

Appendix 2.1. Model Archive Summary for Total Dissolved Solids Concentration at U.S. Geological Survey site 07144100; Little Arkansas River near Sedgwick, Kansas, during May 1998 through December 2019

This model archive summary summarizes the total dissolved solids model developed to compute hourly or daily total dissolved solids. Model development methods follow U.S. Geological Survey (USGS) guidance from Office of Surface Water/Office of Water Quality Technical Memoranda and USGS Techniques and Methods, book 3, chap. C4 (Rasmussen and others, 2009).

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Site and Model Information

Site Number: 07144100

Site Name: Little Arkansas River near Sedgwick, Kansas

Location: Latitude 37°52'59", longitude 97°25'27" referenced to North American Datum of 1927, in NE 1/4 NW 1/4 NW 1/4 sec.15, T.25 S., R.1 W., Sedgwick County, Kansas; hydrologic unit 11030012.

Equipment: A Sutron Satlink II High Data Rate Collection Platform and a Design Analysis Water Log H350/355 nonsubmersible pressure transducer transfers real-time stage and water-quality data via satellite. The primary reference gage is a Type-A wire-weight gage located on the downstream bridge handrail. Check-bar elevation is 33.614 feet. The orifice is enclosed in a well-screen and attached to a concrete pier on the left downstream side of the bridge. Gage height was measured during May 1998 through December 2019. A YSI 6600 water-quality monitor equipped with water temperature, specific conductance, pH, dissolved oxygen, and turbidity (a YSI Model 6026 [September 1998 through December 2006] and YSI Model 6136 [July 2004 through March 2015]) sensors collected data during April 1998 through March 2015. A YSI EXO2 water-quality monitor equipped with water temperature, specific conductance, pH, dissolved oxygen, turbidity, and fluorescent dissolved organic matter sensors collected data during September 2014 through December 2019. A Hach Nitratex monitor collected nitrate data during March 2012 through December 2019.

Date model was developed: June 1, 2020

Model calibration data period: May 1, 1998 through December 11, 2019

Model Data

All data were collected using USGS protocols (U.S. Geological Survey, variously dated; Wagner and others, 2006; Sauer and Turnipseed, 2010; Turnipseed and Sauer, 2010) and are stored in the National Water Information System (NWIS) database (U.S. Geological Survey, 2021). Explanatory variables were evaluated individually and in combination. Potential explanatory variables included streamflow, water temperature, specific conductance, pH, dissolved oxygen, YSI EXO2 turbidity, nitrate, and fluorescent dissolved organic matter. Seasonal components (sine and cosine variables) also were evaluated as explanatory variables.

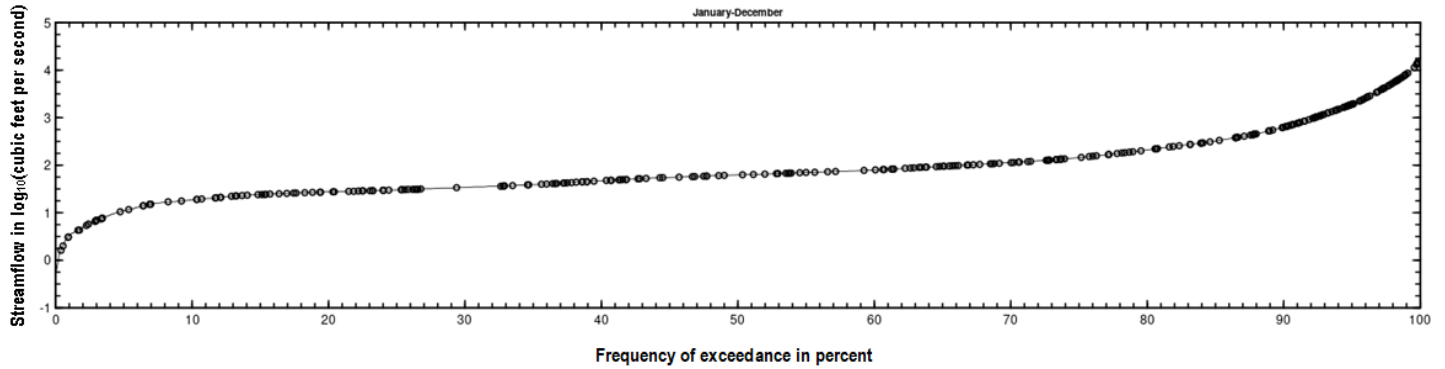
The regression model is based on 315 concomitant values of discretely collected total dissolved solids and continuously measured specific conductance during May 1998 through December 2019. Discrete samples were collected over a range of streamflow and specific conductance conditions. No samples had concentrations that were below laboratory detection limits. Summary statistics and the complete model-calibration dataset are provided below. Outliers and influential points were identified using studentized residuals, DFITS, Cook's D (Cook, 1977), and leverage. Outliers in previously published versions of this model (Christensen and others, 2003; Rasmussen and others, 2016) were examined and retained in the dataset if there were no clear issues, explanations, or conditions that would cause a result to be invalid for model calibration. All samples were retained in the dataset.

Total Dissolved Solids

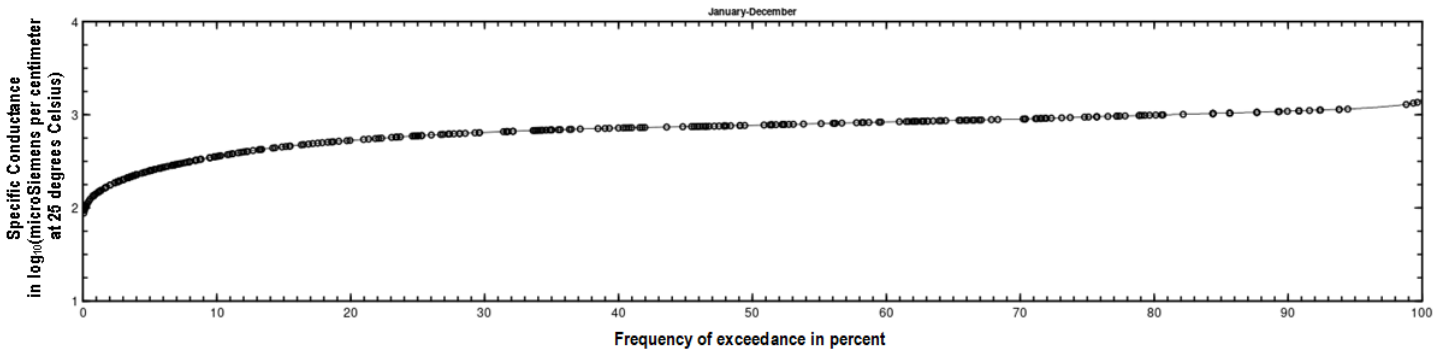
Discrete samples were collected from the downstream side of the bridge or instream within 50 feet of the bridge using equal-width-increment, multi-vertical, single vertical or grab-dip methods following U.S. Geological Survey (variously

dated) and Rasmussen and others (2014). Discrete samples were collected on a semifixed to event-based schedule ranging from 5 to 24 samples per year with a FISP US DH-95 or D-95 with a Teflon bottle, cap, and nozzle depth-integrating sampler, a DH-81 with a Teflon bottle, cap, and nozzle hand sampler or a grab sample with a Teflon bottle depending on sample location. Samples were analyzed for total dissolved solids by the Wichita Municipal Water and Wastewater Laboratory in Wichita, Kansas, or the USGS National Water Quality Laboratory according to standard methods (American Public Health Association and others, 1995).

