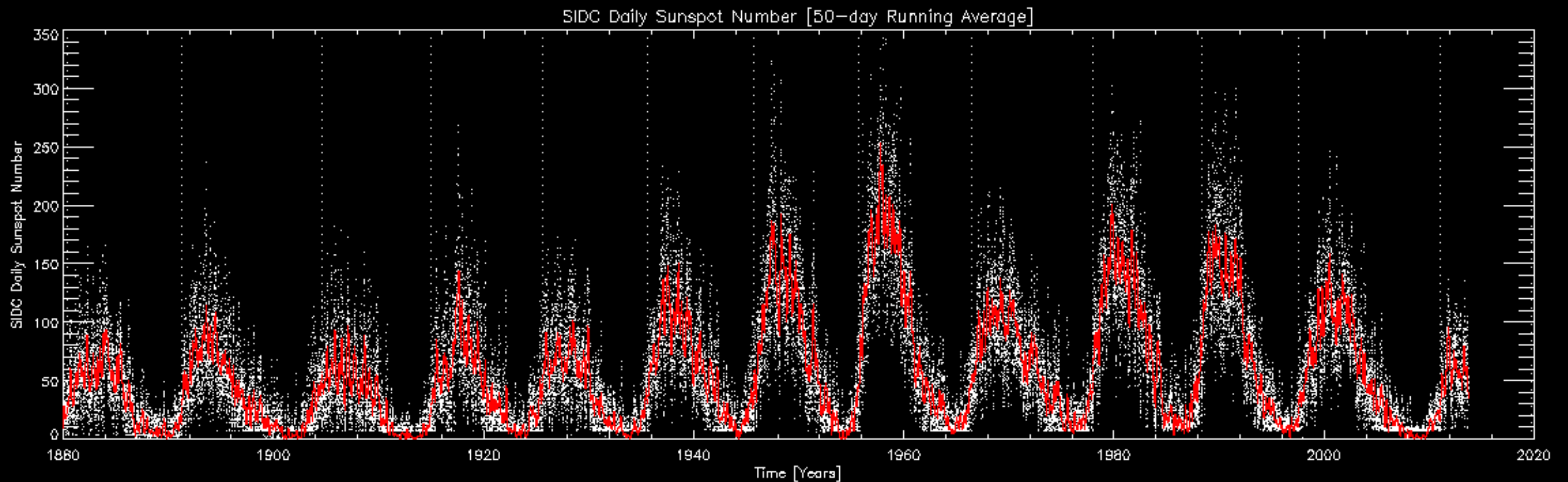




Will There Even Be Sunspot Cycle 25?

Scott W. McIntosh
HAO/NCAR

YES! *

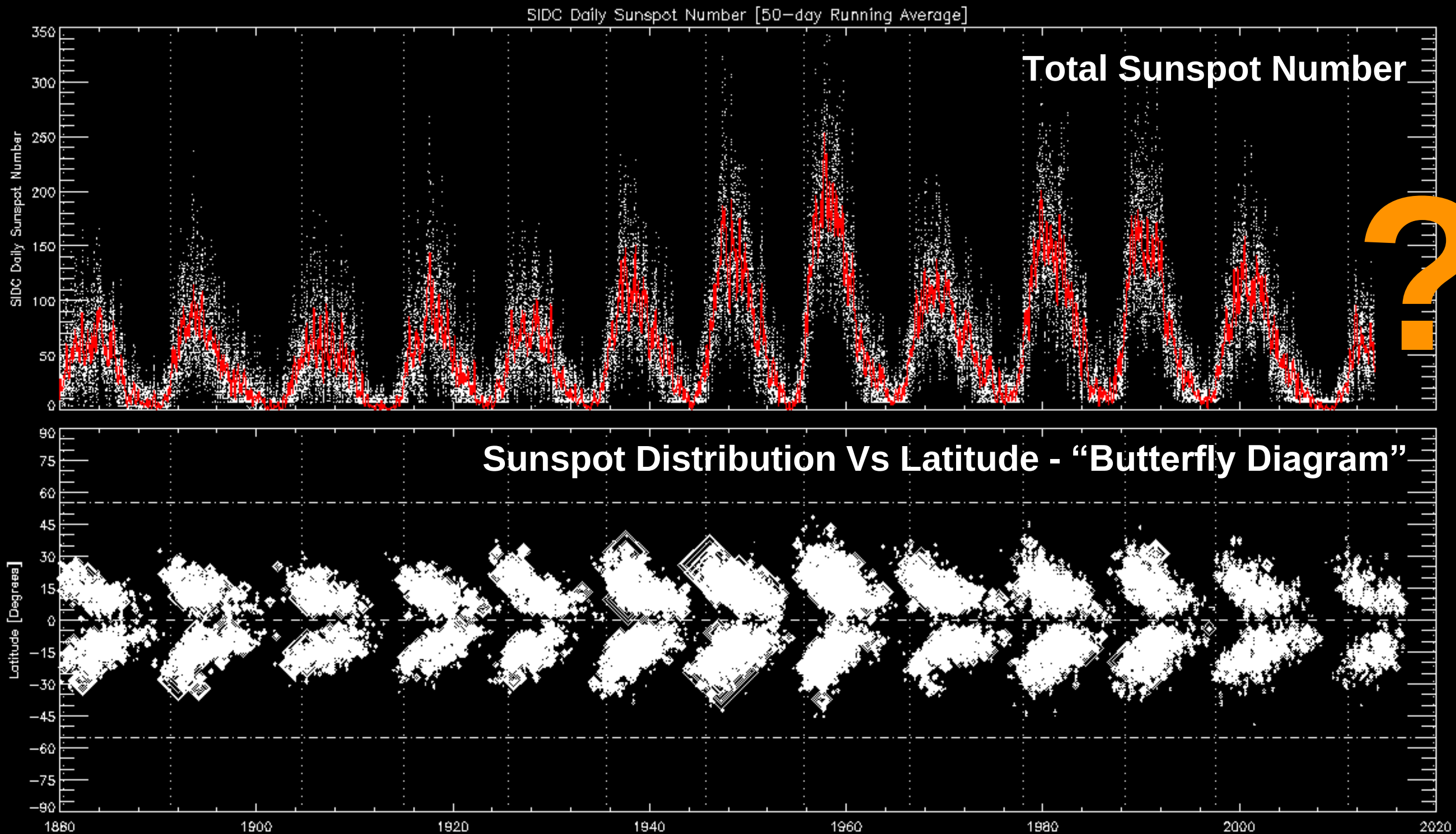
There will be a solar cycle, but a sunspot cycle could be small.....

pre·dict·a·bil·i·ty [prih-dik-tuh-**bil**-i-tee]

noun

1.

consistent repetition of a state, course of action, behavior, or the like, making it possible to know in advance what to expect: *The predictability of their daily lives was both comforting and boring.*



Sunspot Cycle: The predictability challenge!

