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Sr. Service Hydrologist
NWSFO Juneau, AK

Andrew Orrison
Forecast Meteorologist
NWS/NCEP/WPC

Pingping Xie
Research Meteorologist
NWS/NCEP/CPC

Hydrology Panel (Precipitation & Water Vapor)

Thursday February 27, 1315 - 1445

Bob Kuligowski
Meteorologist
NESDIS/STAR

Ralph Ferraro
Supervisory Physical Scientist
NESDIS/STAR

John Forsythe
Sr. Research Associate
CIRA, Colorado St. Univ

WFO Perspective on JPSS/GOES-R Products For Use in Hydrology

JPSS/GOES-R Proving Ground/Risk Reduction Summit
College Park, MD
Feb 24th-28th, 2020

Aaron Jacobs
Senior Service Hydrologist
NOAA/National Weather Service Forecast Office
Juneau, Alaska

WFO's in Alaska: Forecasters Hydrologic Responsibilities

- Maintain a constant weather watch to keep situational awareness of any impactful hydrologic events that could affect their area of responsibility(AOR) with a 7 day time frame.
- Issue statements(outlooks,watch,advisory,warning) to provide Impacted Base Decision Support Services (IDSS) to Emergency Management of impending impactful hydrologic events. Including long/short term drought(even in a rainforest)
- Send out social media (twitter/facebook) to inform the general public

What is important to the Forecasters:

- Total and layered Precipitable Water
- How does weather elements compared to normal
- Rain Rates/Amounts (In data spare areas)
- Snow Water Equivalent on the ground
- Integrated Water Vapor Transport

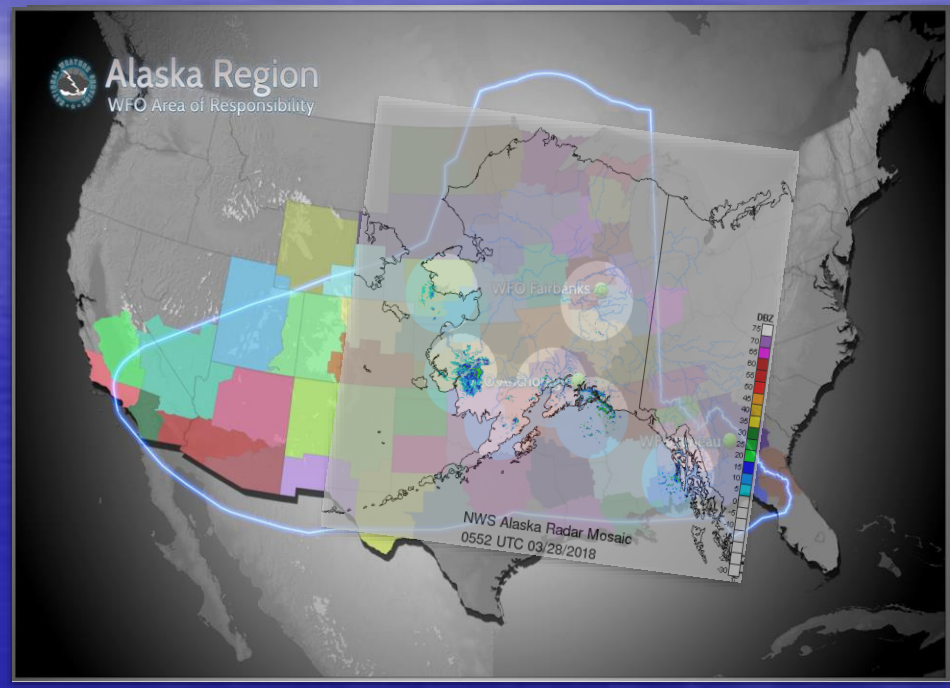
Steps Forecasters Take to Make Decisions & Complete Tasks

(Issue Hydrologic Products)

1. Identify developing atmospheric events that can produce hydrologic impacts
2. How anomalous is the impending atmospheric event
3. Assessing current hydrologic conditions
4. Forecaster's gain enough confidence from current atmospheric conditions(Sat information) and projected NWP output(QPF,Temp) to issue hydrologic flood products

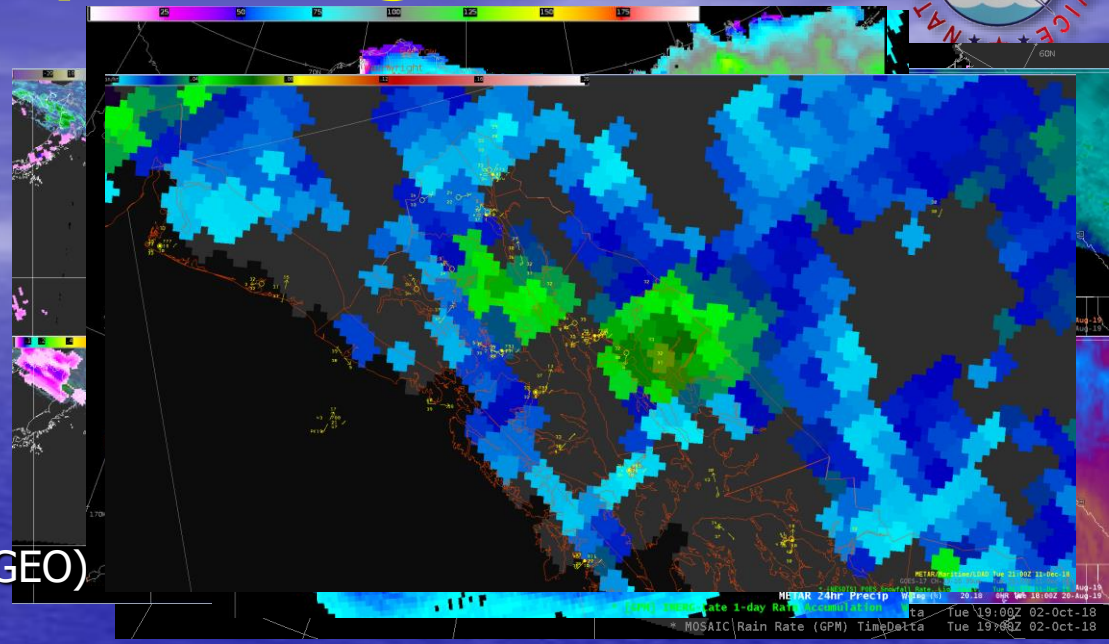
Issues that make tasks time-consuming, unpredictable, or inefficient

- Alaska WFOs-Very large area of responsibility most over water
- Very complex terrain with little ground truth(lots of data gaps), not much radar coverage
- Getting new microwave (MV) derived products in front of the forecasters(security issues within NOAA)
- Latency of MV derived products from time of satellite pass
- Lack of accurate hi-res current analysis (QPE,SWE, for drought, flood potential)



Satellite Data Currently Being Used

- MIMIC TPW
- Blended Total Precipitable Water(TPW) & % of normal TPW (NESDIS)
- TPW (MIRS)
- Advected Layer Precipitable Water (ALPW)
- Rain Rate products(MIRS & GPM), Blended RainRate(NESDIS)
- GPM IMERG QPE (NASA SPoRT)
- MIRS SWE and Snowfall Rate Product(SRF)
- GOES-17 Rain Rate product (not much)
- Combined GEO with LEO products overlay (to limit parallax issues from GEO)
- All GOES-17 RGB products and WV bands



Needs From Satellite Data For Use in Hydrology

- Continue to decrease latency of products(utilize DB), Streamline getting new products to forecasters in AWIPS!
- Get CMORPHv2 to WFOs
- Need a LIS for AK (in development) for drought and flood potential
- Updated data for % of normal PW, provide POR to forecasters
- Provide a composite of GOES-17 and Himawari into AWIPS
- Provide near term verification of MV derived products
  - Gain forecaster confidence in these products
- Standardized color scale and units for RR & TPW products

Forecaster Challenges:

AWIPS memory issues with all the Sat imagery, data overload, training

Challenge for developers:

Develop a satellite IVT product to determine strength of atmospheric river events

JPSS/GOES-R Series Data Integration into WPC Operations

Speaker: Andrew Orrison[1]

(email: andrew.orrison@noaa.gov)

Contributors: James Nelson[1], Ralph Ferraro[2], Scott Rudlosky[2], John Forsythe[3], Kevin Fuell[4]

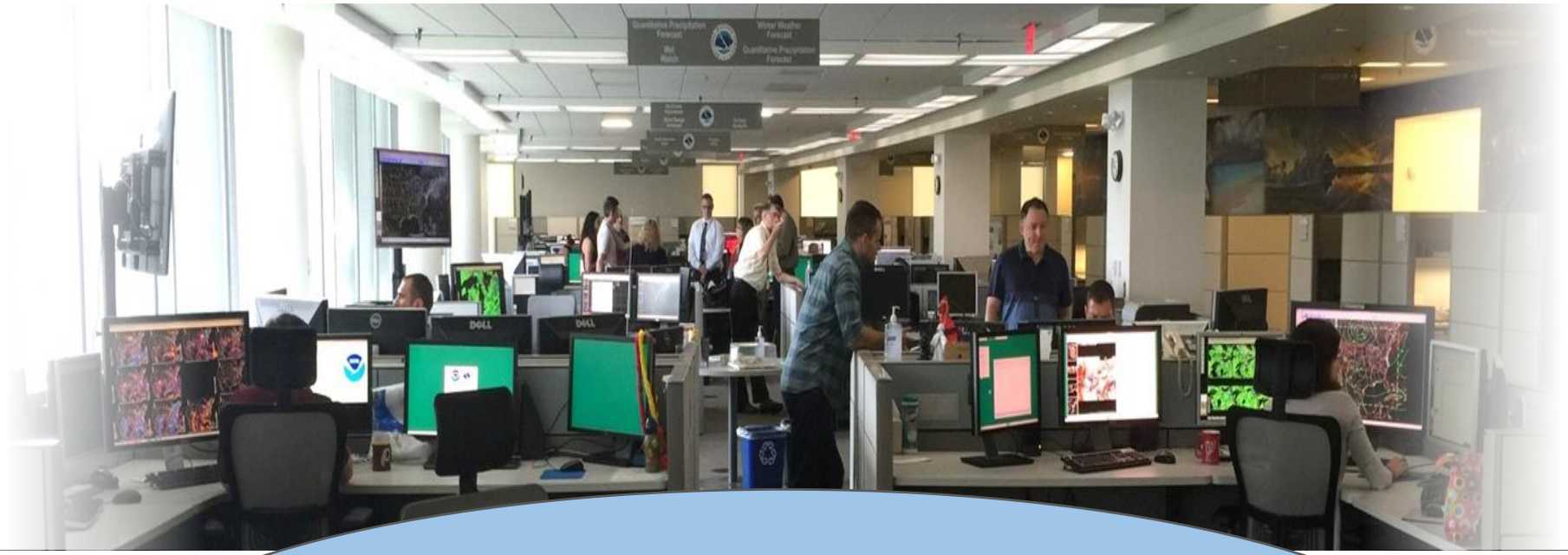
[1]NOAA/NWS/NCEP/WPC – College Park, MD
[2]NOAA/NESDIS/STAR – College Park, MD
[3]CIRA/Colorado State University – Fort Collins, CO
[4]NASA/SPoRT/University of Alabama – Huntsville, AL

JPSS/GOES-R Proving Ground/Risk Reduction Summit, College Park, MD

February 24th – 28th, 2020

NOAA Turns 50 and NWS Turns 150!

Where does the Weather Prediction Center fit?

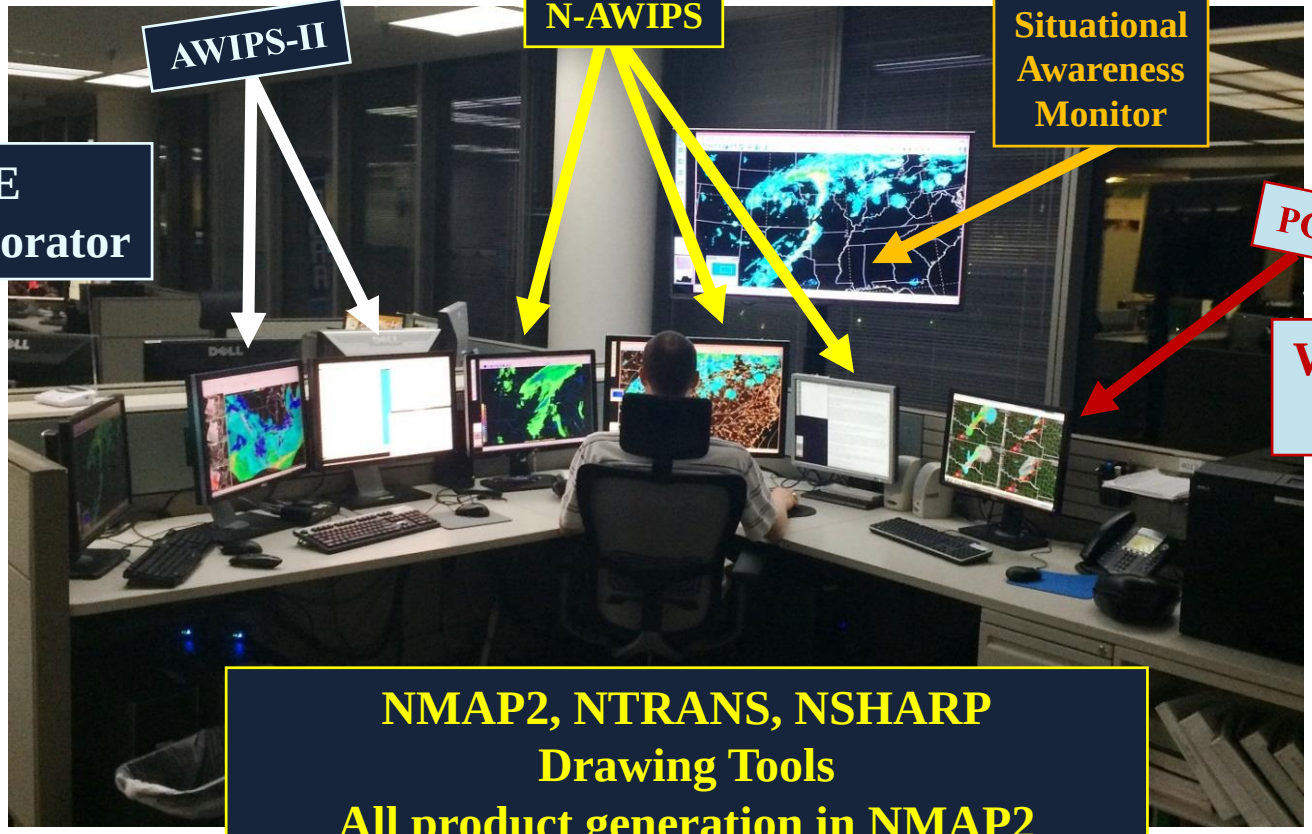


WPC: National Weather Situational Awareness

- Heavy Rainfall
- Winter Weather
- Upcoming Hazards

What is the WPC MetWatch Desk?

