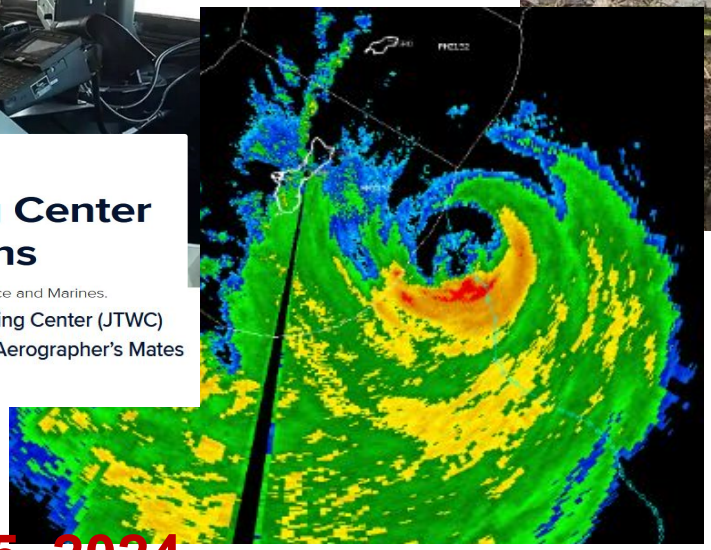
JTWC 2023 Operational Highlights and Interagency Perspectives

EXTREME WEATHER | Published May 25, 2023 6:58pm EDT

How the Joint Typhoon Warning Center prepares fleets for typhoons

The joint operation includes a team of 50 civilians and members of the Navy, Air Force and Marines.

PEARL HARBOR, Hawaii (Nov. 21, 2022) - Sailors from Joint Typhoon Warning Center (JTWC) conducted fleet liaison observation training with Quatermasters (QM) and Aerographer's Mates (AG) onboard the USS DANIEL K. INOUYE (DDG 118).



Left: Fox News Extreme Weather Report, May 25, 2023, by Angeli Gabriel
Center: US NWS Guam radar image of Super Typhoon Mawar
Right: Guam National Guard, photo by Mark Scott

TCORF/78th IHC March 5, 2024

Joint Typhoon Warning Center

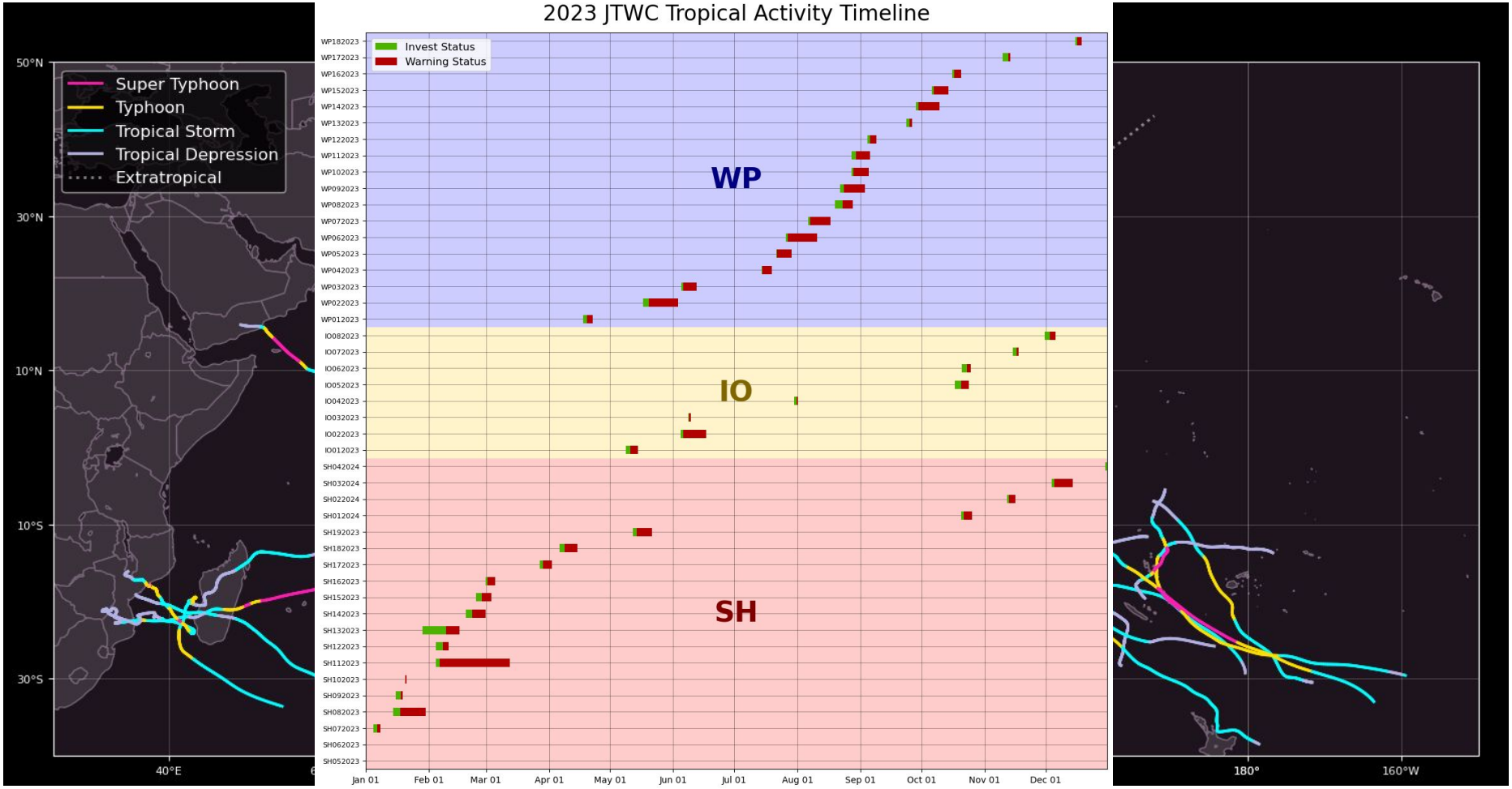
CDR Dominic DiMaggio, Commanding Officer

