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## Supplementary Materials

Supporting Figures S1 – S7

Supporting Tables S1 – S3

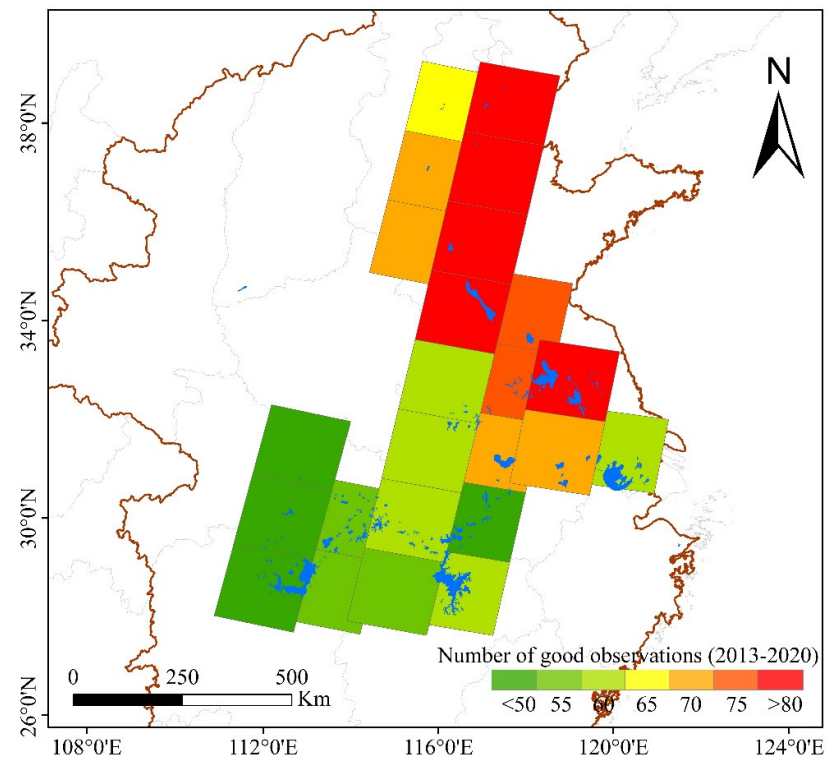


Figure S1. Landsat-8 OLI coverage of observation and number of good observations from 2013 to 2019.

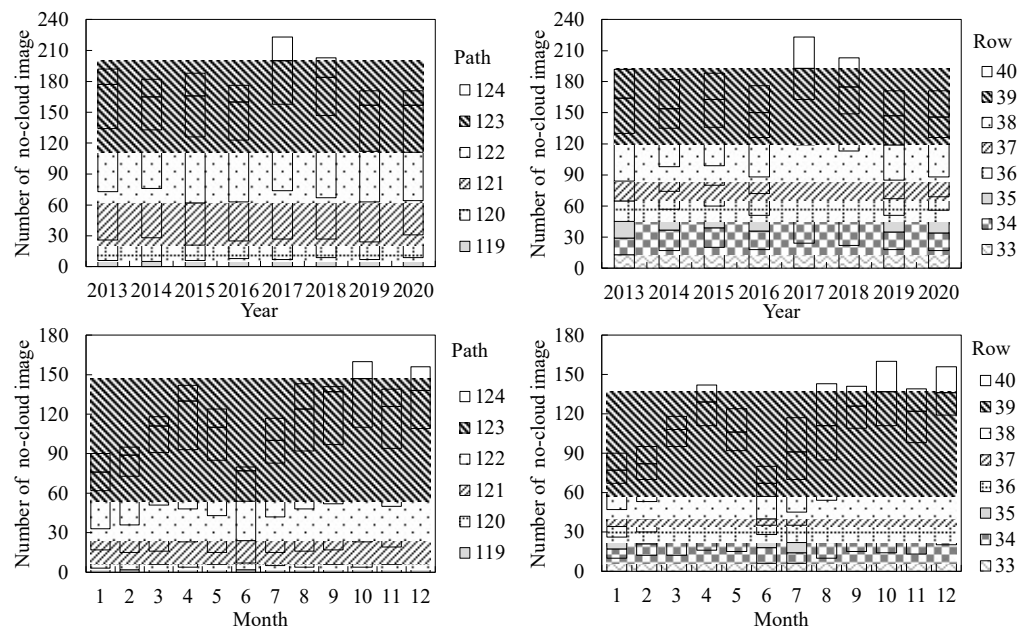


Figure S2. Number of OLI images counted by Landsat-8 path and row.

