Sunspot data from 17th-19th centuries

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Centro
Universitario
de Mérida

1. Introduction

2. A simple test to check inconsistencies in sunspot number series

3. Problems in historical records

3.1. Case studies (I) [published]: (a) Onset of Maunder Minimum and (b) Solar Cycle #-1

3.2. Case studies (II) [unpublished]: (a) 1652, (b) 1741, (c) Weidler revisited, and (d) Solar cycle #-2

4. Recovering "new" old data

4.1. Sunspot number

4.2. Sunspot area

4.3. Sunspot positions

5. Calibration constants and Wolf-Wolfer transition around 1880

5.1. The curious case of Madrid Observatory

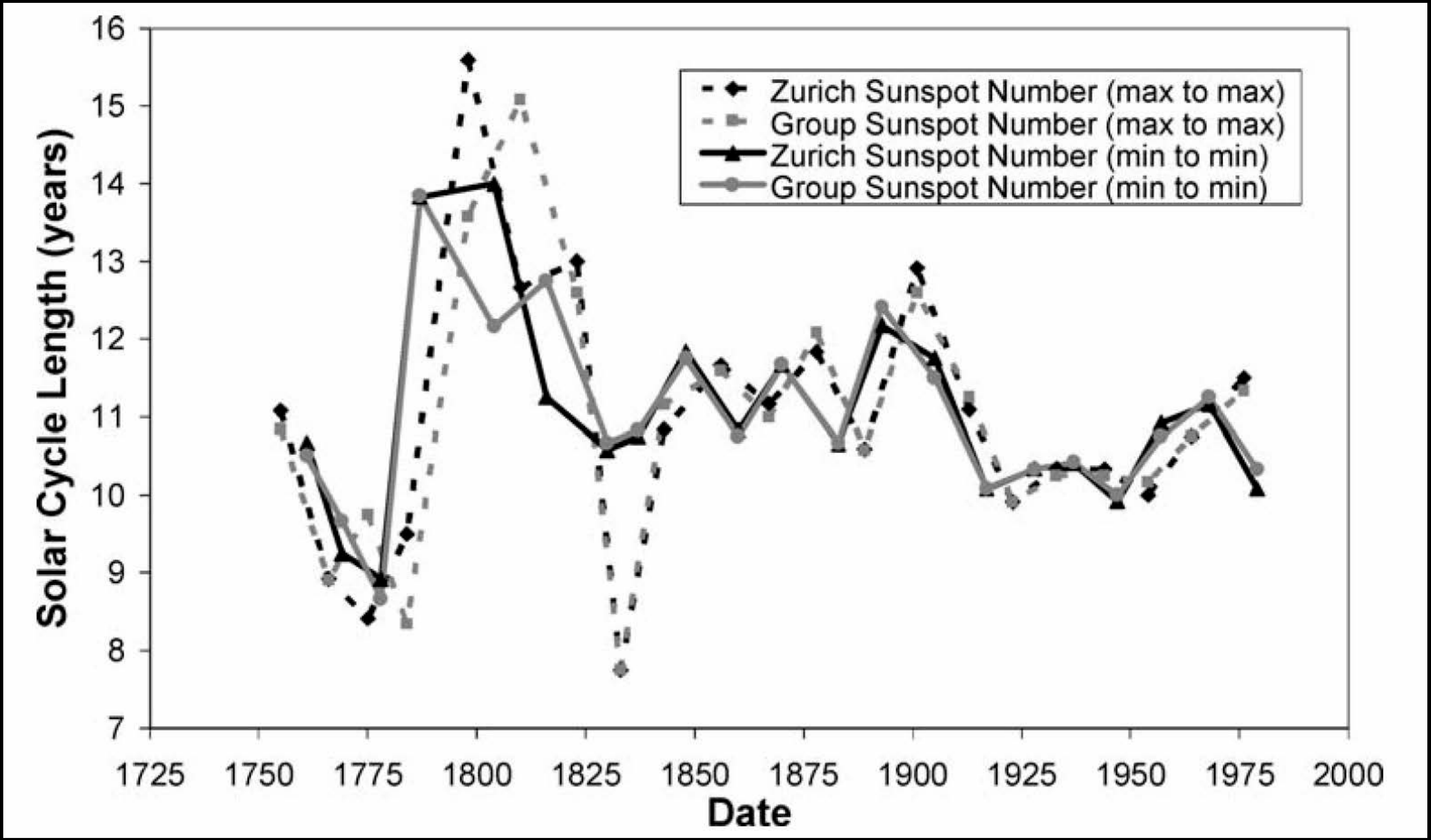
5.2. Royal Greenwich Observatory series is no-homogeneous

5.3. A toy-solar activity reconstruction

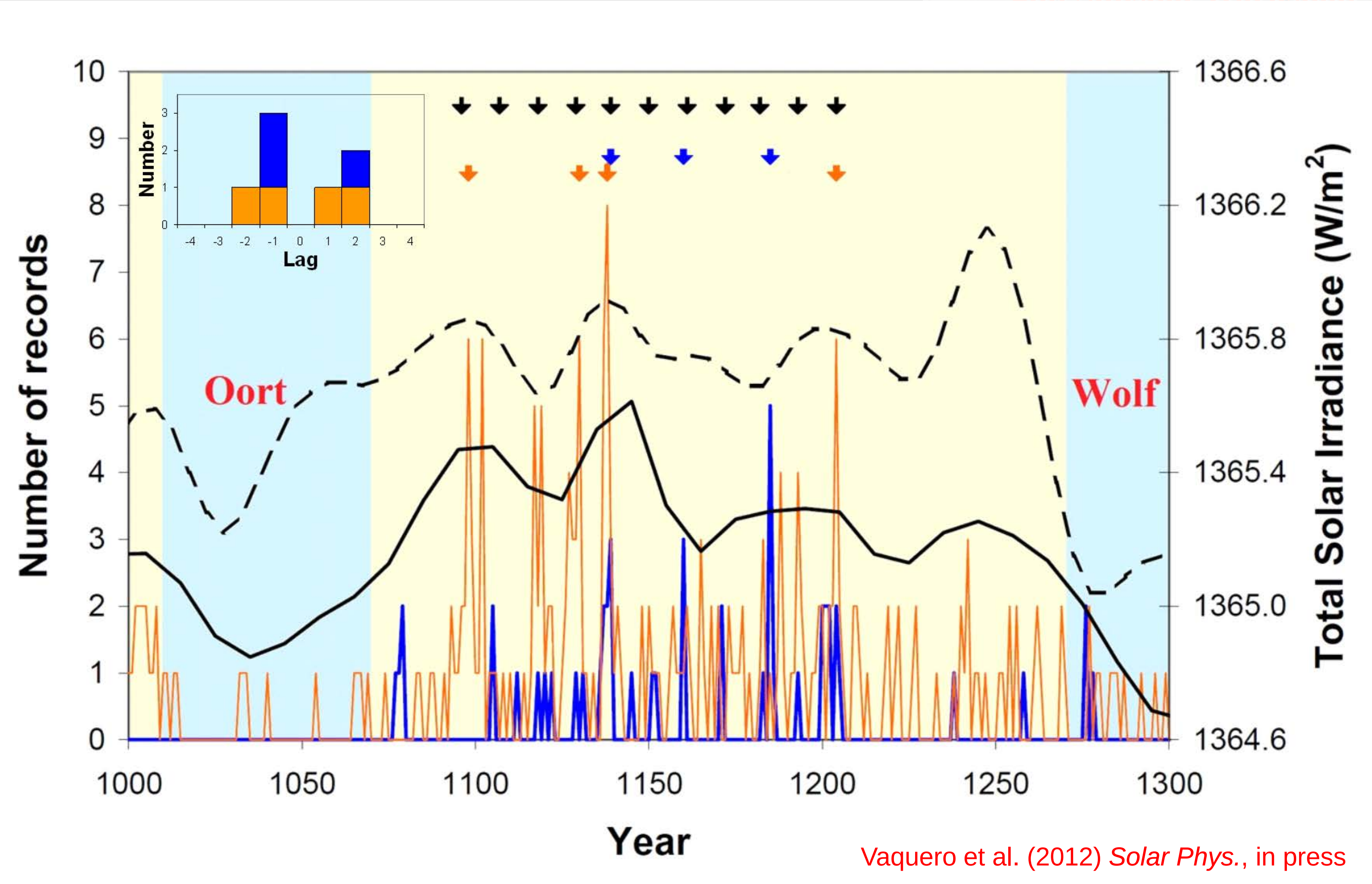
6. Conclusions

1. Introduction

Solar Cycle Amplitude (SCA) and Solar Cycle Length (SCL) in historical times



Vaquero et al. (2006) *Solar Phys*. **235**, 433.



Solar activity proxies during the period 1000–1300: TSI reconstructed by Steinhilber et al. (2009) (dashed black line) and by Vieira et al. (2011) (continuous black line), annual number of naked-eye observations of sunspots (Vaquero et al., 2002) (blue line), and annual number of auroral nights (Křivský & Pejml, 1988) (orange line). Black arrows are evenly spaced maxima of solar cycle derived from our study. Arrows correspond to estimated maxima of solar cycle using naked-eye observations (blue) and auroral nights (orange). Graphic inserted shows a histogram of the delays (in years) between the fitted and estimated maxima of solar cycle.

2. A simple test to check inconsistencies in sunspot number series

Active days, AD, are days with sunspots reported on the solar disc.

AD has been taken as a reliable indicator of solar activity, especially during periods of minimum activity (Maunder, 1922; Harvey and White, 1999; Usoskin, Mursula, and Kovaltsov, 2000, 2001, 2004).

In fact, an equivalent index (inactive days with no spots) was used by Schwabe (1844) to discover the solar cycle.

Schreiben des Herrn Professors *Plantamour*, Directors der Sternwarte in Genf, an den Herausgeber.

Genève 1844. Janvier 23.

Monsieur,

Je suis très-reconnaissant de la prompte communication que vous nous avez faite de la lettre de Mr. *Gauss* par votre circulaire du 5 Janvier. La forme exceptionnelle de l'orbite de cette comète, qui fait une espèce de transition à la forme des orbites planètaires, est un fait fort intéressant. Ce n'est qu'hier que j'ai eu le temps de comparer les éléments calculés par Mr. *Goldschmidt* *) avec les positions observées à Genève; mais avant d'indiquer les résultats de cette comparaison, je vous donnerai d'abord les observations de la comète, que j'ai faites depuis ma dernière lettre.

T. moy. Genève.	AR. appar.	Decl. appar.
1843 Déc. 17,3692	$5^h 13^m 10^s 36$	$+3° 20' 36'' 9$
1844 Janv. 9,2950	5 8 20,77	3 24 1,7
11,3118	5 8 35,07	3 31 48,9
12,3410	5 8 44,48	3 36 7,4
16,3813	5 9 41,06	3 54 57,7
18,4221	5 10 20,29	4 5 33,9

*) Die ersten Elemente des Herrn Doctors *Goldschmidt*. S.

J'ai trouvé maintenant les différences suivantes entre les longitudes et latitudes géocentriques calculées au moyen des éléments de Mr. *Goldschmidt* et les longitudes et latitudes données par l'observation.

	Erreurs des éléments	
	Longitude.	Latitude.
1843 Décembre 3	+ 29″5	— 4″3
9	+ 3,9	— 20,8
17	— 19,8	— 28,0
1844 Janvier 9	— 30,9	+2′ 1,3
11	— 21,6	+2 21,5
12	— 6,6	+2 31,9
16	+ 36,4	+3 23,1
18	+1 5,6	+3 50,0

Cette comparaison montre que les éléments ont besoin d'une correction, pour pouvoir représenter les observations du mois de Janvier; mais, avant d'entreprendre cette correction, j'attendrai que la comète ait terminé son apparition; car j'espère pouvoir l'observer encore pendant quelque temps, quoiqu'elle ait déjà beaucoup diminué d'éclat.

E. Plantamour.

Sonnen-Beobachtungen im Jahre 1843.

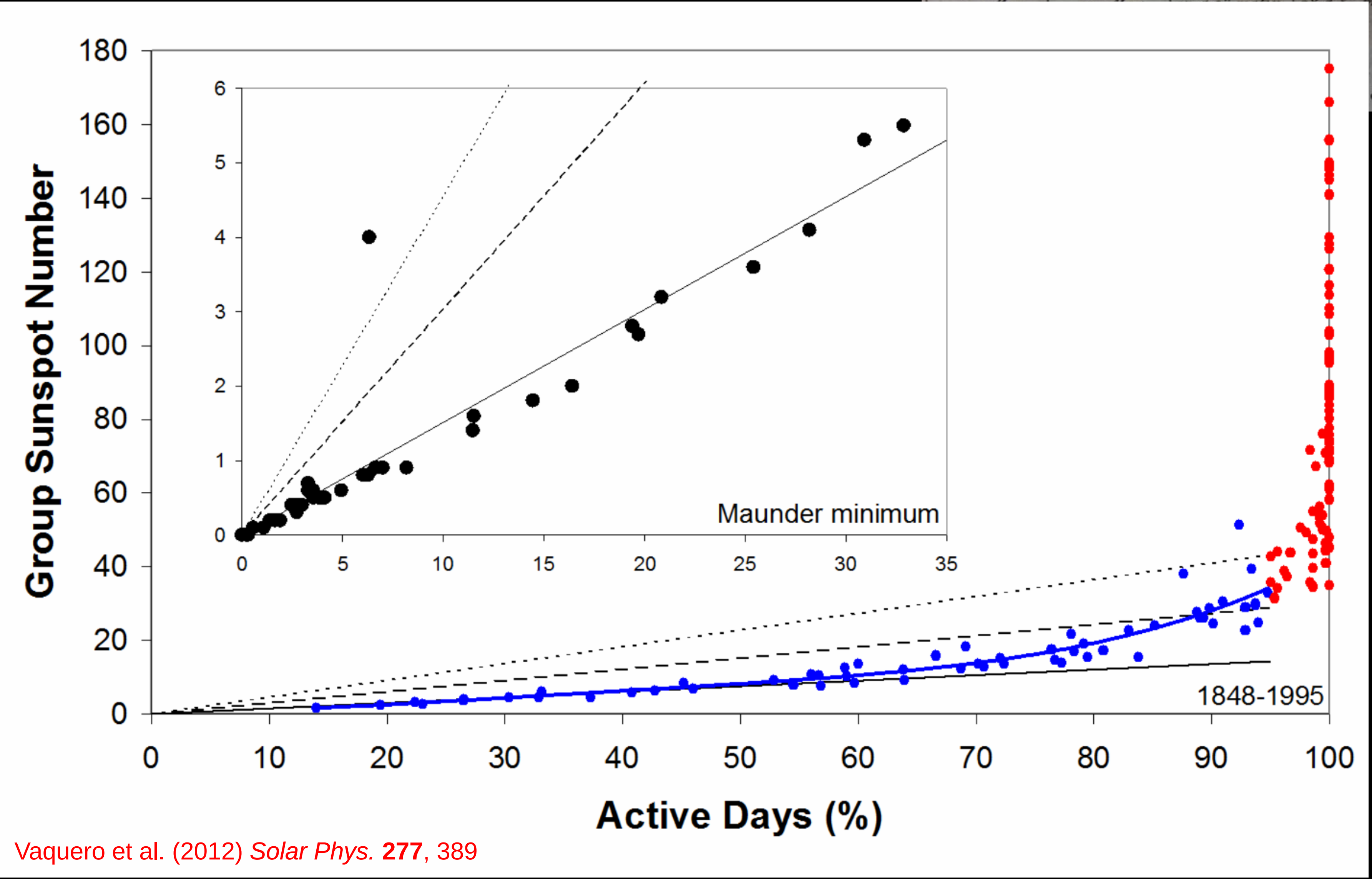
Von Herrn Hofrath *Schwabe* in Dessau.

Die Witterung war in diesem Jahre so äufserst günstig, dafs ich die Sonne an 312 Tagen genau beobachten konnte, dennoch zählte ich nur 34 Gruppen Sonnenflecken, von denen die meisten aus einzelnen kleinen Flecken oder Punkten und wenige aus mehreren behoften Kernflecken bestanden. Zu diesen zahlreichern Gruppen gehörten vorzüglich drei, welche sich durch ihre Beständigkeit auszeichneten. Im Januar, Februar und März trat eine dieser Gruppen dreimal, im April, Mai und Juni eine andere viermal und im Juli, August und September eine dritte dreimal ein. Die zahlreichsten und gröfsten Flecken enthielt die zweite der genannten Gruppen; ihr westlichster und gröfster Flecken war bei den beiden ersten Vorübergängen mit unbewaffnetem Auge als ein feines Pünktchen kenntlich, indem er bei dem ersten Vorübergang am 30sten April 1′ 8″36 und bei dem zweiten am 31sten Mai 1′ 37″72 im gröfsten Durchmesser hatte.

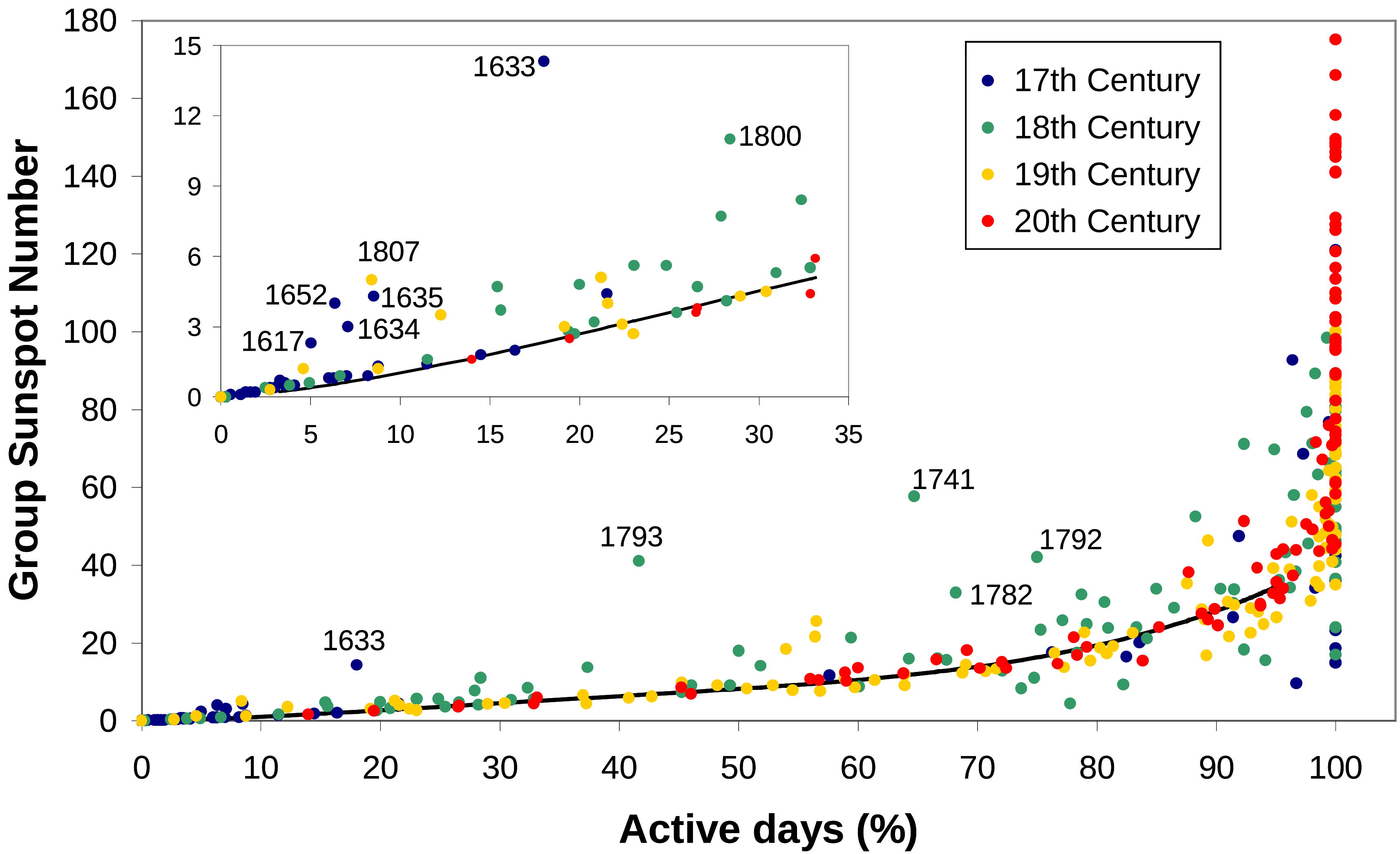
An 149 Tagen, die durch alle Monate ziemlich gleich vertheilt waren, bemerkte ich keine Flecken und nur selten einiges bedeutende Lichtgewölk; meistens war die Oberfläche der Sonne vollkommen gleichförmig hell und bei günstiger Luft zeigte sie sich wie mit feinem Griessande oder hellen Körnern bestreuet.

Schon aus meinen früheren Beobachtungen, die ich jährlich in dieser Zeitschrift mittheile, scheint sich eine gewisse Periodicität der Sonnenflecken zu ergeben und diese Wahrscheinlichkeit gewinnt durch die diesjährigen noch an Sicherheit. Obgleich ich schon in Band 15. Nr. 350 pag. 246 der Astr. Nachrichten die Menge der Gruppen in den Jahren 1826 bis 1837 angab, so füge ich doch hier noch ein vollständiges Verzeichnifs aller meiner bisher beobachteten Sonnenflecken bei, worin ich neben der Zahl der Gruppen auch die Zahl der Beobachtungstage und der fleckenfreien Tage angemerkt habe. Die Zahl der Gruppen allein giebt nämlich keine hinreichende Genauigkeit zur Beurtheilung einer Periode, weil ich mich überzeugt habe, dafs bei sehr starken Anhäufungen der Sonnenflecken eine etwas zu geringe bei dem sparsamen Erscheinen derselben eine etwas zu grofse Anzahl der Gruppen gerechnet wird. Im ersten Falle fliefsen oft mehrere Gruppen zu einer einzigen zusammen und im zweiten trennt sich leicht eine Gruppe, durch Auflösung einiger Flecken, in zwei einzelne. Hiermit wird wohl die Wiederholung des frühern Verzeichnisses entschuldigt sein.

