



*The Solar Climate Link and its Role in
Understanding of 20th Century Climate
Change*

Nir Shaviv
HU Jerusalem

Climate Conference,
Düsseldorf, November 2017

Synopsis

- ❖ Main arguments of the climate alarmists - why they are either irrelevant or wrong
- ❖ Additional problems with the alarmist “scenario”
- ❖ Evidence for a strong solar climate link
- ❖ The physics behind the link: Effects of atmospheric ionization on the growth of cloud condensation nuclei (next talk by Henrik Svensmark)
- ❖ Implications of the solar link to the understanding of past and future climate change

It is commonly believed that...



...why???

What are the arguments?

- ❖ Some of the arguments are irrelevant
- ❖ Some of the arguments are wrong

Irrelevant Arguments

- ❖ Appeal to authority: The argument that 97% of the scientists believe one thing or another is irrelevant!
Science is not a democracy.
- ❖ Evidence for warming \neq evidence for warming my humans.
- ❖ *Qualitative* arguments are irrelevant as well
(e.g., the fact that human population is close to 10 billion people does mean that the warming is anthropogenic).
Gut feelings (or feelings in general) are irrelevant.

Two main arguments of the IPCC

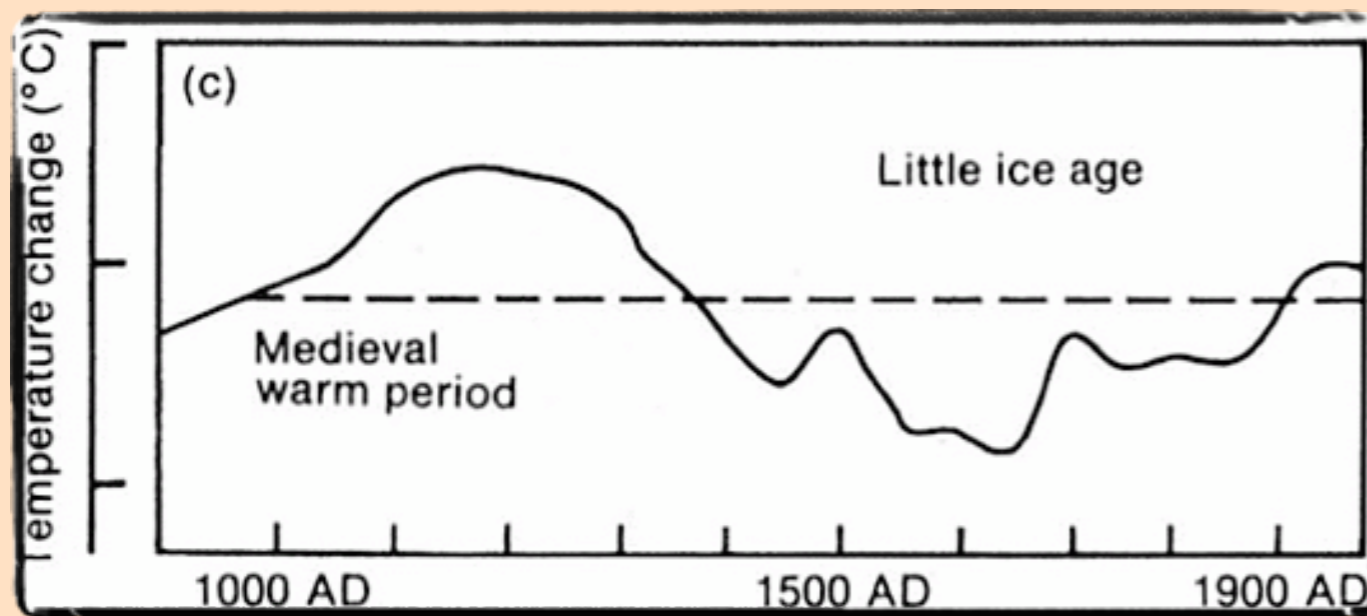
There are actually two “scientific arguments” used by the IPCC:

- ❖ The warming is unprecedented and if it is unprecedented it most likely is human.
- ❖ If one tries to explain (e.g., simulate) 20th century warming while excluding the effect of humans, one *cannot* recover the observed warming. Thus, most of the 20th century warming is necessarily anthropogenic.

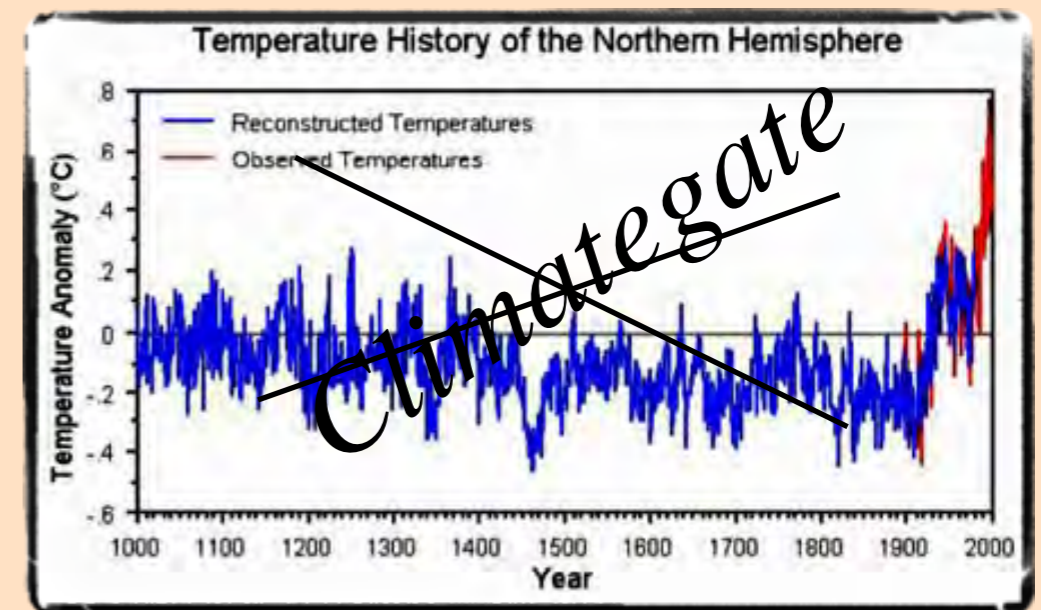
1st (wrong) argument: 20th century warming is unique

- *The claim that 20th century warming is unique is based on a fraud (google “climategate”).*

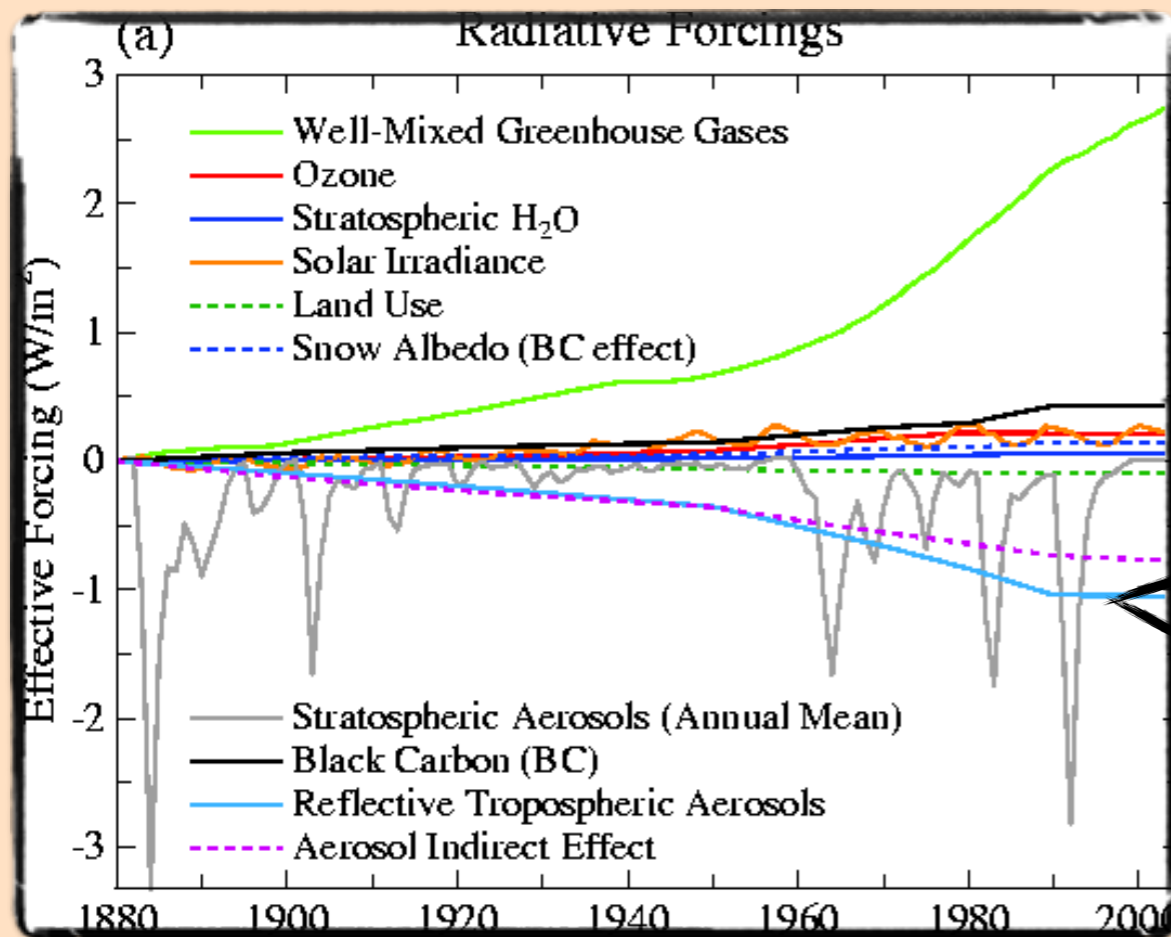
IPCC 1990



IPCC 2001



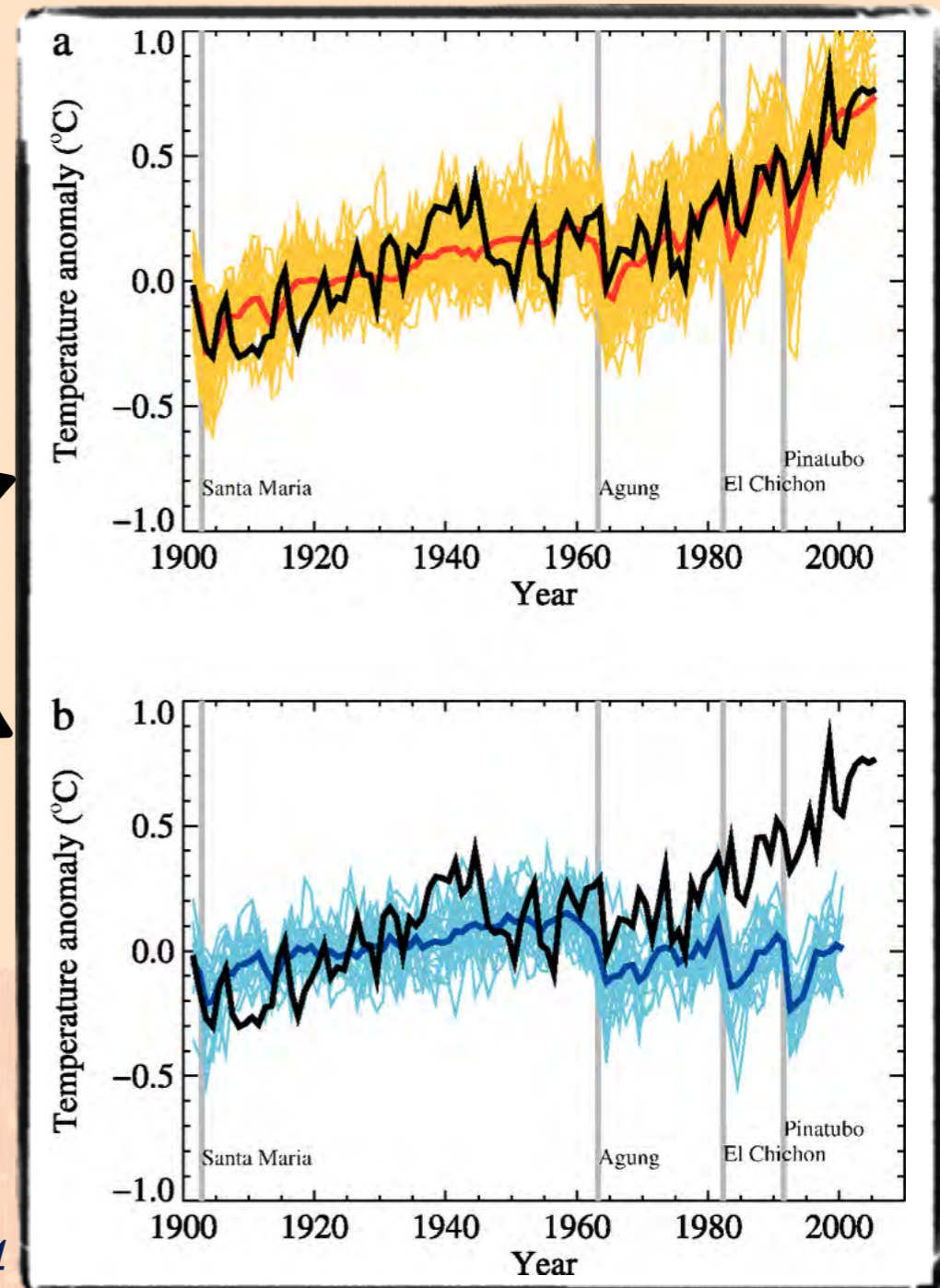
2nd (wrong) Argument: Warming has to anthropogenic



With Anthropogenic Forcings

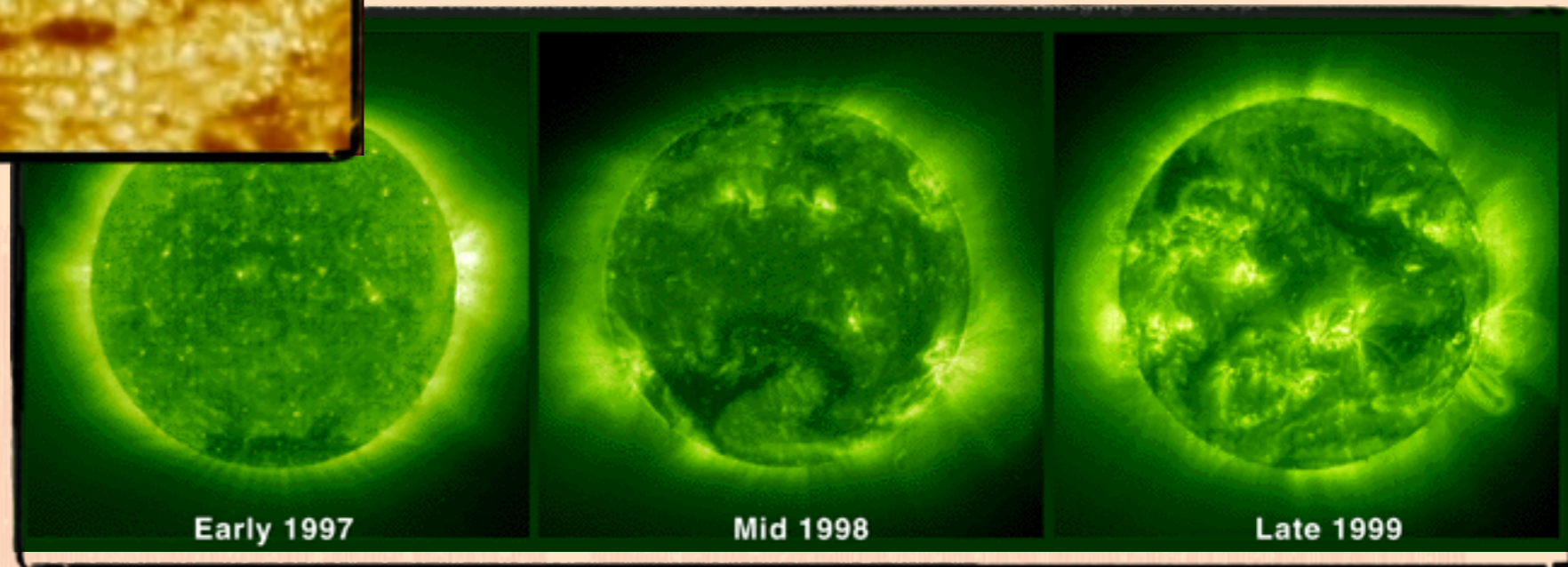
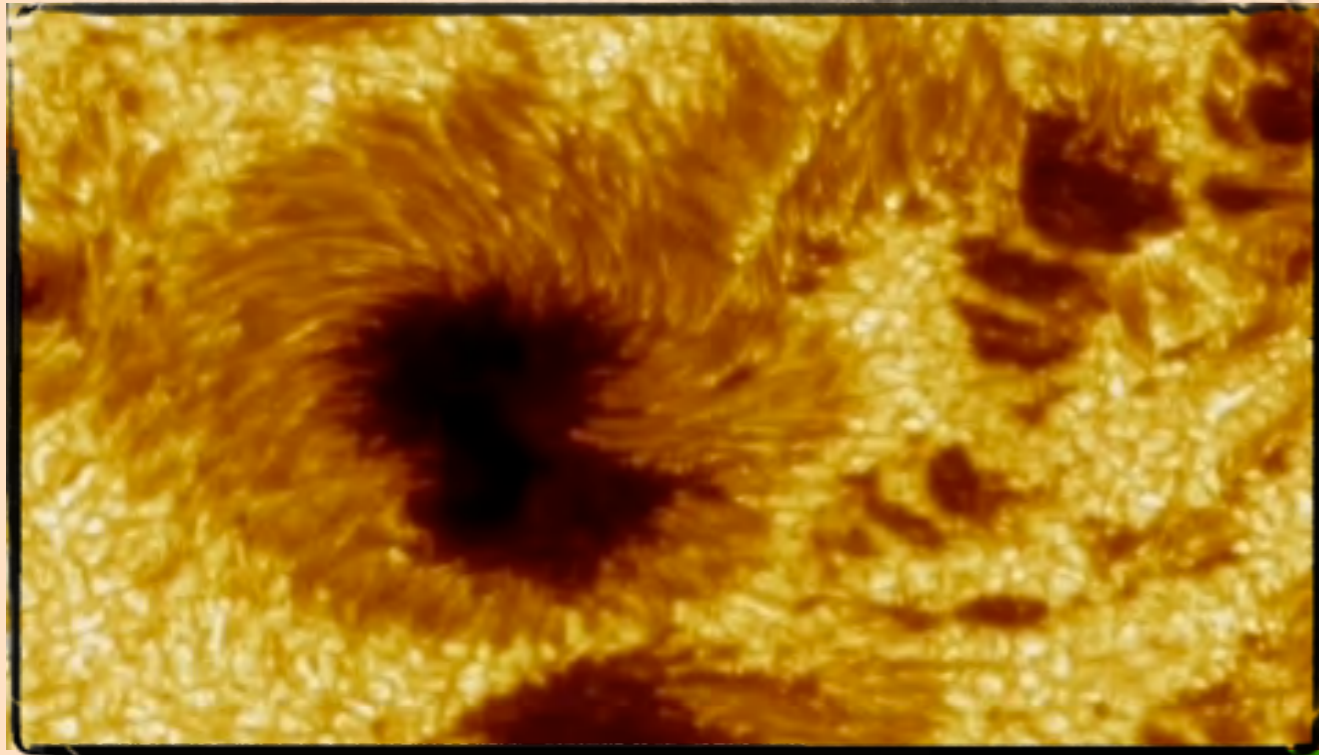
Without Anthropogenic Forcings

