Influence of space weather on heart rate and heart rate variability

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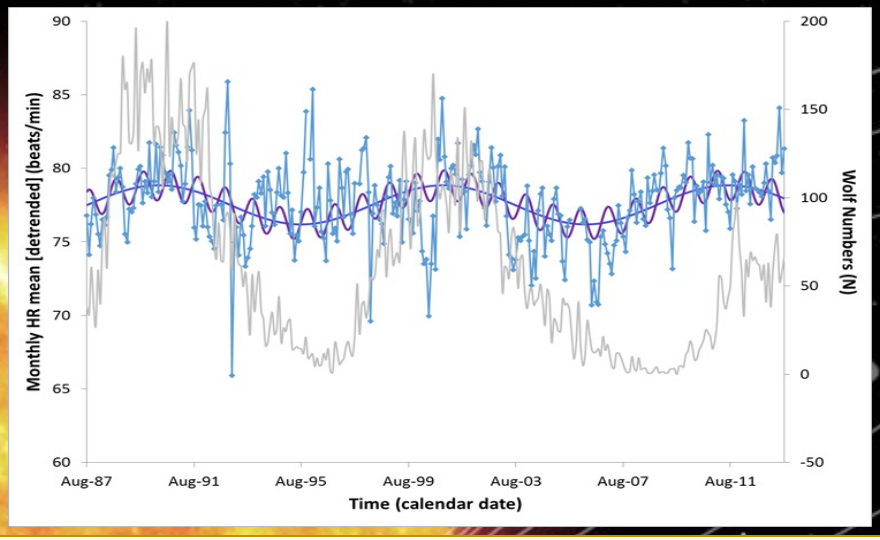
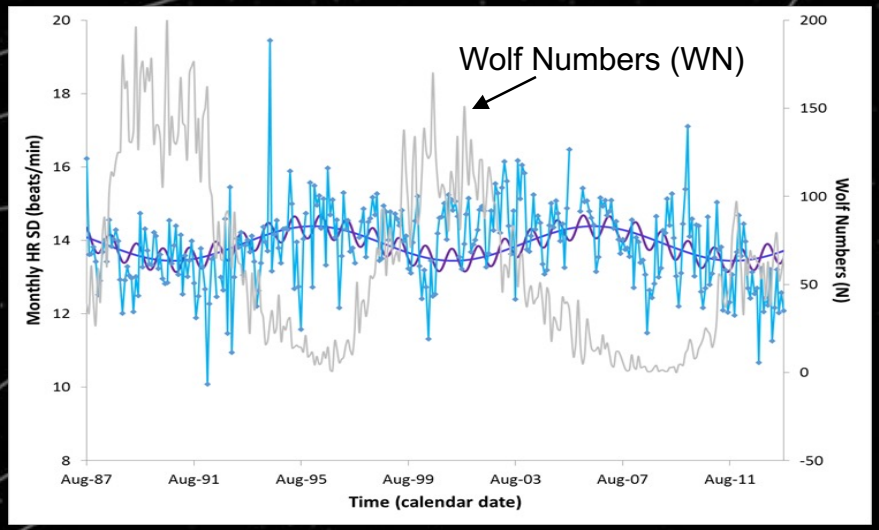
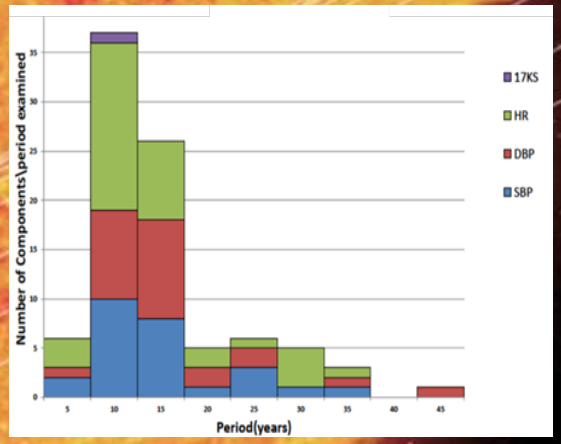




