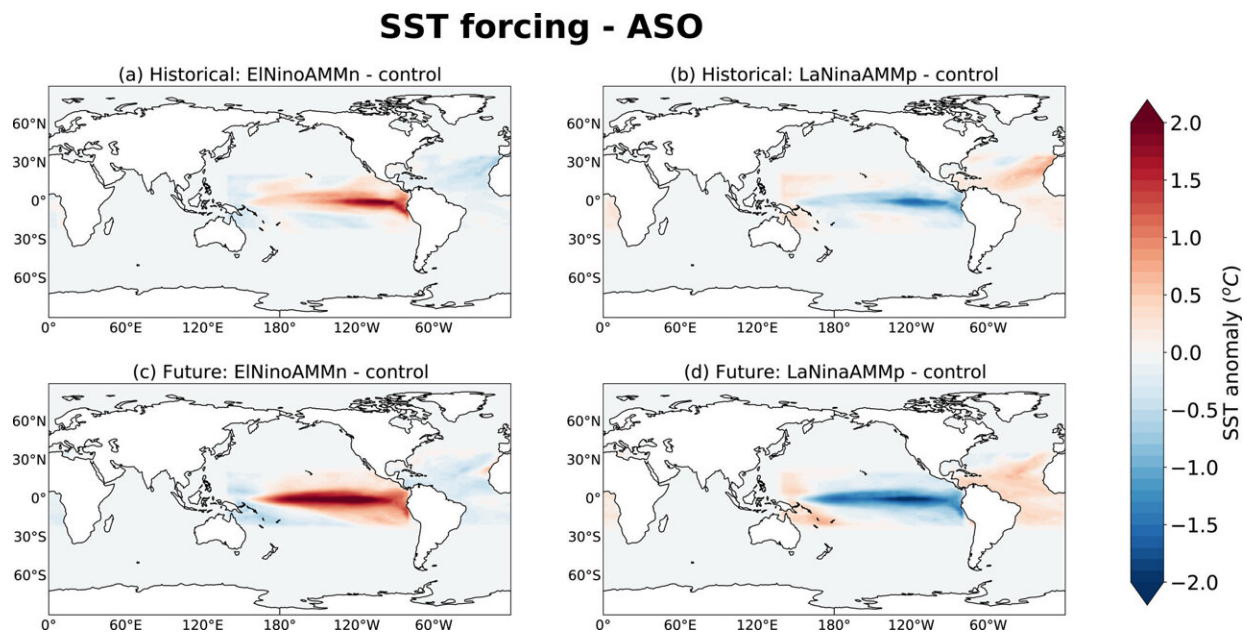


Warmer climate increases Atlantic tropical storms, say cyclone researchers

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Difference in the sea-surface temperature forcing, averaged in ASO, for: (a) El Niño AMMn-hist minus CTL-hist; (b) La Niña AMMp-hist minus CTL-hist; (c) El Niño AMMn-fut minus CTL-fut and (d) La Niña AMMp-fut minus CTL-fut. Credit: *Geophysical Research Letters* (2022). DOI: 10.1029/2022GL100267

A warming climate will increase the number of tropical cyclones and their intensity in the North Atlantic, potentially creating more and stronger hurricanes, according to simulations using a high-resolution, global climate model.

"Unfortunately, it's not great news for people living in [coastal regions](#)," said Christina Patricola, an Iowa State University assistant professor of geological and atmospheric sciences, an affiliate of the U.S. Department of Energy's Lawrence Berkeley National Laboratory in California and a study leader. "Atlantic hurricane seasons will become even more active in the future, and hurricanes will be even more intense."

The research team ran climate simulations using the Department of Energy's Energy Exascale Earth System Model and found that tropical cyclone frequency could increase 66% during active North Atlantic hurricane seasons by the end of this century. (Those seasons are typically characterized by La Niña conditions—unusually cool surface water in the eastern tropical Pacific Ocean—and the positive phase of the Atlantic Meridional Mode—warmer surface temperatures in the northern tropical Atlantic Ocean).

