Assessing the impacts of climate change on UK water resources – groundwater

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Overview

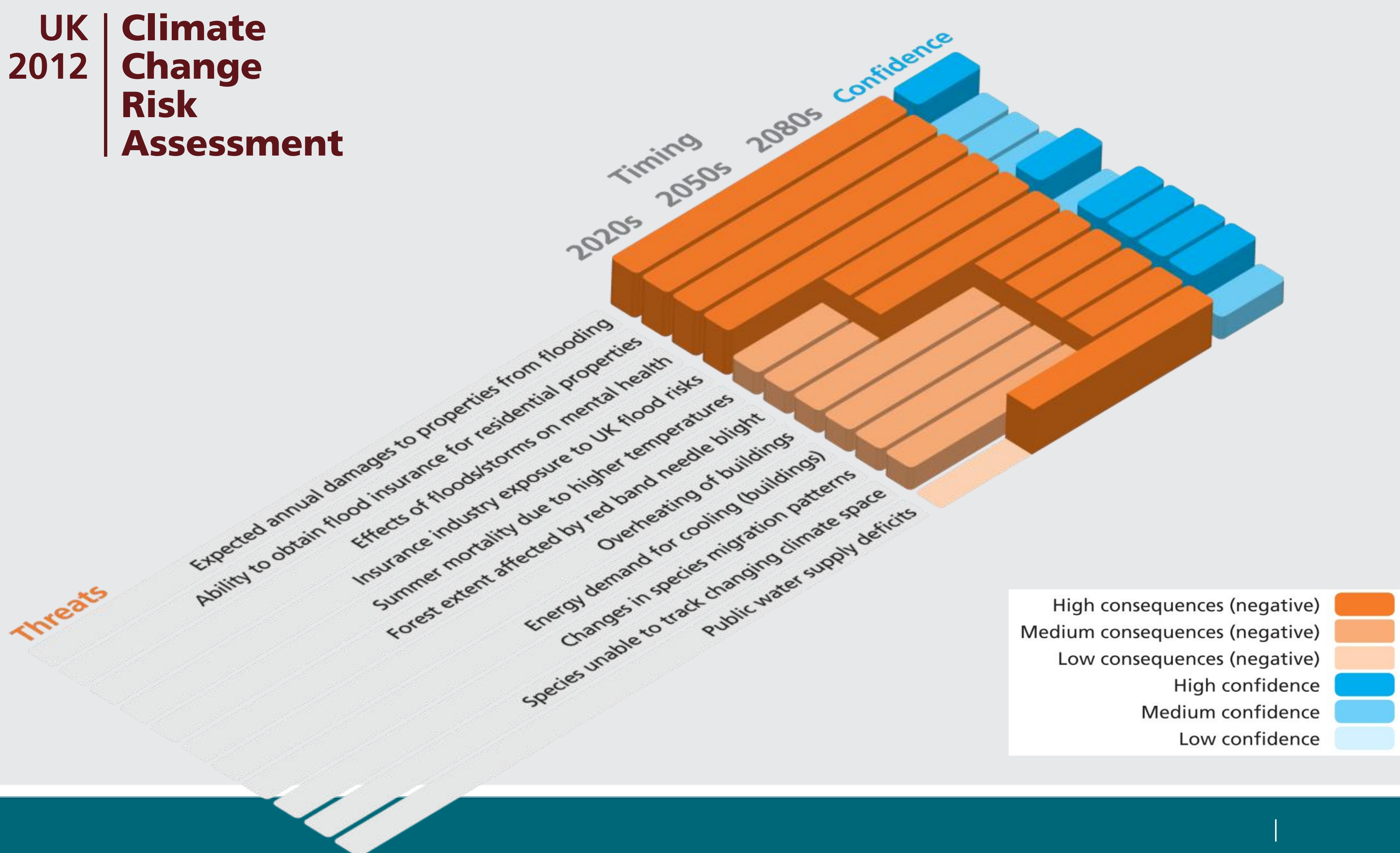
Evidence of the impacts of climate change on water resources

Preliminary results from the ARCC-Water project on groundwater impacts

Using UKCP09 for climate change impacts assessment

Challenges for future work

UK CCRA 2012
Selection of Key National Threats



Climate change plus population growth

Anticipated adaptation

•Reductions in demand will not be sufficient on there own

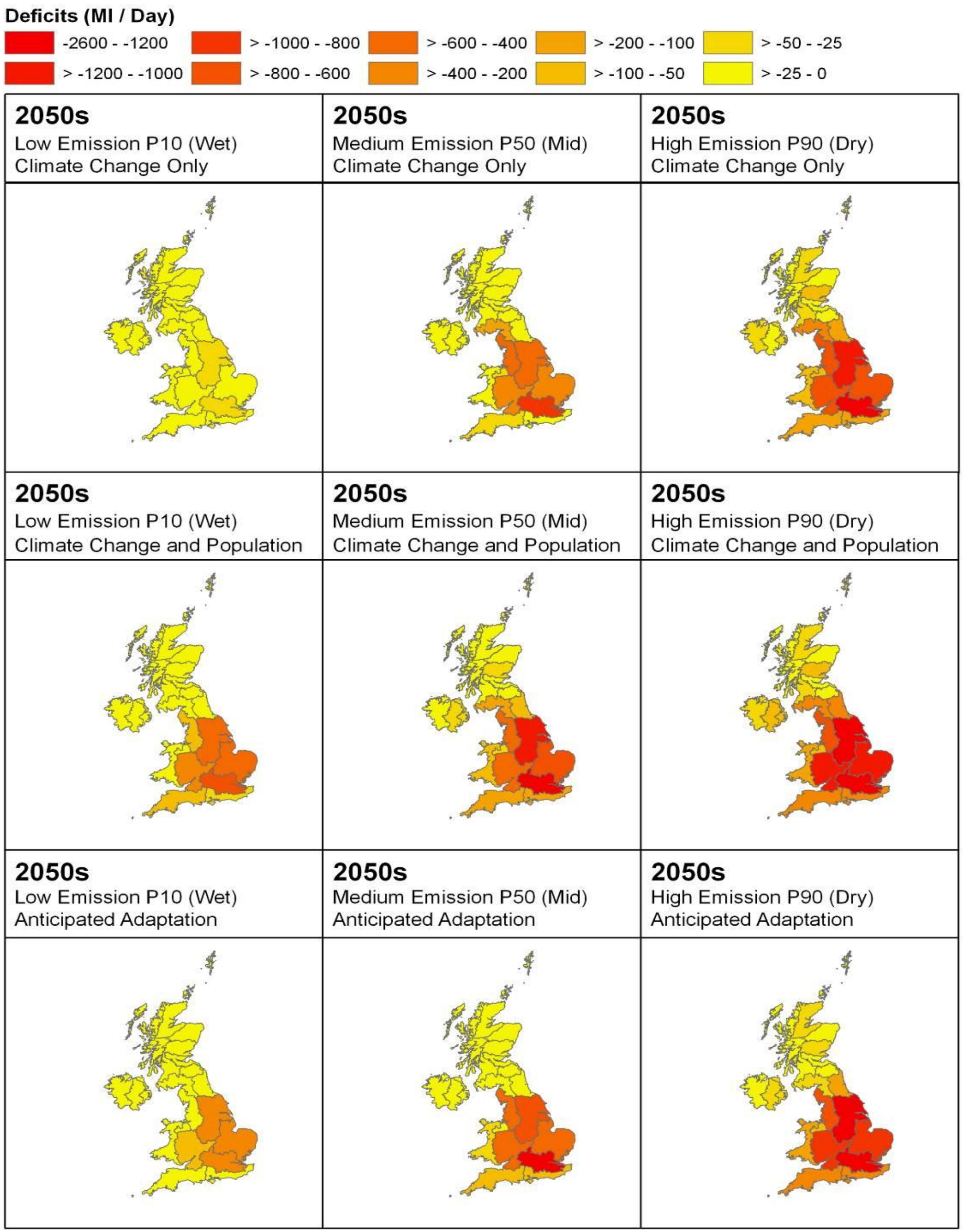
Planned adaptation (excluded)

