SITE NUMBER—07144100

SITE NAME—Little Arkansas River near Sedgwick

DATE CREATED—08/02/2012

MODEL DEVELOPMENT DATA PERIOD—3/9/2004 –8/15/2011

MODEL-CALIBRATION DATASET—All data were collected using U.S. Geological Survey (USGS) protocols and are stored in National Water Information System (NWIS) databases. The regression model is based on 110 concurrent measurements of specific conductance and atrazine samples collected from 03-09-2004 through 08-15-2011. The day of the year is also taken into account for the regression model. Samples were collected throughout the range of continuously observed hydrologic streamflow conditions. Specific conductance values are time-averaged approved unit values corresponding with the duration of sample collection. Summary statistics and complete model-calibration dataset are provided. No values were removed from the dataset.

MODEL DEVELOPMENT— Regression analysis was done using S-PLUS, R, and a spreadsheet macro that examined specific conductance and day of the year together as explanatory variables for estimating atrazine. Different combinations of untransformed and $\log_{10}$-transformed data were evaluated. Atrazine, specific conductance, and day of year were selected as the best model based on residual plots, model standard percentage error (*MSPE*), adjusted R^2, prediction error sum of squares (PRESS), and Mallow's C_p. Model spreadsheet is archived and can be found at http://nrtwq.usgs.gov/ks for review, and contains all relevant sample data and more in-depth statistical information.

MODEL SUMMARY—Summary of final regression analysis for atrazine concentration at 07144100.

Primary specific conductance and day-based model:

$$\log_{10}(Atr) = -0.000824 \times SC + 0.409 \times \sin\left(\frac{2\pi D}{365}\right) - 0.549 \times \cos\left(\frac{2\pi D}{365}\right) + 0.333,$$

where

Atr = atrazine, in micrograms per liter;

SC = specific conductance, in microsiemens per centimeter at 25 degrees Celsius; and

D = Day of the year (a number between 1 and 365).

Time of year shows a strong physical correlation with atrazine levels. The largest observed concentrations are in the spring and summer, presumably when it is applied to crops and rainfall is more abundant. Although specific conductance may not show a strong physical correlation

with atrazine, it does show a statistical correlation. The recorded parameters were chosen because the model showed a high R^2 value, and low values for standard error, Mallow's C_p, and PRESS.

ATRAZINE RECORD— The record is computed using a regression model and National Real-Time Water Quality (NRTWQ) software. Data are computed at 15-minute intervals. The record is complete for the year except as noted. The specific conductance monitor was removed during the winter months because of below freezing conditions. A more in-depth description of the water quality record can be found at –

http://nrtwq.usgs.gov/ks

REMARKS—

- Site location, equipment, and other stream-gaging station information can be found in the Site Information Management System (SIMS).

Computed: Aaron King

Reviewed: Patrick Rasmussen

Model Form

log(Atr) = -0.000824 * (SC) + 0.409 * sin(2πD/365) - 0.549 * cos(2πD/365) + 0.333

Explanatory variable summary statistics

	SC	sin(2πD/365)	cos(2πD/365)
Minimum	54.0	-0.974	-0.999
1st Quartile	322	-0.0473	-0.931
Median	628	0.471	-0.678
Mean	607	0.372	-0.484
3rd Quartile	835	0.845	-0.205
Maximum	1360	1.000	0.991

Notes:

Dependent variable summary statistics

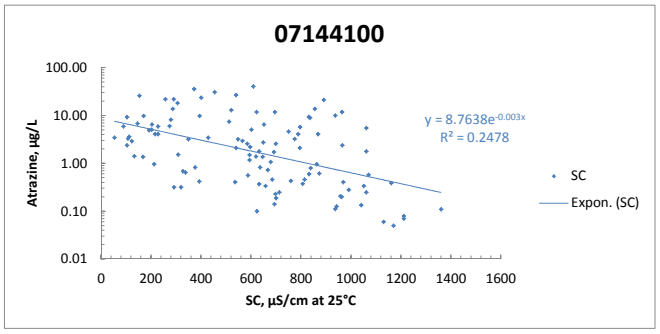
	log(Atr)	Atr
Minimum	-1.30	0.0500
1st Quartile	-0.356	0.441
Median	0.336	2.17
Mean	0.251	5.33
3rd Quartile	0.780	6.03
Maximum	1.61	41.0

