Carbon, Water and Energy Balance of a Poplar Plantation in the Suburban of Beijing, China

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1 site description
1.1 Location

- 35km Southwest Beijing and 60 km to BFU
- 0.8 km² Yongding river flat floodplain area with Poplar Plantation

Beijing Flux Site

Schematic location of Beijing Flux Tower
## 1.2 Site details

<table>
<thead>
<tr>
<th><strong>Location</strong></th>
<th><strong>Daxing district, Beijing</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Latitude</strong></td>
<td>N39° 31 50’’</td>
</tr>
<tr>
<td><strong>Longitude</strong></td>
<td>E116° 15 07’’</td>
</tr>
<tr>
<td><strong>Altitude</strong></td>
<td>30m</td>
</tr>
<tr>
<td><strong>Average annual air temperature</strong></td>
<td>11.5°C</td>
</tr>
<tr>
<td><strong>Average annual precipitation</strong></td>
<td>568.9mm</td>
</tr>
<tr>
<td><strong>Accumulated annual temperature((\geq10°C))</strong></td>
<td>4143°C</td>
</tr>
<tr>
<td><strong>Frostless period</strong></td>
<td>204 days</td>
</tr>
<tr>
<td><strong>Soil type</strong></td>
<td>Sandy</td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td>0.8km²</td>
</tr>
<tr>
<td><strong>gradient</strong></td>
<td>flat</td>
</tr>
</tbody>
</table>
## 1.3 History of the site

<table>
<thead>
<tr>
<th>Period</th>
<th>Land use</th>
<th>Managements and disturbances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 1956</td>
<td>Farm and orchard</td>
<td></td>
</tr>
<tr>
<td>1956</td>
<td></td>
<td>Flood flowed with many bedload because of the collapsing of the Yongding riverbank.</td>
</tr>
<tr>
<td>1956~1962</td>
<td>Wasteland</td>
<td></td>
</tr>
<tr>
<td>Since 1962</td>
<td>Forestry</td>
<td>Reforested by the foresters; Fertilization, irrigation, replanting, pesticide, alternation cutting and turning the soil deeply.</td>
</tr>
</tbody>
</table>
the tower
(built up and installed in October 2004)
2 Measurements
(team and equipments)

PI
Zhiqiang Zhang

EC System
Tonggang Zha

Photosynthesis
Li6400
Jinlin Zhang
& Yingbai Shen

Biomass and LAI
Hemi-camera
Jun Chen

Soil respiration
Li6400-09&Li8100
Linjun Cui

Water Balance
Rain gauge, balance, TDR
Chenfeng Liu

Sap flow, Isotope
Lihua Shen
3 First Data & Results

- 3.1 EC data
- 3.2 Vegetation and biomass
- 3.3 Soil respiration
- 3.4 Photosynthesis
- 3.5 Water balance
3.1 EC data

The CO$_2$ flux in May

$F_{c_{\text{wp}}}$ mg/(m$^2$s)
Daily CO$_2$ flux

![Graph showing daily CO$_2$ flux with time (19:12 to 4:12) and Fc\textsubscript{wpl} (mg/(m$^2$ s)) on the y-axis. The graph displays fluctuations in CO$_2$ flux over time, with peaks and troughs indicating variations in CO$_2$ exchange.]
Daily change of LE and Hs

Hs and LE on May 4
According to the values of LE, we calculated that the ET on May 4 was 13.4mm.
3.2 Vegetation and Biomass

Vegetation Plot
Litter Bags
LAI
Tower

800m

Diagram showing vegetation and biomass distribution with various symbols representing different components.
Plots Survey

• In plots, all trees over 2.5 cm (DHB) were measured
• Average DHB is 9.2cm, and average height is 8.9m.

