Solar Bulletin

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS
SOLAR SECTION

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Preface

The *Solar Bulletin* of the American Association of Variable Star Observers (ISSN 0271-8480) is the publication of record for observational data relating to sunspot and sudden ionospheric disturbance (SID) observations by Solar Section observers of the AAVSO. The *Solar Bulletin* is published monthly in the calendar month following the cover date (i.e. the January issue is published in mid-February, and contains data for January). It has been published regularly with few interruptions since 1944.

The AAVSO *Solar Bulletin* is currently listed in the NASA ADS Abstract Service under journal code "AAVSB". If you use AAVSO solar data or the *bulletin* in your publication, please cite the data accordingly; more importantly, please let us know that you use these data! We would appreciate receiving a copy of any and all publications that reference AAVSO data; please send offprints or links to abstract pages to aavso@aavso.org.

Active solar observers receive a copy of the *Solar Bulletin* each month. Institutions and other entities June subscribe to the *Solar Bulletin* for a free. See our subscriptions page for details.

Note that data from the AAVSO Solar Section are only available either via the *Bulletin* or via NOAA's National Geophysical Data Center. We are working toward making these data available electronically via the AAVSO website in the very near future.

Preparing for the August 12, 2026, Total Solar Eclipse(Figure 1)

For those of us not fortunate to be headed for the path of totality (in Greenland, Iceland, and Spain), there is still a chance to take part in the solar celebration. Numerous websites will have live feeds from the path of totality, for example Time and Date (https://www.timeanddate.com/live/eclipse-solar-2026-august-12) and ESA (https://www.youtube.com/watch?v=DRDx2xDR8NA). Those outside the narrow path of totality need to use approved eclipse viewing glasses or a solar projection device at all times to view the event themselves (https://ccsuniverse.wordpress.com/2024/03/28/preparing-for-the-april-8-solar-eclipse-nutmegger-edition-part-3-how-to-safely-view-it/).

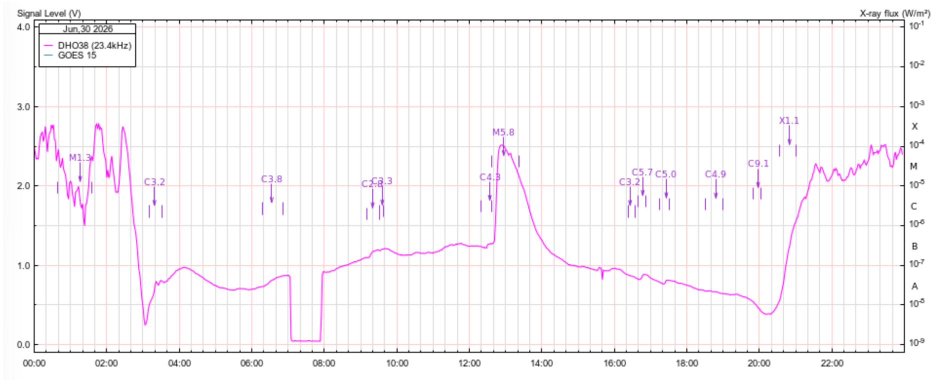
(https://commons.wikimedia.org/wiki/File:Partial_solar_eclipse_October_23,_2014_San_Jose.jpg)

AAVSO Solar observers already know how to safely observe the sun, and can use their equipment to view the partial eclipse, depending on their location. Consult the NASA website for information about seeing the eclipse from your area (https://science.nasa.gov/eclipses/future-eclipses/total-solar-eclipse-on-august-12-2026/). Solar eclipses are the perfect opportunity to educate the public about not only eclipses themselves, but the sun more broadly, and why AAVSO members safely monitor solar activity. Over the next month, keep your ears open for curious members of the general public asking questions about solar eclipses. Direct them to the AAVSO website for more information (https://www.aavso.org/solar) including the webinar "Seeing Spots (Safely): Getting Started in Solar Observing" (https://www.aavso.org/solar). If you hear the media or other individuals giving out erroneous information about the sun (especially unsafe observing techniques), please correct them and point out some of the resources referenced in this article.

1 Sudden Ionospheric Disturbance (SID) Report

1.1 SID Records

June 2026 (Figure 2): Lionel Laudet (118) captures the largest flare this month, on the 30 of June, recording data from DHO (23.4 kHz). This VLF scan was recorded in southern France by Lionel Laudet (A118). (U.S. Dept. of Commerce–NOAA, 2022).



