2021 Update on the JPSS PGRR Tropical Cyclones Initiative

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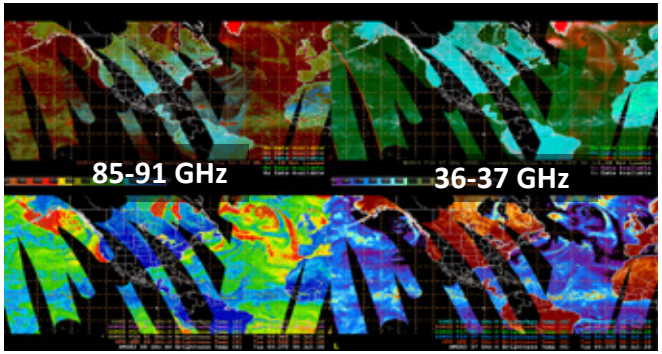
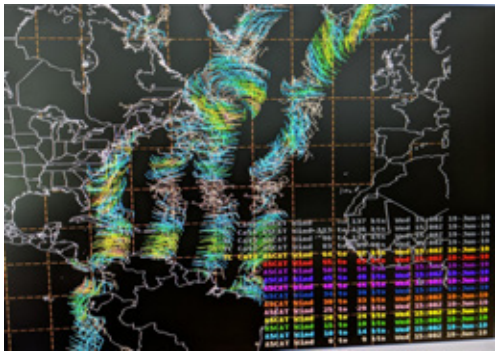
Interdepartmental Hurricane Conference
March 2021

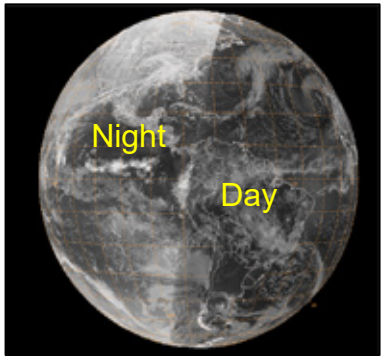
Outline

- Current uses of polar data in NHC operations
- Key takeaways from the 2020 Satellite Summit
- Incorporating ideas to increase the use of polar data in TC operations into the JPSS PGRR that satisfy key takeaways
- Brief on Currently Funded Projects
- Selected results from currently funded projects
- Brief on Upcoming Projects

Current Uses of JPSS & Other Polar data in TC Ops







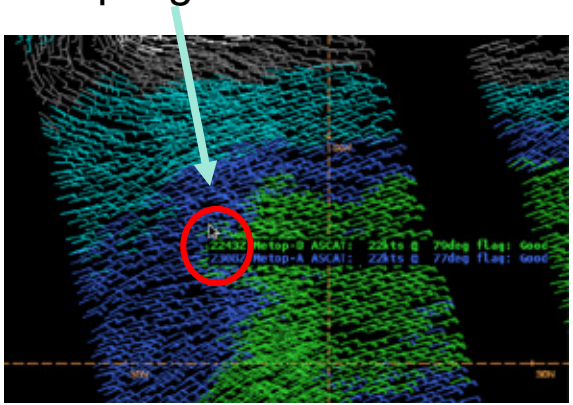
- **Microwave:** Analysis of TC internal structure and center fixing within ATCF, Intensity and wind radii estimation algorithms from **AMSU** and **ATMS**, layered TPW products, used as input into statistical models
- **Scatterometers:** Analysis of closed circulations for TC genesis, Wind radii estimates, TAFB use in gap flow wind events
- **Altimeters:** Wave height estimates for marine forecasting, subsurface temperature structure for Oceanic Heat Content (OHC) for intensity forecasting as input into SHIPS model
- **Application of VIIRS Day Night Band (ProxyVis):** CIRA trained on **DNB** and applied to Geostationary imagery

Key Takeaways from the Feb 2020 GOESR-JPSS PGRR Satellite Summit

Satellite Summit Tropical Session - Feb 26th 2020 at NCWCP - College Park, MD

Holding the Summit was determined to be a best practice for idea exchange between developers and operational users

