OCR
Oxford Cambridge and RSA

Mind the Gap: from research stations to public platforms

Dr Kathryn Adamson
School of Geography, Queen Mary, University of London

Dr Tim Lane
Laboratoire de Géographie Physique, CNRS, Paris

Sponsored by OCR

TALK OUTLINE

Part 1 - From research stations: the current knowledge base

- Climate change - the current knowledge base
- Climate past, present, and future

Part 2 - To public platforms: communicating climate science

- Teaching Physical Geography - the role of teachers
- The research process
- Textbooks vs research papers
- The role of scientists
- Key concepts, exam questions, and useful resources
- Hints for engaging with science outreach

PART 1

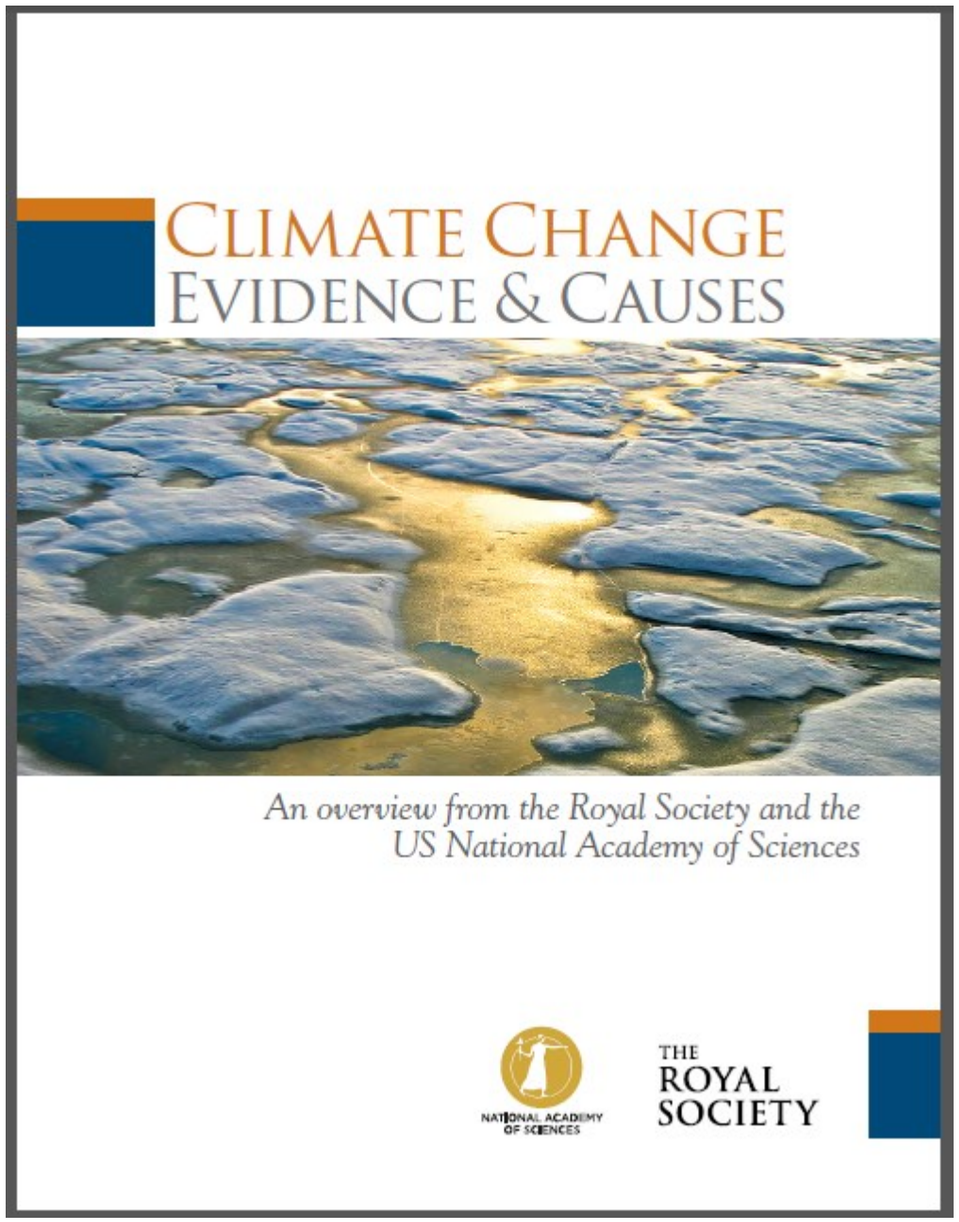
FROM RESEARCH STATIONS

THE CURRENT KNOWLEDGE BASE

Climate change is one of the defining issues of our time. It is now more certain than ever […] that humans are changing Earth's climate.

The atmosphere and oceans have warmed, accompanied by sea-level rise, a strong decline in Arctic sea ice, and other climate-related changes.

Royal Society and the US National Academy of Sciences



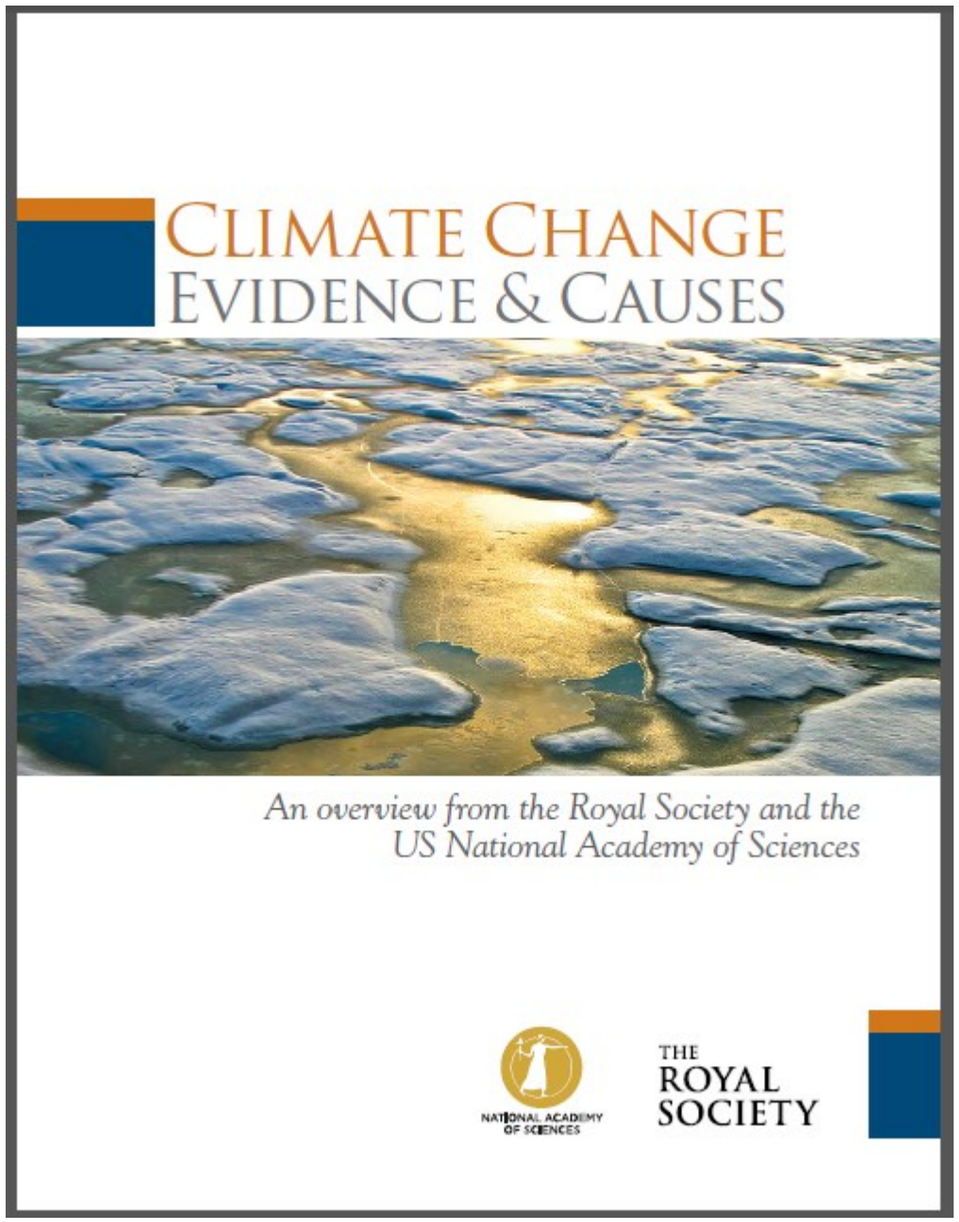
http://royalsociety.org/uploadedFiles/Royal_Society_Content/policy/projects/climate-evidence-causes/climate-change-evidence-causes.pdf

THE CURRENT KNOWLEDGE BASE

The evidence is clear. However, due to the nature of science, not every single detail is ever totally settled or completely certain. Nor has every pertinent question yet been answered.

Scientific evidence continues to be gathered around the world, and assumptions and findings about climate change are continually analysed and tested.

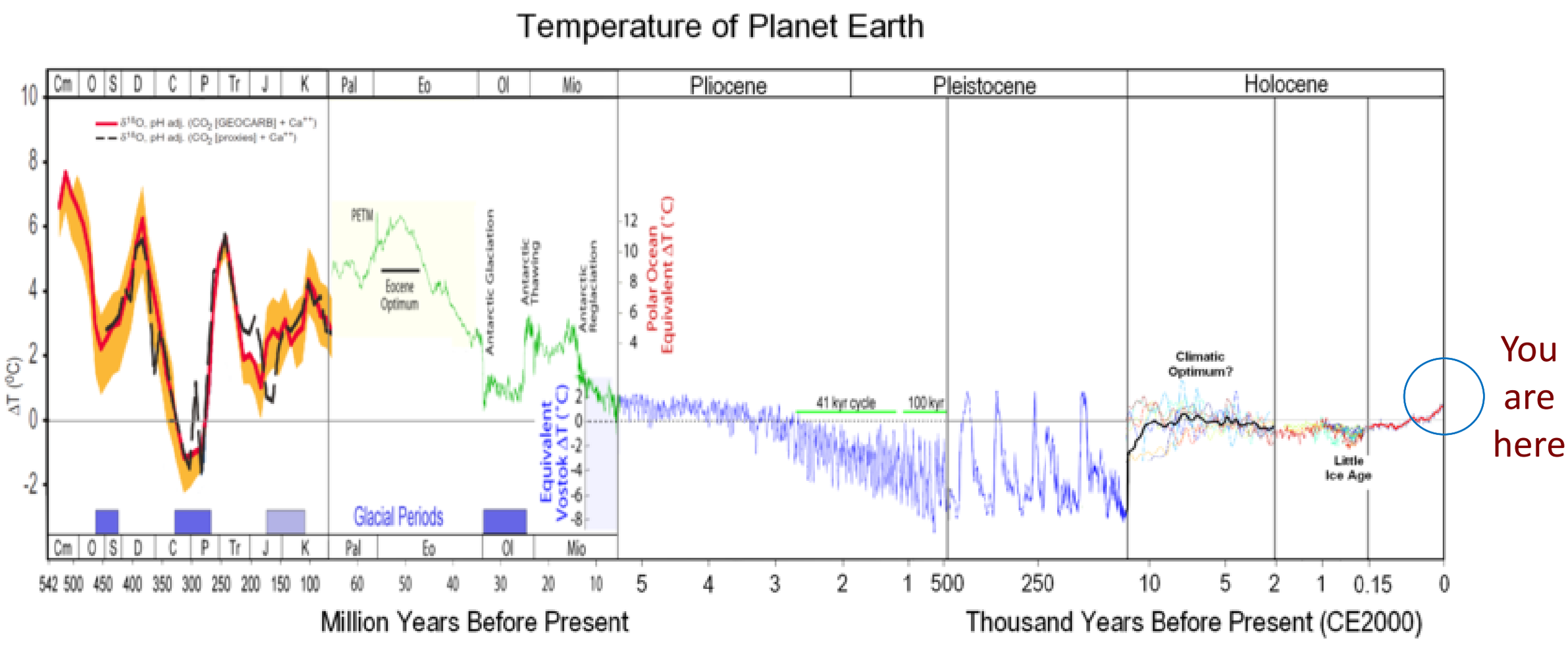
Royal Society and the US National Academy of Sciences



http://royalsociety.org/uploadedFiles/Royal_Society_Content/policy/projects/climate-evidence-causes/climate-change-evidence-causes.pdf

