



---

*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

---

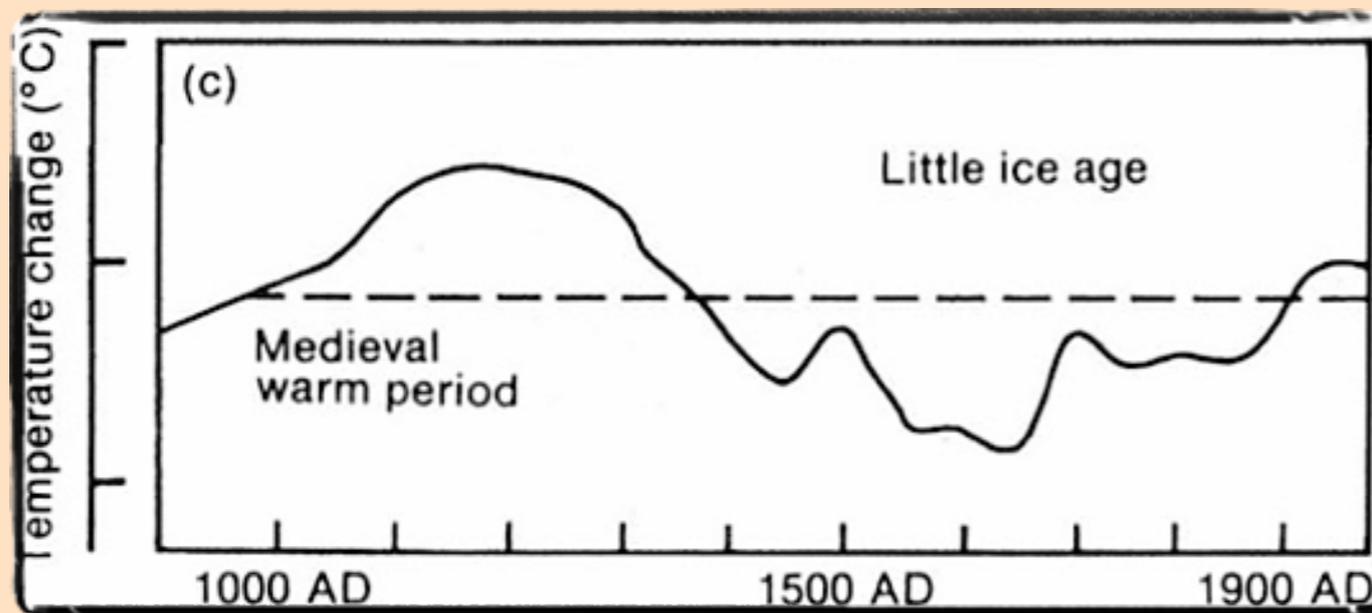
There are actually two “scientific arguments” used by the IPCC:

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

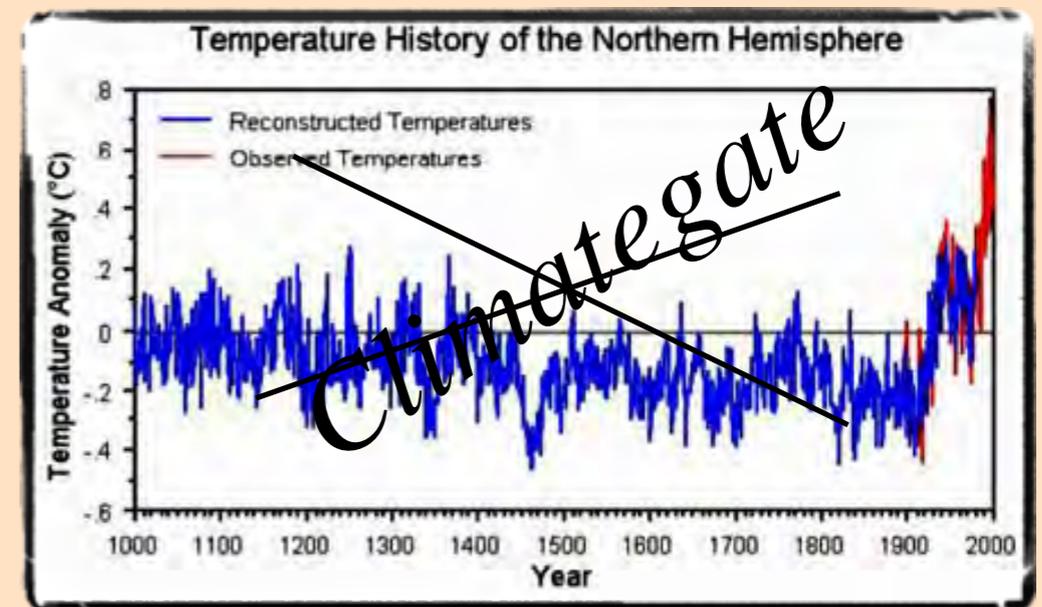
# 1st (wrong) argument: 20<sup>th</sup> century warming is unique

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

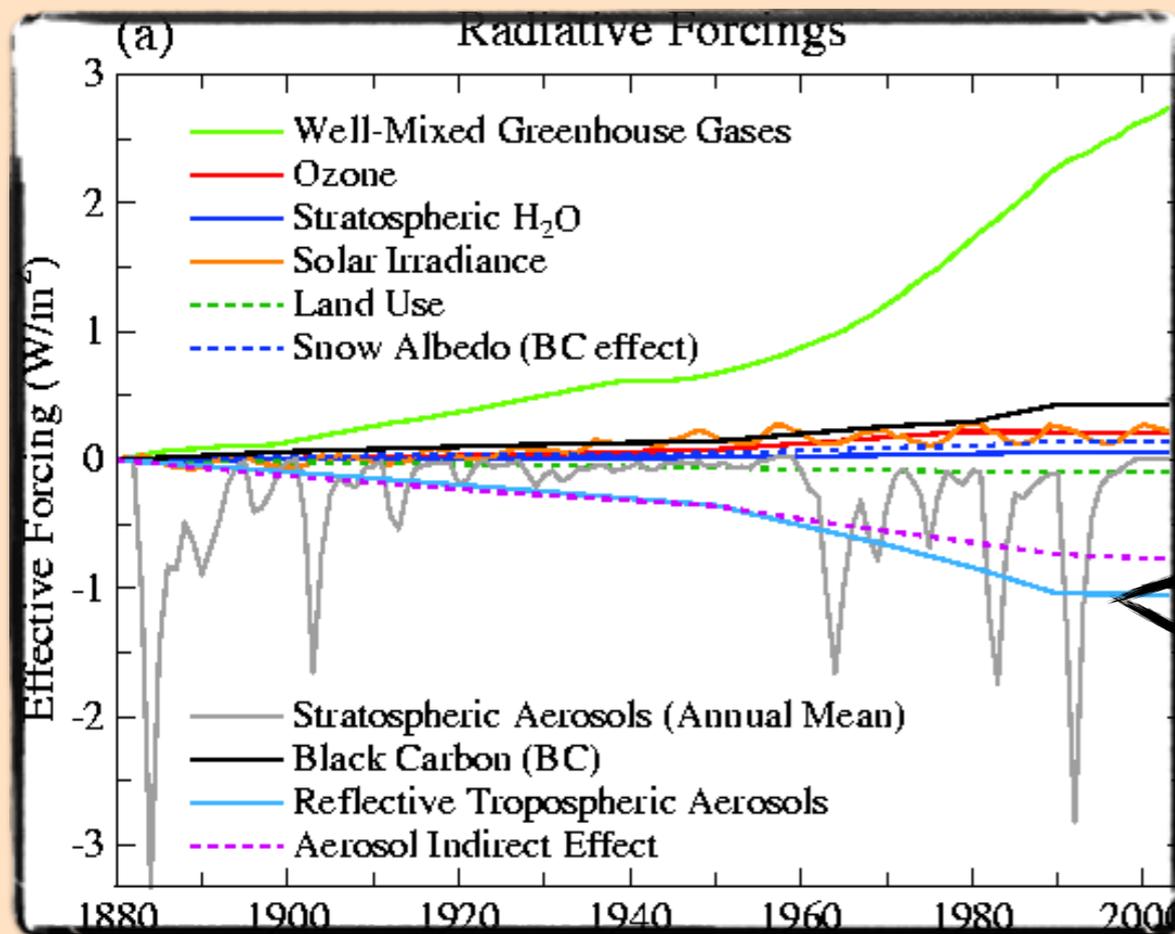
*IPCC 1990*



*IPCC 2001*



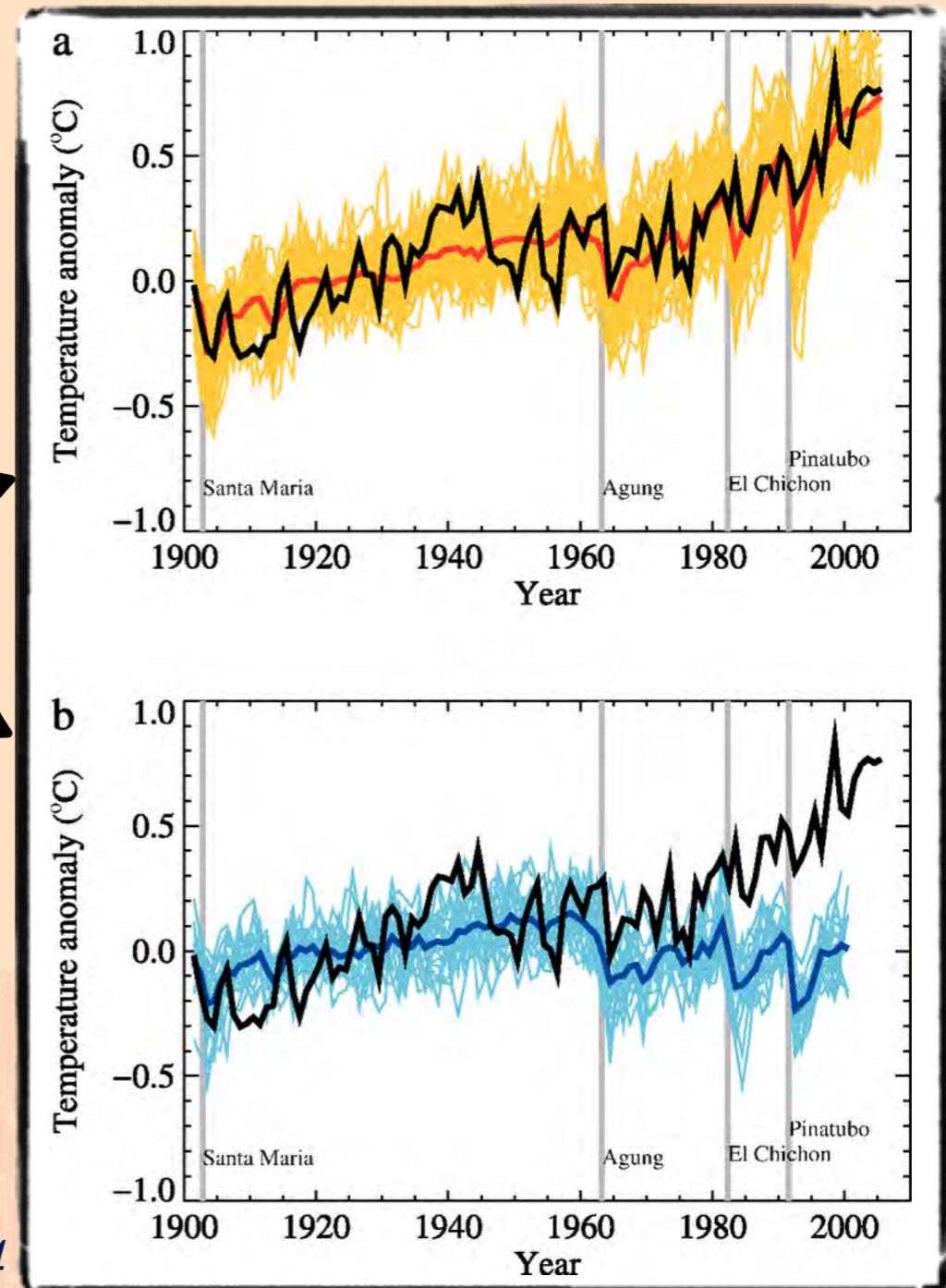
# 2nd (wrong) Argument: Warming has to anthropogenic



With Anthropogenic Forcings

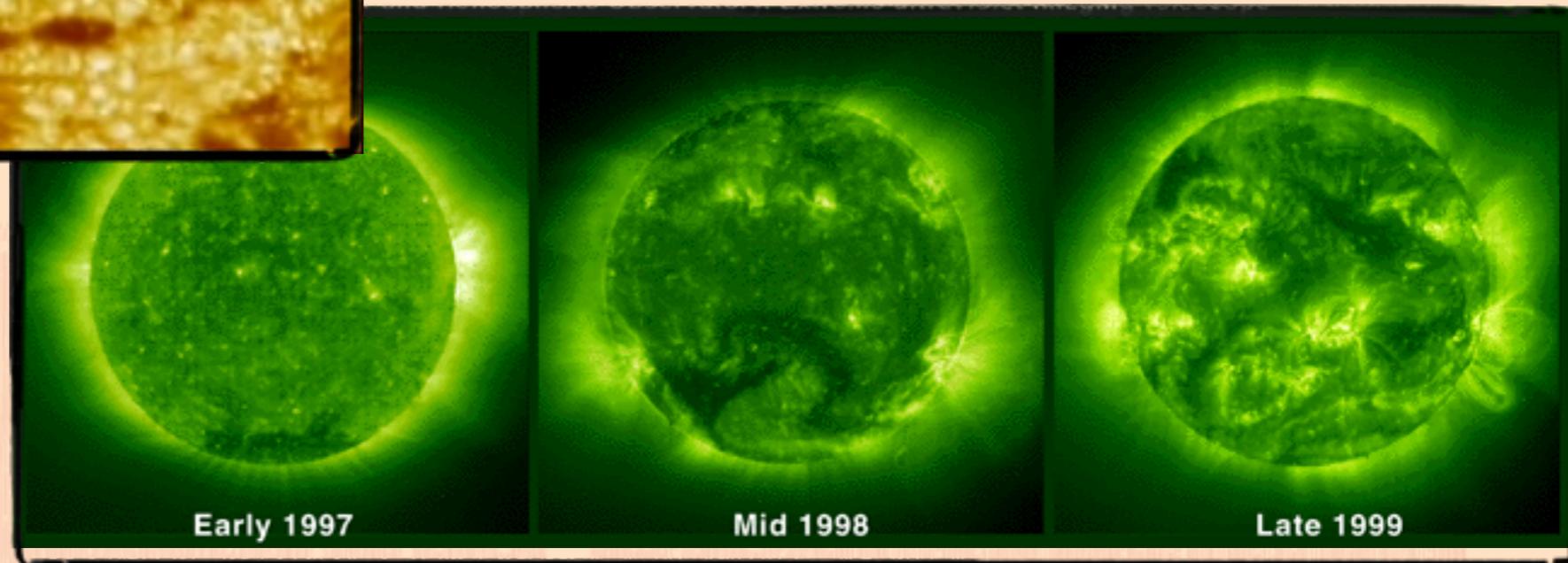
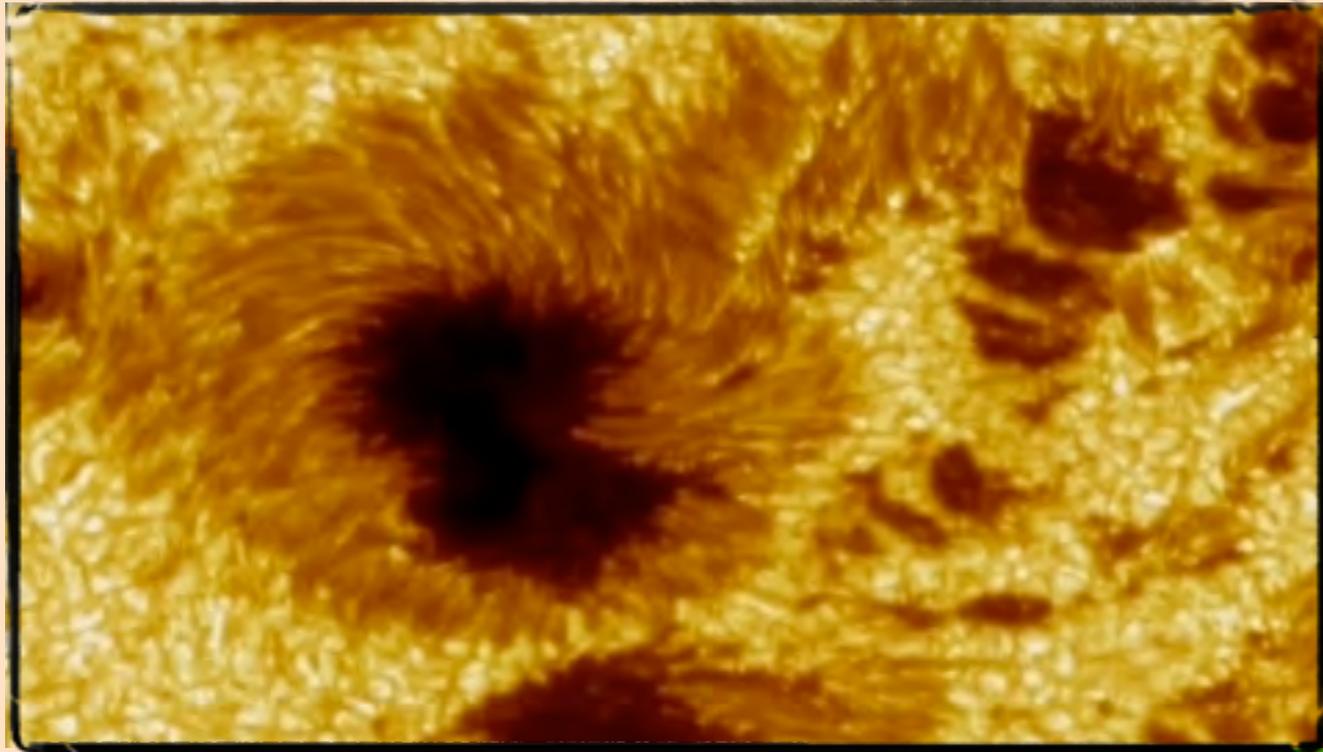
Without Anthropogenic Forcings

