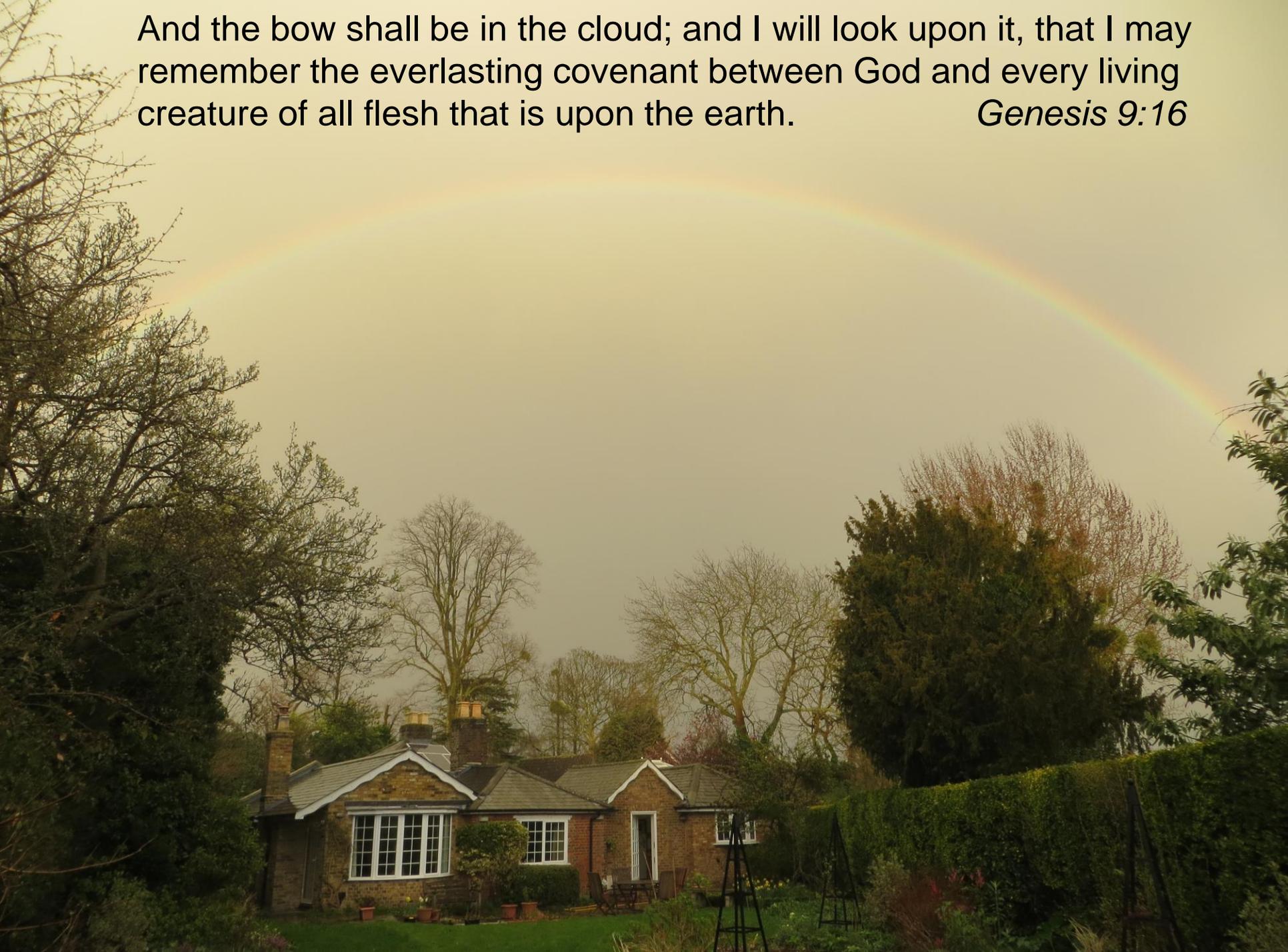


"Our Fragile Planet - a Christian Perspective"
Are we breaking the rainbow?

Euan Nisbet, Royal Holloway and NERC Project MOYA

1. The Rainbow
2. Breaking the rainbow 1 – the greenhouse
3. Breaking the rainbow 2 - pollution
4. Rainbow covenant – Noah
5. How did we get here?
6. Pessimism and Optimism

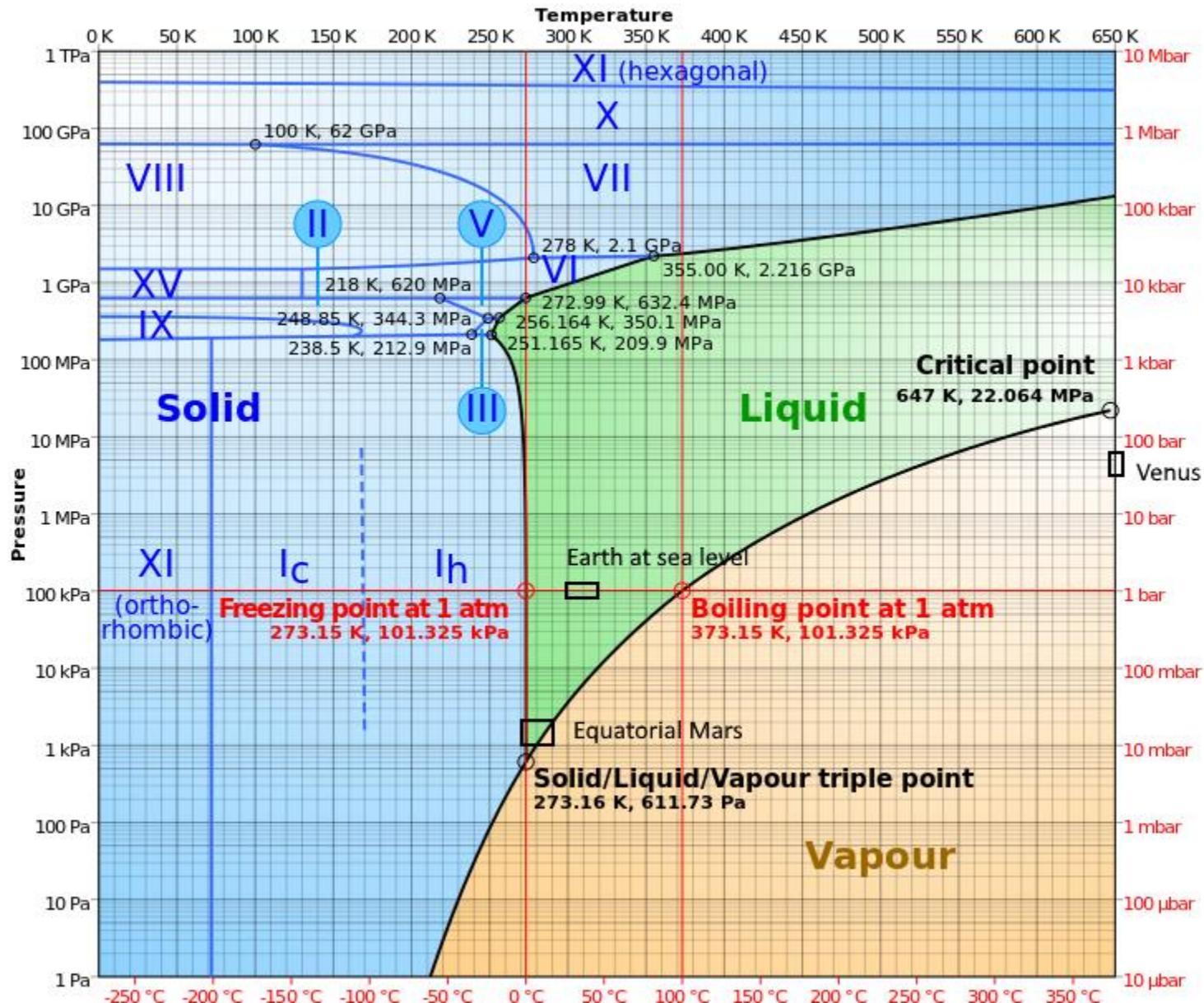
And the bow shall be in the cloud; and I will look upon it, that I may remember the everlasting covenant between God and every living creature of all flesh that is upon the earth. *Genesis 9:16*



But there went up a mist from the earth, and watered the whole face of the ground.
Genesis 2:6

The Oasis in Space

Liquid Water exists on Earth's surface, and has done since the beginning, even as the Sun has warmed



12 Who hath measured the waters in the hollow of his hand, and meted out heaven with the span, and comprehended the dust of the earth in a measure, and weighed the mountains in scales, and the hills in a balance? *Isaiah 40:12*



Sunlight – the visible spectrum (which does not damage DNA)
Water vapour, capable of making drops or ice crystals
(surface temperature around 15C, allowing oceans, vapour and ice)

Sundogs: Fargo. public domain



Let us make man in our image, after our likeness: and let them have dominion
Be fruitful, and multiply, and replenish the earth

Genesis 1:26,28



in the day ye eat thereof, then your eyes shall be opened, and ye shall
be as gods, knowing good and evil.

Genesis 3:5

The Anti-helic point

Science

Aratus - *Phænomena* (circa 250 BC)

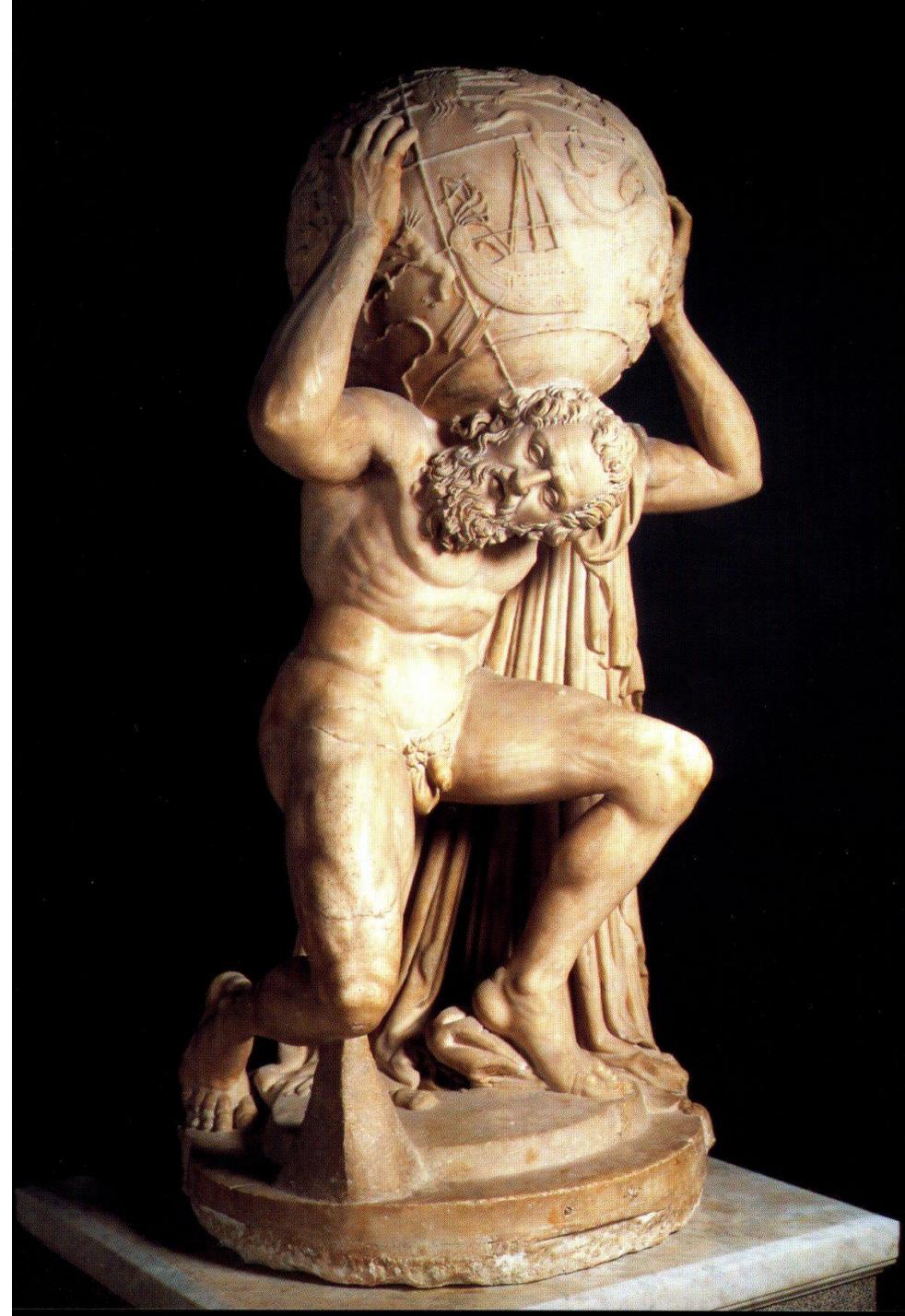
Greek science text of the Natural World,

Based on meticulous observation – the fundamental principle of western Science.

Phænomena is the Greek scientific work directly quoted in the Bible, in Paul's speech to the Council of the Areopagos. (Acts 17:28).

