



Research to Operations Activities of NASA's Short-term Prediction Research and Transition (SPoRT) Center: Current and Future Missions and Capabilities

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Earth Science Branch
NASA Marshall Space Flight Center

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SPoRT History

- **Mission:**
 - **Transition unique NASA and NOAA observations and research capabilities to the operational weather community to improve short-term weather forecasts on a regional and local scale.**
- Established in 2002 through an unsolicited proposal from then-MSFC scientists Bill Lapenta, Steve Goodman, and Gary Jedlovec
- Supported by NASA's Research and Analysis Program and the Weather Focus Area (Tsengdar Lee) and supplemented by NASA, NOAA, and other proposal areas to build upon core capabilities and partnerships.
- Significant support from NOAA received through Satellite Proving Grounds (GOES-R 2009+ / JPSS 2011+) and Risk Reduction activities, and NOAA's Modeling, Analysis, Predictions, and Projections starting 2017



Earth Science Operating Missions and **SPORT** Activities



GOES-R/16



Multispectral RGBs
Lightning / Severe Storms

Lightning Research

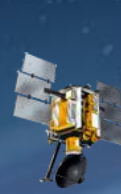


ISS: LIS, SAGE III



Terra

RGBs, SSTs
Aerosols
NUCAPS
Vegetation Health



QuikSCAT



OSTM/Jason-2
(NOAA)



CYGNSS (8)

Soil Moisture / Land Surface Modeling

RGBs, SSTs
Aerosols
NUCAPS
Vegetation Health

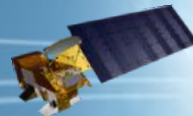


SMAP



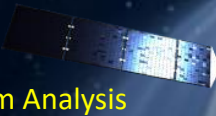
Landsat 7
(USGS)

Severe Storm Analysis

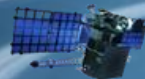


Aqua

RGBs, SSTs
Aerosols
NUCAPS
Vegetation Health



Suomi NPP
(NOAA)



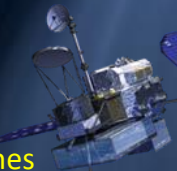
NISTAR, EPIC
(DSCOVR / NOAA)

Severe Storm Analysis

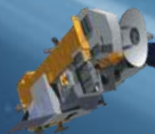
Landsat 8
(USGS)



SORCE,
TCTE (NOAA)



GPM

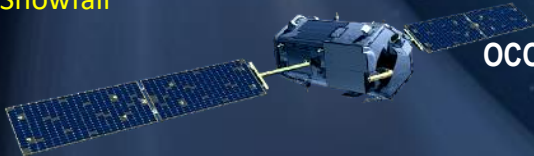
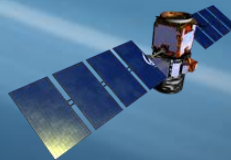


