

# **Climate**

## **- The Breath of Life**

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**2010.10.15**

# Planetary atmospheric composition

## - the Earth is different

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	Venus	Earth	Mars
Carbon dioxide	98%	0.038%	95%
Nitrogen	2%	79%	3%
Oxygen	Trace	21%	0.13%
Methane	0	2 ppm	0

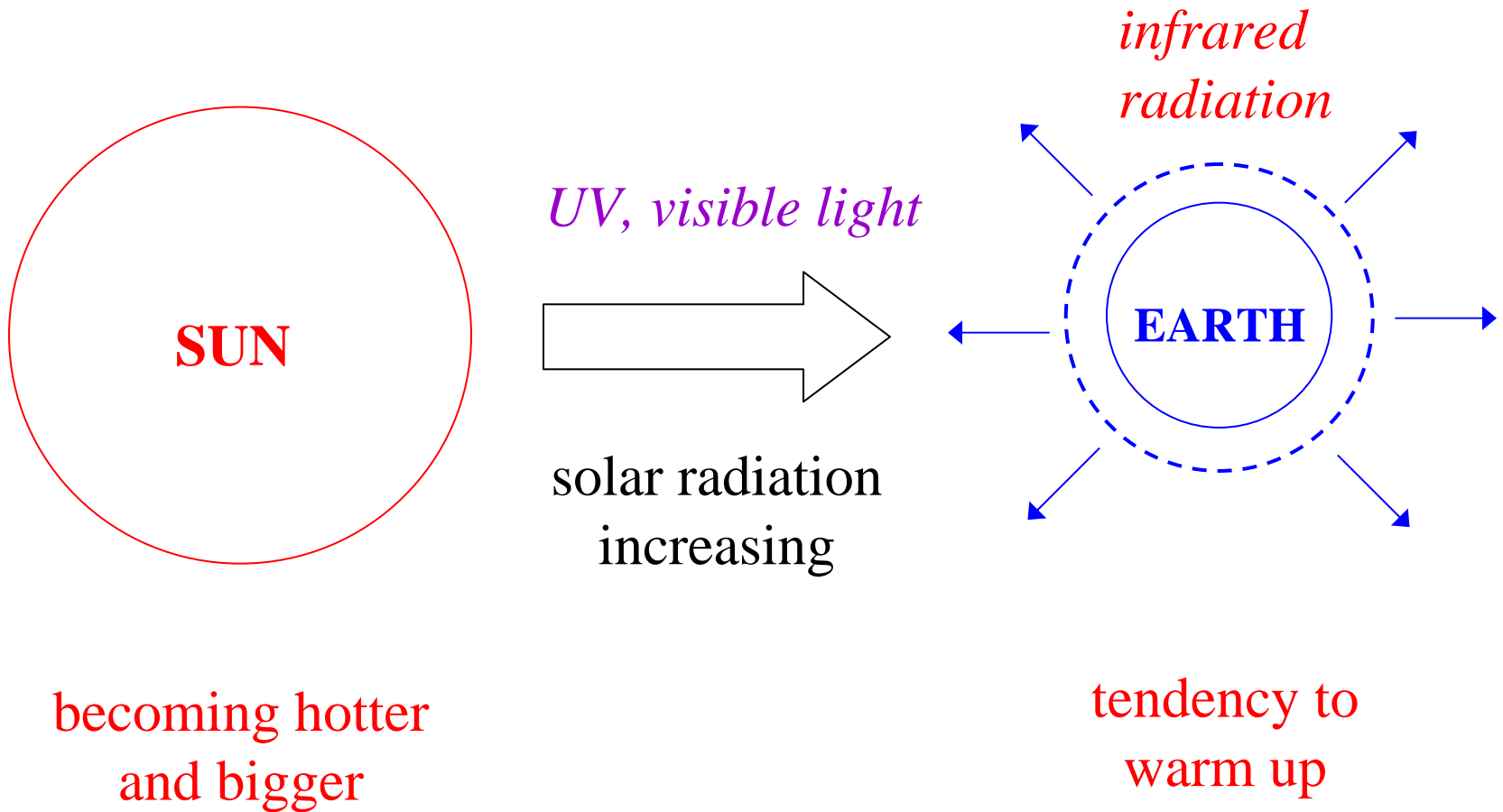
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Surface temperature	~500°C	14.5 °C	~ -50 °C
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**Why ? Life at work.**

