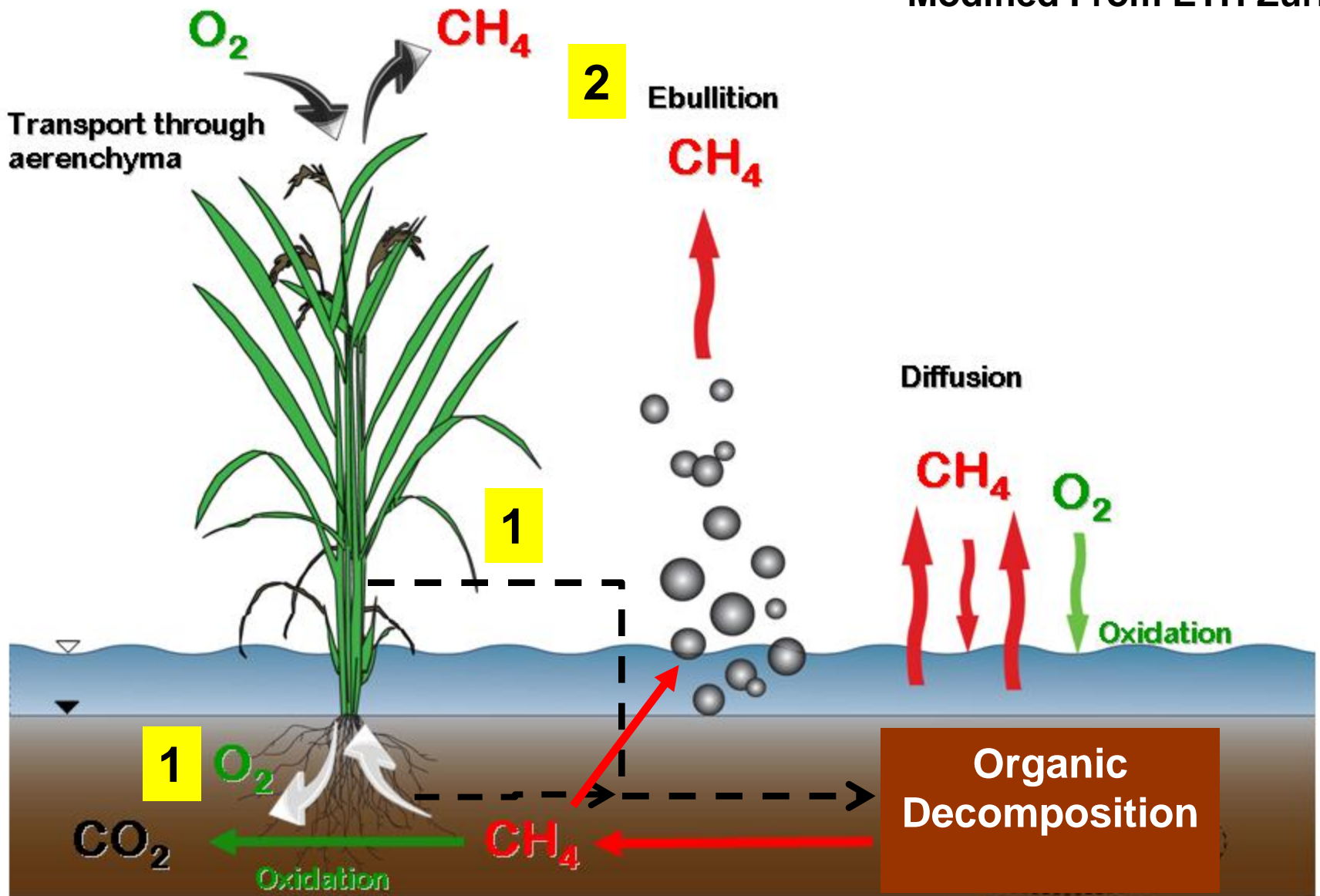


Approaches and Limitations to Quantifying Plant Regulation of Methane Emissions

J. Patrick Megonigal

Smithsonian Environmental Research Center





Methane oxidation:

