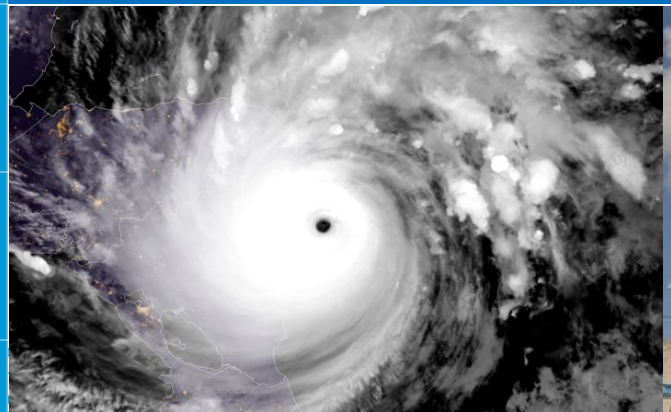
NOAA

National Weather Service

National Hurricane Center Overview

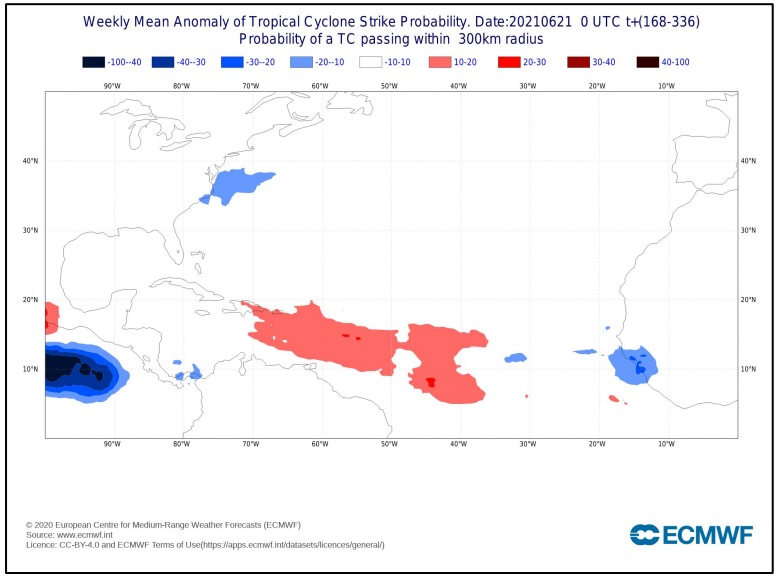
Mike Brennan

NOAA Ensemble Users Workshop
22 August 2023



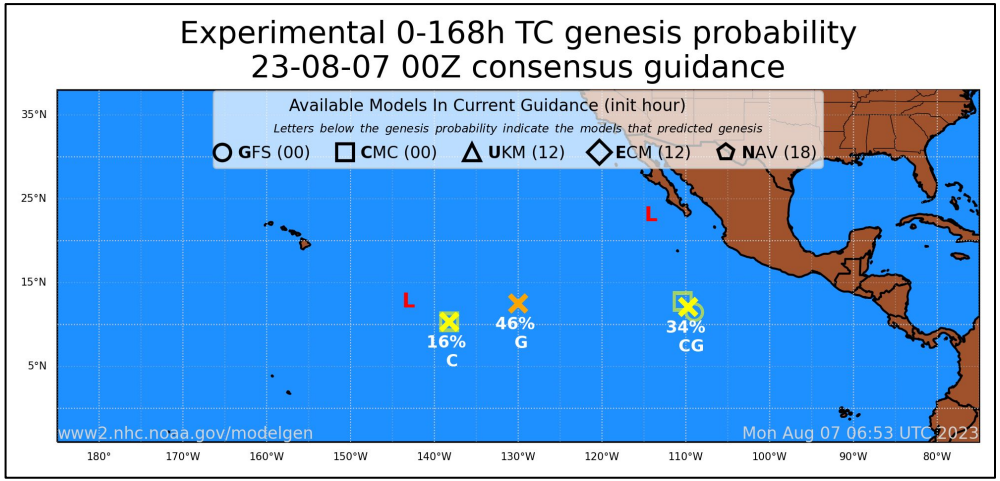
Current Use of Ensemble Guidance

Genesis/Track Guidance



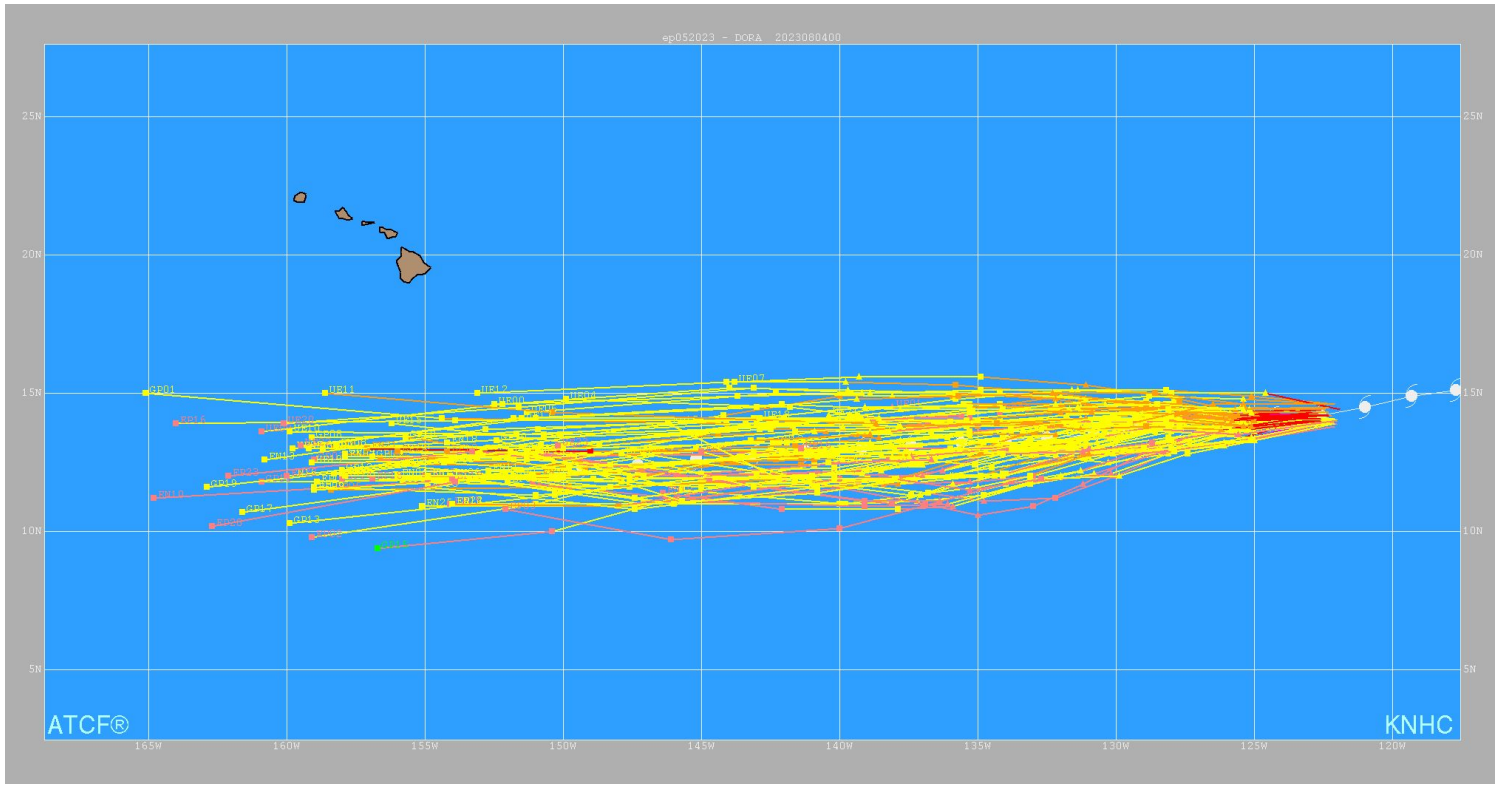
ECMWF ensemble weekly TC strike probabilities

