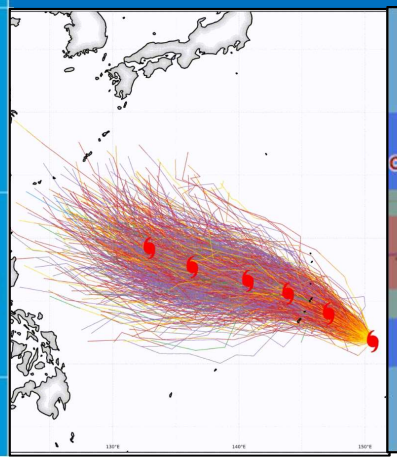
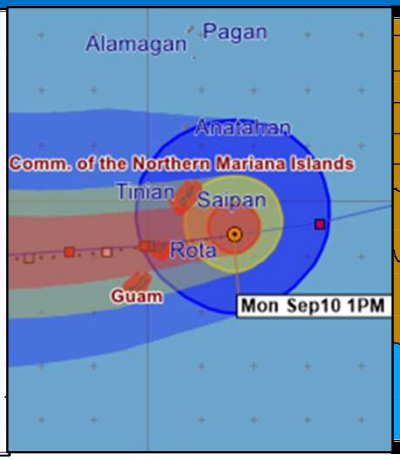
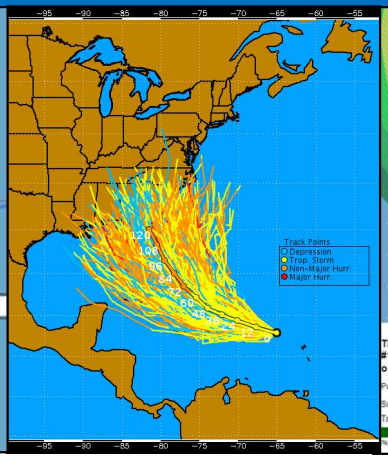
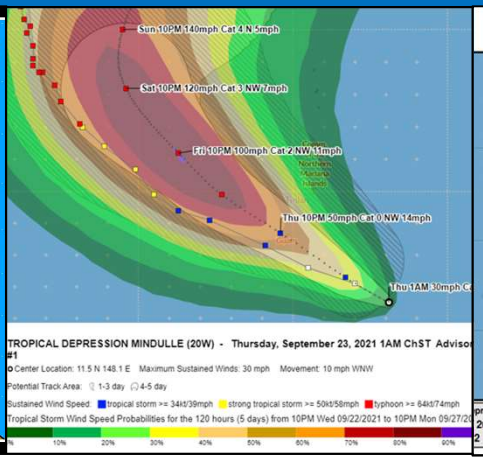
NATIONAL WEATHER SERVICE

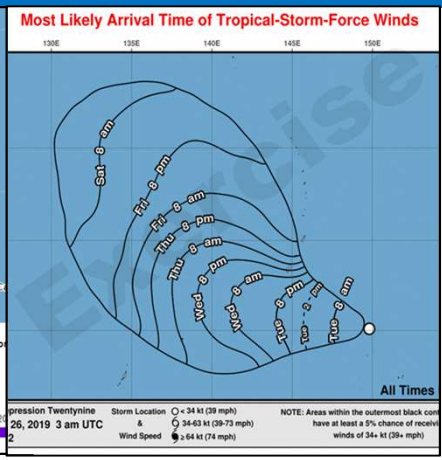
Introduction & Information on How to Use & Interpret the New Probabilistic Tropical Cyclone Graphics Now Available Across the Western North Pacific