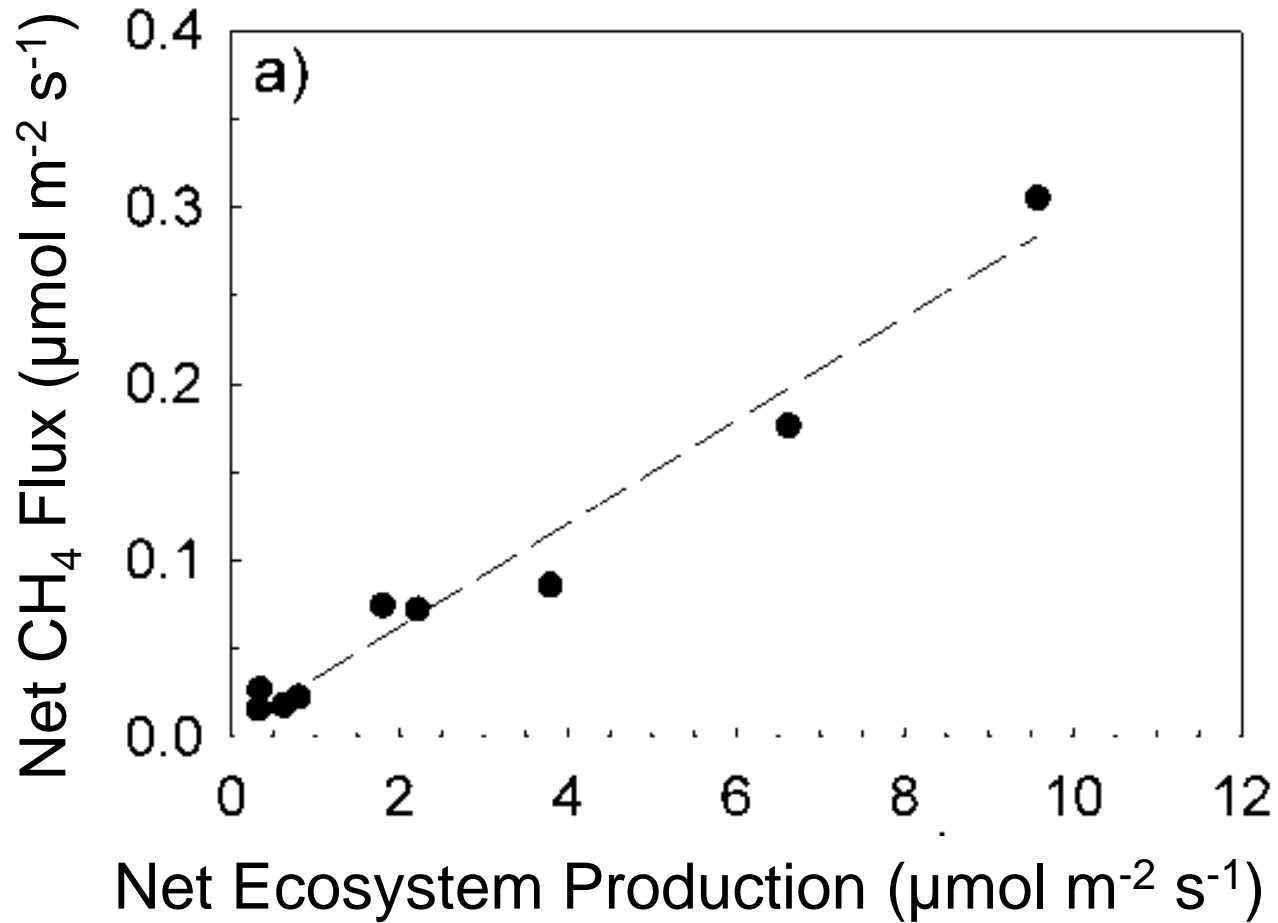


Methanogenesis:



Net Plant Effect on CH₄ Emissions

North American Wetland Survey



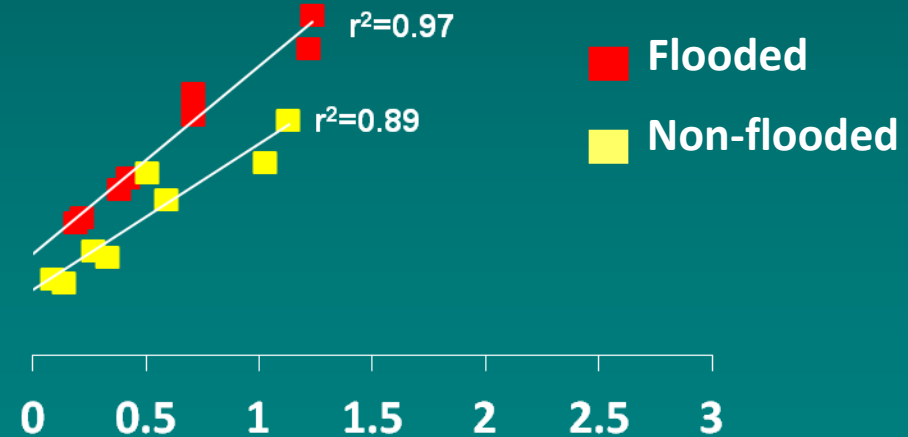
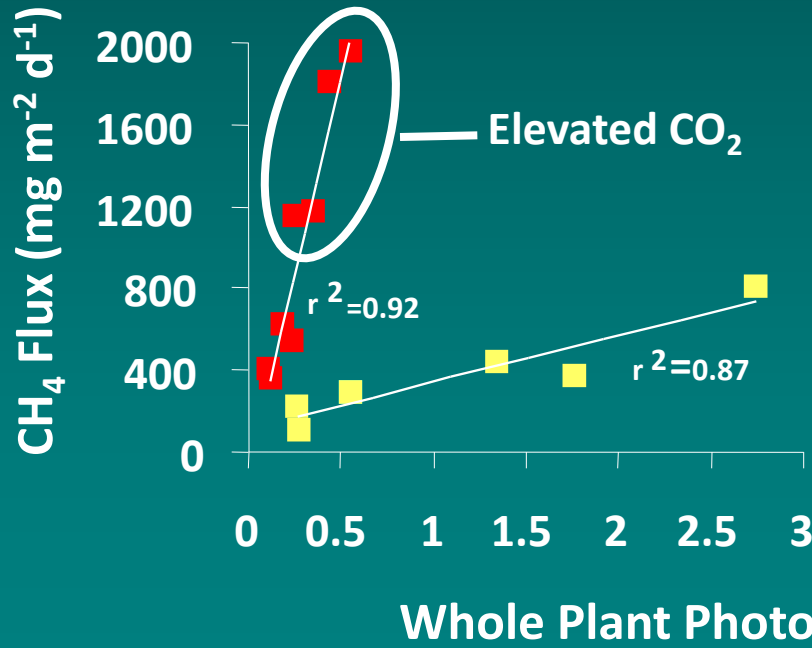
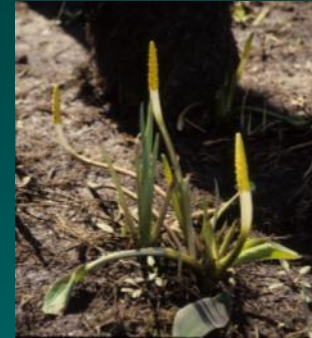
Net Plant Effect on CH₄ Emissions