Total Dissolved Solids Samples Plotted on Streamflow Duration Curve



Total Dissolved Solids Samples Plotted on Specific Conductance Duration Curve



Continuous Data

Concomitant specific conductance values were time interpolated. If no concomitant continuous data were available within 2 hours of sample collection, the sample was not included in the dataset.

Model Development

Ordinary least squares regression analysis was done using R (version 4.0.0) programming language (R Core Team, 2020) to relate discretely collected total dissolved solids to specific conductance and other continuously measured data. The distribution of residuals was examined for normality and plots of residuals (the difference between the measured and model calculated values) compared to model-computed total dissolved solids were examined for homoscedasticity (departures from zero did not change substantially over the range of model calculated values). Previously published explanatory variables were also strongly considered for continuity; however, the best explanatory variable(s) was ultimately selected.

Specific conductance was selected as the best predictor of total dissolved solids based on residual plots, high coefficient of determination (R^2), and low model standard percentage error (MSPE). Specific conductance was positively related to total dissolved solids because it measures water's capacity to conduct an electrical current and is related to the concentration of ionized substances in water (Hem, 1992).

Model Summary

Summary of final total dissolved solids regression analysis at USGS site number 07144100:

Total dissolved solids-based model:

$$\log_{10}(TDS) = 0.93 \times \log_{10}(SC) - 0.0205$$

where,

\log_{10} = logarithm base 10;

TDS = total dissolved solids, in milligrams per liter (mg/L); and

SC = specific conductance, in microsiemens per centimeter at 25 degrees Celsius ($\mu\text{S}/\text{cm}$)

The log-transformed model may be retransformed to original units so that TDS can be calculated directly. The retransformation introduces a bias in the calculated constituent. This bias may be corrected using Duan's bias correction factor (BCF; Duan, 1983). For this model, the calculated BCF is 1. The retransformed model, accounting for BCF is:

$$TDS = 0.9539 \times SC^{0.93}$$

Model Statistics, Data, and Plots

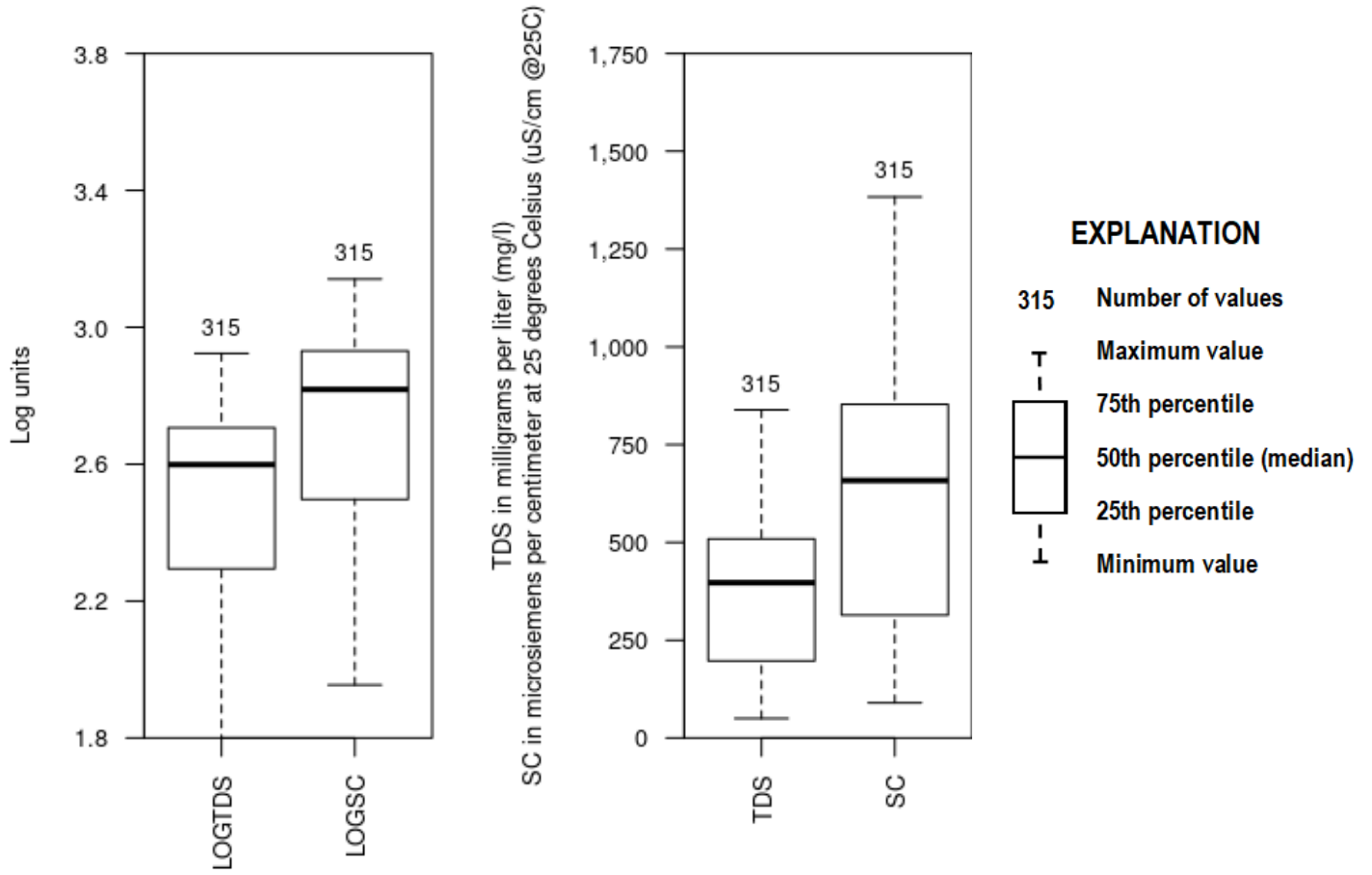
Model

$$\text{LOGTDS} = + 0.93 * \text{LOGSC} - 0.0205$$

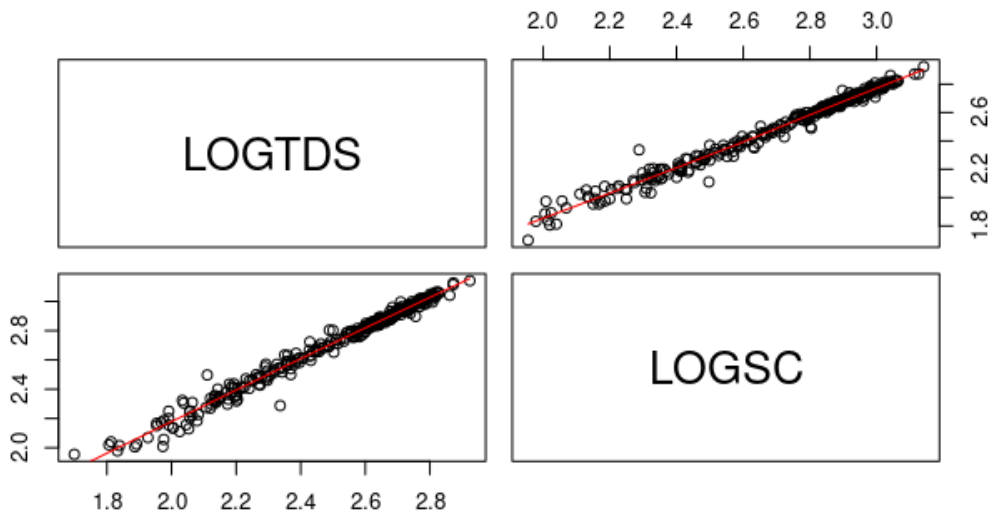
Variable Summary Statistics

	LOGTDS	TDS	LOGSC	SC
Minimum	1.70	50	1.96	90.2
1st Quartile	2.29	196	2.50	314.0
Median	2.60	397	2.82	658.0
Mean	2.50	367	2.71	607.0
3rd Quartile	2.71	509	2.93	853.0
Maximum	2.92	839	3.14	1380.0

