

2021 North-Atlantic Hurricane season forecast – the new normal in a climate change impacted world?

5 July 2021

Executive summary:

- Based on the Twelve Capital and reask forecast, basin wide hurricane activity for 2021 is estimated to be broadly in line with recent activity.
- This year, the National Oceanic and Atmospheric Administration (NOAA) updated their baseline view of a normal hurricane season, to reflect the higher levels of activity seen in recent years.
- The main development region (MDR), a region of the tropical Atlantic that extends approximately from the west coast of Africa to the western Caribbean Sea, is forecast to have a modest increase from the baseline mean with 6.6 named storms expected relative to the mean of 5.8.
- Despite this modest predicted increase in expected activity in the MDR region, landfall risk is marginally lower when compared to the climatology.
- The Gulf region is forecast to expect 4.6 named storms compared to a baseline mean of 3.5 with landfall probability above average values.
- Storms that form in the East Coast region have a forecast expected value of 5.7 relative to the baseline mean of 5.2 with landfall probability in line with the baseline climatology.

Climate change – increasing resilience

The insurance industry plays an important role in helping economies build natural disaster resilience and adapt to the potential impacts of climate change. Analysing and assessing the impact of climate change on natural catastrophes is key for benchmarking risk-adjusted pricing of Insurance-Linked Securities.

This year, the National Oceanic and Atmospheric Administration (NOAA) updated their baseline view of a normal hurricane season¹, to reflect the higher levels of activity seen in recent years, by considering the period 1991-2020 compared to the previous baseline of 1981-2010. The impact is an increase in the average number of named storms from 12 to 14. NOAA likely attributed the increase in activity to the improvement in observing platforms as well as highlighting the warmer ocean and atmosphere and the possible influence of climate change.

¹ <https://www.noaa.gov/media-release/average-atlantic-hurricane-season-to-reflect-more-storms>

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Hurricane season activity expected to be in line with recent activity

With 16.9 storms expected in 2021, basin wide storm activity is forecast to be in line with recent basin activity. The last ten years (2011-2020) has seen an average of 17 named storm per year which is above the NOAA baseline² of 14 storms (1991-2020).



Figure 1: Model region classification. Source: reask and Twelve Capital.

The forecast moves beyond basin wide activity by also considering regional risk, represented as clusters (see Figure 1), in three main regions. The first, the Main Development Region (MDR) being where storms develop in an area that extends approximately from the west coast of Africa to the western Caribbean Sea and move in a westward direction to towards the US and Caribbean. Storms from this cluster are associated with Hurricanes such as Hurricane Irma³. The second region is labelled as the East Coast and represents storms that form in the northern part of the basin with potential landfalls on the North East coast of the United States. Lastly, the Gulf cluster captures storms that develop in the Gulf of Mexico.

Similar to the basin wide activity forecast, the regional activity and subsequent landfall probability is also broadly in line with the recent climatology, with no significant departures expected from the baseline. Interestingly, even with a modest increase in the number of expected storms to form in the MDR, the forecast is predicting a slight decrease in the risk associated with landfalls. This decrease is driven by the potential for atmospheric flow patterns acting to protect the US mainland.

² NOAA have recently updated their average Atlantic hurricane season to reflect more storms and will use the period 1991-2020 as the new 30-year period of record compared to the previous period of 1981-2010. The impact is an increase in the number of names storms from 12 to 14.

³ Hurricane Irma made landfall on 10 September 2017 in the Florida Keys as a Category 4 hurricane.

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Metric	Region	Baseline 1991-2020	2021 Mean Forecast
Count	North Atlantic Basin	14.5	16.9
	East Coast	5.2	5.7
	Main Development Region	5.8	6.6
	Gulf/West Caribbean	3.5	4.6
Landfalls	East Coast	1.1	1.2
	Main Development Region	1.2	1.0
	Gulf/West Caribbean	2.0	2.7

Table 1: Hurricane season 2021 forecast. The machine learning algorithm assumes continuous distributions to estimate discrete data. All figures rounded to one decimal place. Source: reask.

Sea Surface Temperatures (SSTs)

Global anomalies of SSTs⁴ for the month of May 2021 (Figure 2) show the remnants of the 2020 La Niña event, with the “cold tongue” in the Pacific still visible but retreating. The current state of the ENSO⁵ cycle is in its neutral phase.

In terms of North Atlantic Hurricane activity the 2021 season will most likely be characterised by a neutral ENSO or, possibly, the emergence of a new La Niña. Any changes in the ENSO state, in particular a shift to La Niña, could possibly have an impact on risk levels during the peak of the wind season. In the North Atlantic, El Niño events are associated with conditions that typically give rise to fewer hurricanes whereas La Niña events are associated with conditions that give rise to favourable hurricane formation.

⁴ Warmer Sea surface temperatures in the Atlantic favour hurricane formation.

⁵ El Niño-Southern Oscillation.

