We thank the two anonymous referees for their valuable comments and constructive suggestions on the manuscript. Below, we explain how the comments and suggestions are addressed and make note of the revision we made in the manuscript.

Anonymous Referee #1

General comments:

- ***This study investigates the impact of different land surface parameterizations and vegetation distributions on emissions and mixing ratios of biogenic VOCs (and related oxidation products) simulated in California. Isoprene, MACR, MVK and monoterpenes are especially considered. Two different versions of the Model of Emissions of Gases and Aerosols from Nature (MEGAN v2.0 and MEGAN v2.1), together with two different land surface schemes (Noah and CLM4.0) and 5 different vegetation distributions (VEGM, USGS, VEG1, VEG2, VEG3) are alternatively used. Data collected during two field campaigns, CalNex and CARES, providing ground-based or flight observations, are also considered for model evaluation.***

  This manuscript is well written and clearly presents an extensive work, which I really enjoyed reading, a work that provides clues to better understand the variability and uncertainty of biogenic VOC estimates between models. To some extent, the manuscript lacks of precise information, especially regarding the model framework. For example, the differences in emission calculation between the two versions of MEGAN used, or the connexions between the emission model and the land-surface scheme should be better described, in order to fully understand the possible source of variability in results provided. I therefore give a list of corrections and comments to improve the clarity of the manuscript, which I warmly recommend for publication in GMD.

We thank the reviewer for a detail review. Both text and figures are revised as the reviewer suggested.

Specific comments:

- ***Section 2.2 and 2.3:***

  These sections lack of clear information regarding the differences between the emission models or land-surface schemes, and connexions between them. First if CLM4 considers 16 PFTs, how many are taken into account in Noah?

Noah uses the 24 USGS land-use types. We have modified the text to include "Noah has four soil layers, with a total depth of two meters and a single slab snow layer that is lumped with the top-soil layer, which is set to a combined depth of 10 cm. It uses the 24 United States Geological Survey (USGS) land-use types, and does not treat sub-grid scale variability within a model grid cell."

More clarification is added into Section 2.2 and 2.3 as indicated in the responses to the comments below.

- ***From page 9, lines 199-203, it is not really clear to me which meteorology is considered when using MEGAN v2.0: is it eventually provided by WRF-CHEM or***

based on a monthly climatology?

MEGAN v2.0 in WRF-Chem needs instantaneous and past-days' mean meteorological variables that are from the WRF-Chem simulation and the monthly climatology dataset, respectively. We have modified the text to state "The biogenic emission calculation in MEGAN uses both instantaneous and the past-days' surface air temperature and solar radiation. MEGAN v2.0 obtains the instantaneous value from the land surface parameterization and the past-days' value from the climatological monthly mean dataset. In contrast, MEGAN v2.1 obtains both values directly from CLM."

- ***Differences in emission schemes between MEGAN 2.0 and MEGAN 2.1 should also be more precisely stated in the text regarding number of vegetation classes, emission factors (are they prescribed for each PFT for both MEGAN v2.0 and MEGAN v2.1 or is one using EF maps?).***

The text has been modified to include "In this study, both MEGAN v2.0 and v2.1 estimate biogenic species emissions based on the PFT distributions and the PFT specific emission factors. MEGAN v2.0 and v2.1 use 4 and 16 PFTs, respectively, as described below in Section 2.4."

- ***Connexions and variables coupling between emission model and land-surface scheme (any version) should be given in details: which of the variables calculated by the landsurface scheme are actually used in MEGAN v2.0 and v2.1 to calculated emissions? This is also especially important in section 4, when analyzing the impact of using different land-surface parameterizations.***

We have modified the text to say "In the released version, MEGAN v2.0 can be used with any land surface scheme available in WRF-Chem including Noah and CLM4." and "The biogenic emission calculation in MEGAN uses both instantaneous and the past-days' surface air temperature and solar radiation. MEGAN v2.0 obtains the instantaneous value from the land surface parameterization and the past-days' value from the climatological monthly mean dataset. In contrast, MEGAN v2.1 obtains both values directly from CLM." In section 4, we have revised the discussion in the following text: "Although the two land surface parameterizations produce slightly different values of surface temperature (Fig. 1), soil moisture (not shown), and net solar radiation near the surface (not shown), their impact on the biogenic emissions was small." and "Although both experiments with Noah and CLM4 (red and orange lines, respectively) simulate similar isoprene emission fluxes with the maximum in the afternoon (Fig. 10), their respective isoprene+MVK+MACR mixing ratios are different at the four sites, particularly at site T0, where the Mv20CLM simulated isoprene+MVK+MACR mixing ratios during the daytime are about a factor of 2 larger than those from Mv20Noah. This inconsistence mainly results from the differences in the near surface meteorology, such as net surface radiation and temperature, between the two experiments (not shown) that

affects photochemistry, but this impact of surface meteorology occurs only at limited locations."

