

Transformational Climate Science

The future of climate change research
following the IPCC Fifth Assessment Report

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Working Group I

The challenge of climate change

#climate2014

The challenge of climate change

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Climate Change 2013: The Physical Science Basis

Working Group I contribution to the IPCC Fifth Assessment Report

Detection and Attribution of Climate Change : from Global to Regional

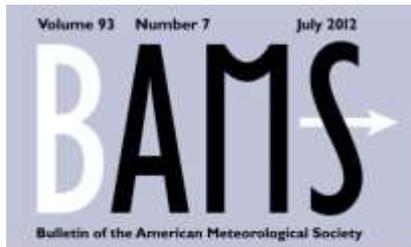
Peter Stott, Nathan Bindoff, Krishna AchutaRao, Myles Allen, Nathan Gillett, David Gutzler, Kabumbwe Hansingo, Gabriele Hegerl, Yongyun Hu, Suman Jain, Igor Mokhov, James Overland, Judith Perlwitz, Rachid Sabberi, Xuebin Zhang.

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Explaining extreme climate and weather events of the previous year from a climate perspective

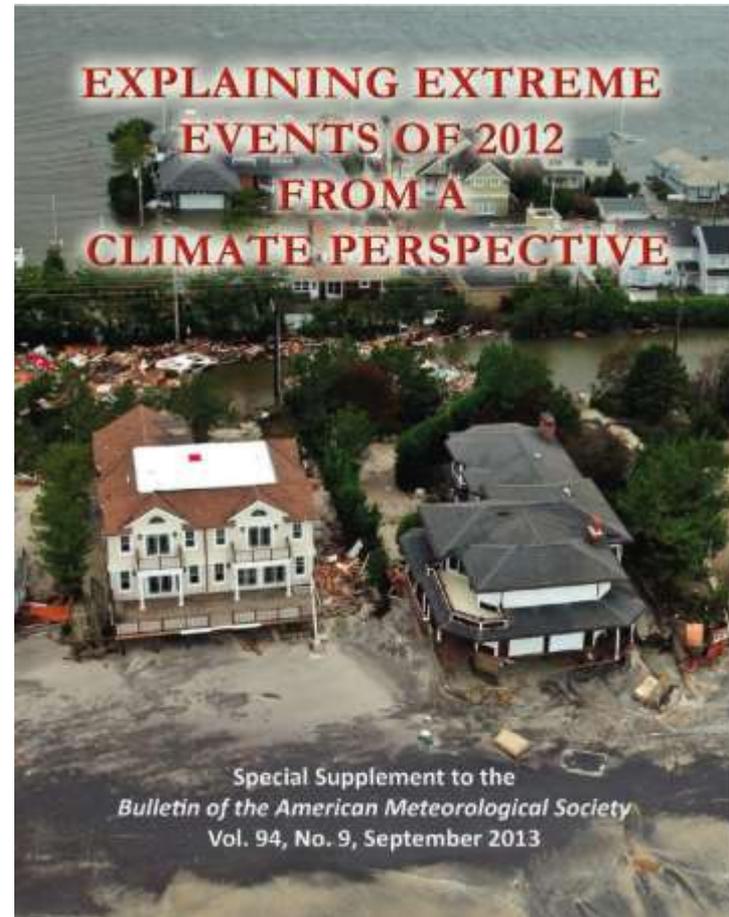
Peter Stott, Stephanie Herring, Martin Hoerling, Tom Peterson.



WEATHER **EXTREMES** OF 2011
IN CLIMATE PERSPECTIVE



Taking Attribution Science to the Limits



What do we mean by attribution?

- **Attribution** requires estimates of the expected changes in climate due to different factors (eg increased greenhouse gas concentrations or changing solar output) : the “fingerprints”.
- An observed change is **attributed** to a particular factor if observed changes are consistent with expected changes that include the relevant fingerprint and inconsistent with expected changes that exclude that fingerprint.
- **Attribution** is defined as the process of evaluating the relative contributions of multiple causal factors to a change or event with an assignment of statistical confidence.
- **Attribution** combines statistical analysis with physical understanding.
- [IPCC Good Practice Guidance Paper, 2010]

Observed warming consistent with that expected from anthropogenic factors and inconsistent with that expected from natural factors

