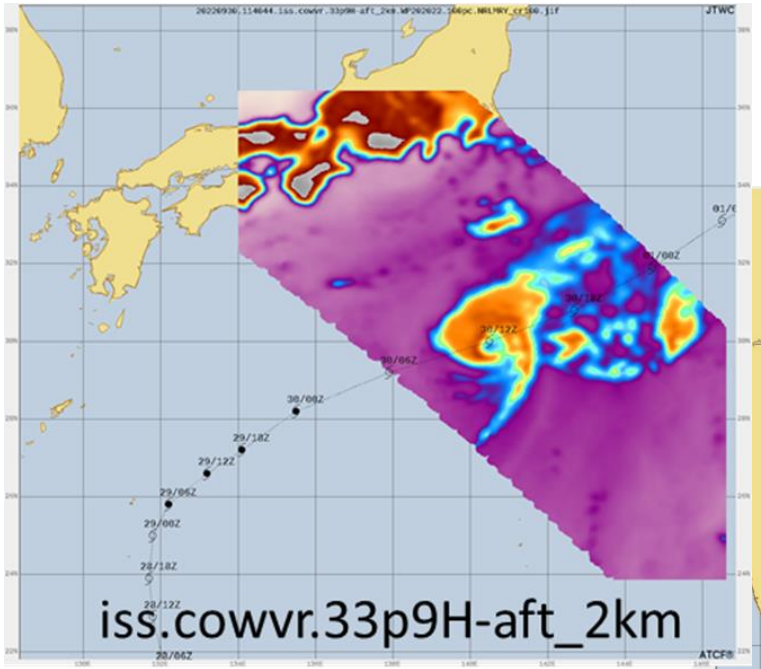
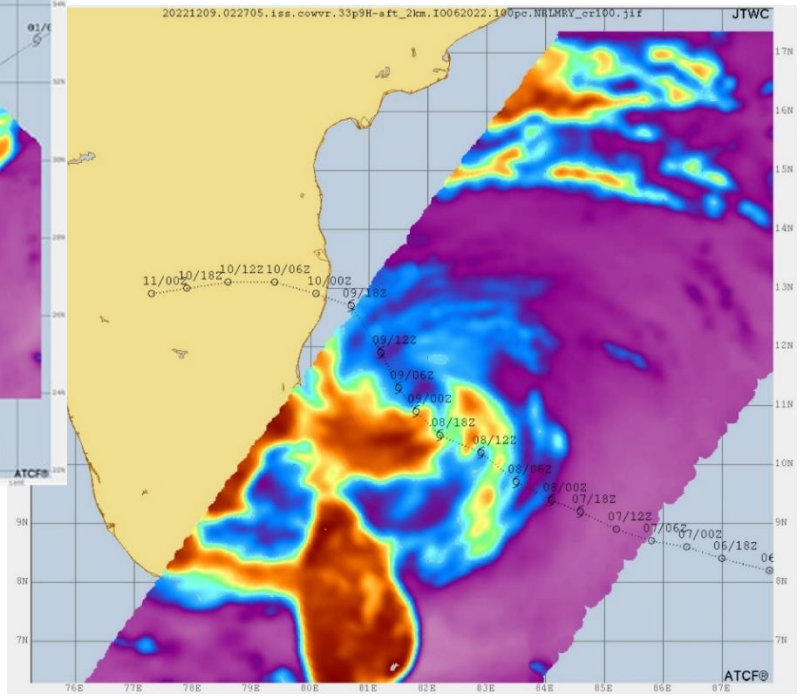
JTWC 2022 Operational Highlights, Challenges, and Future Changes

Examples of 33.9 GHz microwave imagery from COWVR sensor aboard the ISS, rendered in ATCF





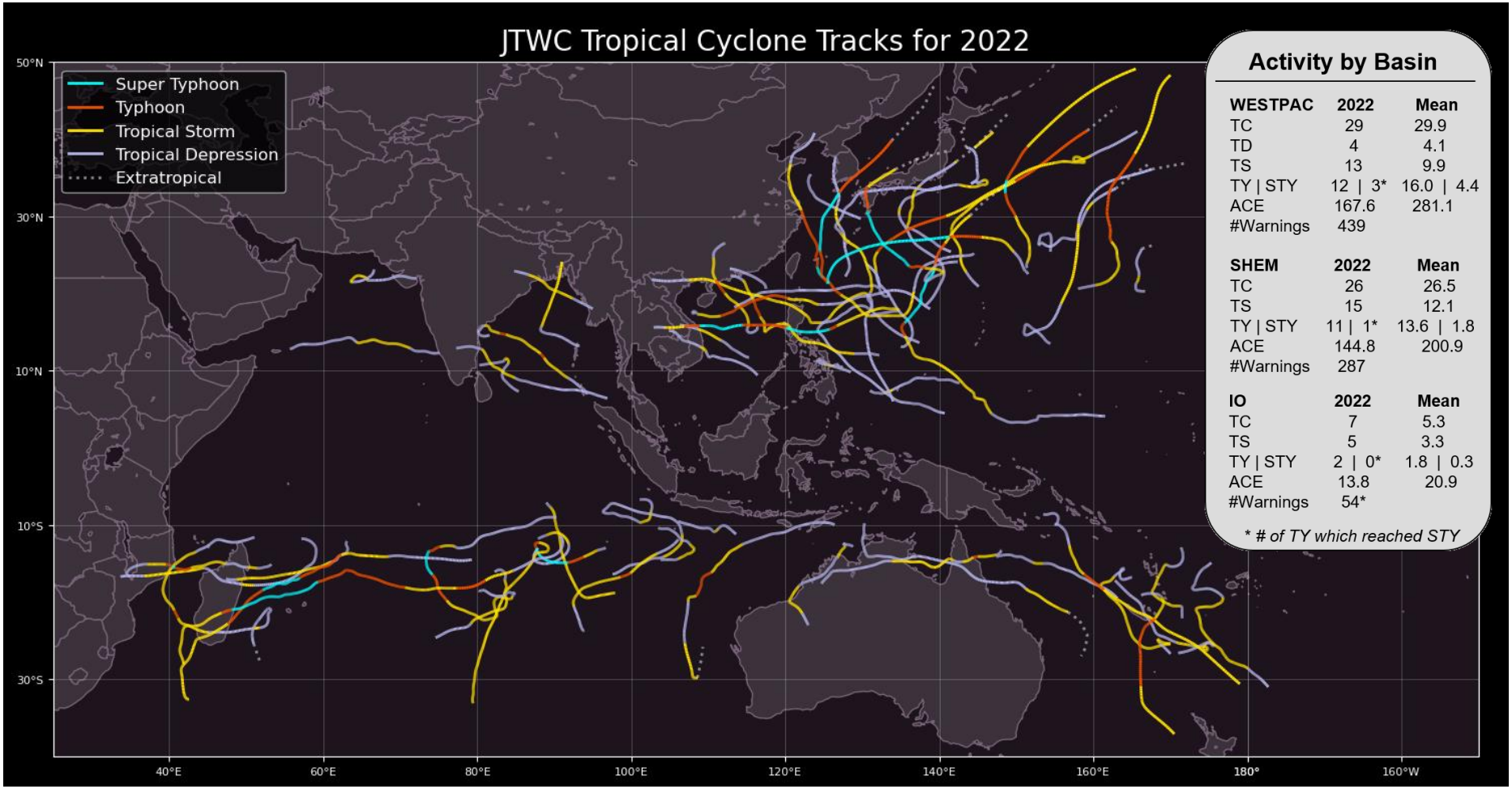
TCORF/77th IHC March 8, 2023

Joint Typhoon Warning Center

CDR Dominic DiMaggio, Commanding Officer

Mr. Brian Strahl, Director

2022* JTWC Warned Tropical Cyclones



Activity by Basin

WESTPAC	2022	Mean
TC	29	29.9
TD	4	4.1
TS	13	9.9
TY | STY	12 | 3*	16.0 | 4.4
ACE	167.6	281.1
#Warnings	439	

