Response to referee comment #2:

BVOCs emission shows great impact on atmospheric chemistry and global climate due to its high chemical reactivity and high loads. This study uses a WRF-CLM-MEGAN coupled model to simulate BVOCs emission over China by update the input data. The paper is well written and the structure is well organized.
But the key issue is, the paper is lack of innovation. Since a series of previous studies have been conducted to estimate BVOCs emission over China or other regions. The author mentioned that the CLM is originally coupled with earth climate models and the spatial resolution is coarse. This study embedded MEGAN model within WRF-CLM with higher spatial resolution, and improved the input data by using satellite data. But higher resolution and high quality of input data is insufficient, since many previous studies had also updated the input data.

Response: The manuscript was revised much according to three referees' comments.

The novelty in this study is that the BVOCs emission is estimated by including some PFT-specific physiological parameters. These parameters are derived from CLM4, but never considered in the previous BVOC estimation algorithms coupled in the weather forecasting models.

We found the improvements are important (more details could be found in the section 3.2). Firstly, the estimations by using leaf temperature in our study were about 20 % higher than those estimated based on air temperature as in the previous methods. Secondly, the separate treatments of sunlit and shaded leaves in this study, which affect within canopy solar radiation, lowered the estimations by a factor of 2 compared with estimates made by methods neglecting shaded canopy. Thirdly, in this study, leaf temperature and solar radiation were averaged over the past running time at each time step to estimate emission response to weather history. However, in the original code, this response was estimated based on fixed parameters. The improved representation in our study resulted in 50 % higher estimations than those based on fixed values.

The results were within a factor of 2 of most canopy-scale flux measurements and top-down isoprene inventories, indicating an overall good performance of the coupled model (section 4).

The author also mentioned that the processes of land biogeophysics, hydrologic cycle, biogeochemistry etc have great impact of BVOCs estimation, but compare with input data, which one is more important on the estimation of BVOCs? Which one has greater uncertainties. Does the performance of BVOCs simulation improve by considering the land surface processes comparing with the BVOCs simulation without the consideration of land surface processes.

Response: The land surface processes in CLM4 were used to provide real-time plant physiological parameters for MEGAN algorithms. Additional experiments were performed to investigate the influence of considering land surface processes on estimations. Details of results and discussions were presented in the section 3.2 (Page 7, Line 201) of the revised manuscript.

Furthermore, the spatial and temporal variations of BVOCs over China are quite clear in previous studies. Therefore, what's the main differences and new findings compare with previous studies?

Response: We reworded the Introduction section to clarify the novelty of our study. The CLM4 scheme was used to provide real-time vegetation physiological factors through the parameterization of comprehensive ecological and biological processes for MEGAN, while most estimates made by weather forecasting models were based on ambient environmental factors. The impacts of physiological parameter applications on estimates were investigated in additional modeling experiments and discussed in section 3.2 of the revised manuscript.

Revisions: (Page 2, Line 51) "The MEGAN algorithms have been incorporated into Community Land Model (CLM), the terrestrial component of the earth climate system model, as one step toward integrating biogeochemical processes in the model. In the coupling of MEGAN and CLM, all the physical and biological variables required by BVOC estimation are determined by comprehensive ecological and physiological processes parameterized in CLM at each time step (Levis et al., 2003; Oleson et al., 2010; Lawrence et al., 2011). Process-based models are typically coupled within dynamic vegetation models that have a mechanistic model for leaf photosynthesis at their core (Arneth et al., 2007; Pacifico et al., 2011; Yue and Unger, 2015). In general, these coupled models are employed to investigate the long-term interactions and feedbacks between terrestrial vegetation and climate change with spin-up and simulation time from tens to thousands of years.

Instead of coupling detailed algorithms within the land surface parameterizations, a simplified version of MEGAN algorithm, the parameterized canopy emission activity (PCEEA) algorithm, has been coupled with weather and climate forecasting models as an independent module to generate online biogenic emission inventory for atmospheric chemistry simulation (Guenther et al., 2006; Sakulyanontvittaya et al., 2008; Fu and Liao, 2012; Henrot et al., 2017). Instead of using a detailed canopy model to calculate leaf temperature and leaf-level photosynthetic photo flux density (PPFD), the PCEEA algorithm parameterizes the modification of these plant physiological variables on emission rates based on ambient temperature and canopy above solar radiation. Although leaf temperature is strongly related to ambient temperature, it is also affected by other physical and biological factors such as irradiation and evapotranspiration. Subin et al. (2011) indicated that the strong advection and boundary layer mixing during the day decoupled the air temperature from the vegetation temperature to a great extent, making daytime surface energy budget the primary controlling factors of vegetation temperature changes. Furthermore, due to the different morphological and physiological properties, relationships between air temperature and leaf temperature, and between canopy above PPFD and leaf-level PPFD, vary significantly among tree species. Since the PCEEA algorithm was based on standard MEGAN canopy model simulations for warm broadleaf forests, using the same equations for representations of other plant types leads to unpredictable uncertainties. Leaf temperature and PPFD averaged over the past 24 and 240 h are used in MEGAN algorithms to account for effects of medium-term weather history. However, the PCEEA algorithm obtains the past conditions from a prescribed climatological monthly mean dataset, which could be much different from the real meteorology (Zhao et al., 2016). Therefore, reasonable plant-specific physiological variables are needed to improve the BVOC estimation in weather models.

CLM version 4 (CLM4) was coupled and released with the Weather Research and Forecasting model (WRF), a mesoscale numerical model designed to simulate regional weather and climate, since version 3.5 as one of the land surface scheme options to better characterize land surface processes (Jin and Wen, 2012; Jin et al., 2010; Subin et al., 2011). Because MEGAN has been embedded within CLM as mentioned above, the coupling of WRF-CLM4-MEGAN allowed regional weather forecasting models to estimate BVOC emissions within a comprehensive ecological climatology framework. Besides improvements result from real-time plant physiological variables derived from land surface parameterizations, sub-grid vegetation compositions represented in CLM4 are also expected to provide a more reasonable estimation in view of the significant variability in basal emission ability among tree species. However, few studies employed the coupled mode to estimate regional BVOC emissions (Zhao et al., 2016).”