Mr. Brian Strahl, Director

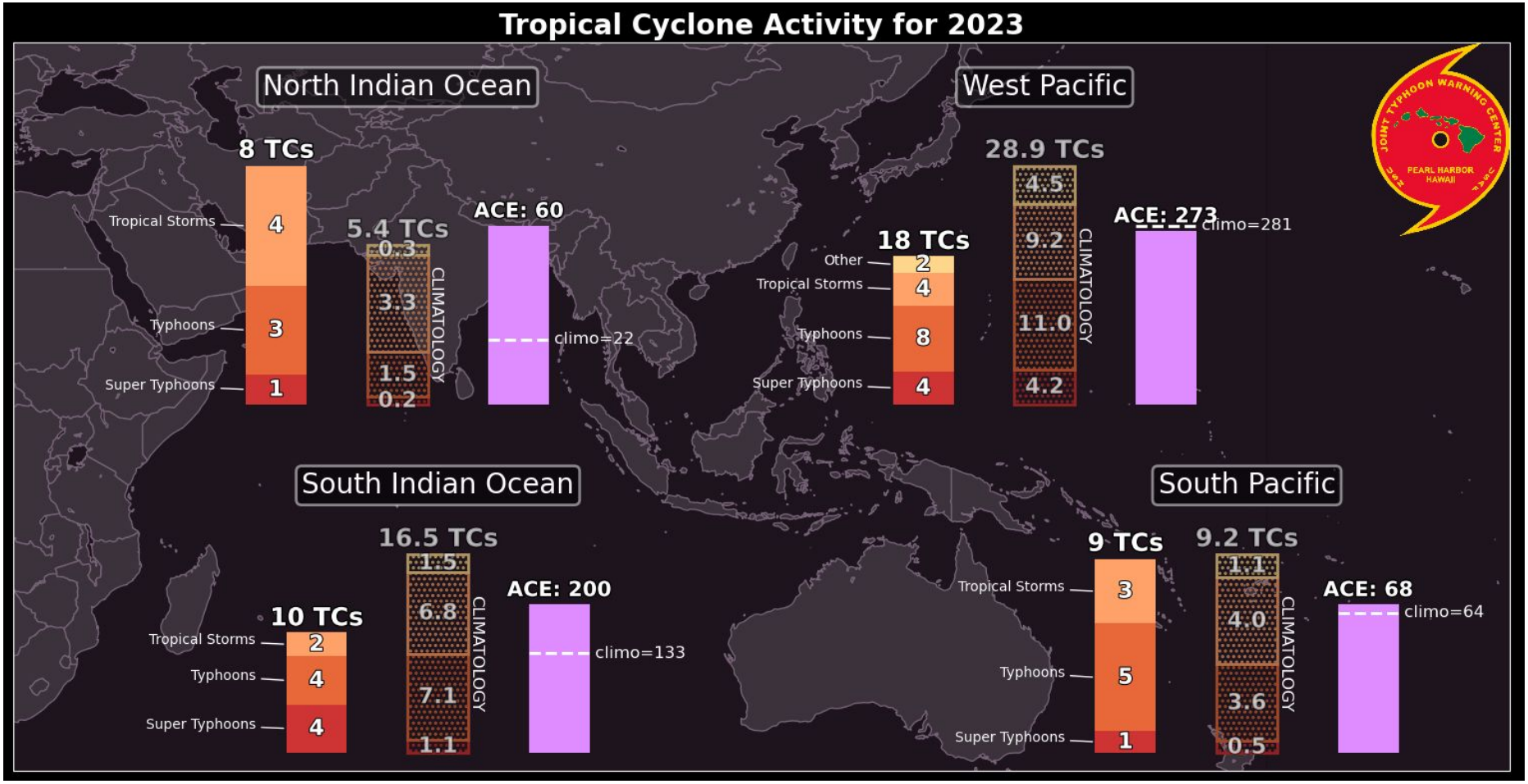
TC Tracks during Calendar Year

Total warnings issued in WP, IO, SH basins: **858**

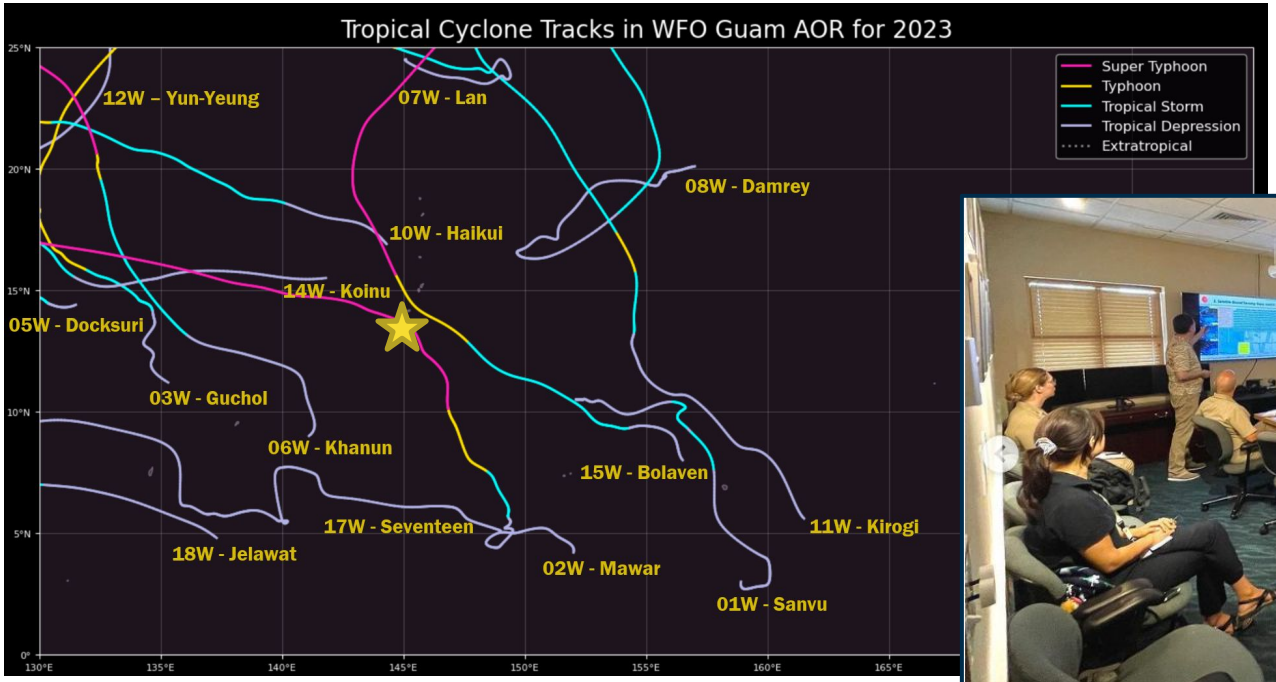
Total satellite fixes issued in all basins: 4239 (TCs) + 4724 (invests) = **8963**