Elevated Carbon Dioxide Treatment

Taxodium distichum

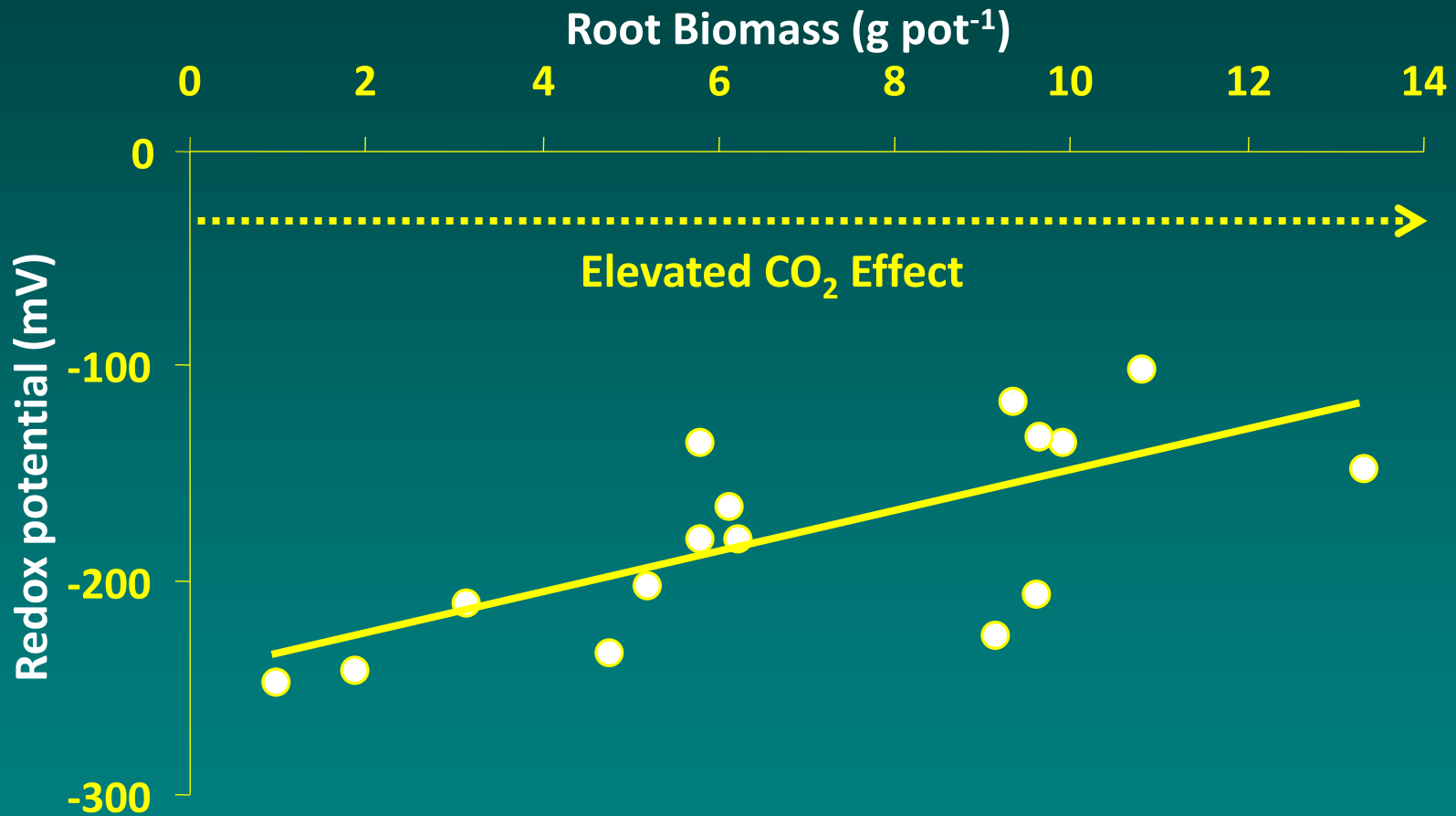


Orontium aquaticum

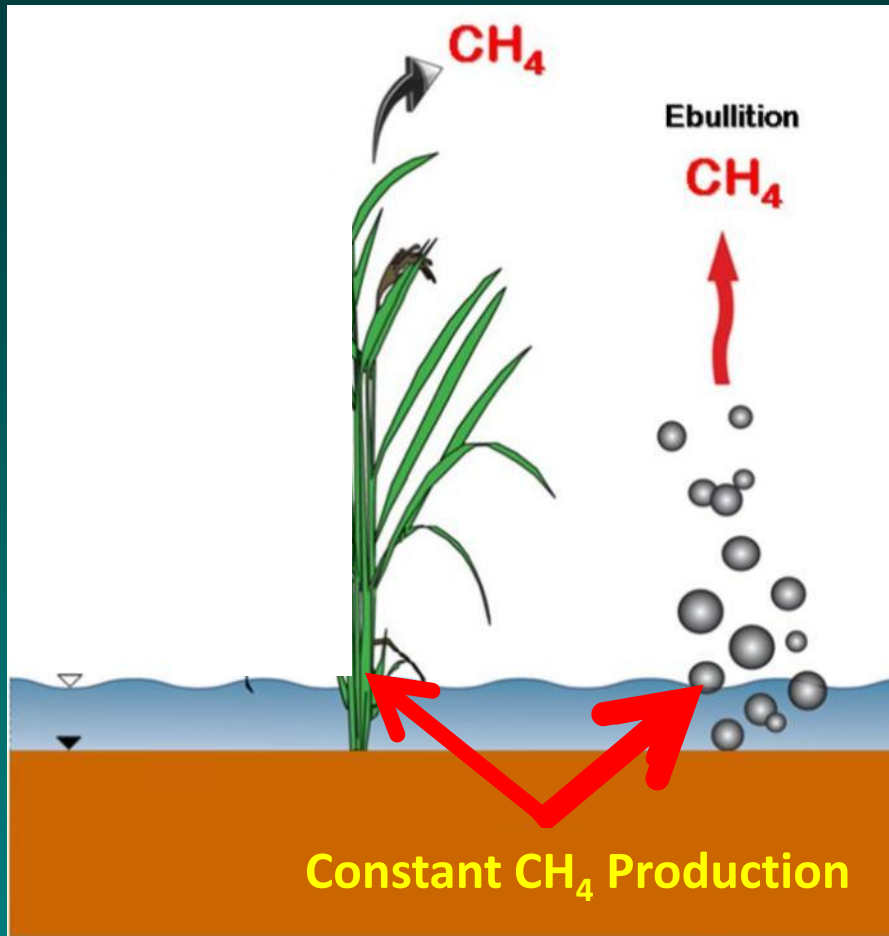


