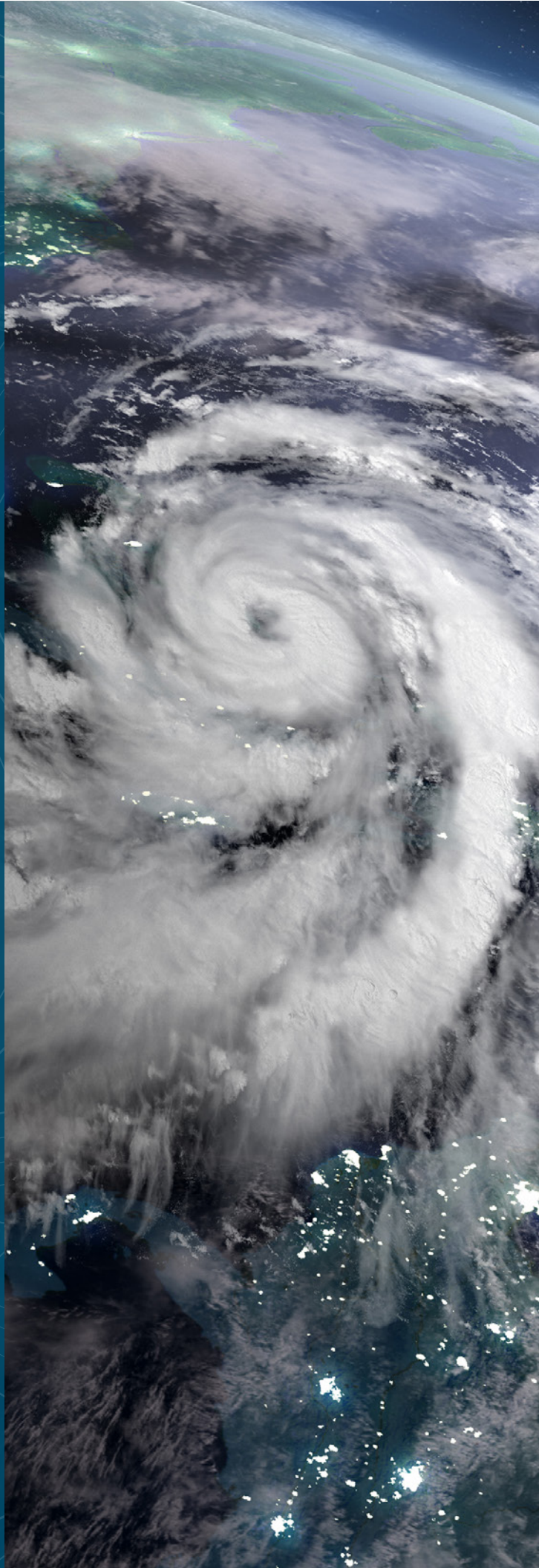
RMS®

2021

Northern Hemisphere Tropical Cyclone Outlook

EXECUTIVE SUMMARY

North Atlantic and
Western North Pacific
Event Response Report



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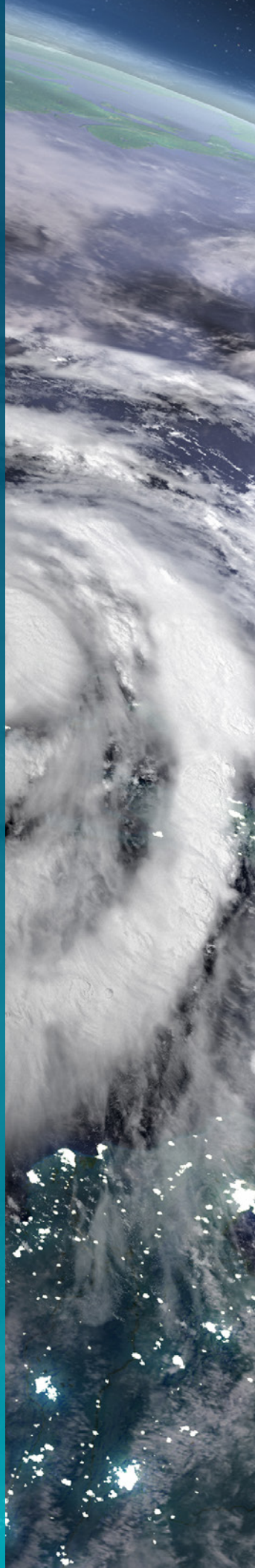

