Joint Polar Satellite System (JPSS)

JPSS PROVING GROUND AND RISK REDUCTION UPDATE

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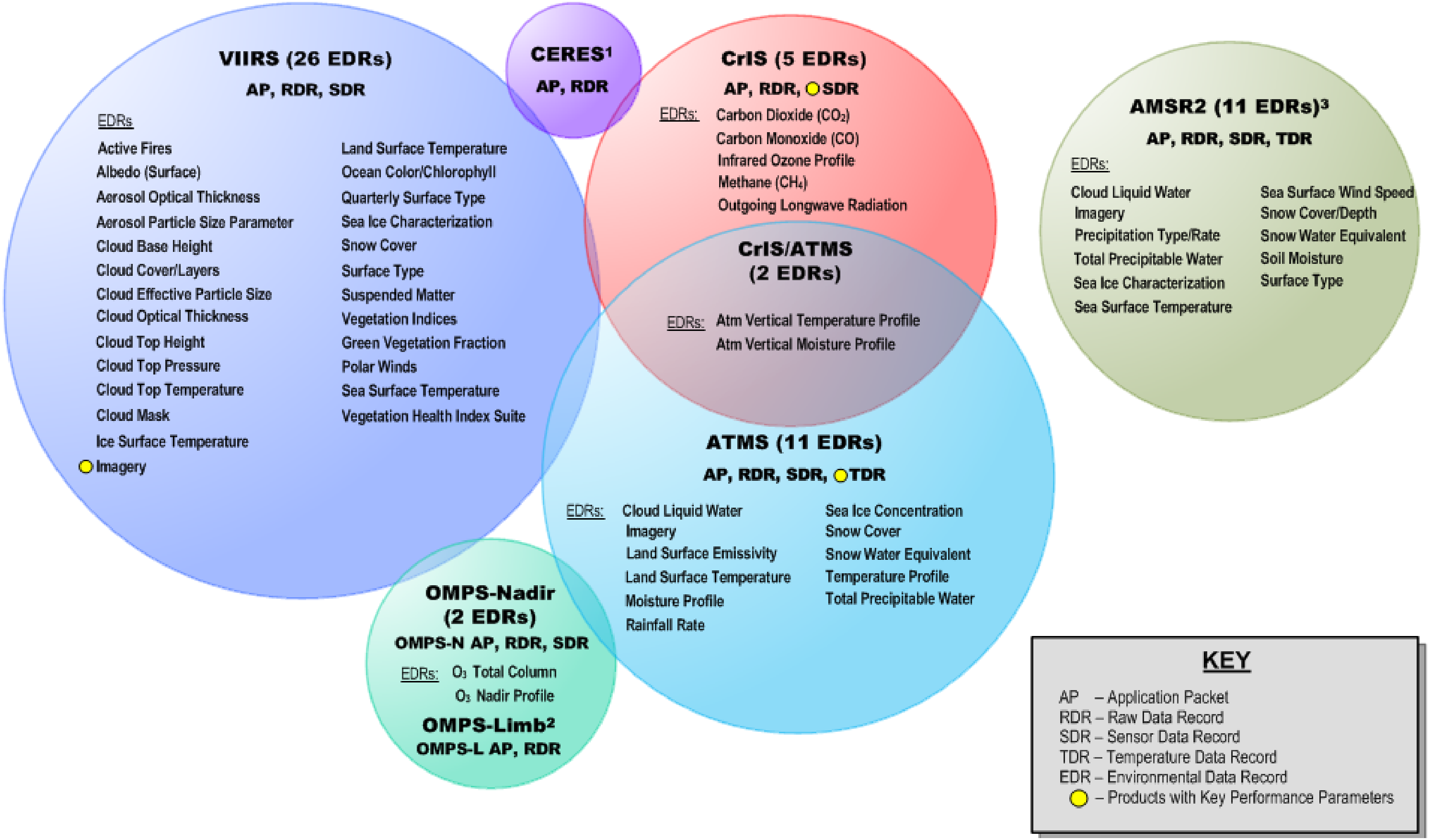
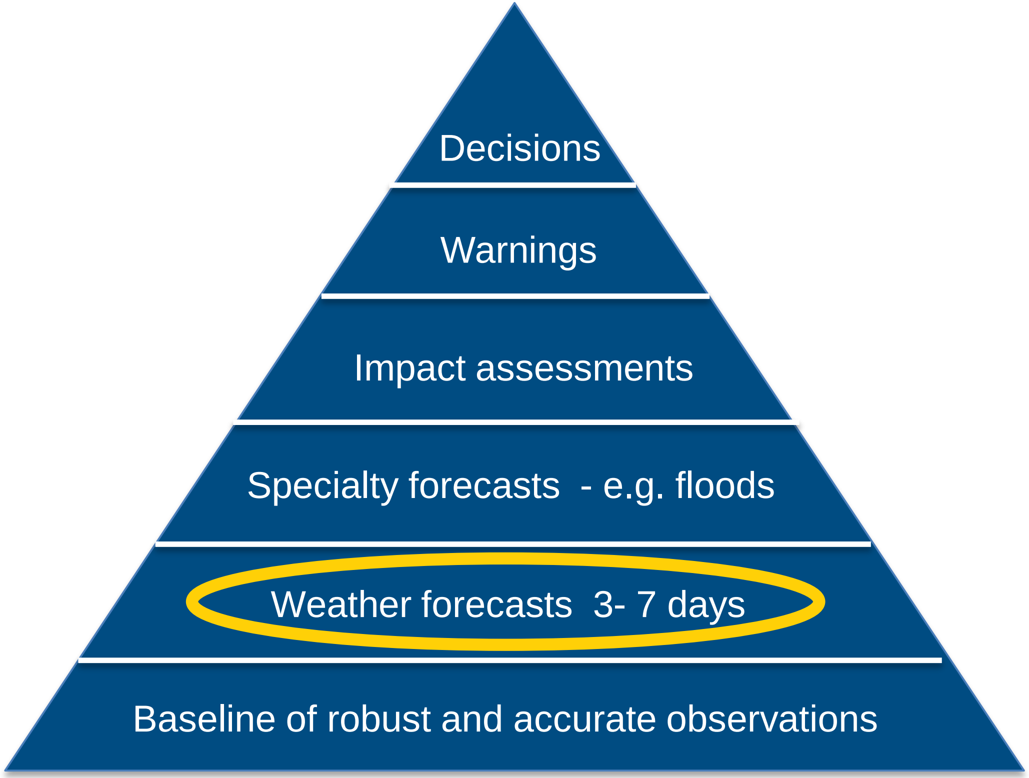
Jordan Gerth, Michael Folmer, Andy Heidinger

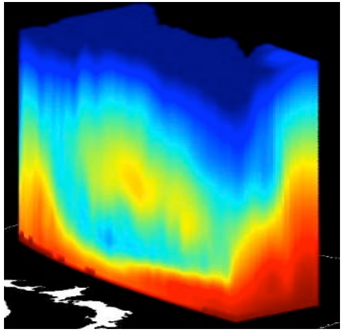
Topics

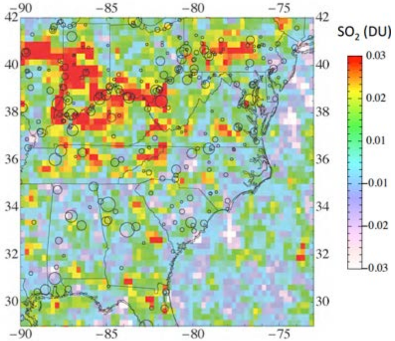
- Overview and Challenge of PGRR
- PGRR Initiatives and their Status
- Scorecard

JPSS Program Data Products




Decisions
Warnings
Impact assessments
Specialty forecasts - e.g. floods
Weather forecasts 3- 7 days
Baseline of robust and accurate observations

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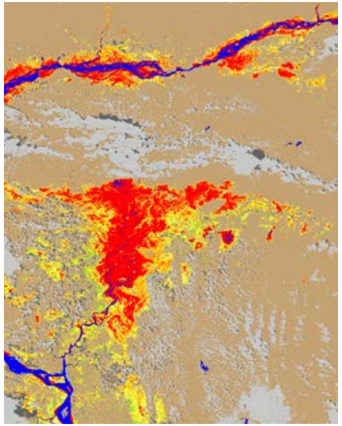

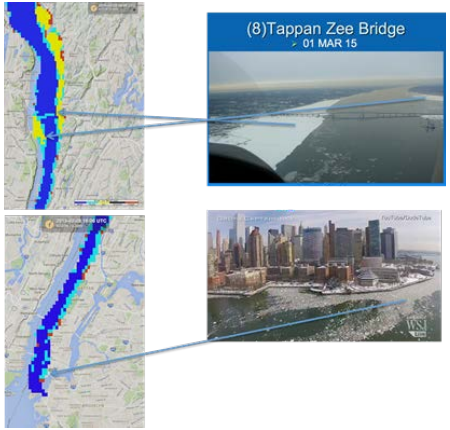
(8)Tappan Zee Bridge
01 MAR 15

JPSS PGRR Scope

- **Proving Ground**
  - Demonstration and utilization of data products by the end-user operational unit, such as at NWS, NOS, NMFS
  - Promote outreach and coordination of new products with the end users, incorporating their feedback for product improvements
- **Risk Reduction**
  - Development of new research and applications to maximize the benefits of JPSS satellite data
    - Example - enhancing the HRRR model to incorporate VIIRS FRP to improve smoke forecasts
  - Encourages fusion of data/information from multiple satellite, models and in-situ data
  - Address potential risk in algorithms and data products/processing by testing alternative algorithms and approaches.

