

Human Activities and early Climate Change

Future Climate Change



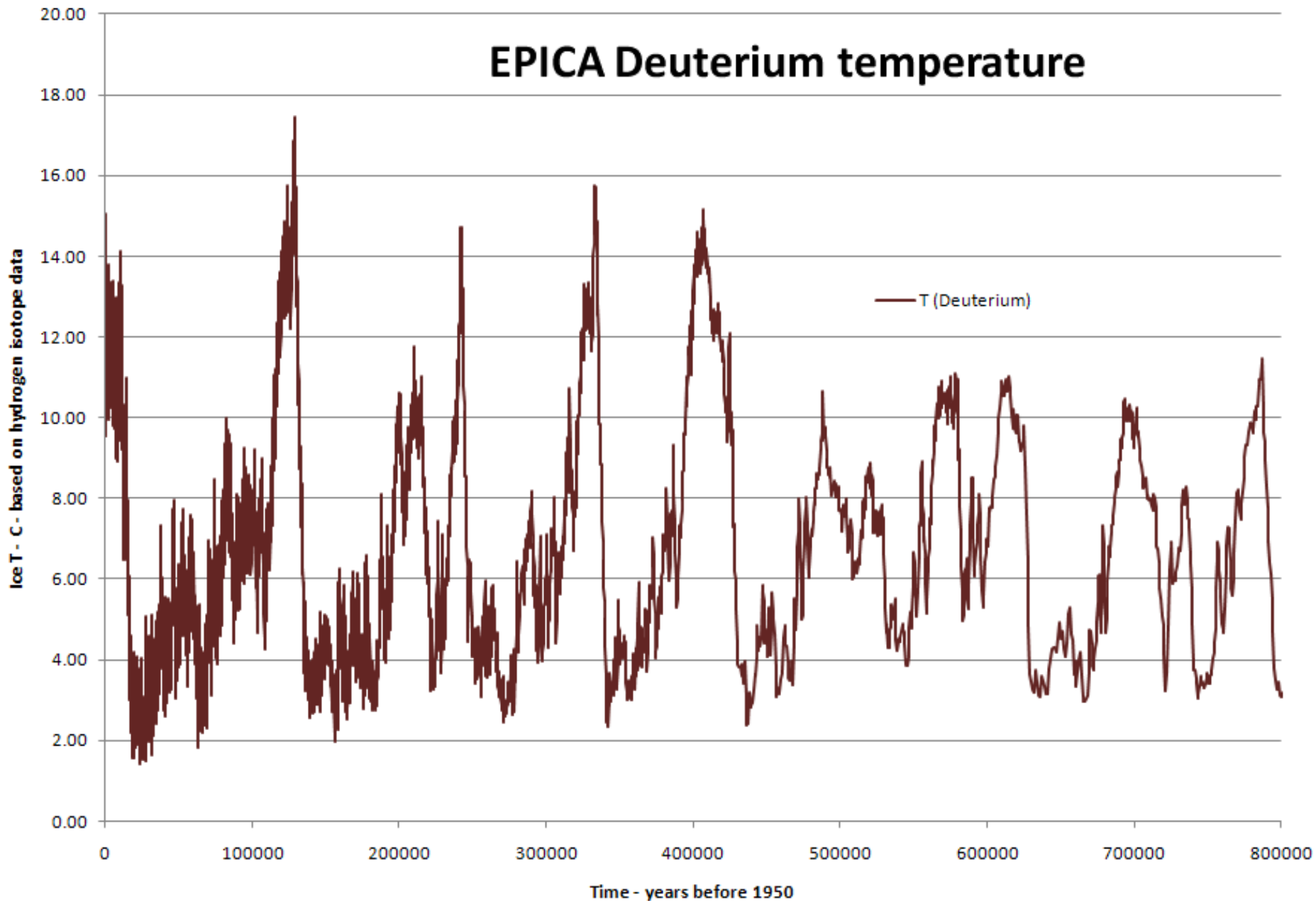
*HOW DID HUMANS
FIRST ALTER*

*GLOBAL
CLIMATE?*

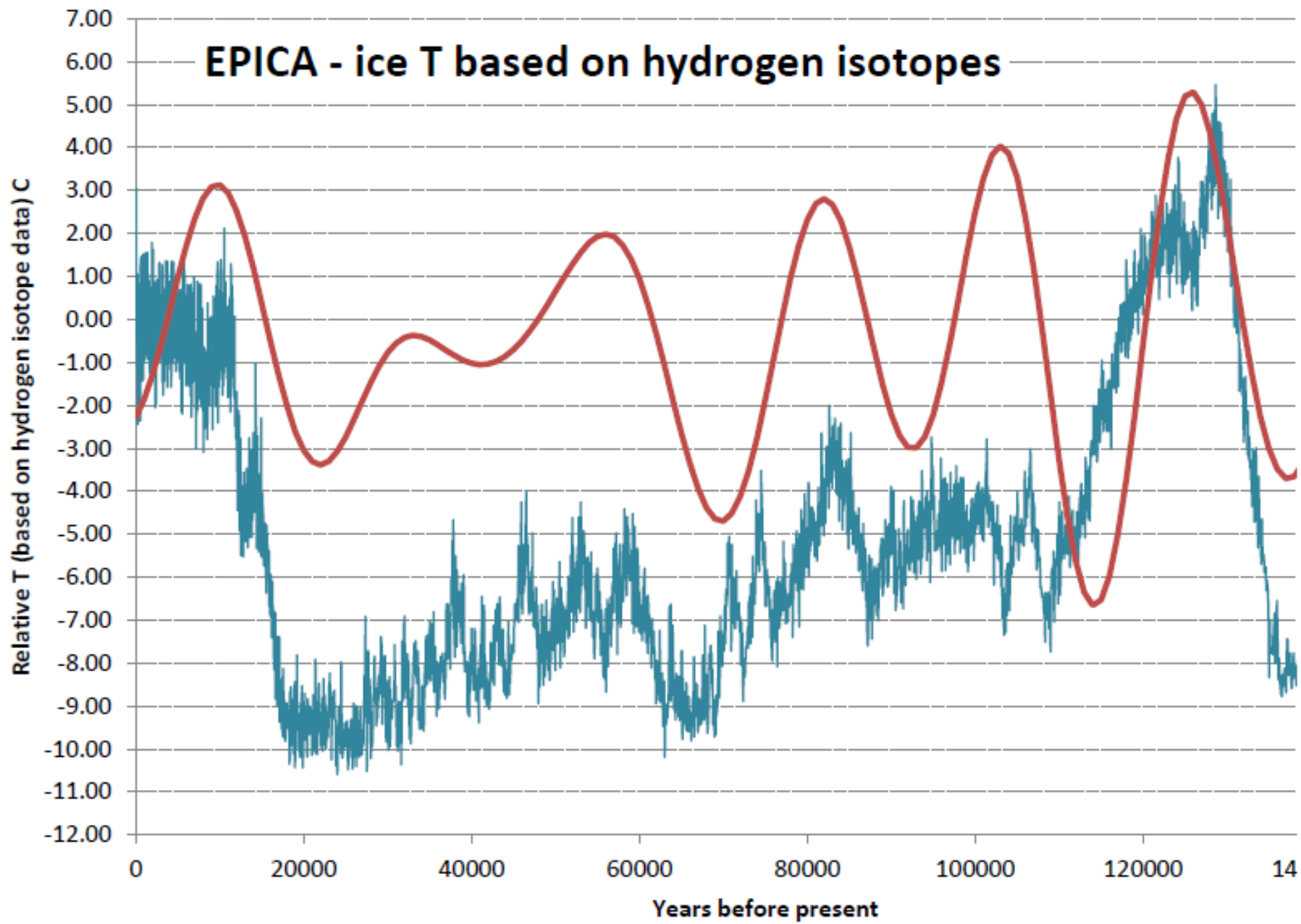
A bold new hypothesis suggests that our ancestors' farming practices kicked off global warming thousands of years before we started burning coal and driving cars