7-day TC genesis probabilities based on calibrated multi-deterministic global model consensus

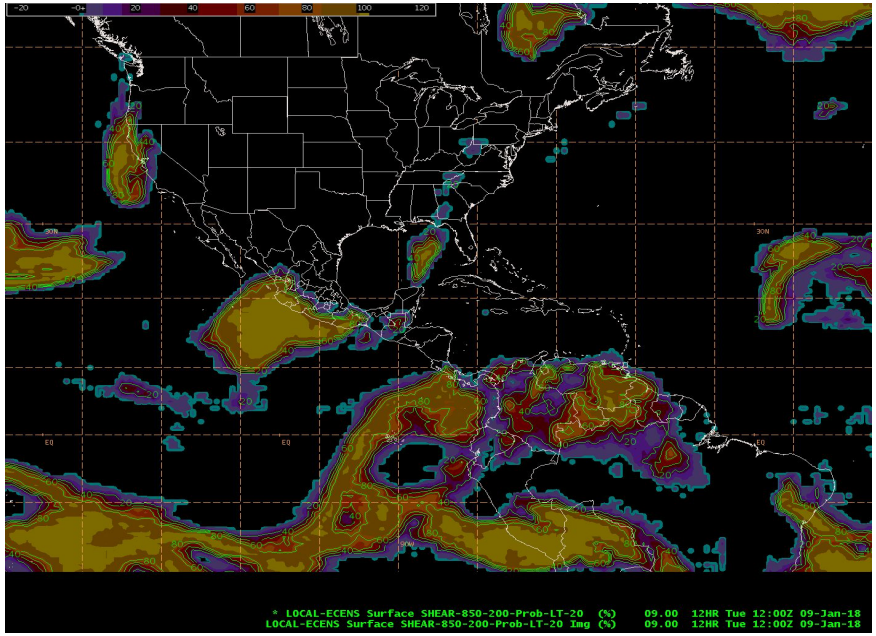


Track/Intensity Guidance

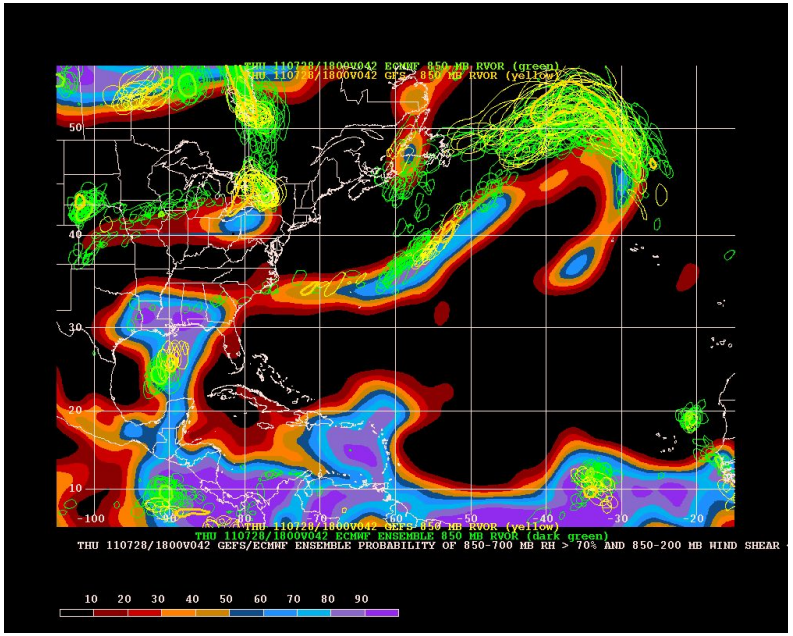
GEFS, UKMET, and ECMWF ensemble tracks for Dora color coded by forecast intensity



TC Environmental Parameters



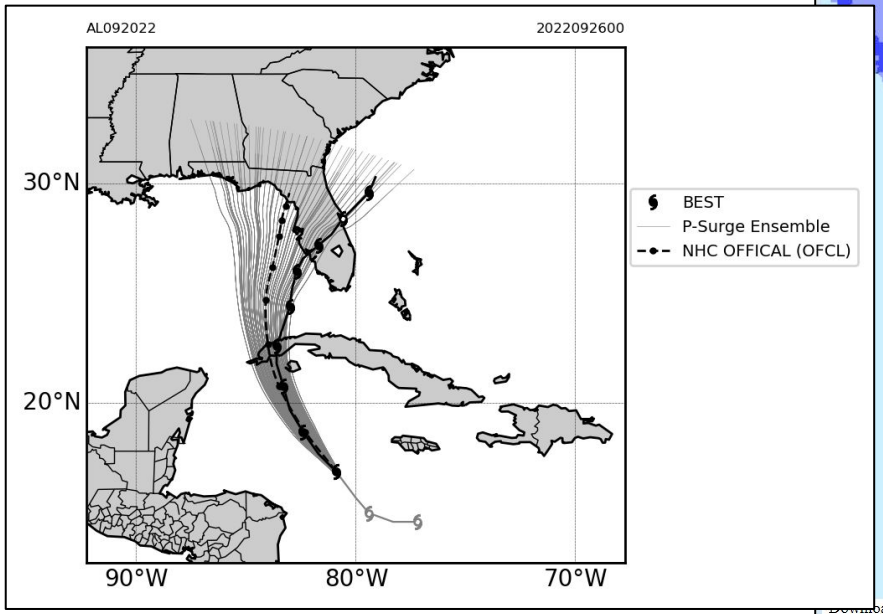
Probability of Vertical Wind Shear ≤ 20kt from ECMWF Ensemble

