Letters submitted to PNAS for the paper 'Slowdown of the Walker circulation at solar cycle maximum', by Stergios Misios, Lesley J. Gray, Mads F. Knudsen, Christoffer Karoff, Hauke Schmidt, and Joanna D. Haigh, (2019), PNAS, 116 (15) 7186-7191.
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Is it always Slowdown of the Walker circulation at solar cycle maximum?

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This article [1] does not comply with many published observational results. This letter highlights those areas and pinpoints discrepancies.

High solar years show cooling in central tropical Pacific before 1957 and after 1998: During that period, high solar years those include peak (or max) solar years, 1-year lag and 2-year lag, all are dominated by the cold event(C) of ENSO (Table-1,(2,3)). Warm ENSO years(W) in Table 1 are only noticed when SSN is sufficiently low, as seen in Fig.1(4,5).

Intervening Period of 1958 to 1997: Solar max or peak years are dominated by cold events(C) of ENSO (Table 1). For all solar cycles, it is warm ENSO (W) in one-year lag. In Fig. 1 also, either using SSN version 1 or 2, solar max (red squares) are still biased towards cold ENSO. Other high solar years, however, do not show any preferences like the earlier period.

Throughout the overall 15 solar cycles, a total of 12 out of 15 solar max years lie on the cold ENSO side (Fig 1, red squares). That is the reason, studies those focused only on peak or max solar years (6) observed a very significant cooling around tropical Pacific for the last 150 years and indicated a strengthening of Pacific Walker Circulation (PWC). Fig. 1 and Table 1 focuses Dec-Jan-Feb (DJF), because ENSO amplitude peaks at northern winter and hence the connection between SSN and ENSO(if any), should be better captured.

The sun (represented by SSN) and ENSO connection-contradiction and possible reconciliation were addressed extensively by previous studies (3,7). Those elaborately discussed contradictory findings (6,8). Solar related possible mechanisms, around the tropical Pacific, which is different in earlier and later periods are also addressed very recently ((4), Fig.3) that considered atmosphere-ocean feedback. The recent study (1) only matches with the work of (8) that focused the period of later half of the twentieth century and found warming in tropical Pacific with high SSN.

Hence the overall analyses raise questions on 'SC forcing is a source of skill for decadal predictions in the Indo-Pacific region' and similar arguments.

Studies found an intensification of the ITCZ around central Pacific in zero-lag, that usually strengthens PWC ((9), their Fig. 1), not weakens and hence wrong referencing. Considering all months of the year, it finds very nominal warming for SSN in central Pacific for 155 years period ((9), Fig 2a) and no warming for earlier period before the 1950s ((3), Fig.11).

The intensification of SLP around ITCZ is also present in observational record of one-year lag for 150 years record ((4), Fig6a). However, it is sensitive to the time period chosen (earlier or later). Interestingly, the later period suggests an insignificant influence of the SSN on tropical Pacific SLP. It is also true for zero-lag case for later periods though significant for earlier period (3).

Since 1998, high SSN suggests cold ENSO (Fig.1, Table-1) and thus strengthens PWC. Moreover, increased GHG also causes a strengthening of PWC since 1998, without even considering any SSN (10). (Hence Abstract, last line, incorrect).

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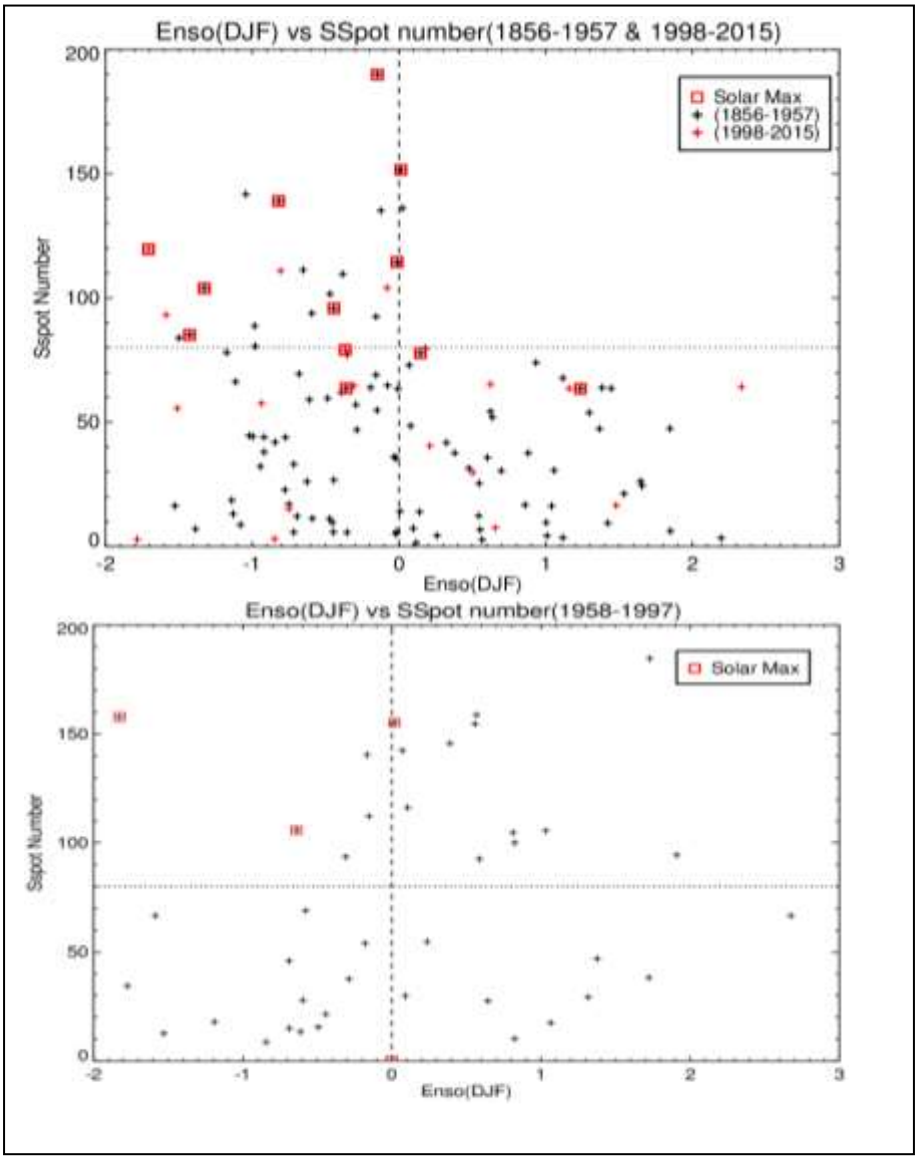
Figure Legend:

