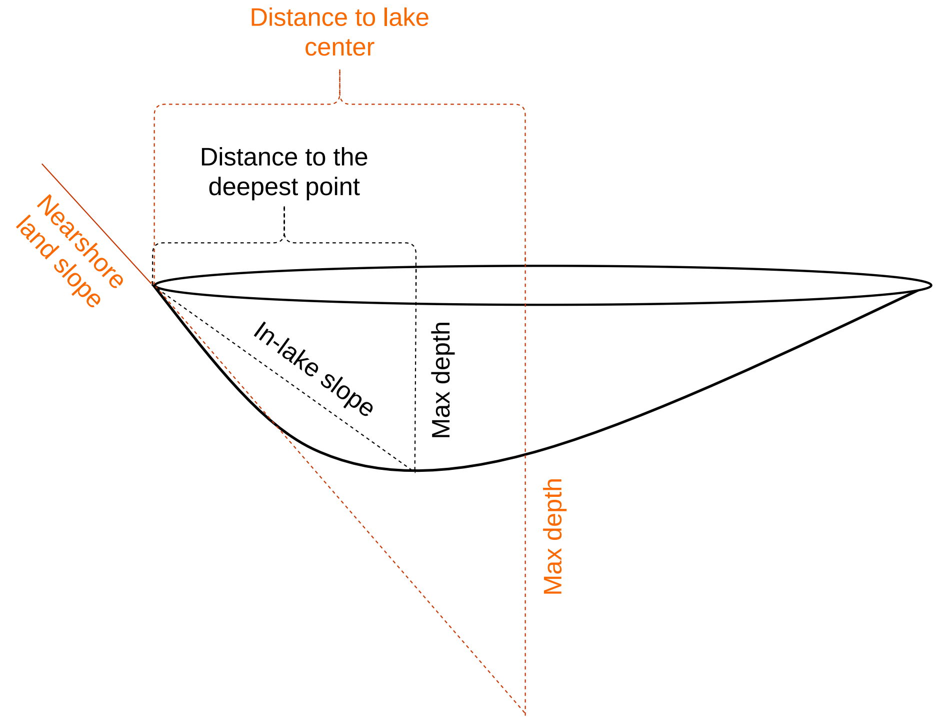

Figure 1: Diagram showing the relations between true (black) and proxy (orange) metrics of lake geometry. Geometric depth calculated via Equation 1 requires a single distance and slope metric.

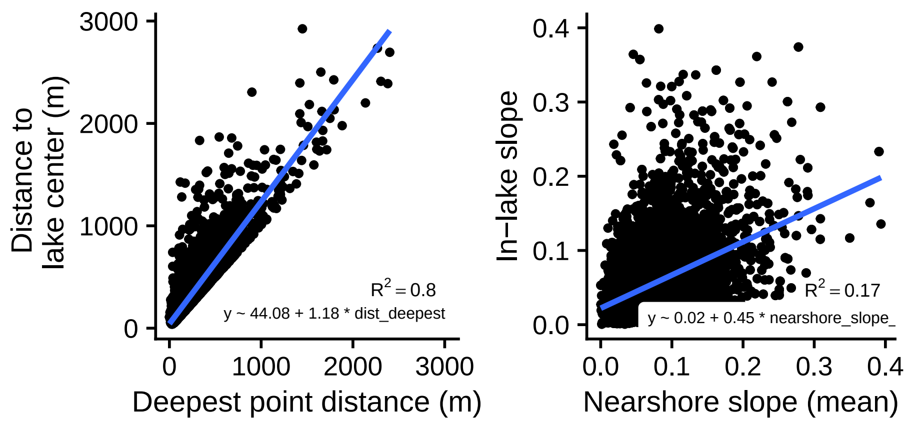

Figure 2: Comparison among proxy and true values of lake geometry for A) distance to deepest point versus distance distance to lake center and B) nearshore land slope versus in-lake slope. A best-fit line and equation is shown to shown to facilitate computation of correction factors for proxy values of lake geometry. Coefficients of determination are shown to illustrate representativeness.

slope	distance	rmse	rsq	mape
true	true	-	-	-
true	proxy	4.4 m	0.70	29 %
proxy	true	6.6 m	0.32	60 %
proxy	proxy	6.4 m	0.35	59 %

Table 1: Model fit and predictive accuracy metrics (RMSE = root mean square error, R2 = coefficient of determination) for all combinations of true (in-lake slope, distance to the deepest point of the lake) and proxy (nearshore land slope, distance to lake center) metrics.

