

UKCP18 Land Projections

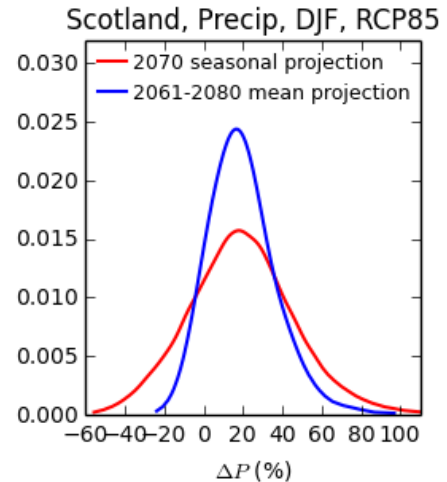
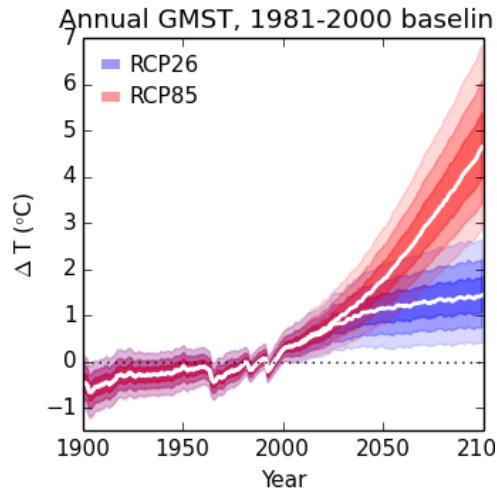
James Murphy, Glen Harris, David Sexton, Lizzie Kendon, Phil Bett, Robin Clark, Karen Eagle, Giorgia Fosser, Fai Fung, Jason Lowe, Ruth McDonald, Rachel McInnes, Carol McSweeney, John Mitchell, John Rostron, Hazel Thornton, Simon Tucker and Kuniko Yamazaki

Three Strands

- Probabilistic projections (Strand 1)
 - Conditional pdfs provided for several emissions scenarios
 - Update to UKCP09
- Global climate model projections (Strand 2)
 - 28 projections for RCP8.5 provided as time series of model output
 - {Derived projections for RCP2.6, using statistical methods}
- Regional climate model projections (Strand 3)
 - 12 projections @12km scale for RCP8.5, driven by subset of Strand 2 runs
 - {Coming later: 12 projections @2.2km using a convection-permitting regional model}

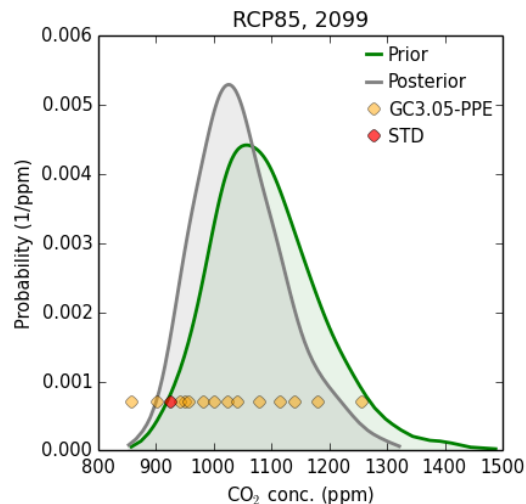
Probabilistic projections

- Derived from ~350 climate model simulations
- RCP2.6, 4.5, 6.0 and 8.5, and SRES A1B
- Presented at annual time scale, cf 30-year means in UKCP09



