

**Monthly Report (00)**  
**202311 Data Set**

**Wednesday 13<sup>th</sup> December, 2023**

**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.

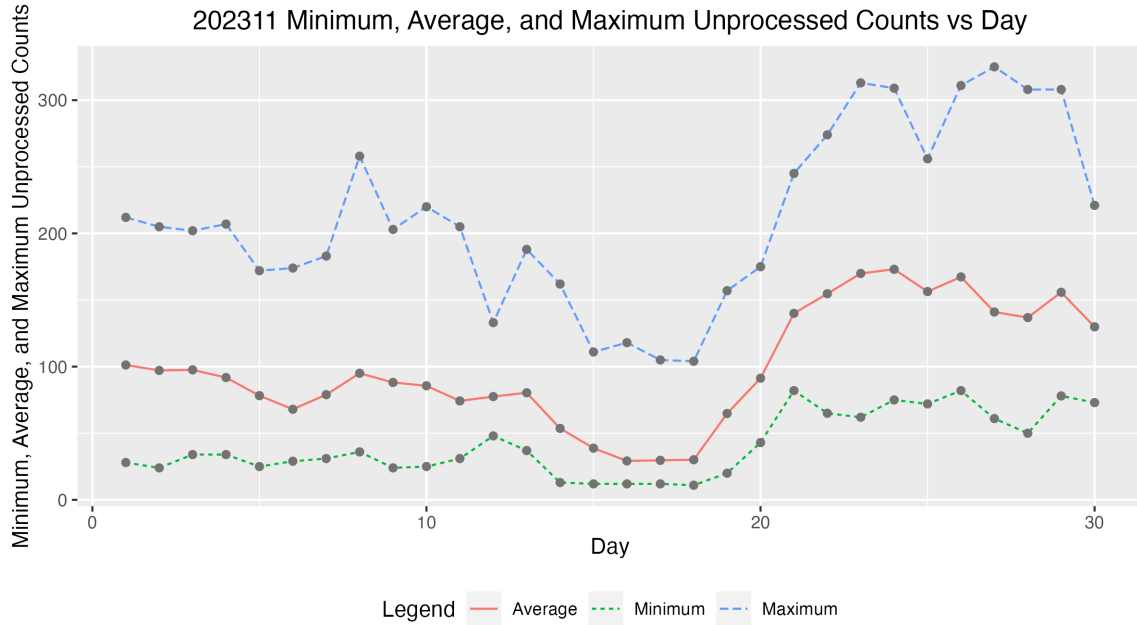


Figure 1: Raw average sunspot count by day of the month.

Table 1: 202311 Daily Raw Counts

Day	Submissions	Minimum	Average	Maximum
1.0000	27.0000	28.0000	101.2593	212.0000
2.0000	28.0000	24.0000	97.1429	205.0000
3.0000	30.0000	34.0000	97.5667	202.0000
4.0000	25.0000	34.0000	91.8000	207.0000
5.0000	39.0000	25.0000	78.2308	172.0000
6.0000	31.0000	29.0000	68.0000	174.0000
7.0000	37.0000	31.0000	78.9459	183.0000
8.0000	38.0000	36.0000	95.0263	258.0000
9.0000	28.0000	24.0000	88.1071	203.0000
10.0000	29.0000	25.0000	85.6207	220.0000
11.0000	34.0000	31.0000	74.2647	205.0000
12.0000	34.0000	48.0000	77.5294	133.0000
13.0000	37.0000	37.0000	80.3784	188.0000
14.0000	24.0000	13.0000	53.6250	162.0000
15.0000	36.0000	12.0000	38.8056	111.0000
16.0000	30.0000	12.0000	29.2000	118.0000
17.0000	32.0000	12.0000	29.6875	105.0000
18.0000	36.0000	11.0000	30.1111	104.0000
19.0000	35.0000	20.0000	64.8000	157.0000
20.0000	27.0000	43.0000	91.2963	175.0000
21.0000	28.0000	82.0000	139.9643	245.0000
22.0000	34.0000	65.0000	154.7353	274.0000
23.0000	34.0000	62.0000	169.9412	313.0000
24.0000	31.0000	75.0000	173.0645	309.0000
25.0000	36.0000	72.0000	156.3333	256.0000
26.0000	23.0000	82.0000	167.3478	311.0000
27.0000	26.0000	61.0000	141.0000	325.0000
28.0000	29.0000	50.0000	136.8276	308.0000
29.0000	36.0000	78.0000	155.8056	308.0000
30.0000	26.0000	73.0000	129.8846	221.0000

