A guide to Representative Concentration Pathways (RCPs)

Purpose

This briefing document has been developed specifically for the UKCP18 project User Groups. It assumes that the reader has some knowledge of climate projections.

The next set of UK climate projections will use different scenarios

The next set of UK climate projections (UKCP18) use new scenarios called Representative Concentration Pathways (RCPs), which were used in the most recent Intergovernmental Panel on Climate Change (IPCC) report. The older Special Report on Emission Scenarios (SRES), used in the UKCP09 projections, did not include any policies to limit climate change and thus did not consider climate change mitigation. The increasing relevance of mitigation scenarios led the IPCC to request the climate research community to develop a new set of scenarios, or pathways. RCPs were introduced to better facilitate interactions between the scientific communities working on climate change, adaptation and mitigation. Unlike with SRES, RCPs enable the costs and benefits of long-term climate goals to be evaluated. RCPs are referred to as 'pathways' to emphasise they are not definitive and could be realised via more than one underlying socioeconomic scenario.

What are RCPs?

SRES were greenhouse gas emissions scenarios used to make projections of possible future climate change (IPCC, 2000). RCPs differ in that they specify concentrations of greenhouse gases that will result in total radiative forcing increasing by a target amount by 2100, relative to pre-industrial levels. Total radiative forcing is the difference between the incoming and outgoing radiation at the top of the atmosphere (see glossary for a more detailed explanation). Radiative forcing targets for 2100 have been set at 2.6, 4.5, 6.0 and 8.5 watts per square metre (W m^{-2}) to span a wide range of plausible future emissions scenarios and these targets are incorporated into the names of the RCPs; RCP2.6, RCP4.5, RCP6.0 and RCP8.5. Each pathway results in a different range of global mean temperature increases over the 21st century (see table 1 & figure 1).

The RCP pathways represent a broad range of climate outcomes and are neither forecasts nor policy recommendations. They include a wide range of assumptions regarding population growth, economic development, technological innovation and attitudes to social and environmental sustainability. Each pathway can be met by a combination of different socioeconomic assumptions. More information on RCPs is available in van Vuuren et al (2011).

Table 1: The increase in global mean surface temperature averaged over 2081-2100 compared to the pre-industrial period (average between 1850-1900) for the RCP pathways (best estimate, 5-95% range). From IPCC AR5 WG1 Table 12.3.

RCP	Change in temperature (°C) by 2081-2100
RCP2.6	1.6 (0.9-2.3)
RCP4.5	2.4 (1.7-3.2)
RCP6.0	2.8 (2.0-3.7)
RCP8.5	4.3 (3.2-5.4)

RCP2.6 (blue in figure 1) represents a pathway where greenhouse gas emissions are strongly reduced, resulting in a best estimate global average temperature rise of 1.6°C by 2100 compared to the pre-industrial period. RCP8.5 (red in figure 1) is a pathway where greenhouse gas emissions continue to grow unmitigated, leading to a best estimate global average temperature rise of 4.3°C by 2100. RCP4.5 and RCP6.0 are two medium stabilisation pathways, with varying levels of mitigation.