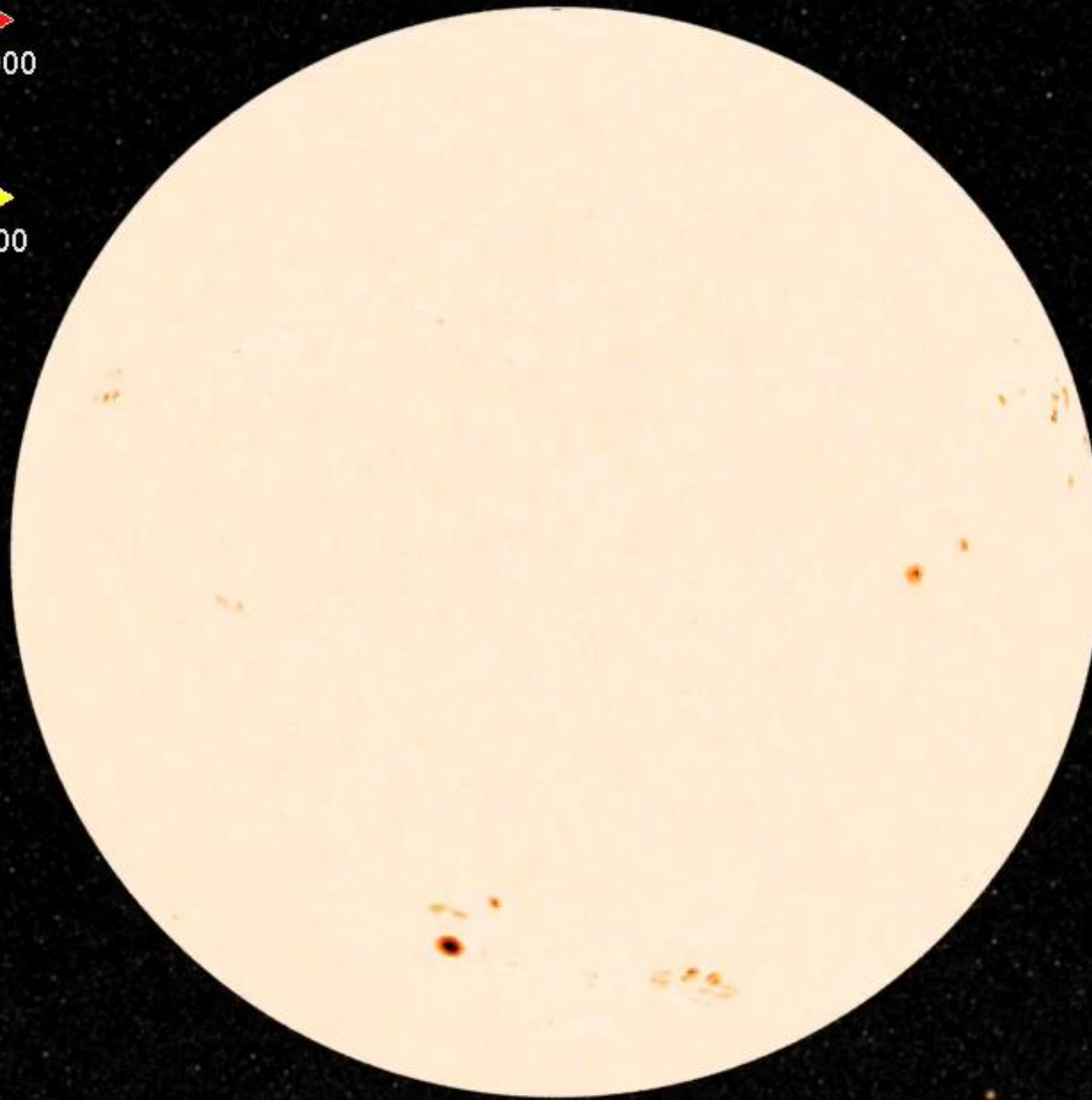
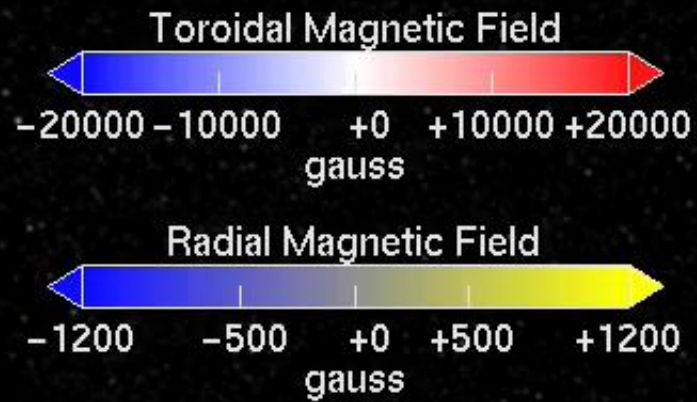


Predictability Comes [some] Physical Understanding of the Underlying Process

The sunspot cycle is erratic.

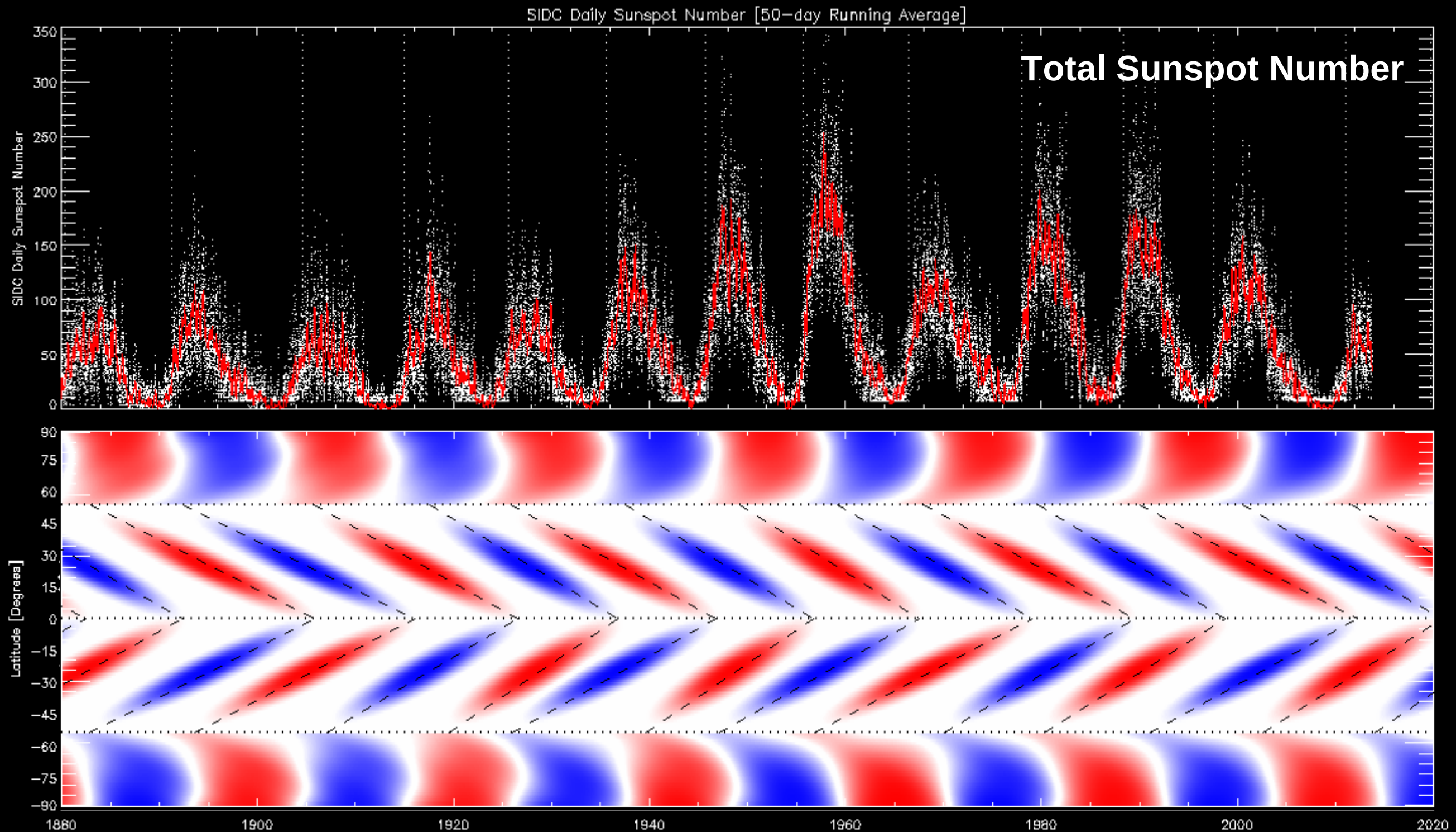
Provocative of a chaotic, turbulent solar interior where sunspot progressions with time and latitude are the **only** tracers.....

