Model Archive Summary for Suspended-Sediment Concentration at Station 05330920; Minnesota River at Fort Snelling State Park, Minnesota

This model archive summary (MAS) documents the suspended-sediment concentration (SSC) model developed to compute 15-minute SSC from mean sediment-corrected backscatter (SCB) readings. This is the first model developed for the site.

SITE AND MODEL INFORMATION

Site number: 05330920
Site name: Minnesota River at Fort Snelling State Park, Minnesota (MN), Hennepin County
Location: Latitude N 44°52'13", Longitude W 93°11'32", referenced to NAD27
Hydrologic Unit: 07020012
Drainage area: 16,900 square miles

Date rating model was created: 11/30/2016
Model calibration data period: 3/15/2012–7/25/2016
Model application date: 4/1/2017

DISCLAIMER

This MAS was not independently reviewed but was produced from an approved report "Suspended-sediment concentrations, bedload, particle sizes, surrogate measurements, and annual sediment loads for selected sites in the lower Minnesota River Basin, water years 2011 through 2016" available at (https://pubs.er.usgs.gov/publication/sir20165174).

PHYSICAL SAMPLING EQUIPMENT AND SAMPLING DETAILS

Samples were collected 7–10 times per year during the open-water season (March through October) throughout the range of continuously observed hydrologic conditions. No samples were collected during the winter months because sediment transport is low (Tornes, 1986) in Minnesota when streamflow (Q) is generally contained under ice and receives little sediment input from the surrounding landscape. Water samples were collected using isokinetic samplers, equal-width-increment (EWI) or equal-discharge intervals (EDIs), and depth-integrating techniques, following procedures by Edwards and Glysson (1999). Most samples were collected using a D-96 bag sampler suspended from a boat downstream from the gage. Following collection, samples were transported to the USGS Sediment Laboratory in Iowa City, Iowa, where they were composited into a single sample and analyzed for suspended-sediment concentration (SSC) and particle-size fractions less than 0.0625 millimeters (fines). Analyses results were stored in the National Water Information System (NWIS) database (U.S. Geological Survey, 2017) and can be found at http://mn.water.usgs.gov.

SURROGATE EQUIPMENT AND SETUP DETAILS

Characteristics	
Make	SonTek™/YSI
Model	1.5-megahertz Argonaut-SL acoustic Doppler velocity meter
Serial number	E2322
Measurement interval and returned	Averaged over 12 minutes out of a 15-minute measurement interval

MODEL SUMMARY

Summary of final regression analysis for suspended-sediment concentration at site number 05330920. In the figures and tables below, the "log" in the outputs refers to "$\log_{10}$". Suspended-sediment concentration-based model:

$\log_{10}(SSC) = [(0.0942)(\text{MeanSCB})] - 4.98$,

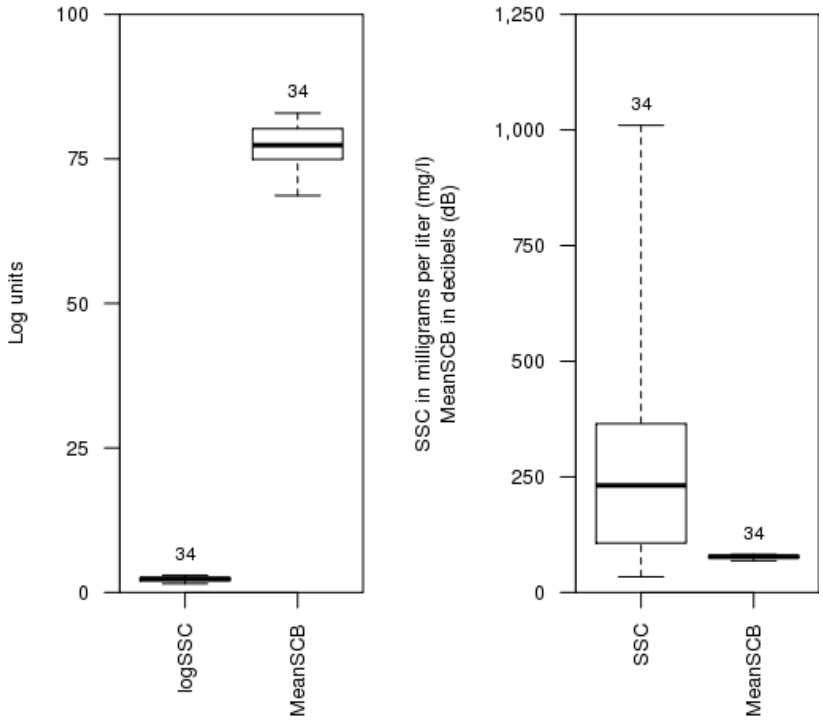
where
SSC = suspended-sediment concentration, in milligrams per liter (mg/L);
SCB = sediment corrected acoustic backscatter (SCB), in decibels.