- ***Finally, nothing is said anywhere in the manuscript about the leaf area index, which is yet a crucial driving variable in emission estimate in MEGAN. How is it taken into account: is LAI prescribed or is it calculated by each land-surface scheme, and if so what are the LAI differences or similarities between them?***

The leaf area index is prescribed using the 4 PFTs in MEGAN2.0 and 16 PFTs in MEGAN2.1. Figure 6 has been added to show the difference in LAI among the experiments and the following description has been added to the text: "Figure 6 shows the spatial distributions of LAI used in MEGAN v2.0 and v2.1. The differences in the spatial distributions of LAI can significantly affect the biogenic emission calculation in MEGAN. It should be noted that in MEGAN v2.0 used in WRF-Chem, the LAI used for the calculation of the biogenic emissions is prescribed using the 4 PFTs, which is different than the land scheme that uses the LAI derived from the 24 USGS land categories."

- ***Page 9, lines 186-194: please also specify here in the text that MEGAN v.2.0 considers 4 PFTs only.***

Done, we have revised the text to say "MEGAN v2.0 and v2.1 use 4 and 16 PFTs, respectively, as described below in Section 2.4."

- ***Results from both MEGAN v2.0 and v2.1 are eventually compared with each other, and with observations. Is this comparison actually consistent since MEGAN v2.0 emission factors represent the net emission flux into the atmosphere, and MEGAN v2.1 ones the net primary emission that escape into the atmosphere? Are there significant differences between the two set of emission factors? MEGAN v2.0 emission factors should also be given, as is done for MEGAN v2.1 in figure 3. Ideally, maps of emission factors, projecting emission factor values over PFT distribution, would really help understanding the differences between both emission models.***

The difference in the definition (net flux versus primary emission) of emission factors affects the emission factors of compounds with bidirectional exchange but does not impact MEGAN isoprene and monoterpene emission factors because they have small deposition rates relative to emission rates. We have revised the text to state "The difference in the definition (net flux versus primary emission) of emission factors affects the emission factors of compounds with bidirectional exchange but does not impact MEGAN isoprene and monoterpene emission factors because they have small deposition rates relative to emission rates."

Figure 4 has been revised to include the biogenic isoprene emission factor for the 4 PFTs used in MEGAN v2.0. Figure 5 has been added to show the differences in the spatial distributions of averaged biogenic isoprene emission factor in MEGAN v2.0 and v2.1 with different PFTs. The text is revised as "Figure 4 shows the biogenic isoprene emission factor for each PFT prescribed in MEGAN v2.0 and MEGAN v2.1 in CLM4. In MEGAN v2.1, it shows that temperate broadleaf deciduous tree (PFT 7 listed in Table 1) has a large isoprene emission factor, while temperate needleleaf evergreen tree (PFT 1 listed in Table 1) has a small isoprene emission factor. A similar difference between broadleaf trees and needleleaf trees is indicated for MEGAN v2.0. Figure 5 shows the spatial distributions of averaged biogenic isoprene emission factor used in MEGAN v2.0 and v2.1 with different PFTs. It is evident that the difference in the distributions of PFTs results in a significant difference in spatial distributions of the isoprene emission factor."

Technical corrections:

- ***Page 3, line 69; page 4, line 74; page 5, line 105: change "BVOCs" to "BVOC"***

Corrected.

- ***Page 5, line 100: change "during the day but a factor of three" to "during the day but by a factor of three"***

Corrected.

- ***Page 7, line 145: please write what RRTMG stands for***

Corrected.

- ***Page 8, line 172: change "PFT's to "PFTs"***

Corrected.

- ***Page 9, line 191: change "defined" to "defines"***

Corrected.

- ***Page 10, line 215: change "MEGAN to "MEGAN v2.1***

Corrected.

- ***Page 12, line 276: change "PFT's" to "PFTs"***

Corrected.

- ***Page 14, line 312: change "BVOCs simulation" to "BVOC simulation"***

Corrected.

- ***Page 18, line 396: change "monterpene" to "monoterpene"***

Corrected.

- ***Page 19, line 422: change "and monoterpene" to "and monoterpenes"***

Corrected.

