The following supplement accompanies the article

A novel quantile method reveals spatiotemporal shifts in phytoplankton biomass descriptors between bloom and non-bloom conditions in a subtropical estuary

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Marine Ecology Progress Series 567: 57–78 (2017)

Supplement 1.

Table S1. Variance Inflation Factor (VIF) values for the candidate explanatory variables.

Station	Quantile	$Chla_{t-1}$	Water temp.	TN	TP	Turbidity	Salinity
1	Bloom	1.52	1.85	1.46	1.88	1.44	1.67
	Non-bloom	1.11	1.17	1.25	1.14	1.03	1.26
2	Bloom	2.1	1.41	1.48	1.47	1.06	1.93
	Non-bloom	1.06	1.12	1.32	1.08	1.01	1.19
3	Bloom	2.48	1.34	1.3	1.26	1.51	1.45
	Non-bloom	1.07	1.12	1.26	1.26	1.32	1.3
4	Bloom	1.58	1.5	1.16	1.09	1.41	1.48
	Non-bloom	1.09	1.33	1.33	1.14	1.13	1.33
5	Bloom	1.13	1.52	1.05	1.2	1.29	1.43
	Non-bloom	1.05	1.24	1.18	1.06	1.09	1.24
6	Bloom	2.55	1.93	1.17	1.33	1.27	1.92
	Non-bloom	1.18	1.14	1.25	1.15	1.29	1.51
7	Bloom	2.43	1.42	1.18	1.81	1.38	1.23
	Non-bloom	1.13	1.06	1.07	1.1	1.1	1.14
8	Bloom	3.39	2.61	1.43	1.17	1.44	2.62
	Non-bloom	1.16	1.22	1.28	1.14	1.22	1.25
9	Bloom	1.26	1.53	1.75	1.31	2.06	2.58
	Non-bloom	1.08	1.25	1.24	1.03	1.23	1.18
10	Bloom	1.26	1.28	1.36	1.07	1.4	1.13
	Non-bloom	1.12	1.12	1.14	1.18	1.17	1.17
11	Bloom	2.05	2.08	1.38	1.29	1.38	1.13
	Non-bloom	1.19	1.15	1.17	1.05	1.21	1.42
12	Bloom	1.63	1.59	1.72	1.6	1.47	1.43
	Non-bloom	1.36	1.13	1.43	1.34	1.55	1.18
13	Bloom	1.57	1.85	2.45	1.4	1.77	1.48
	Non-bloom	1.25	1.36	1.39	1.52	1.2	1.3
14	Bloom	2.37	1.27	1.44	1.51	2.45	1.44
	Non-bloom	1.14	1.16	1.92	2.22	1.36	1.33
15	Bloom	2.6	1.13	1.15	1.83	3.74	1.18
	Non-bloom	1.3	1.33	1.96	1.93	1.36	1.27
16	Bloom	1.45	2.74	1.24	3.21	2.6	2.64
	Non-bloom	1.04	1.34	1.16	1.4	1.32	1.28
17	Bloom	1.52	1.6	1.28	1.39	1.34	1.67
	Non-bloom	1.14	1.27	1.22	1.66	1.6	1.31
18	Bloom	1.6	1.4	1.21	2.52	2.53	1.82

Station	Quantile	$Chla_{t-1}$	Water temp.	TN	TP	Turbidity	Salinity
	Non-bloom	1.22	1.41	1.26	1.38	1.29	1.35
19	Bloom	1.08	2.04	1.08	1.19	1.28	1.84
	Non-bloom	1.21	1.55	1.17	1.21	1.46	1.35
20	Bloom	1.09	2.21	1.17	1.21	1.29	2.57
	Non-bloom	1.17	1.64	1.14	1.09	1.43	1.43
21	Bloom	1.56	2.66	1.51	3.05	4.31	2.52
	Non-bloom	1.07	1.86	1.33	1.07	1.33	1.53
22	Bloom	1.26	3.36	1.52	1.47	1.4	2.17
	Non-bloom	1.07	1.54	1.21	1.03	1.22	1.44
23	Bloom	1.31	1.21	1.42	1.36	1.75	1.25
	Non-bloom	1.09	1.45	1.08	1.1	1.25	1.25
24	Bloom	1.26	2.37	1.97	1.71	1.61	3.03
	Non-bloom	1.04	1.44	1.11	1.03	1.24	1.35
25	Bloom	1.4	3.83	1.87	3.64	1.29	2.14
	Non-bloom	1.08	1.62	1.05	1.93	1.95	1.52
26	Bloom	2.3	2.56	1.28	2.9	2.03	3.65
	Non-bloom	1.11	1.48	1.36	2.73	2.3	1.51
27	Bloom	2.14	1.57	1.62	4.64	3.66	2.47
	Non-bloom	1.14	1.43	1.17	4.34	4.47	1.39
28	Bloom	1.48	1.68	1.39	2.06	1.37	1.63
	Non-bloom	1.08	1.28	1.03	1.06	1.15	1.25

Table S2. Median BIC and R^2 values calculated during model screening. Each combination of candidate explanatory variables was fit to bloom and non-bloom conditions for the 28 monitoring stations. Fitted data were recombined to construct single simulated chlorophyll-a time series for each station, and R^2 and BIC values were constructed based on these recombined time series. Thus, each model had 28 R^2 and BIC values. Final model shown in bold.

Model	Median R^2	Median BIC
CHLA1_SAL_TEMP_TN_TP_TURB	**0.786**	**-977.972**
CHLA1_SAL_TEMP_TP_TURB	0.764	-975.29
CHLA1_SAL_TN_TP_TURB	0.77	-970.905
CHLA1_SAL_TP_TURB	0.755	-966.565
CHLA1_TEMP_TN_TP_TURB	0.771	-965.607
CHLA1_SAL_TEMP_TN_TURB	0.776	-961.179
CHLA1_TEMP_TP_TURB	0.746	-960.671
SAL_TEMP_TN_TP_TURB	0.768	-959.694
CHLA1_TN_TP_TURB	0.758	-959.519
SAL_TEMP_TP_TURB	0.738	-954.222
CHLA1_SAL_TEMP_TURB	0.747	-953.615
CHLA1_SAL_TEMP_TN_TP	0.751	-951.662
CHLA1_TP_TURB	0.739	-950.567
SAL_TN_TP_TURB	0.739	-950.219
CHLA1_SAL_TN_TURB	0.764	-950.207
CHLA1_TEMP_TN_TURB	0.747	-944.872
CHLA1_SAL_TEMP_TP	0.748	-944.087
CHLA1_SAL_TN_TP	0.726	-943.938
CHLA1_SAL_TURB	0.742	-942.162
SAL_TP_TURB	0.716	-942.013
CHLA1_TN_TURB	0.744	-940.311
CHLA1_TEMP_TN_TP	0.727	-939.902
CHLA1_SAL_TEMP_TN	0.735	-937.738
CHLA1_SAL_TP	0.72	-936.669
CHLA1_TEMP_TURB	0.726	-936.443
CHLA1_TN_TP	0.711	-935.366

Model	Median R^2	Median BIC
CHLA1_TEMP_TP	0.721	-933.921
TEMP_TN_TP_TURB	0.73	-932.425
CHLA1_SAL_TN	0.71	-931.073
CHLA1_TURB	0.725	-929.049
TEMP_TP_TURB	0.716	-928.406
CHLA1_TP	0.702	-928.027
TN_TP_TURB	0.713	-927.961
SAL_TEMP_TN_TURB	0.755	-925.813
CHLA1_TEMP_TN	0.71	-924.923
CHLA1_SAL_TEMP	0.725	-924.902
TP_TURB	0.701	-921.539
SAL_TN_TURB	0.731	-921.53
SAL_TEMP_TN_TP	0.72	-921.348
SAL_TEMP_TURB	0.724	-918.603
CHLA1_TN	0.69	-918.305
SAL_TN_TP	0.702	-917.854
CHLA1_SAL	0.701	-917.254
SAL_TEMP_TP	0.705	-917.129
TEMP_TN_TP	0.699	-916.184
TEMP_TN_TURB	0.696	-915.761
CHLA1_TEMP	0.696	-915.224
TEMP_TP	0.691	-914.148
SAL_TURB	0.713	-913.808
TN_TP	0.685	-913.622
SAL_TP	0.687	-913.246
TN_TURB	0.687	-911.898
SAL_TEMP_TN	0.682	-911.881
TP	0.671	-909.206
CHLA1	0.682	-908.844
TEMP_TURB	0.688	-906.59
SAL_TN	0.667	-905.735
TURB	0.677	-900.828
TEMP_TN	0.661	-899.584
SAL_TEMP	0.66	-898.614
SAL	0.631	-892.746
TN	0.647	-892.742
TEMP	0.639	-884.651

Table S3. Breusch-Godfrey statistics for all bloom and non-bloom model residuals. Models that failed the Breusch-Godfrey test at an alpha level of 0.05 are bolded.

Sta.	Quantile	Breusch-Godfrey statistic	p-value
1	**Bloom**	**21.079**	**0.049**
	Non-bloom	**37.974**	**0**
2	Bloom	15.878	0.197
	Non-bloom	**42.617**	**0**
3	Bloom	11.929	0.451
	Non-bloom	12.717	0.39
4	Bloom	12.645	0.395
	Non-bloom	**27.539**	**0.006**
5	Bloom	13.204	0.354
	Non-bloom	19.644	0.074
6	Bloom	19.099	0.086

Sta.	Quantile	Breusch-Godfrey statistic	p-value
	Non-bloom	**23.851**	**0.021**
7	Bloom	16.834	0.156
	Non-bloom	8.265	0.764
8	**Bloom**	**21.167**	**0.048**
	Non-bloom	16.595	0.165
9	**Bloom**	**21.28**	**0.046**
	Non-bloom	**49.785**	**0**
10	**Bloom**	**22.005**	**0.037**
	Non-bloom	13.572	0.329
11	Bloom	16.107	0.186
	Non-bloom	**31.604**	**0.002**
12	Bloom	14.764	0.255
	Non-bloom	15.294	0.226
13	Bloom	10.653	0.559
	Non-bloom	**21.461**	**0.044**
14	Bloom	20.191	0.064
	Non-bloom	8.535	0.742
15	Bloom	14.693	0.259
	Non-bloom	10.506	0.572
16	Bloom	13.22	0.353
	Non-bloom	16.352	0.176
17	**Bloom**	**21.199**	**0.048**
	Non-bloom	**25.411**	**0.013**
18	Bloom	19.055	0.087
	Non-bloom	**22.088**	**0.037**
19	Bloom	15.411	0.22
	Non-bloom	**21.134**	**0.048**
20	Bloom	6.805	0.87
	Non-bloom	12.871	0.378
21	Bloom	15.131	0.234
	Non-bloom	**33.733**	**0.001**
22	Bloom	18.515	0.101
	Non-bloom	**40.604**	**0**
23	Bloom	18.5	0.101
	Non-bloom	20.775	0.054
24	**Bloom**	**21.41**	**0.045**
	Non-bloom	15.115	0.235
25	Bloom	8.346	0.758
	Non-bloom	7.542	0.82
26	**Bloom**	**22.595**	**0.031**
	Non-bloom	9.608	0.65
27	Bloom	17.934	0.118
	Non-bloom	18.941	0.09
28	**Bloom**	**21.129**	**0.049**
	Non-bloom	**32.408**	**0.001**

