Activities of the Hydrology Initiative of the JPSS PGRR Program

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Connecting Models and Observations

Initiative Projects/Participants

Group Leader:Ralph Ferraro NOAA/NESDIS/STAR

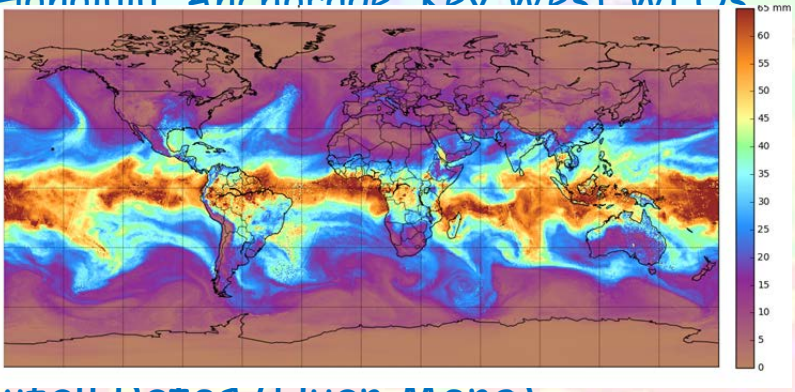
Project PI	Project Title
Dave Gochis *(NCAR)*	Applying Snow Products from S-NPP JPSS and SNODAS to Seasonal Streamflow Forecasting at the NWS National Water Center
Huan Meng *(NESDIS/STAR)*	Continued expansion, enhancement and evolution of the NESDIS snowfall rate product to support weather forecasting
Pingping Xie *(NWS/NCEP)*	Reprocessing of JPSS precipitation and OLR products for improved operational climate applications
Isaac Moradi *(UMD/CICS)*	Extending AMSU/MHS FCDR's and TCDR's to S-NPP ATMS
John Forsythe *(CSU/CIRA)*	Using JPSS Retrievals to Implement a Multisensor, Synoptic, Layered Water Vapor Product for Forecasters
Tony Wimmers *(UW/CIMSS)*	Strengthening TPW visualization in the OCONUS domain with JPSS data products
Tarendra Lakhankar *(CUNY/CREST)*	Validation and Application of JPSS/GCOM-W Soil Moisture Data Product for operational flood monitoring in Puerto Rico
Jerry Zhan *(NESDIS/STAR)*	Enhance Agricultural Drought Monitoring using NPP/JPSS Land EDRs for NIDIS
Andi Walther *(UM/CIMSS)*	Further development of the VIIRS Nighttime Lunar Reflectance-derived Cloud Properties and the Demonstration for their use for Precipitation and Icing Applications

Hydrology Initiative Overview & Objectives

- Goal(s):
  - Create a forum for Hydrology-related project teams to interact regularly
  - Coordinate activities of its stakeholder projects to include:
    - Algorithms/techniques/software that is mutually beneficial
    - Link derived products (surface, atmosphere) where possible
    - Develop potential product intercomparisons
    - Engage users, including WFO, National Centers, Proving Grounds, Testbeds
  - Identify newsworthy 'events' to apply project capabilities & evaluate value
  - Develop linkages to other initiatives under JPSS & GOES-R PGRR.
- **Satellite (sensors) used:**
  - Primary - S-NPP (ATMS, VIIRS; CrIS); GCOM (AMSR-2);
  - Secondary - NOAA POES & MetOp (AMSU/MHS; AVHRR); DMSP (SSMIS)
- **We meet "virtually", approximately every 2 months**
  - Held our kick off meeting on July 21, 2015
  - Six meetings since then, most recently June 29, 2016

Examples of NWS User Engagement

- Layer Precipitable Water Vapor (John Forsythe)
  - NESDIS SAB, WPC, NHC, SPC, OPC, + a few WFO's (e.g. Tucson AZ) with data routed via NASA SPoRT
  - Looked at closely during SC floods in Sept. 2015
- TPW Visualizations (Tony Wimmers)
  - Honolulu, Anchorage, Key West WFOs



- Snowfall Rates (Huan Meng)
  - Exploiting Direct Broadcast over CONUS to reduce latency to 30 minutes or less!
  - Product assessment in winter 2015-2016 at six WFOs (via NASA/SPoRT), WPC, SPC, SAB

MESOSCALE PRECIPITATION DISCUSSION 0530
NWS WEATHER PREDICTION CENTER COLLEGE PARK MD
1016 AM EDT TUE SEP 29 2015

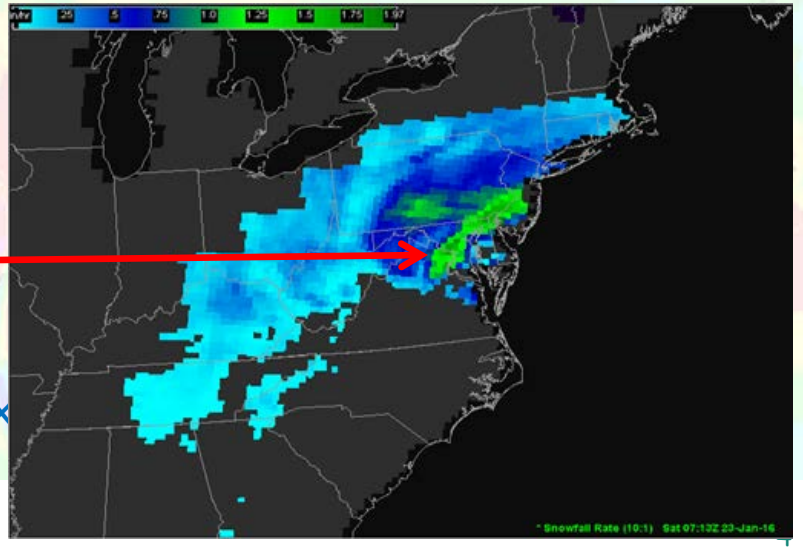
CONCERNING...HEAVY RAINFALL...FLASH FLOODING LIKELY

SUMMARY...A TROPICAL AIRMASS WITH NEAR RECORD PRECIPITABLE WATER WILL RESULT IN A CONTINUED FLOOD AND FLASH FLOOD THREAT INTO THIS AFTERNOON.

...

FORCING FROM THE SHORTWAVE IN GA AND A GENERALLY DIVERGENT PATTERN ALOFT IS HELPING FORCE ASCENT ON THE LARGE SCALE...WITH 20-30 KTS OF LOW LEVEL UPSLOPE FLOW AIDING IN LIFT. LAYERED PRECIPITABLE WATER PRODUCTS SHOW AN IMPRESSIVE COMBINATION OF FACTORS CONTRIBUTING TO THE NEAR RECORD PRECIPITABLE WATER VALUES ACROSS THIS REGION. A CONNECTION TO THE PACIFIC AND TROPICAL STORM MARTY CAN BE SEEN IN THE MID/UPPER LEVELS...WITH A DEEP LAYER CONNECTION TO THE GULF OF MEXICO AND ALSO TROPICAL STORM JOAQUIN IN THE ATLANTIC. THIS IS ALL RESULTING IN A VERY EFFICIENT ATMOSPHERE FOR HEAVY RAIN RATES. THE ONE THING LACKING IS INSTABILITY...BUT AT LEAST SOME DOES EXIST ACROSS THE AREA AS NOTED BY SOME LIGHTNING AND COLDER CLOUD TOPS…

Jan. 16 2016 Snowfall Rate



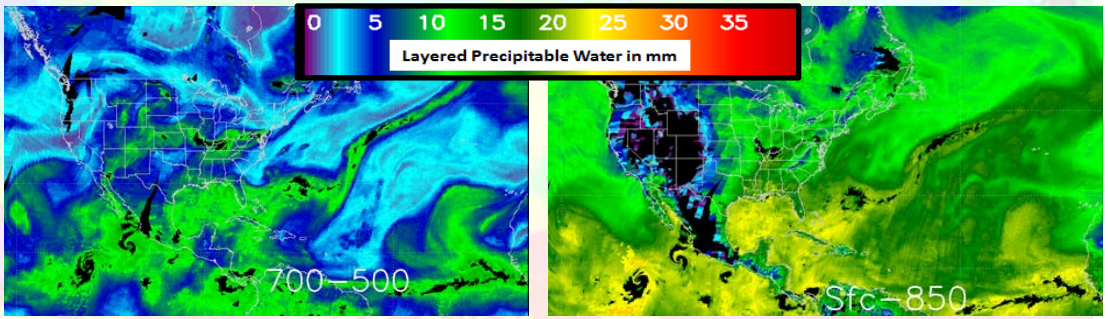
Examples of NWS User Engagement

CIRA Layered Precpitable Water frequently mentioned in NHC Tropical Weather Discussions (45 times in July 2016 in Atlantic Discussion) and WPC Mesoscale Precipitation Discussions. Limited distribution to NASA SPoRT partner NWS WFO's.

Environment of tropical waves

TROPICAL WEATHER DISCUSSION
NWS NATIONAL HURRICANE CENTER MIAMI FL
205 PM EDT THU JUN 02 2016

Tropical wave is over the central Caribbean from 15N76W to 03N76W moving W at 20 kt. **The wave is embedded in a high moist environment from the surface to 850 mb as indicated by CIRA LPW imagery .**
(*See related poster by Forsythe et al.)



Area Forecast Discussion
National Weather Service Tucson AZ
154 PM MST THU MAY 12 2016

Moisture surges in SW U.S.

CIRA layered precipitable water estimates show totals up to .8 inches in the central gulf, with contributions from the surface to 850mb layer up from .3 to .5. The bulk (of what is likely a moderate surge) may not make it fully through the northern gulf.

Collaborative Case Studies

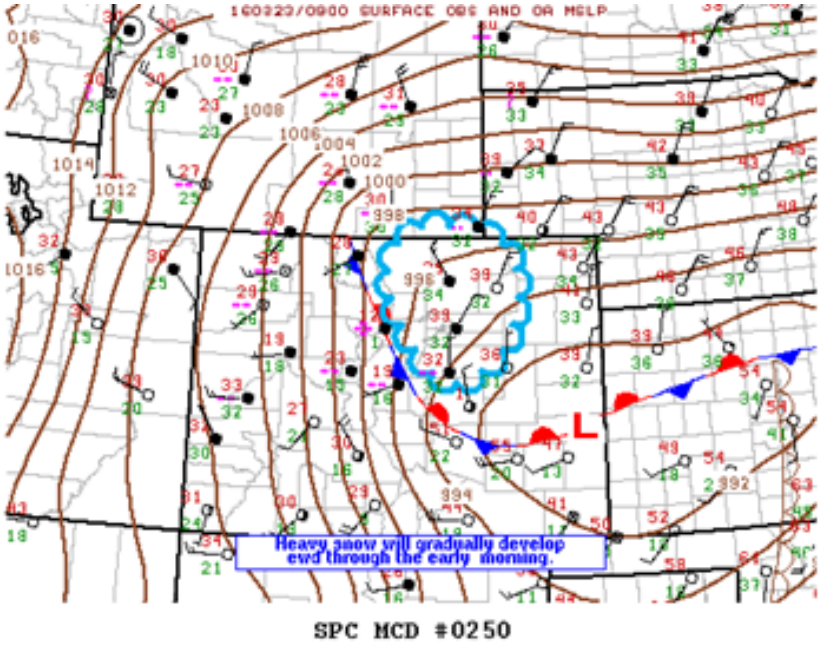
- Hydrology → El Nino of 2015-16 good opportunity to examine various products
  - Note not all of these projects are ripe for this type of study
- CIRA hosting FTP site/data depository
  - Initially start with imagery, but ultimately, data in native resolution with decoders, etc.
- Projects continue to mature, more opportunities to demonstrate the impact on analysis/forecasting/decision making
- Two current case studies:
  - CO Front Range snowstorm – March 23, 2016 (lead J. Forsythe)
  - Houston Texas Area Flooding – Late April 2016 (lead A. Heidinger)

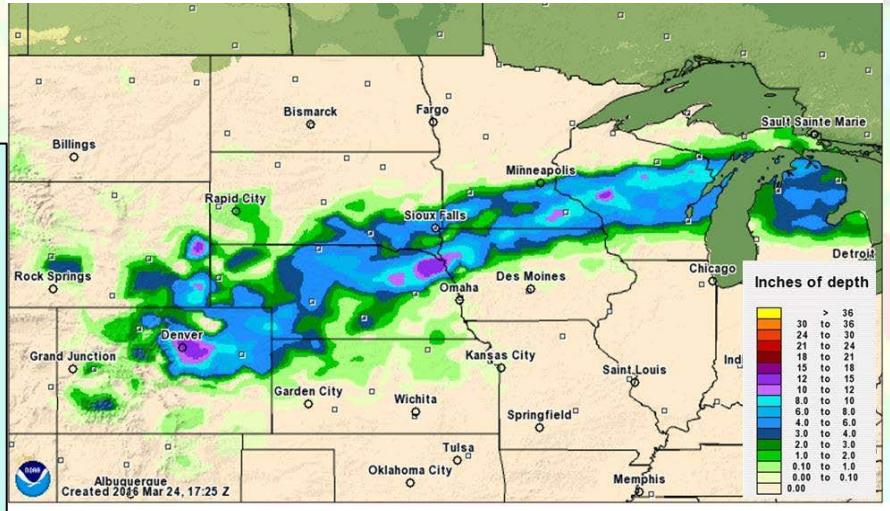
Case 1: March 23-24, 2016 Front Range Blizzard

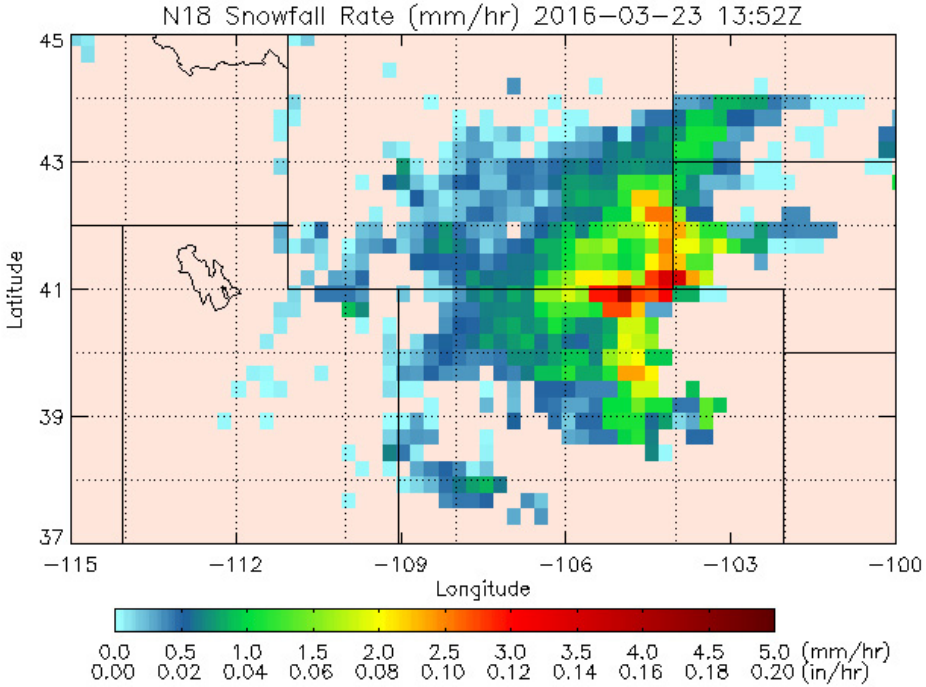
- Interesting synoptic event with very high snowfall rates along Front Range
  - Snowfall rates 2-3"/hr occurred
  - Wetness of snow and strong winds caused extensive power outages

Forecast for Fort Collins for 3/23 morning:
Issued at 4 PM 3/22: Winter Weather Advisory
Issued at 8 PM 3/22: Winter Storm Warning
Issued at 4 AM 3/23: Blizzard Warning

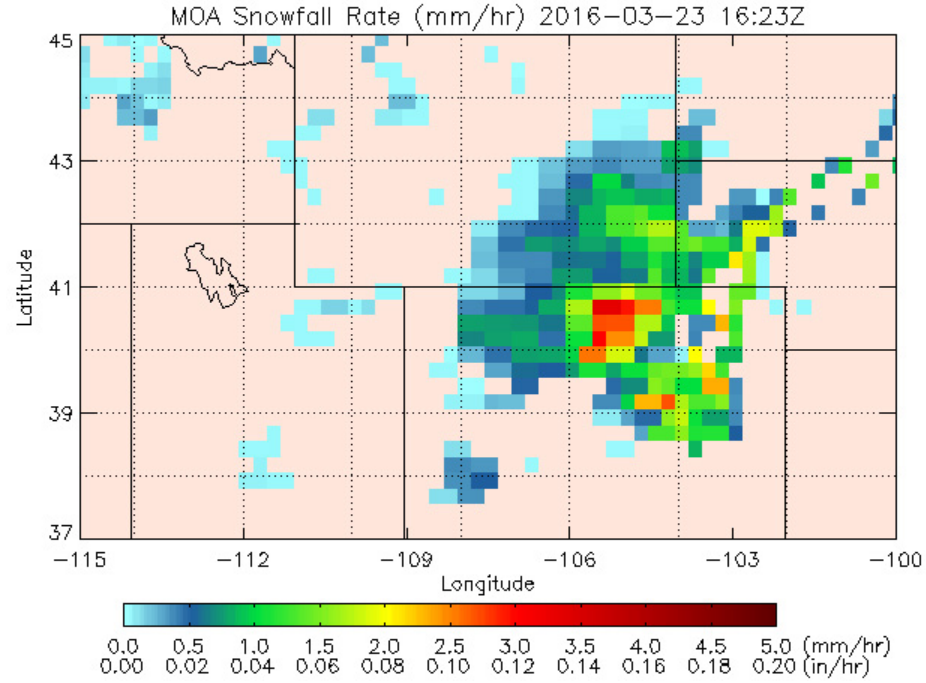
Total: 14" of snow in 7 hours, shut down Fort Collins.
Snowfall rates of 2+" / hour occurred.