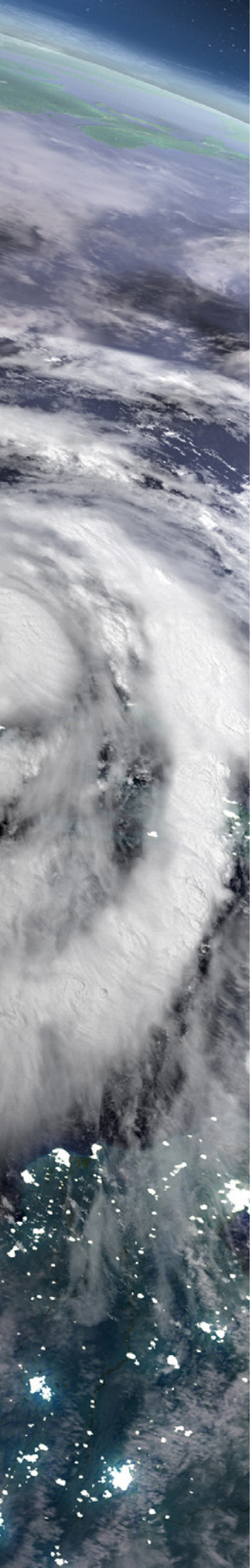

Introduction

The question on everyone's mind is: How will the Atlantic Basin follow up last year's record-breaking hurricane season?

Although most forecasters anticipated above-average hurricane activity in 2020 based on the dominant atmospheric signals, nobody thought we would exhaust the storm name list for only the second time in history. However, the insured losses suffered by the industry in 2020 were lower than in other active seasons; RMS® projected that the six landfalling U.S. hurricanes caused onshore insured loss between US$19 billion and US$30 billion, equivalent to just one of the three memorable 2017 hurricanes.

This does not mean that all areas survived the year unscathed. Many communities in southwestern Louisiana were devastated by the effects of two hurricanes, Laura and Delta, which made landfall within weeks of each other.

Whatever the final count of storms in 2021, RMS is ready to respond. Despite COVID-19 restrictions and remote working conditions in 2020, we added several innovations to RMS Event Response and HWind workflows. These innovations enabled us to accurately assess the impacts of Hurricane Laura, the season's most costly storm: Market losses appear to be settling comfortably within the RMS projected range of between US$9 billion and US$13 billion.

With in-person reconnaissance unavailable due to the ongoing COVID-19 pandemic, we filled the gap by developing a robust and expandable algorithm that surveys building damage from aerial imagery, able to tag more than 100,000 buildings for damage in mere hours. Last year, we used this algorithm to survey more than one million buildings in the aftermath of the year's major Gulf Coast hurricanes.

The U.S. was the focus for insured losses in 2020, but RMS is also prepared to respond in the Western Pacific Basin if the focus switches back. Last year, Japan registered no tropical cyclone landfalls for the first time in 12 years, but our loss estimates for Typhoons Faxai and Hagibis in 2019 were highly accurate. This year marks the first time that RMS has expanded our annual tropical cyclone outlook report to include forecasts of Western Pacific Basin activity.

As COVID-19 restrictions begin to lift, we will reintroduce in-person reconnaissance into our event response process. We will be able to combine the in-person damage surveys with digital techniques to provide a wealth of information unrivaled by other catastrophe model vendors, including a deep understanding of an event at both the local and regional scales.

We continue to work diligently to build upon our recent advancements and provide our clients with faster and more comprehensive analytics. For instance, the ExposureIQ™ application on the RMS platform Risk Intelligence™ now puts RMS Event Response and HWind insights in our clients' hands like never before. As a trusted partner, RMS is ready once again to inform your critical business processes with reliable information during the year's most challenging events.

