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What in the world is weather whiplash?

By Jennifer A. Francis | February 9, 2024



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Average December temperatures in Minnesota, for example, were **14 degrees Fahrenheit warmer than usual**, but the following month, they plummeted below the 30-year average **before swinging back up to break an all-time high on January 31**, hitting a balmy 55 degrees—nine degrees above the previous daily record. **Parts of Montana saw a 90 to 100-degree temperature swing in the span of a month.**

It wasn't just the northern states that experienced the temperature yo-yo. Frigid arctic air swept down over much of the United States. At least **55 deaths** have been attributed to January's cold and winter storms. The airport in Houston, Texas, hit an all-time low for January 16 of 19 degrees Fahrenheit. And as in Minnesota, Houston's **temperatures soon rebounded to warmer-than average.**

"Weather whiplash" events like these can be costly, even deadly. While an exact definition doesn't yet exist, weather whiplash generally connotes an abrupt shift from one set of persistent weather conditions to a very different set. Long-duration drought followed by heavy precipitation, for example, can damage crops. Orchards can be devastated by the arrival of a severe cold snap after a persistent early-spring warm spell. Prolonged summer heat waves and drought have also fueled wildland fires across Canada and Mediterranean Europe in recent years, and if these conditions shift abruptly to a stormy pattern with intense rain, barren burn scars will absorb little moisture, raising the threat of flash flooding. All of these types of whiplash have occurred multiple

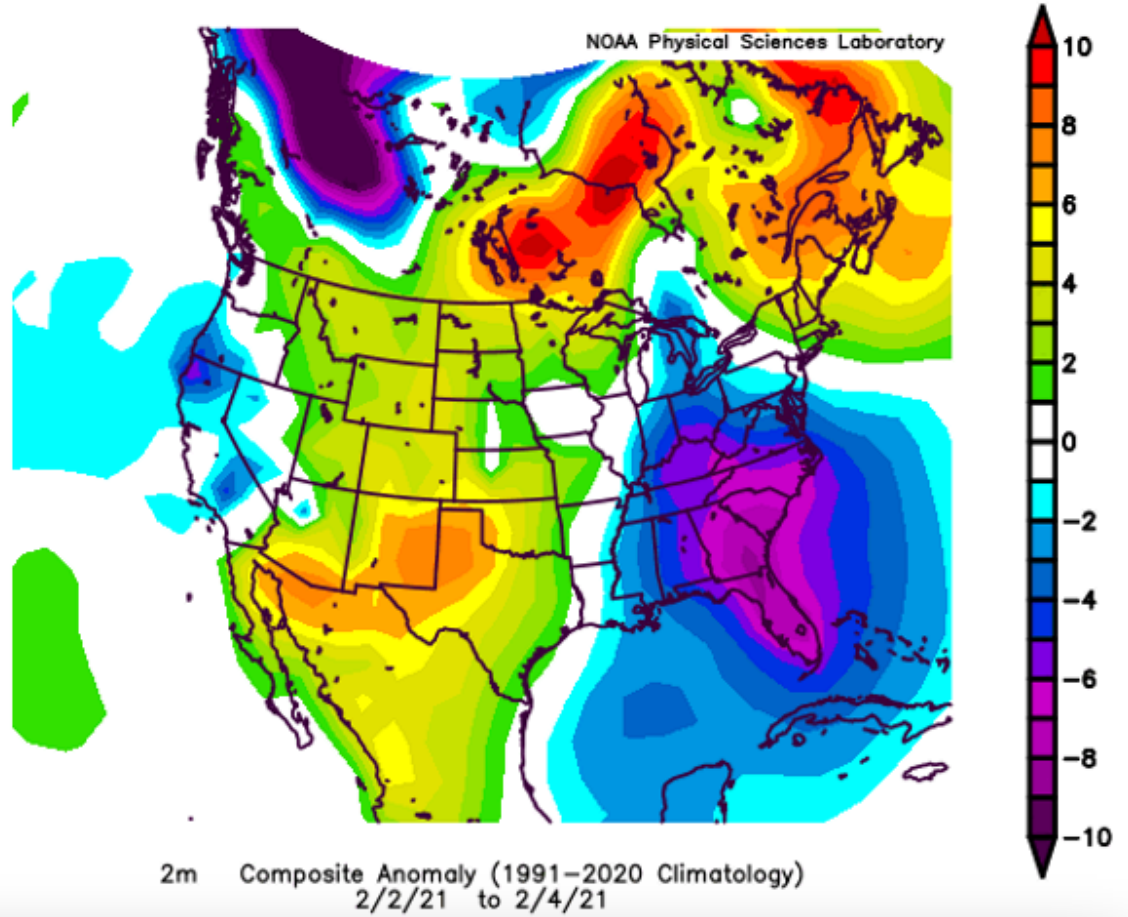
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example, when a northward bulge in the jet stream (called a ridge) is located over western states, dry and warm conditions generally prevail in the region as storms are steered northward into western Canada. In contrast, a large southward dip in the jet stream (a trough) allows cold Arctic air to penetrate unusually far south in winter months, leading to debilitating cold spells in southern states that are ill-equipped to deal with them.

