Climate change impacts on the water industry: UKCP18 and beyond

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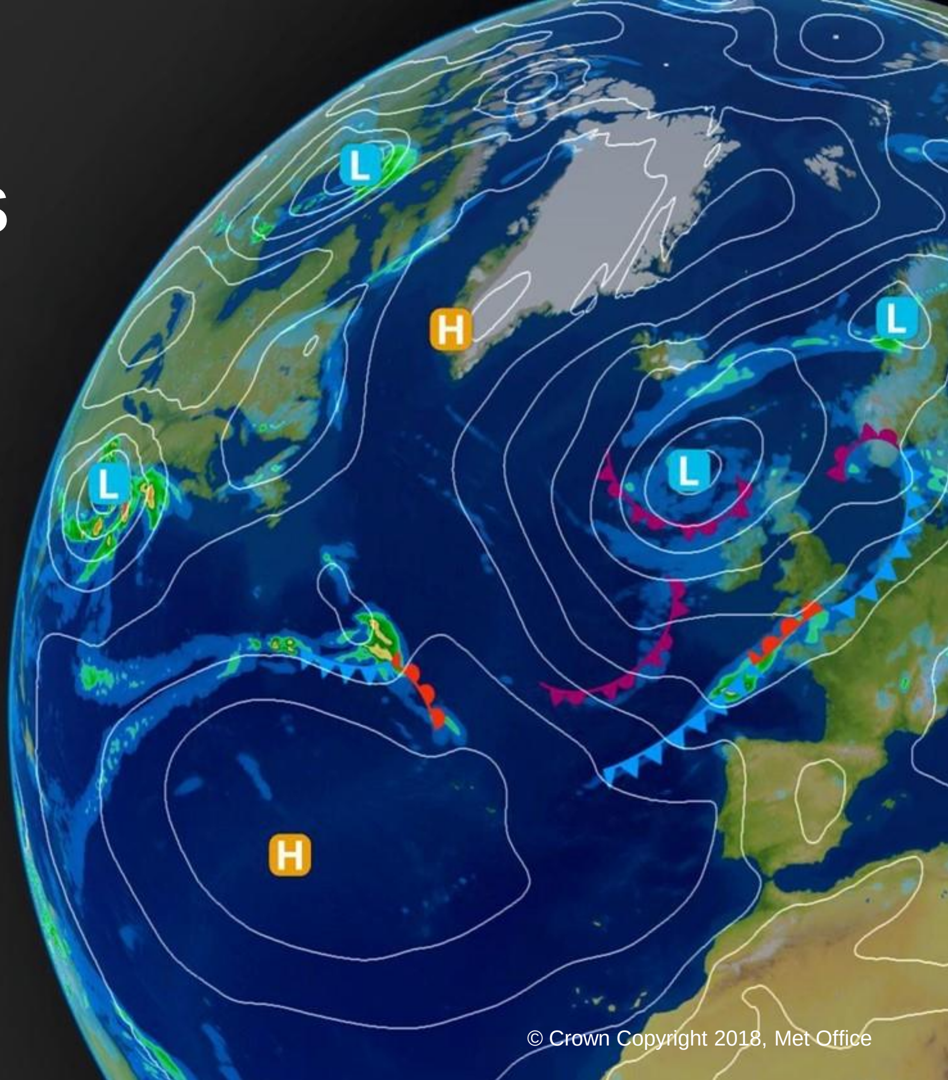
3 December 2019



UKCP18

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What is UKCP18?

