Supplementary materials:

Seasonal dynamics of algal Net primary production in response to phosphorus input in a mesotrophic subtropical plateau lake, Southwestern China

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1. Governing equations of EFDC hydrodynamic model

In EFDC, the hydrodynamic model is based on mass, momentum, and energy conservation laws. The equations are presented horizontally in a curvilinear coordinate system and vertically in Sigma transformations. The hydrodynamic model's output contains fluid flow, advection-diffusion equations for temperature, salinity, dye, toxicants, water quality components, and suspended sediment movement. The governing equations of motion are as follows:

$$\partial(m\zeta)/\partial t + \partial(m_y Hu)/\partial x + \partial(m_x Hv)/\partial y + \partial(mw)/\partial z = 0 \quad (1)$$

$$\frac{\partial(mHu)}{\partial t} + \frac{\partial\left(m_y Huu\right)}{\partial x} + \frac{\partial(m_x Hvu)}{\partial y} + \frac{\partial(mwu)}{\partial z} - \left(mf + \frac{v\partial m_y}{\partial x} - \frac{u\partial m_x}{\partial y}\right)Hv = -\frac{m_y H\partial(g\zeta + p)}{\partial x} - \frac{m_y\left(\frac{\partial h}{\partial x} - \frac{z\partial H}{\partial x}\right)\partial p}{\partial z} + \frac{\partial\left(\frac{mH^{-1}A_v\partial u}{\partial z}\right)}{\partial z} + Q_u \quad (2)$$

$$\frac{\partial(mHv)}{\partial t}+\frac{\partial\left(m_yHuv\right)}{\partial x}+\frac{\partial(m_xHvv)}{\partial y}+\frac{\partial(mwv)}{\partial z}+\left(mf+\frac{v\partial m_y}{\partial x}-\frac{u\partial m_x}{\partial y}\right)Hu$$
$$=-\frac{m_xH\partial(g\zeta+p)}{\partial y}-\frac{m_x\left(\frac{\partial h}{\partial y}-\frac{z\partial H}{\partial y}\right)\partial p}{\partial z}+\frac{\partial\left(\frac{mH^{-1}A_v\partial v}{\partial z}\right)}{\partial z}+Q_v \quad (3)$$

Where u, v and w are the velocity components in the orthogonal coordinates (x, y, z); m_x and m_y are the square roots of the diagonal components of the metric tensor; $m=m_xm_y$ is the square root of the metric tensor determinant; $\rho 0$ and ρ denote the reference density and physical density of water; the pressure $p = (\rho-\rho 0)gH(1-z)/\rho 0$; f is the Coriolis parameter; Av and Ab are the vertical turbulent viscosity and diffusivity respectively; Qu and Qv are momentum source-sink terms; S and T denote salinity and temperature, Qs and QT are the source and sink terms. Besides, the Mellor-Yamada level 2.5 turbulence closure scheme [74,75] is implemented to calculate the vertical turbulent viscosity and diffusivity.

2. Supplementary figures and tables

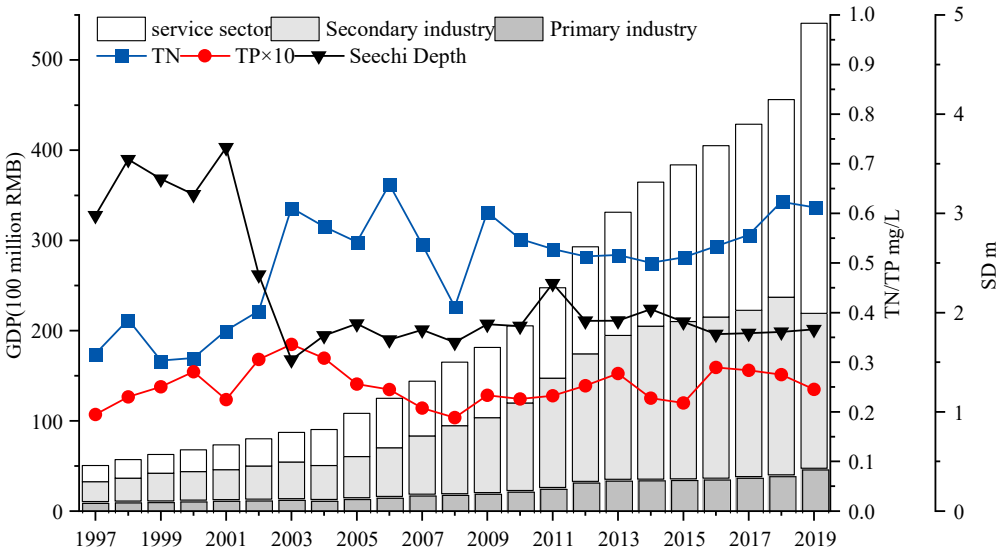


Figure S1. Trends of Gross domestic product (GDP) in Lake Erhai watershed, total nitrogen (TN)/total phosphorous (TP) concentration and average Secchi depth in Lake Erhai. (1997-2019). The economy data was obtained from Dali Bai Autonomous Prefecture People's Government. TN/TP and Secchi depth were obtained from Erhai Lake Research Center of Dali Bai Autonomous Prefecture.

