COLORADO STATE UNIVERSITY FORECAST OF ATLANTIC HURRICANE ACTIVITY FROM SEPTEMBER 16 – SEPTEMBER 29, 2021

We believe that the most likely category for Atlantic hurricane activity in the next two weeks is normal (50%), with above-normal and below-normal assigned a 40% and 10% chance of occurring, respectively.

(as of 16 September 2021)

By Philip J. Klotzbach[1] and Michael M. Bell[2]

In Memory of William M. Gray[3]

This discussion as well as past forecasts and verifications are available online at http://tropical.colostate.edu

Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523
Email: philk@atmos.colostate.edu

[1] Research Scientist
[2] Associate Professor
[3] Professor Emeritus

1 Introduction

This is the 13th year that we have issued shorter-term forecasts of tropical cyclone activity (TC) starting in early August. These two-week forecasts are based on a combination of observational and modeling tools. The primary tools that are used for this forecast are as follows: 1) current storm activity, 2) National Hurricane Center Tropical Weather Outlooks, 3) forecast output from global models, 4) the current and projected state of the Madden-Julian Oscillation (MJO) and 5) the current seasonal forecast.

Our forecast definition of above-normal, normal, and below-normal Accumulated Cyclone Energy (ACE) periods is defined by ranking observed activity in the satellite era from 1966-2019 and defining above-normal, normal and below-normal two-week periods based on terciles. Since there are 54 years from 1966-2019, each tercile is composed of 18 years. The 18 years with the most active ACE periods from September 16 – September 29 are classified as the upper tercile, the 18 years with the least active ACE periods from September 16 – September 29 are classified as the lower tercile, while the remaining 18 years are classified as the middle tercile. We now also issue probabilities for ACE being in each category as defined in Table 1.

Table 1: ACE forecast definition for TC activity for September 16 – September 29, 2021 and forecast probabilities for each category for the next two weeks.

ACE Category	Definition	Probability in each Category
Above-Normal	Upper Tercile (>23 ACE)	40%
Normal	Middle Tercile (6–23 ACE)	50%
Below-Normal	Lower Tercile (<6 ACE)	10%

2 Forecast

We believe that the most likely outcome (50% chance) for the next two weeks is normal TC activity (6–23 ACE). The National Hurricane Center is currently monitoring three areas for potential TC development, and two of these areas could generate moderate ACE if they form. However, there is considerable model spread as to whether these two areas will develop into significant TCs. The ECMWF model also highlights additional potential development off of Africa in the 7-14-day period. Following a suppression of additional TC formation in the next week due to a convectively-suppressed phase of a convectively-coupled Kelvin wave, the large-scale pattern broadly looks to remain relatively conducive for Atlantic hurricane formation and intensification.

The Madden-Julian Oscillation (MJO) is currently located in phase 3 over the Indian Ocean. The MJO is forecast to weaken considerably, potentially due to the predominance of the background state favoring La Niña-like conditions. The latest large-scale forecast from the ECMWF continues to indicate enhanced vertical motion over Africa and the Indian Ocean with suppressed vertical motion over the tropical Pacific, which typically favors Atlantic hurricane activity.

Figure 1 displays the formation locations of TCs from September 16 – September 29 for the years from 1966 – 2019 (e.g., the satellite era), along with the maximum intensities that these storms reached. Figure 2 displays the September 16 – September 29 forecast period with respect to climatology. Although after the climatological peak of the Atlantic hurricane season, the tropical Atlantic generally remains quite active during this time. The primary threat formation area for major hurricanes in mid- to late September is in the eastern and central tropical Atlantic.

