

CATS CENTRE FOR
THE ANALYSIS
OF TIME SERIES

ANNUAL REPORT 2011-12

INTRODUCTION

In 2011-12 CATS research continued to focus on the role of uncertainty in complex models, with special intensity on issues of decision support. Of particular interest is the unexpectedly high quality of probabilistic climate forecasts from relatively simple models, when “quality” is judged relative to the complex models to be used in the next IPCC report. In addition, we have broadened our research footprint, with Henry Wynn landing a significant EU research project on the more efficient use of energy by cities (CELSIUS) as well as new projects on floods and the interpretation of regional climate models due to start next year.

We were also delighted to see three research students successfully submit and defend their doctoral theses this year.

Professor Leonard Smith

Director, Centre for the Analysis of Time Series

NEW GRANTS AWARDED DURING 2011-12

Delivering and Evaluating Multiple Flood Risk Benefits. This EPSRC-funded project will be led by the University of Nottingham (PI Colin Thorne), and will run from January 2013 to December 2015. New strategies for managing urban flood risk are required, necessitating radical changes in the ways cities are managed, planned and developed. Previous research has identified multiple options and measures for future urban flood risk management that align with more general targets for water centric, sustainable communities. However, it remains unclear how these options and measures can be: (1) delivered in practice, and (2) comprehensively evaluated in terms of their benefits and costs. This project aims to develop novel ways of driving new, resilient urban forms and fabrics through delivering measures to manage flood events sustainably while enhancing urban life; providing scope for radical solutions under new build; and, realising possibilities for improving existing performance through retrofit and urban renewal. At LSE the project will be led by Professor Leonard Smith.

Combined Efficient Large Scale Integrated Urban Systems (CELSIUS). This multi-partner EU FP7 Smart Cities project, led by the City of Gothenburg, involves a number of leading utilities

organizations as well as academic partners. It aims to maximize carbon savings in cities by maximizing the unused energy saving potential through tackling ways to effectively and efficiently recover energy losses. The 4-year project will begin in April 2013. The Principal Investigator at LSE is Professor Henry Wynn.

Defining the limits of climate modelling: when to downscale (NERC Doctoral Training Grant). The majority of policy decisions are based on information that comes from regional models, which do not feedback to the global model. This project aims to build statistical methodology to support how far into the future it is reasonable to continue this one-way approach. It will examine existing, very complex climate models, compare outputs from regional and global ones, assess input variables, identify which variable prevents accurate results and determine when small and large models deviate too much. The outcome will be a method of determining what was potentially informative to policy makers, what was likely misleading. The research will also aim to improve correctness of global models, examining whether it can be aggregate of the regional models. The project involves working between CATS and NCAR (National Centre for Atmospheric Research), and will be supervised by Professor Leonard Smith.



ONGOING / CONTINUING PROJECTS IN 2011-12

Evaluating the Economics of Climate Risks and Opportunities in the Insurance Sector. This research programme, funded by **Munich Re** as part of the Centre for Climate Change Economics and Policy, focuses on informing the insurance sector on the impacts of alternative approaches to carbon finance and emission trading; aiding the design of trading schemes and suggesting new financial service products to be developed; informing decision-makers, at the company level and the country level, on how better to balance investment between mitigation and adaptation, survivability and sustainability. The programme runs until September 2013.



End-to-End Quantification of Uncertainty for Impacts Prediction (EQUIP). This NERC-funded collaborative project brings together the UK climate modelling, statistical modelling, and impacts communities to work closely on developing risk-based prediction for decision making in the face of climate variability and change. In CATS our focus is to contrast information from statistical models of observational time series with the output of complicated dynamical models of the atmosphere/ocean system. Our aim is to quantify the spatial and temporal scales on which these different methods can provide quantitative input to policy decisions. The project runs until December 2012 and is led at LSE by Leonard Smith and David Stainforth.

