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Working together on UK Climate Projections

Water resources and drought planning

Future water resources and a bottom-up approach

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HR Wallingford
Working with water

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- The water resources industry has included climate change in its plans since 1999 and has used UKCP09 since 2014. Any new analysis due to UKCP18 must be warranted and proportionate.
- Existing methodologies can be updated using the UKCP18 data from the probabilistic projections. There is the potential for developing new tools such as bespoke weather generators to produce plausible extreme droughts.
- A new rapid assessment approach is proposed that uses UKCP18 and any future climate data updates but does not require further modelling.

Water resources management

In accordance with the Water Industry Act 1991, water companies in England and Wales are required to produce Water Resources Management Plans (WRMPs) every five years. These WRMPs are strategic plans that set out how adequate public water supplies will be maintained into the future considering at least the next 25 years. The plan sets out a schedule of investments required to adapt to a changing climate or increasing demand for water. Water companies also produce Drought Plans to demonstrate how the security of supplies would be maintained during droughts, describing a company's tactical and operational responses. The potential impacts of climate change have been explicitly considered since 1999 and have used UKCP09 products since 2014 (see Figure 1). The water resources industry has completed a large amount of climate change analysis using UKCP09. With the introduction of UKCP18 any further analysis must be warranted and proportionate, building from this existing evidence base.

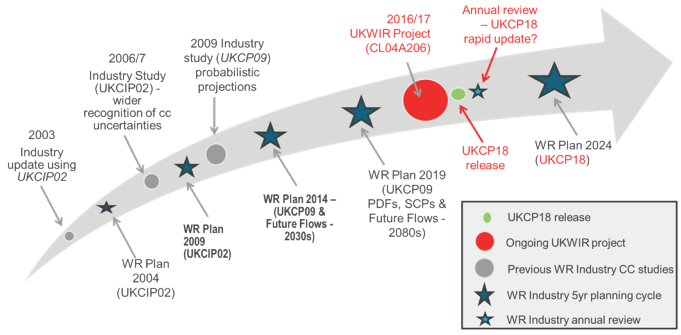

Figure 1. Evolution of climate change within the Water Resources Planning Process, where WR Plan refers to the 5 year planning cycle, PDFs and SCPs are UKCP09 products (probability distribution functions and spatially coherent projections) and the UKWIR CL04A206 is the project described in this document.

Exploiting UKCP18 data

For water resources planning, we currently require monthly datasets for precipitation and the calculation of potential evapotranspiration (PET). The UKCP18 products of interest include the probabilistic projections for updating existing methods and a measure of drought skill. UKCP18 will provide all the variables required for PET calculations consistent with other aspects of the planning process. Other UKCP18 data of interest for water companies are summarised in Figure 2. Although UKCP18 is not providing a weather generator (WG) critical metrics from the global climate models (e.g. North Atlantic Oscillation, sea surface temperatures) could be used as inputs into new WGs and improve the generation of droughts.

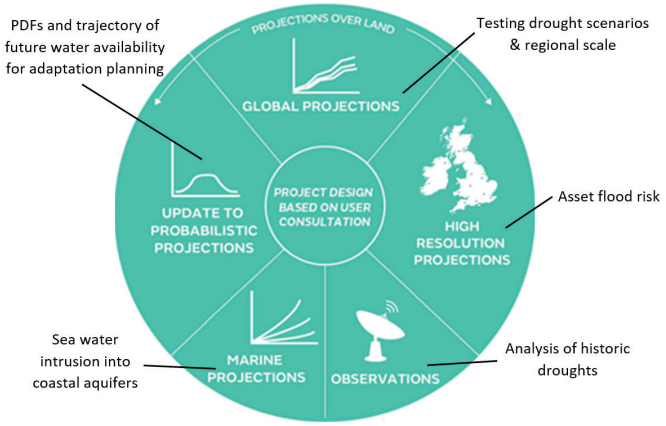

Figure 2. Potential use of UKCP18 products in water resources planning.

Find out more

This project is part of a portfolio of demonstration projects that have worked with the UKCP18 team to understand the implications of the next set of UK Climate Projections for their sector.

To find out more about the UKCP18 project and other demonstration projects, please visit https://www.metoffice.gov.uk/research/collaboration/ukcp

A new “bottom-up” approach

For their latest water resources management planning (WRMP 2019) water companies are undertaking detailed analysis of their resilience to a range of drought events beyond the recent historical record. This analysis is typically presented in the form of a Drought Response Surface (DRS) (see Figure 3). These show the droughts a system is vulnerable to and highlight any “tipping-points” where the system behaves fundamentally different.

For UKCP18 we could exploit previous analyses of climate change and drought resilience by adopting a “bottom-up” approach that considers a system’s specific vulnerabilities. The process involves overlaying existing (e.g. UKCP09) and new (e.g. UKCP18) climate change evidence. Without undertaking any new computational modelling this provides a rapid assessment of how the new climate change evidence compares to the previous evidence. Users can choose to include evidence sources such as probabilities (see Figure 4) or specific future drought events (e.g. from the UKCP18 global projections).

