

Weekly Report

CIRA
STAR/NESDIS
National Oceanic and Atmospheric Administration (NOAA)

Submitted by: Maranda Hutson
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Products and Applications

Updates to the Hurricane Intensity and Structure Algorithm (HISA) delivered to NESDIS/STAR ASSISTT. An updated version of the HISA algorithm was delivered to STAR/ASSISTT on December 15, 2023. HISA estimates tropical cyclone intensity and wind structure for all global tropical cyclones from microwave sounder data (ATMS and AMSU) from NOAA and EUMETSAT Low-Earth Orbiting (LEO) satellites. HISA upgrades include a new data pre-processing system, enhanced metadata, added capabilities to process MetOp-C and NOAA-21 data, and a new bias correction method for tropical cyclone intensity, minimum sea level pressure (MSLP), and wind radii for 34-, 50-, and 64-kt threshold winds. The next step is for STAR/ASSISTT to work with NCCF to make the new version of HISA operational in 2024.

(POCs: Galina Chirokova, Galina.Chirokova@rams.colostate.edu; Mark DeMaria, Mark.DeMaria@colostate.edu; Robert DeMaria, Robert.DeMaria@rams.colostate.edu; CIRA; and John Knaff, John.Knaff@noaa.gov, NOAA/STAR) Funding: JPSS and DACS.

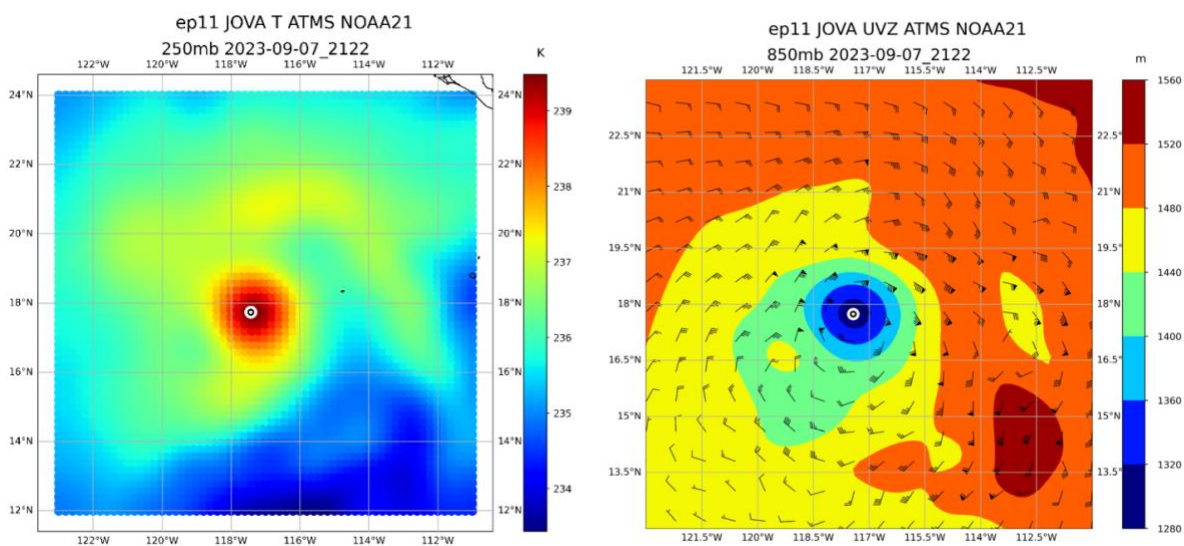


Figure. Example of HISA output for NOAA-21. Left: ATMS MiRS temperature at 250 hPa, re-gridded to the HISA evenly spaced lat/lon grid. Right: example of HISA output of balanced winds and geopotential height at 850 hPa. Both images are from 2023 eastern Pacific Hurricane Jova at 2122 UTC on 07 September 2023.

