

Point-by-point response letter

Note: This file includes two referees' comments, the corresponding point-by-point responses, and the related changes in the manuscript. The black font are comments from the referees and the red font are authors' responses as well as the related change clarifications.

(1) Detailed response to comments from referee #1:

This manuscript presents a deep and extensive review of the research and developments that have emerged during approximately the last few decades with respect to 'Greenhouse gases (GHGs) monitoring in China'. All topics considered are appropriate, timely and well targeted. The document addresses relevant scientific questions; its content represents a successful review of the key elements of the subject under consideration. The manuscript correctly presents the review of ideas, tools and data. The analysis carried out clearly supports the interpretations and conclusions. The number and quality of the references, in general, are adequate and reflect well the review carried out. This study will improve current understanding with respect to what we have done and what we have to do in the field of GHGs monitoring in China. In general, the topic is interesting and fits well in the scope of AMT. I recommend for publication with some minor comments and additions that I have listed below.

Response: Thanks very much for your comments, suggestions and recommendation with respect to improve this paper. All your comments listed below have been addressed. Please check the point by point response as follows.

General comments

Comment [1-1]: Although the number and quality of the references are adequate and reflect well the review carried out, some recent studies regarding GHGs monitoring in China are missing. These include doi:10.3390/rs14143334 for on-orbit calibration of TanSat, etc. I cannot list all of them, but the more comprehensive the article, the more readers will pay attention to it.

Response: In the revised version, we have included more recent studies regarding GHGs monitoring in China, e.g., doi:10.3390/rs14143334, doi:10.3390/rs13030517, doi:10.1080/16742834.2019.1649974. Please check Page 10/Line 21 (P10,L21), P11,L20 in the marked up file for details.

Comment [1-2]: The authors should check if Fig.2 includes geolocations of all sites

coordinated by NOAA and WMO and Fig 3 contains all FTIR sites coordinated by TCCON, NDACC-IRWG, and COCCON.

Response: In the revised version, we have double checked the geolocations of all sites coordinated by NOAA and WMO, and all FTIR sites coordinated by TCCON, NDACC-IRWG, and COCCON. There is no problem.

Comment [1-3]: What's the dashed curve and line in Fig.5 indicating for? The authors should explain in the caption. The authors should check if all acronyms in Table 1 are already properly defined.

Response: In the revised version, we have explained the dashed curve and line in caption of Fig.5. All acronyms in Table 1 have already been properly defined. Please check the caption of Fig.6 (i.e., original Fig.5) in the marked up file for details.

Technical corrections:

Comment [1-4]: Page 2, Line 15 (P2, L15): “reduction energy consumption” should be “energy consumption of reduction”.

Response: Done. Please check P2, L17 in the marked up file for details.

Comment [1-5]: P2, L27: “China is committed to achieve” should be “China is committed to achieving”.

Response: Done. Please check P2, L29 in the marked up file for details.

Comment [1-6]: P3, L2: “In addition to continue” should be “In addition to continuing”.

Response: Done. Please check P3, L4 in the marked up file for details.

Comment [1-7]:P6, L16: “maintenances” should be “maintenance”.

Response: Done. Please check P6, L22 in the marked up file for details.

Comment [1-8]:P8, L1: “put a large effort in” should be “put a large effort into”.

Response: Done. Please check P8, L7 in the marked up file for details.

Comment [1-9]: P9, L20: “more sensitive” should be “more sensitivity”.

Response: Done. Please check P9, L30 in the marked up file for details.

Comment [1-10]: P9, L31: “different spatiotemporal scale” should be “different spatiotemporal scales”.

Response: Done. Please check P10, L8 in the marked up file for details.

Comment [1-11]: P10, L21: “use active” should be “used active”.

Response: Done. Please check P10, L32 in the marked up file for details.

Comment [1-12]: P11, L32: “are committed to provide” should be “are committed to providing”.

Response: Done. Please check P12, L10 in the marked up file for details.

Comment [1-13]: P12, L3: “is that how” should be “is how”.

Response: Done. Please check P12, L13 in the marked up file for details.

Comment [1-14]: P13, L4: “is committed to achieve” should be “is committed to achieving”.