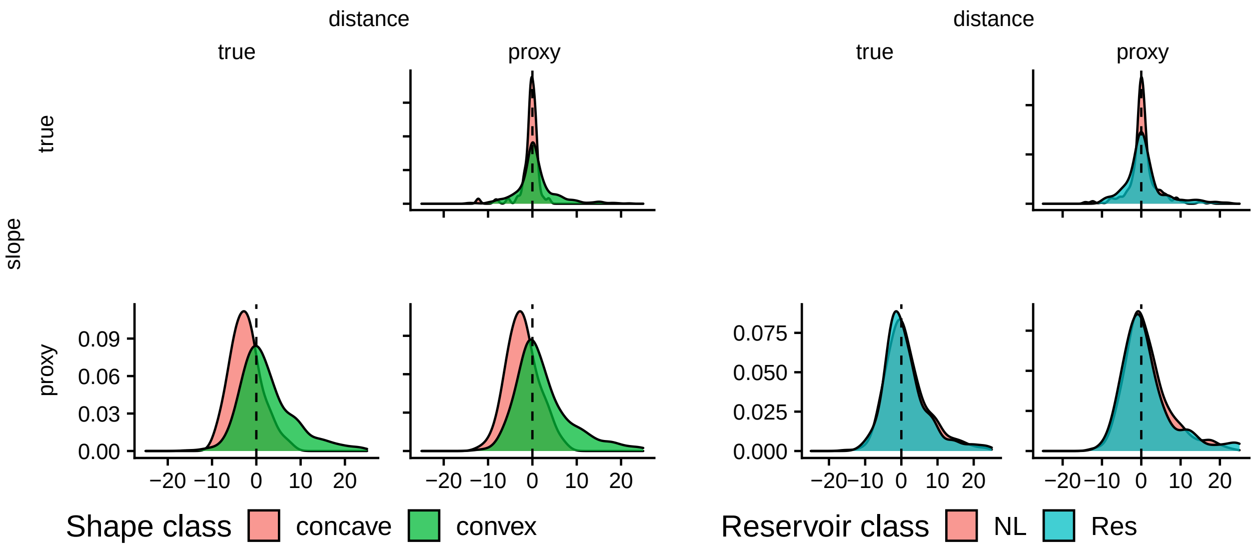

Figure 3: Depth model residuals (residual = observed - predicted) in meters by cross-section shape and reservoir class indicating overprediction of concave and reservoir lakes.

Supporting Information for "Geometric models overestimate lake depth due to imperfect slope measurement"

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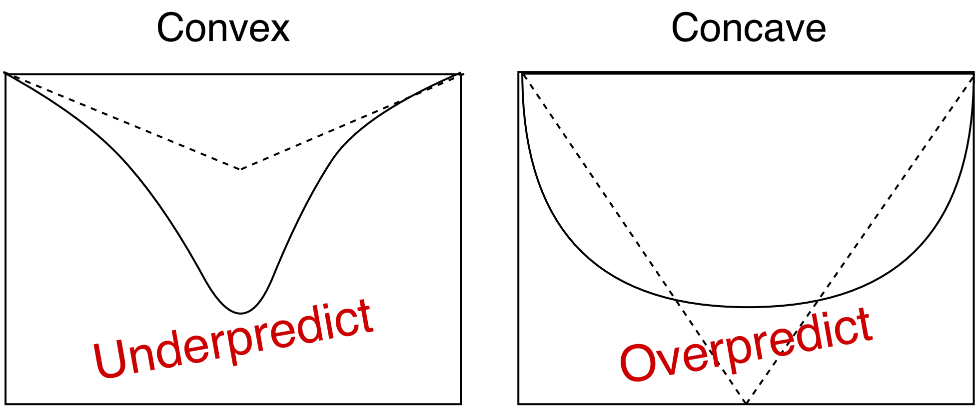

Figure S1. Diagram showing our expectation that slope-based models of lake depth will under predict true depth in convex lakes (left) and over predict true depth in concave lakes (right). Dashed lines represent extrapolated nearshore land slope while solid lines represent the lake bottom.