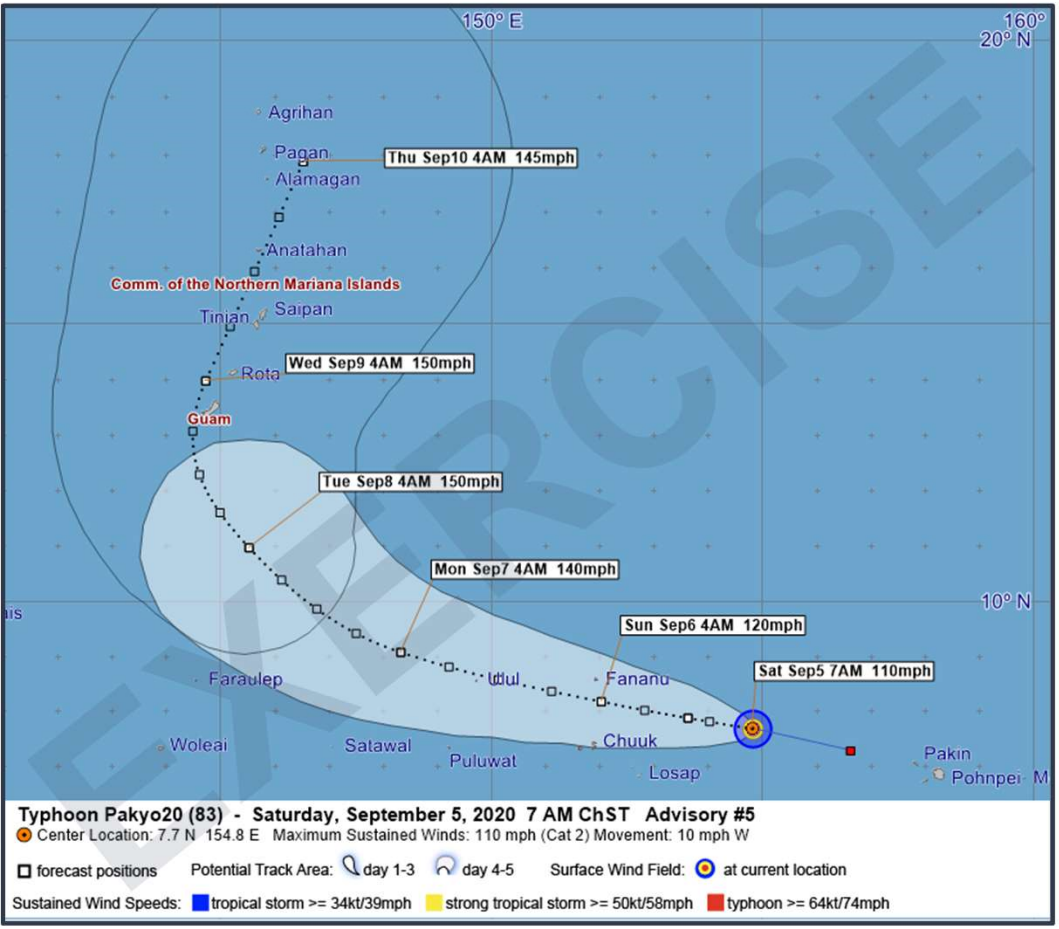


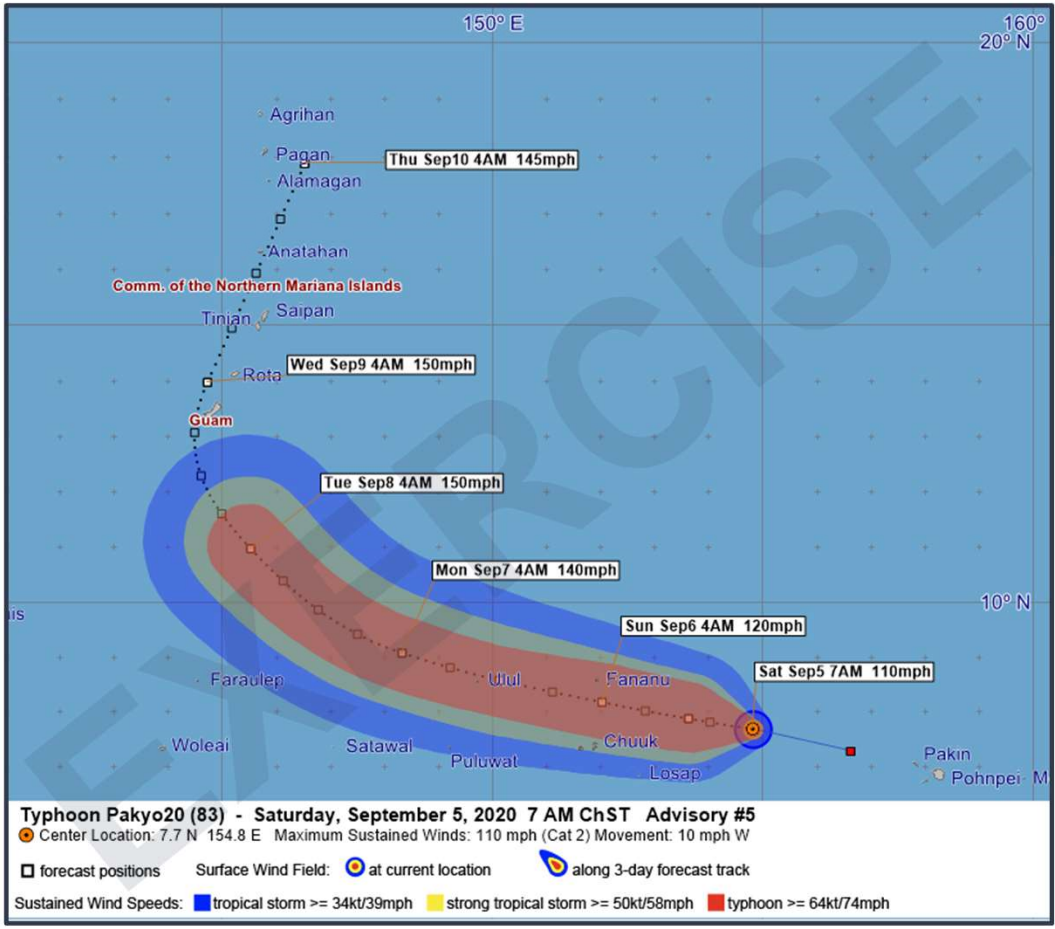
Experimental Probabilistic TC Graphics for the Western North Pacific

The National Hurricane Center (NHC) and Central Pacific Hurricane Center (CPHC) have used probabilistic TC graphics to brief decision makers and the public on approaching TCs.

Only recently have these graphics been available for the Western North Pacific (Guam Area Of Responsibility (AOR)). The CPHC produces these graphics for the Guam AOR.

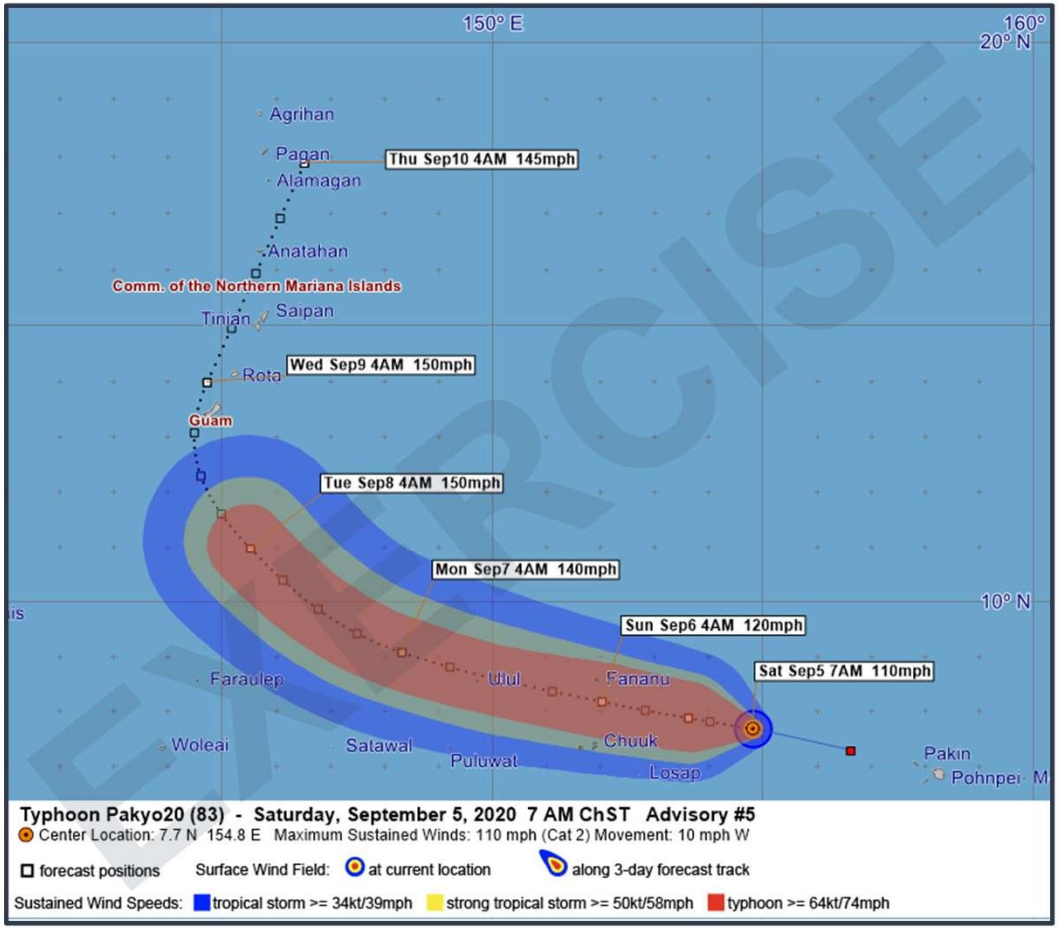
These graphics convey the ***inherent uncertainty*** in TC forecasting better than the traditional HURREVAC graphics we are used to that are based on deterministic wind radii and center position.





What the Western North Pacific is Used To:
Deterministic TC Graphics via HURREVAC

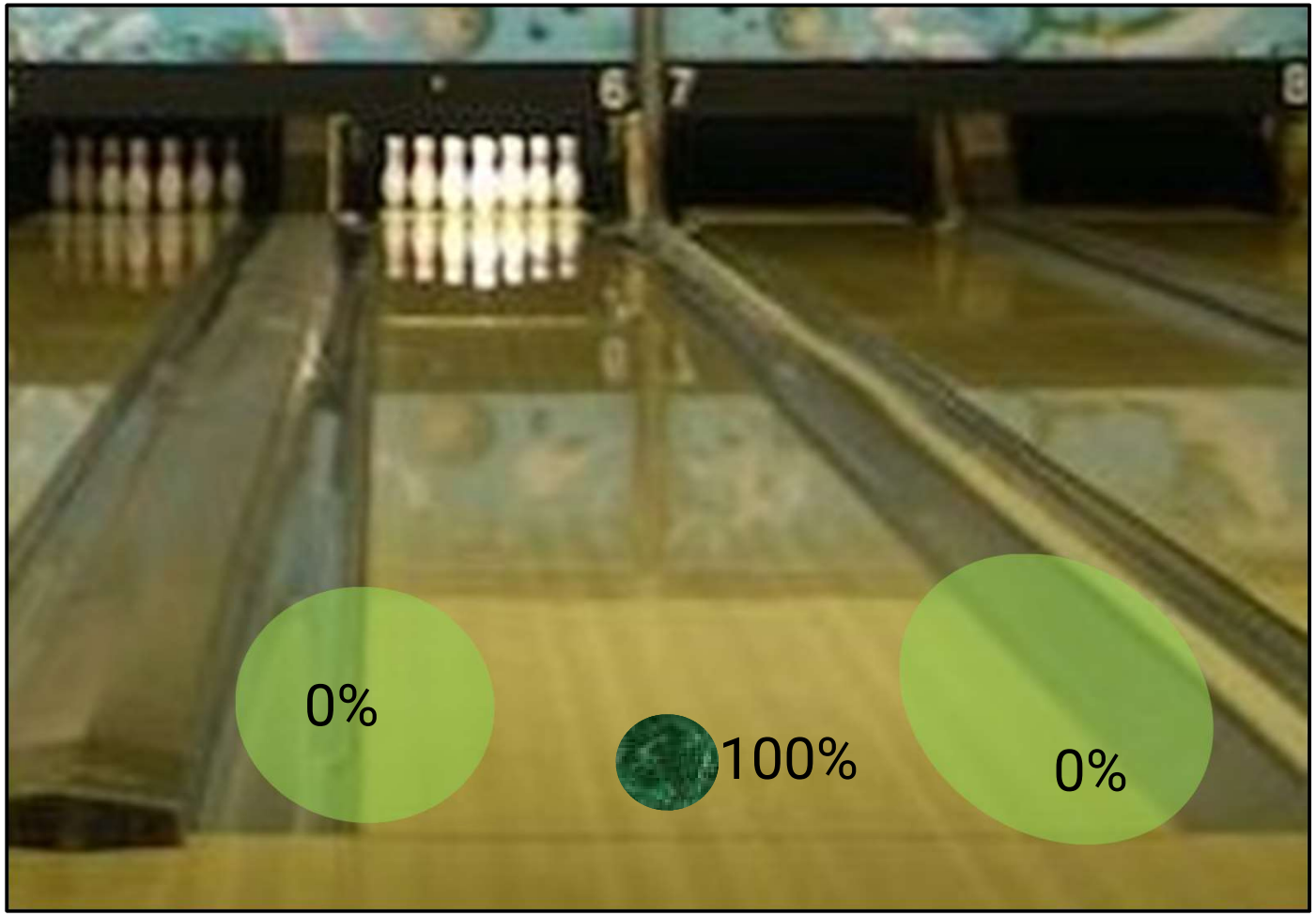
These graphics, while reflecting the latest forecast of an active TC, fail to depict the uncertainty in motion, timing, & scope of wind impacts, especially the wind graphic on the right.