Net Plant Effect on CH₄ Emissions

Elevated Carbon Dioxide Treatment

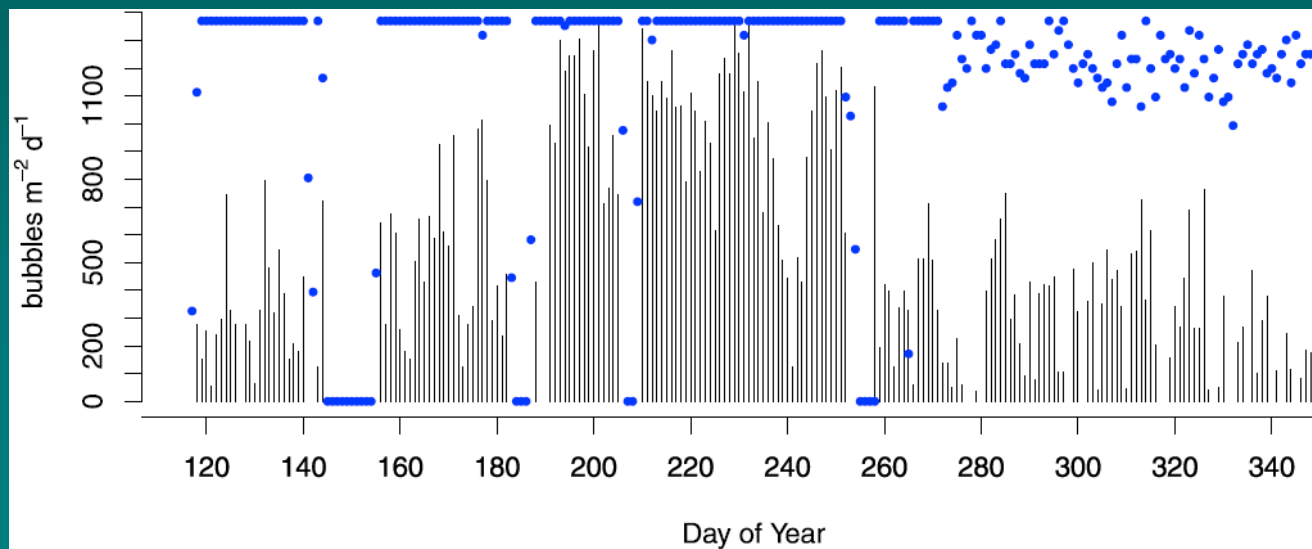
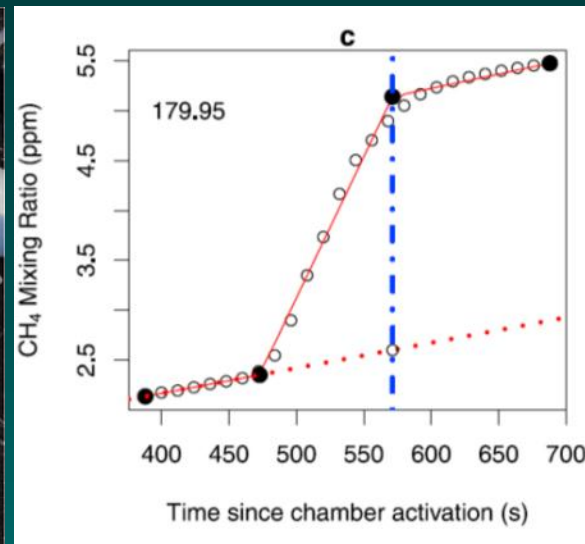