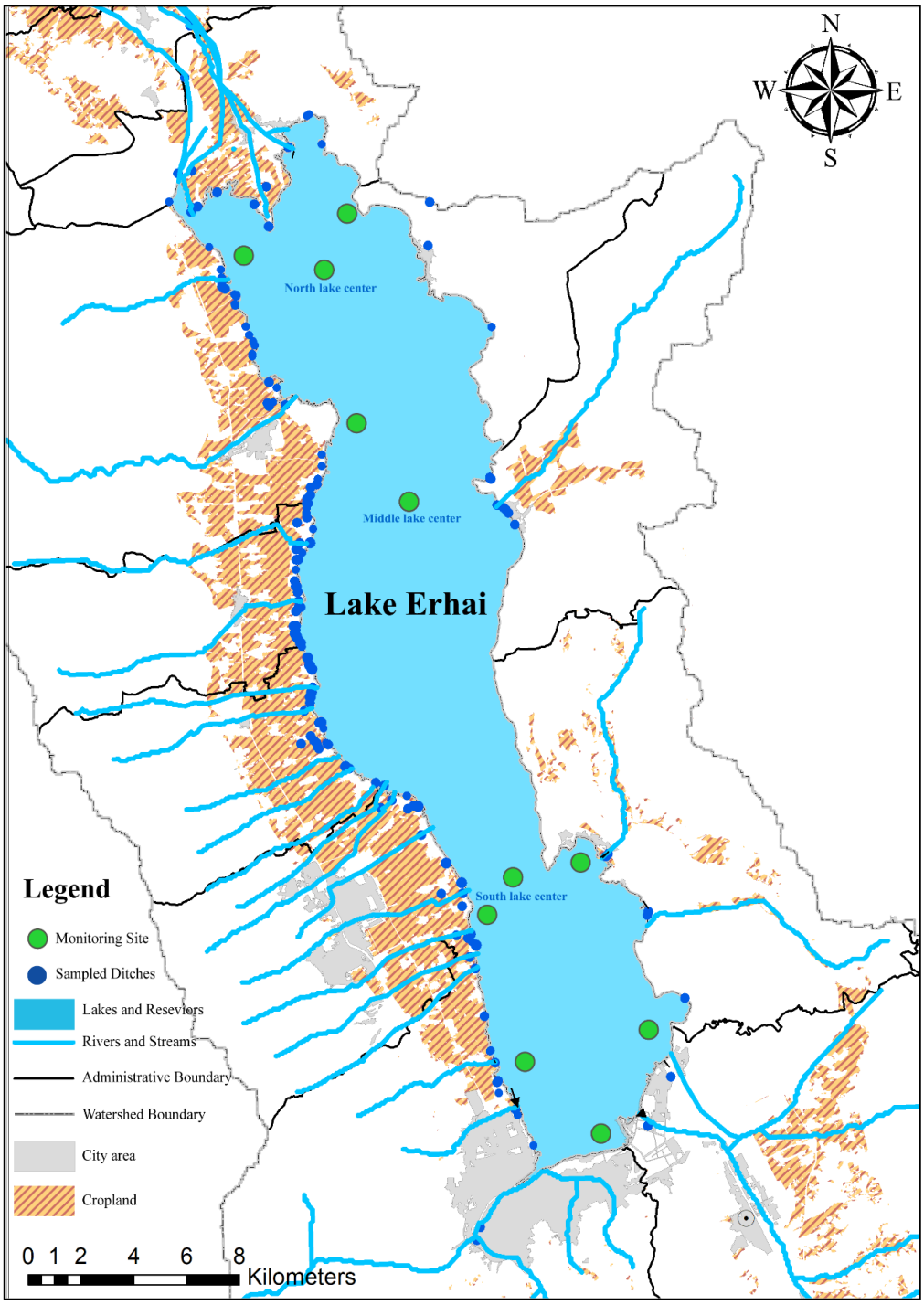


Figure S2. location of water quality monitoring sites in Lake Erhai and sampled agricultural ditches around the lake.