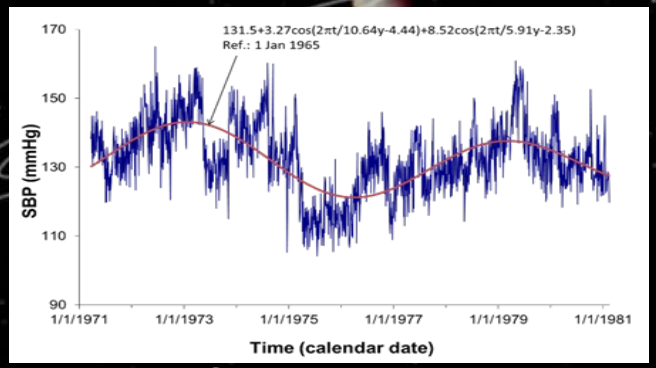
HR & WN both have ~11y cycle, same phase

HR-SD & WN have ~11y cycle, out of phase.

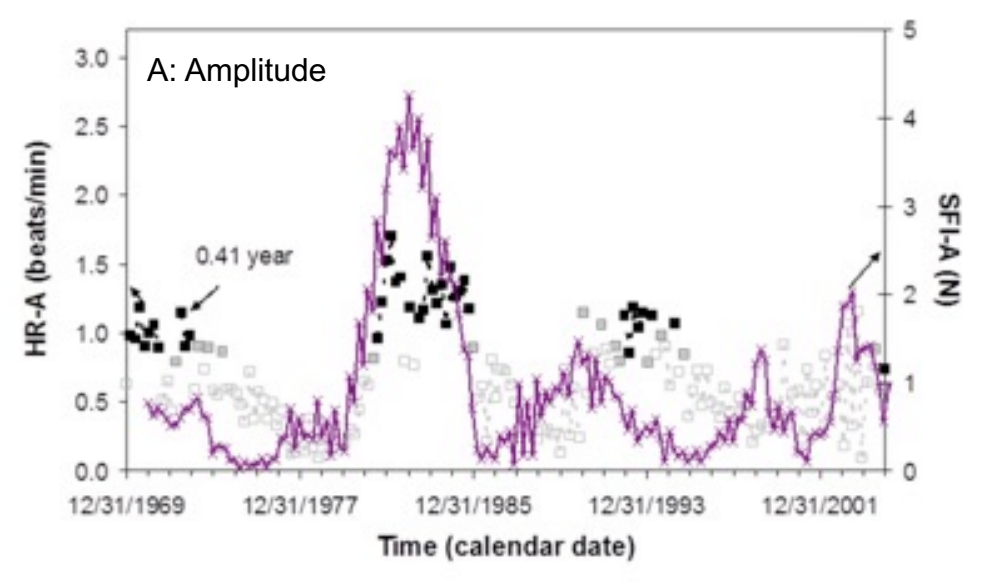


Longitudinal BP & HR records often have ~11y cycles

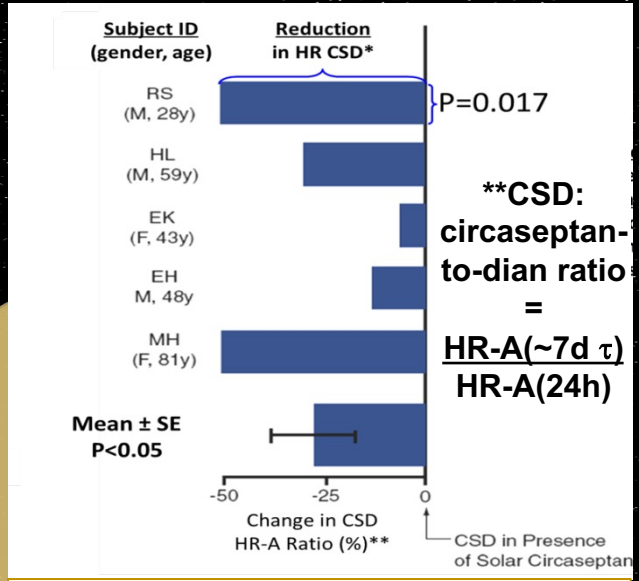
SBP (EH) has an ~11y cycle



HR and HRV undergo cycles of complex periodicities. Some periods (~5mos, ~1.3y, ~11y) are congruent to variations found in the cosmos.



