

WHAT HAVE PLANTS EVER DONE FOR US?

Thursday 8th week Hilary Term

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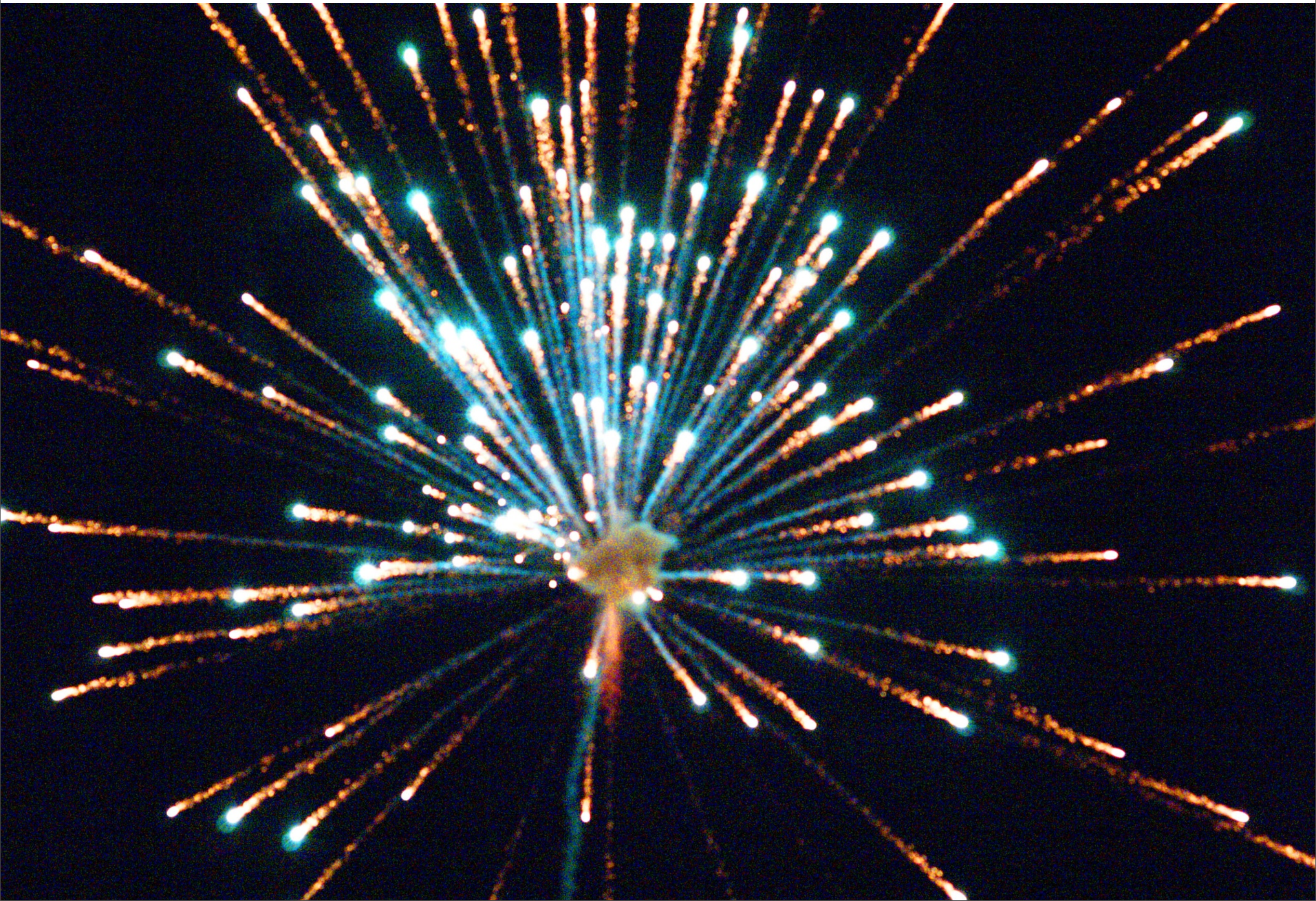


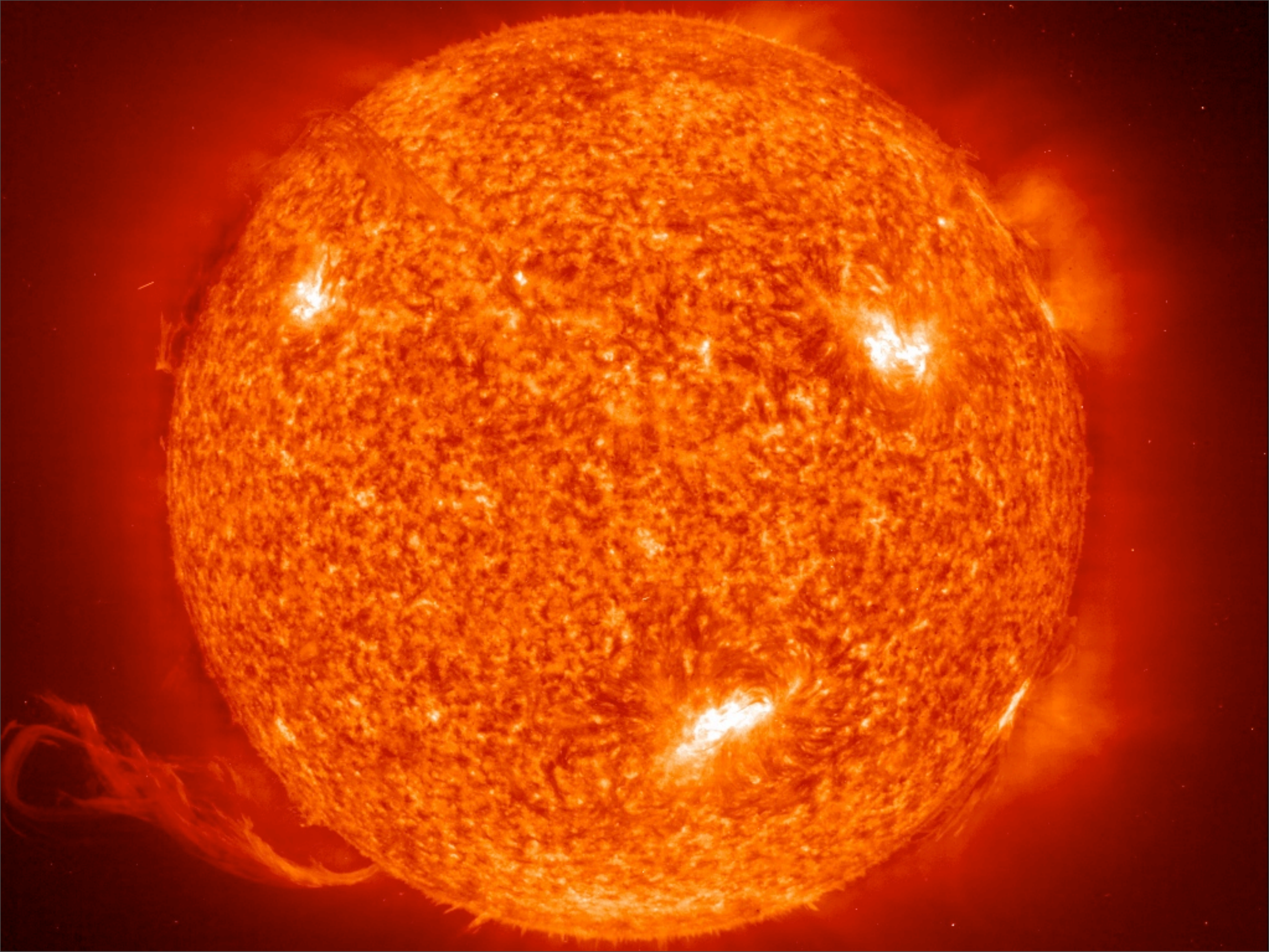
A BRIEF HISTORY OF LIFE ON EARTH



In his hand, he held, the Golden Compass, prepared
In Patience to be used

13,700,000,000 years ago





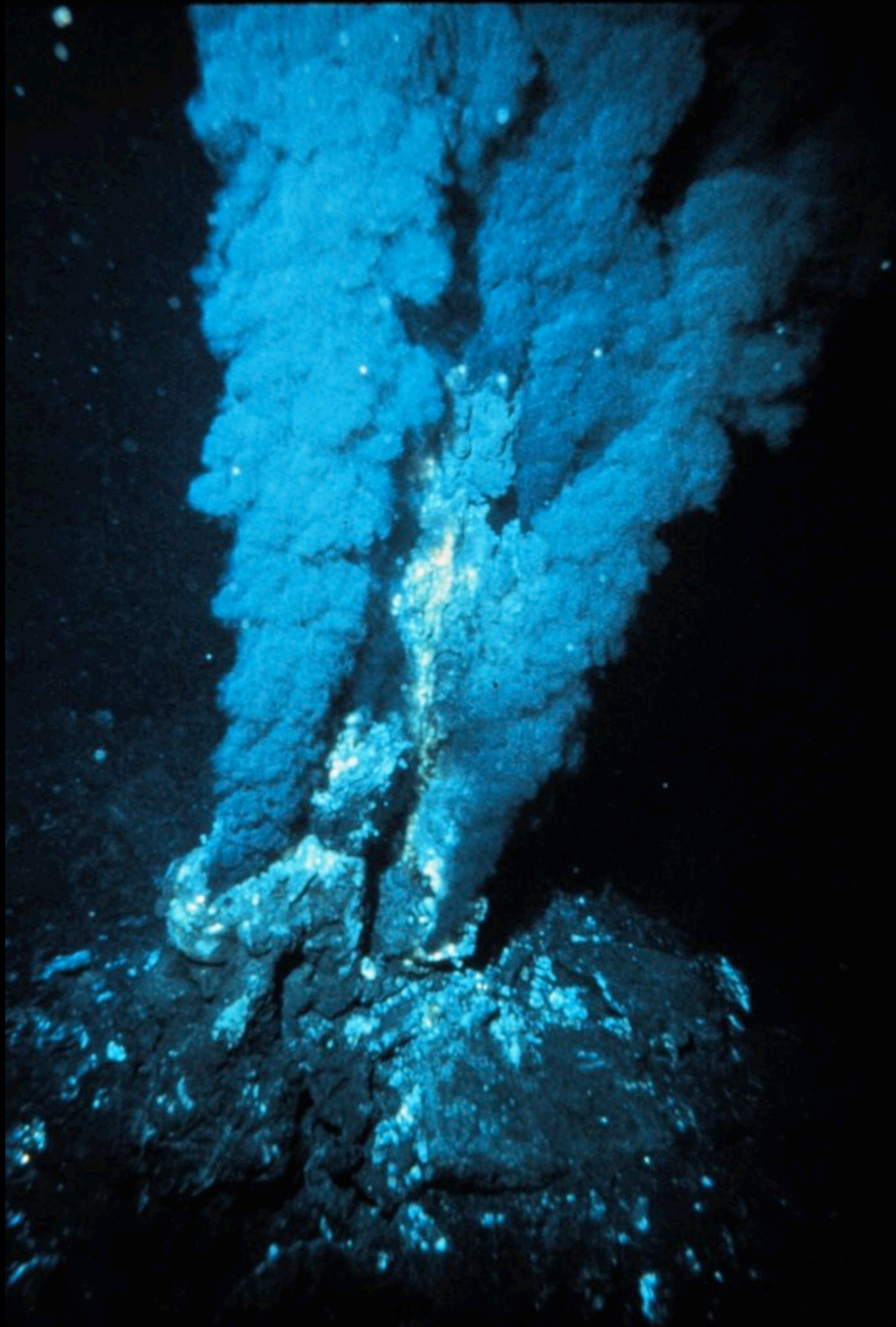
4,000,000,000 years ago





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3,800,000,000 years ago – stromatolites in Western Australia







Chara – possible sister group to the Land Plants



Cooksonia – 450,000,000 year old land plant (now extinct)



Funaria – one of 12,000 21st century mosses



300,000,000 years ago – Horsetails





The true ferns



“Seed ferns” now extinct



Seeds are a survival capsule for the embryo.
Their germination can be delayed by dormancy.
Dormancy can be **imposed** by a number of factors.

