Response to Editor:

We gratefully thank the editor for your time spent making the constructive remarks and useful suggestions, which have significantly raised the quality of the manuscript and have enabled us to improve the manuscript. Each suggested revision and comment, brought forward by you was accurately incorporated and considered. Below are the comments of the editor and response point by point and the revisions are indicated. We use different colored fonts to distinguish between responses to reviewers and the revised sections of the manuscript.

1. Responses to reviewers are highlighted in blue.
2. *Revised sections of the manuscript are highlighted in red.*

Comment 1: many thanks for your revision of the manuscript as a response to the last referee comments.

I read the manuscript and have numerous small comments (see below), I would like you to address before I accept the manuscript for publication in ACP.

Reply: We sincerely appreciate your time and effort in reviewing our revised manuscript. Thank you for your constructive feedback and for considering our work for publication in ACP. We have carefully addressed all the comments and made the necessary revisions to further improve the manuscript. Below, we provide detailed responses to each point.

Comment 2: - Why not using ‘Urban green spaces’ in the title? E.g., Underappreciated contributions of biogenic volatile organic compounds from urban green spaces to ozone pollution

- Note that titles that highlight the method are less preferred according to the journal guidelines

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Reply: Thank you for your suggestion. We have revised the title to use "urban green spaces" instead of "urban greening," as recommended. Additionally, we have removed the “:a high-resolution modelling study” in accordance with the journal's guidelines. The revised title now reads:

Underappreciated contributions of biogenic volatile organic compounds from urban green spaces to ozone pollution

Comment 3: - Abstract: It is too long: Please shorten it so it adheres to the journal guidelines (250 words)

Reply: Thank you for your suggestion. We have revised and shortened the abstract to ensure it adheres to the journal's 250-word limit. The updated abstract now reads as follows:

Urban Green Spaces (UGS), such as parks, and gardens, are widely promoted as a strategy for improving the urban atmospheric environment. However, this study reveals that it can exacerbate urban ozone (O_3) levels under certain conditions, as demonstrated by a September 2017 study in Guangzhou, China. Using the Weather Research and Forecasting Model with the Model of Emissions of Gases and Aerosols from Nature (WRF-MEGAN) and the Community Multiscale Air Quality (CMAQ) model, we assessed the impact of UGS-related biogenic volatile organic compound (BVOC) emissions on urban O_3. Our findings indicate that the UGS-BVOC emissions in Guangzhou amounted to 666 Gg (~90 Mg/km^2), with isoprene (ISOP) and monoterpene (TERP) contributing remarkably to the total UGS-BVOC emissions. Compared to anthropogenic VOC (AVOC) and BVOC emissions, UGS-BVOC emissions account for ~33.45% in the city center, and their inclusion in the model reduces ISOP underestimation. The study shows improved simulation mean biases for MDA8 O_3, from -3.63 to -0.75 ppb in the city center. Integrating UGS-BVOC and UGS-LUCC (Land Use Cover Change) enhances surface monthly mean O_3 by 1.7–3.7 ppb (+3.8–8.5%) and adds up to 8.9 ppb (+10.0%) to MDA8 O_3 during pollution episodes. UGS-BVOC emissions alone increase monthly mean O_3 by 1.0–1.4 ppb (+2.3–3.2%) in urban areas and contribute up to 2.9 ppb (+3.3%) to MDA8 O3 during pollution episodes. These impacts can extend to surrounding suburban and rural areas through regional transport, highlighting the need to accurately account for UGS-BVOC emissions to better manage air quality.

Comment 4: l. 178 – 181: It is worth noting that MEGANv3.1 uses the 2-m temperature variable from the WRF model to calculate BVOC emissions. Meanwhile, The MEGANv3.1 approach can calculate the emissions at each canopy level as the product of the emission factor and emission activity at each level.

Not clear what you mean by ‘meanwhile’. Should it be ‘Therefore’?

Reply: We have removed this sentence. The follows are the revised version:

It is worth noting that MEGANv3.1 uses the 2-m temperature variable from the WRF model to calculate BVOC emissions.

Comment 5: l. 186: Here ‘Meanwhile’ seems redundant.

Reply: We have removed the “Meanwhile” here.

The growth form datasets in MEGANv3.1 contain considerations of evergreen broadleaf forests, grasslands, and crops, which cover all types of UGS in Guangzhou city (Figure S1).

Comment 6: Table 1: Please add sufficient information to the table caption that the table can be understood independently.

Reply: Thanks for this suggestion. We have revised this table caption.

Table 1 Case configurations. The default land cover (LC) datasets are derived from MODIS/MCD12Q1, while the high-resolution LC datasets use MODIS/MCD12Q1 for natural areas and the 10-m datasets from Geographic Remote Sensing Ecological Network Platform for urban areas. N-LAI (None-urban Leaf Area Index) indicates that the model uses LAI data without urban LAI, whereas T-LAI (Total LAI) includes urban LAI. The "Description" column explains the purpose of each case.

Name	*LC dataset*	*LAI dataset*	*Description*
Gdef_N	*Default data*	*N-LAI*	*Base*
Gdef_Y	*Default data*	*T-LAI*	*UGS-BVOC effects*
Ghr_N	*High-resolution data*	*N-LAI*	*UGS-LUCC effects*
Ghr_Y	*High-resolution data*	*T-LAI*	*combined effects*

Comment 7: l. 268: What do you mean by "delineated within this study"? I suggest removing it.

Reply: Thanks for the carefully suggestion. We have removed this.

Table 2 presents the mean concentrations of ISOP derived from various cases juxtaposed with the observed average concentrations.

