An Eddy Flux Mesonet in Lake Taihu (太湖), China

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Lectures on China’s Environment

Xuhui Lee, Editor

Yale School of Forestry & Environmental Studies
Map of Jiangsu
Chinese character “Su” as in Jiangsu Province

Calligraphy by Xin Zhang
Table 1  Local sayings about water quality degradation in Lake Taihu

<table>
<thead>
<tr>
<th>Era</th>
<th>Local Saying</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950s</td>
<td>Cleaning rice and vegetables</td>
</tr>
<tr>
<td>1960s</td>
<td>Washing clothes</td>
</tr>
<tr>
<td>1970s</td>
<td>Becoming dirty</td>
</tr>
<tr>
<td>1980s</td>
<td>Losing fish and shrimp</td>
</tr>
<tr>
<td>1990s</td>
<td>Causing human injury</td>
</tr>
</tbody>
</table>

Source: An and Wang 2009
Water Pollution, Lake Taihu
Treatment by electrolysis
Treatment by electrolysis

Mechanical removal
FluxNet: A Global Network of CO$_2$ Flux Measurements

Source: http://www.fluxnet.ornl.gov
Eddy Flux Mesonet, Lake Taihu (太湖), China

- Buoy
- Eddy covariance
- Surface station
- Microwave radar / Lidar
- In-lake platform
- Ship-borne isotope measurement
- Helicopter profiling
Automated surface station
Helicopter profiling
Ship-borne isotope measurement
Buoy
In-lake platform
Eddy covariance system
Microwave radar/lidar
Data Center
Suzhou Met Bureau
NUIST & other collaborators
EC and microclimate measurement at Taihu site

Photograph by Wei Xiao 肖薇, Nanjing University of Information, Science and Technology
EC installation

Photograph by Wei Xiao 肖薇, Nanjing University of Information, Science and Technology
Photograph by Wei Xiao 肖薇, Nanjing University of Information, Science and Technology
In-lake platform
Science Questions

• **Lake-air energy, momentum and water exchanges**
  – Does algal growth change the water albedo?
  – How do wind-wave interactions affect the lake energy balance?
  – Is the kinetic fractionation during evaporation sensitive to wind motion?

• **Modeling lake-air interactions**
  – Is the NOAH lake-air parameterization applicable to a shallow lake like Lake Taihu?
  – Does a realistic parameterization of the lake energy fluxes improve WRF model predictions of the local weather?

• **Algae ecology**
  – Is algal growth fueled by atmospheric CO$_2$ or CO$_2$ released by sediment decomposition?
  – Can the CO$_2$ exchange pathways be quantified with the $^{13}$C tracer?
  – Can eddy covariance be used to quantify algal activity? Does it agree with the water equilibration method?
  – Are significant amounts of CH$_4$ and N$_2$O released during algal decomposition?
  – Are there value-added climate benefits from lake restoration efforts (global warming potential and albedo effect)?
Precipitation

Data source: Wei Xiao 肖薇

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Short-wave radiation

Data source: Wei Xiao 肖薇

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Albedo at 10:00 LST

Lake albedo at 10:00 LST

DOY of 2010

Data source: Wei Xiao 肖薇
Diurnal composite of lake albedo

Data source: Wei Xiao 肖薇

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Temperature of water and soil

Data source: Wei Xiao 肖薇

Nanjing University of Information Science & Technology
Sensible heat flux

Data source: Wei Xiao 肖薇
Latent heat flux

Data source: Wei Xiao 肖薇
Priestley-Taylor prediction (blue line) against the observed LE (red dots)

Data source: Wei Xiao 肖薇
Water heat flux

Time (LST)

Water heat flux, W m^-2

Data source: Wei Xiao 肖薇

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Energy balance closure

\[ y = 0.8817x + 114.8 \]

Data source: Wei Xiao 肖薇

Nanjing University of Information Science & Technology
NEE

Data source: Wei Xiao 肖薇
Diurnal Composite of NEE (June 13 to July 12)

June 13 - July 12
(DOY164-193)

Net Ecosystem CO2 Exchange, mg m^-2 s^-1

Data source: Wei Xiao 肖薇

Nanjing University of Information Science & Technology
Diurnal Composite of NEE (August 1 to 31)

Data source: Wei Xiao 肖薇
Water-Air Equilibrator

Air 1

Air 2

water
Photograph by Wei Xiao 肖薇, Nanjing University of Information, Science and Technology
平台设计 Platform design

Wind direction

10 - 15 m

EC sensors

Solar energy

Wind energy

Instrument

Protection stake