

# Carbon Dioxide Flux over a Large Ephemeral Lake in China

Xiaosong Zhao<sup>1</sup>, Yuanbo Liu<sup>1</sup>, Timothy J. Griffis<sup>2</sup>, Ke Xiao<sup>2</sup>

<sup>1</sup>Nanjing Institute of Geography and Limnology, CAS, Nanjing, China

<sup>2</sup>University of Minnesota, Twin Cities, Saint Paul, MN, USA

xszhao@niglas.ac.cn



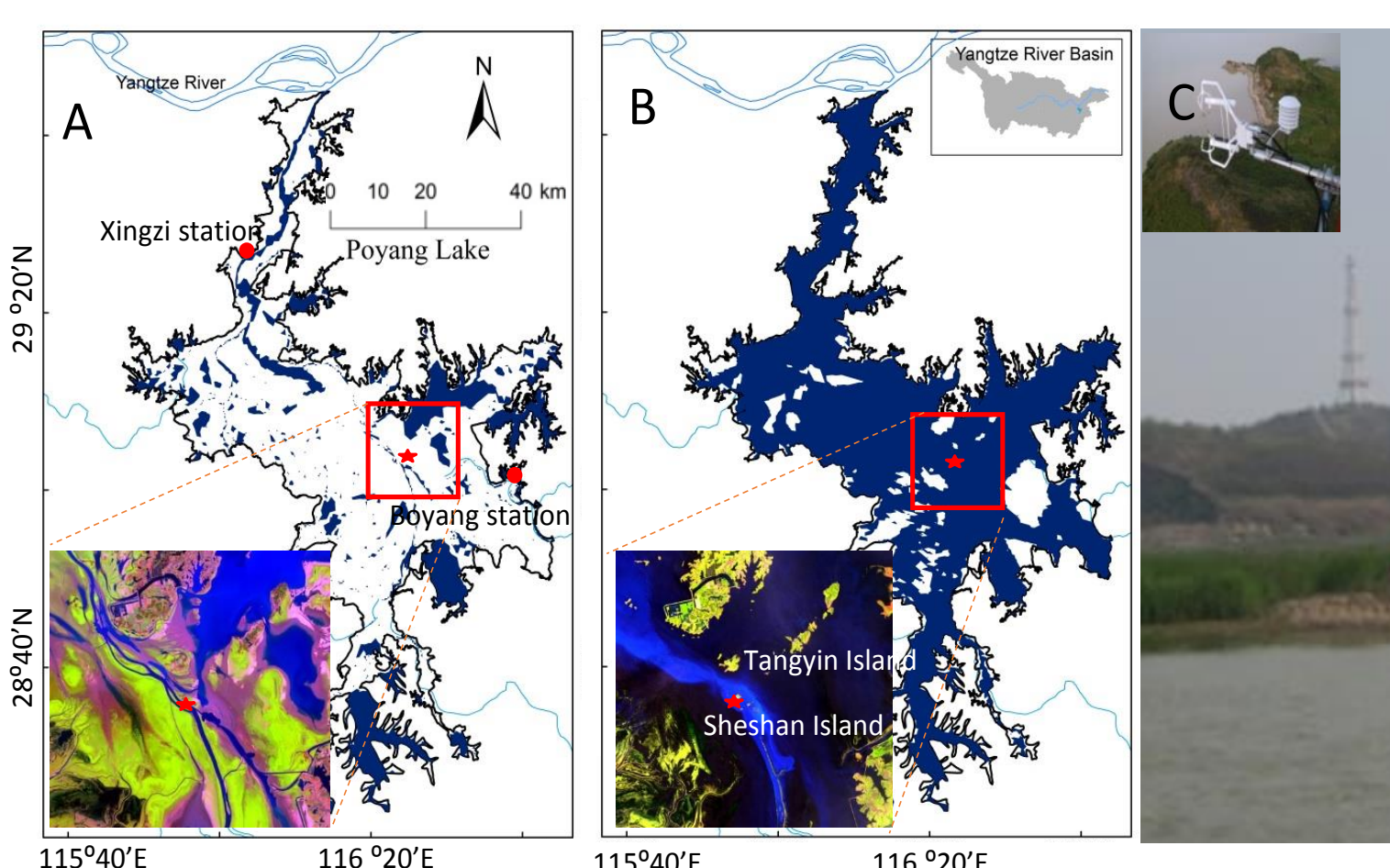
## Highlights

- Water carbon emission was underestimated by 25% when ignoring the change in lake size.
- Poyang Lake act carbon sink in drought year, while carbon source in normal and wet year.

## 1. Introduction

In land water are an important component of the global cycle. CO<sub>2</sub> flux (F<sub>c</sub>) in inland water is related to water body size, depth and water environmental factors. Ephemeral lake, like Poyang Lake, undergo seasonal changes in water area. So if ignoring the water area changes, it will bring a large error in carbon flux estimation over an ephemeral lake.