Model Statistics, Data, and Plots (In the figures and tables below, the "log" in the outputs refers to "$\log_{10}$")

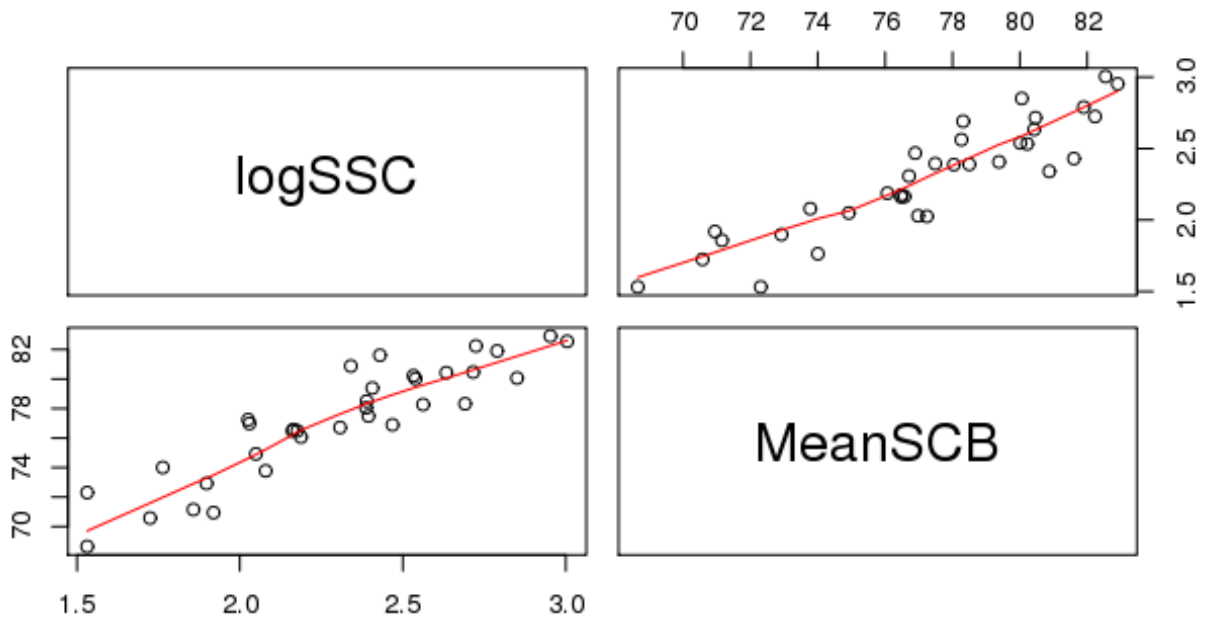
Variable Summary Statistics

	logSSC	SSC	MeanSCB
Minimum	1.53	34	68.7
1st Quartile	2.03	107	74.9
Median	2.36	231	77.4
Mean	2.30	285	77.2
3rd Quartile	2.56	365	80.2
Maximum	3.00	1010	82.9

Box Plots



Exploratory Plots



Basic Model Statistics

Number of Observations	34
Standard error (RMSE)	0.165
Average Model standard percentage error (MSPE)	38.9
Coefficient of determination (R^2)	0.825
Adjusted Coefficient of Determination (Adj. R^2)	0.819
Bias Correction Factor (BCF)	1.07

