Eddy covariance fluxes of CO_2 and CH_4 at the DTH site, Lake Taihu

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Outline

- Introduction
- Materials and methods
- Preliminary results
- Conclusions
- Future work

01 Introduction

- Inland lakes are an important source of atmospheric CO_2 and CH_4. It is estimated that inland lakes emit 0.14 Pg CO_2 yr^{-1} and 8-48 Tg CH_4 yr^{-1}, respectively(Cole *et al*., 1994; Bastviken *et al*., 2004).

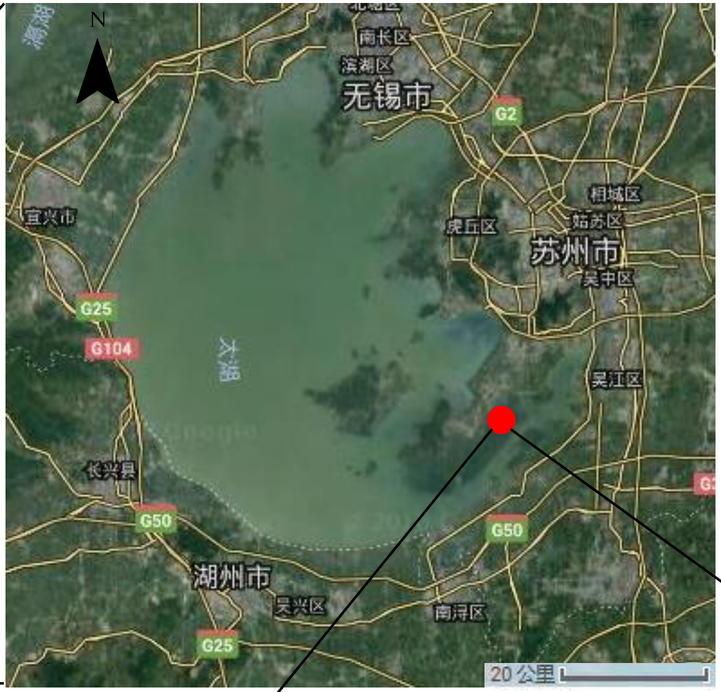
- In recent decades, studies on global lake carbon cycle only focused on natural lakes, ignoring aquaculture lakes which are heavily disrupted by humans.

- Studies have shown that water quality and physical and chemical properties of sediment in aquaculture water bodies would undergo great changes due to excessive feed inputs, animal residues and excretion. Therefore, GHG emission from aquaculture lakes may differ from other natural lakes significantly.

- In 2016, the area of aquaculture lakes was 9908.2 km^2, accounting for 12.2% of the total lake area in China. Clarifying the GHG emission characteristics of this special type of lakes is of great significance for evaluating the contribution of lakes to global carbon emission accurately and deepening the understanding of the impact of human activities on global warming.

02 Materials and methods

2.1 Site description



DTH site
31°03'33"N, 120°28'30"E

- Observation start time: 6 November 2017
- Water depth: about 1.2 m
- Instrument erection height: 3 m above water surface
- CO_2/H_2O gas analyzer: Campbell EC150
- CH_4 gas analyzer: LI-COR 7700

Aquatic vegetation species

Submerged macrophyte:

- Elodea nuttallii(伊乐藻)

Literature:

- Potamogeton malaianus(马来眼子菜)
- Ceratophyllum demersum(金鱼藻)
- Vallisneria spiralis(苦草)

Floating-leafed vegetation：

- Trapa bispinosa(菱)
- Nymphoides peltatum(荇菜)
- Hydrocharis dubia(水鳖)

2.2 Data processing for CO_2

(1) Data correction

2-D coordinate rotation

↓

Sonic temperature correction

↓

WPL correction

(2) Quality control

Instrument Status(samples, signal value)

↓

Eliminating the EC data when it rains

↓

Five point moving average for CO_2 and H_2O (standard deviation: 1.5)

↓

Removing data outside threshold

↓

Half hourly post-processing data

2.3 Data processing for CH_4

(1) Data correction

2-D coordinate rotation
↓
Sonic temperature correction
↓
Frequency correction
↓
WPL correction

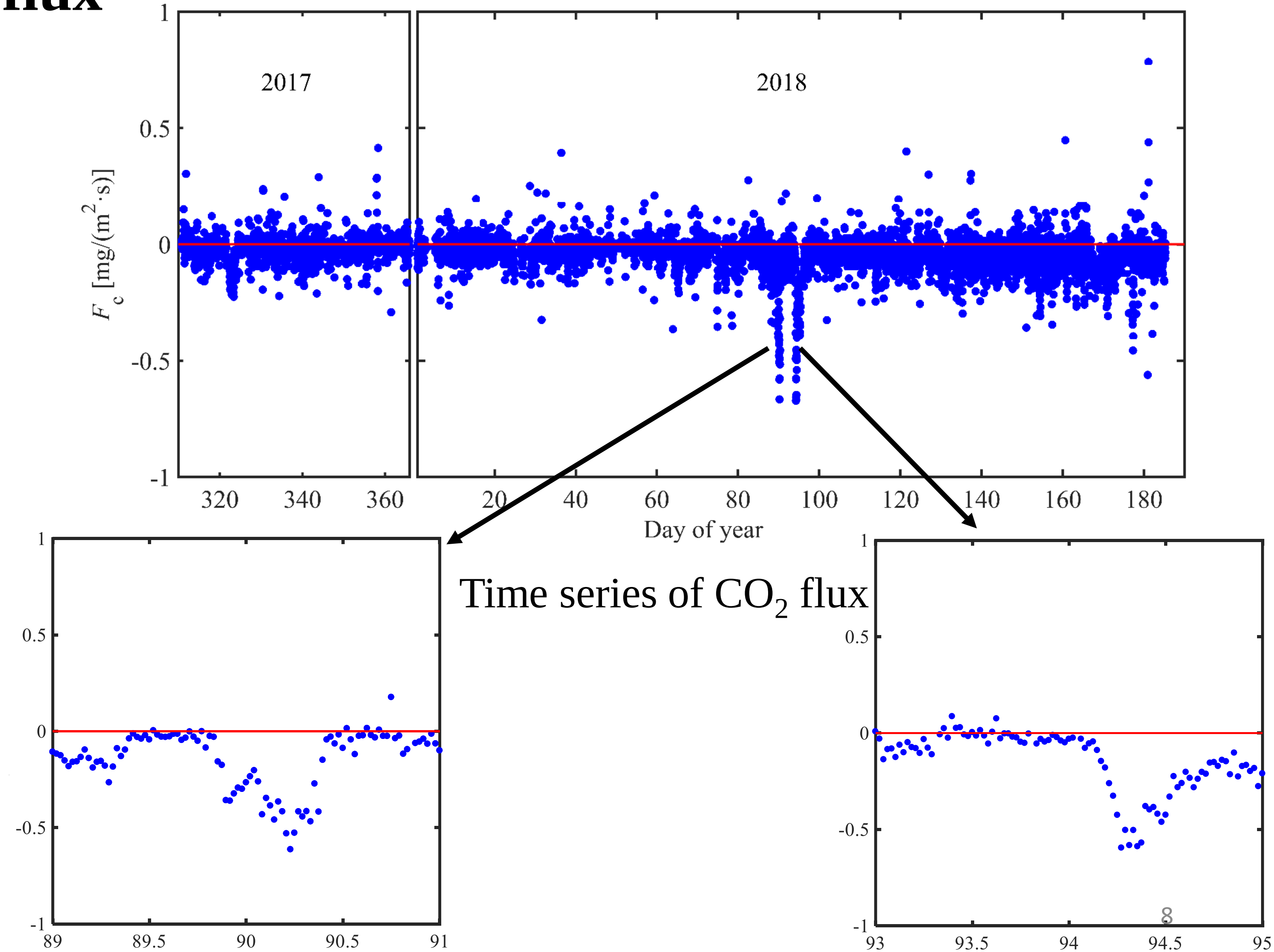
(2) Quality control

Instrument Status(samples, signal value)
↓
Eliminating the EC data when it rains
↓
Removing data outside threshold
↓
Half hourly post-processing data