- ***Page 19, line 423: add "and Figure 13" (for monoterpenes) after "Figure 12" Page***

Corrected.

- ***21, line 463-464: change "while both experiments are slightly smaller" to "while both experiment mixing ratios are slightly smaller"***

Corrected.

- ***Page 28, line 634: change "and hence the atmospheric VOC mixing ratios" to "and hence of atmospheric VOC mixing ratios"***

Corrected.

- ***Page 30, lines 688, 689 and 690: change "BVOCs emission" to "BVOC emission"***

Corrected.

- ***Page 31, line 701: change "v20" and "v21" (twice) to "v2.0" and "v2.1" respectively***

Corrected.

- ***Page 41, line 915: the font used for "Müller J." seems different to me than the one used for the rest of the text***

Corrected.

- ***Table 1 and Figure 2 captions: change "PFT's" to "PFTs"***

Corrected.

- ***Figure 12, bottom left plot: Is actually isoprene mixing ratio plotted or isoprene+MVK+MACR?***

It is isoprene. Now it is clarified as "At the Bakersfield site, only isoprene mixing ratios were reported so that the comparison is for isoprene only."

Anonymous Referee #2

General comments:

- ***This is an excellent paper and it should make a significant contribution to GMD. Because it will serve as a reference for users of the widely used community modeling system WRF-Chem, I agree with comments from reviewer #1 that it requires a bit more information and precision. In addition to the comments from the other reviewer, I would like to see more details and clarification on the following points.***

We thank the reviewer for a detailed review. Both text and figures are revised as the reviewer suggested.

Specific comments:

- ***(1) The authors apply nudging. While is appropriate for their application in which they only look at the sensitivity of biogenic emissions to land surface parameterizations and vegetation distributions, the reader should have a little bit more info. Is the nudging also applied in the Boundary Layer (BL) and at the surface? Why did you choose not to nudge moisture? I would not expect the answers to this question to alter the quality of the results.***

The nudging is only applied in the free atmosphere above the BL. In general, we do not nudge moisture because we want the model to freely simulate clouds. As the reviewer also points out, the nudging method should not lead to changes of our results. It is now clarified in the text as "The modeled u and v wind components and temperature in the free atmosphere above the planetary boundary layer are nudged towards the NARR reanalysis data with a time scale of 6 hours [Stauffer and Seaman, 1990]."

- ***(2) I would have been interested to get a bit more info on the difference in surface meteorology, assuming that nudging was not applied in the BL. What was the relative impact from meteorology compared to land-use and/or a different version of MEGAN? Of course, if nudging was applied in the BL this would be a moot point. If the authors can elaborate a little on this that could be useful.***

In this manuscript we have not focused on the meteorological impact. There are small differences in the surface meteorological fields among the experiments, for example, there are differences in latent heat and sensible heat fluxes. However, as we discussed in the text that the impact of surface meteorological difference on biogenic emissions is relatively small compared to the vegetation impact. For example in the text, "Although the two land surface parameterizations produce slightly different values of surface temperature (Fig. 1), soil moisture (not shown), and net solar radiation near the surface (not shown), their impact on the biogenic emissions was small."

We also discussed about the potential impact of surface meteorology on surface mixing ratios. The text as been modified as follows, "Although both experiments with Noah and

CLM4 (red and orange lines, respectively) simulate similar isoprene emission fluxes with the maximum in the afternoon (Fig. 10), their respective isoprene+MVK+MACR mixing ratios are different at the four sites, particularly at site T0, where the Mv20CLM simulated isoprene+MVK+MACR mixing ratios during the daytime are about a factor of 2 larger than those from Mv20Noah. This inconsistence mainly results from the differences in the near surface meteorology, such as net surface radiation and temperature, between the two experiments (not shown) that affects photochemistry, but this impact of surface meteorology occurs only at limited locations."

- ***(3) I assume this was a dry period in the model simulations, so slight differences in cloud distributions could not have contributed much to the differences between model simulations in this case. However, could this have played a role in under/over forecasting for simulations of all runs in general?***

Yes, this study during a dry and warm period that favors biogenic emissions. For a more general case, the absolute impact may be smaller. The more quantitative conclusion should be drawn with multiple-season simulation in future studies. This is now acknowledged in the discussion section, where the text has been modified to read "It is also noteworthy that this study is in a relatively dry and warm season; therefore the impact of biogenic emission treatments may change for other seasons and during periods with higher cloudiness. A multiple-season investigation may be needed in future."