The Bubble Problem



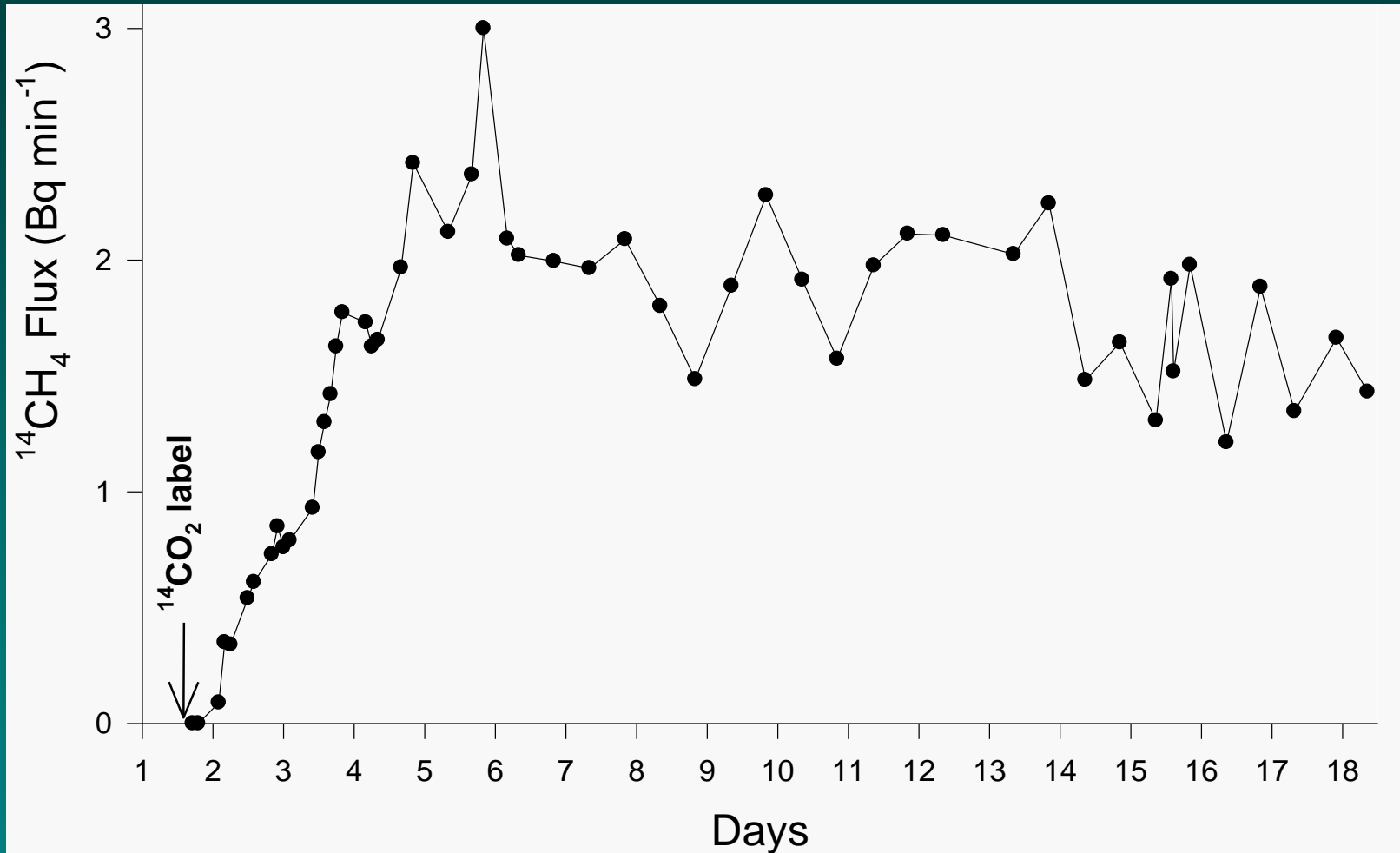
Risky to assume that a difference in CH_4 emissions from a plant-soil system means a difference in CH_4 production