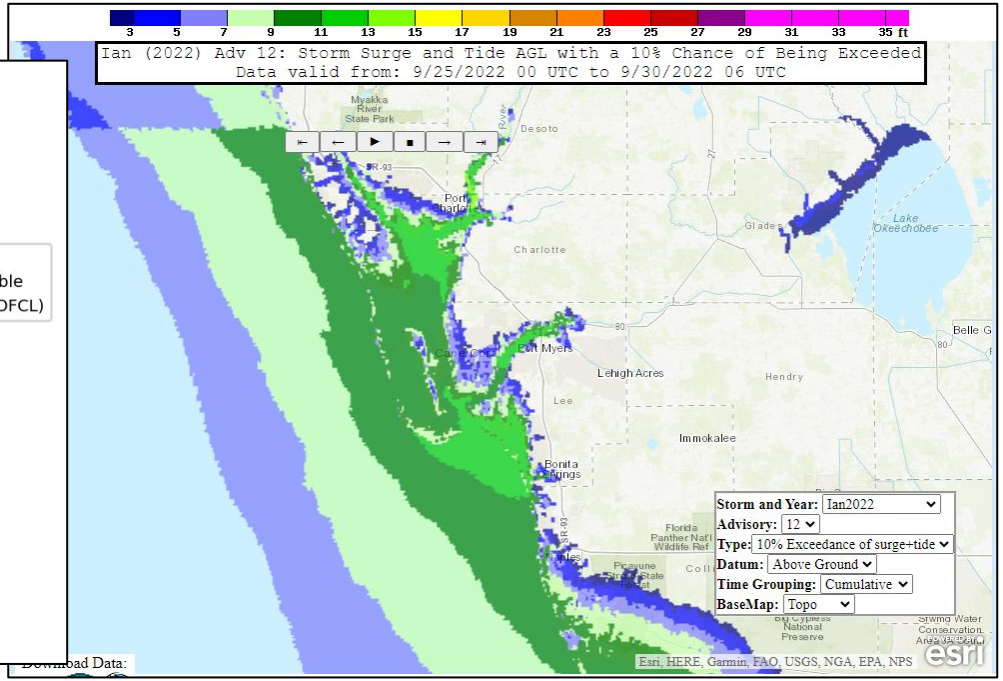


Probability of Vertical Wind Shear ≤ 20kt and 700-850 mb RH > 70% from ECMWF and GEFS ensembles

PSurge

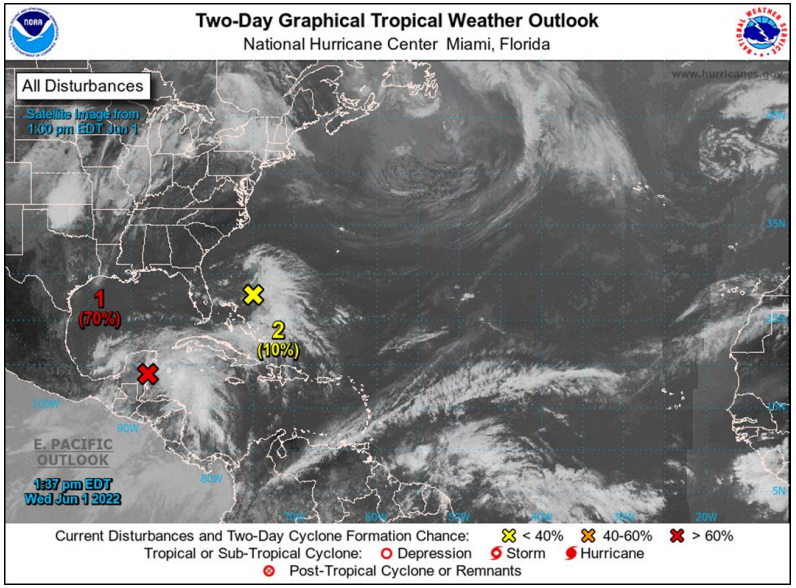
PSurge 10% Exceedance Height from Hurricane Ian Advisory 12

