Department for Environment Food & Rural Affairs

Department for Business, Energy & Industrial Strategy

Met Office Hadley Centre

Environment Agency

UKCP Global (60km) – Low emissions scenario (RCP 2.6)

This factsheet provides summary information on new UKCP Global (60km) simulations run from 1900-2100, using a low emissions scenario (RCP 2.6) for the 21st Century. This dataset supplements existing UKCP Global simulations provided for a high emissions scenario (RCP 8.5). The document describes what they are, the key results, how they compare to the derived projections and where to find further information.

1. What is UKCP Global (60km) and RCP 2.6?

UKCP Global is one of the products from the latest UK Climate Projections published in 2018. It comprised 28 global climate projections at 60km spatial resolution for the 21st Century for a high emissions scenario (RCP 8.5). This factsheet introduces an additional emissions scenario for UKCP Global: a low emissions scenario, RCP 2.6. This scenario is one of the future emissions pathways used in the IPCC's 5th Assessment report. It represents a mitigation scenario aiming to limit the increase of global mean temperature to around 2°C above preindustrial levels for mid-range climate sensitivity. Further details can be found in the guidance on Representative Concentration Pathways.

2. What data are available and where can I find them?

Similar to UKCP Global for RCP 8.5, the RCP 2.6 data is available on the UKCP User Interface and the CEDA Archive for:

- The entire globe at 60km on a latitude-longitude grid (available only on the CEDA Archive)
- The UK at 60km on the Ordnance Survey's British National Grid
- The time period 1/12/1899 to 30/11/2099
- Daily, monthly, seasonal, annual time steps as well as 20- and 30-year time-slices
- Precipitation, temperature (maximum, mean and minimum), total cloud cover, humidity (relative and specific), radiation (net long and short wave), sea-level pressure and wind direction (northward and eastward)

UKCP Global provides information on uncertainties arising from natural climate variability and differences in how key processes are represented in climate models. The simulations are derived from alternative variants of the Met Office Hadley Centre's global climate model (HadGEM3-GC3.05), plus a selection of alternative models from different modelling centres.

The dataset incorporates 15 members of HadGEM3-GC3.05 (PPE-15), and 9 other climate models selected from those that informed the Intergovernmental Panel on Climate Change's (IPCC) 5th Assessment Report[1] (CMIP5-9). Note that data from only nine climate models were available for RCP 2.6 from CMIP5. Further details of the climate models are provided in Murphy et al (2018).

Note there are gaps in the CMIP5 model dataset as certain variables have not been published by the respective climate modelling centres. Further details are provided in UKCP Guidance: Data availability, access and formats on the UKCP web pages.

3. What can I do with the datasets that I couldn't do before?

The new simulations augment UKCP Global (60km) allowing you to explore the impacts of different emissions scenarios using the outputs of a global climate model, i.e. RCP 8.5 and now also RCP 2.6.

Note that RCP 2.6 is also available over the UK for the Derived Projections, which were produced using a statistical approach (see Derived Projections factsheet for more details). See question below for further details.

4. What does UKCP Global, RCP 2.6 show at the global scale?

As expected, the projections for RCP 2.6 show less global warming than RCP 8.5 (see Figure 1). Similar increases in the global mean surface air temperatures are seen for both emissions scenarios up to around 2040. The projections for RCP 8.5 then increase further whereas RCP 2.6 projections level off from the 2050s onwards.