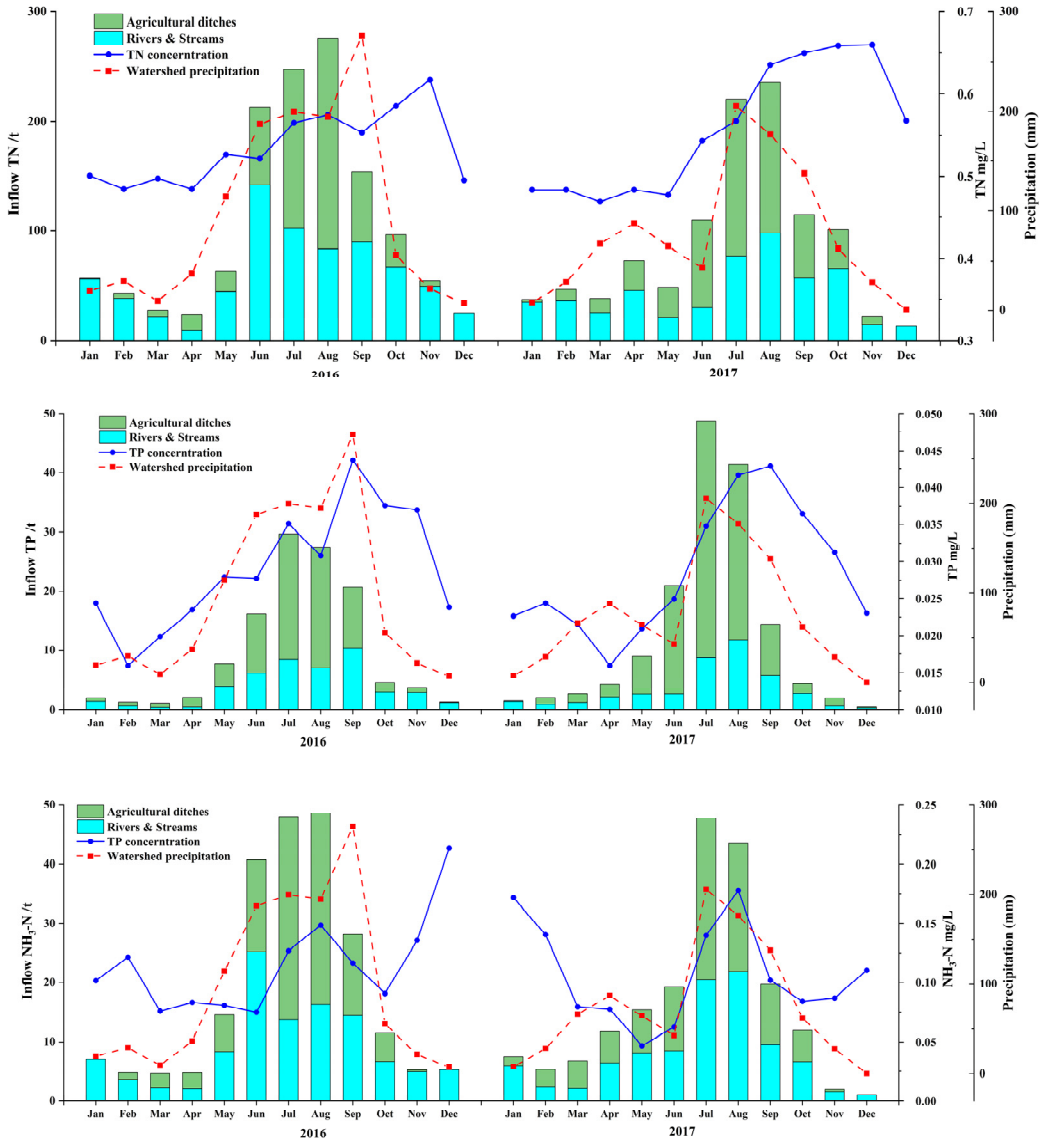


Figure S3. External loading of TN/TP and NH_3-N to Lake Erhai during the study period; The dark green and cyan bar indicate the input from agricultural ditches and major tributaries every month, respectively. The blue line indicates the monthly concentration of the pollutant in Lake Erhai. The red dash line presented the monthly precipitation of the watershed. The data of loading of major tributaries, watershed precipitation and water quality variables concentration are sourced from Ecological and Environmental Bureau of Dali Bai Autonomous Prefecture. The loading from agricultural ditches are sampled and by research group of this study. The meteorological data were sourced from China's Meteorological Scientific Data Sharing Service Network.

