Solar periodicities detected within neutral atmospheric and ionospheric parameters

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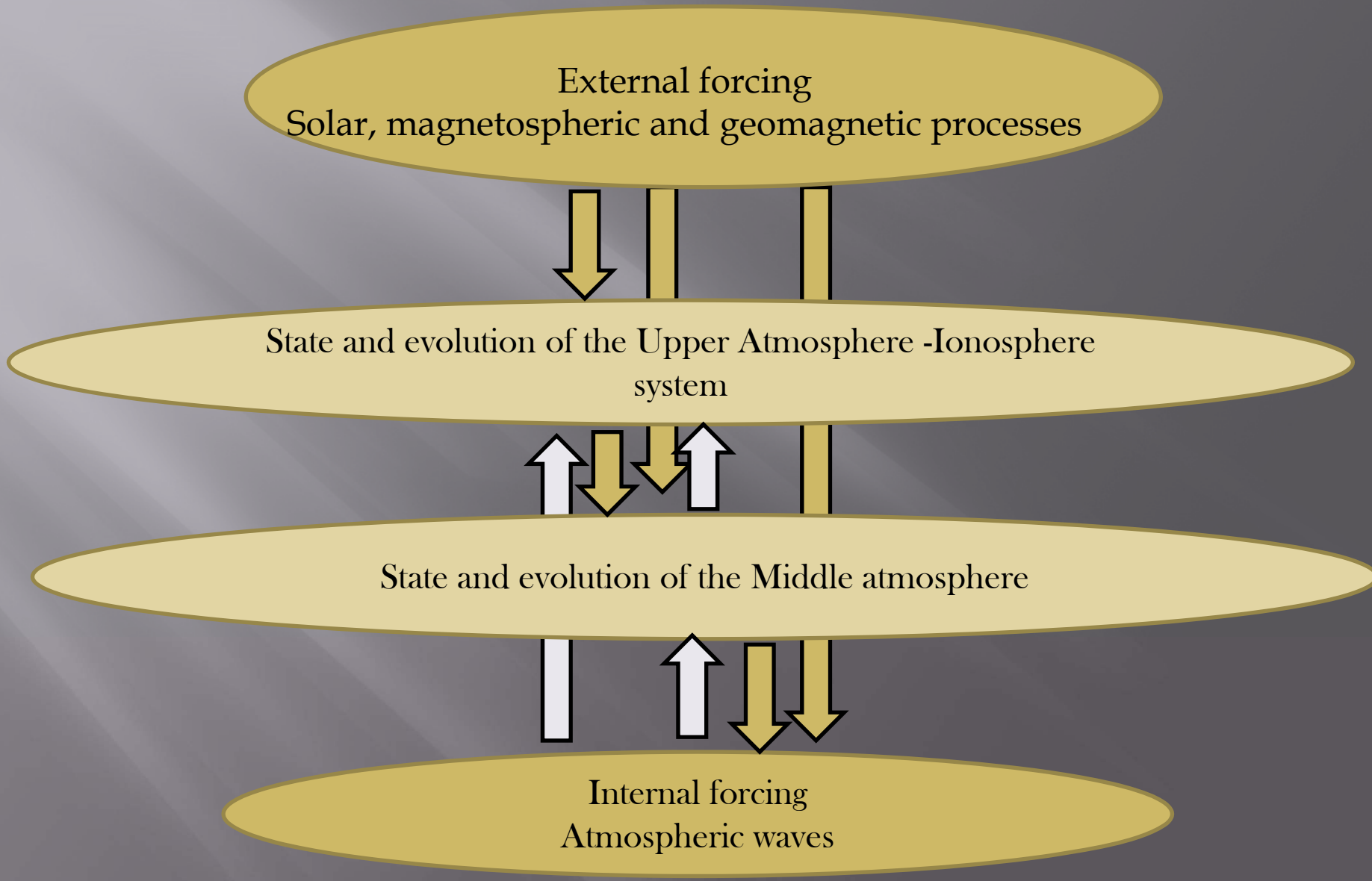
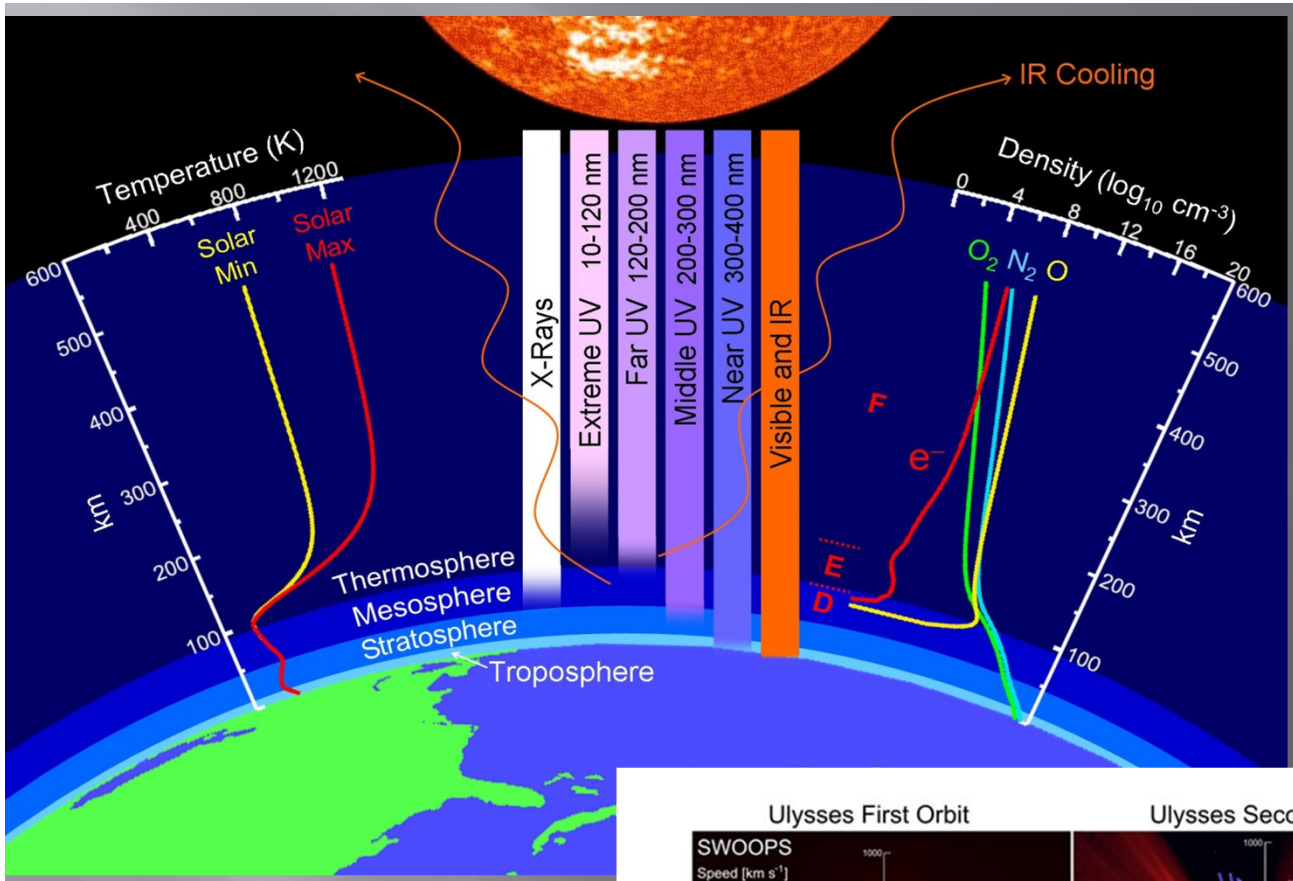
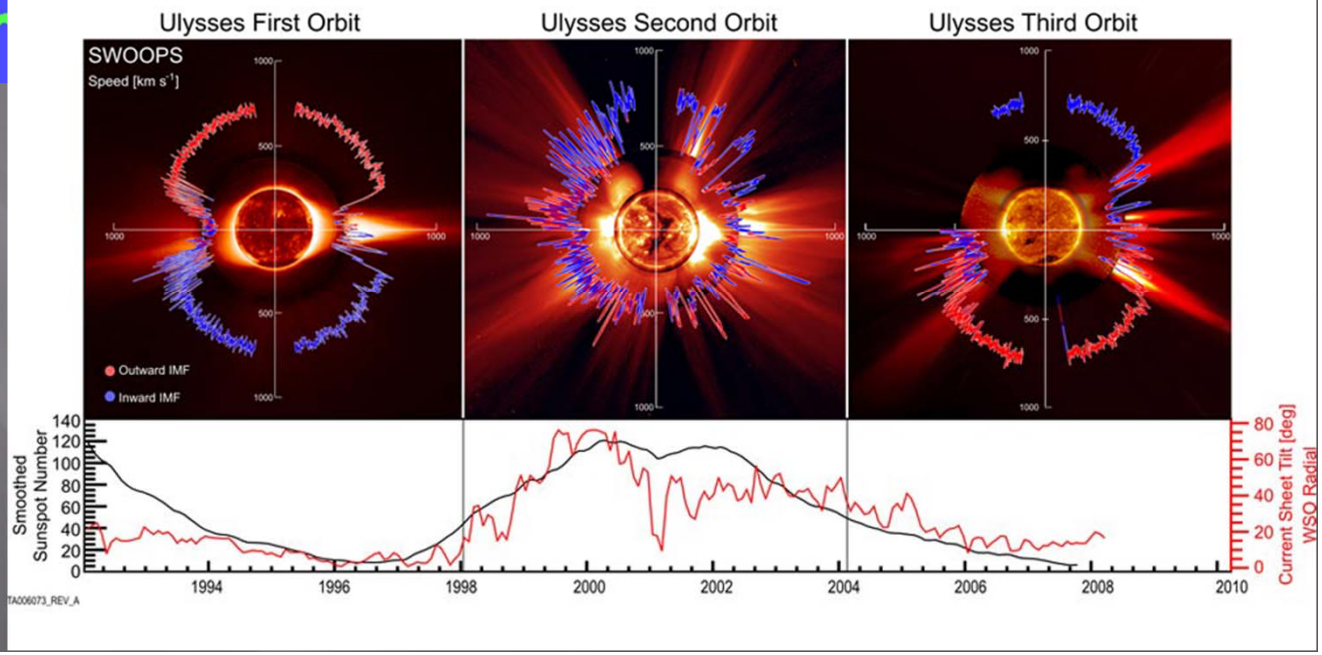
Vertical Coupling

