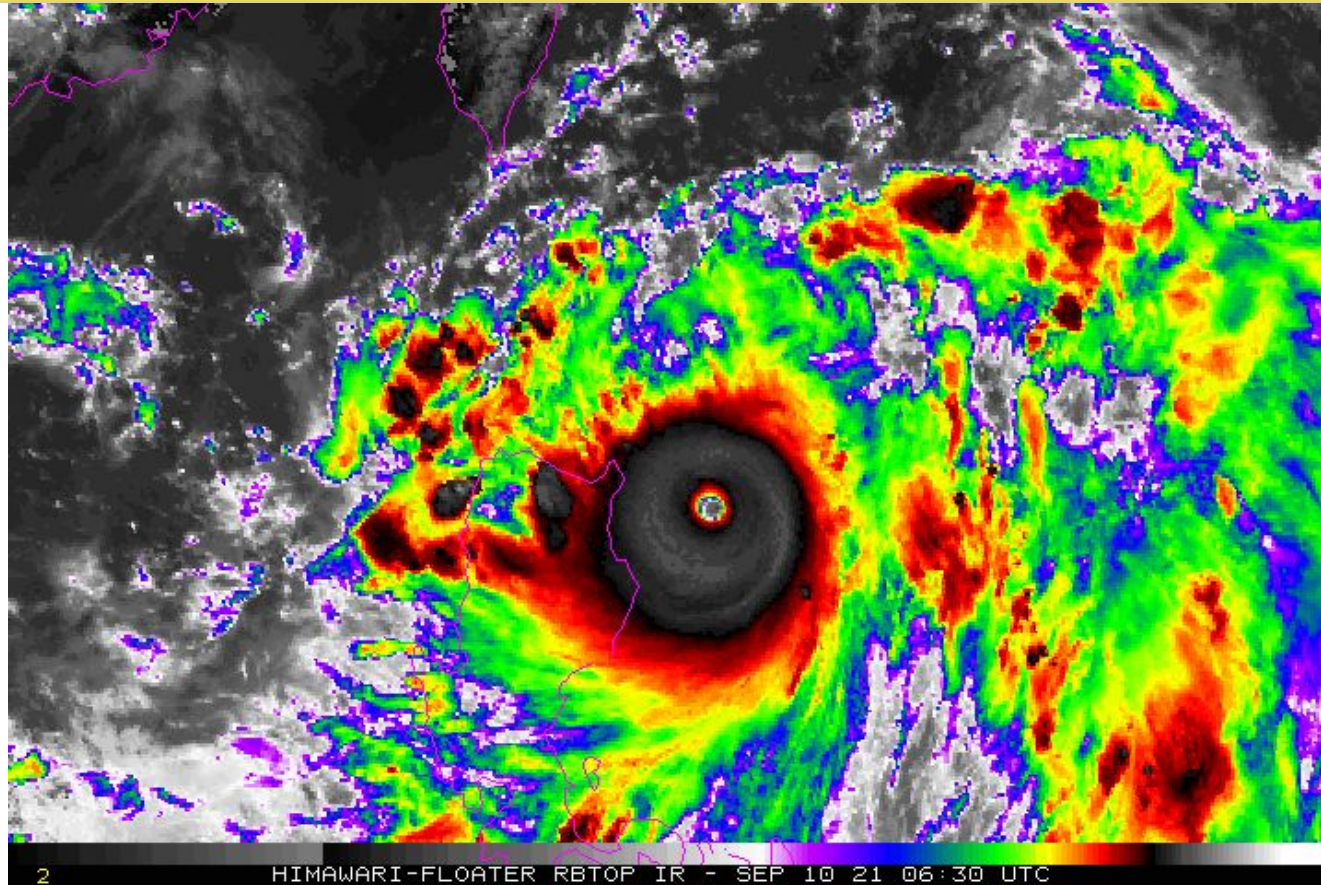# JTWC 2021 Operational Highlights, Challenges, and Future Changes

Supertyphoon 19W, 10 SEP 2021. Image courtesy of NOAA

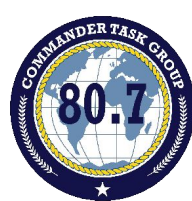**TCORF/76th IHC March 9, 2022**

Dr. Levi Cowan, Senior Scientist | CDR Angela Francis, Commanding Officer
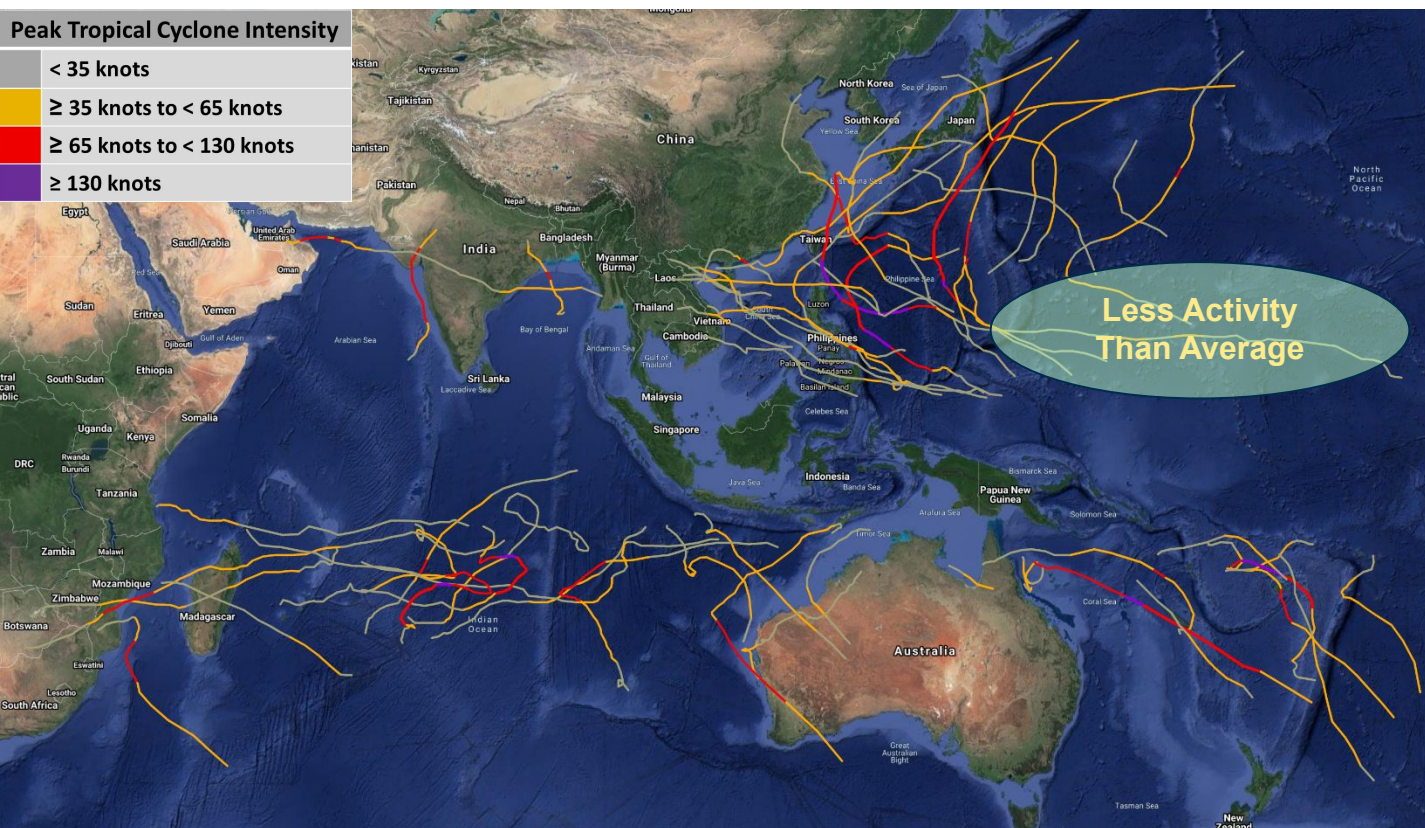**Joint Typhoon Warning Center**

2021 JTWC Warned Tropical Cyclones
(*Preliminary best track as of Jan. 25, 2022)

Peak Tropical Cyclone Intensity
- < 35 knots
- ≥ 35 knots to < 65 knots
- ≥ 65 knots to < 130 knots
- ≥ 130 knots