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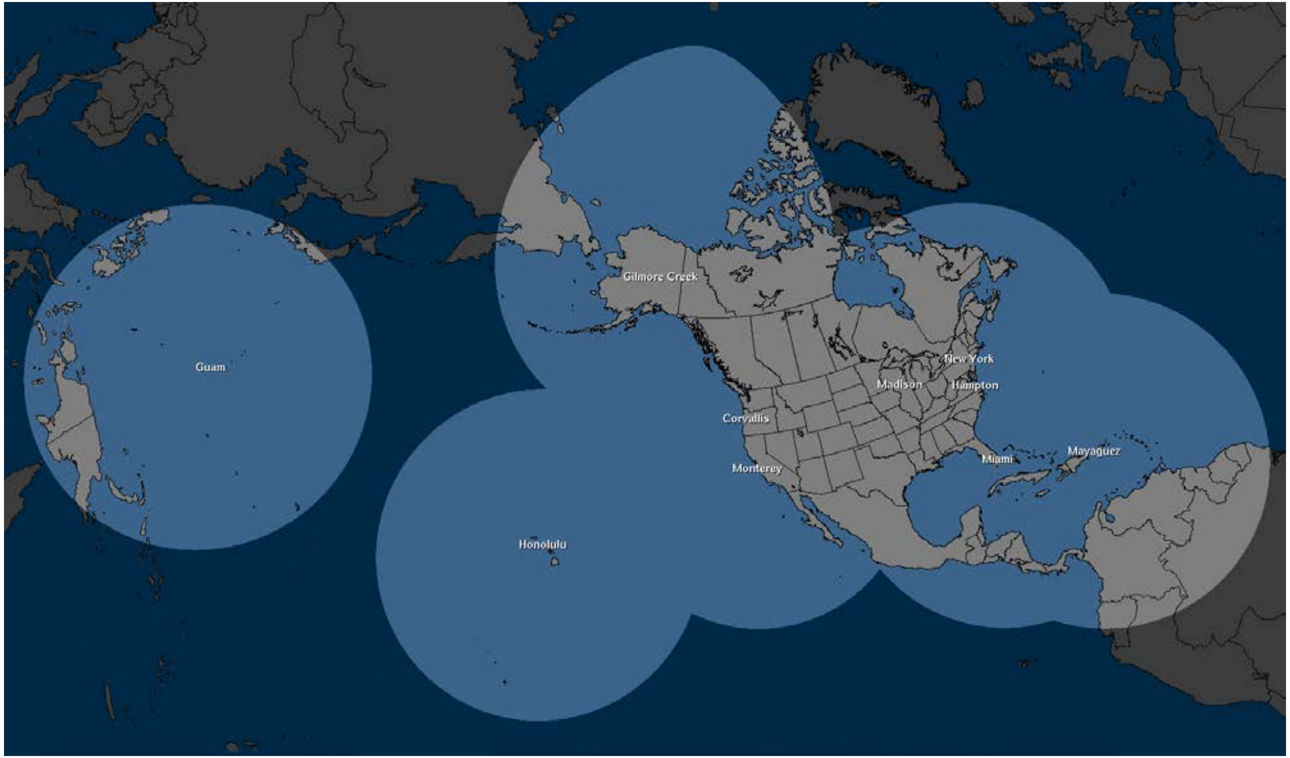
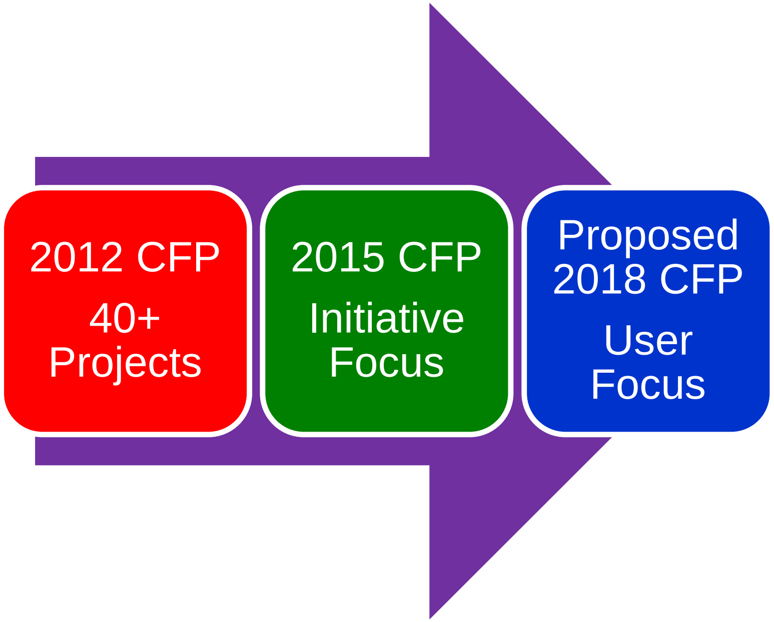
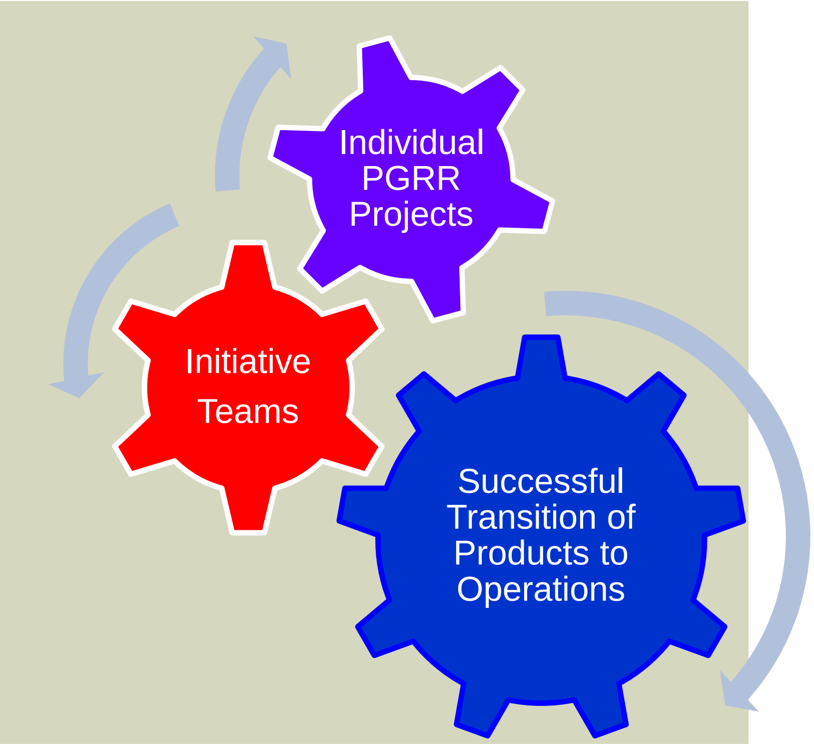
PGRR - Direct Broadcast Real-Time Network (DBRTN) Antenna Sites



JPSS PGRR EVOLUTION





Proving Ground Initiatives

- What is an initiative? An interagency group of developers, service area providers, and stakeholders that frequently interact in a structured forum to address challenges in NOAA and partner service areas.

- Initiative activities
  - Products/capabilities are evaluated to ensure their optimal use in these focus areas.
  - Based on user feedback, changes to these capabilities are considered to increase their effectiveness
  - Actions to transition these capabilities to user operations are identified and implemented

- Why are initiatives successful?
  - Well defined objectives established and specific actions worked
  - Stakeholders are actively participating with engagement of the user advocate.
  - Products and capabilities are evaluated in operational environments
  - Monthly and bi-monthly meetings ensure proposed improvements can be worked on and then implemented quickly

User Engagement: PGRR

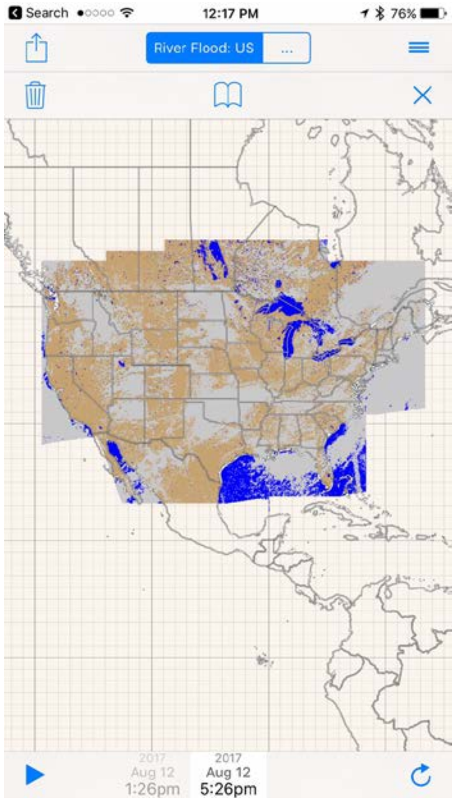
The Proving Ground and Risk Reduction program enhances user applications of JPSS data, algorithms and products by stimulating interactions between technical experts and key user stakeholders.

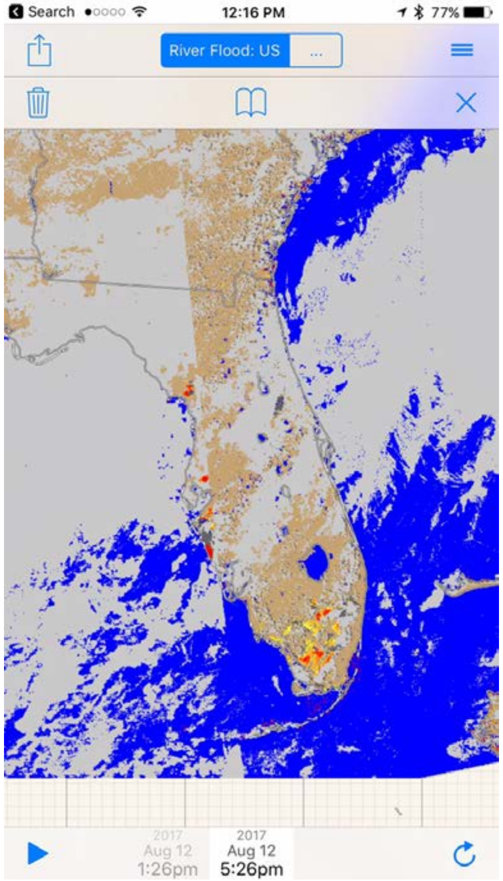
Current Initiatives include:

- River Ice and Flooding (Sjoberg)
- Fire and Smoke (Sjoberg)
- Sounding Applications /NUCAPS (Barnet)
- Hydrology (Ferraro)
- Ocean and Coastal (Lance)
- Severe Weather/NWP/Data Assimilation (Dunlap/Chowdhury)
- Innovation
- Training (UCAR – Stevermer NWS – Torres, WMO VLAB – Connell)
- OCONUS and NCEP Service Centers—AWIPS (Satellite Liaisons)

River Ice and Flooding Successes

- Generated routinely using Direct Broadcast at CIMSS
- Provided on RealEarth Application
  - Iphone/Android
- Provided to AWIPS using Local Data Manager (LDM)
- Used routinely by NWS River Forecast Centers
- Used by FEMA
- Experimental Global Processing for International Charter on Disasters
- Developing capabilities for GOES-R series.
- Next step - operational development





River Ice and Flooding Team – (April 2017 telecon)

