Quantifying the Effects of Salinity on Greenhouse Gas Emissions Using Two Different Approaches: Laboratory Incubations vs. In-situ Measurements

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Wetland Services

- Effective nutrient (N,P) sinks and transformers
- C sequestration
- Flood abatement
- Biodiversity

Wetland Services

- Wetlands can also be significant sources of greenhouse gases (i.e., CO_2, CH_4, N_2O)

- Though as with beneficial services, these functions vary between and among different wetland systems

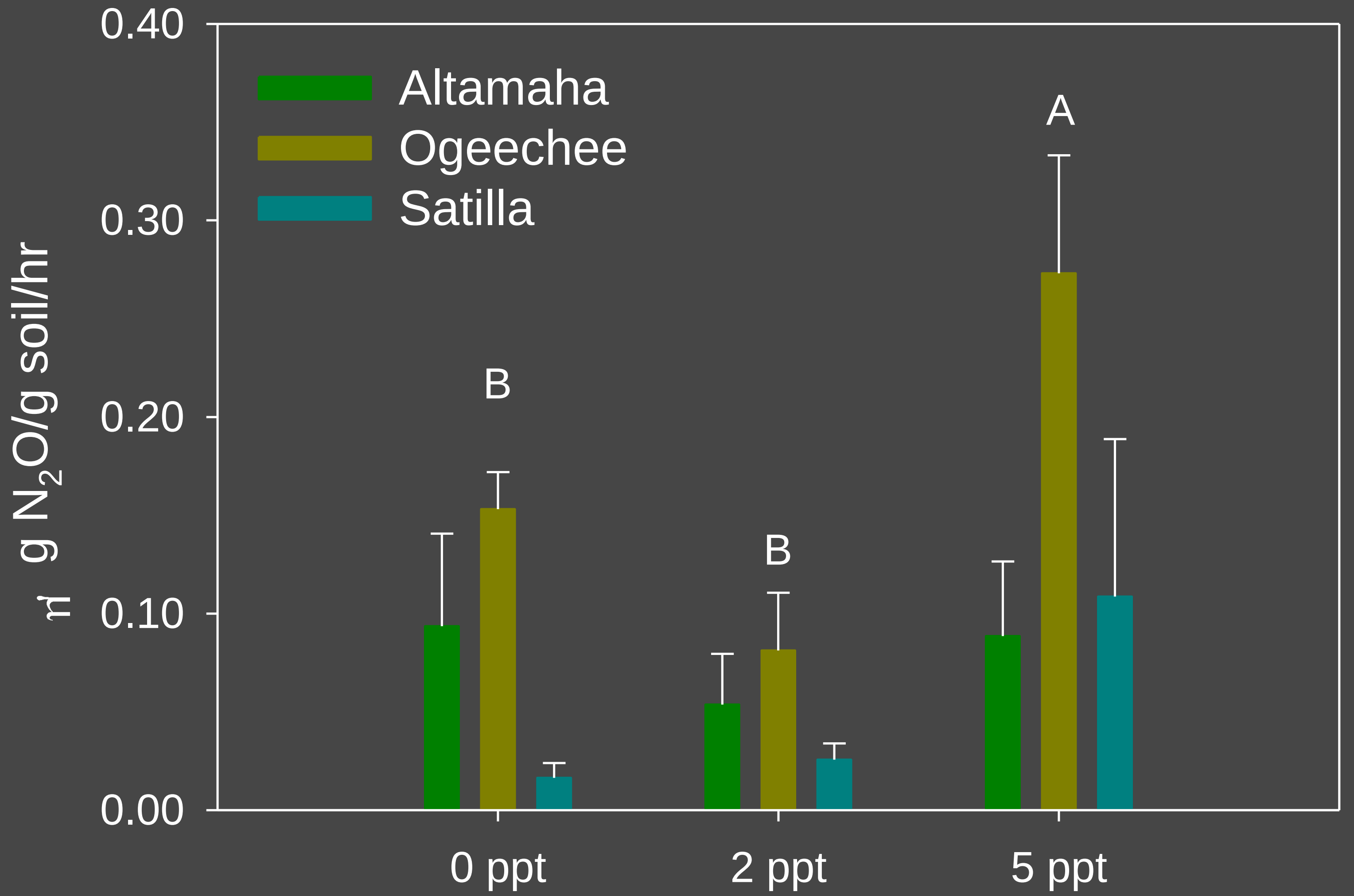
Greenhouse Gases

- Subject to influences by both biotic and abiotic controls
- It is the variability in these factors that drive variation in GHG fluxes
- This variability needs to be accounted for or controlled in quantifying GHG fluxes to obtain accurate and representative measurements
- Specific assessment methods need careful consideration to ensure the usefulness of results

Sample Collection-Denitrification

- 5 soil cores from each river (0-5 cm)
- Site water adjusted to salinity of 0, 2, or 5
- 4 hour ambient incubation