1.2 SID Observer

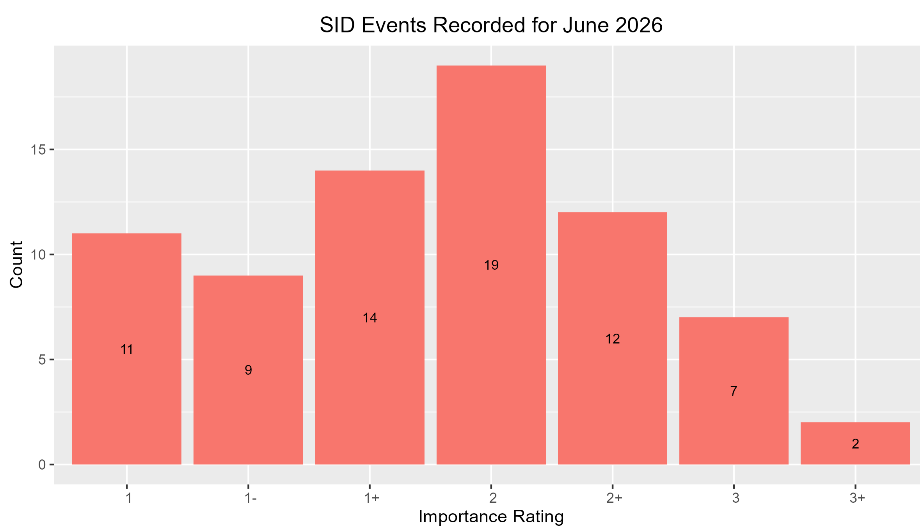
In June 2026 we have 7 AAVSO SID observers who submitted VLF data as listed in Table 1. Observers monitor from one to three stations to provide SID data.

Table 1: 202606 VLF Observers

Observer	Code	Stations
R Battaiola	A96	ICV
L Loudet	A118	DHO GBZ
J Godet	A119	DHO GBZ GQD
L Pina	A148	NAA NML NLK
J Wendler	A150	NAA
J DeVries	A153	NLK
M Cervoni	A154	DHO

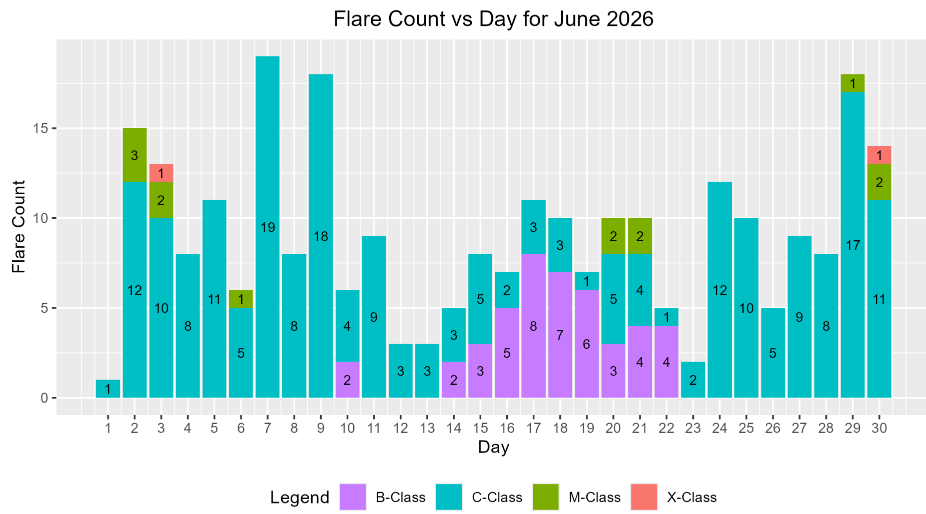
1.3 SID Events

Figure 3 depicts the importance rating of the solar events. The durations in minutes are -1: LT 19, 1: 19-25, 1+: 26-32, 2: 33-45, 2+: 46-85, 3: 86-125, and 3+: GT 125.



1.4 Solar Flare Summary from GOES-16 Data

In June 2026, there were 271 solar flares measured by GOES-19 (see Figure 4): two X-class, 13 M-class, 212 C-class, and 44 B-class flares, about the same as last month. (U.S. Dept. of Commerce–NOAA, 2024). (see Figure 4).