(Naples Museum) 2nd Century AD

The Aratean globe of the universe



“For we are also his offspring” Aratus: *Phænomena*; Acts 17:28

Paul is speaking to the court of the Areopagos, where, in Aeschylus (*Eumenides*), Apollo denies the resurrection, only to be overruled by the casting vote of Athena, where Sophocles (*Oedipus at Colonus*) places the mystery of the afterlife of Oedipus, and where Socrates was condemned.

*“They fashioned a tomb for thee, O holy and high One,
The Cretans, always liars, evil beasts, idle bellies!
But Thou art not dead; for ever Thou art risen and alive,
For in Thee we live and move and have our being.”*

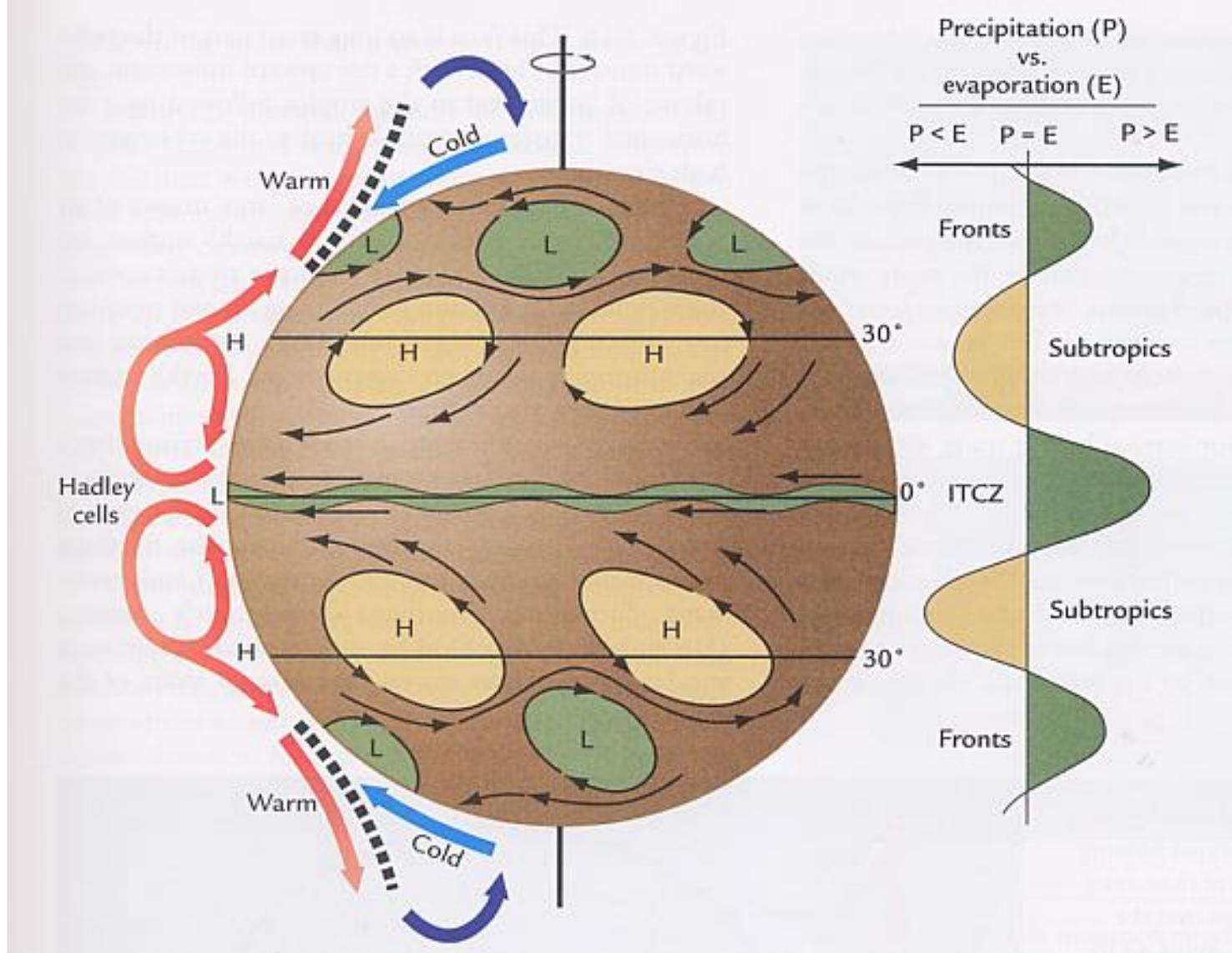
Epimenides; Acts 17:28; Titus 1:12 From Ishodad of Merv, trans. Margaret Gibson

Gödel's incompleteness theorems: a proposition can be true but by its very nature cannot be proven to be true.

“for necessity is laid upon me; yea, woe is unto me, if I preach not the gospel”
1 Cor. 9:16.

“necessity was laid upon me.—the word of God.” Socrates (Plato)

What does a mathematician call the resurrection? Aftermath....



He caused the east wind to blow in the heavens
 And by His power He directed the south wind. *Psalms 78:26*

But we are changing the wind.



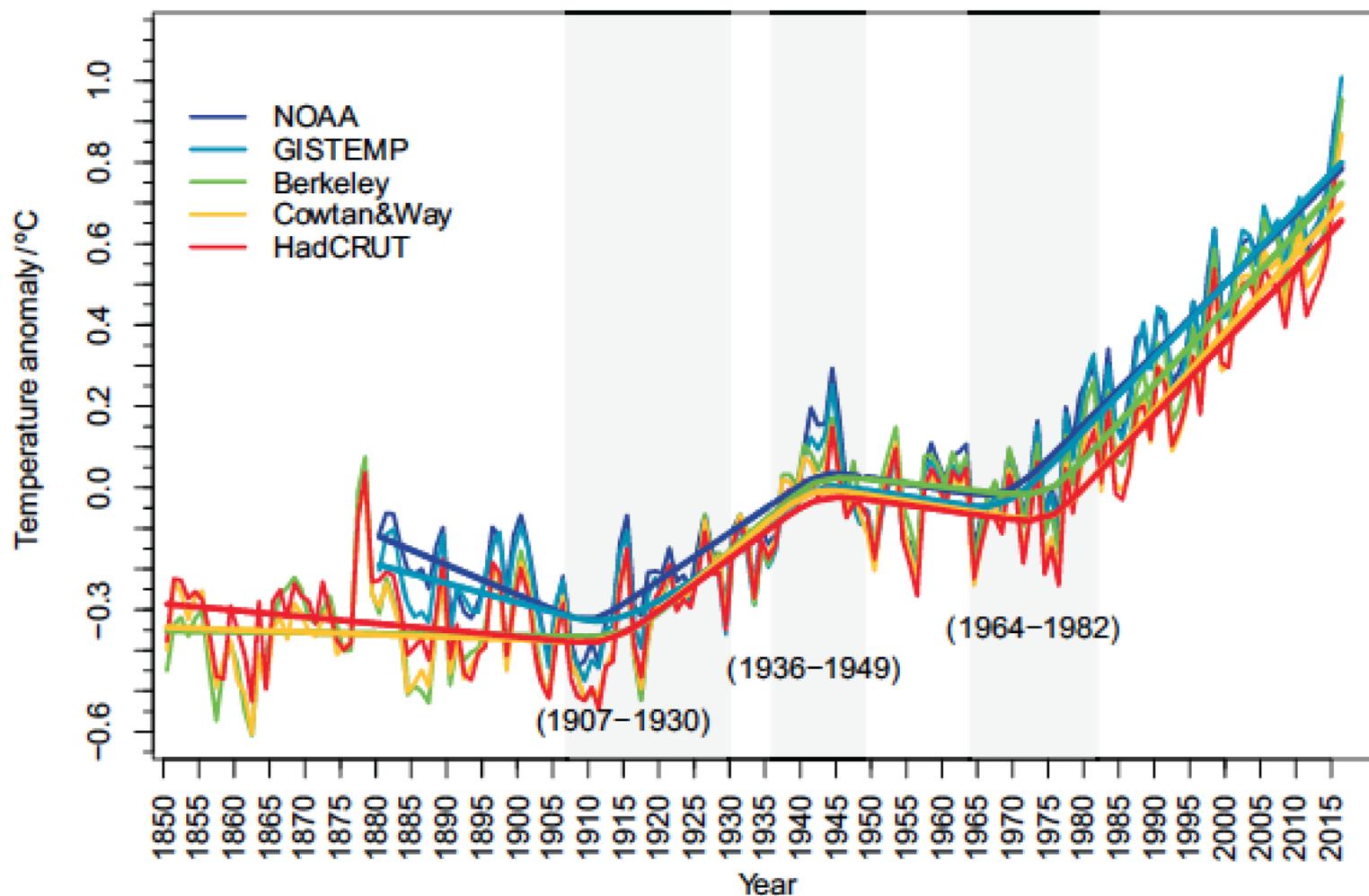
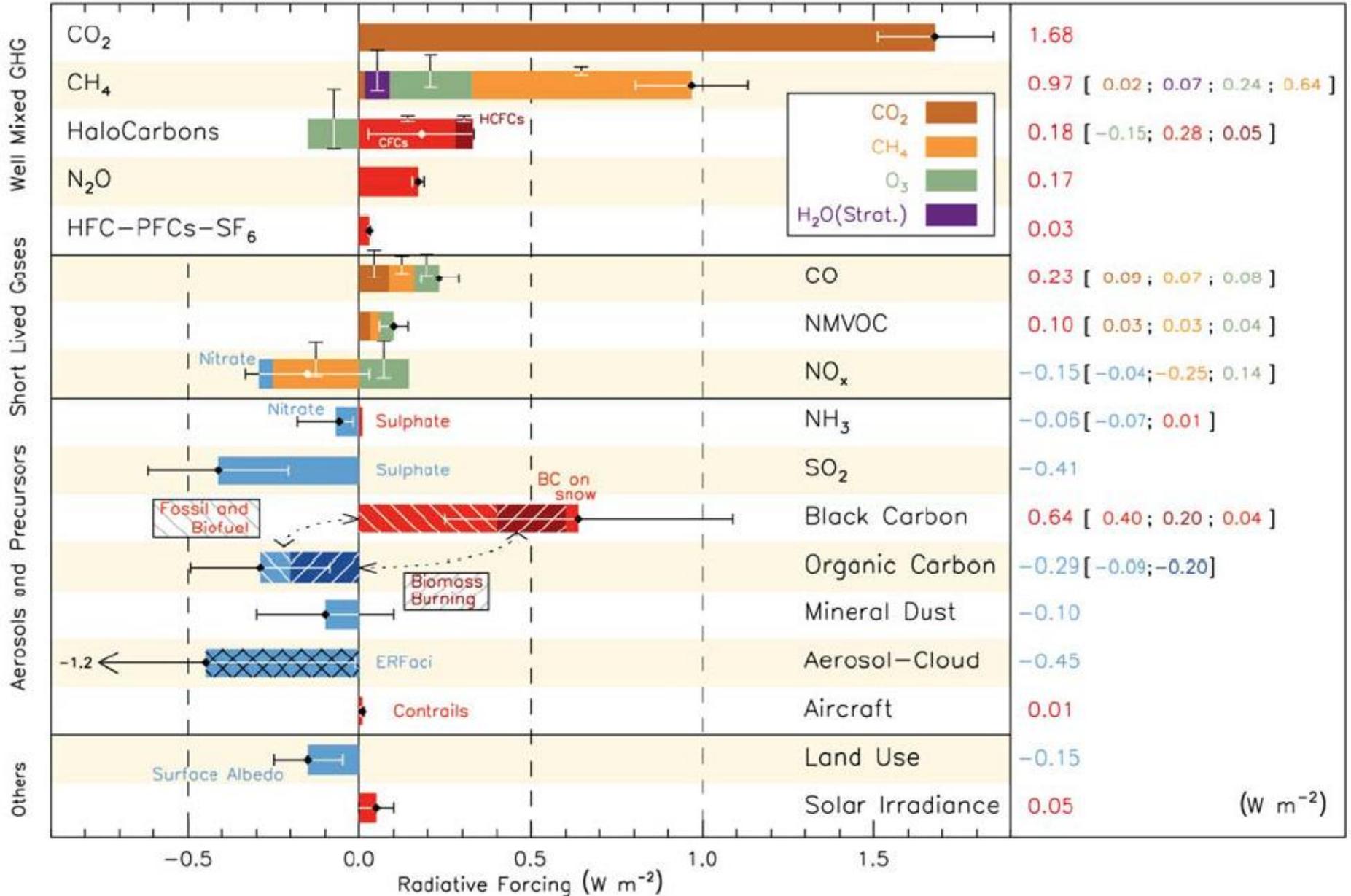


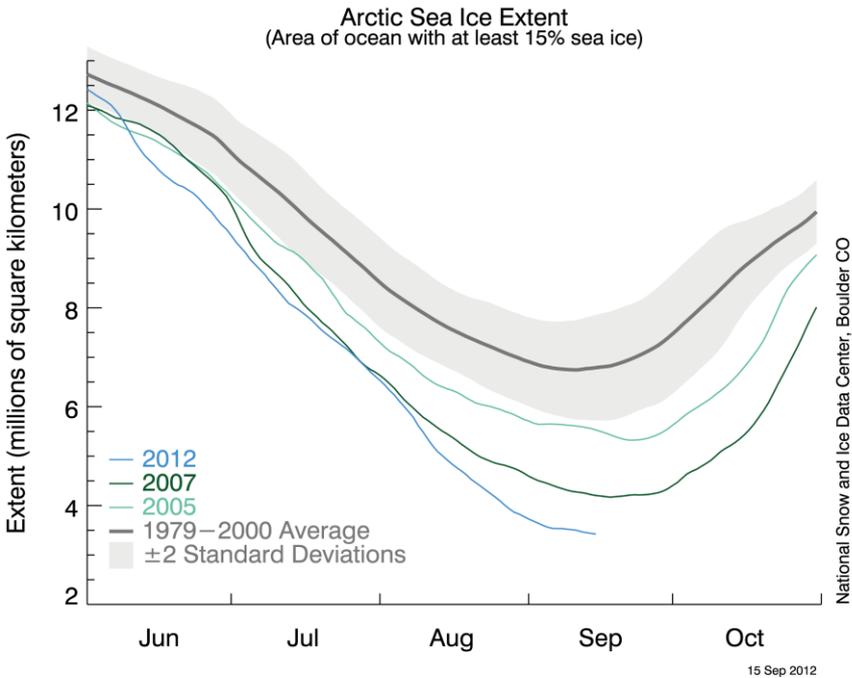
Figure 2. Trends in global temperature according to changepoint analysis. Included data sets are NASA GISTemp, NOAA, HadCRUT4, Cowtan and Way, and Berkeley Earth.