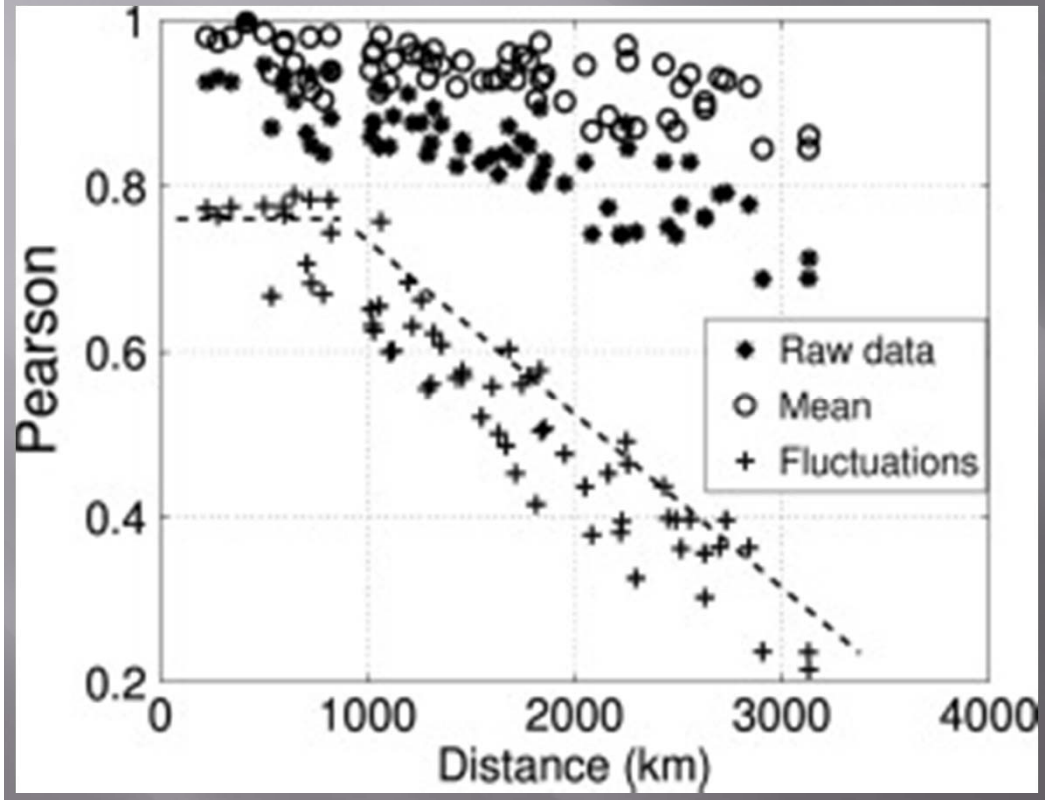




External forcing is the most important!



Correlation coefficients of foF2 (15 European stations)

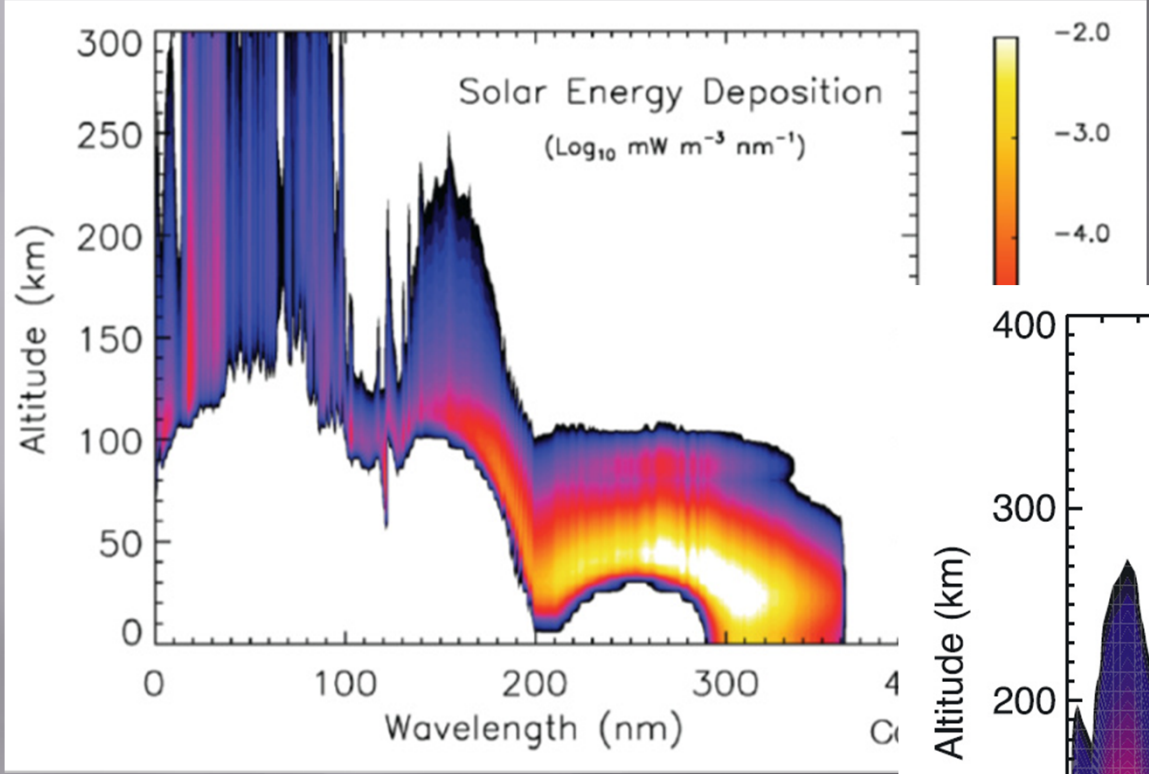


Koucká Knížová et al. (2015)

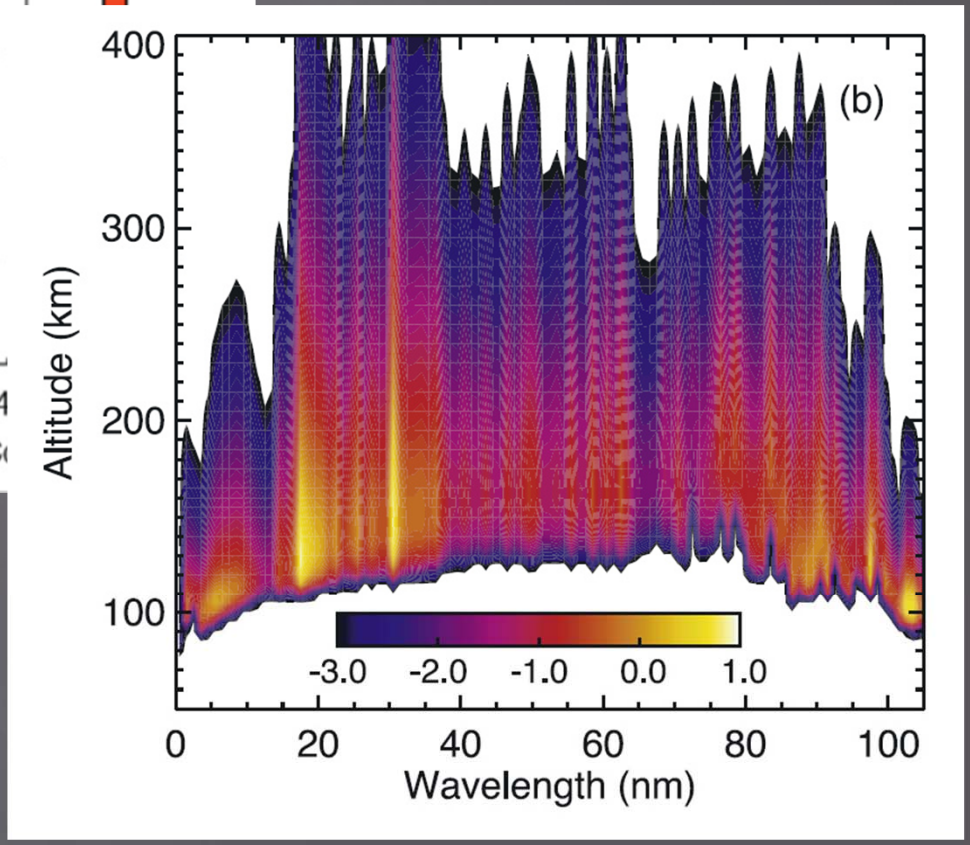
At the distance exceeding 1000 km and/or about 10 degrees of latitude, the correlation coefficient of fluctuations decrease rapidly.

