Methane emissions and uptake in temperate and tropical forest trees on free-draining soils

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1. Introduction

Forests play an important role in the exchange of radiatively important gases with the atmosphere. Previous studies have shown that in both temperate (Gauci *et al*., 2010) and tropical (Pangala *et al*., 2013) wetland forests tree stems are significant sources of methane (CH_4), yet little is known about trace greenhouse gas dynamics in free-draining soils that dominate forested areas globally.

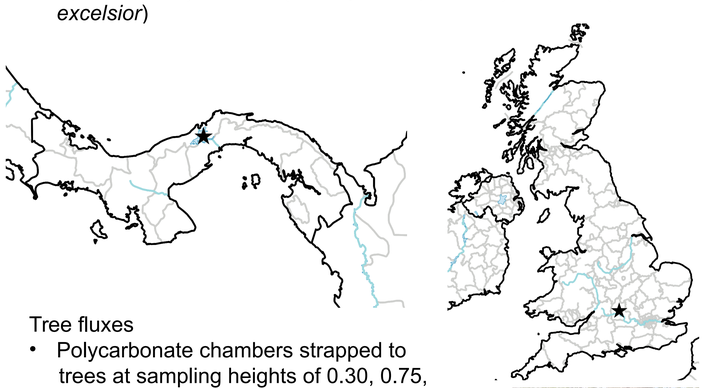
Fluxes were sampled from a lowland tropical rainforest on free-draining soil in Panama and a deciduous temperate woodland in the UK.

Do fluxes in these forests show seasonal variation?
Are fluxes spatially variable on tree stems?
What effects do these forests have at an ecosystem scale?

2. Sites & methods

Two study sites:
1) Lowland semi-evergreen tropical forest, Gigante Peninsula, Panama
- Mean annual precipitation 2600mm
- Species - *Heisteria concinna* & *Simarouba amara*

2) Mixed deciduous broadleaf woodland, Wytham, UK
- Mean annual precipitation 726mm
- Species - Sycamore (*Acer pseudoplatanus*) & Ash (*Fraxinus excelsior*)



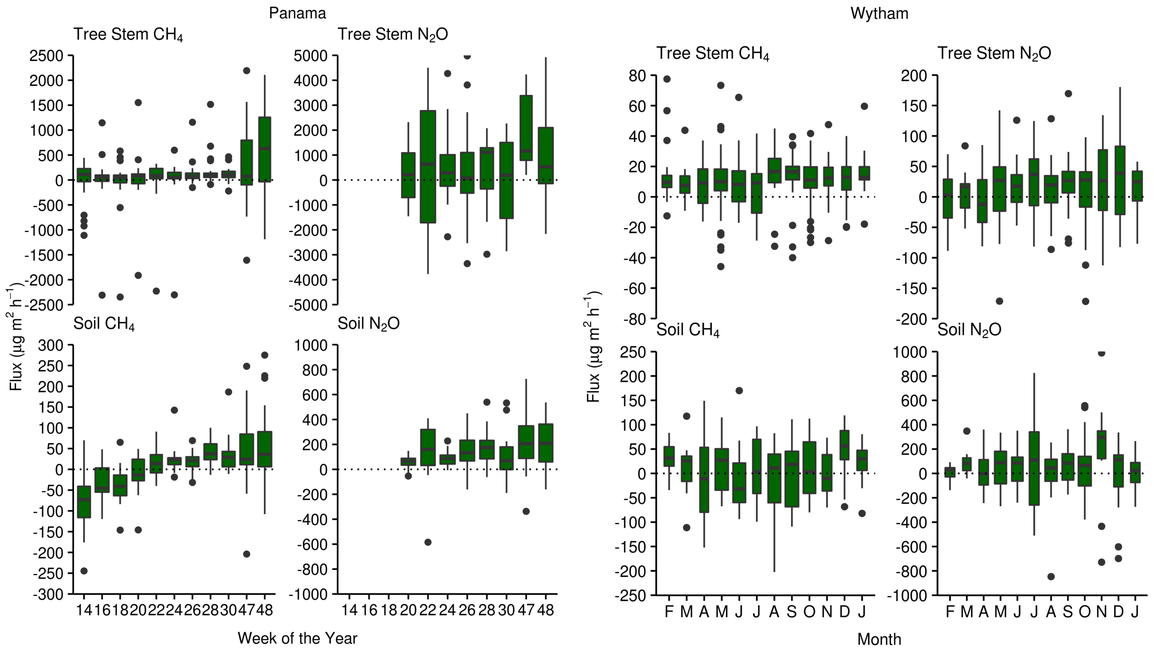
Tree fluxes
- Polycarbonate chambers strapped to trees at sampling heights of 0.30, 0.75, 1.30 & 2 metres (Siegenthaler *et al*., 2016)
- Manual sampling by syringe

