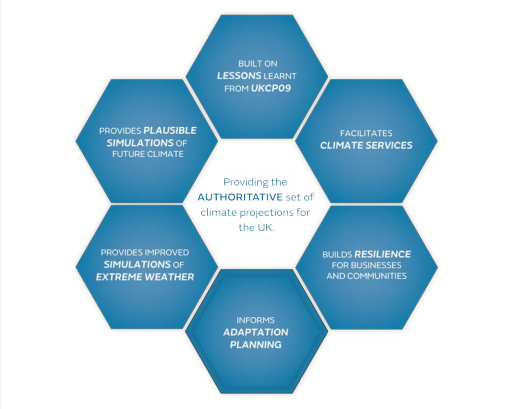
Met Office | Department for Environment Food & Rural Affairs | Department for Business, Energy & Industrial Strategy | Environment Agency

UK CLIMATE PROJECTIONS: A PROJECT OVERVIEW

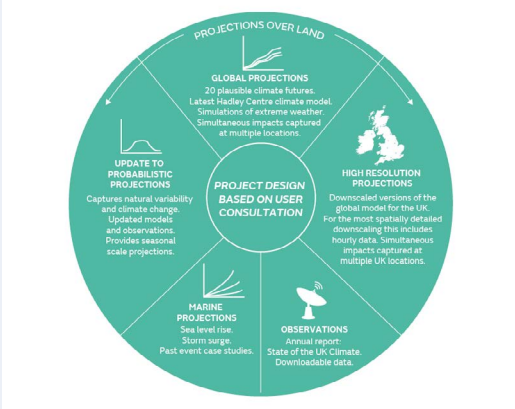


What is UKCP18 and why do we need it?

Following the historic Paris Agreement on Climate Change in December 2015, the Department of Environment, Food and Rural Affairs announced a major upgrade to the UK Climate Projections.

The UKCP18 project will build upon the current set of projections (UKCP09) to provide the most up-to-date assessment of how the climate of the UK may change over the 21st century. This information will be essential to future Climate Change Risk Assessments[1] and to equip the UK with information to help adapt to the challenges and opportunities of climate change in line with the National Adaptation Programme[2].

Organisations and individual users will use UKCP18 to inform risk assessments and adaptation plans to ensure they are resilient to extreme weather and climate change. Some organisations will use UKCP18 in responding to the Adaptation Reporting Power[3] for example.



What improvements does UKCP18 deliver?

UKCP18 will benefit from a range of developments since the release of UKCP09, including:

- Greater understanding of user needs as a result of the adaptation community's use of UKCP09 projections and the subsequent feedback – user workshops indicated that users supported the continued use of probabilistic projections and the importance of spatially coherent information[4].
- Advances in climate models in recent years, such as the Met Office Hadley Centre HadGEM3[5] model and the CMIP5[6] set of models. Improvements include better representation of the past climate, the inclusion of more cloud and aerosol processes and the ability to model important climate phenomena such as the El-Niño Southern Oscillation (ENSO).
- Groundbreaking Met Office research on modelling of extreme events in high resolution regional climate models[7].
- The increased quantity and range of observations available since 2009.
- Use of the new Met Office supercomputer, enabling a credible range of climate projections to be generated in greater spatial detail.

[1] The 2008 Climate Change Act allows UK government to mandate or invite certain organisations to produce reports to assess the impacts of climate change on their operations and present proposals for adaptation. **https://www.gov.uk/government/collections/climate-change-adaptationreporting-second-round-reports**

[2] Expected in 2018, the National Adaptation Programme will be supported by the Evidence Report of the Adaptation Sub-Committee of the Committee on Climate Change (ASC): **https://www.theccc.org.uk/uk-climate-change-risk-assessment-2017/introduction-to-the-ccra/**

[3] Under the 2008 Climate Change Act, organisations are invited to produce Adaptation Reporting Power reports to assess the impacts of climate change on their operations and present proposals for adaptation: **https://www.gov.uk/government/collections/climate-change-adaptation-reporting-second-round-reports**

[4] Spatial coherence means that climate projections can be compared between locations and aggregated over larger areas, enabling climate change to be assessed consistently over larger study areas.

