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_2O 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_2O is set to dominate ozone destruction. (Chipperfield, *Nature Geoscience*, 2009)

1. Background

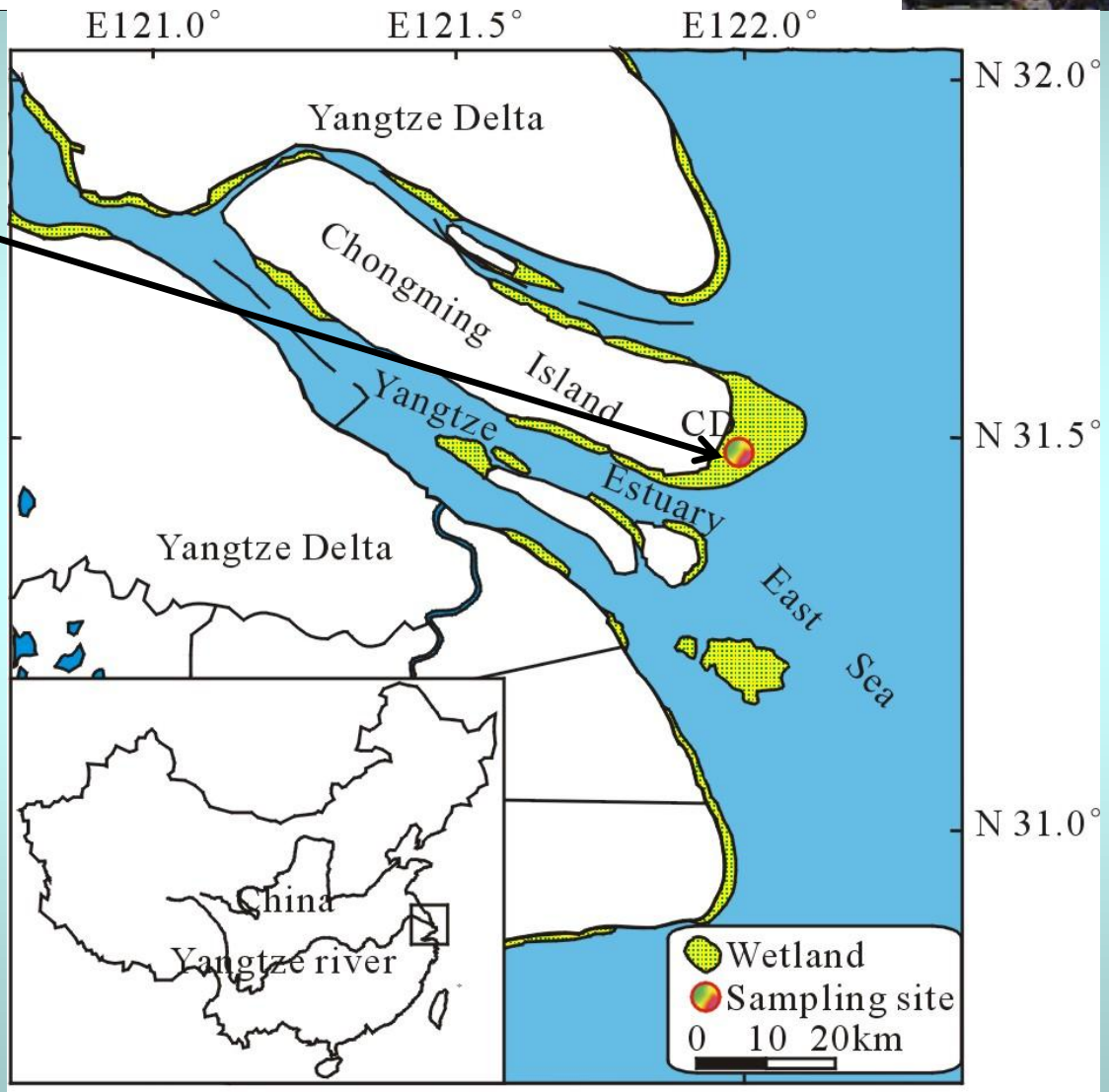
1.2 Estuarine wetlands—an important source of atmospheric CH_4 and N_2O

- Globally, wetlands are the largest single source and emissions constitute more than 75% of the total estimated natural emissions of CH_4 to the atmosphere (IPCC, 2001).
- Nitrate loading is increasing in the coastal zone/estuaries increasing potential for N_2O loading to the atmosphere (Moseman-Valtierra *et al*., *Atmospheric Environment*, 2011).

- Background
- **Research Area**
- Methods and Materials
- Methane and Nitrous oxide flux
- Effects of wetland plant
- Conclusions

2. Research area

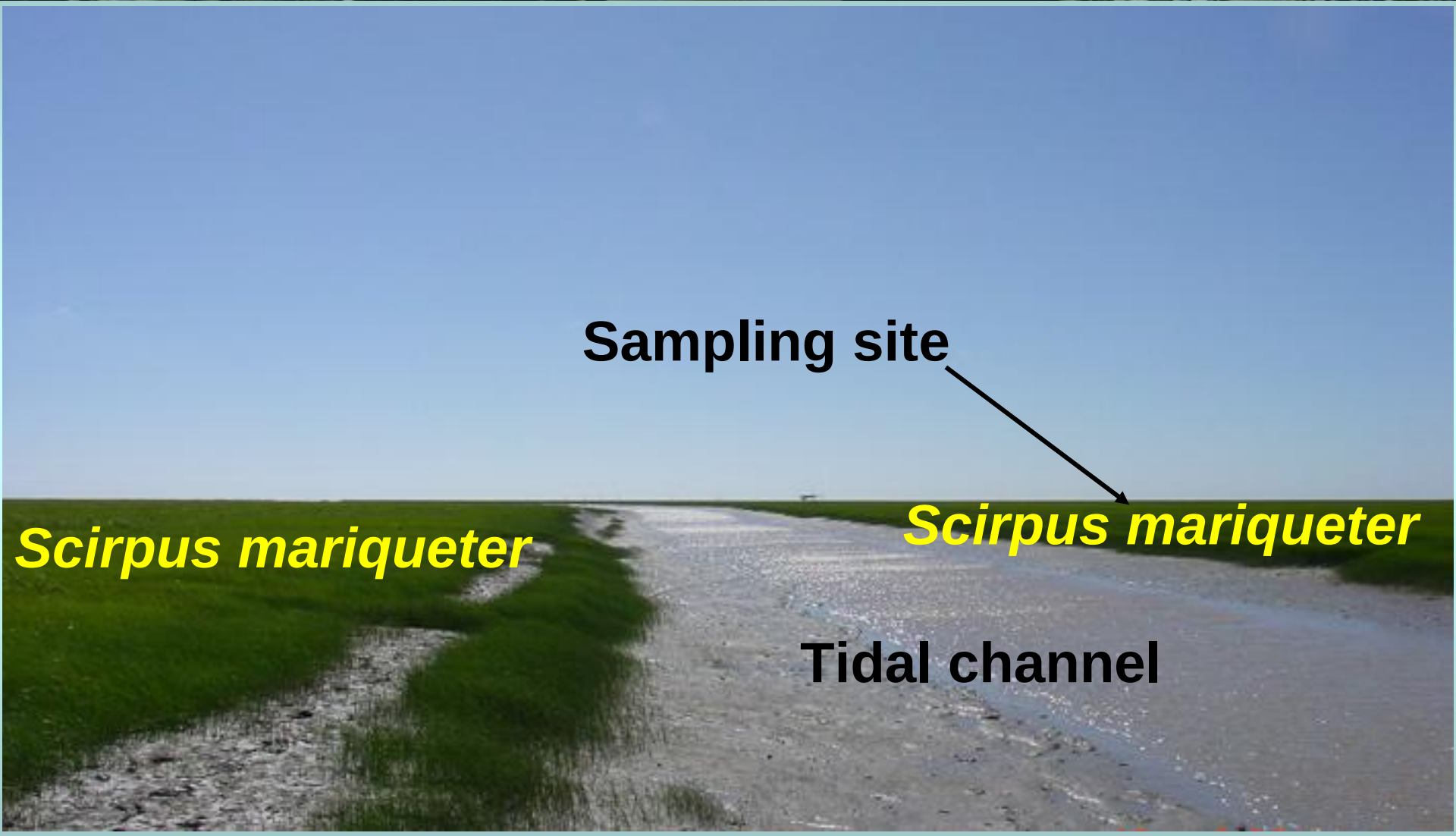
Sampling site



* CD: Chongming Dongtan wetland of Chongming island in Yangtze estuary.

