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The Solar System Large Planets influence on a new Maunder Minimum

*Harald Yndestad *) and Jan-Erik Solheim **)*

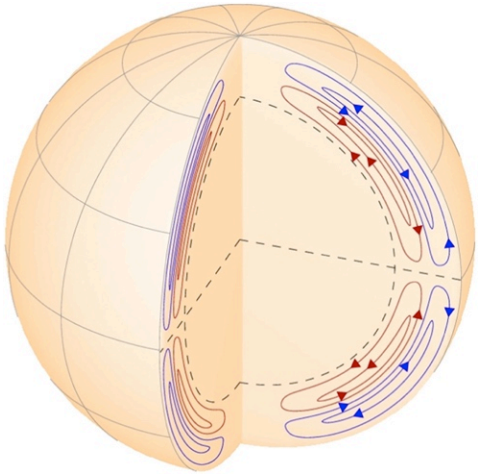
**) Norwegian University of Science and Technology*

***) University of Tromsø, Norway*

Research questions

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

2. **A new Maunder irradiation minimum?**



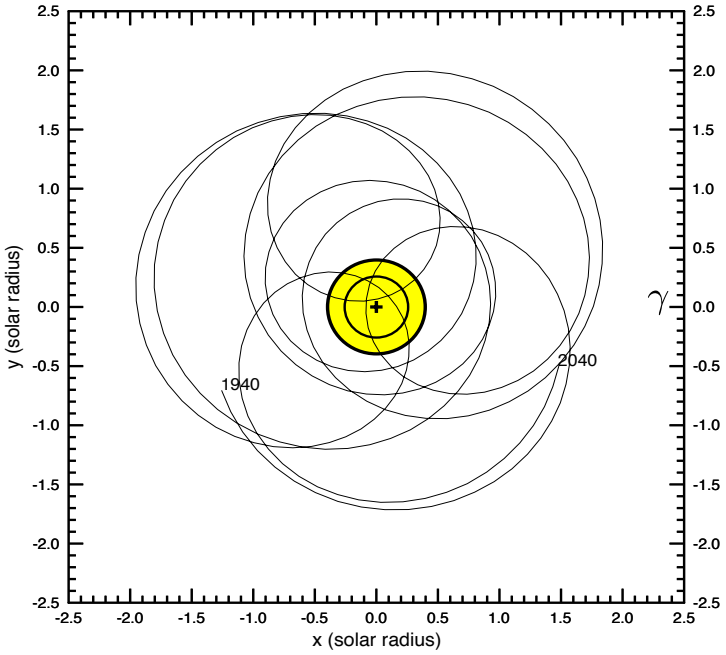
Maunder minimum:
A cold period from: 1640-1720

