北京師範大學
Beijing Normal University
全球变化与地球系统科学研究院
College of Global Change and Earth System Science
GCESS

Monitoring and analysis on blue carbon fluxes in coastal mangrove restoration area in Southern Zhejiang Province, China

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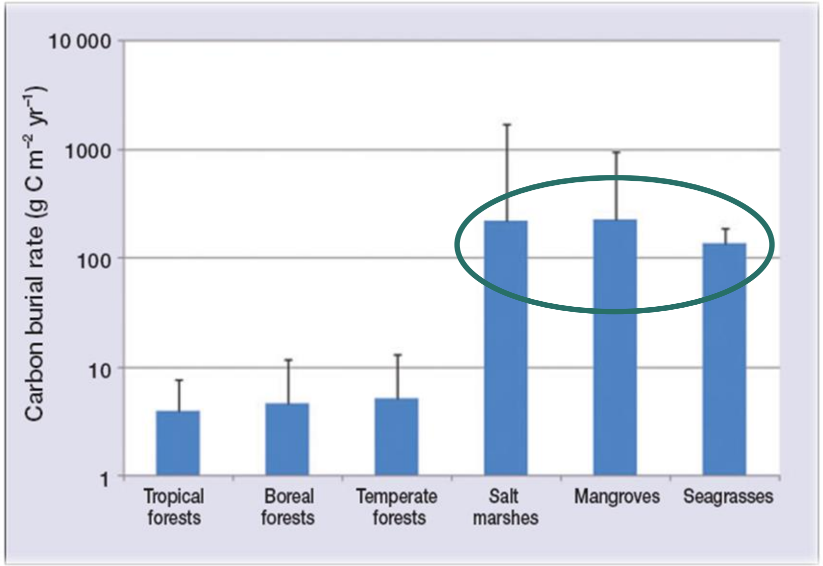
Outlines

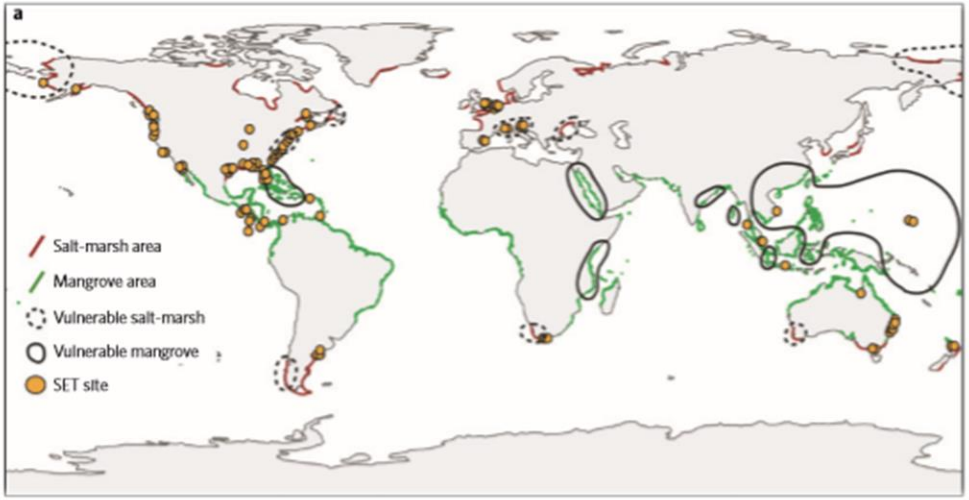
- Research background
- Observation platform
  - EC-LGR-SIF automatic system
  - Aerial photography
  - Monitoring items
- Results and discussion
  - Impact of tide on CH_4/CO_2 fluxes in mangrove ecosystem
  - Impact of vegetation types on CH_4 and CO_2 fluxes
  - Soil organic carbon stock across soil salinity gradient
- Conclusions and implications

Background



Coastal blue carbon plays great role in carbon sink.

- Mangrove forests
- Saltmarsh
- Seaweed bed



(Webb et al., 2013, NCC; Mcleod et al., 2011)

Due to sea level rising, 20% global wetland will disappear by 2080.

- Carbon emission
- Ecological function loss
- Extreme climate
- Relocation and migration

EC-LGR-SIF automatic system

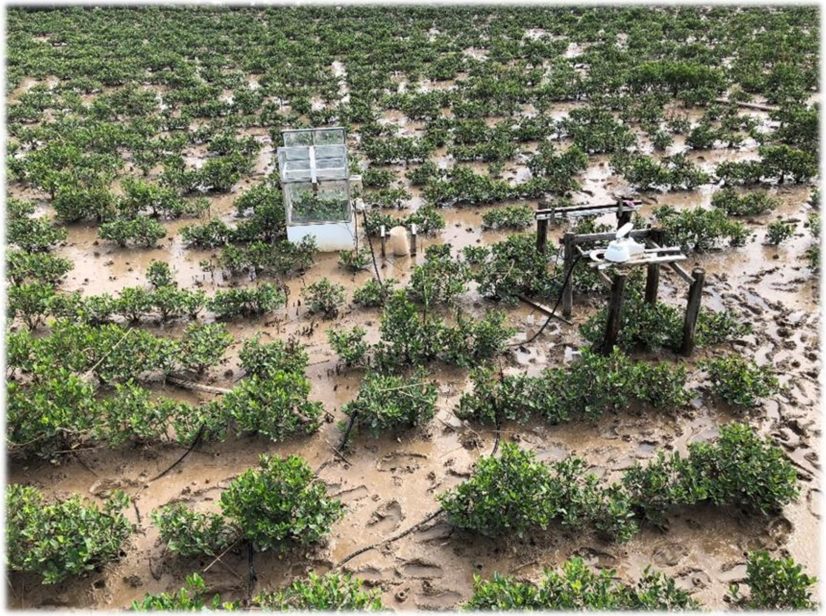
- GHGs: CH_4/CO_2 fluxes
- Duration：2017.6-now
- OTC：NEE/CH_4
- Chamber：Rsoil/CH_4

- SIF observing system
- Duration: 2018.12-now

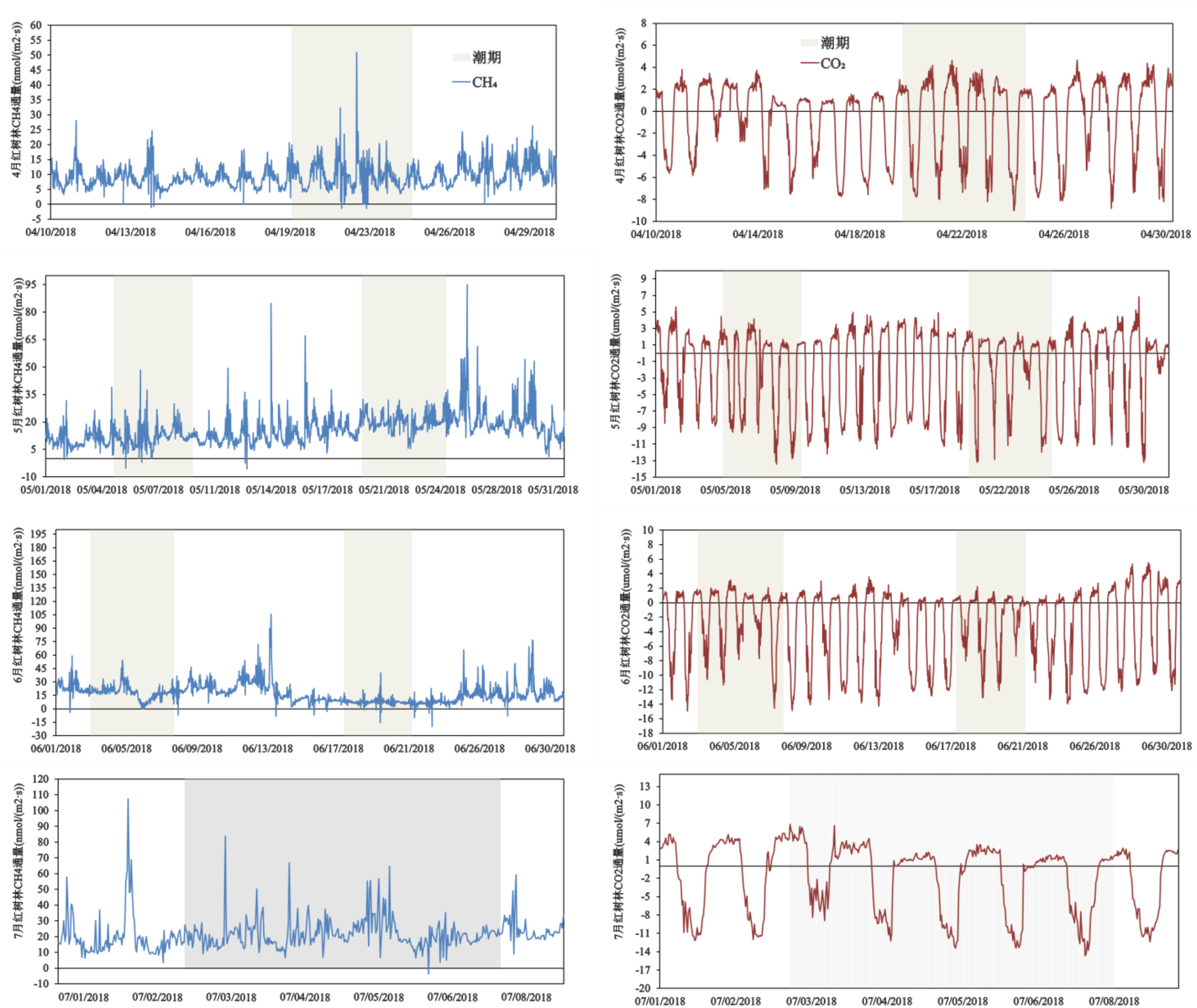
- GHGs: CH_4/CO_2 fluxes
- Duration：2016.6-now