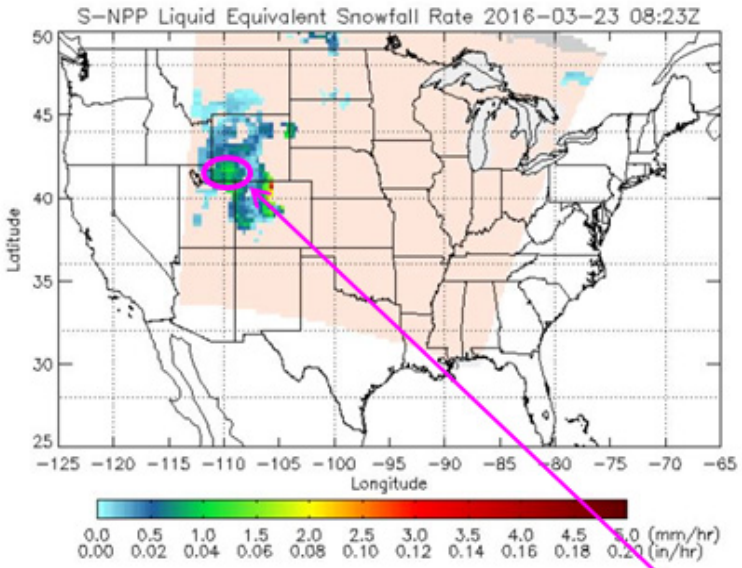


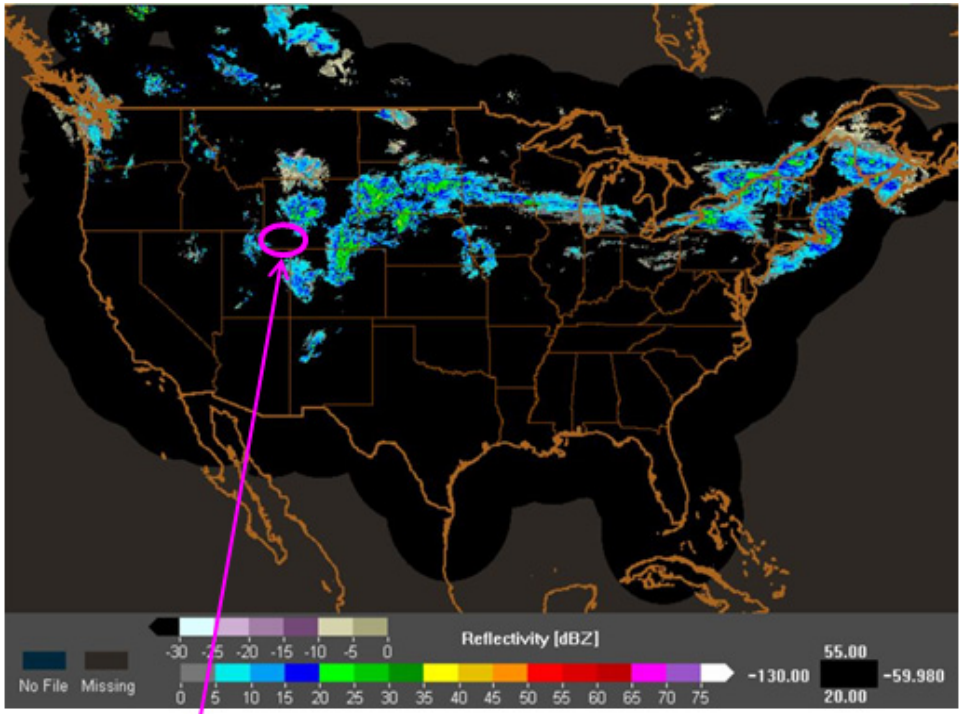


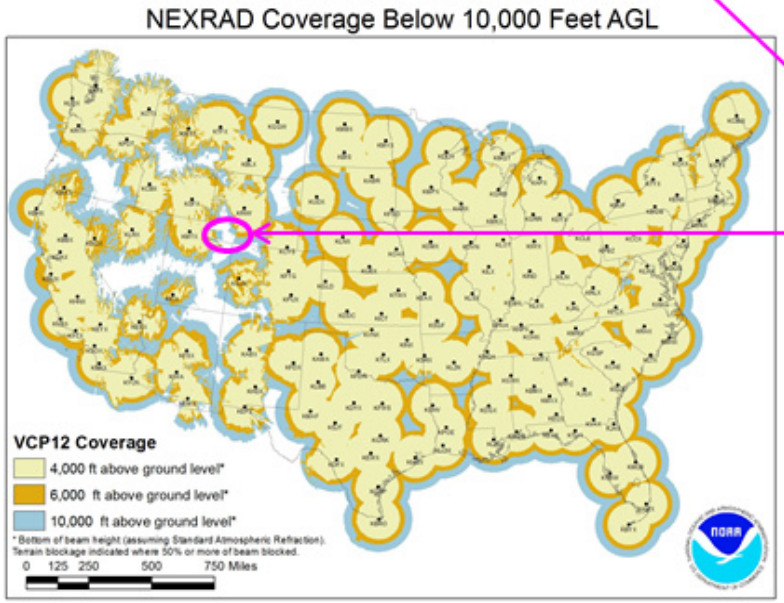
NOAA-18 Liquid Equivalent Snowfall Rate 1345 UTC March 23, 2016 (Blizzard in progress over N. Colorado at this time, 2-3” hour rates reported).



Metop-A Liquid Equivalent Snowfall Rate, 1622 UTC (9:22 AM MST)







Radar gap filled by satellite observation

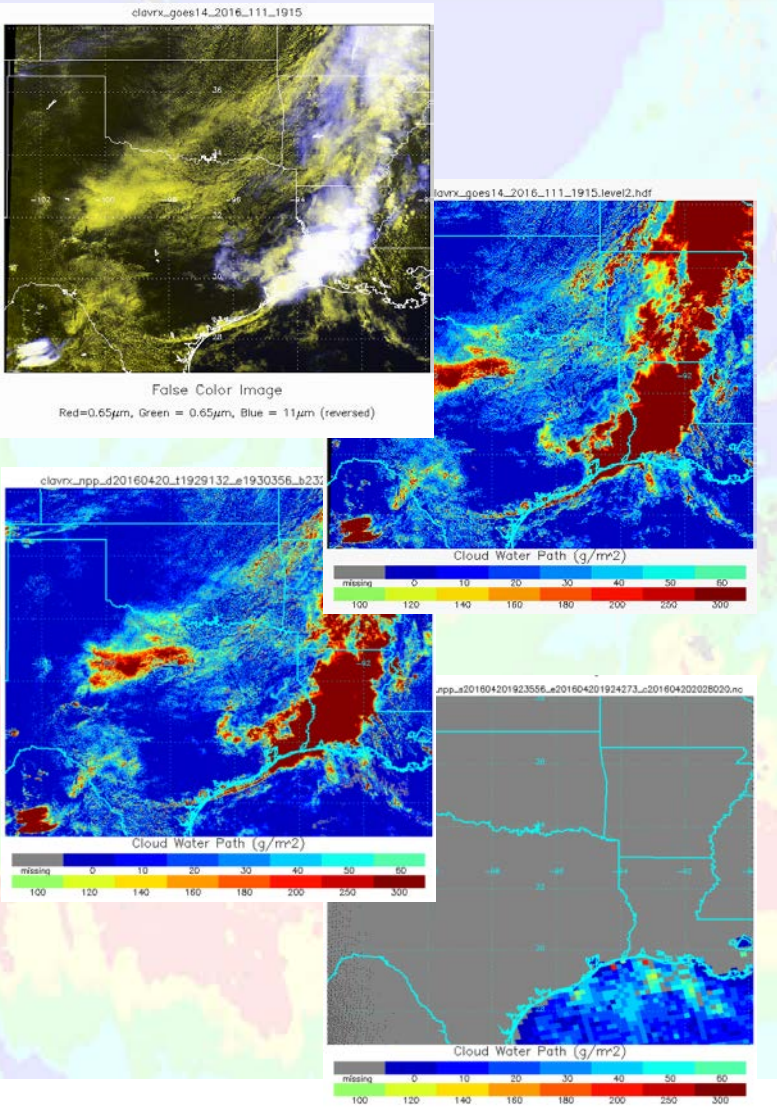
Case 2: Mid-Late April 2016 Texas Flooding

- Up to 17" of rain in Houston area
- Multiple fatalities, damage of ~$5B

Rain rate and water path generated from VIIRS lunar reflectance.
Synergy of GOES-14 1-min data and VIIRS being explored

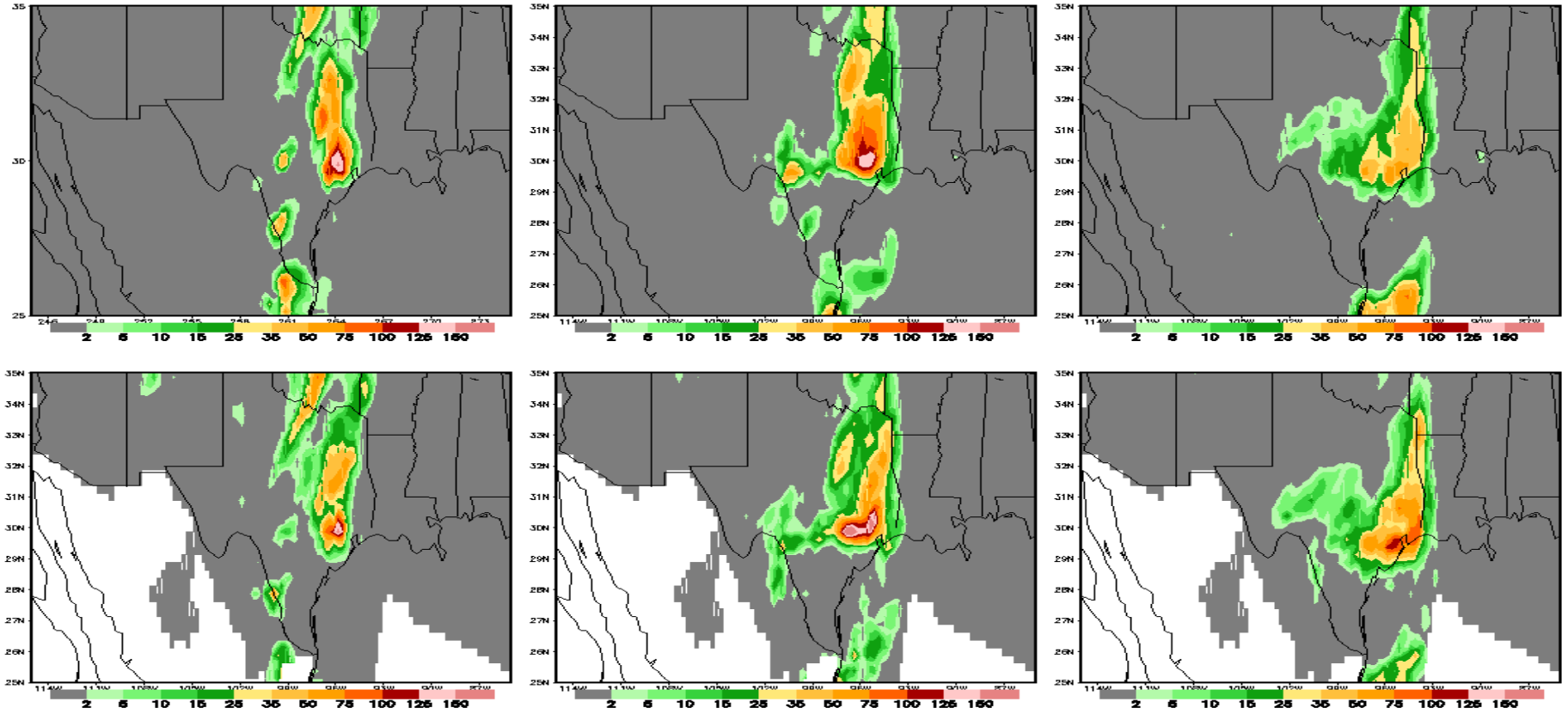
Datasets gathered:

GOES-14
VIIRS
ATMS
RADAR
GCOM-W
LPW
GFS
SCAMPER
GCOM
SMOPS
CMORPH



Texas flooding event 00-18 UTC 18 April 2016

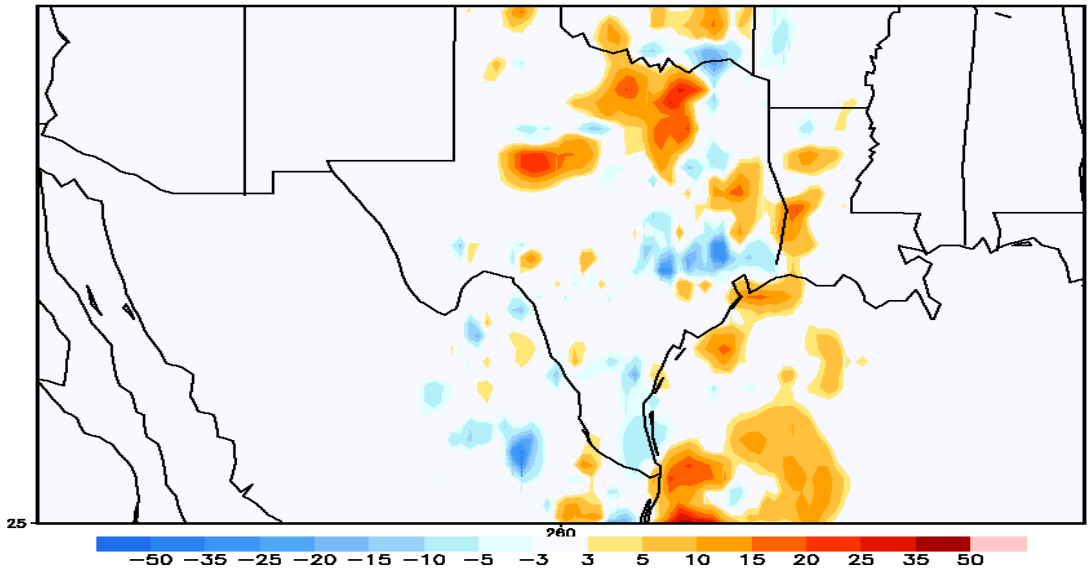
CMORPH with JPSS-ATMS (top) radar (bottom) 6-hour mm total