Total Solar Irradiation
Sunspots

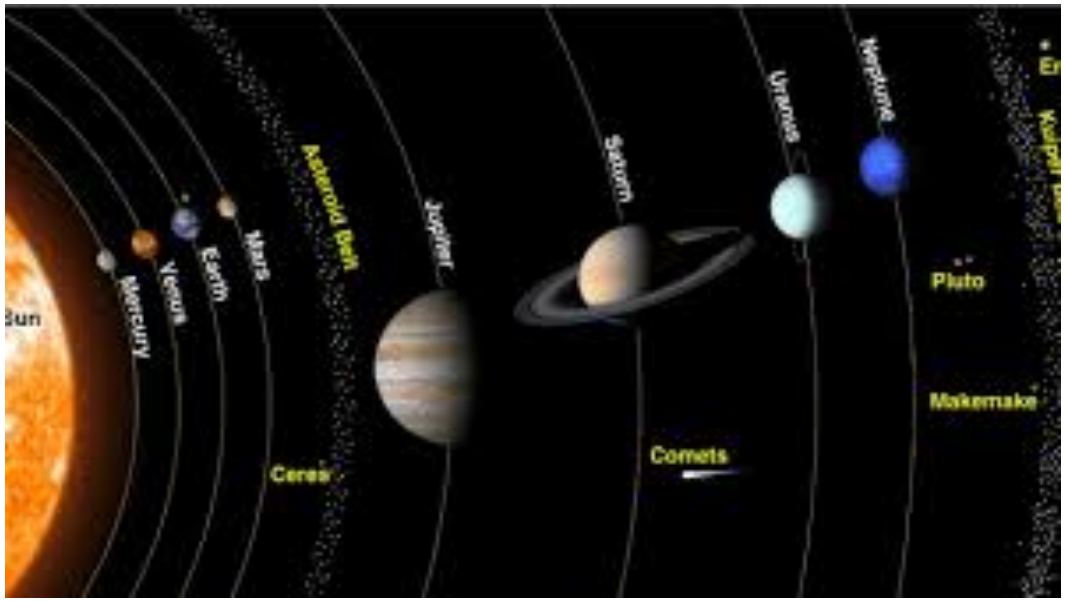
Sola System Oscillation

Mutual gravity between the sun and the planets

Sun Position Oscillation



Mutual gravity

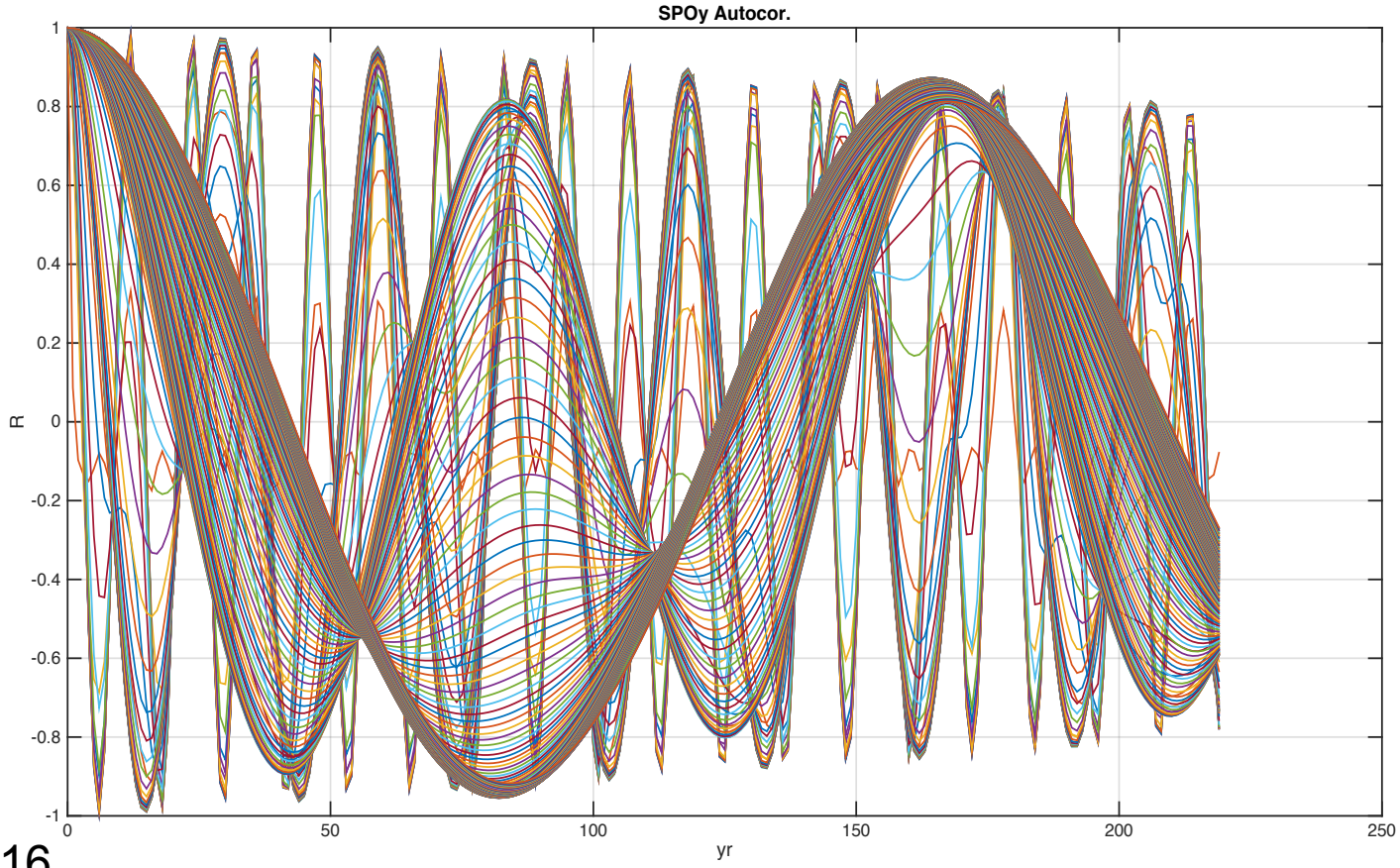


Sun Position Oscillation