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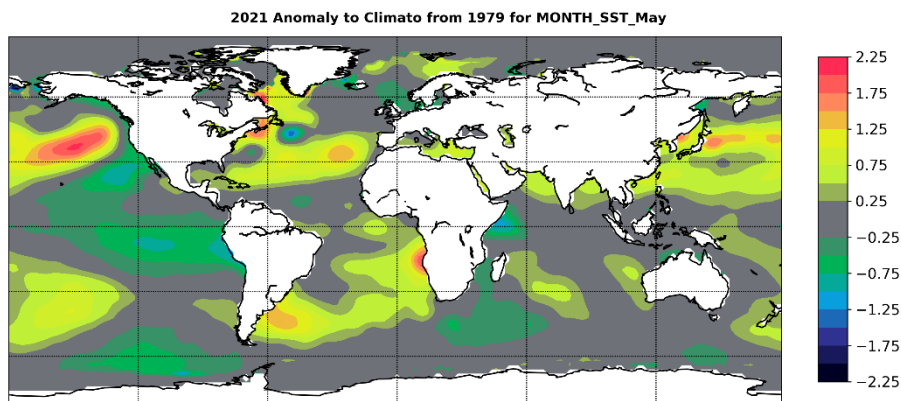


Figure 2: Global SST anomalies for May 2021 relative to 1979-2020.

The SST anomalies are clearly showing warmer than average waters in the mid-tropics and part of the Gulf (Figure 2). This, associated with the lack of any signal for an El Niño event contributes to driving a high SST signal in this year’s forecast.

West African Monsoon (WAM)

The WAM⁶ is exhibiting similar characteristic to those observed over the past three years. This season again sees all predictors tracking global precipitation and convection patterns point towards an active WAM.

The now familiar patterns from Figure 3 show how the precipitation over western Africa has been anomalously high, although levels of activity are predicted to be less influential than those observed over the past three seasons.

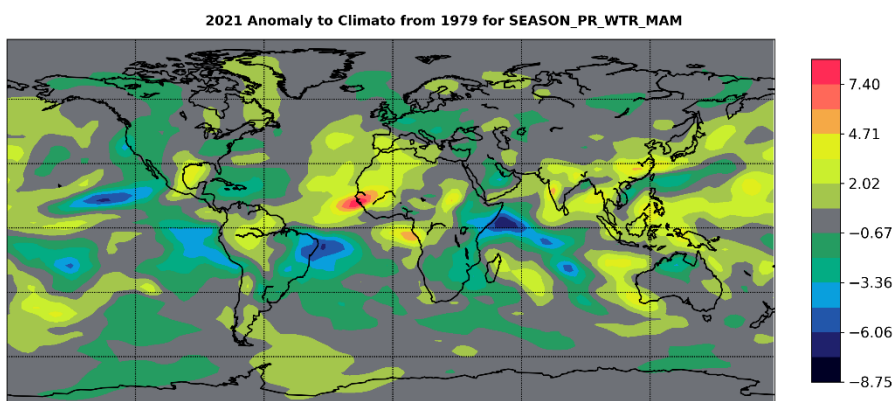


Figure 3: March – May precipitable water content anomalies relative to 1979-2020.

⁶ A strong West African Monsoon is associated with convection patterns that are favourable for hurricane development off the west coast of Africa.

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Steering flow and regional hot spots for August-October

Predictors of the dominant August-October steering flow, associated with the strength of the Bermuda high⁷, are negative this year. This suggests a potential set up where the dominant steering flow⁸ could have less effect in steering activity towards the US coastline, driving a reduction in the landfall risk distribution from the MDR.

Is recent activity the future normal?

Understanding recent hurricane activity is critical in assessing potential risk levels associated with any potential future climate change.

Mean observed basin wide activity from 2011-2020 is above the baseline from 1991-2020 with the last ten years having exhibited both the most active hurricane season on record in terms of named storms (2020) and most costly in terms on insured losses arising from US Hurricane damage (2017). The mean forecast for this year is in line with the expected value from 2011-2020 (see Figure 4).