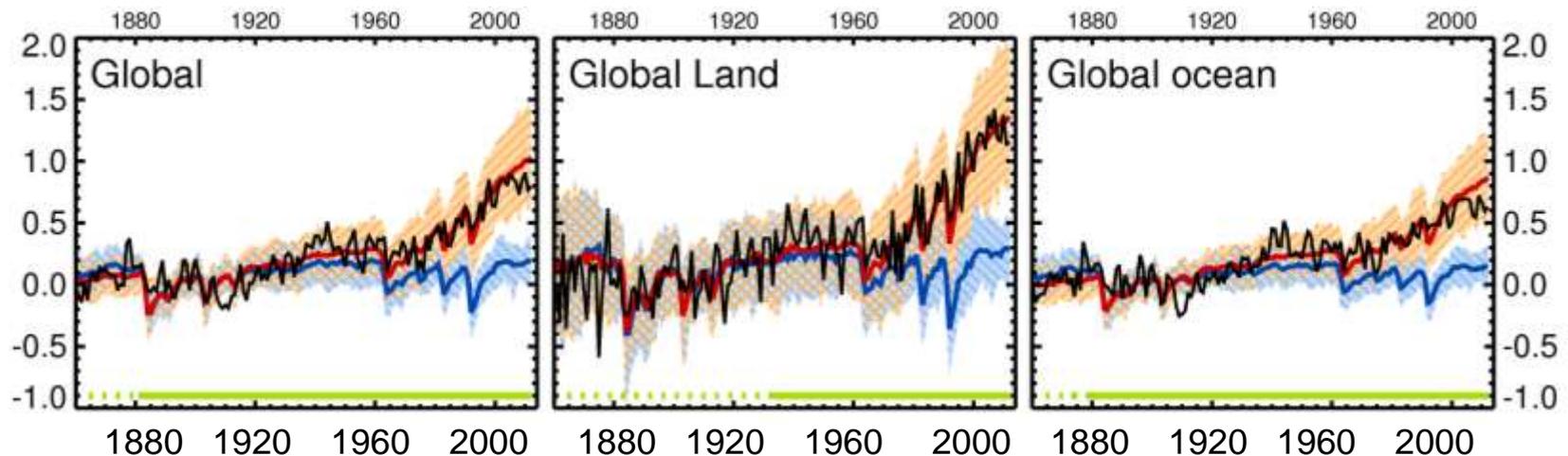
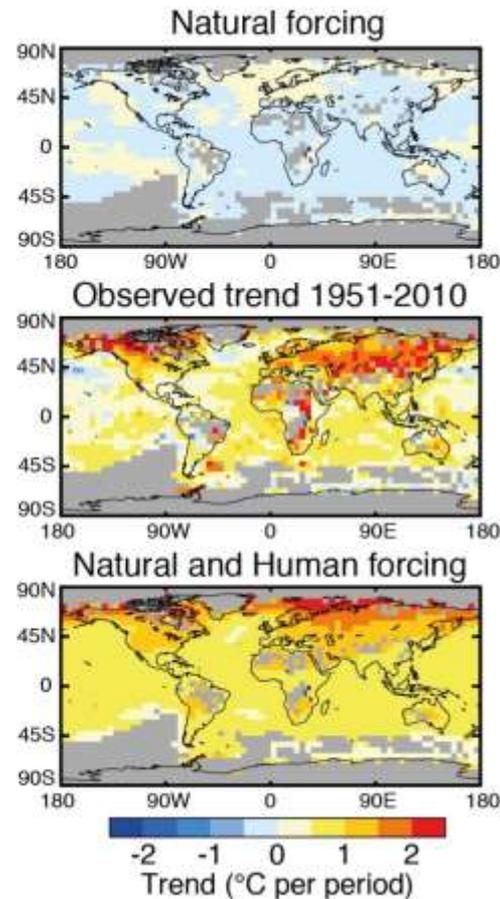
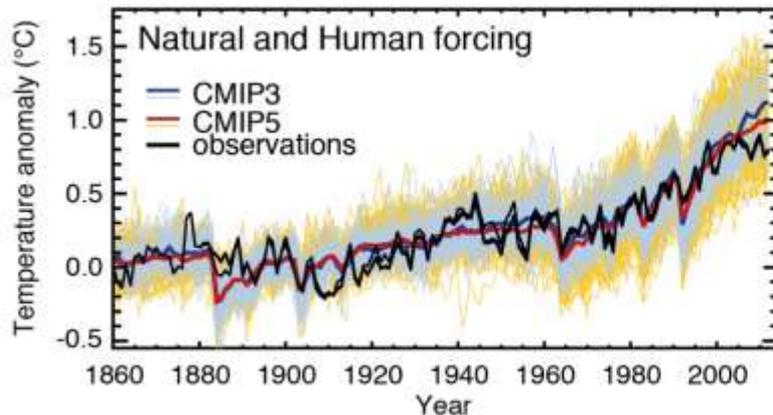
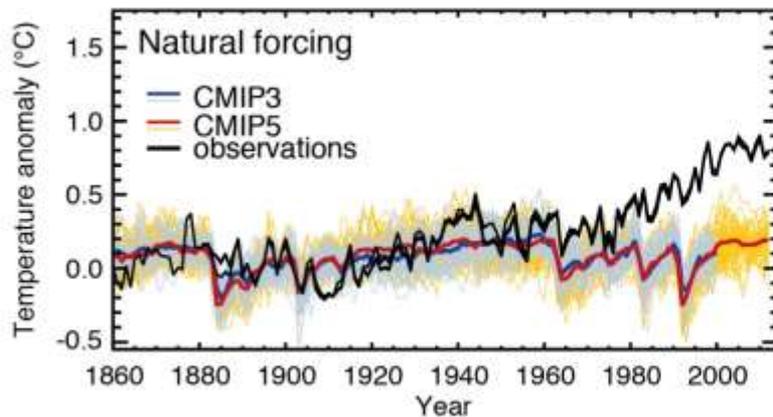


Fig 10.7

The first decade of the 21st century was the warmest on record.

Fingerprint studies quantify the contributions of anthropogenic and natural forcings to observed warming



FAQ 10.1
Fig 1

It is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century.

Attribution studies based on different methodologies, a new generation of climate models and observations to 2010.

The best estimate of the human-induced contribution to warming is similar to the observed warming.

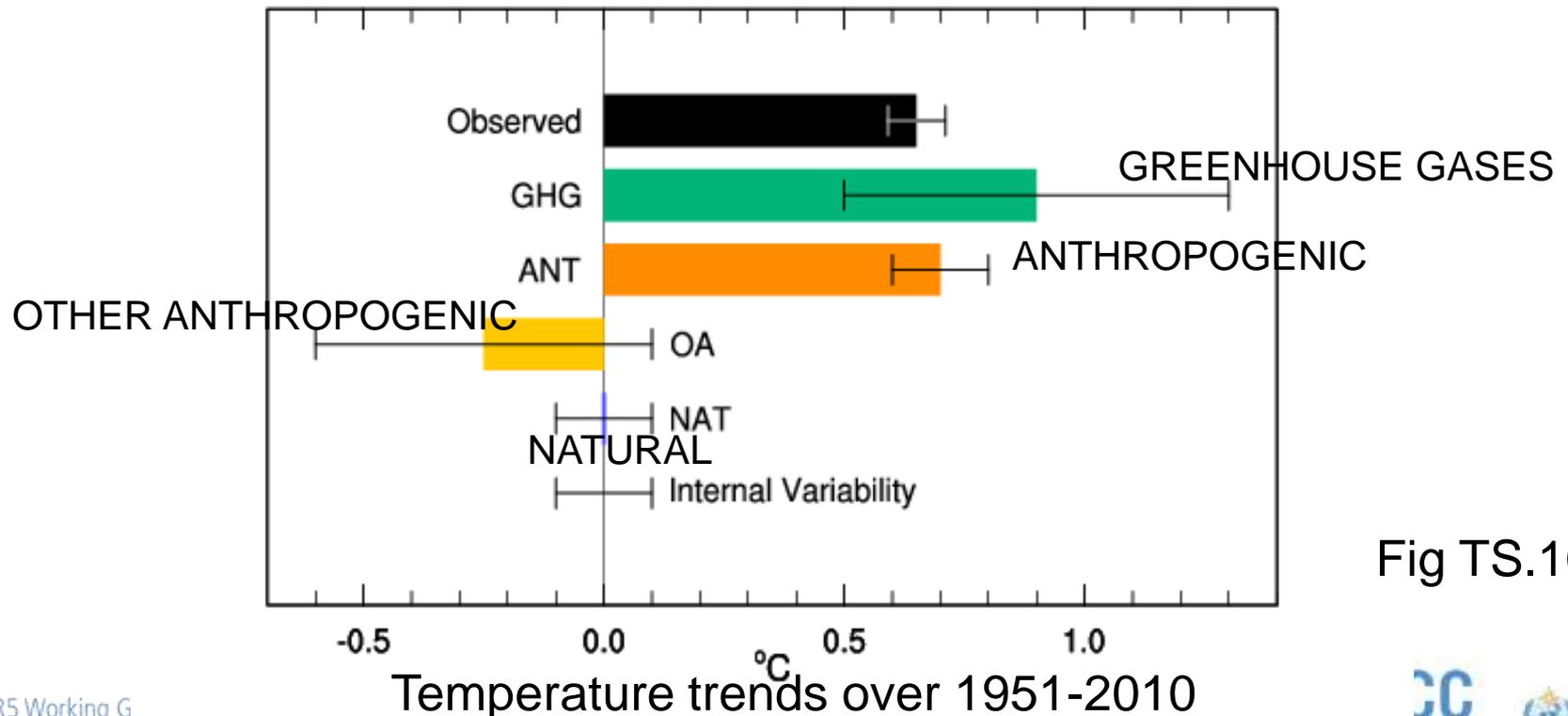
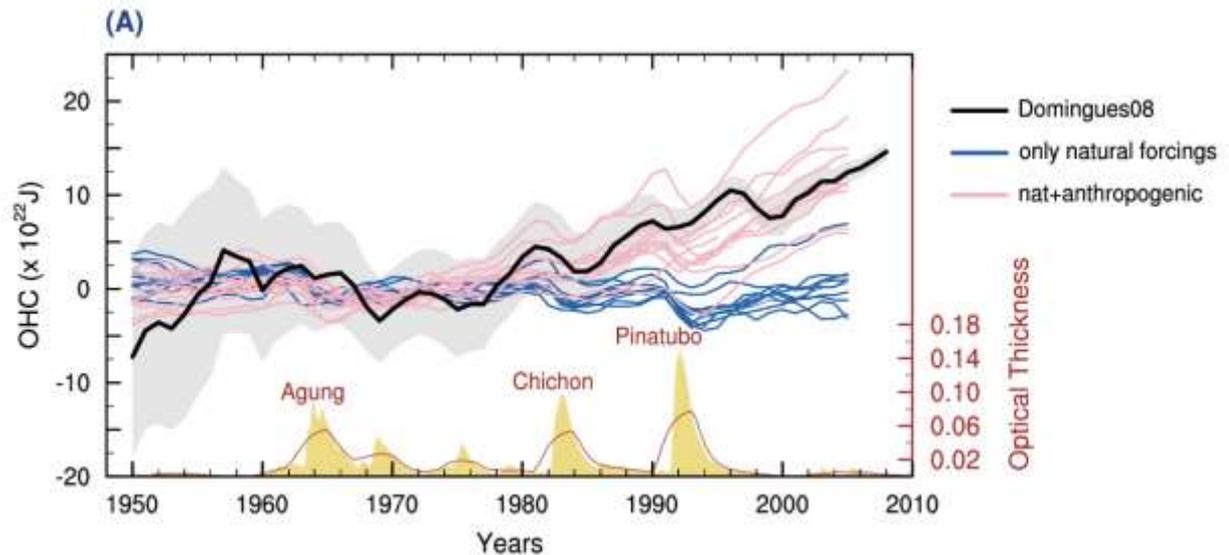


