Methane and Nitrous oxide emission from estuarine wetlands and the effect of wetland plant

Dr. Dongqi Wang
Background

Research Area

Methods and Materials

Methane and Nitrous oxide flux

Effects of wetland plants

Conclusions
1. Background

1.1 Atmospheric consequences

- Global warming potential of CH$_4$ and N$_2$O are 25 and 298 times greater than CO$_2$ on a mass basis at one hundred years horizons. (IPCC, 2007)

- CH$_4$ is involved in a number of atmospheric chemical reactions. (Cicerone and Oremland, *Global Biogeochemical Cycles*, 1988)

- N$_2$O is set to dominate ozone destruction. (Chipperfield, *Nature Geoscience*, 2009)
1. Background

1.2 Estuarine wetlands—an important source of atmospheric CH\textsubscript{4} and N\textsubscript{2}O

- Globally, wetlands are the largest single source and emissions constitute more than 75\% of the total estimated natural emissions of CH\textsubscript{4} to the atmosphere (IPCC, 2001).

- Nitrate loading is increasing in the coastal zone/estuaries increasing potential for N\textsubscript{2}O loading to the atmosphere (Moseman-Valtierra et al., Atmospheric Environment, 2011).
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2. Research area

Sampling site
2. Research area

- Sampling site
- Dike

Sampling site
2. Research area

Sampling site

Scirpus mariqueter

Tidal channel
2. Research area

*Scirpus mariqueter* community
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Base
3. Methods and Materials

Chambers (1. Sample port; 2. Fan; 3. Thermometer; 4. Pressure vent; 5. Aluminum foil and insulating layer.)

Dark (opaque) chamber

Light (transparent) chamber
3. Methods and Materials
3. Methods and Materials
3. Methods and Materials

Sampling
3. Methods and Materials

Air sample was injected into the bag
3. Methods and Materials

The bag was flushed by air sample first
3. Methods and Materials
3. Methods and Materials
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4. Methane and Nitrous oxide flux

Environmental factors
4. Methane and Nitrous oxide flux

Average annual CH$_4$ flux 13.9 g CH$_4$/m$^2$/yr
4. Methane and Nitrous oxide flux

Average annual $\text{N}_2\text{O}$ flux 0.28 g $\text{N}_2\text{O}$ /m$^2$/yr
4. Methane and Nitrous oxide flux

Air temperature-flux correlation in light chamber
4. Methane and Nitrous oxide flux

Air temperature-flux correlation in dark chamber
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5. Effect of wetland plant

Transport through aerenchyma

molecular diffusion

molecular diffusion and convective gas flow

Ebullition

Diffusion

http://www.ibp.ethz.ch/research/environmentalmicrobiology/research/Wetlands
5. Effect of wetland plant

Wetland plants develop an extensive system of internal gas spaces to adapt to waterlogged conditions.

*Scirpus maritimus*
5. Effect of wetland plant

Corm

Intercellular gas spaces

Transverse section of *S. mariqueter* observed by scanning electron microscopy
5. Effect of wetland plant

Transverse section of *S. mariqueter* observed by scanning electron microscopy
5. Effect of wetland plant

Transverse section of *S. mariqueter* observed by scanning electron microscopy
5. Effect of wetland plant

Leaf section

Aerenchyma

Transverse section of S. mariqueter observed by scanning electron microscopy
5. Effect of wetland plant

Transverse section of *S. mariqueter* observed by scanning electron microscopy
5. Effect of wetland plant

CH$_4$ fluxes in Light chamber and Dark chamber
5. Effect of wetland plant

Transport through aerenchyma

molecular diffusion and convective gas flow

Ebullition

Diffusion

Nitrification

Denitrification

Decomposition of organic matter

http://www.ibp.ethz.ch/research/environmentalmicrobiology/research/Wetlands
5. Effect of wetland plant

N$_2$O fluxes in Light chamber and Dark chamber
5. Effect of wetland plant

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6. Conclusions

1. Annual CH$_4$ flux is 13.9 g CH$_4$ /m$^2$/yr, N$_2$O flux is 0.28 g N$_2$O /m$^2$/yr;
2. Temperature has exponential correlation with CH$_4$ and N$_2$O flux;
3. Wetland plant clearly control CH$_4$ and N$_2$O flux, especially photosynthesis greatly decreased N$_2$O flux and induced the consumption of atmospheric N$_2$O;
4. Molecular diffusion and convective gas flow were the two main mechanisms of CH$_4$ transported via $S.$ mariqueter, but was growth stage-dependent;
5. Results demonstrate the need to measure GHGs flux seasonally due to high temporal variability.
Acknowledgments

Hard work! Fun time!

Supported by NSFC, NO. 40131020

2012/6/20


Thank you!

Questions?

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