2 Relative Sunspot Numbers (Ra)

Reporting monthly sunspot numbers consists of submitting an individual observer's daily counts for a specific month to the AAVSO Solar Section. These data are maintained in a Structured Query Language (SQL) database. The monthly data then are extracted for analysis. This section is the portion of the analysis concerned with both the raw and daily average counts for a particular month. Scrubbing and filtering the data assure error-free data are used to determine the monthly sunspot numbers

2.1 Raw Sunspot Counts

Figure 5 and 6, The raw daily sunspot counts consist of submitted counts from all observers who provided data in June 2026. These counts are reported by the day of the month. The reported raw daily average counts have been checked for errors and inconsistencies, and no known errors are present.

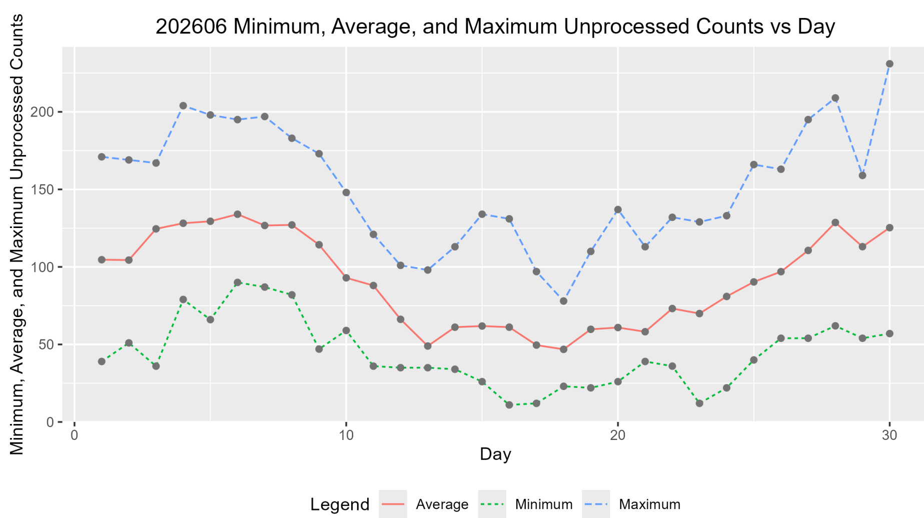


Figure 5: Minimum, Average, and Maximum Unprocessed Counts

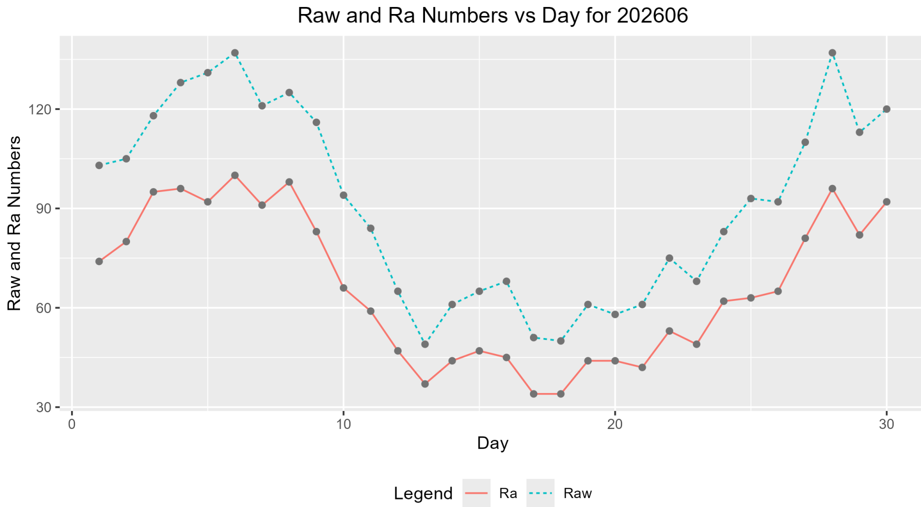


Figure 6: Raw Wolf average and Ra numbers by day of the month for all observers.

2.2 American Relative Sunspot Numbers

The relative sunspot numbers, Ra, represent the sunspot counts after the submitted data have been cleaned and processed using Shapley's method with k-factors (http://iopscience.iop.org/article/10.1086/126109/pdf). The Shapley method is a statistical model that combines random effects, such as observer group selection, and fixed effects, like seeing conditions. The raw Wolf averages and the calculated Ra are shown in Figure 7, while Table 2 presents the day of observation (column 1), the number of observers recording that day (column 2), the raw Wolf number (column 3), and the Shapley Correction (Ra) (column 4).