How do we appropriately convey the uncertainty of…

- TC motion: faster/slower, farther east/west/south/north?
- Storm intensification? Slower/faster/ plateaued intensity?
- Timing & potential impacts to individual islands with a TC expected/likely/ possibly/probably arriving in 3-4 days?

What the Western North Pacific is Used To:
Deterministic TC Graphics via HURREVAC



Deterministic *vs.* Probabilistic Analogy

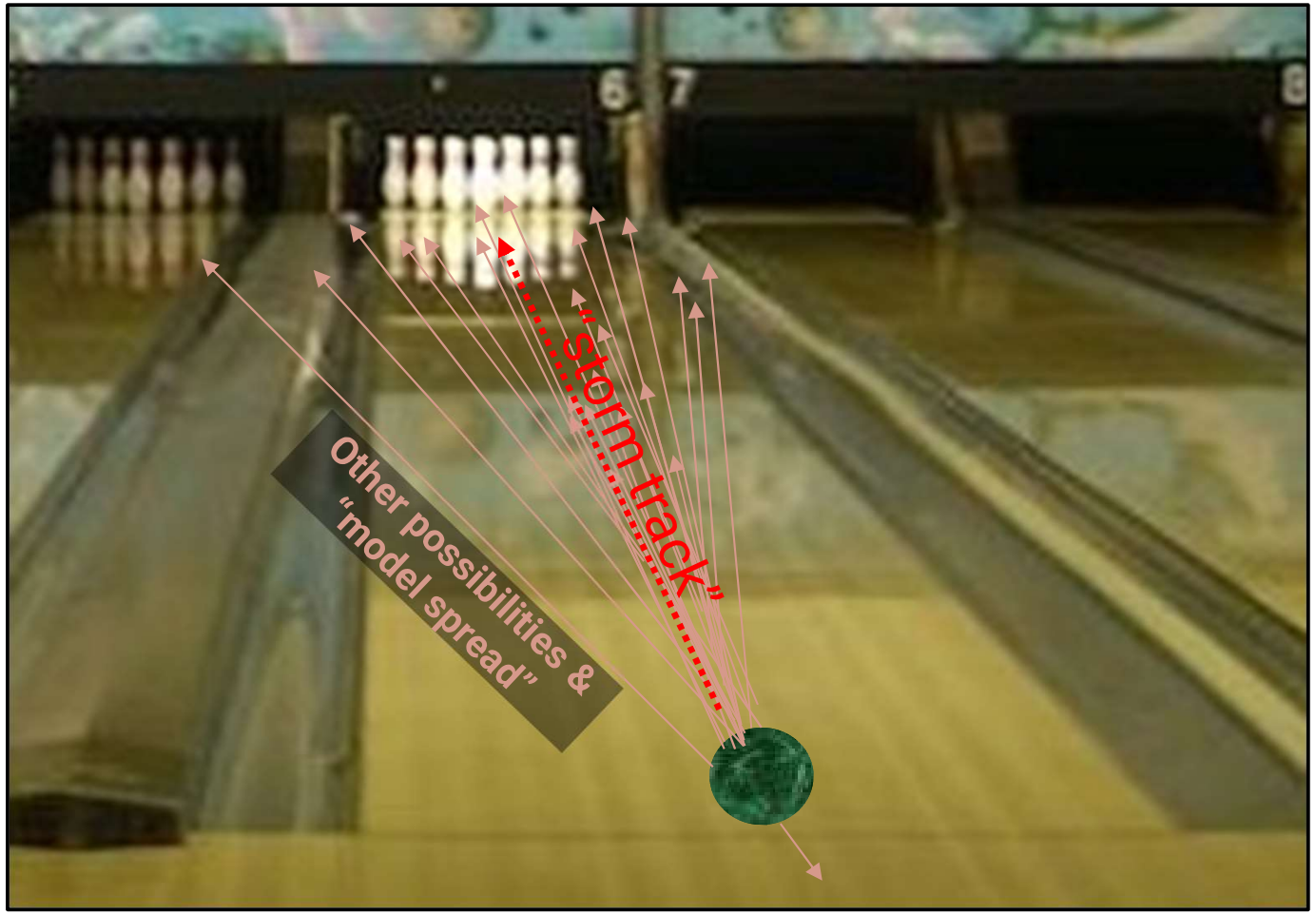
If we were to assess the probability of a bowling ball's location at the time of release, the probabilities would be a certainty (deterministic), related solely on the release point with ***no elapsed time***.

Deterministic *vs.* Probabilistic Analogy

Assessing the probability of a bowling ball's location at the end of the lane (***some amount of elapsed time***), the probabilities would be lower & more spread depending on a number of factors: travel time (speed of roll), slickness of lane (friction), etc. Now we've departed the ***deterministic*** & are now talking ***probabilistic***.

Deterministic *vs.* Probabilistic Analogy

When considering a forecast TC storm track we see the latest forecast, which is the result of a synthesis of all available guidance.