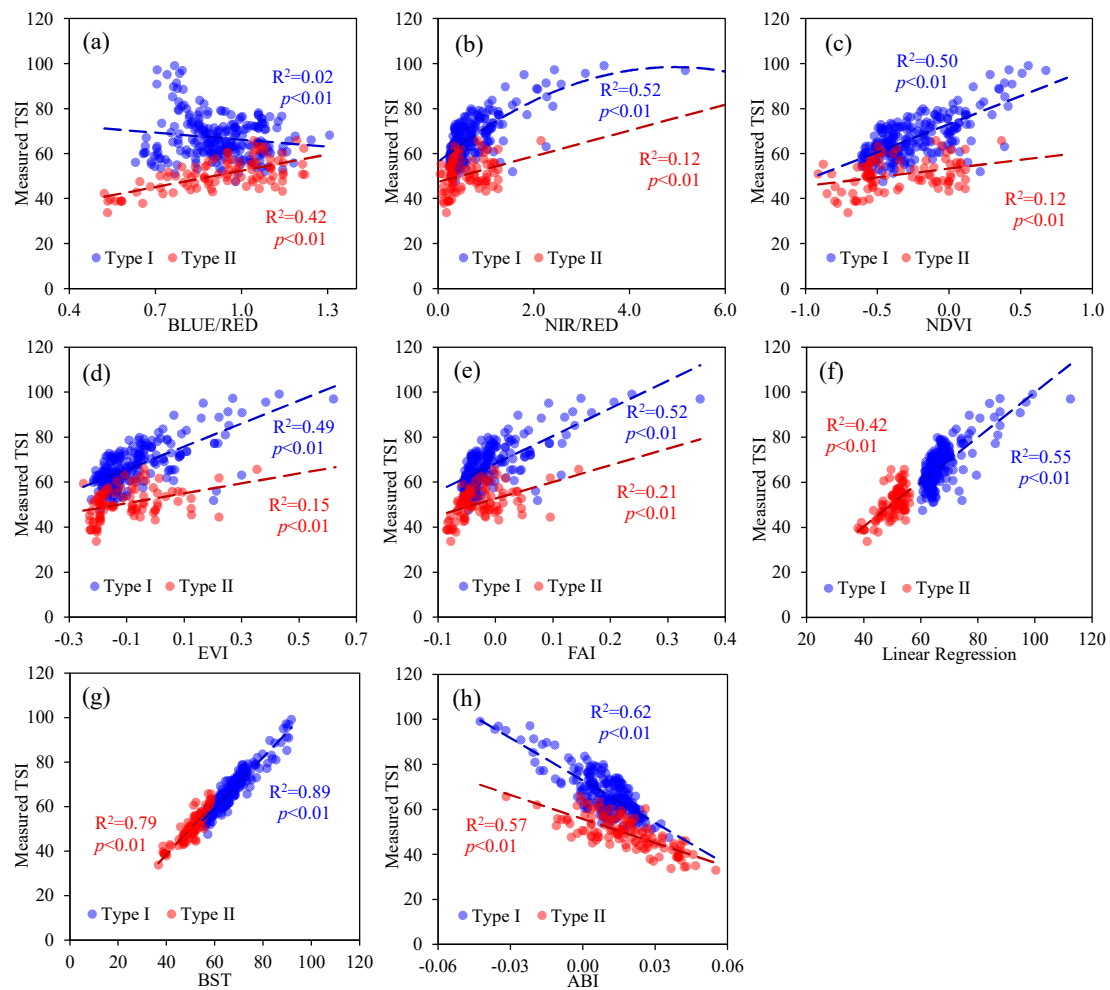


Figure S3. Correlations of different method based on surface reflectance (SR) and measured trophic state index (TSI): (a) BLUE/RED, (b) NIR/RED, (c) normalized difference vegetation index (NDVI), (d) enhanced vegetation index (EVI), (e) floating algae index (FAI), (f) linear regression, (g) the extreme gradient boosting tree (BST) and (h) algal biomass index (ABI).

