Connecting climate model projections of global temperature change with the real world

Ed Hawkins | Rowan Sutton NCAS-Climate, University of Reading

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

Abstract

GCMs produce different values for Earth's mean temperature. When comparing simulations with each other & with observations it is standard practice to compare temperature *anomalies* with respect to a reference period. It is not always appreciated that the choice of reference period can affect conclusions, both about the skill of simulations of past climate, and about the magnitude of expected future changes in climate. We discuss some of the key issues that arise when using anomalies relative to a reference period to generate climate projections and recommend that any studies that involve the use of a reference period should explicitly examine the robustness of the conclusions to alternative choices.

Why does a reference period matter?

It is standard practice when comparing simulations of climate change with observed changes, and with each other, to use a common reference period and define 'anomalies'. Figure 1 illustrates that the temperature anomaly value changes when using different reference periods. In addition, the relative comparison of the different atmospheric reanalyses with each other, and with the simulations, also changes. For instance, the simulations appear mostly warmer than the reanalyses with one choice of reference period but appear mostly cooler than the reanalyses with an alternative choice. There is clearly sensitivity to the choice of reference period in any similar comparison.

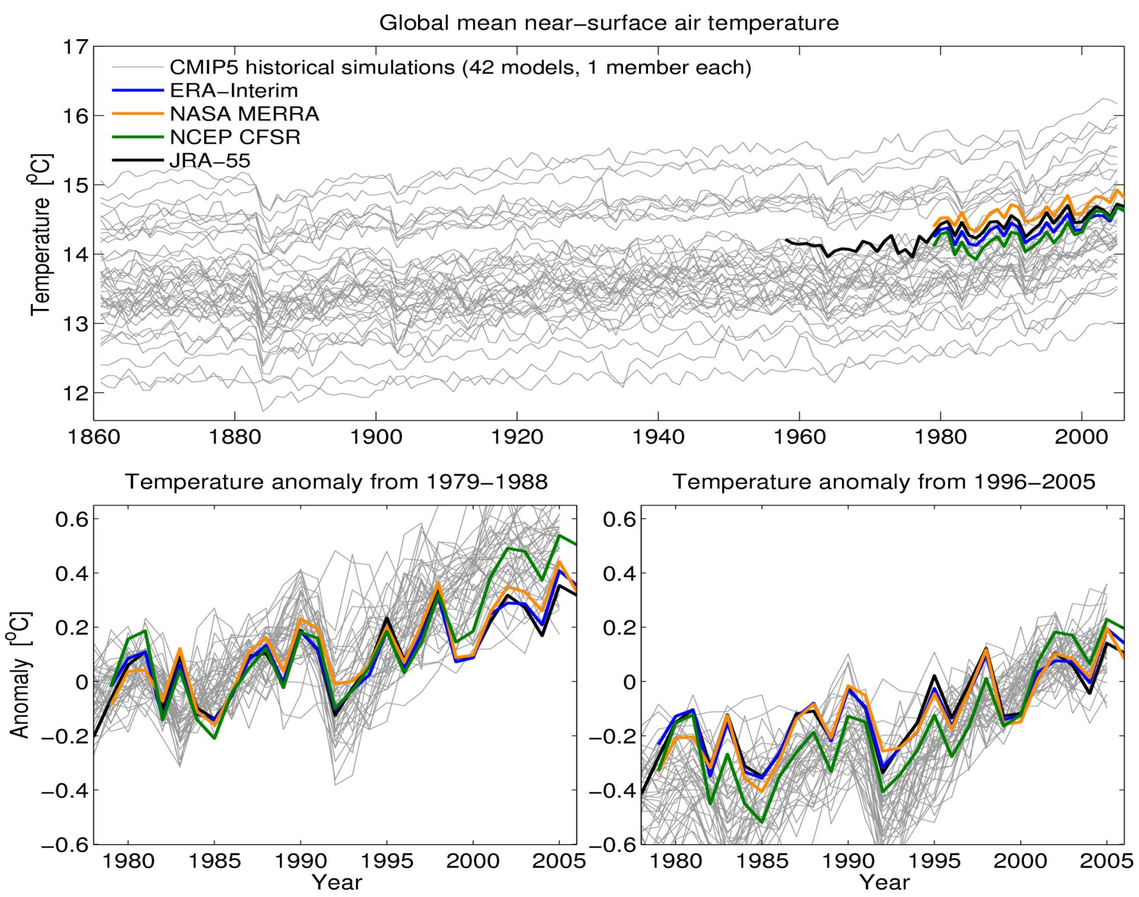


Figure 1: Global mean surface air temperature in CMIP5 models and various atmospheric reanalyses.

Historical & future projections

Historical simulations of global mean surface temperature (GMST) show a range of behaviours when using different reference periods. The simulated ensemble spread & relationship with observations depends on the choice of baseline (Figure 2). Also, uncertainty in near-term projections & the date of crossing thresholds such as 2°C above pre-industrial strongly depends on the choice of baseline (Figure 3).

