Assessing the quality of regional climate information: the case of the UK Climate Projections 2018

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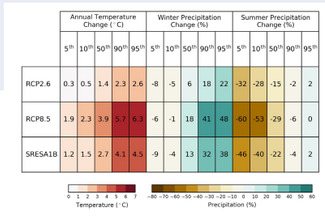
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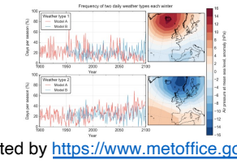
Why we need a quality assessment framework: (for references and full arguments see Baldissera Pacchetti et al. (2021) https://doi.org/10.1175/BAMS-D-20-0008.1):
Long-term regional climate information is increasingly important for making adaptation decisions, but it is difficult to assess: the non-stationarity of the system and the time scales of forward-looking model simulations imply that these simulations cannot be verified, the nature and scope of ensemble experiments is not clearly defined, excessive focus on uncertainty quantification risks being misleading, and it is not always clear that there is an escape from "model land", i.e., statements from models about models, rather than statements from models about the world. The related uncertainty makes a quality framework an important tool given the high stakes of climate change adaptation decisions.

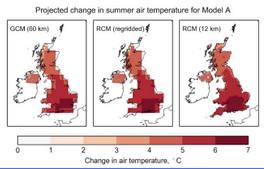
Example of state-of-the-art regional climate information

UK Climate Projections 2018 (UKCP18) Land Projections

Probabilistic Projectionsi noticed some	Global (60km) Projections	Regional (12km) Projections
• Probabilistic Uncertainty Assessments. • Similar Set of Variables as UKCP09. • Presented at seasonal timescales.	• Wide range of daily variables and metrics • Analysis at different geographical locations simultaneously	
	• Large scale extremes information. • Analysis back to 1900. • Information on international risks that could impact on the UK. • Analysis of drivers of climate change at the global scale.	• Enhanced spatial detail. • Improved simulation of extremes on daily and shorter timescales. • Analysis of drivers of climate change at the European scale.





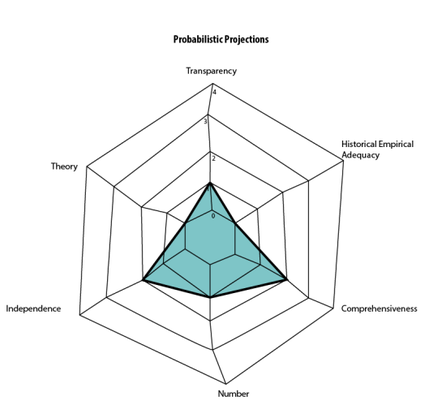


Characteristics of UKCP18 Land Projections as presented by https://www.metoffice.gov.uk/

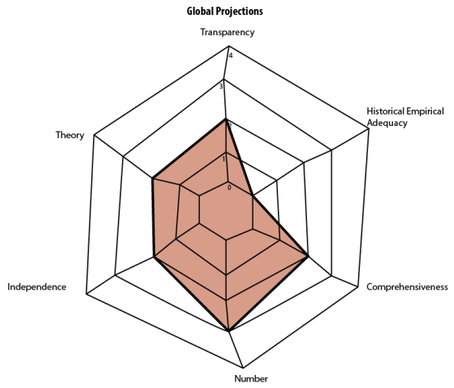
Quality assessment framework adapted from Baldissera Pacchetti et al. (2021) https://doi.org/10.1175/BAMS-D-20-0008.1.

Quality dimension		What it does
Transparency		Assesses whether evidence and methodology are accessible and whether the other quality dimensions can be assessed.
Theory		Assesses the strength of the theoretical underpinning of the statement about future climate.
Diversity and Completeness	Independence	Assesses whether different types of evidence are independent from one another.
	Number	Assesses how many different types of evidence are taken into account.
	Comprehensiveness	Assesses whether individual lines of evidence are exhaustively explored.
Historical Empirical Adequacy		Assesses the empirical adequacy of the components relevant to the statement about future climate.