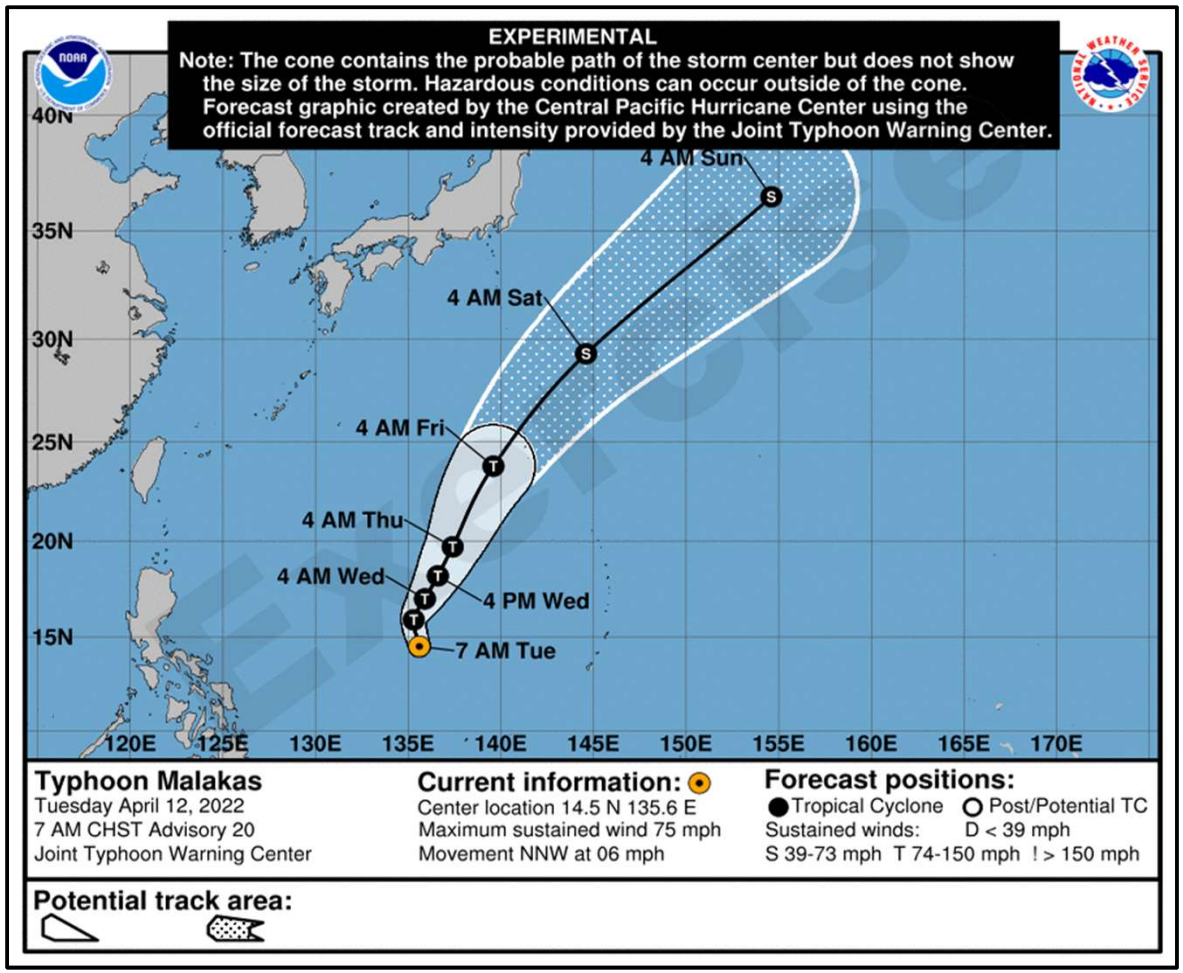


Deterministic *vs.* Probabilistic Analogy

However, the individual computer models each depict some amount of variation: speed, motion, intensity, etc. That is the ***uncertainty***. This is where probabilistic graphics come in handy to better depict the uncertainty that is inherent to TC forecasting.

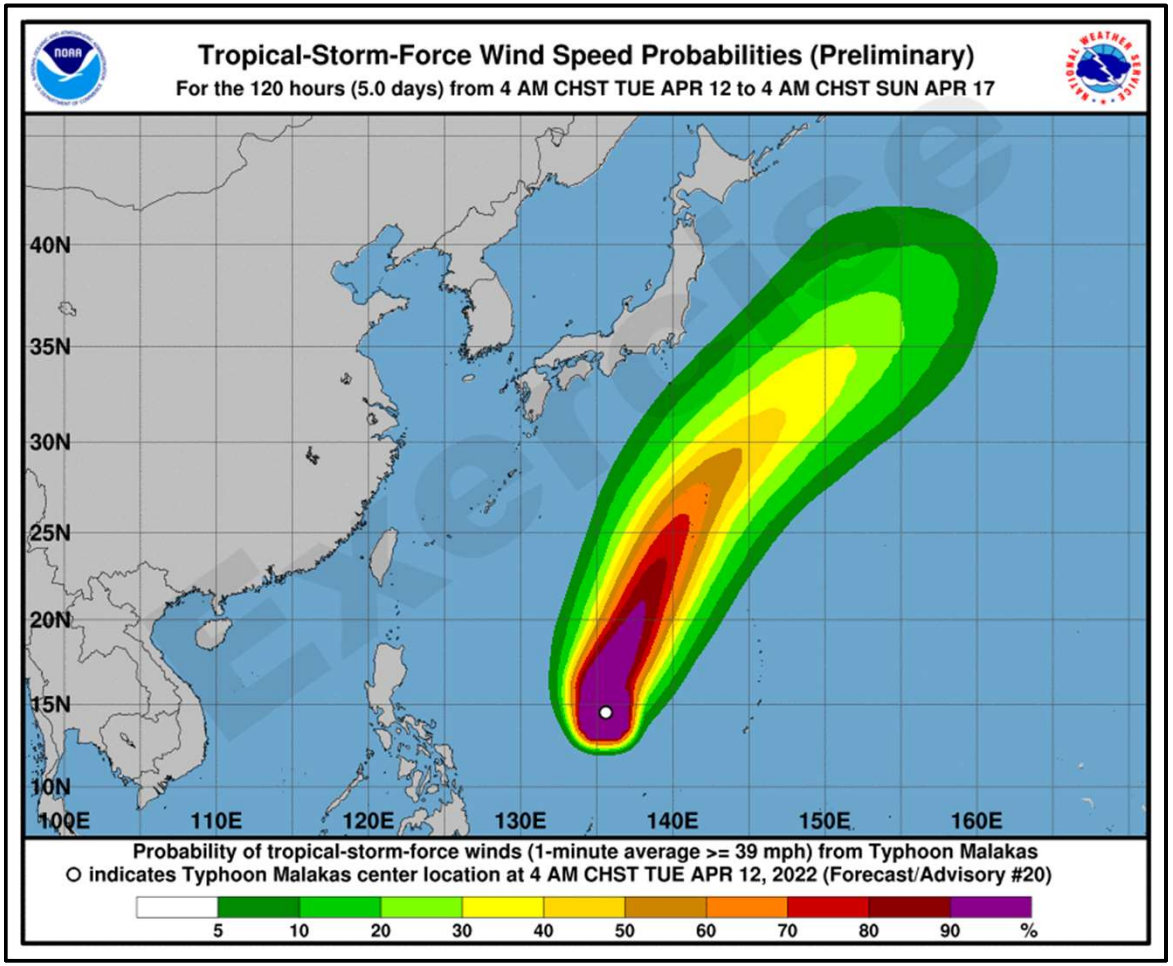
Probabilistic TC Forecast Graphics

- The familiar Track Forecast & Error Cone
- Wind Speed Probabilities
- Time of Arrival Graphics



- While the latest forecast track is reflected as the black line, the white-shaded cone reflects the area where, based on the prior 5 years of TC forecast errors, 2/3rd of TC centers have stayed within.
- 1/3 of TC centers may actually move ***outside*** the white cone
- Keep in mind, though, TC impacts (winds/rain) extend well away from the center and occur outside of the white shaded cone.