Fig. 1. Average ENSO (DJF) (measured in terms of Nino3.4) against annual average Sunspot number (SSN). a) uses SSN version 1 for 1856-2015 and bottom panel separates period 1958-1997 ((4), their Fig. 4); b) uses SSN version 2 for 1856-2016 and right panel segregates period 1958-1997 ((5), their Fig. 10B). For Fig. 1a (top) and Fig. 1b (left), all points above horizontal line, i.e., when SSN is sufficiently high, lie on the cold event (C) side of ENSO (including solar max year, 1-year lag and 2-year lag). A threshold of SSN, above which, it is always cold ENSO, is 80 for SSN version 1 (Fig. 1a, top), while 120 for SSN version 2 (Fig. 1b, left). The rest two plots for the intervening period do not show any such bias for high SSN (above threshold).

a)


Enso(DJF) vs SSpot number(1856-1957 & 1998-2015)
Solar Max
(1856-1957)
(1998-2015)
Sspot Number
Enso(DJF)
Enso(DJF) vs SSpot number(1958-1997)
Solar Max
Sspot Number
Enso(DJF)

b)

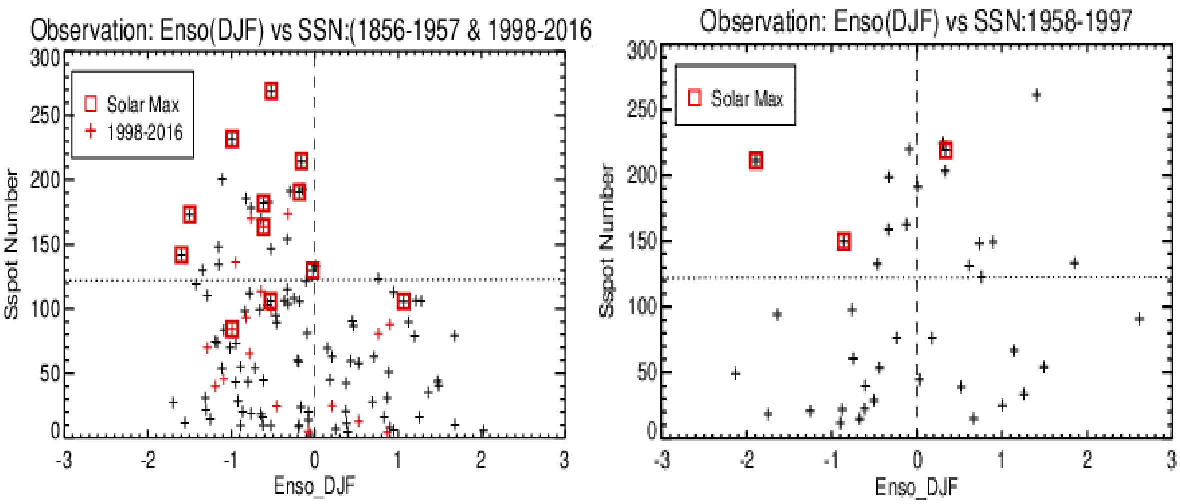

Observation: Enso(DJF) vs SSN:(1856-1957 & 1998-2016
Solar Max
1998-2016
Sspot Number
Enso_DJF
Observation: Enso(DJF) vs SSN:1958-1997
Solar Max
Sspot Number
Enso_DJF

Table 1 The ENSO (DJF) value at the year of peak SSN (using version 1), and the following two years, during 1856–2007. ‘C/W’ indicate that the ENSO 3.4 index is 0.02 units lower/higher than its average value, while ‘-‘ indicates a near neutral state ((2), their Table 1). The horizontal dashed lines indicate a period separated based on slowing down of the oceanic Meridional Overturning Circulation (MOC); weakening of both the Hadley and Walker cell (more for Walker cell) (3). Over the ‘Total**’** period (bottom row), peak year, 1-year lag and 2-year lag all are outnumbered by ‘C’. Used with permission, © American Meteorological Society.

Solar Cycle no	**Years**	**Peak Year**	**State of ENSO (DJF)**		
			peak year	**1 y after peak y**	**2 y after peak y**
10	1856-1867	1860	C	C	C
11	1867-1878	1870	C	C	C
12	1878-1890	1883	C	-	W
13	1890-1901	1893	C	C	C
14	1901-1913	1905	W	W	C
15	1913-1923	1917	C	C	W
16	1923-1933	1928	W	C	W
17	1934-1944	1937	-	C	C
18	1944-1954	1947	-	W	C
19	1955-1964	1957	C	W	W
20	1964-1976	1968	C	W	W
21	1976-1986	1979	-	W	C
22	1986-1996	1989	C	W	W
23	1996-2007	2000	C	C	C
Total			**9 C 3 – 2 W**	**7 C 1 – 6 W**	**8 C 0 – 6 W**