Fig TS.10

Likely substantial anthropogenic contribution to increases in global upper ocean heat content

Ocean heat content



Signal to noise ratio

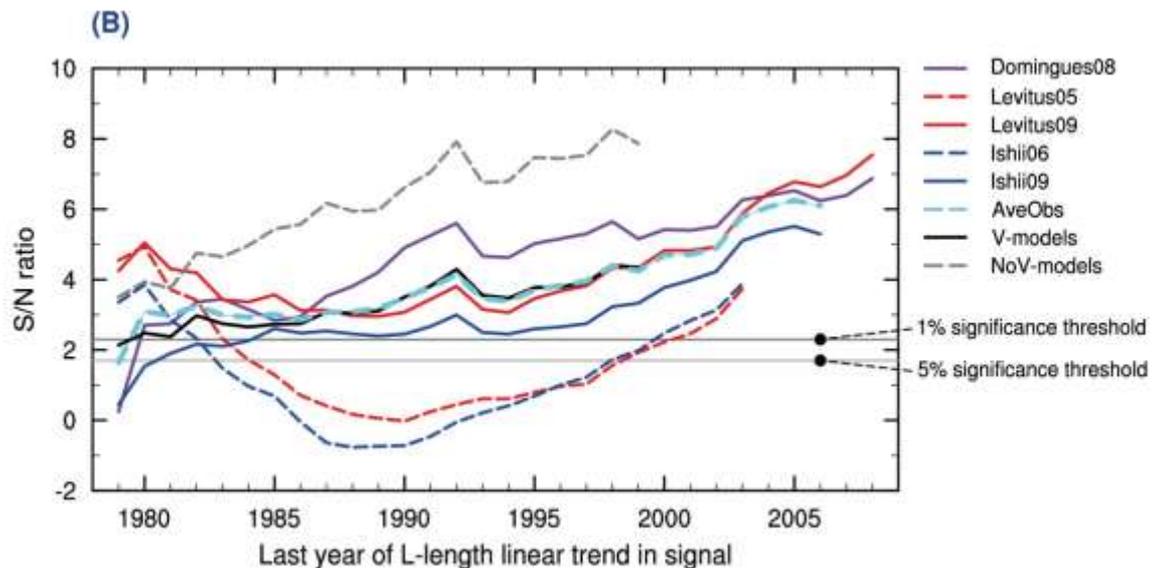
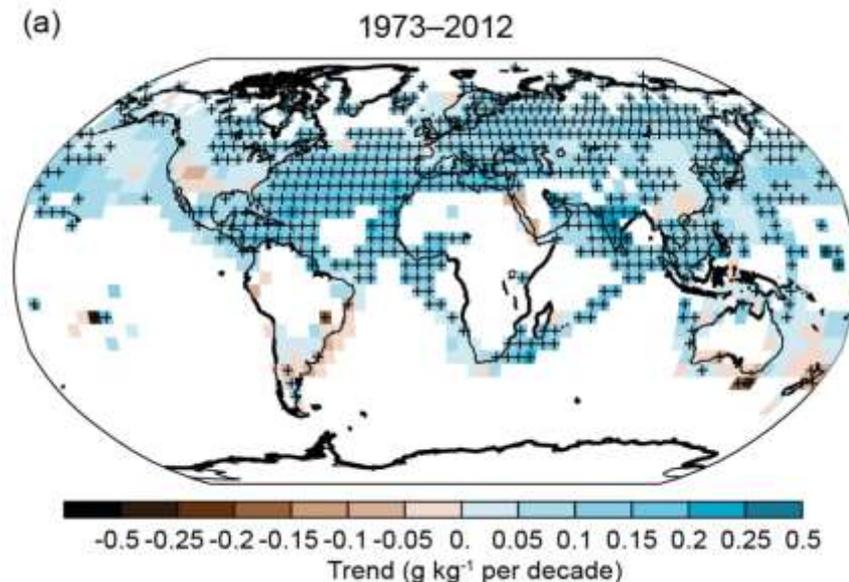


Fig 10.14

It is *likely* that anthropogenic influences have affected the global water cycle.

