

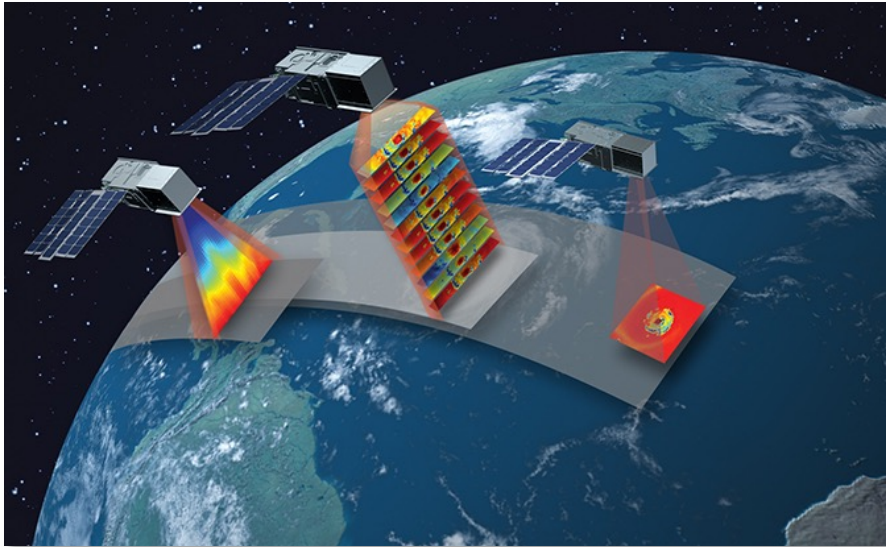


# Near-Real-time Display of TROPICS SmallSat Constellation Imagery and Products

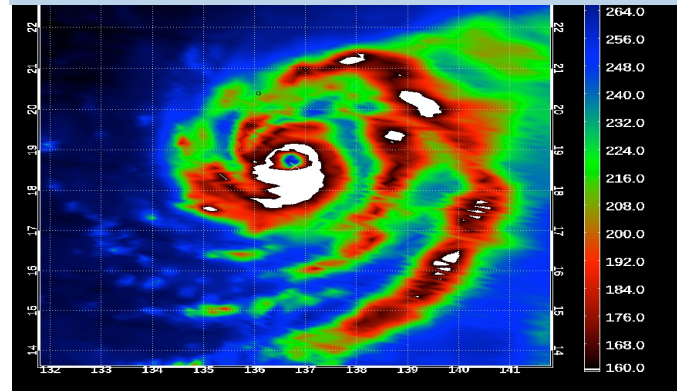


Derrick Herndon (CIMSS/UW, [dherndon@ssec.wisc.edu](mailto:dherndon@ssec.wisc.edu))

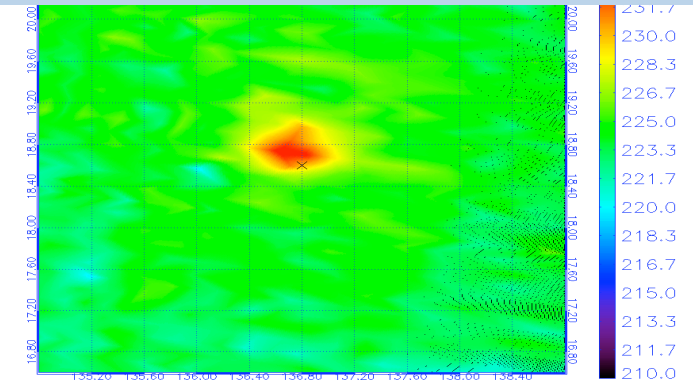
Chris Velden (CIMSS/UW), Jeff Hawkins (CIMSS/UW)



Typhoon Mindulle (20W) Viewed by TROPICS Pathfinder



Channel 12 205 GHz



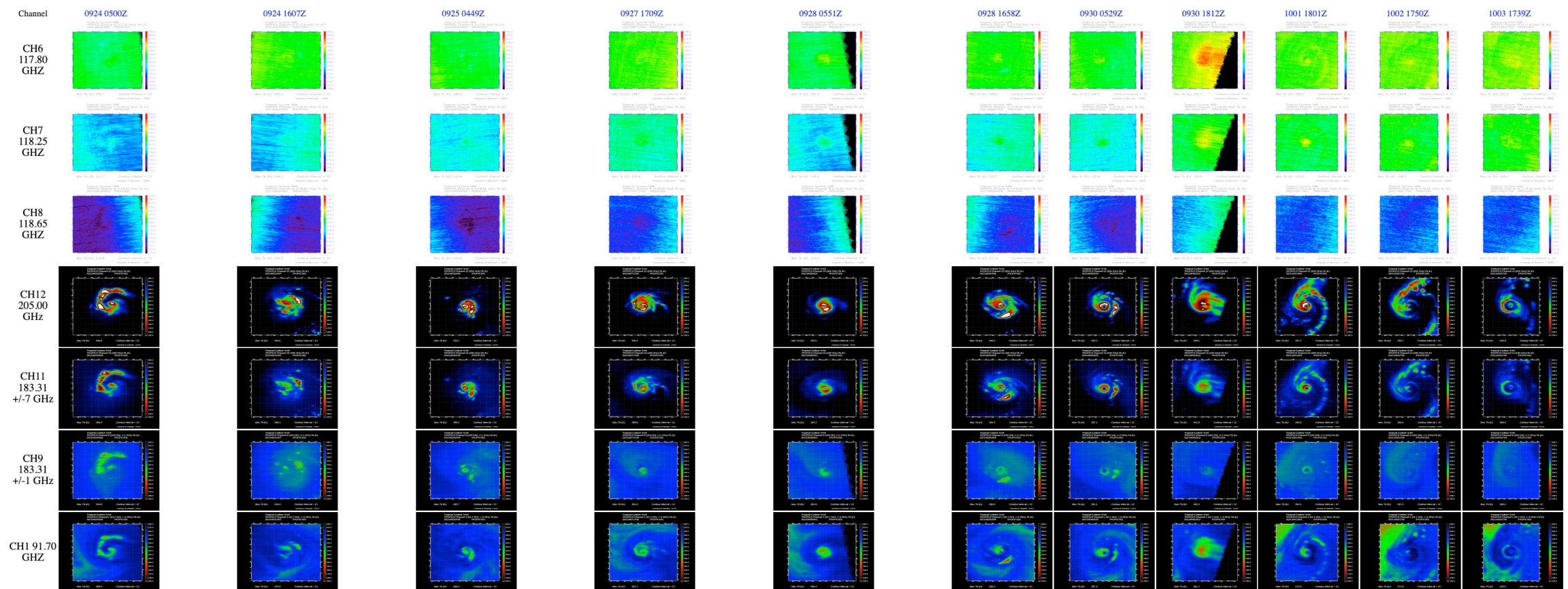
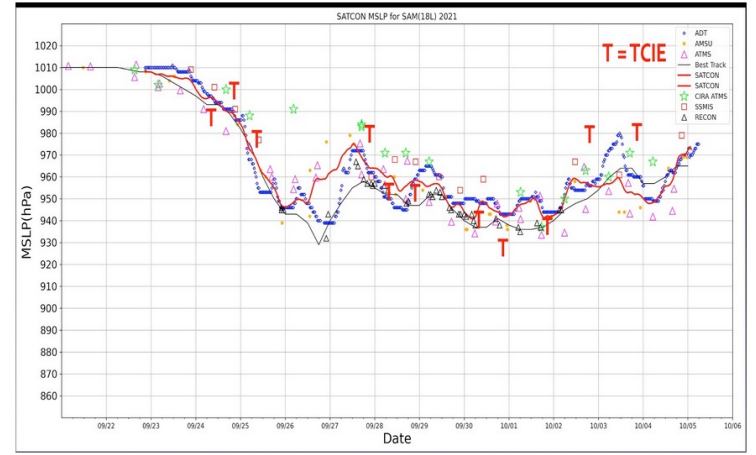
Channel 7 118 GHz