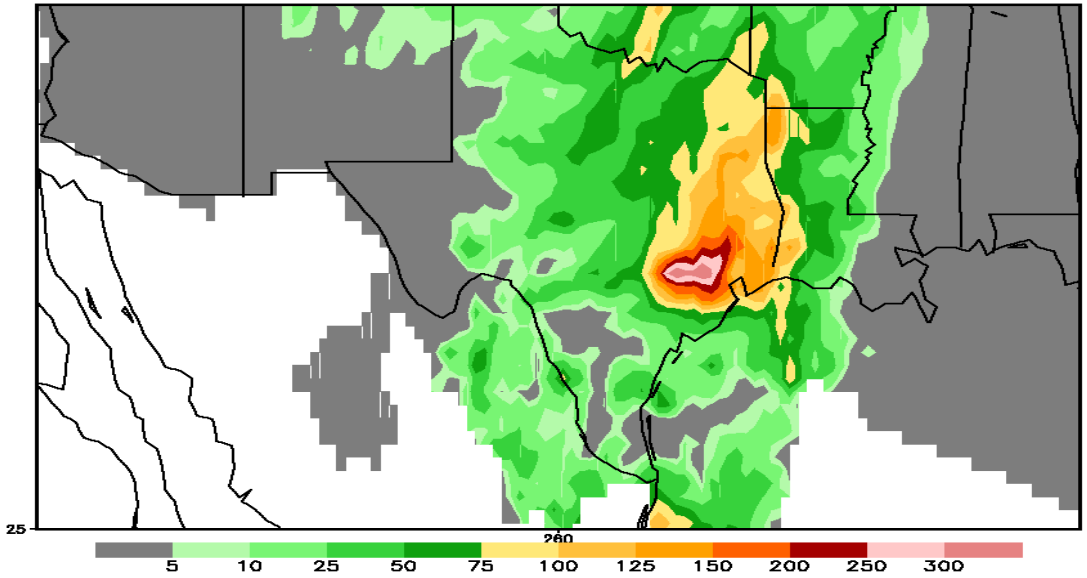


Texas flooding event 18-21 April 2016

With JPSS-ATM –minus w/o JPSS (top) mm

Stage IV radar (bottom) 72-hour mm total





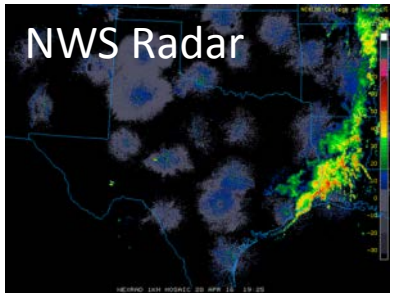
Included in Backup Slides, Summaries of Each Project in the Risk Reduction/Proving Ground – Hydrology Initiative

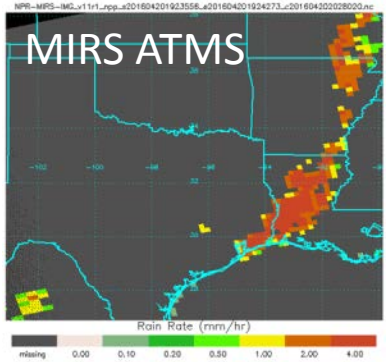
Hydrologic Applications of the VIIRS Cloud Products

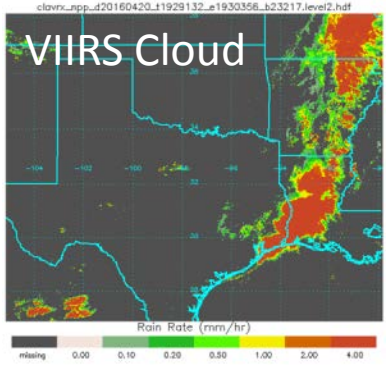
Andi Walther, Andrew Heidinger and Samantha Tushaus

- Objectives
  - Verify the skill in deriving precipitation from VIIRS cloud products and study how they complement other sources (microwave, IR).
  - Explore the accuracy of the cloud water path product from VIIRS and how it can complement that from ATMS (*which lacks coverage over land*)
  - Demonstrate skill with lunar-reflectance to provided unique nighttime ability.
- Primary sensors involved
  - VIIRS including DNB (primary)
  - ATMS (for reference)
- Primary ground data
  - NWS Radar Data
- Targeted end users
  - NWS forecast offices – we think precipitation and water path are better suited for AWIPS displays than the standard cloud optical depth and particle size.

Rain-rates on April 20, 2016 19:30 UTC







Summary and Take Away Points

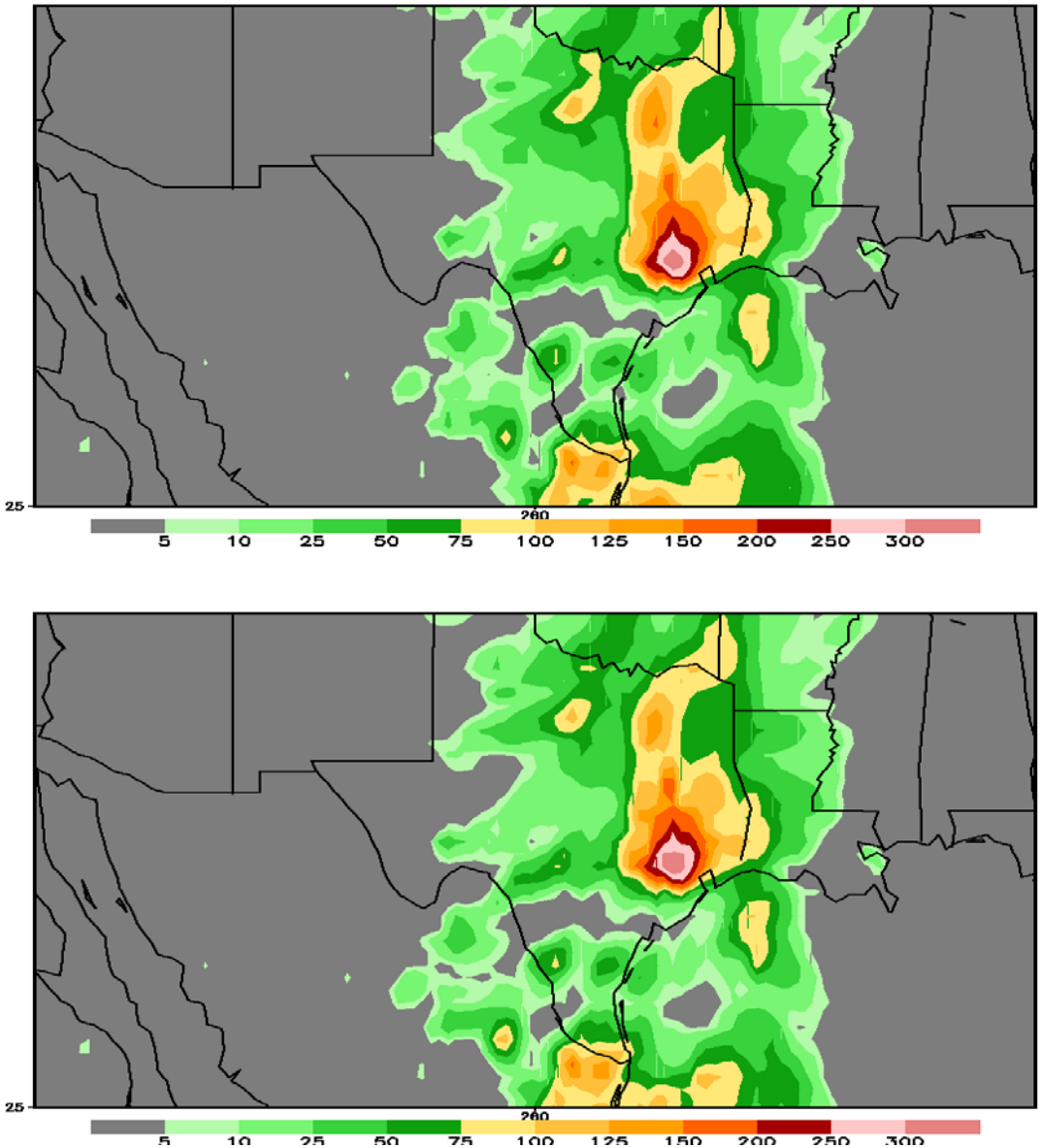
- JPSS is funding a variety of projects related to Hydrology
  - Water vapor, snowfall rates, precipitation, hydrological models, soil moisture, climate data records
  - Some projects are on their second cycle of funding
- Some projects are well engaged with NWS users while others are just starting
  - Engaged with NWSFO's and national centers
  - Have detailed training materials, generally working with NASA/SPoRT and satellite liaisons.
- Some projects are in fact downstream users of some of the hydro. products
- As a way of promoting more end to end use of the products, we are having the PI's collaborate on case studies of interest
  - *If anyone wants to see us focus on a particular case, please let me know!*
  - We plan to develop a publication within 1-year
  - As the case studies mature, we will also engage with other JPSS PGRR initiatives (e.g. NUCAPS)
- Down the road, we hope to engage with similar types of activities under the GOES-R Risk Reduction program

Backup Slides

Hydrology Project Details

Texas flooding event 18-21 April 2016

With/without JPSS-ATM (top/bottom) 72-hour mm totals



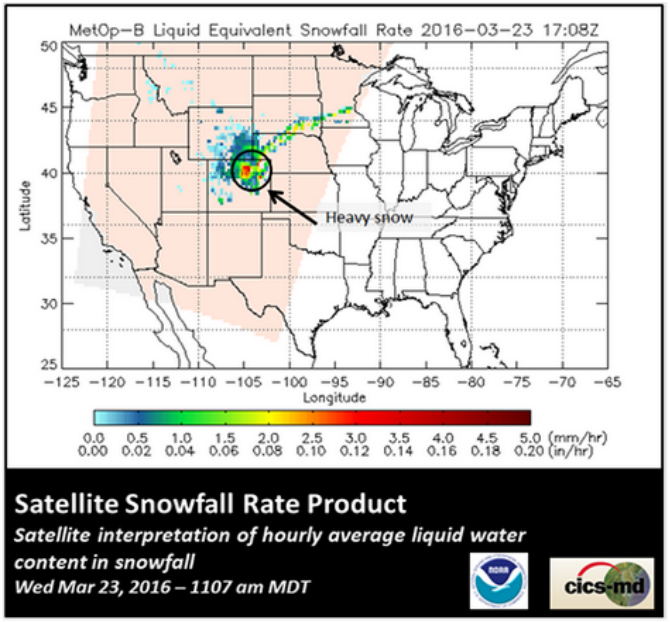
Snowfall Rate Product

Diane Cooper/Sheldon Kusselson

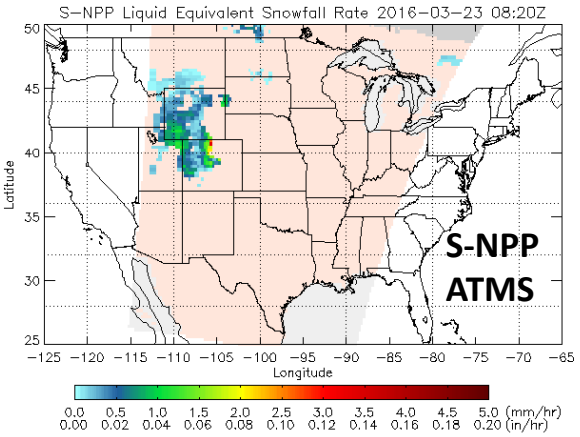
WxIntegrations
March 23 ·

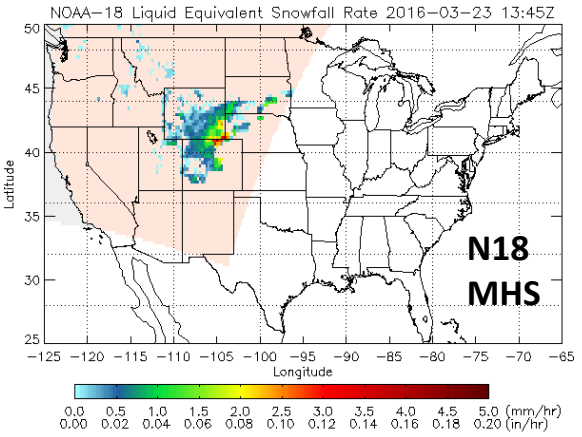
The Colorado Front Range experienced some impressive snowfall rates with the storm this morning. The attached image is the NOAA Satellite Snowfall Rate Product which estimates liquid water content that is in the snow fall. The yellows and brighter reds highlight 0.06 to 0.15 inches of water. Since this was a wet snow, we know the snow ratios were fairly low. Using a ratio of 8 inches of snow to 1 inch of water (8 to 1 ratio) or even a ratio of 10 inches of snow to 1 inch of water (10 to 1 ratio), we can estimate that hourly snowfall rates around 11 am MDT were between 0.5 to 1.5 inches per hour. The snowfall rates were likely heavier in localized areas, but this gives a context of the broader snowfall rates.

While the resolution of the satellite date as is not as fine as radar estimates, it is exceedingly helpful for areas that the radar is blocked such as in hilly or mountainous training or in situations where the radar not seeing the snow.