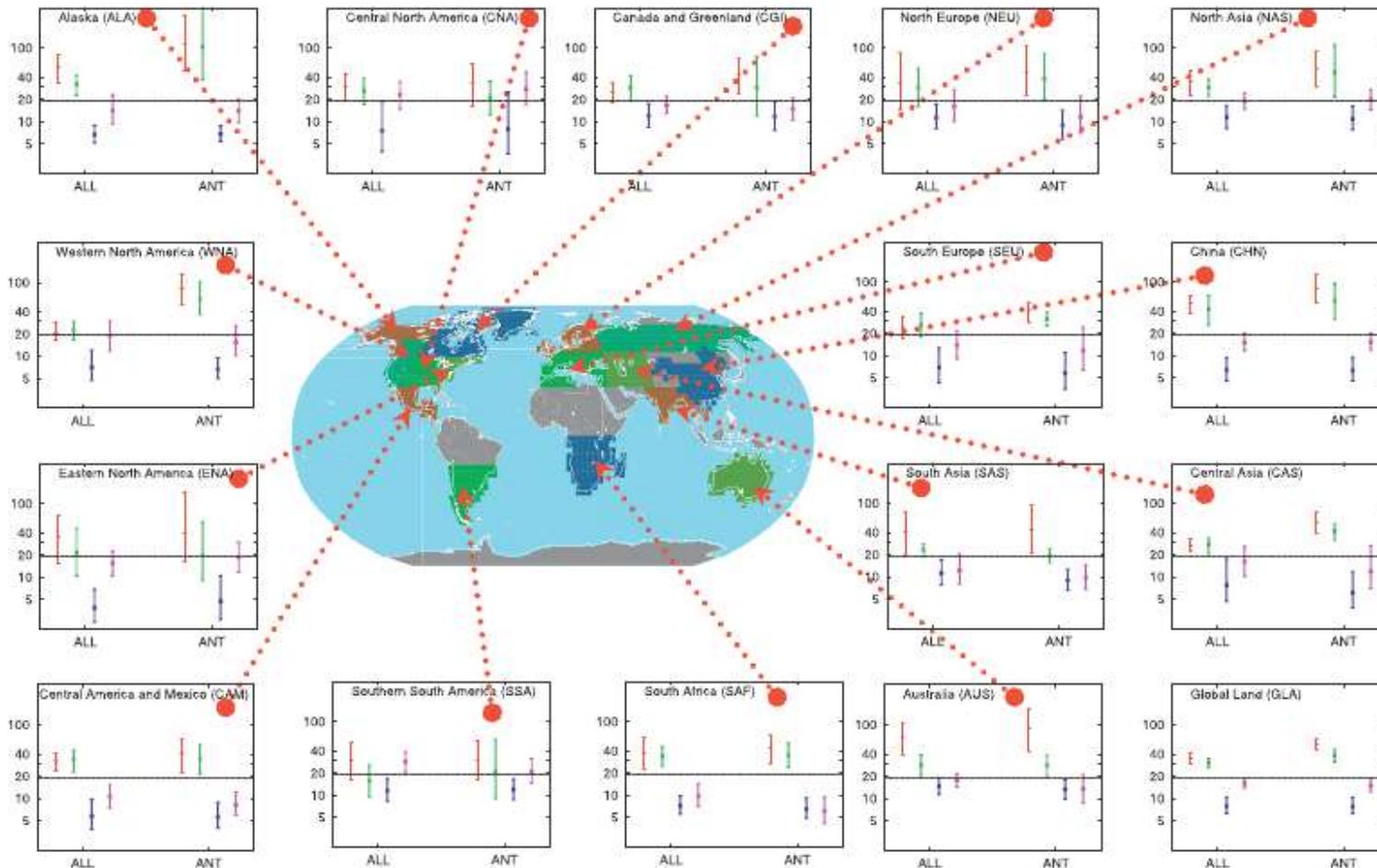
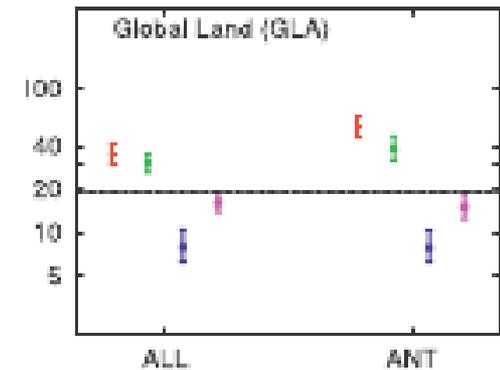
- Anthropogenic influences have contributed to:
 - Observed increases in atmospheric moisture (*medium confidence*)
 - Global-scale precipitation patterns over land (*medium confidence*)
 - Intensification of heavy precipitation over land regions where data is sufficient (*medium confidence*)
 - Ocean salinity changes making fresher regions fresher over time and salty regions saltier (*very likely*)



Increased
atmospheric moisture

Fig 2.30

Occurrences of climatologically hottest days and nights in 20 years have now reduced to fewer than 10 years and 15 years respectively in many places.



Zwiers et al, 2011

Human influence on the climate system is clear

- Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes.

Human influence on the climate system is clear

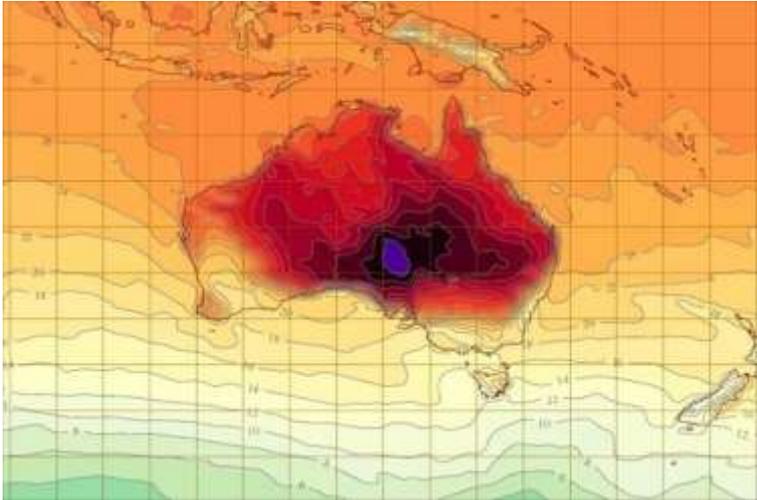
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- This evidence for human influence has grown since AR4.

Human influence on the climate system is clear

- Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes.
- This evidence for human influence has grown since AR4.
- It is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century.

What can we say about individual climate-related events?