2. Research area

2. Research area



2. Research area

- Background
- Research Area
- **Methods and Materials**
- Methane and Nitrous oxide flux
- Effects of wetland plant
- Conclusions

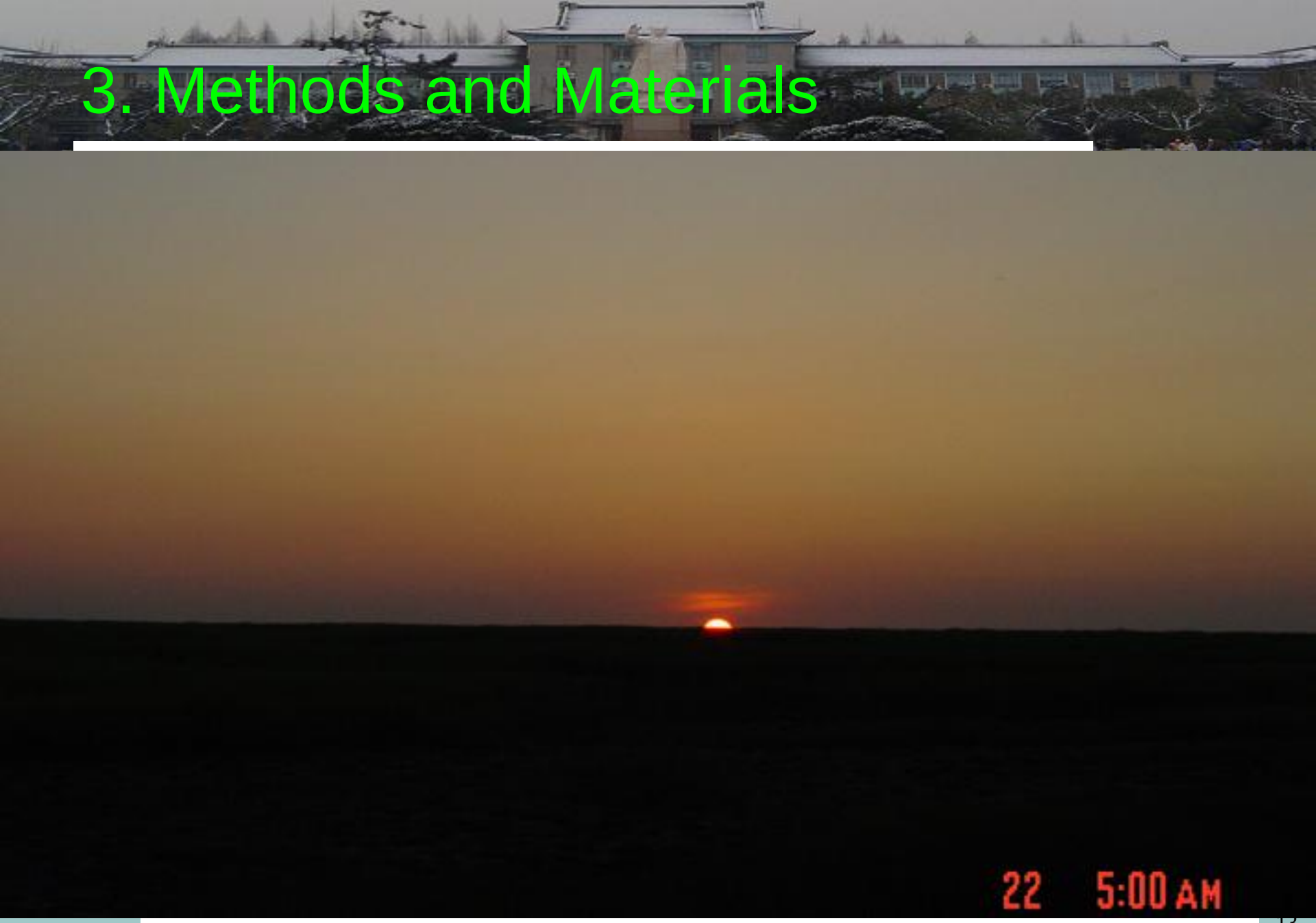
3. Methods and Materials

Base

3. Methods and Materials

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

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

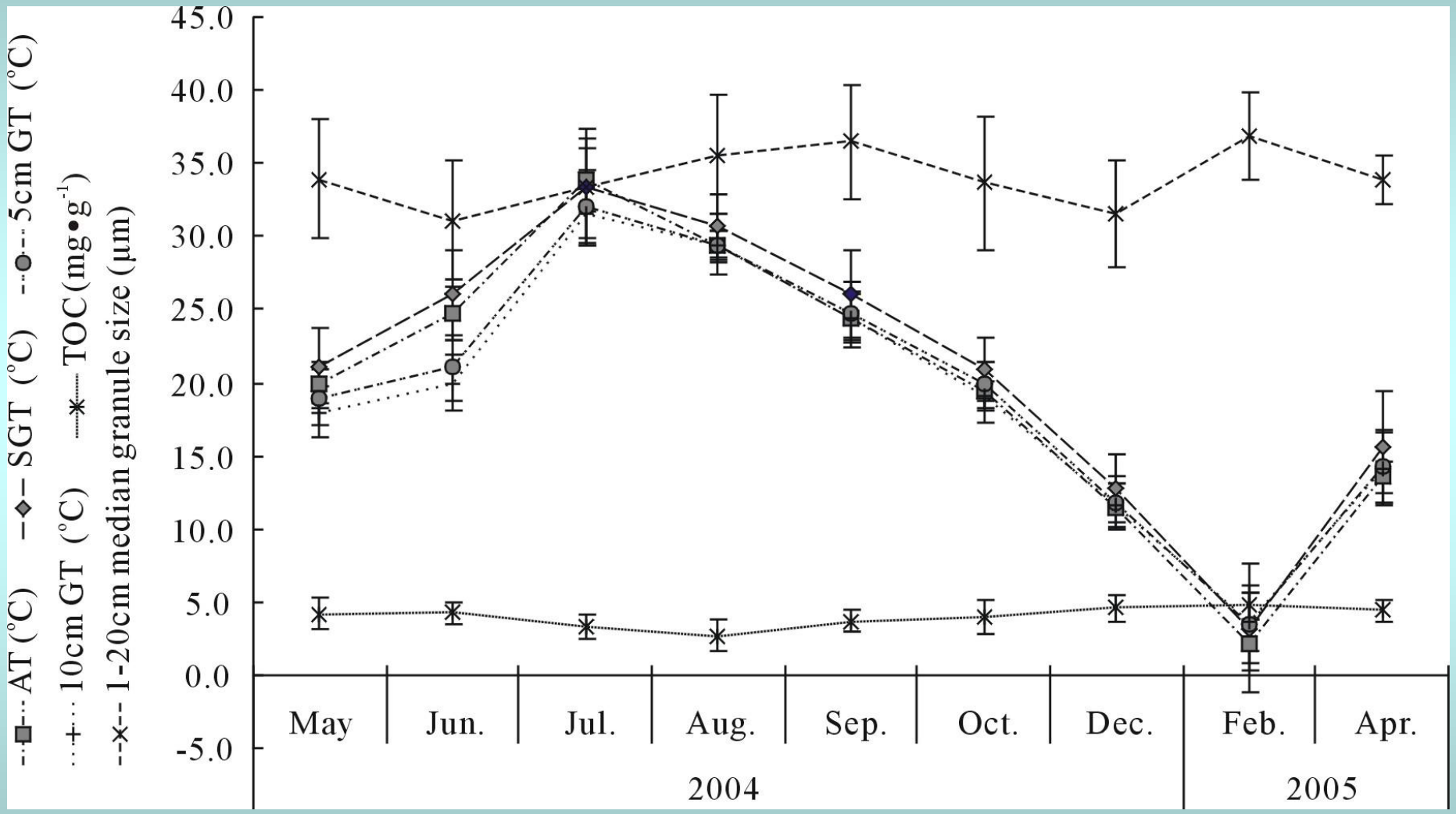
The bag was flushed by air sample first

3. Methods and Materials

3. Methods and Materials

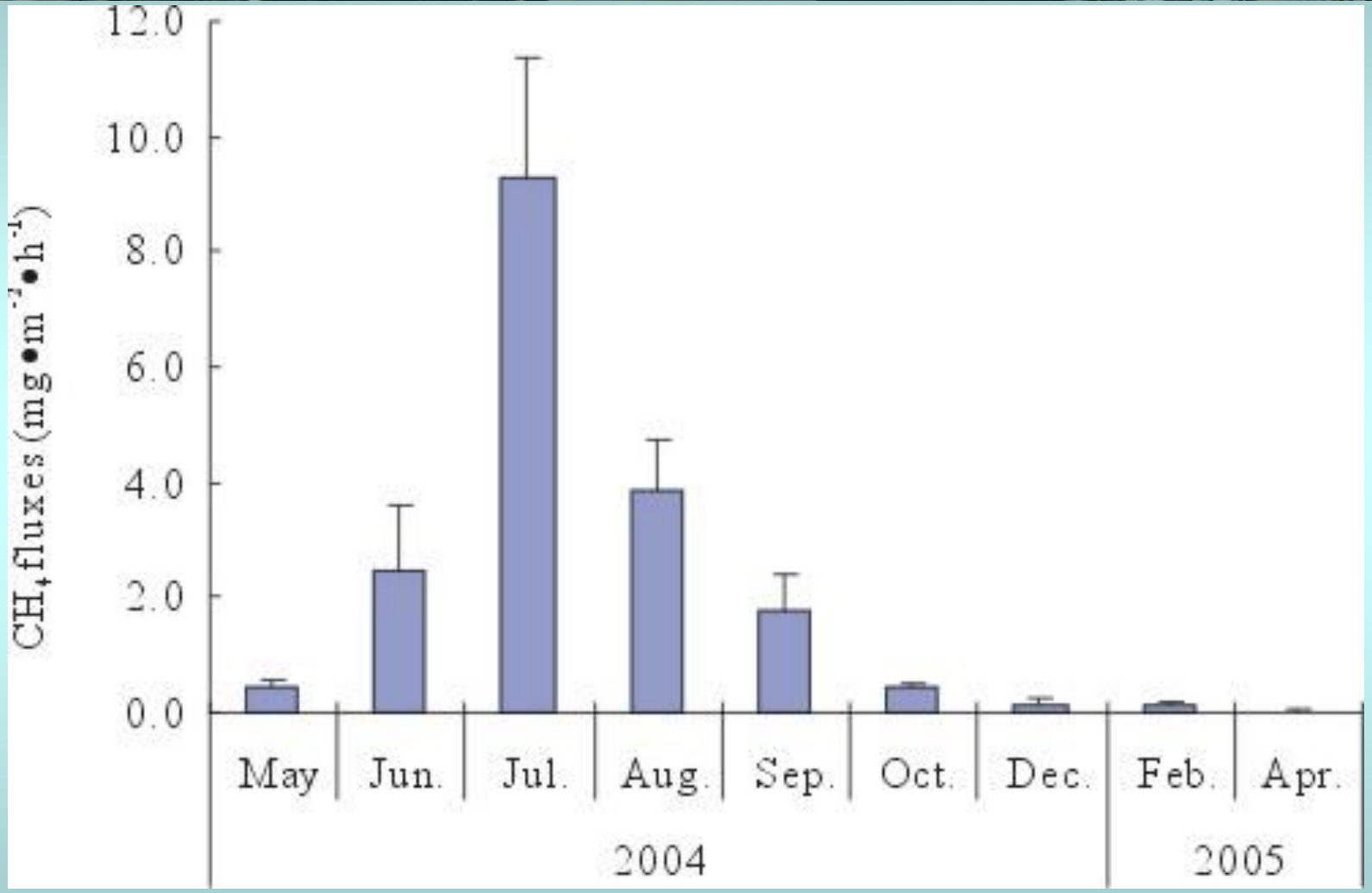
- Background
- Research Area
- Methods and Materials
- **Methane and Nitrous oxide flux**
- Effects of wetland plant
- Conclusions