**CURRENT TROPICS ESTIMATE**  
 CIMSS TROPICS TC Intensity Estimation:  
 2021 1003 1739Z STORM: 18L  
 Latitude: 37.9 Longitude: -53.9  
 Storm position corresponds to TROPICS CH7 FOV 61 [1<---->81]  
 ----- SAT is PATH1 -----  
 | Estimated MSLP: 986.8 hPa  
 | Estimated Maximum Sustained Wind: 55.2 kts  
 Channel 8 Tb Anomaly: 1.2  
 Channel 7 Tb Anomaly: 3.4  
 Channel 6 Tb Anomaly: 4.5  
 EYE: 156.5 km  
 Environmental Pressure: 1014

← Current TCIE Intensity from most recent TROPICS pass

History for 202118L

Year	Date	Time	Lat	Lon	Satellite	FOV	Res	Resdif	Tb6a	Tb7a	Tb6	Tb7	Tb9	Tb11	Tb12	Penv	Eye_sz	ARCHER_score	TMSLP	TVmax
2021	20210924	0500	10.92	-41.13	TROPICS01	10	42.7	12.7	0.4	0.8	241.5	223.5	240.2	254.4	253.3	1011	55.5	0	989.4	50.5
2021	20210924	1607	11.93	-43.33	TROPICS01	16	34.1	21.3	0.2	0.9	241.3	223.1	239.6	254.4	250.5	1011	55.5	19.4	1005.4	50.6
2021	20210925	0449	12.53	-46.16	TROPICS01	57	28.2	-9.8	0.8	1.3	241.4	223.9	239.8	252.4	249.2	1013	18.3	65.1	983.9	54.7
2021	20210927	1709	15.93	-51.52	TROPICS01	60	30.3	-11.9	-0.9	2.2	240.7	226.0	239.8	232.7	220.9	1013	18.3	38.2	981.6	54.3
2021	20210928	0551	17.28	-52.27	TROPICS01	2	75.8	-29.8	2.1	1.9	243.2	225.0	239.9	258.0	255.3	1012	46.0	58.5	957.0	74.5
2021	20210928	1658	17.87	-54.81	TROPICS01	17	33.3	3.5	5.8	4.8	247.0	228.0	241.4	266.7	267.5	1011	36.8	60.5	955.1	84.1
2021	20210930	0529	20.98	-58.75	TROPICS01	60	30.3	15.7	7.4	6.2	249.2	230.7	253.3	276.4	275.4	1011	46.0	77.5	945.2	90.0
2021	20210930	1812	22.65	-58.44	TROPICS01	78	69.4	-32.6	6.8	3.9	248.5	229.4	245.5	253.9	240.4	1011	36.8	67	931.7	98.2
2021	20211001	1801	29.38	-61.90	TROPICS01	56	27.5	18.4	8.8	6.6	251.5	232.9	248.3	272.6	270.7	1012	46.0	66.3	941.2	97.7
2021	20211002	1750	34.98	-58.52	TROPICS01	51	24.7	49.7	5.3	3.6	248.4	230.4	248.8	271.1	270.0	1015	74.0	8.5	984.6	60.1
2021	20211003	1739	37.20	-52.85	TROPICS01	61	31.0	125.51	4.5	3.4	247.6	230.9	243.0	263.0	264.2	1014	156.5	49.5	986.8	55.2



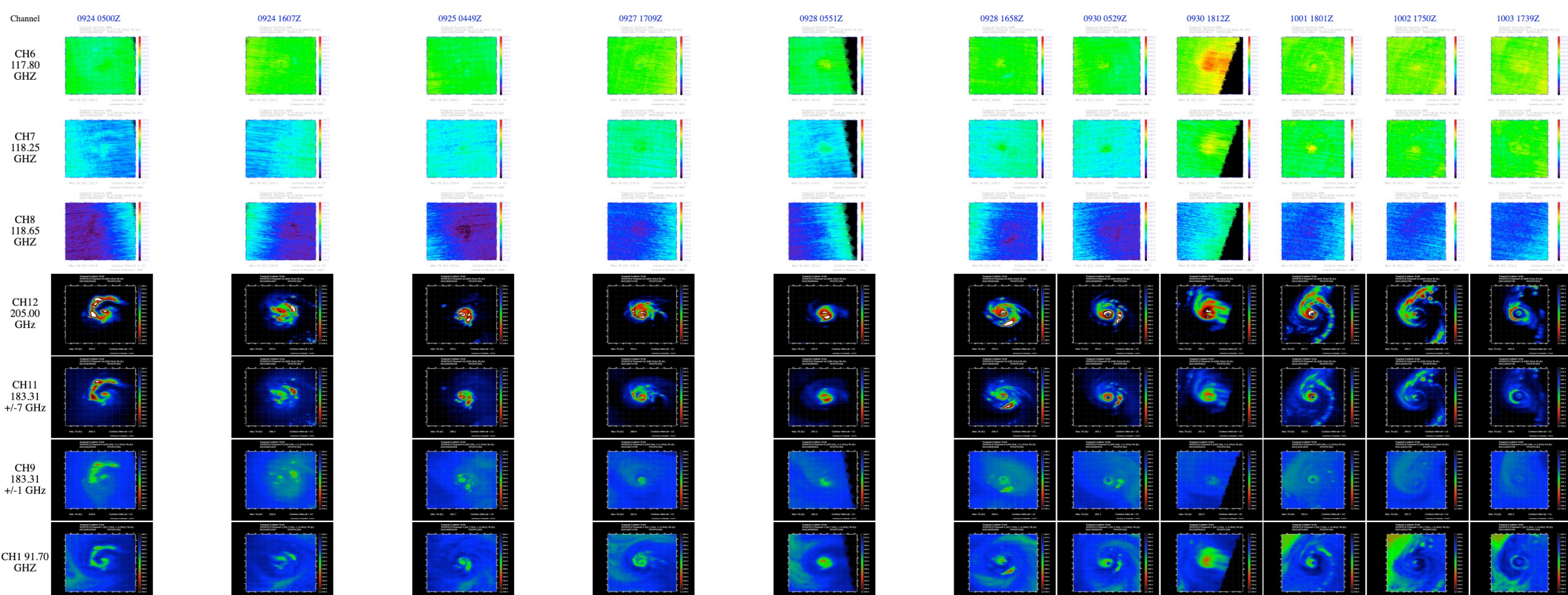
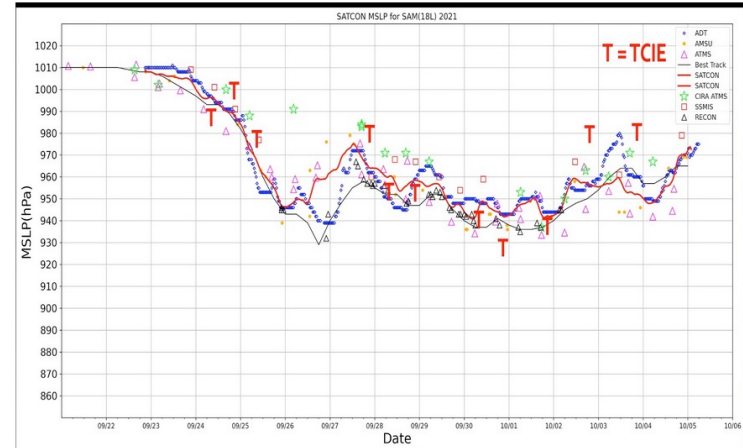
CURRENT TROPICS ESTIMATE  
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 Channel 7 Tb Anomaly: 3.4  
 Channel 6 Tb Anomaly: 4.5  
 EYE: 156.5 km  
 Environmental Pressure: 1014