Results and discussion

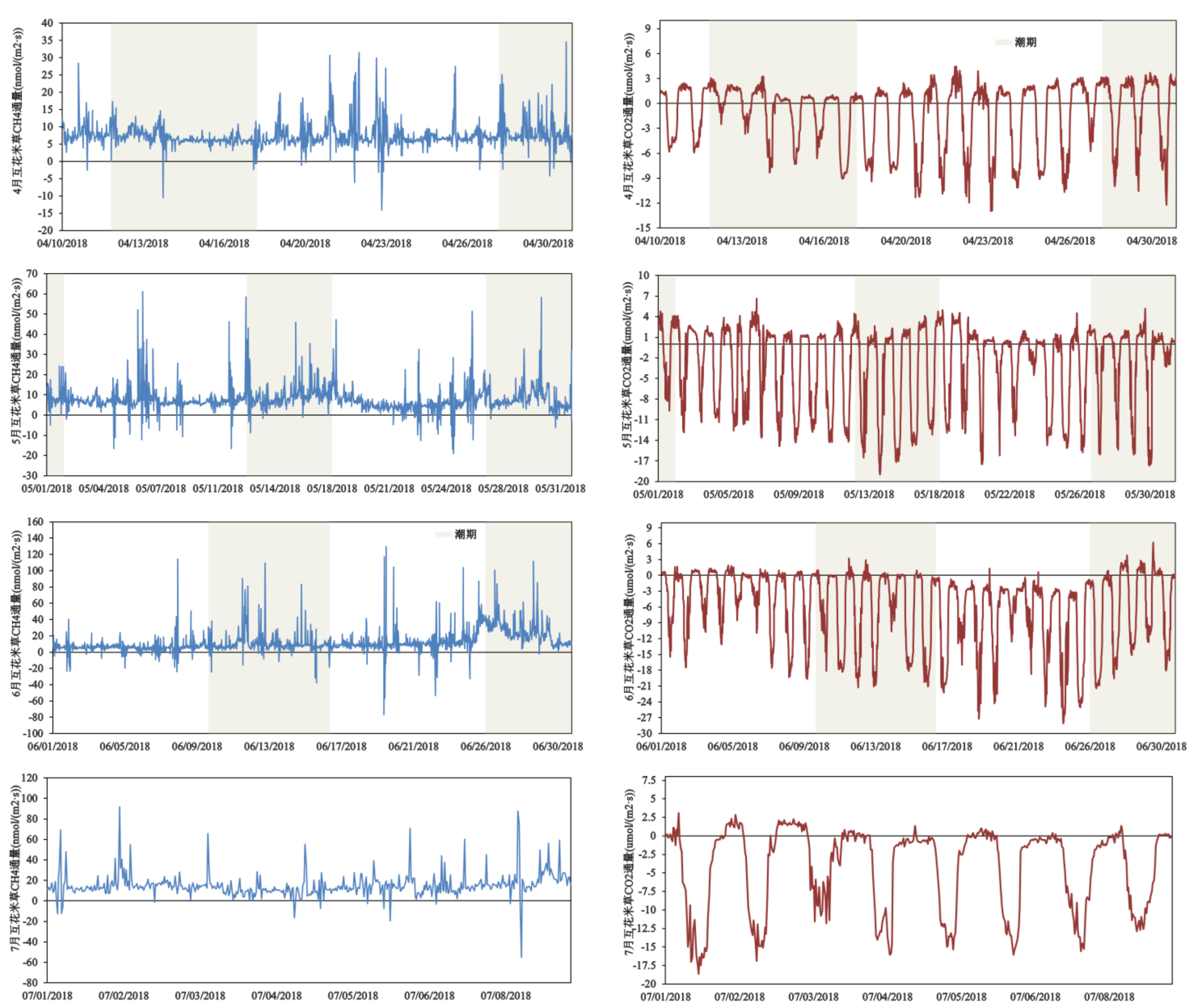
（1） Impact of tide on CH_4/CO_2 fluxes in mangrove ecosystem