Integrated Ocean Observing Systems. Since 2007 CATS has received funding from the US National Oceanic and Atmospheric Administration (NOAA) to fund a professorial research fellow, Dr Ralph Rayner, as the industry liaison for the US Interagency Ocean Observation Committee (IOOC) and the US Integrated Ocean Observing System (IOOS) that it coordinates. Dr Rayner acts as the information point for a broad range of relevant industries; implements and manages a network for the exchange of information; and organises outreach workshops which promote the socioeconomic benefits of ocean observations. He also supports the interface between US IOOS and regional initiatives in other countries as well as the interface with the United Nations coordinated Global Ocean Observing System.

RAPID-RAPIT is a NERC funded collaborative project led by the National Oceanography Centre that will attempt to quantify the likelihood of a shut down in the Meridional Overturning Circulation (MOC) in the North Atlantic. At LSE the project is led by David Stainforth and funds a PhD student who is studying the relationship between models and reality in the context of climate change. The research will work towards the design of ensemble experiments which can evaluate the spatial and temporal scales on which complex climate models can potentially provide quantitative information about the future real world climate. The project runs until September 2013.

Managing Uncertainty in Complex Models (MUCM) is a Research Councils UK funded project that started in 2006. It is held by a consortium of 5 universities led by the University of Sheffield. At LSE it is led by Professor Henry Wynn. MUCM is a multidisciplinary project concerned with quantifying and reducing uncertainty in the predictions of complex models across a wide range of application areas, including basic science, environmental science, engineering, technology, biosciences, and economics. The second phase (MUCM2) will run until October 2012.

RESEARCH STUDENTS WHO SUBMITTED THEIR PHD THESES IN 2011-12

Joseph Daron (sponsored by EPSRC/Lloyd's) on extracting decision-relevant information from climate models for the insurance industry.

Daniel Hawellek (sponsored by EPSRC/Lloyd's and the Grantham Research Institute) on i-Shadowing in Dynamical Systems.

Roman Binter (sponsored by EPSRC/Lloyd's) on Applied Probabilistic Forecasting.

FINANCIAL SUMMARY REPORT

Summary of Income/Expenditure, 2011-12

	£
Research Councils	129,291
UK Industry and Commerce	10,317
Overseas Industry and Commerce	389,832
LSE Funding	56,067
Total Income/expenditure	585,508

EVENTS, SEMINARS AND DISCUSSIONS GROUPS 2011-12

ESRC Festival of Social Science

In November 2011 CATS took part in the ESRC Festival of Social Science. An exhibition was held at LSE on 'Confidence from Uncertainty: Interpreting Climate Predictions' (an exhibition that had also been presented in July that year as part of the Royal Society Summer Science Exhibition). Using a number of interactive computer games, the exhibit explores how we make and communicate predictions, how and when we can deduce probabilities, and the role of computer models in these processes. The focus is particularly on climate change, where basic physics is enough to highlight the severity of the problem but forecasting the details is one of today's grand scientific challenges. Progress requires integrating skills and understanding from disciplines as diverse as physics, mathematics, computer science, statistics, chemistry, ecology, economics, philosophy and more. The exhibit was developed with funding from NERC, ESRC and the LSE Annual fund, and continues to be developed as an online resource. For further details see:

lse.ac.uk/CATS/Events/Confidence%20From%20Uncertainty.aspx

Uncertainty Quantification, Risk and Decision Workshop (UQ 2012)

In May 2012 CATS hosted a 2-day workshop on Uncertainty Quantification, Risk and Decision-making. The workshop brought together experts from various disciplines, as well as representatives from industry, covering different aspects of uncertainty quantification. It focused mainly on the following three topics: the characterisation of uncertainty, the design of experiments and decision-making under uncertainty. Full details of speakers and presentations can be found at:

lse.ac.uk/CATS/Events/UQ%20Workshop.aspx

Symposium on Hurricane Forecasting: Skill and Value

Also in May, CATS together with the Centre for Climate Change Economics and Policy hosted an academic symposium on Hurricane Forecasting. The symposium formed part of the LSE Munich Re programme 'Evaluating the Economics of Climate Risks and Opportunities in the Insurance Sector', and focused on questions relating to the construction, evaluation and use of hurricane forecasts on seasonal scales. Participants from the climate research and forecast user communities included representatives from the UK Met Office, UCL, Imperial College, KNMI, the Bermuda Institute of Biological Sciences, the William J Clinton Foundation, Christian Aid, as well as members of the Munich Re programme at LSE and Munich Re itself. Various aspects of the end-to-end process of forecast production and implementation - such as lead time, forecast targets, and good practice in forecast verification - were covered in detail. The principle focus was on the skill and value of Atlantic basin hurricane forecasts, but other areas of extreme weather risk, such as floods, landslides, and drought, were also presented and discussed.

