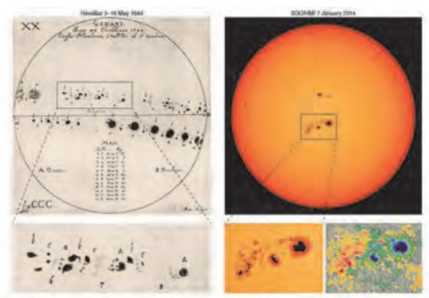
太陽観測データ整備・較正

日本変光星観測者会議
諏訪市駅前交流テラスすわっチャオ
2023/07/21
名古屋大学高等研究院/宇宙地球環境研究所
早川尚志

世界の「長期」観測

- Natureの特集記事 “Slow Science”
- 過去の長期定常観測
- 400年…**太陽黒点数**観測
- 170年…ヴェスヴィオ火山の定常観測
- 170年…穀物収穫量データ
- 90年…IQ計測
- 85年…ピッチドロップ観測

Now a museum, the original building of the Vesuvius Observatory was used to monitor volcanic activity from the side of the mountain.



Muñoz & Vaquero 2019, *Nature Astronomy*, 3, 205

Rothamsted has been home to experiments on the effects of fertilizer on the yield of wheat since 1843.

Owens 2013, *Nature*, 495, 300

そもそもGNとSNで違うトレンド

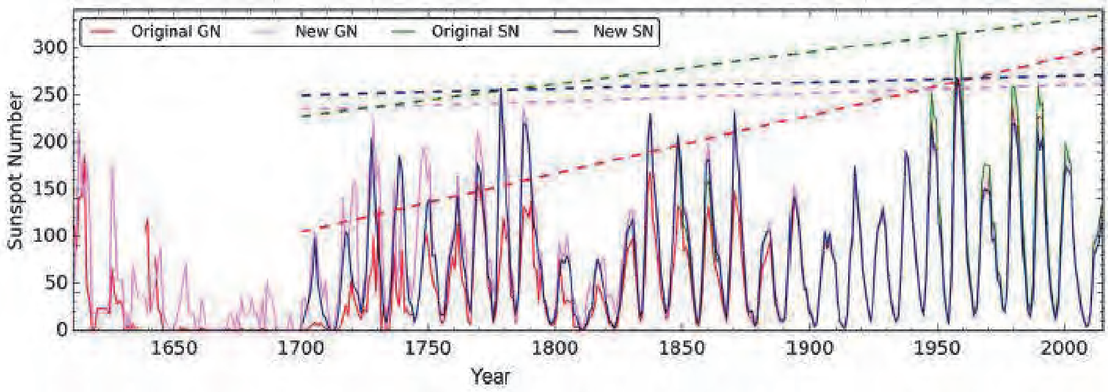
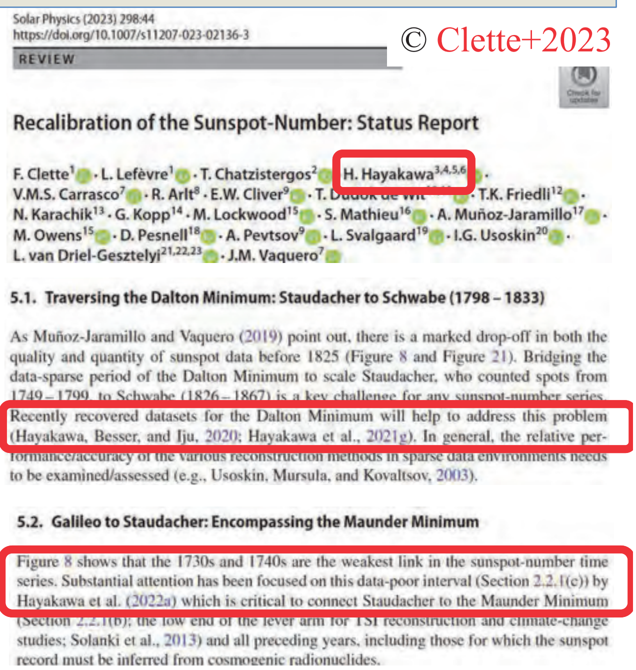