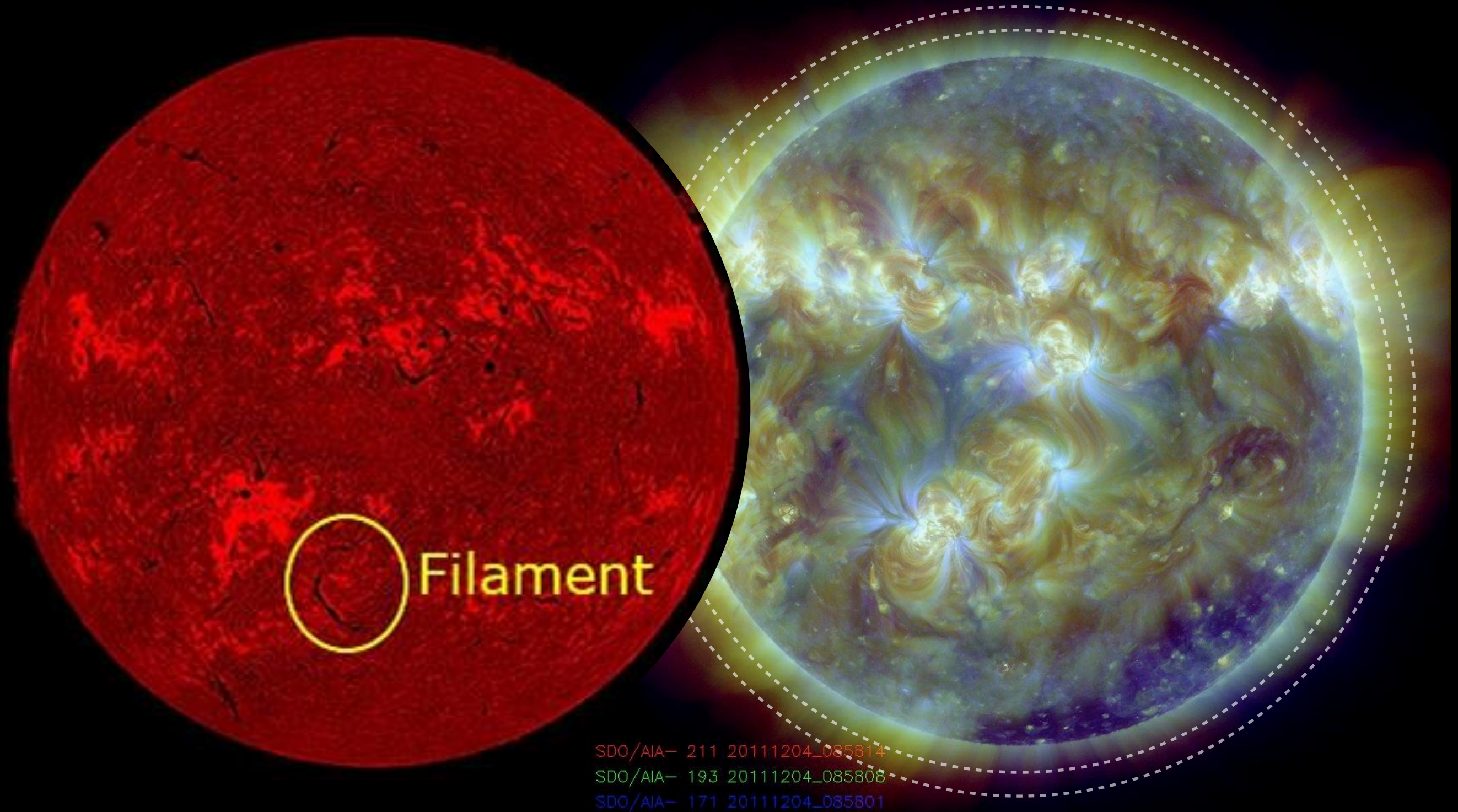
The Solar Dynamo



This looks beautiful but....

However, the 11-ish year sunspot cycle is [somehow] a subset of the Sun's 22-ish year magnetic polarity cycle - **the** solar cycle.

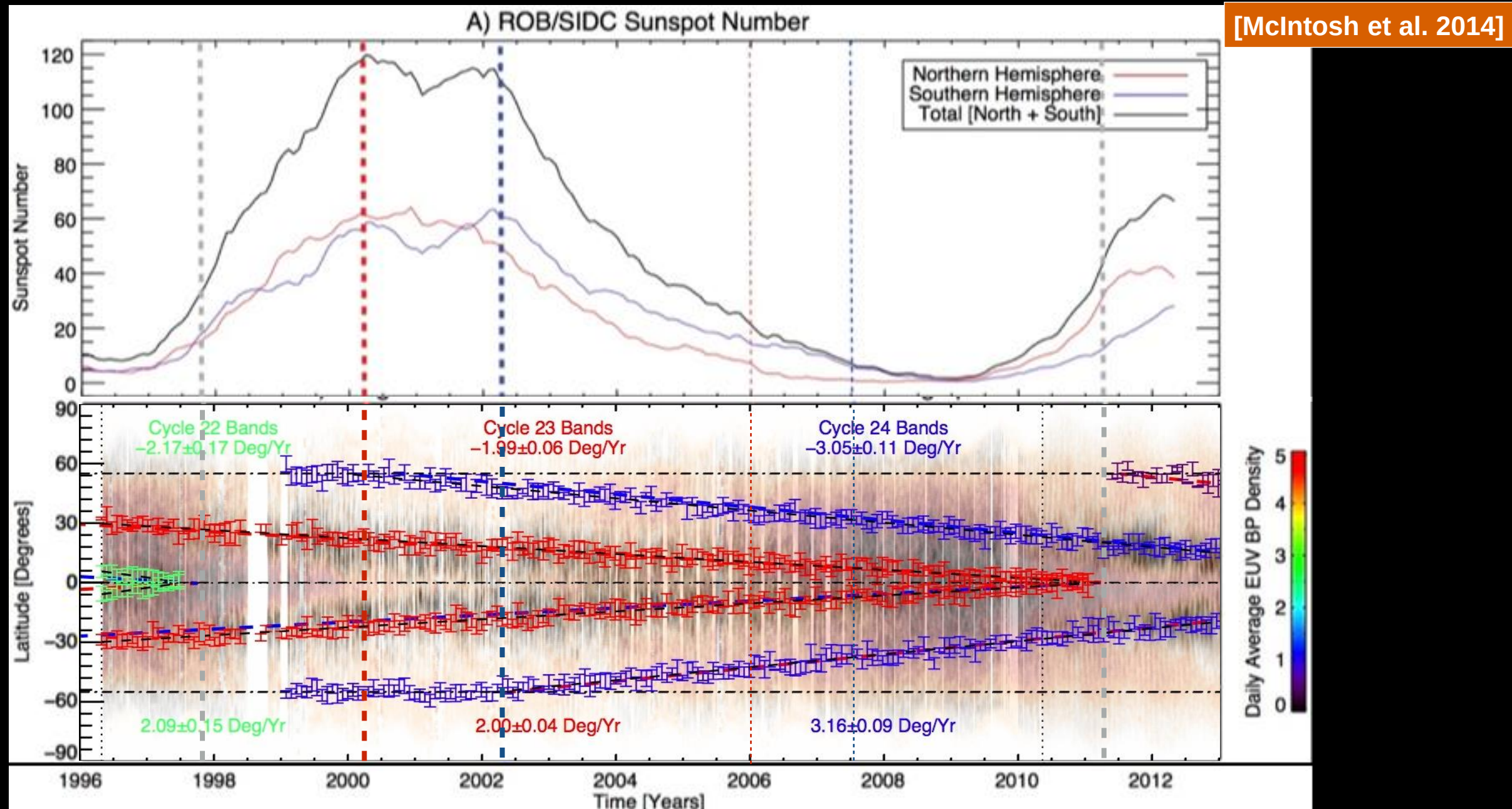




**what about coronal holes, filaments, other multi-scale structures.....
.....is there any other [long-record] contextual information?**

