Monthly Report (00)

2023.06 Data Set

Friday 14th July, 2023

Prepared for

Statistics for Physical and Engineering Sciences

by

Jamie Riggs, Ph.D.

Principal Statistician
Statistics for Physical and Engineering Sciences Institute

1 Introduction

The process of reporting monthly Sunspot numbers consists of submitting individual observer's daily counts for a specific month to the AAVSO Solar Section. These data are maintained in a SQL database. The monthly data then are extracted for analysis using the R statistics package (http://www.R-project.org/). This report is the portion of the analysis concerned with both the raw daily average counts and the data Accuracy, Consistency, and Completeness measures for a particular month. The checks are used to scrub or filter the data to assure only error-free data are used to determine the monthly sunspot number.

This report consists of four sections: the raw daily average counts (Section 2), the known data errors (Section 3), the processed counts using a Generalized Linear Mixed Model to produce the relative sunspot numbers (Section 4), and supporting information on the model construction (Section 5).

The raw daily average of counts consist of submitted counts from all observers who provided data in the particular month. These averaged counts are reported by the day of the month, and are either from data not scrubbed or corrected data. The table captions indicate which. The errors, if any, are reported according to type.

The Error Tables section contains reported errors on missing data, inconsistencies in year and month, inconsistencies in the reported day number (1-31), seeing coding errors, number of annual observations by observer, and inconsistencies between the reported Wolf number and the calculated Wolf number from the group counts and sunspot counts, among other errors that are given in that section.

The relative sunspot numbers R_a section contains the sunspot numbers after the submitted data are scrubbed and modeled by a Generalized Linear Mixed Model (GLMM). The GLMM is a statistical model that accounts for variation due to random effects and fixed effects. For the R_a model random effects include the AAVSO observer as these observers are a selection from all possible observers, and the fixed effects include seeing conditions at one of four possible levels. More details on GLMM are available in a paper (GLMM05) on the sunspot counts research page. The paper title is *A Generalized Linear Mixed Model for Enumerated Sunspots*.

The supporting information for the model is provided for clarification.

2 Raw Daily Average Counts

The reported raw daily average counts have been checked for errors and inconsistencies, and no known errors are present. All observers whose submissions qualify through this month's scrubbing process are represented in Figure 1 and Table 1.

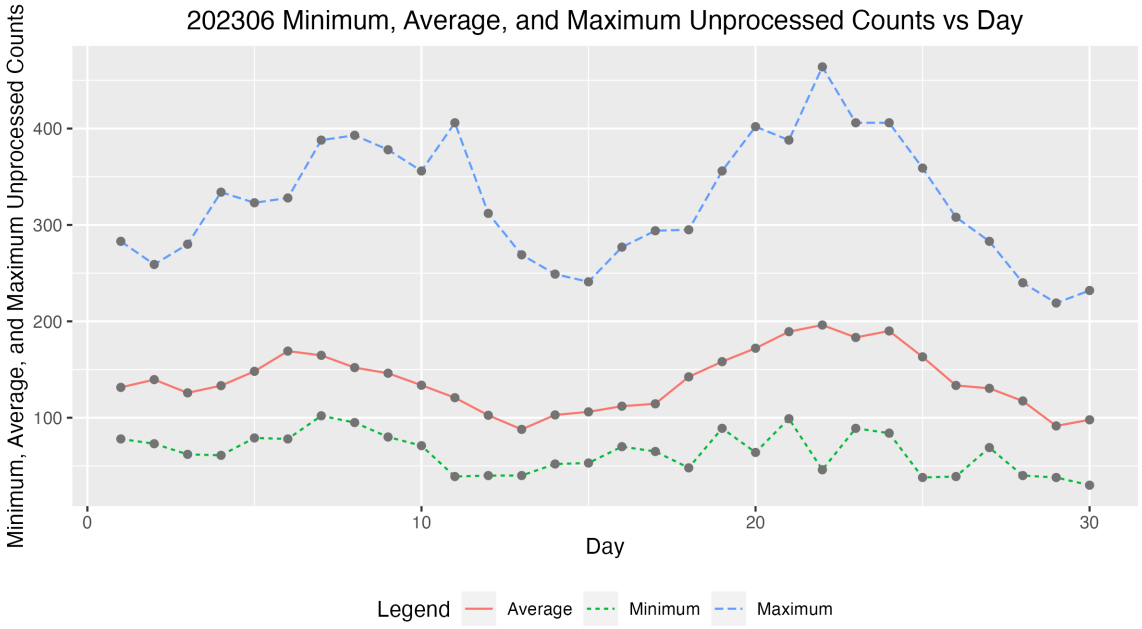

Figure 1: Raw average sunspot count by day of the month.