Figure 11 Comparison of secular trends before and after correcting the sunspot number and group-number series: original sunspot-number [R_i] (green), original group number (red), corrected sunspot number [S_N] described in this article (blue), and new "backbone" group number [G_N] (purple). As a visual guide, the dashed lines give the overall trend in all four series (with matching color), by connecting the highest maxima of the 18th (Cycle 3) and in the 20th centuries (Cycle 19). Both new series show the same absence of a rising trend over the last three centuries.

黒点数再較正の国際共同研究：進捗報告書

黒点数再較正の国際共同研究

進捗報告書がInvited Reviewとして掲載決定



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https://doi.org/10.1007/s11207-023-02136-3

REVIEW

Recalibration of the Sunspot-Number: Status Report

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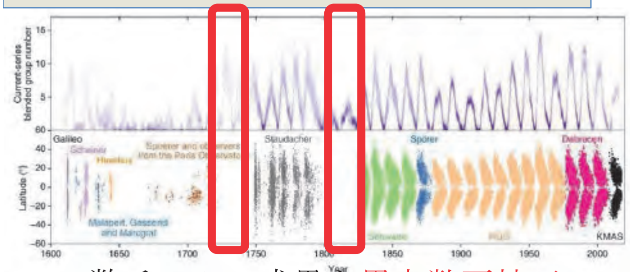
5.1. Traversing the Dalton Minimum: Staudacher to Schwabe (1798 – 1833)

As Muñoz-Jaramillo and Vaquero (2019) point out, there is a marked drop-off in both the quality and quantity of sunspot data before 1825 (Figure 8 and Figure 21). Bridging the data-sparse period of the Dalton Minimum to scale Staudacher, who counted spots from 1749 – 1799, to Schwabe (1826 – 1867) is a key challenge for any sunspot-number series. Recently recovered datasets for the Dalton Minimum will help to address this problem (Hayakawa, Besser, and Iju, 2020; Hayakawa et al., 2021g). In general, the relative performance/accuracy of the various reconstruction methods in sparse data environments needs to be examined/assessed (e.g., Usoskin, Mursula, and Kovaltsov, 2003).

5.2. Galileo to Staudacher: Encompassing the Maunder Minimum

Figure 8 shows that the 1730s and 1740s are the weakest link in the sunspot-number time series. Substantial attention has been focused on this data-poor interval (Section 2.2.1(c)) by Hayakawa et al. (2022a) which is critical to connect Staudacher to the Maunder Minimum (Section 2.2.1(b); the low end of the lever arm for TSI reconstruction and climate-change studies; Solanki et al., 2013) and all preceding years, including those for which the sunspot record must be inferred from cosmogenic radionuclides.