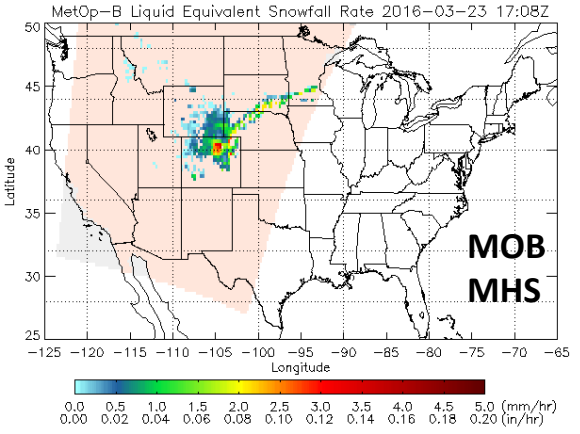


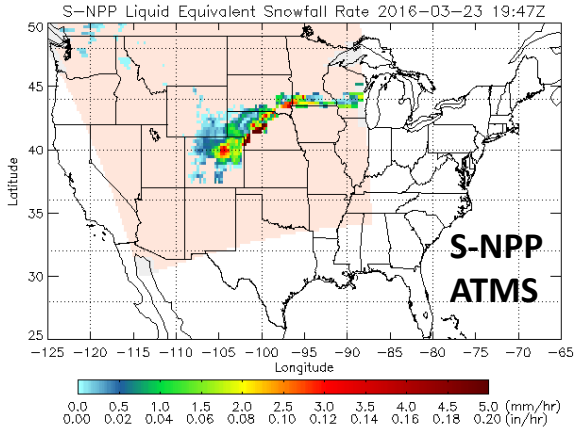
0820 UTC **23 March 2016** **1345 UTC**



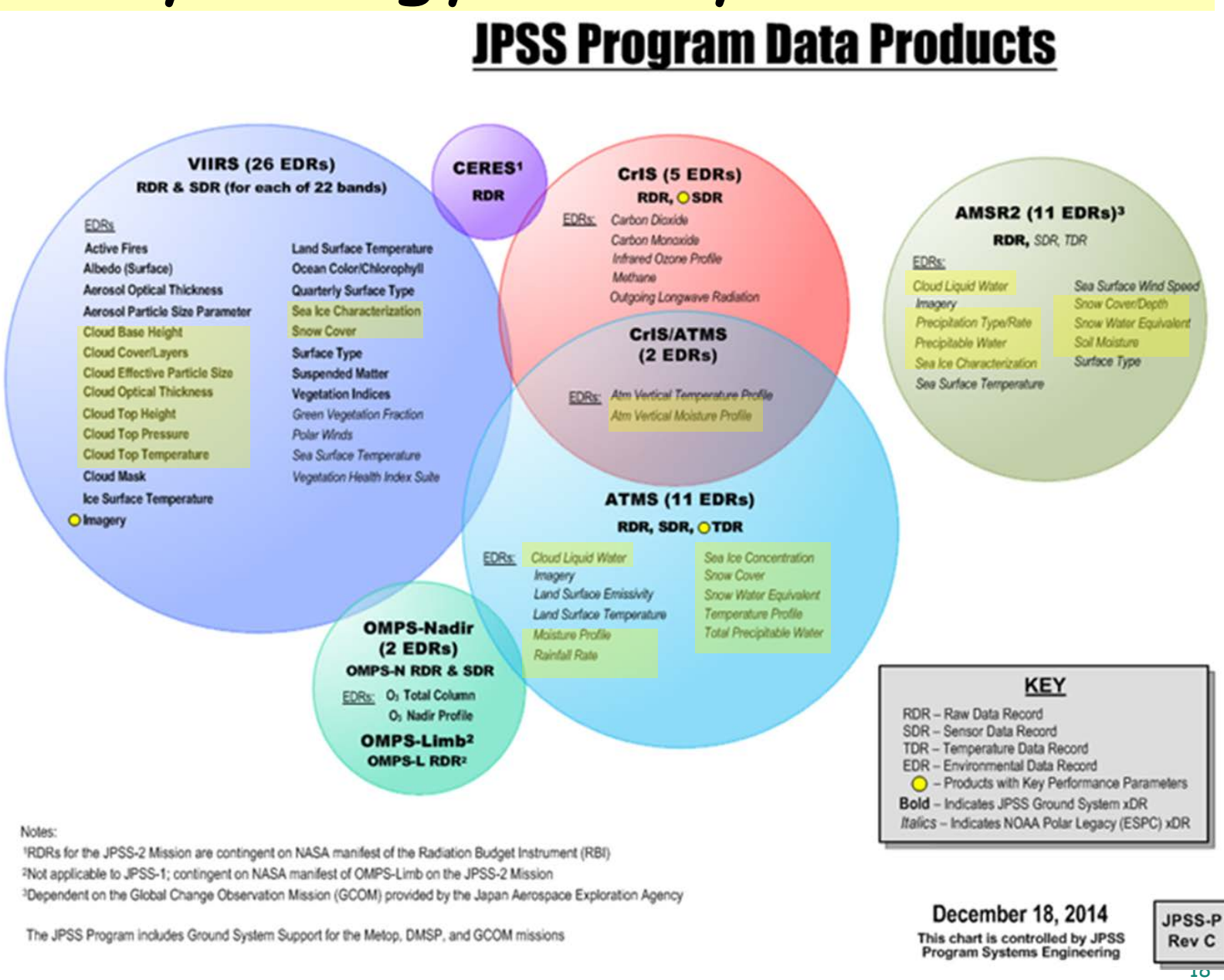


1708 UTC **23 March 2016** **1947 UTC**





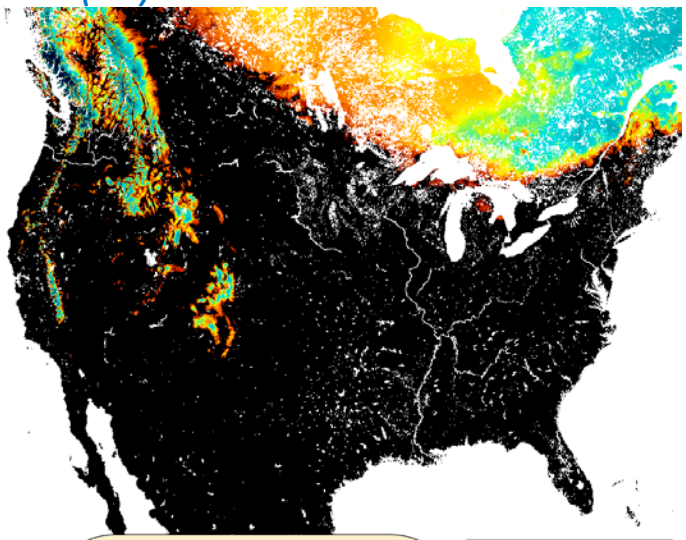
Hydrology – Very Diverse!

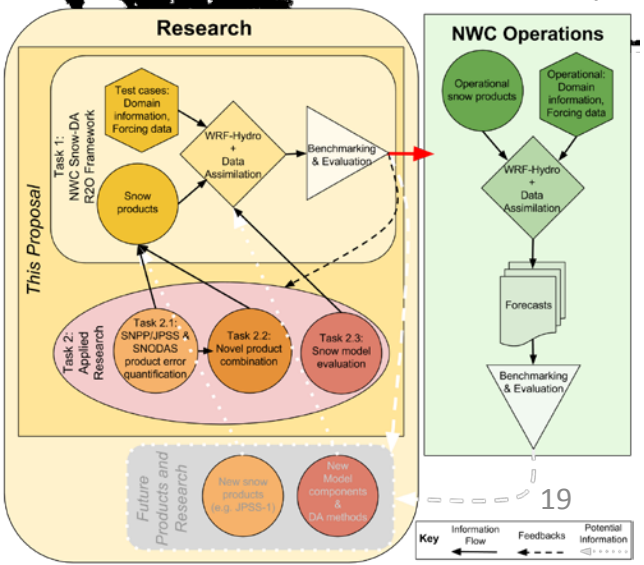


S-NPP/JPSS and SNODAS Applications to the National Water Model

NCAR (Gochis) – NWC (Cosgrove)
NOAA CREST (Romanov) – NCEP (Ek)

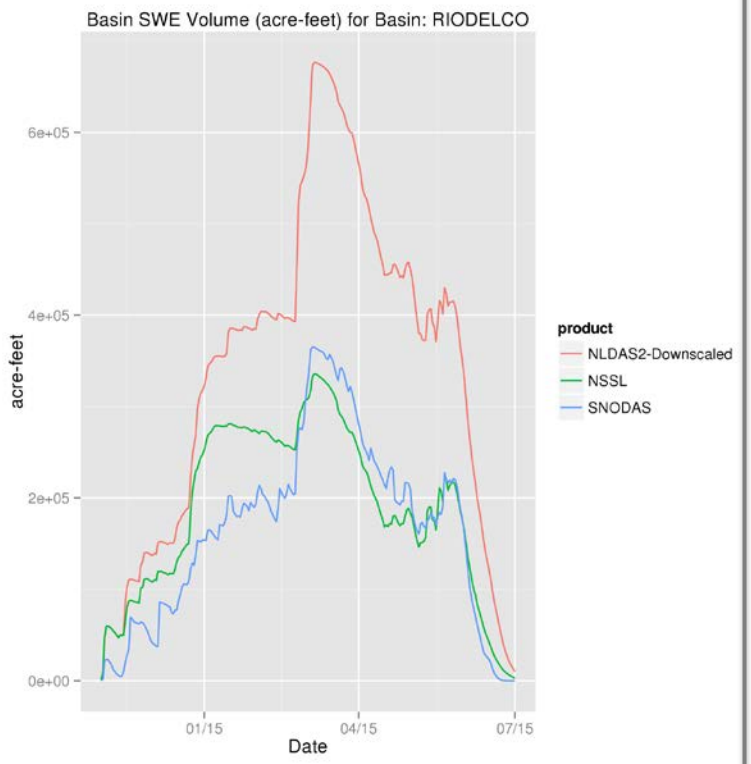
- Objectives
  - Improvement of seasonal streamflow forecasts
    - Assimilation snow observations and SNODAS.
    - Develop error chars of satellite snow obs
    - Combine satellite snow observations
  - Establish and R2O evaluation framework for operational snow products
- Primary sensors involved
  - SNPP satellite:
    - VIIRS snow cover fraction
    - ATMS snow depth and snow water equivalent
  - GCOM-W satellite:
    - AMSR2 snow depth and snow water equivalent
- Primary ground data / ancillary products
  - The SNODAS product & its observations
    - Airborne Gamma
    - Vast point observation data base including SNOTEL, etc.
  - NASA Airborne Snow Observatory
    - LiDAR
    - Hyperspectral (Albedo)
- Targeted end users
  - NWC's National Water Model (NWM)





Project Status/Update

- Accomplishments to date
  - (Not yet funded)
  - Participation in group goals
- Users Engaged to date
  - NWC
  - Colorado Water Conservation Board
  - Colorado Division of Natural Resources
- Near term plans/milestones
  - Compare our forcing product with others in group: development of snow QPE (see figure on right for backgrnd)
  - Establish snow database
- One really interesting result (images on right)

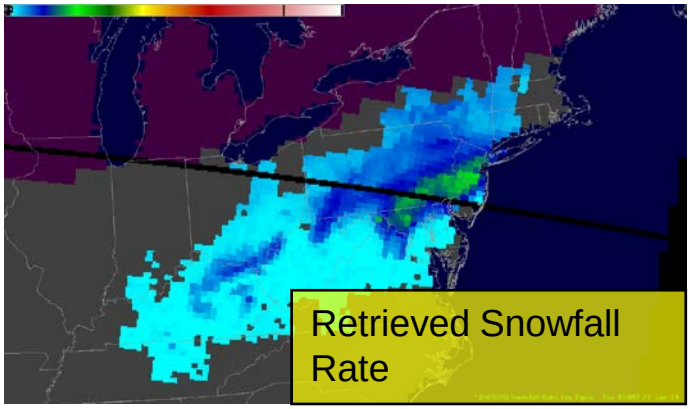


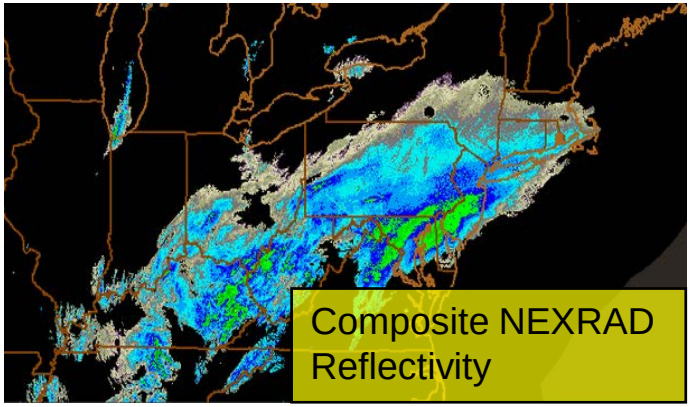
Upper Rio Grande Basin Basin SWE volume uncertainty as a function of forcing product: In-situ-RADAR-based NSSL product improved simulation over NLDAS2 and agreed more with SNODAS.

Continued Expansion, Enhancement and Evolution of the NESDIS Snowfall Rate Product to Support Weather Forecasting

H. Meng, J. Dong, C. Kongoli, R. Ferraro, B. Yan, S. Rudlosky, B. Zavodsky

- Objectives
  - An ATMS snowfall rate (SFR) algorithm was developed previously with the support of JPSS PGRR
  - Improve the SFR algorithm for snowfall associated with low cloud and with dominating emission effect
  - Develop SFR algorithms for SSMIS and GMI sensors
  - Develop prototype over ocean SFR algorithm
- Primary sensors involved
  - ATMS (S-NPP, JPSS)
  - MHS and AMSU pair (POES, Metop)
  - SSMIS (DMSP)
  - GMI (NASA GPM)
- Primary ground data
  - NSSL MRMS radar precipitation
  - NCEI QCLCD gauge
- Targeted end users
  - NWS Weather Forecast Offices (WFOs)
  - National Centers (WPC, SPC)
  - Hydrology community (CMORPH, NWC)

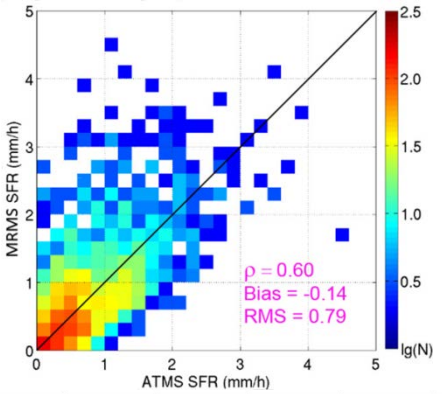


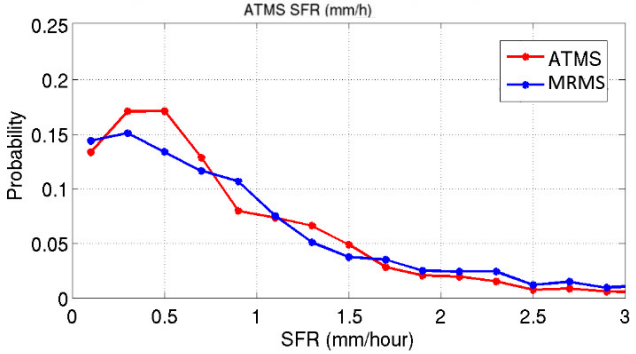


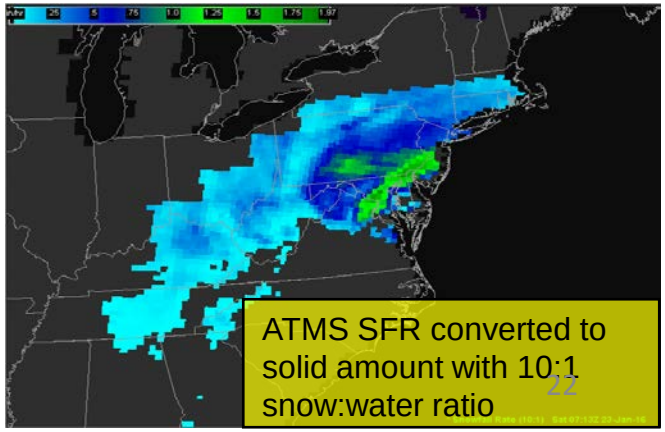
Project Status/Update

- Accomplishments to date
  - Developed a new framework for snowfall detection that can significantly improve probability of detection
  - Completed formulation to incorporate cloud liquid water in the forward radiative transfer model; coding is close to completion
- Users Engaged to date
  - Product assessment in winter 2015-2016 at six WFOs, WPC, SPC, SAB
  - NCEP/CPC, NWC
- Near term plans/milestones
  - Complete development of shallow snowfall detection algorithm
  - Calibrate snowfall rate algorithm after RTM coding is complete
  - Start development of SSMIS snowfall detection algorithm
- One really interesting result (images on right)
  - SFR performed well for the 2016 East Coast Blizzard

ATMS SFR from the East Coast Blizzard
Jan 22-23, 2016



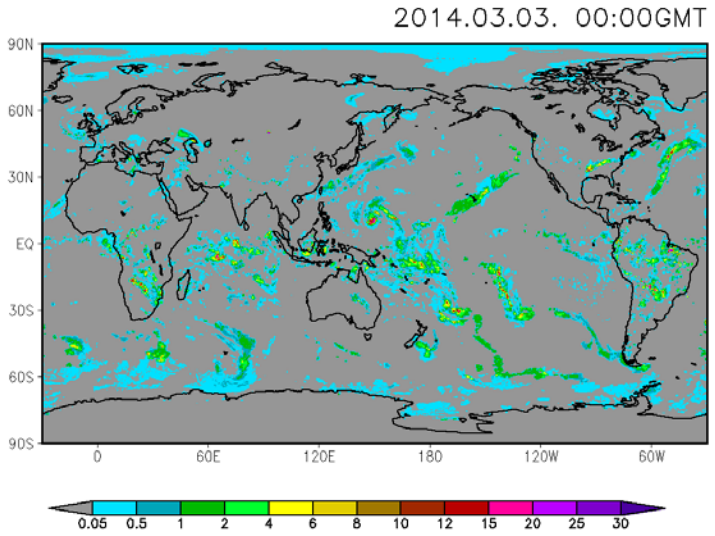




Infusing JPSS PMW Retrievals to CMORPH Precipitation Estimates for Improved Weather, Climate, and Water Applications