The Weather Prediction Center's meteorological watch desk is a 24/7 continuous watch of the weather, focused on providing situational awareness of short-term heavy rainfall events capable of producing flash flooding across the CONUS. MetWatch is also responsible for assessing heavy rain from significant atmospheric river events impacting the U.S. West Coast.



Flash Flood VS Atmospheric River Mesoscale Precipitation Discussions (MPDs)

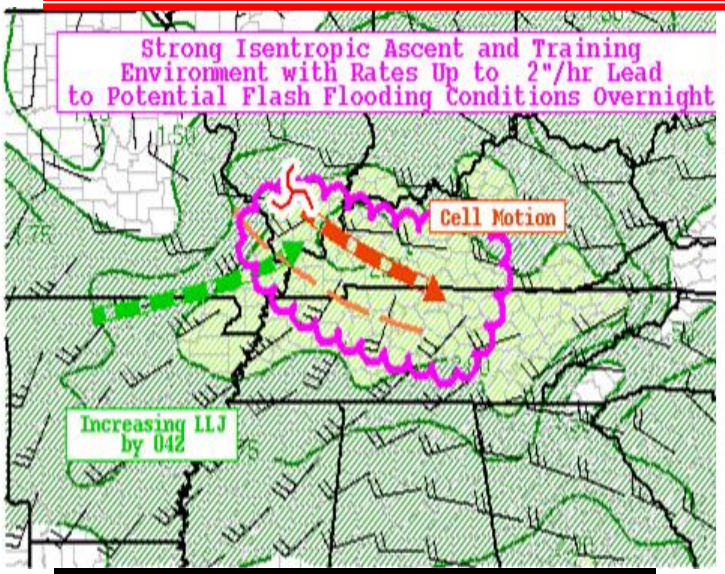
For a Flash Flooding MPD

- *Up to a 6 hour duration for ongoing or anticipated areas of organized heavy rainfall that are expected to generate a threat of flash flooding*
- *Domain = Anywhere within lower 48*
- *Size = Covers an area on the mesoscale that varies in size, but averages approximately half the size of Kansas*

For a West Coast Atmospheric River MPD (satellite image required)

- *Up to 12 hour duration in advance of rainfall rates of 0.50 in/hr or greater which are expected to persist for several hours leading to a heavy rainfall threat and potential flooding impacts.*
- *Domain = California, Oregon & Washington*
- *Heavy rain which MAY or MAY NOT generate a flash flood threat*

Mesoscale Precipitation Discussion



MESOSCALE PRECIPITATION DISCUSSION 0253
NWS WEATHER PREDICTION CENTER COLLEGE PARK MD
1233 AM EDT SUN SEP 15 2013

AREAS AFFECTED...FAR SE AZ...FAR SW CO...SW AND CNTRL NM

CONCERNING...HEAVY RAINFALL...FLASH FLOODING POSSIBLE

VALID 150432Z - 150832Z

SUMMARY...UPPER SUPPORT REMAINS EFFICIENT ENOUGH TO SUSTAIN CLUSTERS OF THUNDERSTORMS OVERNIGHT. SLOW MOVEMENT MAY RESULT IN 1-2 INCH RAINFALL IN SPOTS AND LOCAL FLASH FLOODING.

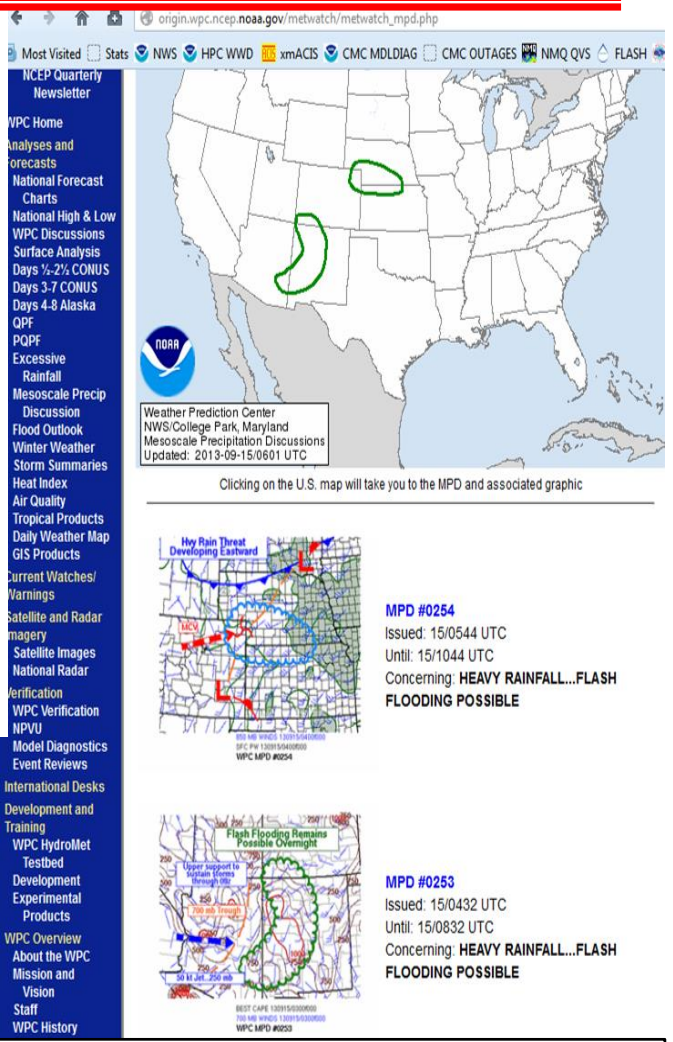
DISCUSSION...THUNDERSTORMS HAD SURVIVED ALREADY A FEW HOURS INTO THE NIGHT. RAOBS INDICATED THE SURFACE WOULD DECOUPLE RATHER EASILY...BUT GIVEN THE PERSISTENCE OF CONVECTION IN SW NM AND SW CO...AND NEW DEVELOPMENT NEAR ABQ AND ALSO OFF THE HIGHER ELEVATIONS OF SE AZ AT 04Z...IT APPEARS THAT MID LEVEL MOISTURE...MODERATELY STEEP LAPSE RATES...AND SUBTLE UPPER FORCING COULD SUSTAIN THUNDERSTORMS ANOTHER FEW HOURS.

WEAK WARM ADVECTION WAS OBSERVED IN THE 700-600 MB LAYER...COINCIDENT WITH SOME OF THE MORE UNSTABLE PARCELS IN THE OBSERVED AND FORECAST SOUNDINGS...RAP AND NAM. THE SREF MEAN PREDICTS MAINTENANCE OF MUCAPE AT LEAST 500-750 J/KG THROUGH 09Z ACROSS THIS REGION...AS THE LOWER/MID LEVEL WARM ADVECTION AND WEAKLY DIFFLUENT UPPER LEVEL FLOW IS SUSTAINED AHEAD OF A 45-50 KT JET STREAK AT 250 MB.

SUSPECT DUAL POL ESTIMATES ARE UNDERESTIMATING IN THE CONVECTIVE LINE APPROACHING SOCCORRO NM...GIVEN THE DISTANCE FROM RADAR...AND PLACEMENT OF ALL THE BASE ELEVATION ECHOES AT RANGE BEYOND THE MELTING LAYER. LEGACY ESTIMATES SUGGEST RATES CLOSER TO 1.5-2 INCH PER HOUR IN ISOLATED SPOTS. WOULD NOT EXPECT ANYTHING MUCH HEAVIER THAN THIS WITH PW VALUES HAVING FALLEN BELOW 1 INCH OVER THIS REGION...BUT WITH FLASH FLOOD GUIDANCE VALUES VERY LOW...ESPECIALLY IN NM...FLASH FLOODING IS CERTAINLY A POSSIBILITY. ACTIVITY MAY PERSIST EVEN BEYOND 09Z...ESPECIALLY TOWARD SOUTHWEST CO WHERE UPPER LIFT BECOMES CONCENTRATED. INTENSITY IS LIKELY TO DECREASE DIURNALLY...BUT SOME AREAS COULD SEE MULTIPLE ROUNDS OF MODERATE RAIN ADDING UP OVER TIME.

BURKE

ATTN...WFO...PUB...ABQ...EPZ...GJT...TWC...FGZ...PSR...

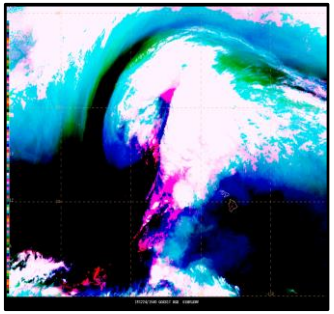


- Mesoanalysis…
- Full suite of hi-res guidance…
- Dual Pol QPE discussion…
- Satellite perspective…
- Event totals…
- Timing & evolution…
- Worst case scenarios expressed

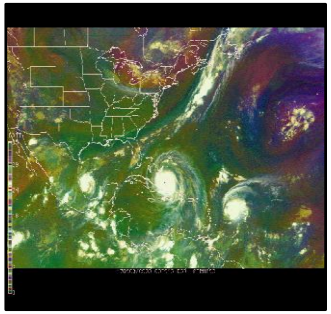
*** Impact-based Decision Support Services (IDSS) are front and center in today's operational routines within the National Weather Service. As a result, meteorologists have a constant need for real-time data that facilitates forecaster confidence, forecast accuracy, and timely communication of high-impact weather.**

GOES-R Series RGB Integration

Simple WV

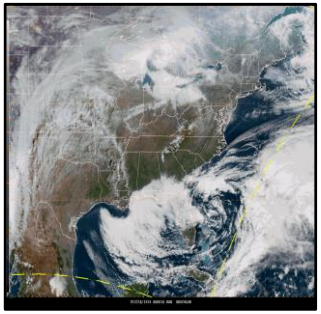


Airmass

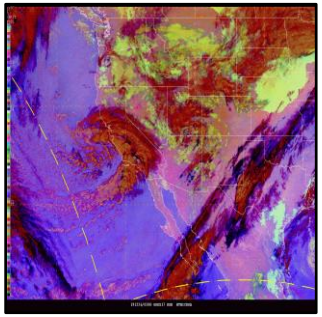


Differential WV

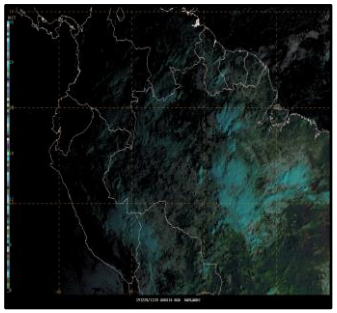
GeoColor



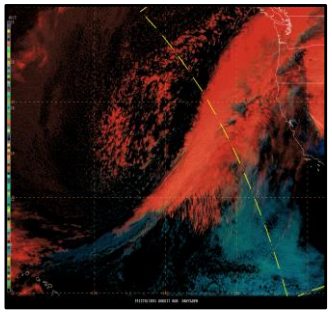
Nighttime Microphysics



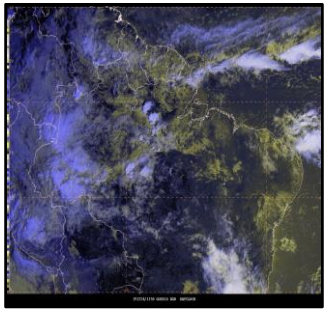
Day Land Cloud



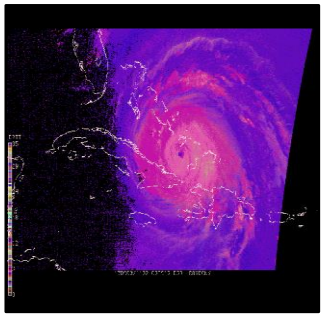
Day Cloud Phase



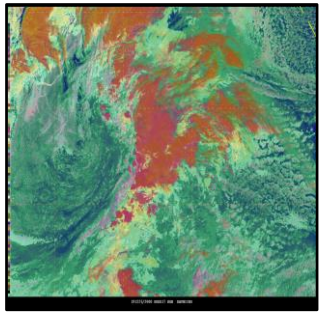
Day Cloud Convection



Day Convection



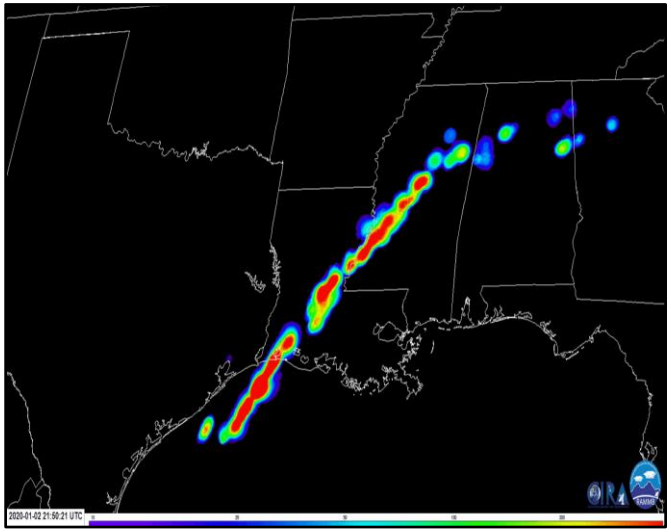
Daytime Microphysics



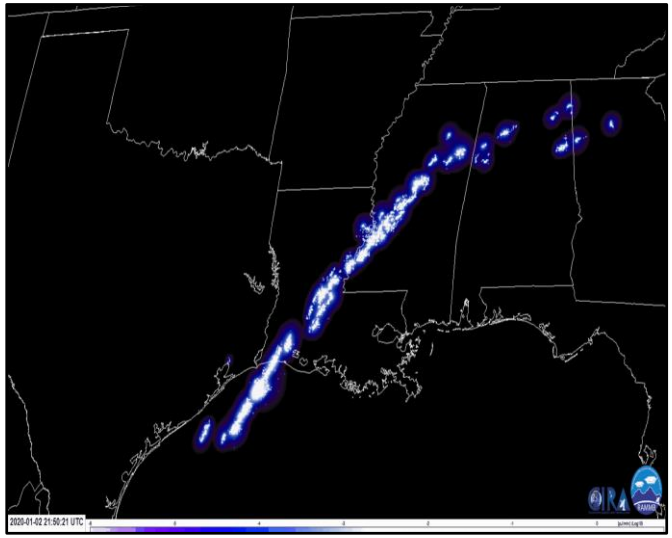
- **WPC provides a NOWcast excessive rainfall service (i.e. the MetWatch desk MPD) that can synthesize as many as 10 GOES-R series RGBs into the decision-making process. These RGBs are used in tandem with individual GOES-R series ABI bands (notably bands 1, 2, 8, 9, 10, 13 (Visible, WV Suite, Clean IR)), radar data, and surface observations to assess heavy rainfall threats.**
- **One of the keys to facilitating GOES-R series RGB integration is training, training, training! WPC uses Google Sites, CIRA/SPoRT sponsored quick-guides and real-time event-driven visualization to gather experience and confidence that only grows with time.**