Less Activity Than Average

Activity by Basin

WESTPAC	2021	Mean
TC	29*	30.3
TD	4*	4.1
TS	13*	9.7
TY | STY	11* | 5*	16.7 | 4.3
ACE	217.4*	282.2
#Warnings	608*	

SHEM	2021	Mean
TC	29	26.4
TD	0	0.8
TS	16	11.9
TY | STY	13 | 4	13.6 | 1.6
ACE	198.5	181.7
#Warnings	376	

IO	2021	Mean
TC	5*	5.2
TD	0*	0.3
TS	2*	3.2
TY | STY	3* | 1*	1.6 | 0.2
ACE	23.1*	24.1
#Warnings	57*	

2021 Tropical Cyclone Timeline

2021 Storm Year JTWC Tropical Activity Timeline

No typhoons for 44 days from July 24 to September 6

First typhoon-less August since records began in 1945
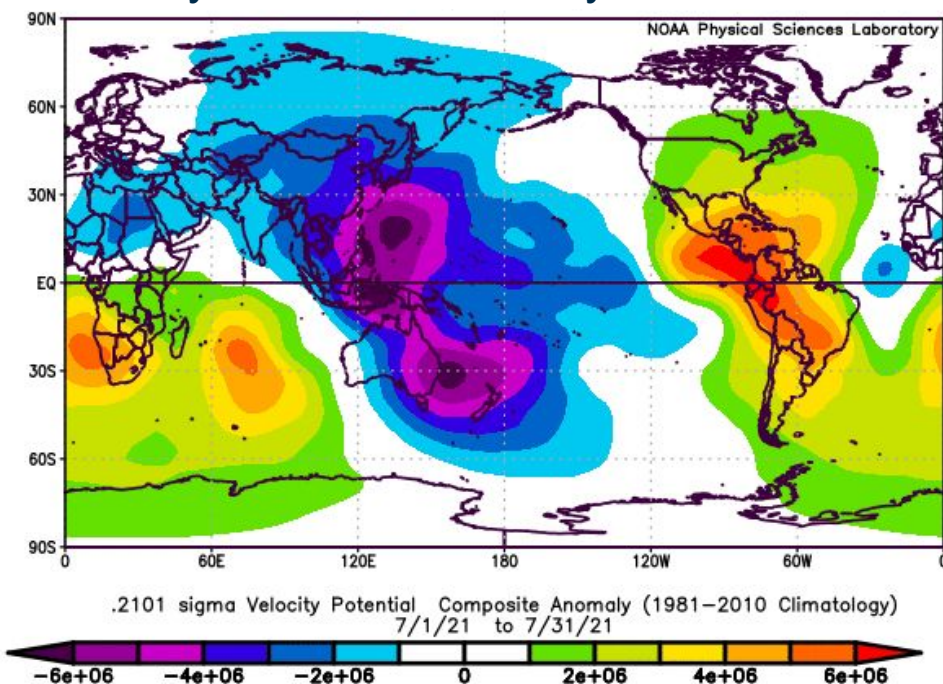
* Based on preliminary best track data, as of 25 JAN 2022
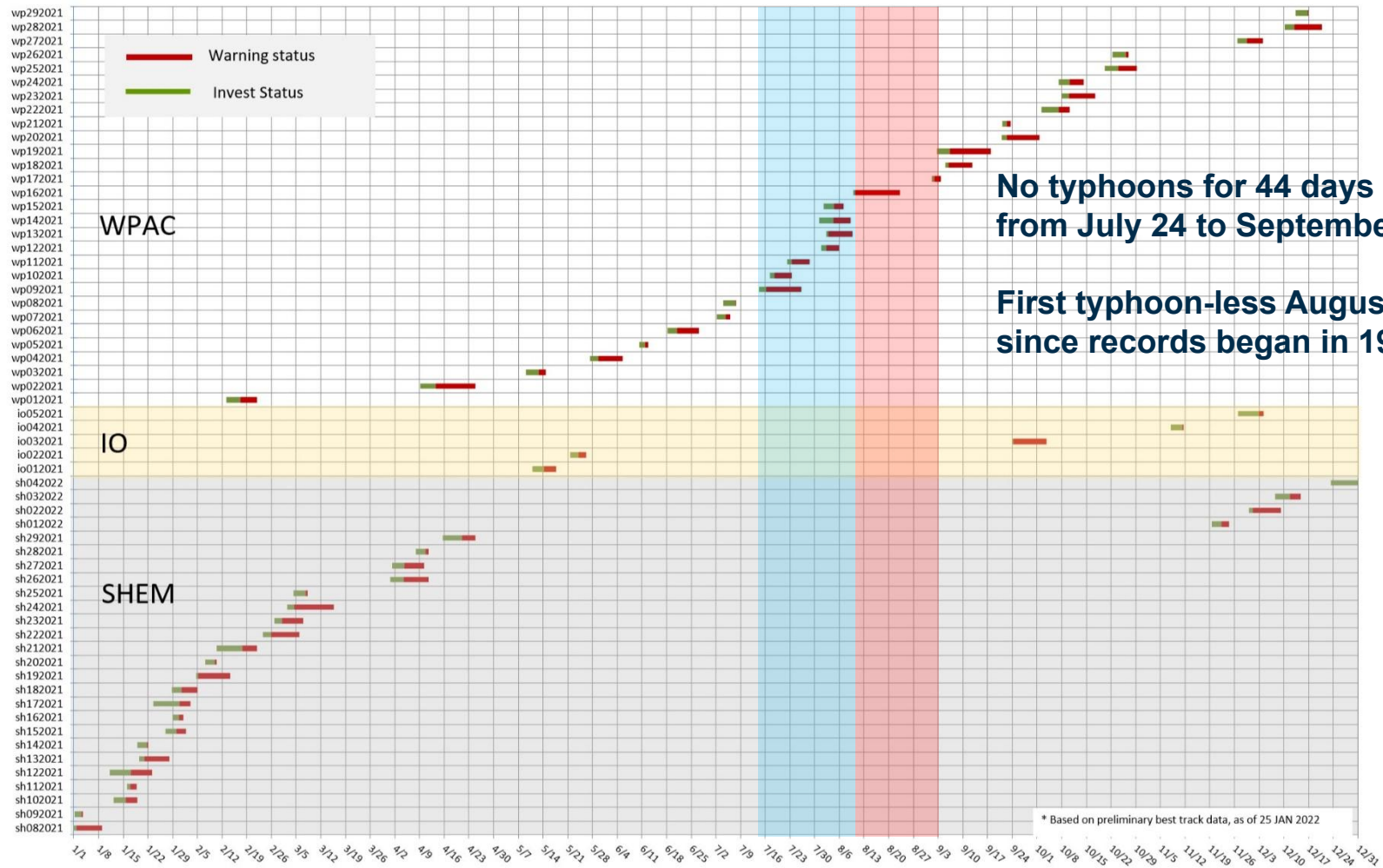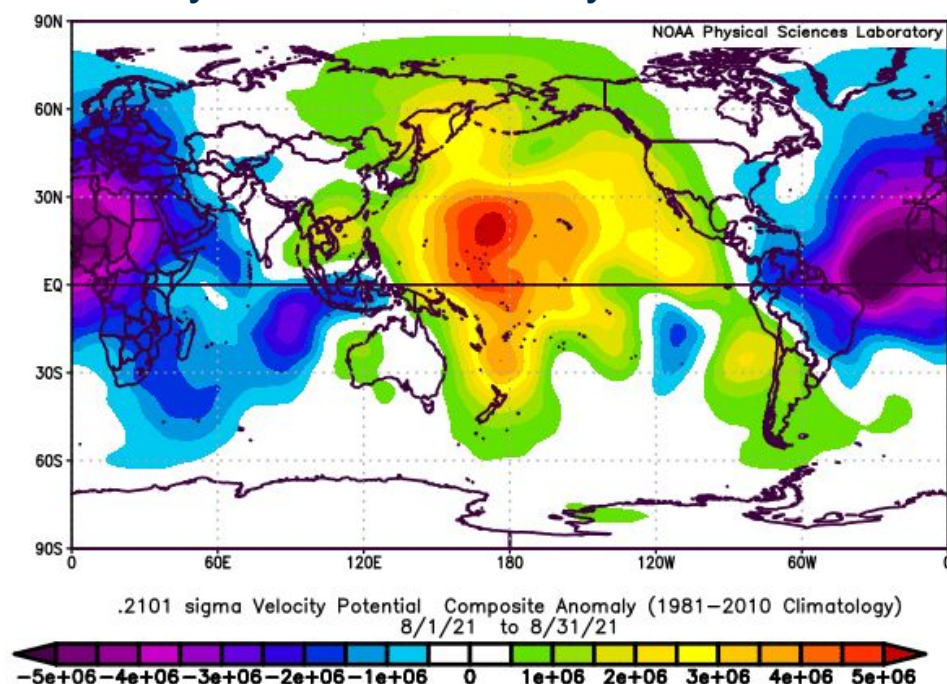
Strong Periods of Intraseasonal Forcing

