I am reluctant to wade in here but feel the need to clarify an issue under discussion. I am in the process of submitting a reply to Dr. Ansmann's comment on my JGR paper describing Raikoke sulfate aerosols (referenced in his comment to the Vernier et al. paper), where I will make the case that aerosols in the Arctic following the Raikoke eruption are predominately sulfates and not smoke. I would advise people to wait for that reply before drawing any final conclusions on the subject. The Ansmann comment on the Vernier et al. paper leans heavily on a perceived significant discrepancy with the evolution of sulfate aerosols from the Sarychev eruption, but if one looks at measurements of both events, there is no such discrepancy.

Both Raikoke and Sarychev are located around latitude 48 °N. Raikoke erupted June 22nd, 2019, while Sarychev erupted June 11-21, 2009, the same time of year. One would expect the evolution of sulfate aerosols following the eruption to be quite similar for the two events. Figure 1 shows the monthly average ACE-Imager 1.02 µm extinction profiles (which can be used as a proxy for aerosol loading) for the latitude range 60-75 °N, looking at the variation over time for the periods following the two eruptions. In each panel, a profile from a different year is included to give a sense of what the extinction would be in the absence of elevated aerosols. The extinction from Raikoke is larger because it was a larger eruption, but changes in aerosol loading as a function of time for the two events track each other very well. The Ansmann comment gives the impression that Sarychev sulfate aerosols are completely gone in a few months, but they remain elevated for close to a year after the eruption, just like Raikoke.

As a means of independent verification, Figure 2 shows average extinction plots for 750 nm for the latitude range 77-83 °N from the OSIRIS instrument on Odin, another instrument that measured aerosols following both eruptions (https://research-groups.usask.ca/osiris/data-products.php). The results are in generally good agreement with the ACE observations. OSIRIS has no measurements at high northern latitudes between October and March, but there remains a clear enhancement in aerosol levels in March 2010, 9 months after the Sarychev eruption.

According to the arguments presented by Dr. Ansmann in the comment to my JGR paper on Raikoke, extinction by Sarychev sulfate aerosols should be more than a factor of 4 smaller than that for Raikoke by October. That effect is not evident in either the ACE or the OSIRIS measurements.

