

## Response to Referee #2:

Thanks very much for your comments, suggestions and recommendation with respect to improve this paper. The response to all your comments are listed below. There was an extensive discussion among the authors regarding how to revise the content, and this paper is subjected to a major revision for addressing the criticisms by all the referees. Thus, the response is delayed, and we are sorry for this.

This paper presented a long term observation of formaldehyde from 2015 to 2019 by ground-based high-resolution FTIR at Hefei, eastern China. They used the dataset to assess the performance of the GEOS-Chem model simulation for the specifics of polluted regions over eastern China. The intercomparison of HCHO VMRs between FTIR and GEOS-Chem showed a good agreement; the seasonal and annual trends of HCHO are also well characterized. The tropospheric HCHO VMR from 2015 to 2019 kept increasing. The tracers from ground observation were used to characterize the source of HCHO. Estimates of OH radical production from the photolysis of HCHO at the measurement site are also obtained. Finally, contributions of various emission sectors and geographical transport to the observed HCHO summertime enhancements are determined using a GEOS-Chem sensitivity study. Overall, this manuscript is well structured, written, and its topic fits the scope of ACP. I recommend this paper for publication subjects to some minor comments.

General comments.

1. Section 2: Characterizations for the retrieval and error analysis should be more detailed. Though ACP mainly focuses on general significance to atmospheric science rather than technical research, a more detailed description for verifying the reliability of the data is needed.

**Response:** We have presented detailed characterizations for the FTIR retrieval and error analysis in the revised version.

2. The statistics of the GEOS-Chem emission inventories are used to interpreting the HCHO variability. More analysis of data and evidence is needed. There should be at least references to the rates of change of CH<sub>4</sub> and various NMVOCs reported in the literature over the same time periods.

**Response:** We have presented detailed statistics and analysis of the GEOS-Chem emission inventories to support the point of this paper in the revised version.

Specific comments for correction.

1. Abstract: The abstract should reflect that measurements from only one FTIR site (Hefei) were used for investigating the HCHO variability.

**Response:** Done!

2. Page 3: The first two paragraphs to be quite long while they bring very little useful

information to the manuscript, and hence they are not necessary. A concise description is suggested.

**Response: Done!**

3. Page6, line 24: YRD should be defined.

**Response: Done!**

4. Page 10, line 25: Where is the location of the CRDS analyzer? At the site where the  $O_x$  in situ measurements is performed?

**Response: In the revised version, we have stated that the CRDS analyser located side by side with the FTIR instrument. Please see section 2.1 and Fig. 1(b) for details.**

5. Page 11, line 12: accounted

**Response: Done!**

6. Page11, line 33: Modelled HCHO was decreased by. . .

**Response: Done!**

7. Page11, line 37: As a short-lived species

**Response: Done!**