

PRESS RELEASE

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**Weather whiplash events in Europe and North Atlantic
assessed as continental-scale atmospheric regime shifts**

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Weather whiplash -- abrupt and disruptive shifts in weather conditions, such as from drought to flood or heat wave to cold snap -- are expected to occur more frequently as global temperatures continue to rise.

When weather conditions flip suddenly after a long period of the same pattern – for example, from a long hot and dry period to a parade of storms, or from abnormally mild winter temperatures to extreme cold – major disruptions to human activities, energy supplies, agriculture, and ecosystems often ensue. These shifts have been dubbed “weather whiplash” events, but measuring and tracking them has proved challenging. In this study we apply our recently demonstrated approach to measuring the frequency of these events based on major and rapid transitions in continental-scale weather regimes. While the frequency of whiplash events in recent decades has not changed substantially, our analysis of future model projections indicates robust increases will occur as the globe continues to warm under a thicker blanket of greenhouse gases. In particular, we find that whiplash events will increase most when the Arctic is abnormally warm, while events will decrease when the Arctic is in a cold regime. As the Arctic continues to warm three-to-four times faster than the global average, whiplash events are expected to occur more often.

Weather whiplash across Europe during 2023 alone was devastating. For example, January brought a record-breaking winter heat wave that closed winter resorts and left snowpacks depleted. In mid-May, northern Italy switched from long-term drought to destructive heavy rains. Similarly in early September, a prolonged heat wave and forest fires in Greece ended abruptly with record-breaking floods. Much of Europe experienced an exceptionally warm November, until a dramatic shift in the jet stream brought a blast of Arctic air into the region that still persists over Scandinavia.

“Europe suffered a costly barrage of weather whiplash events in 2023,” noted lead author, Jennifer Francis, Senior Scientist at the Woodwell Climate Research Center. “They were



devastating to infrastructure, lives, and livelihoods. Our continually warming planet increases the likelihood of longer, more intense droughts and heat waves, and our research suggests these spells will be broken more frequently by sudden shifts to heavy bouts of precipitation, which are also fueled by the climate crisis.”

These sudden shifts – so-called weather whiplash events – can be highly disruptive to all sorts of human activities and wildlife. “As we continue to burn fossil fuels and clear-cut forests, causing greenhouse gas concentrations to rise further,” she added, “we expect these whiplash events to occur more often.” Co-author Dr. Zach Zobel, a principal investigator at Woodwell Climate, remarked, “our new approach to diagnose weather whiplash events allows us to track their frequency over time along with the types of extreme weather associated with the abrupt shifts. We found that certain atmospheric regimes such as abnormal Arctic warmth tend to trigger more whiplash events, and we know Arctic warming will only worsen in the foreseeable future.”