My Climate Risk Interdisciplinary Learning Group

Prof. David Stainforth, London School of Economics
and University of Warwick

Walker Institute

14th October 2024

Grantham Research Institute on Climate Change and the Environment
The Grantham Foundation for the Protection of the Environment
The University of Warwick
LSE The London School of Economics and Political Science

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A

Phil. Trans. R. Soc. A (2007) **365**, 2163–2177
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Published online 14 June 2007

Issues in the interpretation of climate model ensembles to inform decisions

By David A. Stainforth[1,3,*], Thomas E. Downing[2], Richard Washington[4], Ana Lopez[1] and Mark New[4]

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nature climate change

PERSPECTIVE

PUBLISHED ONLINE: 28 JANUARY 2015 | DOI: 10.1038/NCLIMATE2450

Tales of future weather

W. Hazeleger[1,2,3*], B.J.J.M. van den Hurk[1,4], E. Min[1], G.J. van Oldenborgh[1], A.C. Petersen[4,5], D.A. Stainforth[6,9,10], E. Vasileiadou[4,8] and L.A. Smith[6,7]

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[6]*Department of Earth Sciences, The Open University, Milton Keynes MK7 6AA, UK*
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The 2,578 simulations contain 2,017 unique simulations (duplicates are used to verify the experimental design—see Methods). Figure 1a shows the grand ensemble frequency distribution of global mean, annual mean, near-surface temperature (T_g) in these 2,017 simulations, as it develops through each phase. Some model versions show substantial drifts in the control phase owing to the use of a simplified ocean (see Supplementary Information). We remove unstable simulations (see Methods) and average over initial-condition ensembles of identical model versions to reduce sampling uncertainty. The frequency distribution of initial-condition-ensemble-mean time series of T_g for the resulting 414 model versions (for which the initial-condition ensembles involve 1,148

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LETTER

Building narratives to characterise uncertainty in regional climate change through expert elicitation

Suraje Dessai[1,8], Ajay Bhave[1,2], Cathryn Birch[1,3], Declan Conway[2], Luis Garcia-Carreras[4], John Paul Gosling[5], Neha Mittal[1] and David Stainforth[2,6,7]

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AGU PUBLICATIONS

Water Resources Research

RESEARCH ARTICLE
10.1002/2017WR020970

Special Section:
Engagement, Communication, and Decision-Making Under Uncertainty

Water Resource Planning Under Future Climate and Socioeconomic Uncertainty in the Cauvery River Basin in Karnataka, India

Ajay Gajanan Bhave[1,2], Declan Conway[1], Suraje Dessai[2], and David A. Stainforth[1,3,4]

[1]London School of Economics and Political Science, Grantham Research Institute on Climate Change and the Environment, London, UK, [2]Sustainability Research Institute and ESRC Centre for Climate Change Economics and Policy, School of Earth and Environment, University of Leeds, Leeds, UK, [3]London School of Economics and Political Science, Centre for the Analysis of Time Series, London, UK, [4]Department of Physics, University of Warwick, Coventry, UK

Key Points:

- An iterative approach combining qualitative and quantitative methods is used to assess robustness of


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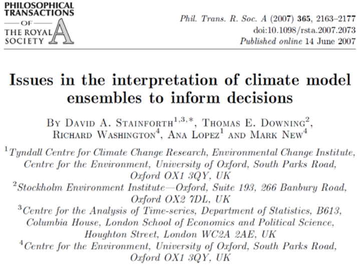
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LETTER

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Distribution of Climate Sensitivity from a perturbed-parameter ensemble