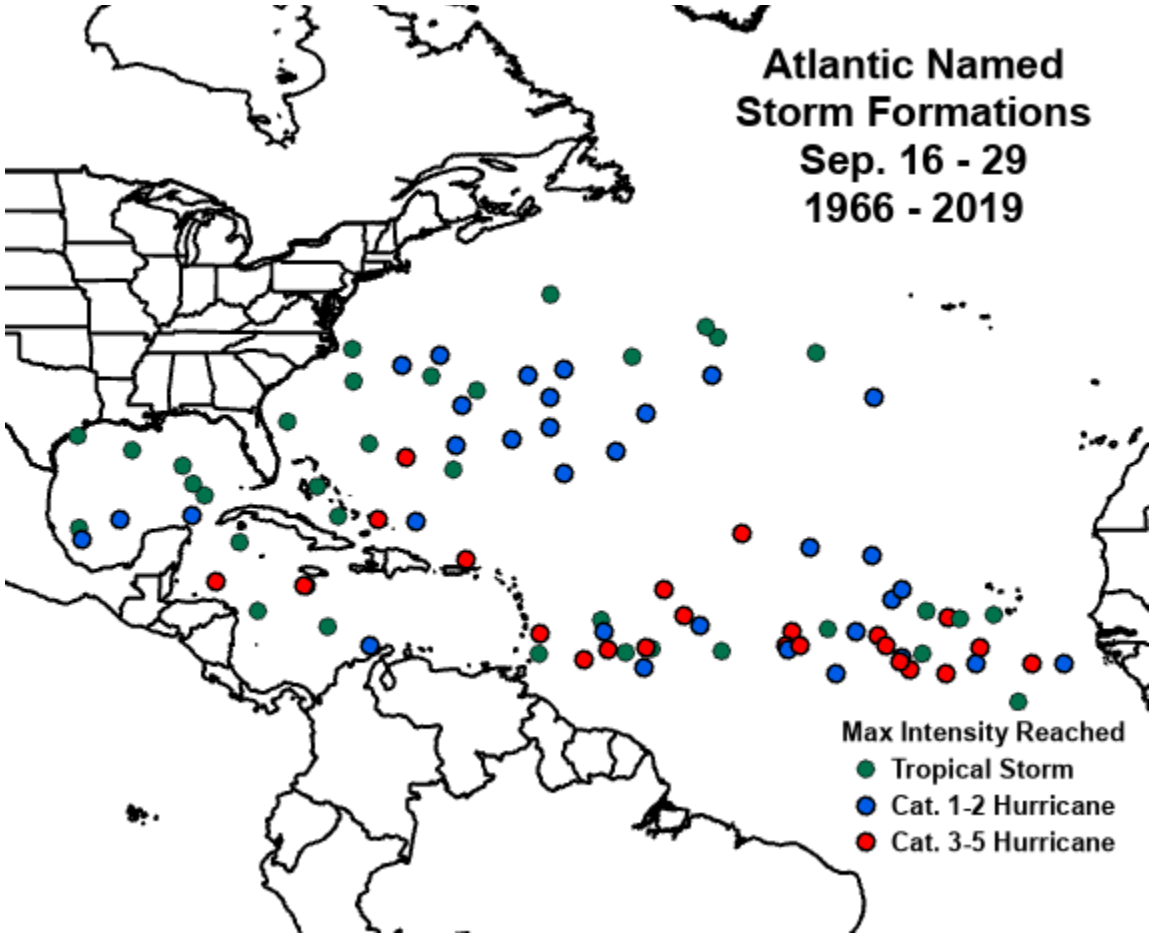

Figure 1: Atlantic named storm formations from September 16 – September 29 during the years from 1966 – 2019 and the maximum intensity that these named storms reached.

