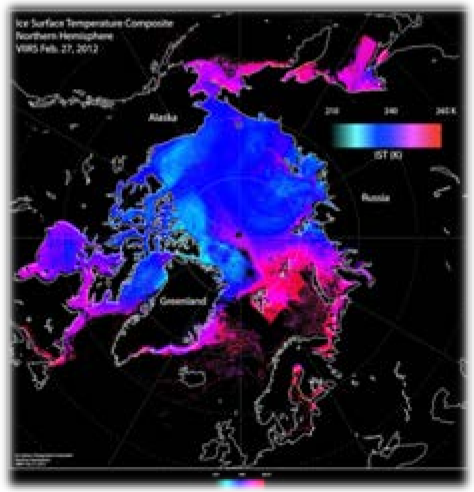
Ice thickness/age:

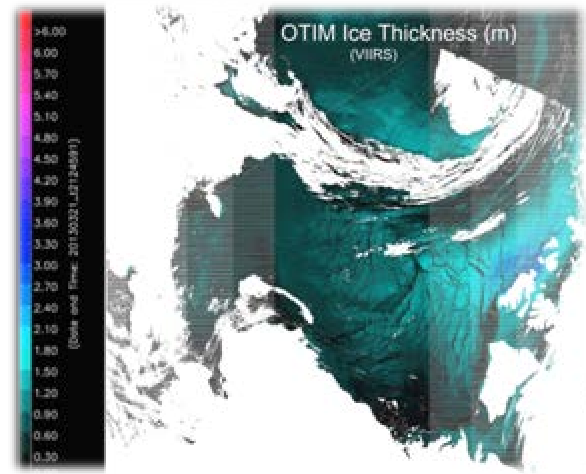
- Add ICESat-2 to validation efforts (launch in 2018)
- Evaluate the utility of bias corrections based on Cryosat-2 and ICESat-2 (2018)

Polar winds:

- Switch from the VCM to the Enterprise cloud mask (ECM)


VIIRS Gap-Filled Snow Fraction
Mar 10, 2014


Ice Surface Temperature Composite
Northern Hemisphere
VIIRS Feb. 27, 2012
Alaska
Russia
Greenland
IST (K)


OTIM Ice Thickness (m)
(VIIRS)
>6.00
6.00
5.70
5.40
5.10
4.80
4.50
4.20
3.90
3.60
3.30
3.00
2.70
2.40
2.10
1.80
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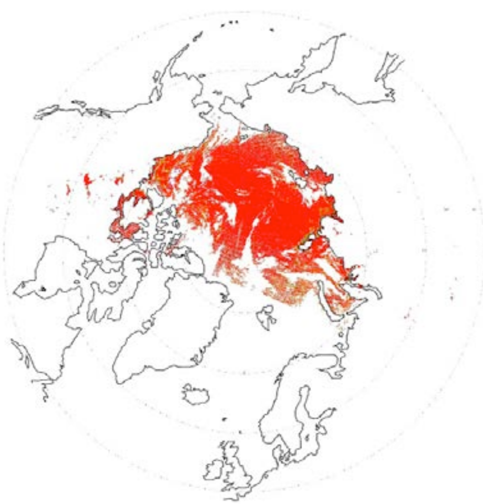
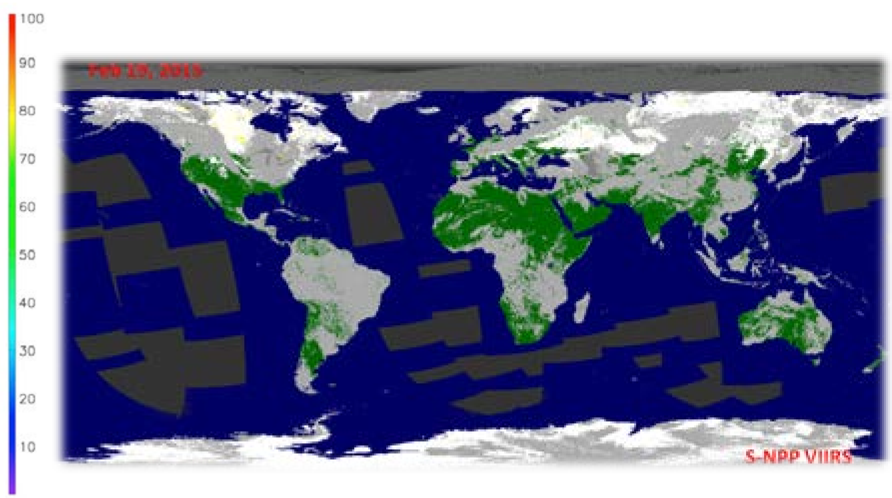
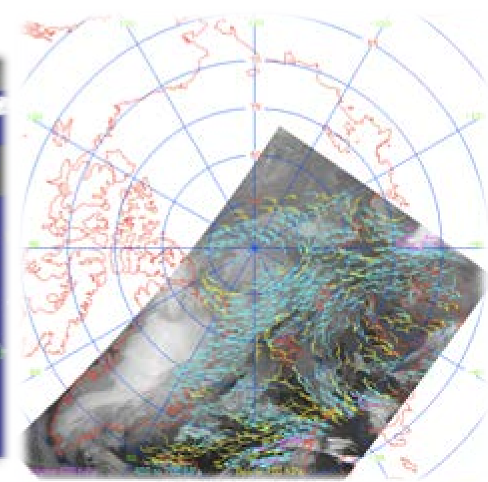
1.20
0.90
0.60
0.30




100
90
80
70
60
50
40
30
20
10
S-NPP VIIRS



ATMOSPHERE (IMAGERY, CLOUDS, AND AEROSOLS) WRAP-UP

Don Hillger for Satya Kalluri
NESDIS/StAR Atmos Lead
12 August 2016

VIIRS EDR IMAGERY WRAP-UP

Don Hillger, PhD
Don.Hillger@noaa.gov
VIIRS EDR Imagery Team

Imagery Main Topics

- VIIRS imagery is **generally very high quality with many operational users**:
  - NRL, NIC, NCEI, JTWC, NWS (including NHC and Alaska Region), US State Department/foreign governments (incomplete list; only includes what was mentioned during the session)
- Image **artifacts inherited from SDRs are rare**, but do happen
  - Attitude error documented in SDR and EDR imagery
- **Uses of VIIRS imagery** include:
  - Boat detections
  - Nightfire product
  - City Lights mapping/power outage detection
  - Hazard detection (floods, fires, dust storms, smog, landslides, explosions/disasters)
  - Snow and ice detection/monitoring
  - Tropical cyclone analysis and forecasting
  - Airglow waves (mesospheric gravity wave detection)
- Value of **Day/Night Band for a wide variety of applications** – mentioned by every speaker
- Near Constant Contrast **(NCC) EDR now in AWIPS**
  - Lack of terrain correction in Imagery EDRs negatively impacts NCC imagery

Imagery Issues/Future Work

- **Terrain-corrected geoloc**ation is needed for all Imagery EDRs
  - Lack of terrain correction impacts any land surface application of VIIRS Imagery
- Only 6 of 16 M-bands are **Imagery EDRs**
  - Desire to have all VIIRS SDRs produced as EDRs
- Work with Land Team (Ivan Csiszar) to better quantify **Day/Night Band for fire detection**
  - Is DNB more sensitive to small/cool fires than M-13, I-4?
  - What are its limitations?
- What happens when **JPSS-1 launches**?
  - How will stray light impact Day/Night Band imagery from JPSS-1?
  - Is L+90 enough time to reach Provisional maturity for NCC?
  - Will AWIPS handle both S-NPP and JPSS-1 at the same time?
  - How will the addition of JPSS-1 imagery impact other operational users?

CLOUD WRAP-UP

Andy Heidinger, PhD
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VIIRS Cloud Team

Enterprise VIIRS Cloud Algorithms

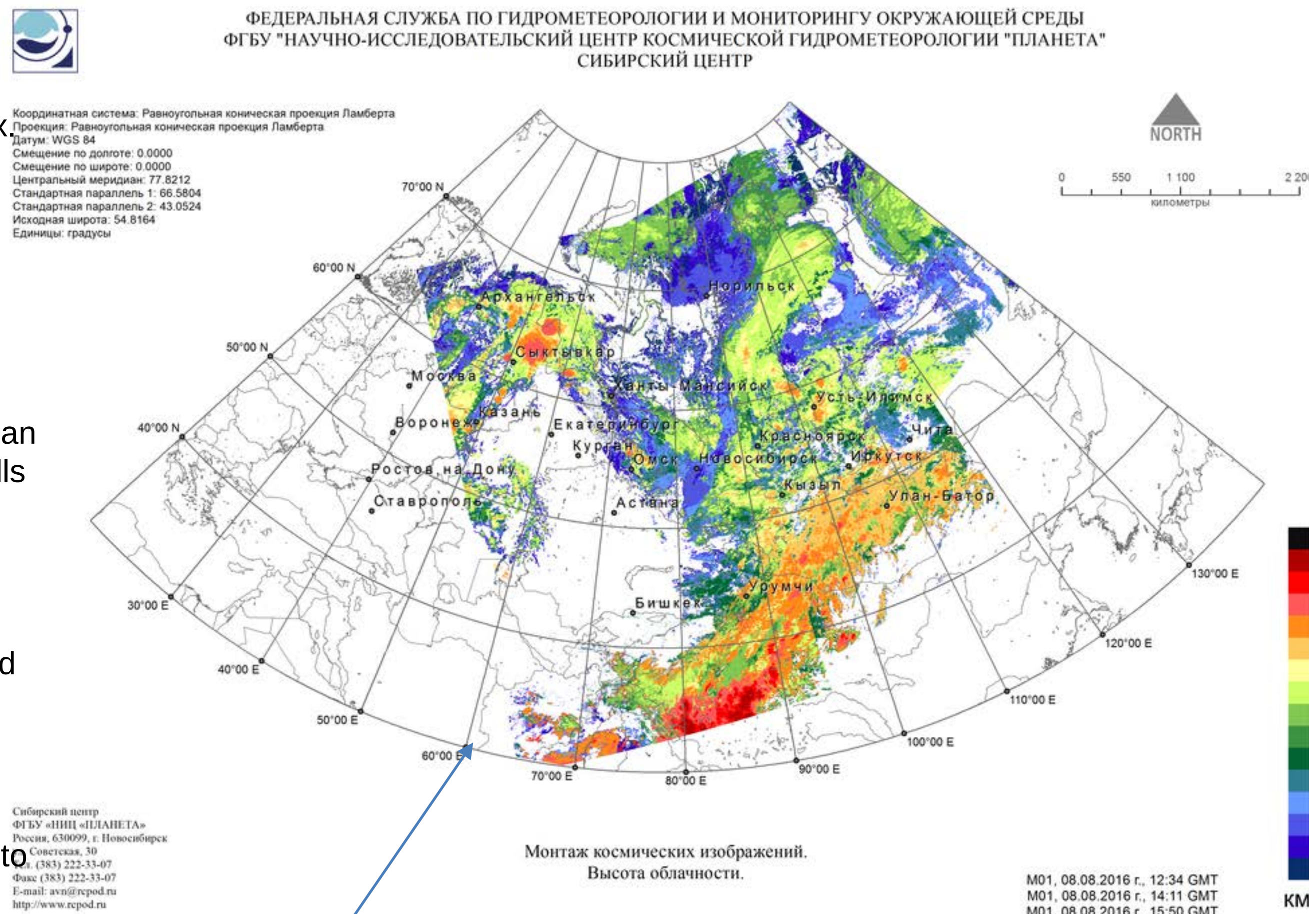
- **Operational Status**:
  - Code Delivered to ASSISTT in April and will go operational in NDE in Nov 2016
  - Next update is August 2016 for a January 2017 operational update.
  - Enterprise now includes Cloud Base and (baseline) Cloud Cover Layers.

- **Cloud team short term user-focused priorities**
  - ECM in SAPF improvement and modification based on team feedback.
  - Working with NCEP on the use of VIIRS cloud products for use in CrIS cloud characterization.
  - Optimizing cloud heights for the Polar Winds Application.