Aura

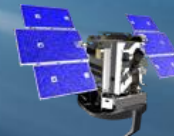
CALIPSO

Tropical Cyclones
Rainfall / Snowfall

NWP Microphysics
CloudSat

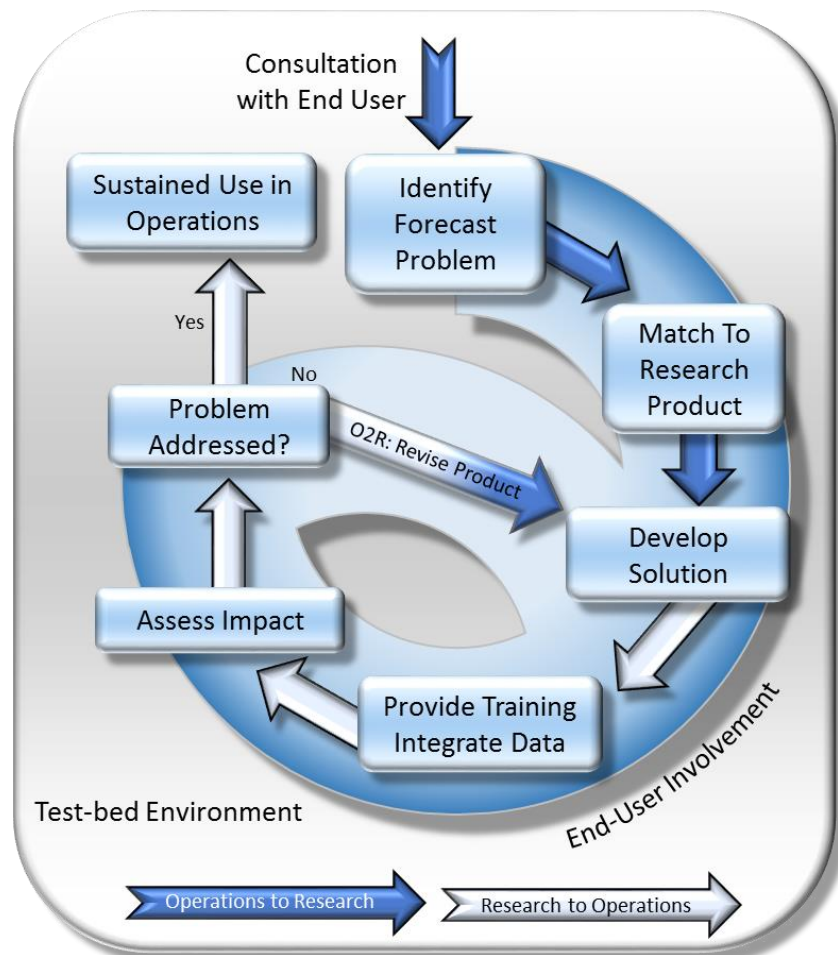


OCO-2



SPoRT R2O/O2R Paradigm

- Bridge the “Valley of Death” through interactive partnership with end users
 - Maintain interactive partnerships with help of specific advocates
 - Integrate into user decision support tools
 - Create product training
 - Perform targeted product assessments
- Concept has been used to successfully transition more than 40 satellite datasets to operational users for nearly 15 years
- Other groups in the community have adopted this paradigm

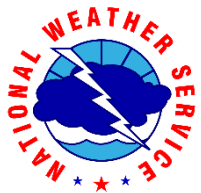


Current Partnerships

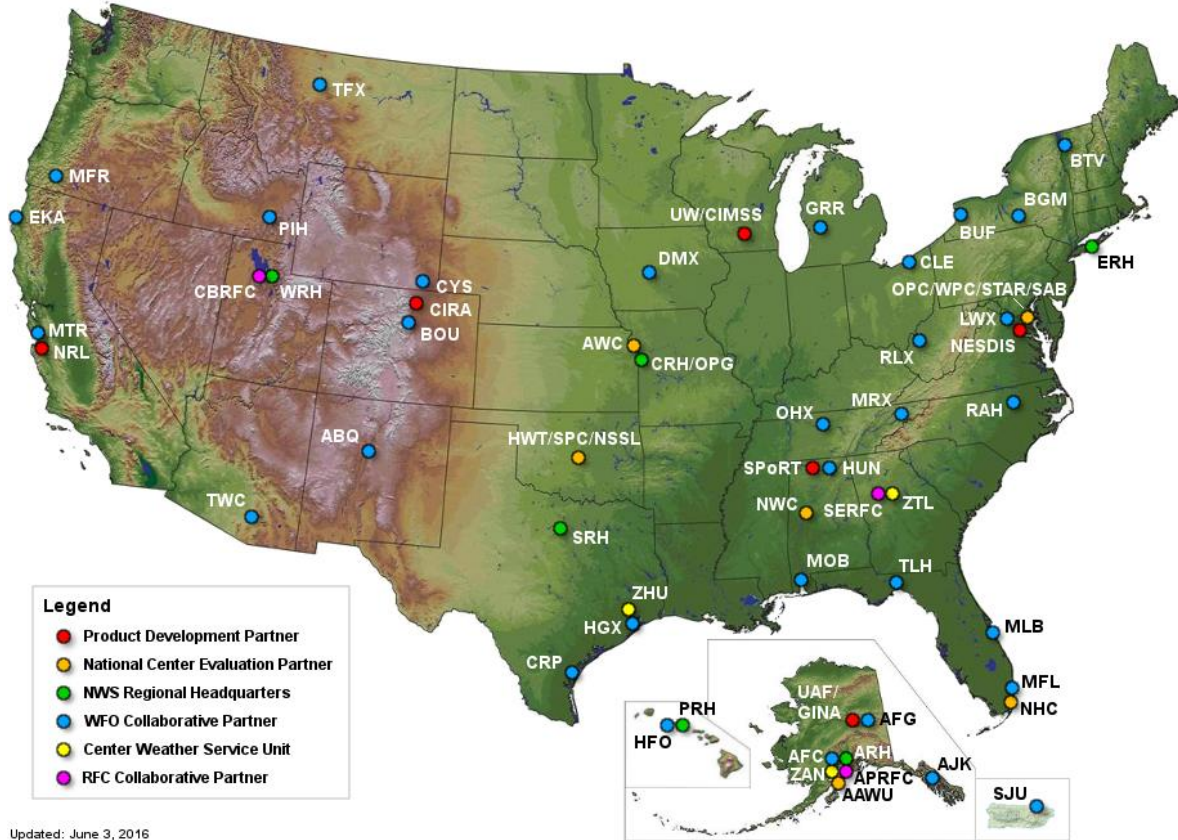


National Centers
for Environmental Prediction

- Environmental Modeling Center
- National Hurricane Center
- Weather Prediction Center
- Ocean Prediction Center
- Aviation Weather Center
- Storm Prediction Center



