

Monthly Report (00)

2023.01 Data Set

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Prepared for

Statistics for Physical and Engineering Sciences

by

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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.

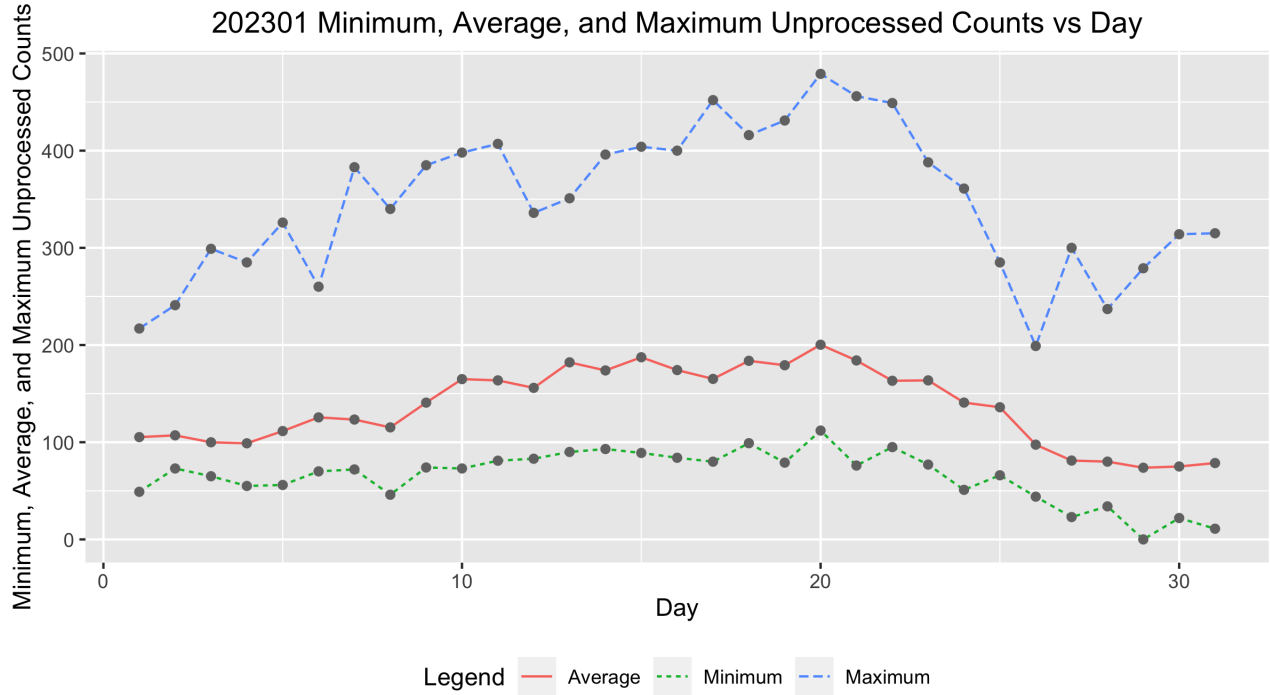


Figure 1: Raw average sunspot count by day of the month.

Table 1: 202301 Daily Raw Counts

Day	Submissions	Minimum	Average	Maximum
1.0000	30.0000	49.0000	105.2667	217.0000
2.0000	24.0000	73.0000	107.0833	241.0000
3.0000	29.0000	65.0000	99.9310	299.0000
4.0000	20.0000	55.0000	98.9000	285.0000
5.0000	27.0000	56.0000	111.4815	326.0000
6.0000	32.0000	70.0000	125.5625	260.0000
7.0000	30.0000	72.0000	123.3333	383.0000
8.0000	30.0000	46.0000	115.2667	340.0000
9.0000	33.0000	74.0000	140.7273	385.0000
10.0000	28.0000	73.0000	164.9286	398.0000
11.0000	30.0000	81.0000	163.6333	407.0000
12.0000	27.0000	83.0000	155.9259	336.0000
13.0000	21.0000	90.0000	182.1905	351.0000
14.0000	28.0000	93.0000	173.8571	396.0000
15.0000	26.0000	89.0000	187.4231	404.0000
16.0000	26.0000	84.0000	174.2308	400.0000
17.0000	25.0000	80.0000	165.1600	452.0000
18.0000	27.0000	99.0000	183.7778	416.0000
19.0000	28.0000	79.0000	179.2143	431.0000
20.0000	29.0000	112.0000	200.3103	479.0000
21.0000	29.0000	76.0000	184.1379	456.0000
22.0000	30.0000	95.0000	163.2333	449.0000
23.0000	22.0000	77.0000	163.6364	388.0000
24.0000	27.0000	51.0000	140.7778	361.0000
25.0000	20.0000	66.0000	136.0000	285.0000
26.0000	33.0000	44.0000	97.4848	199.0000
27.0000	30.0000	23.0000	81.1333	300.0000
28.0000	26.0000	34.0000	80.0385	237.0000
29.0000	25.0000	0.0000	73.7600	279.0000
30.0000	30.0000	22.0000	75.0333	314.0000
31.0000	32.0000	11.0000	78.5938	315.0000