4. Methane and Nitrous oxide flux



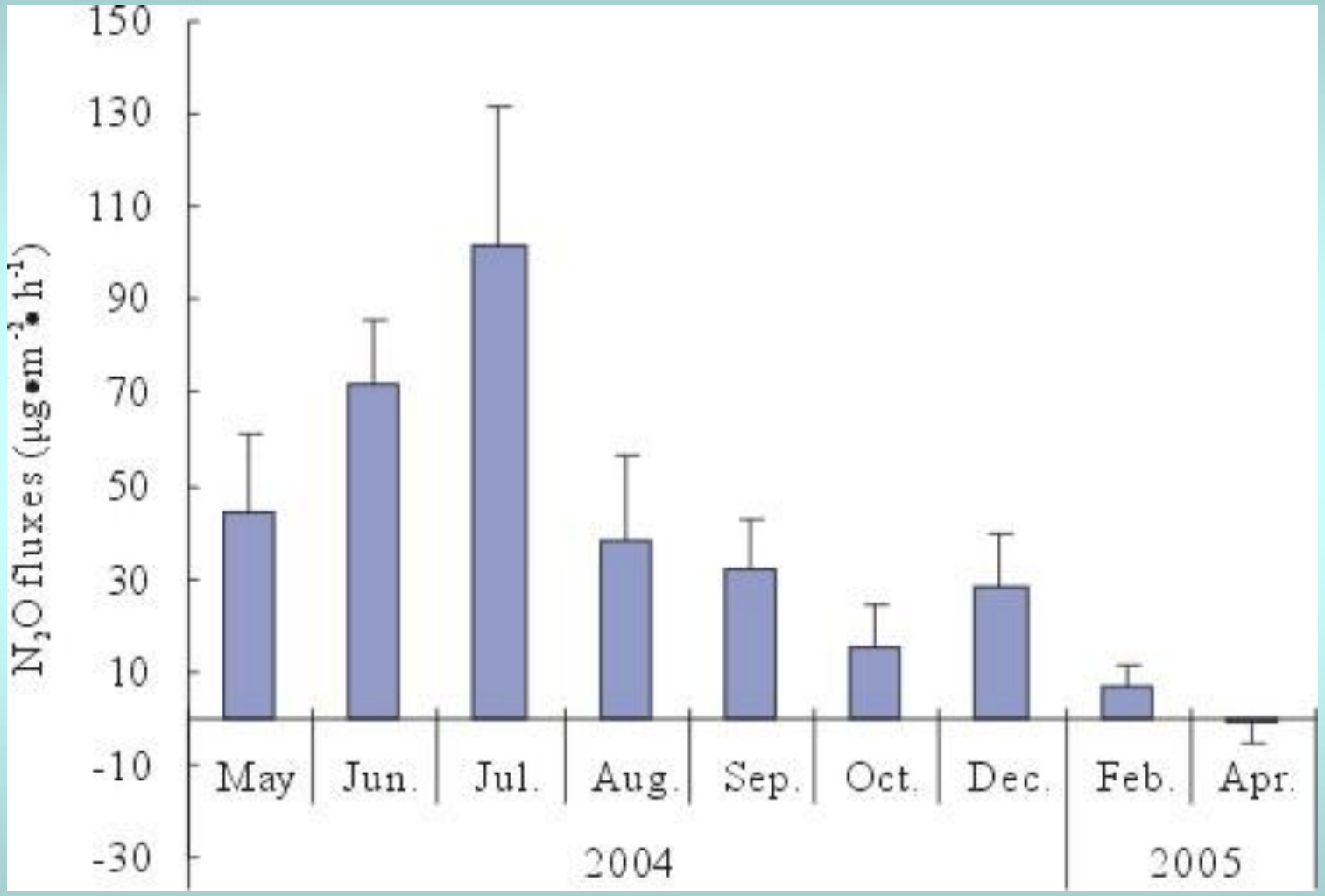
Environmental factors

4. Methane and Nitrous oxide flux



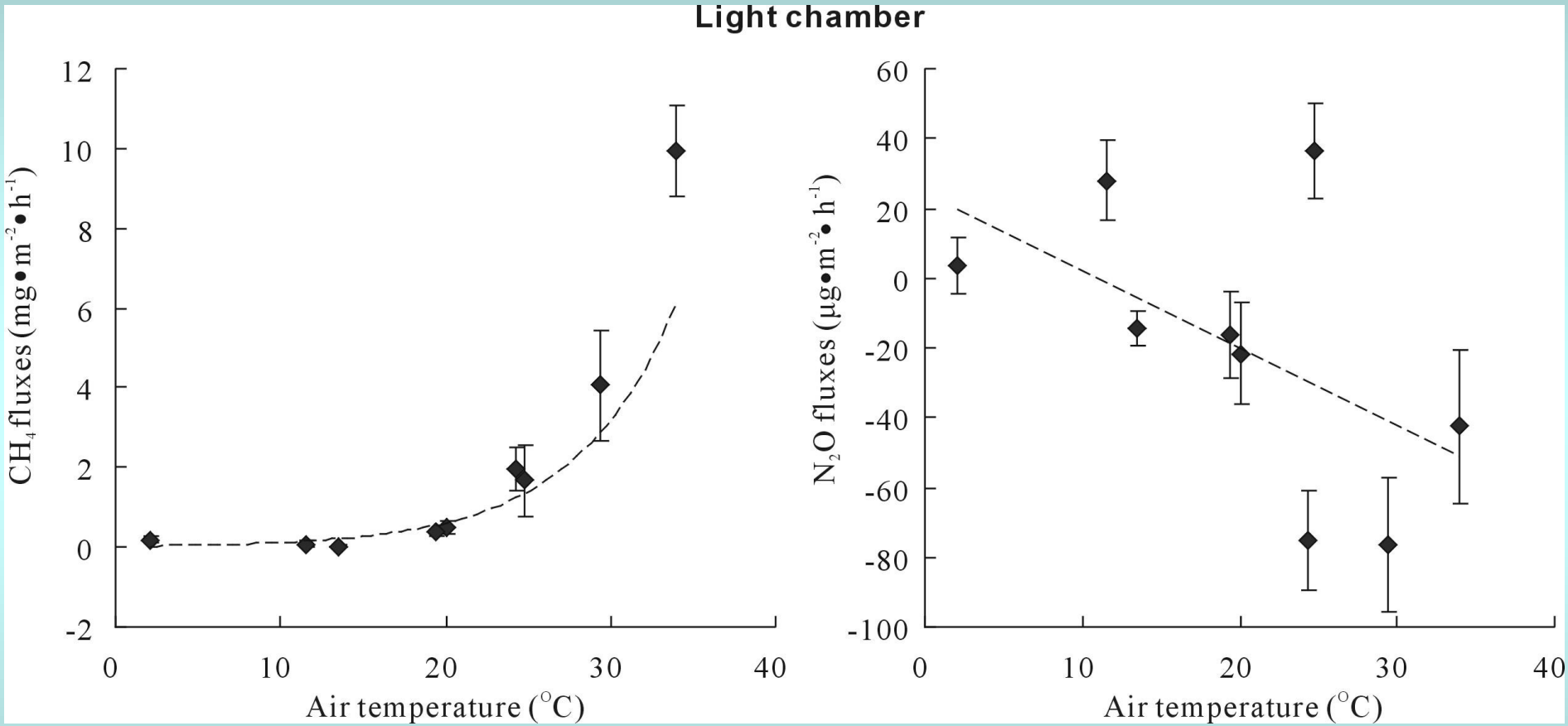
Average annual CH_4 flux 13.9 g $CH_4/m^2/yr$