Probabilistic projections: strengths

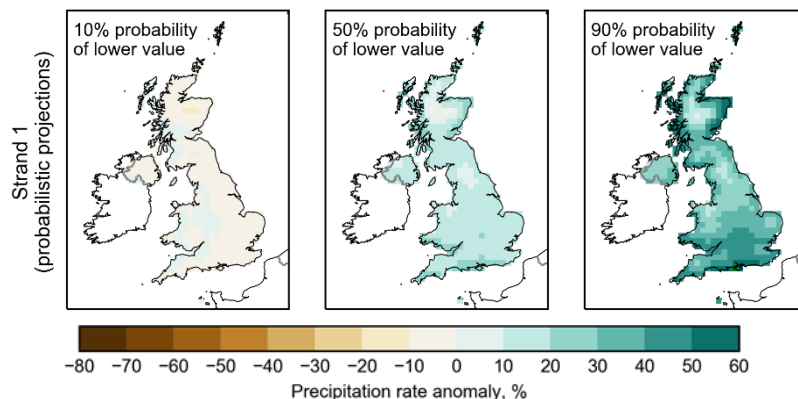
- The main source of information on uncertainties in UKCP18
- Developments since UKCP09:
 - Inclusion of CMIP5 results
 - New observational constraints from historical changes in ocean heat content and CO₂ concentration
 - More information on variability



Probabilistic projections: limitations

- Conditional on modelling inputs and methodological assumptions
- Only available for a limited set of variables
- Lack full spatial coherence

Winter precipitation
changes
2061-2080 relative to
1981-2000
RCP8.5

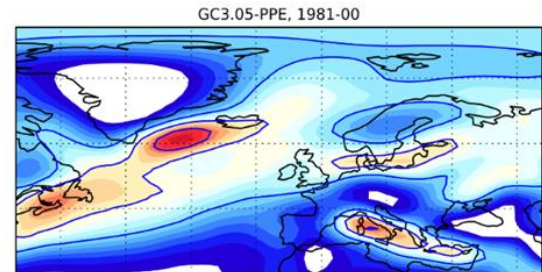
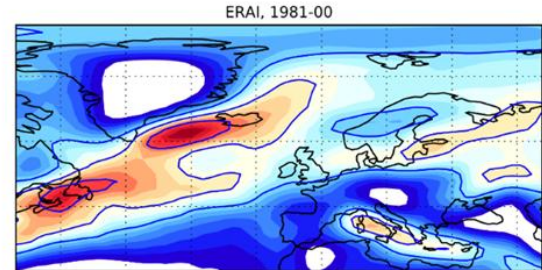


Global projections

- 15 perturbed parameter variants of HadGEM3-GC3.05 (GC3.05-PPE)
- Closely related to GC3.1, the UK submission to CMIP6
- Developed using seamless modelling principles
- ~60km horizontal resolution atmosphere, with 85 levels
- Augmented by 13 CMIP5 models to add diversity to the set of available projections

Global projections: strengths

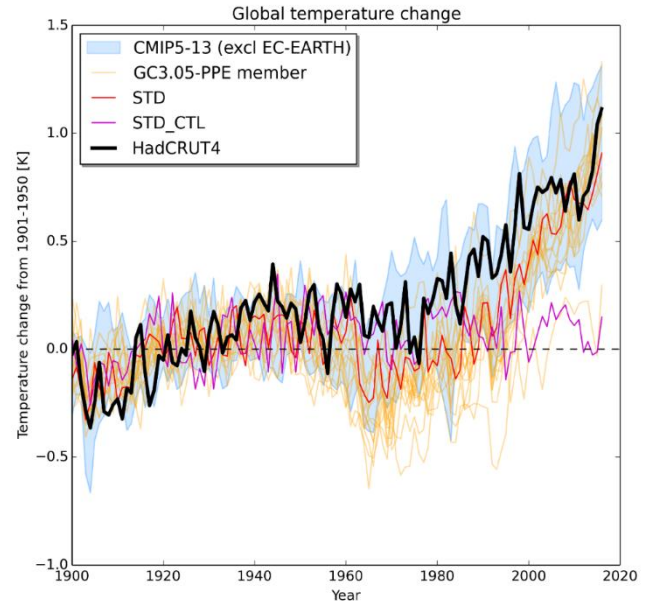
- Flexible dataset for understanding regional impacts and their drivers, for UK and worldwide
- Spatially coherent
- Focus placed on achieving credible simulation of major aspects of regional climate variability



Density of winter storm
tracks (1981-2000)