Table 1: 202306 Daily Raw Counts

Day	Submissions	Minimum	Average	Maximum
1.0000	44.0000	78.0000	131.4773	283.0000
2.0000	38.0000	73.0000	139.5263	259.0000
3.0000	39.0000	62.0000	125.7949	280.0000
4.0000	37.0000	61.0000	133.2703	334.0000
5.0000	34.0000	79.0000	148.1176	323.0000
6.0000	34.0000	78.0000	169.1471	328.0000
7.0000	35.0000	102.0000	164.7143	388.0000
8.0000	36.0000	95.0000	152.0000	393.0000
9.0000	33.0000	80.0000	146.1515	378.0000
10.0000	42.0000	71.0000	133.7381	356.0000
11.0000	40.0000	39.0000	120.7750	406.0000
12.0000	27.0000	40.0000	102.5185	312.0000
13.0000	30.0000	40.0000	87.9000	269.0000
14.0000	30.0000	52.0000	102.9000	249.0000
15.0000	37.0000	53.0000	106.0811	241.0000
16.0000	34.0000	70.0000	111.9706	277.0000
17.0000	36.0000	65.0000	114.4444	294.0000
18.0000	27.0000	48.0000	142.4074	295.0000
19.0000	35.0000	89.0000	158.1714	356.0000
20.0000	29.0000	64.0000	172.1034	402.0000
21.0000	34.0000	99.0000	189.2647	388.0000
22.0000	35.0000	46.0000	196.1714	464.0000
23.0000	33.0000	89.0000	183.2727	406.0000
24.0000	42.0000	84.0000	190.0238	406.0000
25.0000	42.0000	38.0000	163.1429	359.0000
26.0000	39.0000	39.0000	133.4872	308.0000
27.0000	34.0000	69.0000	130.5000	283.0000
28.0000	33.0000	40.0000	117.3636	240.0000
29.0000	38.0000	38.0000	91.4737	219.0000
30.0000	27.0000	30.0000	97.8519	232.0000

3 Error Tables

Data are for the month of June 2023. No errors were found, and hence no errors are reported.

4 Relative Sunspot Numbers

All data errors, if any, have been corrected prior to determining the following relative sunspot numbers. A Generalized Linear Mixed Model (GLMM) was constructed to provide monthly sunspot numbers (see Table 2). The GLMM treats observer as a random effect, with year, month, seeing conditions, observer rank, and dual submission to both AAVSO and SILSO as fixed effects.

Figure 2 shows the monthly R_a numbers for the years and months (ym) in Table 2. The solid cyan curve that connects the cyan X's are the GLMM model estimates given in 2. The dotted black curves on either side of the cyan curve depict a 99% confidence band about the GLMM estimates. The confidence band uses the large sample approximation based on the Gaussian distribution. The dashed red curve connecting the red O's are the SILSO values for the monthly sequence.

The tan box plots for each month are the actual observations submitted by the AAVSO observers. The heavy solid lines approximately midway in the boxes represent the count medians. The box of the box plot represents the InterQuartile Range (IQR), which depicts from the 25^{th} through the 75^{th} quartiles. The lower and upper whiskers extend 1.5 times the IQR below the 25^{th} quartile, and 1.5 times the IQR above the 75^{th} quartile. The black circles below and above the whiskers traditionally are considered outliers, but with GLMM modeling, they are observations that comprise overdispersion. Overdispersion skews the counts data from a true Poisson distribution. The GLMM adjusts for this overdispersion.

Table 2: Year Month (ym) Relative Sunspot Numbers with 99% CI

ym	Ra	lci99	uci99	aavso	sidc
2008.12	2.7705	2.4268	3.1142	0.5000	1.0000
2009.01	5.1908	4.6582	5.7234	1.3000	1.3000
2009.02	4.6416	4.1508	5.1324	0.7000	1.2000
2009.03	6.0139	5.7923	6.2355	0.3000	0.6000
2009.04	6.5123	6.2954	6.7292	0.4000	1.2000
2009.05	6.9053	6.6465	7.1642	1.6000	2.9000
2009.06	6.8305	6.5037	7.1574	3.2000	6.3000
2009.07	6.3401	6.0927	6.5875	3.6000	5.5000
2009.08	6.6490	6.4084	6.8896	0.0000	0.0000
2009.09	7.3307	7.0860	7.5754	4.5000	7.1000
2009.10	6.8554	6.5066	7.2041	4.5000	7.7000
2009.11	6.8654	6.6709	7.0600	3.3000	6.9000
2009.12	7.3252	7.1063	7.5441	10.4000	16.3000
2010.01	19.6362	17.5244	21.7479	13.3000	19.5000
2010.02	15.8907	13.8557	17.9256	19.4000	28.5000