- A hard seed coat
 - Chemical inhibitors
 - An immature embryo
- These may act alone or in combination

Seeds are a survival capsule for the embryo.
Their germination can be delayed by dormancy.
Dormancy can be **broken** by a number of factors.

- Time
- Leaching
- Cold temperatures
- Heat
- Smoke
- Decay
- Chemical corrosion
- Physical abrasion

220,000,000 years ago – Araucariaceae



185 million years ago – *Ginkgo biloba*



125,000,000 years ago – the mysterious emergence of flowering plants







200,000 years ago – *Homo neanderthalensis*



Domestication of fire



11,500 years ago – the Younger Dryas event



THE EMERGENCE OF AGRICULTURE

As opposed to hunting and gathering

10,500 years ago – The Fertile Crescent





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10,000 years ago – Millet & Rice in China





8,700 years ago – Central America



Chillies at West Dean. East Sussex (cultivated for 6,000 years)





**7,000 years ago
– Andes**





6,000 years ago – Pakistan



4,000 years ago – African sorghum





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3,000 years ago – New Guinea



Other 21st century commodities

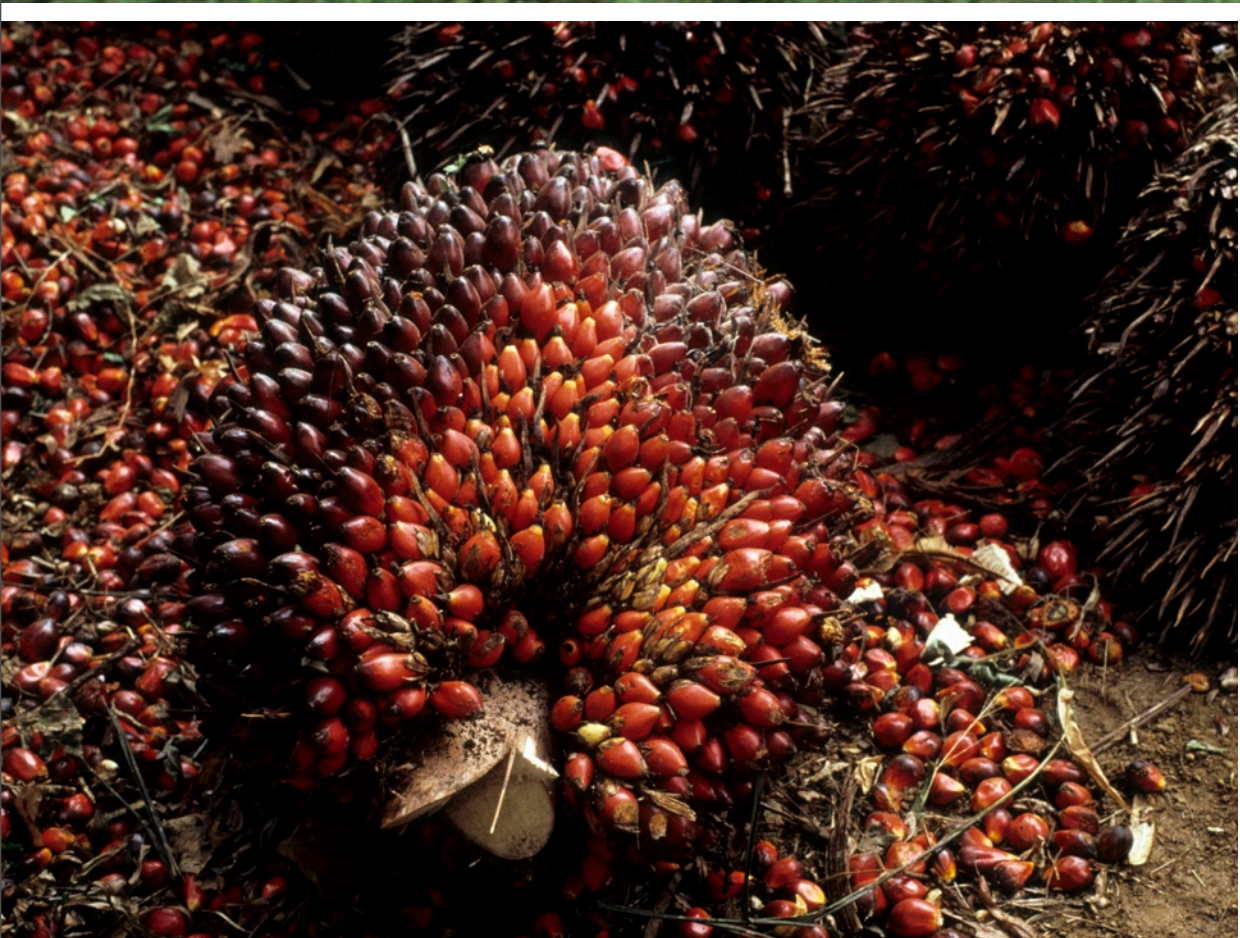




Clockwise: rape, linseed, evening primrose & lavender



Palm oil



FIBRES: Eucalyptus in southern Portugal



Haverhill cannabis houses



DRUGS – Pain-killers



**Barley for gramine &
poppies on Salisbury
Plain for opiates**



**Strophanthine from
Strophanthus and
Digoxin from
foxgloves to treat
heart disease**





**Galanthamine from
snowdrops to treat
Alzheimer's disease &
Ginkgo biloba to improve
blood circulation**



Prunus africana to treat prostate cancer



Podophyllotoxin to treat testicular cancer



Taxol & taxotere from the leaves of the English Yew to treat ovarian & breast cancers





Illicium henryi origin of shikimic acid



Why this exotic fruit is the world's only weapon against bird flu

By Jeremy Laurance
Health Editor

A rare herb grown in China used to flavour duck dishes and treat infants for colic is at the centre of a worldwide search for a cure for avian flu.

Star anise, the unusual fruit of a small oriental tree, is sold in supermarkets in the UK to consumers seeking its pungent, liquorice-like flavour.

But the herb has a vital function as the source of shikimic acid from which the drug Tamiflu is made, the only defence the world currently has against the threatened flu pandemic. Tamiflu cannot prevent infection with avian flu but it can reduce its severity.

In the absence of an effective vaccine – which has not yet been developed – it is all that stands between the world and what could become a modern plague. Shortage of star anise is one of the main reasons why countries including Britain cannot obtain enough Tamiflu to protect their populations.

The deadly H5N1 strain of the virus, which has infected more than 100 humans, killing more than 60, in the Far East, was identified this week in poultry in Turkey. Results of tests on infected birds in Romania are expected to be revealed on Monday.

European Union ministers met yesterday to discuss measures to reduce contact between wild birds and poultry to curb its spread. EU scientists agreed measures that could lead to millions of chickens and turkeys being kept indoors to prevent contact with migrating birds. In Britain, the Animal Welfare minister, Ben Bradshaw, said that the Government had not ruled out ordering free-range poultry to be moved indoors.

As moves to halt the growing threat of avian flu intensified, governments were doing their utmost to maximise stocks of Tamiflu.

The herb from which it is made is grown in four provinces in China and “huge quantities” of

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BIO-FUELS?

Miscanthus in Northamptonshire



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Surface temperature change 1976-2006