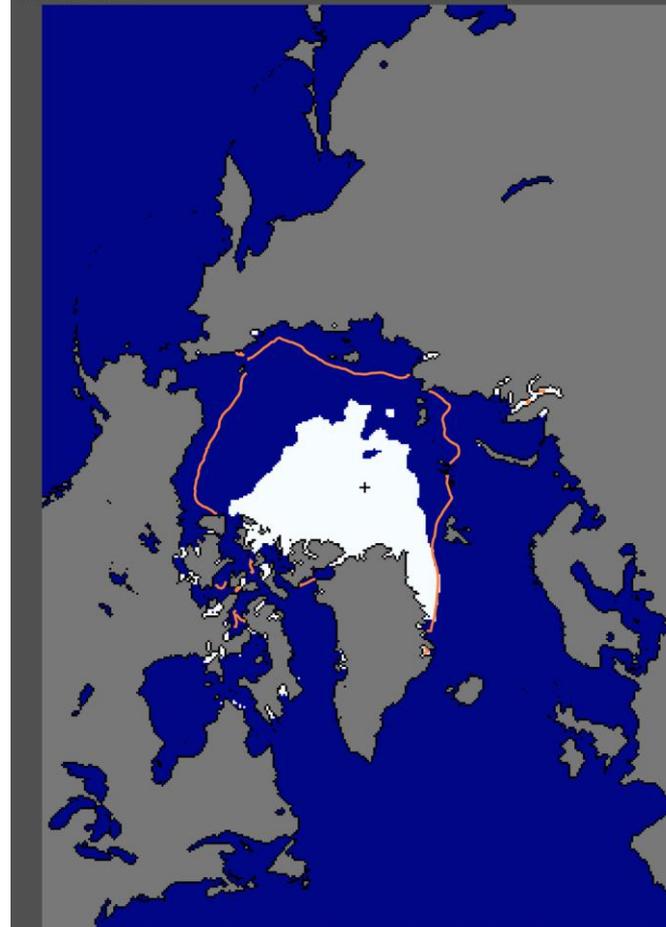
Are humans the elephant in the room?

Components of Radiative Forcing

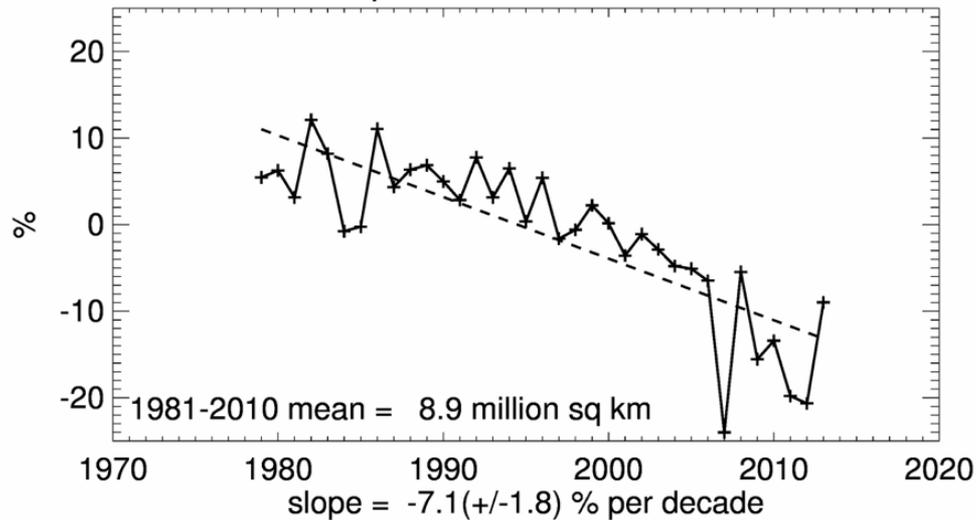


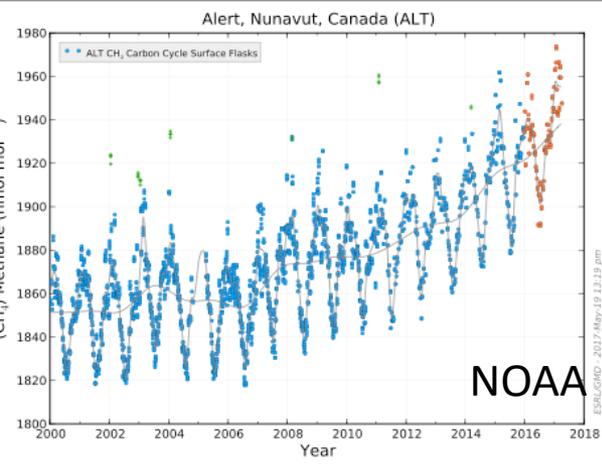


Sea Ice Extent
09/16/2012

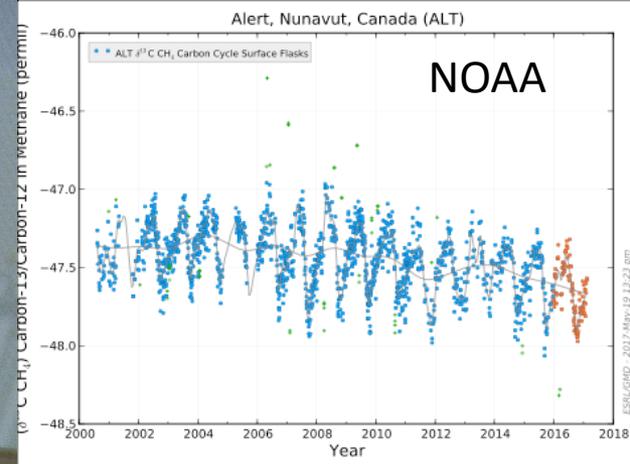


Northern Hemisphere Extent Anomalies Oct 2013





What next?



RHUL

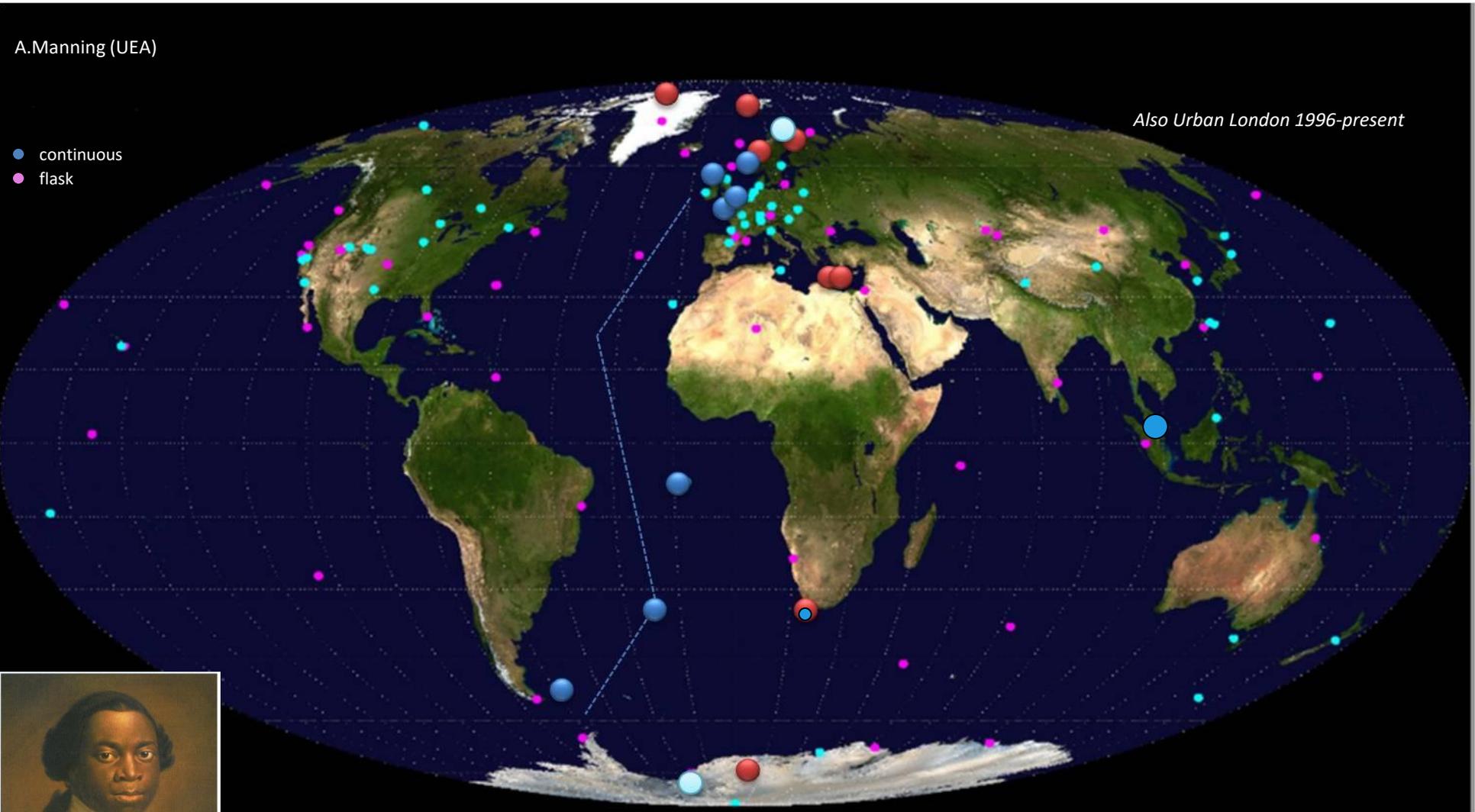
Equianos partnership - Atlantic Greenhouse Gas measurements (large dots)

RHUL, NILU, FMI, South Africa Weather Service, Jersey, British Antarctic Survey

A.Manning (UEA)

- continuous
- flask

Also Urban London 1996-present



Olaudah Equiano

Equator-InterAtlantic-NOrth-South measurement

18th century Cambridge Arctic scientist, partly responsible for Ascension settlement

Greenhouse gases are rising – the evidence is very strong
that the Earth's climate is changing as a result.