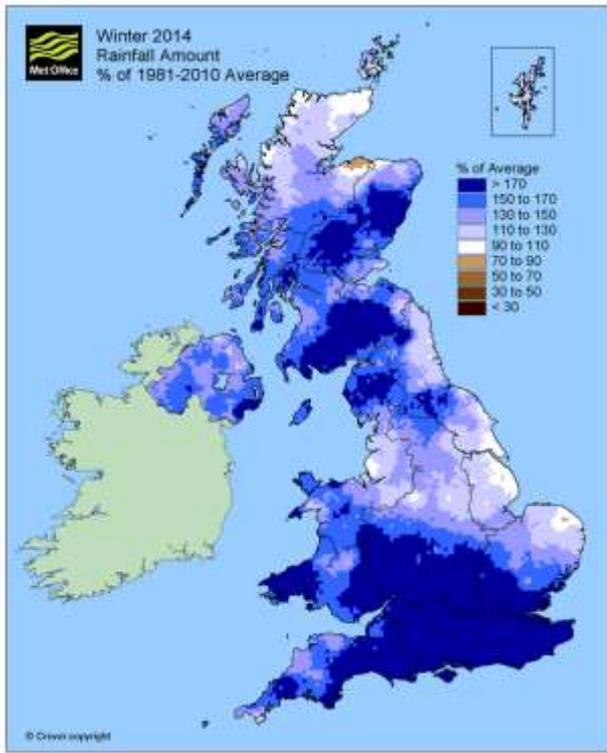
Australia's angry summer of 2013



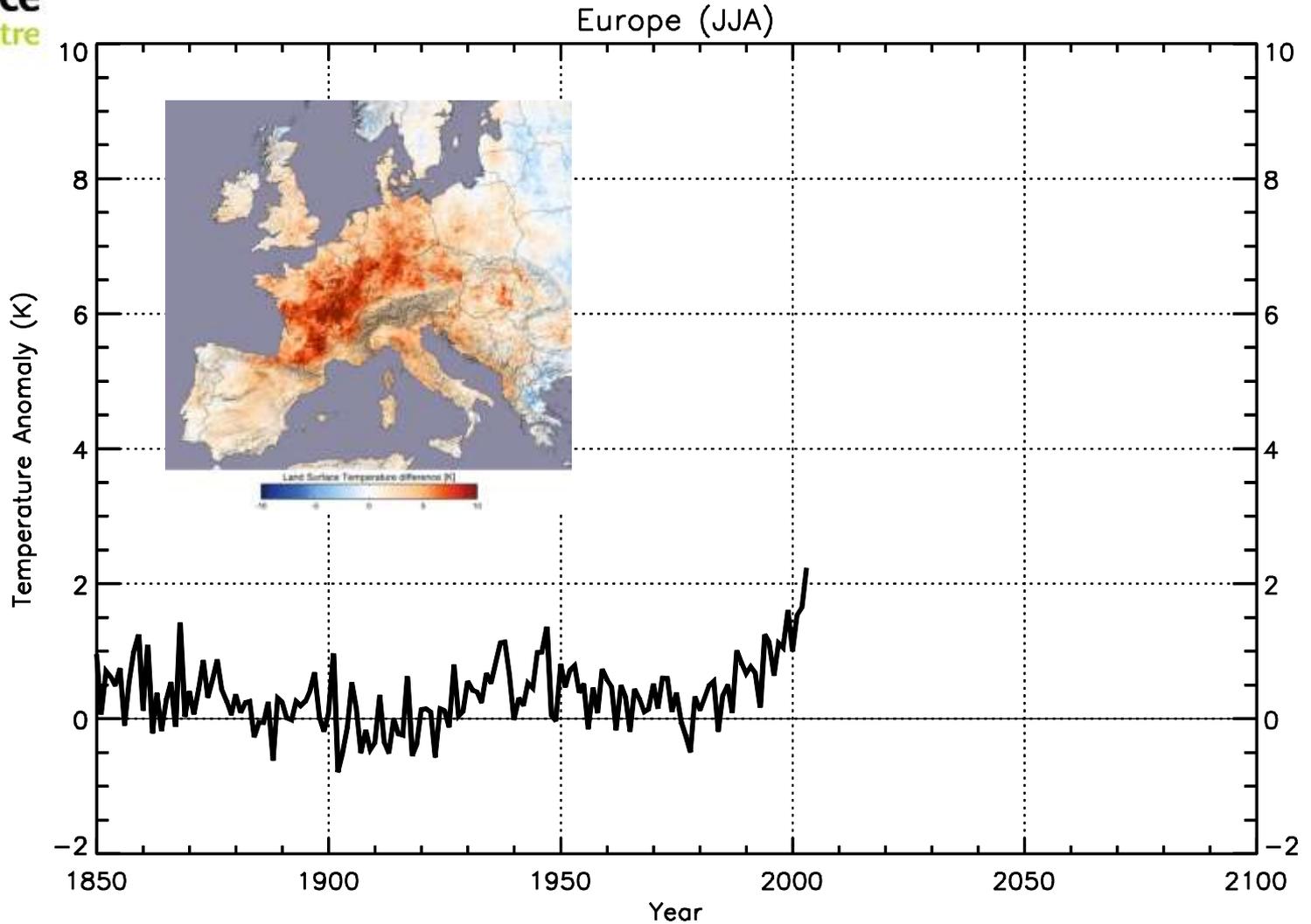


What can we say about individual climate-related events?