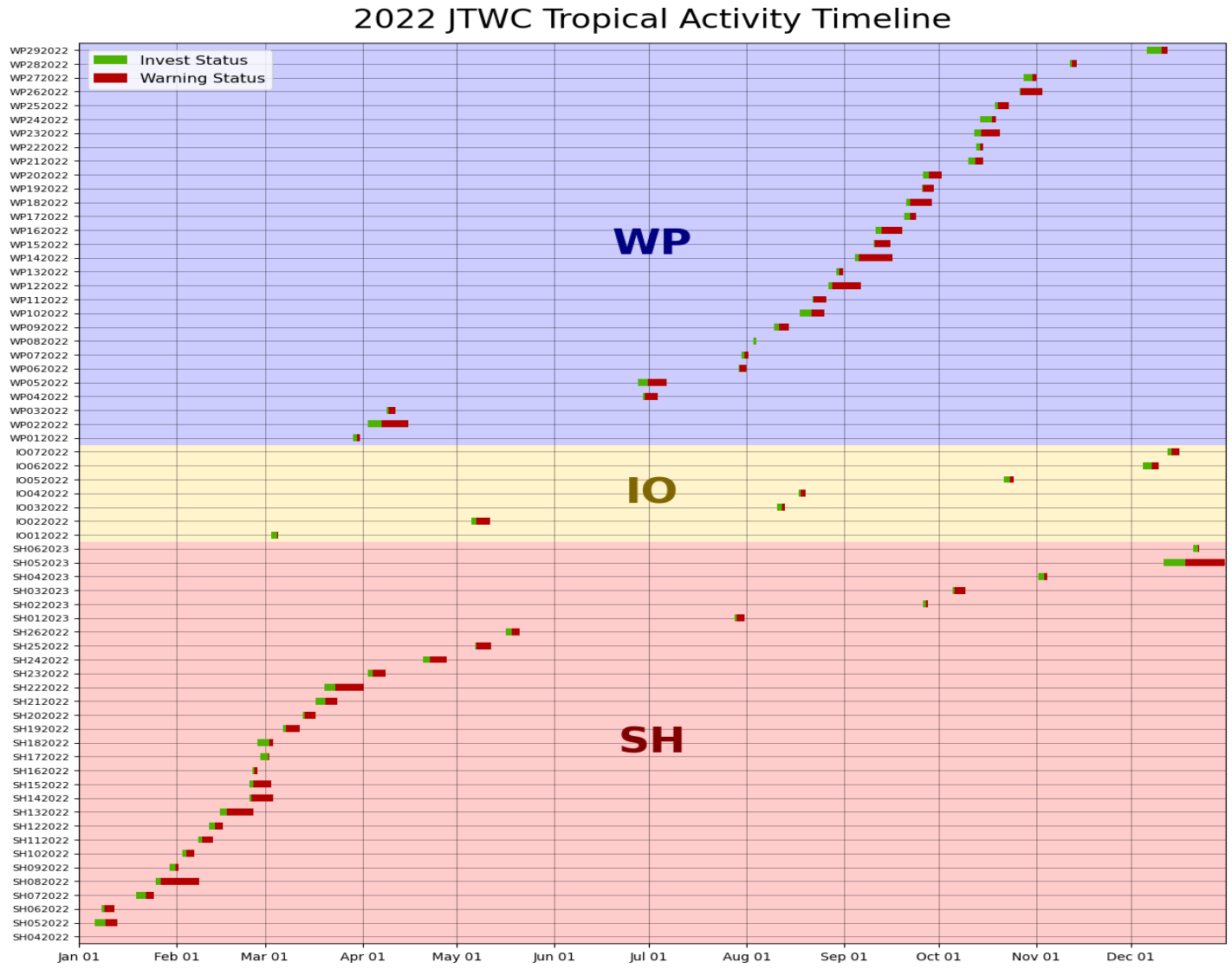
SHEM	2022	Mean
TC	26	26.5
TS	15	12.1
TY | STY	11 | 1*	13.6 | 1.8
ACE	144.8	200.9
#Warnings	287	

IO	2022	Mean
TC	7	5.3
TS	5	3.3
TY | STY	2 | 0*	1.8 | 0.3
ACE	13.8	20.9
#Warnings	54*	

** # of TY which reached STY*

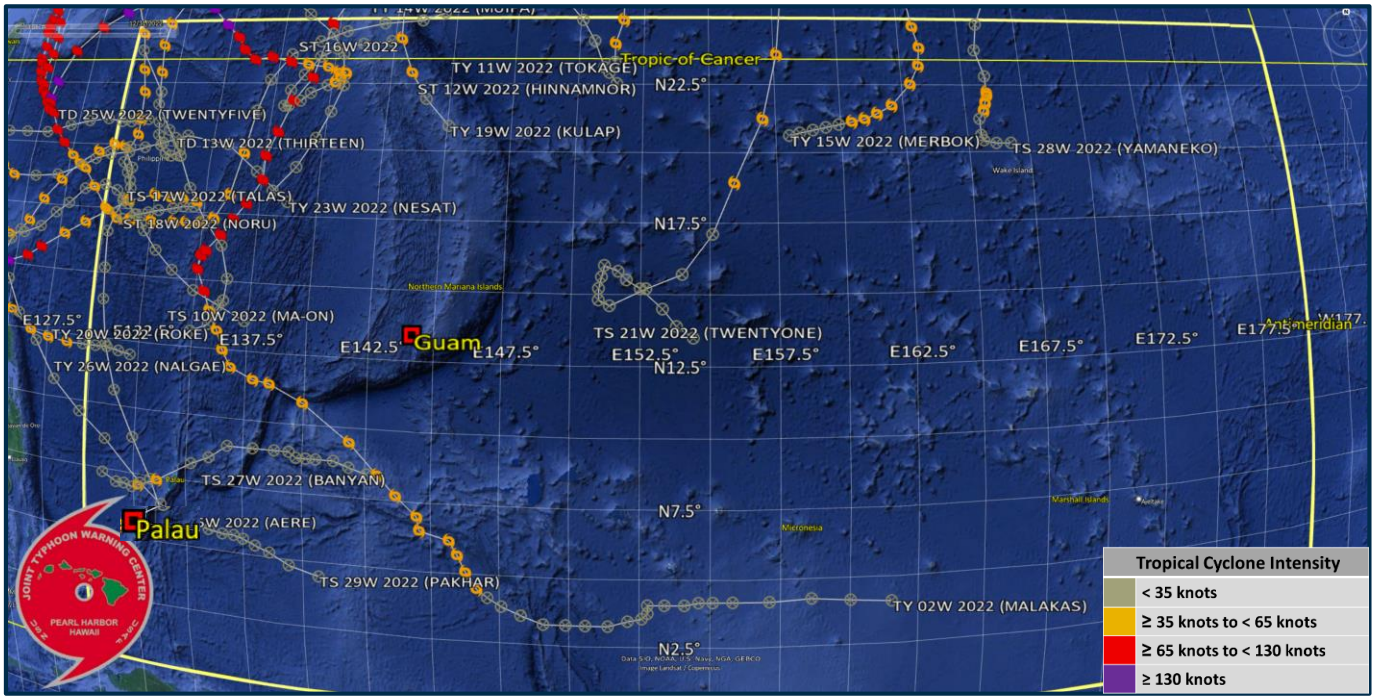
(*Based on 2022 season, not calendar year)