4. Methane and Nitrous oxide flux



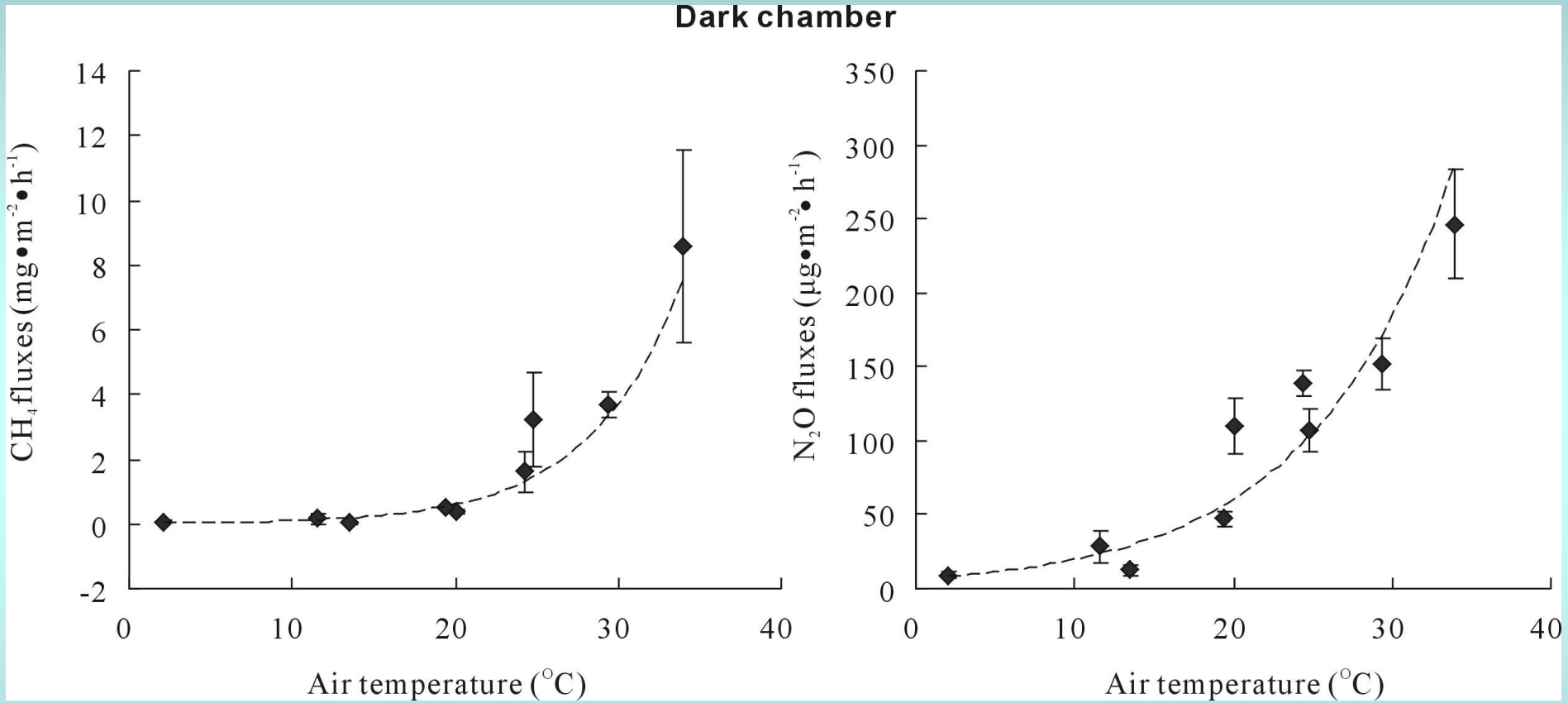
Average annual N_2O flux 0.28 g N_2O /m^2/yr

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

- Background
- Research Area
- Methods and Materials
- Methane and Nitrous oxide flux
- **Effect of wetland plants**
- Conclusions

5. Effect of wetland plant

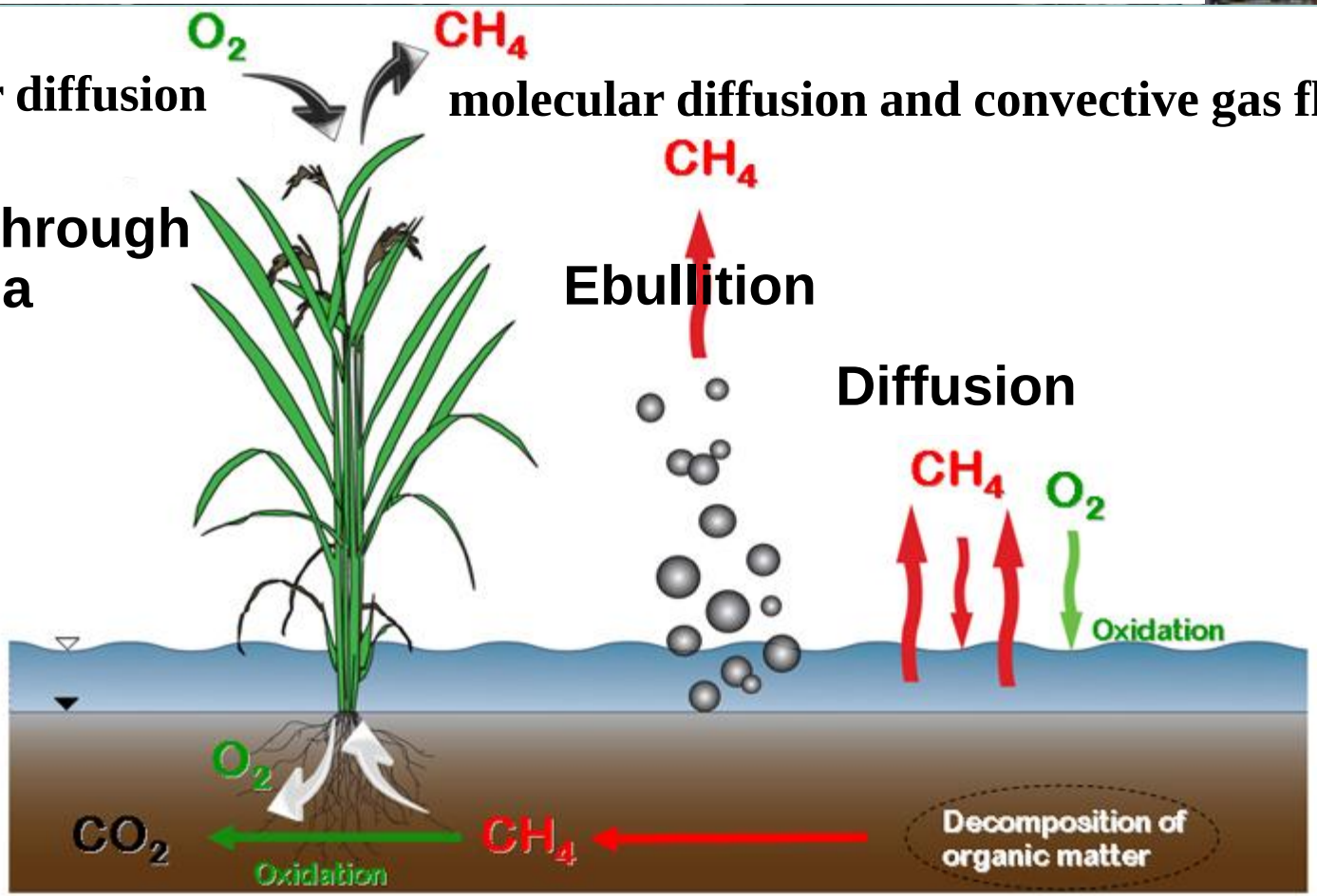
molecular diffusion

molecular diffusion and convective gas flow

Transport through aerenchyma

Ebullition

Diffusion



Methane oxidation:

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

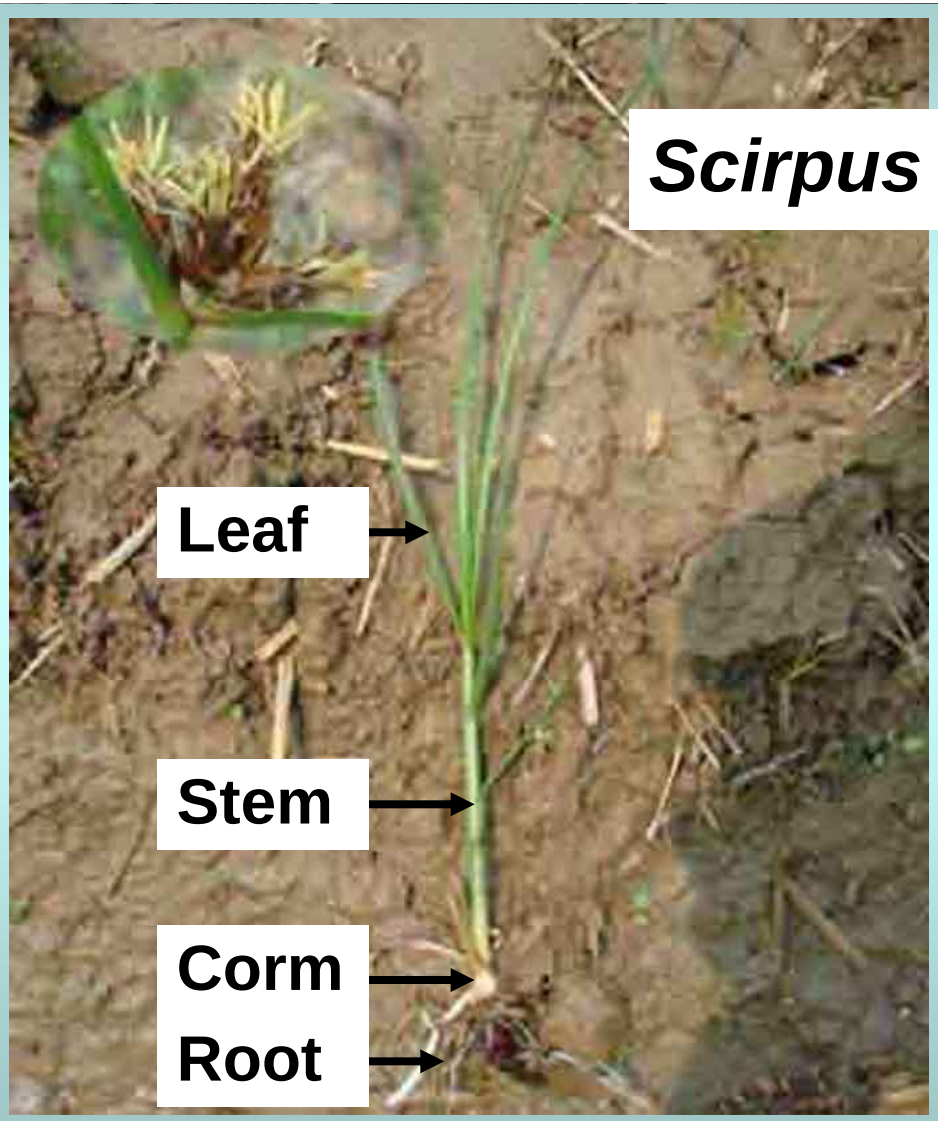
Methanogenesis:

Hydrogenotrophic: $CO_2 + 4H_2 \rightarrow 2\,H_2O + CH_4$

Acetotrophic: $CH_3COOH \rightarrow CO_2 + CH_4$

http://www.ibp.ethz.ch/research/environmentalmicrobiology/research/Wetlands

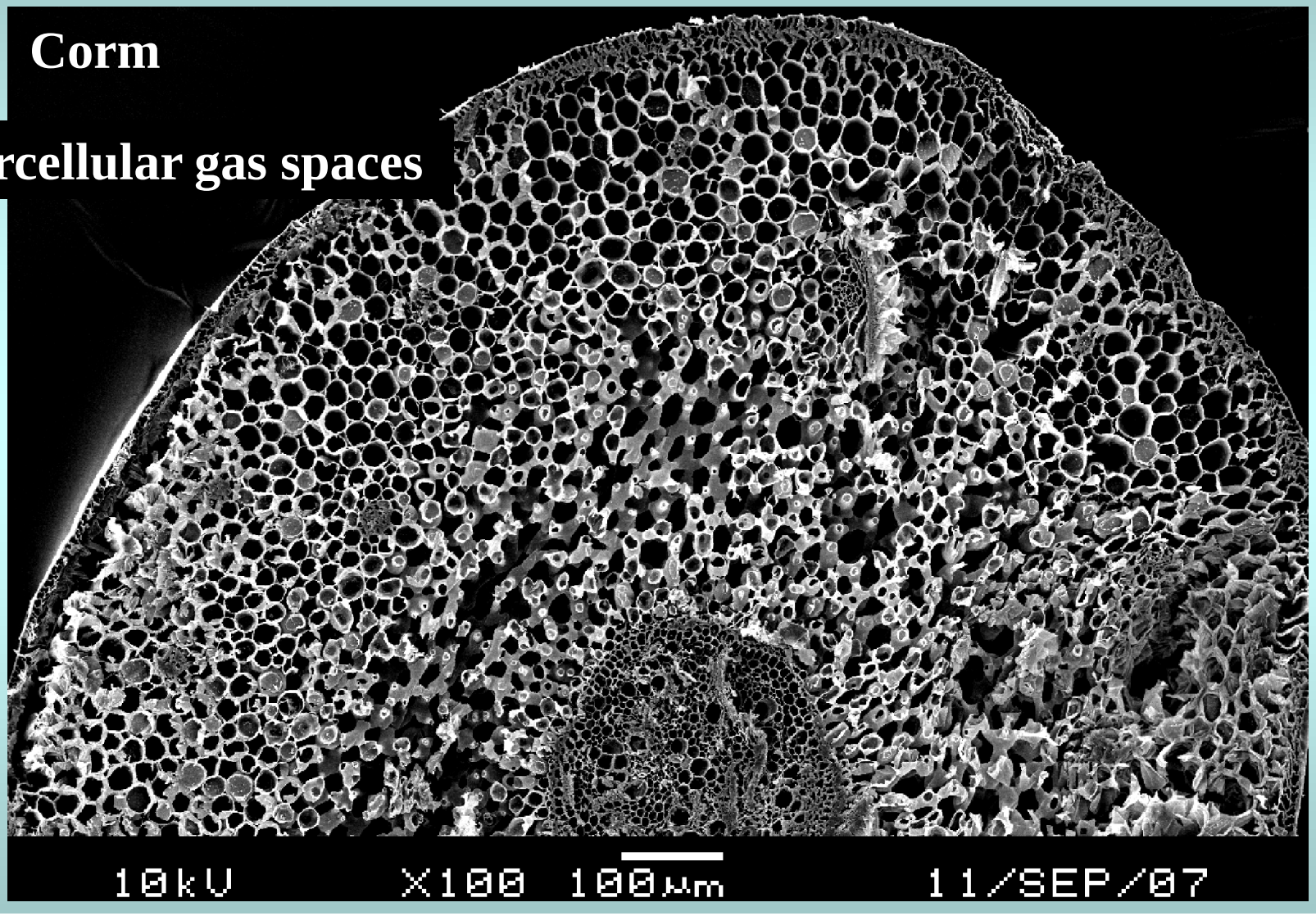
5. Effect of wetland plant



Scirpus mariqueter

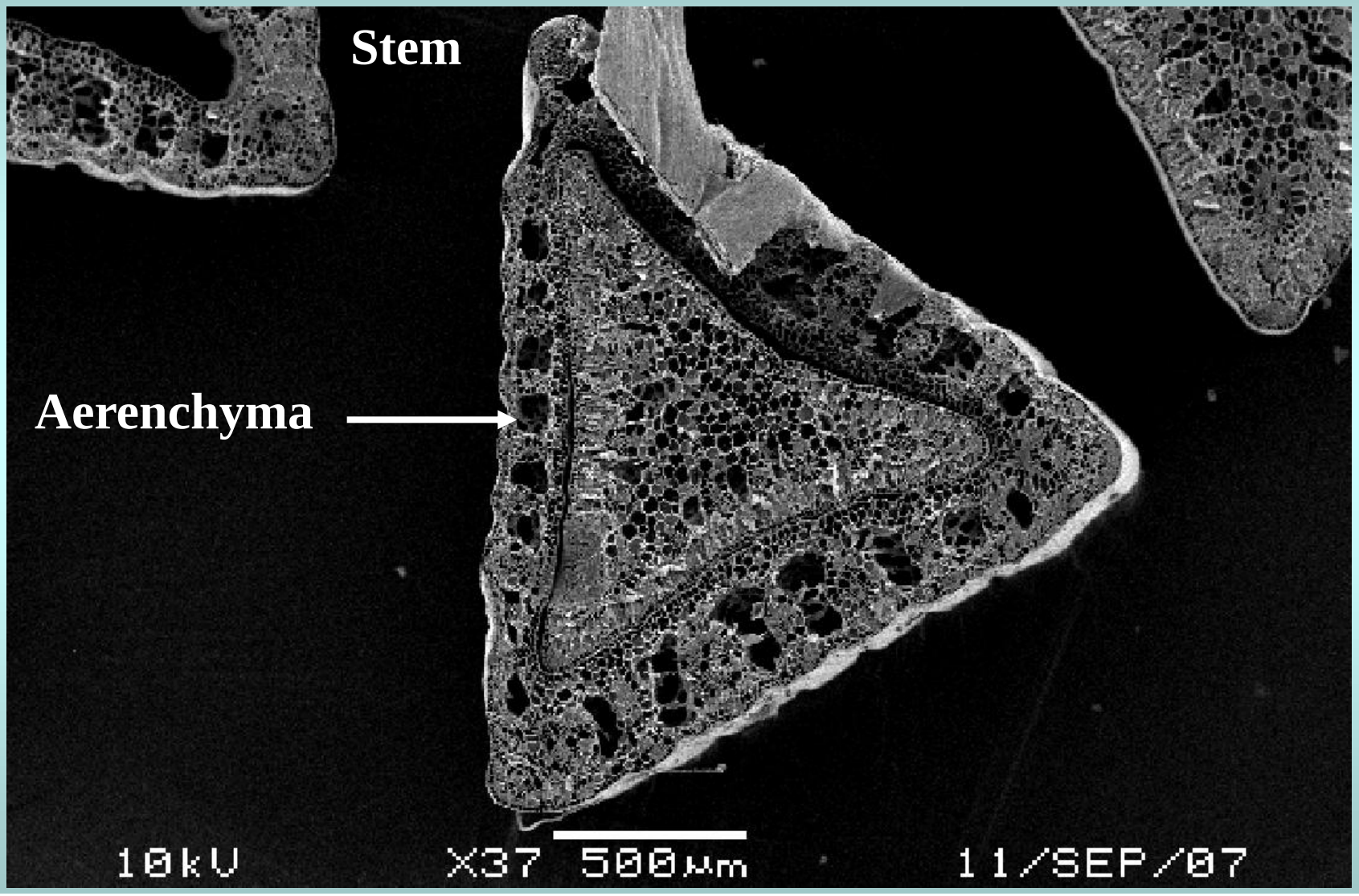
Wetland plants develop an extensive system of internal gas spaces to adapt to waterlogged conditions.