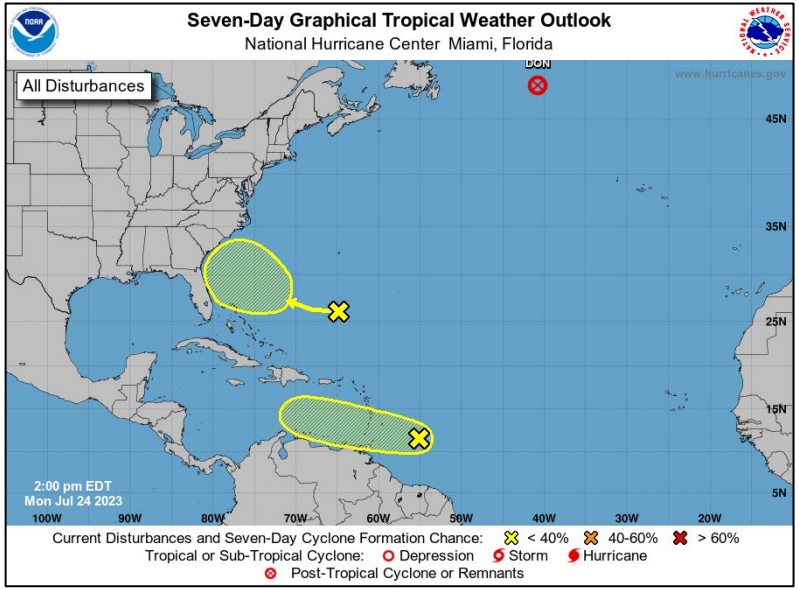




Current Probabilistic Products Supporting IDSS

Tropical Weather Outlook

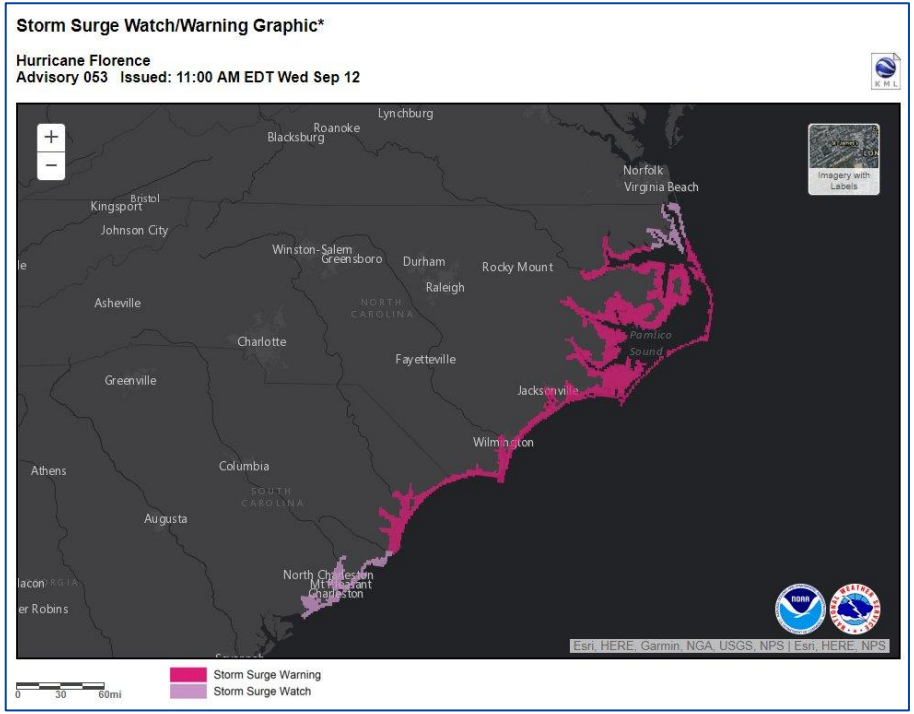




2-day and 7-day Tropical Cyclone Genesis Probabilities

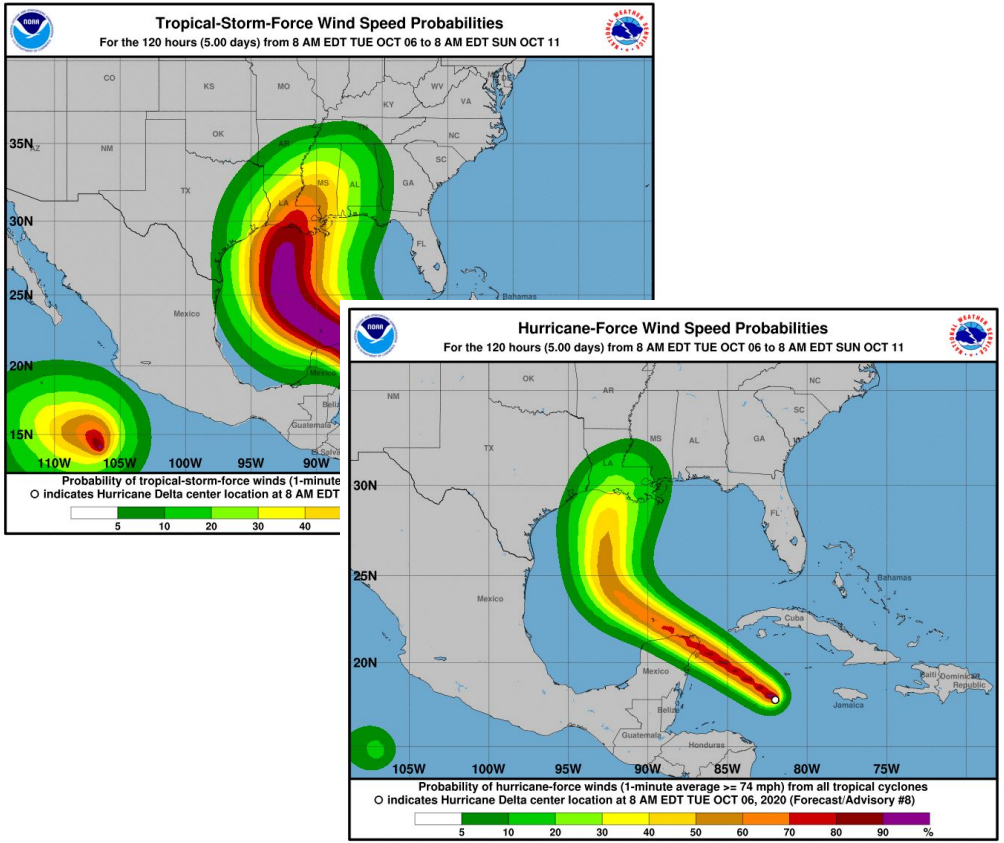
Storm Surge Watch/Warning

- Highlights areas with a significant risk of life-threatening inundation from storm surge
- Based on probabilistic storm surge model (PSurge, PETSS) output
- First guess for watch/ warning is 10% chance of ≥ 3 ft. inundation AGL
- Collaborated between NHC and WFO forecasters

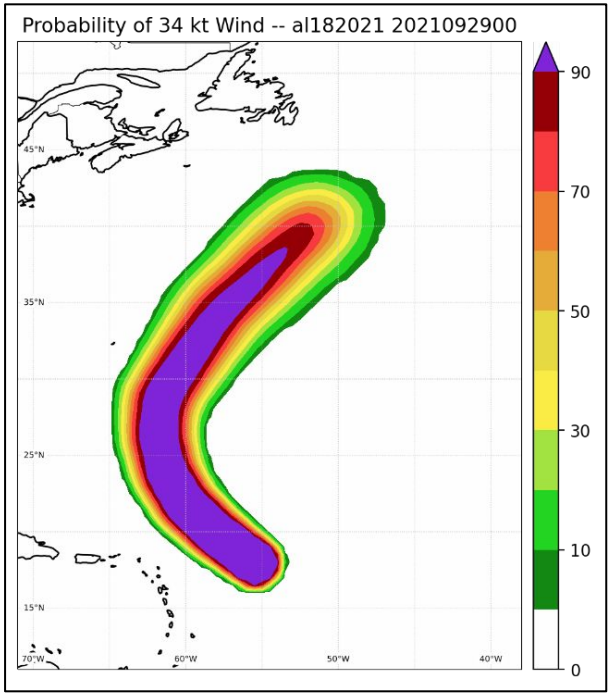


Wind Speed Probabilities

- Location specific chances of 34, 50, and 64-kt sustained winds over the next 5 days
- Created using 1,000 “realizations” centered around official NHC forecast and typical forecast track, intensity, and size uncertainties