Impact of tide on CH4/CO2 fluxes in mangrove ecosystem

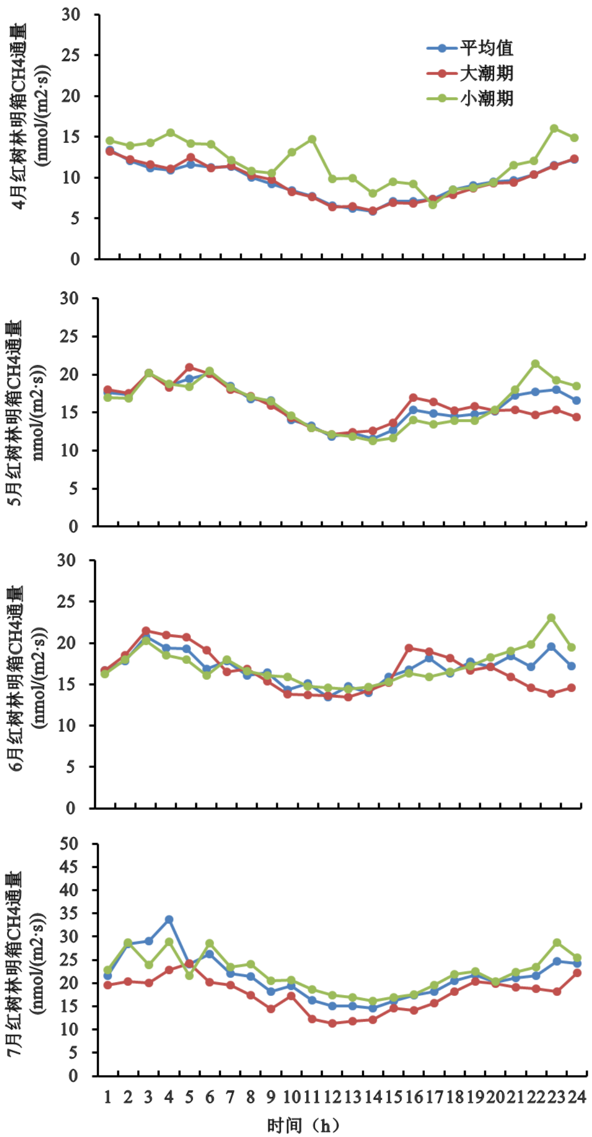


Impact of tide on CH_4/CO_2 fluxes in cordgrass ecosystem

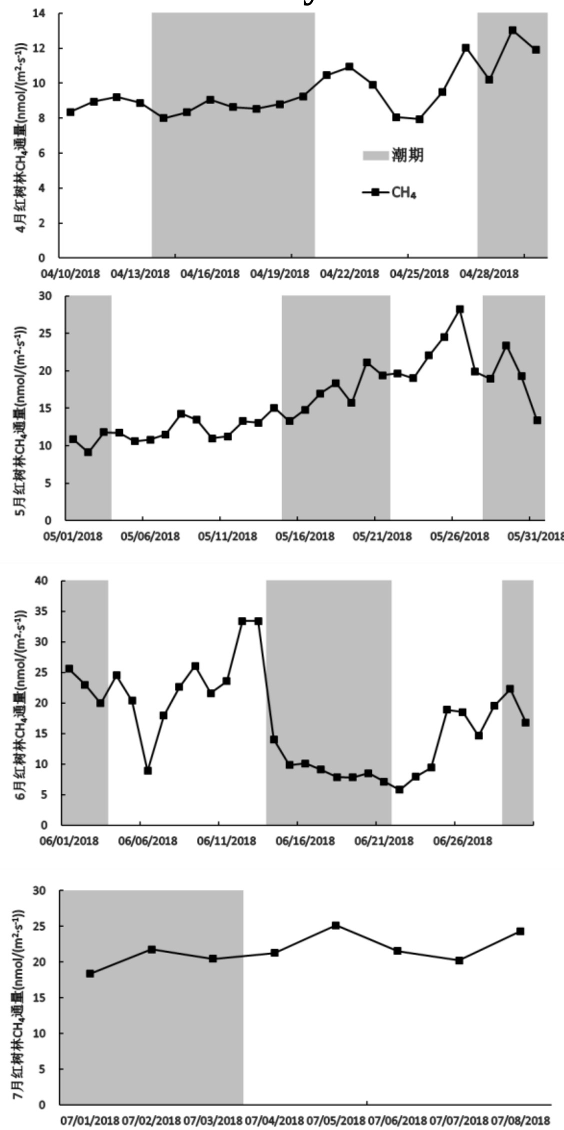


CH_4 fluxes in mangrove from different time scales

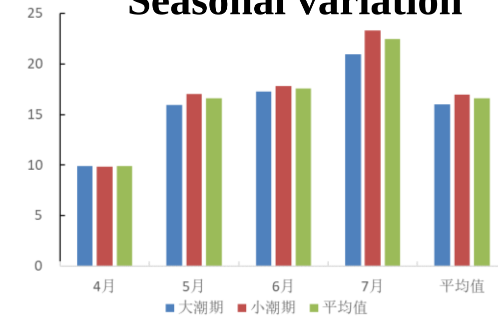
Diurnal variation



Monthly variation



Seasonal variation

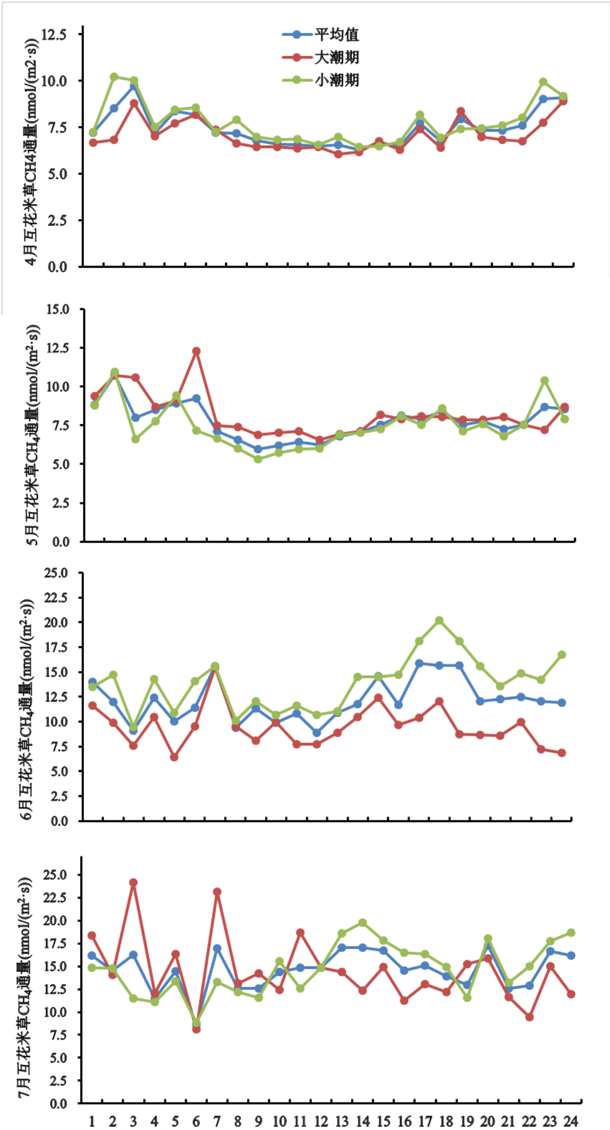


- **Spring tide: CH_4 decreasing**
- **Neap tide: CH_4 increasing**
- **Mean Flux: 16.6 mg C m^{-2} d^{-1}**

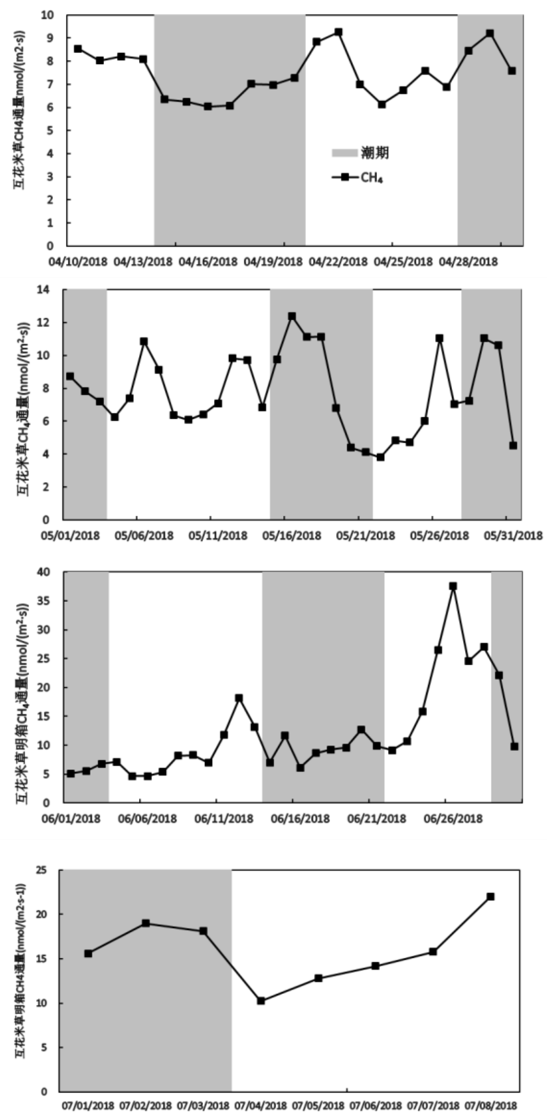
Neap > Spring

CH_4 fluxes in cordgrass from different time scales

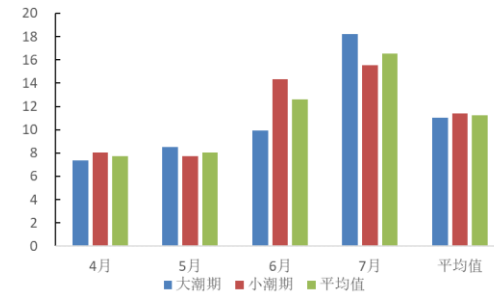
Diurnal variation



Monthly variation



Seasonal variation



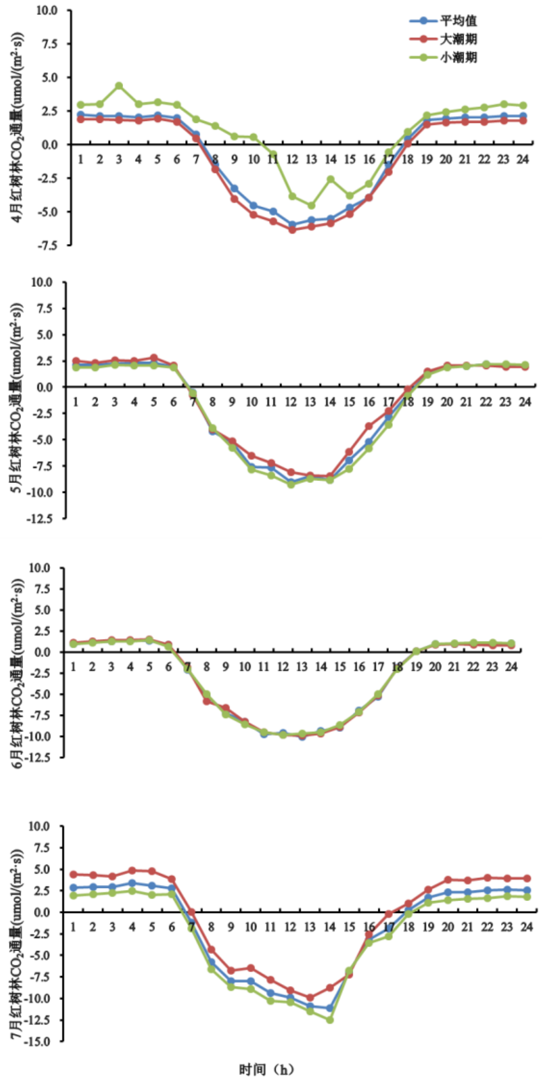
- **Spring tide: CH_4 decreasing**
- **Neap tide: CH_4 increasing**
- **Mean Flux: 11.2 mg C m^{-2} d^{-1}**