03 Preliminary results

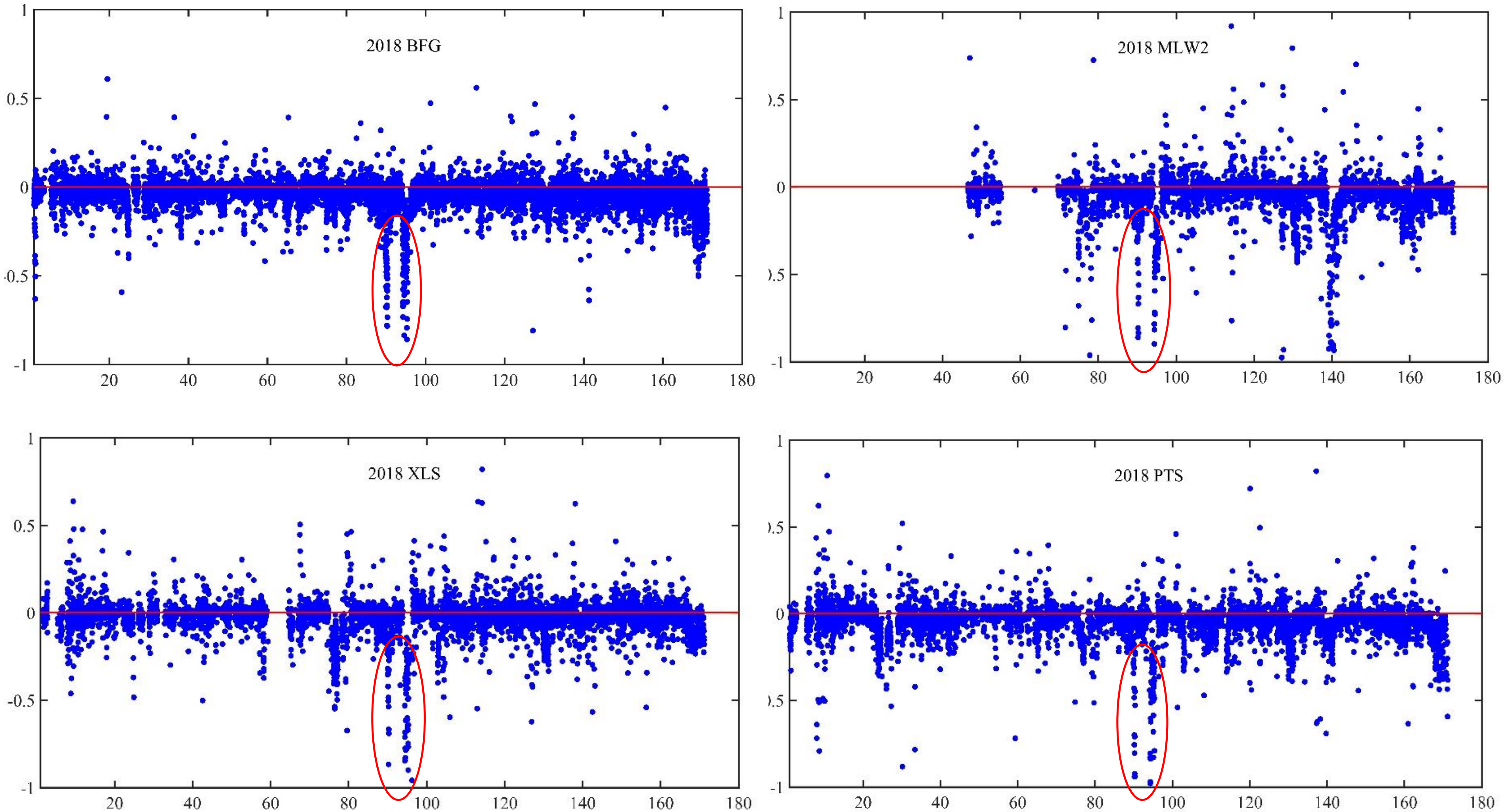
3.1 CO_2 flux

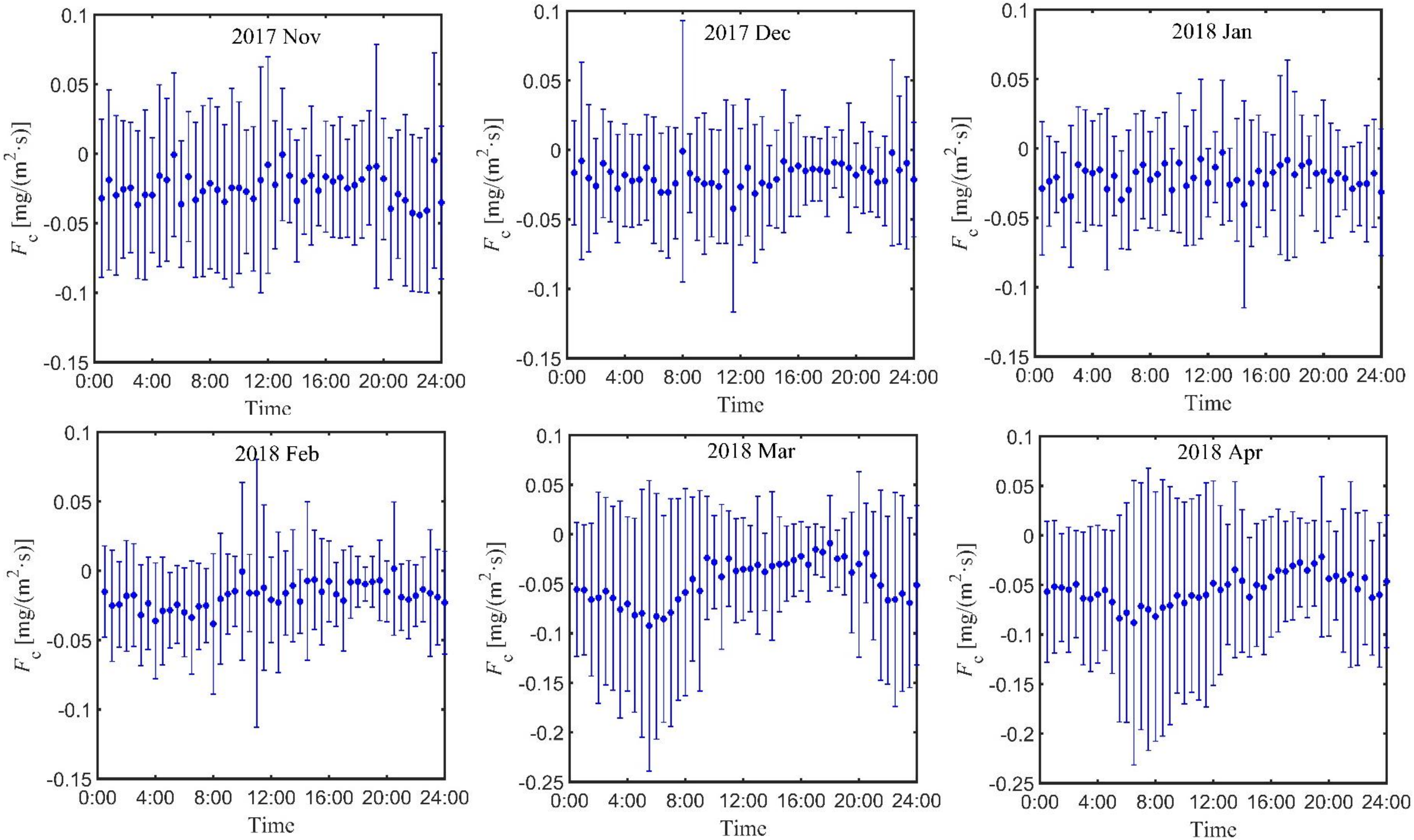
2017.11.6—2018.7.4

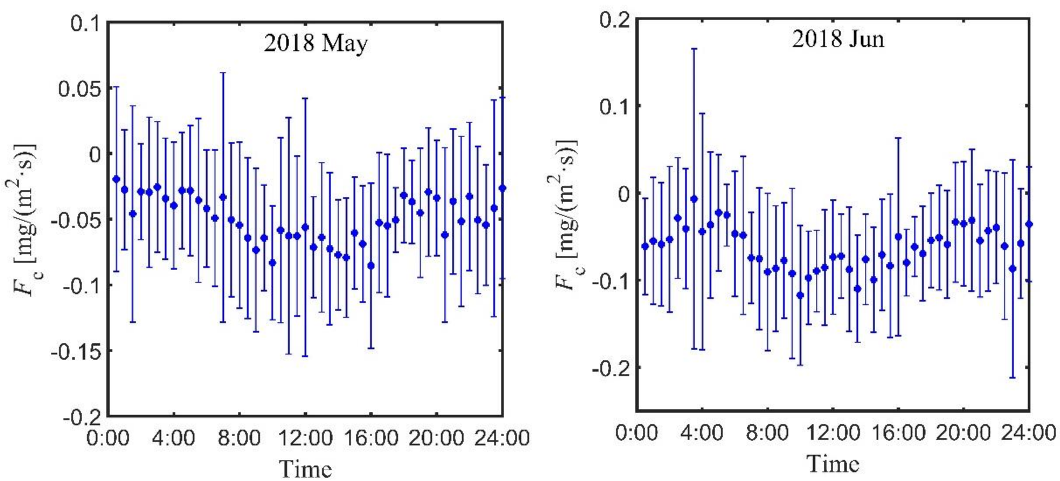