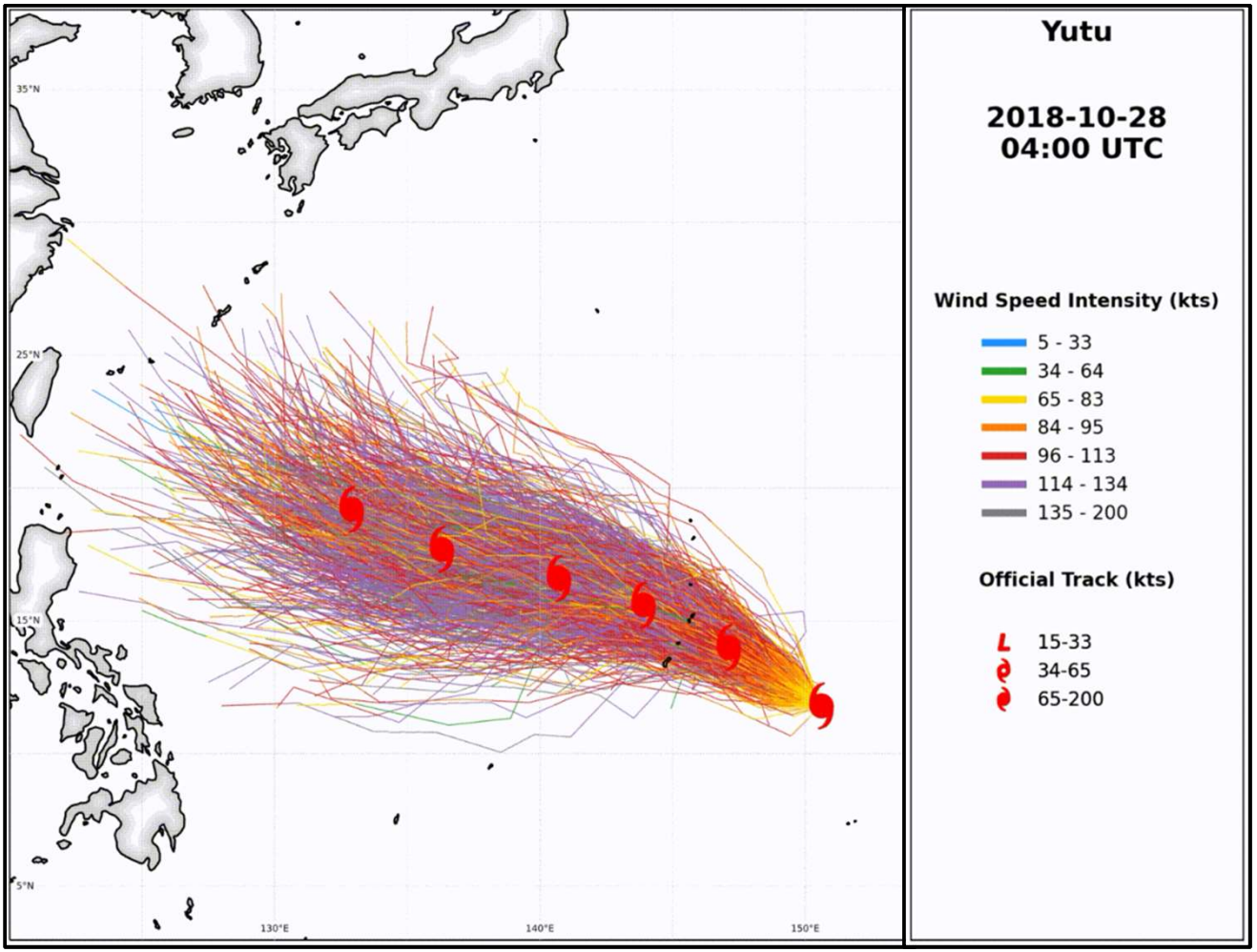
Track Forecast and Error Cone



NEW GRAPHIC:
Wind Speed Probabilities…

- Created for 34 kt, 50 kt & 64 kt *(the graphic to the left shows the probabilities for 34 kt winds)*
- Derived from 1000 simulations produced for each 6hrly TC forecast.
- Remember: always carefully read the graphic title & legend to know exactly what kind of graphic you're viewing.

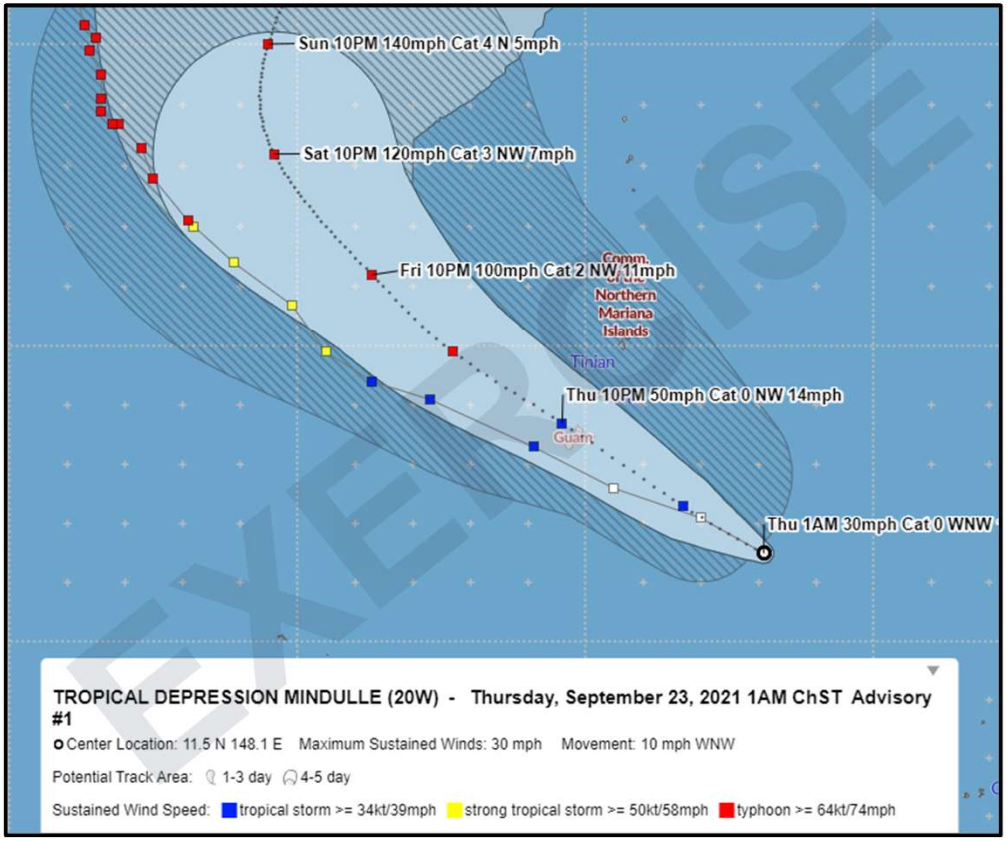
Wind Speed Probabilities



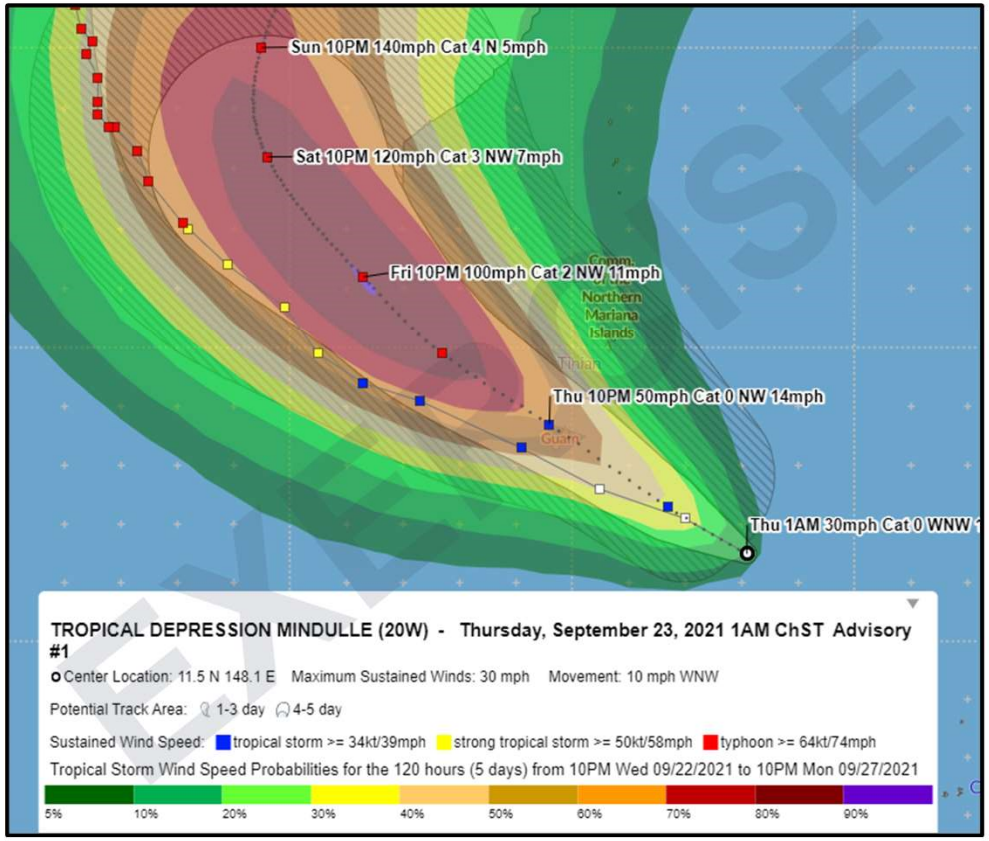
Example of the 1000 alternative tracks (Monte Carlo simulations) of 2018's Yutu

- 1000 realistic alternative tracks and intensities roughly centered on the current forecast.
- Location-based errors from the past 5yrs of TC forecast tracks & cyclone size are incorporated.
- Uses model spread to account for track forecast uncertainty.

Monte Carlo Simulations



While the cone indicates where the center of 2/3rd (67%) of TCs stays, the outer shading reflects the possible extent of TS winds (>34kt / >39mph) based on a TC motion within the cone.