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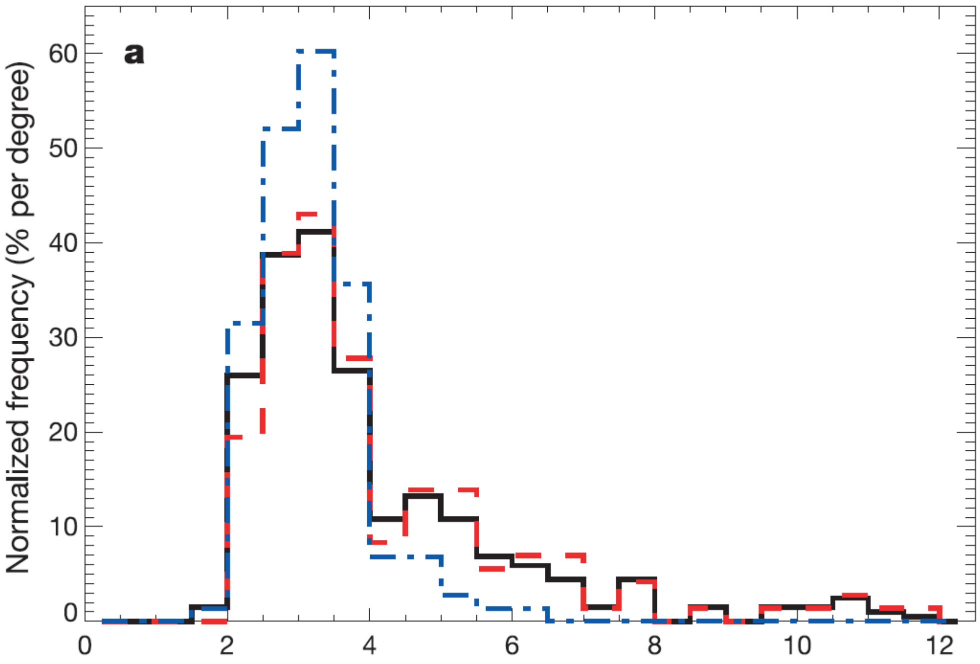
"The shape of the distribution is determined by the parameters selected for perturbation and the perturbed values chosen, which were relatively arbitrary."

"In our case even the physical interpretation of many of these parameters is ambiguous."

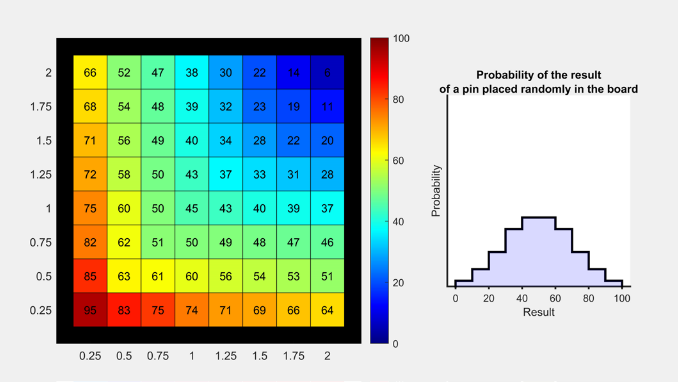


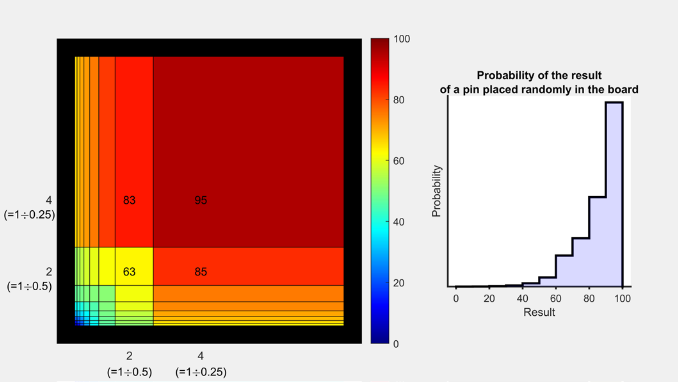
Stainforth et al., Nature, 2005

Challenge: How can we relate models and reality?

- A probability distribution across different models is fundamentally arbitrary because we have no metric for the space of possible models.

