**Supplementary Information**

Chart, bar chart

Description automatically generated

**Figure S1** The relationship between half-hourly Tair and GPP.

Chart

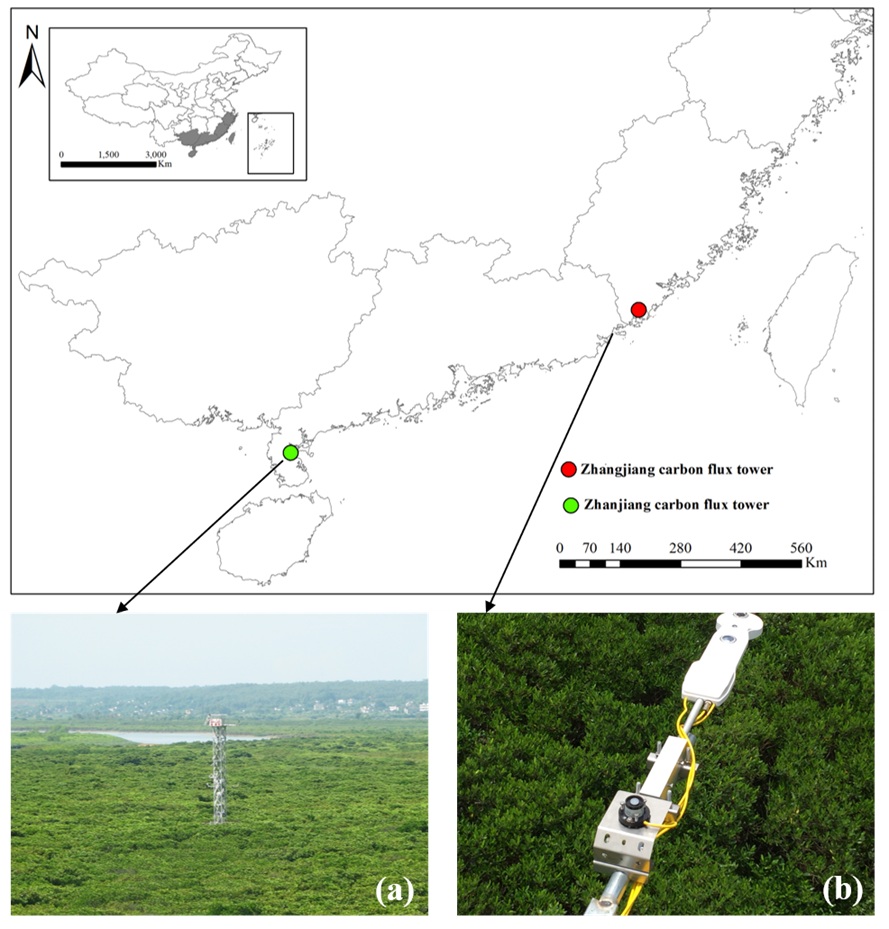
Description automatically generated

**Figure S2** Time series in-situ surface water salinity, satellite-based seawater salinity, and rainfall.

Chart, scatter chart

Description automatically generated

**Figure S3** Validation of LUE by individual environmental variables specified: (a) SST, (b) Salinity, and (c) PAR.



**Figure S4** Locations of carbon flux towers in China at: (a) Zhangjiang, and (b) Zhanjiang (Field photos from ChinaFLUX website: [http://www.chinaflux.org](http://www.chinaflux.org/index.aspx) ).