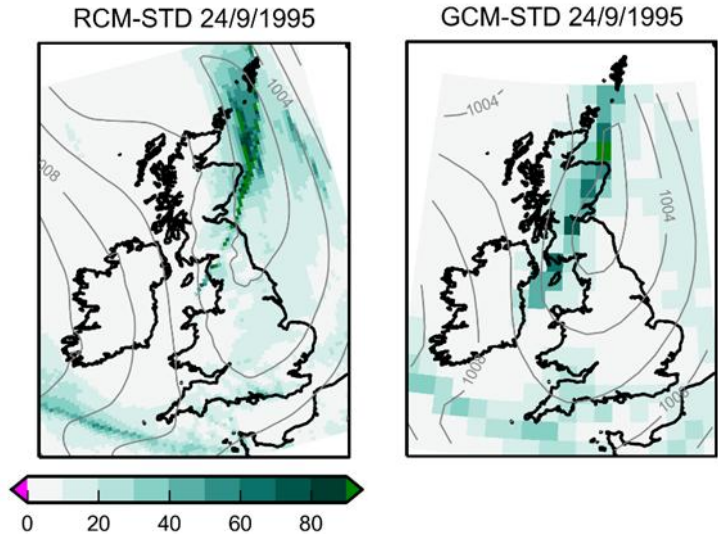
Global projections: limitations

- Not designed to support a probabilistic interpretation
- The new GC3.05-PPE simulations perform well (cf CMIP5) in general...
- ... but do contain some notable biases
 - Cold bias in N Europe winter surface temperature
 - Trends in global temperature since ~1950 differ from observations



Regional projections and their strengths

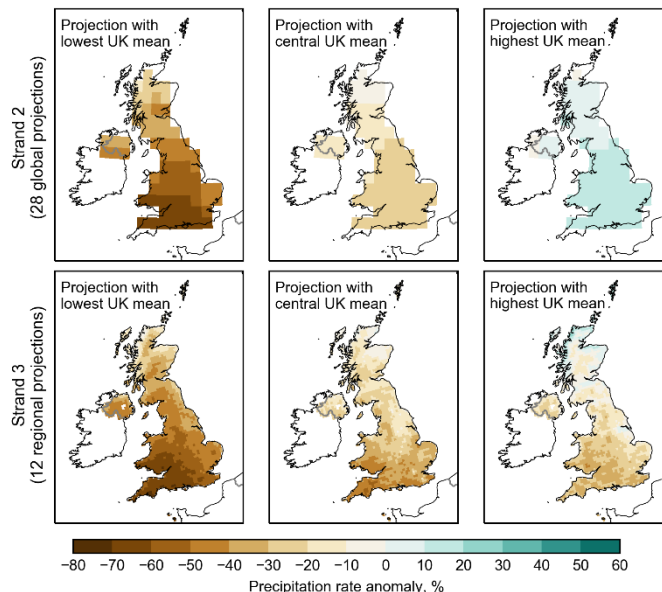
- Twelve perturbed RCM variants, driven by 12 corresponding GC3.05-PPE members from 1980-2080, RCP8.5
- European domain, 12km resolution, changes in GHG and aerosol forcing taken from global runs
- **Model output for detailed impacts assessments and case-study analysis for UK and Europe**



Heaviest local precipitation event simulated during 1981-2000

Regional projections: limitations

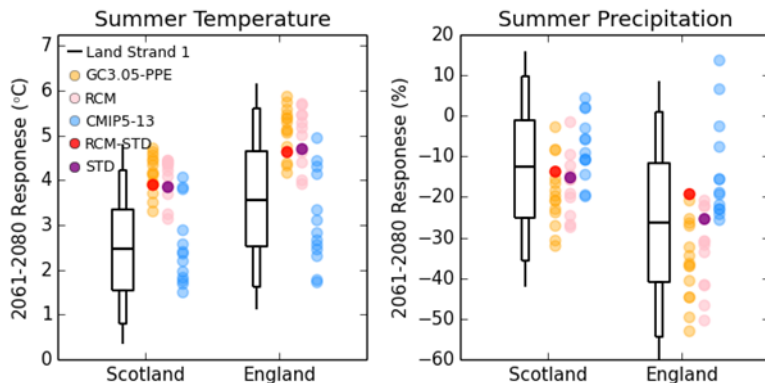
- The high resolution downscaling adds skilful local detail, especially for precipitation....
- ... but also inherits biases from the driving simulations
- **The regional projections lack a multi-model counterpart to the PPE approach, which limits the spread of projections.**