Wavelet spectrum autocorrelations

Controlled by the large planets

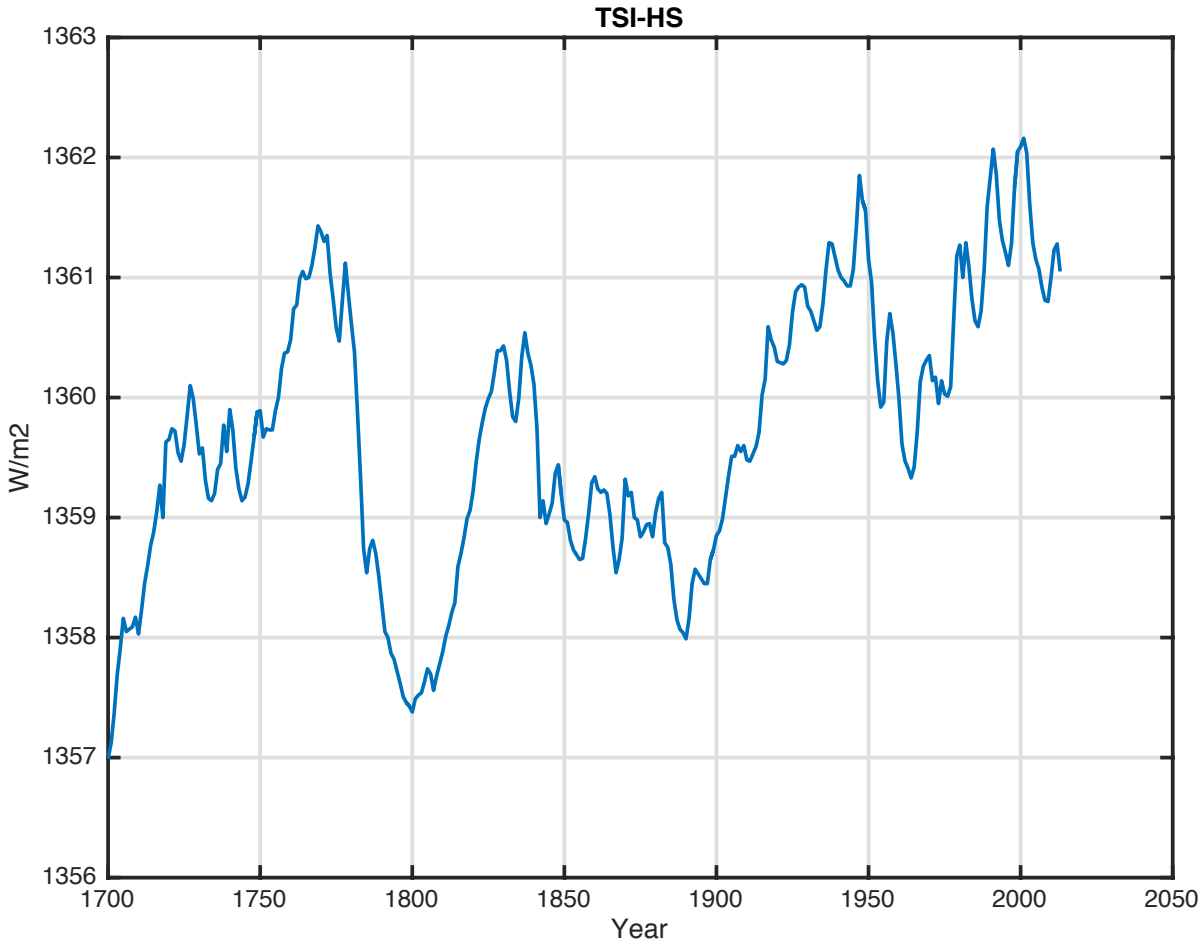
Jupiter:12yr, Saturn: 29yr, Neptune:84yr, Uranus:164yr



1700-2013: Total Solar Irradiation

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

Stationary periods?