### 3 Error Tables

Data are for the month of November 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<sup>th</sup> through the 75<sup>th</sup> quartiles. The lower and upper whiskers extend 1.5 times the IQR below the 25<sup>th</sup> quartile, and 1.5 times the IQR above the 75<sup>th</sup> 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	2.4250	3.1160	0.5000	1.0000
2009.01	5.3030	4.7554	5.8505	1.3000	1.3000
2009.02	4.7477	4.2422	5.2532	0.7000	1.2000
2009.03	6.1397	5.9143	6.3651	0.3000	0.6000
2009.04	6.6515	6.4321	6.8710	0.4000	1.2000
2009.05	7.0639	6.8013	7.3264	1.6000	2.9000
2009.06	7.0582	6.7261	7.3903	3.2000	6.3000
2009.07	6.6363	6.3780	6.8946	3.6000	5.5000
2009.08	6.6073	6.3730	6.8416	0.0000	0.0000
2009.09	7.3403	7.0972	7.5835	4.5000	7.1000
2009.10	6.6241	6.2875	6.9607	4.5000	7.7000
2009.11	6.6758	6.4838	6.8678	3.3000	6.9000
2009.12	7.3958	7.1709	7.6206	10.4000	16.3000
2010.01	19.9482	17.7925	22.1038	13.3000	19.5000
2010.02	16.1249	14.0492	18.2007	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	17.8328	15.7232	19.9423	15.4000	24.0000
2010.04	18.9399	16.8127	21.0671	7.0000	10.4000
2010.05	23.1775	22.7355	23.6195	8.4000	8.7000
2010.06	21.8436	21.4365	22.2508	11.0000	13.6000
2010.07	22.4545	22.0765	22.8325	15.2000	16.1000
2010.08	21.4945	21.0855	21.9035	18.3000	19.6000
2010.09	25.0036	24.5254	25.4818	22.8000	25.2000
2010.10	22.9537	22.4855	23.4220	21.0000	23.5000
2010.11	23.4243	22.9585	23.8902	20.9000	21.6000
2010.12	25.0575	24.5054	25.6095	13.9000	14.5000
2011.01	71.3564	69.7722	72.9406	17.7000	18.7000
2011.02	62.8049	61.3447	64.2652	29.1000	29.6000
2011.03	67.0171	65.6125	68.4216	48.0000	55.8000
2011.04	72.7033	71.1682	74.2385	47.3000	54.4000
2011.05	76.9460	75.4726	78.4194	37.3000	41.5000
2011.06	72.0429	70.6416	73.4443	35.2000	37.0000
2011.07	72.9853	71.6386	74.3321	41.5000	43.8000
2011.08	70.5718	69.3261	71.8174	42.4000	50.5000
2011.09	81.2044	79.6374	82.7713	73.8000	78.0000
2011.10	74.2605	72.8786	75.6423	78.9000	88.0000
2011.11	75.9214	74.2792	77.5637	84.6000	96.7000
2011.12	79.5036	77.8065	81.2007	65.8000	73.0000
2012.01	76.7278	75.1335	78.3222	55.8000	58.2000
2012.02	66.5495	65.1039	67.9950	29.2000	33.1000
2012.03	71.4498	70.1148	72.7847	53.1000	64.1000
2012.04	75.8412	74.3761	77.3062	51.4000	55.2000
2012.05	82.2229	80.7296	83.7163	61.8000	69.0000
2012.06	76.5633	75.1532	77.9735	59.7000	64.5000
2012.07	78.2751	76.8717	79.6784	64.2000	51.3000
2012.08	72.8151	71.5282	74.1020	57.7000	63.1000
2012.09	83.9670	82.4194	85.5146	57.7000	61.5000
2012.10	77.7801	76.2623	79.2978	48.3000	53.3000
2012.11	79.8352	78.1566	81.5138	56.7000	61.4000
2012.12	83.4212	81.5552	85.2871	37.4000	40.8000
2013.01	84.9893	83.2890	86.6897	63.8000	62.9000
2013.02	73.8177	72.2434	75.3919	37.8000	38.0000
2013.03	76.8845	75.2448	78.5242	50.6000	57.9000