•*RSA*

•*Abstraction reform*

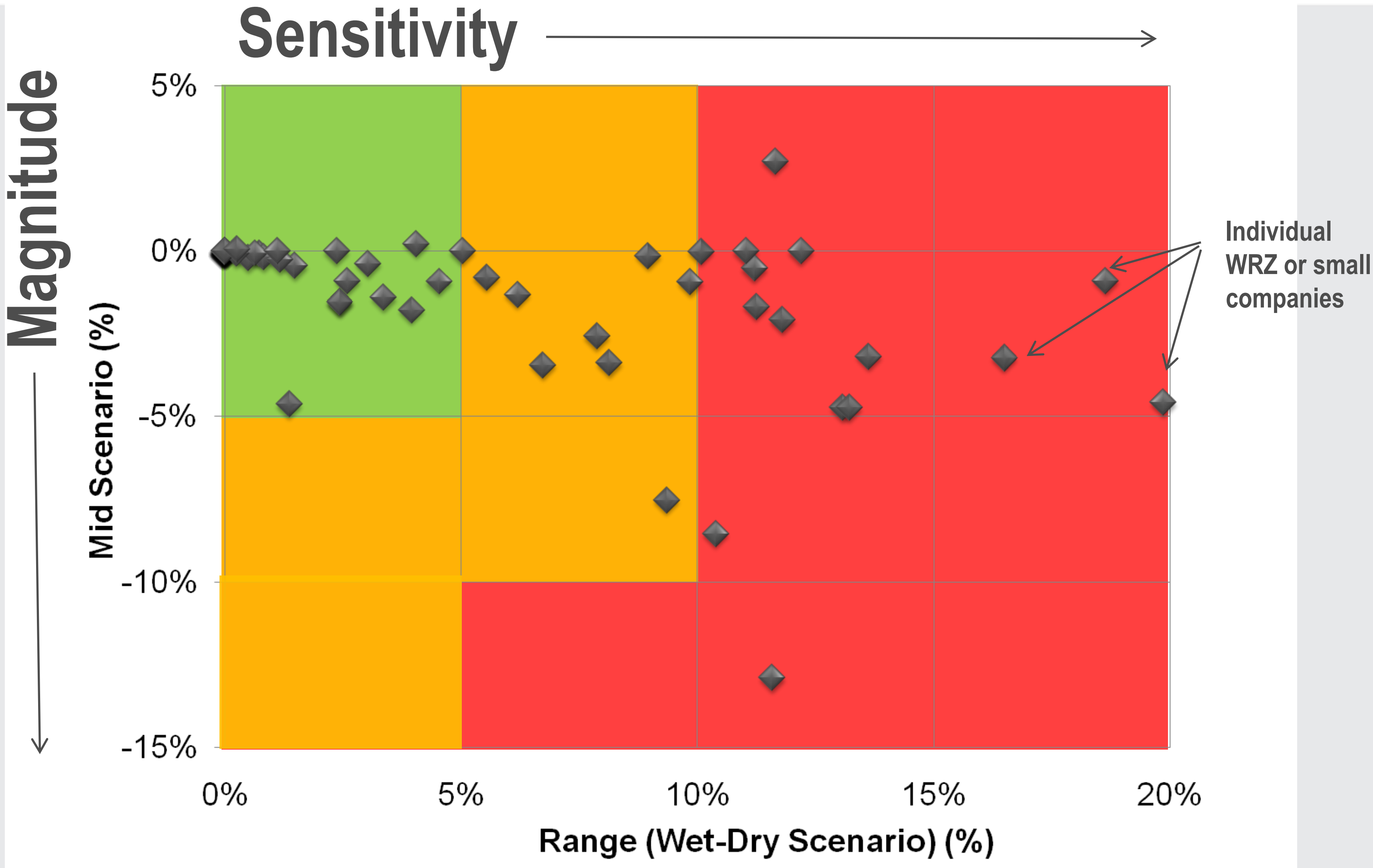
•*Demand side and supply side schemes*

•Will environmental targets be achievable without stronger adaptation?



UK 2012 | Climate Change Risk Assessment

Evidence – Climate change and DO



Policy background (WRP Guideline Principles)

The Water White Paper identifies policy priorities:

> A long term perspective

> Water scarcity and environmental damage

> Water trading

> Reducing demand for water

The 25 year planning horizon….”does not constrain companies from taking a longer term view where it is appropriate to do **so…it is important that the water resources management plans are resilient to a range of potential climate scenarios and are designed with climate risks built in.”**

Our approach (following the EA CC & WSP project)

Vulnerability Assessment
- Understand sensitivity to climate

Climate change assessment
- Make full use of UKCP09 or Future Flows

Headroom
- Clear & consistent approach to CC

Decision making
- Check plan is robust to range of CC scenarios

DO assessment – general view of levels of detail

Climate change projections

UKCP09 Rapid Assessment (5-20) → Future Flows (11) →UKCP09 (20 to 1000s)

Flow Factors | **Hydrological / hydrogeological modelling**

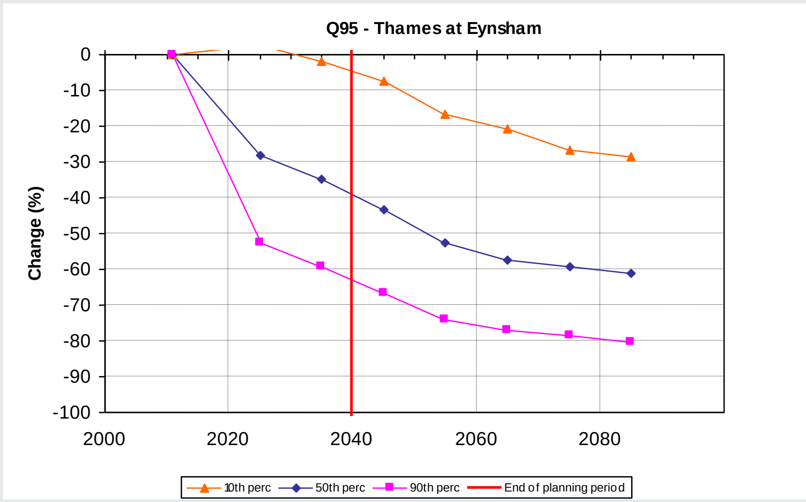
Use flow factors or climate change factors or transient climate data in models (5 to 1000s)