- **Cloud Team longer term user-focused activities**.
  - Active in inserting VIIRS cloud / precip. information in JPSS Hydro Initiative
  - Working with Tony Wimmers (CIMSS) to get ”morphed” cloud product data from all polar orbiters into Alaska NWS Region with GINA.
  - Working with NCEP to get VIIRS clouds in Real-Time Mesoscale Analysis (RTMA)
  - Demonstrating use of I-bands for cloud products – a unique capability from VIIRS.

CSPP LEO / CLAVR-x Providing NOAA Enterprise Clouds to DB Now

- The NOAA Enterprise Cloud Algorithms are distributed through UW/SSEC CSPP LEO.
- CSPP LEO runs NESDIS CLAVR-x.
- Provided good feedback for VIIRS Enterprise cloud products before operational in NDE this fall.
- Roughly 50 downloads
- Active communication with a Russian Remote Sensing Company that sells services to the Russian Weather Agency.
- Goal is to release updates in step with our deliveries to SAPF. (ahead of operations but in-sync with ASSIST)
- CSPP LEO supports VIIRS DNB usage. We hope to transition this to SAPF.



Example CSPP LEO CLAVR-x image provided by Russian CSPP customer

AEROSOL WRAP-UP

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and

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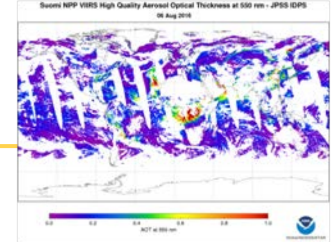
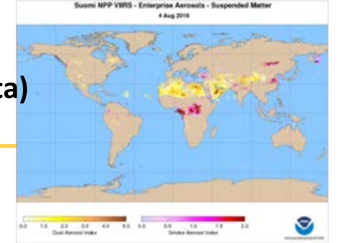
VIIRS Aerosol Team

Aerosol – Summary (Laszlo & Kondragunta)



- **Products**: Aerosol Detection (AD) and Aerosol Optical Thickness (AOT)
- No work on S-NPP IDPS AD and now only (reactive) maintenance of AOT algorithms.
- IDPS AD/AOT product remains at beta/validated maturity level. No degradation in AOT product quality as indicated by Long Term Monitoring (LTM) at fixed sites and comparison to AERONET ground measurements.
- **Developed and delivered EPS AD and AOD algorithms**
  - Both algorithms represent significant improvements compared to IDPS:
    - better accuracy; extended AOD measurement range; AOD retrieval over bright snow-free surface;
  - **Both products meet L1RDS requirements**.
- Tools for LTM have been developed and deployed.
- **Completed reprocessing of aerosol products with EPS algorithms for 2015** and provided them to users. Reprocessing of other years is ongoing.
- **Overall feedback from users on product quality is positive.**
- **Planned Algorithm improvements:** update AD thresholds to minimize false AD; develop technique to estimate surface concentration; update AOT algorithm to decrease seasonal/regional and spectral biases.
- **From S-NPP to JPSS-1:** No major algorithm changes are expected. No major risks or issues at this time, assuming S-NPP VIIRS instrument performance is maintained, and J1 VIIRS instrument performance is better or comparable to that of S-NPP VIIRS.

Aerosol - User Feedback and Team Interaction (Laszlo & Kondragunta)



- VIIRS AOT, and dust and smoke masks are evaluated for assimilation in aerosol forecast models, for monitoring model forecasts (NCEP, ESRL, NRL), and for improving air-quality forecast (PSU). VIIRS AOT is investigated in field experiment (UMBC).
- **Findings**:
  - IDPS aerosol product has deficiencies for DA (missed smoke plums, no retrieval over bright surface, max AOT reported is “only” 2; positive over-land bias).
  - EPS AOT product has smaller bias than IDPS AOT.
  - EPS, by extending the reporting range, allows greater number of dust-related values into NAAPS data assimilation (DA);
  - Using VIIRS+MODIS is better than using MODIS alone.
  - Combining EPS AOT with EPS dust and smoke masks has better potential for assimilation to improve dust and smoke forecast.
  - VIIRS RGB and AOT essential for identifying smoke plume transport upwind; 48 hour aerosol trajectories are critical tool for forecast.
  - VIIRS IDPS AOT retrievals at 6 km matched AERONET well over the southeast U.S. during August/September 2013, but are less capable over the urban surface in greater Houston.
  - The VIIRS AOT algorithm is showing some skill at deriving size parameter over land, and seems to be able to choose the correct aerosol model.
- **Side meeting with Cloud Team:** discussed ECM vs VCM differences and their impact on AOT, and correct interpretation of flags and masks (glint, cloud shadow, snow, land-sea) for aerosol retrieval.

Report on JPSS Soundings EDR (session 6)

Presented by Quanhua (Mark) Liu
On behalf of JPSS Soundings Team

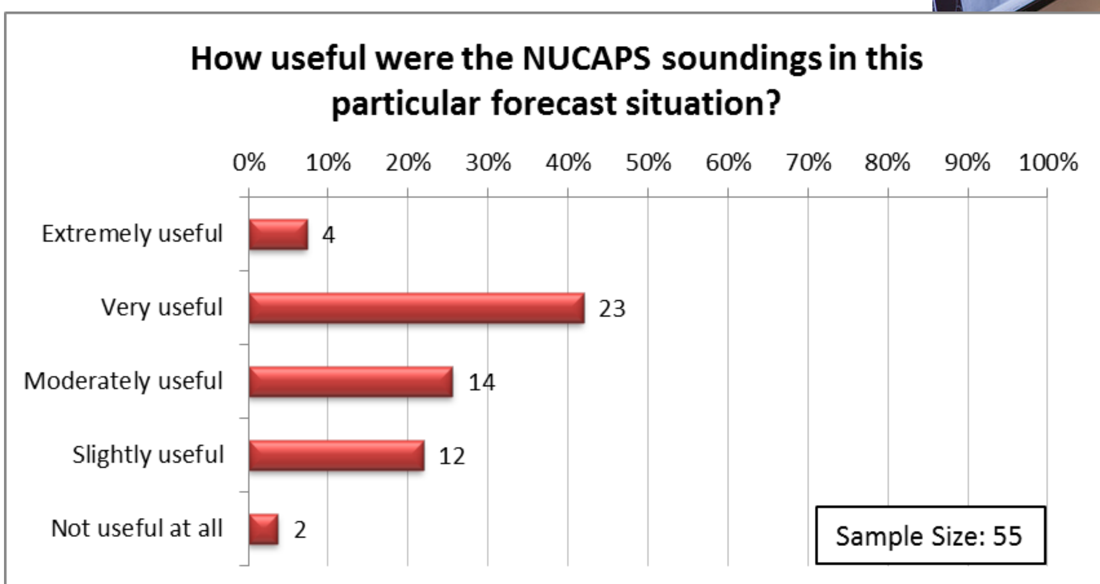
August 12, 2016

NUCAPS Progresses

- NUCAPS has been implemented in AWIPS-II.
- NUCAPS in the Community Satellite Processing Package (CSPP).
- Direct broadcast; latency ~0.5 hour.
- NUCAPS is fully operational for multi-sensors (IASI, CrIS) onboard multi-satellites (SNPP, Metop-A and –B). NUCAPS now stands for NOAA Unique Combined Atmospheric Processing System.
- New channel configuration and tuning for ATMS, MW only retrievals are significantly improved; IR+MW “yield” is increased by 3%.
- NUCAPS is upgraded for CrIS full-spectral data. Experimental test demonstrated similar or slightly better performance for T, q retrievals, much better trace gas EDRs.

How was NUCAPS used in the HWT?

- Assessing the thermodynamic environment…
  - … prior to convective initiation (pre-convective environment)
  - … in the vicinity of ongoing convection
  - … near boundaries
- Comparing with other datasets
  - Water Vapor Imagery
  - Radiosondes
  - NWP



Survey

See presentation of Bill Line

3

NUCAPS Future Plan

- J1 Readiness: implementation of new SARTA model, regression coefficients generation, new tuning, testing.
- Improving quality control: find an operationally efficient way to provide averaging kernels and/or error covariances along with tailored products
- Incorporating improvements (e.g., better BL skill, better QC) derived from the research of others (e.g., Bill Smith, Joel Susskind)
- Interactive with users: NUCAPS in AWIPS-II: training & improvements.
- High quality Testbed: Aviation Weather Testbed (AWT); Hazardous Weather Testbed (HWT); Hydrometeorology Testbed (HMT).

MiRS

- MiRS v11 largely improved the performance of MiRS EDRs.
- Problem in MiRS retrieval of snow products for Blizzard 2016 is found.
- MiRS GPM/GMI RR completed and many others.
- Future works

➢ J1 Readiness.

➢ Snow (vegetation correction).

➢ Rainy condition sounding (update a priori constraints)

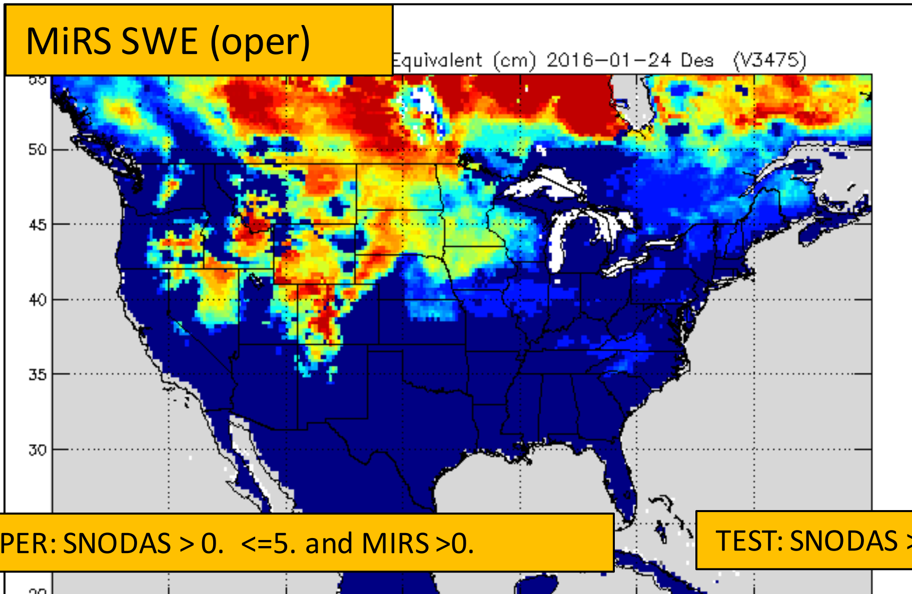
➢ Hydrometeors (improvements to CRTM i.e. scattering, precharacterization of precip type, particle size/shape distribution in CRTM, CLW over land for light rain detection)

➢ Air mass-dependent bias corrections

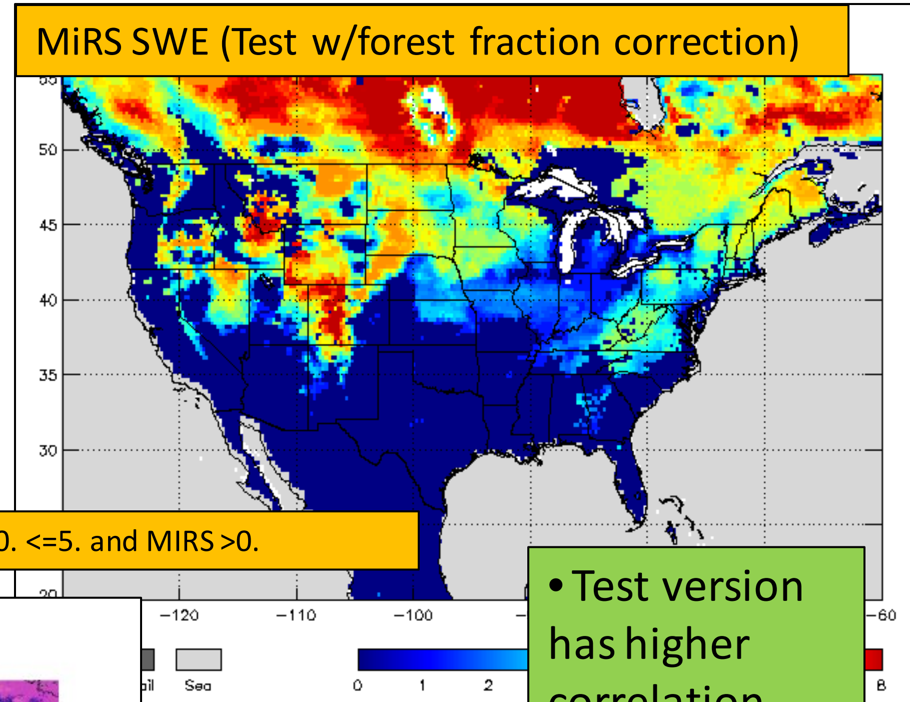
➢ Stakeholders/user needs…

Snow Water Equivalent: Potential Improvements
Case 1, 2016-01-24

MiRS SWE (oper)