3 Error Tables

Data are for the month of January 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 25th through the 75th quartiles. The lower and upper whiskers extend 1.5 times the IQR below the 25th quartile, and 1.5 times the IQR above the 75th 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	2.4241	3.1169	0.5000	1.0000
2009.01	5.1399	4.6084	5.6714	1.3000	1.3000
2009.02	4.5722	4.0857	5.0588	0.7000	1.2000
2009.03	6.0920	5.8676	6.3165	0.3000	0.6000
2009.04	6.8783	6.6481	7.1085	0.4000	1.2000
2009.05	7.0681	6.8036	7.3326	1.6000	2.9000
2009.06	6.3571	6.0506	6.6636	3.2000	6.3000
2009.07	6.3409	6.0943	6.5874	3.6000	5.5000
2009.08	6.6349	6.3931	6.8768	0.0000	0.0000
2009.09	7.3366	7.0907	7.5824	4.5000	7.1000
2009.10	6.8642	6.5155	7.2129	4.5000	7.7000
2009.11	6.8655	6.6756	7.0555	3.3000	6.9000
2009.12	7.3250	7.1133	7.5367	10.4000	16.3000
2010.01	19.5010	17.3844	21.6176	13.3000	19.5000
2010.02	15.7143	13.6821	17.7464	19.4000	28.5000

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

ym	Ra	lci99	uci99	aavso	sidc
2010.03	17.7658	15.6594	19.8721	15.4000	24.0000
2010.04	19.7199	17.4998	21.9401	7.0000	10.4000
2010.05	23.5636	23.1366	23.9906	8.4000	8.7000
2010.06	19.9145	19.5656	20.2634	11.0000	13.6000
2010.07	21.7477	21.4090	22.0863	15.2000	16.1000
2010.08	21.9272	21.5409	22.3135	18.3000	19.6000
2010.09	25.2812	24.8370	25.7253	22.8000	25.2000
2010.10	24.0058	23.5590	24.4527	21.0000	23.5000
2010.11	24.4011	23.9428	24.8593	20.9000	21.6000
2010.12	25.1067	24.5893	25.6242	13.9000	14.5000
2011.01	69.9355	68.4778	71.3933	17.7000	18.7000
2011.02	61.3224	59.9948	62.6500	29.1000	29.6000
2011.03	67.0236	65.7000	68.3471	48.0000	55.8000
2011.04	75.6720	74.2015	77.1425	47.3000	54.4000
2011.05	77.7102	76.3321	79.0883	37.3000	41.5000
2011.06	65.5286	64.3366	66.7205	35.2000	37.0000
2011.07	70.5810	69.3468	71.8153	41.5000	43.8000
2011.08	71.9797	70.7858	73.1736	42.4000	50.5000
2011.09	81.8669	80.3895	83.3442	73.8000	78.0000
2011.10	77.6247	76.2685	78.9808	78.9000	88.0000
2011.11	78.8739	77.2250	80.5227	84.6000	96.7000
2011.12	79.5246	77.8820	81.1671	65.8000	73.0000
2012.01	75.1592	73.6526	76.6657	55.8000	58.2000
2012.02	64.8088	63.4563	66.1614	29.2000	33.1000
2012.03	71.5309	70.2401	72.8217	53.1000	64.1000
2012.04	79.2079	77.7527	80.6631	51.4000	55.2000
2012.05	83.1488	81.7183	84.5793	61.8000	69.0000
2012.06	69.5713	68.3546	70.7879	59.7000	64.5000
2012.07	75.5728	74.2902	76.8554	64.2000	51.3000
2012.08	74.1541	72.9111	75.3970	57.7000	63.1000
2012.09	84.7500	83.2446	86.2554	57.7000	61.5000
2012.10	81.2637	79.7387	82.7887	48.3000	53.3000
2012.11	82.8508	81.1576	84.5440	56.7000	61.4000
2012.12	83.5152	81.6828	85.3476	37.4000	40.8000
2013.01	83.3713	81.7472	84.9953	63.8000	62.9000
2013.02	72.0112	70.5283	73.4940	37.8000	38.0000
2013.03	77.0393	75.4387	78.6399	50.6000	57.9000
2013.04	86.3433	84.7743	87.9124	70.6000	72.4000
2013.05	88.5296	86.8912	90.1681	77.4000	78.7000