Common influence on scale 1000 km/10 degree - tropospheric systems (mesoscale systems have typically up to 2000 km in diameter) and atmospheric waves with corresponding scale.

Deposition of solar energy in the atmosphere



Non-uniform in time and height
Wide spectral range



Aprox. 30 % reflected back to the space

Heating of the atmosphere and surface

Stanley C. Solomon and Liying Qian, 2005

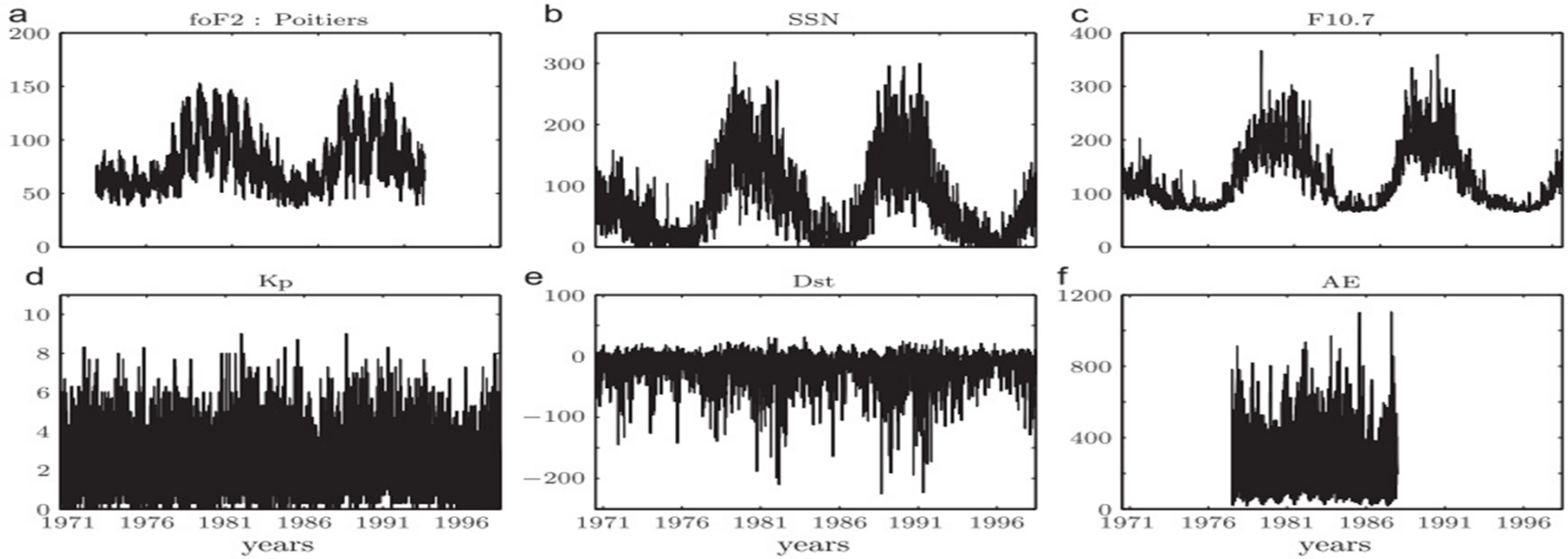
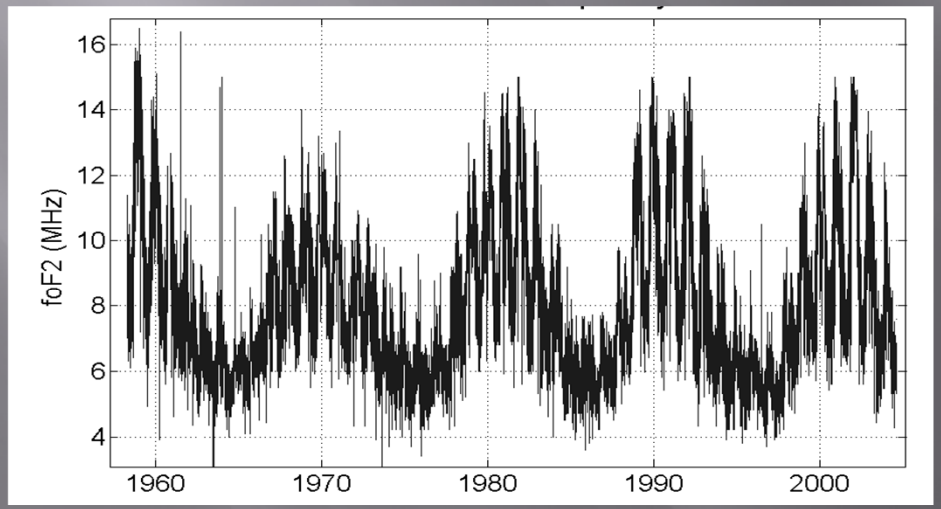
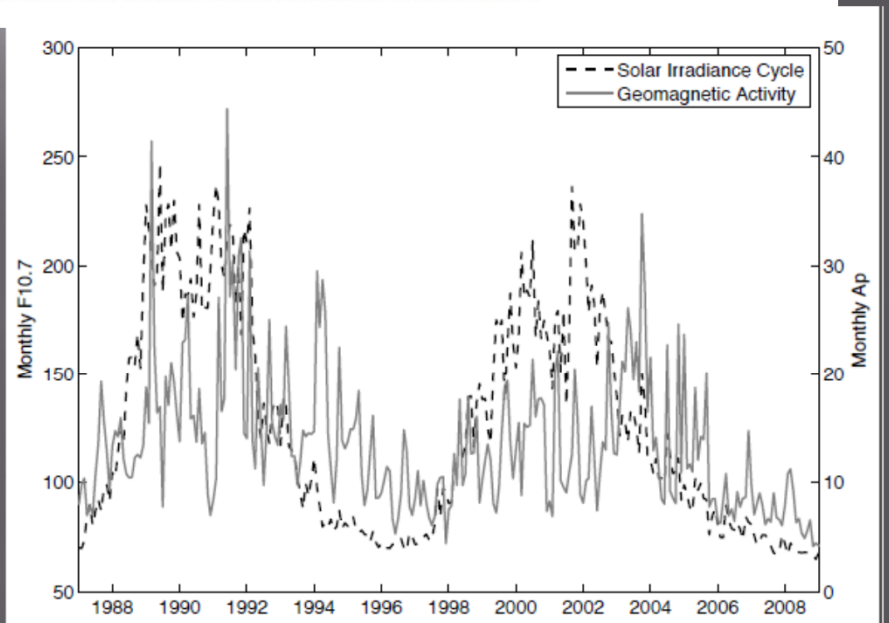