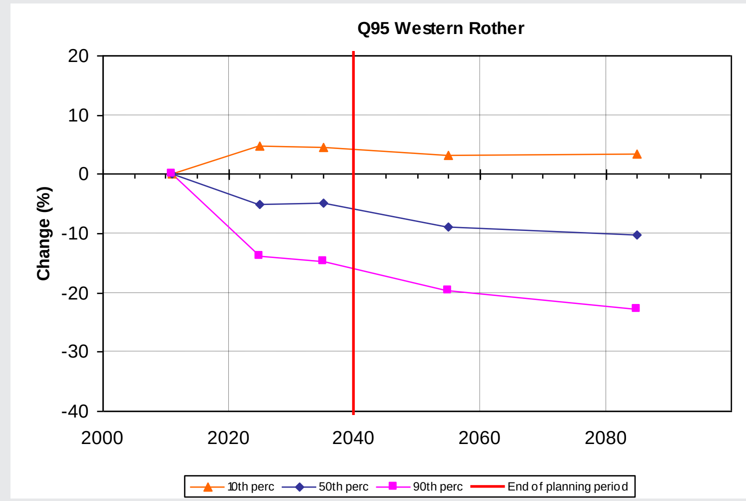
Water resources system modelling (LoS)

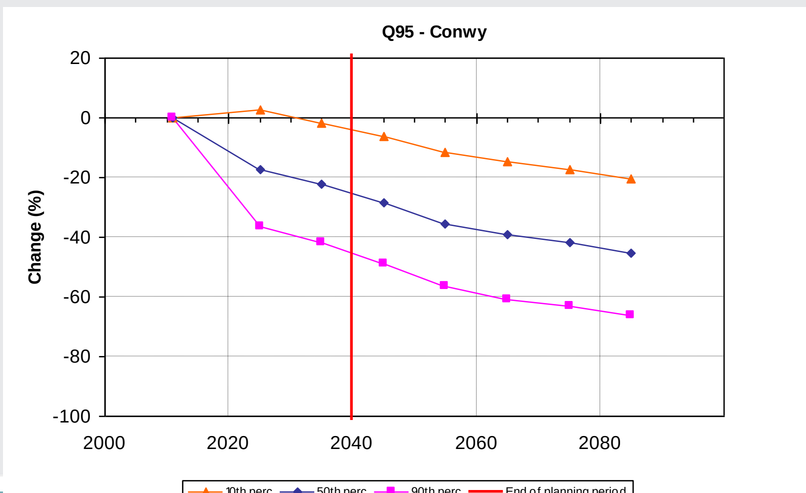
Use all scenarios (or a subset?) in water resources zone models

Trajectories of climate change impacts

Q95 based on UKCP09 scenarios







Groundwater issues (EA CC WSP project)

Groundwater DO assessment presents some difficulties

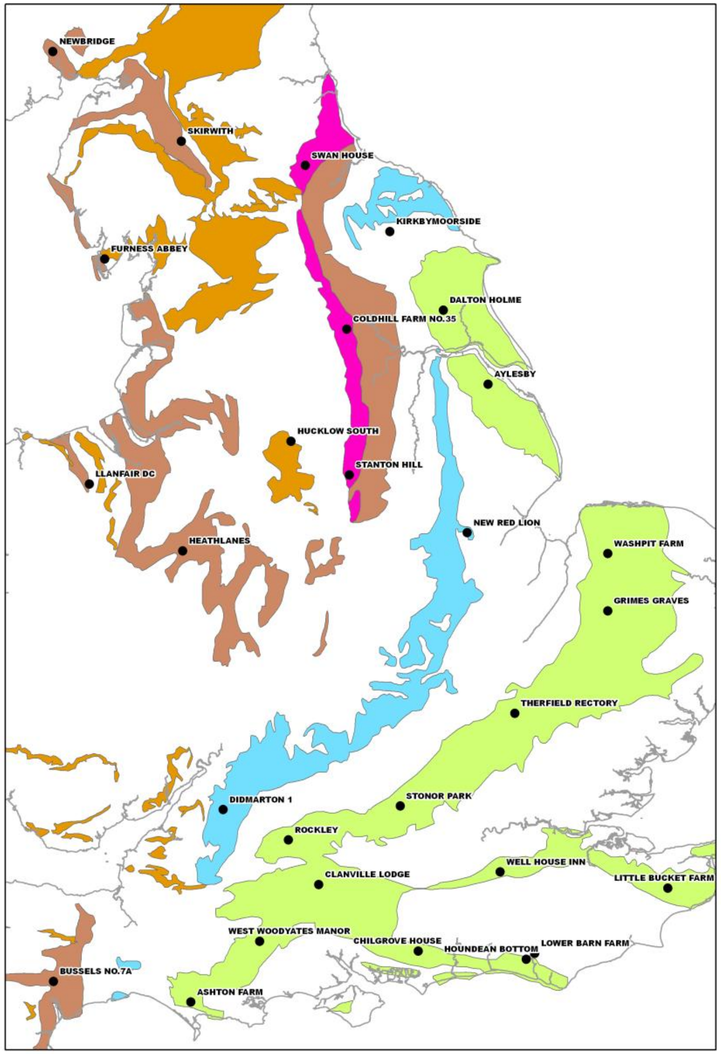
> Running lots of runs through distributed models and translating to many sources is not practical