By William F. Ruddiman

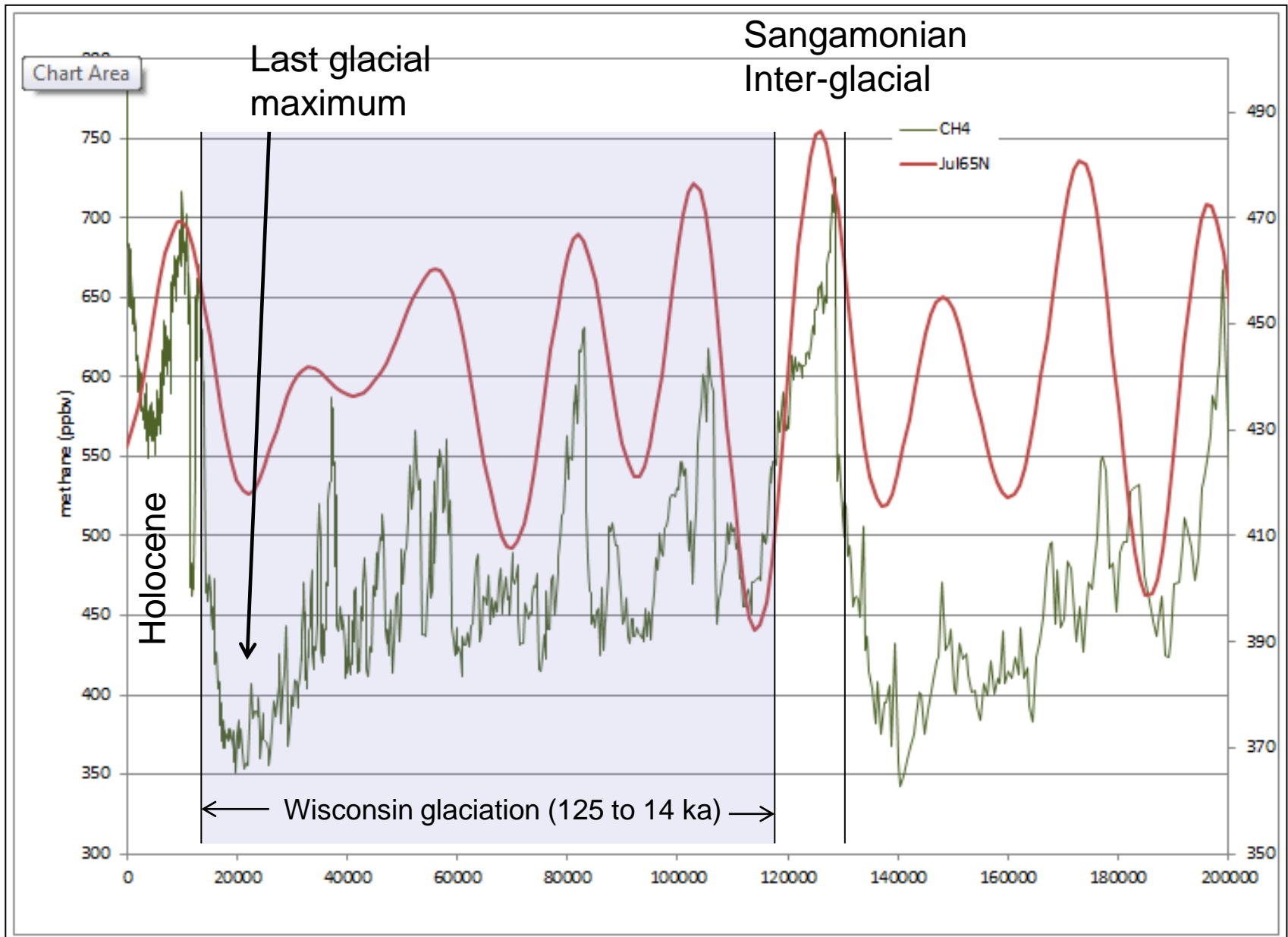
EPICA Deuterium temperature



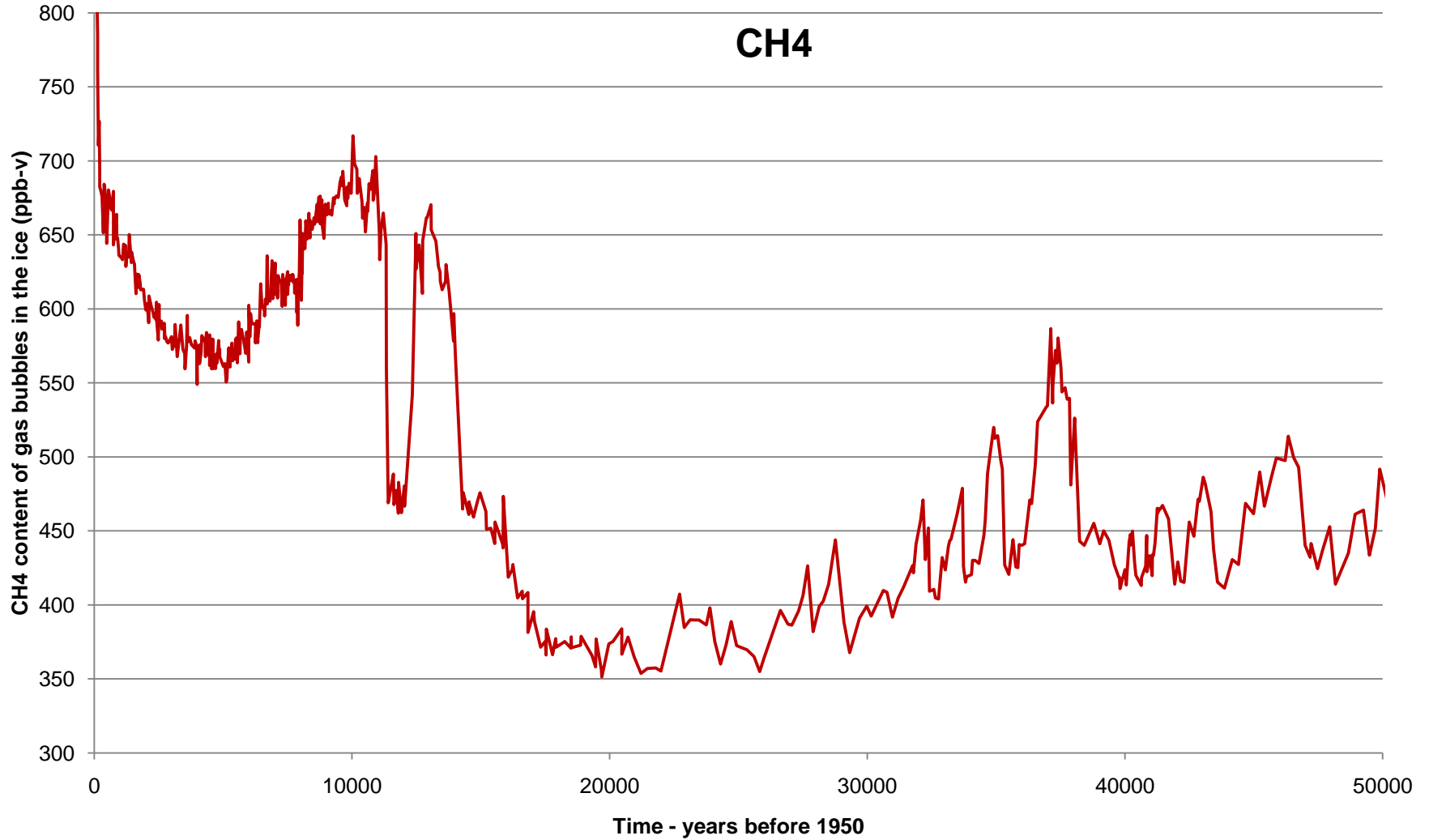
EPICA - ice T based on hydrogen isotopes



