Changes in Carbon Dioxide Concentration and Flux Over a Large Southern Inland Water Body

[1]Justin Bonds, [2]Raleigh Grysko, [2]Zhongming Gao, [2]Heping Liu

[1]Jackson State University Department of Physics, Atmospheric Sciences & Geoscience

[2]Washington State University Laboratory for Atmospheric Research

Introduction

Inland lakes and reservoirs are major contributors to the global carbon cycle. It is important to understand how much carbon they emit as well as any significant changes in carbon emissions. Eddy covariance flux tower located in the Ross Barnett Reservoir (RBR) in Ridgeland, MS was used to measure carbon dioxide (CO_2) concentrations, CO_2 fluxes, and components of the surface energy budget.

Table 1: Instruments at the tower site

Instrument Name	Instrument Heights (m)
CSAT3 3-D sonic anemometer	2.8
LI-7500 CO_2/H_2O IR gas analyzer	2.8
CRN 2 net radiometer	1.5
HMP45C Temperature & RH Probe	1.2, 2.4, 2.8, 3.5, 4.7
IRR-P Water skin Temperature sensor	1.5

Objectives

- Understand CO_2 diurnal patterns and determine what factors influence concentrations.
- Determine if seasonal change in weather variables impacts CO_2 concentration and flux.

Methods

Data that the RBR flux tower had collected in 2008 were analyzed from June 4th to June 18th, Nov. 18th to Nov. 24th, and Dec 1st to Dec. 7th. An LI-7500 infrared open-path gas analyzer measured CO_2 concentrations and flux. 30 minute averages of CO_2 concentrations were compared with flux data and other meteorological variables, including temperature, net radiation, water surface temperature and wind speed. A CR5000 data logger was used to store data from the tower.

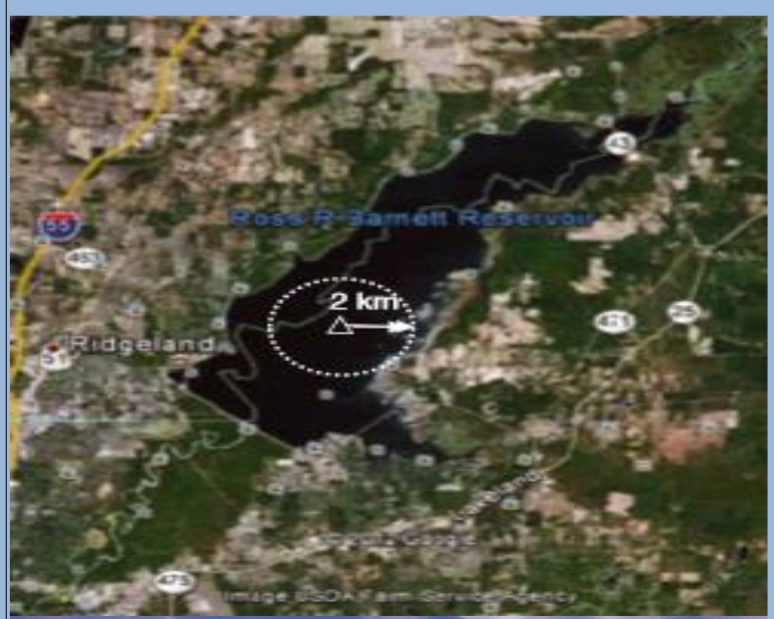

Figure 1: Aerial View of Ross Barnett Reservoir and the Flux Tower Site

Figure 2: The RBR eddy covariance flux tower located roughly 2 km from reservoir shore

