Water Resources Planning in the UK

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27 September 2016

Overview

- Trends and drivers
- Key issues and solutions
- Drought generation:
  - Historical evidence and implications
  - The need for spatial coherence
- Summary: accounting for drought risk

Trends and Drivers (1)

- Risk!
- Increasing recognition of the scale of uncertainty faced
- Focus on resilience and the consequences of drought
- WRMP19 (and associated UKWIR guidance):
  - Examination of droughts outside of the historic record
  - Links to Drought Plans
  - Much greater freedom and guidance to select ‘best value’ methods
  - Much wider range of approaches for incorporating uncertainty

Trends and Drivers (2)

- Trading, transfers, *conjunctive use between water resource suppliers* are all being promoted
- Regional focus through WRSE & WRE
- National level study recently supported potential for inter-regional evaluations

Key Issues and Solutions

- Much of this requires *system simulation*:
  - Models of the bulk hydrology, hydrogeology and supply systems
  - Need to incorporate the risks from growth and climate change, plus the benefits of different types of schemes
  - Other methods are available!
- Rapid processing and optimisation to run:
  - Multiple portfolio types
  - ..through multiple ‘future worlds’
  - …with multiple hydrological droughts
  - …..with multiple different demand patterns (?)

Drought Generation: Historic Evidence

- West and northwest dominated by ‘random’ variability, plus Atlantic Sea Surface Temperature (SST) and regional pressure oscillations (NAO):
  - For rainfall, no observable ‘persistence’ between months that cannot be explained by those factors
- However, as analysis moves further south and east, observable ‘anomalies’ start to occur that show significant persistence between months:
  - Only seem to affect driest 5% to 10% of years
  - Seem to be associated with ‘blocking high’ behaviour across northern Europe
  - Testing of continental regional pressure indices (EA/WR) does not ‘explain’ the behaviour

Drought Generation: Historic Evidence

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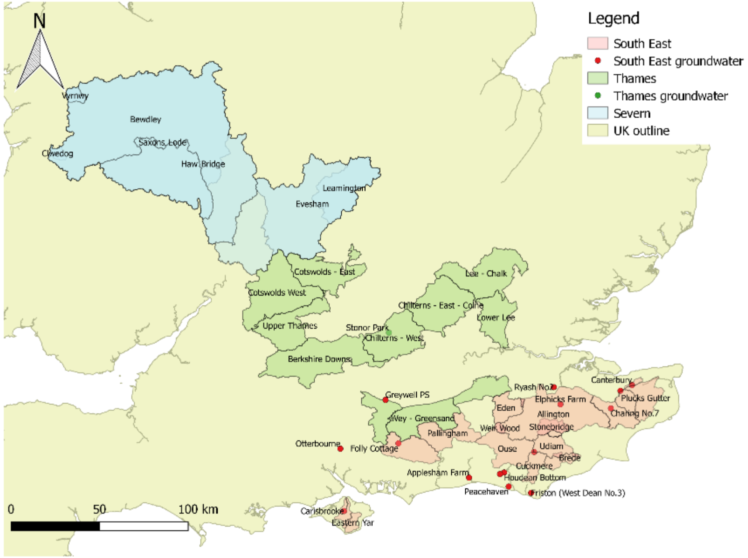
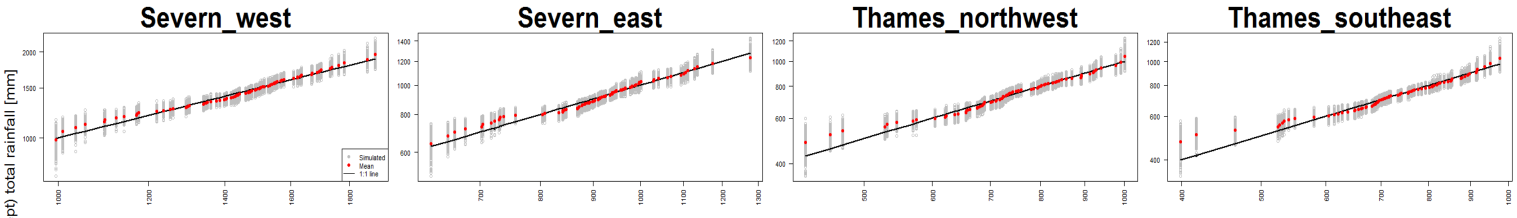
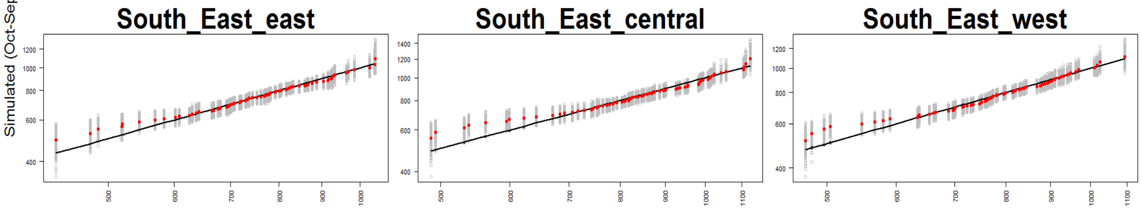
- Take WRSE locations as an example, but evidence from other studies shows similar:
  - United Utilities – no anomaly behaviour
  - WRE – similar evidence to WRSE