Neap > Spring

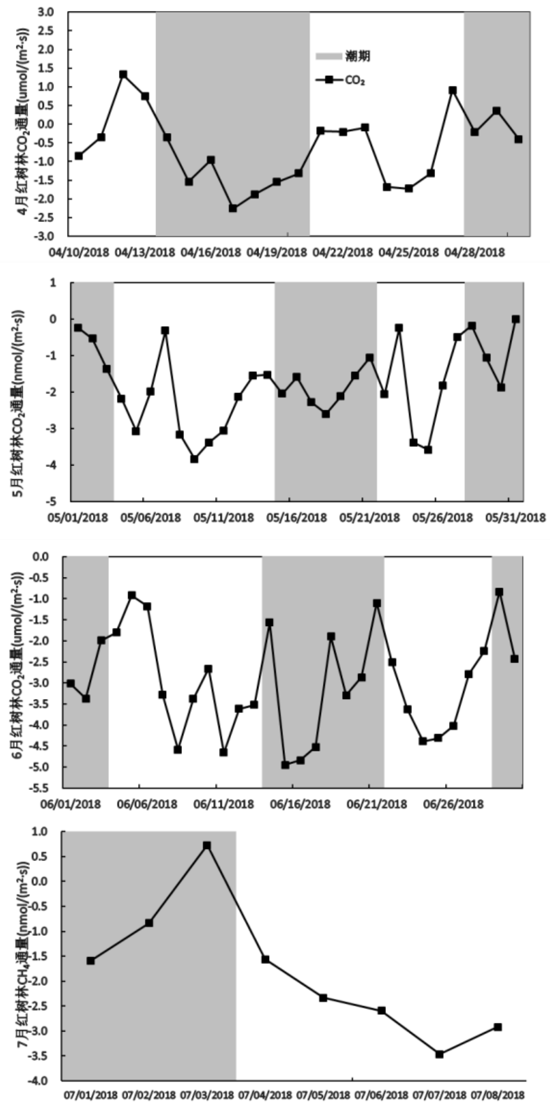
Cordgrass<Mangrove

CO_2 fluxes in mangrove from different time scales

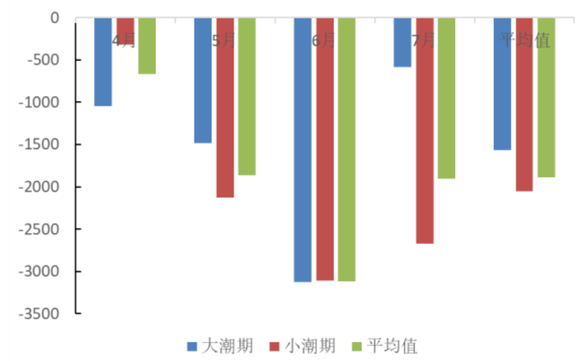
Diurnal variation



Monthly variation



Seasonal variation

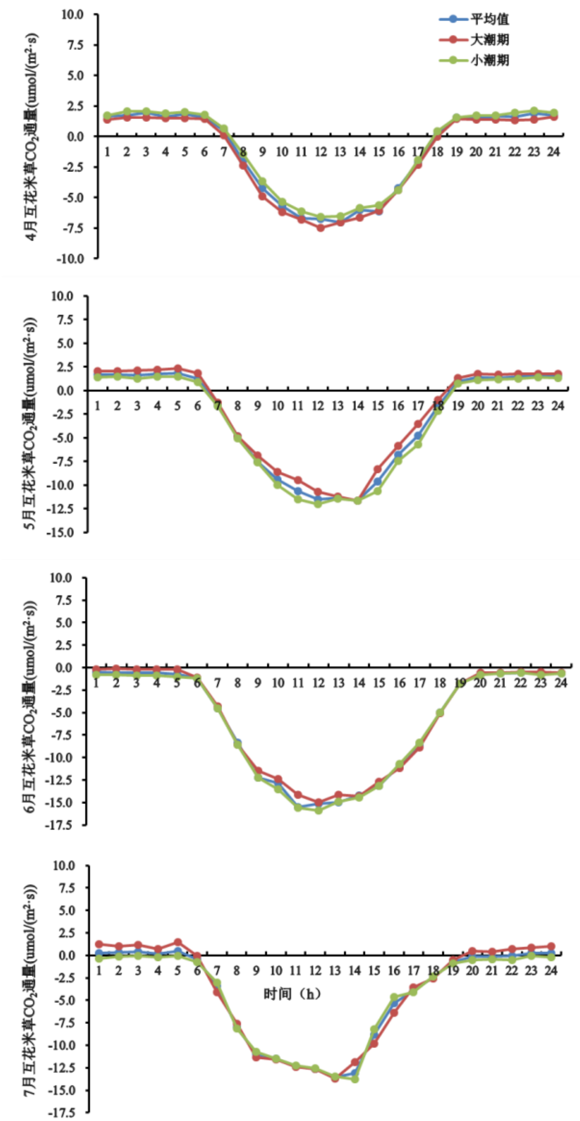


- Spring tide: CO_2 decreasing
- Neap tide: CO_2 increasing
- Mean NEE: -1888 mg C m^{-2} d^{-1}