Climate Change Decision Theory Group (CCDTG)

The Climate Change Decision Theory Group, led by Dr David Stainforth, addresses questions of how we evaluate the information content of statements about future climate change. It meets on a monthly basis and brings together multi-disciplinary expertise, with members from across LSE including CATS, Statistics, Philosophy, Economics and Operations Research. There is considerable discussion of the role and interpretation of models - unsurprising given the extrapolatory nature of the climate change problem - but there is also much discussion of alternative information sources and alternative approaches to decision making in the context of climate change. Communication of research outputs, confidence and uncertainty are also key themes.

CATS 'roasts'

CATS holds a regular seminar series with a difference: rather than giving a presentation, the invited 'speaker' (whether a member of CATS, other LSE departments, or from another institution) is asked to highlight a current aspect of their research. They are then 'grilled' on this (in friendly fashion!) by the other members/attendees. The aim is to foster informal but serious discussions.



PUBLICATIONS 2011-12

H Du and L A Smith (2012) 'Parameter estimation using ignorance' *Physical Review E* 86, 016213

K Beven, W Buytaert & L A Smith (2012) On virtual observatories and modelled realities (or why discharge must be treated as a virtual variable) *Hydrol. Process.*, 26: 1905–1908

A Giovagnoli and H P Wynn (2012) '(U,V) ordering and a duality theorem for risk aversion and Lorenz type orderings' in *LSE Philosophy Papers*

A Lopez (2012) 'Regional Implications' in C Booth, F Hammond, J Lamond and D Proverbs (eds) *Solutions to Climate Change Challenges in the Built Environment* London: Wiley-Blackwell

A Lopez (2012) 'Understanding Flood Hazard' in A Jha, R Bloch and J Lamond (eds) *Cities and Flooding: A Guide to Integrated Urban Flood Risk Management for the 21st Century* A World Bank Report, Washington D.C A World Bank Report

S Suminski, A Lopez, J Birkmann and T Welle (2012) 'Current knowledge on relevant methodologies and data requirements as well as lessons learned and gaps identified at different levels, in assessing the risk of loss and damage associated with the adverse effects of climate change' *UNFCCC Technical Report*

T Maynard and N Ranger (2012) 'What role for 'Long-term Insurance' in Adaptation? An analysis of the prospects for and pricing of multi-year insurance contracts' in *The Geneva Papers on Risk and Insurance - Issues and Practice*

S Surminski (2012) The role of insurance risk transfer in encouraging climate investment in developing countries in Vinales (ed) *Harnessing Foreign Investments for Environmental Protection* Cambridge: Cambridge University Press

D J Rowlands, D J Frame, D Ackerley, T Aina, B B B Booth, C Christensen, M Collins, N Faull, C E Forest, B S Grandey, E Gyspeerd, E J Highwood, W J Ingram, S Knight, A Lopez, N Massey, F McNamara, N Meinshausen, C Piani, S M Rosier, B M Sanderson, L A Smith, D A Stone, M Thurston, K Yamazaki, Y Hiro Yamazaki & M R Allen (2012) 'Broad range of 2050 warming from an observationally constrained large climate model ensemble' *Nature Geoscience*, 5, 256–260

A Petersen (2012) 'Simulating Nature: A Philosophical Study of Computer-Simulation Uncertainties and Their Role in Climate Science and Policy Advice' (2nd edition)

P Barrieu and B Sinclair-Desgagné (2012) 'Economic Policy When Models Disagree' *CIRANO - Scientific Publication No. 2009s-03*

