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The Solar System Large Planets influence on a new Maunder Minimum

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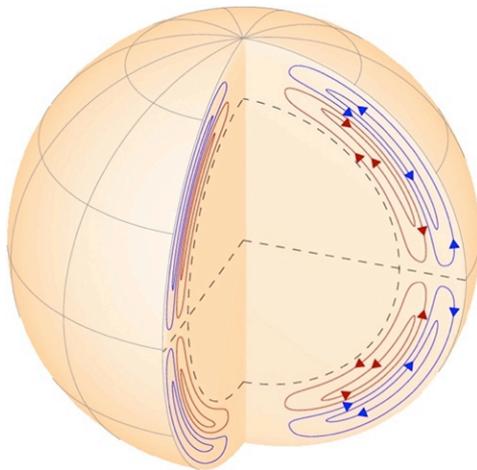
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Research question

1. Is there a next minimum sun irradiation period coming?

1. A new Maunder irradiation minimum?



Maunder minimum:

A cold period from: 1640-1720

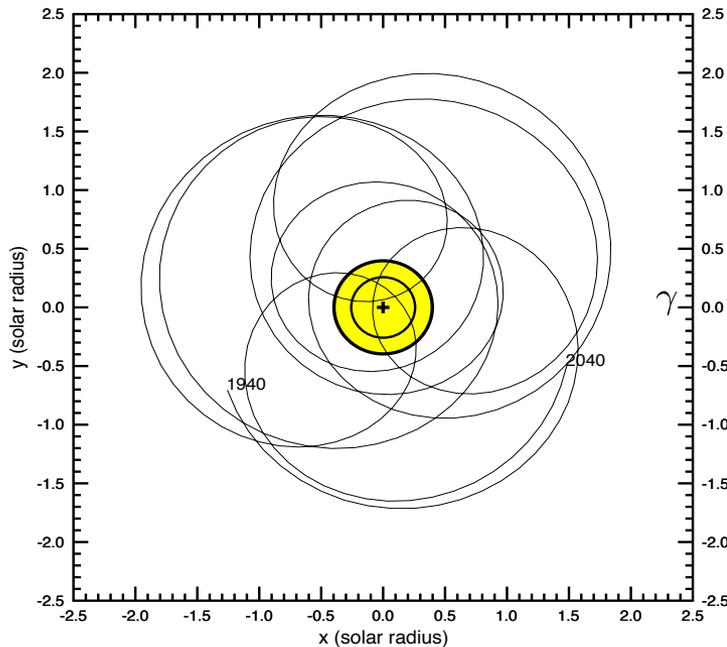


**Total Solar Irradiation
Sunspots**

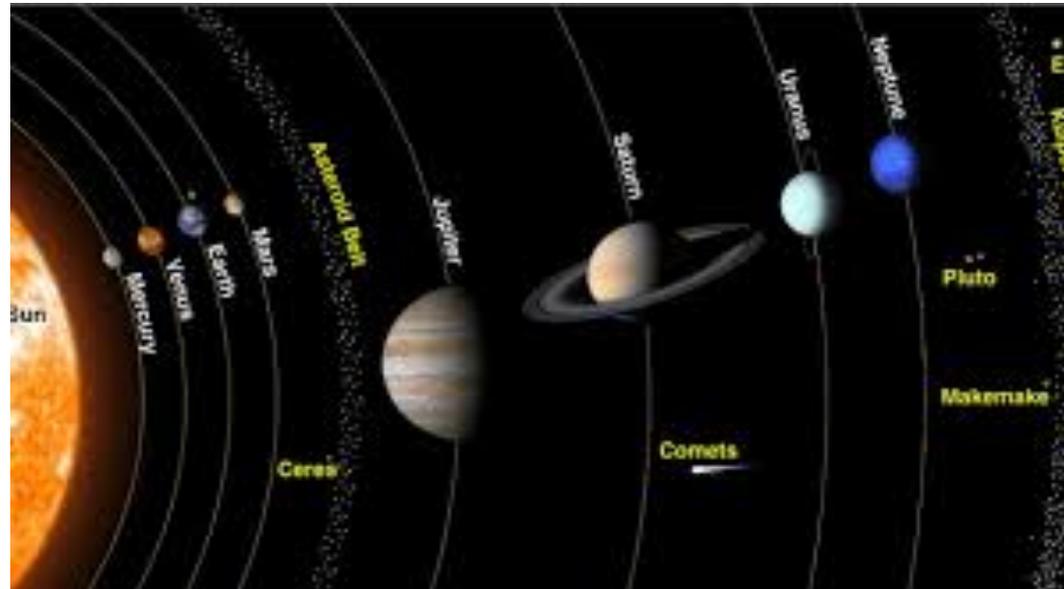
Solar System Oscillation

Mutual gravity between the sun and the planets

Sun Position Oscillation



Mutual gravity