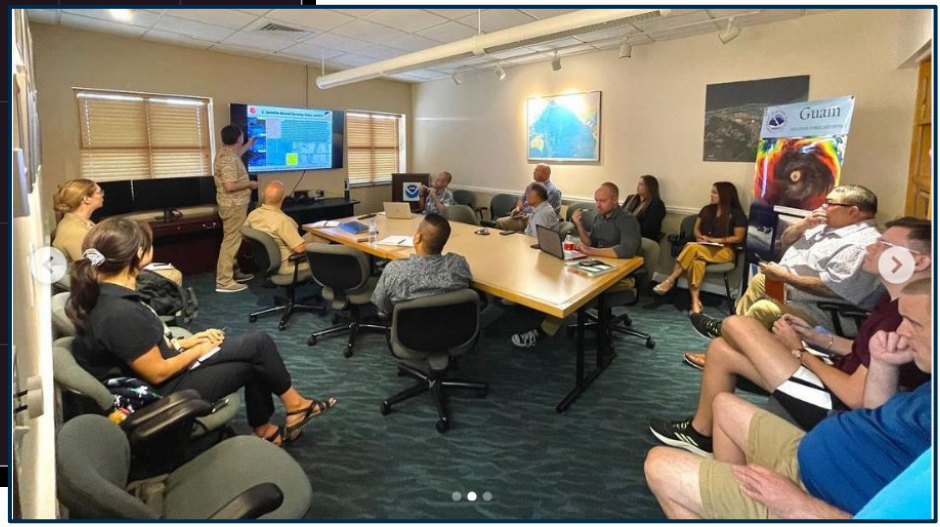


TC Activity vs. Climatology by Basin



JTWC-NOAA Support/Coordination

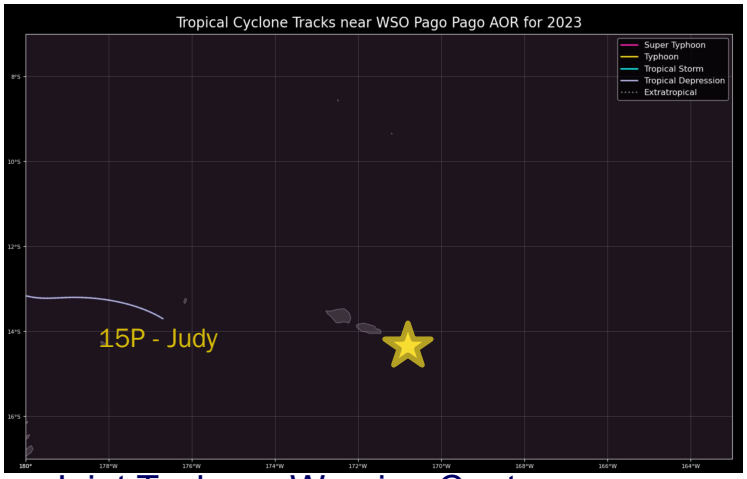




- 14 of18 WESTPAC TCs passed through WFO Guam's AOR
- TC Genesis region generally consistent with ENSO neutral conditions, despite El Niño
- Super Typhoon Mawar landfall along northern coast of Guam, May 24th
  - Assisted WFO in data re-analysis and report generation
  - JTWC leadership visit to discuss support and lessons learned with WFO Guam, DHS, FEMA, Gov Guam, and DoD
- Typhoon Bolaven passed between Rota and Tinian, Oct 10th

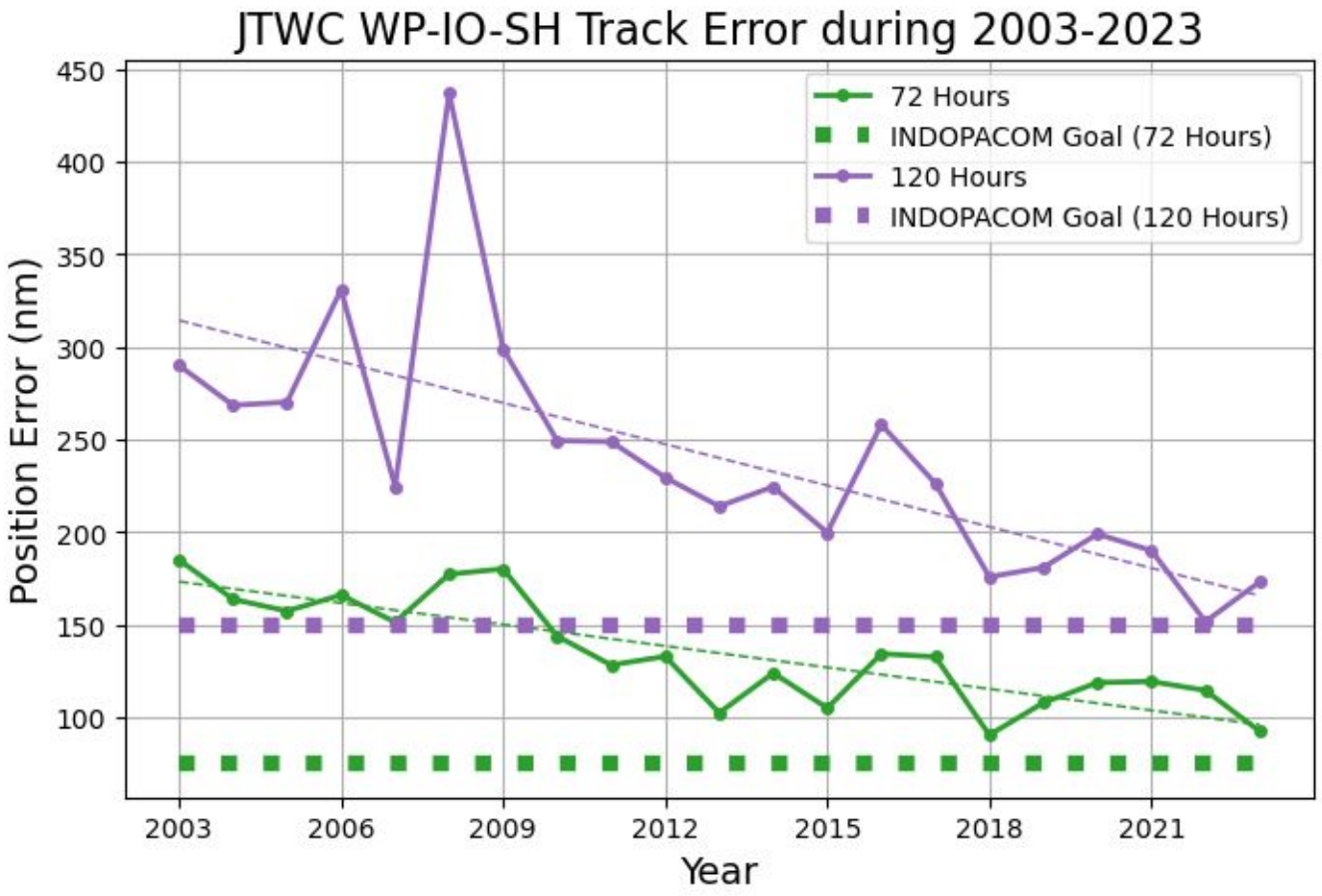
JTWC-NOAA Support/Coordination, cont'd

- 1,707 KNES fixes in JTWC AOR
- 92 PHFO fixes in SHEM for JTWC; 9 JTWC fixes in CPAC for CPHC
- JTWC repackaged 389 NHC/CPHC Pacific advisories for DoD
- Utilizing NWS Chat 2.0 for routine discussions, added OPC
- JTWC makes CPHC-generated time of arrival graphics available to JTWC DoD customers
- Annual ATCF requirements meeting (JTWC, NHC, CPHC, FWCs, CIMSS, CIRA)
- Resumed in-person participation in WMO Typhoon Committee/Integrated Workshop
- Second season with AWIPS II at JTWC
  - Continuing to develop expertise, customize displays, perform data visualization and interrogation
- Very quiet season for American Samoa