IPCC AR4



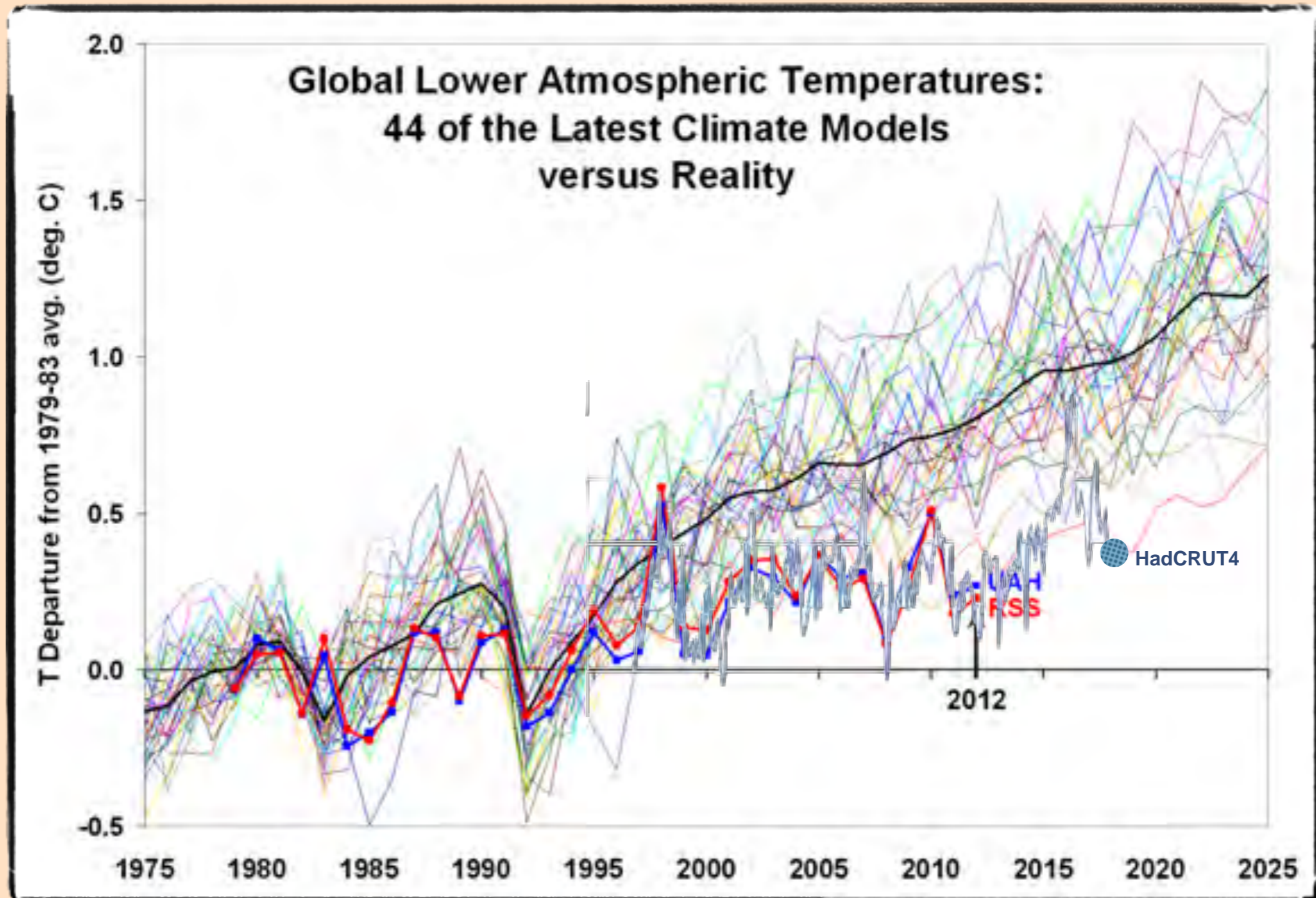
Main argument's flaw: Solar Activity is important

- *The claim that there isn't any other explanation, and therefore the warming must be primarily human, is wrong. There is another explanation: **Solar Activity**.*



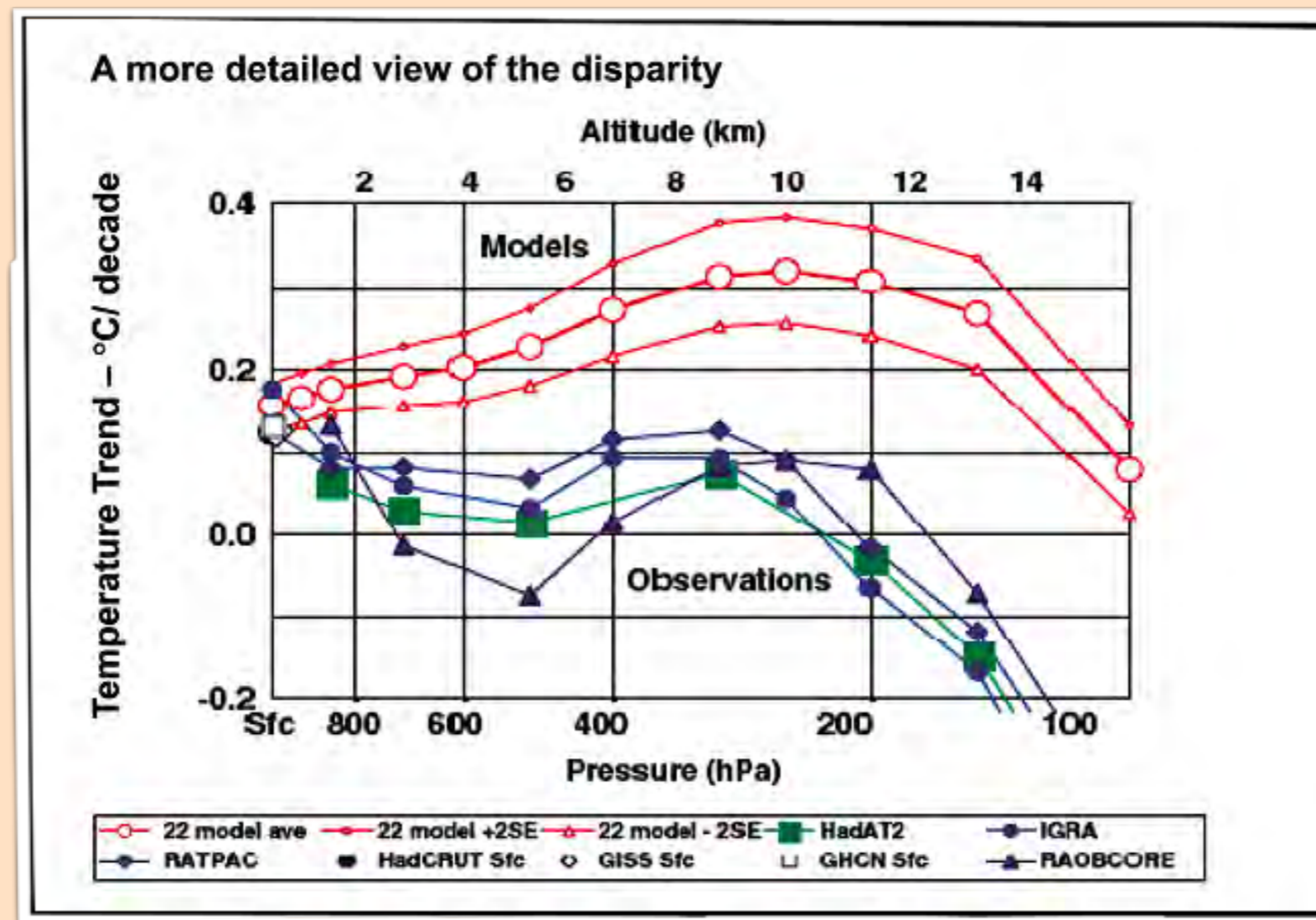
Problem 1: Size of Warming

- *Heating over the past 20 years running below the low estimate of the IPCC*



Problem 2: Location of Warming

- *Model: Uniform heating up to 15 km*
- *Reality: Heating near the ground*

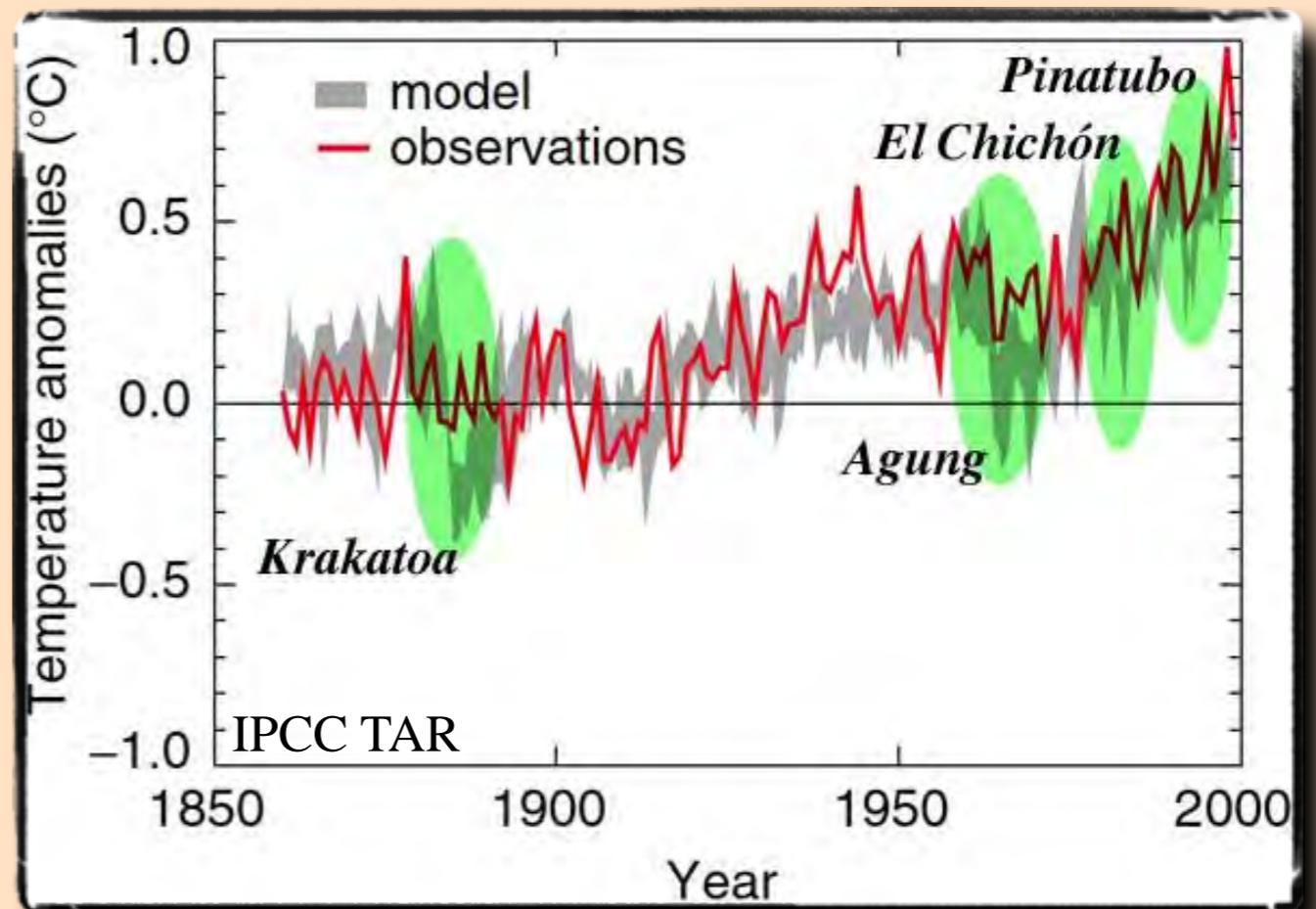
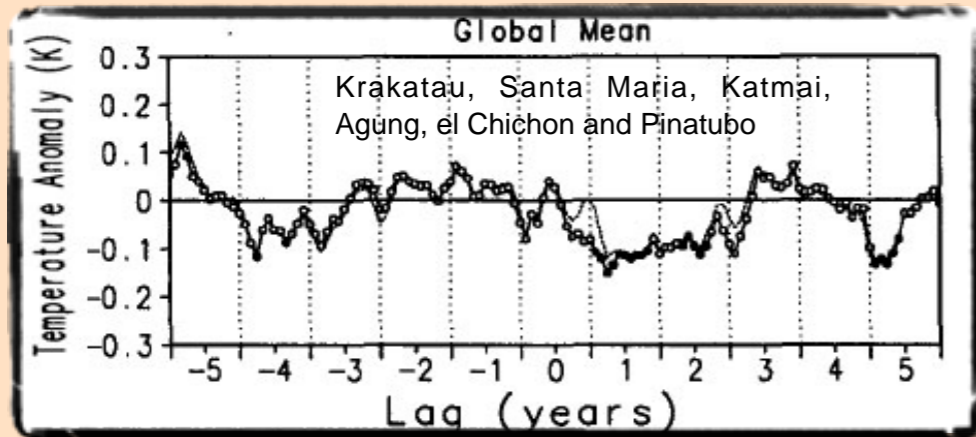