Notes:

Model Calibration

Basic Data

Number of Measurements:	110
Standard Error:	0.536
MSPE (Upper)	+243.29
MSPE (Lower)	-70.870
R^2	0.463
Adj R^2	0.448
Duan BCF:	2.07
VIF	1.31



Explanatory Variables

Variable	Value	Standard Error
Intercept	0.333	0.153
SC	-0.000824	0.000187
sin(2πD/365)	0.409	0.0952
cos(2πD/365)	-0.549	0.103

Notes:

Covariance Matrix

	Intercept	SC	sin(2πD/365)	cos(2πD/365)
Intercept	1	-0.852	-0.165	0.682
SC	-0.852	1	-0.139	-0.449
sin(2πD/365)	-0.165	-0.139	1	-0.112
cos(2πD/365)	0.682	-0.449	-0.112	1

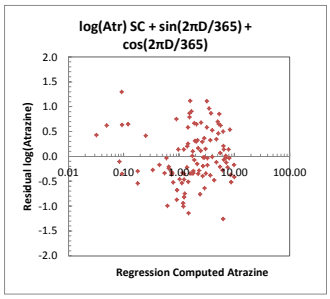
Test Criteria

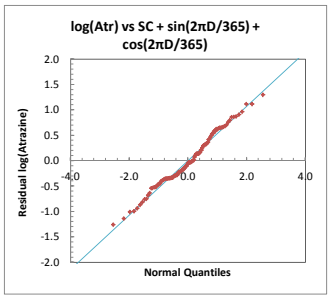
Leverage	Cook's D	DFITS
0.109	0.876	0.381

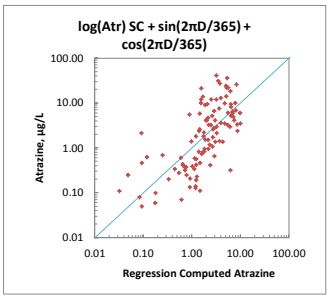
Observations exceeding at least one test criterion

Observation	Observed log(Atr)	Predicted log(Atr)	Residuals	Standardized Residuals	Studentized Residuals	Leverage	Cook's D	DFITS
15	-1.15	-0.161	-0.994	-1.90	-1.93	0.0498	0.0475	-0.441
49	0.326	-0.973	1.30	2.55	2.62	0.0975	0.176	0.862
65	-0.337	-0.971	0.634	1.25	1.25	0.0999	0.0431	0.416
66	-0.602	-1.23	0.623	1.23	1.23	0.106	0.0450	0.425
67	-0.959	-1.39	0.430	0.851	0.850	0.112	0.0228	0.301
80	-0.162	-0.578	0.416	0.831	0.830	0.125	0.0245	0.313
108	1.33	0.214	1.11	2.12	2.16	0.0378	0.0443	0.428

Notes:







Date	SC, µS/cm at 25°C	Atrazine, µg/L	log(Atrazine)	Regression Computed Atrazine	Residual log(Atrazine)	Normal Quantiles
3/9/2004	212	0.960	-0.0177	2.19	-0.350	-0.731
5/12/2004	1160	0.390	-0.409	1.02	-0.456	-0.959
5/13/2004	279	8.20	0.914	6.36	0.139	0.312
5/14/2004	400	24.0	1.38	4.98	0.703	1.30
5/15/2004	372	36.0	1.56	5.30	0.854	1.48
5/16/2004	540	27.0	1.43	3.76	0.865	1.56
6/12/2004	862	0.960	-0.0177	1.81	-0.290	-0.434
6/16/2004	788	4.14	0.617	2.03	0.300	0.536
6/22/2004	273	6.04	0.781	5.50	0.0698	0.218
7/5/2004	123	2.94	0.468	6.10	-0.279	-0.385
7/9/2004	536	0.410	-0.387	2.40	-0.762	-1.48
7/26/2004	112	3.61	0.558	3.94	-0.00656	0.148
7/27/2004	133	1.42	0.152	3.68	-0.384	-0.856
3/23/2005	227	4.13	0.616	3.00	0.153	0.385
4/12/2005	1210	0.0700	-1.15	0.613	-0.994	-1.84
4/15/2005	1060	5.50	0.740	0.885	0.754	1.36
5/8/2005	1060	1.80	0.255	1.21	0.141	0.360

