Sustainable agriculture in a rapidly changing world

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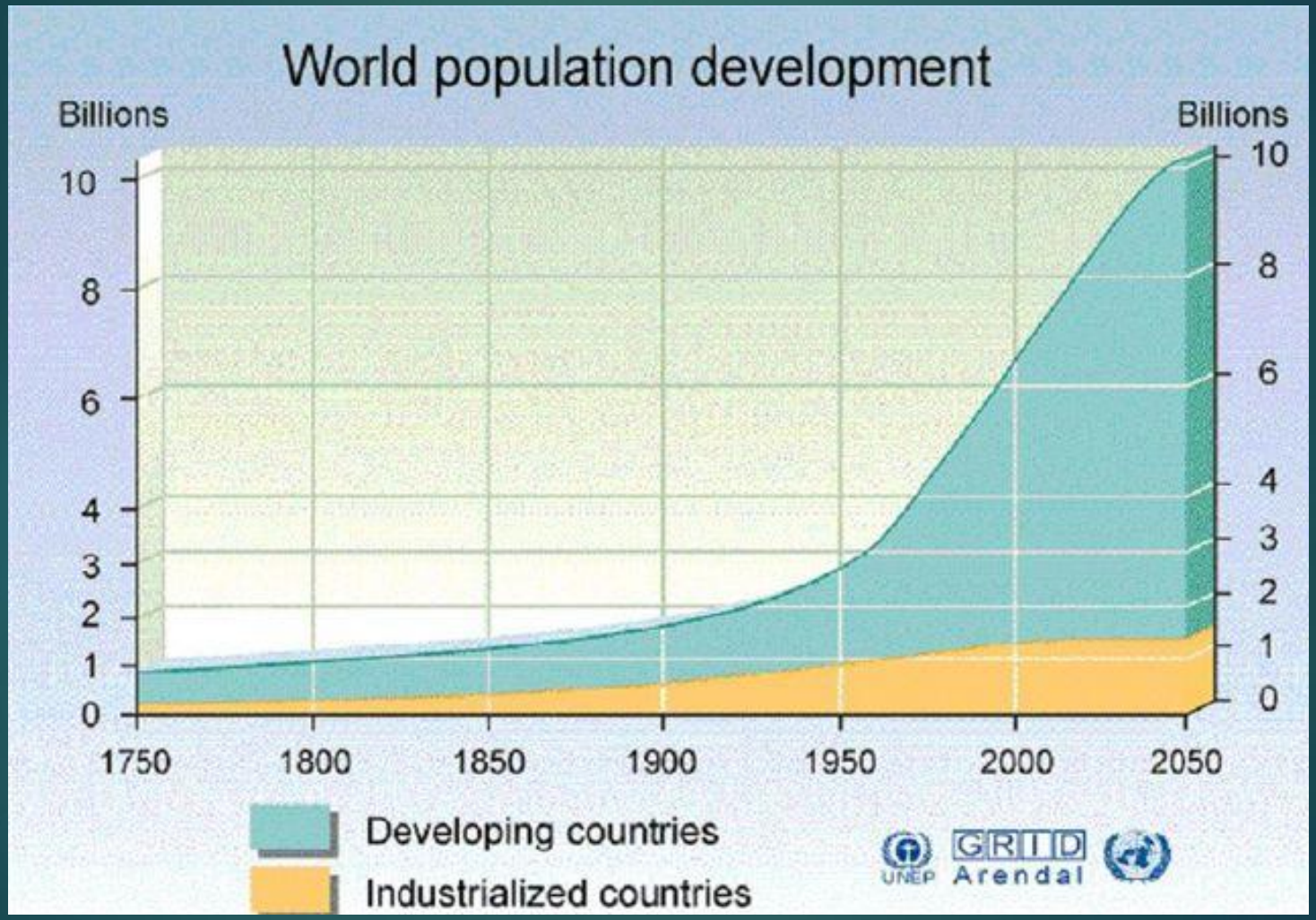
CHRISTIANS IN SCIENCE, BRISTOL
(25TH JANUARY 2019)

The Plan

- The Problems
- The Solutions
- A Short Theological Reflection

Problems: Human Population



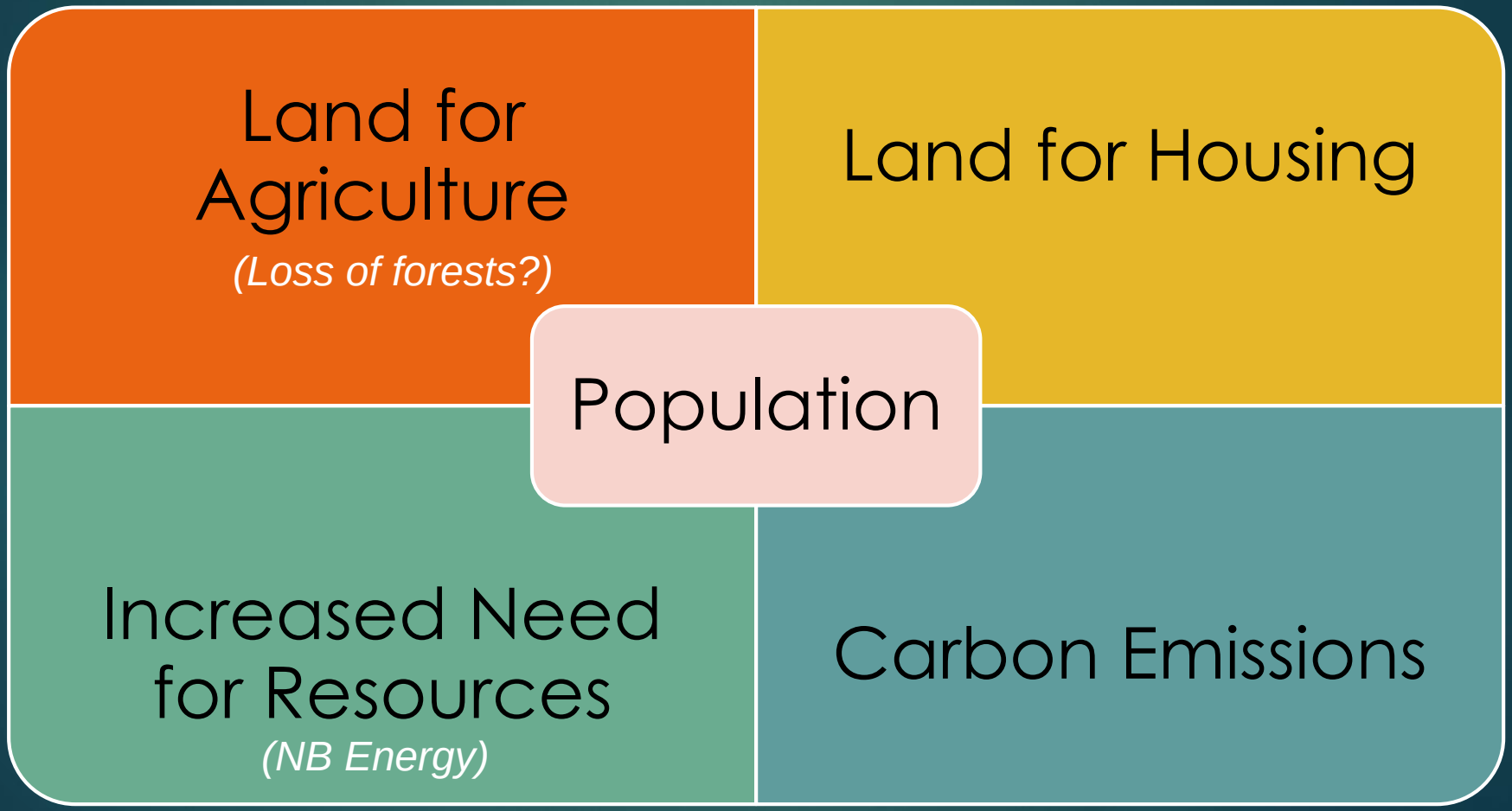
World Population Growth

- 10,000 yrs bp – few million
- 1 AD 250 million
- 1500 461 million
- 1900 1.6 billion (1,600 million)
- 1950 2.5 billion (2,500 million)
- 1960 3.0 billion (3,000 million)
- 2000 6.0 billion (6,000 million)
- 2009 6.8 billion (6,800 million)
- 2019 7.7 billion (7,700 million)

Where is Population Highest?

- China and India have the largest populations
- African population is due to grow by one billion this century

Population/Environment Interactions



Is There an Upper Limit?

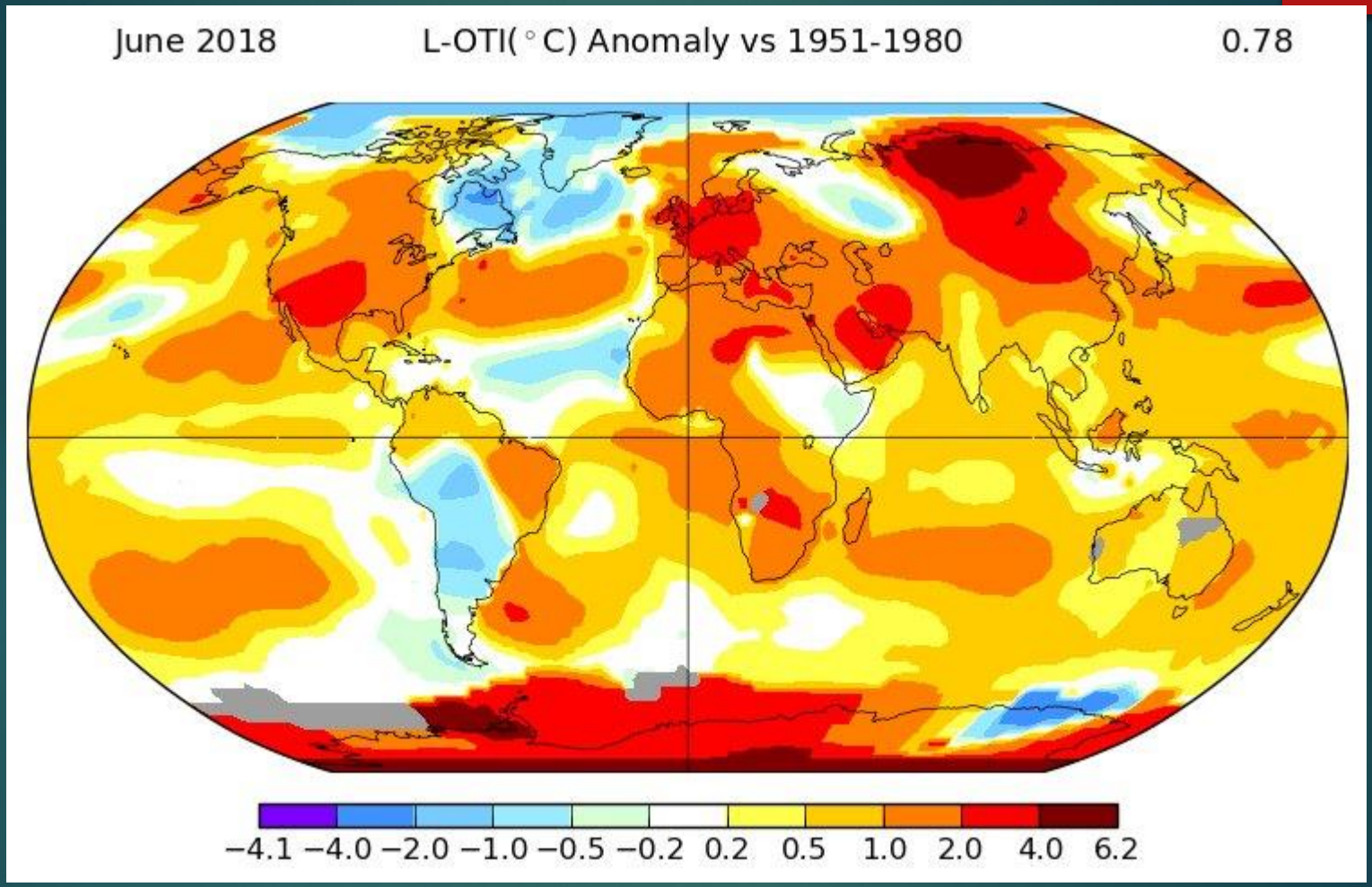
- Carrying capacity
- Determined by food supply
- Agricultural technology
- Political, cultural, social restrictions
- 10 billion?? Really???
- 9 billion by 2050??