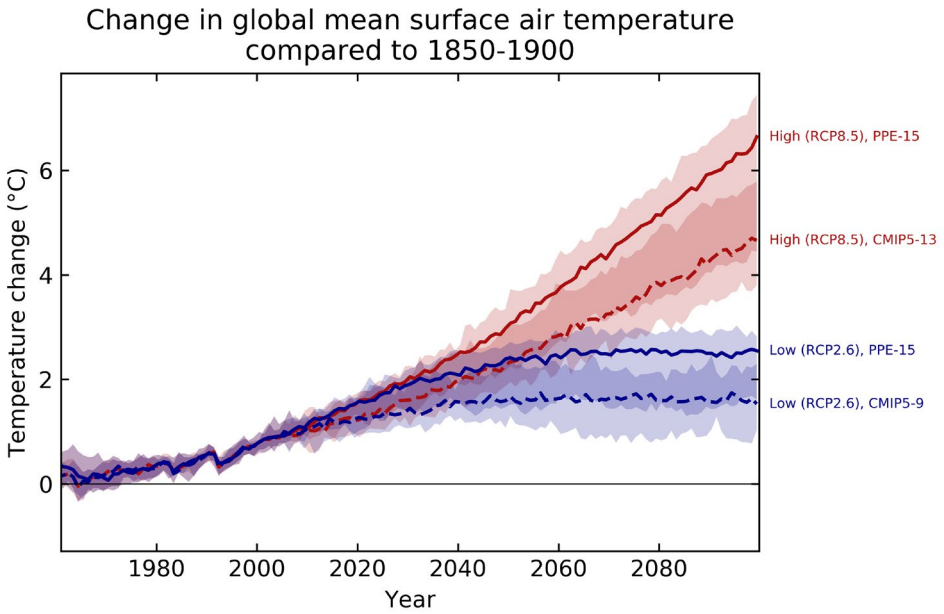

Figure 1 UKCP Global (60km) projections of change in global mean surface air temperature compared to preindustrial* for a high emissions scenario (RCP 8.5) and a low emissions scenario (RCP 2.6). UKCP Global comprises 15 members of the Met Office Hadley Centre model, HadGEM3-GC3.05 (PPE -15), and other climate models selected from those that informed the Intergovernmental Panel on Climate Change's (IPCC) 5th Assessment Report (CMIP5) – 13 members for RCP 8.5 and 9 members for RCP 2.6. Shading represents the whole range of changes from each set of models and the bold lines represent the median change. *this was calculated by obtaining global projections with respect to a 1981-2000 baseline and then shifting the baseline to 1850-1900.

[1] IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, TF, Qin D, Plattner GK, Tignor M, Allen SK, Boschung J, Nauels A, Xia Y, Bex V and Midgley PM (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp

5. What does UKCP Global, RCP 2.6 show at the regional scale?

Figure 2 shows changes in seasonal temperature and precipitation at the country-scale over the UK, for UKCP Global and the Probabilistic Projections. As reported in the UKCP18 Projections over Land: Science Report (Murphy et al, 2018), we find that the Probabilistic Projections cover a broad range of future outcomes for RCP 8.5. These ranges are invariably either similar to, or larger than, the combined range of the 28 UKCP Global projections, dependent on the variable under consideration. In contrast, we see examples for RCP 2.6 (detailed below) in which one UKCP Global member gives results beyond the 5-95th percentile range of the probabilistic results. More generally, however, we also see notable similarities across the two emissions scenarios in how the degree of overlap between PPE-15 and CMIP5 depends on the variable in question. This applies globally (Figure 1) and over the UK (Figure 2). In particular, some PPE-15 members project changes in summer that are warmer and/or drier than the ranges of change found in CMIP5 members, for both scenarios.

