Ever wonder how those satellite products are used?

Ralph Ferraro4th CICS-MD
Science MeetingChief, Satellite Climate Studies BranchNOAA/NESDIS/STAR/CoRP

With contributions from MANY others....





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- We work on a lot of satellite-based projects...but how are they really used at NOAA?
- How do they all come together to generate a "prediction"?
 - Today's products

AZOMIA ON

- Future products (GOES-R, JPSS-1, non-NOAA, etc.)
- Super Storm Sandy example
 First sort of attempt to do this
- Here, I'll focus on the "Joaquin Event" – Sept/Oct 2015
 - I will highlight examples from across CICS (not 100% inclusive) and some from CIRA and CIMSS
 - Will stress imagery type of products – "see" the meteorology



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Satellite tools to monitor and predict Hurricane Sandy (2012): Current and emerging products

Michael J. Folmer ^{a,*}, Mark DeMaria ^b, Ralph Ferraro ^c, John Beven ^b, Michael Brennan ^b, Jaime Daniels ^c, Robert Kuligowski ^c, Huan Meng ^c, Scott Rudlosky ^c, Limin Zhao ^d, John Knaff ^e, Sheldon Kusselson ^d, Steven D. Miller ^f, Timothy J. Schmit ^g, Chris Velden ^h, Brad Zavodsky ⁱ

⁴ University of Maryland/ESSIC/CICS, College Park, MD, United States ⁸ NOA/NWS/NCEP/NHC, Miami, FL, United States ⁶ NOA/NKSDIS/STAR, College Park, MD, United States ⁶ NOA/NKSDIS/STAR, College Park, MD, United States ⁶ NOA/NKSDIS/STAR, Fort Collins, CO, United States ⁶ NOA/NKSDIS/STAR, Fort Collins, CO, United States ⁸ NOA/NKSDIS/STAR, Madison, VA, United States ⁸ NOA/NKSDIS/STAR, Madison, VA, United States ⁸ NOA/NKSDIS/STAR, Madison, VA, United States ¹ Minversity of Wisconsin-Madison/CIMSS, Madison, VA, United States ¹ NASA/SPORT, Huntsville, AL, United States

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ARTICLE INFO

ABSTRACT

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Hurricane Sandy - a tropical cyclone that transitioned into an extratropical cyclone near the time of landfall along the east coast of the United States - caused historic damage in many regions which rarely receive such a direct hit from a storm of this magnitude, including many of the large metropolitan areas along the U.S. eastern seaboard. Specifically, Sandy generated record low-pressure, a large wind field with corresponding storm surge and copious amounts of precipitation in some areas, including record snowfall in mountainous regions. Sandy presented several forecast challenges to the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS). Satellites played an integral role in the analysis and forecast of Sandy's track and intensity. The NOAA National Hurricane Center, Ocean Prediction Center, and Weather Prediction Center all relied on information from satellites to make critical warning decisions using various satellite products that assist with diagnosing tropical cyclone intensity, surface winds over the ocean, and heavy precipitation. All of the skillful global forecast models used satellite data for initiation to better forecast the track and intensity of Sandy. As part of the Geostationary Operational Environmental Satellite - R-series (GOES-R) and Joint Polar Satellite System (JPSS) Proving Ground activities, new satellite products were available to forecasters at these national centers in experimental form to assist with observing this unique, high impact event. This paper will demonstrate how the current satellite products assisted NOAA forecasters during Sandy and introduce some new satellite products that could be used to analyze and predict future high impact weather systems.

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CrossMark

1. Introduction

From a meteorological perspective, Hurricane Sandy (henceforth simply referred to as Sandy) was a "perfect storm". The convergence of several synoptic features phased together along the U.S. Mid-Atlantic coastline to create record low-pressure, a huge wind field with corresponding storm surge, and copious amounts of precipitation in some areas, including record snowfall. Sandy caused over 250 deaths and upwards of \$70 billion in damage and economic loss during its trek from the Caribbean northward to the mid-Atlantic and Northeastern United States (Blake et al., 2013).