Problem 3: Model climates are too sensitive

- *Response to volcanoes is too large!*

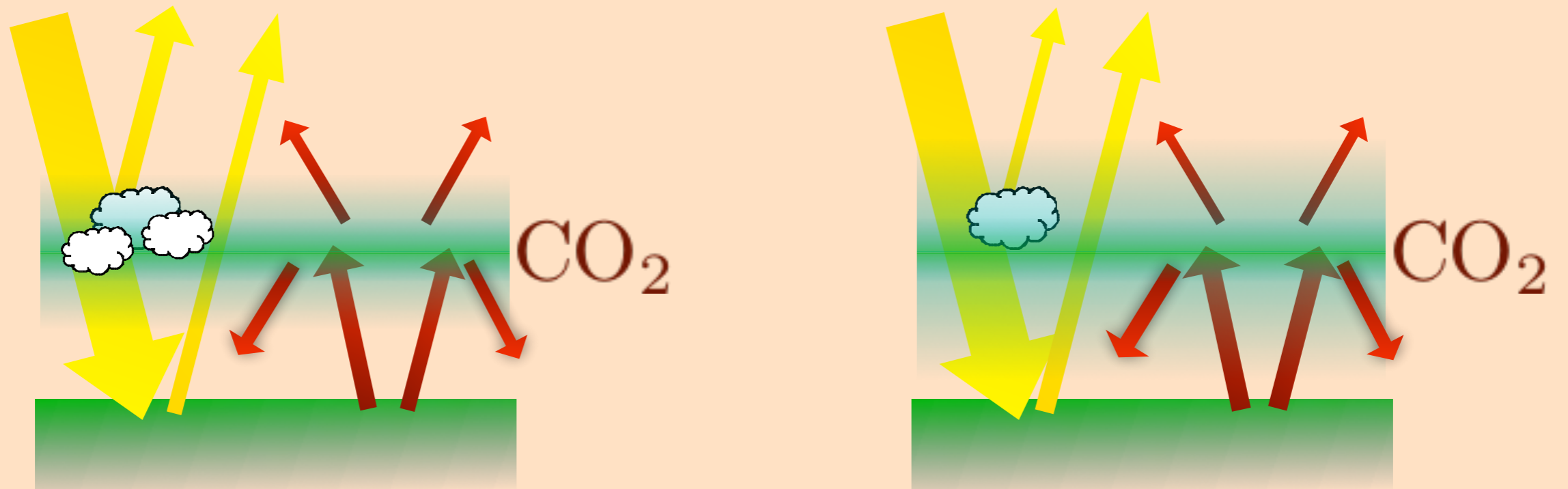


Robock and Mau 1995

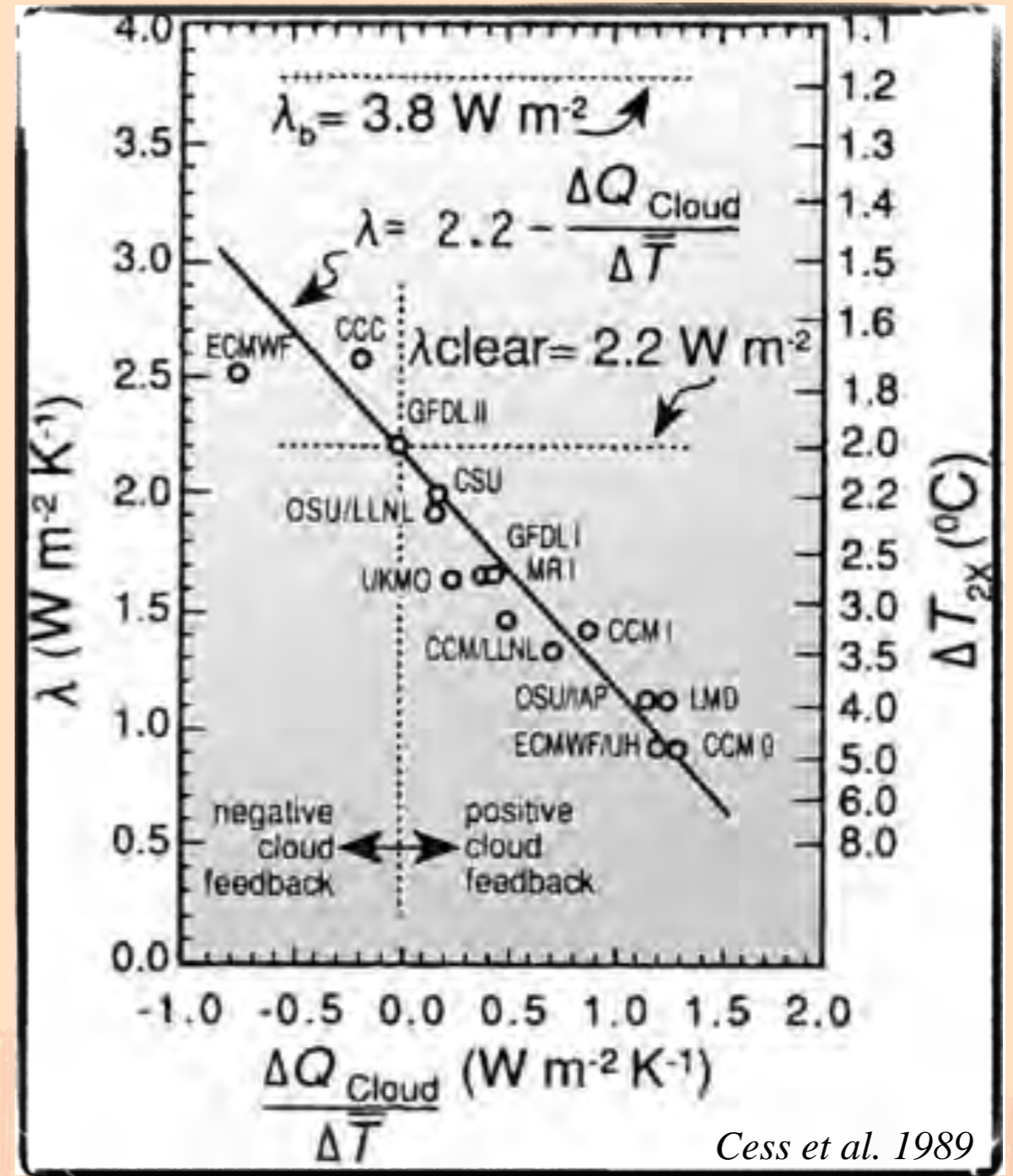
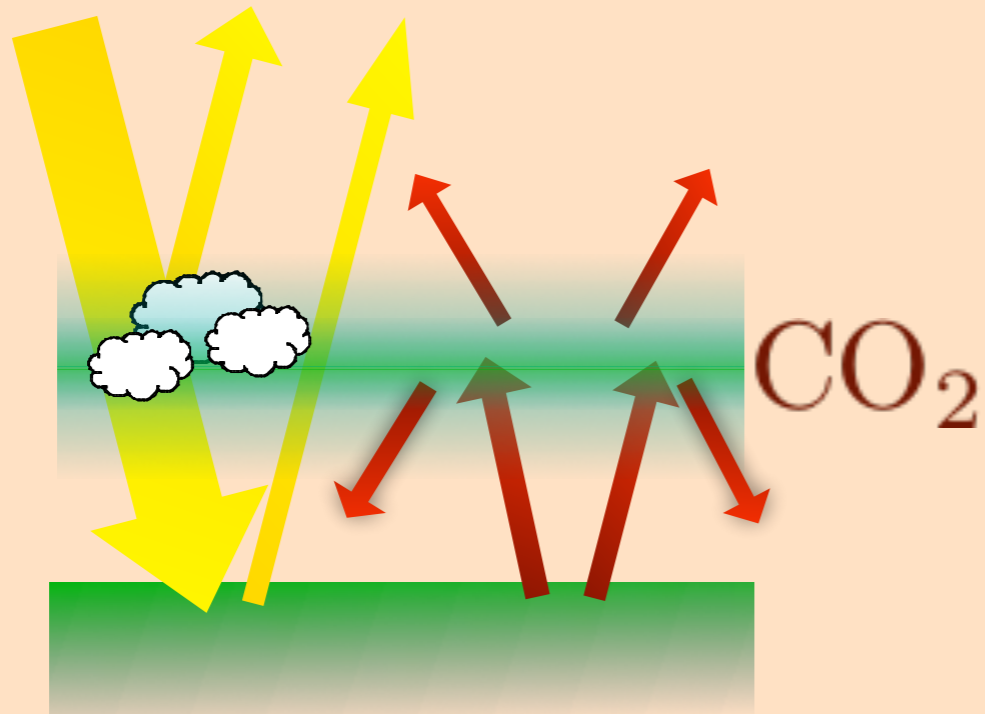


Model predictions: Decrease of 0.3-0.5°C.
Reality: Decrease of 0.1°C on average

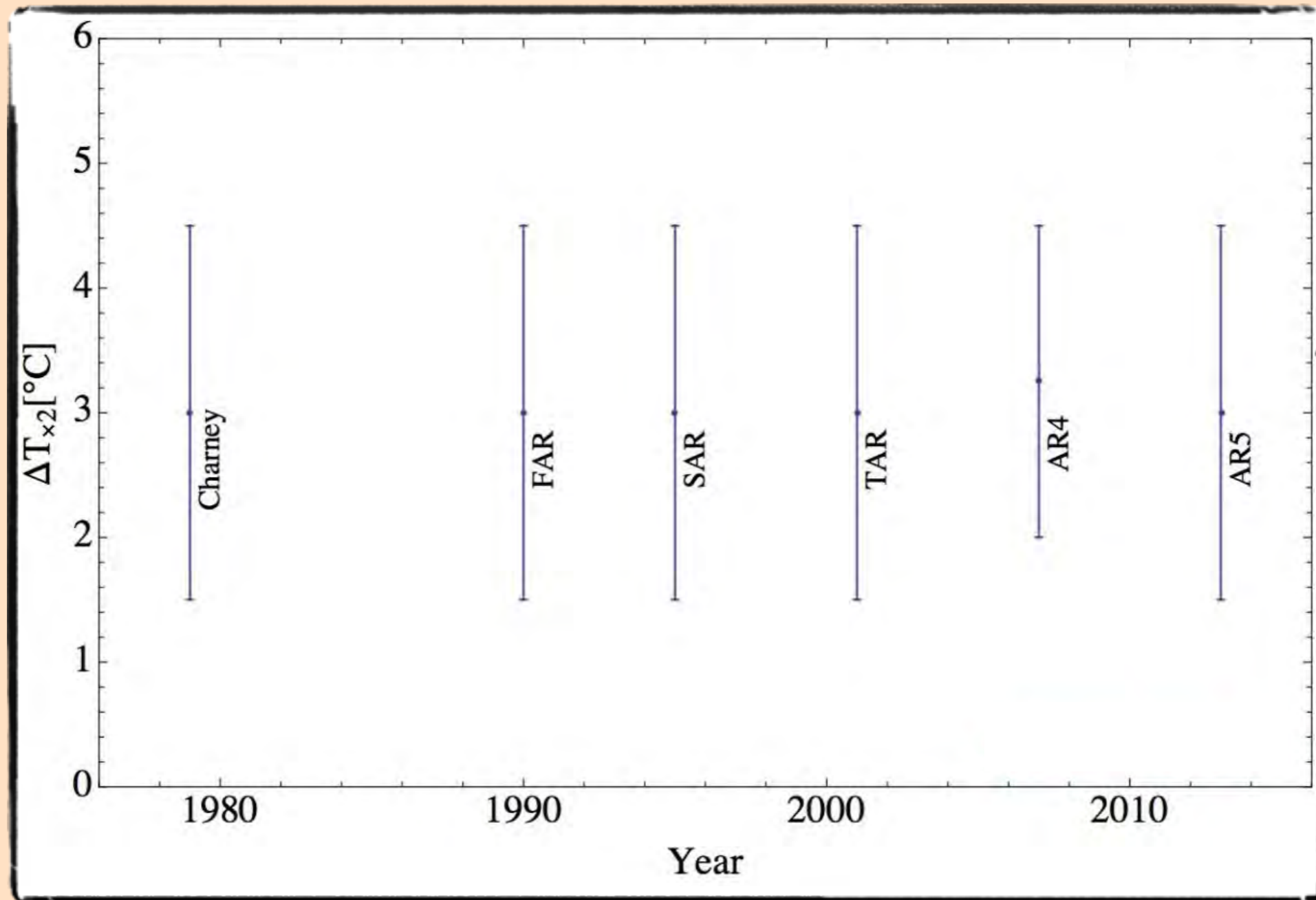
Problem 4: Model climates can give any sensitivity!



Different “recipes” for the cloud cover produce different sensitivities: Increase of 1.5 to 5°C per CO₂ doubling.



In fact, after billions of dollars invested....