Population- Relationship to Global Warming

- there is an approximate relationship between human population and carbon dioxide emissions
- But this hides a complex picture

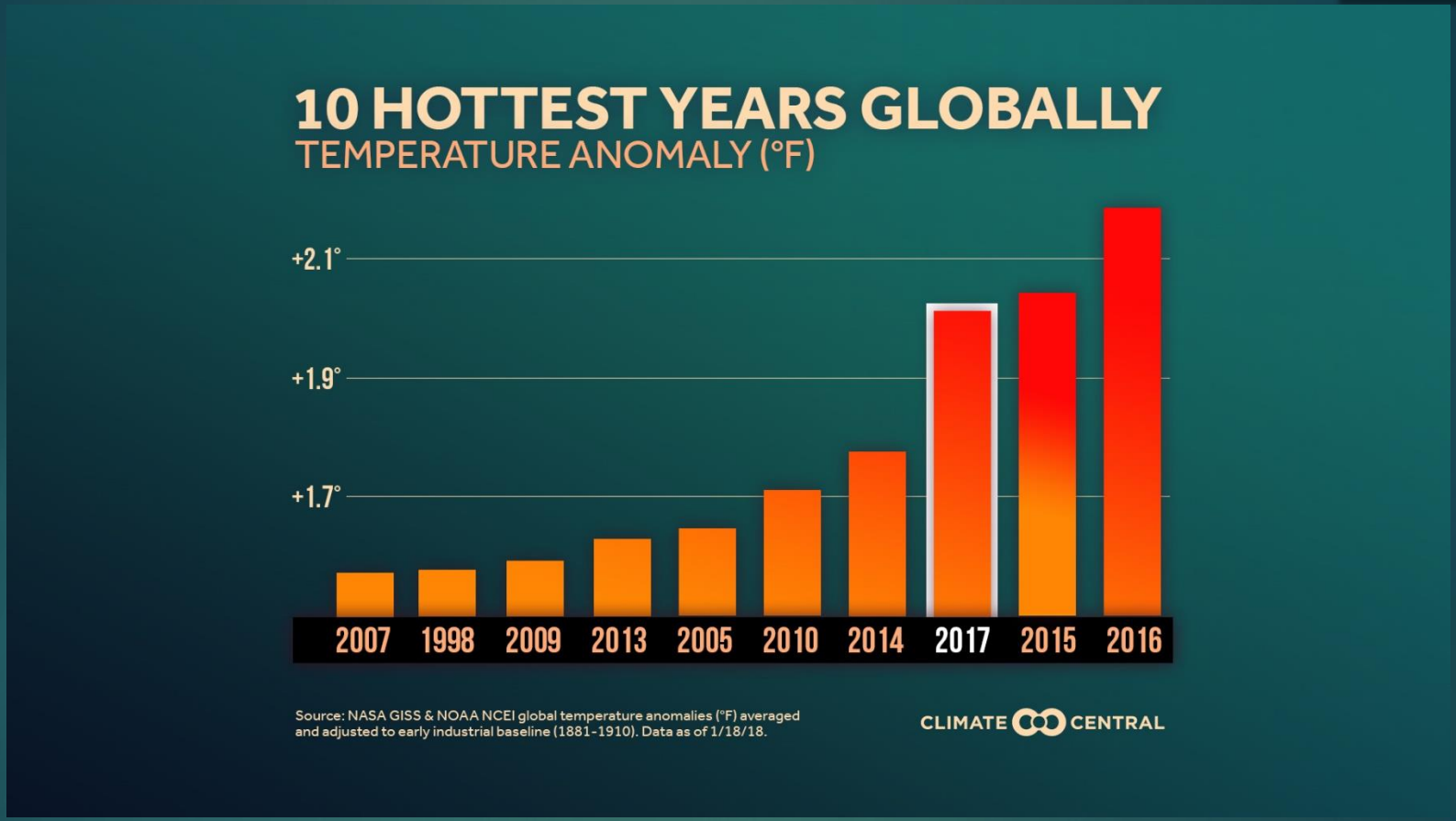
Problems: Climate Change

1976 and 2018



Credit: Simon Lee

Ten hottest years



Australian Climate Sceptic Blog

- Judge: “I find you innocent of all charges”
- CO2: “I was framed your honour”