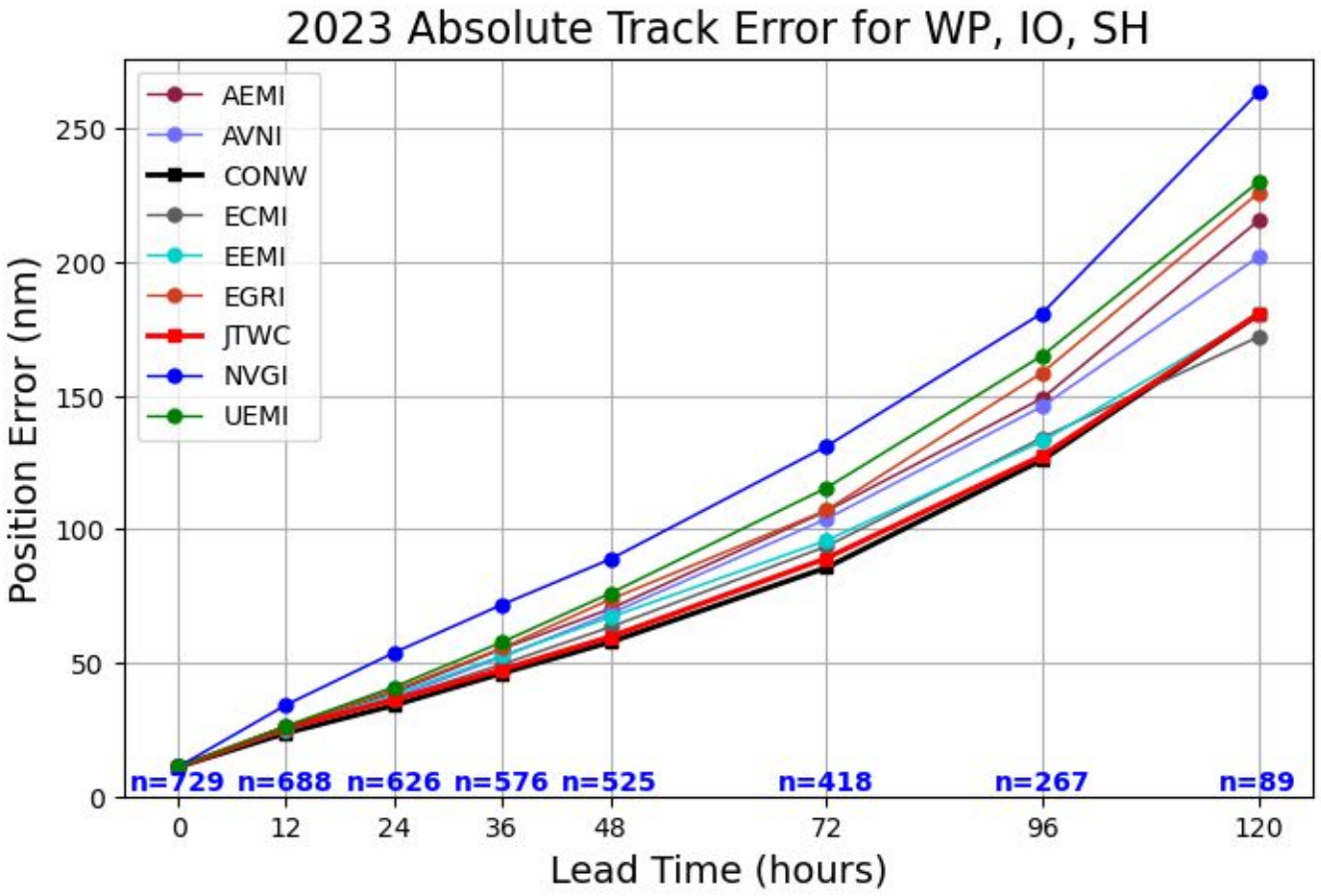
JTWC Track Error Time Series vs. Goals

- 3-day and 5-day track error improvement trend continues, approaching INDOPACOM goals



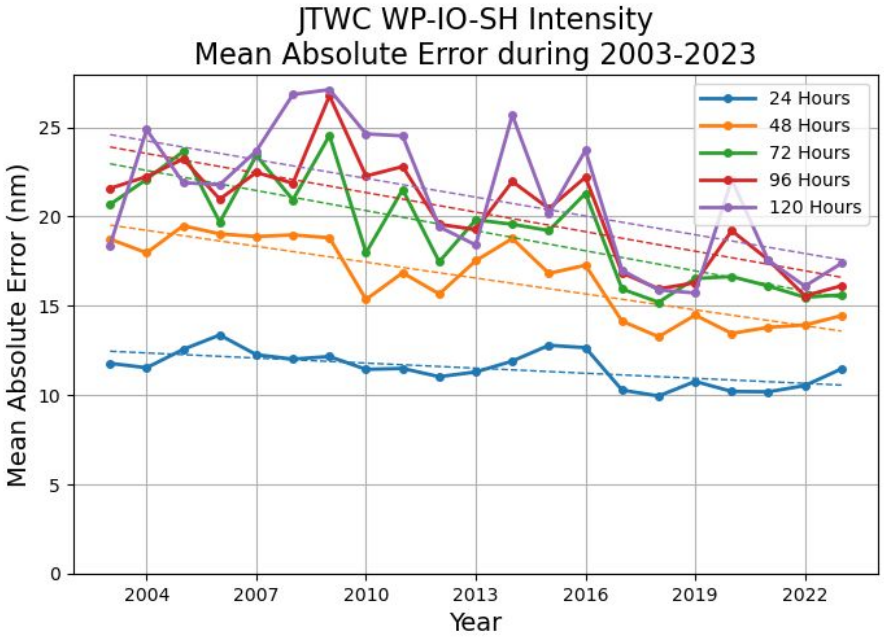
Model Track Error Homogeneous Comparison