Results

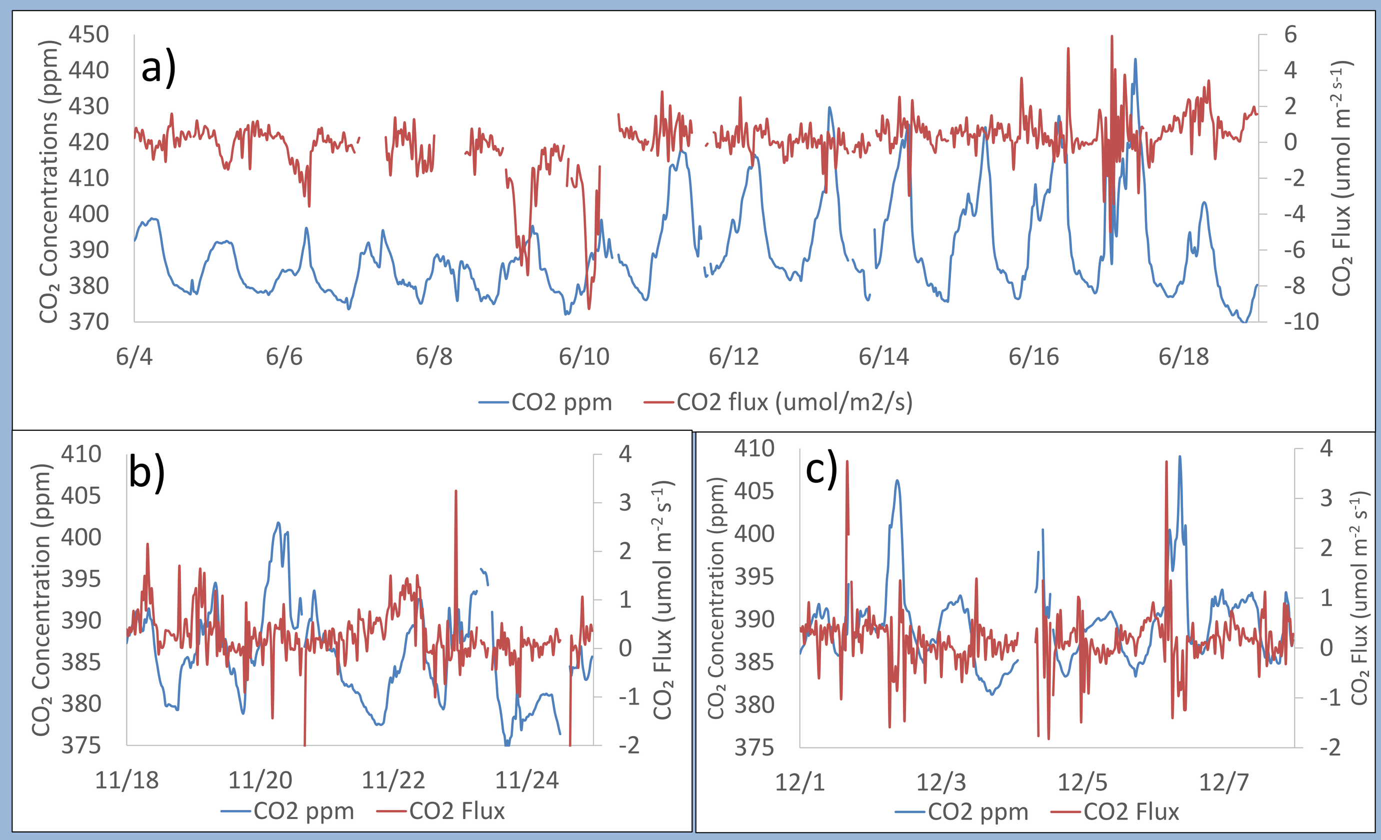

Figure 3: CO_2 concentration and CO_2 flux time series for a) June 4th to 18th, b) Nov, 18th to 24th, c) Dec. 1st to Dec 7th.