Over 30 NWS WFOs
and All Regional
Headquarters



Updated: June 3, 2016



NOAA Cooperative Institutes
as Data and Product Partners



Team Focus Areas

Remote Sensing

Land and Atmospheric Modeling

Lightning

Data Dissemination and Integration

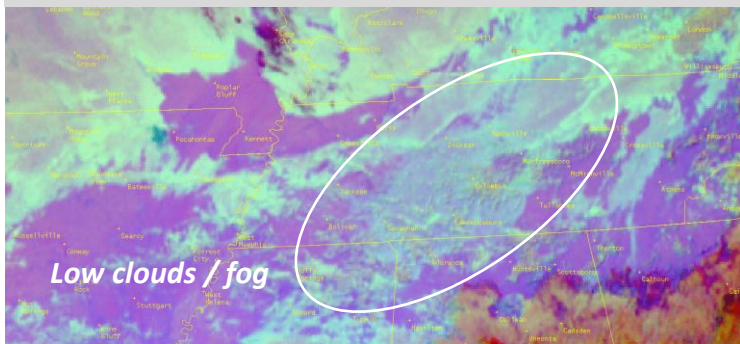
End User Outreach

- Perform targeted research activities to exploit unique capabilities of NASA satellites and technologies to solve specific weather forecasting challenges
- Support for product dissemination to AWIPS, AWIPS II, N-AWIPS, WMS, etc.
- Apply unique R2O/O2R paradigm for transitioning data and obtaining valuable feedback from NWS forecasters, engagement via blogs and social media



Remote Sensing

Nighttime Microphysics RGB from GOES-16 of a TN Valley fog event on 28 Mar 2017

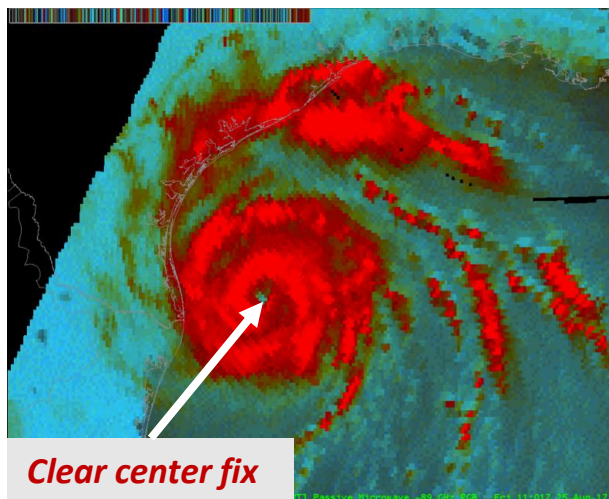


Low clouds / fog

Quickly differentiates cloud types by resulting colors / texture

NASA GPM Data:

- False color composites for improved TC diagnosis
- IMERG rainfall estimates gap-fill radar/data-void areas

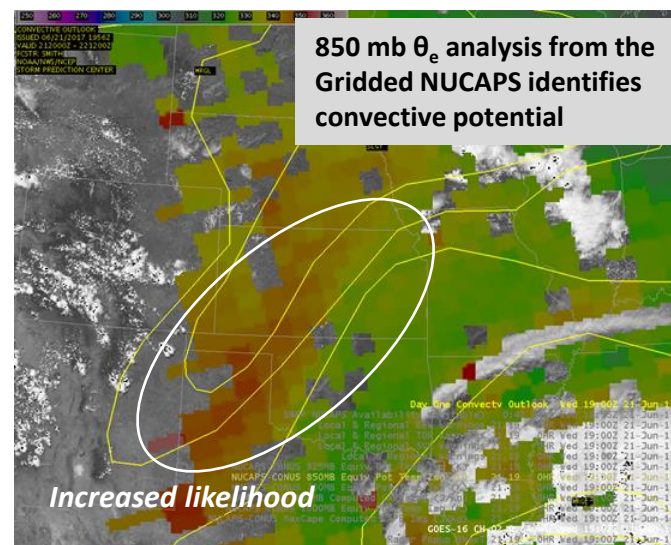


Clear center fix

GMI clearly shows center of Hurricane Harvey on 25 Aug 2017; used by NHC

False Color Composites (RGBs)

- Past assessments and demonstrated value of multispectral compositing of MODIS, VIIRS, now GOES-16 upcoming GOES-S
- Transitioned to operations through collaborations with OPG, assisting with training development and related activities.