Time series of CO_2 flux

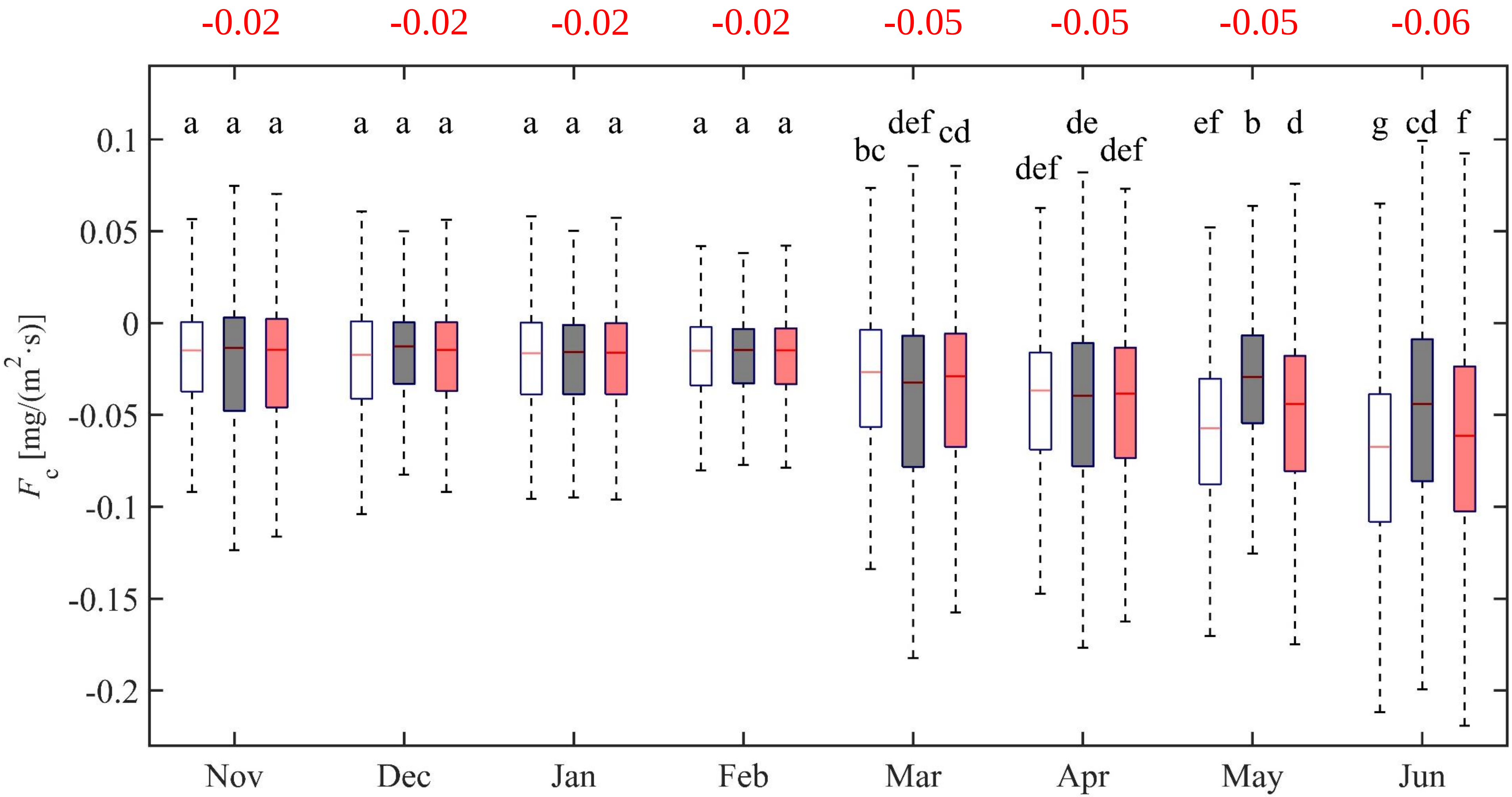
CO_2 flux at other four sites







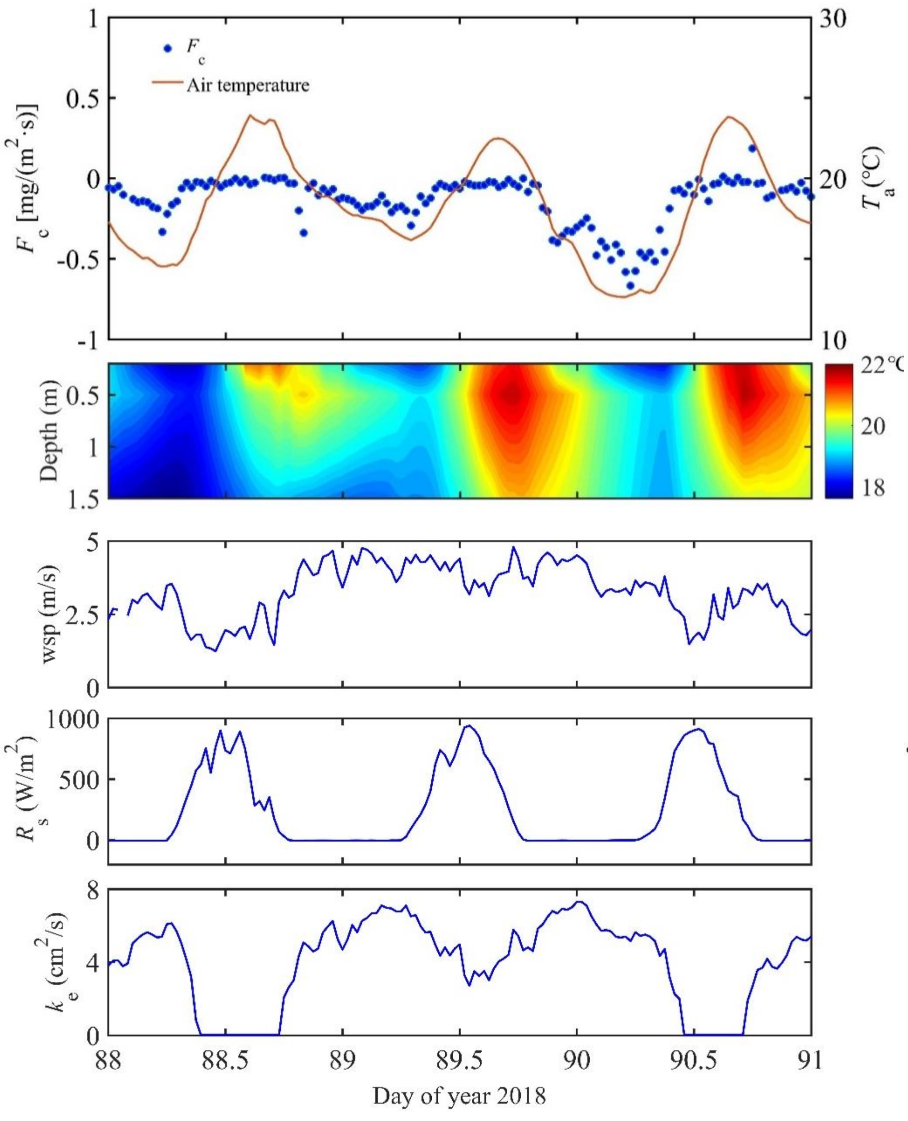
Diurnal pattern of CO_2 flux in different months