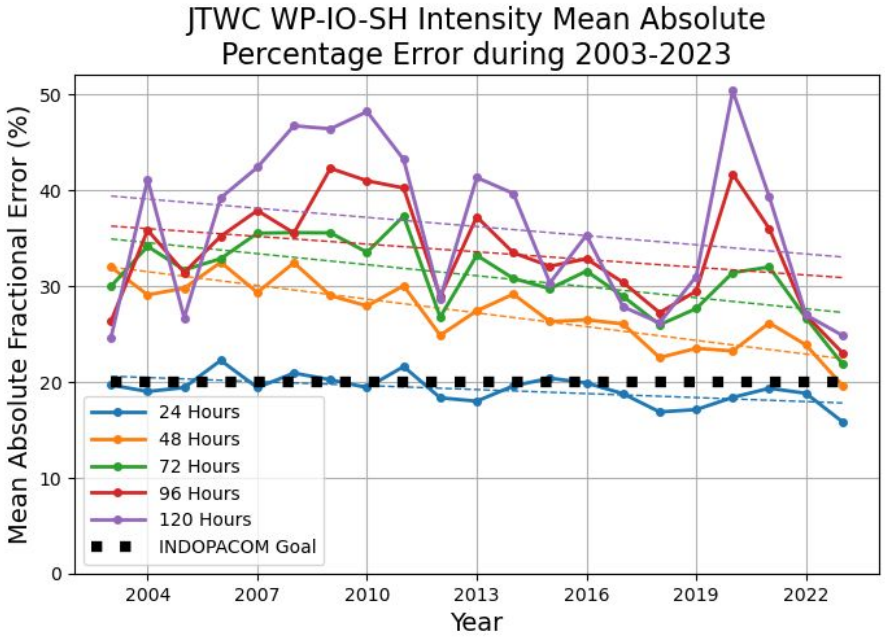
- ECMWF best individual model
- JTWC and multi-model consensus were best performers



JTWC Intensity Error Time Series vs. Goals

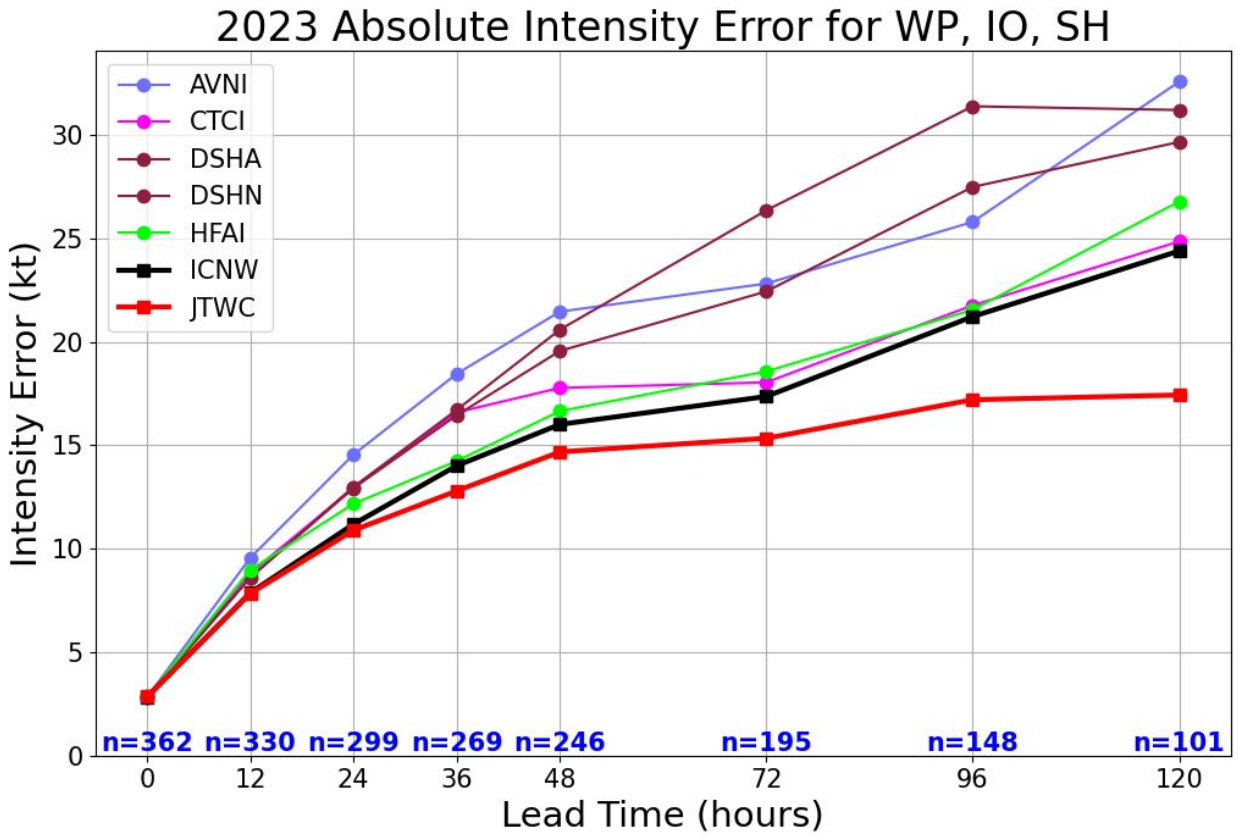
- Slight uptick in mean absolute error vs. 2022 at all lead times
- Long-term improvement trend continues toward INDOPACOM goals, but has slowed since ~2017





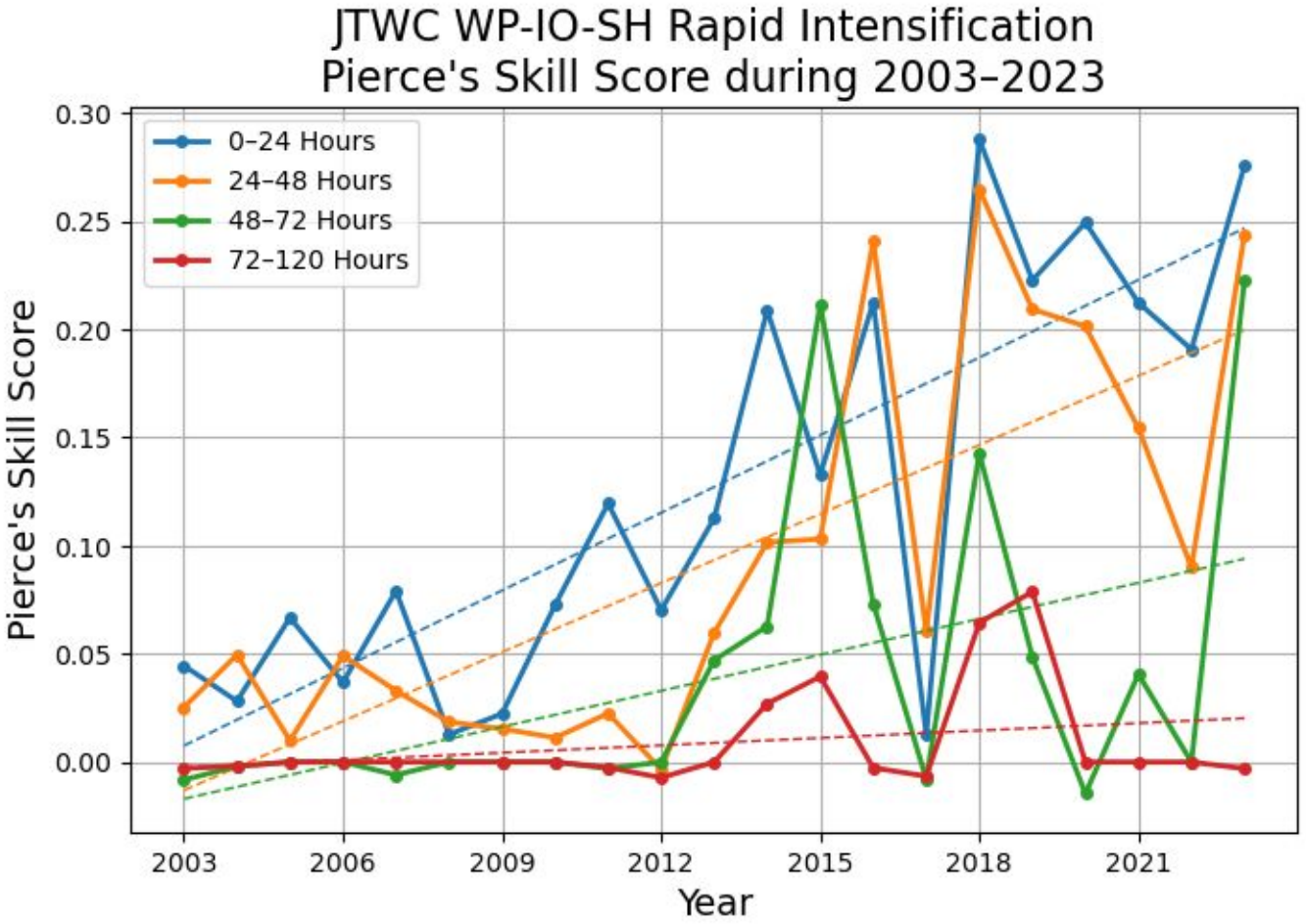
Model Intensity Error Homogeneous Comparison