PAST CLIMATE CHANGE

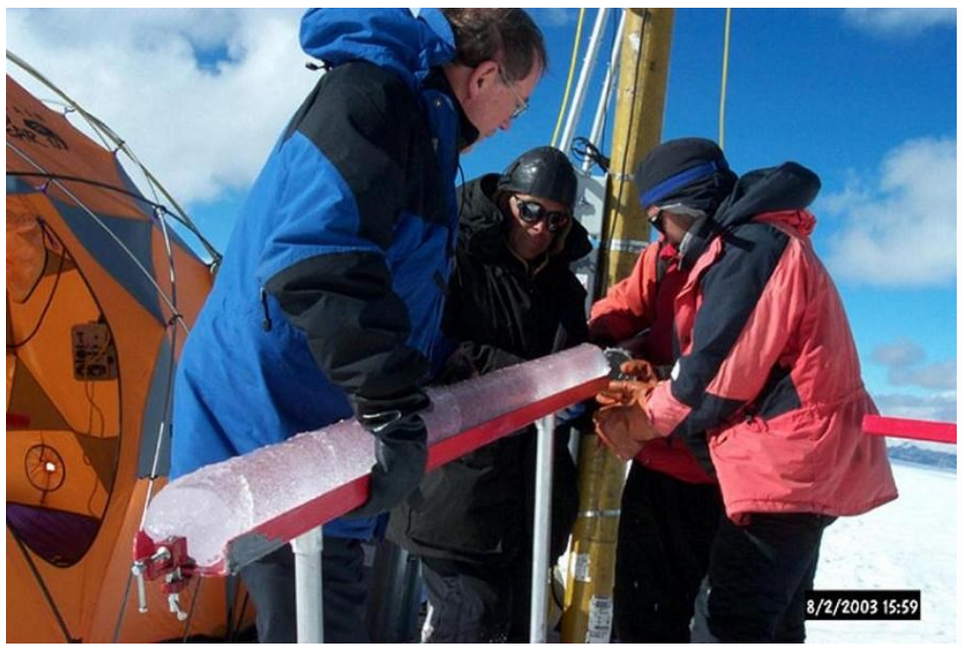
- The Earth's climate is **naturally variable**
- This is mainly due to its orbit around the sun
- Over millions (or billions) of years, climate has fluctuated a great deal

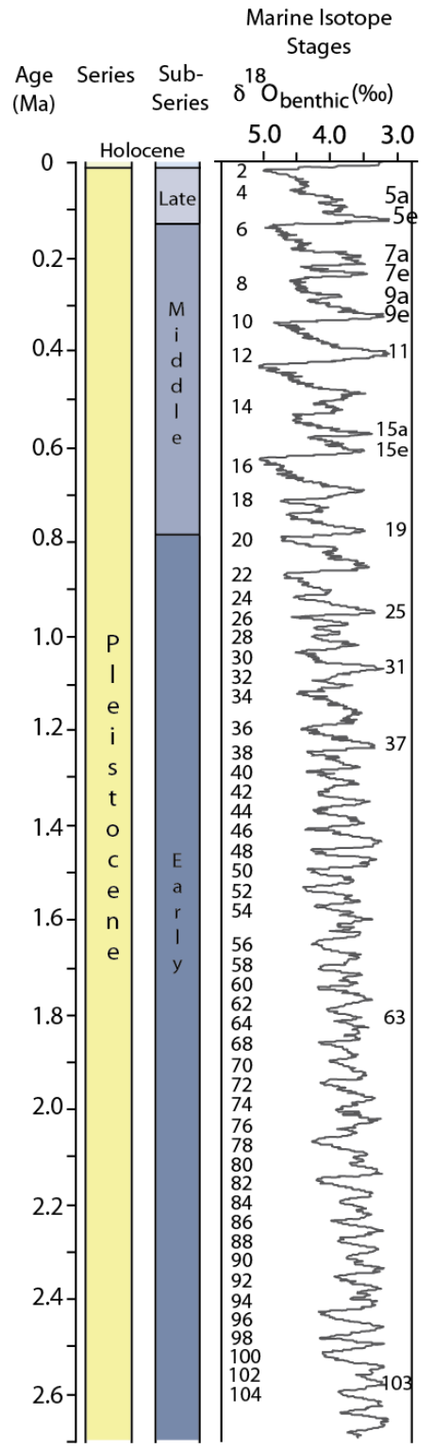


PAST CLIMATE CHANGE

The Quaternary is the most recent geological time period (2.58 million years to present)

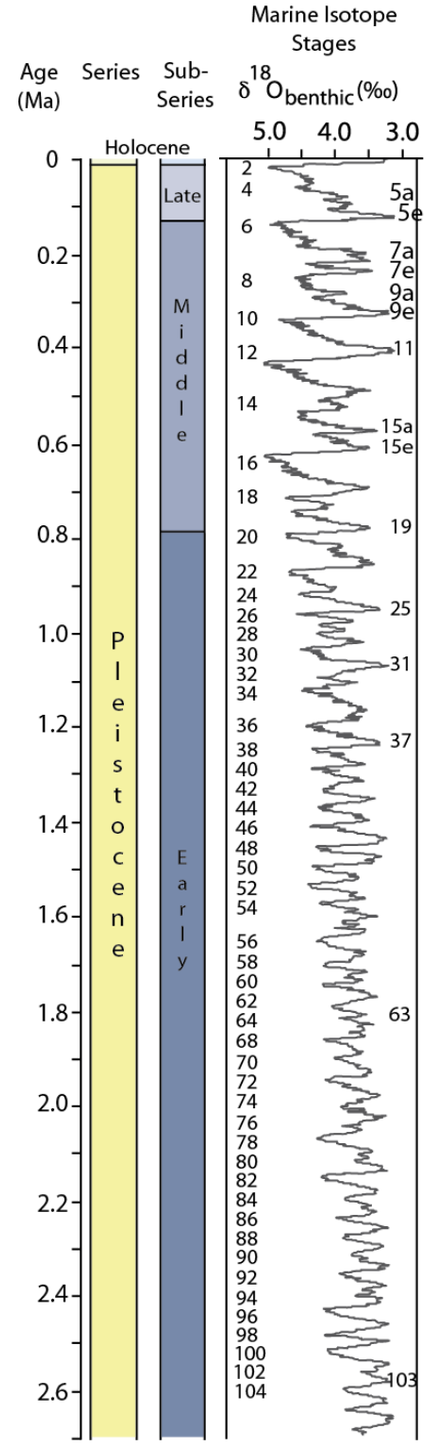
- **The records are very well preserved**
  - so we can develop **high precision**…
  - …and **high resolution** reconstructions
- **Characterised by large, often rapid, climate changes**
  - Warm interglacials and cold glacials
  - Evidence of natural change





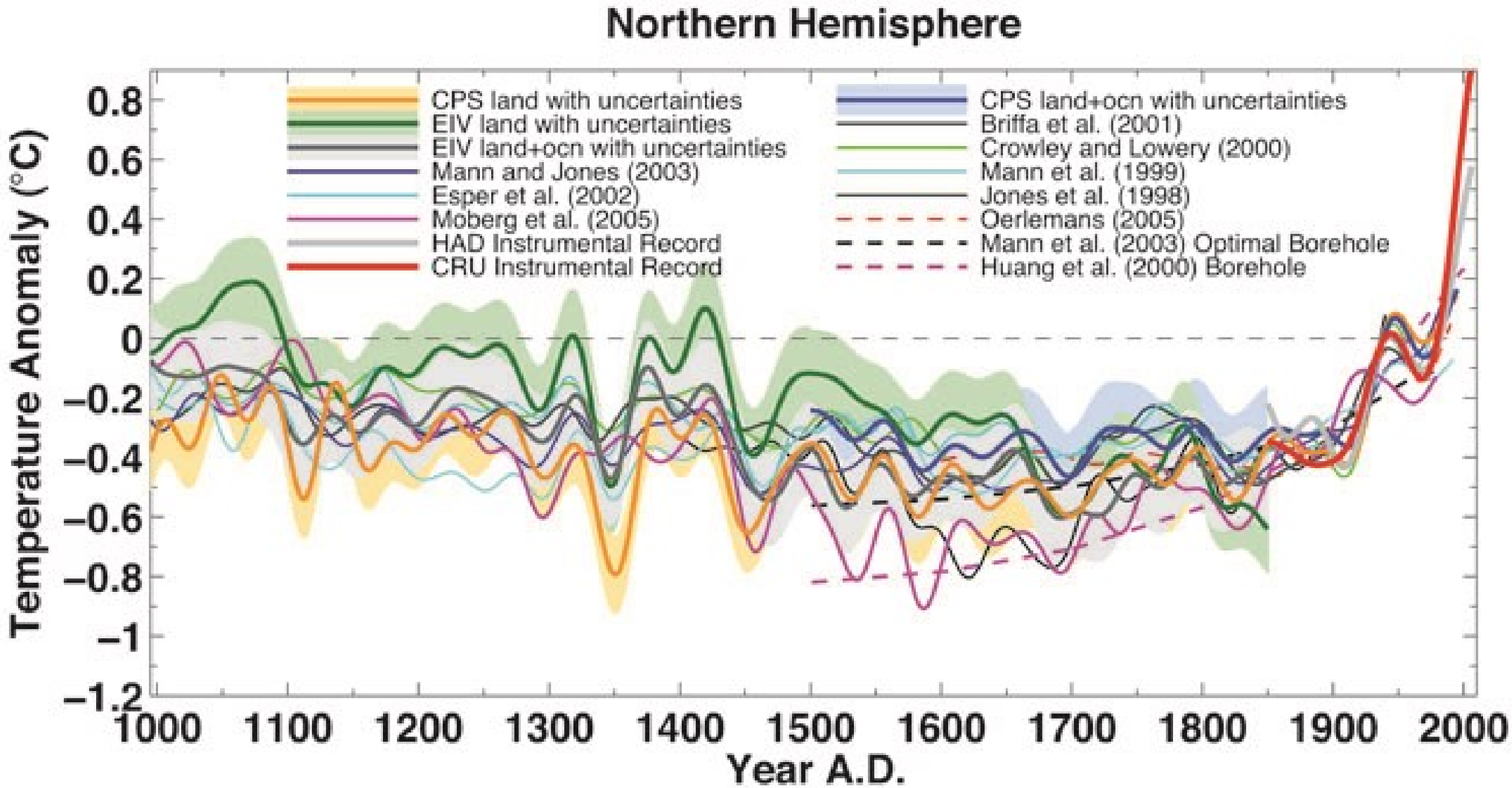
PAST CLIMATE CHANGE

- Observations of recent climate change are only as long as the written record – i.e. since people have been ‘monitoring’
- So we rely on proxy evidence (ice cores, fossils etc.) if we want to look further into the past
- **Studying the past allows us to:**
  - Place current changes into a longer-term context
  - More fully understand present day processes
  - Enhance the accuracy and precision of our models of future environmental change