Wettest winter in England and Wales since 1766

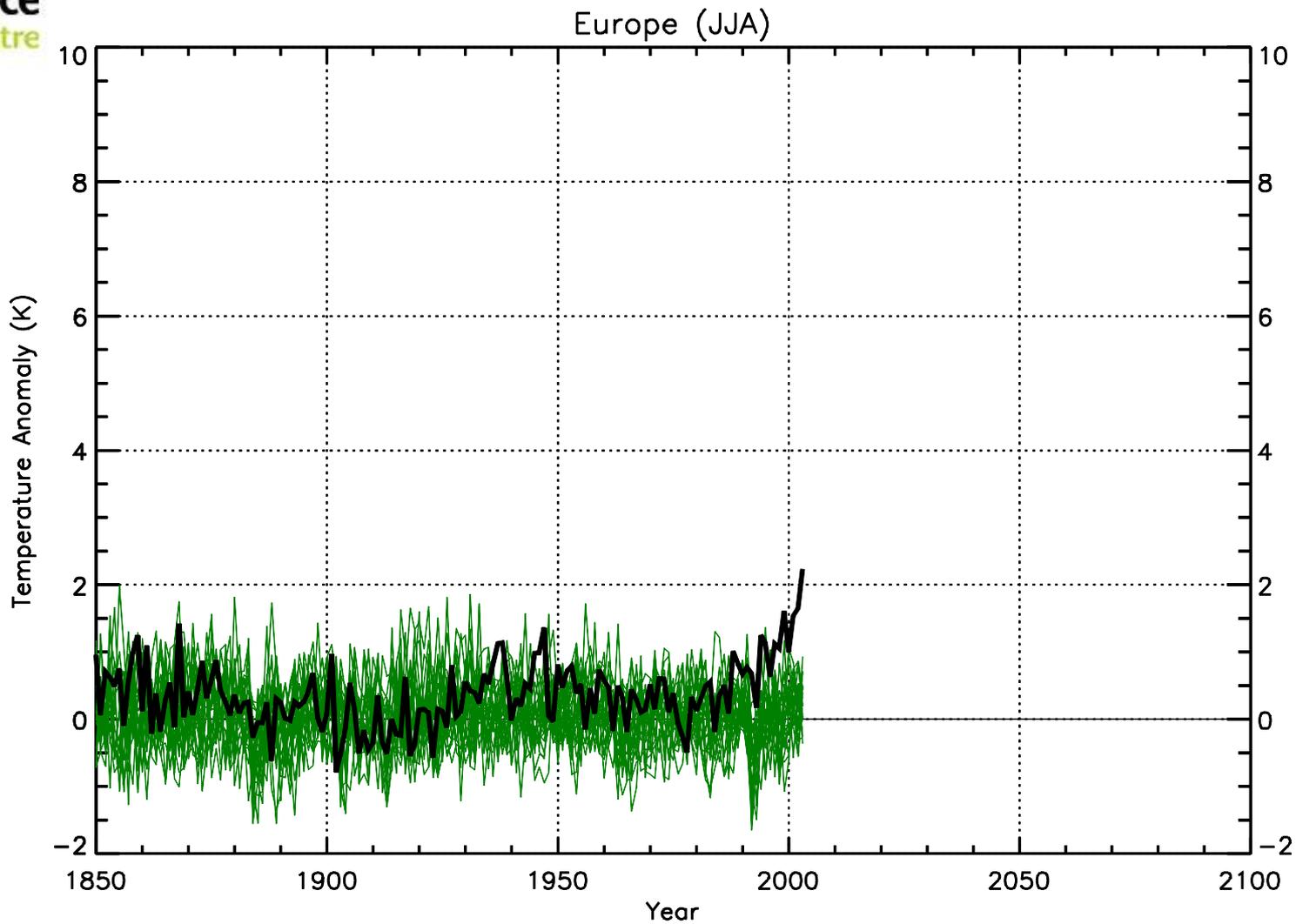


European heatwave 2003



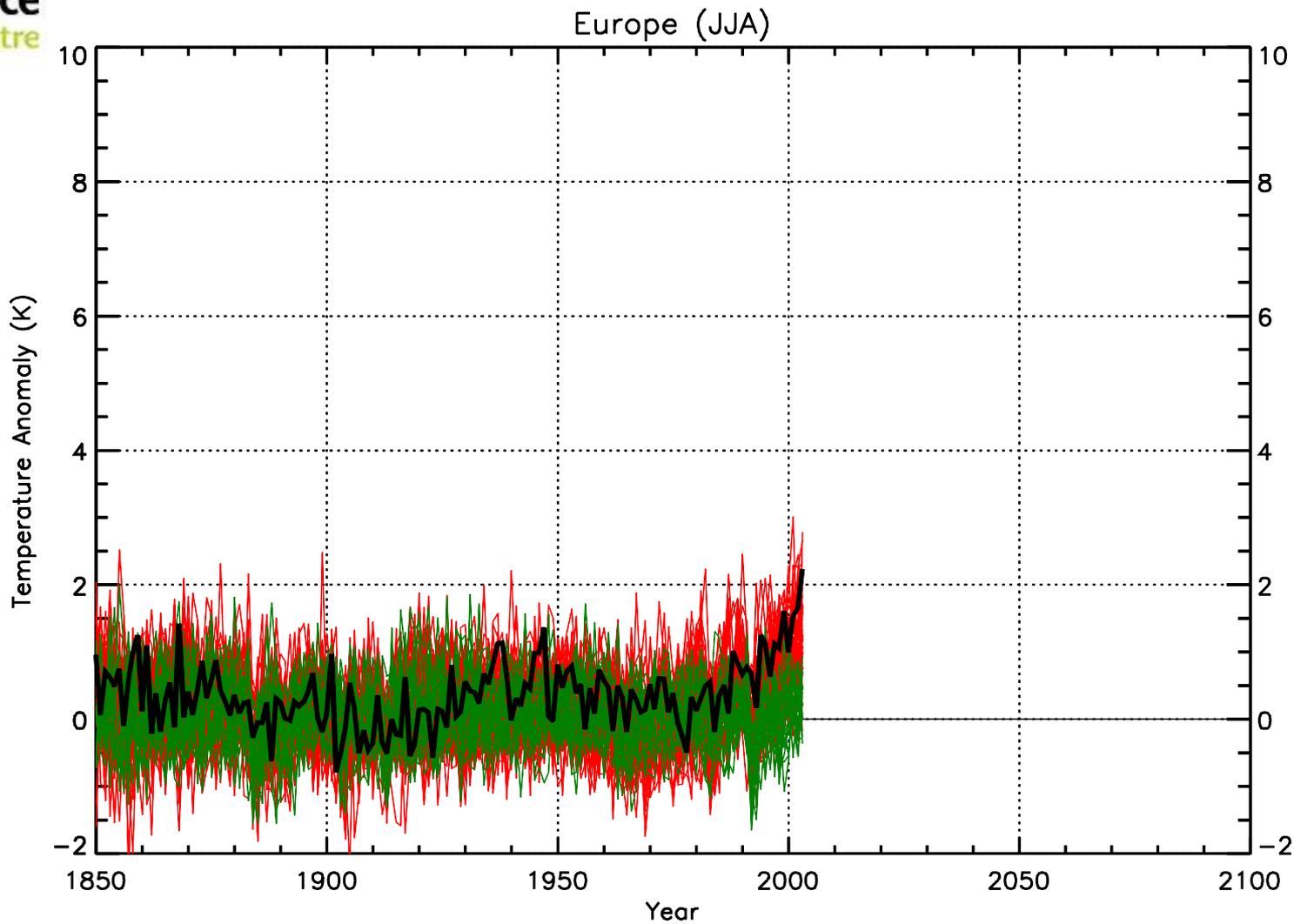


Met Office
Hadley Centre



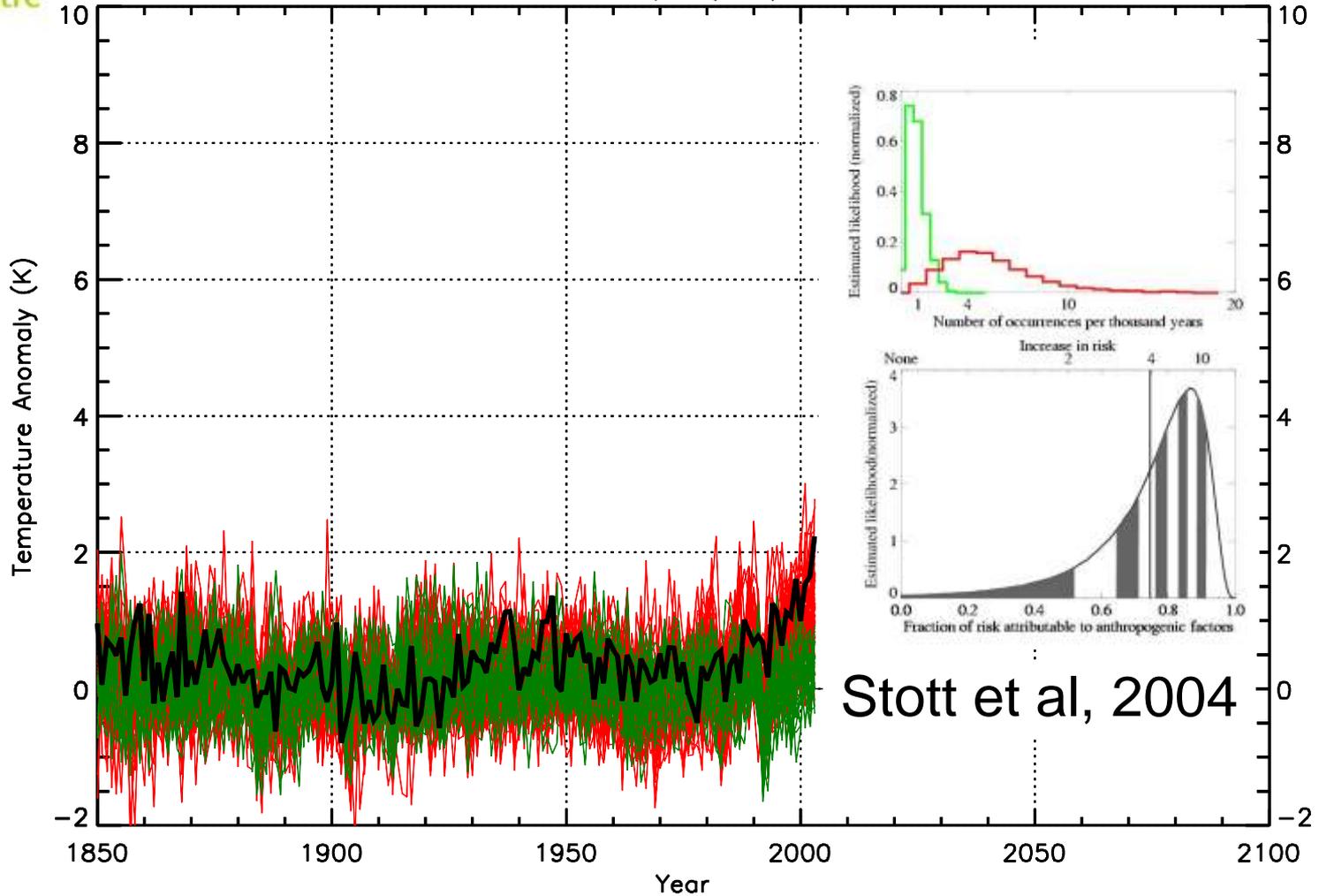