IPCC AR4



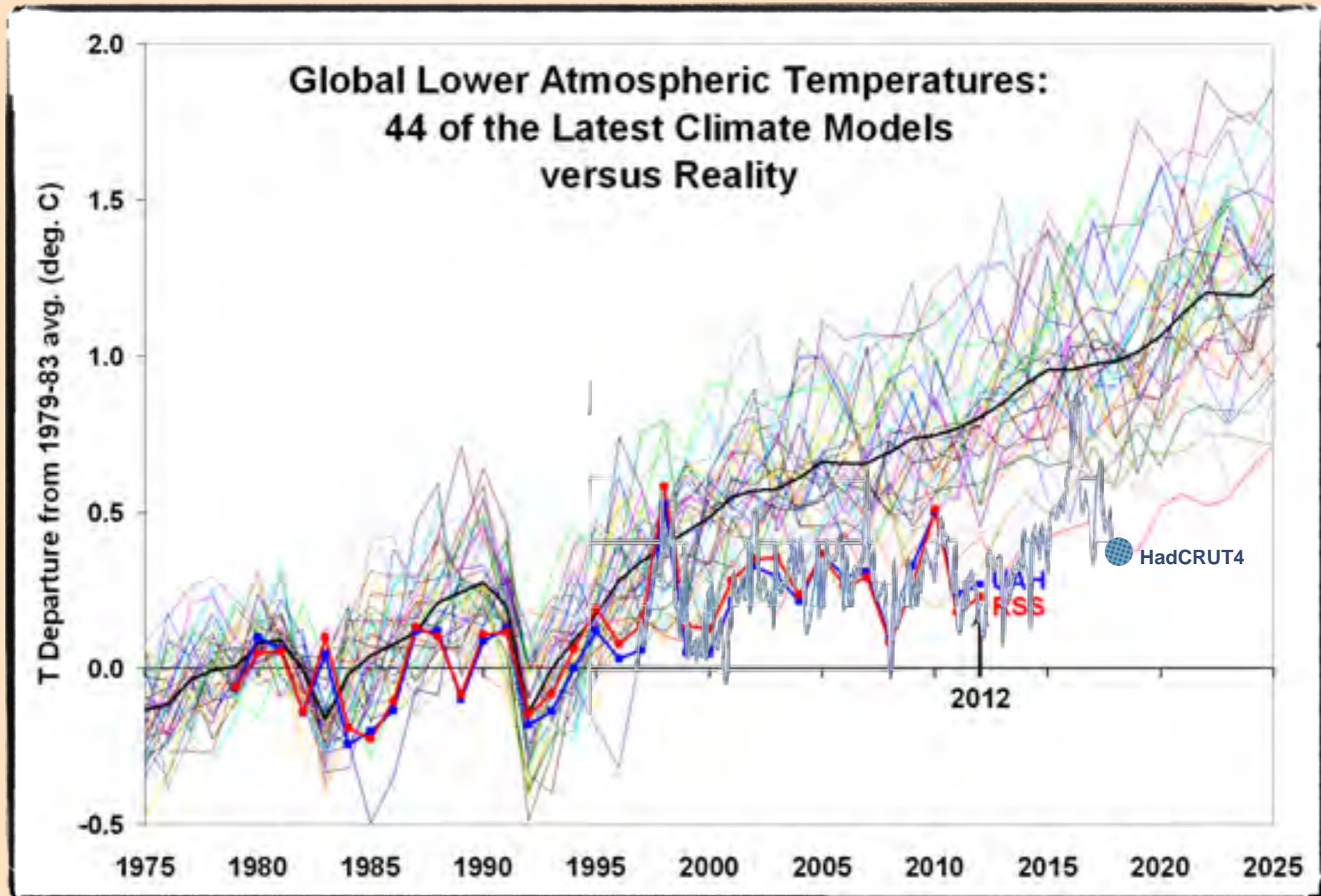
# Main argument's flaw: Solar Activity is important

- *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**.*



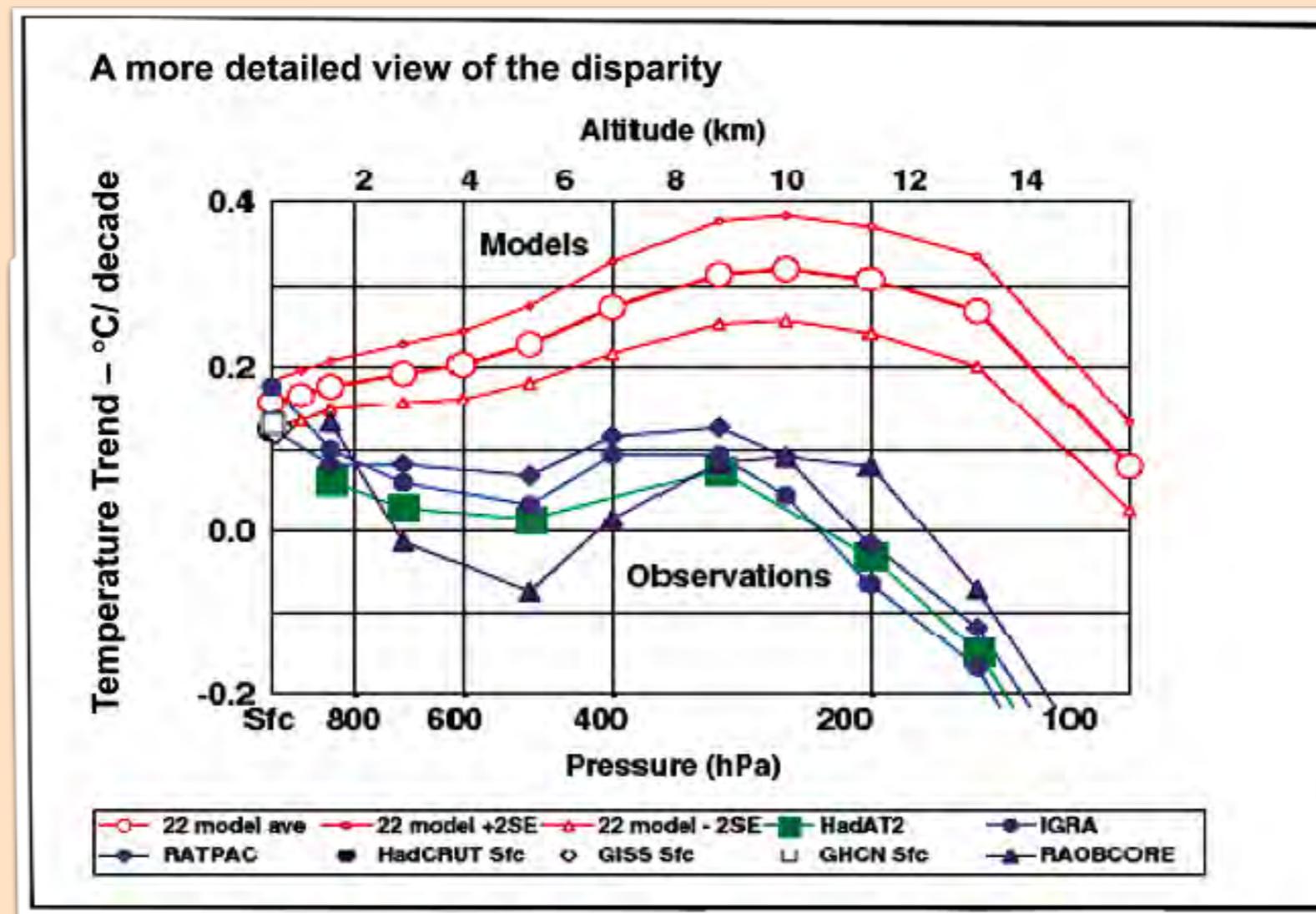
# Problem 1: Size of Warming

- *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*

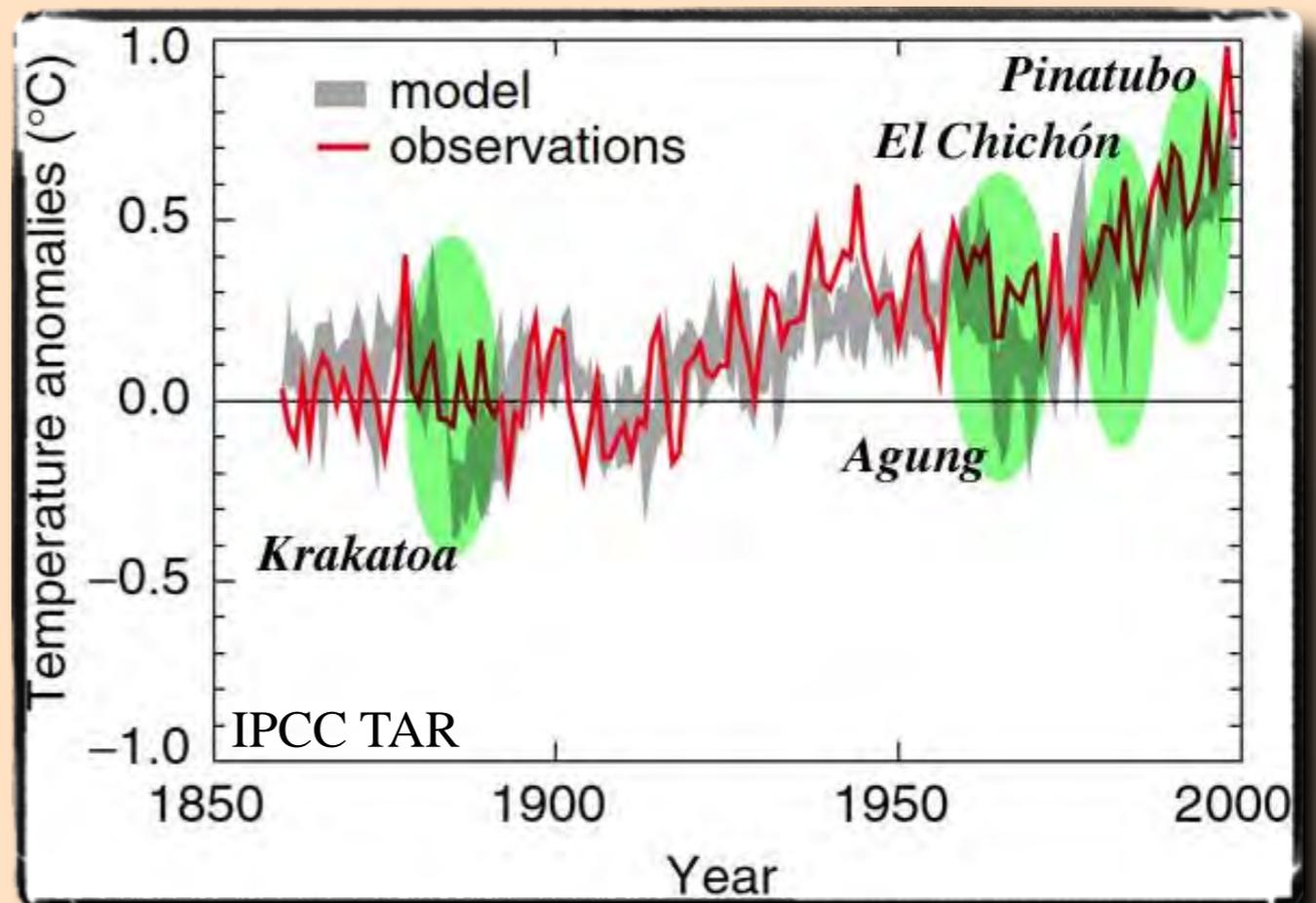
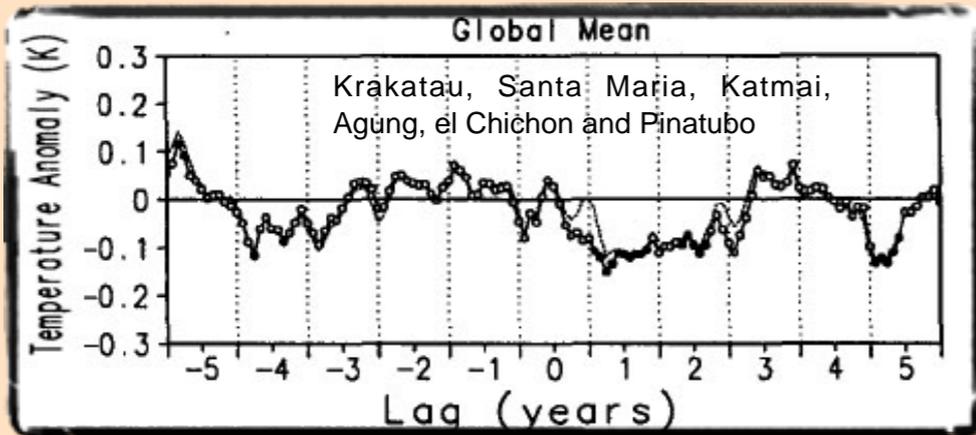