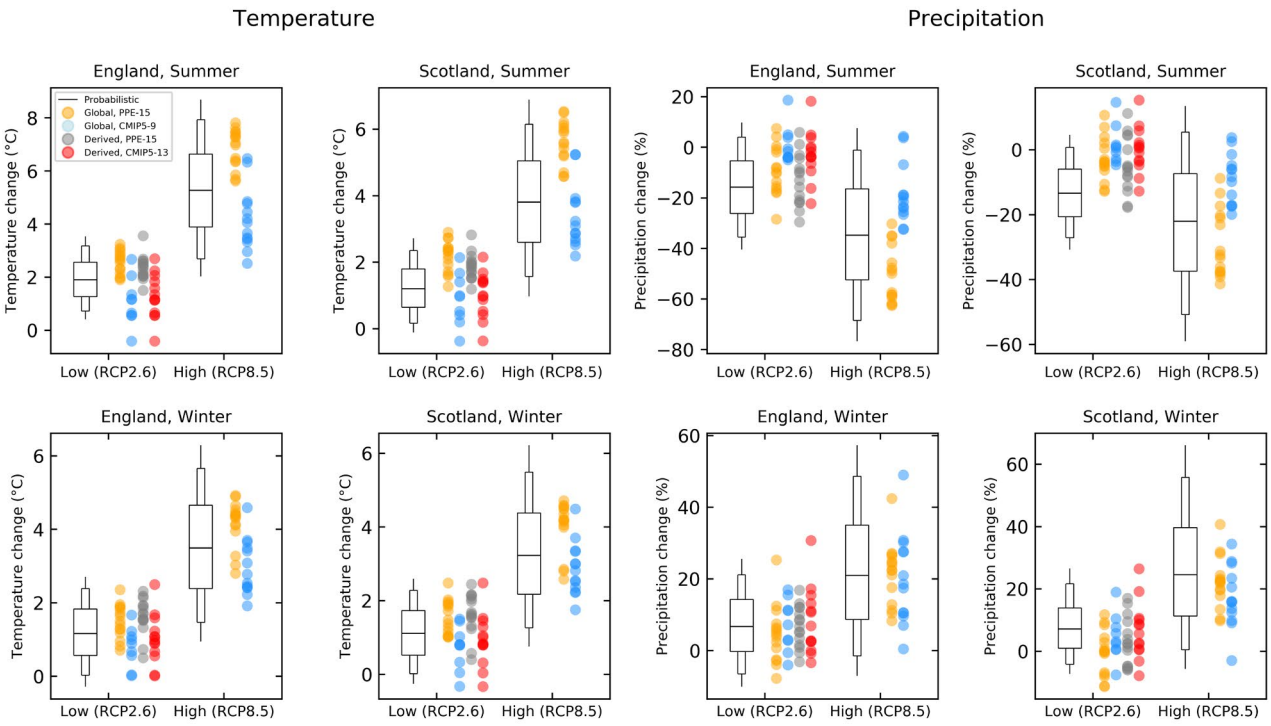

Figure 2 A comparison of UKCP Probabilistic Projections, UKCP Global (60km) and the Derived Projections for changes in mean daily temperature averaged over 2080-2099 across England and Scotland compared to 1981-2000 for a low (RCP 2.6) and a high emissions scenario (RCP 8.5). UKCP Global and the Derived Projections comprises 15 variants of the Met Office Hadley Centre model, HadGEM3-GC3.05 (PPE -15), and other climate models selected from those that informed the Intergovernmental Panel on Climate Change's (IPCC) 5th Assessment Report (CMIP5). There are 13 members available for UKCP Global, RCP 8.5 and the Derived Projections. For UKCP Global, RCP 2.6, there are 9 members. Boxes and whiskers denote the 5, 10, 25, 50, 75, 90 and 95th percentiles of the Probabilistic Projections. Individual dots represent each member of each set of models.

For RCP 2.6 in Figure 2, examples of changes from UKCP Global that lie outside the 5-95% ranges of the Probabilistic Projections include:

- In summer, CMIP5-9 shows one outcome projecting a slight cooling over England and Scotland, below the 5th percentile of the Probabilistic Projections. In winter, CMIP5-9 also produces one outcome showing a slightly larger cooling than shown at the 5th percentile of the Probabilistic Projections.
- There are some high temperature extremes found over Scotland in PPE-15, where some members are above the 95th percentile of the Probabilistic Projections.

- In Scotland, there are higher increases in summer precipitation in UKCP Global, compared with the 95th percentile of the Probabilistic Projections. There are also examples of larger reductions in winter precipitation, compared with the 5th percentile of the Probabilistic Projections.

We do expect to see examples in UKCP Global that explore near or beyond the 5-95th percentile ranges of the Probabilistic Projections. As discussed in UKCP18 Guidance: How to use the UKCP18 land projections, we find that UKCP Global explores extremes outside of the Probabilistic Projections for RCP 8.5. In this guidance, we suggested exploring unlikely but plausible heat-related impacts in summer using the PPE-15 and/or CMIP5-13 for unusually cool future seasons for the RCP 8.5 scenario. The reasons for this are (a) the Probabilistic Projections do not include the UKCP Global set of models (although there are similar variants of CMIP5-13 included) in its analysis, and (b) we would (by definition) not expect 5-95th percentile ranges from any of the Probabilistic Projections to encompass all possible outcomes. As with RCP 8.5, the results highlighted here show that UKCP Global offers opportunities to carry out analysis at more extreme values than available in the 5-95% ranges of the Probabilistic Projections.

6. What if you have already used the Derived Projections RCP 2.6 scenario?

The earlier Derived Projections (see UKCP Factsheet on Derived Projections) were produced in order to meet requests for additional scenarios (RCP 2.6 emissions scenario and global warming levels of 2°C and 4°C). They used an approximate statistical method to translate UKCP Global high emissions results to these additional scenarios. You should continue to use the Derived Projections if you're interested in the 2°C and 4°C scenarios, as there are no other products providing this information at present and the method to produce them provides a suitable approach for generating these scenarios.

For RCP 2.6, in general:

- Use UKCP Global if you require global data and/or variables not included in the Derived Projections
- Use UKCP Global if you require month-to-month coherence, i.e. if you want to apply duration-based metrics longer than a month. For example, if you're interested in accumulated rainfall over multiple seasons for drought analysis
- Use UKCP Global if you're interested in the variability as the Derived Projections adopt these from UKCP Global high emissions
- If you're embarking on new analysis, we recommend using UKCP Global

For other use cases, you need to consider the variable and region of interest and the sensitivity of the system that you're analysing. The results in Figures 2 and 3 indicate that:

- For regional temperatures, the Derived Projections encompass the range of changes in UKCP Global (Figure 2). Note that the Derived Projections also show some cold seasons in the 2010s and 2070s not seen in UKCP Global RCP 2.6 (Figure 3).