# TROPICS TCIE storm history including diagnostics



History for 202118L

Year	Date	Time	Lat	Lon	Satellite	FOV	Res	Resdif	Tb6a	Tb7a	Tb6	Tb7	Tb9	Tb11	Tb12	Penv	Eye_sz	ARCHER_score	TMSLP	TVmax
2021	20210924	0500	10.92	-41.13	TROPICS01	10	42.7	12.7	0.4	0.8	241.5	223.5	240.2	254.4	253.3	1011	55.5	0	989.4	50.5
2021	20210924	1607	11.93	-43.33	TROPICS01	16	34.1	21.3	0.2	0.9	241.3	223.1	239.6	254.4	250.5	1011	55.5	19.4	1005.4	50.6
2021	20210925	0449	12.53	-46.16	TROPICS01	57	28.2	-9.8	0.8	1.3	241.4	223.9	239.8	252.4	249.2	1013	18.3	65.1	983.9	54.7
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2021	20210928	0551	17.28	-52.27	TROPICS01	2	75.8	-29.8	2.1	1.9	243.2	225.0	239.9	258.0	255.3	1012	46.0	58.5	957.0	74.5
2021	20210928	1658	17.87	-54.81	TROPICS01	17	33.3	3.5	5.8	4.8	247.0	228.0	241.4	266.7	267.5	1011	36.8	60.5	955.1	84.1
2021	20210930	0529	20.98	-58.75	TROPICS01	60	30.3	15.7	7.4	6.2	249.2	230.7	253.3	276.4	275.4	1011	46.0	77.5	945.2	90
2021	20210930	1812	22.65	-58.44	TROPICS01	78	69.4	-32.6	6.8	3.9	248.5	229.4	245.5	253.9	240.4	1011	36.8	67	931.7	98.2
2021	20211001	1801	29.38	-61.90	TROPICS01	56	27.5	18.4	8.8	6.6	251.5	232.9	248.3	272.6	270.7	1012	46.0	66.3	941.2	97.7
2021	20211002	1750	34.98	-58.52	TROPICS01	51	24.7	49.7	5.3	3.6	248.4	230.4	248.8	271.1	270.0	1015	74.0	8.5	984.6	60.1
2021	20211003	1739	37.20	-52.85	TROPICS01	61	31.0	125.51	4.5	3.4	247.6	230.9	243.0	263.0	264.2	1014	156.5	49.5	986.8	55.2

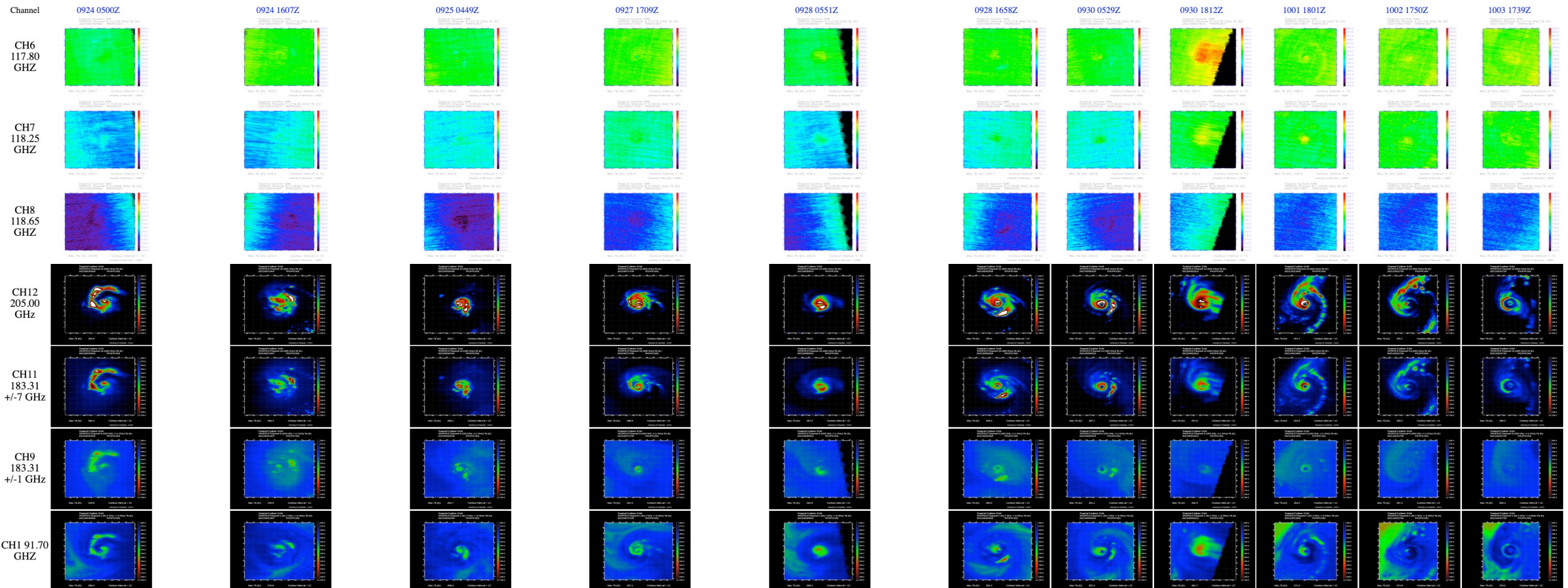
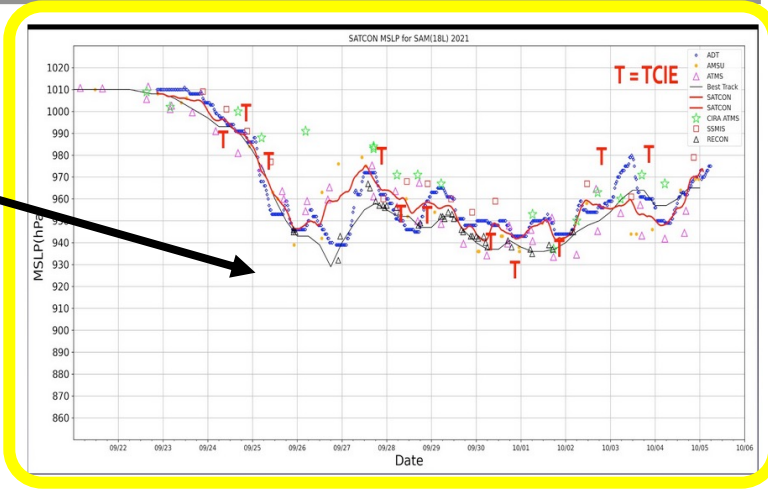


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 | Estimated Maximum Sustained Wind: 55.2 kts  
 Channel 8 Tb Anomaly: 1.2  
 Channel 7 Tb Anomaly: 3.4  
 Channel 6 Tb Anomaly: 4.5  
 EYE: 156.5 km  
 Environmental Pressure: 1014

History for 202118L

Year	Date	Time	Lat	Lon	Satellite	FOV	Res	Resdif	Tb6a	Tb7a	Tb6	Tb7	Tb9	Tb11	Tb12	Penv	Eye_sz	ARCHER_score	TMSLP	TVmax
2021	20210924	0500	10.92	-41.13	TROPICS01	10	42.7	12.7	0.4	0.8	241.5	223.5	240.2	254.4	253.3	1011	55.5	0	989.4	50.5
2021	20210924	1607	11.93	-43.33	TROPICS01	16	34.1	21.3	0.2	0.9	241.3	223.1	239.6	254.4	250.5	1011	55.5	19.4	1005.4	50.6
2021	20210925	0449	12.53	-46.16	TROPICS01	57	28.2	-9.8	0.8	1.3	241.4	223.9	239.8	252.4	249.2	1013	18.3	65.1	983.9	54.7
2021	20210927	1709	15.93	-51.52	TROPICS01	60	30.3	-11.9	-0.9	2.2	240.7	226.0	239.8	232.7	220.9	1013	18.3	38.2	981.6	54.3
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2021	20210930	0529	20.98	-58.75	TROPICS01	60	30.3	15.7	7.4	6.2	249.2	230.7	253.3	276.4	275.4	1011	46.0	77.5	945.2	90
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2021	20211001	1801	29.38	-61.90	TROPICS01	56	27.5	18.4	8.8	6.6	251.5	232.9	248.3	272.6	270.7	1012	46.0	66.3	941.2	97.7
2021	20211002	1750	34.98	-58.52	TROPICS01	51	24.7	49.7	5.3	3.6	248.4	230.4	248.8	271.1	270.0	1015	74.0	8.5	984.6	60.1
2021	20211003	1739	37.20	-52.85	TROPICS01	61	31.0	125.51	4.5	3.4	247.6	230.9	243.0	263.0	264.2	1014	156.5	49.5	986.8	55.2

SATCON display of TROPICS estimates relative to other intensity estimates linked to SATCON page.