# Problem 3: Model climates are too sensitive

- *Response to volcanoes is too large!*

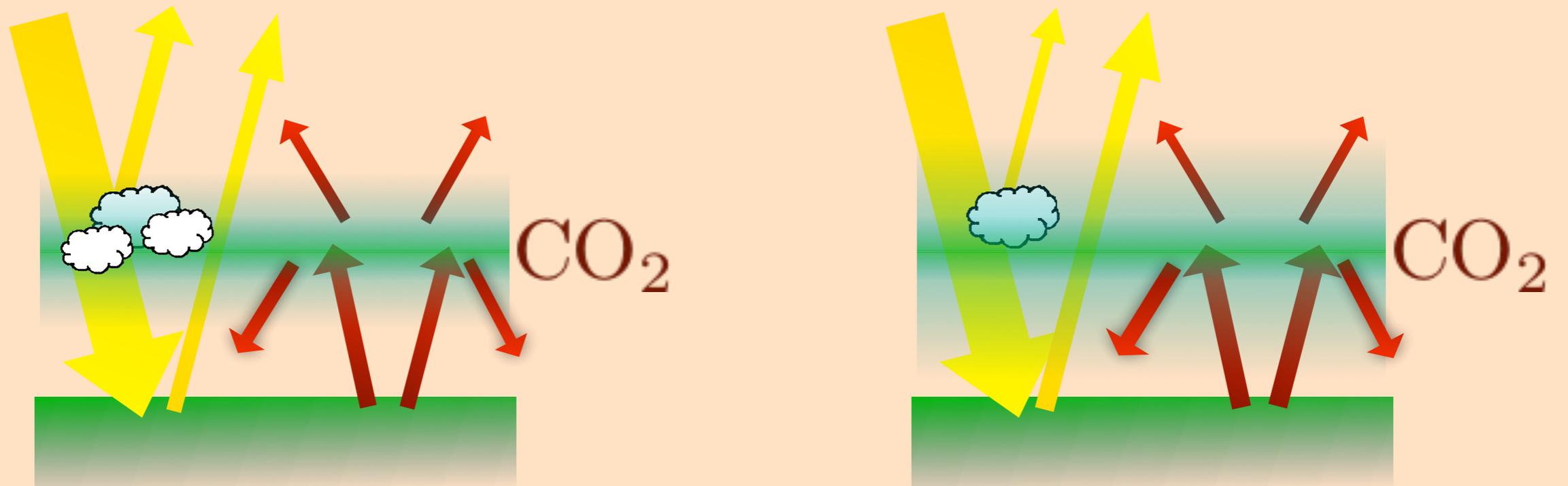


Robock and Mau 1995

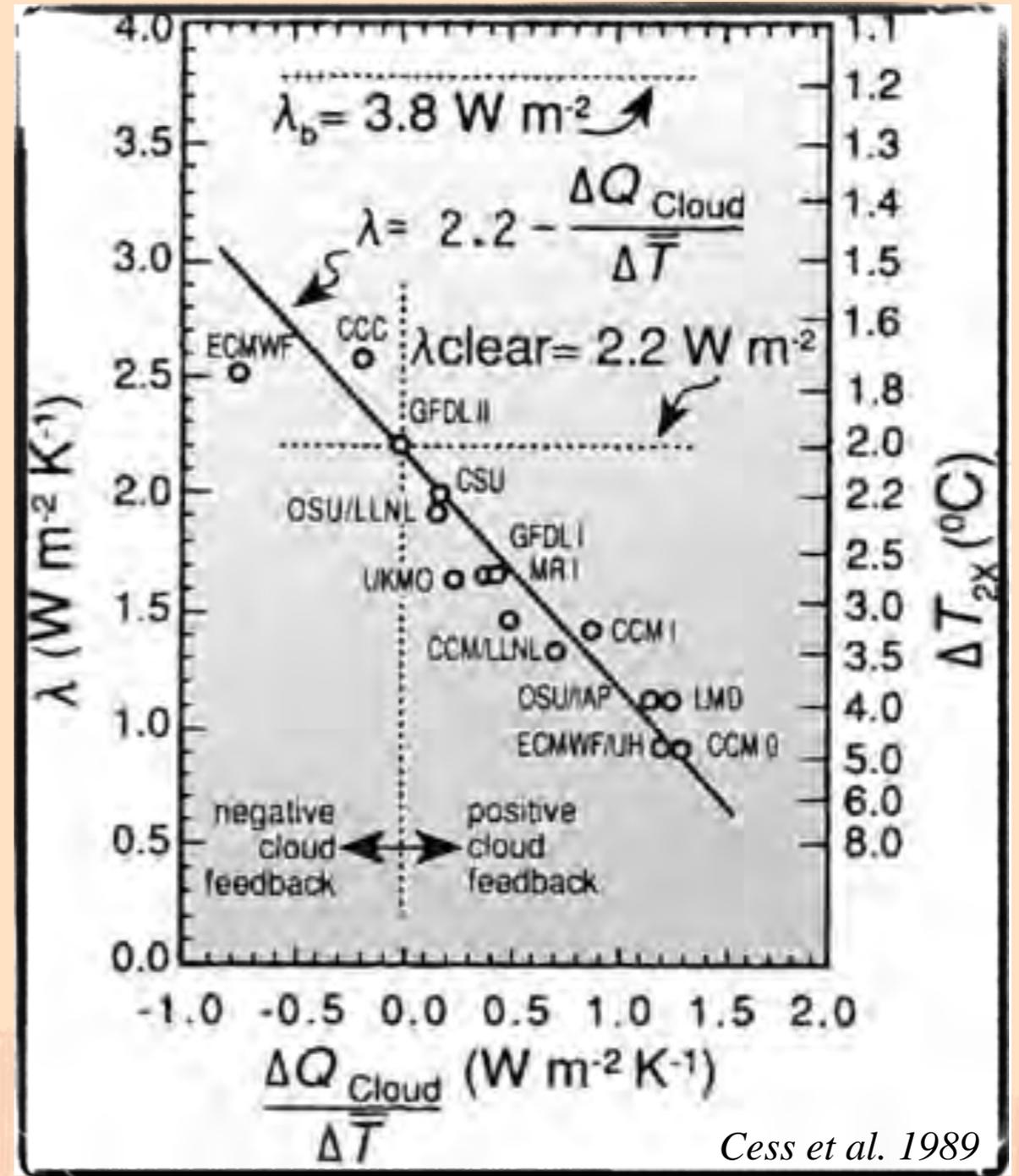
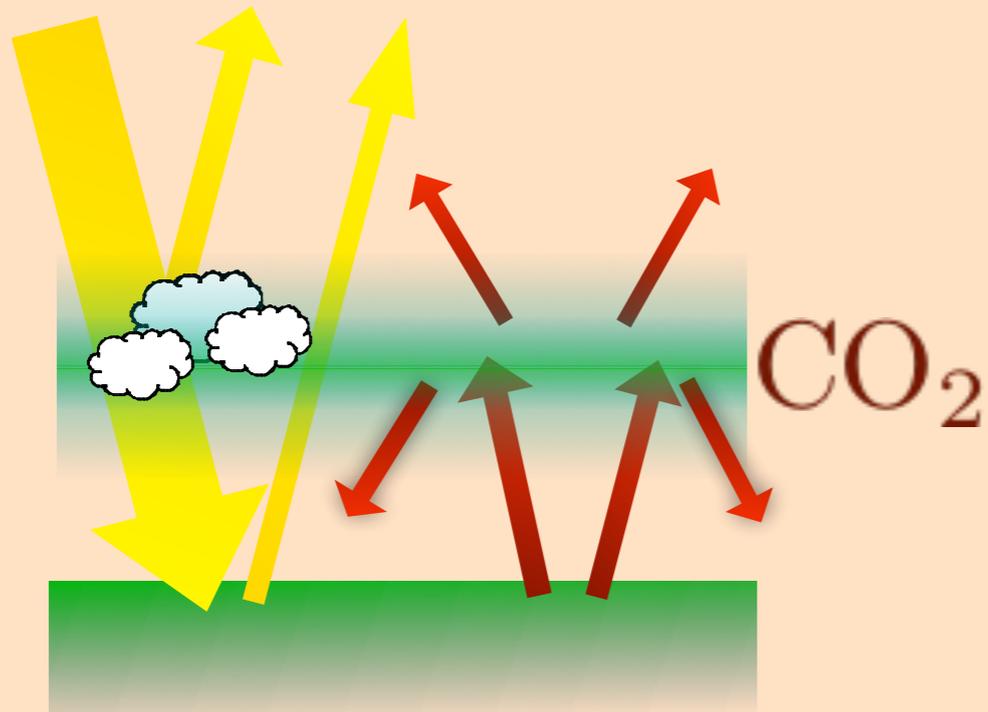


Model predictions: Decrease of 0.3-0.5°C.  
Reality: Decrease of 0.1°C on average

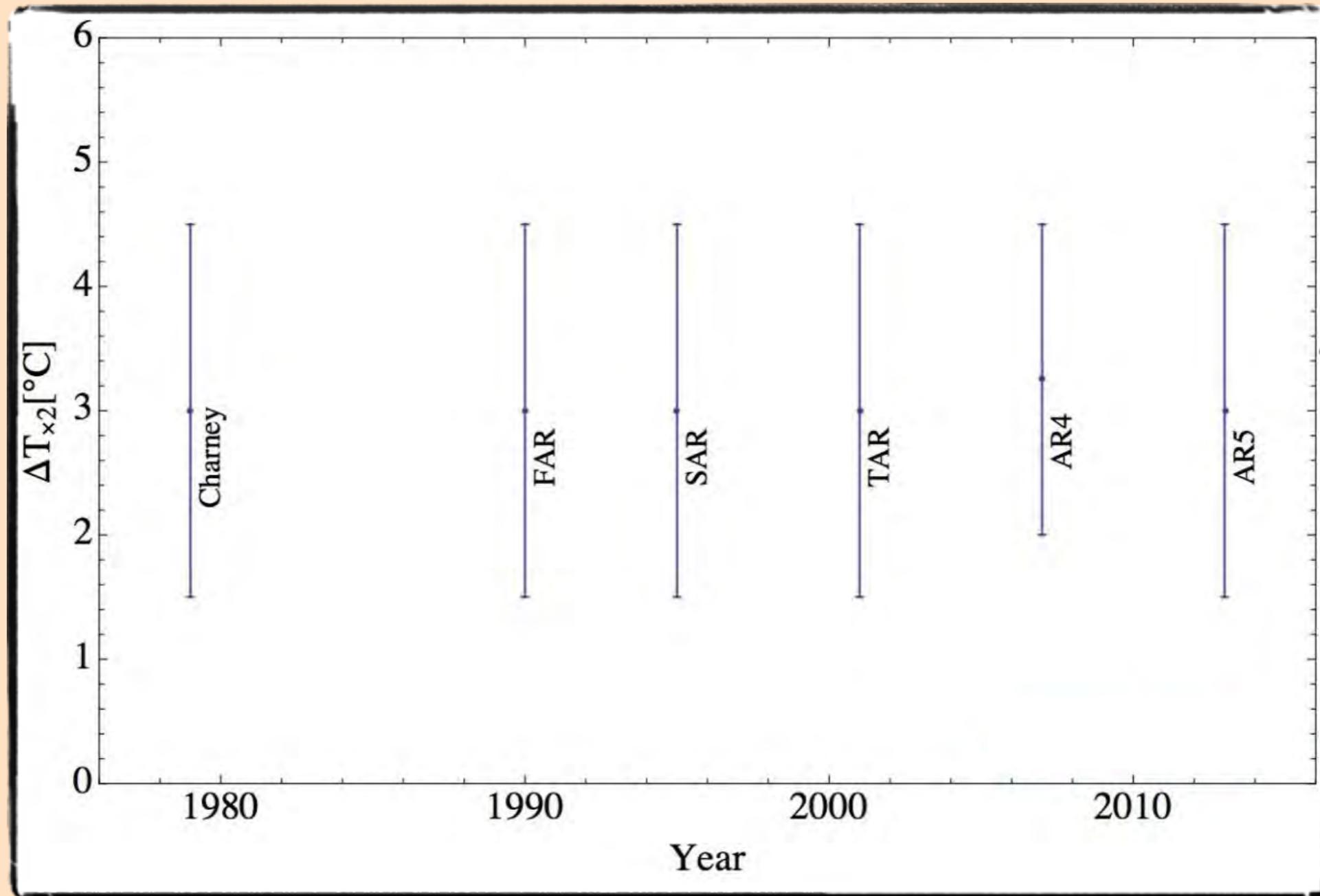
# Problem 4: Model climates can give any sensitivity!



Different “recipes” for the cloud cover produce different sensitivities: Increase of 1.5 to 5°C per CO<sub>2</sub> doubling.