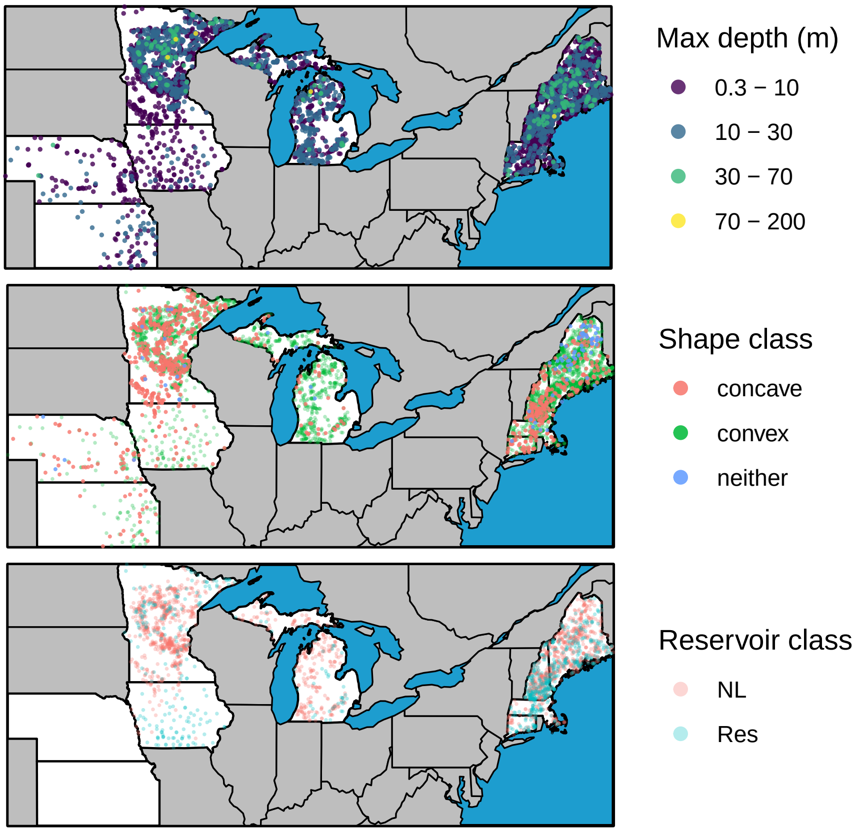

Figure S2. Map of study lakes showing A) lake maximum depth measurements, B) cross-section shape class, and C) reservoir classification.

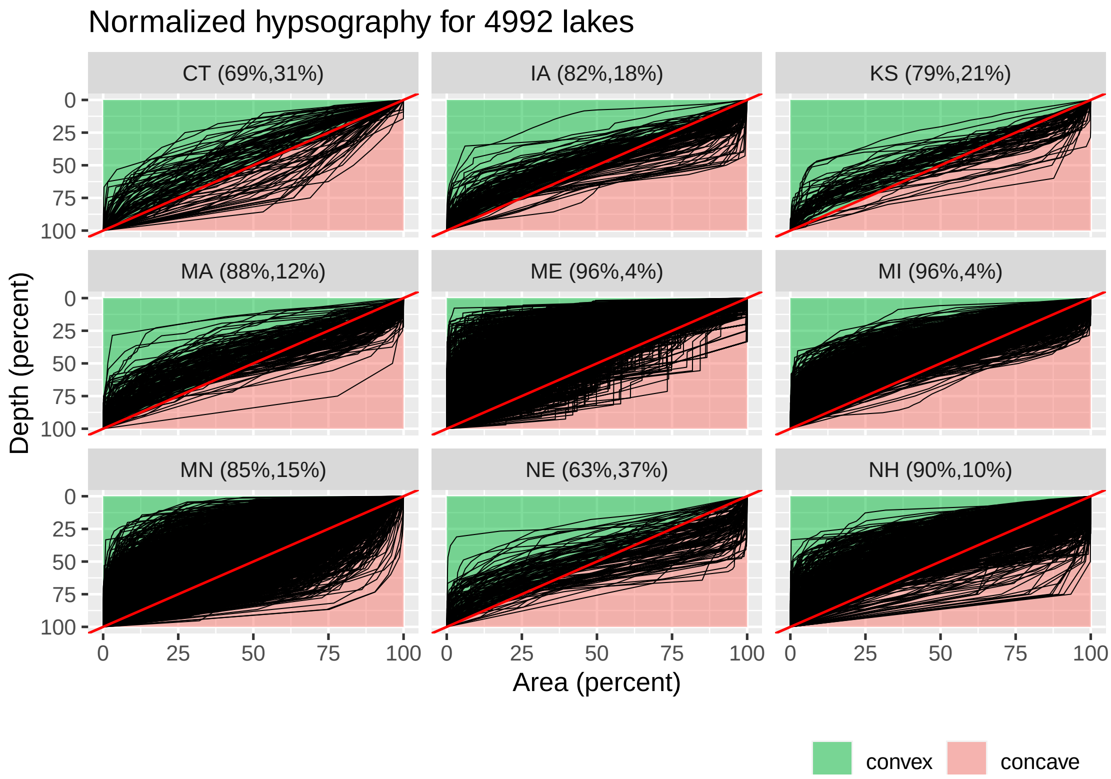

Figure S3. Hypsography classification by state. Numbers on panel labels indicate the percentage of lakes in each state with a convex versus a concave cross-section shape.