2013.04	82.6389	81.0806	84.1971	70.6000	72.4000
2013.05	87.4846	85.7894	89.1797	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	83.1481	81.5369	84.7592	51.0000	52.5000
2013.07	84.0437	82.5568	85.5306	57.0000	57.0000
2013.08	79.8778	78.4778	81.2778	60.0000	66.0000
2013.09	90.5643	88.8425	92.2861	34.6000	36.9000
2013.10	82.7438	81.1133	84.3744	74.5000	85.6000
2013.11	83.7498	81.7458	85.7537	73.9000	77.6000
2013.12	89.9364	87.9562	91.9166	77.8000	90.3000
2014.01	99.3927	97.2203	101.5651	77.4000	82.0000
2014.02	88.2112	86.3390	90.0835	93.9000	102.8000
2014.03	93.9025	92.0880	95.7170	80.9000	92.2000
2014.04	101.0486	99.1396	102.9575	76.9000	84.7000
2014.05	107.5595	105.6015	109.5176	72.3000	75.2000
2014.06	102.0907	100.2093	103.9722	67.2000	71.0000
2014.07	102.7462	100.8773	104.6151	72.5000	72.5000
2014.08	97.6863	96.0401	99.3325	71.2000	74.7000
2014.09	112.0603	109.9278	114.1928	83.2000	87.6000
2014.10	101.8517	99.8766	103.8268	59.5000	60.6000
2014.11	104.0356	101.7412	106.3300	65.8000	71.1000
2014.12	108.9861	106.4296	111.5427	75.8000	78.0000
2015.01	61.4167	60.1554	62.6779	65.9000	67.0000
2015.02	53.3835	52.1200	54.6470	42.4000	44.8000
2015.03	57.6377	56.5224	58.7530	38.0000	38.4000
2015.04	61.7038	60.5101	62.8976	49.0000	54.4000
2015.05	65.6456	64.4889	66.8024	56.3000	58.8000
2015.06	61.8029	60.6684	62.9374	50.2000	68.3000
2015.07	61.5470	60.5000	62.5940	47.9000	65.8000
2015.08	59.7127	58.7086	60.7167	39.5000	57.2000
2015.09	67.8513	66.6144	69.0883	49.2000	72.1000
2015.10	62.1073	60.9059	63.3087	39.3000	48.3000
2015.11	63.9607	62.5530	65.3685	39.6000	55.9000
2015.12	67.7583	66.2396	69.2769	36.4000	44.8000
2016.01	33.6128	32.9054	34.3202	33.7000	43.3000
2016.02	29.1745	28.5605	29.7885	38.3000	46.8000
2016.03	31.0524	30.4258	31.6790	30.5000	38.9000
2016.04	33.0006	32.3655	33.6356	26.6000	30.9000
2016.05	35.2802	34.6335	35.9269	33.7000	48.4000
2016.06	33.0074	32.4405	33.5744	13.1000	19.5000
2016.07	33.5929	33.0502	34.1357	21.2000	27.5000
2016.08	32.1678	31.5982	32.7374	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	37.3698	36.6836	38.0560	27.7000	37.1000
2016.10	33.9259	33.2695	34.5824	22.7000	31.7000
2016.11	34.5692	33.8444	35.2939	14.0000	22.2000
2016.12	37.0591	36.2599	37.8583	11.1000	20.0000
2017.01	18.1142	17.7296	18.4988	18.4000	26.2000
2017.02	15.7837	15.4336	16.1337	14.4000	20.6000
2017.03	16.9076	16.5818	17.2334	11.3000	15.5000
2017.04	18.1526	17.8297	18.4756	21.6000	33.2000
2017.05	19.1642	18.8306	19.4979	12.5000	18.1000
2017.06	17.8842	17.5864	18.1820	15.5000	19.3000
2017.07	18.2713	17.9778	18.5648	11.5000	16.3000
2017.08	17.4780	17.1724	17.7835	22.8000	35.7000
2017.09	20.6083	20.1756	21.0409	34.6000	42.9000
2017.10	18.1988	17.8256	18.5719	10.5000	11.0000
2017.11	18.4597	18.0688	18.8507	4.2000	5.6000
2017.12	19.6878	19.3875	19.9881	4.0000	4.6000
2018.01	5.0421	4.9338	5.1504	3.1000	6.3000
