

## On the extremely strong sudden stratospheric warming event in the Arctic in February 2018

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As of February 18, 2018, an extremely strong, possibly the largest ever, sudden stratospheric warming (SSW) event is ongoing in the Arctic. Characteristics of this event, which can be confirmed with the temperature and geopotential height data by Aura MLS until February 14, stratospheric preliminary report diagrams by Japan Meteorological Agency up to February 15, and stratospheric predictions by ECMWF until February 27, are reported. This SSW is a vortex splitting type, and was satisfied the major warming criterion on February 12. It is expected that the major warming criterion will be met until February 27 at the shortest.

The easterly wind in the stratosphere in the high latitude region of the northern hemisphere is strong, reaching 40 m/s at about 60 degree N on February 14. The low latitude extension of this easterly region is large, the lower end of which is located at about 40 degrees N at an altitude of about 35 km (5 hPa) on February 15. A 10 m/s contour of the easterly winds reaches at least the height of 80 km in the mesosphere, and on the other hand, the easterly winds reaching 5 m/s is observed in the whole troposphere to the north of 70 degree N. Thus, this major SSW is characterized by a widely expanded easterly wind region in the latitude-height section.

The upward EP flux at 100 hPa associated with the Rossby waves, which are thought to have caused this SSW event, became strong from around February 3 and was maximized during February 6 to 12. The strong EP-flux state is ongoing (at least until February 15). Interestingly, there is strong upward EP flux even in the strong easterly wind region which is seen from February 12 to 15. This is a feature contrary to Charney & Drazin's theorem. It probably reflects the existence of a longitude region, in which the Rossby wave can propagate, and this will be able to be elucidated by analyzing the three-dimensional wave activity flux when the needed data are complete in future. Another notable feature is that there is a relatively strong equatorward EP flux at 10 hPa to 5 hPa in the latitudes lower than 40 degree N. This is likely due to a modified refractive index structure of the Rossby wave associated with the easterly wind spreading in the middle and high latitudes. This momentum transport by Rossby waves may affect the quasi-biennial oscillation in the equatorial stratosphere. Furthermore, the scale of this SSW event is comparable to that of the SSWs followed by the elevated stratopause event that occurred in 2006, 2009 and 2013. Thus, there is a possibility that an elevated stratopause may appear as well in the near future.

Since it is expected that we have all the data necessary for the analysis until the meeting of JpGU2018, and we will be able to report the entire and more detailed features of this SSW event. In addition, an international observation campaign utilizing a high-resolution radar network in the mesosphere is also on going. There is a possibility that the modulation of gravity waves, which predominantly affect dynamical features of the mesosphere in association with the SSW will be captured.

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