Explanatory Variables

	Coefficients	Standard Error	t value	Pr(>|t|)
(Intercept)	-4.9800	0.59400	-8.38	1.41e-09
MeanSCB	0.0942	0.00768	12.30	1.22e-13

Correlation Matrix

	Intercept	E.vars
Intercept	1.000	-0.999
E.vars	-0.999	1.000

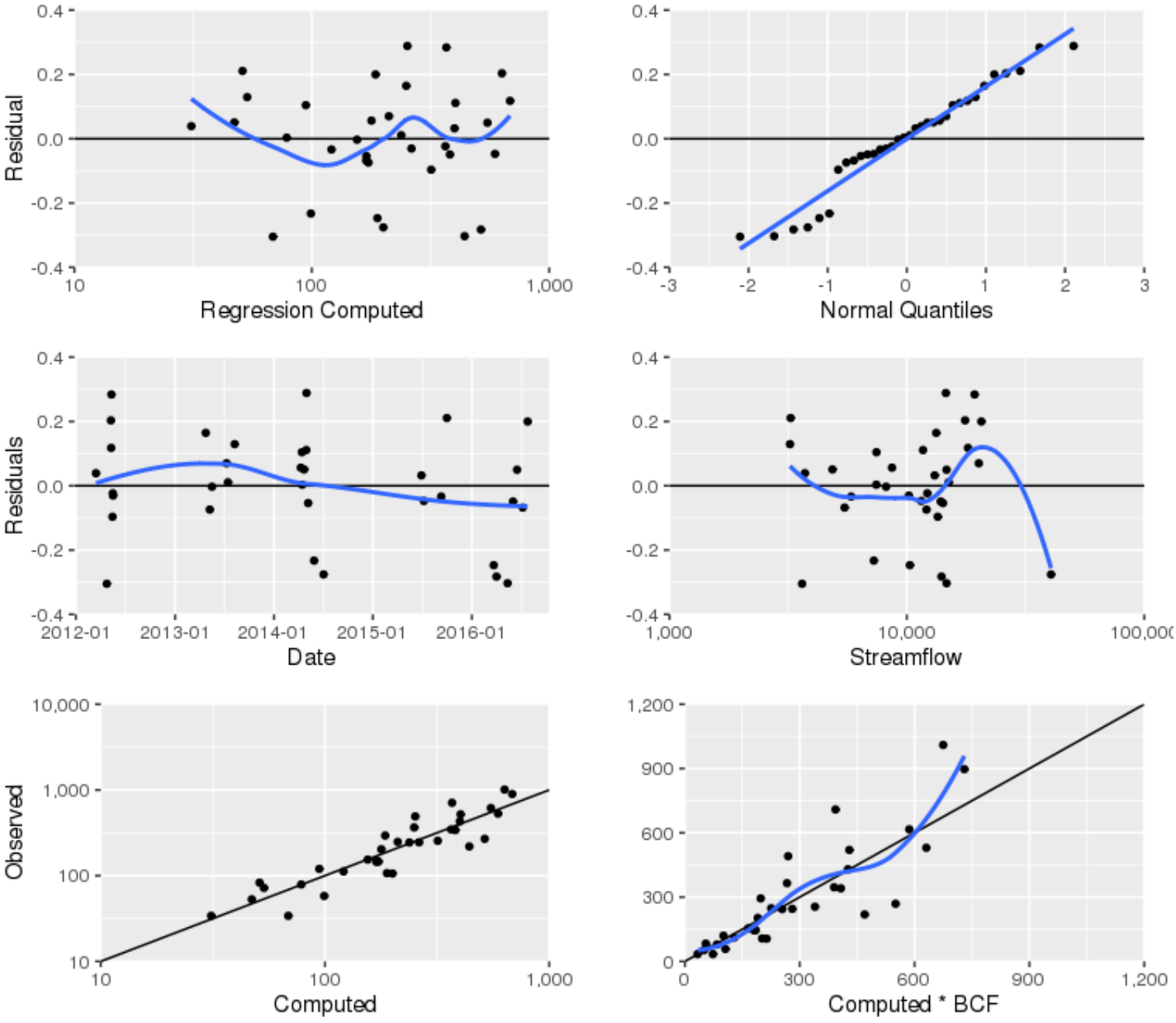
Outlier Test Criteria

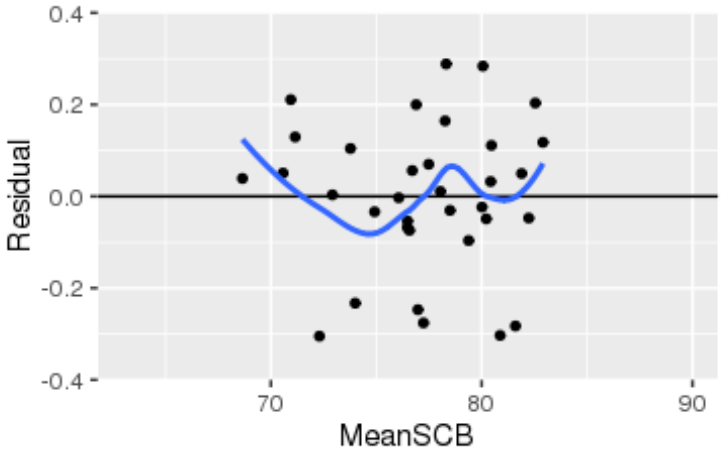
Leverage	Cook's D	DFFITS
0.0882	0.1057	0.3430

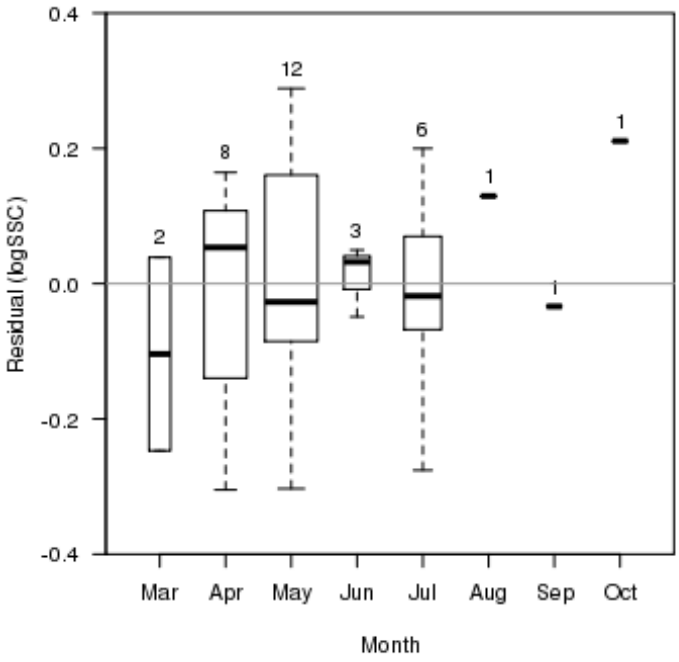
Flagged Observations

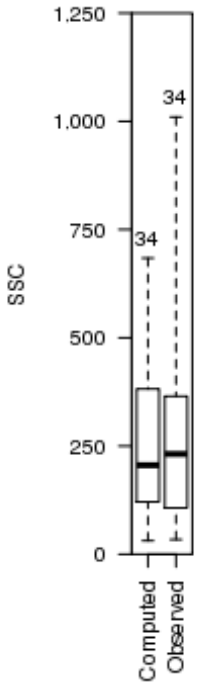
	logSSC	Estimate	Residual	Standard Residual	Studentized Residual	Leverage	Cook's D	DFFITS
3/15/2012 11:55	1.53	1.49	0.0390	0.263	0.259	0.1890	0.00801	0.125
4/24/2012 12:17	1.53	1.84	-0.3050	-1.930	-2.020	0.0819	0.16600	-0.603
5/9/2012 10:55	3.00	2.80	0.2030	1.290	1.310	0.0904	0.08300	0.412
5/10/2012 10:20	2.95	2.84	0.1180	0.751	0.746	0.0991	0.03100	0.247
5/11/2012 10:05	2.85	2.57	0.2840	1.760	1.820	0.0467	0.07600	0.404
8/9/2013 11:30	1.86	1.73	0.1290	0.831	0.827	0.1090	0.04240	0.290
4/22/2014 18:15	1.72	1.67	0.0507	0.328	0.324	0.1250	0.00772	0.122
5/29/2014 10:38	1.76	2.00	-0.2330	-1.450	-1.470	0.0520	0.05750	-0.345
10/1/2015 10:30	1.92	1.71	0.2110	1.360	1.380	0.1150	0.12000	0.496
4/1/2016 12:00	2.43	2.71	-0.2830	-1.780	-1.840	0.0708	0.12000	-0.508
5/12/2016 11:25	2.34	2.64	-0.3030	-1.890	-1.980	0.0581	0.11000	-0.491