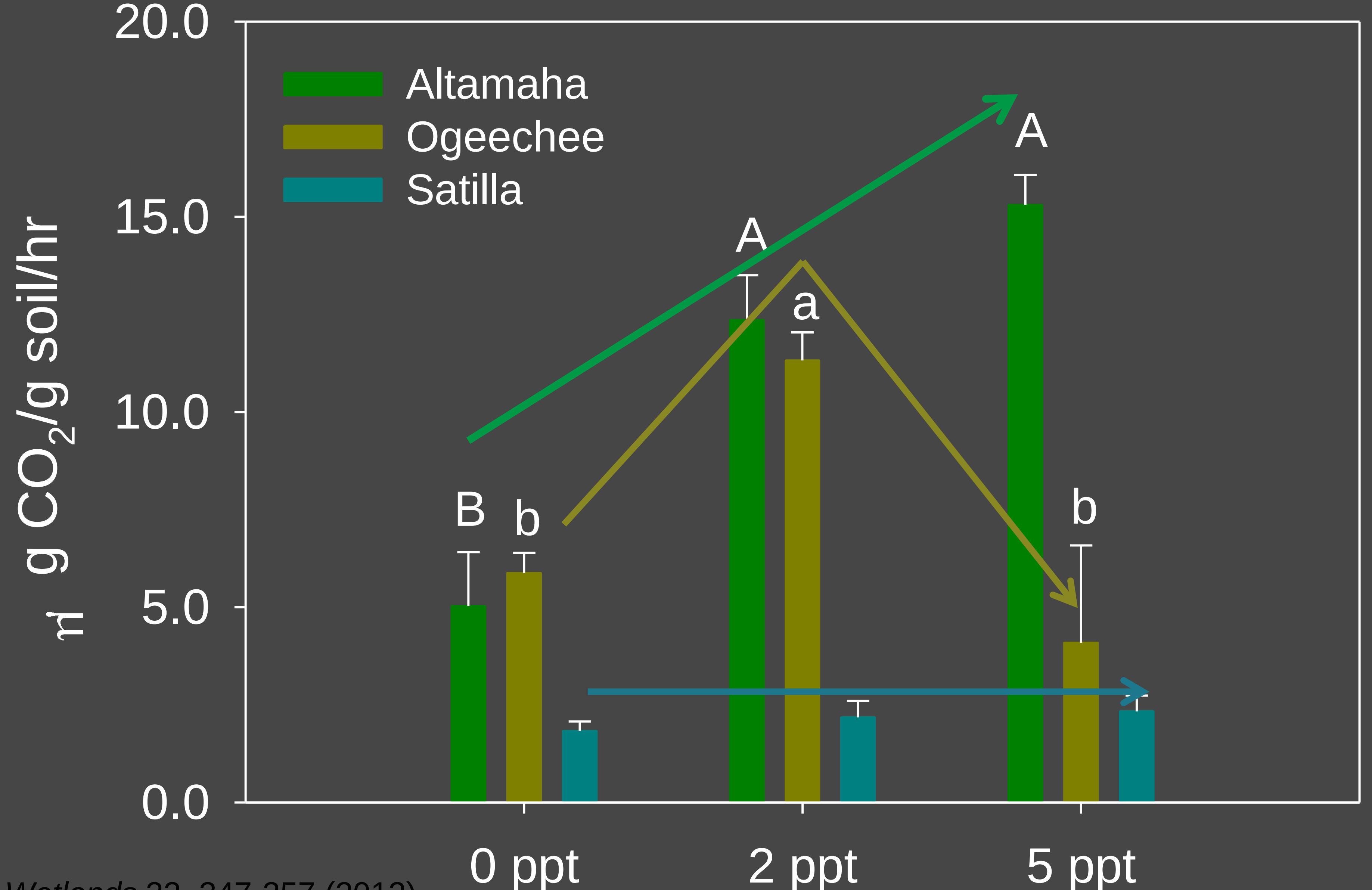
Ambient Denitrification



Sample Collection- GHG (laboratory incubations)