Box Plots



Exploratory Plots



Basic Model Statistics

Number of Observations	315
Standard error (RMSE)	0.0341
Average Model standard percentage error (MSPE)	7.85
Coefficient of determination (R ²)	0.983
Adjusted Coefficient of Determination (Adj. R ²)	0.983
Bias Correction Factor (BCF)	1

Explanatory Variables

	Coefficients	Standard Error	t value	Pr(> t)
(Intercept)	-0.0205	0.01860	-1.1	2.71e-01
LOGSC	0.9300	0.00682	136.0	1.19e-280

Correlation Matrix

	Intercept	E.vars
Intercept	1.000	-0.995
E.vars	-0.995	1.000

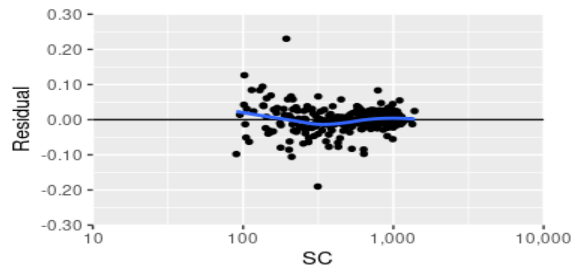
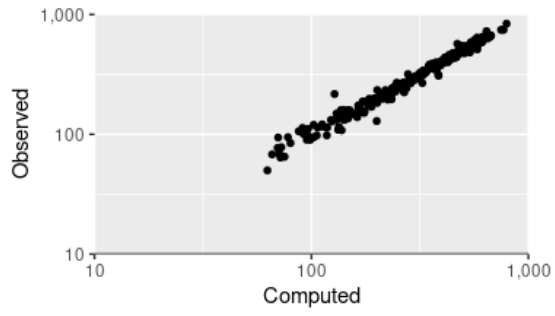
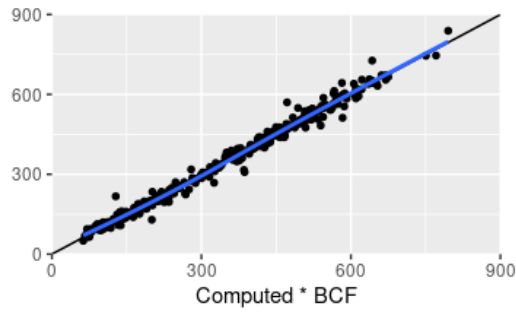
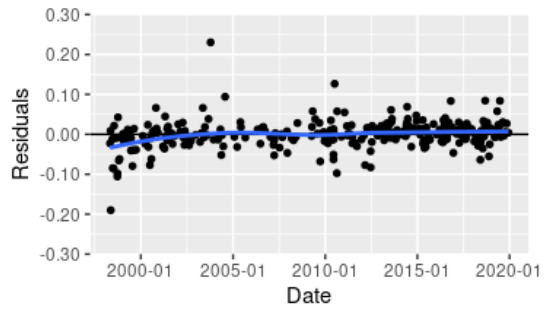
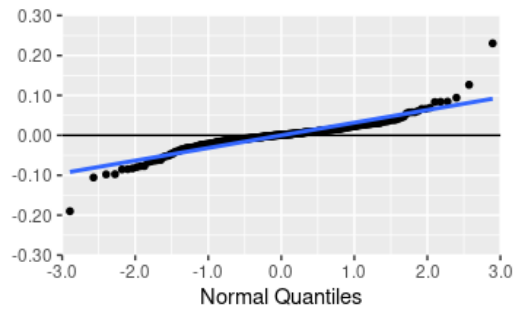
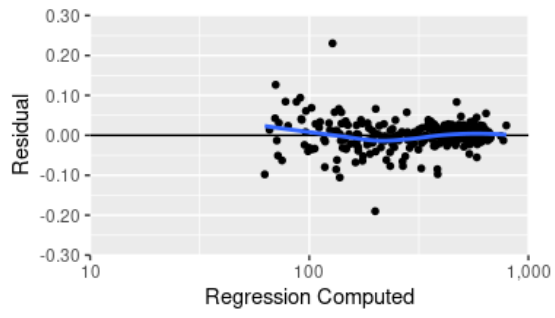
Outlier Test Criteria

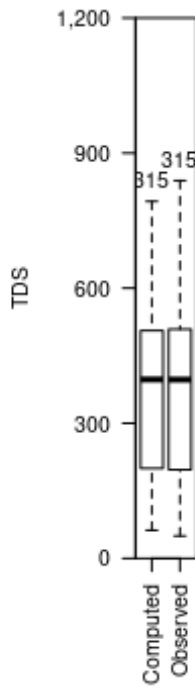
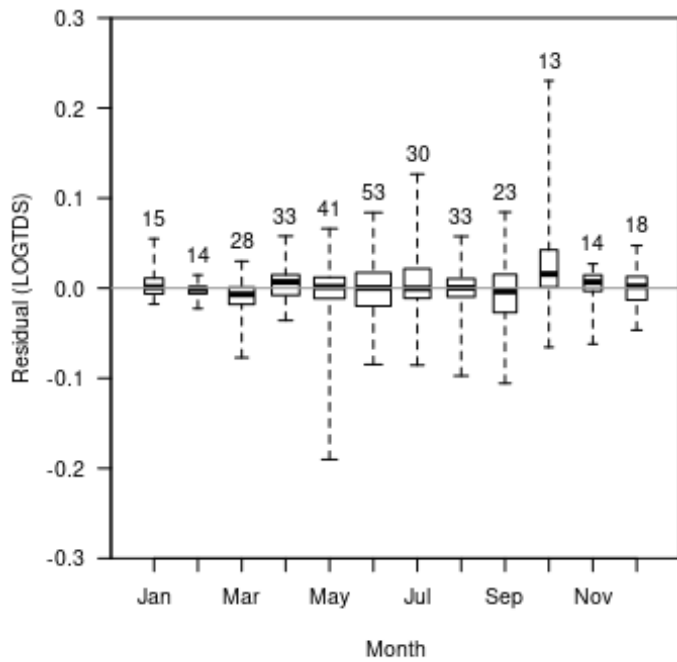
Leverage	Cook's D	DFFITS
0.019	0.195	0.159