UK Climate Projections 2018

A major upgrade to the range of UK climate projection tools designed to help decision-makers assess their risk and exposure to climate change impacts

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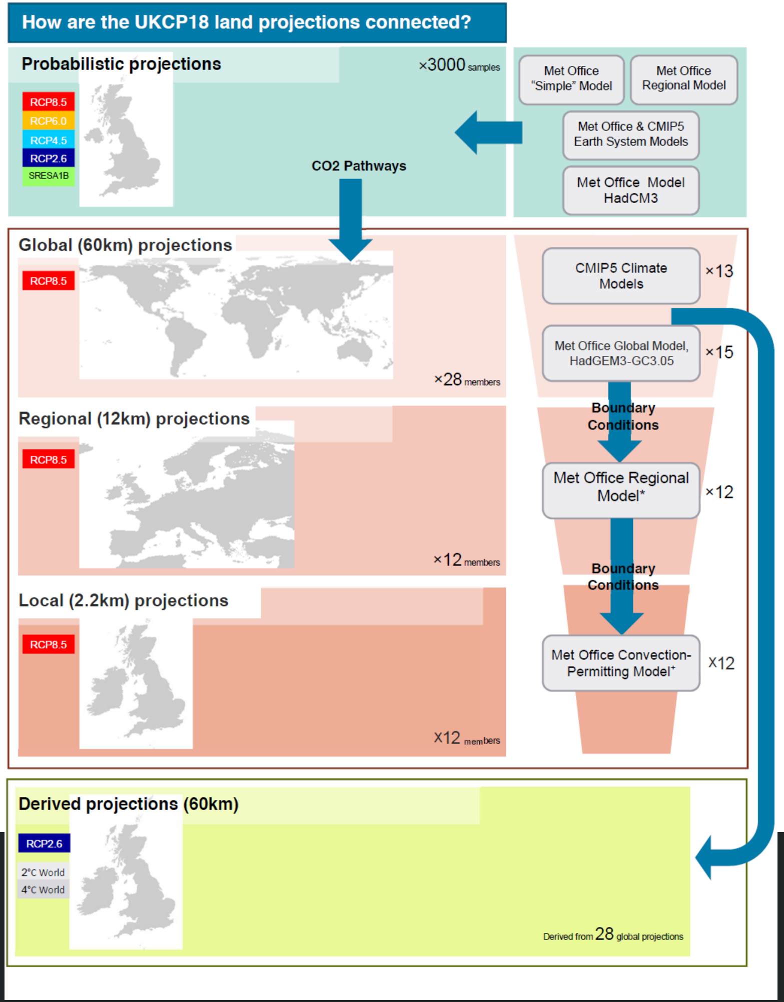
UKCP18 projections over land

- **Probabilistic** projections (3,000 samples)
  - Based on UKCP09 statistical methodology
  - Aim to sample full range of uncertainty
- **Global** projections (28 x 60 km simulations)
  - Spatially and temporally coherent
  - Can look at global impacts and interconnectivity
- **Regional** projections (12 x 12 km simulations)
  - Greater focus on climate extremes
- **Local** projections (12 x 2.2 km simulations)
  - Extreme, short duration rain and wind gusts
- **Derived** projections (derived from 28 x 60 km simulations)
  - Derived using statistics (“time shifting” + “pattern scaling”)
  - Allows framing around 2°C and 4°C worlds, for the UK