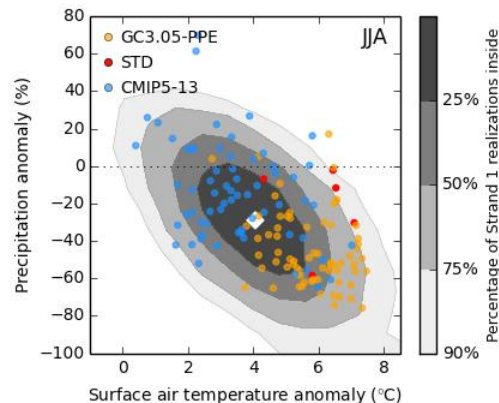
Summer precipitation changes for 2061-2080 relative to 1981-2000, RCP8.5

Comparing the projections and using them together

Uncertainty ranges from Strand 1 provide context for impacts studies using Strands 2 and 3



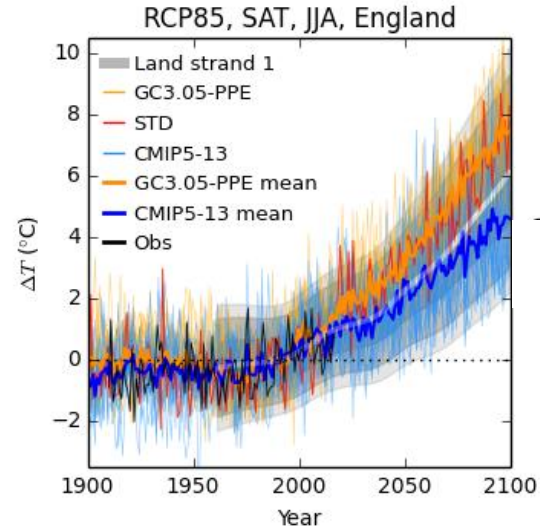
National changes for 2061-2080 relative to 1981-2000, RCP8.5



Seasonal summer anomalies for England during 2075-2079, relative to 1981-2000

Main Results

- Central estimates of projected trends show:
 - Scenario-dependent warming that is somewhat larger in summer than in winter, and quite similar to UKCP09
 - Increasing precipitation in winter, reductions in summer.
- Considerable uncertainties in changes
 - e.g. by 2070, average 10-90% range of local summer warming in RCP8.5 is 0.9-5.4°C
- Increasing risk of individual hot and/or dry summers, and wet winters
- But cold winters or wet summers remain possible, to at least 2050.



Projected anomalies in individual summers for England relative to 1981-2000, RCP8.5

Spare Slides

Three Strands of the UKCP18 Land Projections

	Probabilistic projections	Global model projections	Regional model projections
Description	Probabilistic changes in future climate based on assessment of model uncertainties.	A set of 28 projections with detailed data on how climate may evolve in the 21 st century.	A set of 12 high-resolution climate projections over Europe downscaled from the global projections.
Period	1961-2100	1900-2100	1981-2080 for 12km
Temporal resolution	Monthly Seasonal Annual	Daily Monthly Seasonal Annual	Daily Monthly Seasonal Annual
Spatial resolution	25km	60km	12km
Geographical extent	UK and regions	UK and regions Global	UK and regions Europe
Emissions scenarios	RCP2.6 RCP4.5 RCP6.0 RCP8.5 SRES A1B	RCP2.6 (UK only) † RCP8.5 2°C world (UK only) † 4°C world (UK only) †	RCP 8.5
Why use it?	<ul style="list-style-type: none"> ■ The most comprehensive assessment of uncertainties in UKCP18. ■ Explores emissions scenario uncertainty. ■ Explores uncertainty in key processes in climate models. ■ Helps characterise future extremes in risk assessment. 	<ul style="list-style-type: none"> ■ Long time series. ■ Spatially coherent*. ■ Direct access to 'raw' climate model data. ■ Includes results from the Met Office Hadley Centre global climate model. ■ Includes CMIP5 model results. 	<ul style="list-style-type: none"> ■ Enhanced spatial detail. ■ Spatially coherent. ■ Improved extremes. ■ Direct access to 'raw' climate model data.

