Solar Bulletin

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS
SOLAR SECTION

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The Solar Bulletin of the AAVSO is a summary of each month's solar activity recorded by visual solar observers' counts of group and sunspots, and the very low frequency (VLF) radio recordings of SID Events in the ionosphere. The sudden ionospheric disturbance report is in Section 3. The relative sunspot numbers are in Section 4. Section 5 has endnotes.

1 A blue spike from southern hemisphere sunspot counts

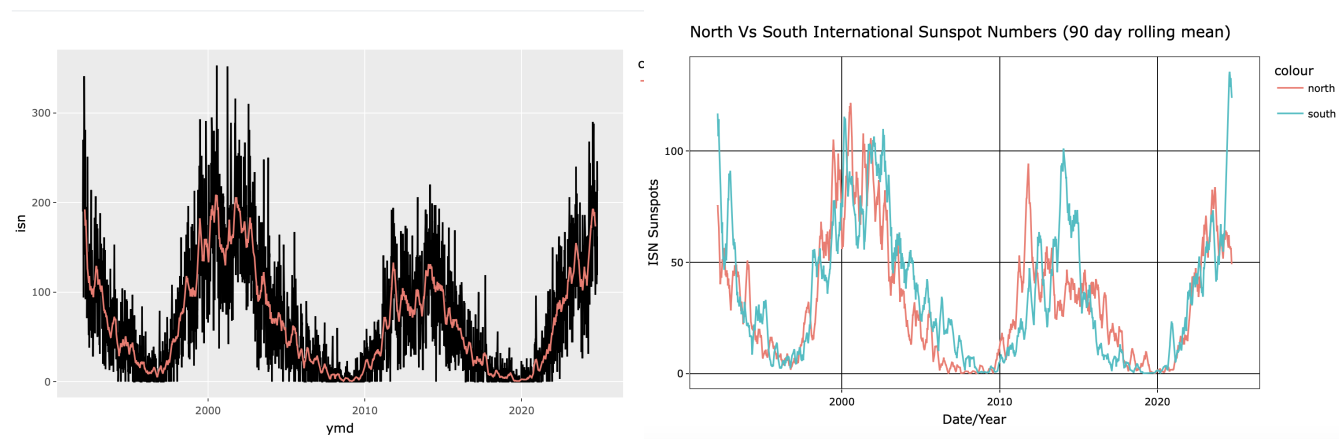

Figure 1: (left panel) Last 4 cycles back to 1992. The (right panel) shows in blue the Southern Hemisphere count of sunspots, with a sharp spike. (`https://www.sidc.be/SILSO/datafiles`). Graphs by David Jackson (JDAC).

"THE SOUTHERN HEMISPHERE IS STILL IN CHARGE: NASA and NOAA announced in October that Solar Maximum has arrived. Only half of the sun is paying attention. The sun's southern hemisphere continues to dominate sunspot production." (`https://www.spaceweather.com/archive.php?view=1&day=02&month=12&year=2024`)

2 A project to rescue as much old AAVSO data as possible.

Please send me your pre-2000 daily raw sunspot counts

I am looking for your daily raw sunspot counts for AAVSO observers from before the year 2000. I am hoping that several of you active AAVSO sunspot counters will still have your original raw daily data back in your old logbooks or records, and that you can pass them along. This is a data-rescue or data-recovery operation.

The goal is to recover as much as possible of the full AAVSO raw sunspot data base, with the aim of putting out a data paper in *ApJ*, which contains an on-line-only full data table (with half-a-million observations) of every recovered daily measure. I want to include every observation for every AAVSO observer for every day. The minimum for each day would be YEAR, MONTH, DAY, OBSERVER, the observed G (group count), the observed S (spot count), and the observed Wolf number (10G+S). This must be only for observers who have contributed their data to the AAVSO, back in the day. I am only looking for the raw daily counts for before the year 2000.