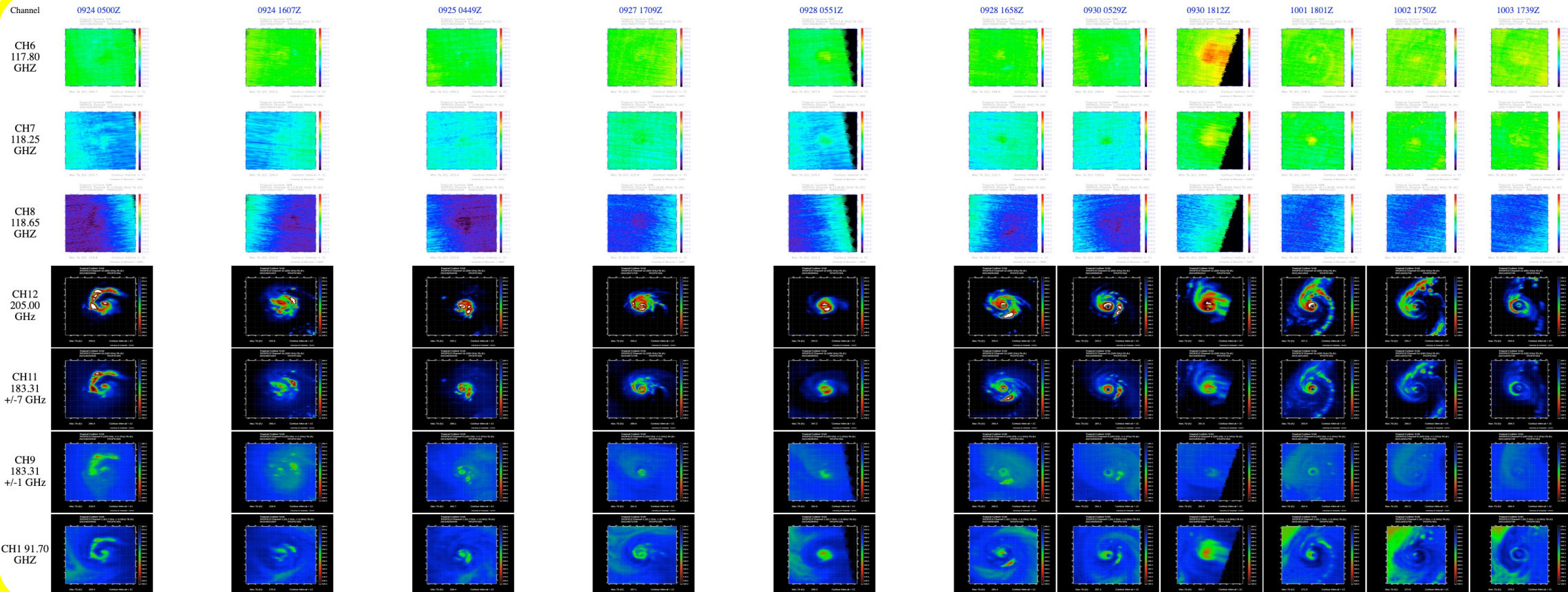
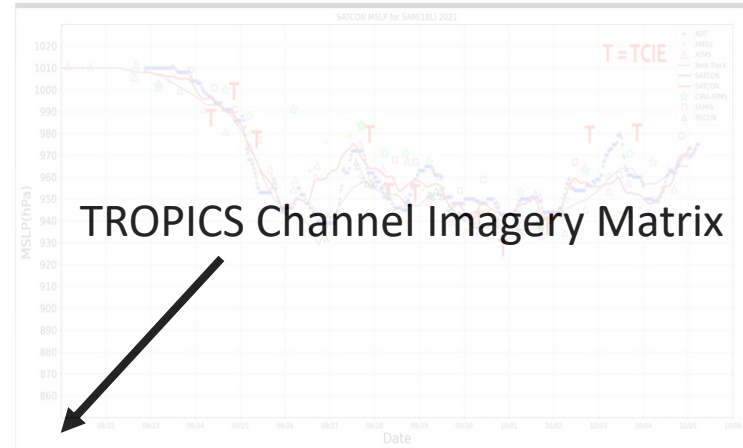


CURRENT TROPICS ESTIMATE  
 CIMSS TROPICS TC Intensity Estimation:  
 2021 1003 1739Z STORM: 18L  
 Latitude: 37.9 Longitude: -53.9  
 Storm position corresponds to TROPICS CH7 FOV 61 [1<--->81]

----- SAT is PATH1 -----  
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 | Estimated Maximum Sustained Wind: 55.2 kts  
 Channel 8 Tb Anomaly: 1.2  
 Channel 7 Tb Anomaly: 3.4  
 Channel 6 Tb Anomaly: 4.5  
 EYE: 156.5 km  
 Environmental Pressure: 1014

History for 202118L

Year	Date	Time	Lat	Lon	Satellite	FOV	Res	Resdif	Tb6a	Tb7a	Tb6	Tb7	Tb9	Tb11	Tb12	Penv	Eye_sz	ARCHER_score	TMSLP	TVmax
2021	20210924	0500	10.92	-41.13	TROPICS01	10	42.7	12.7	0.4	0.8	241.5	223.5	240.2	254.4	253.3	1011	55.5	0	989.4	50.5
2021	20210924	1607	11.93	-43.33	TROPICS01	16	34.1	21.3	0.2	0.9	241.3	223.1	239.6	254.4	250.5	1011	55.5	19.4	1005.4	50.6
2021	20210925	0449	12.53	-46.16	TROPICS01	57	28.2	-9.8	0.8	1.3	241.4	223.9	239.8	252.4	249.2	1013	18.3	65.1	983.9	54.7
2021	20210927	1709	15.93	-51.52	TROPICS01	60	30.3	-11.9	-0.9	2.2	240.7	226.0	239.8	232.7	220.9	1013	18.3	38.2	981.6	54.3
2021	20210928	0551	17.28	-52.27	TROPICS01	2	75.8	-29.8	2.1	1.9	243.2	225.0	239.9	258.0	255.3	1012	46.0	58.5	957.0	74.5
2021	20210928	1658	17.87	-54.81	TROPICS01	17	33.3	3.5	5.8	4.8	247.0	228.0	241.4	266.7	267.5	1011	36.8	60.5	955.1	84.1
2021	20210930	0529	20.98	-58.75	TROPICS01	60	30.3	15.7	7.4	6.2	249.2	230.7	253.3	276.4	275.4	1011	46.0	77.5	945.2	90
2021	20210930	1812	22.65	-58.44	TROPICS01	78	69.4	-32.6	6.8	3.9	248.5	229.4	245.5	253.9	240.4	1011	36.8	67	931.7	98.2
2021	20211001	1801	29.38	-61.90	TROPICS01	56	27.5	18.4	8.8	6.6	251.5	232.9	248.3	272.6	270.7	1012	46.0	66.3	941.2	97.7
2021	20211002	1750	34.98	-58.52	TROPICS01	51	24.7	49.7	5.3	3.6	248.4	230.4	248.8	271.1	270.0	1015	74.0	8.5	984.6	60.1
2021	20211003	1739	37.20	-52.85	TROPICS01	61	31.0	125.51	4.5	3.4	247.6	230.9	243.0	263.0	264.2	1014	156.5	49.5	986.8	55.2