Name	Organization	Name	Organization
Paul Alabi	CCNY	Paul McKee	WGRFC
Aaron Bisig	NIC	Julie Price	JPSS
Ed Capone	NERFC	Fernado Salas	NWC
Jessica Cherry	APRFC	Bill Sjoberg	JPSS
Reggina Cabrera	SERFC	Donglian Sun	GMU
Gene Derner	MBRFC	Tim Szeliga	NWC
Mitch Goldberg	JPSS	Marouane Temimi	CCNY
Andy Heidinger	STAR	Jonathan Thornburg	NCRFC
Jay Hoffman	CIMSS	Jorel Torres	CIRA
Eric Holloway	APRFC	David Vallee	NERFC
Sanmei Li	GMU	John Walker	NOAA UAS
Yinghui Liu	SSEC		

VIIRS Flood Maps in Response to International Charter Activation from Venezuela

International Charter
SPACE & MAJOR DISASTERS

About the Charter | Activations | Media Gallery | News

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Latest Activation

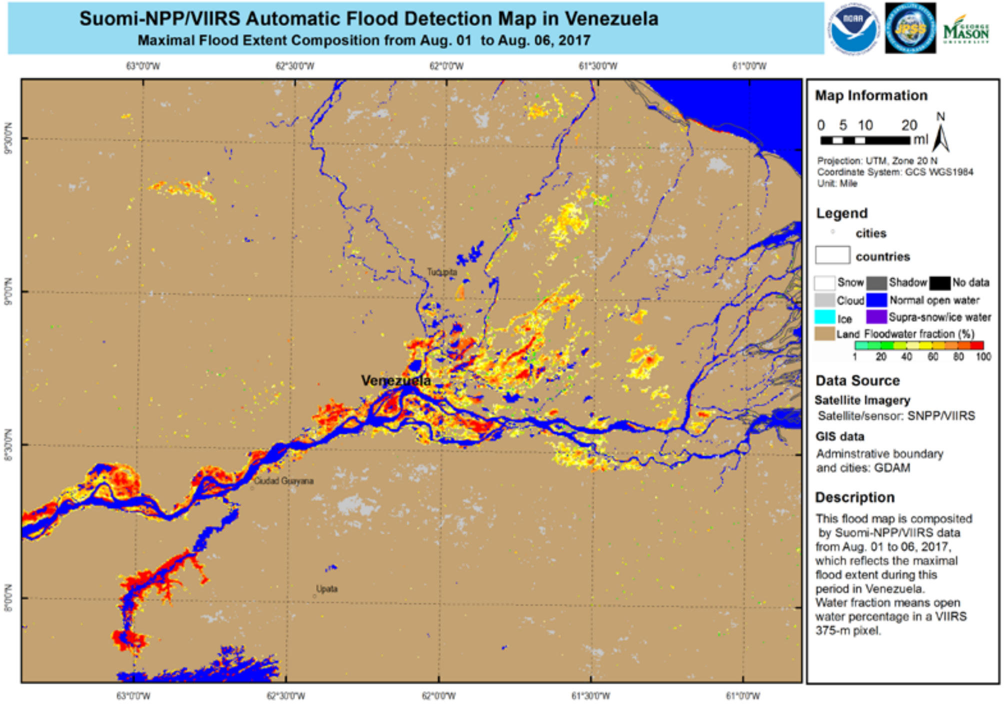
Flood in Venezuela

Sunday, 06 August 2017

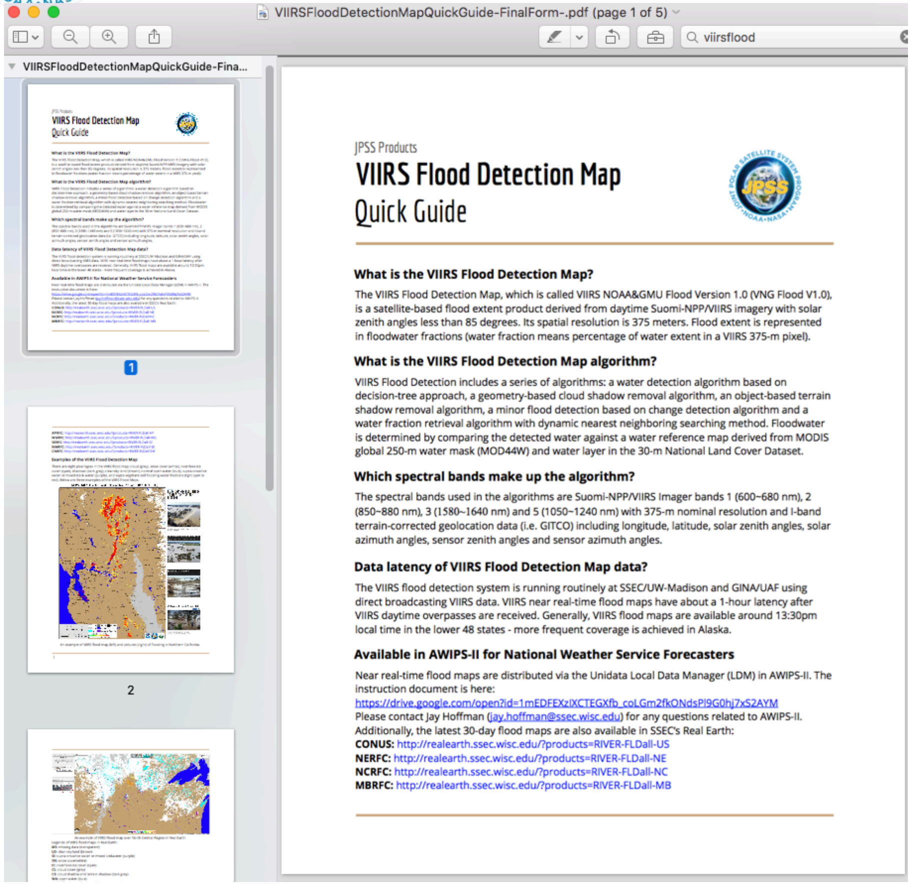
Location of Event:	Venezuela
Date of Charter Activation:	6 August 2017
Time of Charter Activation:	22:04:00
Time zone of Charter Activation:	UTC-04:00
Charter Requestor:	ABAE on behalf of Civil Protection of Venezuela
Activation ID:	541

Description of the event

Heavy rains fell for several days across eastern parts of Venezuela causing widespread flooding. Largely affected areas are the states of Delta Amacuro, Bolivar and Merida.
The Civil Protection Agency of Venezuela raised alert levels to the highest level and provided support to people in the worst affected areas.



Quick Guides and Training



JPSS Products

VIIRS Flood Detection Map
Quick Guide

What is the VIIRS Flood Detection Map?

The VIIRS Flood Detection Map, which is called VIIRS NOAA&GMU Flood Version 1.0 (VNG Flood V1.0), is a satellite-based flood extent product derived from daytime Suomi-NPP/VIIRS imagery with solar zenith angles less than 85 degrees. Its spatial resolution is 375 meters. Flood extent is represented in floodwater fractions (water fraction means percentage of water extent in a VIIRS 375-m pixel).

What is the VIIRS Flood Detection Map algorithm?

VIIRS Flood Detection includes a series of algorithms: a water detection algorithm based on decision-tree approach, a geometry-based cloud shadow removal algorithm, an object-based terrain shadow removal algorithm, a minor flood detection based on change detection algorithm and a water fraction retrieval algorithm with dynamic nearest neighboring searching method. Floodwater is determined by comparing the detected water against a water reference map derived from MODIS global 250-m water mask (MOD44W) and water layer in the 30-m National Land Cover Dataset.

Which spectral bands make up the algorithm?

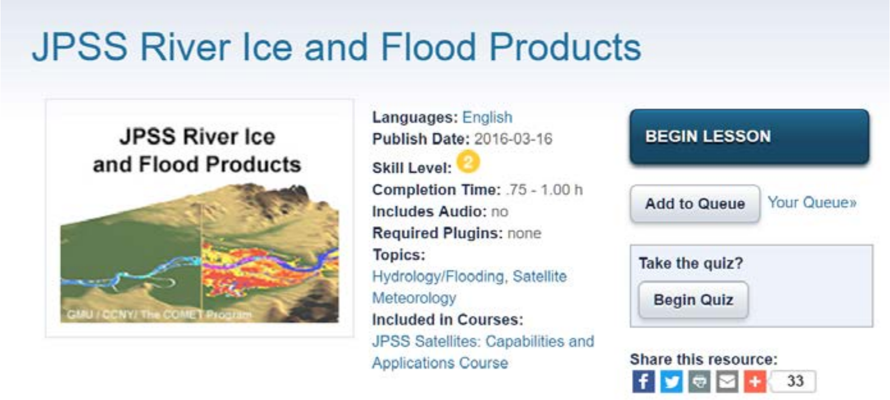
The spectral bands used in the algorithms are Suomi-NPP/VIIRS Imager bands 1 (600~680 nm), 2 (850~880 nm), 3 (1580~1640 nm) and 5 (1050~1240 nm) with 375-m nominal resolution and I-band terrain-corrected geolocation data (i.e. GITCO) including longitude, latitude, solar zenith angles, solar azimuth angles, sensor zenith angles and sensor azimuth angles.

Data latency of VIIRS Flood Detection Map data?

The VIIRS flood detection system is running routinely at SSEC/UW-Madison and GINA/UAF using direct broadcasting VIIRS data. VIIRS near real-time flood maps have about a 1-hour latency after VIIRS daytime overpasses are received. Generally, VIIRS flood maps are available around 13:30pm local time in the lower 48 states - more frequent coverage is achieved in Alaska.

Available in AWIPS-II for National Weather Service Forecasters

Near real-time flood maps are distributed via the Unidata Local Data Manager (LDM) in AWIPS-II. The instruction document is here:
https://drive.google.com/open?id=1mEDFEXzIXCTEGXfb_coLGm2fkONdsPl9G0hj7xS2AYM
Please contact Jay Hoffman (jay.hoffman@ssec.wisc.edu) for any questions related to AWIPS-II.
Additionally, the latest 30-day flood maps are also available in SSEC's Real Earth:
CONUS: http://realearth.ssec.wisc.edu/?products=RIVER-FLDall-US
NERFC: http://realearth.ssec.wisc.edu/?products=RIVER-FLDall-NE
NCRFC: http://realearth.ssec.wisc.edu/?products=RIVER-FLDall-NC
MBRFC: http://realearth.ssec.wisc.edu/?products=RIVER-FLDall-MB



Sounding - NUCAPS

Appeal of NUCAPS

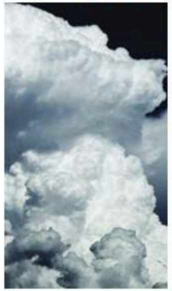
Forecasters need to analyze the pre-convective thermodynamic environment

7 hour gap between 7 am and 2 pm!