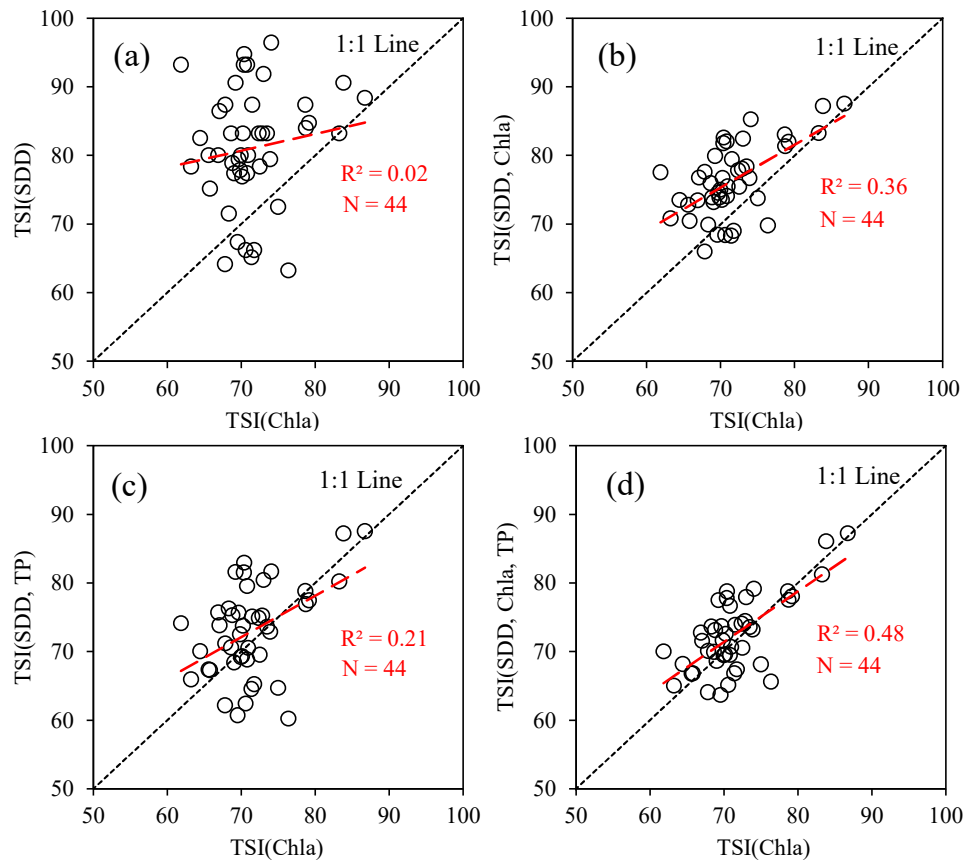


Figure S4. Comparison of the TSI(Chla) and (a) TSI(SDD), (b) TSI (SDD, Chla), (c) TSI(SDD, TP) and (d) TSI(TP, Chla, SDD)