# TROPICS Constellation Imagery for Mawar (202302W)

CIMSS TROPICAL CYCLONE TROPICS INTENSITY ESTIMATE TC 202302W

## CURRENT TROPICS ESTIMATE

CIMSS TROPICS TC Intensity Estimation:

2023 0528 1742 02W

Latitude: 18.153 Longitude: 126.869

Storm position corresponds to TROPICS CH7 FOV 58 [1<--->96]

SAT is TROPICS01

Estimated MSLP: 944.6 hPa

Estimated Maximum Sustained Wind: 80.6 kts

Channel 7 Tb Anomaly: 8.0

Channel 6 Tb Anomaly: 6.5

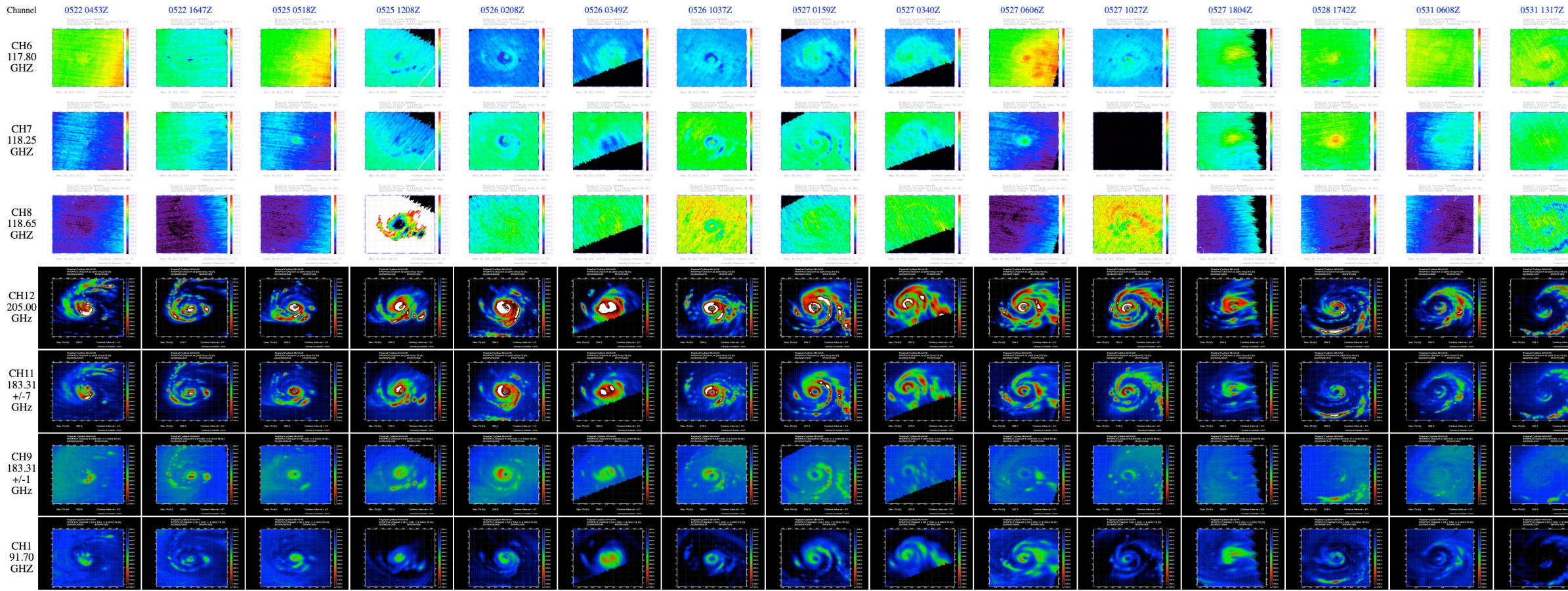
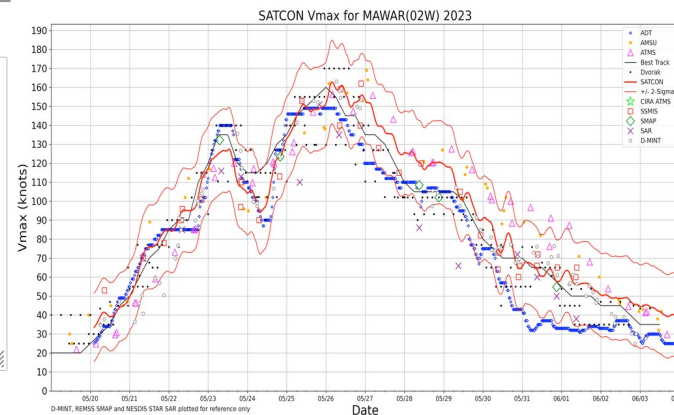
EYE: 64.4561 Km

Environmental Pressure: 1005

ARCHER score used is: 70.1

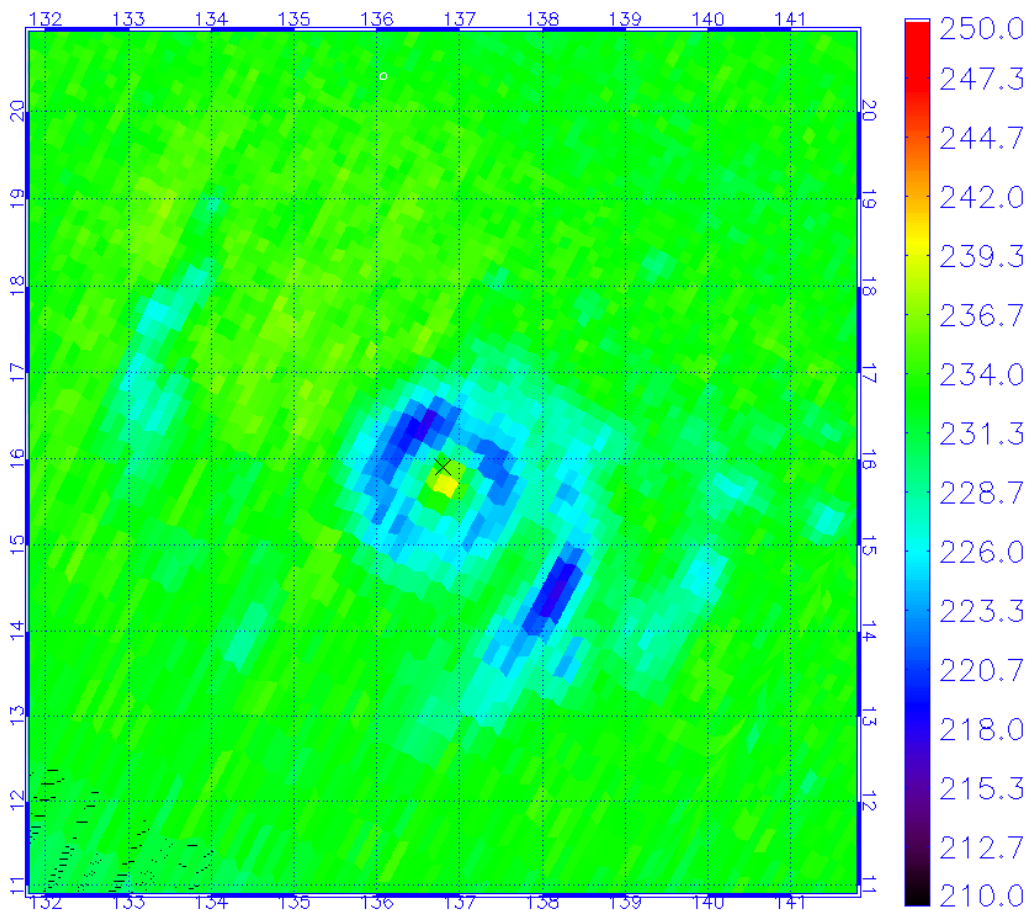
## History for 202302W

Year	Date	Time	Lat	Lon	Satellite	FOV	Res	Resdif	Tb6a	Tb7a	Tb6	Tb7	Tb9	Tb11	Tb12	Penv	Eye_sz	ARCHER_score	TMSLP	TVmax
2023	20230528	1742	18.15	126.90	TROPICS01	58	31.0	125.51	6.5	8.0	250.6	234.9	243.0	263.0	264.2	1005	64.5	70.1	944.6	80.6