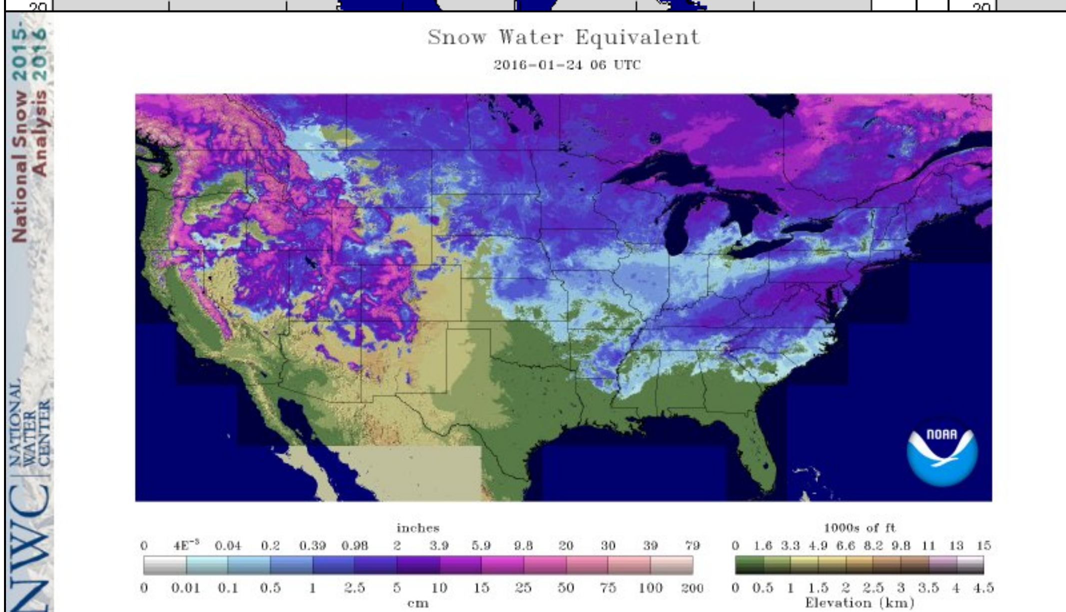


MiRS SWE (Test w/forest fraction correction)



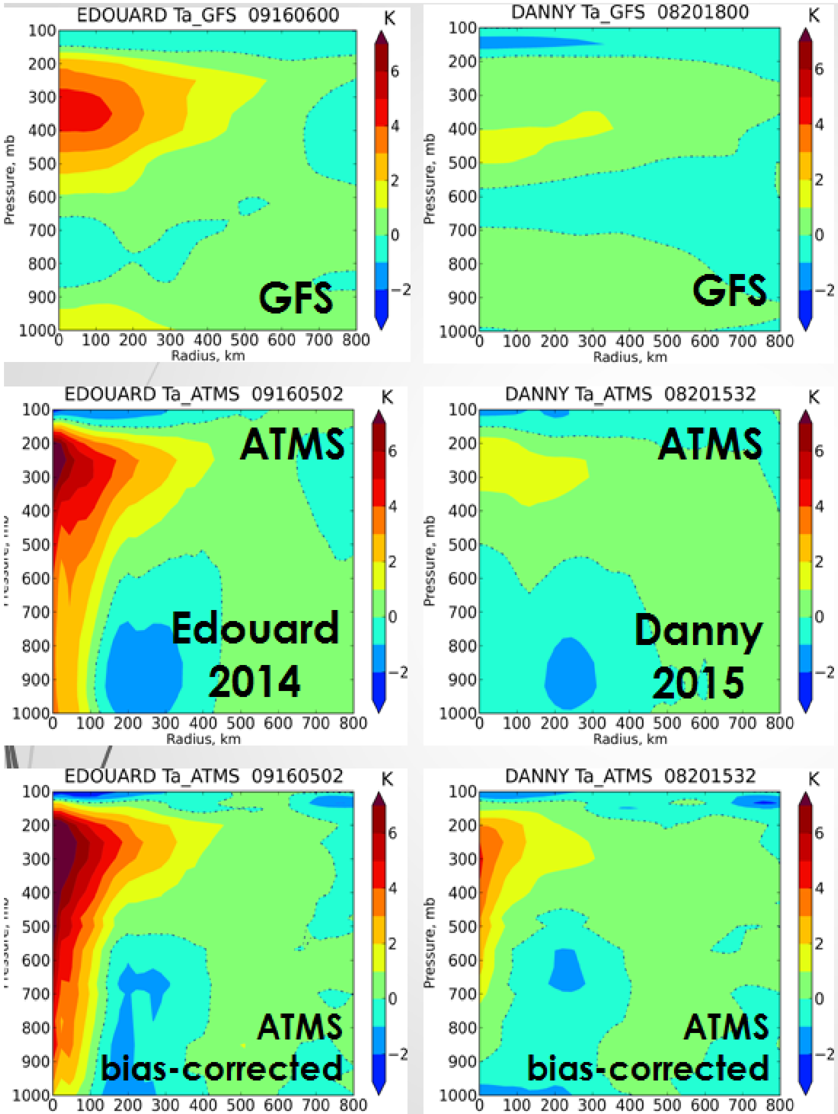
OPER: SNODAS > 0. <=5. and MIRS >0.

TEST: SNODAS > 0. <=5. and MIRS >0.



- Test version has higher correlation, smaller StDv, and regression fit has slope closer to 1
- Note increase in Npts with SWE> 0 in Test version

Three of CIRA's Applications use ATMS-MIRS data: Galina Chirokova



Vertical T cross-section in TCs

- **GFS:** underestimated warm core
- **ATMS:** usually best available warm core representation
- **Bias-Corrected ATMS:**
  - More pronounced warm anomaly at 250 hPa
  - Warm anomaly extends further to the surface

1) **CIRA Operational Microwave TC Intensity and Structure Estimates**: **utilize better ATMS T near TC center.**

2) **Moisture Flux Application**: **utilize better ATMS moisture**, possibly blend it with GFS moisture at lower levels

3) **Detecting Warm Core Changes** during rapid intensification (RI) events: **use unique information provided by ATMS about the TC warm core**

Status of the NOAA Unique Combined Atmospheric Processing System (NUCAPS): algorithm upgrades and lessons learned after 5 years in orbit

Antonia Gambacorta [1], Chris Barnet [1], Nadia Smith (1), Jonathan Smith (1), Walter Wolf (2), Tom King (2), Michael Wilson (2), Letitia Suillard (2), Mark Liu (2), Tony Reale (2), Nick Nalli (2), Bomin San (2), Kexin Zhang (2), Changyi Tan (2), Flavio Iturbide-Sanchez (2), Xiaozhen Xiong (2), Mitch Goldberg [3]

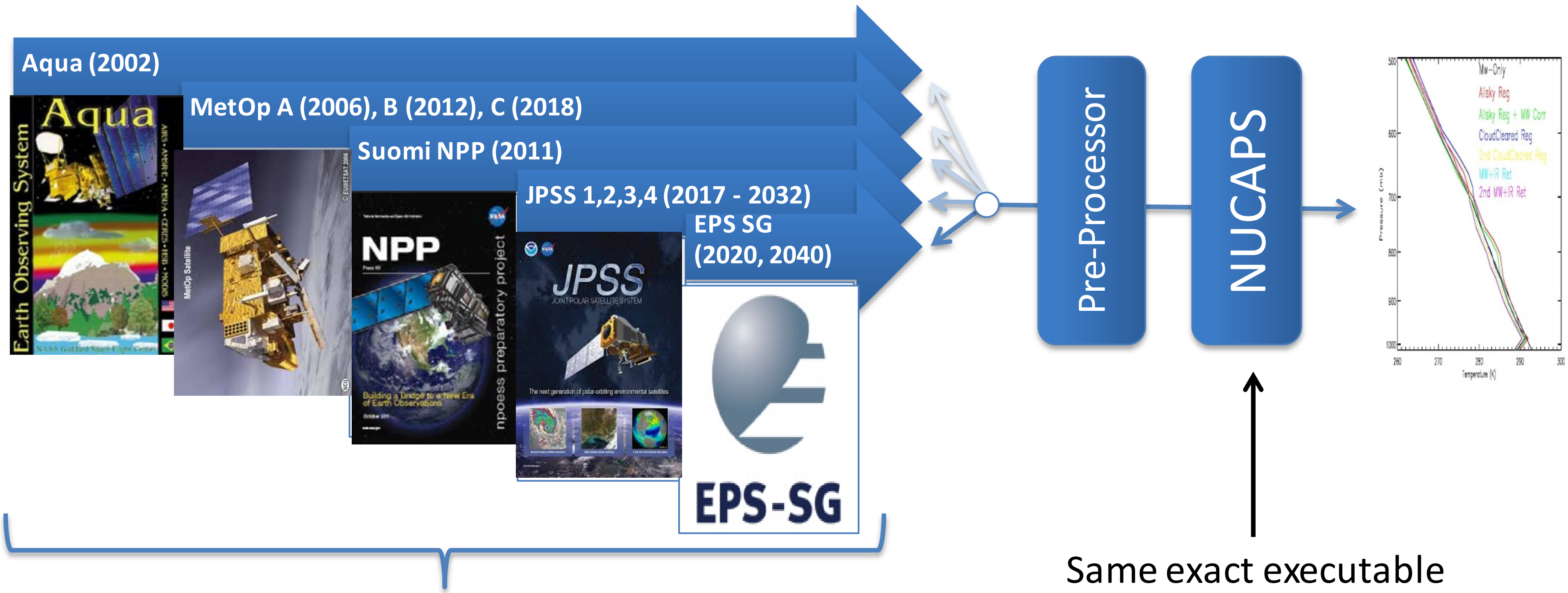
3rd JPSS Annual Meeting
August 10, 2016

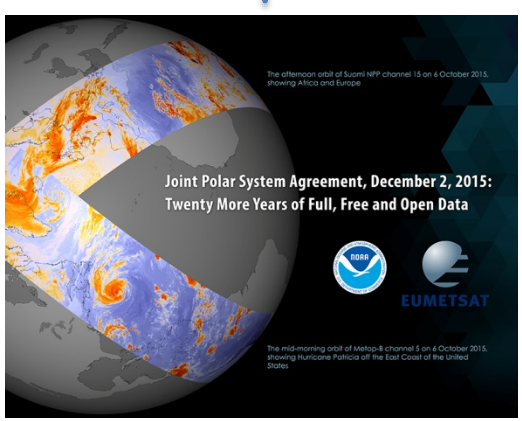
1. Science and Technology Corporation, STC
2. NOAA NESDIS STAR
3. NOAA JPSS Project Scientist

Introduction

- The **NOAA Unique Combined Atmospheric Processing System (NUCAPS)** is the NOAA operational algorithm to retrieve temperature, water vapor and trace gases from IR hyper spectral sounders (AIRS, CrIS, IASI) in combination with microwave (AMSU, MHS, ATMS) and visible (MODIS, AVHRR, VIIRS) instruments .
- NOAA/NESDIS/STAR has been operationally running NUCAPS since 2003 and distributing its products in near real time (~2 hour latency) to the science community through CLASS.
- On September 3rd 2014, NUCAPS passed stage 1 at the JPSS validation review.
- NUCAPS has been implemented in AWIPS-II.
- Full implementation of NUCAPS in the Community Satellite Processing Package (CSPP) was completed in Dec. 2014 and went operational in February 2015. Direct broadcast latency is ~ 0.5 hour.
- **Focus of this talk:** an overview of the status of the algorithm, lessons learned in the past years and the path forward.