The problem is that much of the raw-daily-data from roughly 1976 to 1999 has been lost. We have the processed data over the entire AAVSO record from 1944 to 2024, but we are ambitiously trying to reprocess the original observed data, and for this we need the original raw sunspot counts. We have a complete record of raw data from 2000 to present. And I have rescued the data from 1945 to around 1976 (with some months missing), from a complete photocopy of the AAVSO Headquarters records that I made in 1995. We have recovered a variety of special case observations collected for various individual observers based on their original logbooks. But this leaves us with big gaps, mostly 1976–1999.

Many of you long-term AAVSO observers might have your own personal archival records of your data going back to before the year 2000. You might have it as old data scattered in your logbooks, or you might have it in copies of your original monthly report sheets. Or you might have put your old data into some electronic summary listing. I will take whatever you conveniently have. Even if you do not have such, maybe you know someone who might have the needed data, and if so then please pass along my request.

My heartfelt plea is for you to send along to me your pre-2000 daily raw data. The preferred format would be electronic and in EXCEL. But any format is fine, from handwritten lists, up to photocopies of logbooks or monthly report sheets, up to any spreadsheet listing. Please use my private email address (bradschaefer@mac.com), as my LSU email makes occasional stupidities of returning or dropping emails from non-academic addresses. Or, you can postal-mail it to Brad Schaefer, 1434 E. Seneca St., Tucson AZ 85719 USA.

The goal here is to rescue as much old AAVSO data as possible.
Cheers, Brad

Bradley E. Schaefer, Professor, Department of Physics and Astronomy Louisiana State University Baton Rouge, Louisiana 70803, USA email to bradschaefer@mac.com [schaefer@lsu.edu]

3 Sudden Ionospheric Disturbance (SID) Report

3.1 SID Records

November 2024 (Figure 2): there were low level C-class flares, and one M1.1 flare on the 24th. (U.S. Dept. of Commerce–NOAA, 2022).

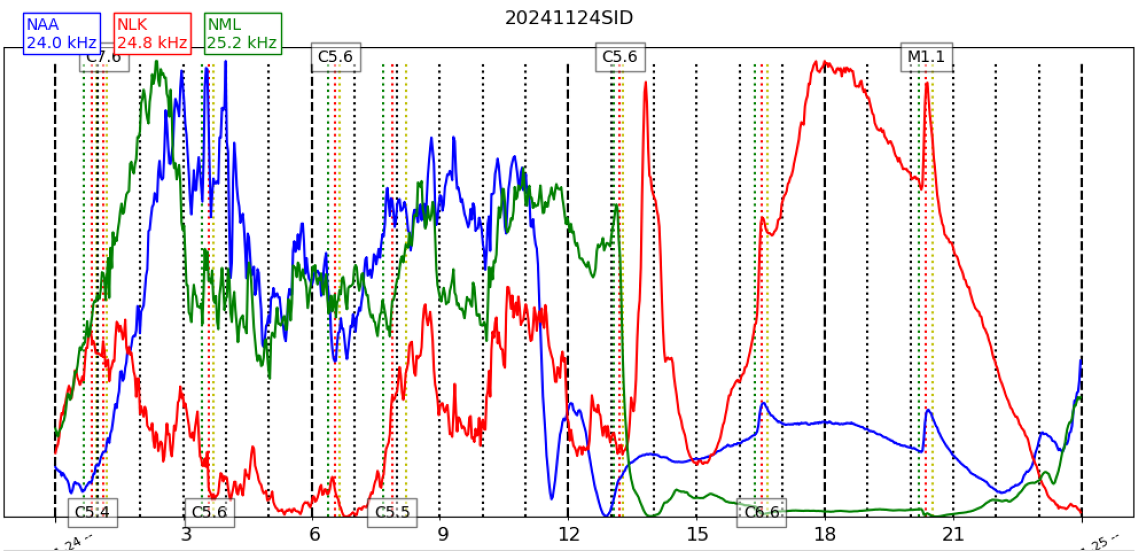

Figure 2: VLF recording here in Fort Collins, Colorado shows a smooth ionosphere and a few 'shark' tails of SID Events.