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

ym	Ra	lci99	uci99	aavso	sidc
2013.06	75.5827	74.1920	76.9735	51.0000	52.5000
2013.07	81.1300	79.7675	82.4926	57.0000	57.0000
2013.08	81.3546	79.9930	82.7161	60.0000	66.0000
2013.09	91.3957	89.7182	93.0732	34.6000	36.9000
2013.10	86.5594	84.9110	88.2077	74.5000	85.6000
2013.11	86.8148	84.8062	88.8233	73.9000	77.6000
2013.12	89.9262	87.9788	91.8737	77.8000	90.3000
2014.01	97.4035	95.3191	99.4880	77.4000	82.0000
2014.02	85.9514	84.2000	87.7029	93.9000	102.8000
2014.03	93.9862	92.2280	95.7445	80.9000	92.2000
2014.04	105.5004	103.5891	107.4117	76.9000	84.7000
2014.05	108.7647	106.8569	110.6725	72.3000	75.2000
2014.06	92.7478	91.1211	94.3746	67.2000	71.0000
2014.07	99.1481	97.4292	100.8669	72.5000	72.5000
2014.08	99.4976	97.8938	101.1013	71.2000	74.7000
2014.09	113.0787	111.0196	115.1379	83.2000	87.6000
2014.10	106.5728	104.5674	108.5782	59.5000	60.6000
2014.11	107.9728	105.6703	110.2754	65.8000	71.1000
2014.12	109.1988	106.6566	111.7410	75.8000	78.0000
2015.01	60.1757	58.9603	61.3911	65.9000	67.0000
2015.02	51.9197	50.7385	53.1009	42.4000	44.8000
2015.03	57.5334	56.4557	58.6111	38.0000	38.4000
2015.04	64.2527	63.0639	65.4414	49.0000	54.4000
2015.05	66.3160	65.1892	67.4429	56.3000	58.8000
2015.06	56.2569	55.2404	57.2733	50.2000	68.3000
2015.07	59.5334	58.5241	60.5426	47.9000	65.8000
2015.08	60.9284	59.9097	61.9471	39.5000	57.2000
2015.09	68.5202	67.2763	69.7641	49.2000	72.1000
2015.10	65.0215	63.7678	66.2751	39.3000	48.3000
2015.11	66.4445	64.9913	67.8977	39.6000	55.9000
2015.12	67.6943	66.1842	69.2044	36.4000	44.8000
2016.01	32.9345	32.2468	33.6222	33.7000	43.3000
2016.02	28.4284	27.8342	29.0227	38.3000	46.8000
2016.03	31.0432	30.4216	31.6649	30.5000	38.9000
2016.04	34.4755	33.8162	35.1348	26.6000	30.9000
2016.05	35.7358	35.0826	36.3889	33.7000	48.4000
2016.06	30.0583	29.5442	30.5724	13.1000	19.5000
2016.07	32.4663	31.9447	32.9880	21.2000	27.5000
2016.08	32.8281	32.2501	33.4061	33.0000	47.9000

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

ym	Ra	lci99	uci99	aavso	sidc
2016.09	37.7795	37.0895	38.4695	27.7000	37.1000
2016.10	35.5487	34.8642	36.2333	22.7000	31.7000
2016.11	35.9302	35.1784	36.6821	14.0000	22.2000
2016.12	37.0755	36.2778	37.8732	11.1000	20.0000
2017.01	17.7462	17.3705	18.1218	18.4000	26.2000
2017.02	15.3782	15.0389	15.7174	14.4000	20.6000
2017.03	16.9224	16.5986	17.2462	11.3000	15.5000
2017.04	18.9797	18.6438	19.3156	21.6000	33.2000
2017.05	19.4061	19.0697	19.7425	12.5000	18.1000
2017.06	16.2749	16.0040	16.5458	15.5000	19.3000
2017.07	17.6519	17.3686	17.9353	11.5000	16.3000
2017.08	17.8109	17.4995	18.1224	22.8000	35.7000
2017.09	20.8313	20.3950	21.2676	34.6000	42.9000
2017.10	19.0784	18.6854	19.4715	10.5000	11.0000
2017.11	19.1669	18.7592	19.5746	4.2000	5.6000
2017.12	19.6729	19.3720	19.9737	4.0000	4.6000
2018.01	4.9613	4.8551	5.0676	3.1000	6.3000
2018.02	4.2577	4.1543	4.3612	6.8000	11.8000
2018.03	4.6110	4.5176	4.7044	1.1000	1.2000
2018.04	5.1158	5.0129	5.2187	4.7000	7.5000
2018.05	5.3046	5.2055	5.4038	8.4000	14.0000
2018.06	4.4706	4.3920	4.5492	10.2000	13.6000
2018.07	4.8546	4.7999	4.9094	0.5000	1.7000
2018.08	4.8450	4.7620	4.9279	5.9000	9.5000
2018.09	5.4570	5.3548	5.5592	1.6000	2.9000
2018.10	5.2643	5.1609	5.3676	2.5000	5.6000
2018.11	5.3052	5.1941	5.4164	3.1000	4.2000
2018.12	5.5486	5.4405	5.6567	1.6000	2.3000
2019.01	3.2843	3.2217	3.3468	5.4000	2.3000
2019.02	2.8781	2.8216	2.9346	0.1000	1.2000
2019.03	3.0836	3.0313	3.1359	6.1000	12.1000
2019.04	3.4561	3.3912	3.5210	6.2000	9.3000
2019.05	3.4740	3.4136	3.5343	7.0000	11.9000
2019.06	2.9393	2.8899	2.9888	0.7000	1.5000
2019.07	3.1867	3.1396	3.2339	0.4000	2.2000
2019.08	3.2319	3.1841	3.2797	0.3000	0.8000
2019.09	3.7188	3.6606	3.7769	0.5000	1.0000
2019.10	3.4809	3.4218	3.5400	0.2000	0.5000
2019.11	3.5854	3.5168	3.6541	0.3000	0.6000