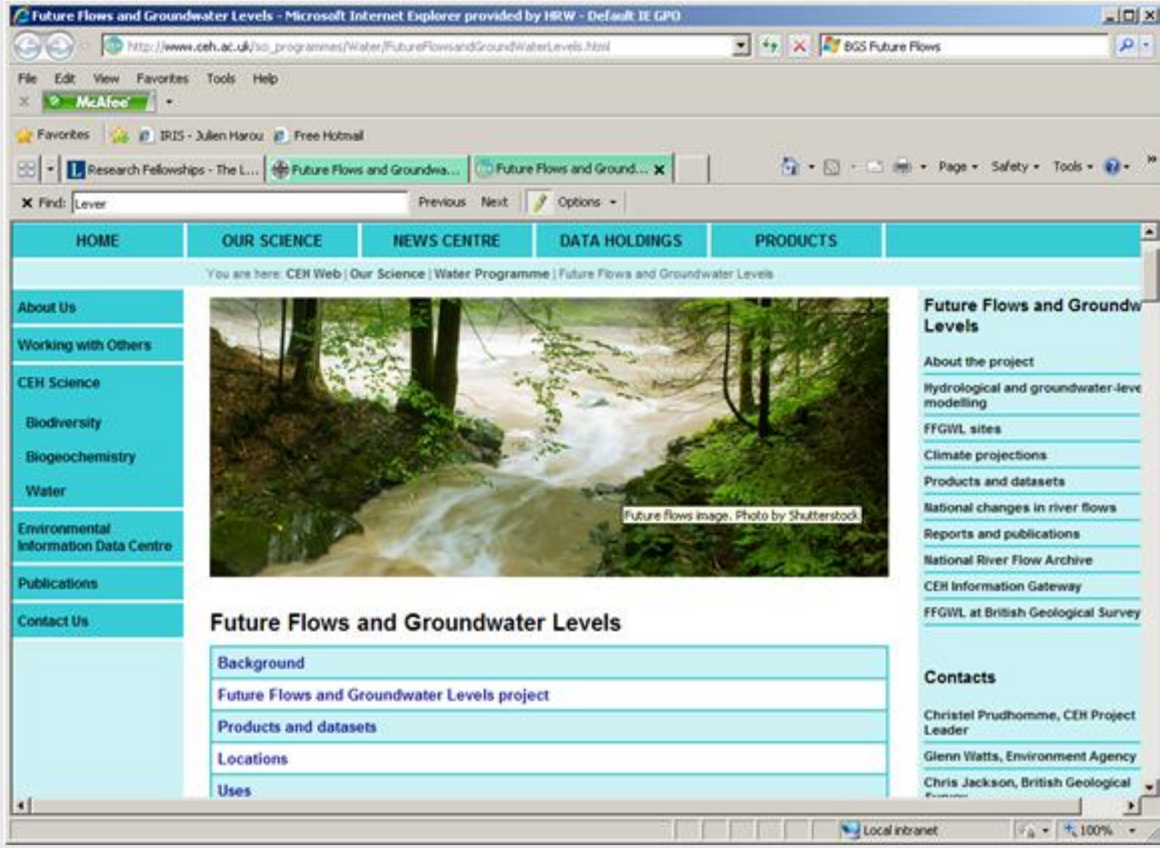
> Intermediate vulnerability method may have limitations – similar to the former GR1 method

> However modelling recharge is straightforward using FA0 56 or similar methods

Some pragmatism and innovation needed

NERC “Future Flows” data sets for 24 groundwater observation boreholes





http://www.bgs.ac.uk/research/groundwater/change/FutureFlows/sites.html

http://www.ceh.ac.uk/sci_programmes/Water/FutureFlowsandGroundWaterLevels.html

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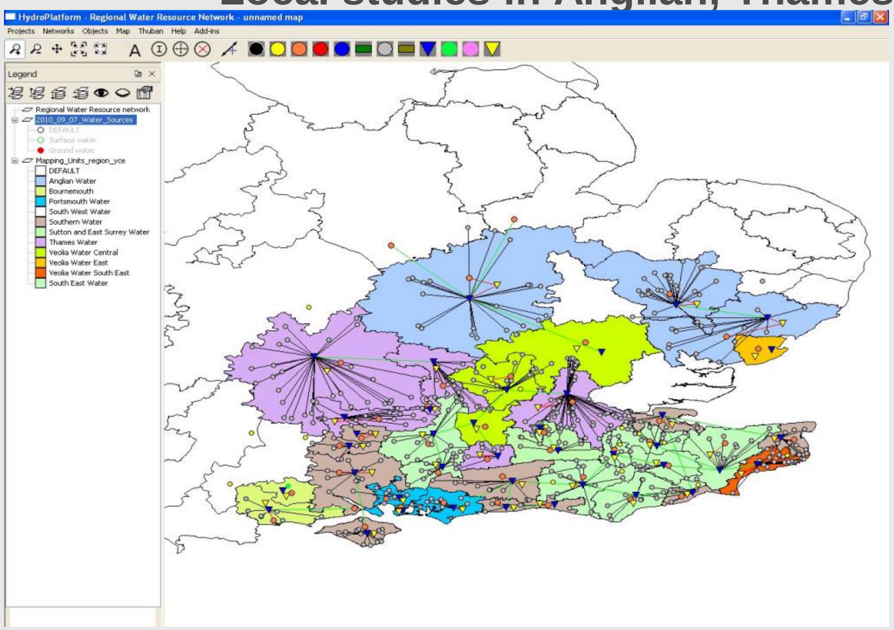
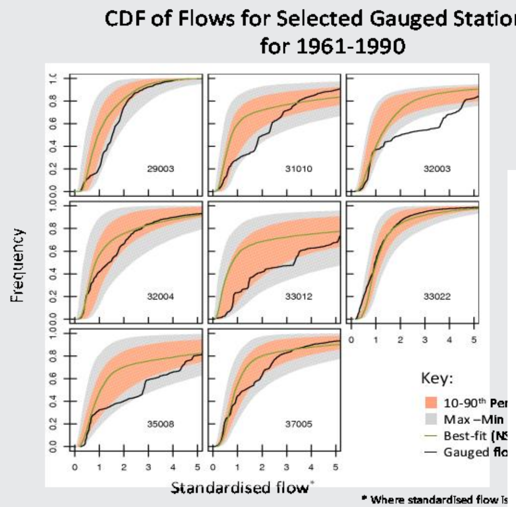
ARCC-Water Project

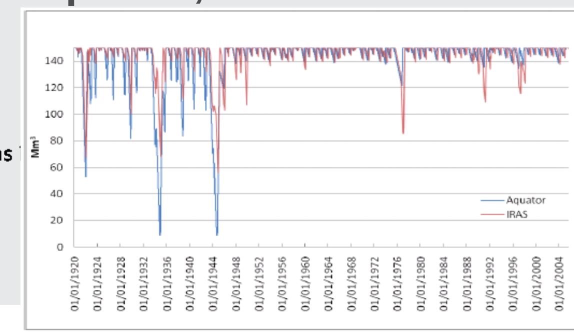
Adaptive and Resilient Water Systems

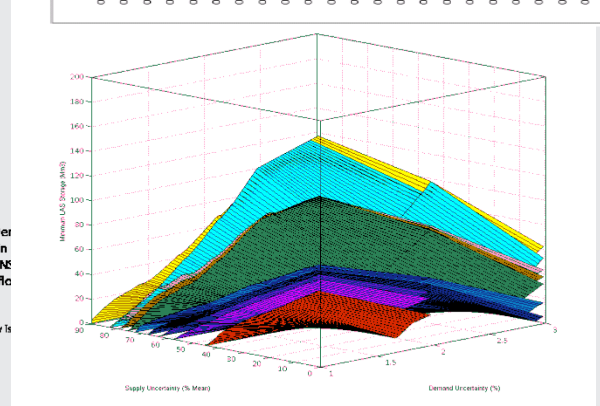
EPSRC/ESRC-funded research into Water Resources Planning

