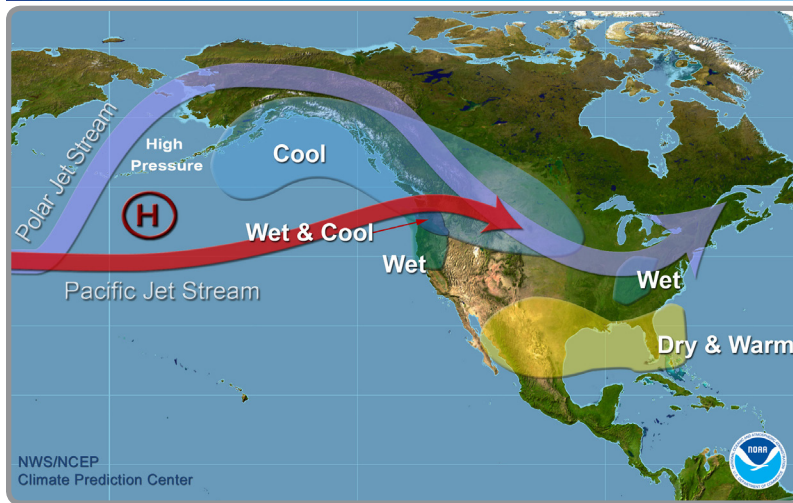


## Typical La Niña Winter Pattern



The image above shows the typical pattern during La Niña winters. High pressure over the eastern North Pacific leads to increased blocking. The polar and Pacific jet streams tend to split around this area of high pressure and join over the Northwest U.S. The jet stream tends to be wave-like but variable, with the active storm track along the northern states. This increases the likelihood of cooler, stormier conditions. Across the southern U.S., conditions tend to be drier and warmer. It is important to note that this is a schematic diagram representing general patterns and is not created from actual data. For more information, please visit: <https://www.climate.gov/news-features/department/enso-blog>.

A La Niña develops when sea surface temperatures are cooler than average in the equatorial Pacific for at least several months, altering tropical rainfall patterns and the global atmospheric circulation. This is important to North America because La Niña has an impact on our weather patterns, most predominantly in the winter.

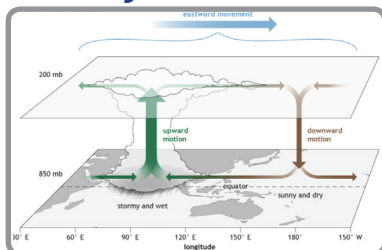
Although each La Niña is different, there are some general patterns that are predictable. The jet stream flow tends to be very wave-like (see figure to left). An area of high pressure over the eastern North Pacific leads to increased blocking. The jet stream strength is variable, but usually enters North America in the northwestern U.S.

This pattern brings increased storminess and above-normal precipitation to the Ohio Valley, as the jet stream steers storms that direction. There is also an increased frequency of cold air outbreaks in the central U.S. There tends to be month-to-month variability in these conditions because the jet stream is more variable. Conversely, southern parts of the Eastern Region tend to experience below-normal precipitation and warmer-than-normal temperatures.

It is more difficult to define conditions in the northern sections of the Eastern Region because of other atmospheric and oceanic influences. This La Niña is expected to be weak and short-lived, so its impacts may be more variable and other factors may dominate the Northeast's weather patterns this winter.

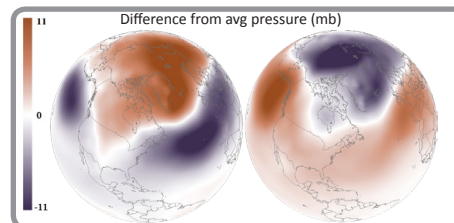
## Other Factors

### Madden-Julian Oscillation



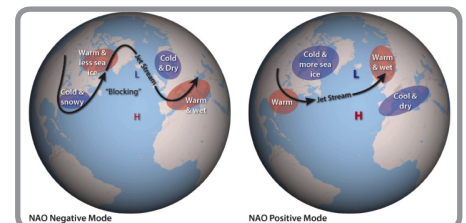
The Madden-Julian Oscillation (MJO) is a tropical disturbance that results in changes in clouds, rainfall, winds, and pressure across much of the global tropics. The disturbance moves eastward with time, traversing the planet in the tropics and returning to its starting point in about 30–60 days. This atmospheric disturbance is distinct from ENSO (El Niño–Southern Oscillation), which once established, is associated with persistent features that last several seasons or longer over the Pacific Ocean basin. There can be multiple MJO events within a season, so the MJO is best described as intraseasonal tropical climate variability (i.e. varies on a week-to-week basis). The MJO can be an important factor during the winter months as it often results in changes in the jet stream. This can impact the storm track, which affects precipitation including snowfall, and often can lead to cold air outbreaks. One way to view the MJO influence on the higher latitudes is to understand that it can produce impacts similar to those of ENSO, but typically only for 1–2 weeks before changing.