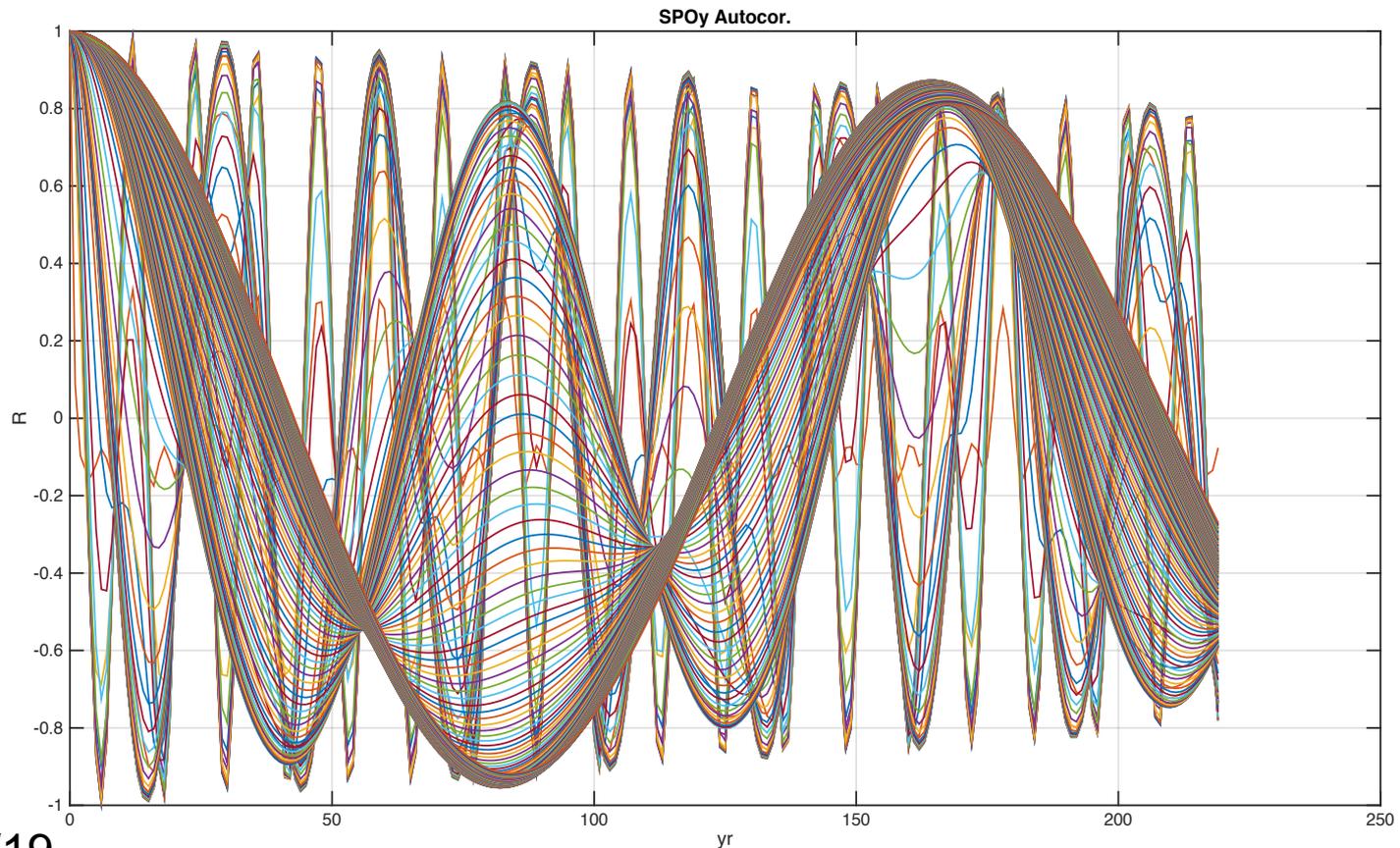


Sun Position Oscillation

Wavelet spectrum autocorrelations

Controlled by the large planets

Jupiter:12yr, Saturn: 29yr, Neptune:84yr, Uranus:164yr

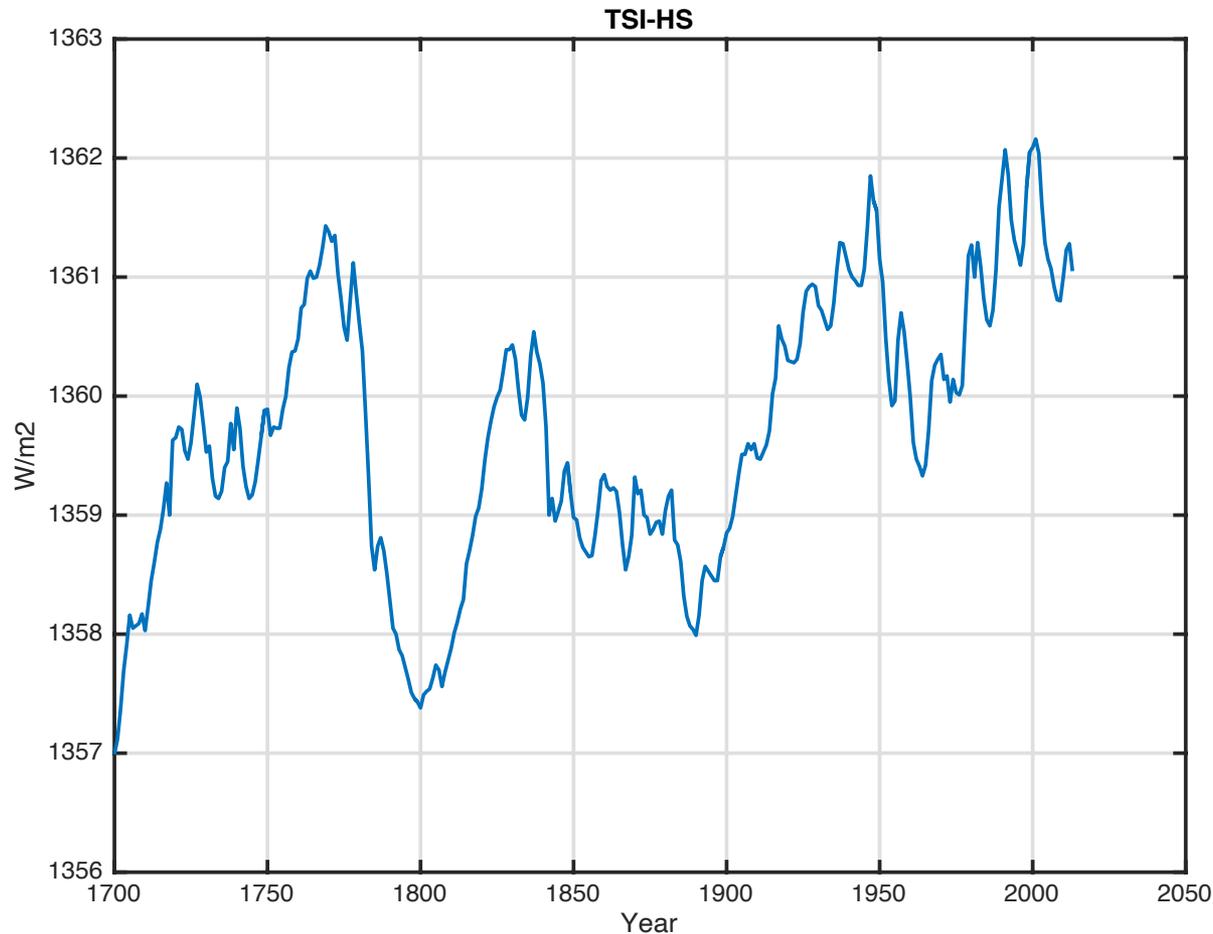


10/16/19

1700-2013: Total Solar Irradiation

ACRIM TSI (Hoyt-Schatten) (Scafetta and Willson 2014)