The Bubble Problem



Direct Quantification of Plant Carbon Source

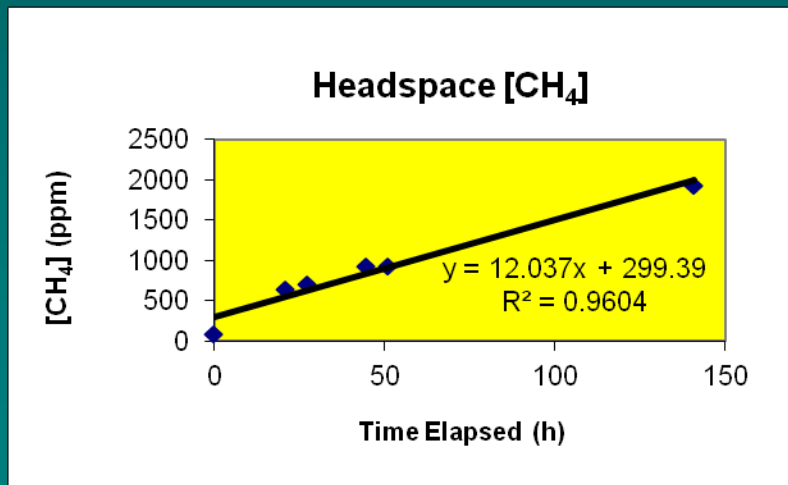
Isotopic Tracers



Direct Quantification of Plant Carbon Source

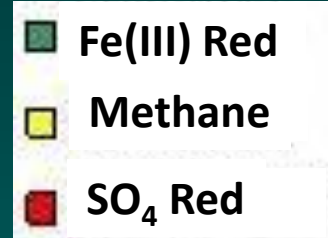
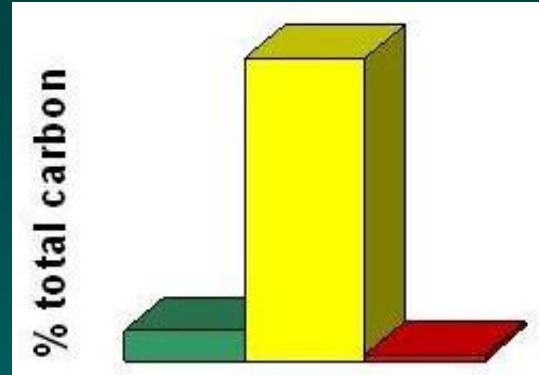
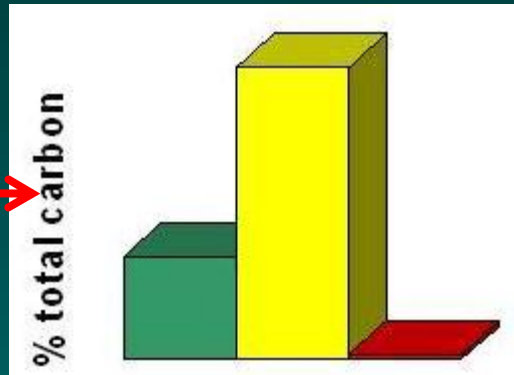
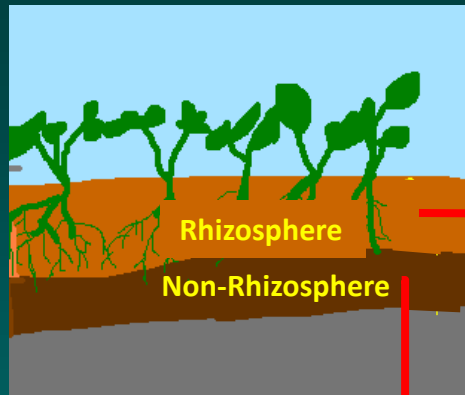
Anaerobic Incubation Technique

- (-) anaerobic processing
- (-) soil disturbance
- (+) no *new* plant inputs
- (+) no bubbles, oxidation

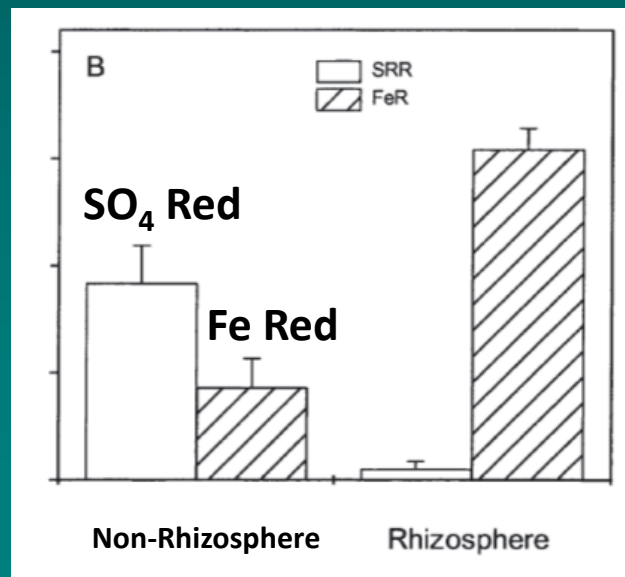
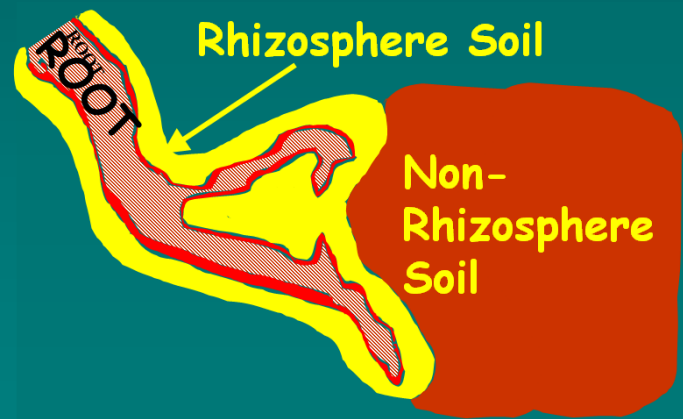