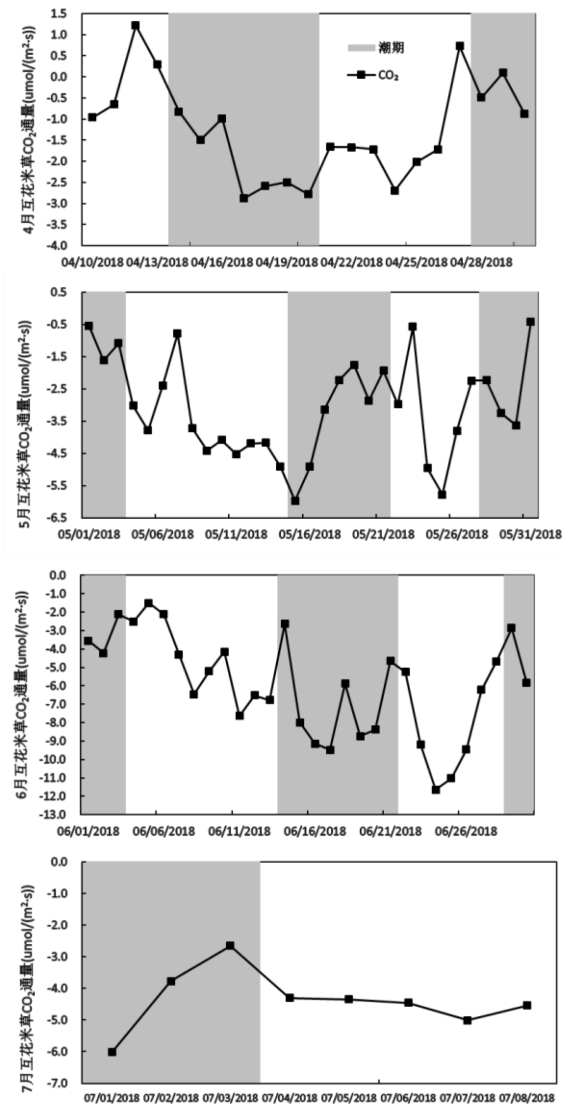
Sink：Neap > Spring

CO_2 fluxes in cordgrass from different time scales

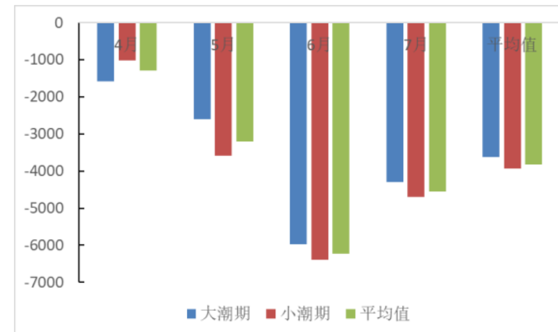
Diurnal variation



Monthly variation



Seasonal variation

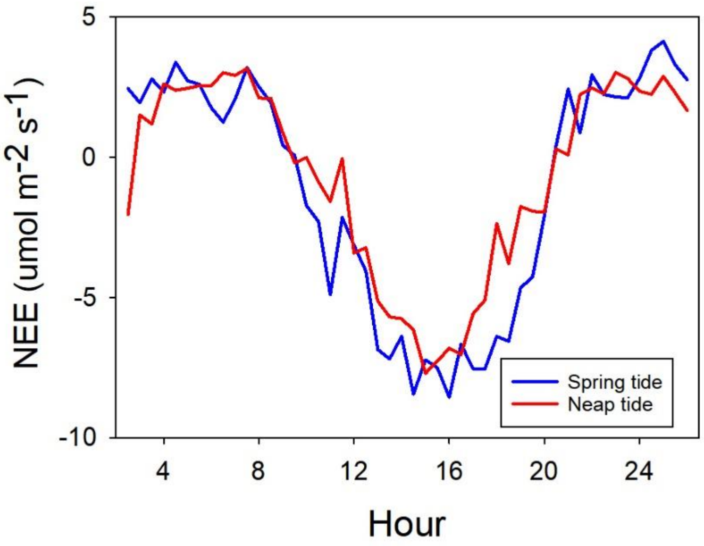


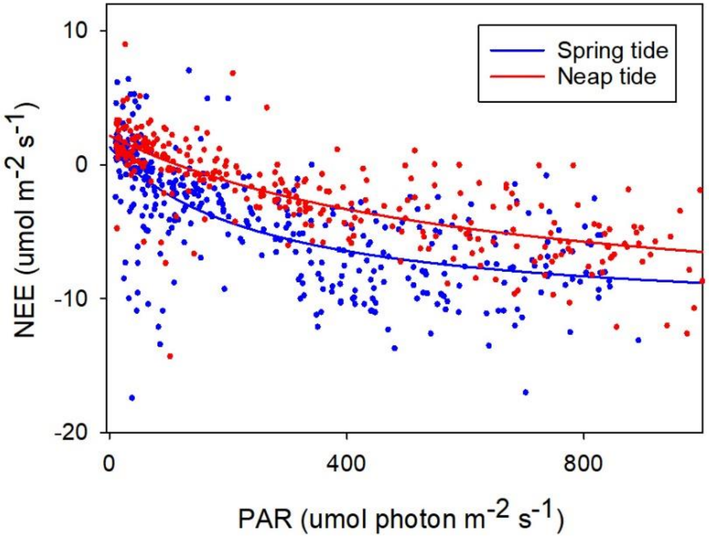
- Spring: CO_2 decreasing
- Neap: CO_2 increasing
- Mean NEE: -3818 mg C m^{-2} d^{-1}

Sink：Neap > Spring

Cordgrass > Mangrove

EC based NEE variations and the response to par





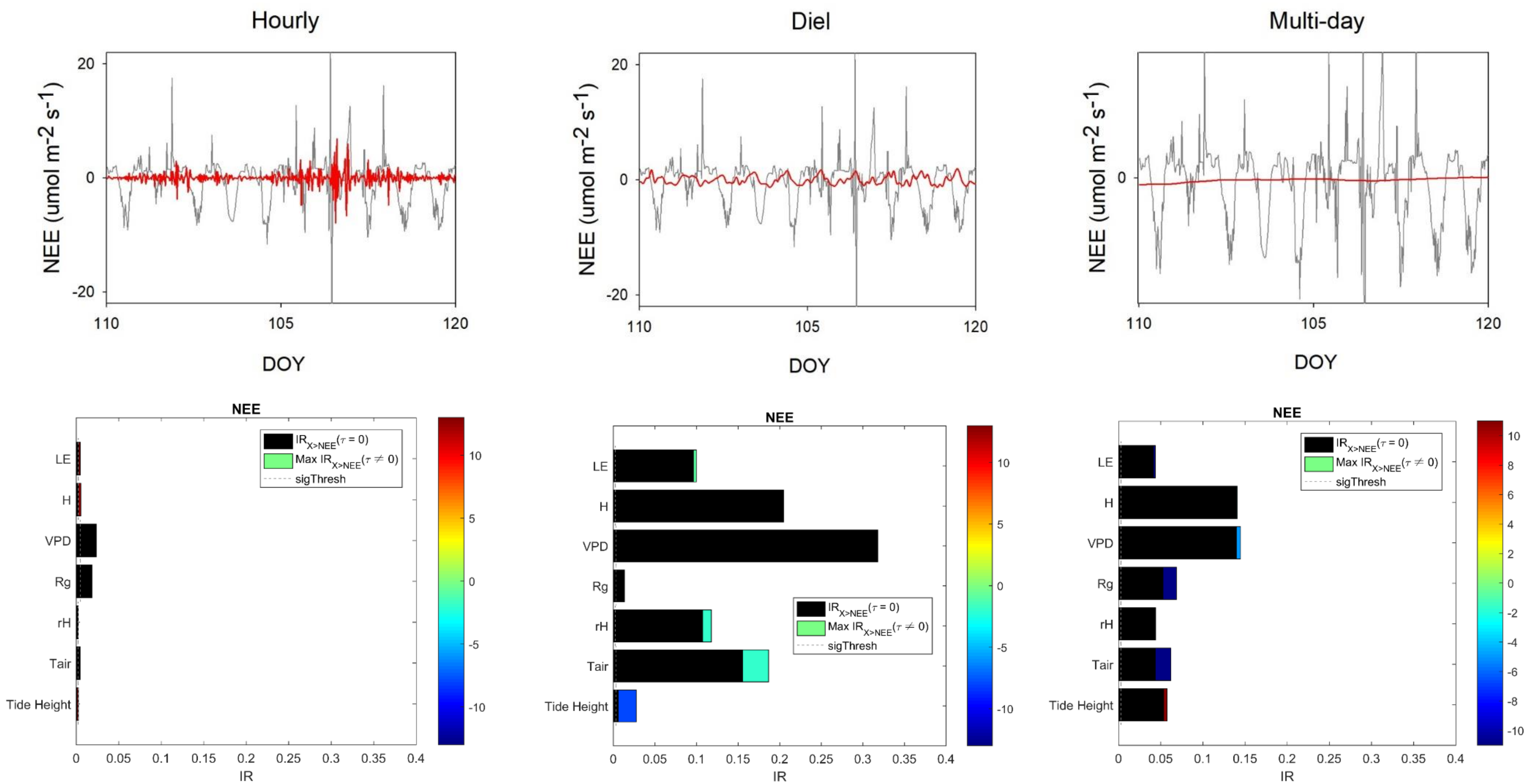
- **At night, spring tide, Rsoil relatively high.**
- **During day time，spring tide>neap tide.**

$$\mathrm{NEE} = -\frac{A_{max}\alpha \mathrm{PAR}}{A_{max} + \alpha \mathrm{PAR}} + R_{eco}$$

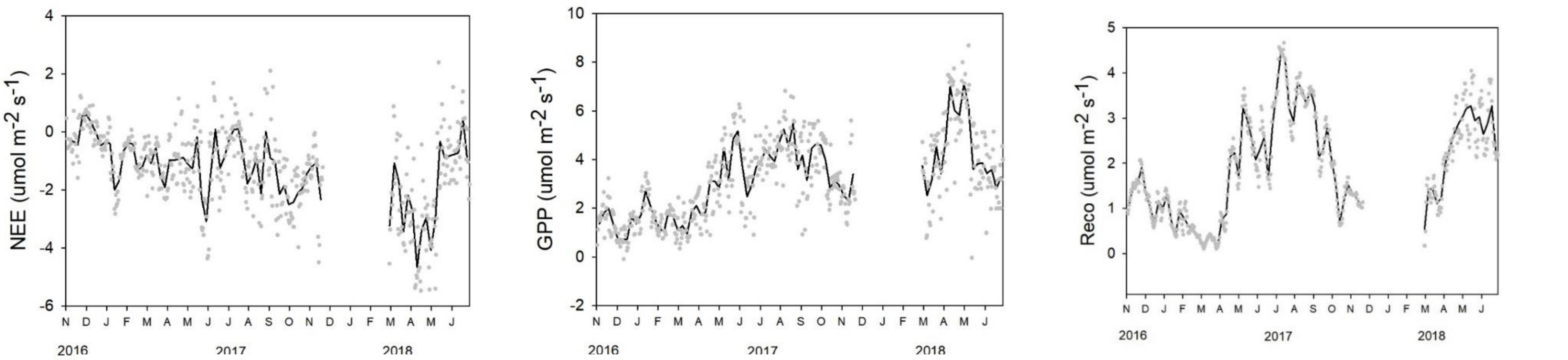
Amax: light-saturated net CO_2 exchange;
a: apparent quantum yield