GOES-R Series GLM and Level 2 Product Integration

Group Flash Count DensityDensity

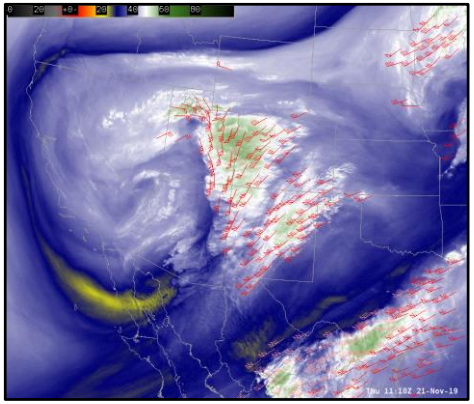


Group Energy Density

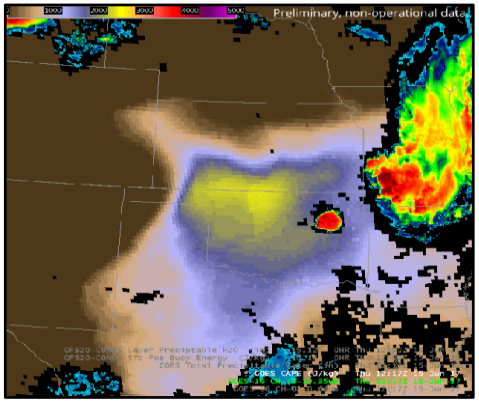


GLM and Level 2 products only make up one component of the decision-making process. It's all about developing levels of confidence for the MetWatch MPD product. These are used along with the full suite of observational data.

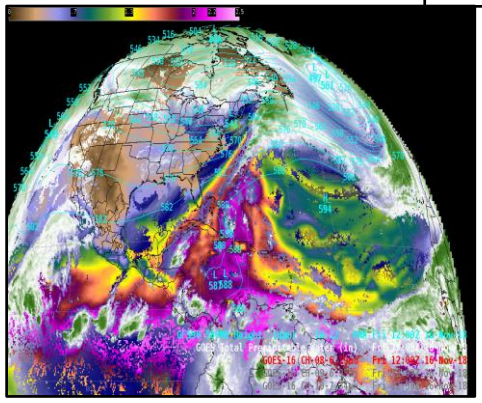
DMWs (AMVs)



CAPE



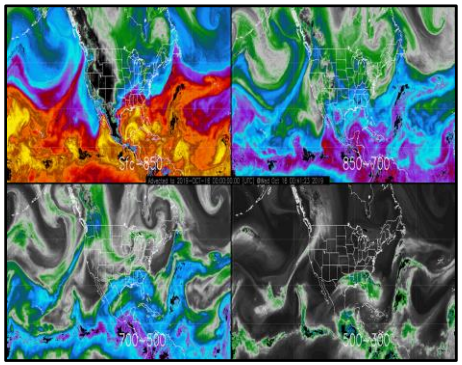
TPW



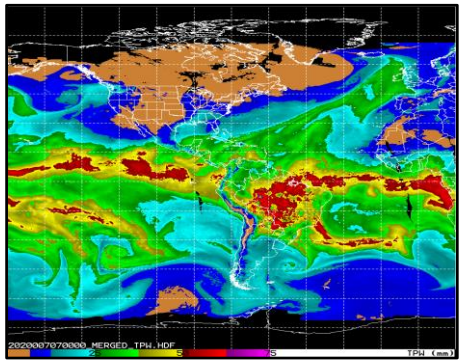
Pros: Real-time data that facilitates quick analysis, comparisons to NWP.

JPSS/LEO (POES) Dataset Integration

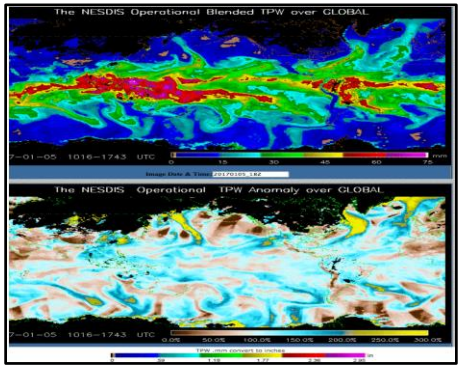
CIRA ALPW



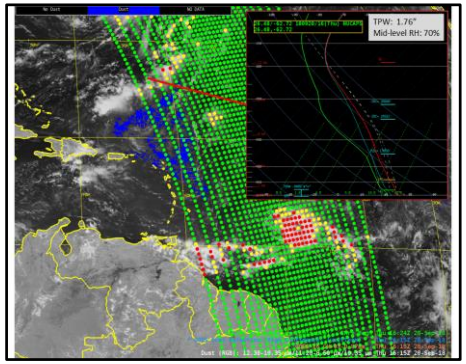
CIRA Merged TPW



Blended TPW



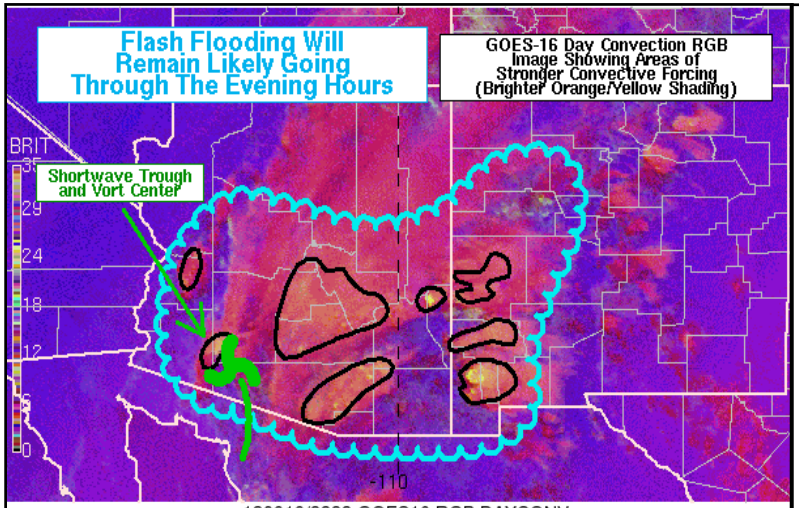
NUCAPS



- The increasing suite of LEO (POES) data sets with MW sensory (NOAA- AMSU, DMSP- SSMI/S, JPSS, METOP, GPM, etc..) are offering forecasters additional resources to assess moisture and rainfall far from the CONUS.
- This facilitates greater confidence, product accuracy and messaging on potential high-impact heavy rainfall/flash flood events. Examples include West Coast Atmospheric River events and Tropical Cyclones for which WPC issues products on both. (i.e. EROs, MPDs and public rainfall statements for NHC).

*NESDIS - Blended TPW, Rain Rate Layered Precipitable
*CIRA - GFS/HRRR-based ALPW and LPW difference fields
*CIRA – Merged TPW (integrates GOES-16 TPW retrievals)
*NUCAPS (only have S-NPP available for now in AWIPS)
*NESDIS - Ensemble Tropical Rainfall Potential (eTRaP)

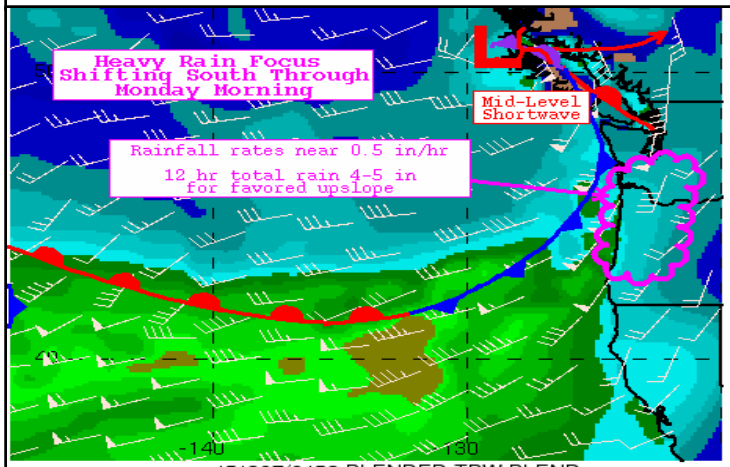
GOES and POES Integration at the WPC MetWatch Desk



180919/2222 GOES16 RGB DAYCONV
WPC MPD #0866

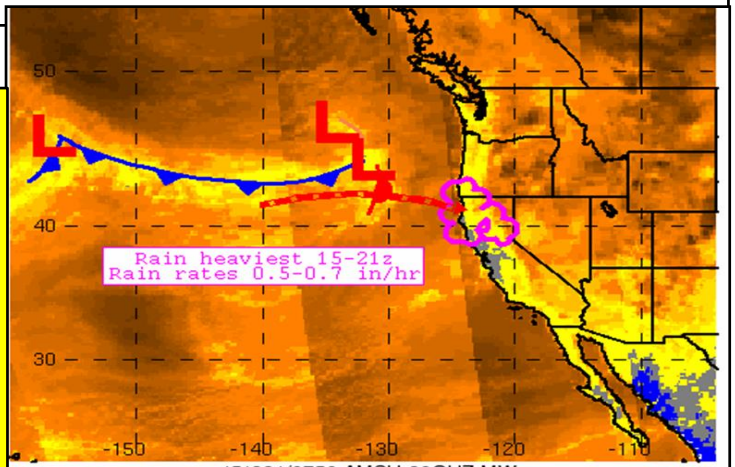
Mesoscale Precipitation Discussion 0866
NWS Weather Prediction Center College Park MD
631 PM EDT Wed Sep 19 2018
Areas affected...Central/Southern AZ...Western NM
Concerning...Heavy rainfall...**Flash flooding likely**
Valid 192230Z - 200430Z

Discussion...The thermodynamic environment will remain conducive for heavy showers and thunderstorms well into the evening hours across many of these areas as MLCAPE values of 1000 to 2000 j/kg remains in place, especially over southern AZ, along with anomalously high PWATS. **In fact, AMSU and GPS-derived data sets show PWATS still near or even above 2.25 inches across northwest Mexico and near the border of southern AZ and southwest NM….this degree of anomalous moisture and concentration through the vertical column as seen in the latest CIRA-LPW data sets will set the stage for highly efficient rainfall processes that coupled with areas of strong forcing/instability will likely produce rainfall rates of as much as 2 to 3 inches/hr. Regarding the level of forcing in place, there is evidence in the latest GOES-16 Airmass and Day Convection RGBs of a shortwave trough entering south-central AZ which is helping to greatly channel moisture northward from northwest Mexico.**



151207/0152 BLENDED-TPW BLEND
RAP32 850 MB WINDS 151207/0200f000
WPC MPD #0666

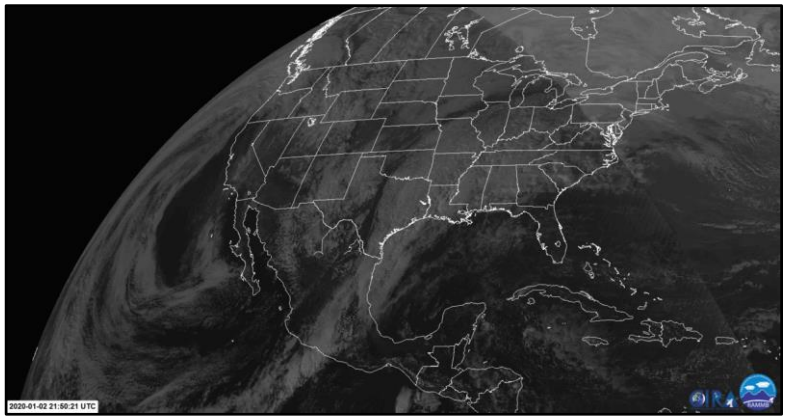
MW-driven data sets are great for assessing West Coast Atmospheric River threats!! They are highly useful for moisture, rain rate and frontal analysis!