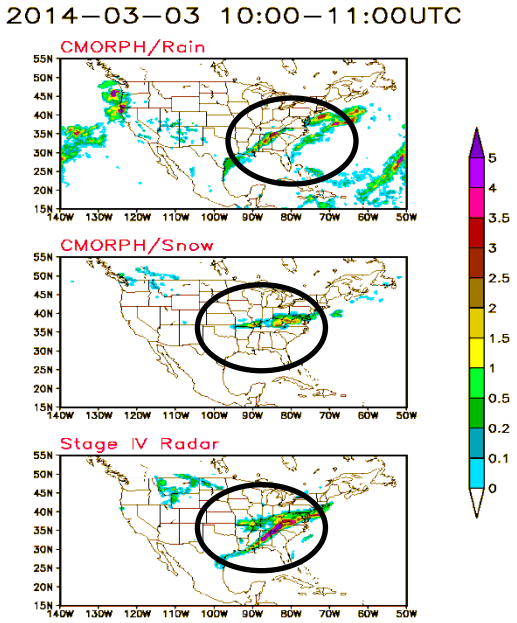
P. Xie, R. Joyce, S. Wu and collaborators

- Objectives
  - *To improve CMORPH integrated precipitation estimates through infusing retrievals from JPSS sensors*
    - Pole-to-pole coverage
    - Snowfall rate representation
    - Improved accuracy / reduced latency
- Primary sensors involved
  - *ATMS, VIIRS*
- Primary ground data
  - Gauge measurements of precipitation
- Targeted end users
  - *NHC, WPC, EMC, CPC and field offices*
  - National / international centers, research institutes, universities, governments, private industries (>100s)



Project Status/Update

- Accomplishments to date
  Component techniques developed; Test system established
- Users Engaged to date
  - We have been communicating with our users in several key areas (CPC, EMC, NHC, et al) with regard to their users requirements
- Near term plans/milestones
  - Real-time production of the pole-to-pole CMORPH (this coming summer)
  - *Reprocessing the new CMORPH for the JPSS era (?)*
- One really interesting result (images on right)
  - Improved capacity in detecting snowfall rate (left figure) and quantification for storm rainfall (right figure)



CMORPH w/o SFR retrievals

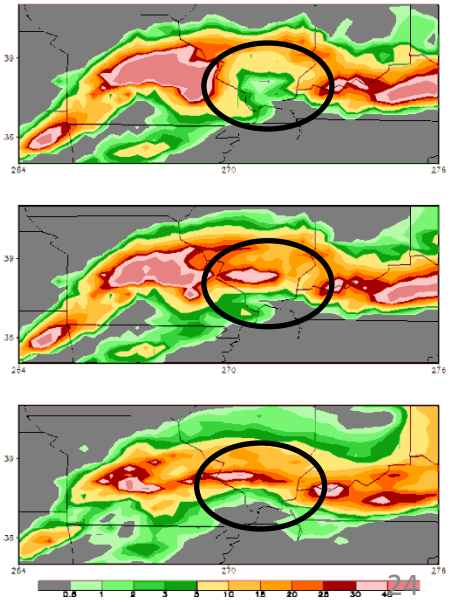
CMORPH with SFR retrievals

Stage IV Radar Est

CMORPH w/o SNPP

CMORPH with SNPP

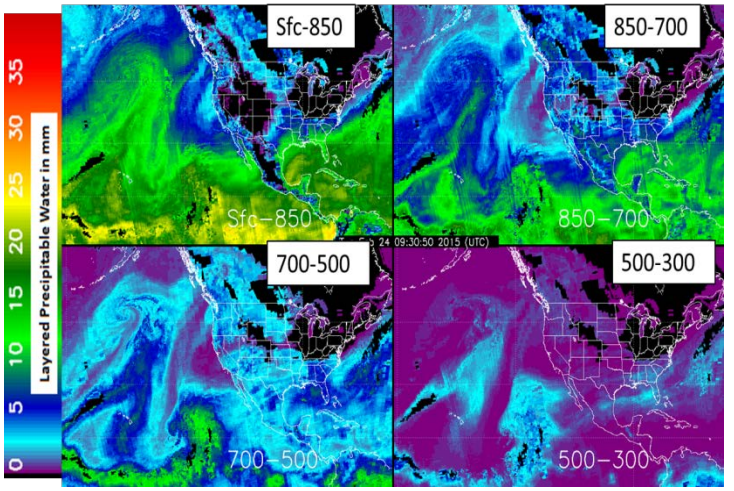
Stage IV Radar Est



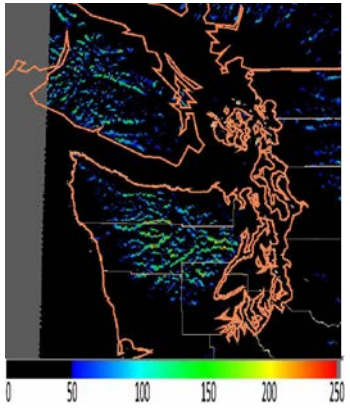
Using JPSS Retrievals to Implement a Multisensor, Synoptic, Layered Water Vapor Product for Forecasters

John Forsythe, Andy Jones, Stan Kidder, Dan Bikos, Ed Szoke
Cooperative Institute for Research in Atmosphere (CIRA),Colorado State University

- Objectives
  - Blend multiple polar soundings of layer precipitable water (LPW) and advect through time to benefit forecasters
  - Update the orographic rain index (ORI)
  - Obtain feedback and develop training materials
- Primary sensors involved
  - S-NPP (ATMS), DMSP F18/~~19~~ (SSMIS), NOAA-18/19 (AMSU-A/MHS), Metop-A/B 9(MHS); all via NOAA MiRS retrieval system.
  - NASA Aqua (AIRS); NUCAPS products
- Primary ground data
  - Radiosondes
  - GFS 0-6 hour forecasts
- Targeted end users
  - National centers (WPC, NHC, SPC, OPC, AWC)



Example of 4-layer blended LPW product produced in near-realtime at CIRA at 0900 UTC 24 February 2015.



ORI product at 00 UTC 14 Feb. 2010. Units are mm * m/s.

Project Status/Update

- Accomplishments to date
  - Product served in near-realtime to national centers.
  - S-NPP MiRS V11 (high resolution (~15 km)) retrievals now included in product
- Users Engaged to date
  - WPC, NHC, SPC, OPC, + WFO's (e.g. Tucson AZ) with data routed via NASA SPoRT
- Near term plans/milestones
  - Develop the advection component by combining GFS winds with the layered water vapor
  - Continue to receive forecaster feedback
- One really interesting result (images on right)
  - Played a key role in understanding the many sources of moisture for record flooding in South Carolina in late September. 12 SOO's briefed via VISIT chat.

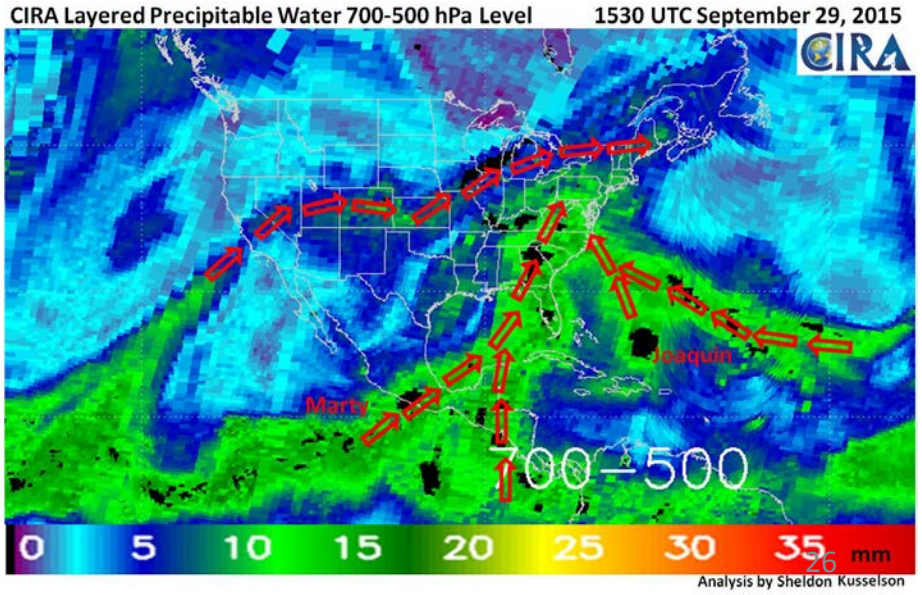
MESOSCALE PRECIPITATION DISCUSSION 0530
NWS WEATHER PREDICTION CENTER COLLEGE PARK MD
1016 AM EDT TUE SEP 29 2015

CONCERNING...HEAVY RAINFALL...FLASH FLOODING LIKELY

SUMMARY...A TROPICAL AIRMASS WITH NEAR RECORD PRECIPITABLE WATER WILL RESULT IN A CONTINUED FLOOD AND FLASH FLOOD THREAT INTO THIS AFTERNOON.

...

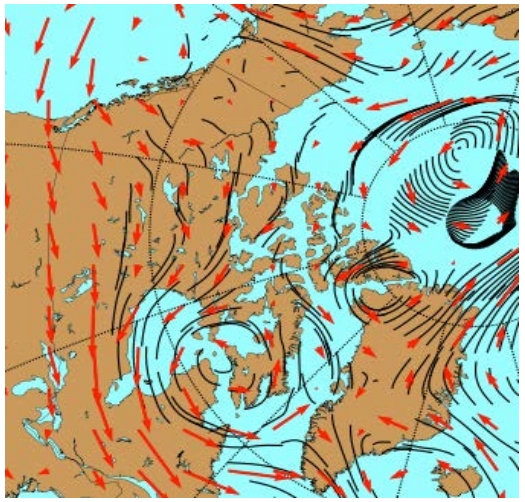
FORCING FROM THE SHORTWAVE IN GA AND A GENERALLY DIVERGENT PATTERN ALOFT IS HELPING FORCE ASCENT ON THE LARGE SCALE...WITH 20-30 KTS OF LOW LEVEL UPSLOPE FLOW AIDING IN LIFT. LAYERED PRECIPITABLE WATER PRODUCTS SHOW AN IMPRESSIVE COMBINATION OF FACTORS CONTRIBUTING TO THE NEAR RECORD PRECIPITABLE WATER VALUES ACROSS THIS REGION. A CONNECTION TO THE PACIFIC AND TROPICAL STORM MARTY CAN BE SEEN IN THE MID/UPPER LEVELS...WITH A DEEP LAYER CONNECTION TO THE GULF OF MEXICO AND ALSO TROPICAL STORM JOAQUIN IN THE ATLANTIC. THIS IS ALL RESULTING IN A VERY EFFICIENT ATMOSPHERE FOR HEAVY RAIN RATES. THE ONE THING LACKING IS INSTABILITY...BUT AT LEAST SOME DOES EXIST ACROSS THE AREA AS NOTED BY SOME LIGHTNING AND COLDER CLOUD TOPS…



Strengthening TPW visualization in the OCONUS domain with JPSS data products

Tony Wimmers, Chris Velden, Jordan Gerth, Bill Ward, Carven Scott, Kennard Kasper, Xiwu Zhan

- Objectives
  - 1) Add SNPP ATMS and AMSU/MHS to the hourly, morphed-composite MIMIC-TPW product and ready the system for JPSS
  - 2) Streamline the algorithm and extend the product domain to 70°N-70°S
  - 3) Direct all development toward a future merger with the Blended TPW product
- Primary sensors involved
  - SNPP ATMS, AMSU/MHS, SSMIS
- Targeted end users
  - 1) Operational NWS forecasters in the OCONUS domain
  - 2) Tropical weather and tropical cyclone forecasters (NHC, JTWC) and global partners

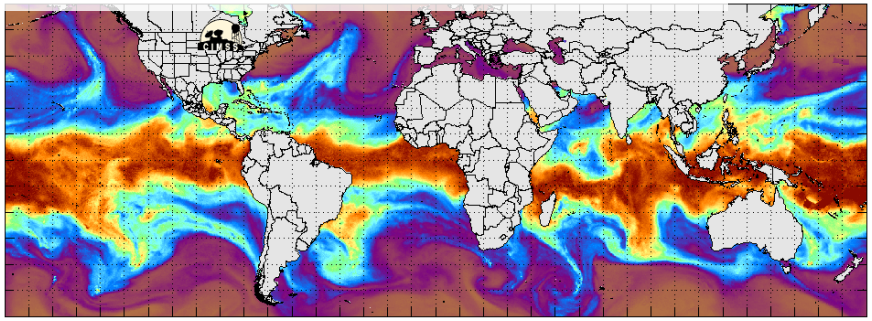


Example of improved data advection scheme
Red: GFS surface winds,
Black: 10-hour Runge-Kutta trajectories used for image morphing of TPW

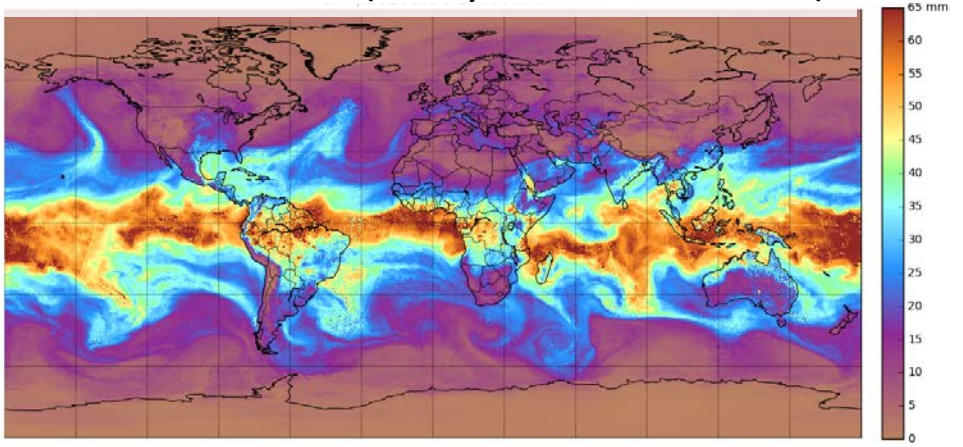
Project Status/Update

- Accomplishments to date
  - 1) Rewrote the algorithm for full portability (Python language, DDS input, NetCDF/AWIPS output)
  - 2) Producing full-globe retrievals (beyond original proposal of 70°N-70°S over water)
  - 3) New algorithm has improved accuracy and 10x improvement in speed
- Users Engaged to date
  - Honolulu, Anchorage, Key West WFOs
- Near term plans/milestones
  - 1) Bring MIMIC-TPW ver 2 online in real-time
  - 2) Engage users with in-person consultation and online materials
- One really interesting result (images on right)
  - Using MIRS ver11.2 retrieval of TPW provides a composite with good intercalibration, 3x higher resolution than MIRS ver9, and no gaps in data.