Most stable time of the day to the most unstable time of the day

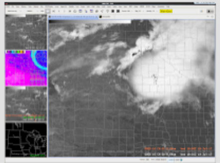
~7 am

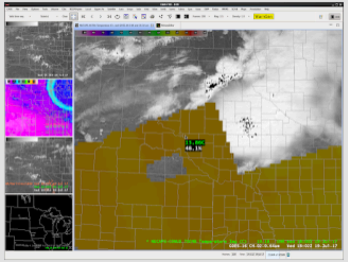
~2 pm



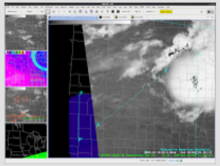
~4 pm

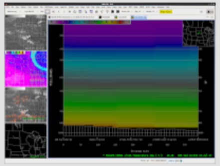
NUCAPS grids arrived about 1945Z, and we were able to determine what kind of cap existed. We knew there was warm air, but we did not know how warm. We have been seeing a slight increase in towering Cu, but our hopes and dreams were dashed after seeing NUCAPS grids, which reported temps >13C at 700 mb behind the anvil shield of the departing MCS. Not sure what the convective temperature is, but it must be really high.





But when NUCAPS sounding came in it told a scary story, producing SBCAPES >5000 in south central SD. I did a cross section of temperatures in NUCAPS grid. Drew a line A across a thin line of towering Cu. In the middle of the cross section, I could see a thermal boundary right were the line of Cu had developed. (I was unable to use the drawing tool, but the gradient is seen a the bottom of the screen about halfway between the bottom left and bottom right edge of the image.





Convection quickly popped up along that boundary, and so did ProbSevere product, with 80% ProbHail. The object appeared immediately next to the SFD METAR plot, which was 103/65. Immediately to the SW, the measurement at VTN (Valentine, NE) was 109/52.

NUCAPS Initiative Team (Mar 24, 2017 telecon)

Name	Organization	Name	Organization
Chris Barnet	STC	Dan Neitfeld	NWS
Emily Berndt	SPORT	Tony Reale	STAR
Jack Dostalek	CIRA	AK Sharma	OSPO
Jim Heil	NWS	Bill Sjoberg	JPSS
Dan Lindsey	CIRA	Nadia Smith	STC
Scott Lindstrom	CIMSS	Eric Stevens	GINA
Bill Line	NWS	Brad Zavodsky	SPoRT
Nick Nalli	STAR	Antonia Gambcorta	STC

Fire and Smoke Successes

- Providing easy access for fire and smoke imagery use eIDEA website
- Boots on the ground efforts – working with NWS IMETS and US Forest Service on providing real-time products using direct broadcast - both I-band and M-band fire products - Applications for Fire Management
- Inclusion of VIIRS FRP into the HRRR model for smoke forecasts
- Use of CrIS CO products to better characterize vertical height of smoke.
- Case Studies, Training and Educations
- Research on the use of the DNB for fire detection

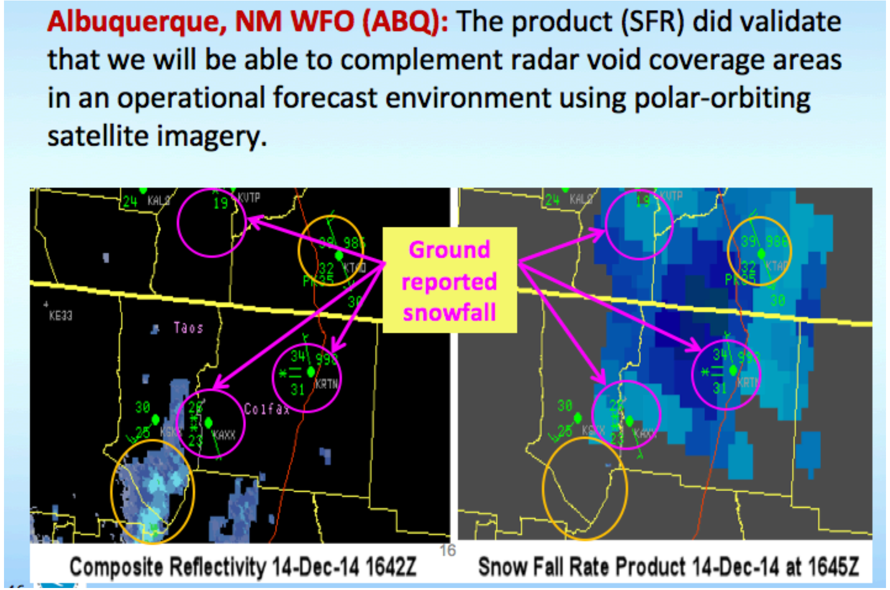
F&S Team (May 17 2017 telecon)

Name	Organization	Name	Organization
Ravan Ahmadov	CIRES	Jan Mandel	Univ of CO-Denver
Tianfeng Chai	CICS	Jeff McQueen	NCEP
Ivan Csiszar	STAR	Brian Motta	NWS
Russ Dengel	CIMSS	Li Pan	ARL
Andy Edman	NWS	Julie Price	JPSS
Evan Ellicott	U of MD	Brad Pierce	STAR
Greg Frost	STAR	Katherine Rowden	NWS
Robyn Heffernan	NWS	Scott Rudlosky	CICS
Amy Huff	PSU	Curtis Seaman	CIRA
Eric James	ESRL/GSD	Bill Sjoberg	JPSS
Hyun Kim	ARL(?)	Eric Stevens	GINA
Adam Kochanski	Univ of UT	Jebb Stewart	ESRL
Scott Lindstrom	CIMSS	Jorel Torres	JPSS Training Liaison
Mark Loeffelbein	NWS		

Hydrology Successes

Establish a Hydrology Initiative Working Group and create a forum for PGRR Hydrology-related project teams to interact on a periodic basis. This interaction will allow teams to optimize their activities and leverage other team activities to meet their project commitments.

- Evolving connections with the National Water Center
- Need for seasonal stream flow forecasting at NWC.
- Focus on snow, moisture and precipitation
- Multi-sensor /fusion approach for better temporal coverage

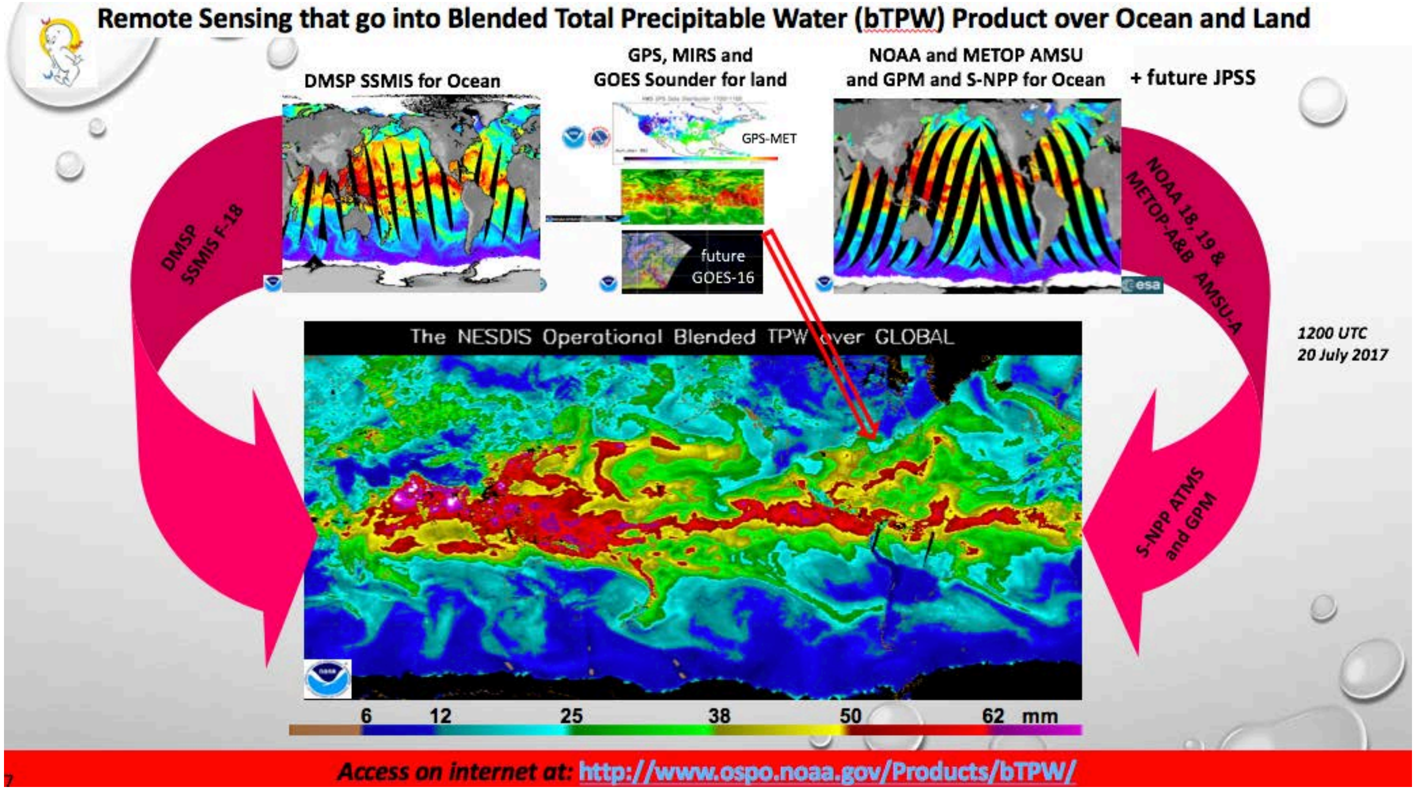


Hydrology Initiative Projects

Project PI	Project Title
John Forsythe (CSU/CIRA)	**Using JPSS retrievals to implement a multisensor, synoptic, layered water vapor product for forecasters**
Dave Gochis (NCAR)	**Applying snow products from S-NPSS JPSS and SNODAS to seasonal stremflow forecasting at the NWS National Water Center**
Tarendra Lakhankar (CUNY/CREST)	**Validation and application of JPSS/GCOM-W soil moisture data product for operational flood monitoring in Puerto Rico**
Huan Meng (NESDIS/STAR)	**Continued expansion, enhancement and evolution of the NESDIS snowfall rate product to support weather forecasting**
Andi Walther (UW/CIMSS)	**Further development of the VIIRS nightime lunar reflectance-derived cloud properties and demonstration for their use for precipitation & icing applications**
Tony Wimmers (UW/CIMSS)	**Strengthening TPW visualization in the OCONUS domain with JPSS data products**
Pingping Xie (NWS/NCEP/CPC)	**Reprocessing of JPSS OLR and CMORPH products for improved operational climate applications**
Jerry Zhan (NESDIS/STAR)	**Enhance agricultural drought monitoring using NPP/JPSS land EDR's for NIDIS**

