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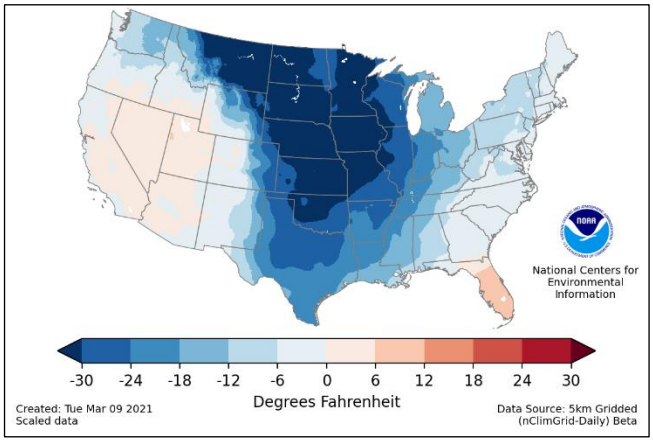
The Polar Vortex: Background and Forecasting

In recent years, broadcast meteorologists and the media have begun using the term *polar vortex* to describe some instances of unseasonable temperatures and storms across the United States during the winter months. The polar vortex is a regular seasonal occurrence, and disruptions to it can cause both milder- and colder-than-average temperatures across North America. For example, in February 2021, the South-Central United States experienced an influx of record-breaking cold air from the north with accompanying snow and ice (**Figure 1**), contributing to over $20 billion in economic losses and more than 220 fatalities. During that event, multiple sectors experienced damage and losses, including agriculture and water and electric utilities, resulting in nearly 10 million Texans without power at one point. Congress has shown interest in protecting life and property from extreme weather events associated with disruptions to the polar vortex and may consider whether to modify the federal government's role in forecasting and researching such events.

Figure 1. Mean Temperature Departures from Average, February 7-21, 2021

Average Period: 1981-2010



Source: National Oceanic and Atmospheric Administration, National Centers for Environmental Information, "Monthly Climate Reports – Synoptic Discussion February 2021."

The Arctic stratospheric polar vortex (hereinafter polar vortex) is a strong band of winds about 10 to 30 miles above the Earth's surface that forms every winter. In typical years, a stable polar vortex and the *polar jet stream* (another band of strong winds, hereinafter jet stream) work together to contain cold air at higher latitudes (**Figure 2**). Every so often, the polar vortex weakens, shifts, or splits into multiple vortices. When this occurs, the jet stream becomes "wavy" and cold air moves south and warm air moves north, producing a disrupted polar vortex. Meteorologists sometimes identify these cold air pulses as *Arctic blasts* or *cold air outbreaks*. The polar vortex and jet stream are two of several simultaneous global atmospheric patterns created by the interaction of the Earth, its tilt, and the sun's rays. Scientists have not observed a long-term trend or pattern in disruptions to the polar vortex. Some models predict that increased warming and reductions in sea ice cover will produce a weaker polar vortex; others predict a stronger polar vortex.

Forecasting

Congress has authorized the Secretary of Commerce, acting through the National Oceanic and Atmospheric Administration's (NOAA's) Administrator, to forecast weather and issue storm warnings (15 U.S.C. §313 and §313 notes). NOAA National Weather Service (NWS) forecasters examine atmospheric conditions at the North Pole and forecast changes to the polar vortex. Forecasters generally are able to predict specific disruptions to the polar vortex a few days to about two weeks ahead of time; the disruption's associated impacts on U.S. weather can last for weeks to months. NOAA forecasters issue watches and warnings for hazards associated with these disruptions, such as extreme cold, freezes, frosts, blizzards, winter storms (snow, ice, sleet, or blowing snow), and ice storms. Forecasters provide their predictions and other services to various stakeholders, such as emergency managers, government partners, members of the media, and the public, to help with preparedness and response efforts.

Research

Congress has directed NOAA and other federal agencies (e.g., National Science Foundation, National Aeronautics and Space Administration) to perform and support research that could address some outstanding research questions. These include the relationships between the polar vortex, other parts of the atmosphere, other global atmospheric patterns, and environmental conditions (e.g., surface temperature and pressure, sea ice cover), as well as the impact of climate change on those patterns and conditions. NOAA historically has funded research at its laboratories and cooperative institutes, such as the Pacific Marine Environmental Laboratory and the Cooperative Institute for Climate, Ocean, and Ecosystem Studies, as well as through competitive grants from NOAA's Office of Oceanic and Atmospheric Research (OAR).