850 mb θ_e analysis from the Gridded NUCAPS identifies convective potential

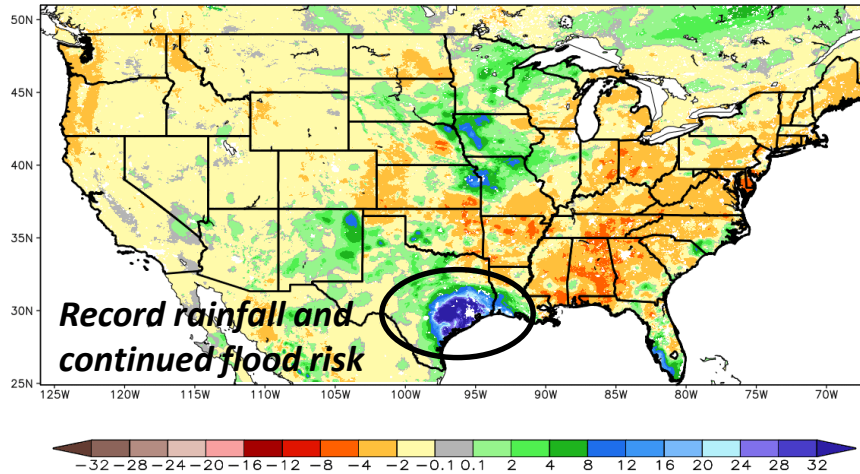
Increased likelihood

Gridded NUCAPS Applications

- Supporting new applications of NUCAPS information to support weather forecasting

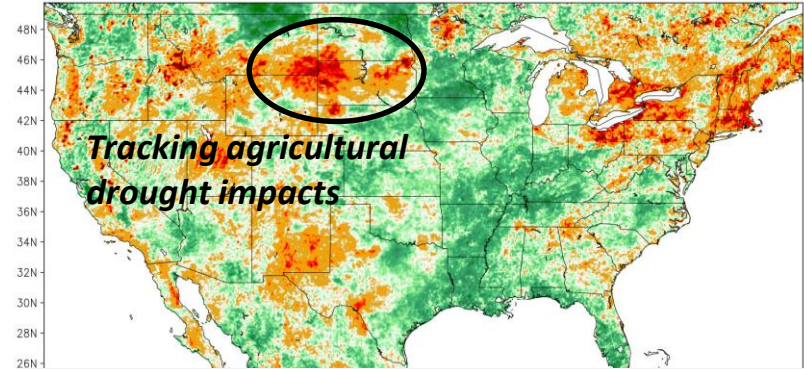


Land and Atmosphere Modeling

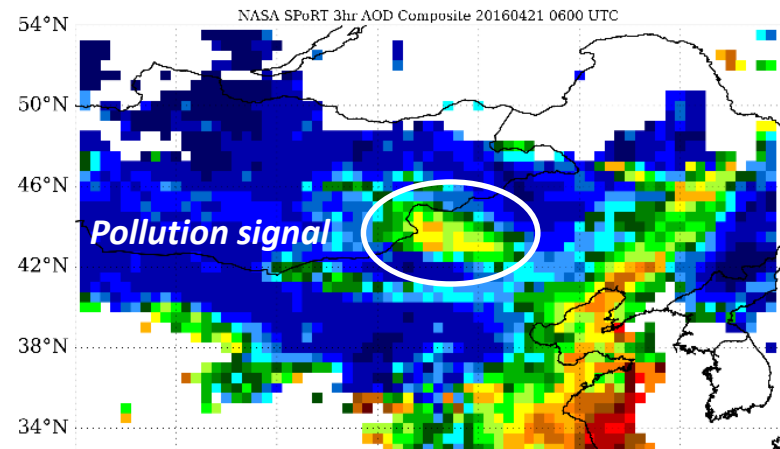


1-Week Difference in Column Relative Soil Moisture (%) on 28 Aug 2017 shows rapid changes from Hurricane Harvey

- Land surface (LIS; SMAP) to improve short-term weather and agricultural forecasts
- Use satellite-derived aerosols to improve satellite data assimilation and cloud microphysics in models