Boxplot of CO_2 flux in different months

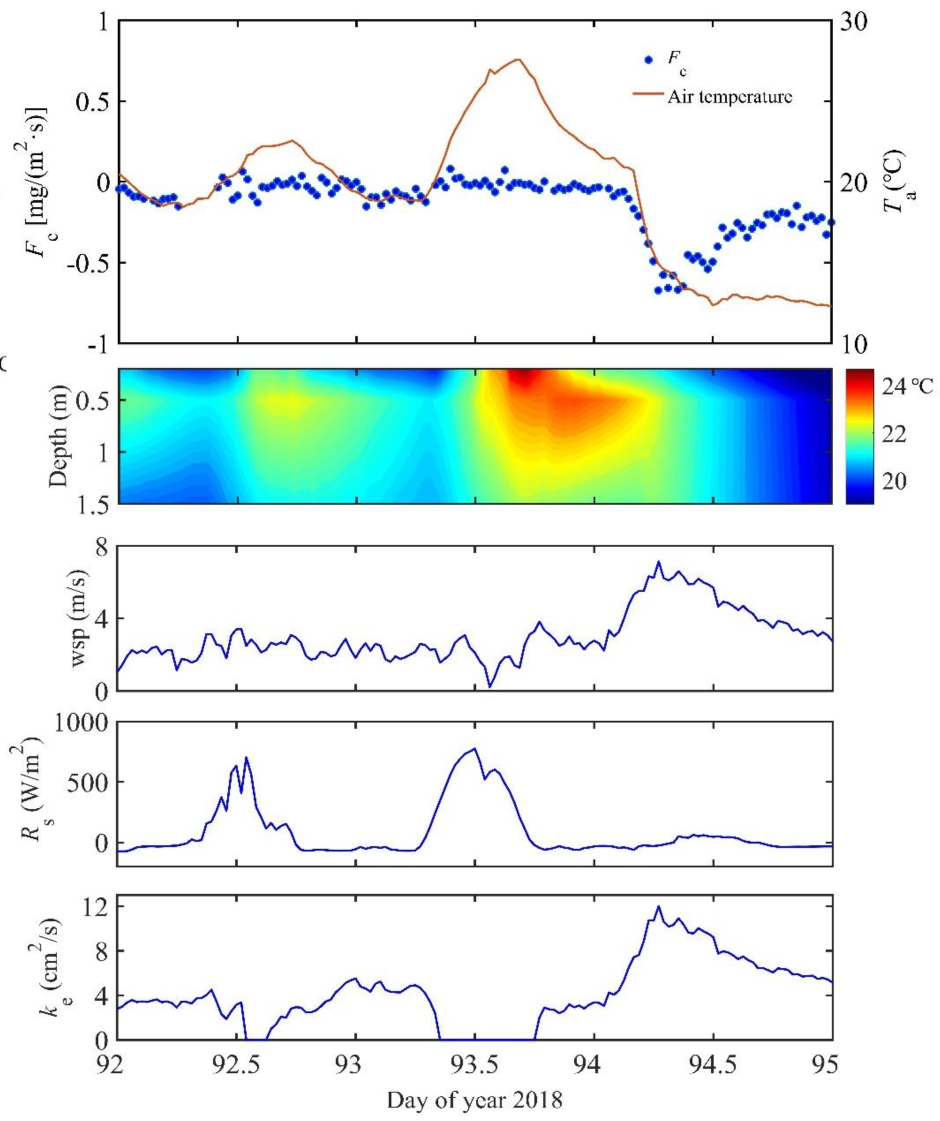
White boxplot: daytime(solar elevation angle>0) ; Black boxplot: nighttime(solar elevation angle<0); Red boxplot: the whole month

Case 1



Fc
Air temperature
Fc [mg/(m2·s)]
Ta (°C)
Depth (m)
22 °C
20
18
wsp (m/s)
Rs (W/m2)
ke (cm2/s)
Day of year 2018

Case 2



Fc
Air temperature
Fc [mg/(m2·s)]
Ta (°C)
Depth (m)
24 °C
22
20
wsp (m/s)
Rs (W/m2)
ke (cm2/s)
Day of year 2018

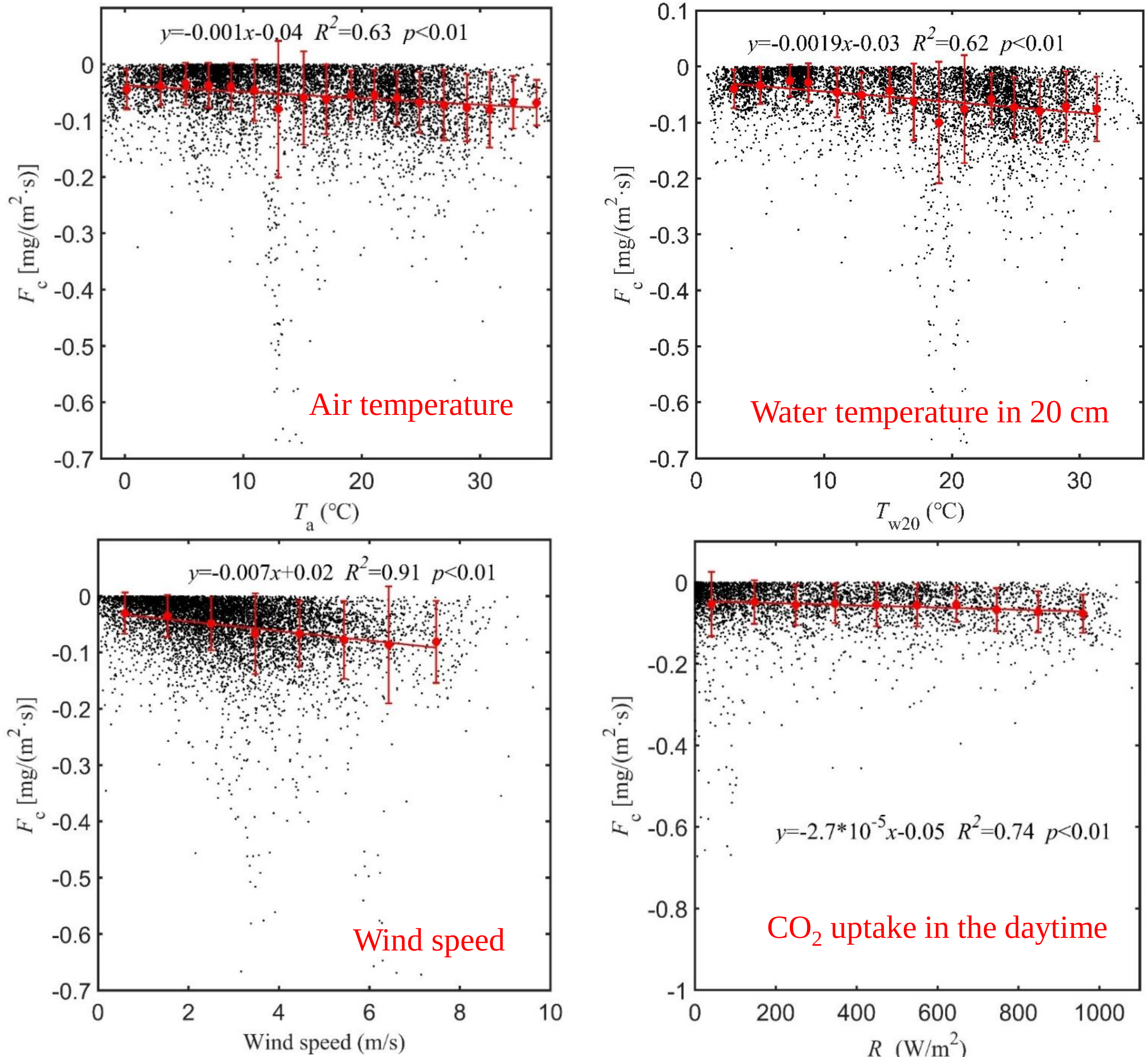
Correlation analysis between CO_2 uptake flux and meteorological factors

	Air temperature	Water temperature	Wind speed	Solar radiation	
				daytime	nighttime
CO_2 uptake flux	-0.19**	-0.28**	-0.28**	-0.10**	-0.11