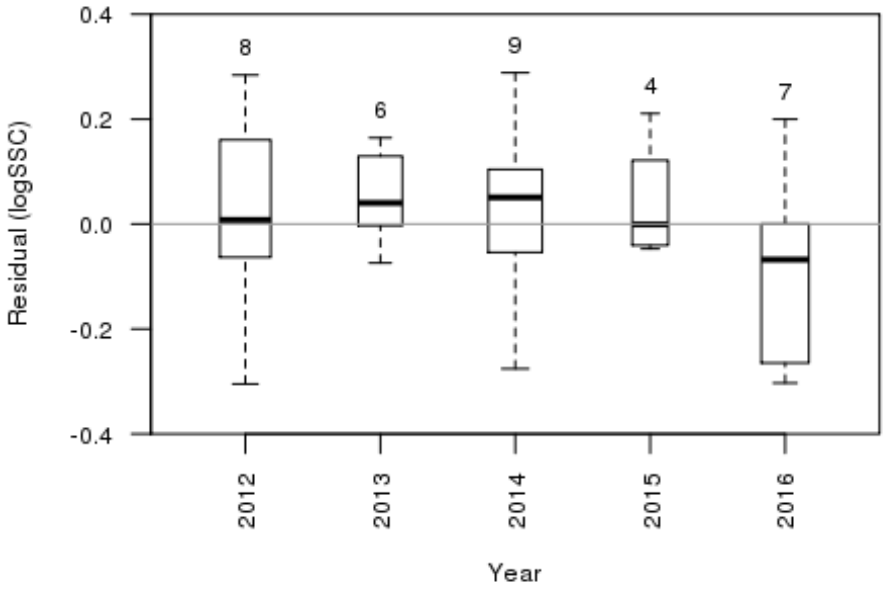
Statistical Plots



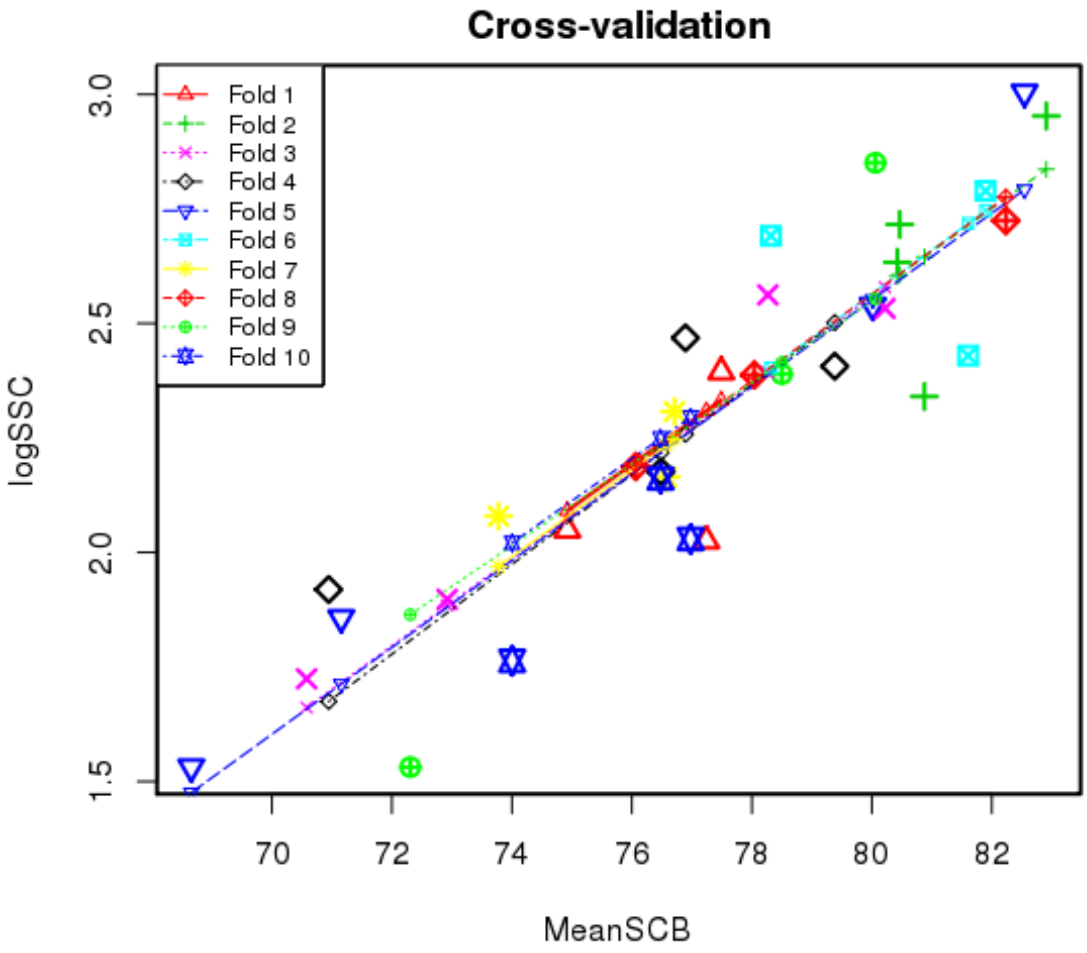

0.4
0.2
0.0
-0.2
-0.4
Residual
70
80
90
MeanSCB


0.4
0.2
0.0
-0.2
-0.4
Residual (logSSC)
2
8
12
3
6
1
1
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Month


1,250
1,000
750
500
250
0
SSC
34
34
Computed
Observed



Cross-Validation