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

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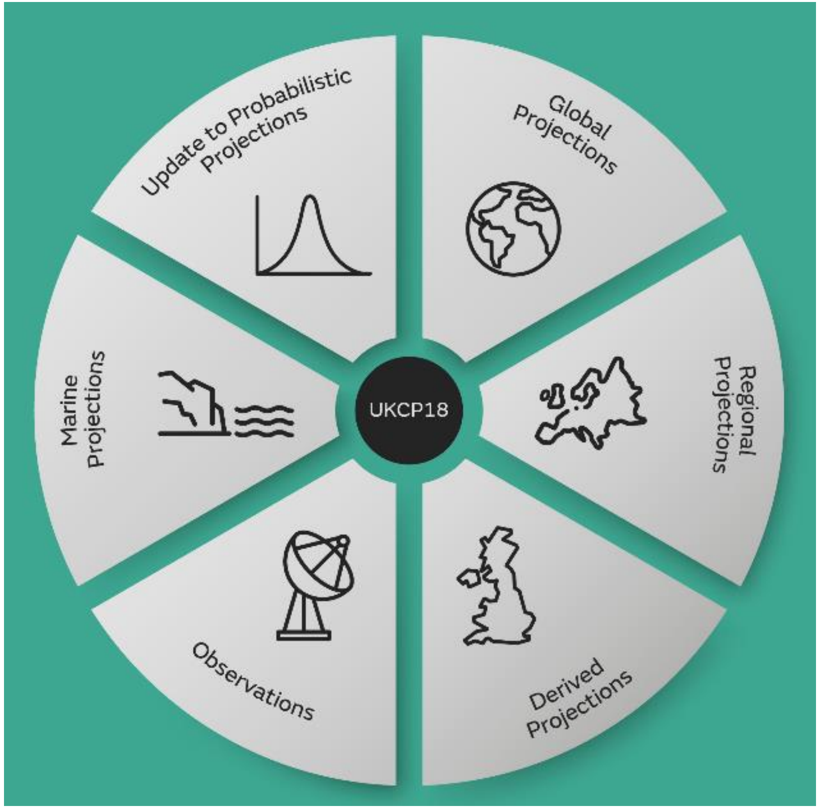
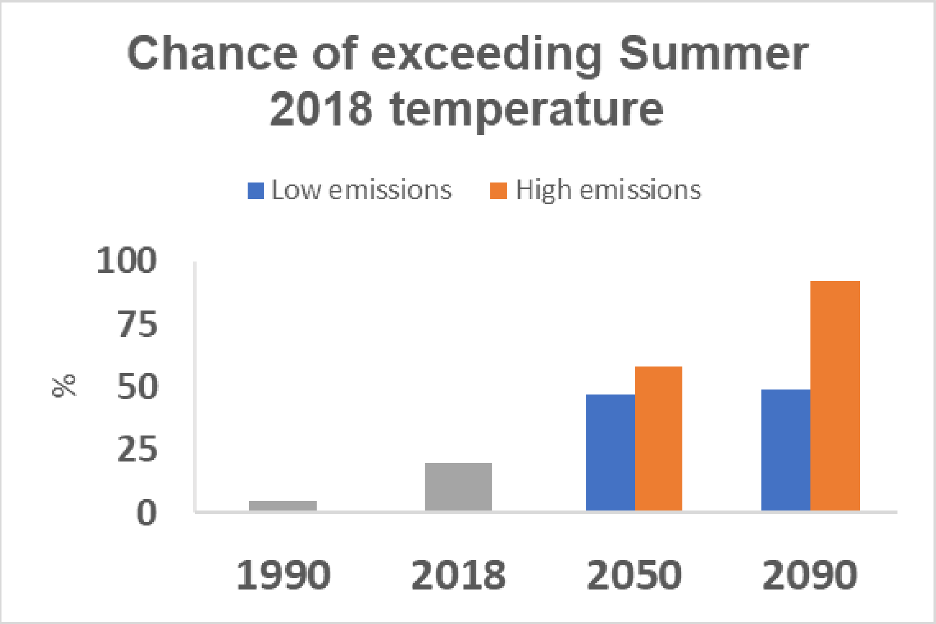
Headline result

“a greater chance of warmer, wetter winters and hotter, drier summers”



Probabilistic projections – summer 2018 heatwave

- Chance of such hot summers low in the baseline period (<10%)
- By mid-century the chance of hot summers will be of the order of 50%
- Beyond 2050 the chance of a warmer summer more strongly depends on future GHG pathway



