Tree Contributions to Temperate Forest Methane Budgets

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Smithsonian Environmental Research Center

Scott Pitz


CH_4
Sink
NOAA
CH_4
Unsaturated **Oxic** Soil
(anoxic microsites)

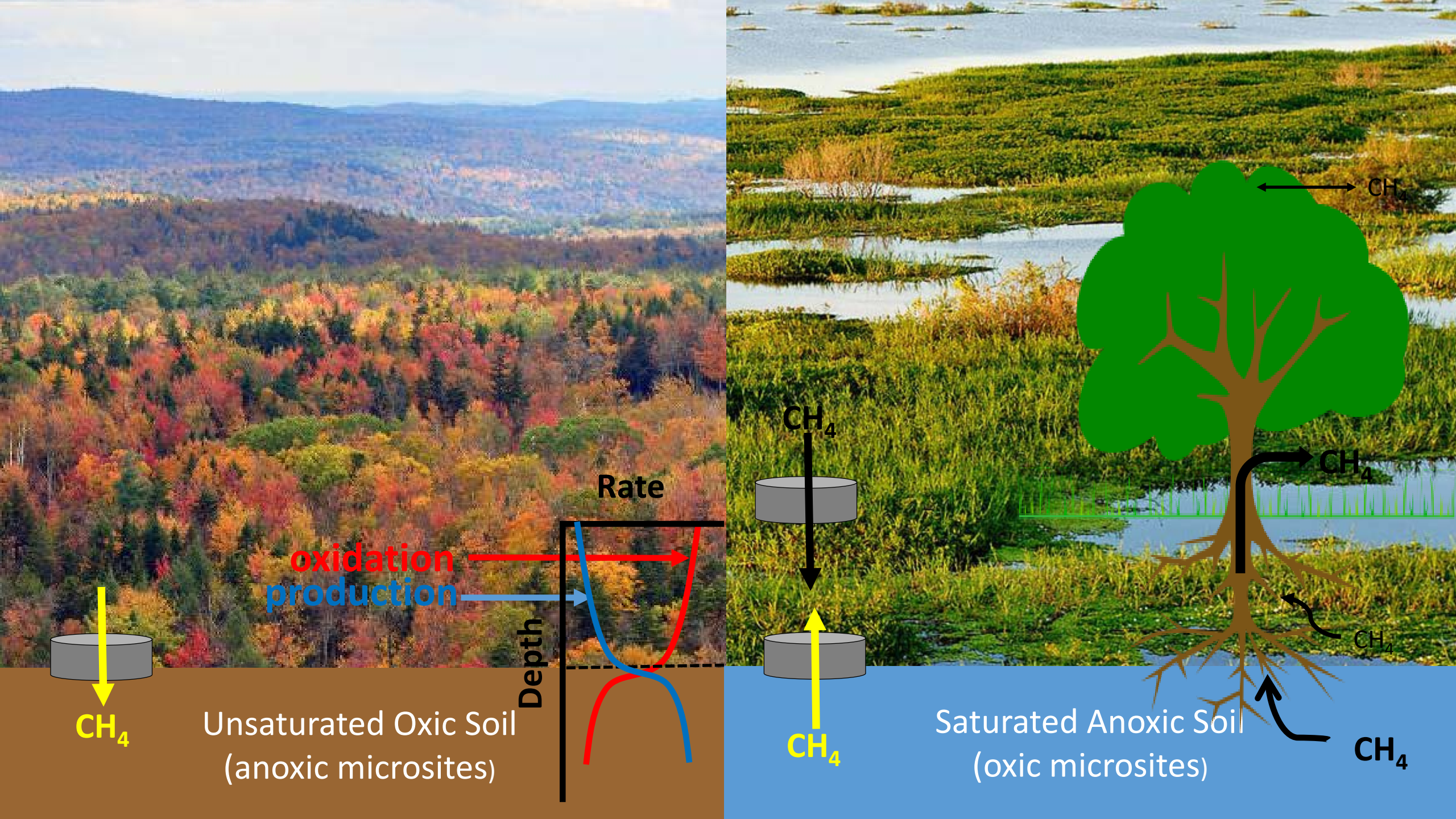

CH_4
Source
Walter Wust
CH_4
Saturated **Anoxic** Soil
(oxic microsites)

Plant Aerobic, Abiotic CH_4 Production

Keppler et al. (2006) *Science*

Search for Cryptic Sources of Upland Methane

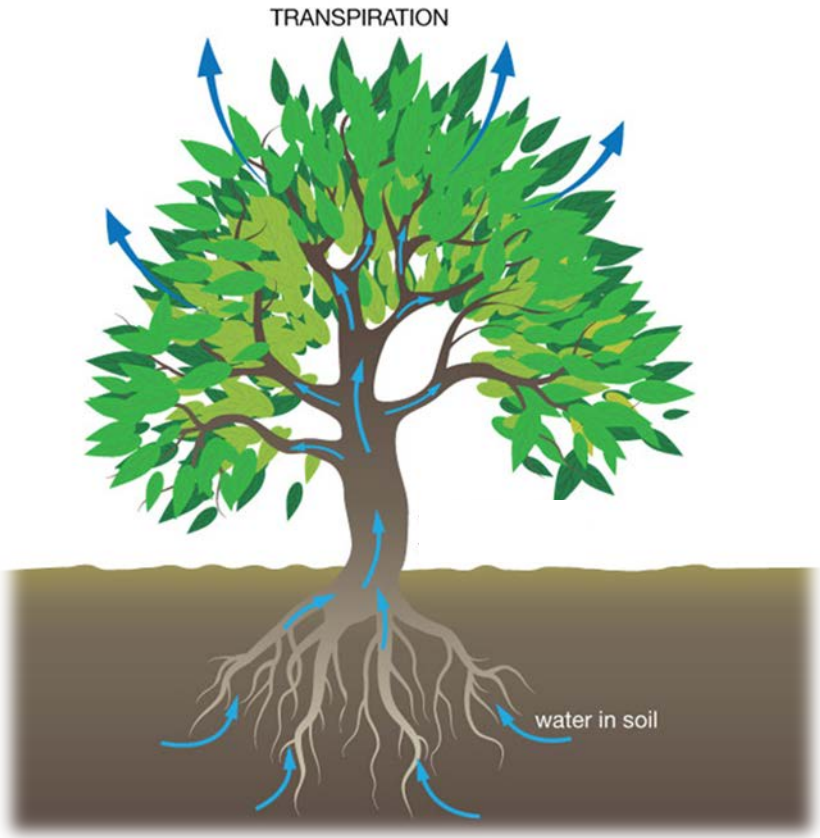
Heart Rot http://green.blogs.nytimes.com /


Rate
oxidation
production
Depth
CH_4
Unsaturated Oxic Soil
(anoxic microsites)
CH_4
CH_4
CH_4
CH_4
CH_4
CH_4
Saturated Anoxic Soil
(oxic microsites)

Hypotheses

Soils will switch from sinks to sources across the hydrologic gradient, while trees will always be CH_4 sources.