- Wider distribution of polar data from direct readout sites to reduce latency
- More integration of products into the operational workstations (AWIPS2, ATCF)
- Data providers should add metadata to datasets and work directly with APO/TOWR-S to create AWIPS2 displays that utilize the sampling feature
- Developers have a hard time gathering feedback from operations. Users need to work alongside developers to strengthen interaction and collaboration on products



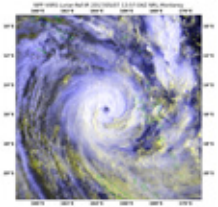
Implementing Takeaways from the Satellite Summit into the PGRR:
Ideas to Increase JPSS Utilization in TC Operations

- Get data to forecasters faster - Processing of direct readout data to reduce latency
- Implement products into the operational infrastructure:
  - Implement GeoIPS directly into NHC-supported VMs
    - Reduces technical spin up
    - Easier facilitate R2O transition and IT support once fully operational
    - Use GeoIPS as the delivery mechanism for R2O algorithms and applications (use on WCOSS)
  - Continue to add JPSS data in AWIPS2 - leverage relationships with APO/CP and TOWR-S for their AWIPS expertise
    - Process data into AWIPS2-friendly formats to provide more polar global coverage
    - Take output from NRL's GeoIPS to design AWIPS displays that:
      - Leverage sampling for quick access to metadata
      - Reduce the number of products to load via combo/blended/mosaic products
- Developer-Forecaster collaboration:
  - Demo PGRR products to forecasters at the NHC "Lapenta Tropical-Marine Laboratory" and/or NHC AWIPS Cloud Instance

PGRR TC Projects & PIs: Current Projects (FY19-21)

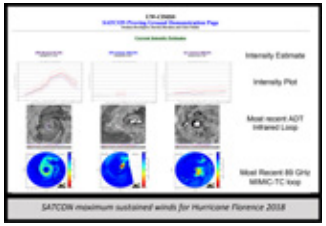
Real-time acquisition, processing, analysis, and operational integration of TC-centric polar orbiting data:

Project Part I: Implementation of a data ingest, standardization, and output system
NRL: Josh Cossuth, Mindy Surratt



NRL GeoIPS is used to replace proprietary software that processes multiple data formats within a common infrastructure to normalize satellite data and create TC-centered imagery

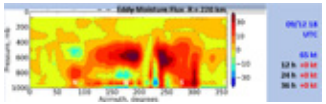
Project Part II: Serving forecasters with advanced satellite-based TC center-fixing and intensity information
CIMSS: Tony Wimmers, Derrick Herndon



Adapting ARCHER and SATCON algorithms into GeoIPS framework and using JPSS as input. Also assisting forecasters to understand algorithm output with quick guides

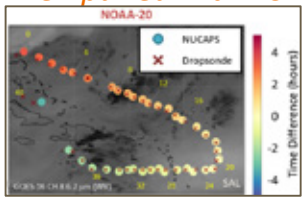
Project Part III: Improving Tropical Cyclone Forecast Capabilities Using the JPSS data Suite
CIRA/NESDIS: Galina Chirkova, John Knaff

Development of multiple TC applications using JPSS input data to improve TC intensity forecasting



Collaboration with JPSS Soundings Group:

Understanding the Value of Real-Time NUCAPS Soundings for Hurricane Monitoring and Forecasting when paired with TC Aircraft Reconnaissance missions



NRL: Proof of Concept - Better Latency with Direct Readout

- NRL Geolocated Information Processing System (GeoIPS) is an open source Navy TC processing suite for research and NRT operations
- GeoIPS at NHC now supports processing of JPSS Direct Readout (DRO) data

- Preliminary NRL findings of **JPSS DRO** compared to **NESDIS PDA** proves substantial latency improvement more conducive to operational timetables with DRO!