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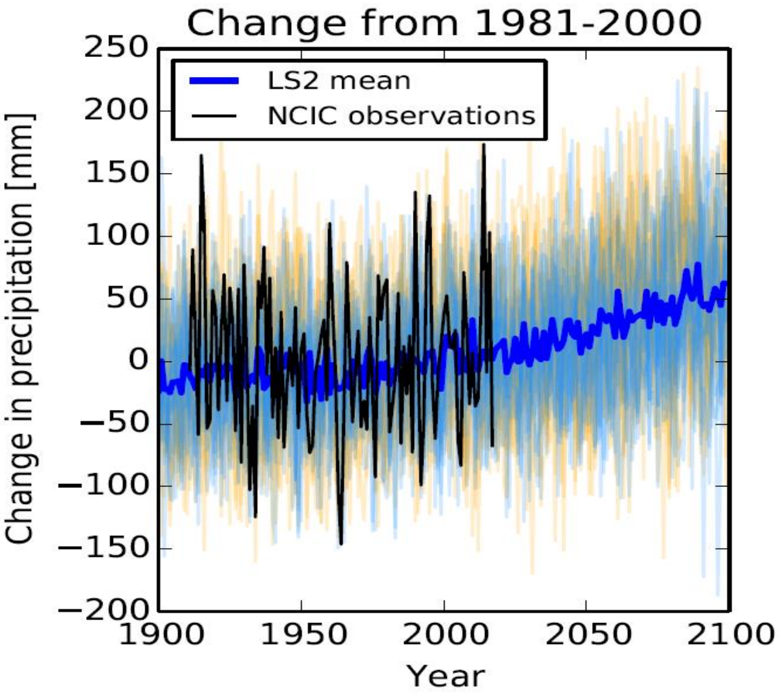
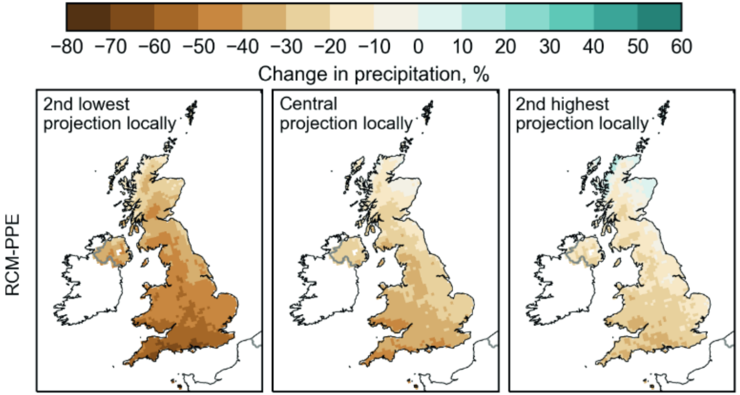
Global projections – UK mean precipitation change

- Winter precipitation is expected to increase significantly
  - We will still get some dry winters, but wet winters will become wetter
- Summer rainfall is expected to decrease significantly
  - But when it rains in summer there may be more intense storms
- As for temperature the amount of change depends on future greenhouse gas emissions
  - Increases across all scenarios