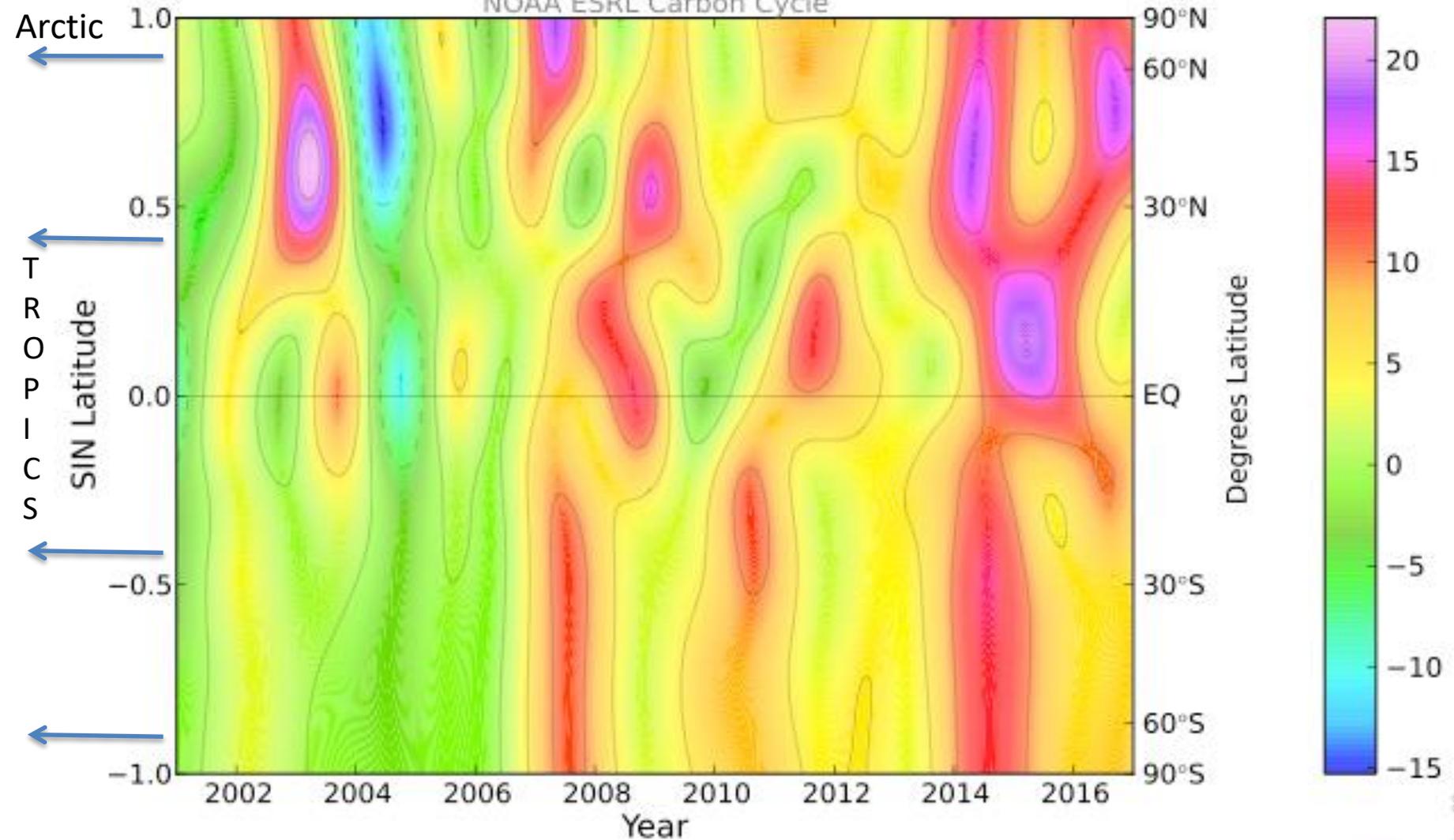


And he drank of the wine, and was drunken;
and he was uncovered within his tent.

Genesis 9:21

Growth Rate of Methane (ppb yr⁻¹)

NOAA ESRL Carbon Cycle

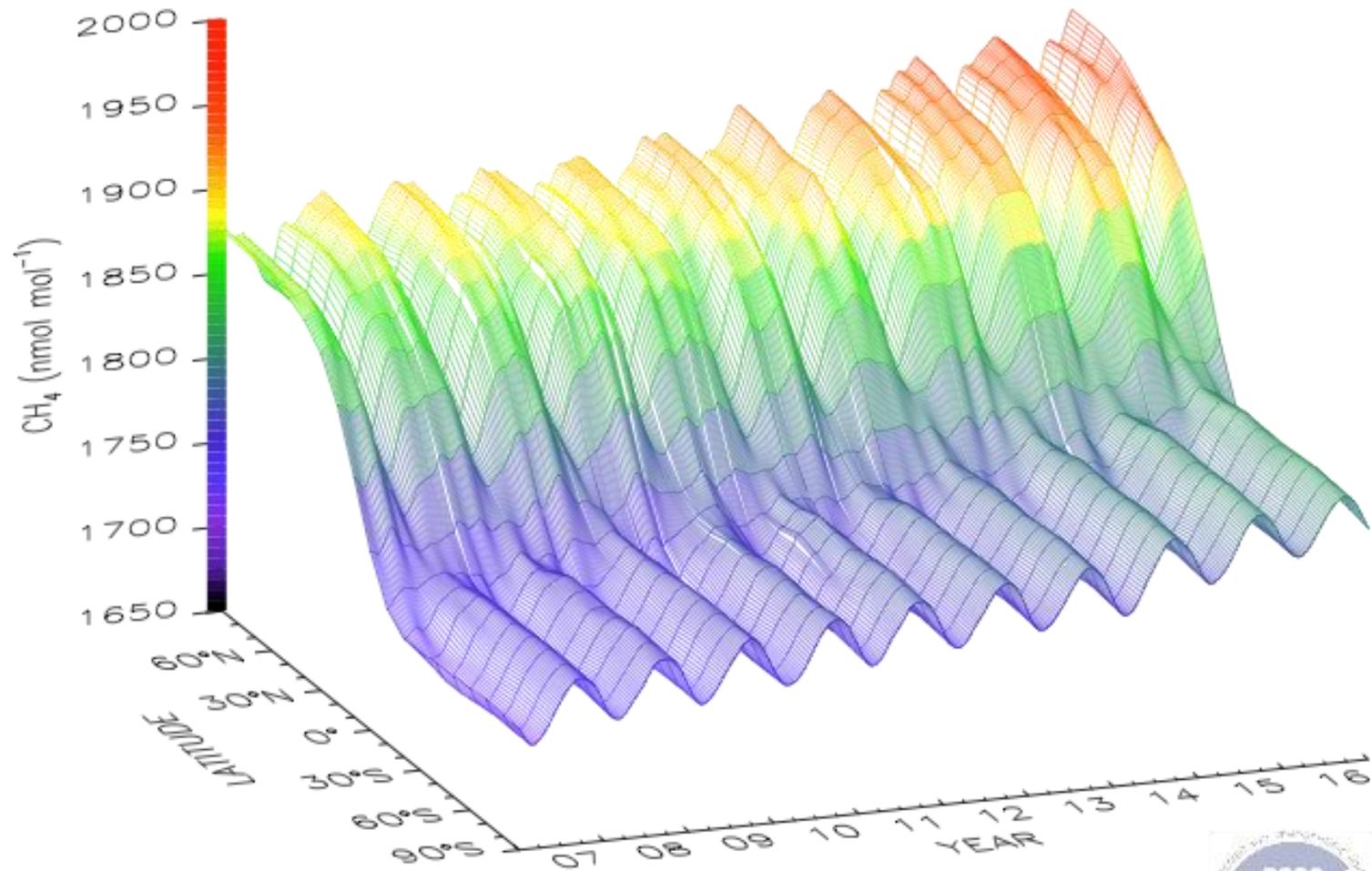


Contour plot showing the temporal and spatial variations in the atmospheric increases of methane. The cooler colors (green, blue, violet) represent periods of lower than average growth rates and the warmer colors (yellow, orange, red) represent periods of higher growth rates. The plot is derived from measurements of samples collected at the Carbon Cycle cooperative air sampling network sites. The variations in the growth rate of this climatically important gas are due to interannual variations in the imbalance between sources and sinks, and also to variations in atmospheric transport. Contact: Dr. Ed Dlugokencky, NOAA ESRL Carbon Cycle, Boulder, Colorado, (303) 497-6228, ed.dlugokencky@noaa.gov, <http://www.esrl.noaa.gov/gmd/ccgg/>.



Global Distribution of Atmospheric Methane

NOAA ESRL Carbon Cycle

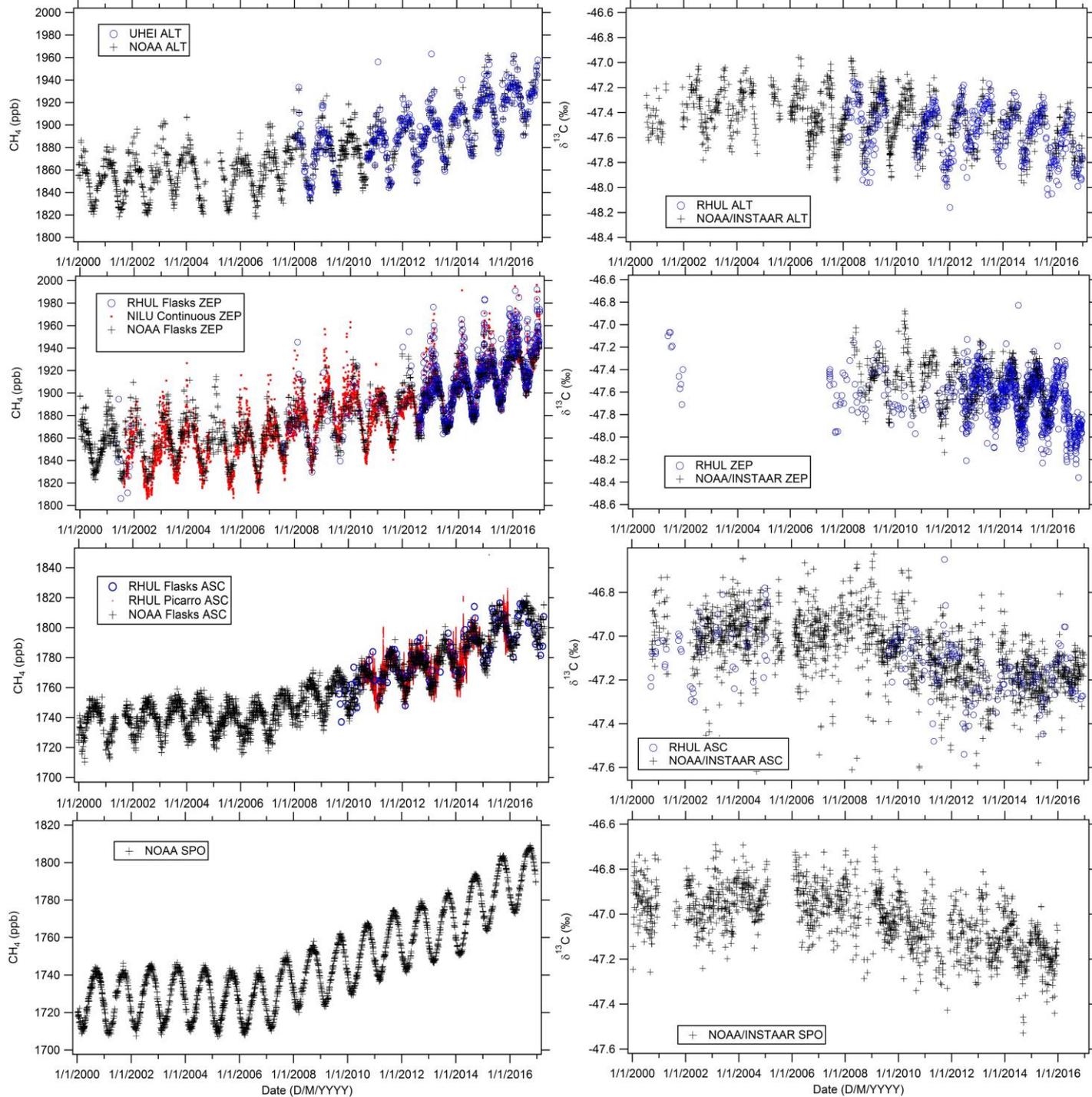


September 2017

Three-dimensional representation of the latitudinal distribution of atmospheric methane in the marine boundary layer. Data from the Carbon Cycle cooperative air sampling network were used. The surface represents data smoothed in time and latitude. Contact: Dr. Ed Dlugokencky, NOAA ESRL Carbon Cycle, Boulder, Colorado, (303) 497-6228, ed.dlugokencky@noaa.gov, <http://www.esrl.noaa.gov/gmd/ccgg/>.



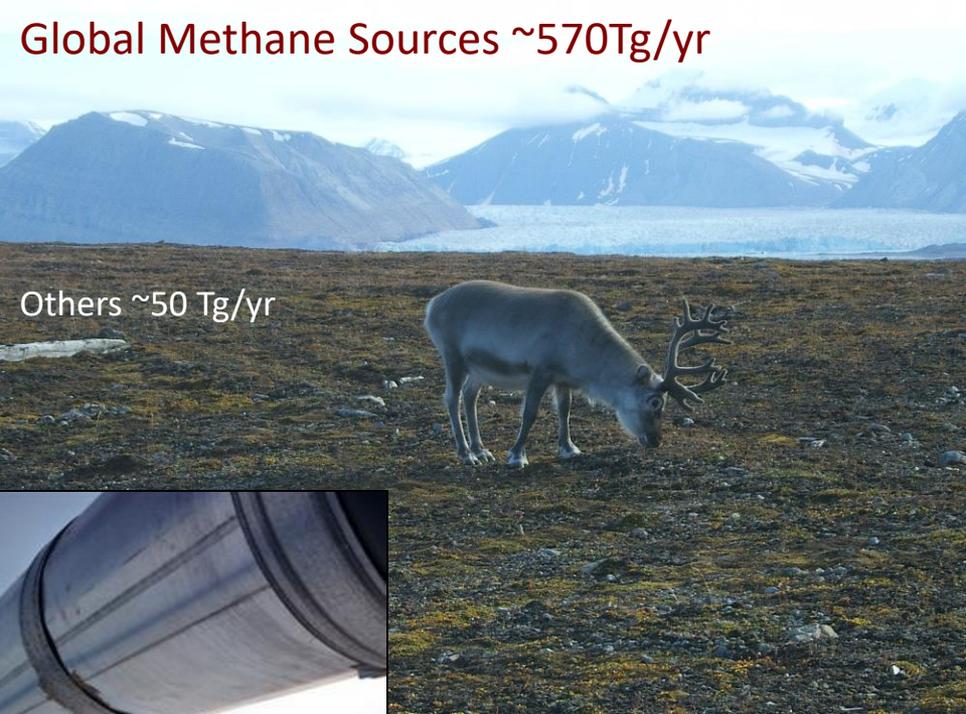
The isotopic picture –
NOAA and RHUL records from
Alert, Zeppelin
and Ascension