July 200 hPa
Velocity Potential Anomaly

August 200 hPa
Velocity Potential Anomaly

.2101 sigma Velocity Potential Composite Anomaly (1981-2010 Climatology)
7/1/21 to 7/31/21

.2101 sigma Velocity Potential Composite Anomaly (1981-2010 Climatology)
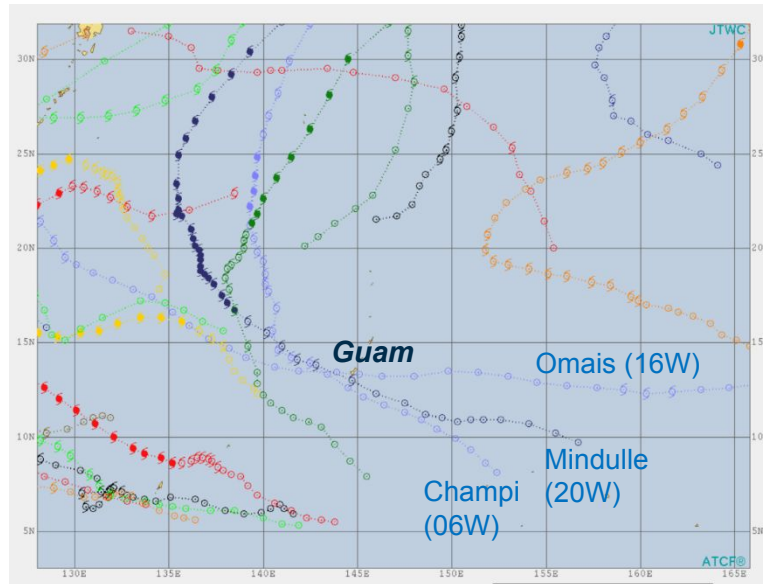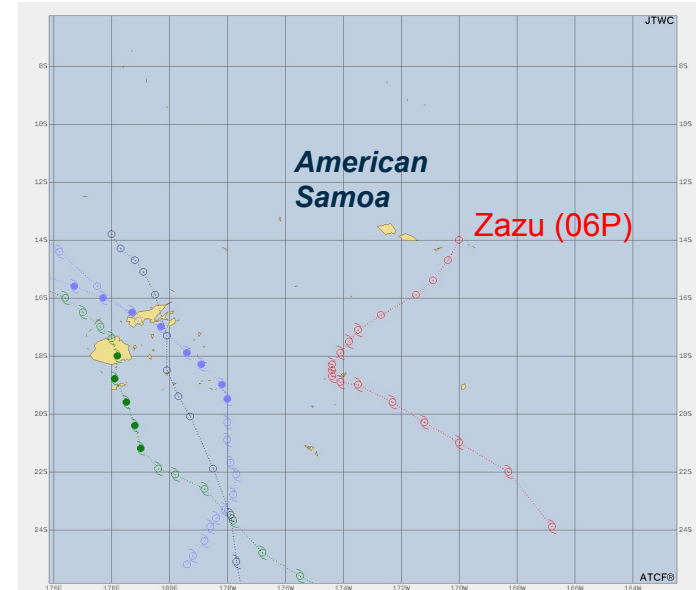8/1/21 to 8/31/21

Images courtesy of NOAA/ESRL

JTWC-NOAA Support/Coordination

2021 TCs Near Guam

2021 TCs Near American Samoa

- − 6 PGTW fixes in Central Pacific
- − 2 PHFO fixes in western Pacific (likely undercounted due to data issue)
- − 30 PHFO fixes in South Pacific
- − 1,211 KNES fixes in JTWC AOR
- − 359 NHC EPAC advisories for 19 tropical cyclones repackaged for DoD by JTWC
- − Utilized NWS Chat channel for JTWC / WSO Pago Pago communications

Major Impacts

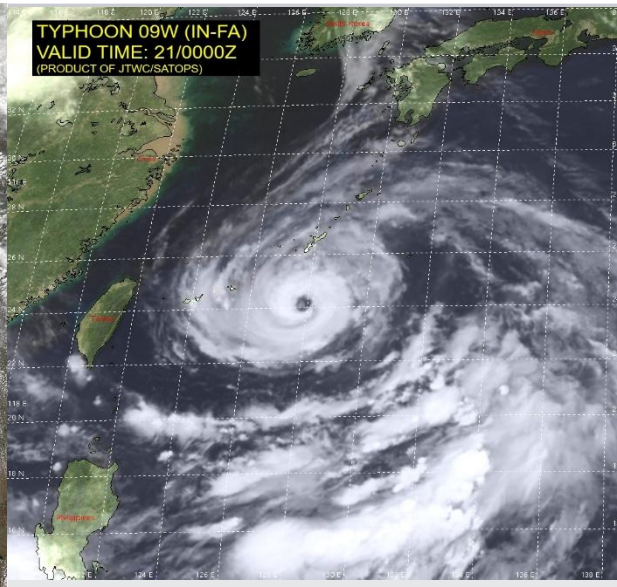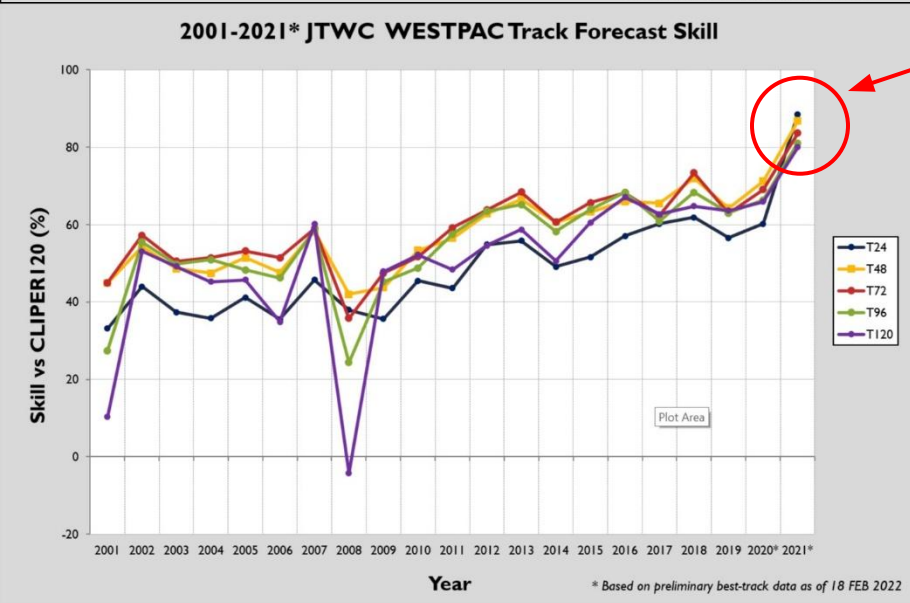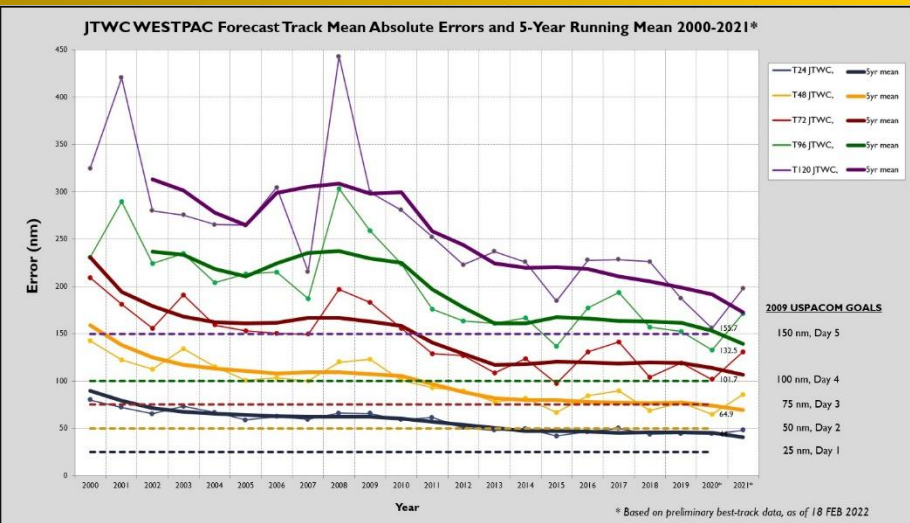| Cyclone Tauktae (01A) 15–19 May 2021	Typhoon In-Fa (09W) 19–26 July 2021	Super Typhoon Rai (28W) 13–20 December 2021
Primary Impact Region: Western India	**Primary Impact Region:** Ryukyu Islands, eastern China	**Primary Impact Region:** Philippines, Vietnam, southern China
Fatalities: 174 **Damage:** $2.1 billion USD	**Fatalities:** 6 **Damage:** $1+ billion USD	**Fatalities:** 410 **Damage:** $1.02 billion USD
• Strongest TC to hit Gujarat since 1998 • Peak intensity: 130 kt	• 2nd-wettest typhoon in China, with up to 37 inches of rain	• 2nd-most intense TC of WPAC season • 2nd-most damaging Philippine typhoon behind Haiyan • Double RI periods in Philippine Sea and South China Sea

