

Mukougawa, H., S. Noguchi, Y. Kuroda, and R. Mizuta, 2022: On the existence of the predictability barrier in the wintertime stratospheric polar vortex: Intercomparison of two stratospheric sudden warmings in 2009 and 2010 winters. *J. Meteor. Soc. Japan*, **100**.
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Plain Language Summary: This study examines the predictability of two stratospheric sudden warming (SSW) events occurring in 2009 and 2010 by conducting ensemble forecasts using an Atmospheric General Circulation Model (AGCM) combined with linear stability analysis of zonally-asymmetric ensemble mean fields using a nondivergent barotropic vorticity equation. The 2009 (2010) event has characteristics of vortex-splitting (vortex-displacement) SSW.

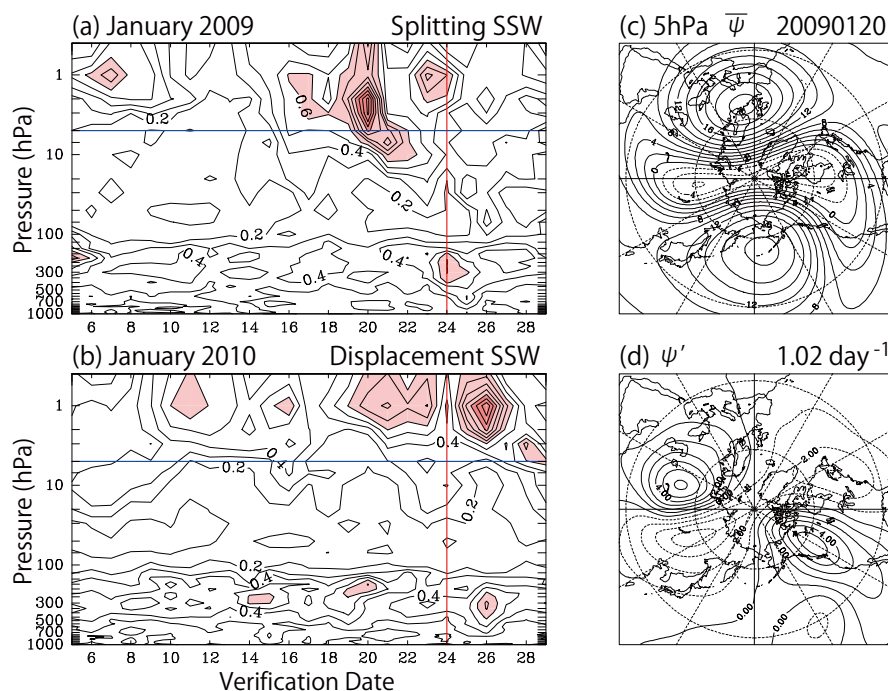


Figure 1. Growth rate (day⁻¹) of the most unstable modes computed for zonally-asymmetric fields at each pressure level (the ordinate) of the 4-day ensemble mean forecasts in January 2009 (a) and January 2010 (b). The abscissa is the verification date for each forecast. The red vertical line denotes the onset date of each SSW (24 January), and the blue horizontal line represents 5 hPa. Horizontal structure of the 5 hPa stream function field ($10^6 \text{ m}^2 \text{ s}^{-1}$) of the 4-day ensemble mean forecast on 20 January 2009 (c) and the obtained most unstable mode (d), which has an extremely large growth rate of 1.02 day^{-1} .

- The predictable period of the 2009 SSW is about 7 days which is much shorter than that of the 2010 SSW. The latter event is predictable more than 13 days.
- The distorted polar vortex in the upper stratosphere just before the onset of the 2009 SSW is highly unstable, whereas such unstable modes are absent in the stratosphere for the 2010 SSW.
- A predictability barrier inherent in the upper stratospheric circulation characterized by the unstable modes with large growth rates limits the predictable period of the 2009 SSW.