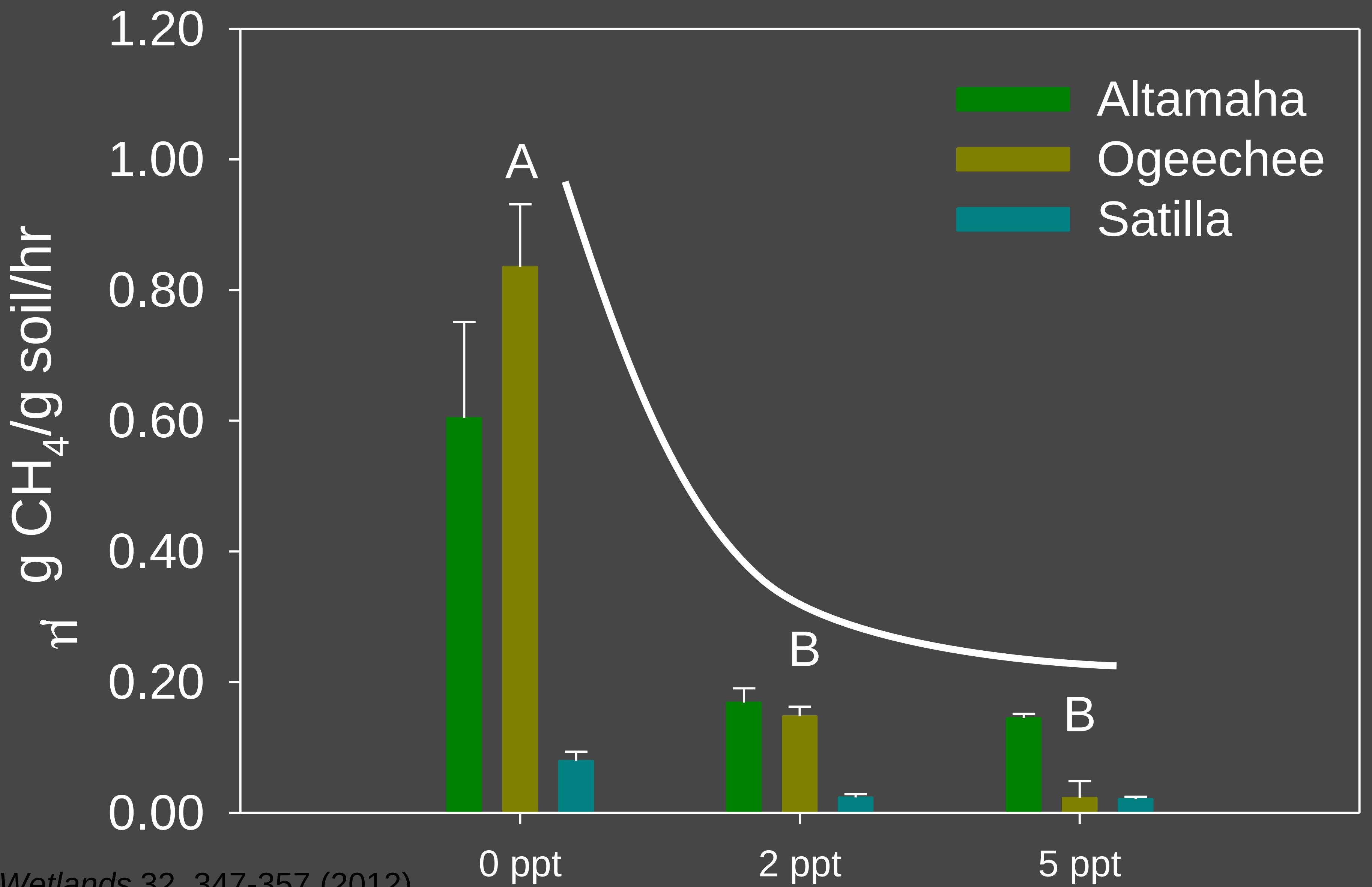
- 5 soil cores from each river (levee)
- Site water amended to salinity of 0, 2, or 5
- 5 day incubation