- Even a distribution across a perturbed parameter ensemble is arbitrary because the parameter space is not defined.





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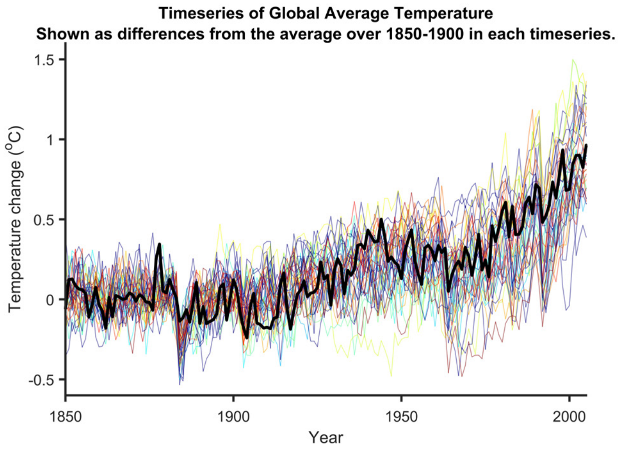
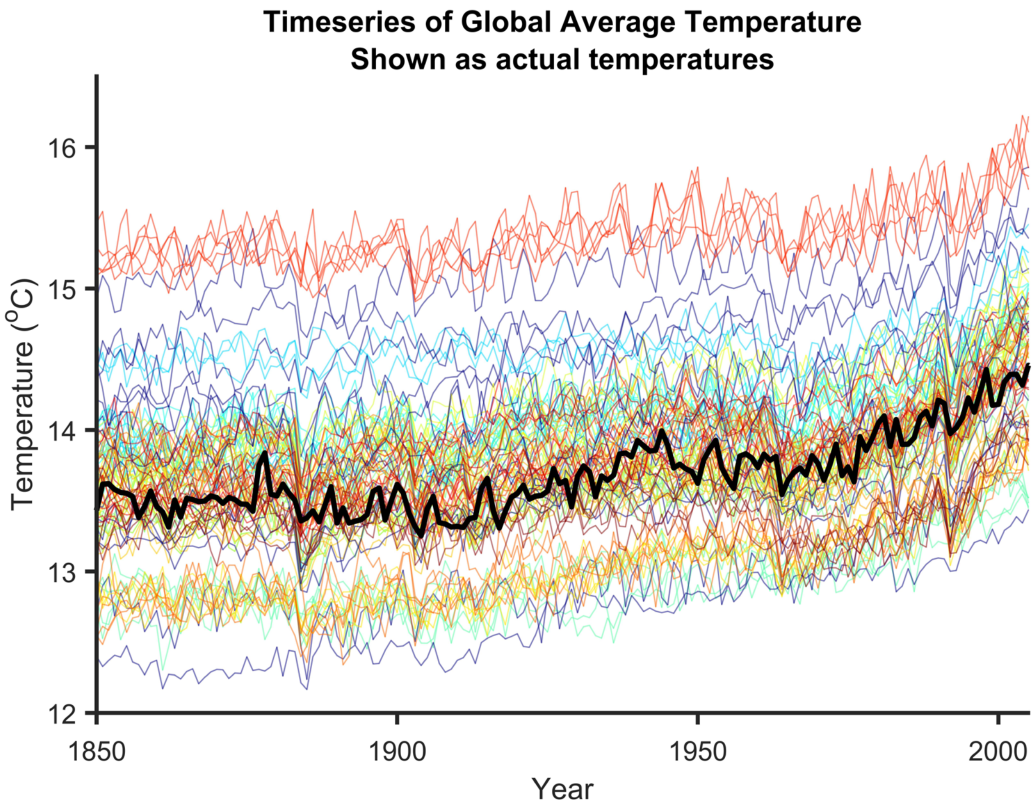
All models are substantially different to reality.