FIGURES

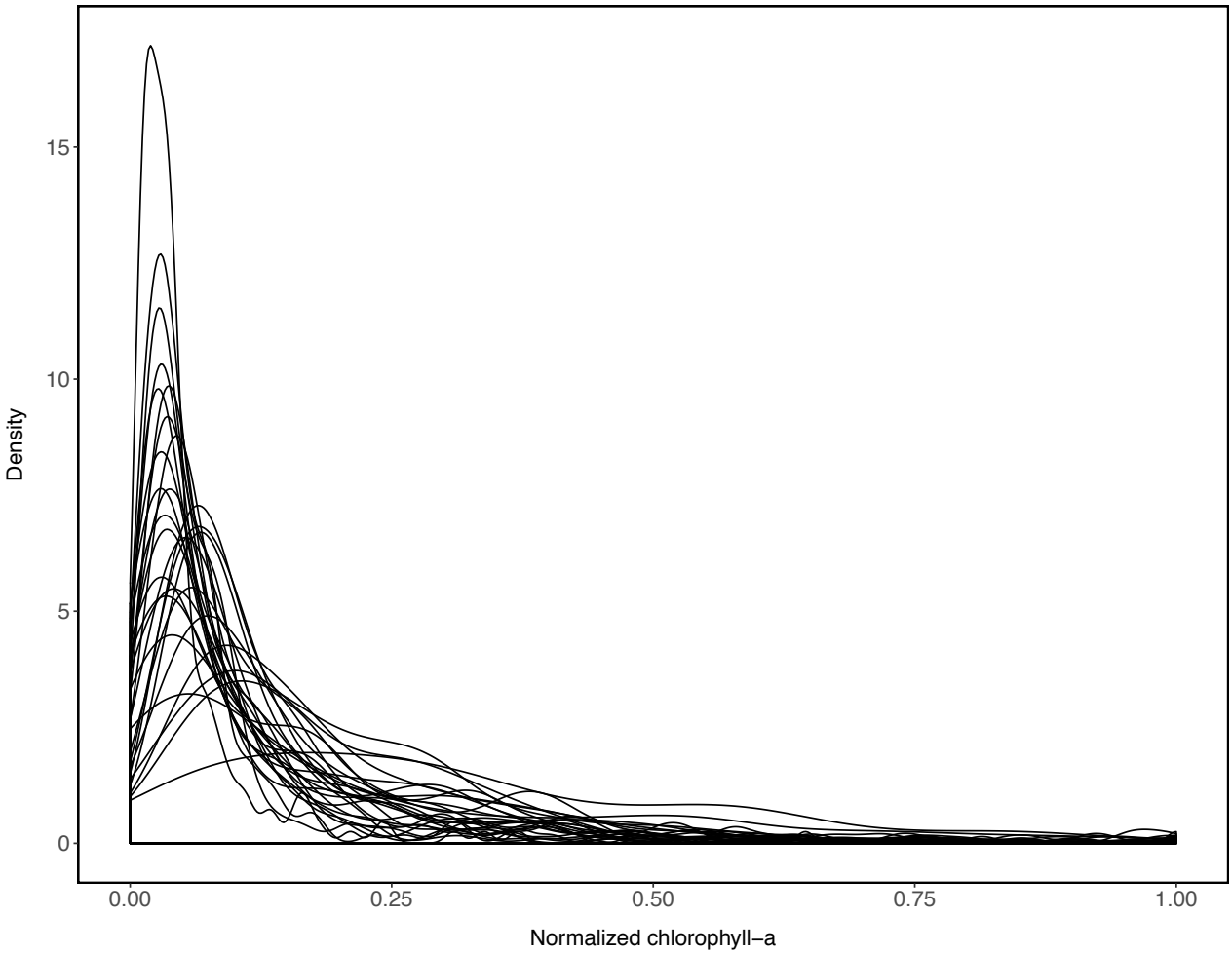


Figure S1. Density functions of normalized chlorophyll-*a* (unitless) from the 28 stations. All functions depict a strong right skew.

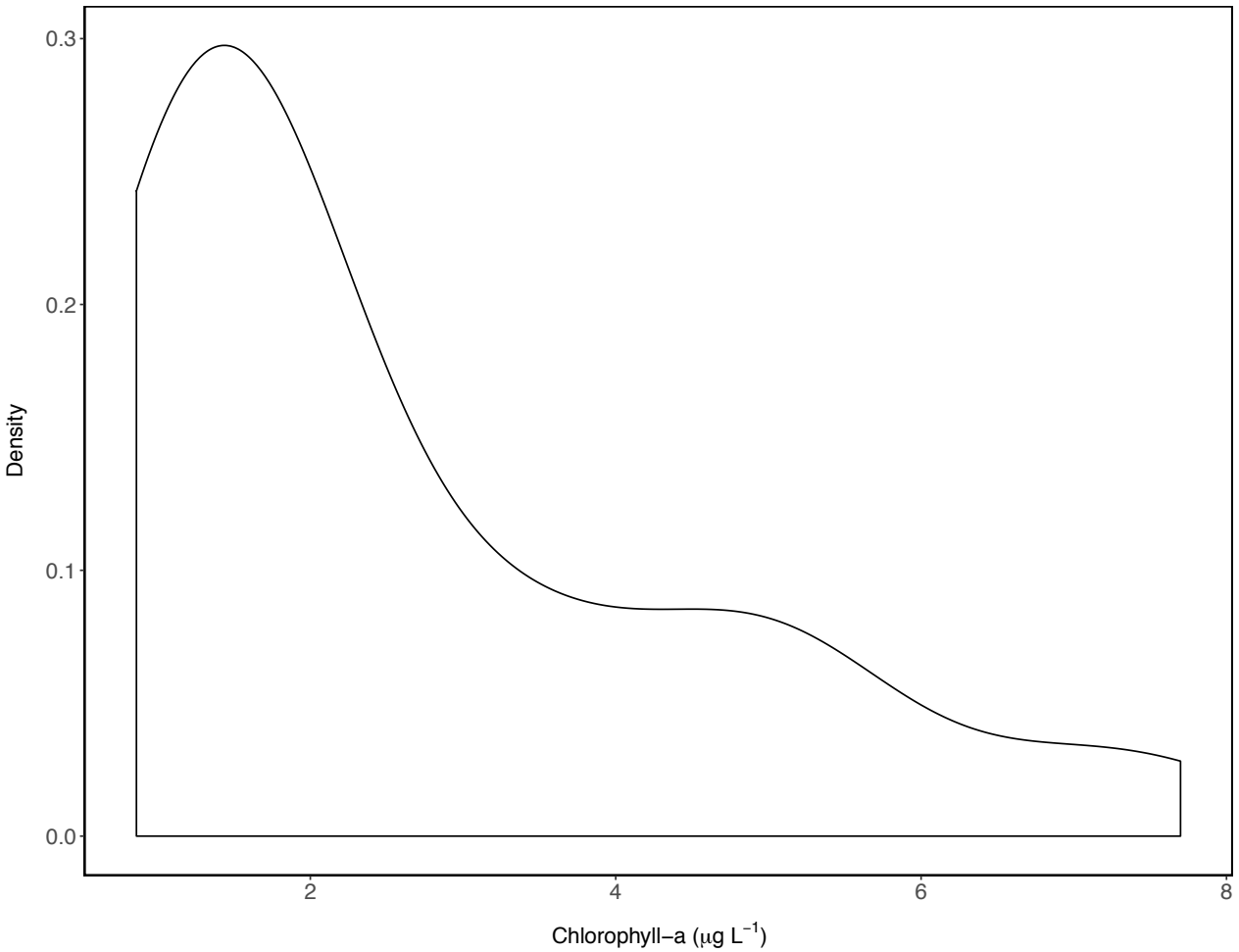
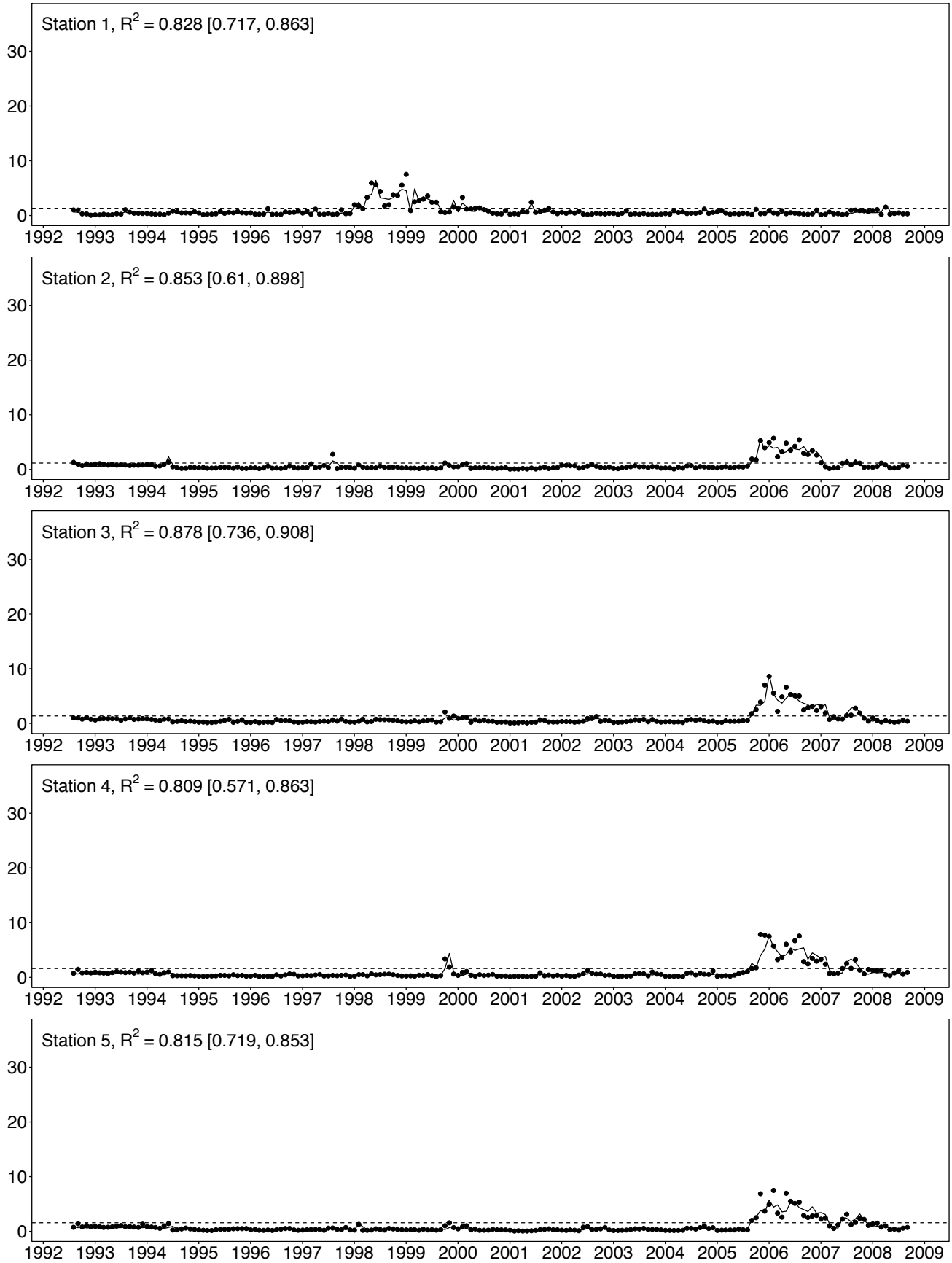
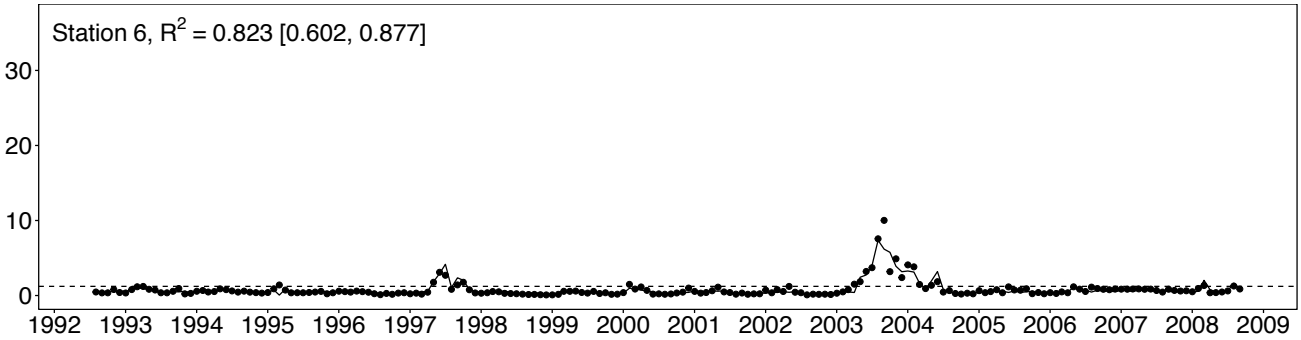
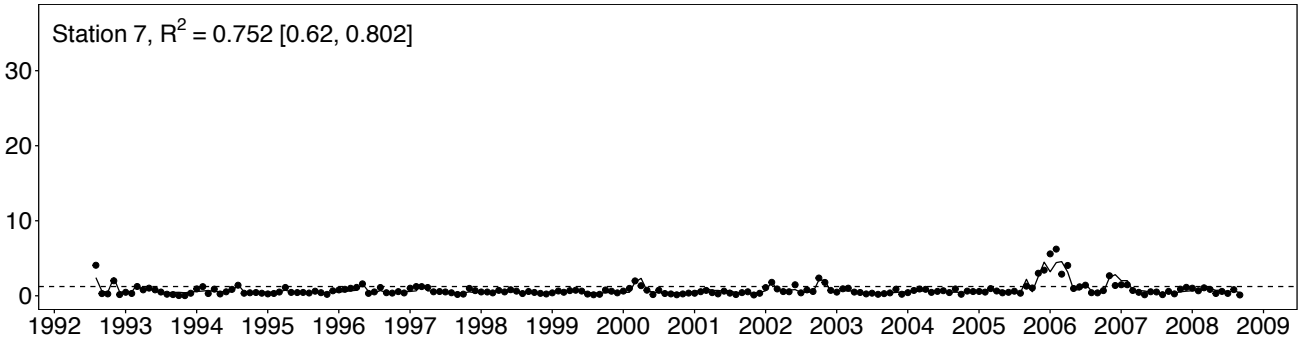
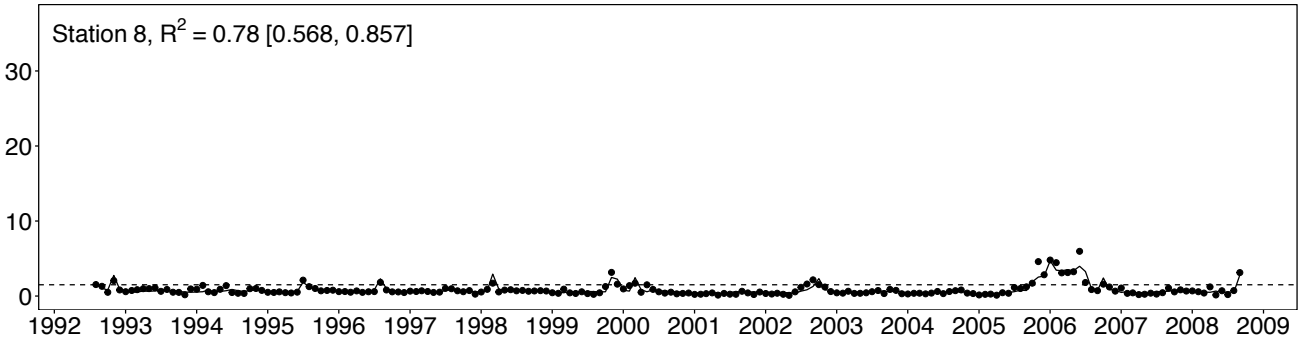