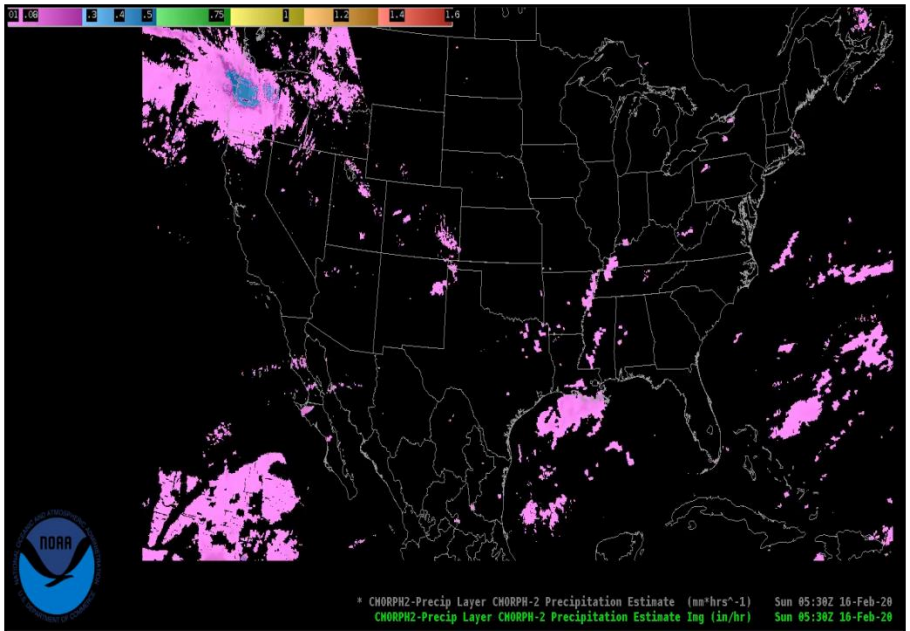


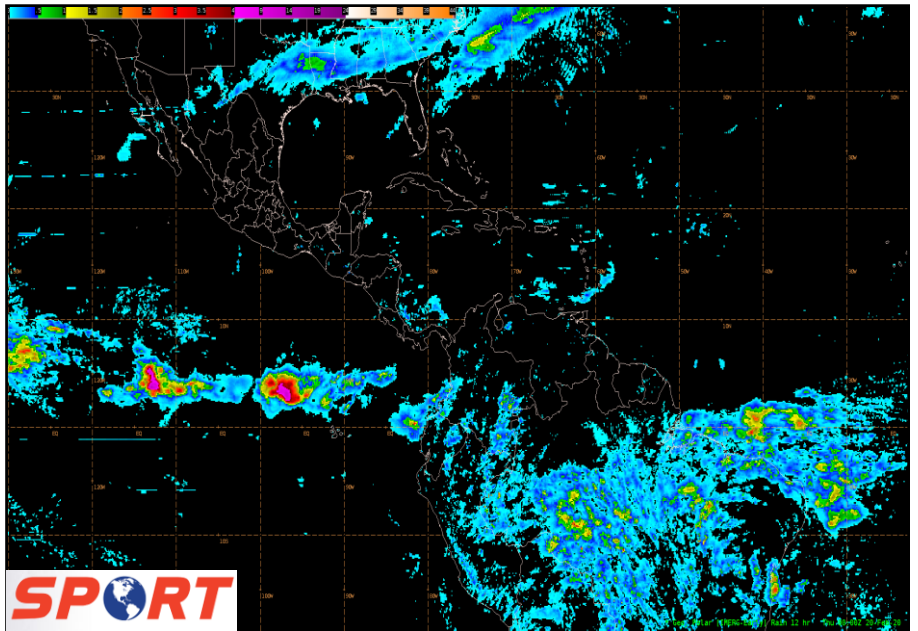
151221/0750 AMSU-89GHZ MW
WPC MPD #0684

Future WPC Satellite Interests/Requests

- **Needs for WPC highly focused on QPE with emphasis on data sparse geographical domains (aiding WPC decision-making on Atmospheric Rivers, Tropical Cyclone Rainfall, Convection over Central/South America (on behalf of the WPC International Desk))**
- **Yearly Flash Flood and Intense Rainfall Experiments (FFaIR) >>>>>R2O Opportunities**
- **GOES Proxy-Visible Imagery – CIRA**
- **CONUS Layered PW/WV Climatology – CIRA**
- **CMORPHv2 – NESDIS/STAR**
- **GOES-R series Rain Rate – NESDIS/STAR**
- **NUCAPS Gridded Data – NASA SPoRT**
- **IMERG – NASA SPoRT (WPC International Desk only)**
- **GEO/LEO Data Fusion focused on thermodynamics**







Thank You!

Comments or Questions?

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"Where America's Climate, Weather, Ocean, and Space Weather Services Begin"

Climate Applications of JPSS Hydrometeorological Products

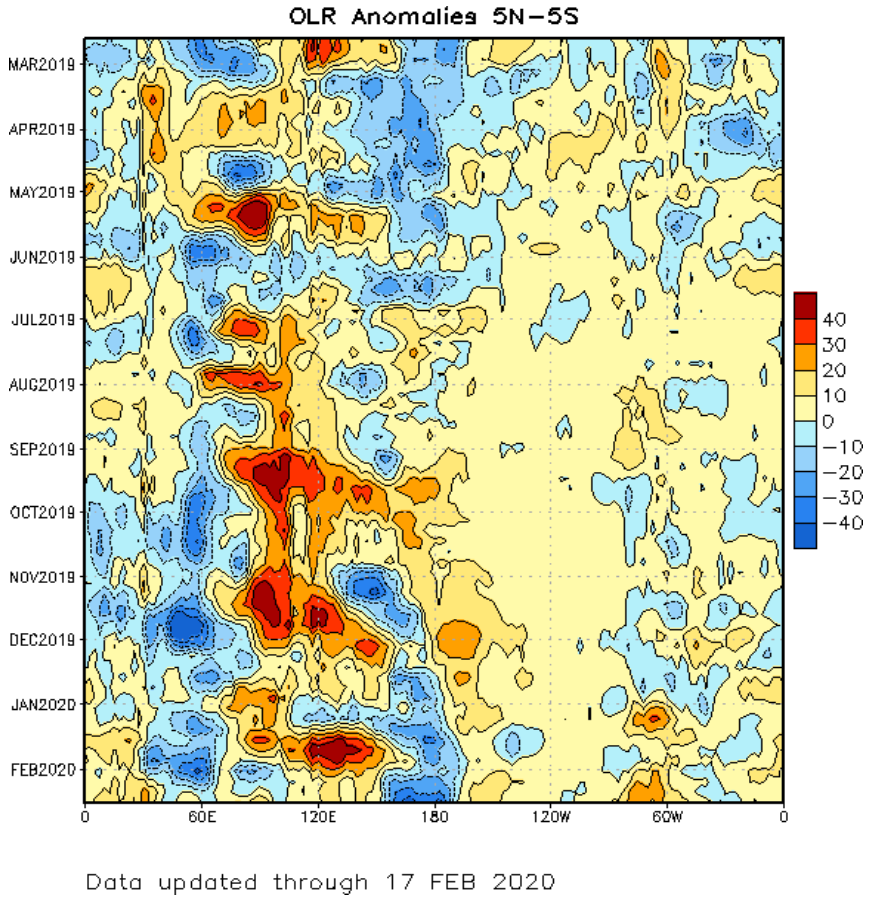
Pingping Xie

NOAA Climate Prediction Center

February 27, 2020

Satellite Products are Critical for Climate Operations

- Primary Climate Variables
  - *Sea surface temperature (SST)*
  - *Outgoing longwave radiation (OLR)*
  - *Precipitation (P)*
  - *Water vapor*
  - *Soil Moisture (SM)*
  - *Vegetation Index*
- Satellite products provide critical and indispensable information to the climate operations
  - *Monitoring of climate status*
  - *Diagnostics / attribution of climate variability*
  - *Providing initial and boundary conditions to the climate forecast models;*
  - *Verifying climate forecasts*
  - *Enhancing Climate services*



Time-longitude section (5S-5N) of anomalous 10-90 day band pass filtered outgoing long wave radiation. Contour interval is 10 W m^{-2}. The data are smoothed by using a 3-point running average. Negative (positive) OLR anomalies indicate enhanced (suppressed) convection.

Basic Requirements for Climate Data Sets

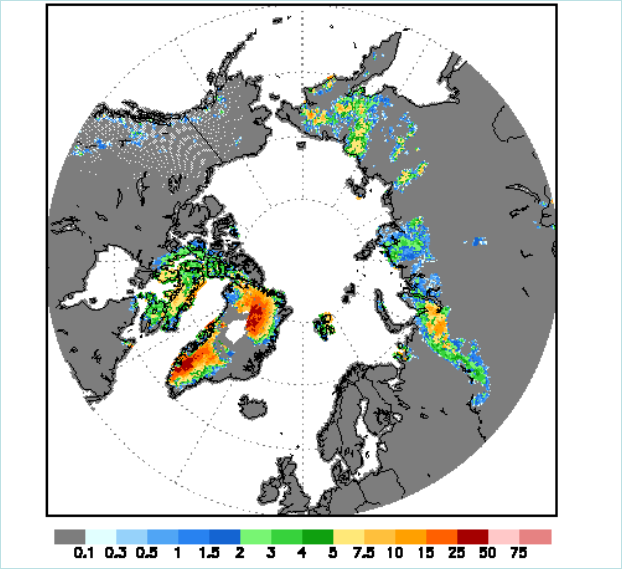
- Basic Requirements for climate data sets
  - *Gridded fields covering the entire globe (or the target region)*
  - *Long-term (>=30 years) with temporal homogeneity*
  - *Reasonable time / space resolution to resolve climate variability and major contributing atmospheric phenomena (daily / 0.25^{o}lat/lon)*
  - *Reasonable accuracy to capture range of variability and extremes*
  - *Real-time availability (latency<=24 hours)*

- Traditionally, satellite products are often developed to serve weather applications
  - *Level 2 retrieval products of geophysical variable at an instant and over satellite FOV*
  - *Created for each individual satellites over their respective life spans*
  - *Frequent upgrades with newly refined algorithms but with no reprocessing for previous periods*

- Development of satellite products for climate applications requires close collaborations between satellite developers and climate users

JPSS Provides Hydrometeorological Products for Improved Climate Applications

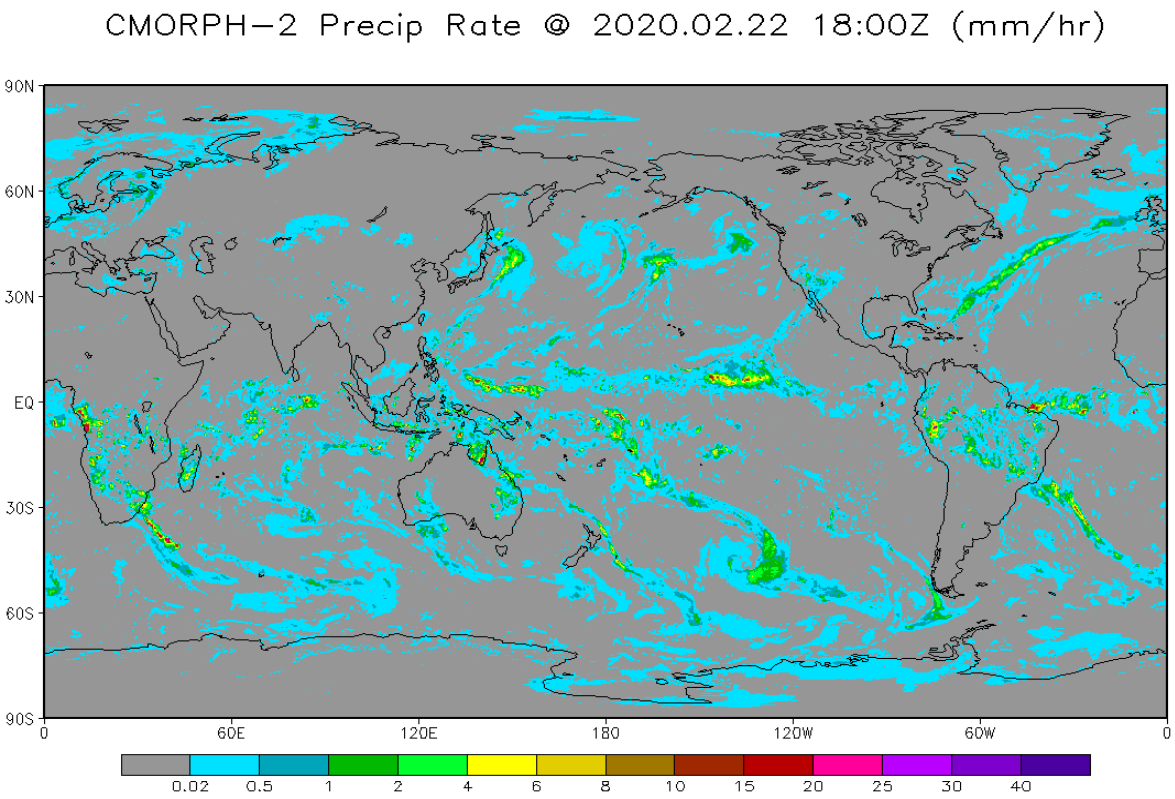
- JPSS hydrometeorological products
  (an incomplete list)
  - *Level 2 precipitation retrievals*
    - *MiRS retrievals of instantaneous rainfall rate*
    - ***Snowfall rate (SFR) retrievals from PMW sounders*** ➔
  - *Hyperspectral OLR*
    - *Level 2 retrievals from all satellites with hyperspectral sensors*
  - *Soil Moisture*
    - *SMOPS (Soil Moisture Operational Products Systems)*
    - *SNPP SFR retrievals for 1 Jun, 2018, from NESDIS/STAR*



SNESDIS/STAR SNPP SFR retrievals for 1 Jun, 2

- How does CPC utilize satellite-based hydrometeorological products
  - ***Direct use*** *of the products with minor post-processing if the products satisfy the basic requirements*
  - ***Develop level 3 products*** *of climate quality with collaborations with NESDIS colleagues*
    - *Get level 2 products from NESDIS and/or other satellite centers as inputs*
    - *Know-how on satellite data from satellite colleagues*
    - *Develop algorithm to blend inputs from multiple sensors / satellites into an integrated product with refined quality*

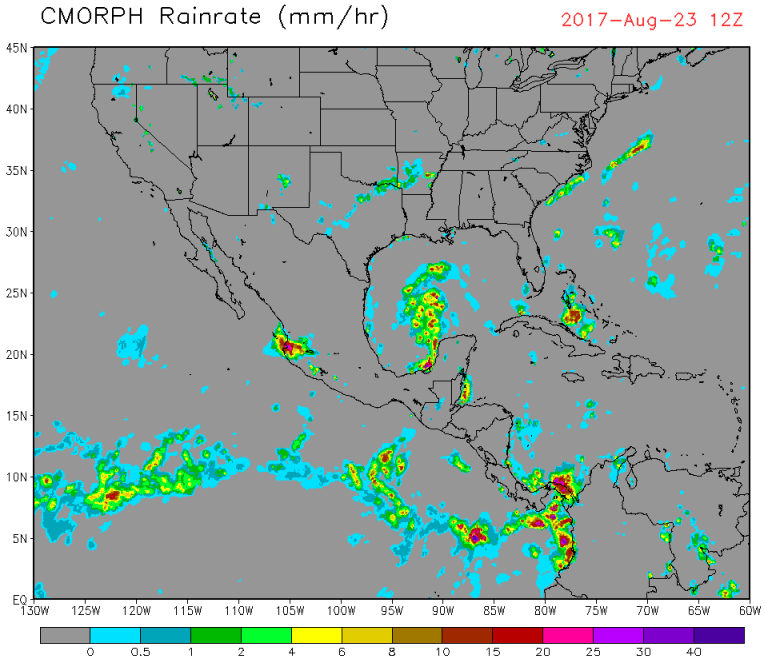
CMORPH2
Integrated Satellite Precipitation Estimates