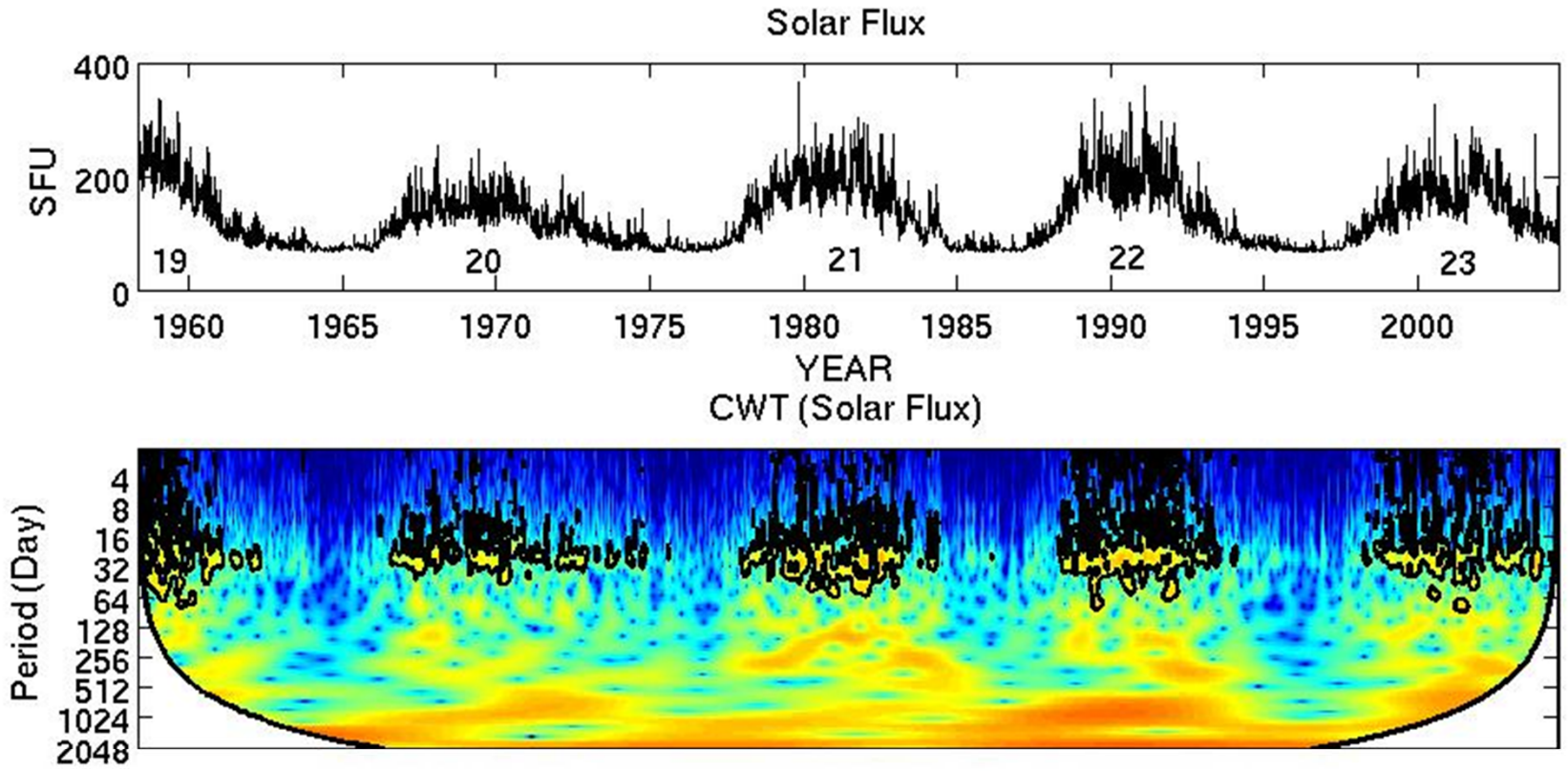
Fig. 1. *Data set*: raw signals without missing data. For foF2 measurement in (a) the longest segment available is shown.