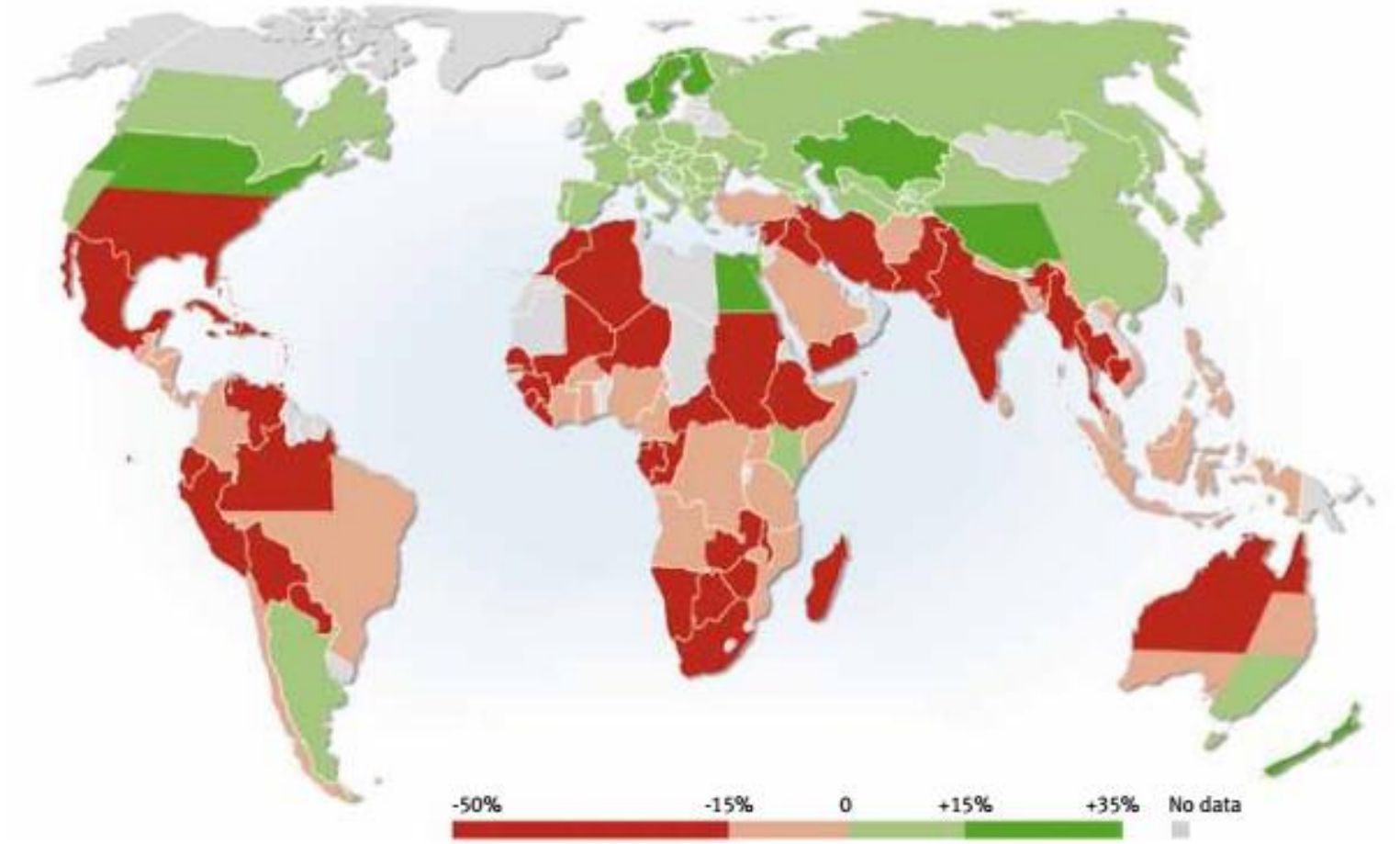
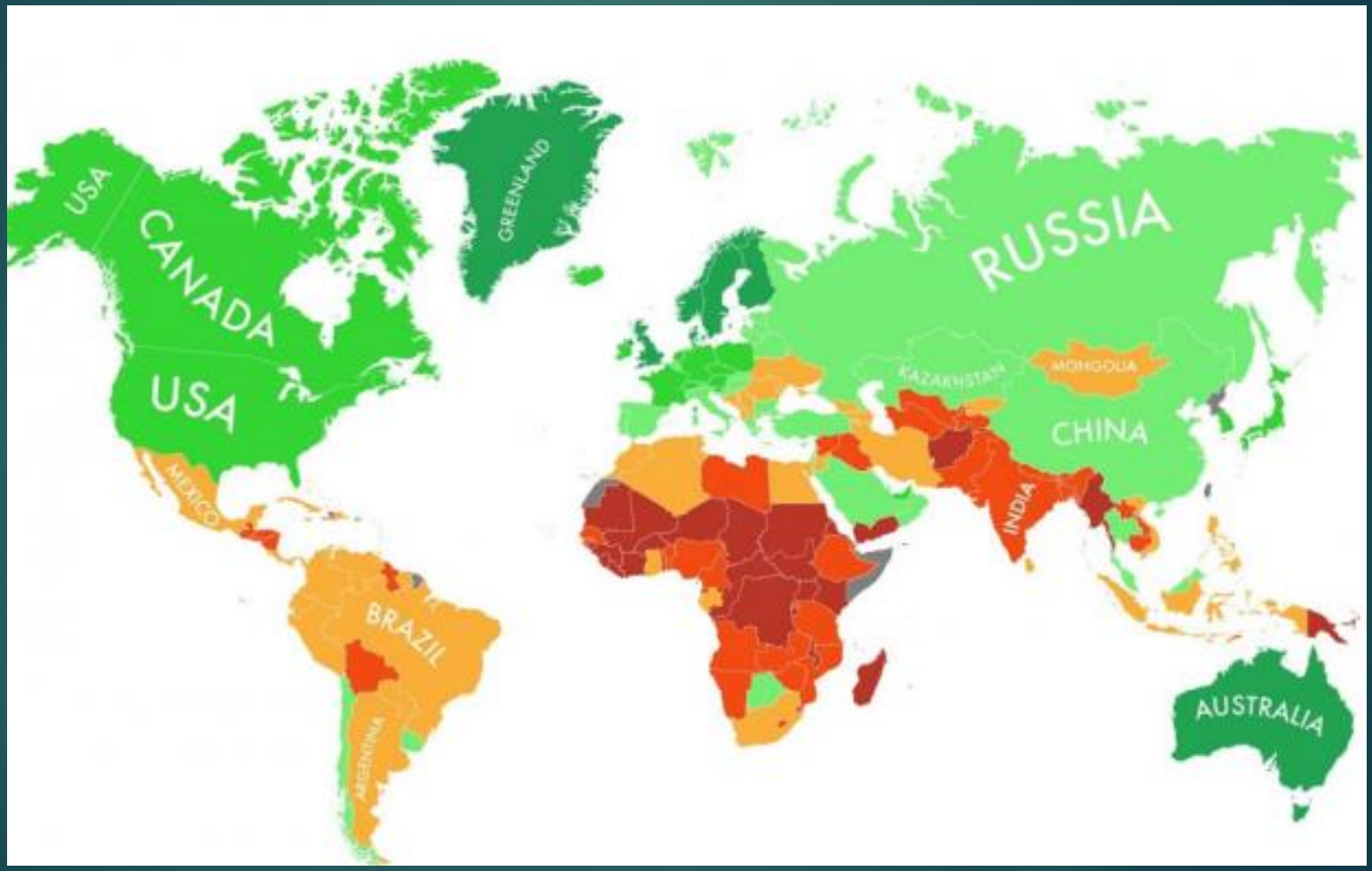
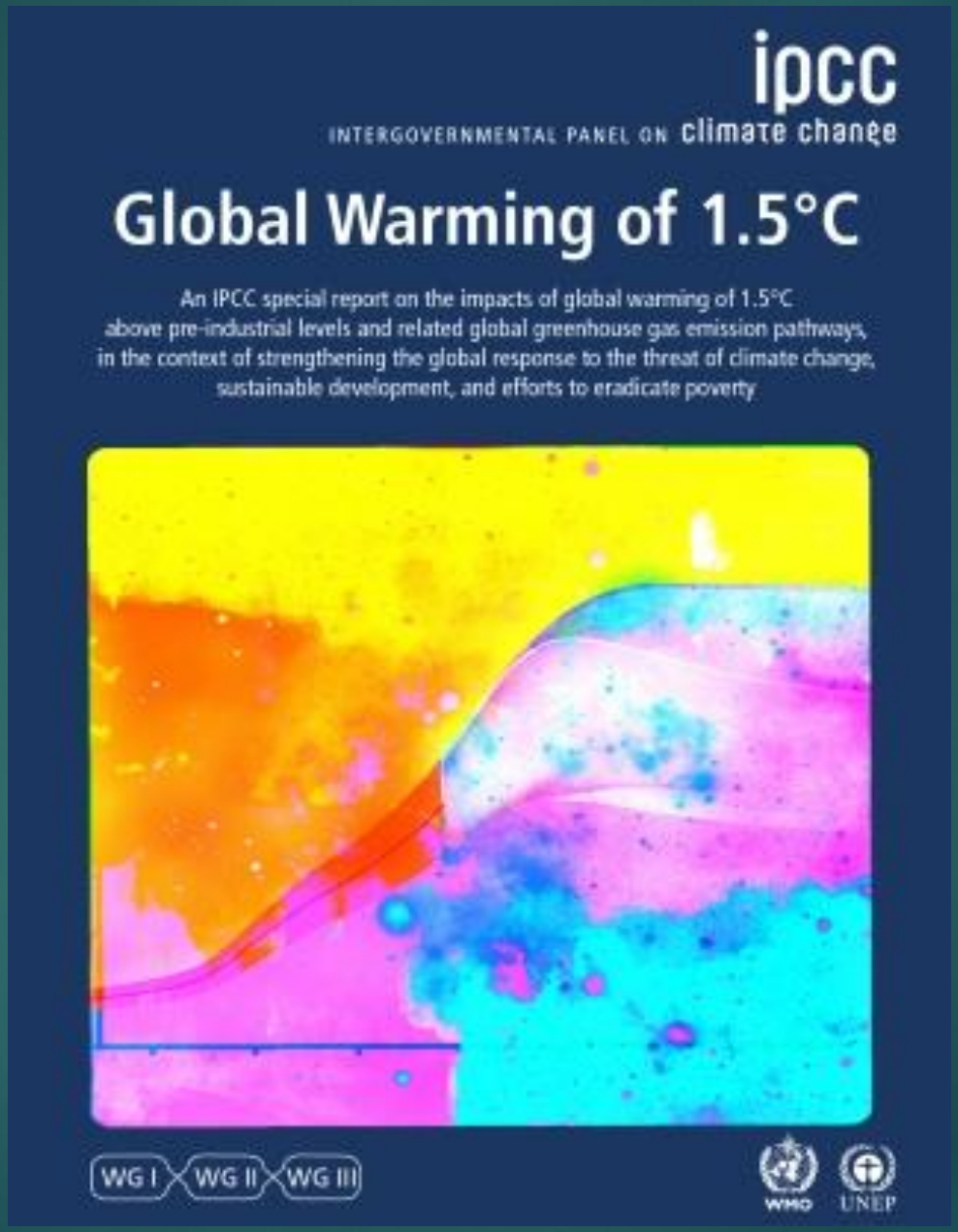


Figure 6. Projected changes in agricultural production in 2080 due to climate change. Source: Cline. 2007. Projections assume a uniform 15% increase in yields due to the fertilization effect of rising carbon dioxide in the atmosphere on some plant species. (Note that this coarse-grain analysis does not project local-scale impacts which require geographically-specific analysis.)

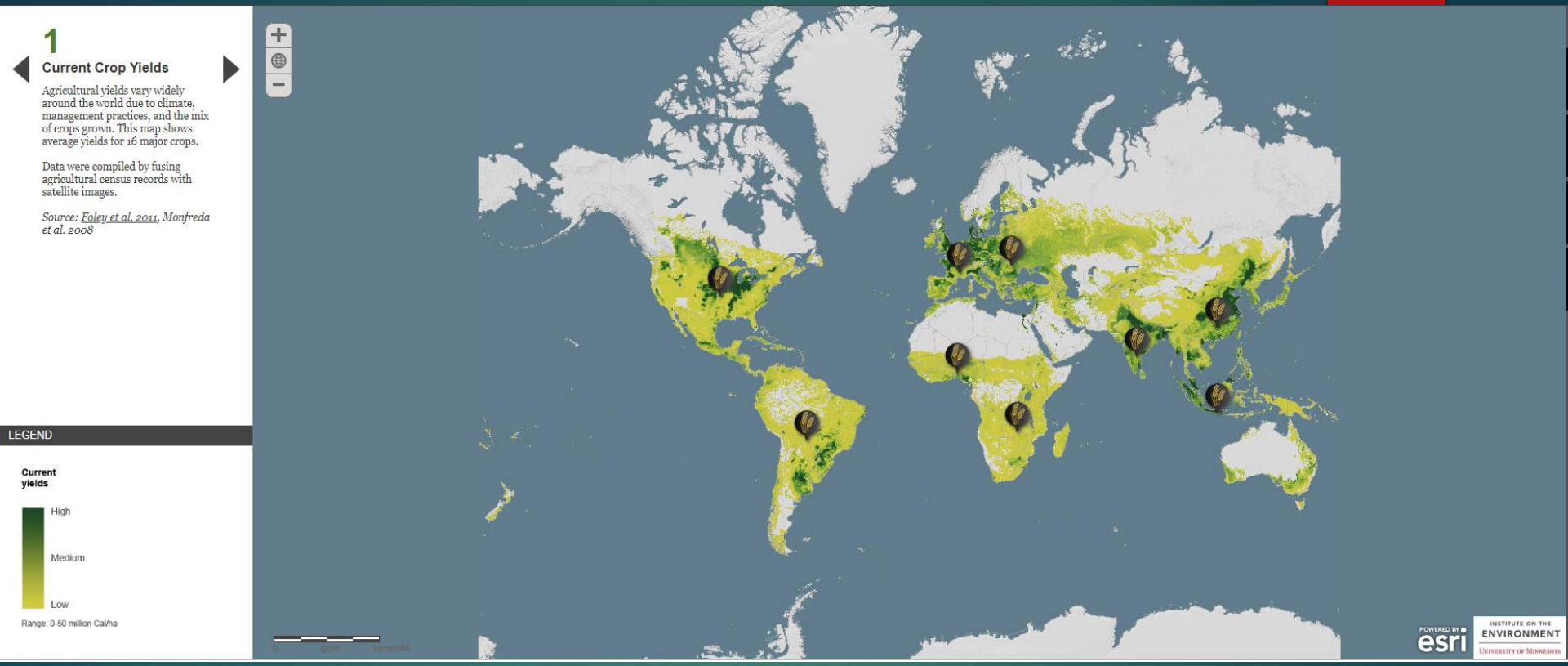
Countries most Likely to Survive Climate Change



Credit: University of Notre Dame


ipcc
INTERGOVERNMENTAL PANEL ON climate change
Global Warming of 1.5°C
An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty
WG I
WG II
WG III
WMO
UNEP

Problems: Agricultural Land



Agricultural land covers 38.4% of the world's land area as of 2011. Permanent pastures are 68.4% of all agricultural land (26.3% of global land area), arable land (row crops) is 28.4% of all agricultural land (10.9% of global land area), and permanent crops (e.g. vineyards and orchards) are 3.1% (1.2% of global land area). FAO