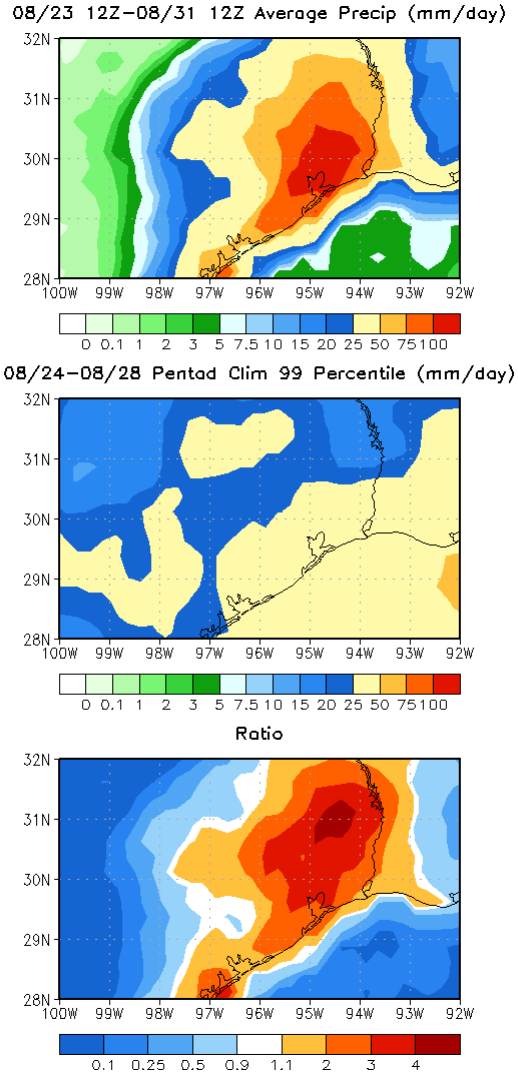


- *Created through integrating information from all (~15) satellites with precipitation / cloud sensors*
- *CMORPH2 created at a latency of one hour, then refined once an hour with new inputs until at a latency of 12 hours;*
- *Real-time pushed into NWS/AWIPS2 as part of the JPSS Hydrology Products package;*
- *Pilot reprocessing for 2017 to the present underway;*

Weather and Climate Applications:

An example of monitoring Hurricane Harvey with CMORPH





- Weather applications emphasize more on the absolute severity of an event such as the maximum intensity of rainfall over a certain location;
- Climate applications look at an observed precipitation amount from a climate perspective: how severe the event is compared to historical record;

Towards Improved Applications of JPSS Hydrometeorological Products

- *Development of Climate Quality Products*
  - *Identify products key to climate applications*
  - *Establishing / Enhancing mechanisms for the reprocessing of L1, L2 and L2 products for the identified climate variables*
  - *Continue efforts to develop and generate gridded products (L3) for major climate variables*
- *Coordinate efforts to develop weather and climate products*
- *Improve Quantitative consistency / combined applications of products for multiple GEO / climate variables*

Development of CMORPH2

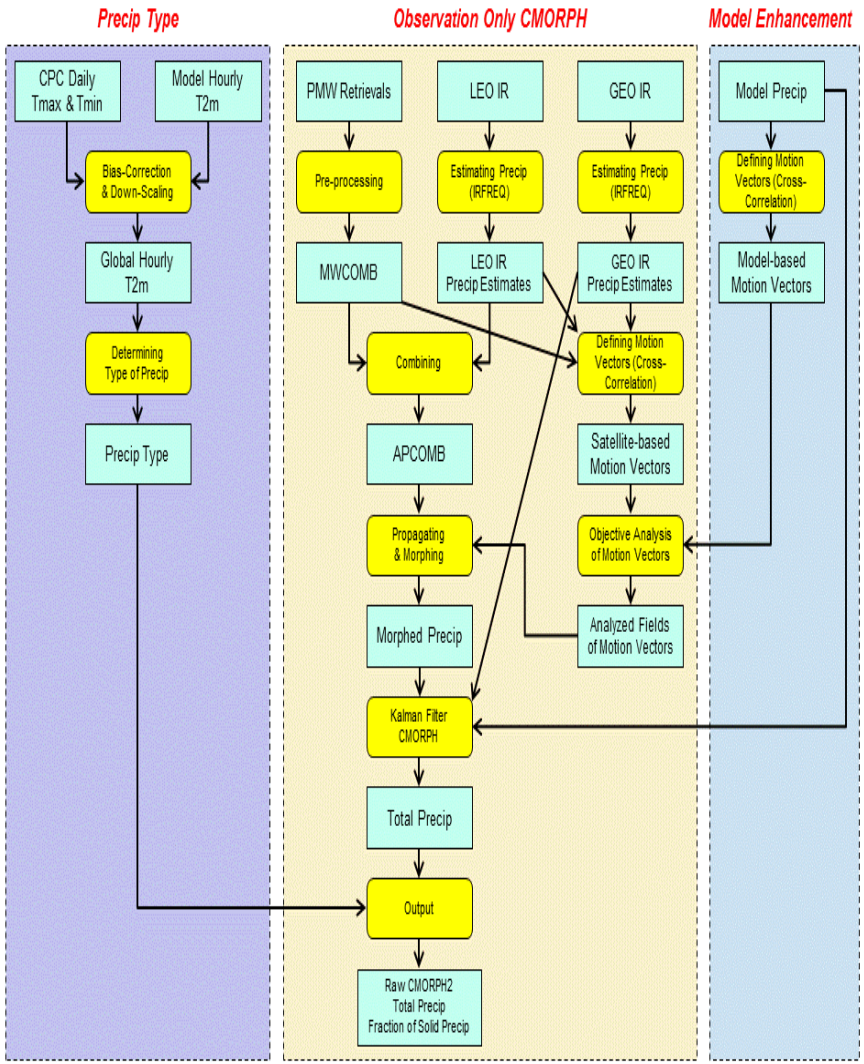
[1] Overview

- 2nd generation CPC Morphing technique

- Strategy
  - Constructing high quality, high-resolution global precipitation estimates through integrating information from GEO/LEO satellites as well as in situ observations and numerical model forecasts

- Goal
  - 0.05°lat/lon grid over the globe;
  - 30-min precipitation updated at a short latency
  - (eventual) back to 1991
  - Enhanced presentation of snowfall rate (and eventually orographic rain)

- Roles of JPSS
  - *Financial supports for development work*
  - *Level 2 retrievals of MiRS rainfall and snowfall rate (SFR) Inter-satellite calibration algorithm*
  - *Facilitate interactions with developers of other products and user-interactions*

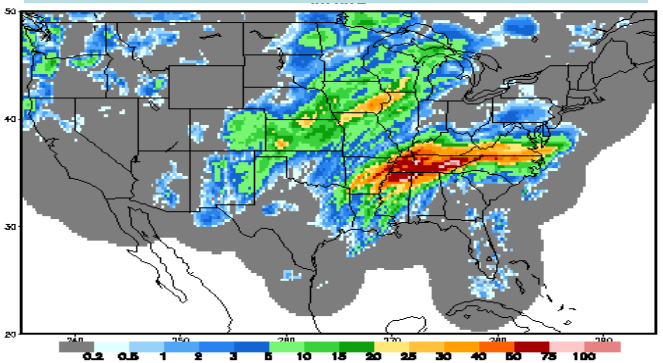


Development of CMORPH2

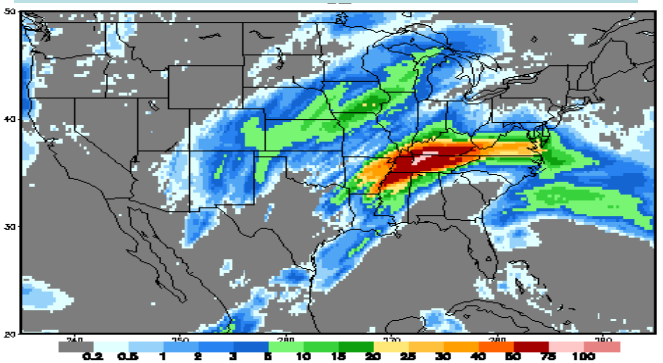
[3] Performance for a Winter Storm Case

- ***Daily precipitation (mm)***
- *for 23 February, 2019*

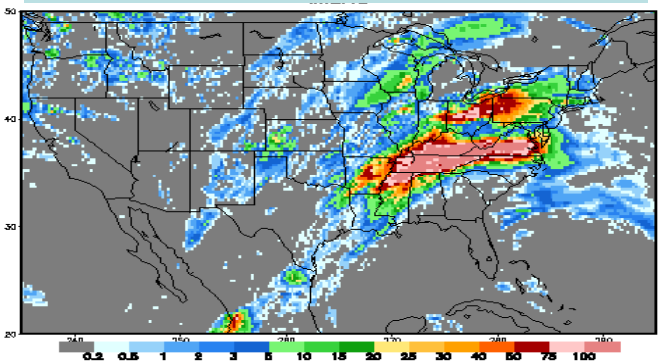
MRMS Radar Estimates



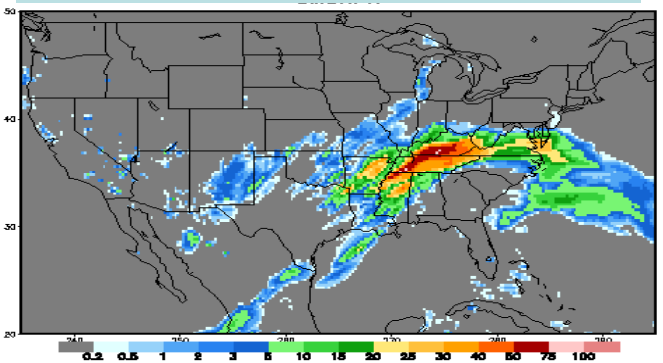
CMORPH2



NASA / IMERG



CMORPH1



Bob Kuligowski

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

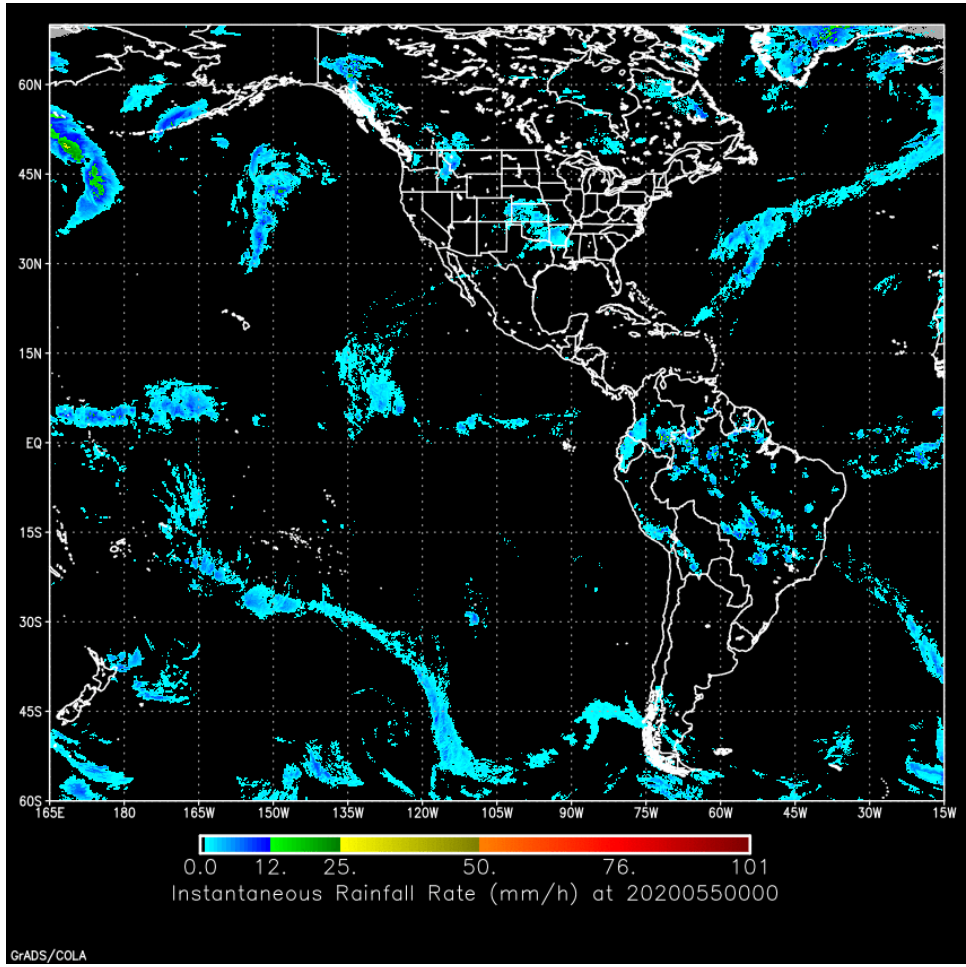
Bob Kuligowski has been at NESDIS/STAR for 20 years working on satellite infrared (IR)-based estimates of rainfall for flash flood forecasting. He is the developer of the GOES-R Rainfall Rate algorithm, which uses IR data to provide rapid refresh and short latency and is calibrated against microwave (MW)-based estimates of rainfall to maximize accuracy.