Continued on next page

Table 2: Year Month (ym) Relative Sunspot Numbers with 99% CI

ym	Ra	lci99	uci99	aavso	sidc
2010.03	17.5616	15.4946	19.6285	15.4000	24.0000
2010.04	18.6600	16.5748	20.7452	7.0000	10.4000
2010.05	22.8844	22.4552	23.3137	8.4000	8.7000
2010.06	21.2858	20.8957	21.6760	11.0000	13.6000
2010.07	21.6469	21.2902	22.0037	15.2000	16.1000
2010.08	21.8325	21.4254	22.2395	18.3000	19.6000
2010.09	25.1595	24.6894	25.6296	22.8000	25.2000
2010.10	23.9177	23.4419	24.3936	21.0000	23.5000
2010.11	24.2706	23.7958	24.7453	20.9000	21.6000
2010.12	24.9993	24.4608	25.5378	13.9000	14.5000
2011.01	70.5352	69.0027	72.0677	17.7000	18.7000
2011.02	62.1058	60.6959	63.5157	29.1000	29.6000
2011.03	66.2873	64.9216	67.6530	48.0000	55.8000
2011.04	71.8752	70.3900	73.3603	47.3000	54.4000
2011.05	76.0277	74.6042	77.4512	37.3000	41.5000
2011.06	70.3749	69.0328	71.7170	35.2000	37.0000
2011.07	70.5217	69.2417	71.8016	41.5000	43.8000
2011.08	71.9358	70.6889	73.1828	42.4000	50.5000
2011.09	81.9007	80.3498	83.4516	73.8000	78.0000
2011.10	77.6178	76.1983	79.0373	78.9000	88.0000
2011.11	78.8163	77.1265	80.5060	84.6000	96.7000
2011.12	79.4780	77.7975	81.1584	65.8000	73.0000
2012.01	75.8759	74.3134	77.4383	55.8000	58.2000
2012.02	65.7511	64.3365	67.1658	29.2000	33.1000
2012.03	70.7296	69.4181	72.0411	53.1000	64.1000
2012.04	75.0648	73.6315	76.4981	51.4000	55.2000
2012.05	81.3007	79.8440	82.7574	61.8000	69.0000
2012.06	74.7944	73.4347	76.1541	59.7000	64.5000
2012.07	75.6160	74.2789	76.9531	64.2000	51.3000
2012.08	74.1779	72.8827	75.4732	57.7000	63.1000
2012.09	84.7498	83.2009	86.2987	57.7000	61.5000
2012.10	81.2733	79.7019	82.8446	48.3000	53.3000
2012.11	82.9149	81.1828	84.6470	56.7000	61.4000
2012.12	83.4587	81.5976	85.3199	37.4000	40.8000
2013.01	84.1177	82.4439	85.7916	63.8000	62.9000
2013.02	73.0106	71.4668	74.5544	37.8000	38.0000
2013.03	76.1593	74.5444	77.7742	50.6000	57.9000
2013.04	81.8477	80.3182	83.3772	70.6000	72.4000
2013.05	86.5834	84.9244	88.2424	77.4000	78.7000

Continued on next page

Table 2: Year Month (ym) Relative Sunspot Numbers with 99% CI

ym	Ra	lci99	uci99	aavso	sidc
2013.06	81.2667	79.7132	82.8202	51.0000	52.5000
2013.07	81.2234	79.8056	82.6412	57.0000	57.0000
2013.08	81.4185	80.0076	82.8294	60.0000	66.0000
2013.09	91.4352	89.7119	93.1586	34.6000	36.9000
2013.10	86.5697	84.8777	88.2617	74.5000	85.6000
2013.11	86.9414	84.8771	89.0057	73.9000	77.6000
2013.12	89.9520	87.9767	91.9273	77.8000	90.3000
2014.01	98.3136	96.1733	100.4538	77.4000	82.0000
2014.02	87.2251	85.3924	89.0578	93.9000	102.8000
2014.03	92.9746	91.1916	94.7576	80.9000	92.2000
2014.04	100.0542	98.1835	101.9248	76.9000	84.7000
2014.05	106.3979	104.4797	108.3160	72.3000	75.2000
2014.06	99.7562	97.9416	101.5709	67.2000	71.0000
2014.07	99.2785	97.4947	101.0623	72.5000	72.5000
2014.08	99.5835	97.9235	101.2435	71.2000	74.7000
2014.09	113.1360	111.0060	115.2660	83.2000	87.6000
2014.10	106.5454	104.4932	108.5976	59.5000	60.6000
2014.11	108.0399	105.6765	110.4032	65.8000	71.1000
2014.12	109.0689	106.5095	111.6283	75.8000	78.0000
2015.01	60.7850	59.5405	62.0295	65.9000	67.0000
2015.02	52.7713	51.5343	54.0084	42.4000	44.8000
2015.03	57.0214	55.9252	58.1175	38.0000	38.4000
2015.04	61.0400	59.8708	62.2093	49.0000	54.4000
2015.05	64.9051	63.7697	66.0405	56.3000	58.8000
2015.06	60.4339	59.3261	61.5416	50.2000	68.3000
2015.07	59.5136	58.4982	60.5290	47.9000	65.8000
2015.08	60.9128	59.8868	61.9388	39.5000	57.2000
2015.09	68.5266	67.2748	69.7785	49.2000	72.1000
2015.10	64.9909	63.7301	66.2517	39.3000	48.3000
2015.11	66.4548	64.9887	67.9210	39.6000	55.9000
2015.12	67.7747	66.2515	69.2980	36.4000	44.8000
2016.01	33.2586	32.5580	33.9591	33.7000	43.3000
2016.02	28.8469	28.2394	29.4543	38.3000	46.8000
2016.03	30.7302	30.1093	31.3512	30.5000	38.9000
2016.04	32.6757	32.0457	33.3058	26.6000	30.9000
2016.05	34.9048	34.2627	35.5469	33.7000	48.4000
2016.06	32.2684	31.7124	32.8244	13.1000	19.5000
2016.07	32.4612	31.9348	32.9877	21.2000	27.5000
2016.08	32.8083	32.2251	33.3914	33.0000	47.9000