Flagged Observations

	LOGTDS	Estimate	Residual	Standard Residual	Studentized Residual	Leverage	Cook's D	DFFITS
5/14/1998 9:25	2.11	2.3	-0.19	-5.59	-5.89	0.00496	0.078	-0.416
7/10/1998 10:45	2.04	2.12	-0.0855	-2.52	-2.54	0.00967	0.031	-0.251
9/22/1998 10:15	2.03	2.14	-0.106	-3.12	-3.16	0.00912	0.0447	-0.303
9/25/1998 10:10	1.7	1.8	-0.0978	-2.91	-2.95	0.0259	0.113	-0.481
10/5/1998 10:20	1.89	1.84	0.0426	1.26	1.26	0.023	0.0188	0.194
11/5/1998 13:40	2.06	2.13	-0.0619	-1.83	-1.83	0.00955	0.0161	-0.18
7/20/1999 10:45	1.99	2.07	-0.0796	-2.35	-2.37	0.0116	0.0324	-0.256
10/26/2000 11:35	2.2	2.14	0.0662	1.95	1.96	0.00925	0.0178	0.19
6/6/2001 10:10	1.83	1.82	0.0139	0.414	0.413	0.0245	0.00215	0.0655
10/14/2003 11:00	2.34	2.11	0.23	6.8	7.35	0.0103	0.24	0.748
7/27/2004 9:45	2.05	1.96	0.0941	2.78	2.82	0.0166	0.0655	0.366
4/28/2009 10:05	2.17	2.12	0.0578	1.71	1.71	0.00993	0.0146	0.171
9/24/2009 11:15	2.14	2.21	-0.0679	-2	-2.01	0.00697	0.014	-0.168
6/13/2010 15:20	1.84	1.85	-0.013	-0.385	-0.385	0.0225	0.00171	-0.0584
6/13/2010 19:20	1.81	1.86	-0.0508	-1.51	-1.51	0.0222	0.0258	-0.228
6/14/2010 9:40	1.81	1.88	-0.0629	-1.87	-1.87	0.0211	0.0375	-0.275
7/6/2010 9:00	1.97	1.85	0.127	3.76	3.84	0.0228	0.165	0.587
8/19/2010 12:15	2.49	2.59	-0.0974	-2.86	-2.9	0.00354	0.0146	-0.173
7/29/2013 10:30	2.05	1.98	0.0609	1.8	1.81	0.0154	0.0254	0.226
8/7/2013 9:45	1.89	1.86	0.0309	0.918	0.918	0.0219	0.00946	0.137
6/12/2014 11:40	2.08	2.01	0.0689	2.04	2.05	0.0142	0.0298	0.246
10/24/2016 10:10	2.76	2.67	0.0834	2.45	2.47	0.00461	0.0139	0.168
9/6/2018 12:00	1.98	1.89	0.0844	2.5	2.52	0.0202	0.0646	0.362
5/1/2019 13:10	2.2	2.15	0.0578	1.7	1.71	0.00888	0.013	0.162
5/23/2019 12:20	1.93	1.9	0.0237	0.704	0.703	0.0195	0.00494	0.0993
6/24/2019 10:40	2.03	1.94	0.0839	2.49	2.51	0.0175	0.055	0.334

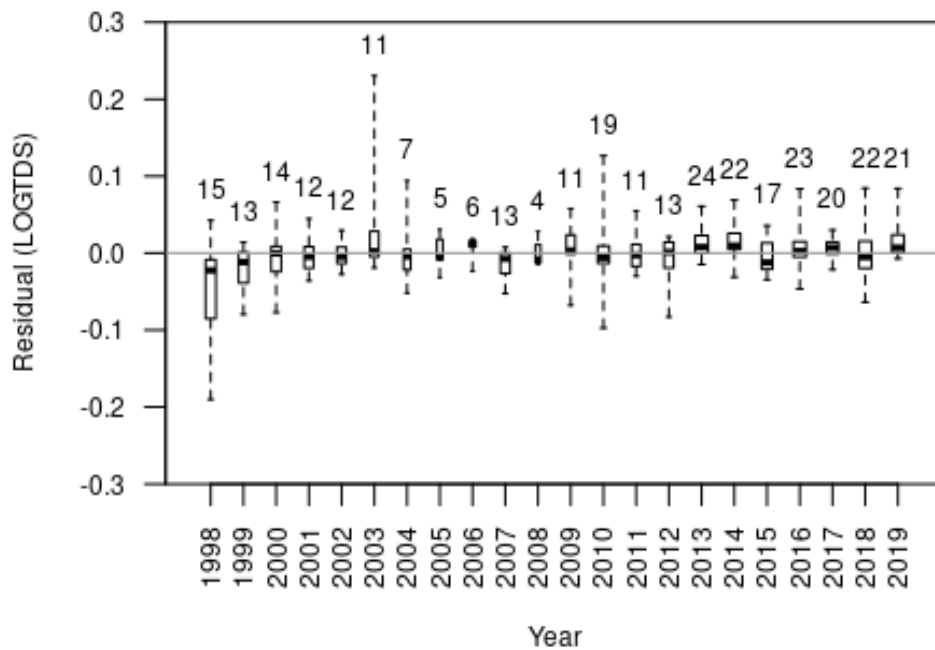
Statistical Plots





EXPLANATION

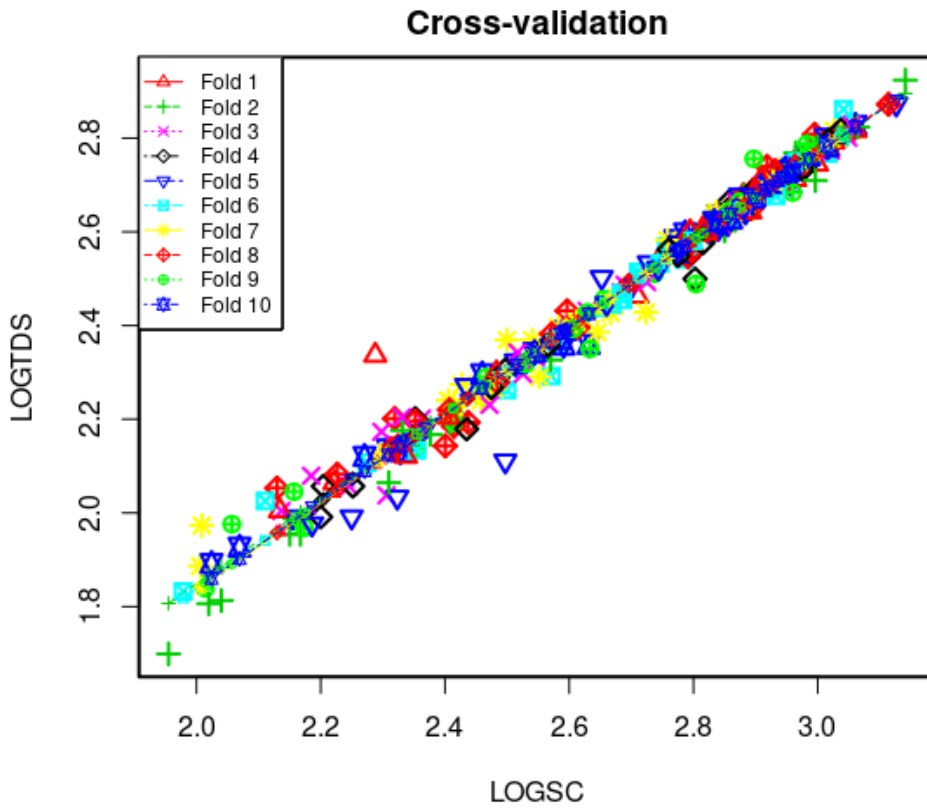
- 315 Number of values
- T Maximum value
- 75th percentile
- 50th percentile (median)
- 25th percentile
- Minimum value



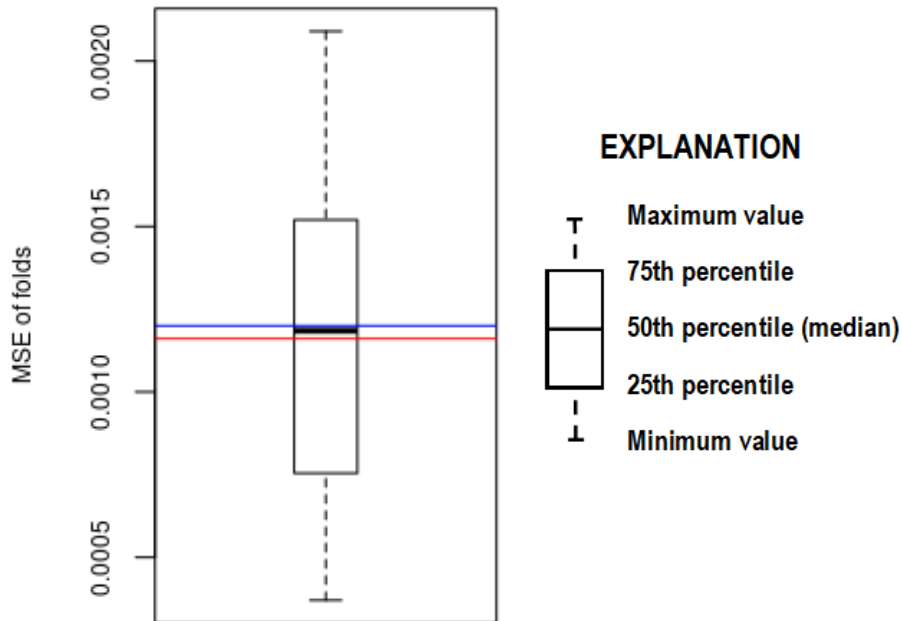
EXPLANATION

- 15 Number of values
- T Maximum value
- 75th percentile
- 50th percentile (median)
- 25th percentile
- Minimum value