Developer Perspective on GOES-R ABI Rain Rates

Bob Kuligowski

GOES-R Rainfall Rate / QPE Summary

- Satellite (IR)-based estimates of rain rate
  - Latency: 5 min after completion of scan
  - Refresh rate: 10 min
  - Spatial resolution: ABI IR footprint (2 km at nadir)
  - Coverage: GOES-16/17 full disk
- IR-based algorithm calibrated vs. MW-based rain rates
- “Enterprise” version transitioning to ops in November (👉) will significantly improve performance



Upcoming QPE Algorithm Changes

- Fixed calibration replaced by regularly updated calibration
  - Improves ability to capture seasonal changes in calibration
- Calibration regions will shrink from 30° latitude bands to 15x15° lat / lon bands
  - Improves ability to capture regional variations in calibration
- Adjustment for subcloud evaporation of precip using GFS RH
  - Significantly fewer false alarms (particularly over the western US)
- Single-channel algorithm for GOES-17
  - Significantly less noise and lost during warm FPM periods
- Additional details in poster #9 this evening!

Strengths in Meeting User Needs

- Short latency—product takes < 5 min to produce
- Rapid refresh—every 10 min
- Complete spatial coverage—includes mountains, oceans, sparsely populated areas, etc.

Unaddressed User Needs (Usability)

- Overwhelming number of precip products—need to reduce the number of products forecasters must consult
  - Collaborating with NSSL to improve the satellite rain rate retrievals and incorporate them into the Multi-Radar Multi-Sensor (MRMS) framework—more details in poster #8 this evening

Unaddressed User Needs (Performance)

- Poor performance in orographically complex terrain
  - Orographic controls on precip are extremely difficult to model—many solutions give results that *look* reasonable but validate poorly vs. ground truth
- Rainfall overestimated in convective cores
  - Anvils frequently obscure activity beneath—determining how GLM data can be used to help
- Rainfall is horizontally displaced in highly sheared environments (non-vertical rain shafts)
  - Trying to develop rorobust relationships between these spatial errors and vertical wind profiles have been challenging

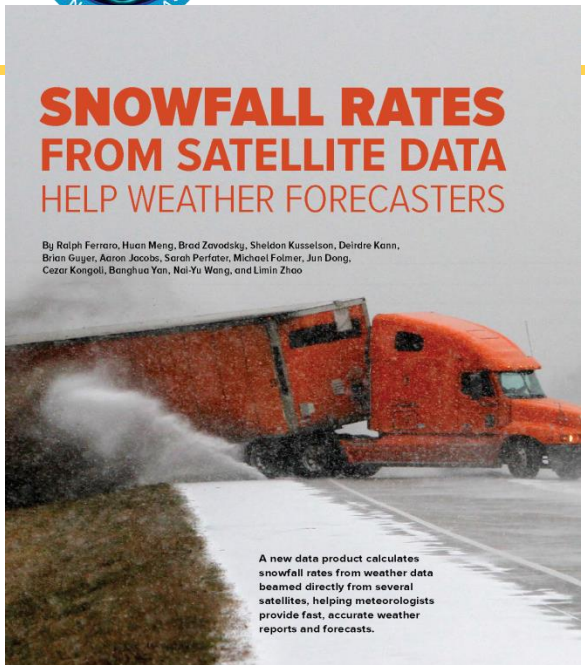
LEO (MOSTLY MW) L2 & L3 PRODUCTS

Ralph Ferraro, NESDIS/STAR
Ralph.R.Ferraro@noaa.gov

Three Classes of Products

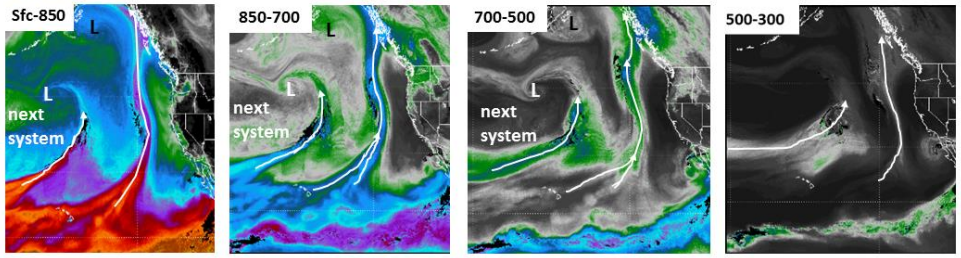
- JPSS Baseline products/systems
  - Primarily from ATMS, AMSR-2, VIIRS
    - MiRS, SFR, NOGAPS (GCOM-W1), Blended TPW/RR
- JPSS/Legacy POES “blended” products
  - Primarily MW driven, includes AMSU/MHS and non-NOAA satellites like GPM and DMSP
- JPSS Proving Ground Risk Reduction (PGRR) developmental products
  - Enhancements to baseline, could include data fusion with GOES and in-situ
    - Snowfall Rate – now a JPSS requirement and operational
    - Layered TPW – now moving towards operations…
    - CMORPH2 – JPSS infused
  - Newer, pushing limits of sensor capabilities
- **NOTE – Many of the products are microwave sensor driven**

Some Uses of the Products….



"Atmospheric Rivers" of High Concentrated Moisture into Alaska at 4 layers For a Week of Excessive Rainfall – Juneau, AK
11 & 13-14 December 2017

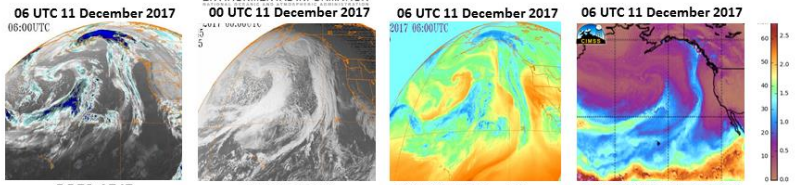
CIRA/Colorado State University Advected Layered Precipitable Water (ALPW) for 06 UTC 11 December 2017



Juneau*/Sitka, AK
Precipitation
11 December 2017
1.69"*/1.26"
*Record Precip

(Photo by Rashah McChesney/Alaska's Energy Desk)
https://www.ktoo.org/2017/12/11/southeast-alaska-sees-warm-temps-lots-rain/

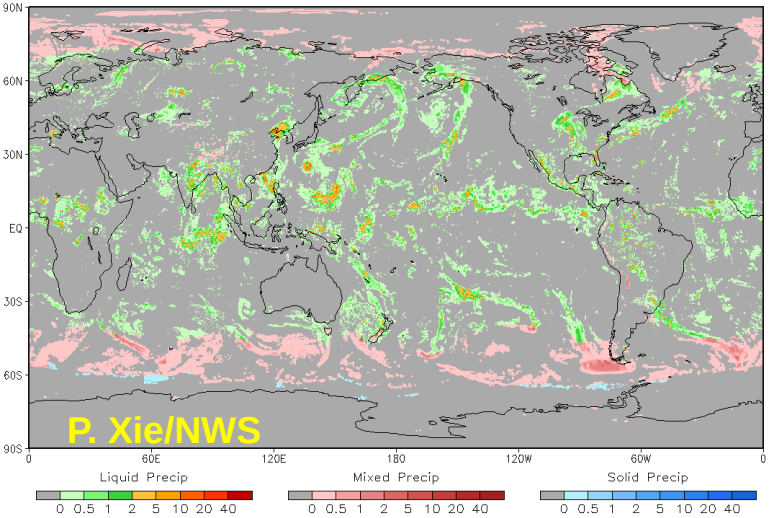
NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION



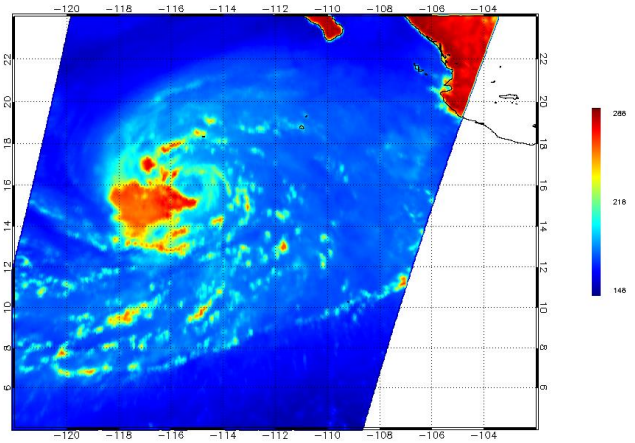
ftp://ftp.cira.colostate.edu/ftp/Forsythe/LPW/Anim_GIF/2017Dec1121Advect_LPW_ALT_anim.gif

Analysis Prepared by Sheldon Kusselson

CMORPH2 Precip Rate @ 2018.08.20 00:00Z (mm/hr)



AMSR-2 36.5GHz H-pol Date: 20180629-1218Z
Storm Name: EMILIA Region: Eastern_Pacific
AMSR2 L1B file: GW1AM2_201806290855_035B_L1SNBTBR_2220220.h5



Unmet Goals/Needs, Obstacles, etc.

- Proving Ground, R20 process
  - Users get accustomed to developmental products, yet, the operational products lags ("versionitis")
    - Developmental product outages
    - Operational lags product improvement
      - Sometimes its due to higher level decisions, system freezes, security, etc.
      - AWIPS delivery schedules; SBN vs. LDM
  - Funding lines – who pays for what?
- Product Latency
  - Direct broadcast (but can suffer from above issues)
- Improved coordination/training
  - For some products, multiple PG's involved…
- We never quite seem to get some things done
  - Regional products
  - Integrating promising research into baseline products
  - "Apples to Apples" cal/val
  - Reprocessing

Future Opportunities

- Enterprise solutions
  - Improved science and retrievals in one place
  - Optimize system = faster implementation down the road
- New sensors show promise
  - GOES-R era
    - GLM
    - ABI – high refresh, more channels, etc.
  - S-NPP, N20, GCOM-W1 synergy
    - “super swaths” possible
- Improved baselines through reprocessing
  - EDR reprocessing capability being developed in College Park
- Upcoming new missions next 3-4 years including:
  - EPS-SG (METIMAGE, MWS, MWI, ICI)
  - AMSR-3 (includes HF channel options like GMI)

Blended, Multisensor Hydrometeorology Products for Forecasters

John Forsythe

Cooperative Institute for Research in the Atmosphere (CIRA)
Colorado State University, Fort Collins CO

(John.Forsythe@colostate.edu)

CIRA Team: Stan Kidder, Andy Jones, Dan Bikos, Ed Szoke, Louie Grasso, Sheldon Kusselson

Collaborators: Limin Zhao (OSPO), Ralph Ferraro (STAR), NOAA Weather Prediction Center, National Hurricane Center + WFO's

JPSS / GOES Summit February 2020 College Park, MD

Big Picture

- **Blended, multisensor satellite products are an excellent example of NOAA's geostationary, polar and surface assets working together to create "one stop shopping" and a better view of the atmosphere for forecasters.**

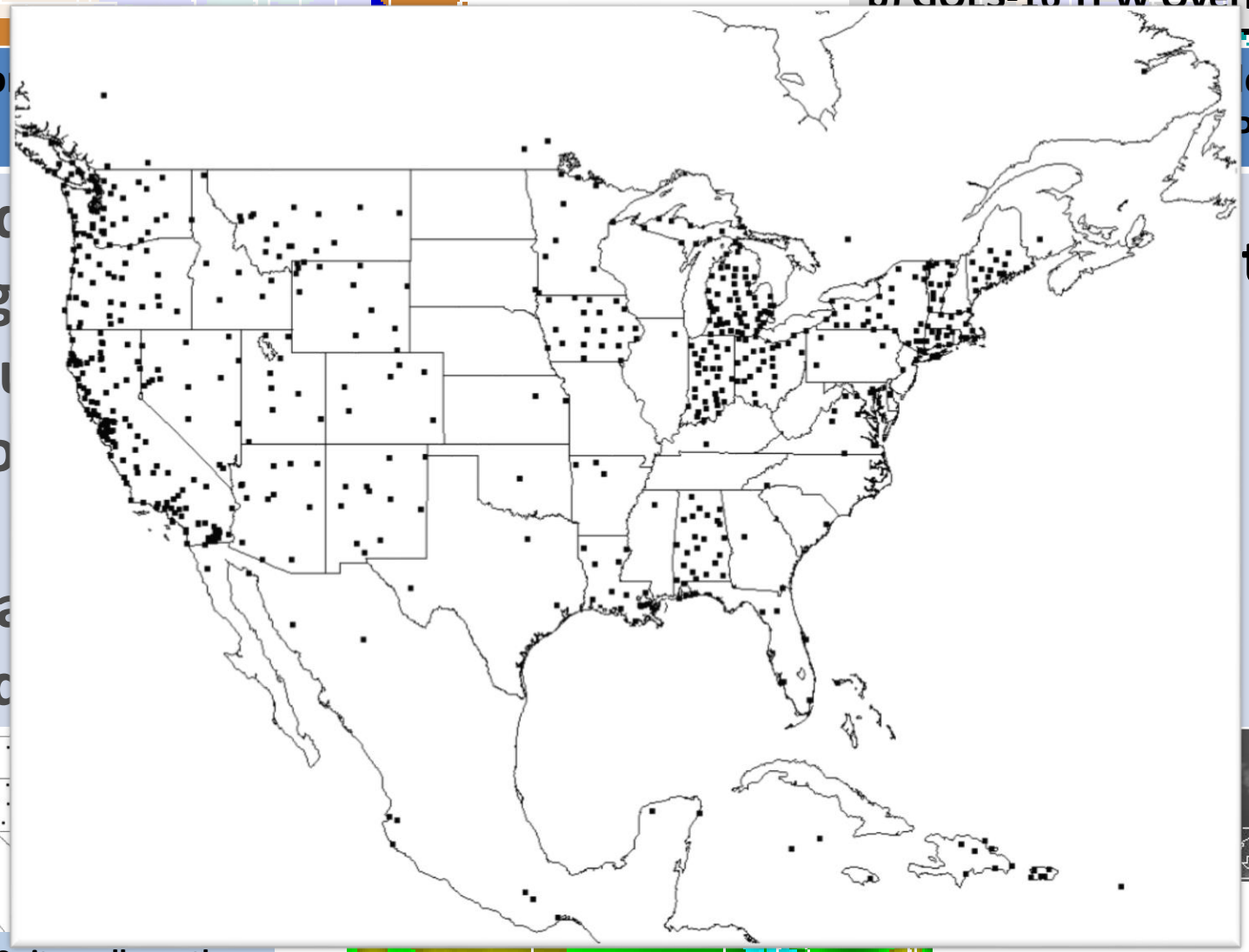
Science Question:
How to reduce observing system impacts and make forecaster-friendly products?