Jahr.	Gruppen.	Fleckenfreie tage.	Beobachtungstage.
1826	118	22	277
1827	161	2	273
1828	225	0	282



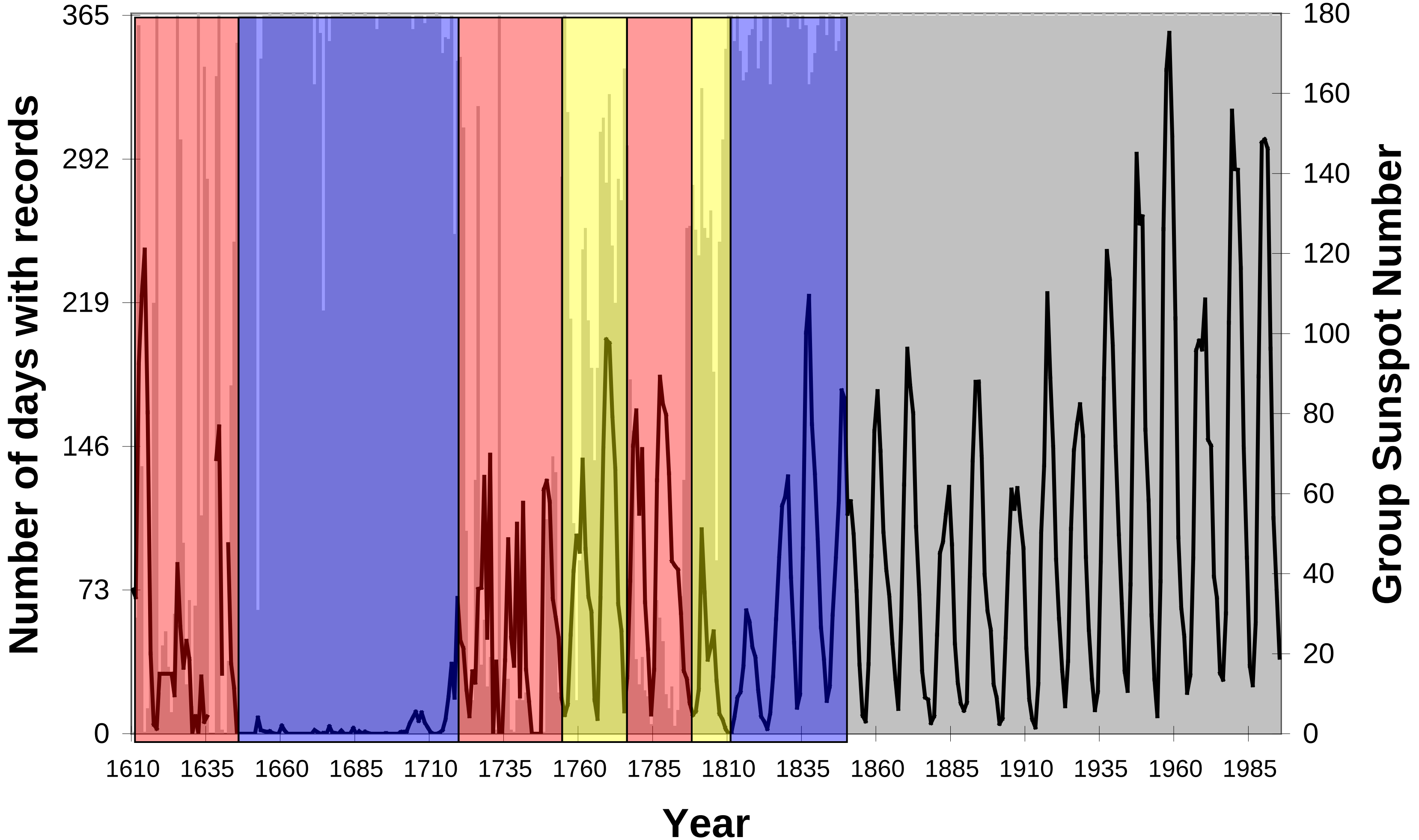
Relationship between GSN and AD for 1848–1995 from Hoyt & Schatten (1998). Polynomial fit (order 4) is shown for AD < 95% (blue line and points). Graphic inserted shows the same relationship during the Maunder minimum. Black lines represent the theoretical values for an average observer with 1 (continuous),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

3. Problems in historical records



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

3. Problems in historical records

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Advances in Space Research 40 (2007) 929–941
ADVANCES IN SPACE RESEARCH (a COSPAR publication)
www.elsevier.com/locate/asr

Historical sunspot observations: A review

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Abstract

Early observations of sunspots were made by the naked eye. We discuss here the possibilities to use these records to study the long-term change in the Sun. Other historical sunspot observations with camera obscura are also discussed. The best record of the behaviour of the Sun is available for the last four centuries thanks to the observations of sunspots with telescope. These observations allow us to know the number, position, and area of sunspots as well as some specific episodes like the Maunder Minimum, optical flares, etc. Rudolf Wolf developed the first reconstruction of solar activity in the 19th century. Another reconstruction was made by Hoyt and Schatten in 1998 which improves the database and uses a new methodological approach. Here we also discuss some mistakes, pending tasks and minor improvements related to sunspot observations.

Keywords: Historical sunspot observation; Solar activity reconstruction; Long-term change in the Sun

Calendar problems

Groups or sunspots?

Change of date

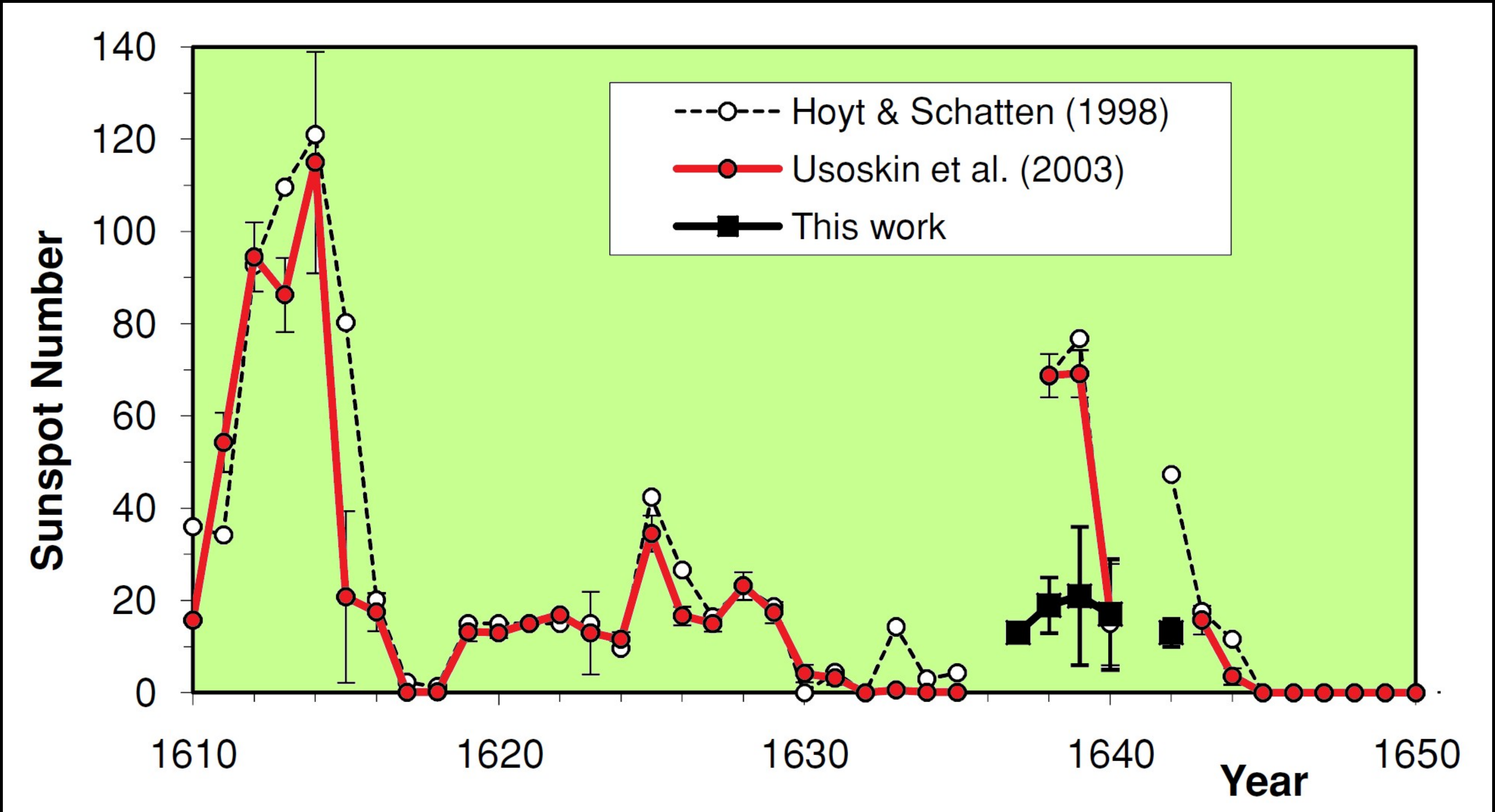
Partial information from eclipse reports

Tasks remaining after Hoyt and Schatten's work

- Lost original observations
- Lost daily data
- Observations not included in the database
- Observations too vague, ambiguous or narrative style
- Incomplete observations
- References need to be re-checked

3.1. Case studies (I) [published]:

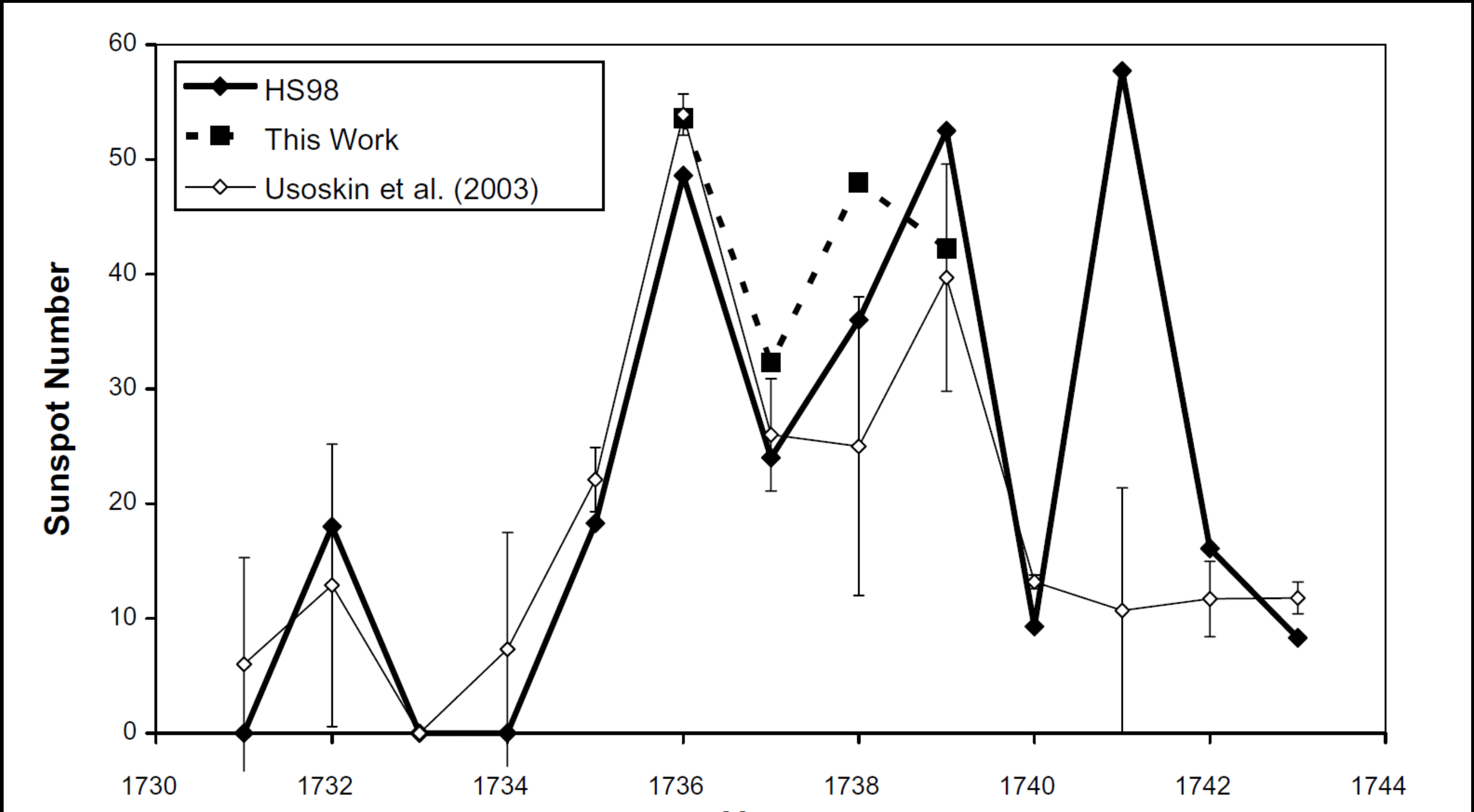
(a) Onset of Maunder Minimum



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

3.1. Case studies (I) [published]:

(b) Solar Cycle #-1



Vaquero et al. (2007) *Adv. Spa. Res.* **40**, 1895.

3.2. Case studies (II) [unpublished]: (a) 1652

73) Gren, Neues Journal der Physik.

Band 3 enthält einen Aufsatz von Murhard über Atmosphäre der Sonne, des Mondes, etc.

74) Johannis Hevelii Epistolæ II. Prior: De motu lunæ libratorio ad J. B. Ricciolum. Posterior: De utriusque Luminaris defectu A. 1654. ad P. Nucerium. Gedani 1654. fol. —

Er erzählt, dass bei der Sonnenfinsterniss am 12. August 1654 die Sonne ganz fleckenfrei gewesen sei.

75) Illustribus Viris, Petro Gassendo et Ismaeli Bullialdo, Johannis Hevelius.

Acht, »Gedani 1652 die 10. Julii, st. n.« datirte Folioseiten über die Sonnenfinsterniss vom 8. April 1652. Er erzählt, dass er am 1. April 5 Flecken, am 3. noch 2 gesehen habe, die aber am 6. in Fackeln degenerirt seien, so dass man am 7. und 8. April gar nichts in der Sonne gesehen habe.

76) Observationes Astronomicæ Annis 1781–1783 in Observatorio Havniensi. Auctore Thoma Bugge. Havniæ 1784. 4.

Enthält nichts über Sonnenflecken.

77) Observationes siderum habitæ Pisis Annis 1778—1782. Edit. Jos. Slop de Cadenberg. Pisis 1789. 4.

Enthält nichts über Sonnenflecken.

78. Francisci Blanchini Observationes Astronomicæ. Coll. Eustachii Manfredi. Veronæ 1737. 4.

Anno 1703 verfolgte er vom 20–29. Juni einen Flecken. 1707 April 2 spricht er von einem Flecken; Mai 5 und 6 sucht er wiederholt Merkur in der Sonne, aber sagt nichts von Flecken. 1708 Septemb. 11 und 12 beobachtet er einen Flecken. 1715 April 28 bis Mai 4 verfolgt er einen Flecken; Mai 30 sah er eine Fackel und am 31. zwei kleine Flecken bei derselben, die er auch am 1. Juni noch sah, während er am 2. wieder

NUMBER OF SUNSPOT GROUPS FOR THE YEAR: 1652
AS OBSERVED BY: HEVELIUS, J., DANZIG

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-99	-99	-99	5	-99	-99	-99	-99	-99	-99	0	-99
2	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	0	-99
3	-99	-99	-99	2	-99	-99	-99	-99	-99	-99	-99	-99
4	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	0	-99
5	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
6	-99	-99	-99	0	-99	-99	-99	-99	-99	-99	-99	0
7	-99	-99	-99	0	-99	-99	-99	-99	-99	-99	-99	0
8	-99	-99	-99	0	-99	-99	-99	-99	-99	-99	-99	-99
9	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
10	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
11	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
12	-99	-99	-99	-99	-99	-99	-99	-99	-99	0	-99	-99
13	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
14	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
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22	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
23	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
24	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
25	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
26	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	0	-99
27	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	0
28	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
29	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
30	-99	-99	-99	-99	-99	-99	-99	-99	-99	0	0	-99
31	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
means:	-9.0	-9.0	-9.0	1.4	-9.0	-9.0	-9.0	-9.0	-9.0	0.0	0.0	0.0

3.2. Case studies (II) [unpublished]: (a) 1652

2nd Sunspot Workshop

Brussels, 21-25 May 2012

Illuſtribus Viris,

PETRO GASSENDO,

&

ISMAELI BULLIALDO,

Philoſophis ac Mathematicis noſtri ſeculi ſummis, amicis ſuis officioſè honorandis,

JOHANNES HEVELIUS

S.

VOs tot tantoſq; inter Martis adverſos tumultus, quibus Gallia Veſtra iam ab aliquot annis acerbisſimè affligi-

Atq; ita reſtat ampliùs nihil, niſi quòd admonendum inſuper cenſeo, durante hac Eclipſi, ut & totâ eà die, nihil prorſus in Sole macularum apparuisſe; quanquam die 1. Aprilis, horâ 11. 45′. in diſco Solis quinq; viſæ fuerint maculæ: duæ quidem debilisſimæ non procul à limbo orientali, dilutioribus concomitantibus faculis umbriſq; ; tres autem ſatis denſæ, circa centrum, in latitudine Boreali. Ex quibus poſterioribus die 3. Aprilis tantùm duæ conſpectæ, quæ die ſextâ in faculas penitus degeneravére; reliquæ verò duæ debiliores, die 7. omnino etiam ſunt exſtinctæ.

Sed & deniq;, ut hac de noſtrâ quali quali obſervatione quilibet eò certior eſſe poſſit, ſubjungam ſimul adhuc geminam ejuſdem Eclipſeos annotationem, hic item Gedani, alteram ab Excellentiſſimo, & Præclariſſimo viro D. L. Eichſtadio, amico noſtro ſingulari; alteram

Atq; ita reſtat ampliùs nihil, niſi quòd admonendum inſuper cenſeo, durante hac Eclipſi, ut & totâ eà die, nihil prorſus in Sole macularum apparuisſe; quanquam die 1. Aprilis, horâ 11. 45′. in diſco Solis quinq; viſæ fuerint maculæ: duæ quidem debilisſimæ non procul à limbo orientali, dilutioribus concomitantibus faculis umbriſq; ; tres autem ſatis denſæ, circa centrum, in latitudine Boreali. Ex quibus poſterioribus die 3. Aprilis tantùm duæ conſpectæ, quæ die ſextâ in faculas penitus degeneravére; reliquæ verò duæ debiliores, die 7. omnino etiam ſunt exſtinctæ.

3.2. Case studies (II) [unpublished]: (b) 1741

NUMBER OF SUNSPOT GROUPS FOR THE YEAR: 1741
AS OBSERVED BY: MUSANO, M., VENICE

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
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3	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
4	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
5	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
6	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
7	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
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11	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
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28	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	0
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30	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	1
31	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	1
means:	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	0.6

NUMBER OF SUNSPOT GROUPS FOR THE YEAR: 1741
AS OBSERVED BY: WINTHROP, J., CAMBRIDGE, MA

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3	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
4	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
5	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
6	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
7	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
8	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
9	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
10	7	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
11	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
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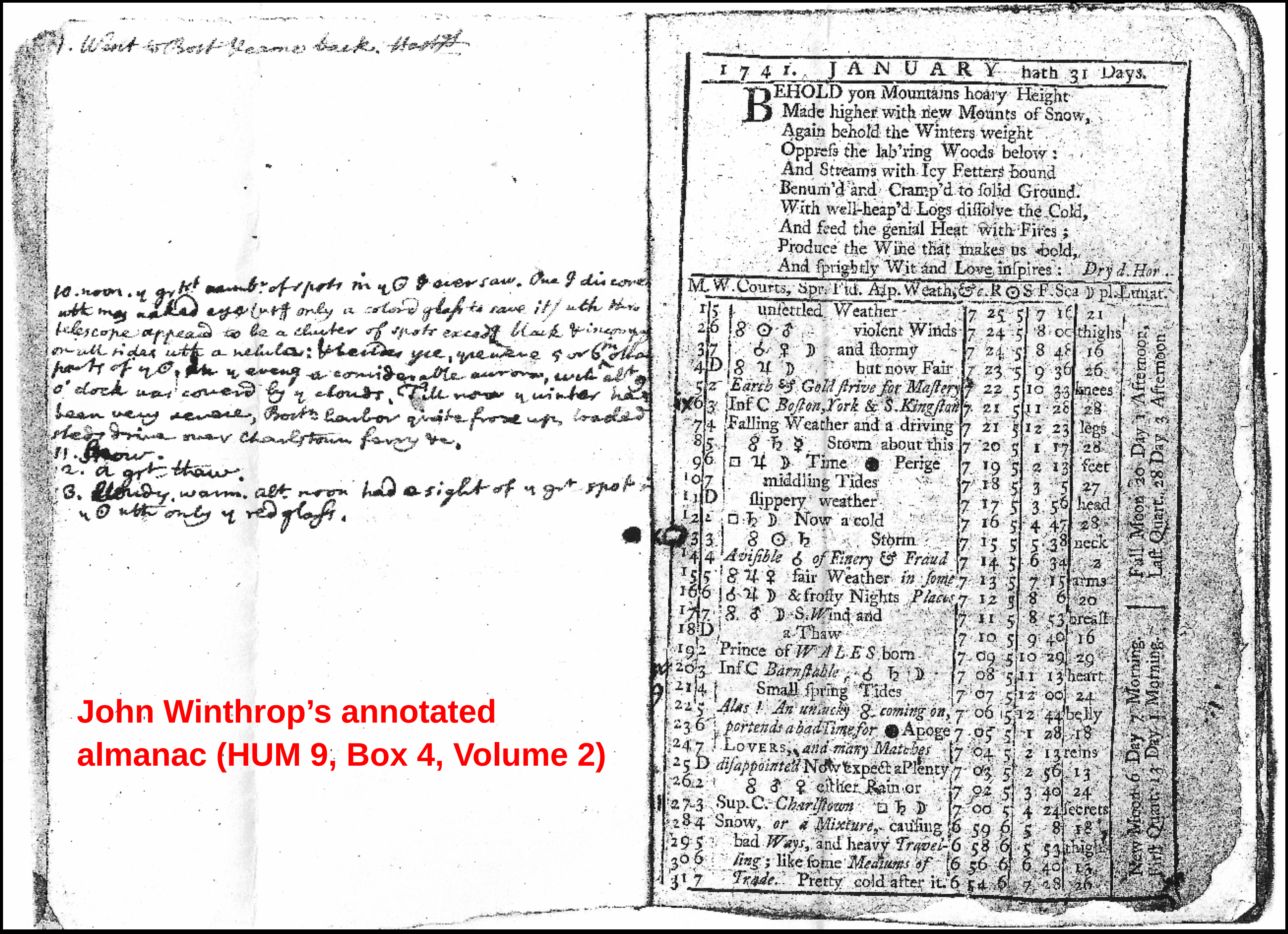
31	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
means:	7.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0

3.2. Case studies (II) [unpublished]: (b) 1741


1). Went to Bost. Came back. ...