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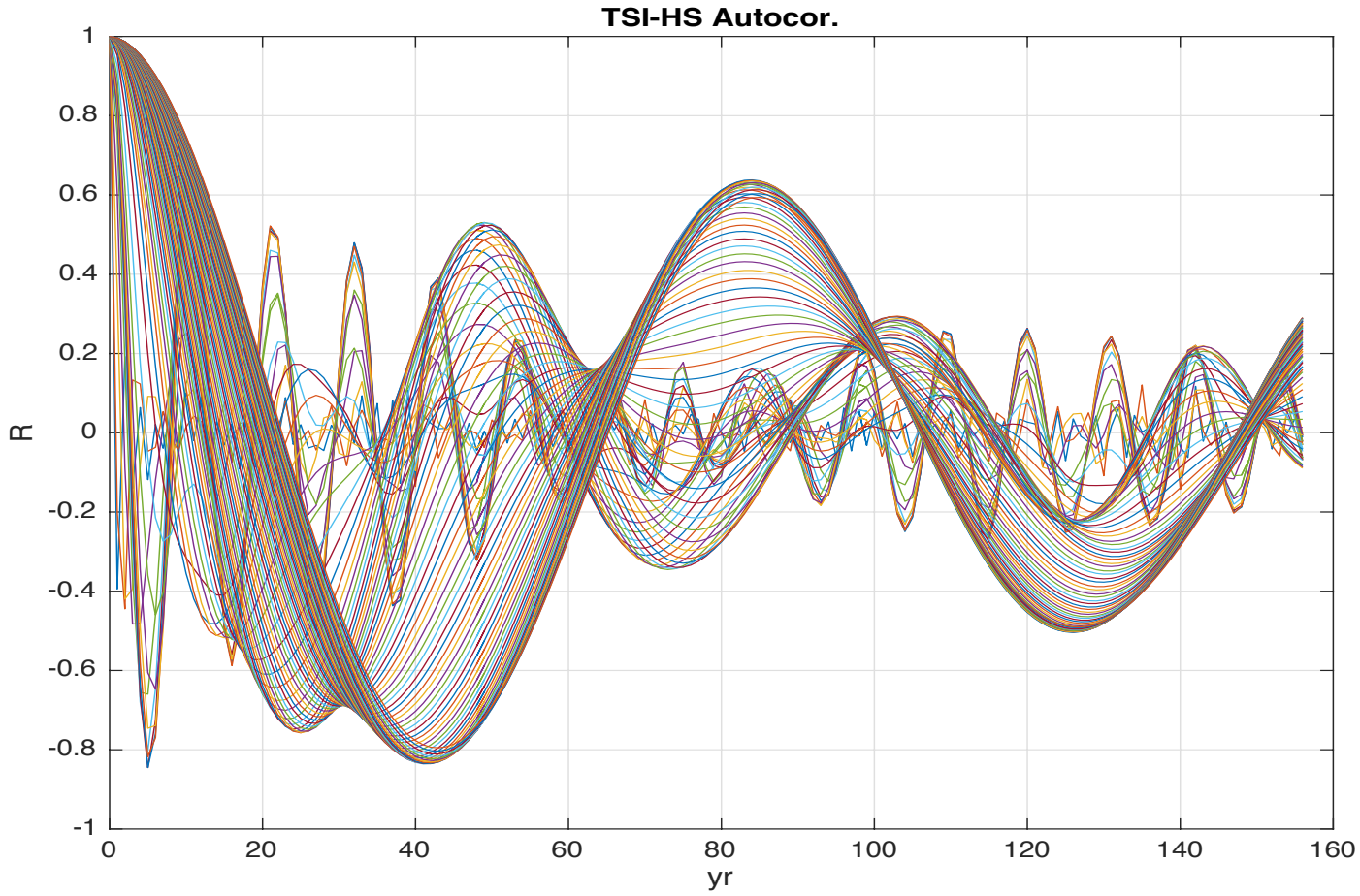
1700: Total Solar Irradiation

Wavelet spectrum autocorrelations

Periods: 11yr (Jupiter); 29yr (Saturn); 84yr (Neptune); 164 yr (Uranus)