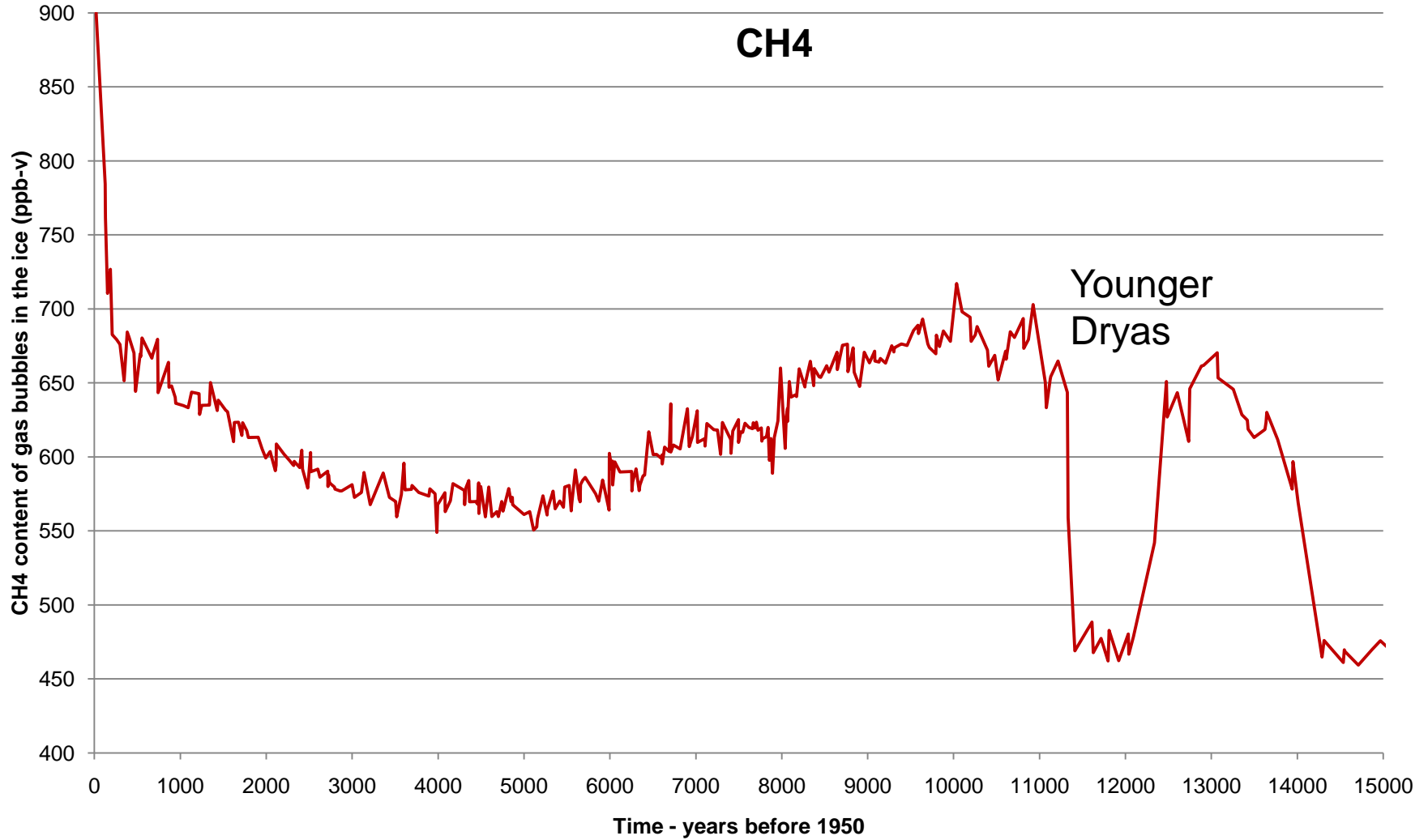
EPICA Dome C methane & July Insolation at 65 N



EPICA CH₄



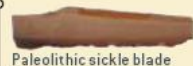
EPICA CH₄





Human Activities and Greenhouse Gases

11,000 years ago: Early peoples invent agriculture in Mesopotamia and China



Paleolithic sickle blade



Carbonized wheat

8,000 years ago: Late Stone Age Europeans begin clearing forests to grow wheat, barley, peas and other nonindigenous crop plants



5,000 years ago: Farmers in the south of China begin flooding lowlands near rivers to grow rice



2,000 years ago: Europe, India, Southeast Asia and China have cleared much of their natural forest cover to grow crops such as wheat

200 years ago: Combustion of fossil fuels and accelerating deforestation result in unprecedented releases of greenhouse gases



Otto engine

10,000 YEARS AGO

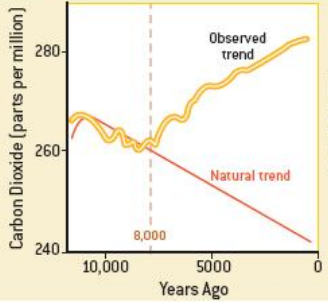
8,000 YEARS AGO

6,000 YEARS AGO

4,000 YEARS AGO

2,000 YEARS AGO

PRESENT

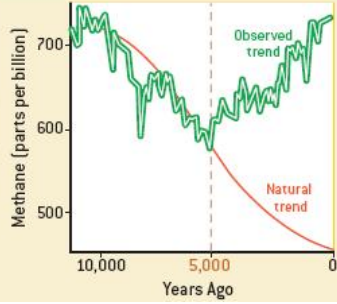


8,000 years ago: CO₂ trend, which has been falling for 2,500 years, bottoms out and suddenly reverses direction

7,500 years ago: Humans adapt wild rice for cultivation



5,000 years ago: Methane trend, which has been falling for 6,000 years, suddenly reverses direction