WWF Report 2018

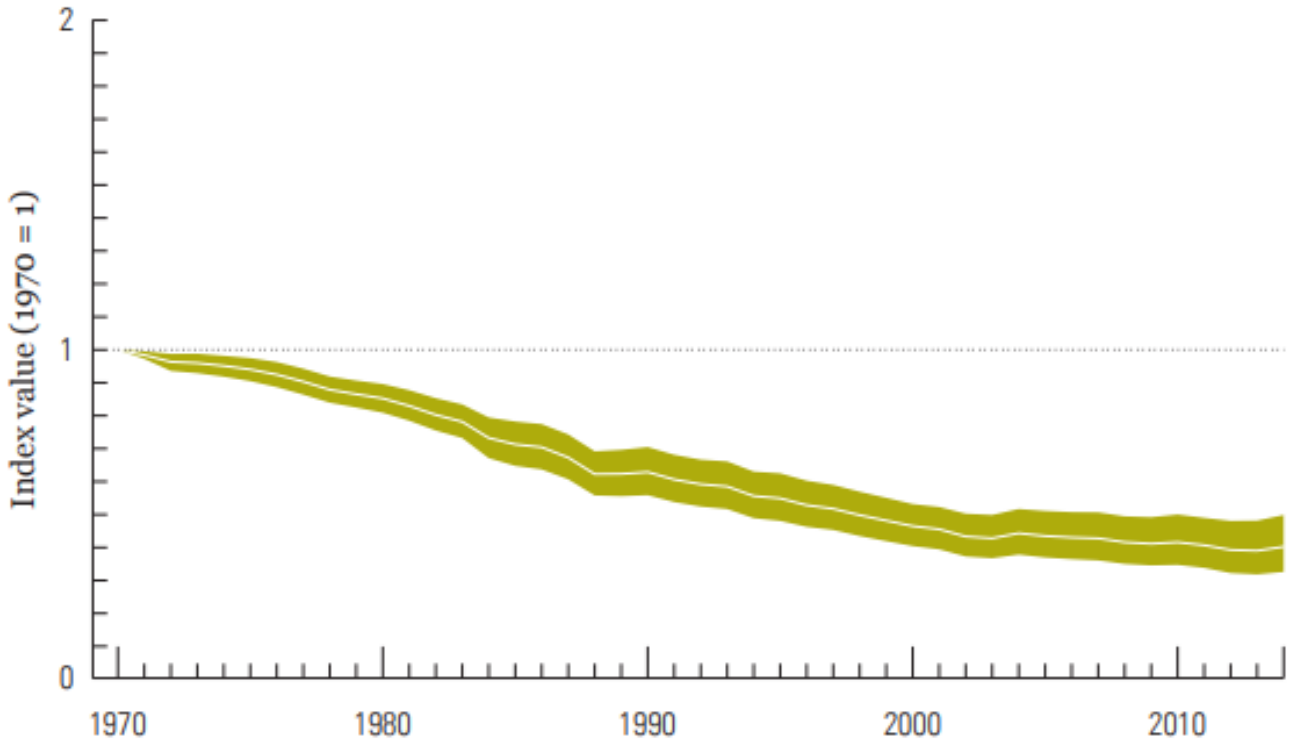


Figure 20: The Global Living Planet Index: 1970 to 2014

Average abundance of 16,704 populations representing 4,005 species monitored across the globe declined by 60%. The white line shows the index values and the shaded areas represent the statistical certainty surrounding the trend (range: -50% to -67%)[1].

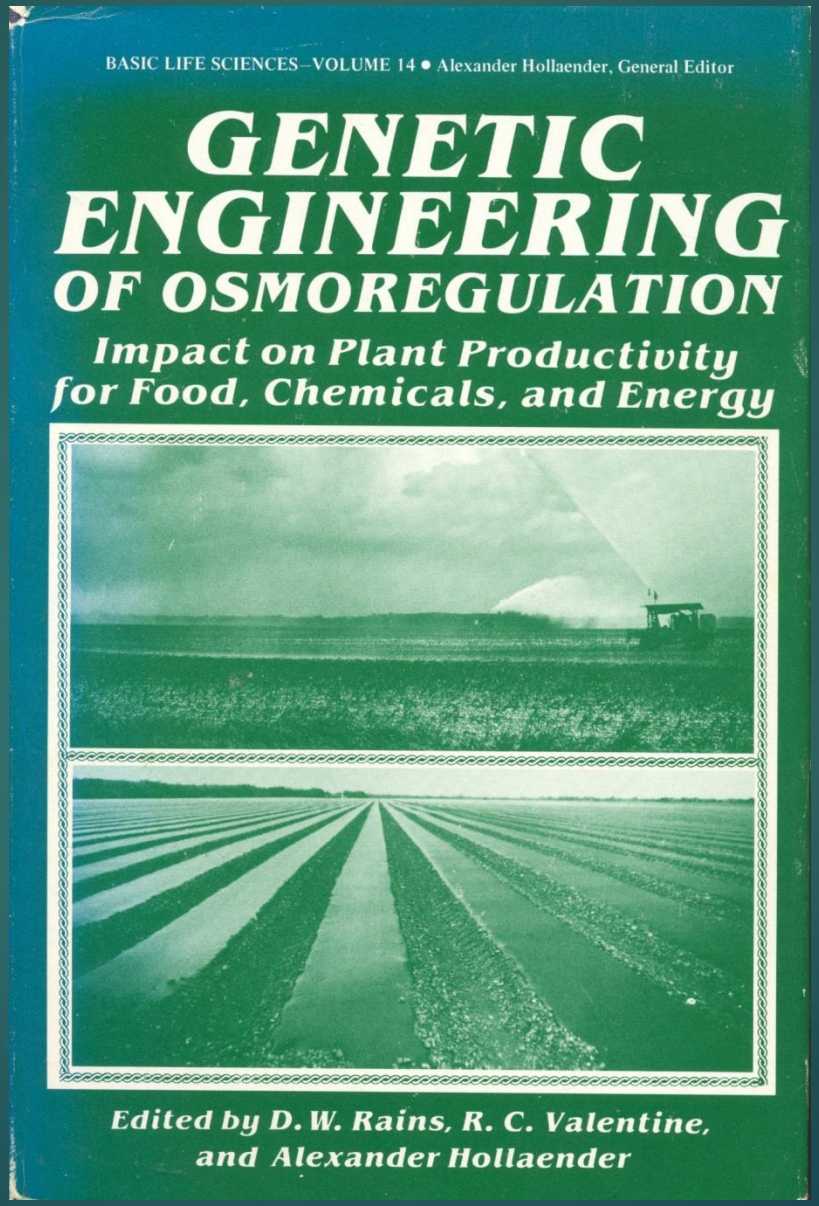
Key

Global Living Planet Index

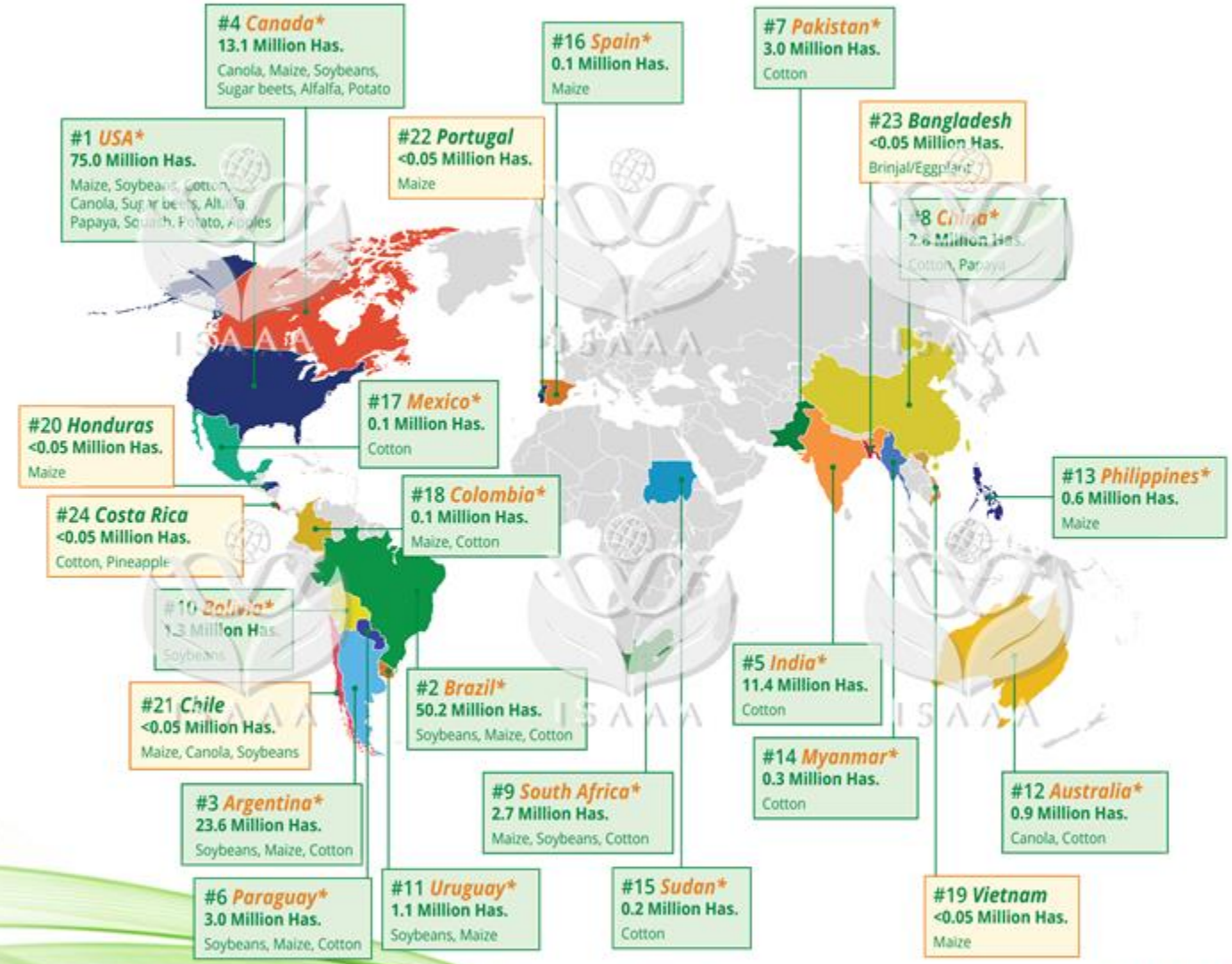
Confidence limits

Solutions: GM Crops

1980


BASIC LIFE SCIENCES–VOLUME 14 • Alexander Hollaender, General Editor
GENETIC ENGINEERING OF OSMOREGULATION
Impact on Plant Productivity for Food, Chemicals, and Energy
Edited by D. W. Rains, R. C. Valentine, and Alexander Hollaender