# Sun-Earth relationship over geological time scale



*Question: how to keep the surface temperature suitable for Life?*

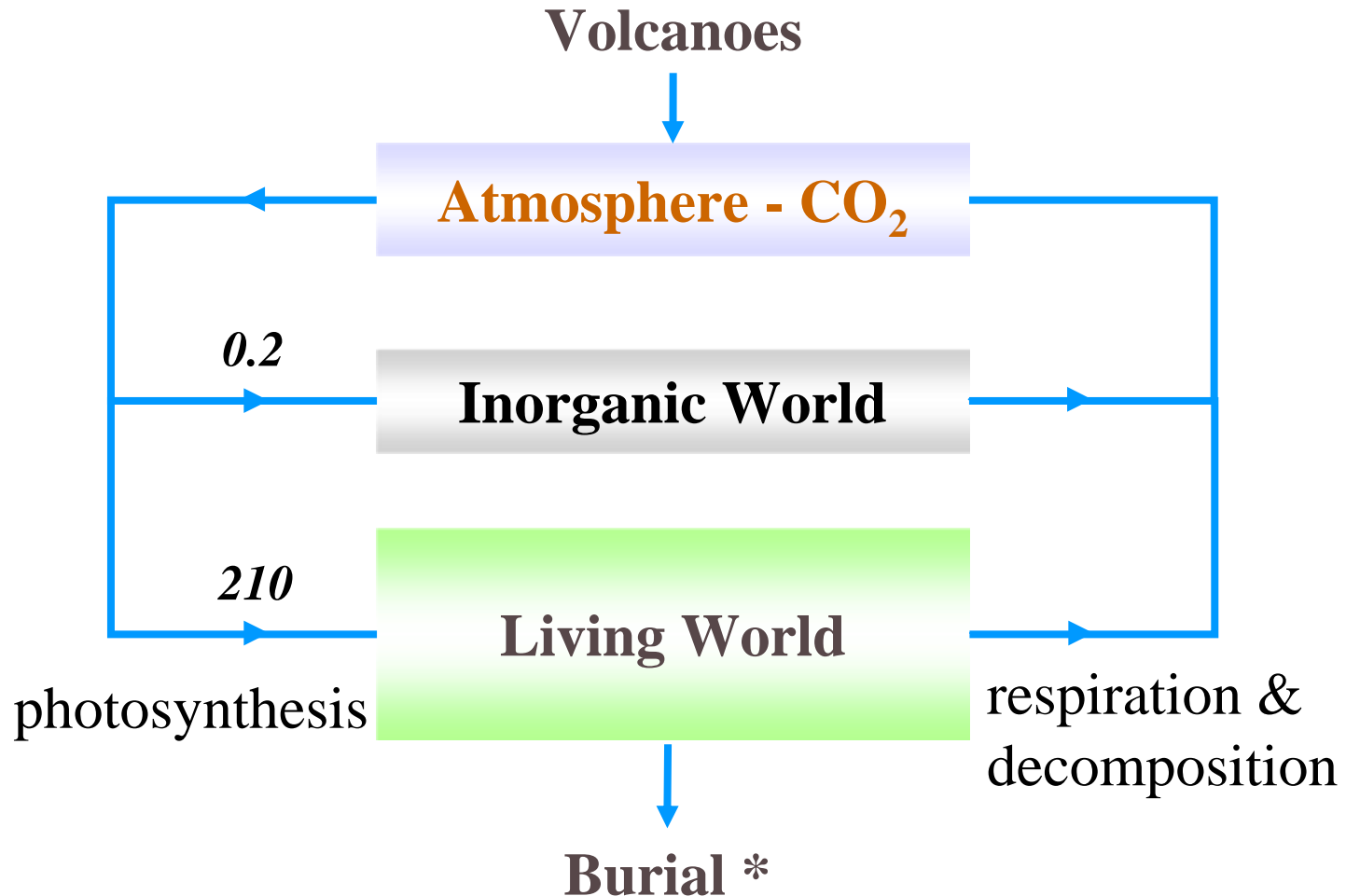
# Greenhouse Effect

More carbon dioxide = warmer near the surface

To remain cool for Life

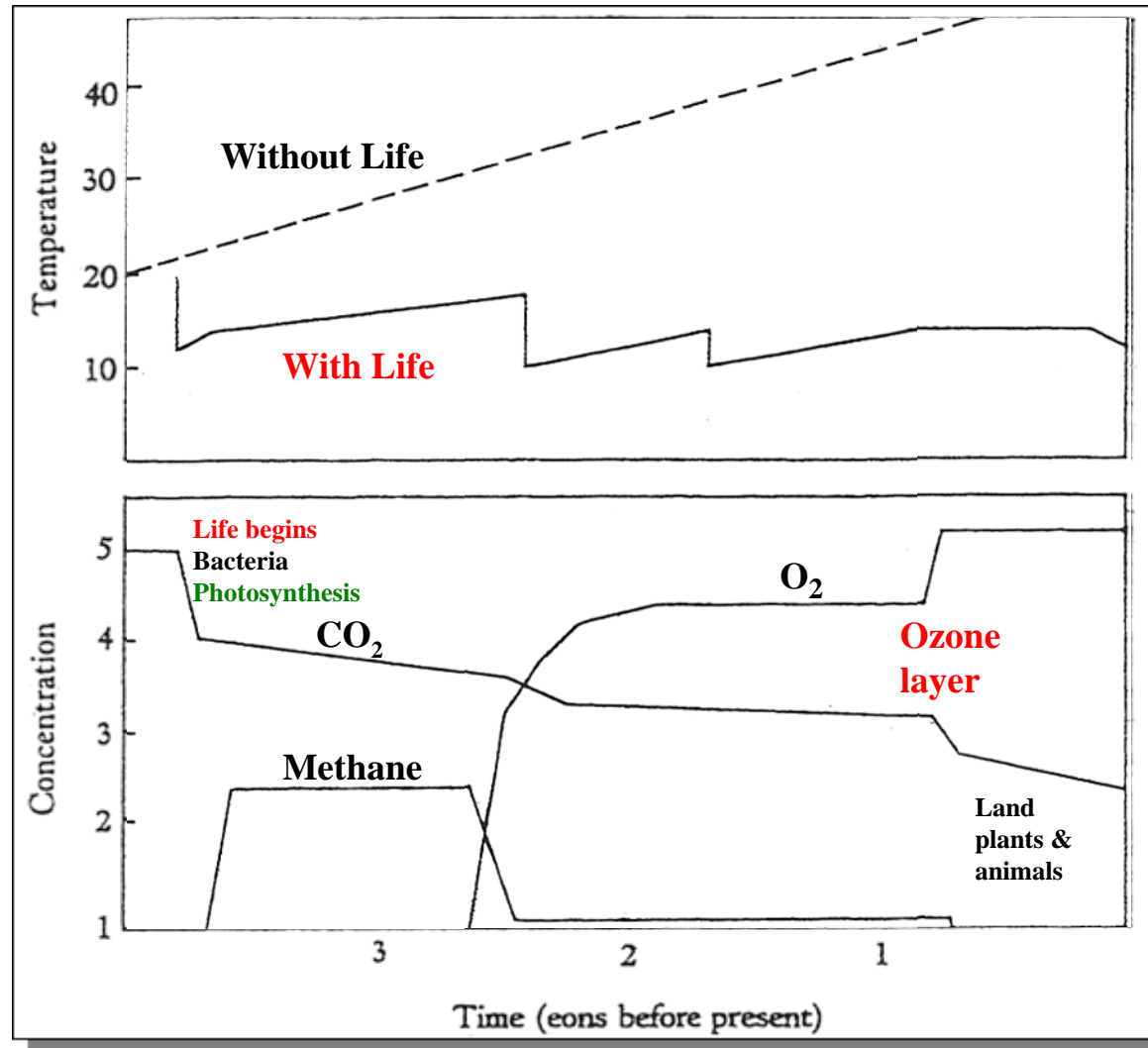
→ constant removal of carbon dioxide  
“by photosynthesis”

# The Grand Air-conditioner



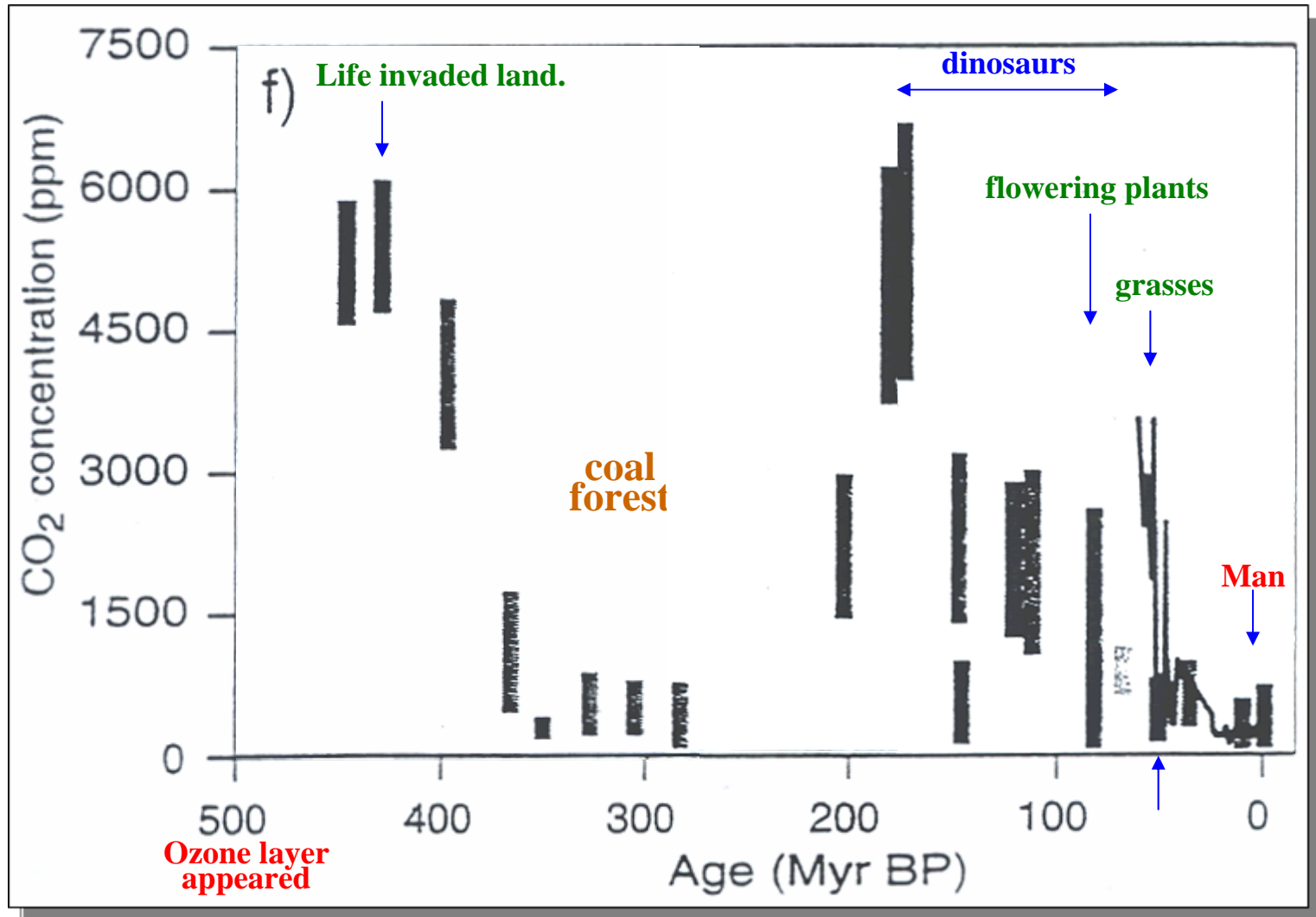
\* bacterial control

# The Earth's atmosphere over geological time



(After Lovelock)