CURRENT CLIMATE CHANGE

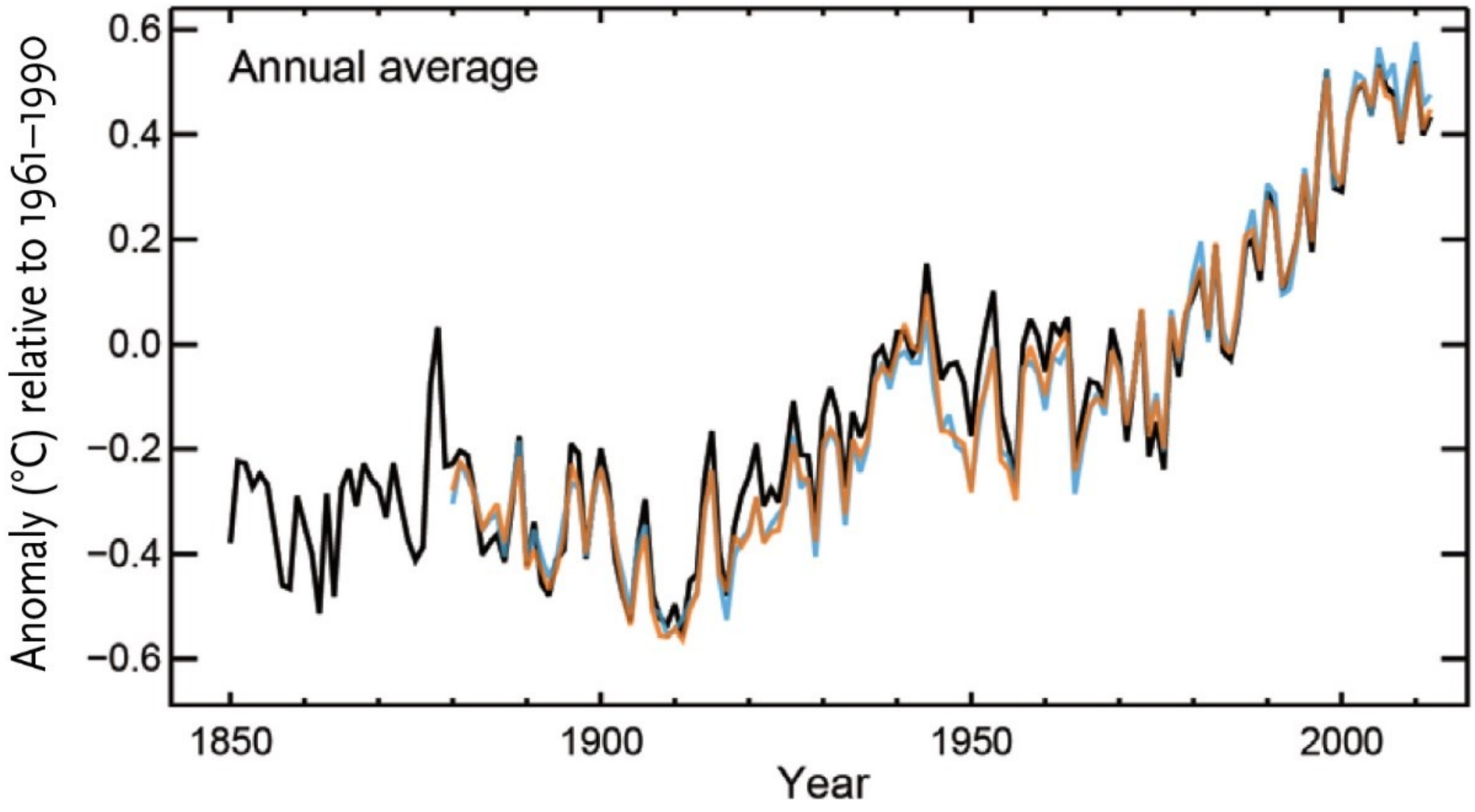
- Based on a number of different records (marine sediments, lake sediment, ice cores, coral cores and tree rings), the temperature is known to be warmer now than it has been in at least the last 1000 years.



Mann and others 2008, Proceedings of the National Academy of Sciences

CURRENT CLIMATE CHANGE

- Since 1900, the global average surface temperature has increased by about 0.8 °C, about 50% of which occurred since the mid-1970s.

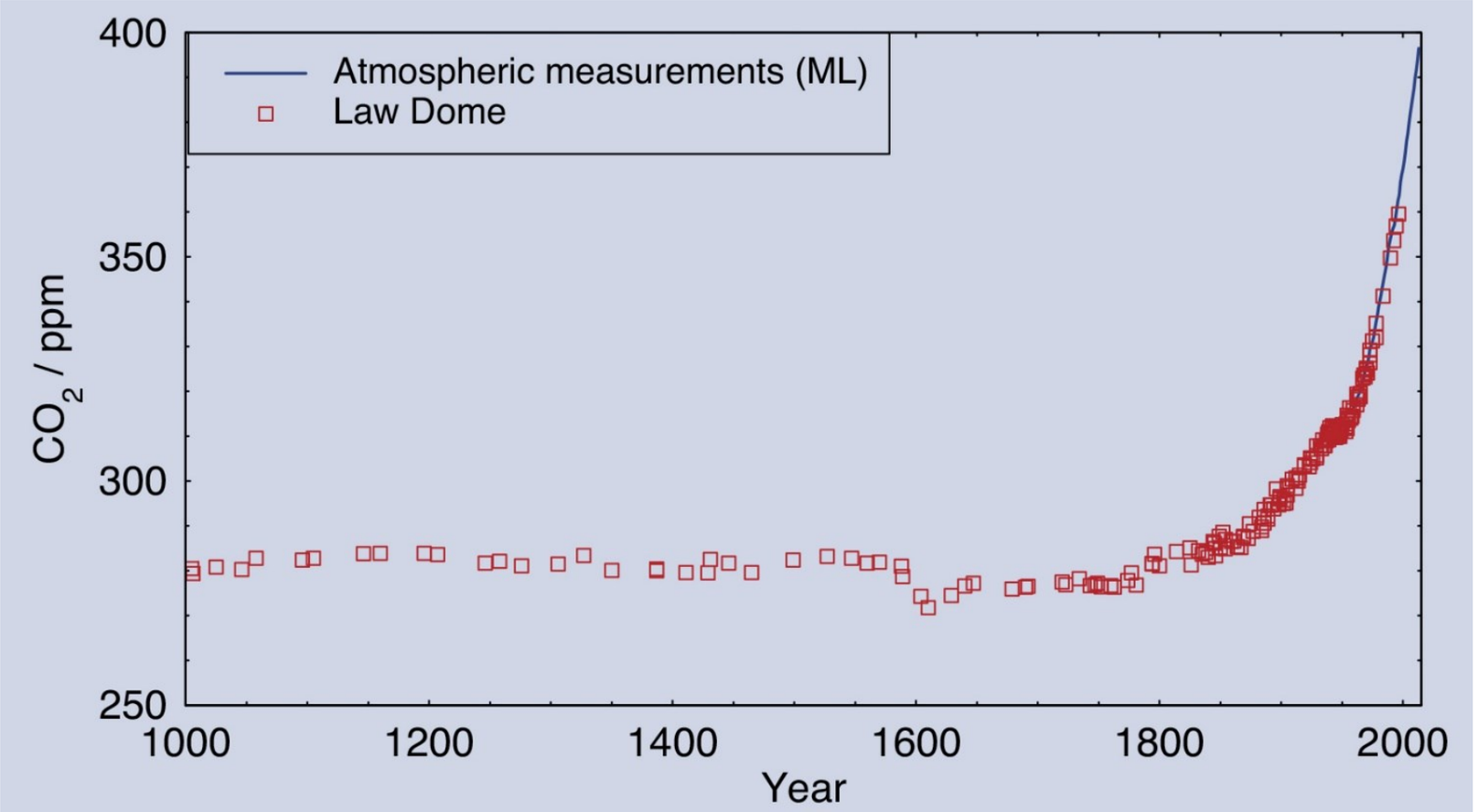


IPCC AR5

CURRENT CLIMATE CHANGE

- Measurements of CO_2 in the atmosphere and in air trapped in ice show that **atmospheric CO_2 increased by about 40% from 1800 to 2012**
- **Atmospheric CO_2 is derived from:**
  - Plants and animals
  - Volcanic emissions
  - Fossil fuel combustion

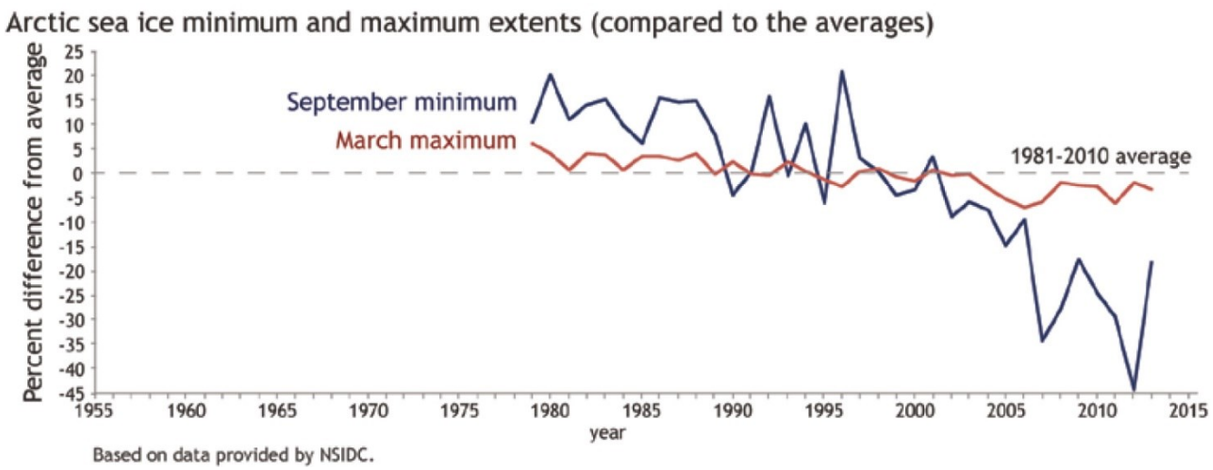
- Each CO_2 source has a unique chemical signature.
- Measurements demonstrate that the rise in CO_2 is largely from combustion of fossil fuels.