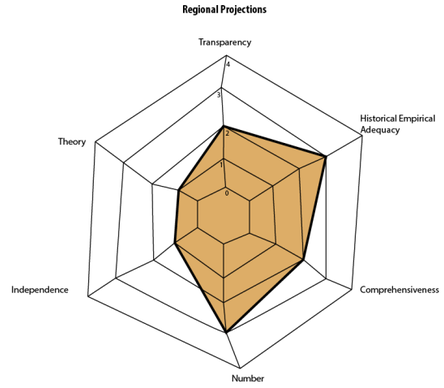
Key assessment results



- Extensive exploration of parameter uncertainty space.
- Low transparency.
- No theoretical justification for the method and consequences for quality.



- Analysis of some possible drives of climate change and use of multiple lines of evidence
- Model evaluation is shown on *anomalies* in the documents provided, not adequate for purpose where it can be assessed.



- Extensive empirical evaluation of model output (but only for selected periods).
- Little independence among multiple lines of evidence: all evidence is sourced from the same research center.

Full analysis in Baldissera Pacchetti et al. (submitted). Assessing the quality of regional climate information: the case of UKCP18. *Climatic Change.*

Key recommendations to improve UKCP18

Probabilistic Projections
- Improve transparency: more accessible references to evidence and methodology (e.g. expert elicitation?).
- Improve adequacy for purpose: independent empirical verification of probabilistic projections (e.g. hindcasts).
- Improve theory: clearer justification of consequences of key methodological assumptions, theoretical understanding of key phenomena.

Global Projections
- Improve adequacy for purpose: provide access to model performance with respect to absolute values of available variables.
- Improve transparency: include traceability of individual models in the user interface.
- Improve independence: source expert judgment for elicitation from a wider community of experts (beyond UK)

Regional Projections
- Improve independence and comprehensiveness: use models from different research centers.
- Improve theory: use and explain the limitations of different downscaling techniques.

Score.	Qualifier	Transparency	Theory	Diversity and Completeness			Historical Empirical Adequacy
				Independence	Number	Comprehensiveness	
0	Not satisfied	No access	No theoretical support that warrants X. Or Can't assess.	Only one type of evidence is taken into consideration to justify X. Or Can't assess	No (scientific) evidence is taken into consideration. Or Can't assess	No exploration of uncertainty within individual lines of evidence. Or Can't assess	No empirical tests (e.g. hincasts) for X. Or Can't assess
1	Minimally satisfied	Evidence and Methodology are mentioned but not well explained and not appropriately traceable.	Weak theoretical support that warrants X. (theoretical underpinning is weak, and doesn't justify the precision of X)	There is considerable overlap among the evidence.	Few of the available lines of evidence are taken into account.	Minimal exploration of uncertainty within individual lines of evidence.	Empirical tests are performed but only of few components relevant to X.
2	Somewhat satisfied	Evidence and methodology are somewhat accessible and traceable, but there are gaps.	Medium theoretical support that warrants X.	The evidence overlaps somewhat.	Multiple, but not most available lines of evidence are taken into account.	Partial exploration of uncertainty within individual lines of evidence.	Empirical tests are performed but not for all components relevant to X.
3	Generally satisfied	Evidence and methodology are well-explained, and all evidence is traceable.	Strong theoretical support that warrants X.	There is little overlap among sources of evidence.	Most available lines of evidence are taken into account.	Sufficient exploration of uncertainty within individual lines of evidence.	Extensive empirical tests are performed for all components relevant to X.
4	Satisfied	Evidence and methodology are well-explained, and all evidence is immediately available.	Theory unequivocally justifies X.	Completely independent types of evidence are taken into account.	All possible lines of evidence are taken into account.	Comprehensive exploration of uncertainty within individual lines of evidence.	All possible empirical tests for all components relevant to X.

[1] Components: model output for variable(s) of interest at the relevant spatial and temporal scale.