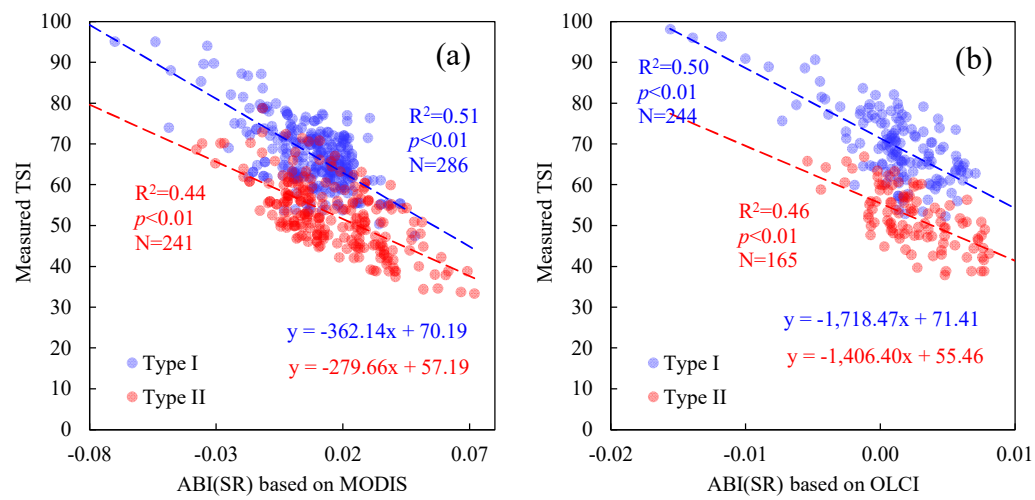


Figure S5. Application of ABI algorithm based on (a) MODIS; (b) OLCI.

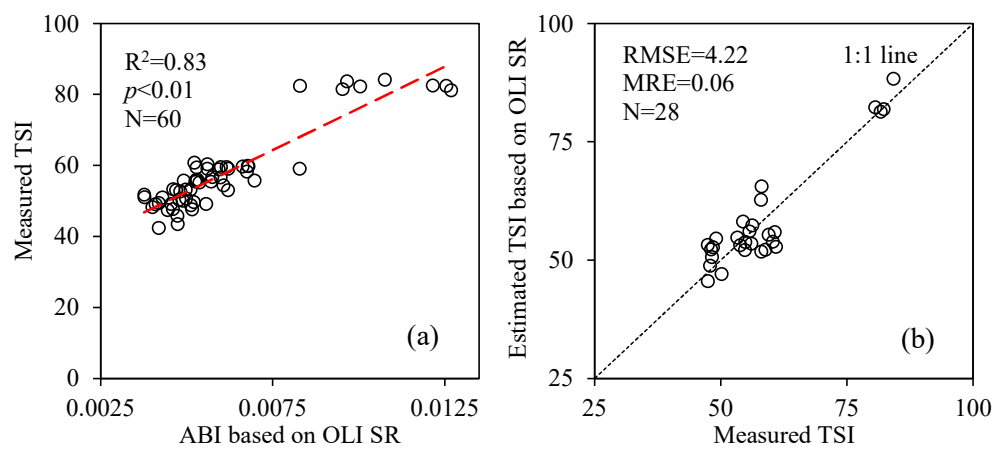


Figure S6. (a) Performance of ABI-derived TSI for lakes in the Yunnan-Guizhou plateau lake (TGPL) zone and (b) independent validation.