MIMIC-TPW ver 1 (existing product)



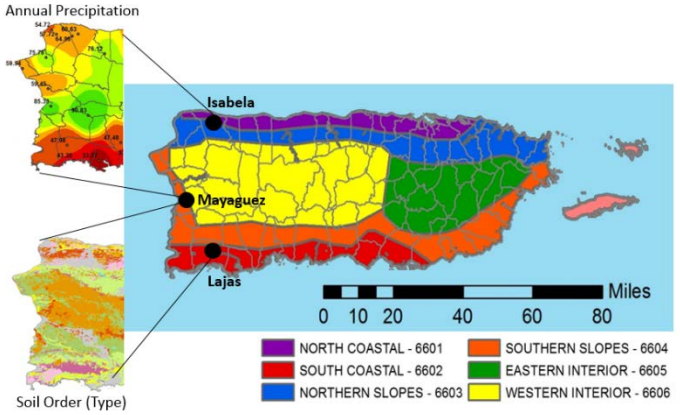
MIMIC-TPW ver 2 (ready in summer 2016)

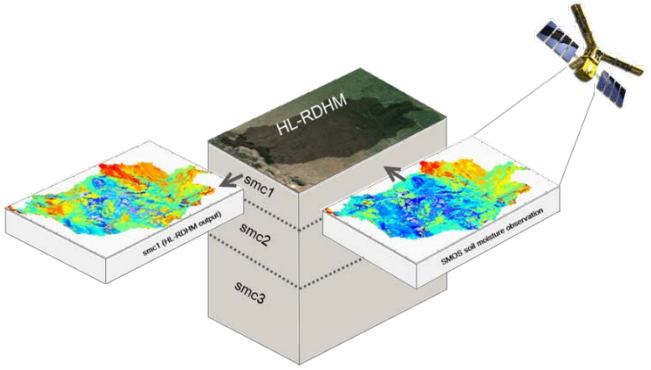


Validation and Application of JPSS/GCOM-W Soil Moisture Data Product for operational flood monitoring in Puerto Rico

Tarendra Lakhankar, Jonathan Munoz, Reza Khanbilvardi, and Nir Krakauer
Xiwu Zhan, Jorge Rivera-Santos, and Reggina Cabrera (Collaborators)

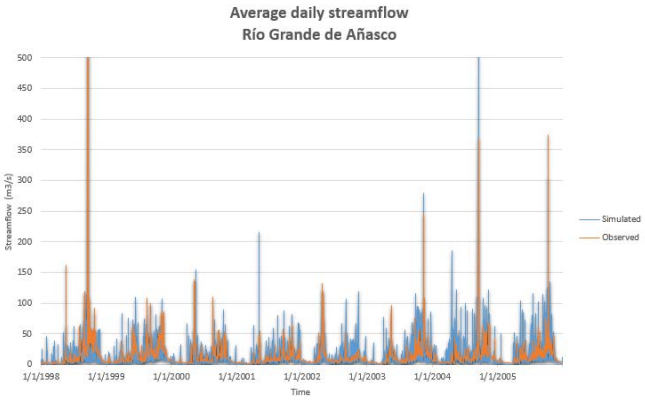
- Objectives
  - Validation of GCOM-W Soil Moisture Data Product using field measurements
  - Field Experiment using L-band Radiometer for GCOM-W soil moisture
  - Development of framework for GCOM-W soil moisture in Flash Flood Guidance System in Puerto Rico
- Primary sensors involved
  - GCOM-W1/AMSR2
  - SMOS and SMAP
- Primary ground data
  - L-Band dual polarized microwave radiometer
  - Soil moisture, vegetation and ancillary data
- Targeted end users
  - WFO/NWS (San Juan)
  - NESDIS/STAR (Cal/Val)





Project Status/Update

- Accomplishments to date
  - Soil moisture field experiment carried out during Feb 2016 at Western part of Puerto Rico
  - Data acquisition and processing of GCOM-W, SMOS, and SMAP microwave sensors and in-situ soil moisture and ancillary data
- Users Engaged to date
  - NWS/WFO San Juan
  - NESDIS/STAR
- Near term plans/milestones
  - Cross-comparison and validation of GCOM-W1/AMSR2, SMOS, and SMAP soil moisture data using in-situ soil moisture data in Puerto Rico
  - Identification of framework for GCOM-W1/AMSR2 soil moisture in Flash Flood Guidance System in Puerto Rico
  - Second round of field experiment for quantification of the effect of land cover heterogeneity in summer 2016
- One really interesting result (images on right)
  - None

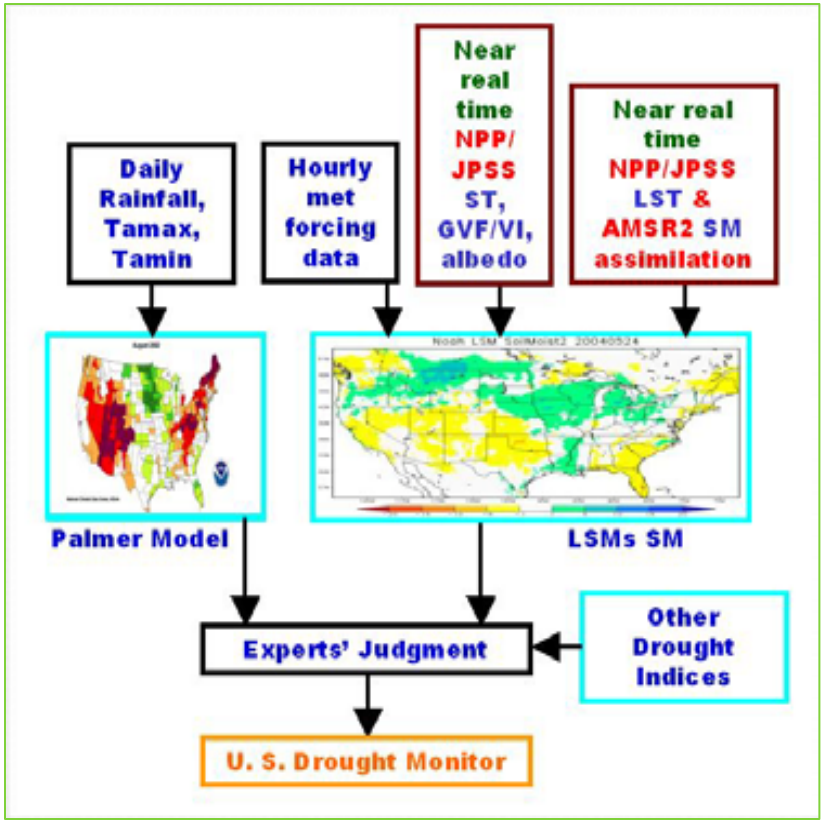


Simulation of streamflow using a conceptual empirical model for the Río Grande de Añasco watershed, PR

Enhance Agricultural Drought Monitoring Using SNPP/JPSS Land EDRs for NIDIS

X. Zhan, C. Hain, J. Yin, J. Liu, L. Fang, M. Ek, J. Huang, M. Anderson, M. Svoboda

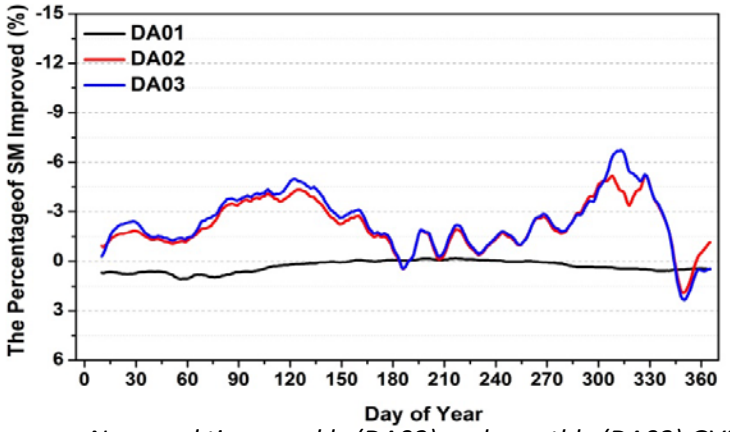
- Objectives
  - Improve current US and global drought monitoring via using near real time SNPP/JPSS land data products
- Primary sensors involved
  - S-NPP/VIIRS
  - GCOM-W1/AMSR2
- Primary ground data
  - Palmer Drought Severity Index
  - In situ soil moisture measurements from USDA SCAN/NOAA CRN ground networks
- Targeted end users
  - NIDIS of USDA, NOAA and USGS
  - NWS-NCEP



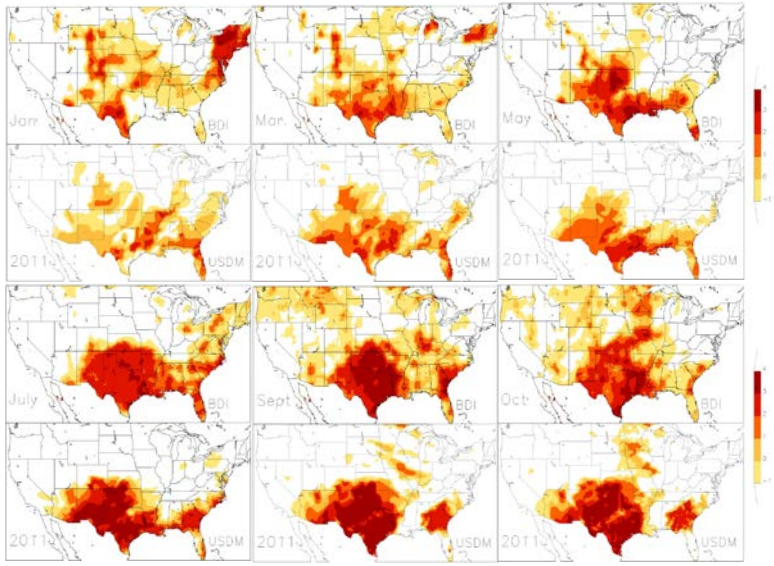
Data flow of Weekly US Drought Monitor (USDM) Generation

Project Status/Update

- Accomplishments to date
  - The most recent surface type data improves Noah model soil moisture simulations
  - Results indicated that NRT JPSS/GCOM land data of GVF and SM may improve Noah model soil moisture estimates and in turn enhances drought monitoring
  - Blending various soil moisture estimates or satellite retrievals generates better drought index (BDI)
  - Four refereed journal papers appeared and two more will be forthcoming
- Users Engaged to date
  - NCEP EMC/CPC drought related research/operations
  - NIDIS of USDA, NOAA and USGS
- Near term plans/milestones
  - Give a talk to national NLDAS monthly telecon on results from this project before project ends in May 2016
  - Further validate the BDI for longer time periods (e.g. 1980-current year) and submit two more journal papers
- One really interesting result (images on right)
  - BDI compared with US drought Monitor (see lower right comparing images)



Near real time weekly (DA02) and monthly (DA03) GVF data improved Noah LSM soil moisture simulations while NRT albedo (DA01) did not for 2012 data.



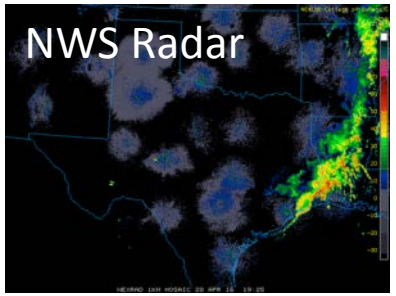
Blended Drought Index (BDI) Compared with USDM

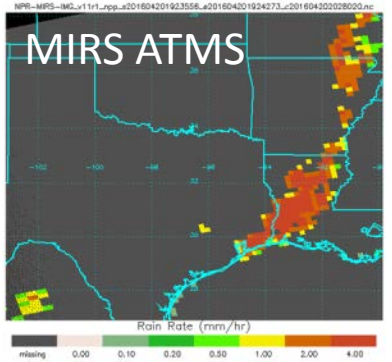
Hydrologic Applications of the VIIRS Cloud Products

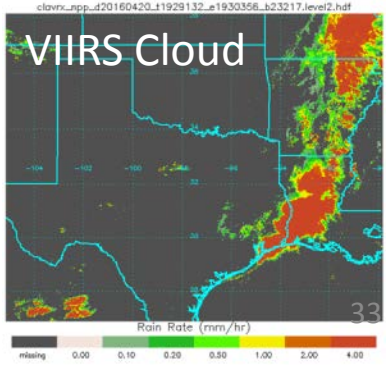
Andi Walther, Andrew Heidinger and Samantha Tushaus

- Objectives
  - Verify the skill in deriving precipitation from VIIRS cloud products and study how they complement other sources (microwave, IR).
  - Explore the accuracy of the cloud water path product from VIIRS and how it can complement that from ATMS (*which lacks coverage over land*)
  - Demonstrate skill with lunar-reflectance to provided unique nighttime ability.
- Primary sensors involved
  - VIIRS including DNB (primary)
  - ATMS (for reference)
- Primary ground data
  - NWS Radar Data
- Targeted end users
  - NWS forecast offices – we think precipitation and water path are better suited for AWIPS displays than the standard cloud optical depth and particle size.

Rain-rates on April 20, 2016 19:30 UTC



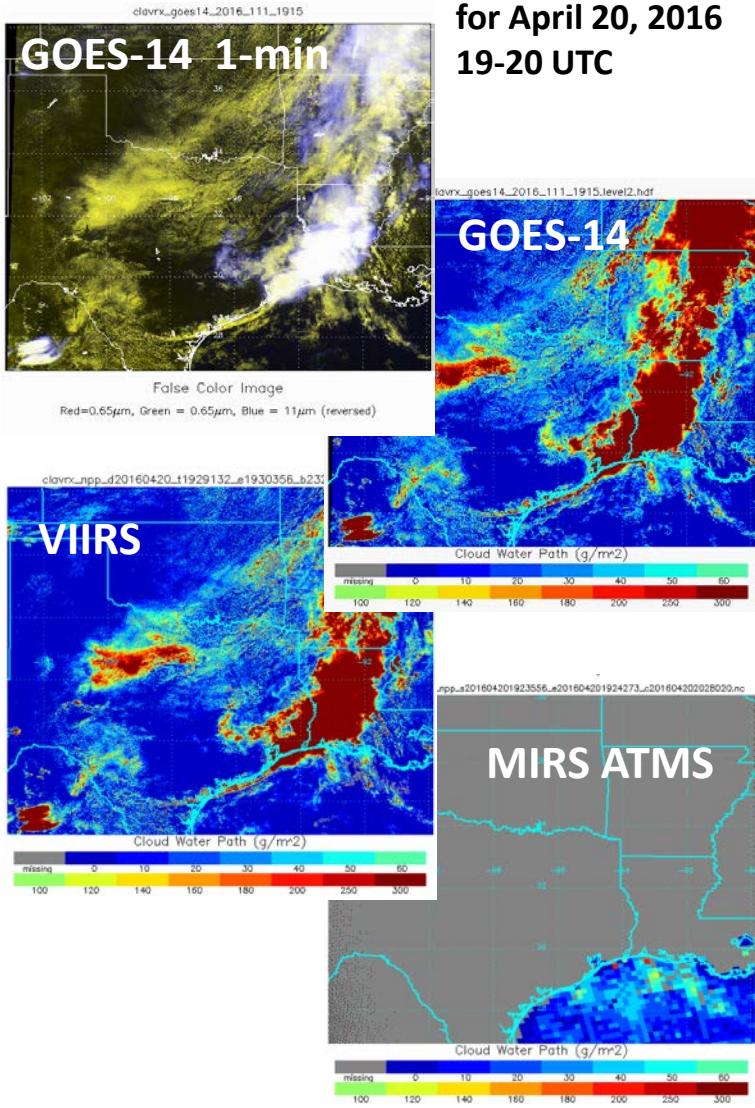




Project Status/Update

- Accomplishments to date
  - The KNMI (Dutch Met Agency's) cloud product precipitation implemented on VIIRS in CLAVR-x.
  - Rain rate and water path generated from VIIRS Lunar reflectance.
  - Generated data for 2 JPSS Hydro test cases
- Users Engaged to date
  - None yet, cloud-derived hydro products are still being tested.
- Near term plans/milestones
  - Analyze April 20,2016 case (Houston Floods)
  - Explore remaining issues with VIIRS lunar products.
- One really interesting result (images on right)
  - April 20, 2016 had GOES-14 1-minute data.
  - We are exploring the synergy of the high temporal GOES and high spatial VIIRS for this significant hydrological event.

Cloud Water Path for April 20, 2016 19-20 UTC



Case 1: Atmospheric River, California, January 5 2016

MESOSCALE PRECIPITATION DISCUSSION 0001
NWS WEATHER PREDICTION CENTER COLLEGE PARK MD
544 AM EST TUE JAN 05 2016

AREAS AFFECTED...CENTRAL CA COAST...SRN CA

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

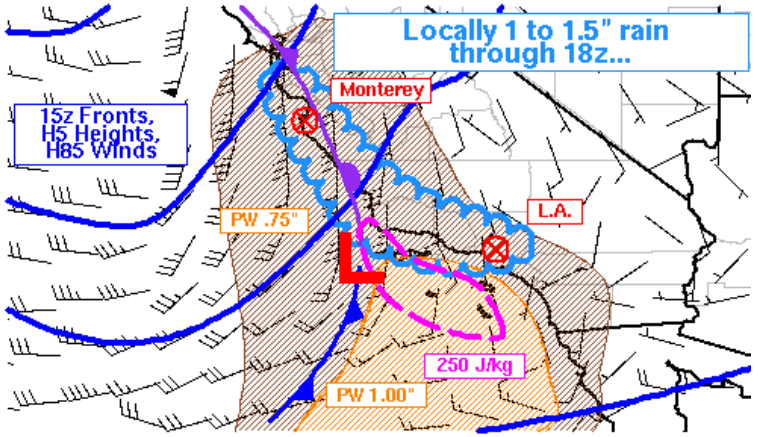
VALID 051043Z - 051643Z

SUMMARY...RAIN RATES WILL INCREASE ALONG THE CENTRAL AND SOUTHERN CALIFORNIA COAST EARLY THIS MORNING...AND HEAVIER RAIN WILL BEGIN TO SPREAD INTO THE L.A. BASIN AROUND 15Z. FLASH FLOODING IS POSSIBLE.

