Comparison of large-scale dynamical variations in the extratropical stratosphere among the JRA-55 family datasets

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This study seeks to compare the “JRA-55 family” datasets in terms of the extratropical stratospheric and tropospheric circulation in both hemispheres. In particular, we explore large-scale dynamical variations such as stratospheric sudden warmings (SSWs) during NH winter and SH spring when the extratropical stratosphere is dynamically active.
The JRA-55 family consists of three datasets: a main product of the JRA-55 reanalysis data (referred to as STDD below), and two sub-products of JRA-55C and JRA-55AMIP (referred to as CONV and AMIP, respectively). CONV assimilates only conventional observations, whereas AMIP runs the same numerical weather prediction (NWP) model without assimilation of observational data. Kobayashi et al. (2014) reported preliminary results from these data, such as cold bias in the SH winter upper stratosphere (i.e., strong polar night jet bias) for CONV and AMIP compared to STDD.
Our comparison of AMIP to STDD reveals characteristic features of AMIP in frequency and vortex morphology of major SSWs during NH winter: AMIP shows a much smaller frequency, and has only vortex displacement events. These differences are contributed by two factors. First, the fixed threshold, or zonal wind reversal, for the major SSWs is disadvantageous to AMIP where the polar night jet is strong more often. Furthermore, the zonal wind response to planetary wave activity bursts in the lower stratosphere of a similar strength is weaker in AMIP than in STDD. This is particularly the case when wave 2 plays an important role. As for SH spring, large variability occurs later in AMIP than in STDD; e.g., AMIP exhibits no zonal wind reversal before late October
It is also found that CONV reproduces most of the DJF major SSWs identified in STDD, although some cases are identified a few days later or missed. In SH spring, CONV misses the major SSW in September 2002, as it, albeit slightly, underestimates the zonal wind deceleration. These differences of CONV would be understood by the bias of the NWP model (as seen in AMIP) and the paucity of data assimilation as hypothesized by Kobayashi et al. (2014).

Keywords: JRA-55 family datasets, Stratospheric sudden warmings

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