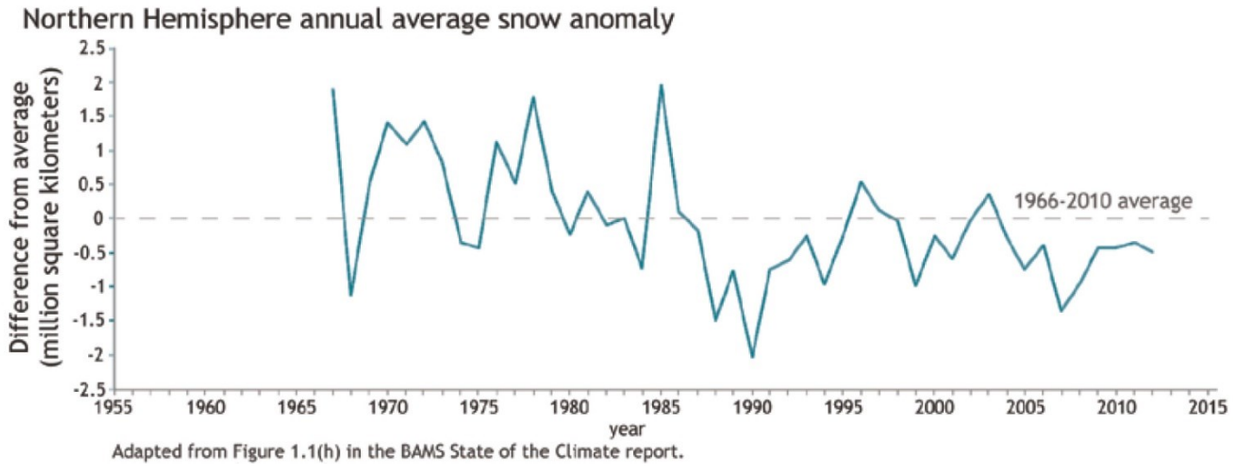


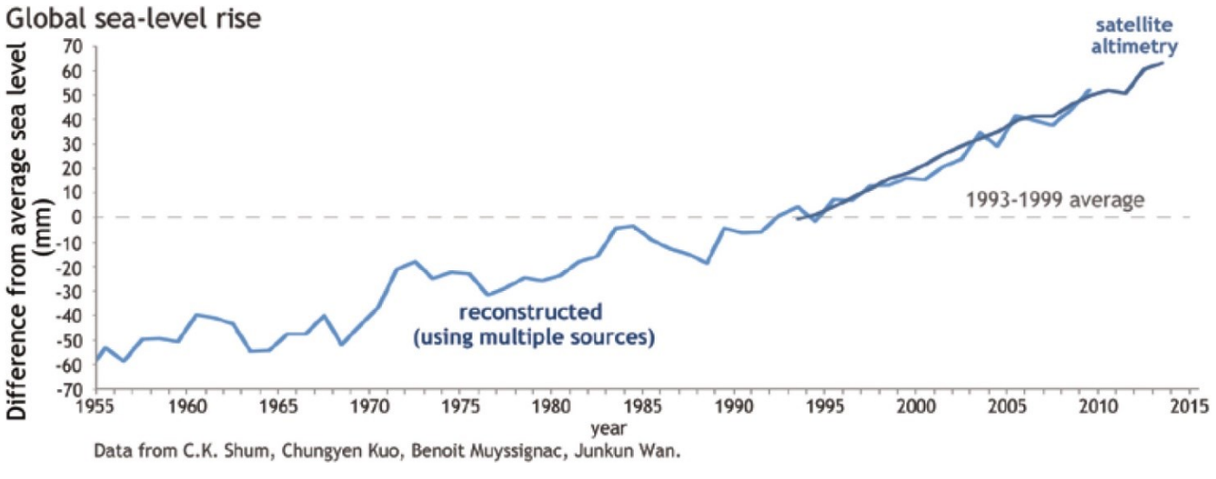
Wolff, Royal Society and US National Academy of Sciences

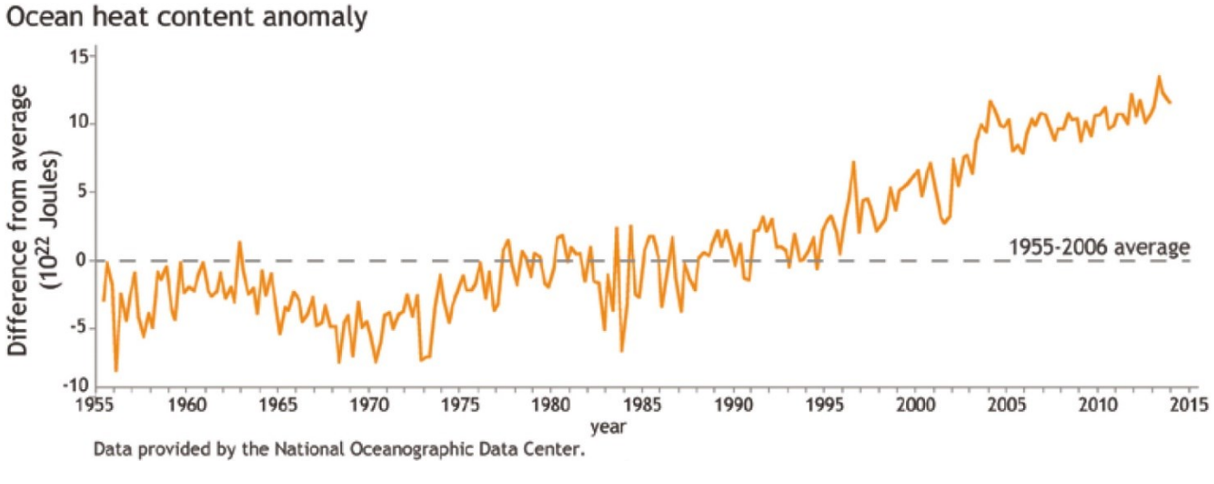
CURRENT CLIMATE CHANGE

- Other observations provide a more comprehensive picture of warming throughout the climate system.





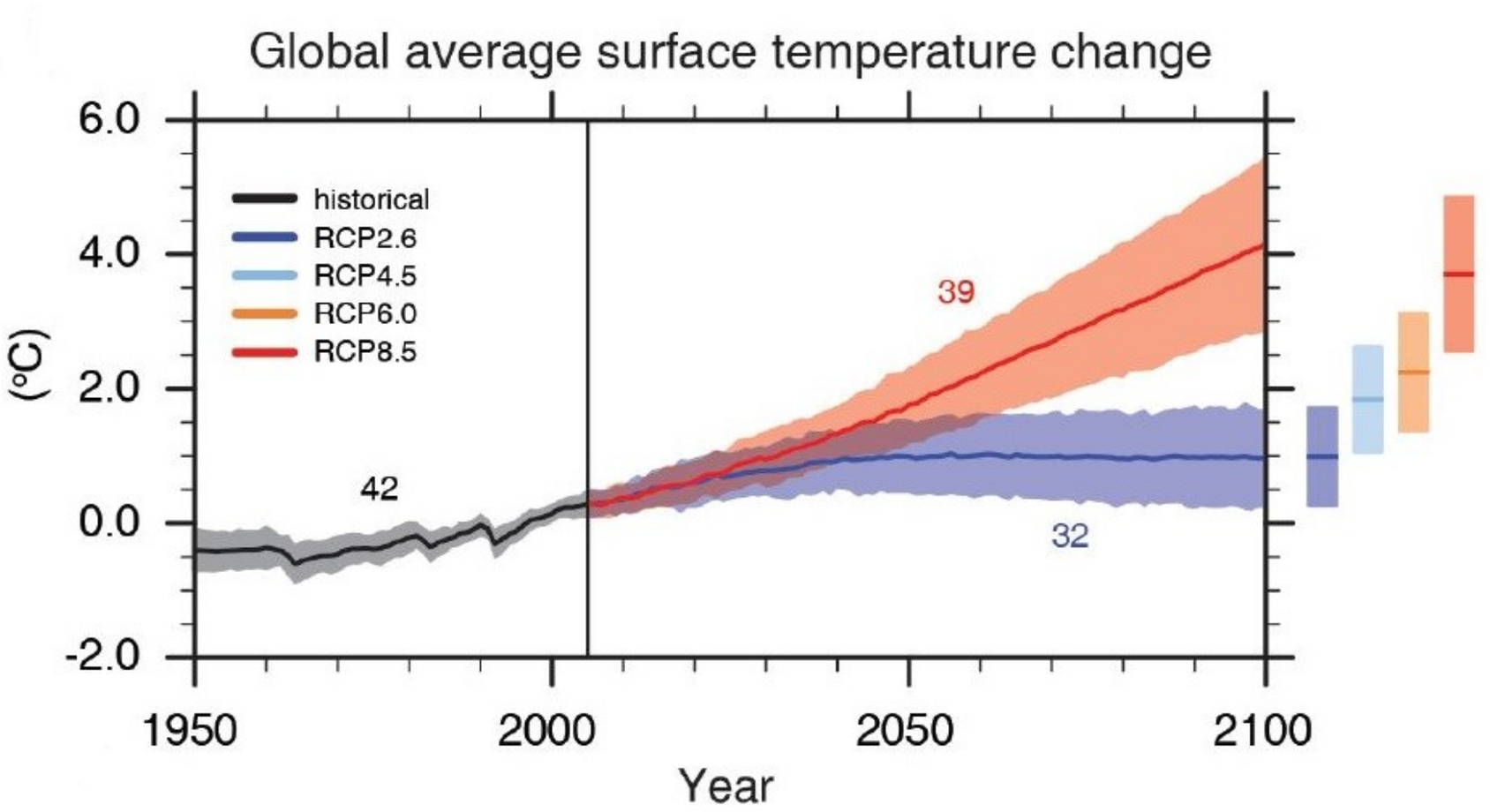




NOAA climate.gov

FUTURE CLIMATE CHANGE

- Temperatures are predicted to rise by around **0.3°C** - **4.8°C** by 2100.
- Based on the IPCC's low emissions scenario (**RCP2.6**), with aggressively cut emissions, the mean rise is predicted to be **1°C** by 2100.
- Under a high emissions scenario (**RCP8.5**) with emissions continuing to grow, warming of **3.7°C** is likely by 2100.



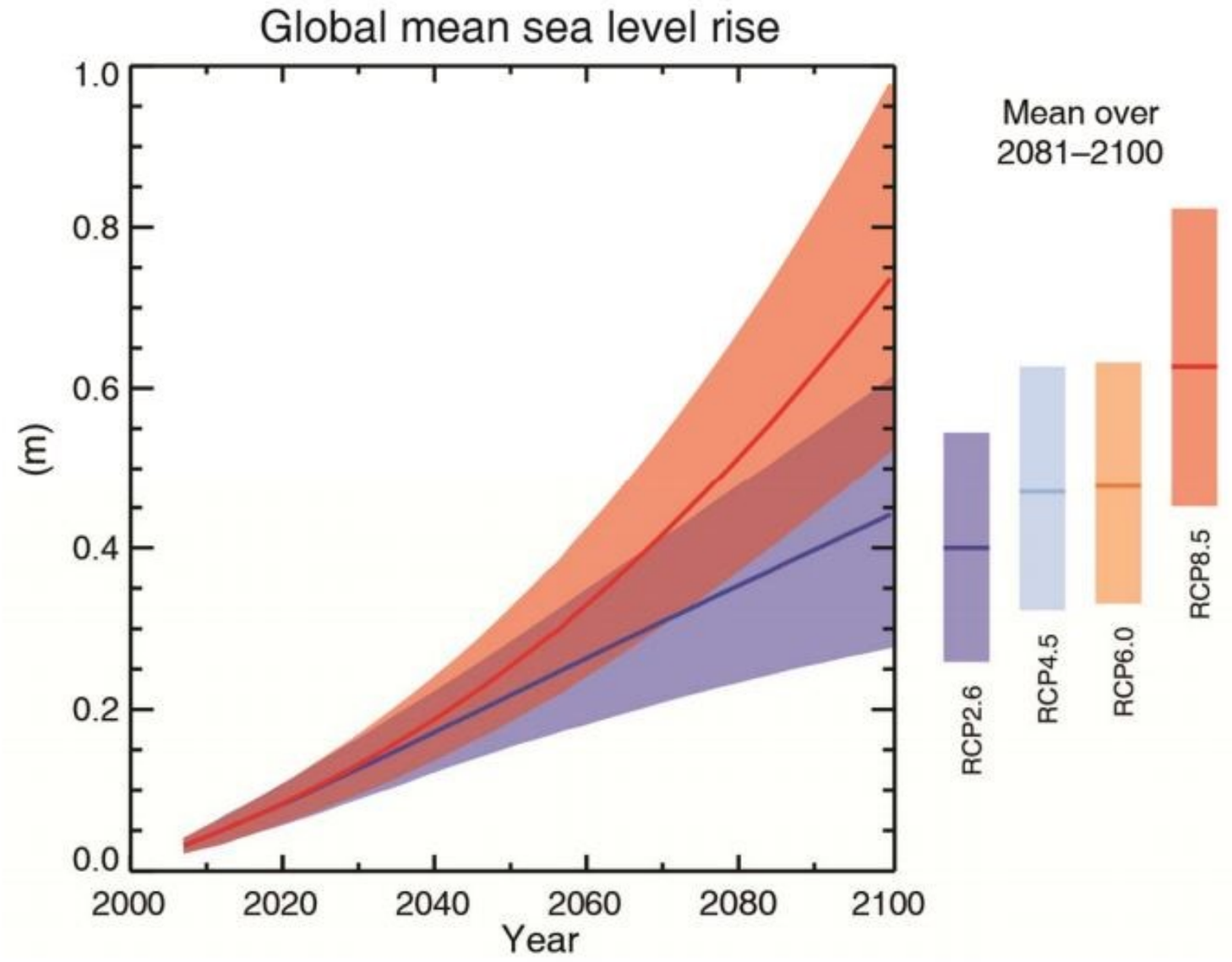
IPCC AR5

FUTURE CLIMATE CHANGE

- Sea level rise by 2100 is likely to be between **26** and **82 cm**

- Based on the low emissions scenario (**RCP2.6**) the average predicted sea level rise is **40 cm**