# Two cycles of Life on land – still learning



(Background after IPCC 2001)

# Co-evolution of atmosphere and living things

- The physical world influences the survival of various life-forms (traditional “evolution”).
- Living things in turn modify the physical world (“collective survival instinct” of Life).
- On Earth, the atmosphere and living things co-evolve.



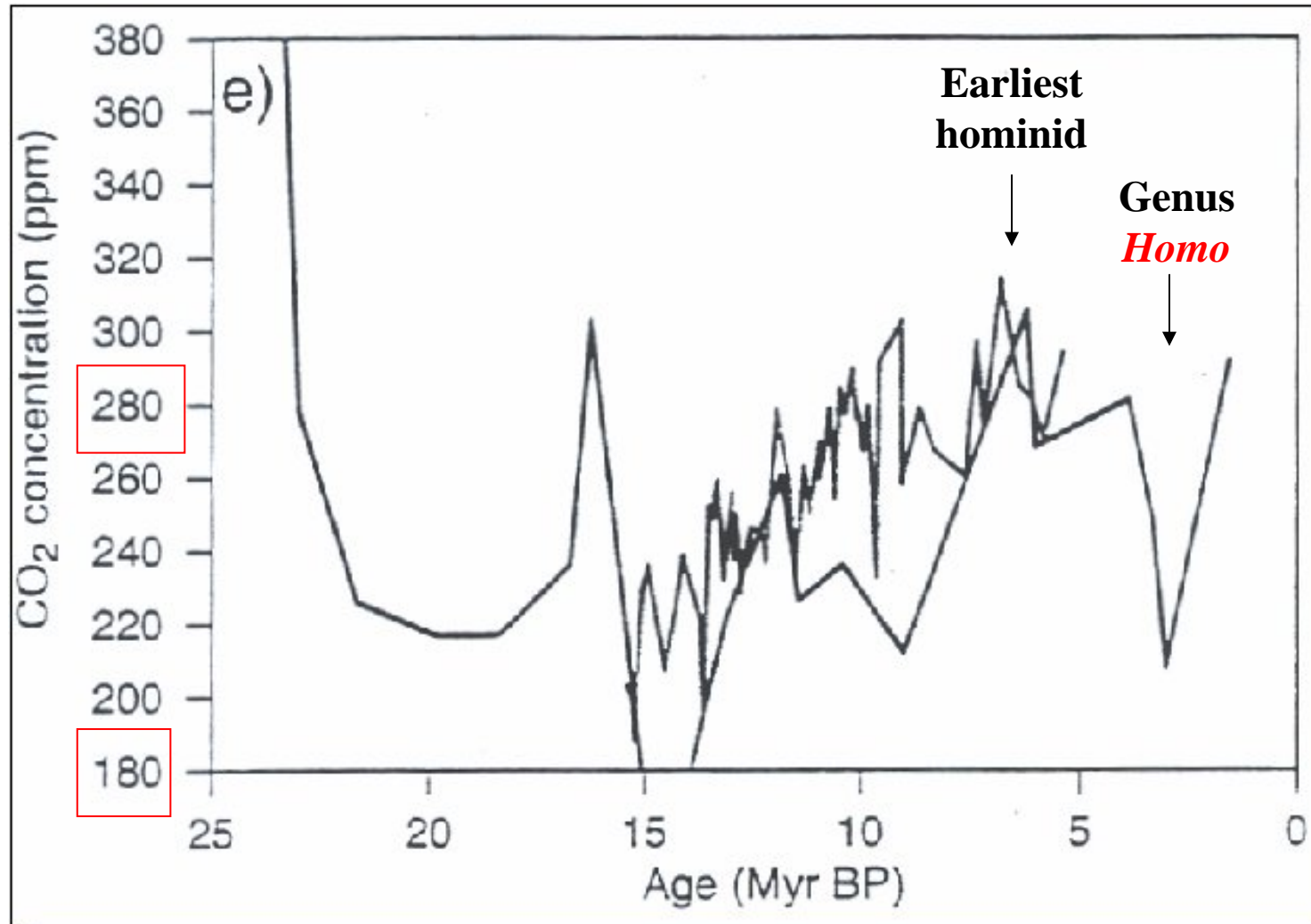
Earth's atmosphere  
- different from those of Venus & Mars

The same Physics applied.

Life made the difference.