黒点数再較正の断層線



- 弊チームの成果も黒点数再較正の二大断層線を超える重要成果として、この国際共同研究に大きく貢献

データベースの舞台裏

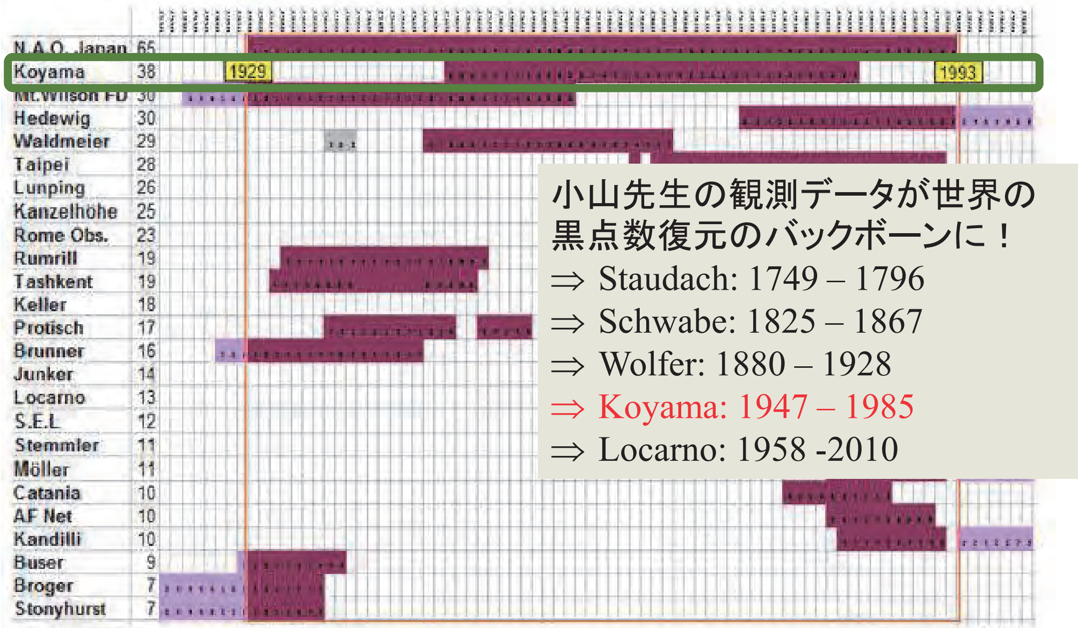


Fig. 25 Coverage and observers for the Koyama Backbone (1921–2000)

Clette+2014, Space Science Review, 118, 35

データベースの元になってるのは
あくまで個々の観測

Table 1
Main Characteristics of the Subset of Stations

ID	Name	Location	Prof. versus Amateur	Team versus Individual	Observing Period	Level	% Obs.	% Obs. Period
A3	Athens Obs.	Athens (Greece)	Prof.	team	1949–1995	1.039	30.16	44.01
BN-S	WFS Obs.*	Berlin (Germany)	Am.	team	1965–2013	1.179	23.50	32.74
CA	Catania Obs.	Catania (Italy)	Prof.	team	1950–2019	1.039	61.87	64.80
CRA	Cragg†	Australia	Am	indiv.	1947–2009	0.904	72.43	77.44
FU	Fujimori	Nagano (Japan)	Am	indiv.	1968–2019	1.055	45.73	67.32
HD-S	Hedewig*	Germany	Am	indiv.	1967–2013	0.931	25.42	36.96
HU	Public Observatory	Hurbanovo (Slovakia)	Am	team	1969–2019	1.004	35.452	52.80
KH	KOERI	Kandilli (Turkey)	Prof.	team	1967–2019	0.968	48.81	51.38
KOm	Koyama	Tokyo (Japan)	Am	indiv.	1947–1996	1.052	40.18	54.84
KS2	Kislovodsk Mountain Obs.	Kislovodsk (Russia)	Prof.	~indiv.	1954–2019	1.057	85.96	95.98
KZm	University of Graz	Kanzelhohe (Austria)	Prof.	team	1944–2019	1.110	74.23	74.24
LFm	Luft	New York (USA)	Am	indiv.	1944–1988	0.985	34.06	54.68
LO	Specola Solare	Locarno (Switzerland)	Prof.	~indiv.	1958–2019	1.260	68.27	81.68
MA	Manila Obs.	Manila (Philippines)	Prof.	team	1971–1988	1.023	20.85	78.69
MO	Mochizuki (Urawa)	Saitama (Japan)	Am	indiv.	1978–2019	1.073	35.51	66.09
PO	Observatory	Postdam (Germany)	Prof.	team	1955–1999	0.991	22.12	29.73
QU	PAGASA weather Bureau	Quezon (Philippines)	Prof.	~indiv.	1957–2019	0.829	45.46	53.83
SC-S	Schulze*	Germany	Am	indiv.	1960-2007	0.943	23.32	33.16
SK	Skalnate Pleso Obs.	Vysoke Tatry (Slovakia)	Prof.	team	1950–2012	0.992	37.95	40.75
SM	San Miguel Obs.	Buenos Aires (Argentina)	Prof.	team	1967–2013	1.220	39.09	56.34
UC	USET	Uccle (Belgium)	Prof.	team	1949–2019	0.991	57.00	59.64