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



## Problem 5: No fingerprint

- *There is no finger print proving  $CO_2$  is the culprit!*



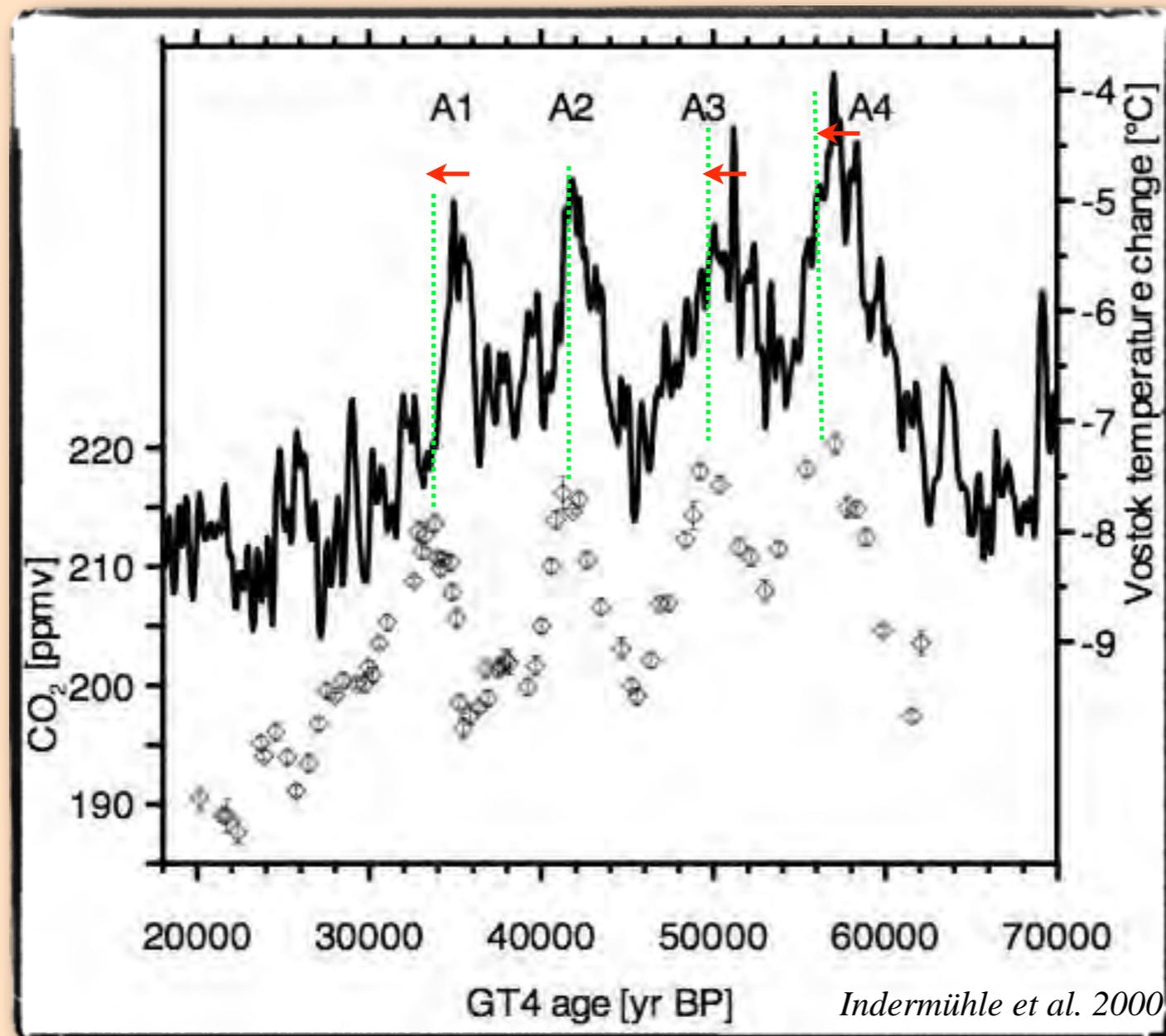
# Problem 5: No fingerprint

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



# Problem 5: No fingerprint

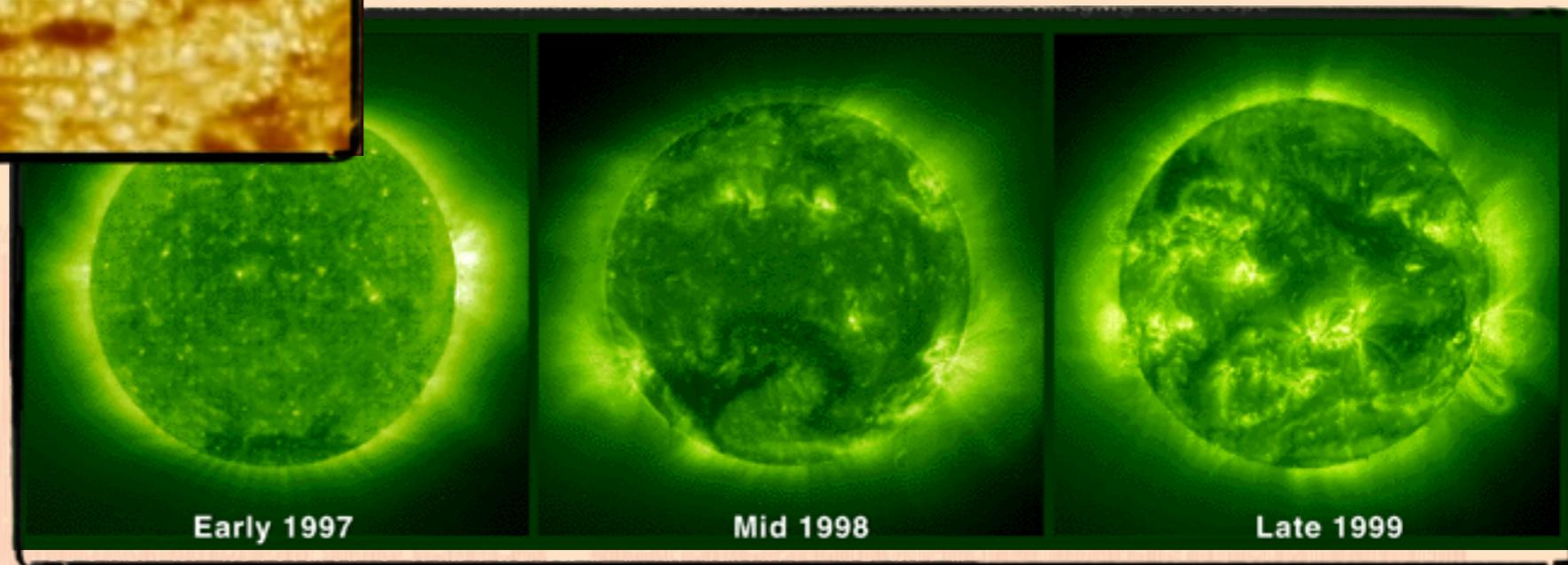
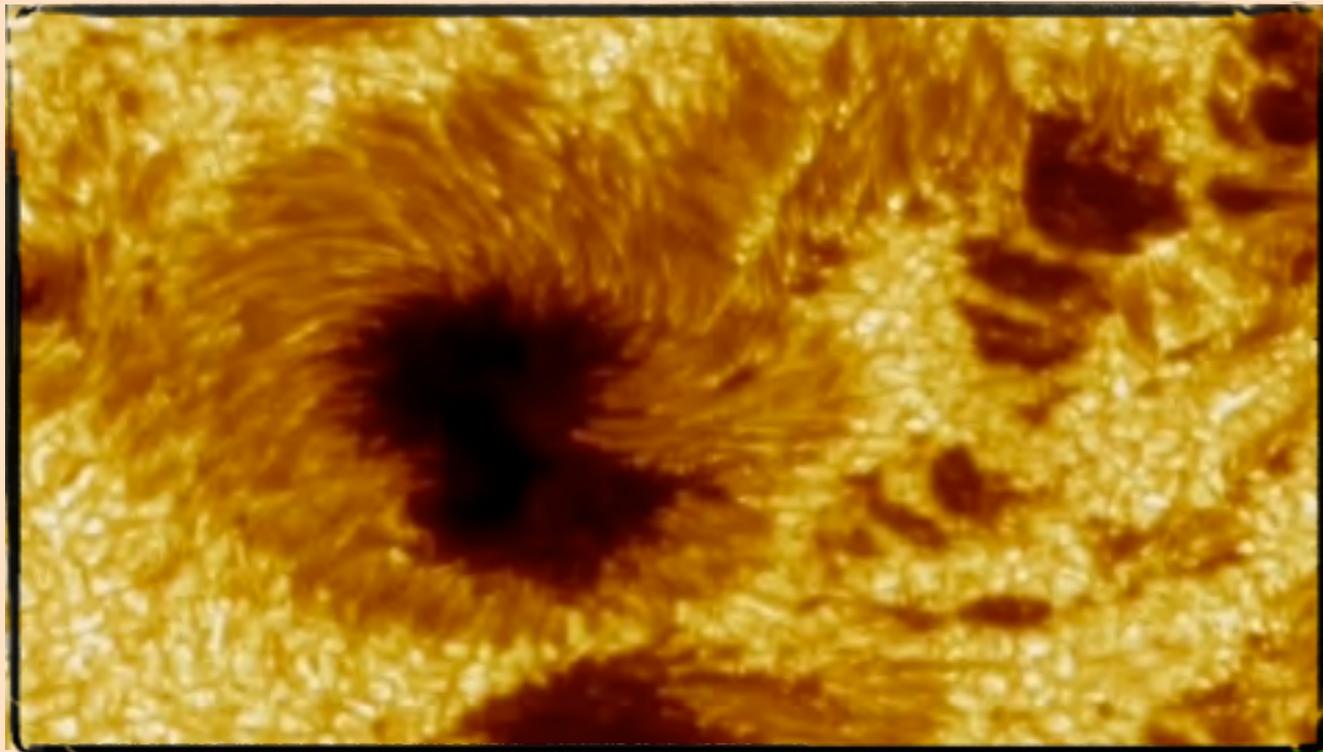
- *CO<sub>2</sub> lags temperature!*



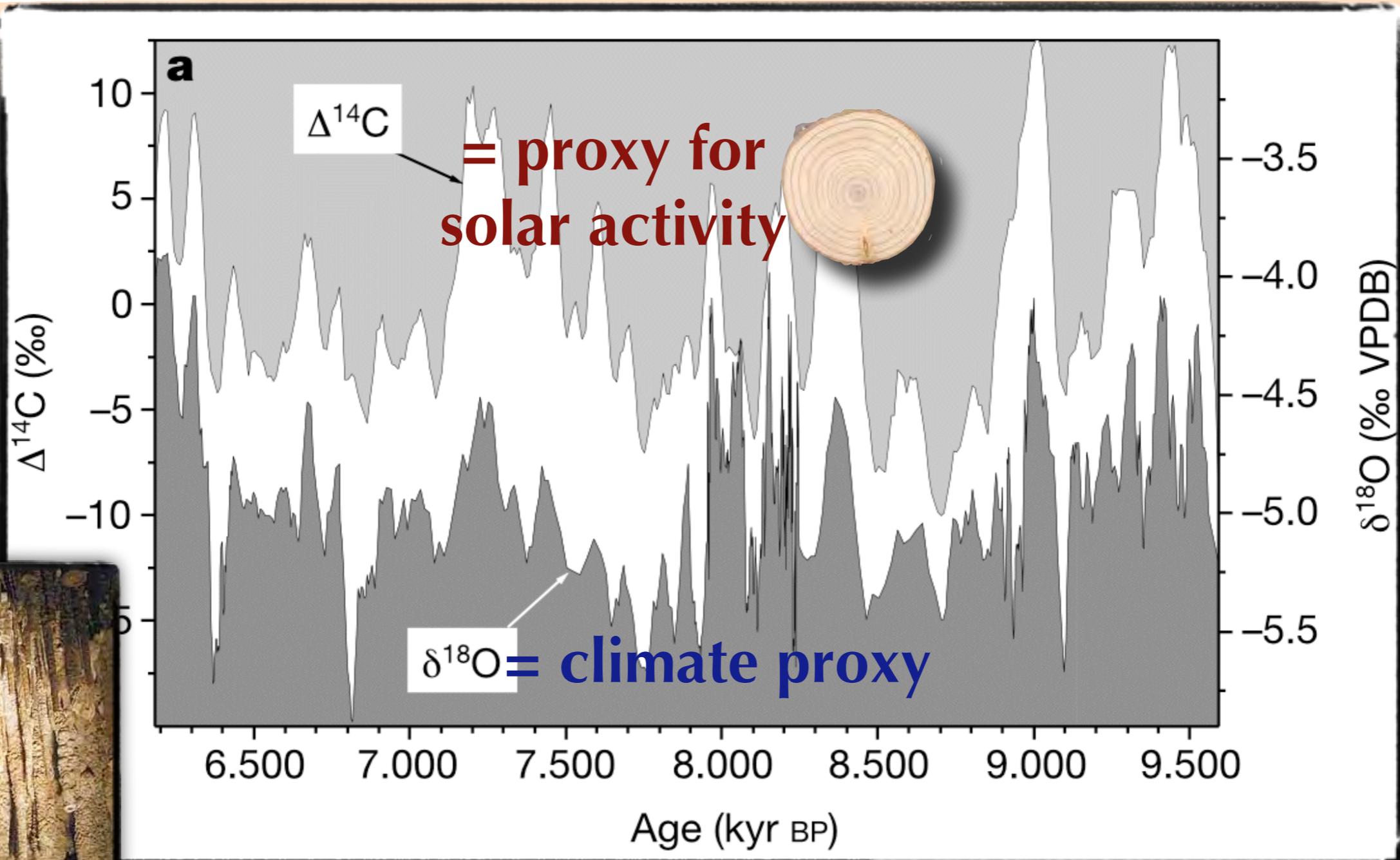


# Problem 8: There is another explanation

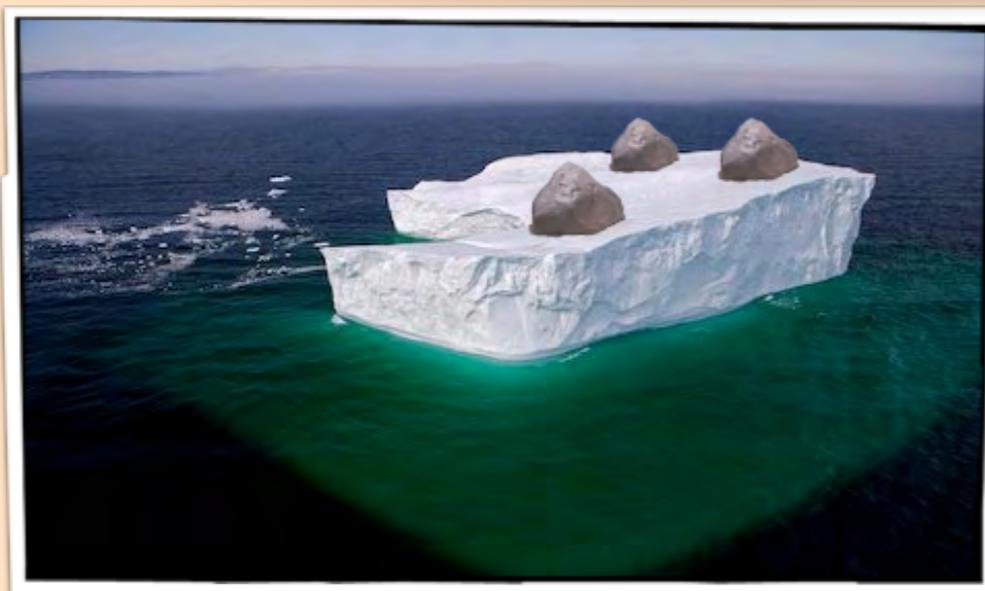
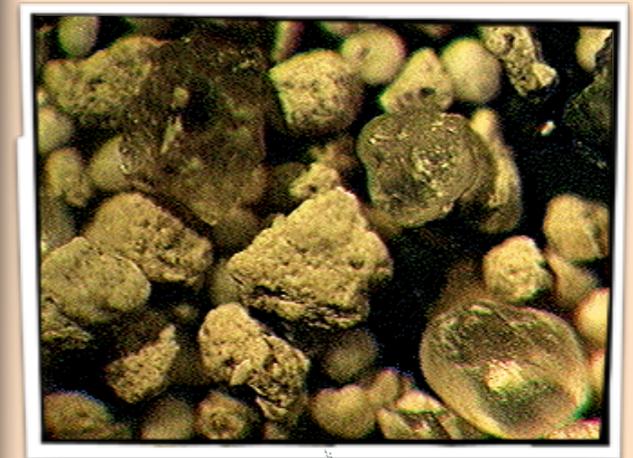
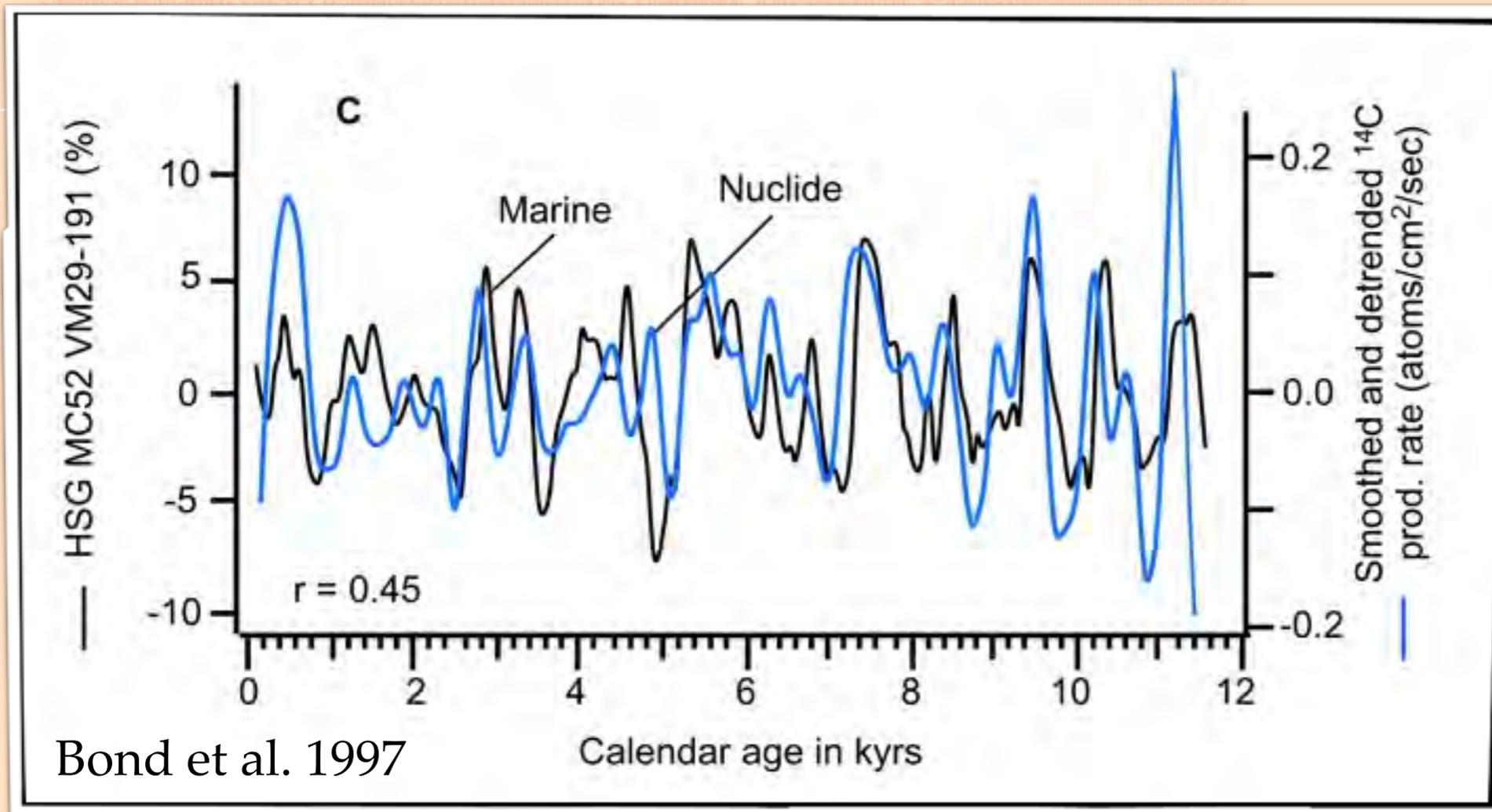
- *The claim that there isn't any other explanation, and therefore the warming must be primarily human, is wrong. There is another explanation: **Solar Activity**.*