Cross Validation



Minimum MSE of folds: 0.00037
Mean MSE of folds: 0.00120
Median MSE of folds: 0.00119
Maximum MSE of folds: 0.00209
(Mean MSE of folds) / (Model MSE): 1.03000



Red line - Model MSE
Blue line - Mean MSE of folds

Model-Calibration Dataset

	Date	LOGTDS	LOGSC	TDS	SC	Computed LOGTDS	Computed TDS	Residual	Normal Quantiles
1	5/1/1998	2.7	2.96	506	903	2.73	535	-0.0226	-1.02
2	5/11/1998	2.74	2.96	550	914	2.73	541	0.00876	0.444
3	5/14/1998	2.11	2.5	129	314	2.3	200	-0.19	-2.89
4	6/16/1998	2.7	2.94	505	877	2.72	521	-0.0119	-0.637
5	6/24/1998	2.5	2.8	316	634	2.58	385	-0.0848	-2.1
6	7/10/1998	2.04	2.31	109	202	2.12	133	-0.0855	-2.18
7	7/20/1998	2.56	2.75	364	568	2.54	347	0.0216	0.954
8	8/6/1998	2.68	2.91	475	817	2.69	487	-0.00968	-0.552
9	9/15/1998	2.7	2.93	496	853	2.7	507	-0.00854	-0.497
10	9/22/1998	2.03	2.32	108	210	2.14	138	-0.106	-2.57
11	9/25/1998	1.7	1.96	50	90.2	1.8	62.8	-0.0978	-2.4
12	10/5/1998	1.89	2.01	77	101	1.84	70	0.0426	1.62
13	10/22/1998	2.36	2.63	229	428	2.43	267	-0.0655	-1.79
14	11/5/1998	2.06	2.31	116	204	2.13	134	-0.0619	-1.68
15	12/4/1998	2.63	2.86	428	728	2.64	438	-0.00872	-0.524
16	1/12/1999	2.81	3.04	643	1100	2.81	643	0.00105	0.00795
17	2/1/1999	2.27	2.49	187	306	2.29	196	-0.0182	-0.905
18	2/19/1999	2.79	3.02	610	1040	2.78	611	0.000849	-0.0159
19	3/16/1999	2.87	3.13	746	1340	2.89	771	-0.0128	-0.717
20	4/7/1999	2.44	2.66	274	454	2.45	282	-0.0117	-0.627
21	4/16/1999	2.14	2.31	137	203	2.12	134	0.0118	0.561
22	5/24/1999	2.14	2.32	139	211	2.14	139	0.00283	0.112
23	6/18/1999	2.26	2.5	183	316	2.3	202	-0.0406	-1.44
24	6/21/1999	2.15	2.35	142	223	2.16	146	-0.0101	-0.58
25	7/20/1999	1.99	2.25	98	178	2.07	118	-0.0796	-1.98
26	8/3/1999	1.95	2.17	90	147	1.99	99	-0.0399	-1.42
27	8/19/1999	2.75	2.96	557	914	2.73	541	0.014	0.687
28	9/28/1999	2.18	2.41	153	259	2.22	168	-0.0389	-1.4
29	2/9/2000	2.81	3.05	643	1120	2.81	651	-0.00395	-0.249
30	3/7/2000	2.25	2.46	178	287	2.26	185	-0.0143	-0.78
31	3/28/2000	2.19	2.41	156	255	2.22	165	-0.0242	-1.1
32	5/19/2000	2.82	3.03	655	1060	2.79	622	0.0237	1.02
33	5/31/2000	2.43	2.67	267	464	2.46	288	-0.0316	-1.3
34	6/28/2000	2.29	2.57	196	372	2.37	235	-0.0771	-1.87
35	7/20/2000	2.63	2.86	426	725	2.64	436	-0.00889	-0.533
36	7/28/2000	2.29	2.55	195	356	2.35	225	-0.0617	-1.65
37	8/16/2000	2.65	2.87	450	745	2.65	447	0.0039	0.168
38	9/8/2000	2.71	2.93	514	849	2.7	505	0.00876	0.452
39	9/25/2000	2.71	2.93	512	857	2.71	510	0.00344	0.152
40	10/26/2000	2.2	2.32	159	208	2.14	137	0.0662	1.98
41	11/8/2000	2.51	2.71	327	515	2.5	317	0.0146	0.717
42	12/4/2000	2.81	3.04	639	1090	2.8	635	0.00413	0.184
43	3/14/2001	2.3	2.53	198	335	2.33	213	-0.0304	-1.23
44	4/13/2001	2.46	2.71	290	513	2.5	316	-0.0359	-1.38
45	4/26/2001	2.81	3	643	989	2.76	582	0.0447	1.65
46	5/8/2001	2.6	2.82	397	666	2.6	403	-0.00545	-0.324
47	6/4/2001	2.25	2.46	178	288	2.27	185	-0.0152	-0.813
48	6/6/2001	1.83	1.98	68	95.2	1.82	66.1	0.0139	0.676
49	6/23/2001	2.06	2.22	116	167	2.05	111	0.0194	0.893
50	7/11/2001	2.68	2.91	483	815	2.69	486	-0.0016	-0.136
51	8/2/2001	2.65	2.89	451	769	2.66	461	-0.00818	-0.47
52	8/28/2001	2.68	2.9	474	790	2.67	472	0.00298	0.12
53	9/20/2001	1.95	2.15	90	141	1.98	95.4	-0.024	-1.09