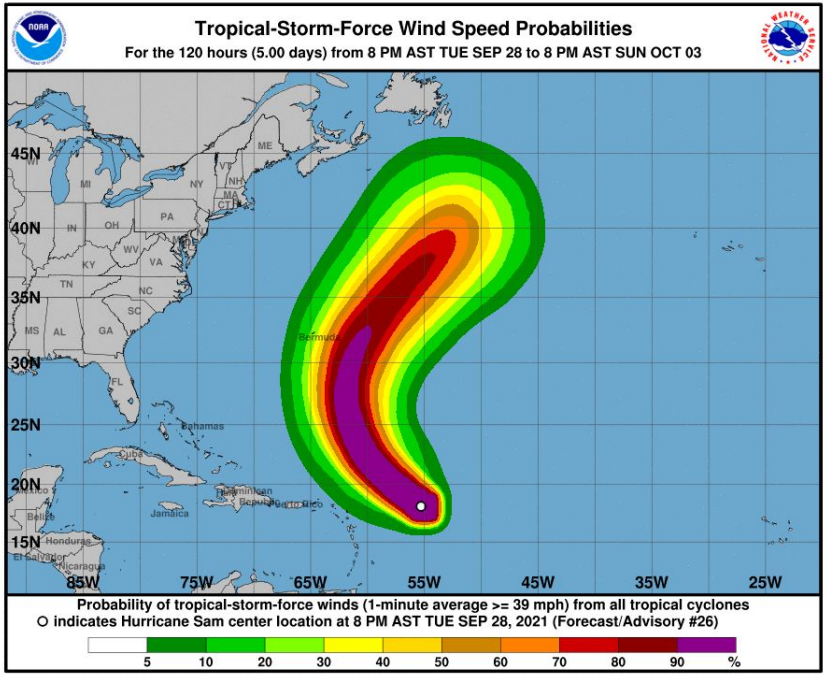


Possible Future WSP Products



Experimental version of 34-kt WSP with dynamical ensemble information

34-kt WSP for Bermuda: < 5%

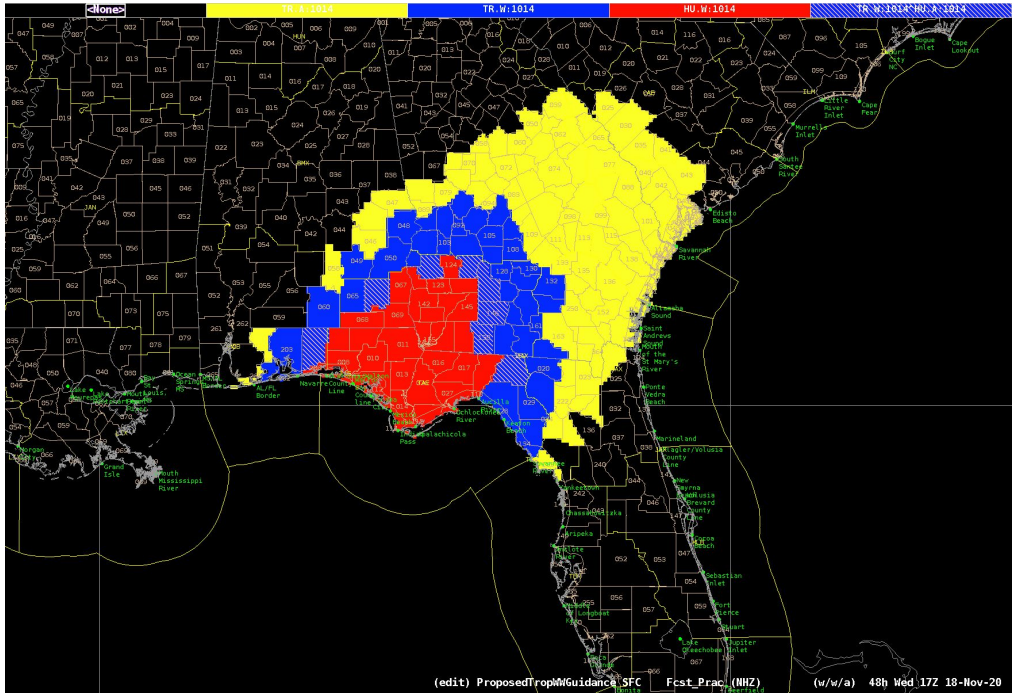


Operational 34-kt WSP using statistical error information

34-kt WSP for Bermuda: 25%

Wind Hazard Recommender

- Uses cumulative 34-kt (TS) and 64-kt (HU) wind speed probabilities and thresholds to provide recommended TS/HU watches/warnings for inland zones to WFOs
- Will be operational in 2024



WHR Output for Hurricane Michael (2018)

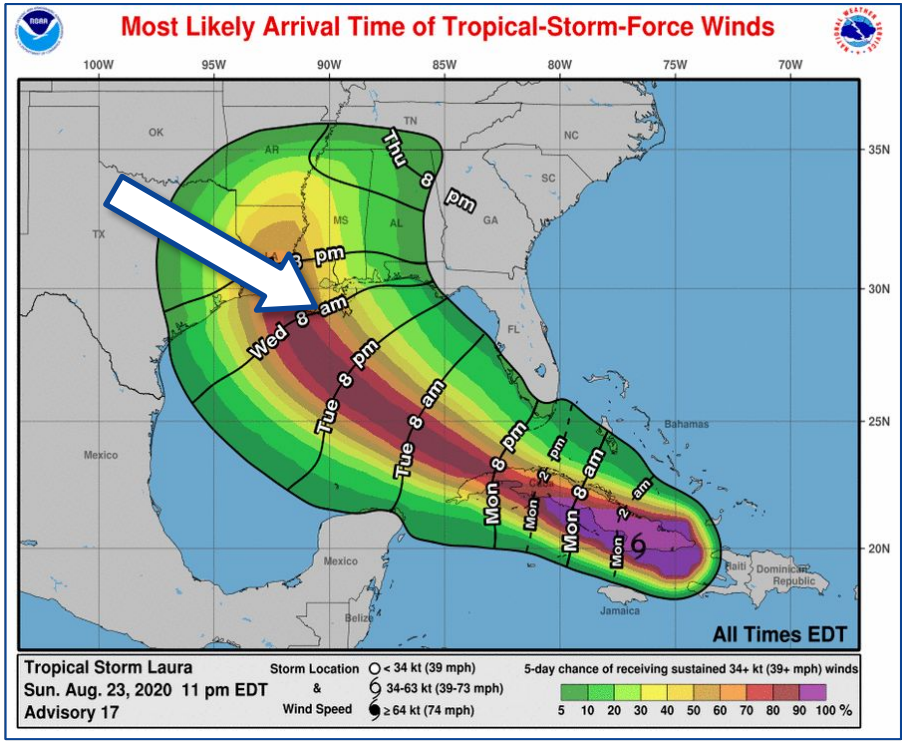
Time of Arrival of 34-kt Winds

34-kt Time of Arrival graphics provide range of TS-force wind arrival times, accounting for typical track, intensity, and size uncertainties

Earliest Reasonable
- 10% chance of onset
- Most conservative timing
- **Tuesday 8 PM EDT**

Most Likely
- 50% chance of onset
- Equally likely before as after
- **Wednesday 8 AM EDT**

Range of wind arrival: 12 h
Tuesday 8 PM-Wednesday 8 AM



Probabilistic Rapid Intensification Guidance

Based on statistical-dynamical output from SHIPS model

RI probabilities from various methods also included

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     ** 2023 E. PACIFIC RI INDEX EP052023 DORA       08/01/23  18 UTC **
 (SHIPS-RII PREDICTOR TABLE for 30 KT OR MORE MAXIMUM WIND INCREASE IN NEXT 24-h)