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              Minimum MSE of folds:  0.000909
                 Mean MSE of folds:  0.029200
               Median MSE of folds:  0.028700
              Maximum MSE of folds:  0.066500
(Mean MSE of folds) / (Model MSE):  1.070000
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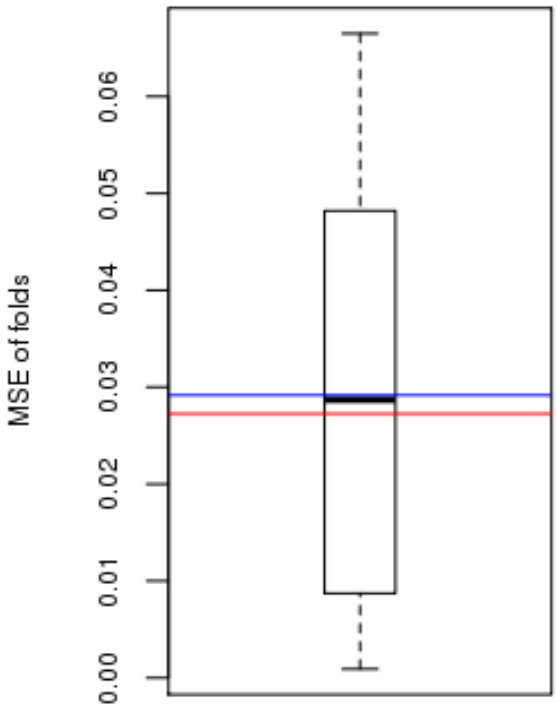