2022 Tropical Cyclone Timeline



JTWC-NOAA Support/Coordination

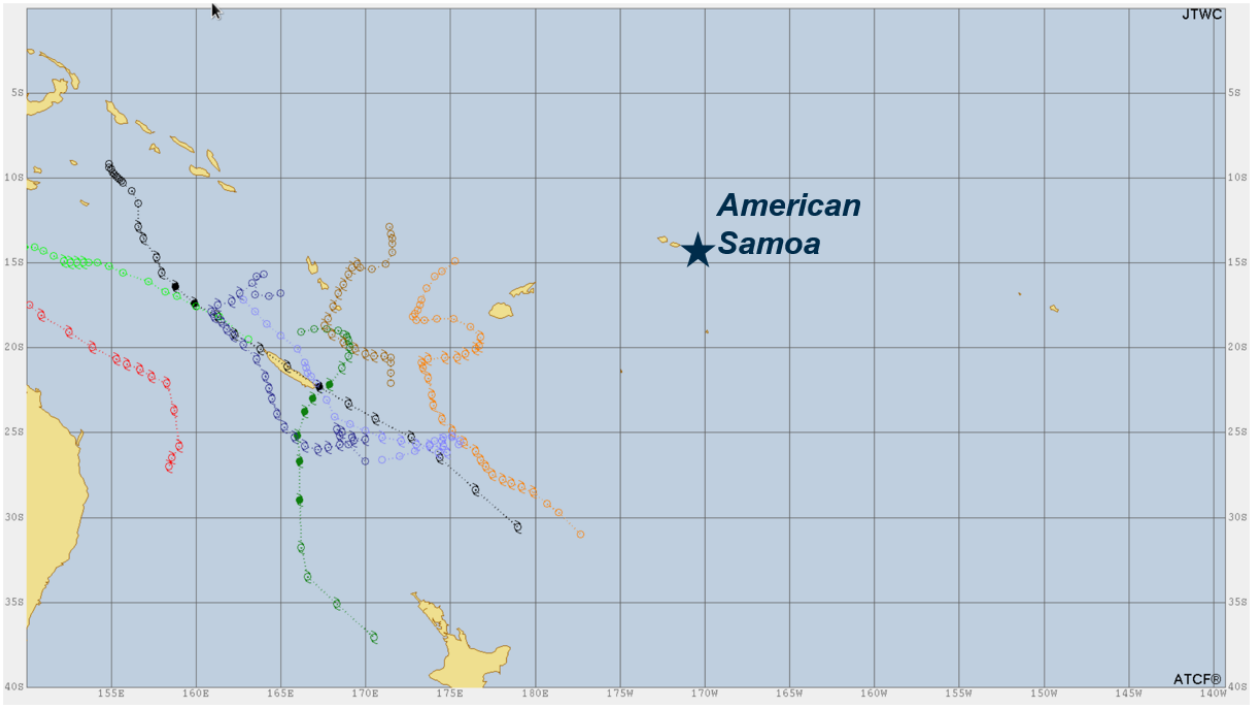
2022 TCs in WFO Guam AOR



- 20/29 WESTPAC TCs passed through the WFO's AOR
- TC Genesis was predominantly well west of Guam, consistent with La Niña conditions
- The only typhoon force winds were from TY02W (Malakas) and briefly ST16W (Nanmadol)
- 28* PHFO fixes in western Pacific (undercounted due to data ingest issue)
- 526 KNES fixes in WESTPAC
- JTWC resumed annual roadshow, including WFO Tiyan

JTWC-NOAA Support/Coordination

2022 TCs Near American Samoa

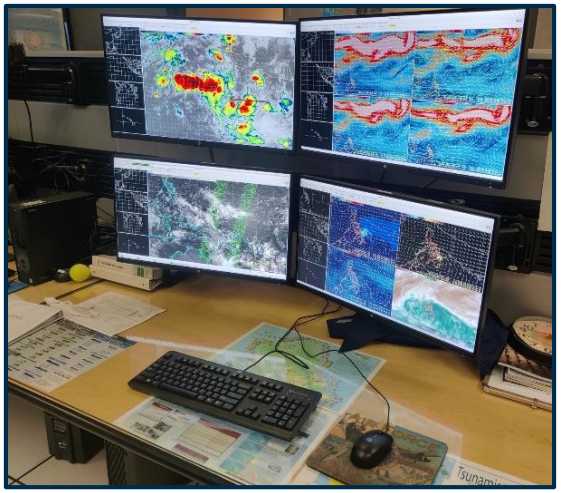


- Very quiet year! Activity shifted westward consistent with La Niña conditions
- 67 PHFO, 260 KNES fixes in South Hemisphere
- JTWC provided pre-season virtual training to WSO Pago Pago
- Utilized NWS Chat channel for JTWC / WSO Pago Pago communications
  - Need to confirm that NWS Chat v2.0 will work with Navy NMCI network