Table 2: 202606 American Relative Sunspot Numbers (R_a).

Day	Number of Observers	Raw	R_a
1	39	103	74
2	34	105	80
3	35	118	95
4	38	128	96
5	39	131	92
6	37	137	100
7	35	121	91
8	33	125	98
9	30	116	83
10	31	94	66
11	30	84	59
12	35	65	47
13	38	49	37
14	32	61	44
15	29	65	47
16	30	68	45
17	35	51	34
18	30	50	34

Continued

Table 2: 202606 American Relative Sunspot Numbers (R_a).

Day	Number of Observers	Raw	R_a
19	33	61	44
20	29	58	44
21	30	61	42
22	32	75	53
23	35	68	49
24	36	83	62
25	32	93	63
26	33	92	65
27	37	110	81
28	37	137	96
29	39	113	82
30	35	120	92
Averages	33.9	91.4	66.5

2.3 Sunspot Observers

Table3 lists the Observer Code(column1), the Number of Observations (column2) submitted for June 2026, and the Observer Name(column3). The final row gives the total number of observers who submitted sunspot counts(64),and total number of observations submitted(1075)

Table 3: 202606 Number of observations by observer.

Observer Code	Number of Observations	Observer Name
AAX	21	Alexandre Amorim
AJV	27	J. Alonso
ARAG	30	Gema Araujo
ASA	1	Salvador Aguirre
BATR	4	Roberto Battaiola
BKL	6	John A. Blackwell
BMIG	29	Michel Besson
BVZ	24	Jesus E. Blanco
BXZ	26	Jose Alberto Berdejo
BZX	27	A. Gonzalo Vargas
CKB	26	Brian Cudnik
CMAB	9	Maurizio Cervoni
CNT	30	Dean Chantiles
CWD	5	David Cowall
DARB	17	Aritra Das
DELS	7	Susan Delaney
DFR	15	Frank Dempsey
DIL	22	Bill Dillon
DJOB	11	Jorge Del Rosario
DJSA	2	Jeff DeVries
DMIB	28	Michel Deconinck
DPAL	15	Pacal Dabrowski
DUBF	29	Franky Dubois
EHOA	25	Howard Eskildsen