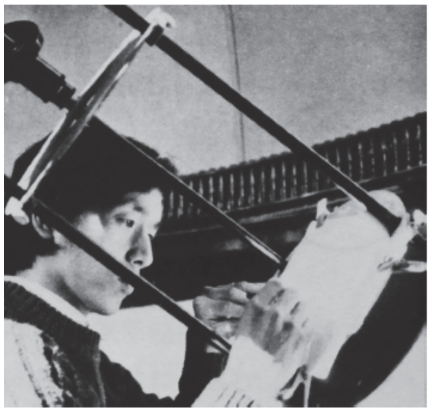
Mathieu+2019 (ApJ, 887, 7)

本邦からも個人観測者が大いに貢献

小山ひさ子先生
SILSO : 1947-1996
実観測 : 1945-1996

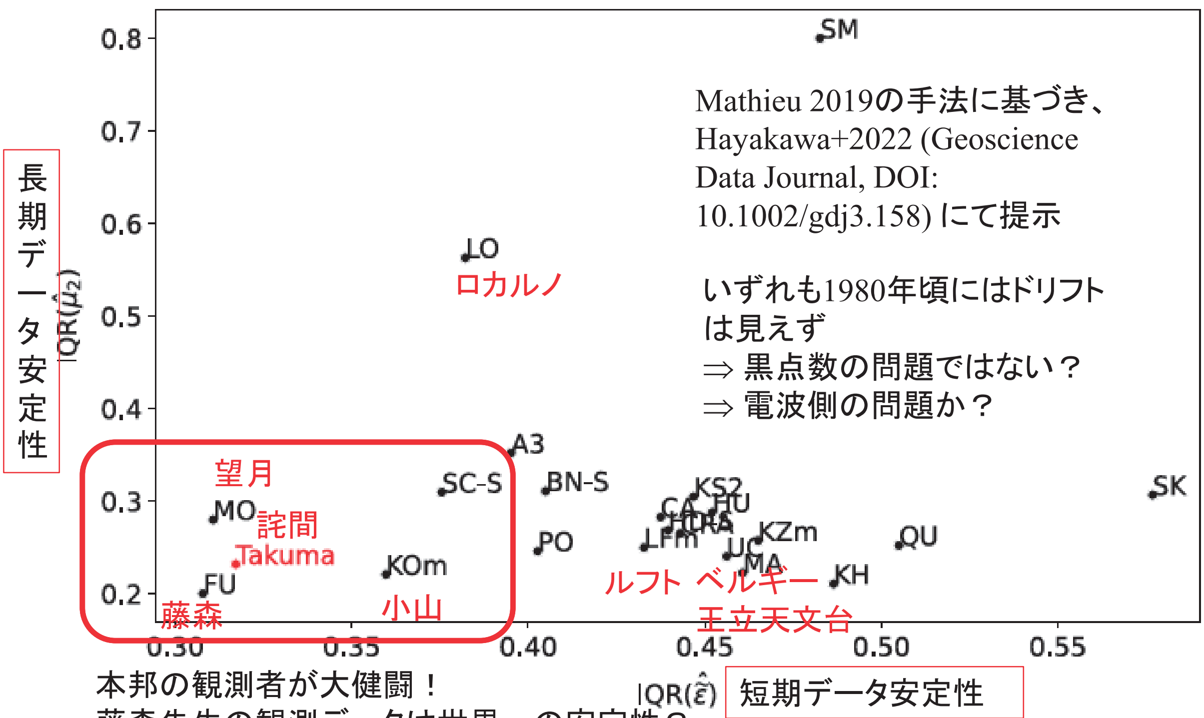
藤森賢一先生
SILSO : 1968-2022
実観測 : 1954-2022 [68!!]