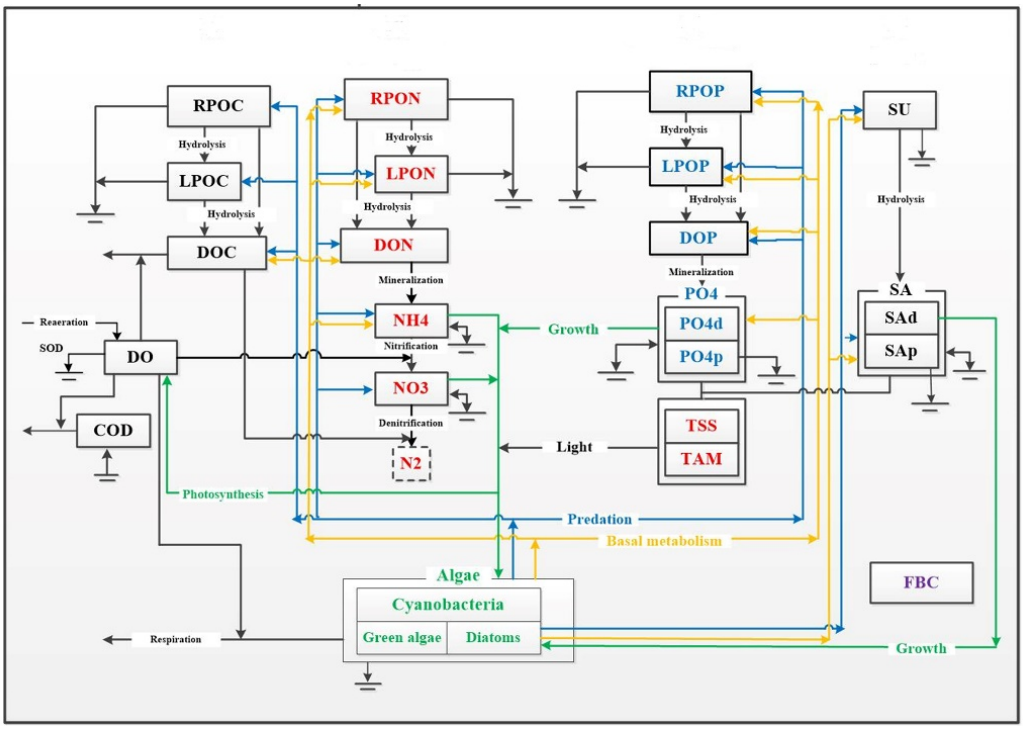


Figure S4. Schematic diagram of EFDC water quality model. (Park et al. 1995).

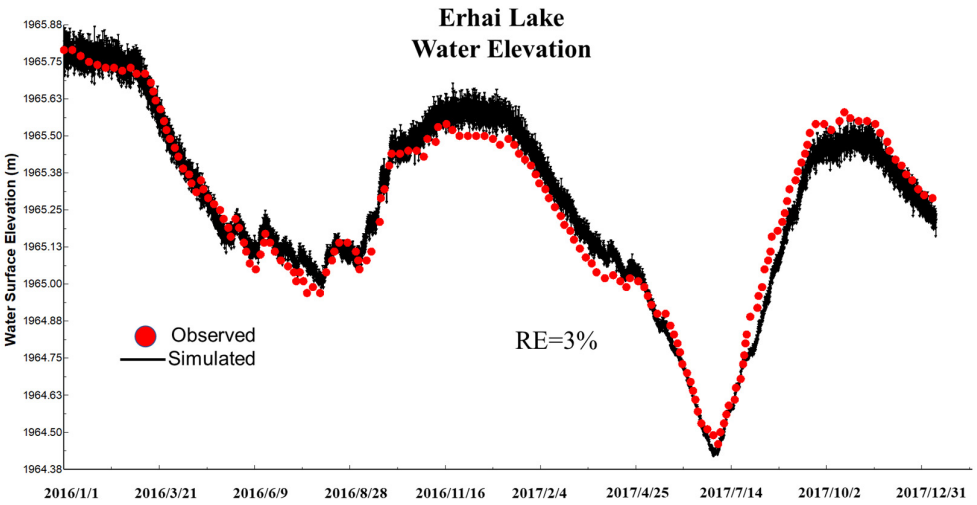


Figure S5. simulated and observed water elevation of Lake Erhai.

Table S1. Variables used in EFDC model.

(1)Bc: Algae group 1-Cyanobacteria	(12)LPON: Labile particulate organic nitrogen
(2)Bd: Algae group 2-Diatom	(13)DON: Dissolved Organic Nitrogen
(3)Bg: Algae group 3-Green algae	(14)NH_4: Ammonia nitrogen
(4)RPOC: Refractory particulate organic Carbon	(15)NOX: Nitrate Nitrogen
(5)LPOC: Labile particulate Organic Carbon	(16)SU: Particulate Biogenic Silica
(6)DOC: Dissolved Organic Carbon	(17)SA: Dissolved Available Silica
(7)RPOP: Refractory particulate phosphorus	(18)COD: Chemical Oxygen Demand
(8)LPOP: Labile particulate organic Phosphorus	(19)DO: Dissolved Oxygen
(9)DOP: Dissolved Organic Phosphorus	(20)TAM: Total Active Metal
(10)PO_4t: Total Phosphate	(21)FCB: Fecal Coliform bacteria
(11)RPON: Refractory particulate nitrogen	(22)Bm: Macrophyte/periphyton