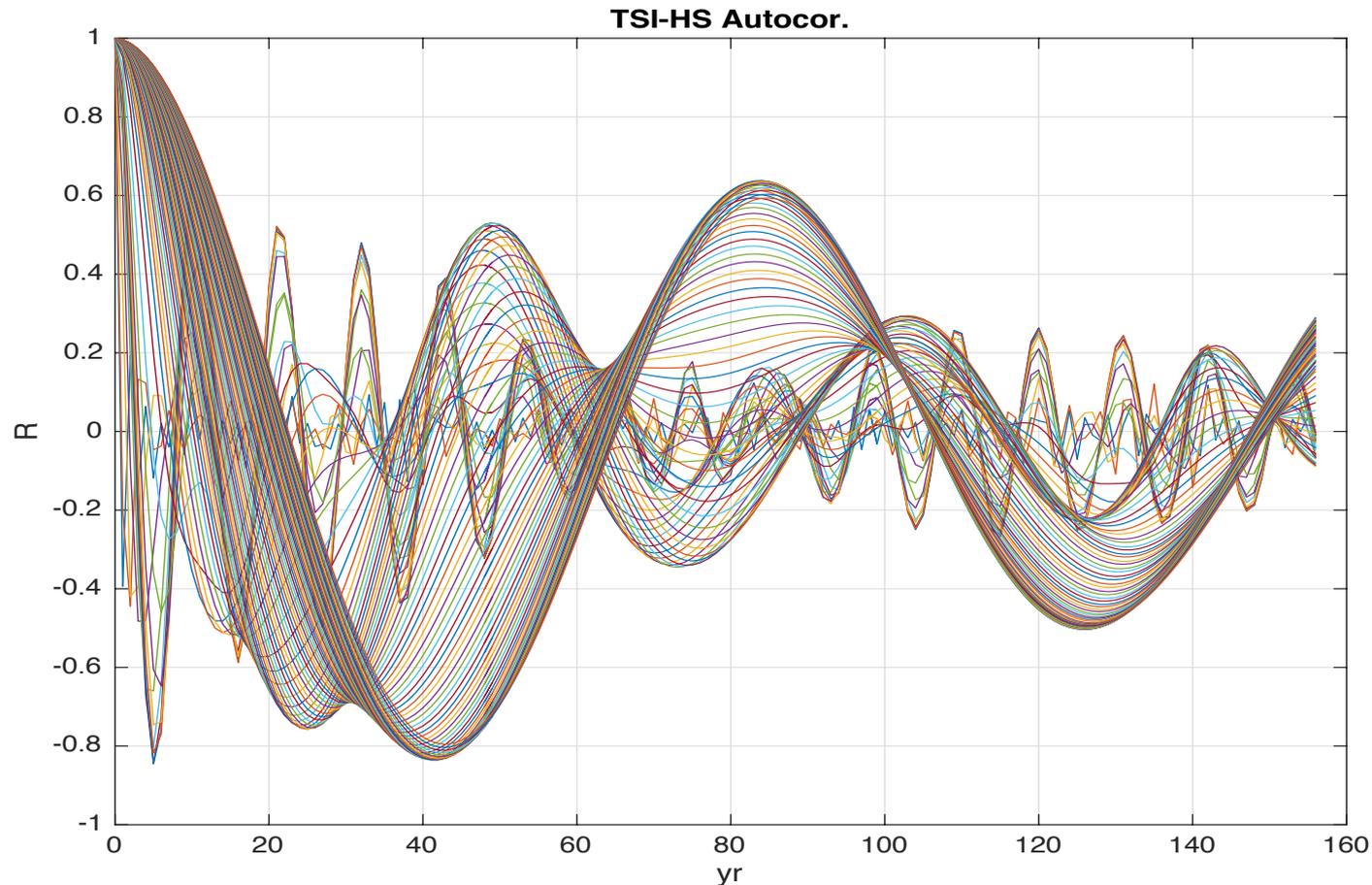
Stationary periods?