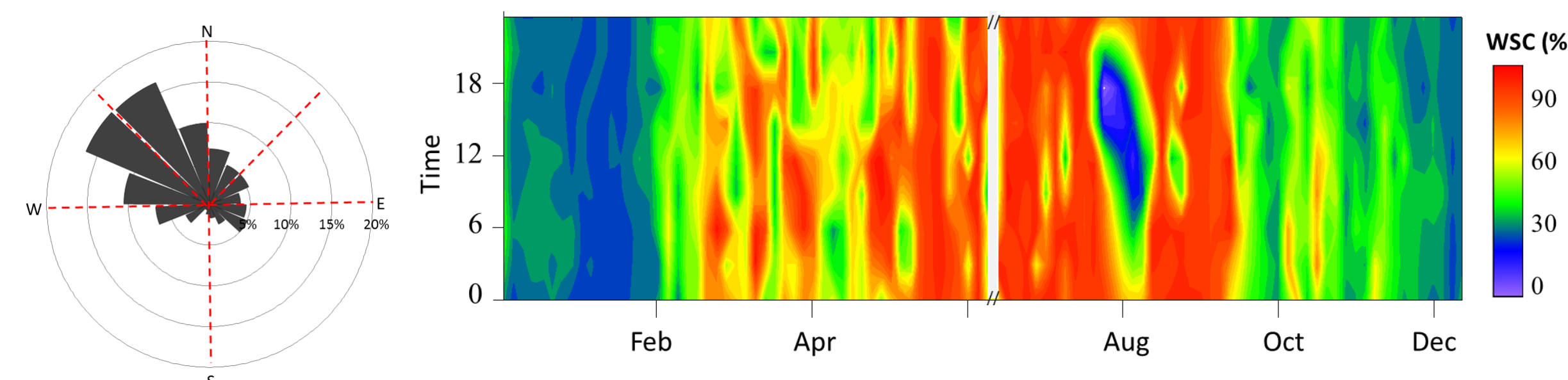
## 2. Eddy Covariance Measurements



(A) Map of Poyang Lake and inundated area during the dry season, and (B) during the flooding seasons; (C) location of the EC system

The water area of Poyang Lake shrink to <1000 km<sup>2</sup> during dry seasons and expand to >3000 km<sup>2</sup> during flooding seasons. The fluxes were measured by EC from August 2013 to July 2016.

## 3. Footprint Analysis



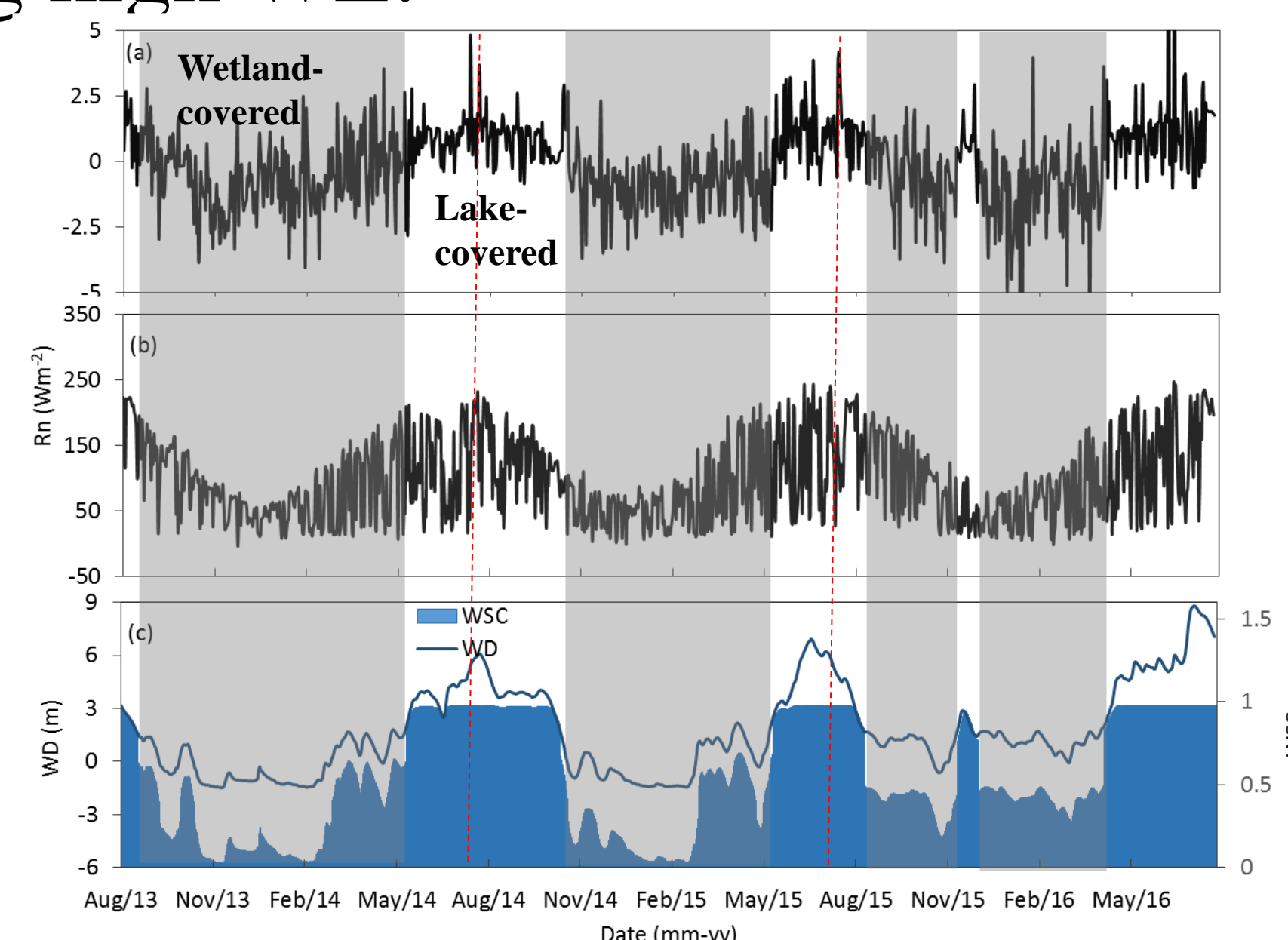
The footprint analysis shows the water surface contribution (WSC) varies in diurnally and seasonally with wind direction, stable condition.