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

ym	Ra	lci99	uci99	aavso	sidc
2019.12	3.6531	3.5809	3.7254	0.8000	1.0000
2020.01	7.2688	7.1267	7.4108	4.0000	5.3000
2020.02	6.3015	6.1751	6.4279	0.1000	0.0000
2020.03	6.8133	6.6860	6.9406	1.2000	1.5000
2020.04	7.6868	7.5606	7.8130	3.0000	5.1000
2020.05	7.7914	7.6700	7.9128	0.1000	0.4000
2020.06	6.6356	6.5342	6.7371	3.9000	6.4000
2020.07	7.0885	6.9846	7.1923	4.2000	7.7000
2020.08	7.0825	6.9843	7.1807	5.3000	7.8000
2020.09	8.1213	7.9914	8.2513	0.4000	0.9000
2020.10	7.7861	7.6580	7.9142	9.9000	13.6000
2020.11	7.9400	7.8113	8.0687	21.2000	33.1000
2020.12	8.1169	7.9711	8.2626	15.4000	19.8000
2021.01	25.4410	24.9856	25.8963	7.0000	15.8000
2021.02	22.4183	22.0168	22.8197	5.8000	10.7000
2021.03	24.3995	24.0105	24.7884	11.0000	17.2000
2021.04	27.5977	27.1456	28.0498	18.5000	28.8000
2021.05	28.2901	27.8656	28.7146	15.9000	22.9000
2021.06	23.9235	23.5555	24.2916	19.9000	24.1000
2021.07	25.4980	25.0848	25.9112	23.8000	35.6000
2021.08	26.3397	25.9165	26.7630	15.7000	19.5000
2021.09	29.8640	29.3667	30.3614	39.1000	52.5000
2021.10	28.9426	28.4456	29.4397	27.1000	37.0000
2021.11	29.2021	28.7039	29.7004	27.2000	35.1000
2021.12	30.6527	30.0686	31.2369	50.6000	69.0000
2022.01	72.2953	71.0494	73.5412	43.9000	62.0000
2022.02	63.5594	62.4269	64.6918	48.8000	60.5000
2022.03	69.8704	68.6405	71.1004	58.4000	80.6000
2022.04	75.8963	74.7106	77.0820	59.1000	83.9000
2022.05	80.5613	79.2908	81.8317	72.5000	0.4000
2022.06	66.3040	65.2691	67.3389	58.9000	0.4000
2022.07	72.5904	71.4234	73.7574	76.7000	102.5000
2022.08	73.2111	72.0497	74.3724	63.3000	86.0000
2022.09	82.7496	81.2519	84.2473	72.6000	94.5000
2022.10	78.5843	77.2279	79.9408	66.4000	112.1000
2022.11	79.4890	78.0162	80.9617	54.3000	82.1000
2022.12	81.8744	80.2169	83.5319	93.7000	165.0000
2023.01	135.6979	132.9000	138.4958	112.9000	173.8000