Global Methane Sources ~570Tg/yr



~150-200Tg/yr



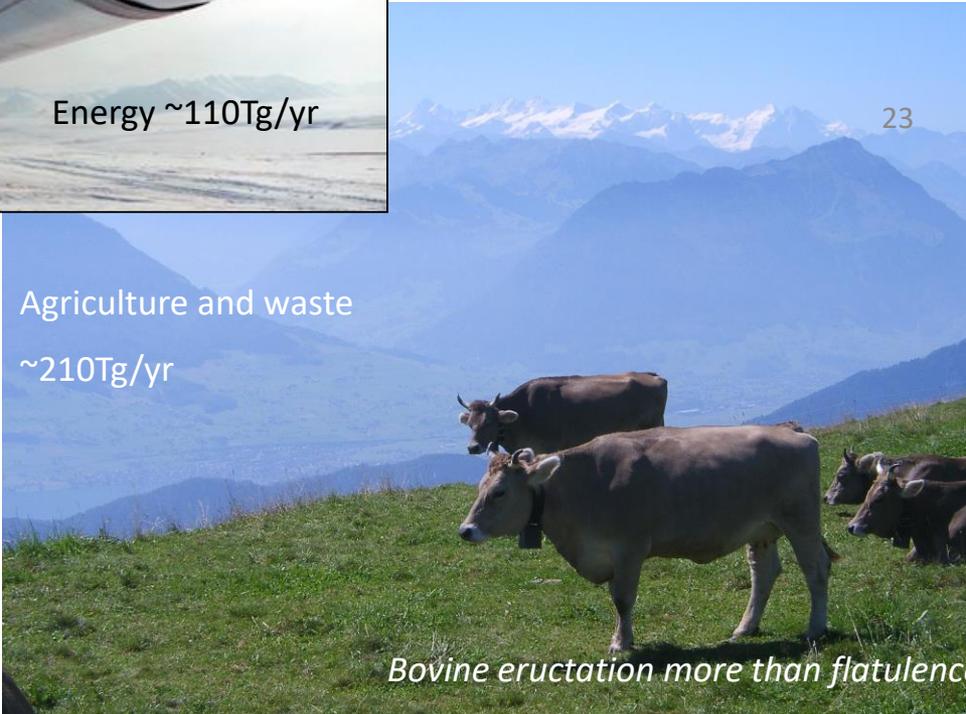
Others ~50 Tg/yr



Energy ~110Tg/yr



~50 Tg/yr



Agriculture and waste
~210Tg/yr

Bovine eructation more than flatulence



Causes of the methane rise?



Emissions? – isotopically light, tropical ‘leading’

Wetlands?

Agriculture? – cows, rice?

Rising fossil fuel leaks in parallel with declining biomass burning?

Sinks? – increasing destruction and isotopic shift

OH in tropical mid-troposphere?

Cl in trade wind marine boundary layer?

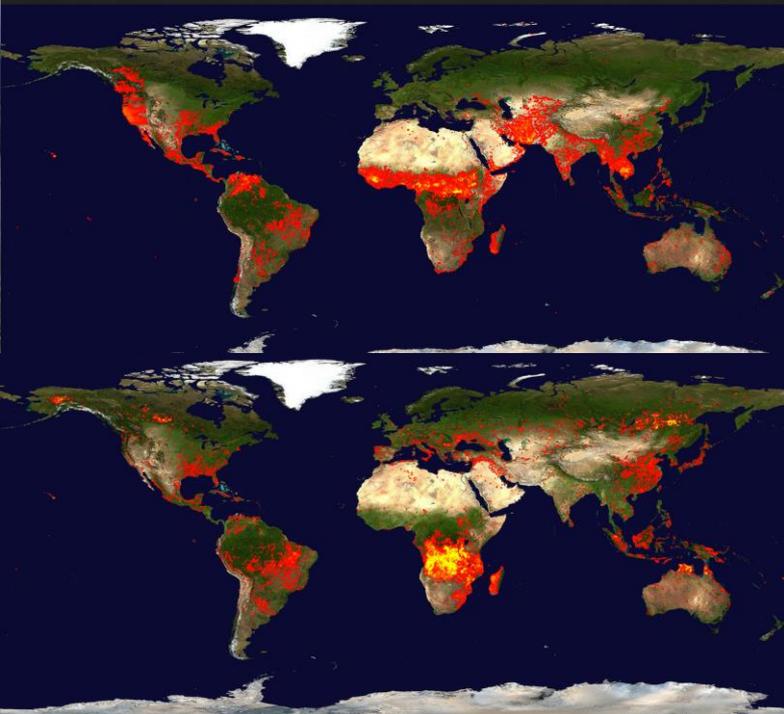
soil methanotrophy in tropics?

Expansion of the ITCZ under the Hadley cells?

There is currently not enough information to determine the global budget by modelling.



Is Biomass burning declining in parallel with increased fossil fuel emissions?



Dec-
Feb

Jun-
Aug



Are Tropical wetlands driving methane growth?



South China wetland, Hong Kong

1. **CH₄ detection with the new Instruments and satellites means effective reduction of gas, coal, landfill and deliberate fire emissions is now possible.**
2. **Cutting anthropogenic CH₄ is arguably the most cost-effective, politically possible greenhouse reduction target. This would be wise.**

"Why did nobody notice it?"

The Queen's question: LSE, 4 Nov. 2008

"She was asking me if these things were so large how come everyone missed it." LSE Director of Research Prof. L. Garicano

Long-term measurement time series are essential, even if unfashionable in UK funding models.



The Law of Adam – the 1st great commandment:
Love God - dominion, not dictatorship

The Law of Noah the 2nd great commandment:
Love your neighbour – for all creation

The seven laws from Adam and Noah

Not to worship idols.

Not to curse God.

To establish courts of justice.

Not to commit murder.

Not to commit adultery or sexual
immorality.

Not to steal.

**Not to eat flesh torn from a
living animal (Acts 15:20).**

²² For we know that the whole creation groaneth and
travailleth in pain together until now. *Romans 8:22*

The Laws of Moses – Israel, ‘wrestling with God’.

The Law of Adam – Dominion over nature
We rule the air – are we Solomon or Stalin?





East Asia
Need to wear a face mask?

Wealth? Or Health?



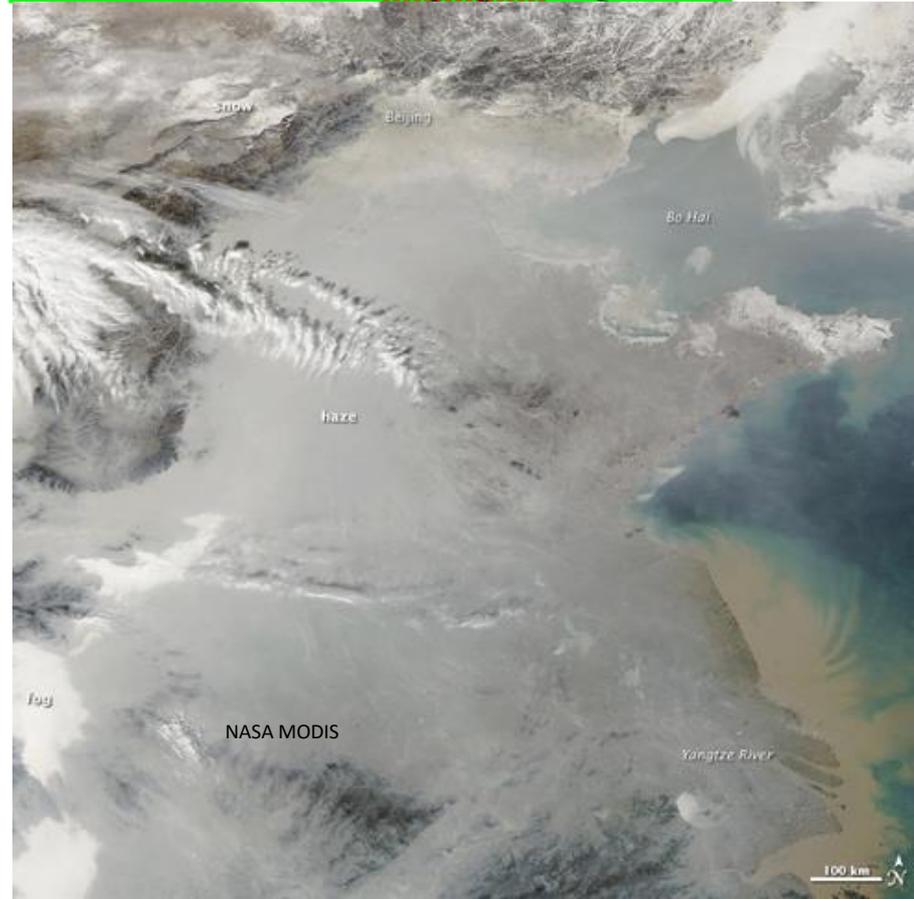
A 'Crazy Bad' Day for Pollution in Beijing - NYTimes.com

November 26, 2010, 3:17 pm

New York Times

A 'Crazy Bad' Day in Beijing

11-19-2010; 11:00; PM2.5; 557.0; 500; Beyond index //
3:18 AM Nov 19th via BeijingAir AQI Tweet



And he looked toward Sodom and Gomorrah,
and toward all the land of the plain, and
beheld, and, lo, the smoke of the country
went up as the smoke of a furnace.

Genesis 19.28



The great cleanser – reaction with OH, especially in the middle tropical troposphere.

OH depends on Ozone

Smaller sinks – soil uptake, marine Cl reaction.

How did we get here?

Where wast thou when I laid the foundations of the earth?
declare, if thou hast understanding.

⁵ Who hath laid the measures thereof, if thou knowest? or who
hath stretched the line upon it?

⁶ Whereupon are the foundations thereof fastened? or who laid
the corner stone thereof;

⁷ When the morning stars sang together, and all the sons of God
shouted for joy?

Job 38

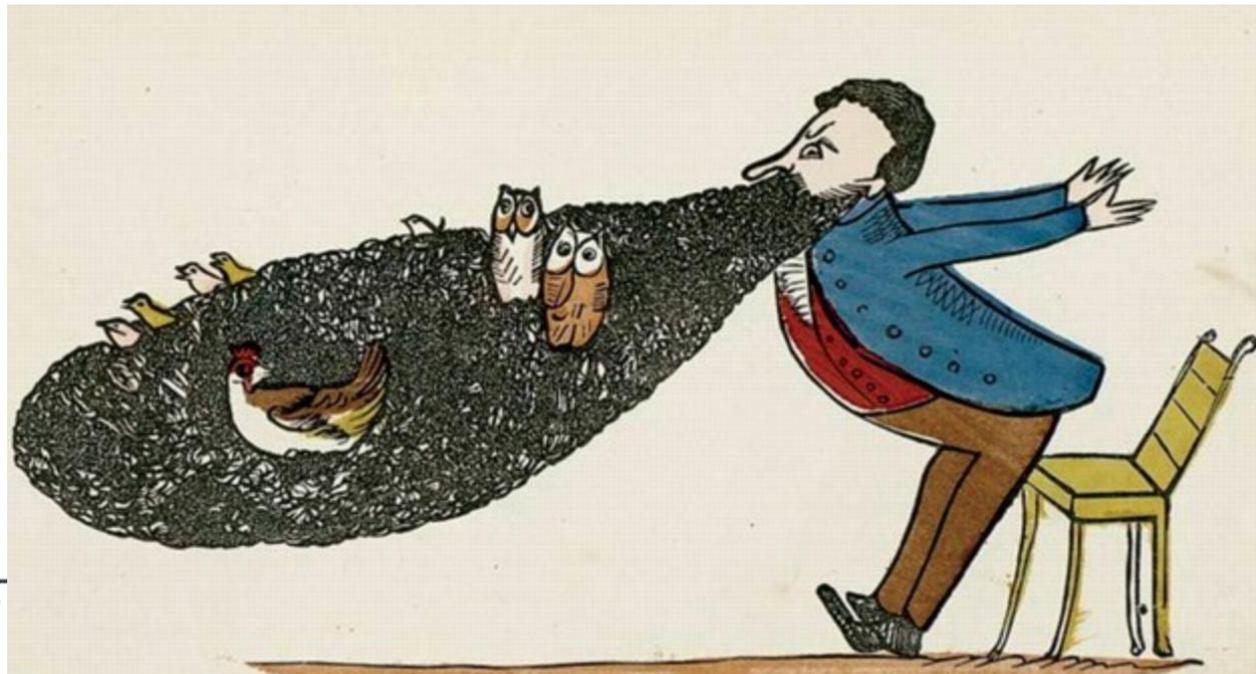
Time is not the movement of a body.

