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

Justin Bonds, Raleigh Gryska, Zhongming Gao, Heping Liu

Jackson State University Department of Physics, Atmospheric Sciences & Geoscience

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 (CO₂) concentrations, CO₂ fluxes, and components of the surface energy budget.

Objectives

- Understand CO₂ diurnal patterns and determine what factors influence concentrations.
- Determine if seasonal change in weather variables impacts CO₂ 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 CO₂ concentrations and flux. 30 minute averages of CO₂ 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.

Results

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

Table 1: Instruments at the tower site

<table>
<thead>
<tr>
<th>Instrument Name</th>
<th>Instrument Heights (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSAT3 3-D sonic anemometer</td>
<td>2.8</td>
</tr>
<tr>
<td>LI-7500 CO₂/H₂O IR gas analyzer</td>
<td>2.8</td>
</tr>
<tr>
<td>CRN 2 net radiometer</td>
<td>1.5</td>
</tr>
<tr>
<td>HMP45C Temperature &amp; RH Probe</td>
<td>1.2, 2.4, 2.8, 3.5, 4.7</td>
</tr>
<tr>
<td>IRR-P Water skin Temperature sensor</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Figure 3: CO₂ concentration and CO₂ 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: CO₂ 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 CO₂ flux for a) June 4th to June 18th, b) Nov. 18th to 24th and Dec. 1st to 7th.

Figure 7: CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂.

Acknowledgements

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