The projected numbers of tropical cyclones could increase by 34% during inactive North Atlantic hurricane seasons. (Inactive seasons generally occur during El Niño conditions with warmer surface temperatures in the eastern tropical Pacific Ocean and the negative phase of the Atlantic Meridional Mode with cooler surface temperatures in the northern tropical Atlantic Ocean.)

In addition, the simulations project an increase in storm intensity during the active and inactive storm seasons.

The scientific journal *Geophysical Research Letters* recently published the findings. Ana C.T. Sena, an Iowa State postdoctoral research associate, is first author.

"Altogether, the co-occurring increase in (tropical cyclone) number and strength may lead to increased risk to the continental North Atlantic in the future climate," the researchers wrote.

Patricola added, "Anything that can be done to curb greenhouse gas emissions could be helpful to reduce this risk."

Cyclone studies in Cyclone Country

Iowa State is home to the Cyclones and storm sirens are part of the hype at most athletic contests. Talk of the Cyclones is all over campus. But North Atlantic tropical cyclones? What are they?

"Tropical cyclone is a more generic term than hurricane," Patricola said. "Hurricanes are relatively strong tropical cyclones."

Exactly, says the National Oceanic and Atmospheric Administration. Tropical cyclone is a general reference to a low-pressure system that forms over tropical waters with thunderstorms near the center of its closed, cyclonic winds. When those rotating winds exceed 39 mph, the system becomes a named tropical storm. At 74-plus mph, it becomes a [hurricane](#) in the Atlantic and East Pacific oceans, a typhoon in the northern West Pacific.

Patricola grew up in the Northeast and can still tell stories about 1991's Hurricane Bob.

"That was a big one for us in Massachusetts," she said. "For me, it was very exciting. It really caught my interest."

She was a Weather Channel fanatic through a lot of hurricanes in the mid-1990s. That led to studies of geological and atmospheric sciences at Cornell University in New York, followed by atmospheric science and climate research at Texas A&M University and Lawrence Berkeley National Laboratory. Patricola joined the Iowa State faculty in August 2020.

Patricola's research interests include climate dynamics, climate variability and change, extreme weather events, atmosphere-ocean interactions, high-resolution [climate](#) modeling, land-atmosphere interactions, paleoclimates and of course, tropical cyclones.

Why are tropical cyclone numbers so consistent?

Patricola and another set of collaborators have published [a second research paper](#) about tropical cyclones. This one is also in *Geophysical Research Letters*, with Derrick Danso, an Iowa State postdoctoral research associate, as first author. The paper examines a possible explanation for the relatively constant number of tropical cyclones observed globally from year to year.

Could it be that African Easterly Waves, [low pressure systems](#) over the Sahel region of North Africa that take moist tropical winds and raise them up into thunderclouds, are a key to that steady production of storms?

Using regional model simulations, the researchers were able to filter out the African Easterly Waves and see what happened. As it turned out, the simulations didn't change the seasonal number of Atlantic tropical cyclones. But, tropical cyclones were stronger, peak formation of the storms shifted from September to August, and the formation region shifted from the coast of North Africa to the Gulf of Mexico.

So African Easterly Waves may not help researchers predict the number of Atlantic [tropical cyclones](#) every year, but they do appear to impact important storm characteristics, including intensity and possibly where they make landfall.

Both papers call for more study.

"We are," Patricola said, "chipping away at the problem of predicting the number of tropical [cyclones](#)."

More information: Ana C. T. Sena et al, Future Changes in Active and Inactive Atlantic Hurricane Seasons in the Energy Exascale Earth System Model, *Geophysical Research Letters* (2022). [DOI: 10.1029/2022GL100267](#)

Derrick K. Danso et al, Influence of African Easterly Wave Suppression on Atlantic Tropical Cyclone Activity in a Convection-Permitting Model, *Geophysical Research Letters* (2022). [DOI: 10.1029/2022GL100590](#)

Provided by Iowa State University

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