10. noon. y^e grtst numb^r of spots in y^e ☉ I ever saw. One I discovered with my naked eye (w^th only a colord glass to save it) w^th the telescope appeard to be a cluster of spots exceedg black & incompassd on all sides with a nebulos: besides yse, y^re were 5 or 6 in other parts of y^e ☉. In y^e eveng a considerable aurora, wch ab^t 9 o'clock was coverd by y^e clouds. Till now y^e winter has been very severe, Bost^n harbor quite froze up, loaded sleds drive over Charlstown ferry &c.
11. Snow.
12. A grt thaw.
13. Cloudy. warm. ab^t noon had a sight of y^e grt spot in y^e ☉ with only y^e red glass.

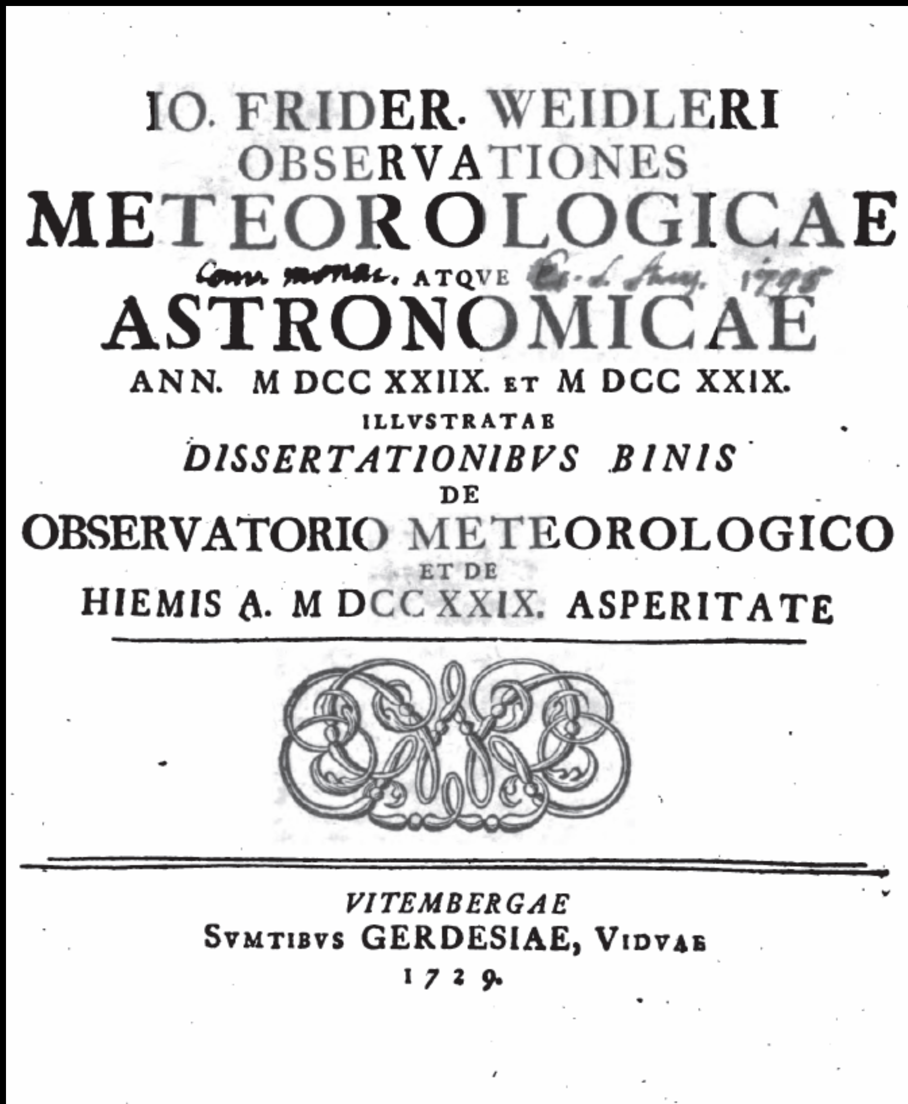
1741. JANUARY hath 31 Days.

BEHOLD yon Mountains hoary Height
Made higher with new Mounts of Snow,
Again behold the Winters weight
Oppress the lab'ring Woods below:
And Streams with Icy Fetters bound
Benum'd and Cramp'd to solid Ground.
With well-heap'd Logs dissolve the Cold,
And feed the genial Heat with Fires;
Produce the Wine that makes us bold,
And sprightly Wit and Love inspires: *Dryd. Hor.*

M.	W.	Courts, Spr. Tid. Asp. Weath, &c.	R ☉ S			F. Sea		☽ pl.	Lunat.
1	5	unsettled Weather	7	25	5	7	16	21	
2	6	☍ ☉ ♂ violent Winds	7	24	5	8	00	thighs	
3	7	☌ ♀ ☽ and stormy	7	24	5	8	48	16	
4	D	☍ ♃ ☽ but now Fair	7	23	5	9	36	26	
5	2	*Earth & Gold strive for Mastery*	7	22	5	10	33	knees	
6	3	Inf C *Boston, York & S. Kingstan*	7	21	5	11	28	28	New Moon 6 Day 7 Morning.
7	4	Falling Weather and a driving	7	21	5	12	23	legs	
8	5	☍ ♄ ☿ Storm about this	7	20	5	1	17	28	
9	6	□ ♃ ☽ Time ● Perige	7	19	5	2	13	feet	
10	7	middling Tides	7	18	5	3	5	27	
11	D	slippery weather	7	17	5	3	56	head	
12	2	□ ♄ ☽ Now a cold	7	16	5	4	47	28	
13	3	☍ ☉ ♄ Storm	7	15	5	5	38	neck	First Quart. 13 Day 1 Morning.
14	4	*A visible* ☌ *of Finery & Fraud*	7	14	5	6	34	2	
15	5	☍ ♃ ♀ fair Weather *in some*	7	13	5	7	15	arms	
16	6	☌ ♃ ☽ & frosty Nights *Places*	7	12	5	8	6	20	
17	7	☍ ♂ ☽ S. *Wind* and	7	11	5	8	53	breast	
18	D	a Thaw	7	10	5	9	40	16	
19	2	Prince of *WALES* born	7	09	5	10	29	29	
20	3	Inf C *Barnstable* ☌ ♄ ☽	7	08	5	11	13	heart	
21	4	Small spring Tides	7	07	5	12	00	24	
22	5	*Alas! An unlucky* ☍ *coming on,*	7	06	5	12	44	belly	
23	6	*portends a bad Time for* ● Apoge	7	05	5	1	28	18	
24	7	LOVERS, *and many Matches*	7	04	5	2	13	reins	
25	D	*disappointed* Now expect a Plenty	7	03	5	2	56	13	
26	2	☍ ♂ ♀ either Rain or	7	02	5	3	40	24	
27	3	Sup. C. *Charlstown* □ ♄ ☽	7	00	5	4	24	secrets	
28	4	Snow, *or a Mixture,* causing	6	59	6	5	8	18	Last Quart. 28 Day 3 Afternoon.
29	5	bad *Ways*, and heavy *Travel-*	6	58	6	5	53	thighs	
30	6	*ling*; like some *Mediums of*	6	56	6	6	40	13	Full Moon 30 Day 1 Afternoon.
31	7	*Trade.* Pretty cold after it.	6	54	6	7	28	26	

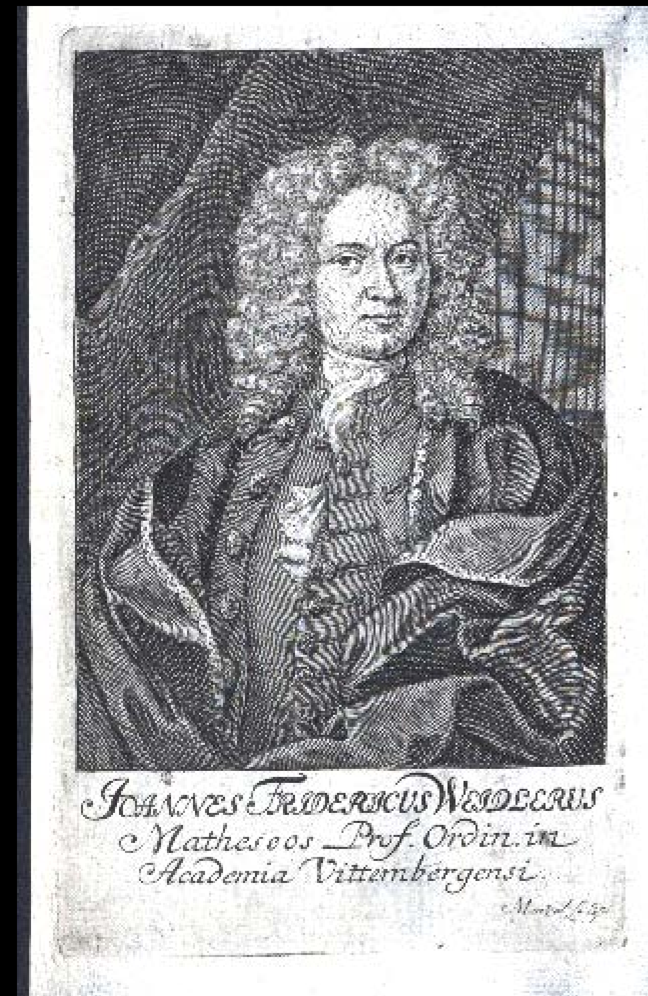
John Winthrop's annotated almanac (HUM 9, Box 4, Volume 2)

3.2. Case studies (II) [unpublished]: (c) Weidler revisited



IO. FRIDER. WEIDLERI
OBSERVATIONES
METEOROLOGICAE
ATQVE
ASTRONOMICAE
ANN. M DCC XXIIX. ET M DCC XXIX.
ILLVSTRATAE
DISSERTATIONIBVS BINIS
DE
OBSERVATORIO METEOROLOGICO
ET DE
HIEMIS A. M DCC XXIX. ASPERITATE

VITEMBERGAE
SVMTIBVS GERDESIAE, VIDVAE
1729.



Johann Friedrich Weidler (1691- 1755)

NUMBER OF SUNSPOT GROUPS FOR THE YEAR: 1728
AS OBSERVED BY: WEIDLER, J.F., WITTENBERG

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
2	-99	-99	-99	2	-99	-99	-99	-99	-99	-99	-99	-99
3	-99	-99	-99	-99	7	-99	-99	-99	-99	-99	-99	-99
4	-99	-99	-99	4	-99	-99	-99	-99	-99	-99	-99	-99
5	-99	-99	-99	7	-99	-99	-99	-99	-99	-99	-99	-99
6	-99	-99	-99	-99	-99	-99	2	-99	-99	-99	-99	-99
7	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
8	-99	-99	-99	-99	5	-99	-99	-99	-99	-99	-99	-99
9	-99	-99	-99	-99	-99	-99	7	-99	-99	-99	-99	-99
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12	-99	-99	-99	-99	10	-99	-99	-99	-99	-99	-99	-99
13	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
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24	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	9	-99
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26	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
27	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
28	-99	-99	-99	-99	-99	2	-99	-99	3	-99	-99	-99
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30	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
31	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
means:	-9.0	-9.0	-9.0	7.3	7.0	3.8	4.5	-9.0	2.5	-9.0	9.0	-9.0

44 OBSERVATIONES

1728 Iulius St. N. D. H.	Barom. alt. Dig. Lin.	Therm. alt. Gr.	Vent.	Tempestas.	Pluuia Cub. Lin
29. 6	27. 5	33	W.N.W.o	pluit lente - -	4. 18
				continuat pluu. ad h. 11. - -	5. 14
12	- $5\frac{3}{4}$	$33\frac{1}{2}$	S. W. 1	calignosum. pluit - -	9. 9
8	- 6	$34\frac{1}{4}$	S. o.	nubes tenues sparsae pluu.	- 4
30. 6	- 7	44	S. W. 3	serenum albae nub. passim pluu. noct	- 9
12		$32\frac{1}{2}$		idem. pluit h. 6. p. m.	- 9
8	- $8\frac{1}{4}$	$31\frac{3}{4}$	W.N.W.1	nubilosum pluit - -	- 8
31. 6	- 8	45	S. W. 1	sparsae nubes albae pluu. noct.	- 3
				pluu. h. 8. a. m. - -	- 2
				maculae 7. sub ☉ maxima $\frac{1}{20}$ diam. solis par. stipata utrimque paruis quatuor, quae totum tractum cui incumbebant obscurum reddere, et unam maculam referre uidebantur.	
12	- $7\frac{3}{4}$	$31\frac{1}{2}$		nubilosum.	
8		33	S. W. 2	idem.	
				Pluuia M. Iulii.	77.20
				Nota	
				1. altit. max. ☿ 27. 9. d. 6.	
				2. altit. min. ei. 27. 2. d. 28.	
				3. altit. max. therm. 11. d. 1.	
				4. altit. minim. ei. 48. d. 18.	
				M. Augustus. 1728.	
1. 6	- $7\frac{1}{2}$	47	S. W. o	nubilosum. pluu. noct.	8
12		$30\frac{1}{2}$	S. W. 1	albae nubes sparsae. pluu. h. 9.	- 10
8	- 7	26		nubilosum.	
2. 6	- 6	$37\frac{1}{4}$	O. o	idem. pluit noctu - -	24. 7
				iterum h. 8. pluit. - -	9 -
12	- 5	28	S. W. o	caliginosum. tonat et pluit -	10 -
				denuo pluit p. m. h. 3.	13 -
				et h. 4.	- 9

3.2. Case studies (II) [unpublished]: (c) Weidler revisited

NUMBER OF SUNSPOT GROUPS FOR THE YEAR: 1728
AS OBSERVED BY: WEIDLER, J.F., WITTENBERG

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
2	-99	-99	-99	2	-99	-99	-99	-99	-99	-99	-99	-99
3	-99	-99	-99	-99	7	-99	-99	-99	-99	-99	-99	-99
4	-99	-99	-99	4	-99	-99	-99	-99	-99	-99	-99	-99
5	-99	-99	-99	7	-99	-99	-99	-99	-99	-99	-99	-99
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12	-99	-99	-99	-99	10	-99	-99	-99	-99	-99	-99	-99
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15	-99	-99	-99	-99	-99	3	-99	-99	-99	-99	-99	-99
16	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
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18	-99	-99	-99	11	-99	-99	4	-99	-99	-99	-99	-99
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21	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
22	-99	-99	-99	6	-99	8	-99	-99	-99	-99	-99	-99
23	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
24	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	9	-99
25	-99	-99	-99	8	-99	-99	-99	-99	-99	-99	-99	-99
26	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
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30	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
31	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
means:	-9.0	-9.0	-9.0	7.3	7.0	3.8	4.5	-9.0	2.5	-9.0	9.0	-9.0

METEOROLOGICAE. 45

1728 August. St. N. D. H.	Barom. alt. Dig. Lin.	Therm. alt. Gr.	Vent.	Tempestas.	Pluuia Cub.Lin.
8	- 6½	43	N. W. 3	caliginosum.	
3. 6	- 7	49		serenum pluu. noct.	- 9
12	- 7¾	40½	N. W. 2	nubilosum. pluit h. 11. et 12 hor. 3. et 5.	2. 14 / 7. 5
8	- 8	46	W. 2	nubilosum.	
4 6	- 7½	49	S. W. 3	idem. pluit noctu	- 4
12	- 7	40¾	N. W. 2	idem. pluit - -	1. 16
8		36½	N. W. 1	idem	
5. 6	- 8	40½	S. W. 2	pluit -	5 7
12	- 7½	32¼	S. W. 1.	caliginosum.	
8		31	S. W. 2	idem. pluit. h. 7. - -	- 10
6. 6	- 7½	34¾	S. W. 0	caliginosum. pluu. noct.	1. 20
12	- 7	23¾	S. W. 1	nubilosum.	
8	- 5	19¾		albae nubes sparsae.	
7. 6	- 6½	33¼	W. S. W. 2	caliginosum. pluit	- 5
12	- 7	27	W. S. W. 1	idem pluit h. 1.	1. 17
8		30½	W. 2	idem pluit h. 8.	6 -
8. 6	- 7½	43	S. 0	albae nubes sparsae.	
12	- 6½	26¼	S. 1	idem c.	
8		20	S. 2	caliginosum. pluit h. 10. uesp.	21 -
9 6	- 7	40¼	S. W. 1	nubilosum.	
12	- 7½	35	N. N. W. 2	serenum.	
8	- 8¼	30¾	N. W. 0	idem. pluit p. m.	- 15
10. 6	- 7	44	S. O. 0	albae nubes sparsae.	
12	- 7	[illegible]		idem.	
8	- 9	18¾	N. O. 1	serenum	
11. 6	- 7½	37	W. S. W. 1	pluit lente - - -	2 -
12	- 8	30¼	W. S. W. 1	caliginosum.	
8	- 9	33	S. W. 0	idem.	
12. 6	- 11	46¾	S. S. W. 1	serenum. duae magnae maculae in sole spectatae quaeuis 3' diam. solis.	

3.2. Case studies (II) [unpublished]: (c) Weidler revisited

NUMBER OF SUNSPOT GROUPS FOR THE YEAR: 1728
AS OBSERVED BY: WEIDLER, J.F., WITTENBERG

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
2	-99	-99	-99	2	-99	-99	-99	-99	-99	-99	-99	-99
3	-99	-99	-99	-99	7	-99	-99	-99	-99	-99	-99	-99
4	-99	-99	-99	4	-99	-99	-99	-99	-99	-99	-99	-99
5	-99	-99	-99	7	-99	-99	-99	-99	-99	-99	-99	-99
6	-99	-99	-99	-99	-99	-99	2	-99	-99	-99	-99	-99
7	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
8	-99	-99	-99	-99	5	-99	-99	-99	-99	-99	-99	-99
9	-99	-99	-99	-99	-99	-99	7	-99	-99	-99	-99	-99
10	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
11	-99	-99	-99	-99	-99	2	-99	-99	-99	-99	-99	-99
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15	-99	-99	-99	-99	-99	3	-99	-99	-99	-99	-99	-99
16	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
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21	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
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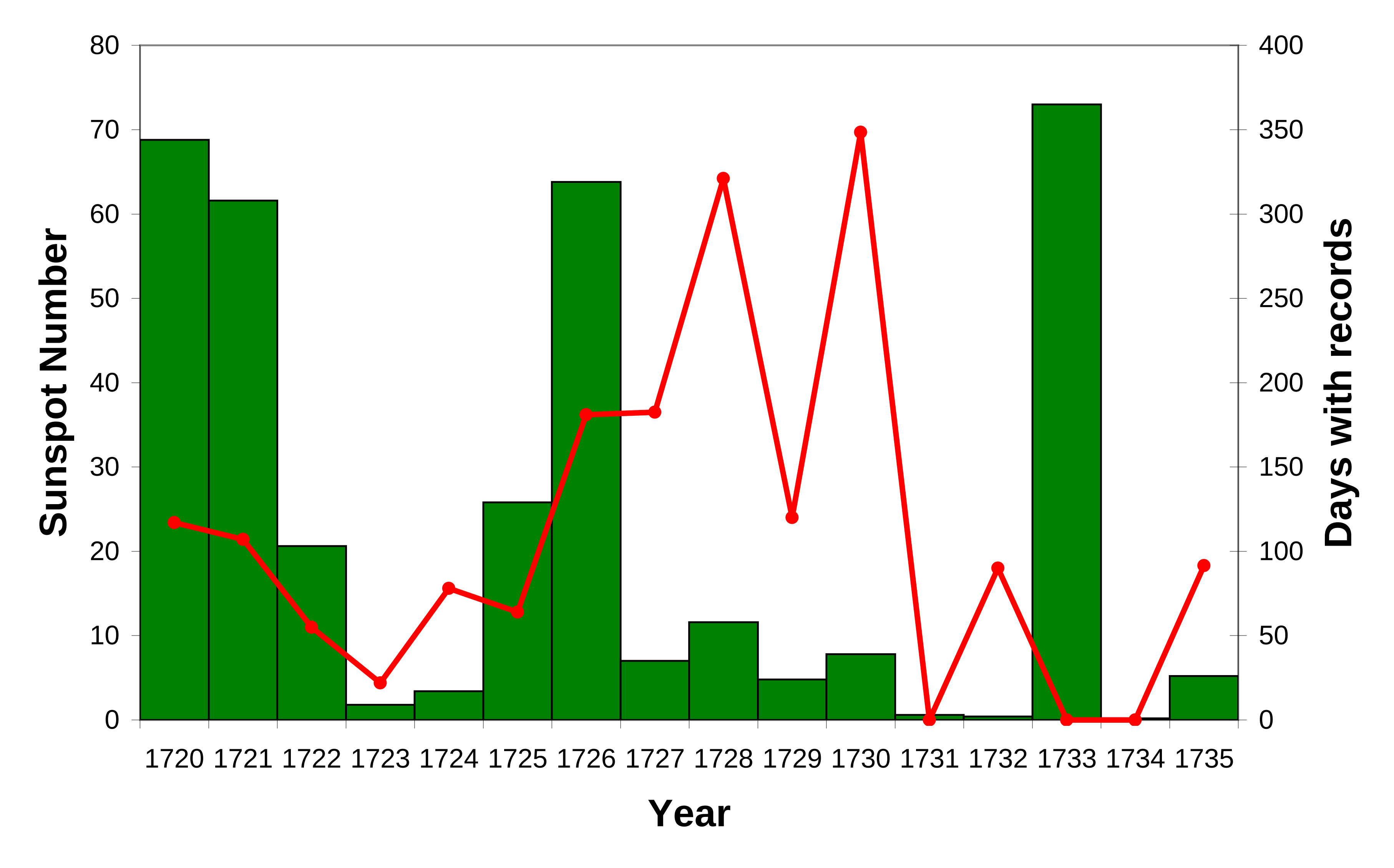
24	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	9	-99
25	-99	-99	-99	8	-99	-99	-99	-99	-99	-99	-99	-99
26	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
27	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
28	-99	-99	-99	-99	-99	2	-99	-99	3	-99	-99	-99
29	-99	-99	-99	13	-99	-99	-99	-99	-99	-99	-99	-99
30	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
31	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
means:	-9.0	-9.0	-9.0	7.3	7.0	3.8	4.5	-9.0	2.5	-9.0	9.0	-9.0