JTWC WESTPAC Forecast Track Mean Absolute Errors and 5-Year Running Mean 2000-2021*

2009 USPACOM GOALS

150 nm, Day 5
100 nm, Day 4
75 nm, Day 3
50 nm, Day 2
25 nm, Day 1

* Based on preliminary best-track data, as of 18 FEB 2022

2001-2021* JTWC WESTPAC Track Forecast Skill

* Based on preliminary best-track data as of 18 FEB 2022

- Uptick in mean track error vs. 2020

- 5-year running mean errors continuing decreasing trend

- Record track skill at all lead times

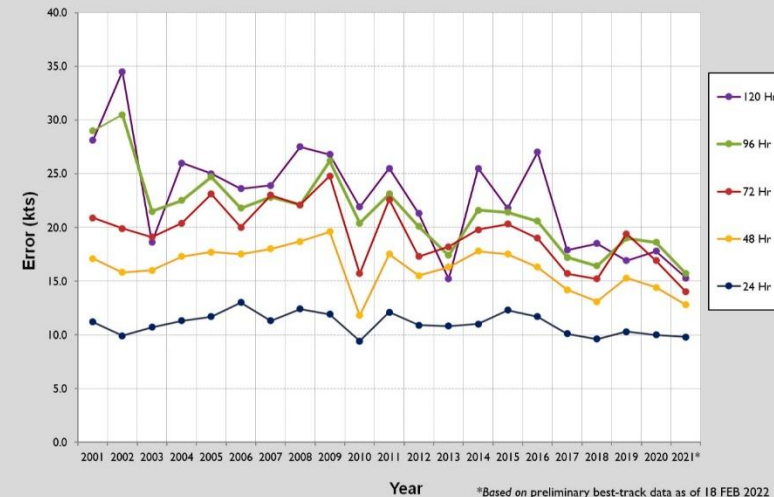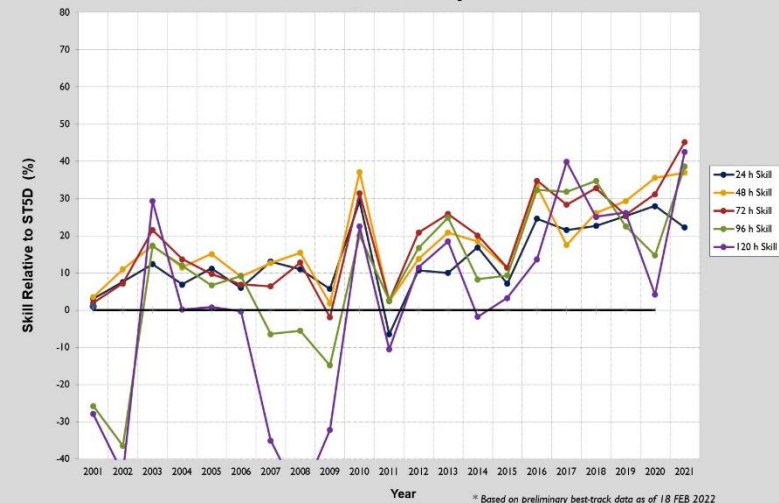- 2021 track forecasts more climatologically "challenging" according to CLIPER

- Record or near-record low mean intensity error at 72-120 hours

- 5-year running mean errors continuing decreasing trend

- Record high intensity skill at 72-120 hours

JTWC Mean Absolute Intensity Errors (WESTPAC), 2001-2021*
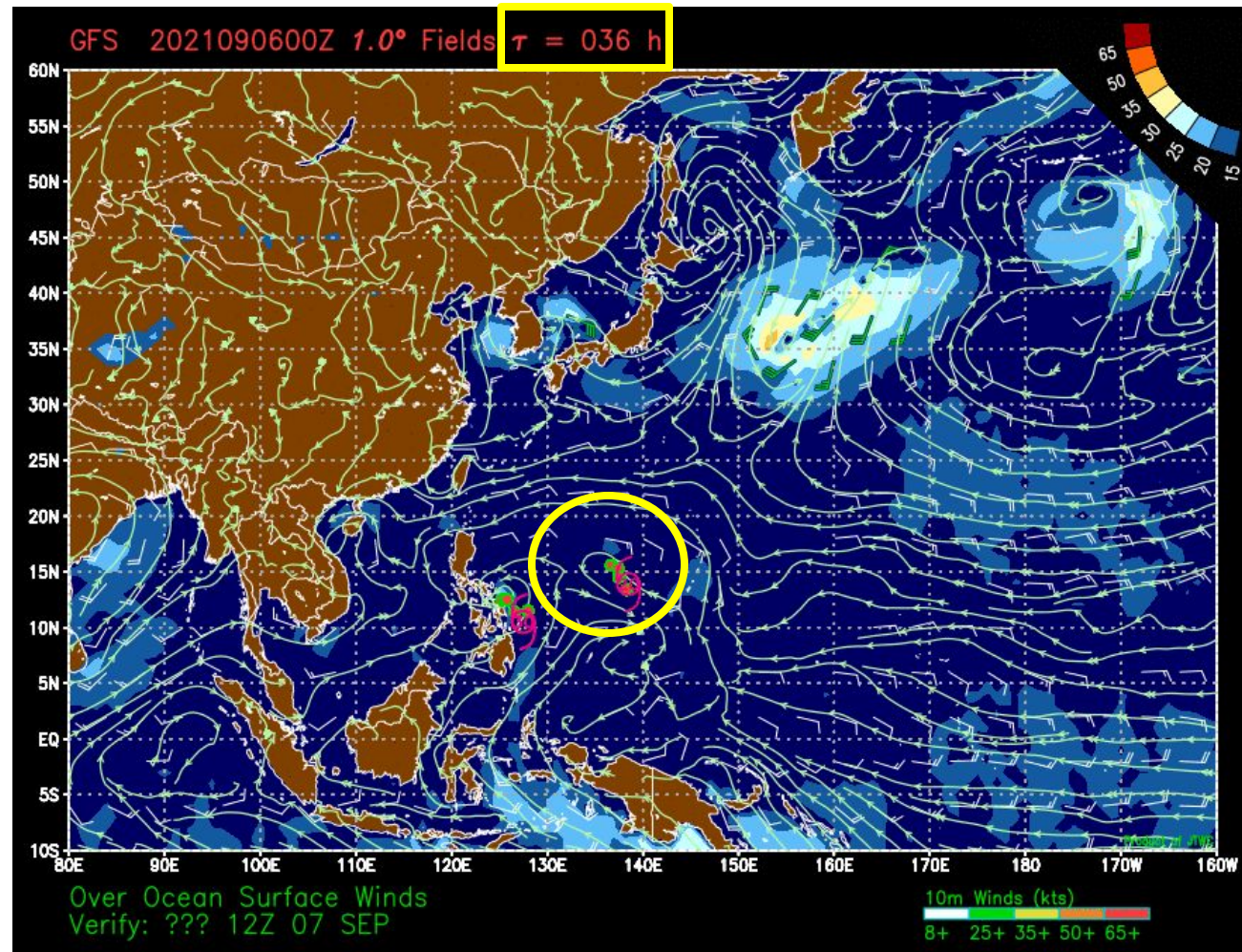