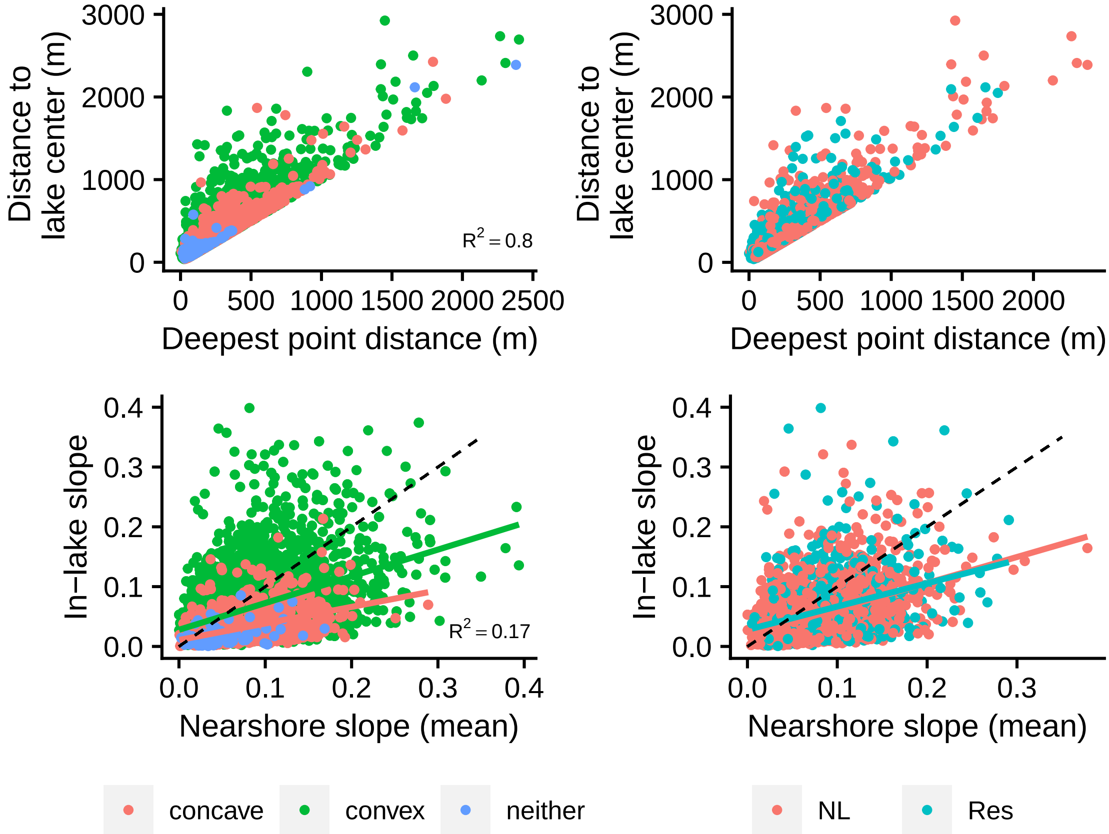

Figure S4. Comparison among lake shape and reservoir classes for A-B) distance to deepest point versus distance to lake visual center and C-D) nearshore slope versus inlake slope. A dashed 1:1 line is shown for comparison. Cross-section shape and reservoir class plots are not identical because not all lakes had a reservoir classification exceeding a 0.75 probability confidence level.

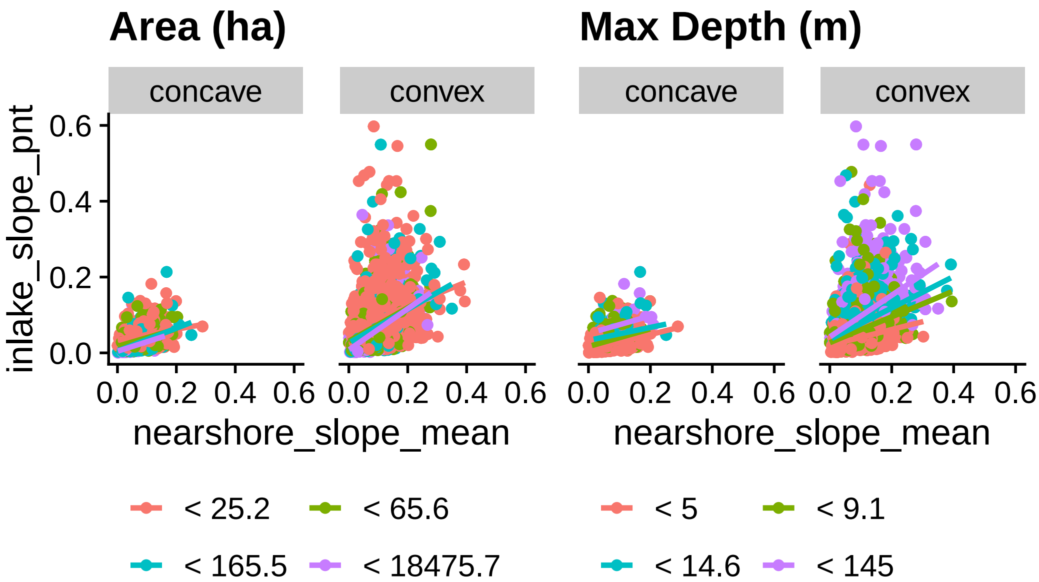

Figure S5. Comparison between in-lake and nearshore slopes in concave and convex lakes of the same size and max depth.

