Comment on acp-2021-103
Anonymous Referee #2

Referee comment on "Spatial and temporal variations of CO$_2$ mole fractions observed at Beijing, Xianghe, and Xinglong in North China" by Yang Yang et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-103-RC2, 2021

This is an important and valuable data to assess temporal and spatial variations of CO2 in North China. However, this data must be further discussed in order to support the main reasons of those CO2 variations. Comparisons with other megacities will be a good approach to improve the discussions. Follow specific suggestions to help the authors improve descriptions and discussions of the manuscript:

Section 2.2.2: Further description of calibration and data processing:
1) How CRDS stability was checked over time, before and after malfunctions?
2) Describe the steps used during data processing; what kind of filters were used?

P5 – lines 101-102: Data filtering were not used to reduce uncertainties but to exclude no-valid data. Review this sentence.

Results and discussion
Section 3.1 time series: Strategies/methods to selection of background mole fractions must be further presented and discussed in order to show low influence of anthropogenic sources.

P7 - lines 138-144 : Please add mean (std) concentrations related to higher and low CO2 levels.

P7 – lines 149-150: Contribution of main sources (fossil fuel and heating) must be further discussed. Other sources as biomass burning from wildfires are important? If possible, trace gases/species would be used to identify activity of specific sources.

P9 – lines 166-167: Discuss the reasons of higher amplitudes in BJ.

P9 – lines 216-217: References must be added to support the assumption.

Section 3.4: Is important discuss CO2 variations with the wind direction based on local and remote sources.

Section 3.5: Reasons to CO2 mole fractions variations in L1 and L2 altitudes must be
discussed.

Section 3.6: This section must be further assessed using different approaches. One of these strategies would be investigate seasonal differences during weekday-weekend.

P13 – line 255: Assumption of lowest anthropogenic emissions on Tuesday must be proven.