Contemporary Observations

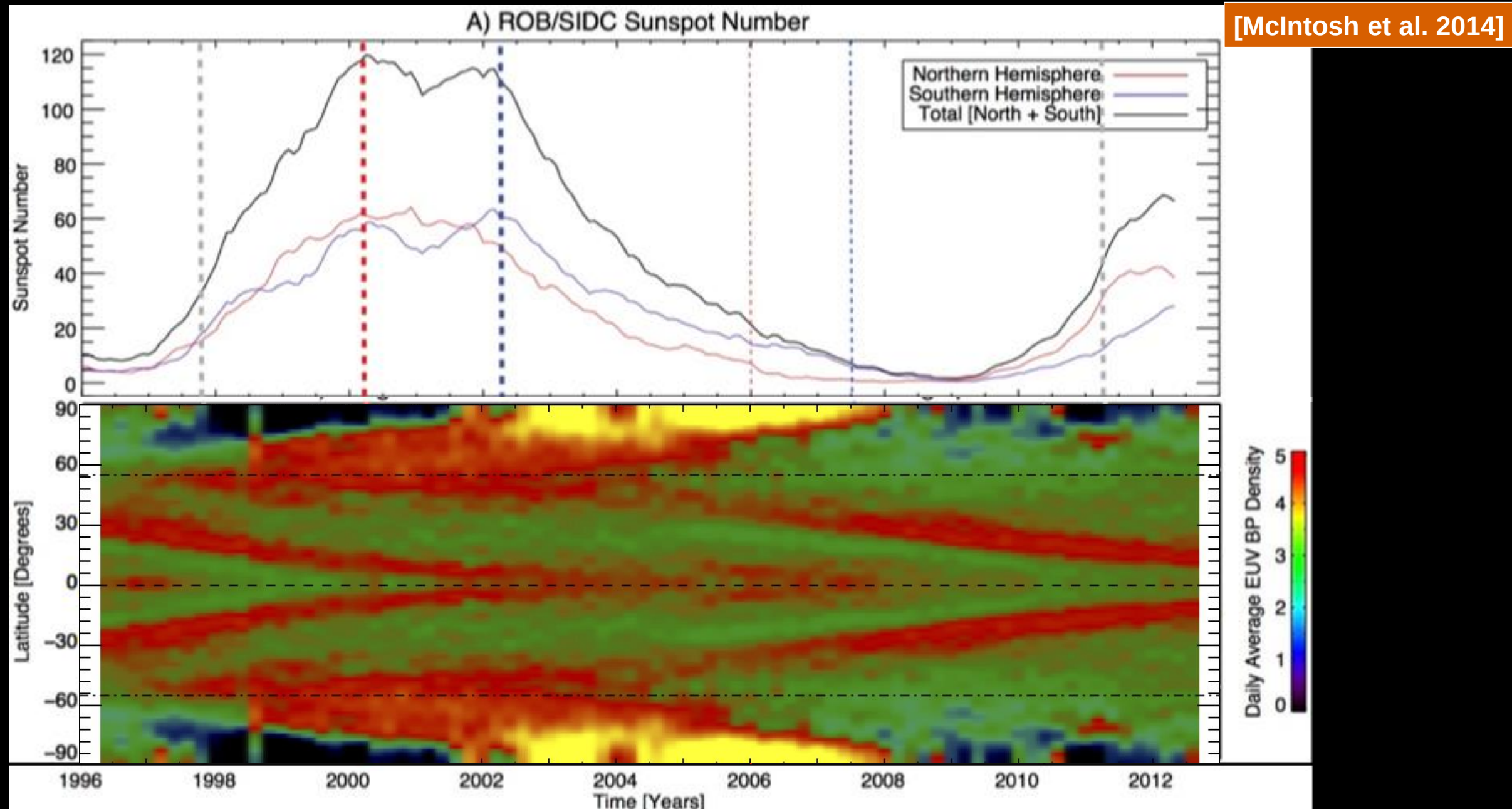
Tracking the evolution of small scale - magnetically rooted - features in the Sun's corona leads to a picture of evolution that can be used to explain the landmarks and strength of present, current (and possibly future) sunspot cycles in the context of the 22-year solar magnetic activity cycle.



cf. work of Ulrich, LaBonte, Harvey, Wilson, Snodgrass, McIntosh, others in the 1980s