Carbon Dioxide Production



Wetlands 32, 347-357 (2012)

Methane Production



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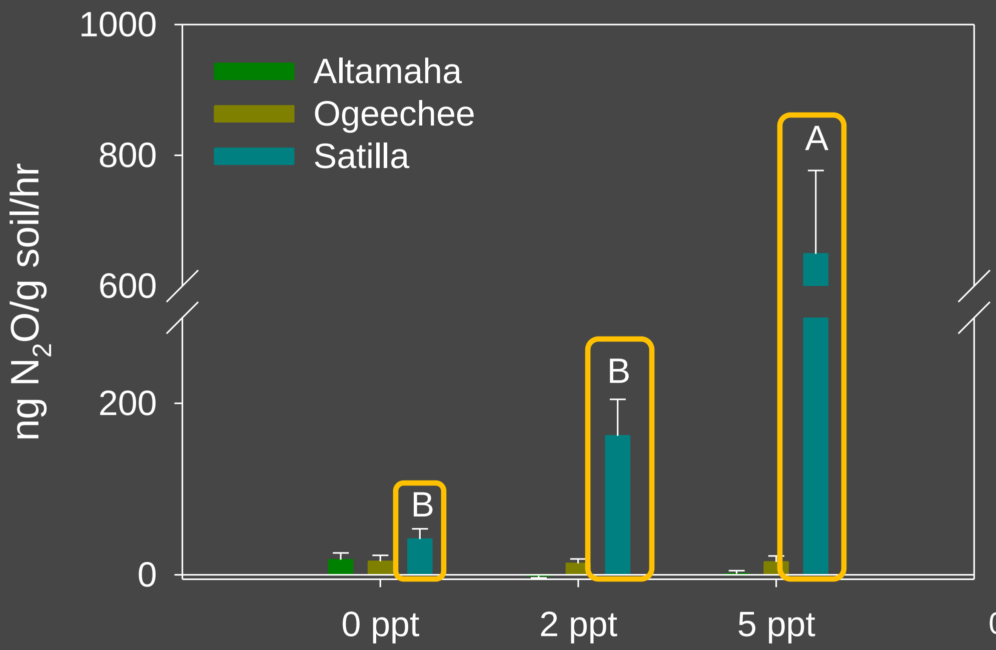
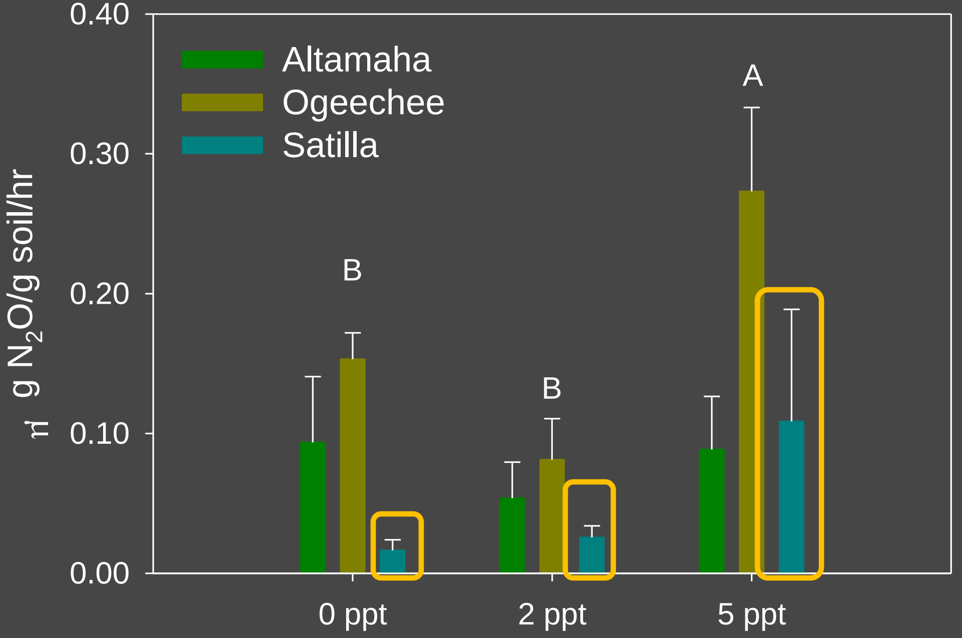
Nitrous Oxide Dioxide Production