3.2 SID Observers

In November 2024 we had 13 AAVSO SID observers who submitted VLF data as listed in Table 1.

Table 1: 202411 VLF Observers

Observer	Code	Stations
R Battaiola	A96	HWU
J Wallace	A97	NAA
A Son	A112	DHO
L Loudet	A118	DHO GQD
J Godet	A119	DHO GBZ GQD
J Karlovsky	A131	DHO
R Mrllak	A136	GQD NSY
S Aguirre	A138	NLK
G Silvis	A141	HWU NAU NLK
L Pina	A148	NAA NML
J Wendler	A150	NAA
J DeVries	A153	NLK
M Salo	A157	NLK

Figure 3 depicts the importance rating of the solar events. The duration 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.

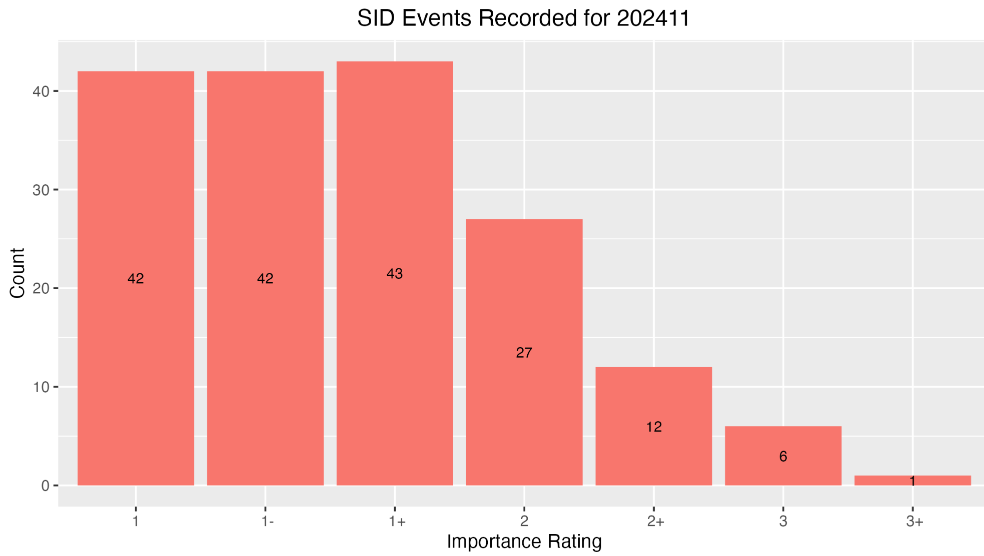

Figure 3: VLF SID Events.

3.3 Solar Flare Summary from GOES-16 Data

In November 2024, there were 277 GOES-16 flares: 9 X-class, 80 M-class, and 188 C-class. There was a lot more flaring this month compared to last. (U.S. Dept. of Commerce–NOAA, 2024). (see Figure 4).