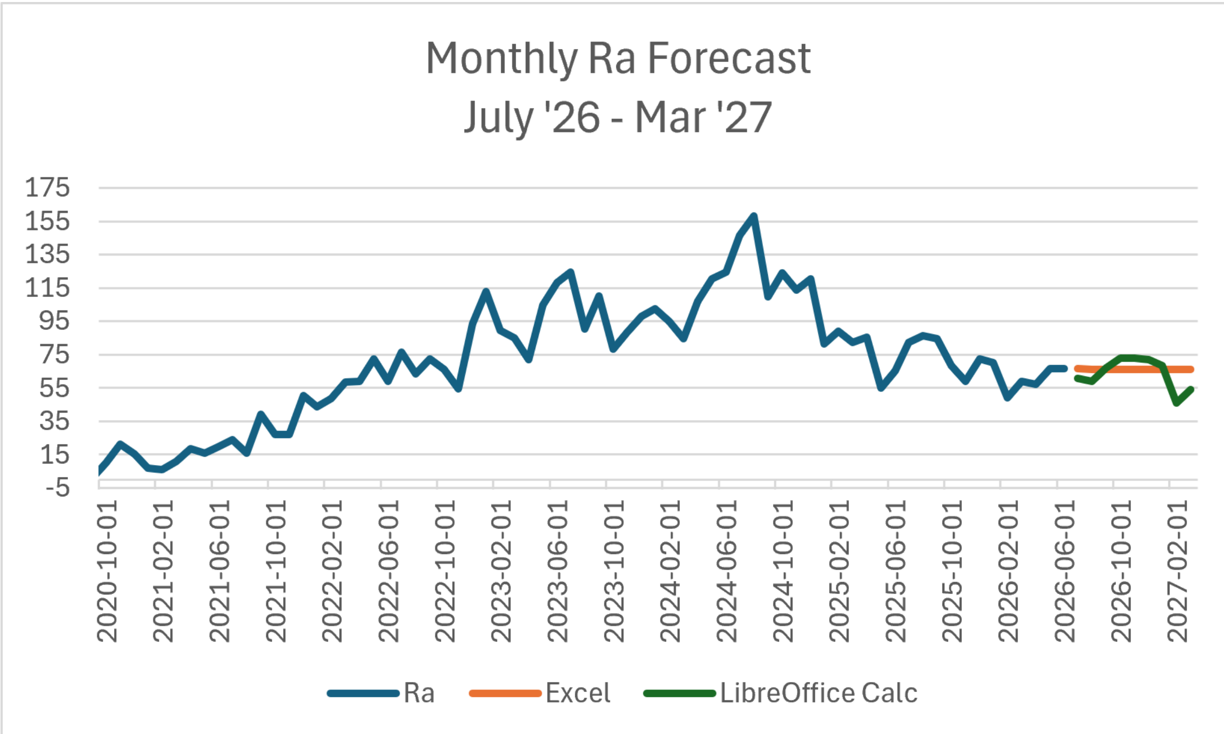
Continued

Table 3: 202606 Number of observations by observer.

Observer Code	Number of Observations	Observer Name
FALB	4	Allen Frohardt
FERA	24	Eric Fabrigat
GCNA	2	Cándido Gómez
HKY	21	Kim Hay
HOWR	19	Rodney Howe
HRUT	26	Timothy Hrutkay
ILUB	3	Luigi Iapichino
JGE	3	Gerardo Jiménez López
KAMB	30	Amoli Kakkar
KAND	27	Kandilli Observatory
KAPJ	23	John Kaplan
KNJS	25	James & Shirley Knight
KTOC	16	Tom Karnuta
LKR	10	Kristine Larsen
LLEC	20	Leroy Leonard
LRRA	21	Robert Little
MARE	10	Enrico Mariani
MJHA	25	John McCammon
MMI	30	Michael Moeller
MUDG	13	George Mudry
MWMB	4	William McShan
MWU	18	Walter Maluf
PCEA	2	Peter Crute
PLUD	16	Ludovic Perbet
RJV	17	Javier Ruiz Fernandez
SDAW	22	David Scott
SDOH	30	Solar Dynamics Obs - HMI
SNE	13	Neil Simmons
SQN	4	Lance Shaw
SRIE	22	Rick St. Hilaire
TDE	22	David Teske
TPJB	4	Patrick Thibault
TST	24	Steven Toothman
URBP	29	Piotr Urbanski
WGI	3	Guido Wollenhaupt
Totals	1018	59

3 Forecasting Sunspot Activity: An ETS Comparison of Excel and LibreOffice Calc

Observed monthly Ra (Oct 2020–mid 2026) is shown with forecasts through March 2027 from Excel and LibreOffice Calc, using Ra data back to 2000. Both use exponential triple smoothing (ETS), which isn't suited to solar-cycle data, so treat these projections as illustrative only.