詫間等先生
SISLO : データなし
実観測 : 1972-2013



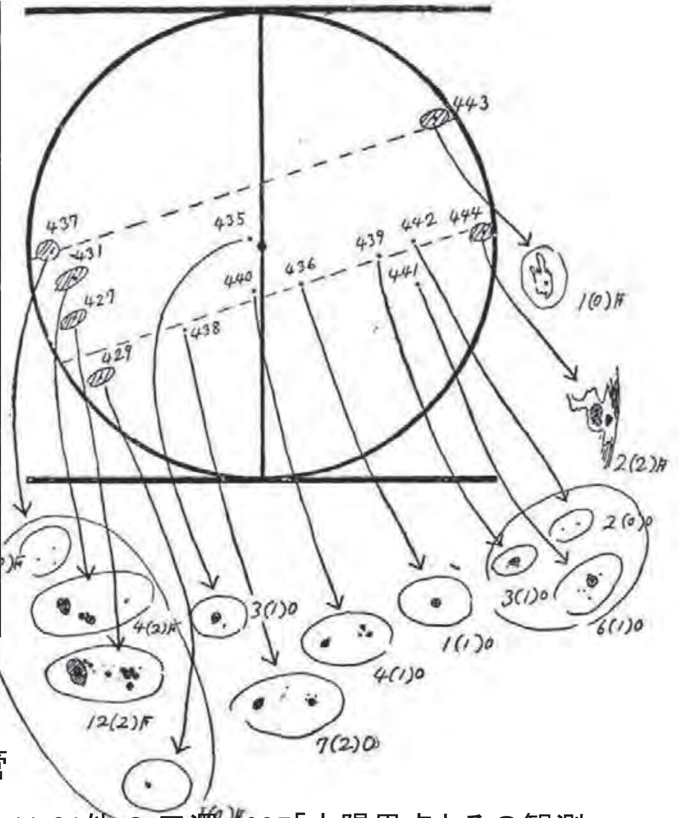
Hayakawa+2019 (MNRAS, 492, 4513), Hayakawa's personal photo, and 清水（1983, 太陽観測）