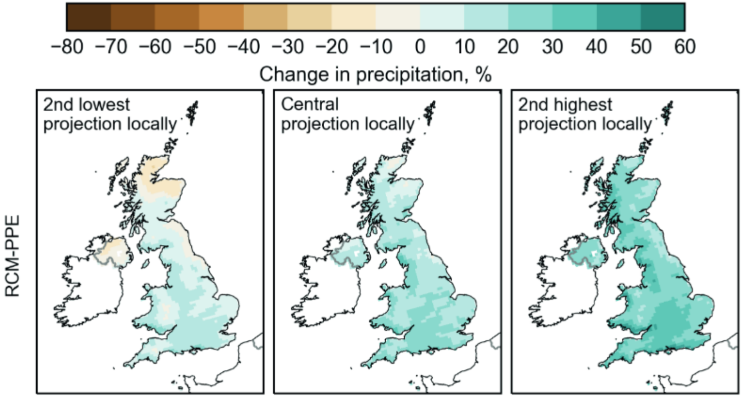


UK mean winter precipitation

Regional projections – pattern of precipitation change



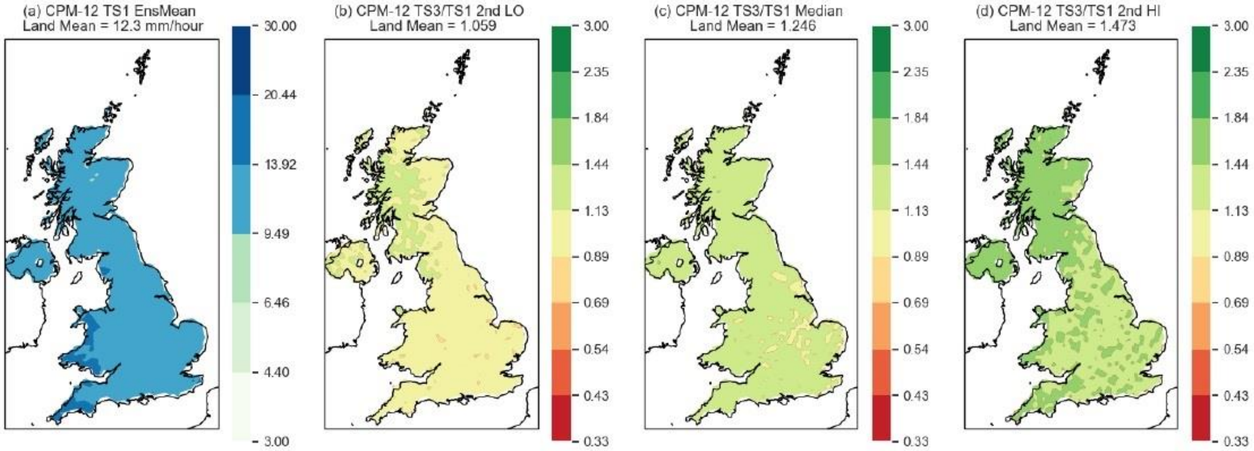
Summer precipitation change



Winter precipitation change

Spatial pattern of change to 2061-2080 (RCP8.5) shows detailed structure over the UK (compare S England and N Scotland)

Local projections – extreme precipitation change



- Local (2.2 km) model:
  - Fewer wet days, in agreement with observed
  - Better simulates heavy rainfall in winter and over mountains

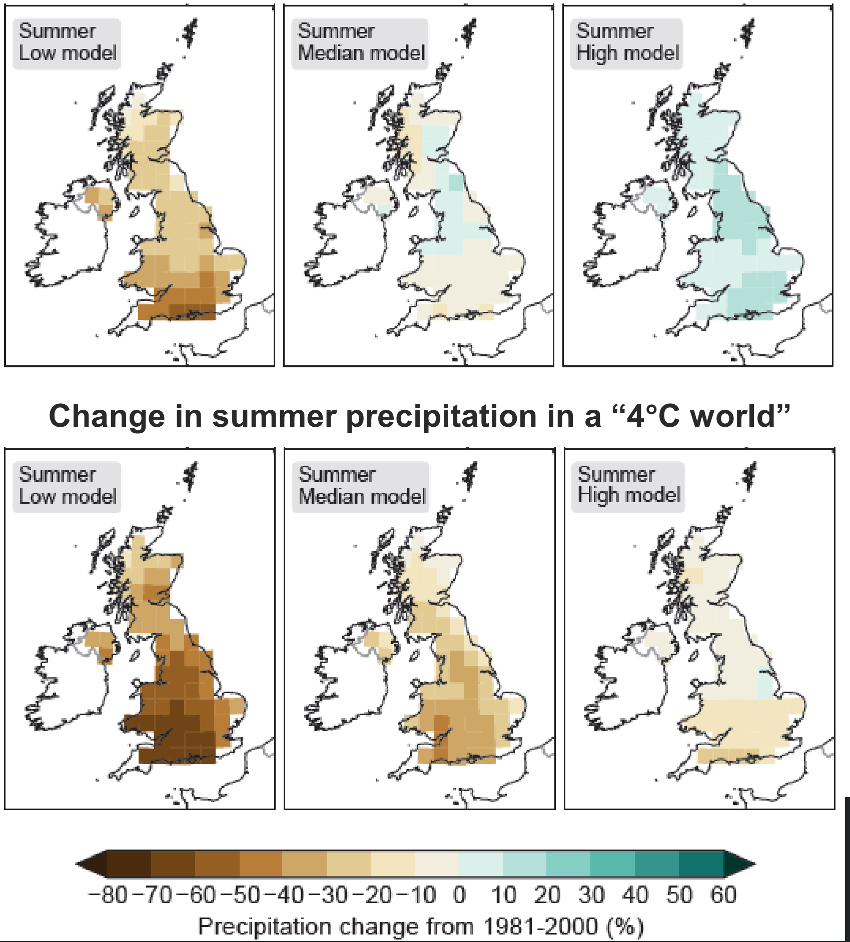
- Future change in 2-year return level of daily maximum hourly precipitation
  - A central estimate increase of 25% by 2070
  - Greatest increases in intensity over wettest areas (north and west)

