We would like to thank the reviewers for their time taken to review the manuscript and for their helpful comments which will improve the manuscript.

## RC2

Mir et al. report the IR-spectroscopy and time-resolved detection of the simplest Criegee intermediate,  $CH_2OO$ , and the time-resolved detection of  $SO_3$  from the reaction of  $CH_2OO$  with  $SO_2$ . These measurements have been made using a new apparatus involving a mid-IR quantum cascade laser as a tunable IR source, which enables the detection of multiple species. The new results are in accord with previous measurements in the literature, supporting the reliability of the new apparatus. This is a nice study, which is within the scope of this journal. The paper is well written, the literature appropriately cited, and the methods and analysis clearly stated. I anticipate that this new apparatus will provide novel kinetic and mechanistic insights to atmospherically important reactions. I have only a few minor comments and suggestions, detailed below.

Fig 3: you determine that the expected change in CH<sub>3</sub>I concentration on photolysis under your experimental conditions is 4 %. It would be good to also state the percentage change that you measure experimentally.

Evaluation of the observed percentage change in  $CH_3I$  concentration requires knowledge of the  $CH_3I$  absorption crosssection at the probe wavelength and the effective path length, the determination of which relied on the calculation of a 4 % change in concentration based on the laser fluence and absorption cross-section of  $CH_3I$  at the photolysis wavelength. Assessment of the observed percentage change in  $CH_3I$  concentration is therefore somewhat circular and inevitably agrees with the calculated value of 4 %.

If I understand this correctly, noise from the Q-switch inhibits reliable measurements from -500 to+500  $\mu$ s. It would be beneficial to the reader to show an example of the full kinetic trace (including this time window) in the supplementary material.

Figure 3 uses data recorded from -1.5 ms to 3 ms and defines the pre-photolysis region from -1.5 ms to -0.5 ms. We have clarified the definition of the pre-photolysis region for these experiments in the caption to the figure. We have also replaced the figure in the manuscript to show the full time series.

## What vapor pressure of $CH_2I_2$ was used in the calculation of $[CH_2I_2]$ ?

The vapour pressure was estimated as 0.2 Torr from the vapour pressure at room temperature (1.2 Torr) and the standard enthalpy of vaporisation (45.6 kJ mol<sup>-1</sup>). We note that the vapour pressure is uncertain since the temperature inside the bubbler is not known exactly, but the  $CH_2I_2$  concentration was estimated from separate previous experiments under identical bubbler and flow conditions in which the  $CH_2I_2$  concentrations were measured by UV absorption spectroscopy, and so the estimated  $CH_2I_2$  concentration ought to be robust. We also note that the absolute concentration of  $CH_2I_2$  is not required in the analysis of any results obtained in this work.

Figs 2 and 4: I think the vertical inversion of the literature spectra make it easier for the reader to see the features of the new spectra, but it is difficult to compare the relative intensities of spectral features in the literature vs. current spectra in these plots. I suggest that in the supplementary material, the literature and current spectra are overlaid so this comparison can be more easily made.

For  $SO_2$  (Figure 2), the number of peaks in the absorption spectrum makes it difficult to compare the spectrum measured in this work and that given on the HITRAN database when the two are overlaid. We have included the comparison below to demonstrate this, but prefer not to include this figure in the manuscript or supplementary information as we do not feel it helps to compare the two spectra.



Normalised observed spectrum (black) for SO<sub>2</sub> with the corresponding normalised spectrum reported on the HITRAN database (red).

For CH2OO (Figure 4), we have added the suggested plot as an inset to the figure in the manuscript.

Fig 5: Why is the pre-photolysis signal (at least that before the Q-switch noise at -500 µs) not shown ?

We have extended the scale to show the pre-photolysis signal on the plot.

I agree with reviewer #2 that it would be beneficial to show some additional examples of  $CH_2OO$  decays in the supplementary material.

We have added some additional examples as an inset to Figure 6.