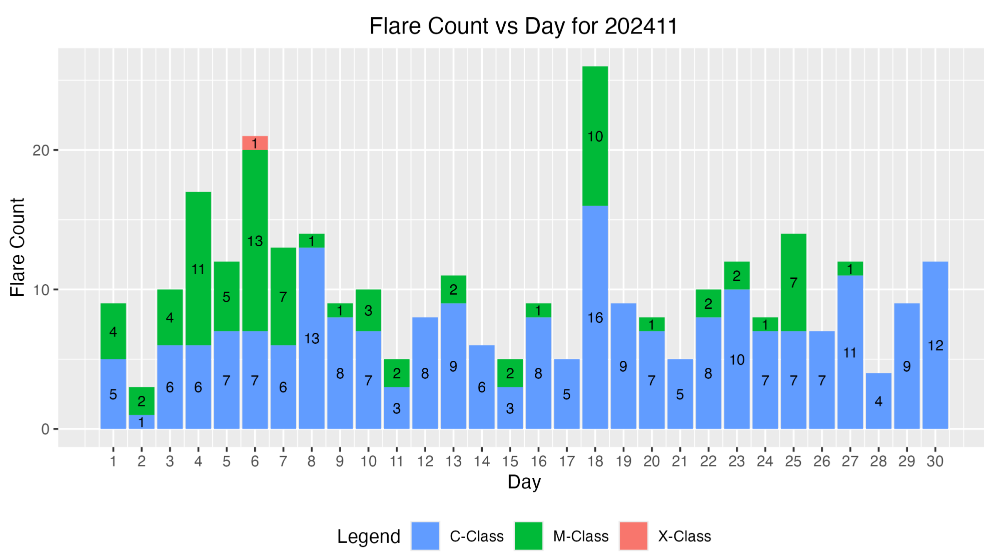

Figure 4: GOES-16 XRA flares (U.S. Dept. of Commerce–NOAA, 2024).

4 Relative Sunspot Numbers (R_a)

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.

4.1 Raw Sunspot Counts

The raw daily sunspot counts consist of submitted counts from all observers who provided data in November 2024. 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. All observers whose submissions qualify through this month's scrubbing process are represented in Figure 5.

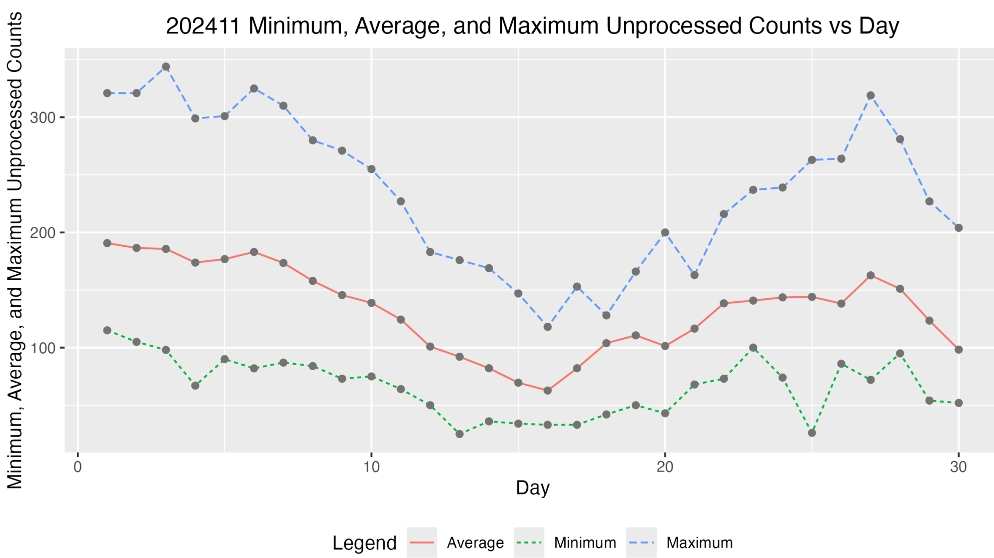

Figure 5: Raw Wolf number average, minimum and maximum by day of the month for all observers.