54	10/31/2001	2.7	2.93	501	853	2.7	507	-0.00411	-0.257
55	1/10/2002	2.81	3.01	640	1030	2.78	606	0.0251	1.07
56	2/21/2002	2.81	3.04	651	1100	2.81	643	0.00697	0.315
57	4/9/2002	2.78	2.98	603	958	2.75	565	0.0295	1.26
58	4/22/2002	2.21	2.41	164	259	2.22	168	-0.00792	-0.444
59	5/13/2002	2.54	2.78	348	610	2.57	371	-0.0267	-1.15
60	5/22/2002	2.43	2.63	270	425	2.42	265	0.00866	0.426
61	6/6/2002	2.39	2.59	245	393	2.39	247	-0.00194	-0.168
62	6/13/2002	2.15	2.34	141	221	2.16	144	-0.00858	-0.506
63	7/9/2002	2.62	2.86	420	717	2.63	432	-0.0104	-0.599
64	8/15/2002	2.55	2.79	352	618	2.57	376	-0.0274	-1.16
65	9/19/2002	2.62	2.86	414	717	2.63	431	-0.0165	-0.847
66	12/18/2002	2.87	3.11	745	1300	2.87	751	-0.00189	-0.152
67	3/20/2003	2.26	2.48	184	301	2.28	193	-0.0191	-0.917
68	4/17/2003	2.83	3.06	672	1150	2.82	670	0.00282	0.0956
69	4/23/2003	2.6	2.82	397	654	2.6	396	0.00233	0.0876
70	5/14/2003	2.37	2.5	234	316	2.3	202	0.0661	1.92
71	5/29/2003	2.47	2.68	296	482	2.47	298	-0.00222	-0.192
72	6/11/2003	2.6	2.83	399	673	2.61	407	-0.00724	-0.417
73	6/24/2003	2.77	2.99	593	967	2.75	570	0.0184	0.858
74	7/30/2003	2.72	2.95	523	889	2.72	527	-0.00198	-0.176
75	9/3/2003	2.27	2.43	188	267	2.24	173	0.0385	1.51
76	10/14/2003	2.34	2.29	217	194	2.11	128	0.23	2.89
77	12/11/2003	2.8	3.05	632	1120	2.81	653	-0.0132	-0.738
78	3/9/2004	2.13	2.33	135	213	2.14	140	-0.0132	-0.748
79	3/30/2004	2.77	3	584	1010	2.77	592	-0.00427	-0.274
80	4/26/2004	2.78	3	597	989	2.76	582	0.0123	0.599
81	5/13/2004	2.19	2.44	156	274	2.25	176	-0.0519	-1.56
82	5/26/2004	2.78	3.01	601	1030	2.78	606	-0.00217	-0.184
83	6/22/2004	2.19	2.41	156	259	2.22	168	-0.0302	-1.21
84	7/27/2004	2.05	2.13	113	135	1.96	91.3	0.0941	2.4
85	1/27/2005	2.34	2.54	217	349	2.34	221	-0.00632	-0.357
86	3/23/2005	2.14	2.35	137	226	2.17	148	-0.0316	-1.28
87	5/27/2005	2.3	2.46	198	288	2.27	185	0.0306	1.34
88	6/6/2005	2.29	2.47	195	293	2.27	188	0.0178	0.835
89	8/31/2005	2.35	2.56	226	366	2.36	231	-0.00826	-0.479
90	5/2/2006	2.65	2.86	451	732	2.64	440	0.0121	0.589
91	6/26/2006	2.24	2.46	174	287	2.26	184	-0.0237	-1.07
92	7/27/2006	2.64	2.84	432	692	2.62	418	0.0158	0.78
93	8/15/2006	2.61	2.82	411	658	2.6	399	0.0146	0.707
94	8/23/2006	2.57	2.77	370	582	2.55	356	0.0184	0.87
95	9/27/2006	2.66	2.88	457	750	2.65	450	0.00792	0.383
96	1/10/2007	2.71	2.94	509	873	2.71	518	-0.0064	-0.366
97	2/5/2007	2.75	2.99	564	974	2.76	574	-0.00622	-0.349
98	3/12/2007	2.6	2.85	400	708	2.63	427	-0.0266	-1.13
99	3/21/2007	2.62	2.86	420	728	2.64	438	-0.0168	-0.858
100	3/27/2007	2.39	2.65	243	442	2.44	275	-0.0526	-1.59
101	4/2/2007	2.06	2.25	114	176	2.07	117	-0.0101	-0.589
102	4/18/2007	2.18	2.37	153	234	2.18	152	0.00299	0.128
103	7/11/2007	1.99	2.2	98	159	2.02	106	-0.0333	-1.32
104	8/16/2007	2.61	2.83	412	684	2.61	413	0.000325	-0.0318
105	9/6/2007	2.74	2.98	552	954	2.75	563	-0.00724	-0.409
106	11/26/2007	2.69	2.91	490	815	2.69	486	0.0048	0.225
107	12/6/2007	2.74	2.96	544	906	2.73	536	0.00753	0.349
108	12/13/2007	2.23	2.47	170	296	2.28	190	-0.0466	-1.51
109	3/6/2008	2.28	2.48	190	305	2.29	195	-0.01	-0.57

110	4/14/2008	2.45	2.67	279	467	2.46	290	-0.0149	-0.802
111	5/29/2008	2.15	2.34	140	218	2.15	143	-0.00661	-0.383
112	6/30/2008	2.37	2.54	234	347	2.34	220	0.0283	1.19
113	4/6/2009	2.6	2.83	400	670	2.61	405	-0.0044	-0.282
114	4/13/2009	2.53	2.73	342	535	2.52	329	0.0187	0.881
115	4/28/2009	2.17	2.3	149	198	2.12	131	0.0578	1.83
116	6/16/2009	2.43	2.6	270	395	2.39	248	0.0382	1.49
117	7/30/2009	2.23	2.41	168	259	2.22	168	0.00176	0.0637
118	9/9/2009	2.06	2.2	114	160	2.03	107	0.0286	1.23
119	9/24/2009	2.14	2.4	139	251	2.21	163	-0.0679	-1.83
120	11/3/2009	2.32	2.51	208	327	2.32	208	0.00159	0.0398
121	11/19/2009	2.67	2.89	469	780	2.67	467	0.00335	0.144
122	12/1/2009	2.74	2.96	550	921	2.73	545	0.0056	0.282
123	12/17/2009	2.77	3.02	585	1040	2.78	610	-0.0168	-0.87
124	1/6/2010	2.82	3.06	655	1150	2.82	670	-0.00831	-0.488
125	1/19/2010	2.78	3.02	598	1040	2.78	610	-0.00726	-0.426
126	2/4/2010	2.73	2.98	543	949	2.75	560	-0.0121	-0.667
127	2/23/2010	2.74	3	555	997	2.77	586	-0.0226	-1.03
128	3/10/2010	2.64	2.85	433	713	2.63	430	0.00473	0.216
129	3/11/2010	2.57	2.79	373	619	2.57	376	-0.00257	-0.2
130	4/14/2010	2.79	3.02	623	1040	2.78	610	0.0105	0.515
131	4/23/2010	2.59	2.77	389	590	2.56	360	0.0348	1.42
132	5/13/2010	2.33	2.55	215	351	2.35	223	-0.0136	-0.769
133	6/9/2010	1.99	2.16	98	143	1.98	96.5	0.00825	0.4
134	6/13/2010	1.84	2.01	69	103	1.85	71.3	-0.013	-0.727
135	6/14/2010	1.81	2.02	64	105	1.86	72.2	-0.0508	-1.54
136	6/14/2010	1.81	2.04	65	110	1.88	75.4	-0.0629	-1.72
137	6/15/2010	2.11	2.27	128	188	2.09	125	0.0131	0.627
138	6/16/2010	2.14	2.31	137	206	2.13	136	0.00573	0.29
139	7/6/2010	1.97	2.01	94	102	1.85	70.5	0.127	2.57
140	8/19/2010	2.49	2.8	308	637	2.59	387	-0.0974	-2.28
141	8/25/2010	2.5	2.65	318	449	2.44	279	0.0575	1.75
142	11/16/2010	2.48	2.7	304	501	2.49	309	-0.00597	-0.34
143	1/19/2011	2.86	3.04	727	1100	2.81	643	0.0549	1.72
144	3/7/2011	2.68	2.88	476	759	2.66	455	0.0208	0.917
145	3/16/2011	2.68	2.91	478	808	2.68	482	-0.00264	-0.208
146	4/6/2011	2.75	2.98	565	956	2.75	564	0.00208	0.0716
147	5/2/2011	2.74	2.97	553	936	2.74	553	0.00135	0.0239
148	6/7/2011	2.64	2.84	439	692	2.62	418	0.023	0.992
149	6/21/2011	2.71	2.96	515	920	2.73	544	-0.0227	-1.05
150	6/22/2011	2.69	2.92	491	841	2.7	501	-0.00698	-0.4
151	8/15/2011	2.36	2.58	228	382	2.38	240	-0.0217	-1.01
152	9/22/2011	2.36	2.59	228	390	2.39	245	-0.0301	-1.19
153	12/20/2011	2.32	2.53	208	338	2.33	215	-0.0128	-0.697
154	2/6/2012	2.45	2.66	284	461	2.46	287	-0.00265	-0.216
155	3/1/2012	2.35	2.63	224	430	2.43	268	-0.0772	-1.92
156	4/7/2012	2.4	2.58	249	382	2.38	241	0.0161	0.791
157	4/17/2012	2.65	2.86	450	725	2.64	436	0.0149	0.738
158	6/18/2012	2.33	2.57	212	372	2.37	234	-0.0423	-1.46
159	6/19/2012	2.43	2.72	268	529	2.51	325	-0.0829	-2.03
160	7/12/2012	2.65	2.89	446	781	2.67	468	-0.0193	-0.929
161	7/19/2012	2.64	2.83	432	683	2.61	413	0.0213	0.942
162	9/11/2012	2.63	2.84	426	685	2.62	414	0.0137	0.657
163	10/24/2012	2.6	2.82	401	663	2.6	401	0.00123	0.0159
164	11/7/2012	2.69	2.92	487	826	2.69	492	-0.00335	-0.233
165	11/14/2012	2.72	2.93	522	860	2.71	511	0.0106	0.524