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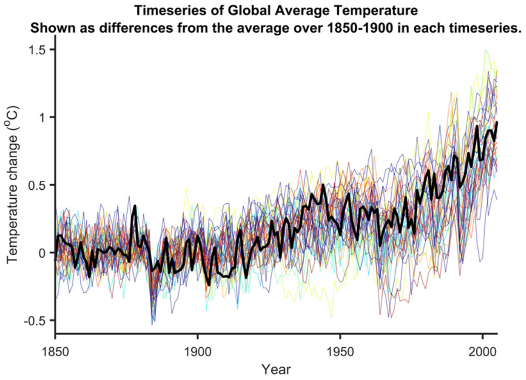

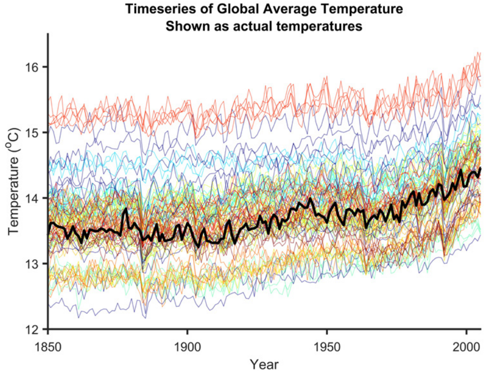

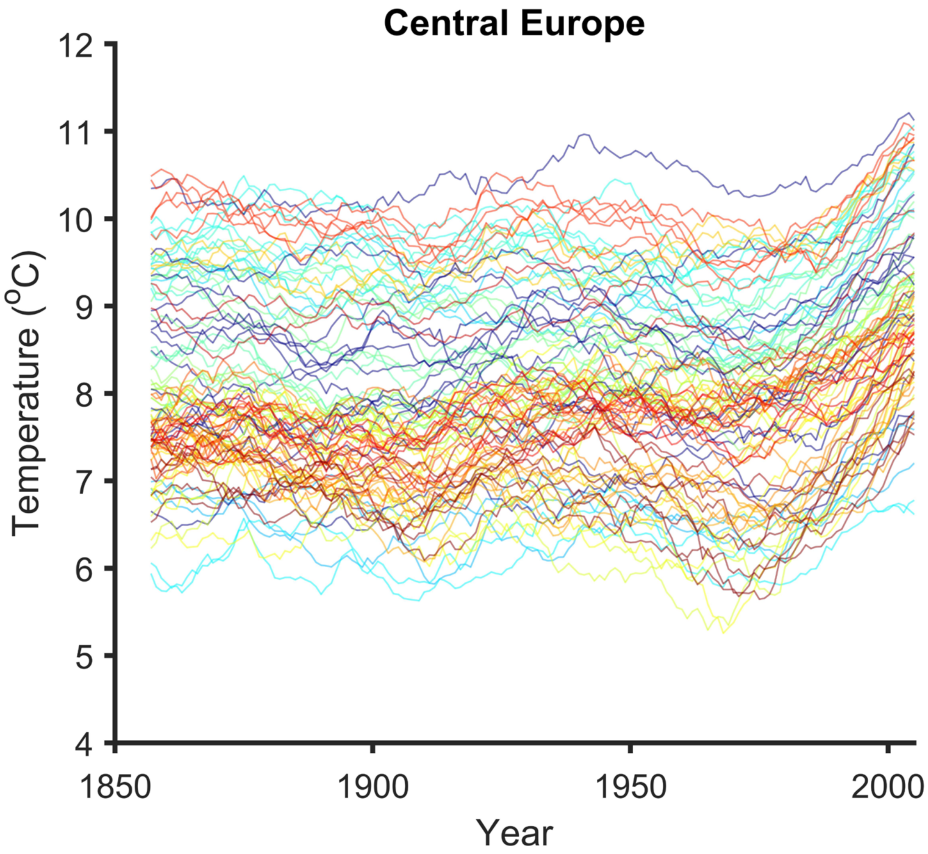

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Chasing better models is unlikely to be fruitful at the moment.

