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2015

Document Version:
Publisher's PDF, also known as Version of record

Geophysical Research Abstracts
Vol. 17, EGU2015-8457, 2015
EGU General Assembly 2015

Using adult cloned trees grown under natural conditions to characterize BVOC emission variation

Ylva Persson (1), Guy Schurgers (2), Anna Ekberg (1), Riikka Rinnan (2), and Thomas Holst (1)
(1) Lund University, Sweden, (2) Copenhagen University, Denmark

Biogenic Volatile Organic Compounds (BVOCs) are diverse chemical species produced and emitted from the vegetation as trace gases. BVOCs are commonly grouped into isoprene, monoterpenes and sesquiterpenes, where isoprene is mainly emitted by deciduous trees and monoterpenes and sesquiterpenes by coniferous trees. BVOCs are known to have a considerable impact on atmospheric chemistry and are precursors for secondary organic aerosol, which in turn are important for the aerosol feedback on the Earth's climate.
Recently, Bäck et al. (2012) reported a high diversity of the chemical composition of emitted compounds from pine trees growing at the same stand due to genetic variation. This study here uses cloned trees growing naturally in a transect in Europe in order to exclude genetic variation and to assess emission variation between and within selected tree species grown at different climatic conditions.
The International Phenological Garden (IPG) network, where cloned trees are used to monitor the long-term phenological observations of representative tree species for Europe provides a specific, cloned set of important tree species, which had been planted throughout Europe starting in 1957. This gives a unique opportunity to study the adaptation to various climatic conditions and field conditions in genetically identical plants in relation to BVOC emissions.

During a field campaign in 2013 at the IPG site in Taastrup, Denmark (55°40′ N, 12°18′ E), seven trees were measured at three heights within the canopy. Measured trees were two English oaks (Quercus robur), one European beech (Fagus sylvatica) and four Norway spruces (Picea abies) of two provenances. For oak and one provenance of spruce, measurements were performed twice, both in June and in August in order to examine any emission pattern change with the progression of the summer. Measurements were performed using a gas-exchange cuvette of a photosynthesis system combined with BVOC adsorbent tubes, which were later analyzed with a GC-MS. The BVOC emission spectra within the same species were almost identical for the most relevant BVOC compounds, which is supported by other performed studies. The results also suggested that emission from different provenances within the same tree species vary in chemical composition, that the fraction of total BVOCs emitted as isoprene from oak increases during the growing season and the overall compound mixture for oak and one of the provenances of spruce changed with the progression of the growing season. There were no significant changes in the emission pattern with height within the same tree.