The history of the NOAA Unique Combined Atmospheric Processing System (NUCAPS)





Same exact executable
Same underlying Spectroscopy
Same look up table methodology
for all platforms

Philosophy of NUCAPS

- **The challenge**: high computationally efficiency and sophisticated inversion methods to maximize utilization of large volumes of data for real time weather and long-term climate applications

- **Philosophy of NUCAPS**: developing a mathematically sound and globally applicable (land/ocean, day/night, all season, all sky, TOA-surface) retrieval product that can fully exploit all available satellite assets (infrared, microwave, visible). These are among the essential metrics defining a modern, physical and independent data record of atmospheric variables, suitable for both weather and climate applications.

What’s unique about NUCAPS?

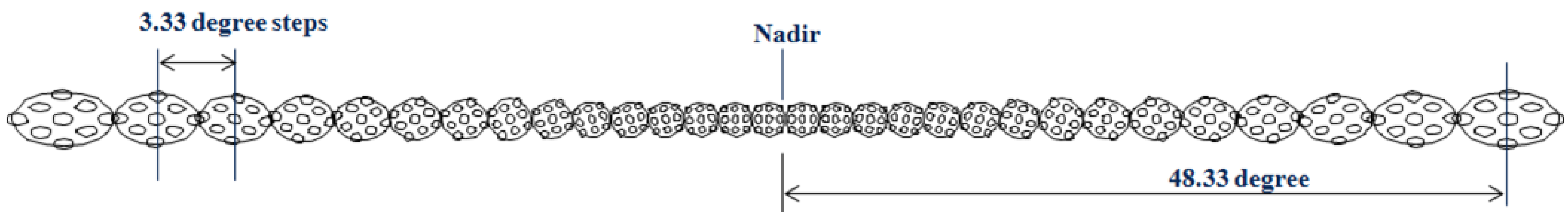
- **NOAA operational algorithm heritage of the AIRS Science Team code**, with additional unique components
- **Designed, from the beginning, to be product-centric** rather than sensor-centric (NPP Science Team priority recommendation)
  - AIRS/AMSU, IASI/AMSU/MHS, and CrIS/ATMS are processed with literally the same NUCAPS code.
  - Same underlying spectroscopy and look up table methodology
  - Instrument agnostic: specific items are file-driven, not hardwired
  - Extremely fast compared to other approaches (1 CPU for CrIS/ATMS)
  - Code is backward and forward (as much as possible) compatible.
  - Retrieval components are programmable via namelists (can quickly compare retrieval enhancements and/or methodologies).
  - Operational code is a “filtered” version of the science code.
  - Capable of processing CrIS full-resolution spectra (Gambacorta 2013 IEEE GRSL);
- **Uses an open framework** (NPP Science Team priority recommendation)
  - other researchers can link other algorithms for the core products and new algorithms for ancillary products (e.g., cloud microphysical products, trace gases, etc.).
- **Could add new products**
  - Ammonia, Formic Acid (HCOOH), and Peroxyacetyl Nitrate (PAN), etc.

What's unique about NUCAPS?

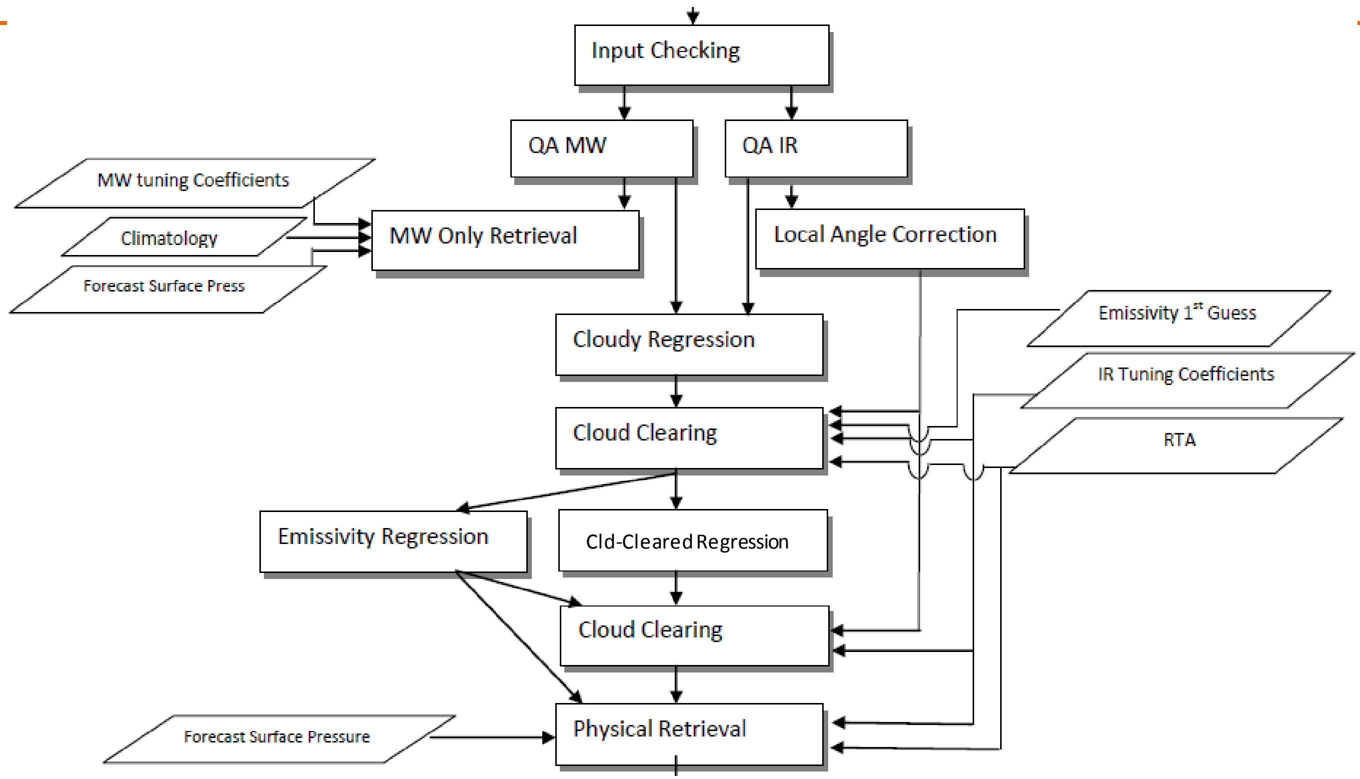
- **Designed to use all available sounding instruments.**
  - Microwave radiances used in microwave-only physical retrieval, "allsky" regression solution, "cloud cleared" regression and downstream physical T(p) and q(p) steps.
  - Visible radiances used to improve cloud clearing
- **Utilizes the high-information content of the hyper-spectral infrared – both radiances and physics.**
  - Climatological startup. Only ancillary information used is surface pressure from GFS model
  - Sequential physical algorithm allows for a robust and stable system with minimal geophysical a priori dependence
  - Utilizes forward model derivatives as spectral constraint to help stabilize the solution
  - Error from previous steps are mapped into an error estimate from interfering parameters
- **Utilizes cloud clearing**
  - Goal is to sound as close to the surface as possible
  - Sacrifices spatial resolution to achieve global coverage: no clear sky biases
  - Allows graceful degradation with decreased information content
  - Avoids ad hoc switches between clear sky only and cloudy sky single FOV algorithms

Goal of NUCAPS is to sound as close to the surface as possible

- We use a cluster of 9 infrared footprints to eliminate the effects of clouds
  - Cloud clearing sacrifices spatial resolution for coverage
  - Cloud clearing works in ~70% of cases (~225,000 / 324,000 per day)
  - Removes the difficulty of separating clouds from temperature and water vapor, typical of simultaneous cloudy retrievals
  - Works with complex cloud systems (multiple level of different cloud types).
  - Simple concept: a small number of parameters can remove cloud contamination from thousands of channels.
  - Does not require knowledge of cloud microphysics, nor cloud a priori.
  - Error introduced by cloud clearing is formally built into the measurement error covariance matrix and propagated through downstream retrieval error steps.



NUCAPS Flow Chart



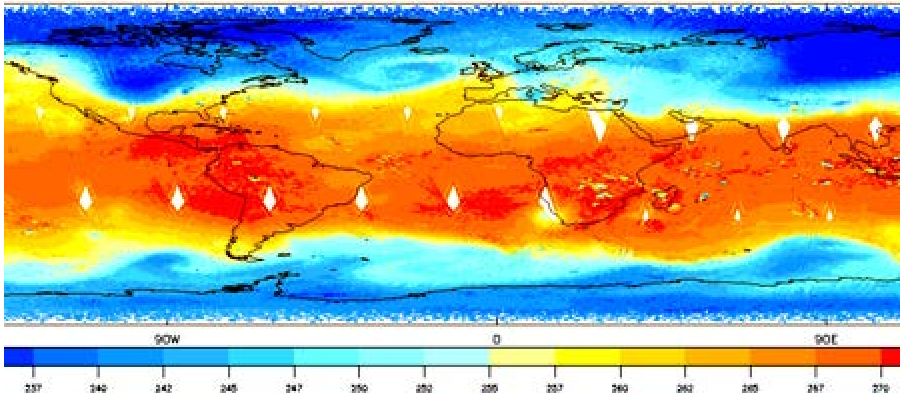
- **I. A microwave retrieval module** which computes Temperature, water vapor and cloud liquid water (Rosenkranz, 2000)
- **II. A fast eigenvector regression** retrieval that is trained against ECMWF and all sky radiances which computes temperature and water vapor (Goldberg et al., 2003)
- **III. A cloud clearing module** (Chahine, 1974)
- **IV. A second fast eigenvector regression** retrieval that is trained against ECMWF analysis and cloud cleared radiances
- **V. The final infrared physical retrieval** based on a regularized iterated least square minimization: temperature, water vapor, trace gases (O_3, CO, CH_4, CO_2, SO_2, HNO_3, N_2O) (Susskind, Barnet, Blaisdell, 2003)

NUCAPS operational retrieval products

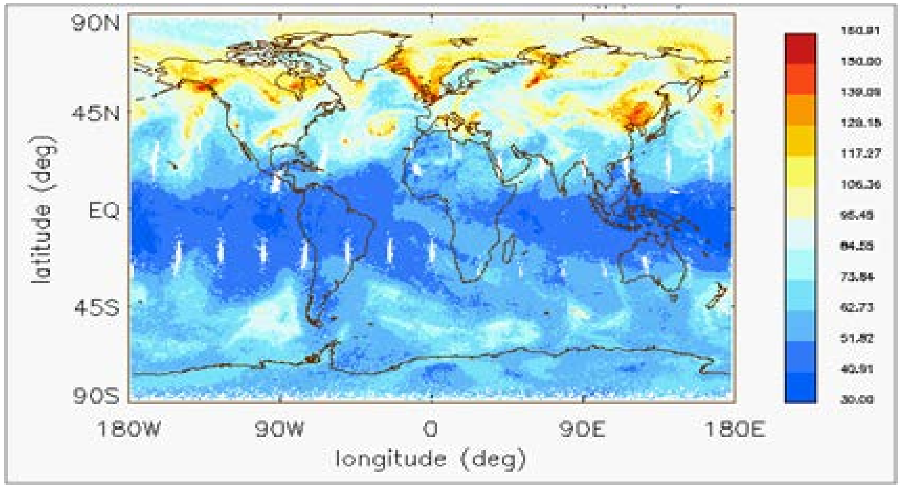
Retrieval Products

Cloud Cleared Radiances	660-750 cm-1 2200-2400 cm-1
Cloud fraction and Top Pressure	660-750 cm-1
Surface temperature	window
Temperature	660-750 cm-1 2200-2400 cm-1
Water Vapor	780 – 1090 cm-1 1200-1750 cm-1
O3	990 – 1070 cm-1
CO	2155 – 2220 cm-1
CH4	1220-1350 cm-1
CO2	660-760 cm-1
N2O	1290-1300cm-1 2190-2240cm-1
HNO3	760-1320cm-1
SO2	1343-1383cm-1