Contemporary Observations

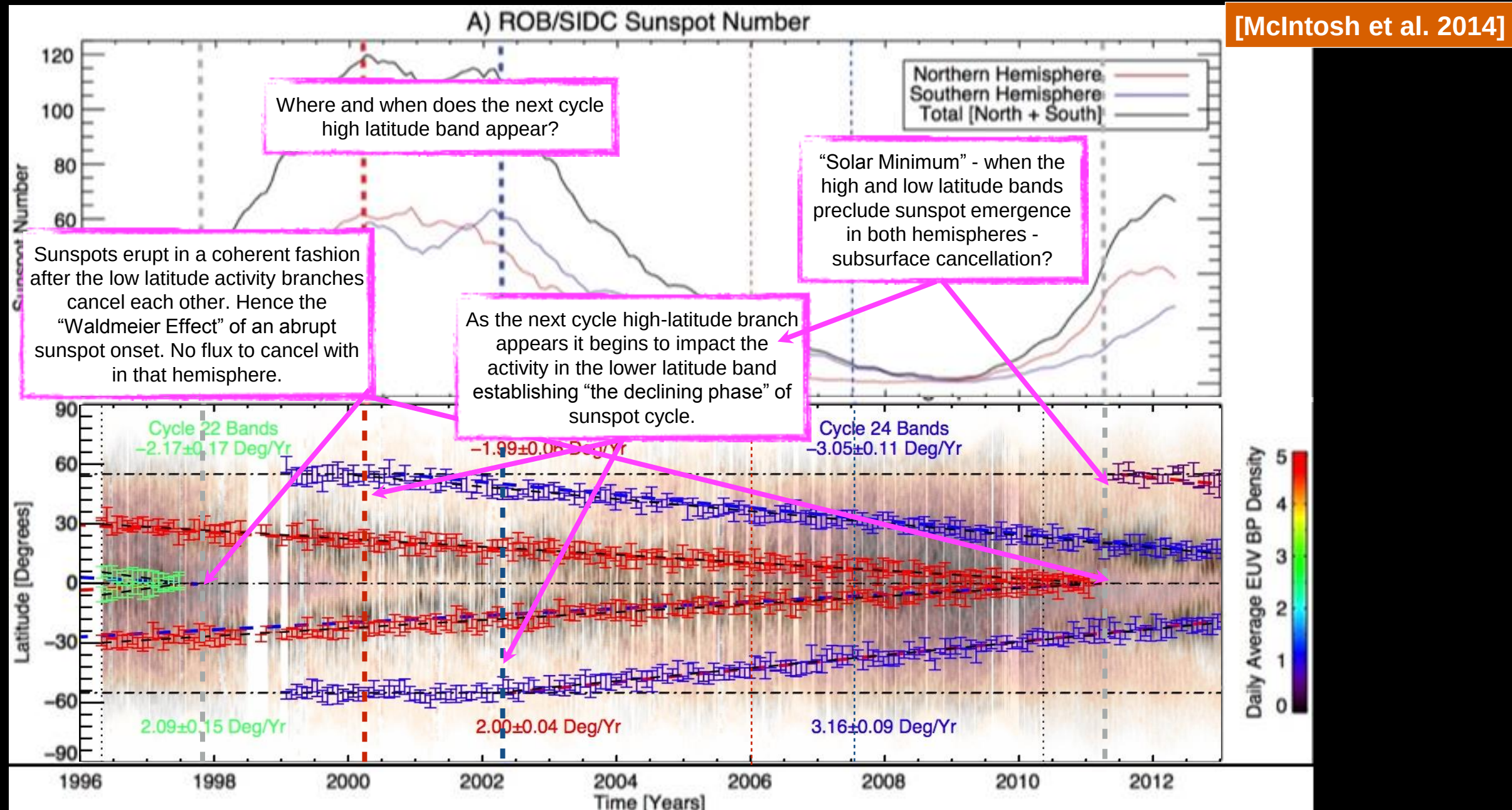
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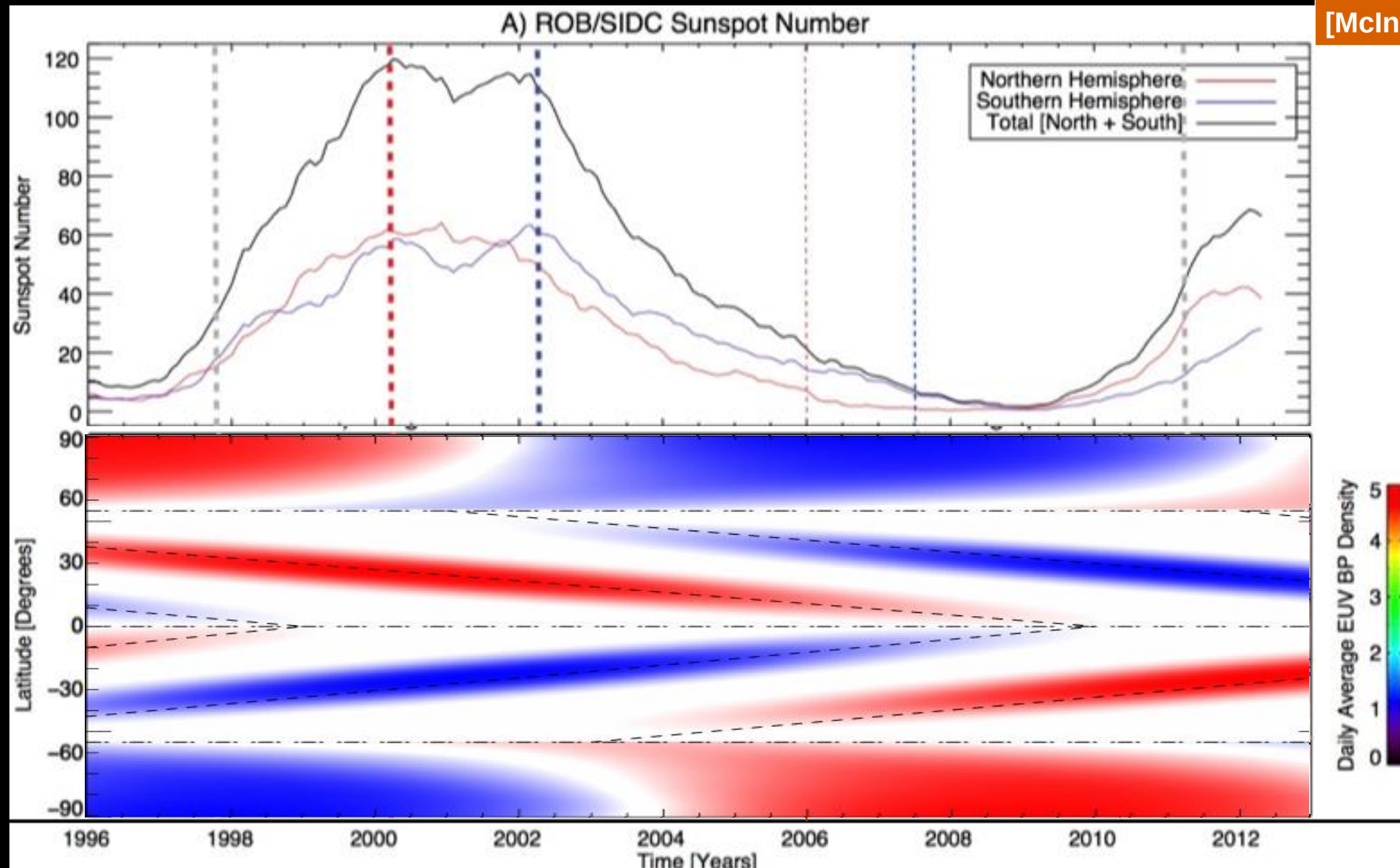
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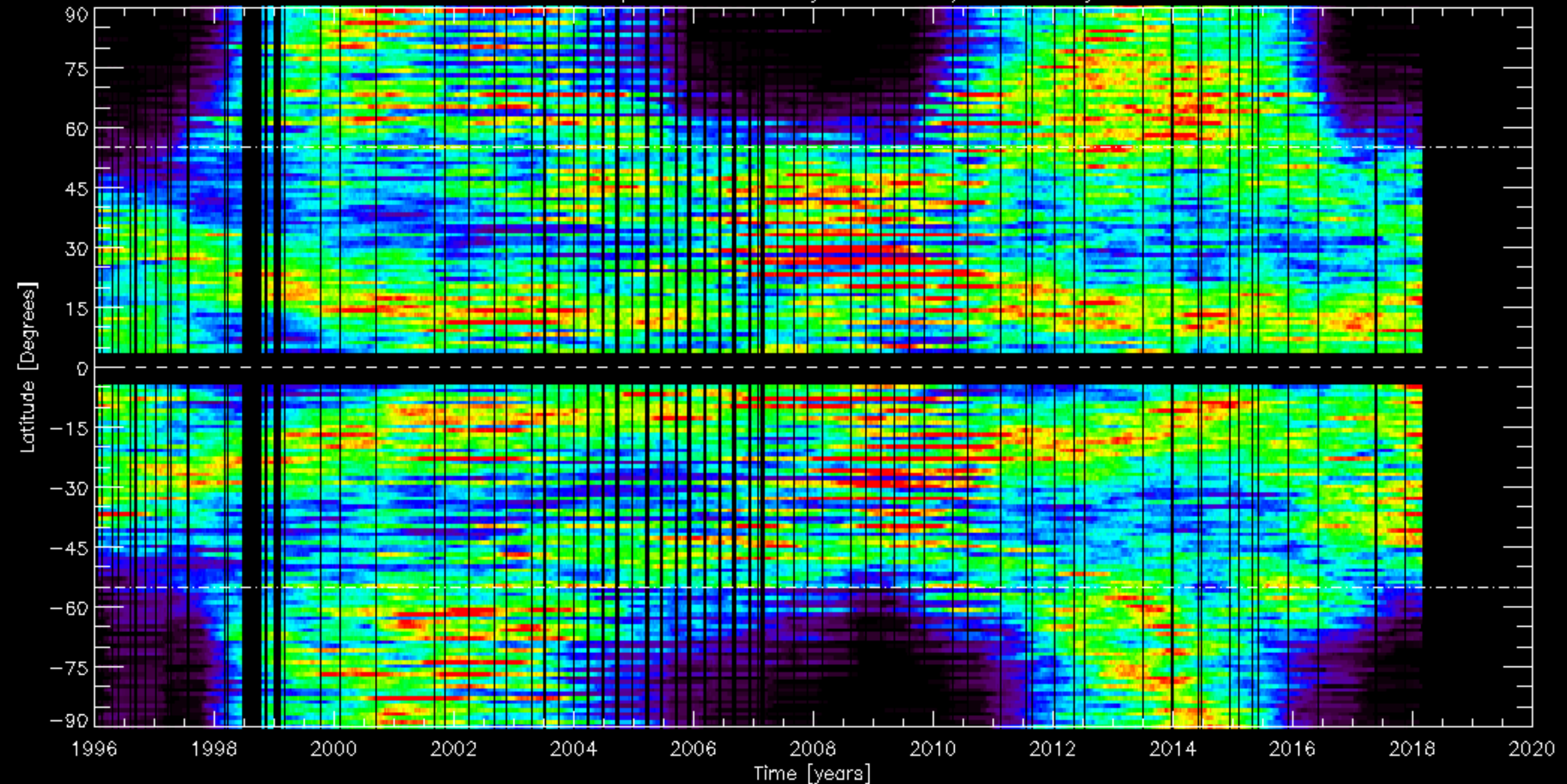
140 Years.....

#SWW2018

[McIntosh et al. 2018]

SoHO [1996 - Present]

Southern Hemisphere – Intensity Maxima $\pm$ 150 Day Window



The song repeats...