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Mohsen Rahnama
Chief Risk Modeling Officer and Executive Vice President, Models and Data

2021 North Atlantic Hurricane Seasonal Forecasts

The North Atlantic hurricane season officially runs from June 1 to November 30. Several forecast groups and agencies issue preseason activity forecasts to provide an indication of potential storm activity for the upcoming season. This report presents and evaluates the latest-available forecasts at the time of publication.

Table 1 shows the latest-available forecasts, including those from the National Oceanic and Atmospheric Administration (NOAA) and two of the most widely known forecast groups: Colorado State University and Tropical Storm Risk. Also displayed are several climatological averages and 2020's activity count. Please note that most forecasts cover the period between June 1 and November 30, and therefore exclude Tropical Storm Ana.

Forecast Agency	Forecast Date	Tropical Storms	Hurricanes	Major Hurricanes	ACE Index
NOAA	May 20	13–20	6–10	3–5	106–184
Colorado State University	June 3	15–21	6–10	2–6	100–205
Tropical Storm Risk	May 27	18	9	4	140
U.K. Met Office	May 20	9–19	4–10	1–5	44–190
ECMWF	May 6	12–21	6–12	n/a	102–204
Servicio Meteorológico Nacional	May 12	15–20	7–9	3–4	n/a
North Carolina State University	April 14	15–18	7–9	2–3	n/a
Penn State University ESSC	April 12	9–15	n/a	n/a	n/a
University of Arizona	April 1	15–21	6–10	3–5	97–177
AccuWeather	April 6	16–20	7–10	3–5	120–160
The Weather Company	May 13	19	8	4	n/a
1950–2019 average[1]		**12.1**	**6.4**	**2.6**	**104.7**
1991–2020 average[2]		**14.4**	**7.2**	**3.2**	**122.3**
1995–2020 average[3]		**15.5**	**7.7**	**3.5**	**134.1**
2011–20 average[4]		**16.6**	**7.4**	**3.1**	**122.9**
2020 North Atlantic hurricane season		**30**	**14**	**6**	**179.8**

Table 1: Summary of the most recent 2021 North Atlantic hurricane forecasts, average activity for the 1950–2020, 1991–2020, 1995–2020, and 2011–20 periods, plus seasonal activity for 2020.

[1] Storms only given official names since 1950.

[2] This represents the latest NOAA three-decade Climate Normals, https://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/climate-normals.

[3] Representing the recent high-activity era of the Atlantic Basin since 1995.

[4] Representing the most recent decade.

National Oceanic and Atmospheric Administration's Forecast

The National Oceanic and Atmospheric Administration's outlook for the 2021 North Atlantic hurricane season indicates that an above-normal season is most likely. The outlook indicates a 60 percent probability that the season will be above normal,[5] a 30 percent probability that the season will be near normal,[6] and a 10 percent probability the season will be below normal.[7]

NOAA's 2021 forecast calls for a 70 percent probability that the season will produce:

- 13–20 named storms
- 6–10 hurricanes
- 3–5 major hurricanes[8]
- Accumulated Cyclone Energy (ACE)[9] index of 106–184

The predicted ranges for activity in 2021 are centered above NOAA's new Climate Normals[10] seasonal average of 14 named storms, seven hurricanes, and three major hurricanes. NOAA's Climate Normals were updated this year in conjunction with the conclusion of the previous decade.

If NOAA's forecast verifies, the 2021 Atlantic hurricane season would be a record sixth consecutive above-normal season, which would extend the current ongoing record of five (2016–present). Of the past 26 Atlantic hurricane seasons, 17 seasons (65 percent) have been designated as above normal, while five seasons (19 percent) have been categorized as near normal, and just four seasons (15 percent) designated as below normal.

NOAA will update its forecast at the beginning of August, just before the historical peak of North Atlantic hurricane activity.

Landfall Forecasts

Long-term statistics indicate that the probability of a hurricane making landfall in the U.S. increases during more active seasons. Using statistical models to examine the relationship between the number and intensity of historical landfalls and the observed climatological conditions, some agencies issue landfall probability forecasts. As of June:

- Colorado State University (CSU) estimates a 69 percent probability of at least one major hurricane making landfall in the U.S. this season.
- Tropical Storm Risk (TSR) forecasts two hurricanes and five tropical storms to make landfall over the contiguous U.S. in 2021.
- AccuWeather forecasts three to five named storms to directly impact the mainland U.S., Puerto Rico, or the U.S. Virgin Islands during the 2021 season.