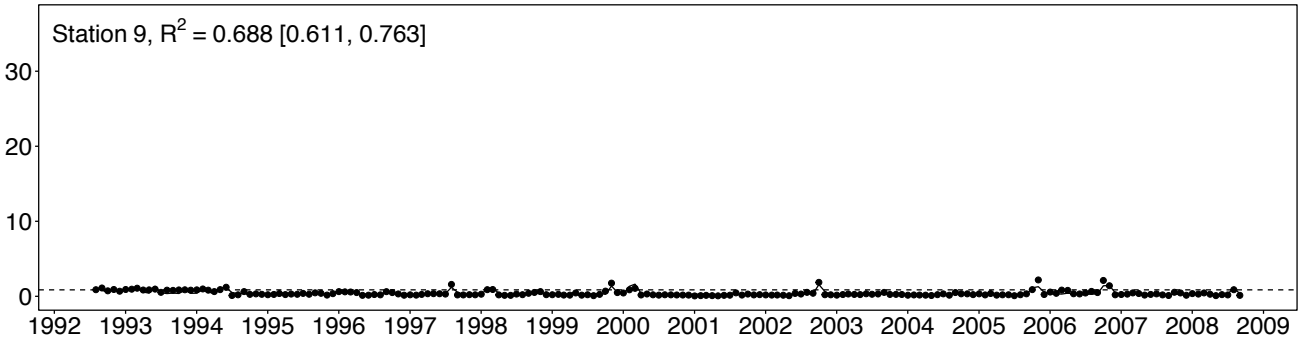
Figure S2. Density function of all chlorophyll-*a* (μg l^{-1}) bloom threshold values.


Station 1, R^2 = 0.828 [0.717, 0.863]
Station 2, R^2 = 0.853 [0.61, 0.898]
Station 3, R^2 = 0.878 [0.736, 0.908]
Station 4, R^2 = 0.809 [0.571, 0.863]
Station 5, R^2 = 0.815 [0.719, 0.853]
0
10
20
30
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009


Station 6, R^2 = 0.823 [0.602, 0.877]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009


Station 7, R^2 = 0.752 [0.62, 0.802]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009


Station 8, R^2 = 0.78 [0.568, 0.857]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009