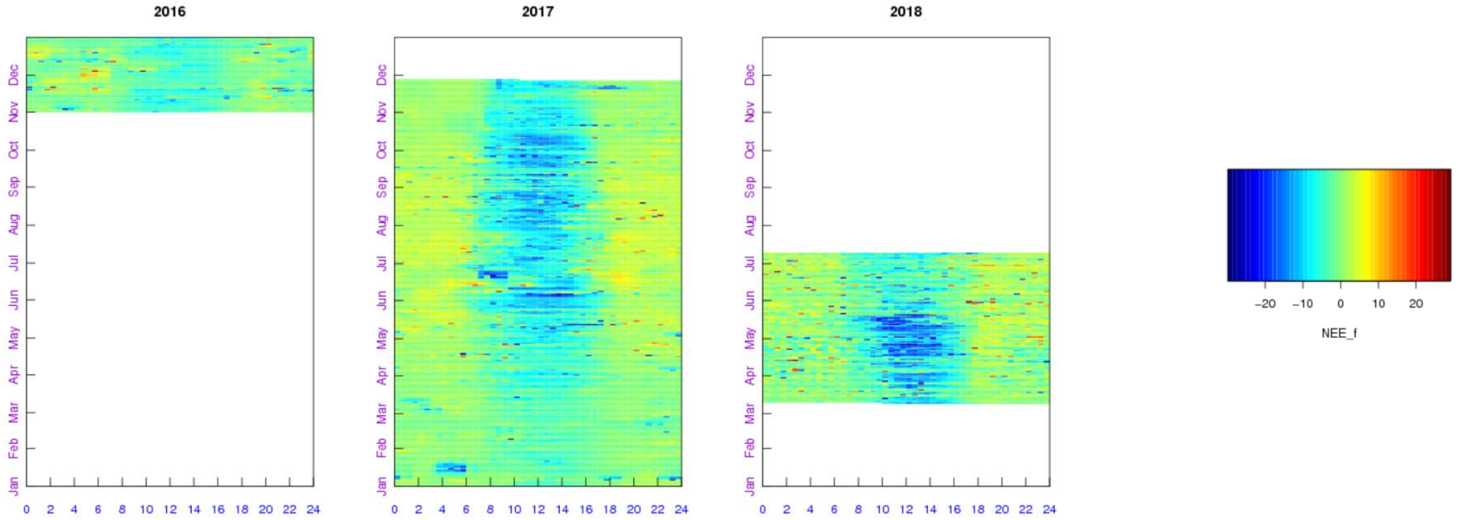
- **Amax: Spring tide（14.17）>neap tide (12.77).**
- **a: Spring tide（0.03）< neap tide (0.04).**

NEE variation and the impact factors



NEE, GPP, and Reco during 2016-2018



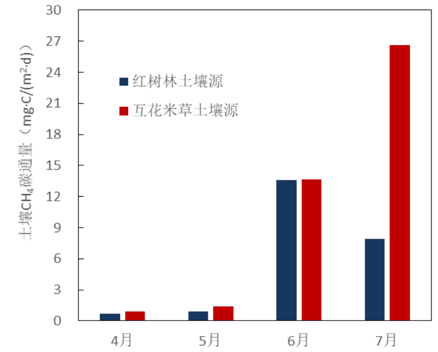


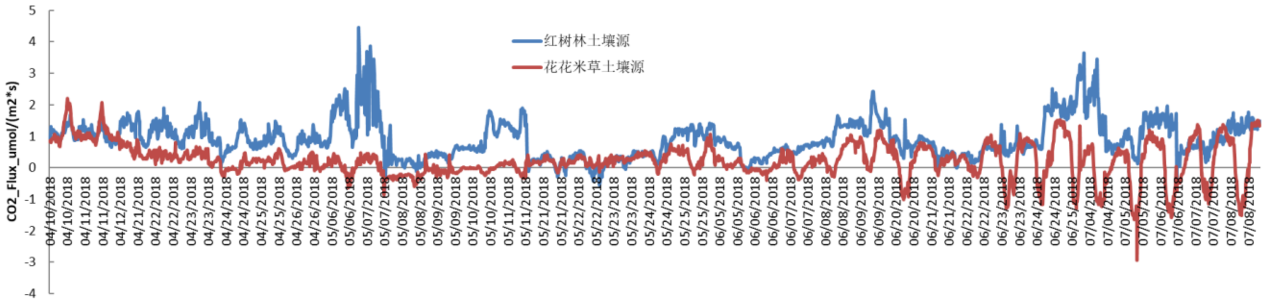
- **During 2016-2018, GPP, Reco, and NEE showed similar tendency with the annual carbon sink of 441.65 g C m^{-2} .**
- **NEE fluxes fluctuated at -16-4 umol m^{-2} s^{-1}, in agreement with LGR results.**

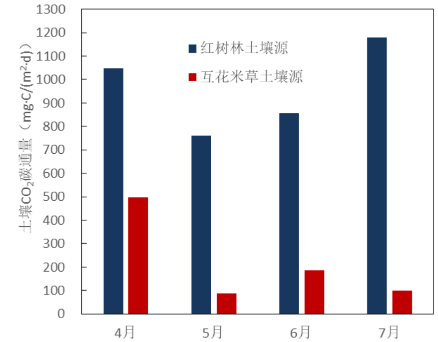
Results and discussion

(2) Impact of mangrove and cordgrass on CH_4 and CO_2 fluxes

CH_4 and CO_2 fluxes from soil sources

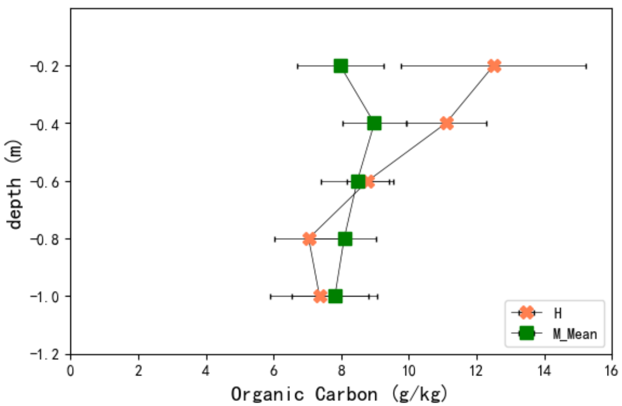


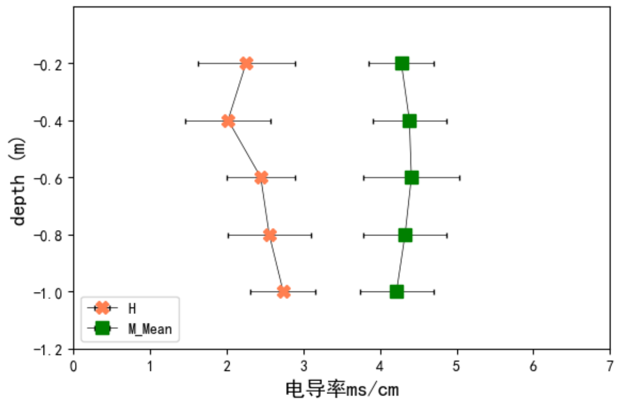


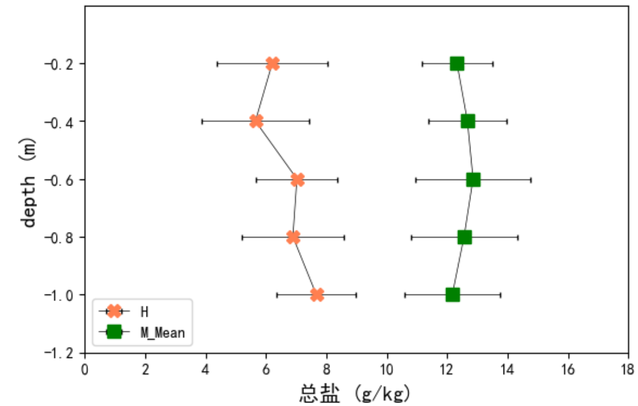


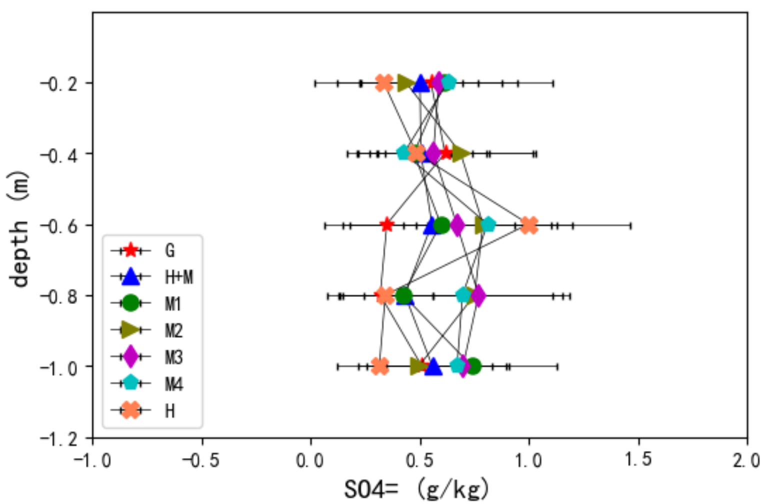
- **Both mangrove and cordgrass were the sources of CH_4 and CO_2 emissions.**
- **Soil CH_4 emissions: Cordgrass (0.88-13.6 mg $C/(m^2 \cdot d)$) > Mangrove (0.66-11.6 mg $C/(m^2 \cdot d)$).**
- **Soil CO_2 emissions: Cordgrass (86-497 mg $C/(m^2 \cdot d)$) < Mangrove (761-1049 mg $C/(m^2 \cdot d)$).**
- **GWP: Mangrove CO2-eq 529 g m^{-2} > Cordgrass 407 g CO2-eq m^{-2}.**
- **Much higher carbon sink potential would be found when the mangrove forests ages was old.**