2018.02	4.3513	4.2459	4.4566	6.8000	11.8000
2018.03	4.5931	4.5004	4.6857	1.1000	1.2000
2018.04	4.8741	4.7761	4.9720	4.7000	7.5000
2018.05	5.2188	5.1218	5.3158	8.4000	14.0000
2018.06	4.8929	4.8068	4.9791	10.2000	13.6000
2018.07	5.0119	4.9561	5.0678	0.5000	1.7000
2018.08	4.7360	4.6550	4.8169	5.9000	9.5000
2018.09	5.3868	5.2863	5.4872	1.6000	2.9000
2018.10	5.0118	4.9145	5.1091	2.5000	5.6000
2018.11	5.0887	4.9825	5.1948	3.1000	4.2000
2018.12	5.5205	5.4132	5.6278	1.6000	2.3000
2019.01	3.3525	3.2888	3.4162	5.4000	2.3000
2019.02	2.9485	2.8903	3.0067	0.1000	1.2000
2019.03	3.0821	3.0297	3.1344	6.1000	12.1000
2019.04	3.3108	3.2488	3.3728	6.2000	9.3000
2019.05	3.4345	3.3749	3.4942	7.0000	11.9000
2019.06	3.2362	3.1818	3.2906	0.7000	1.5000
2019.07	3.3035	3.2547	3.3523	0.4000	2.2000
2019.08	3.1707	3.1239	3.2175	0.3000	0.8000
2019.09	3.6802	3.6227	3.7378	0.5000	1.0000
2019.10	3.3254	3.2693	3.3815	0.2000	0.5000
2019.11	3.4555	3.3893	3.5217	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	3.6568	3.5837	3.7299	0.8000	1.0000
2020.01	7.4200	7.2754	7.5646	4.0000	5.3000
2020.02	6.4676	6.3383	6.5970	0.1000	0.0000
2020.03	6.8167	6.6897	6.9436	1.2000	1.5000
2020.04	7.3720	7.2522	7.4917	3.0000	5.1000
2020.05	7.7062	7.5873	7.8251	0.1000	0.4000
2020.06	7.3053	7.1936	7.4170	3.9000	6.4000
2020.07	7.3536	7.2455	7.4616	4.2000	7.7000
2020.08	6.9588	6.8626	7.0550	5.3000	7.8000
2020.09	8.0444	7.9154	8.1734	0.4000	0.9000
2020.10	7.4389	7.3166	7.5613	9.9000	13.6000
2020.11	7.6358	7.5107	7.7609	21.2000	33.1000
2020.12	8.1075	7.9609	8.2541	15.4000	19.8000
2021.01	25.8499	25.3869	26.3130	7.0000	15.8000
2021.02	22.9686	22.5629	23.3743	5.8000	10.7000
2021.03	24.3645	23.9814	24.7476	11.0000	17.2000
2021.04	26.5086	26.0378	26.9793	18.5000	28.8000
2021.05	28.0272	27.5735	28.4809	15.9000	22.9000
2021.06	26.3969	25.9617	26.8321	19.9000	24.1000
2021.07	26.4847	26.0333	26.9360	23.8000	35.6000
2021.08	25.8739	25.4377	26.3101	15.7000	19.5000
2021.09	29.6023	29.0825	30.1222	39.1000	52.5000
2021.10	27.7088	27.2102	28.2075	27.1000	37.0000
2021.11	28.0285	27.5029	28.5541	27.2000	35.1000
2021.12	30.6160	29.9817	31.2504	50.6000	69.0000
2022.01	73.8608	72.4813	75.2403	43.9000	62.0000
2022.02	65.2105	63.9504	66.4705	48.8000	60.5000
2022.03	69.9459	68.6099	71.2819	58.4000	80.6000
2022.04	72.5688	71.3355	73.8021	59.1000	83.9000
2022.05	79.3339	78.0044	80.6633	72.5000	0.4000
2022.06	72.6003	71.4108	73.7897	58.9000	0.4000
2022.07	74.8515	73.5717	76.1314	76.7000	102.5000
2022.08	71.7271	70.5354	72.9188	63.3000	86.0000
2022.09	82.0403	80.4559	83.6246	72.6000	94.5000
2022.10	75.3758	73.9890	76.7627	66.4000	112.1000
2022.11	76.6976	75.1581	78.2371	54.3000	82.1000
2022.12	82.1766	80.3156	84.0376	93.7000	165.0000
2023.01	123.7599	120.9739	126.5458	112.9000	173.8000
2023.02	106.5580	104.2293	108.8868	89.6000	152.3000