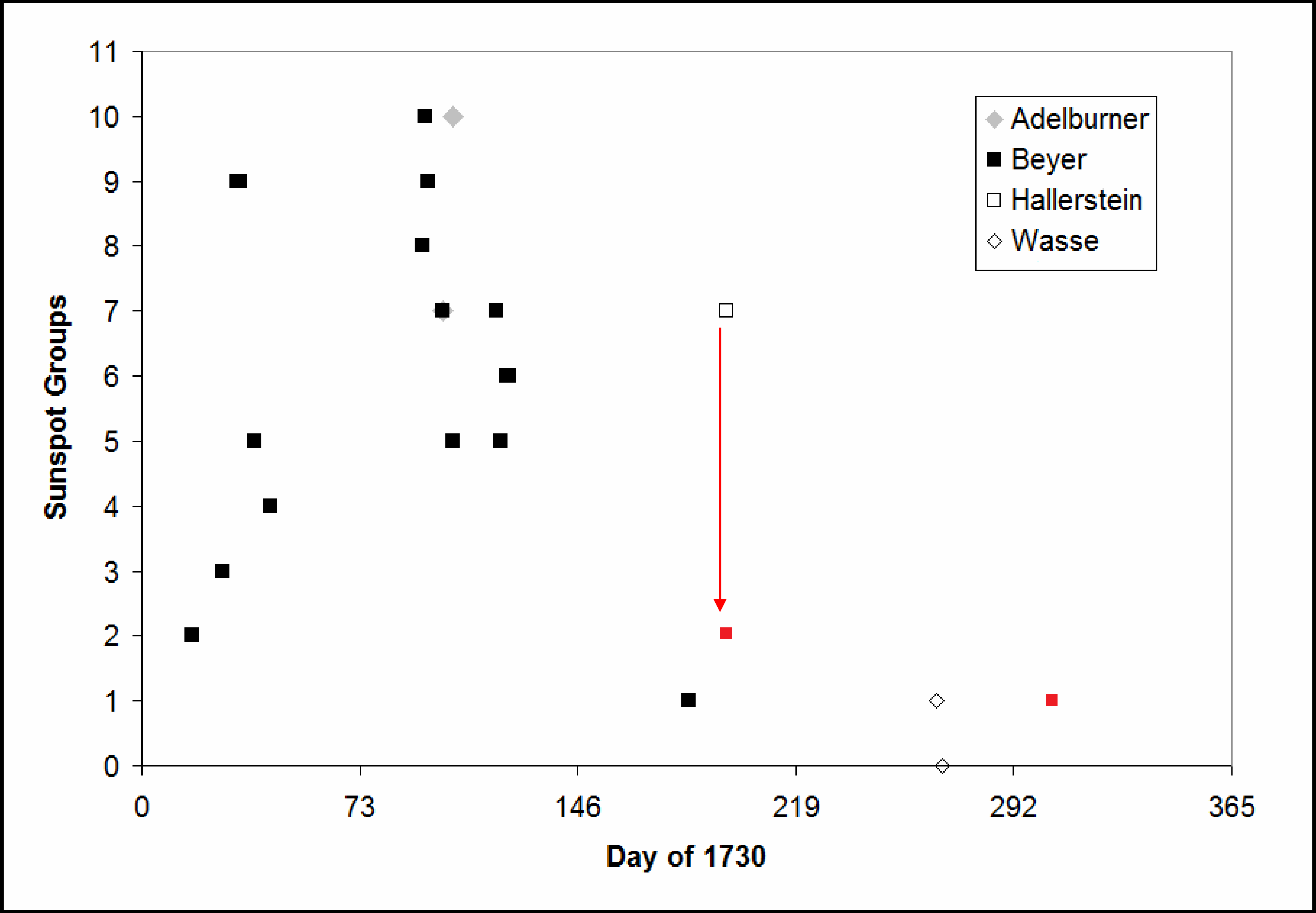
46 OBSERVATIONES

1728 August. St. N. D. H.	Barom. alt. Dig. Lin.	Therm. alt. Gr.	Vent.	Tempeſtas	Pluuia Cub. Lin.
12	- 10¾	28	S. W. 3	albae nubes ſparſae.	
8	11	25¼	W.N.W. 1	nubiloſum	
13. 6		36	S. W 0	caliginoſum.	
12		23	N. W. 1	ſerenum.	
				id. nubes uerſus occaſum.	
8	- 11½	21			
14. 6	28 0	39	N. W. 0	ſerenum.	
12		23¾		idem albae nubes paſſim.	
8		23	N. O. 1	idem.	
15. 6	27. 11¼	26¾	N. O. 2	caliginoſum. macula una ex iis quae apparuere d. 12. iam magnitudine ſic creuit, ut 1/25 diam. ſolis caperet.	
12	- 10½	21¼	S. O. 1	ſerenum.	
8	- 10	16½		idem	
16. 6	- 9	37¼	N.W. 1	id.	
12	- 8½	23	S. 1	id.	
8	- 7	16	S. 0	idem, atrae nubes uerſus occaſum.	
17 6					
12		32	S. W. 2	nubiloſum.	
12	- 6¾	24	S. W. 1	pluit.	
8	- 6	20	S. W. 3	iterum pluit - -	4. 10
18 6	- 6	47	S. W. 4	ſerenum.	
12	7	40¼	W. 3	nubiloſum pluit h. 1. et 2.	4. 1
				pluit h. 6.	- 21
7	7½	44¼	W. S. W. 3	nubes ſparſae	
19 6	8½	52	W.N.W. 2	ſerenum. albae nubes ſparſae.	
12	9	42¼	W.N.W. 3	nubes ſparſae. pluit p. m.	3. 1
7	-	-	W. 1	calignoſum. pluit. h. 7.	
20 6	10½	55	W. 2	nubiloſum. pluu. noct. -	- 20
12		44	N. W. 1	idem	
7	10¾	41¼	W. 2	nubiloſum. pluit h. 5.	- 14
6	10	49	W.S.W. 0	pluit leniter -	5 -

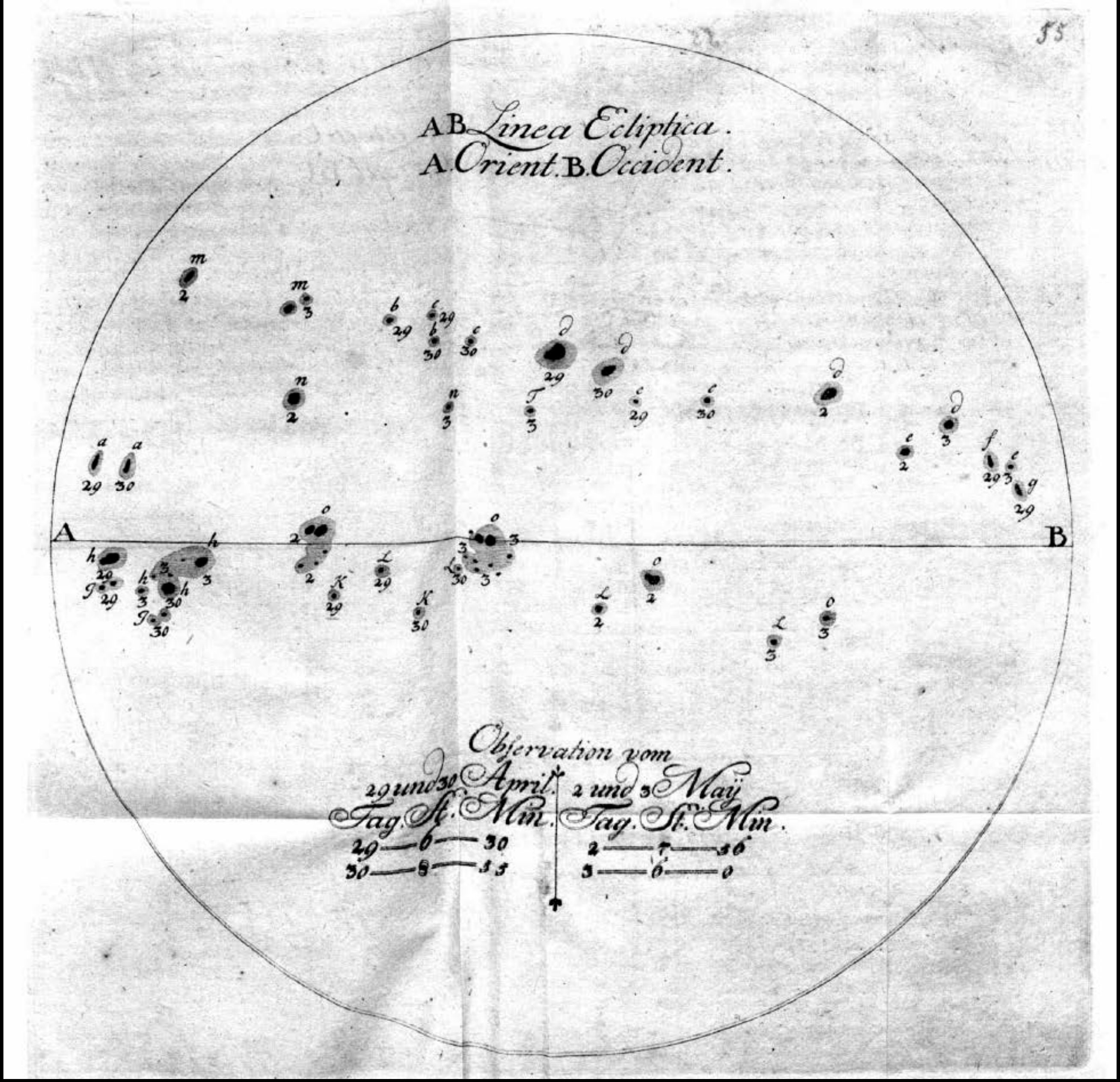
3.2. Case studies (II) [unpublished]: (d) Solar cycle #-2



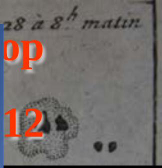

2nd Sunspot Workshop
Brussels, 21-25 May 2012


Sunspot Groups
Day of 1730
0
73
146
219
292
365
0
1
2
3
4
5
6
7
8
9
10
11
Adelburner
Beyer
Hallerstein
Wasse

3.2. Case studies (II) [unpublished]: (d) Solar cycle #-2

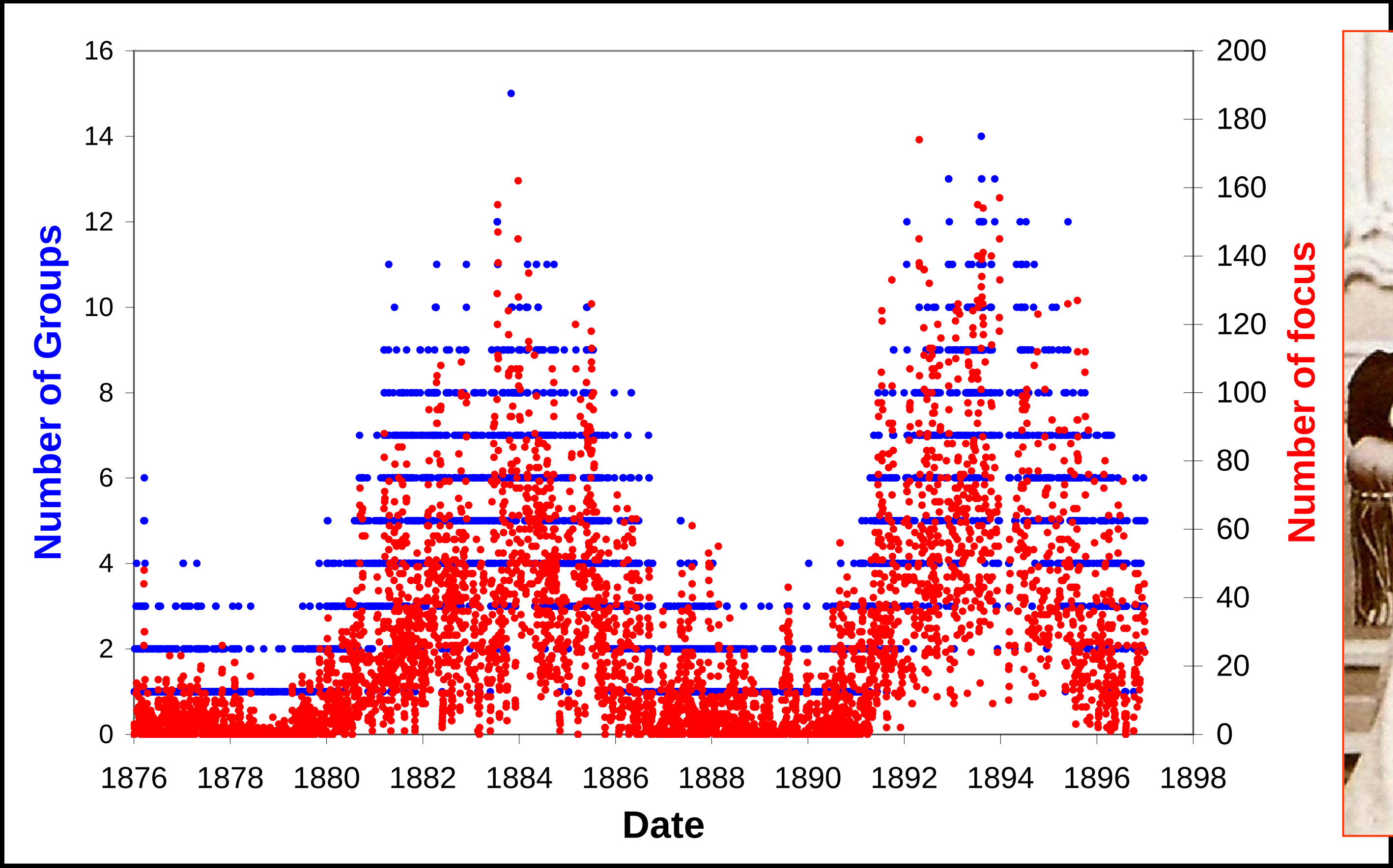


4. Recovering "new" old data



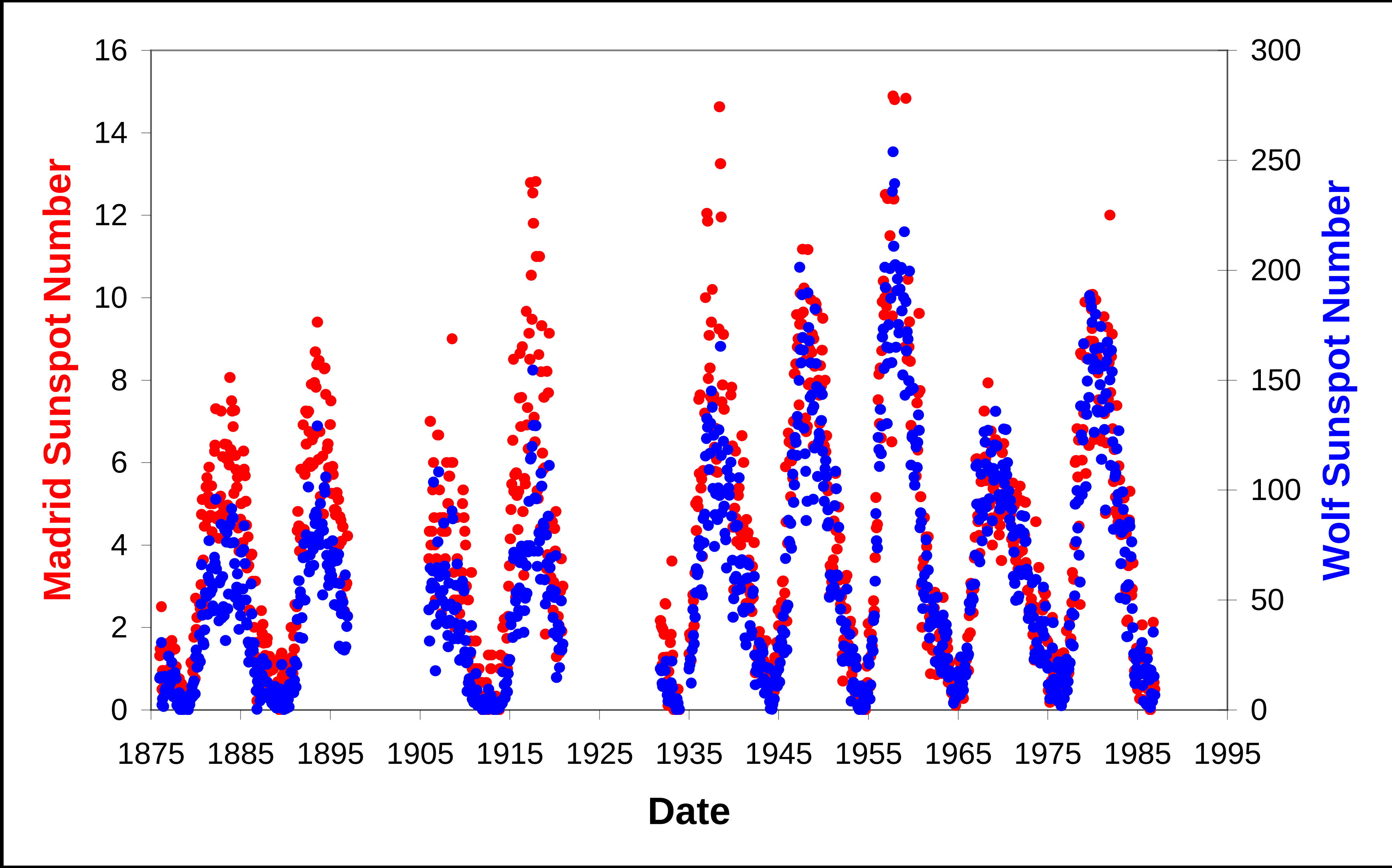
4.1. Sunspot number: Madrid Observatory, Spain

Drawings are lost!!!