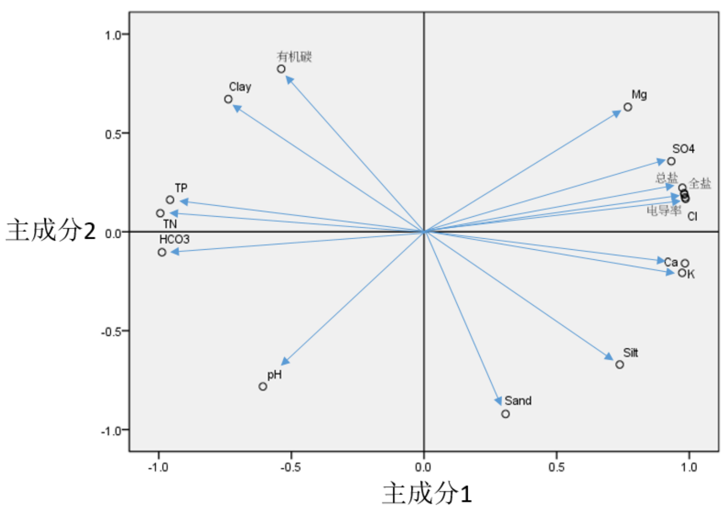
Impact factors of CH_4 and CO_2 fluxes from soil sources



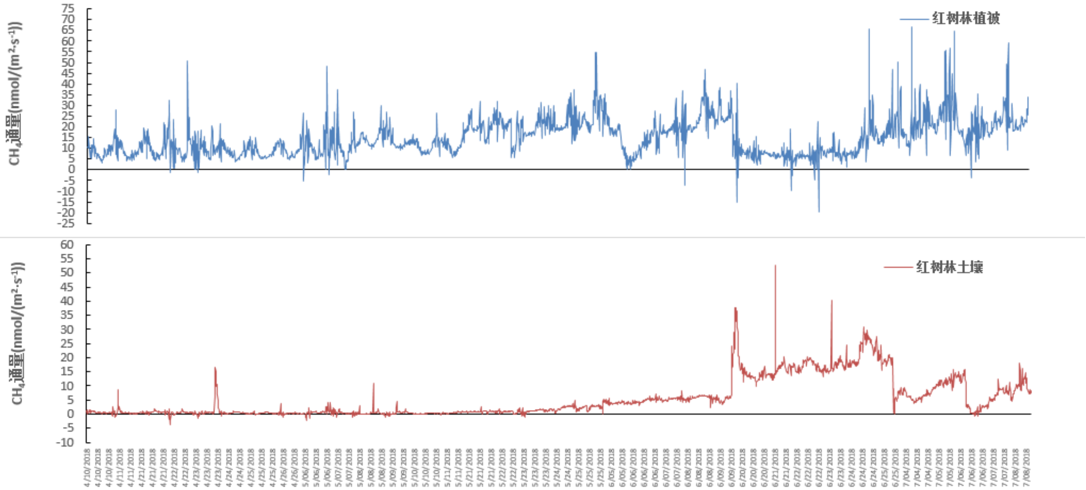


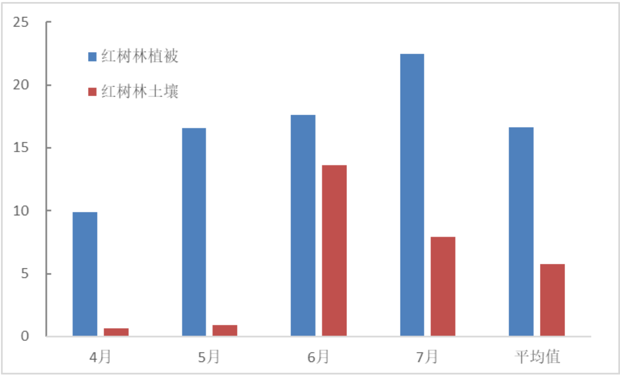






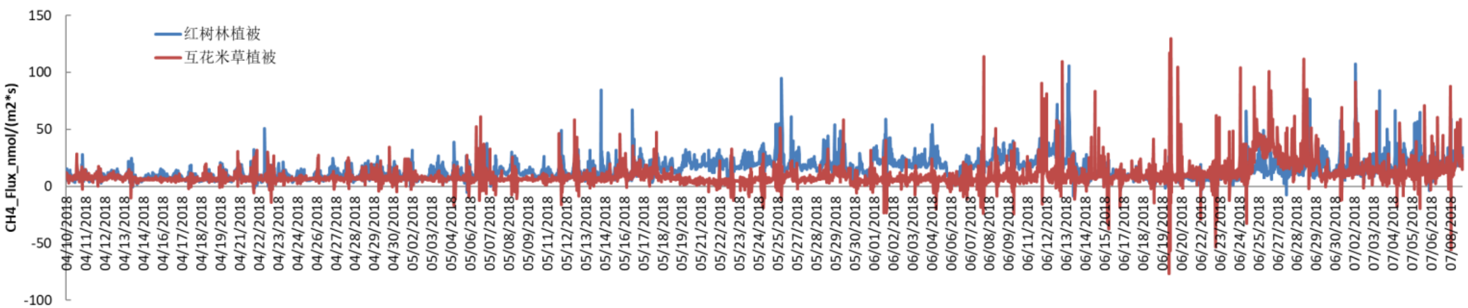
Mangrove forests promoted CH_4 fluxes

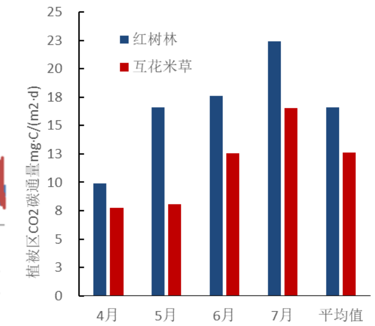


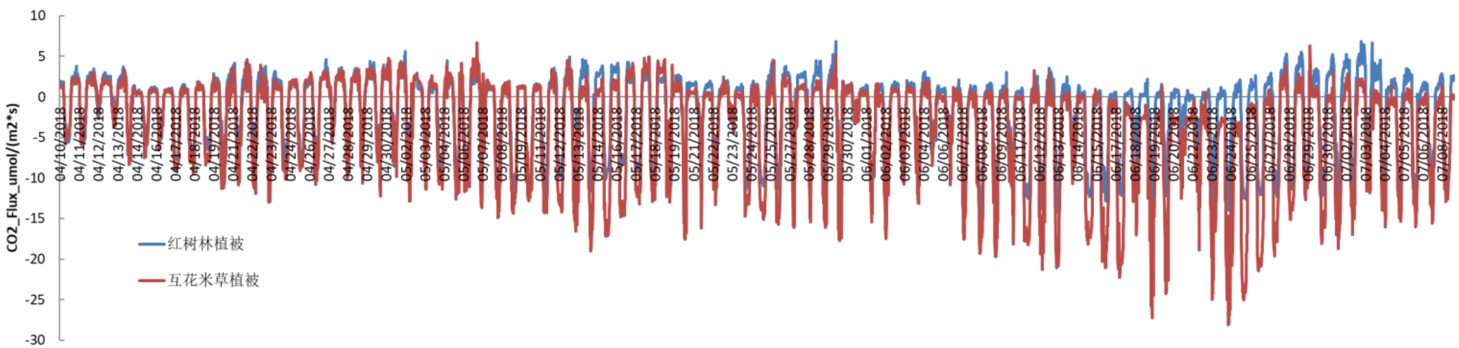


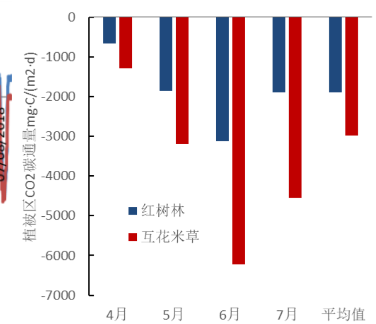
- **Compared with CH_4 fluxes in mangrove soil (0.66-13.6mg C m^{-2} d^{-1}), mangrove forests significantly promoted CH_4 fluxes (9.9-22.4mg C m^{-2} d^{-1}) by 3-18 times.**
- **About 60% CH_4 emitted via mangrove vegetation.**