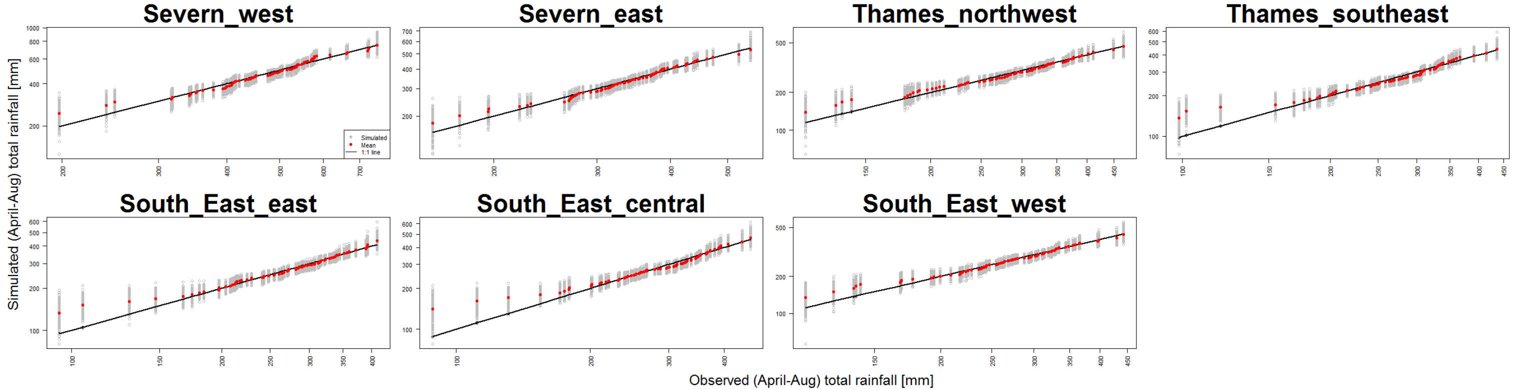
Drought Generation: Historic Evidence

- Persistence effect seen across the hydrological year, circa 100mm, biggest anomaly 6-9 month spring/summer, less evidence in autumn





Some evidence of more widespread anomalies in summer

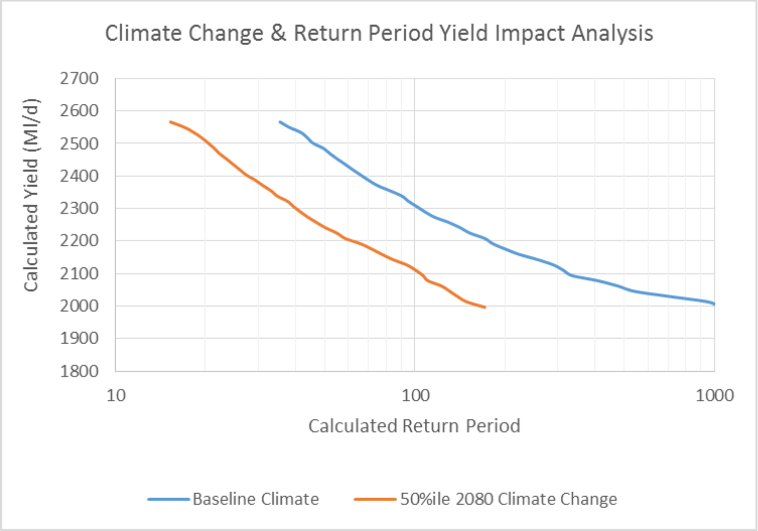


Drought Generation: Implications

- Does this matter in the context of climate change?
  - There is a temperature persistence anomaly between circa March and August that strongly correlates with the rainfall persistence anomaly; what happens under climate change?

  - Without anomaly behaviour a 1 in 100 type drought reduces to circa a 1 in 20 to 33 type drought

  - Testing indicates that this is likely to be more significant to yield than the 50%ile climate change at 2080..



Drought Generation; Spatial Coherence

- As more and larger transfers are considered, the need for accurate statistical representation of spatial coherence becomes more important
- Water UK project testing indicates there is an ‘inherent’ benefit in transferring between different meteorological regions
  - E.g. average expected drought severity in Wales circa. 1 in 50 during a 1 in 100 event in Thames
  - Explains the more resilient behaviour of systems such as Yorkshire, Severn Trent and UU

Drought Generation; Spatial Coherence

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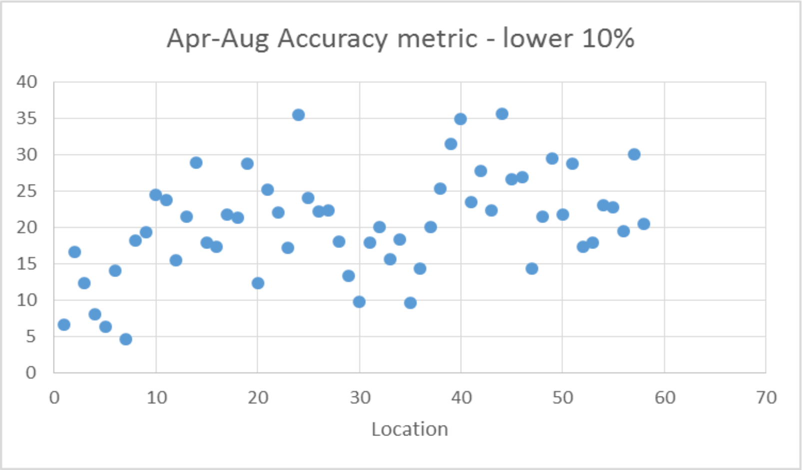
- Adds to the complexity of weather generation, drought selection and system simulation
  - individual smaller catchments vary quite significantly during a given drought
  - Graph shows the localised variation in the effective anomaly over 8 droughts



Summary: Accounting for Drought Risk

- Large variability and anomaly behaviour across drier events
- Accounting for anomaly behaviour is as important as climate change perturbation
- To plan well to 1 in 100 or 1 in 200 return period, need a large number of ‘valid’ droughts in this range
  - Risk from different temporal patterns to different systems
  - Ability to simulate enough droughts so that investments can look at ‘localised’ versus ‘transfer’ benefits in a risk based way

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