Joint Typhoon Warning Center (JTWC) uses TROPICS data in their operations. The Joint Typhoon Warning Center (JTWC) mentioned the use of TROPICS data in their forecast discussion on Dec 07 2023. The constellation of five TROPICS cubesats provides the ability to view the same tropical cyclone with a median revisit time around one hour and with high spatial resolution and from multiple viewing angles. TROPICS has higher horizontal resolution compared to ATMS and AMSU (24 km for temperature channels and 16 km for moisture channels at nadir) and provides similar data. CIRA has been providing TROPICS data in AWIPS2 format in near-real-time to JTWC since 2022. JTWC is receiving AWIPS2-ready imagery for all TROPICS satellites (currently five) and displays them in their operational AWIPS2 system. CIRA is also working with the TROPICS science team on making TROPICS AWIPS2 imagery available to the National Hurricane Center (NHC), JTWC and other operations centers via TROPICS Data Processing Center. We also started coordinating with NESDIS on making TROPICS AWIPS2 imagery available via NCCF and PDA. (POCs: Galina Chirokova, Galina.Chirokova@rams.colostate.edu; Mark DeMaria, Mark.DeMaria@colostate.edu; Debra Molenar, Debra. Molenar@colostate.edu; Robert DeMaria, Robert.DeMaria@rams.colostate.edu; Alan Brammer, Alan.Brammer@colostate.edu; Coleman McClelland, Coleman.McClelland@colostate.edu, CIRA; Funding: TROPICS, ONR)

WDPS31 PGTW 080300

MSGID/GENADMIN/JOINT TYPHOON WRNCEN PEARL HARBOR HI//

SUBJ/PROGNOSTIC REASONING FOR TROPICAL CYCLONE 03P (JASPER) WARNING NR 013//

SUMMARY:

INITIAL POSITION: 14.2S 156.6E

INITIAL INTENSITY: 120 KTS

GEOGRAPHIC REFERENCE: 645 NM EAST-NORTHEAST OF CAIRNS, AUSTRALIA

MOVEMENT PAST 6 HOURS: SOUTHWARD AT 05 KTS

SIGNIFICANT WAVE HEIGHT: 38 FEET

SATELLITE ANALYSIS, INITIAL POSITION AND INTENSITY DISCUSSION:

ANIMATED MULTISPECTRAL SATELLITE IMAGERY (MSI) DEPICTS A WELL-DEFINED, ROUGHLY 25NM EYE WITH TIGHTLY WRAPPING SPIRAL BANDS OF DEEP CONVECTION IN ALL QUADRANTS. A RECENT 072253Z TROPICS-6 91GHZ MICROWAVE IMAGE REVEALS A WELL-DEFINED AND SYMMETRIC 25NM MICROWAVE EYE WITH DEEP CONVECTION PRIMARILY TO THE SOUTH OF THE LLCC.