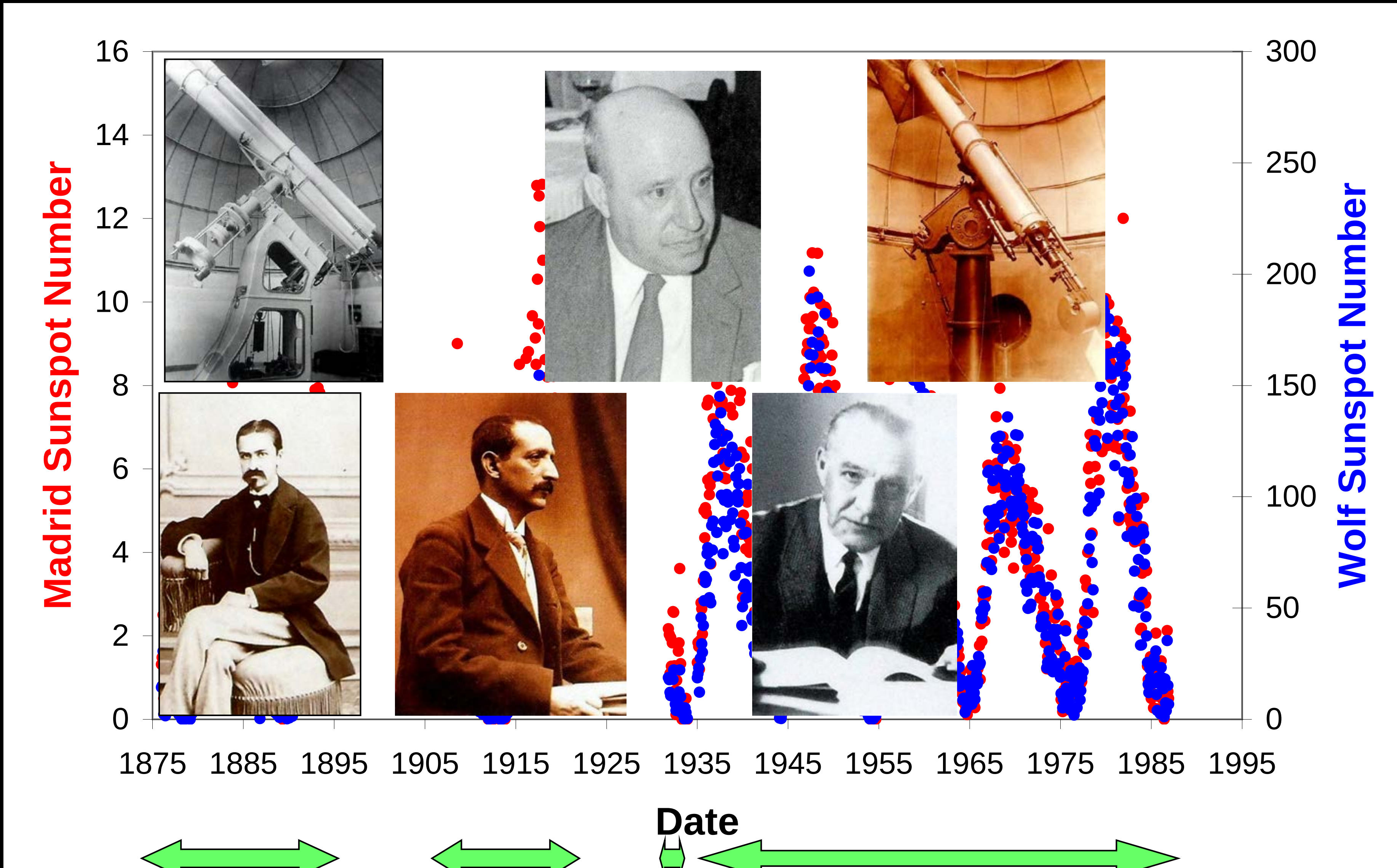
4. Recovering "new" old data

4.1. Sunspot number: Madrid Observatory, Spain



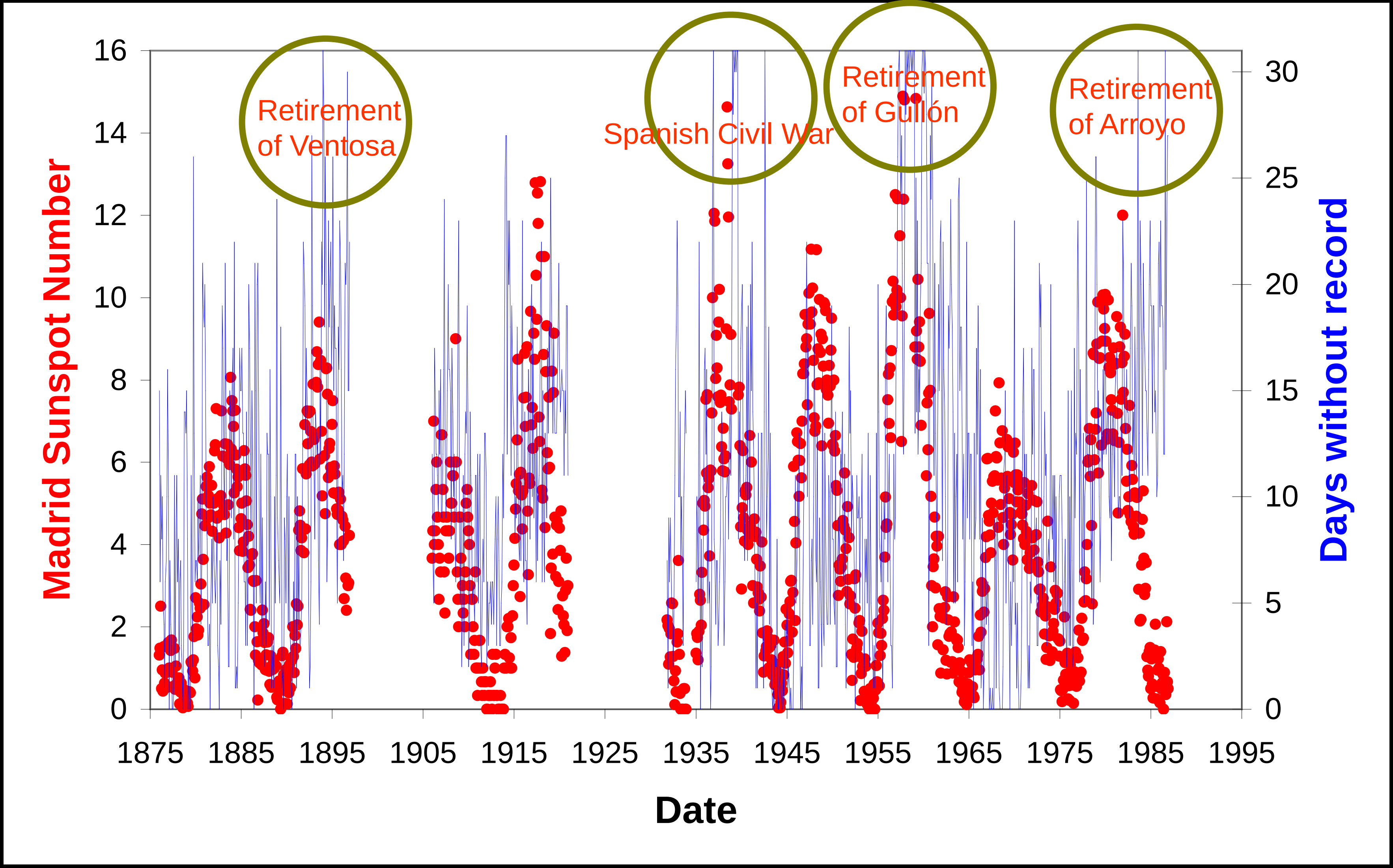
4. Recovering "new" old data

4.1. Sunspot number: Madrid Observatory, Spain

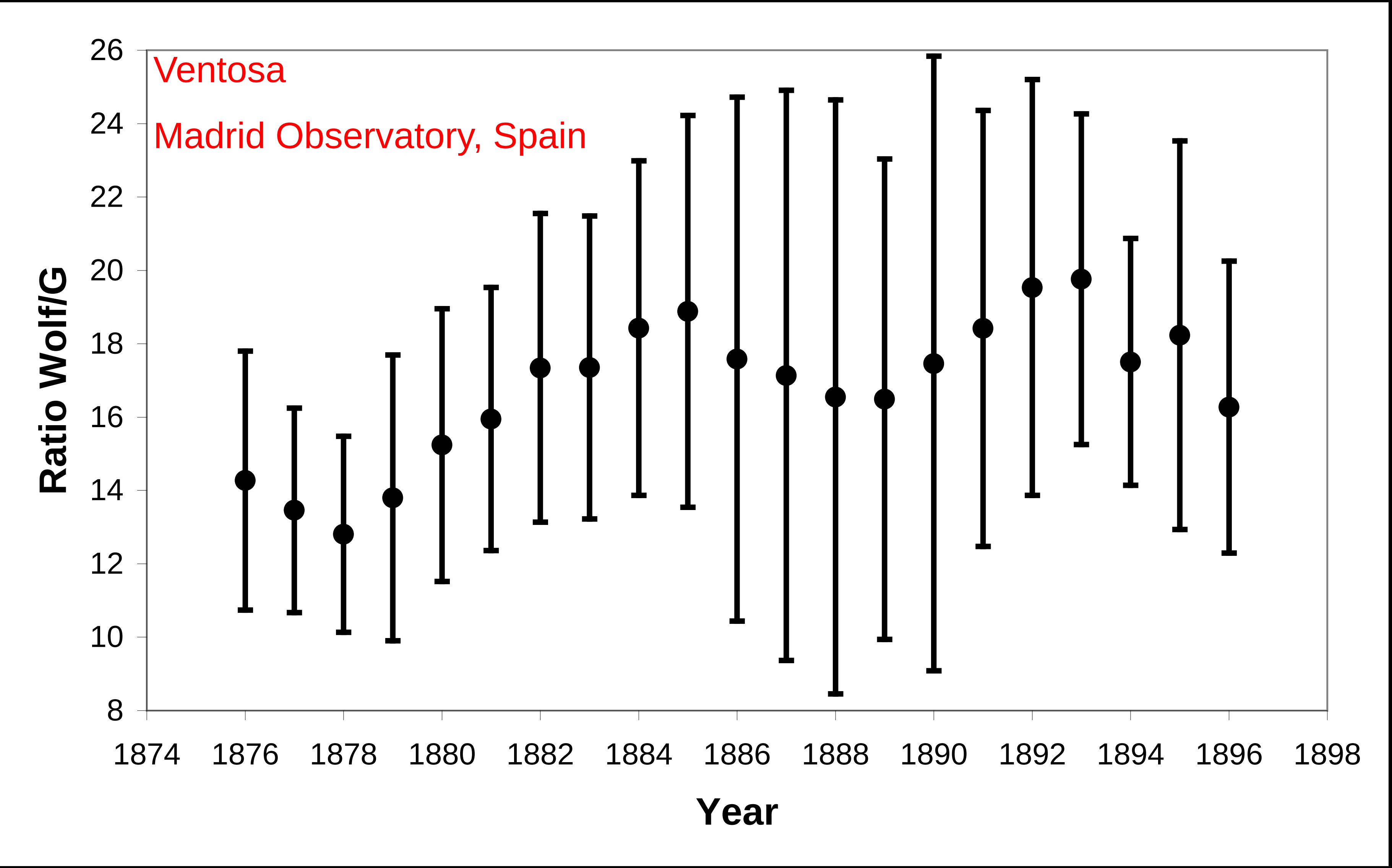


4. Recovering "new" old data

4.1. Sunspot number: Madrid Observatory, Spain

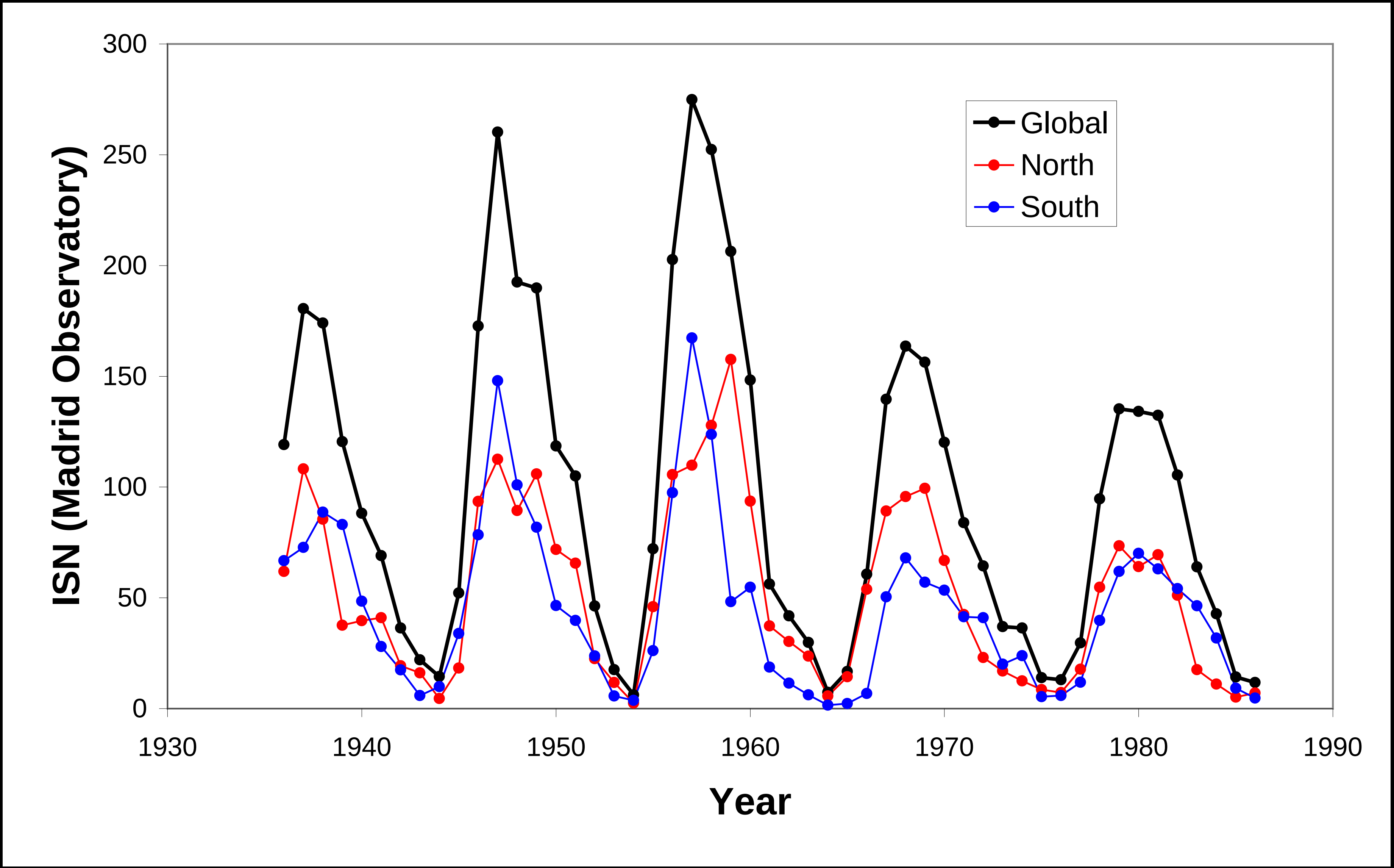


4. Recovering "new" old data



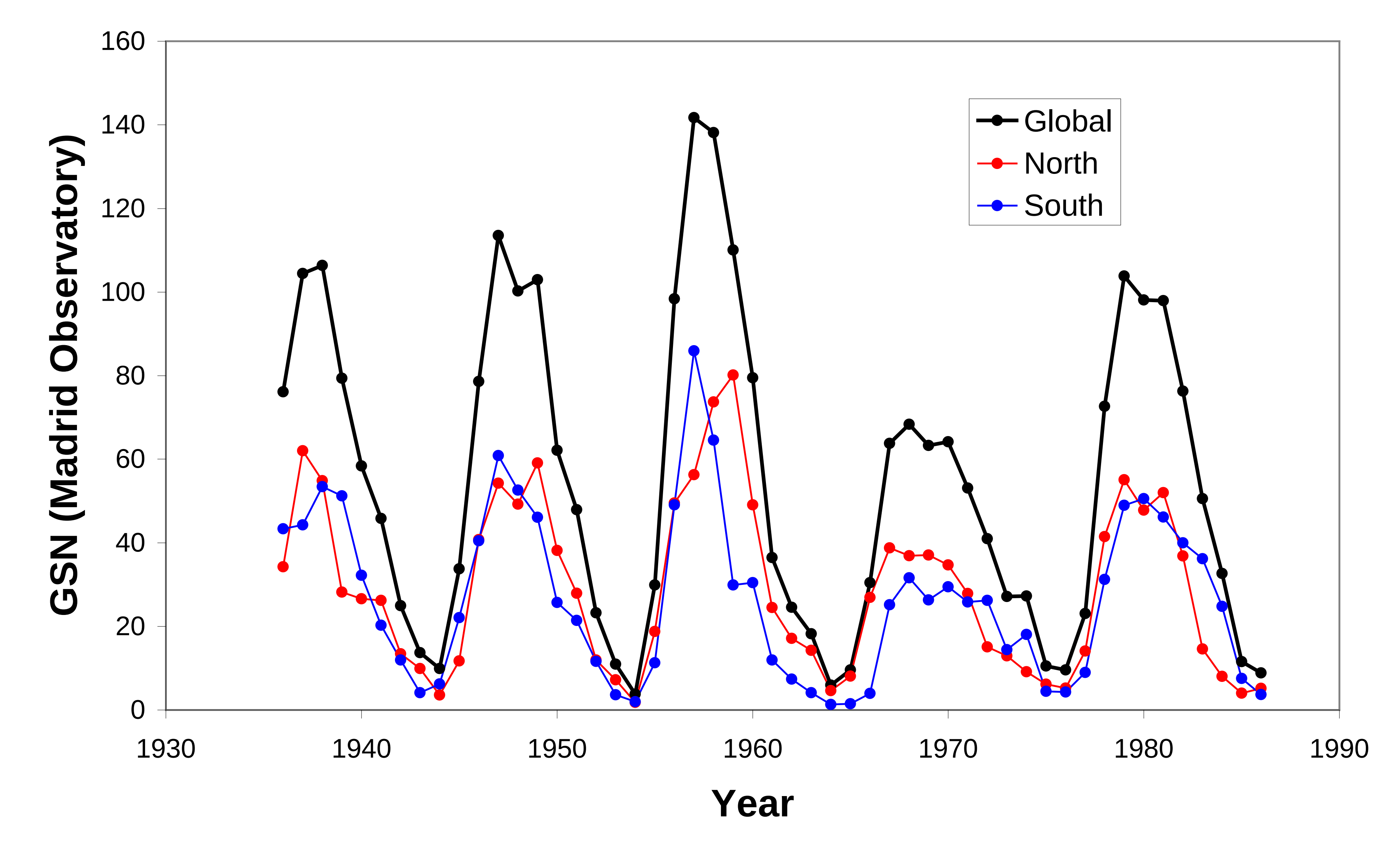
4. Recovering "new" old data

4.1. Sunspot number: Madrid Observatory, Spain



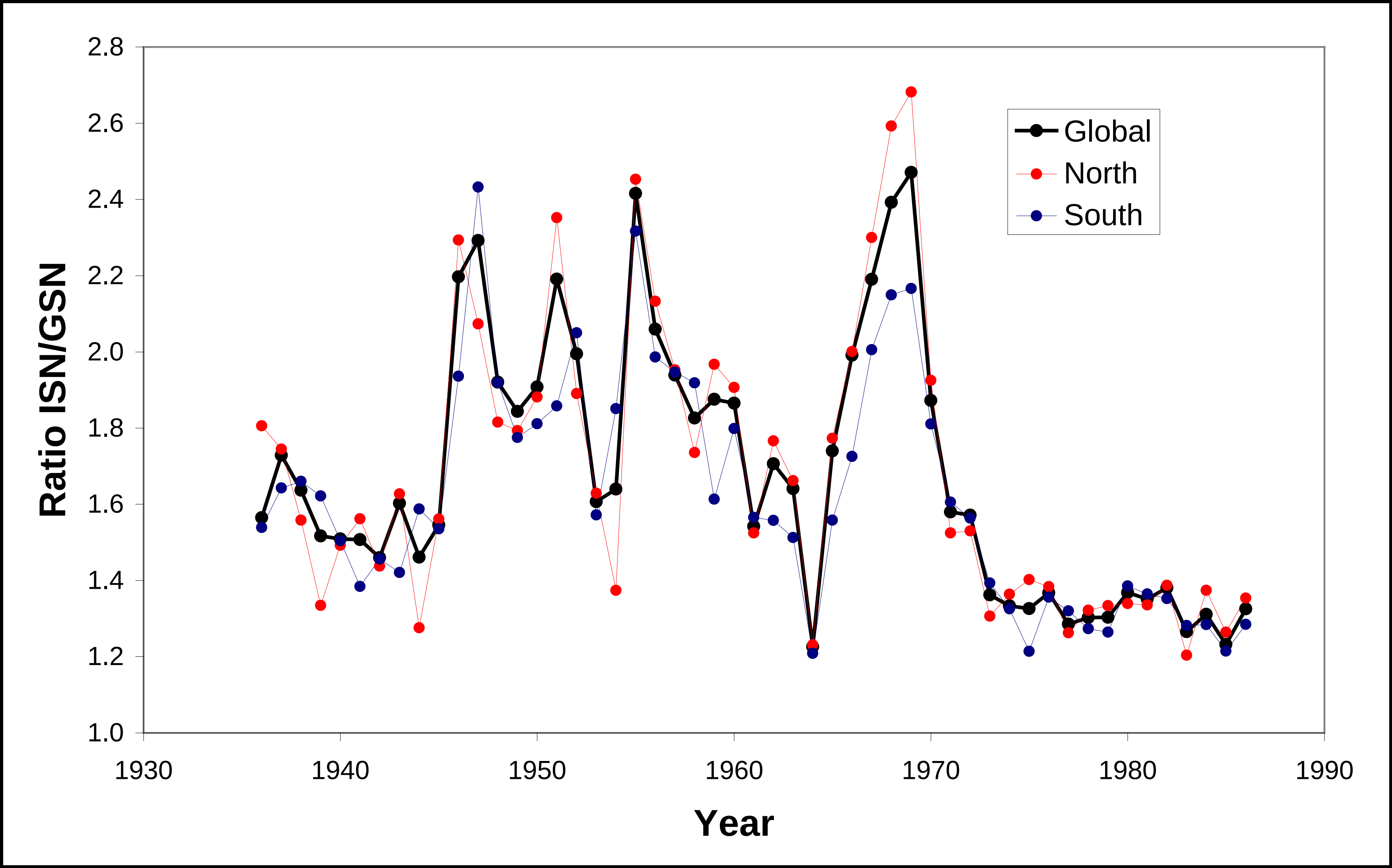
4. Recovering "new" old data

4.1. Sunspot number: Madrid Observatory, Spain

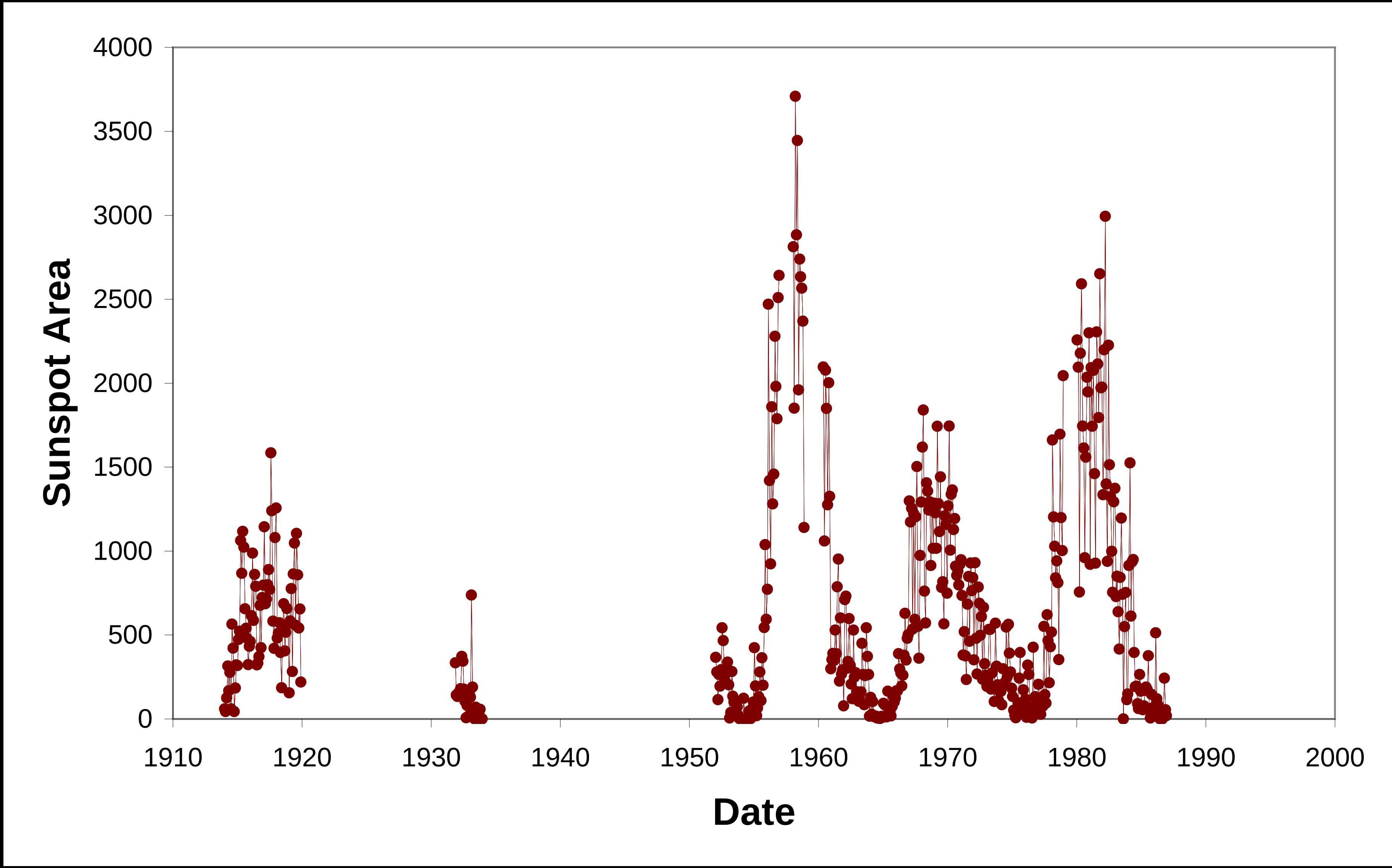


4. Recovering "new" old data

4.1. Sunspot number: Madrid Observatory, Spain

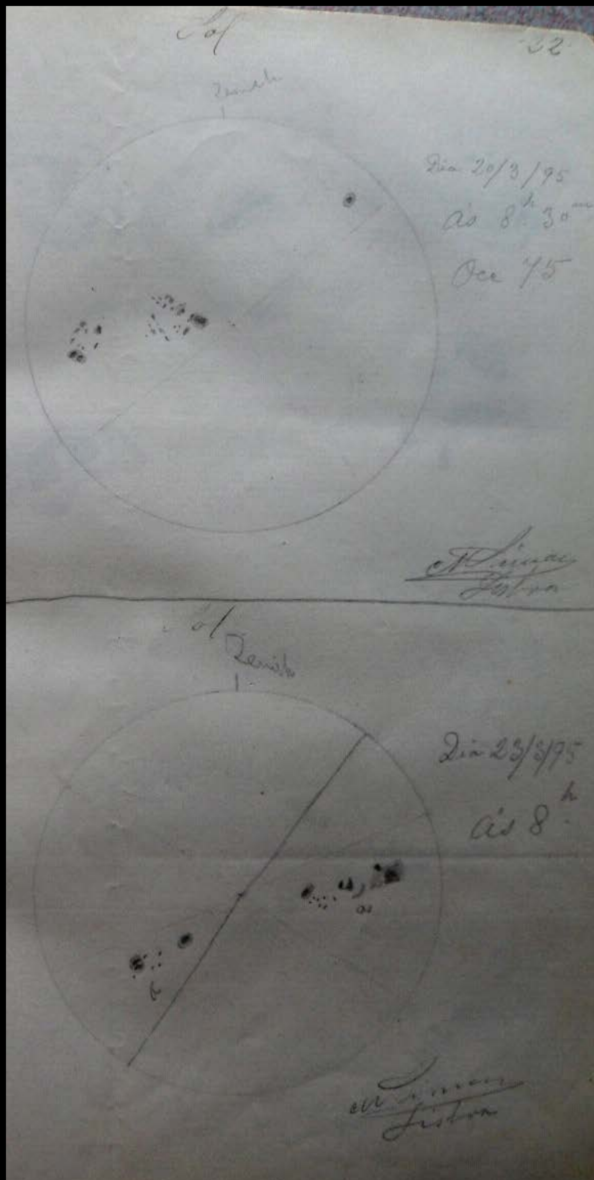


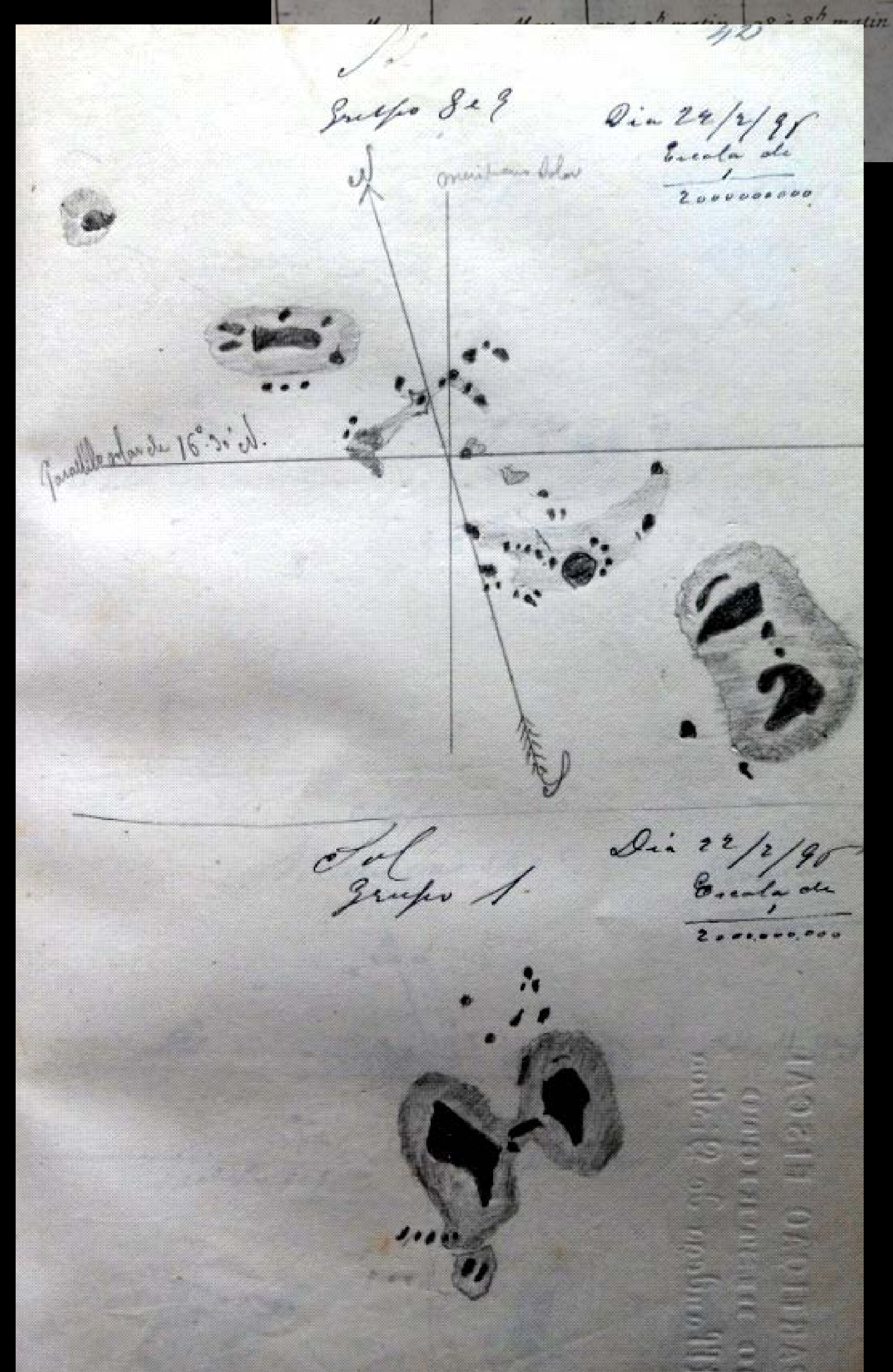
4. Recovering "new" old data



4. Recovering "new" old data