Considerations for Congress

The Trump Administration has taken steps to change NOAA's implementation and support of forecasting and research; Congress may consider whether to take additional steps to codify, modify, or reverse the Administration's actions. The Administration's actions include pausing disbursement of NOAA funds appropriated through P.L. 117-169, commonly referred to as the Inflation Reduction

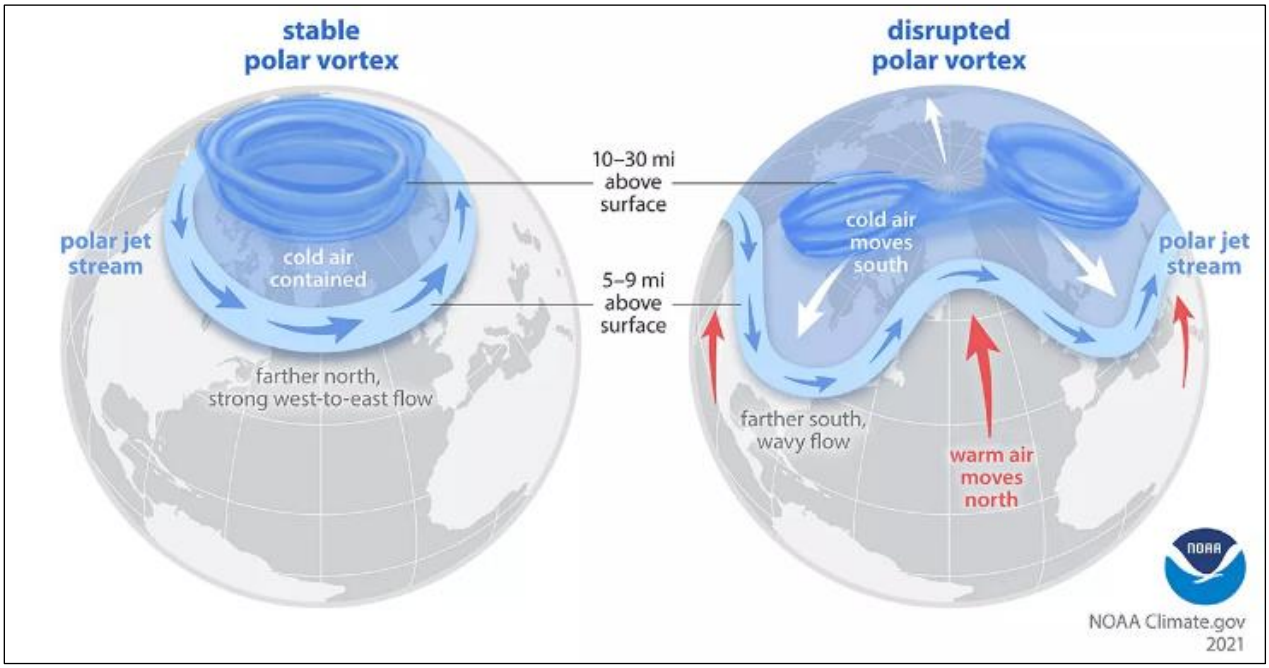
Act of 2022 (IRA), in January 2025 and proposing to eliminate funding for some programs (e.g., climate labs and cooperative institutes, climate competitive research) and to dissolve OAR in FY2026. In July 2025, Congress rescinded unobligated balances of IRA funding for NOAA (P.L. 119-21 §40008). CRS was unable to identify how the Administration's pause and congressional rescission of IRA funds may have specifically impacted NOAA's weather and climate forecasting and research efforts. In January 2026, Congress supported "full staffing levels at all Weather Forecast Offices," provided funding for weather and climate forecasting and research, and retained OAR, as described in the explanatory statement accompanying the FY2026 NOAA appropriations law (P.L. 119-74).

Some may assert that Congress should put greater emphasis on forecasting and researching the impacts of polar vortex disruptions. Congress could do so by directing NOAA to focus on the phenomena in existing programs or create a new standalone program for certain weather events, such as the hurricane forecast improvement program (15 U.S.C. §8514). Others may note that disruptions to the polar vortex and their impacts are already part of NOAA's weather forecasting activities or that extreme events are rare and do not warrant additional attention.

Others may emphasize to Congress that a greater understanding of the relationships between atmospheric and other environmental components broadly could increase the lead time and accuracy of forecasts of both disruptions to the polar vortex and the resulting extreme winter weather, among other phenomena. Improved forecasts could further protect life and property. The 119th Congress is considering directing NOAA to improve weather forecasting broadly across multiple components and timescales (e.g., H.R. 5089, see CRS In Focus IF12698, *Weather Act Reauthorization Act of 2025 (H.R. 3816 and H.R. 5089)*) and may deliberate additional directives.

Congress also could address aspects of polar vortex-related weather forecast communication. For example, scientists have found that the term *polar vortex* is used by the media but that the "use of the term without adequate explanation can suggest a more dramatic change to the global [atmospheric] circulation than has actually occurred." Poor use of the term may cause unnecessary public alarm or, alternatively, may put life and property at risk if the public and emergency managers misunderstand the potential severity of an event. Congress has previously required NOAA to assess and recommend improvements to the communication of hazardous weather events (P.L. 115-25, §406). NOAA continues to update its hazard communications (e.g., cold weather products) and to fund social science research as it relates to improving weather forecast understanding and response (e.g., FY2025 funded projects). Given how the term *polar vortex* is sometimes misused, Congress could direct or encourage NOAA to improve its polar vortex-related weather forecast communication and/or to provide training to its partners, among other actions, to further protect life and property.

Figure 2. Schematic of Stable vs. Disrupted Artic Polar Vortex



Source: Rebecca Lindsey, "Understanding the Arctic Polar Vortex," Climate.gov, March 5, 2021.

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