Satellite data are utilized in three primary ways for tropical cyclone (TC) analysis and prediction. First, they are used for situational awareness. For example, water vapor imagery loops from geostationary satellites are often used subjectively to assess the flow in the cyclone environment. Second, quantitative satellite products are used for storm analysis, such as satellite-based cyclone position and intensity estimates and sea surface temperature analyses. Third, satellite data are assimilated into numerical forecast models. All three of these applications were heavily utilized in Sandy. For example, numerical weather forecasts were generally very good, with models such as the National Oceanic and Atmospheric Administration (NOAA) National Center for Environmental Prediction's (NCEP) Global Forecast System (GFS) and



 ^{*} Corresponding author at: NOAA Center for Weather and Climate Prediction (NCWCP), 5830 University Research Court, Rm. 4000, College Park, MD 20740.

E-mail addresses: Michael.Folmer@noaa.gov (M.J. Folmer), Mark.DeMaria@noaa.gov (M. DeMaria), Ralph.R.Ferraro@noaa.gov (R. Ferraro).



A Review of Satellites Used at NOAA

- NOAA (Baseline satellite systems)
 - Geostationary Operational Environmental Satellites (GOES)
 - GOES-E (75°W; Atl. Ocean); GOES-W (135°W; Pac. Ocean)
 - GOES-R (2017)
 - New sensors ABI, GLM
 - Polar-orbiting Operational Environmental Satellites (POES)
 - NOAA-18, 19; MetOp-A, B ; DMSP F-17, 18, 19
 - S-NPP and JPSS
 - New Sensors VIIRS, ATMS, CrIS, ...
 - JPSS-A (2017)
 - Collectively, global coverage ~3 hrs
- Non-NOAA (and there are plenty of them!)
 - NASA Jason (w/CNES), EOS, GPM, SMAP, others...
 - DOD Windsat
 - JAXA- GCOM-W1 AMSR-2 (part of JPSS)
 - JMA MTSAT, Himawari-8
 - ESA Jason, ERS-2, Sentinel, others...
 - EUMETSAT MetOp, Meteosat
 - ISRO– Megha-Tropiques (w/CNES), others...

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Satellite attributes

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GOES

- Fixed location
- Visible and IR (and lightning)
 - Rapid scan available
- Movement
 - Clouds, water vapor, ocean currents, etc.
- Rapidly changing events hurricanes, thunderstorms, fires, volcanic ash, aerosols,...
- Cloud drift winds/NWP

POES (and LEO)

- (Near) global coverage
 - Snow and Ice
- Wider variety of sensors and applications
 - Visible and IR (including hyperspectral sounders)
 - Passive (active) MW
- Unique capabilities, including
 - Vertical profiles of atmos. (NWP)
 - Atmospheric Chemistry
 - Vegetation
 - MW cloud penetration, ocean surface



Relevant Satellite Products 4th CICS-MD Science Meeting



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Geostationary (Regional, rapid update)	Low Earth Orbiting (Global, 3-6 hourly, wide array of sensors)
Visible, IR and WV loops + RGB Composites	Visible, IR, RGP and microwave imagery
Rain Rate (and lightning – GOES-R)	Rain and Snowfall Rate
Temperature and moisture soundings (and radiances), including total precipitable water (TPW); cloud drift winds	Temperature and moisture soundings (and radiances); cloud drift winds (high latitudes)
Sea-Surface Temperature (SST)	Ocean products – SST, TPW, surface wind speed
Land surface temperature (LST)	Soil Moisture, LST, water inundation
Blended Operational Products (some examples)	
Blended soundings, TPW and Rain Rate (LEO)	
Ensemble Tropical Rainfall Potential (eTRaP)	
NOAA/NWS CPC Cloud Morphing Product (CMORPH)	







Who are some of the 24 hr x 7 day users...