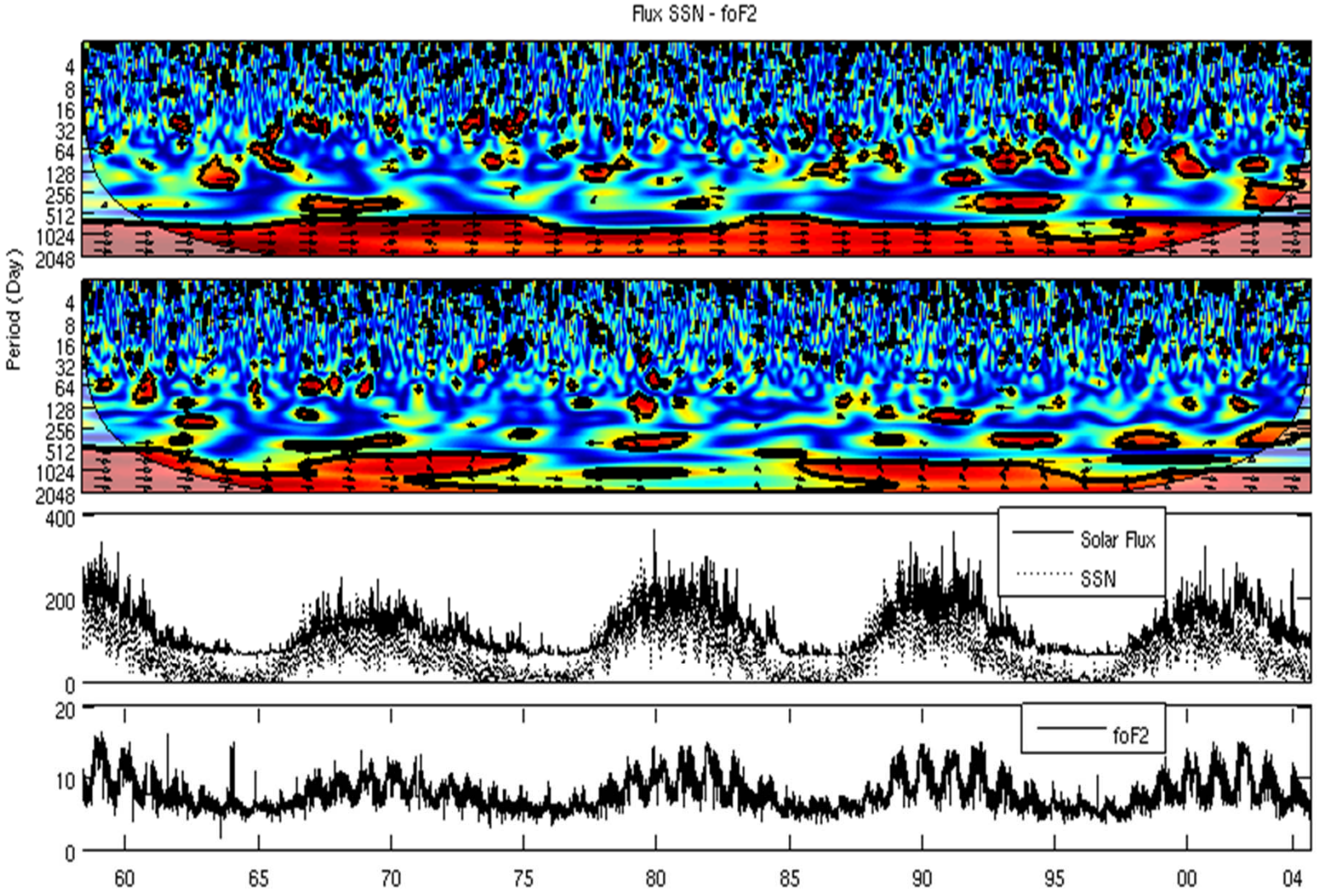


EPP doesn't follow solar cycle!