Ambient Denitrification

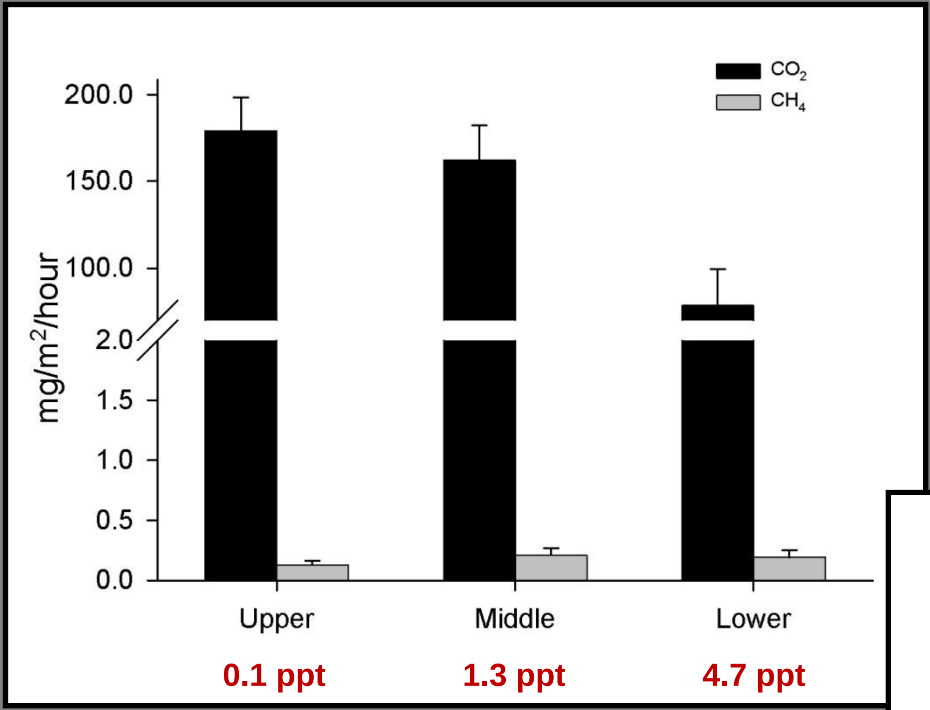


Wetlands 32, 347-357 (2012)