NUCAPS Temperature retrieval @ 500mb



NUCAPS Ozone retrieval @ 500mb



One year has gone by…

- A team effort between NOAA/STAR, NPP Science Team and NOAA JPSS:
  - A fully functional NUCAPS MW-only retrieval module, consistent across AMSU/MHS and ATMS
  - A fully functional NUCAPS in CrIS high resolution mode
    - NUCAPS Phase IV CDR held on February 4, 2016
    - NUCAPS high resolution first guess modules
    - NUCAPS high resolution channel selection
    - NUCAPS high resolution RTA model and bias correction
    - Delivery expected in late 2016.
  - A fully functional capability of NUCAPS in IR-only mode

Global RMS Performance of NUCAPS

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Temperature RMS

Water vapor RMS

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NUCAPS MW ONLY (95%) NUCAPS MW+IR (70%) NUCAPS MW ONLY (rejected by IR, 30%)

Global Performance (BIAS)

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Temperature RMS

Water vapor RMS

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NUCAPS MW ONLY (95%) **NUCAPS MW+IR (70%)** **NUCAPS MW ONLY (rejected by IR, 30%)**

A busy list of JPSS funded initiatives to demonstrate NUCAPS application capabilities

I. **Aviation Weather Testbed (AWT)**: Cold Air Aloft

II. **NUCAPS in AWIPS-II**: training & improvements

III. **Hazardous Weather Testbed (HWT)**: Convective Initiation

IV. **Hydrometeorology Testbed (HMT)**: Pacific field campaigns (2014, 2015 CalWater & 2016 ENRR)

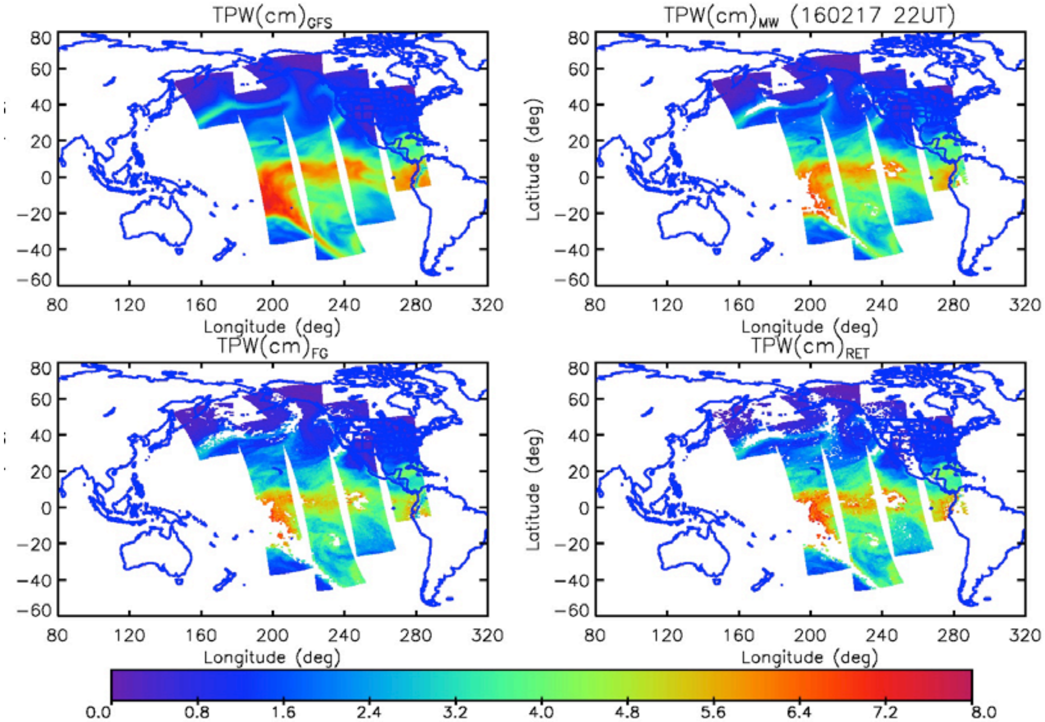
V. **Carbon Monoxide and Methane product evaluation** (NESDIS/STAR & OAR/ESRL/CSD)

VI. **Use of NUCAPS Ozone in hurricane extratropical transition applications**

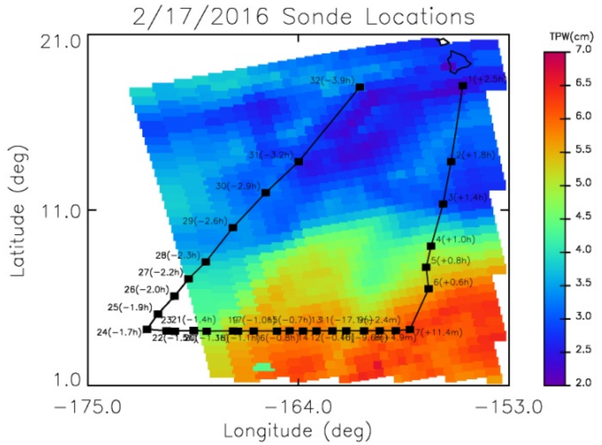
How can NUCAPS add value to the forecast of societally relevant weather events?

- Our goal is to demonstrate NUCAPS soundings capability in capturing high impact mesoscale phenomena over otherwise poorly sampled regions.
- NUCAPS implementation into CSPP direct broadcast enables unprecedented low latency data distribution, suitable for decision aid applications.
- Primary goal is to promote user applications.
- Intensive field campaign data are incredibly valuable for algorithm validation
  - Synergistic initiatives yield a large sample of in-situ data (~450 dropsondes and 175 radiosondes from CalWater-15 alone)
  - NUCAPS is a test-bed to study new methodologies

Assessing and improving NUCAPS sounding capability during high impact weather events: a test case from the 2016 El Nino Rapid Response Campaign



A snapshot of the full region



A close up figure over the flight path

➤Satellite data can provide near real time (~0.5 hour), 3D context to a high impact weather event

El Nino Rapid Response Campaign
February 17, 2016

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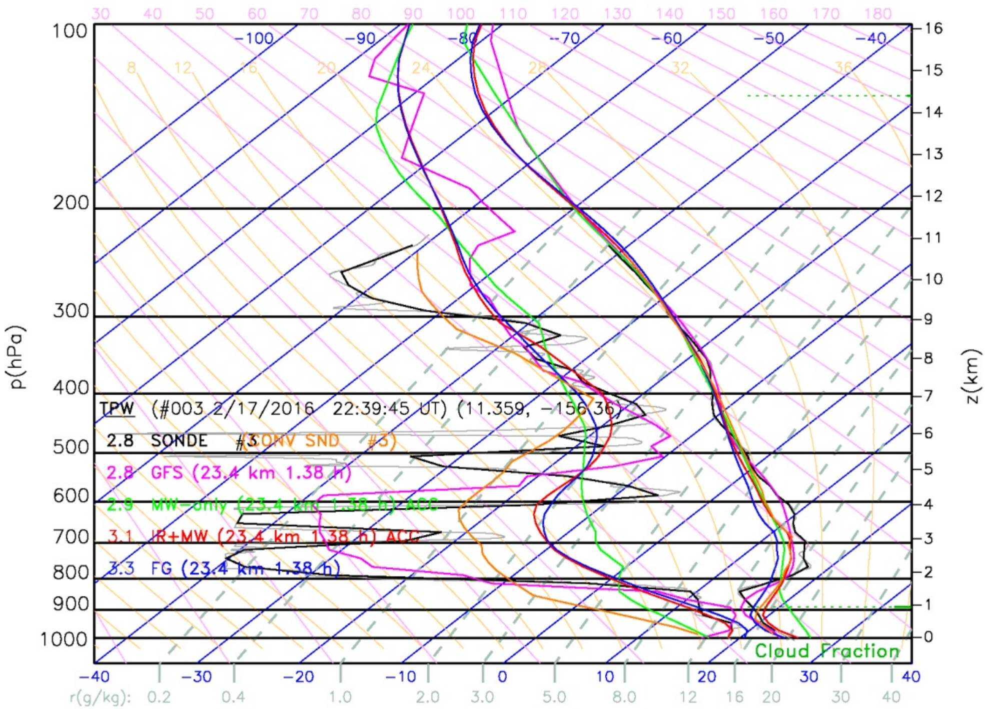

Orginal Sonde, AK-conv. Sonde, GFS, MW-only, MW+IR, FG

- We are building a diagnostic capability to assess NUCAPS performance under high impact weather events. This will enable a more intelligent use of NUCAPS products and ultimately serve to make improvements on the algorithm.

Vertical resolution, information content and departure from first guess as metrics to assess *and improve* retrieval performance

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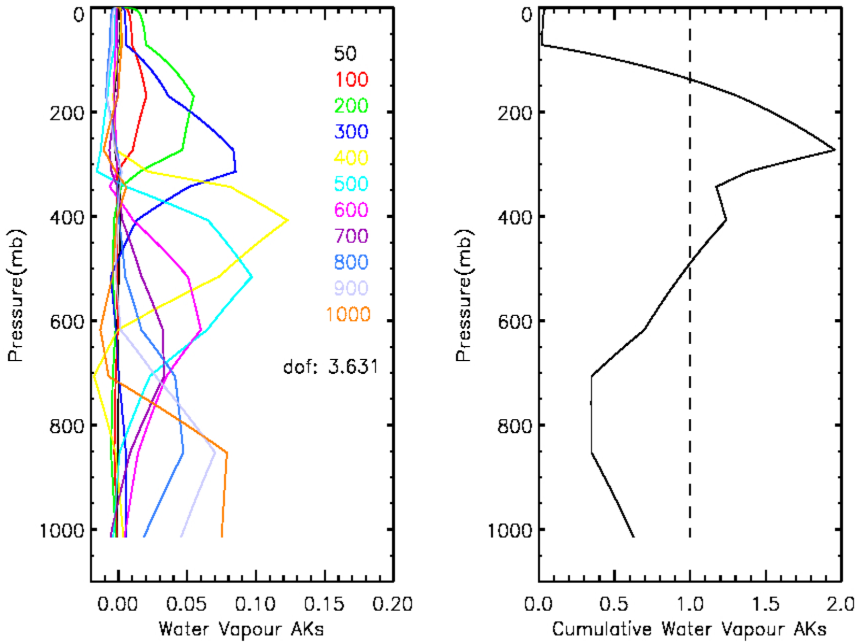

- Averaging Kernels provide insights on NUCAPS effective vertical resolution (broadness of the peaks), information content (magnitude of the peaks) and separation of the contributions to the solution originating from the measurement and from the a-priori.
- They represent a necessary tool for any characterization, validation and proper application of a retrieval product.

El Nino Rapid Response Campaign
February 17, 2016

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- We are building a diagnostic capability to assess NUCAPS performance under high impact weather events. This will enable a more intelligent use of NUCAPS products and ultimately serve to make improvements on the algorithm.
- What's NUCAPS effective vertical resolution and how can we improve it?
- Where do we have and how can we improve information content?
- What are the sources of retrieval error at play?

Channel selections, A priori, QCs, RTA, CCR, err prop., etc.

Summary & Future Work

- NUCAPS has demonstrated to meet user requirements
- NUCAPS Phase IV expected to become operational this Fall in preparation for J1.
- We now have ground truth and a diagnostic capability to assess NUCAPS performance under high impact weather events for user applications of societal importance.
- This new type of validation approach enables a more intelligent use of NUCAPS products, engages new users, promotes new users requirements, leads to improvements to the retrieval products, justifies transition to operations.