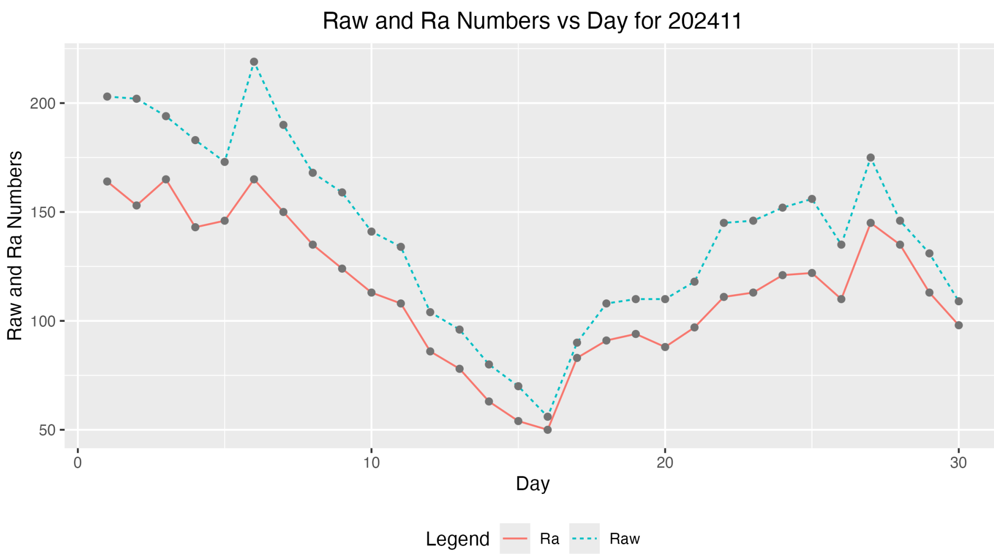

Figure 6: Raw Wolf average and R_a numbers by day of the month for all observers.

4.2 American Relative Sunspot Numbers

The relative sunspot numbers, R_a, contain the sunspot numbers after the submitted data are scrubbed and modeled by Shapley's method with k-factors (`http://iopscience.iop.org/article/10.1086/126109/pdf`). The Shapley method is a statistical model that agglomerates variation due to random effects, such as observer group selection, and fixed effects, such as seeing condition. The raw Wolf averages and calculated R_a are seen in Figure 6, and Table 2 shows the Day of the observation (column 1), the Number of Observers recording that day (column 2), the raw Wolf number (column 3), and the Shapley Correction (R_a) (column 4).

Table 2: 202411 American Relative Sunspot Numbers (R_a).

Day	Number of Observers	Raw	R_a
1	34	203	164
2	23	202	153
3	27	194	165
4	26	183	143
5	26	173	146
6	25	219	165
7	27	190	150
8	23	168	135
9	21	159	124
10	21	141	113
11	34	134	108
12	31	104	86
13	24	96	78
14	28	80	63
15	26	70	54

Continued

Table 2: 202411 American Relative Sunspot Numbers (R_a).

Day	Number of Observers	Raw	R_a
16	28	56	50
17	24	90	83
18	25	108	91
19	25	110	94
20	27	110	88
21	17	118	97
22	24	145	111
23	19	146	113
24	31	152	121
25	23	156	122
26	23	135	110
27	21	175	145
28	20	146	135
29	23	131	113
30	24	109	98
Averages	25	140.1	113.9

4.3 Sunspot Observers

Table 3 lists the Observer Code (column 1), the Number of Observations (column 2) submitted for November 2024, and the Observer Name (column 3). The final row gives the total number of observers who submitted sunspot counts (60), and total number of observations submitted (750).

Table 3: 202411 Number of observations by observer.

Observer Code	Number of Observations	Observer Name
AAX	17	Alexandre Amorim
ARAG	29	Gema Araujo
ASA	2	Salvador Aguirre
BATR	3	Roberto Battaiola
BMIG	17	Michel Besson
BTB	5	Thomas Bretl
BXZ	22	Jose Alberto Berdejo
BZX	13	A. Gonzalo Vargas
CIOA	1	Ioannis Chouinavas
CKB	21	Brian Cudnik
CLDB	15	Laurent Cambon
CMAB	10	Maurizio Cervoni
CNT	26	Dean Chantiles
DARB	27	Aritra Das
DFR	6	Frank Dempsey

Continued

Table 3: 202411 Number of observations by observer.

