Definition of Stratospheric Sudden Warming for Multi-Model Analysis and its Application to the CMIP5 models

Junsu Kim[1], Seok-Woo Son[1], and Hyo-Seok Park[2]

[1]School of Earth and Environmental Sciences, Seoul National University, Seoul, South Korea

[2]Korea Institute of Geoscience and Mineral Resources, Daejeon, South Korea

An alternative definition of major stratospheric sudden warming (SSWs) and its application to climate models are investigated. Specifically, the tendency of the zonal mean zonal wind, such as the rapid weakening of upper level westerly, is used to identify SSW events. This is different from the conventional method, which defines SSW events using the threshold value of zonal mean zonal wind (i.e., 0 m s^{-1}). The SSW event captured by this tendency-based definition is generally independent of the climatological zonal mean zonal wind speed that varies widely among climate models. The models are further grouped into the high-top models with a well-resolved stratosphere and low-top models with a relatively simple stratosphere. Consistent with previous studies, high-top models well capture the SSW frequency while low-top models somewhat underestimate it. However, the underestimation of SSW frequency by low-top models is moderate compared to previous studies, which define SSW events using the conventional method. Moreover, planetary wave activity does not exhibit significant difference between them. These results indicate that the sensitivity of the SSW frequency and the associated downward coupling between the stratosphere and the troposphere to the model's vertical resolution, which is reported in the literature, may be realistic. Finally, this tendency-based SSW definition suggests that the SSW frequency is likely to remain unchanged in the projections of future climate change.

Key words: stratospheric sudden warming, CMIP5, SSW definition