- Based on the high emissions scenario (**RCP8.5**) the average predicted sea level rise is **63 cm**



IPCC AR5

PART 2

TO PUBLIC PLATFORMS

GEOGRAPHY – THE ROLE OF TEACHERS

Geography is one of the most rapidly changing subjects

- This makes it exciting, relevant, and societally important

Geography teachers play an important role in inspiring the next generation to be more environmentally aware, even if they leave the subject

- It is about:
  - Conveying complex ideas in a manageable format
  - Developing an awareness of the links between systems
  - Highlighting the importance and application of Geography
  - Preparing students for independent learning at university

Climate change is a complex subject to understand and teach

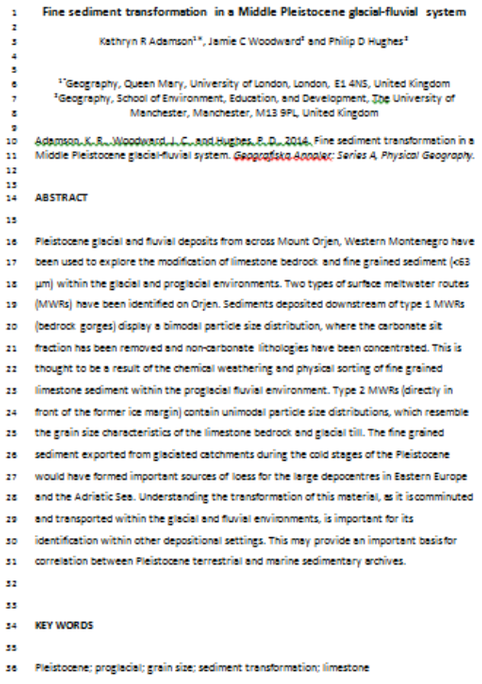
- It is politically charged
- The bewildering array of data means that it is often difficult to stay up to date with the current knowledge base

THE RESEARCH PROCESS

A rapid way to communicate to other scientists

Several months to draft a paper

Draft manuscript



Fine sediment transformation in a Middle Pleistocene glacial-fluvial system

Kathryn R Adamson[1]*, Jamie C Woodward[2] and Philip D Hughes[1]

[1]Geography, Queen Mary, University of London, London, E1 4NS, United Kingdom
[2]Geography, School of Environment, Education, and Development, The University of Manchester, Manchester, M13 9PL, United Kingdom

Adamson, K. R., Woodward, J. C., and Hughes, P. D., 2014. Fine sediment transformation in a Middle Pleistocene glacial-fluvial system. *Geografiska Annaler: Series A, Physical Geography*.

ABSTRACT

Pleistocene glacial and fluvial deposits from across Mount Orjen, Western Montenegro have been used to explore the modification of limestone bedrock and fine grained sediment (<63 μm) within the glacial and proglacial environments. Two types of surface meltwater routes (MWRs) have been identified on Orjen. Sediments deposited downstream of type 1 MWRs (bedrock gorges) display a bimodal particle size distribution, where the carbonate silt fraction has been removed and non-carbonate lithologies have been concentrated. This is thought to be a result of the chemical weathering and physical sorting of fine grained limestone sediment within the proglacial fluvial environment. Type 2 MWRs (directly in front of the former ice margin) contain unimodal particle size distributions, which resemble the grain size characteristics of the limestone bedrock and glacial till. The fine grained sediment exported from glaciated catchments during the cold stages of the Pleistocene would have formed important sources of loess for the large depocentres in Eastern Europe and the Adriatic Sea. Understanding the transformation of this material, as it is comminuted and transported within the glacial and fluvial environments, is important for its identification within other depositional settings. This may provide an important basis for correlation between Pleistocene terrestrial and marine sedimentary archives.

KEY WORDS

Pleistocene; proglacial; grain size; sediment transformation; limestone

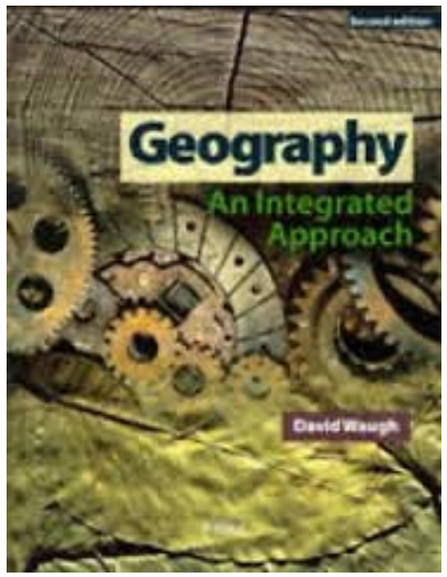
Peer review…
Revisions…
Re-submission…
Several (more) months

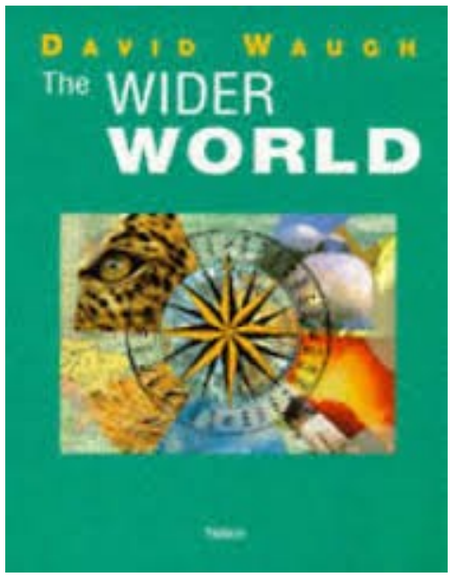
Journal publication!

TEXTBOOKS VS RESEARCH PAPERS

Textbooks

- Do a great job at synthesizing complex ideas
- They are accessible, provide excellent graphics and neatly packaged case studies…
- …but they are quickly outdated





Research papers

- Are at the forefront of geographical ideas. They present emerging theories and paradigms…
- …but they are largely inaccessible beyond universities and research institutions

How can we start to bridge this divide?

TEXTBOOKS VS RESEARCH PAPERS

Textbooks

- Do a great job at synthesizing complex ideas
- They are accessible, provide excellent graphics and neatly packaged case studies…
- …but they are quickly outdated

Research papers

- Are at the forefront of geographical ideas. They present emerging theories and paradigms…
- …but they are largely inaccessible beyond universities and research institutions

How can we start to bridge this divide?

THE ROLE OF SCIENTISTS

- Scientists drive the research trajectories
- Scientists know far in advance of the textbooks were their field is going

- Every year, across all disciplines:
- **Over £27 billion is spent on research in the UK alone** (Office for National Statistics)
- **Over 1 million research papers are published each year globally** (Information Research)

- With all of this public funding (and the research output) perhaps scientists have a responsibility to publish their findings more broadly
- After all…

enhanced uptake at school level →

sustained university numbers →

research is safeguarded

THE ROLE OF SCIENTISTS

- But scientists are not teachers
- We are trained researchers and lecturers and do not necessarily have the skills to address younger age groups – this is a very different approach!

- But at school we have a responsibility to provide an introduction to:
  - The work that climate scientists do
  - The key concepts and theories
  - The scientific terminology
  - The practical importance of Geography

- We need to develop a synergy
- To more effectively (and rapidly) disseminate our research in a way that teachers can package it for their students

SCIENCE OUTREACH

Science outreach platforms provide an effective way to bridge the gap between scientific knowledge and school curriculums

- There is an increasing emphasis on outreach within research grants

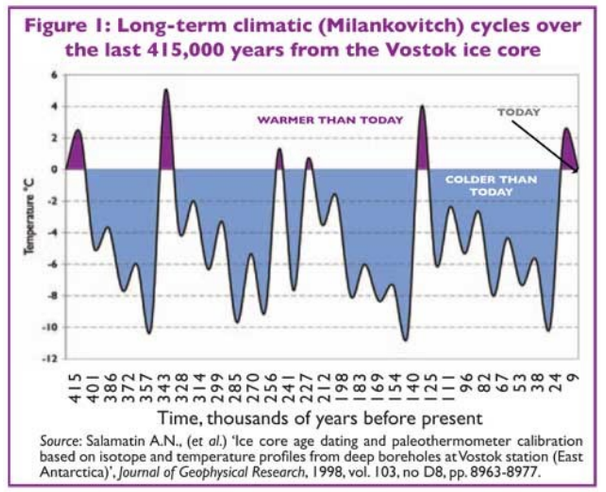
This can take a variety of forms:

- Websites
- Blogs
- Datasets
- Schools talks
- Museum exhibitions
- Newspaper and magazine articles
- And many others

KEY CONCEPTS

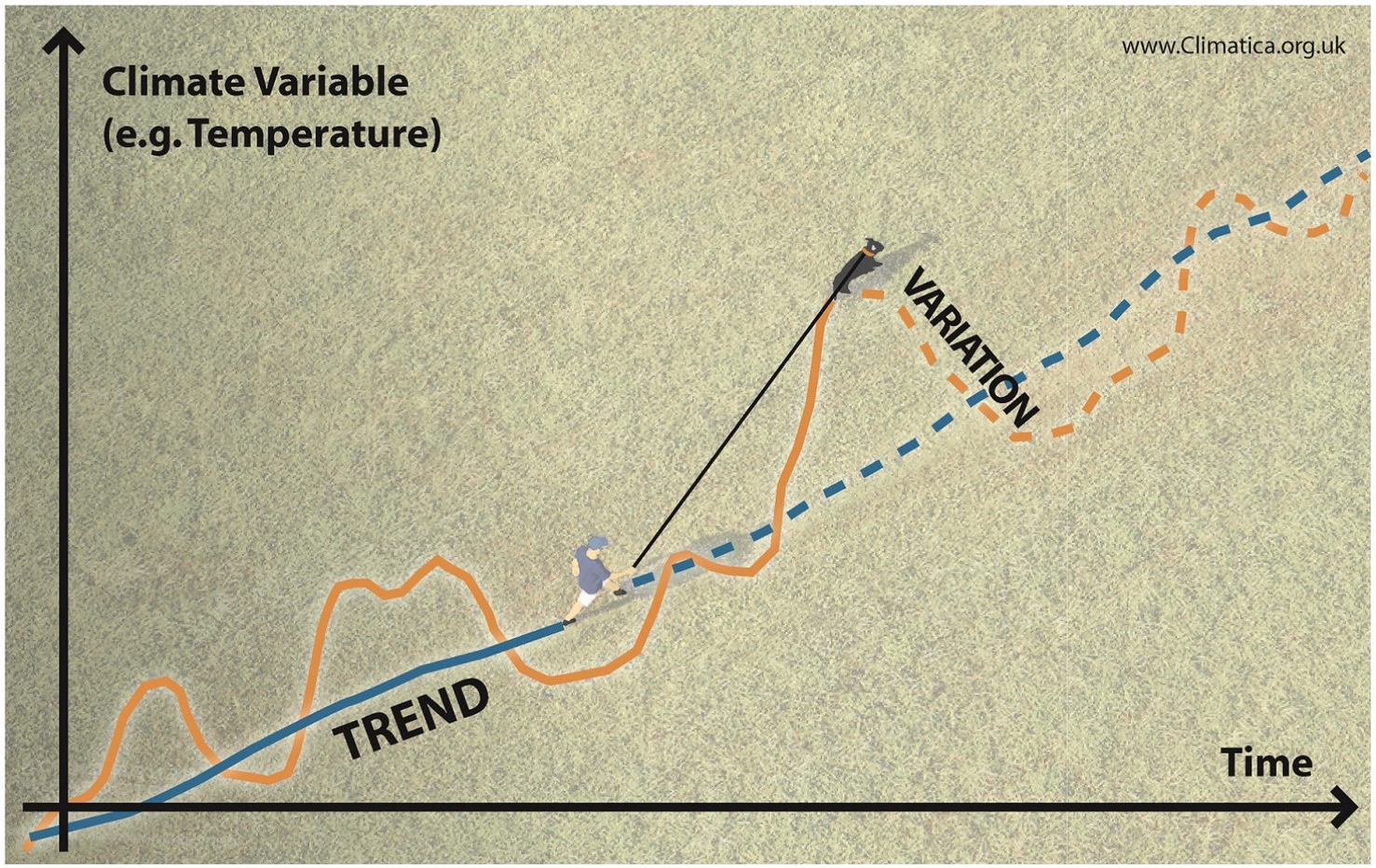
As well as the content, climate change can be used to teach key concepts