1700: Total Solar Irradiation

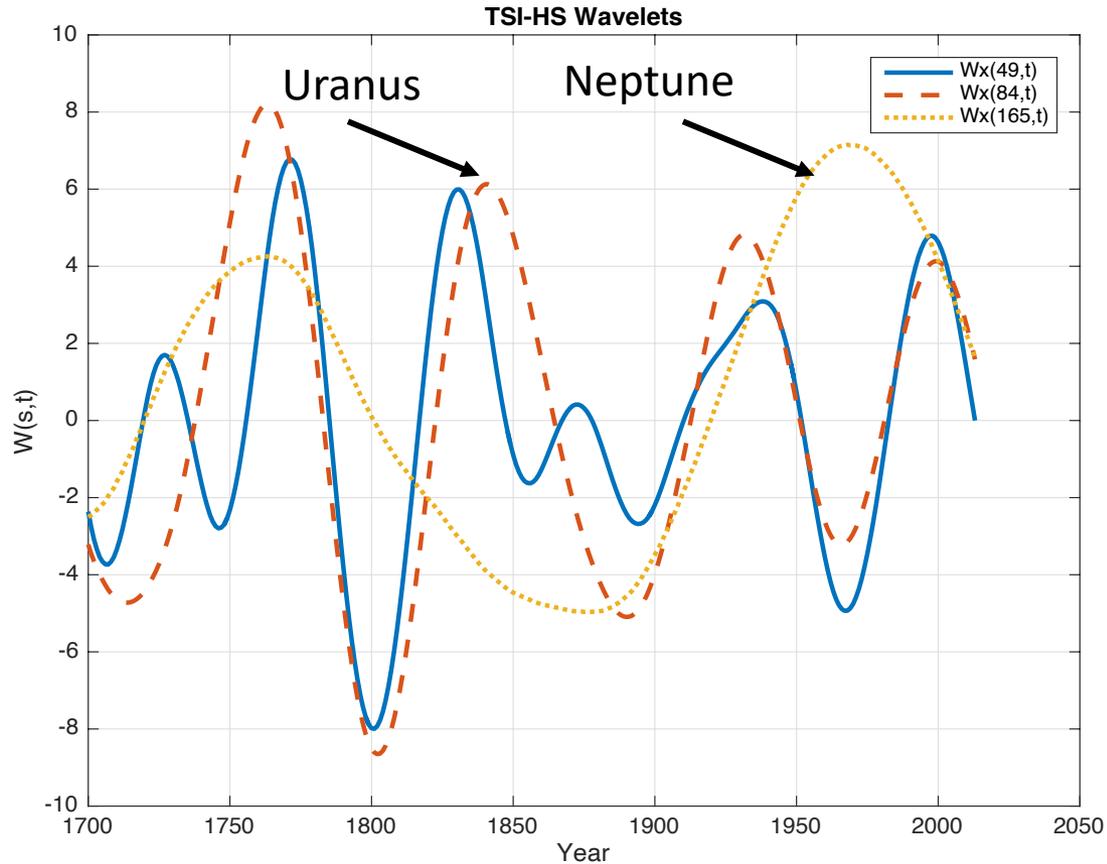
Wavelet spectrum autocorrelations

Periods: 11yr (Jupiter); 49 yr; 84 yr (Neptune); 164 yr (Uranus)



1700: Total Solar Irradiation

Stationary periods



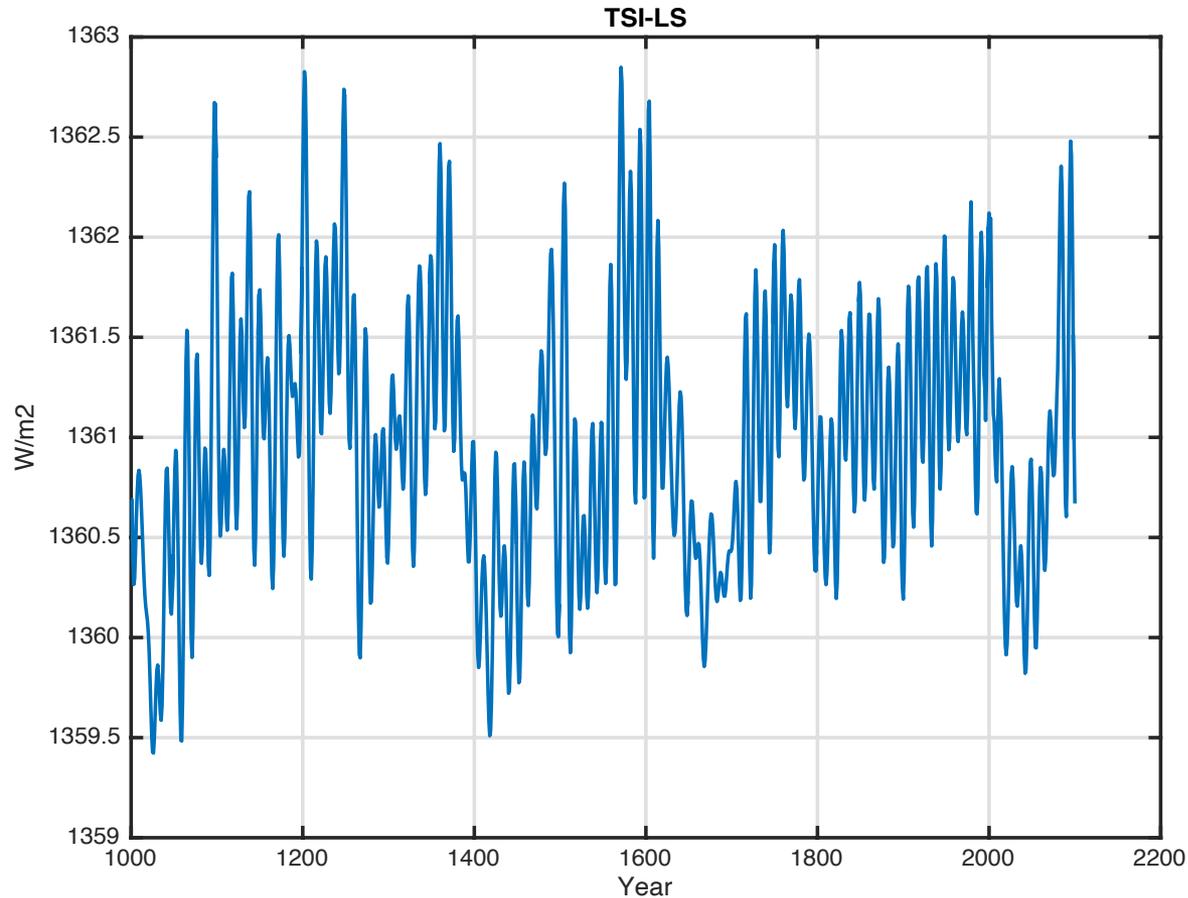
Dalton



1000-2100: Total Solar Irradiation

Estimated TSI from 1000 A.D (Velasco Herrera et al. 2015)