Continued on next page

Table 2: Year Month (ym) Relative Sunspot Numbers with 99% CI

ym	Ra	lci99	uci99	aavso	sidc
2016.09	37.7527	37.0570	38.4484	27.7000	37.1000
2016.10	35.5108	34.8214	36.2003	22.7000	31.7000
2016.11	35.9110	35.1543	36.6677	14.0000	22.2000
2016.12	37.0834	36.2799	37.8869	11.1000	20.0000
2017.01	17.9162	17.5342	18.2982	18.4000	26.2000
2017.02	15.6033	15.2561	15.9505	14.4000	20.6000
2017.03	16.7365	16.4133	17.0598	11.3000	15.5000
2017.04	17.9755	17.6546	18.2965	21.6000	33.2000
2017.05	18.9556	18.6243	19.2869	12.5000	18.1000
2017.06	17.4792	17.1866	17.7718	15.5000	19.3000
2017.07	17.6564	17.3715	17.9414	11.5000	16.3000
2017.08	17.8166	17.5037	18.1296	22.8000	35.7000
2017.09	20.8153	20.3774	21.2532	34.6000	42.9000
2017.10	19.0491	18.6562	19.4421	10.5000	11.0000
2017.11	19.1701	18.7612	19.5789	4.2000	5.6000
2017.12	19.6853	19.3832	19.9874	4.0000	4.6000
2018.01	5.0068	4.8989	5.1147	3.1000	6.3000
2018.02	4.3201	4.2152	4.4250	6.8000	11.8000
2018.03	4.5634	4.4709	4.6559	1.1000	1.2000
2018.04	4.8429	4.7454	4.9404	4.7000	7.5000
2018.05	5.1797	5.0830	5.2764	8.4000	14.0000
2018.06	4.7979	4.7132	4.8826	10.2000	13.6000
2018.07	4.8568	4.8020	4.9115	0.5000	1.7000
2018.08	4.8426	4.7592	4.9260	5.9000	9.5000
2018.09	5.4549	5.3524	5.5574	1.6000	2.9000
2018.10	5.2623	5.1592	5.3654	2.5000	5.6000
2018.11	5.3067	5.1954	5.4179	3.1000	4.2000
2018.12	5.5452	5.4369	5.6536	1.6000	2.3000
2019.01	3.3172	3.2538	3.3805	5.4000	2.3000
2019.02	2.9175	2.8598	2.9752	0.1000	1.2000
2019.03	3.0501	2.9980	3.1022	6.1000	12.1000
2019.04	3.2771	3.2153	3.3389	6.2000	9.3000
2019.05	3.3957	3.3364	3.4550	7.0000	11.9000
2019.06	3.1601	3.1065	3.2136	0.7000	1.5000
2019.07	3.1896	3.1421	3.2371	0.4000	2.2000
2019.08	3.2319	3.1838	3.2799	0.3000	0.8000
2019.09	3.7166	3.6580	3.7751	0.5000	1.0000
2019.10	3.4785	3.4193	3.5377	0.2000	0.5000
2019.11	3.5907	3.5217	3.6598	0.3000	0.6000

Continued on next page

Table 2: Year Month (ym) Relative Sunspot Numbers with 99% CI

ym	Ra	lci99	uci99	aavso	sidc
2019.12	3.6588	3.5857	3.7319	0.8000	1.0000
2020.01	7.3419	7.1979	7.4859	4.0000	5.3000
2020.02	6.3934	6.2648	6.5221	0.1000	0.0000
2020.03	6.7476	6.6213	6.8739	1.2000	1.5000
2020.04	7.2940	7.1743	7.4138	3.0000	5.1000
2020.05	7.6185	7.4998	7.7371	0.1000	0.4000
2020.06	7.1296	7.0197	7.2396	3.9000	6.4000
2020.07	7.0943	6.9892	7.1994	4.2000	7.7000
2020.08	7.0848	6.9858	7.1838	5.3000	7.8000
2020.09	8.1166	7.9854	8.2479	0.4000	0.9000
2020.10	7.7805	7.6515	7.9096	9.9000	13.6000
2020.11	7.9374	7.8073	8.0675	21.2000	33.1000
2020.12	8.1205	7.9736	8.2675	15.4000	19.8000
2021.01	25.6311	25.1714	26.0908	7.0000	15.8000
2021.02	22.7267	22.3214	23.1320	5.8000	10.7000
2021.03	24.1361	23.7539	24.5183	11.0000	17.2000
2021.04	26.2469	25.7889	26.7050	18.5000	28.8000
2021.05	27.7238	27.2826	28.1651	15.9000	22.9000
2021.06	25.7661	25.3464	26.1857	19.9000	24.1000
2021.07	25.5386	25.1069	25.9702	23.8000	35.6000
2021.08	26.3509	25.9114	26.7905	15.7000	19.5000
2021.09	29.8478	29.3302	30.3655	39.1000	52.5000
2021.10	28.9609	28.4456	29.4762	27.1000	37.0000
2021.11	29.1166	28.5831	29.6501	27.2000	35.1000
2021.12	30.6051	29.9814	31.2289	50.6000	69.0000
2022.01	73.0657	71.7241	74.4072	43.9000	62.0000
2022.02	64.5053	63.2794	65.7312	48.8000	60.5000
2022.03	69.2561	67.9563	70.5559	58.4000	80.6000
2022.04	71.8819	70.6811	73.0827	59.1000	83.9000
2022.05	78.6114	77.3232	79.8996	72.5000	0.4000
2022.06	71.0053	69.8594	72.1512	58.9000	0.4000
2022.07	72.4316	71.2186	73.6447	76.7000	102.5000
2022.08	73.1543	71.9593	74.3493	63.3000	86.0000
2022.09	82.7786	81.2023	84.3549	72.6000	94.5000
2022.10	78.7285	77.2917	80.1653	66.4000	112.1000
2022.11	79.4932	77.9070	81.0795	54.3000	82.1000
2022.12	82.0752	80.2549	83.8954	93.7000	165.0000
2023.01	130.1240	127.2298	133.0183	112.9000	173.8000
2023.02	111.9829	109.5559	114.4098	89.6000	152.3000