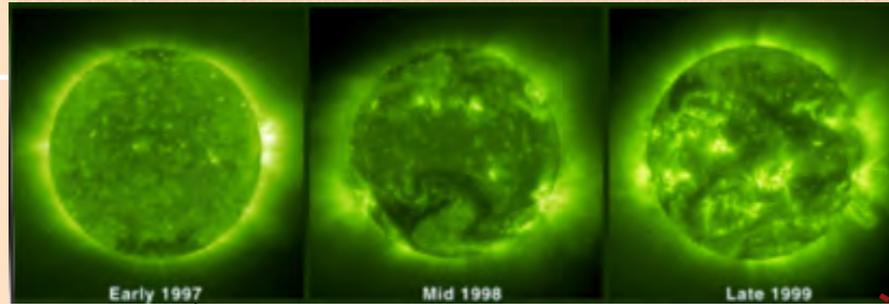
# The link over several millennia



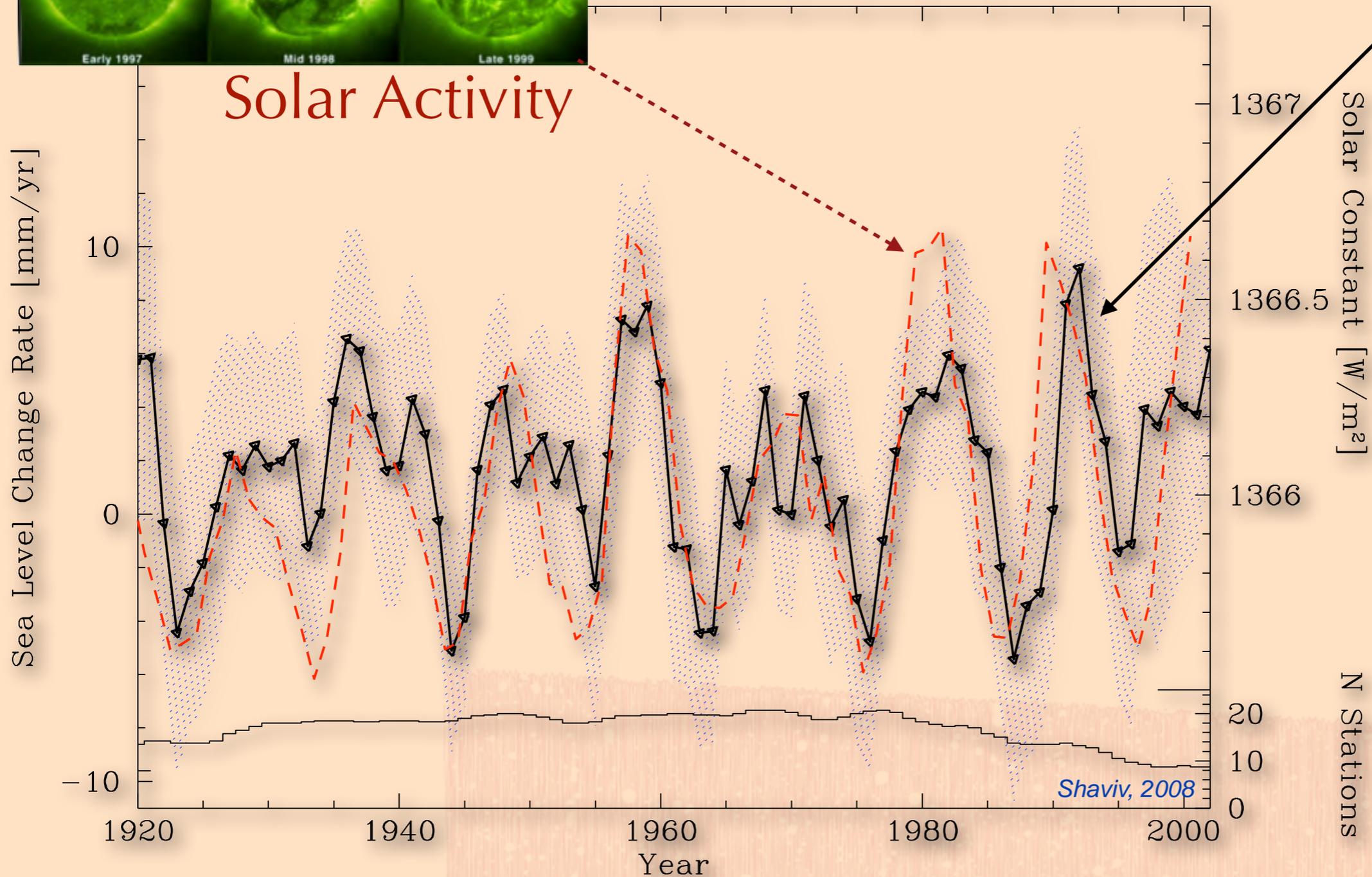
# The link over several millennia



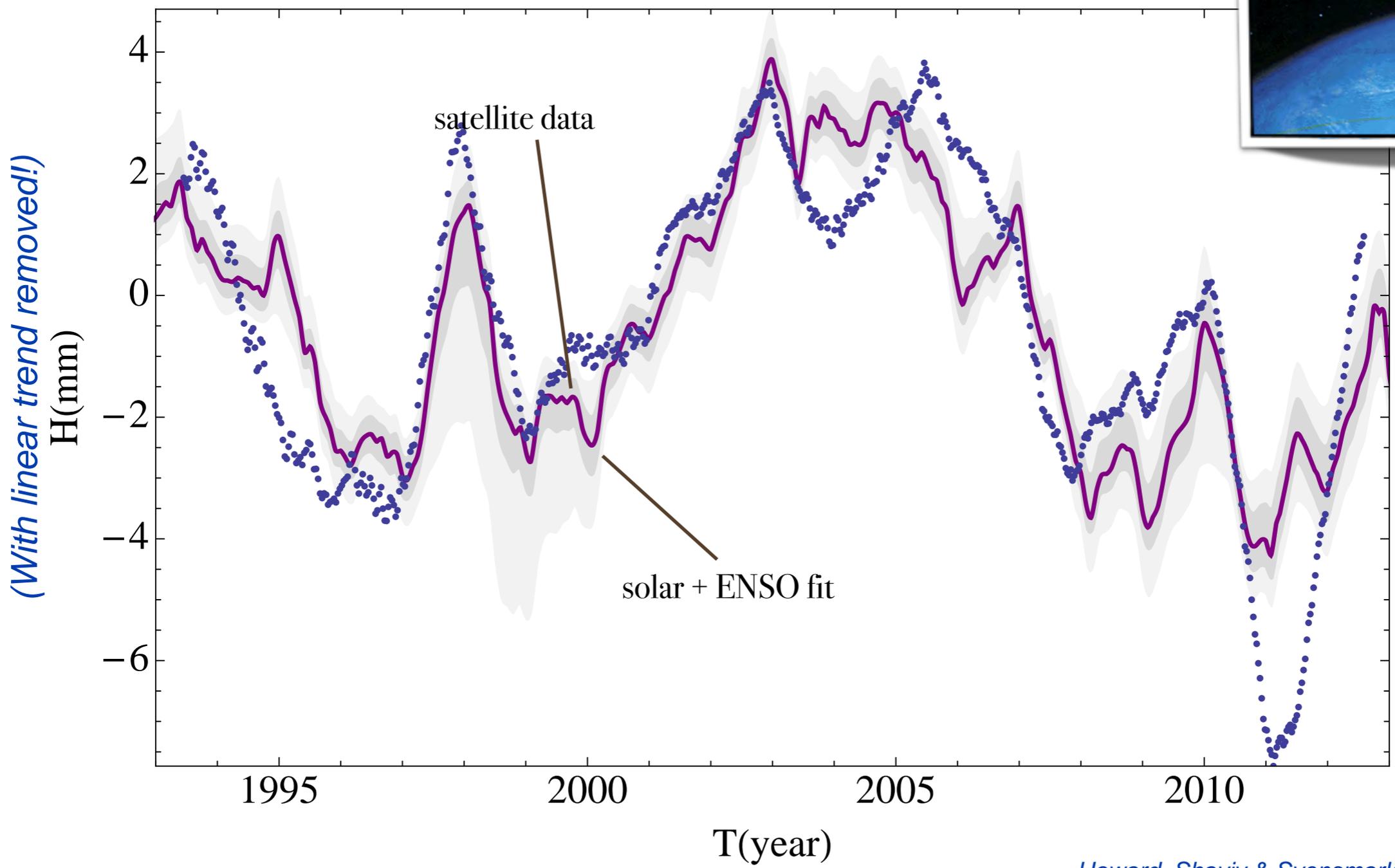
# Link over the 11-year Cycle



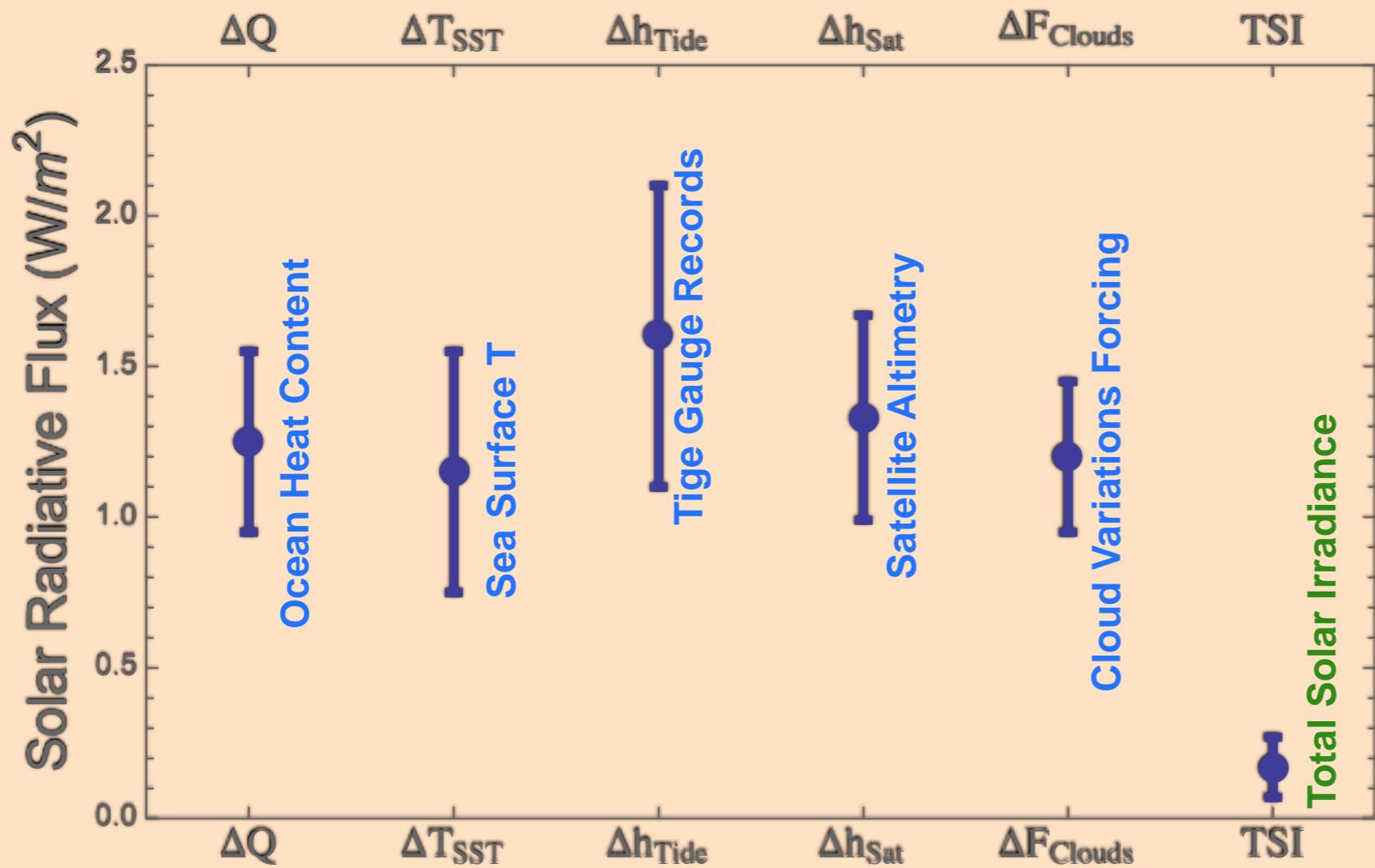
Solar Activity



Sea Level Change Rate

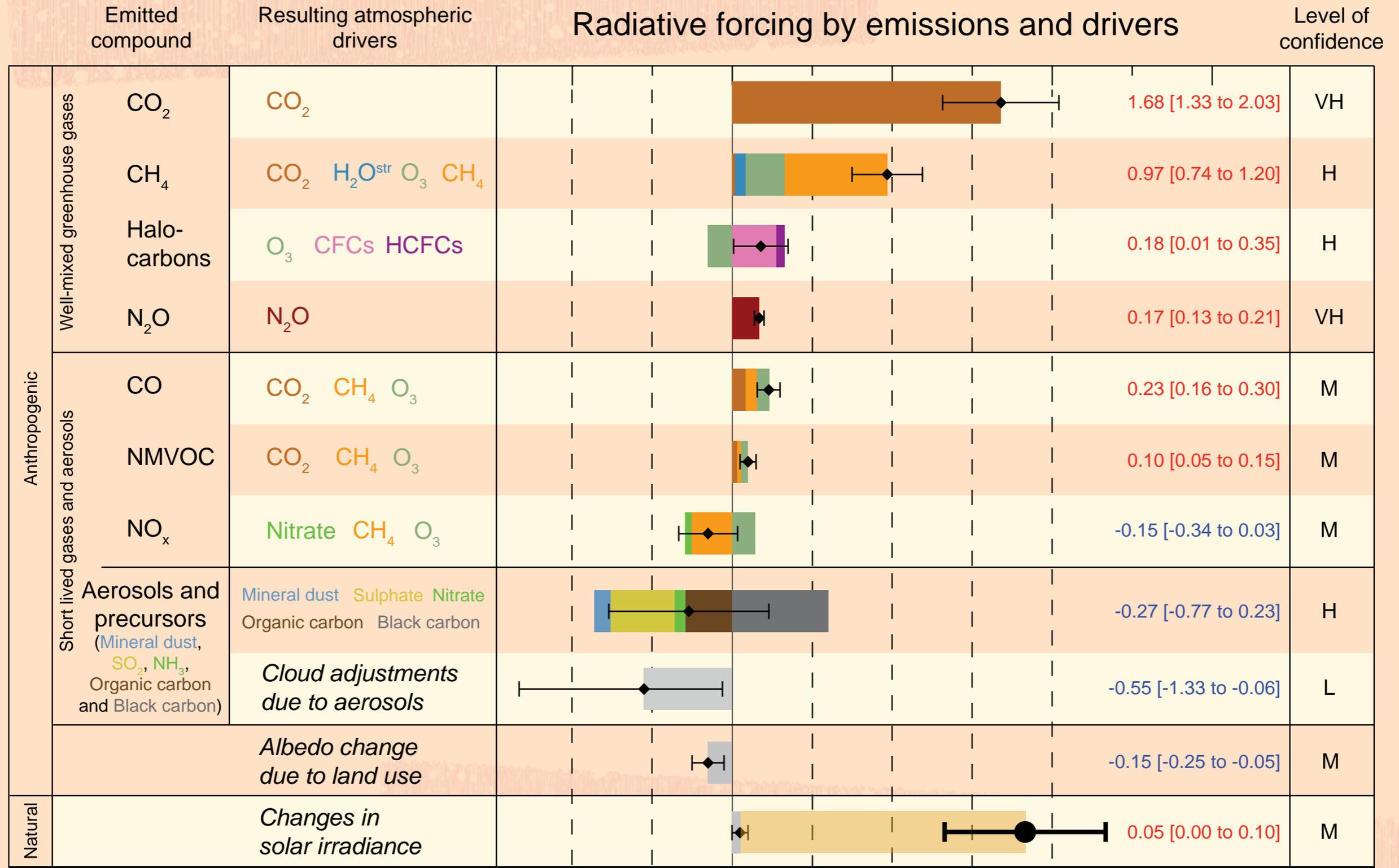


# Link over the 11-year Cycle

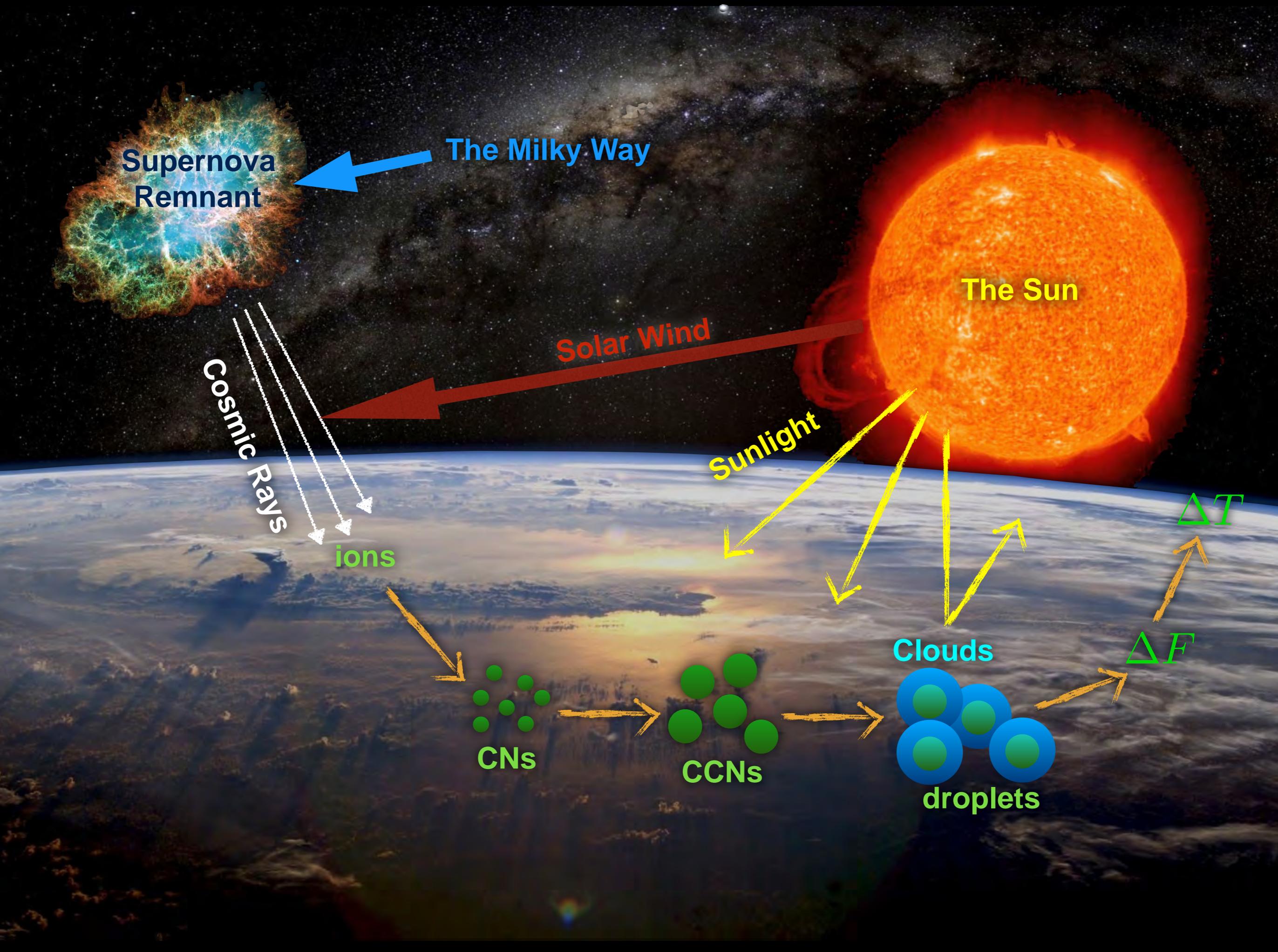


Require an amplification mechanism