- NWS National Centers
 - Weather Prediction Center (WPC)
 - Ocean Prediction Center (OPC)
 - National Hurricane Center (NHC)
- NWS Forecast Offices (NWSFO) and regional centers
- Other agencies
 - Naval Research Laboratory (NRL)
 - Air Force Weather Agency (AFWA)
 - Joint Typhoon Warning Center (JTWC)
 - □ NASA e.g., GPM program



The "Joaquin" Event 29 Sep - 7 Oct 2015

- An interesting interaction between the tropics and midlatitudes
 - Somewhat analogous to Sandy 2012
 - If Joaquin did not exist, this still would have been major weather event
- Far reaching impacts
 - Caribbean (Cat 4 storm), US East Coast, Bermuda, even Portugal
 - Tidal flooding, wind damage, ship (El Faro)/lives lost, historic rain flooding, ...
 - It was a long duration event
 - Wind/tides
 - Atmospheric River/Historic rains
 - 1000 year flood in SC
 - 19 lives lost



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Products we'll focus on

- GOES-based Visible/IR
 - Visible imagery and Super Rapid Scan imagery
 - WV imagery
 - RGB imagery
 - Ground lightning (GOES-R proxy)
 - Precipitation

POES-based microwave

- Imagery
- Temp and RH profiles (MiRS) and warm core anomalies
- TPW/Atm. Rivers
- Precipitation rates, accumulations, eTRaP
- Ocean surface winds



Visible Imagery

S-NPP VIIRS



End Users – Just about everyone!

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Courtesy of NRL



2015

CICS Contributors – Anyone doing VIS "calibration"

Including S. Blonski, L. Wang, M. Bali, ...

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S-NPP VIIRS



GOES-13

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CICS Contributors – Anyone doing IR "calibration" Including S. Blonski, L. Wang, M. Bali, ...

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End Users – Just about everyone!

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GOES-13 Rapid Scan

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Courtesy of CIMSS

- Current GOES can have rapid scan mode "on demand"
- GOES-R will have routine rapid scan modes
- Amazing science to come from this!



CICS Contributors – GOES-R/JPSS Satellite Liaison – Michael Folmer



The Role of MW

GOES-13 IR

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Courtesy of NRL

GCOM-W AMSR-2



CICS Contributors – J. Park, P. Meyers, T. Yang



Use of VIS and MW together

10/02/15 0600Z 11L JOAQUIN 10/02/15 1800Z 11L JOAQUIN 10/02/15 0543Z GCOM-W1 89H 10/02/15 1710Z GCOM-W1 89H 10/02/15 0515Z GOES-13 IR 10/02/15 1655Z GOES-13 VIS Naval Research Lab www.nrlmry.navy.mil/sat_products.html <-- 89H Brightness Temp (Kelvin) --> Naval Research Lab www.nrlmry.navy.mil/sat_products.html <-- 89H Brightness Temp (Kelvin) --> 250 210 250 270 270

End Users – National Hurricane Center, Naval Research Laboratory, Joint Typhoon Warning Center

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Courtesy of NRL



Use of Imagery -Visible, IR, MW

ZCZC MIATCDAT1 ALL TTAA00 KNHC DDHHMM

HURRICANE JOAQUIN DISCUSSION NUMBER 17 NWS NATIONAL HURRICANE CENTER MIAMI FL 1100 PM EDT THU OCT 01 2015

AL112015

The eye of Joaquin contracted in satellite imagery late this afternoon, but has become obscured by cirrus clouds since that time. Recent microwave imagery and aircraft observations have not shown any indications of an eyewall replacement, but the intensity appears to have leveled off for now. The aircraft has measured peak 700-mb flight-level winds of 123 kt and reliable SFMR surface winds of 116 kt, which support an initial wind speed of 115 kt. Satellite images show that the outflow is well established over the hurricane and some additional strengthening is possible during the next 12 hours or so. After that time, there could be some fluctuations in intensity due to eyewall replacement cycles. Joaquin is forecast to encounter increasing southwesterly shear in 2 to 3 days, which is expected to cause some weakening during that time. However, Joaquin is expected to remain a large and powerful hurricane for the next several days. The NHC intensity forecast is near the upper-end of the guidance in the short-term, and is close to the intensity consensus throughout the remainder of the forecast period.