# TROPICS Constellation Imagery for Mawar (202302W)

Tropical Cyclone MAWAR  
TROPICS Channel 7 (118.25 GHz) Tb (K)  
202305261037 TROPICS05

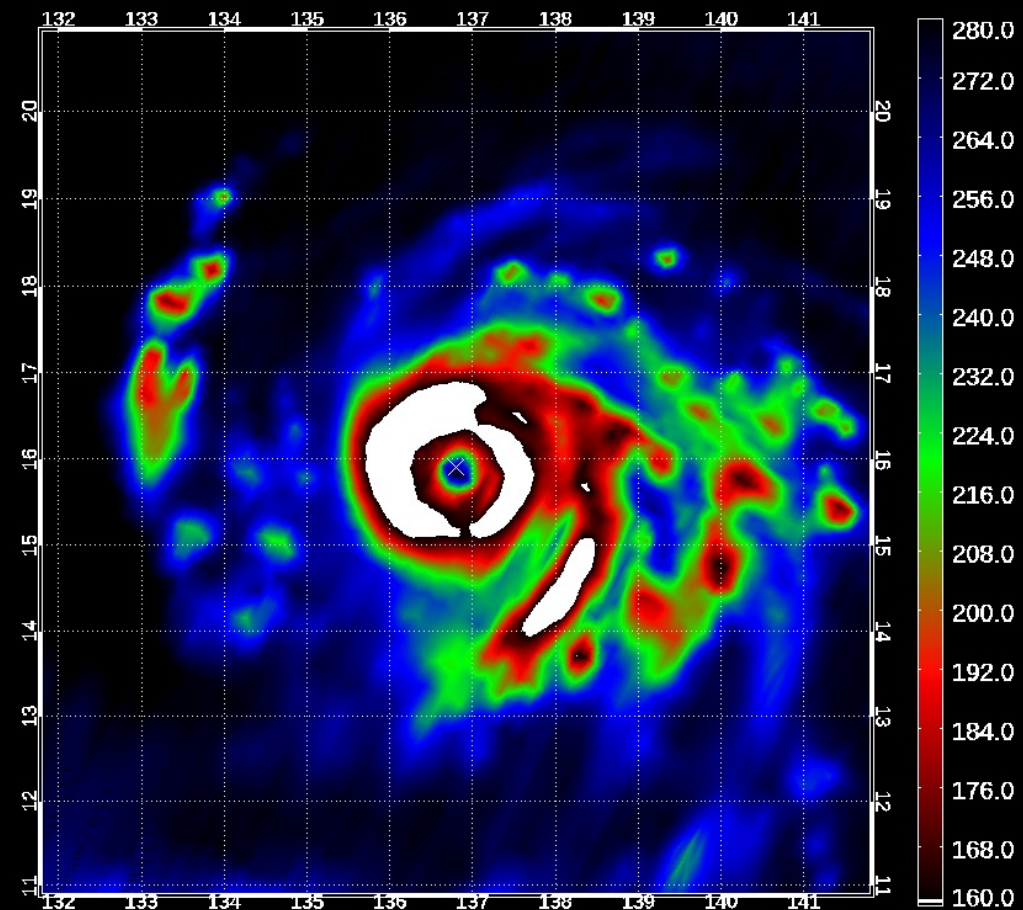


Max Tb (K): 239.3

Contour Interval = 1C

University of Wisconsin - CIMSS

Tropical Cyclone MAWAR  
TROPICS Channel 12 (205 GHz) Tb (K)  
202305261037 TROPICS05



Max Tb (K): 285.2

Contour Interval = 1C

University of Wisconsin - CIMSS

# Recent Application of CIMSS Sounder Products

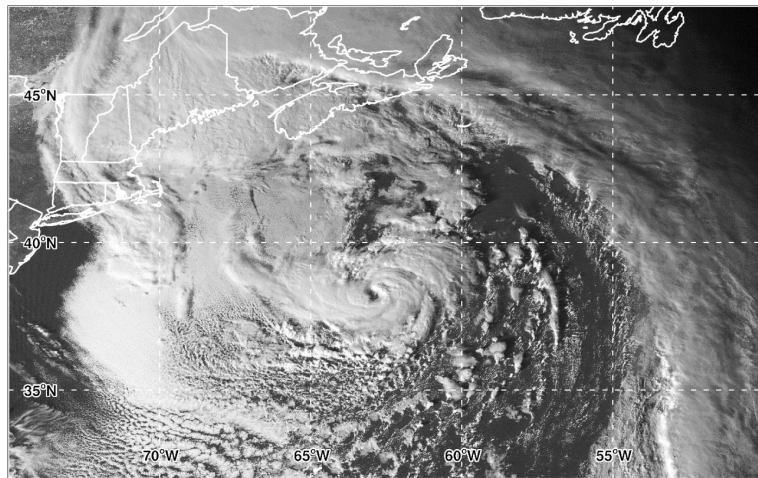


**NATIONAL HURRICANE CENTER  
TROPICAL CYCLONE REPORT**

**UNNAMED SUBTROPICAL STORM  
(AL012023)**

**16–17 January 2023**

Philippe P. Papin, John P. Cangialosi, and John L. Beven  
National Hurricane Center  
6 July 2023



Warm core



Unnamed Subtropical Storm 15

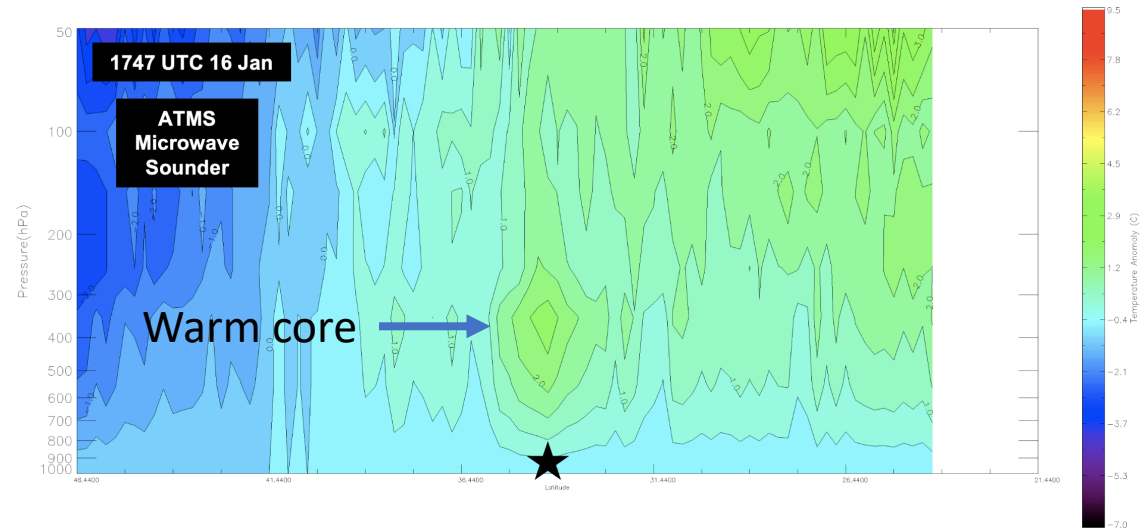
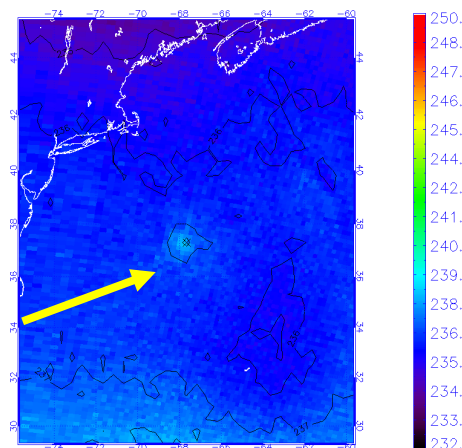
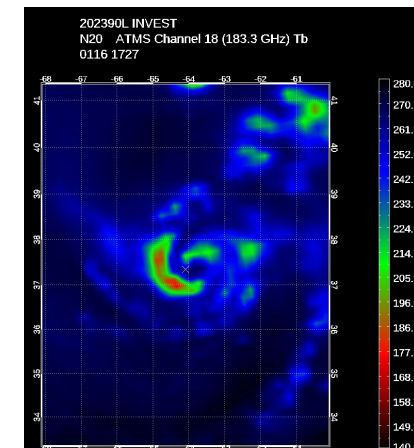


