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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Using beryllium-7 to assess cross-tropopause transport in global models" *by* H. Liu et al.

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We thank Meiyun Lin for her comments. Our responses are itemized below.

1. "This is an interesting paper on the uncertainties in simulating STE in global models, especially with regard to global mean cross-tropopause flux. However, I believe your introduction and discussion sections will be more complete if you could place your study in the context of recent new findings on stratospheric influence on tropospheric ozone, particularly on high surface ozone events in the western United States [Langford et al., 2009; Lin et al., 2012]. A recent work by Lin et al. [2015, Nature Geoscience] shows that deep stratospheric intrusions can explain much of the year-to-year variability of springtime high surface ozone events measured at western US high-elevation sites

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during 1990-2012".

Reply – Thanks for the suggestion. We now state in the Introduction section that "Ozone is an important greenhouse gas, especially in the upper troposphere. It is a harmful pollutant near the surface where stratospheric ozone intrusions may make significant contributions (e.g., Lin et al., 2012, 2015; Langford et al., 2014)."

2. "Large interannual variability in STE can confound the attribution of observed tropospheric ozone changes to human-induced emission trends [Lin et al., 2015; GRL]. There is great current interest to better understand the stratospheric influence on tropospheric ozone variability observed over the past few decades [e.g. Hess et al., 2015; Strode et al., 2015]. However, different models can do very differently in terms of STE and thus their simulation of tropospheric ozone interannual variability. Can you discuss if beryllium-7 can provide constraints on interannual variability of STE simulated in the model?"

Reply – We now state in the last paragraph that ".....This can serve as a first-order assessment of cross-tropopause transport in the meteorological fields. With improved estimates of 7Be production rates as well as their year-to-year variations, model multi-year 7Be simulations together with long-term observations would provide useful constraints on the interannual variability of STE. While this study uses 7Be alone, future modeling work will include using 10Be/7Be, a more sensitive indicator of STE (Rehfeld and Heimann, 1995; Koch and Rind, 1998; Jordan et al., 2003)."

3. "Most discussions on STE in your introduction section are based on the models with linoz or synoz chemistry, but there are recent model developments with interactive strat-trop chemistry at higher horizontal resolution (e.g., 50 km), which may be important to realistically simulate stratospheric intrusion events [e.g., Lin et al., 2012; Langford et al., 2014]."

Reply – We now state in the Introduction section that "Observation-based estimates of STE fluxes of ozone into the troposphere are typically in the range of 400-600 Tg/year

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(Murphy and Fahey, 1994). Some global models are able to produce STE fluxes of ozone in this range (e.g., Olsen et al., 2004; Hsu et al., 2005; Hsu and Prather, 2009; Lin et al., 2012; Young et al., 2013; Skerlak et al., 2014).” and “. . .. . .Nevertheless, using Linoz (or full stratospheric chemistry) in global CTMs or chemistry-climate models that focus on the troposphere requires a realistic model representation of net cross-tropopause total mass fluxes. In this context, 7Be tracer simulations may provide a simple way of evaluating cross-tropopause transport in these models.”

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 26131, 2015.

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