REVIEWER#3

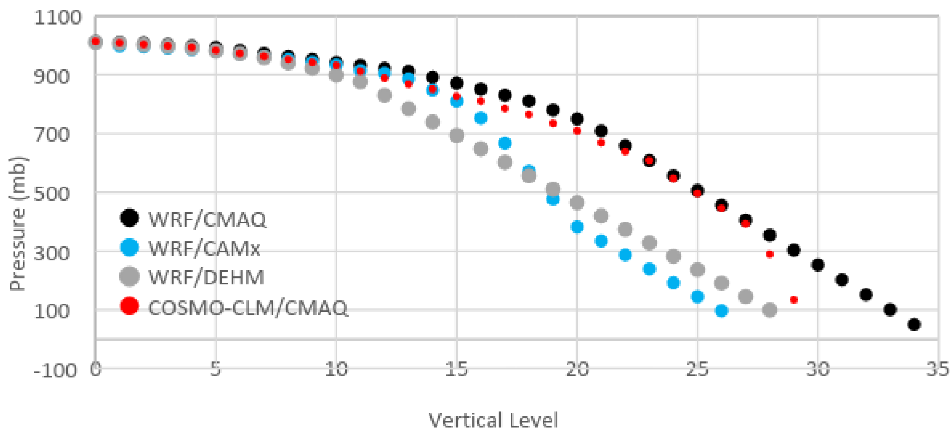
The manuscript provides multi-model simulations of ozone profiles for a number of observational sites in the United States and Europe and validates the model results. The models seem to underestimate ozone up to 6 km. For stratospheric intrusions, the ozone maxima are also underestimated between 2 and 6 km.

It is difficult to judge where the advances of this study are. There have been numerous modelling efforts for evaluating the ozone budget in the more recent past such as (Stevenson et al., 2006), (Wild, 2007), (Young et al., 2013), or (Knowland et al., 2017). None of these papers are cited or included in the discussion. Spatial resolution is an important issue (e.g., Roelofs et al., 2003; Eastman and Jacob, 2016), and at least a good horizontal resolution of 0.25° × 0.25° is reported. However, no information on the vertical resolution is given in Sec. 2.1. In Sec. 2.2 an interpolation to 18 "standard vertical heights" up to 18000 m is mentioned. This kind of grid does not allow one to resolve narrow atmospheric layers. For this reason, also the value of the figures shown is limited. There is a host of literature on stratosphere-to-troposphere transport after the 2003 review by Stohl et al., in particular from North America, Europe and East Asia (have a look at papers citing the review paper!), also discussing the role of mixing (Trickl et al., 2014; 2016).

In summary, I cannot recommend publishing this manuscript in the current version.

<u>Authors' Response:</u> We would like to thank the reviewer for providing these references. However, we need to note that this study did not include any global atmospheric chemistry models neither a European domain. All of the mentioned publications discuss global modeling of ozone (tropospheric and stratospheric), primarily for Europe. Our study focuses on vertical ozone distribution and stratospheric intrusions over North America, with four research groups from the US and Europe providing year-long regional scale simulations (Fig. 1a). The horizontal grid spacing of all modeling systems ranges from 12 to 24 km (Table 1) and the vertical grid spacing varies depending on the model (information on the vertical resolution is included in Table 1). The 18 standard vertical layers mentioned in the manuscript are used to compare model outputs with ozonesonde data as these layers align better with the ozonesonde launches. Model data was interpolated from each native model grid to those 18 layers.

The vertical resolution of each model is given in a recent publication of Liu et al. (2018) and shown below:



AQMEII Phase 3 (AQMEII3) is devoted to performing joint modelling experiments with HTAP2. The AQMEII modelling community (Table 5) includes almost all of the major existing modelling systems for regional-scale chemical transport simulation in research and regulatory applications on both continents. Most of the groups participating are part of modelling initiatives in the individual European member states, and some of these groups utilize models developed in North America, thus providing the opportunity of assessing the application of these models outside of their conventional modelling context.

The unique configuration of the model simulations conducted under AQMEII3 is that "*common anthropogenic emission inventories and lateral chemical boundary conditions were implemented by all modeling groups, which helps us further investigate model-to-model variability and performance evaluation for the vertical distribution of ozone mixing ratios*." Our contribution to the scientific knowledge of modeled ozone vertical profiles in the regional scale is new information about how different meteorological drivers, air quality models, grid resolution, and lateral boundary conditions influence the seasonal depiction of ozone vertical profiles. This information can help model developers improve model performance by looking at specific processes and configurations.

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