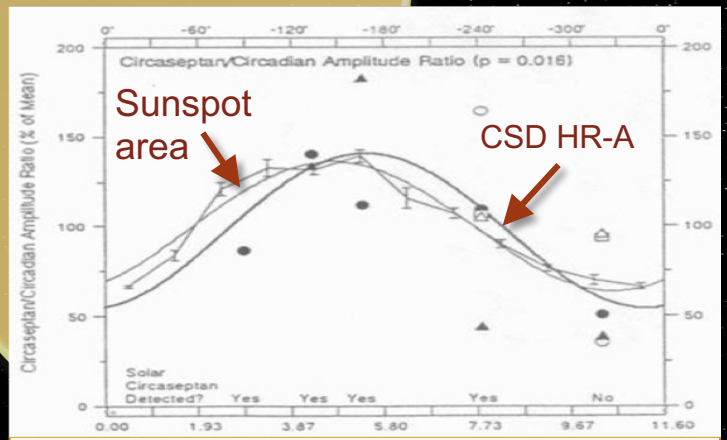
~5-mo HR-A (circles - filled when P<0.05) changes with the ~5-mo solar flares (purple).



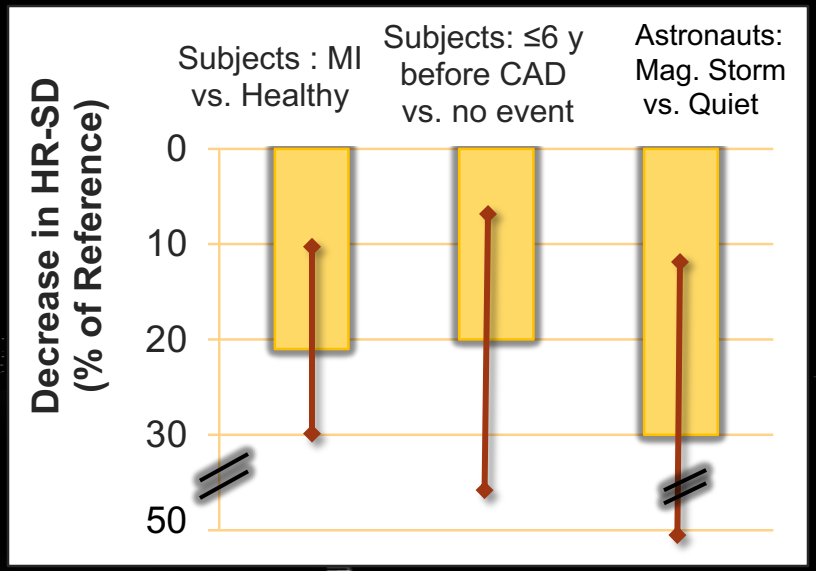
~7d/24h (CSD) HR-A is dampened when there is no 7-day cycle in sunspot area

HR-A and solar flares (SFI) A are both modulated by an ~11 y cycle.

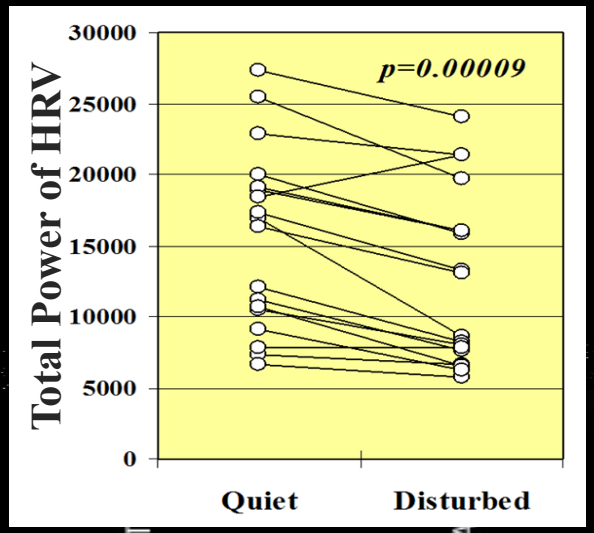
Cycles of different frequencies interact.

