EGU24-5216, updated on 02 Jul 2024
https://doi.org/10.5194/egusphere-egu24-5216
EGU General Assembly 2024

Understudied BVOC emissions in Europe and their potential atmospheric impacts

Heidi Hellén[1], Toni Tykkä[1], Simon Schallhart[1], Steven Thomas[2], Wenche Aas[3], Robert Wegener[4], Thérèse Salameh[5], Kaisa Rissanen[2], Roseline Thakur[2], Mari Losoi[2], Lauri Laakso[1], Jukka Seppälä[6], Kaisa Kraft[6], Hannele Hakola[1], and Arnaud Praplan[1]

[1]Finnish Meteorological Institute, P.O. Box 503, FI-00101 Helsinki, Finland (heidi.hellen@fmi.fi)
[2]Institute for Atmospheric and Earth System Research, Faculty of Science, University of Helsinki, Helsinki, Finland
[3]The Climate and Environmental Research Institute NILU, Instituttveien 18, 2007 Kjeller, Norway
[4]Institute of Energy and Climate Research, IEK-8:Troposphere, Forschungszentrum Jülich GmbH, 52425 Jülich, Germany
[5]IMT Nord Europe, Institut Mines-Télécom, Univ. Lille, Centre for Energy and Environment, F-59000, Lille -France
[6]Finnish Environment Institute, Latokartanonkaari 11, FIN-00790 Helsinki, Finland

Europe is one of the most studied areas related to biogenic volatile organic compound (BVOC) emissions. However, our knowledge of these atmospheric reactive compounds is still quite limited even there. Total hydroxyl radical (OH) reactivity studies indicate that half of the atmospheric reactive compounds are still unknown especially in the forested areas (Yang et al. 2016) and OH and ozone reactivity studies of our group have shown high fractions of reactivity from biogenic emissions (Praplan et al. 2020 and Thomas et al. 2023).

Globally, isoprene is the primary emitted BVOC. While boreal forests in Northern Europe are mainly considered as monoterpene emitters, Central Europe is expected to be dominated by isoprene (e.g. Messina et al. 2016). However, our results from a campaign at 17 stations over Europe in summer 2022 indicated that BVOC mixing ratios are highly variable and some areas also in Central Europe may be dominated by monoterpenes.

Sesquiterpenes and diterpenes have very high potential for secondary organic aerosol formation, but much less is known on their emissions and atmospheric concentrations. Our studies show that birches and spruces may be strong sesquiterpene emitters. We have also found that some urban trees in Montreal and wetlands in Lapland known as isoprene emitters may also release significant amounts of sesquiterpenes. Additionally, forest floor represents a potential source of sesquiterpenes.

Compared to terrestrial sources very little is known on the marine emissions of BVOCs. There are studies on dimethyl sulphide, but our recent results on an island in Baltic Sea suggest that other sulphuric compounds, like methanethiol, may be important too and could have strong impacts on SO_2 production and therefore also on new particle and cloud formation. Furthermore, our recent campaign at the coast of Baltic Sea indicates that phytoplankton and macrophytes could be a source of isoprene and monoterpenes (Thakur et al., 2024 publication under prep).

Compounds classified as BVOCs (e.g. monoterpenes) can also be emitted from anthropogenic sources, such as construction sites (e.g. from wooden material), as well as cleaning and personal care products. Our studies in a street canyon in Helsinki in 2022 indicates that they strongly impact local atmospheric chemistry even in wintertime.

Messina, P., Lathière, J., Sindelarova, K., Vuichard, N., Granier, C., Ghattas, J., Cozic, A., and Hauglustaine, D. A.: Global biogenic volatile organic compound emissions in the ORCHIDEE and MEGAN models and sensitivity to key parameters, Atmos. Chem. Phys., 16, 14169–14202, https://doi.org/10.5194/acp-16-14169-2016, 2016

Praplan, A. P., Tykkä, T., Schallhart, S., Tarvainen, V., Bäck, J., and Hellén, H.: OH reactivity from the emissions of different tree species: investigating the missing reactivity in a boreal forest, Biogeosciences, 17, 4681–4705, https://doi.org/10.5194/bg-17-4681-2020, 2020.

Thomas, S. J., Tykkä, T., Hellén, H., Bianchi, F., and Praplan, A. P.: Undetected biogenic volatile organic compounds from Norway spruce drive total ozone reactivity measurements, Atmos. Chem. Phys., 23, 14627–14642, https://doi.org/10.5194/acp-23-14627-2023, 2023.

Yang, Y., Shao, M., Wang, X., Nölscher, A. C., Kessel, S., Guenther, A., and Williams, J.: Towards a quantitative understanding of total OH reactivity: A review, Atmos. Environ., 134, 147–161, https://doi.org/10.1016/j.atmosenv.2016.03.010, 2016.