Red line - Model MSE

Blue line - Mean MSE of folds

Model-Calibration Data Set

	Date	logSSC	MeanSCB	SSC	Computed logSSC	Computed SSC	Residual	Normal Quantiles	Censored Values
1	2012-03-15	1.53	68.7	34	1.49	33.2	0.039	0.184	--
2	2012-04-24	1.53	72.3	34	1.84	73.2	-0.305	-2.11	--
3	2012-05-09	3	82.5	1010	2.8	675	0.203	1.25	--
4	2012-05-10	2.95	82.9	897	2.84	730	0.118	0.765	--
5	2012-05-11	2.85	80.1	709	2.57	393	0.284	1.68	--
6	2012-05-15	2.41	79.4	255	2.5	340	-0.0964	-0.867	--
7	2012-05-16	2.54	80	346	2.56	390	-0.0235	-0.184	--
8	2012-05-17	2.39	78.5	245	2.42	281	-0.0306	-0.259	--
9	2013-04-24	2.56	78.3	365	2.4	267	0.165	0.979	--
10	2013-05-09	2.16	76.6	146	2.24	185	-0.0741	-0.765	--
11	2013-05-17	2.19	76.1	154	2.19	166	-0.00305	-0.11	--
12	2013-07-10	2.39	77.5	248	2.32	225	0.0699	0.496	--
13	2013-07-15	2.39	78	244	2.38	254	0.0108	0.0367	--
14	2013-08-09	1.86	71.2	72	1.73	57	0.129	0.867	--
15	2014-04-10	2.31	76.7	203	2.25	190	0.0563	0.415	--
16	2014-04-14	2.08	73.8	120	1.97	101	0.104	0.581	--
17	2014-04-15	1.9	72.9	79	1.89	83.7	0.0033	-0.0367	--
18	2014-04-22	1.72	70.6	53	1.67	50.3	0.0507	0.336	--
19	2014-04-30	2.72	80.5	520	2.6	430	0.111	0.67	--
20	2014-05-01	2.69	78.3	491	2.4	270	0.289	2.11	--
21	2014-05-07	2.18	76.5	150	2.23	181	-0.0539	-0.581	--
22	2014-05-29	1.76	74	58	2	106	-0.233	-0.979	--
23	2014-07-03	2.03	77.2	106	2.3	214	-0.276	-1.25	--
24	2015-06-29	2.63	80.4	430	2.6	426	0.0323	0.11	--
25	2015-07-08	2.72	82.2	530	2.77	631	-0.0473	-0.415	--
26	2015-09-10	2.05	74.9	112	2.08	129	-0.0336	-0.336	--
27	2015-10-01	1.92	70.9	83	1.71	54.5	0.211	1.43	--
28	2016-03-22	2.03	77	107	2.28	202	-0.247	-1.11	--
29	2016-04-01	2.43	81.6	269	2.71	550	-0.283	-1.43	--
30	2016-05-12	2.34	80.9	219	2.64	470	-0.303	-1.68	--
31	2016-06-01	2.53	80.2	341	2.58	407	-0.049	-0.496	--
32	2016-06-16	2.79	81.9	616	2.74	586	0.0498	0.259	--
33	2016-07-07	2.16	76.5	145	2.23	181	-0.0678	-0.67	--
34	2016-07-25	2.47	76.9	294	2.27	198	0.2	1.11	--

Definitions

SSC: Suspended sediment concentration (SSC) in mg/l (80154)
MeanSCB: sediment corrected backscatter (SCB) in dB (72238)

App Version 1.0

References

Edwards, T.K., and Glysson, G.D., 1999, Field methods for measurement of fluvial sediment: U.S. Geological Survey Techniques of Water-Resources Investigations, book 3, chap. C2, 89 p. [Also available at http://pubs.usgs.gov/twri/twri3-c2/.]

Tornes, L.H., 1986, Suspended sediment in Minnesota streams: U.S. Geological Survey Water-Resources Investigations Report 85–4312, 33 p. [Also available at http://pubs.er.usgs.gov/publication/wri854312.]

U.S. Geological Survey, 2017, National Water Information System (NWISWeb)—USGS surface-water data for Minnesota: U.S. Geological Survey database, accessed January, 2017, at http://waterdata.usgs.gov/mn/nwis/sw/. [Also available at http://dx.doi.org/10.5066/F7P55KJN.]