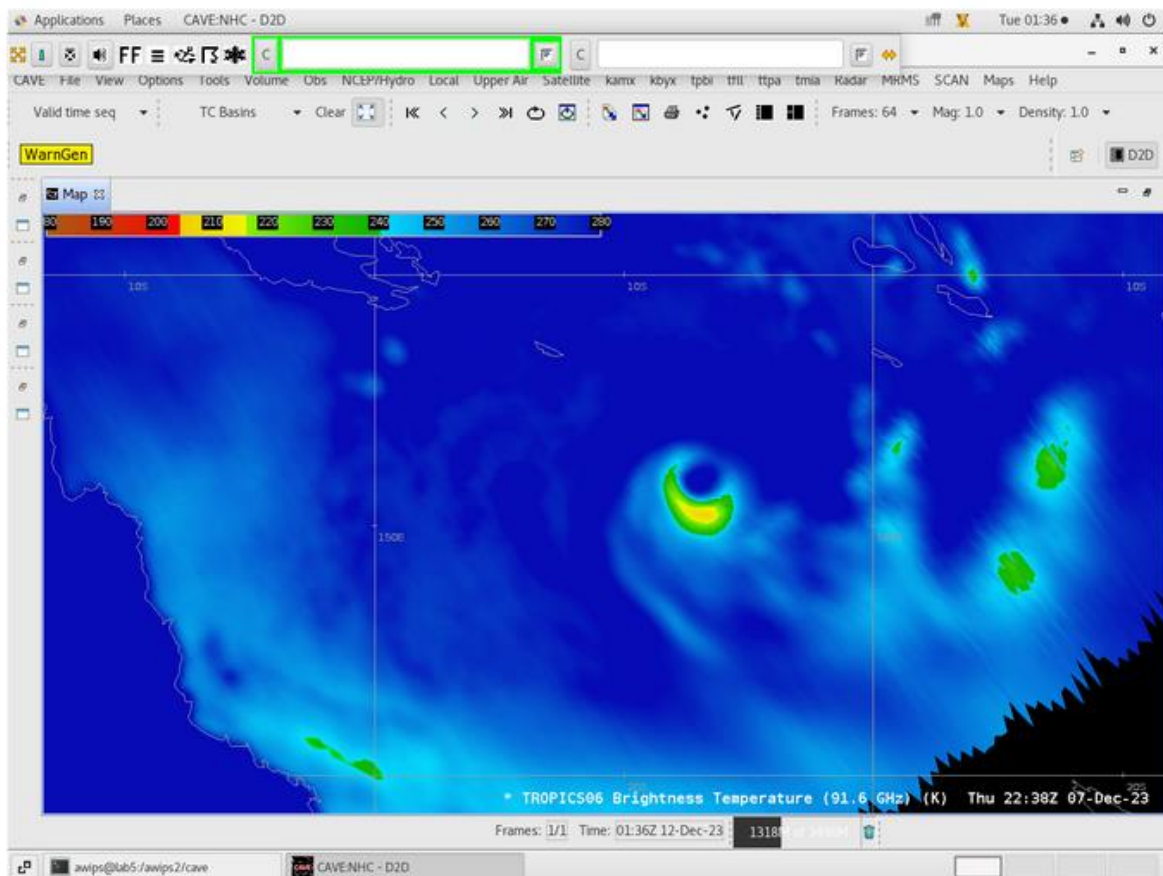


Figure. Snapshot of TROPICS 06 data mentioned in JTWC discussion on 07 December 2023 and the AWIPS2 display of TROPICS06 view of tropical cyclone Jasper.

The NOAA/NESDIS ensemble Tropical Rainfall Potential (eTRaP), developed by CIRA and NESDIS scientists in the 2000's and 2010's is a simple ensemble whose members are the four 6-hourly rainfall totals produced from the single-orbit TRaPs that go into producing one 24-hour rainfall forecast totals every six hours. This ensemble approach allows for the generation of deterministic rainfall totals in addition to probabilistic forecasts of rainfall. The eTRaPs can be found at <https://www.ssd.noaa.gov/PS/TROP/etrap.html> and are generated globally whenever a tropical cyclone of tropical storm strength or greater exists.

Each eTRaP is made up of forecasts using observations from polar microwave sensors-currently on NOAA-20, S-NPP, METOP-B and -C, GPM, and AMSR2 along with GOES Hydro-Estimator rainfall estimates and a rainfall climatology (R-Clipper) that are initialized at several observation times, and possibly using several different Tropical Cyclone Center track forecasts. The diversity among the ensemble members helps to reduce the large (unknown) errors associated with a single-sensor. Here is an excellent example of an eTRaP generated on December 13 for Tropical Cyclone Jasper as it approached the Northeast Australian coast. The eTRaP 24-hour maximum rainfall forecast compared favorable with the observed 24 hour rainfall total map produced by the Australian Bureau of Meteorology.