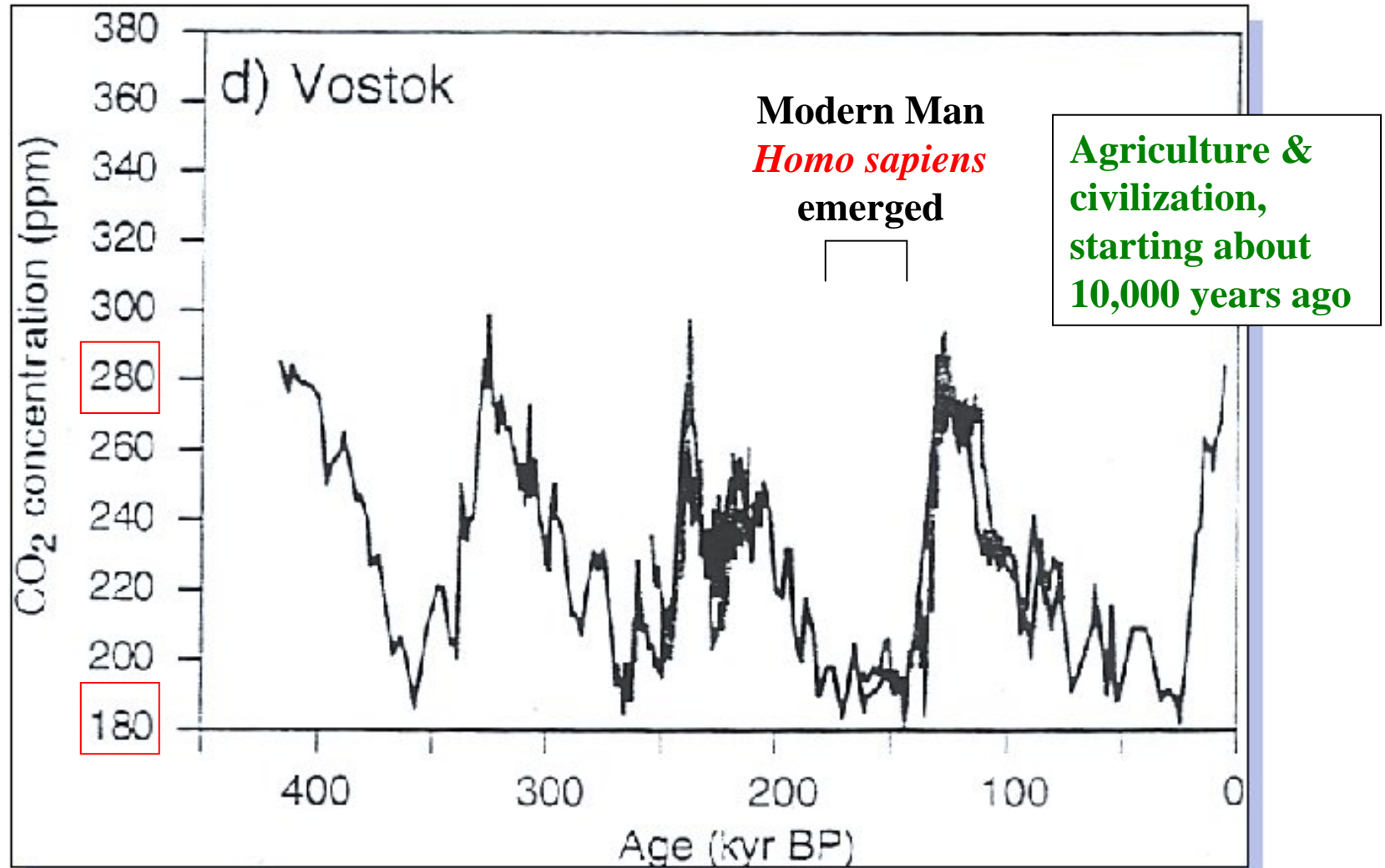
Atmosphere = breath of Life

# Genus *Homo* emerged in low carbon dioxide atmosphere



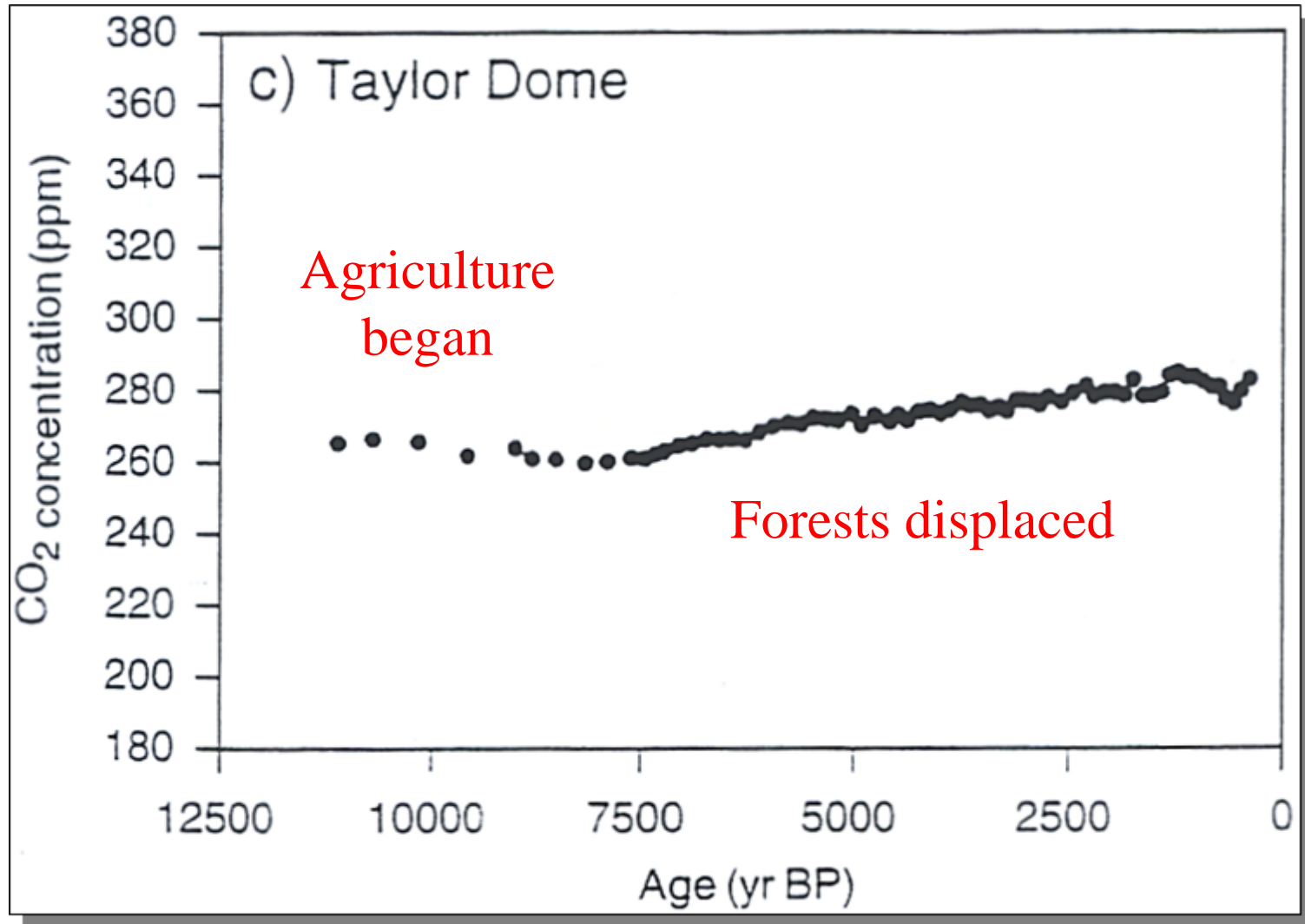
(Background after IPCC 2001)

## Stable oscillations – atmosphere & plants



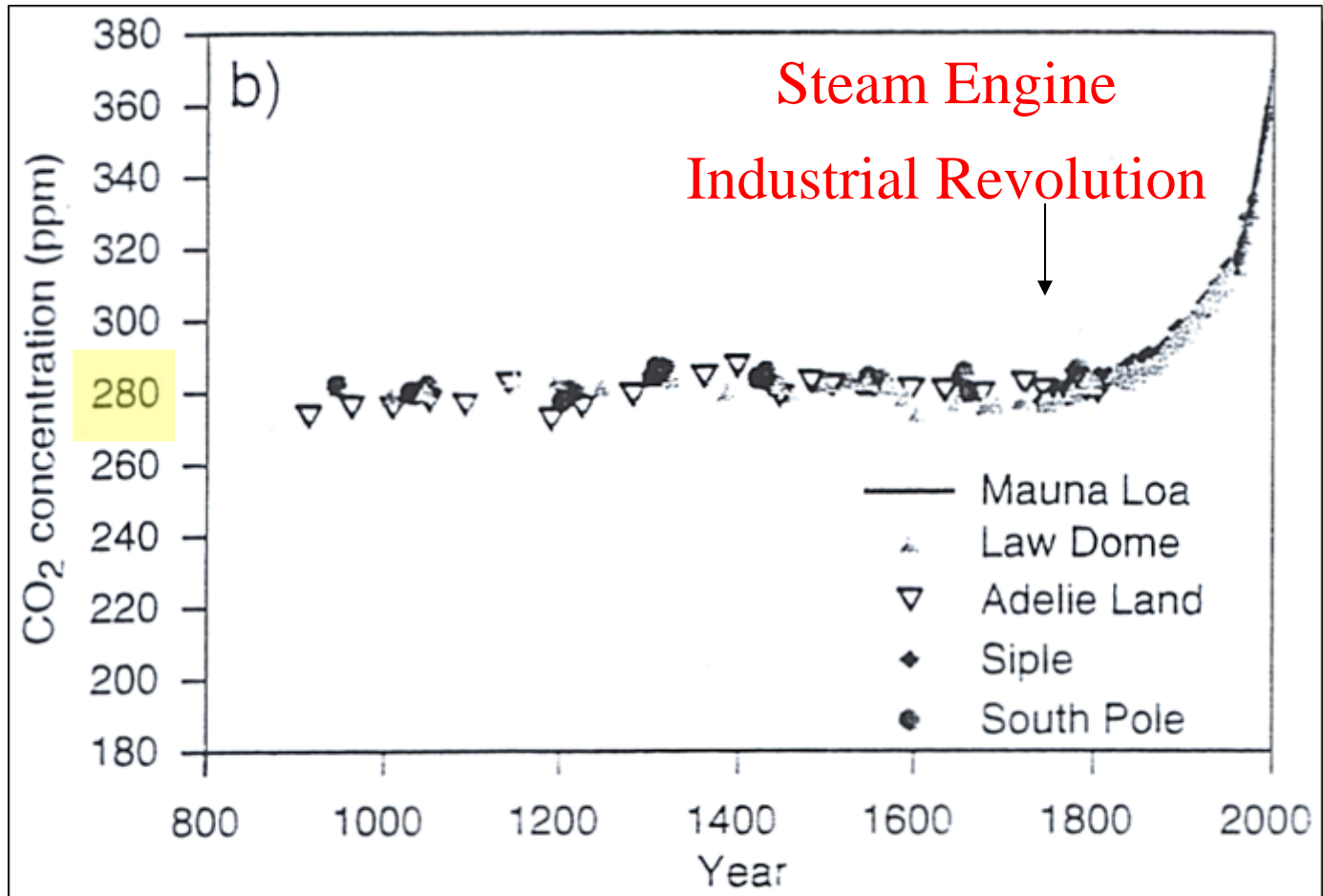
(Background after IPCC 2001)