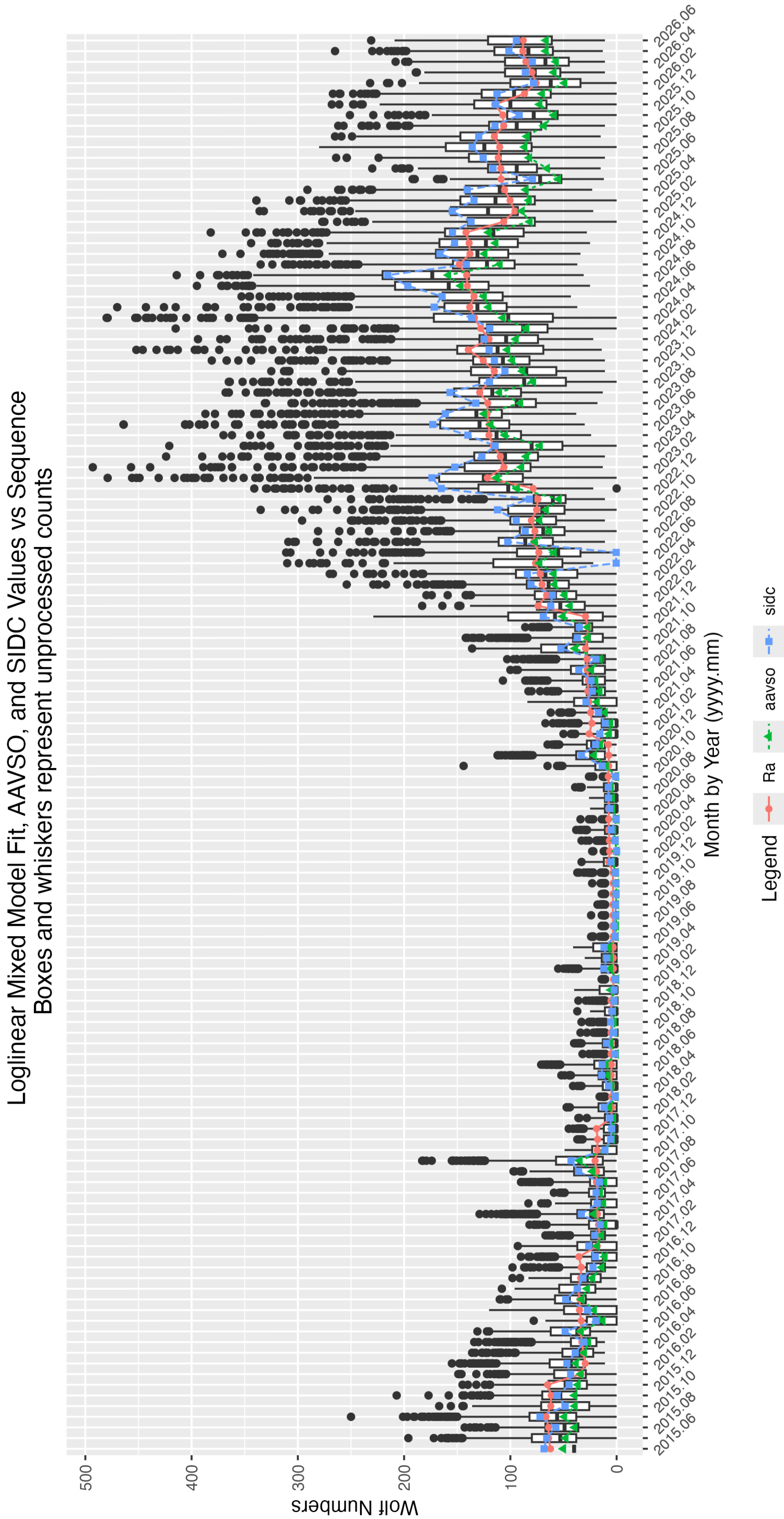


4 A Generalized Linear Mixed Model for Enumerated Sunspots

Dr. Jamie Riggs, Solar System Science Section Head, International Astrostatistics Association, maintains a relative sunspot number (Ra) model containing the sunspot numbers after the submitted data are scrubbed and modeled by a Generalized Linear Mixed Model (GLMM), which is a different model method from the Shapley method of calculating Ra in Section 2 above. The GLMM is a statistical model that accounts for variation due to random effects and fixed effects. For the GLMM Ra 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 the paper, A Generalized Linear Mixed Model for Enumerated Sunspots (see 'GLMM06' in the sunspot counts research page at http://www.spesi.org/?page id=65).

Figure 8 shows the monthly GLMM Ra numbers for a rolling eleven-year (132-month) window beginning within the 24th solar cycle and ending with last month's sunspot numbers. The solid cyan curve that connects the red X's is the GLMM model Ra estimates of excellent seeing conditions, which in part explains why these Ra estimates often are higher than the Shapley Ra values. The dotted black curves on either side of the cyan curve depict a 99% confidence band about the GLMM estimates. The green dotted curve connecting the green triangles is the Shapley method Ra numbers. The dashed blue curve connecting the blue O's is the SILSO values for the monthly sunspot numbers.

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 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 dots below and above the whiskers traditionally are considered outliers, but with GLMM modeling, they are observations that are accounted for by the GLMM model.


Loglinear Mixed Model Fit, AAVSO, and SIDC Values vs Sequence
Boxes and whiskers represent unprocessed counts
Wolf Numbers
Month by Year (yyyy.mm)
Legend
Ra
aavso
sidc

4 Endnotes

- Sunspot Reports: Kim Hay solar@aavso.org
- SID Solar Flare Reports: Rodney Howe rhowe137@icloud.com
- Sunspot data as of July 13, 2026

5 References

- Dr. Jamie Riggs (2017), Solar System Science Section Head, International Astrostatistics (using R Statistical Software (2023), TSA Libraries: (https://cran.r-project.org)
- Shapley, (1949), method with k-factors (http://iopscience.iop.org/article/10.1086/126109/pdf).
- U.S. Dept. of Commerce–NOAA, Space Weather Prediction Center, 2022. GOES-16 XRA data. ftp://ftp.swpc.noaa.gov/pub/indices/events/