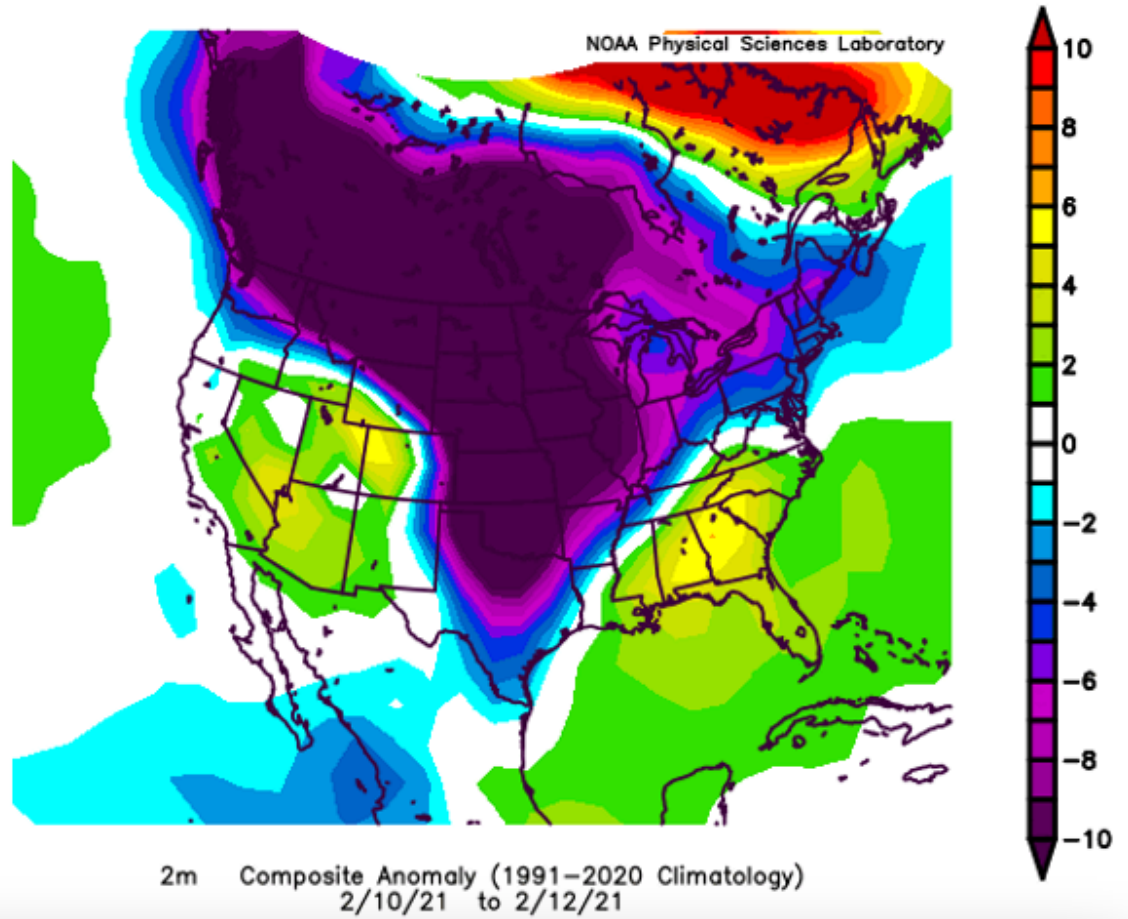
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The “Texas freeze” in February 2021, which **killed 246 people** and cost around \$200 billion, is an excellent example of a highly disruptive weather whiplash event. In early February (Figure 1), temperatures were running well above normal across much of the United States west of the Mississippi River, while in southeastern states temperatures were much cooler than usual. Only a few days later (Figure 2), a major pattern shift occurred that brought frigid Arctic air all the way down to the US-Mexico border, wreaking havoc with energy utilities that couldn’t keep up with the demand for heating, especially in Texas.

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each season and year, then tracked changes in frequency based on the pattern where they started.

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Interestingly, we found that when the initial persistent pattern of the whiplash event features abnormally warm temperatures in the Pacific and Atlantic sectors of the Arctic Ocean (note the Arctic is warming three to four times faster than the globe as a whole!), weather whiplash events occurred more often in recent years. And when the Arctic is unusually cold (which is occurring less and less often), fewer whiplash events were produced. We found whiplash events have become more frequent in recent years when the Pacific and Atlantic sectors of the Arctic are abnormally warm, and less frequent when it's colder than normal.

One beauty of this method is we can analyze both past conditions as well as those for the future based on simulations by climate models. Our research suggests that if we continue to expel greenhouse gases into the atmosphere and cut down forests as we have been doing, future changes in the frequency of weather whiplash events will

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