St. Augustine, *Commentary on Genesis*

Seeing in Two Dimensions, Three Dimensions, Four Dimensions,
and from outside the created dimensions

- ⁷ Wherefore as the Holy Ghost saith, To day if ye will hear his voice,
⁸ Harden not your hearts, as in the provocation, in the day of temptation in the wilderness:
⁹ When your fathers tempted me, proved me, and saw my works forty years.
¹³ But exhort one another daily, while it is called To day

Hebrews 3

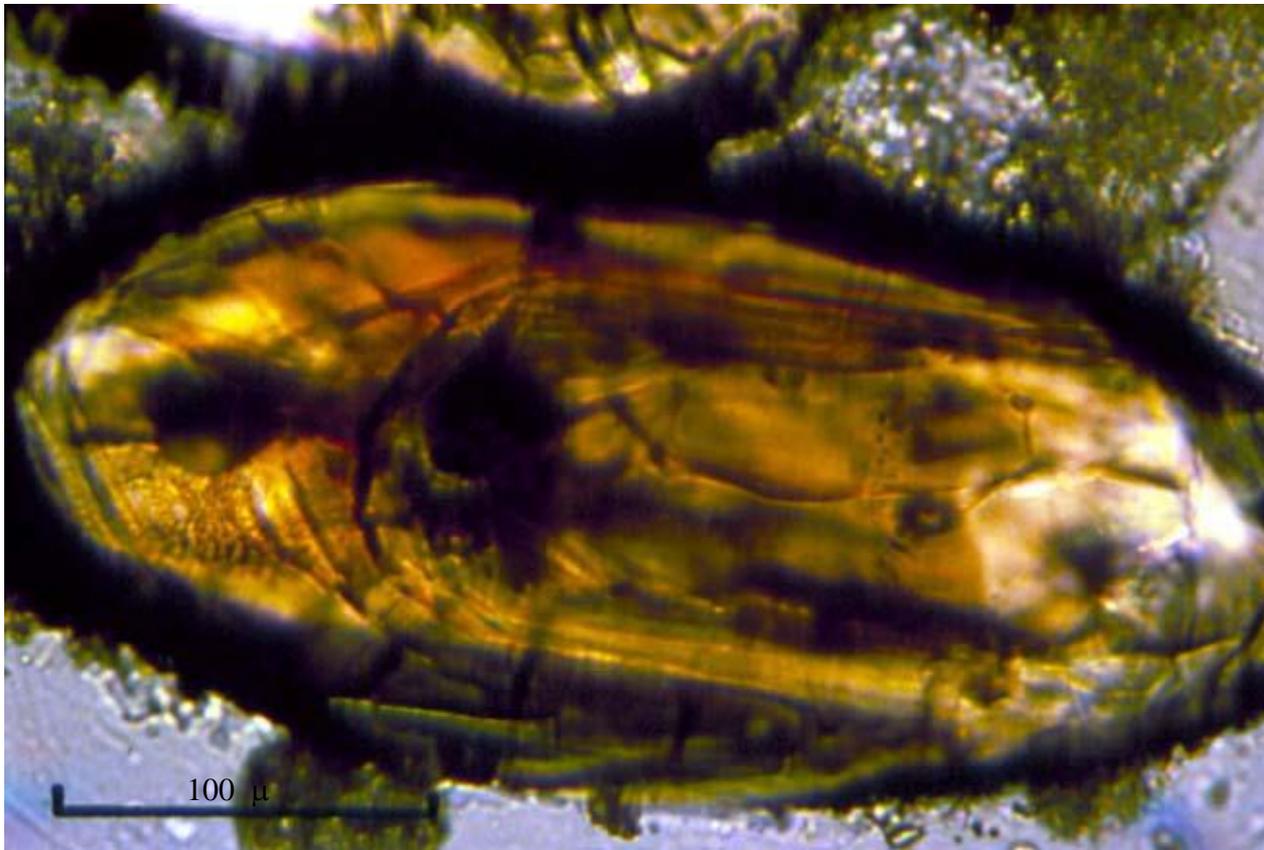


There was an Old Man with a beard. who said. "It is just as I feared!
Two Owls and a Hen, four Larks and a Wren,
Have all built their nests in my beard!"

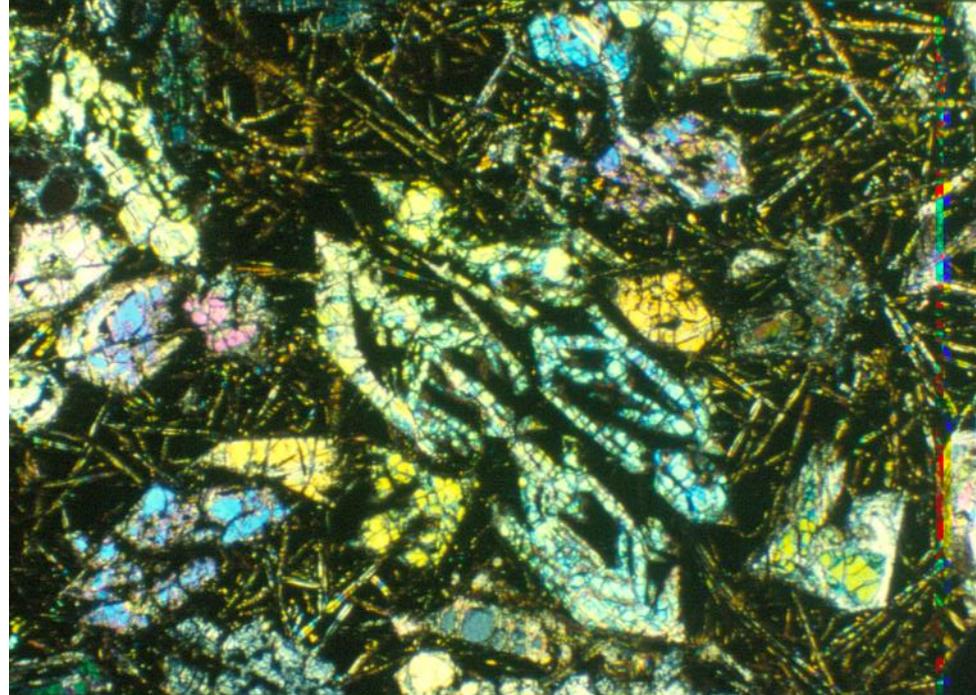
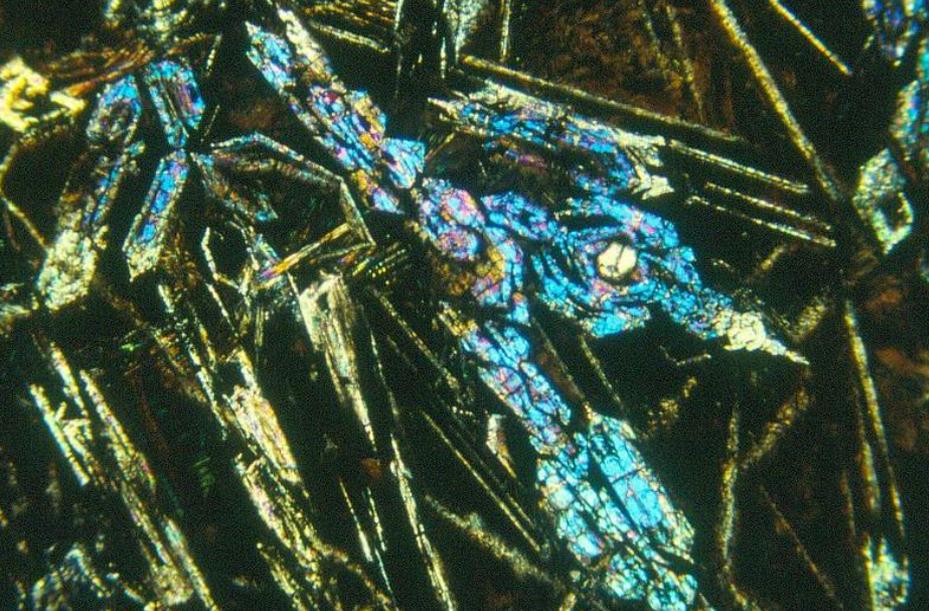
⁸ Or who shut up the sea with doors, when it brake forth, as if it had issued out of the womb? *Job 38:8*.

Liquid Water is of great antiquity - prior to 4.4Ga

The abundant evidence for very early zircons is reasonable though not wholly conclusive evidence for the existence of liquid water oceans in the Hadean



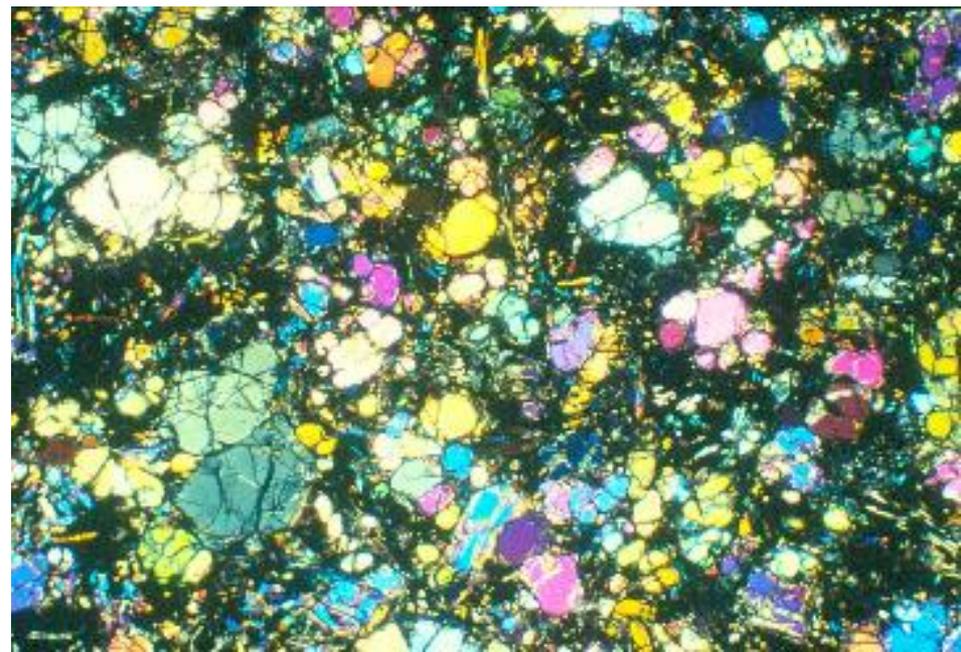
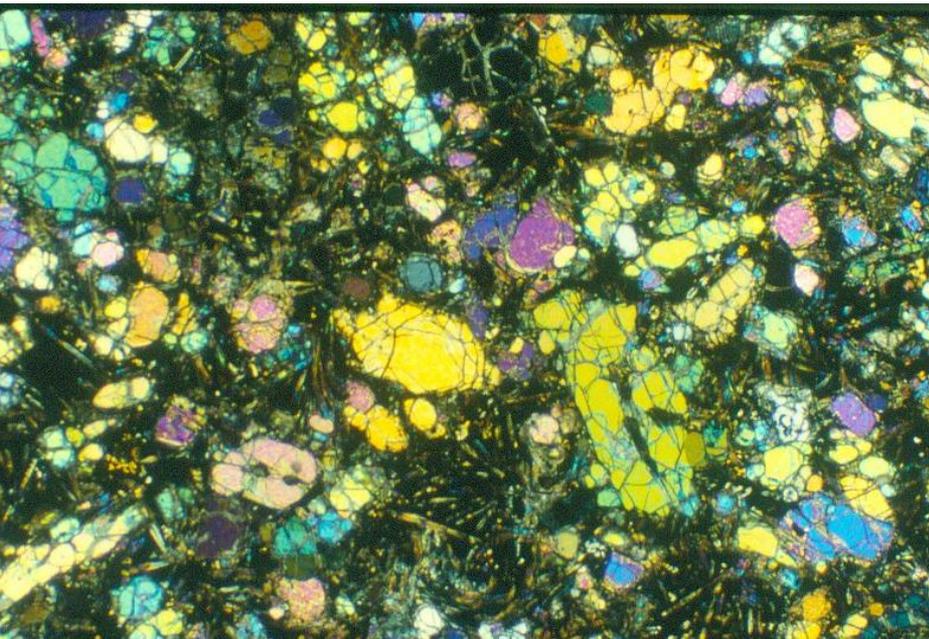
W. Australia: W. Compston, with thanks



Reliance Fm. Komatiites

(high MgO, high Ni, >1500°C lavas, hosting alkaline hydrothermal systems as they cool)