Biotech Crop Countries and Mega-Countries*, 2017

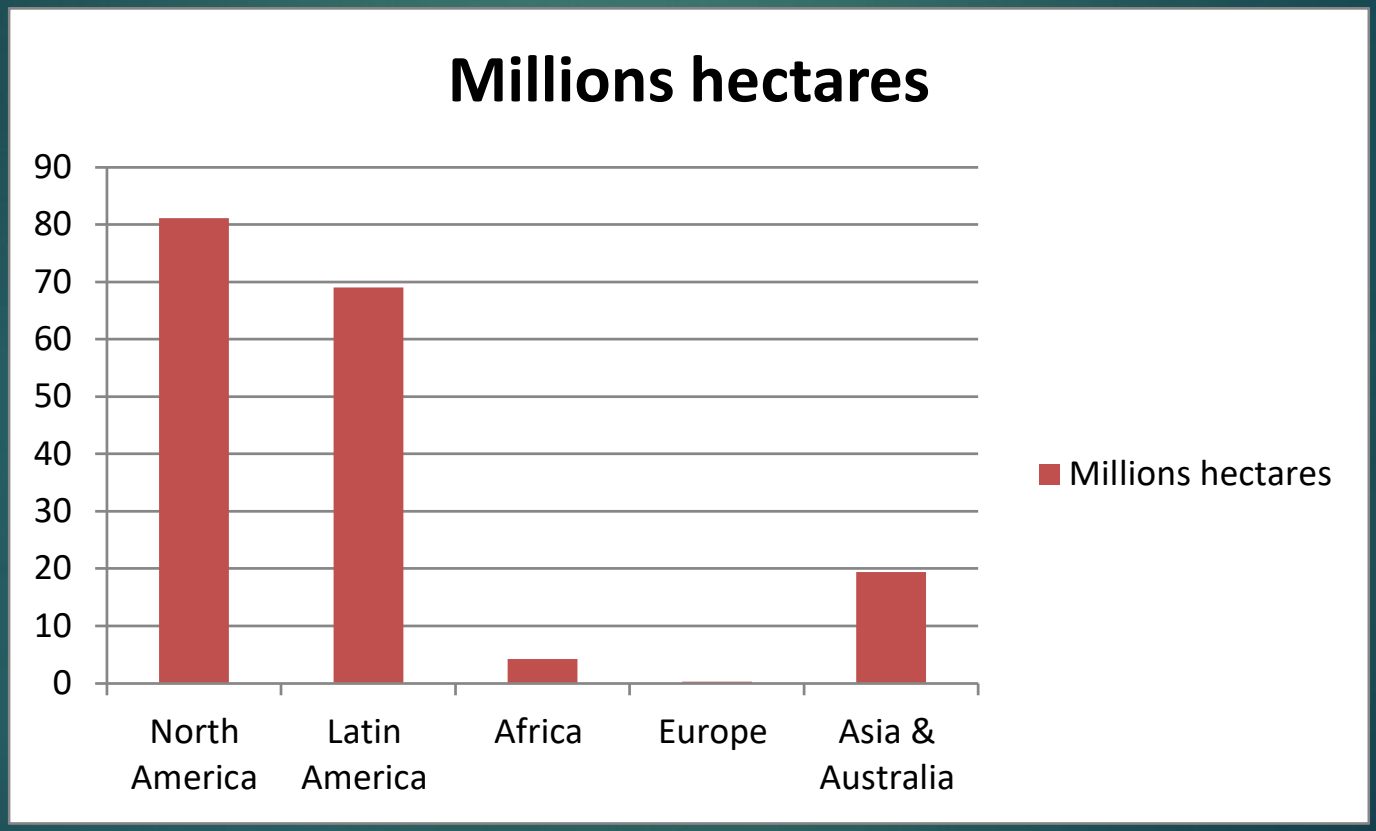


*18 biotech mega-countries growing 50,000 hectares, or more, of biotech crops.

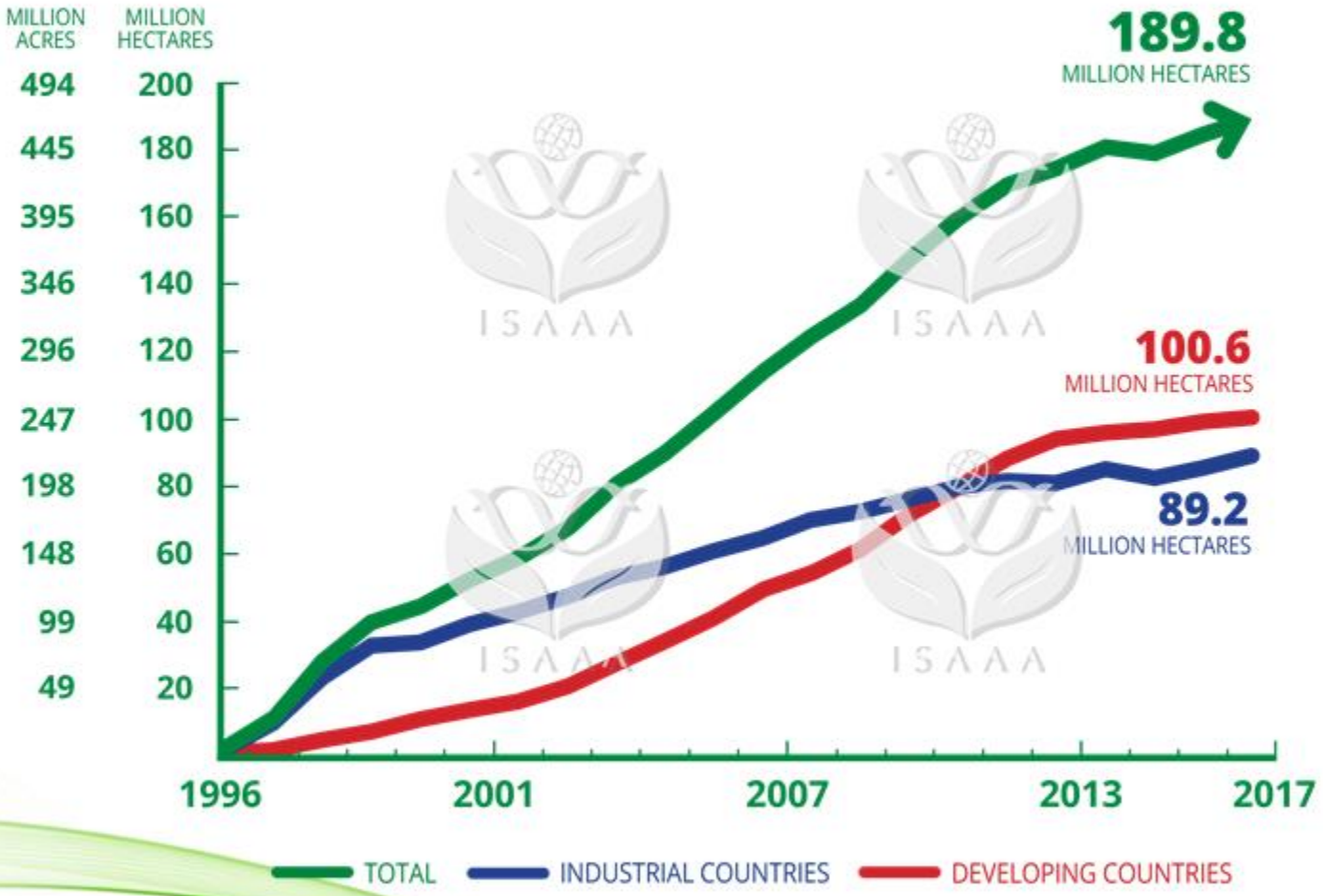
ISAAA, 2017

ISAAA

Where?

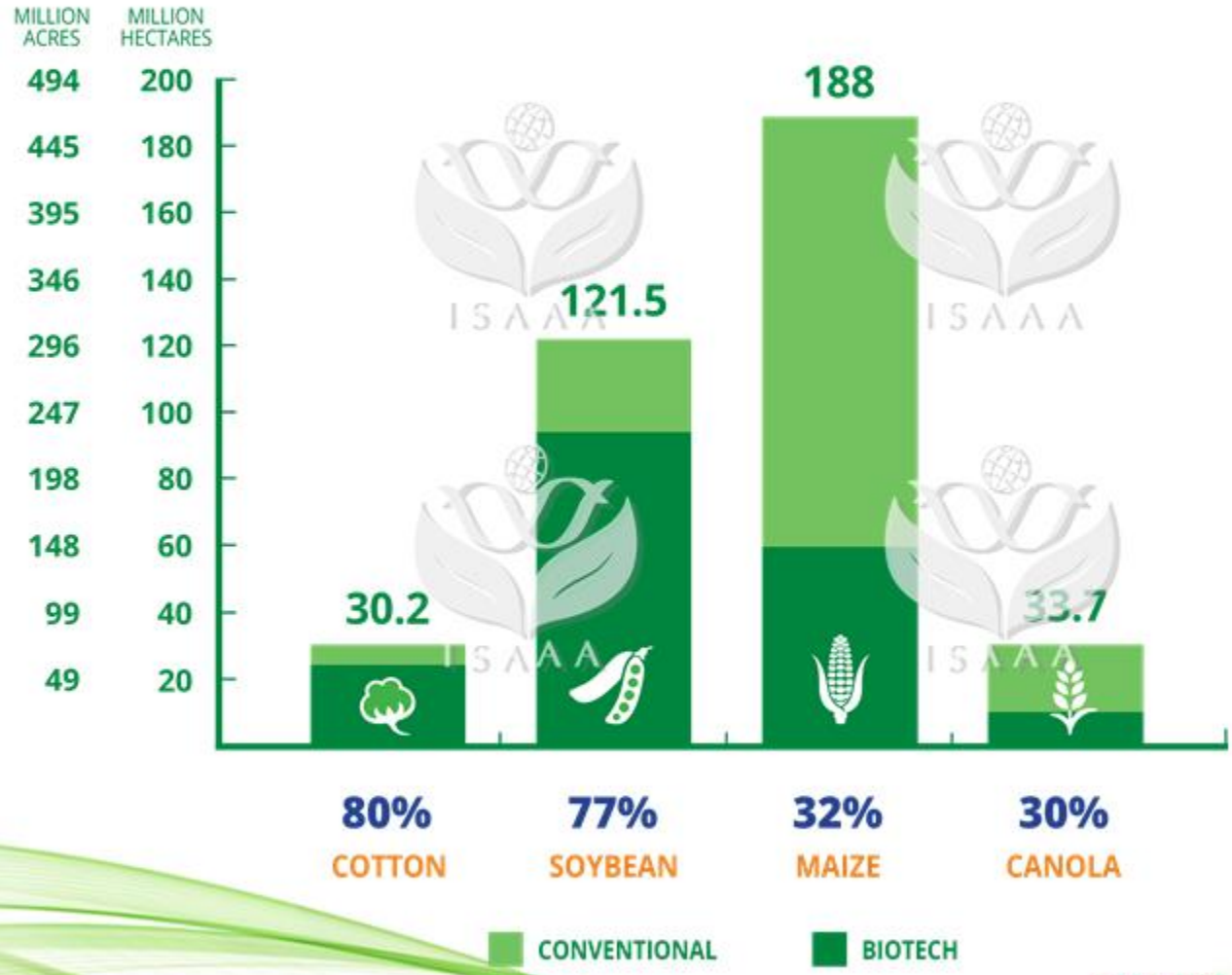

Millions hectares
90
80
70
60
50
40
30
20
10
0
North America
Latin America
Africa
Europe
Asia & Australia
Millions hectares