- We don’t know what we’re aiming for.
  We haven’t studied the question: when would a model be good enough to answer the questions we’re asking.

- We have no means of forecast verification so we rely on model fidelity.

Non-discountable Envelopes
Lower Bounds on the Maximum Range of Uncertainty

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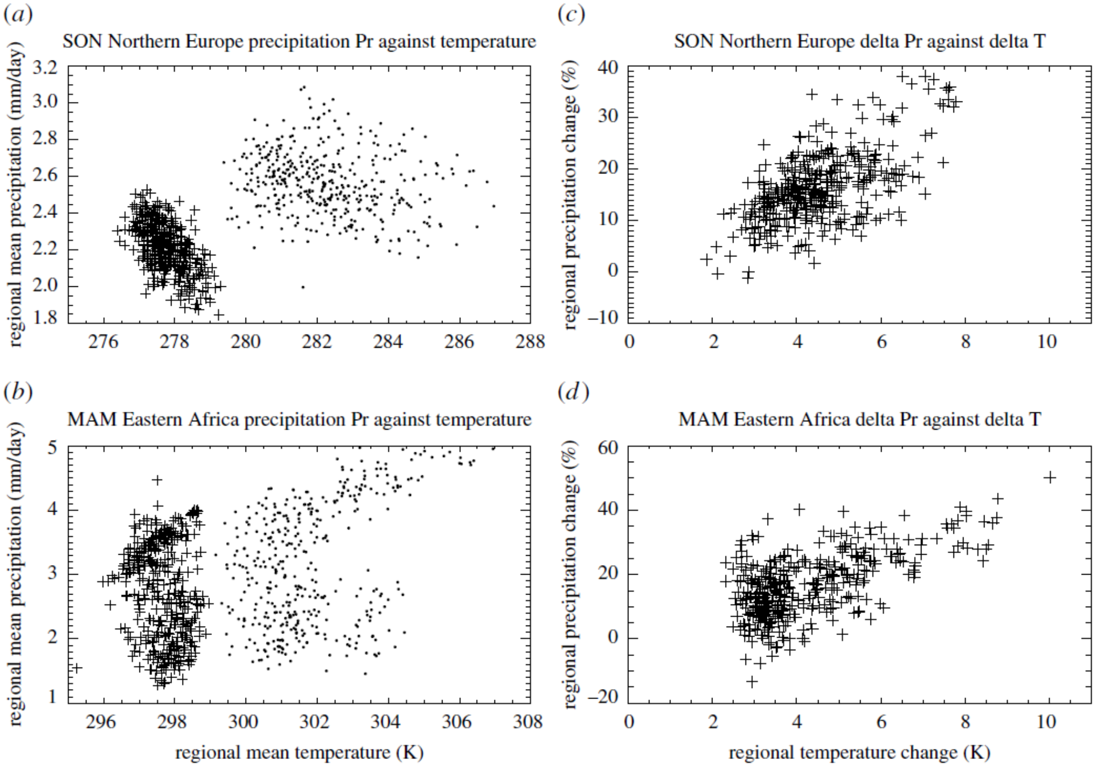