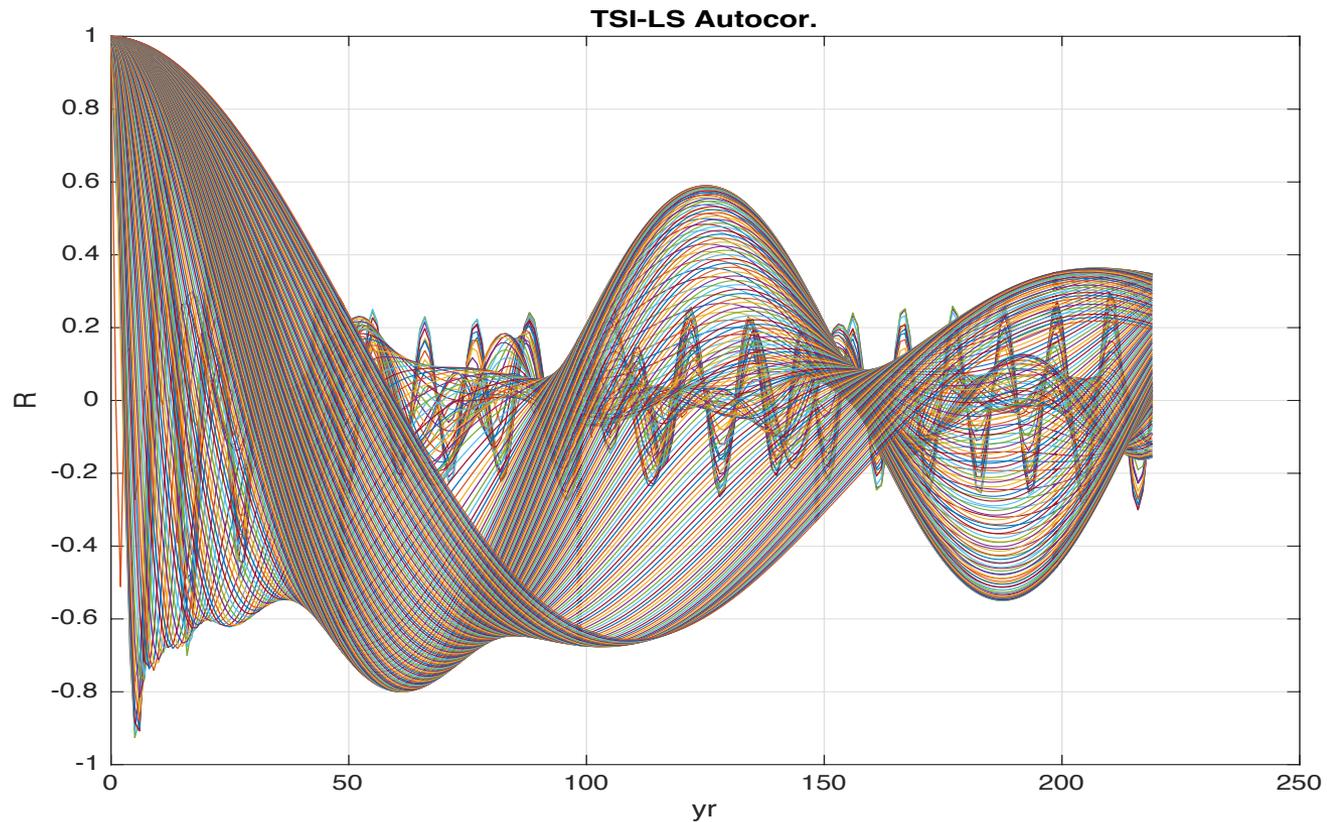
Longer stationary periods?