• Assign numbers to all trees and marked with tags in every subplot.
Herbage Catalog

Medicago sativa  紫苜蓿
Melilotus officinalis  黄香草木樨
Salsola collina  猪毛菜
Chenopodium acuminatum  尖头叶藜
Chenopodium album  藜（灰菜）
Tribulus terrestris  蒺藜
Trigonotispeduncularis  附地菜
Lagopsis supine  夏至草

Erodium stephanianum  牛儿苗（太阳花）
Lepidium apetalum  独行菜
Capsella bursa-pastoris  荠菜
Erysimum cheiranthoides  小花糖芥
Descurainia Sophia  播娘蒿
Humulus Scandens  葎草（拉拉秧）
Phragmites australis  芦苇
Ixeris chinensis  苦菜
Xanthium sibiricum  苍耳
Conyza Canadensis  小蓬草（小白酒菊）
Above-ground herbage were collected destructively in 1×1m² area monthly. Eighteen samples were done in six vegetation plots. (9 is *Medicago sativa* that planted as forage)
Underground biomass of herbage

Live roots biomass in June

Live roots biomass in May
Litter traps design

subplot

Litter traps
Leaf Area Index

- Hemispherical photos
  Take five photos in the north, south, east, west and the center of subplot.
- Gap Light Analyzer (GLA)
  Using imaging software GAL deal with these fisheye photographs.
LAI = 1.40 in May and LAI = 1.70 in June
3.3 Soil respiration

Equipments: Li6400-09 & Li8100
Frequency: once every 10 days
Plots: 4 plots with 3 repeats
Daily change of Eflux, Ts and SMC
Relationship between the soil respiration and the soil temperature

\[ y = 1.1176e^{0.0462x} \]

\[ R^2 = 0.3847 \]
3.4 Photosynthesis

Method

Confirmed standard tree and functional leaf based on the investigation of the forest

Measured the photosynthesis once in every 10 days with the Li6400;
**Daily change of CO2 flux**

![Graph showing daily change of CO2 flux](image)

**Diurnal change of CO2 flux**

![Graph showing diurnal change of CO2](image)

**Diurnal change of transpiration(2005-05-18)**

![Graph showing diurnal change of transpiration](image)

**Diurnal change of respiration(2005-05-18)**

![Graph showing diurnal change of respiration](image)
Cloudy

- Daily weather change (2005-05-13)
- Diurnal CO₂ exchange (2005-05-13)
- Diurnal PAR (2005-05-13)
- Diurnal relative humidity (2005-05-13)
- Diurnal air temperature (2005-05-13)
- Diurnal light intensity (2005-05-13)
- Diurnal Pn (μmol·m⁻²·s⁻¹) (2005-05-13)
- Diurnal Rb (μmol·m⁻²·s⁻¹) (2005-05-13)
- Diurnal Gs (μmol·m⁻²·s⁻¹) (2005-05-13)
- Diurnal Ls (%) (2005-05-13)
3.5 Water balance

3.5.1 Measurements

- Soil moisture content
- Stemflow
- Through fall
- Rainfall
- Soil evaporation
- Water evaporation
- Sapflow (to be installed soon)
Through fall equipments
Stemflow
Soil evaporation
3.5.2 Data

1 Soil moisture content

![Graph showing soil moisture content with depth in May 2005.](image1)

![Graph showing soil moisture content with soil depth in June 2005.](image2)
Air Temperature and Precipitation

<table>
<thead>
<tr>
<th>Date</th>
<th>Temp °C</th>
<th>Precip (mm/day)</th>
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<tbody>
<tr>
<td>5.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.4</td>
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<tr>
<td>5.7</td>
<td></td>
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<tr>
<td>5.10</td>
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<td>5.13</td>
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<td>5.16</td>
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<td>5.19</td>
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<td>5.22</td>
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<td>5.25</td>
<td></td>
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<tr>
<td>5.28</td>
<td></td>
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</tbody>
</table>

Graph showing air temperature and precipitation over a period from 5.1 to 5.28.
Surface Soil Moisture Content Dynamics

0.1 m depth
0.4 m depth
1 m depth

Graph showing soil moisture content dynamics at different depths over time from 2005-05-03 to 2005-05-28.
Rainfall and the actual soil moisture content (0.1m)
4 Discussions

1 Water and nutrient stress (sandy soil and reforested):

Due to the low content of soil moisture and nutrient, the biomass and assimilation of the system is quite low; so we are wondering whether we should plant trees in such area. (may strengthen the desertification of the area).
2 Many disturbances in the site, how to quantify?

3 The poplar plantation is a carbon sink on May; The CO$_2$ flux is a sink in the daytime, and a very weak source at night, next we would try to confirm it is not an error of the equipments or data rotation.
thanks!