- **GOES provides high time resolution clear-sky data, quality is good near CONUS (Schmidt et al. 2019; CIRA validation).**
- **Surface GPS provide regionally dense, all-weather data over portions of CONUS. Network spatial distribution is irregular.**

- **CIRA Advected Layer Precipitable Water (ALPW) requested for transition to operations by Weather Prediction Center (Fall 2019)**

Cooperative Institute for Research in the Atmosphere

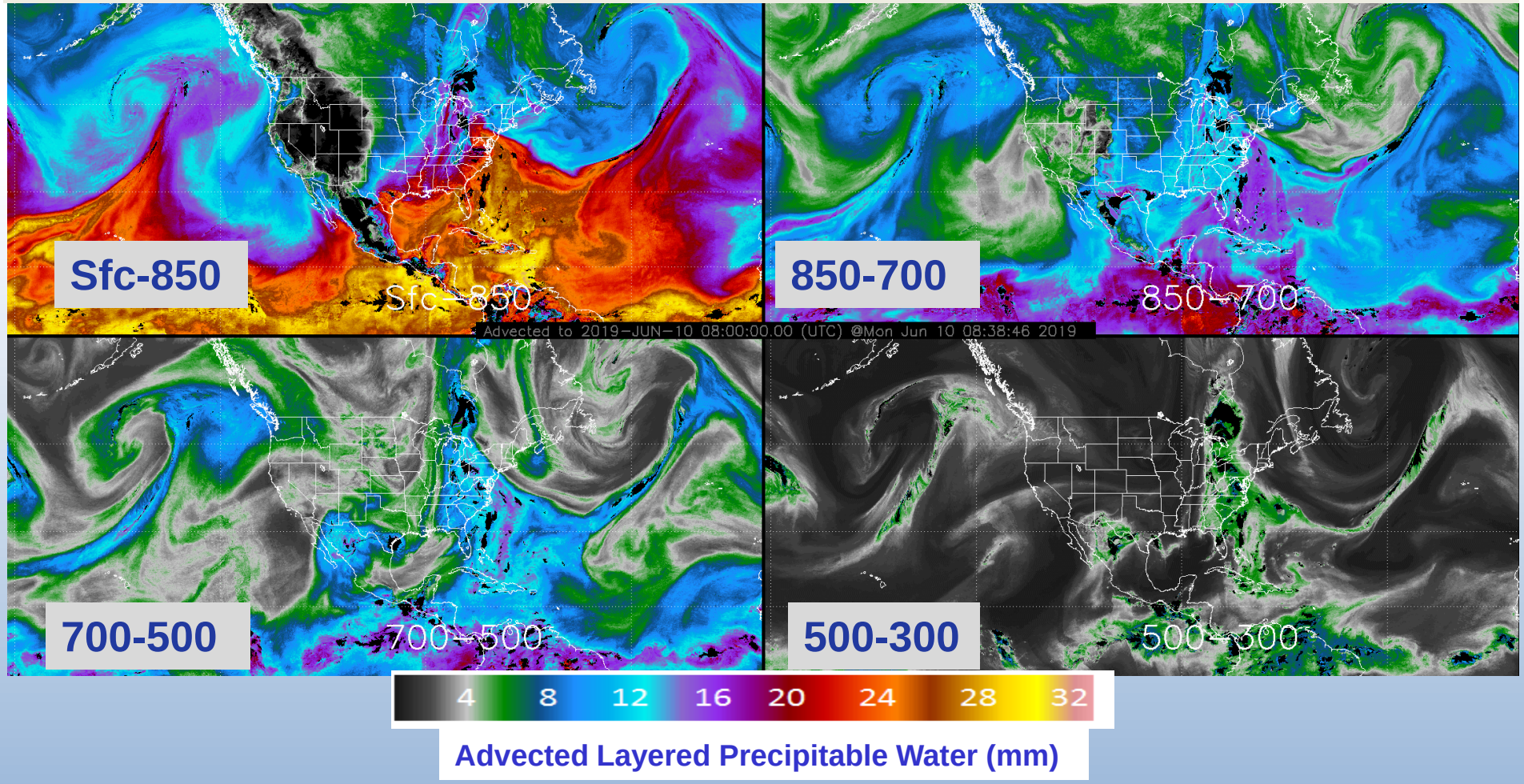
How is the new CIRA merged total precipitable water (TPW) constructed?



Challenge: Water vapor profiles are difficult for forecasters to view in time

- Radiosondes land only, 12 hours.
- Geostationary water vapor channels cloud impacted.

Solution: Advected Layer Precipitable Water (ALPW) uses polar satellite microwave retrievals advected with GFS model winds

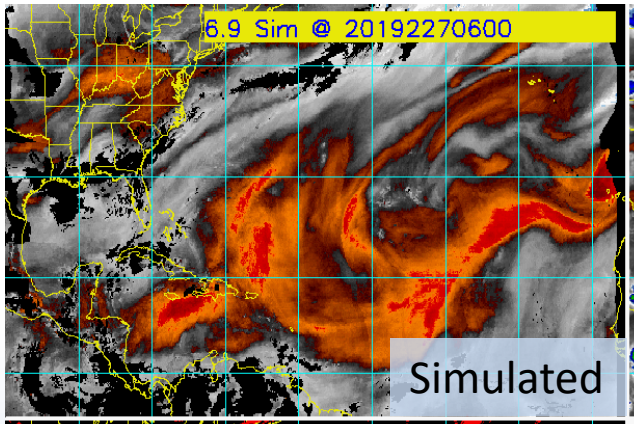


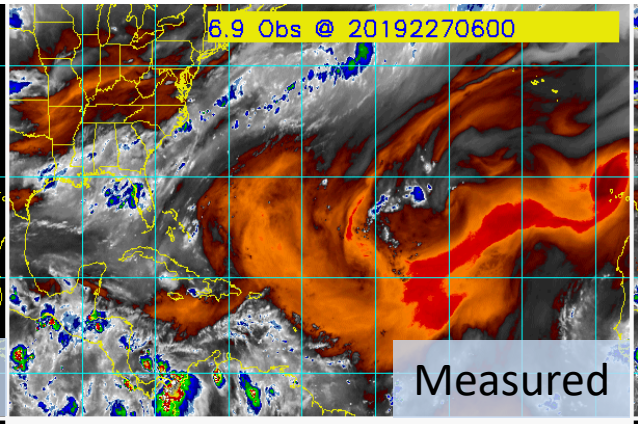
http://cat.cira.colostate.edu/sport/layered/advected/lpw_alt.htm

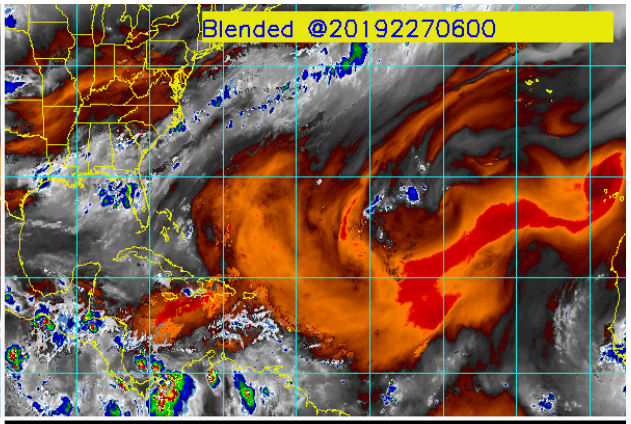
Future Possibilities

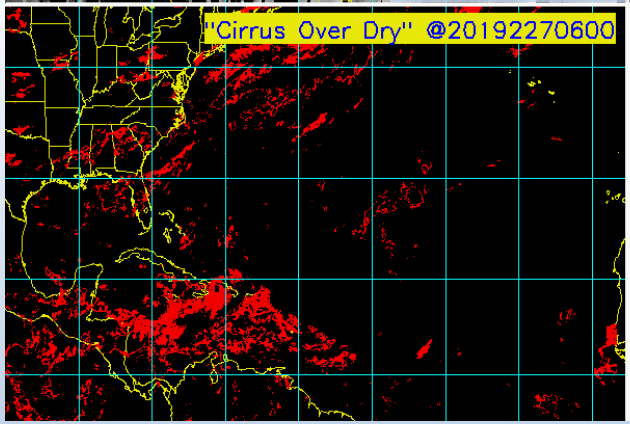
Cloud-free GOES Channel 09 (6.9 µm) imagery simulated from microwave profiles

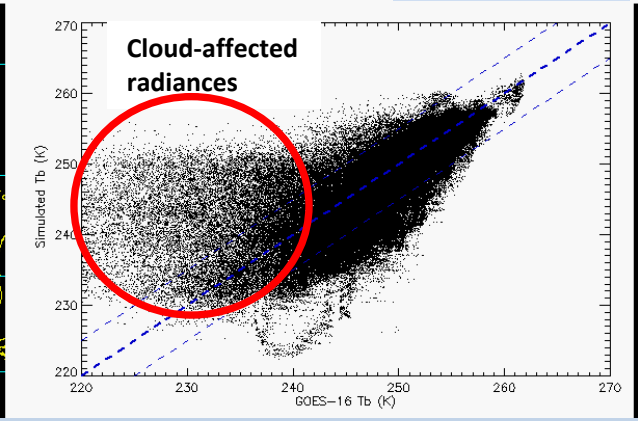
Near-realtime animations available at: http://cat.cira.colostate.edu/GR3/GOESR_TB09_SIM_Hourly.htm





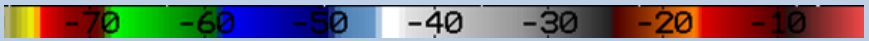






Future Product

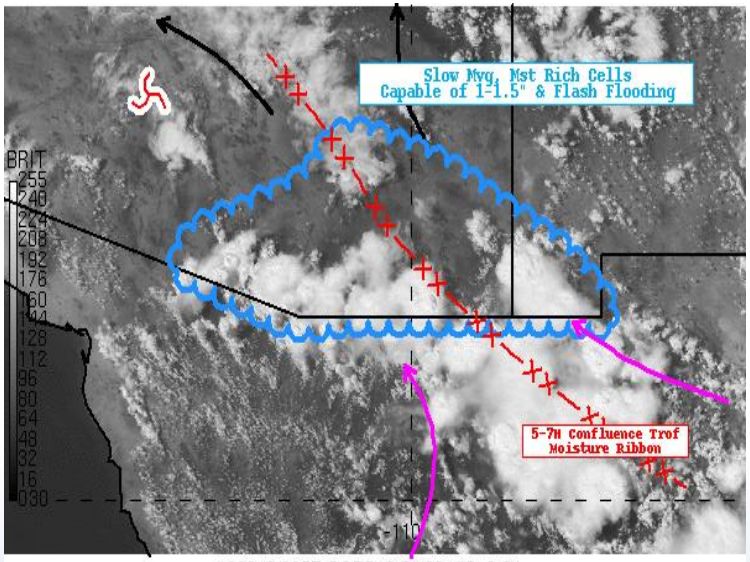
GOES-16 tropical Atlantic panel



Tb (K)

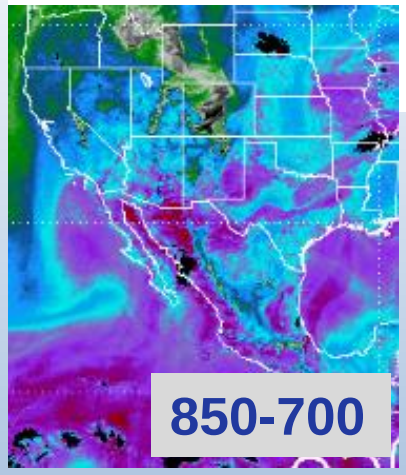
Backup Slides

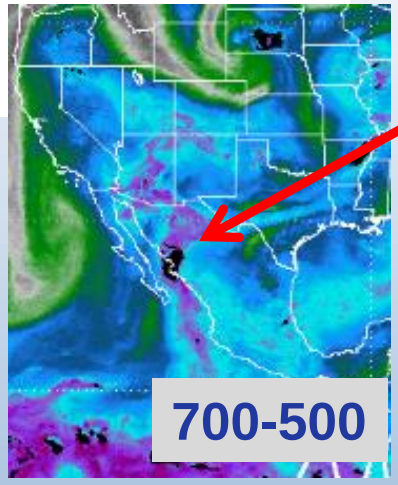
CIRA Advected Layer Precipitable Water (ALPW) shows long-distance moisture transports – 4 vertical layers

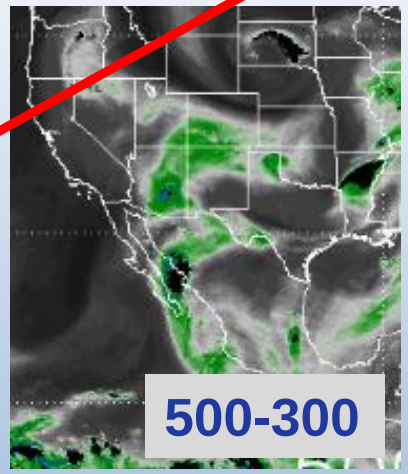


Mesoscale Precipitatation Discussion 0669
NWS Weather Prediction Center College Park MD
459 PM EDT Wed Aug 15 2018
Areas affected...Ext Southeast AZ...Ext. Southwest NM...
Concerning...Heavy rainfall...Flash flooding possible

DISCUSSION...GOES-16 Visible depicts the eroding cloud shield of last evening's MCV that is moving lifting from Pima to Maricopa county. **CIRA LPW 7-5H loop depicts deepest/rich moisture of .4 to .6"** PWATs along the eastern band of the exiting MCV toward Northern Chihuahua. … Gallina







Layer Precipitable Water (mm)