Correlation analysis between CO_2 emission flux and meteorological factors

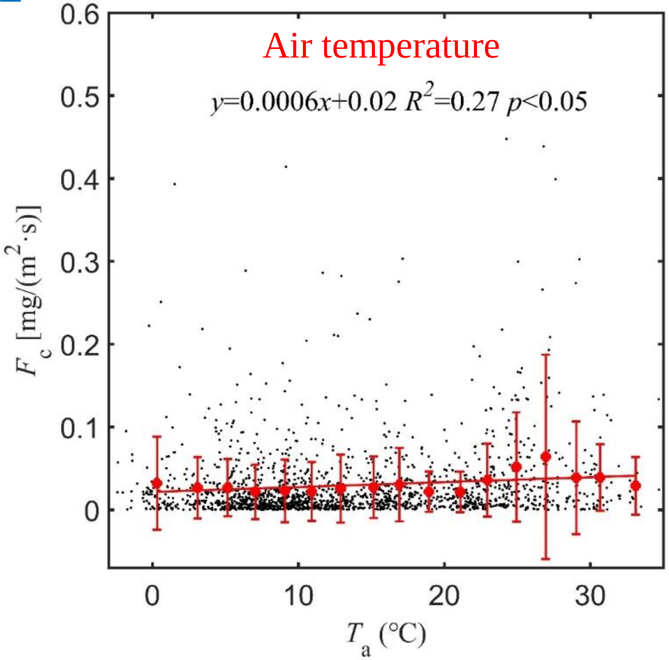
	Air temperature	Water temperature	Wind speed
CO_2 emission flux	0.13**	0.16**	0.15**

