

## ***Interactive comment on “Evaluation of improved land use and canopy representation in BEIS v3.61 with biogenic VOC measurements in California” by J. O. Bash et al.***

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We would like to thank the anonymous referee for his/her insightful and thoughtful recommendations. The quality and constancy of this manuscript has been improved due to the revisions in response to this review. The response to the referee's suggestions are in blue to better distinguish them from the referee's text.

1. In Section 2.2 the similarities and differences between MEGAN and BEIS should be discussed in greater detail. Explain the sentence “MEGAN and BEIS have similar governing equations but differ in vegetation characterization, emission factors, meteorological adjustments and canopy treatment.” This becomes es-  
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pecially important to understand later in the paper when comparisons between CMAQ model predictions and observations are made.

The referee makes a good point here. Section 2.2 has been expanded to provide more information regarding the similarities and differences between MEGAN and BEIS. The following sentence “MEGAN and BEIS have similar governing equations but differ in vegetation characterization, emission factors, meteorological adjustments, and canopy treatment.” was replaced with “MEGAN and BEIS both estimate BVOC emissions following the widely empirical algorithm initially developed by Guenther et al (2006). The Emission Factors between MEGAN and BEIS differ as MEGAN uses emission factors for 16 different global plant functional types (Guenther et al. 2012) while BEIS uses species or species group specific emission factors where available and MODIS plant function types where no species specific data is available, see section 2.1. The canopy models between BEIS and MEGAN also differ. MEGAN uses a five layer canopy model where leaf temperature is iteratively solved for each layer by adjusting the MEGAN modeled latent, sensible heat fluxes, and outgoing long wave radiation to minimize the incoming and outgoing energy balance for the modeled leaf (equation 1). BEIS approximates the leaf temperature for sun and shaded layers of the canopy from the surface energy and momentum balance in the meteorological model as detailed in section 2.3. ” Additionally, the description of Equation 15 was updated to indicate that this was one of the similarities between BEIS and MEGAN.

2. Are there other important updates (e.g. emission factors, etc.) to BEIS 3.6.1 relative to BEIS 3.14 in addition to the canopy model of leaf temperature and use of BELD 3 versus BELD 4 data?

The emissions factors for different plant groups were not changed between BEIS 3.61 and 3.14. The BEIS model differences were entirely driven by the changes in the canopy model and the underlying land cover changes between BELD 3 and BELD 4. This is now explicitly stated at the end of section 2.2.

3. Table 2 is difficult to read because of the size and amount of text. Are these emission rates presented as relevant to the current study in California or as predominant types, in the United States? Have these been updated from the previous version of BEIS? How do they differ from those used in MEGAN?

The emission rates in Table 2 are the predominant types used by BEIS. Note that most of these emission rates presented in this table are aggregated by genus. BEIS supports a much more detailed representation of tree species and tree species types than MEGAN making a comparison with MEGAN plant functional types difficult. For example, MEGAN has a uniform emission factor for a deciduous forest while BEIS uses USDA Forest Inventory and Analysis data, in the US domain, to add more refined plant species information to the same plant functional type. The units in this table are the same as in Table 2 in Guenther et al. (2012). The following sentence was added to section 2.2 after the introduction of Table 2; "The variability in BEIS emission rates is greater than MEGAN 2.1 (Guenther et al. 2012) due to a more detailed representation of vegetation species."

4. Please briefly explain how the estimates of forest biomass of Blackard et al. were made. Section 3.2 describes differences between the BELD4 and Blackard estimates, but does not sufficiently explain - beyond the use of different canopy data sets - their underlying reasons. Why was the Blackard data selected to evaluate BELD4?

The following sentence was added to section 3.2; "Blackard et al. (2008) created a spatially explicit live forest biomass dataset for the United States based on FIA observations mapped to MODIS, 250 meter aggregated NLCD, topographic and climatic data." The Blackard et al (2008) data was chosen for an evaluation because we felt that it was important to evaluate the data that went into building the BELD 4 dataset and it is the only evaluated gridded forest biomass dataset for the continental US that the authors are aware of.

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5. Little explanation is given to provide a context for the discrepancies between the BEIS and MEGAN performance against observations. What are the author's hypotheses regarding factors that are driving these differences? How did MEGAN estimates compare with BEIS 3.14 predictions, i.e. do the updates to BEIS for version 3.6.1 result in more similar estimates between the two modeling frameworks?

To better describe the context for the discrepancies between MEGAN 2.1 and BEIS 3.61, the following text was added to section 3.4 "The airborne flux measurements of Misztal et al. (2014) are lower than the MEGAN estimates for the Northern California modeling domain evaluated here and the MEGAN canopy model behaved similarly to BEIS 3.61 (Figure 1) indicating that the MEGAN over estimate in isoprene is likely due to the MEGAN 2.1 emission factors in the modeling domain." Table 3, and the paragraph beginning on line 16 page 8135 documents the BELD 3.14 performance and the impact that updating the canopy model and land use has on the results.

6. Consider switching the order of Sections 2.1 and 2.2 such that a context is provided for the requisite input data first.

Sections 2.1 and 2.2 were not switched as the content of section 2.1 is needed to provide details of the land use data and context as to how the input land use data in section 2.2 was changed.

7. Figure 2. Could you add a difference plot for clarity?

A difference plot was added to figure 2 (see Figure 1 below).

8. p.8136, line 10: The reference to Figure 6 for the MEGAN results does not appear to be correct.

The referee is correct. This sentence referred to an earlier draft of the manuscript and the reference to figure 6 has been removed.

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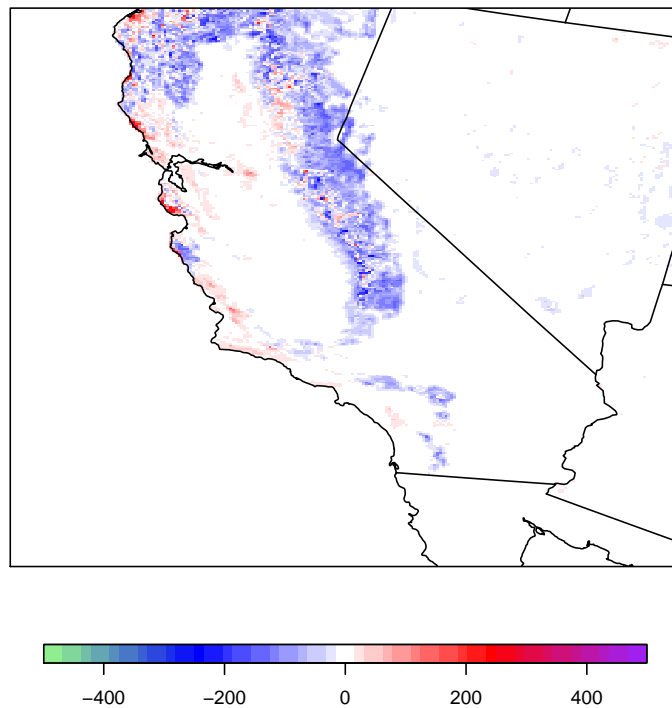
9. Some acronyms are not spelled out before the first use, please check all.

The acronyms in the manuscript have been checked and corrected.

Interactive comment on Geosci. Model Dev. Discuss., 8, 8117, 2015.

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Interpolated forest biomass – Blackard et al 2008 Mg/ha



**Fig. 1.** Difference between the BELD 4 total above ground biomass (Mg/ha) and the estimates of Blackard et al. (2008)

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