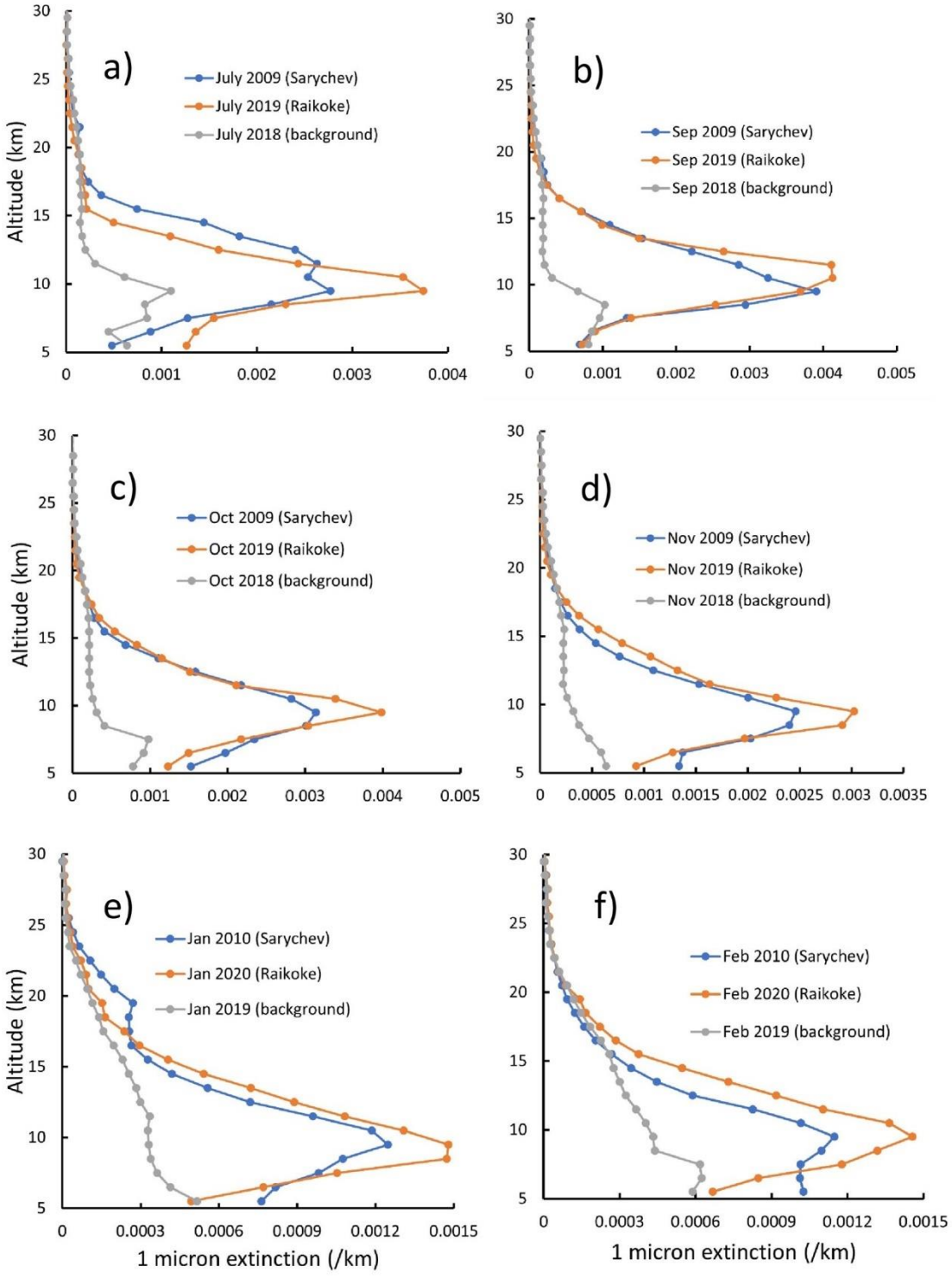

Figure 1: Average ACE-Imager 1.02 µm aerosol extinction in the latitude region 60-75 °N for the periods following the Sarychev and Raikoke eruptions, along with a profile showing extinction where aerosols were closer to background levels. a) July. b) September. c) October. d) November. e) January. f) February. Note the different horizontal scales.

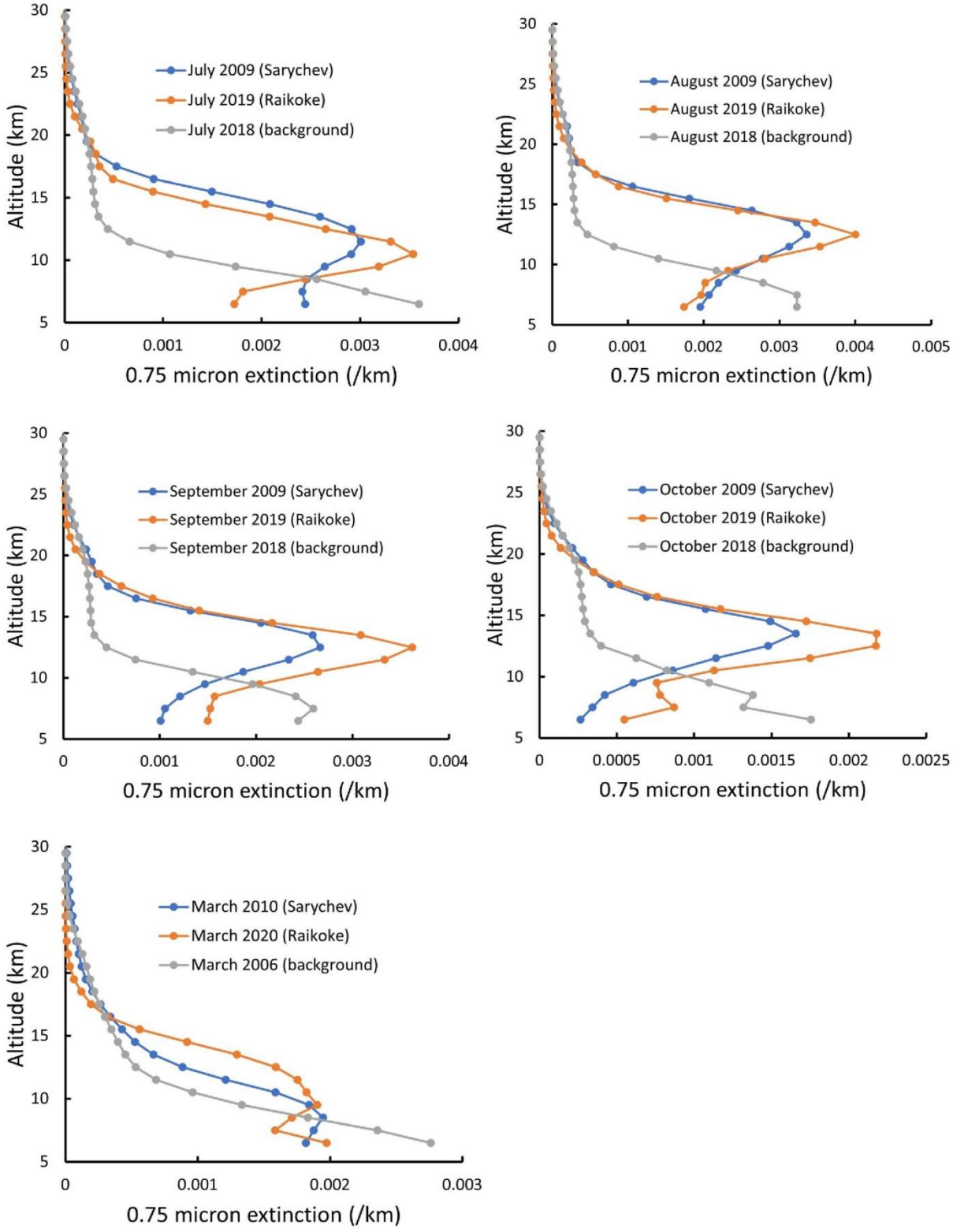

Figure 2: Average monthly OSIRIS 750 nm aerosol extinction for the latitude range 77-83 °N for the periods following the Sarychev and Raikoke eruptions, along with a profile to give a sense of background levels. Note the changing x-axis scale.