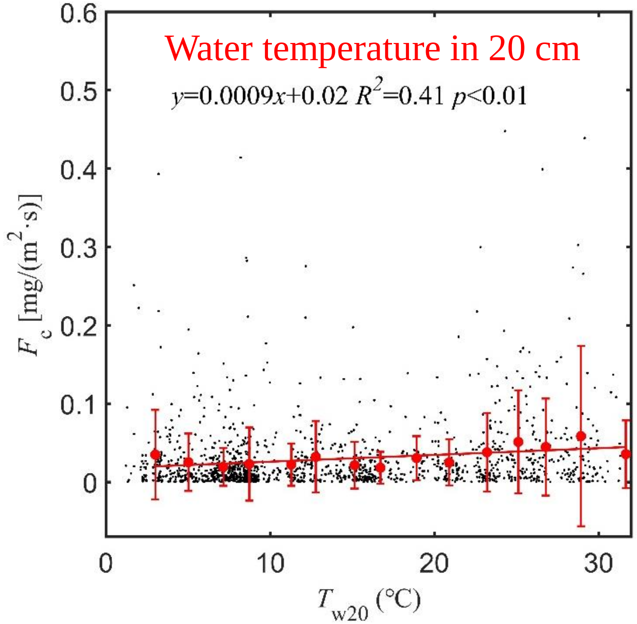
CO_2 uptake flux

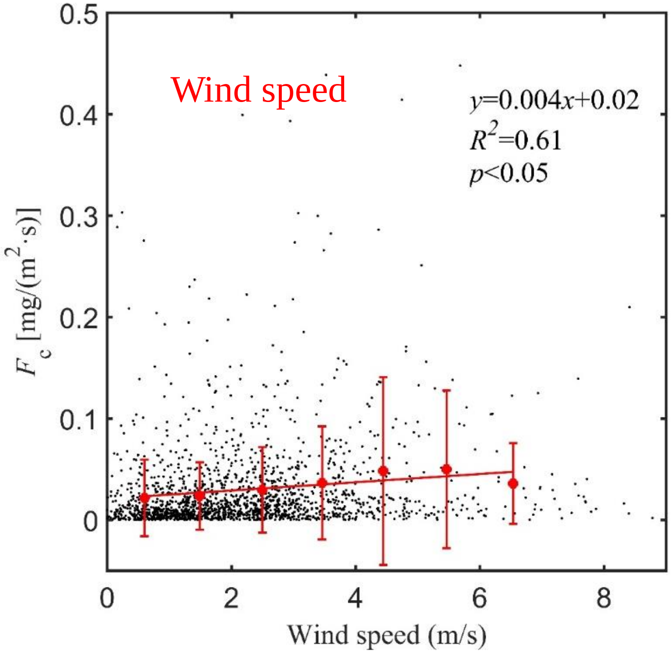


CO_2 uptake flux versus meteorological factors and bin-averaged plot

CO_2 emission flux



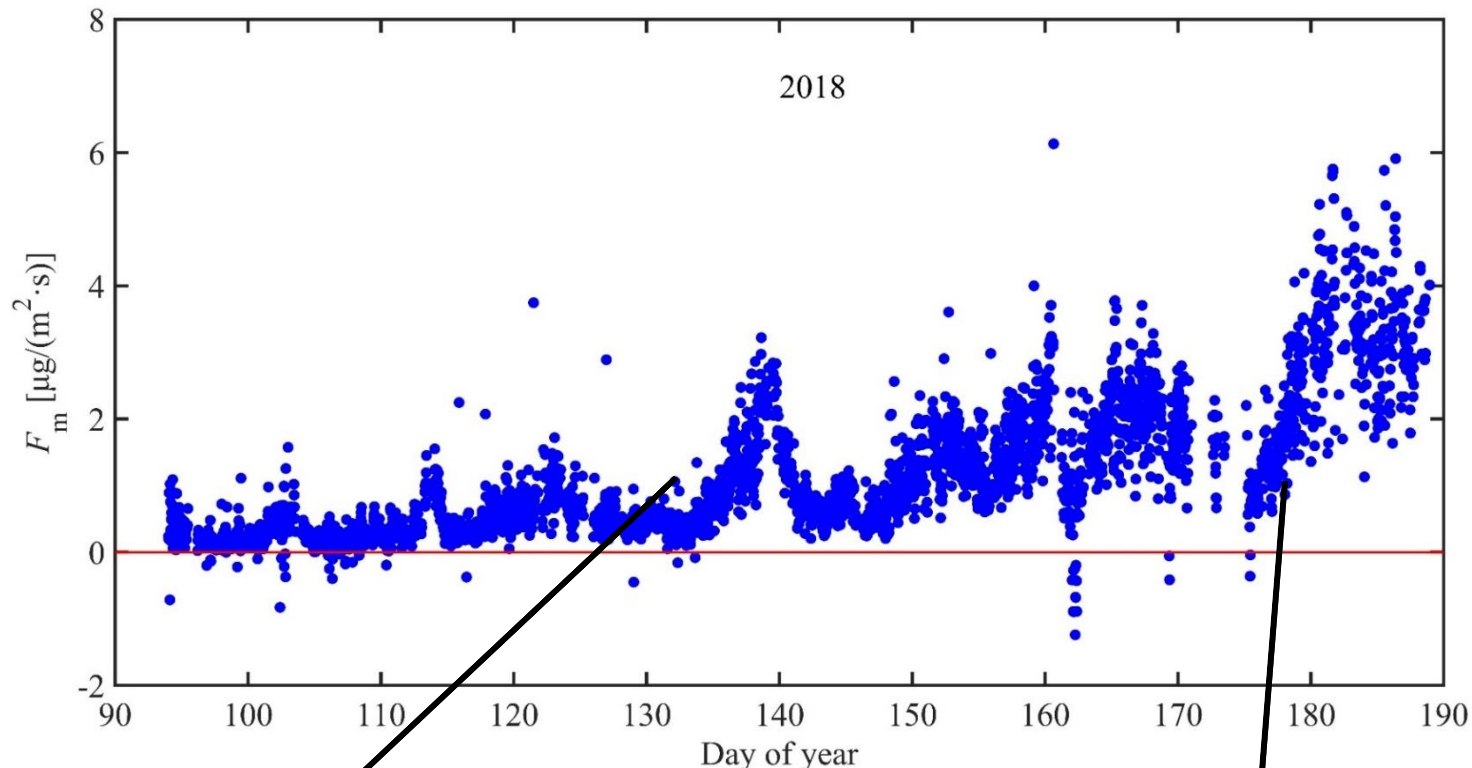


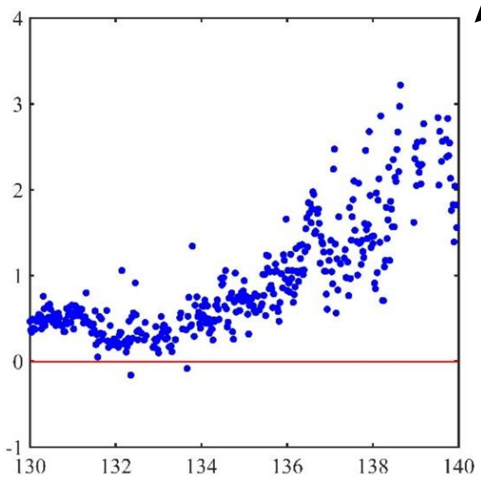


CO_2 emission flux versus meteorological factors and bin-averaged plot

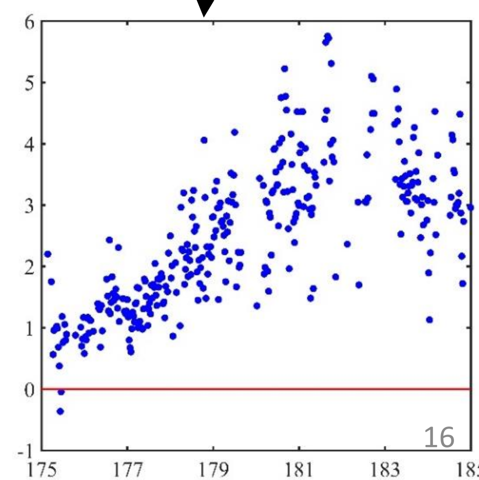
3.2 CH_4 flux

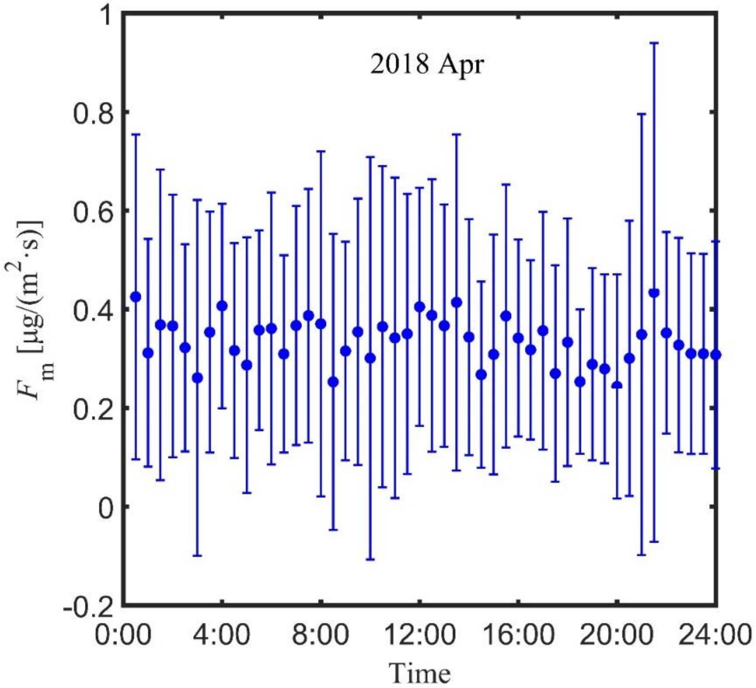
2018.4.4—2018.7.7