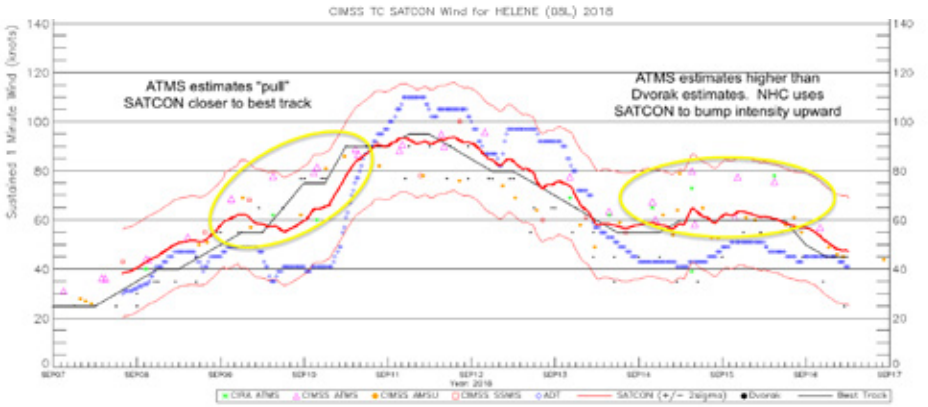
DRO gets in **~24 mins earlier** with Ascending pass
DRO gets in **86 mins earlier** with Descending pass

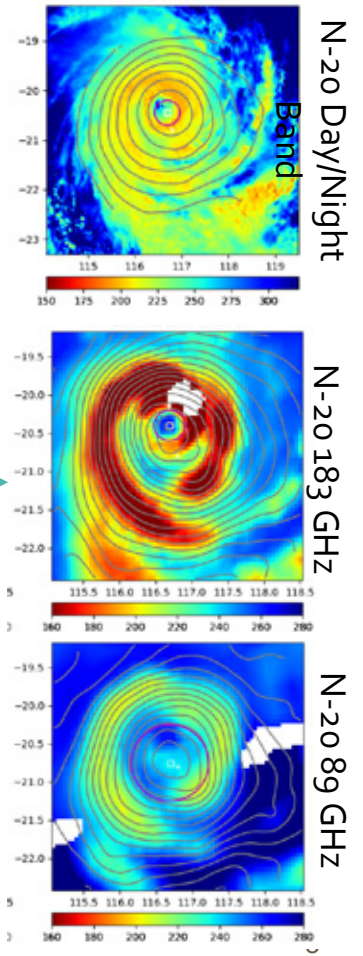
Latency example for GCOM-W1 AMSR2

Ascending Branch	Mean	Standard Deviation	Units
How quickly do we go from Point overpass to file for DRO?	13.5	3	minutes
How quickly for PDA?	37.6	5	minutes
Descending Branch			
How quickly do we go from Point overpass to file for DRO?	15.6	2	minutes
How quickly for PDA?	101.6	3	minutes
GeoIPS Processing Time			
For DRO	17.7	1	second(s)
For PDA	21.6	1	second(s)

CIMSS: Adapting ARCHER & SATCON to JPSS Data

- Adapted CIMSS' ARCHER TC center-fixing algorithm to operate on JPSS imagery which increases the sampling of TC measurement by including wider-swath microwave sounders and supports more TC analysis algorithms to operate on JPSS





- Added SNPP and N20 to the SATCON algorithm and assessing it's impact to SHIPS. SATCON is CIMSS' ATMS-based ensemble estimate of TC intensity.

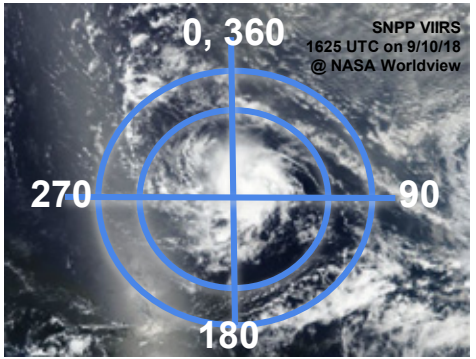
Both algorithms are being adapted into NRL's Python-based GeoIPS framework in order to be deployed to operational TC forecasting centers