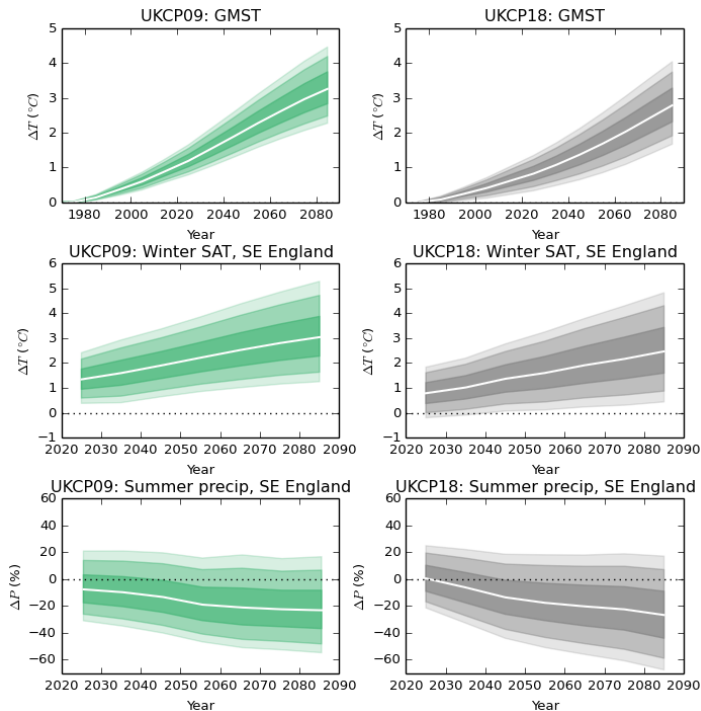
Table 2.5. A summary of the key characteristics of each of the three strands of information for the UKCP18 land projections.

†Only available for the UKCP18 derived projections. *spatial coherence is important when analysing climate risks at different geographical locations at the same time, e.g. national assessments. ** A smaller set is available for RCP2.6 as some CMIP5 data is unavailable.

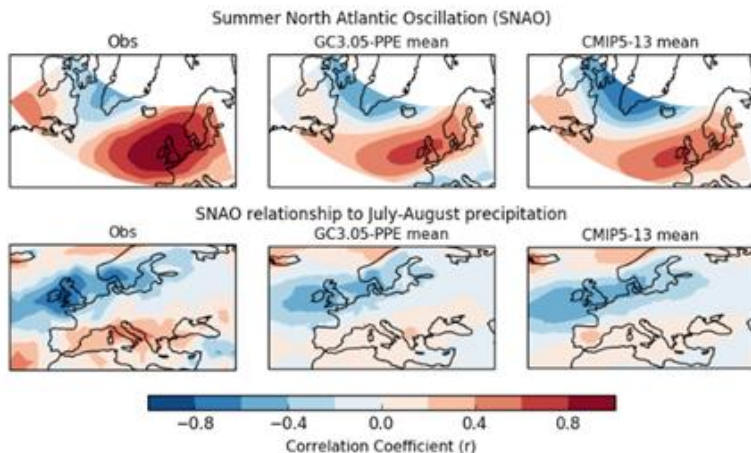
***Only available for Met Office Hadley Centre model

Comparing UKCP18 and UKCP09

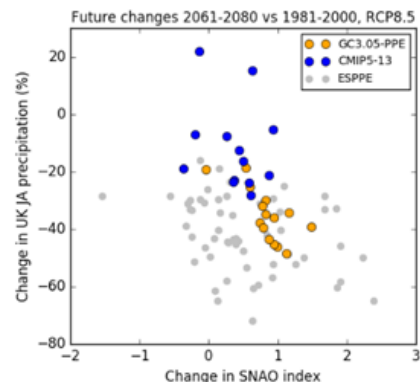
Projected 30-year average changes relative to 1961-1990 under SRES A1B emissions from UKCP18 and UKCP09



Understanding drivers of UK changes for climate storylines



Summer North Atlantic Oscillation and its relationship to precipitation in observations and the Strand 2 simulations



Projected future changes in UK summer precipitation and the SNAO, 2061-2080 relative to 1981-2000, RCP8.5