

Severe Thunderstorms

Key Message

Marine heatwaves in the Gulf can provide warm moist air needed for severe thunderstorms inland, although that air needs to travel north for extensive hail or tornadoes to appear.

Overview

Marine heatwaves are defined as extended periods of anomalously warm (higher-than-normal) temperatures in the ocean. These warm waters impact ecosystems, communities, and industries that are in, on or near the water, but those impacts can stretch inland too.

When there are higher-than-normal temperatures in the Gulf, the air above that water also tends to be warmer and, as a result, can hold more moisture. If that air is pushed inland so that it runs into cold air, there can be a rapid rise of warm, moist air that is conducive for severe thunderstorms that can bring hail and/or tornadoes.

There is evidence that high Gulf temperatures are associated with more severe thunderstorms and hail east of the Rocky Mountains from March-May (Molina et al. 2016). The association is particularly clear in the Southeastern U.S. in April and is more likely when there are both colder-than-usual waters in the North Pacific and warmer-than-usual waters in the Gulf (or conditions associated with the La Niña phase of the ENSO cycle) (Allen et al. 2015; Chu et al. 2019; Edwards and Weiss 1996). This is likely because the conditions in the North Pacific can facilitate a northward push of the warm, moist air from the Gulf (Chu et al. 2019). However, warm moist air from the Gulf — particularly with dew points above 65F/18C — is associated with tornadoes in the fall as well (Evans and Guyer 2006). Similarly, anomalously warm sea surface temperatures in the northern Gulf are associated with hail events in the Southern Great Plains region of the U.S. (Texas, Oklahoma, Kansas, Colorado), with the highest hail frequencies in March-May (Jeong et al. 2020).

What this means is that, while marine heatwaves alone are not enough to cause severe thunderstorms in the Southeastern U.S., it is worth being vigilant. When there is a marine heatwave, communities should be particularly watchful of conditions that would push warm, moist air north, especially in the spring. The higher-than-normal water temperatures, and the hotter and more moist air that come with them, can provide the energy for severe thunderstorms inland.

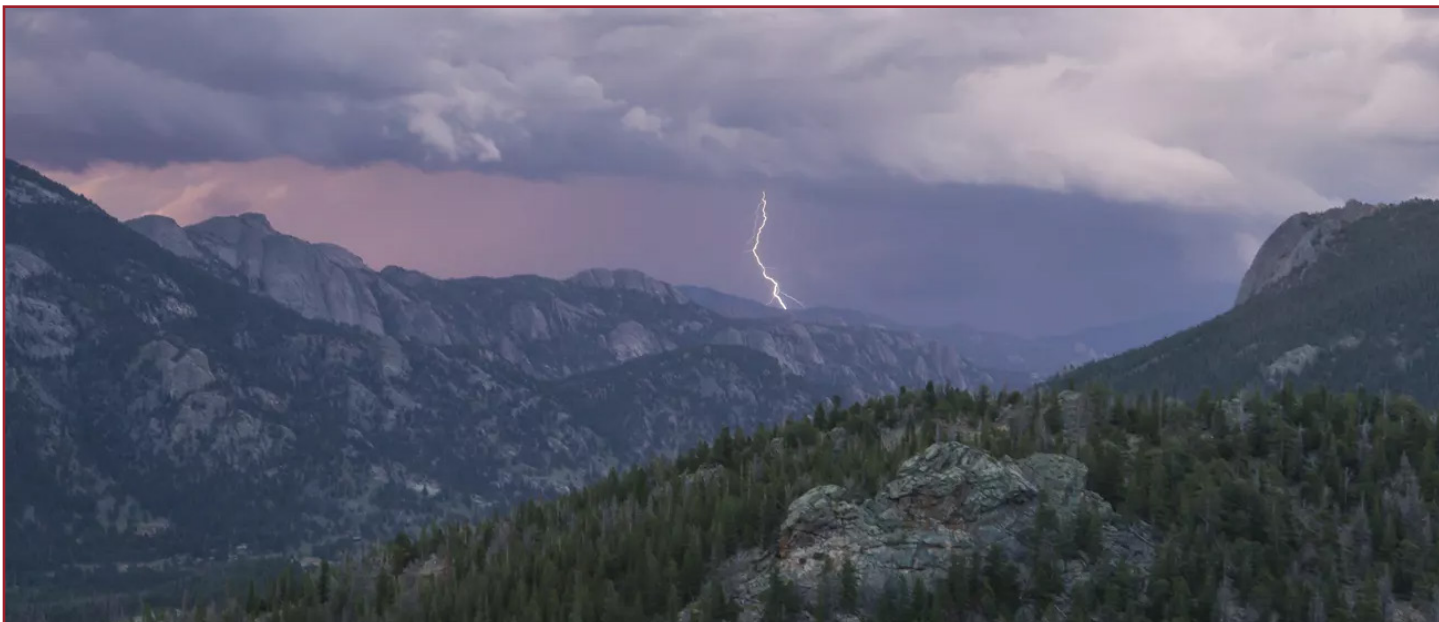


Weather Awareness: Higher-than-normal water temperatures can create warm, moist air that provides the energy for severe thunderstorms. Photo: Josh Sorenson

Temperature Datasets Commonly Used and Relevant Temperature Thresholds

Analyses of the relationships between marine heatwaves and severe thunderstorms generally use remotely sensed sea surface temperature data, but can also rely on surface buoy data.

- Moist air with dew points above 65F/18C are associated with tornadoes in the fall (Evans and Guyer 2006)
- Hot April temperatures (no clear threshold) associated with severe thunderstorms (Allen et al. 2015, Chu et al. 2019, Edwards and Weiss 1996, Molina et al. 2016)



Inland Impacts from Marine Heatwaves: There is evidence that high Gulf temperatures are associated with more severe thunderstorms and hail even as far east as the Rocky Mountains between March and May. Photo: National Park Service.

Resources/Communities of Practice

- Gulf Tree (<http://www.gulftree.org/>)
- OSHA Tornado Preparedness and Response (<https://www.osha.gov/tornado/preparedness>)
- VORTEX-SE (<https://masgc.org/vortex-se-engagement>)

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About the Authors: Dr. Renata Poulton Kamakura is a 2024 National Academies Gulf Research Program Science Policy Fellow with GCOOS. Dr. Chris Simoniello is GCOOS Outreach and Education Manager. Based within the Department of Oceanography at Texas A&M University, GCOOS is the regional component of the U.S. Integrated Ocean Observing System dedicated to the Gulf of America.



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