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

ym	Ra	lci99	uci99	aavso	sidc
2023.03	110.6172	108.2477	112.9867	85.0000	126.8000
2023.04	118.7501	116.3996	121.1006	72.1000	114.3000
2023.05	126.3319	123.8101	128.8536	105.0000	140.0000
2023.06	120.5181	119.1489	121.8874	118.5000	173.0000
2023.07	118.6543	116.4392	120.8693	124.7000	161.2000
2023.08	113.4918	111.3224	115.6611	90.6000	132.5000
2023.09	131.5141	128.8865	134.1417	110.4000	156.8000
2023.10	120.8384	118.1588	123.5180	78.4000	119.6000
2023.11	119.4633	116.6411	122.2854	88.6000	105.1000

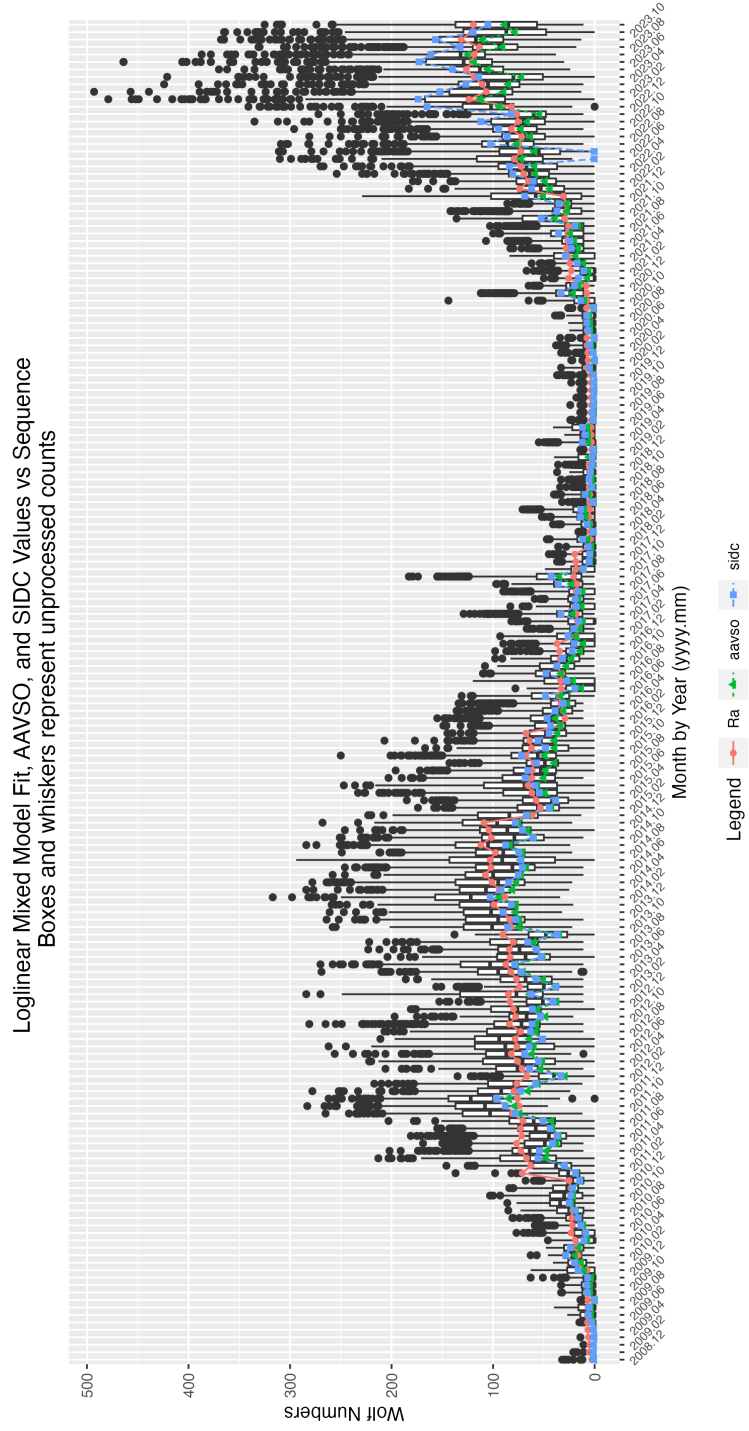


Figure 2: GLMM fitted data for  $R_a$ . AAVSO data: <https://www.aavso.org/category/tags/solar-bulletin>. SILSO data: WDC-SILSO, Royal Observatory of Belgium, Brussels

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: 202311 Parameter Estimates

	Estimate	Std. Error	t-value	Pr(> t )
(Intercept)	1.1832	0.3157	3.7474	0.0002
seeG	-0.1093	0.0042	-25.9615	0.0000
seeF	-0.2257	0.0048	-46.7142	0.0000
seeP	-0.3197	0.0070	-45.8492	0.0000
seeM	-0.1857	0.0243	-7.6313	0.0000
sidc1	0.0519	0.0108	4.8185	0.0000
year2009	0.7741	0.3173	2.4399	0.0147
year2010	2.0031	0.3151	6.3573	0.0000
year2011	3.1510	0.3150	10.0035	0.0000
year2012	3.1941	0.3150	10.1408	0.0000
year2013	3.2886	0.3150	10.4409	0.0000
year2014	3.4881	0.3150	11.0743	0.0000
year2015	3.0086	0.3150	9.5516	0.0000
year2016	2.3930	0.3150	7.5964	0.0000
year2017	1.7798	0.3151	5.6493	0.0000
year2018	0.4953	0.3153	1.5705	0.1163
year2019	0.0858	0.3156	0.2718	0.7858
year2020	0.8920	0.3152	2.8300	0.0047
year2021	2.1721	0.3150	6.8948	0.0000
year2022	3.1668	0.3150	10.0534	0.0000
year2023	3.6568	0.3150	11.6093	0.0000
mon2	-0.1333	0.0077	-17.2892	0.0000
mon3	-0.0759	0.0073	-10.4150	0.0000
mon4	-0.0165	0.0071	-2.3318	0.0197
mon5	0.0394	0.0069	5.7316	0.0000
mon6	-0.0228	0.0067	-3.4223	0.0006
mon7	-0.0156	0.0069	-2.2592	0.0239
mon8	-0.0579	0.0069	-8.3953	0.0000
mon9	0.0892	0.0069	12.9925	0.0000
mon10	0.0023	0.0071	0.3249	0.7453
mon11	0.0370	0.0073	5.0472	0.0000
mon12	0.1025	0.0076	13.4796	0.0000