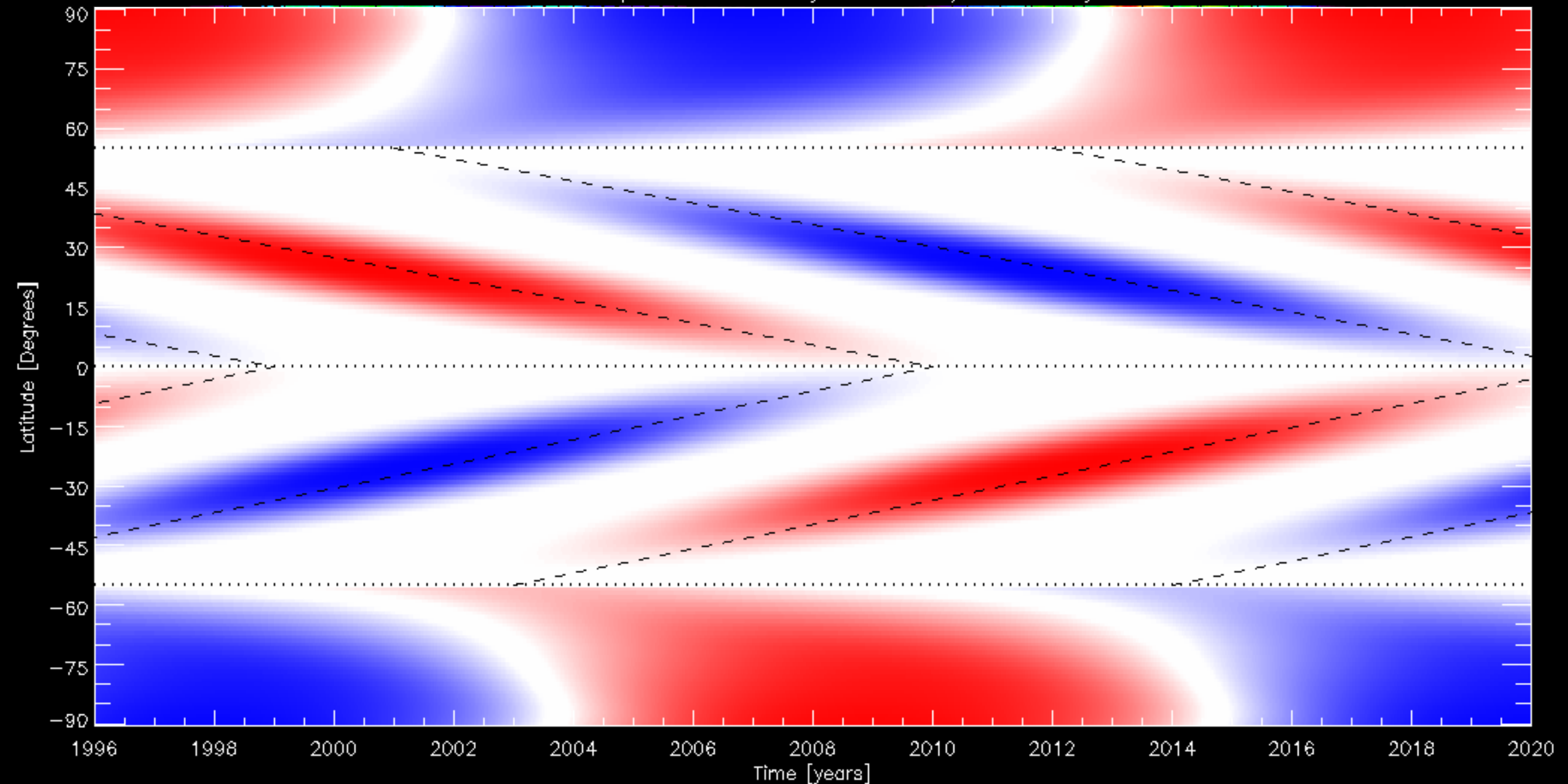
140 Years.....

#SWW2018

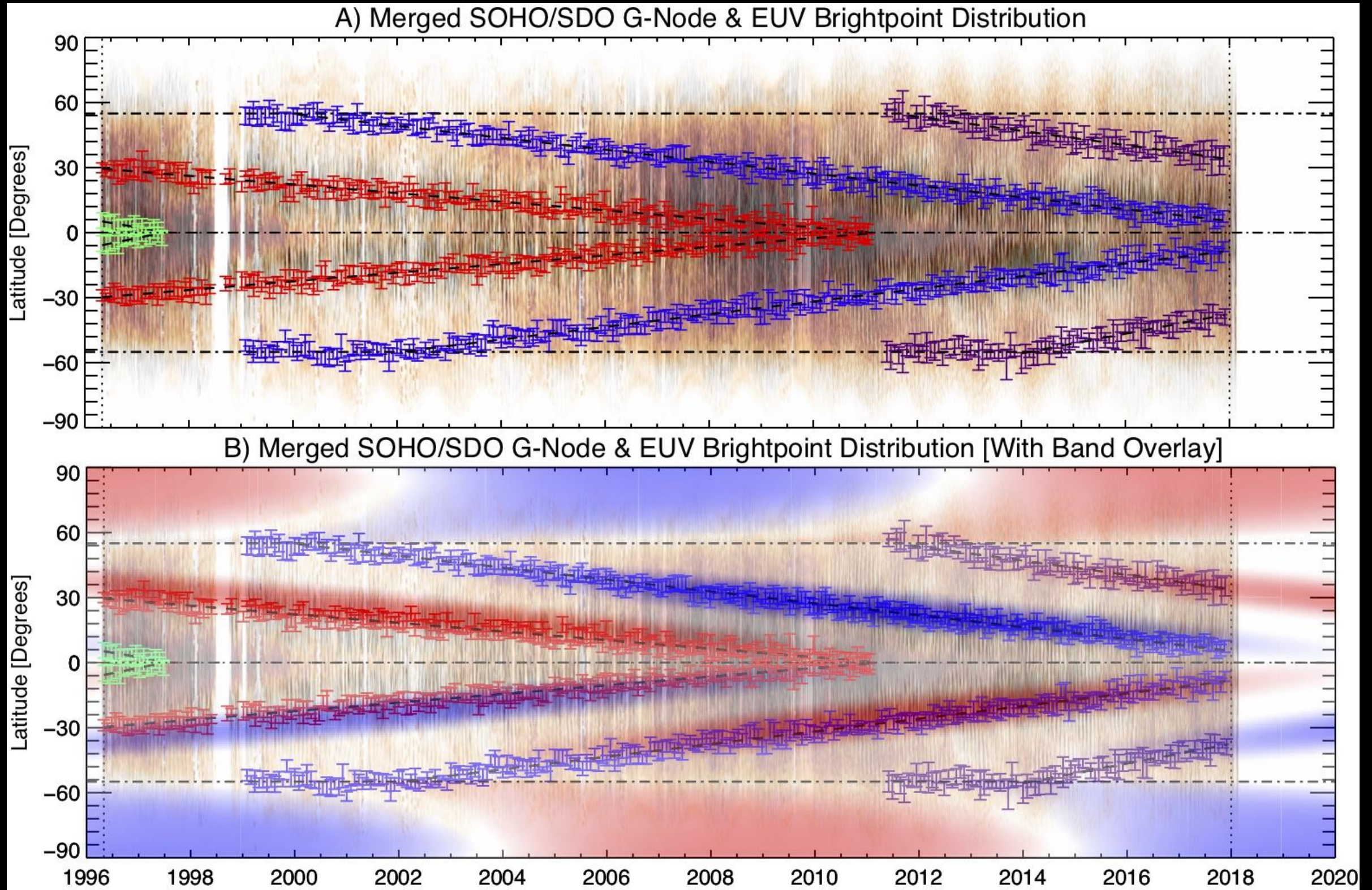
[McIntosh et al. 2018]

SoHO [1996 - Present] STEREO "A" [2007 - Present] STEREO "B" [2007 - 2014] SDO [2010 - Present]