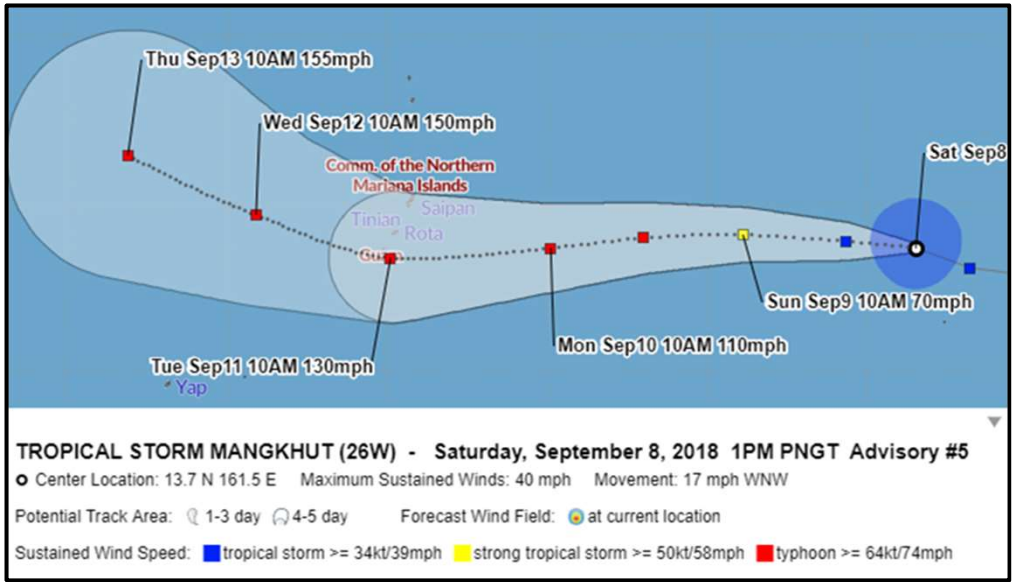


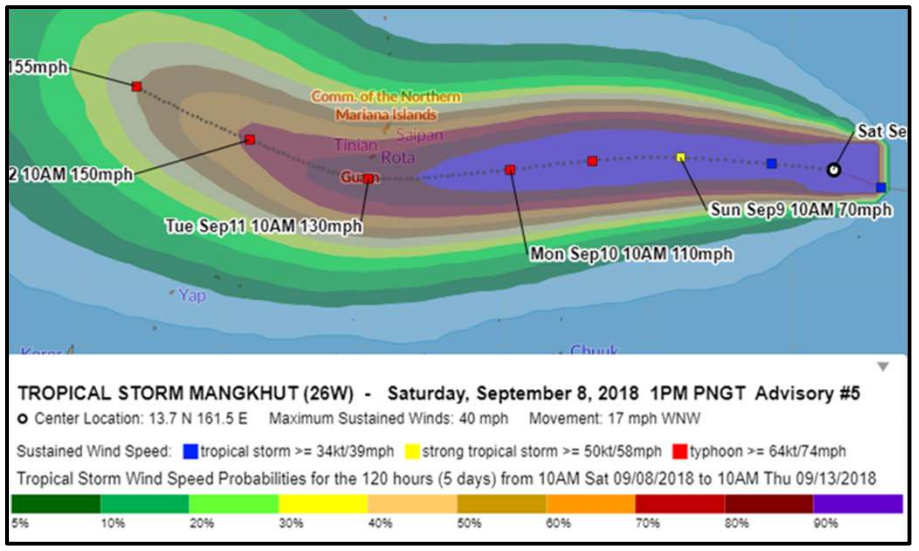
Overlaying the TS wind speed probabilities, we see that, even outside the outer shading, there is still a small possibility of TS winds, based on the modeled uncertainty.

The Cone + Fringe Winds + 5d TS Wind Speed Probabilities

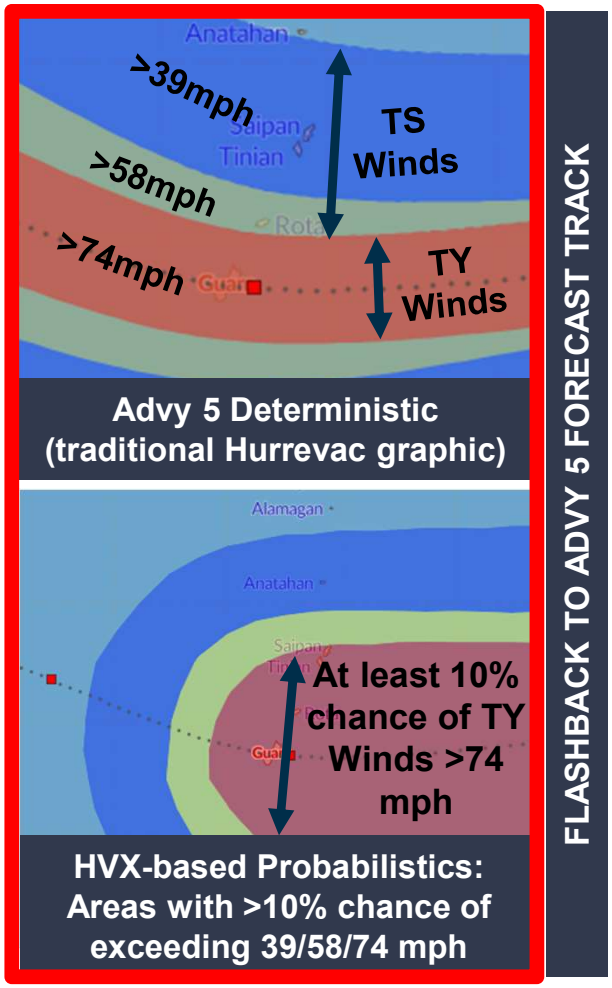
Wind Speed Probabilities

Probabilistic Graphics help to steer the focus of an event 3-5 days out to the ***possibilities, uncertainty, and general risk*** vs an inferred *deterministic* 'certainty'.





Redirect the audience focus from the center black line to the broader risk posed by the uncertainty of motion.