DISCUSSION...STRONG ASCENT WILL ACCOMPANY AN OCCLUDED FRONT COMING ONSHORE ALONG THE LENGTH OF THE CA COAST...AND ASSOCIATED POSITIVE TILT UPPER TROUGH...WITH LATER EMPHASIS FOR HEIGHT FALLS IN THE BASE OF THE TROUGH ALONG THE SOUTHERN CALIFORNIA COAST. ALTHOUGH LIGHTNING HAD NOT BEEN DETECTED AS OF 1030Z...RADAR AND SATELLITE PRESENTATION WAS IMPRESSIVE NEAR AND OFFSHORE OF MONTEREY...WHERE CLOUD TOPS HAD COOLED TO -40C...AND CONVECTIVE RADAR ELEMENTS WERE TRACKABLE...NOT SIMPLY HIGH REFLECTIVITY DUE TO BRIGHT BANDING. SURFACE OBSERVATIONS HAD BEGUN TO SAMPLE HEAVY RAIN AND ACCUMULATIONS EXCEEDING A HALF INCH PER HOUR IN THE BAY AREA.

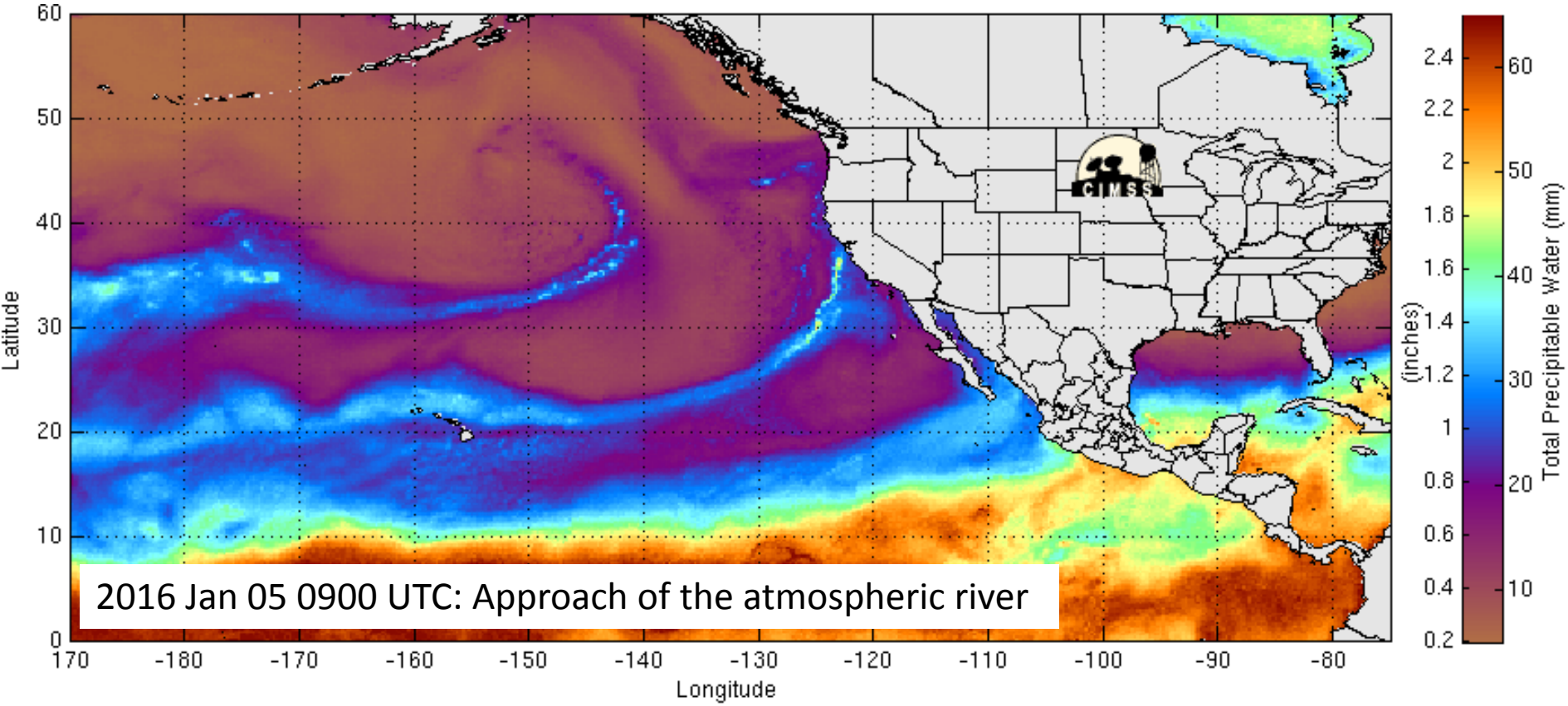
A FRONTAL PRECIPITATION BAND WILL PROGRESS STEADILY EASTWARD...WITH THE BACK EDGE COMING SOUTH ALONG THE COAST THIS MORNING. EXPECTATIONS PER THE HIGH RESOLUTION MODELS ARE FAIRLY UNIFORM...WITH AREAL AVERAGE 0.50 TO 1.0 INCHES OF RAIN THROUGH 18Z...BUT LOCALLY GREATER THAN 1.5. TOTALS MAY BE ESPECIALLY ENHANCED IN THE SOUTHWARD FACING MOUNTAINS OF SOUTHERN CALIFORNIA...OWING TO S/SW LOW LEVEL FLOW...LONGER DURATION OF BROAD HEIGHT FALLS...AND PROXIMITY TO GREATER PW VALUES NEAR 1.00 INCH ALONG WITH ENOUGH INSTABILITY FOR THE HRRR TO PICK UP ON 250 J/KG. **THE HEAVIER RAIN RATES SHOULD REACH LOS ANGELES BY 15-17Z...AND THE EVENT IS EXPECTED TO CONTINUE INTO THE AFTERNOON FROM THERE SOUTHWARD...WITH MAXIMUM HOURLY RATES APPROACHING 0.75 INCHES. THIS WOULD BE VERY CLOSE TO FLASH FLOOD GUIDANCE VALUES...AND WOULD BE MORE THAN ENOUGH TO CAUSE FLASH FLOODING IN THE MORE SUSCEPTIBLE BURN SCAR AREAS.**

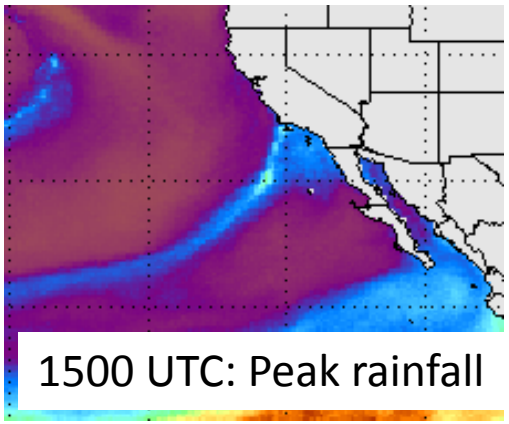
BURKE
ATTN...WFO...HNX...LOX...MTR...SGX.

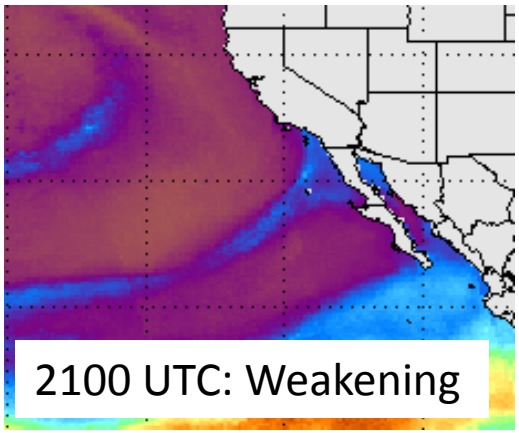


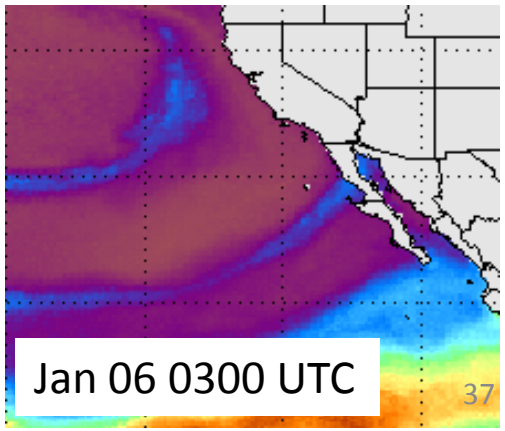
HRW_NMMB_5 850 MB WINDS 160105/0000f007
WPC MPD #0001

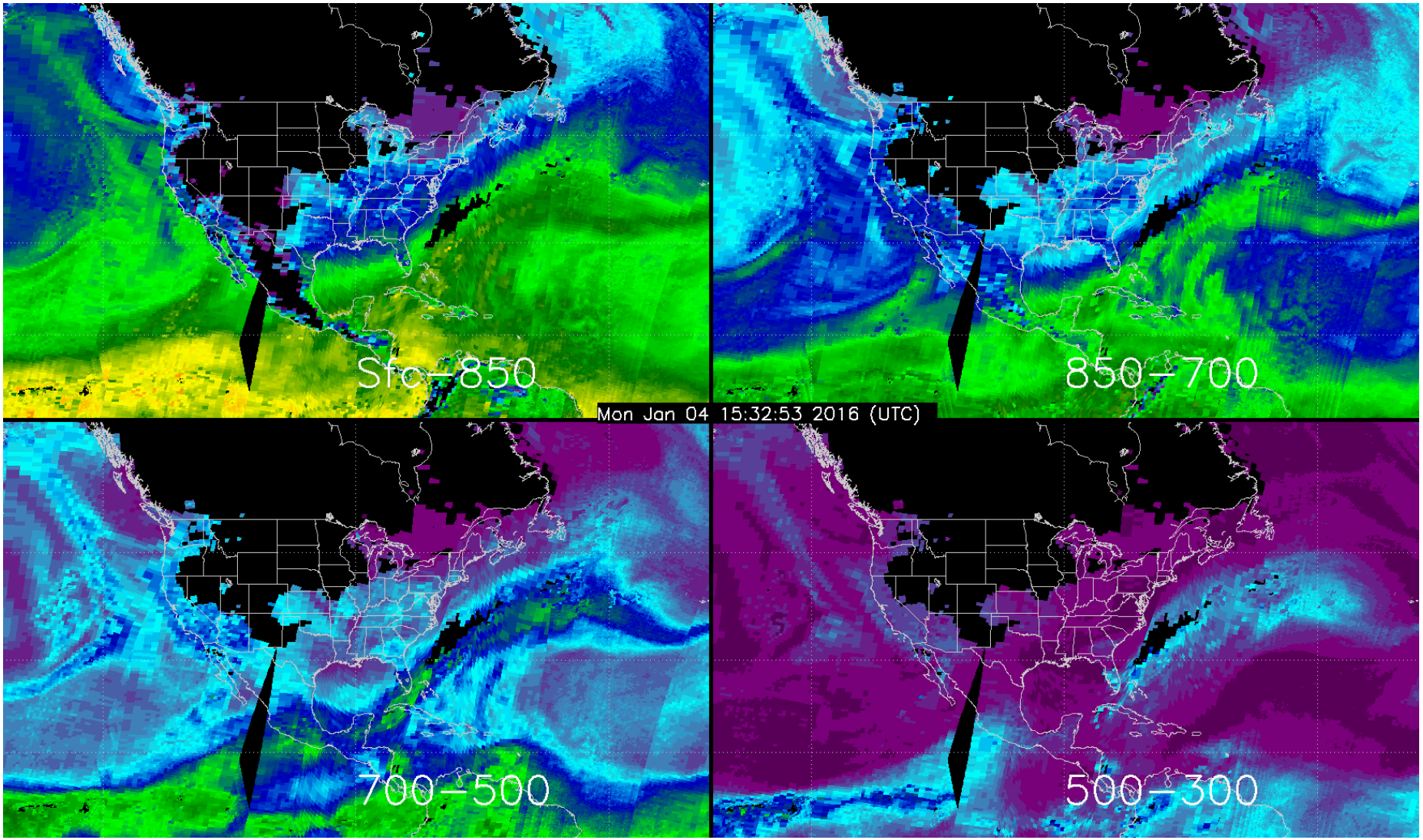
MIMIC TPW


Latitude
Longitude
(inches)
Total Precipitable Water (mm)
2016 Jan 05 0900 UTC: Approach of the atmospheric river