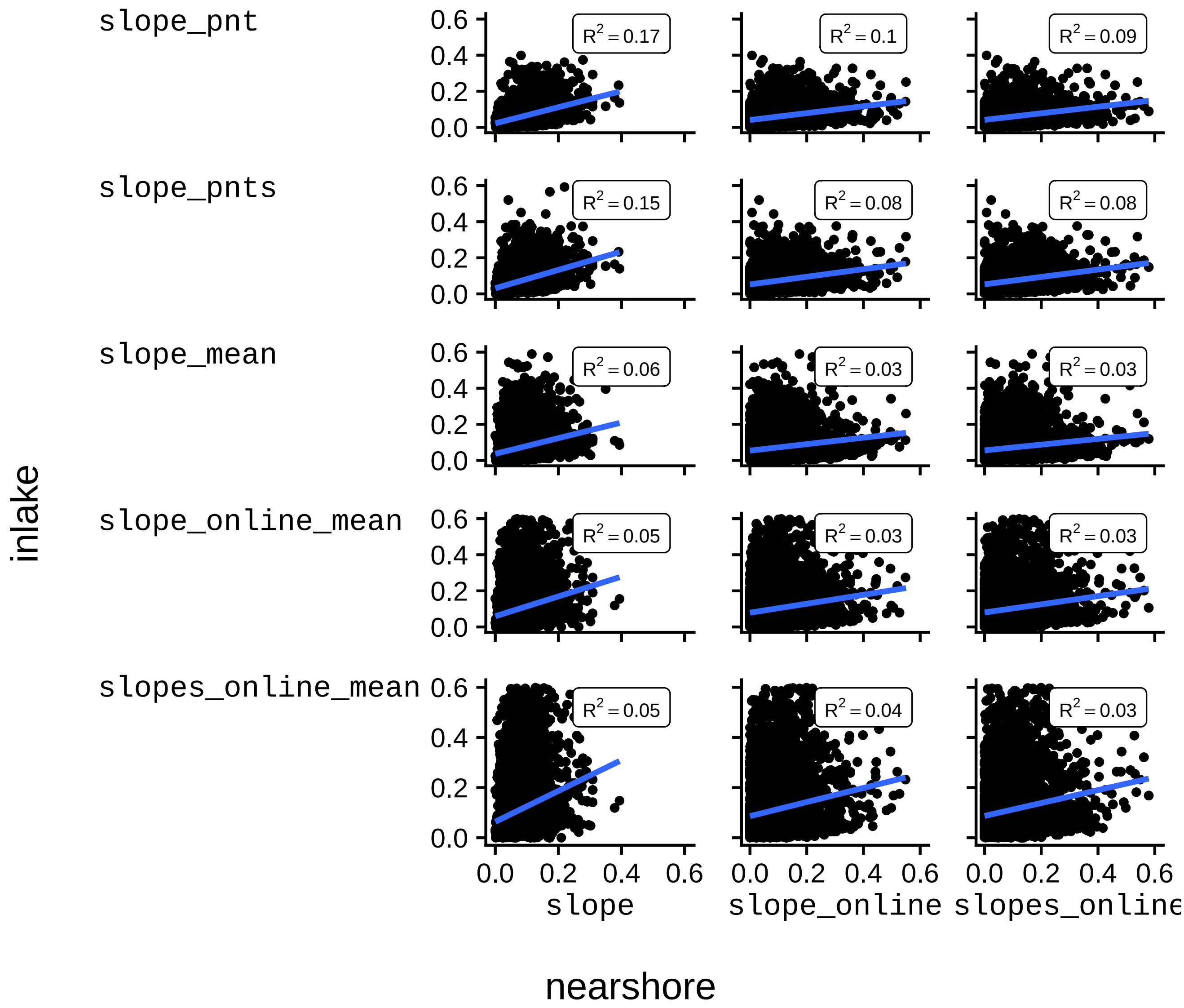

Figure S6. Comparison between in-lake and nearshore slope using different calculation techniques. See Table S2 for explanation of each.