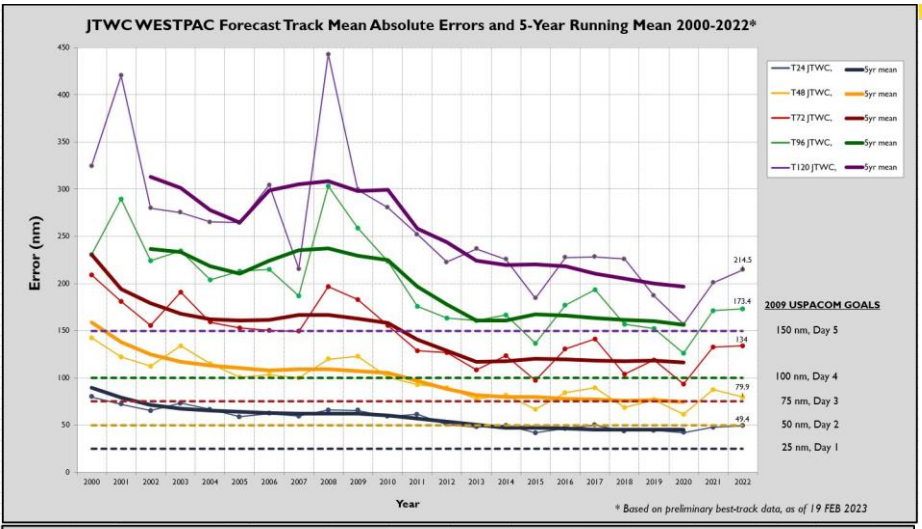
JTWC-NOAA Support/Coordination

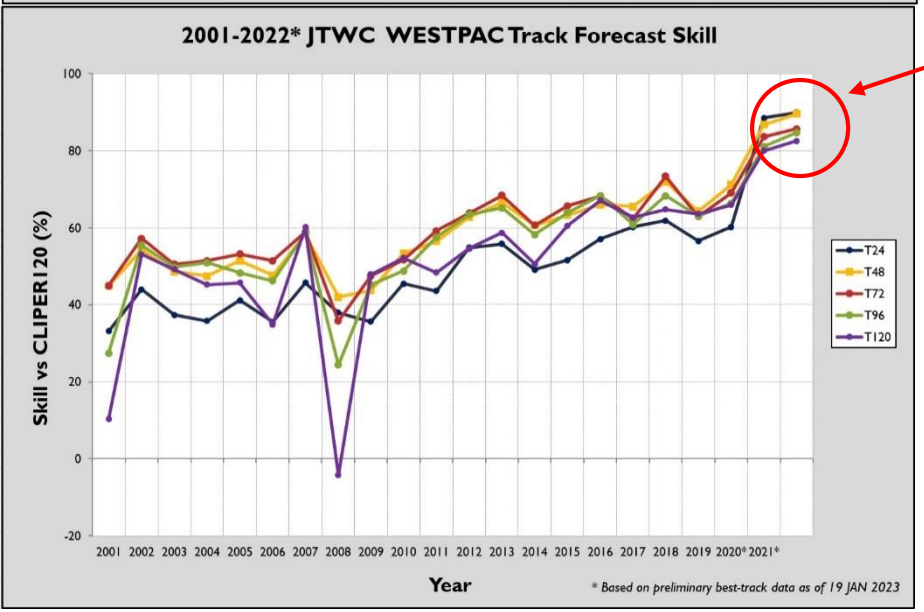
- 15 JTWC fixes in CPAC (an invest)
- 102 KNES fixes in IO
  - **Almost 900 total KNES fixes in JTWC AOR**
- JTWC repackaged 373 NHC east Pacific advisories for 19 tropical cyclones for DoD
- JTWC made CPHC-generated time of arrival graphics available to JTWC DoD customers via cac-enabled site
  - Very well received. Working through NRL to adapt code for Navy production
- Annual ATCF requirements meeting (JTWC, NHC, CPHC, FWCs, CIMSS, CIRA)
- First full season with AWIPS II at JTWC
  - Continuing to develop expertise, customize displays, and use system for data visualization and interrogation

- **Outstanding coordination and/or support from NHOP partners**



JTWC WESTPAC Forecast Track Errors
(Preliminary for 2022)



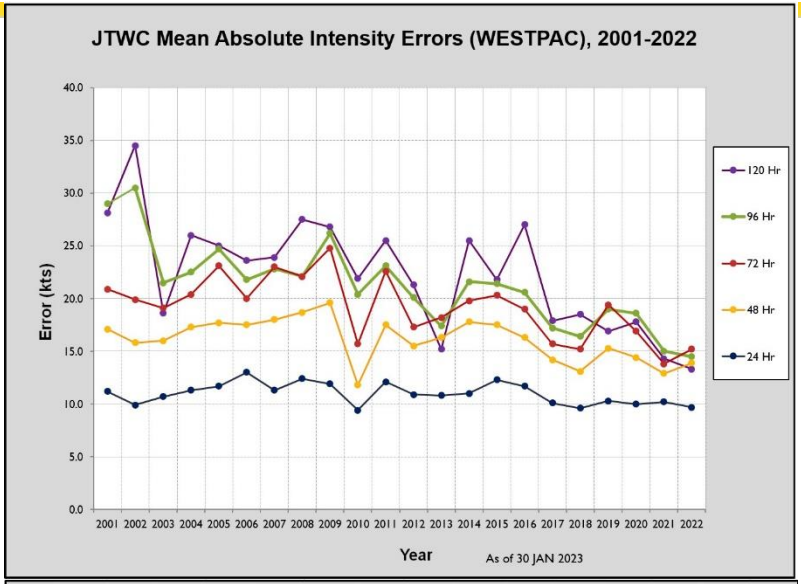


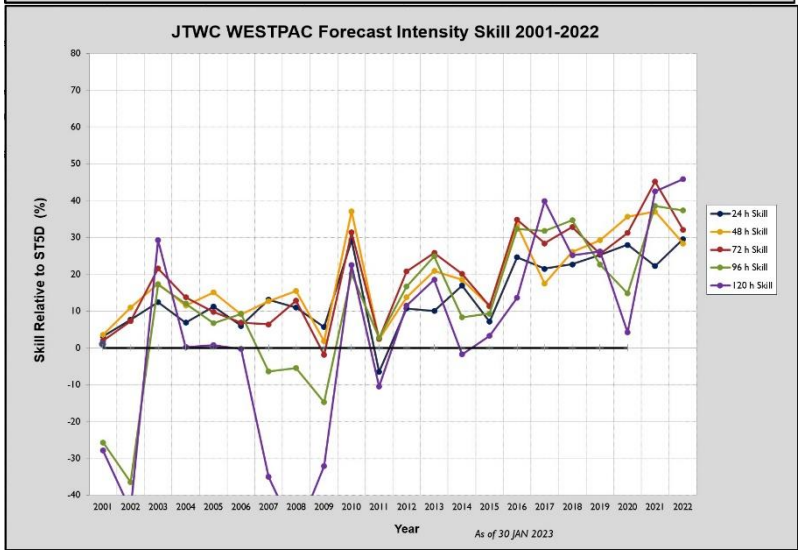
- Mean track error generally flat vs. 2021
  - Day 5 error climbed slightly
- Mean tracks errors higher than the 5-year running mean, and remain well above 2009 US(INDO)PACOM goals
- Record track skill at all lead times
- 2022 track forecasts more climatologically “challenging” according to CLIPER

JTWC WESTPAC Forecast Intensity Errors (Preliminary for 2022)

