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Increased Predictability of Sudden Stratospheric Warmings

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This work explores current knowledge of the Sudden Stratospheric Warming (SSW) lifecycle to find indicators of enhanced probability of future SSW occurrence. Using a nearly ten thousand year integration of the CM2.1 coupled climate model, we show that anomalously strong upward wave activity in the lower stratosphere (100hPa) increases the probability of an SSW happening within the following week by almost an order of magnitude. The second component of the SSW lifecycle considered here is the stratospheric meridional potential vorticity (PV) gradient, which has been shown to steepen in the build up of SSWs. Using the PV gradient as indicator impacts the probability of future SSWs in two different ways: First, if the PV gradient is anomalously weak, the SSW probability is enhanced during the following week, but diminished thereafter. Second, if the PV gradient is anomalously strong, SSWs are greatly suppressed during the following week, but the SSW probability is enhanced over the long term (from three weeks up to the entire rest of the winter season ahead). Finally, the study shows that if both events are combined (i.e. enhanced upward wave flux plus stratospheric PV gradient), all effects described above can be enhanced, and short- as well as long term probabilities of occurrence of SSWs are much larger than if one only uses climatological (day of year) data, and it is also larger than using only one of the two variables independently.