(POC: S. Kusselson, sheldon.kusselson@colostate.edu, Funding: JPSS)

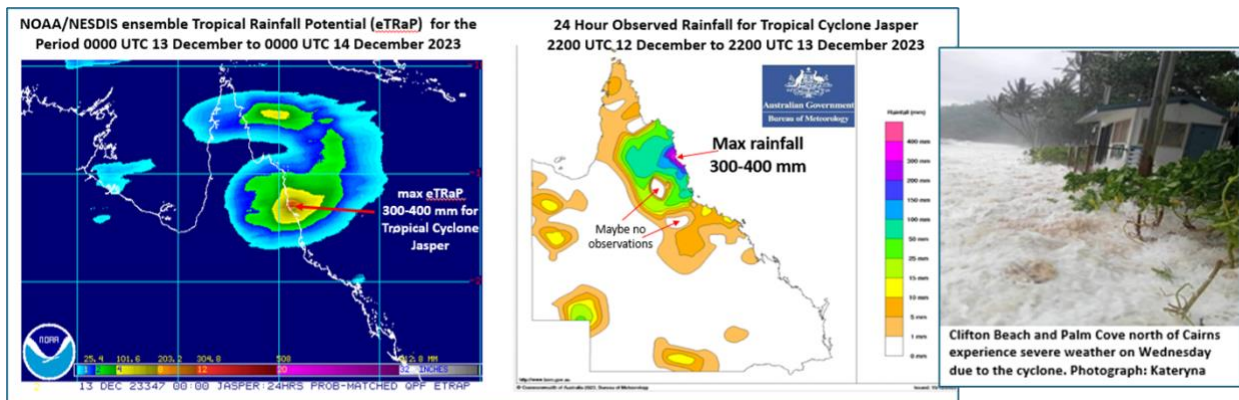


Figure: eTRaP for 24 hour period before 14 December 2023 and observed rainfall from tropical

cyclone Jasper. Severe flooding occurred in NE Australia.

Publications (Citation: followed by a short Summary: (Why & so what), & detailed summary):

Citation: Chirokova, G., J. A. Knaff, M. J. Brennan, R. T. DeMaria, M. Bozeman, S. N. Stevenson, J. L. Beven, E. S. Blake, A. Brammer, J. W. Darlow, M. DeMaria, S. D. Miller, C. J. Slocum, D. Molenaar, and D. W. Hillger, 2023. ProxyVis—A Proxy for Nighttime Visible Imagery Applicable to Geostationary Satellite Observations. *Wea. Forecasting*, **38**, 2527-2550, <https://doi.org/10.1175/WAF-D-23-0038.1>.

Short Summary: ProxyVis imagery is a new method for combining satellite infrared channels to qualitatively mimic daytime visible imagery at nighttime. Results show that ProxyVis significantly improves a forecaster’s ability to track low-level oceanic clouds, circulation features (such as tropical cyclone center locations) at night, works for all current geostationary satellites, and is useful across a wide range of backgrounds and meteorological scenarios. Animated ProxyVis geostationary imagery has been operational at the National Hurricane Center since 2019 and is also currently being transitioned to operations at other NWS offices and the Joint Typhoon Warning Center. Forecaster feedback described in the paper shows that ProxyVis is an extremely valuable addition to their satellite product suite.