# Changing land use



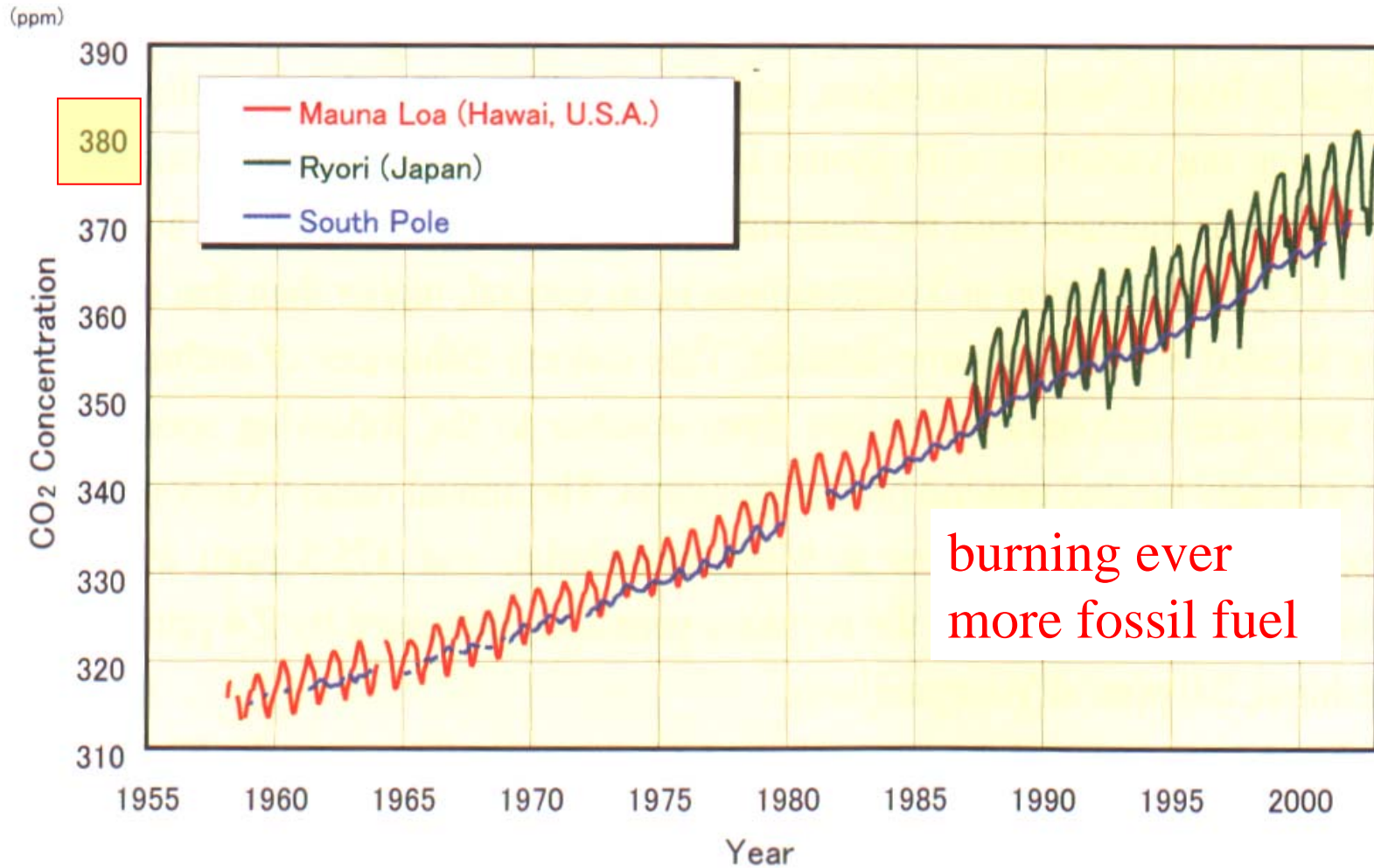
(Background after IPCC 2001)