# IPCC 5AR forcing graph



Since Maunder Minimum



Supernova Remnant

The Milky Way

The Sun

Solar Wind

Sunlight

Cosmic Rays

ions

$\Delta T$

$\Delta F$

Clouds

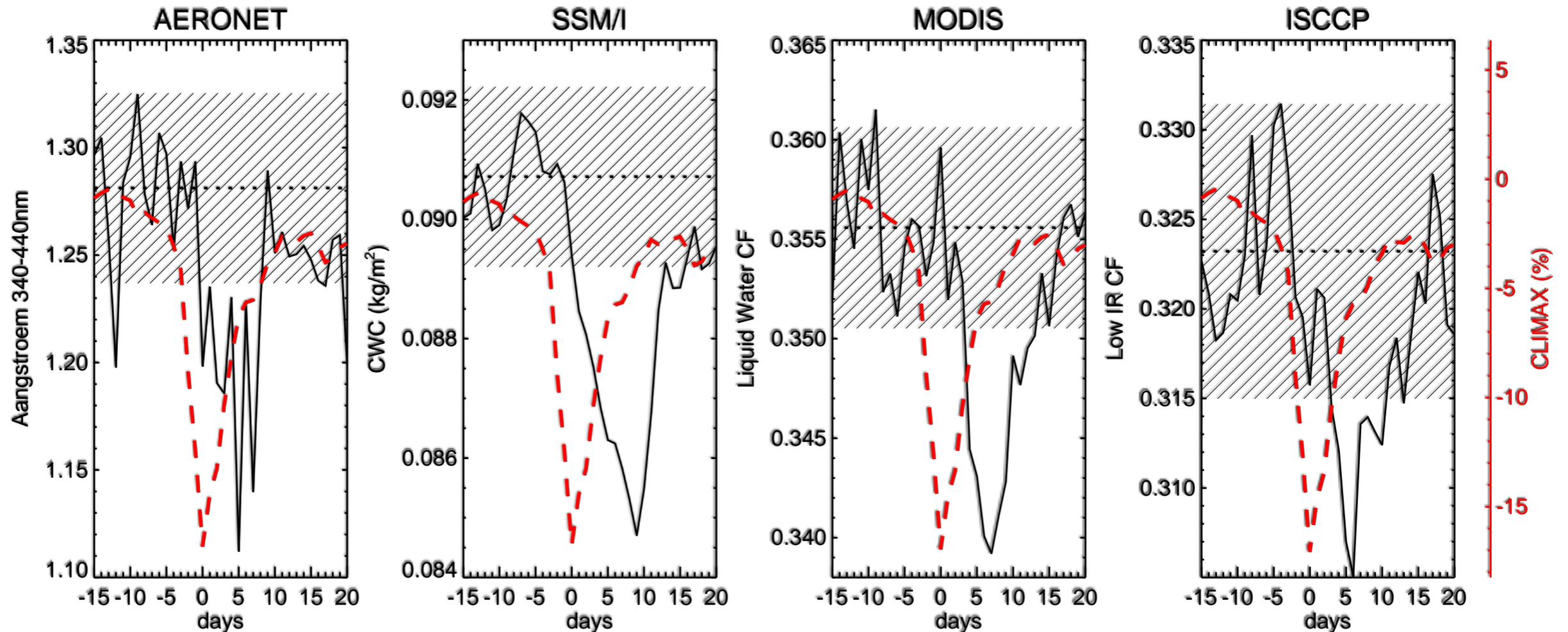
CNs

CCNs

droplets

# Forbush decreases

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

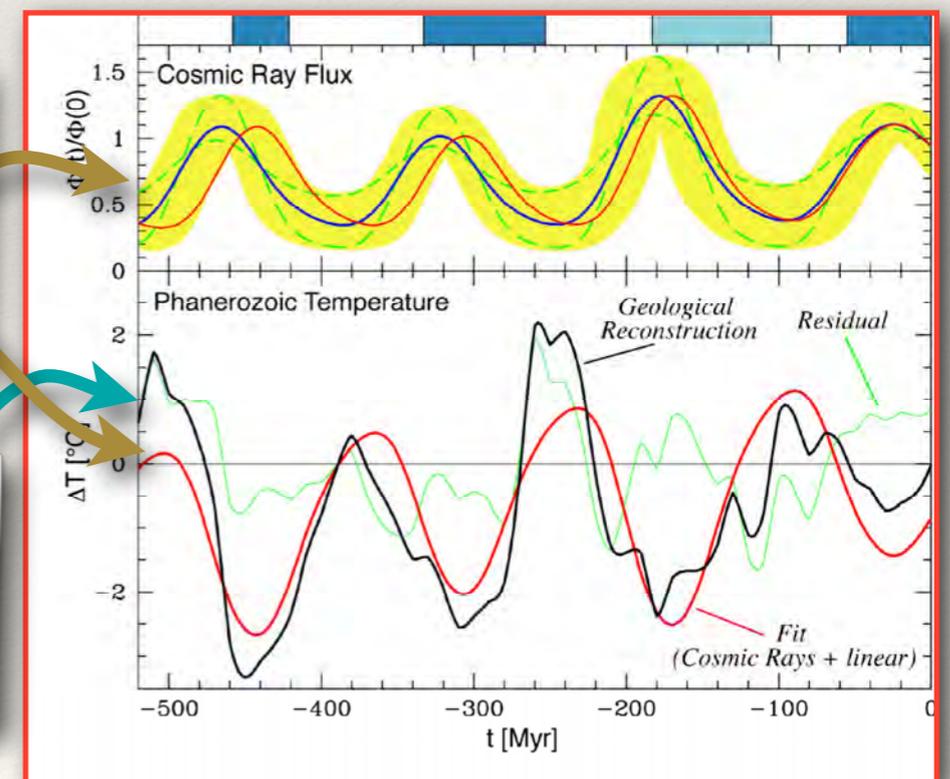
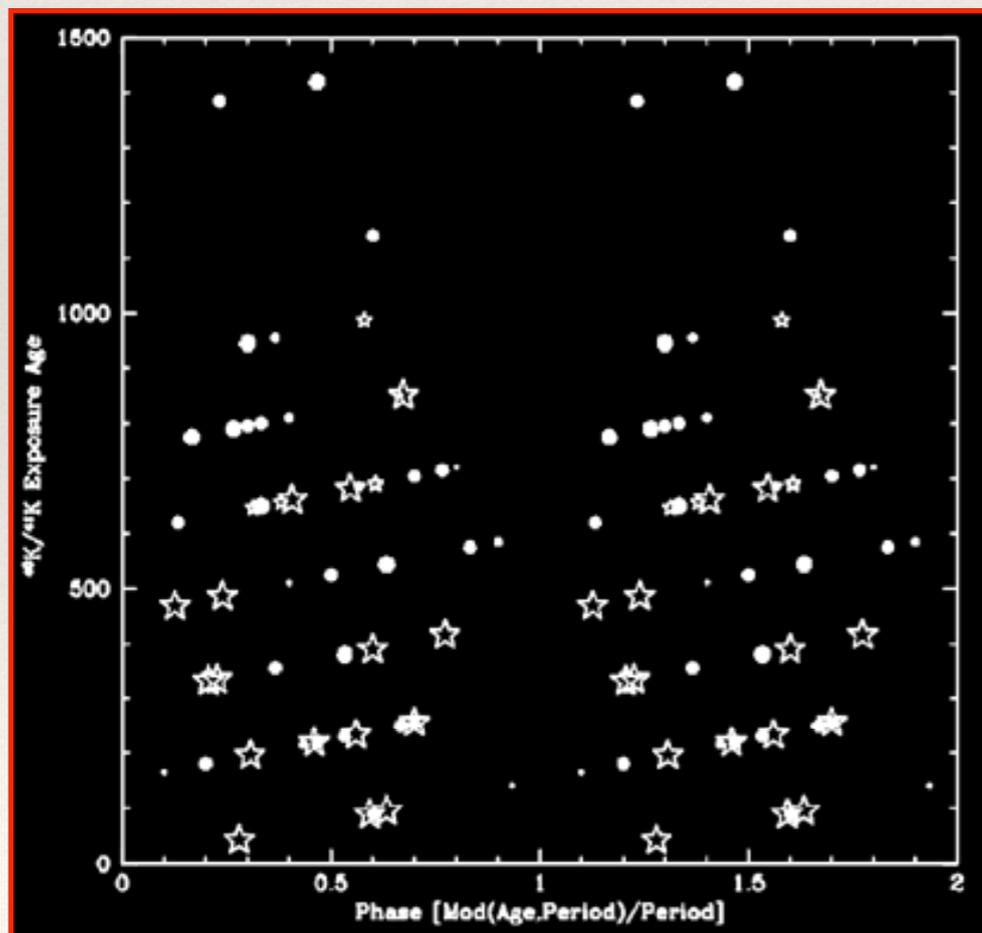


5 strongest forbush decreases (1987-2007)