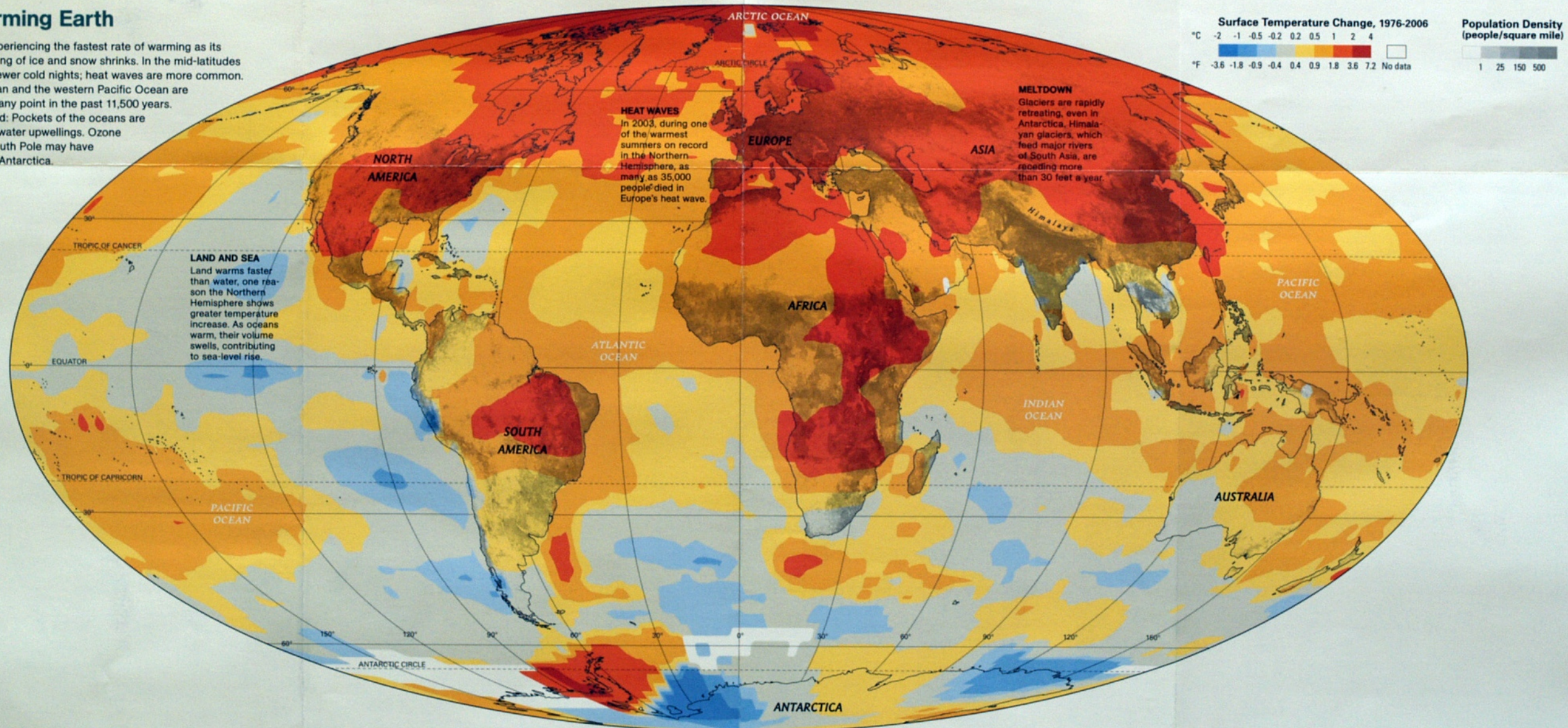
The Warming Earth

The Arctic is experiencing the fastest rate of warming as its reflective covering of ice and snow shrinks. In the mid-latitudes there are now fewer cold nights; heat waves are more common. The Indian Ocean and the western Pacific Ocean are warmer than at any point in the past 11,500 years. Against the trend: Pockets of the oceans are cooled by deepwater upwellings. Ozone loss over the South Pole may have cooled parts of Antarctica.

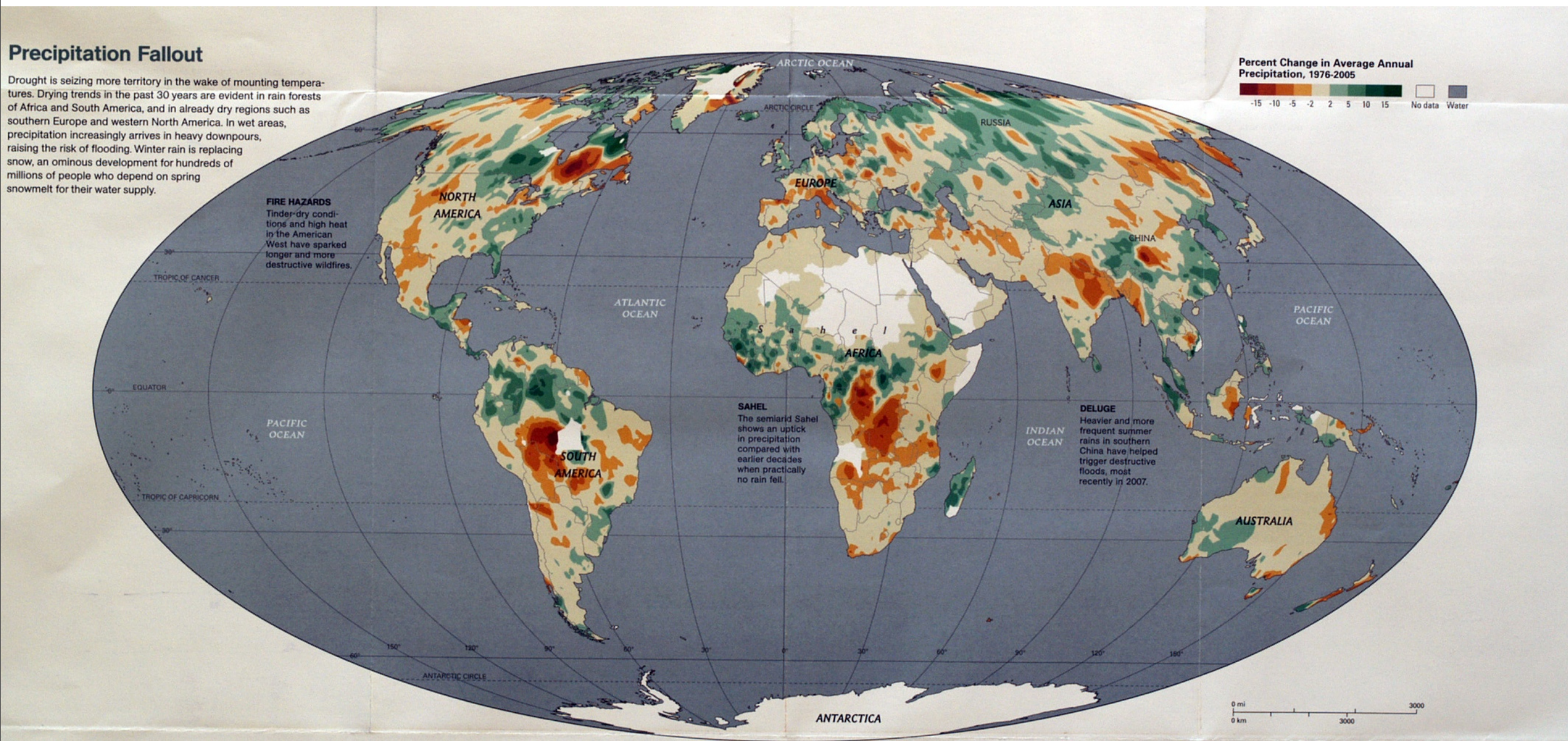
LAND AND SEA
Land warms faster than water, one reason the Northern Hemisphere shows greater temperature increase. As oceans warm, their volume swells, contributing to sea-level rise.

HEAT WAVES
In 2003, during one of the warmest summers on record in the Northern Hemisphere, as many as 35,000 people died in Europe's heat wave.

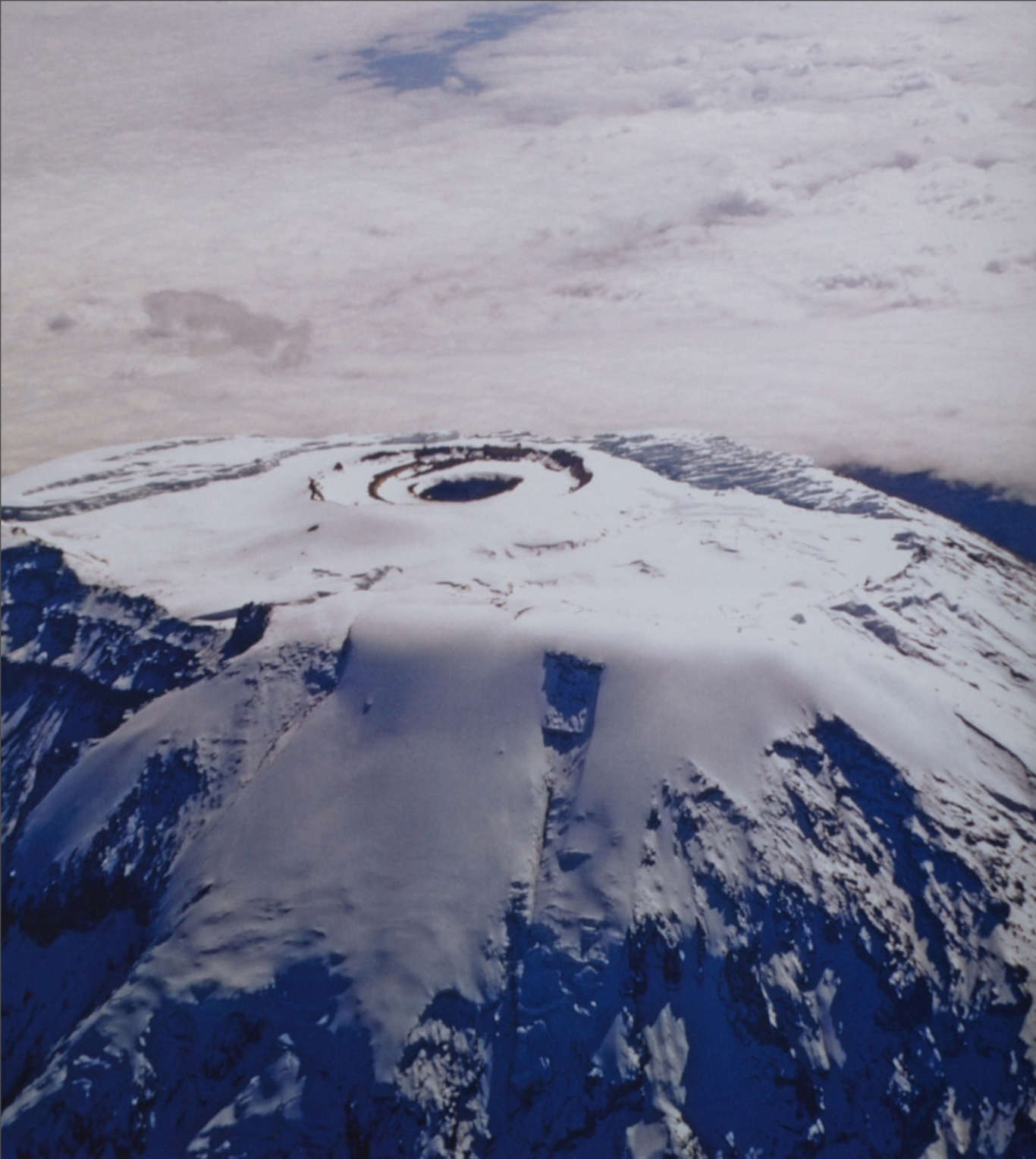
MELTDOWN
Glaciers are rapidly retreating, even in Antarctica. Himalayan glaciers, which feed major rivers of South Asia, are receding more than 30 feet a year.



