Award: ESRC Centre for Climate Change Economics and Policy
Project: Improving the use of evidence from climate models (CCCEP Phase 1)
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Overview of project aims

This project asks: what might we learn from today's climate models? This is a tremendously important question for the social science of climate change.

The evidence produced by complex computer simulation models has the capacity to make or break social scientific analysis, as well as the use of such information in decision-making by governments, businesses and households.

The hope is that adaptation planning will be informed by these predictions. Where does the balance lie?

The project is divided into two sections:

i) Interpreting climate models: climate science (L.A.Smith and Piers Forster)

This draws on computer science, physics and statistics to understand in detail the uncertainties in state-of-the-art climate models.

ii) Interpreting climate models (N. Cartright)

This applies the philosophy of science and the philosophy of social science to climate change modelling. It aims to understand and clarify the standards of evidence provided by climate models, linked to economic models, and to articulate the philosophical assumptions behind the predictive expectations projected on to these models.

Overview of data

- The research in this project has not generated new data so there has been no data to archive in ReShare.
- In relation to data, the research in this project can be placed in three categories:
    1. Research of a philosophical nature or perspective pieces which reflect on the procedures used in climate science and their relevance for policy. No data is used or generated.
    2. Research which uses simple nonlinear or statistical models to understand issues in climate model interpretation. The resulting publications provide details of the techniques used and the analysis often generates plots directly without producing data to archive.
    3. Research which involves analysis of the output of large ensembles of climate models which has been generated by other projects; often international projects. The responsibility for archiving this data lies with the projects that generate it.
- Philosophically oriented papers which fall into category 1 include 1,5,9,10,11,16,17 and 18.
- Those in category 2 include: 2,6,8,12,14. Several of these also have elements in category 1.
- Two papers (3, 15) use data from the Coupled Model Intercomparison Project version 3 (CMIP3) which is available in the UK from the Centre for Environmental data analysis (CEDA), http://archive.ceda.ac.uk/
- Two (4, 13) use data from the EU ENSEMBLES project. Directions to the various components of this dataset are collated at http://ensembles-eu.metoffice.com/.

- One (4) paper used data from the EU DEMETER project which is accessible from the European Centre from Medium Range Weather Forecasting (https://www.ecmwf.int/en/research/projects/demeter).
- Three papers (3,7,19) used data produced by the climateprediction.net project which is curated by that project (https://www.climateprediction.net/).

Links to other projects

This project is related to a broader programme of work at the Grantham Research Institute on Climate Change and the Environment, LSE, on decision-making under uncertainty and its implications for climate/environmental economics, under the *Changing Behaviour* programme.

CCCEP publications

After each publication there are details of: i) Acknowledgements (A) – no they aren't included or yes they are, ii) Data (D), iii) Authors (Au) – the role of CCCEP authors.