Table 4: 202311 Summary of Sunspot Numbers

year	mon	day	obs	sidc
Min. :2008	Min. : 1.000	Min. : 0.0	Length:177437	Min. :0.000
1st Qu.:2014	1st Qu.: 4.000	1st Qu.: 8.0	Class :character	1st Qu.:0.000
Median :2017	Median : 7.000	Median :16.0	Mode :character	Median :0.000
Mean :2017	Mean : 6.604	Mean :15.7		Mean :0.239
3rd Qu.:2020	3rd Qu.: 9.000	3rd Qu.:23.0		3rd Qu.:0.000
Max. :2023	Max. :12.000	Max. :31.0		Max. :1.000

Table 5: 202311 Summary of Sunspot Numbers

g	s	w	see	method
Min. : 0.000	Min. : 0.00	Min. : 0.0	E:37334	Length:177437
1st Qu.: 1.000	1st Qu.: 1.00	1st Qu.: 11.0	G:72859	Class :character
Median : 2.000	Median : 10.00	Median : 37.0	F:51765	Mode :character
Mean : 3.187	Mean : 18.44	Mean : 50.3	P:14694	
3rd Qu.: 5.000	3rd Qu.: 28.00	3rd Qu.: 80.0	M: 785	
Max. :30.000	Max. :295.00	Max. :493.0		

Table 6: 202311 Summary of Sunspot Numbers

inst	filter	unit
Length:177437	Length:177437	Length:177437
Class :character	Class :character	Class :character
Mode :character	Mode :character	Mode :character

Table 7: 202311 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.: 4.00	1st Qu.: 150.0	1st Qu.: 40.0
Median : 80.00	Median : 14.00	Median : 900.0	Median : 57.0
Mean : 93.45	Mean : 39.47	Mean : 890.1	Mean : 180.3
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

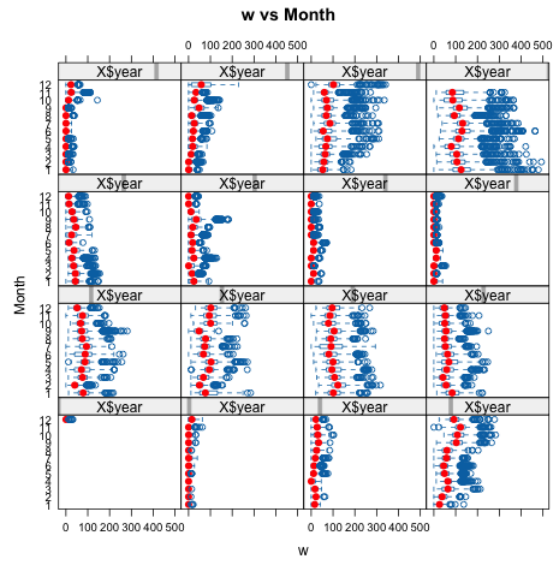
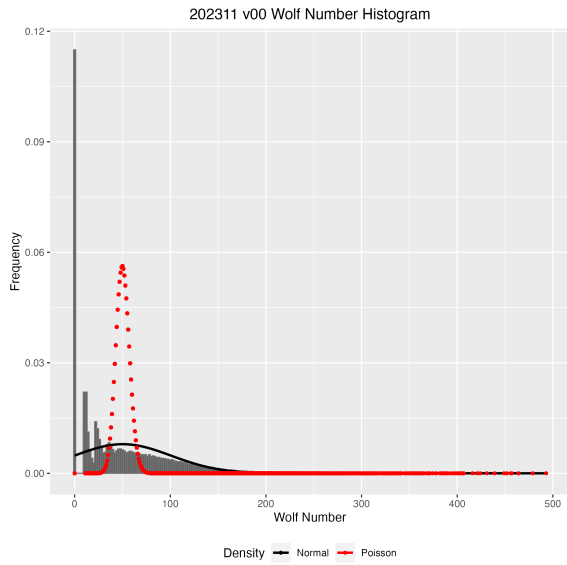


Figure 3: Box plots of raw Wolf number (w) by observer rank.