% change in average annual precipitation 1976-2006

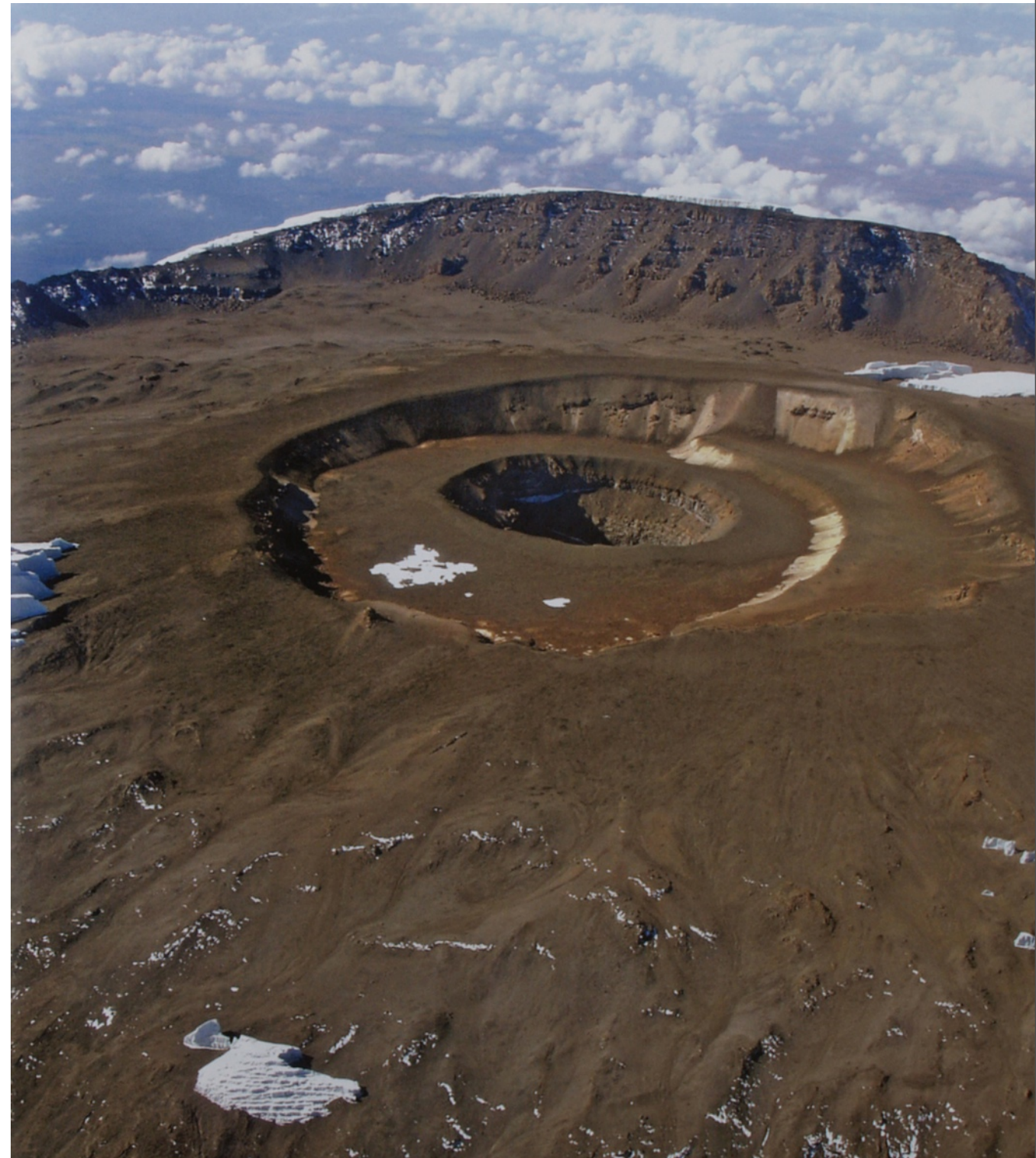


Kilimanjaro, Tanzania



▲ 1974

2005 ►



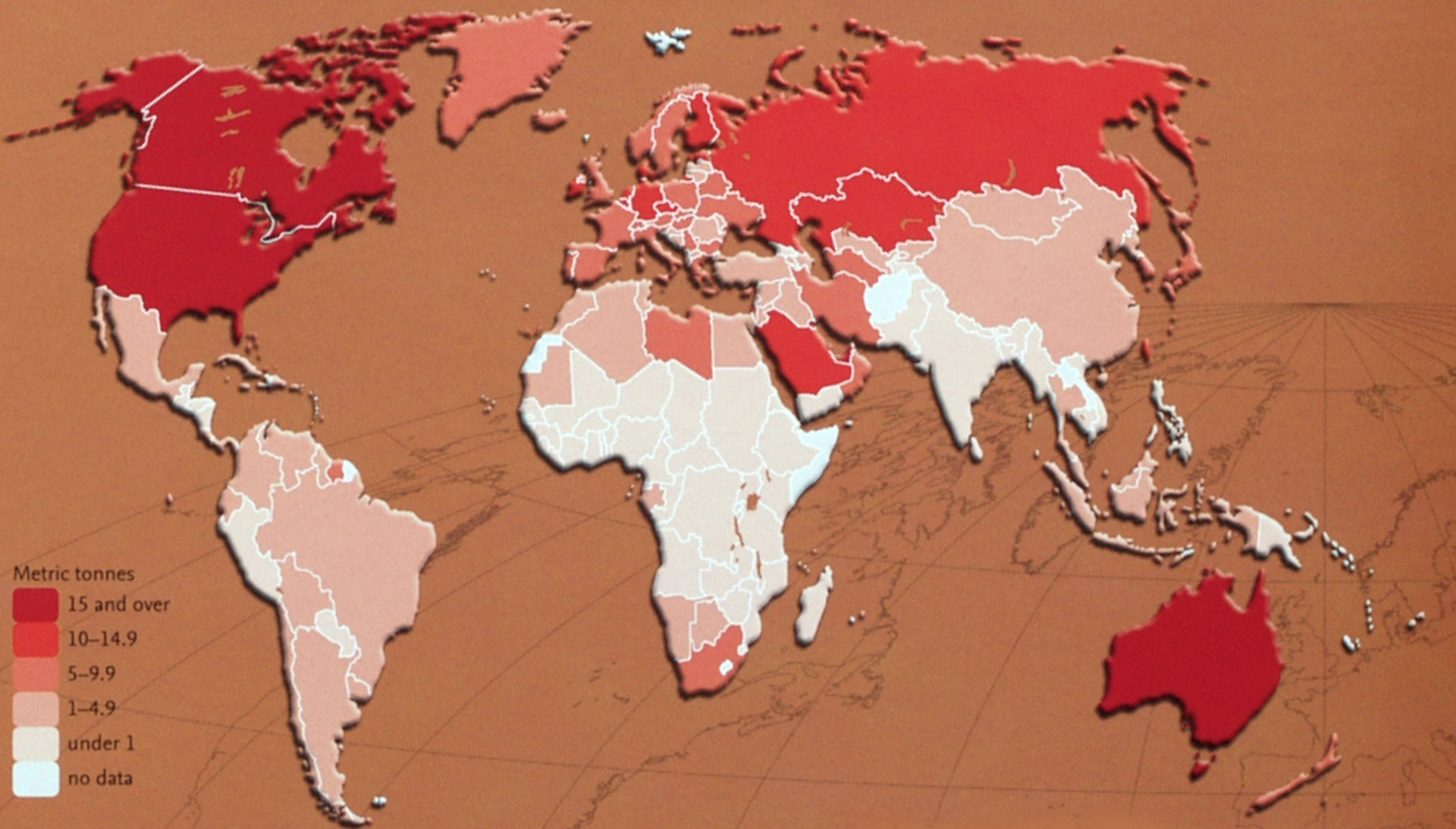




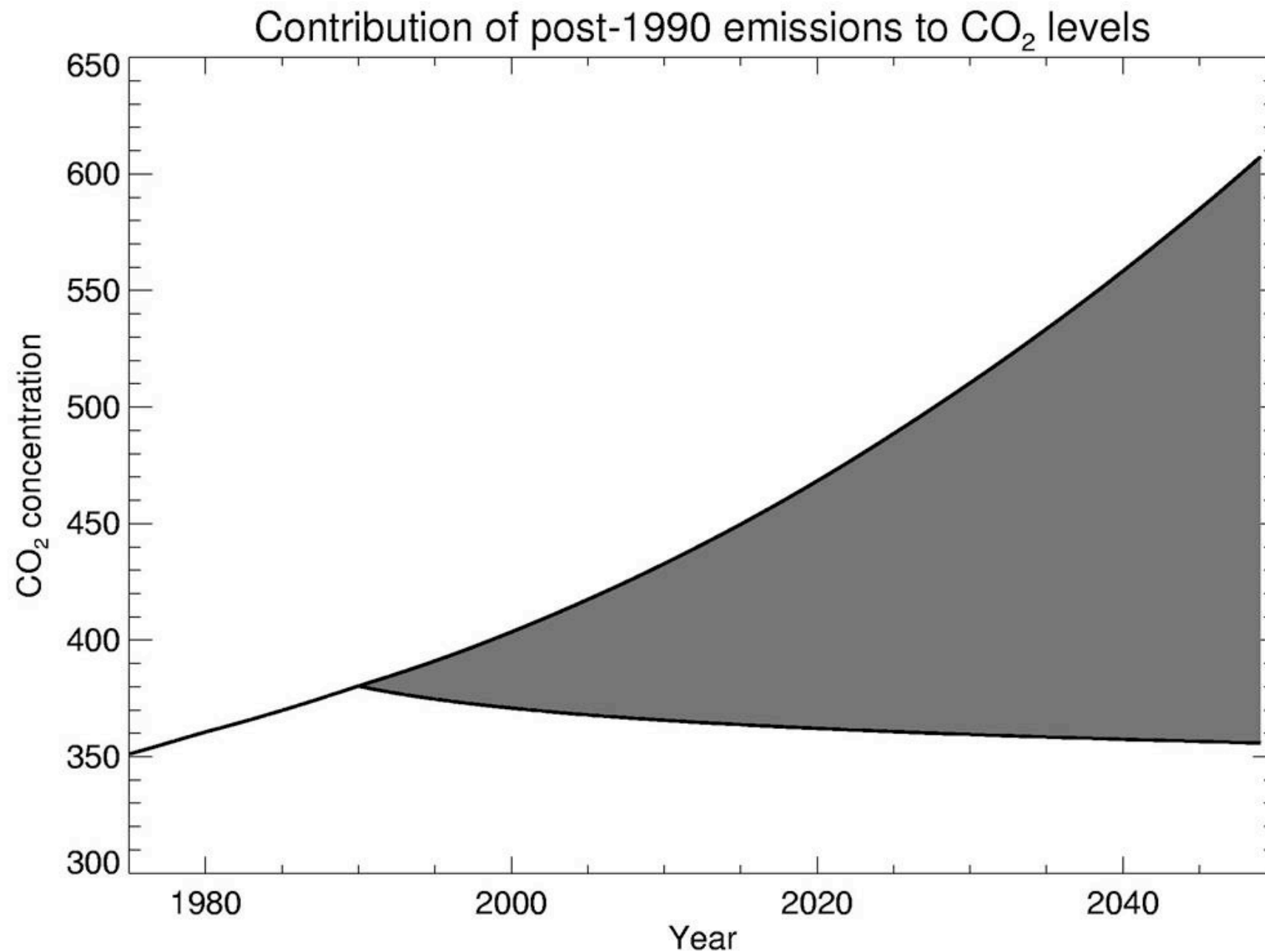
Oxford: July 23rd 2007 rain stopped play