- Record mean intensity errors at 96 and 120 hours

- Record high intensity skill at 24 and 120 hours

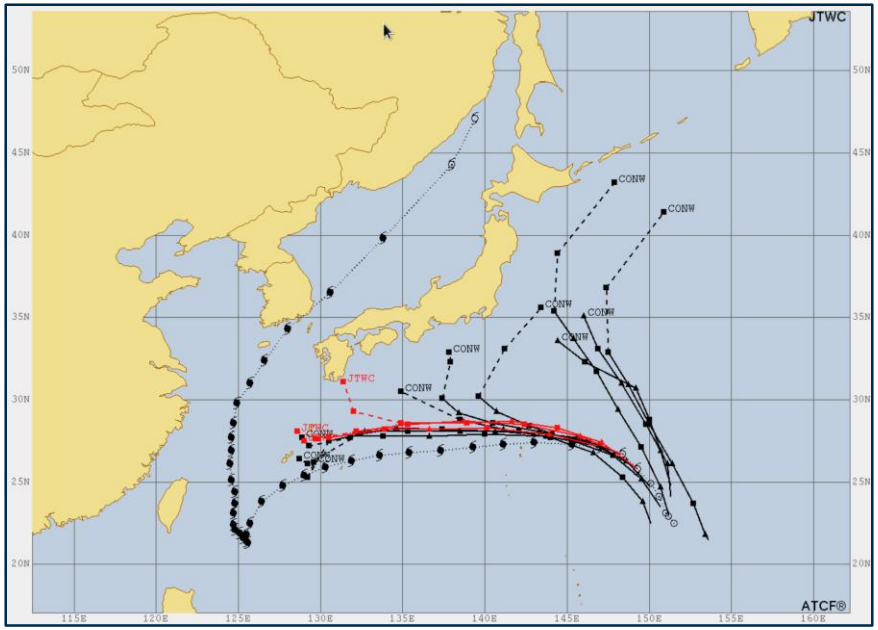




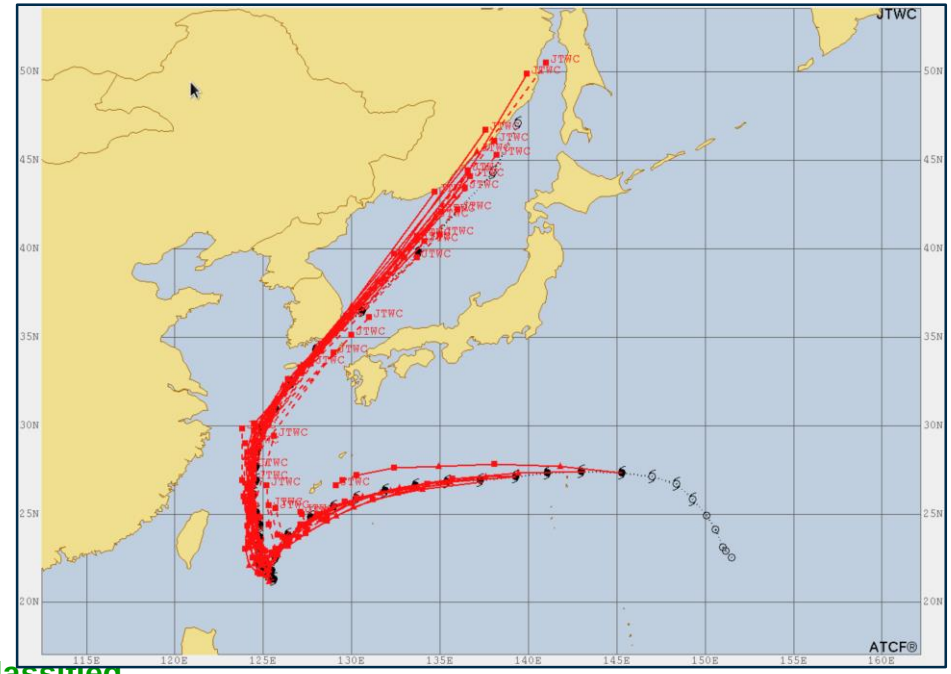
Significant TC Forecast Challenges

- **Rapid intensification (RI) events (#1 improvement priority)**
  - Particularly problematic immediately following genesis
- **TC track (#3 improvement priority)**
  - Highest errors seen in early warnings for weak (25-30 kt) warnings and along-track errors during extra-tropical transition
- **TC genesis (#5 improvement priority)**
  - Formation probability, timing, and location are all important for anticipating impacts
  - Impacts shortly after TC formation can have short lead time and low awareness
- **Communication of forecast uncertainty and spatial distribution of impacts**
  - Many customers focus on the storm center and deterministic numbers (e.g., distance of closest approach)
  - Communication of uncertainty is still often done through text products, which are absorbed by customers with poor efficiency

Forecast Success Story: 12W

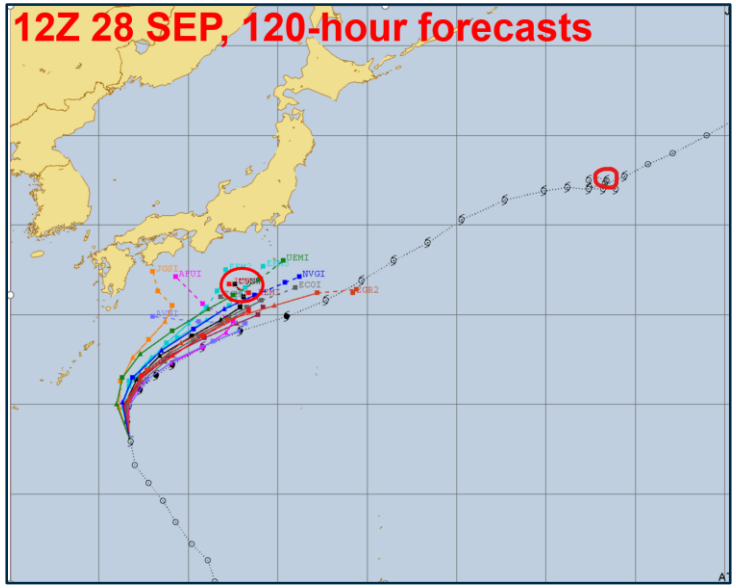


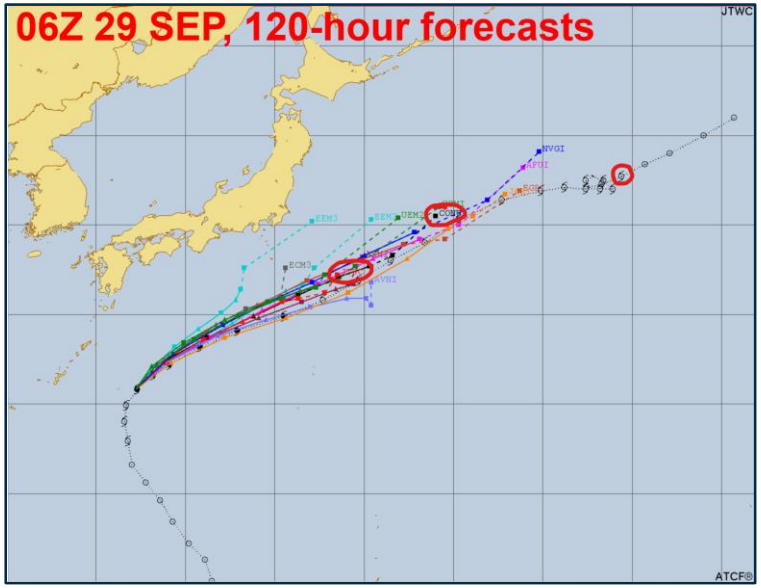
- Pre-genesis guidance called for northerly motion
- Early warnings in TD and TS phase shifted westward but had Okinawa in the cross-hairs



- As Hinnamnor strengthened, models locked on the track south of Okinawa
- Models (and forecasts) captured the stall southwest of Okinawa, the large expansion of wind radii, and subsequent poleward track