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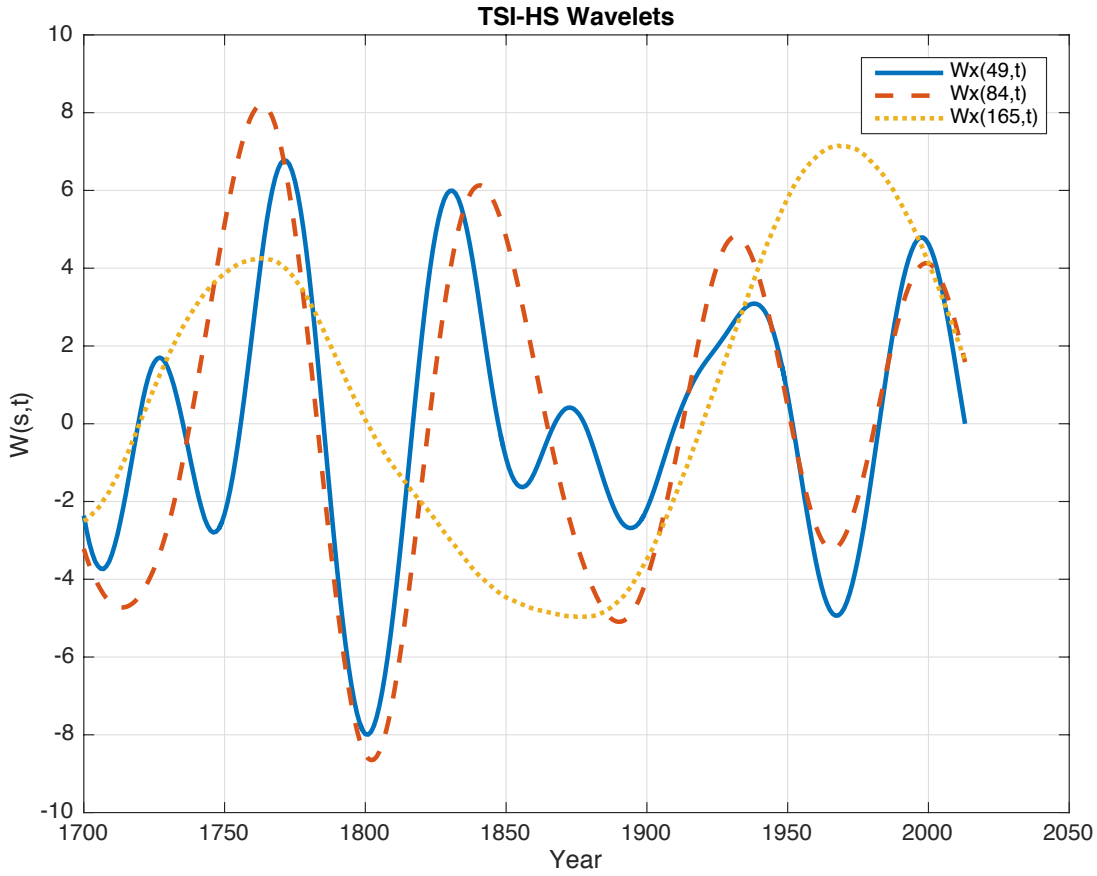
NTNU

1700: Total Solar Irradiation

Stationary periods



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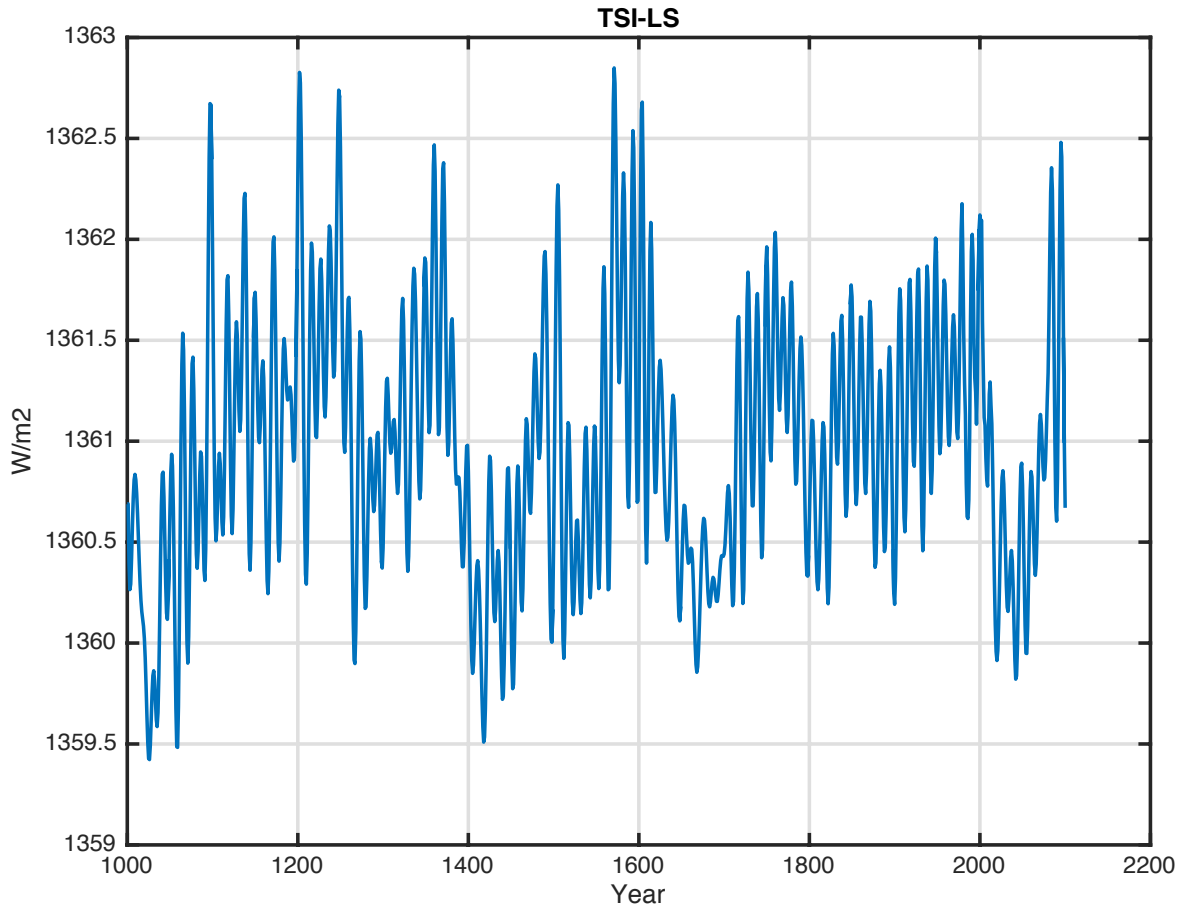
1000-2100: Total Solar Irradiation