## 4. Model description

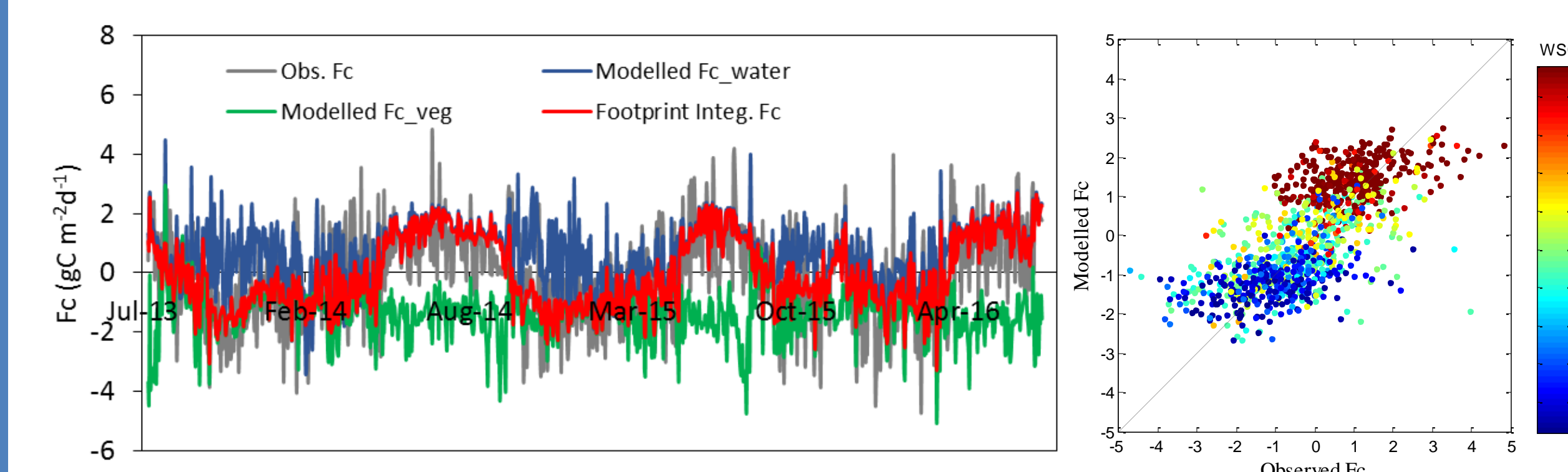
Artificial Neural Network (ANN) model was used to estimate daily F<sub>c</sub> over lake. The input variables are WSC, water depth (WD), NDVI, air temperature (T<sub>a</sub>), wind speed (U), net radiation (R<sub>n</sub>) etc. The water flux (F<sub>c\_water</sub>) and vegetation flux (F<sub>c\_veg</sub>) were separated.

## 5. Seasonal variations in carbon flux

F<sub>c</sub> patterns are related to the WSC. Carbon uptake during low WL, while carbon release during high WL.