1. Wesselink, A., Challinor, A. J., Watson, J., Beven, K., Allen, I., Hanlon, H., Lopez, A., Lorenz, S., Otto, F., Morse, A., Rye, C., Saux-Picard, S., Stainforth, D. & Suckling, E. *Equipped to deal with uncertainty in climate and impacts predictions: lessons from internal peer review*. **Climatic Change** 132, 1-14, Sep 2015.[A: no – difficult with so many authors, Data: none to archive, Au: non-lead]
2. Daron J D and Stainforth D A, *On quantifying the climate of the nonautonomous Lorenz-63 model*, **Chaos,** 25, Apr 2015. [A: yes, D: simple model, no data to archive, Au: lead]
3. Lopez, A., Suckling, E.B., Otto, F.E.L., Lorenz, A., Rowlands, D. and Allen, M. (2014) 'Towards a typology for constrained climate model forecasts', *Climatic Change.*DOI:10.1007/s10584-014-1292-z. [A:yes, D: cmip3 and cpdn, Au: lead]
4. Smith, L.A., Du, H., Suckling, E.B. and Niehörster, F. (2014) 'Probabilistic skill in ensemble seasonal forecasts', *Quarterly Journal of the Royal Meteorological Society.*Vol. 141, Iss. 689. DOI:10.1002/qj.2403.[A: yes, D: DEMETER and ENSEMBLES, Au: lead]
5. Smith, L.A. and Petersen, A.C., (2014) 'Variations on reliability: connecting climate predictions to climate policy,' in Boumans, M., Hon, G. and Petersen, A.C. (ed.) *Error and Uncertainty in Scientific Practice*, London: Pickering & Chatto. 9 [A: No – it's a book, D: none, Au: lead]
6. Frigg, R., Bradley, S., Du, H. and Smith, L.A. (2014) 'Laplace's Demon and the adventures of his apprentices', *Philosophy of Science,* 81 (1) (January 2014), pp. 31-59.DOI: 10.1086/674416. [A: no – not an option in this journal, D: simple models only, Au: lead]
7. Lopez, A., Smith, L.A. and Suckling, E.B. (2014) 'Robustness of pattern scaled climate change scenarios for adaptation decision support', *Climatic Change,* DOI:10.1007/s10584-013-1022-y [A:yes, D: cpdn, Au: lead]
8. Daron, J., and D. A. Stainforth, *On Predicting Climate Under Climate Change,* **Environmental Research Letters**, 2013 (8). [A:yes, D: simple models, Au: Joint lead]
9. Stainforth, D.A., *Climate projection: Testing climate assumptions.* **Nature Climate Change**, 4, 248–249, Apr 2014, doi:10.1038/nclimate2172. [A: no, D: none, Au: lead]
10. Frigg, R., L. A. Smith and D. A. Stainforth, *An assessment of the foundational assumptions in high-resolution climate projections: the case of UKCP09,* **Synthese,** 1-30, Dec 2015, DOI 10.1007/s11229-015-0739-8 [A: yes, D: none, Au: Lead]
11. Frigg, R., L.A. Smith, D. A. Stainforth, *The Myopia of Imperfect Climate Models: The Case of UKCP09,* **Philosophy of Science**, 2013. [A: no –not possible in this journal, D: none, Au: Lead]
12. Frigg, R., Bradley, S., Machete, R.L. and Smith, L.A. (2013) 'Probabilistic forecasting: why model imperfection is a poison pill', in Andersen, H., Dieks, D., Wheeler, G., Gonzalez, W., and

Uebel, T. (ed.) *New Challenges to Philosophy of Science*. Berlin and New York: Springer, Vol. 4, 479-491. DOI: 10.1007/978-94-007-5845-2_39. [A: yes, D: simple models, Au: Lead]

13. Suckling, E.B. and Smith, L.A. (2013) 'An evaluation of decadal probability forecasts from state-of-the-art climate models', *Journal of Climate,* 26 (23): 9334-9347. DOI: 10.1175/JCLI-D-12-00485.1 [A: yes, D: ENSEMBLES, Au: lead]
14. Imbers, J., Lopez, A., Huntingford, C. and Allen, M.R. (2013) 'Testing the robustness of the anthropogenic climate change detection statements using different empirical models', *Journal of Geophysical Research: Atmospheres*, 118 (8), 3192–3199. DOI: 10.1002/jgrd.50296. [A: yes, D: none (it is all about fitting statistical models), Au: non-lead]
15. Imbers, J., Lopez, A., Huntingford, C. and Allen, M.R. (2013) 'Sensitivity of climate change detection and attribution to the characterization of internal climate variability*', Journal of Climate.* DOI: 10.1175/JCLI-D-12-00622.1. [A: yes, data: CMIP3, Au: non-lead]
16. Stainforth, D.A. and L.A. Smith, *Clarify the limits of climate models*. **Nature**, 2012. 489(7415): p. 208-208. [A: no – not possible in this type of article, D: none, Au: Lead]
17. Smith, L.A. and Stern, N. (2011) 'Uncertainty in science and its role in climate policy', *Phil. Trans. R. Soc. A,* 369. DOI: 10.1098/rsta.2011.0149 [A: yes, D: none, Au: Lead]
18. Oreskes, N., D.A. Stainforth, and L.A. Smith, *Adaptation to Global Warming: Do Climate Models Tell Us What We Need to Know?* **Philosophy of Science**, 2010. 77(5): p. 1012-1028. [A: no – not possible in this journal, D: none, Au: Non-lead]
19. Stainforth, D. A., *Estimating Uncertainty in Future Climate Projections* in O J Rolf, J Kiang and R Waskom (eds) Workshop on Nonstationarity, Hydrologic Frequency Analysis, and Water Management, 2010. **Colorado Water Institute Information Series** No. 109. [A: No – not an option, D: cpdn, Au: Lead]