Station 9, R^2 = 0.688 [0.611, 0.763]
30
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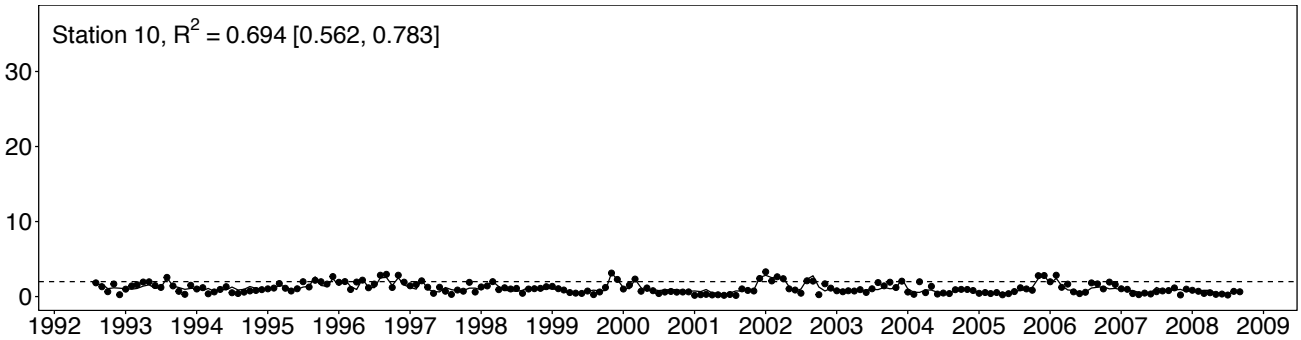
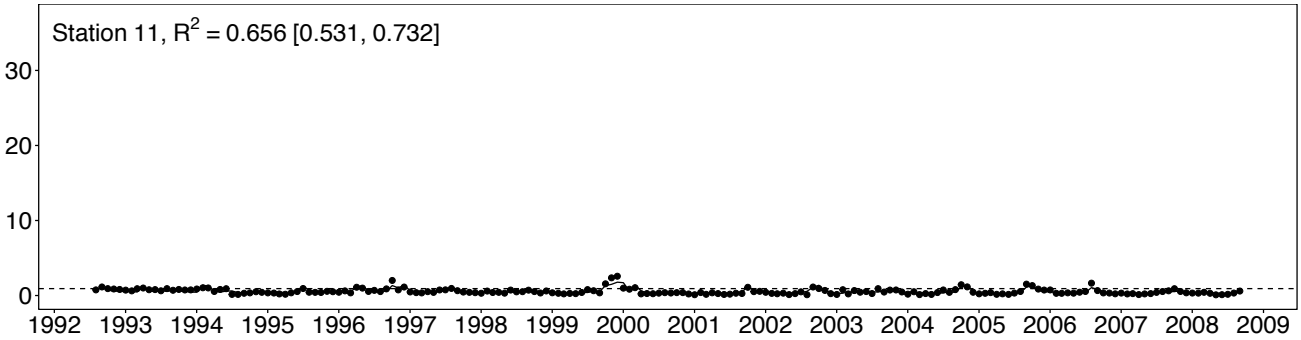
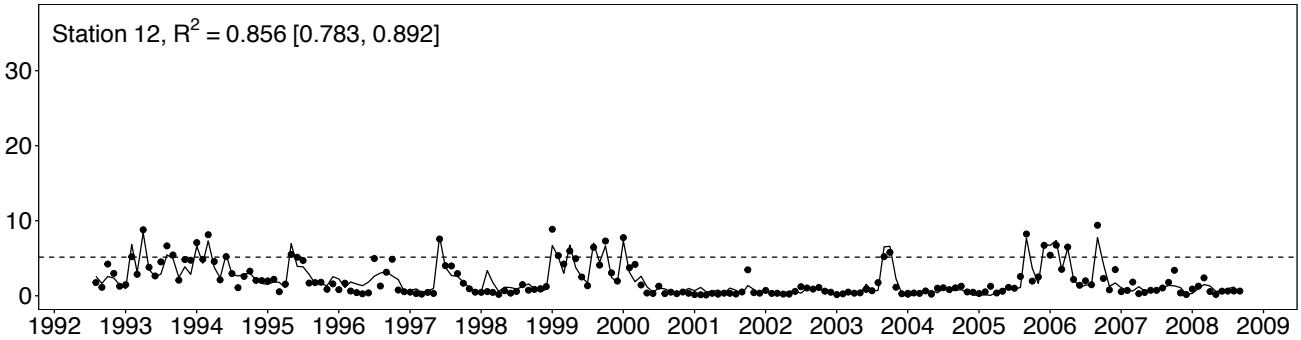
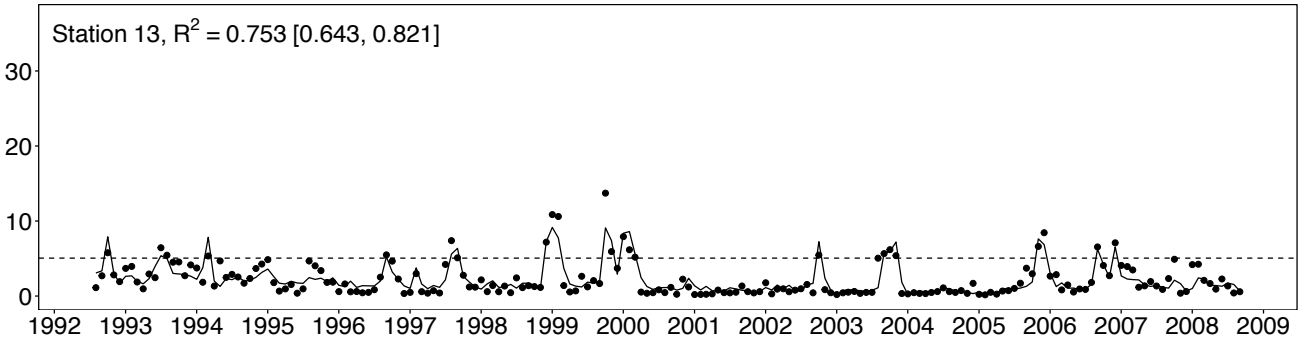
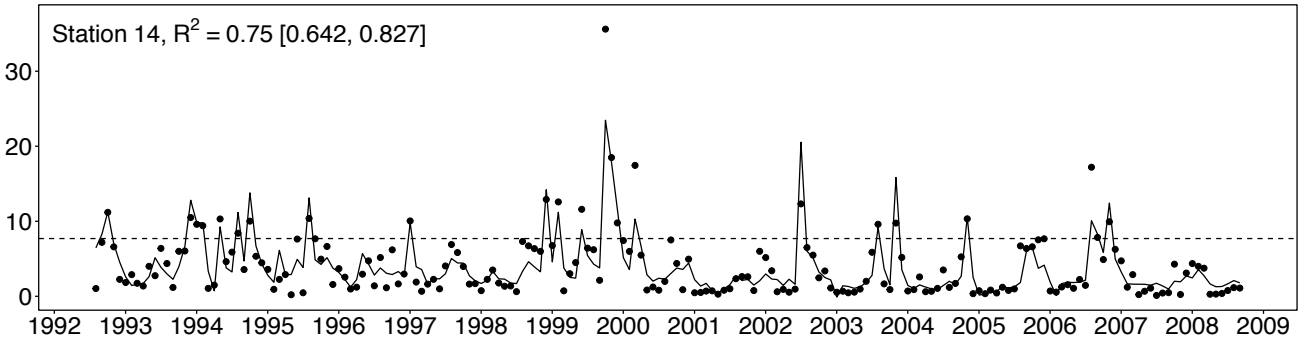
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009

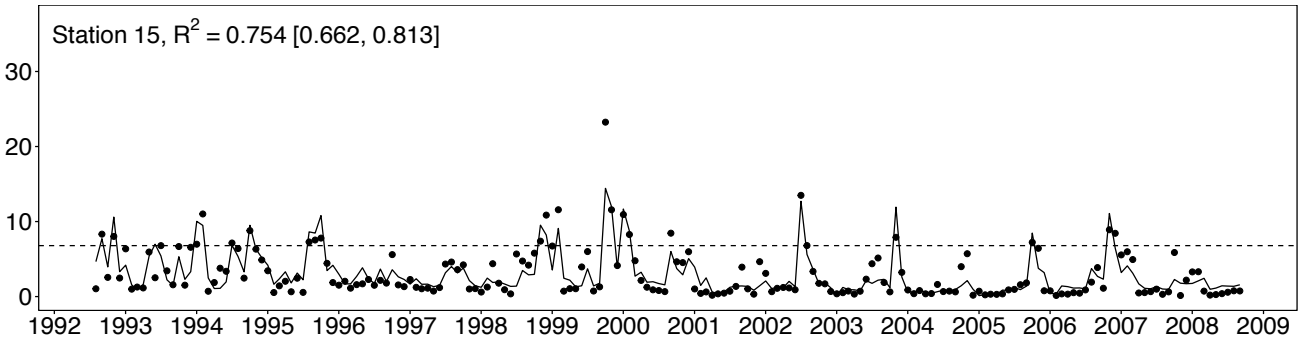

Station 10, R^2 = 0.694 [0.562, 0.783]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009

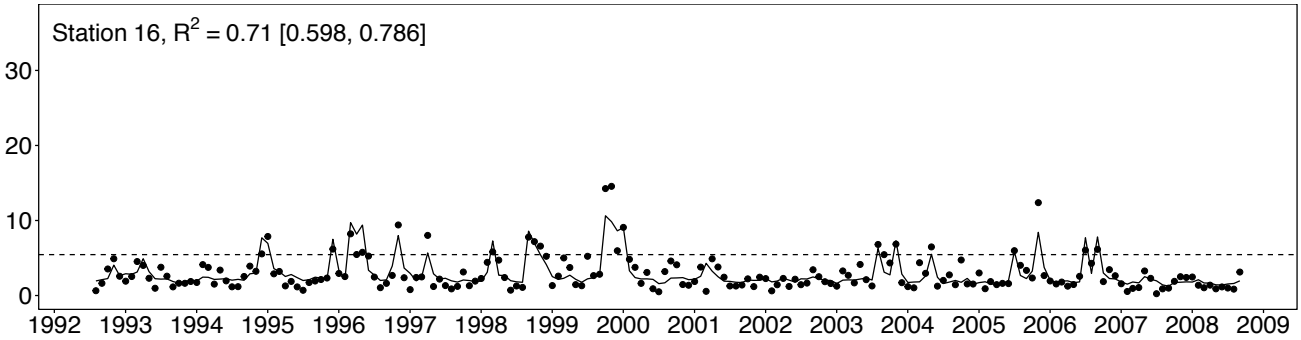

Station 11, R^2 = 0.656 [0.531, 0.732]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009

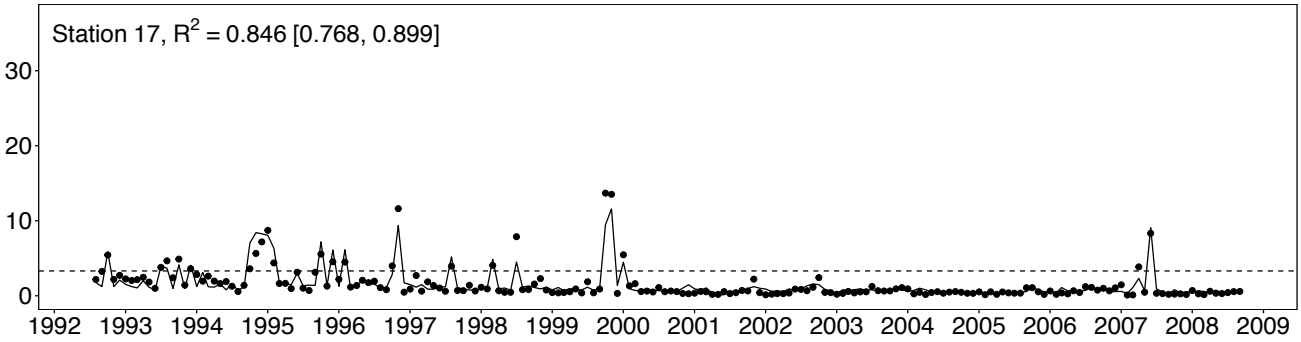

Station 12, R^2 = 0.856 [0.783, 0.892]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009

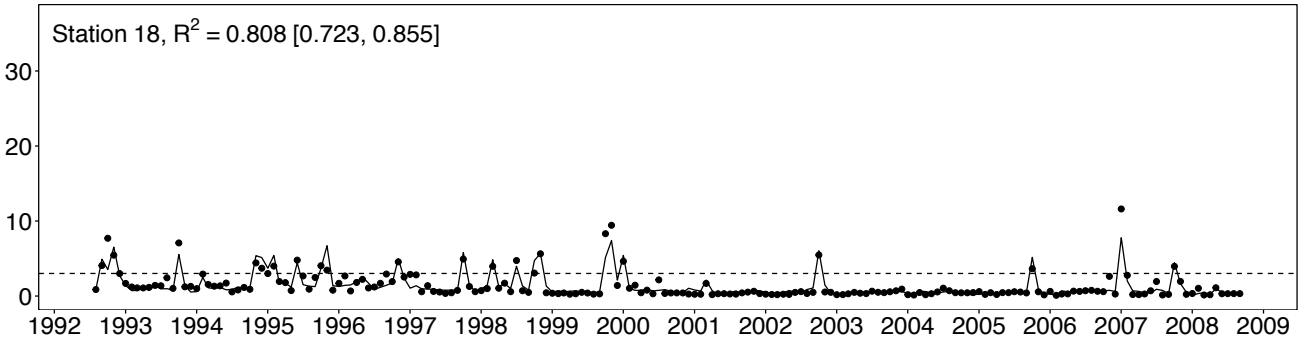

Station 13, R^2 = 0.753 [0.643, 0.821]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009