Soils (rather than tree stems) are the primary source of CH_4 emitted from upland trees.

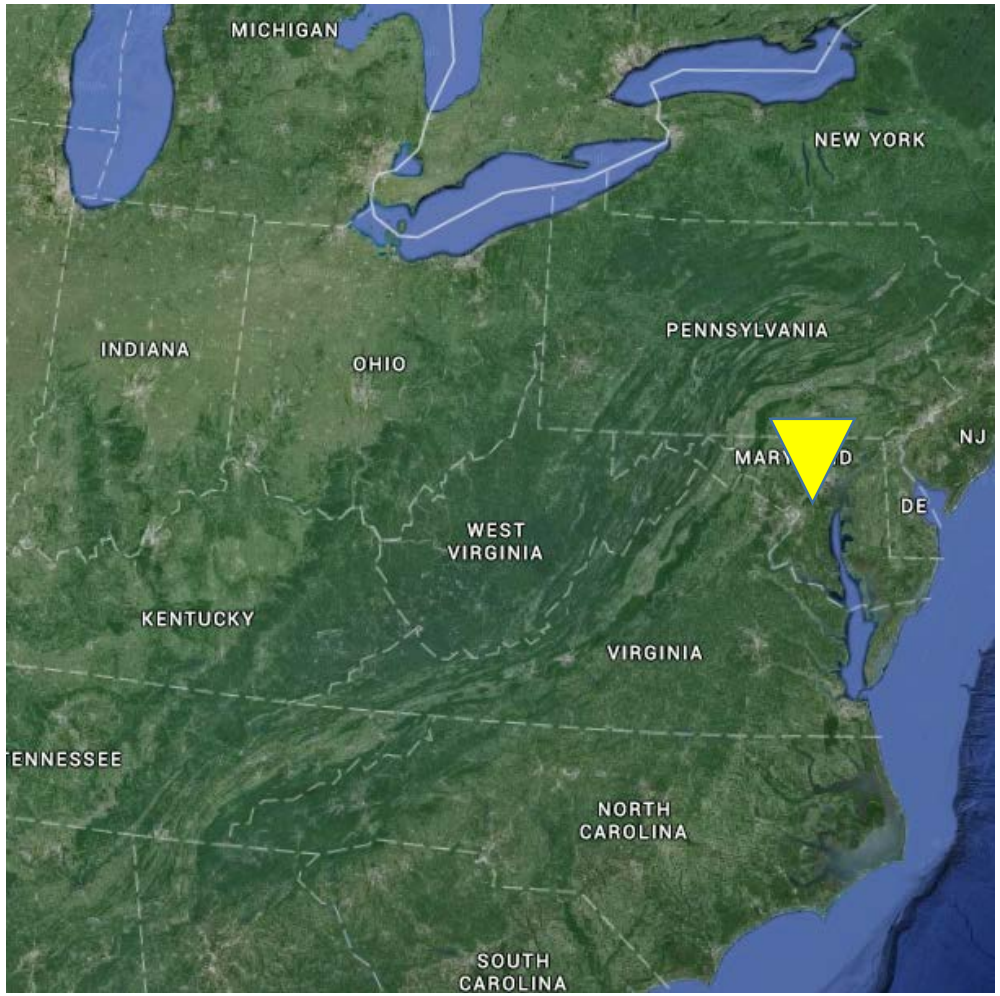


References

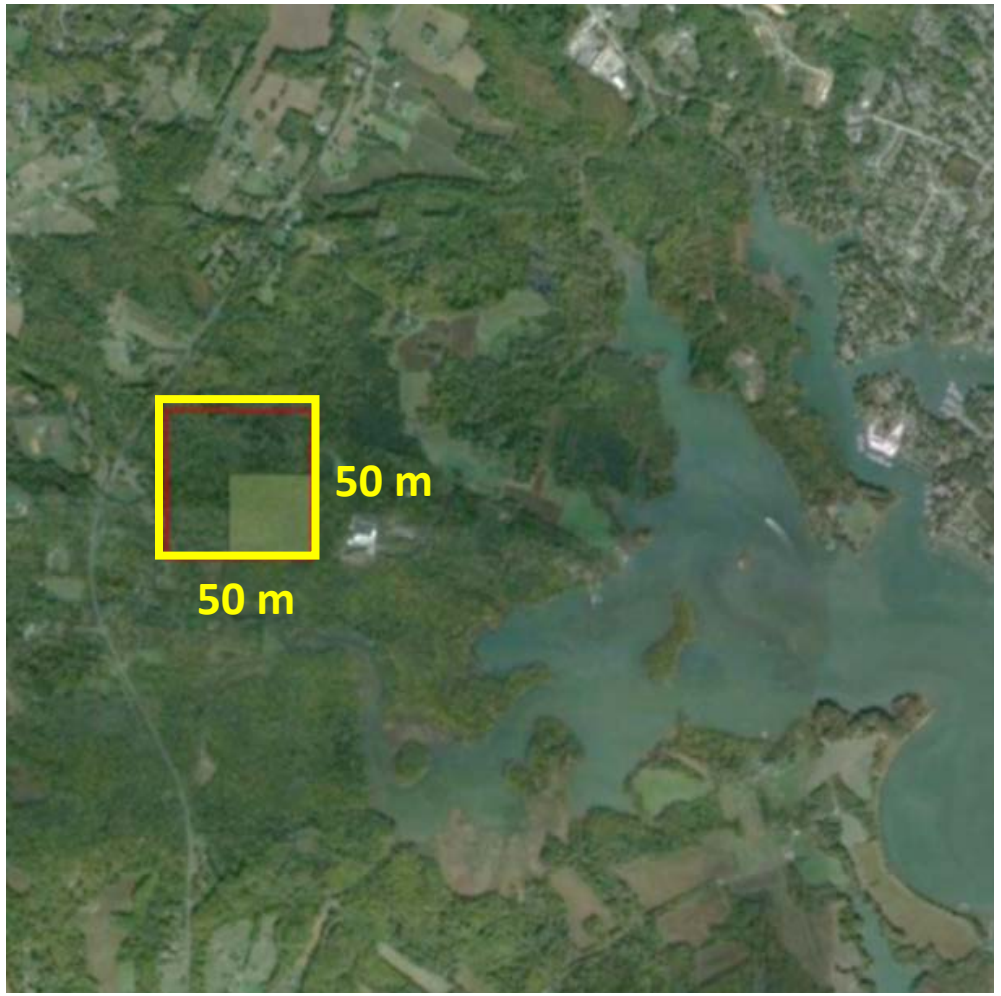
Pitz et al. 2018 *Biogeochemistry*
Pitz and Megonigal 2017 *New Phytologist*