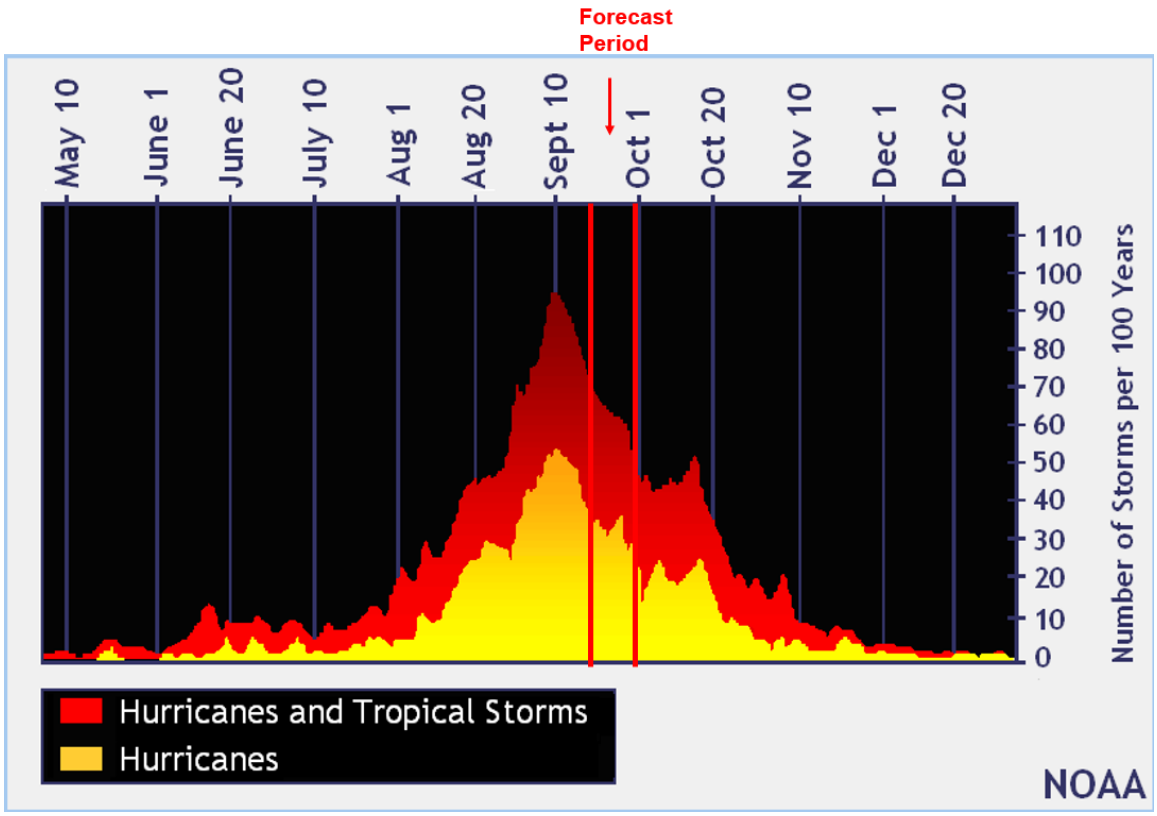

Figure 2: The current forecast period (September 16 – September 29) with respect to climatology. Figure courtesy of NOAA.

We now examine how we believe each of the five factors discussed in the introduction will impact Atlantic TC activity for the period from September 16 – September 29.

1) Current Storm Activity

There are currently no tropical storms or hurricanes in the Atlantic basin.

2) National Hurricane Center Tropical Weather Outlook

The latest NHC Tropical Weather Outlook is monitoring three areas for potential TC formation in the next five days (Figure 3). Both of the areas with a high probability for TC formation in the next five days could generate moderate levels of ACE if they were to develop. However, there is considerable spread in the model guidance as to how much these two systems will develop, and if they do develop, how long they will last. The other area in the eastern tropical Atlantic looks to generate only modest levels of ACE if it does form, given that it should recurve quite far east in the Atlantic where sea surface temperatures are relatively cool.