CO₂ emissions

Emissions of CO₂ per person



By 2030 most of the excess CO₂ in the atmosphere will be due to post-1990 emissions



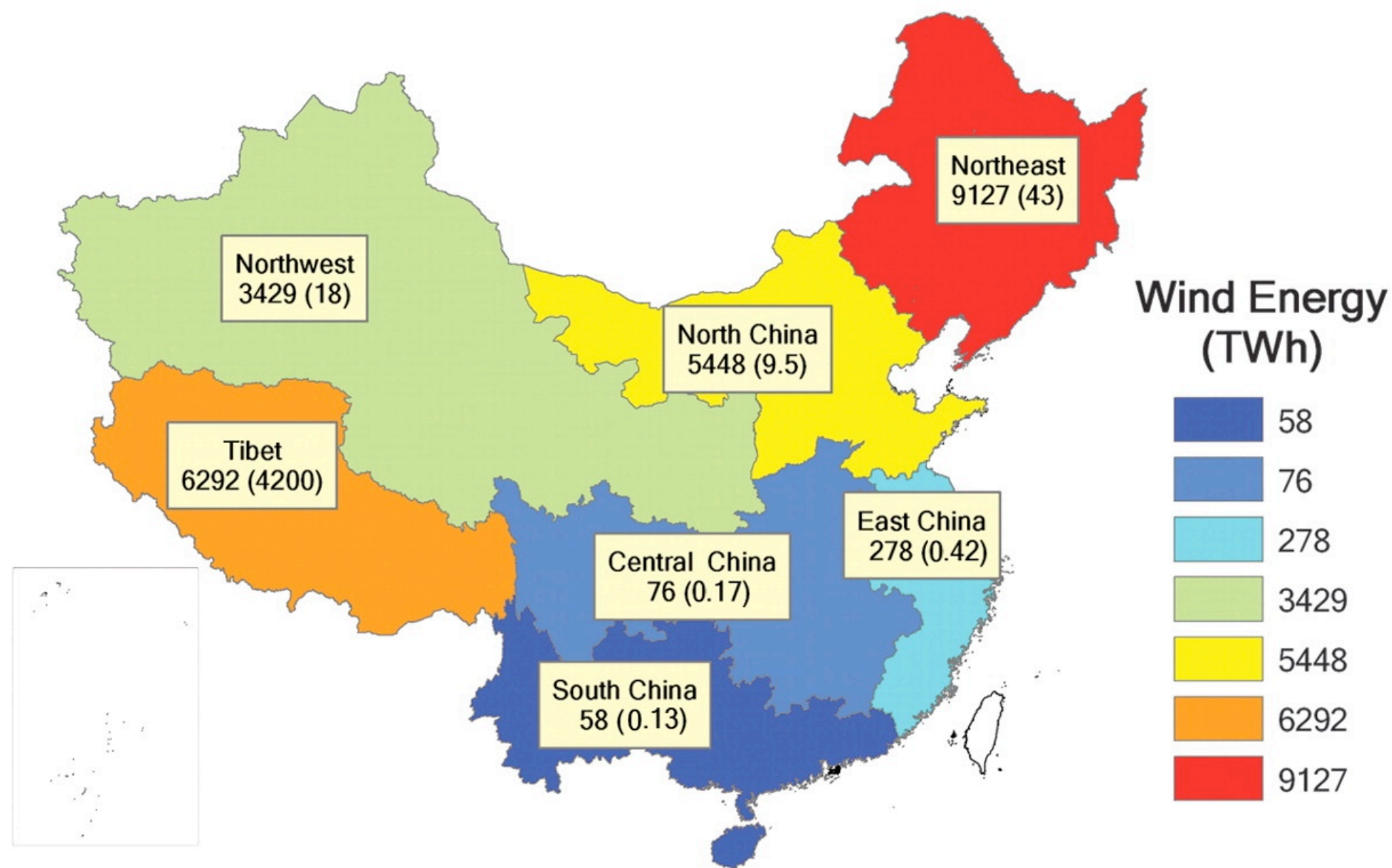
Chinese factory on the Yangtze River



Wind farm at Cape St Vincent Portugal



Potential electricity irrespective of price that could be generated over seven electric grid areas of China mainland



M. B. McElroy et al., Science 325, 1378-1380 (2009)

Published by AAAS



Projected changes in global land cover for land-use case 1 (A) and case 2 (B)