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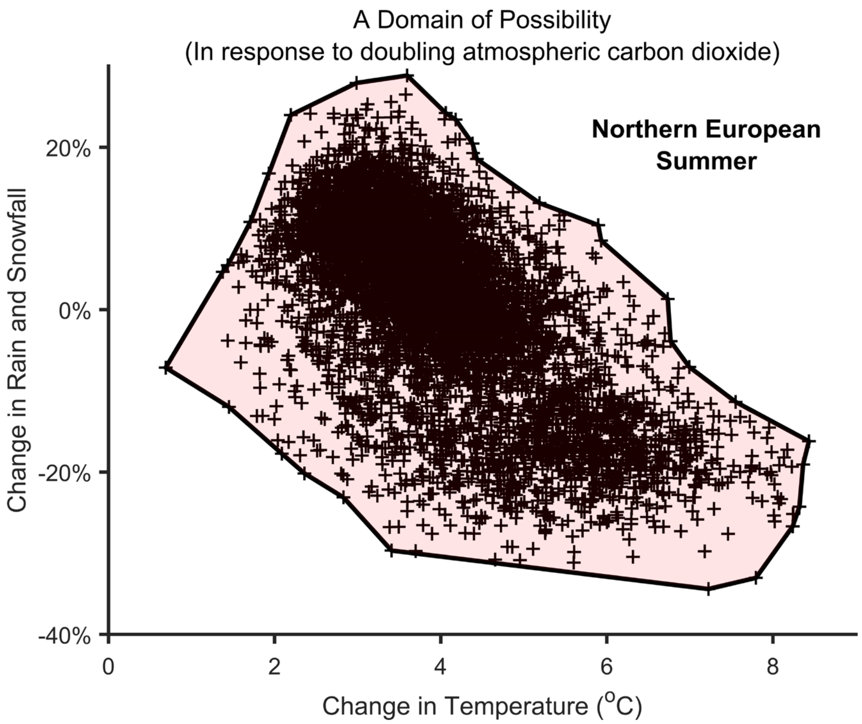

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Non-discountable Envelopes
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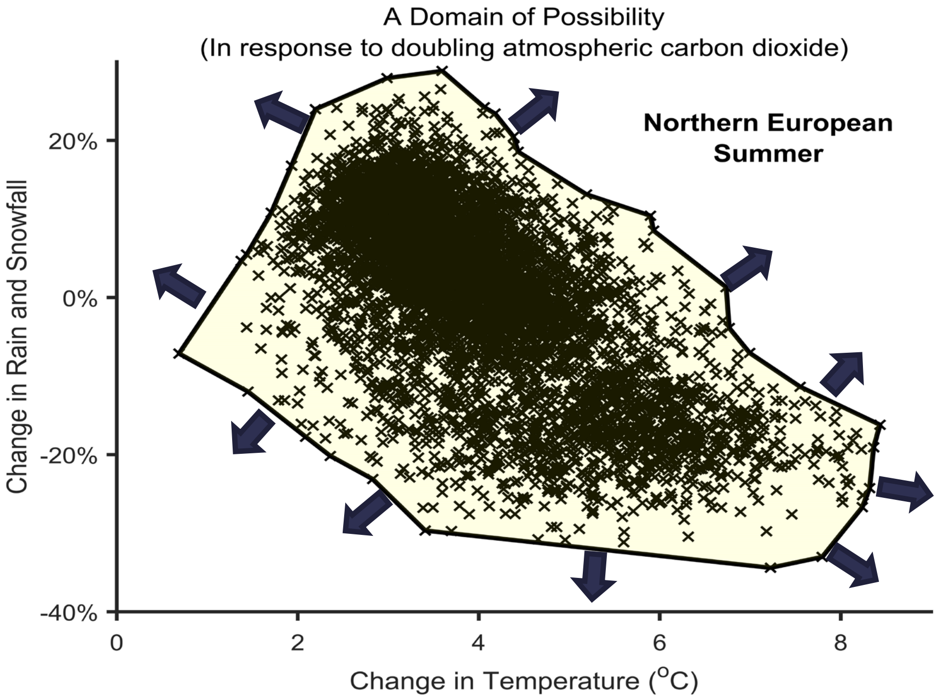

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Storylines as a route to identifying possible futures

nature climate change

PERSPECTIVE

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Tales of future weather

W. Hazeleger[1,2,3]*, B.J.J.M. van den Hurk[1,4], E. Min[1], G.J. van Oldenborgh[1], A.C. Petersen[4,5], D.A. Stainforth[6,9,10], E. Vasileiadou[4,8] and L.A. Smith[6,7]