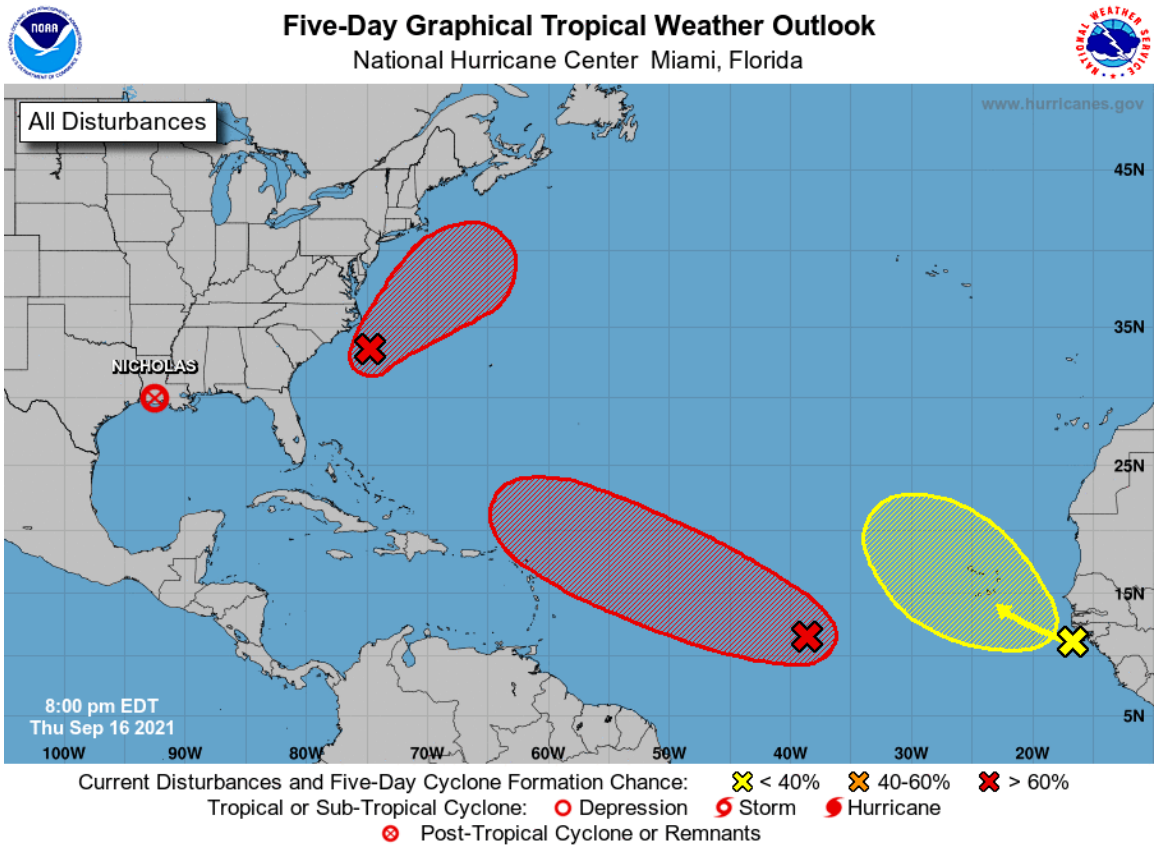

Figure 3: Current five-day Tropical Weather Outlook from the National Hurricane Center.

3) Global Model Analysis

The ECMWF ensemble remains fairly aggressive with additional African easterly wave development in the 7-14-day period. For example, the latest ensemble minimum MSLP output from ECMWF shows quite a few members with low pressure areas on Wednesday, 29 September in the eastern and central tropical Atlantic (Figure 4).