Southern Hemisphere – Intensity Maxima $\pm$ 150 Day Window



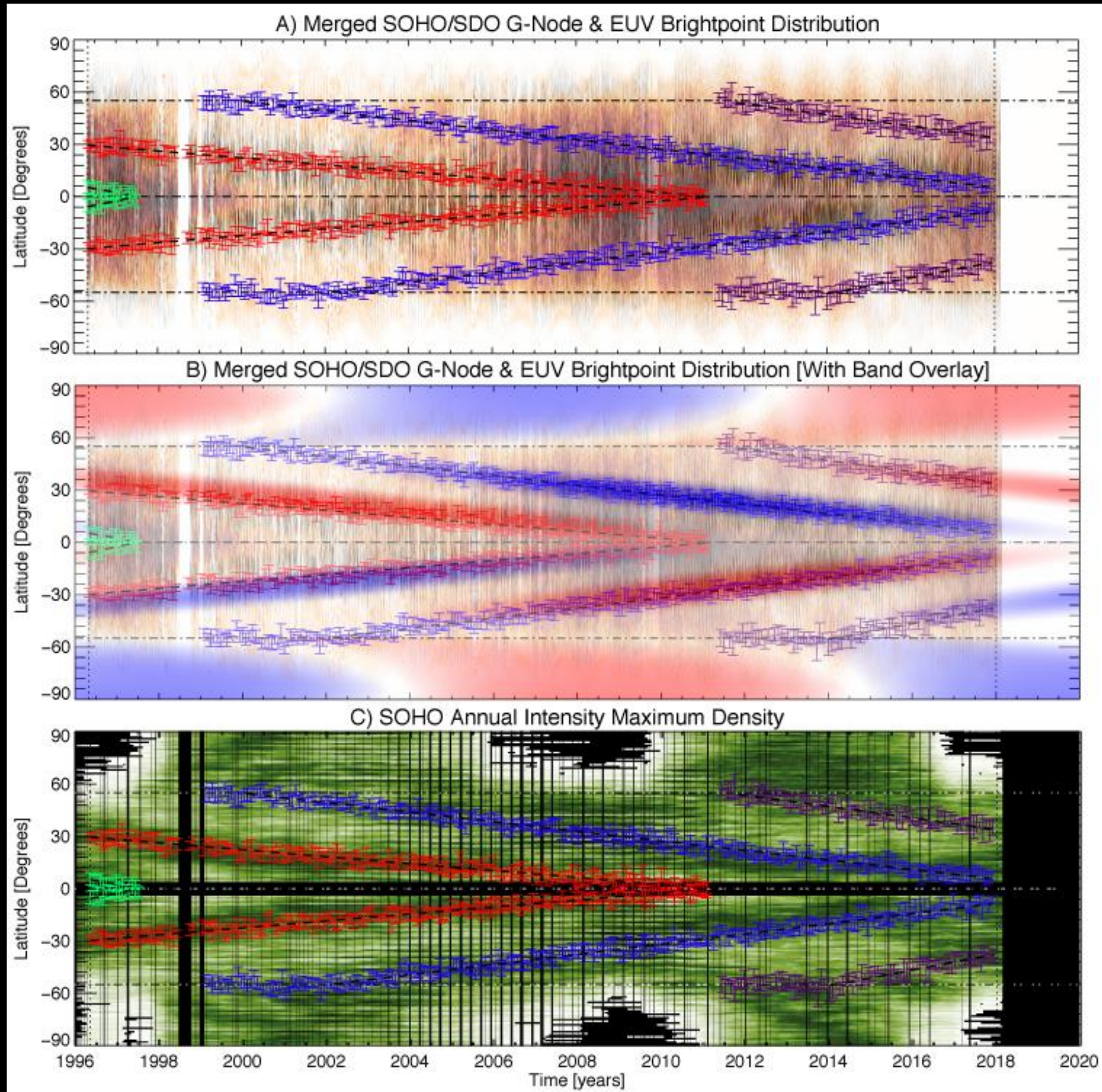
.....but it is only 22 years.....



We've been tracking "sunspot cycle" since 2012. Anticipate cycle 25 spots will begin to appear in 2019. Overlap is increasing. Cycle 25 will explode following the "termination" in 2020.

140 Years.....

#SWW2018



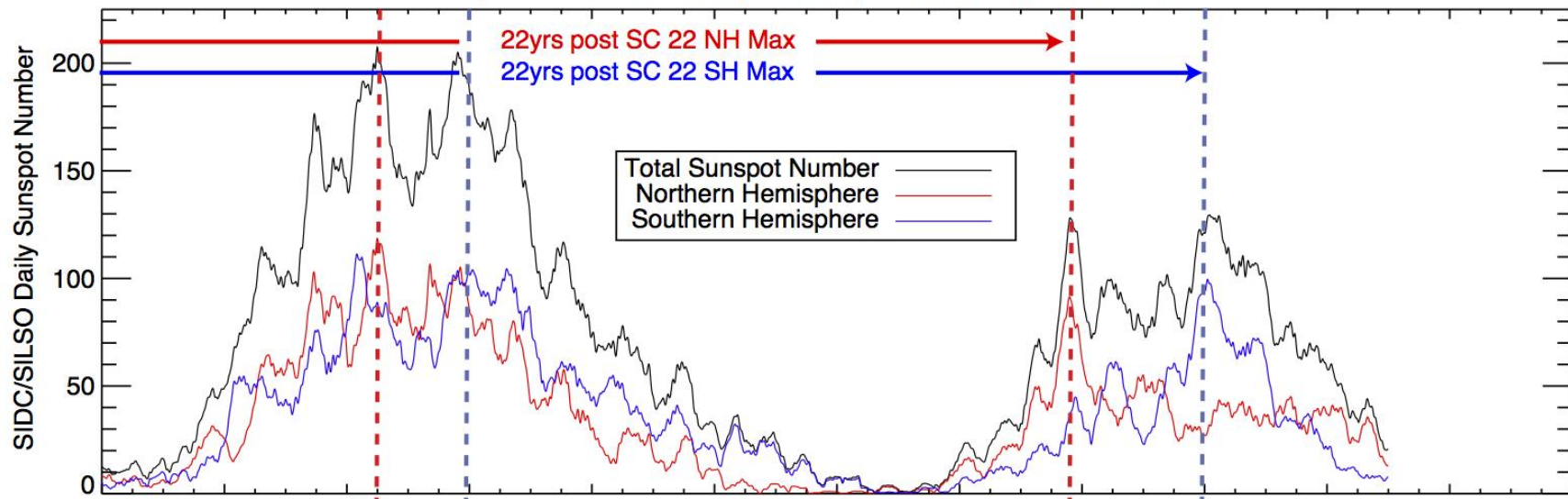
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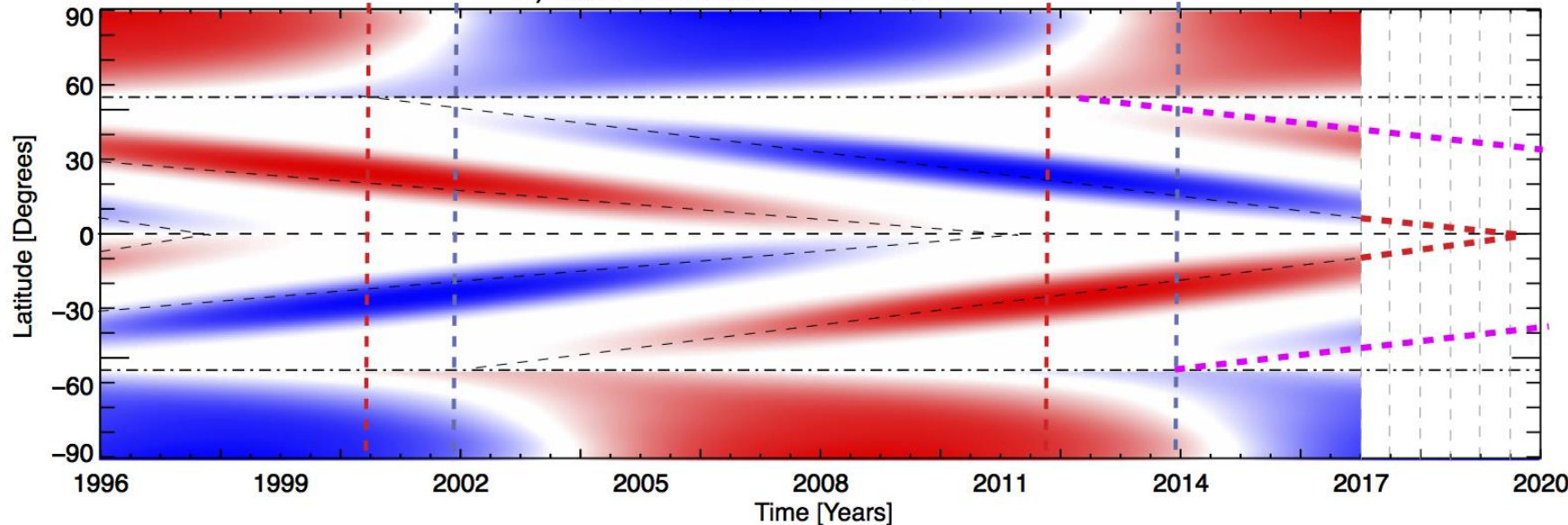
[McIntosh et al. 2017]

[McIntosh et al. 2014]

A) SIDC/SILSO Daily Hemispheric Sunspot Number



B) Data-Motivated Band-O-Gram



Solar Minimum is close!

Solar Cycle 25 is here!

WILL be < cycle 24!

**Spots in
late 2019 - early 2020.**

Terminator in 2020!