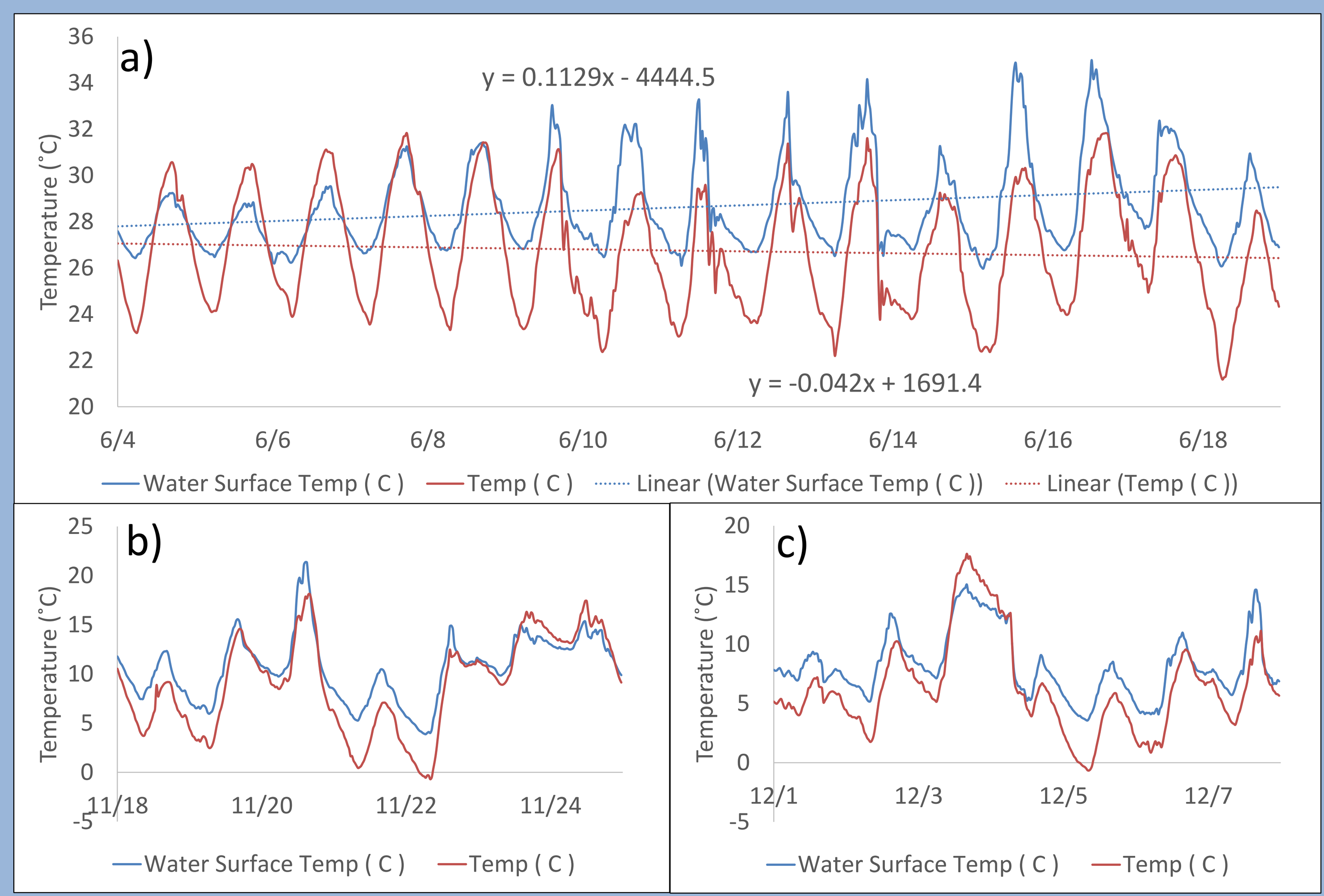

Figure 4: Air temperature and water surface temperature time series for a) June 4th to 18th, b) Nov. 18th to 24th, c) Dec 1st to 7th