- JTWC significantly outperformed the multi-model consensus on average
- HAFS-A and COAMPS-TC competed for best individual model, with HAFS performing better for lead times under 48 hours
- NOTE: homogeneous samples unavailable before HAFS-A release in July 2023



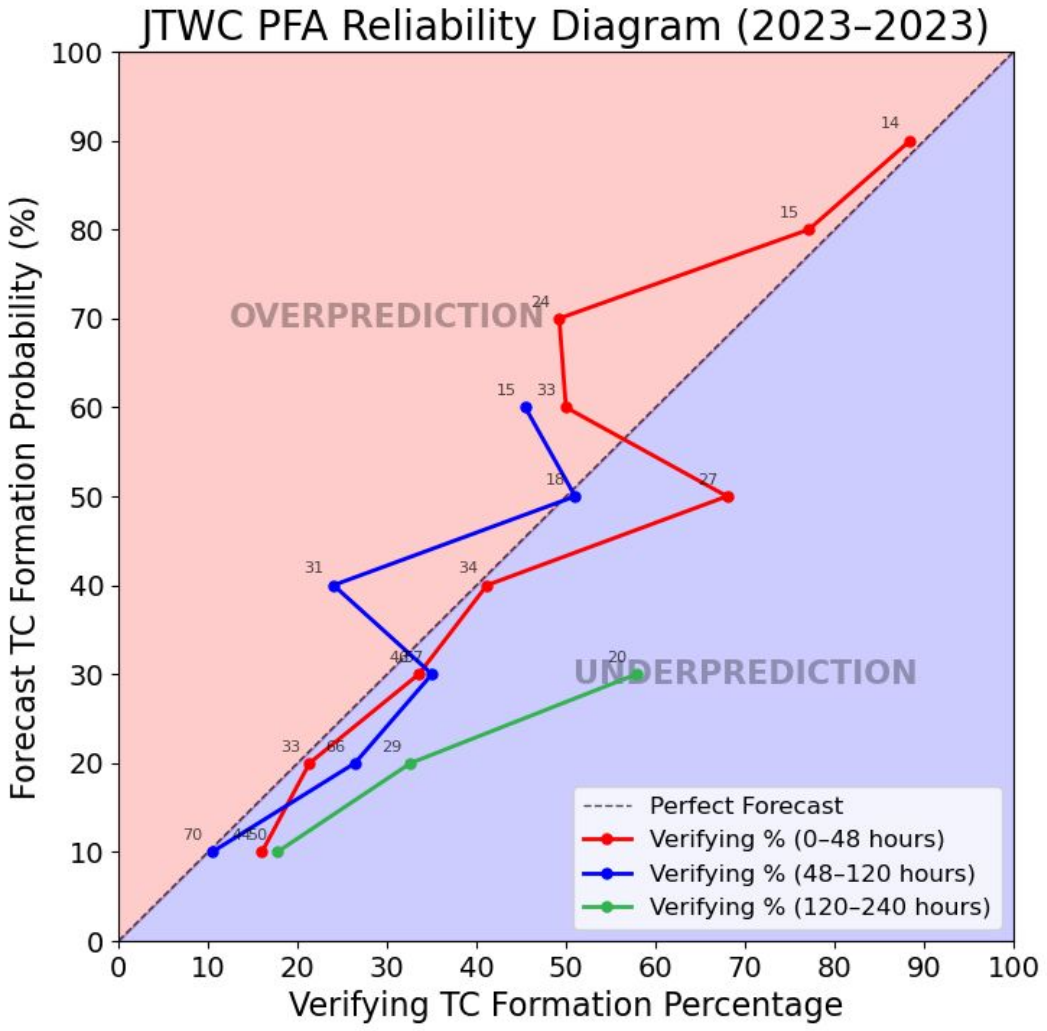
JTWC RI Skill Time Series

- Nice jump in RI skill vs. 2021 and 2022
- Long-term increasing trend in skill continues, most pronounced at short lead times
- RI prediction beyond 72 hours remains generally unskillful



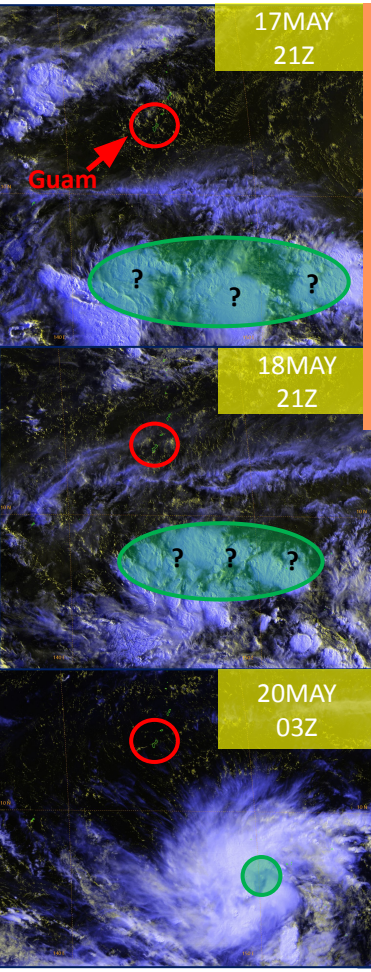
JTWC Genesis Probability Calibration

- Reasonably well-calibrated in 2023 for lead times up to 120 hours
- Significant underprediction for lead times beyond 120 hours