Approx 3mm across photomicrographs



Belingwe stromatolites, Zimbabwe, 2.65 Ga old



Belingwe
Cheshire Fm.
Stromatolites

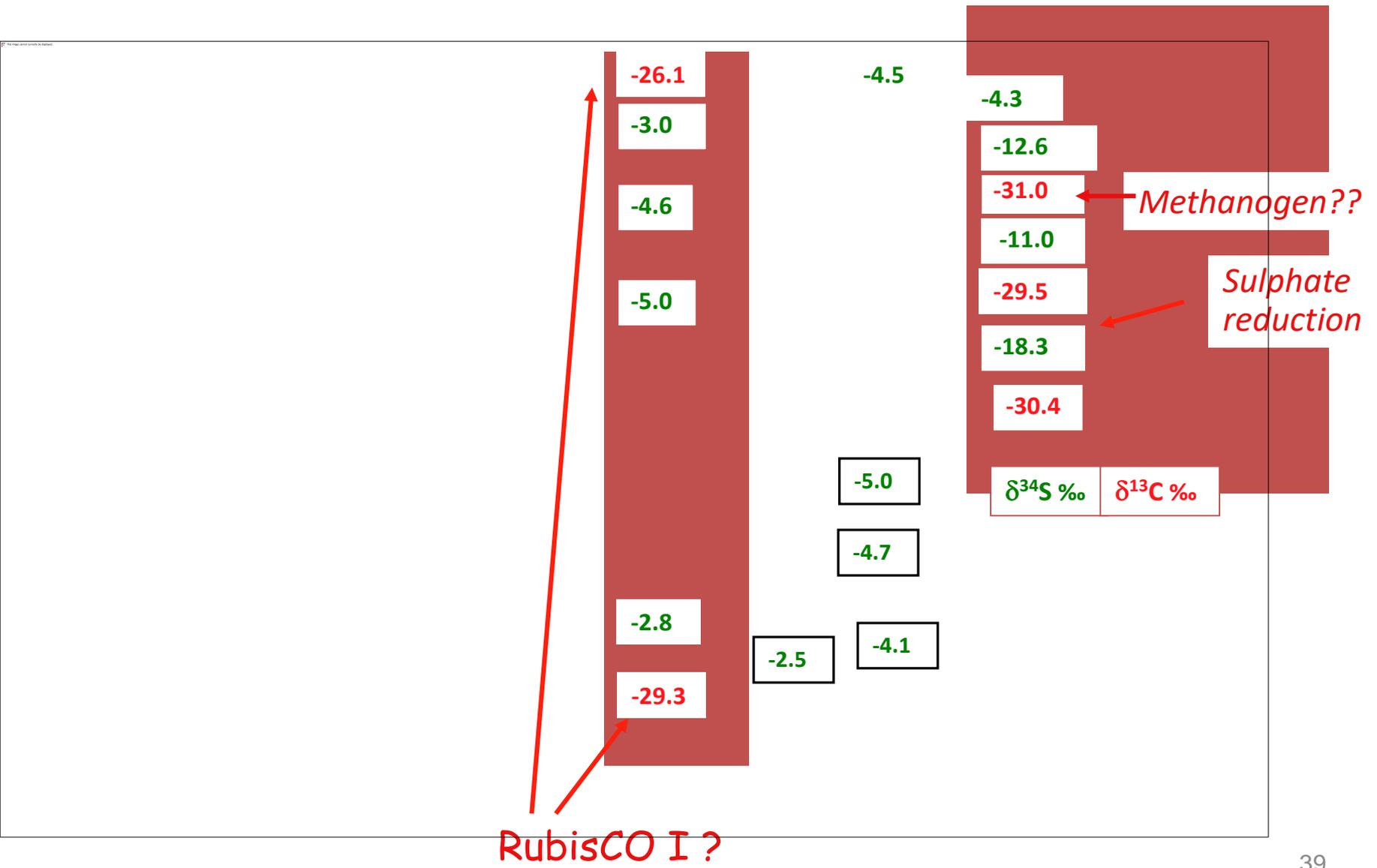
2.65 Ga old.



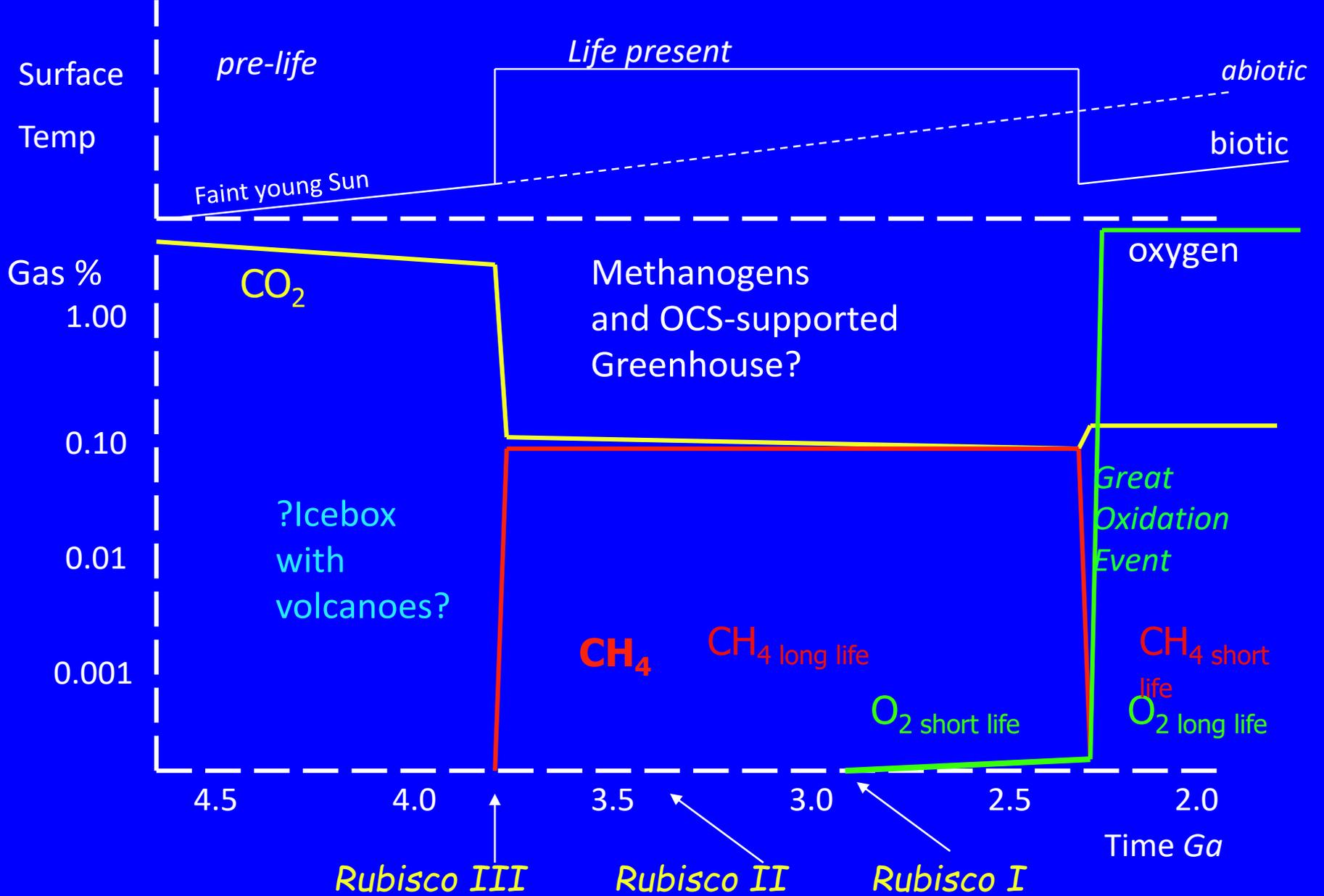
Shallow water silts



Sulphide stringers in anoxic shallow water silty facies, Manjeri Fm.

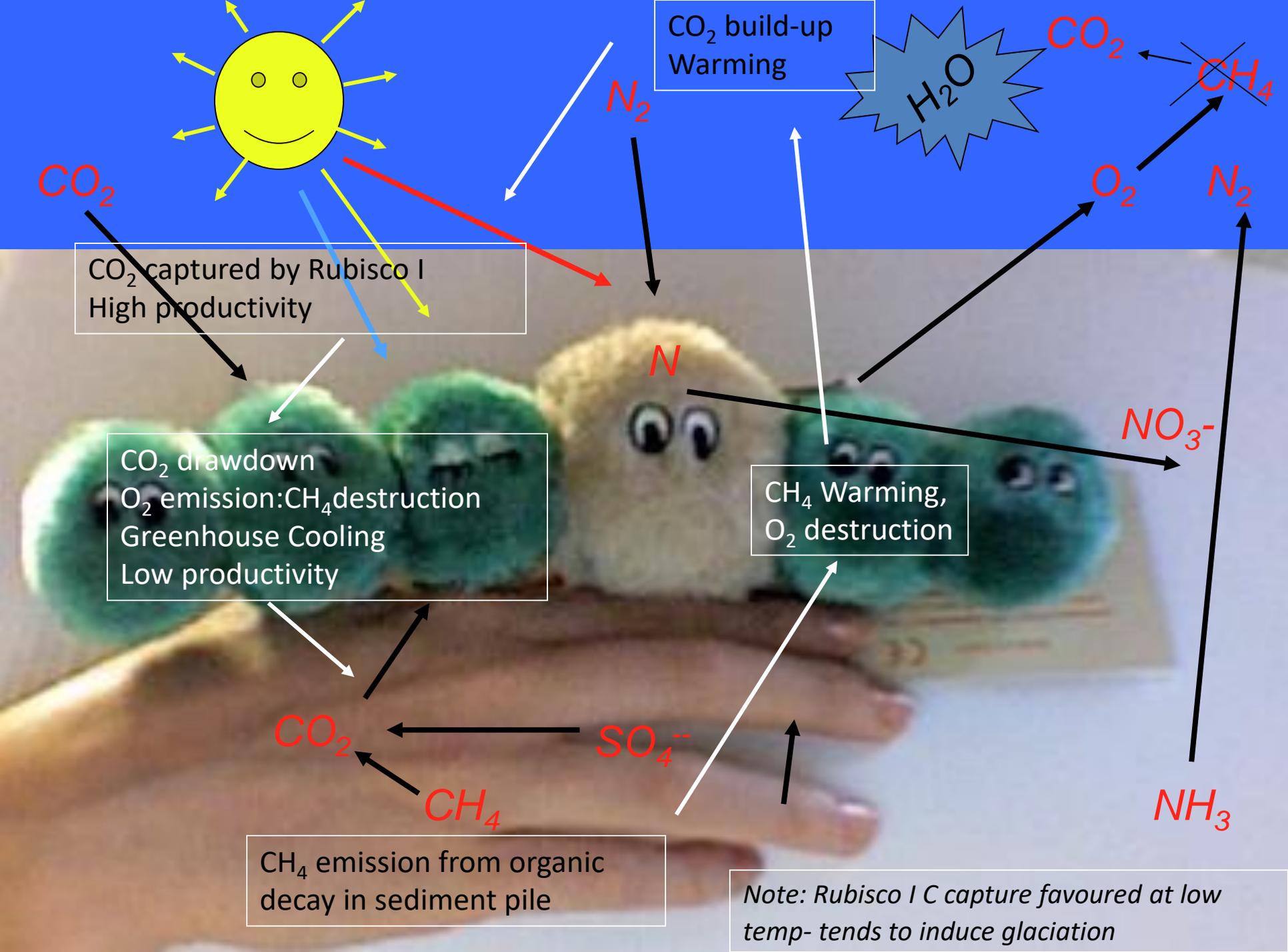


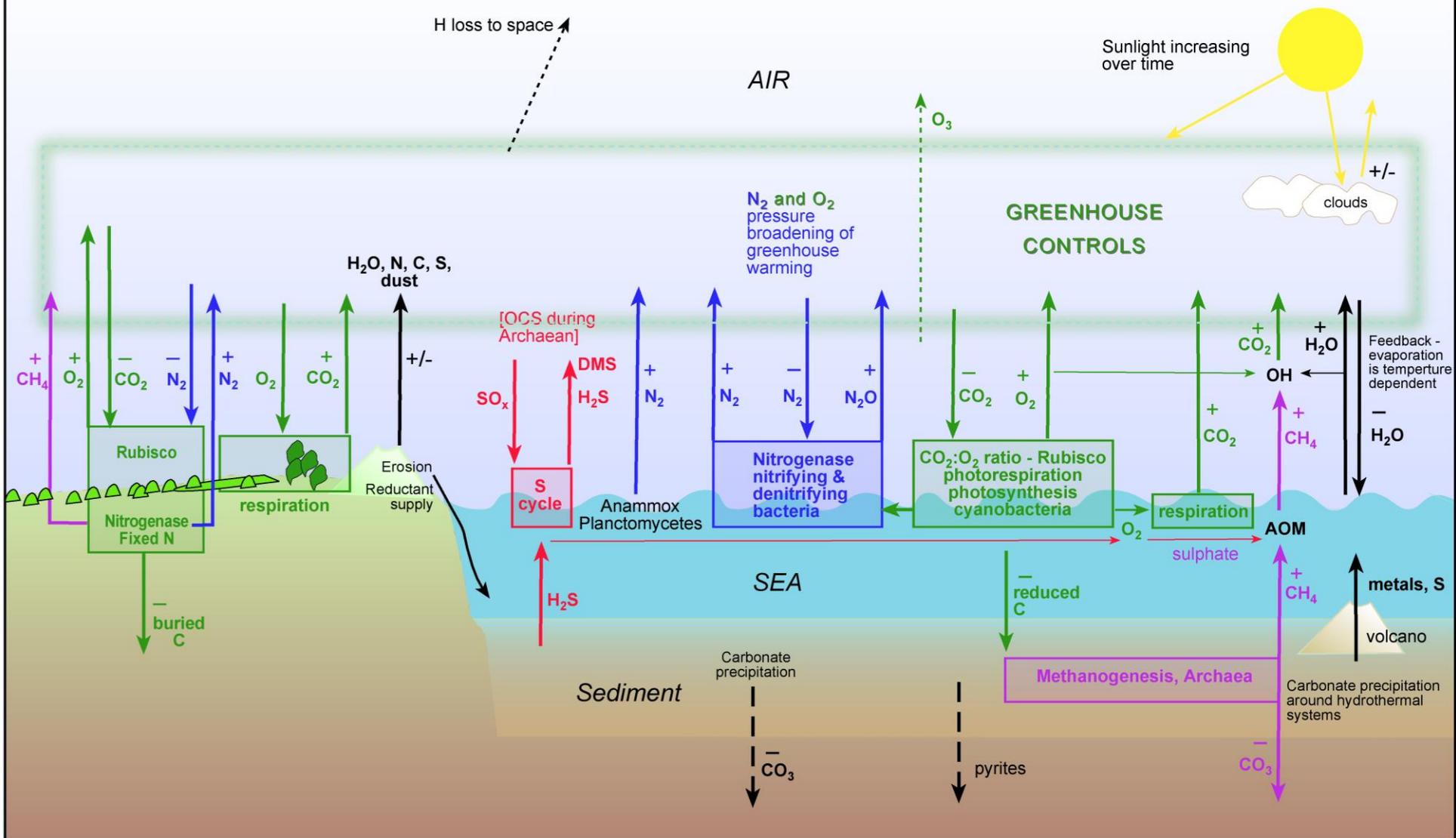
RubisCO I ?