Backup slides

Radiosonde measurements from CalWater 2015 February 6th test case

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Transect 1 Transect 2 Transect 3 Transect 4

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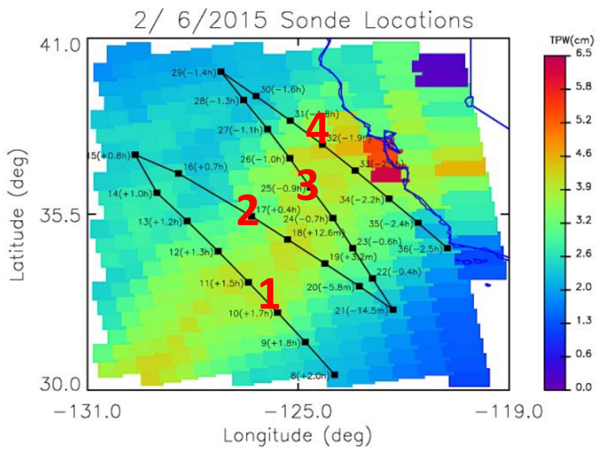

- ~ 4 hours flight with 4 transects across the river capturing pre, in and post river environment as the river quickly approaches the US West coast
- Good spatial and temporal matching with NPP (drop sonde location 19 is ~ 3.2 minutes ahead of over pass

Understanding the role of the a priori and first guess

- NUCAPS is currently using a statistical operator (linear regression) as a priori

Pro' s	Con' s
Does not require a radiative transfer model for training or application.	Training requires a large number of co-located "truth" scenes.
Application of eigenvector & regression coefficients is VERY fast and for hyper-spectral instruments it is very accurate.	The regression operator does not provide any diagnostics or physical interpretation of the answer it provides. It can introduce sub-resolved structures in the retrieval
Since real radiances are used the regression implicitly handles many instrument calibration (e.g., spectral offsets) issues. This is a huge advantage early in a mission.	The regression answer builds in correlations between geophysical parameters. For example, retrieved O_3 in biomass regions might really be a *measurement* of CO with a statistical correlation between CO and O_3.
Since clouds are identified as unique eigenvectors, a properly trained regression tends to "see through" clouds.	Very difficult to assess errors in a regression retrieval without the use of a physical interpretation.

Towards a more stable a-priori and first guess choice

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Transect 1 Transect 2 Transect 3 Transect 4

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MW-only retrieval

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Precipitating cases

GFS

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Linear Regression

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Correct choice of a priori and first guess

We have started investigating three possible *a-priori:*

1) climatology built from a decade of ECMWF (this has already been constructed by the AIRS science team and will be tested)

2) ERA-interim; NCEP reanalysis; MERRA.

3) microwave-only retrieval. For CrIS/ATMS this has the potential to be an exceptional *a-priori*. For AIRS/AMSU and IASI/AMSU/MHS it is unlikely that the AMSU information content is sufficient.

Note:

- the retrieval solution is derived on the assumption that both measurement and a priori error statistics are Gaussian. Gaussian behaviour in a priori and first guess statistics must be be verified.
- Need a statistically significant validation ensemble.

El Nino Rapid Response Initiative
January – March 2016

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Simultaneous vs sequential OE approach

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Simultaneous OE	Sequential OE
Solve all parameters simultaneously	Solve each state variable (*e.g.*, T(p)), separately.
Error covariance includes only instrument model.	Error covariance is computed for all *relevant* state variables that are held fixed in a given step. Retrieval error covariance is propagated between steps.
Each parameter is derived from all channels used (*e.g.*, can derive T(p) from CO_2, H_2O, O_3, CO, … lines).	Each parameter is derived from the best channels for that parameter (*e.g.,* derive T(p) from CO_2 lines, q(p) from H_2O lines, etc.)
A-priori must be rather close to solution, since state variable interactions can de-stabilize the solution.	*A-priori* can be simple for hyperspectral.
This method has large state matrices (all parameters) and covariance matrices (all channels used). Inversion of these large matrices is computationally expensive.	State matrices are small (largest is 25 T(p) parameters) and covariance matrices of the channels subsets are quite small. Very fast algorithm. Encourages using more channels.

Global impact of losing MW-only sounding capability (2)

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Temperature RMS

Water vapor RMS

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NUCAPS MW+IR (67%)

NUCAPS IR ONLY (35%)

- Losing the MW instrument degrades the global retrieval performance of temperature (water vapor) rms statistics by ~2K (~5%) in the lower troposphere and 1.5K (7%) in the mid troposphere

Impact of losing MW-only sounding capability during extreme events: a case study from May 6, 2015 tornado event in Norman, OK (3)

Temperature RMS   Water vapor RMS

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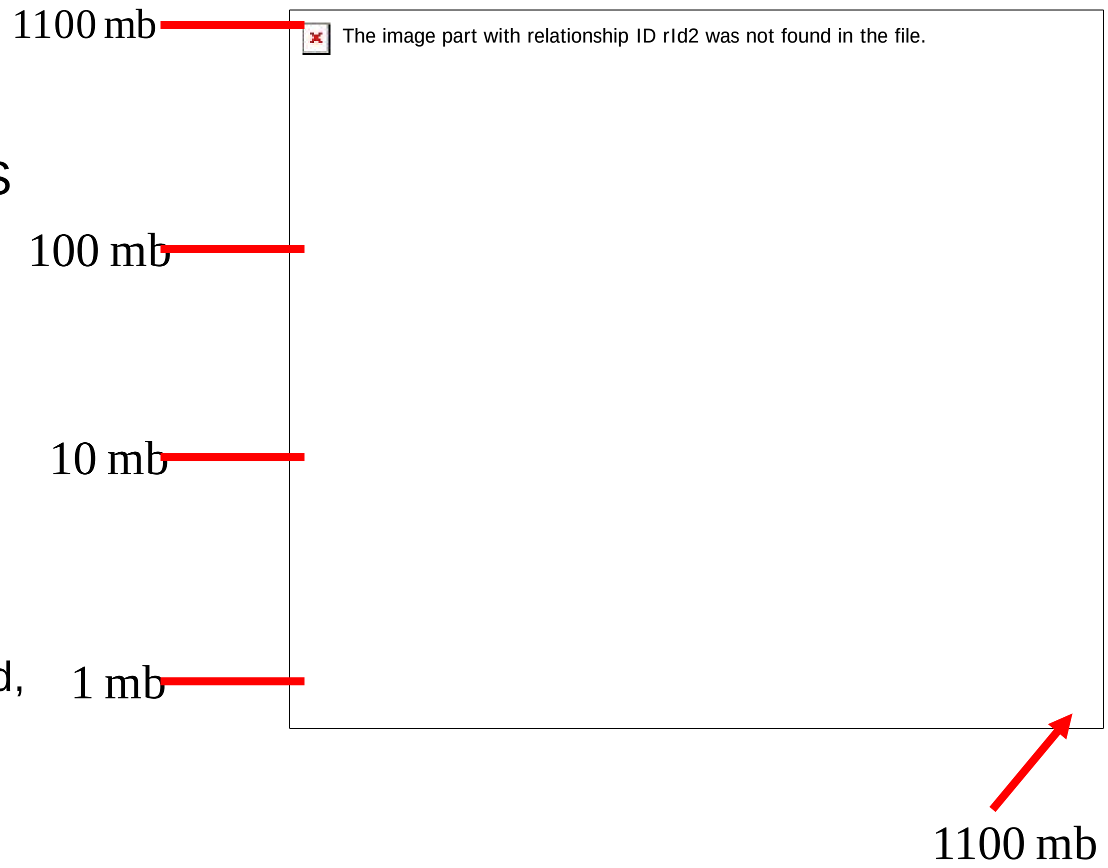
NUCAPS MW+IR (67%)   **NUCAPS IR ONLY (62%)**

- Losing the MW instrument degrades the global retrieval performance of temperature (water vapor) rms statistics by ~2K (~5%) in the lower troposphere and 1.5K (7%) in the mid troposphere

Example of temperature retrieval error covariance

- An example of temperature retrieval correlation (minimum variance method) for the AIRS instrument
- Top of atmosphere radiances (TOA) are used to invert the radiative transfer equation for T(p).
- This results in a correlation that is a vertical oscillatory function.
  - TOA radiances are minimized, but
  - An error in one layer is compensated for in other layer(s).



Therefore, the use of retrieval products requires knowledge of retrieval "averaging kernels" and/or error *covariance* estimates.

OZONE

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Outline

- Executive Summary
- Product Performance
- Major Risks/Issues and Mitigation
- Milestones and Deliverables
- Future Plans/Improvements

Executive Summary

- Heritage/Enterprise Version 8 Algorithms to create Total Column Ozone and Nadir Ozone Profiles with improved horizontal resolution are ready for implementation at NDE and for reprocessing.
- An improved atmospheric SO2 algorithm will allow correction of ozone amounts for elevated SO2 levels.
- The Version 2 Limb Ozone Profile algorithm is ready for implementation at NDE.
- We are working with users, operations, and the OMPS SDR team to prepare for these new products and their improved horizontal resolution with J-01.

OMPS Total Ozone Product Requirements

- JPSS Level 1 Requirements Document (L1RD) Supplement for the OMPS Ozone Total Column Environmental Data Records (EDRs)

Table 5.2.11 - Ozone Total Column (O

EDR Attribute	Threshold
Ozone TC Applicable Conditions: 1. Threshold requirements only apply under daytime conditions with Solar Zenith Angles (SZA) up to 80 degrees. 2. The EDR shall be delivered for all SZA.	
a. Horizontal Cell Size	50 x 50 km^2 @ nadir
b. Vertical Cell Size	0 - 60 km
c. Mapping Uncertainty, 1 Sigma	5 km at Nadir
d. Measurement Range	50 - 650 milli-atm-cm
e. Measurement Precision	
1. X < 0.25 atm-cm	6.0 milli-atm-cm
2. 0.25 < X < 0.45 atm-cm	7.7 milli-atm-cm
3. X > 0.45 atm-cm	2.8 milli-atm-cm + 1.1%
f. Measurement Accuracy	~2%
1. X < 0.25 atm-cm	9.5 milli-atm-cm
2. 0.25 < X < 0.45 atm-cm	13.0 milli-atm-cm
3. X > 0.45 atm-cm	16.0 milli-atm-cm
g. Refresh	At least 90% coverage of the globe every 24 hours (monthly average) ~3%

Verification of Performance:

a. 20-Pixel Aggregation and 7-S along track integration.

b. 318 nm channel BUV comes from the surface to top of atmosphere. Standard profiles in tables account for full range.

c. Confirmed by coastlines and comparison to 750x750 m^2 VIIRS.

d. Confirmed by standard profiles and four years of processing and ground-based matchup scatter.

e. Precision estimates from Nearest Neighbor analysis. Use of 1512 Latitude/Month/TOz profiles.

f. Accuracy is adjusted by soft calibration and checked by zonal mean and overpass statistics.

g. 105° cross-track swath provides full daily coverage.

OMPS Version 8 Ozone Profile EDR Requirements

Ozone Nadir Profile (OMPS-NP) (3)	
Attribute	**Threshold**
a. Horizontal Cell Size	250 x 250 km^2 (1)
b. Vertical Cell Size	3 km reporting
1. Below 30 hPa (~ < 25 km)	10 -20 km
2. 30 -1 hPa (~ 25 -50 km)	7 -10 km
3. Above 1 hPa (~ > 50 km)	10 -20 km
c. Mapping Uncertainty, 1 Sigma	< 25 km
d. Measurement Range 0-60 km	0.1-15.0 ppmv
e. Measurement Precision (2)	
1. Below 30 hPa (~ < 25 km)	Greater of 20 % or 0.1 ppmv
2. 30 -1 hPa (~ 25 -50 km)	5% -10%
3. Above 1 hPa (~ > 50 km)	Greater of 10% or 0.1 ppmv
f. Measurement Accuracy (2)	
1. Below 30 hPa (~ < 25 km)	Greater of 10 % or 0.1 ppmv
2. 30 -1 hPa (~ 25 -50 km)	5% -10%
3. Above 1 hPa (~ > 50 km)	Greater of 10 % or 0.1 ppmv
g. Refresh	At least 60% coverage of the globe every 7 days (monthly average) (2,3)

Notes: 1. SDRs will go to 50x50 km^2 for J-01. 2. The OMPS Nadir Profiler performance is expected to degrade in the area of the South Atlantic Anomaly (SAA) due to the impact of periodic charged particle effects in this region. 3. All OMPS measurements require sunlight, so there is no coverage in polar night areas.

Verification of Performance:

a. 93-Pixel cross-track aggregation and 37.5-S along track integration.
b. Version 8 Algorithms Averaging Kernels
c. Confirmed by to Nadir Mapper, Pixel size, and co-alignment.
d. Confirmed by four years of processing and ground-based matchup scatter.
e. Precision estimates from SNR and Version 8 measurement contribution functions, and along-track differences
f. Accuracy is adjusted by soft calibration and checked by zonal mean statistics, chasing orbits, and Version 8 a priori profiles
g. Suborbital track and precession of orbits.