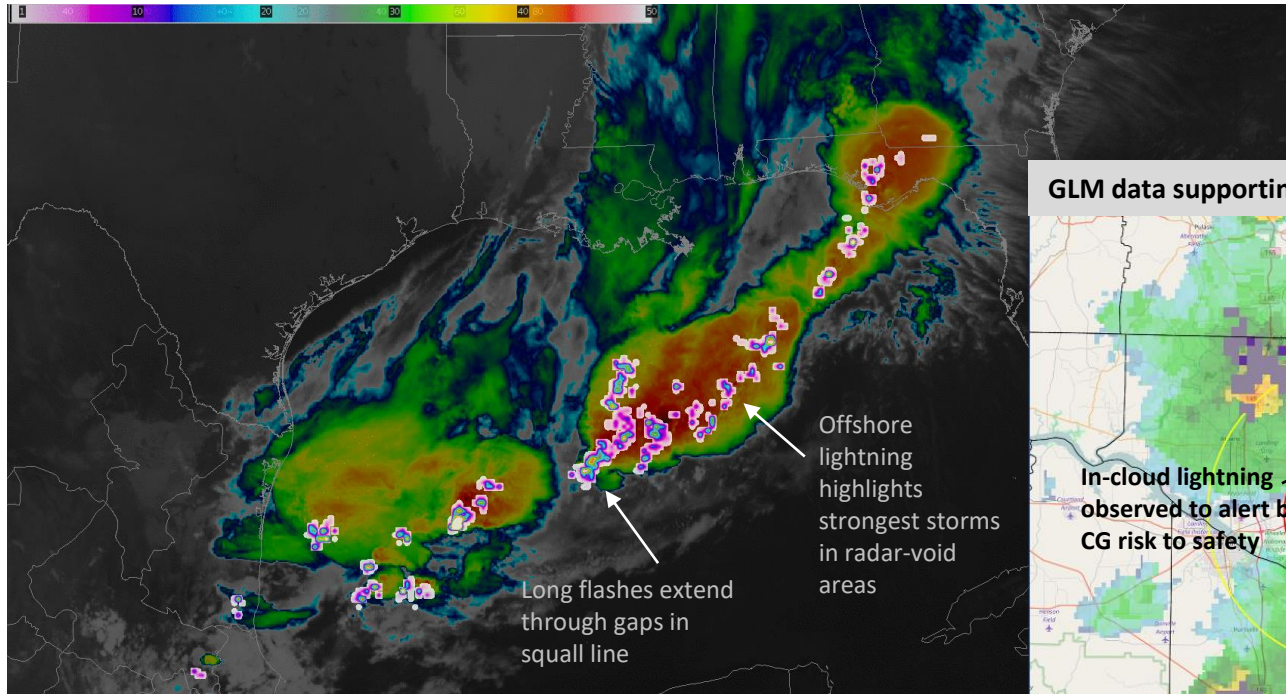


3-Mo. Evaporative Stress Index ending August 2016 captures evolving drought and informs drought monitoring



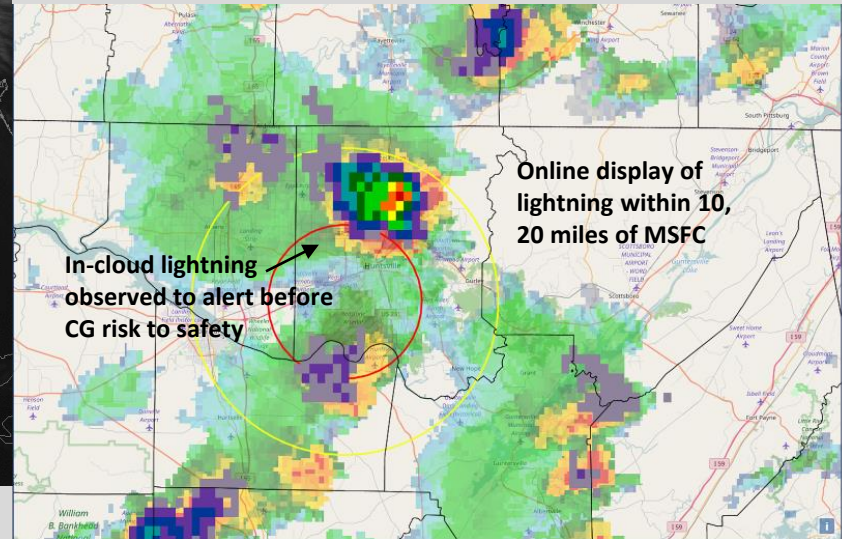
Capturing pollution transport through new AOD products and for assimilation into NWP models

