

3rd Sunspot Workshop

Tucson, Arizona

22-25 January 2013

Recent Work on Improving the Historical Sunspot Record

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First "drawing" of the solar corona

Vaquero & Malville (2013), in preparation





PREHISTORIC ASTRONOMY IN THE SOUTHWEST





Different solar activity proxies during the period 1055–1145: annual number of naked-eye observations of sunspots, annual number of auroral nights. Arrows correspond to estimated maxima of solar cycle. Green arrows correspond to the estimated maxima of solar cycle using a high resolution 14C record from tree rings (courtesy of H. Miyahara). Both kinds of information suggest that the date of maximum of the solar cycle is close to AD1098. This fact is, therefore, a support for the hypothesis of the solar corona represented in the petroglyph of the "Piedra del Sol".

Outline

- Main changes in the Hoyt & Schatten Database
 - 17th century
 - 18th century
- Recovering old data
 - Great observers
 - Sunspot positions
 - Solar diameter
- Maunder Minimum: reading original sources

Main changes in the database compiled by Hoyt and Schatten

17th century18th century



Vaquero (2007) Adv. Spa. Res. 40, 929.



Relationship between GSN and AD for 1848–1995 from Hoyt & Schatten (1998). Polynomial fit (order 4) is shown for AD < 95% (blue line and points). Graphic inserted shows the same relationship during the Maunder minimum. Black lines represent the theoretical values for an average observer with 1 (continuous), 2 (dashed), and 3 (dotted) groups for each active day.



Vaquero et al. (2012) Solar Phys. 277, 389

Relationship between GSN and AD for all available data from Hoyt & Schatten (1998). Black line is the polynomial fit of last Figure. The inset presents an enlarged version but restricted to values AD < 35%.



Vaquero et al. (2011) *ApJL* **731**, L24.



Vaquero & Trigo (2013), in progress

Important sunspot observers: the case of D.E. Hadden (Alta, Iowa)

Carrasco et al. (2013), in preparation







 $\text{GSN}_{\text{Hadden}}$

ISN_{Hadden}

Recovering old data on sunspot positions

Nogales & Vaquero (2013), in preparation Casas & Vaquero (2013), in preparation Carrasco et al. (2013), in preparation On Dr. Sæmmerring's Observations of the Solar Spots in the Years 1826, 1827, 1828, and 1829. By R. C. Carrington, Esq.

When I visited North Germany in the year 1856, one object which I had in view was to obtain personal information of the observations of the solar spots made by Dr. von Sœmmerring; as I thought it probable, from the account given of them by Professor Thilo, in a dissertation published in the year 1828, that records made by a man of Sœmmerring's eminence would exhibit a degree of accuracy which would repay the labour of reduction; and, when reduced, would put me in immediate possession of an ancient series which might enable me to obtain a more exact value of the time of rotation of the sun on its axis. I Carrington (1860) *MNRAS* **20**, 71



Nogales & Vaquero (2013),

1827.0

in progress

2 3



1829.0

1828.0

1830.0

The sunspot catalogues of Carrington, Peters and de la Rue: quality control and machine-readable versions (Casas & Vaquero, in preparation)



Difference between the latitude calculated by de la Rue and our study. A sinuosoidal behaviour is present from January 1^{st} , 1864 with a period of a year and an amplitude of 14.5 degrees.



Astronomical Observatory of Universidad de Valencia (Spain)



Carrasco et al. (2013), in preparation

Solar diameter in 18th century

Ruiz-Lorenzo et al. (2013), in preparation





Mural quadrant by Bird (London)

Cadiz Observatory used the some instrument and methodology that Tobias Mayer used in Göttingen Observatory (Wittmann, 1980, 1998).

Table 1. Observations performed in Observatory of Cádiz (Spain) in late 18th Century.							
Period	Number of obs.	Solar Radius (")					
Jun-Dec 1776	68	959.61±1.61					
1773-1776	310	959.84±2.90					
1788-1790	391	964.55±5.48					
1776-1790	701	962.46±5.09					



This observations are comparable to the observations of Tobias Mayer in the same time, but the dispersion is higher.