High Track Error Example: 20W



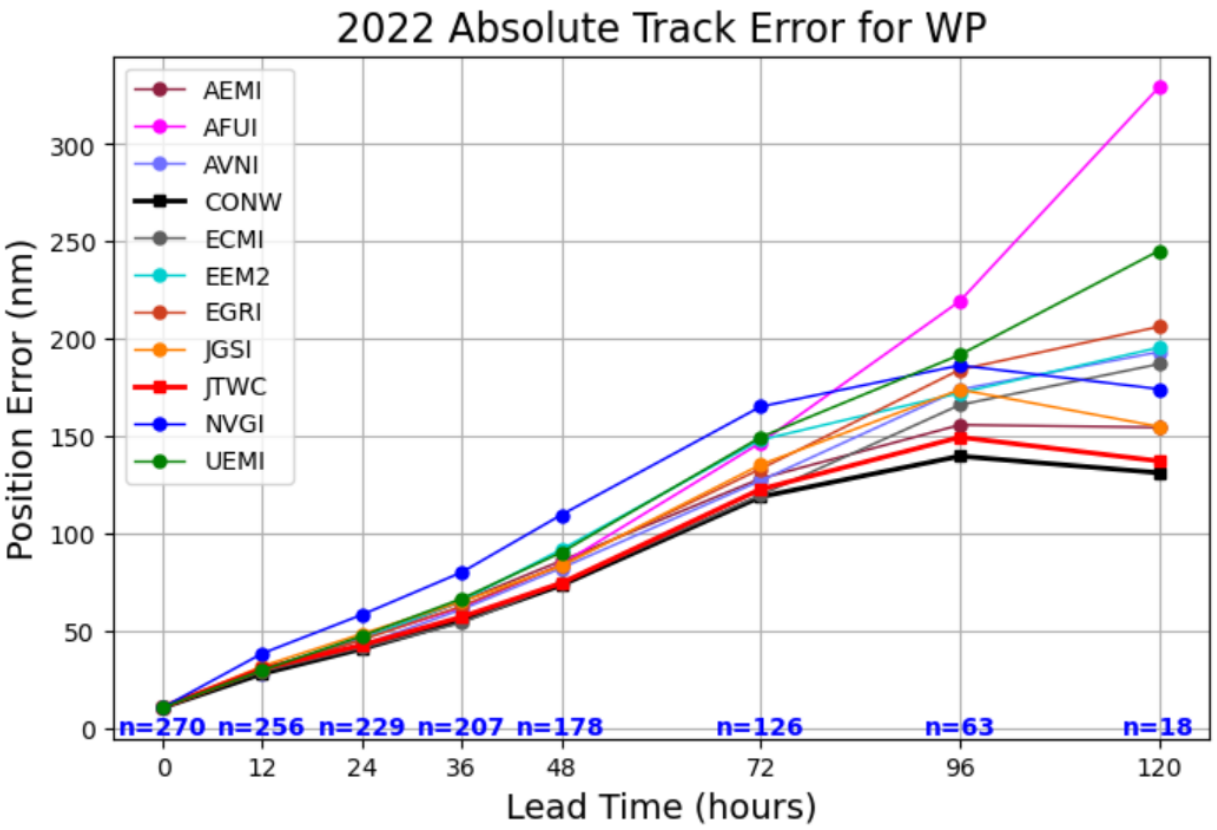


stormID	fhour	modelname	Error	Cross-track Error	Along-track Error	Sample Size
WP202022	0	JTWC	10.6	-1.6	-1.3	16
	12	JTWC	40.9	-7.3	-37.2	16
	24	JTWC	86.6	-8.9	-84.0	16
	36	JTWC	152.0	-10.7	-150.2	15
	48	JTWC	260.7	-15.7	-258.9	12
	72	JTWC	499.8	-4.3	-480.9	10
	96	JTWC	711.8	62.7	-541.3	8
	120	JTWC	810.8	-112.9	-256.3	7

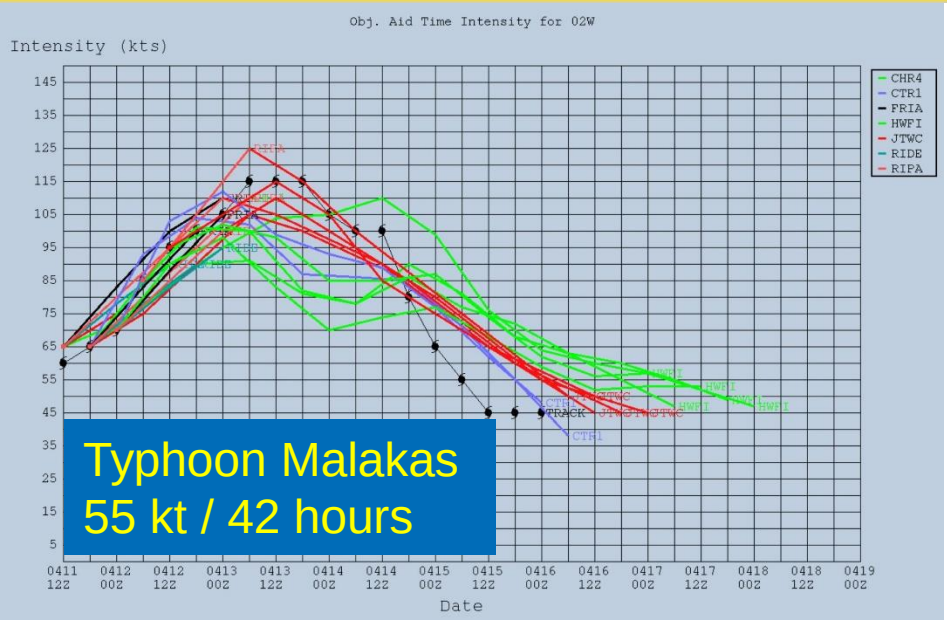
Track Performance by Model
(Homogeneous comparison)

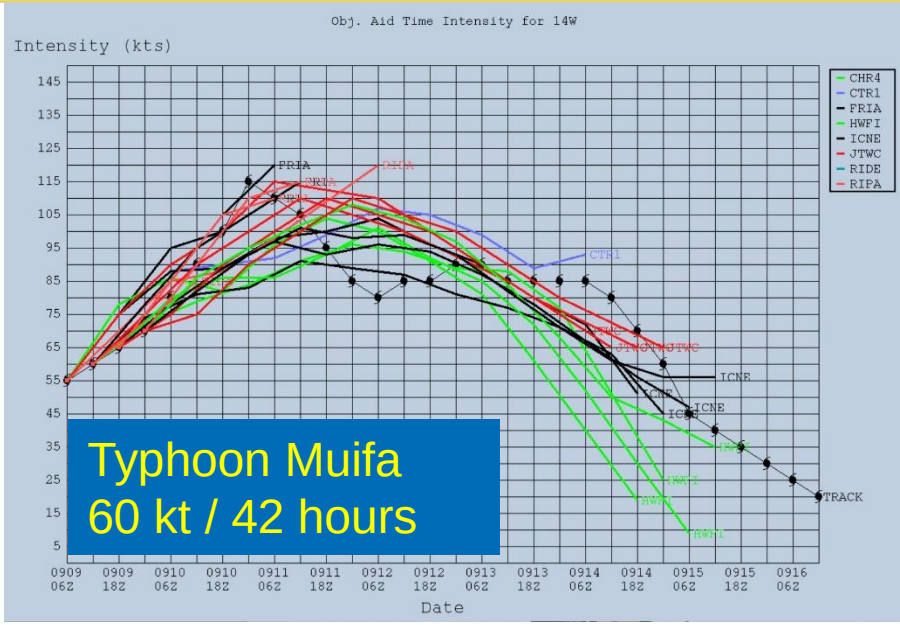
- ECMWF better than JTWC and even CONW at 0-72 hours
- CONW outperformed all individual model inputs at 96-120 hours
- GFS ensemble outperformed ECMWF ensemble significantly