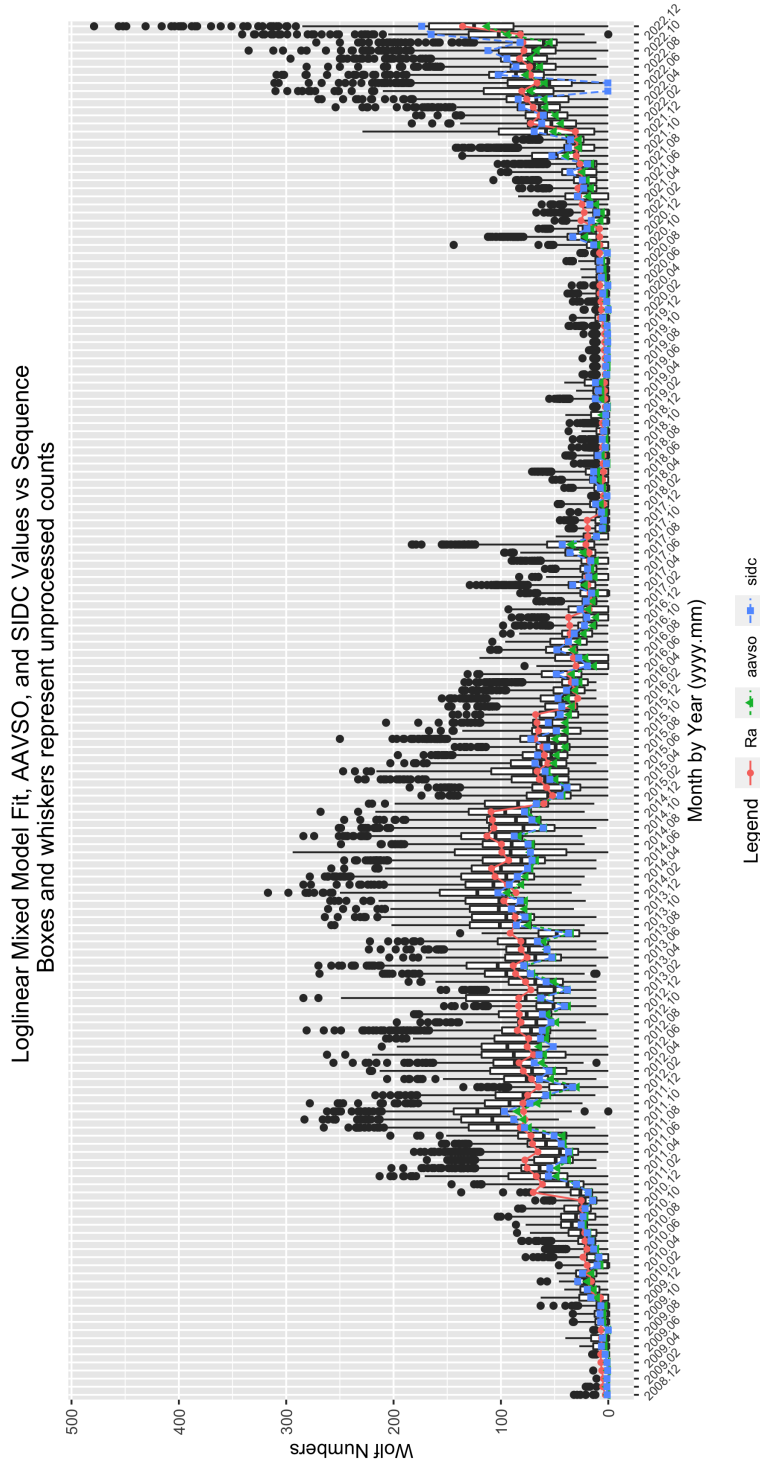


Figure 2: GLMM fitted data for R_a . AAVSO data: <https://www.aavso.org/category/tags/solar-bulletin>. SILSO data: WDC-SILSO, Royal Observatory of Belgium, Brussels

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 contribute to both institutions tend to differ from those observers contributing only to the AAVSO.

5 Supporting Information

Table 3: 202301 Parameter Estimates

	Estimate	Std. Error	t-value	Pr(> t)
(Intercept)	1.1925	0.3156	3.7783	0.0002
seeF	-0.2267	0.0053	-42.8742	0.0000
seeG	-0.1175	0.0046	-25.4447	0.0000
seeM	-0.1872	0.0244	-7.6843	0.0000
seeP	-0.3212	0.0076	-42.3532	0.0000
sidc1	0.0551	0.0130	4.2444	0.0000
year2009	0.7641	0.3171	2.4099	0.0160
year2010	2.0027	0.3149	6.3602	0.0000
year2011	3.1459	0.3148	9.9941	0.0000
year2012	3.1872	0.3148	10.1256	0.0000
year2013	3.2821	0.3148	10.4270	0.0000
year2014	3.4809	0.3148	11.0587	0.0000
year2015	2.9984	0.3148	9.5254	0.0000
year2016	2.3829	0.3148	7.5692	0.0000
year2017	1.7689	0.3149	5.6181	0.0000
year2018	0.4873	0.3151	1.5464	0.1220
year2019	0.0718	0.3154	0.2277	0.8199
year2020	0.8777	0.3150	2.7864	0.0053
year2021	2.1593	0.3148	6.8587	0.0000
year2022	3.1492	0.3148	10.0041	0.0000
year2023	3.7571	0.3151	11.9251	0.0000
mon2	-0.1381	0.0086	-16.0839	0.0000
mon3	-0.0547	0.0080	-6.8130	0.0000
mon4	0.0484	0.0077	6.2568	0.0000
mon5	0.0726	0.0076	9.5857	0.0000
mon6	-0.0972	0.0079	-12.3220	0.0000
mon7	-0.0294	0.0077	-3.8439	0.0001
mon8	-0.0179	0.0076	-2.3669	0.0179
mon9	0.1195	0.0076	15.7721	0.0000
mon10	0.0682	0.0077	8.8244	0.0000
mon11	0.0947	0.0080	11.8134	0.0000
mon12	0.1223	0.0080	15.3173	0.0000