- For precipitation, there is a large overlap between the Derived Projections and UKCP Global:
    - For summer, the Derived Projections include members with larger decreases in summer precipitation in Scotland.
    - For winter, UKCP Global includes one member with larger decreases in the winter. You should consider rerunning your analysis with the improved UKCP Global results if this is important for your system.

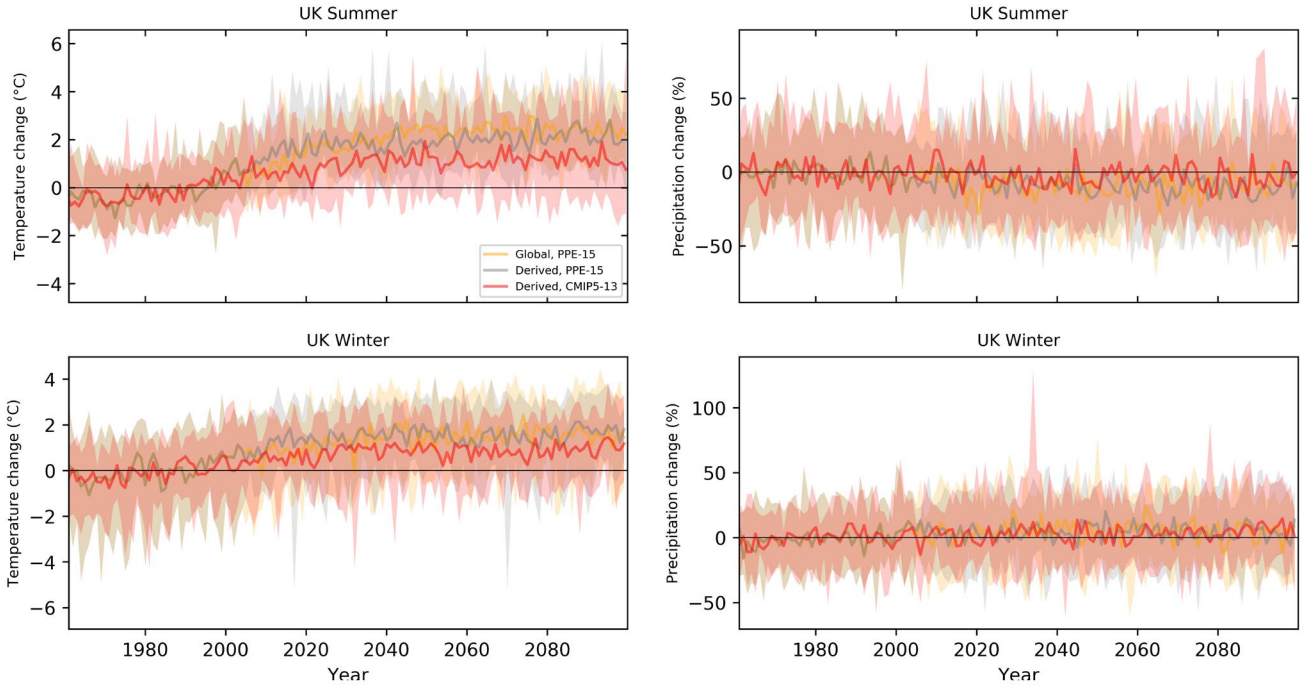

Figure 3 A comparison of UKCP Global and the Derived Projections over the UK for the low emissions scenario (RCP 2.6) through the 21st Century compared to 1981-2000. Temperature and precipitation changes are the same up to 2005 as both set of projections use the same climate forcings until 2005. For the remainder of the 21st Century, the trajectory and range of changes are similar, although individual years are different.

7. What else should I be aware of when using the data?

The guidance applied to UKCP Global (60km) for the high emissions scenario also applies to the RCP 2.6 emissions scenario dataset. Before you start using the data, you should consult the following set of UKCP guidance materials:

- How to use the UKCP18 land projections
- Caveats and limitations
- Data availability, access and formats
- Bias correction

This document can be cited as:

Fung F, Bett P, Murphy J, Gohar L and Lowe J, UKCP Factsheet: UKCP Global (60km) – Low Emissions Scenario (RCP 2.6), Met Office, Exeter

References

Murphy JM, Harris GR, Sexton DMH, Kendon EJ, Bett PE, Clark RT, Eagle KE, Fosser G, Fung F, Lowe JA, McDonald RE, McInnes RN, McSweeney CF, Mitchell JFB, Rostron JW, Thornton HE, Tucker S and Yamazaki K, 2018. UKCP18 Land Projections: Science Report, Met Office. Available at https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Land-report.pdf.