Reconnaissance

Mawar highlighted the challenges and criticality of sensing

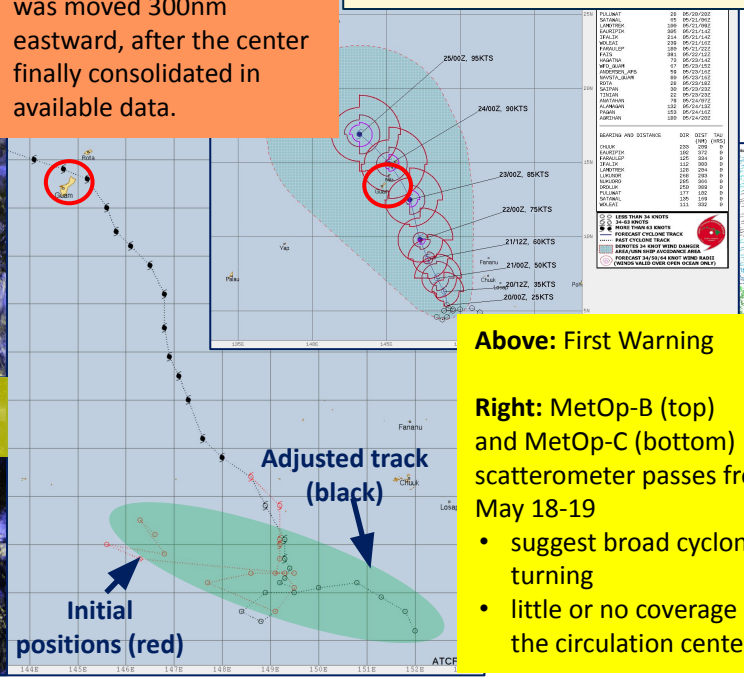


Left: Himawari-9 visible imagery.
- Green shading indicates system center uncertainty
- Guam in red circle

Bottom: Initial track data was moved 300nm eastward, after the center finally consolidated in available data.

18-20 MAY 2023 02W "Mawar" SBEM Summary: Pre-Warning Phase

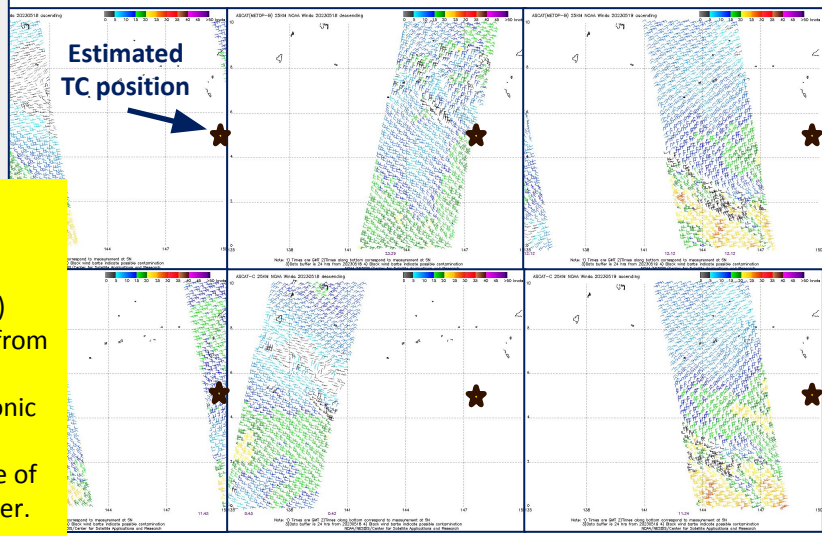
First Warning was issued May 20 at 0300Z, or 1300L Saturday at Guam. JTWC discussed early warning issuance, between 18-19 May. However, a system center position could not be ascertained with confidence. Based on initial track data, a warning issued during this time may have placed the forecast up to 300nm to the west, potentially detrimental to military planners. **If available, aircraft recon may have located a distinct system center and enabling a First Warning issued up to 2 days earlier.**



Above: First Warning

Right: MetOp-B (top) and MetOp-C (bottom) scatterometer passes from May 18-19
- suggest broad cyclonic turning
- little or no coverage of the circulation center.

Little or no OSVW to determine center location



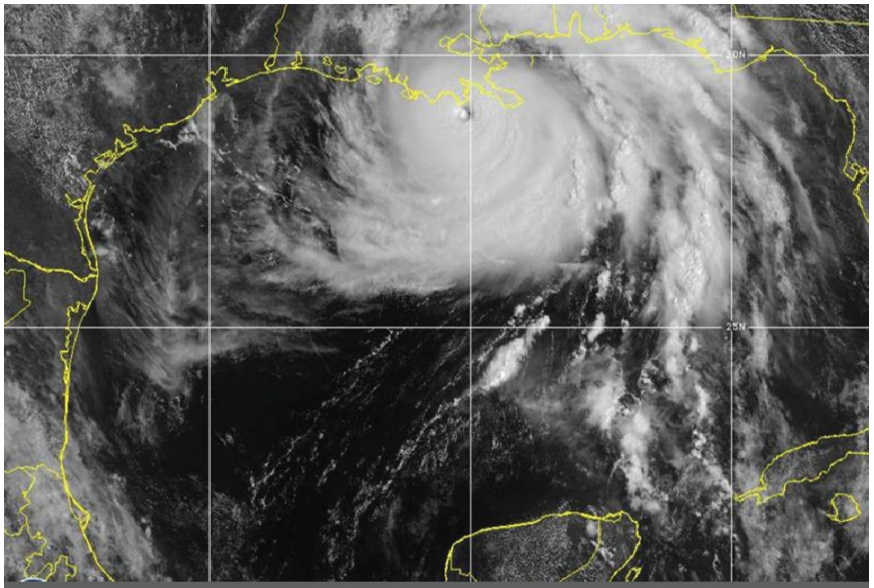
Tropical Cyclone Impacts U.S. Whole of Government Activities

US OCONUS TC Forecast and Coordination Requirements

NHOP includes:

- **DOT, DHS, and DOS responsibilities in LANT, EPAC, CPAC**
- **DOD-DOC coordination in support of NWS (Guam and American Samoa)**

… but no requirements for DOD to support DOT, DHS, DOS, etc. OCONUS



- JTWC primary mission is to support DOD in the Indo-Pacific, where over 70% of mean annual TC activity occurs.
- Public-facing internet replaced dedicated circuits, agreements, and routine coordination across the Interagency
- What happens when JTWC's public-facing page is unavailable?

Global TC Requirements for the Whole of Government

Increasing risk to global warning production and dissemination

- Increased cybersecurity threats
- Decreasing regional stability
- Competition for resource prioritization

NHOP/ICAMS is an avenue for Agencies and Departments to provide annual requirements for TC forecasts and warnings

CHARTER

of the

INTERAGENCY COUNCIL FOR ADVANCING METEOROLOGICAL SERVICES (ICAMS)

1. OFFICIAL DESIGNATION

The Interagency Council for Advancing Meteorological Services (ICAMS) is chartered under authority of the Director of the Office of Science and Technology Policy (OSTP) to serve as the Interagency Committee for Advancing Weather Services pursuant to Public Law No. 115-25, title IV, sec. 402 (Apr. 18, 2017), 15 U.S.C. § 8542.