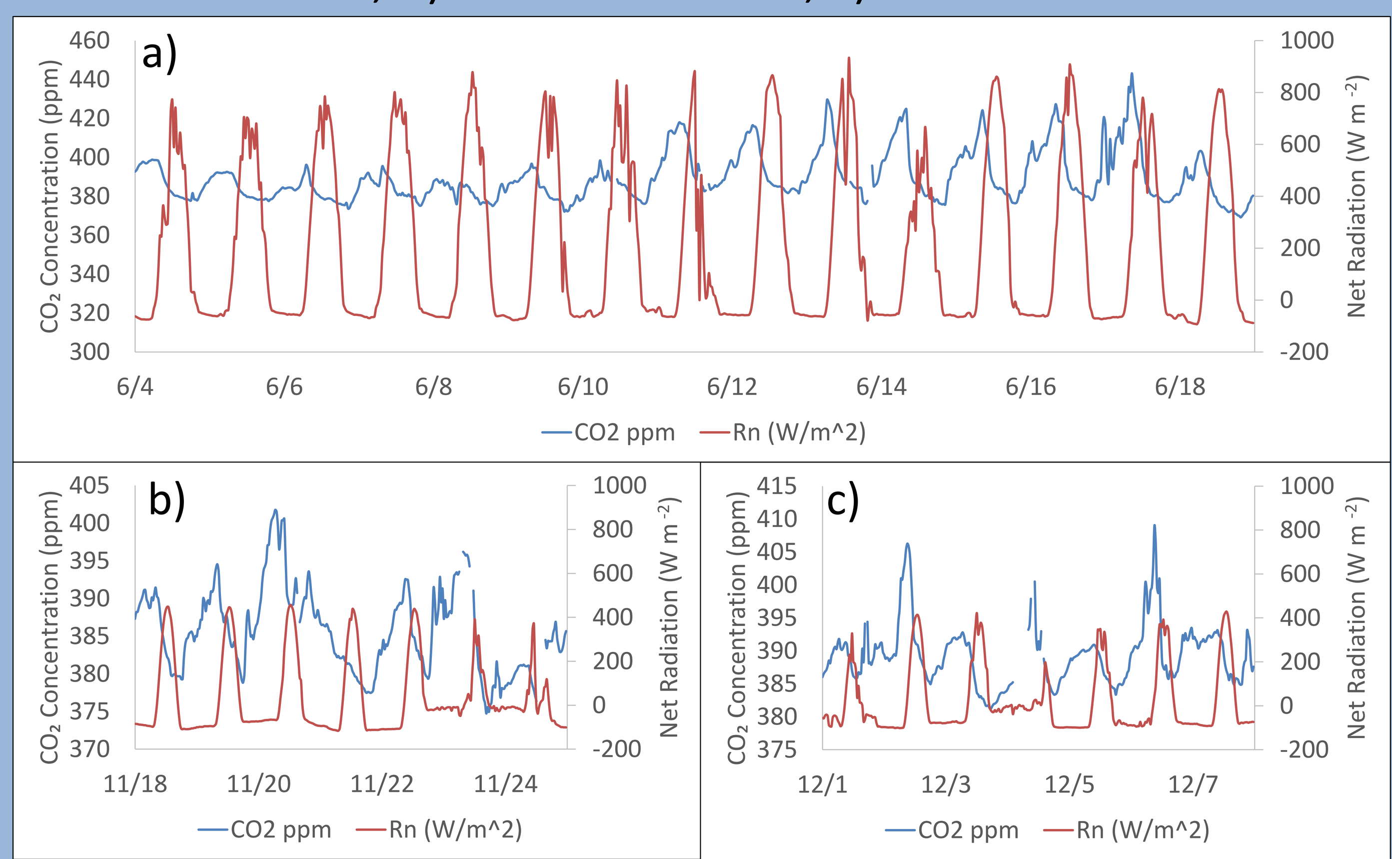

Figure 5: CO_2 concentration and net radiation time series for a) June 4th to June 18th, b) Nov. 18th to Nov 24th, c) Dec. 1st to Dec. 7th