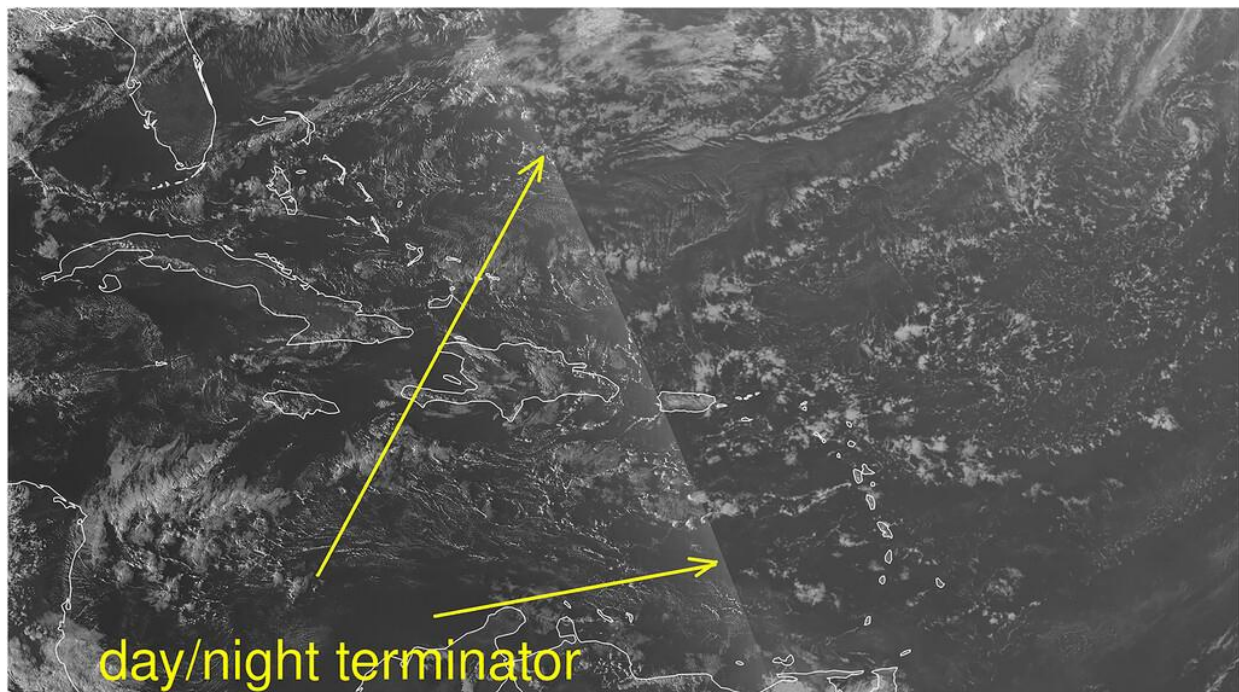


Figure. Day/night terminator (shown by yellow arrows) as seen on GOES-16 GeoProxyVis at 2210 UTC 29 Jan 2023, showing smooth transition between visible and proxyVis parts of the GeoProxyVis imagery. The image is centered near 20°N, 65°W. Visible GOES-16 CO2 is on the left, and ProxyVis is on the right. (From Chirokova et al. 2023)

Detailed Summary: Visible satellite imagery is widely used by operational weather forecast centers for tropical and extratropical cyclone analysis and marine forecasting. The absence of visible imagery at night can significantly degrade forecast capabilities, such as determining tropical cyclone center locations or tracking warm-topped convective clusters. This paper documents ProxyVis imagery, an infrared-based proxy for daytime visible imagery developed to address the lack of visible satellite imagery at night and the limitations of existing nighttime visible options. ProxyVis was trained on the VIIRS day/night band imagery at times close to the full moon using VIIRS IR channels with closely matching GOES-16/17/18, Himawari-8/9, and Meteosat-9/10/11 channels. The final operational product applies the ProxyVis algorithms to geostationary satellite data and combines daytime visible and nighttime ProxyVis data to create full-disk animated GeoProxyVis imagery. The simple versions of the ProxyVis algorithm enable its generation from earlier GOES and Meteosat satellite imagery. ProxyVis offers significant improvement over existing operational products for tracking nighttime oceanic low level clouds. Further, it is qualitatively similar to visible imagery for a wide range of backgrounds and synoptic conditions and phenomena, enabling forecasters to use it without special training. ProxyVis was first introduced to National Hurricane Center (NHC) operations in 2018 and was found to be extremely useful by forecasters becoming part of their standard operational satellite product suite in 2019. Currently, ProxyVis implemented for GOES-16/18, Himawari-9, and Meteosat-9/10/11 is being used in operational settings and evaluated for transition to operations at multiple NWS offices and the Joint Typhoon Warning Center.