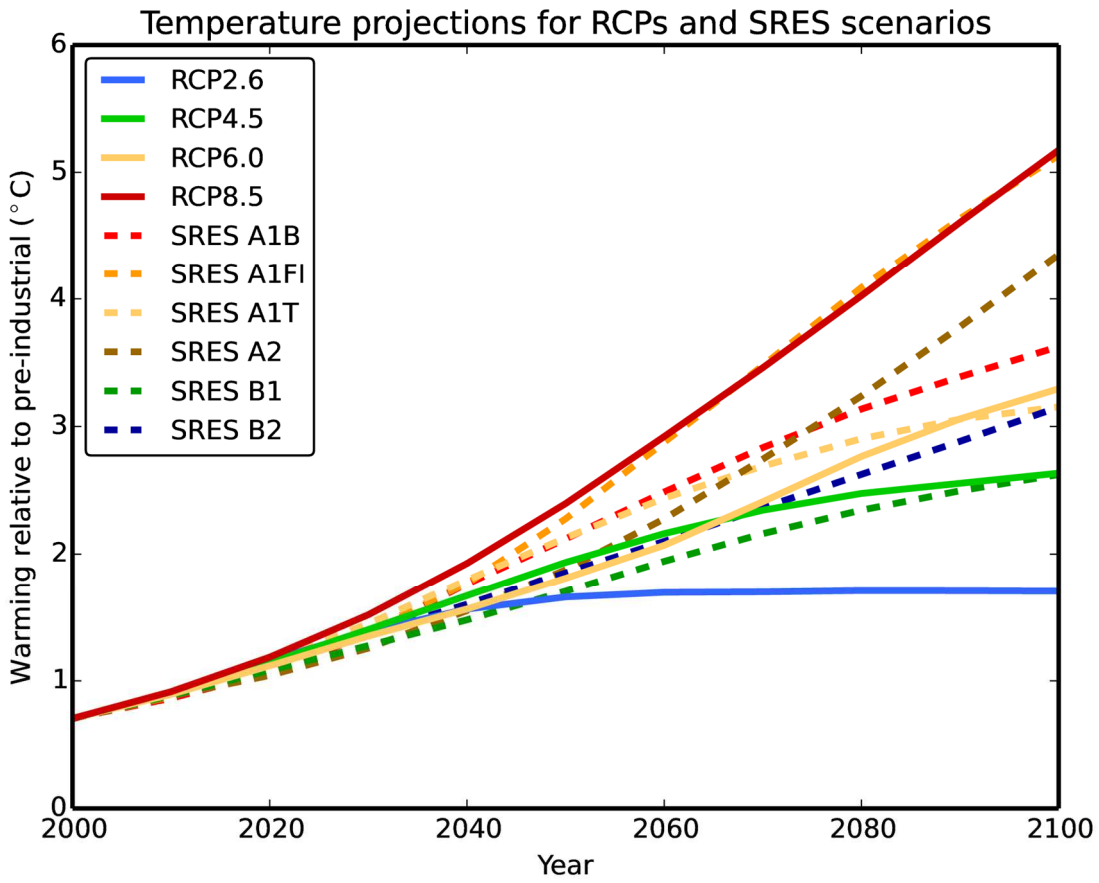

Figure 1: Global mean temperature projections from a climate model (called MAGICC6) relative to a pre-industrial average (1850-1900) for RCP2.6 (blue), RCP4.5 (green), RCP6.0 (yellow) and RCP8.5 (red) and the older SRES scenarios (dashed coloured lines).

How do RCPs compare to SRES?

The SRES scenarios do not assume any policies to control climate change, whereas the RCP scenarios do. Therefore the low RCP2.6 pathway (blue in figure 1), which assumes heavy mitigation and results in a mean global temperature rise of less than 2°C, is not directly comparable to any SRES scenario (Table 2). One of the new medium pathways RCP4.5 (green in figure 1) is most similar to SRES B1 (green dashed in figure 1), the low emissions scenario used in UKCP09. RCP4.5 and SRES B1 evolve similarly throughout the 21st century and have very similar global temperature increases in 2100. The other new medium pathway RCP6.0 (yellow in figure 1) is most similar to SRES B2 (blue dash in figure 1), which is between the low and medium emission

scenarios of UKCP09. The high RCP8.5 pathway is most similar to the older SRES A1F1 scenario, the high emissions scenario from UKCP09.

Figure 1 also shows that global temperature rise in the near-term will be similar regardless of which RCP we follow. It is not until after 2030 when global temperature projections begin to truly diverge.

Table 2: SRES scenarios that are most similar to the new RCPs, in terms of median global temperature increase by 2100.

RCP	Most similar SRES scenario (in terms of temperature)
RCP2.6	None
RCP4.5	SRES B1 (low emissions scenario in UKCP09)
RCP6.0	SRES B2 (between the low and medium emission scenarios in UKCP09)
RCP8.5	SRES A1F1 (high emissions scenario in UKCP09)

Glossary:

Radiative forcing - the difference between the sun's energy that is absorbed and that which is radiated back to space. The relative impact of a gas or pollutant on the energy balance is known as its 'radiative forcing' and is measured in watts per square metre (W/m^{-2}) – the amount of energy it contributes (or takes away from) one metre squared of the Earth's surface. A positive forcing warms the Earth system, while a negative forcing cools it. Radiative forcing is normally calculated relative to levels in 1750 in order to provide a measure of how human activity has altered it since pre-industrial times.

References:

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