Problem 5: No fingerprint

- *There is no finger print proving CO₂ is the culprit!*



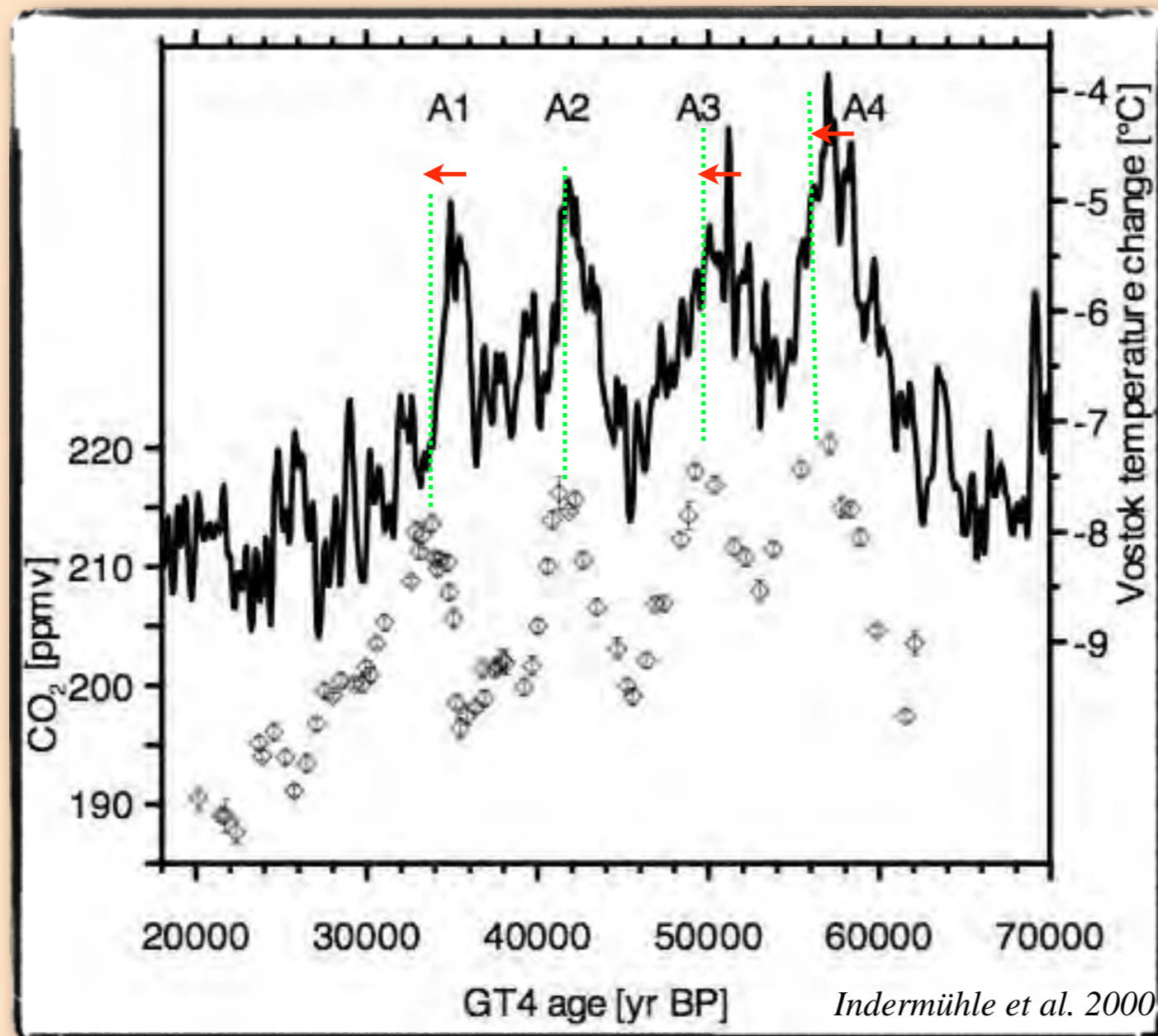
Problem 5: No fingerprint

- *But what about Al Gore and his ice cores?*



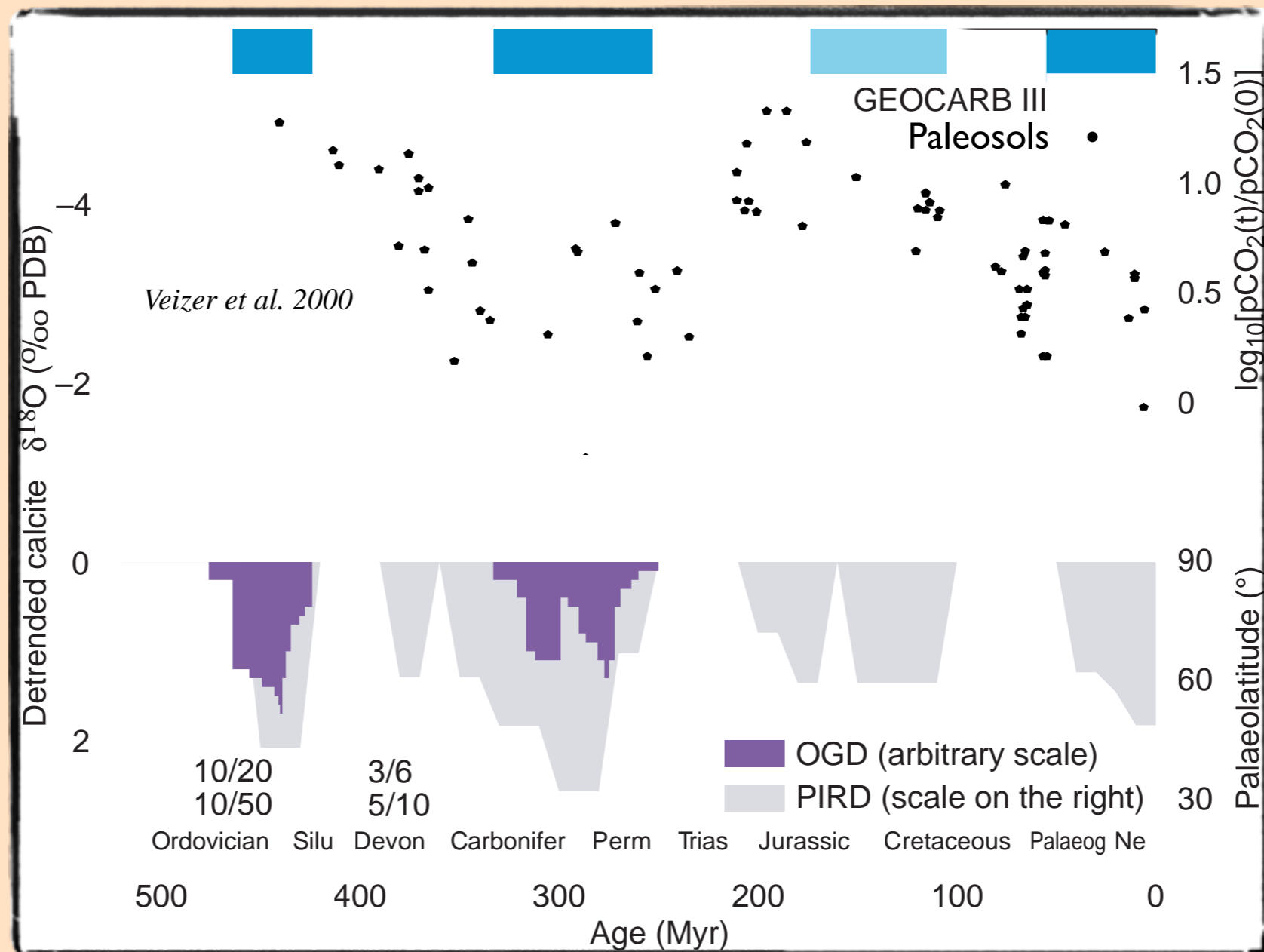
Problem 5: No fingerprint

- *CO₂ lags temperature!*



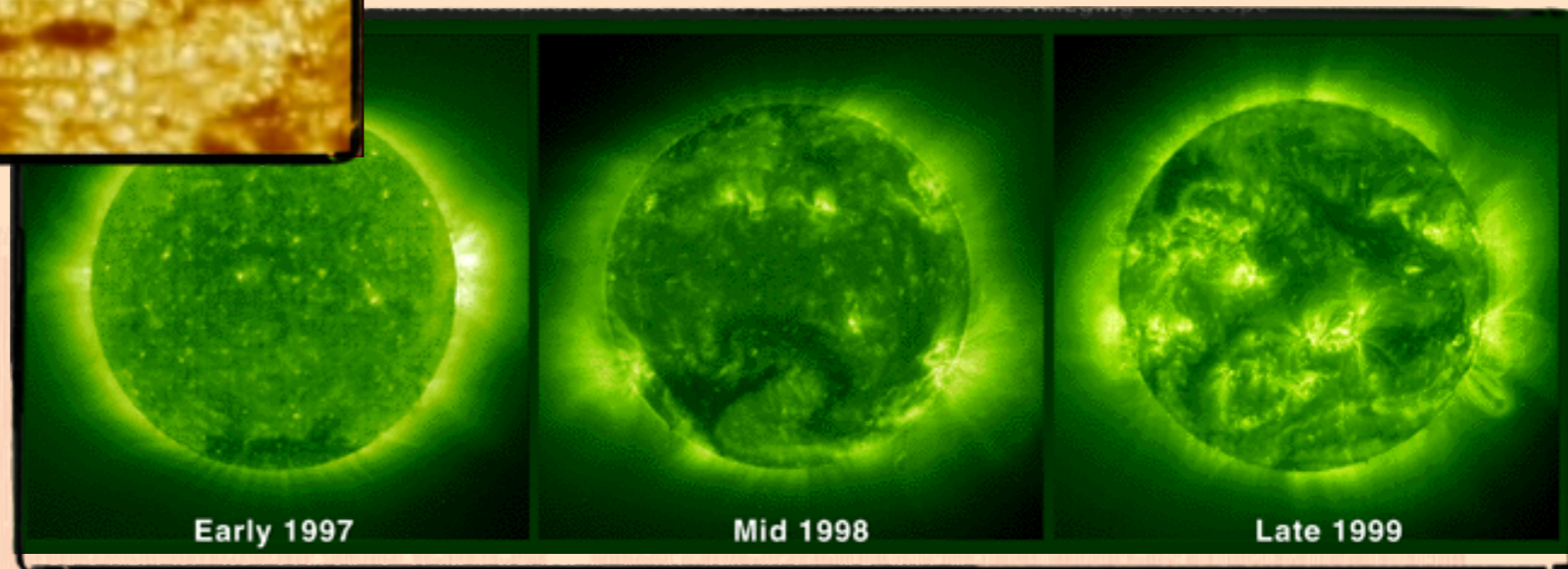
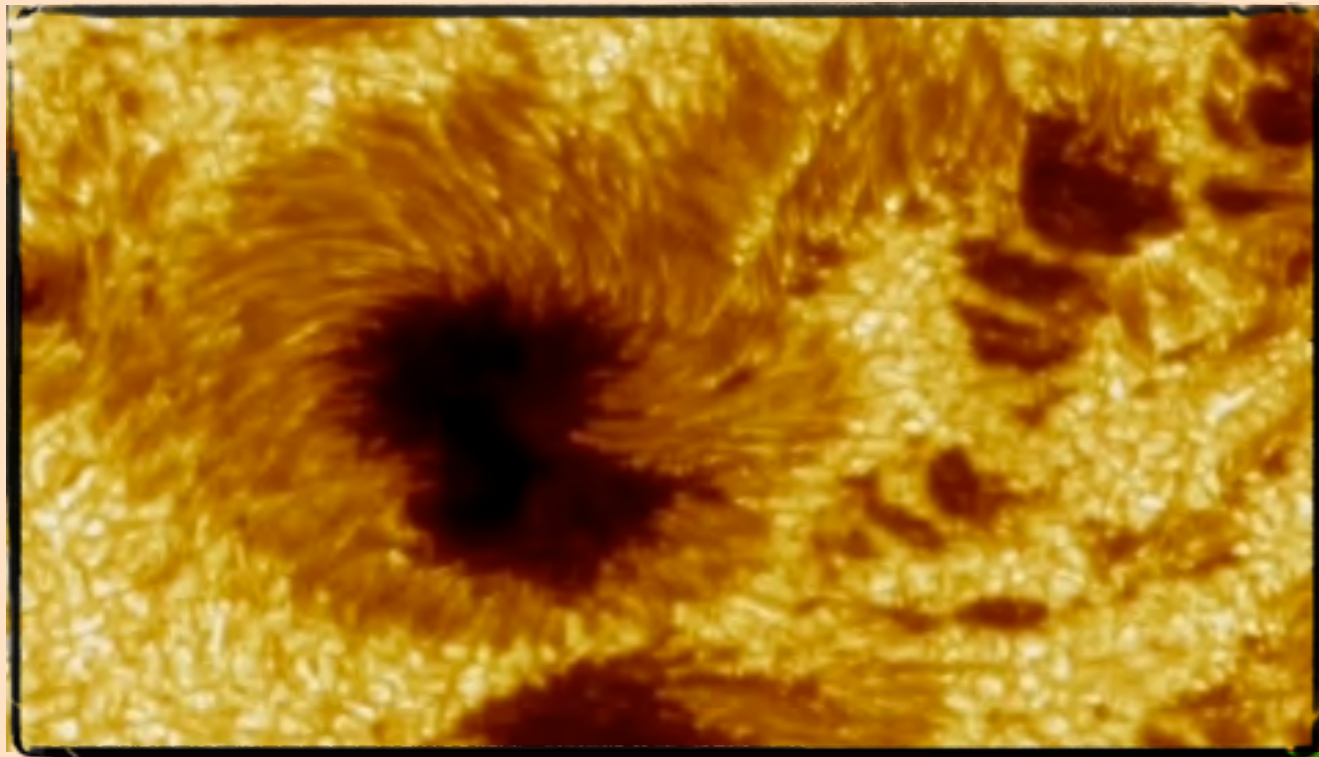
Problem 6: No ΔT from CO_2 variations

- *Over geological time scales: Large intrinsic variations in CO_2 do not cause large temperature changes.*
- *Gives climate sensitivity of 1 to $1.5^\circ C$*

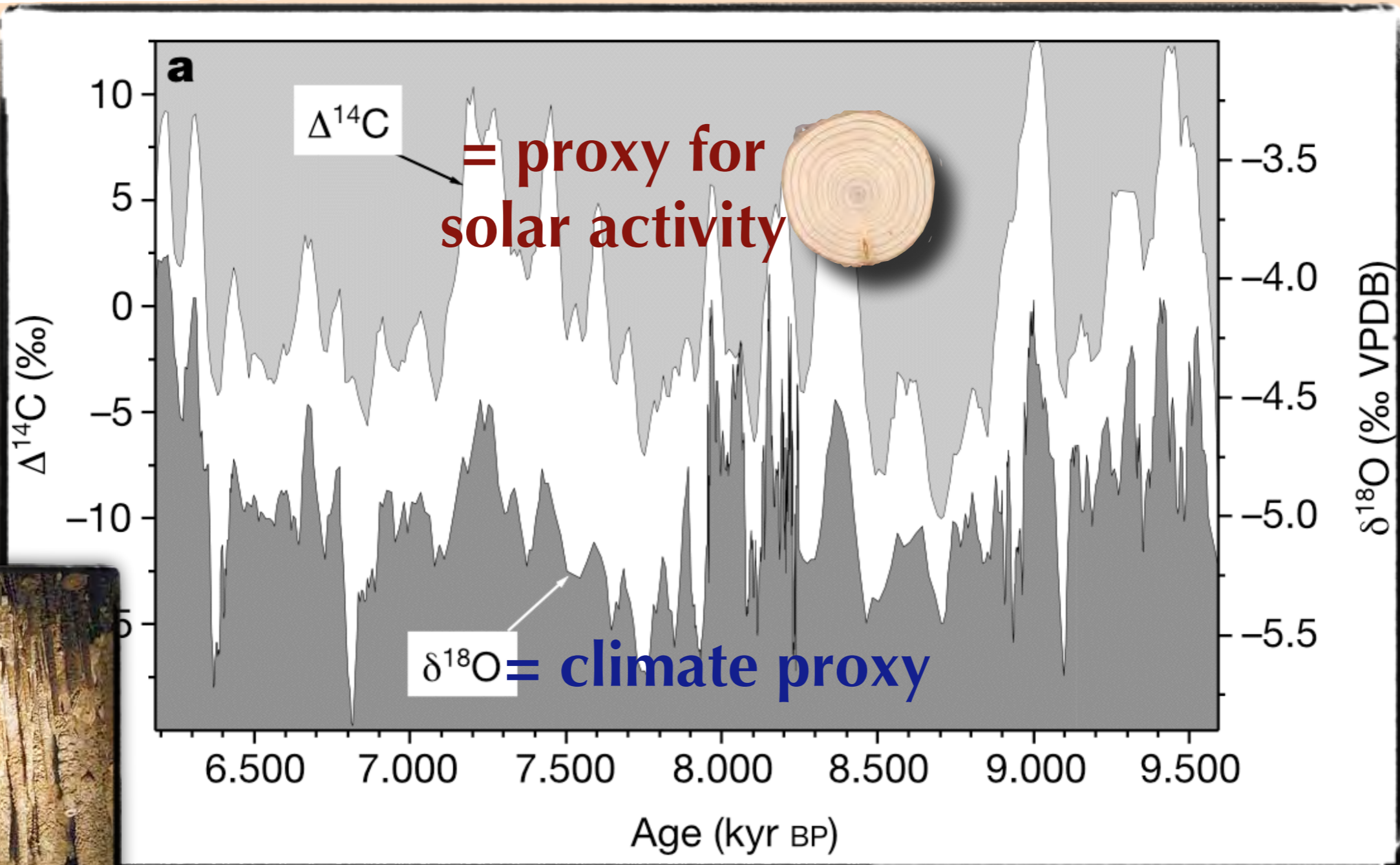


Problem 8: There is another explanation

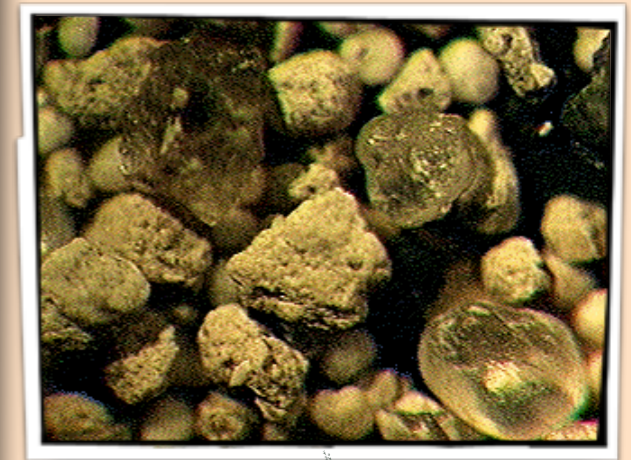
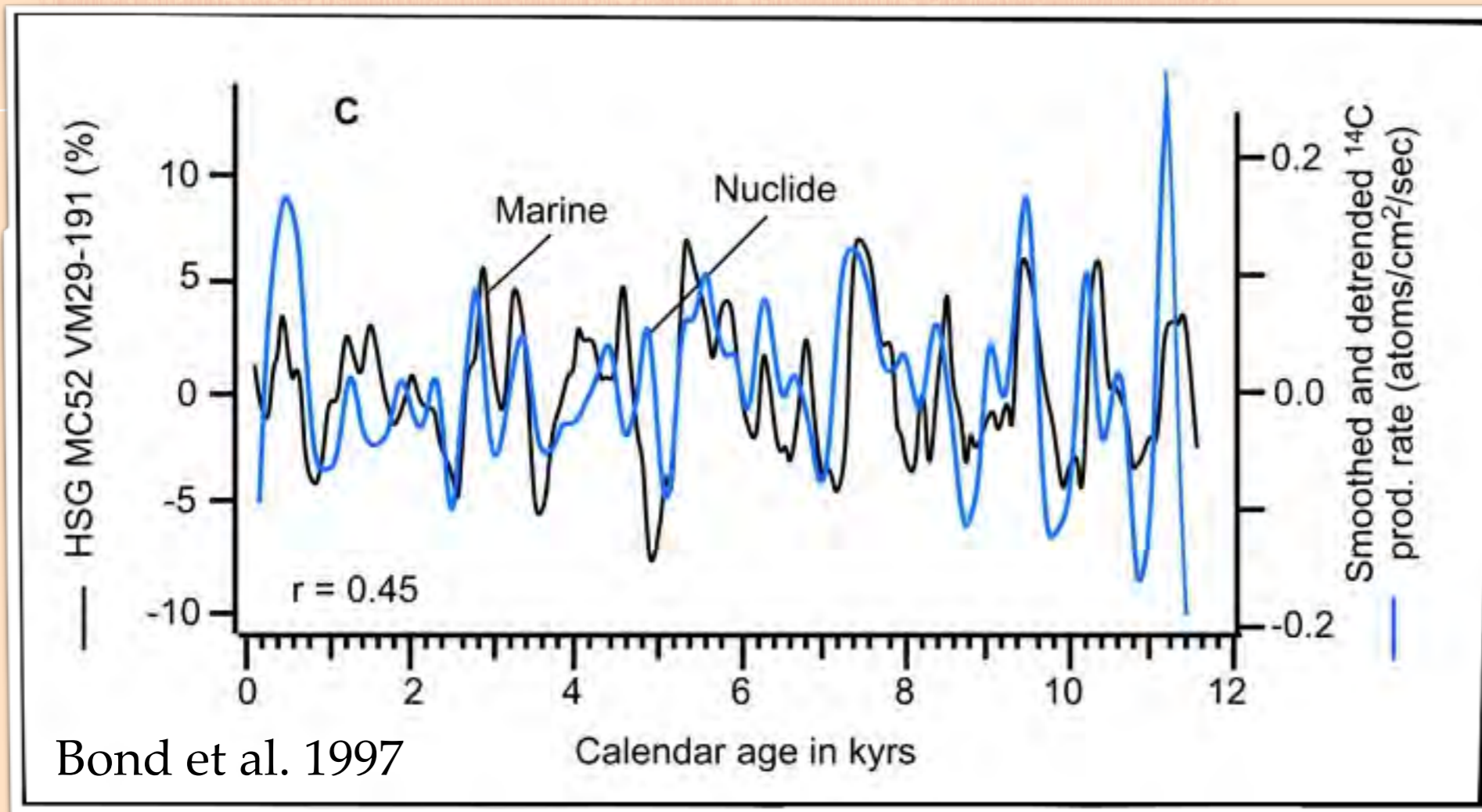
- *The claim that there isn't any other explanation, and therefore the warming must be primarily human, is wrong. There is another explanation: **Solar Activity**.*