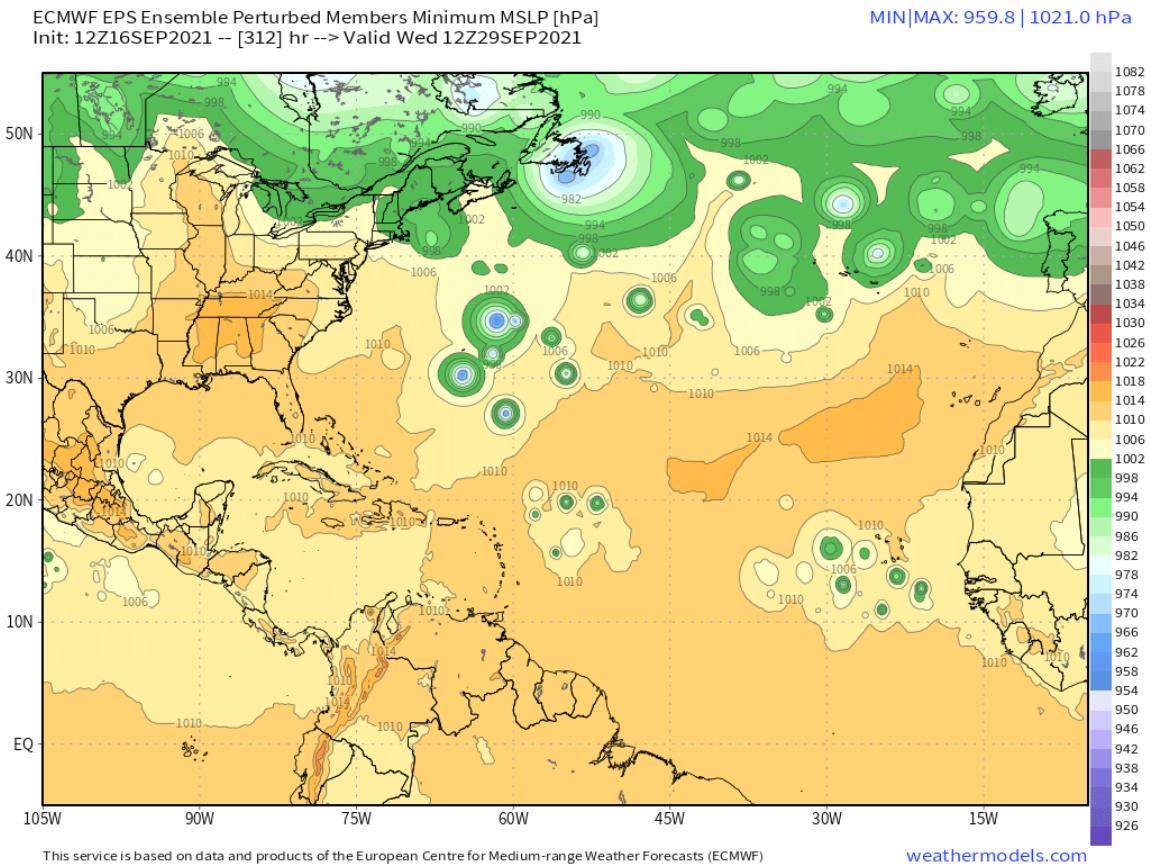

Figure 4: ECMWF ensemble minimum pressure values on 29 September. The ECMWF continues to highlight a relatively active period for TCs in the eastern and central tropical Atlantic.

4) Convectively-coupled Kelvin waves/Madden-Julian Oscillation

Another convectively-suppressed phase of a Kelvin wave is forecast to propagate across the Atlantic in the next 5-7 days, potentially stifling TC development in the tropical Atlantic during that time (Figure 5).