Figure 9. Advanced Microwave Sounder Unit temperature anomaly north (left) – south (right) cross section at 1747 UTC 16 January 2023. The black star denotes the center of the Unnamed Subtropical Storm at the time the cross-section was available. Adapted image courtesy of the Cooperative Institute for Meteorological Satellite Studies, University of Wisconsin.



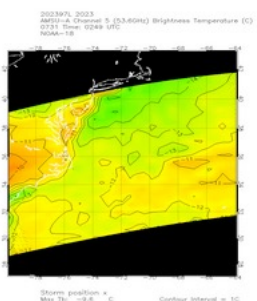
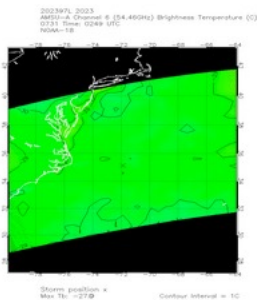
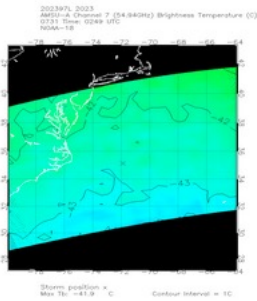
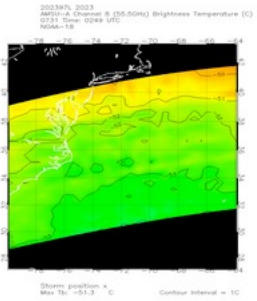
ATMS Channel 7



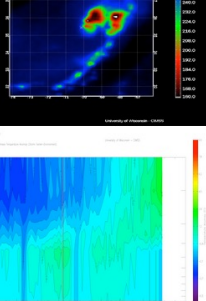
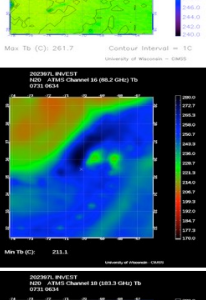
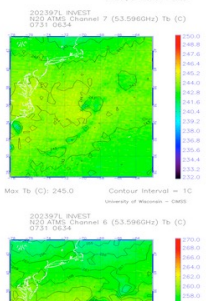
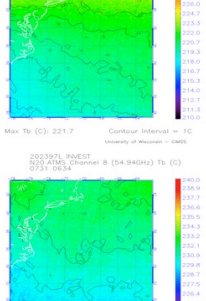
ATMS Channel 18



# AMSU



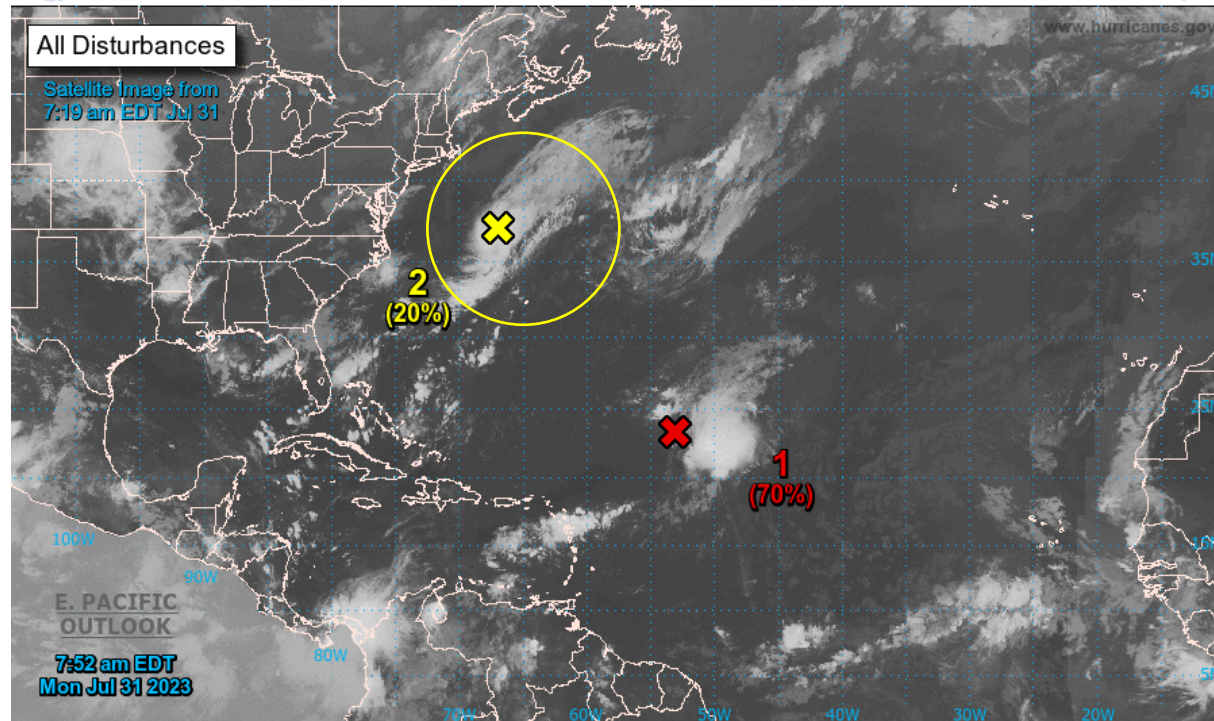
# ATMS



# Recent Application of CIMSS Sounder Products



Two-Day Graphical Tropical Weather Outlook  
National Hurricane Center Miami, Florida



Current Disturbances and Two-Day Cyclone Formation Chance:   
 X < 40%    X 40-60%    X > 60%  
 Tropical or Sub-Tropical Cyclone:    O Depression    O Storm    O Hurricane  
 X Post-Tropical Cyclone or Remnants

Invest 97L determined to be not sub-tropical based on microwave  
sounder imagery