166	12/12/2012	2.72	2.93	523	854	2.7	508	0.0141	0.697
167	1/16/2013	2.74	2.94	547	880	2.72	523	0.0212	0.929
168	1/29/2013	2.68	2.9	483	791	2.67	473	0.0105	0.497
169	2/13/2013	2.71	2.93	509	860	2.71	511	-0.000526	-0.0956
170	3/12/2013	2.72	2.94	525	878	2.72	521	0.00455	0.2
171	3/13/2013	2.77	3.02	593	1050	2.79	615	-0.0148	-0.791
172	3/27/2013	2.82	3.06	666	1160	2.83	675	-0.00457	-0.29
173	4/15/2013	2.81	3.04	644	1100	2.81	643	0.00228	0.0796
174	4/24/2013	2.57	2.76	370	571	2.54	349	0.0263	1.13
175	5/6/2013	2.65	2.87	451	745	2.65	447	0.00488	0.241
176	5/15/2013	2.58	2.78	376	599	2.56	365	0.0138	0.667
177	5/21/2013	2.46	2.66	286	453	2.45	282	0.00791	0.374
178	5/28/2013	2.66	2.86	460	718	2.63	432	0.0283	1.21
179	6/5/2013	2.49	2.69	307	489	2.48	302	0.00781	0.357
180	6/13/2013	2.74	2.96	545	907	2.73	537	0.00782	0.366
181	6/24/2013	2.92	3.14	839	1380	2.9	795	0.0246	1.05
182	7/9/2013	2.63	2.86	424	721	2.64	434	-0.00871	-0.515
183	7/29/2013	2.05	2.16	111	143	1.98	96.8	0.0609	1.87
184	8/7/2013	1.89	2.02	78	106	1.86	72.9	0.0309	1.36
185	8/15/2013	2	2.14	101	137	1.97	92.7	0.0386	1.54
186	8/29/2013	2.6	2.82	394	665	2.6	403	-0.00814	-0.461
187	10/24/2013	2.72	2.94	526	878	2.72	521	0.00553	0.274
188	10/30/2013	2.4	2.61	249	411	2.41	257	-0.0128	-0.707
189	11/25/2013	2.72	2.94	524	863	2.71	513	0.0107	0.533
190	12/11/2013	2.79	3.03	619	1060	2.79	621	3.76E-05	-0.0637
191	1/14/2014	2.79	3.03	619	1060	2.79	621	3.76E-05	-0.0557
192	2/20/2014	2.78	3.02	607	1040	2.78	610	-0.000775	-0.112
193	3/17/2014	2.77	3	592	998	2.77	587	0.005	0.249
194	4/9/2014	2.77	2.99	591	989	2.76	582	0.00813	0.391
195	4/14/2014	2.76	2.99	578	967	2.75	570	0.00734	0.332
196	5/14/2014	2.56	2.78	359	597	2.56	364	-0.00479	-0.299
197	5/15/2014	2.67	2.9	470	791	2.67	473	-0.00138	-0.128
198	5/29/2014	2.73	2.94	541	869	2.71	516	0.0219	0.967
199	6/3/2014	2.6	2.79	396	612	2.57	372	0.028	1.18
200	6/5/2014	2.64	2.85	438	707	2.63	426	0.0133	0.647
201	6/9/2014	2.2	2.36	159	231	2.18	150	0.0257	1.09
202	6/12/2014	2.08	2.18	120	153	2.01	103	0.0689	2.03
203	6/24/2014	2.58	2.76	382	573	2.54	350	0.0387	1.56
204	7/10/2014	2.61	2.82	406	657	2.6	398	0.00998	0.488
205	7/15/2014	2.68	2.88	476	760	2.66	456	0.0203	0.905
206	7/24/2014	2.68	2.89	477	783	2.67	469	0.00906	0.47
207	8/4/2014	2.7	2.92	497	823	2.69	491	0.00687	0.299
208	8/7/2014	2.68	2.9	478	786	2.67	470	0.00859	0.417
209	9/3/2014	1.97	2.17	93	149	2	100	-0.0311	-1.24
210	10/16/2014	2.58	2.78	377	598	2.56	365	0.0158	0.769
211	12/9/2014	2.74	2.92	549	829	2.69	494	0.0473	1.68
212	12/15/2014	2.77	2.96	587	921	2.73	545	0.0337	1.4
213	2/11/2015	2.82	3.04	657	1090	2.8	637	0.0146	0.727
214	2/25/2015	2.78	3.02	605	1040	2.78	608	-0.000912	-0.12
215	4/6/2015	2.78	3	604	999	2.77	588	0.0133	0.637
216	4/16/2015	2.79	2.98	613	960	2.75	566	0.0357	1.46
217	4/22/2015	2.56	2.8	360	627	2.58	381	-0.0234	-1.06
218	5/5/2015	2.64	2.88	440	763	2.66	457	-0.0154	-0.824
219	5/20/2015	2.13	2.35	136	226	2.17	148	-0.0347	-1.34
220	5/27/2015	2.17	2.38	147	238	2.19	155	-0.0213	-0.979
221	6/10/2015	2.56	2.8	362	627	2.58	381	-0.021	-0.967