Comment 8: l. 306: 'Modeling process' could be simply replaced by 'model'

Reply: Thanks for the valuable suggestion. We have rephrased this sentence as follows:

It should be emphasized that integrating UGS-BVOC into the model can slightly improve the accuracy of NO_2 predictions, reducing the MB from 3.27 to 3.24 ppb, and from 2.84 to 2.81 ppb for Gdef and Ghr cases, respectively.

Comment 9: l. 332: 'the primary' can be removed

Reply: Thanks for the carefully suggestion. We have removed this.

Given that the variances in the UGS-BVOC emissions due to different land use covers are relatively minor, Table 5 presents emissions driven by the default land use cover.

Comment 10: l. 334: 'highest emitting species' should be either 'highest emissions' or 'species with highest emissions'.

'Emitting species' does not make sense as it would imply that the species are emitting something.

Reply: Thanks for the valuable suggestion. We have rephrased this sentence as follows:

A review of the data reveals that TERP and ISOP rank as the highest emissions with proportions are 20.46% and 31.91% in this study, respectively, ...

Comment 11: Figure 2: Please improve the figure caption to clearly describe what is shown in each panel.

Reply: Thanks for the valuable suggestion. We have revised the caption of Figure 2 as follows:

Figure 2 (A) The UGS-BVOC emissions of each species (upper panel) and relative difference (Ghr - Gdef) from various land use cover (lower panel), (B) the proportion of the BVOC emissions from urban and nature areas (upper panel) and the relative proportion difference (Ghr - Gdef) from various land use cover (lower panel), (C) the relative difference of solar radiation (C), and (D) surface temperature in each region driven via various land use cover datasets. All values in these figures are during September 2017.

Comment 12: l. 365: Figures should be numbered in the order as they are cited in the text. As you refer several times in this paragraph to Figure 5, you should move this figure before Figure 3.

Reply: Thank you for your careful review. We have adjusted the figure numbering and placement to ensure that figures are cited in the correct order, moving Figure 5 before Figure 3 as recommended.

Comment 13: l. 381: ‘delves’ is an overused verb since the advent of large language models. Simply replace by ‘shows’.

Reply: Thank you for your careful review. I have changed the \`delves\` to \`shows\`.

Additionally, Figure 4C shows into the disparities in the UGS-BVOC emissions attributed to different land use cover datasets.

Comment 14: l. 439: calling an increase of ~3% ‘great’ seems an exaggeration. I suggest removing ‘greatly’ here.

Reply: Thanks for this valuable suggestion. We have removed ‘greatly’ here.

The analysis reveals that the UGS-BVOC emissions alone (Figure 6A) primarily affect the city center region, increasing MDA8 O_3 concentrations by 1.0-1.4 ppb (+2.3-3.2%), …

Comment 15: l. 487/8: This sentence is quite convoluted. Please simplify.

Reply: Thanks for the valuable suggestion. We have rephrased this sentence as follows:

Figure 8 presents the assessment of O3 episode simulations. The Gdef_N case initially underestimated O_3 concentrations, leading to an evaluation of improvements using three cases: UGS-LUCC (Ghr_N), UGS-BVOC emissions (Gdef_Y), and their combined effects (Ghr_Y).

Comment 15: - I suggest merging 'Sections 4 and 5' into a a coherent concluding section. Please make sure to include all elements as requested in our journal guidelines

https://www.atmospheric-chemistry-and-physics.net/policies/guidelines_for_authors.html

Reply: Thanks for the valuable suggestion. We have merged 'Sections 4 and 5' into a coherent concluding section.

In Section 4: Conclusion:

However, some uncertainties and limitations remain in this study. First, the 10-m resolution land use and land cover data still cannot fully capture the spatial pattern of UGS in Guangzhou. As shown in Figure S2, although UGS in Guangzhou is primarily composed of EBTs, most of these EBTs are distributed along urban edges. This may result from distortions in the definition of urban extent, such as misclassifying mixed urban-vegetation grids as urban grids, caused by the coarse resolution of the 1-km land use and land cover data. The fuzzy definition of urban boundaries could lead to non-UGS areas being misclassified as UGS, potentially resulting in an overestimation of UGS-BVOC emissions. Second, due to resolution limitations, only larger patches of grassland, cropland, and woodland are recognized as UGS, while smaller UGS vegetation, such as street trees, often goes undetected at a 10-m resolution. This omission can lead to an underestimation of the UGS-BVOC emissions. Third, the 10-m and 1-km resolution land use and land cover data, along with the growth forms and ecotype data, use simplified categorizations for grids, which cannot fully capture the diversity of vegetation species within UGS. Since different vegetation species have varying emission factors, this simplification introduces some errors. Similarly, the oversimplified classification of land grids limits this study's ability to provide specific planning strategies for UGS at the species level. Nevertheless, it can highlight the importance of considering UGS-BVOC and UGS-LUCC in air pollution prevention and control policies. Finally, Guangzhou, the study area, is a highly urbanized Chinese metropolis with a VOC-limited region (Gong et al., 2018; Liu et al., 2018; Zhou Kai et al., 2011). As a result, even a relatively small amount of VOC emissions, such as those from UGS-BVOC, can significantly impact ozone concentrations. Therefore, policymakers in Guangzhou should prioritize addressing the role of UGS-BVOC emissions in air pollution prevention and control. In other cities, particularly those with advanced urban development, high NO_x emissions—often resulting from factors like high motor vehicle ownership—can lead to VOC-limited conditions. In such areas, it is equally important to emphasize the role of UGS-BVOC emissions in ozone pollution. In contrast, cities with lower NO_x emissions identified as NO_x-limited regions may experience minimal impact from UGS-BVOC emissions on ozone concentrations.