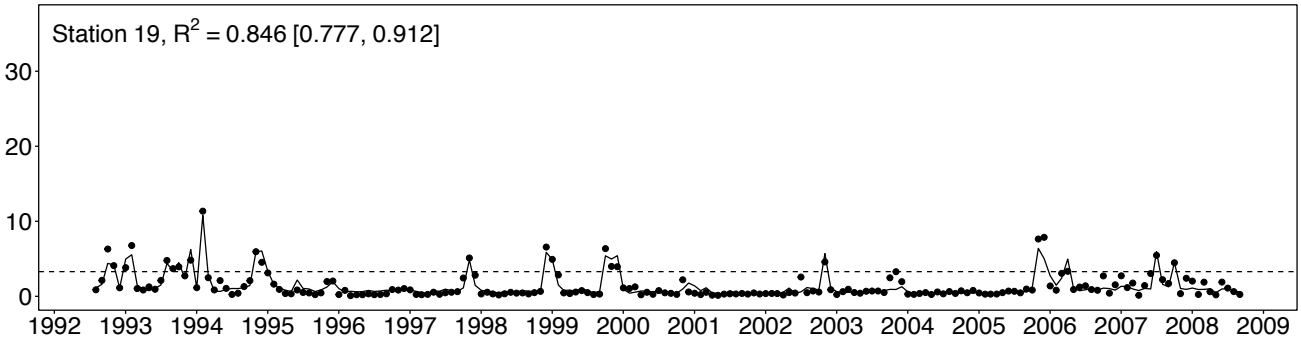

Station 14, R^2 = 0.75 [0.642, 0.827]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009

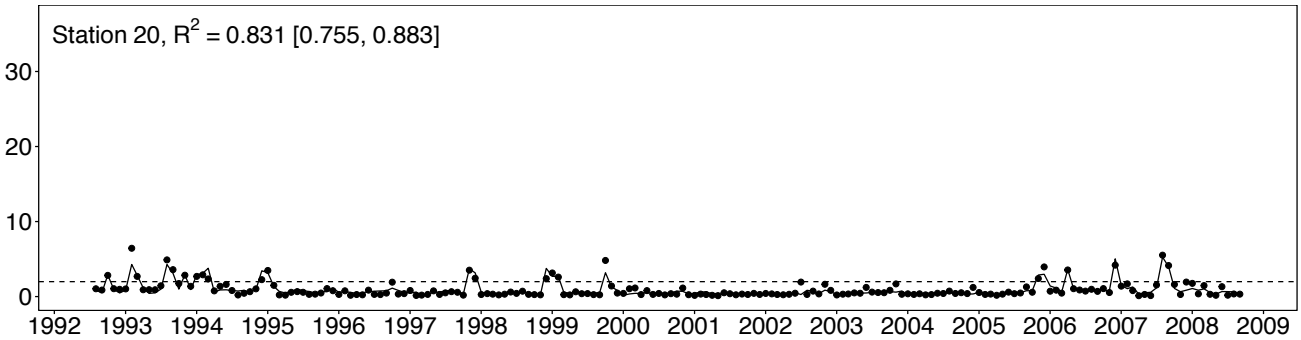

Station 15, R^2 = 0.754 [0.662, 0.813]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009

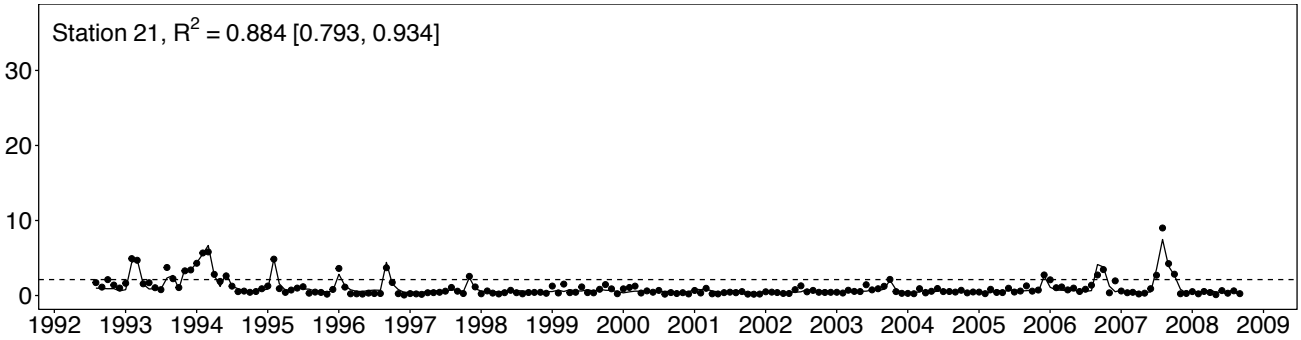

Station 16, R^2 = 0.71 [0.598, 0.786]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009

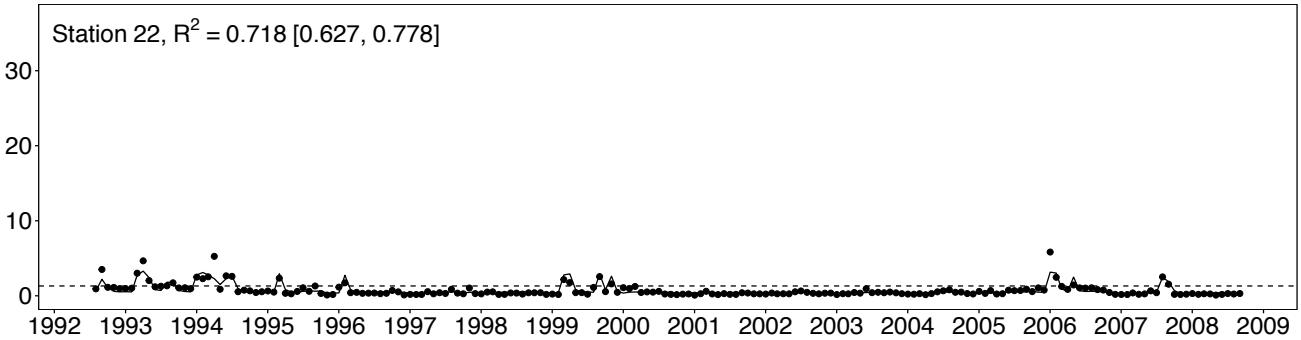

Station 17, R^2 = 0.846 [0.768, 0.899]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009

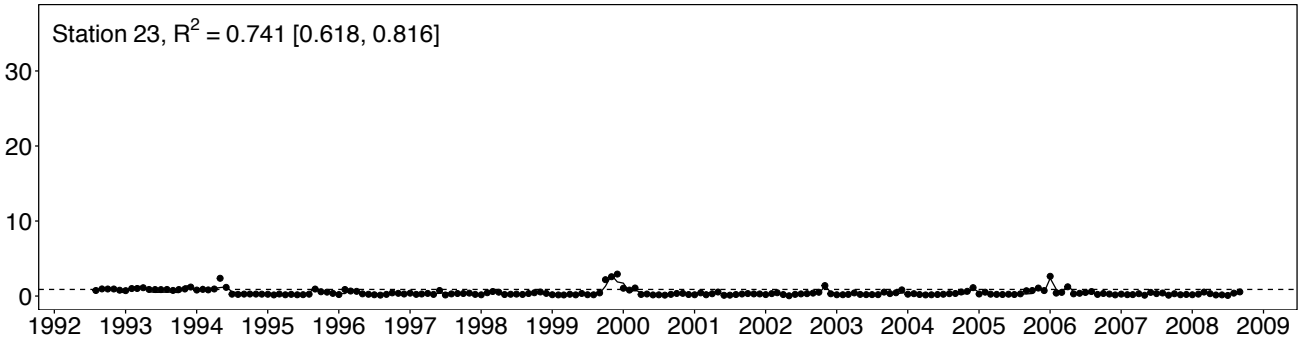

Station 18, R^2 = 0.808 [0.723, 0.855]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009

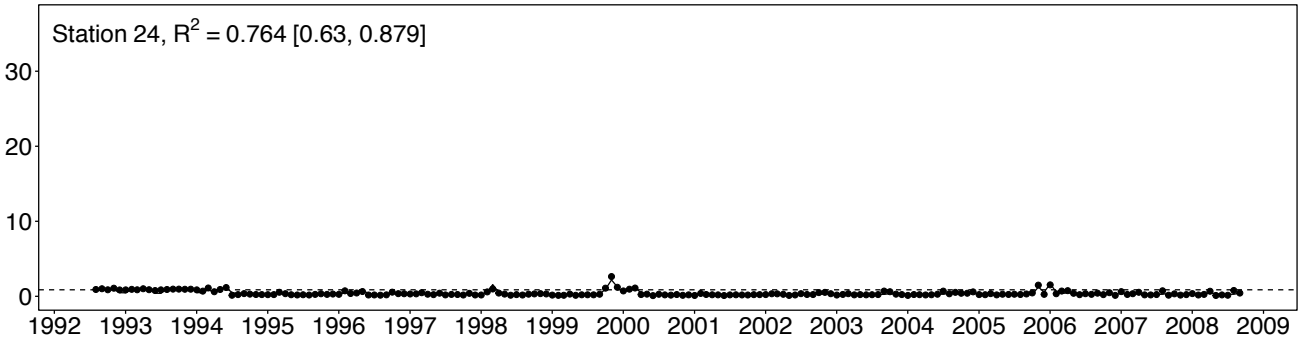

Station 19, R^2 = 0.846 [0.777, 0.912]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009

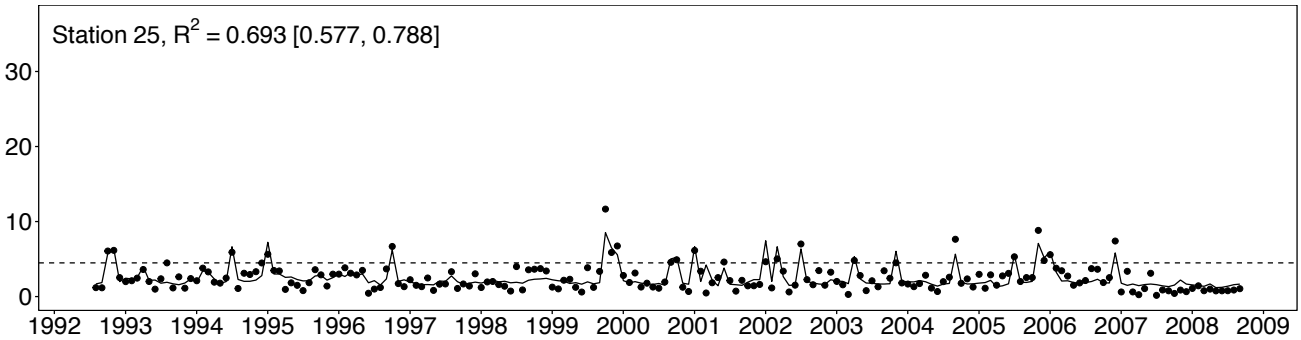

Station 20, R^2 = 0.831 [0.755, 0.883]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009


Station 21, R^2 = 0.884 [0.793, 0.934]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009


Station 22, R^2 = 0.718 [0.627, 0.778]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009


Station 23, R^2 = 0.741 [0.618, 0.816]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009