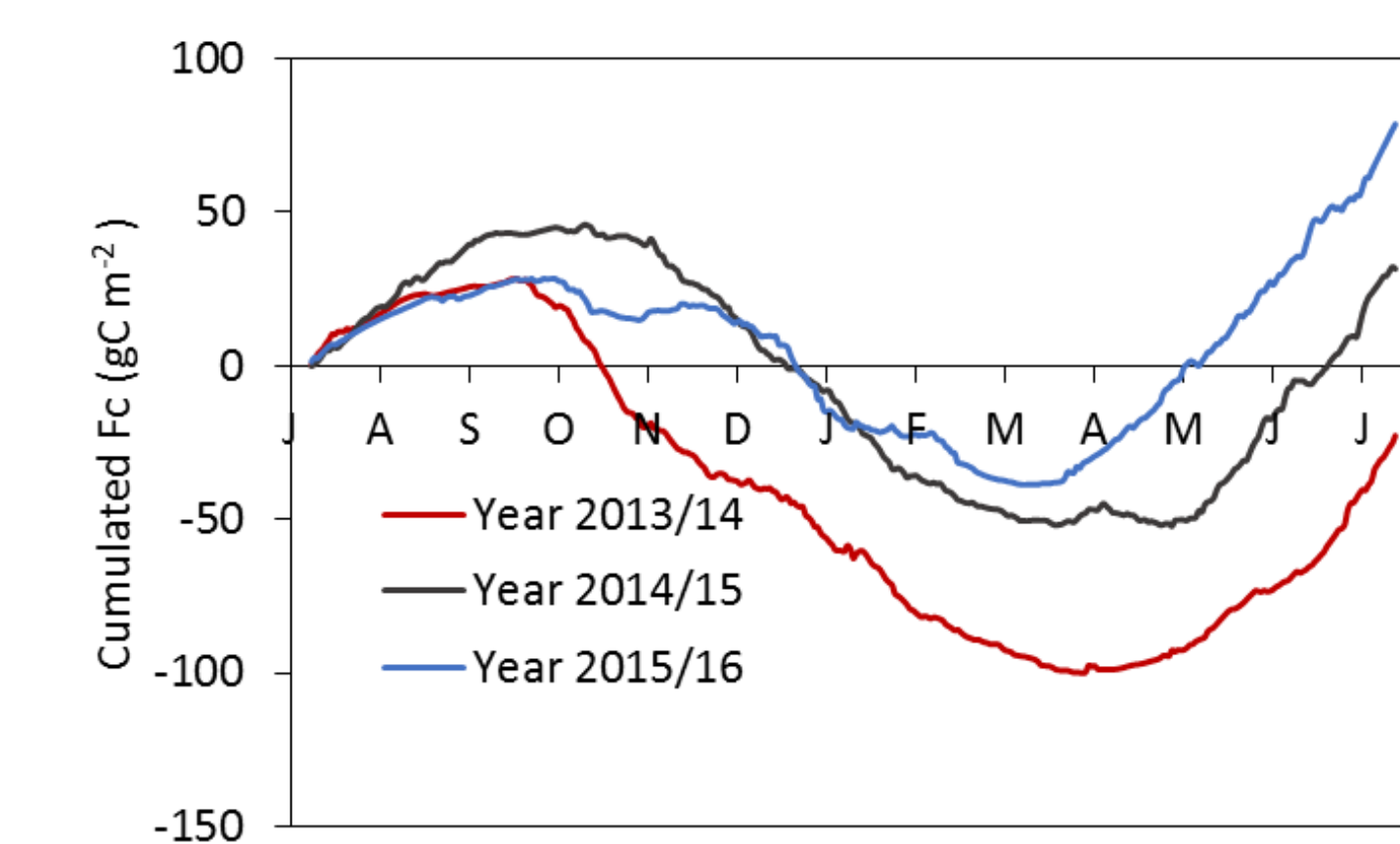
## 7. Model performance



ANN model shows good performance in F<sub>c</sub> estimation. The correlation coefficient (R<sup>2</sup>) between the observation and estimation is 0.68.

## 8. Annual Carbon dioxide exchange

Year	WL (m)	Water area (km <sup>2</sup> )	T <sub>a</sub> (°C)	F <sub>c</sub> (gCm <sup>-2</sup> )	F <sub>c_Water</sub> (gCm <sup>-2</sup> )	F <sub>c_Veg</sub> (gCm <sup>-2</sup> )
2013/14	11.6	1800	18.4	-23	141	-164
2014/15	13.1	2204	18.2	31	166	-135
2015/16	14.2	2433	18.1	80	207	-127



The annual F<sub>c</sub> over Poyang Lake ranges from -23 to 80 gCm<sup>-2</sup>, which act as net carbon sink in dry year, and carbon source in wet year.

In global carbon estimation for inland water, the size of Poyang Lake was set as a constant of 2100 km<sup>2</sup>, which will cause the underestimation of carbon emission by 25%.