CSU researchers correctly predict above-average 2023 Atlantic hurricane season

Note to Reporters: The full verification report and a chart showing the predicted vs. observed storms are available with this news release at http://tropical.colostate.edu/. This report includes an extensive discussion of the climate features that caused the 2023 hurricane season to end up above average despite a robust El Niño event.

FORT COLLINS, COLORADO – The 2023 Atlantic hurricane season ended up with above-average activity and close to what was forecast by the Tropical Meteorology Project at Colorado State University's (CSU's) June, July and August forecasts. Colorado State University's earliest seasonal forecast in early April somewhat under-predicted activity. Twenty named storms formed in 2023, with 7 of these storms becoming hurricanes and 3 reaching major hurricane strength. The average Atlantic hurricane season has 14 named storms, 7 hurricanes and 3 major hurricanes. Three named storms and one hurricane made landfall in the continental United States, with Hurricane Idalia striking the Big Bend region of Florida as a Category 3 hurricane. Idalia was responsible for ~$2.5 billion dollars in damage and 5 direct fatalities in the continental United States.

"The 2023 Atlantic hurricane season ended up above average. In general, our seasonal forecasts correctly anticipated these heightened levels of activity. Named storms and named storm days were well above their long-term averages, while Accumulated Cyclone Energy was somewhat above normal," said Phil Klotzbach, lead author of the forecast. Accumulated Cyclone Energy is an integrated metric accounting for intensity and duration of storms. Seasonal Accumulated Cyclone Energy (ACE) was approximately 120 percent of the 1991–2020 average.

The report summarizes all tropical cyclone activity in the Atlantic basin during the 2023 hurricane season and compares the team's seasonal and two-week forecasts to what occurred.

The above-average Atlantic hurricane season was likely driven by the record warm tropical Atlantic and Caribbean. These record warm temperatures were primarily driven by an anomalously weak subtropical high and associated weak trade winds, with climate change warming potentially also playing a role. These hurricane-favorable conditions counteracted the hurricane-unfavorable conditions generated by the robust El Niño that developed in the tropical Pacific. While El Niño typically increases tropical Atlantic and Caribbean vertical wind shear, from August-October during the peak three months of the Atlantic hurricane season, the vertical wind shear was below normal in that region. Strong vertical wind shear tears apart hurricanes as they are trying to develop and intensify. The record warm Atlantic also provided copious amounts of fuel for the hurricanes that formed this year.

CSU's initial forecast for the 2023 season was issued on April 13 and called for a slightly below-average hurricane season. The team predicted 13 named storms, 6 hurricanes and 2 major hurricanes. The CSU team increased its forecast on June 1, calling for 15 named storms, 7 hurricanes and 3 major hurricanes. CSU increased its forecast further on July 6,

calling for 18 named storms, 9 hurricanes and 4 major hurricanes. This forecast was maintained with its August 3 update. Observed activity was 20 named storms, 7 hurricanes and 3 major hurricanes. The team predicted slightly below-average ACE of 100 on April 13, increased its ACE forecast to 125 on June 1 and increased its forecast further to an ACE of 160 on July 6 and August 3. Observed ACE through November 28 was 146. The 1991-2020 average Atlantic ACE was 123.

For the first time this year, Colorado State University also forecast ACE west of 60°W, as ACE in the western part of the basin is likely more impactful to populated areas. They correctly anticipated a lower percentage of basinwide ACE occurring west of 60°W this year, due in part to El Niño favoring early recurvature of storms.

The team bases its annual forecasts on 70 years of historical data and includes factors such as Atlantic sea surface temperatures and sea level pressures, levels of vertical wind shear (the change in wind direction and speed with height), El Niño (an anomalous warming of waters in the central and eastern tropical Pacific) and other factors. While these forecast factors generally work well and explain approximately 50–60 percent of the year-to-year hurricane variability in these 70 years of historical data, there remains 40–50 percent of this variability which is not explained.

Hurricane statistics for 2023 contained in the report include:

- 20 named storms formed in the Atlantic this season. That is tied with 1933 for the 4th most on record, trailing 2020 (30 named storms), 2005 (28 named storms), and 2021 (21 named storms).

- 13 named storms formed in the Atlantic from August 20th through September 28th. That is the most on record between August 20 – September 28, breaking the old record of 12 named storm formations set in 2020.

- Tropical Storms Bret and Cindy formed in the tropical Atlantic (south of 23.5°N, east of 60°W) in June. This is the first time on record that two named storms formed in the tropical Atlantic in June on record.

- Hurricane Idalia made landfall with max winds of 110 kt – the strongest hurricane to make landfall in the Big Bend region of Florida since 1896.

- Hurricane Lee intensified by 70 kt in 24 hours. Six other Atlantic hurricanes in the satellite era (since 1966) have intensified by 70+ kt in 24 hours: Wilma (2005), Felix (2007), Ike (2008), Matthew (2016), Maria (2017) and Eta (2020).

- Tammy became a hurricane on October 20 - the latest calendar year hurricane on record in the tropical Atlantic (south of 20°N, east of 60°W)

The Tropical Meteorology Project has attributed the general upturn in major hurricane activity since 1995 as well as the earlier increase in major hurricane activity from the late 1940s through the mid-1960s to be primarily due to natural multi-decadal variability in the strength of the Atlantic Multidecadal Oscillation (AMO). A concomitant increase in several favorable hurricane-enhancing parameters occur in the tropical Atlantic during the positive phase of this oscillation - while these same parameters tend to suppress hurricanes during the negative phase of this oscillation. An additional driver of the increase in Atlantic hurricane activity in recent years may be a reduction in sulfate aerosols across the tropical Atlantic due to the Clean Air Act, allowing for additional warming of the tropical Atlantic. Climate change warming may also be fueling the observed increase in the percentage of hurricanes reaching Category 4-5 intensity and high-end rapid intensification events. However, this is a global trend with wider scope than year-to-year predictions of tropical cyclone activity in one basin.

The Tropical Meteorology Project was founded by the late Dr. William Gray and has been issuing forecasts for the past 40 years. The first forecast for next Atlantic hurricane season will be issued on Wednesday, April 3, 2024.