# Formation Mechanism for a Front-like Temperature Structure during a stratospheric sudden warming event in 2016

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A front-like temperature structure is observed in the Arctic stratosphere during a stratospheric sudden warming (SSW) event in February 2016. Previous studies have reported that such a structure (i.e., a narrow baroclinic zone) develops in a significant temperature enhancement event in the stratosphere including SSW events (e.g., Fairlie et al. 1990; Manney et al. 1994, 2005; Thayer et al. 2010). This study aims to examine the behavior and formation mechanism of the stratospheric front by using MERRA-2 reanalysis data in the time period of January to March 2016.

The front is formed near a jet streak along the polar vortex edge in the middle to upper stratosphere and is vertically tilted to a colder region. Horizontal gradient of potential temperature in the front area is the strongest two days prior to the central day of the warming, when a local maximum of potential temperature appears in the exit region of the jet streak. It is shown from an analysis of potential vorticity (PV) on an isentropic surface that a narrow low PV air enters into the polar region due to advection by the cyclonic circulation of the polar vortex when the vortex shifts to the lower latitude region associated with an increase of the wavenumber-1 Rossby wave amplitude. It is suggested that the intrusion of the low PV air is responsible to the jet streak formed near the front prior to the SSW event. To examine a formation mechanism of the stratospheric front, Q-vector and frontogenesis function in the semi-geostrophic equations are calculated. During the frontogenesis, ageostrophic secondary circulation develops in the exit region of the jet streak. The vertical component of the ageostrophic term of the frontogenesis function has a large positive value near the front. Adiabatic heating and cooling due to the vertical motion associated with the secondary circulation increases the horizontal gradient of potential temperature. This is likely a main process for strengthening the stratospheric front. It is suggested that the frontogenetic effect of the vertical motion would work more efficiently during SSW events because the vertical gradient of potential temperature is larger in the wave structure tilting to the colder region. The formation mechanism of the stratospheric front described above is different from that of the tropospheric front formed near the ground where vertical motion is suppressed.

**References**

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