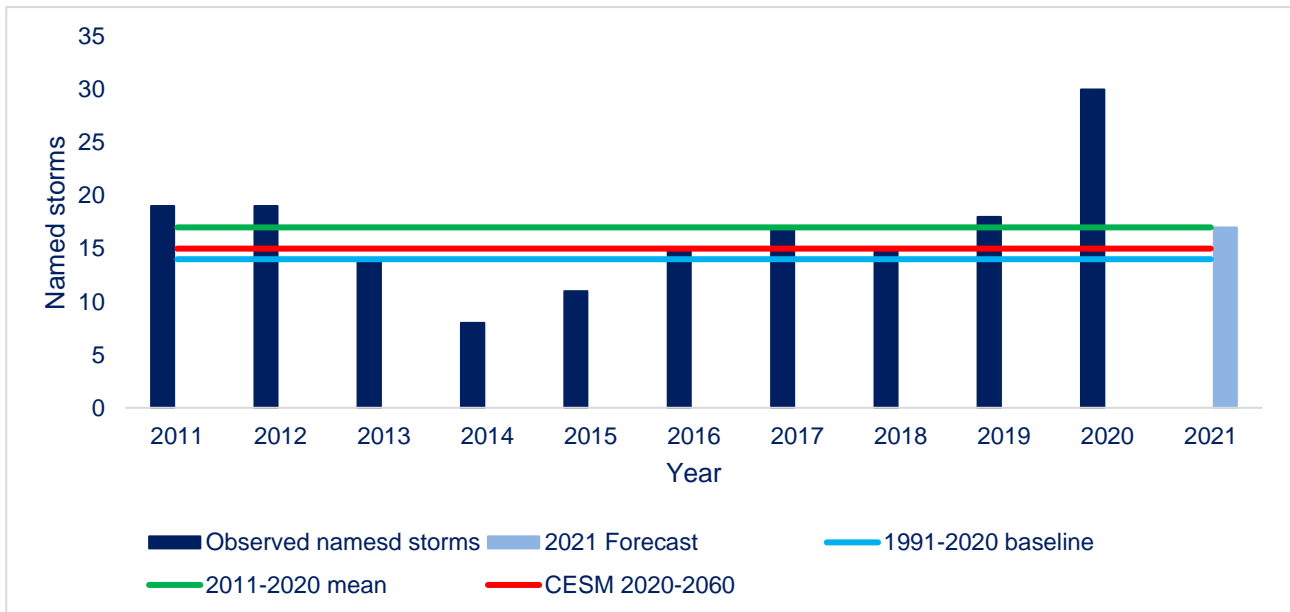


Figure 4: Comparison of numbers of named storms per year between 2011-2020, the forecast for 2021 and the Twelve/reask climate projection for 2020-2060. The baseline mean 1991-2020 and the recent 2011-2020 average are also shown. CEM: Community Earth System Model.

To understand how the periods 1991-2020 and 2011-2020 might compare to future expected values, the seasonal forecast was extended to include the possible impacts of continued greenhouse emissions using

⁷ The Bermuda high is a semi-permanent area of high pressure in the North Atlantic. The position of the Bermuda high can have a major influence on the movement of tropical cyclones in the North Atlantic.

⁸ Steering flow corresponds to the atmospheric flow conditions that can influence the motion of tropical cyclones.

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simulations of possible future climates from the Community Earth System Model (CESM).⁹ Figure 4 includes the expected value of named storms based on simulation years from 2020-2060 under the RCP8.5¹⁰ scenario.

Under the RCP8.5 scenario hurricane frequencies are expected to rise modestly by about 12%. The model simulations also suggest that the heightened activity of the last 10 to 20 years was in fact “unlucky” relative to other simulated scenarios and that the future expected value, albeit clearly trending up, might not be as extreme as the value observed in recent history.

The last ten years also experienced a “hurricane drought”. Between 2013-2016, insured losses from US Hurricane totalled less than USD 3bn in the aggregate between 2013-2016 inclusively. This period of inactivity drove significant softening in the market, even during a period of perceived heightened hurricane activity. It is exactly this variability in natural catastrophe risk distributions that drives the risk premium in the Insurance-Linked Securities (ILS) asset class and why analysing and assessing the impact of climate variability on natural catastrophes is key for benchmarking risk-adjusted pricing. Twelve Capital has proactively taken a view to weight the most recent history in its assessment of risk and risk selection process.

Following the losses of 2017, 2018 and 2019, a period during which the Cat Bond market performed well, and the subsequent related loss development, together with the impact of COVID-19, spread levels reached multi-year highs in 2020 based on Twelve Capital estimates. Risk-adjusted returns have increased and portfolios are well positioned to deliver improved returns.

Away from hurricane risk, over the long term, Twelve believes climate change will manifest itself in a variety of ways and with different impacts across peril regions. Further Twelve does not believe all forms of investment within ILS will be impacted uniformly.

⁹ Community Earth System Model (CESM) is a fully-coupled, community, global climate model that provides state-of-the-art computer simulations of the Earth's past, present, and future climate. <https://www.cesm.ucar.edu/>

¹⁰ The Representative Concentration Pathway (RCP) 8.5 corresponds to a future climate scenario where emissions continue to rise through the 21st century.

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Twelve Capital and reask – co-operation

Since June 2018, Twelve Capital and reask have worked closely together to further the development of hurricane forecasting tools by using machine learning. Both parties believe that advancements in technology and computing power can enhance ILS investment management.

reask is a catastrophe analytics specialist providing global solutions for tropical cyclone risk management and forecasting. reask is based in Sydney with its team of experts in risk analysis, machine learning and high performance computing. Their team has vast experience in natural catastrophe modelling having developed their expertise from previous engagements at RMS, Willis Re and other specialised firms.

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