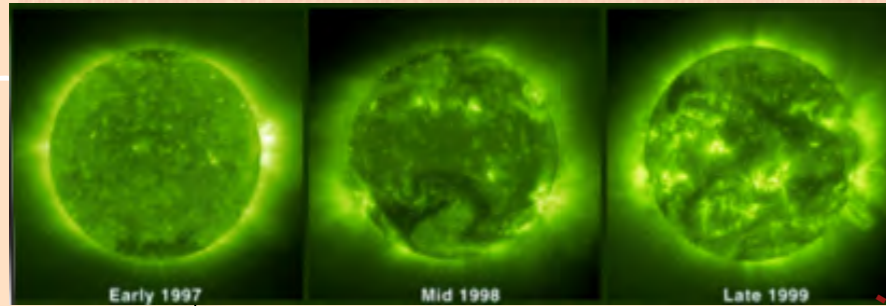
The link over several millennia



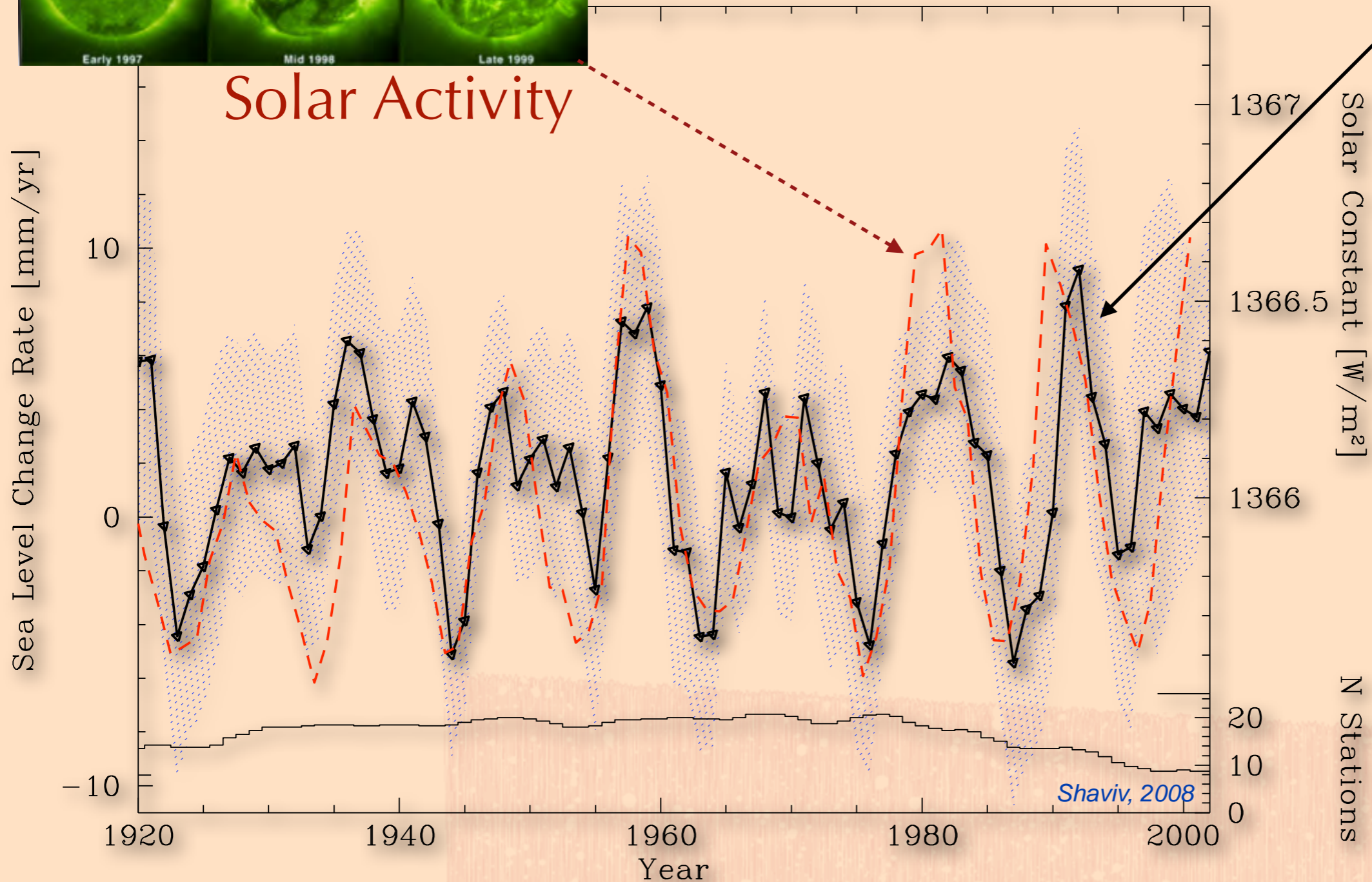
The link over several millennia



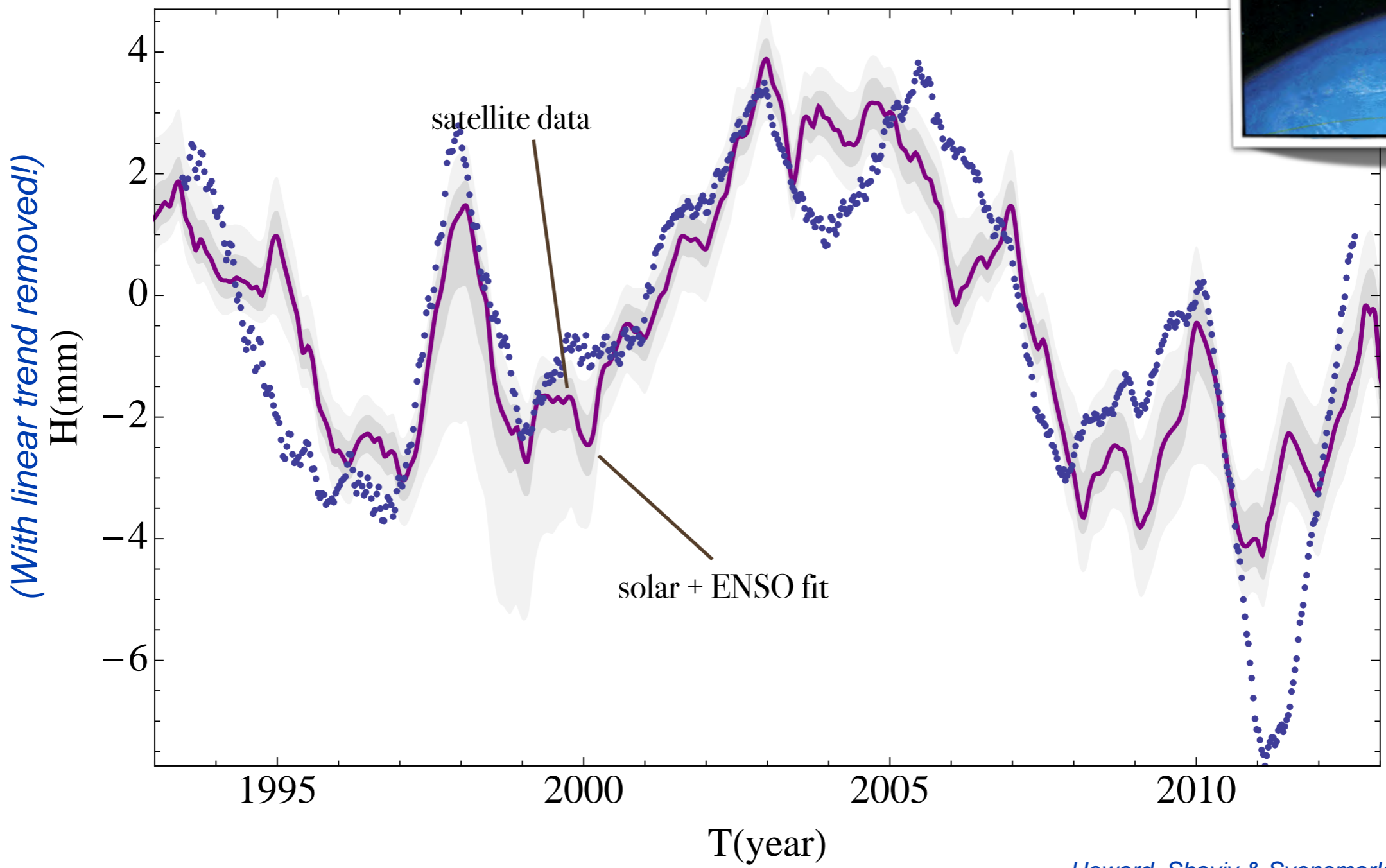
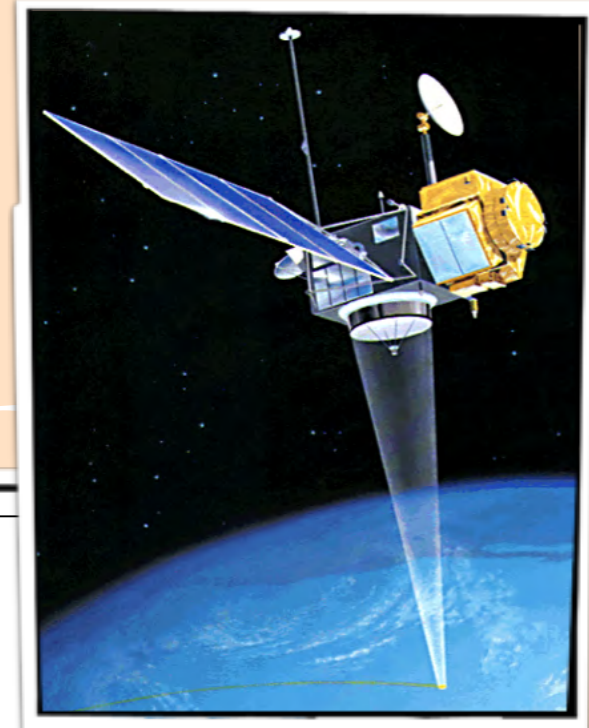
Link over the 11-year Cycle