Table 4: 202301 Summary of Sunspot Numbers

year	mon	day	obs	sidc
Min. :2008	Min. : 1.000	Min. : 0.00	Length:164670	Min. :0.0000
1st Qu.:2013	1st Qu.: 4.000	1st Qu.: 8.00	Class :character	1st Qu.:0.0000
Median :2017	Median : 7.000	Median :16.00	Mode :character	Median :0.0000
Mean :2016	Mean : 6.611	Mean :15.71		Mean :0.2446
3rd Qu.:2020	3rd Qu.: 9.000	3rd Qu.:23.00		3rd Qu.:0.0000
Max. :2023	Max. :12.000	Max. :31.00		Max. :1.0000

Table 5: 202301 Summary of Sunspot Numbers

g	s	w	see	method
Min. : 0.000	Min. : 0.00	Min. : 0.00	Length:164670	Length:164670
1st Qu.: 1.000	1st Qu.: 1.00	1st Qu.: 11.00	Class :character	Class :character
Median : 2.000	Median : 8.00	Median : 32.00	Mode :character	Mode :character
Mean : 2.849	Mean : 16.52	Mean : 45.02		
3rd Qu.: 5.000	3rd Qu.: 24.00	3rd Qu.: 72.00		
Max. :25.000	Max. :262.00	Max. :479.00		

Table 6: 202301 Summary of Sunspot Numbers

inst	filter	unit
Length:164670	Length:164670	Length:164670
Class :character	Class :character	Class :character
Mode :character	Mode :character	Mode :character

Table 7: 202301 Summary of Sunspot Numbers

aperture	eyep	foclen	mag
Min. : 0.0	Min. : 0.00	Min. : 0.0	Min. : 0.0
1st Qu.: 60.0	1st Qu.: 5.00	1st Qu.: 150.0	1st Qu.: 40.0
Median : 80.0	Median : 14.00	Median : 900.0	Median : 57.0
Mean : 92.6	Mean : 37.26	Mean : 890.6	Mean : 180.5
3rd Qu.: 104.0	3rd Qu.: 23.00	3rd Qu.:1200.0	3rd Qu.: 75.0
Max. :1524.0	Max. :2010.00	Max. :9990.0	Max. :4591.0

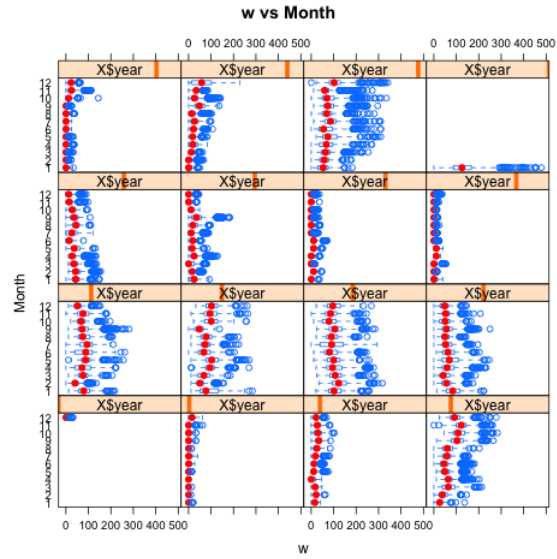
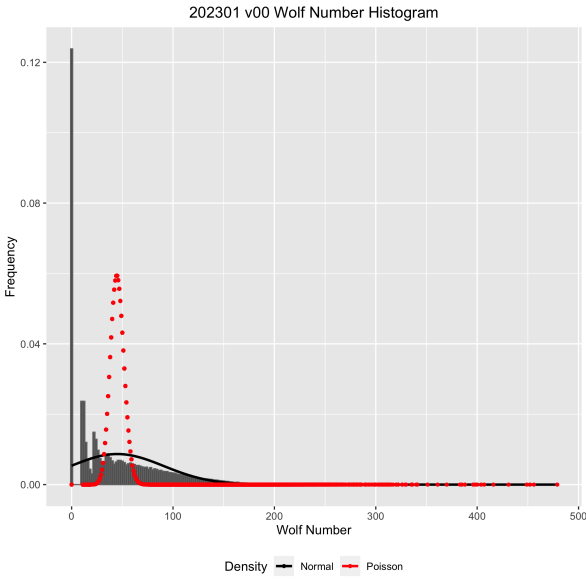


Figure 3: Box plots of raw Wolf number (w) by observer rank.