Recent reconnaissance fixes suggest that Joaquin has turned westward and slowed down, with an initial motion of 260/3. The mid- to upper-level ridge that has been steering Joaquin southwestward is expected to quickly weaken overnight while a mid- to upper-level 4th CICS-MD 24-25 Science Meeting November 2015



- Eye location and structure
- Storm motion
- Intensity (Dvorak Technique)
- Intensity changes
- Surrounding Environment
- Prediction

Critical is the quality of the satellite measurements – CICS-MD scientists (H. Yang, X. Zou, J. Park, Y. Ma, Y. Chen, S. Blonski, S. Pan, others) are HEAVILY involved with sensor calibration



Satellite Sounders -

Warm Core, Moisture, Assimilation

- Microwave sensors can provide "all weather" capability
 - Penetrate cirrus clouds
- Microwave Integrated Retrieval System (MiRS)
 - All MW sensors!
- Attributes for tropical systems include
 - Warm core structure
 - Changes signal intensification
 - Atmospheric Moisture
 - Precipitation rates
- These MW (and IR) radiances are assimilated in NWP models and are critical for storm prediction!
 - Several CICS researchers support activities at JCSDA – Kalnay, Moradi, Masutani, Casey, Chen, ...

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MIRS NPP/ATMS Temperature (K) at 600mb 2015—10—02 Asc (V3259)





End Users – Just about everyone!



NESDIS Satellite Applications Branch (SAB)

SATELLITE PRECIPITATION ESTIMATES..DATE/TIME 10/02/15 0640Z SATELLITE ANALYSIS BRANCH/NESDIS---NPPU---TEL.301-683-1404 LATEST DATA USED: GOES-13: 0630Z DS NOAA AMSU: 0246Z

LOCATION ... E/CENTRAL NORTH CAROLINA ... E SOUTH CAROLINA ...

ATTN WFOS...AKQ...MHX...RAH...ILM...RNK...CHS...CAE...GSP... ATTN RFCS...SERFC...

EVENT...INCRSG COVERAGE OF MOD-LOCALLY HVY RAINS

SATELLITE ANALYSIS AND TRENDS...DIGGING MID/UPPER LVL TROF OVER THE ERN US COUPLED WITH S/WV ENERGY BEGINNING TO LIFT NWD ALONG ITS ERN FRINGE WILL CONTINUE TO AID IN INCRSG PRECIPITATION ACROSS THE CAROLINAS OVERNIGHT. LARGE SCALE LIFT WILL GRADUALLY INCRS WITH MORE NEGATIVE TILT OF THE S/WV ENERGY OVER TIME. UL SPEEDMAX ANALYZED OVER E GA/W SC/W NC/W VA SHOULD CONTINUE TO STRENGTHEN AS THE S/WV ENERGY BEGINS TO SWING NEWD AND THE TROF SHARPENS WITH THE RIGHT ENTRANCE REGION DYNAMICS LIKELY TO BE OVER. ERN SC INITIALLY, A PLUME OF AMPLE DEEP MOISTURE REMAINS OFF/ALONG THE COAST OF THE SE US WITH CONNECTION TO TROPICAL MOISTURE SOURCES IN THE E PAC/WRN CARIBBEAN AT MID-UPPER LVLS AND AN INITIAL SURGE OF LOW LVL MOISTURE STRETCHING NWWD FROM THE BAHAMAS ASSCD WITH HURRICANE JOAQUIN. BLENDED TPW IMAGERY INDICATES A RECENT UPTICK IN PW VALUES OFF THE GA/SC/FAR SE NC COASTS WITH A POOL OF 2.5-2.9" PW VALUES NOTED. WHILE PRESENCE OF DEEP CNVCTN OFF SC MAY BE INFLATING THE PW VALUES SLIGHTLY ... EVEN THE RECENT 0246Z AMSU PASS OVER THIS AREA INDICATED MAX PW VALUES OF 2.6-2.75", SFC ANALYSIS INDICATES A FRONTAL BNDRY DRAPED JUST OFF THE NC/SC COAST NR WHERE COLD TOPPED CNVCTN HAS BEEN DVLPG. LOW LVL SERLY FLOW OVERRUNNING THIS BNDRY WILL BRING STRATIFORM TROPICAL-LIKE RAINS INTO THE CAROLINAS PRIOR TO DAYBREAK EVEN THOUGH THE INSTABILITY AXIS WILL REMAIN JUST OFFSHORE OVER THE WARMER WATERS OF THE GULF STREAM.

AN ANNOTATED SATELLITE GRAPHIC SHOWING THE HEAVY PRECIPITATION THREAT AREA SHOULD BE AVAILABLE ON THE INTERNET ADDRESS LISTED BELOW IN APPROXIMATELY 10-15 MINUTES.