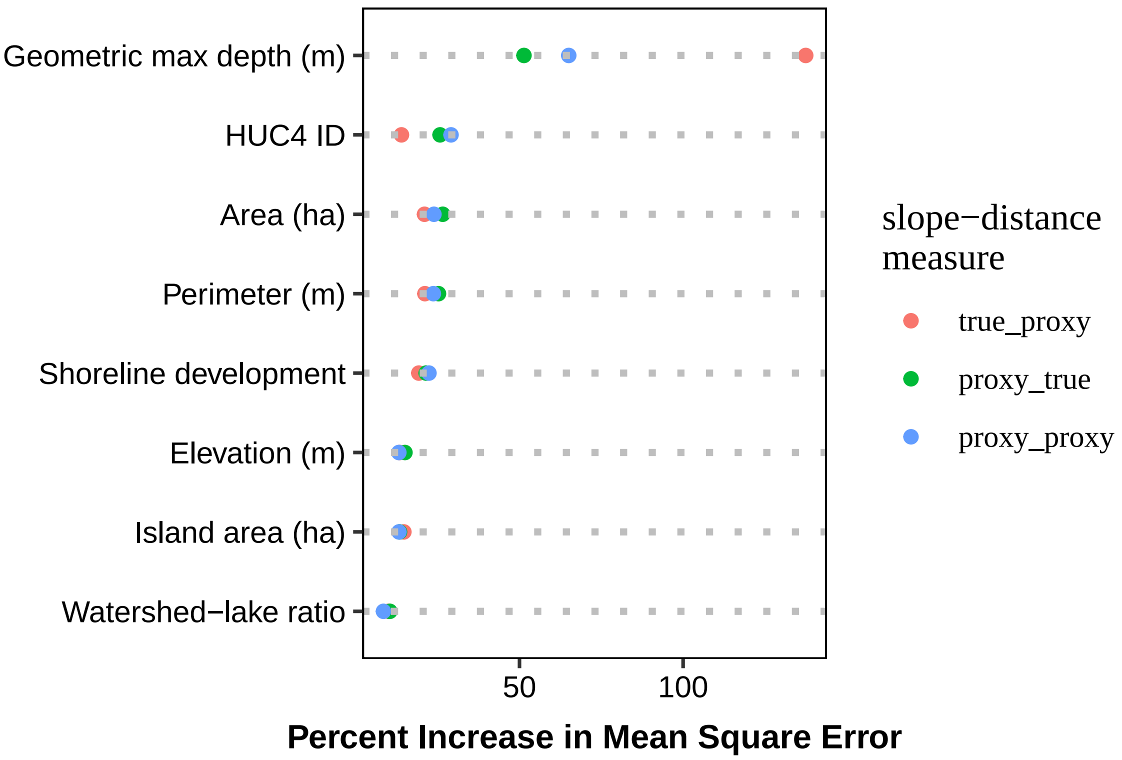

Figure S7. Importance plot for random forest variables showing increase in mean square error. Higher values indicate greater importance to model predictions. See Equation 1 for a definition of geometric max depth. HUC4 ID is a 'dummy' variable of geographic (hydrologic subbasin) location.

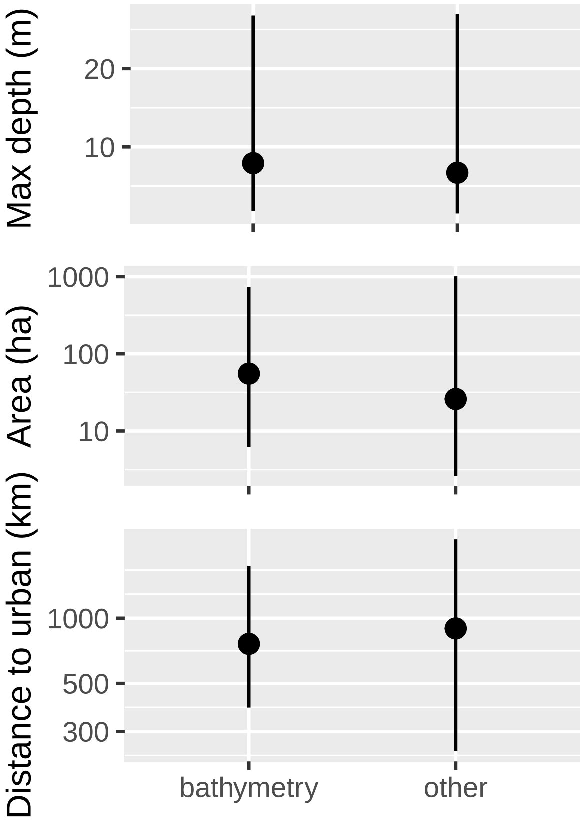

Figure S8. Comparison between characteristics of lakes with bathymetry data against lakes with depth from other sources in the LAGOSUS-Depth product. The distance to urban area metric is calculated using data from the 2018 US Census Urban and Rural Classification.