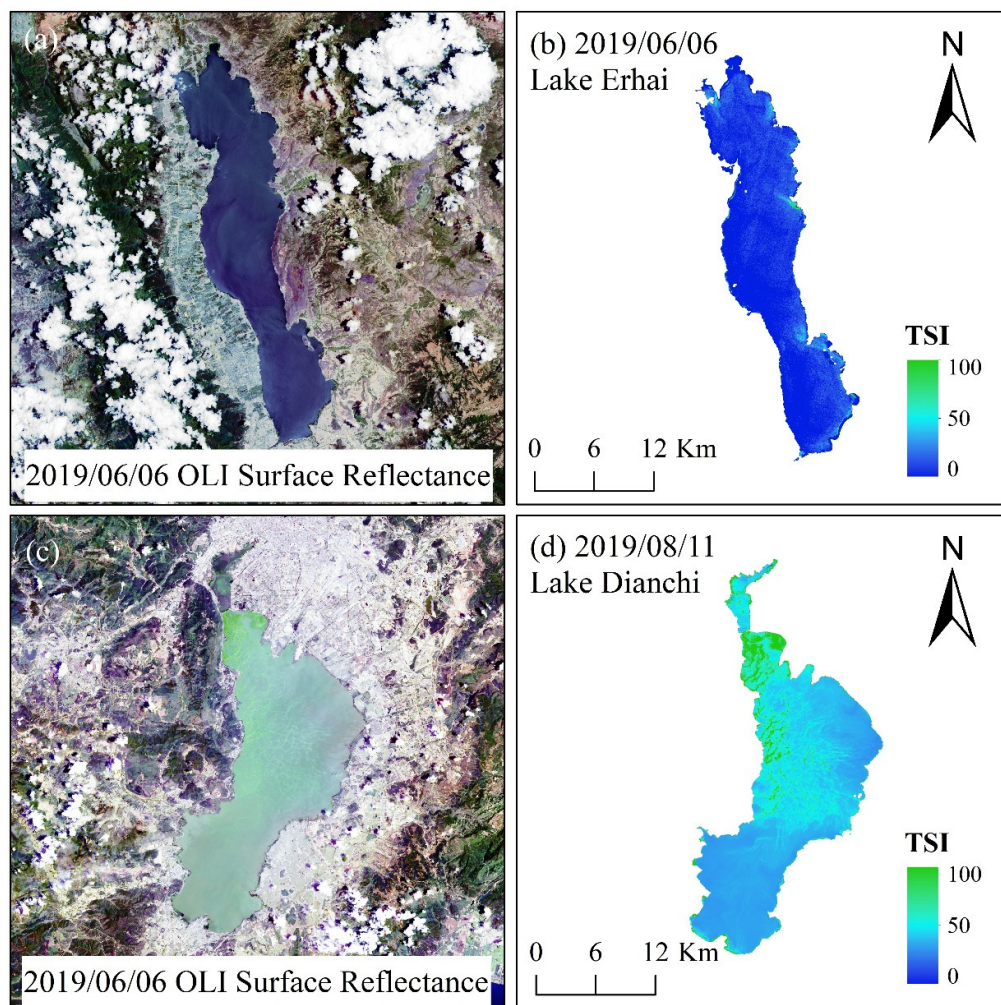


Figure S7. Landsat-8 OLI RGB images (stretched by histogram specification) of (a) Lake Erhai on June 6 and (c) Lake Dianchi on August 11, 2019; and simulated TSI of (b) Lake Erhai and (d) Lake Dianchi.



Table S1. Correlation and precision with different fitting model

Fitting Model	$R^2$	$MAE$	$MRE$	$RMSE$
<b>Type I (N = 282 for building and N = 89 for validation)</b>				
Linear	0.62**	2.96	4.45%	3.79
Exponential	0.59**	3.17	4.73%	4.02
Logarithmic	0.62**	3.17	4.71%	4.04
Power function	0.57**	3.49	5.09%	4.66
Quadratic linear	0.62**	2.99	4.48%	3.82
<b>Type II (N = 132 for building and N = 86 for validation)</b>				
Linear	0.57**	6.22	12.87%	7.65
Exponential	0.57**	6.48	13.36%	7.88
Logarithmic	0.53**	6.34	12.88%	7.74
Power function	0.54**	6.83	13.53%	8.77
Quadratic linear	0.57**	6.58	13.60%	7.93

\*\*, Correlation is significant at the 0.01 level (2-tailed)

Table S2. Accuracy of trophic state classification based on ABI algorithm for MODIS and OLCI.

Sensor	Trophic State	Accu- racy	Overesti- mate	Underesti- mate
MODIS	Oligotrophic	-	-	-
	Mesotrophic	67.82%	32.18%	0
	Eutrophic	88.67%	6.15%	5.18%
	Hypertrophic	79.79%	0	20.21%
	Overall Accu- racy		83.27%	
OLCI	Oligotrophic	-	-	-
	Mesotrophic	82.22%	17.78%	0
	Eutrophic	87.59%	6.57%	5.84%
	Hypertrophic	72.41%	0	27.59%
	Overall Accu- racy		82.92%	

Table S3. Statistics of Chl $a$ , SDD of Lake Dianchi and Lake Erhai, and Pearson correlation analysis between ABI(SR) and measured TSI.

	<b>Dianchi</b>	<b>Erhai</b>
Chl $a$ ( $\mu\text{g/L}$ )	71.58 $\pm$ 7.96	11.57 $\pm$ 5.48
SDD (m)	0.27 $\pm$ 0.05	1.92 $\pm$ 0.48
Trophic State	Supertrophic	Eutrophic
Correlation	0.86**	0.68**
N	12	76

\*\* . Correlation is significant at the 0.01 level (2-tailed)