  (but note EEM2 is a 2nd-interpolation vs. AEMI, a 1st-interpolation)
- **NOTE:** Days 4-5 have small sample size here due to homogeneous constraint



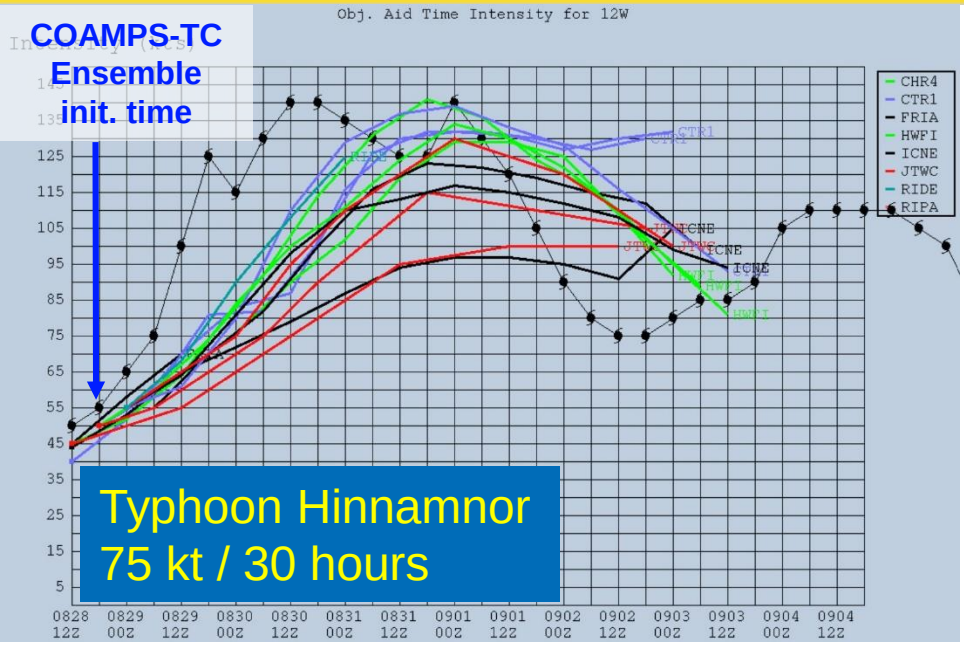
RI Success Stories in 2022 using New Aids





- New RI guidance tools doing a good job catching a lot of RI events
- Can even correctly overshoot HWRF, typically an aggressive model in WPAC

COAMPS-TC Ensemble: Uniquely Useful



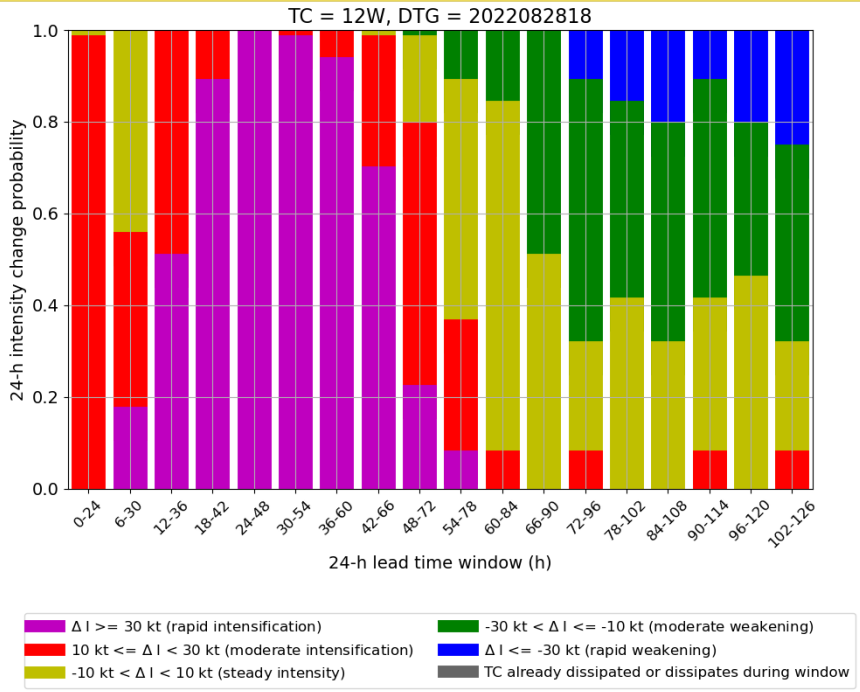
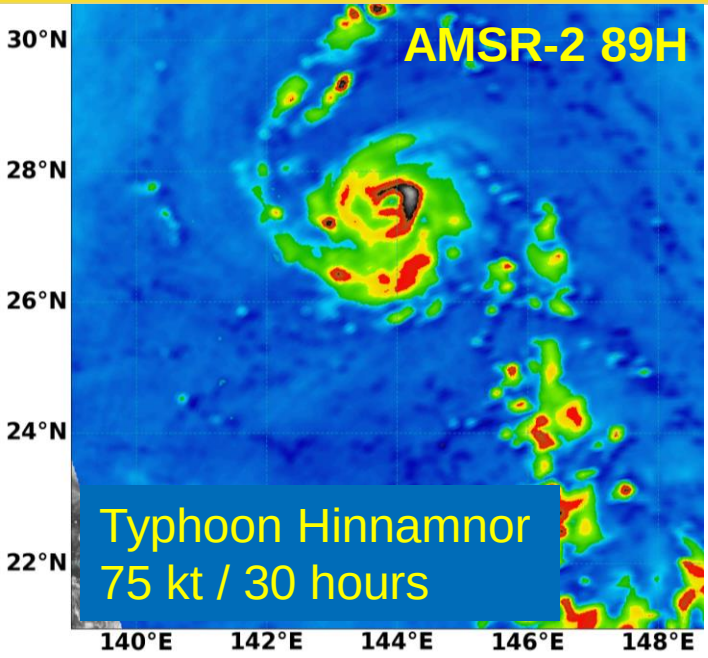
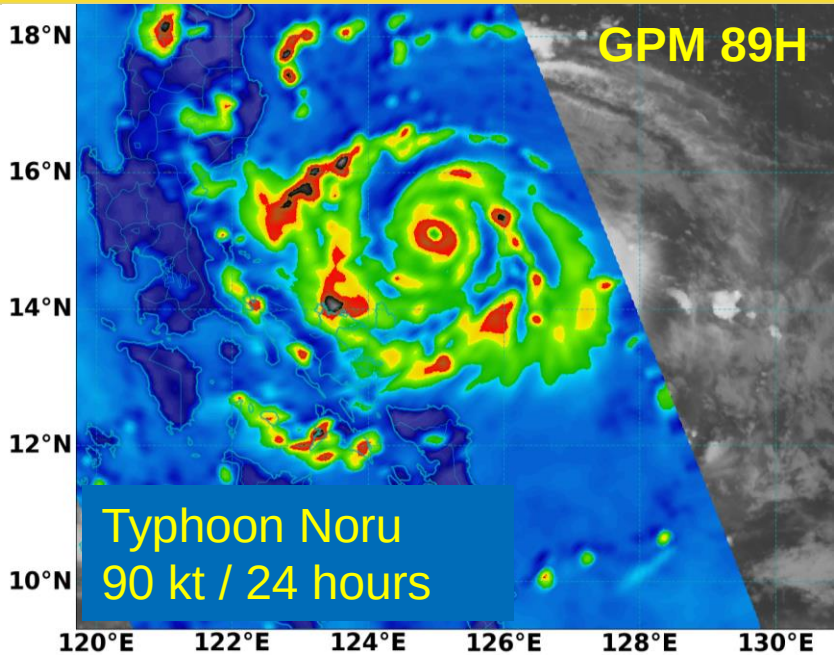