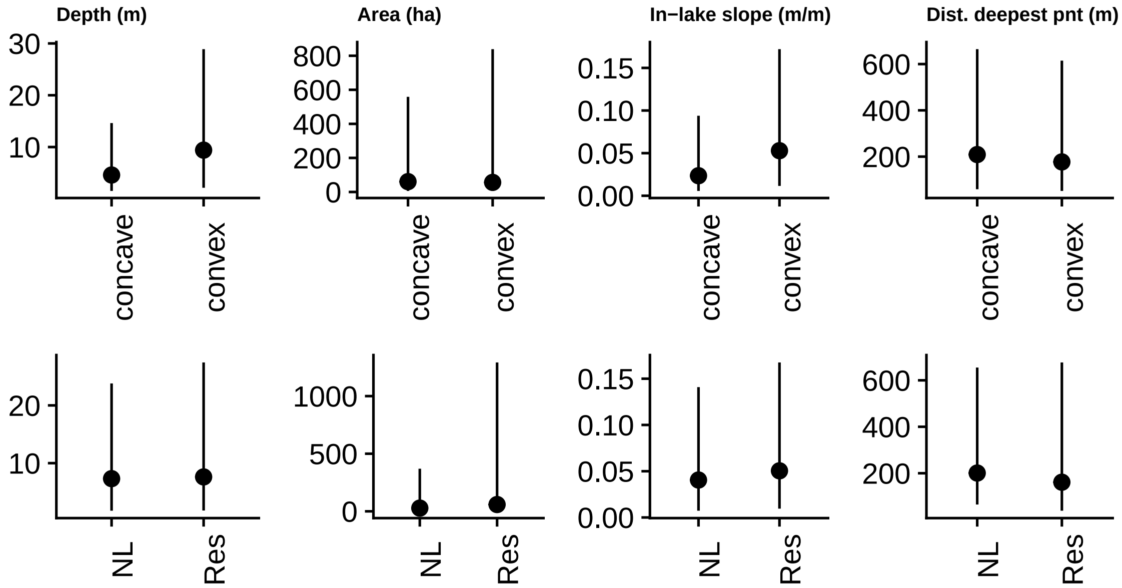

Figure S9. Comparison of lake characteristics according to differences in lake cross-section shape or reservoir status.

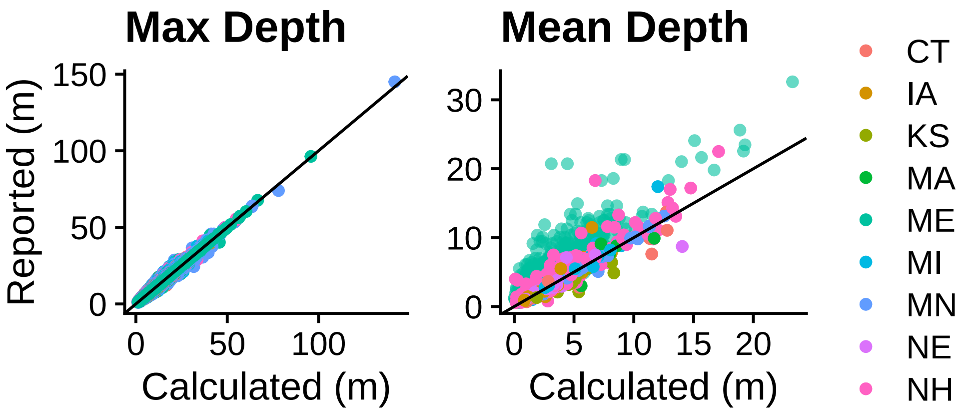

Figure S10. Comparison between reported depth and depth extracted from bathymetry surfaces by US State where reported depths come from the LAGOSUS-Depth product. For this figure, no reported depth values originated from the same source as its corresponding bathymetry-derived value.

Table S1. Summary of lake characteristics for the present study (and for lakes in the contiguous United States). Predictor variables for computing random forest offsets (Equation 2) are printed in bold face. Dashes (-) indicate an identical sample size among this study and that of the contiguous United States.