5. Effect of wetland plant



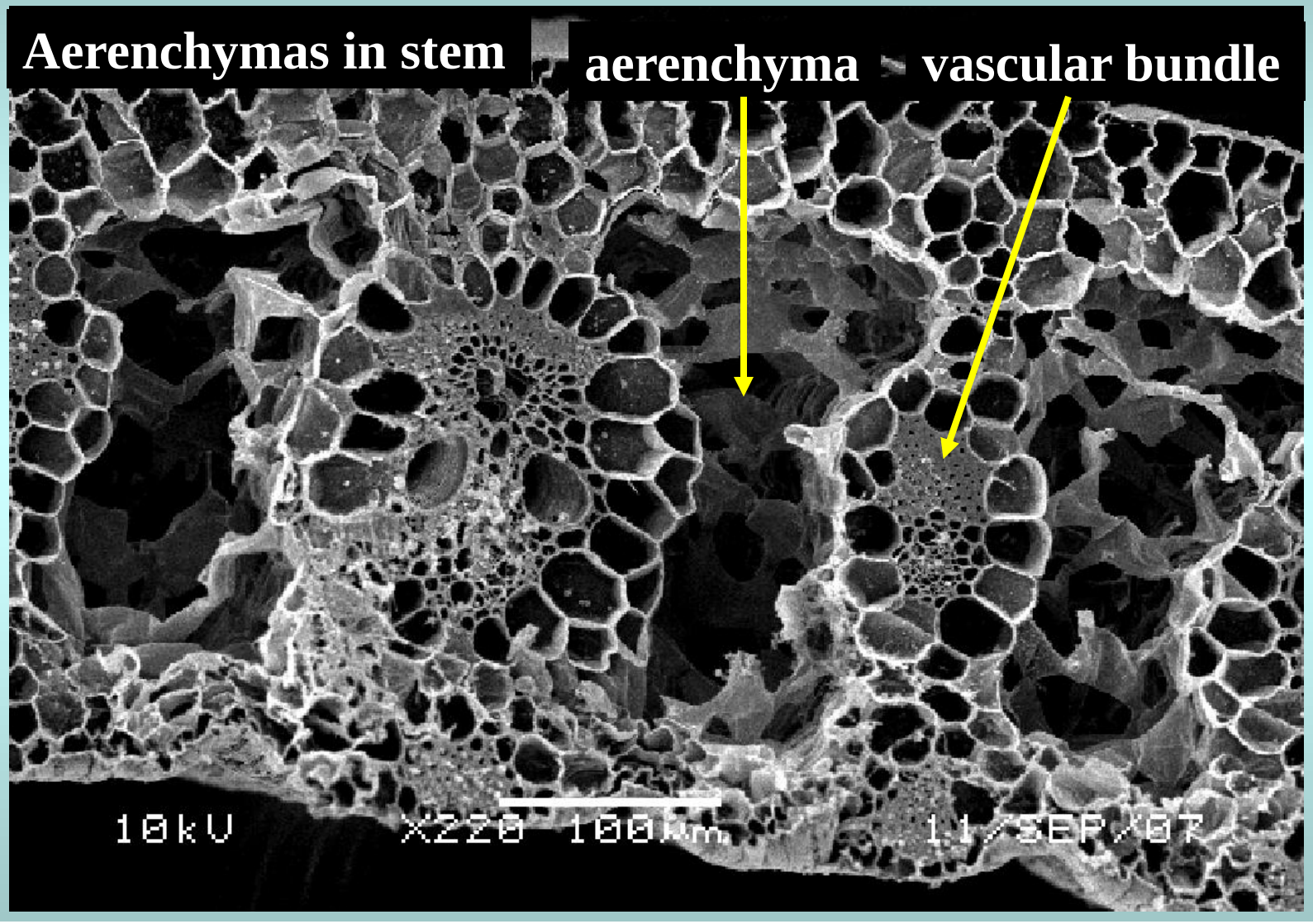
Transverse section of *S. mariqueter* observed by scanning electron microscopy

5. Effect of wetland plant



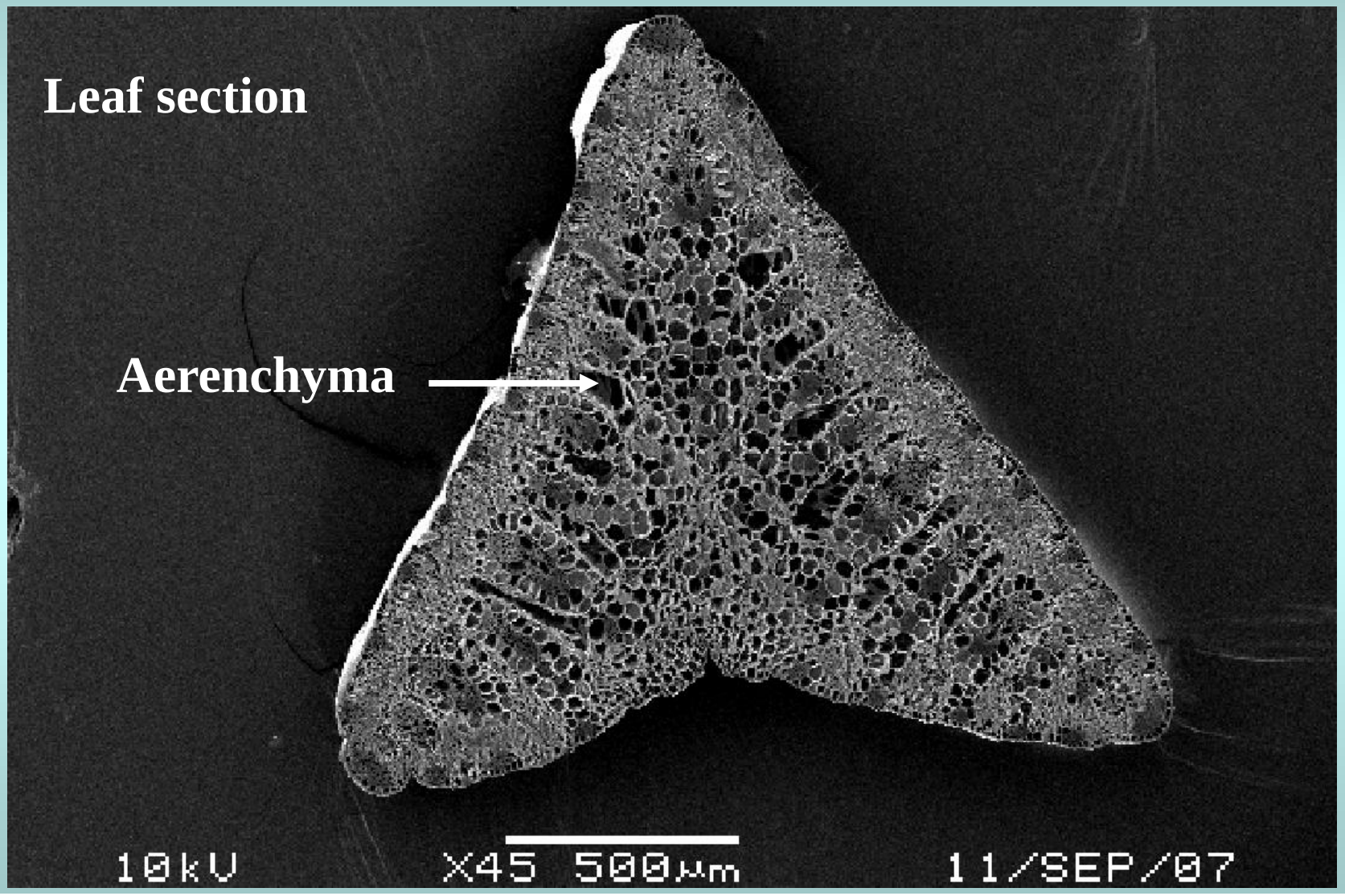
Transverse section of *S. mariqueter* observed by scanning electron microscopy