Global Area of Biotech Crops, 1996 to 2017: Industrial and Developing Countries (Million Hectares, Million Acres)



ISAAA, 2017

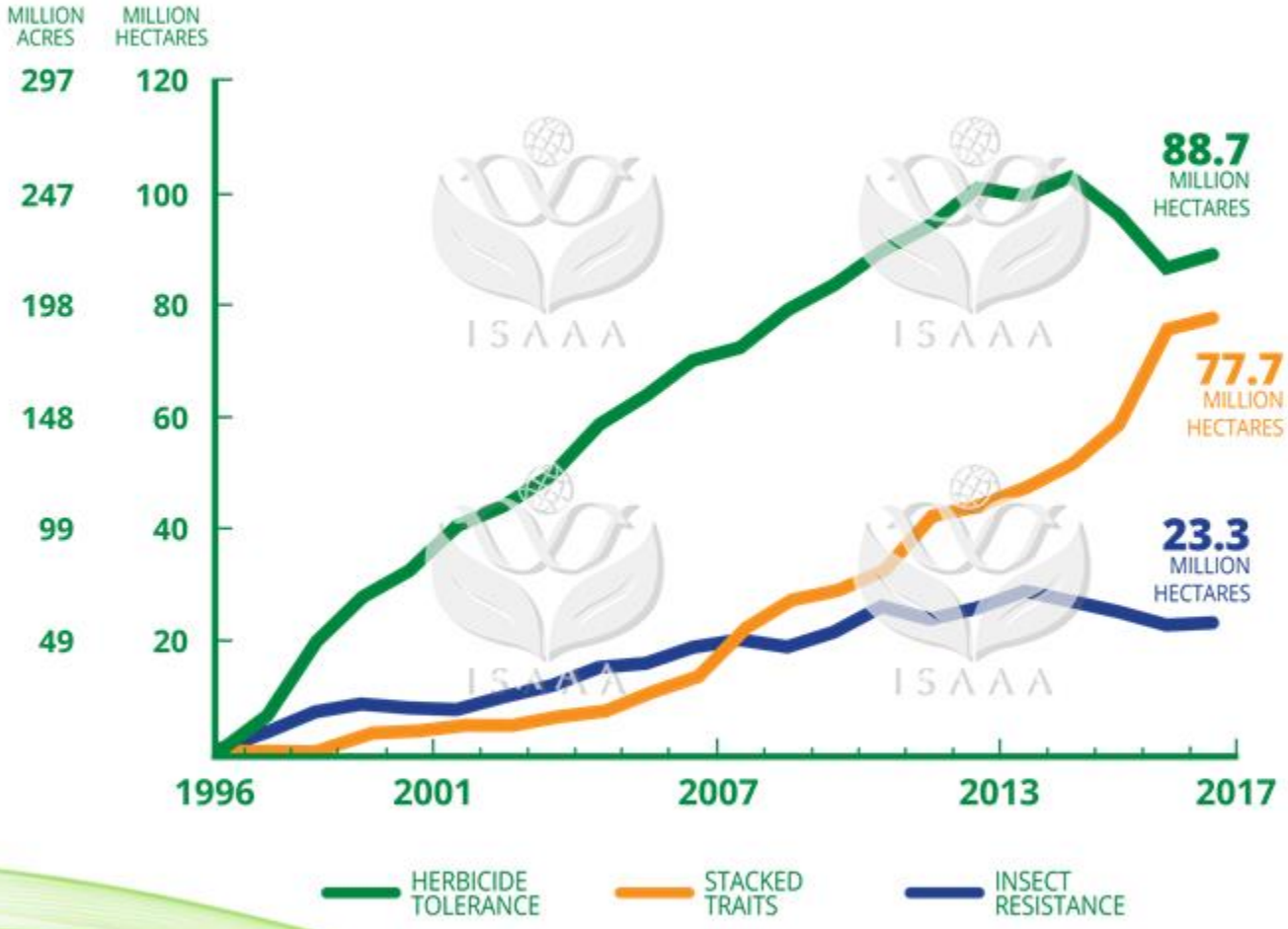
Global Adoption Rates (%) for Principal Biotech Crops (Million Hectares, Million Acres), 2017



ISAAA, 2017

ISAAA

Global Area of Biotech Crops, 1996 to 2017: By Trait (Million Hectares, Million Acres)

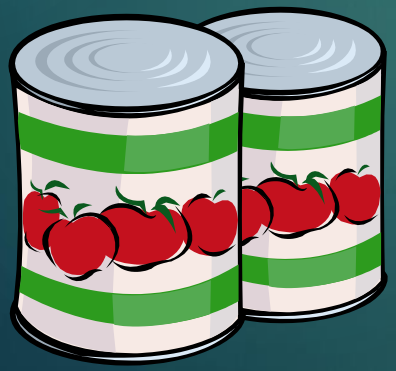


ISAAA, 2017

ISAAA

Problems of GM Crops

- Ethical / Religious Problems
- Food Problems
- Environmental Problems
- Globalisation Problems



The five
Gene editing

The five: genetically modified fruit

New varieties created through genetic editing and engineering promise to beat disease, and offer enticing new flavours

Bertille Duthoit

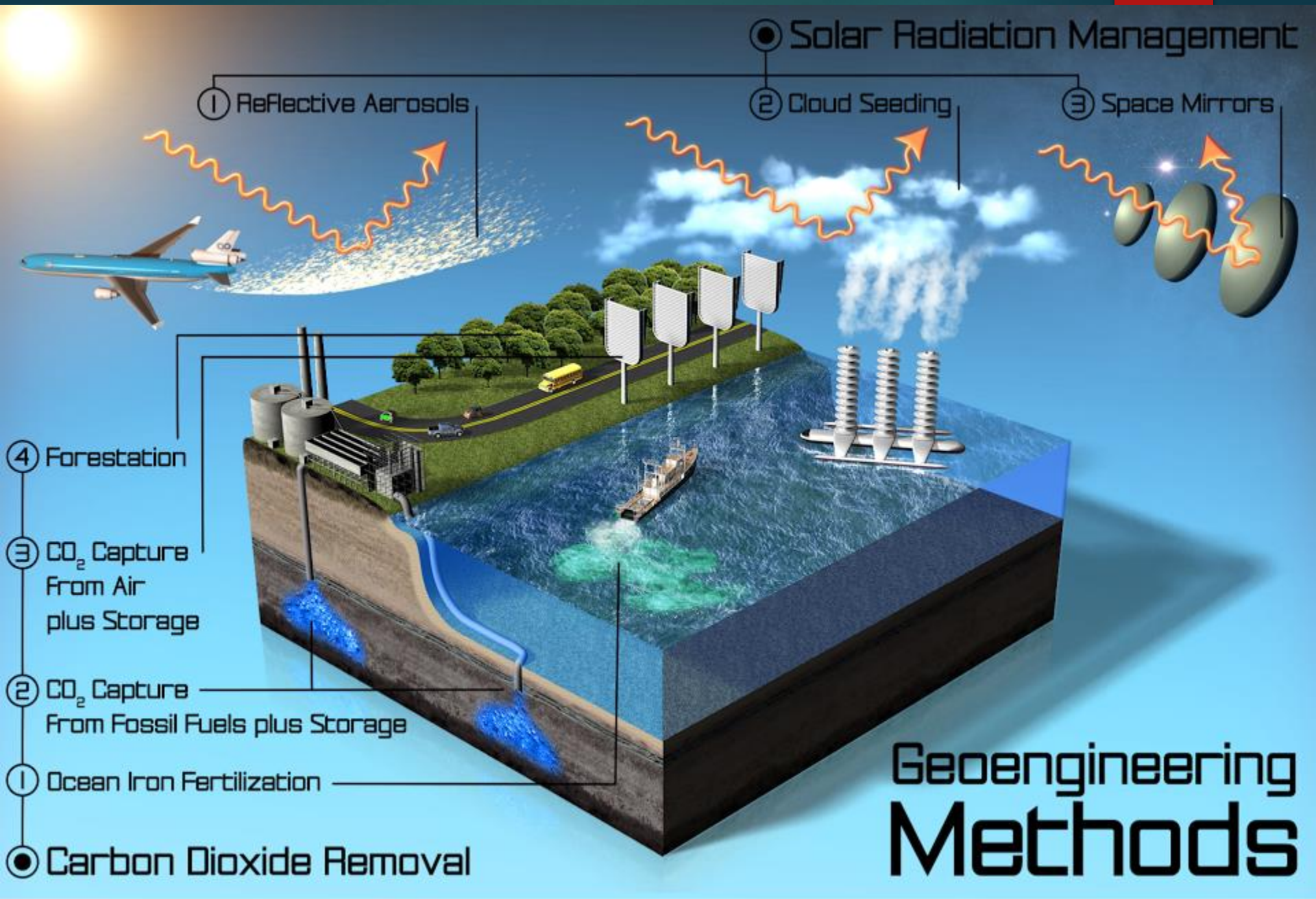
Sun 13 Jan 2019 07.00 GMT

▲ Soon to be red-hot tomatoes. Photograph: Alamy

Tomatoes

It was reported this week that Brazilian scientists are hoping to create spicy tomatoes using Crispr gene-editing techniques. Although tomatoes contain the genes for capsaicinoids (the chemicals that give chillies their heat) they are dormant - Crispr could be used to make them active. This is desirable