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

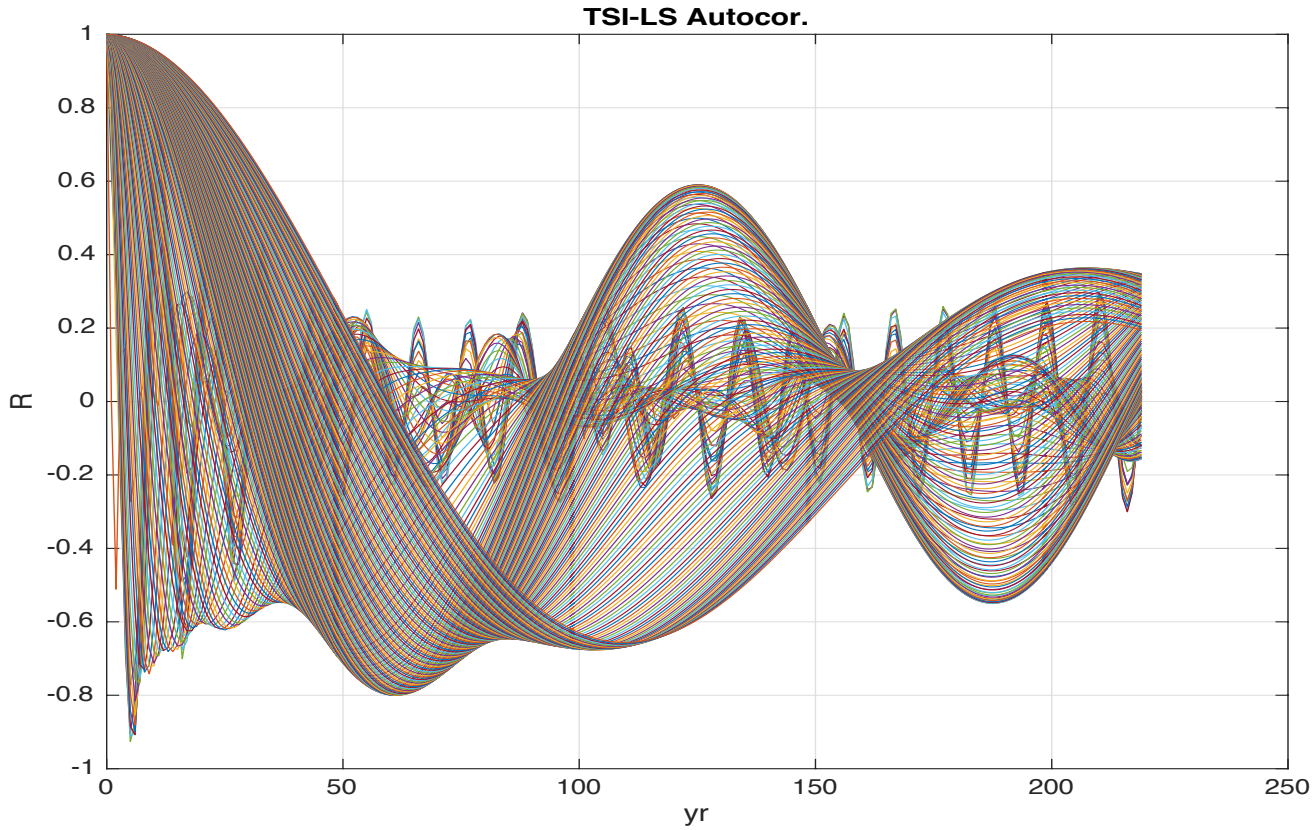
Longer stationary periods?