Derived projections

- Derived using a combination of “time shifting” and “pattern scaling”
  - For RCP2.6, 2°C global mean warming and 4°C global mean warming
- Such techniques can be expanded to 1.5°C
  - In line with 2015 Paris agreement
- UKCP18 extremes product scheduled for 2020:
  - 20-, 50- and 100- year return level
  - Annual maximum; 1-day precipitation, 5-day precipitation, 1-day temperature
  - DJF, MAM, JJA and SON, at 25km

Change in summer precipitation in a “2°C world”

Change in summer precipitation in a “4°C world”



Water sector science

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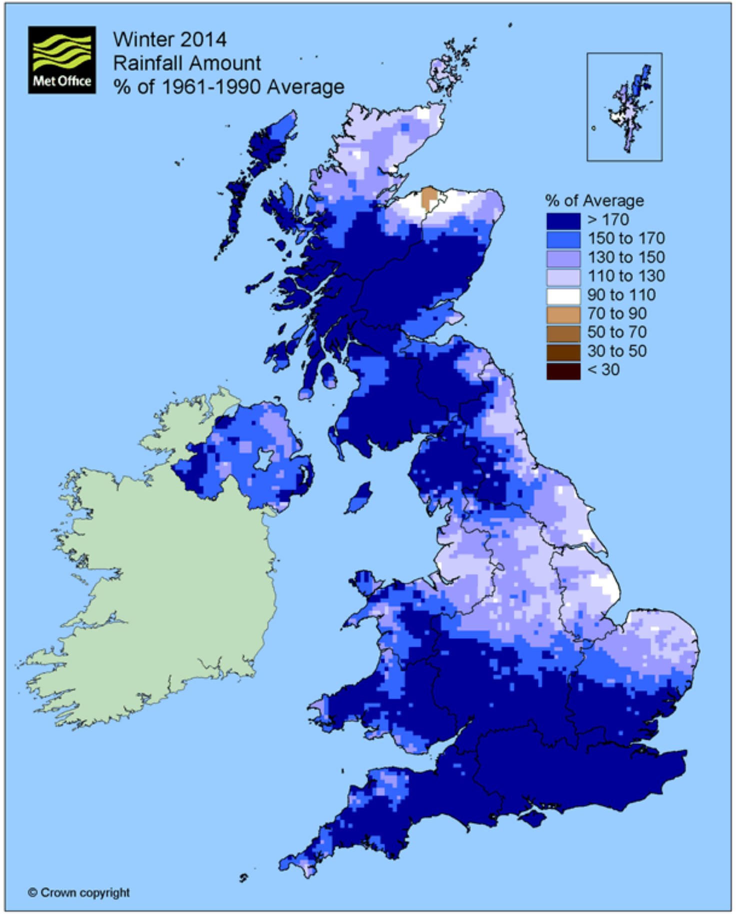
UNprecedented Simulated Extremes using Ensembles (UNSEEN)