Stay Tuned - Space Weather is about to evolve!

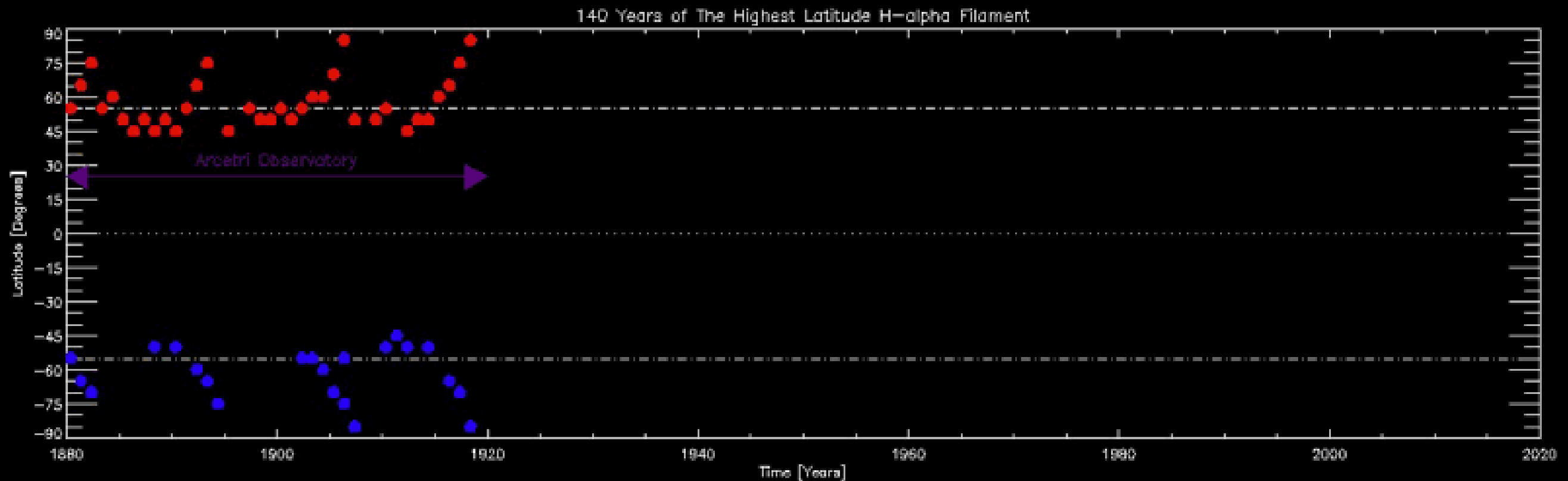
Solar Activity is a STRONGLY longitudinal thing and has recurrent repeating patterns.

**Are we heading for an extended 24/25 solar minimum?
Likely en route to a Grand Minimum.**

140 Years.....

#SWW2018

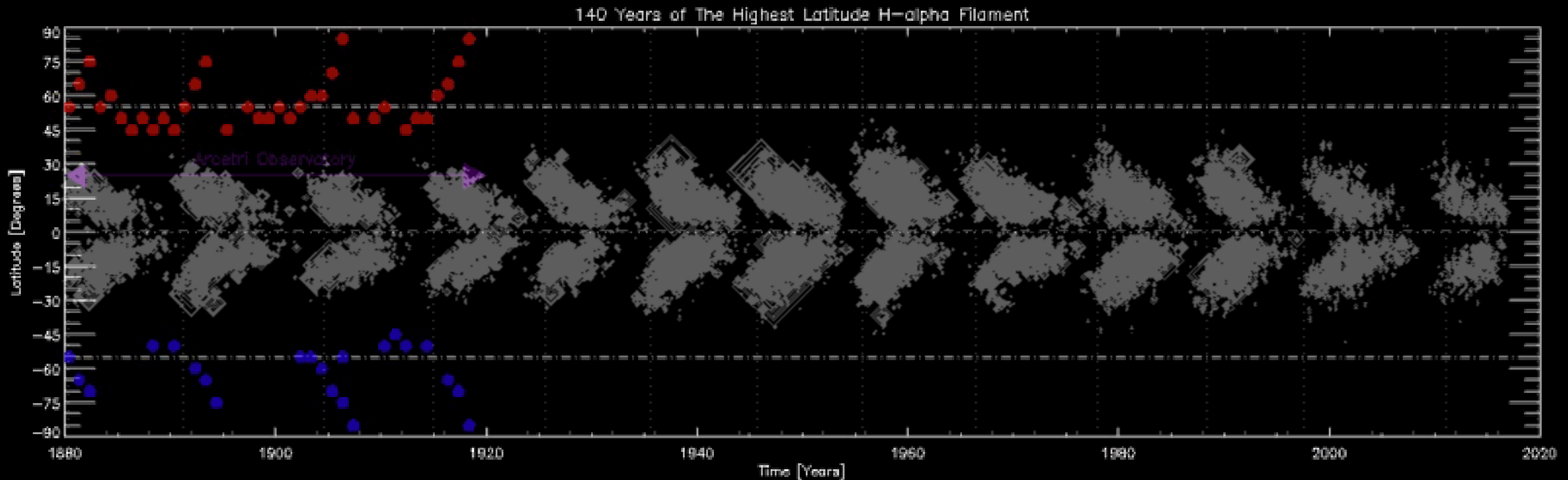
**The highest latitude solar filament..... evolves like the Sun's EKG.
filaments trace the presence of neutral/cancellation points in the system**



There is a repeating, periodic unit of activity in both solar hemispheres - that is the magnetic activity cycle.

#SWW2018

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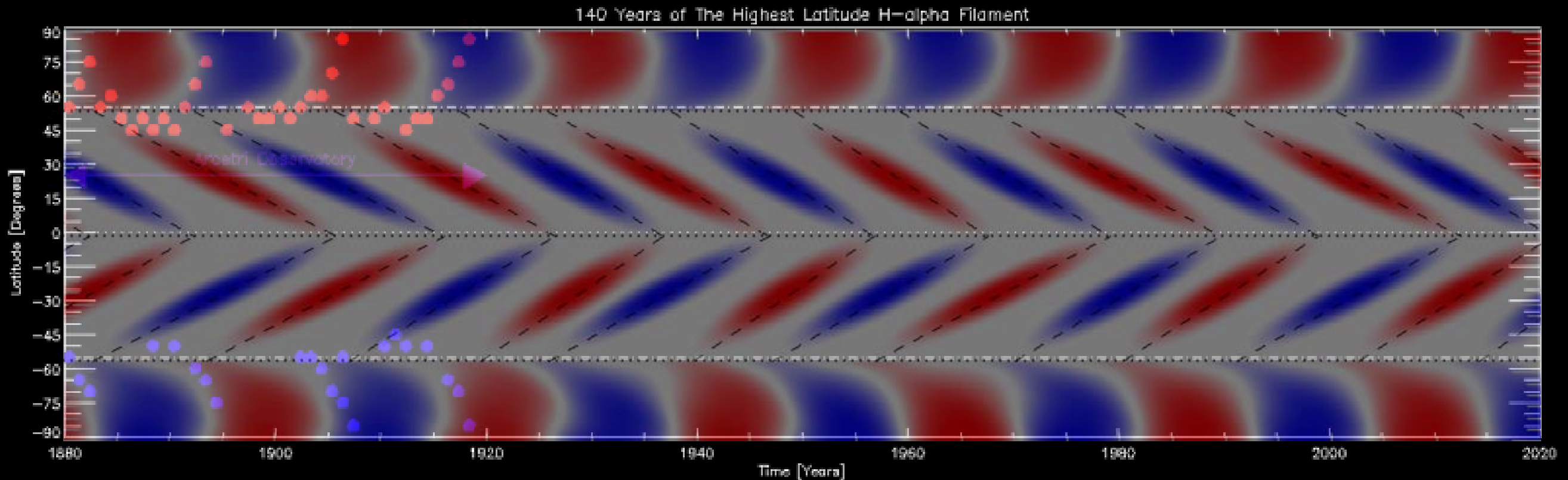
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Synchronized by a new event in the solar “canon” - the terminator

140 Years.....

#SWW2018

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Synchronized by a new event in the solar “canon” - the terminator

Sunspot activity is phase shifted by about 2 years across hemispheres