Lightning



GLM detects lightning along a squall line over the Gulf of Mexico on 4 May 2017

GLM data supporting lightning safety at NASA Marshall

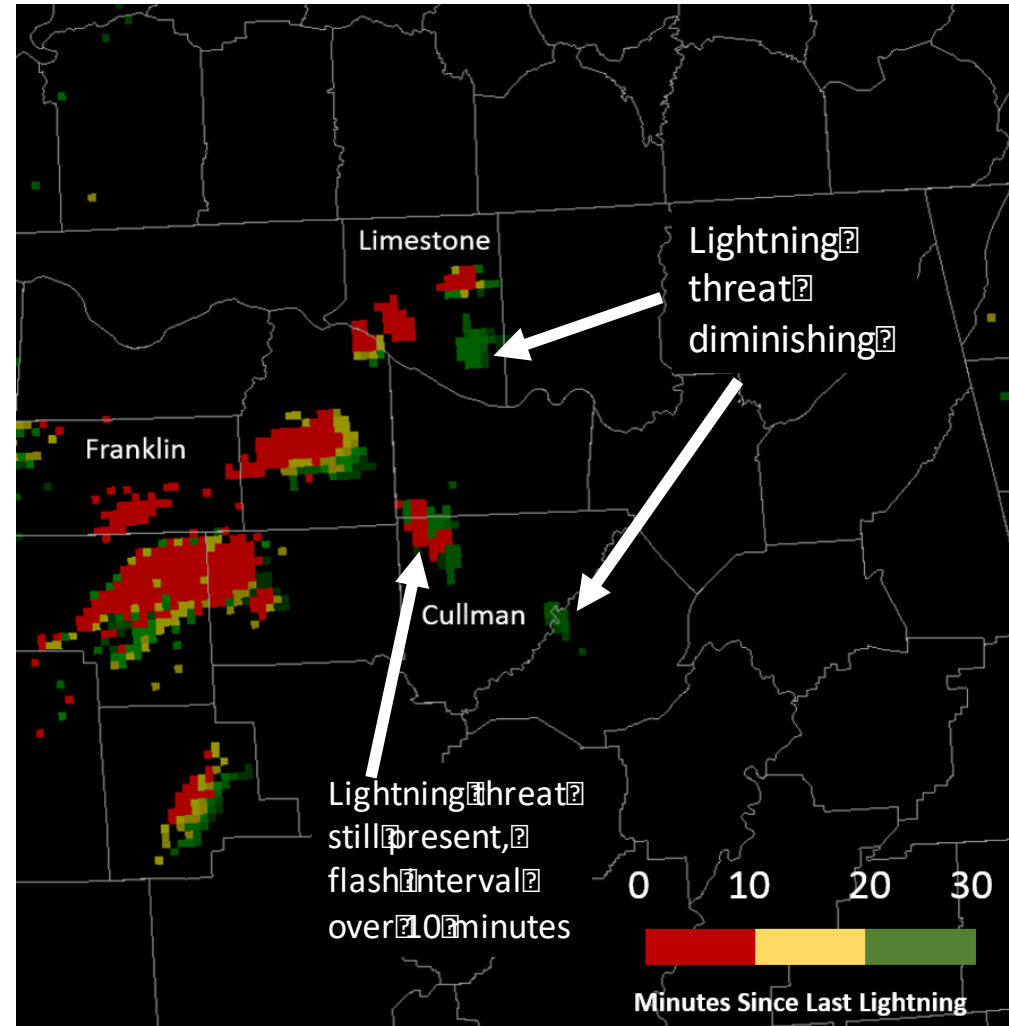
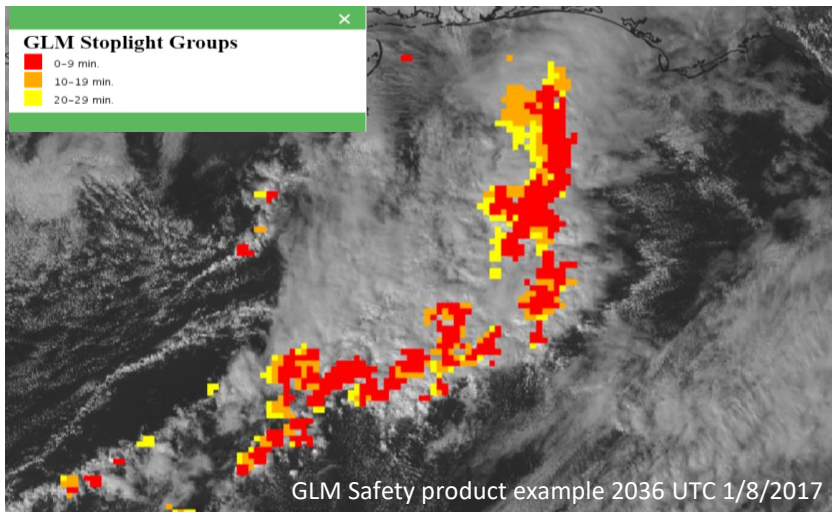