SHORT TERM OUTLOOK VALID 0645-0945Z...HIGH CONFIDENCE FACTOR IN SHORT TERM OUTLOOK...GREATEST THREAT FOR HVY RAINS WILL BE OVER ERN PORTIONS OF SC AND SE NC OVER THE NEXT FEW HRS THOUGH MORE MOD RAINS WILL BE GRADUALLY SPREADING NWD/WWD AS WELL OVER THIS TIME ACROSS CENTRAL/ERN PORTIONS OF NC AND EVEN TWDS SE VA. GIVEN RICH DEEP LAYERED MOISTURE FROM SVRL TROPICAL SOURCES COMING TOGETHER OFF THE SE COAST...LOCALIZED RAINRATES OF AT LEAST 1-2"/HR ARE LIKELY OVER SE NC/E SC DURING THE OUTLOOK PERIOD EVEN THOUGH PRECIP IS NOT EXPECTED TO BE CONVECTIVE. 0246Z AMSU PASS HAD INDICATE AREAL AVG RATES OF UP TO 1.3"/HR JUST S OF KMYR AND PRECIP HAS BECOME MORE MORE MORE DINCE THEN. INCRSG 4th CICS-MD 24-25 Science Meeting November 2015



0640 UTC 2 October 2015



151002/0645 GOES13 IR_10.7

End Users – NWSFO's; NWS WPC



NESDIS Satellite Applications Branch (SAB)

SATELLITE PRECIPITATION ESTIMATES..DATE/TIME 10/04/15 1639Z SATELLITE ANALYSIS BRANCH/NESDIS---NPPU---TEL.301-683-1404 LATEST DATA USED: GOES-13 IR 1625Z KC

LOCATION...NORTH CAROLINA...SOUTH CAROLINA...

ATTN WFOS...ILM...CHS...CAE...GSP... ATTN RFCS...SERFC...

EVENT... UPDATE TO PREVIOUS SPE FOR HEAVY RAIN THREAT

SATELLITE ANALYSIS AND TRENDS...THE EXPERIMENTAL CIRA LAYERED PW PRODUCT CONTINUES TO SHOW A DEEP MOISTURE CONNECTION FROM JOAOUIN INTO SC/S NC AS DRYER AIR IS ROTATED AROUND THE ELONGATED UPPER LOW IN S GA HELPING TO PIVOT THIS MOIST BAND COUNTERCLOCKWISE, LATEST WATER VAPOR IMAGERY SHOWS ADDITIONAL SHORTWAVE ENERGY IN N FL ROUNDING THE BASE OF THE CLOSED LOW WHICH SHOULD AID IN REDEVELOPMENT LATER ON, CURRENTLY IR IMAGERY HAS SHOWN A WARMING TREND OF CLOUD TOP TEMPERATURES ALTHOUGH RAIN RATES CONTINUE TO IMPRESS WITH A MESONET SITE IN LITTLE RIVER. SC INDICATING AN UNOFFICIAL TOTAL OF 0.8" IN LESS THAN 20 MIN. THE SURFACE LOW HAS REMAINED OFF THE S SC COASTLINE (ABOUT 100KM FROM SHORE) ALONG WITH A COASTAL FRONT THAT IS ANALYZED FROM THIS LOW PRESSURE THEN N TOWARDS THE SC COAST THEN NE PARALLEL WITH THE NC COAST, A POOL OF INSTABILITY DEPICTED IN GOES SOUNDER WAS SEEN E OF THE COASTAL FRONT OFF THE OF S NC COAST WHICH HAS AIDED IN ISOLATED CONVECTION FORMING OVER THE ATLANTIC AND DRIVING INTO S NC AND NE SC. MERGERS BETWEEN THESE ISOLATED CONVECTIVE CELLS AND THE HEAVY RAIN BAND SEEN IN NE SC HAS HELPED MAINTAIN ISOLATED RAIN RATES ABOVE 3"/HR. THE BLENDED TPW PRODUCT AND THE GPS NETWORK DISPLAY 2.1" PWS ALONG THE NE SC COASTAL COUNTIES WITH LOWER VALUES SEEN IN W SC BUT STAYING STEADY AT 1.7" PW, OVER THE LAST FEW HOURS THE HEAVY RAIN BAND IN E SC HAS SLOWLY MOVED N MOST LIKELY FROM A STRONGER ENE 85H FLOW IN FROM F AND SE NC INTO FAR NW SC OF 45-50 KTS ACCORDING TO VWPS AND STRONG LOW LVL CONVERGENCE ANALYZED IN SE NC AND NE SC. EXPECT THE NEXT FEW HOURS TO SEE HEAVIEST RAIN CONTINUE IN NE SC AND FAR SE NC WITH MERGERS OCCURRING ON THE N SIDE OF HEAVY RAIN BAND SHIFTING THIS BAND SLIGHTLY FURTHER N BUT REMAINING RELATIVELY STATIONARY FOR THE OUTLOOK PERIOD, FOR ADDITIONAL DETAILS ON THIS EVENT PLEASE SEE WPC MPD #0551.