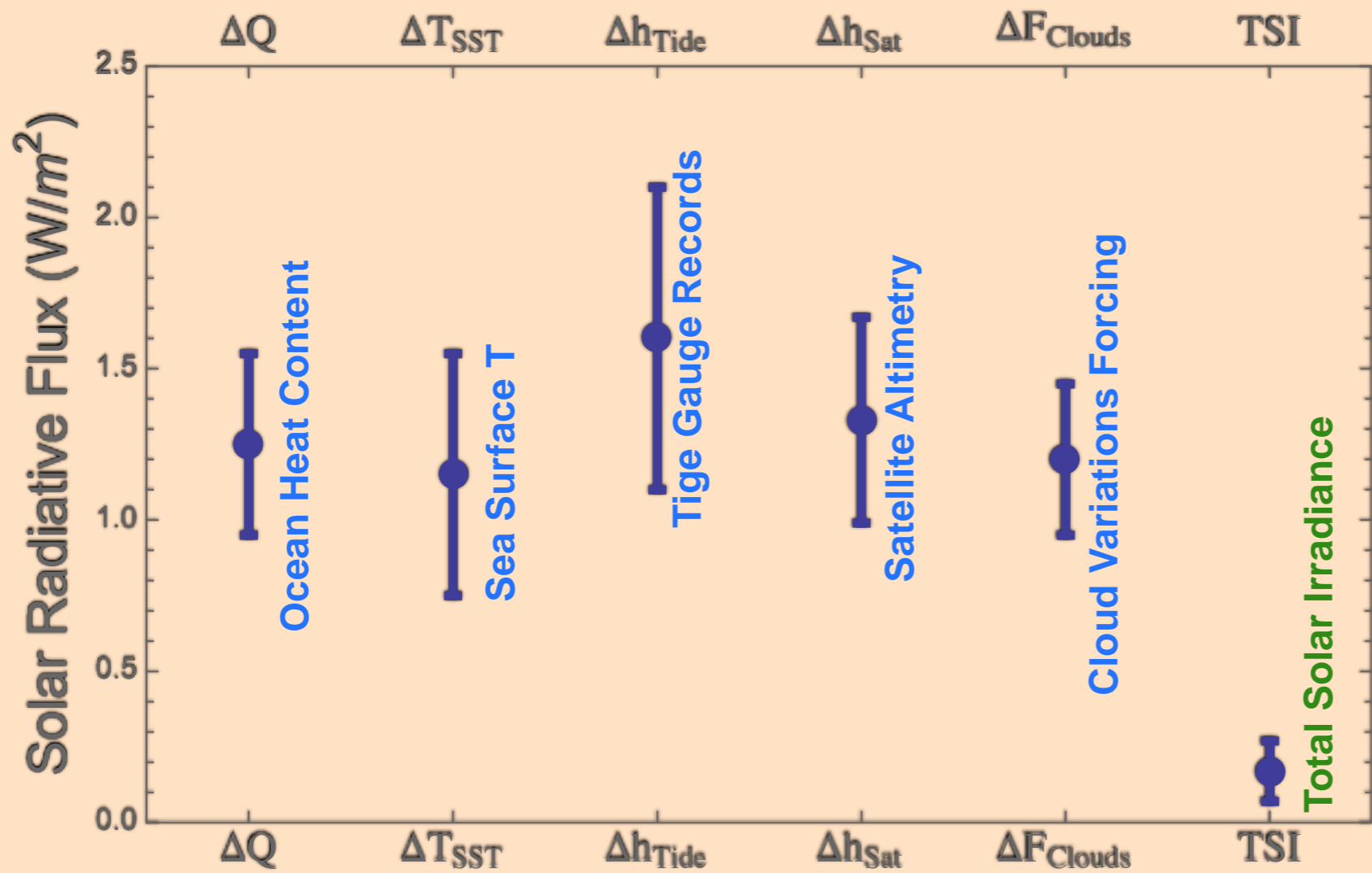
Solar Activity



Sea Level Change Rate

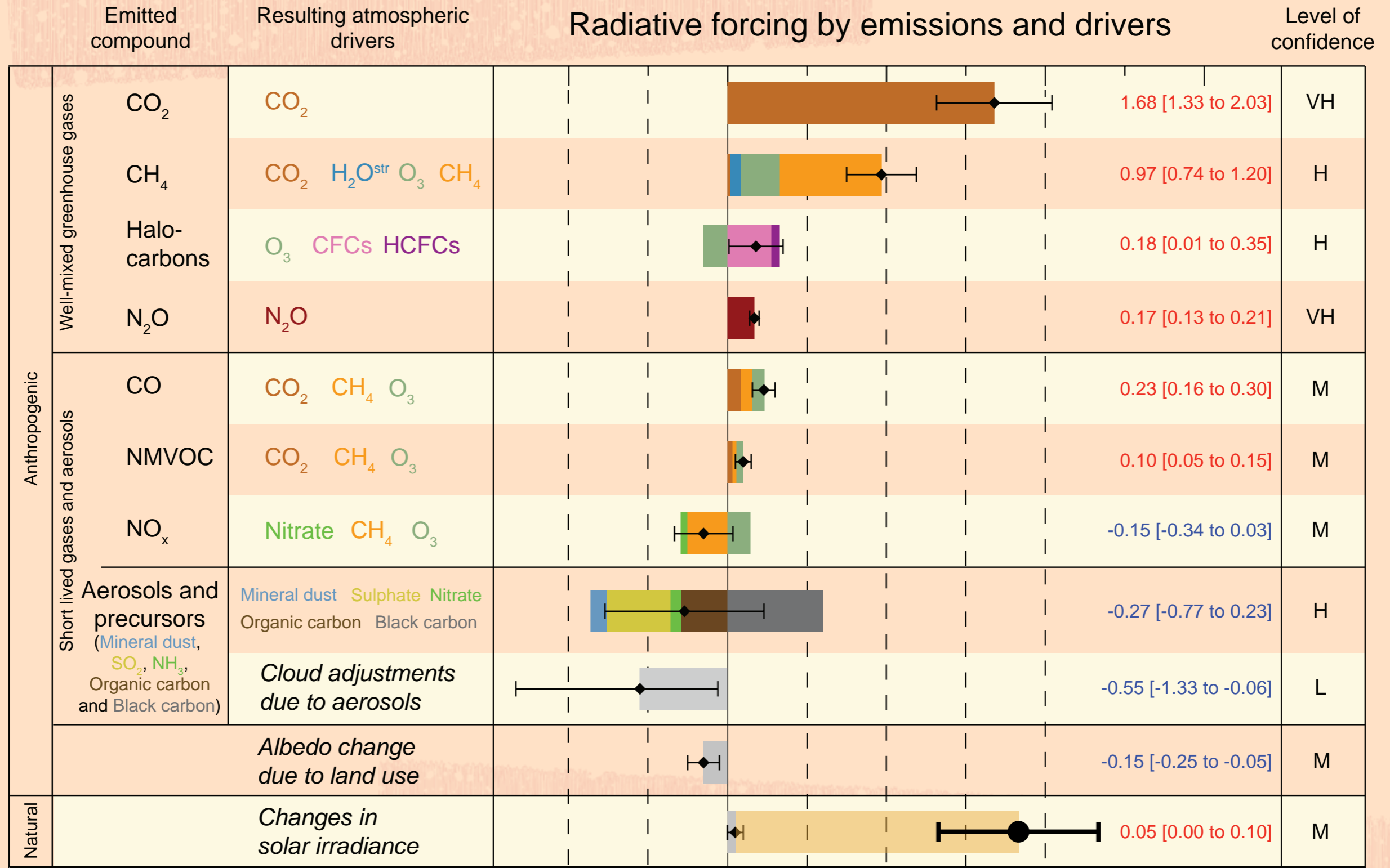


Link over the 11-year Cycle

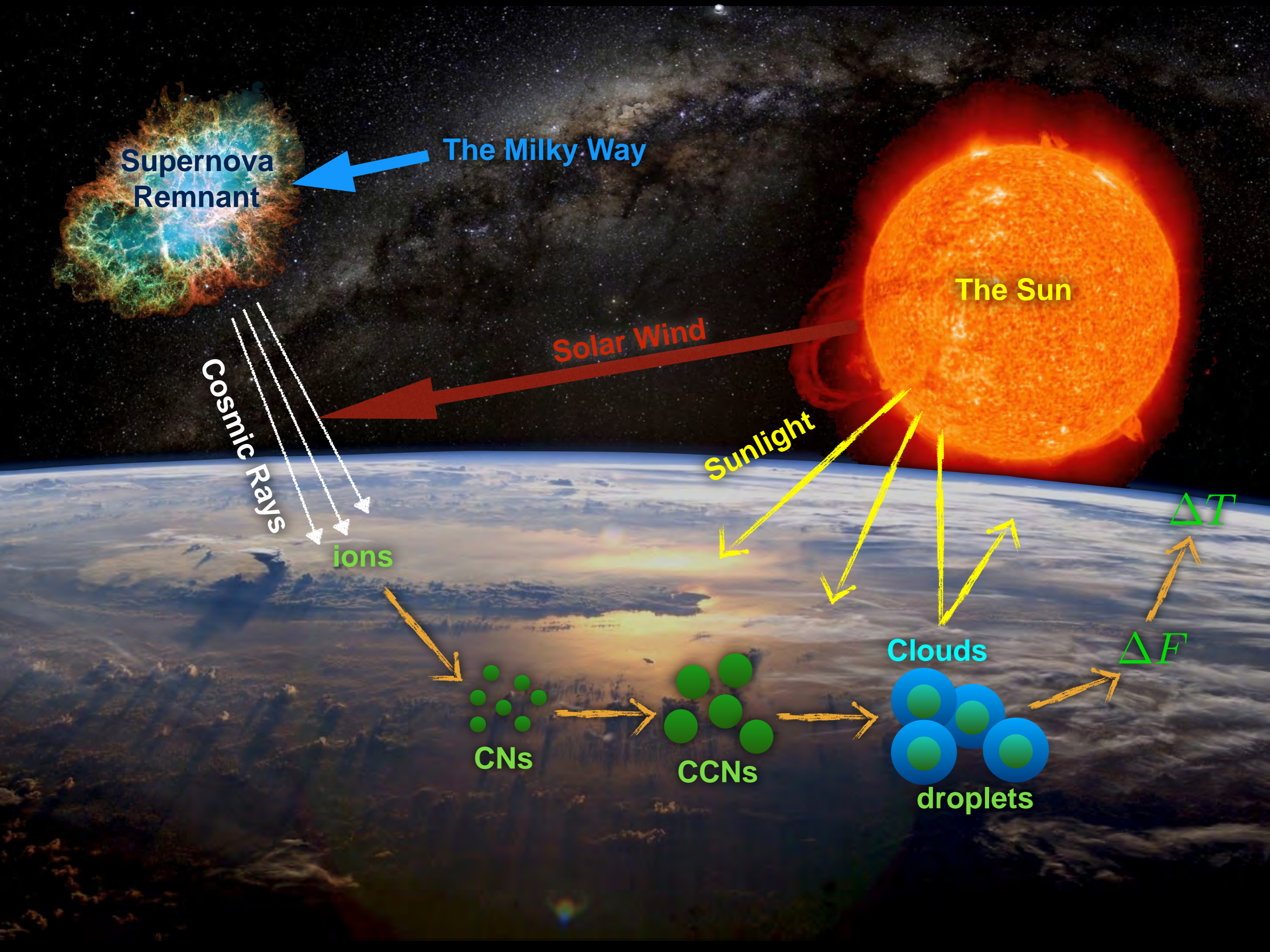


Require an amplification mechanism

IPCC 5AR forcing graph



Since Maunder Minimum



Supernova Remnant

The Milky Way

The Sun

Solar Wind

Sunlight

Cosmic Rays

ions

ΔT

ΔF

Clouds

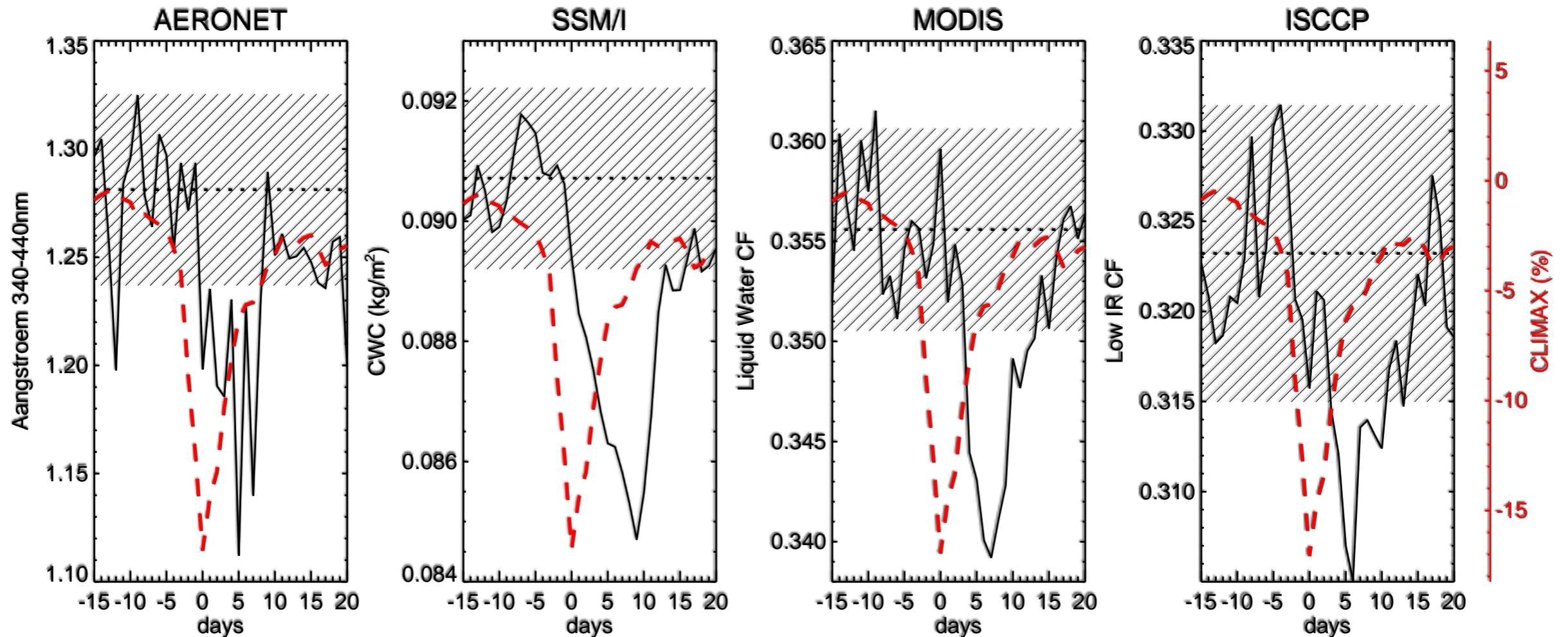
CNs

CCNs

droplets

Forbush decreases

- ❖ Forbush decreases of the cosmic ray flux induce a large apparent effect on clouds

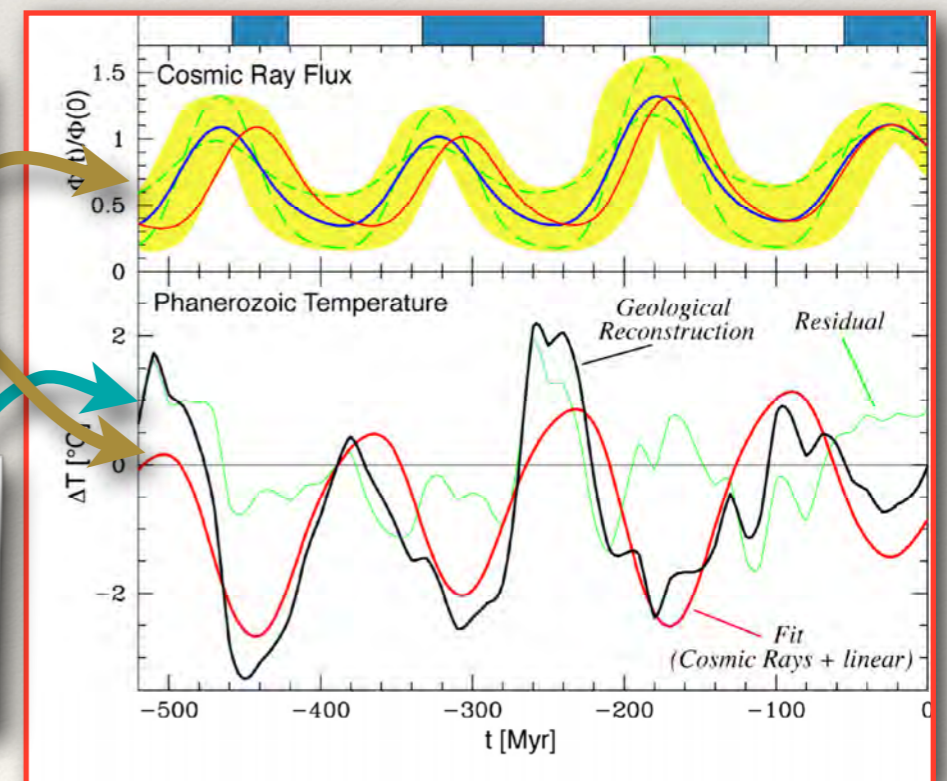
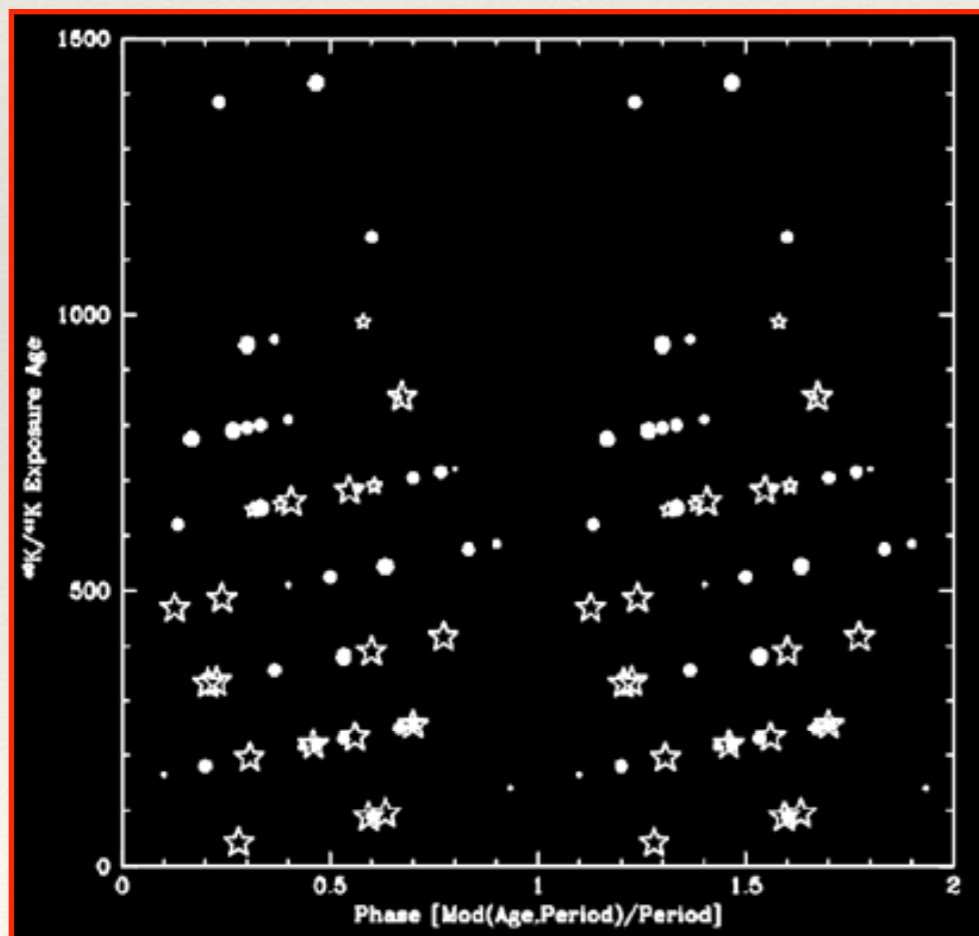


5 strongest forbush decreases (1987-2007)

Svensmark et al. GRL 2009

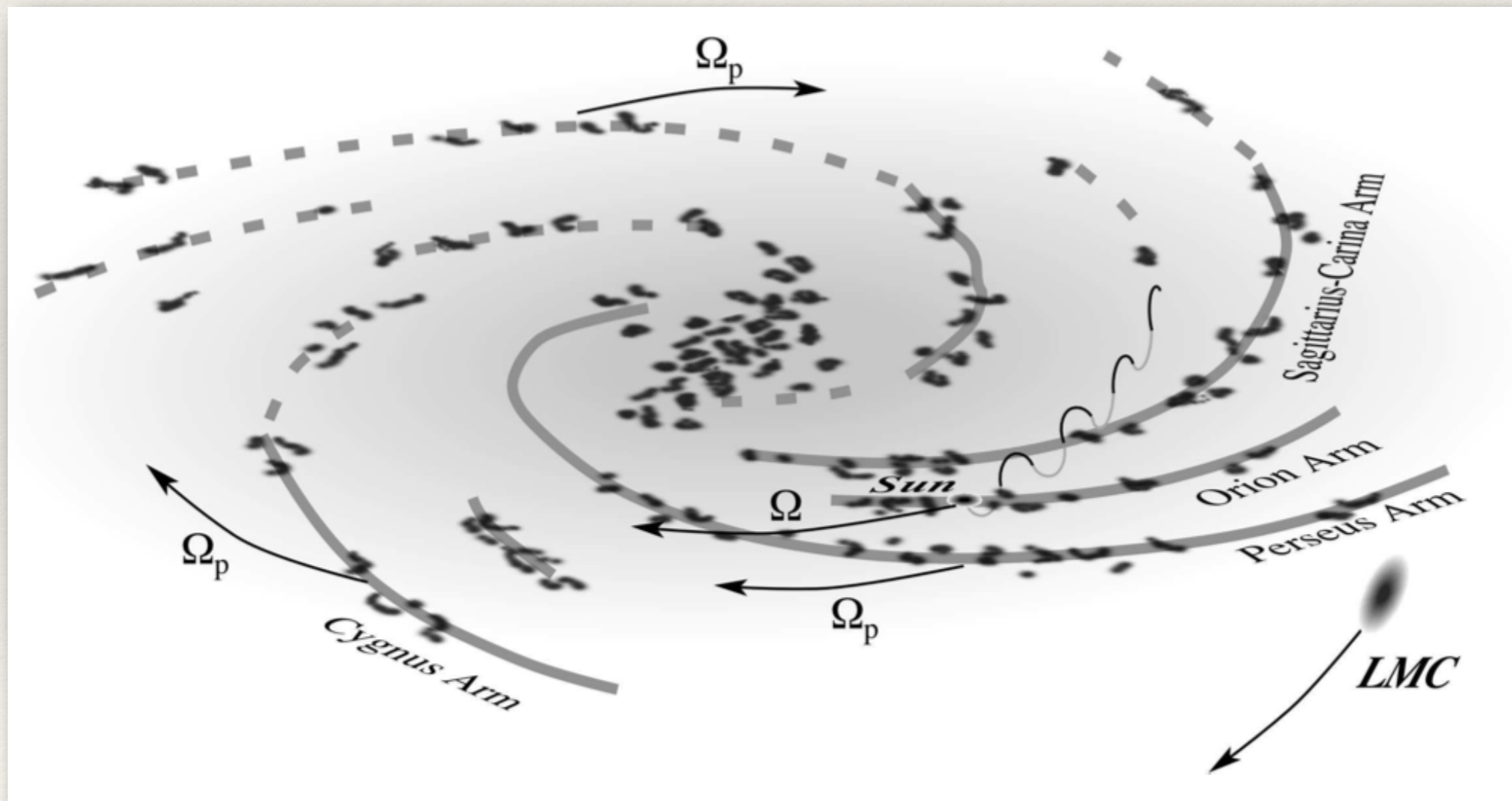
Time Variability

- ❖ Lower Diffusion coefficient + Smaller Halo + Inhomogeneous source distribution implies more inhomogeneous CR density
- ❖ As solar system passes through spiral arms, $\phi(t)$ varies by $O(1)$.