- **Ensemble of correlated, spatially coherent climatic projections for South-East**
- **Regional Water System Model (RWSM) using IRAS-2010**
- **Ensemble modelling of climate change impacts on water availability**
- **Demand projections – informed by customer surveys, analysis and workshops**
- **Multi-criteria robust decision-making to identify system vulnerabilities and test alternative strategies (demand and supply side) – RDM, Real-Options, Info-GAP**
- **Local studies in Anglian, Thames and Southern regions**









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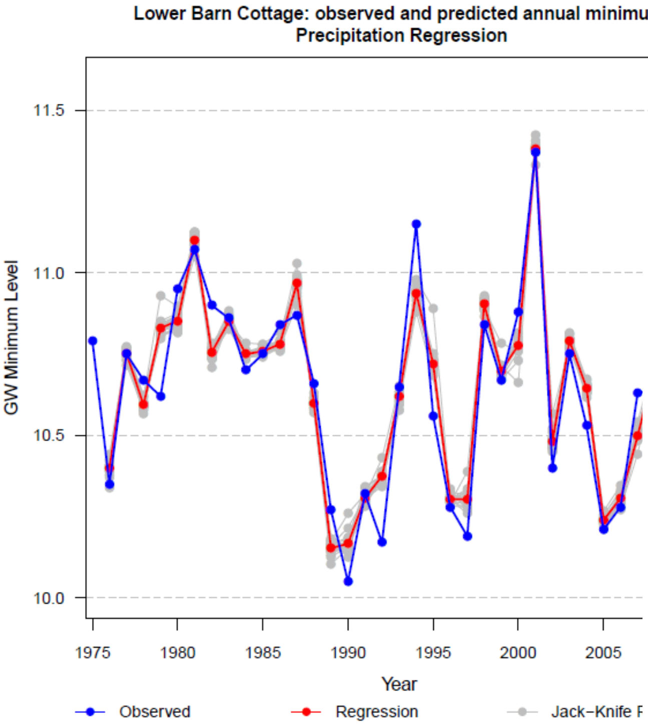
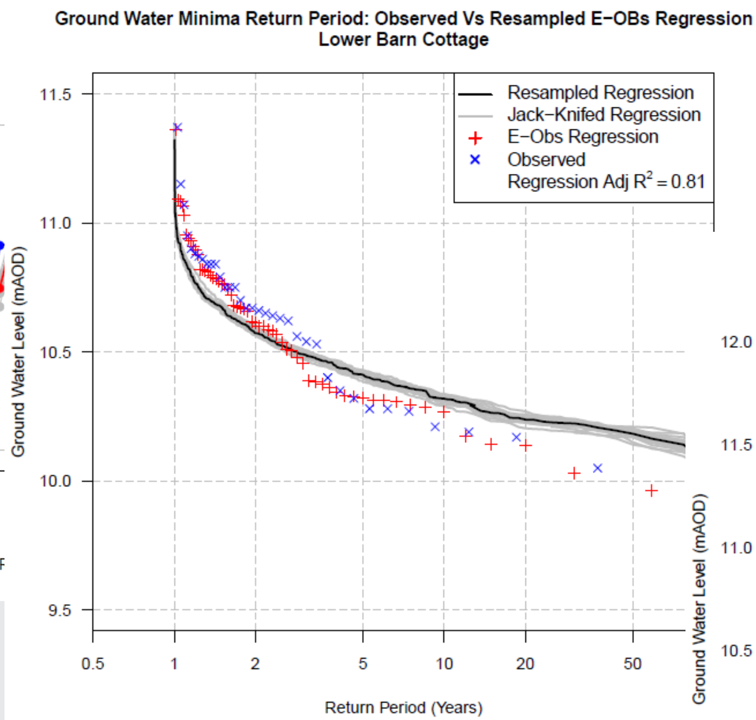
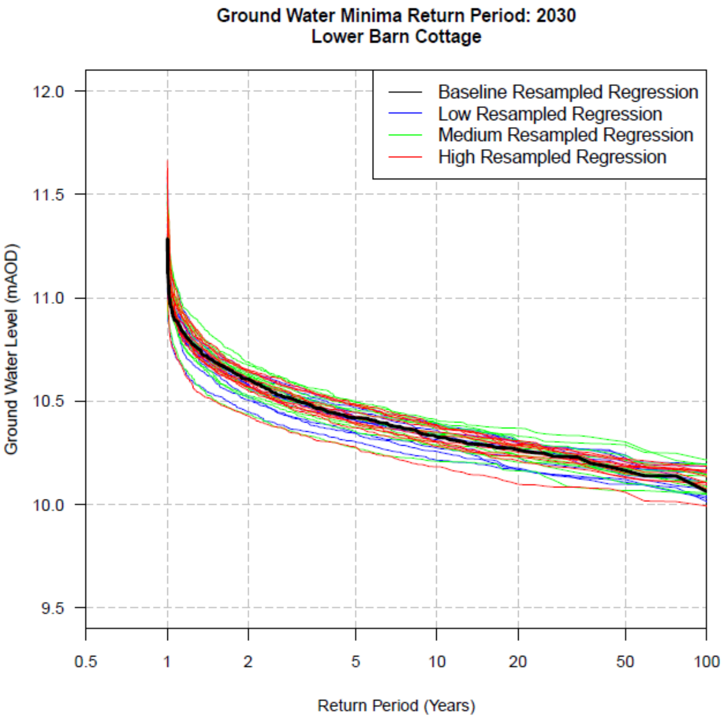
Simple groundwater level modelling approach for 45 sites in SE England