Observer Code	Number of Observations	Observer Name
DJOB	11	Jorge del Rosario
DJSA	4	Jeff DeVries
DJVA	28	Jacques van Delft
DMIB	17	Michel Deconinck
DUBF	12	Franky Dubois
EHOA	11	Howard Eskildsen
FJOF	3	Joe Fazio
GALQ	1	Alejandro Gonzalez-Ojeda
GIGA	19	Igor Grageda Mendez
HALB	7	Brian Halls
HKY	22	Kim Hay
HOWR	12	Rodney Howe
HSR	10	Serge Hoste
IEWA	10	Ernest W. Iverson
ILUB	4	Luigi Iapichino
JGE	6	Gerardo Jimenez Lopez
KAND	19	Kandilli Observatory
KAPJ	8	John Kaplan
KNJS	12	James & Shirley Knight
LKR	8	Kristine Larsen
LRRA	12	Robert Little
LVY	27	David Levy
MARC	2	Arnaud Mengus
MARE	8	Enrico Mariani
MCE	20	Etsuiku Mochizuki
MJHA	24	John McCammon
MLL	2	Jay Miller
MMI	26	Michael Moeller
MUDG	4	George Mudry
MWMB	15	William McShan
MWU	17	Walter Maluf
NMID	4	Milena Niemczyk
PLUD	17	Ludovic Perbet
RJV	12	Javier Ruiz Fernandez
SDOH	26	Solar Dynamics Obs - HMI
SNE	3	Neil Simmons
SQN	7	Lance Shaw
SRIE	13	Rick St. Hilaire
TDE	16	David Teske
TPJB	3	Patrick Thibault
TST	9	Steven Toothman
URBP	17	Piotr Urbanski
VIDD	11	Dan Vidican

Continued

Table 3: 202411 Number of observations by observer.

Observer Code	Number of Observations	Observer Name
WGI	1	Guido Wollenhaupt
WWM	16	William M. Wilson
Totals	750	60

4.4 Generalized Linear Model of Sunspot Numbers

Dr. Jamie Riggs, Solar System Science Section Head, International Astrostatistics Association, maintains a relative sunspot number (R_a) 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 R_a in Section 4 above. The GLMM is a statistical model that accounts for variation due to random effects and fixed effects. For the GLMM 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 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 7 shows the monthly GLMM R_a 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 R_a estimates of excellent seeing conditions, which in part explains why these R_a estimates often are higher than the Shapley R_a 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 R_a 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 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 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.