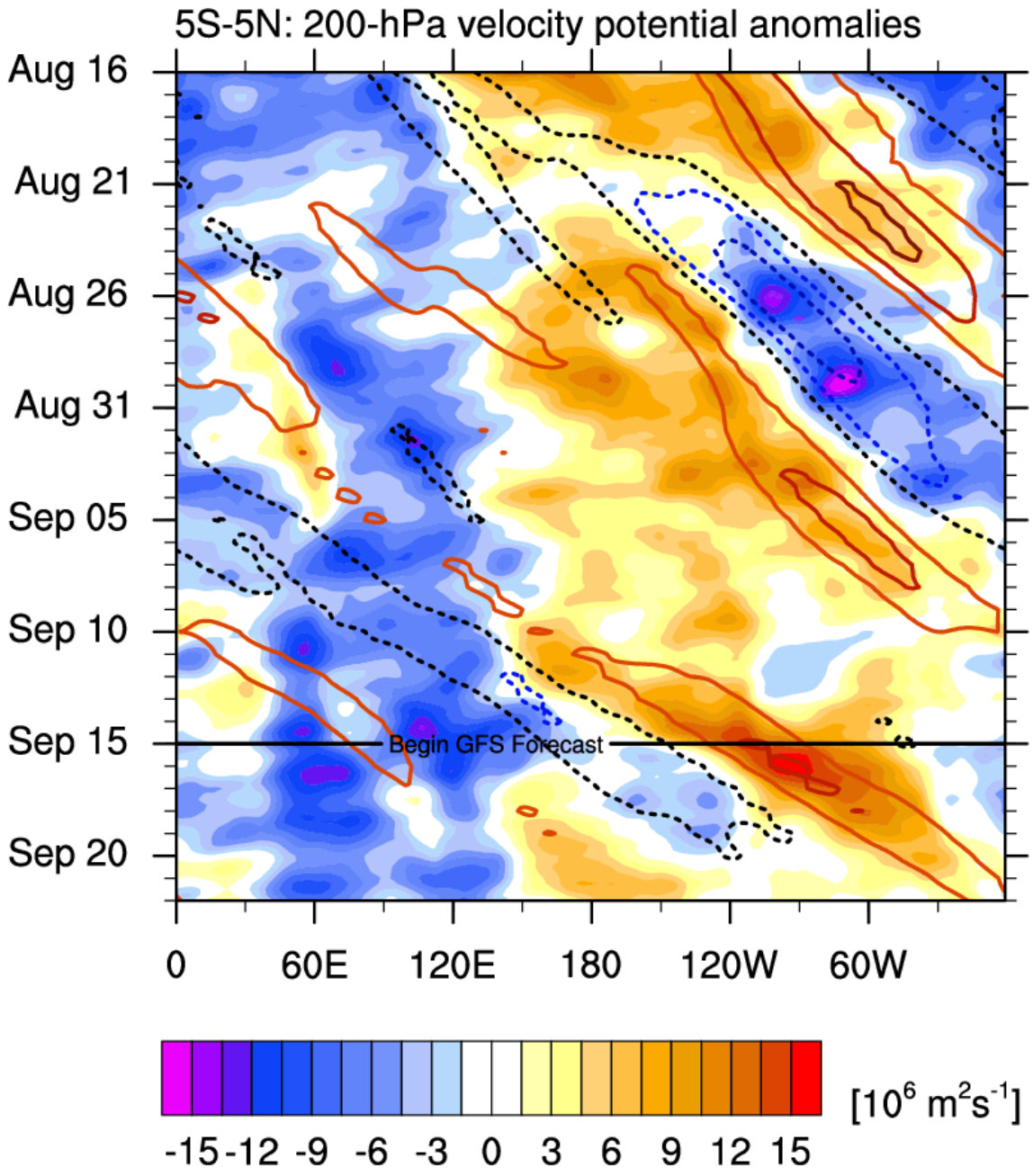

Figure 5: 200-hPa velocity potential anomalies with a Kelvin-wave filtered applied. Positive velocity potential anomalies indicate suppressed vertical motion, that typically stifles Atlantic TC formation. Figure courtesy of Mike Ventrice.

The Madden-Julian Oscillation (MJO), as measured by the Wheeler-Hendon index, is currently in phase 3 over the Indian Ocean. The MJO is forecast to weaken over the next two weeks and slowly shift into phase 4 (albeit it at a very weak magnitude), potentially due to the La Niña-like basic state reestablishing itself (Figure 6). Table 2 summarizes the typical MJO impacts on Atlantic TC activity. Phase 3 is typically associated with relatively favorable conditions for Atlantic TC formation. The forecast upper-level

velocity potential field favors upward motion over Africa and the Indian Ocean (especially in week two), with suppressed vertical motion over the tropical Pacific (Figure 7). This large-scale setup reduces vertical wind shear over the tropical Atlantic and Caribbean.