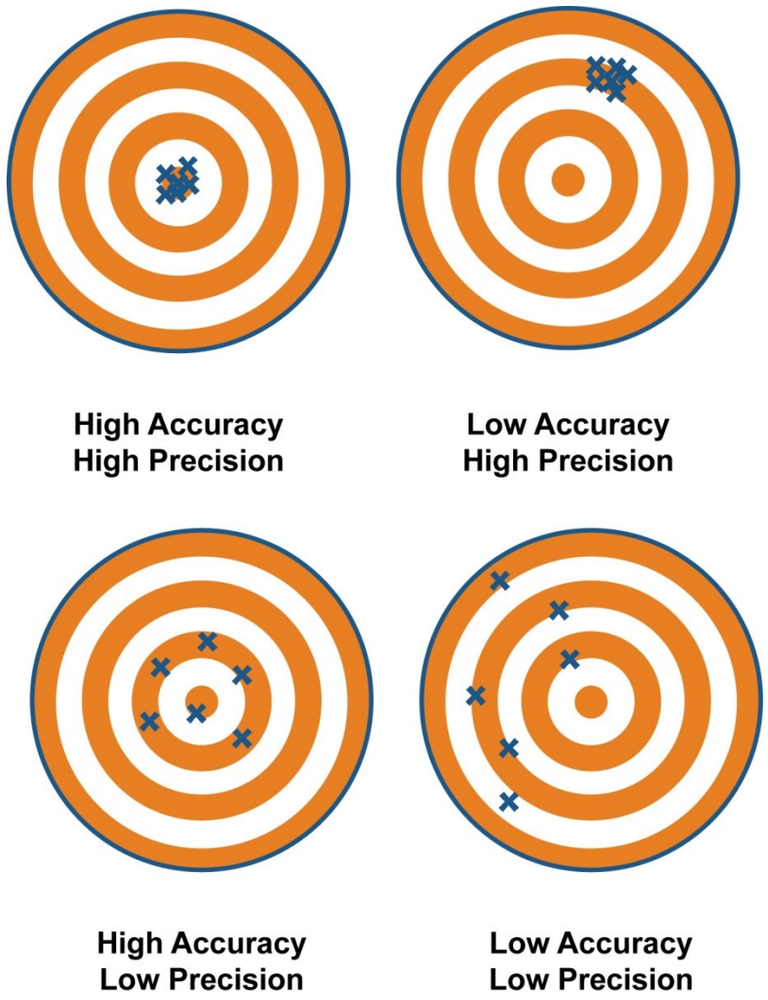
- **Key scientific concepts:**
  - Uncertainty (or 'error margins'), accuracy, and precision
  - Feedback mechanisms and links *between* systems
  - Correlation and causation
  - Long-term change
  - Future projections
  - Human impacts and management strategies
  - Critical thinking and 'flair'



KEY CONCEPTS

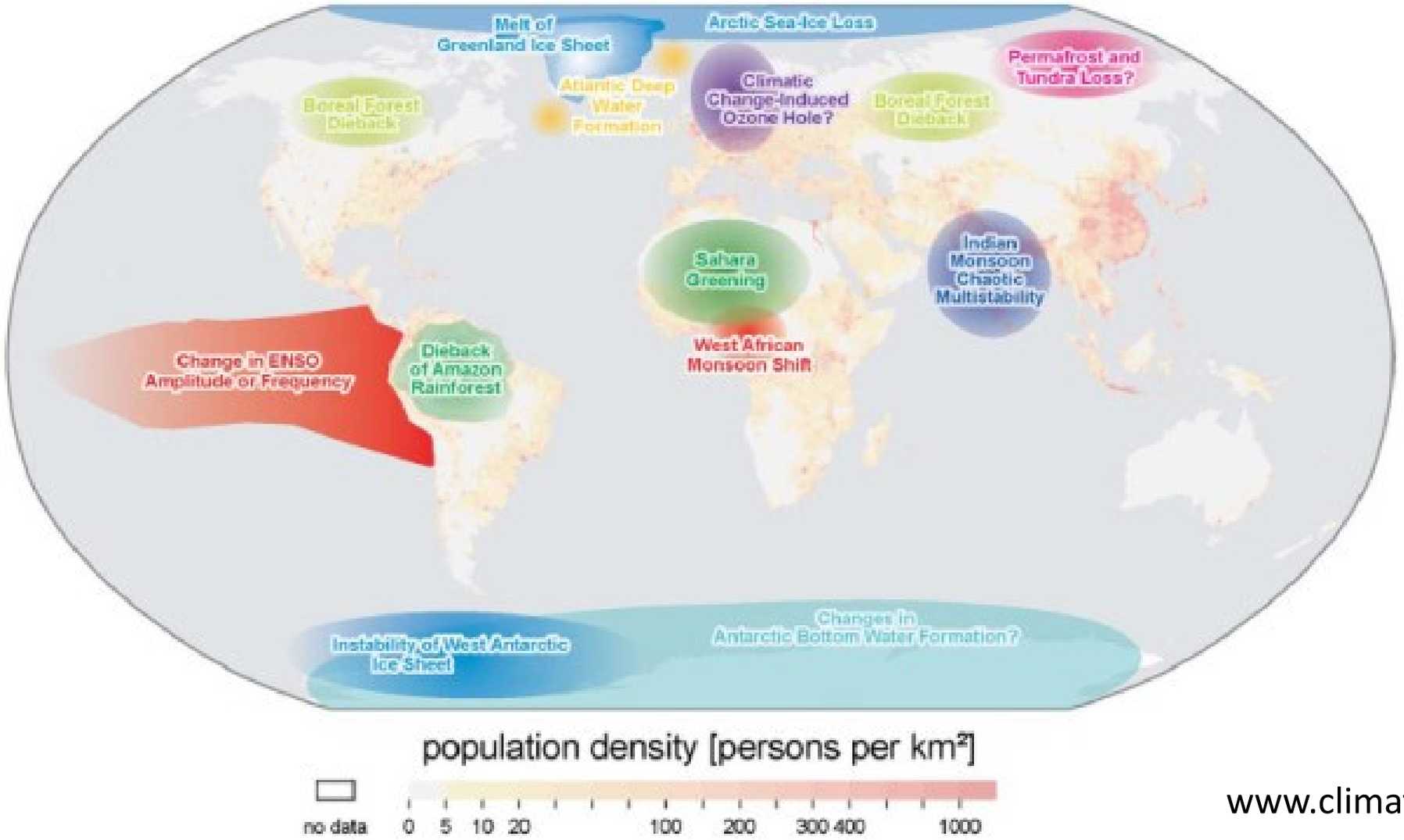
- **Trends**
- **Uncertainty, accuracy, and precision**





KEY CONCEPTS

- **Feedback mechanisms**

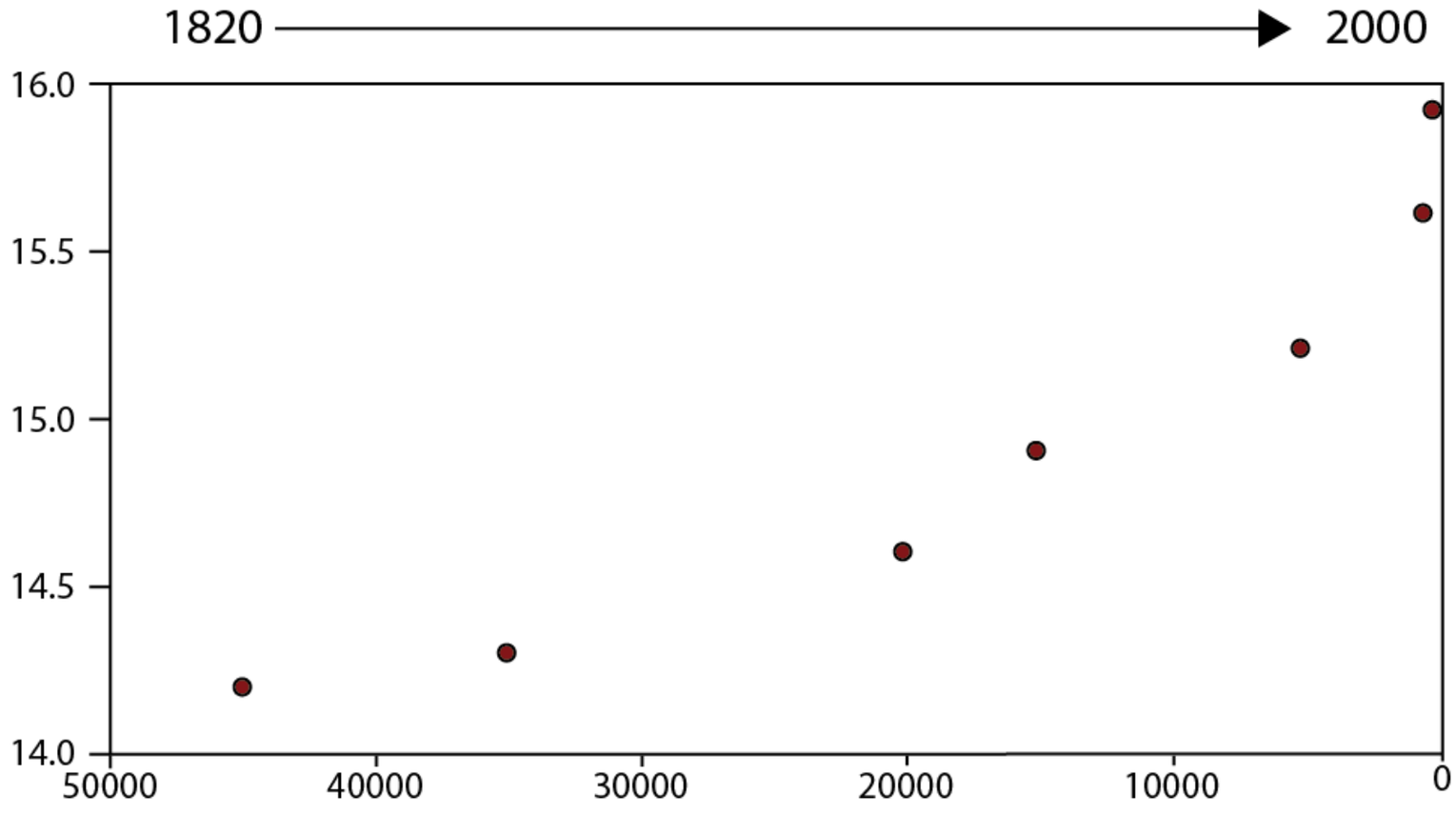


www.climatica.org.uk

Map of positive feedbacks with potential tipping points that could be triggered this century. Question marks (?) indicate system which are not yet fully understood. Figure courtesy of Lenton et al. (2008) (PNAS).