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

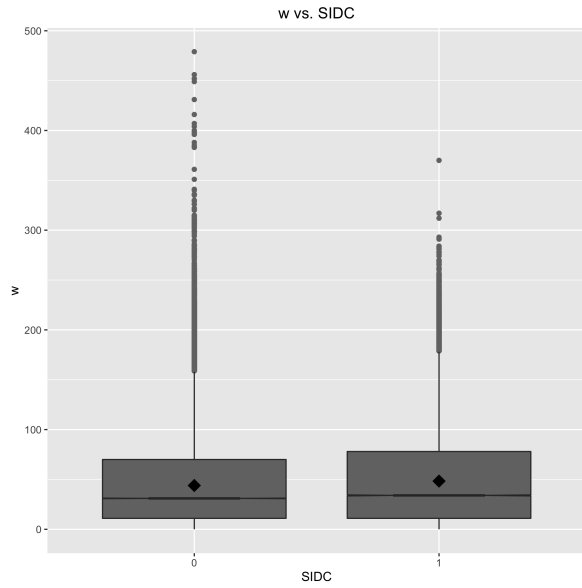
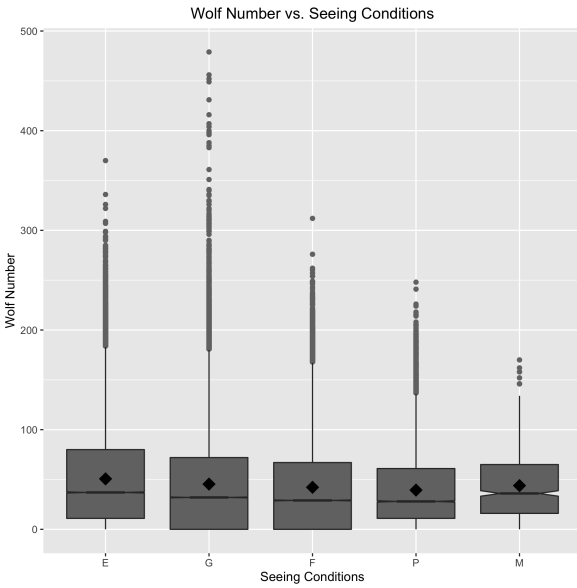


Figure 5: Box plots of raw Wolf number (w) by seeing condition.

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

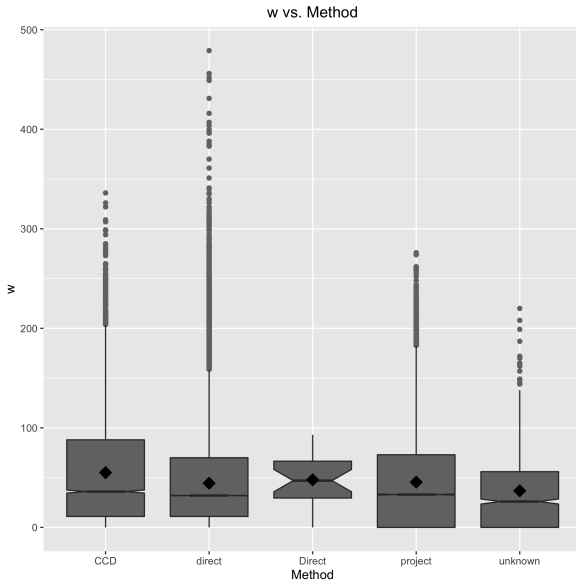


Figure 7: Box plots of raw Wolf number (w) by observer rank.

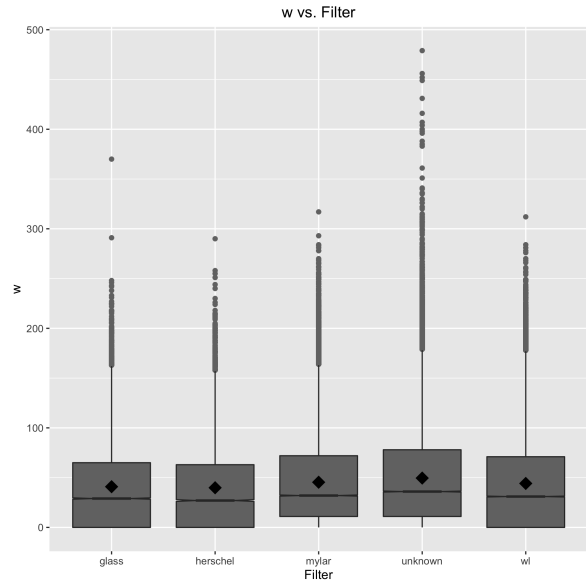


Figure 8: Box plots of raw Wolf number (w) by month and year.