[5] **http://www.metoffice.gov.uk/research/modelling-systems/unified-model/climate-models/hadgem3**

[6] Coupled model intercomparison project phase 5, see **http://cmip-pcmdi.llnl.gov/cmip5/**

[7] Kendon, E. J., Roberts, N. M., Senior, C. A. & Roberts, M. J. Realism of rainfall in a very high resolution regional climate model. J. Clim. 25, 5791–5806 (2012) **http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-11-00562.1**

What can users expect from UKCP18?

There are three components to UKCP18: observations of historic climate, marine projections and projections over land. These components are described below and summarised in Table 1. UKCP18 will provide each of these components at a higher spatial and temporal resolution than UKCP09 and with more information on different types of uncertainty.

OBSERVATIONS

Annual report: State of the UK Climate. Downloadable data.

The "State of the UK Climate" report for 2017 will be included as part of the UKCP18 package, bringing the observed data right up to date. This annual update[8] covers trends, the multi-decade climate record and significant weather events such as the early July 2015 hot spell and the exceptionally mild and wet December of the same year.

Quality controlled UK observational datasets from the Met Office observing network, provided at spatial resolutions to match the land projections and for pre-defined administrative regions and river basins, will be available under an Open Government Licence[9]. For variables such as temperature and precipitation these data sets will span the late 19th Century to the present day and will be provided for daily, monthly, seasonal, annual and long term averages.

MARINE PROJECTIONS

Sea level rise. Storm surge. Past event case studies.

Sea-level rise projections will extend to 2100 and will include contributions from glaciers, ice sheets, freshwater reservoirs, groundwater and thermal expansion. Outputs will include an estimate of the year-to-year changes in sea level rise and a "plausible but highly unlikely" scenario known as H++. A new feature of UKCP18 will be assessing the credibility of making sea level rise projections to 2300. The projections will use the latest information from the CMIP5 models and application of the methods used in the Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report[10].

The UKCP09 storm surge projections will be updated to provide new estimates of the change in high water levels over the 21st Century. These estimates will be based on a combination of projected mean sea level change and projections of change in the extremes due to changes in atmospheric storminess. These "storminess" projections will use the same surge model used in operational weather forecasting, using the wind and pressure from the CMIP5 ensemble to drive the surge. New understanding of the modification of large-scale sea level change signals as they pass from the open ocean onto the shelf sea around the UK will be incorporated into the UKCP18 marine projections. UKCP18 will also include storm surge historical case studies derived from applying plausible future sea level change to historical extreme events.

[8] The latest update can be found at **http://www.metoffice.gov.uk/climate/uk/about/state-of-climate**
[9] **http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/**
[10] **https://www.ipcc.ch/report/ar5/**

PROJECTIONS OVER LAND

The land projections comprise three components:

60KM GLOBAL PROJECTIONS

20 plausible climate futures. Latest Hadley Centre climate model. Simulations of extreme weather. Simultaneous impacts captured at multiple locations.

This resolution will enable more realistic simulations of climate for the UK and capture the drivers of extreme weather, a significant advance on the 300 km-resolution simulations of UKCP09. A set of 20 plausible global projections of 21st century climate will be generated using an ensemble of the Met Office Hadley Centre HadGEM3 climate model. These projections will be selected to represent a wide range of possible future climate states to reflect key uncertainties, informing a risk-based approach to planning. They will be generated to provide spatially coherent daily data at a horizontal resolution of 60 km for two greenhouse gas concentration scenarios. These will be compared with an ensemble of CMIP5 models to provide additional information on uncertainties in the projections relative to other climate models.

25KM PROBABILISTIC PROJECTIONS

Captures natural variability and climate change. Updated models and observations. Provides seasonal scale projections.

Based on the established, peer-reviewed, ground-breaking method of UKCP09 for estimating uncertainty for use in risk-based analysis. Probabilistic projections will be updated using an up-to-date collection of Met Office climate simulations and the latest IPCC-assessed simulations to estimate the model uncertainties, incorporate the latest observations and estimate carbon cycle feedbacks. Projections will be on a 25 km grid for the UK at monthly intervals for several emission scenarios, including one used in UKCP09[11]. The new probabilistic projections will indicate the range of uncertainty in our knowledge of the climate system and natural variability through the 21st century, using probability density functions to provide information on how climate varies from month to month. This contrasts with UKCP09 for which only 30-year means were provided[12].