- Past experience in using ground-based Lightning Mapping Arrays (LMAs) to prepare forecasters for GLM applications, support continuing through liaison and training efforts focused on GOES-16/GLM
- Increased focus on lightning safety applications in collaborations with NASA Marshall, other NASA Centers, NOAA partners, and emergency managers



Lightning

- Extending interest in lightning safety research to explore displays to help advise on time since last observed lightning, and distance from recent threat
- Adopting GIS tools and other displays to extend reach of GLM and other SPoRT generated data sets



Training and Outreach

Training development implements educational design concepts, complimenting NOAA, in collaboration with the Satellite Training Advisory Team.

Diverse methods to meet a wide range of learning styles:

- Site visits by SPoRT / SMEs
- 1-minute videos, 3-5 minute videos, and 20+ case studies comprising the **SPoRT Applications Library**
- User-based, operational modules
- Quick Guide format adopted for use in GOES-16 and JPSS products

Developed collaboratively with operational meteorologists to leverage their expertise.



Short, Narrated Modules

micro_lesson_RGB_Fog_20130823_NASA_SPoRT (01:30 / 08:20)

Kevin Fuell Meteorologist

SPoRT

Night-time Microphysics RGB

- Utilizes MODIS & VIIRS channels/channel differences:
 - 12.0 μm - 10.8 μm (optical depth)
 - Thicker = more red

Annotations on the Night-time Microphysics RGB image:

- Low stratus (bluish green)
- Mid-level Cumulus, Cumulonimbus (tans, browns)
- Mid/Upper level stratus (purples)
- Fog in Shearsteeple and TN valleys (grayish aqua)
- Fog in elevated valleys (grayish aqua)
- Mid/Upper level stratocumulus (red tones)
- Upper level cirrus (dark blue tones)

Site Visits to WFOs

Day Convection RGB Quick Guide

Why is the Day Convection RGB Imagery Important?

The Day Convection RGB was designed for identification of convection with strong updrafts and small ice particles indicative of severe storms. This RGB helps increase forecasting capabilities of severe storms by identifying the early stage of strong convection. Knowing the microphysical characteristics of convective clouds helps determine storm strength and stage to improve forecasts and short-term forecasts. Bright yellow in the RGB indicates strong updrafts prior to the mature storm stage.

Color	Band / Band Off.	Physically Relates To...	Small contribution to pixel indicators...	Large Contribution to pixel indicators...
Red	6.2 - 7.3	Cloud height	Low clouds	High clouds
Green	3.9 - 10.5	Particle size	Large ice or water particles, weak updrafts	Small ice or water particles, strong updrafts
Blue	3.6 - 0.64	Cloud phase	Ice clouds	Water clouds

Impact on Operations

Primary Application Convection and Severe Weather: Identify intense updrafts that indicate strong convection. Strong convection is bright yellow: smaller particles are more reflective; the 3.9um value is large for small ice particles. Within strong convective updrafts, particles do not have enough time to grow. Strong convection quickly saturates in the red and green colors resulting in yellow.

Differentiate new and mature convection: mature or dissipating convection is orange or red depending on the amount of larger ice particles and warmer cloud tops.

Daytime only application: the RGB relies on solar reflectance from visible, near-IR, and shortwave IR channels. Piled color impacted by sun/satellite viewing angles; yellow can be falsely increased due to sun glint in the 3.9 channel. Piled color fades during dawn/dusk when the sun angle is low. Yellow colors may not always indicate strong convection; very cold cloud tops with only moderate 3.9um reflectivity can result in yellow, but the updrafts are average strength. Yellow can also occur in mountain view clouds or "puffed" air. Dust carried aloft can lead to long-lived, small ice particles

Contributor: Dr. Emily Berndt NASA SPoRT <https://weather.mscf.nasa.gov/spoirt/>

"Quick Guides"

Product quick references available online or in AWIPS



Assessments and Feedback

Targeted Assessments

- Quantitative questions and qualitative feedback, soliciting open commentary on products and utility

User Engagement

- Following up on Q&A via email and responding to questions
- Sharing between SPoRT and forecasters via email, blogs, and social media
- Assessments finalized with report shared with product developers/contributors

Outreach

- Wide World of SPoRT blog
 - <https://nasasport.wordpress.com>
- @NASA_SPoRT, SPoRT Facebook Page



Message NESDIS-SFR_ProductEvaluation030415.pptx (5 MB)

Brad,

I am behind on these SFR assessments, but here is one for an event on March 4. The biggest problem I have noted with the assessments is receiving a SFR product when it is snowing, and continuing to receive them to get an idea of whether or not the trend is being captured by the product. It seems like we may receive three or four products, then we'll go 8 hours without a product. That was certainly the case for an event I archived in February (but have yet to blog or compile in ppt). I think it was the case for this March event too, but I can't be sure because my notes are not clear and the SPoRT archive ends on the 6th.