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1639 UTC 4 October 2015

2015



End Users – NWSFO's; NWS WPC







- Generate QPF out to several days over CONUS
- Also make storm related predictions
- "Fuse" together NWP, satellite (SAB), etc. products





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RAP32 850 MB WINDS 151003/1800f006 RAP32 PRECIP WATER 151003/1800f006 WPC MPD #0547

End Users – NWSFO's, media, etc.

CICS Contributors – M. Folmer



GOES Sounder Air Mass RGB 10/02/15





CICS Contributors – M. Folmer End Users – NWSFO's, media, etc.



RAP32 PRECIP WATER 151002/2300f000 WPC MPD #0544

Courtesy of M. Folmer

DISCUSSION...DEEP STRATOSPHERIC FOLD SEEN WELL IN STANDARD WV AS WELL AS RGB AIR MASS OCCURRING OVER THE EXTREME NORTHEAST GULF OF MEXICO... ALLOW EXCELLENT DIVERGENCE WITH STRONG 100-110 KT JET...WHICH WILL SUPPORT VERY STRONG LARGE SCALE ASCENT ACROSS THE DISCUSSION AREA. SURFACE FRONTAL ZONE HUGS THE SOUTH CAROLINA COASTLINE THROUGH CAPE FEAR INTO THE OUTER BANKS OF NC...BROAD/DEEP LOW LEVEL WITH AN EXTREME MOISTURE TONGUE PULLED FROM THE OUTER PORTIONS OF HURRICANE JOAQUIN ARE POOLED AROUND 2.4-2.5" WITHIN TPW ANALYSIS POINTED UPP THE FRONT TOWARD KCHS. ~Gallina

IR and 15-min Lightning Density 10/03/15



Courtesy of M. Folmer



Persistent regeneration/ increase in offshore lighting 925-700 mb flow (via VWP) 925-700 mb flow (via VWP) 125 Flash flooding likely vith 1-25 Flooding likely vit

NOAA

CURRENT SATELLITE IMAGERY AND LIGHTNING DATA SHOWS A PERSISTENT AREA OF CONVECTIVE REGENERATION JUST OFFSHORE OF CHARLESTON SC WITH AN INCREASE IN LIGHTNING ACTIVITY ACROSS THIS REGION. THE 07Z RAP OBJECTIVE ANALYSIS INDICATED THIS CONTINUAL REGENERATION PROCESS IS OCCURRING IN THE PRESENCE OF MUCAPES ABOVE 3000 J/KG WITH 500 TO 1000 J/KG VALUES EXTENDING ALONG THE MOISTURE PLUME INTO UPSTATE SC. HOURLY RAINFALL RATES IN THE 1 TO 2 INCH RANGE ARE LIKELY ALONG THE COAST WITH SLIGHTLY LOWER RATES FARTHER INLAND WHERE THE INSTABILITY DECREASES. ~Rubin-Oster



GCOM Products Composite – Rain Rates over TPW

- Products include:
 - Radiances
 - Imagery
 - Rain Rate
 - Water vapor (TPW)
 - Cloud water
 - Ocean surface wind speed
 - Soil Moisture
 - Snow cover/water equiv.
 - Sea ice cover/concentration



CICS Contributors – P. Meyers, J. Park, N-Y. Wang, C. Hain, T. Yang,...