5/12/2005	609	41.0	1.61	3.17	1.11	1.98
5/14/2005	153	26.0	1.41	8.26	0.536	0.856
5/20/2005	520	13.0	1.11	3.96	0.527	0.824
5/27/2005	305	18.4	1.26	6.23	0.498	0.792
6/4/2005	429	3.47	0.540	4.72	-0.115	-0.0797
6/6/2005	291	0.320	-0.495	6.22	-1.26	-2.55
6/9/2005	54.0	3.47	0.540	9.98	-0.411	-0.924
4/28/2006	838	0.810	-0.0915	1.72	-0.345	-0.673
4/29/2006	540	2.13	0.328	3.23	-0.176	-0.195
5/1/2006	750	4.68	0.670	2.14	0.329	0.617
5/4/2006	694	12.0	1.08	2.49	0.679	1.25
5/5/2006	836	9.06	0.957	1.87	0.669	1.20
5/6/2006	937	10.0	1.00	1.53	0.792	1.42
5/9/2006	774	3.28	0.516	2.20	0.162	0.409
5/10/2006	649	2.75	0.439	2.88	-0.0203	0.125
5/13/2006	963	12.0	1.08	1.53	0.870	1.64
6/1/2006	646	1.37	0.137	3.04	-0.345	-0.645
6/2/2006	698	2.60	0.415	2.72	-0.0220	0.103
6/3/2006	622	12.0	1.08	3.18	0.581	0.889
6/24/2006	257	22.0	1.34	5.61	0.624	0.996
6/25/2006	290	22.0	1.34	5.17	0.657	1.16
6/26/2006	287	14.0	1.15	5.12	0.464	0.761
7/6/2006	594	1.18	0.0719	2.30	-0.288	-0.409
7/10/2006	594	1.51	0.179	2.13	-0.148	-0.125
7/14/2006	636	0.830	-0.0809	1.80	-0.339	-0.590
7/17/2006	666	0.730	-0.137	1.58	-0.343	-0.617
7/19/2006	684	0.460	-0.337	1.46	-0.510	-1.07
7/24/2006	697	0.230	-0.638	1.26	-0.751	-1.42
7/25/2006	700	0.190	-0.721	1.22	-0.821	-1.56
7/27/2006	693	0.140	-0.854	1.18	-0.939	-1.73
7/28/2006	585	2.61	0.417	1.44	0.253	0.485
12/12/2006	794	2.12	0.326	0.0910	1.30	2.55
1/10/2007	873	0.620	-0.208	0.119	0.650	1.11
2/26/2007	962	0.200	-0.699	0.332	-0.274	-0.360
3/31/2007	338	0.650	-0.187	2.89	-0.639	-1.30
4/2/2007	167	1.37	0.137	4.31	-0.475	-1.03
5/4/2007	1070	0.580	-0.237	1.14	-0.327	-0.510
5/7/2007	145	6.82	0.834	7.98	-0.0310	0.0797
5/25/2007	89.0	5.98	0.777	9.75	-0.168	-0.171
6/13/2007	678	1.07	0.0294	2.65	-0.395	-0.889
6/15/2007	394	9.86	0.994	4.69	0.343	0.645
6/29/2007	454	31.0	1.49	3.46	0.966	1.84
7/19/2007	596	2.21	0.344	1.75	0.0993	0.241
8/9/2007	308	1.54	0.188	1.87	-0.0729	-0.0341
3/18/2008	657	0.340	-0.469	1.11	-0.534	-1.20
4/11/2008	796	5.79	0.763	1.45	0.582	0.924
5/29/2008	216	4.12	0.615	7.46	-0.223	-0.312