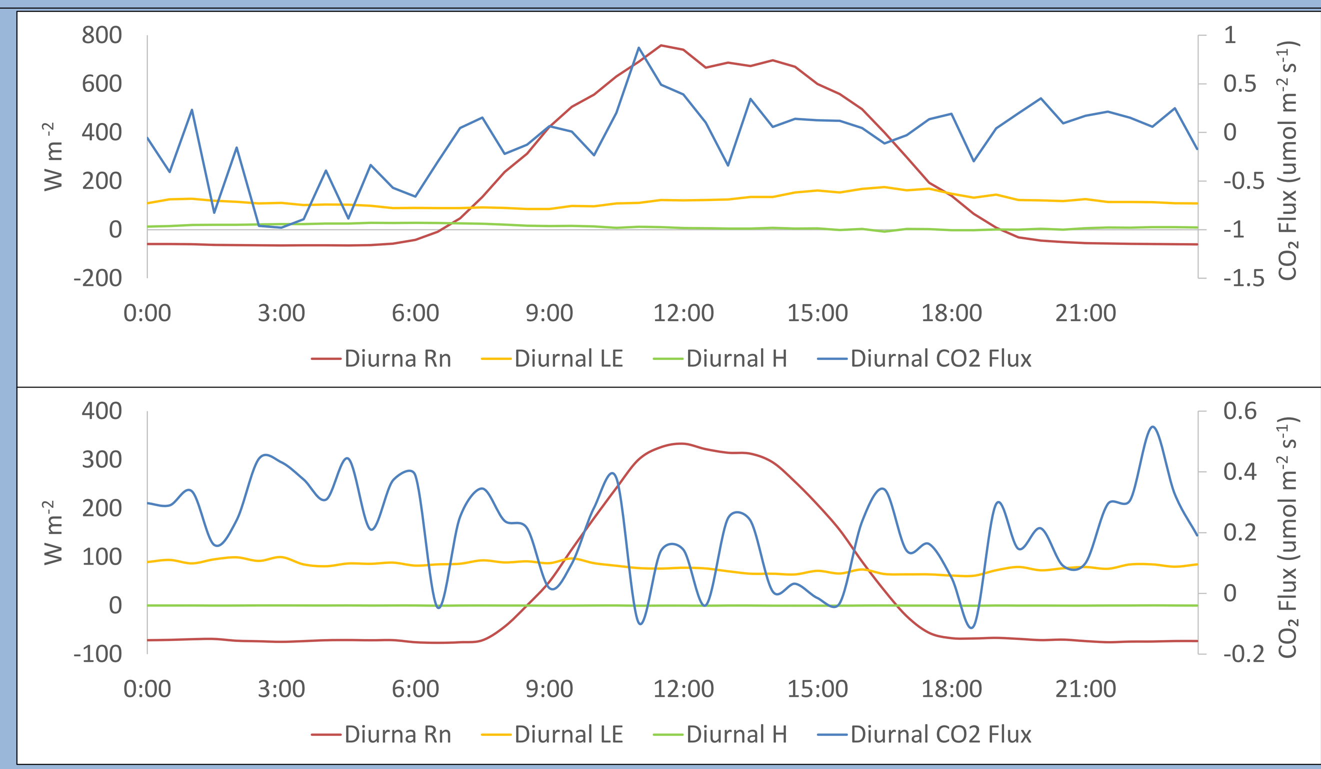

Figure 6: Diurnal analysis of net radiation (Rn), latent heat (LE), sensible heat (H), and CO_2 flux for a) June 4th to June 18th, b) Nov. 18th to 24th and Dec. 1st to 7th.