Credit: Guardian



Sources: IPCC / Royal Society | More info: www.get2.cc/5e

climatecentral.org

Vertical Agriculture

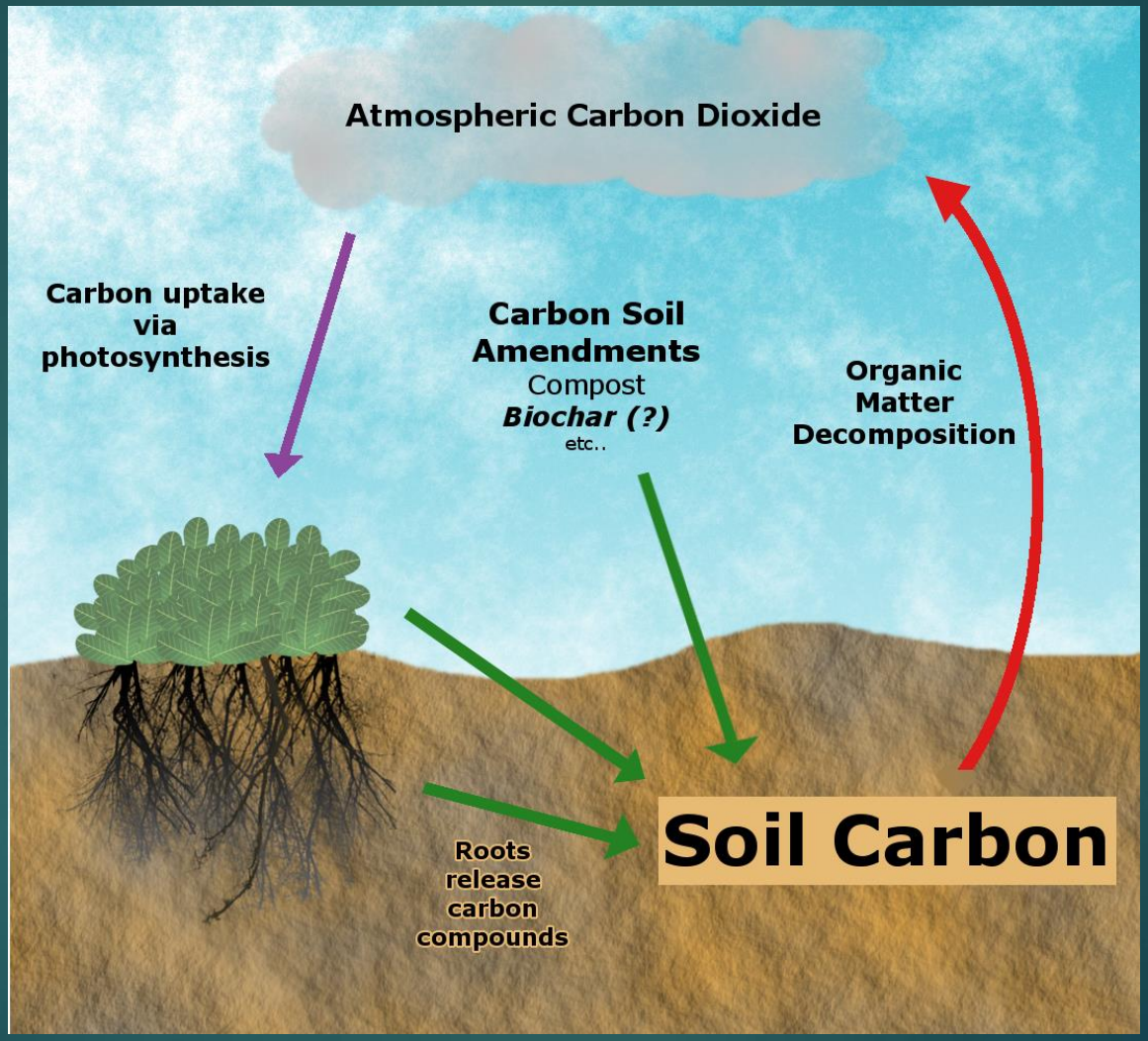
A bit of meat, a lot of veg - the flexitarian diet to feed 10bn

By James Gallagher
Health and science correspondent, BBC News

17 January 2019 | 169 Share

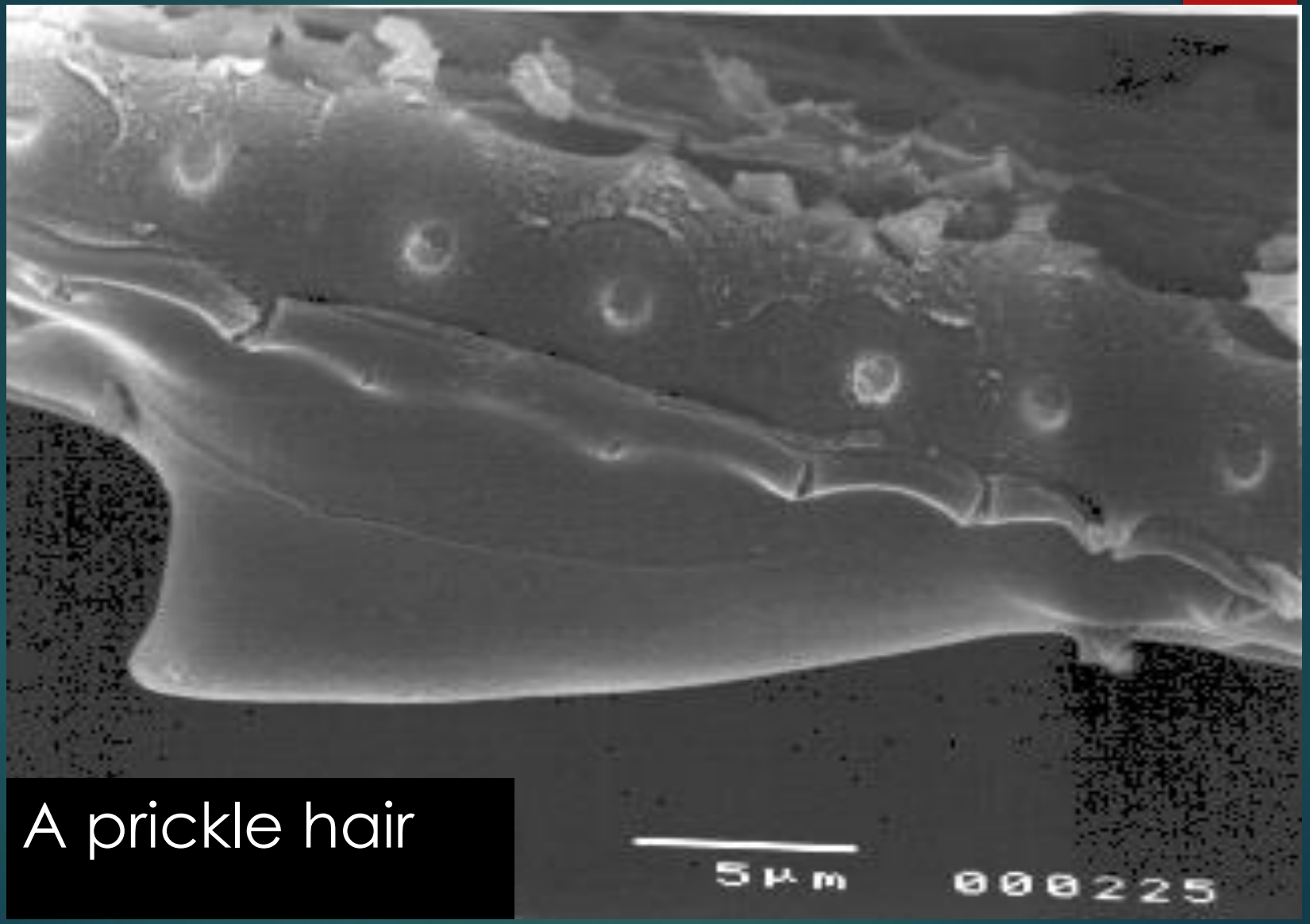
A diet has been developed that promises to save lives, feed 10 billion people and all without causing catastrophic damage to the planet.