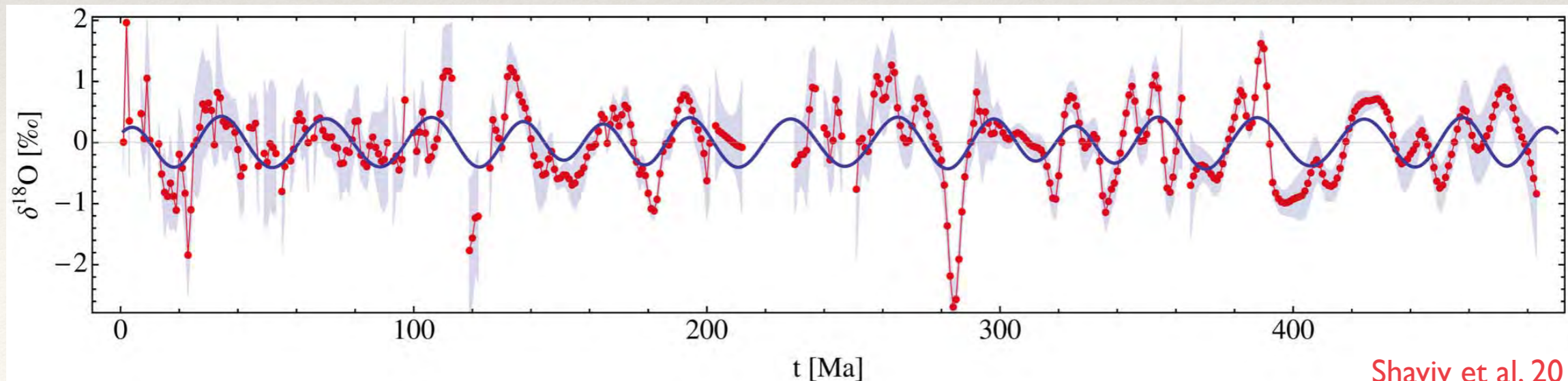
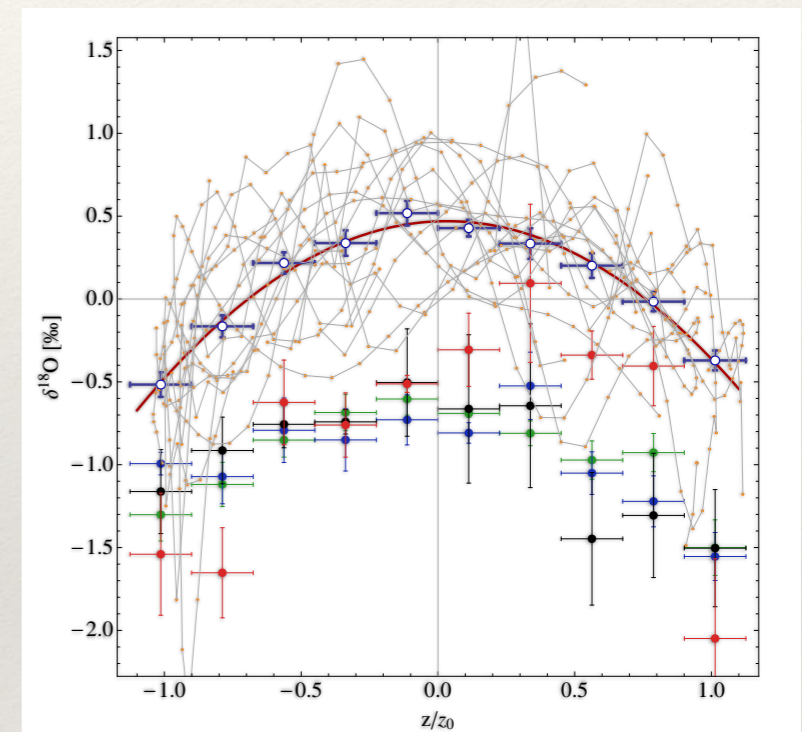
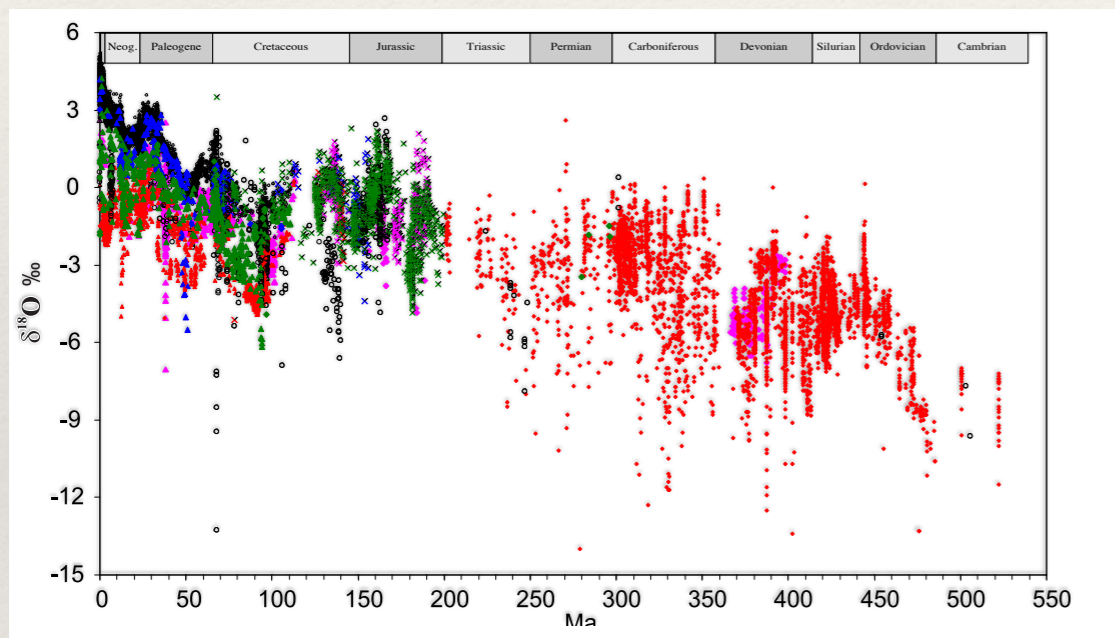
Vertical Oscillation of the Sun

- ❖ Small CR Halo implies that vertical oscillation of Solar system + CR/cloud cover effect should give rise to a 30-40 Myr variability in the paleoclimate.

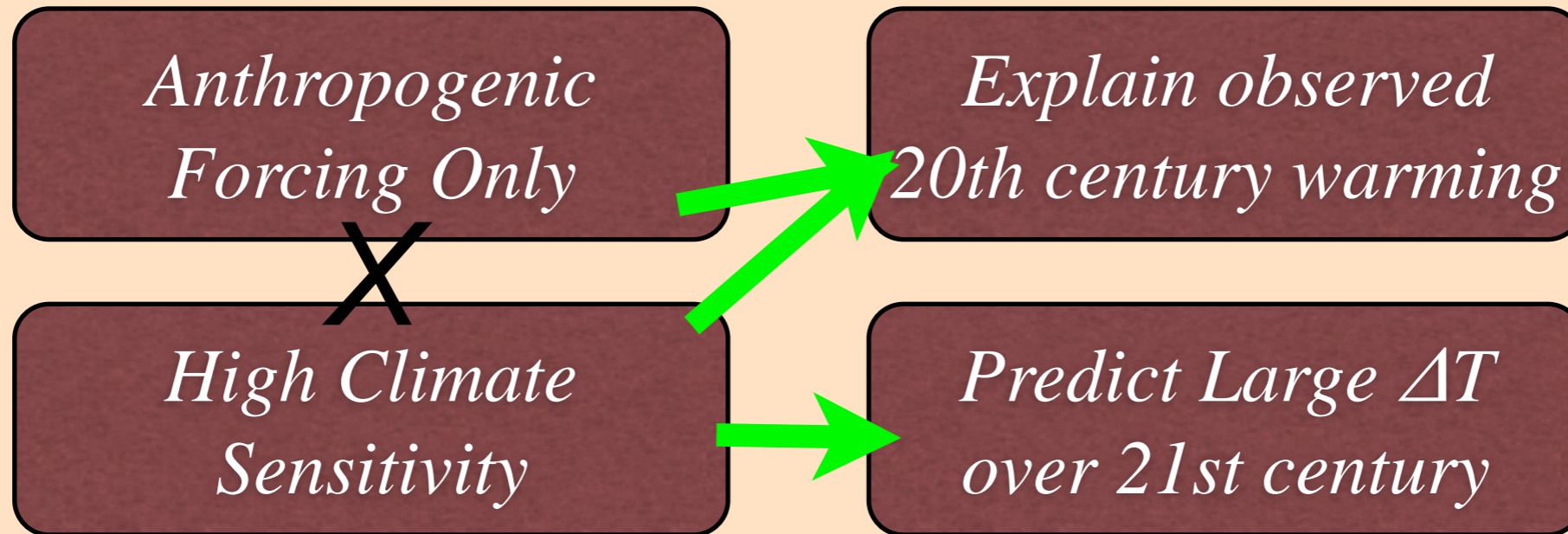


Vertical Oscillation of the Sun

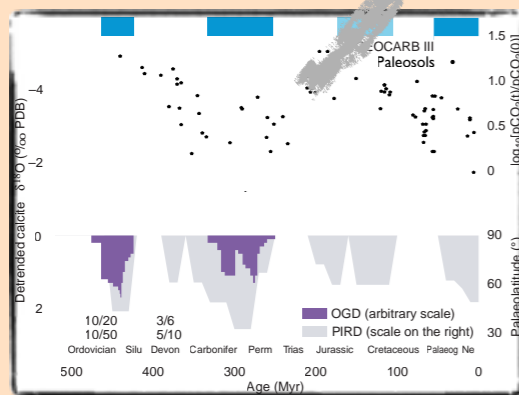
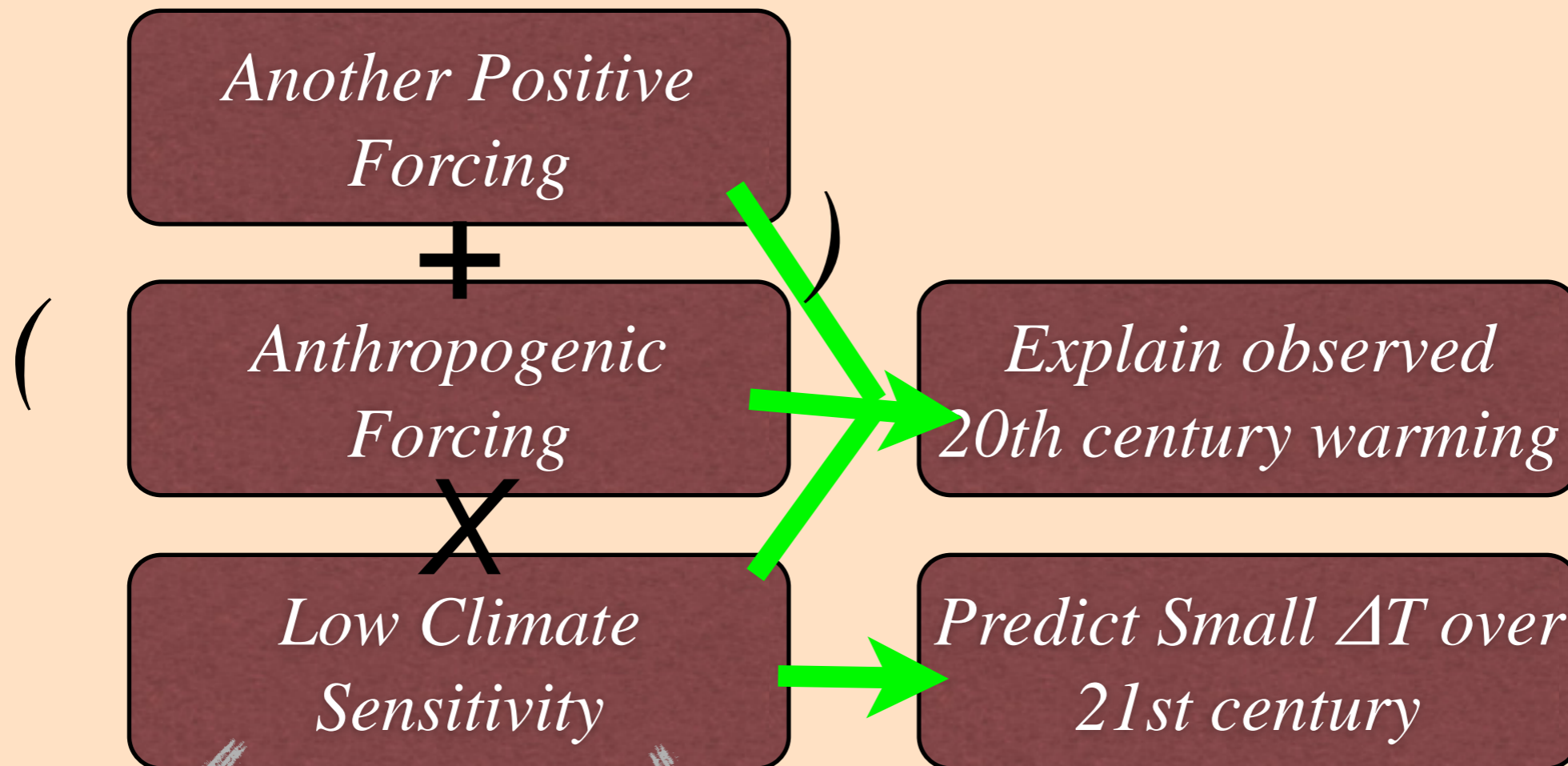
- ❖ Small CR Halo implies that vertical oscillation of Solar system + CR/cloud cover effect should give rise to a 30-40 Myr variability in the paleoclimate.



