1. The authors have not provided the answer to the following initial query in their responses:

   From laboratory tests, what is the conversion efficiency of an alkene RO_2 to OH at 5 ppm and 2.5 ppm NO? Furthermore, if the HO_2 signal measured with the high NO injection is 6% higher than the HO2 signal that is measured with the low NO injection, then I think that this does indicate that there is an RO_2 interference being observed. I suggest the authors attempt to put an upper limit on the RO_2 interference using the methodology described in Whalley et al., (AMT, 2013) (equations 7 and 8).

   Answer:

   Previous laboratory experiments of another LIF system (FZJ-LIF) with the same cell design and operating parameters to PKU-LIF indicated the conversion efficiency of isoprene derived RO_2 to OH was lower than 0.1 at NO concentration of 4×10^{12} cm^{-3} (Fuchs et al., 2011) (Figure 5, 0.4 mm nozzle). Therefore, the conversion efficiencies for the NO concentrations of 5 ppm and 2.5 ppm used in this study (i.e. 5×10^{11} cm^{-3} and 2.5×10^{11} cm^{-3} at cell pressure of 4 hPa) were expected to be less than 0.1.

   According to Equation 7 and 8 in Whalley et al. (2013), the HO_2 interference from RO_2 radical can be calculated by multiplying the complex RO_2 concentrations (RO_2i) with corresponding conversion efficiency (α). Unfortunately, RO_2 was not measured during this campaign while one would expect a strong correlation between RO_2 (or RO_2i) and HO_2. Previous summer campaigns in China demonstrated that the RO_2i to HO_2 ratio varies from 0.6 in a rural site in Wangdu (Tan et al., 2017) to 2 in an urban site in Beijing (Whalley et al., 2021). As the chemical condition encountered in YRD was more similar to that of Wangdu (the Beijing campaign was conducted at an urban site), it was reasonable to assume the RO_2i to HO_2 ratio in this study was closer to 0.6. By applying the conversion efficiency of 0.1 as an upper limit and assuming RO_2i to HO_2 ratio to be 0.6, the maximum HO_2 interference from RO_2 radicals should be closer to 6% of the HO_2 measurement in this study. But we acknowledge that the interference would increase, if RO_2i to HO_2 ratio become larger.

   We revised the paragraph as 'To minimize the potential interference from RO_2, the added NO mixing ratio was switched between 2.5 ppm and 5 ppm every 2 minutes, corresponding to the HO_2 conversion efficiencies of 10% and 20%, respectively. The expected RO_2 conversion efficiency for both modes was below 10% for this experimental setup for isoprene derived RO_2 from laboratory tests (Fuchs et al. 2011). The extent of the RO_2-interference was also proportional to the complex-RO_2-to-HO_2 ratio. Unfortunately, RO_2 was not measured during this campaign but one would expect a strong correlation between RO_2 (or complex-RO_2) and HO_2 (Tan et al., 2017; Whalley et al., 2021). Previous field summer campaigns in China showed that, the ratio of complex-RO_2 to HO_2 varies from 0.6 at a rural site in Wangdu (Tan et al., 2017) to 2 at an urban site in Beijing (Whalley et al., 2021). As

the chemical condition encountered in YRD was more similar to that of Wangdu (the Beijing campaign was conducted at an urban site), it was reasonable to assume the complex-RO_2 to HO_2 ratio in this study was closer to 0.6. Therefore, by applying the RO_2 conversion efficiency of 0.1 as an upper limit, the maximum HO_2 interference from RO_2 radicals should be closer to 6% of the HO_2 measurement in this study assuming complex-RO_2 to HO_2 ratio to be 0.6.'

2. The authors have not responded fully to the following:
How well did the model predict the diurnal variation of PAN/ other model-generated species such as formaldehyde and glyoxal? Could the authors include the modelled and observed formaldehyde and glyoxal profiles in the SI and with modelled and observed PAN?

Answer:

The diurnal variations of modelled and observed PAN, formaldehyde and glyoxal were shown in Fig. S2. As discussed in the last version of revision, the modelled PAN concentration agreed to measurements from late morning to the midnight but slightly lower than measurements in the early morning, and the discrepancy was not caused by the effect of boundary layer height variation. While the model under-predicted the HCHO concentrations and over-predicted the glyoxal concentrations, which might be related to the significant primary emission of HCHO and missing sinks of glyoxal in the current mechanisms. However, the missing sources and sinks of HCHO and glyoxal are not the scope of this study. To avoid interruption from incapability of model performance, both HCHO and glyoxal were constrained to observations in this study.

We added some discussions about the observed and modelled HCHO and glyoxal in the model description section as 'In addition, sensitivity test without HCHO and glyoxal constrained indicated that model would under-predicted the HCHO and over-predicted the glyoxal concentrations (Fig. S2), which might be related to the significant primary emission of HCHO and missing sinks of glyoxal in the current mechanisms. However, the missing sources and sinks of HCHO and glyoxal are not the scope of this study. To avoid interruption from incapability of model performance, both HCHO and glyoxal were constrained to observations in this study.'
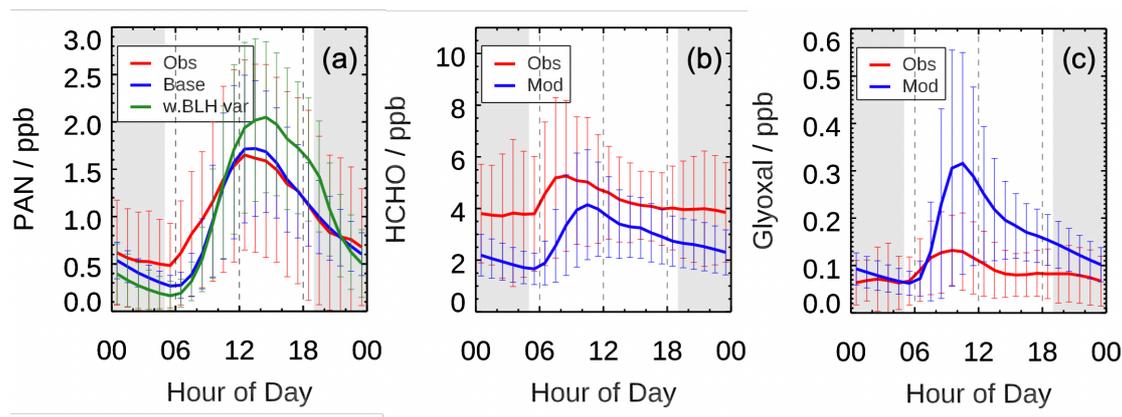
Figure S2. The mean diurnal profiles of measured and modelled PAN (a), HCHO (b), and glyoxal (c) concentrations. (a) The base model run (Base) applied a first-order loss term equivalent to a lifetime of 8 hours to all species. The other model run (w. BLH var) imposed a boundary layer height (BLH, derived from ECMWF) dependent loss rate to all species. (b) and (c) The model run (Mod) free the HCHO and glyoxal compared to the base model run (Base) in (a). The grey areas denote nighttime.

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