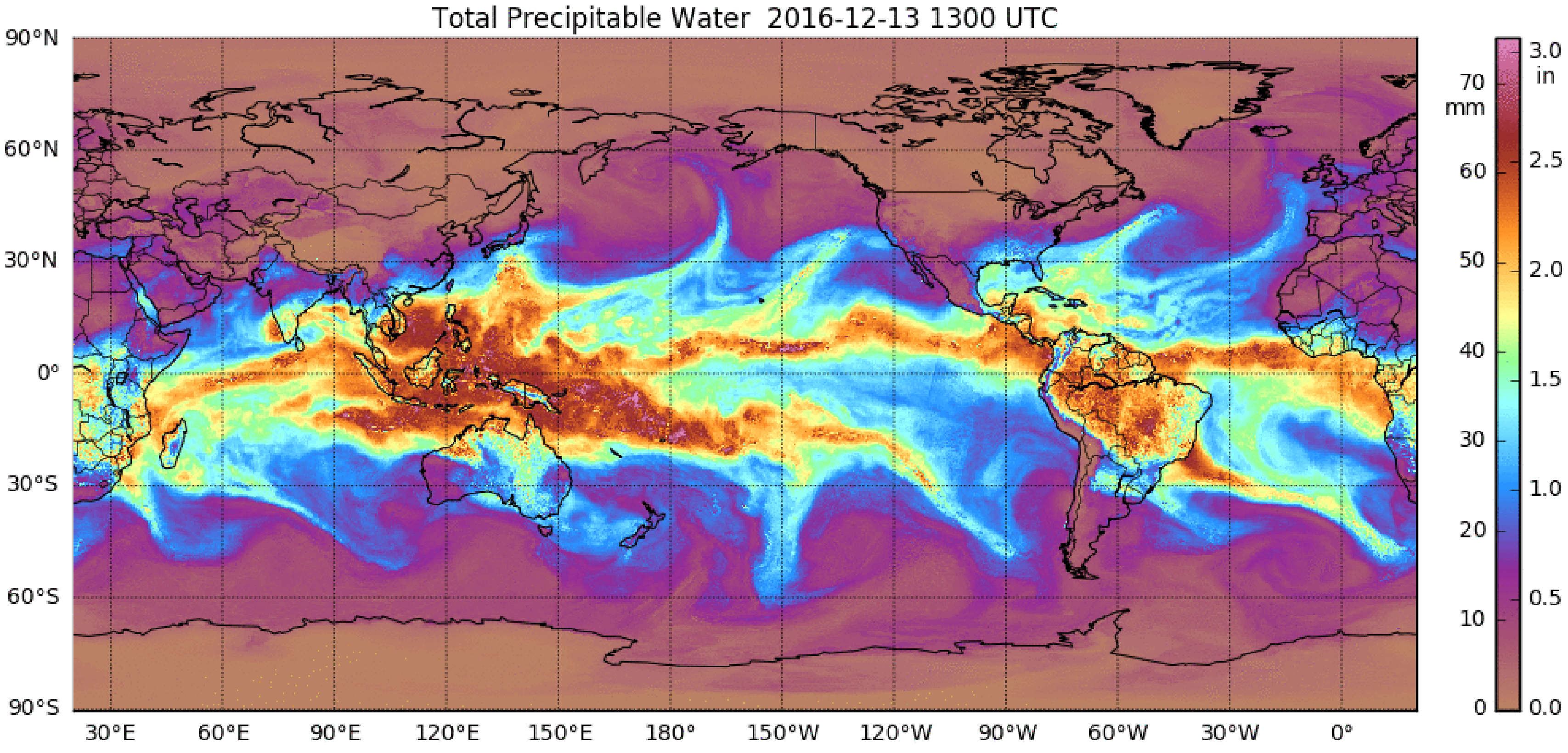
Gray – part of activity but unfunded project

A key goal is to improve upon NESDIS operational blended TPW products



From Sheldon Kusselson

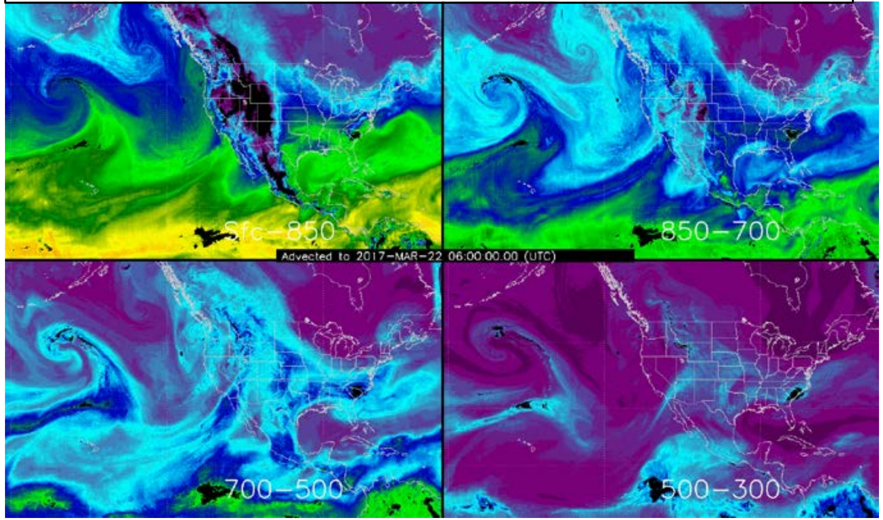
Morphing MIRS TPW from 5 satellites with forecasts



Credit: Tony Wimmers, CIMSS

Success: Multi-Layer moisture fields

First ever multisensor and multilayer microwave (4 AMSUs, 1 ATMS, 2 SSMIS) using the operational MiRS Version 11 products. (credit: John Forsythe, CIRA)



Four Layers of integrated precipitable water - Surface to 850 mb, 850 – 700 mb, 700 – 500 mb, and 500 – 300 mb.
Excellent feedback from operational users - now working to replace the operational static blended product to this "advective blending" product

"A pretty amazing lake-effect/lake-enhanced event is unfolding for western/central NY tonight. **LPW data shines again, as the 700-500 mb panels show a lengthening moisture inflow,** … Mid-level moisture is normally the achilles heel of many otherwise good lake-effect events, but not so this time."
-- Michael Jurewicz, NWS Binghamton NY, 11/20/16

NWS National Hurricane Center Miami FL
616 AM EDT SUN JUL 10 2016

...TROPICAL WAVES... The wave is embedded in **a mainly low moist environment from surface to 850 mb as indicated by CIRA LPW imagery.** … A tropical wave is in the central Caribbean with axis near 75W, moving west at 15 knots within the last 24 hours. **CIRA LPW imagery show the wave is embedded in shallow moisture whereas water vapor imagery show strong subsidence aloft.**

Critical Weather, Numerical Weather Prediction, Data Assimilation (Wx/NWP/DA) Initiative

- The main purpose of this initiative is to further the scientific advancement of the use of JPSS satellite data to support critical weather forecasting and numerical modeling efforts in NOAA and beyond.
- Projects range from improvement of tropical cyclone forecast capabilities, satellite based hurricane intensity estimation , data assimilation improvements, and CrIS radiance assimilation in GSI for better forecasts of high impact weather events etc.
- Goals for the initiative:
  - **Collaboration!**
    - Grouping projects in similar areas serves as an effective forum for the initiative project teams to interact
  - **Research to Operations (R2O)!**
    - Focused on application of research to a pointed user community at NOAA and beyond
  - **User engagement!**
    - As with our other initiatives, heavy user engagement to clearly direct the R2O process but also to provide feedback and support for your development efforts.

Initiative Projects

Principal Investigator	Project Title	Summary
Stan Benjamin	Direct readout enhancement of short-range forecast impact for global and regional models	Leverage CSPP latency to assimilate ATMS and CrIS data into hourly RAP/HRRR forecasts and transition this to NCEP
Galina Chirokova	Improving Tropical Cyclone Forecast Capabilities Using the JPSS Data Suite	Leverage ATMS and VIIRS data to obtain quantitative inputs for the Rapid Intensification Index (RII) to improve its performance.
James Jung	Support of NPP and JPSS Data Assimilation Experiments	Demonstrate and quantify the impacts of ATMS and CrIS satellite data on NWP models
Eugenia Kalnay	Ensemble Forecast Sensitivity to Observations (EFSO) and Proactive Quality Control (PQC)	Created groundbreaking method to test and flag the impact of each assimilated observation type then to eliminate the flawed observations from the assimilation cycle before they negatively impact a forecast
Jun Li	Enhance the utilization of real time JPSS sounder data in SDAT for tropical cyclone forecast application	Use ATMS and CrIS data from CSPP in the CIMSS Satellite Data Assimilation for Tropical storm forecasting (SDAT) and prepare for transition to NCEP
Zhanqing Li	Retrieving cloud base height and updraft speed for shallow convective clouds and boundary-layer moisture from VIIRS for improving the NCEP-GFS	Developed a groundbreaking cloud base updraft speed product from VIIRS retrievals and transition this to be assimilated at NCEP
Benjamin Ruston	NRL/JPSS Extending CrIS/ATMS Assimilation and Calibration/ Validation through correlated error, over clouds and to the surface	Test the impact of ATMS and CrIS sensors on the Navy's NAVGEM model to demonstrate the value of JPSS data
Chris Velden	Satellite-Based Hurricane Intensity Estimation in the JPSS/GOES-R Era	Integrate LEO and GEO satellite tropical cyclone intensity methodologies and demonstrate a satellite-based consensus approach for enhanced intensity estimate
Fuzhong Weng	Improved CrIS Radiance Assimilation in GSI for Better Forecasts of High-Impact Weather Events	Investigate the quality control of CrIS data in the GSI then create and implement a cloud detection algorithm from CO2 bands

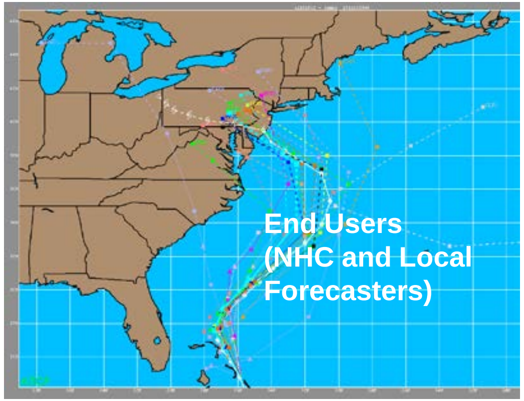
Satellite Data Assimilation for Tropical storms (SDAT)
(http://cimss.ssec.wisc.edu/sdat) (Jun Li, CIMSS)

SDAT
(http://cimss.ssec.
wisc.edu/sdat)

Research Path

WRF/GSI at CIMSS

Using JPSS sounder Radiances
GOES-R series TPW and AMVs



Research testbed for improving the utilization of GOES-R/JPSS data (Sounder, ABI, radiances, TPW, AMVs, Clouds, etc.)