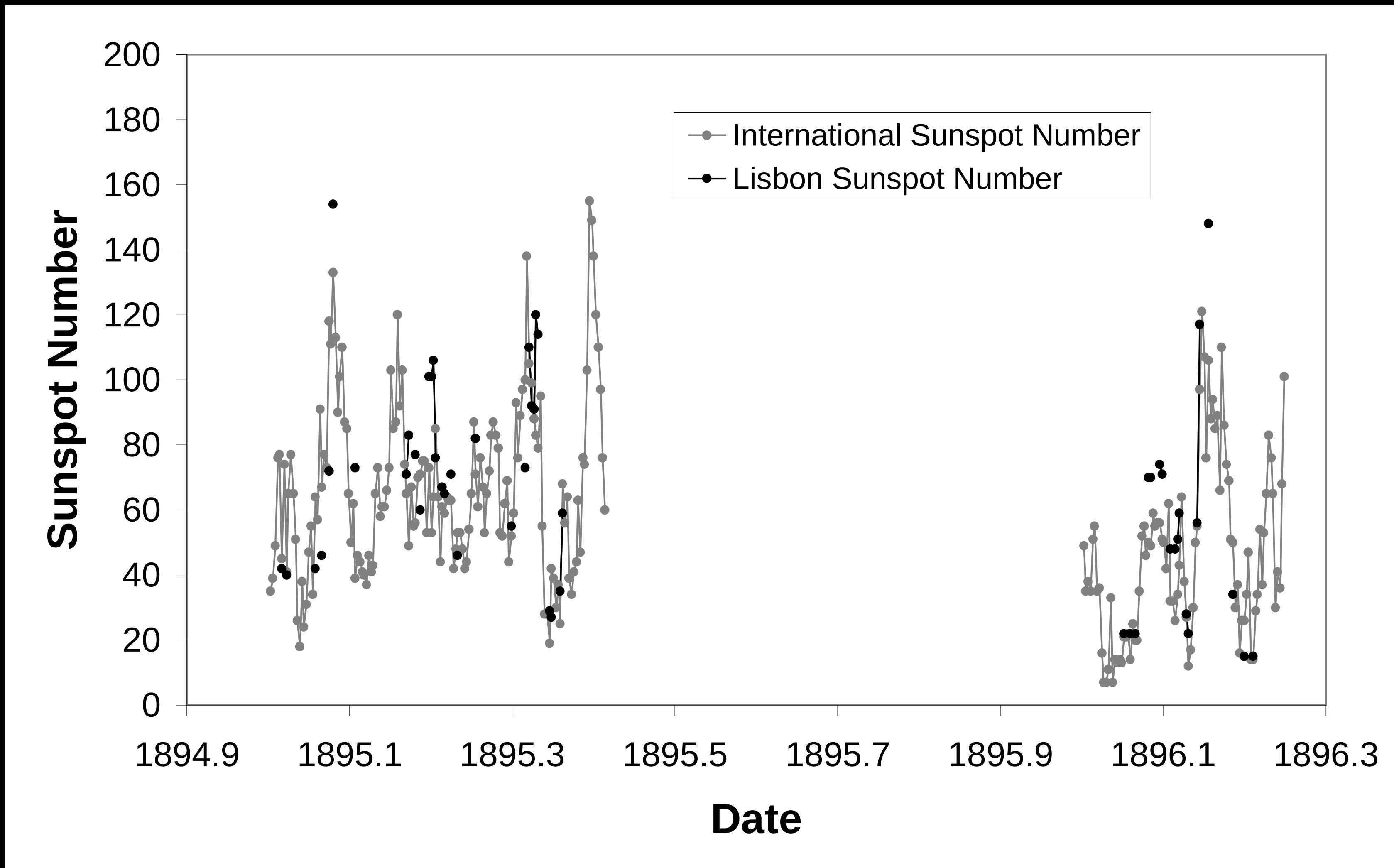
4.1. Sunspot number: Lisbon Observatory, Portugal





4. Recovering "new" old data

4.1. Sunspot number: Lisbon Observatory, Portugal



4. Recovering "new" old data

4.2. Sunspot area: Goodsell Observatory, Carleton College, Northfield, Minnesota

OBSERVATIONS OF SUN-SPOTS

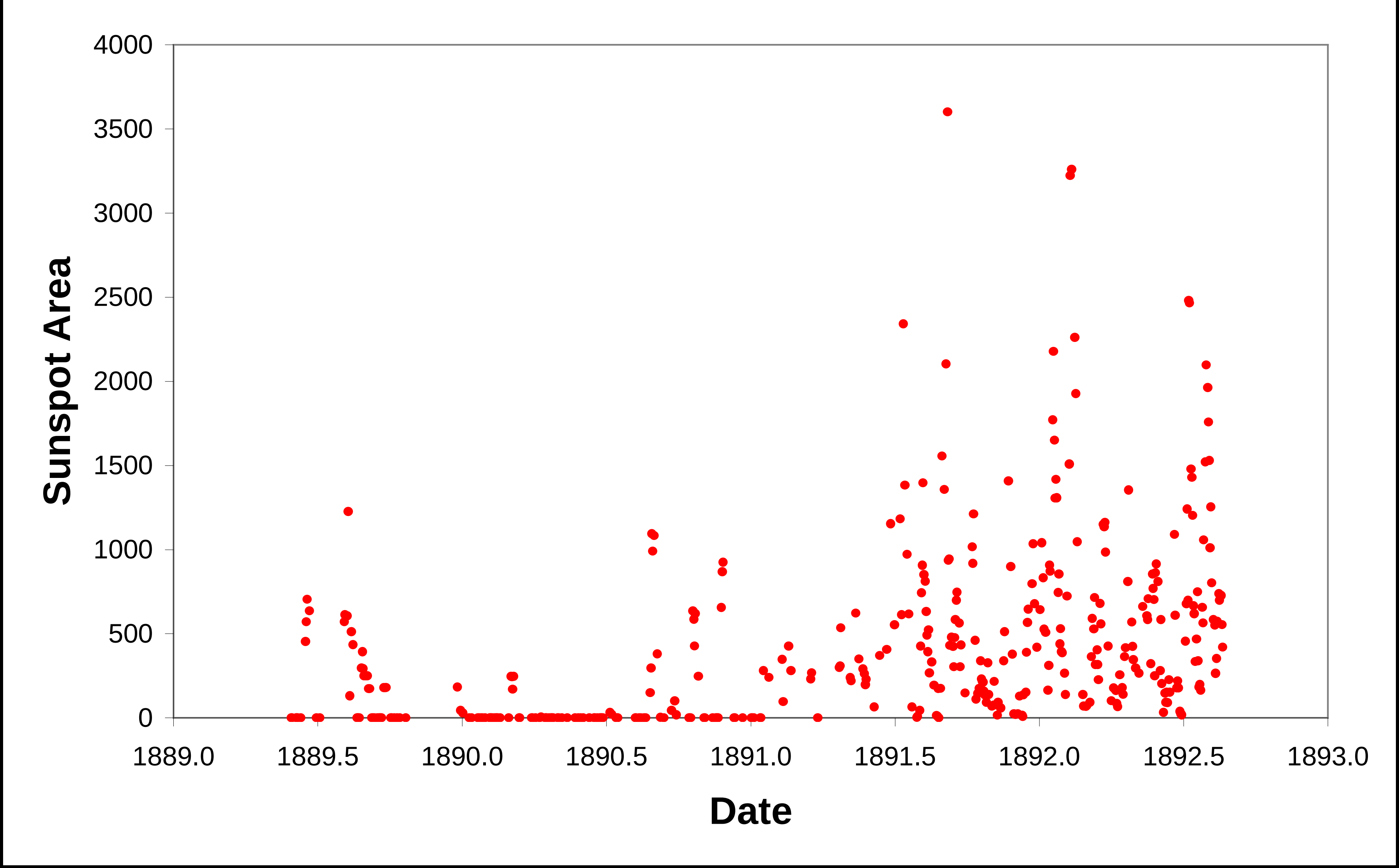
MADE AT

GOODSELL OBSERVATORY

IN THE YEARS 1889 TO 1892.

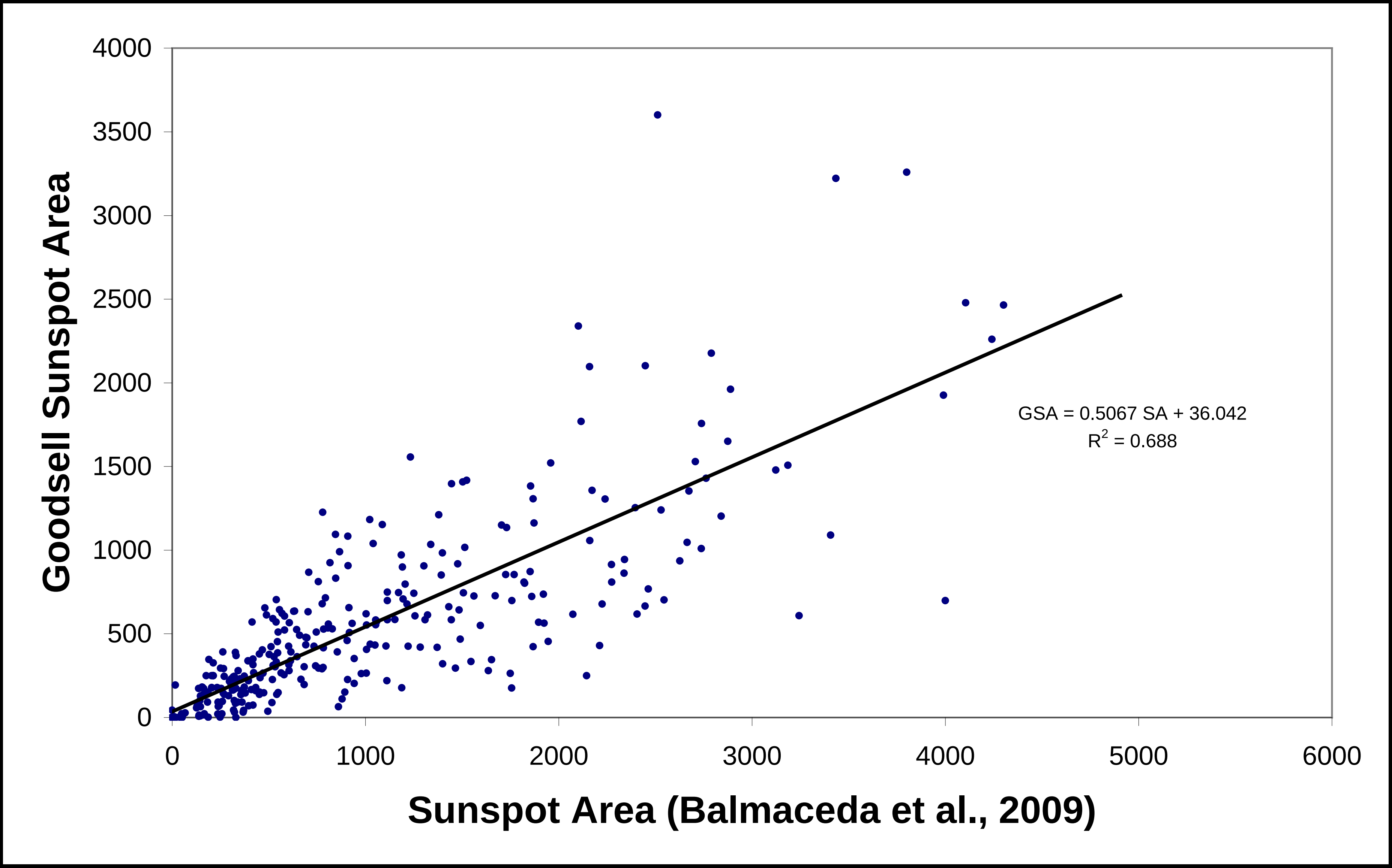
4. Recovering "new" old data

4.2. Sunspot area: Goodsell Observatory, Carleton College, Northfield, Minnesota



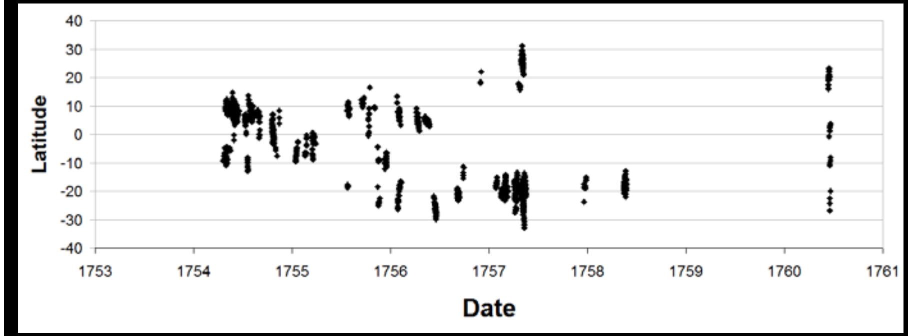
4. Recovering "new" old data

4.2. Sunspot area: Goodsell Observatory, Carleton College, Northfield, Minnesota

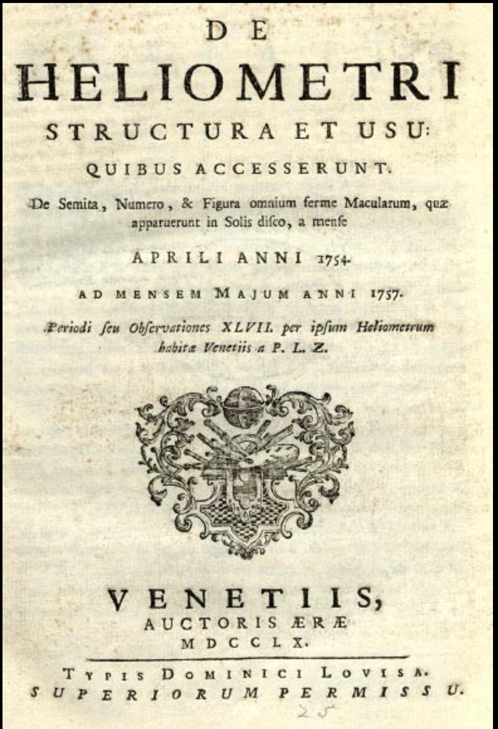


4. Recovering "new" old data

4.3. Sunspot positions



Butterfly diagram based on the sunspot latitude estimations obtained from Zucconi drawings (April 1754 – June 1760).