CIRA: TC Applications adapted to JPSS Data

1) TC monitoring with VIIRS by remapping onto the GOES-R projection & adding DNB into the Geostationary ProxyVis nighttime imagery product

2) Extend IR-based eye detection and automated objective RMW (oRMW) estimation algorithms to use MW data with ATMS and VIIRS IR channels

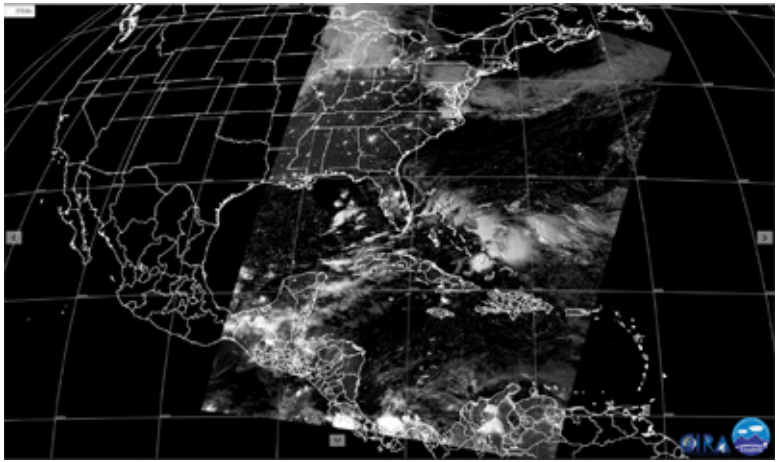
3) ATMS-MiRS moisture analysis and detection of dry air intrusions with MIST



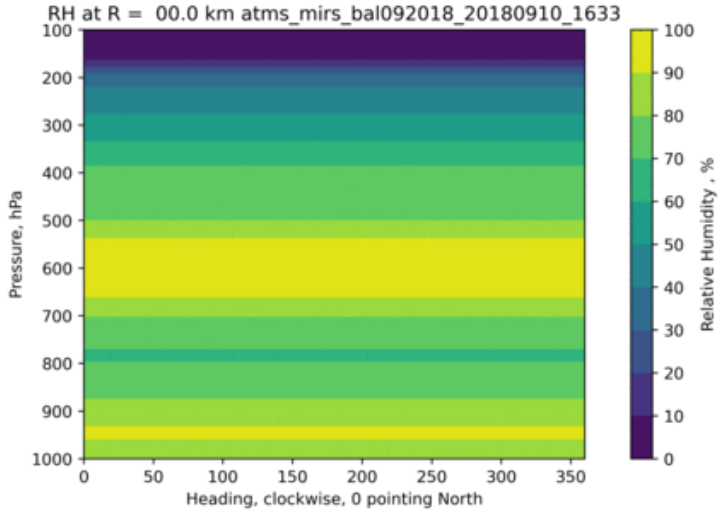
Pressure – Heading ATMS-MIRS

RH at R = 0 - 1000 km for MIST

VIIRS Day-Night Band Imagery remapped in GOES-16 satellite projection



Hurr Isaac at 1633 UTC on 09/10/2018



PGRR TC Projects & PIs: Upcoming Projects (FY21-23)

1: Improvements to near-real time GeoIPS LEO data processing: Direct readout and AWIPS-2 integration into operations
NRL: Josh Cossuth, Chris Selman, Mindy Surratt

Build upon the currently funded project leveraging the NRL GeoIPS software to develop a common framework that normalizes polar data and creates TC-centered products to enhance the local ability for R2O by the use of low latency direct-readout and NESDIS PDA products in operational forecast interests. The project also intends to incorporate CIMSS algorithms into GeoIPS and provide input into CIRA applications

2: Direct integration of JPSS observations into Tropical Cyclone surface wind structure retrievals using Deep Learning
CIMSS: Tony Wimmers, Derrick Herndon

Transition the Deep Learning model output (based on passive MW, JPSS imagery, and feature detection from CIMSS' SATCON and ADT) into NRL's GeoIPS platform to reconstruct the entire TC 2D surface wind field and provide insight for use in operational forecasting of TC intensity and analyzing structure