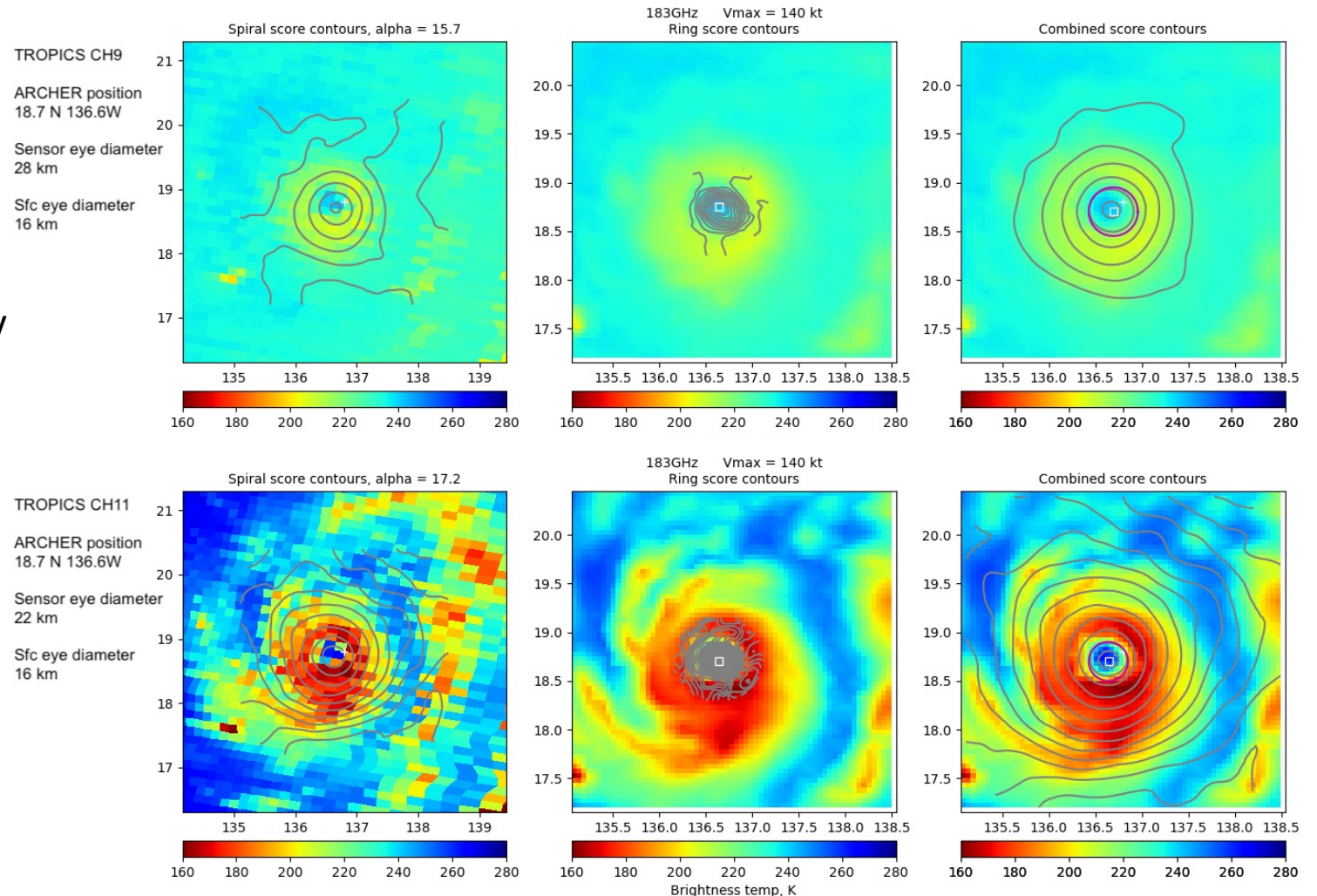
# CIMSS ARCHER Applied to TROPICS Imagery

## Automated storm position information

- Provides independent storm location
- Storm position confidence
- Multi-channel (183 GHz, 205 GHz, 89 GHz)

## Automated storm structure estimation

- Eye diameter is used by several TC intensity algorithms as an input variable
- Radius of Maximum Winds (RMW)
- Multi-channel (183 GHz, 205 GHz, 89 GHz)
  - Can at times show eyewall slope
- RMW is part of warning agency best tracks but often is a “guess”. ARCHER can provide skillful guidance to improve this critical structure parameter



# CIMSS ARCHER Applied to TROPICS Imagery

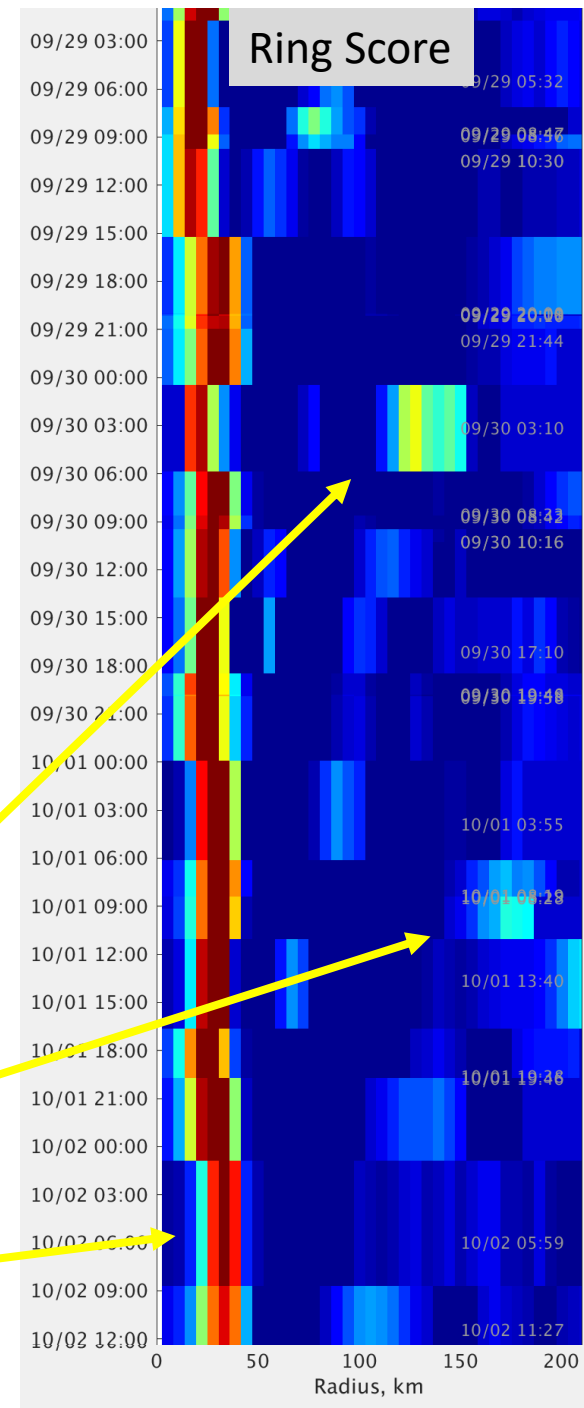
ARCHER outputs diagnostics about the TC structure including ring score which is a measure of eyewall completeness and strength.

- Ring scores are used by the MPERC algorithm to estimate the onset of an Eyewall Replacement Cycle (ERC)
- Can be plotted as a hovmöller to show the evolution of inner core features
- Diagnostic alerts forecasters to change in structure important to the intensity forecast.

Contracting outer eyewall in Hurricane Sam  
During the onset of an ERC

Next ERC starting

ERC completed. New primary eyewall



# Project Tasks and Timelines

## Specific Tasks/Deliverables

- 1) Design a TROPICS image display page based on existing similar sites
- 2) Test the functionality on NRL TROPICS Pathfinder and Constellation data
- 3) Off beta version to limited user group for feedback
- 4) When provisional, set up link on CIMSS TC site and open up for public use
- 5) Maintain site and troubleshoot when necessary

## Timeline

First Phase (A): Within 2 months of start of project. Create webpage matrix production code. Modify CIMSS ARCHER algorithm for automated TROPICS data processing. Test NRT imagery production.

Year 1 (Phase B): During 2023 TC season. Engage early adopters, evaluate data production and respond to early adopter feedback. Compare output products to legacy microwave products.

Year 2 (Phases C-E): Transition from provisional products to public-facing page and provide the links on CIMSS homepage. Throughout this process continue to engage end users and provide training as needed.

# Thank You !