

Transcript for Sudden Stratospheric Warming video

Link to video: [Sudden Stratospheric Warming](#)

First discovered in 1952, the term **Sudden Stratospheric Warming** has become infamous in the last few years due to media coverage on the extreme cold weather it can sometimes bring. A sudden stratospheric warming of the atmosphere refers to a rapid rise in temperatures in the stratosphere. SSWs are naturally occurring events, but how do they occur and how can rising temperatures at high altitude bring cold weather down to us?

Starting with the layers of the atmosphere, the stratosphere sits above the troposphere and extends between approximately 10km and 50km. This is the home of the ozone layer which is essential for protecting us from damaging UV radiation from the Sun. By absorbing sunlight through its ozone layer, the stratosphere above the North Pole heats up during the summer. Then, when the polar stratosphere tilts away from the Sun during the winter, the air above the pole becomes extremely cold becoming as low as minus 80 Celsius by December.

Circulating around this cold pool is the **stratospheric polar vortex** with an area of low pressure at its centre. The vortex appears each winter in the stratosphere above the Arctic and exists until sunlight returns to the polar regions in the following spring. Due to the high temperature difference between the cold polar air and the warmer air at mid-latitudes a jet stream flows around the perimeter of the vortex known as the **Polar Night Jet**. This jet helps to lock the cooler air in place within the stratospheric polar vortex. The Polar Night Jet moves west to east in tandem with our own, more familiar, jet stream some 20km below.

Sometimes the usual westerly flow can be disrupted. These disruptions are caused by upward-travelling planetary waves, also known as **Rossby Waves**. These are giant meanders in high-altitude winds and occur in the atmosphere due to the Earth's rotation. These types of waves are generated by flow over mountains and continental land-sea contrasts. They can also be generated by year-to-year changes in large-scale weather patterns such as El Niño. With larger landmasses in the Northern Hemisphere compared to the Southern Hemisphere this leads to more Rossby waves and so SSW events are largely a Northern Hemisphere-focussed phenomenon. There is only one known exception to this; in September 2002, major warming was observed for the first time in the stratosphere in the Southern Hemisphere.

Only Rossby waves with the greatest spatial scales are able to spread upward into the stratosphere. When the Rossby waves are strong, their amplitudes grow with height into the stratosphere where the waves break, just like on a beach. The breaking waves exert a drag on the Polar Night Jet, which weakens and distorts it. If the waves are strong enough, they may decelerate the jet sufficiently so that the westerlies turn easterly. Such a change in airflow disrupts the stratospheric polar vortex either by displacing it from its normal location over the pole or by splitting it into two daughter vortices.

Winds within the weakened jet slow down and turn towards the centre of the vortex. As the air converges in the centre of the vortex, it must then descend. This descent causes the air to compress and its temperature rises dramatically, sometimes by more than 50 Celsius in just a few days. This descent also increases the pressure above the North Pole. Over the following weeks, the action of further Rossby waves allow the easterly winds to burrow down through the stratosphere. When they reach the tropopause, they often weaken Atlantic weather systems and the jet stream.

We normally expect our weather to come in from the west, with a flow of relatively mild air coming in off the Atlantic. But a weaker jet stream means less flow of mild Atlantic air and increases the likelihood of cold northerly or easterly outbreaks in the winter. Sudden Stratospheric Warming **does not** always result in this outcome – but a cold snap follows more often than not so these events greatly increase the risk of wintry weather.