1000: Total Solar Irradiation

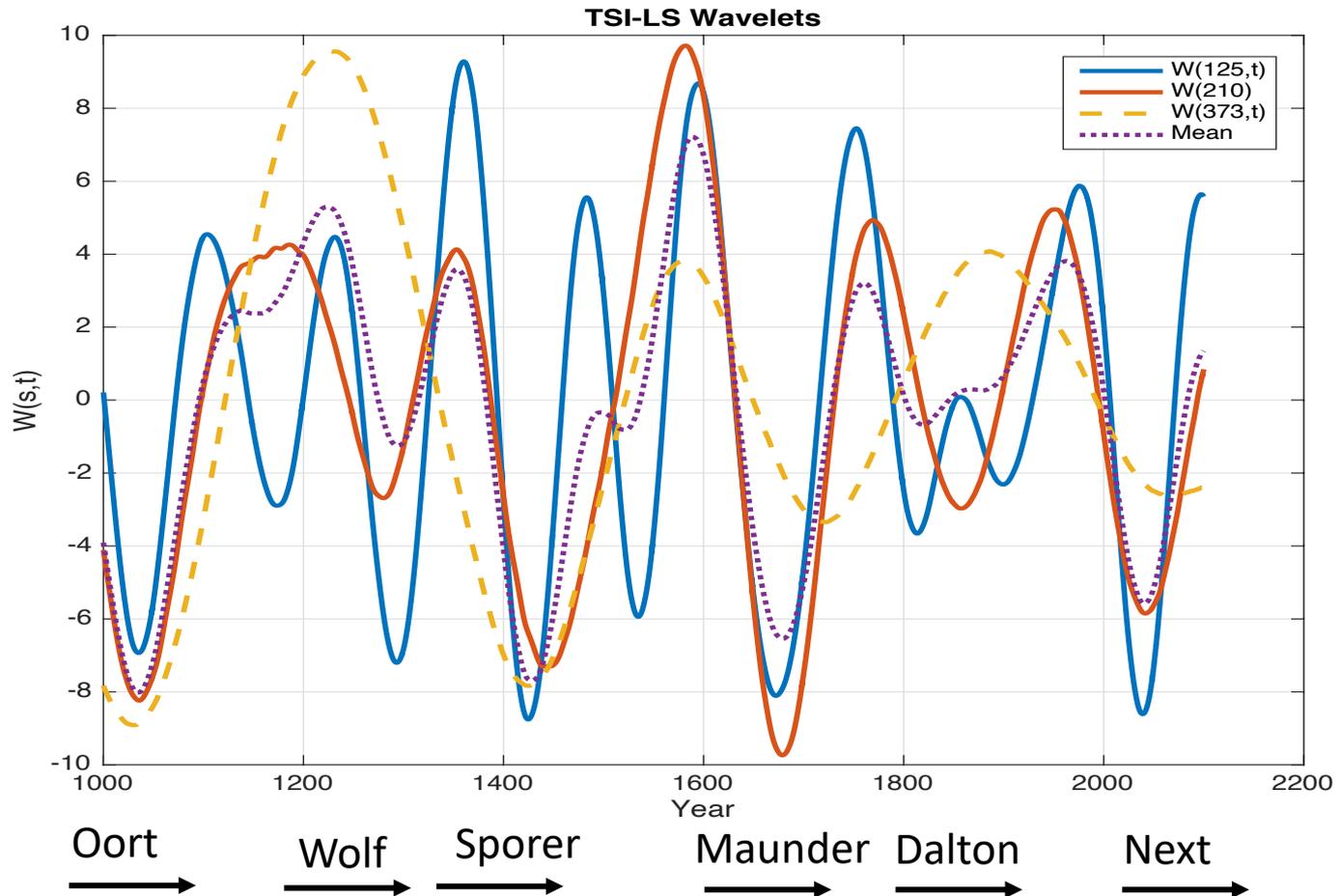
Wavelet spectrum autocorrelations

Periods: 11 yr (Jupiter); 125 yr; 210yr



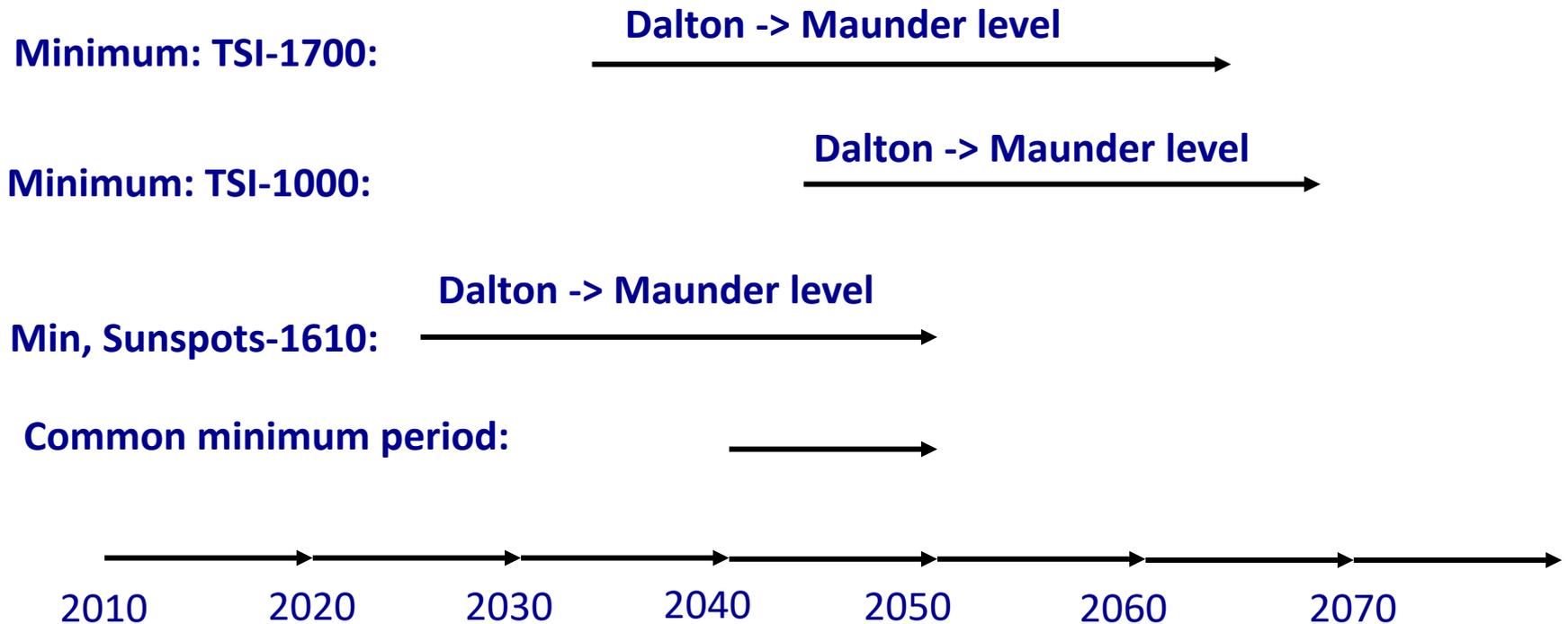
1000-2100: Total Solar Irradiation

*Stationary wavelet periods and
known minimum irradiation periods*



Estimated Next Maunder period

Computed Next minimum periods



Research results

1. Is there a next minimum?

From new long TSI-data series, we may expect

A new minimum period from about 2040-2050

2. Is the minimum a Maunder period?

From these data series, we may expect

A Dalton to Maunder level period

A photograph of a modern university building with a rainbow in the sky and mountains in the background. The building is a large, multi-story structure with a white facade and many windows. A vibrant rainbow arches across the dark, cloudy sky above the building. In the background, there are snow-capped mountains under a blue sky with scattered clouds. The foreground shows green trees and a paved area.

Thank you

My campus, at the end of the rainbow

<http://www.ntnu.no/ansatte/harald.yndestad>

Identified Stationary Periods

The stationary periods

Data	Per, R	Per, R	Per, R	Per, R	Per, R	Per, R	Per, R	Per, R
Planet period	P(Jupiter, 11.862)	P(Saturn, 29.447)	P(55= 2*84.02/3)	P(Uranus, 84.02)	P(110= 4*84.02/3)	P(Neptune, 164.79)	P(210= 3*84.02/2)	P(373= 5*84.02/2)
