

## **A controlled environment chamber system for high frequency of leaf level CH<sub>4</sub> exchange measurements: setup, operating principles, and initial results**

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Plant shoots can emit methane (CH<sub>4</sub>) from multiple source processes (microbial methanogenesis in soils and core wood, aerobic CH<sub>4</sub> production in foliage). We constructed a chamber system to isolate these processes and study how leaf level CH<sub>4</sub> emissions respond to environmental factors like dark-light-cycles, temperature, drought, or CO<sub>2</sub> concentrations. Tree samplings are located in a FITOCLIMA D 1200 plant growth chamber to for PAR, temperature and humidity control and equipped with a measurement chamber to quantify CH<sub>4</sub> exchange in a closed loop setup with a Picarro G2301 CH<sub>4</sub> analyser. The system was further customized to control temperature, CO<sub>2</sub>, and humidity control in the measurement chamber. The system allows the detection of CH<sub>4</sub> flux rates of on the order of 1 nmol CH<sub>4</sub> h<sup>-1</sup> and can conduct high frequency (< 15 min) measurements of CH<sub>4</sub> emissions rates from small shoots (<5g foliage biomass). Initial measurements were conducted with Scots pine and birch saplings. These experiments demonstrated that the shoots of different tree species emit CH<sub>4</sub> from distinct sources. Shoots of Scots pine and some birch species emitted CH<sub>4</sub> produced within the shoot, likely through aerobic CH<sub>4</sub> production, which showed a strong diurnal cycles that follows irradiation and photosynthesis rates. Shoot from some birch species, in contrast, showed emissions of soil-borne CH<sub>4</sub> that remained constant throughout day and nighttime. We expect that future experiment with this unique setup will allow to further disentangle shoot CH<sub>4</sub> emissions and characterize their response to environmental conditions including light, temperature, and relative humidity.

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