JTWC WESTPAC Forecast Intensity Skill 2001-2021*

- Genesis 100% missed by GFS, ECMWF, UKMET, and others

- GFS 36-hour forecast: 15 kt circulation

  Reality: 95 kt typhoon

- Atlantic analogy: Hurricane Hanna (2020)

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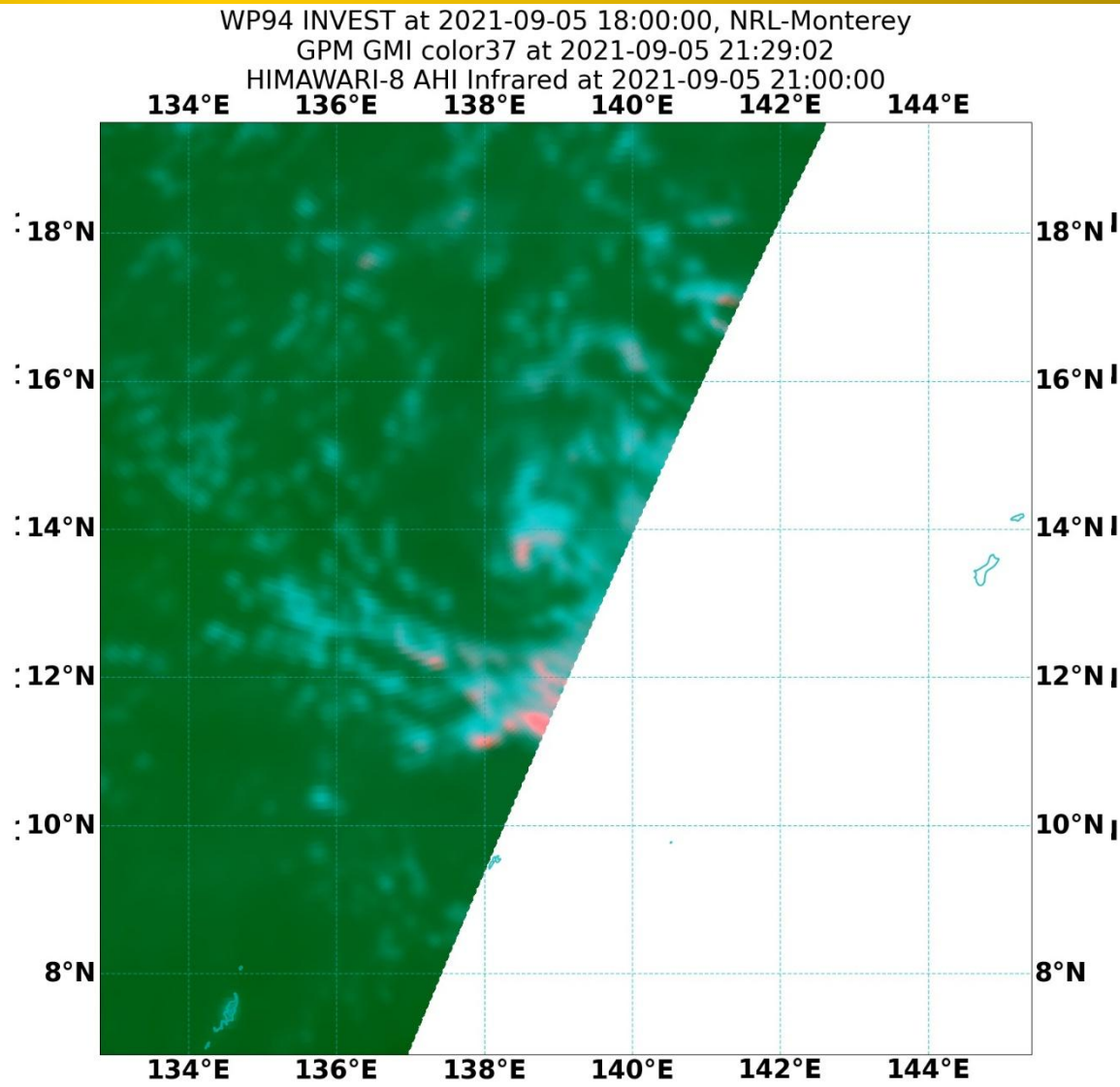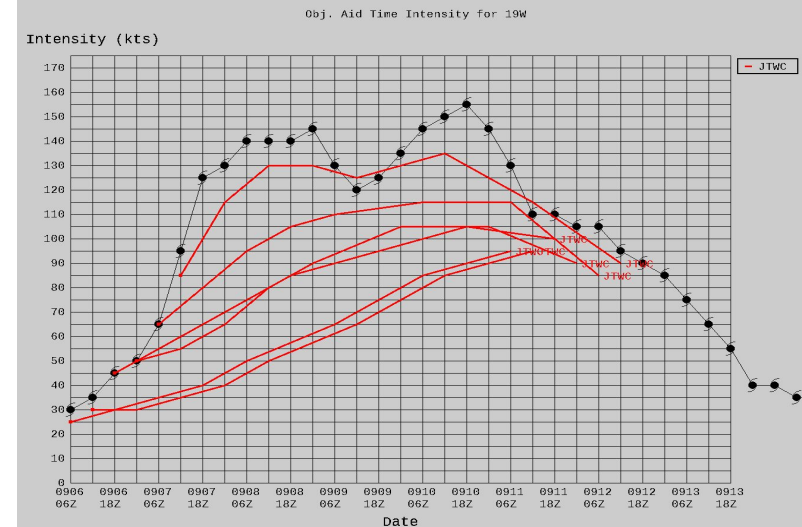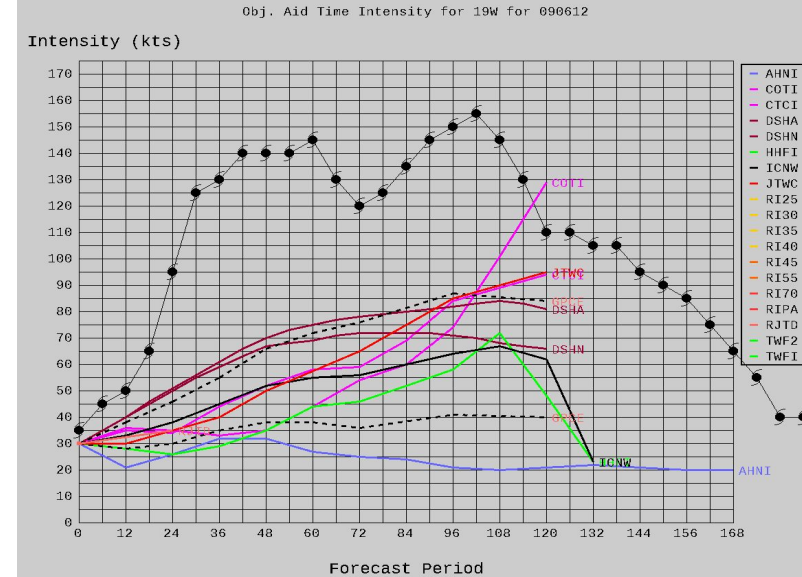

WP94 INVEST at 2021-09-05 18:00:00, NRL-Monterey
GPM GMI color37 at 2021-09-05 21:29:02
HIMAWARI-8 AHI Infrared at 2021-09-05 21:00:00