JPSS-1 Readiness – Algorithms

- Major Accomplishments and Highlights Moving Towards J-01
  - V8Pro was implemented in IDPS Mx8.11
  - Delivered V8TOz single granule package with medium FOV capability to NDE
  - Delivered 15-granule moving-window version of the LFSO2 Code to NDE
  - Ready to deliver V8Pro single granule package with medium FOV capability to NDE
  - Working with NASA on early operations and Cal/Val Plan test timelines
- J1 Algorithm Summary
  - LFSO2/V8TOz for 17x17 km^2 FOV

The V8TOZ has been implemented on LINUX systems with NetCDF output. The LFSO2/V8TOz has been adapted to run on 15-granule sequences on the STAR LINUX system using the first-run V8TOz EDR as input. Both algorithms have been delivered with the capability to handle large and medium FOV SDR products, and they will be integrated into NDE following the October 2016 NDE Block 2.0 ORR.

  - V8Pro for medium FOV

The V8Pro has been implemented in IDPS. We have developed a new glue-ware aggregator to create 50x250 km^2 FOV EDR product from the full range of large and medium FOV SDR products. The algorithm will be delivered after completion of the code reviews, and it will be integrated into NDE following the October 2016 ORR.

JPSS-1 Readiness – Cal/Val

- J1 Cal/Val Overview
  - Pre-Launch Calibration/Validation Plans
    - Ozone Cal/Val Plan Completed January 2016
    - Demonstrating V8Pro and V8TOz soft calibration capabilities with S-NPP
    - Working to develop and test all analysis programs as described in the plan with new medium FOV data sets.
  - Post-Launch Calibration/Validation Plans
    - "Beta" ten days after activation and doors open (launch plus 60 days).
      - Geolocation, product range and reporting
    - "Provisional" L+120 days.
      - Precision and first iteration of soft calibration
    - "Validated 1" after ICV (L+210 days)
      - Accuracy and stability from six months of data
    - "Validated 3" After 1 year of measurements (L+410 days)
      - Accuracy and stability over one annual cycle

JPSS-1 Readiness – Issues & Applications

- Issues - Risks / Mitigation
  - Program guidance on platform for OMPS products – NDE Transition
    - Products in NetCDF4 (+ changes for downstream)
    - Details for product deliveries to Users (BUFR) , STAR and CLASS
    - New system for maintenance and table deliveries
  - Small FOV preparations and short granules / Using diagnostic test data sets, restrict to medium FOV RDRs, CCR Requesting upgrade for S-NPP OMPS to Flight Software 6.0 .
  - Uneven records (moving targets) / Develop better initial tables and reprocessing capabilities
    - Product validation analyses have to be repeated or adjusted as new algorithms and SDR resolution improvements and calibration corrections enter the system.
  - NP Degradation, wavelength scale, solar activity and bandpass / Working with SDR team to implement and demonstrate improvements for S-NPP OMPS.
  - Bandpass and Wavelength Scales for J-01 OMPS NP / revise with in-orbit solar measurement analysis
- Users' Readiness
  - o We are upgrading the BUFR products to be created from the OMPS V8 algorithm products and parameters. V8 algorithm BUFR products are already in use.
  - o We are working on soft calibration to homogenize the suite of ozone products from OMPS, SBUV/2, OMI and GOME.
  - o We are working with users of aerosol, SO_2 and O_3 products to prepare them for the higher spatial resolution products.

Summary

- Heritage/Enterprise Version 8 algorithms are ready for implementation at NDE and provide the capability to process medium FOV J-01 data.
- The products will meet the program requirements.
- S-NPP OMPS Limb Profile Ozone products will also be made operationally at NDE.

FY17 OMPS EDR Milestones/Deliverables

Task Category	Task/Description	Start	Finish	Deliverable
Development (D)	Deferred algorithm improvements (EOFs, Solar, Wavelengths, Bandpasses]	Present	Q3	Code modification
Integration & Testing (I)	Final V8Pro, LFSO2, &V2LP algorithm deliveries to NDE	Present	Q1, Q2	Code logic and output changes
Calibration & Validation (C)	Final RT Tables for J-01 Reprocess S-NPP V8 EDRs Evaluation/validation of S-NPP V8 products including SO2 Prepare, demonstrate and exercise tools for J-01 Soft Calibration for J-01	Present	Q2 Q1,Q2 Q1,Q2 Q2, Q3 Q4	New Tables CDRs! Report and statistics on C/V C/V Plan RR and execution Adjustment LUT
Maintenance	Monitor performance and resolve anomalies	Ongoing	Ongoing	New DRs and CCRs as needed
LTM & Anomaly Resolution (L)	Continue and expand ICVS Monitoring Trending of ground-based comparisons	Ongoing Ongoing	Ongoing Q4	New ICVS content Report for S-NPP and J-01

Path Forward (FY-18 thru FY-21)
High Priority Ozone Tasks/Milestones

	S-NPP	JPSS-1	JPSS-2
FY18	**Sustainment, monitoring, maintenance** **Implement Cloud Optical Centroid, DOAS NO_2 and SO_2 Retrievals, and Limb Aerosol**	**Provide feedback to SDR Team** **Complete Validation of Ozone Profile, Total Column Ozone, Aerosol Index, and Total Column SO_2 per Cal/Val Plan**	**Review FM3 performance and evaluate impact of any waivers etc.**
FY19	**Sustainment, monitoring, maintenance, reprocessing**	**Complete coordination with users for applications** **Sustainment, monitoring, maintenance**	**J-02 product algorithm review including Limb Profiler**
FY20		**Sustainment, monitoring, maintenance**	**Deliveries for J-02 tables and code specifics**
FY21		**Sustainment, monitoring, maintenance, reprocessing**	**Prepare resources and analysis tools to execute Cal/Val Plan**

GSICS USERS' WORKSHOP

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Outline

- Executive Summary
- Workshop Goals
- Workshop Agenda

Executive Summary

- GISCS activities have matured to the point where they are providing the foundation for a true Global System of Infrared instrument measurements including Polar and Geostationary satellites.
- Methods for Visible, Microwave and Ultraviolet instruments are progressing and are addressing differences in the reference measurements, sensor technologies and Earth signatures in their different spectral regions.
- The ICVS is an important asset in the NOAA participation in GSICS activities.

Workshop Goals

- Applications of current GSICS products,
- GPRC resources (e.g., Calibration/Validation Systems, Long Term Monitoring, Instrument Landing Pages, and Monitoring notices, alerts and summaries),
- Interactions between data assimilation groups and measurement calibration, characterization and monitoring teams,
- Introduction to the NESDIS Integrated Calibration Validation System (ICVS) design and content www.star.nesdis.**noaa**.gov/**icvs**/
- Introduction to upcoming GSICS products and research areas (e.g., GEO Ring, GOES-R on-orbit calibration),
- Practical experience in the use of JPSS Mission and other instruments as references for Monitoring GEO/LEO instrument measurements in Near Real Time and Climate Data Record applications, and
- Calibration advances (e.g., Lunar, Deep Convective Cloud, Reference Migration, Best Practices).

Morning Agenda

Session 12: GSICS Users Workshop ESSIC Room 4201

0830 - 0835		Session Introduction	Chair - L. Flynn
0835 - 0845		Introduction to GSICS Workshop	Mitch Goldberg
0845 - 0900		GSICS Past Present and Future	Ken Holmlund
0900 - 0915		GSICS Research Working Group	Fred Wu for D. Kim/T. Hewison
0915 - 0930		GSICS Data Working Group	Masaya Takahashi
0930 - 0945		GCC GSICS Products and Deliverables	Larry Flynn
0945 - 1000		GSICS User Survey	Manik Bali
1000 - 1015		Break	
1015 - 1030		Well Calibrated JPSS Instruments as GSICS References	Fuzhong Weng
1030 - 1045		ICVS Design, content and structure	L. Brown
1045 - 1100		ICVS Calibration and science	N Sun
1100 - 1115		ICVS Alerts, events and monitoring	N Sun
1115 - 1120		MW Session Introduction	Chair - R. Ferraro
1120 - 1140		Investigating Shortcomings of Radiative Transfer Models at Microwave Frequencies	Wesley Berg
1140 - 1200		Stability and Interconsistency of Passive Microwave Water Vapor Products for Weather and Climate	J. Forsythe
1200 - 1220		What Happens to Radiances after They Leave Home: Precipitation	G. Huffman
1220 - 1240		Toward Long-Term Climate Change Monitoring in the JPSS Era	Cheng-Zhi Zou
1240 – 1245		Closing	Ralph Ferraro

Afternoon Agenda

Session 12: GSICS Users Workshop ESSIC Room 4201

1245 - 1330		Lunch	
1330 - 1445		IR Session	Chair - Fred Wu
1330 - 1345		Inter-Calibration with Hyperspectral Sounders	Fred Wu
1345 - 1350		Inter-Calibration of HIRS using IASI as Reference	Fred Wu on behalf of Tim Hewison
1350 - 1410		Inter-Calibration of Himawari-8 AHI Using CrIS as Reference	Masaya Takahashi
1410 - 1425		ISRO's GSICS Activities for Intercalibration of the INSAT-3D radiances	Pradeep Thapliyal
1425 - 1445		Calibration Requirements for SST	Andy Harris & Eileen Maturi
1445 - 1530		VIS Session	Chair - Dave Doelling
1445 - 1500		GSICS visible sub-group calibration activities	Dave Doelling
1500 - 1515		MODIS and VIIRS Reflective Solar Calibration Update	Jack Xiong
1515 - 1530		PATMOS-x Reflective Solar Calibration Status	Andy Heidinger
1530 - 1545		Poster Session 3 - NCWCP Atrium	
1545 - 1600		Preliminary SCIAMACHY Lunar observations as intercalibration source	Matthijs Krijger
1600 - 1615		The Moon and Earth Radiation Budget Experiment (MERBE)	Grant Matthews
1615 - 1630	--	Instrument landing pages, OSCAR	L. Flynn, M. Bali
1630 - 1645	--	UV Projects	L. Flynn
1645 - 1700	--	Discussions and Conclusions	

2016 JPSS STAR Science Team Annual Meeting

Summary

Great Turnout:

- Over 350 registered participants from NOAA, NASA, Universities, and industries. 194 oral presentations plus 38 poster presentations
- Visions/Plans from JPSS Director, STAR Acting Director, JPSS Program Scientist, EUMETSAT Program Scientist
- SDR, EDR, Flight, Ground, overviews followed by detailed science presentations and discussions, great interactions among SDR, EDR science team members
- Updates on Enterprise Algorithms and Reprocessing: Progress, Challenges, Actions
- Recommendation from science communities and users on next steps of JPSS Algorithms and Cal Val strategy
- Nuances:
  - Societal benefits: What are the values of our work
  - Interns: JPSS Education and Outreach

Met All Meeting Objectives

√ Review JPSS Program Level and NESDIS Level Priorities

√ J-1 Instruments and Algorithm Readiness

√ Review Science Teams Support for Suomi NPP

√ Interaction/Communication among stake holders

√ Feedback from user community

Moving Forward

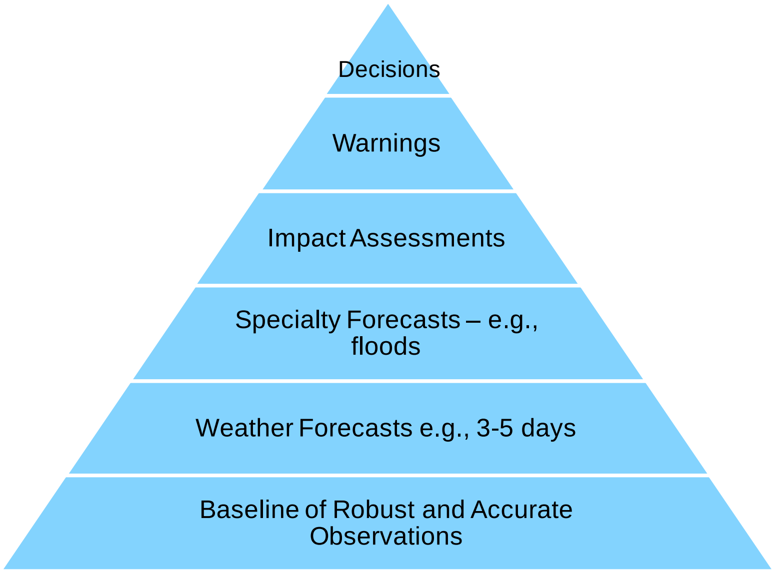
- √ **Baseline Algorithms/LUTs for Reprocessing**
  - √ SDR generate demonstration data sets
  - √ Evaluation/feedback from EDR teams
  - √ Reach consensus on the baseline for reprocessing
  - √ Coordinate with NCEI and other stakeholders on the R2O of the JPSS products reprocessing

- √ **Leveraging resource by building collaboration**
  - √ Enterprise Algorithms
  - √ Enterprise cal val, Datasets, tools
  - √ Coordinated campaign planning/opportunities

- √ **J1 Readiness**
  - √ Work with ASSIST to setup test data flows
  - √ Efficient R2O Process
  - √ Continue building ICVS LTM

- √ **Advanced Products to support user applications**

Observations To Decision Making



- Develop a robust baseline of accurate observations through requirement analysis, traceability, and user consultation to ensure J1 products generated are accurate and address user needs.
- Work with users, understand how products are used, Identify improvements and enhance algorithm development to meet user needs. Provide user training on product utility (e.g. NUCAPS on AWIPS and training)
- Map capabilities of various data products from J1, and other satellite platforms (e.g. GOES-R), in-situ and other fused data sets to address data needs across NOAA line offices and a wide variety of users.
- Operations to Operations (O2O): Evaluate NESDIS operationally produced S-NPP/J-1 products and use of the products for operational applications (e.g. Fire Products to NAM model applications to forecast trajectories.

