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Monoterpene emissions from boreal tree species: Determination of de novo and pool emissions

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Boreal forests emit a large amount of monoterpenes into the atmosphere. Traditionally these emissions are assumed to originate as evaporation from large storage pools. Thus their diurnal cycle would depend mostly on temperature. However, there is indication that a significant part of the monoterpene emission would originate directly from de novo synthesis.

By applying $^{13}CO_2$ fumigation and analyzing the isotope fractions with proton transfer reaction mass spectrometry (PTR-MS) and classical GC-MS we studied the origin of monoterpene emissions from some major Eurasian boreal and alpine tree species. We determined the fractions originating from de novo biosynthesis and from large internal monoterpene storages for three coniferous tree species with specialized monoterpene storage structures and one dicotyledon species without such structures.

The emission from dicotyledon species Betula pendula originated solely from the de novo synthesis. The origin of the emissions from coniferous species was mixed with varying fraction originating from de novo synthesis (Pinus sylvestris 58 %, Picea abies 33.5 %, Larix decidua 9.8 %) and the rest from large internal monoterpene storage pools.

We have also measured the ecosystem scale monoterpene emission fluxes from a boreal Pinus sylvestris forest by disjunct eddy covariance technique. Application of the observed fraction of emission originating from de novo synthesis and large storage pools in a hybrid emission algorithm resulted in a better description of ecosystem scale monoterpene emissions, as compared to the measured fluxes.