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## Spotting C<sub>2</sub>H<sub>4</sub> in forest soils- what influences the occurrence of the phytohormone?

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As a reactive gaseous hydrocarbon, the phytohormone ethylene (Ethene, C<sub>2</sub>H<sub>4</sub>) influences root growth, senescence, and fruit ripening. While plants produce ethylene, microorganisms and fungi are also capable of degrading it. Ethylene therefore acts as an indicator for soil biological processes, but due to its reactivity it is hardly detectable in the atmosphere and soil air. In the 1970s to 1990s, studies were able to demonstrate that up to several ppm of C<sub>2</sub>H<sub>4</sub> occur in soil under certain conditions. However, these studies were limited to laboratory experiments and have a limited transferability to undisturbed forest soils.

We investigated the occurrence of ethylene as well as the influencing environmental parameters in forest soils in southwestern Germany using long-term measurement series from the Forest Environmental Monitoring (ICP Forests), as well as from project studies over the past 30 years. In total, soil gas data were available from 24 sites covering a period from 1994 to 2021. Data from gas samplers were used which were installed at various soil depths, at which the soil gas concentration was determined at regular intervals.

The data analysis showed that ethylene in the forest soil very rarely reached the detection limit of our highly sensitive gas chromatography system and that the occurrence is not subject to a regular temporal pattern, but rather cluster in hotspots and hot moments. Ethylene is measured far more frequently under spruce than under deciduous trees. The observed tree species effect indicates a correlation between rooting intensity and ethylene occurrence, as revealed by the evaluation of the root profiles. Artificial soil compaction also leads to increased ethylene concentrations, whereas no effect of liming could be observed.

Thus, the extensive field measurements confirm the patterns known from laboratory studies and show that ethylene, despite its rare occurrence in forest soils, is potentially found at all sites. The accumulation of ethylene in soil air could be observed significantly more frequently in compacted soils than in well-aerated forest soils, where the faster exchange with ethylene free atmospheric air makes accumulation and thus detection difficult.