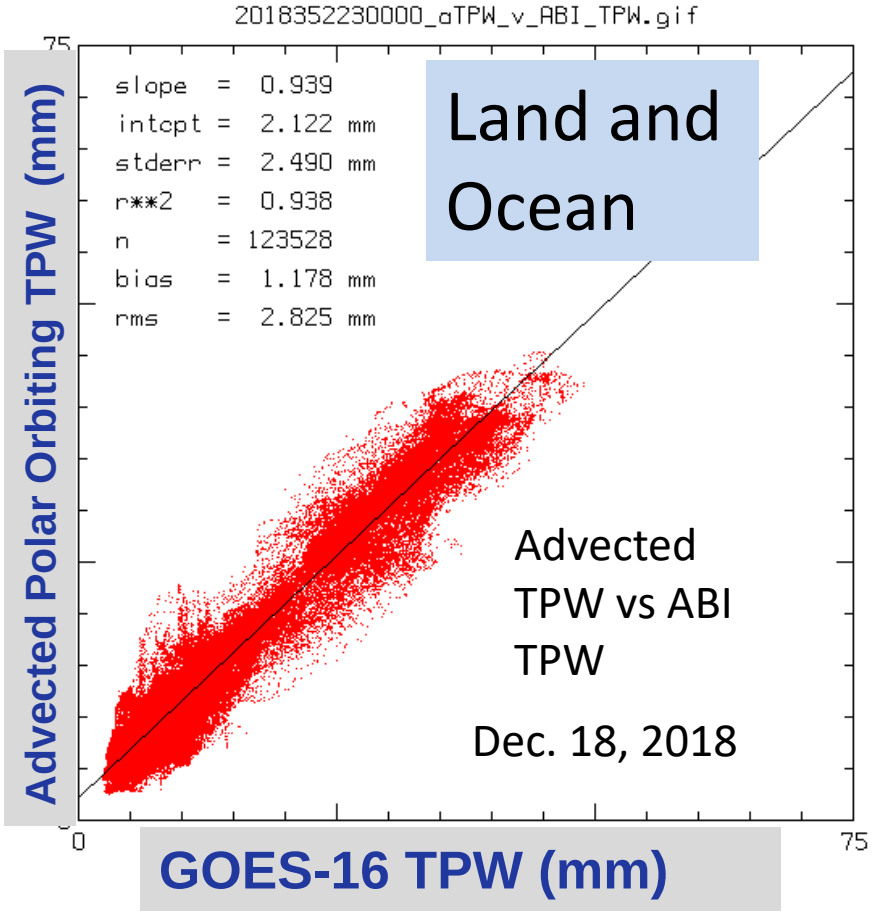
- **Derived from 7 polar orbiters with 183 GHz sounders**

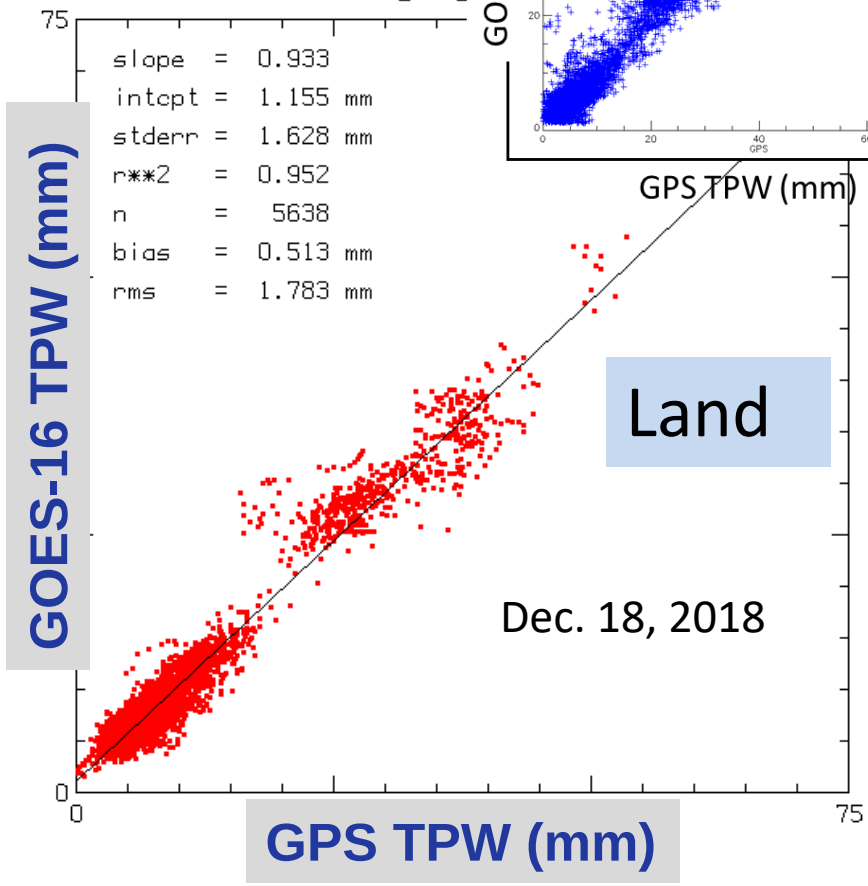
Example CIRA ALPW Usage at NOAA WPC (Weather Prediction Center)

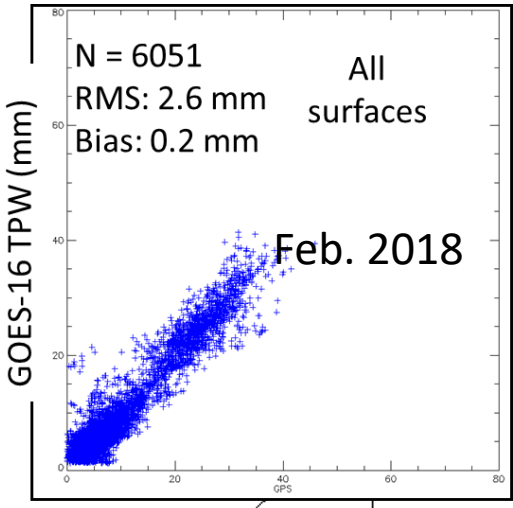
Error Characterization of GOES TPW

Comparison with highly accurate surface GPS measurements indicates GOES-R TPW is sufficiently accurate

ing

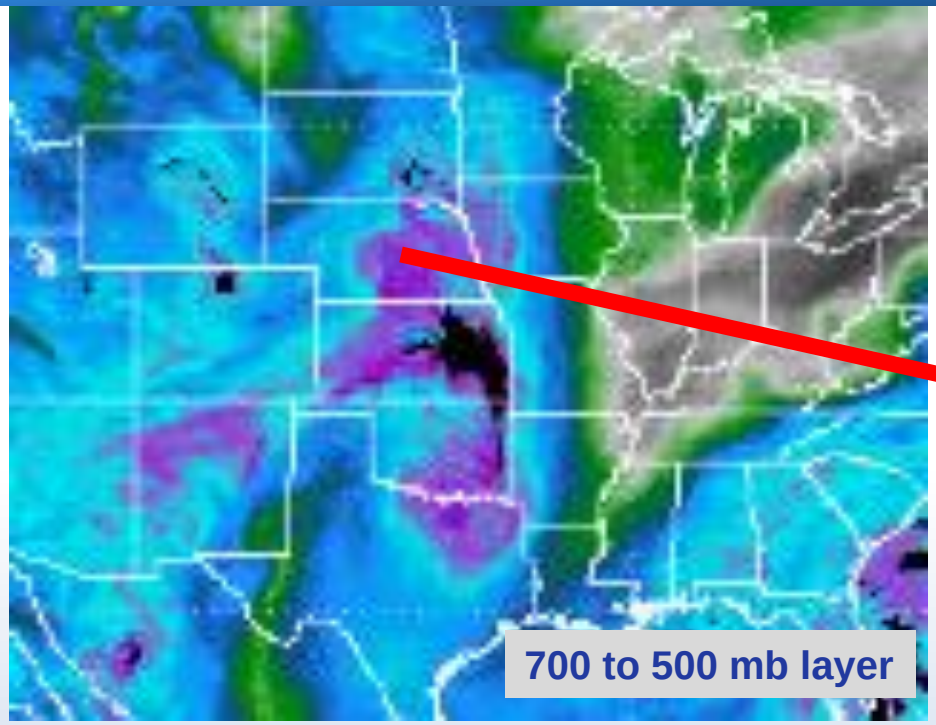


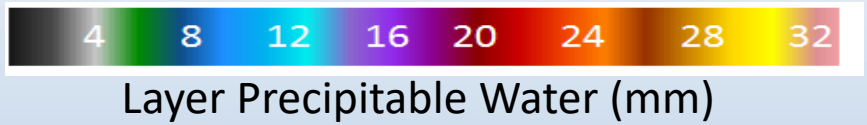




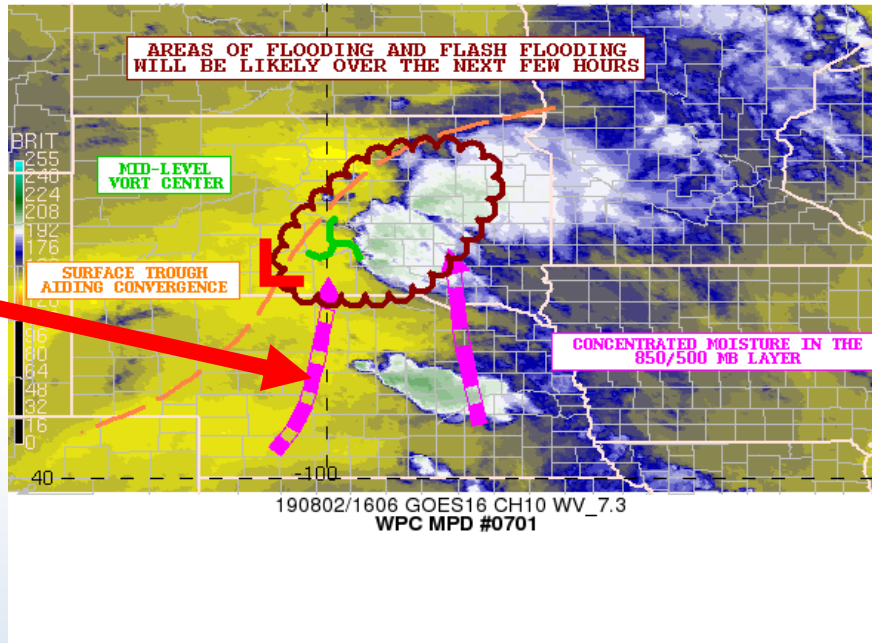
Cooperative Institute for Research in the Atmosphere

Example Usage of ALPW at NOAA Weather Prediction Center





Layer Precipitable Water (mm)

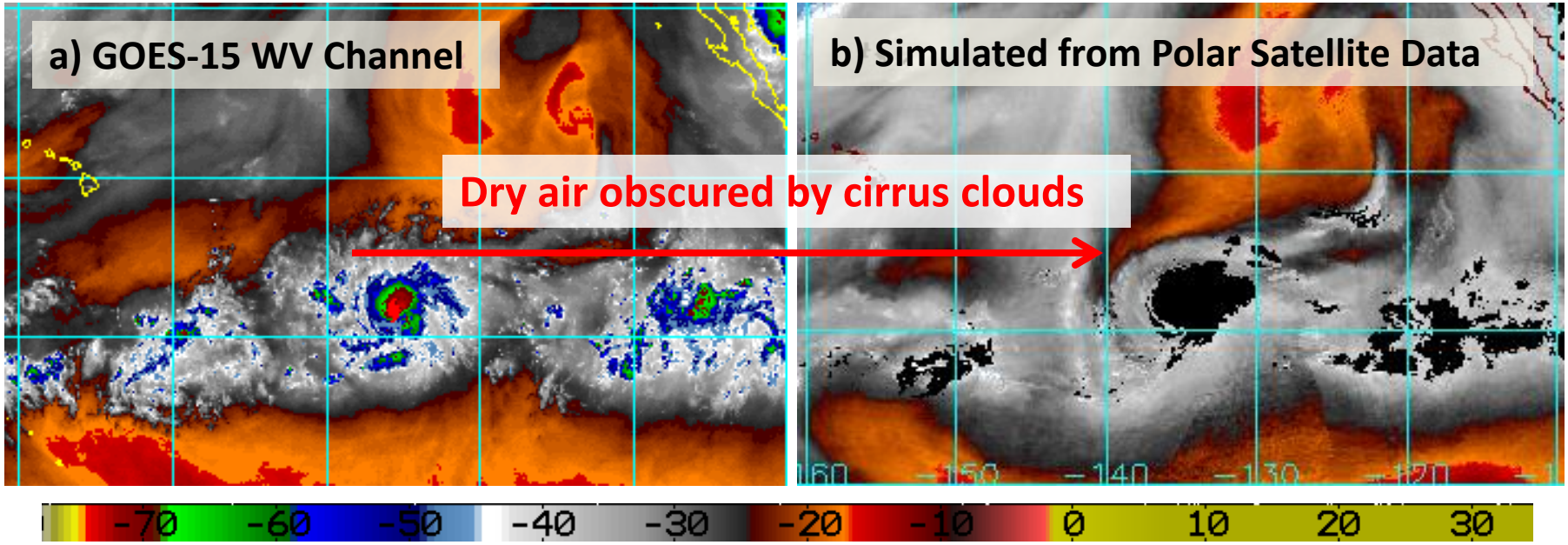


Mesoscale Precipitation Discussion 0701
NWS Weather Prediction Center College Park MD
1213 PM EDT Fri Aug 02 2019

Areas affected...Central /Eastern SD

Concerning...Heavy rainfall...**Flash flooding likely**

…The moisture environment across the region along and to the rightof the surface trough is rather conducive to enhanced rainfall rates, **with the latest CIRA-LPW data sets** showing a concentrated channel of moisture advected up across central and southern SD in the 850/500 mb layer. This is aiding in some highly efficient rainfall processes for enhanced rain rates that have already been as high as 2.5 inches in 30 minutes...



August 18, 2018 03 UTC Hurricane Lane

```
Hurricane Lane Discussion Number  13
NWS National Hurricane Center Miami FL       EP142018
800 PM PDT Fri Aug 17 2018
…
The first portion of the intensity forecast is a bit problematic.
With the exception of the HMON model, none of the intensity
guidance shows much additional strengthening.  However, except for
the possibility of some dry air wrapping around the west side of
the central convection, there is no apparent reason why the current
rapid intensification should stop that quickly.  The intensity
forecast will show 12 h more of rapid intensification, followed by
a period of little change from 12-48 h.  This portion of the
intensity forecast lies above all of the guidance.  After 48 h,
Lane should start to encounter westerly shear, which should
increase by the end of the forecast period and cause the cyclone to
steadily weaken.  This portion of the intensity forecast lies near
or a little above the intensity consensus.
…
$$
Forecaster Beven
```

Enhancing the usefulness of Channel 9 (6.9 μm) data:

- **Cloud-free simulated data will be compared to Channel 9 to detect cloud-obscured dry air.**
- **Could be an important signal for hurricane intensification**