Image courtesy of the Naval Research Laboratory

- COAMPS-TC ensemble is providing valuable, probabilistic guidance on RI likelihood *__and__* timing
- For Hinnamnor at 55 kt, risk of immediate RI (vs. 24-hour delayed) is captured

Some Cases Remain Challenging



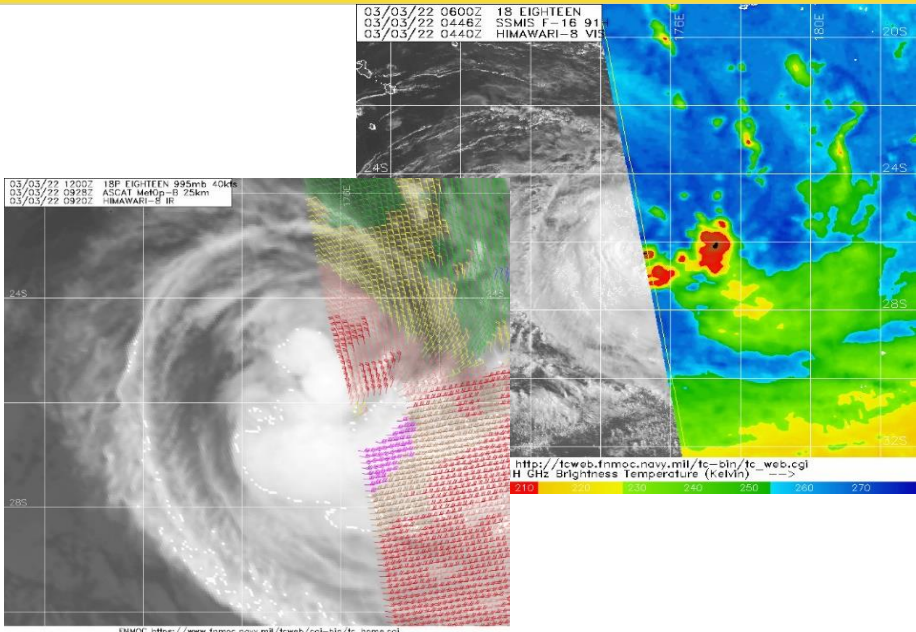


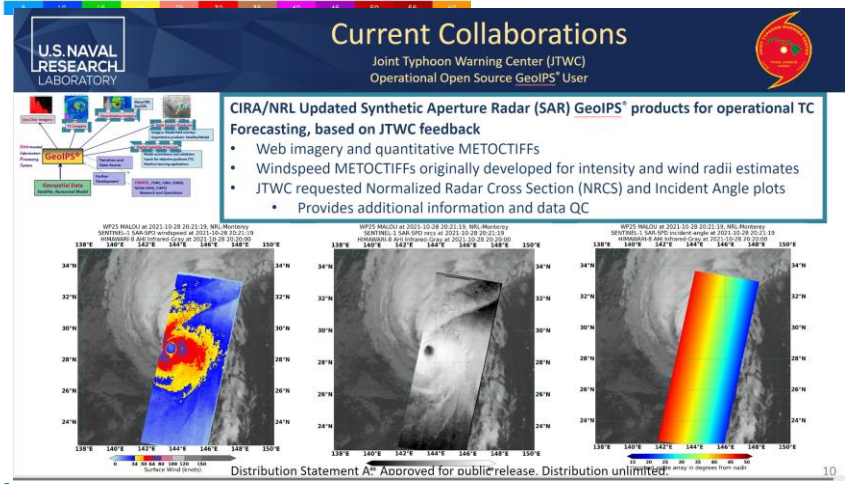
- Many extreme RI events are preceded by the formation of a compact inner core shortly after genesis
- Hinnamnor and Noru both had RMW < 10-15 km at start of RI
  - So did Super Typhoon Chanthu (19W) in 2021, the most extreme RI case of that season

Reconnaissance

Coverage Struggles Continue:

- Average interval between scatterometer TC hits: ~27.7 hours (estimated)
- Interval between microwave non-R&D TC passes >6 hours approximately 44% of the time
- New NRL product developments (GeoIPS)
  - ProxyVis, COWVR, TROPICS, GEMS, ARCHER, more SAR, etc
  - FNMOC operational TCWeb to transition to GeoIPS
- Evaluating COWVR and TEMPEST imagery
  - COWVR better than DMSP, but lower resolution than GMI, AMSR
  - Have not yet received COWVR ocean surface wind vectors





Upcoming Changes

- Final warnings will now expire at the time of the last forecast point on the final warning message and graphic, or at the 24-hour mark, whichever occurs first.
  - Once expired, warning is removed from the bulletin, but may be tracked as an invest if warranted; e.g., sub-tropical transition, or potential for post-landfall re-emergence over water, etc.

Questions?

THANK YOU!

JTWC R&D Priorities

Priority	Need
1 TC Intensity Change	***Basin-specific*** (WESTPAC, SHEM, NIO, SIO, and SWPAC) probabilistic and deterministic ***forecast guidance for TC intensity change***, ***particularly*** the onset, duration, and magnitude of ***rapid intensity change*** events (including ERC, over-water weakening, etc.) at 2-3 day lead times.
2 TC Genesis Timing and Forecast	Guidance to ***improve*** the ***forecasting of TC genesis timing*** and the subsequent track, intensity and structure of pre-genesis tropical disturbances out to two week lead-times, that exhibits a high probability of detection and a low false alarm rate. Techniques to diagnose and predict the formation of TCs via transition of non-classical disturbances (e.g. monsoon depressions, sub-tropical, hybrids, etc).
3 Data Exploitation	Techniques, products, or sources that ***improve*** the utility and ***exploitation of microwave satellite, ocean surface wind vectors, and radar data*** for fixing (center, intensity, radii) TCs, or for diagnosing RI, ETT, ERC, *etc*. (*e.g*., develop a "Dvorak-like" technique using microwave imagery). Leverage machine learning methods to maximize automation, and ensure rapid integration into visualization system.
4 TC Structure Specification	***Basin-specific*** (WESTPAC, SHEM, NIO, SIO, and SWPAC) probabilistic and deterministic guidance for the ***specification*** (analysis and forecast) ***of key TC structure variables***, ***including*** the production of 34-, 50- and 64- knot wind radii and a ***dynamic*** (situational) confidence-based ***swath*** of potential 34-kt wind impacts
5 TC Track Improvement	Model and DA enhancements or guidance to ***improve TC track forecast skill and*** the ***conveyance of probabilistic track uncertainty***. Includes development of guidance-on-guidance to identify and reduce forecast error outliers resulting from large speed (e.g., accelerating recurvers) and directional (e.g., loops) errors, or from specific forecast problems such as upper-level trough interaction, near/over-land, elevated terrain, and extratropical transition.