The observations performed in June-December 1776 seem more reliable.

Maunder Minimum: consulting original sources

Vaquero et al. (2013), in preparation

JOHANNIS HEVELII MACHINÆ COELESTIS PARS POSTERIOR; Rerum Uranicarum OBSERVATIONES, Tam Eclipfium Luminarium, quàm Occultationum Planetarum, & Fixarum, Altitudinum Meridianarum Solarium, Solftitiorum, & Aquinoctiorum; Reliquorum Planetarum, Fixarumá; omnium hactenus cognitarum, Globisqi adfcriptarum, æquè ac plurimarum hucufq; ignotarum OBSERVATIS; Pariter quoad Distantias, Altitudines Meridianas, & Declinationes ; Innumeris aliis notatu dignissimis, atquè ad Astronomiam excolendam maximè spectantibus rebus, Plurimorum annorum, fummis vigiliis, indefesfoque labore, ex ipfo æthere hauftas, permultisquè Iconibus, Auctoris manu, ari incifis, illustratas, & exornatas, TRIBUS LIBRIS, exhibens. Cum Gratia & Privilegio Sac. Regie Majeft. Polon. GEDANL In ædibus Auctoris, cjusq; Typis, & Sumptibus Imprimebat SIMON REINIGER. ANNO M DC LXXIX.









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Sunspot record with measurement of solar meridian altitude

Sunspot record without measurement of solar meridian altitude

No sunspot record with measurement of solar meridian altitude

No sunspot record without measurement of solar meridian altitude

Be careful!!!

Sunspot records are not associated with measurement of solar meridian altitude!!!

ibus.

Year	AD	NAD	AD%	
1653	11	11	50.00	
1654	3	1	75.00	
1655	n.a.	n.a.	n.a.	
1656	n.a.	n.a.	n.a.	
1657	4	2	66.67	
1658	0	2	0.00	
1659	0	47	0.00	
1660	28	30	48.28	
1661	2	16	11.11	
1662	n.a.	n.a.	n.a.	
1663	0	7	0.00	
1664	n.a.	n.a.	n.a.	
1665	n.a.	n.a.	n.a.	
1666	n.a.	n.a.	n.a.	
1667	n.a.	n.a.	n.a.	
1668	n.a.	n.a.	n.a.	
1669	n.a.	n.a.	n.a.	
1670	n.a.	n.a.	n.a.	
1671	2	3	40.00	
1672	n.a.	n.a.	n.a.	
1673	n.a.	n.a.	n.a.	
1674	n.a.	n.a.	n.a.	
1675	0	2	0.00	
Total:	50	121	29.24	
1653-1663:	48	116	29.27	
1659-1661:	30	93	24.39	

		H&S98	/ear
	0.9	53	165
	0.7	54	165
	0.5	55	165
	0.6	56	165
	0.2	57	165
	0	58	165
	0	59	165
+ GSN-0 9	2	60	166
	0.8	61	166
•	0	62	166
	0	63	166

AD%=24.39 GSN≈3

> The estimations of GSN from Hevelius' observations are 3-8 times greater that the values obtained by Hoyt and Schatten!!!

> > GSN=0.5

Some conclusions

- In last years, three mayor changes in H&S98 database have been proposed:
 - Onset of Maunder Minimum (Vaquero et al., 2011).
 - Solar Cycle #-1 (Vaquero et al., 2007; Vaquero & Trigo, 2013)
 - Lost solar cycle (Usoskin et al., 2009; Zolotova & Ponyavin, 2011).
- There are interesting lost solar information that are preserved in archives and libraries. This task is boring and unrecognized. We need a "Sunspot/Solar Historical Archive".
- Maunder minimum was a period of very low sunspot numbers as Hoyt & Schatten stated. However, their values probably are understimated because they used astrometric observation records (including *camera obscura* records!)



Comments, suggestions, etc.:

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