[5] NOAA defines an above-normal season as one with an ACE index above 126.1 (corresponding to more than the 67th percentile of the 1951–2020 median), with a range of 11 to 30 named storms, six to 15 hurricanes, and two to seven major hurricanes.

[6] NOAA defines a near-normal season as one with an ACE index between 73.0 and 126.1 (corresponding to between the 33rd and 67th percentiles of the 1951–2020 median), with a range of six to 18 named storms, three to nine hurricanes, and one to four major hurricanes.

[7] NOAA defines a below-normal season as one with an ACE index below 73.0 (corresponding to less than the 33rd percentile of the 1951–2020 median), with a range of four to 14 named storms, two to six hurricanes, and zero to two major hurricanes.

[8] A hurricane that is classified as Category 3 or higher.

[9] Accumulated Cyclone Energy (ACE) index is calculated as the square of the sum of the maximum sustained wind speed (in knots) at 6-hour intervals for the duration of the storm at tropical storm strength (35 knots) or greater.

[10] NOAA's Climate Normals are three-decade averages of climatological variables, including temperature and precipitation, updated every 10 years. The 1991–2020 U.S. Climate Normals dataset represents the latest Climate Normals.

Uncertainty in seasonal forecasts of landfalling storms is far greater than the uncertainty in seasonal forecasts of overall hurricane activity, because individual storm tracks are highly sensitive to the location of cyclogenesis and the local atmospheric and oceanic conditions and weather patterns during the season.

Although the probability of a hurricane making landfall in the U.S. increases during more active seasons, there are notable exceptions to this tendency. In 2010, 19 named storms and 12 hurricanes developed in the Atlantic Basin, but only one tropical storm made landfall on the U.S. coast. Conversely, Hurricane Andrew, one of the costliest hurricanes in U.S. history, was one of only seven named storms to develop during the relatively quiet 1992 season. It only takes one event to make a season costly or memorable.

Key Drivers of the 2021 North Atlantic Activity Forecasts

The forecasts of an above-average season reflect the influence of the key seasonal oceanic and meteorological factors, including the El Niño-Southern Oscillation (ENSO), sea surface temperatures in the tropical Atlantic, and the Atlantic Multidecadal Oscillation (AMO).

A large proportion of the uncertainty associated with seasonal hurricane activity forecasts can be attributed to the uncertainty of which phase of the El Niño-Southern Oscillation (ENSO) will materialize during the peak months of the hurricane season during August, September, and October. At this time, most of the forecast models favor cool-neutral conditions throughout the remainder of the year, with an increasing possibility that La Niña conditions could reemerge during the late fall or winter of 2021–22; the official probabilistic ENSO forecast indicates a greater probability of La Niña conditions during the three-month period between September and November onward. Should ENSO remain in a neutral phase throughout the 2021 hurricane season, and in the absence of influence from any other factors, activity would be expected to be near normal.

Although there is generally low skill and high uncertainty in forecasting Atlantic sea surface temperatures several months in advance, models are forecasting above-average departures, with many areas forecast to experience anomalies of between 0.0°C to +1.0°C for the period covering the peak months of the hurricane season. Warmer sea surface temperatures typically enhance tropical activity by providing increased energy and moisture to the environment.

These conditions, along with other factors such as weaker vertical wind shear and a stronger West African monsoon system, are conducive to increased hurricane activity in the basin.

Other factors, such as the North Atlantic Oscillation (NAO), the Madden-Julien Oscillation (MJO), and the Saharan Air Layer (SAL), can influence tropical cyclone activity on a weekly or monthly basis but are difficult to forecast at seasonal timescales.