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

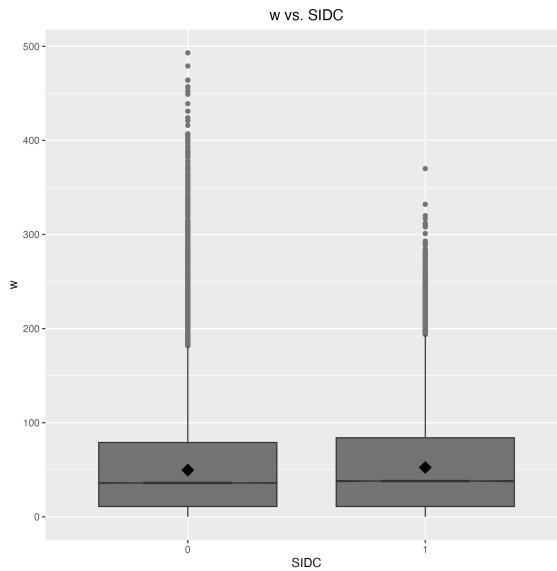
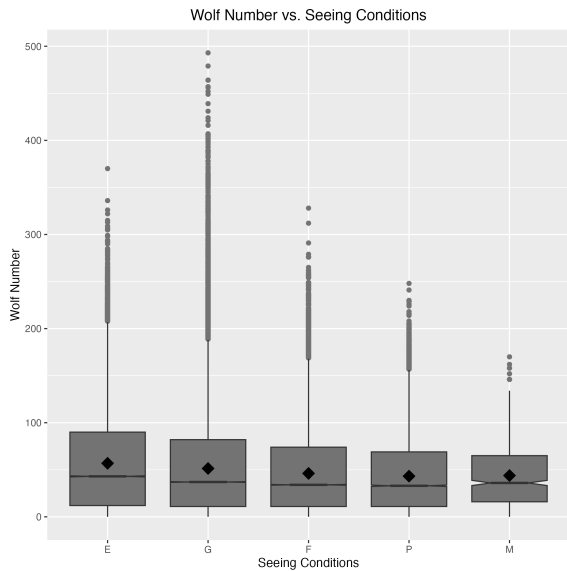


Figure 5: Box plots of raw Wolf number (w) by seeing condition.

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



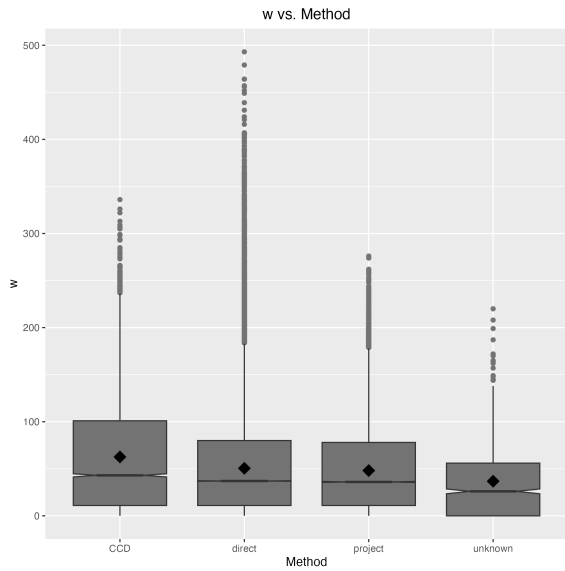


Figure 7: Box plots of raw Wolf number ( $w$ ) by observer rank.

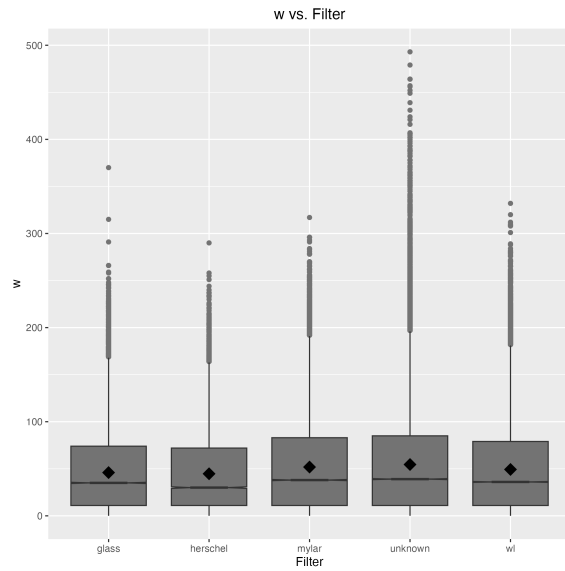


Figure 8: Box plots of raw Wolf number ( $w$ ) by month and year.