Direct Quantification of Plant TEA Source

Anaerobic Incubation Technique



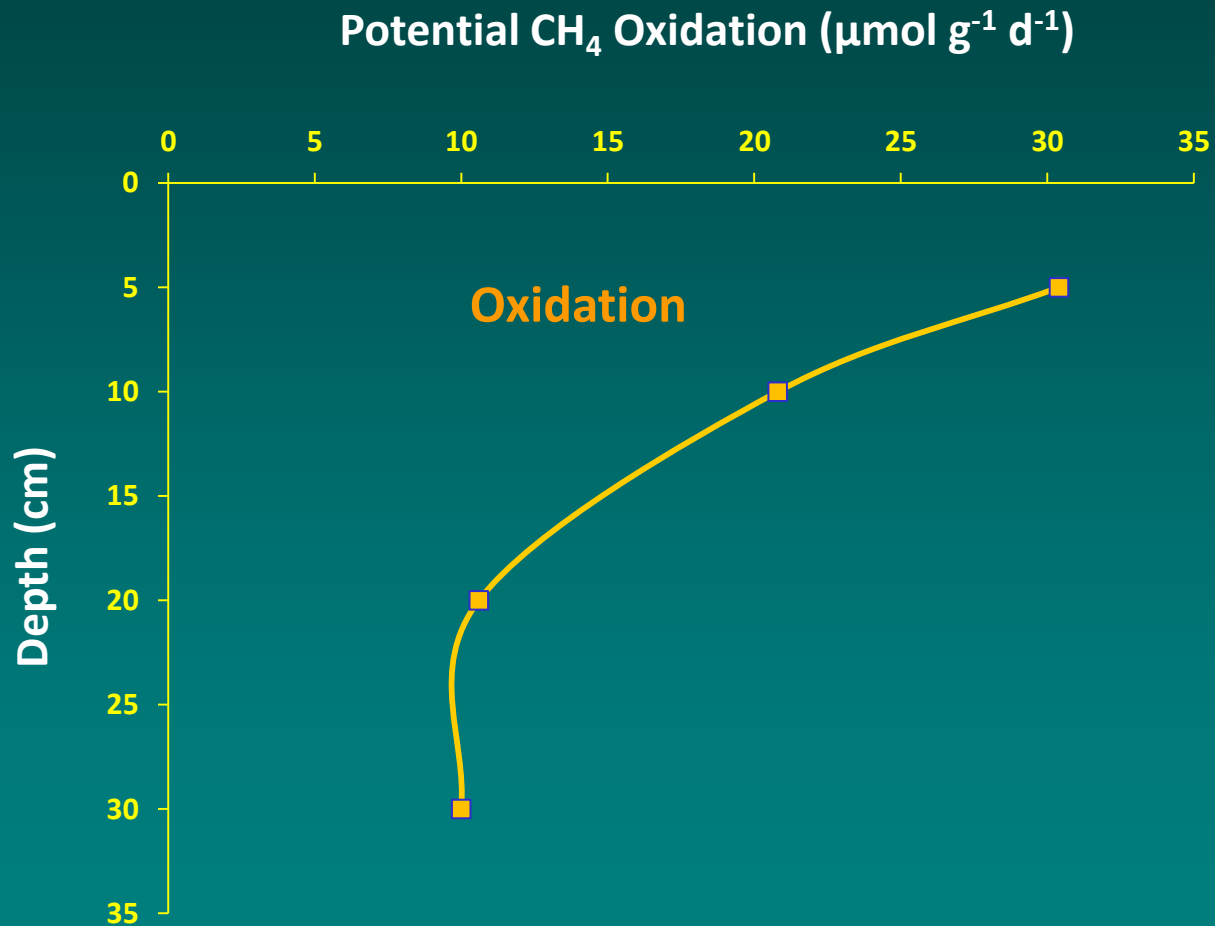
Neubauer et al. *Ecology* 2005



Gribsholt et al. *MEPS* 2003

Quantification of CH₄ Oxidation

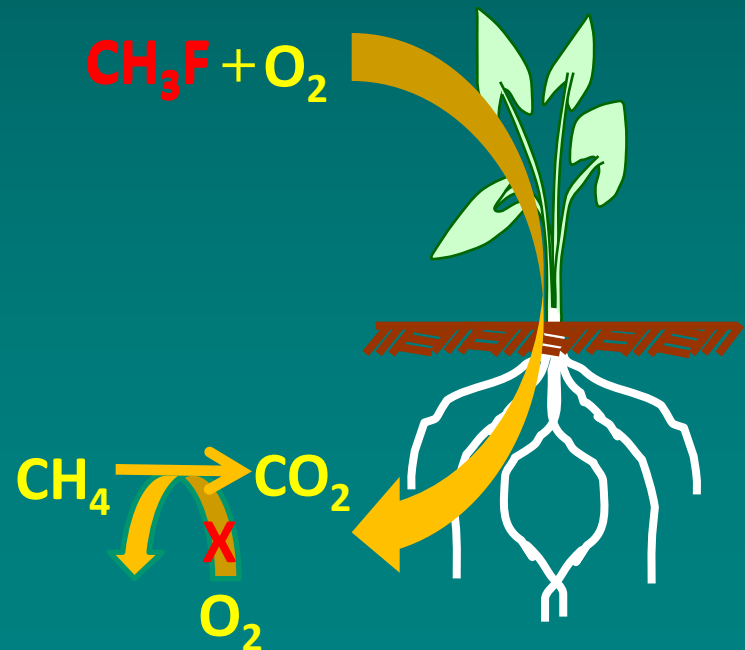
CH₄ Oxidation
Potential Oxidation



Quantification of CH₄ Oxidation

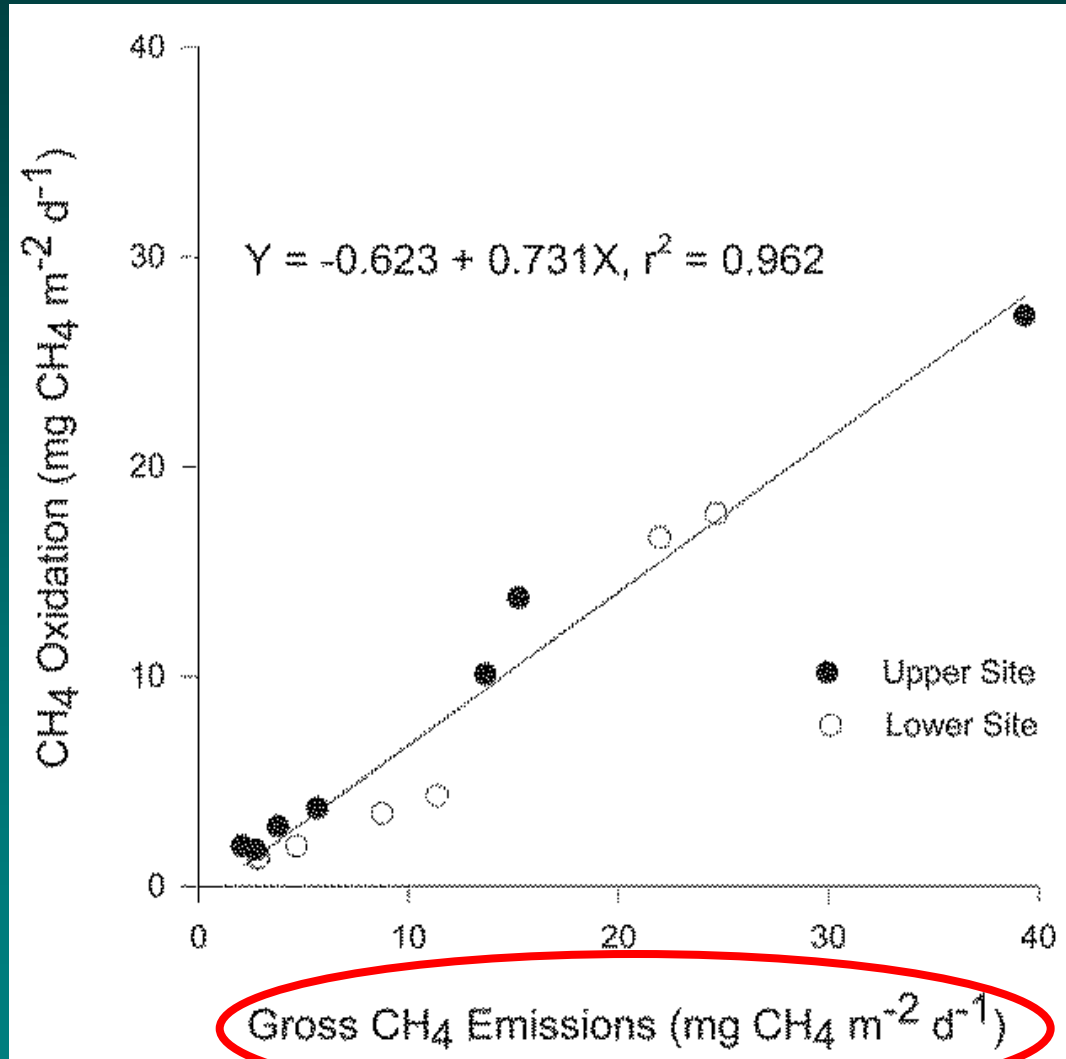
Specific Inhibition

Technique	Strength	Weakness
O ₂ -free air (100% N ₂)	Cheap, simple mechanism	Stimulates CH ₄ production
Acetylene	Cheap	Irreversible
Methylfluoride	Reversible inhibition	Expensive, inhibits CH ₄ production
Difluormethane	Reversible inhibition	Expensive



Quantification of CH₄ Oxidation

Anaerobic Incubation Technique



Observations & Recommendations

Plant Regulation of CH₄ Emissions

- Fairly powerful suite of methods, each with weakness that can be overcome through wise experimental design.
- Emission techniques are very limited for trees and foliage.
- All emission-based techniques are exposed to uncertainty about ebullition fluxes (strong research need).
- Broader application of *in situ* estimates of gross CH₄ emissions are helpful.
- Limited ability to understand rates of plant-mediated O₂ flux (strong research need).

Thank You!