- RI period missed following genesis

- 35 kt to 140 kt in 42 hours

- Model and JTWC errors > 90 kt in early forecasts

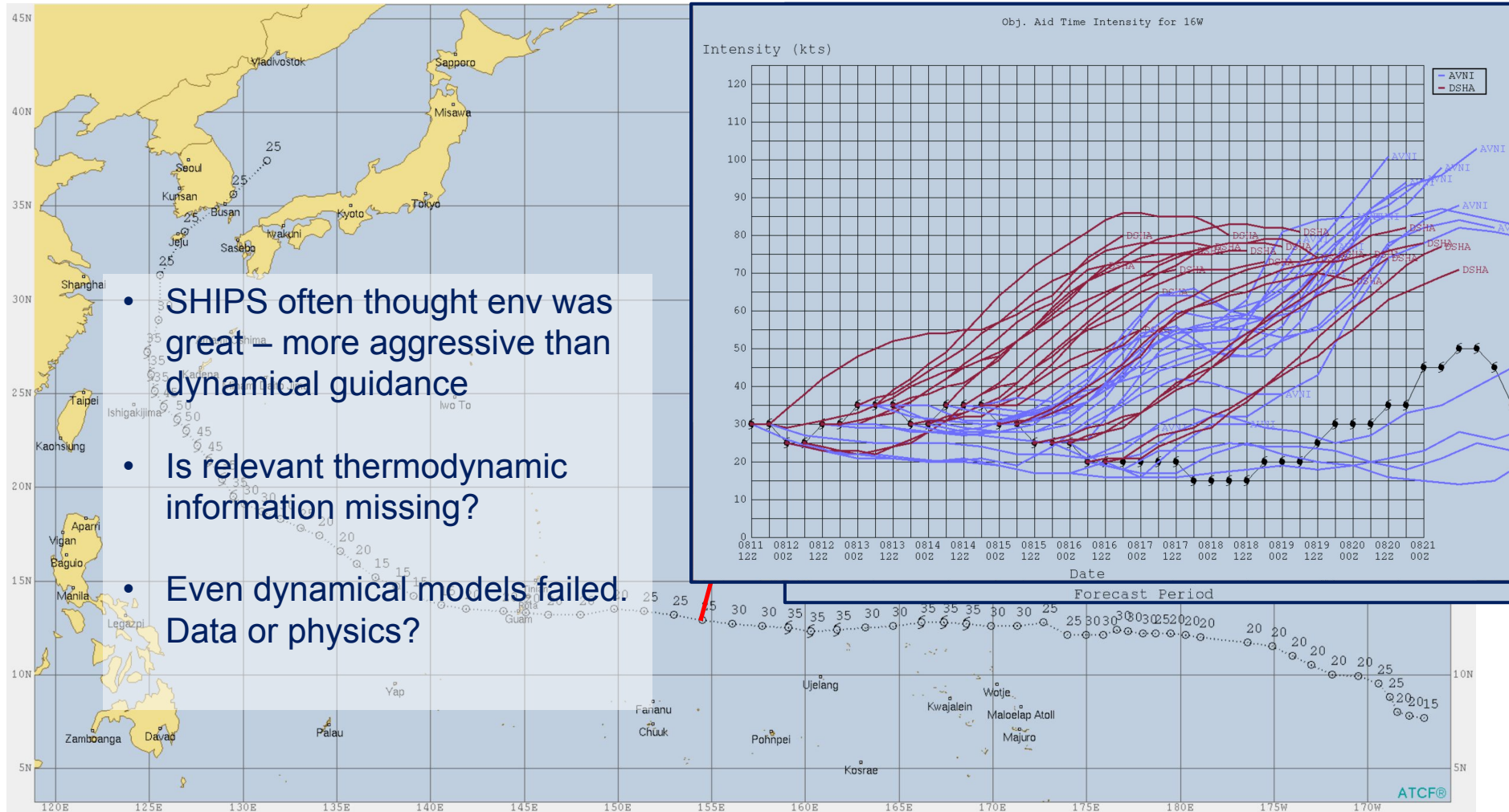- Second RI period induced by ERCs also poorly forecast

- 10.5-day period at 35 kt or weaker post-genesis (longest in WPAC record)

- SHIPS often thought env was great – more aggressive than dynamical guidance

- Is relevant thermodynamic information missing?

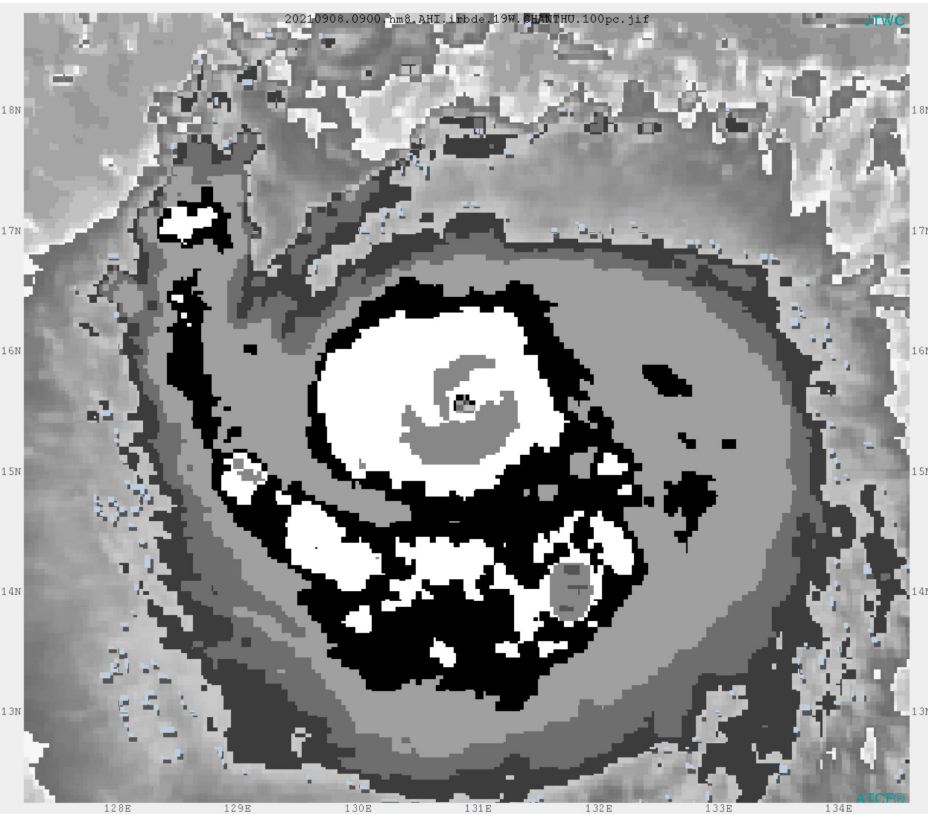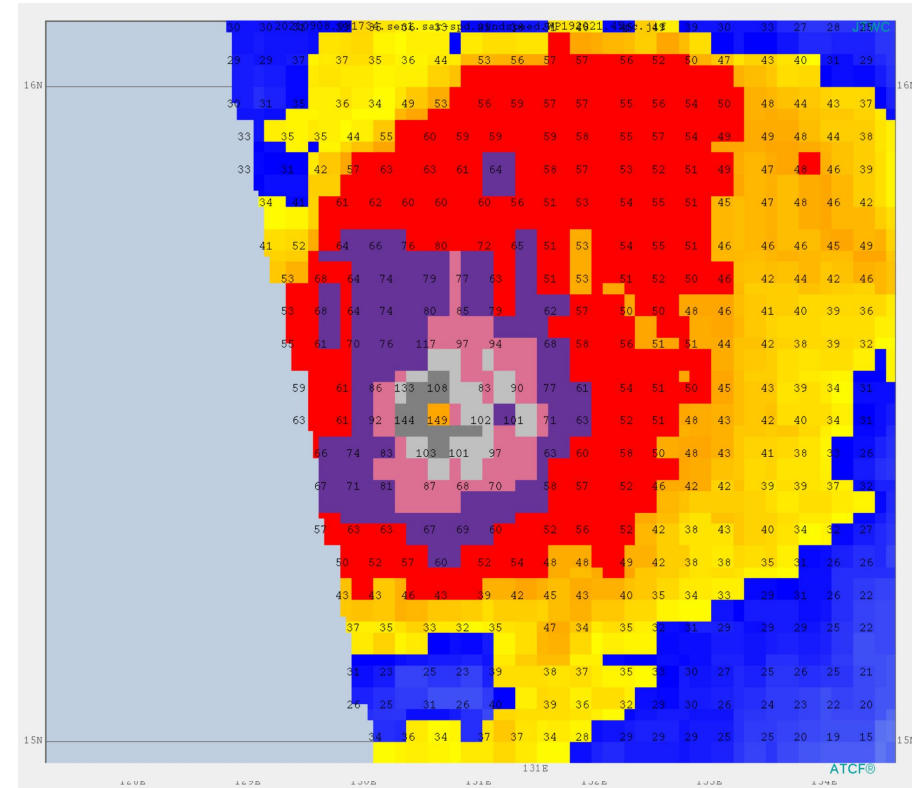- Even dynamical models failed. Data or physics?