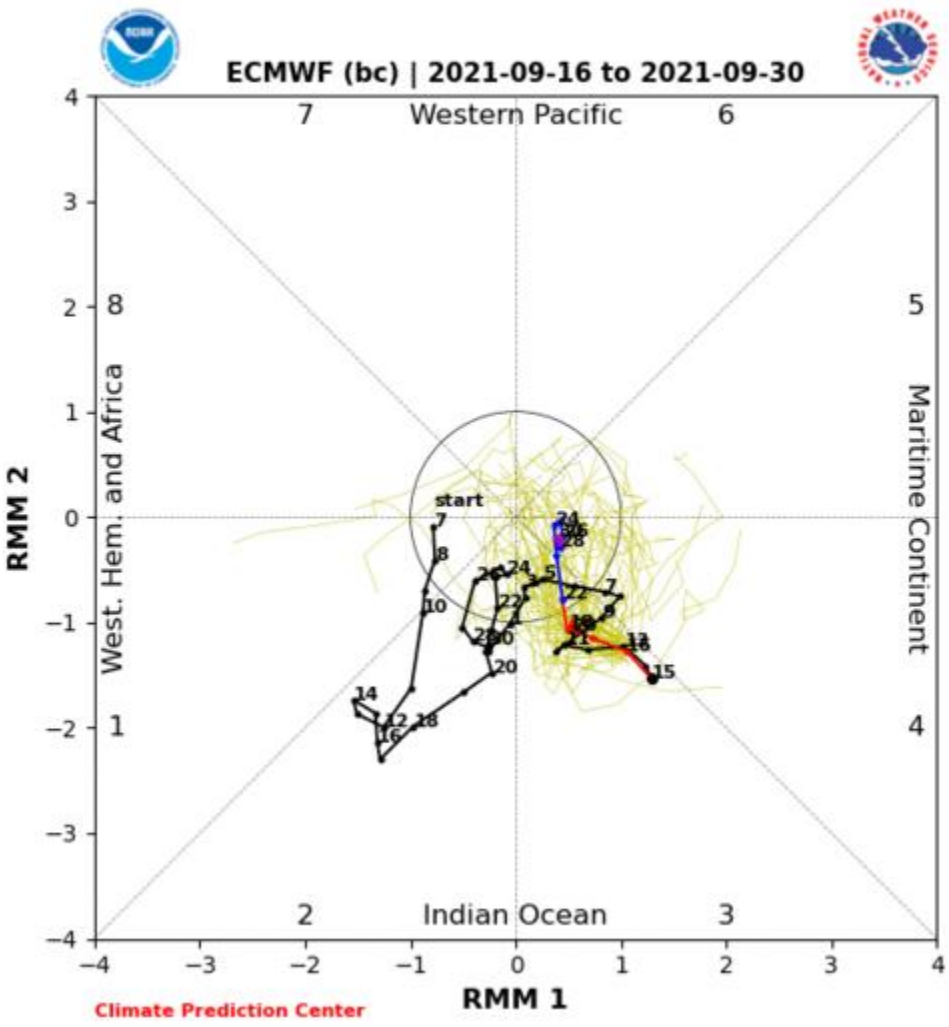

Figure 6: Predicted propagation of the MJO by the ECMWF model. Figure courtesy of NOAA.

Table 2: Normalized values of named storms (NS), named storm days (NSD), hurricanes (H), hurricane days (HD), major hurricanes (MH), major hurricane days (MHD) and Accumulated Cyclone Energy (ACE) generated by all tropical cyclones forming in each phase of the MJO over the period from 1974-2007. Normalized values are calculated by dividing storm activity by the number of days spent in each phase and then multiplying by 100. This basically provides the level of TC activity that would be expected for 100 days given a particular MJO phase.

MJO Phase	NS	NSD	H	HD	MH	MHD	ACE
Phase 1	6.4	35.9	3.7	17.9	1.8	5.3	76.2
Phase 2	7.5	43.0	5.0	18.4	2.1	4.6	76.7
Phase 3	6.3	30.8	3.0	14.7	1.4	2.8	56.0
Phase 4	5.1	25.5	3.5	12.3	1.0	2.8	49.4
Phase 5	5.1	22.6	2.9	9.5	1.2	2.1	40.0
Phase 6	5.3	24.4	3.2	7.8	0.8	1.1	35.7
Phase 7	3.6	18.1	1.8	7.2	1.1	2.0	33.2
Phase 8	6.2	27.0	3.3	10.4	0.9	2.6	46.8
Phase 1-2	7.0	39.4	4.3	18.1	1.9	4.9	76.5
Phase 6-7	4.5	21.5	2.5	7.5	1.0	1.5	34.6
Phase 1-2 / Phase 6-7	1.6	1.8	1.7	2.4	2.0	3.2	2.2