(POC: Galina Chirokova, Galina.Chirokova@rams.colostate.edu, CIRA ; Funding GOES-R, JPSS PGRR, ONR)

Citation: Razin, M. N., C. J. Slocum, J. A. Knaff, P. J. Brown, and M. M. Bell, 2023: Tropical Cyclone Precipitation, Infrared, Microwave, and Environmental Dataset (TC PRIMED). *Bull. Amer. Meteor. Soc.*, **104**, E1980–E1998, <https://doi.org/10.1175/BAMS-D-21-0052.1>.

Short Summary: The article discussing the Tropical Cyclone Precipitation, Infrared, Microwave, and Environmental Dataset (TC PRIMED) is now fully published in the Bulletin of the American Meteorological Society. TC PRIMED is a dataset compiled to facilitate tropical cyclone research and forecast product development. It contains intercalibrated passive microwave brightness temperature observations, passive-microwave-based retrieved rainfall, spaceborne precipitation radar observations, infrared brightness temperature observations, tropical cyclone

information like position and intensity, and tropical cyclone environmental information. The article discusses data sources and processing in compiling TC PRIMED and provides an example analysis of tropical cyclones using TC PRIMED. TC PRIMED is awaiting full publication on NCEI (<https://doi.org/10.25921/dmy1-0595>) and is fully available on an Amazon Web Service S3 bucket through the NOAA Open Data Dissemination program (NODD; <https://noaa-nesdis-tcprimed-pds.s3.amazonaws.com/index.html>).

Detailed Summary: To study tropical cyclones and generate forecast applications using satellite observations, researchers often consolidate disparate sources of raw and ancillary data. Data consolidation involves obtaining, collocating, and intercalibrating data from different sensors and derived products; calculating environmental diagnostics from a homogeneous source; and standardizing these various products for a straightforward analysis. To alleviate preprocessing issues and provide a long-term, global digital dataset of tropical cyclone satellite observations, we construct the Tropical Cyclone Precipitation, Infrared, Microwave, and Environmental Dataset (TC PRIMED). TC PRIMED contains tropical cyclone-centric 1) intercalibrated, multichannel, multisensor microwave brightness temperatures, 2) retrieved rainfall from NASA's Goddard Profiling Algorithm (GPROF), 3) nearly coincident geostationary satellite infrared brightness temperatures and derived metrics, 4) tropical cyclone position and intensity information, 5) ECMWF fifth-generation reanalysis fields and derived environmental diagnostics, and 6) precipitation radar observations from the TRMM and GPM Core Observatory satellites. TC PRIMED consists of over 197,000 overpasses of over 2,300 storms from 1998 to 2021, providing researchers with an analysis-ready dataset to promote and support research into improving our understanding of the relationship between tropical cyclone convective and precipitation structure, intensity, and environment. Here, we briefly describe data sources and processing steps to create TC PRIMED. To demonstrate TC PRIMED's potential utility for studying important tropical cyclone processes and for application development, we present a shear-relative composite analysis of several multisensor satellite variables relative to the tropical cyclone lifetime maximum intensity. The composite analysis provides a simple example of how TC PRIMED can benefit future studies to advance our understanding of tropical cyclones and improve forecasts. (POC: Naufal Razin, CIRA, naufal@colostate.edu)