    Predictor                    Value   RI Predictor Range  Scaled Value(0-1) % Contribution
 POT = MPI-VMAX (KT)          :  105.9     36.9  to  148.5        0.62           18.9
 12 HR PERSISTENCE (KT)       :   20.0    -22.0  to   44.0        0.64           16.8
 MULTI-LAYER SHEAR (KT)       :   13.9     30.9  to    7.7        0.73           15.2
 BL DRY-AIR FLUX (W/M2)       :  305.8    816.2  to  -81.4        0.57          -13.4
 D200 (10**7s-1)              :    2.4    -33.0  to  159.5        0.18            3.4
 MAXIMUM WIND (KT)            :   55.0     22.5  to  132.0        0.93           16.5
 STD DEV OF IR BR TEMP        :   10.5     37.8  to    2.1        0.76           11.2
 HEAT CONTENT (KJ/CM2)        :   23.4      2.7  to  103.4        0.21            1.8
 %area of TPW <45 mm upshear  :    0.0     49.8  to    0.0        1.00            5.6
 2nd PC OF IR BR TEMP         :   -0.6      2.2  to   -2.3        0.62            0.2

 SHIPS Prob RI for 20kt/ 12hr RI threshold=  59% is   9.3 times climatological mean ( 6.3%)
 SHIPS Prob RI for 25kt/ 24hr RI threshold=  77% is   5.9 times climatological mean (12.5%)
 SHIPS Prob RI for 30kt/ 24hr RI threshold=  76% is   9.0 times climatological mean ( 8.6%)
 SHIPS Prob RI for 35kt/ 24hr RI threshold=  74% is  12.3 times climatological mean ( 6.2%)
 SHIPS Prob RI for 40kt/ 24hr RI threshold=  54% is  12.9 times climatological mean ( 4.2%)
 SHIPS Prob RI for 45kt/ 36hr RI threshold=  68% is  10.2 times climatological mean ( 6.7%)
 SHIPS Prob RI for 55kt/ 48hr RI threshold=  46% is   7.8 times climatological mean ( 5.9%)
 SHIPS Prob RI for 65kt/ 72hr RI threshold=  11% is   2.3 times climatological mean ( 4.7%)

Matrix of RI probabilities
-------------------------------------------------------------------------------
  RI (kt / h)  | 20/12 | 25/24 | 30/24 | 35/24 | 40/24 | 45/36 | 55/48  |65/72
-------------------------------------------------------------------------------
   SHIPS-RII:    58.6%   77.3%   76.2%   74.1%   54.3%   68.1%   45.9%   10.8%
    Logistic:    53.8%   62.6%   52.9%   39.6%   28.7%   15.5%    5.1%    8.6%
    Bayesian:    19.0%   50.8%    6.8%    3.6%   11.5%    4.0%    0.5%    0.0%
   Consensus:    43.8%   63.6%   45.3%   39.1%   31.5%   29.2%   17.1%    6.5%
       DTOPS:    59.0%   79.0%   75.0%   73.0%   59.0%   74.0%   56.0%   23.0%
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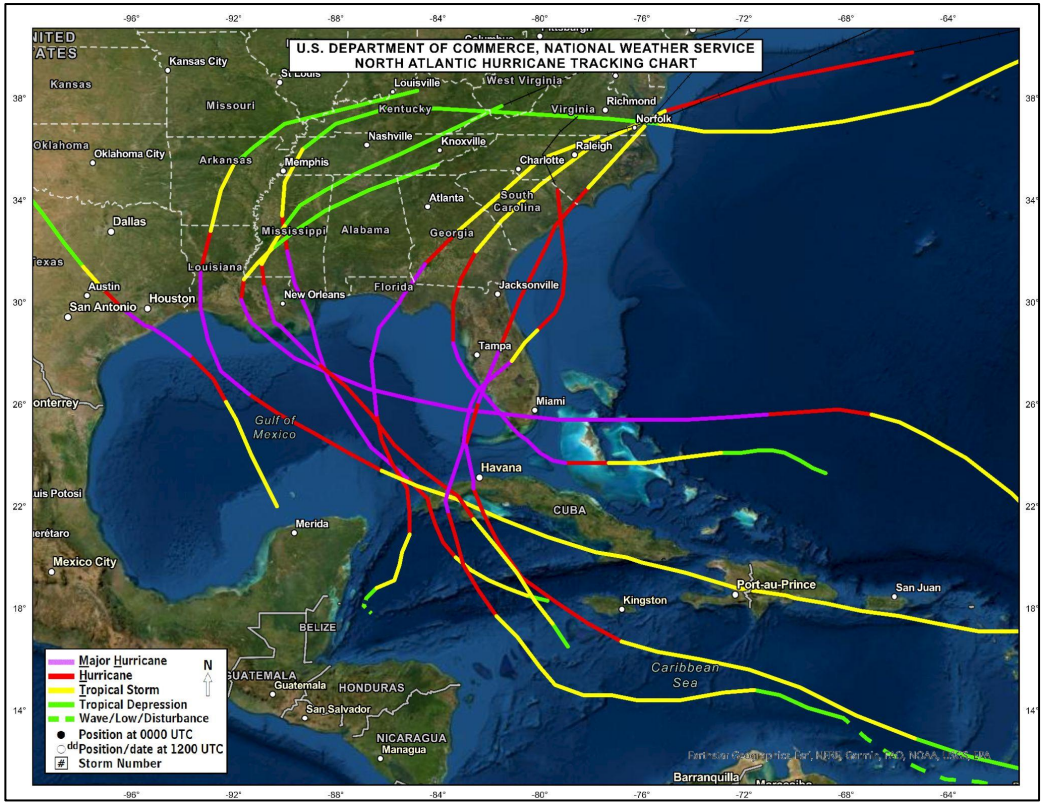
Short Lead Time – Major Risk for Florida