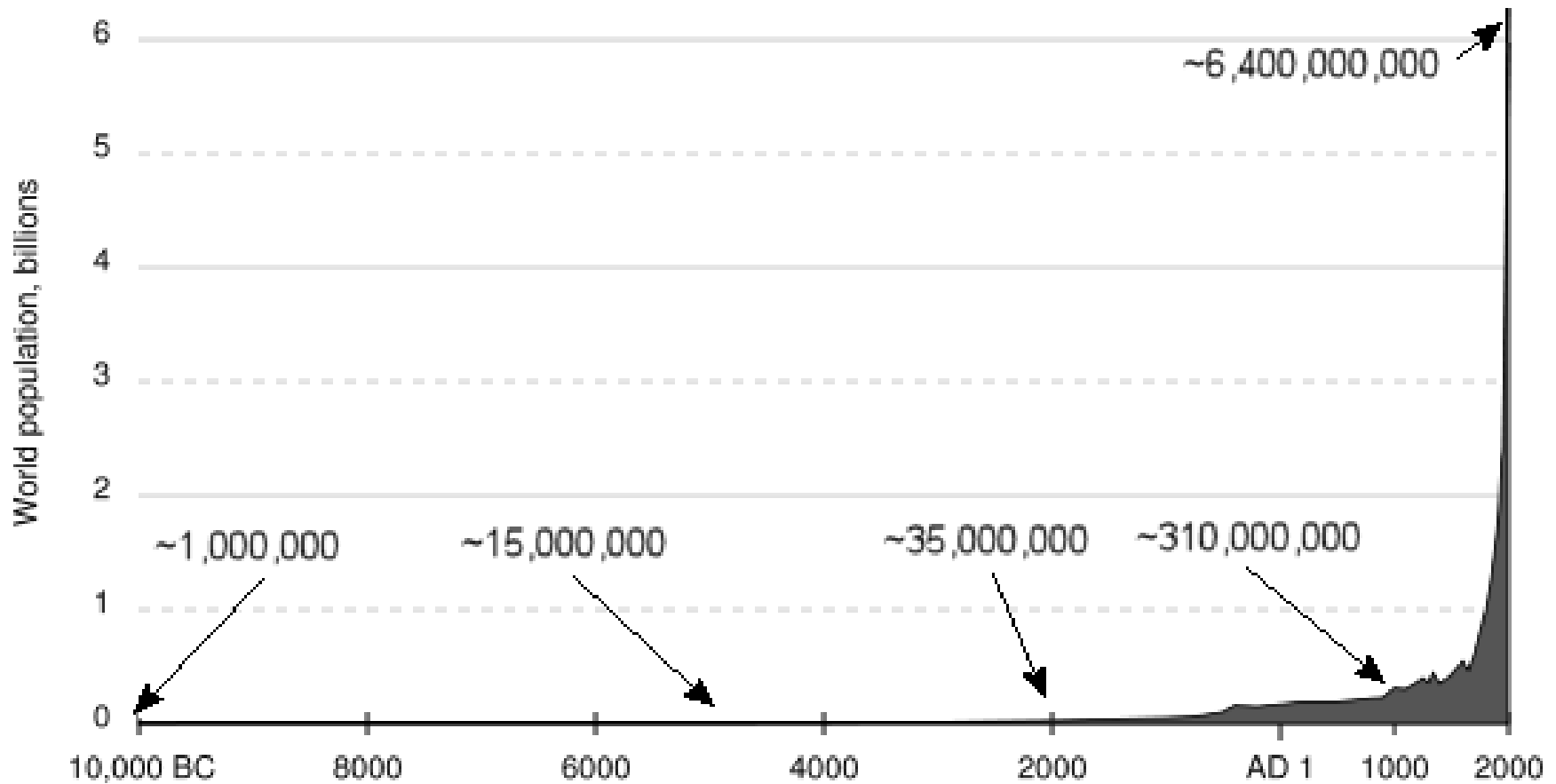


2,000 years ago: Farmers in Southeast Asia begin to construct terraced rice paddies on steep hillsides



Global population – 10 ka

~7,070,200,000 by Oct. 3rd, 2012*



*United Nations, Department of Economic and Social Affairs

Human Activities and Greenhouse Gases

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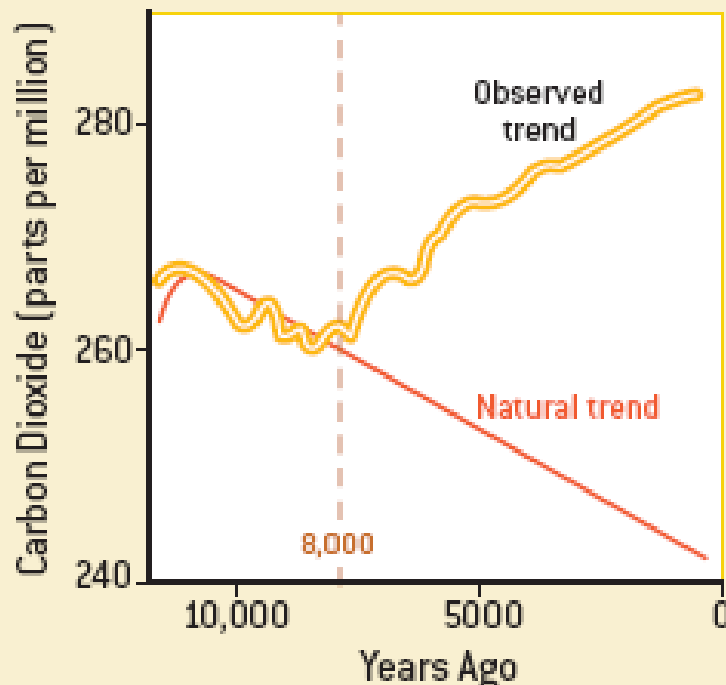


Carbonized wheat

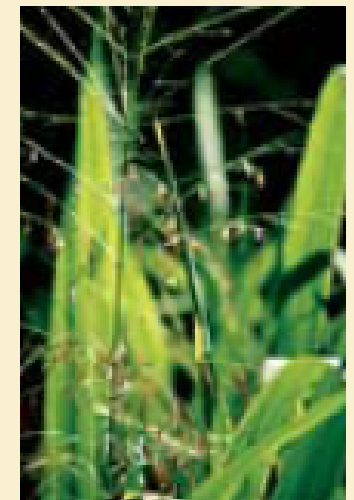
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10,000 YEARS AGO

8,000 YEARS AGO



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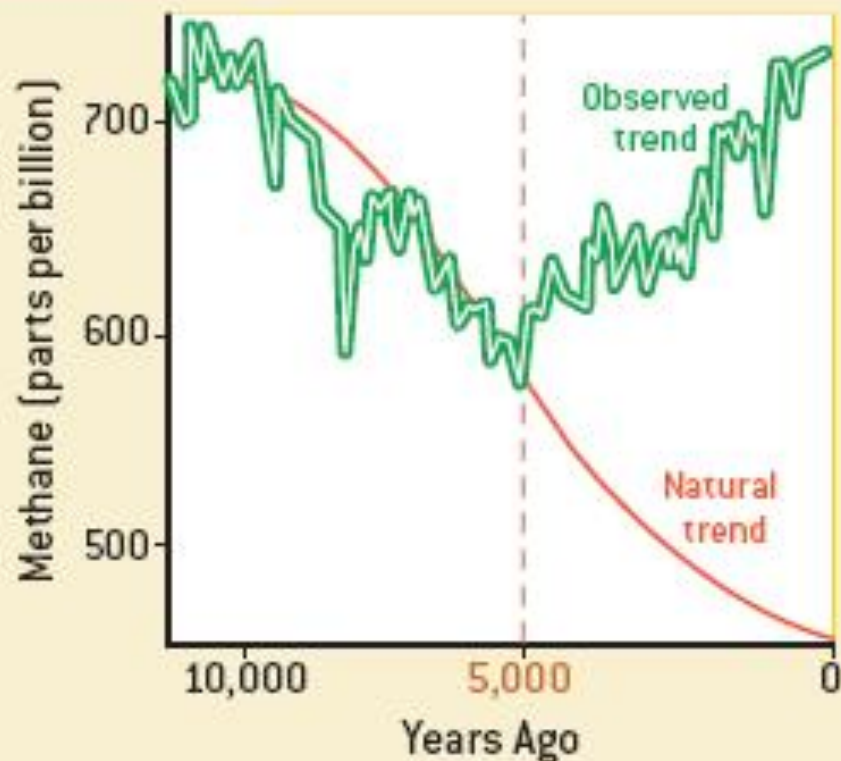


5,000 years ago:
Farmers in the south
of China begin flooding
lowlands near rivers
to grow rice

6,000 YEARS AGO

4,000 YEARS AGO

5,000 years ago:
Methane trend, which
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Otto engine