222	6/17/2015	2.12	2.34	132	217	2.15	142	-0.0314	-1.26
223	6/29/2015	2.66	2.87	458	735	2.64	442	0.0172	0.824
224	7/13/2015	2.37	2.59	235	385	2.38	242	-0.0123	-0.676
225	8/3/2015	2.66	2.88	458	763	2.66	458	0.00167	0.0557
226	8/17/2015	2.55	2.77	354	596	2.56	363	-0.00987	-0.561
227	8/27/2015	2.27	2.47	185	298	2.28	191	-0.0127	-0.687
228	9/8/2015	2.51	2.74	324	546	2.52	335	-0.0133	-0.759
229	11/17/2015	2.64	2.84	439	687	2.62	415	0.0257	1.1
230	1/19/2016	2.65	2.88	451	755	2.65	453	-5.00E-04	-0.0796
231	3/16/2016	2.73	2.94	534	878	2.72	521	0.0119	0.57
232	4/20/2016	2.68	2.9	480	793	2.67	474	0.00691	0.307
233	4/21/2016	2.64	2.88	440	767	2.66	460	-0.0176	-0.881
234	5/3/2016	2.34	2.54	220	350	2.34	222	-0.0019	-0.16
235	5/18/2016	2.58	2.82	377	654	2.6	396	-0.0201	-0.954
236	5/26/2016	2.31	2.5	202	314	2.3	200	0.00463	0.208
237	5/31/2016	2.2	2.35	159	225	2.17	147	0.0354	1.44
238	6/7/2016	2.53	2.75	341	558	2.53	342	0.000156	-0.0477
239	6/17/2016	2.06	2.25	114	178	2.07	119	-0.0156	-0.835
240	6/21/2016	2.24	2.41	174	254	2.22	165	0.0251	1.06
241	6/28/2016	2.51	2.71	320	518	2.5	319	0.00282	0.104
242	7/6/2016	2	2.13	101	136	1.96	92.2	0.0409	1.59
243	7/13/2016	2.41	2.61	256	409	2.41	256	0.00103	-0.00795
244	7/25/2016	2.61	2.84	412	698	2.62	421	-0.00809	-0.452
245	8/11/2016	2.2	2.41	160	255	2.22	165	-0.012	-0.647
246	8/16/2016	2.49	2.7	306	497	2.49	307	0.000247	-0.0398
247	8/29/2016	2.12	2.3	133	198	2.11	130	0.0105	0.506
248	9/7/2016	2.43	2.63	268	426	2.42	266	0.0048	0.233
249	9/13/2016	2.27	2.43	187	272	2.24	175	0.0297	1.28
250	10/24/2016	2.76	2.9	570	789	2.67	472	0.0834	2.1
251	11/15/2016	2.69	2.9	489	787	2.67	471	0.0179	0.847
252	12/14/2016	2.68	2.96	483	911	2.73	539	-0.0466	-1.49
253	1/10/2017	2.75	2.97	562	928	2.74	549	0.0118	0.552
254	2/14/2017	2.72	2.94	521	878	2.72	521	0.00138	0.0318
255	3/14/2017	2.73	2.95	538	890	2.72	528	0.00962	0.479
256	3/30/2017	2.2	2.35	157	225	2.17	147	0.0299	1.3
257	4/11/2017	2.45	2.69	285	485	2.48	300	-0.0214	-0.992
258	5/1/2017	2.38	2.57	241	373	2.37	235	0.012	0.58
259	5/15/2017	2.59	2.8	385	637	2.59	387	-0.000503	-0.0876
260	5/31/2017	2.69	2.9	486	786	2.67	470	0.0155	0.748
261	6/5/2017	2.61	2.84	412	687	2.62	415	-0.00168	-0.144
262	6/13/2017	2.72	2.95	524	886	2.72	526	-1.24E-05	-0.0716
263	6/28/2017	2.71	2.94	517	862	2.71	512	0.00542	0.266
264	7/13/2017	2.63	2.86	424	725	2.64	436	-0.0111	-0.608
265	7/31/2017	2.6	2.79	398	623	2.58	379	0.0228	0.979
266	8/2/2017	2.58	2.8	381	630	2.58	383	-0.000684	-0.104
267	8/16/2017	2.61	2.84	405	692	2.62	418	-0.012	-0.657
268	8/30/2017	2.65	2.87	445	748	2.65	449	-0.00274	-0.225
269	9/6/2017	2.68	2.87	477	749	2.65	450	0.027	1.15
270	10/17/2017	2.66	2.87	461	740	2.65	445	0.0169	0.813
271	11/15/2017	2.65	2.86	442	722	2.64	435	0.00869	0.435
272	12/12/2017	2.66	2.87	462	749	2.65	450	0.013	0.618
273	1/18/2018	2.71	2.94	518	866	2.71	515	0.00428	0.192
274	1/31/2018	2.64	2.88	439	765	2.66	459	-0.0177	-0.893
275	3/6/2018	2.65	2.88	446	754	2.65	453	-0.00499	-0.307
276	3/22/2018	2.65	2.88	444	753	2.65	452	-0.0064	-0.374
277	4/18/2018	2.68	2.93	475	856	2.71	509	-0.0287	-1.18

278	5/2/2018	2.7	2.93	502	844	2.7	502	0.00104	0
279	5/9/2018	2.73	2.96	538	904	2.73	535	0.00362	0.16
280	5/23/2018	2.73	2.98	542	945	2.75	558	-0.0114	-0.618
281	6/1/2018	2.18	2.43	151	272	2.24	175	-0.0638	-1.75
282	6/6/2018	2.49	2.73	311	531	2.51	327	-0.0198	-0.942
283	6/20/2018	2.62	2.83	419	681	2.61	412	0.00888	0.461
284	6/26/2018	2.39	2.61	247	404	2.4	253	-0.00955	-0.542
285	7/19/2018	1.98	2.19	94.7	154	2.01	103	-0.0352	-1.36
286	7/31/2018	2.08	2.23	121	168	2.05	112	0.0336	1.38
287	8/16/2018	2.45	2.66	280	457	2.45	284	-0.00514	-0.315
288	8/28/2018	2.34	2.52	220	329	2.32	209	0.0235	1.01
289	9/6/2018	1.98	2.06	94.6	114	1.89	78.1	0.0844	2.28
290	9/18/2018	2.56	2.76	365	576	2.55	352	0.0169	0.802
291	10/16/2018	2.18	2.33	150	215	2.15	141	0.0294	1.24
292	11/19/2018	2.71	3	512	991	2.76	583	-0.0552	-1.62
293	12/4/2018	2.64	2.89	439	779	2.67	466	-0.0249	-1.12
294	12/17/2018	2.72	2.93	528	859	2.71	511	0.0156	0.759
295	1/29/2019	2.7	2.92	505	837	2.7	498	0.00699	0.324
296	2/19/2019	2.83	3.05	672	1130	2.82	661	0.0083	0.409
297	3/14/2019	2.47	2.68	294	483	2.47	299	-0.00558	-0.332
298	3/19/2019	2.52	2.74	333	554	2.53	340	-0.00727	-0.435
299	4/11/2019	2.65	2.88	450	760	2.66	456	-0.00422	-0.266
300	4/16/2019	2.77	2.99	586	968	2.76	571	0.0128	0.608
301	5/1/2019	2.2	2.33	160	214	2.15	141	0.0578	1.79
302	5/15/2019	2.3	2.48	199	304	2.29	194	0.0114	0.542
303	5/23/2019	1.93	2.07	84.5	117	1.9	80.3	0.0237	1.03
304	6/5/2019	2.57	2.79	372	610	2.57	372	0.00163	0.0477
305	6/12/2019	2.68	2.9	484	799	2.68	477	0.00739	0.34
306	6/24/2019	2.03	2.11	106	129	1.94	87.6	0.0839	2.18
307	7/10/2019	2.36	2.57	228	368	2.36	232	-0.00663	-0.391
308	7/30/2019	2.73	2.93	537	853	2.7	507	0.0261	1.12
309	8/7/2019	2.67	2.9	470	787	2.67	471	0.000578	-0.0239
310	8/20/2019	2.12	2.27	132	186	2.09	123	0.0305	1.32
311	8/26/2019	2.22	2.41	166	255	2.22	165	0.00304	0.136
312	9/11/2019	2.6	2.82	396	662	2.6	401	-0.00363	-0.241
313	10/9/2019	2.71	2.93	509	847	2.7	504	0.00539	0.257
314	11/6/2019	2.71	2.91	513	810	2.68	484	0.0271	1.16
315	12/11/2019	2.74	2.96	547	919	2.73	544	0.0041	0.176

Definitions

TDS: Total dissolved solids in mg/L (70300)

SC: Specific conductance in $\mu\text{S}/\text{cm}$ @25C (00095)

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