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## Methane facts

- Methane (CH<sub>4</sub>) is a green-house gas and contributes to ~20% of global warming
- 21-25 times more potent than CO<sub>2</sub> <sup>(1)</sup>
- 56% of world emissions due to human activities (e.g. agriculture, landfills, etc.)
- Removal by natural processes (95% by atmosphere; 5% by soils)
- CH<sub>4</sub> oxidation by soil bacteria (methanotrophs), particularly in temperate forests

## Objectives

- Determine methane fluxes from grassland, pine forest, bog, moorland, and birch forest
- Estimate their contribution and the effect of land-use change to the national CH<sub>4</sub> budget
- Identify the methanotroph communities present in each land use and determine the shift in their structure when land management is altered

## Measurements of CH<sub>4</sub> fluxes from different land uses

- Four sites in Scotland sampled



- Observation of seasonal changes
- Laboratory incubation of soil cores

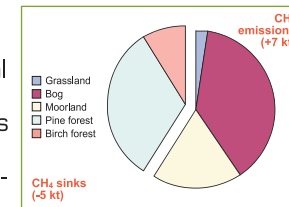
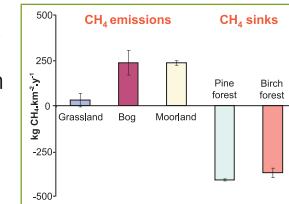


- Measure changes in CH<sub>4</sub> concentration in closed-chamber by gas chromatography <sup>(2)</sup>



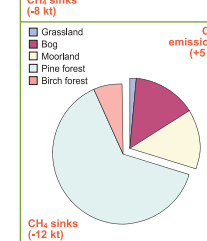
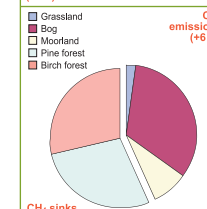
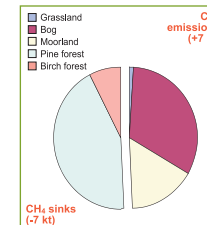
## Contribution of land uses to national CH<sub>4</sub> budget

- Upscaling of local CH<sub>4</sub> flux data to a yearly estimate
  - CH<sub>4</sub> emission (flux > 0) in non-forested areas
  - CH<sub>4</sub> oxidation/sink (flux < 0) in forests
- Relate the CH<sub>4</sub> flux of each land uses to their area in Scotland to calculate their contribution to the national CH<sub>4</sub> budget
  - Balance between sources and sinks is a positive CH<sub>4</sub> emission from non-forested areas (+2 kt)



## Effect of land-use change on CH<sub>4</sub> mitigation

- Based on the conversion of 50% of the original land use
- Grassland conversion into pine forest:
    - Balance between sources and sinks is neutral
  - Moorland conversion into birch forest:
    - Balance between sources and sinks is a positive CH<sub>4</sub> sink by forests (-2 kt)
  - Bog conversion into pine forest:
    - Balance between sources and sinks is a positive CH<sub>4</sub> sink by forests (-7 kt)

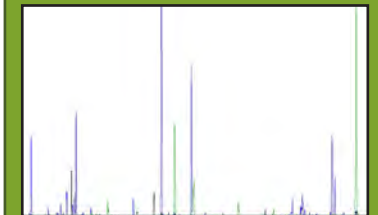


## Take-home messages

- Afforestation** (land conversion into forest) has a positive impact on CH<sub>4</sub> mitigation
- Bog afforestation would be more potent at mitigating methane than moorland or grassland afforestation
  - Bog afforestation could offset methane emissions from non-afforested areas
  - Additionally, it could offset almost 7% of the CH<sub>4</sub> emissions due to animal production

## Future work

- Molecular approaches: Information on how land-use changes affect structure and diversity of methanotrophs



- Identification of specific bacterial species and genera (T-RFLP, cloning) <sup>(3)</sup>



- Linking community structure with function (PLFA-SIP, DNA-SIP) <sup>(4)</sup>