# Life-style based on fossil fuel burning

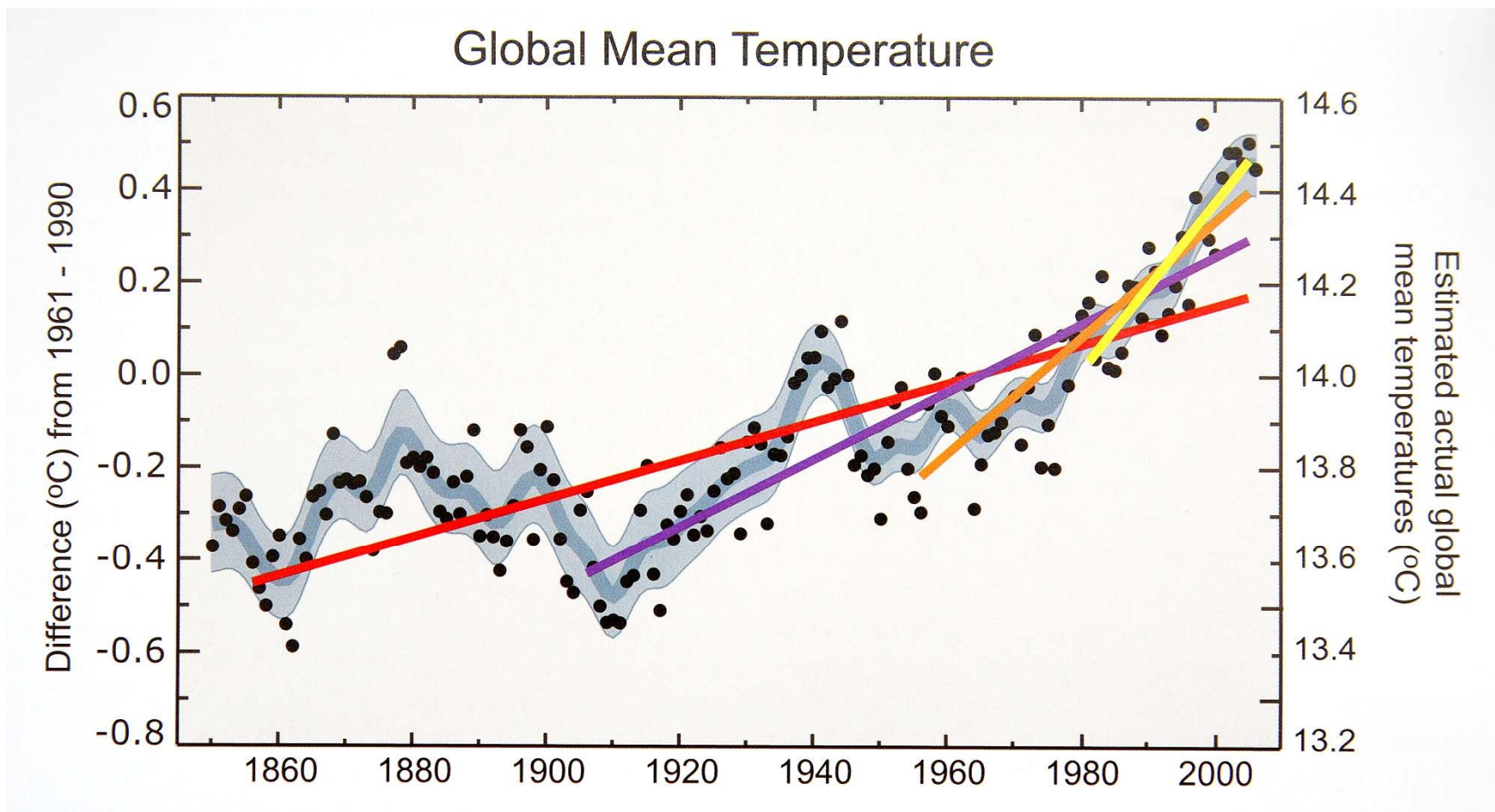


(Background after IPCC 2001)