**Table S1** Summary of Tmin, Tmax and Topt for Tair and SST based on literature reviews.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Tmin (℃)** | **Tmax (℃)** | **Topt (℃)** | **Reference** |
| Florida, United States (25.36° N, 81.08° W) | 2.6 | 33.5 | 27.8 | Barr et al. (2013) |
| New Caledonia (20.94° N, 164.66° E) | 10.5 | 34.4 | 26.8 | Leopold et al. (2016) |
| Trat River, Thailand (12.20° N, 102.57° E) | 24.0 | 32.1 | 27.6 | Poungparn et al. (2020) |
| Ningde, China (26.68° N) | 1.4 | -- | 19.0 | Chen et al. (2017) |
| Longhai, China (24.43° N) | 4.6 | -- | 21.0 | Chen et al. (2017) |
| Zhangjiang, China (23.90° N) | 6.5 | -- | 21.2 | Chen et al. (2017) |
| Shenzhen, China (22.53° N) | 5.3 | -- | 22.5 | Chen et al. (2017) |
| Gaoqiao, China (21.56° N) | 5.2 | -- | 23.0 | Chen et al. (2017) |
| Zhanjiang, China (21.00° N) | 3.8 | -- | 23.0 | Chen et al. (2017) |
| Fangchenggang, China (21.46° N) | 4.1 | -- | 22.5 | Chen et al. (2017) |
| Qinzhou, China (21.72° N) | 3.3 | -- | 22.0 | Chen et al. (2017) |
| Haikou, China (19.90° N) | 7.7 | -- | 23.8 | Chen et al. (2017) |
| Wenchang, China (19.57° N) | 9.5 | -- | 24.0 | Chen et al. (2017) |
| Global | -- | 33 | 30 | Alongi (2018) |
| Yueqing, China (28.42° N) | 9.3 (Tair)  10.6 (SST) | -- | -- | Huang et al. (2009) |
| Fuding, China (27.33° N) | 9.8 (Tair)  10.9 (SST) | -- | -- | Zhang et al. (2001) |
| Global (*Avicennia* species) | 8.1 (Tair)  12.7 (SST) | 35.6 (Tair)  32.8 (SST) | -- | Quisthoudt et al. (2012) |
| Global (*Rhizophora* species) | 13.1 (Tair)  16.4 (SST) | 34.6 (Tair)  32.6 (SST) | -- | Quisthoudt et al. (2012) |
| Global | 19 | 35 | -- | Noor et al. (2015) |
| Global | 16 | 38-40 | 28-32 | Gilman et al. (2008) |

**Table S2** Summery of VPDmin and VPDmax in mangrove forests.

|  |  |  |  |
| --- | --- | --- | --- |
| Locations | VPDmin | VPDmax | Reference |
| Everglades National Park, USA (25.36° N, 81.08° W) | 0.16 | 2.23 | Barr et al. (2014) |
| North Peninsula State Park, USA (29.42° N, 81.10° E) | 0.15 | 2.20 | Devaney et al. (2021) |
| Old Point Mangrove Regional Park, San Andrés Island (12.58° N, 81.74° W) | 1.18 | 1.72 | Sánchez-Núñez and Mancera-Pineda (2011) |
| North Stradbroke Island, Australia (27.45° S, 135.43° E) | 0.10\* | 1.25\* | Vandegehuchte et al. (2014) |
| Amelia Island, USA (30.67° N, 81.43° W) | 0.90\* | 3.70\* | Aspinwall et al. (2021) |
| Terranora Broadwater, Australia (28.22° S, 153.51° E) | 0.10\* | 1.20\* | Vilas et al. (2019) |
| Okinawa Island, Japan (26.18° N, 127.67° E) | 0.64 | 1.15 | Sharma et al. (2012) |
| Pichavaram, India (11.33° N, 79.92° E) | 0.10\* | 4.50\* | Gnanamoorthy et al. (2020) |
| Sinnamary, France (52.93° E, 5.39° N) | 0.10\* | 1.25\* | Muller et al. (2009) |
| Sundarban, India (20.53 - 20.67° N, 88.08 - 89° E) | 0.09 | 2.17 | Ganguly et al. (2014) |

\*Values extracted from figures by visual interpretation.

**Table S3** Information on the mangrove forest structures and local climate.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Site** | **Mangrove forest** | | |  | **Microclimate (Annual mean)** | | | |
| Height (m) | Species | Age  (yr) |  | Tair  (°C) | humidity | Tide range (m) | Rainfall  (mm) |
| Zhangjiang | 6 | *Kandelia obovate*, Avicennia *marina*, *Aegiceras corniculatum* | -- |  | 21.2 | 79% | 2.3 | 1715 |
| Zhanjiang | 12 | *Sonneratia apetala* | >20 |  | 24.5 | -- | 3.0 | 1619 |

**Table S4** In-situ data availability.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Site** | **Carbon flux tower data** | | | | |  | **Meteorological data** | | | | |
| GPP | NEE | Re | fAPAR | LUE |  | PAR | Tair | VPD | SST | Salinity |
|  | μmol/m2/s | | |  |  |  | mol/m2/s | °C | kPa | °C | ppt |
| Zhangjiang | Half-hourly, 2012.01-12, 2016.08-2017.08 | | Half-hourly, 2012.01-12 | Half-hourly, 2016.08-2017.08 | |  | Half-hourly,  2012.01-12,  2016.08-2017.08 | | | Half-hourly, 2016.08-2017.08 | |
| Zhanjiang | Half-hourly,  2015.01-2015.12 | | |  | |  | Half-hourly,  2015.01-2015.12 | | |  | |

\* NEE = net ecosystem exchange; fAPAR = fraction of absorbed photosynthetic active radiation.

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