3: Use of JPSS Instrument Suite to Improve Operational Tropical Cyclone Structure and Intensity Analysis and Forecasts
CIRA/NESDIS: Galina Chirkova, Alex Libardoni, John Knaff

Continue development of funded Tropical Cyclone forecast applications, but focus on TC moisture analysis and Extratropical Transition:

1. *The development of a new ATMS-MiRS moisture application to display storm-centered shear-relative TPW, moisture flux, and vertical and azimuthal cross-sections of RH which will be added into the SHIPS model - (a JPSS expansion of the MIST tool)*
2. *Creation of storm-centered databases of ATMS-MiRS, NUCAPS, and VIIRS during TT/ET and used to develop warm core applications to diagnose TT/ET and cyclone phase.*
3. *Additional training on CIRA's ProxyVisible algorithm for ET in the northern latitudes and develop an imagery product for forecasters*

4: Continued Collaboration with JPSS PGRR Soundings Initiative

Follow up questions about the JPSS PGRR for TCs?
Interested in joining our Stakeholder meeting on 3/16?
Email Monica.Bozeman@noaa.gov

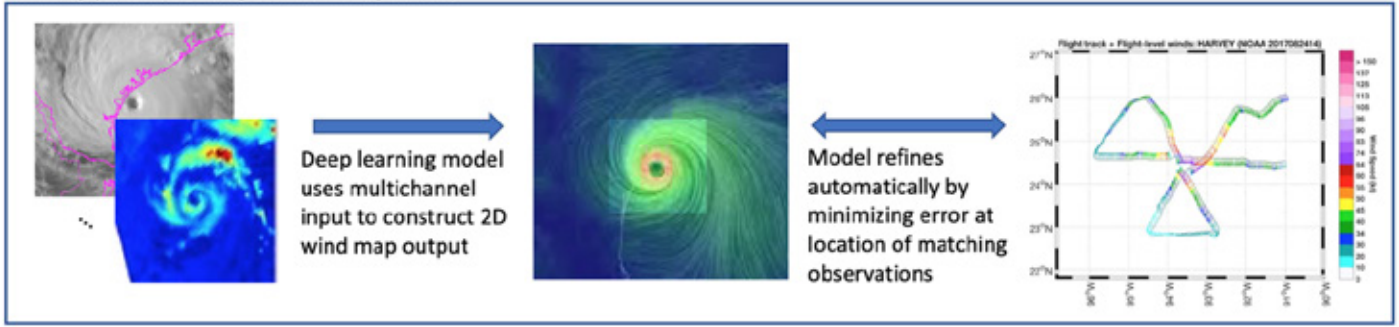
Backup Slides

CIMSS Upcoming: Using Deep Learning to construct a 2D TC wind field

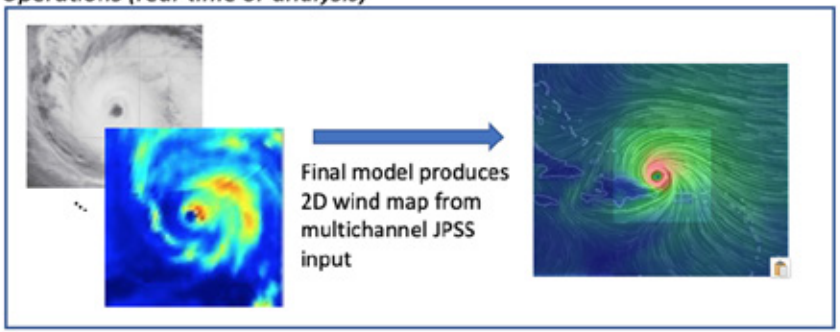
- Our 2021-2024 research effort will use deep learning to associate ATMS and VIIRS imagery to two-dimensional TC surface wind fields

- The motivation is that satellite imagery has uniquely detailed depictions of TC structures, and deep learning can be used to relate this to elusive inner-core wind patterns

Training process (using hundreds of cases)



Operations (real-time or analysis)



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