各観測者のデータ安定性



本邦の観測者が大健闘！
藤森先生の観測データは世界一の安定性？
シフトを組んでいると個人観測者ごとにデータの短期安定性が揺れる

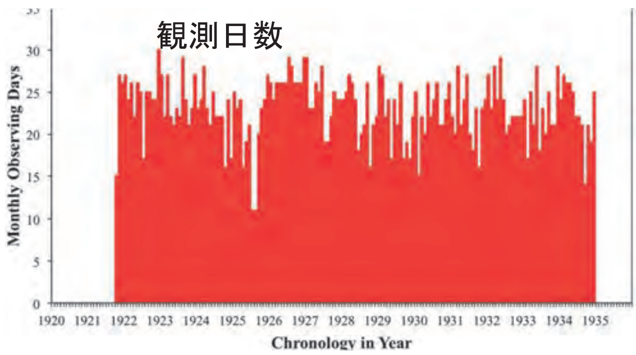
三澤勝衛の黒点観測: 1921-1934

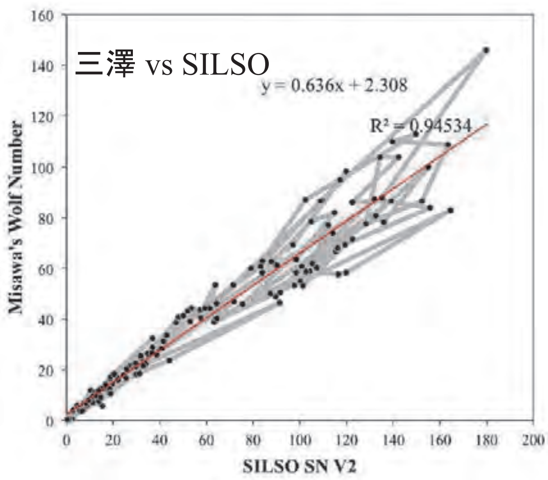


三澤勝衛: 1885 – 1937
⇒ 太陽黒点観測 1921 – 1934
⇒ オリジナルの記録は三澤文庫に保管

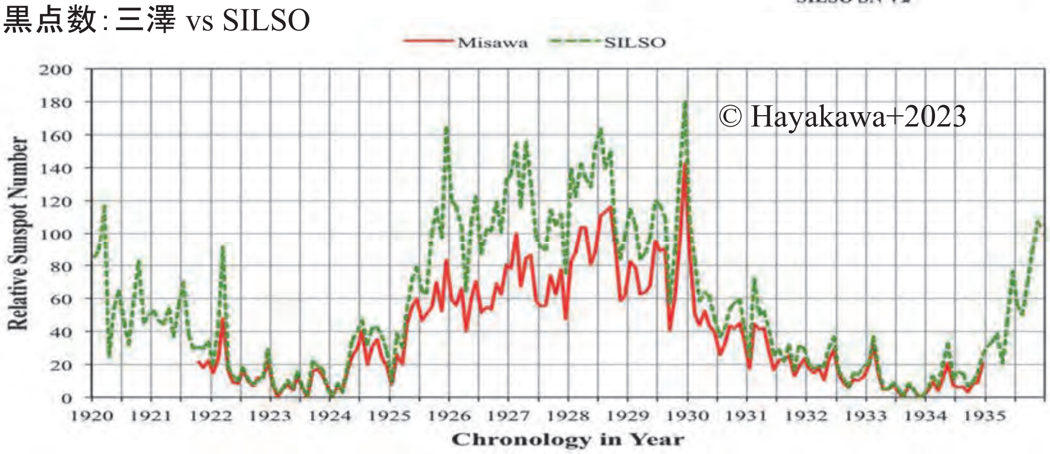
黒点スケッチ 1929-11-21他 © 三澤 1937「太陽黒点とその観測」

三澤黒点観測

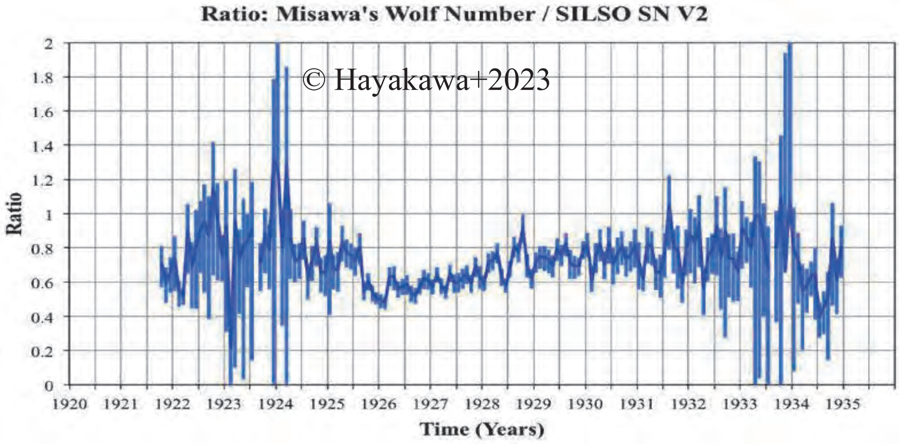


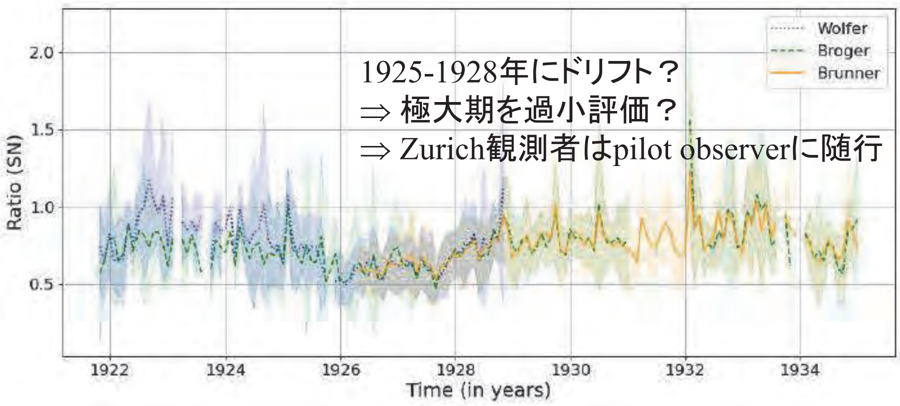


黒点数: 三澤 vs SILSO

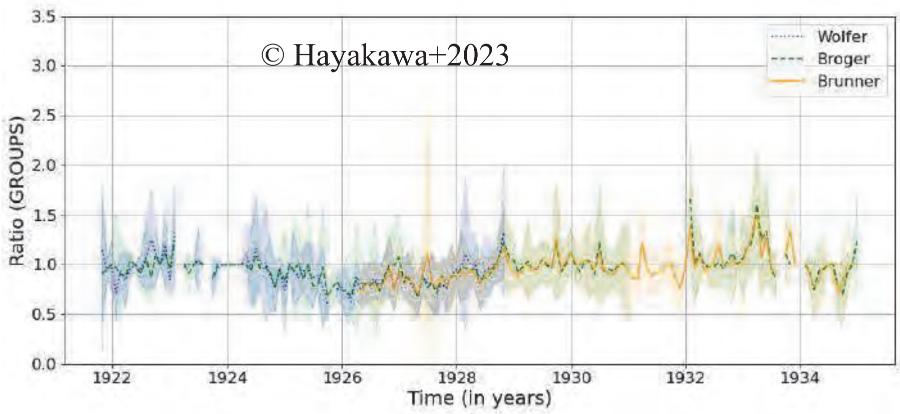