Continued on next page

Table 2: Year Month (ym) Relative Sunspot Numbers with 99% CI

ym	Ra	lci99	uci99	aavso	sidc
2023.03	116.2504	113.7677	118.7331	85.0000	126.8000
2023.04	124.9681	122.5118	127.4243	72.1000	114.3000
2023.05	132.8526	130.2249	135.4803	105.0000	140.0000
2023.06	125.2441	123.8383	126.6498	118.5000	173.0000

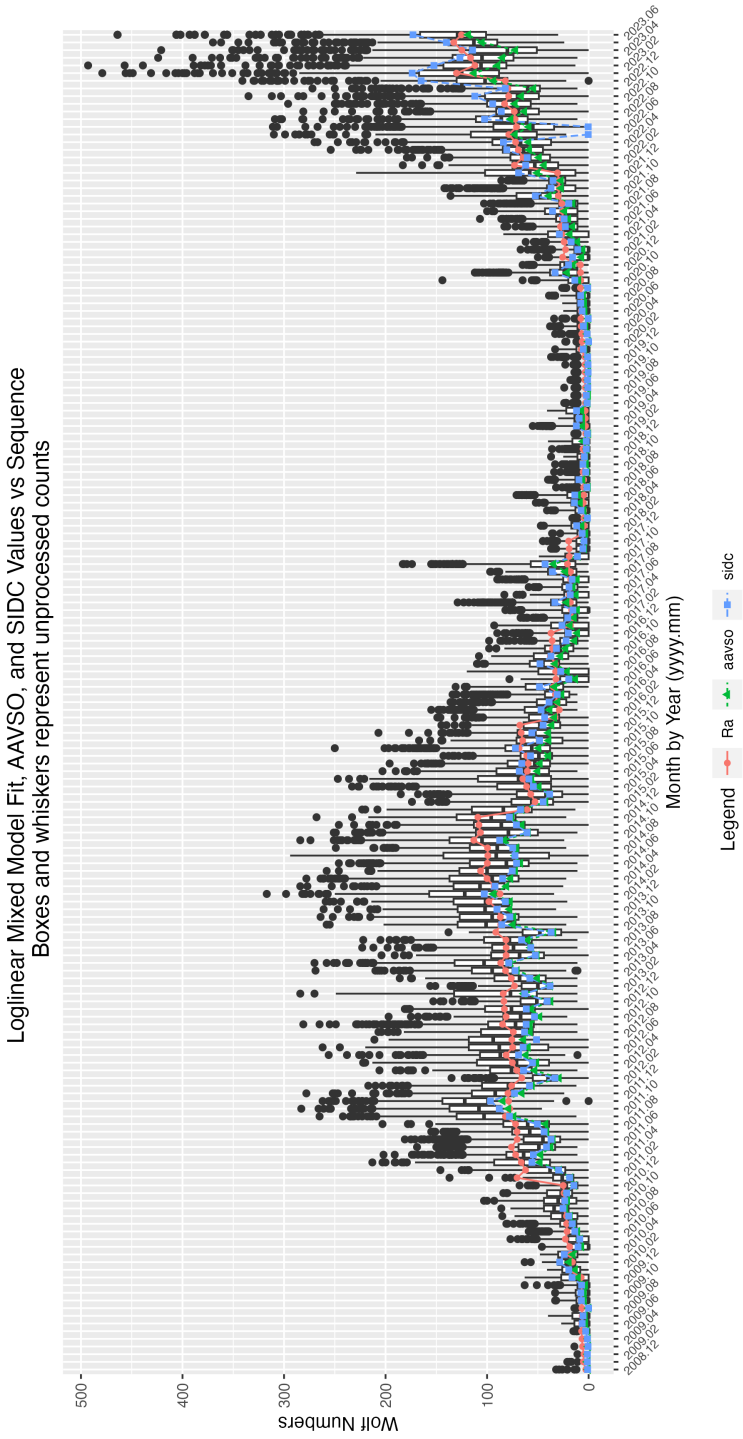

Figure 2: GLMM fitted data for R_a. AAVSO data: https://www.aavso.org/category/tags/solar-bulletin. SILSO data: WDC-SILSO, Royal Observatory of Belgium, Brussels

The GLMM parameter estimates and measures of importance in the determining the monthly R_a values are given in Table 3. The parameter estimates and levels of statistical significance are determined for the residual error size combined with the observer random effect error size. Thus, the parameter estimates are adjusted for the random effect of observer. The significance level is set at 0.05. Any Pr(>|z|) values equal to or less than 0.05 are considered statistically significant.

The year effect levels are given as year2011, year2012, and year2013. The yearly effect is significant as $Pr(> |z|) < 0.05$. So the year in which the observations are made is commensurate with the expected rise toward and anticipated sunspot number maximum. Similarly, the monthly effect, denoted as mon2 through mon12, is significant at the 0.05 level.

The seeing conditions account for a significant amount of deviation in sunspot numbers. The seeing conditions are denoted as seeF (Fair), seeG (Good), and seeP (Poor), and are significant at the 0.05 level. Therefore, seeing conditions influence the reported sunspot numbers, as intuition anticipates.

The level of observer experience (denoted r1000B through r5000H, which is least to most experience) is not significant at the 0.05 significance level. It therefore does not contribute to changes in the monthly sunspot numbers.

Whether an observer contributes counts to the SILSO as well as the AAVSO (silsoy) is not significant at the 0.05 level, and hence we conclude that those observers who contribution to both institutions tend to differ from those observers contributing only to the AAVSO.