Soil fluxes
- Collars installed two weeks prior to sampling
- 12cm PVC pipe, embedded 3cm into soil
- 10 minute enclosure time – samples taken manually at 0, 3, 6 & 10 minutes

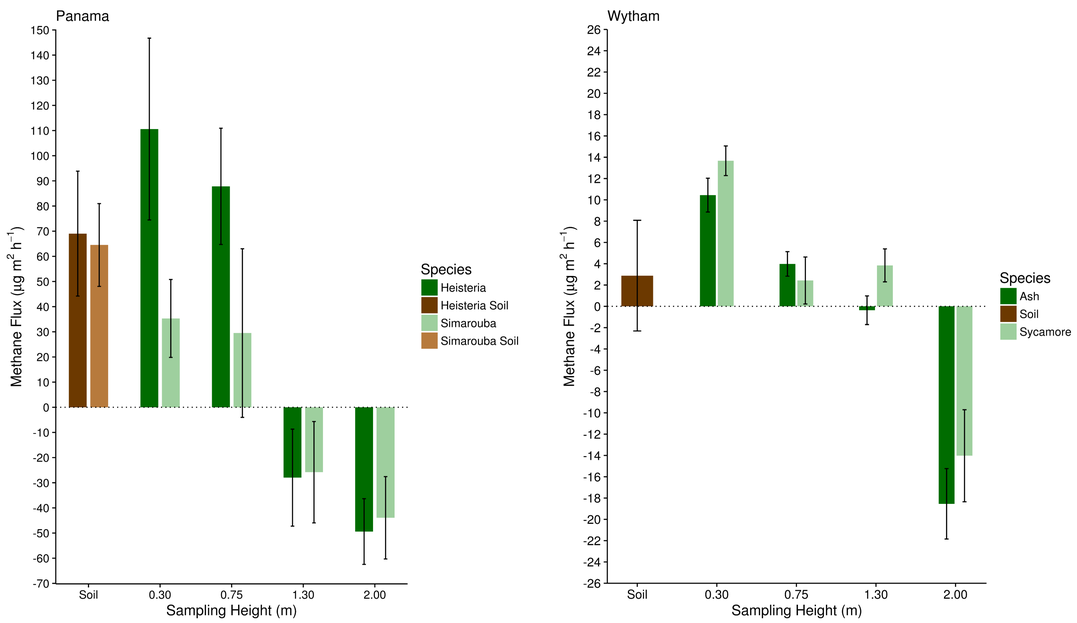
CH_4 analysed using Los Gatos FMA
N_2O analysed using Cambridge Instruments Gas Chromatograph
Fluxes derived using Baird *et al*., 2010.

3. Results

Greater seasonal variation in tropical tree stem & soil fluxes



CH_4 flux decreased significantly with sampling height at both sites



4. Conclusions

Forests on free-draining soils exhibit both uptake and emission from soils and tree stems and this behaviour varies both in space and time.

Seasonality

	Panama	Wytham
Tree CH_4	$p < 0.05$*	$p < 0.0001$***
Soil CH_4	$p < 0.0001$***	$p > 0.05$
Tree N_2O	$p < 0.05$*	$p < 0.01$ **
Soil N_2O	$p > 0.05$	$p > 0.05$

Tropical fluxes display significant seasonal variation, likely due to the stark contrast in precipitation between the dry and wet seasons in Panama. Whereas precipitation is more evenly distributed over the year at the UK site.

Flux-Height relationships

Species	Flux~Height	
Heisteria concinna	$r^2 = 0.2709$	$p < 0.0001$***
Simarouba amara	$r^2 = 0.0729$	$p < 0.05$*
Ash (Fraxinus excelsior)	$r^2 = 0.1249$	$p < 0.0001$***
Sycamore (Acer pseudoplatanus)	$r^2 = 0.0661$	$p < 0.0001$***

All species studied show a significant negative correlation between CH_4 flux and sampling height. This corresponds with similar spatial variation at a wetland site in Borneo observed by Pangala *et al*.

References

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