Smithsonian Environmental Research Center

Chesapeake Bay, Maryland, USA

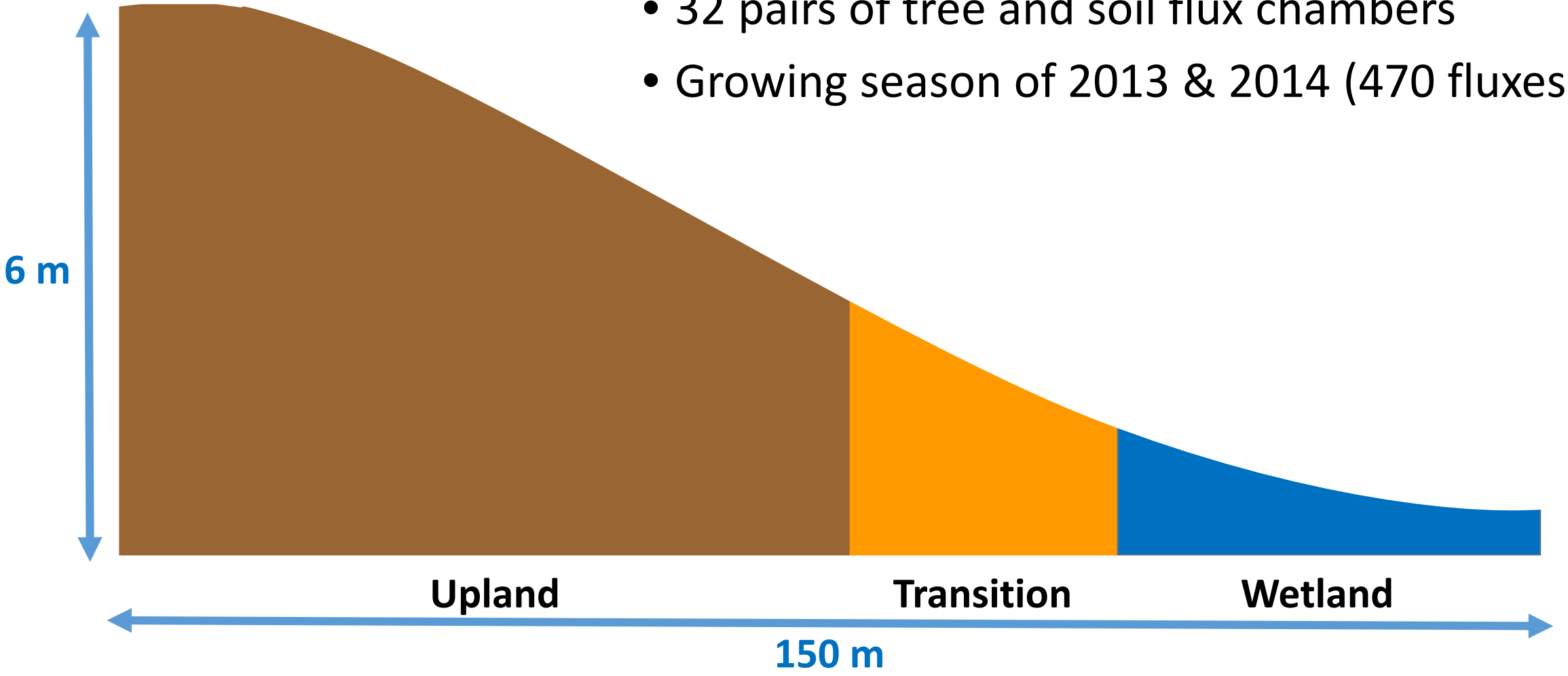


Forest Global Earth Observatory Plot



Methods

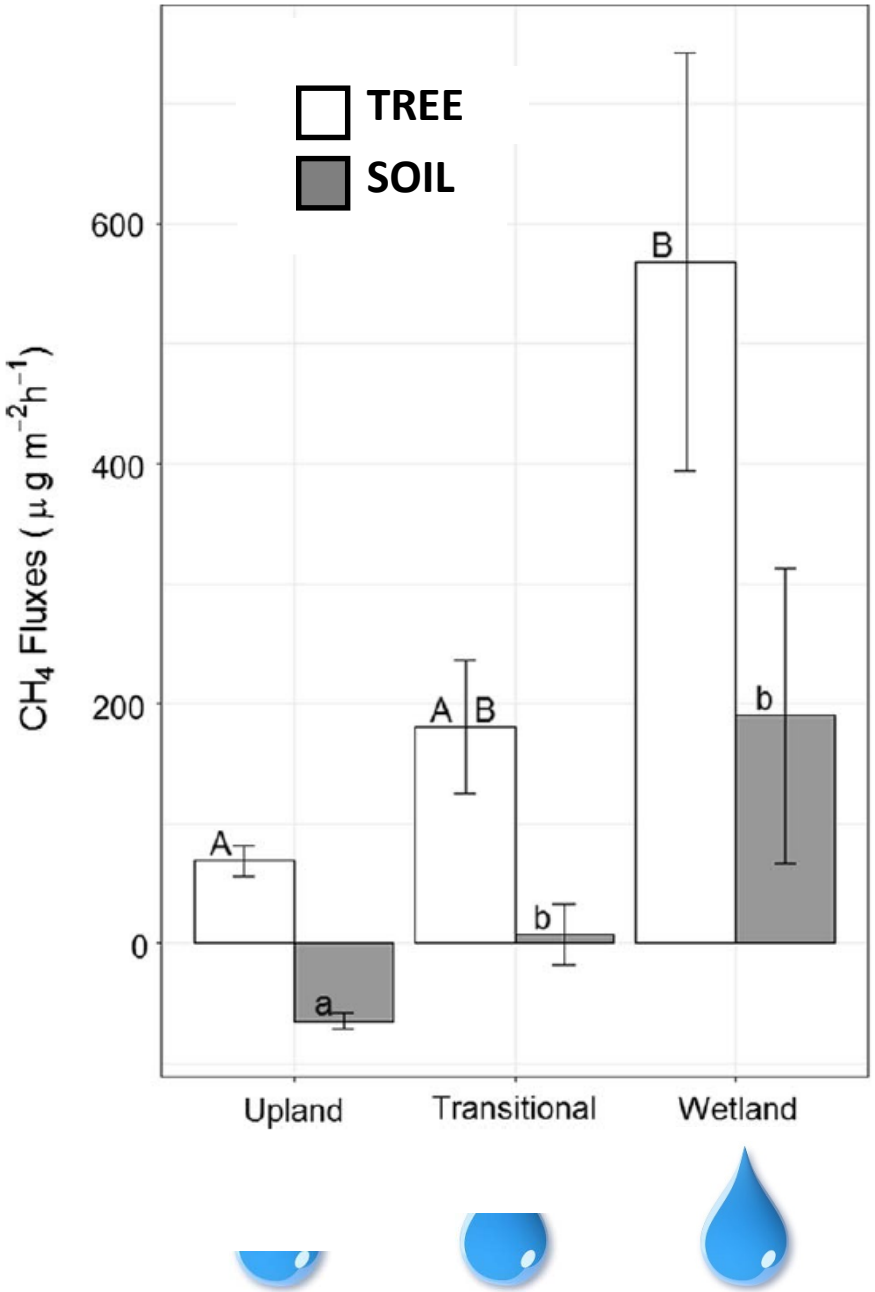
- Temperate deciduous forest
- 32 pairs of tree and soil flux chambers
- Growing season of 2013 & 2014 (470 fluxes)