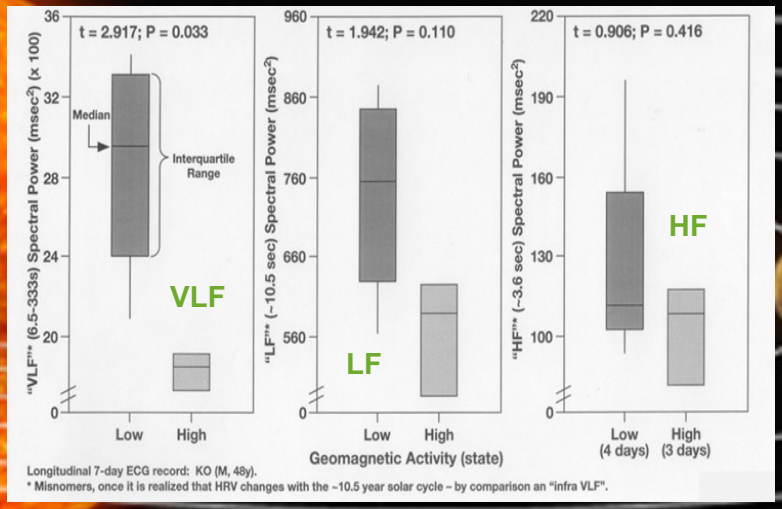


CSD HR-A & solar sunspot area are in phase, with similar periods



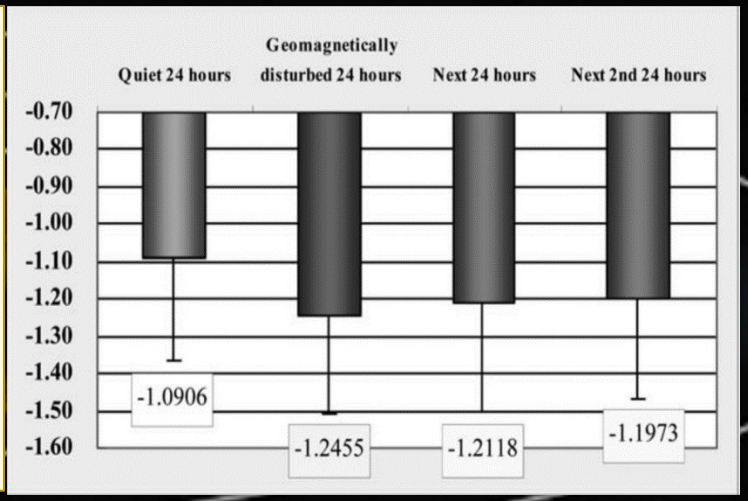
HRV is decreased during a magnetic storm.
(A decreased HRV elevates CVD risk)



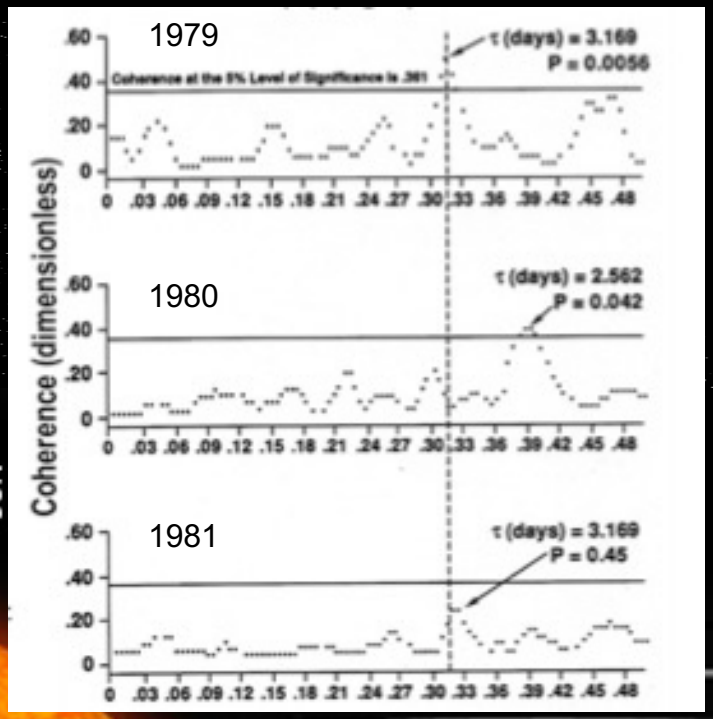


HRV decrease during magnetic storm depends on spectral region.