- How often will we see something *at least as bad* as the worst we have seen so far?
- Model run with 40 x 12-month hindcasts (retrospective forecasts) for each year (1959-present)
- 40 times more data than is available from observations
- Capable of sampling more extreme cases than in the available observations
  - Allows for the identification of unprecedented (**UNSEEN**) events



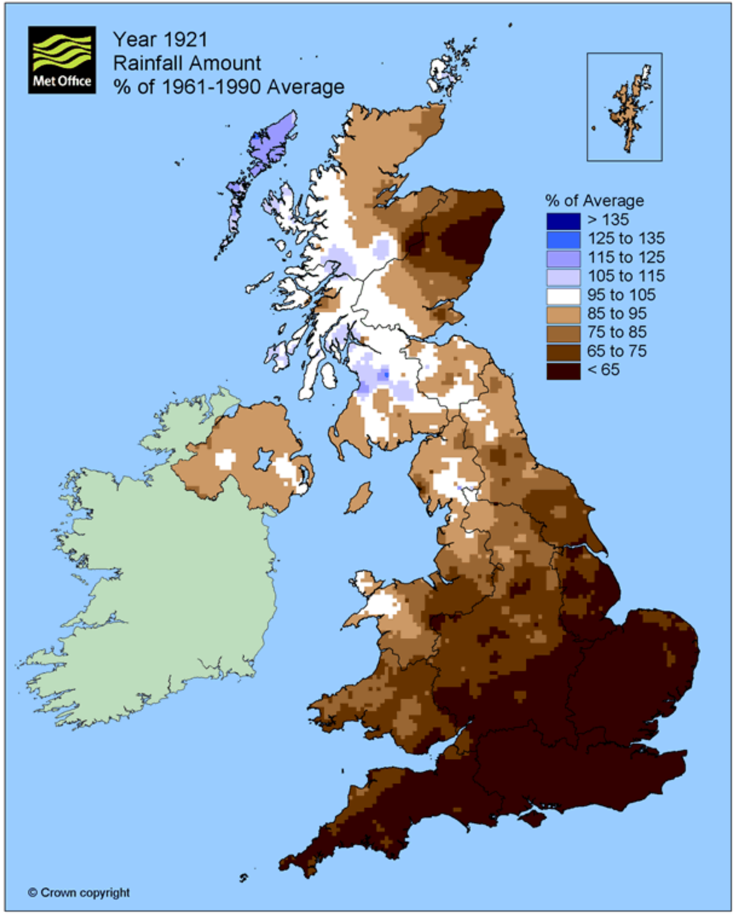
Extreme multi-year drought

- Multi-year droughts have a significant impact on water resources
- Some water companies are particularly sensitive to 36-month precipitation accumulation deficits
- But there are few data points to robustly fit statistical models to
- Hindcast approach bypasses the need for statistical methods
- Early findings:

Model data represents observed precipitation and drought faithfully

AND

simulates droughts that are more extreme than those in the observational record



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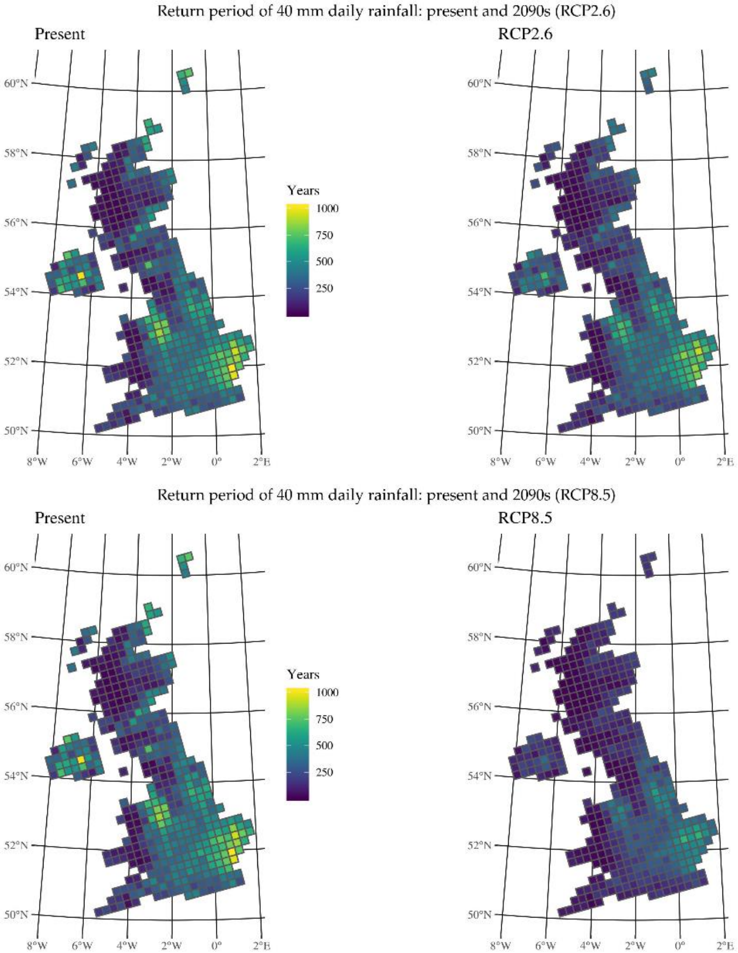
Future extreme daily rainfall

- Use extreme value analysis (GEV) to consider “shifts” in the observed rainfall extremes under global mean warming

- Climate change is characterised by linking properties of the extremes with global mean temperature

- Global mean temperature taken from UKCP18, to quantify future extreme daily rainfall



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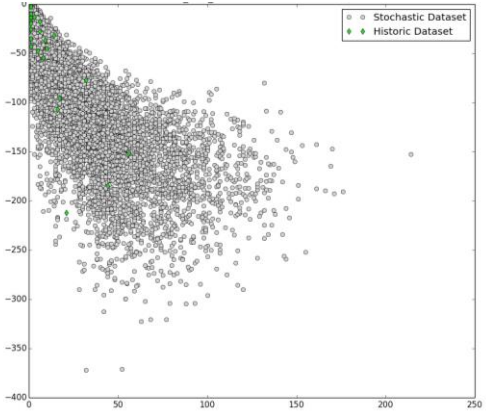
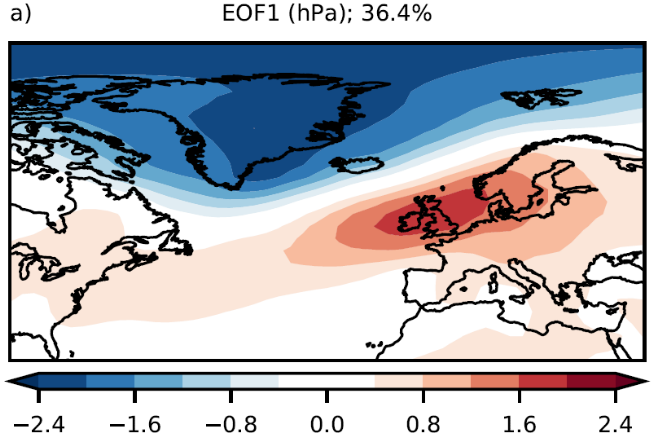
Future extreme multi-year drought

- UKCP18 is an extensive resource
- It can be supplemented by synthetic data
  - Relevant to historical/current climate
  - Relevant for future warming levels (1.5°C…)
- Again drawing on relationship of rainfall distribution parameters with global mean temperature
  - Carefully select sample of UKCP18 products
- Considers changes in large scale explanatory variables simulated in models
  - e.g. summer North Atlantic Oscillation

Synthetic weather data…



…with realistic drivers



Thank you for listening

- For more information:

https://www.metoffice.gov.uk/research/collaboration/ukcp/

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