At any rate, I am attaching a powerpoint. I left the images fairly large so that you can take them out of ppt and look at the details. I hope it is helpful.

Dee

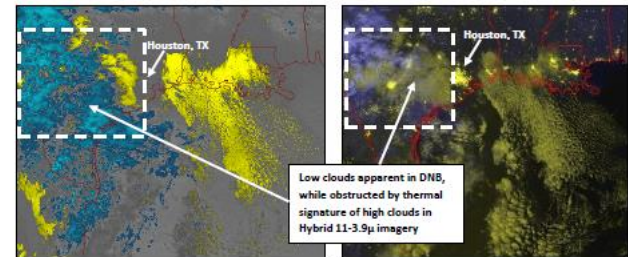


Figure 7. The SPoRT Hybrid GEO/LEO 11-3.9µ with VIIRS inserted (left) and the VIIRS Day-Night Band Radiance RGB Imagery

The image shows a screenshot of a web browser displaying the 'The Wide World of SPoRT' blog. The blog post is titled 'Spring High Tornado Swirl Mexico Square Event' and includes a map of Mexico. To the right of the blog post is a chat room interface with a list of users and a text input area. The chat room is titled 'The Wide World of SPoRT' and has a 'Feeds' tab selected. The chat room contains several messages, including one that says 'to all forecasters at each' and another that says 'n. The chat room was created to'. The chat room also has a 'Feeds' tab and a 'Comments' tab. The chat room is active and shows a list of users and their messages.

to all forecasters at each
n. The chat room was created to
in an open forum setting. In addition,
nation about specific products and
via email with users to acknowledge
or clarification. These conversations
that can then be shared with other

from 8 different WFOs stretching
were submitted during the two
In addition, a variety of blog posts and
considered here from users. Overall, the
ferred product and 2/3rd of the users
s (Figure 8).



Continued Collaborations

- Extended and evolving collaborations with NOAA's Satellite Proving Ground efforts to continue engagement with NWS meteorologists on exciting new applications of GOES-16, upcoming GOES-S, and S-NPP/NOAA-20 data
 - Investigate development of new value-added products and applications with emphasis on weather forecasting and decision support
- Engagement with the National Water Center and National Water Model, exploring data assimilation opportunities for current and future NASA mission data
 - Potential use of NASA Land Information System fields, soil moisture data assimilation, and other hydro-focused missions (e.g. SWOT)
- Spinoff projects established separately from SPoRT's core activities, but applying R2O/O2R paradigm in new ways:
 - NASA's Earth / Applied Science Disasters Team at Marshall
 - Space Weather Applications leveraging unique NASA products



Earth Science Missions and **SPORT** Opportunities

ISS Instruments

LIS, SAGE III
TSIS-1, OCO-3, ECOSTRESS, GEDI
CLARREO-PF



Lightning Research



JPSS-1 / NOAA-20

NUCAPS
Disasters
Snowfall Rate
GOES-S/17



Multispectral RGBs
Lightning
Winter Weather



OCO-2

Soil Moisture / Hydrology

Sea Ice / Arctic



GRACE-FO (2)

ICESat-2



SMAP

Suomi NPP
(NOAA)

Landsat 8
(USGS)



GPM



Air Quality



Sentinel-6A/B

Hydrology / Streamflow



SWOT

TEMPO



NI-SAR

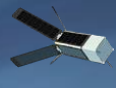


Hurricanes / Microwave

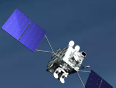


TROPICS (12)

MAIA



GeoCARB



PACE



Landsat 9

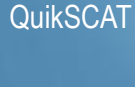


Severe Storms / Flooding

Severe Storms / Flooding

Ocean Winds / Hurricanes

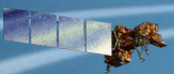
NISTAR, EPIC
(DSCOVR / NOAA)



SORCE,
TCTE (NOAA)



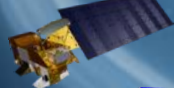
Landsat 7
(USGS)



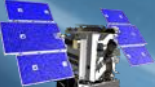
Terra



Aqua



CloudSat



CALIPSO



Aura



OSTM/Jason-2 (NOAA)



... and continued successes with current missions