Station 24, R^2 = 0.764 [0.63, 0.879]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009


Station 25, R^2 = 0.693 [0.577, 0.788]
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009

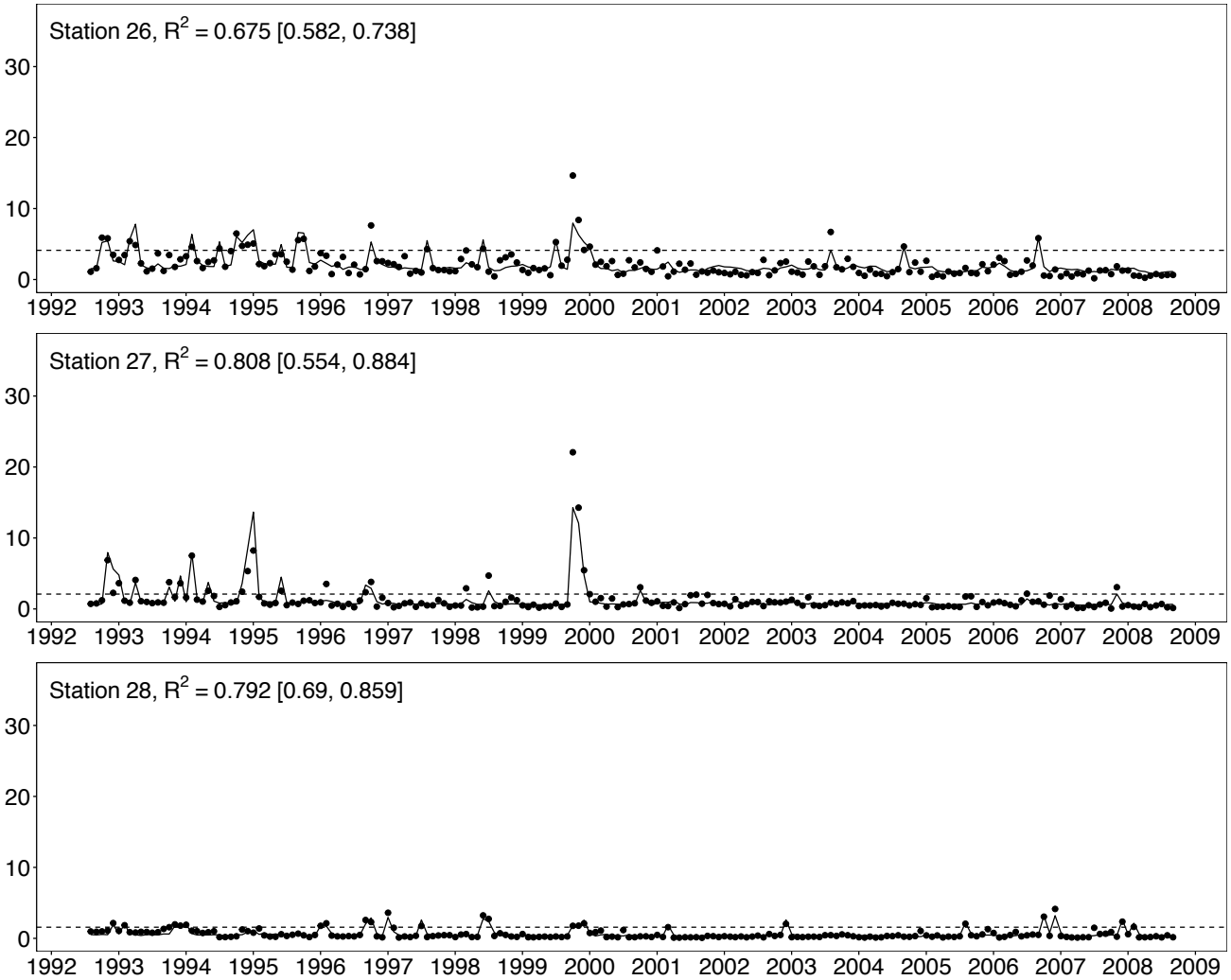


Figure S3. Observed (points) and modeled (solid line) chlorophyll-*a* data of each site in Florida Bay (units are μg l^{-1}); station-specific bloom thresholds shown as horizontal dashed lines. Coefficients of determination (R^2) and corresponding confidence intervals are included.

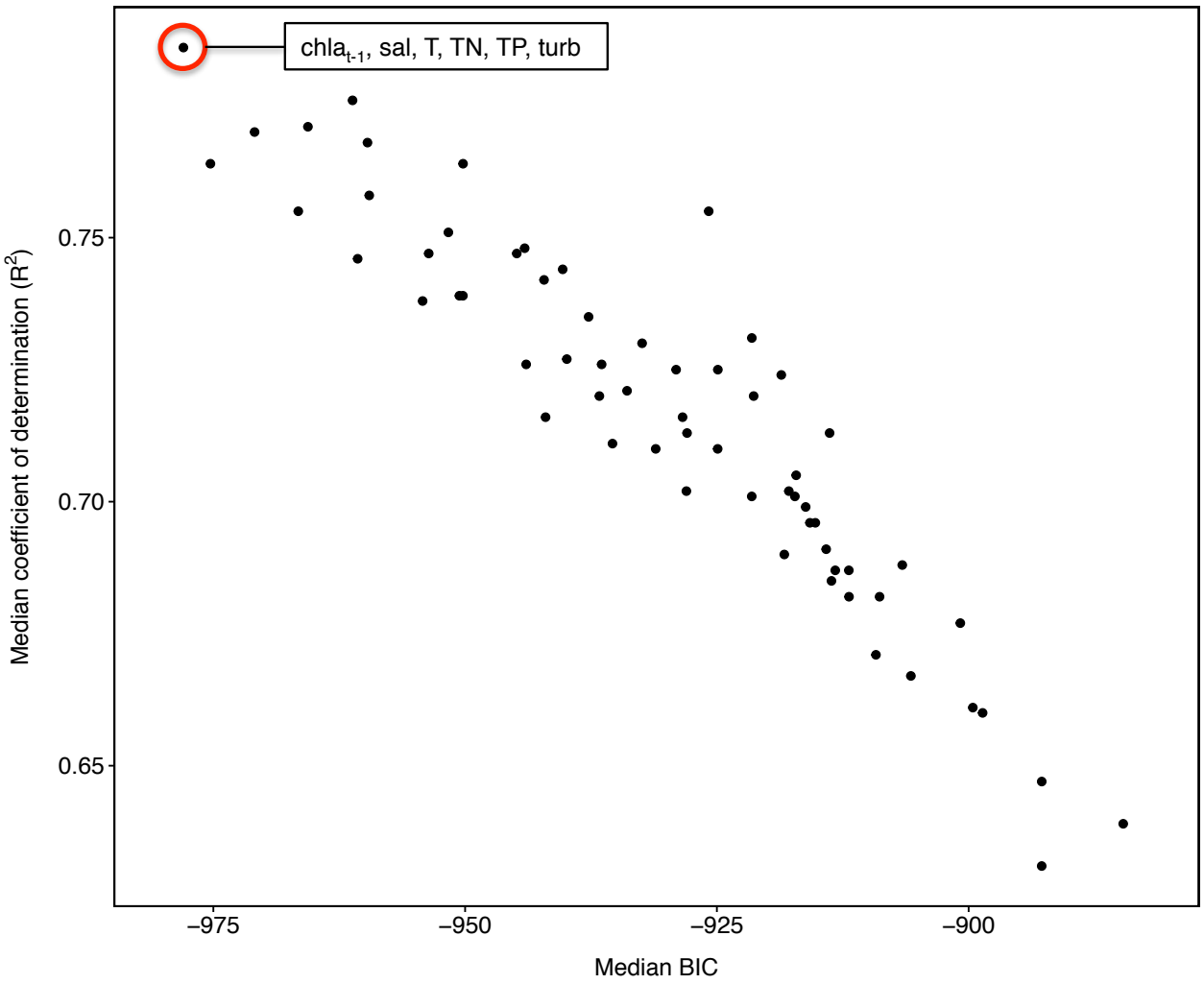
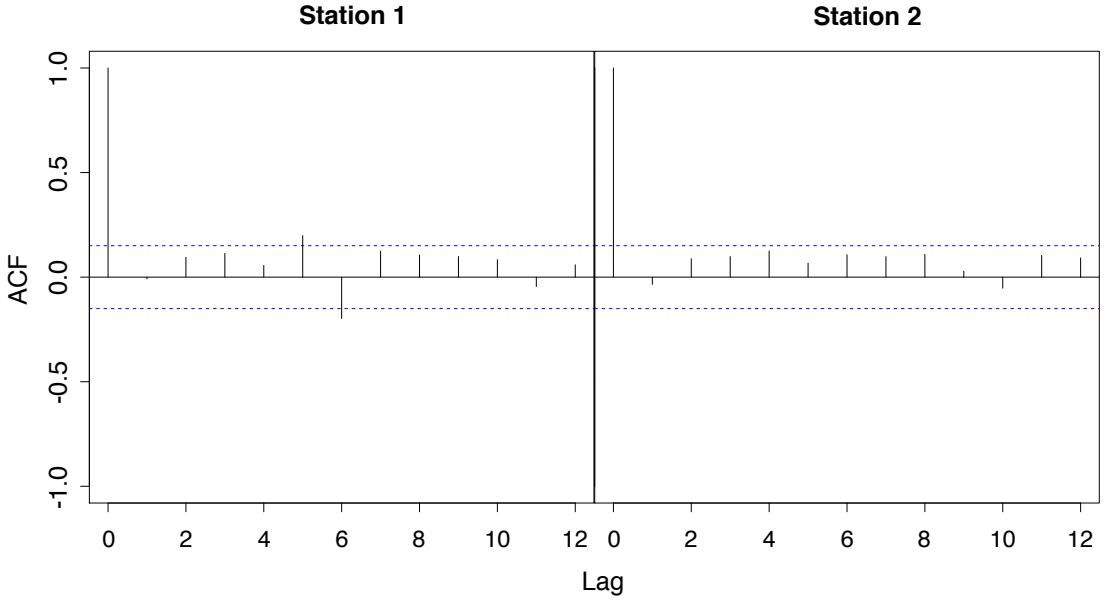
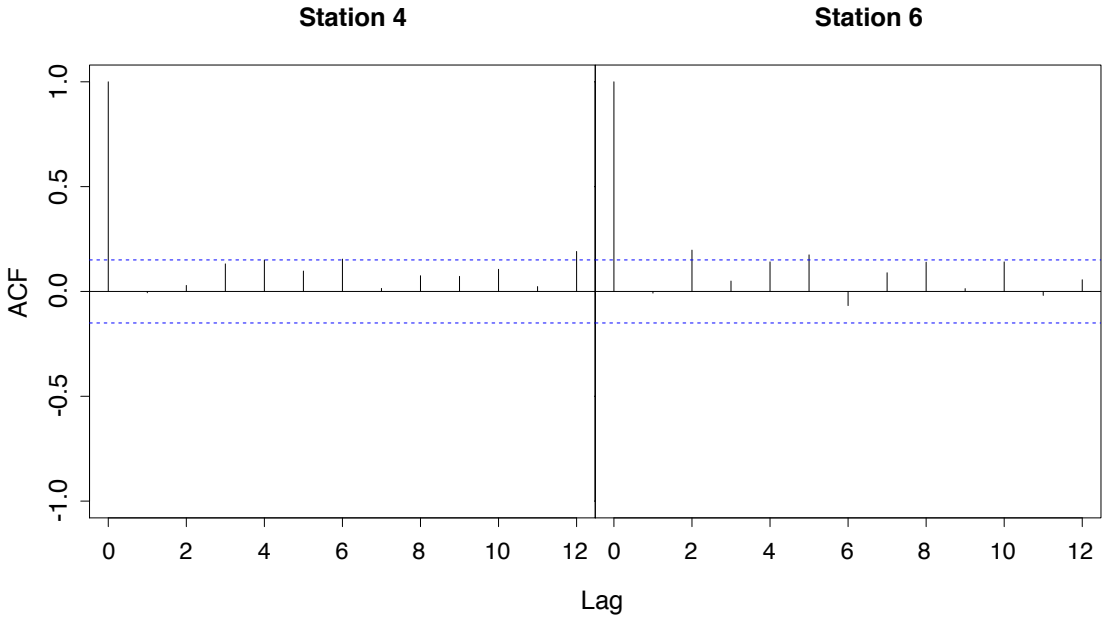