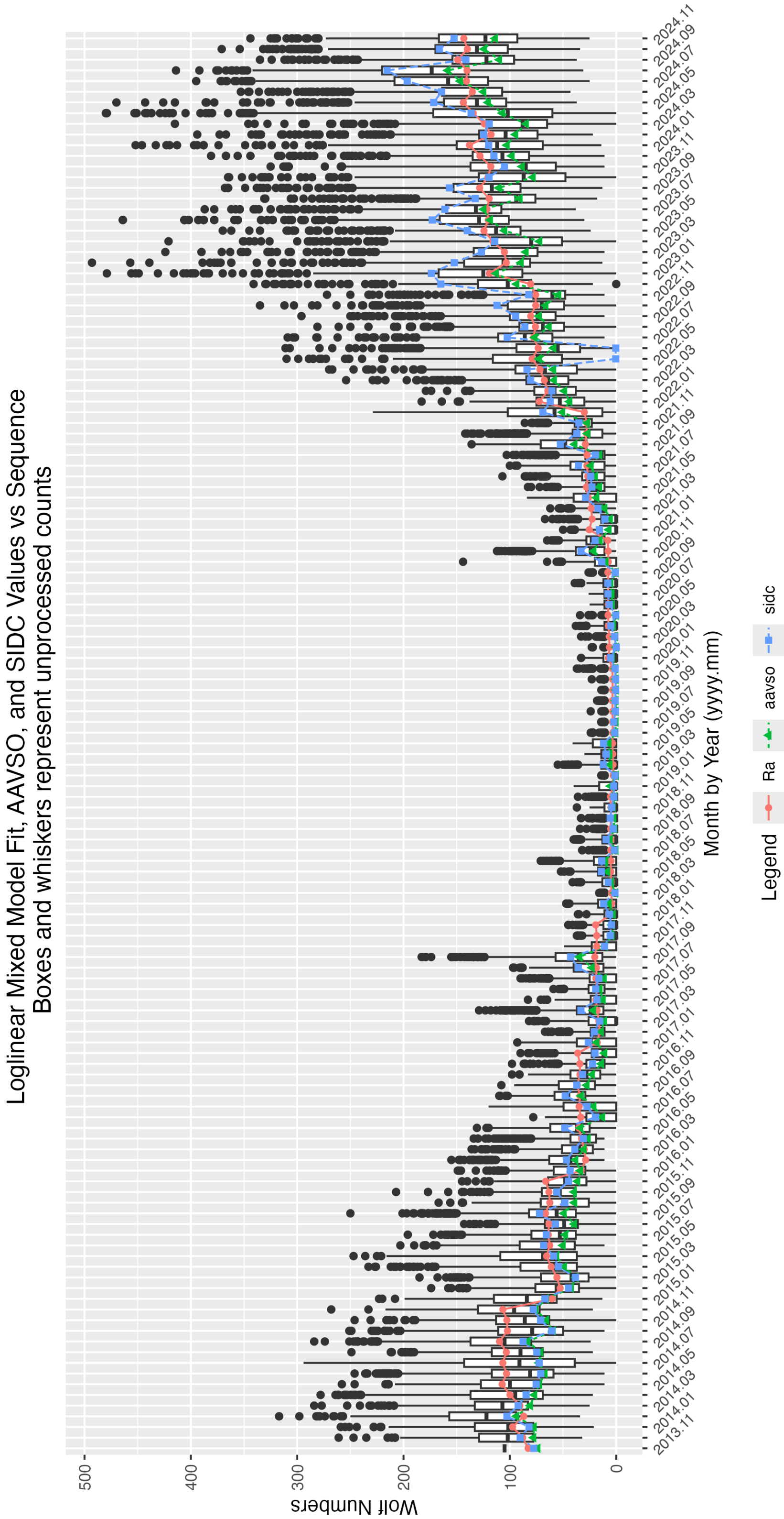

Figure 7: GLMM fitted data for R_a. AAVSO data: https://www.aavso.org/category/tags/solar-bulletin. SIDC data: WDC-SILSO, Royal Observatory of Belgium, Brussels

5 Endnotes

- Sunspot Reports: Kim Hay solar@aavso.org
- SID Solar Flare Reports: Rodney Howe rhowe137@icloud.com

6 Antique telescope project

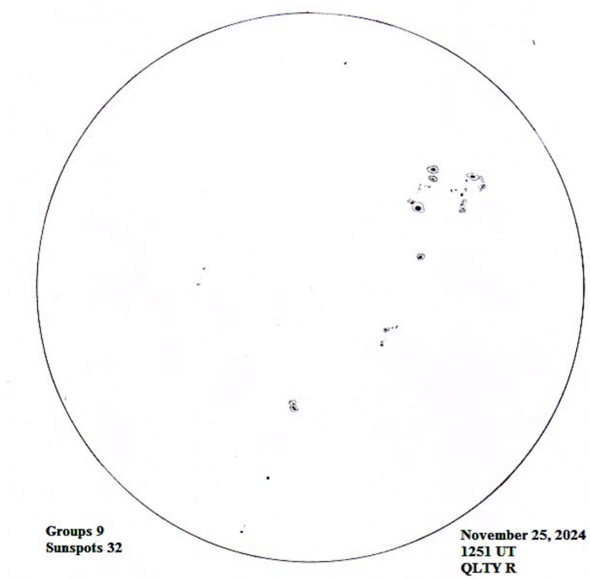

Figure 8: A recent replica of an antique telescope built by Gonzalo Vargas (BZX) in Cochabamba, Bolivia (left), and a drawing for the 24th of November (right).

7 References

Riggs, Jamie (2017), Solar System Science Section Head, International Astrostatistics (using R Statistical Software (2023), TSA Libraries: (`https://cran.r-project.org`)

U.S. Dept. of Commerce–NOAA, Space Weather Prediction Center (2024). *GOES-16 XRA data.* `ftp://ftp.swpc.noaa.gov/pub/indices/events/`