DE
HELIOMETRI
STRUCTURA ET USU:
QUIBUS ACCESSERUNT.
De Semita, Numero, & Figura omnium ferme Macularum, quæ apparuerunt in Solis disco, a menſe
APRILI ANNI 1754.
AD MENSEM MAJUM ANNI 1757.
Periodi ſeu Obſervationes XLVII. per ipſum Heliometrum habitæ Venetiis a P. L. Z.

VENETIIS,
AUCTORIS ÆRE
MDCCLX.
TYPIS DOMINICI LOVISA.
SUPERIORUM PERMISSU.

Cristo et al. (2011) *JASTP* **73**, 187.

4. Recovering "new" old data

4.3. Sunspot positions: solar rotation 1847-1848

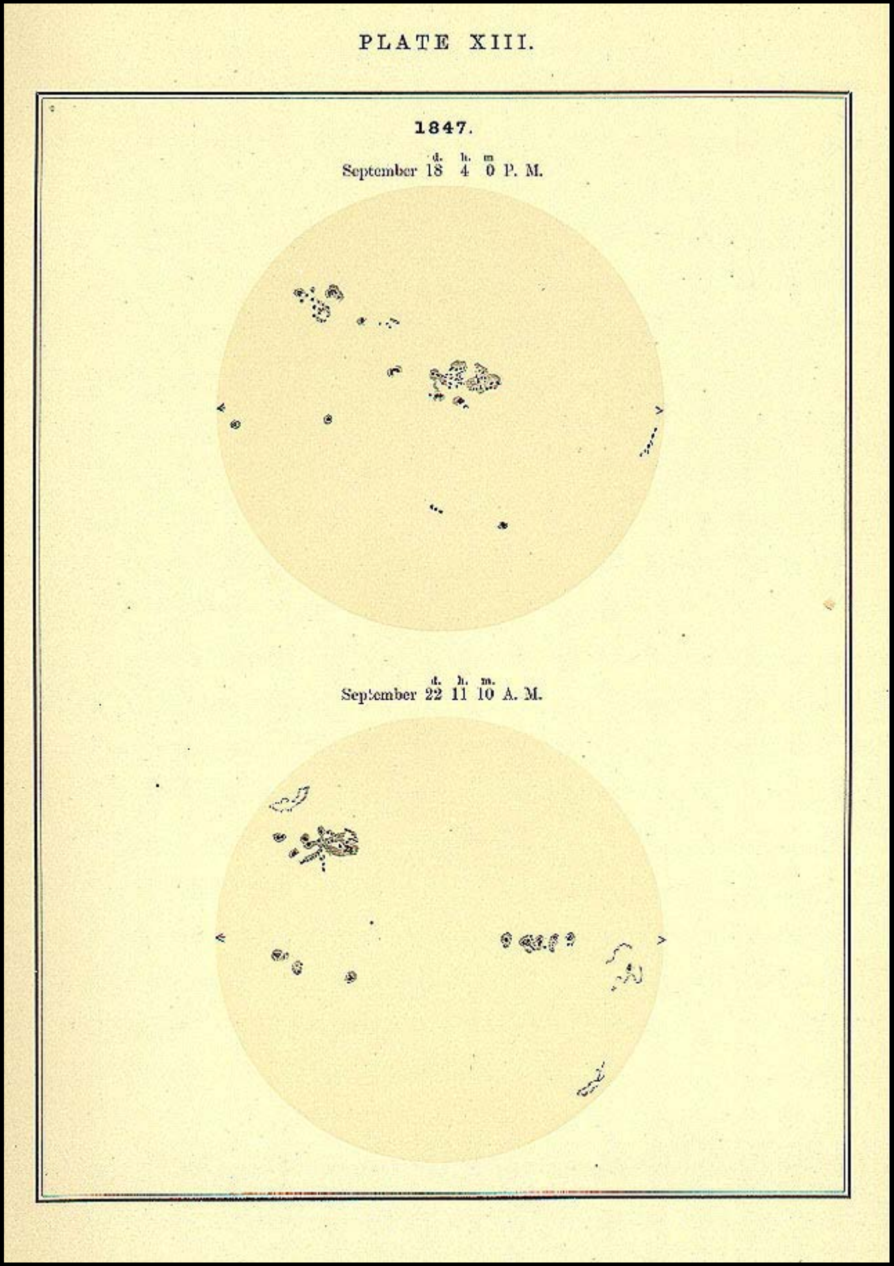


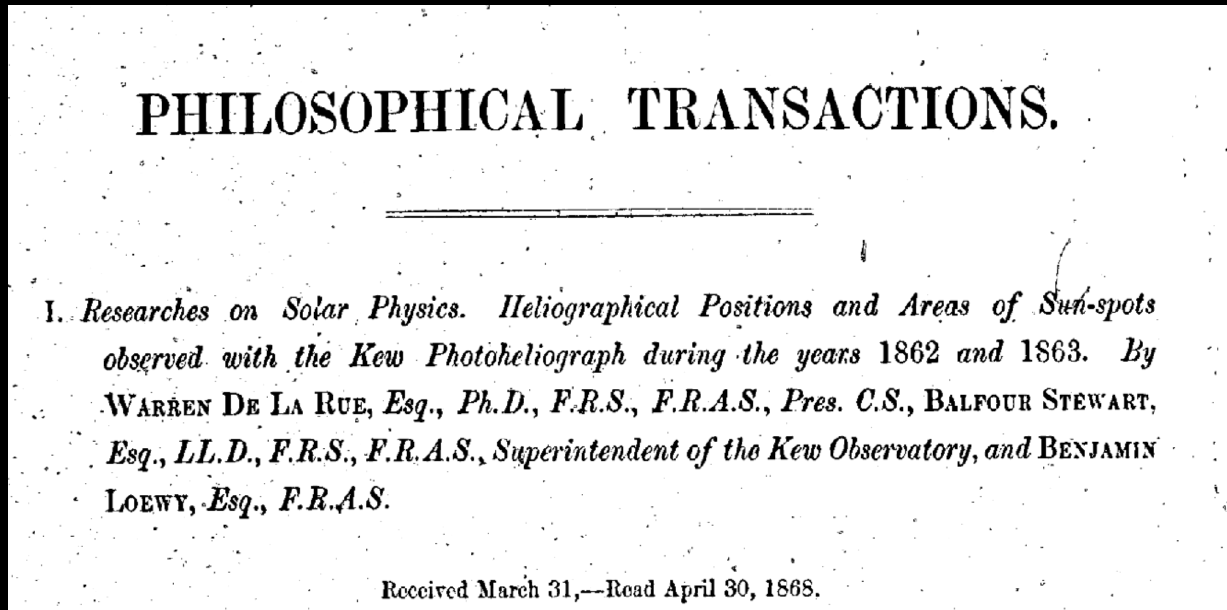
Table 1 Data of the sunspots used in this work. Column 1: day-month-year. Column 6: Numbers 1 and 2 indicate the top and bottom figures in each plate in Bond's (1871) publication. Column 7: The ordinal number of the spot by Bond. Parenthesized are the spot labels used in this work to identify the different sunspots. The asterisks to our spot No. 2 indicates that the sunspot was not clearly identified in the second and third days so that the two nearby spots were used instead.

Date	Hour	Julian day	Latitude (deg)	Longitude (deg)	Plate ID	Sunspot number
21-12-1847	9 h 22 min A.M.	2 396 017.088	+9.85	+16.94	XXXIX 1	2 (1)
23-12-1847	11 h 10 min A.M.	2 396 019.163	+12.74	+47.55	XXXIX 2	1 (1)
24-12-1847	11 h 0 min A.M.	2 396 020.156	+14.36	+59.31	XL 1	1 (1)
21-12-1847	9 h 22 min A.M.	2 396 017.088	+11.86	+10.50	XXXIX 1	4 (2)
23-12-1847	11 h 10 min A.M.	2 396 019.163	+13.42	+37.86	XXXIX 2	2 (2)*
23-12-1847	11 h 10 min A.M.	2 396 019.163	+14.28	+37.00	XXXIX 2	3 (2)*
24-12-1847	11 h 0 min A.M.	2 396 020.156	+15.52	+50.29	XL 1	2 (2)*
24-12-1847	11 h 0 min A.M.	2 396 020.156	+16.46	+49.51	XL 1	3 (2)*
21-12-1847	9 h 22 min A.M.	2 396 017.088	+23.07	−34.53	XXXIX 1	5 (3)
23-12-1847	11 h 10 min A.M.	2 396 019.163	+23.19	−8.21	XXXIX 2	5 (3)
24-12-1847	11 h 0 min A.M.	2 396 020.156	+25.27	+5.28	XL 1	5 (3)
21-12-1847	9 h 22 min A.M.	2 396 017.088	+8.35	−72.36	XXXIX 1	6 (4)
23-12-1847	11 h 10 min A.M.	2 396 019.163	+8.58	−46.70	XXXIX 2	7 (4)
24-12-1847	11 h 0 min A.M.	2 396 020.156	+10.26	−30.39	XL 1	8 (4)
27-12-1847	11 h 55 min A.M.	2 396 023.194	+4.62	+6.28	XL 2	5 (4)
30-12-1847	11 h 0 min A.M.	2 396 026.156	+9.79	+42.03	XLI 1	2 (4)
21-12-1847	9 h 22 min A.M.	2 396 017.088	−4.17	−70.97	XXXIX 1	7 (5)
23-12-1847	11 h 10 min A.M.	2 396 019.163	−3.78	−45.81	XXXIX 2	8 (5)
24-12-1847	11 h 0 min A.M.	2 396 020.156	−2.61	−30.29	XL 1	9 (5)
27-12-1847	11 h 55 min A.M.	2 396 023.194	−8.49	+5.76	XL 2	11 (5)
30-12-1847	11 h 0 min A.M.	2 396 026.156	−2.64	+41.65	XLI 1	1 (5)
21-12-1847	9 h 22 min A.M.	2 396 017.088	−9.25	−78.07	XXXIX 1	8 (6)
23-12-1847	11 h 10 min A.M.	2 396 019.163	−9.15	−51.50	XXXIX 2	9 (6)
24-12-1847	11 h 0 min A.M.	2 396 020.156	−8.33	−33.98	XL 1	10 (6)
27-12-1847	11 h 55 min A.M.	2 396 023.194	−13.16	+1.62	XL 2	8 (6)
21-12-1847	9 h 22 min A.M.	2 396 017.088	−11.87	−76.36	XXXIX 1	9 (7)
23-12-1847	11 h 10 min A.M.	2 396 019.163	−12.19	−46.01	XXXIX 2	10 (7)
24-12-1847	11 h 0 min A.M.	2 396 020.156	−11.46	−29.43	XL 1	11 (7)
27-12-1847	11 h 55 min A.M.	2 396 023.194	−16.50	+6.95	XL 2	9 (7)
30-12-1847	11 h 0 min A.M.	2 396 026.156	−10.99	+42.30	XLI 1	12 (7)
21-12-1847	9 h 22 min A.M.	2 396 017.088	−18.36	−67.41	XXXIX 1	10 (8)
23-12-1847	11 h 10 min A.M.	2 396 019.163	−19.87	−36.90	XXXIX 2	12 (8)
24-12-1847	11 h 0 min A.M.	2 396 020.156	−19.79	−20.47	XL 1	15 (8)
27-12-1847	11 h 55 min A.M.	2 396 023.194	−23.77	+11.13	XL 2	10 (8)
30-12-1847	11 h 0 min A.M.	2 396 026.156	−19.21	+48.91	XLI 1	11 (8)
10-1-1848	0 h 45 min P.M.	2 396 037.229	15.37	+37.24	XLII 1	2 (9)
11-1-1848	11 h 30 min A.M.	2 396 038.177	18.65	+46.06	XLII 2	1 (9)
12-1-1848	11 h 25 min A.M.	2 396 039.174	14.54	+61.15	XLIII 1	1 (9)
10-1-1848	0 h 45 min P.M.	2 396 037.229	8.96	+1.90	XLII 1	4 (10)

Sánchez-Bajo et al. (2010) *Solar Phys.* **261**, 1.

4. Recovering "new" old data

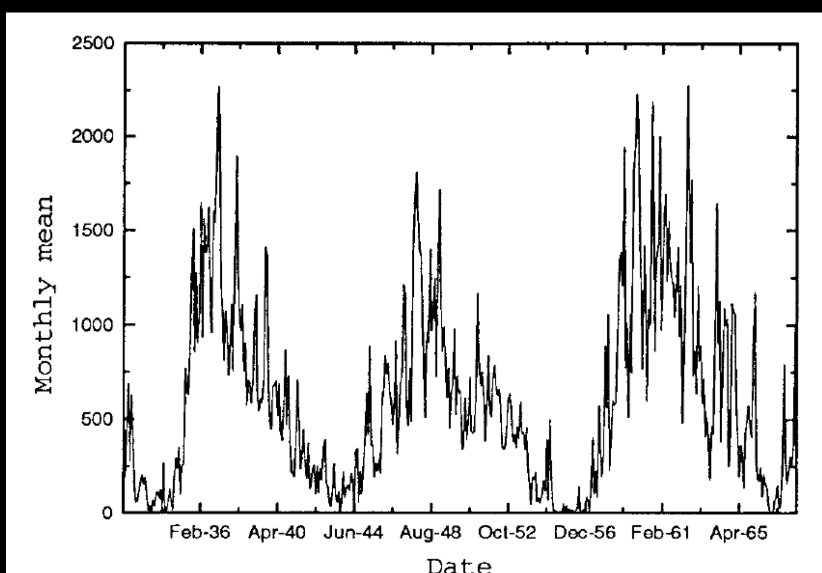
4.3. Sunspot positions



PHILOSOPHICAL TRANSACTIONS.

I. *Researches on Solar Physics. Heliographical Positions and Areas of Sun-spots observed with the Kew Photoheliograph during the years* 1862 *and* 1863. *By* WARREN DE LA RUE, *Esq., Ph.D., F.R.S., F.R.A.S., Pres. C.S.,* BALFOUR STEWART, *Esq., LL.D., F.R.S., F.R.A.S., Superintendent of the Kew Observatory, and* BENJAMIN LOEWY, *Esq., F.R.A.S.*

Received March 31,—Read April 30, 1868.



1832-1853: Schwabe

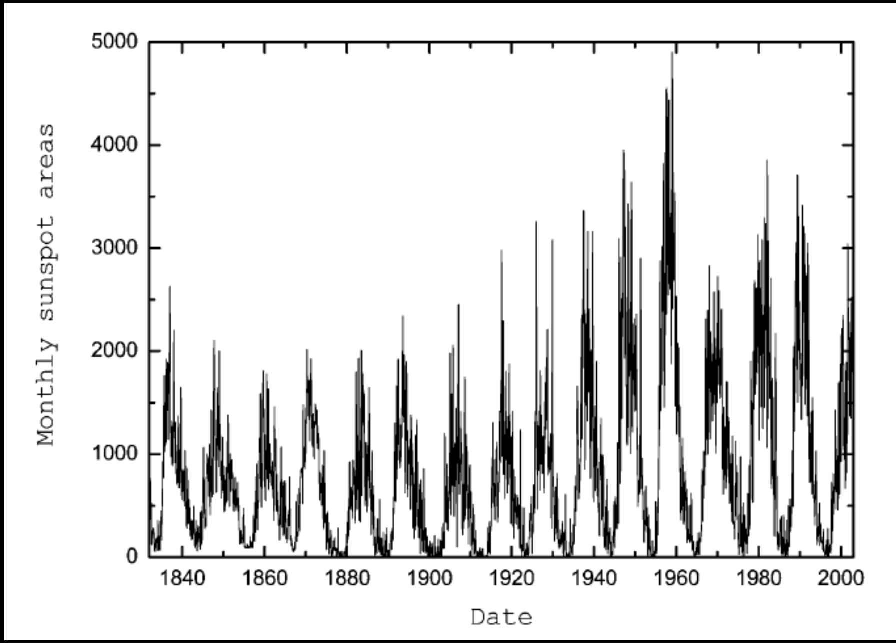
1854-1860: Carrington

1861-1868: Kew Observatory

Vaquero et al. (2002) *Solar Phys.* **209**, 311.

4. Recovering "new" old data

4.3. Sunspot positions



Vaquero et al. (2005) *The Observatory* **125**, 152.

Vaquero et al. (2004) *Solar Phys.* **221**, 179.

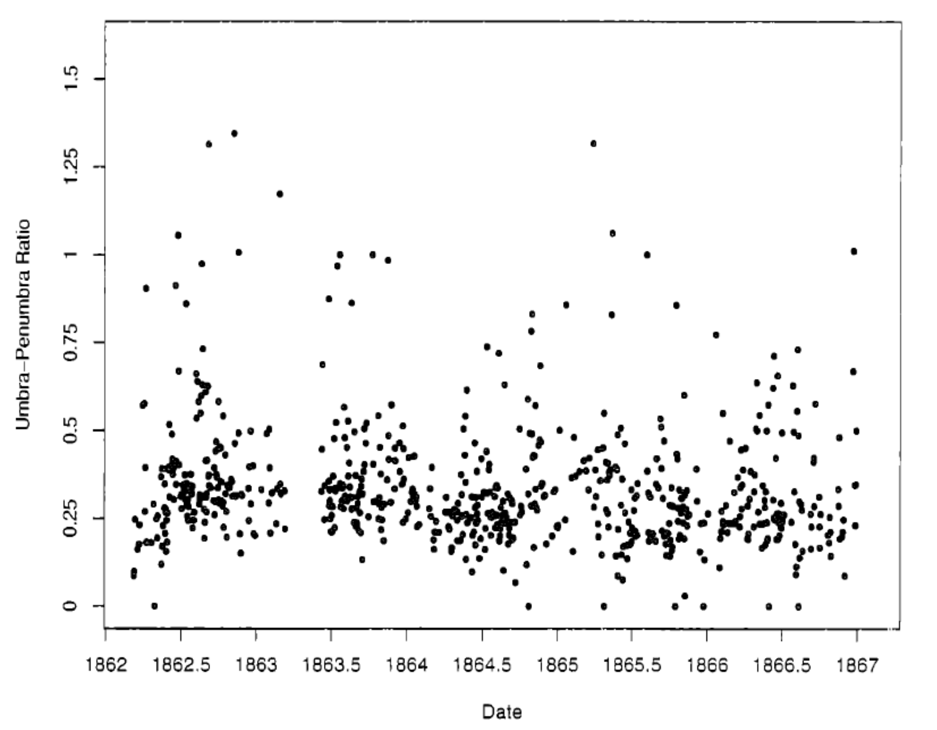


FIG. 3

Time evolution of the umbra–penumbra area ratio of sunspots.

4. Recovering "new" old data

4.3. Sunspot positions…

A brief history of solar observations made at Coimbra can be consulted in Mouradian & Garcia (2007). Full-disk spectroheliograms in the Ca II K line (K1 and K3) have been routinely taken in Coimbra since 1926. Solar data were published from 1929 to 1943 in its "Annais do Observatório Astronómico da Universidade de Coimbra. Fenómenos Solares". In 2002, Coimbra Observatory started the digitalization of its collection of more than 30 000 solar images (Dorotovič et al. 2007). Also, there are a long series of magnetic record since 1865 (Pais 1995).

Observatorio Astronómico de Madrid (now Observatorio Astronómico Nacional) developed a complete program of solar observation (sunspot statistics, white-light and spectroheliographic photography, "solar constant" measurements, etc.) during the first third of 20th century (Ruiz Castell 2008).

Barcelona. There are historical sunspot drawings and photographs from Comás-Solá (Fabra observatory) and several Catalonian amateur astronomers.

Ebro observatory was founded by Jesuits developing the most ambitious Spanish program for solar-terrestrial studies including solar and geomagnetic observations and ionosphere studies. H. W. Newton (1958) stated when reviewed the Greenwich sunspot records that: "*This brief account of the long photographic records of sunspot available at the Royal Greenwich Observatory would be incomplete without a reference to two or three other sites that have been running for a number of years in the Unites States and Spain respectively. […] The third series for mention is that produced by the Ebro Observatory, Tortosa, in Spain. This series has been running since the early years of the century. The instrument and methods used for measuring the position and areas of spots resemble those at Greenwich, which may fairly be regarded as the standard for the positions and areas of sunspots*" (Newton, 1958, pp. 68-69).

The "Instituto geofísico Infante D. Luiz" was the main geophysical observatory in Portugal. Geomagnetic records were taken during the second half of 19th century. However the magnetograms were lost in fire and only some tabulated data are available. In this observatory was developed a program of solar photography during the years 1870-1880 but, again, only few photographs have survived (see Bonifacio 2007).

The Astronomical Observatory of Lisbon did not make a program of solar observations. However, some drawings, photographs, and eclipse observations can be consulted in the historical archive.

Astronomical Observatory of the Valencia University. There are sunspot drawings and photographs and data about sunspot area and positions (only 1920s).

Observatorio astronómico de San Fernando (military observatory). There are solar diameter measurements and scarce sunspot drawings in the archive. The history of this observatory has been well studied (Lafuente & Sellés, 1988; González González, 1992, 2004).

Toledo Geomagnetic station: a brief account of the first years of this observatory appear in Sancho de San Román (1951).

Observatorio Astronómico y Geofísico de la Cartuja. It was founded also by Jesuits. Solar-terrestrial studies including solar and geomagnetic observations (Ruiz Castell 2008).