Historical Performance of North Atlantic Seasonal Activity Forecasts

Since 2019, RMS has evaluated the historical performance of North Atlantic seasonal activity forecasts to provide additional insight into the skill of the agencies' seasonal forecasts and to determine whether they are outperforming their own expectations:

- NOAA expects that the observed seasonal activity should be within its ranges in 70 percent of cases. It falls short of this target across the 2001–20 period, achieving 60 percent for tropical storms, 45 percent for hurricanes, 65 percent for major hurricanes, and 28 percent for ACE.
- The U.K. Met Office expects its forecast range to verify in 70 percent of cases; it surpasses this target for both hurricane count (75 percent) and ACE (77 percent).
- Based on the historical verification of its statistical forecast scheme, CSU expects 67 percent of its ranges (equivalent to one standard deviation) to encompass the observed storm total. Forecasts of hurricane counts (58 percent) and major hurricane counts (58 percent) fall beneath their expectations, whereas its ACE forecast (79 percent) exceeds expectations.

Based on RMS analyses, when the observed hurricane, major hurricane, or ACE index counts fall outside the forecast group's and agency's late May or early June forecast ranges, they tend to be underestimates of activity, rather than overestimates.

The analysis also shows an increase in forecast skill closer to the peak months of the season. In all cases, the updated August forecasts provide a more valuable outlook than climatology estimates, signifying that the updated forecasts better reflect the interannual variability of activity in the North Atlantic Basin.

2021 Western North Pacific Typhoon Seasonal Forecasts

The Western North Pacific typhoon season runs throughout the calendar year with no seasonal boundaries, although most of the activity typically occurs between May and November.

Unlike the North Atlantic Basin, the number of seasonal forecasts for the Western Pacific Basin is not exhaustive. Several forecasting groups and agencies issue activity forecasts to provide an indication of potential storm activity for the peak months of the year. The majority of forecasts call for a near-average number of tropical storms and typhoons to develop this year. Table 2 shows the latest-available forecasts at the time of publication. Also displayed are several climatological averages and 2020's activity count.

Forecast Agency	Forecast Date	Tropical Storms	Typhoons
Tropical Storm Risk	May 11	24	15
European Centre for Medium-Range Weather Forecasts	May 6	18–25	10–15
Guy Carpenter Asia-Pacific Climate Impact Centre	May 27	19,5	n/a
PeakRe / Shanghai Typhoon Institute	April 27	24–27	n/a
1951–2020 average		**26.6**	**15.7**
1991–2020 average		**25.1**	**13.3**
2020 Western North Pacific typhoon season		**23**	**10**

Table 2: Summary of the most recent 2020 Western North Pacific typhoon forecasts, average activity for the 1951–2020 and 1991–2020 periods, plus seasonal activity for 2020.

Key Drivers of the 2021 Western North Pacific Activity Forecasts

The forecasts of a near-average year in the Western North Pacific reflect the influence of the key seasonal oceanic and meteorological factors, including the El Niño-Southern Oscillation (ENSO) and sea surface temperatures in the Western North Pacific.

Most ENSO forecast models favor cool-neutral conditions throughout the remainder of the year, with an increasing possibility that La Niña conditions could reemerge during the late fall or winter of 2021–22. The cool-neutral or La Niña conditions are anticipated to result in a shift in the main cyclogenesis region westward toward the Philippines and the South China Sea, along with stronger trade winds and decreased cyclonic vorticity over the basin that normally would result in slightly less overall activity for the basin.

Sea surface temperatures across the Western North Pacific Basin are expected to be near or above average between July and November. The waters immediately surrounding the Philippines and areas off the northeast–coast of Japan are expected to be between +0.5°C and +1.5°C above average, with the remainder of the basin near or slightly above average. Warmer sea surface temperatures typically enhance tropical activity by providing increased energy and moisture to the environment.

Risk Management Solutions (RMS) has shaped the world's view of risk for over 30 years, leading the catastrophe risk industry that we helped to pioneer. RMS models underlie the nearly US$2 trillion Property & Casualty industry, and many insurers, reinsurers, and brokers around the world rely on RMS model science. Our unmatched science, technology, and 300+ catastrophe risk models help (re)insurers and other organizations evaluate and manage the risks of natural and man-made disasters. Leaders across multiple industries can address the risks of tomorrow with RMS Risk Intelligence™ (RI), our open, unified cloud platform for global risk.

Today's risk professionals trust RMS to help them manage and navigate the risks of natural and man-made catastrophes.

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