Estimation of future levels using UKCP09 SCPs and resampling methods



Multiple Linear Regression Groundwater level versus monthly recharge

Return Period Analysis

Recharge estimate based on FAO method

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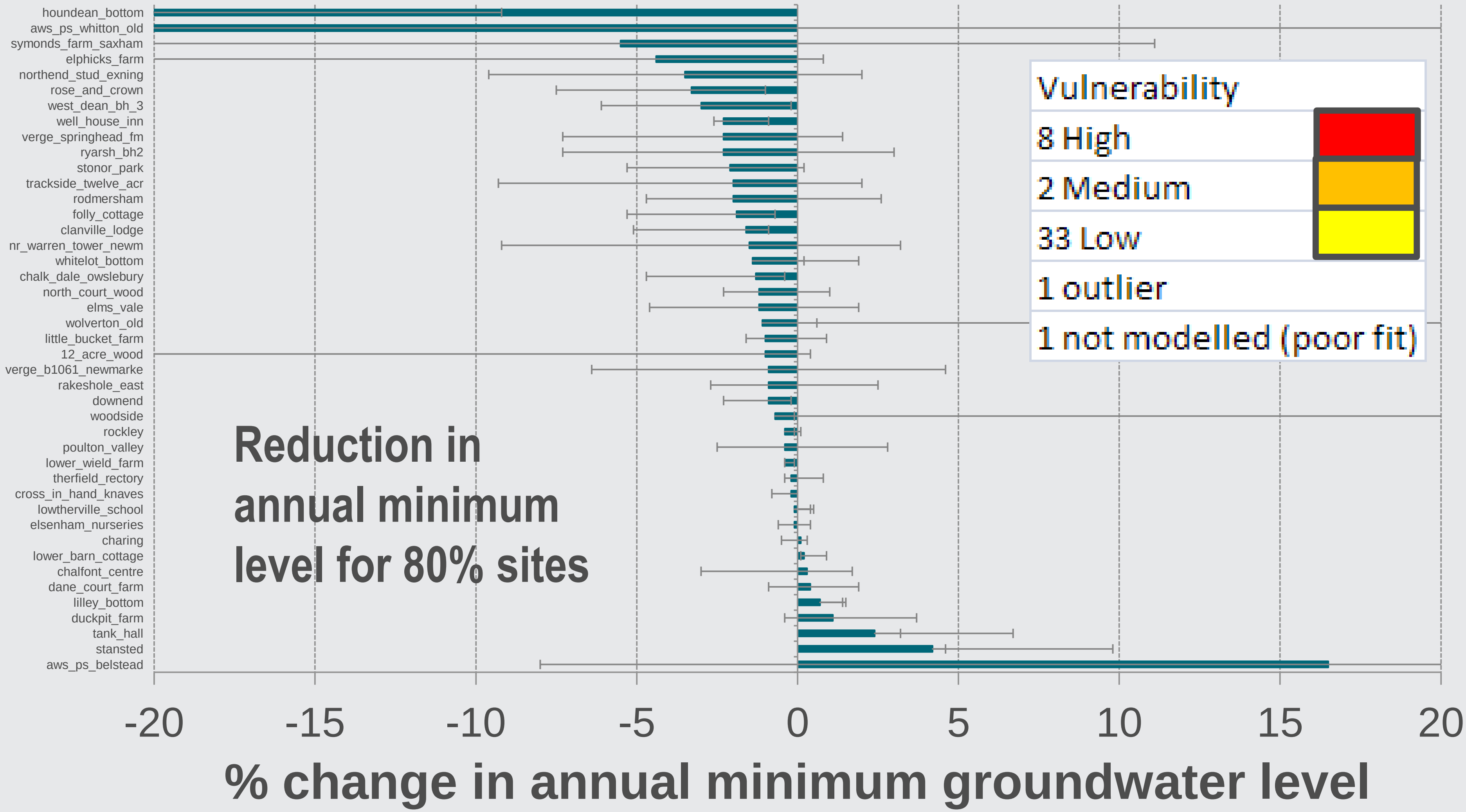
Simple groundwater level modelling 2030s Medium Emissions climate



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Comparison with Future Flows modelled groundwater levels for 6 sites

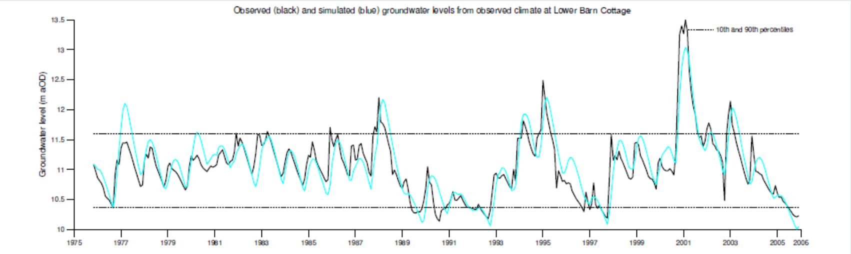


Figure Error! No text of specified style in document..**1 Lower Barn Cottage: FFGWL comparison of observed record (black) and R-Groundwater simulated (cyan). Taken from FFGWL fact sheet for Lower Barn Cottage.**

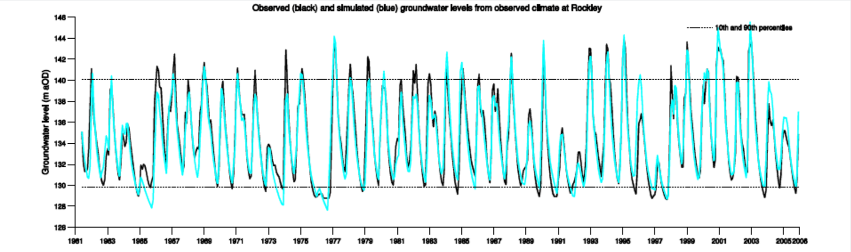


Figure Error! No text of specified style in document..**2 Rockley: FFGWL comparison of observed record (black) and R-Groundwater simulated (cyan). Taken from FFGWL fact sheet for Rockley.**