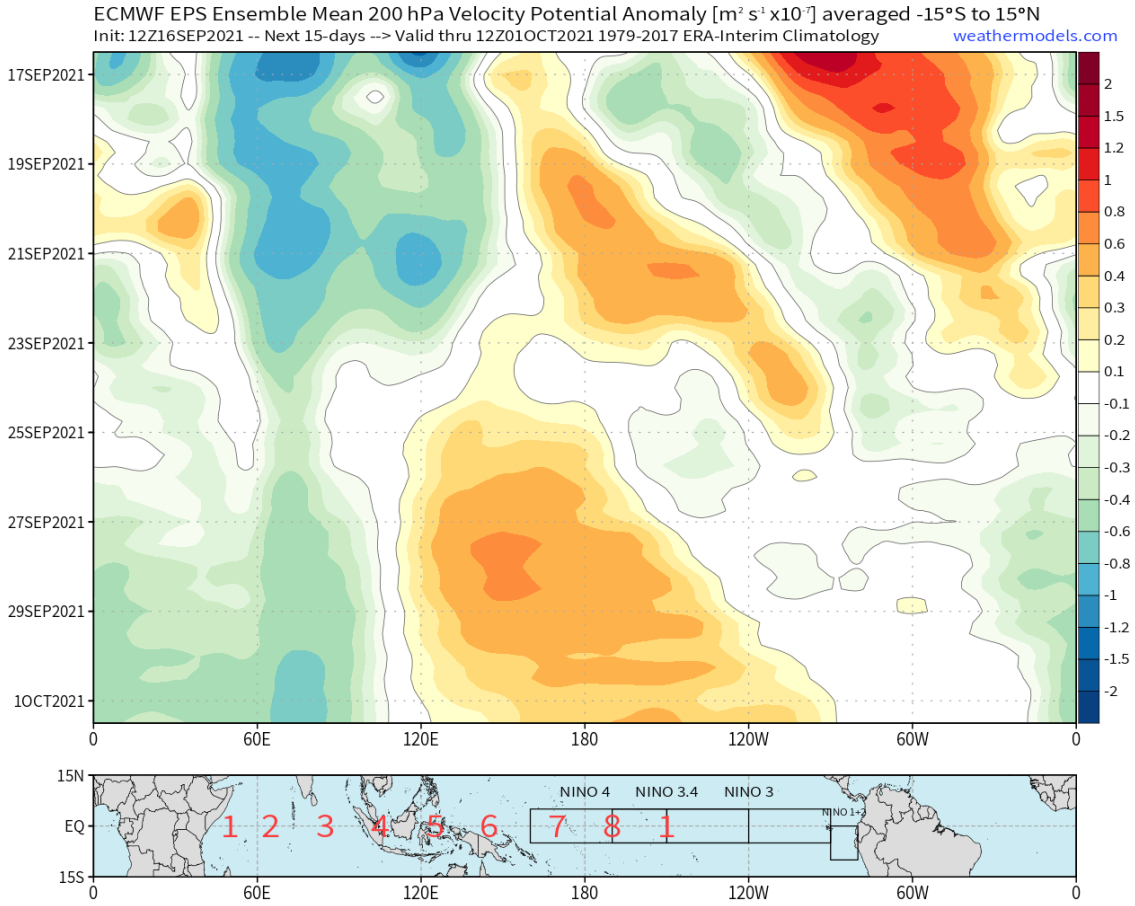

Figure 7: Ensemble mean forecast from the ECMWF model for 200 hPa velocity potential anomalies over the next 15 days.

5) Seasonal Forecast

The most recent seasonal forecast calls for an active season. We slightly favor normal activity relative to above-normal activity over the next two weeks.

3 Upcoming Forecasts

The next two-week forecast will be issued on September 30 for the September 30–October 13 period. A final two-week forecast will be issued on October 14.

VERIFICATION OF SEPTEMBER 2 – SEPTEMBER 15, 2021 FORECAST

The two-week forecast of tropical cyclone activity from September 2 – 15, 2021 verified in the above-normal category (~35 ACE). We predicted a 90% chance of reaching the above-normal category with our outlook (>34 ACE). Larry generated almost all of the ACE during the two-week period (32 ACE), while Nicholas (2.4 ACE) and Mindy (0.4 ACE) generated much lower amounts of ACE. Table 3 displays the percentage chance that we gave for each category being reached and the observed amount of ACE.

Table 3: ACE forecast for TC activity for September 2 – September 15, 2021, the probability assigned for each category being reached and observed ACE.

ACE Category	Definition	Probability in each Category	Observed ACE
Above-Normal	Upper Tercile (>34 ACE)	90%	35
Normal	Middle Tercile (12–34 ACE)	10%	
Below-Normal	Lower Tercile (<12 ACE)	<1%	