Svensmark et al. GRL 2009

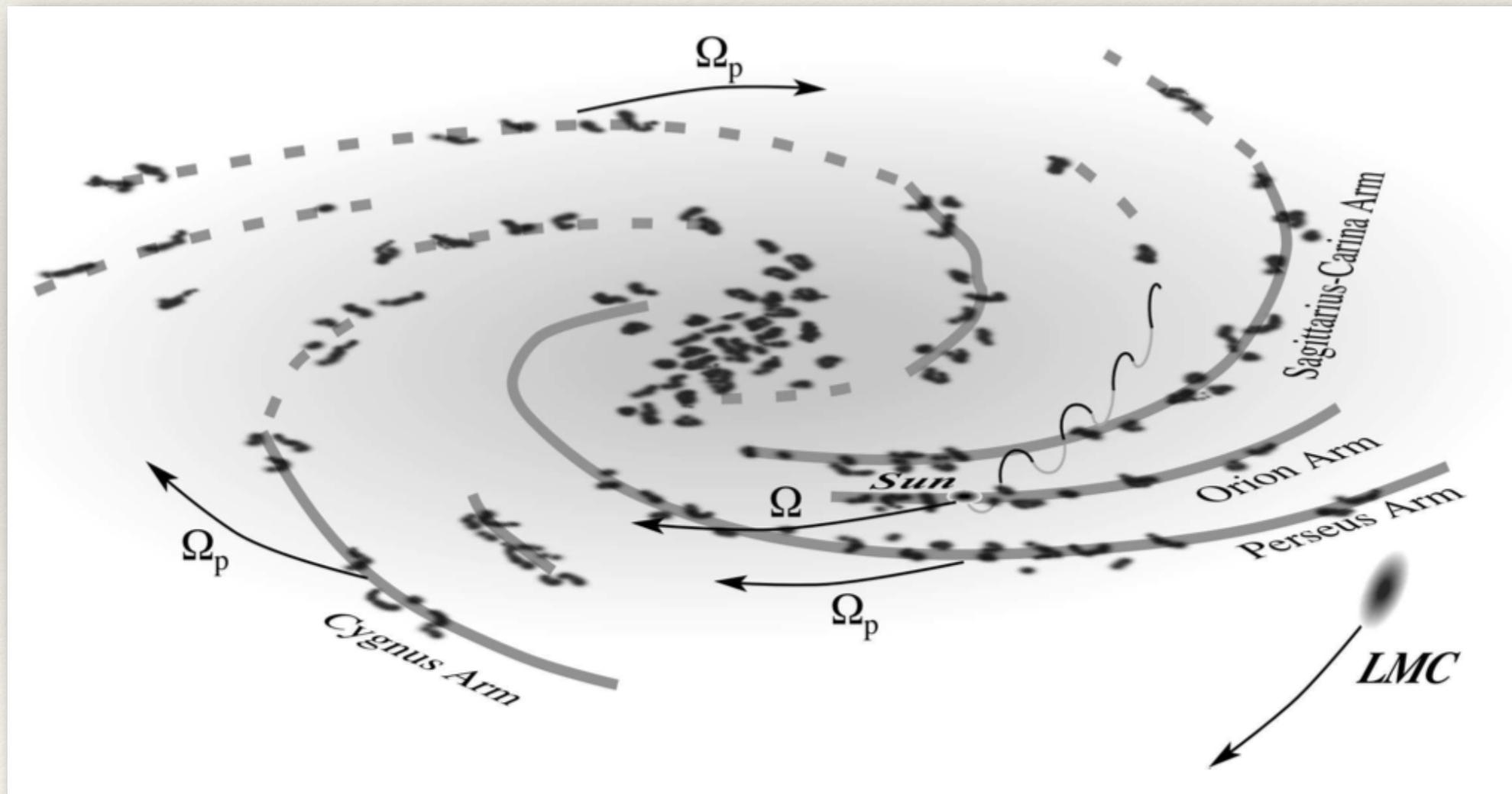
# Time Variability

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



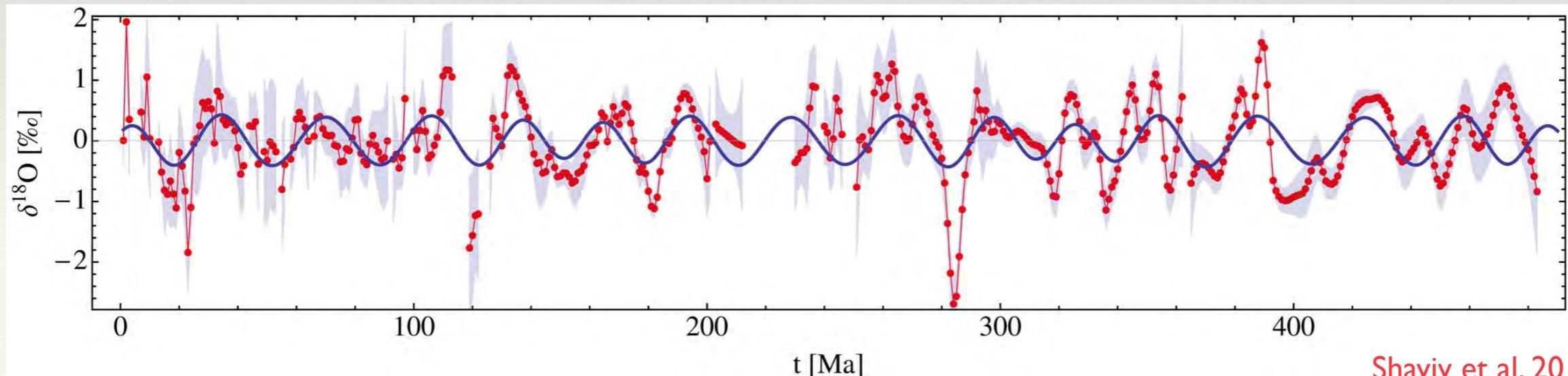
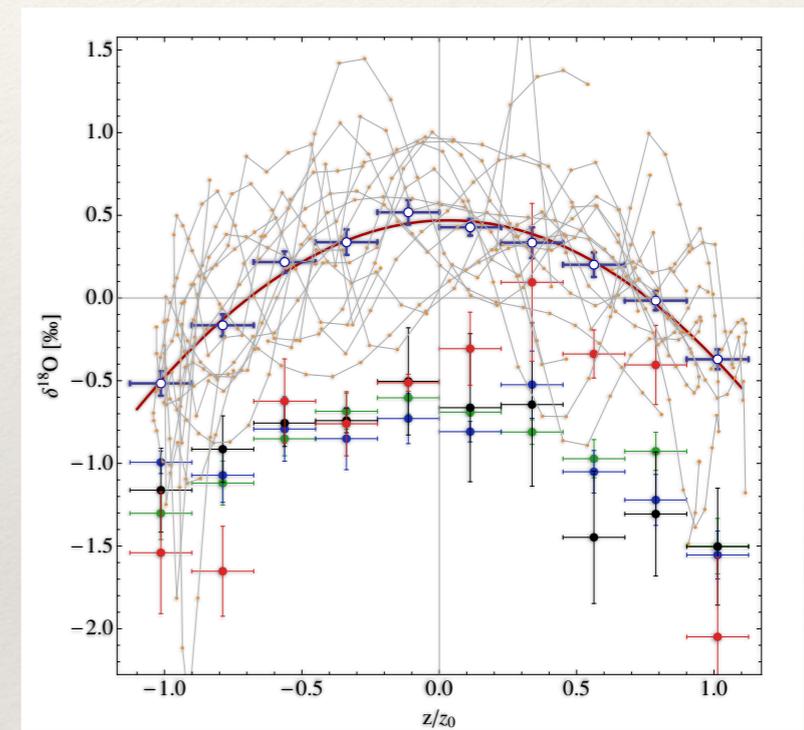
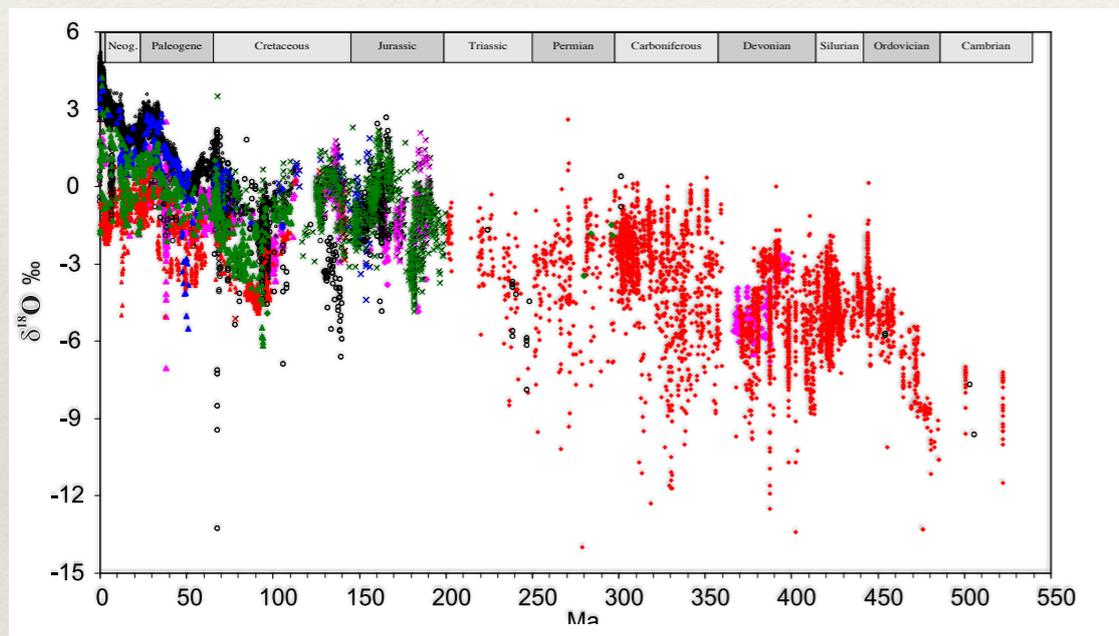
# Vertical Oscillation of the Sun

- ❖ 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.

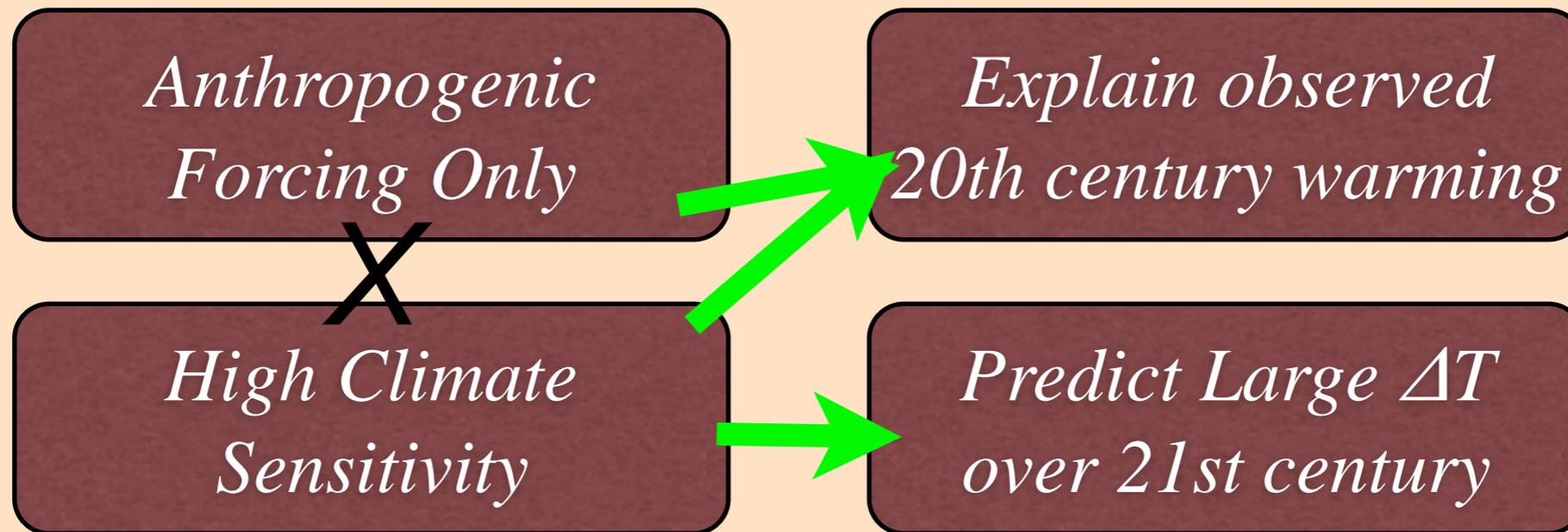


# Vertical Oscillation of the Sun

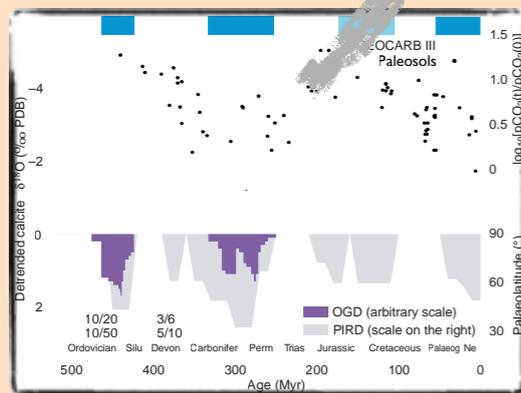
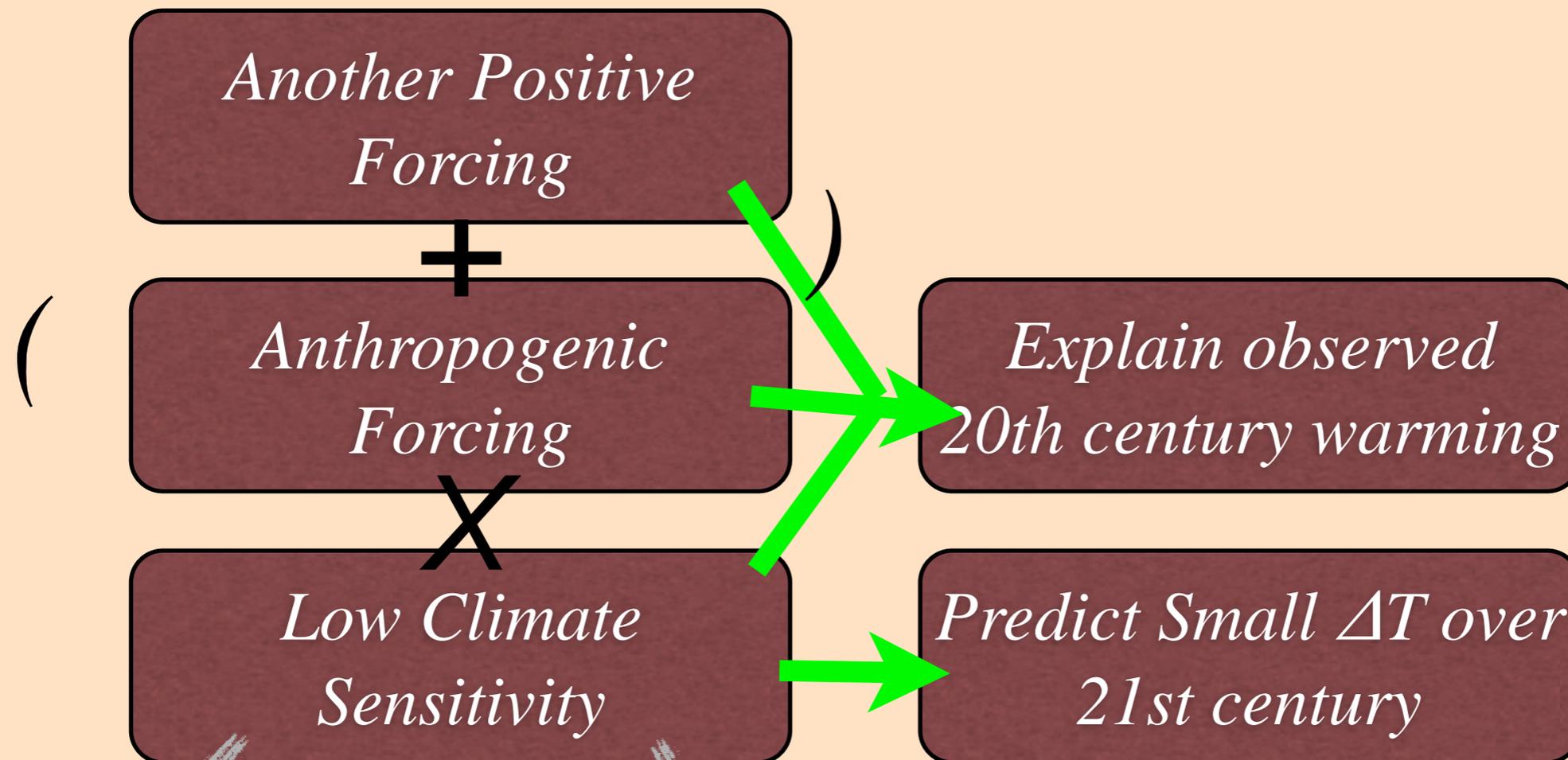
- ❖ Small CR Halo implies that vertical oscillation of Solar system + CR/cloud cover effect should give rise to a 30-40 Myr variability in the paleoclimate.