Figure S4. Median coefficient of determination (R^2) and Bayesian Information Criterion (BIC) values for each combination of explanatory variables. Circled point corresponds to the "best model," which maximized R^2 and minimized BIC. See Table S2 for more details.

Non-bloom


Station 1
Station 2
ACF
1.0
0.5
0.0
-0.5
-1.0
0
2
4
6
8
10
12
Lag


Station 4
Station 6
ACF
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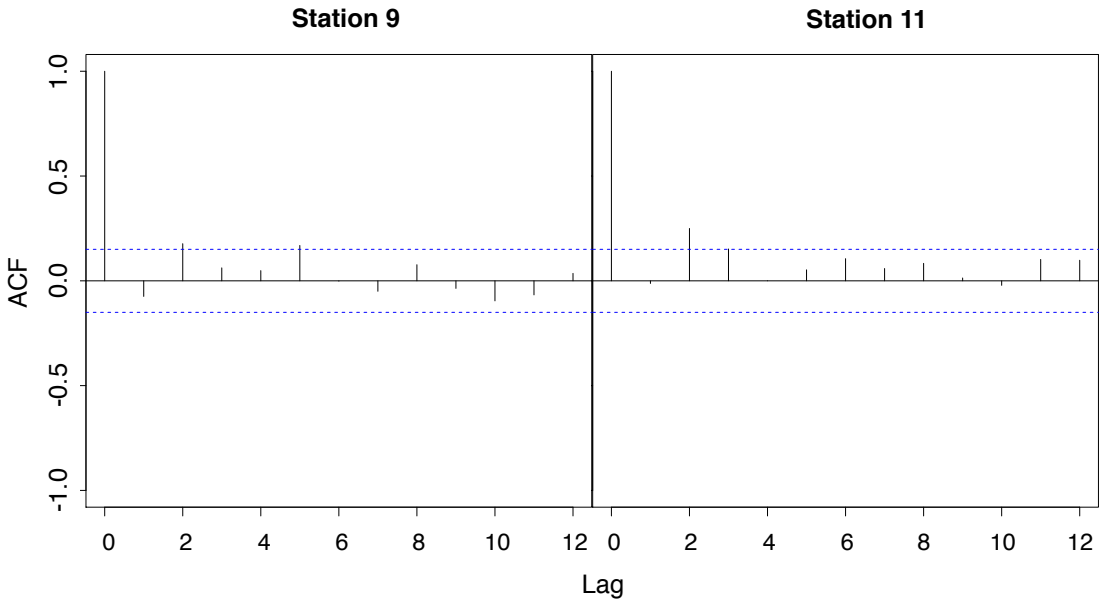
0.5
0.0
-0.5
-1.0
0
2
4
6
8
10
12
Lag


Station 9
Station 11
ACF
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0.0
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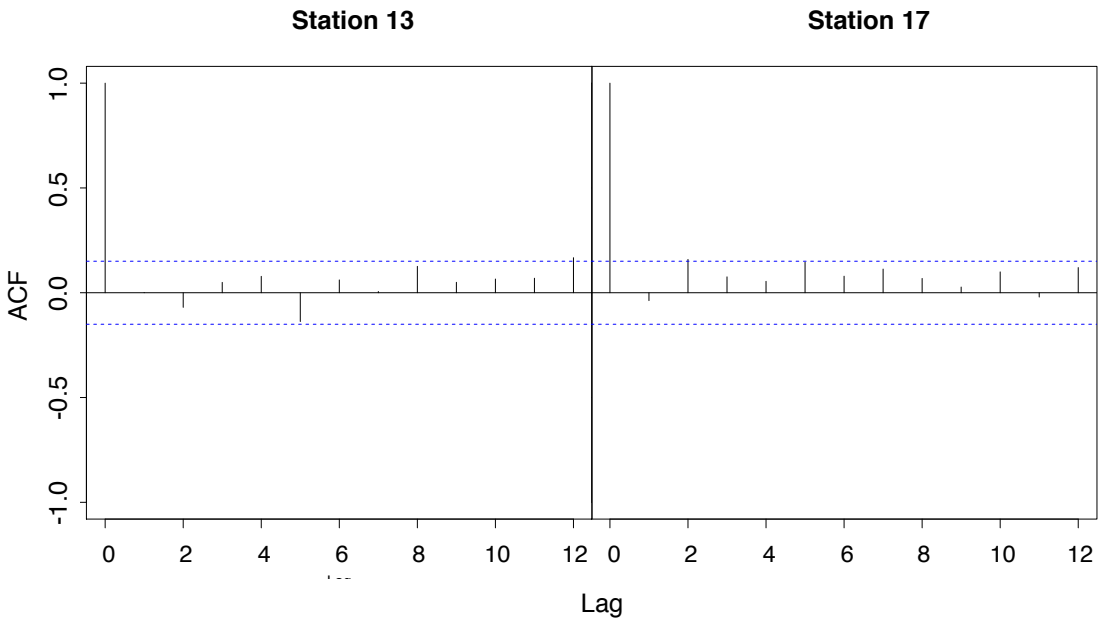
-1.0
0
2
4
6
8
10
12
Lag


Station 13
Station 17
ACF
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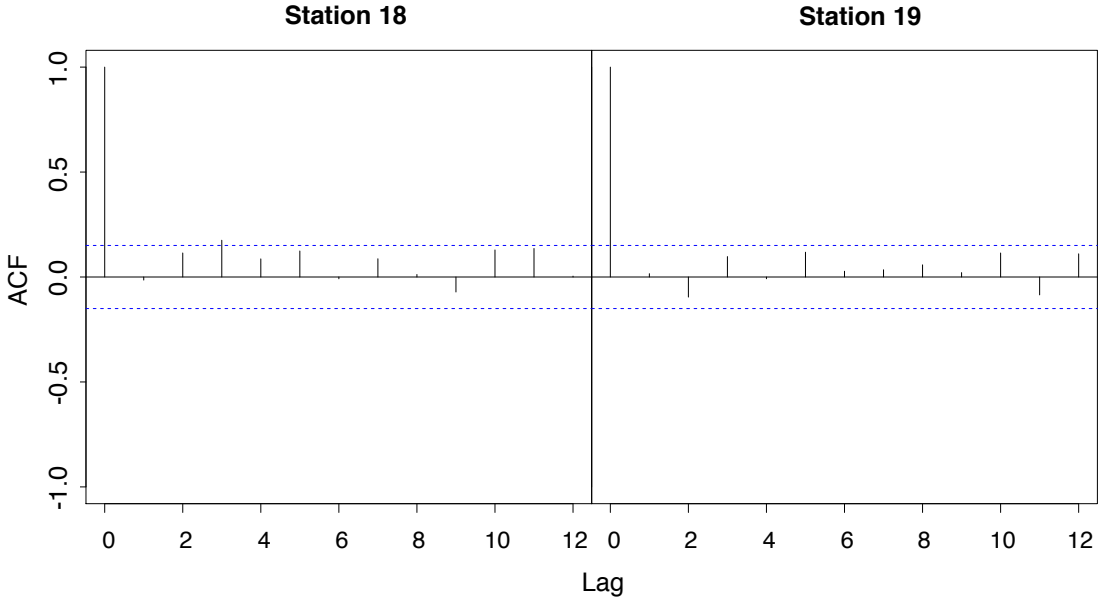
0.5
0.0
-0.5
-1.0
0
2
4
6
8
10
12
Lag


Station 18
Station 19
ACF
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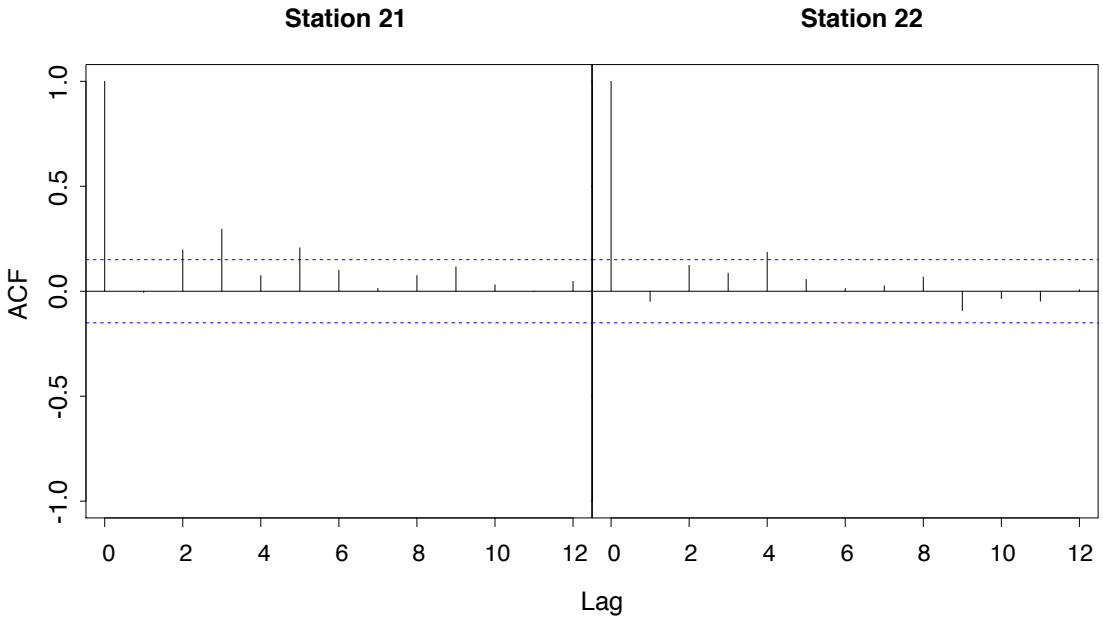
-1.0
0
2
4
6
8
10
12
Lag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Station 22
ACF
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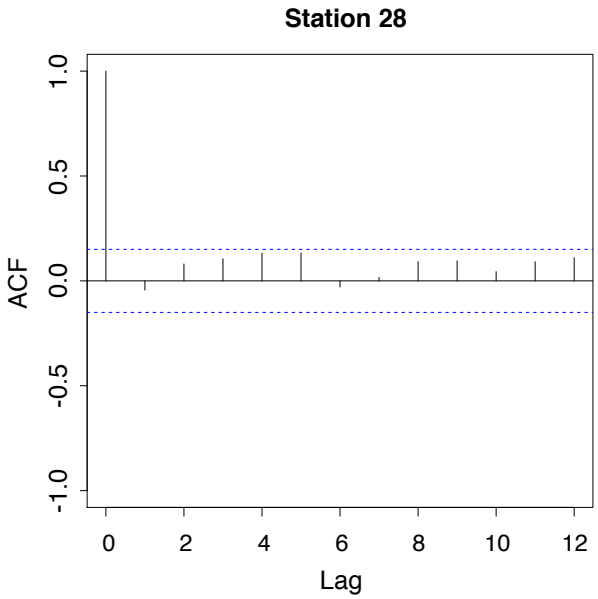
-1.0
0
2
4
6
8
10
12
Lag