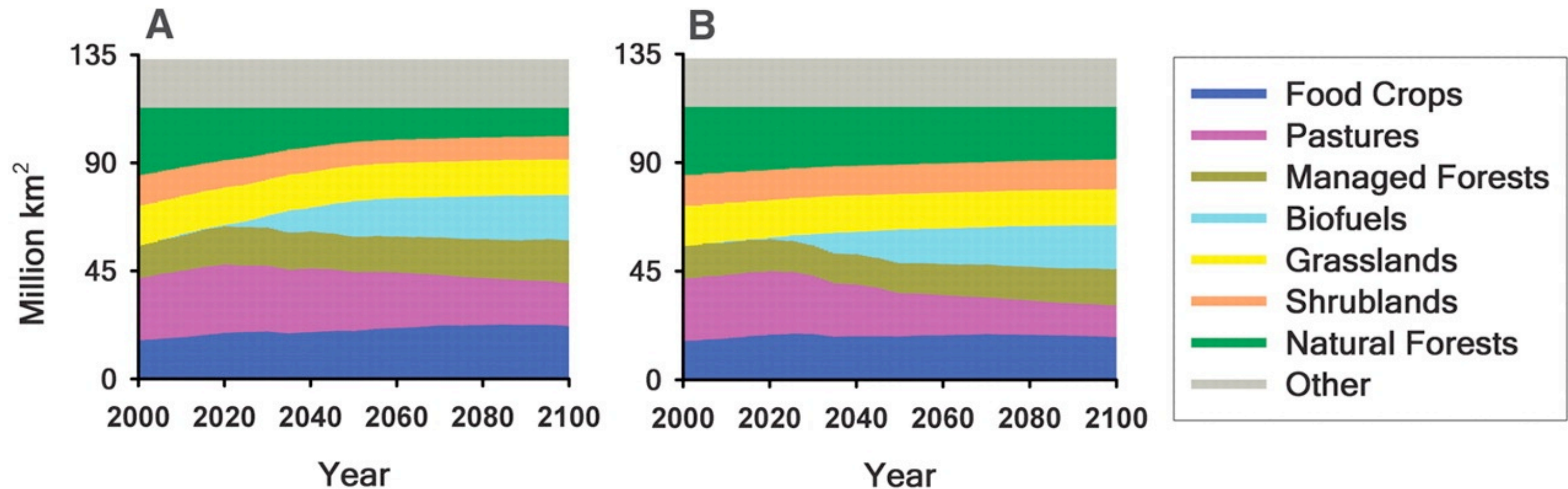


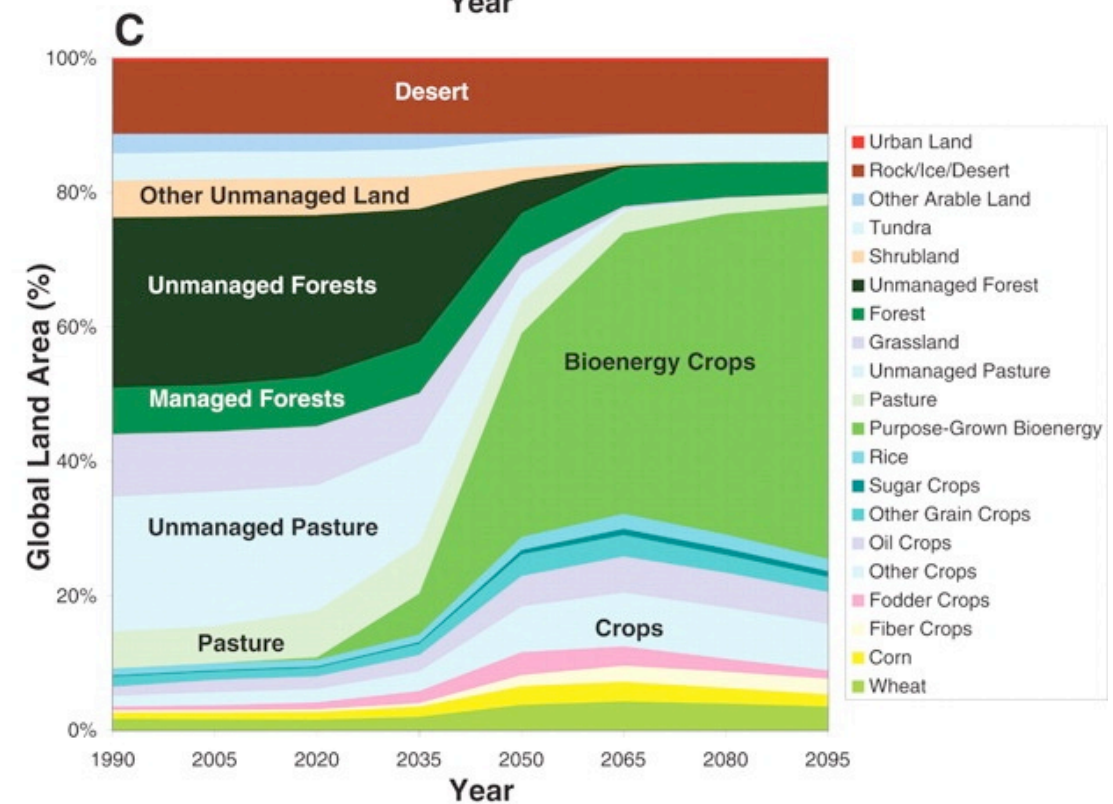
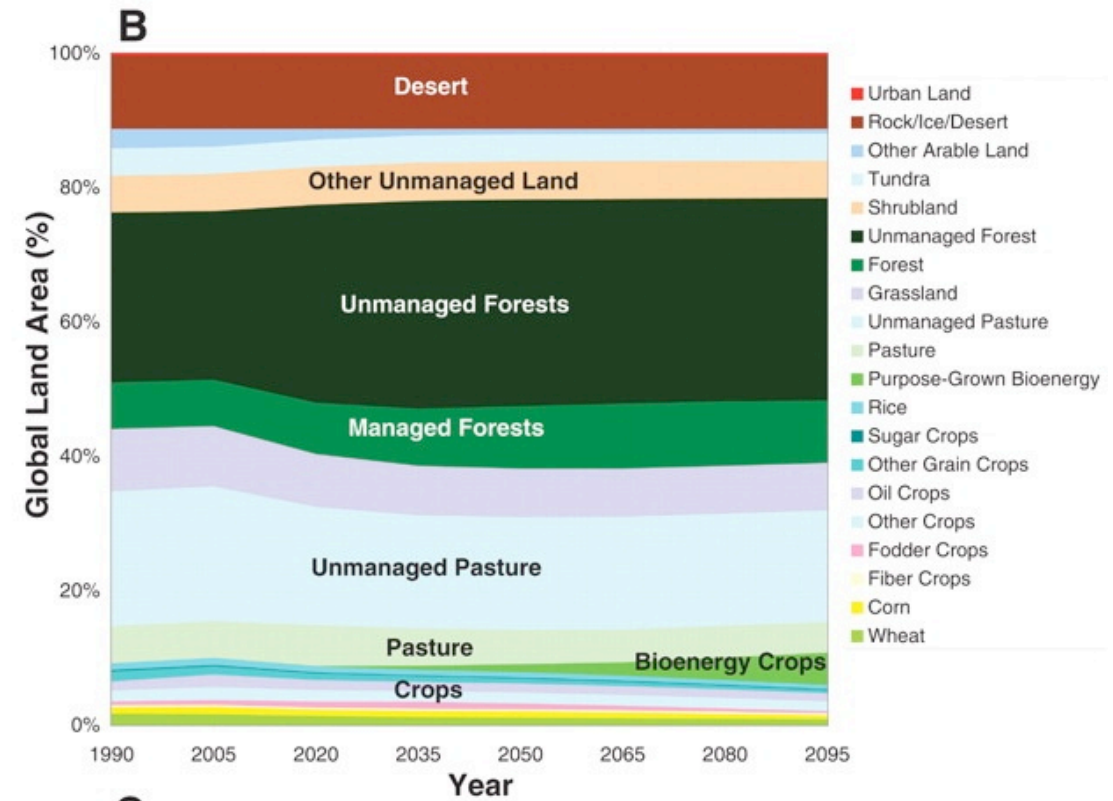
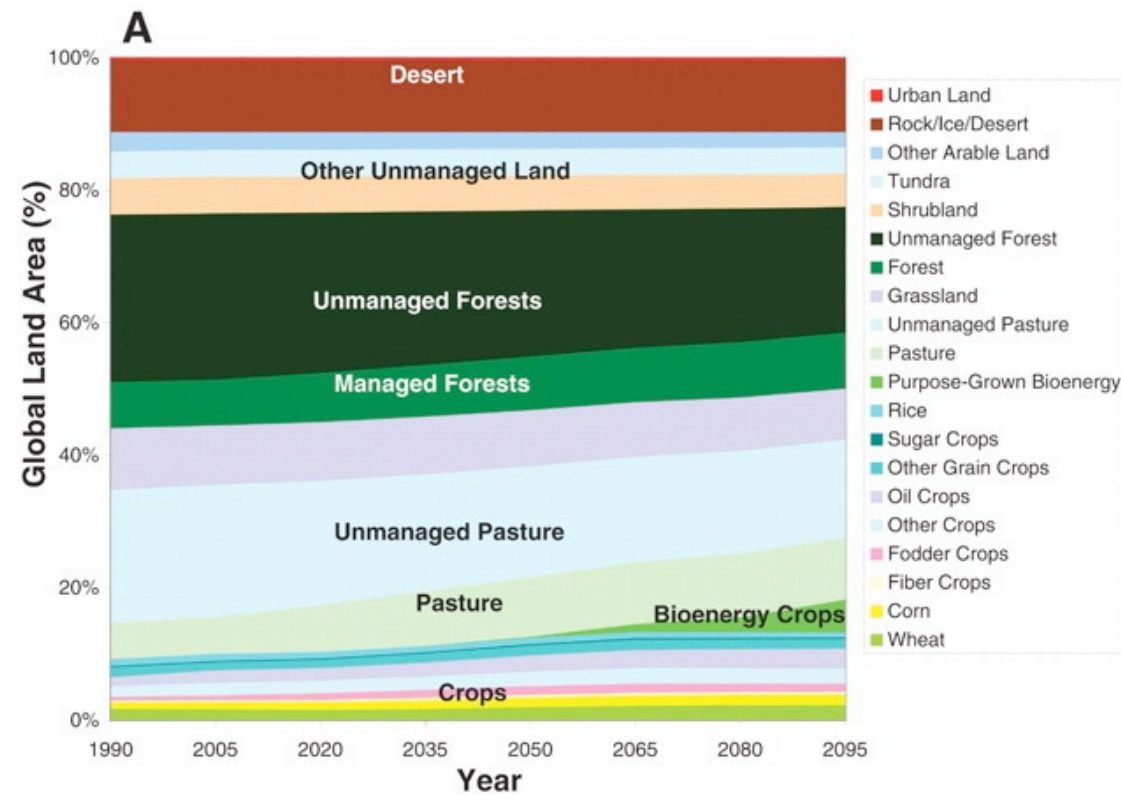
Fig. 1. Projected changes in global land cover for land-use case 1 (A) and case 2 (B). In either case, biofuels supply most of the world's liquid fuel needs by 2100. In case 1, 365 EJ of biofuel is produced in 2100, using 16.2% (21.6 million km²) of the total land area; natural forest area declines from 34.4 to 15.1 million km² (56%), and pasture area declines from 25.8 to 22.1 million km² (14%). In case 2, 323 EJ of biofuels are produced in 2100, using 20.6 million km² of land; pasture areas decrease by 10.3 million km² (40%), and forest area declines by 8.4 million km² (24% of forest area). Simulations show that these major land-use changes will take place in the tropics and subtropics, especially in Africa and the Americas (fig. S2).

J. M. Melillo et al., Science 326, 1397-1399 (2009)

Published by AAAS



Comparison of global land use under different scenarios

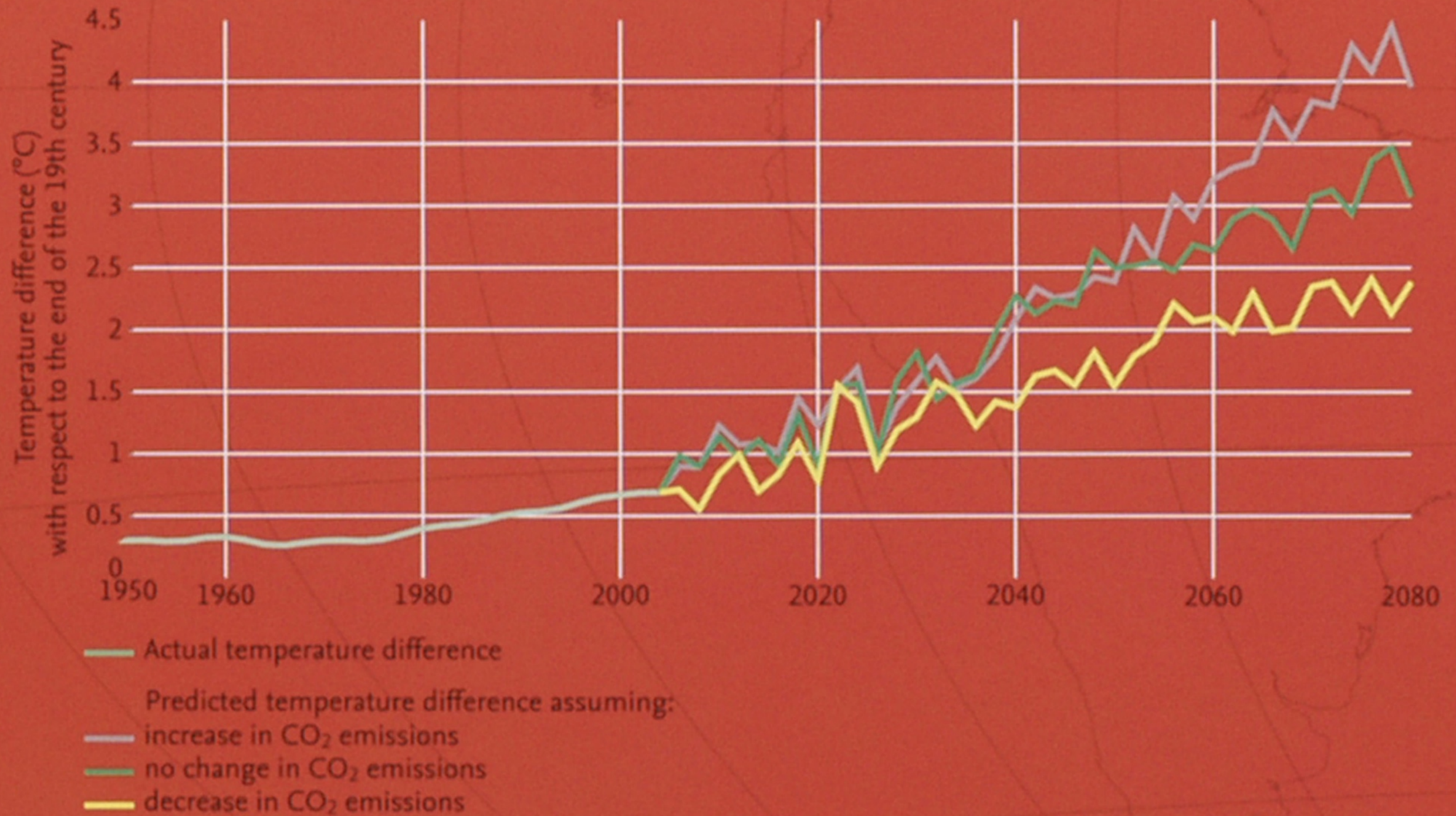


M. Wise et al., Science 324, 1183 -1186 (2009)

Published by AAAS



Global temperature increase, 1950–2080



Winners & losers from changed climate

1,424 sq.km. of *Empetrum nigrum* in North western Scandanavia had 26% less growth after an early warm Spring

