Map of locations

Figure S1. The Arctic and temperate locations (red dots). At each location two soil types were collected and in addition air samples were taken for BVOC analysis.

The method to determine BVOC mineralization

It is not possible to measure mineralization of volatile compounds using standard biometer flasks, since the volatile compound will disappear in the air stream. A commonly used alternative to the use of biometer flasks in mineralization studies is to place an alkaline trap in a closed incubation bottle, in which the $^{14}CO_2$ liberated during mineralization is captured. From time to time, the bottle is opened and the alkaline solution exchanged. We tested if this was a suitable method for our model BVOCs, however the more volatile compounds (like chloroform) were lost when the bottle was opened and the more water soluble compounds (like methanol and benzaldehyde) were dissolved in the alkaline solution along with $^{14}CO_2$.

Previously, a method for chloroform mineralization was developed, in which the alkaline solution was exchanged without opening the bottle and where $^{14}CO_2$ was separated from dissolved ^{14}C-chloroform by precipitation of the $^{14}CO_2$ with Ba^{2+} (Albers et al. 2011). That method, however, turned out to rely on non-labeled CO_2 from other soil processes in order to exceed the solubility product of $BaCO_3$ sufficiently to quantitatively remove $^{14}CO_2$ by precipitation as $Ba^{14}CO_3$. The short incubation time needed for most BVOCs in our incubations did not allow sufficient production of CO_2 to facilitate full precipitation. However, by including 0.01M $NaHCO_3$ in the alkaline CO_2-trap, any $^{14}CO_2$ liberated from mineralization was completely removed when Ba^{2+} was added. The question was then how fast $^{14}CO_2$ would be transferred from the soil to the trap or in other words the lower limit between sampling points. This transfer would depend very much on soil properties, especially on pH. We therefore investigated the individual transfer times for the four soil types included in the study by adding $H^{14}CO_3^-$ and incubating as if ^{14}C-BVOC had been added. Adding $H^{14}CO_3^-$ corresponds to 100% mineralization at time 0. For the three organic soils, around 80% of the added $H^{14}CO_3^-$ was captured after 2 hours and almost all was captured after 6 hours (Fig. S1). This shows that in soils with low pH the method is very well suited for mineralization studies with fast BVOC mineralization although in cases where mineralization is complete within a few hours, BVOC mineralization rates will be slightly underestimated. In the Arctic bare soil with relatively high pH, this underestimation in cases with very fast mineralization will be worse (Fig. S1).

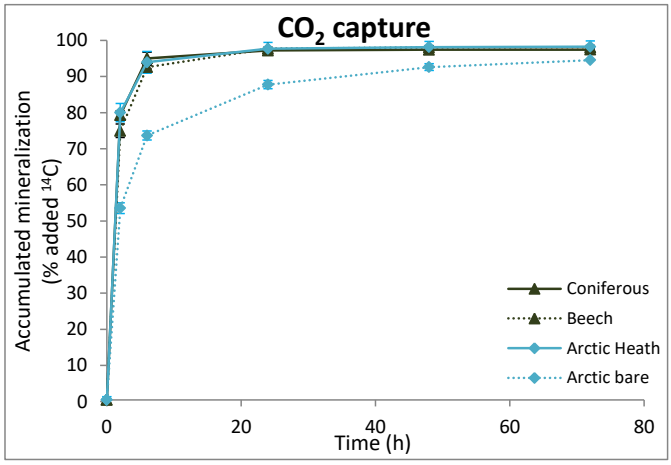

Figure S2. Method validation. $^{14}HCO_3^-$ was added at T=0, corresponding to 100% mineralization of a radiolabeled BVOC at T=0. Error bars are standard deviation of triplicate incubations. Some error bars are smaller than the symbols.

Supplementary results from mineralization experiment

Table S1. Supplementary mineralization parameters from the mineralization experiment shown in Fig. 3. Mineralization extent is the accumulated liberation of $^{14}CO_2$ at the end of experiment (144 h, except chloroform (21 d)). Final extraction is the amount of ^{14}C extractable with methanol at the end of experiment. All data are average of three replicate incubations. nd = no data.

	Mineralization extent (%)				Extractable ^{14}C (%)			
	Conif.	Beech	Heath	Bare	Conif.	Beech	Heath	Bare
Chloroform	36	30	44	47	nd	nd	nd	nd
Methanol	93	90	98	85	1	1	0	1
p-Cymene	81	66	87	48	8	7	4	5
Benzaldehyde	60	53	59	57	4	4	2	1
Acetophenone	43	41	37	46	6	4	3	4
Geraniol	46	42	42	33	19	17	16	25

References

Albers, C. N., Jacobsen, O. S., Flores, É. M. M., Pereira, J. S. F. and Laier, T.: Spatial variation in natural formation of chloroform in the soils of four coniferous forests, Biogeochemistry, 103, 317–334, doi:10.1007/s10533-010-9467-9, 2011.