Solution: Carbon Sequestration in Soil



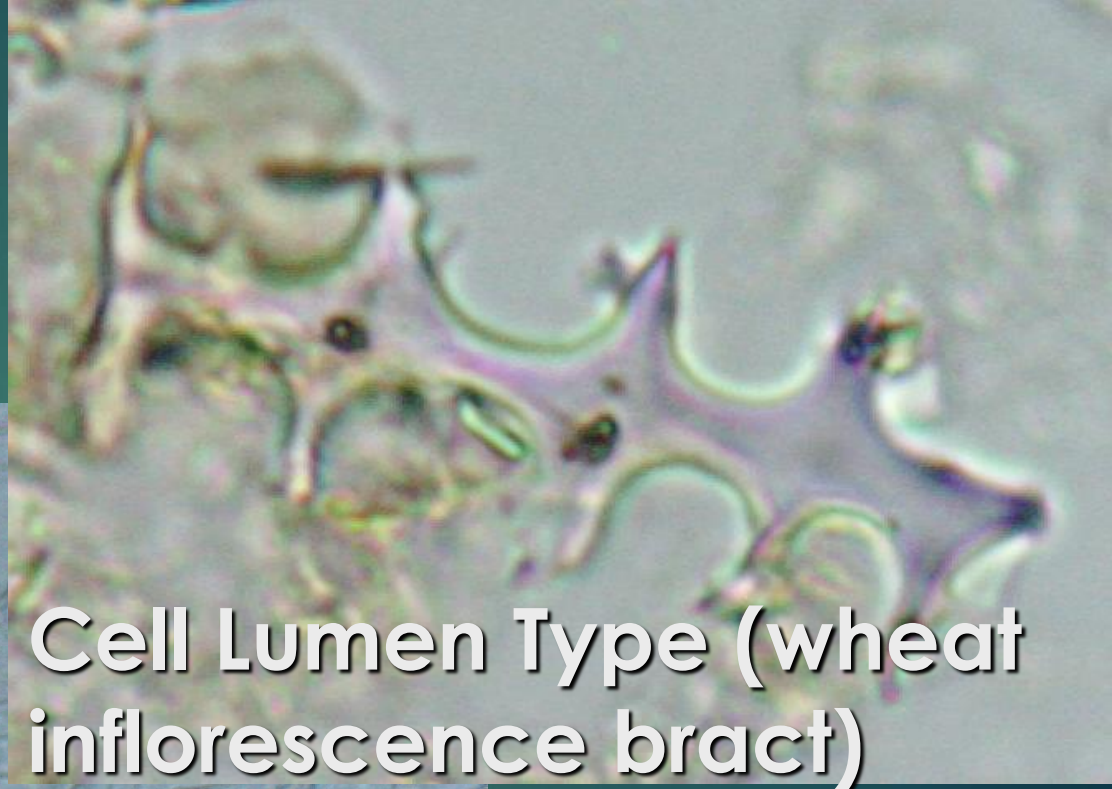
ucanr.edu

Pampas Grass

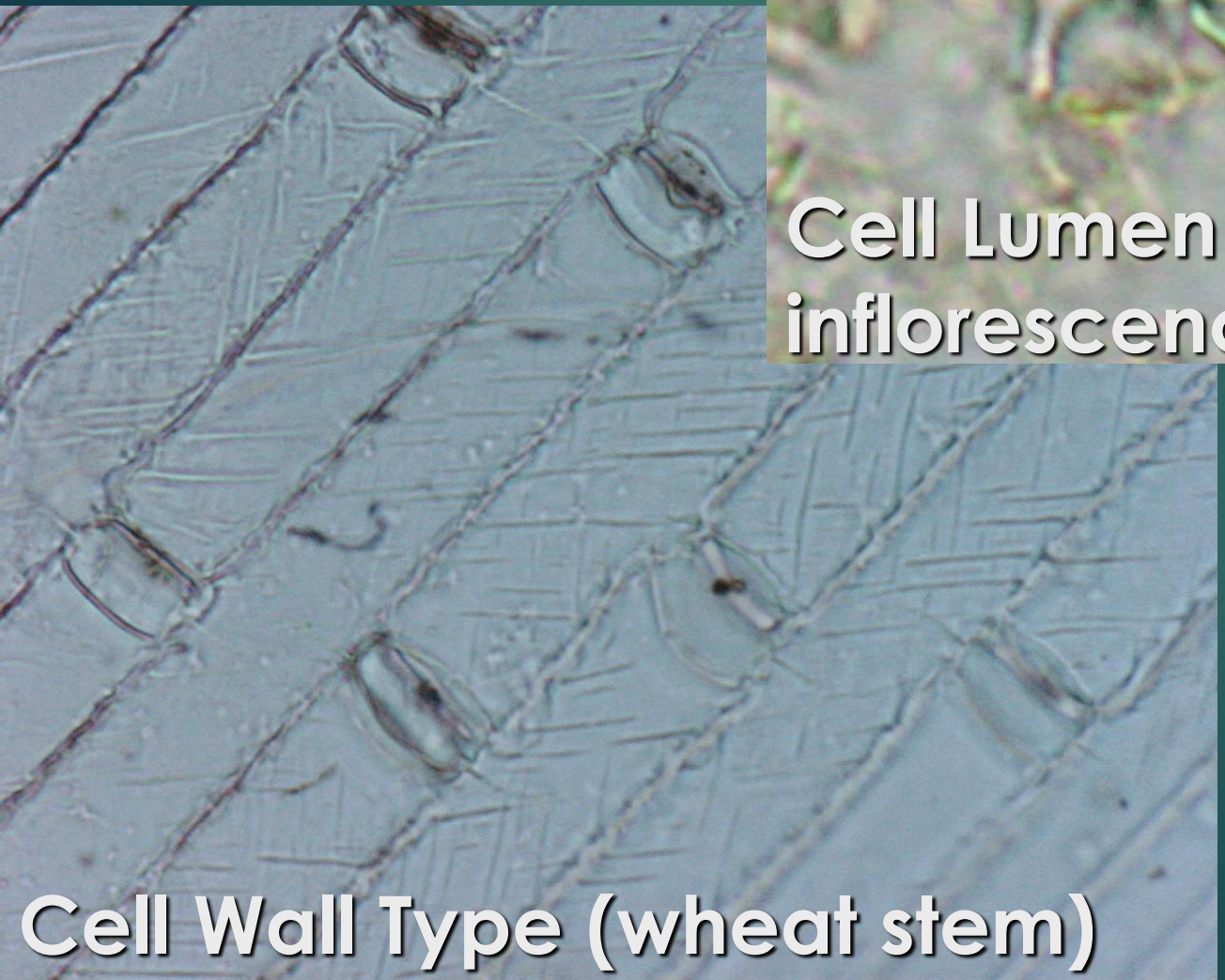


A prickle hair

Types of Phytolith

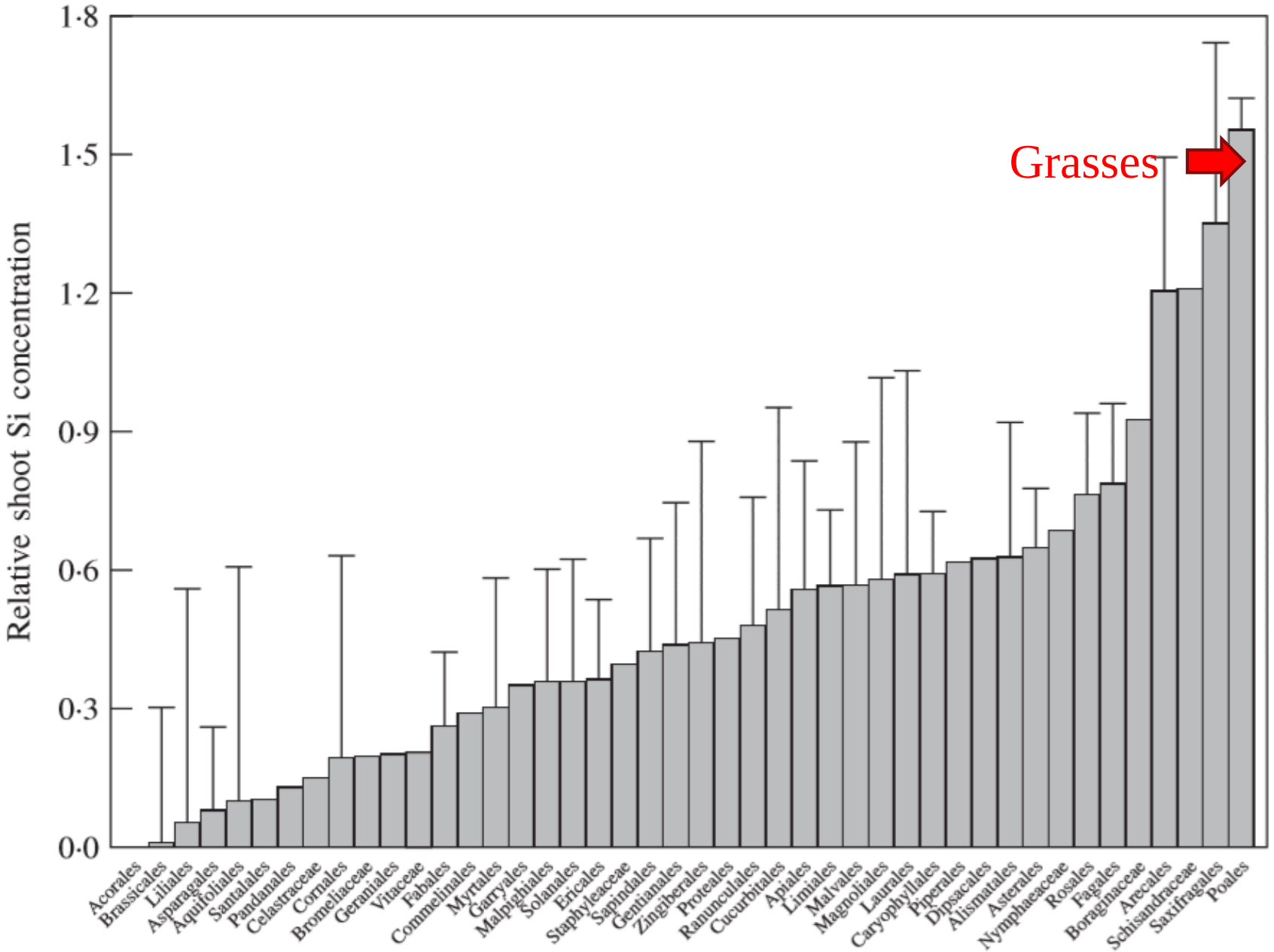


Cell Lumen Type (wheat inflorescence bract)



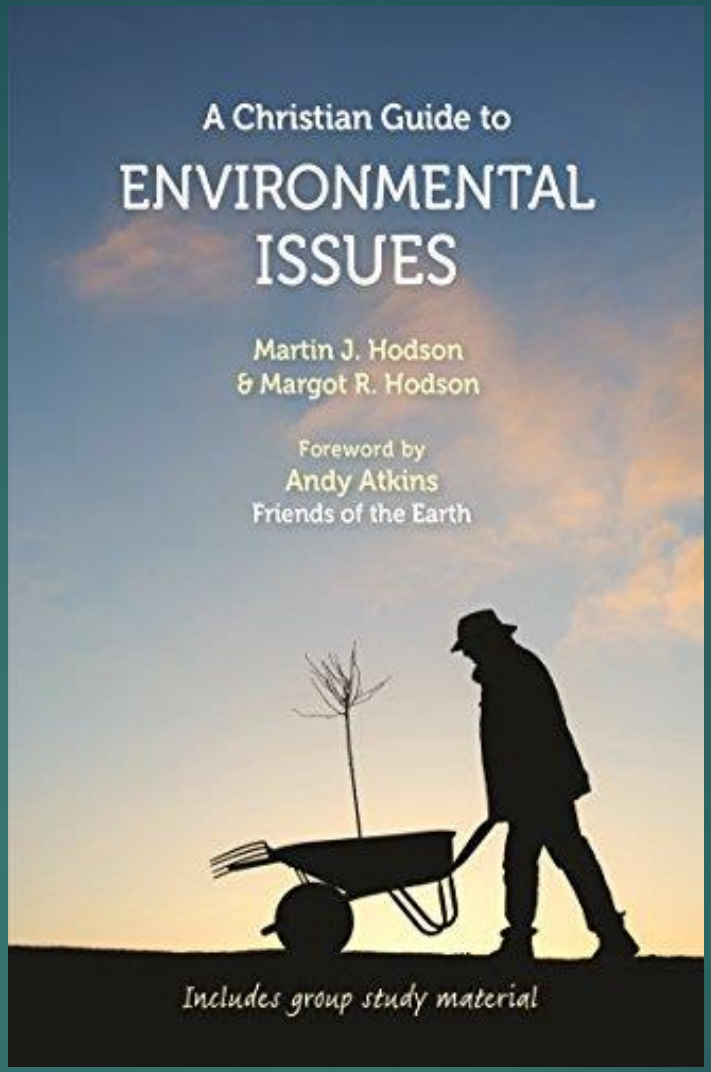
Cell Wall Type (wheat stem)

Hodson et al. — *Phylogenetic Variation of Silicon in Plants*



Can Phytoliths Save the World??

- Soil is a huge carbon store
- But it is released back to the atmosphere
- There is carbon trapped in phytoliths
- They survive hundreds or thousands of years in the soil
- Could this be increased?
- Natural carbon capture and storage??
- Working on it!!



- A Christian Guide to Environmental Issues: £8

Isaiah's vision for a sustainable future

- Significant use of natural images in all sections of Isaiah
- Images used to develop theological themes
- Reveal attitude to material world
- Ideas developed in the New Testament.

Understanding the context of Isaiah

- 8th – 6th centuries BC
- Maquis: "Land of Milk and honey"
- Mostly farming sheep/goats, vines and 'fruit' trees (figs, olives, almonds)
- Contrast to coastal plain and Mesopotamia.

Environmental perception in Isaiah: use of natural images

- Heaven and Earth
- Mountains
- Deserts
- Vineyards
- Animals
- Plants.

Theological themes: *First part of Isaiah*

- Should be full of Glory but under judgement
- Consequences: War, drought, poor crops, briers and thorns
- Nature not inherently sinful
- Relationships abused.

Theological themes: *Second/third part of Isaiah*

- Images of rejoicing and fruitfulness
- Earth/Holy Mountain is dwelling place of God – full of Glory
- Results from restored relationship of humans to God
- Renewal of Creation
- A promise of restoration.

Wilderness or Farming ethic?

- Wilderness = special place to meet with God

  (eg desert/mountain)

- Farmed land = valued place to live and work out ones relationships
- Sustainable and harmonious relationships (God, people, Land).

Stewardship in Isaiah

- Redemption leading to future harmony
- Intrinsic worth
- Wilderness the place to meet God but not to live/work in
- Humans fulfilling our role to take responsibility
- Rest of creation flourishing
- God blessing the harmony.

Conclusion: What can we learn from Isaiah?

- Positive image of cultivation
- Harmony between God, humans and nature = flourishing cultivation
- Holistic approach – not anthropocentric
- Use to build a responsible interventionist ethic for conservation
- Very valuable for this century when it is essential that humans take action to restore and maintain ecological relationships.