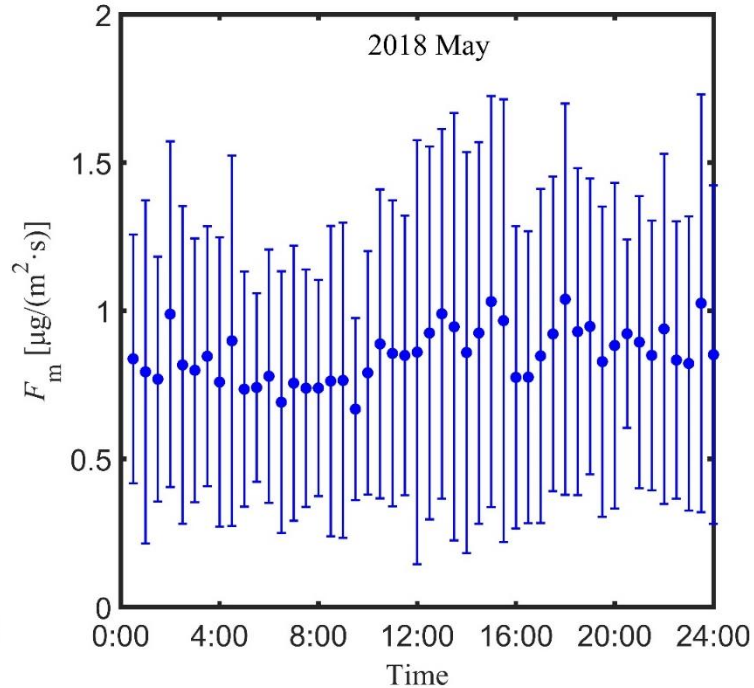


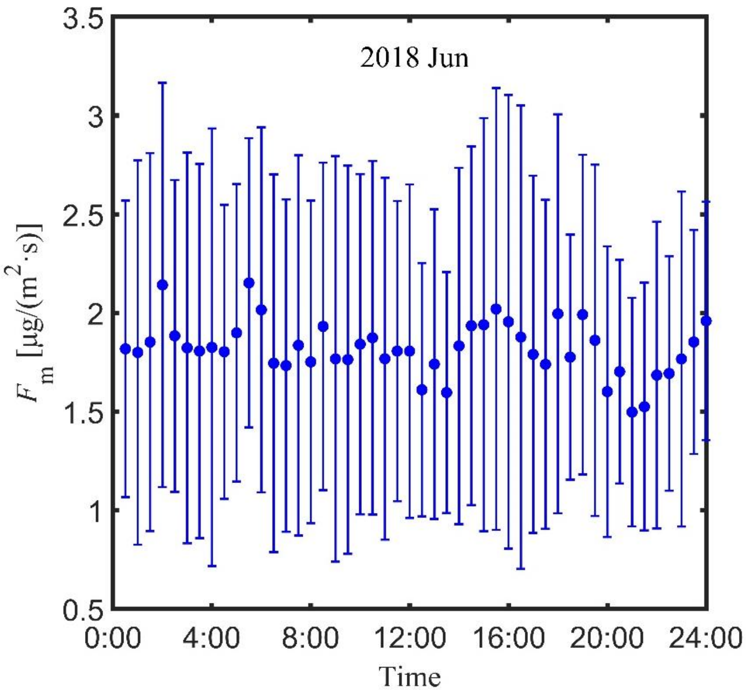


Time series of CH_4 flux

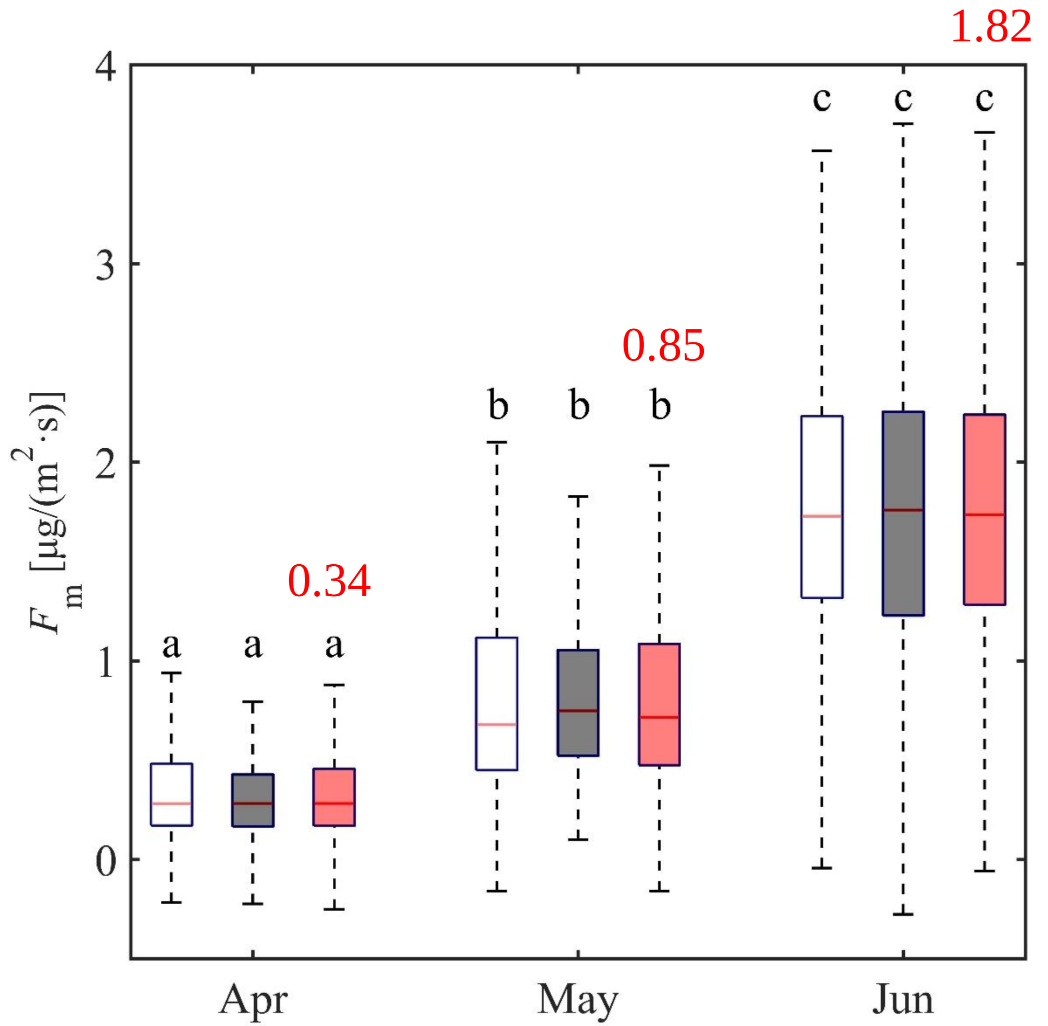








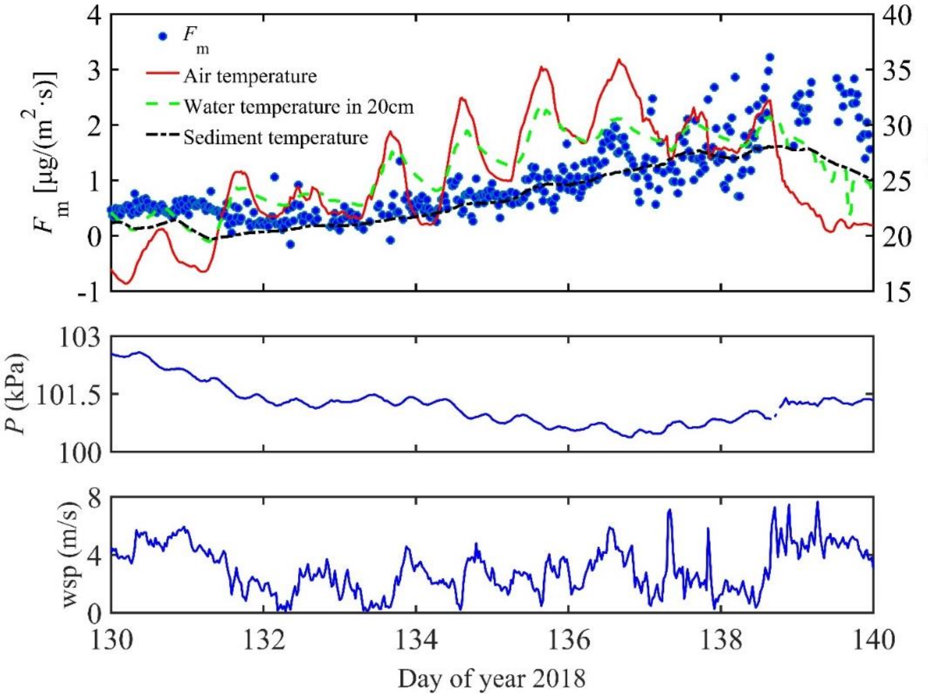
Diurnal pattern of CH_4 flux in different months



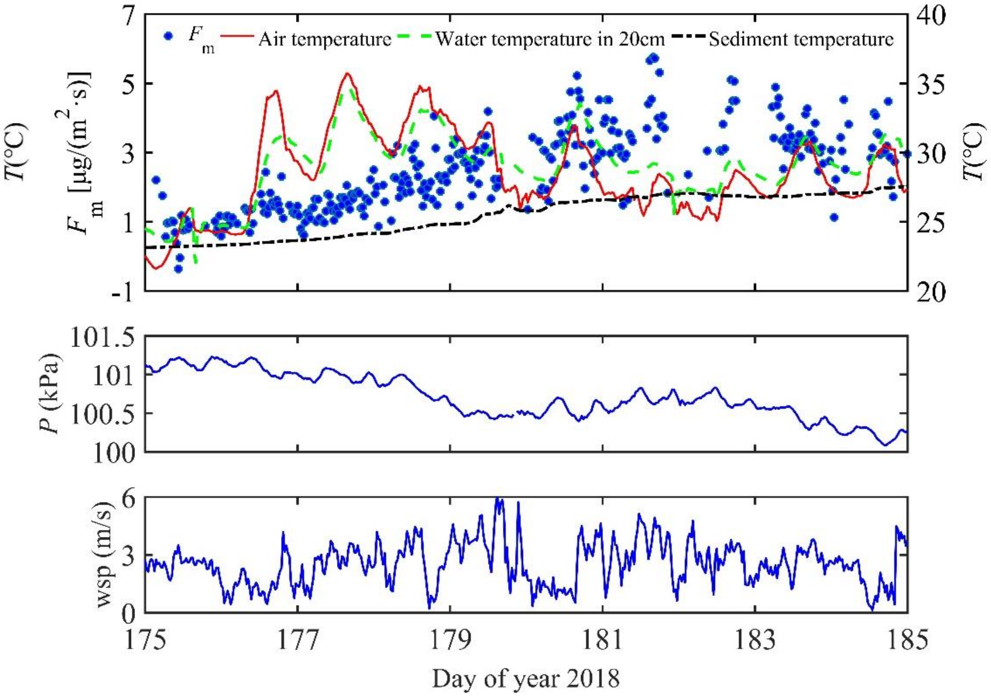
Boxplot of CH_4 flux in different months

White boxplot: daytime(solar elevation angle>0) ; Black boxplot: nighttime(solar elevation angle<0); Red boxplot: the whole month