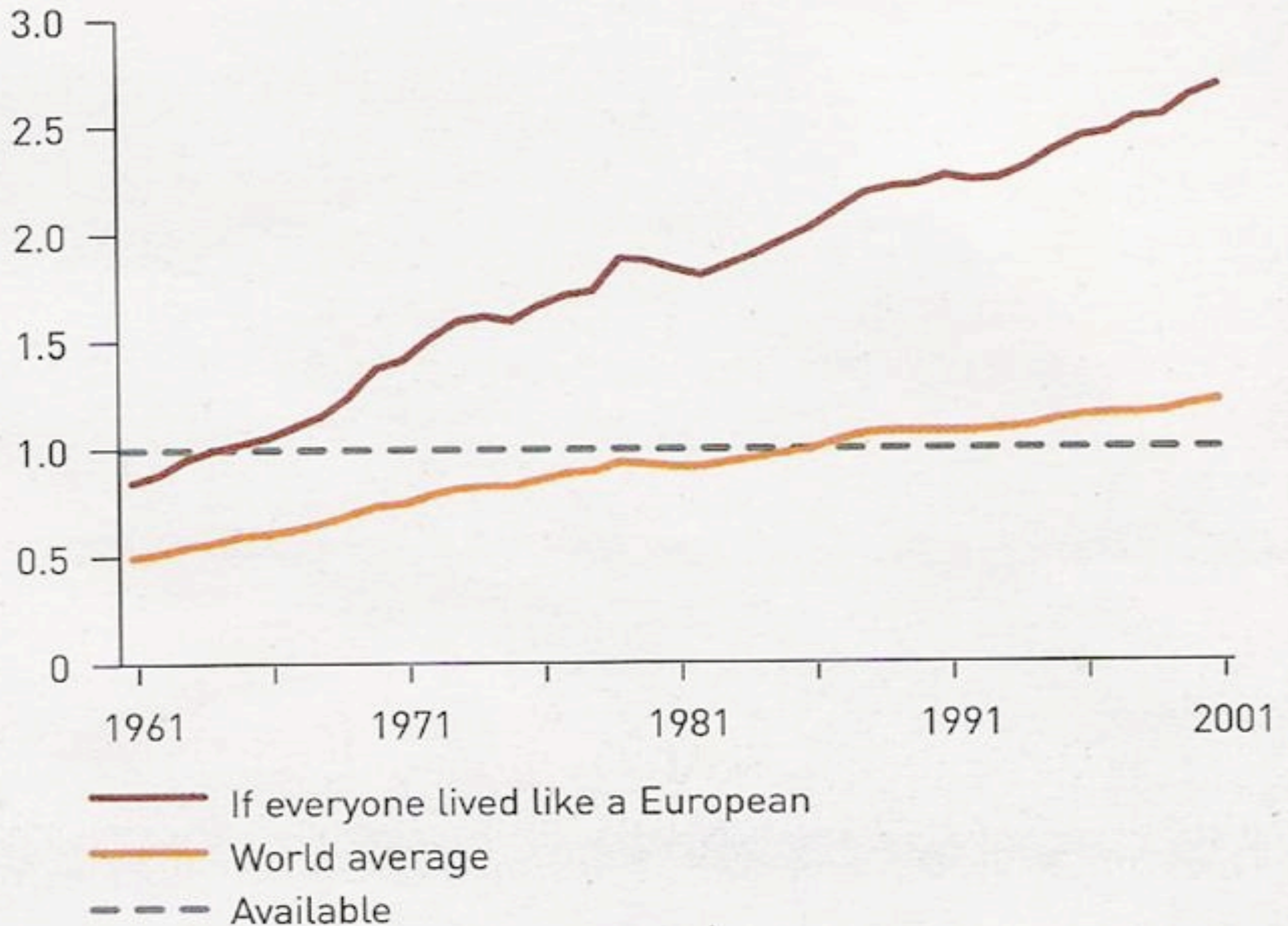
[Nature (**2009**) 460 p.1060]

919 *Populus tremuloides* trees in Wisconsin growth rate increased by 50% in the past 50 years

[Nature Reports climate change (**2010**) vol4 p2]

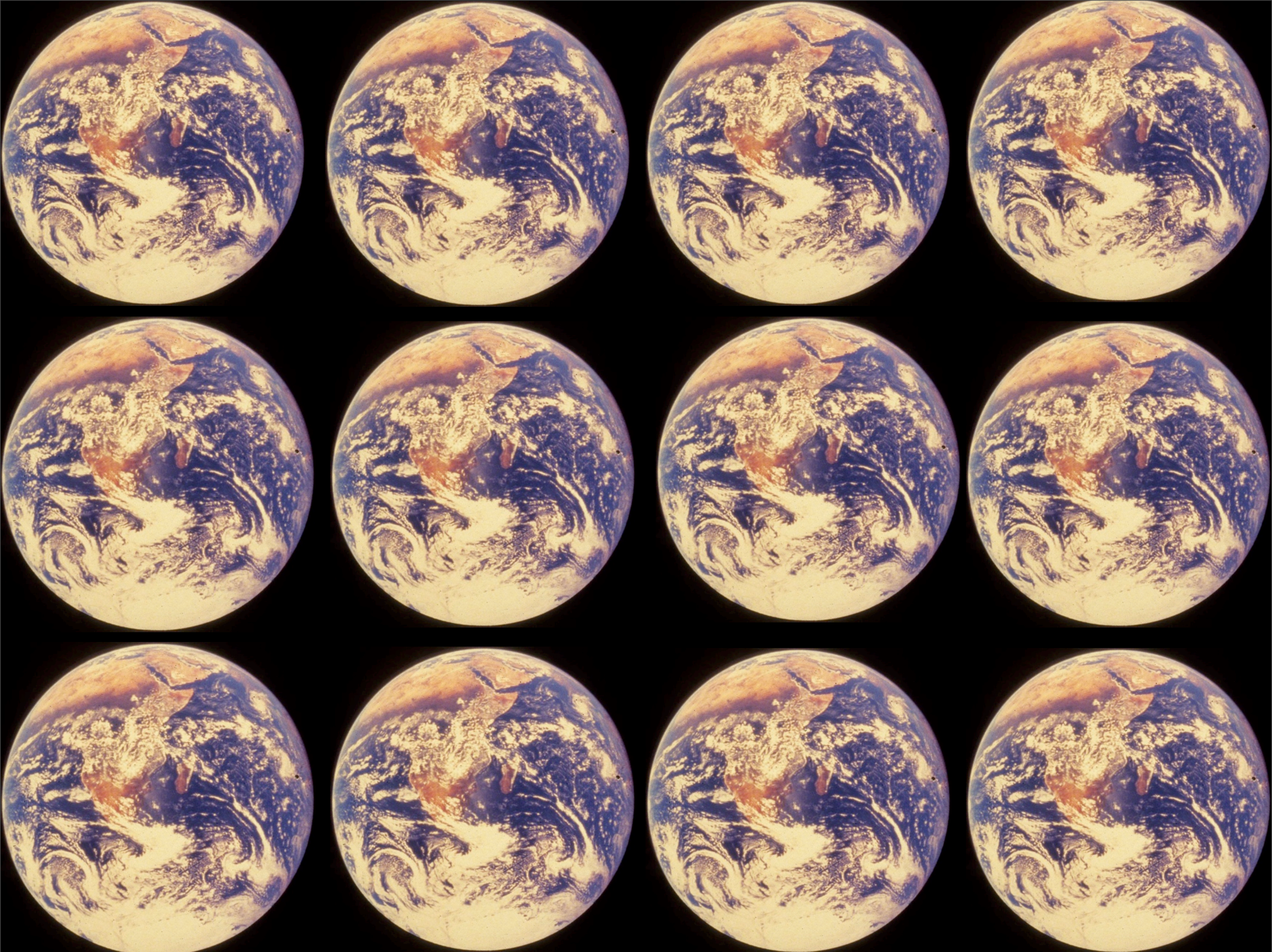


Number of planets





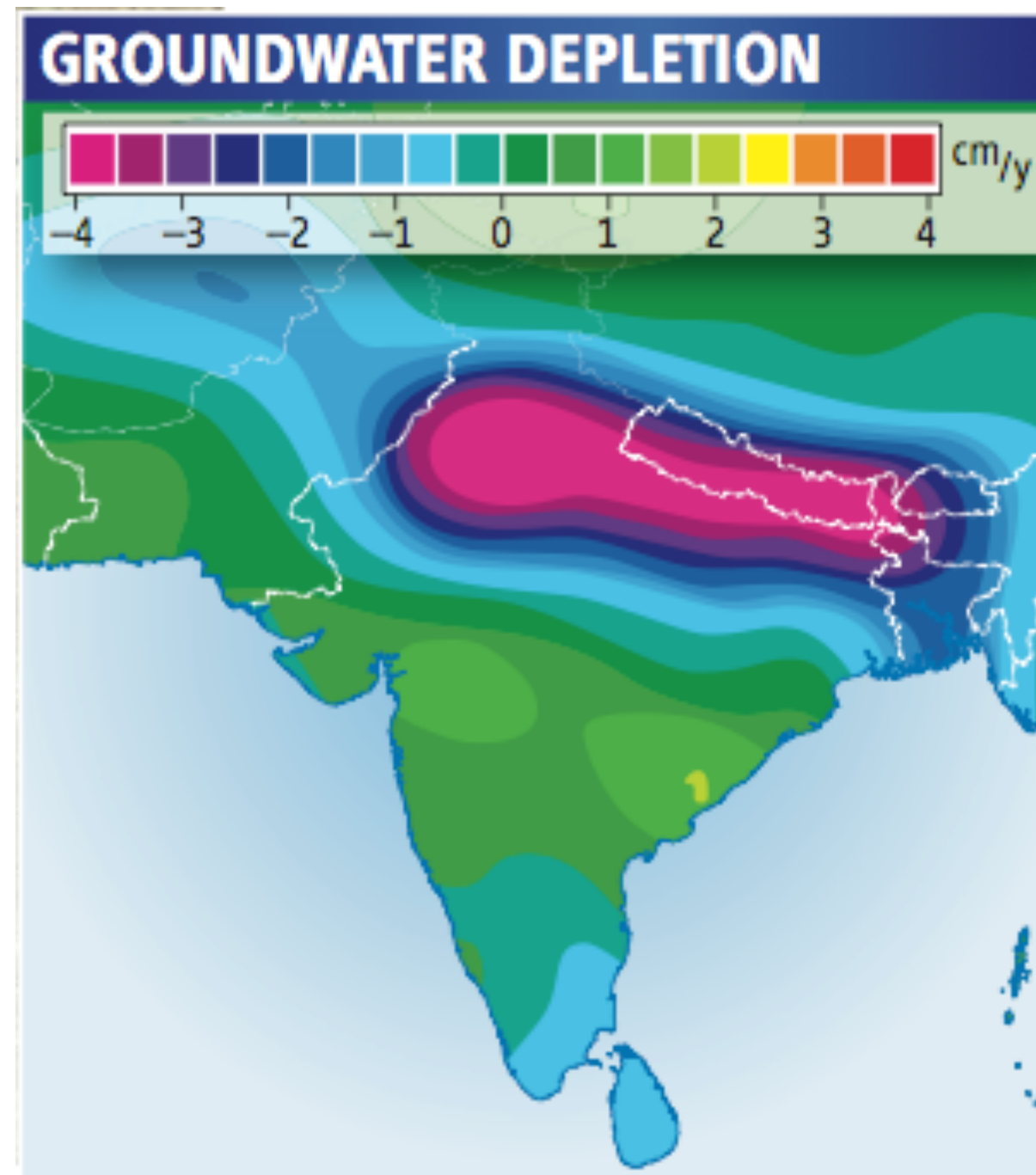




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Ground water depletion in India

Kerr (**2009**) Science 325 p.798



Do nations go to war over water?