Utility of High-Resolution Satellite-Derived Wind Products

SAR at 09Z 08 SEP for Supertyphoon 19W (Chanthu)

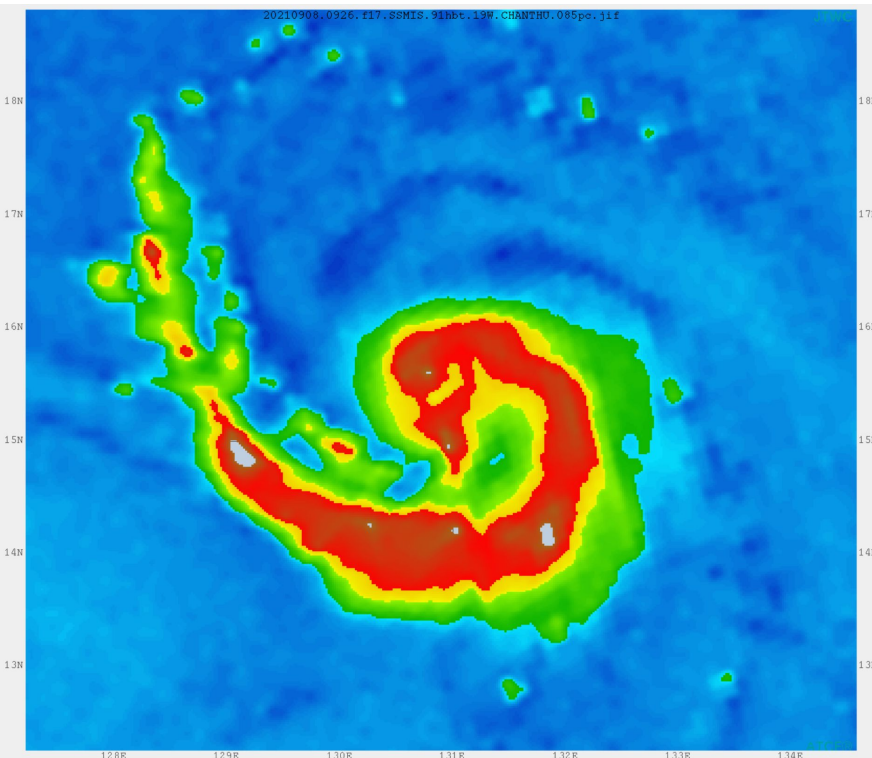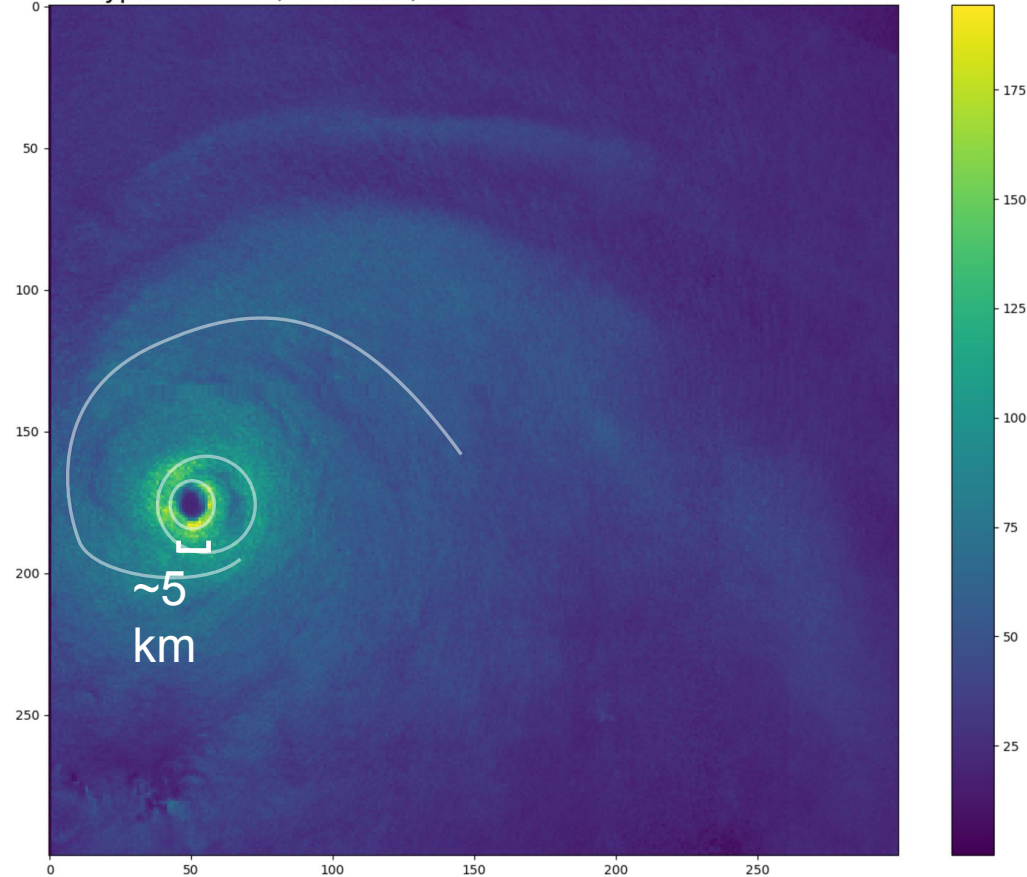Himawari at 09Z 08 SEP for Supertyphoon 19W (Chanthu)

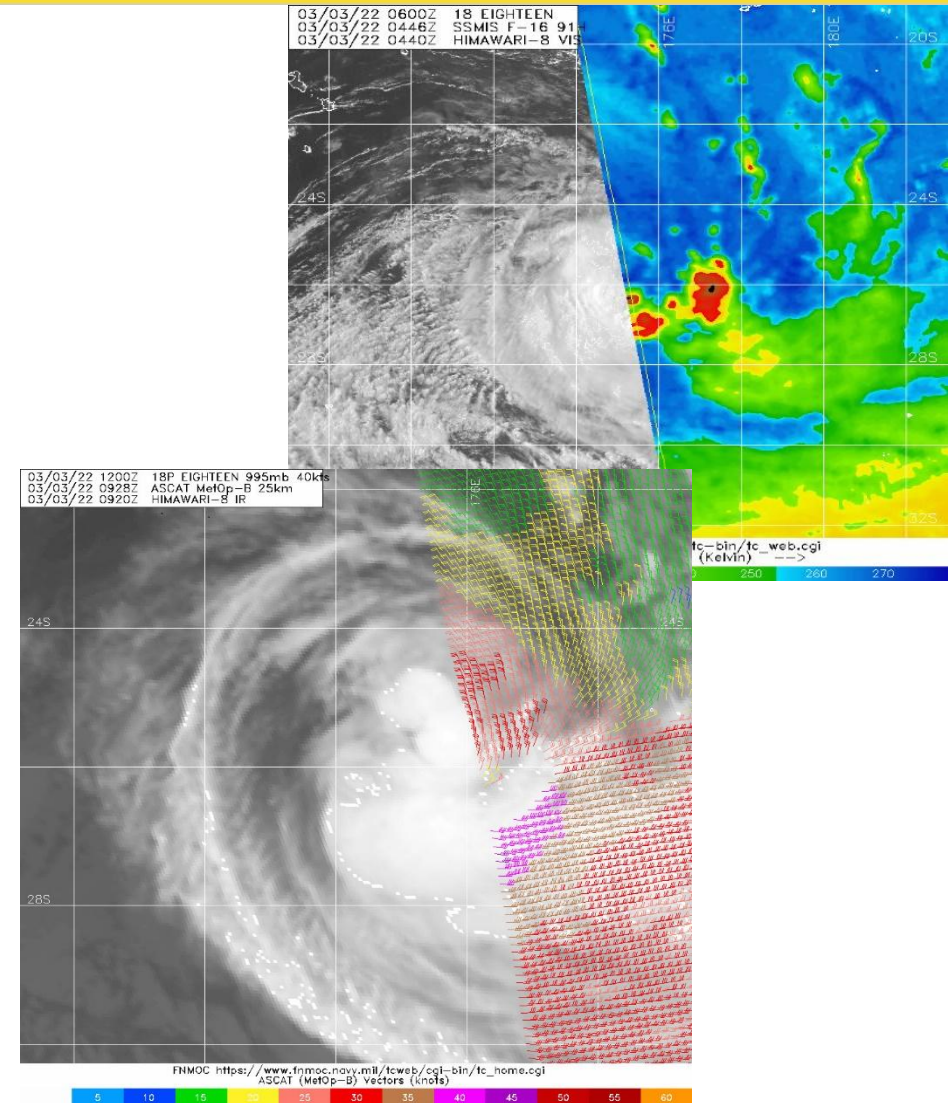## SSMIS 91 GHz at 09Z 08 SEP for Supertyphoon 19W (Chanthu)