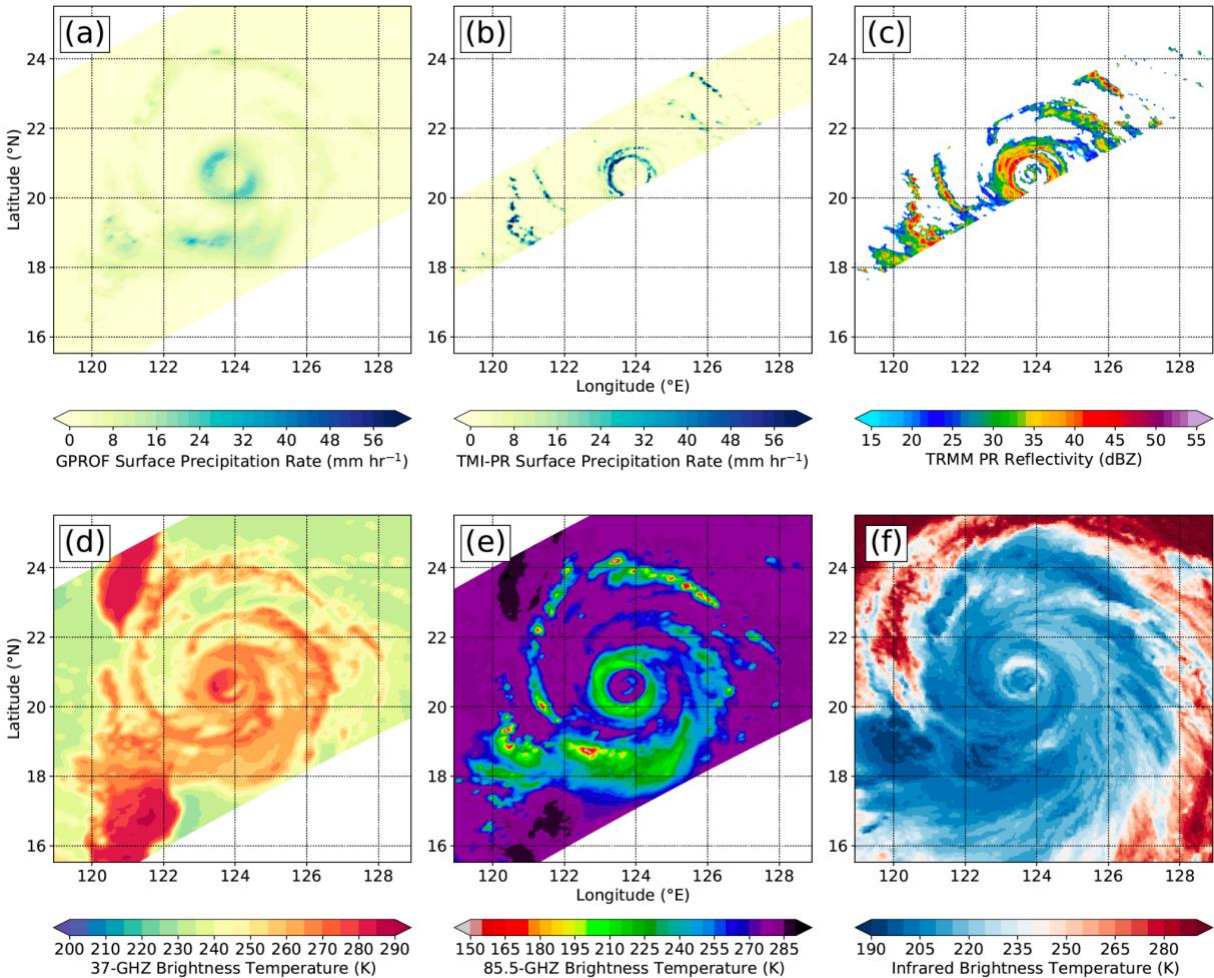


Figure. Example of select satellite variables available in a single satellite overpass file in TC PRIMED, taken from a TRMM overpass of Typhoon Sepat (2007) at 0223:17 UTC 17 Aug 2007. (a) GPROF surface precipitation rate, (b) combined TMI-PR surface precipitation rate, (c) TRMM PR reflectivity at 3-km altitude, (d) 37-GHz vertically polarized microwave brightness temperatures, (e) 85.5-GHz vertically polarized microwave brightness temperatures, and (f) infrared brightness temperatures at $10.8 \mu\text{m}$ from MTSAT-1R.

Awards and Recognition

Media Interactions and Requests

Blog Posts and Social Media

Travel, Workshops, Conferences, and Meeting Reports

Training and Education activities

Future Meetings and Events (dates, meeting/event, location, staff involved)

Other

Manuscript Reviews: N. Razin reviewed a manuscript for the Geophysical Research Letters.
(POC: Naufal Razin, CIRA, naufal@colostate.edu)