Station 28
ACF
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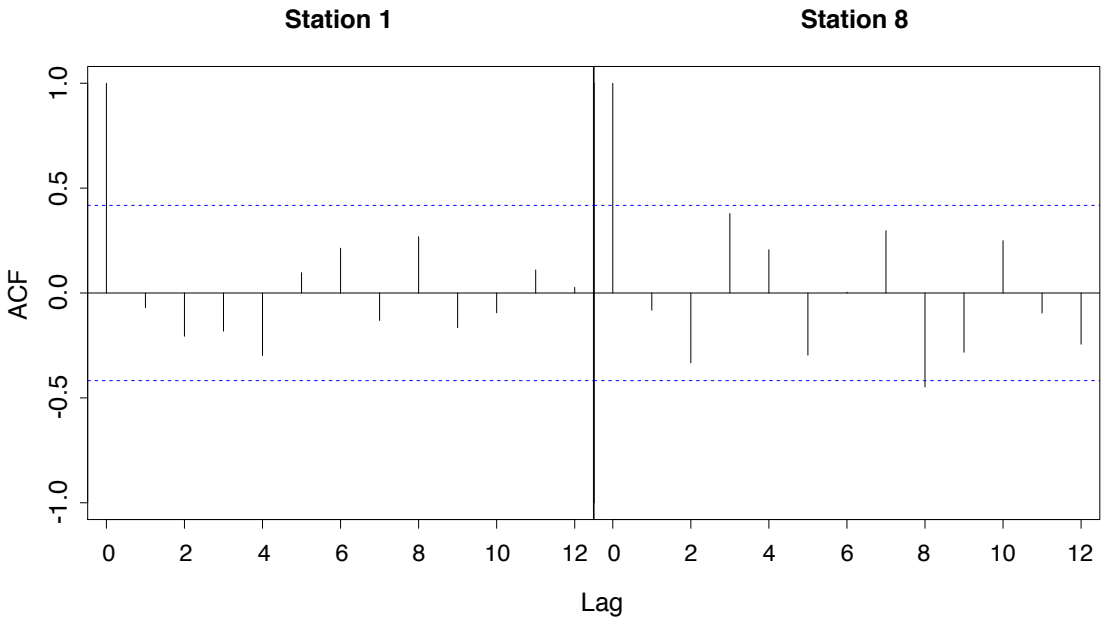
0.0
-0.5
-1.0
0
2
4
6
8
10
12
Lag

Bloom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Station 8
ACF
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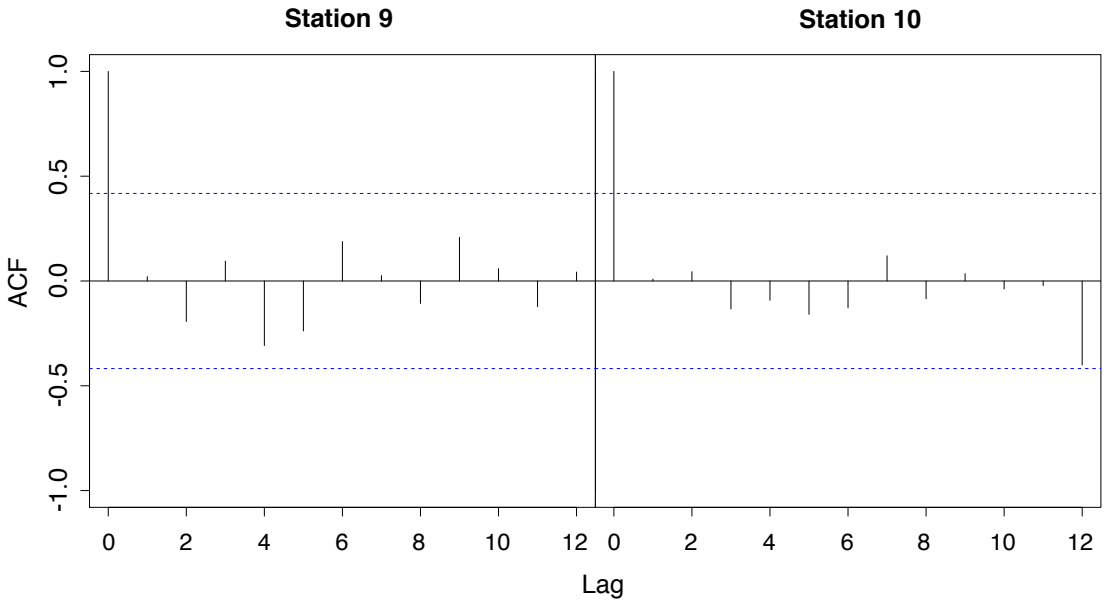
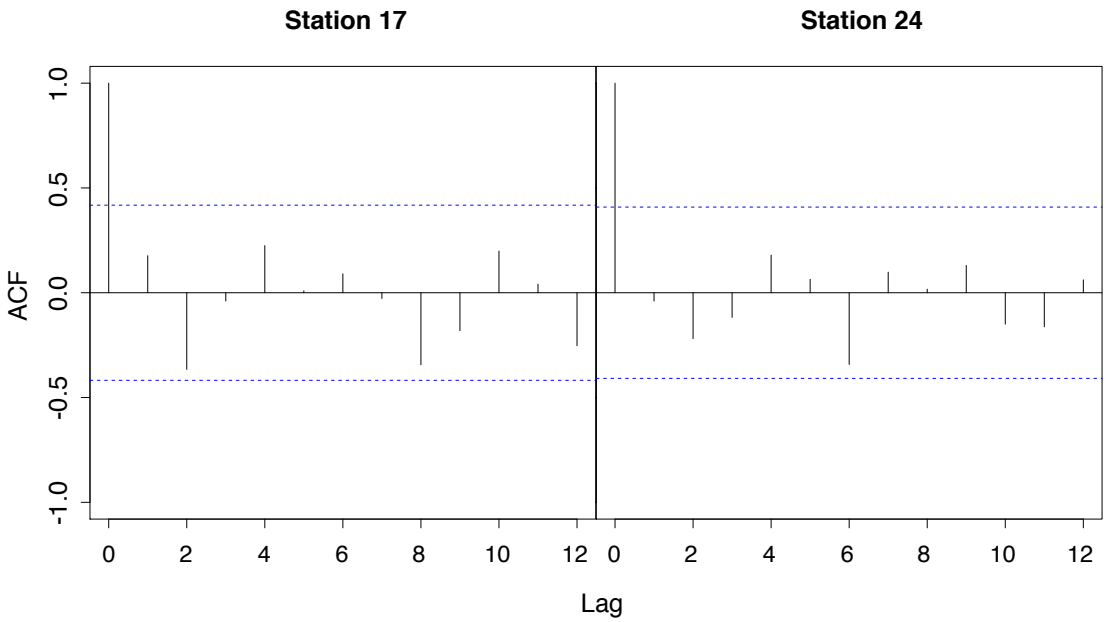
-0.5
-1.0
0
2
4
6
8
10
12
Lag


Station 9
Station 10
ACF
1.0
0.5
0.0
-0.5
-1.0
0
2
4
6
8
10
12
Lag


Station 17
Station 24
ACF
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0.0
-0.5
-1.0
0
2
4
6
8
10
12
Lag

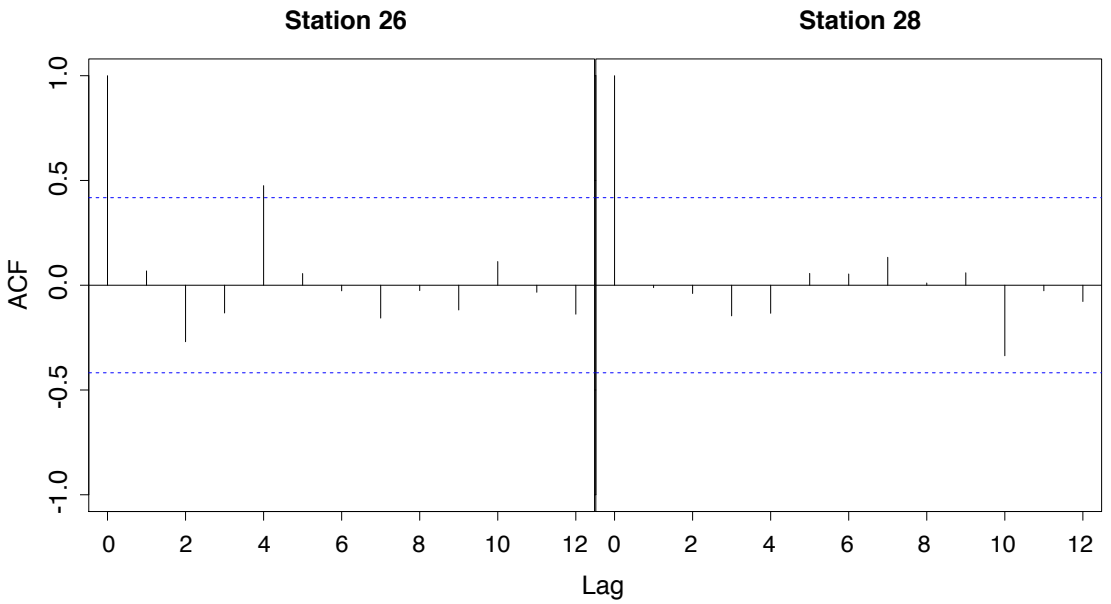

Figure S5. Autocorrelation function (ACF) plots of residuals that have been fit with an autoregressive model of order one.