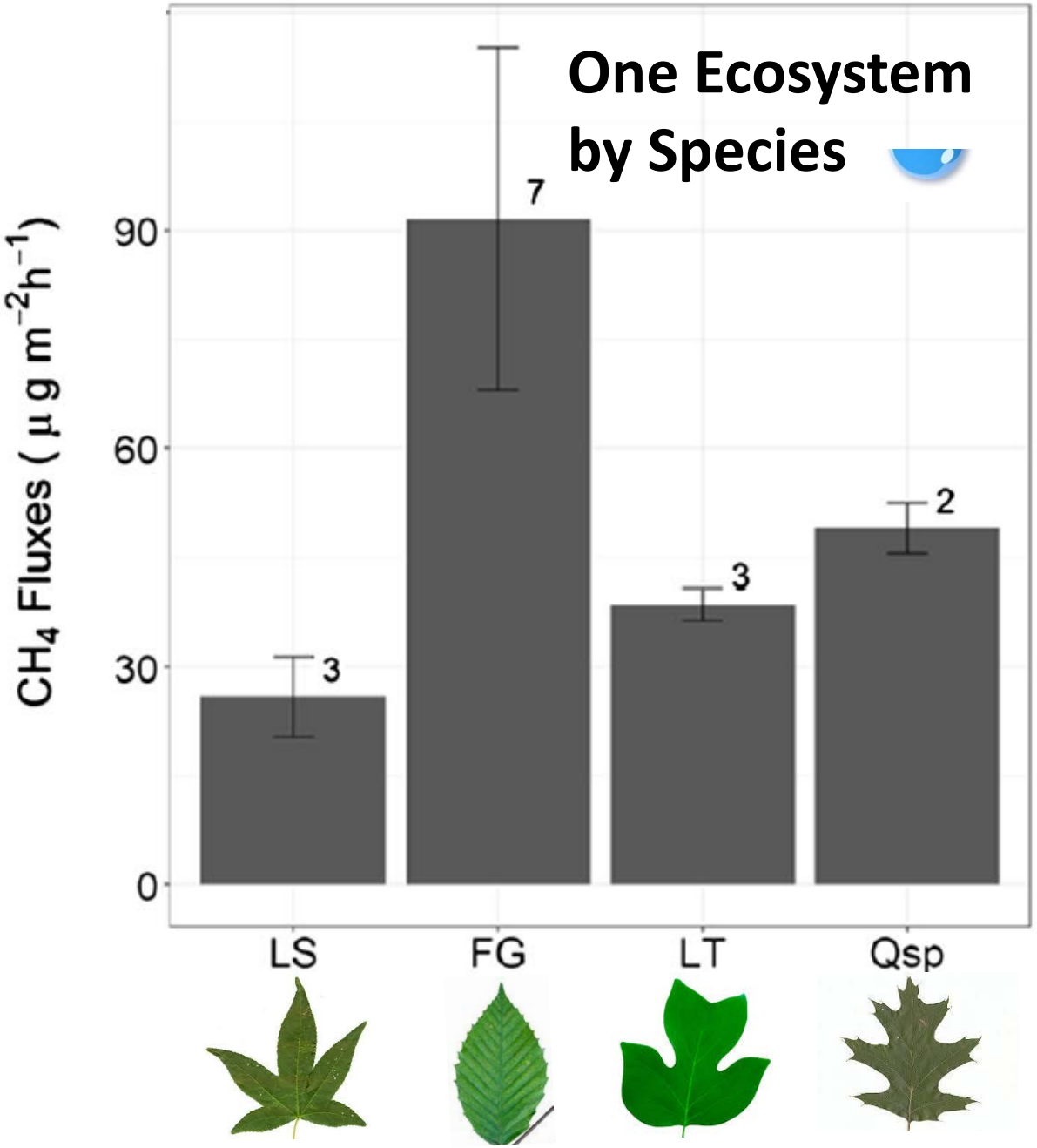


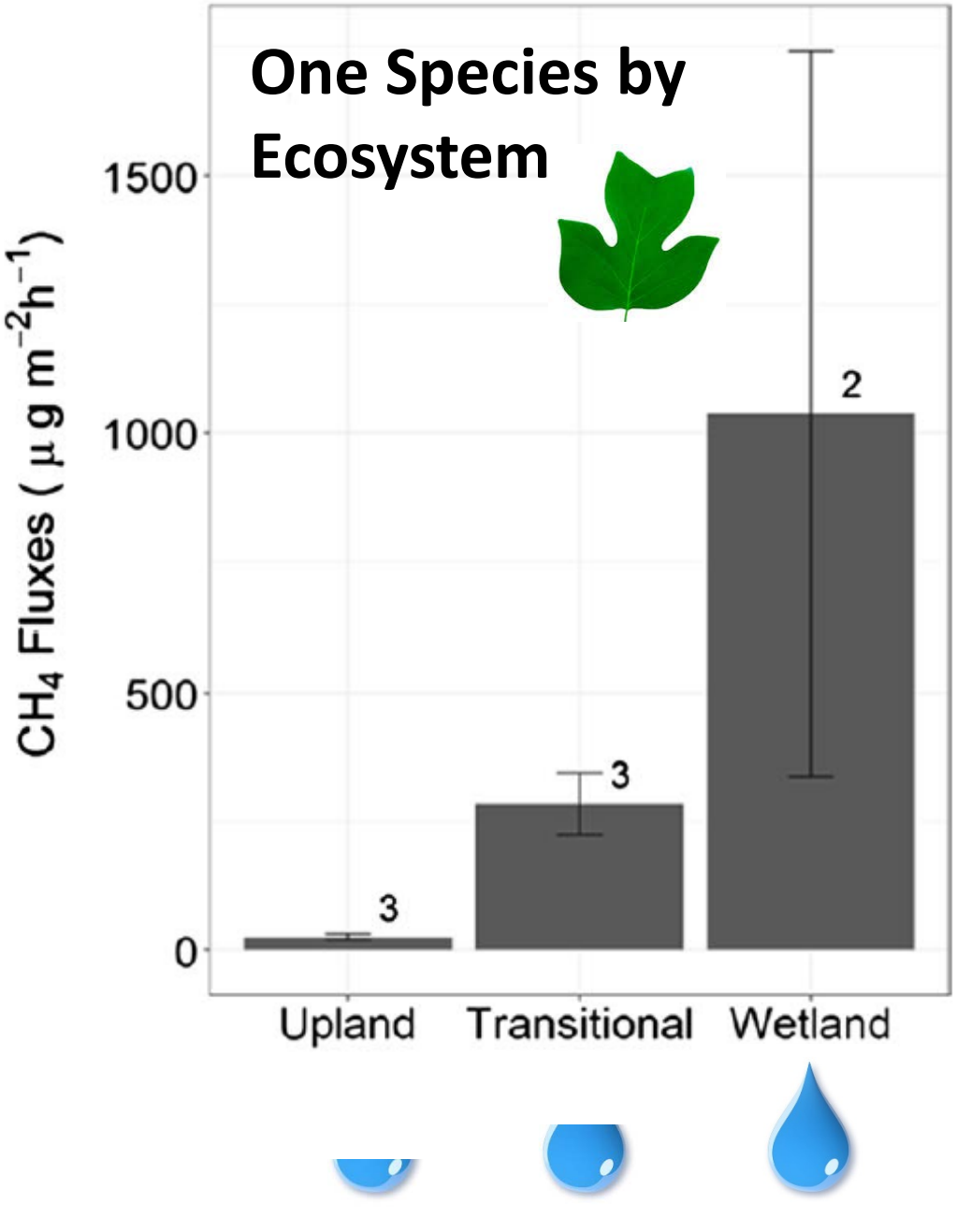
Tree Species

- *Fagus grandifolia* (American beech)
- *Liriodendron tulipifera* (tulip poplar)
- *Carya tomentosa* (mockernut hickory)
- *Quercus velutina* (black oak)
- *Quercus michauxii* (swamp chestnut oak)
- *Acer rubrum* (red maple)
- *Liquidambar styraciflua* (sweetgum)
- *Fraxinus pennsylvantica* (green ash)
- *Carpinus caroliniana* (ironwood)