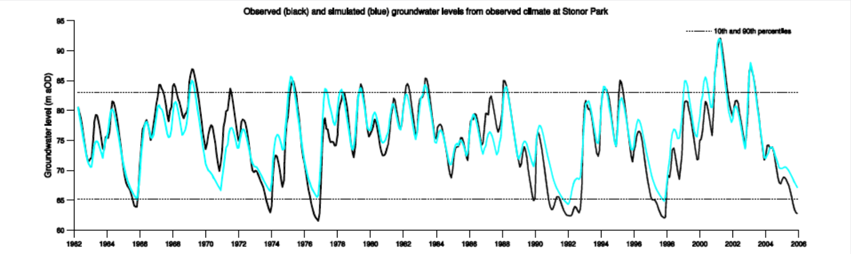


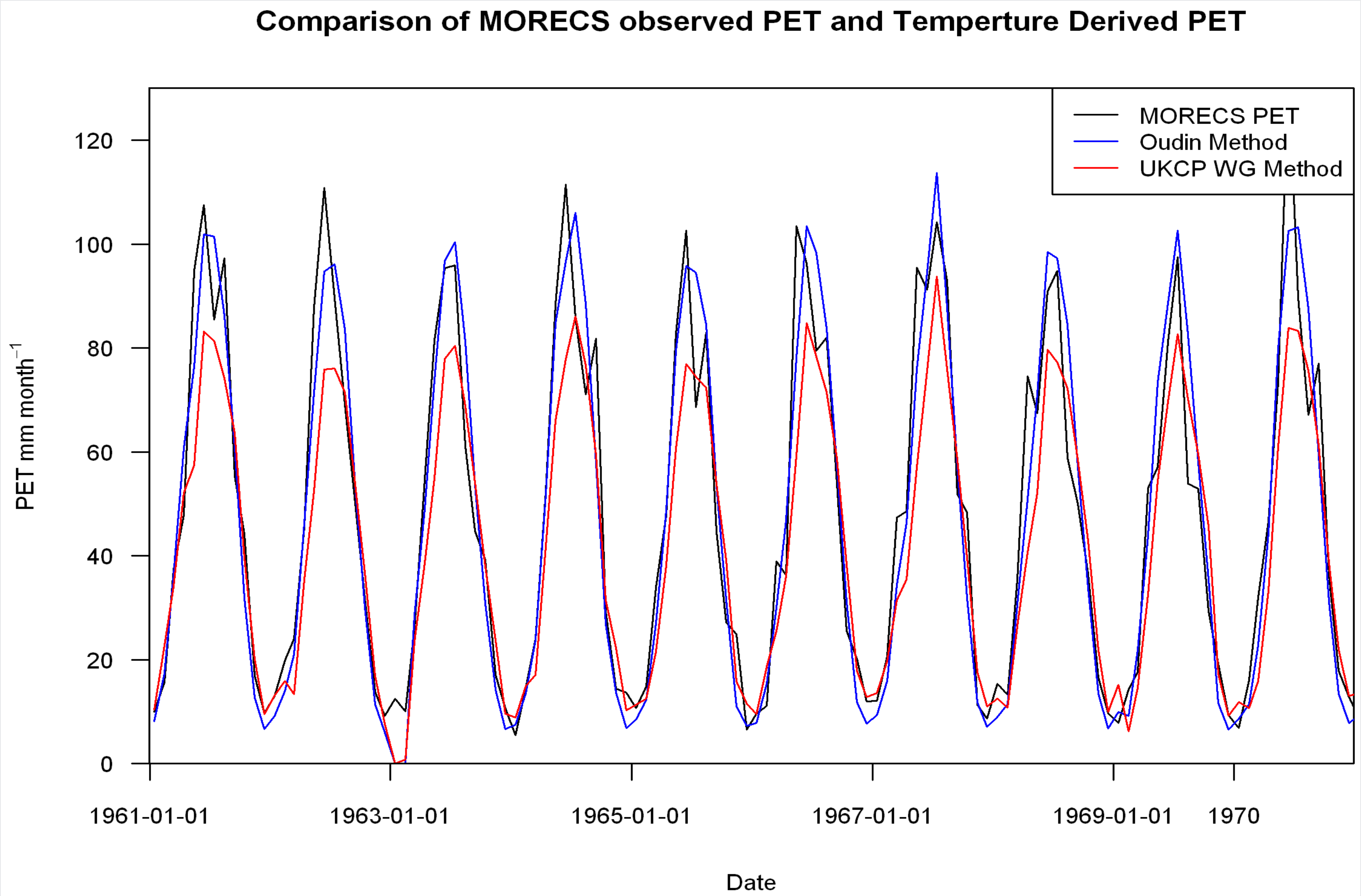
Figure Error! No text of specified style in document..**3 Stonor Park: FFGWL comparison of observed record (black) and R-Groundwater simulated (cyan). Taken from FFGWL fact sheet for Stonor Park.**

Comparison with other published models shows a similar level of performance and that all models struggle with reproducing levels (and by inference DOs) in the same drought years

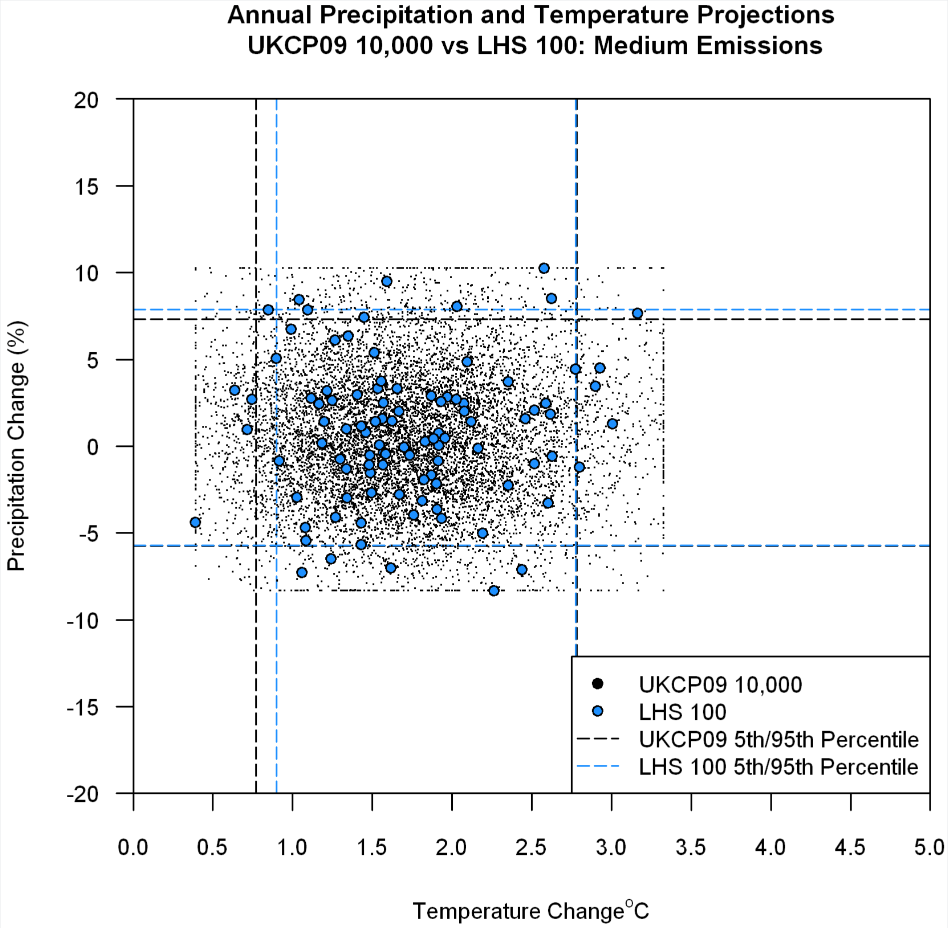
Prudhomme, C, Dadson, S, Morris, D, Williamson, J, Goodsell, G, Crooks, S, Boelee, L, Davies, H, Buys, G, Lafon, T. 2012. 'Future Flows Climate', http://dx.doi.org/10.5285/bad1514f-119e-44a4-8e1e-442735bb9797