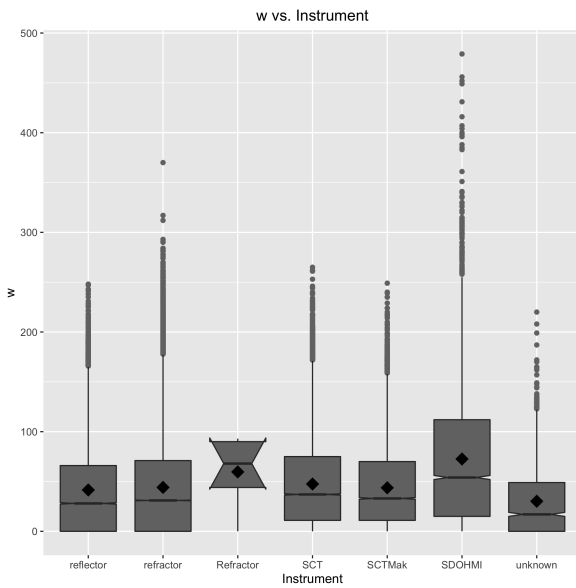


Figure 9: Box plots of raw Wolf number (w) by seeing condition.

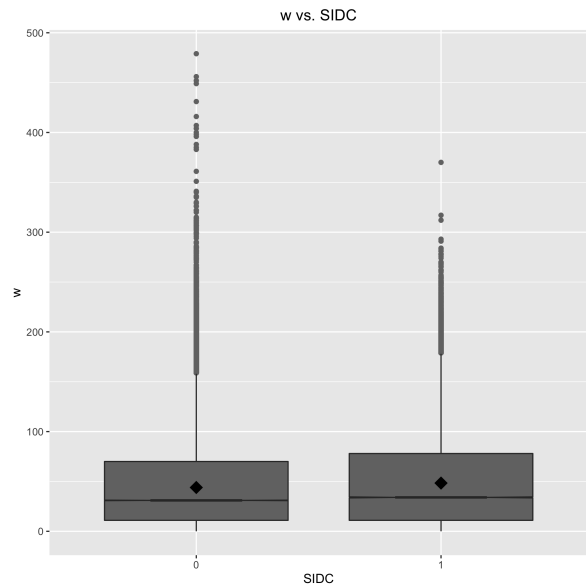


Figure 10: Box plots of raw Wolf number (w) by organization.

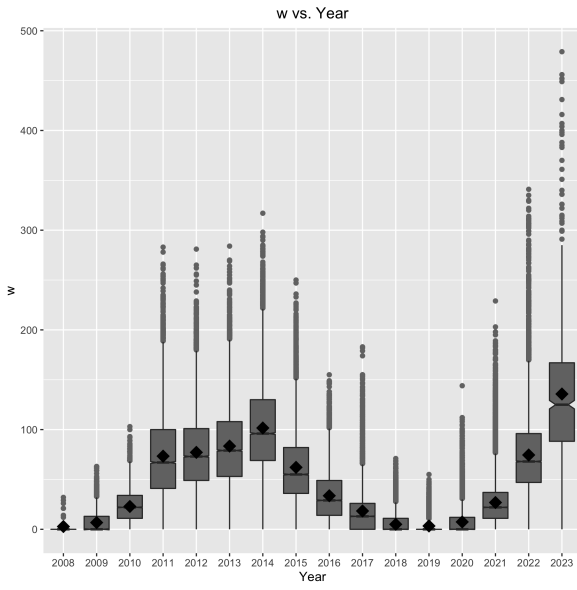


Figure 11: Box plots of raw Wolf number (w) by year.

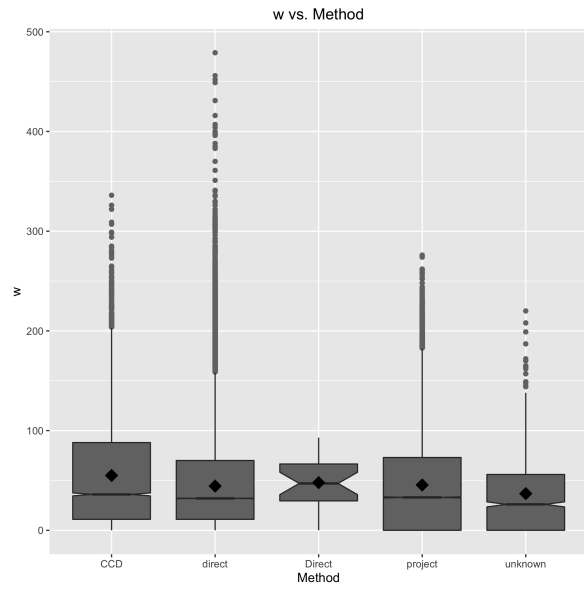


Figure 12: Box plots of raw Wolf number (w) by observing method.