Figure 4 suggests that the new climate change evidence has significantly changed from previous evidence, so further computational modelling is required. This should use targeted scenarios which reflect the climate characteristics which pose the greatest risk to the system vulnerability identified in the “bottom-up” assessment.

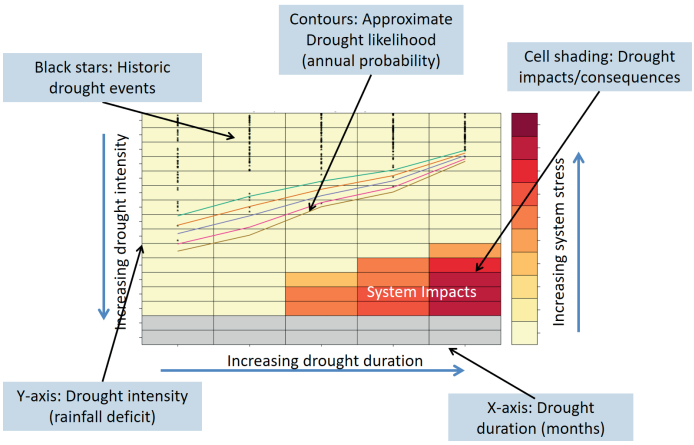

Figure 3. Overview of a Drought Response Surface.

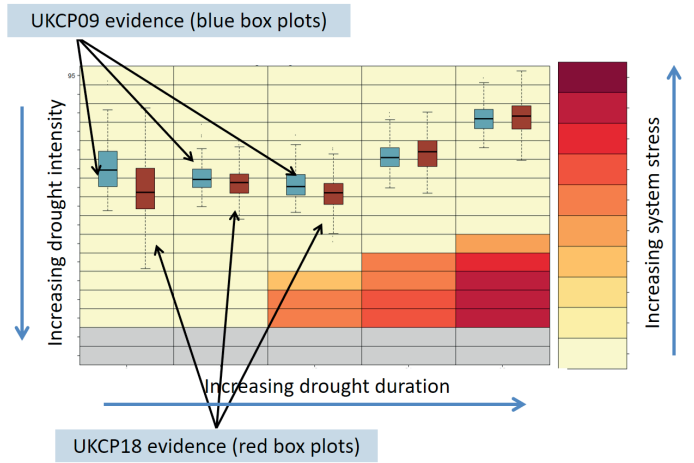

Figure 4. Rapid comparison of UKCP09 and UKCP18 in the context of system vulnerabilities and relevant climate metrics.

What to be aware of with UKCP18

- The biases in the global and regional model projections may need to be corrected to allow direct use in more local scale climate change impact assessments.
- Potential evapotranspiration data will need to be calculated from the climate model outputs.
- Spatially coherent probabilistic projections will not be available as they were for UKCP09.

Previous studies using UKCP09

The industry has previously used the UKCP09 probabilistic projections for the 2030s (WRMP 2014) and 2080s (WRMP 2019). For less climate-sensitive systems and larger, regional scale studies, the UKCP09 spatially coherent projections and Future Flows products were used (see https://www.ceh.ac.uk/our-science/projects/future-flows-and-groundwater-levels for further information). The industry has also made extensive use of bespoke WGs. The UKCP09 WG was not used as it was not considered appropriate for the low probability drought events.

Accounting for present day climate change

A particular challenge for WRMP 2014 and WRMP 2019 has been developing a time series of climate change impacts through the planning horizon to plan the timing of adaptation measures. This includes accounting for climate change impacts which may already have occurred. This is particularly important for sensitive systems and when considering extended planning horizons a long way into the future. Simple linear interpolation has been used to-date in the industry, although it is recognised that both the climate change signal and a system’s response to climate change are both non-linear. This is no longer an issue in UKCP18, as it will enable users to define their own reference baselines (both duration and timing) and specific future time-horizons.

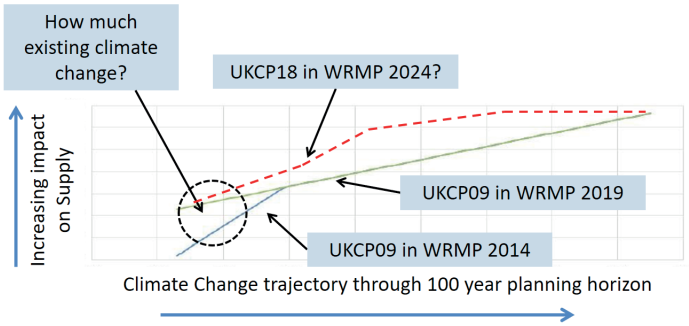

Figure 5. Accounting for existing climate change in WRMPs.

Acknowledgments:

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