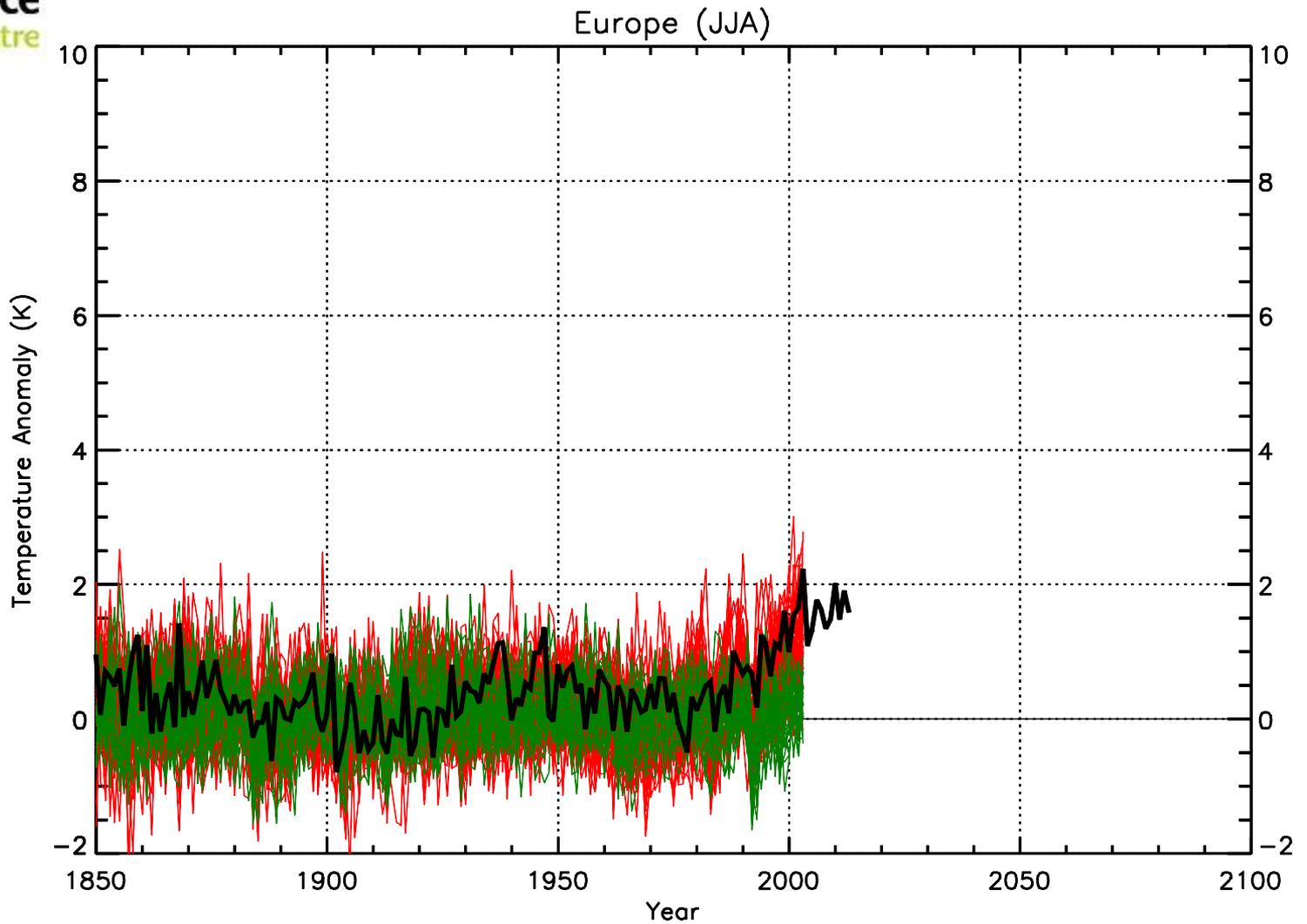
Met Office
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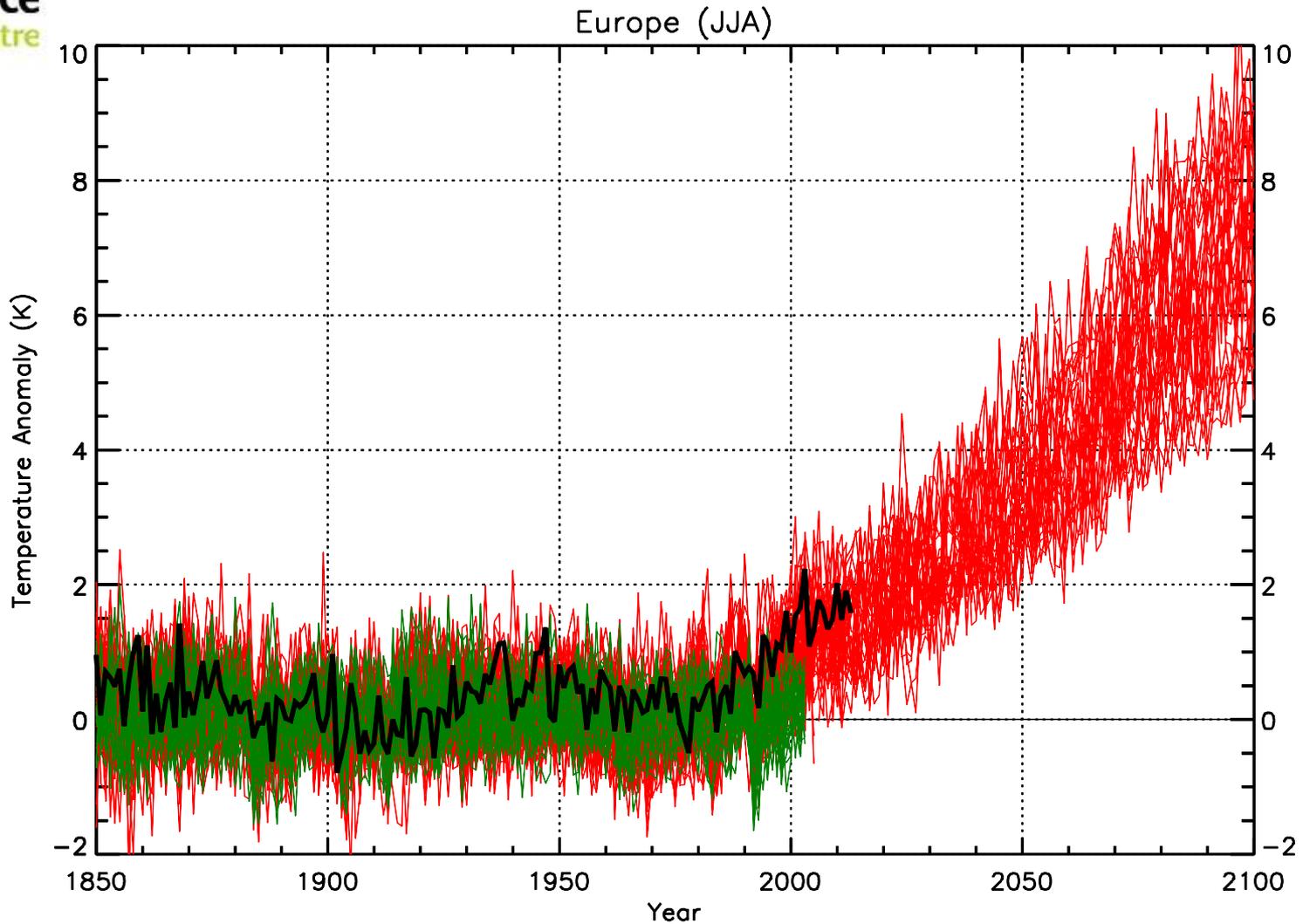
Attribution statements about individual events by examining the changed probability attributable to different factors

