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Driving forces of individual BVOC emissions from a spruce tree in Central Germany; results from a dynamic enclosure study.

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We have conducted seasonal ambient and emission measurements of a series of biogenic VOCs such as monoterpenes (MT), sesquiterpenes (SQT), isoprene, methanol, methyl chavicol and acetaldehyde. Therefore a plant enclosure technique was applied in order to investigate a Central European spruce forest and its emissions responses to meteorological and environmental parameters. A healthy ≈15m tall Norway spruce tree was selected and a vegetation enclosure technique was applied from April to November 2011. VOCs are measured by PTR-MS, while samples have also been analyzed with GC-MS (Gas Chromatography – Mass Spectrometry) techniques for intercomparison and identification of individual VOCs. E/N ratio was adjusted at 117Td[2] and the primary ion signal (H3O+) was continuously above 4×107cps, implying a high sensitivity to our measurements. Temperature, relative humidity, ozone, photosynthetic active radiation (PAR) and CO_2 concentrations were continuously measured inside the plant cuvette. Meteorological and environmental parameters (radiation, atmospheric pressure, wind velocity, wind direction, temperature, O_3, relative humidity, soil moisture, precipitation, global radiation, H_2O, NO, NO_2) were measured by HLUG (Hessian Agency for Environment and Geology) and DWD (German Weather Service), 50 meters away from the measuring site.

In a peculiar season, which was characterized by a warm spring (temperature anomaly >40C), a wet summer (precipitation anomaly 126-150%) and an extremely dry autumn (precipitation anomaly <50%), VOC emissions were analyzed and studied in order to discern different driving forces for the individual compounds. The suggested[3] empirical beta factor for MT found to be in a reasonable range but the temperature dependency was almost double for daytime compared to nighttime measurements, suggesting that light is also influencing MT emissions. On the contrary, SQT emissions showed similar temperature dependency for both day and night measurements. The beta factor showed a different behavior during the seasons for different compounds implying different driving forces and storage inside the tree. Especially for SQT, there are indications that a storage pool that is getting empty while moving towards winter. Interestingly, it has been found that SQT emissions are not only correlated with ambient temperature but also with high ambient ozone levels. In a wide range of meteorological conditions and ozone concentrations, we found different emission behavior when ozone values are exceeding a critical threshold.

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