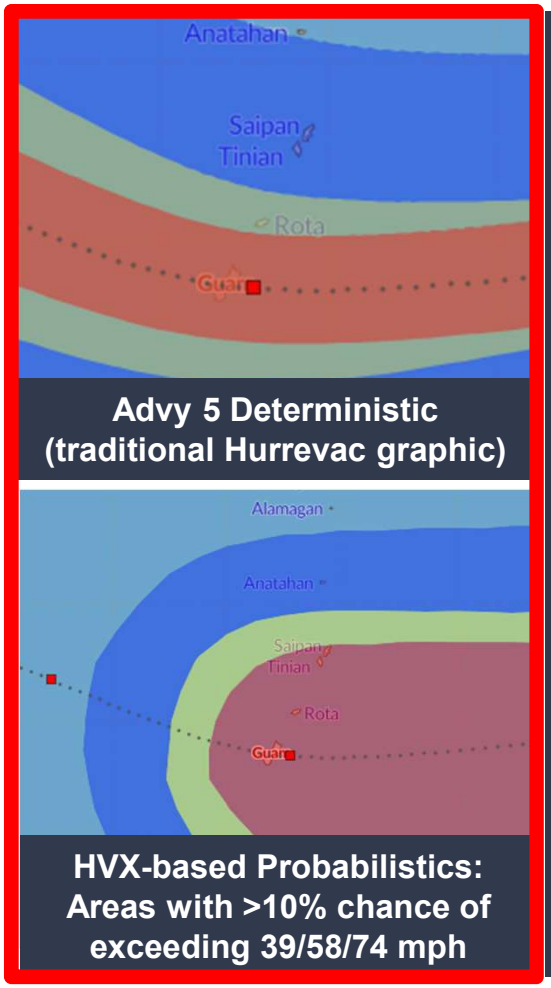


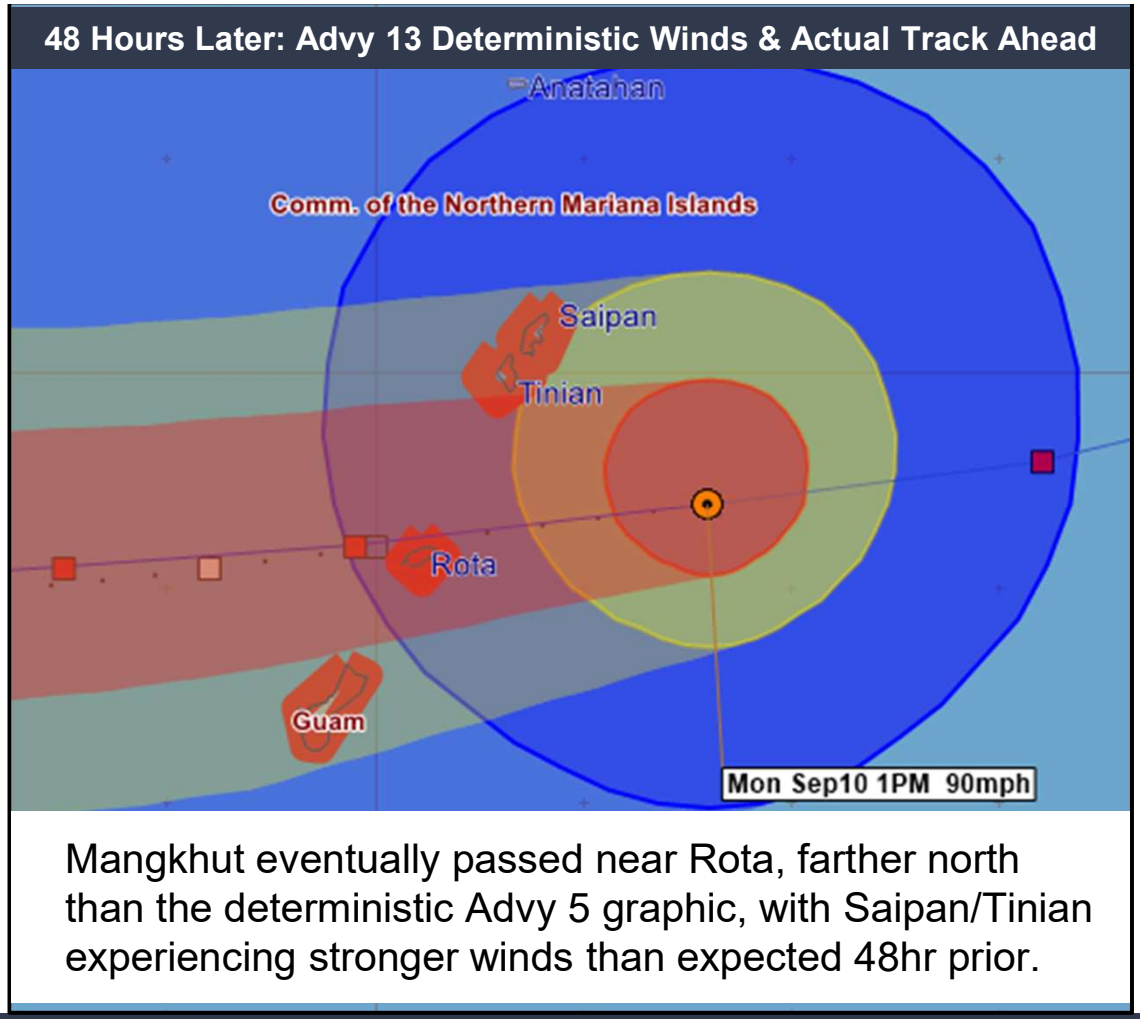
Example of Why Reliance On Only Deterministic Graphics Doesn't Tell the Whole Story: ***2018 Typhoon Mangkhut***

TOP: The deterministic track shows Mangkhut passing directly over Guam as a TY, with CNMI seeing only TS winds. Saipan/Tinian: weaker TS winds.

BOTTOM: wind speed probabilities, at the same time as the top graphic, show that even Saipan has at least a 10% chance of experiencing TY force winds based on the simulations.

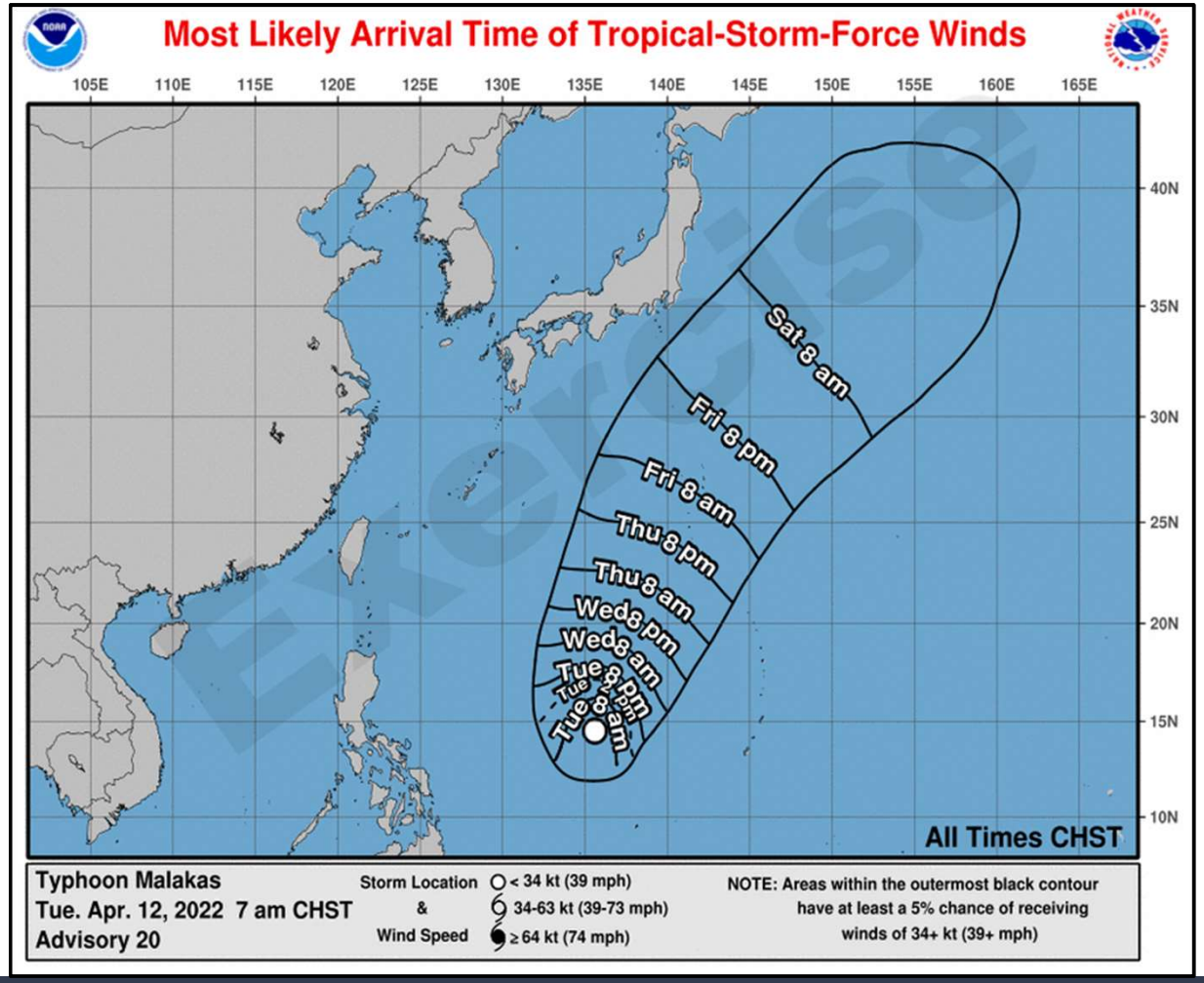
2018's Mangkhut: Marianas Passage & Approx Wind Swath





Mangkhut eventually passed near Rota, farther north than the deterministic Advy 5 graphic, with Saipan/Tinian experiencing stronger winds than expected 48hr prior.