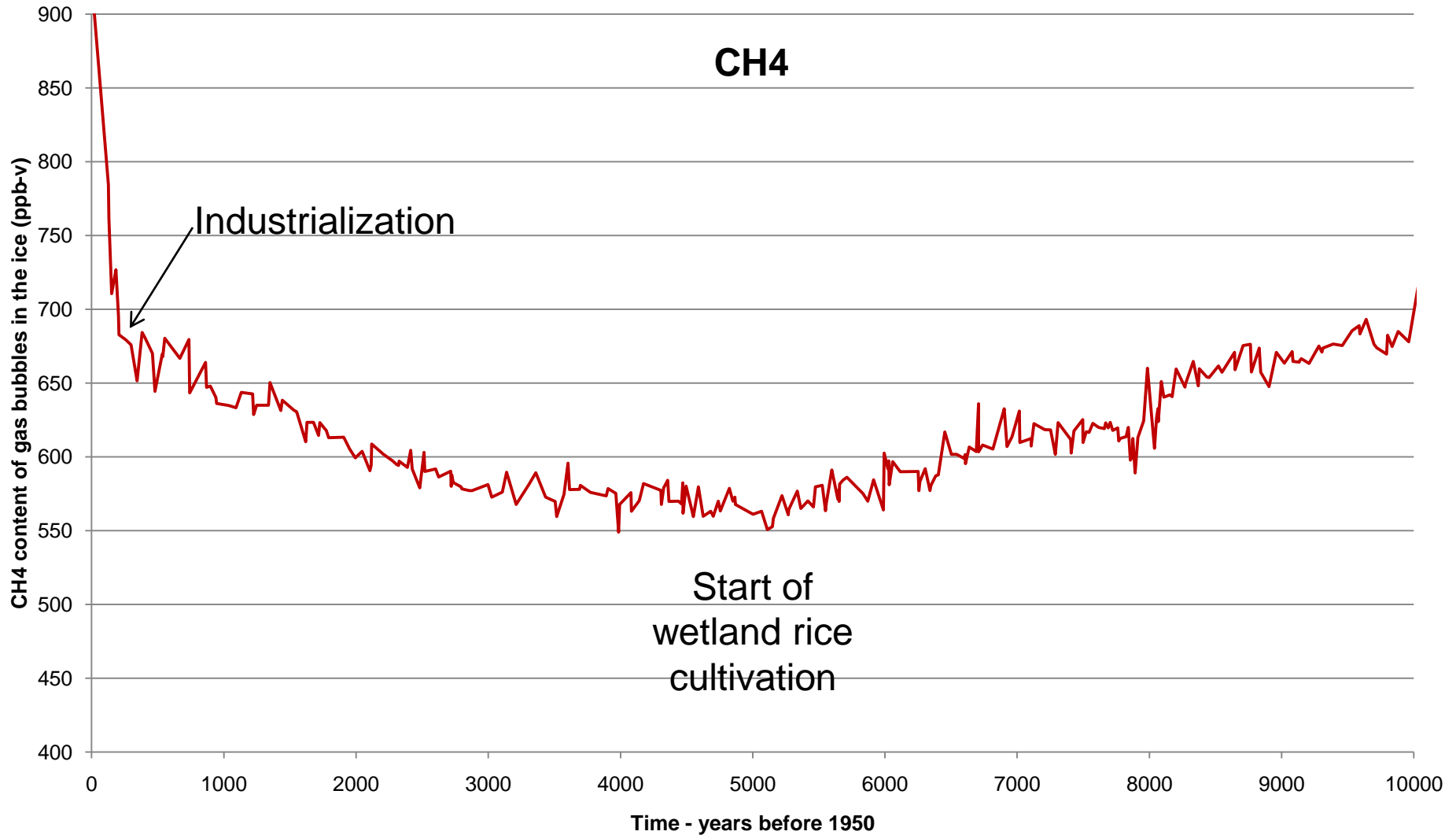
2,000 YEARS AGO

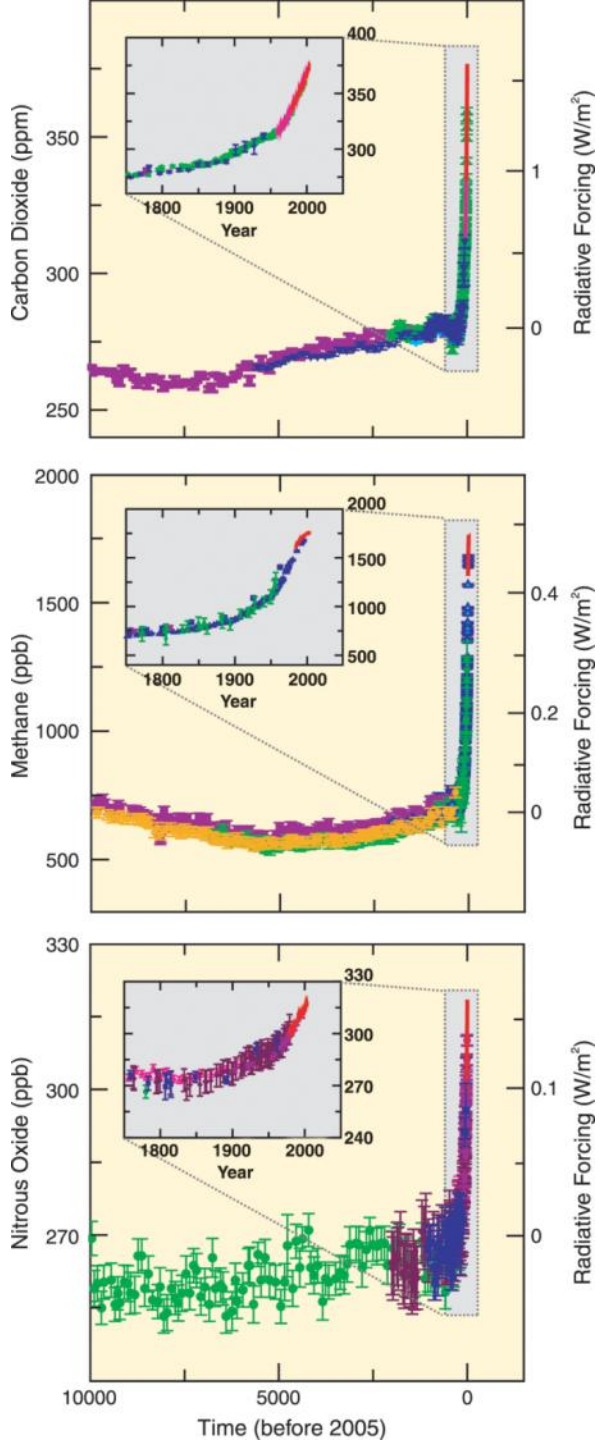
PRESENT

2,000 years ago:
Farmers in Southeast Asia begin to construct terraced rice paddies on steep hillsides