TC Forecast Improvement

R2O
Researc
h

Refining the Operational Path

Operational NWP models:

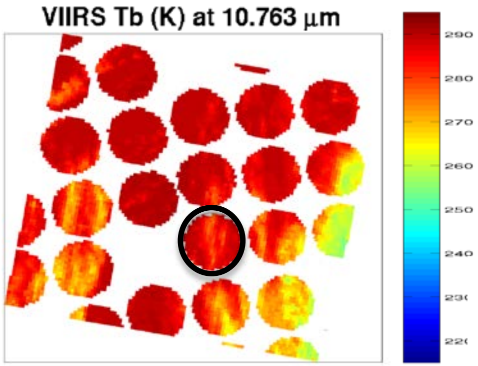
EMC GFS

EMC HWRF

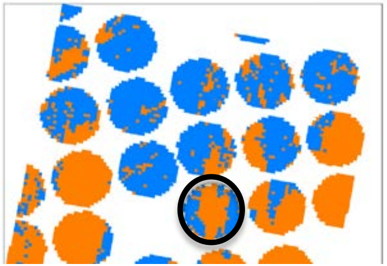
ESRL RAP

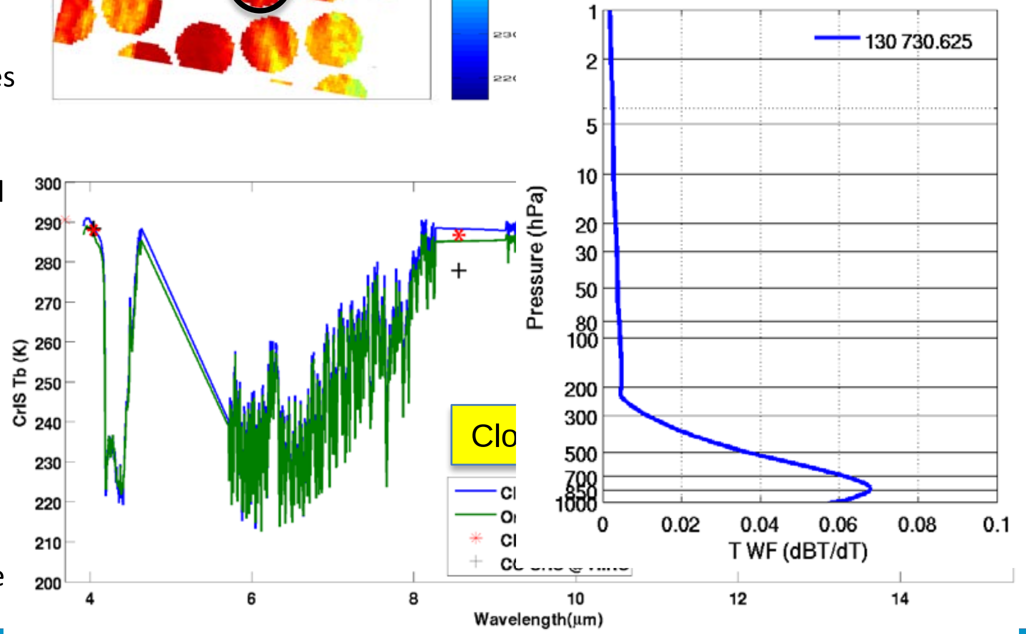
CrIS/VIIRS cloud clearing for CrIS radiance assimilation

- The N* method (Li et al., 2005)
- VIIRS cloud mask identifies partially cloudy FOVs **(black circle)**
- VIIRS radiances help quality control cloud cleared CrIS radiances
- Only three VIIRS bands (4.05, 10.763, and 12.013 um) used (overlapped with CrIS)
- Cloud cleared radiances very close to VIIRS clear sky radiances
- 12.5 % of partially cloudy FOVs are successfully cloud cleared for Hurricane Sandy case

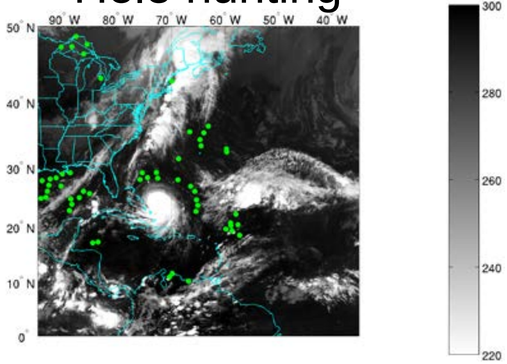


VIIRS Cloud Mask

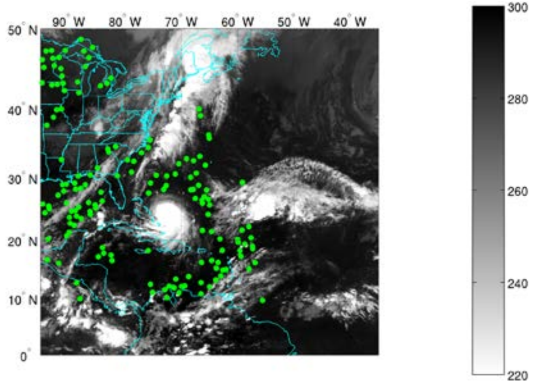




Hole hunting

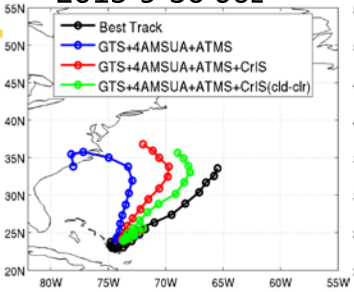


V/C Cloud Clearing

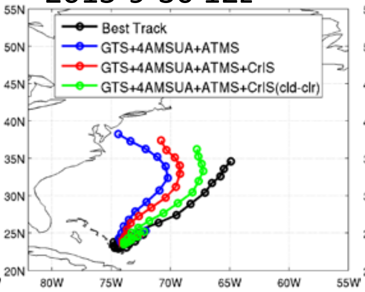


Hurricane Joaquin (2015) track forecasts

2015-9-30 06z



2015-9-30 12z



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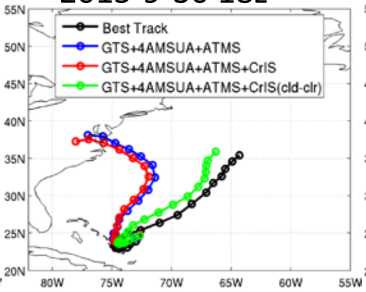

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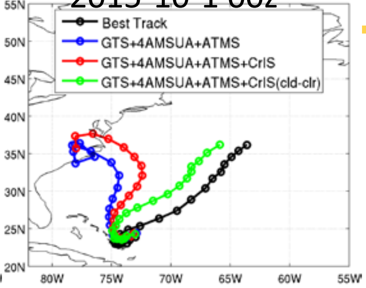

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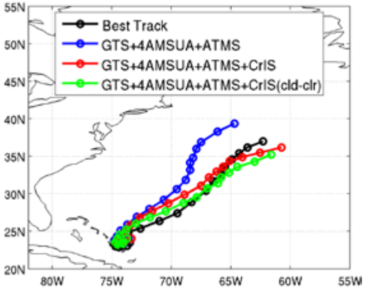

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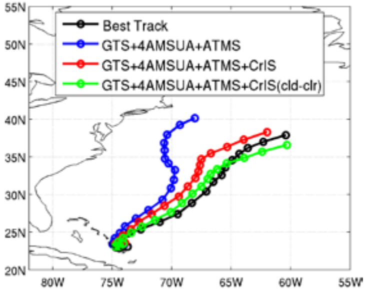

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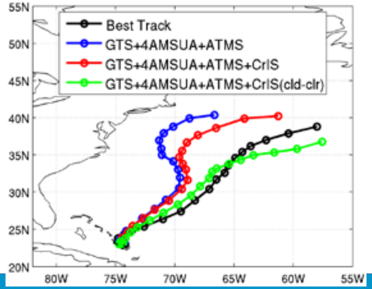
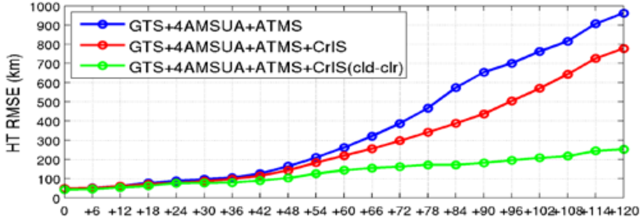
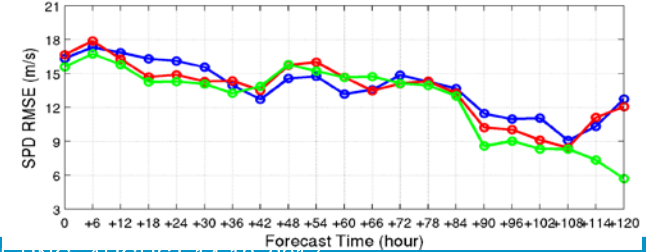