Modified from Lovelock 1988, Ages of Gaia (see Nisbet & Nisbet 2008)

Atmospheric evolution and the problem of the faint young Sun





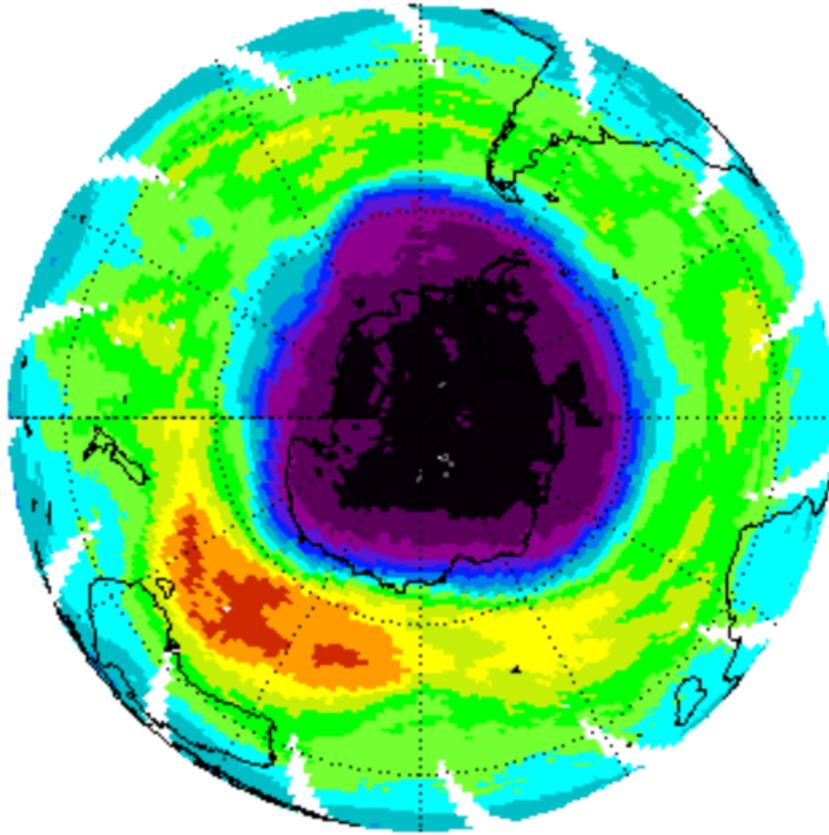
External Physical setting: Solar evolution
Biological controls: Nitrogen, Carbon & S cycles
Consequent chemical framework, pH, Redox sequestration
 The greenhouse

The Montreal Protocol – The ozone example

1987 – signed.

1990 – London amendment

1992 – Copenhagen amendment



Ozone Fading Fast, Thatcher Tells World 1

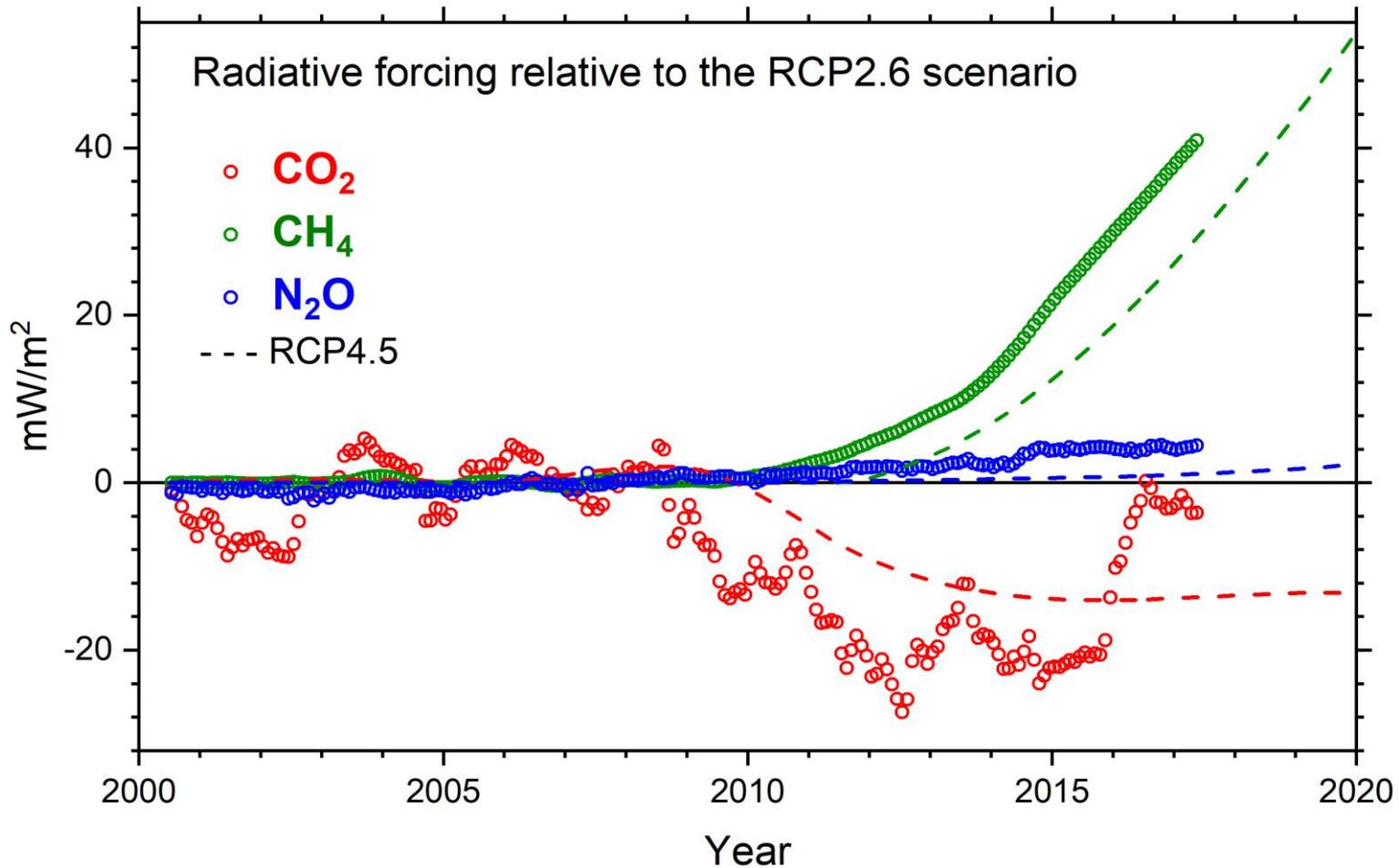
By MALCOLM W. BROWNE, Special to The New York Times
Published: June 28, 1990

LONDON, June 27— Prime Minister Margaret Thatcher warned representatives of more than 100 nations today that destruction of the earth's ozone layer was proceeding even faster than scientists had feared.

As a result, she said, efforts to reduce ozone-destroying chemicals must be hastened.

Mrs. Thatcher's speech opened an international meeting that is expected to result in an agreement on a worldwide end to the production of chlorofluorocarbon chemicals, which destroy the ozone layer, by 2000 and restrictions on the production of related chemicals.

However, there is growing pressure to bring the ban into effect by 1995, more comprehensive than originally planned.



Methane's challenge to the Paris Agreement

Radiative forcing from greenhouse gases relative to the RCP 2.6 pathway, which is compliant with the Paris target (Meinshausen et al, 2011, Rogelj et al. 2012).

Calculation by Martin Manning using values from Etminan et al. 2016.



Pessimism

CO₂ is rising and so closely connected to wealth that the rise cannot be stopped.

Methane is rising and the cause of the rise seems to be some sort of climate feedback: there is very little we can do. Pollution is inevitable as people put wealth before health.

Optimism

Fossil fuel, waste, and agricultural emissions – all these can be controlled. There are good economic alternatives. Paris has a chance.

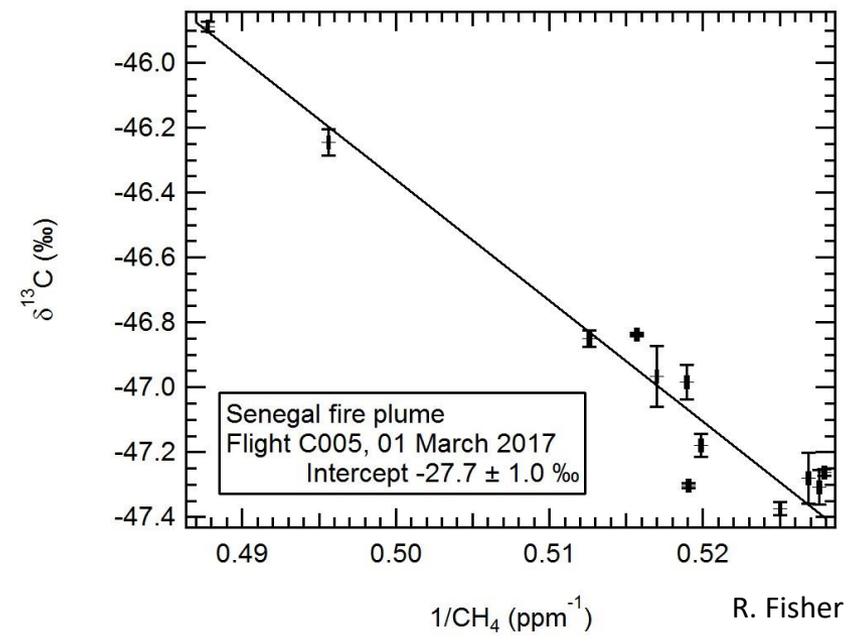
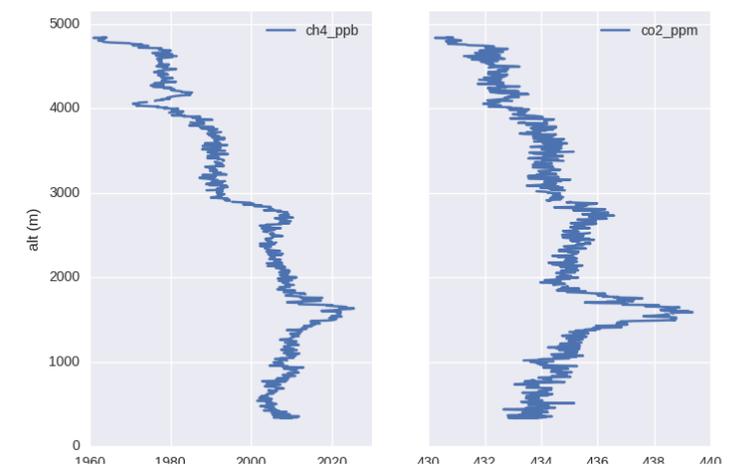
Pollution: even in east Asia and India there are signs of concern. Is wealth really more precious than health?

Darwin College:
the vine and the fig tree
Micah 4:4, 1 Kings 4:25, and
Zechariah 3:10



Speak to the earth, and it shall teach thee
Job 12:8

Constable. Salisbury Cathedral, 1831



MOYA flights in Senegal – biomass burning in 2017 dry season:
 Is part of the negative trend in $\delta^{13}\text{C}_{\text{CH}_4}$ a result of declining biomass burning?

Anoxia

InterOxia

Oxic



>3.5 Ga Anoxygenic
Photosynthesis

*carbonate
reefs*

abundant stromatolites

Methanogens?

~2.9 Ga Oxygenic
Photosynthesis

2.4 Ga Great
Oxidation event

Start of life

4.5

2.5

0.5

Time

Isua

Barberton
Pilbara

Steep Rock
Mushandike
Pongola

Belingwe 2.7 Ga
stromatolites &
shales

Early
Proterozoic
Snowball?

Late Proterozoic
snowballs