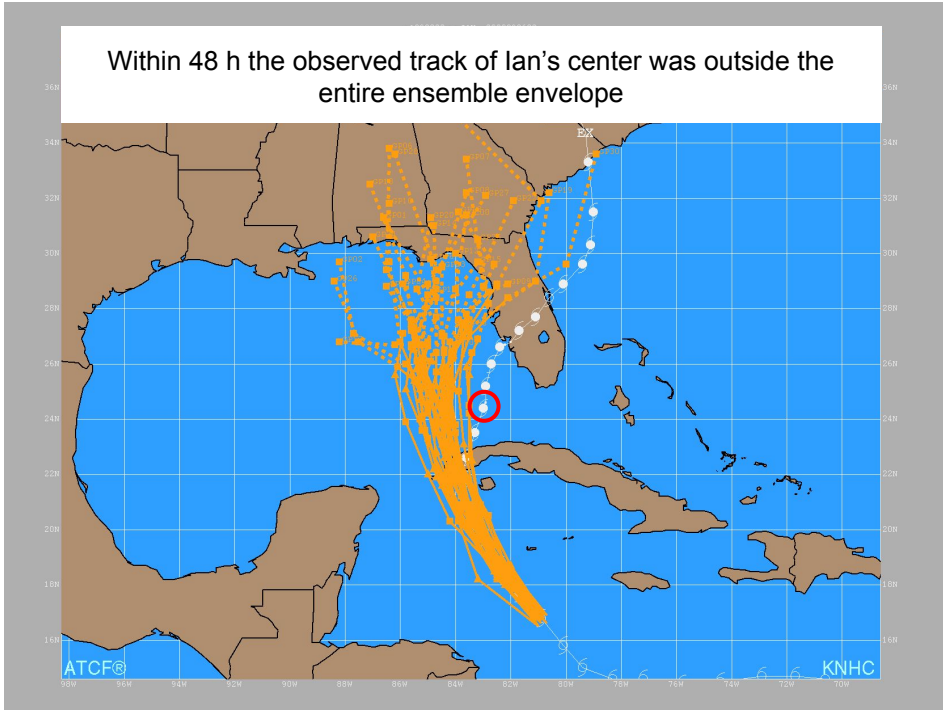
The Nation's Strongest Hurricanes (150+ MPH) in the last 100 years were all Tropical Storms 3 Days Before Landfall

1932 – Storm 2
1935 – Labor Day
1969 – Camille
1992 – Andrew
2004 – Charley
2018 – Michael
2020 – Laura
2021 – Ida
2022 – Ian



Current Gaps

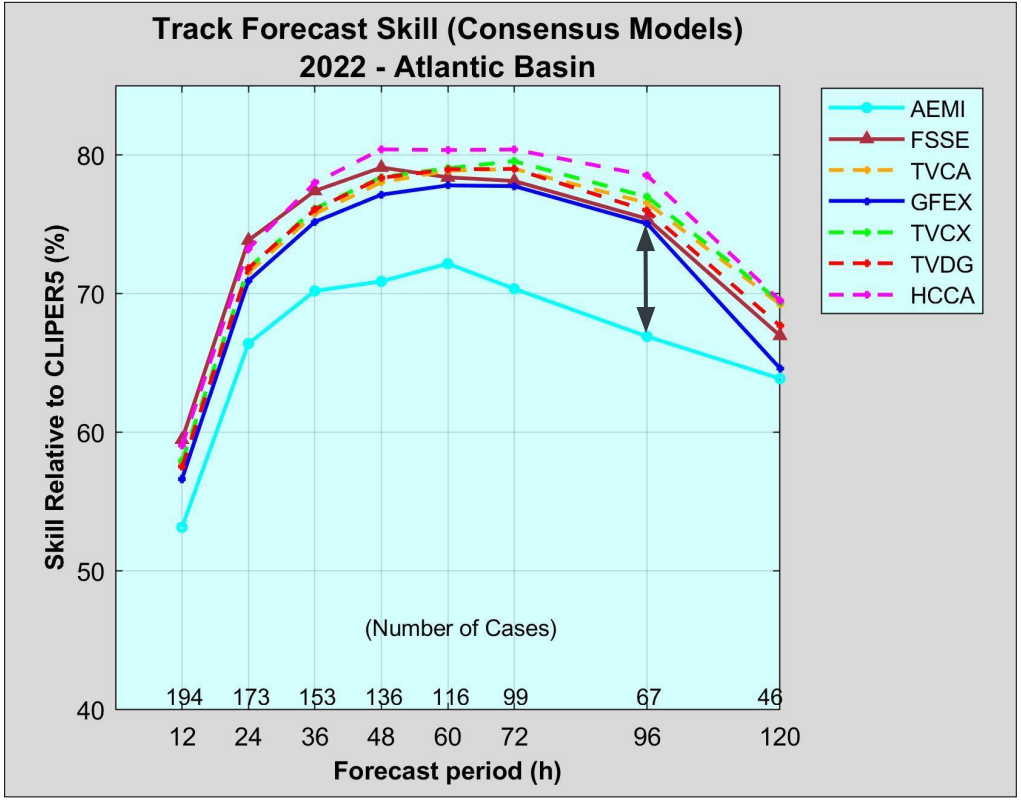
- Current probabilistic hazard products (wind, surge) driven by climatological uncertainty information based on historical forecast errors
- Lack of a dynamical regional hurricane model ensemble system that can represent intensity and structure
- Global ensembles are still too under-dispersive for track and lack spatial resolution to properly represent TC intensity and structure



Under-dispersion of GEFS members for track of Hurricane Ian (2022)

Current Gaps

- Consensus approaches blending deterministic models still out-perform single model ensembles for TC track
- Includes simple (e.g., TVCA) and corrected consensus (e.g., HCCA, FSSE) approaches

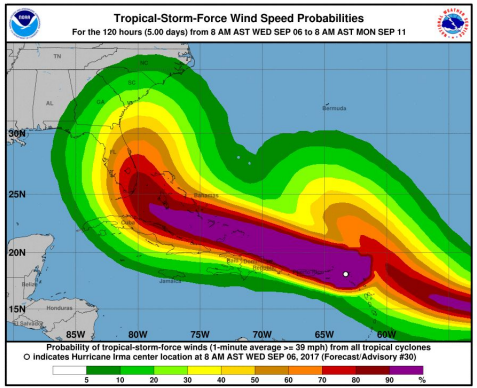


Looking Ahead

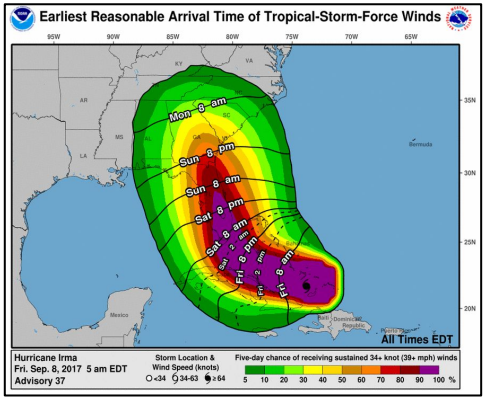
- EMC is running a 21-member experimental HAFS ensemble in the cloud (HERC) this season
- Testing underway incorporating dynamical ensemble information into Wind Speed Probabilities
- For more see Wallace Hogsett's presentation later today