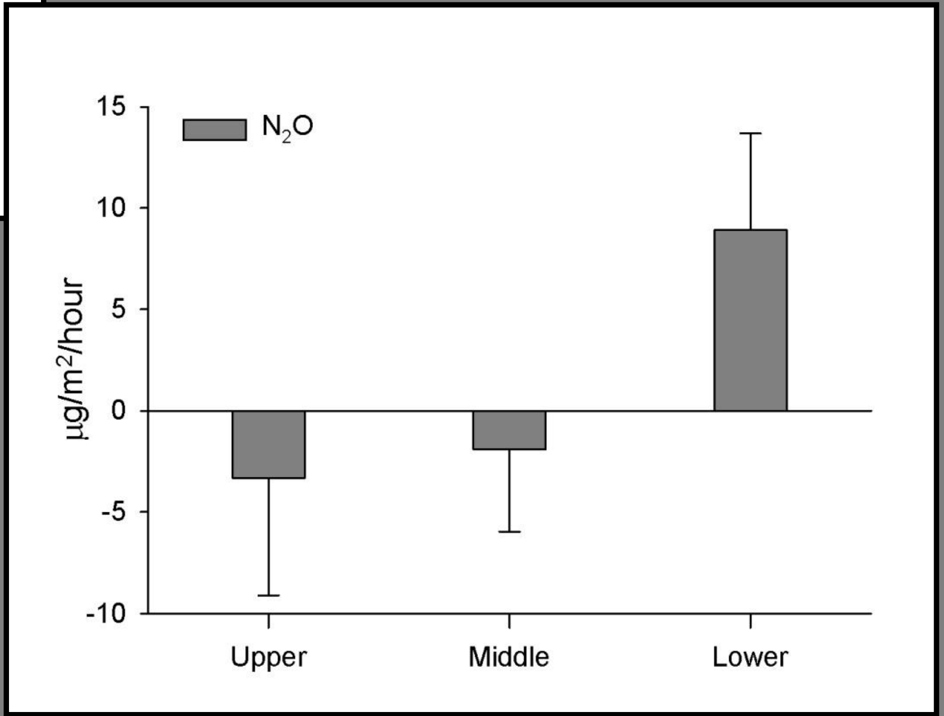
Sample Collection- GHG (in-situ field measurements)

- Savannah River (3 sites)
- CO_2, CH_4, N_2O measured 23 times over 2 years (2005-2007)
- Site porewater salinity of <0.2, 1.3, and 4.7
- 6 chambers per site, 1-hr sample period

Relative balance among CO_2, CH_4, and N_2O fluxes



- Soil CH_4 efflux is approximately 0.1% of soil CO_2 efflux
- Significant site by time interactions; lowest from high salinity site during two sampling months



- Soil N_2O efflux is approximately 0.001% of soil CO_2 efflux
- Perhaps soil N_2O efflux is related to salinity? Similar to Ogeechee River, but not significant from Savannah River