Track RMSE



SPD RMSE



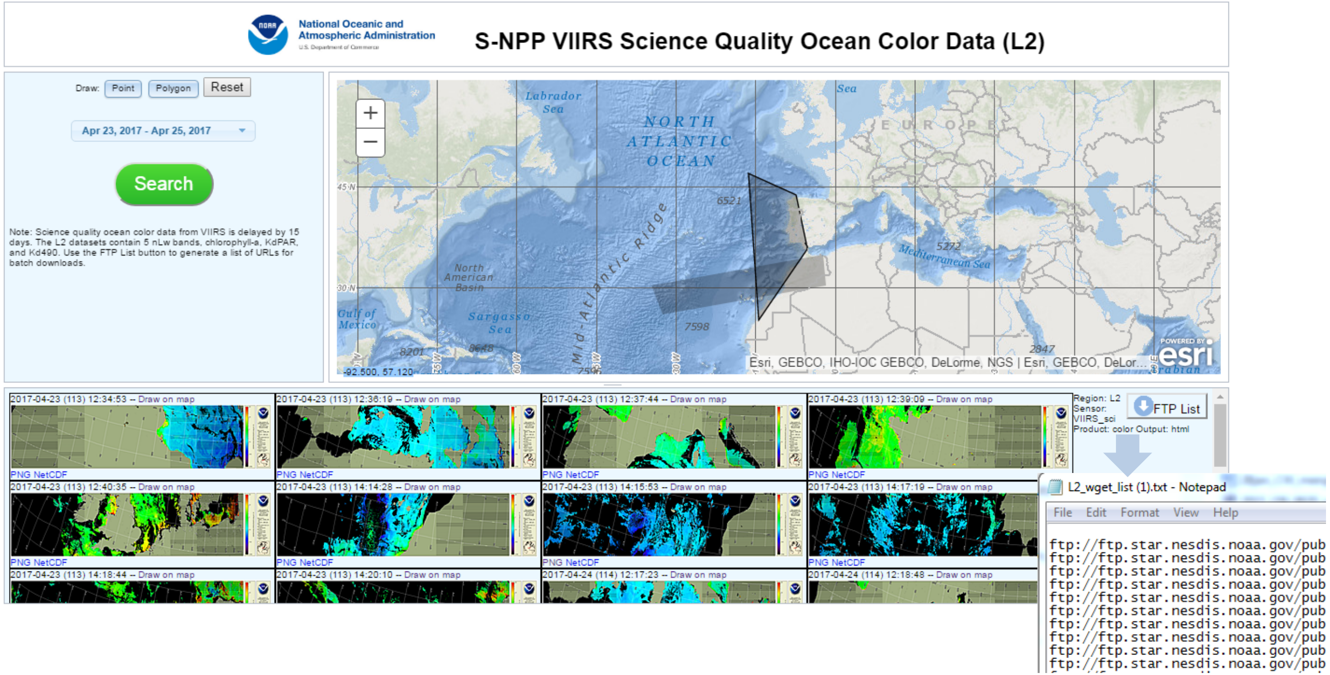
Oceans and Coasts

- Facilitate the use of VIIRS ocean data products
  - within each NOAA Line Office for their operational forecasts or research needs.
  - outside of NOAA by other US agencies, academic researchers, resources managers, commercial sector users, international partners and the general public who use satellite data products or downstream products and/or knowledge derived from satellite data (e.g., forecasts)

Projects
Ahmed, CCNY: A new technique for VIIRS detection and delineation of *Karenia brevis* HABS in the West Florida Shelf without the need for a fluorescence channel
Bayler, STAR: Using Neural Networks for gap-filling and preliminary short-range (1-2 weeks) to medium-range (3-4 weeks) predictions of satellite-derived ocean color fields (Chl-a, Kd490, KdPAR)
DiGiacomo, STAR: Enhancing use and access to near-real-time VIIRS ocean color data: Support for harmful algal bloom operational forecast system
Elvidge, NCEI: VIIRS illegal boat detection service
Mehra,, NCEP: Initial biogeochemical modeling at NOAA/NCEP: Using VIIRS ocean color data for validation and data assimilation
Tong, ARL: Development, validation, and implementations of three marine isoprene products (isoprene) using multiple JPSS ocean products

NOAA CoastWatch/OceanWatch: L2 VIIRS OC Space and Time Search

Example of science quality with data thumbnails



https://coastwatch.star.nesdis.noaa.gov/cw_html/cw_polygon_search.html#searchbox

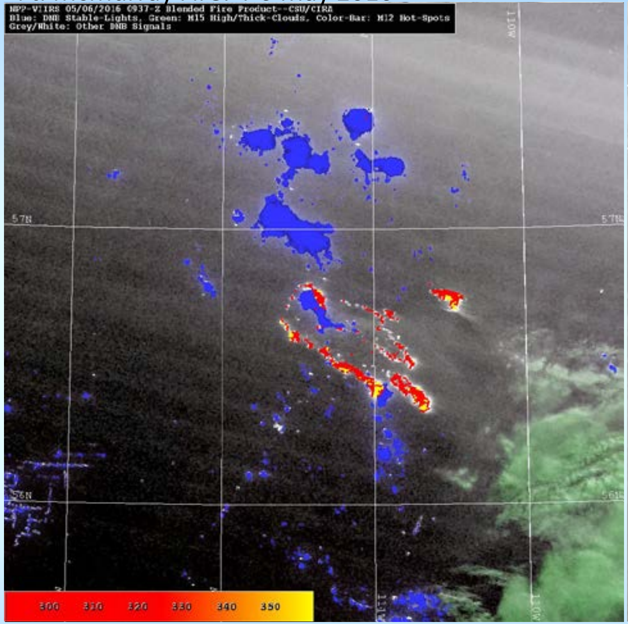
Innovation

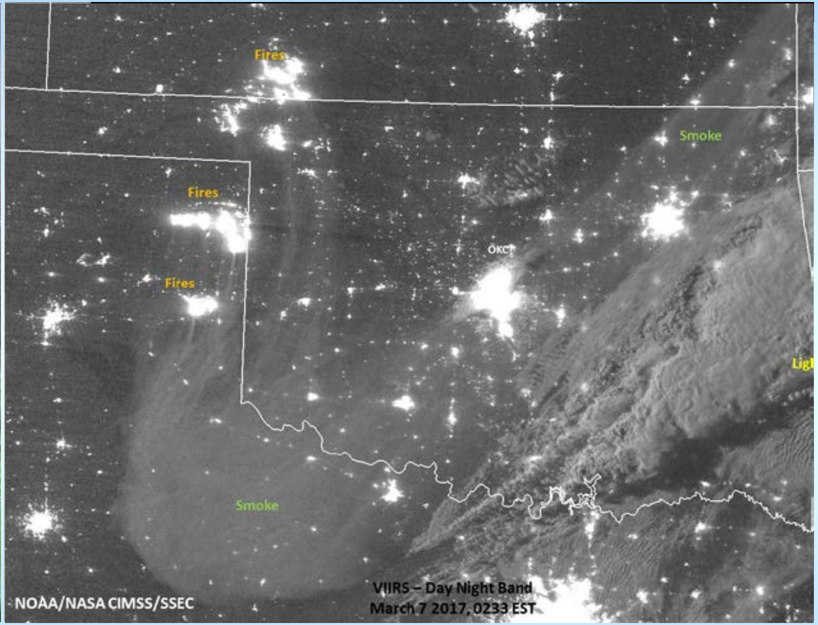
NOAA missions are very broad, comprehensive and evolving as society increases their demand on information. **Innovation is critical to keep NOAA science fresh and cutting edge.** The JPSS PGRR is designed to capture these innovations and apply them toward societal benefits. The information content from the JPSS sensors holds the potential to develop new applications that were not envisioned as part of the original scope of any particular sensor. The innovation initiative is for “out-of-the-box” ideas and concepts to keep NOAA science fresh. New algorithms and products to reduce risk in the current products from not being used effectively in downstream user applications can also be considered.

Nocturnal Fire and Smoke Detection

Steve Miller, CIRA

Ft. McMurray Fire: 4-6 May 2016



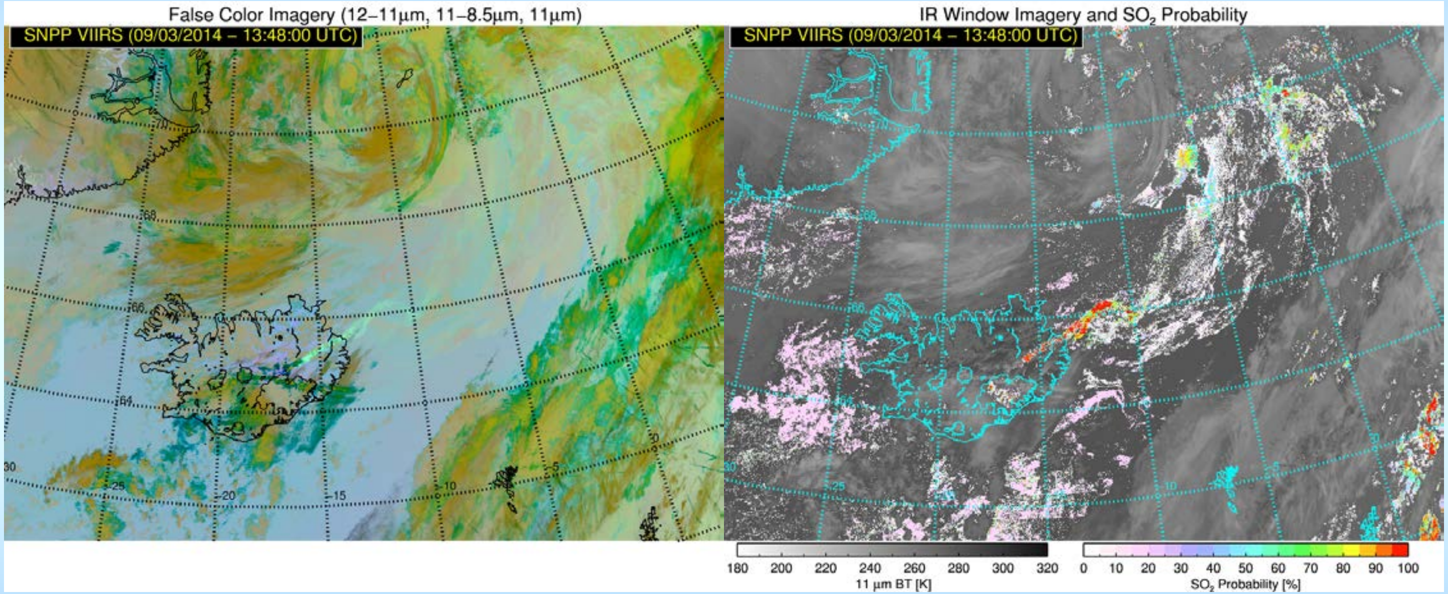


Discussions with Ivan Csiszar (NOAA) on detection of hot spots by the IDPS algorithm for cases of small sources and cirrus-covered pixels.

The ability to detect (and when coupled with J1, track) smoke plumes at night via moonlight is a capability that is entirely unique to the DNB.