End Users – Just about everyone



Ocean Prediction Center (OPC) Use



- Both passive and active MW products aid in their interpretation of weather features and how to issue warnings
- Additionally, off-shore lightning and RGB products have been vital to improving short-term forecast critical for shipping interests



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Soil Moisture Operational Products System (SMOPS)

- Fuses together passive and active MW measurements from a variety of satellites
- Product is used in a variety of applications
 - Hydrological forecasts
 - Agriculture
 - NWP assimilation
 - LDAS



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End Users – NWS RFC's, EMC CICS Contributors – C. Hain







- If you have a flood event, there is typically an AR associated with it
- AR prevalent with Joaquin, connecting tropics with mid-latitudes
- W. Yang, working on an automated AR detection scheme so that global AR climatology can be developed
 - Look for changes in characteristics over time
 - Origin regions
 - Rain regions

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TPW from S-NPP ATMS – Atmospheric Rivers





Despite apparent disconnection between cloud circulations of coastal low and Hurricane Joaquin, there was strong tropospheric moisture connection!



CICS Contributors – C. Grassotti 25

DORR DO CUMPTO

TPW from S-NPP ATMS – Atmospheric Rivers

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Despite apparent disconnection between cloud circulations of coastal low and Hurricane Joaquin, there was strong tropospheric moisture connection!



CICS Contributors – C. Grassotti 26



421 36N

Why Satellite Rainfall

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- Fills in data voids over CONUS from radar & gauges
 - **Offshore systems**
 - **Beam blockage**
 - **OCONUS** domain
 - In-situ data can stop working in extreme weather
 - NOAA has global responsibilities
- Radar and gauges don't always agree!
- Climatology

End Users – WPC, SAB, TPC, CPC

CICS Contributors – N-Y. Wang, Y. You, P. Meyers, M. Nichols, R. Smith





/data/Petrap/2015/JOAQUIN/2015JOAQUIN.WTNT21.KNHC.011455.AMSUM2.10011445 /data/Petrap/2015/JOAQUIN/2015JOAQUIN.WTNT21.KNHC.011455.AMSUNN.10011030 /data/Petrap/2015/JOAQUIN/2015JOAQUIN.WTNT21.KNHC.011455.SSMISC.10011245 /data/Petrap/2015/JOAQUIN/2015JOAQUIN.WTNT21.KNHC.020240.AMSUNN.10012147 /data/Petrap/2015/JOAQUIN/2015JOAQUIN.WTNT21.KNHC.020240.GHEHR.10020200 /data/Petrap/2015/JOAQUIN/2015JOAQUIN.WTNT21.KNHC.020240.SSMISB.10012321 /data/Petrap/2015/JOAQUIN/2015JOAQUIN.WTNT21.KNHC.020240.SSMISB.10012321 /data/Petrap/2015/JOAQUIN/2015JOAQUIN.WTNT21.KNHC.020240.SSMISB.10012321 /data/Petrap/2015/JOAQUIN/2015JOAQUIN.WTNT21.KNHC.020240.SSMISD.10012321 /data/Petrap/2015/JOAQUIN/2015JOAQUIN.WTNT21.KNHC.020240.SSMISD.10012321

Total Ensemble TRaP members: 200

Used POES (3), DMSP (4) and GOES (1) rain estimates

End Users – SAB, WPC, NHC, JTWC CICS Contributors – P. Meyers, C. Grassotti, N-Y. Wang, Y. You 28



Summary and Final Thoughts



2015

• CICS work clearly supports the NOAA core mission goals!

 The cal/val activities are extremely critical for the quality of the downstream product generation

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- There is a lot I did not show
 - NWP Data Assimilation and impacts
 - Cloud drift winds
 - SST, Ocean color related products
- The future...we need to think beyond "our piece" but how improvements can come about through
 - Common approaches to multiple sensors
 - Exploitation of other sensors/technologies
 - Putting things together to better understand *physical processes*
 - Don't forget the fundamentals; imagery shows a lot!
 - Engaging your colleagues "next door" to accomplish this!
 - This building CICS, ESSIC, JGCRI, IMSG, ...
 - NCWCP
 - NASA/GSFC



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Backup





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Continuity of GOES Mission



2015 Approved: Assistant Administrator for Satellite and Information Service







NOAA & Partner Polar Weather Satellite Programs Continuity of Weather Observations

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