KEY CONCEPTS

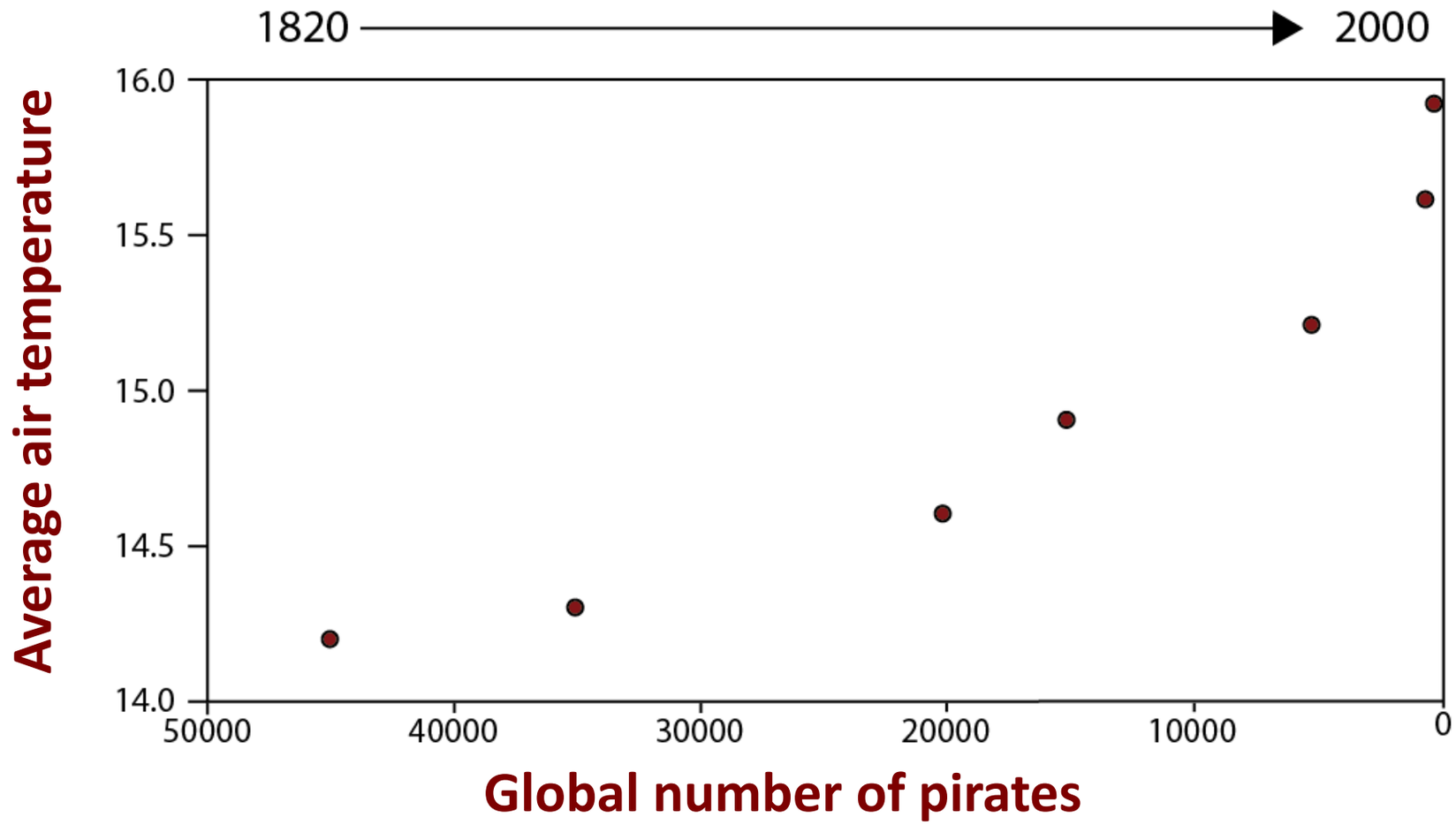
- **Critical thinking and ‘flair’**
- **Correlation vs causation**
- There is an important distinction between two variables being correlated and having a cause and effect relationship



Two variables plotted against one another through time (1820 – 2000).
They are clearly correlated to one another, but there is no cause and effect relationship.

KEY CONCEPTS

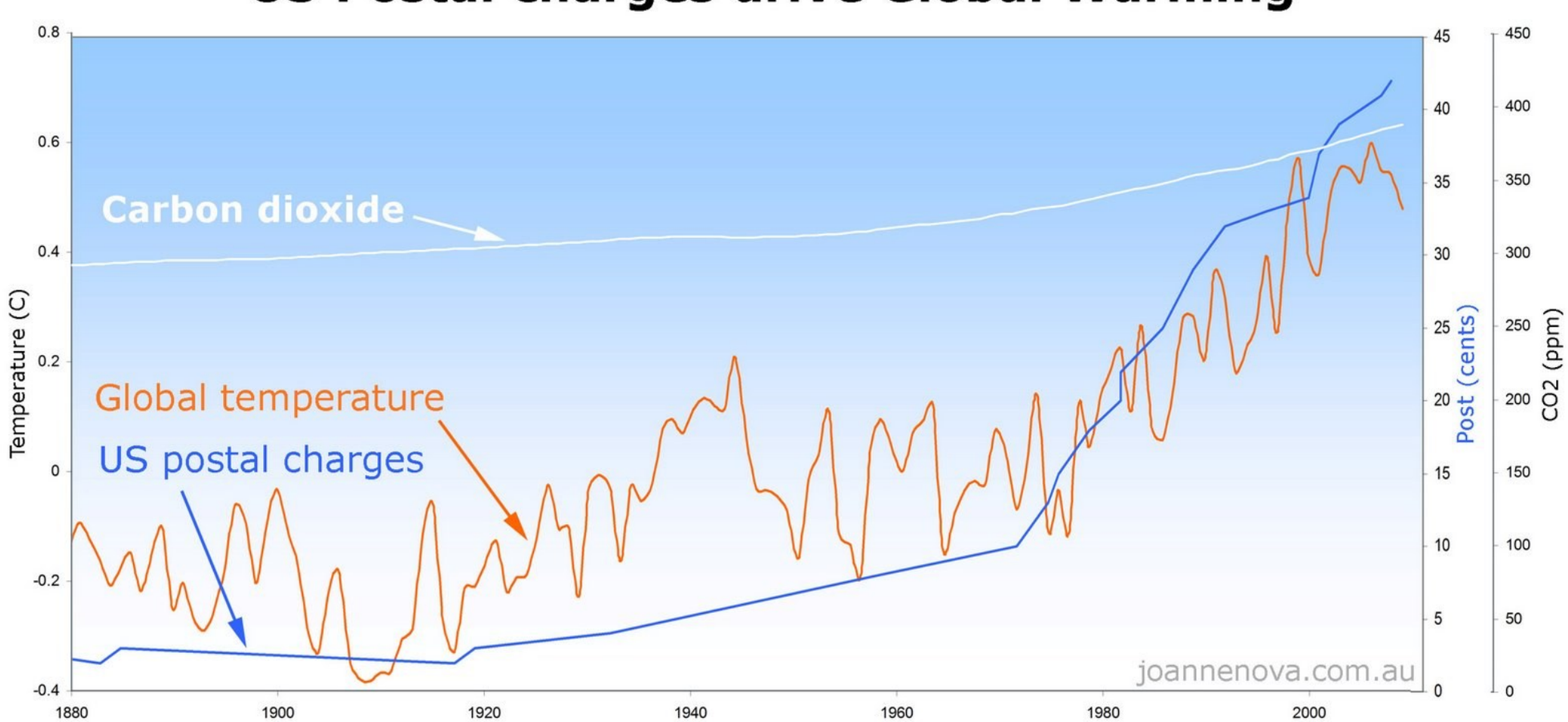
- **Critical thinking and ‘flair’**
- **Correlation vs causation**
- There is an important distinction between two variables being correlated and having a cause and effect relationship



Two variables plotted against one another through time (1820 – 2000).
They are clearly correlated to one another, but there is no cause and effect relationship.

KEY CONCEPTS

- **Critical thinking and ‘flair’**
- **Correlation vs causation**
- There is an important distinction between two variables being correlated and having a cause and effect relationship



EXAM QUESTION EXAMPLE

‘The Earth has a fever, and the fever is rising…. We are what is wrong, and we must make it right.’ (Al Gore, 2007)

In the context of global warming, discuss the extent to which you agree with this statement. (40 marks)

- Knowledge and understanding of the changes in global temperatures both over **long periods of time and in recent decades**, and the **rates of increase** in greenhouse gases (carbon dioxide, methane and nitrous oxide)
- **Critical understanding of the reasons** for these increases
- Knowledge and understanding of the **impacts of these increases**, at a **variety of scales**
- Critical understanding of the means by which **mitigation and/or adaptation** to can be achieved

EXAM QUESTION EXAMPLE

‘The Earth has a fever, and the fever is rising…. We are what is wrong, and we must make it right.’ (Al Gore, 2007)

In the context of global warming, discuss the extent to which you agree with this statement. (40 marks)

- Evidence in the **breadth/depth of supporting evidence** both for and against, using varying locations
- Recognition of the range of **organisations and individuals that have an opinion** on this issue, and the variety of contexts from which they arise e.g. political, economic and scientific
- Recognition of the **complexity of the issue** of global warming; some understanding of the debate surrounding the issue.

EXAM QUESTION EXAMPLE

‘The Earth has a fever, and the fever is rising…. We are what is wrong, and we must make it right.’ (Al Gore, 2007)

In the context of global warming, discuss the extent to which you agree with this statement. (40 marks)

Examiner comments:

- **…many answers were simplistic – often based on ill-informed arguments**. These were mostly **lacking in scientific or historical evidence** to support either side of the debate. On the other hand, there were **some students who presented precise details** of the enhanced greenhouse effect with **appropriate use of data** from organisations/pressure groups such as the IPCC and Copenhagen Dilemma. Some even referred to ‘Global Weirding’ - the thoughts of another ‘think-tank’ based in the USA. There was some discussion of i**ce core analysis, pollen analysis, dendrochronology, historic data/events and other evidence**…