5. Effect of wetland plant



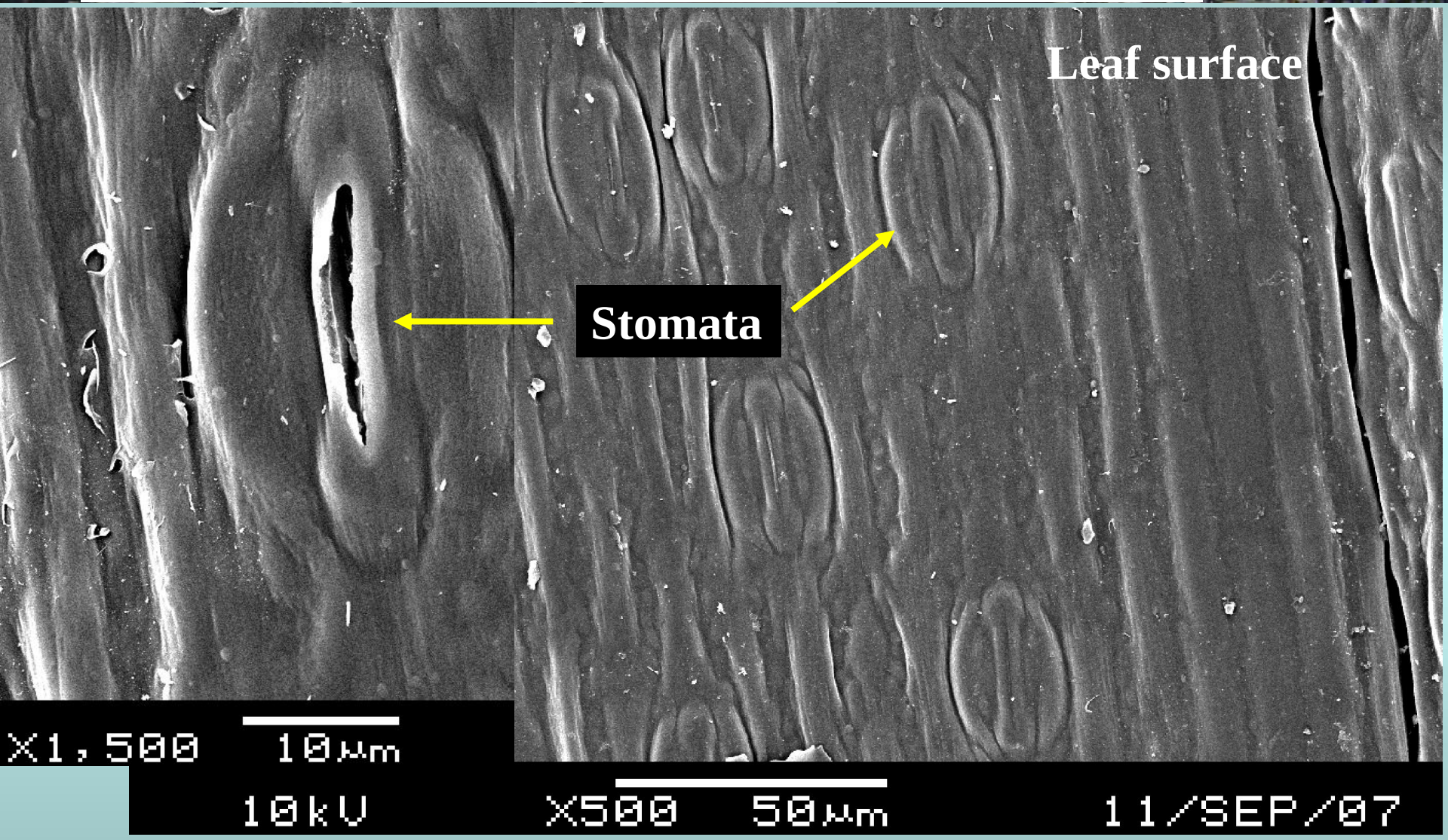
Transverse section of *S. mariqueter* observed by scanning electron microscopy

5. Effect of wetland plant



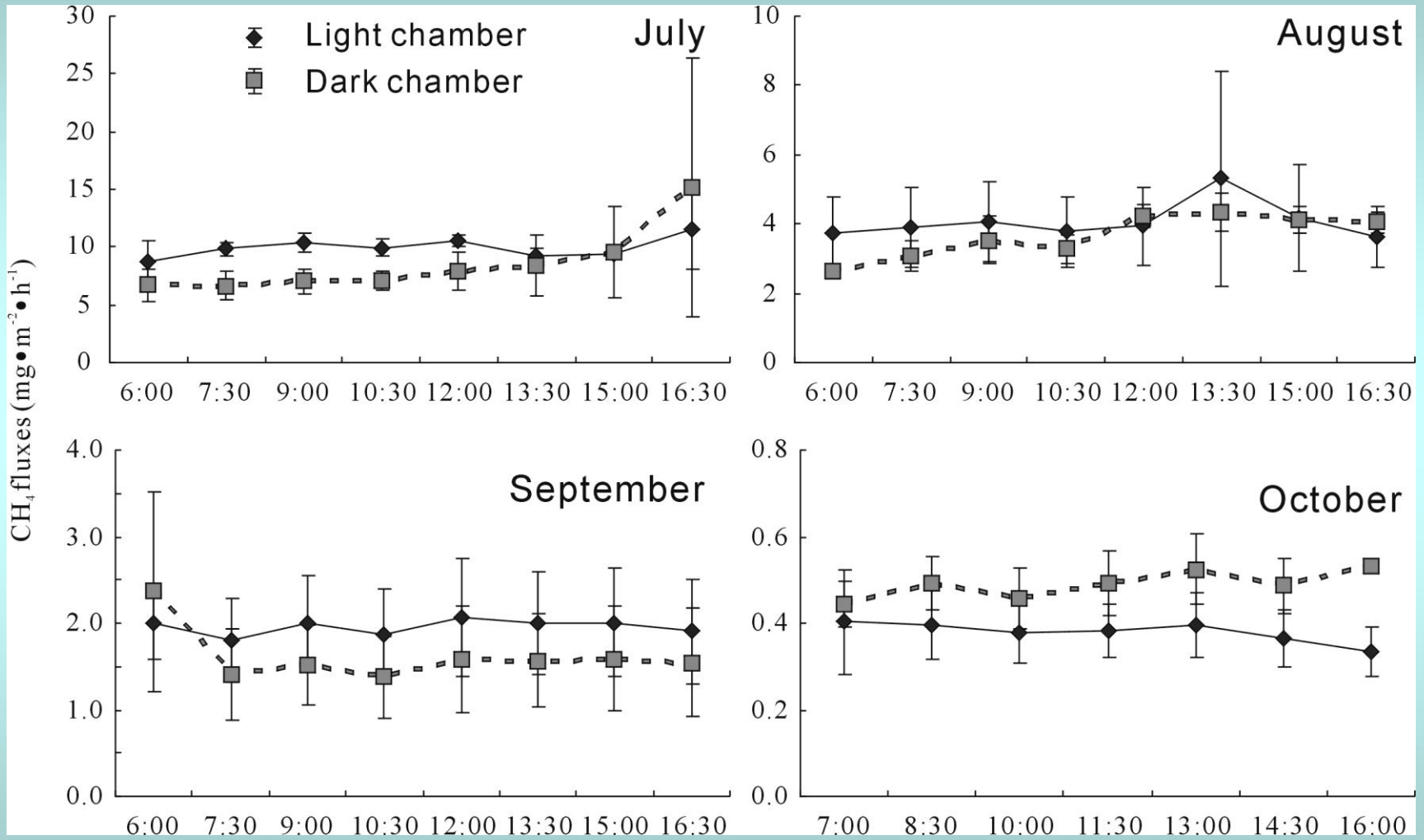
Transverse section of *S. mariqueter* observed by scanning electron microscopy

5. Effect of wetland plant



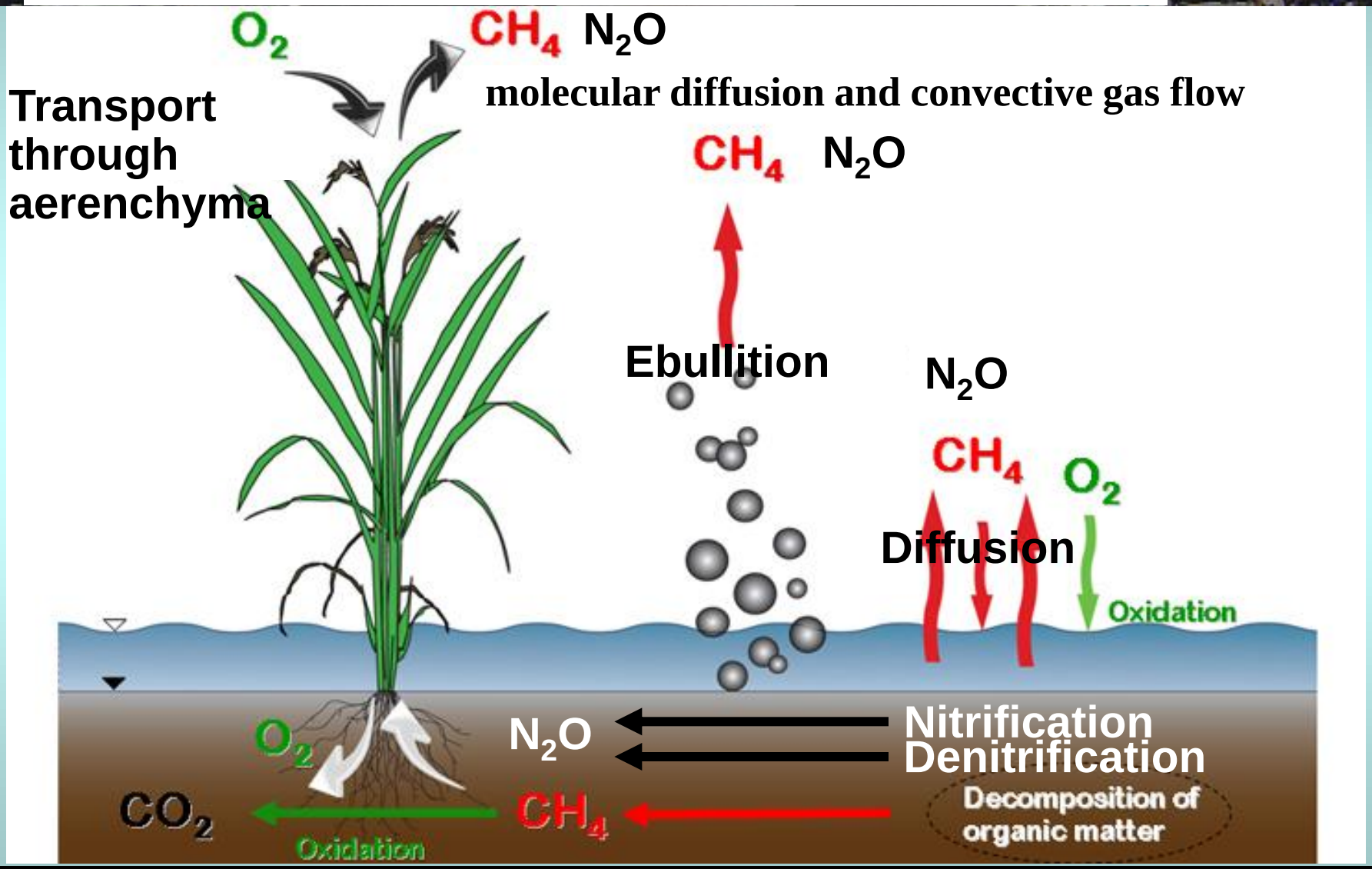
Transverse section of *S. mariqueter* observed by scanning electron microscopy