Solar periodicities within solar flux 10.7 cm

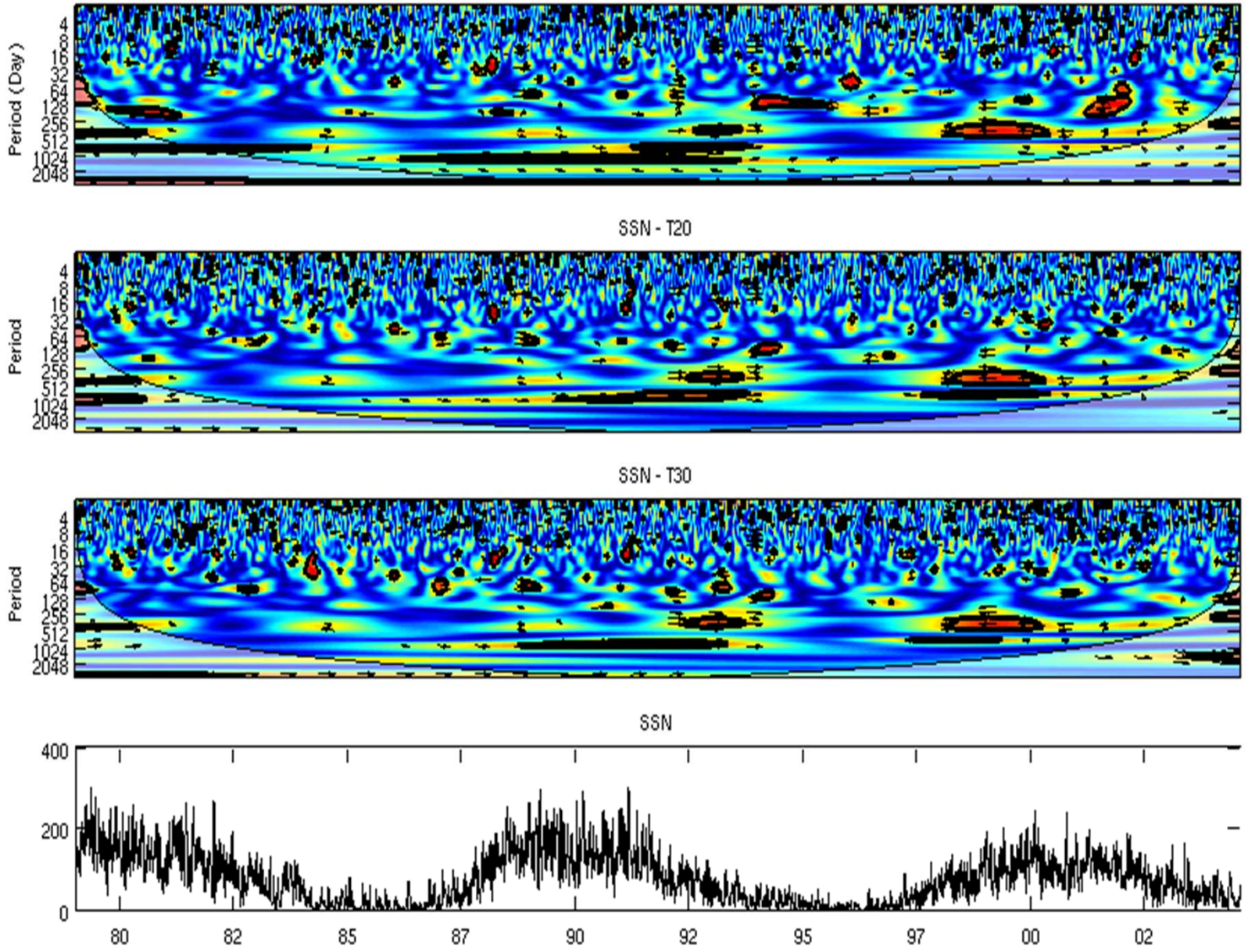


Wavelet Transform Coherence
Solar Flux, Sunspot number vs. Critical frequency

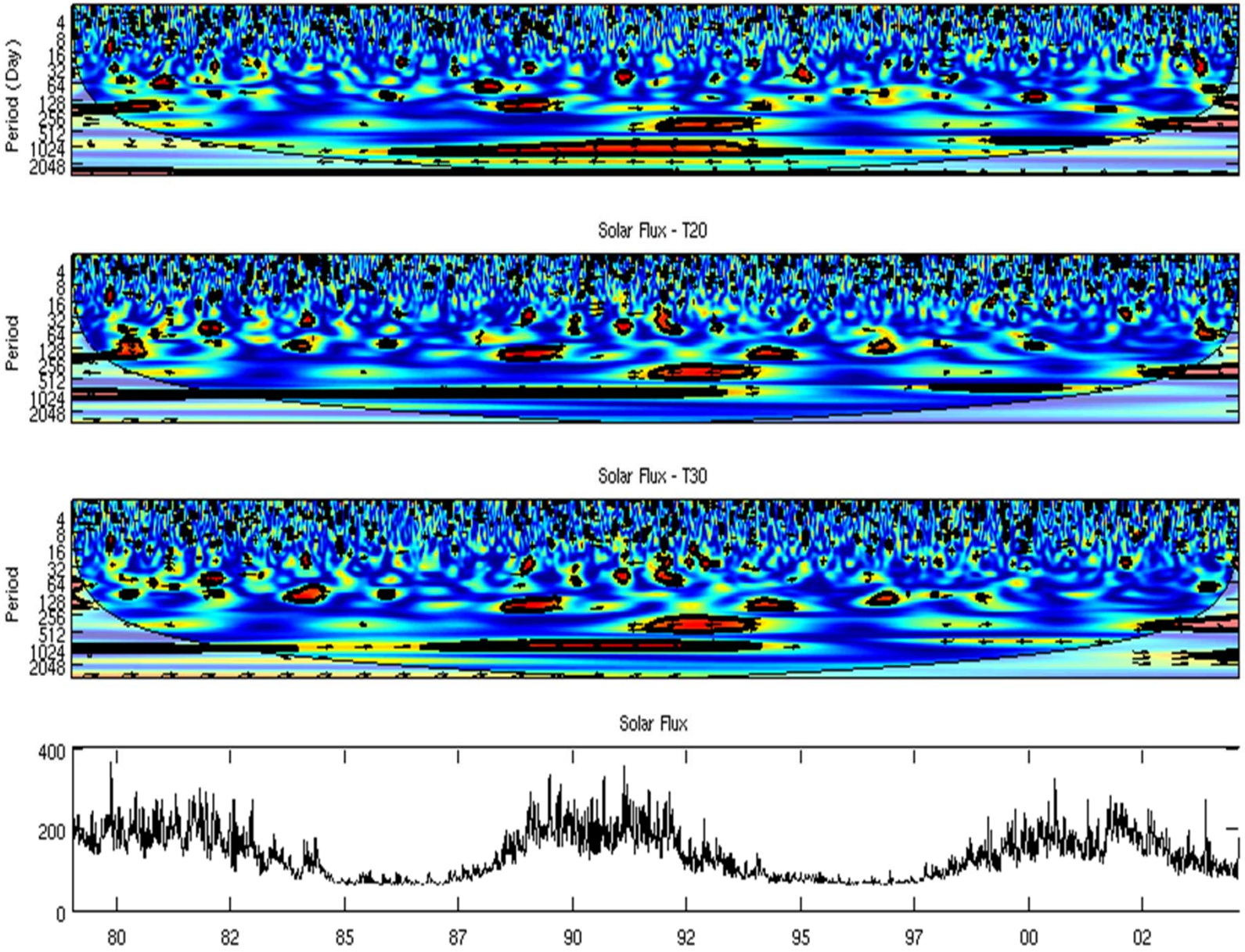


Period	Persistence (cycle)	Time occurence SC	WTC
3 years	all	19-23 SC	F10.7, foF2
3 years	2	Max 21 SC	SSN, foF2
2 years	6 6	20- beginning 21 SC 21-22 SC	F10.7, foF2
2 years	5 6	20 SC 22 SC	SSN, foF2
1 year	4 3 3	Max 20 SC Max 21 SC descending phase 22	F10.7, foF2
1 year	4 3 bursts	Max 20 SC Max 21 SC ascending phase 22 SC – descending phase 23 SC	SSN, foF2;
6 months	Short bursts	19-23 SC	F10.7, foF2
6 months	Short bursts	19-23 SC	SSN, foF2
2 months	bursts	Mainly 22 SC	F10.7, foF2
2 months	bursts	Mainly 21 SC almost no occurrence 22-23 SC	SSN, foF2
30 days (27 days)	bursts	stronger 20 SC and 22-23 SC	F10.7, foF2
30 days (27 days)	bursts	stronger 19-20 SC,	SSN, foF2