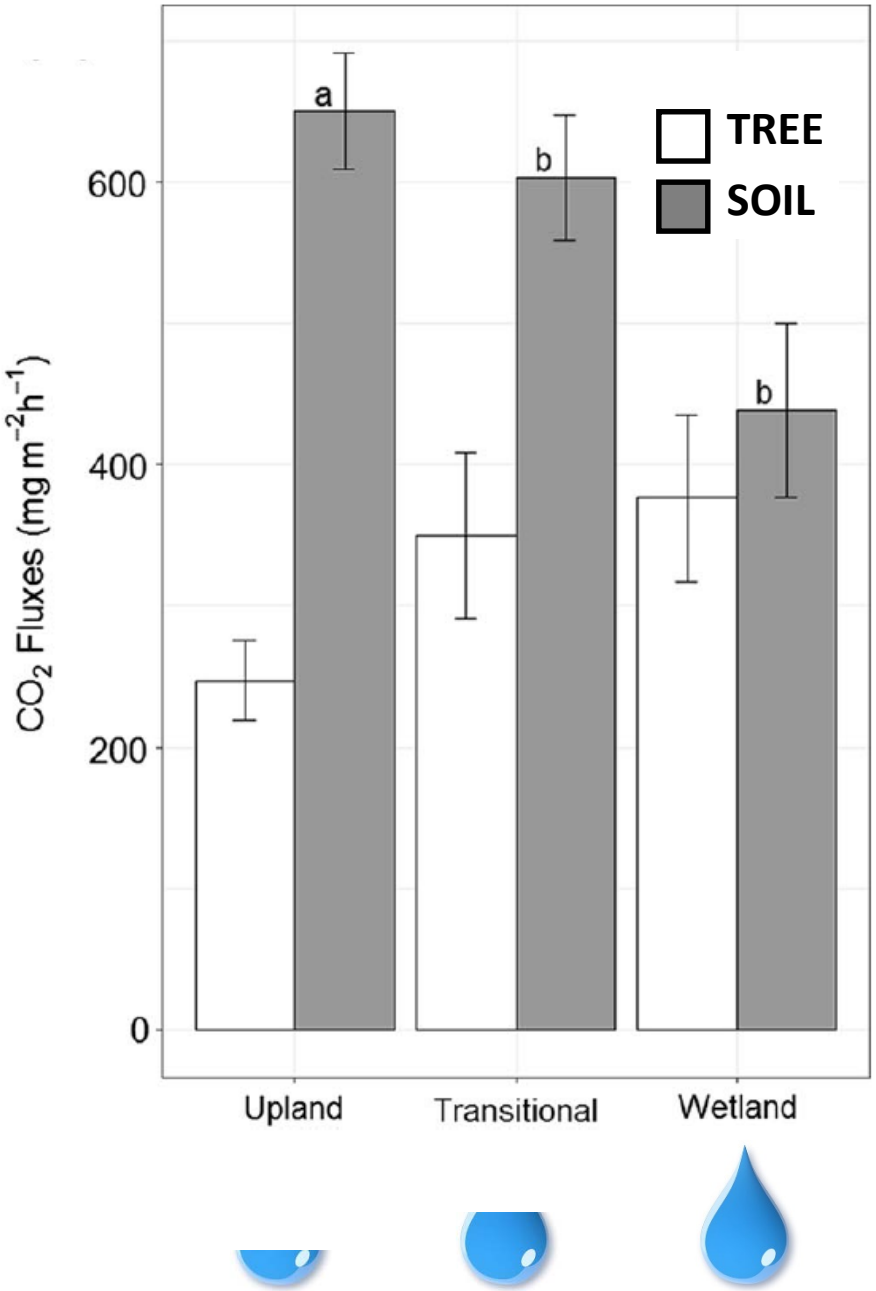
Methane Flux




One Ecosystem by Species
CH_4 Fluxes ($\mu g\ m^{-2}h^{-1}$)
0
30
60
90
3
7
3
2
LS
FG
LT
Qsp

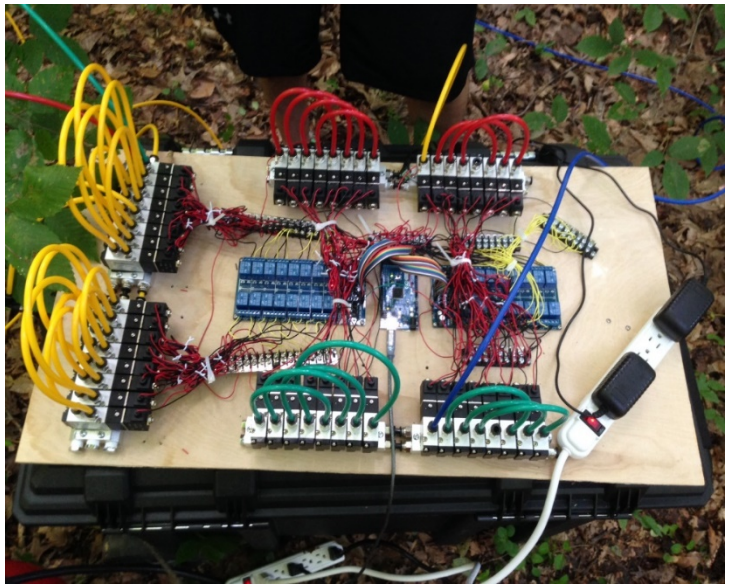

One Species by Ecosystem
CH_4 Fluxes ($\mu g\ m^{-2}h^{-1}$)
0
500
1000
1500
3
3
2
Upland
Transitional
Wetland