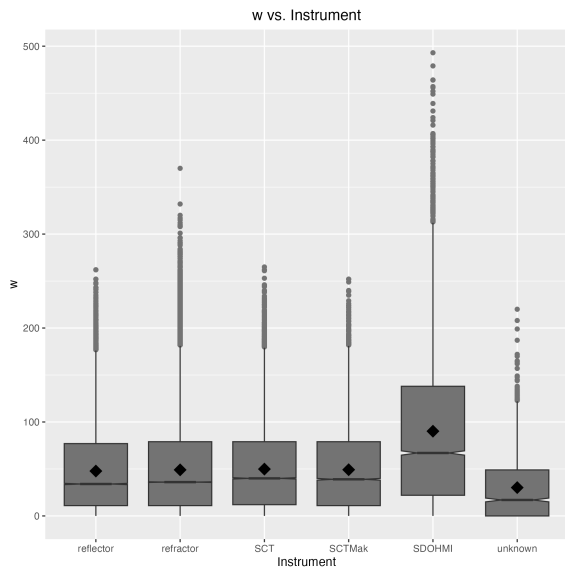


Figure 9: Box plots of raw Wolf number ( $w$ ) by seeing condition.

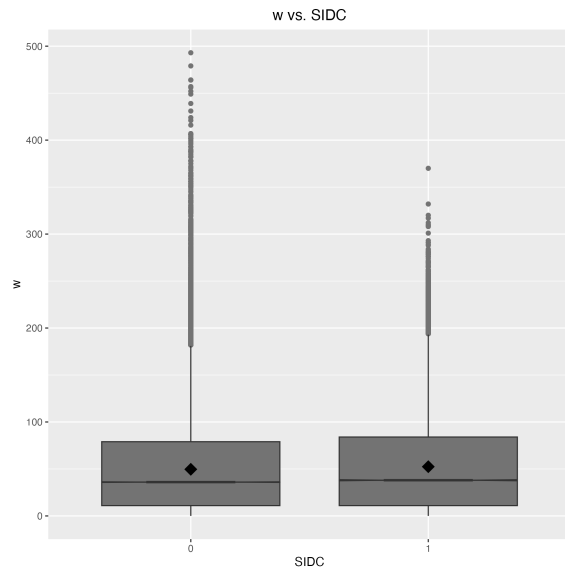


Figure 10: Box plots of raw Wolf number ( $w$ ) by organization.

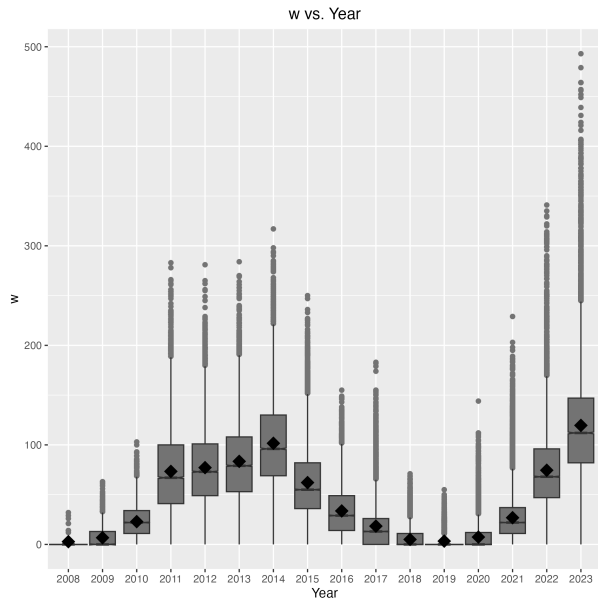


Figure 11: Box plots of raw Wolf number ( $w$ ) by year.

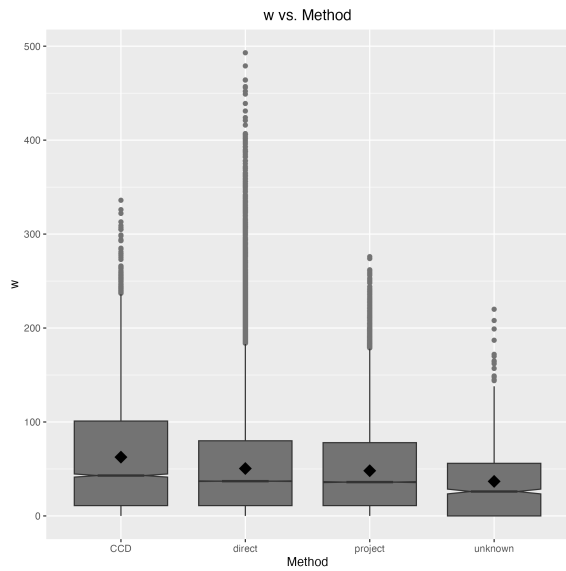


Figure 12: Box plots of raw Wolf number ( $w$ ) by observing method.