# Past 50 years – cities, materialism, consumerism

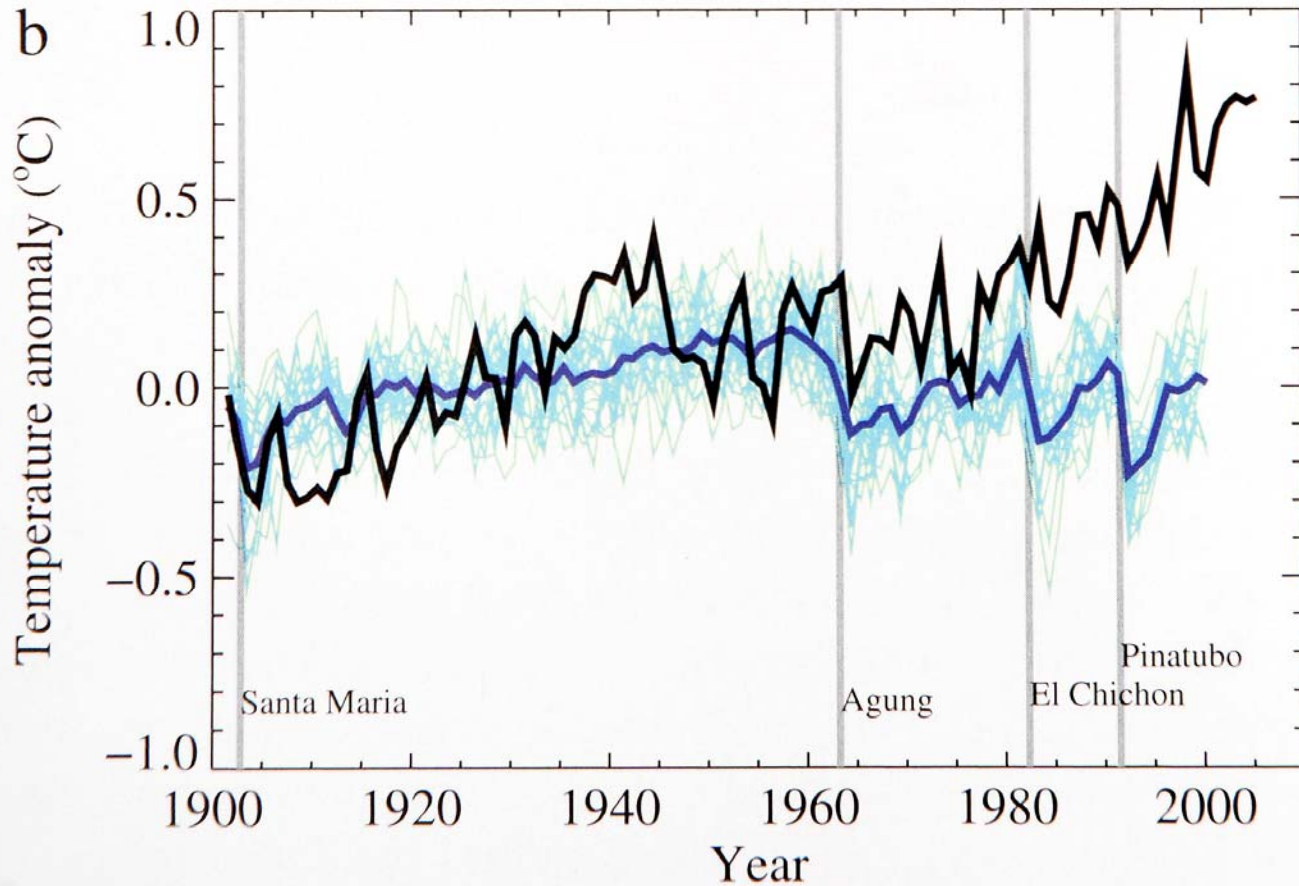


# Last 150 years - accelerating temperature rise





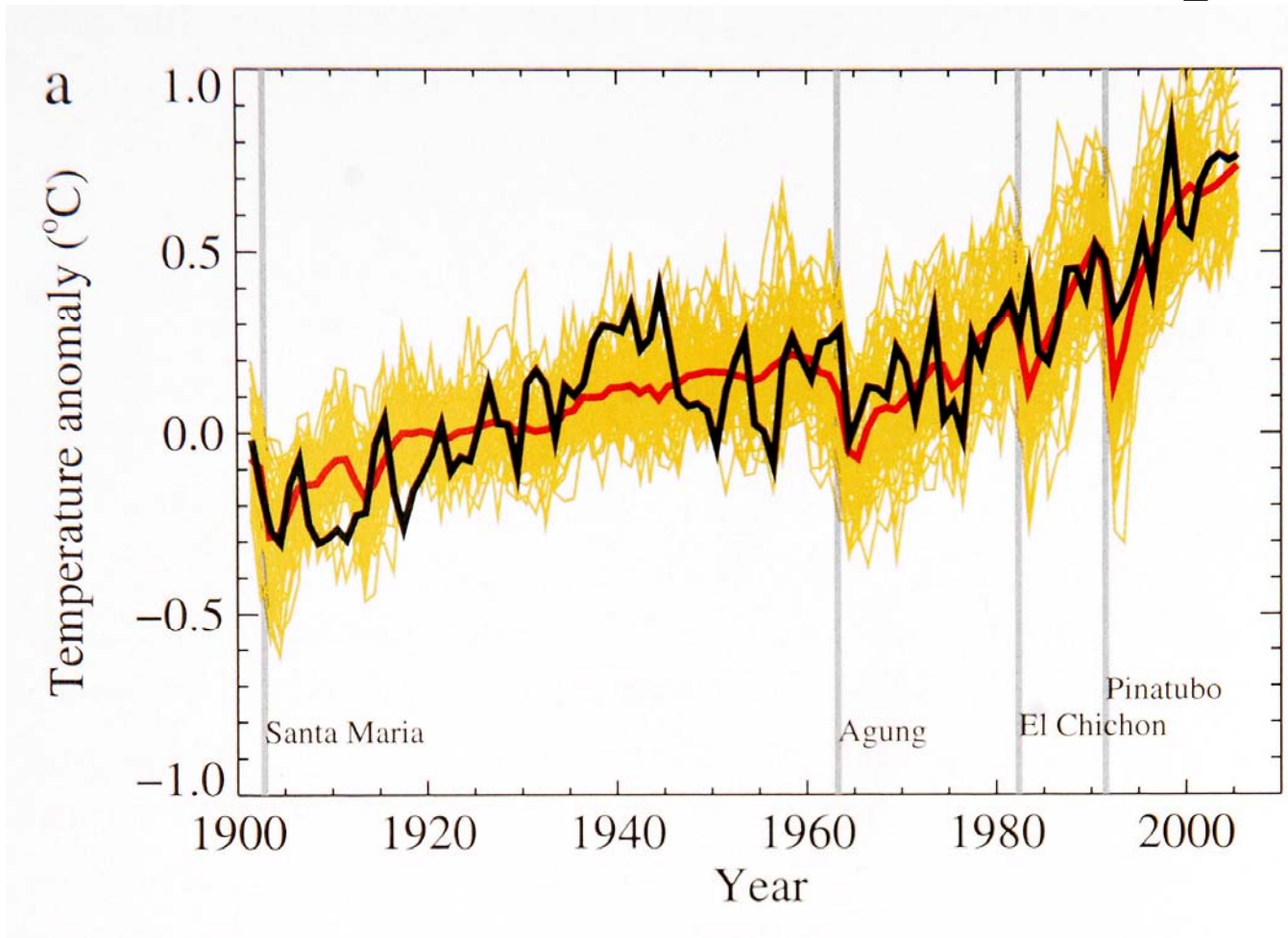
# Simulation without human CO<sub>2</sub>



(IPCC 2007)



# Simulation with human CO<sub>2</sub>

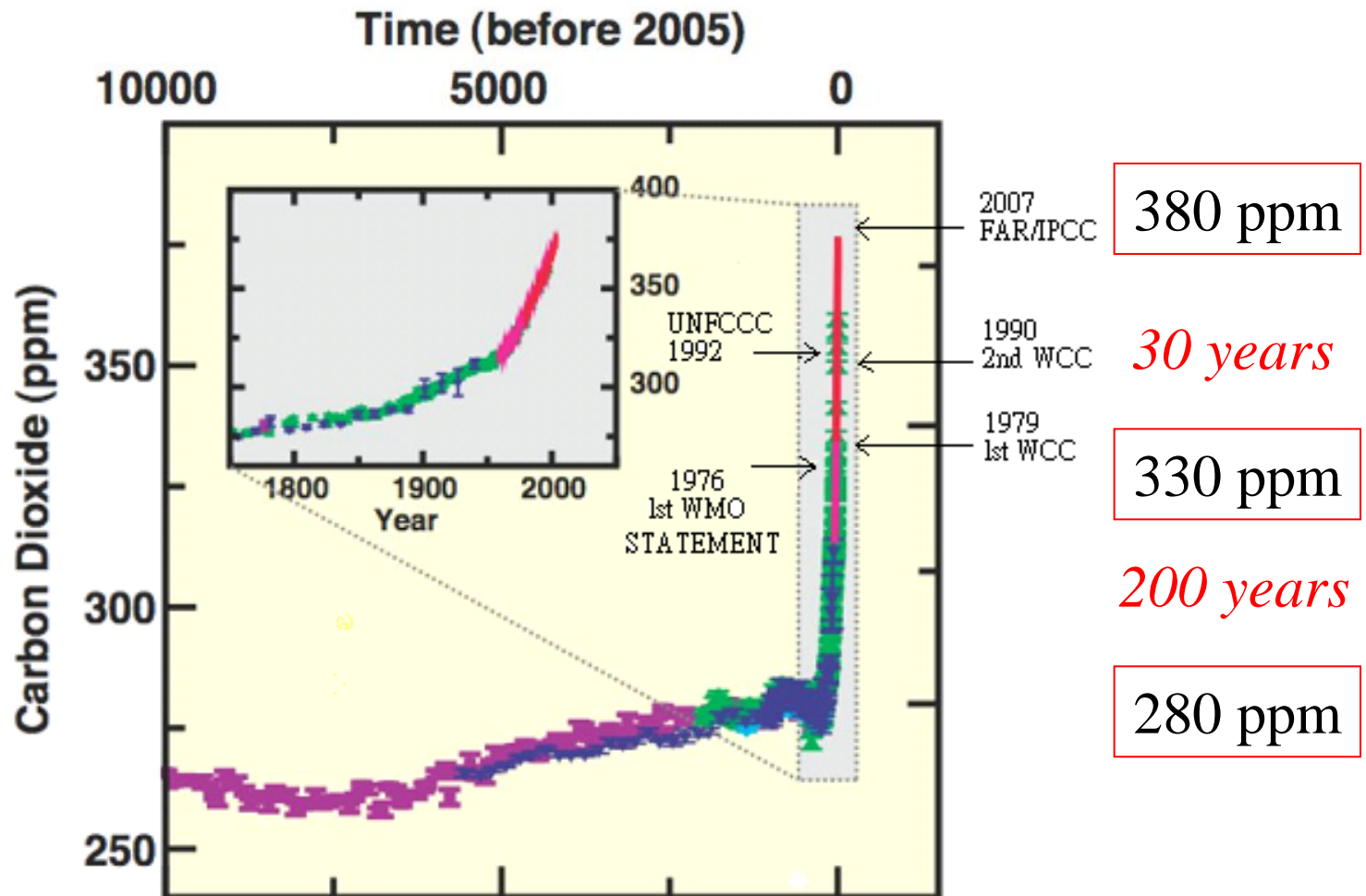


(IPCC 2007)

# Last two centuries

- Physicists + Engineers
  - steam engine, machines, computers, communication means
  - amplifiers of human power
- Others
  - exploiting the means
  - amplifying human impacts on Nature
  - combustion & exhaustion
  - releasing ancient CO<sub>2</sub>

# The last 30 years!



(background figure after IPCC, 2007)