### Arctic Oscillation



The Arctic Oscillation (AO) is an important type of climate variability. With its origin in the Northern Hemisphere, it can substantially impact conditions during winter for many areas, including eastern North America. Atmospheric air pressure conditions oscillate between two common patterns. In the positive phase, lower-than-average pressure over the Arctic and higher-than-average pressure over the surrounding region tends to keep cold air locked up within the polar region. When conditions flip to the negative phase, air pressure is higher than average over the Arctic and lower than average over the surrounding regions. This allows cold, dense air from the Arctic to push southward to locations in the middle latitudes. Flips back and forth between the positive and negative phases of the Arctic Oscillation occur routinely and result in changes in the jet stream, which affects temperature and precipitation. The AO is less predictable far in advance, so there is considerable uncertainty as to how much it will impact a given winter season.

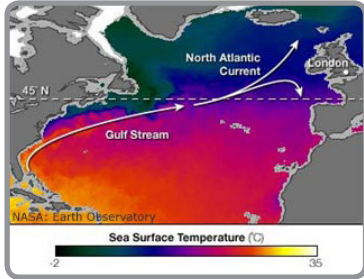
### North Atlantic Oscillation



The North Atlantic Oscillation (NAO), often considered a regional subset of the AO, is a prominent pattern of climate variability that can have a strong influence on weather over northeastern North America, Greenland, and Europe. The high latitudes of the North Atlantic Ocean generally experience lower air pressure than surrounding regions, while air pressure over the central North Atlantic Ocean is generally higher than surrounding regions. Phases of the NAO are defined by higher-than-normal air pressure in one of these regions and lower-than-normal air pressure in the other. These patterns affect weather all around the Atlantic by influencing the intensity and location of the jet stream and the storm tracks that follow it. During the positive phase, the eastern U.S. tends to be warmer and drier than average, while during the negative phase, cold and wetter (or snowier) conditions are observed. The NAO is less predictable far in advance, so there is considerable uncertainty as to how much it will impact a given winter season.

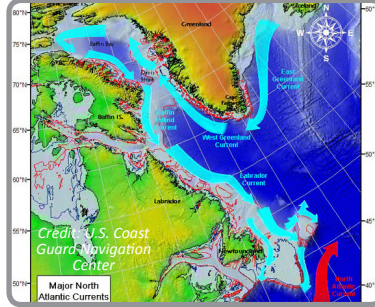
# Ocean Patterns

## Gulf Stream



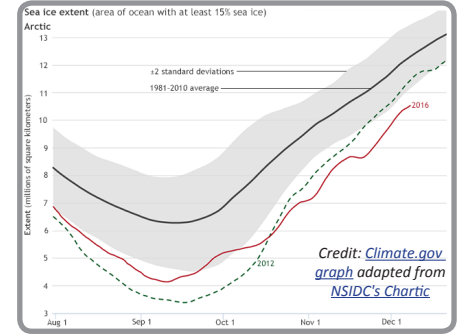
The Gulf Stream carries warm, salty water northward along the Northeast Shelf (Gulf of Maine to Cape Hatteras, NC), bringing heat from the tropics to higher latitudes. Shifts in its position are correlated with atmospheric fluctuations, including changes in wind and density that are [associated with the NAO](#). The northward and landward extent of warm Gulf Stream waters affects ecological processes in the ocean, including the distribution of commercially important fish species. It also affects weather in the region. The Gulf Stream returns a considerable amount of heat to the atmosphere. [Nor'easters are fueled](#) by the meeting of cold Arctic air from land and warm air over the Gulf Stream and coastal waters. The trajectory of the Gulf Stream also influences storm tracks in the North Atlantic.

## Labrador Current



The Labrador Current brings cold, fresh water from the north to the Northeast Shelf via the Gulf of Maine. The [NAO and AO influence](#) the volume of Labrador Current flow and shape interactions between the Labrador Current and the Gulf Stream. When the NAO is in a negative phase, volume transport of the Labrador Current is high, and its influence extends into the Mid-Atlantic. Persistent positive AO conditions have been associated with the release of large pulses of low salinity water that are transported southward by the Labrador Current. The strength of Labrador Current relative to the Gulf Stream has important implications for the ecology of the region, influencing bottom temperatures, layers in the water column, and species present.