Variable	Median	Q25	Q75	n
Max depth (m)	8.2 (7)	4.6 (3.7)	14 (12)	4820 (17700)
Area (ha)	55 (33)	21 (11)	140 (100)	4820 (17700)
Island area (ha)	0 (0)	0 (0)	0.18 (0.076)	4820 (17700)
Perimeter (m)	4400 (3500)	2500 (1800)	8100 (7300)	4820 (17700)
Shoreline development	1.7 (1.7)	1.4 (1.4)	2.1 (2.2)	4820 (17700)
Elevation (m)	300 (340)	180 (210)	400 (460)	4820 (17700)
Watershed-lake ratio	7.8 (10)	3.8 (4.4)	17 (29)	4820 (17700)
Deepest point distance (m)	180 (-)	110 (-)	290 (-)	4820 (-)
Mean deepest point distance (m)	140 (-)	87 (-)	230 (-)	4820 (-)
Visual center distance (m)	240 (-)	160 (-)	390 (-)	4820 (-)
Inlake slope (m/m)	0.046 (-)	0.024 (-)	0.079 (-)	4820 (-)
Inlake slope online (m/m)	0.062 (-)	0.029 (-)	0.14 (-)	4800 (-)
Inlake slopes (m/m)	0.057 (-)	0.032 (-)	0.098 (-)	4820 (-)
Inlake slopes online (m/m)	0.07 (-)	0.034 (-)	0.15 (-)	4800 (-)
Mean inlake slope (m/m)	0.043 (-)	0.021 (-)	0.09 (-)	4820 (-)
Nearshore mean slope (m/m)	0.077 (-)	0.051 (-)	0.11 (-)	4820 (-)
Nearshore slope online (m/m)	0.077 (-)	0.038 (-)	0.13 (-)	4590 (-)
Nearshore slopes online (m/m)	0.077 (-)	0.037 (-)	0.13 (-)	4540 (-)

Table S2. Model fit and predictive accuracy metrics (RMSE = root mean square error, R^2 = coefficient of determination, MAPE = mean absolute percent error) for the proxy - proxy combination of geometry metrics (see main text Table 1). Each row shows model metrics when proxy and "true" measures are calculated with slight differences from the default (bolded) used in the main text. `slope_mean` is the mean slope of all inlake or nearshore buffer points. `slope_pnts` is the average `slope_pnt` of all points at maximum depth. `slope_online_mean` is the mean pixel-to-pixel slope of each pixel lying on a straight line either from the single deepest point to the lake shoreline (in the case of inlake slope) or from the lake shoreline point extending to the buffer exterior (in the case of nearshore slope). `slopes_online_mean` is the same as `slope_online_mean` except for all inlake points at maximum depth. `dists_deepest` is the same as `dist_deepest` except distance is calculated for all points at maximum depth.

Inlake slope	Nearshore slope	Inlake distance	RMSE	R^2	MAPE
slope_pnts	slope_mean	dists_deepest	6.2 m	0.38	58 %
slope_pnt	**slope_mean**	**dist_deepest**	**6.4 m**	**0.35**	**59 %**
slope_pnts	slopes_online_mean	dist_deepest	6.4 m	0.32	61 %
slope_online_mean	slope_mean	dists_deepest	6.5 m	0.41	63 %
slope_pnts	slope_mean	dist_deepest	6.7 m	0.44	58 %
slope_online_mean	slope_mean	dist_deepest	6.7 m	0.36	59 %
slope_online_mean	slopes_online_mean	dist_deepest	6.7 m	0.32	66 %
slope_mean	slope_mean	dists_deepest	6.8 m	0.36	59 %
slope_pnt	slopes_online_mean	dists_deepest	6.8 m	0.25	73 %
slope_pnts	slope_online_mean	dist_deepest	6.9 m	0.3	71 %
slope_online_mean	slope_online_mean	dist_deepest	6.9 m	0.32	68 %
slope_online_mean	slope_online_mean	dists_deepest	6.9 m	0.33	65 %
slope_mean	slopes_online_mean	dists_deepest	7 m	0.24	65 %
slope_mean	slope_mean	dist_deepest	7.1 m	0.4	64 %
slopes_online_mean	slope_mean	dist_deepest	7.1 m	0.37	56 %
slope_mean	slope_online_mean	dist_deepest	7.1 m	0.3	69 %
slopes_online_mean	slopes_online_mean	dists_deepest	7.2 m	0.32	63 %
slopes_online_mean	slopes_online_mean	dist_deepest	7.3 m	0.25	64 %
slope_pnt	slope_mean	dists_deepest	7.3 m	0.35	61 %
slopes_online_mean	slope_mean	dists_deepest	7.3 m	0.36	60 %
slope_online_mean	slopes_online_mean	dists_deepest	7.3 m	0.29	58 %
slope_pnts	slope_online_mean	dists_deepest	7.4 m	0.27	64 %
slopes_online_mean	slope_online_mean	dists_deepest	7.4 m	0.33	67 %
slopes_online_mean	slope_online_mean	dist_deepest	7.5 m	0.26	61 %
slope_pnt	slopes_online_mean	dist_deepest	7.5 m	0.33	69 %
slope_mean	slopes_online_mean	dist_deepest	7.6 m	0.26	64 %
slope_pnt	slope_online_mean	dist_deepest	7.7 m	0.27	68 %
slope_pnts	slopes_online_mean	dists_deepest	7.8 m	0.3	65 %
slope_pnt	slope_online_mean	dists_deepest	7.9 m	0.27	67 %
slope_mean	slope_online_mean	dists_deepest	7.9 m	0.31	60 %