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Impact of the extratropical cyclone over the North Pacific on the onset of Sudden Stratospheric Warming: A case study of 2021

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The role of the midlatitude cyclone on the onset of January 2021 sudden stratospheric warming (SSW) is examined by conducting a set of numerical model experiments. The control simulation initialized on 26th December 2020, 10 days before the SSW onset, successfully reproduces the spatio-temporal evolution of SSW. Since this event is preceded by the developing cyclone over the North Pacific, its impact is tested by initializing the model without cyclonic anomaly, over the North Pacific (20°–80°N, 110°E–160°W) from 1000 hPa to 150 hPa. The potential vorticity inversion technique is used to modify the initial condition. This perturbed simulation shows much weaker polar-vortex deceleration than the control simulation resulting in no distinct SSW onset. Such a difference is attributable to the fact that constructive linear interference between the climatological wave and the North Pacific cyclone is reduced in the perturbed simulation. It weakens the upward propagation of wavenumber one into the stratosphere, thereby reducing the breaking of the planetary-scale waves in the polar stratosphere.