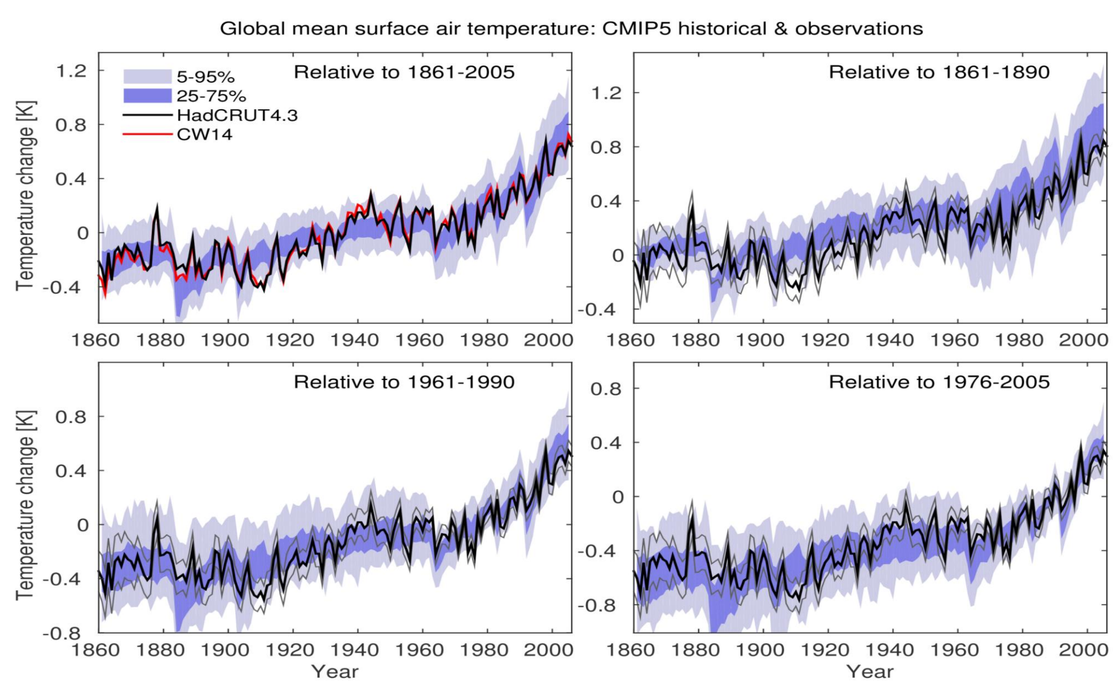


Figure 2: Historical simulations of GMST in CMIP5

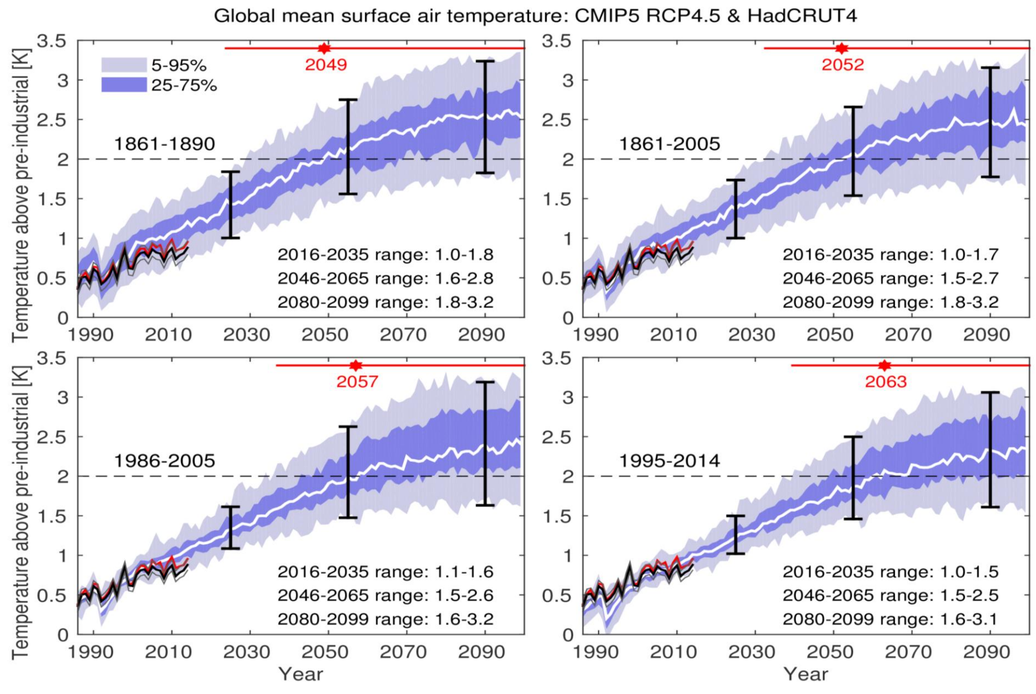
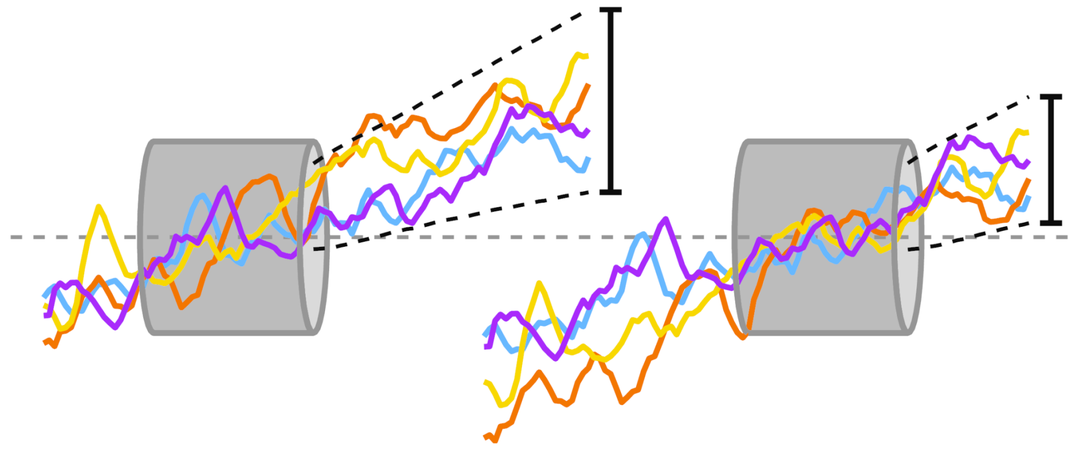


Figure 3: Projections of GMST in CMIP5 for different choices of reference period.

Summary analogy



Time series can be thought of as stiff, 'wiggly' wires that pass through a fixed length of tube. Different length reference periods correspond to tubes of different lengths. The constraint on where the wires are positioned vertically, relative to each other and relative to the tube, varies as the tube is slid horizontally along the loose bundle of wires.

Find out more.....

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www.met.reading.ac.uk/~ed

Email: e.hawkins@reading.ac.uk
Twitter: @ed_hawkins

University of Reading