Summary for Breakout Sessions

S-NPP SDR Performance and J1-Readiness

ATMS

- SNPP ATMS has a stable performance in orbit and all the parameters meet the specifications with large margins. ATMS striping mitigation algorithm updated to further improve data quality. Additional improvements applicable to both S-NPP and J1 include:
  - ✓ Radiance based calibration algorithm
  - ✓ Physical model based Lunar contamination correction algorithm
  - ✓ Allan variance NEdT monitoring
- STAR ICVS monitoring of SNPP ATMS scan drive motor current excursion supported NASA/NOAA decision makers for defining the Suomi NPP ATMS scan reversal schemes.
- ATMS SDR team have completed two rounds of J1 ATMS TVAC analysis and supported anomaly investigations.
- J1 ATMS PCT has been updated for operations.

CrIS

- SNPP CrIS instrument and SDR performances are very stable.
- CrIS full spectral resolution (FSR) SDR data are routinely produced at STAR processing system and the FSR data have been made available to the user community for various applications and research
- SDR algorithm/software is ready for operation to J1 CrIS

S-NPP SDR Performance and J1-Readiness

VIIRS

- All SNPP VIIRS SDRs meet or exceed requirement.
- VIIRS SDR team evaluated J1 waivers, developed, tested, and delivered J1 SDR algorithms upgrades mitigating certain instrument waivers; developed research capabilities for post-launch implementation to address SWIR nonlinearity, saturation handling, and testing other DNB agg modes
- Geolocation software code/LUTs are ready for operation to J1 VIIRS

OMPS

- SNPP earth view SDR and Geo-SDR for both SNPP OMPS NM and NP meet the requirement and are well defined for representative conditions
- SDR algorithms and their LUTs have been modified for J1 OMPS SDR processing. The J1 SDR algorithm was delivered after performing end-to-end tests. The SDR team intends further testing support with JCT 3.5 and TVAC data

All SDR teams participated in J1 pre-launch characterization and continued support for pre-operational testing of J1 algorithms. The SDR teams also finalized post-launch Cal/Val plans and schedules for Beta, Provisional and Validated maturity.

SST Products

- VIIRS **L2/L3 Data Producers**-8: STAR(5), NAVO(2), U. Miami(1)
  - NOAA ACSPO product continues history of solid performance
  - Reduced-size ACSPO L3U widely used & improved
  - New ACSPO error characterization improves SST performance
  - U. Miami and NAVO continue improving their VIIRS SST products
- ACSPO **Holdings/Archives**-2: STAR(1), NCEI/Silver Spring(1)
  - ACSPO L2P/L3U Products are fully archived at PO.DAAC and NCEI
  - STAR is exploring supplemental product access via CoastWatch
- ACSPO **Users**-10: UKMO(1), ABoM(2), JMA(1), NOAA CRW(1) and Geo-Polar Blend(1), JPL(1), NCEI(1), NOS(1)
  - Sustained 2 major users: CMC and NOAA Geo-Polar-Blended
  - 2 new users: **Met Office (OSTIA)** and NOAA CRW
  - 5 emerging users: ABoM, JMA, JPL, NOS, NCE/Asheville

Ocean Color Products

- VIIRS global ocean color products have been routinely produced using the NIR, SWIR, and NIR-SWIR atmospheric correction algorithms, providing necessary satellite data for various applications in coastal and inland waters, as well as for further improving data quality.

- The team completed VIIRS mission-long science quality ocean color data reprocessing (including SDR and EDR) with MSL12 Processing System. Two data streams are routinely produced: near-real-time and science quality ocean color data.

- Developed VIIRS instrument calibration capability with new calibration LUTs resulting in significant improvements to VIIRS OC products. The OC team also achieved significant improvement in OC products over global high altitude lakes through important updates, new algorithms, and with vicarious calibration using MOBY data.

- Results of evaluation indicate that the VIIRS-SNPP is now capable of providing high quality global OC products in support of science research and operational applications.

GCOM-W1/AMSR2

- JAXA's GCOM-W1/AMSR-2 Day-1 products have been operational since 11/14/2015. Research products are available since 11/2013. The products include:
  - AMSR-2TB's, Total Precipitable Water (TPW), Ocean Surface Winds (OSW) , SST, Cloud Liquid Water (CLW), Rain Rate (RR)/Type
- The team has delivered product updates for improved ocean EDRs, and Day-2 products, and awaiting ORR. The Day-2 products include:
  - Snow water equivalent (SWE), Snow Depth (SD), Sea-Ice concentration (SIC) and Soil Moisture (SM)
- The team is coordinating with JAXA on sensor calibration/updates and continuity for follow-on missions.
- On-going Interactions with users on developing new applications and expand utility of data sets
  - Tropical Cyclones – NHC, JTWC
  - Marine forecasts – OPC
  - Hydrology – WPC, NWC
  - Day 2 products – NIC, NWC, etc.

Land Products

- Land algorithms are currently transitioning to Enterprise solutions. JPSS Enterprise Workshop has numerous presentations describing the changes in the retrieval algorithm, product content and other details. The team continues preparations for re-processing and details of reprocessing efforts are at STAR reprocessing workshop.
  - LSA retrieval quality has significantly improved after three updates of LUTs of regression coefficients since launch. An improved enterprise albedo algorithm is currently under development to address many issues with the current IDPS product.
  - The SNPP LST marginally meets the mission requirements based on the ground based validations (CONUS, Europe, Greenland, Australia, China), radiance based validations, and cross satellite comparisons with MODIS, AATSR, SEVIRI etc.
  - Overall Surface Type Products classification accuracy is about ~78%. Recent updates have shown some accuracy improvements for croplands.
- Product development for operational applications
  - NCEP/EMC land: consistent, gridded, global, 1-km composites
  - biophysical variables for terrestrial ecological studies
  - fire radiative power for smoke/air quality applications
- Pursuit of Interagency / international coordination and collaboration for
  - science algorithms / products
  - validation
  - multi-satellite observing systems

Cryosphere (Snow, Ice, and Polar Winds)

- Products:
  - Snow: Binary snow cover, snow fraction
  - Ice: Ice surface temperature, ice concentration, ice thickness/age
  - Polar winds
- All products meet requirements (with one qualification)
- All products have better performance than their IDPS counterparts (a few only slightly better; others substantially better)
- Planned improvements for J1 are minor
- All products are ready for J1!

Atmosphere Products

- **VIIRS imagery is generally very high quality with many operational users:**
  - NRL, NIC, NCEI, JTWC, NWS (including NHC and Alaska Region), US State Department/foreign governments
- **Terrain-corrected geolocation is needed for all Imagery EDRs**
  - Lack of terrain correction impacts any land surface application of VIIRS Imagery
  - Working with NCEP on the use of VIIRS cloud products for use in CrIS cloud characterization.
- **Clouds Operational Status**:
  - Code will go operational in NDE in Nov 2016. The next update is August 2016 for a January 2017 operational update. Enterprise now includes Cloud Base and (baseline) Cloud Cover Layers.
- **Cloud team user-focused priorities**
  - Working on the use of VIIRS cloud products for use in CrIS cloud characterization, optimizing cloud heights for the Polar Winds Application., active in inserting VIIRS cloud / precip. information in JPSS Hydro Initiative, and demonstrating use of I-bands for cloud products – a unique capability from VIIRS.
- **Aerosols findings**
  - VIIRS AOT, and dust and smoke masks are evaluated for assimilation in aerosol forecast models, for monitoring model forecasts (NCEP, ESRL, NRL), and for improving air-quality forecast (PSU). VIIRS AOT is investigated in field experiment (UMBC). Found that EPS AOT has less bias than IDPS, that VIIRS+MODIS is better than MODIS alone, and that VIIRS RGB and AOT essential for identifying smoke plume transport upwind; 48 hour aerosol trajectories are critical tool for forecast.

Soundings Products

NUCAPS

- NUCAPS has been implemented in NWS AWIPS-II and is is fully operational for multi-sensors (IASI/AMSU, CrIS/ATMS) onboard multi-satellites (Suomi NPP, Metop-A/B)
- New channel configuration and tuning for ATMS, MW only retrievals improved; IR+MW “yield” is increased by 3%; still more to do
- NUCAPS is upgraded for CrIS full-spectral data, test results indicate similar or slightly better performance for T, q retrievals and significant improvements for trace gas EDRs
- A lot of good feedback from users in NWS forecast office.

- J1 Readiness: implementation of new SARTA model, regression coefficients generation, new tuning, testing.
- Maintain interaction with users, NUCAPS in AWIPS-II, training support, feedback, response.

MIRS

- MiRS v11 sounding EDR implemented with significantly improved performance and the problems with retrieval of snow products for Blizzard 2016 have been corrected .

- Future work: Snow (vegetation correction), Rainy condition sounding (update a priori constraints), Hydrometeors (improvements to CRTM i.e. scattering, precharacterization of precip type, particle size/shape distribution in CRTM, CLW over land for light rain detection) and Air mass-dependent bias correction

Traces Gases

- Future algorithm developments: Mathematically sound retrieval algorithms are key and multi-sensor products should be developed from NIR and TIR measurements for joint retrievals of trace gases.

- Users application initiatives:
  - More trace gas user’s verification efforts using planned field campaigns (FIREX, Atom) of opportunity for real time user support and post mission data assimilation studies. The goal is to evaluate the impact of these retrievals on global and regional chemistry forecasts.
  - NWS (NGGPS and AQFC) to use JPSS operational trace gas products (NO2, O3, etc.).
  - A network of commercial air craft based trace gas measurements (especially CO2 and CH4) for a global scale verification of the COP-21 agreement.

Ozone Products

- Heritage/Enterprise Version 8 Algorithms to create Total Column Ozone and Nadir Ozone Profiles with improved horizontal resolution are ready for implementation at NDE and for reprocessing.
- An improved atmospheric SO2 algorithm will allow correction of ozone amounts for elevated SO2 levels.
- The Version 2 Limb Ozone Profile algorithm is ready for implementation at NDE.
- We are working with users, operations, and the OMPS SDR team to prepare for these new products and their improved horizontal resolution with J1.

GSICS Workshop Summary

- GISCS activities have matured to the point where they are providing the foundation for a true Global System of Infrared instrument measurements including Polar and Geostationary satellites.
- Methods for Visible, Microwave and Ultraviolet instruments are progressing and are addressing differences in the reference measurements, sensor technologies and Earth signatures in their different spectral regions.
- The ICVS is an important asset in the NOAA participation in GSICS activities.