Case 1

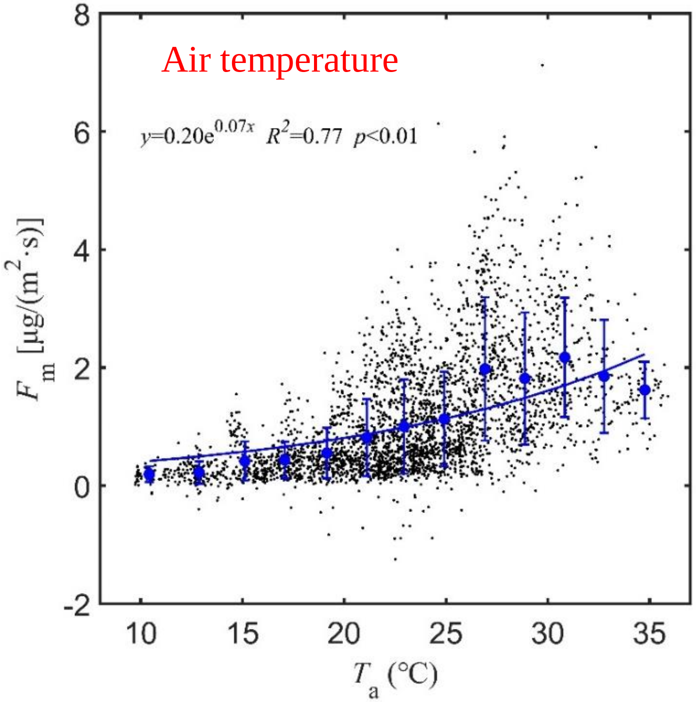


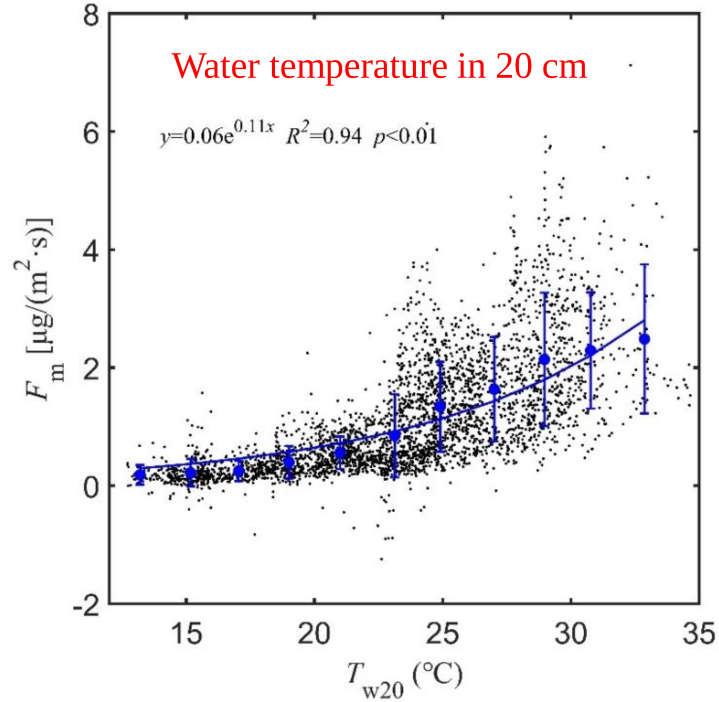
Case 2

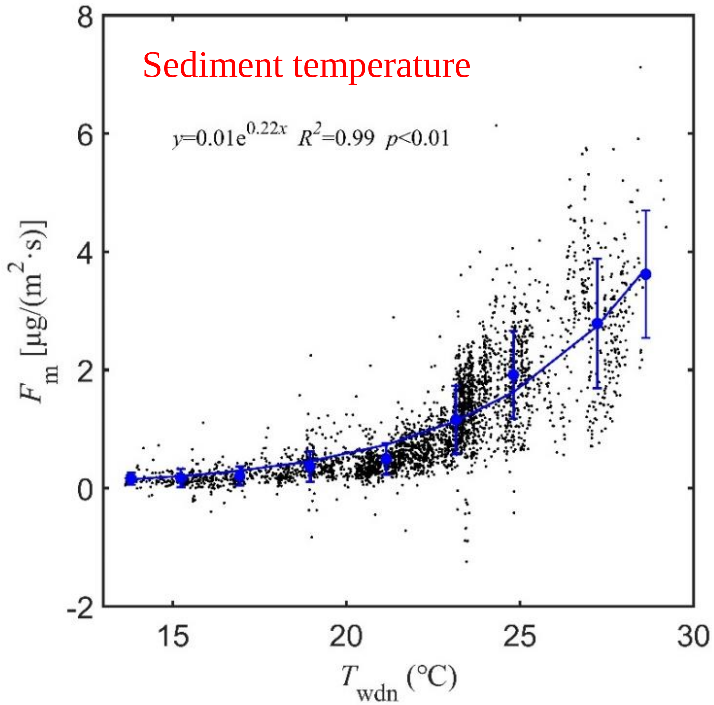


Correlation analysis between CH_4 flux and meteorological factors

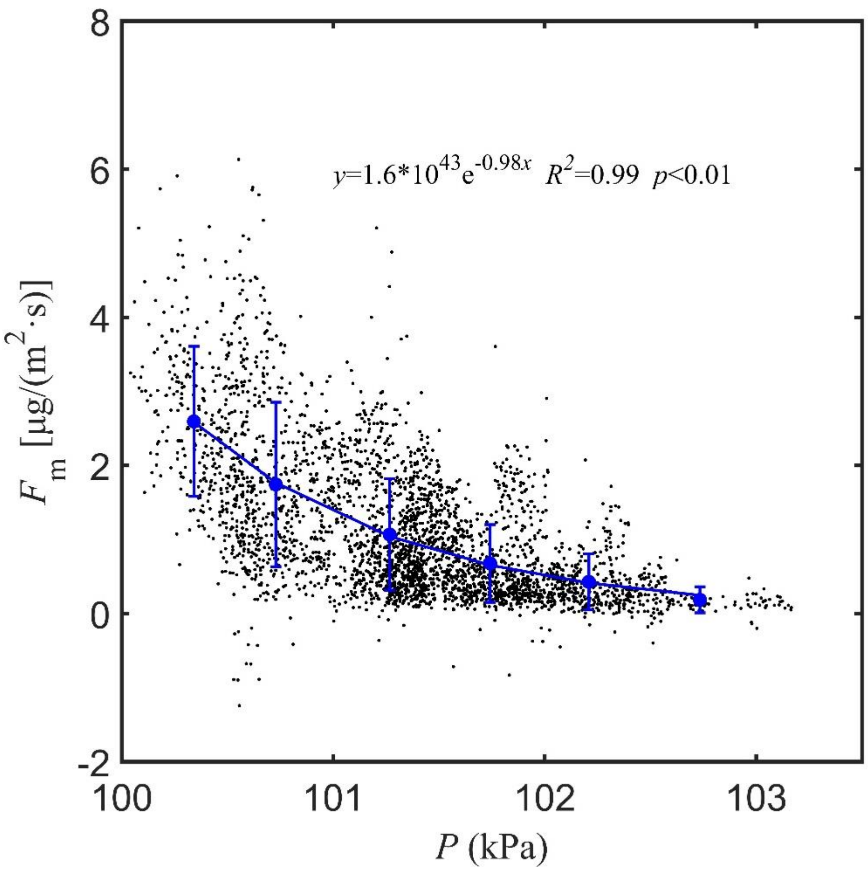
	Air temperature	Water temperature	Sediment temperature	Air pressure	Wind speed
CH_4 flux	0.55**	0.67**	0.75**	-0.62**	-0.03

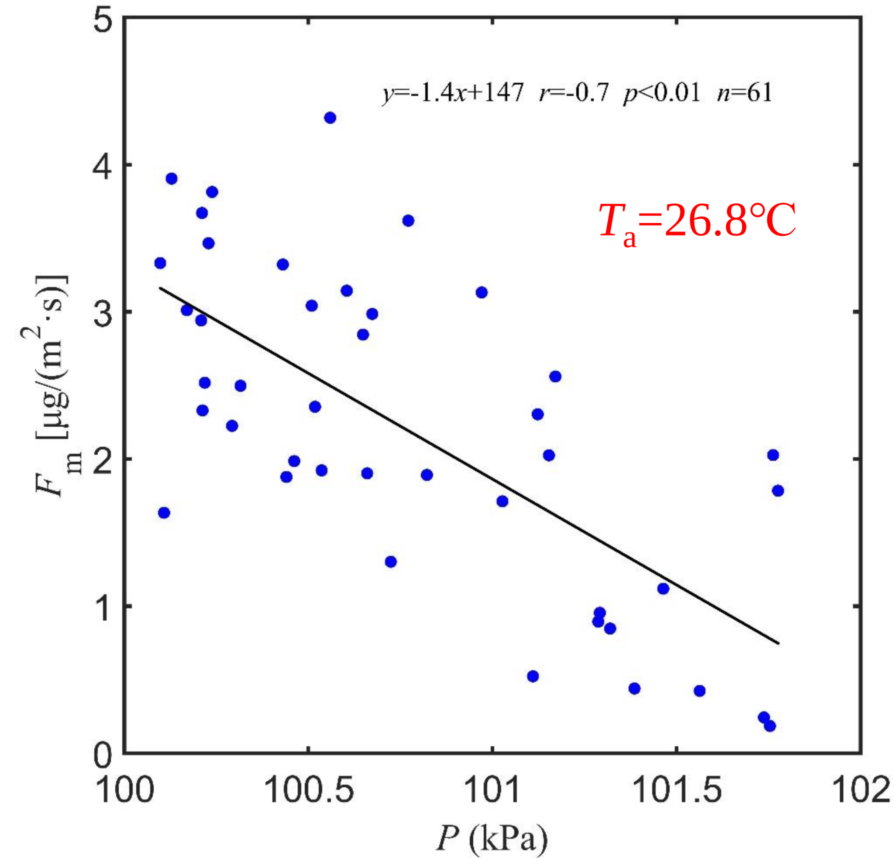






CH_4 flux versus temperature and bin-averaged plot





CH_4 flux versus air pressure and bin-averaged plot

04 Conclusions

- The DTH site is a atmospheric CO_2 sink during observation. CO_2 flux shows obvious diurnal pattern since March.

- Temperature, wind speed and solar radiation have significant correlation with the half-hourly CO_2 flux.

- There is no diurnal cycle of CH_4 flux during observation.

- Temperature and air pressure control CH_4 emission.

05 Future work

- Measure parameters in water quality and sediment every 2 weeks.

- Read more papers about GHG fluxes in lakes and aquaculture water bodies to get new inspiration and ideas.

Thanks for your attention!