Response: Done. Please check P13, L16 in the marked up file for details.

Comment [1-15]: P13, L20: “challenges for” should be “challenges of”.

Response: Done. Please check P13, L27 in the marked up file for details.

Comment [1-16]: P14, L13: “data sharing platform” should be “data sharing platforms”.

Response: Done. Please check P14, L23 in the marked up file for details.

Comment [1-17]: P14, L26: “promote the implement of” should be “promote the implementation of”.

Response: Done. Please check P15, L2 in the marked up file for details.

Comment [1-18]: For consistency, “Det” in Fig.4 should be “Det.”

Response: Done. Please check Fig.4 in the marked up file for details.

(2) Detailed response to comments from referee #2:

This paper by Sun et al. presented an extensive summary of status and perspective of GHGs monitoring in China. In addition, authors emphasized the necessity of establishing a creditable GHGs stereoscopic monitoring and assessment system at an operational level. This review gives the technical and methodological references for supporting low-carbon policy in China. In general, the topic is interesting and well done. The paper is well organized and written, but I recommend acceptance to of Atmospheric Measurement Techniques after addressing the comments below.

Response: Thanks very much for your comments, suggestions and recommendation with respect to improve this paper. All your comments listed below have been addressed. Please check the point by point response as follows.

Minor comments

Comment [2-1]: Line 21 in page 5: Why are only the XCO₂ precisions of GOSAT and OCO-2 given? What about other satellites?

Response: In the revised version, we have included the XCO₂ precisions of more satellites, i.e., “SCIAMACHY, GOSAT, OCO-2, and TanSat have XCO₂ precisions of 2.5ppmv, 1–2 ppmv, ~1 ppmv, and 1–4 ppmv, respectively (Reuter et al., 2011; Nassar et al., 2017; Boesch et al., 2021; Yang et al., 2020a). Studies with satellite data have yielded anthropogenic CO₂ flux estimates at the scale of megacities or larger regions (Eldering et al., 2017), and recently have extended CO₂ emissions estimate at the scale of an individual facility, such as a single power plant (Nassar et al., 2017; Zheng et al., 2020a). Jacob et al. (2022) have summarized the capability of current and scheduled satellite observations of atmospheric CH₄ in the shortwave infrared (SWIR) to quantify methane emissions from the global scale down to point sources, where XCH₄ precisions of various satellites are presented”. Please check P5, L22-31 in the marked up file for details.

Comment [2-2]: Line 16 in page 8: This sentence is inaccurate. Remote sensing technology should also include active forms. In addition, commonly used active and passive remote sensing techniques can be separately described in detail here.

Response: In the revised version, we have revised this sentence to avoid misleading. Now it becomes “ Monitoring technologies include a variety of active and passive measurement technologies”. In addition, commonly used active and passive techniques are separately described in detail here. Please check P8, L21-31 in the marked up file for details.

Comment [2-3]: Line 4 in page 9: It is better to add a graphic to summarize the stereoscopic monitoring system of GHGs system. This can provide reference for relevant project designers.

Response: In the revised version, we have add a graphic to summarize the stereoscopic monitoring system for GHGs. Please check Fig.5 in the marked up file for details.

Comment [2-4]: Line 28 in page 11: Please clarify which satellites are capable of these functions.

Response: We have clarified that “Most recently, Chinese scientists have used the public accessible OCO-2 satellite observations to quantify CO₂ emissions down to individual point sources such as middle- to large-size coal power plants over China”. Please check P12, L5-7 in the marked up file for details.

Comment [2-5]: Line 4 in page 12: Please elaborate on the complexity of China's carbon emission scenarios and the corresponding reasons.

Response: In the revised version, we have elaborated on the complexity of China's carbon emission scenarios and the corresponding reasons. i.e., “GHGs emissions in China are complex and diverse (Liu et al., 2022). GHGs concentrations measured at a specific place include both local generation and long-range transport, which occurs not only near the surface but also in upper atmosphere. In addition, China has a complex ecological environment characterized as high aerosol levels, high variability, and compound pollution mixed with many constituents, which poses unprecedented challenges (i.e., increase monitoring uncertainty) to the establishment of GHGs stereoscopic monitoring network in China.” Please check P12, L15-21 in the marked up file for details.