5. Calibration constants and Wolf-Wolfer transition around 1880

5.1. The curious case of Madrid Observatory

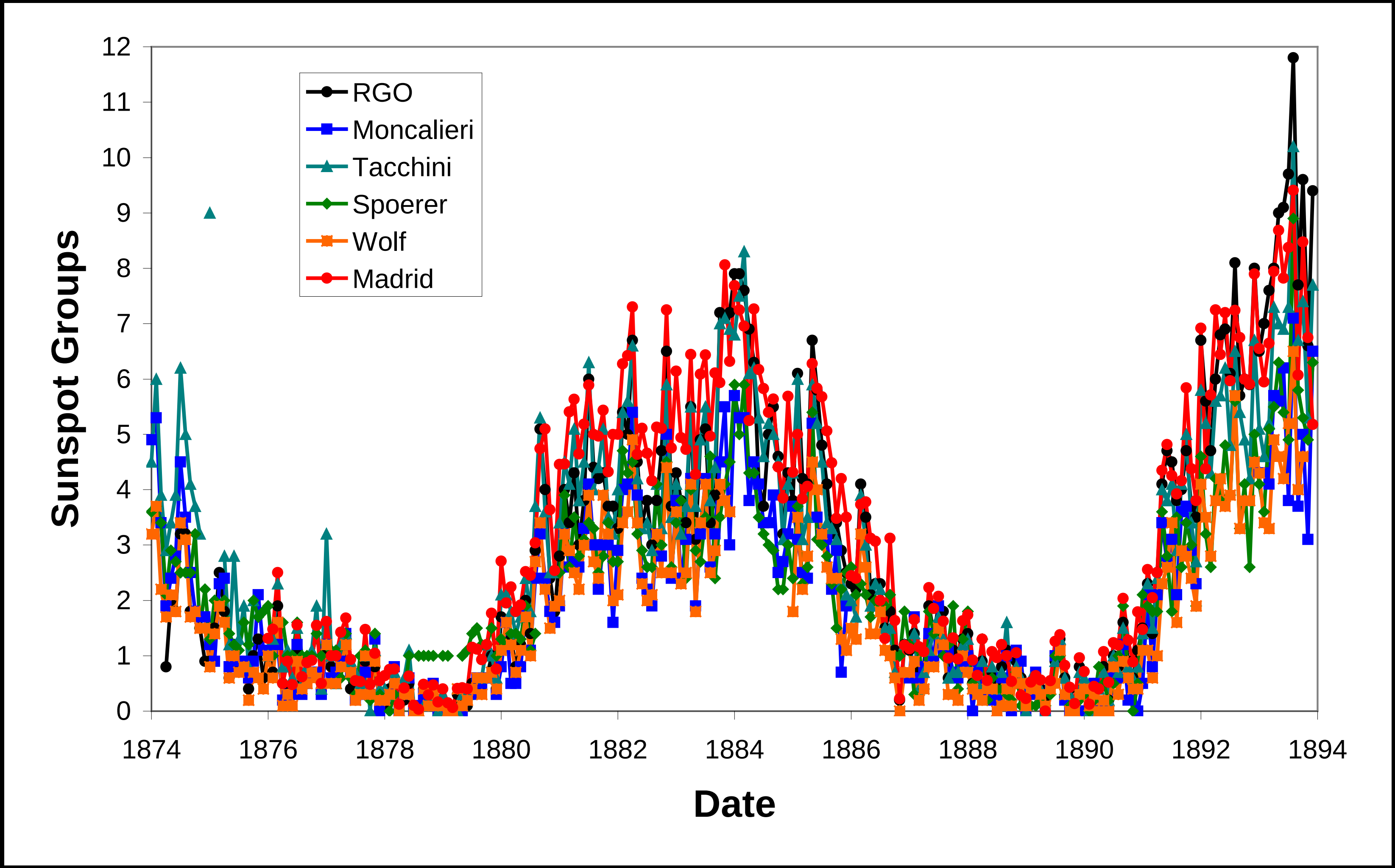
334	1.170	.064	2	MAIN, RADCLIFFE OBS., OXFORD
335	.838	.008	2	BILLWILLER AND WOLFER, ZURICH
336	.796	.049	2	AGUILAR, MADRID
337	1.021	.063	2	MONTHLY WEATHER REVIEW
338	1.094	.016	2	WOLFER, ZURICH
339	.896	.026	2	RICCO, PALERMO
340	1.007	.052	2	MIETHE, POTSDAM
341	1.148	.162	2	WINKLER, JENA
342	1.014	.031	2	JANESCH, LAIBACH
343	.997	.000	2	MERINO, MADRID
344	1.429	.000	1	KOKIDES, ATHENS
345	1.604	.000	1	KONKOLY, OGYALLA
346	1.392	.000	1	VOGEL, POTSDAM
347	1.329	.000	1	STONYHURST COLLEGE OBS.
348	2.000	.000	1	WILSING, POTSDAM
349	1.180	.000	1	SCHMOLL, PARIS
350	1.274	.000	1	HAVERFORD COLLEGE OBS., PA

327	1870	1879	2059	BERNAERTS, G.L., ENGLAND
328	1871	1900	7584	TACCHINI, ROME
329	1871	1877	1530	SECCHI, ROME
330	1872	1875	308	BILLWILLER, ZURICH
331	1872	1874	282	SAWYER, E.F., CAMBRIDGEPORT
332	1874	1976	37472	ROYAL GREENWICH OBSERVATORY
333	1874	1893	3598	MONCALIERI
334	1874	1875	107	MAIN, RADCLIFFE OBS., OXFORD
335	1876	1879	997	BILLWILLER AND WOLFER, ZURICH
336	1876	1882	1940	AGUILAR, MADRID
337	1877	1886	2383	MONTHLY WEATHER REVIEW
338	1880	1928	12536	WOLFER, ZURICH
339	1880	1892	3709	RICCO, PALERMO
340	1882	1882	88	MIETHE, POTSDAM
341	1882	1910	6161	WINKLER, JENA
342	1882	1887	1164	JANESCH, LAIBACH
343	1883	1896	3221	MERINO, MADRID
344	1884	1886	965	KOKIDES, ATHENS
345	1885	1905	3531	KONKOLY, OGYALLA
346	1886	1886	162	VOGEL, POTSDAM
347	1886	1935	4534	STONYHURST COLLEGE OBS.
348	1887	1887	52	WILSING, POTSDAM
349	1888	1892	1359	SCHMOLL, PARIS
350	1888	1899	2063	HAVERFORD COLLEGE OBS., PA
351	1888	1890	326	YENDELL, P.S., BOSTON
352	1889	1921	10860	QUIMBY, PHILADELPHIA
353	1889	1892	523	CARLETON COLLEGE OBSERVATORY
354	1889	1890	262	FROST, E.B., DARTMOUTH
355	1890	1891	258	SMITH OBSERVATORY
356	1890	1890	67	HADDEN, D.E., ALTA, IOWA
357	1890	1890	9	FURNISS, C., VASSAR

But one only observer…!

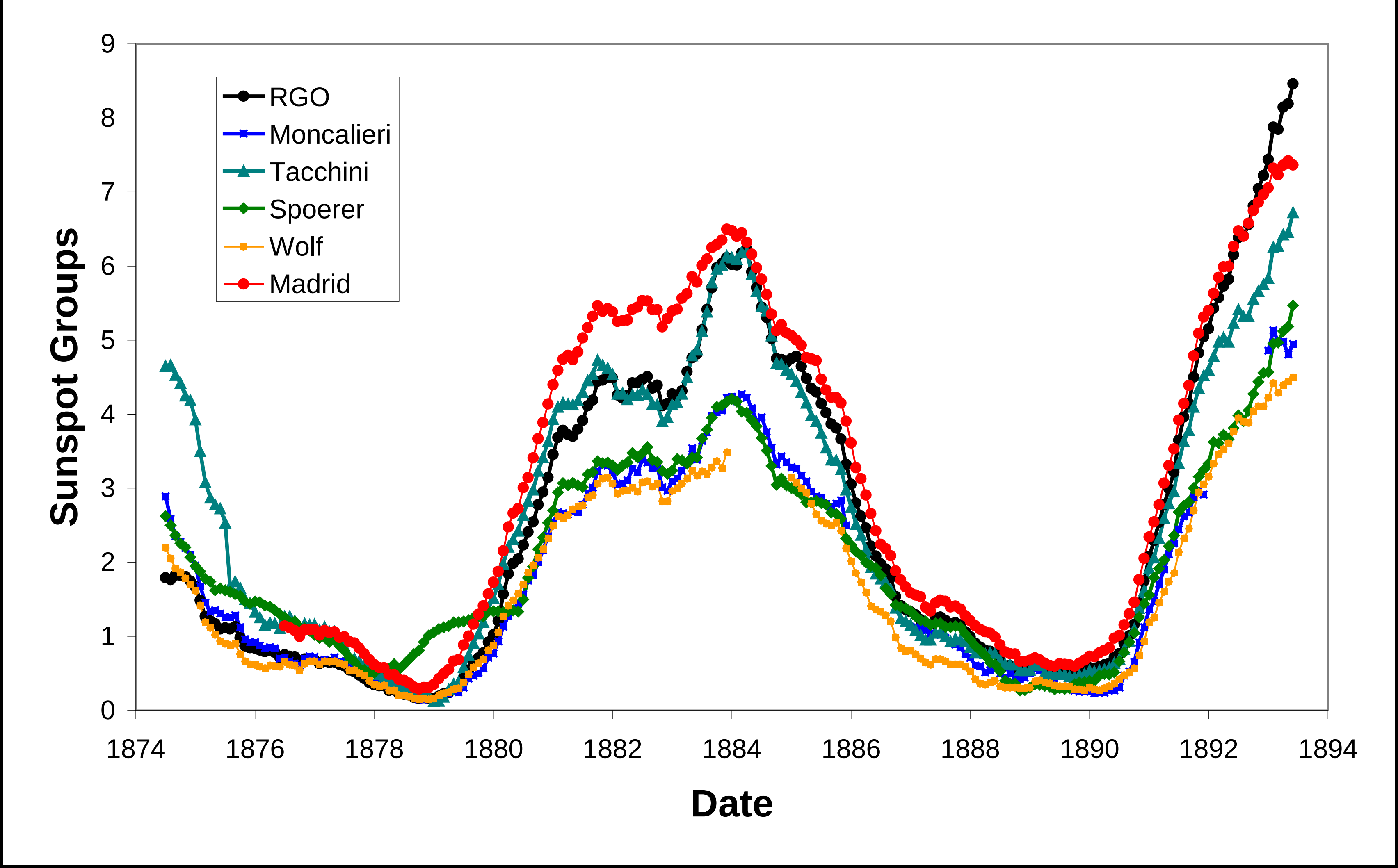
5. Calibration constants and Wolf-Wolfer transition around 1880

5.2. Royal Greenwich Observatory series is no-homogeneous



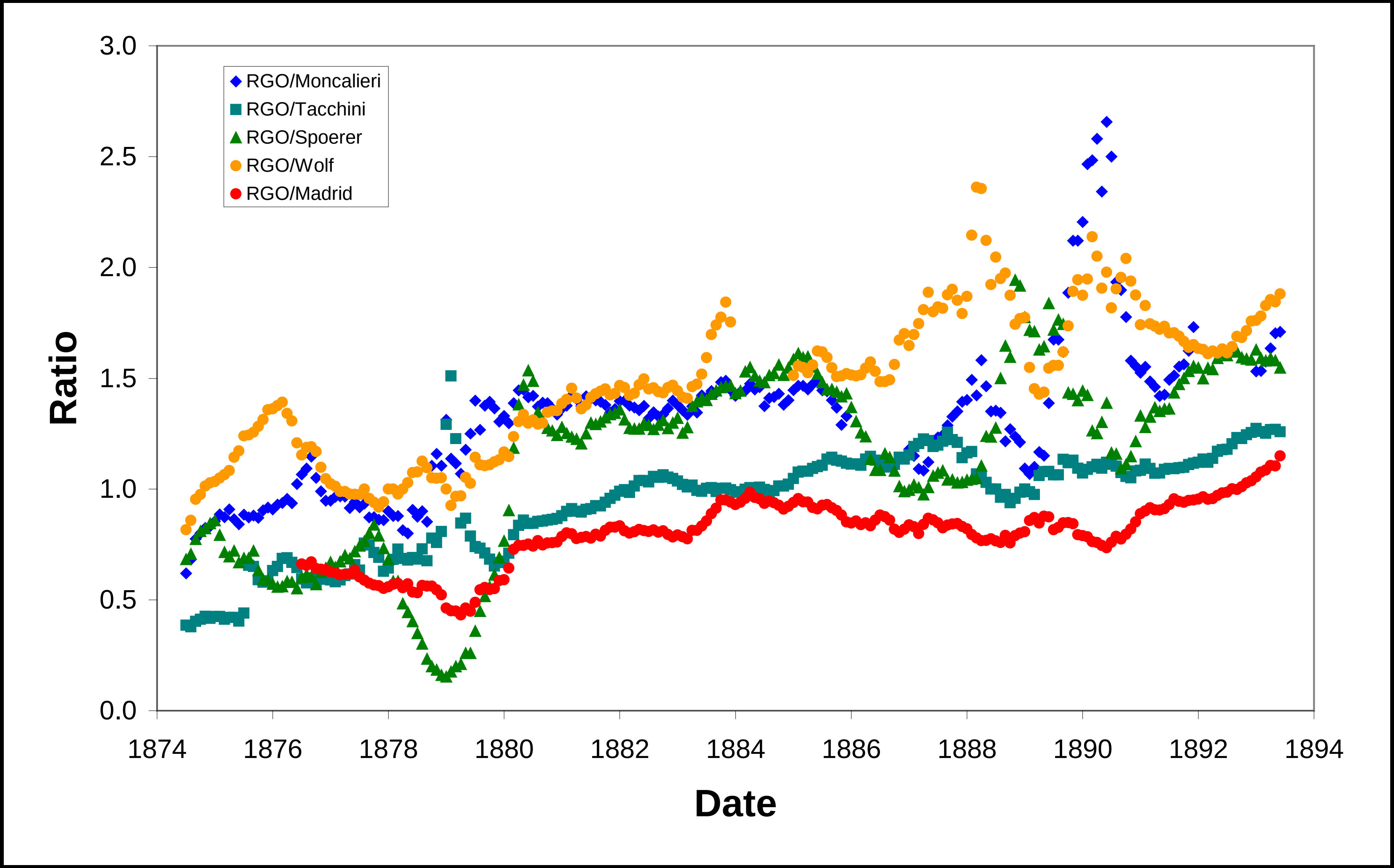
5. Calibration constants and Wolf-Wolfer transition around 1880

5.2. Royal Greenwich Observatory series is no-homogeneous



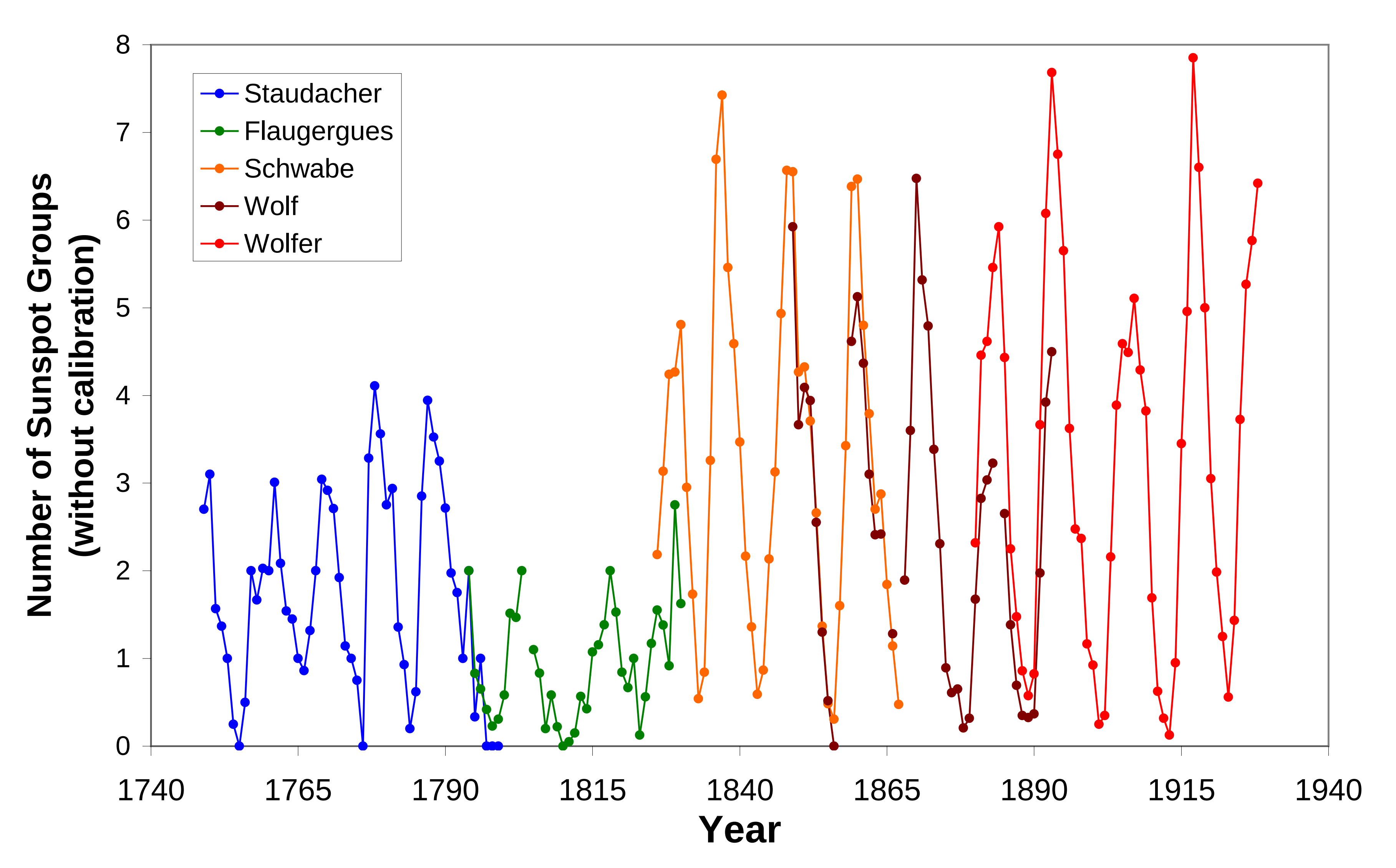
5. Calibration constants and Wolf-Wolfer transition around 1880

5.2. Royal Greenwich Observatory series is no-homogeneous



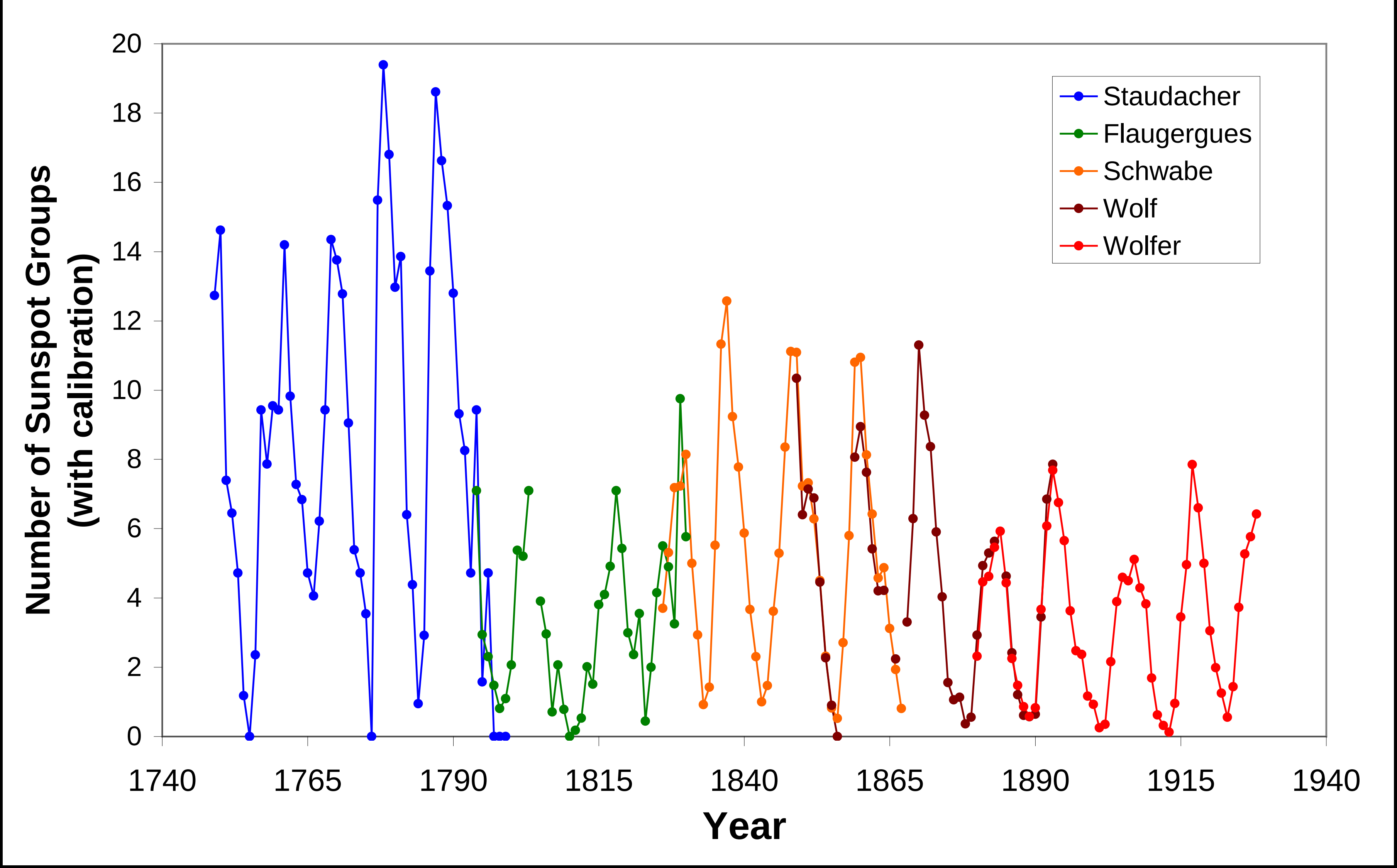
5. Calibration constants and Wolf-Wolfer transition around 1880

5.3. A toy-solar activity reconstruction



5. Calibration constants and Wolf-Wolfer transition around 1880

5.3. A toy-solar activity reconstruction



6. Conclusions

6.1. We need more work to check and recover historical data.

6.2. We need a library or archive that preserve all historical information.

6.3. Reconciling ISN and GSN? We need a new reconstruction (more data and new methodology).