5. Effect of wetland plant



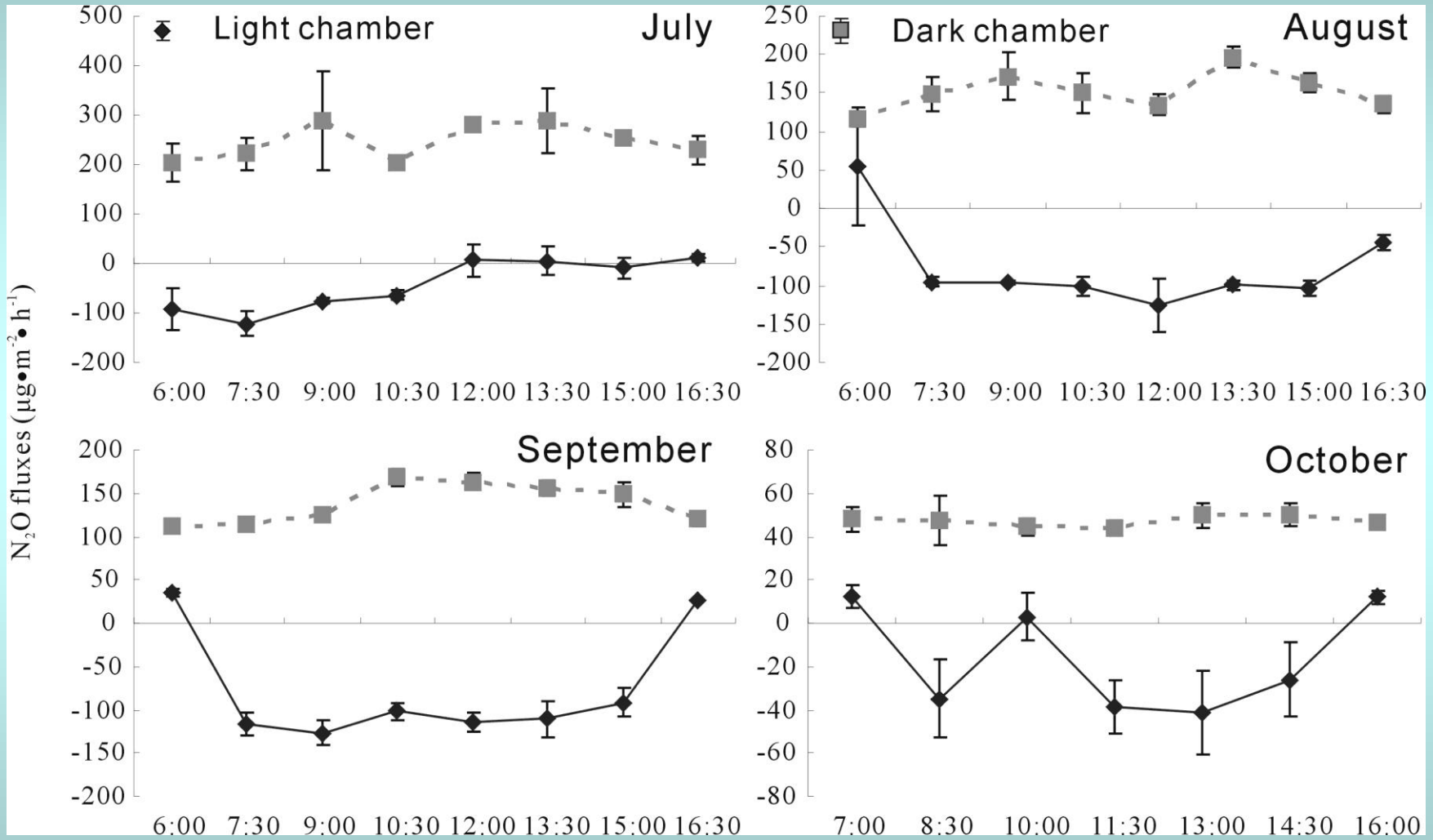
CH_4 fluxes in Light chamber and Dark chamber

5. Effect of wetland plant



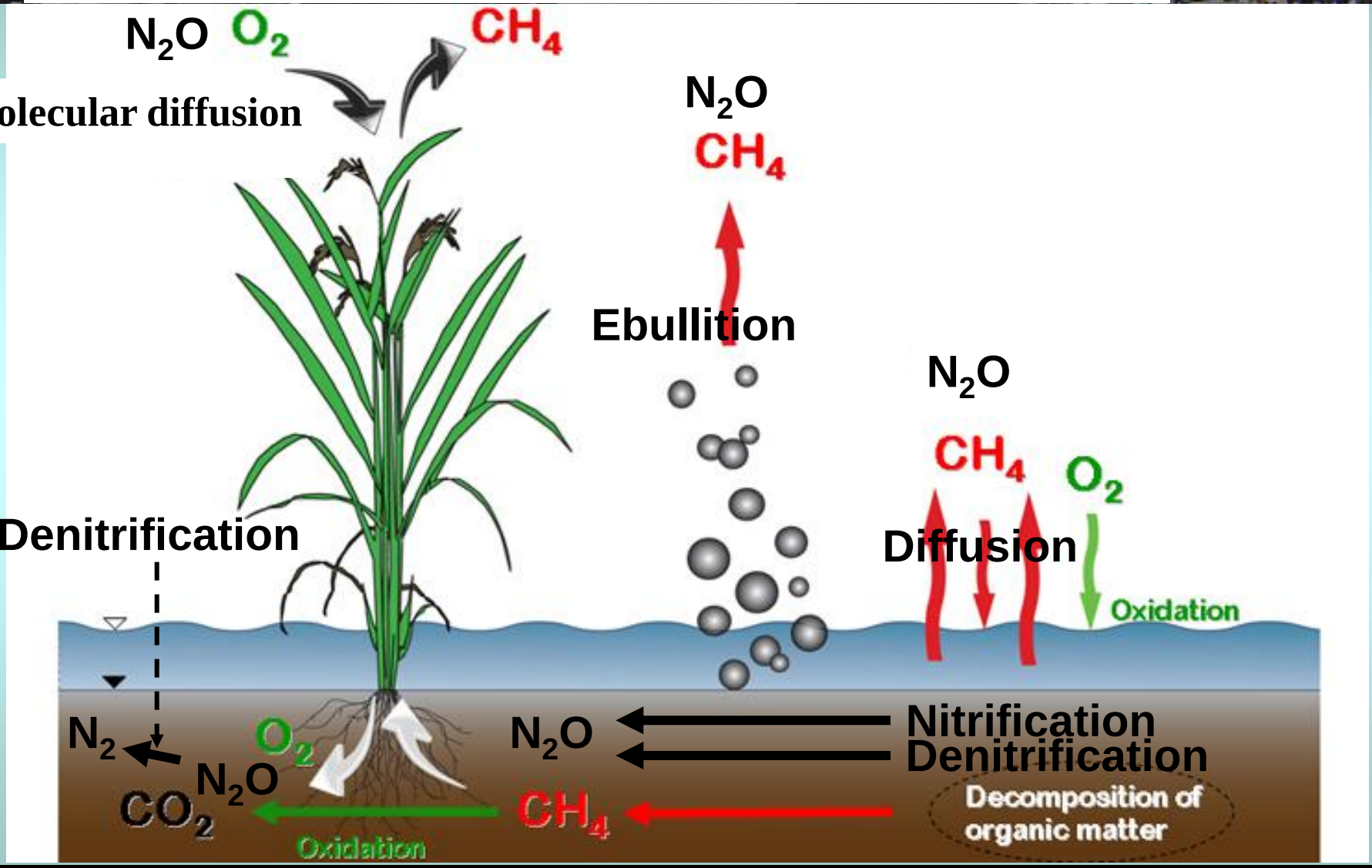
http://www.ibp.ethz.ch/research/environmentalmicrobiology/research/Wetlands

5. Effect of wetland plant



N_2O fluxes in Light chamber and Dark chamber

5. Effect of wetland plant



http://www.ibp.ethz.ch/research/environmentalmicrobiology/research/Wetlands

- Background
- Research Area
- Methods and Materials
- Methane and Nitrous oxide flux
- Effects of wetland plant
- **Conclusions**

6. Conclusions

1. Annual CH_4 flux is 13.9 g CH_4 /m^2/yr, N_2O flux is 0.28 g N_2O /m^2/yr;
2. Temperature has exponential correlation with CH_4 and N_2O flux;
3. Wetland plant clearly control CH_4 and N_2O flux, especially photosynthesis greatly decreased N_2O flux and induced the consumption of atmospheric N_2O;
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

Wang, D., Z. Chen, and S. Xu (2009), Methane emission from Yangtze estuarine wetland, China, *J. Geophys. Res.*, 114, G02011, doi:10.1029/2008JG000857.

Yu, Z., Y. Li, H. Deng, D. Wang, Z. Chen, and S. Xu (2012), Effect of *Scirpus mariqueter* on nitrous oxide emissions from a subtropical monsoon estuarine wetland, *J. Geophys. Res.*, G02017, doi:10.1029/2011JG001850.

Thank you !

Questions?

dqwang@geo.ecnu.edu.cn