Vegetation-soil CH_4 and CO_2 fluxes







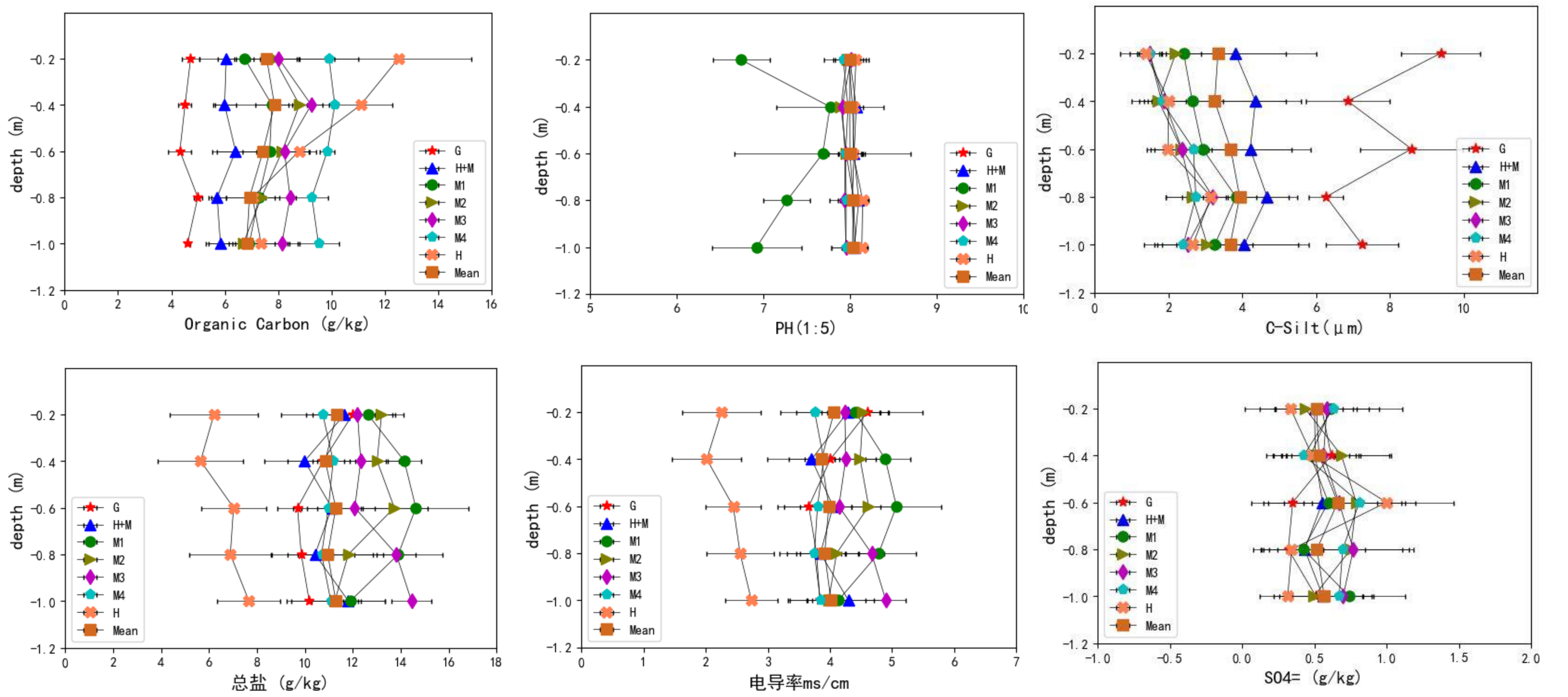


- **Both mangrove and cordgrass were the sources of CH_4 (16.6-22.4; 8.0-16.5 mg C/(m^2 d)) and the sinks of CO_2 (1866-3117; 3202-6227 mg C/(m^2 d)).**
- 红树林和互花米草覆被区均为大气和，互花米草土壤CH_4的释放量低于红树林土壤、CO_2吸收量高于红树林。
- 互花米草覆被区CH_4排放量较低、CO_2碳汇功能较大，可能由于红树林的树龄较小（4-5年）而互花米草长势迅猛，是造成植被覆盖区气体排放通量差异的主要因素

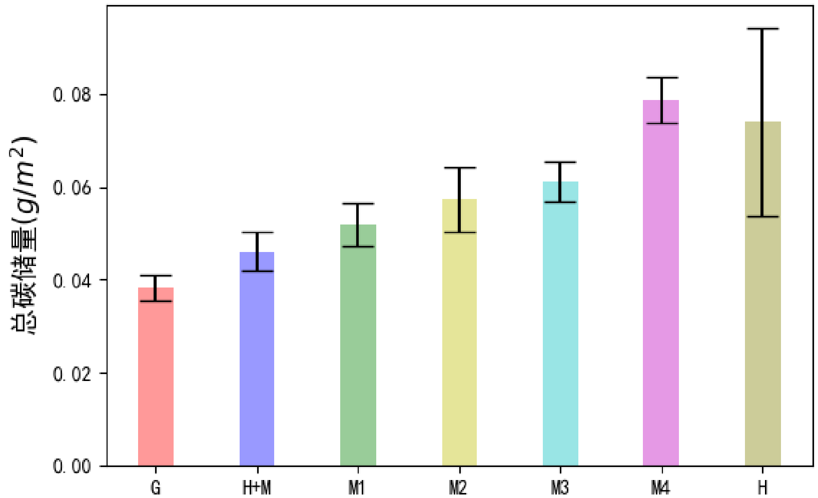
Results and discussion

(3) Soil organic carbon stock across soil moisture and salinity gradient

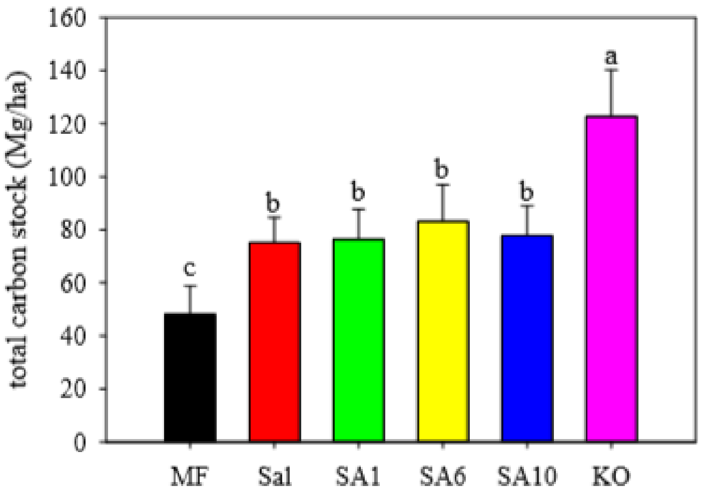
Soil properties across soil moisture and salinity gradient



Soil organic carbon stock



In this study



(Feng et al., 2019)

- Soil organic carbon stock increased across soil moisture and salinity gradient with the mean values of 40-80 Mg/ha.

Conclusions and implications

- EC-LGR-SIF automatic monitoring system supplies an important platform to analyze the carbon sink potential of mangrove forests in coastal zone.
- Spring and neap tides play great role in controlling CH_4 and CO_2 emissions from blue carbon ecosystems. From large scale, the carbon sink potential was high during the spring tide period since the response of NEE to PAR was significant. From point scale, high carbon sink potential occurred during neap tide period. The soil moisture and properties cause the difference in this study.
- Both mangrove and cordgrass were the sources of CH_4 and the sinks of CO_2. The mangrove promoted CH_4 emissions, while the cordgrass increased the carbon sink potential. As the increasing of mangrove forests age, high carbon sink potential might be found with long-term observation in this study area. Lateral carbon cycling is necessary to calculate the carbon budget of mangrove restoration regions.

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