Development of a measurement method for BVOCs emitted by Japanese cedar

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Biogenic volatile organic compounds (BVOCs) emitted by plants mediates plant-plant, and/or plant-herbivore communications in the biosphere. Besides, atmospheric degradation of BVOCs might lead to the formation of O_3 and secondary organic aerosols, which could affect BVOCs emission from the biosphere. Thus, BVOCs play an important role in atmosphere-biosphere interactions.

Conifers are known to emit considerable amount of BVOCs (Guenther, 2013; Matsunaga et al., 2012). In our previous study (Hiura et al., 2021), we measured BVOCs emitted by Japanese cedar (*Cryptomeria japonica* (Thunb. Ex L.f.)*D. Don*), the most dominant conifer in Japan, using cultivated individuals collected across Japan and grown in a common garden, and reported that the composition of emitted BVOCs diversified among regional populations. To further elucidate factors that determine emission characteristics of BVOCs, more data are needed.

However, the method used in the previous study was complex and time-consuming, because Japanese cedar accumulates BVOCs in storage pools (Saito et al., 2022) and thus extra emission due to mechanical damages during sampling procedure needs to be minimized. Here, we developed a new, simplified BVOCs measurement method based on the previous method.

Like the previous method, the new method employed the dynamic branch enclosure technique in which tree branches are enclosed FEP bag and supplied with VOC-free air.
To enable portable sampling under natural condition, the two following improvements were made. First, to reduce purging time, a folded bag is attached at the end of the branch a day before sampling and stretch it on the day of measurement. Second, air source was changed from compressed air cylinders to ambient air. To supply VOC- and O_3- free air, an activated carbon filter and ozone scrubber were incorporated into the air-supply line. The BVOC and O_3 removal capabilities were experimentally confirmed to be sufficient. The analytical precisions of the developed method were evaluated to be as good as those of the previous method. Another benefit of the developed method is that interior of enclosure maintains ambient humidity.

We applied the developed method for measuring BVOC emissions from local populations of Japanese cedar in a common garden. Among BVOCs measured, including 12 monoterpenes, 6 sesquiterpenes, and 2 diterpenes, *a*-pinene, sabinene, *b*-farnesene, and *ent*-kaurene were the predominant species. The measured emission profiles were found to be different not only among populations but also among individual trees. The method developed in this study can be widely applied to the study of BVOCs in conifers, including Japanese cedar.

Keywords: BVOCs, dynamic branch enclosure, Japanese cedar