Comment [2-6]: Line 14-17 in page 12: I don't understand this argument of the challenges here. Is it the challenge that the complex ecological environment brings uncertainty to the establishment of GHGs stereoscopic monitoring network? Or does the complex ecological environment bring challenges to the formulation of GHGs emission reduction policies? Or something else. Please clarify.

Response: The complex ecological environment will bring uncertainty to the establishment of GHGs stereoscopic monitoring network in China. Please check P12, L15-21 in the marked up file for details.

Comment [2-7]: Line 18 in page 12: The authors put forward these main technical problems and challenges, and whether some preliminary or mature solutions can be proposed.

Response: In view of status, advances, and challenges of China's GHGs monitoring, section 6 has proposed future developments (solutions) in a few aspects. Please check section 6 in the marked up file for details.

Comment [2-8]: Line 7-16 in page 13: These sentences are too long. Please re-structure to make them easier for reading.

Response: In the revised version, we have re-structured these sentence and made them easier for reading. “It is suggested to take full advantages of various monitoring technologies, monitoring platforms, numerical simulations, and inventory compilation techniques to form a creditable GHGs stereoscopic monitoring and assessment (M & A) system. Implementation of this M & A system should be coordinated with the established international networks, and routinely quantify GHGs on global, national, provincial, regional, and individual point scales with high spatiotemporal resolution and wide coverage. Improved knowledge of carbon emissions on different scales is

very useful for adjustment of low-carbon policy in China”. Please check P13, L19-26 the marked up file for details.

Comment [2-9]: Line 1-3 in page 14: I can't understand the logical relationship between these two sentences. I assume you mean, not all GHGs are needed, major GHGs are enough to improve China's GHGs monitoring capacity?

Response: Indeed, key GHGs are enough to improve China's GHGs monitoring capacity. There are many types of GHGs and they have different GHG effects. It is not necessary and also expensive to include all of them into China's surface environmental quality monitoring network. Key GHGs are enough. Please check P14, L12 in the marked up file for details.

Comment [2-10]: Please do careful proofreading and grammar check, as well as the order of references. Besides, some sentences in the manuscript are repetitive and verbose. Please simplify them.

Response: Done. Please check the marked up file for details.

Grammar related comments:

Comment [2-11]: Line 22 in page 2: “has” should be “have”, and “its” should be “their”.

Response: Done. Please check P2, L24 in the marked up file for details.

Comment [2-12]: Line 23 in page 2: “counties” should be “countries”

Response: Done. Please check P2, L25 in the marked up file for details.

Comment [2-13]: Line 27 in page 2: “China is committed to achieve” should be “China is committed to achieving”.

Response: Done. Please check P2, L29 in the marked up file for details.

Comment [2-14]: Line 20 in page 5: Please unify the marking of CO₂ concentration throughout the manuscript.

Response: Done. Please check the marked up file for details.

Comment [2-15]: Line 34 in page 5: “provide” should be “provided”.

Response: Done. Please check P6, L6 in the marked up file for details.

Comment [2-16]: Line 9 in page 6: “station” should be “stations”.

Response: Done. Please check P6, L15 in the marked up file for details.

Comment [2-17]: Line 25 in page 8: “sun” should be “sunlight”. In addition to sunlight, other natural light sources should also be listed.

Response: Done. Please check P8, L33 in the marked up file for details.

Comment [2-18]: Line 24 in page 9: “the volume mixing ration” should be “the volume mixing ratio”.

Response: Done. Please check P9, L34 in the marked up file for details.

Comment [2-19]: Line 31 in Page 9: “different spatiotemporal scale” should be “different spatiotemporal scales”.

Response: Done. Please check P10, L8 in the marked up file for details.

Comment [2-20]: Line 1 in page 14: Please add a definite article for “targets”.

Response: For clarity, we have revised this sentence to “GHGs are not included in the atmospheric constituents routinely monitored by the China National Environmental Monitoring Center (CNEMC) network”. Please check P14, L10 in the marked up file for details.