

Forecast of the 2021 Hurricane Activities over the North Atlantic

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Coming off a record-breaking 2020 hurricane season, we provide our view of the 2021 season, which runs from June 1 to November 30. The prediction includes total numbers of named storms, hurricanes, major hurricanes, and accumulated cyclone energy (ACE, defined as the sum of the squares of the 6-hourly windspeeds in knots above tropical storm strength). Our forecast combines dynamic forecasts with machine learning as informed by our physical understanding of hurricane activities.

Specifically we utilize a Random Forest approach based on seasonal forecast data from the European Centre for Medium-Range Weather Forecasts (ECMWF). We utilize the forecast July/August/September tropical Atlantic area-averaged sea surface temperatures (SSTs) in the same region used in our June predictions (Davis, Zeng, and Ritchie 2015; Davis and Zeng 2019) as well as August/September area-averaged SSTs in the Nino 3.4 region. Our method uses 25 ensemble members from 1993-2016 and 51 members from 2017-2021.

We calibrate the model using data from 1982 to 2006: we first train the model on the first ensemble member (from the model control run) on all data from 1993 to 2006; use it to predict for the other members from 1993 to 2006; and average predictions from all members for a year as our prediction for that year. Then we validate the model using data from 2007 to 2020 in “real time” (for example, for 2015, we would train the model using data from 1993 to 2014 and use the 2015 data to make a prediction for 2015).

Figure 1 compares our model’s performance during the calibration and validation periods against observations and the 5-year running average, or a no-skill metric. Table 1 shows that our model during the calibration and validation periods beat the average error for the 5-year running average in all categories. We began to predict all four quantities, starting from 2020, and Table 2 shows that our April 2020 prediction has a smaller error in each of the quantities than those from two groups with the longest history in hurricane seasonal prediction.

For our April forecast, we expect above-average hurricane activities over the North Atlantic:

	2021 Prediction	Probability Range	Median Since 1980
Hurricanes	8	6-10 (66%)	7
Major Hurricanes	4	3-5 (74%)	2
Named Storms	18	15-21 (64%)	13
ACE	137	97-177 (59%)	103

Atlantic SSTs are forecast to be warm across the main development region during July, August, and September. In the Pacific, an ENSO-neutral state is most likely to prevail in August and September though a La Niña is possible.

We will update our prediction in early June 2021.

Reference:

Davis, K., X. Zeng, and E. A. Ritchie, 2015: A New Statistical Model for Predicting Seasonal North Atlantic Hurricane Activity. *Wea. Forecasting*, 30, 730–741, doi: 10.1175/WAF-D-14-00156.1

Davis, K. and X. Zeng, 2019: Seasonal Prediction of North Atlantic Accumulated Cyclone Energy and Major Hurricane Activity. *Wea. Forecasting*, 34, 221–232, doi: 10.1175/WAF-D-18-0125.1

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Category	Calibration	Validation	5-yr Average
Named Storms	2.8	3.6	3.9
Hurricane	1.9	2.4	2.6
Major Hurricane	1.3	1.1	1.5
ACE	43.5	41.4	53.8

Table 1. Mean absolute errors of our forecasts and those using the 5-year average as the prediction.

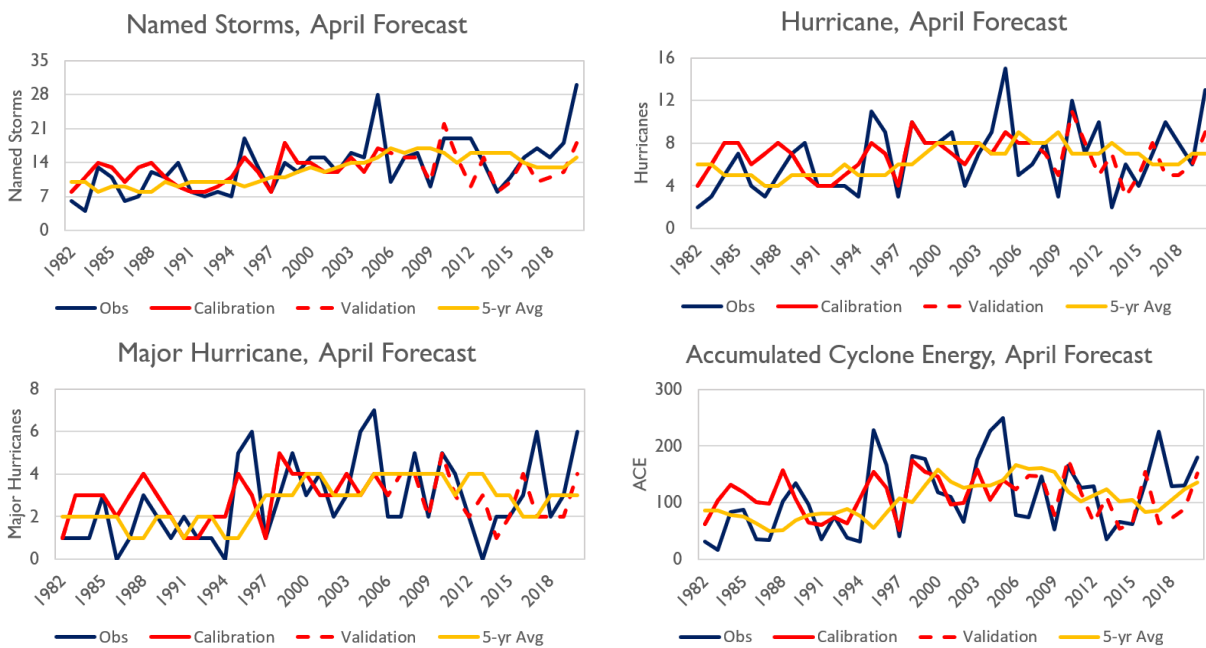


Figure 1. The observed and predicted (using our model and the 5-year average) hurricane number, major hurricane number, named storm number, and ACE.

Organization	Last Year's Error, April Forecast			
	Hurricane	Major Hurricane	Named Storms	ACE
CSU	5	2	14	30
TSR	5	3	14	50
UA	3	1	11	17

Table 2. A comparison of the April 2020 forecast between our model (UA) with two well-respected models, Colorado State University and Tropical Storm Risk.