SPO	P(spo,12), R=0.98	P(spo,29), R=0.95		P(spo,84), R=0.9		P(spo,165), R=0.9		
TSI-HS	P(hs,11), R=0.55			P(hs,84), R=0.65		P(hs,164), R=0.7		
TSI-LS	P(ls,11), R=0.8	P(ls,29), R=0.2		P(ls,83), R=0.17	P(ls,125), R=0.6		P(ls,210), R=0.35	P(ls,373), R=0.5
SN	P(sn,11), R=0.73		P(sn,55), R=0.43	P(sn,86), R=0.35	P(sn,110), R=0.4		P(sn,210), R=0.36	

Minimum Irradiation Periods

Relation to known periods

Data series	Oort	Wolf	Sporer	Maunder	Dalton	Next
Min per Usoskin	1010-1070	1270-1340	1390-1550	1640-1720	1790-1820	
P(spox,84 max)	1127	1296	1462	1630	1798	1965,2065
P(spo,84 max)	1152	1320	1487	1654	1821	1989
P(psox,84,164,vel)	1152	1320	1487	1654	1821	1989
P(psoy,29,84,164)			1488			1990
HS model period	1033-1055	1369-1389	1537-1534	1706-1721	1796-1830	2035-2065
P(hsc, t)	<-1.0	<-1.00	<-1.0	<-1.0	<0	<-0.70
HS model,	1040	1337	1547	1714	1810	2049
P(lsc, t) min	-1.30	-1.23	-1.87	-1.13	-0.33	-1.0
LS model period	1014-1056	1276-1301	1404-1435	1657-1689	1785-1810	2045-2070
P(lsc, t)	<-1.0	<-0.5	<-1.0	<-0.70	<-0.70	<-0.70
LS-state	1035	1289	1418	1672	1796	2060
P(lsc, t) min	-1.40	-0.62	-1.20	-0.91	-0.81	-0.79
SN model period	1019-1032	1242-1256	1467-1478	1693-1699	1802-1820	2025-2050
P(snc, t)	<-1.0	<-1.0	<-1.0	<-1.0	<-0.5	<-0.5
SN model	1026	1249	1473	1696	1811	2035
P(snc, t) min	-1.7	-1.18	-1.13	-1.04	-0.70	-0.84