Society is vulnerable to extreme weather events and, by extension, to human impacts on future events. As climate changes weather patterns will change. The search is on for more effective methodologies to aid decision-makers both in mitigation to avoid climate change and in adaptation to changes. The traditional approach uses ensembles of climate model simulations, statistical bias correction, downscaling to the spatial and temporal scales relevant to decision-makers, and then translation into quantities of interest. The veracity of this approach cannot be tested, and it faces in-principle challenges. Alternatively, numerical weather prediction models in a hypothetical climate setting can provide tailored narratives of high-resolution simulations of high-impact weather in a future climate. This 'tales of future weather' approach will aid in the interpretation of lower-resolution simulations. Arguably, it potentially provides complementary, more realistic and more physically consistent pictures of what future weather might look like.

How might one construct Tales to inform adaptation decisions and mitigation policy? The use of global high-resolution atmosphere models that resolve the synoptic scales (model grid-spacing is currently about 10 km and is expected to improve in the near term) — the reliability of which are well understood within the frame of numerical weather prediction — allows a more physically coherent expression of what weather in an altered climate could feel and look like[25]. It is possible to provide a limited set of future weather scenarios that explore a range of plausible realizations of future climate. The scenarios are imposed onto the boundary conditions (sea surface temperatures, atmospheric composition, land use and so on) of a high-resolution model. The boundary conditions may be obtained from traditional coupled climate model simulations of future climate, but they could equally well be inspired by other sources, including palaeoclimate data, sensitivity experiments with coupled models, archives of past meteorological analyses and forecasts, or even simple constructions of physically credible possibilities. The synoptic patterns related to the 2003 heat wave or the 2013 floods in Europe, for instance, could be simulated repeatedly using expert-elicited patterns of changes in sea surface temperatures and radiative forcing representative of a warmer world. In this way a wider range of plausible realizations of an alternative climate can be considered than with traditional coupled climate model experiments.

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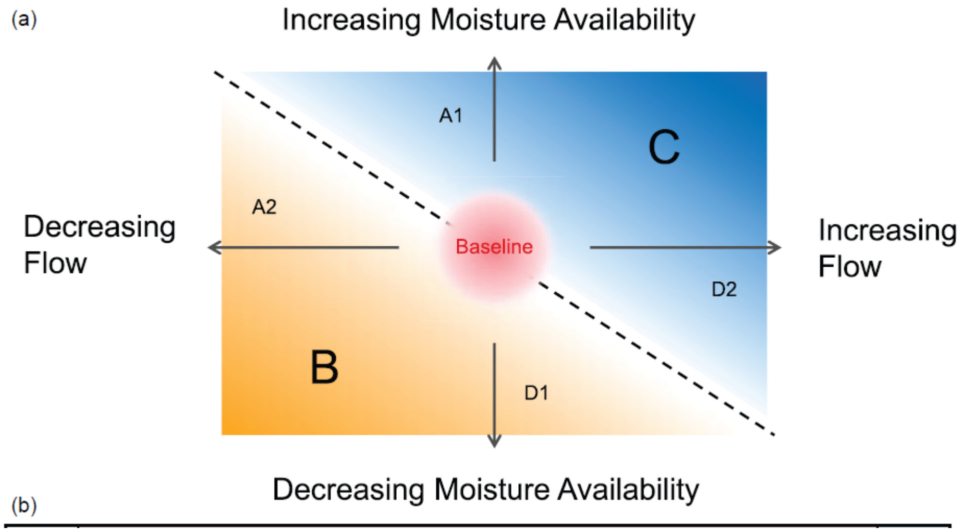
Storylines /Narratives
Use imagination constrained by physical understanding to provide a range of credible futures



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Building narratives to characterise uncertainty in regional climate change through expert elicitation

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Questions / Debate

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