Response to Dr. Russ Schnell – We are grateful to you for providing these references. The inclusion of Hansen and Rosen, 1984; 1985, Hansen and Novakov, 1989 and Hansen et al., 1997 help us to present an improved perspective on Arctic BC. Besides two additions to the introduction, the following has been revised/added as lines 383-397 of the current revised manuscript:

Using version 10.01 of GEOS-Chem (without TOMAS) and its adjoint, Xu et al. (2017) found that BC corresponding to these observations was dominated by sources from eastern and southern Asia. Xi et al. (2017) also found better agreement of modelled BC with these observations; although the same version of GEOS-Chem is used here, all biomass burning emissions were injected only within the boundary layer, potentially accounting for some of the lower modelled BC relative to rBC. The relative increase in rBC in the 600-900 hPa region is consistent with the mean profiles of McNaughton et al. (2011), and the median observed rBC concentration in the 600-900 hPa range is similar to the mode concentration of normally distributed values for "free tropospheric background haze" of 0.06 μg m^{-3} estimated by Brock et al. (2011). The present result is considerably lower than the medians of 0.1-0.5 μg m^{-3} measured in the Arctic in 1983 (Hansen and Rosen, 1984), 1986 (Hansen and Novakov, 1989) and 1992 (Hansen et al., 1997). A decrease in BC at Alert, Nunavut, during the 1990s of more than 50% was associated with a reduction in Eurasian emissions (e.g. Sharma et al., 2019), and the present lower rBC concentrations near the surface may be connected to that reduction. Since east Asian emissions increased during the same time (e.g. van Donkelaar et al., 2008), it is difficult to assess the reason for the present lower concentrations in the 600-900 hPa range. It appears that the present observations represent particles that spent a considerable length of time in the Arctic atmosphere.