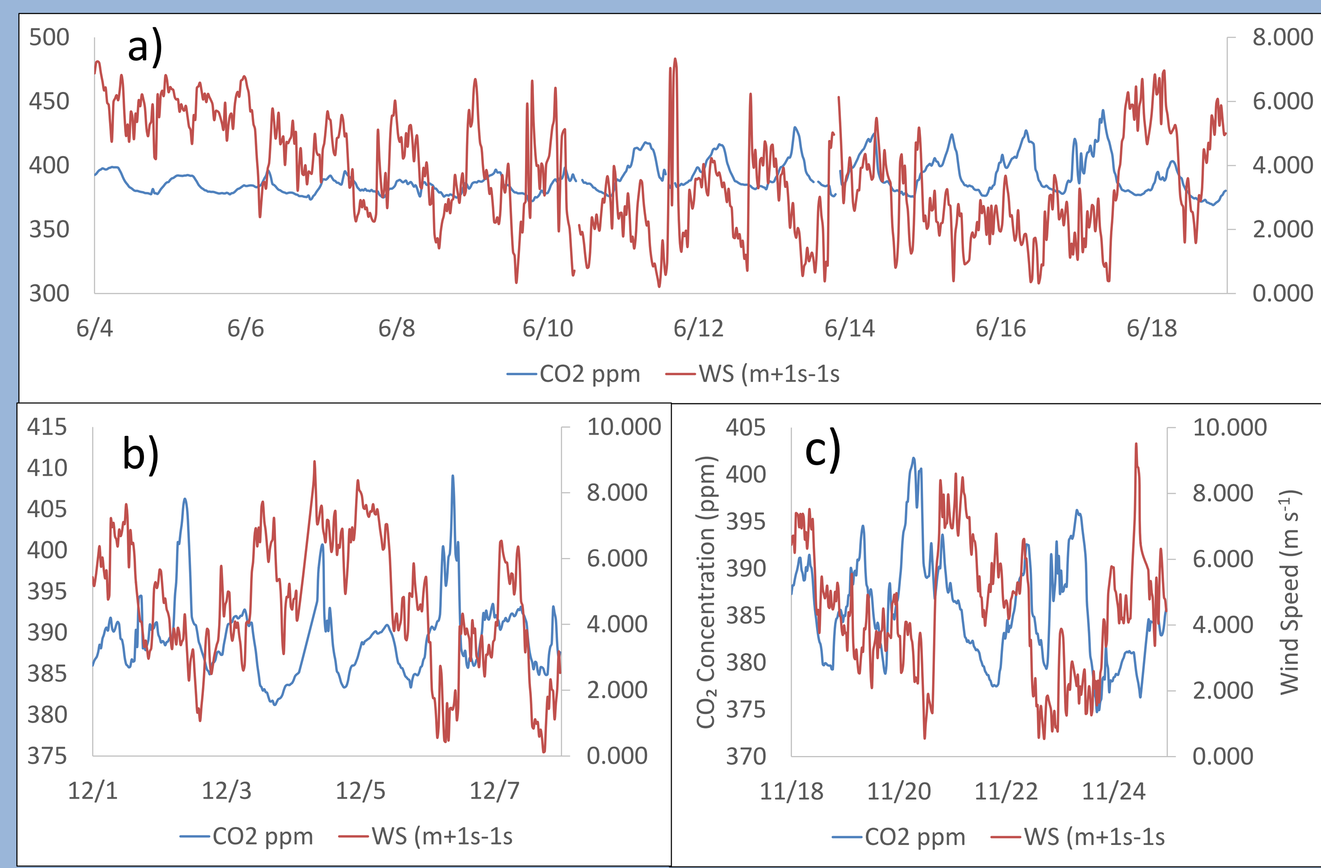

Figure 7: CO_2 concentration and wind speed for a) June 4th to 18th, b) Nov. 18th to 24th, and c) Dec. 1st to 7th.

Conclusion

- An increase in CO_2 concentrations was observed with a negative flux from June 11th to the 17th and sporadically on Nov. 20th and 23rd, and on Dec. 2nd, 4th, and 6th.
- Average CO_2 concentrations were found in both June and November/December, with June having the higher average. This was likely due to a decrease in temperature during the fall.
- Periods of maximum CO_2 concentration typically occurred after the passage of cold fronts
- Calm winds and synoptic conditions allowed surface water to become warmer than the cold air above.
- The attributing factors of passing cold fronts with clear weather, increased net radiation, and water temperature were the cause of the flux in CO_2.

Acknowledgements

This work was supported by the National Science Foundation's REU program under grant number AGS-1461292