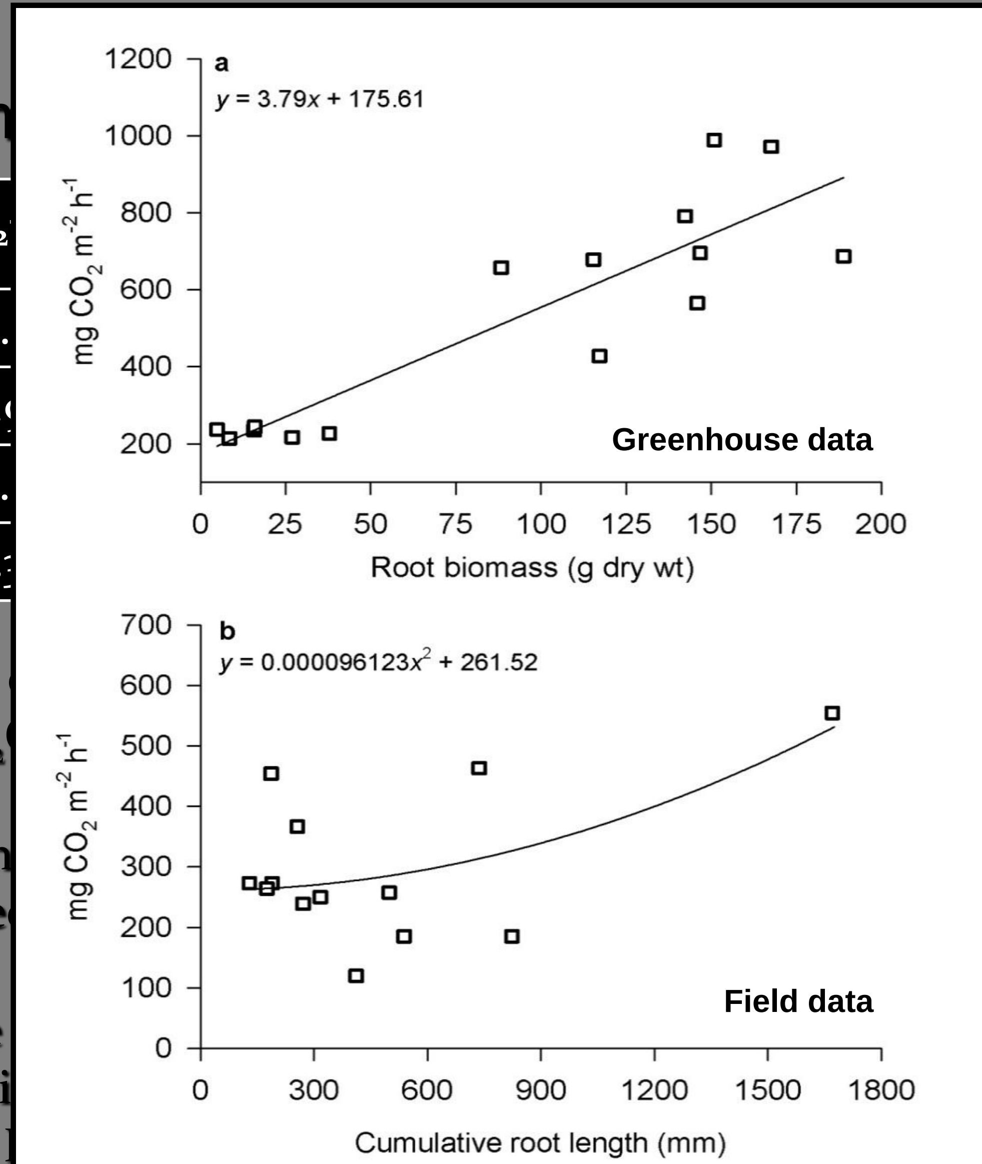
Wetlands 32, 73-81 (2012)

Greenhouse Gas Fluxes from Tidal Swamps

(g/m

Site	CO_2
Upper	289.
Middle	255.
Lower	298.
Mean	**281.**

- Tidal swamps of CH_4 and N_2
- Effects of salin from Ogeeche
- The root zone perhaps explai the Savannah



Plant and Soil (in press)

Conclusions

- N2O production varied by river and technique, but increased with salinity significantly only along the Satilla
- In laboratory incubations, salinity reduced CH_4 production and yielded mixed results on CO_2 production
- In field studies, salinity exerted no influence on CH4 production and indicated reduced CO_2 seasonally on the highest salinity site

Benefits of Incubations

- Better experimental manipulation (controlling for variance in site conditions)
- Greater interpretation of processes/kinetics
- Logistics and cost

Benefits of in-situ Field Studies

- Data are more realistic in terms of what is happening on sites currently
- Include all components controlling rates, e.g., roots, soil, and microbial communities. Can even include plant photosynthesis with modified chambers.

Limitations of Incubations

- Alteration of hydrology- tidal systems → laboratory incubations
- Carbon and nutrient inputs
- Difficult to scale to greater spatial and temporal scales

Limitations of in-situ Field Studies

- Inability to control for various environmental factors require repetitive measurements across a range of conditions
- No experimental links to specific processes (e.g., water level)
- Need for constant site access and disturbance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Questions?