Europe (JJA)



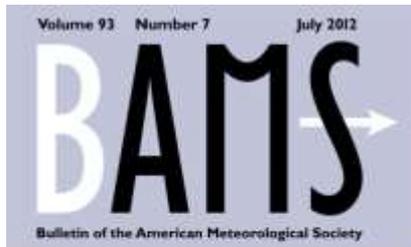


European summer temperatures on track for 2003 to become the norm by 2030s



Explaining extreme climate and weather events of the previous year from a climate perspective

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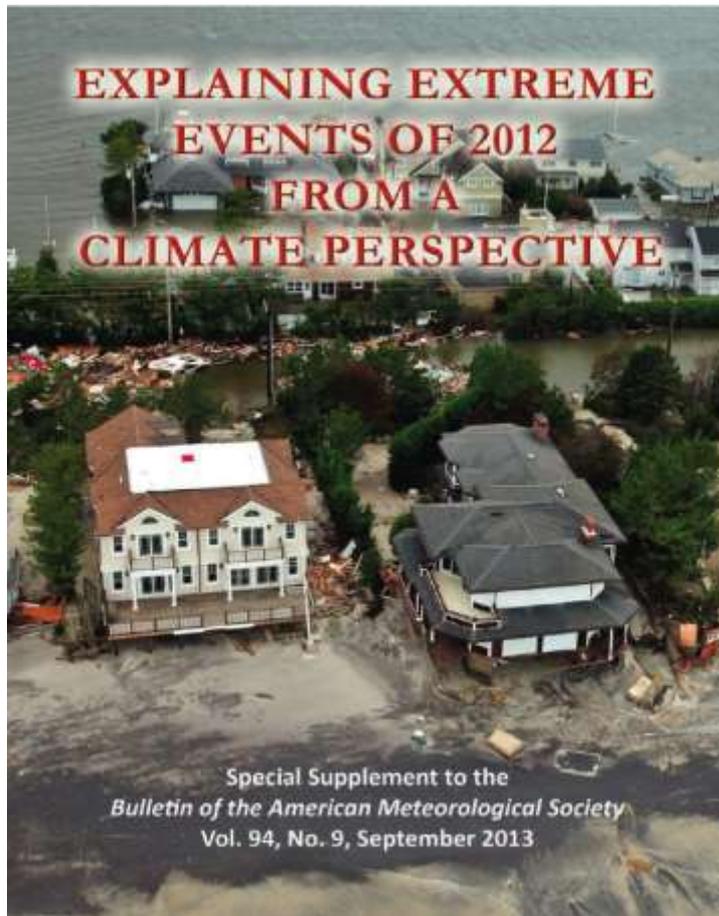


Taking Attribution Science to the Limits

- Report ground breaking in applying attribution science to recent extreme weather events.
- Climate change has made some events more likely, some less likely
- We do not see evidence for a strong human influence in all weather extremes. Natural variability also plays an important role
- Inaugural report quickly became “most read” article in BAMS

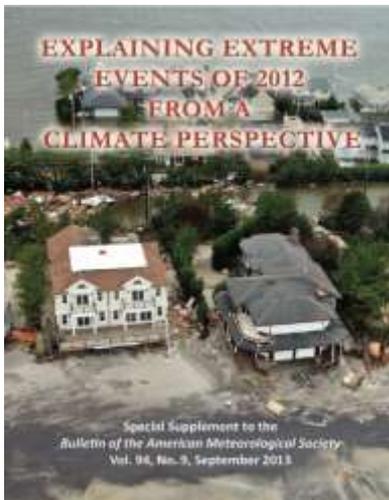
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- Increase from 6 contributions last year to 19 this year
- 18 different research groups, 12 extreme events
- Some events have multiple different groups looking at them
- About half the analyses found some evidence that anthropogenic climate change was a contributing factor
- Natural climate variability a factor in all events

Human influence on the climate system is clear



- What is our vulnerability to extremes in a changing climate?
- Operational attribution systems can provide regular assessments of attributable risk of extreme events.
- Further development of models, observations and understanding is required.
- European project, EUCLEIA, aims to develop our ability to provide reliable attribution assessments for heatwaves, floods, droughts, cold spells and storm surges.

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Further Information
www.climatechange2013.org

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