RESOURCES EXAMPLES – WEBSITES

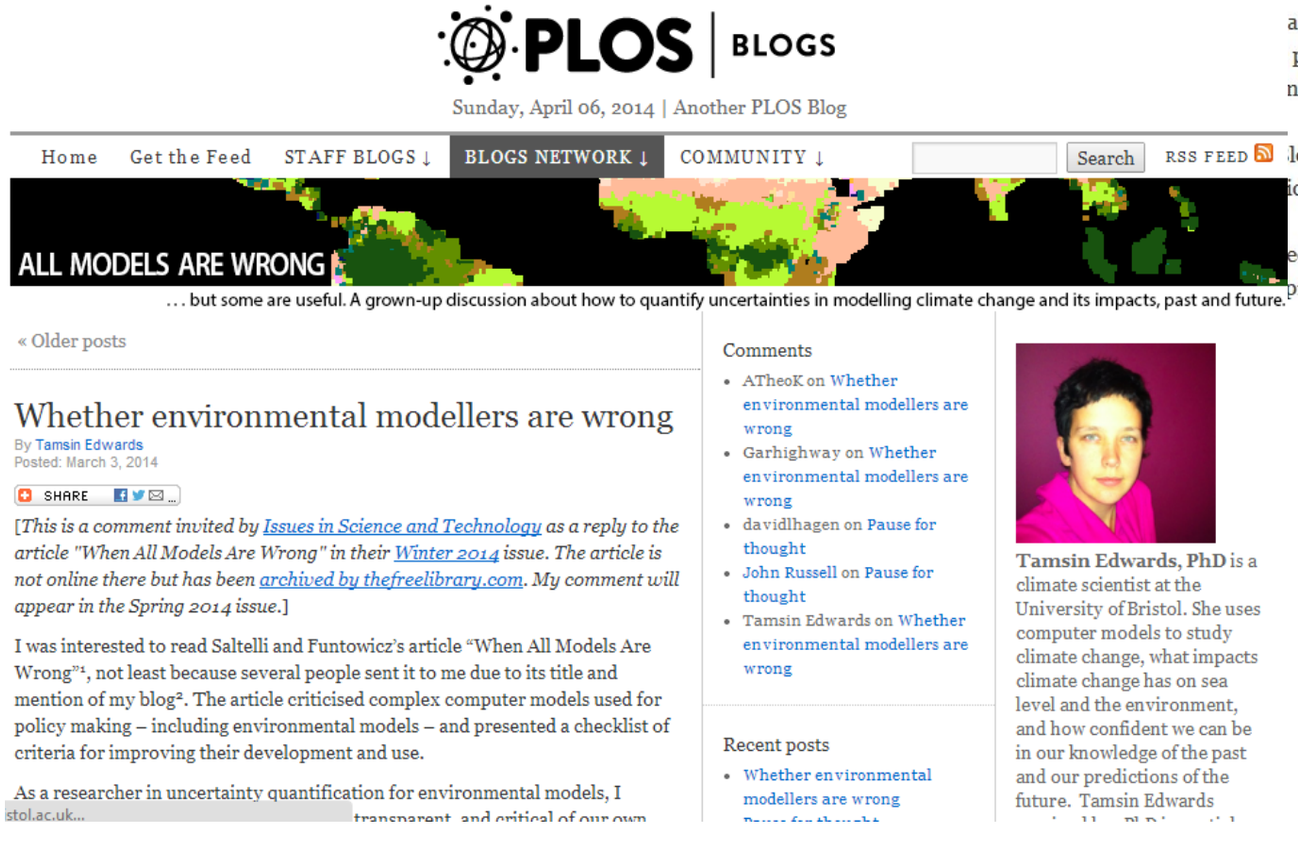
www.climatica.org.uk

http://www.antarcticglaciers.org

http://www.skepticalscience.com

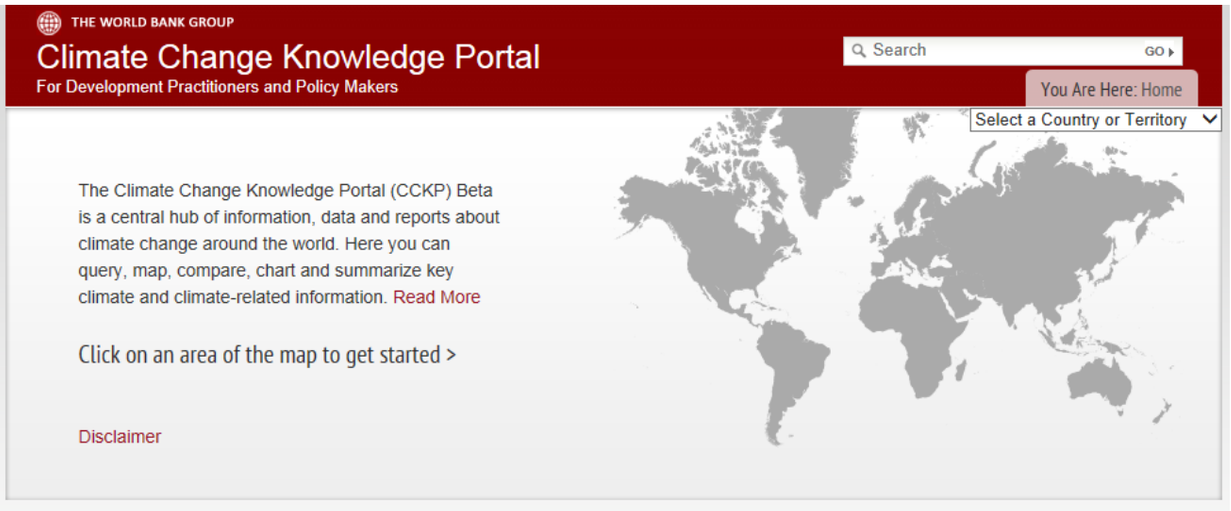
RESOURCES EXAMPLES – BLOGS

http://blogs.plos.org/models/

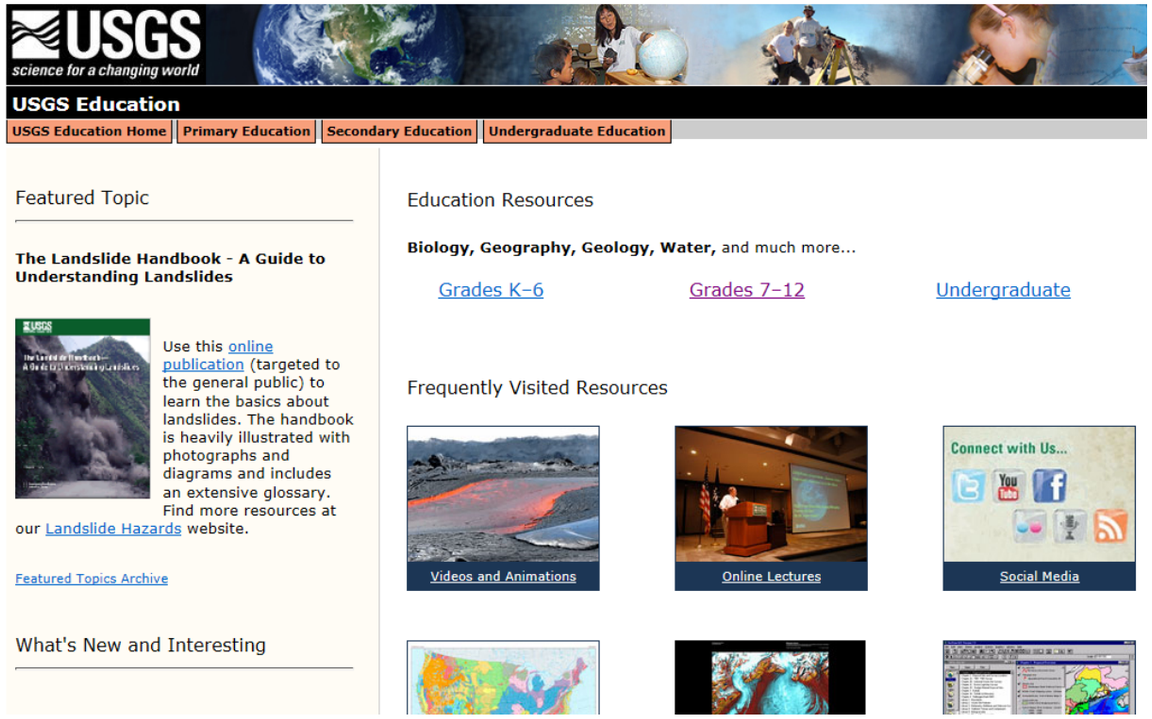


http://arcticresearch.wordpress.com/

RESOURCES EXAMPLES – DATASETS



http://sdwebx.worldbank.org/climateportal/index.cfm



http://education.usgs.gov/

HINTS FOR USING SCIENCE OUTREACH

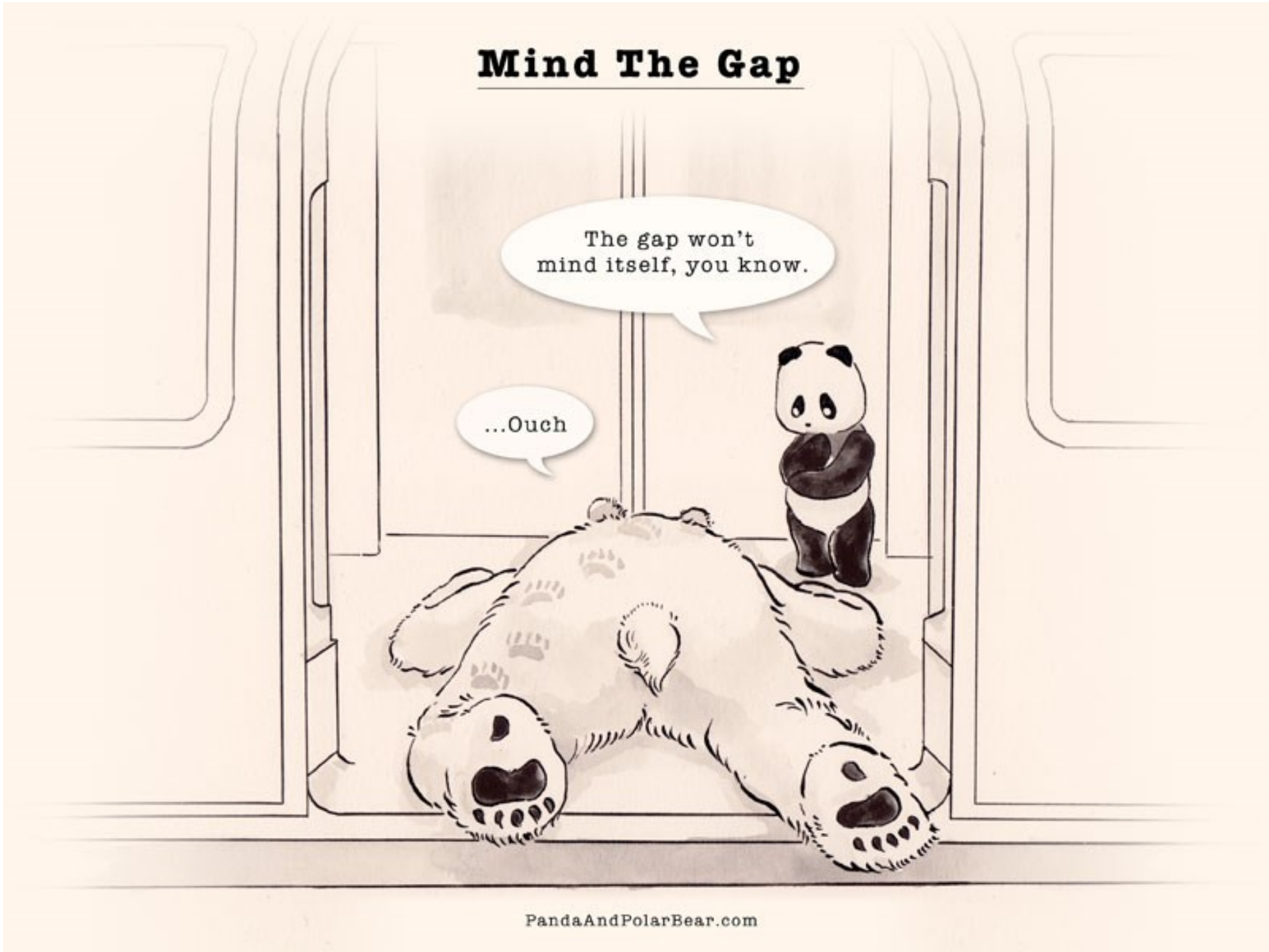
- **Follow the trends in outreach** – explore the options available
- **Get in touch with local universities and museums** – many offer open days, talks, and teachers evenings
- **Sign up to mailing lists**
- **Use Twitter** – follow academics, University departments, research centres, news outlets, and other outreach providers
- **Many datasets exist** – some of the websites listed here provide some useful and highly accessible resources for schools
- **Look beyond the UK** – the European Geosciences Union (EGU), the American Geophysical Union (AGU), NASA, and the United States Geological Survey (USGS) all provide excellent resources for schools and colleges
- **Contact us at Climatica** – if there is something you would like to see, or have any questions, then let us know and we will work it into our site! (climaticauk@gmail.com)

CONCLUSIONS

From research stations to public platforms

- Scientists drive the research agenda
- But there is a need for more frequent communication to the wider public and schools
- A range of outreach and educational resources exist:
    - Websites, blogs, museum exhibitions, datasets
- Scientists play an important role in making their findings more accessible…
- …and teachers play an important role in delivering these datasets
- Developing a synergy between teachers and academics is important

QUESTIONS


Mind The Gap
The gap won't mind itself, you know.
...Ouch
PandaAndPolarBear.com

Visit us at **stand 16**

Enter our prize draw to win a £50 Amazon voucher!

OCR
Oxford Cambridge and RSA

Thank you

ocr.org.uk/geography

ocr.humanities@ocr.org.uk

facebook.com/ocrexams

@ocrexams

Oxford Cambridge and RSA