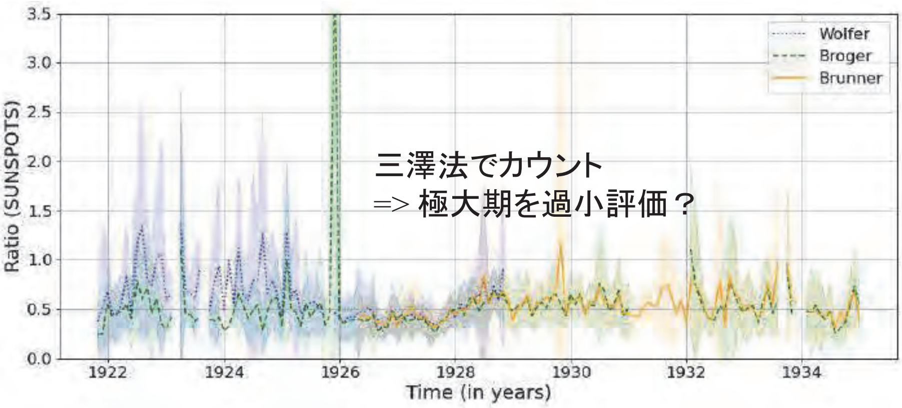
三澤勝黒点観測の安定性：比率





三澤勝黒点観測の安定性：比率





まとめと展望

- 太陽黒点観測: 人類最長の科学観測 & 市民科学案件
  - 過去413年の時を越えて太陽活動を知るための根本資料
- 黒点数の再較正は現在も進行中
  - 現代側でもデータの再検討が必要（1926-1928, 1945-1950, 1980-1985など）
- 黒点数データベースの基礎は個別観測者のデータ
  - 個人観測者も数多く貢献
  - 本邦からも小山、藤森、望月、詫間など
- 本邦の観測データは部分的にしか知られていない => 分析・再検討
  - 小山、詫間などのデータを改訂・追加
  - 世界屈指のデータ安定性
  - 小山、詫間、三澤データ他は黒点数再較正にも新たに反映
  - SN ver 3に反映予定

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