5 Supporting Information

Table 3: 202306 Parameter Estimates

	Estimate	Std. Error	t-value	Pr(>|t|)
(Intercept)	1.1814	0.3153	3.7465	0.0002
seeG	-0.1137	0.0044	-26.0332	0.0000
seeF	-0.2291	0.0050	-45.7739	0.0000
seeP	-0.3195	0.0072	-44.2981	0.0000
seeM	-0.1849	0.0243	-7.6034	0.0000
sidc1	0.0472	0.0115	4.1174	0.0000
year2009	0.7643	0.3168	2.4124	0.0158
year2010	1.9998	0.3146	6.3562	0.0000
year2011	3.1487	0.3145	10.0111	0.0000
year2012	3.1916	0.3145	10.1477	0.0000
year2013	3.2865	0.3145	10.4496	0.0000
year2014	3.4857	0.3145	11.0828	0.0000
year2015	3.0059	0.3145	9.5570	0.0000
year2016	2.3903	0.3146	7.5989	0.0000
year2017	1.7770	0.3146	5.6484	0.0000
year2018	0.4960	0.3149	1.5751	0.1152
year2019	0.0828	0.3151	0.2629	0.7926
year2020	0.8891	0.3147	2.8247	0.0047
year2021	2.1695	0.3146	6.8968	0.0000
year2022	3.1645	0.3145	10.0610	0.0000
year2023	3.7180	0.3145	11.8203	0.0000
mon2	-0.1336	0.0077	-17.3447	0.0000
mon3	-0.0751	0.0073	-10.3217	0.0000
mon4	-0.0154	0.0071	-2.1723	0.0298
mon5	0.0397	0.0069	5.7750	0.0000
mon6	-0.0349	0.0067	-5.1949	0.0000
mon7	-0.0388	0.0073	-5.3439	0.0000
mon8	-0.0276	0.0072	-3.8332	0.0001
mon9	0.1099	0.0072	15.2839	0.0000
mon10	0.0585	0.0074	7.9574	0.0000
mon11	0.0860	0.0077	11.2322	0.0000
mon12	0.1137	0.0076	14.9168	0.0000

Table 4: 202306 Summary of Sunspot Numbers

year	mon	day	obs	sidc
Min. :2008	Min. : 1.00	Min. : 0.0	Length:171843	Min. :0.0000
1st Qu.:2013	1st Qu.: 4.00	1st Qu.: 8.0	Class :character	1st Qu.:0.0000
Median :2017	Median : 7.00	Median :16.0	Mode :character	Median :0.0000
Mean :2017	Mean : 6.53	Mean :15.7		Mean :0.2417
3rd Qu.:2020	3rd Qu.: 9.00	3rd Qu.:23.0		3rd Qu.:0.0000
Max. :2023	Max. :12.00	Max. :31.0		Max. :1.0000

Table 5: 202306 Summary of Sunspot Numbers

g	s	w	see	method
Min. : 0.000	Min. : 0.00	Min. : 0.00	E:35933	Length:171843
1st Qu.: 1.000	1st Qu.: 1.00	1st Qu.: 11.00	G:70523	Class :character
Median : 2.000	Median : 9.00	Median : 35.00	F:50424	Mode :character
Mean : 3.056	Mean : 17.71	Mean : 48.27	P:14178	
3rd Qu.: 5.000	3rd Qu.: 26.00	3rd Qu.: 77.00	M: 785	
Max. :30.000	Max. :262.00	Max. :493.00		

Table 6: 202306 Summary of Sunspot Numbers

inst	filter	unit
Length:171843	Length:171843	Length:171843
Class :character	Class :character	Class :character
Mode :character	Mode :character	Mode :character

Table 7: 202306 Summary of Sunspot Numbers

aperture	eyep	foclen	mag
Min. : 0.00	Min. : 0.00	Min. : 0.0	Min. : 0.0
1st Qu.: 60.00	1st Qu.: 4.70	1st Qu.: 150.0	1st Qu.: 40.0
Median : 80.00	Median : 14.00	Median : 900.0	Median : 57.0
Mean : 92.98	Mean : 38.62	Mean : 890.1	Mean : 180.6
3rd Qu.: 104.00	3rd Qu.: 23.00	3rd Qu.:1200.0	3rd Qu.: 72.0
Max. :1524.00	Max. :2010.00	Max. :9990.0	Max. :4591.0

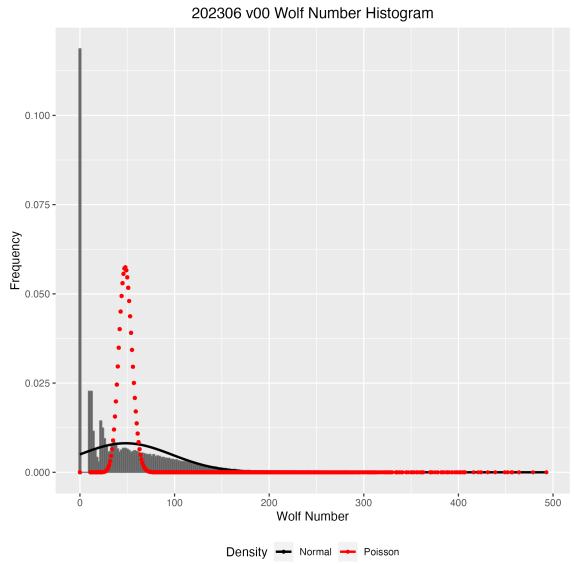

Figure 3: Box plots of raw Wolf number (w) by observer rank.