## Arctic Sea Ice

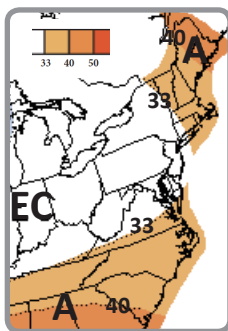


The extent of Arctic sea ice is currently at the [lowest level](#) ever observed during this time of year since satellite data records began in 1978. Further, the timing of seasonal freeze-up is currently 4–6 weeks behind the typical schedule due to exceptionally warm air temperatures over the Arctic Ocean. Atmospheric scientists are only beginning to understand how low coverage of Arctic sea ice can influence weather in the Northeast Shelf region. In a few studies, loss of Arctic sea ice has been linked to a [weakening in the polar vortex](#), which could make it easier for cold Arctic air masses to spill southward and lead to severe outbreaks of cold weather and snowfall in the middle latitudes.

## Outlooks

### Winter Temperature and Precipitation Outlooks

The Climate Prediction Center's ENSO temperature and precipitation composites show that during winter, La Niña tends to slightly tip the scale towards cooler-than-normal temperatures in the Northeast and warmer-than-normal temperatures in the Southeast. For precipitation, the Ohio Valley, including West Virginia and western Pennsylvania, tend to be wetter than normal, while New Jersey through the Carolinas tends to be drier than normal. Northern New England and portions of New York can be snowier than usual, while the Mid-Atlantic tends to be less snowy. These composites can be found here: <http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ENSO/composites>.

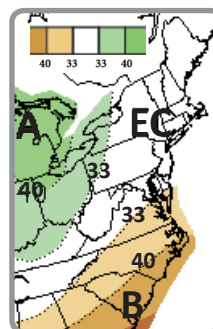


Climate Prediction Center's temperature outlook for winter issued on November 17.

**A:** Above-normal  
**B:** Below-normal  
**EC:** Equal chances of above-, near, or below-normal  
**Number:** Probability of above- or below-normal

The winter outlooks resemble La Niña temperature and precipitation anomaly patterns for the region; however, probabilities on the map are more conservative due to the uncertainty associated with the favored strength and longevity of this La Niña event. The above-normal precipitation that is favored for the Ohio Valley extends into northwestern Pennsylvania and western New York, while below-normal precipitation is likely for the Carolinas and southern Virginia. Meanwhile, the temperature outlook indicates that southern parts of the Eastern Region are more likely to experience above-normal temperatures. In New England, increased chances for warmer-than-normal temperatures are primarily linked to long-term climate trends. Equal chances were forecast in areas where climate signals are not as strong or historically reliable. These areas have a 33.3% chance each of above-, near, or below-normal seasonal total precipitation and/or seasonal mean temperatures. The seasonal outlooks above combine many factors including dynamical models and the effects of long-term trends, in addition to past La Niña patterns. Therefore, they may not match typical La Niña conditions exactly. Also, other factors can affect winter conditions,

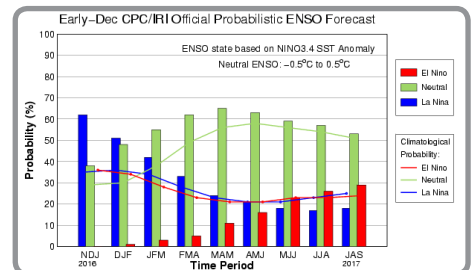
such as pre-existing global snow cover patterns or climate variability such as the MJO, AO, and NAO. To learn more about these outlooks or see the latest temperature, precipitation, and drought outlooks, please visit the Climate Prediction Center at: <http://www.cpc.ncep.noaa.gov>.



Climate Prediction Center's winter precipitation outlook issued on November 17.

### La Niña Strength

Winter 2016–2017



Atmospheric and oceanic observations through November 2016 and the mean of the [IRI forecast plume values](#) thereafter favor weak La Niña conditions through winter 2016–17, transitioning to ENSO-neutral conditions during January–March 2017.

## Eastern Region Partners

- National Oceanic and Atmospheric Administration  
[www.noaa.gov](http://www.noaa.gov)
- National Centers for Environmental Information  
[www.ncei.noaa.gov](http://www.ncei.noaa.gov)
- National Weather Service, Eastern Region  
[www.weather.gov](http://www.weather.gov)  
[www.weather.gov/climate](http://www.weather.gov/climate)
- NOAA Fisheries Science Centers and Regional Offices, Atlantic  
[www.nmfs.noaa.gov](http://www.nmfs.noaa.gov)
- Climate Prediction Center  
[www.cpc.ncep.noaa.gov](http://www.cpc.ncep.noaa.gov)
- Northeast Regional Climate Center  
[www.nrcc.cornell.edu](http://www.nrcc.cornell.edu)
- Cooperative Institute for North Atlantic Research  
[www.cinar.org](http://www.cinar.org)
- Gulf of Maine Research Institute  
[www.gmri.org](http://www.gmri.org)

