



The Impact of Stratospheric Sudden Warmings on Earth Rotation

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Stratospheric sudden warmings (SSWs) are an extremely dramatic phenomenon in the polar winter stratosphere, characterized by a rapid warming and concomitant reversal of polar vortex winds from westerly to easterly, over the course of a few days. Major warmings can induce anomalous winds far outside the polar region, and the polar wind and temperature anomaly can eventually propagate downward into the troposphere, where they can strongly affect the surface weather.

Since SSWs represent a sudden change in both winds and the distribution of atmospheric mass, they have the potential to significantly alter the rate of Earth rotation, as well as the orientation of its rotational axis, by exchange of angular momentum. In this study we composite the observed length-of-day and polar motion anomalies associated with the SSWs of the last 50 years, and show that, on average, SSWs have a noticeable effect on Earth rotation. We further use reanalysis data to investigate the mechanisms by which this happens. It is found that SSWs tend to cause a rapid decline, followed by a more gradual rise, in the length-of-day, due to anomalous winds induced in the tropics. One of the two polar motion angles shows significant negative anomalies before a warming event, followed by weak positive anomalies after, due to the mass distribution changes that typically precede / follow SSW events.