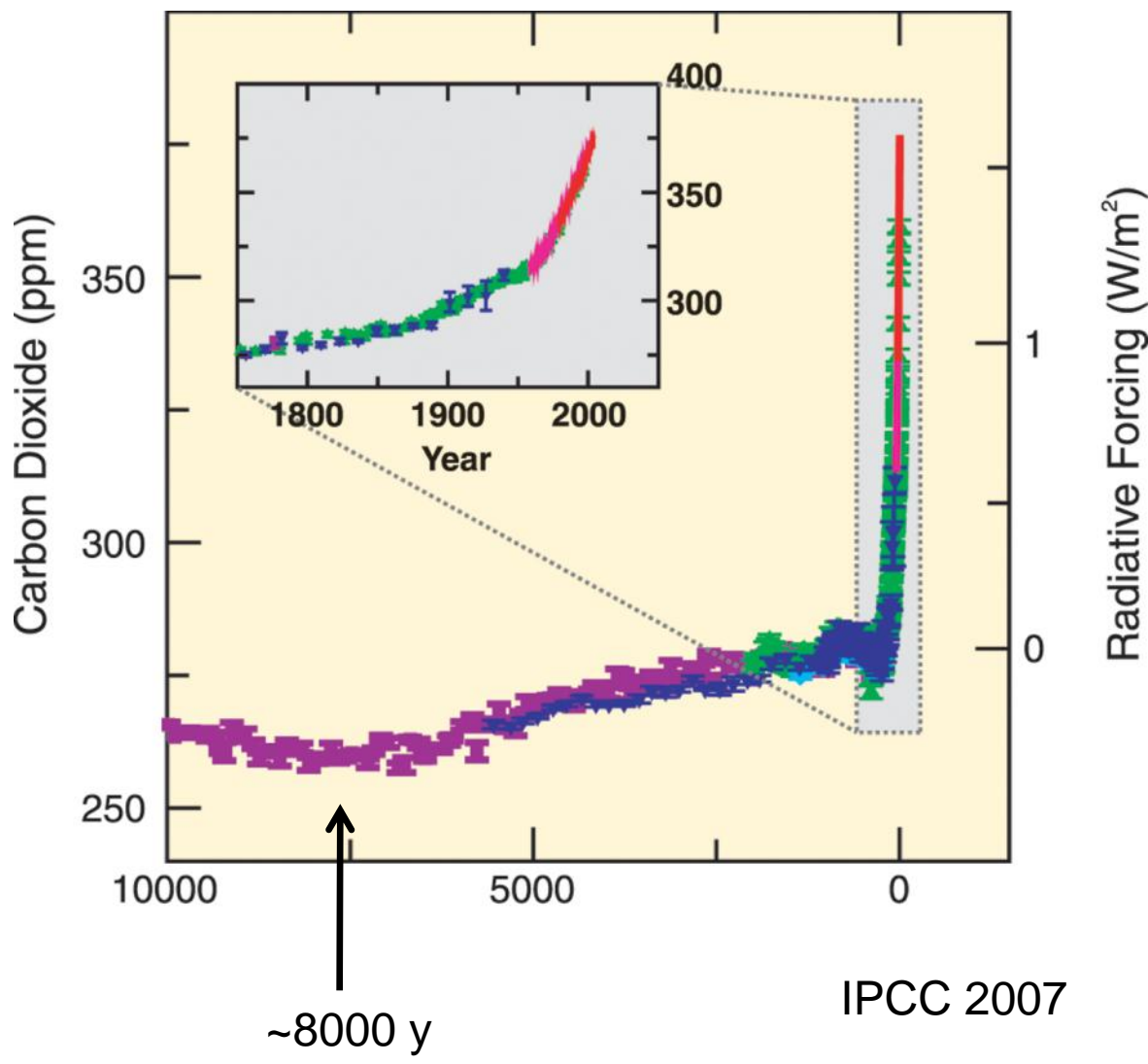


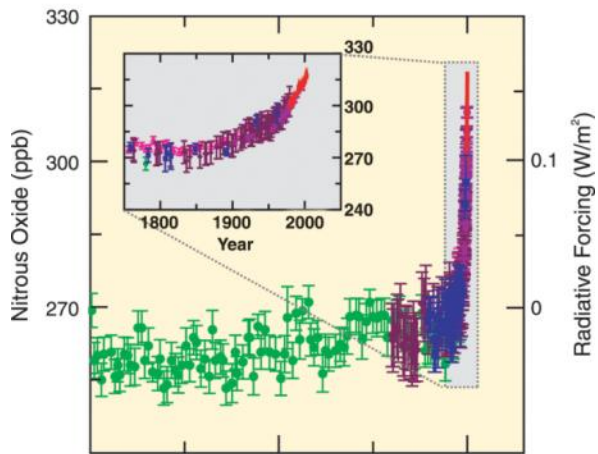
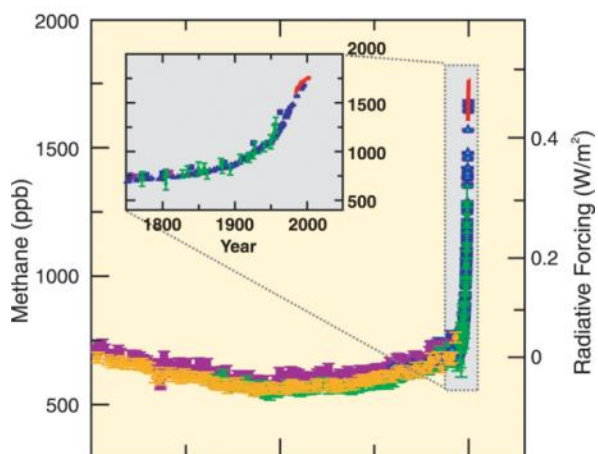
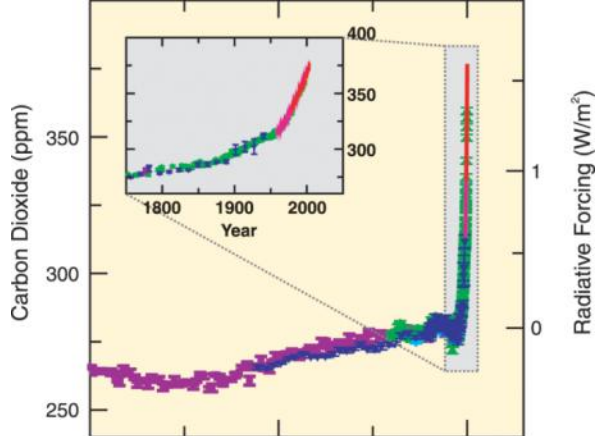
EPICA CH₄