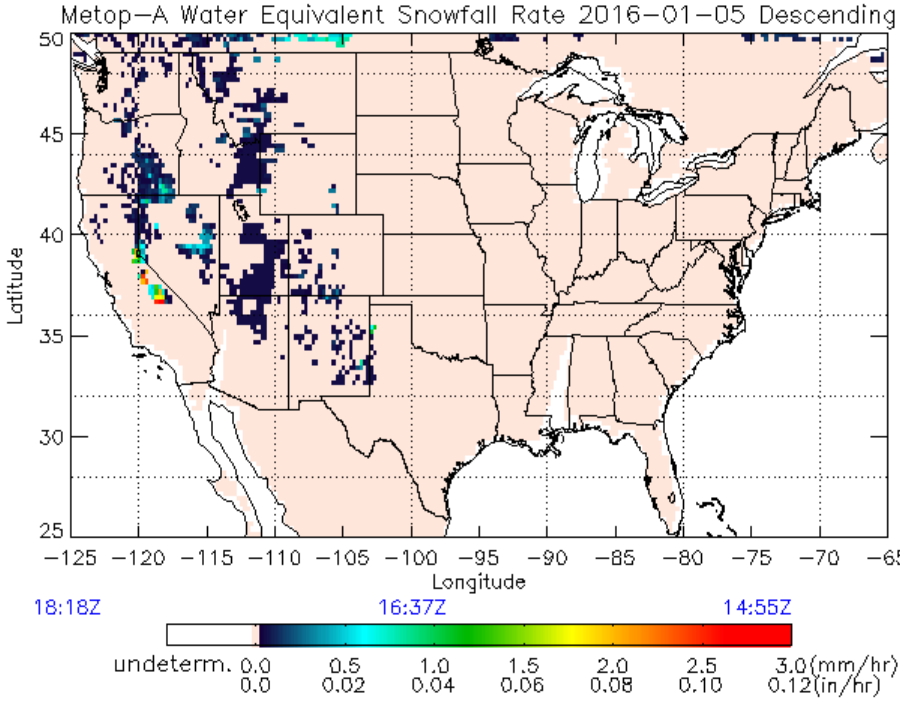

1500 UTC: Peak rainfall

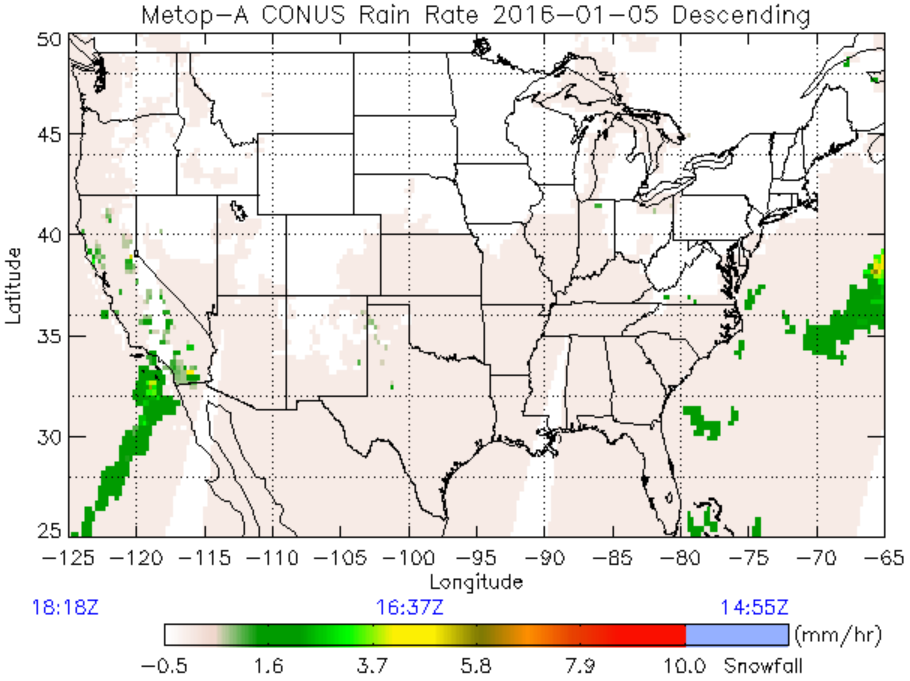

2100 UTC: Weakening


Jan 06 0300 UTC

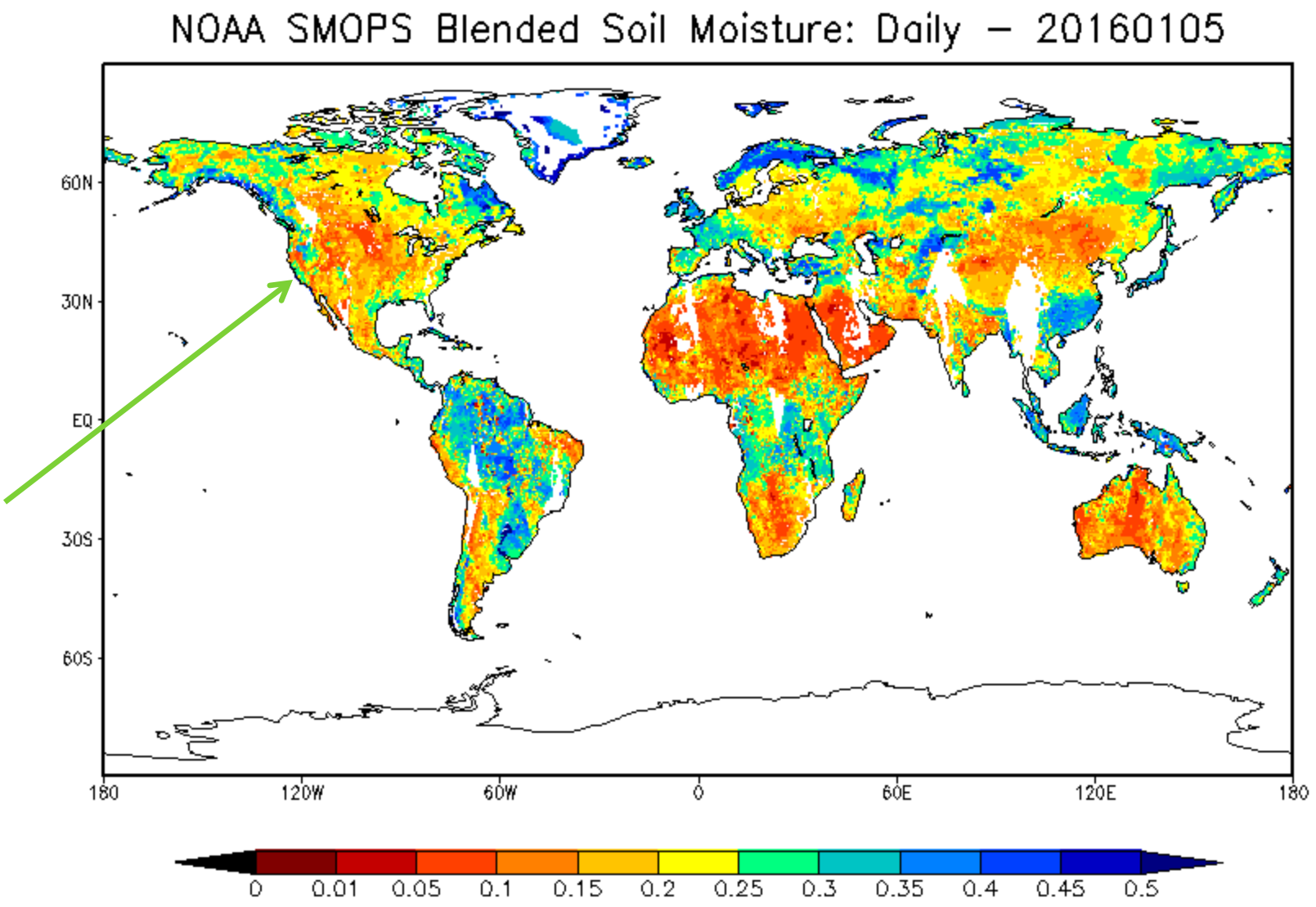


Broad moisture signature at lower layers, small signal above 500 mb





http://www.star.nesdis.noaa.gov/corp/scsb/mspps_backup/sfr_realtime.html

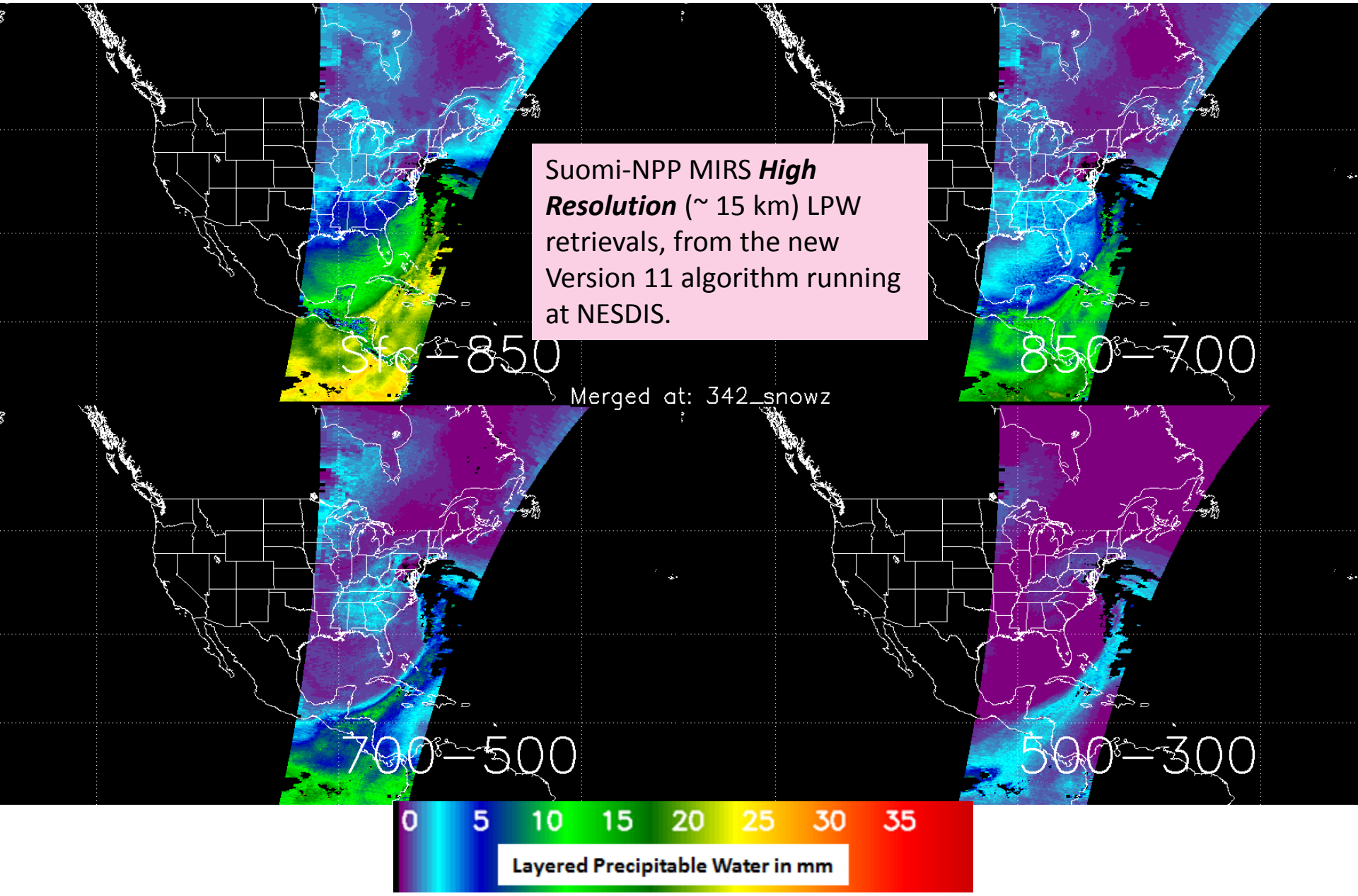

NOAA SMOPS Blended Soil Moisture: Daily – 20160105
60N
30N
EQ
30S
60S
180
120W
60W
0
60E
120E
180
0
0.01
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5

Case 2: East Coast Blizzard of 2016. January 22-23 2016

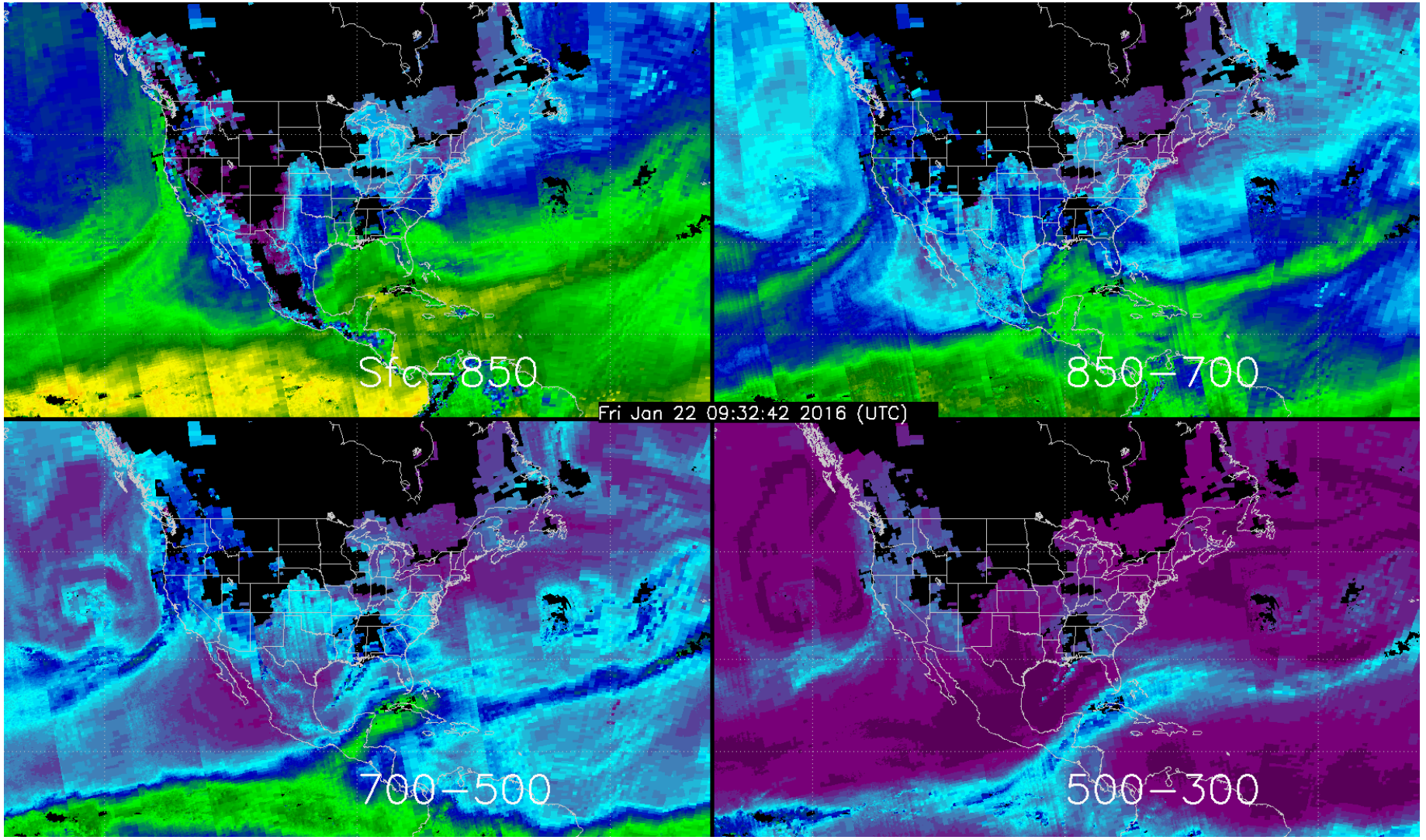
See also:

http://www.star.nesdis.noaa.gov/jpss/Blizzard2016.php

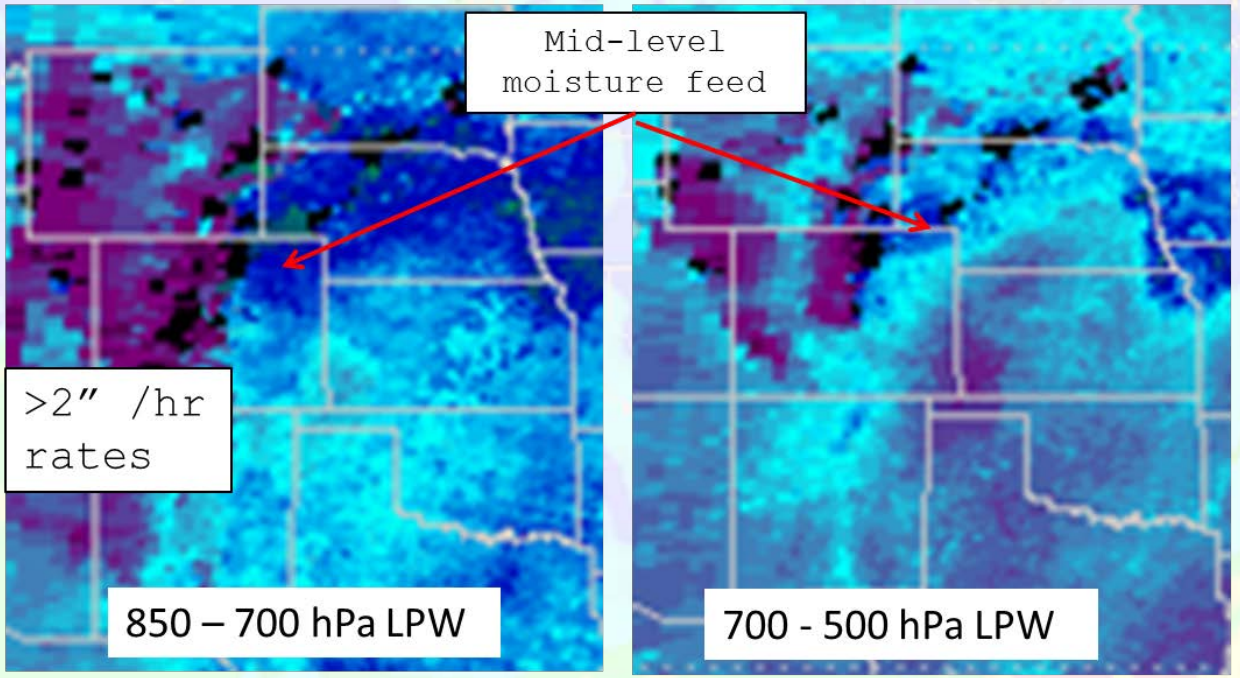
East Coast Snowstorm: Layered water vapor: Jan. 23 07 UTC (coastal low was forming at this time)



East Coast Snowstorm: Layered water vapor Jan 22, 09 UTC to Jan. 23 18 UTC (NOAA-18/19; Metop-A, -B, DMSP F18) using MIRS V8 (old version). SNPP to be added soon.



Water Vapor Products



CIRA Blended Layered Precipitable Water Vapor merged at 1200 UTC 23 March 2016 [S-NPP MiRS retrievals shown]

Forecast for Fort Collins for 3/23 morning:
4 PM 3/22: Winter Weather Advisory
8 PM 3/22: Winter Storm Warning
4 AM 3/23: Blizzard Warning
Total: 14" of snow in 7 hours, shut down city.