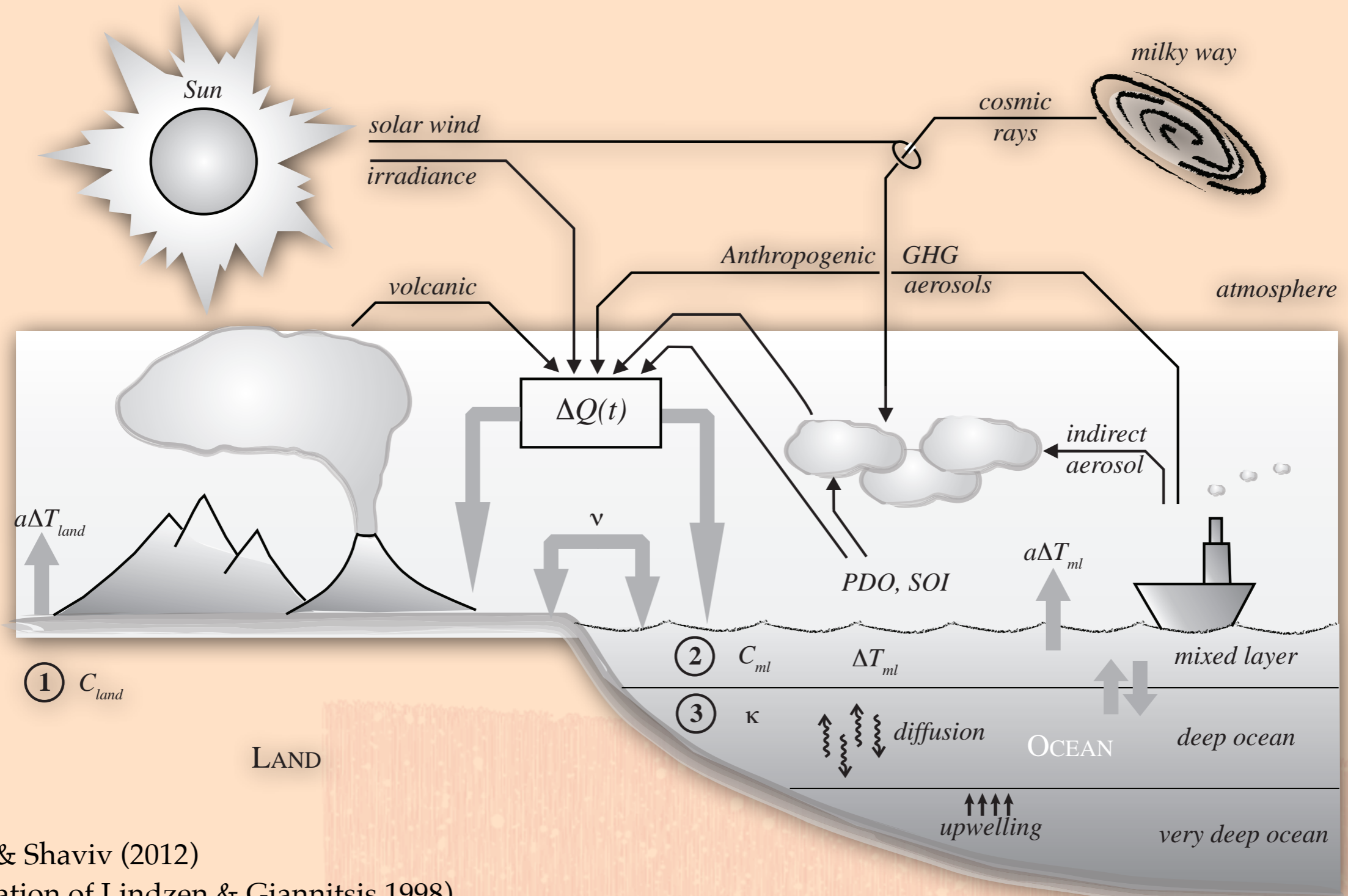
Standard Explanation to 20th century



And if there is another explanation?



Basic Climate Model

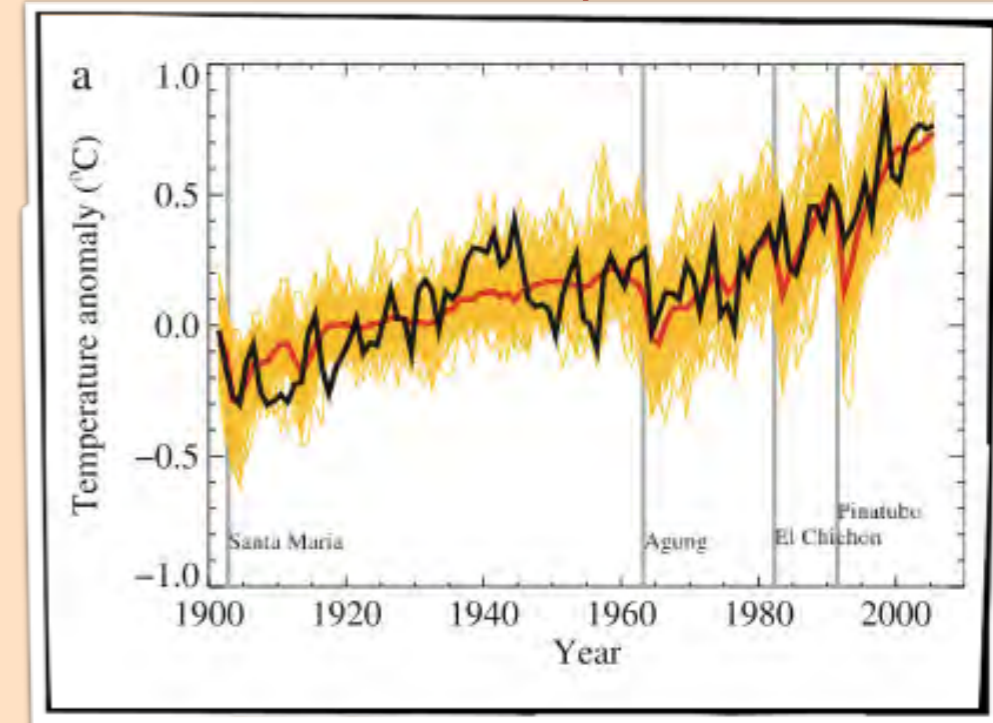
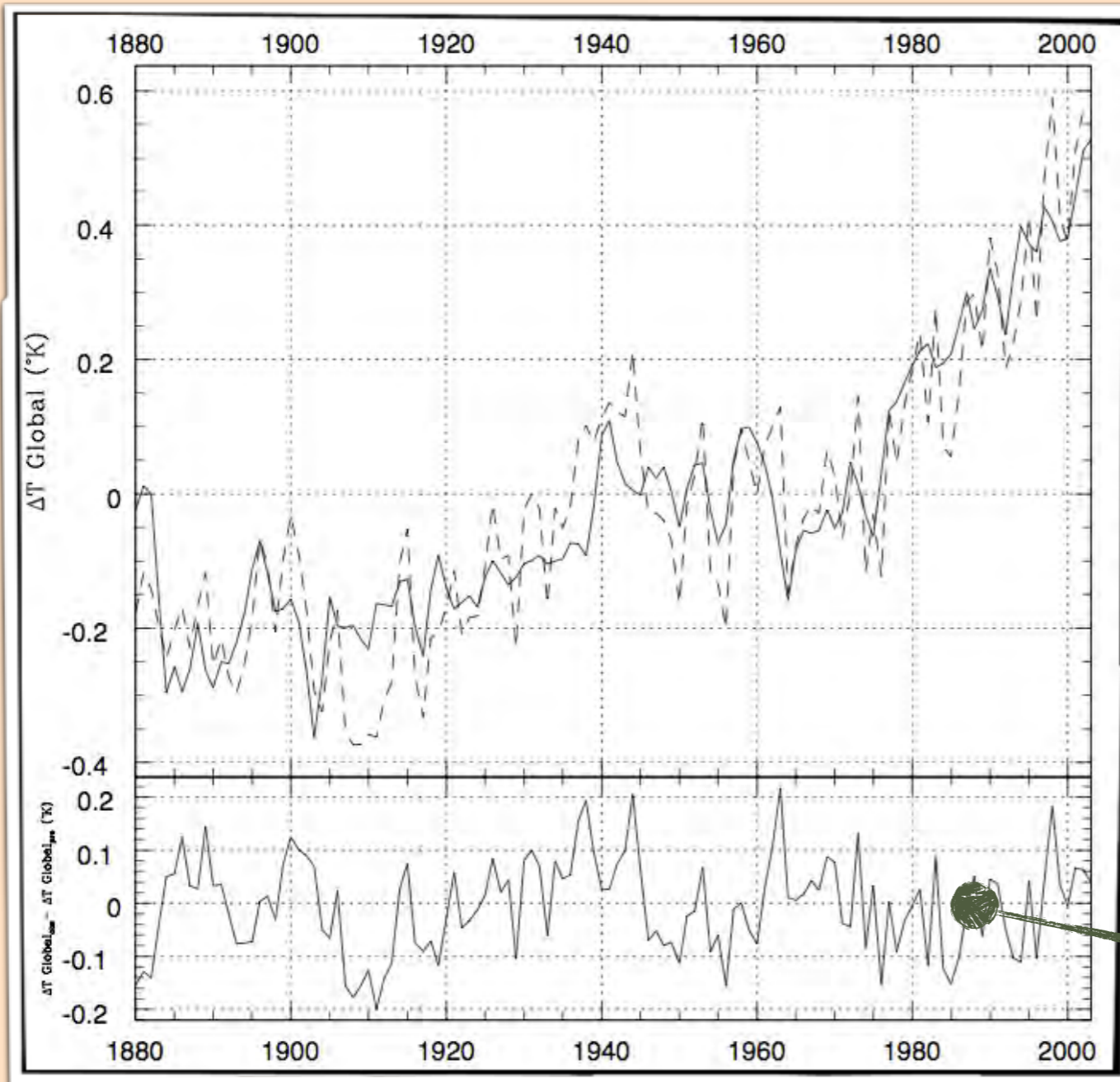


Ziskin & Shaviv (2012)
(elaboration of Lindzen & Giannitsis, 1998)

20th century warming

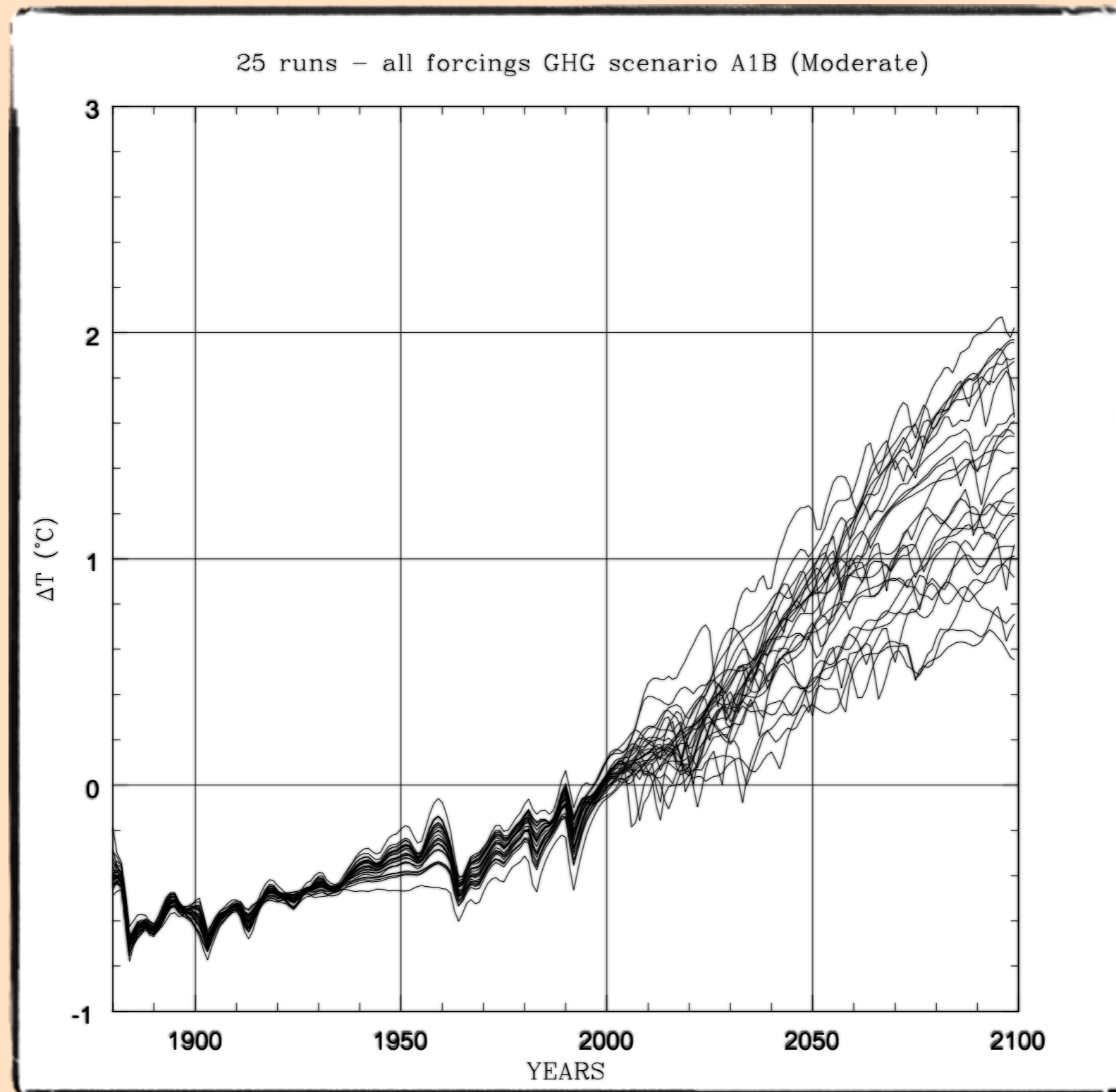
◆ Best fit (i.e., after parameter optimization)

Comparison: IPCC-AR4

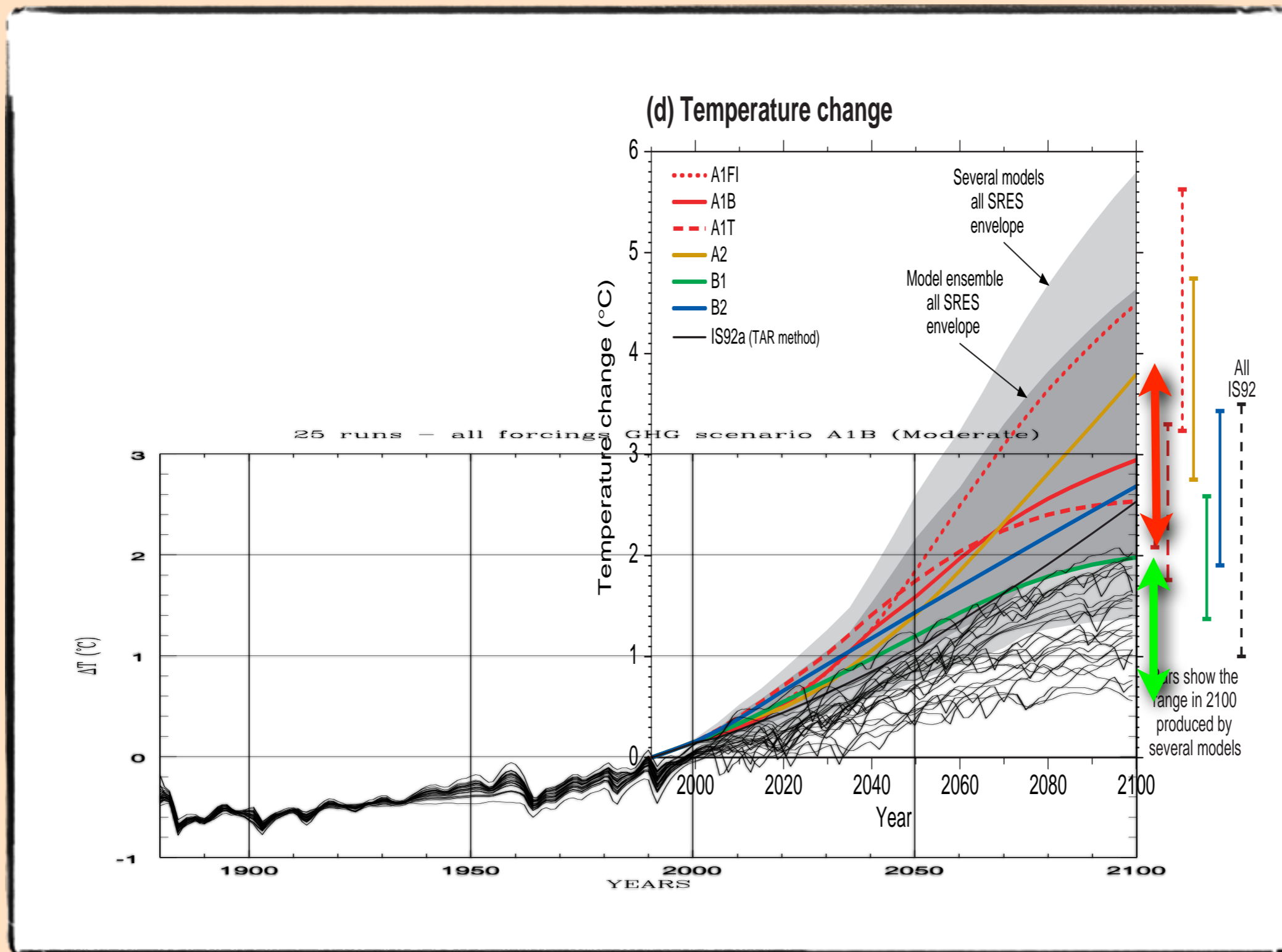


Residual more than twice smaller than with GCMs (without solar amplification)

21st century temperature increase



21st century temperature increase



Summary

- ❖ There are no arguments proving that warming is mostly human.
- ❖ Actual evidence points to a strong solar climate link and a low climate sensitivity.
- ❖ Today we know how the physics behind the link (but in fact, it is totally irrelevant - solar activity should be taken, but is ignored!)