DOWNSCALED HIGH RESOLUTION PROJECTIONS

Downscaled versions of the global model for the UK. For the most spatially detailed downscaling this includes hourly data. Simultaneous impacts captured at multiple UK locations.

The high resolution projections will provide information on types of weather of relevance to adaptation at two different resolutions. The 12 km model provides a downscaled product that is similar to UKCP09's 25 km simulations but driven by an improved global model and at a higher resolution. This may be especially useful for those interested in water availability and some aspects of agriculture. A key reason for providing this data is that users will be able to compare it directly with EURO-CORDEX[13].

The global projections will also be downscaled to 2.2 km using a process of nesting models at finer resolution that maintains the integrity of the representation of evolving atmospheric processes. Key benefits of simulations at this resolution will be the information provided on high impact events such as localised heavy rainfall in summer and potential improvements in the diurnal cycle.

The output will be available at a time resolution of 3-hourly, possibly higher for some output, for a high emission scenario. Spatial coherence will be maintained. Specific time slices (e.g. 2061-2080) will be made available with the exact nature of these still to be confirmed.

[11] SRESA1B: IPCC future scenario based on rapid economic growth and a balance of energy sources

[12] 30-year means can be created using the UKCP18 PDF data

[13] http://www.euro-cordex.net/

Met Office | Department for Environment Food & Rural Affairs | Department for Business, Energy & Industrial Strategy | Environment Agency

Summary of expected outputs

Table 1 below indicates the likely dimensions of the outputs for each of the components as of July 2017.

			Land			
	Observations (UK State of the Climate)	**Marine and coastal projections**	**Global projections**	**Probabilistic projections**	**High resolution projections**	
Characteristics	Observed trends; long-term climatologies; weather events for the preceding year	Updated sea level rise and surge projections based on operational storm surge model (CS3) using CMIP5, EURO-CORDEX‡	Ensemble of ~20 spatially coherent time series of the Met Office Hadley Centre model and a similar number of CMIP5 models	Updated probability density functions presented as 30-year and monthly time series based on Met Office models (HadCM3, ESPPE) and CMIP5	Downscaled projections over the UK for ~10 spatially coherent time series. 2.2 km model provides realistic information on heavy rainfall events	
Scale	UK	UK	Global	UK	UK	
Spatial resolution*	To match land projections	UK Coastline†	60km	25km	12km+	2.2km
Highest temporal resolution	Daily / monthly	Annual	Daily	Monthly	Daily	Sub-daily
Period of data	bulk of 20th century to present day	1950-2100	1900-2100	1961-2100	1981-2080	1981-2000 2021-2040 2061-2080
Emissions scenarios	N/A	RCP2.6, RCP4.5, RCP8.5 H++	RCP8.5; additional lower scenario (for Met Office Hadley Centre model only)	SRES A1B, RCP2.6, RCP4.5, RCP6.0 RCP8.5	RCP8.5	RCP8.5
Variables available++	Temperature, precipitation (including snow), sunshine, wind	Sea level rise, storm surge	Temperature, precipitation, humidity, wind speed, wind direction, solar radiation	Temperature, precipitation, humidity, wind speed, solar radiation	Temperature, precipitation, humidity, wind speed, wind direction, solar radiation	Temperature, precipitation, humidity, wind speed, wind direction, solar radiation

* Data also available for whole UK, administrative regions, devolved administrations and river basin regions.
†Additional information on variability and observations available at Class A tide gauges (see **http://www.ntslf.org/data/uk-network-real-time**).
‡An ensemble of regional climate model results over Europe (see **http://www.euro-cordex.net**).
+Now included due to user request and Peer Review Panel advice.
++This is not an exhaustive list and further user-requested variables will be made available subject to evaluation of models.

How can I get the information and when?

Access to the raw data, pre-prepared data and maps, headline messages and user guidance will be available through a dedicated website.

A dedicated user interface will provide users with a means to download the data and produce customised visualisations. The exact nature of these outputs is still the subject of consultation with users.

Detailed descriptions of the scientific basis of the projections will be available as the project progresses. For the latest information visit:
http://ukclimateprojections.metoffice.gov.uk/24125

UKCP Project Team

July 2017