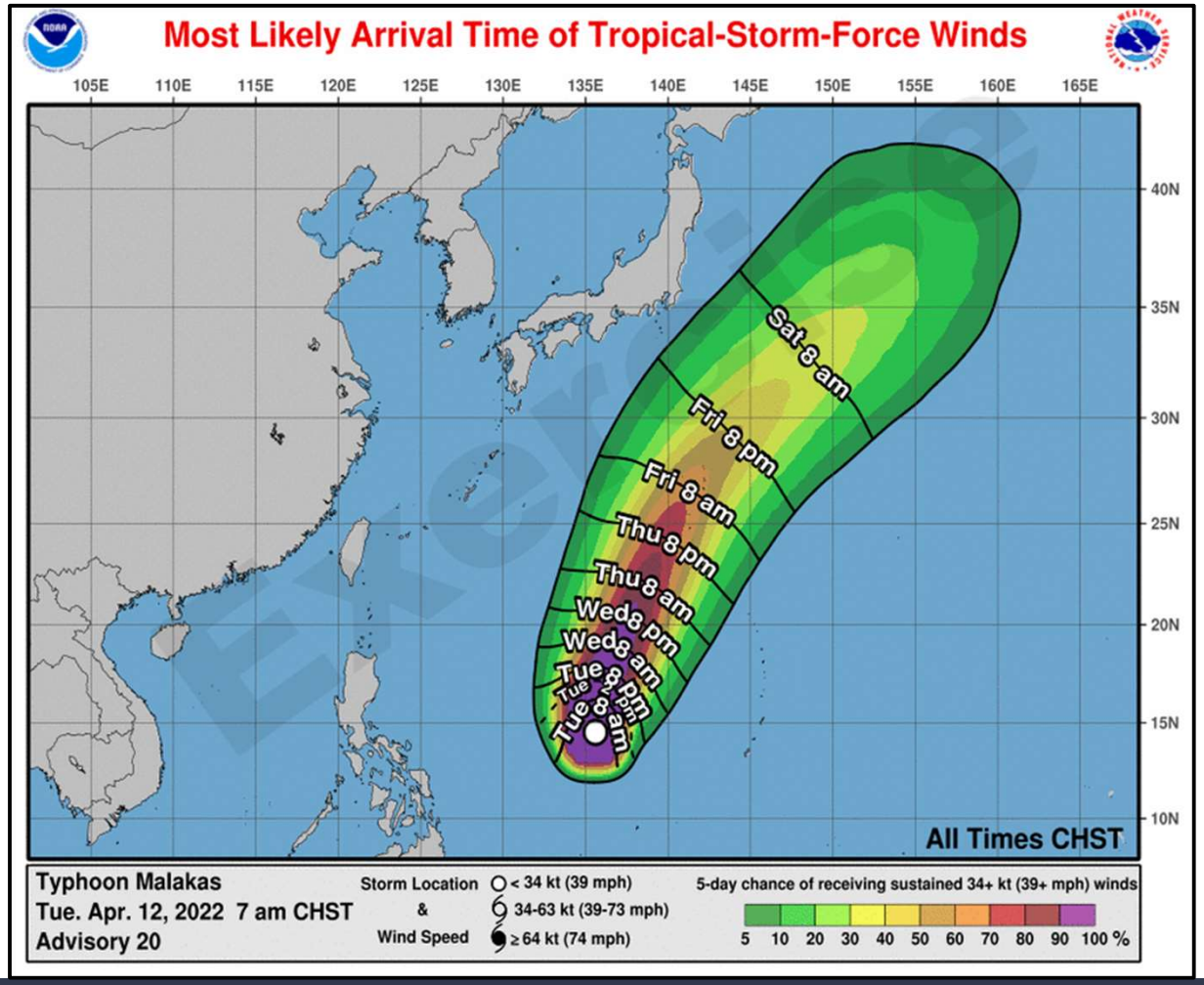
2018's Mangkhut: Marianas Passage & Approx Wind Swath



NEW GRAPHICS:
Time of Arrivals…

- Produced only for TS Force Winds (>39mph).
- Uses the same Monte Carlo method to determine the ‘times of arrival’.
- Used as a decision-making tool to determine when to begin and complete evacuations or other precautionary measures.
- Can be used to indicate the ***most likely arrival*** and ***earliest reasonable arrival*** times.

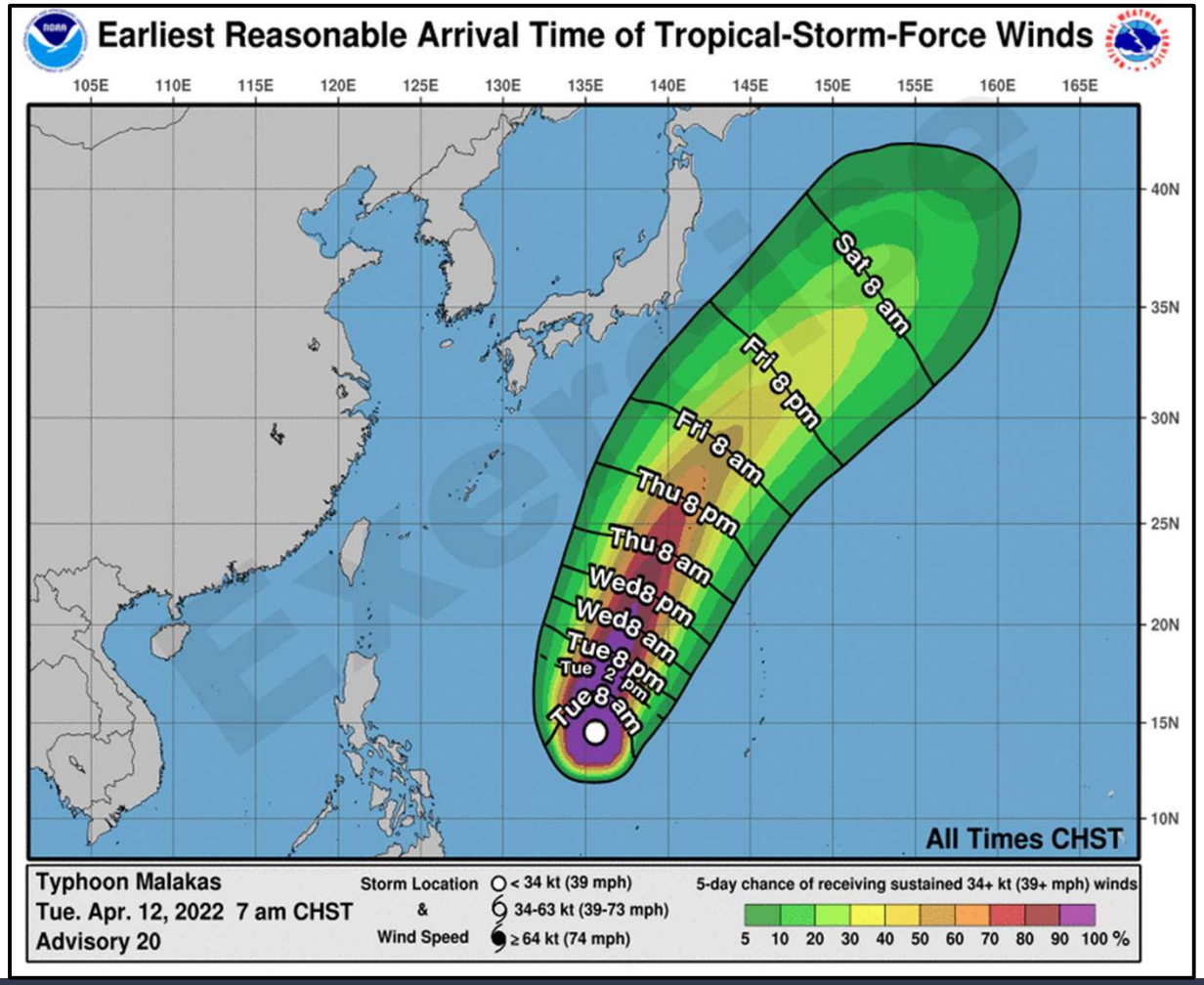
Time of Arrival



NEW GRAPHICS:
Most Likely Time of Arrival of TS Winds…

- **50%** of the 1000 alternate tracks had the onset of TS force winds at the given time (had already begun).
- More appropriate for users who are willing to risk not having completed all preparations before the storm arrives.
- Generally better for use when a TC is closing in on a location.

Time of Arrival - Most Likely



NEW GRAPHICS:
Earliest Reasonable Time of Arrival of TS Winds…

- **10%** of the 1000 alternate tracks had the onset of TS force winds at the given time.
- This is when preparations should ideally be completed for those with a low tolerance for risk.
- Perhaps best earlier in a TC event, in the pre-watch or watch phases.

Time of Arrival - Earliest Reasonable

Where can these probabilistic TC graphics be found?

The "live" page for active West Pacific TCs:

weather.gov/gum/wpacTropical

The "examples" page for a sample West Pacific TC:

weather.gov/gum/wpacTropicalExample

NATIONAL WEATHER SERVICE

Questions?

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