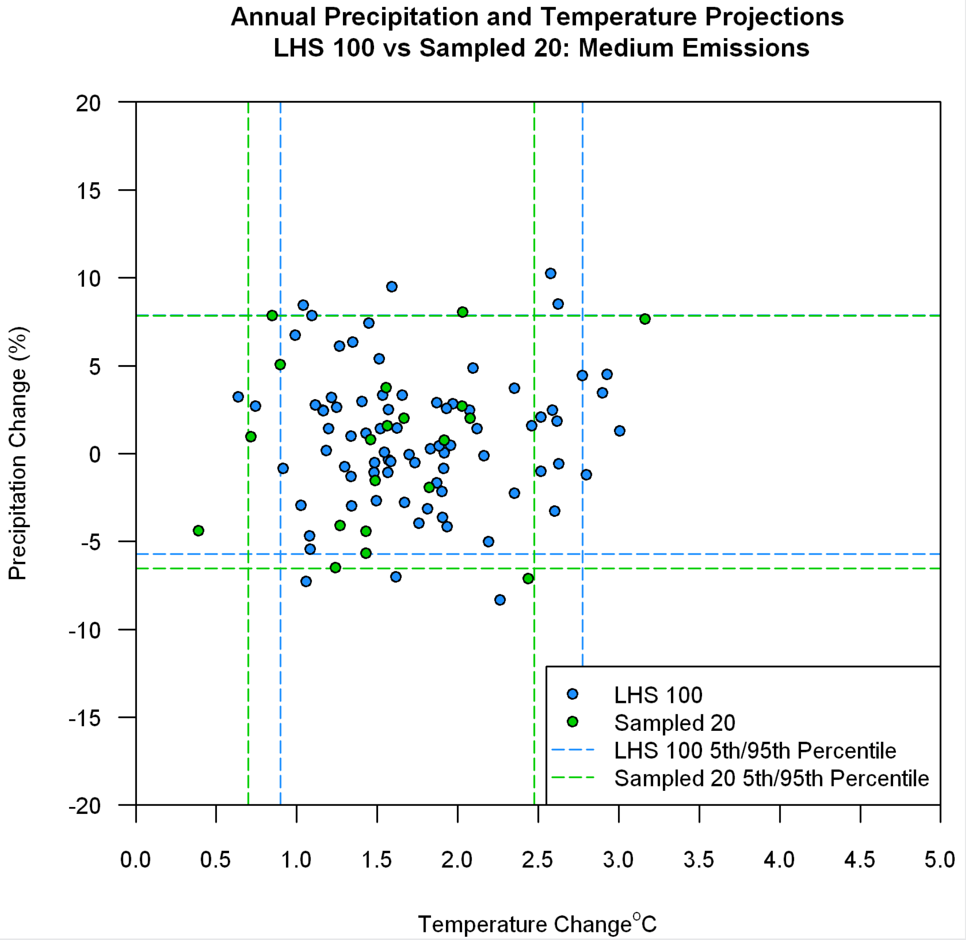
Haxton, T, Crooks, S, Jackson, C R, Barkwith, A K A P, Kelvin, J, Williamson, J, Mackay, J D, Davies, H, Young, A, Prudhomme, C. 2012. 'Future Flows Hydrology', http://dx.doi.org/10.5285/f3723162-4fed-4d9d-92c6-dd17412fa37b

Water resources planning
Practical use of UKCP09 – PET

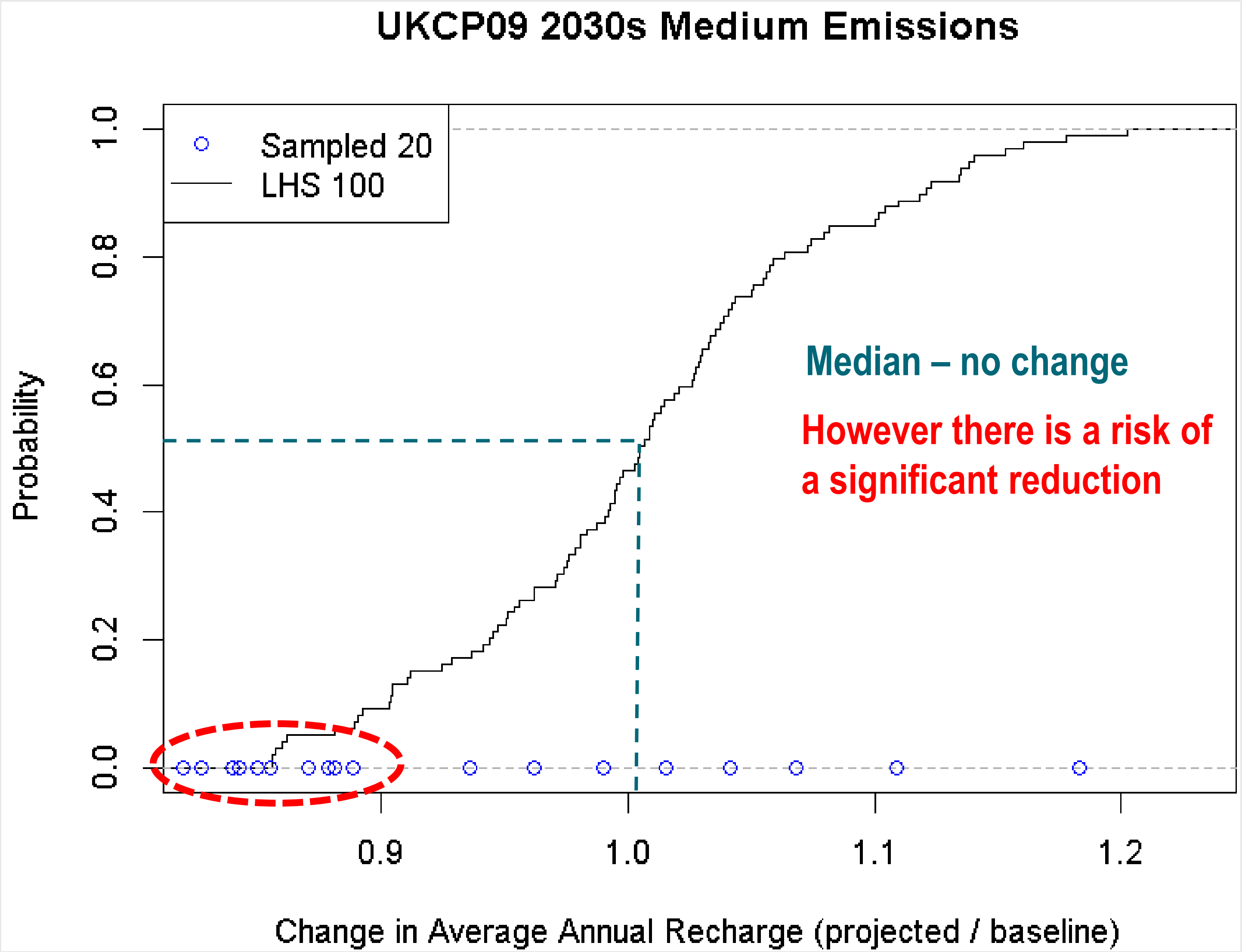


Water Resources Planning: Practical use of UKCP09 - Sampling methods





Practical use of UKCP09 - Sampling methods based on recharge



Conclusions on climate change and groundwater

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Impacts on water resources and groundwater

> Climate change may have a significant impact on the supply-demand balance in England by the 2030s

> Groundwater impacts are evident in 80% of sites modelled in SE England; changes in average annual minima are small< 5%

> Groundwater could be an important part of adaptation to climate change; demand side measures are not enough on their own

For better assessments we need

> Improved data on source performance under drought conditions, possibly source works models

> Better access to existing EA groundwater models

> A step change in modelling speed

Conclusions

Vulnerability and DO assessment