Improving SO2 probability detection (Pavalonis, STAR)

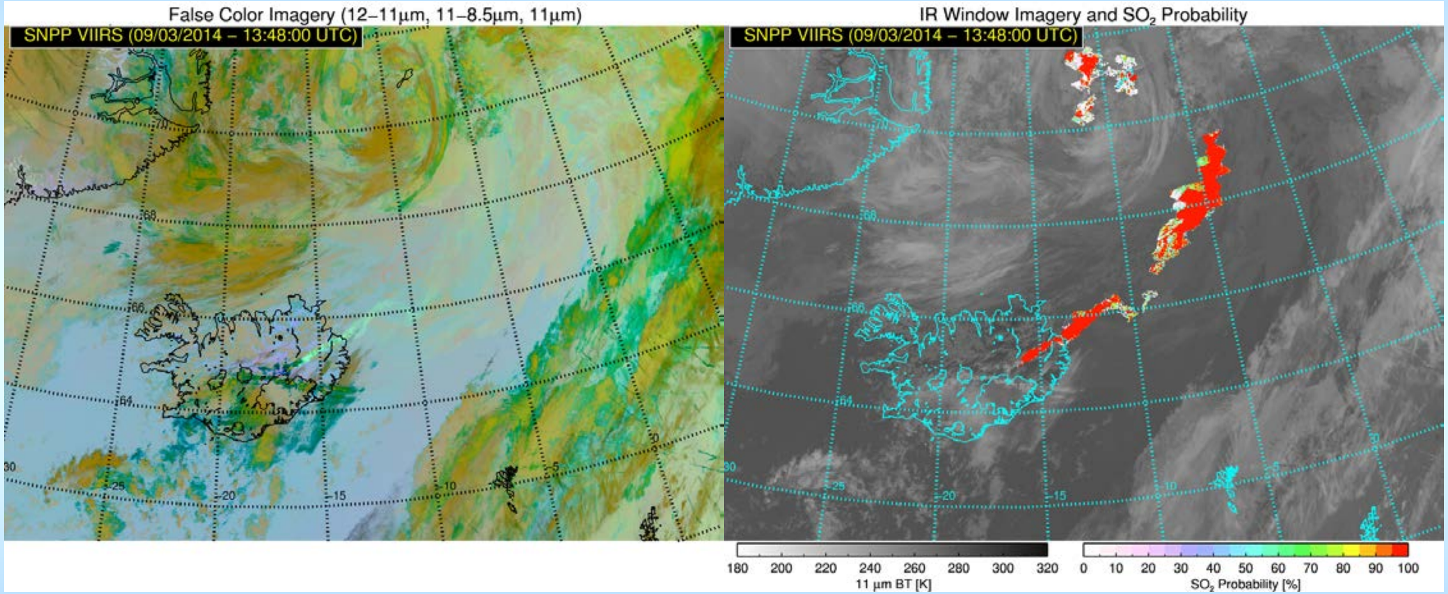
Application of Bayesian Classifier to VIIRS



The VIIRS SO_2 probability exceeds 50% over much of the SO_2 cloud that is visible in multi-spectral VIIRS imagery. However, distinguishing between SO_2 and other features with VIIRS alone is often difficult.

Now with CrIS …

Integration of CrIS and SO_2 Feature Selection



When CrIS "offline" minus "online" SO_2 BTD is used to improve the VIIRS *a priori* probability and a cloud object screening procedure is applied (e.g. Pavolonis et al., 2015b), very high quality SO_2 detection results are achieved.

New Initiatives

- Arctic (Layns/Reed)
  1. Provide a forum for JPSS data and product providers, developers, and users to determine the how JPSS Products can best be used to support Arctic missions.
  2. Leverage existing Arctic working groups to identify key data and how it can be most effectively accessed and visualized.
  3. Increase use of JPSS/NPP products for Arctic applications
  4. Explore experimental products as necessary to meet the needs of the Arctic users.

- Volcanic Ash/SO2 (Pavolonis)

  Objective 1: Full Utilization of JPSS Measurements

  Improve operational tracking and characterization of volcanic SO_2 through the development of a multi-sensor JPSS SO_2 analysis

  Objective 2: Improved Environmental Intelligence through Data Integration

  Integrate the JPSS volcanic SO_2 products with volcanic ash and SO_2 products derived from all relevant LEO and GEO satellites via the VOLcanic Cloud Analysis Toolkit (VOLCAT)

Arctic Initiative Team

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Kreller, Melissa	National Weather Service Fairbanks WFO - SOO
Layns, Arron	JPSS Algorithm Management Project Lead
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Petrescu, Eugene	Acting Alaska ESSD Chief and in charge of the Arctic Testbed
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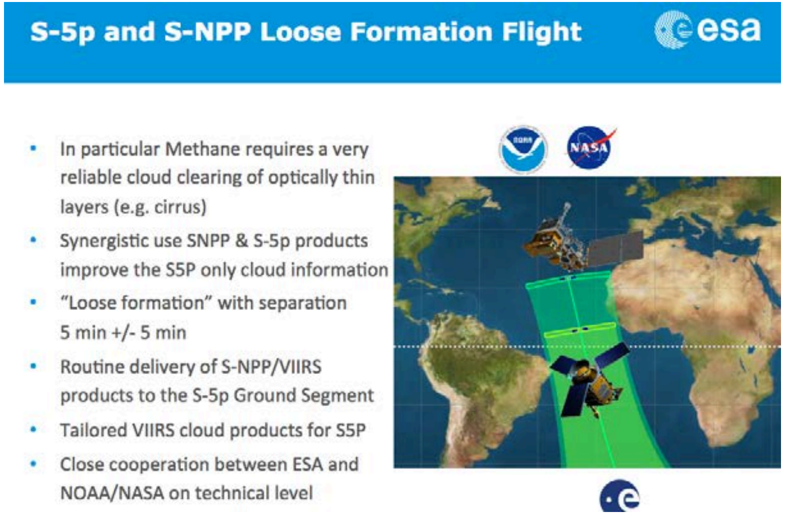
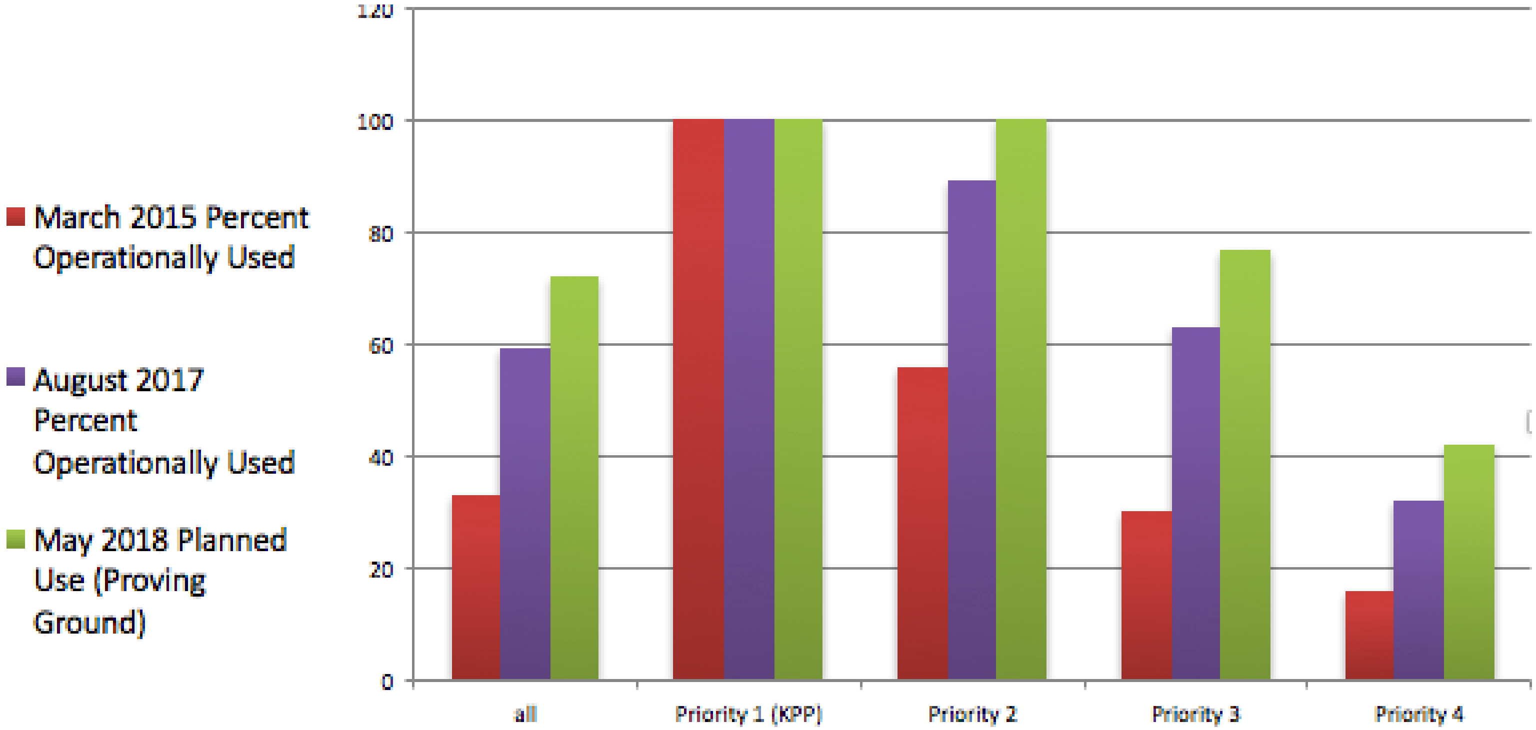
Sjoberg, Bill	JPSS Program Office
Stevens, Eric	GINA Science Liaison and Meteorologist
Tatusko, Renee	International and Arctic Policy Coordinator, NOAA/NWS Alaska Region HQ
Torres, Jorel	Research Scientist, CIRA

Atmospheric Composition (Frost, Pierce, Kondragunta)

- Expand user community for JPSS trace gas and aerosol products
- Demonstrate improvements to model forecasts of atmospheric composition using JPSS data products
- Carry out deep-dive validation of JPSS products with research observations and models
- Collaborate with ESA on Sentinel 5P (Kondragunta)



Score Card


March 2015 Percent Operationally Used
August 2017 Percent Operationally Used
May 2018 Planned Use (Proving Ground)
120
100
80
60
40
20
0
all
Priority 1 (KPP)
Priority 2
Priority 3
Priority 4

Thank You!

www.jpss.noaa.gov