Barnaby (**2009**) Nature 458 p.282

Irrigation requirement for Biofuels

Service (**2009**) Science 326 p.516

WATER REQUIREMENTS FOR ENERGY PRODUCTION (Liters per megawatt hour)

Petroleum Extraction	10-40
Oil Refining	80-150
Oil shale surface retort	170-681
NGCC* power plant, closed loop cooling	230-30,300
Coal integrated gasification combined-cycle	~900
Nuclear power plant, closed loop cooling	~950
Geothermal power plant, closed loop tower	1900-4200
Enhanced oil recovery	~7600
NGCC*, open loop cooling	28,400-75,700
Nuclear power plant, open loop cooling	94,600-227,100
Corn ethanol irrigation	2,270,000-8,670,000
Soybean biodiesel irrigation	13,900,000-27,900,000

*Natural Gas Combined Cycle

Breeding plants in the future





Golden rice, rich in Vitamin A





Will / does the crop escape?







Will / does the crop hybridize with UK species?







Does the crop escape?
Does the crop hybridize with UK natives?
How far does the pollen travel?





**What have plants ever
done for us?**

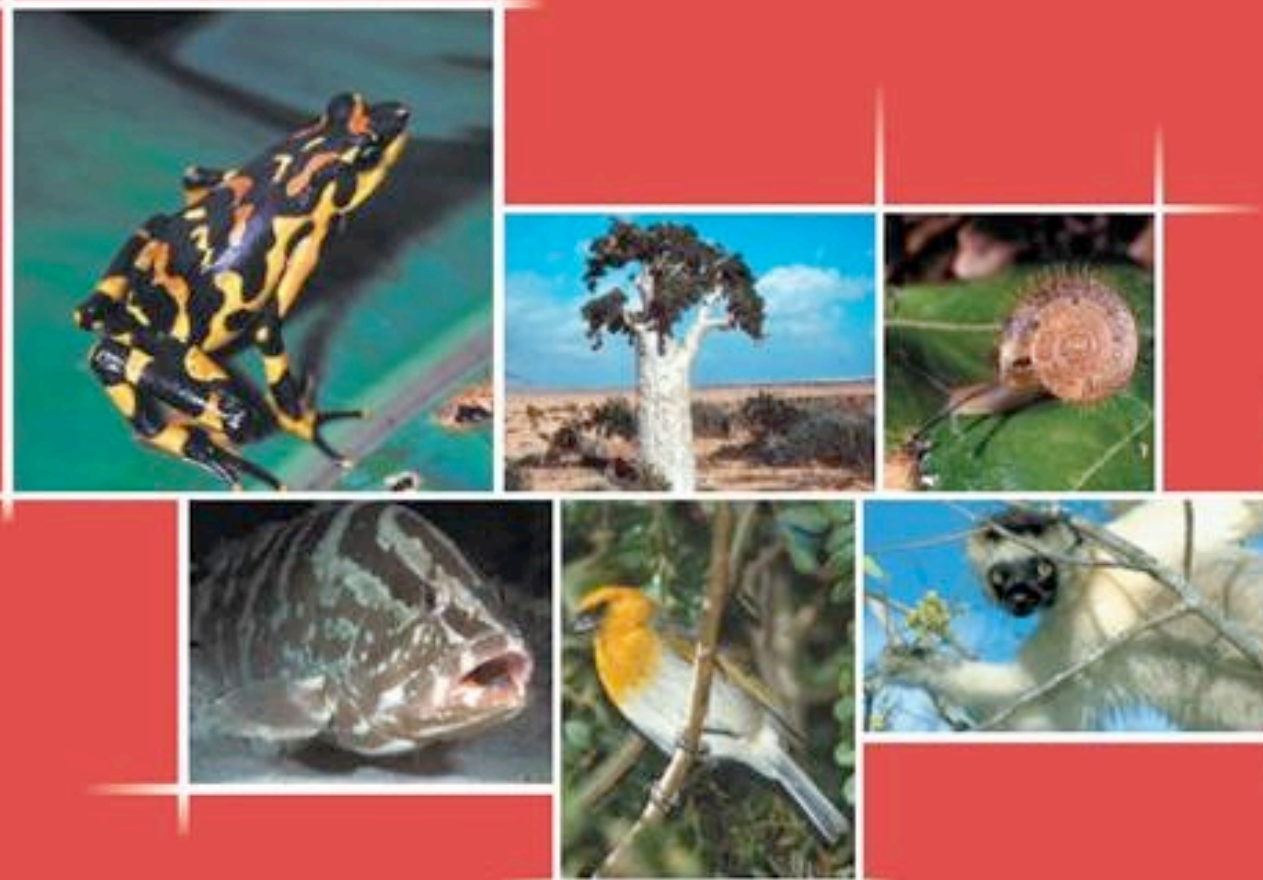
What have plants ever
done for us?

EVERYTHING

The IUCN Species Survival Commission

2004 IUCN Red List of Threatened Species™

A Global Species Assessment



Edited by

Jonathan E.M. Baillie, Craig Hilton-Taylor and Simon N. Stuart

The Red List Consortium

IUCN
The World Conservation Union

SSC
Species Survival Commission

BirdLife
INTERNATIONAL

CONSERVATION
INTERNATIONAL

CENTRE
FOR APPLIED
BIODIVERSITY
SCIENCE

NatureServe

2008 estimate

28% of all plant species are threatened with extinction by 2058



Mummy?
What did **you** do to
prevent the
extinction of plant
species?

*Ask not what have plants ever
done for us but*

**WHAT CAN WE DO
FOR PLANTS?**

Politicians must be involved in conservation





**Local people must take
ownership of the
problems**

Pragmatic compromises will be required





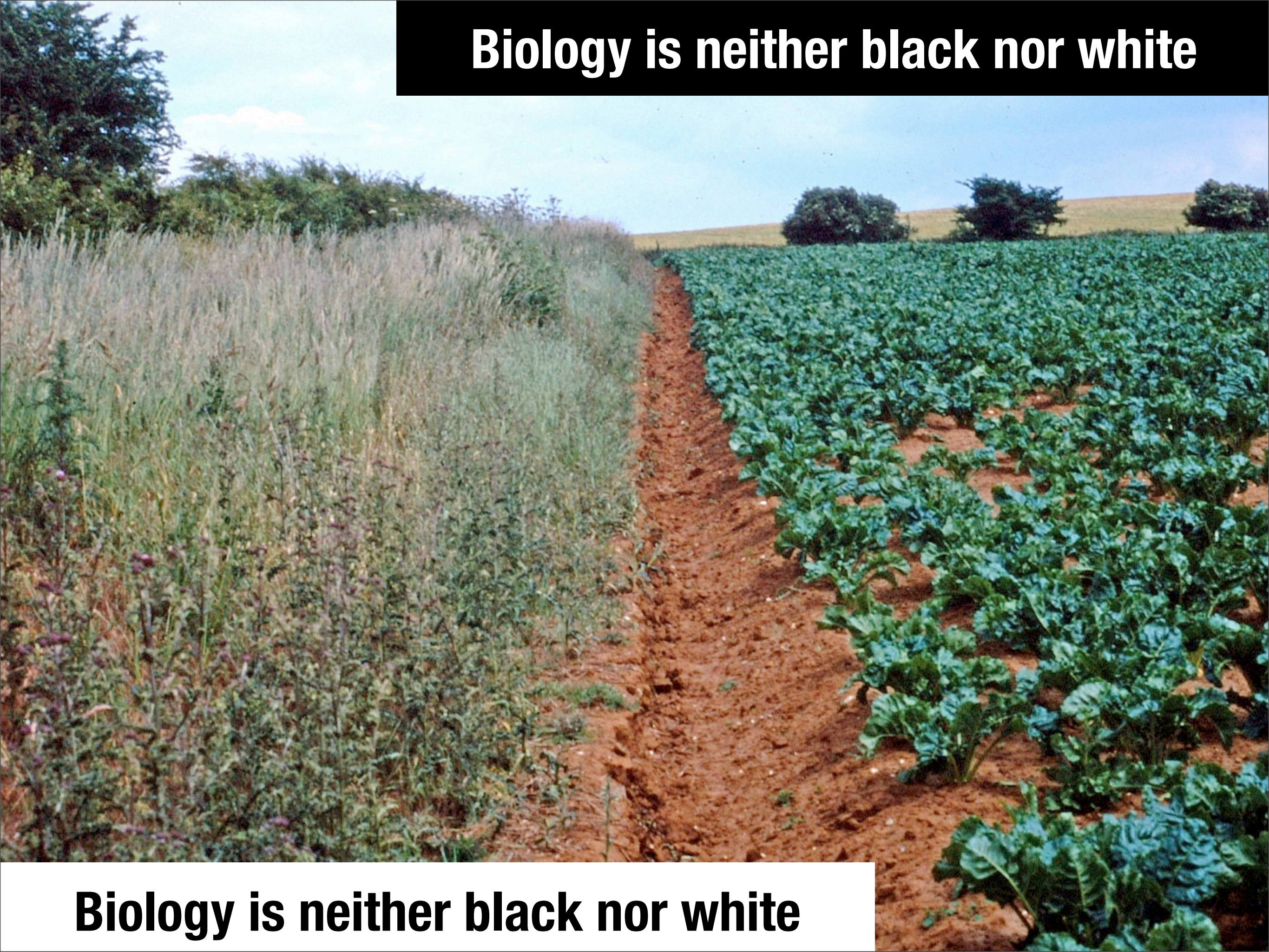
The managed wild

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Defeatism is a self-fulfilling prophecy but it is not an option



Biology is neither black nor white



Biology is neither black nor white