10/31/2008	814	0.460	-0.337	0.0920	0.634	1.03
11/24/2008	1060	0.250	-0.602	0.0486	0.623	0.959
12/22/2008	1360	0.110	-0.959	0.0318	0.430	0.731
1/26/2009	1170	0.0500	-1.30	0.0924	-0.352	-0.761
3/23/2009	969	0.410	-0.387	0.644	-0.239	-0.336
4/13/2009	548	3.23	0.509	2.46	0.117	0.265
4/28/2009	202	5.13	0.710	6.42	-0.0672	-0.0114
5/4/2009	566	2.96	0.471	3.24	-0.0348	0.0114
6/3/2009	830	9.45	0.975	2.06	0.649	1.07
6/11/2009	651	6.58	0.818	2.85	0.365	0.673
6/16/2009	511	7.56	0.879	3.65	0.329	0.590
7/16/2009	632	1.80	0.255	1.74	0.0118	0.195
8/18/2009	393	0.420	-0.377	1.22	-0.463	-0.996
9/11/2009	320	0.320	-0.495	0.724	-0.361	-0.792
10/14/2009	623	0.100	-1.00	0.179	-0.297	-0.459
11/3/2009	327	0.689	-0.162	0.247	0.416	0.702
1/25/2010	1210	0.0800	-1.10	0.0830	-0.104	-0.0569
2/16/2010	1130	0.0600	-1.22	0.176	-0.541	-1.25
3/9/2010	831	0.600	-0.222	0.592	-0.0329	0.0341
3/10/2010	712	0.250	-0.602	0.778	-0.523	-1.16
3/11/2010	619	1.40	0.146	0.970	0.138	0.288
3/15/2010	1050	0.340	-0.469	0.442	-0.167	-0.148
3/18/2010	990	0.280	-0.553	0.542	-0.334	-0.536
4/14/2010	1040	0.134	-0.873	0.906	-0.868	-1.64
4/23/2010	601	5.14	0.711	2.62	0.291	0.510
5/3/2010	965	2.40	0.380	1.40	0.207	0.434
5/13/2010	349	3.20	0.505	5.47	-0.210	-0.265
5/28/2010	868	4.10	0.613	1.94	0.311	0.563
6/9/2010	170	9.92	0.997	7.85	0.140	0.336
6/10/2010	228	5.94	0.774	6.91	-0.0316	0.0569
6/13/2010	104	2.40	0.380	8.72	-0.517	-1.11
6/14/2010	107	3.32	0.521	8.59	-0.370	-0.824
6/15/2010	192	4.94	0.694	7.13	-0.123	-0.103
6/16/2010	203	6.50	0.813	6.90	0.00933	0.171
7/6/2010	104	9.35	0.971	6.35	0.207	0.459
8/3/2010	587	0.560	-0.252	1.23	-0.350	-0.702
8/19/2010	632	0.370	-0.432	0.723	-0.309	-0.485
3/7/2011	759	0.434	-0.363	0.650	-0.210	-0.241
3/16/2011	806	0.377	-0.424	0.753	-0.334	-0.563
4/6/2011	957	0.208	-0.682	0.916	-0.679	-1.36
4/18/2011	942	0.126	-0.900	1.19	-1.00	-1.98
5/2/2011	937	0.112	-0.951	1.47	-1.14	-2.18
6/7/2011	691	1.73	0.238	2.70	-0.194	-0.218
6/21/2011	890	21.3	1.33	1.57	1.11	2.18
6/22/2011	854	13.9	1.14	1.67	0.905	1.73
8/15/2011	376	0.825	-0.0835	1.37	-0.219	-0.288