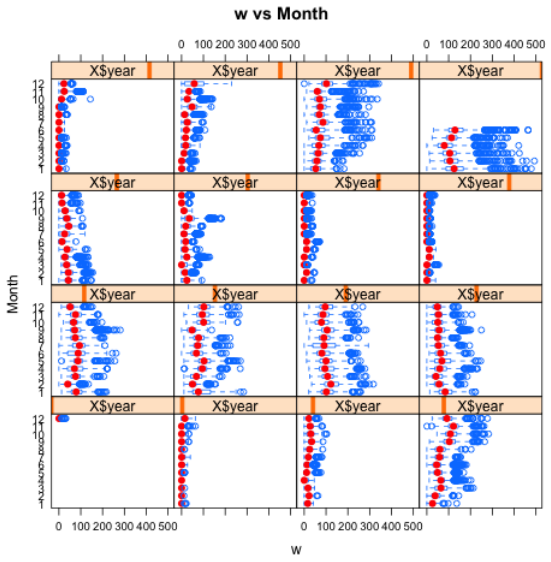

Figure 4: Box plots of raw Wolf number (w) by month and year.

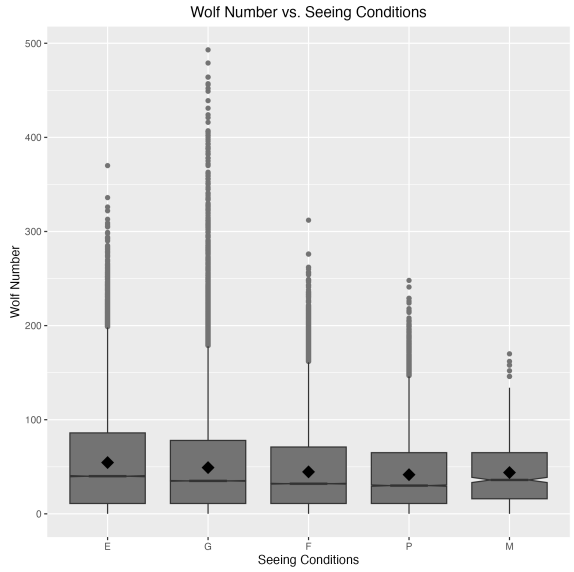

Figure 5: Box plots of raw Wolf number (w) by seeing condition.

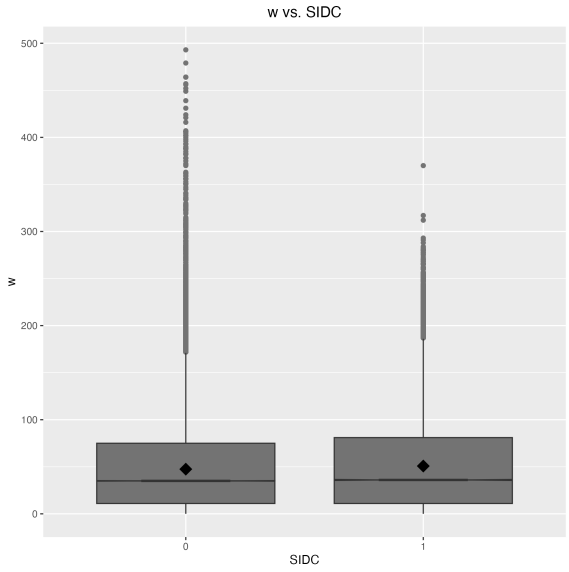

Figure 6: Box plots of raw Wolf number (w) by organization.

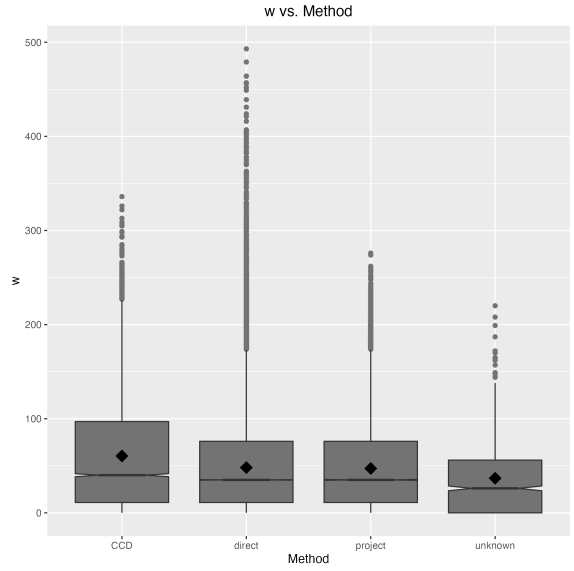

Figure 7: Box plots of raw Wolf number (w) by observer rank.