TC Wind and Surge Hazard Products

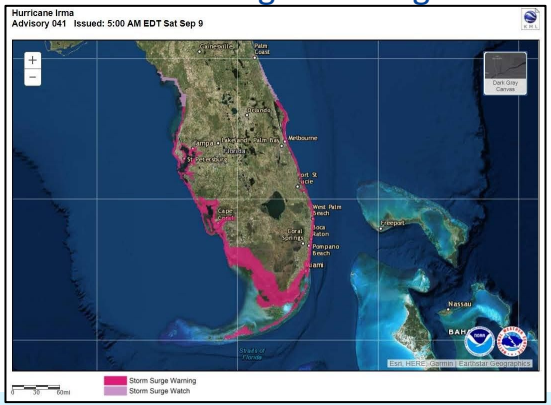
Wind Speed Probabilities



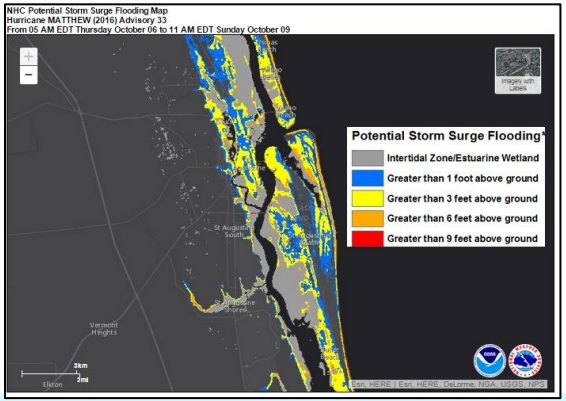
Time of Arrival of TS Winds



Storm Surge Warnings

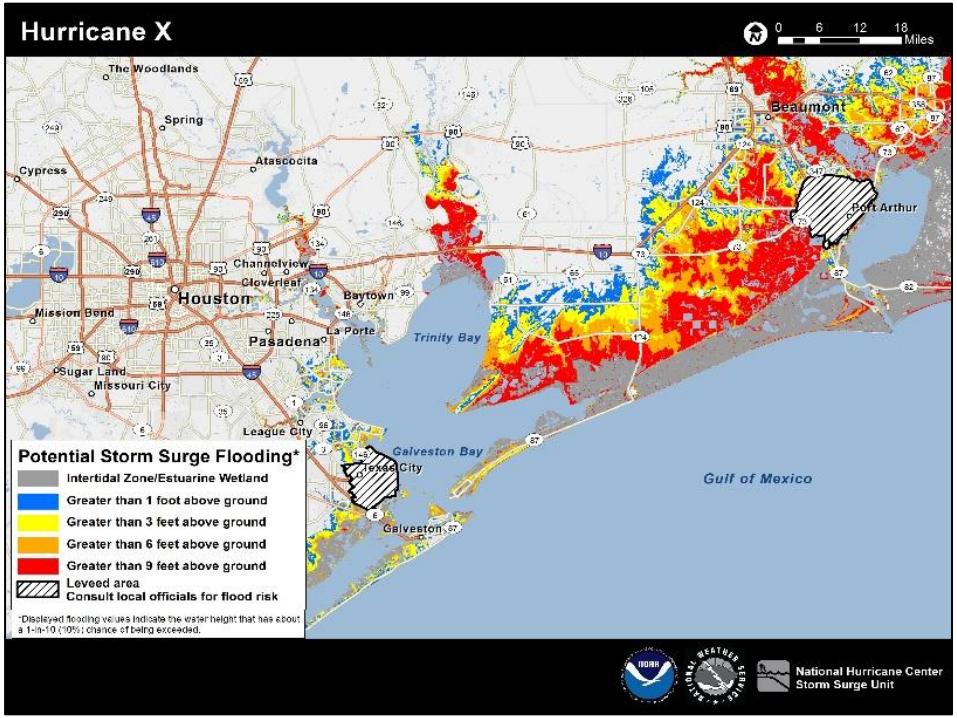


Storm Surge Potential Inundation



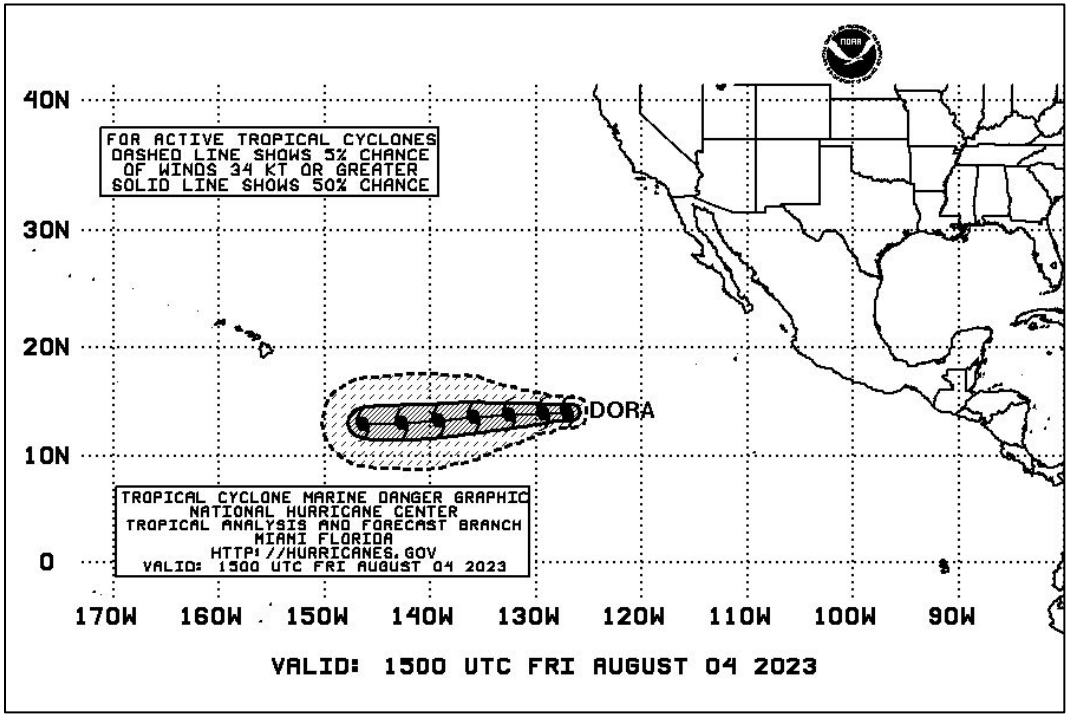
Potential Storm Surge Flooding Map

- Provides a quantitative risk assessment for decision makers
- Shows height above ground that the water could reach
  - Depicts the reasonable worst-case scenario at any individual location
  - Shows inundation levels that have a 10% chance of being exceeded



Marine TC Danger Graphic

- Shows locations where 34-kt winds are possible (10% chance) and likely (50% chance) over the next 72 h for active tropical cyclones
- Uses TC Wind Speed Probabilities



TC Danger Graphic for Hurricane Dora