Stratospheric age of air in NIES-TM and ACTM

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The stratospheric response to climate forcing is often unpredictable due to interaction between radiation, dynamics and chemistry. Stratospheric change such as the decadal increase of water vapor in turn drives global scale surface warming (Solomon et al. 2010). The difficulty in studying the stratospheric change is understood by the fact that long-term trend of the strength of Brewer-Dobson circulation (BDC) remains inconsistent between diagnoses in climate models and estimates from tracer observations (Engel et al. 2017). In the present study, we focus on the strength of the BDC commonly quantified by the age of air, the stratospheric transit time since the entry of air from the troposphere. Due to multiple circulation pathways, any air parcel is composed of air elements that have different age, which is expressed by the age spectrum (Kida 1983; Hall and Plumb 1994; Waugh and Hall 2002). The age spectra are estimated by applying the Boundary Impulse Response method (Haine et al. 2008; Li et al. 2012) to the transport fields of National Institute for Environmental Studies Transport Model (NIES TM) driven by JRA-25 and Center for Climate System Research/National Institute for Environmental Studies/Frontier Research Center for Global Change atmospheric general circulation model (AGCM)-based chemistry transport model (ACTM) nudged to ERA-Interim. The age spectra and mean age of stratospheric air are discussed by comparing the results simulated by both models. The effect of nudging on diffusive mixing is being explored by comparing with free run simulations.