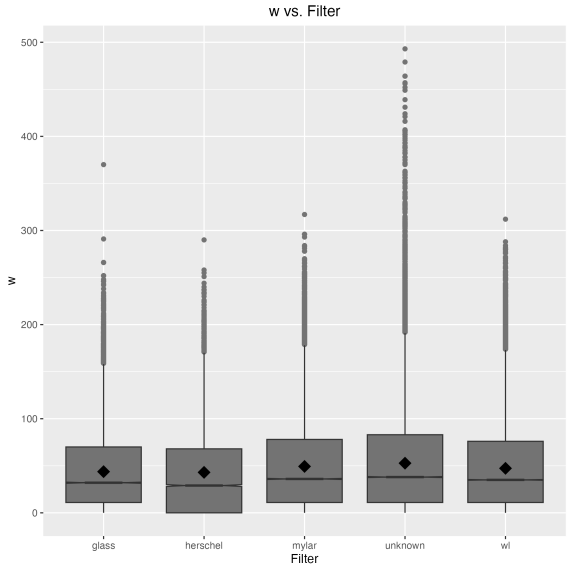

Figure 8: Box plots of raw Wolf number (w) by month and year.

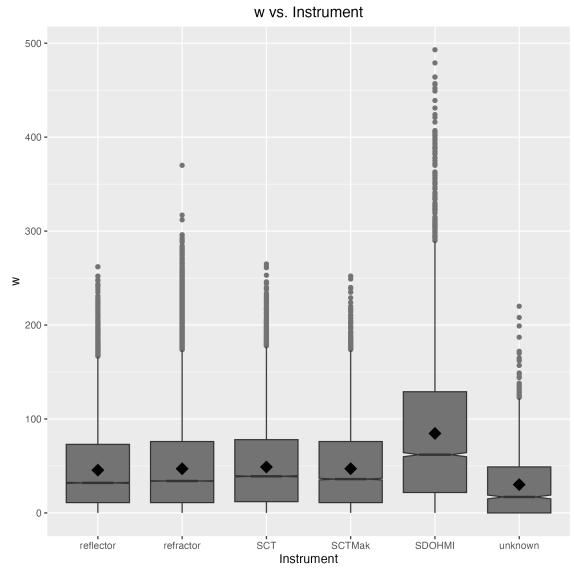

Figure 9: Box plots of raw Wolf number (w) by seeing condition.

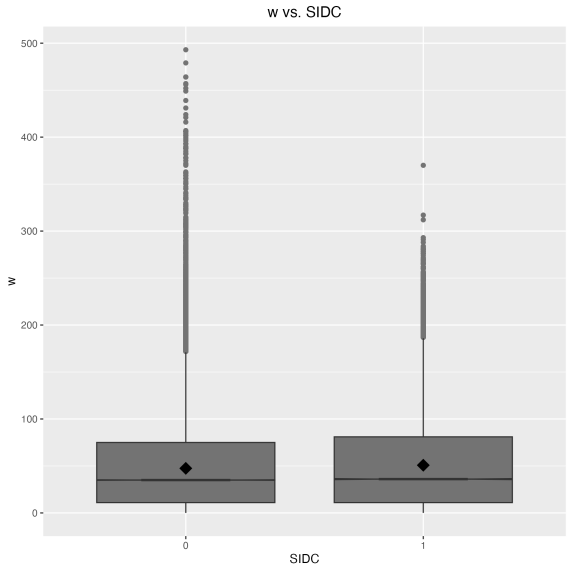

Figure 10: Box plots of raw Wolf number (w) by organization.

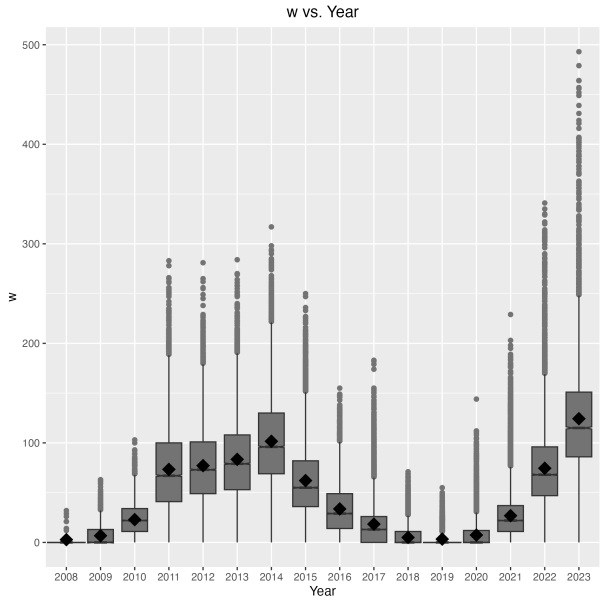

Figure 11: Box plots of raw Wolf number (w) by year.

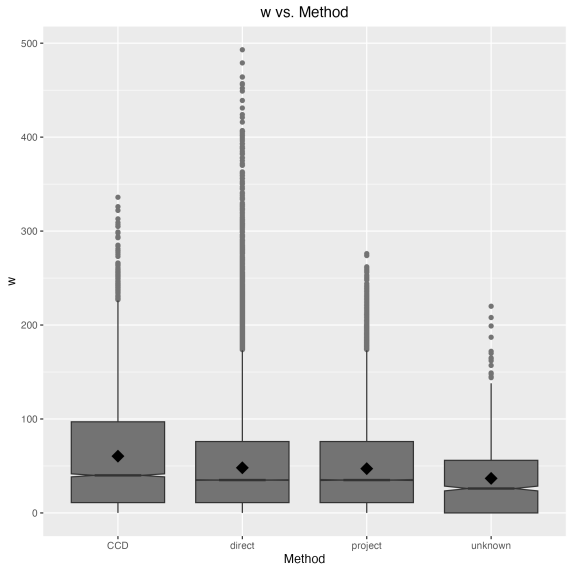

Figure 12: Box plots of raw Wolf number (w) by observing method.