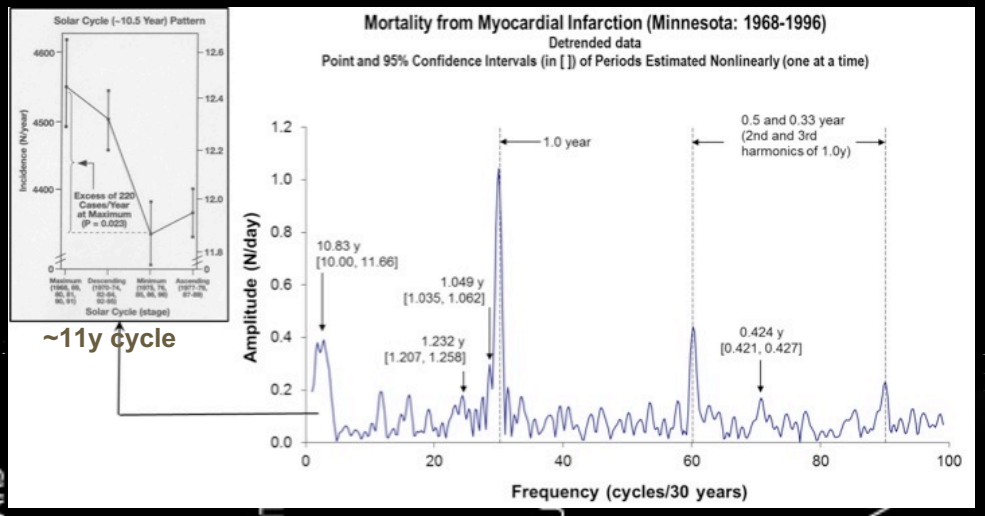
Decrease in β remains statistically significant for 1-2 days after a magnetic storm.



HRV decreases with magnetic storms

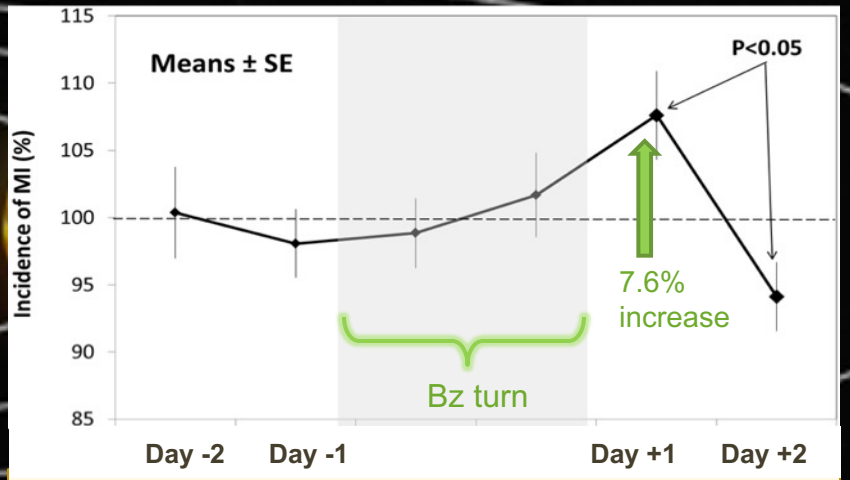


Cross-spectral coherence between daily MIs & local K at frequency of about 1 cycle in 3.15 days. 85,819 MIs (Moscow, 1979-81).

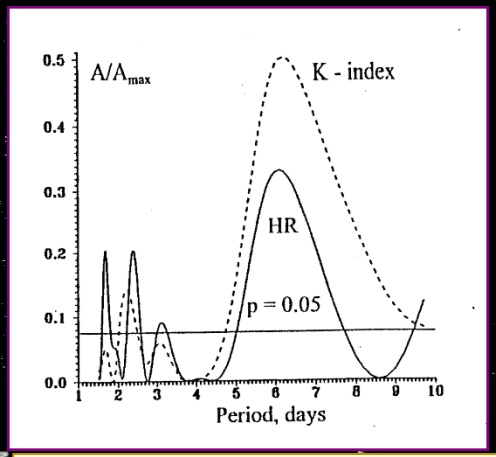


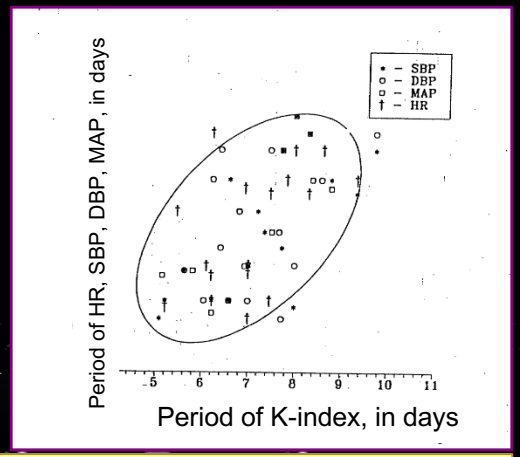
Daily MI mortality in MN (1968-1996) has cycles of ~11y (solar activity), ~1.3y (solar wind), ~0.42y (solar flares), & 1y (seasons)

The reduced HRV in the presence of magnetic storms may underlie a concomitantly observed increase in MI, illustrating clinical relevance for long-term space exploration.