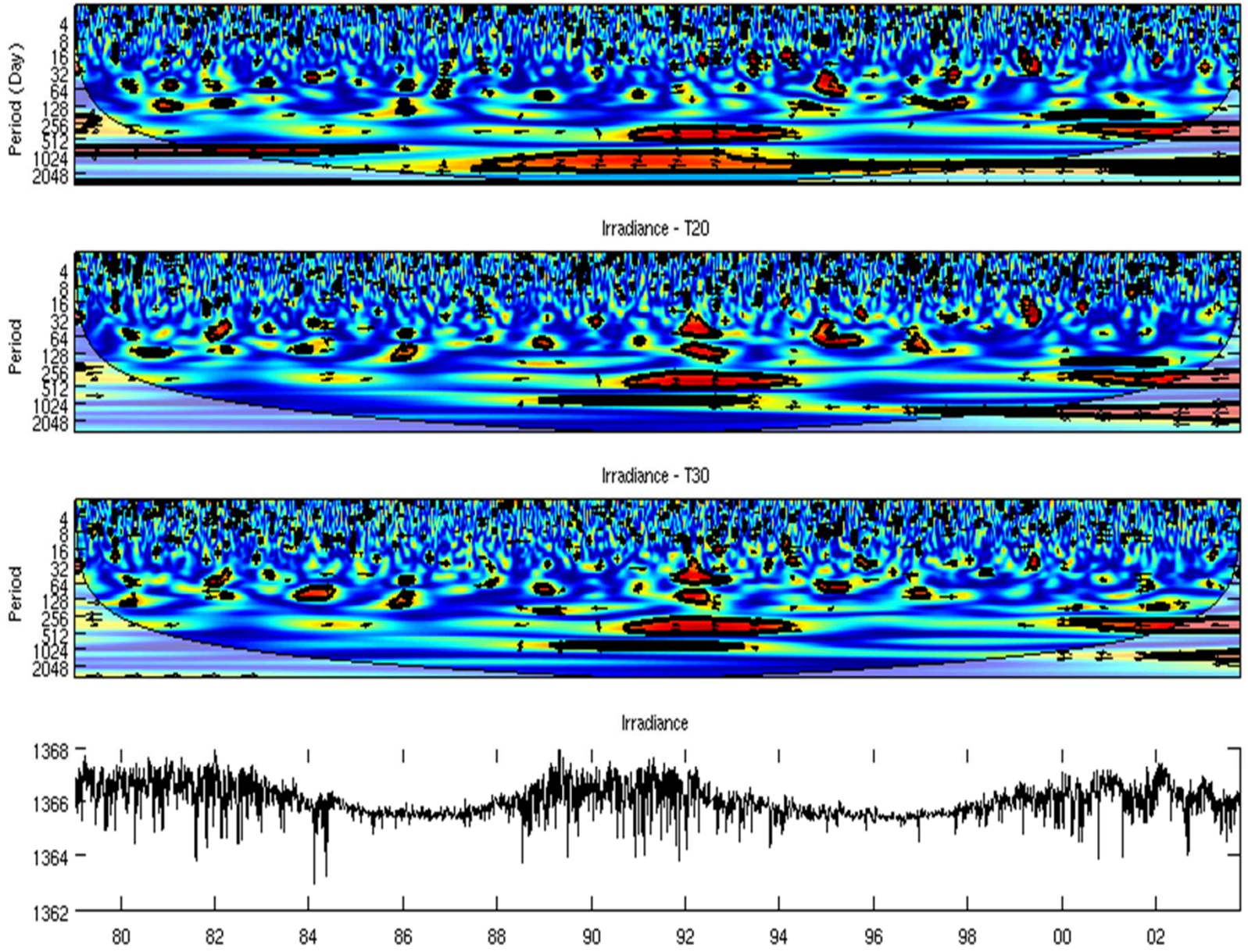
WTC Sunspot number vs Stratospheric temperature



WTC Solar flux vs Stratospheric temperature



WTC Solar Irradiance vs Stratospheric temperature



Period	Persistence (cycle)	Time occurence SC	WTC
4 years	7	22 SC	F10.7;T10hPa
4 years	6	22 SC	SSN;T10hPa
4 years	10	22 SC – 23 SC merges with 2years	TSI;T10hPa
2 years	11	21 SC – 23 SC; strongest 22 SC	F10.7;T10hPa
2 years	4 around maxima	21 SC – 23 SC; strongest 22 SC	F10.7;T20hPa F10.7;T30hPa
2 years	8	22 SC – 23 SC	SSN;T10hPa
2 years	5 around maxima	22 SC – 23 SC;	SSN;T20hPa SSN;T30hPa
2 years	8	22 SC – 23 SC	TSI;T10hPa
2 years	3 around maxima	22 SC – 23 SC;	TSI;T20hPa TSI;T30hPa
1 year	4	22 SC – descending phase	F10.7;T10hPa F10.7;T20hPa, F10.7;T30hPa
1 year	3; 5 (longest burst)	21 SC – 23 SC; before and after maxima of the cycle	SSN;T10hPa SSN;T20hPa SSN;T30hPa
1 year	5 2	22 SC - after maxima 21 SC descending phase	TSI;T10hPa TSI;T20hPa TSI;T30hPa

Period	Persistence (cycle)	Time occurence SC	WTC
6 months	4 bursts	22 SC 22 SC - 23 SC	F10.7;T10hPa
6 months	4	Before and after max of 22 SC	F10.7;T20hPa, F10.7;T30hPa
6 months	bursts	21 SC – 23 SC	SSN;T10hPa SSN;T20hPa SSN;T30hPa
6 months	bursts	21 SC – 23 SC	TSI;T10hPa TSI;T20hPa TSI;T30hPa
2 months	2 2	21 SC – 23 SC, around max	F10.7;T10hPa F10.7;T20hPa, F10.7;T30hPa
2 months	bursts	23 SC	SSN;T10hPa
2 months	bursts	random	SSN;T20hPa SSN;T30hPa
2 months	bursts	minima	TSI;T10hPa TSI;T20hPa TSI;T30hPa
30 days (27 days)	bursts	21 – 23 SC	F10.7;T10hPa
30 days (27 days)	bursts	21 – 23 SC; mainly in 22 SC	F10.7;T20hPa, F10.7;T30hPa
30 days (27 days)	bursts	21 – 23 SC,	SSN;T10hPa SSN;T20hPa SSN;T30hPa
30 days (27 days)	bursts	21 – 23 SC,	TSI;T10hPa TSI;T20hPa TSI;T30hPa

Conclusion

- Wide range of coherent structures within solar and atmospheric data series
- Periodicities 3-4 years, 2 years, 1 year
  6 months, 2 months, 1 month
- Domains of coherence vary significantly during particular solar cycle (SC)
- Significant difference between cycles.
- Domains of coherence depend on the selected indices
- It indicates the changing solar forcing and/or atmospheric sensitivity with time.