Carbon Dioxide Flux

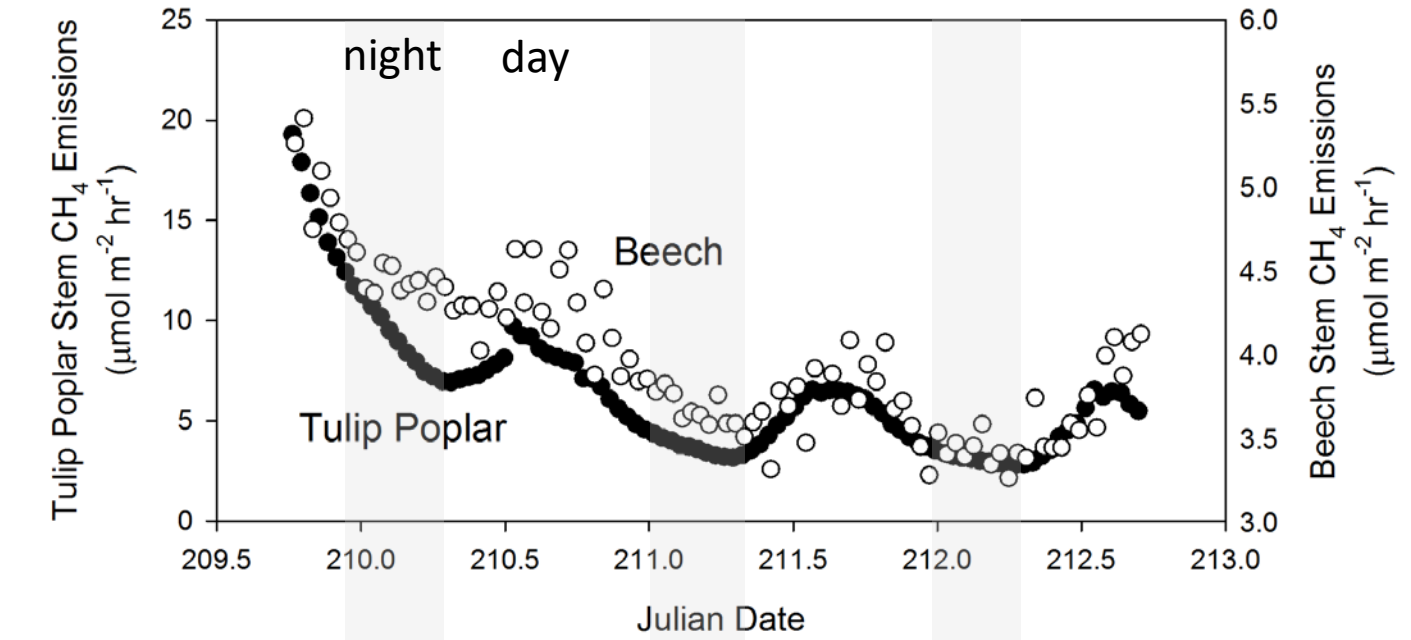


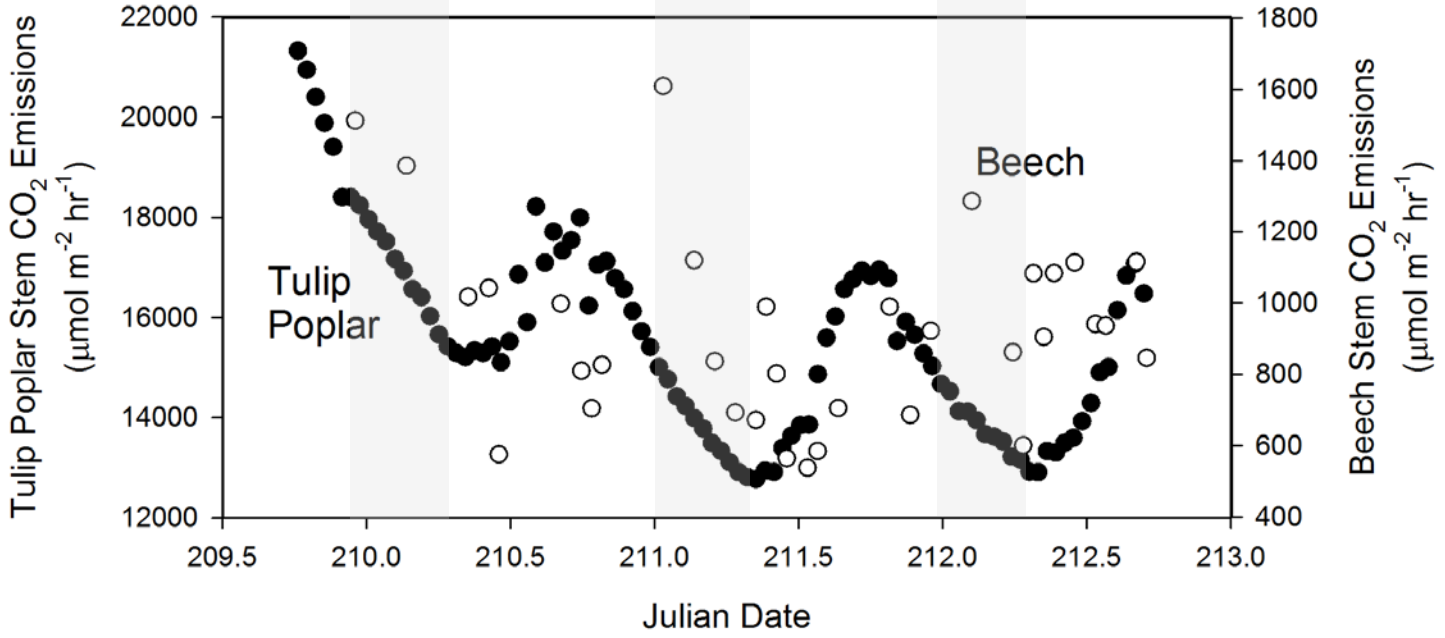
High Frequency Measurements

- Three heights on Tulip poplar
- One height on Beech
- Three days of data

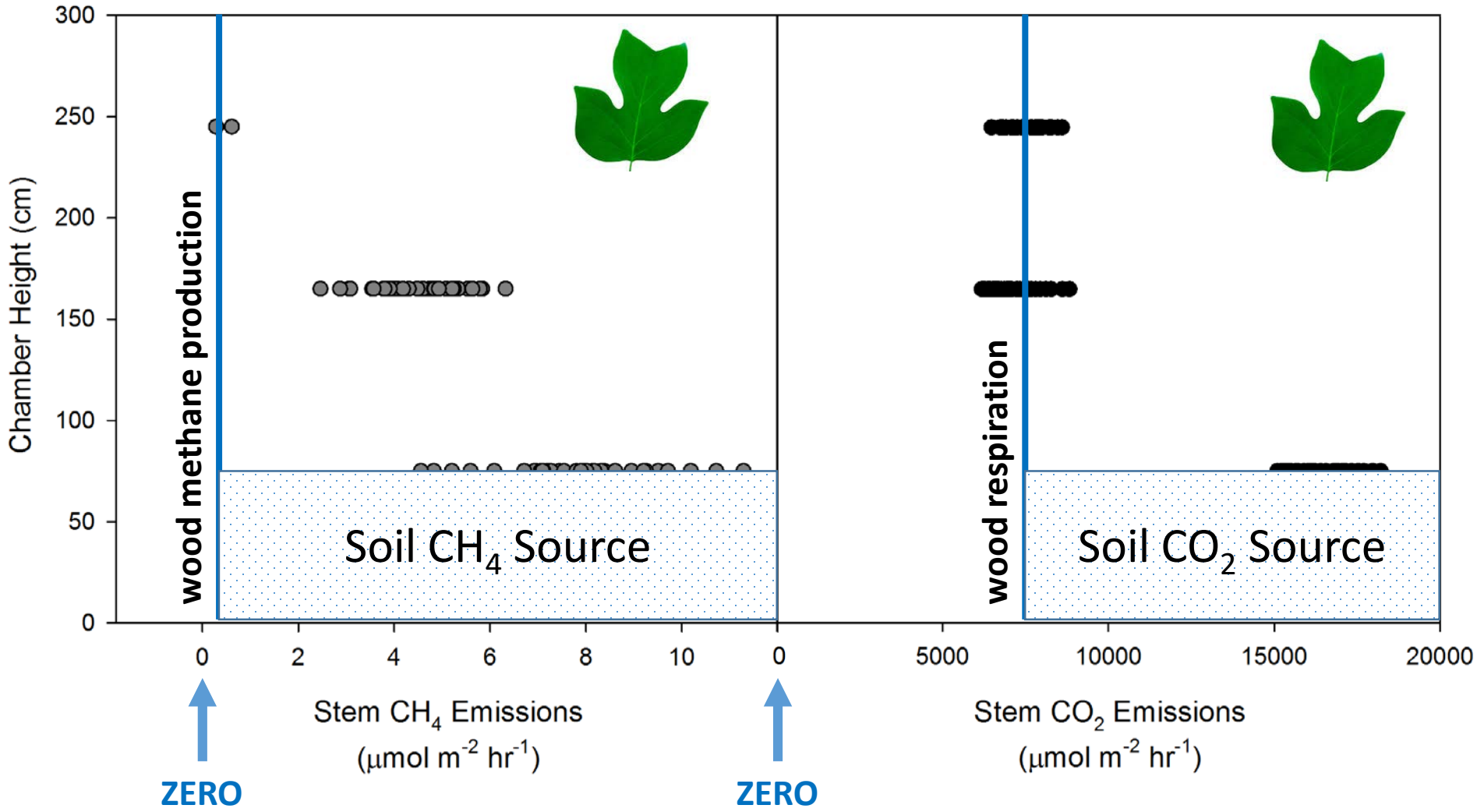


Patterns by Time and Species





Question of Methane Sources in Upland Forest



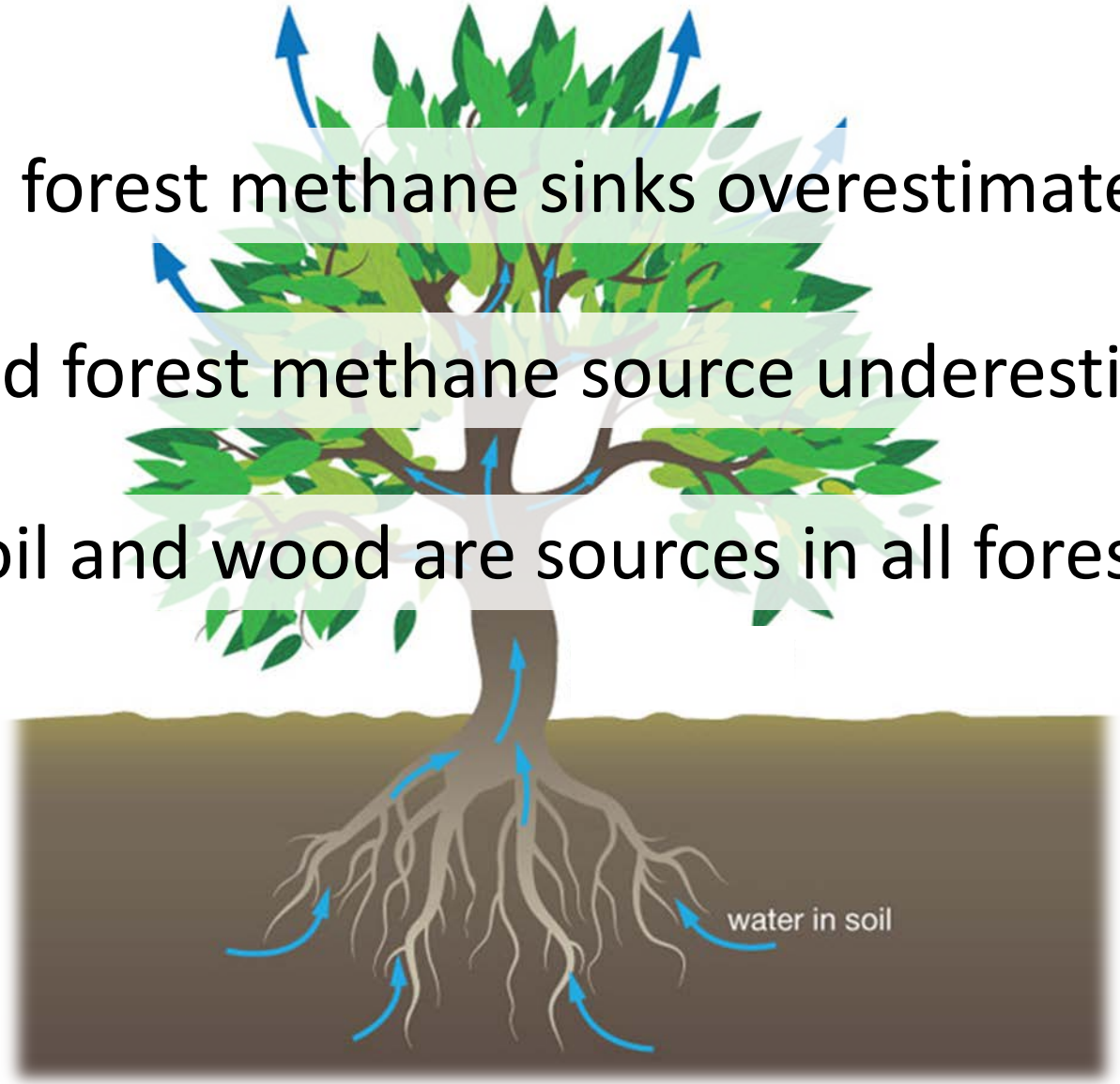
Upland Forest Trees Offset Soil Methane Uptake

- Tree surface area to 3 meters = 13% of soil area
- **Tree emissions offset 5% of soil sink**
- Whole tree surface area = 104% of soil area
- Ecosystem was a net source in June

Forest Global Earth Observatory Plot

Conclusions

- Upland forest methane sinks overestimated
- Wetland forest methane source underestimated
- Both soil and wood are sources in all forest types




Thank You
Peter van der Sleen