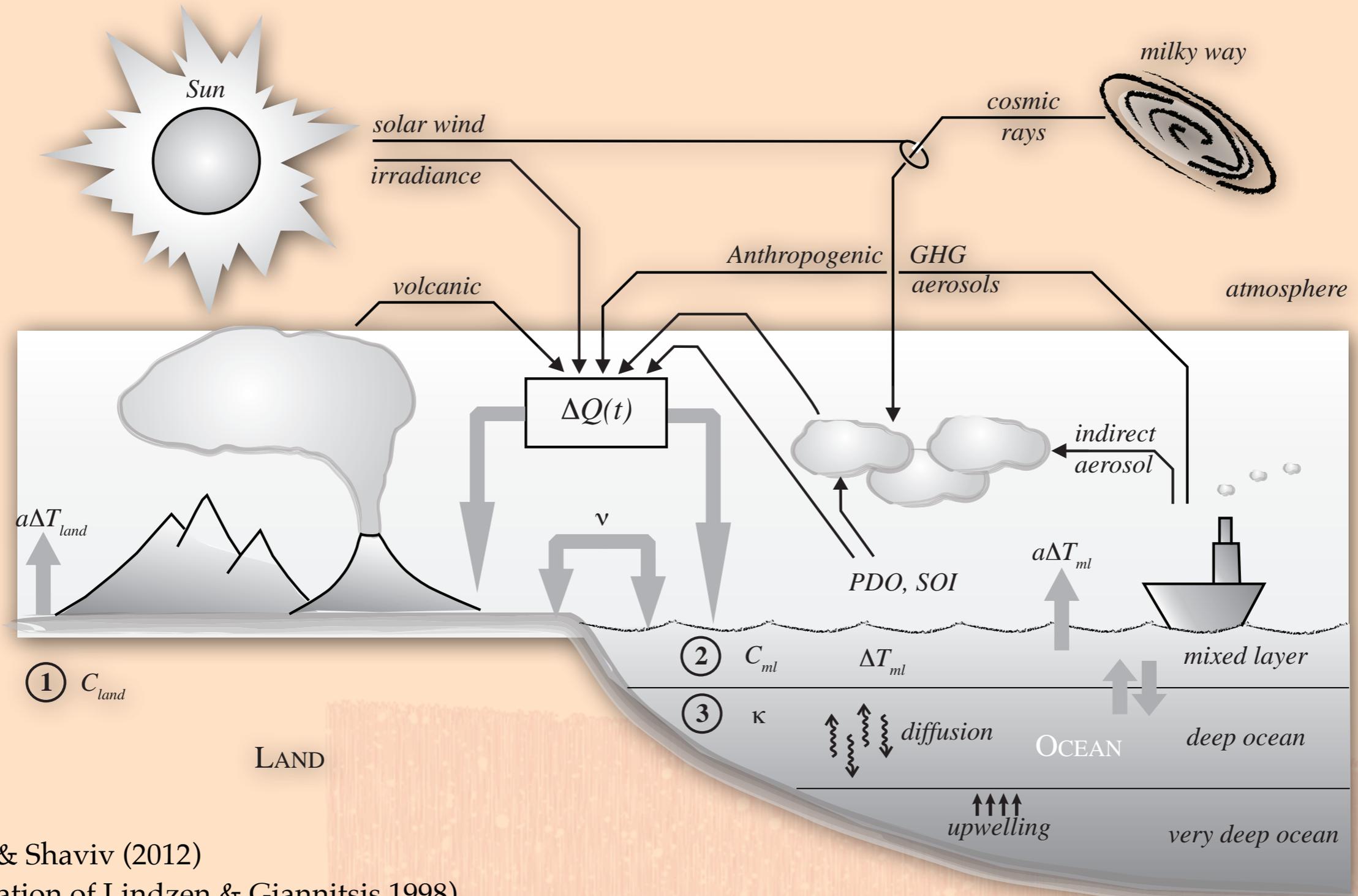
# Standard Explanation to 20th century



# And if there is another explanation?



# Basic Climate Model

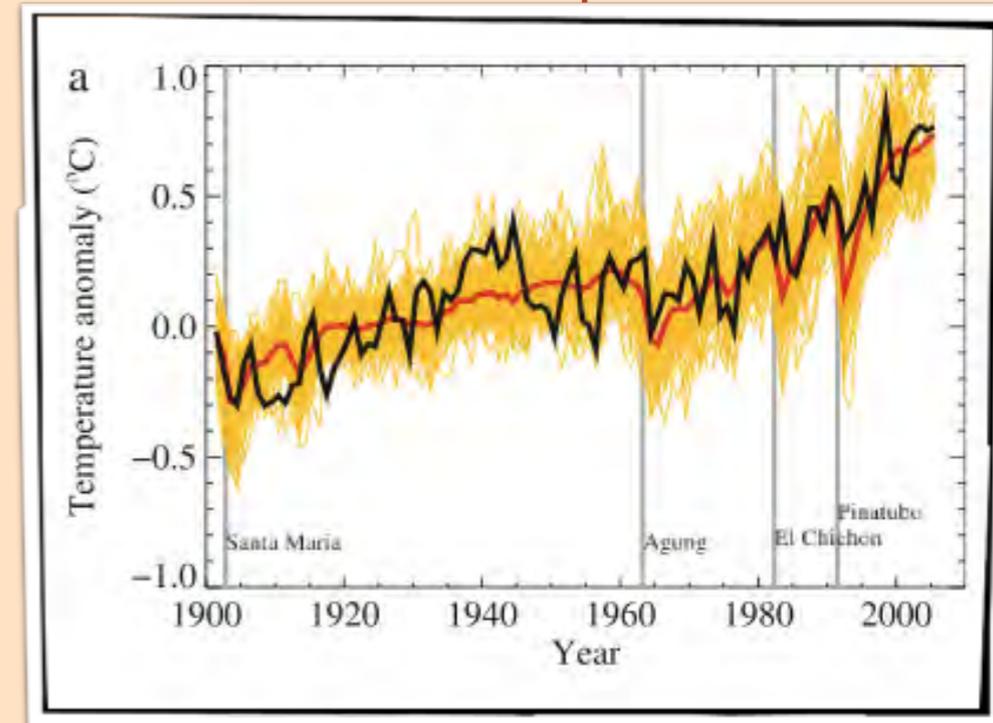
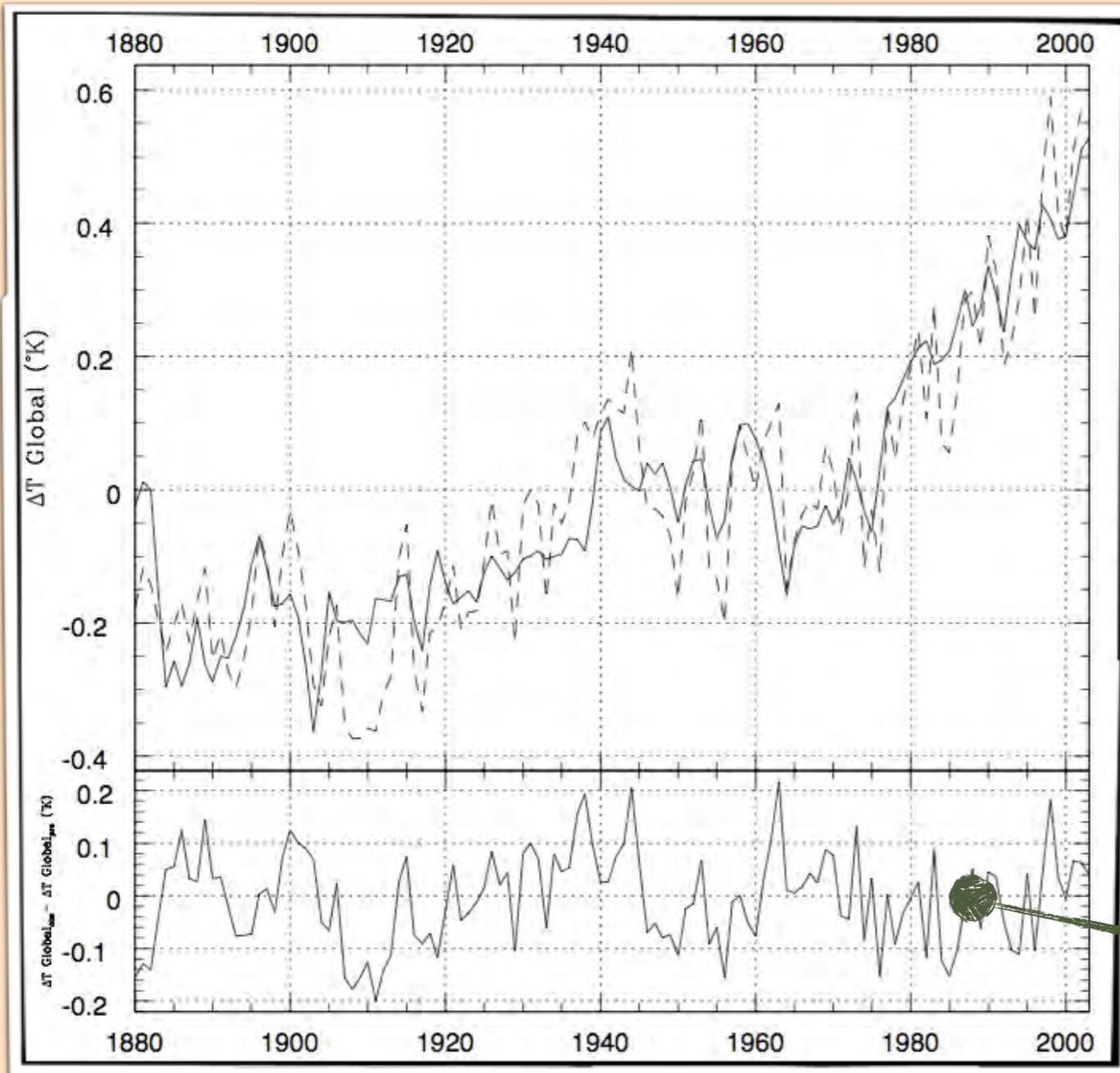


Ziskin & Shaviv (2012)  
 (elaboration of Lindzen & Giannitsis, 1998)

# 20th century warming

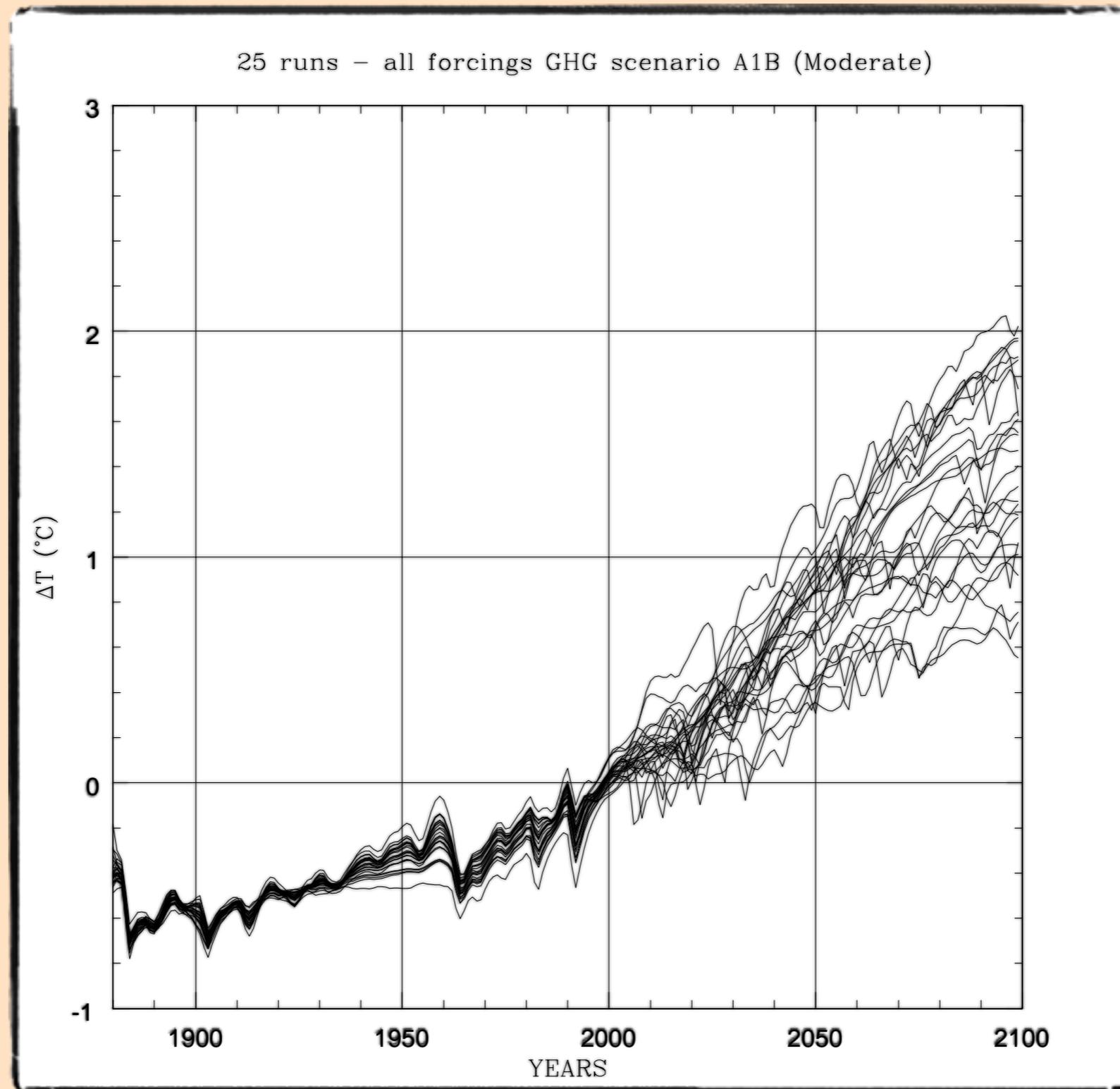
◆ Best fit (i.e., after parameter optimization)

Comparison: IPCC-AR4

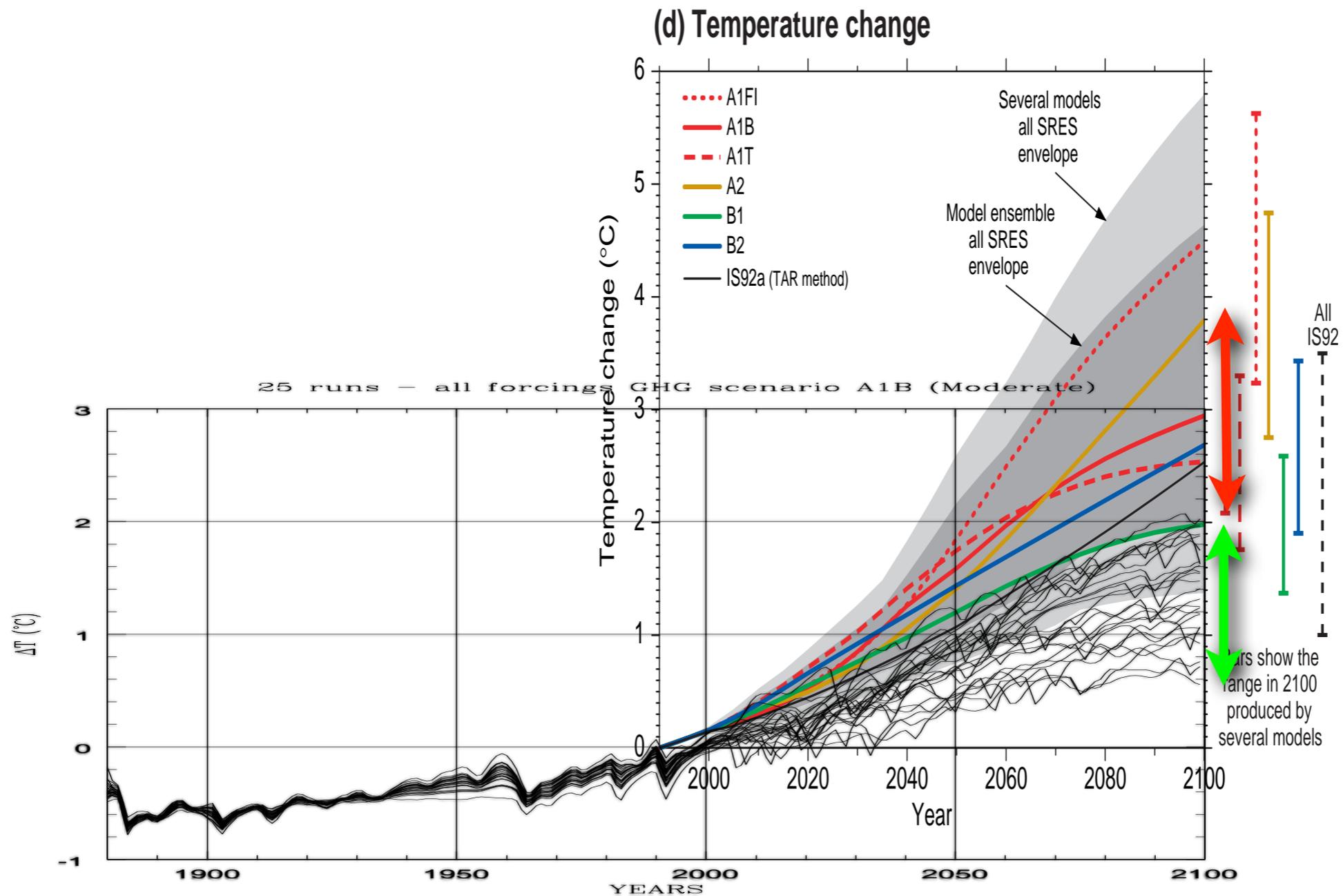


Residual more than twice smaller than with GCMs (without solar amplification)

# 21<sup>st</sup> century temperature increase



# 21<sup>st</sup> 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!)