1000: Total Solar Irradiation

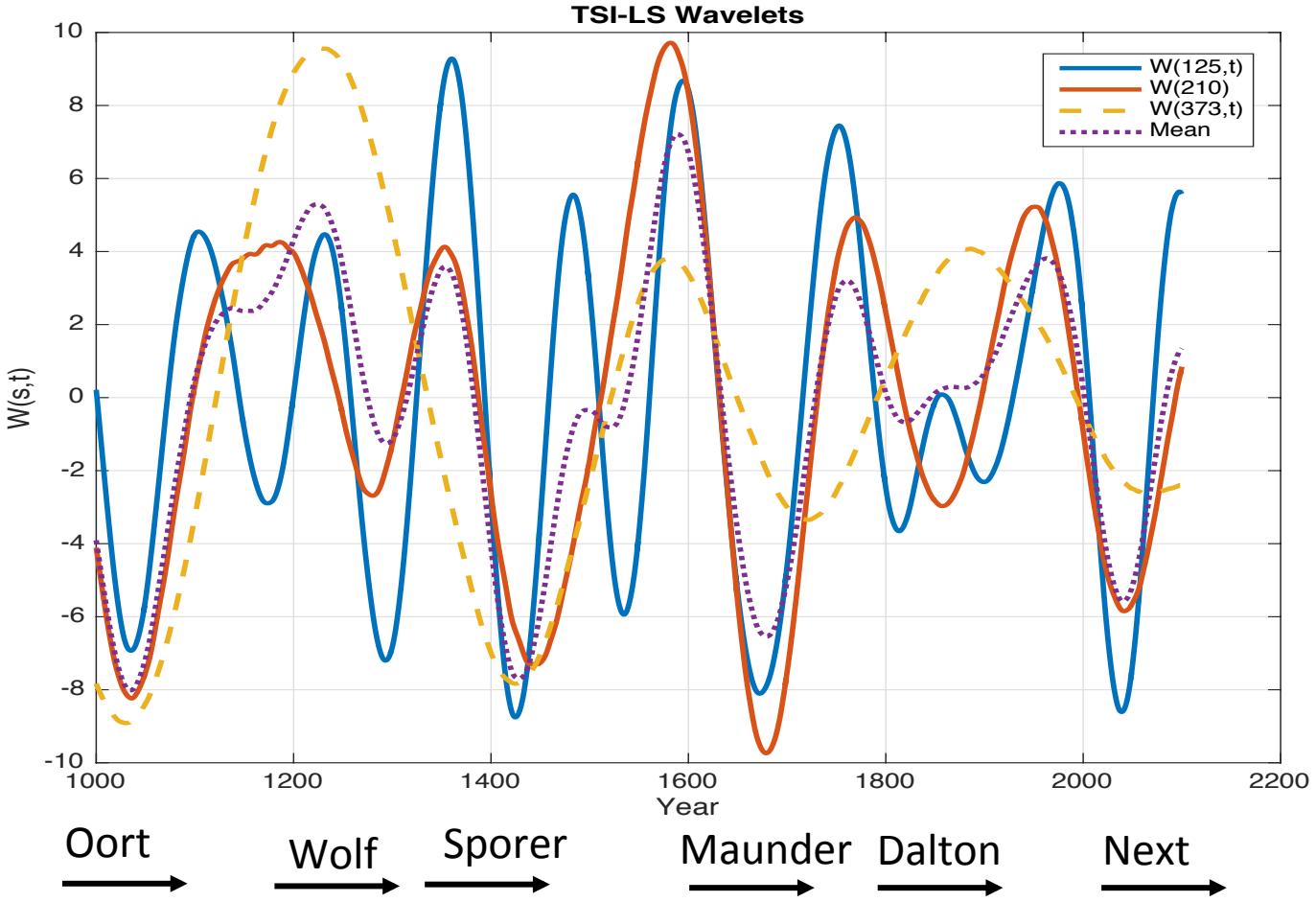
Wavelet spectrum autocorrelations

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



1000-2100: Total Solar Irradiation

Stationary wavelet periods and known minimum irradiation periods



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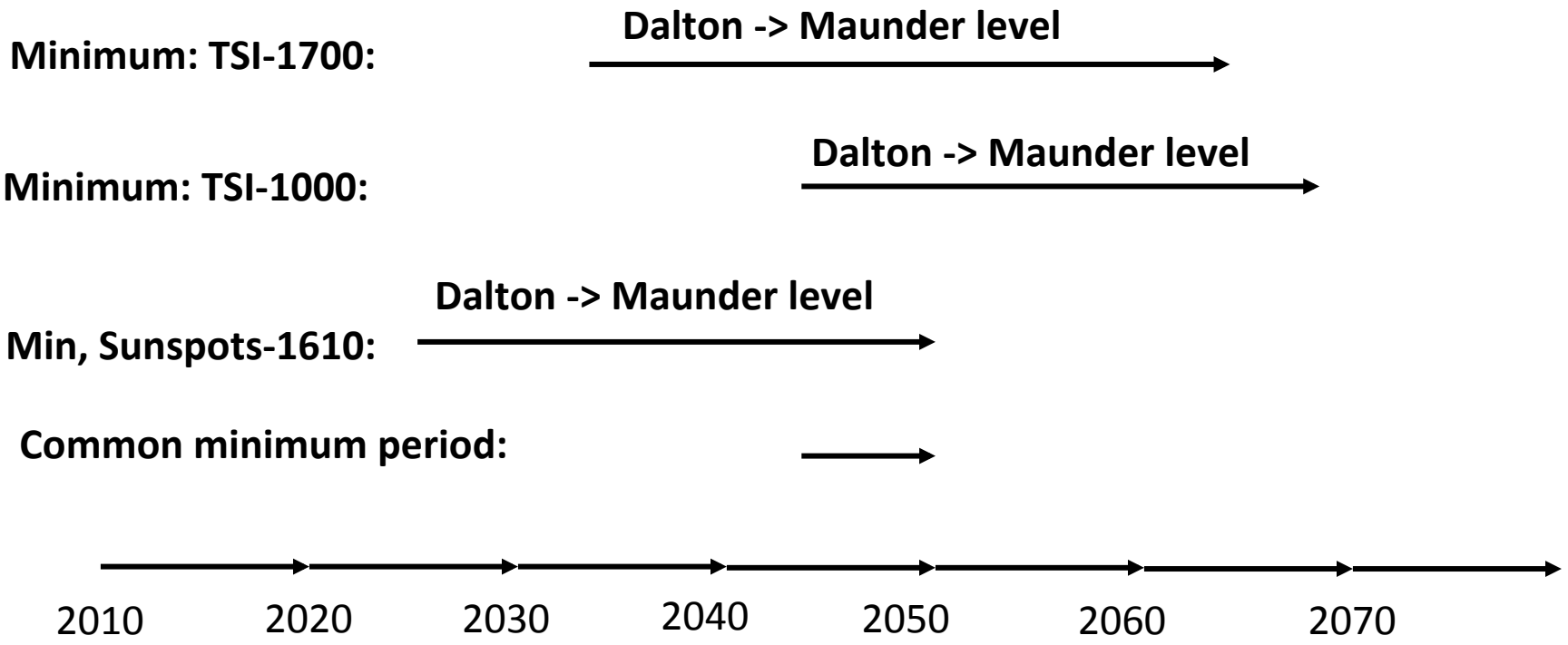
Estimated Next Maunder period

Computed Next minimum periods



Thank you

My campus, et 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(spoy,12), R=0.98	P(spoy,29), R=0.95		P(spoy,84), R=0.9		P(spoy,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) P(spoy,84 max) P(psox,84,164,vel) P(psoy,29,84,164)	1127 1152 1152	1296 1320 1320	1462 1487 1487 1488	1630 1654 1654	1798 1821 1821	1965,2065 1989 1989 1990
HS model period P(hsc, t)	1033-1055 <-1.0	1369-1389 <-1.00	1537-1534 <-1.0	1706-1721 <-1.0	1796-1830 <0	2035-2065 <-0.70
HS model, P(lsc, t) min	1040 -1.30	1337 -1.23	1547 -1.87	1714 -1.13	1810 -0.33	2049 -1.0
LS model period P(lsc, t)	1014-1056 <-1.0	1276-1301 <-0.5	1404-1435 <-1.0	1657-1689 <-0.70	1785-1810 <-0.70	2045-2070 <-0.70
LS-state P(lsc, t) min	1035 -1.40	1289 -0.62	1418 -1.20	1672 -0.91	1796 -0.81	2060 -0.79
SN model period P(snc, t)	1019-1032 <-1.0	1242-1256 <-1.0	1467-1478 <-1.0	1693-1699 <-1.0	1802-1820 <-0.5	2025-2050 <-0.5
SN model P(snc, t) min	1026 -1. 7	1249 -1.18	1473 -1.13	1696 -1.04	1811 -0.70	2035 -0.84