Incidence of MI increases 7.6% after Bz turn. 32 events (1979-81).

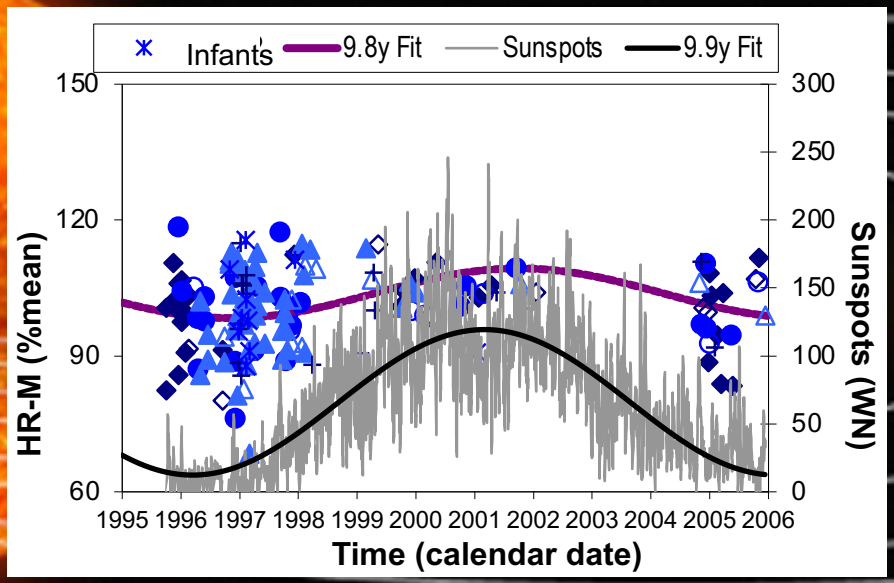


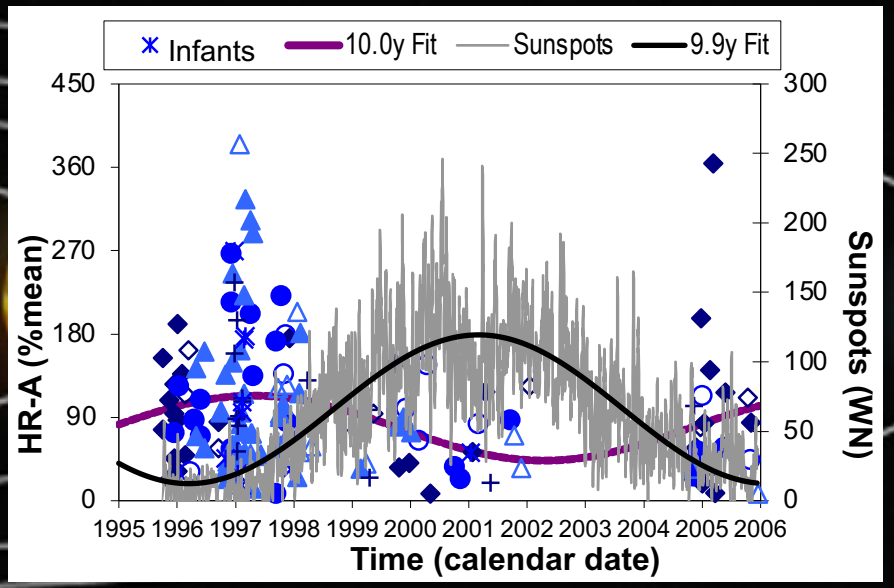


The circaseptan period of neonatal HR (and BP) correlates with that of the local K index.

As part of an open environment, humans share broad intermodulating time structures with it.

Results from transverse study in babies replicates those found in longitudinal record.





~10 y cycle of neonatal HR-M (left) vs. HR-A (right) is ~in vs. ~out of phase with WN.