Reconnaissance

Coverage Struggles Continue:

- Loss of ASCAT-A

- Average interval between scatterometer TC hits: ~28.5 hours (estimated)

- Interval between microwave TC hits >6 hours 44% of the time

- New NRL product development
  - GeoIPS

- New R&D satellites on the way
  - COWVR (microwave + passive scat)
  - TROPICS
  - TEMPEST

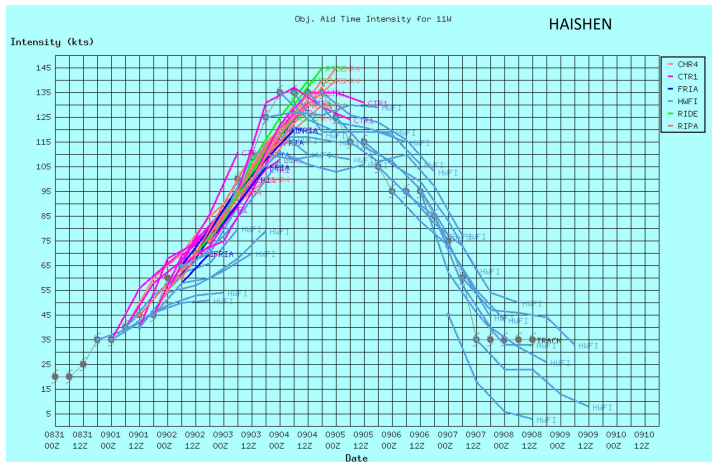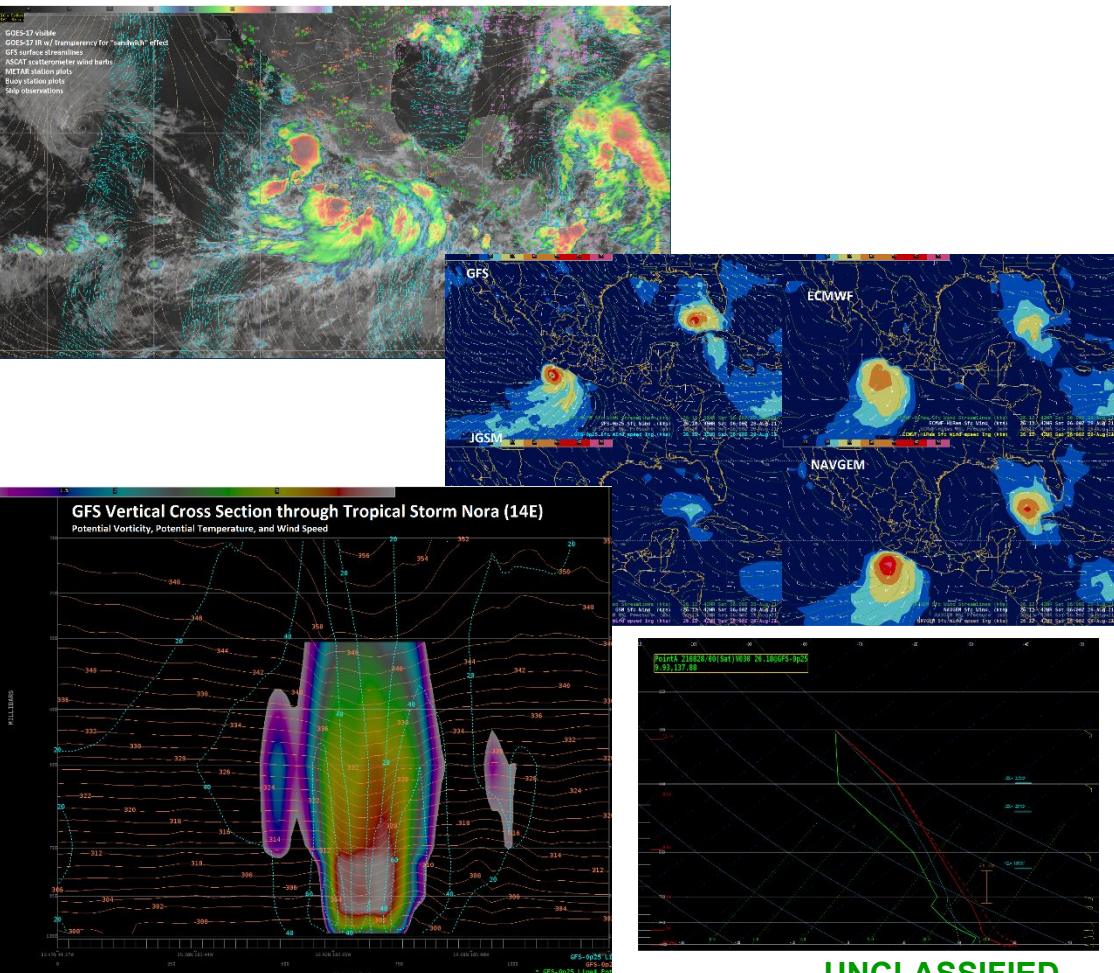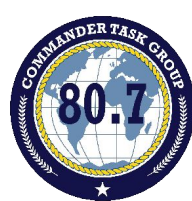# *New R&D Tools*

Integrating AWIPS-II for advanced and efficient data interrogation (yes we're late to the party)
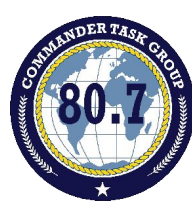
Testing new RI prediction aids from NRL

Naval Oceanography

Observe-Predict ▯ Fight-Win 16

JTWC R&D Priorities

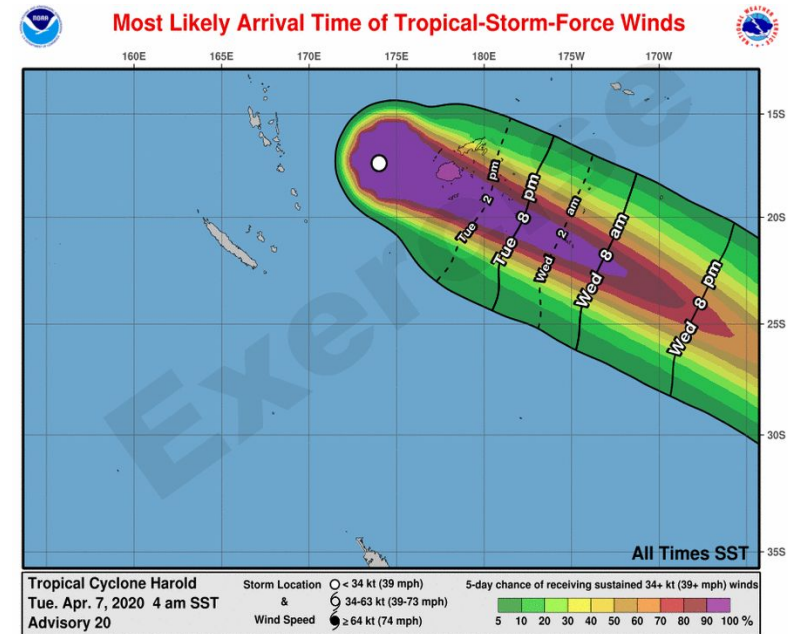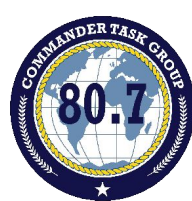| Priority	Need
1 **TC Intensity Change**	*Basin-specific* (WESTPAC, SHEM, NIO, SIO, and SWPAC) probabilistic and deterministic *forecast guidance for TC intensity change*, *particularly* the onset, duration, and magnitude of *rapid intensity change* events (including ERC, over-water weakening, etc.) at 2-3 day lead times.
2 **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.
3 **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
4 **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.
5 **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).

Upcoming Changes

- TCs that dissipate and then regenerate in a new basin will now receive new identifiers per NHOP section 3.3:

  - Central Pacific → Western Pacific
  - Western Pacific ↔ North Indian Ocean
  - IO or WP ↔ S. Hemisphere

- Working with Maureen Ballard at CPHC to incorporate NHC-style time of arrival and wind probability graphics into JTWC decision support product suite

Most Likely Arrival Time of Tropical-Storm-Force Winds

Tropical Cyclone Harold
Tue. Apr. 7, 2020 4 am SST
Advisory 20

All Times SST

Naval Oceanography   *Observe-Predict □ Fight-Win*   18

Questions?

THANK YOU!