*The atmosphere = gases from "dead bodies"!*

better Physics

X

consumerism

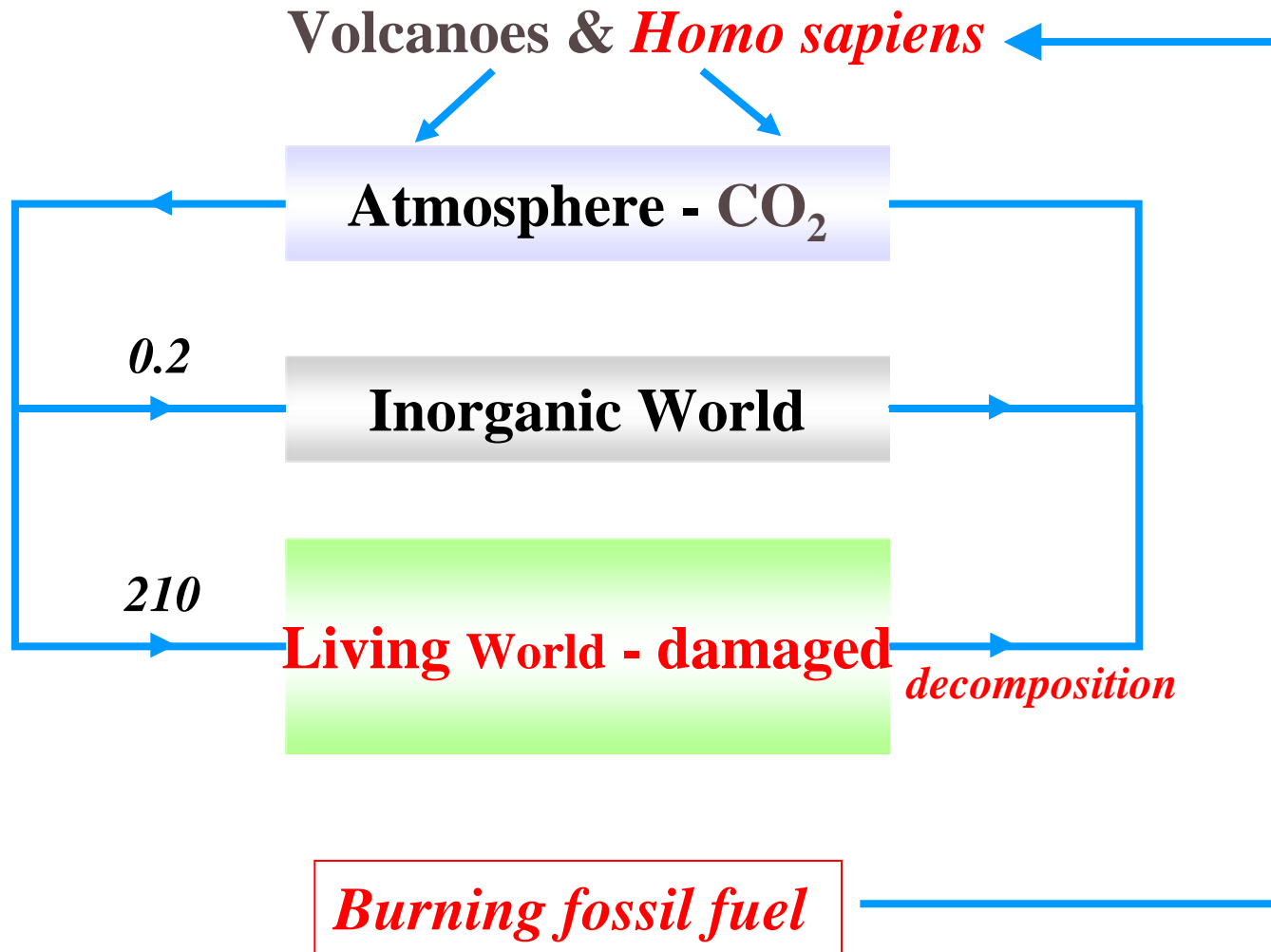


magnified CO<sub>2</sub> emission  
from combustion



foul atmosphere

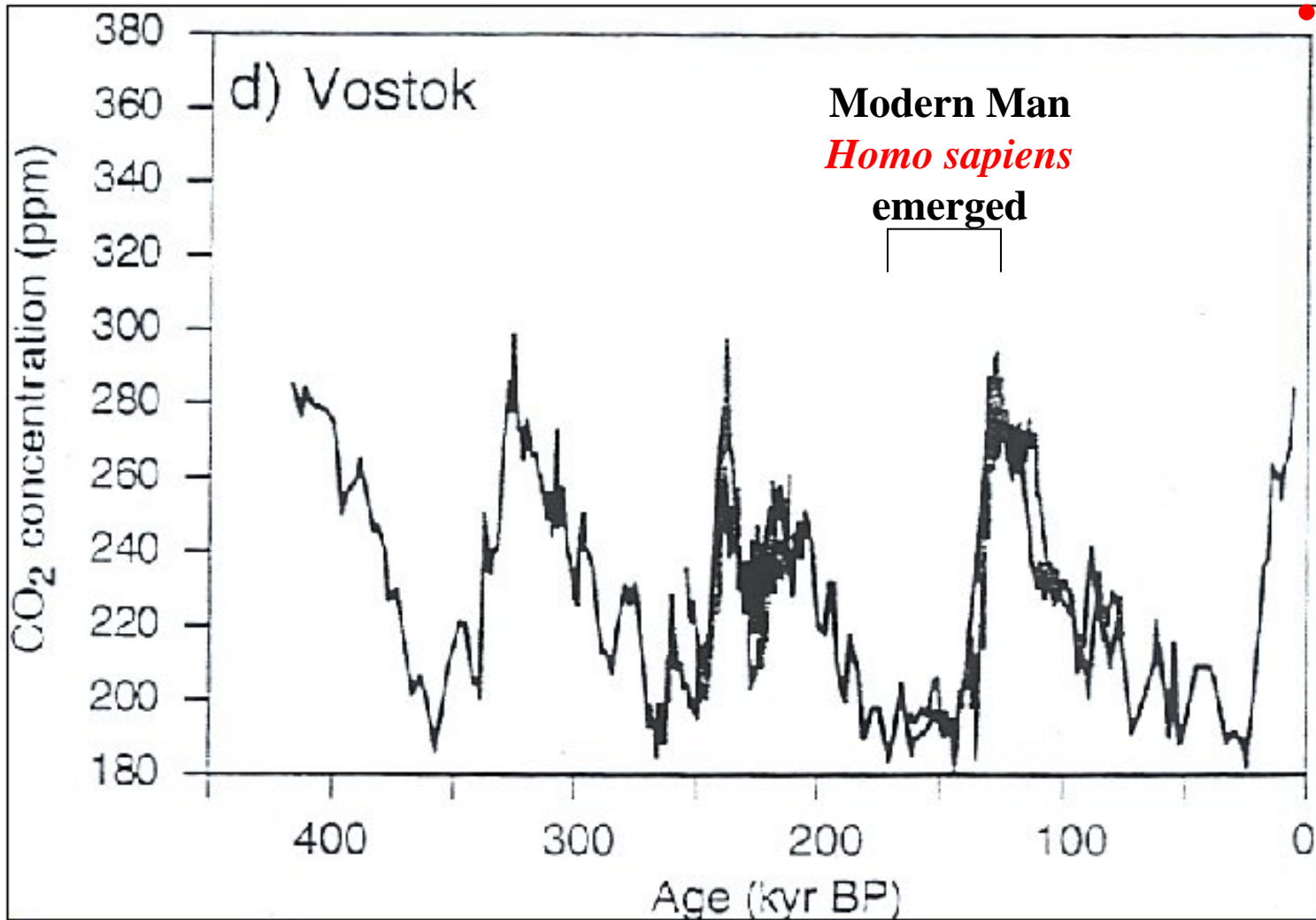
# The **Impaired** Grand Air-conditioner



# Last two centuries

- Same Physics as before, but great differences in the atmosphere occurred - moving towards hazardous climate change.
- Life at work, this time by one species “out of control”, aided by physicists.

# UnStable oscillations?



We are  
here now

*Homo sapiens* especially “civilization”

- has returned ancient carbon dioxide into the atmosphere
- has moved itself into an atmospheric state the species has never seen before
- has disrupted the ozone layer
- has cut the Earth’s self-repair ability



*Homo sapiens* may be  
disabling its own perpetuation  
by changing the atmosphere.

# Climate Change

- Not just a matter of physics, or of the physical world
- But also involves the living world, from bacteria to *Homo sapiens*

Who disrupted the breath of  
the Earth?

US

Can we be the solution?

Perhaps.

Time to wonder.

!

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