As a continuation of the mandate in Public Law No. 87-843, title III, sec. 304 (Oct. 18, 1962), 68 Stat. 1114, and consistent with Public Law No. 115-25, ICAMS leads the annual development of an interagency budget review of programs supporting meteorological services and supporting research and annual implementation plans.[1]

2. PURPOSE AND SCOPE

ICAMS is the formal mechanism by which all relevant Federal departments and agencies (Ds/As) coordinate implementation of policy and practices to ensure U.S. global leadership in the meteorological services[2] enterprise. ICAMS also informs the development of relevant Federal policies via the National Science and Technology Council (NSTC) and within individual Ds/As.

ICAMS AGENCIES and DEPARTMENTS

Fostering coordination across the broad set of relevant agencies and departments.

- **Executive Office of the President (EOP)**
  - Office of Science and Technology Policy (OSTP)
  - Office of Management and Budget (OMB)
- **Department of Agriculture (USDA)**
  - Office of the Chief Scientist (OCS)
- **Department of Commerce (DOC)**
  - National Institute of Standards and Technology (NIST)
  - National Oceanic and Atmospheric Administration (NOAA)
    - NOAA National Weather Service (NWS)
    - NOAA National Environmental Satellite, Data, and Information Service (NESDIS)
    - NOAA National Ocean Service (NOS)
    - NOAA Office of Oceanic and Atmospheric Research (OAR)
- **Department of Defense (DOD)**
  - United States Army (USA)
  - United States Air Force (USAF)
  - United States Marine Corps (USMC)
  - United States Navy (USN)
  - United States Space Force (USSF)
- **Department of Energy (DOE)**
- **Department of Health and Human Services (HHS)**
  - National Institutes of Health (NIH)
  - Centers for Disease Control and Prevention (CDC)
- **Department of Homeland Security (DHS)**
  - Federal Emergency Management (FEMA)
  - United States Coast Guard (USCG)
- **Department of the Interior (DOI)**
  - United States Geological Survey (USGS)
  - Bureau of Land Management (BLM)
  - National Park Service (NPS)
  - Bureau of Ocean Energy Management (BOEM)
  - U.S. Fish and Wildlife Service (FWS)
- **Department of State (DOS)**
  - Bureau of Oceans and International Environmental and Scientific Affairs (OES)
- **Department of Transportation (DOT)**
  - Federal Aviation Administration (FAA)
  - Federal Highway Administration (FHWA)
- **Environmental Protection Agency (EPA)**
- **National Aeronautics and Space Administration (NASA)**
- **Nuclear Regulatory Commission (NRC)**
- **National Science Foundation (NSF)**
- **National Transportation Safety Board (NTSB)**

Questions?

THANK YOU!

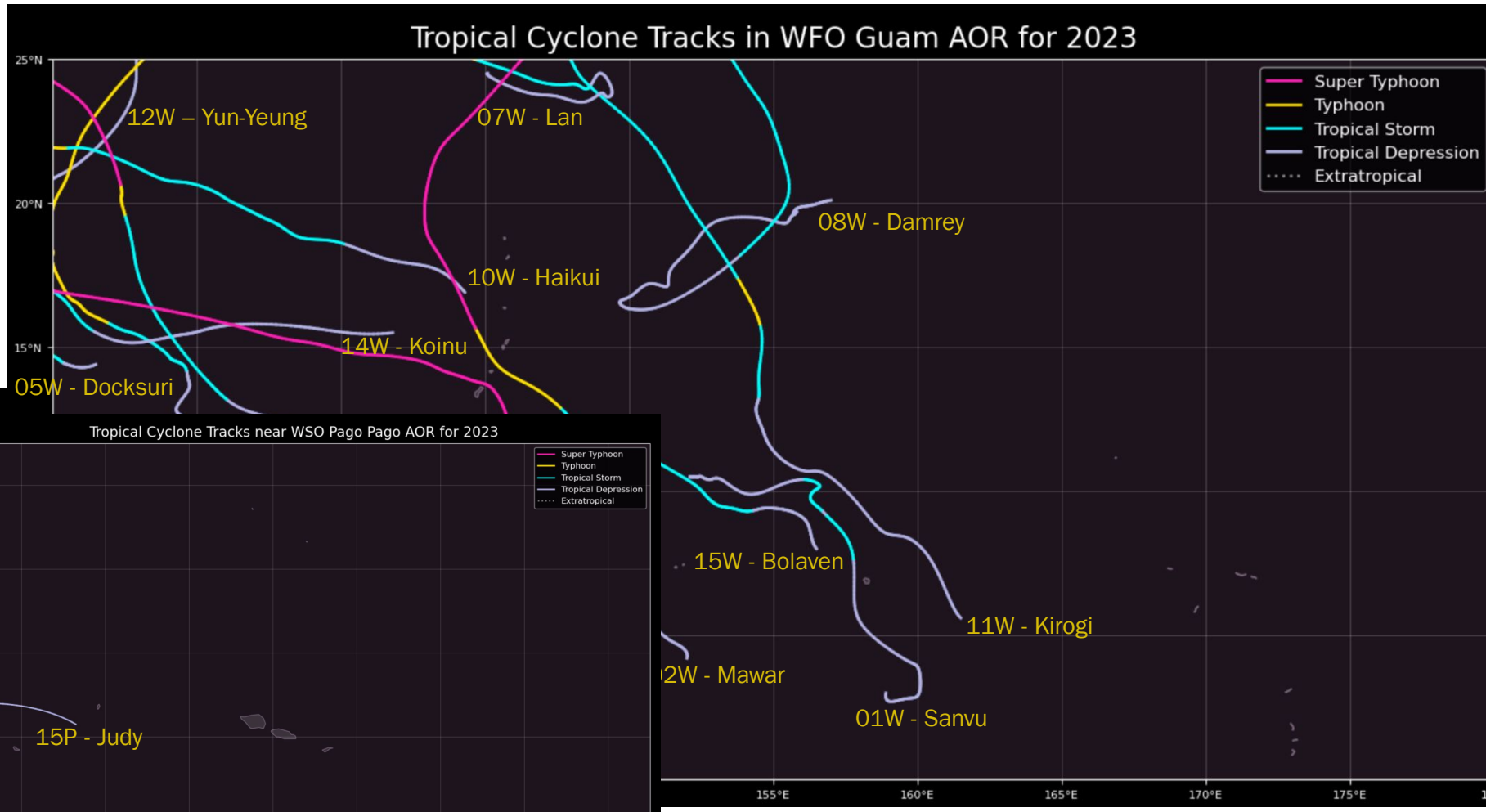
Significant TC Forecast Challenges

- **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

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.

JTWC-NOAA Support/Coordination



ugh 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)