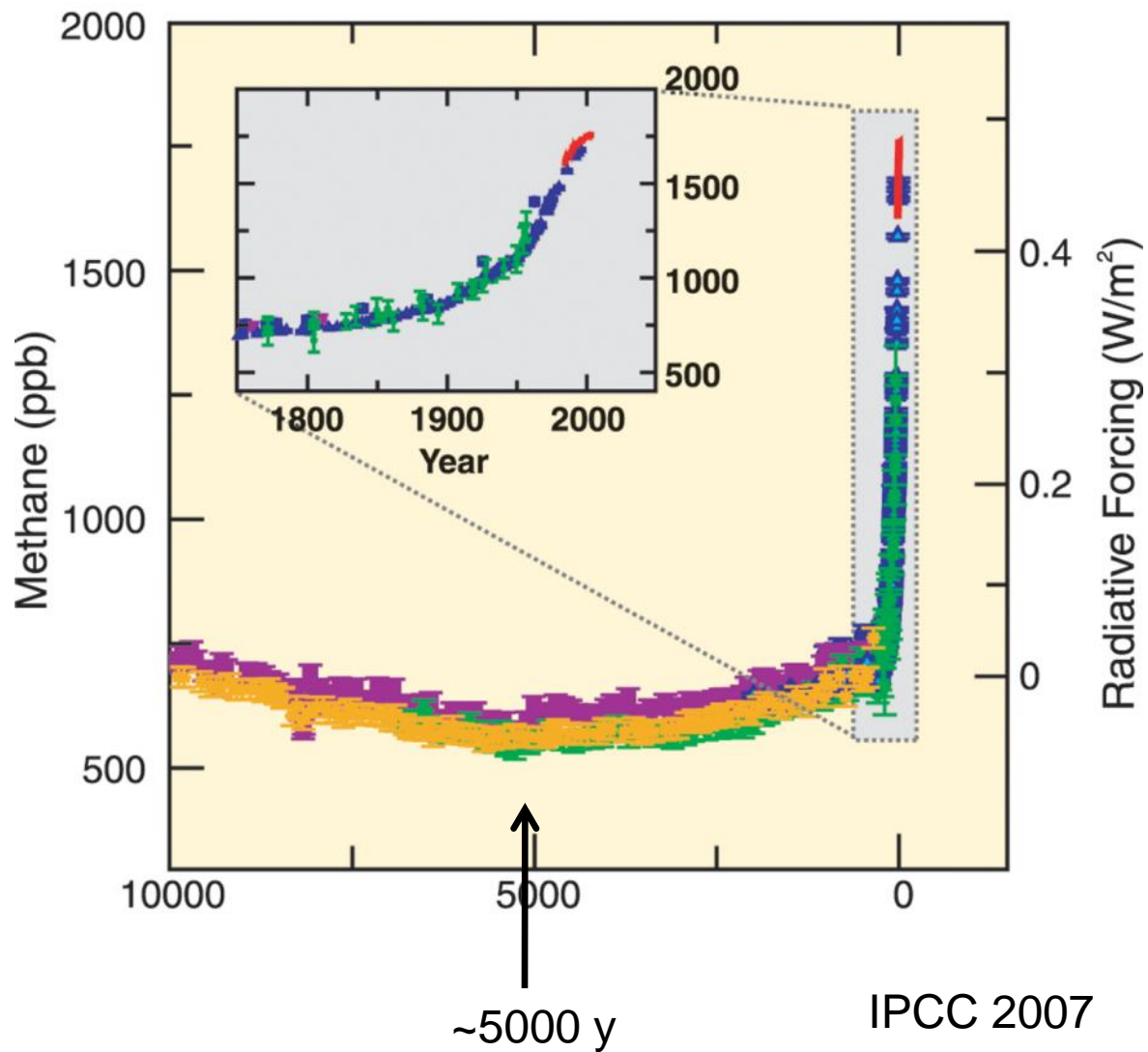


CO₂

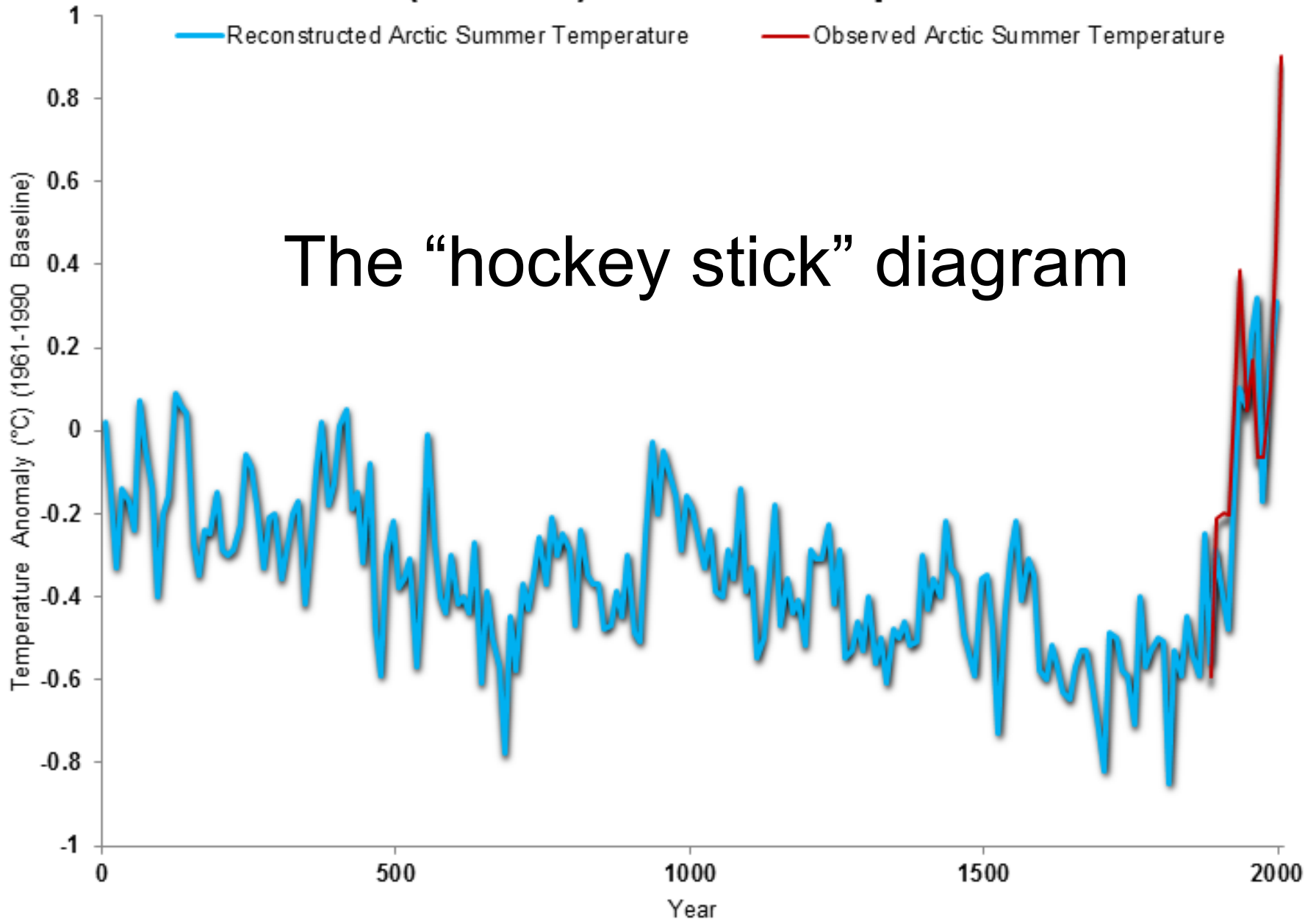




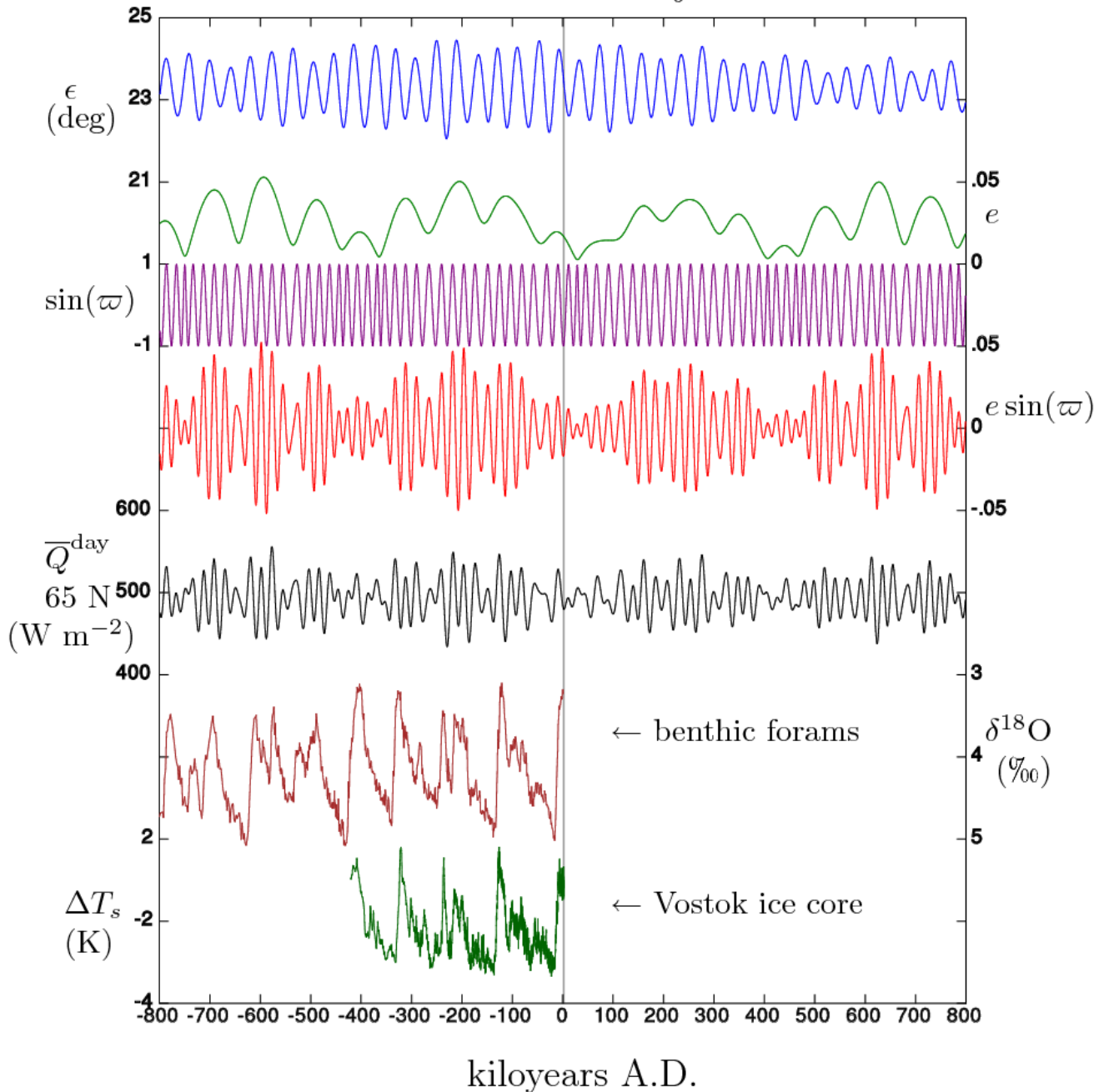
CH₄



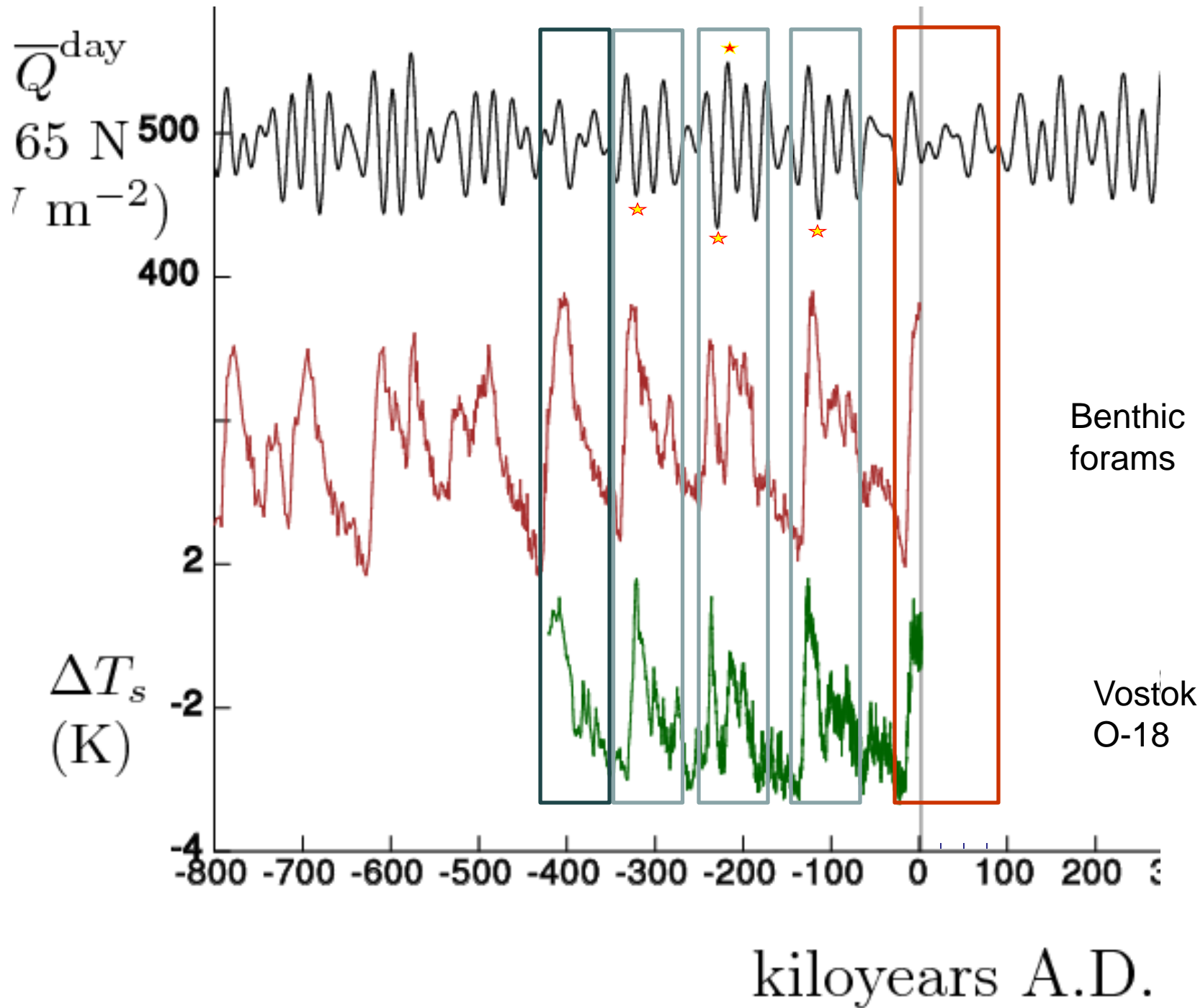
Arctic (60-90°N) Summer Temperature



Milankovitch Cycles



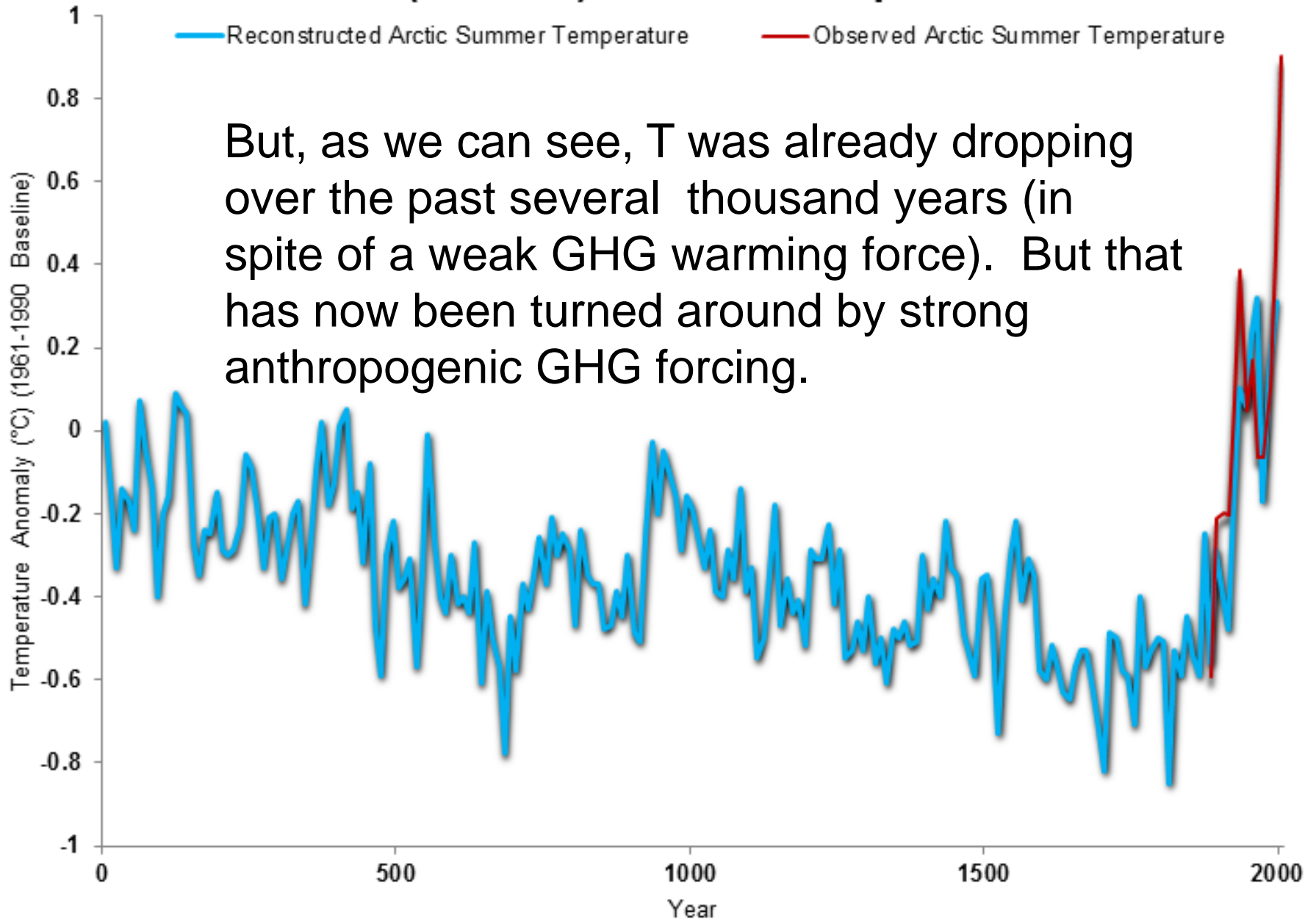
What about
the future?
Are we
heading
into
another
glaciation?



When will the next ice age take hold?

- Imbrie and Imbrie (1980): within the next 23 ka
- Berger and Loutre (2002): not for another 50 ka
- Tzedakis et al. (2012): within 1500 years, but only if atmospheric CO₂ is below 240 ppm

Arctic (60-90°N) Summer Temperature



But, as we can see, T was already dropping over the past several thousand years (in spite of a weak GHG warming force). But that has now been turned around by strong anthropogenic GHG forcing.