H Visser and A C Petersen (2011) 'Inferences on weather extremes and weather-related disasters: a review of statistical methods' *Clim. Past Discuss* 7

L A Smith and Stern, N (2011) 'Uncertainty in science and its role in climate policy' *Phil. Trans. R. Soc. A* 369

S Khare and LA Smith (2011) 'Data assimilation: A fully nonlinear approach to ensemble formation using Indistinguishable States'

Monthly Weather Review 139:7

K Beven, PJ Smith and A Wood (2011) On the colour and spin of epistemic error (and what we might do about it) in *Hydrology and Earth System Sciences Discussion* 8

K J Beven (2011) 'I believe in climate change but how precautionary do we need to be in planning for the future?' in *Hydrological Processes* 25:9

P Barrieu, H Bensusan, N El Karoui, C Hillairet, S Loisel, C Ravanelli & S Yahia (2011) 'Understanding, modelling and managing longevity risk: key issues and main challenges' in *Scandinavian actuarial journal*, ISSN 0346-1238. Abstract].

N Ranger, S Hallegatte, S Bhattacharya, M Bachu, S Priya, K Dhore, F Rafique, P Mathur, N Naville, F Henriet, C Herweijer, S Pohit and J Corfee-Morlot (2011) An Assessment of the Potential Impact of Climate Change on Flood risk in Mumbai in *Nature Climate Change* 104:1

S Hallegatte, N Ranger, O Mestre, P Dumas, J Corfee-Morlot, C Herweijer and R Muir Wood (2011) 'Assessing Climate Change Impacts, Sea Level Rise and Storm Surge Risk in Port Cities: a case study on Copenhagen' in *Nature Climate Change* 104:1

S Hanson, R Nicholls, N Ranger, S Hallegatte, J Corfee-Morlot, C Herweijer and J Chateau (2011) A Global Ranking of Port Cities with High Exposure to Climate Extremes in *Nature Climate Change* 104:1



STAFF AND ASSOCIATES 2011-12

Directors and Management

Professor Leonard Smith – Director of CATS, Professor of Statistics

Dr Pauline Barrieu – Co-director of CATS Reader in Statistics

Dr Roman Frigg – Co-director of CATS Reader in Philosophy

Professor Henry Wynn – Chair of CATS Professor of Statistics

Lyn Grove – Centre manager

Administrative support

Esther Heyhoe

Rosie Tilson-Thomas

Research Staff

Dr Hailiang Du – Research Assistant

Dr Ana Lopez – Research Officer

Dr Nicola Ranger – Research Fellow

Dr Ralph Rayner – Professorial Research Fellow

Dr David Stainforth – Senior Research Fellow

Dr Swenja Surminski – Senior Research Fellow

Dr Emma Suckling – Research Assistant

Dr Noha Youssef – Research Officer

Research students

Roman Binter

Joe Daron

Daniel Hawellek

Sarah Higgins

Alex Jarman

Trevor Maynard

Ed Wheatcroft

Associate members from across LSE

Dr Simon Dietz – Deputy Director of the Grantham Research Institute on Climate Change and the Environment and Deputy Director of the Centre for Climate Change Economics and Policy; senior lecturer in the Department of Geography and Environment

Dr Sam Fankhauser – Principal Research Fellow, Grantham Research Institute on Climate Change and the Environment

Professor Conor Gearty – Director, Centre for the Study of Human Rights; Professor of human rights law

Professor Mary Morgan – Professor of the History of Economics, Department of Economic History

Professor Nick Stern – Chair of the Grantham Research Institute on Climate Change and the Environment; Chair of the Centre for Climate Change Economics and Policy; IG Patel Professor of Economics and Government at the Suntory and Toyota International Centres for Economics and Related Disciplines (STICERD); Chair of the Asia Research Centre; and Director of the India Observatory at LSE

Visiting Professors and Fellows

Dr D. James Baker – Senior Visiting Fellow Director, Global Carbon Measurement Program, William J. Clinton Foundation

Professor Mark Berliner – Visiting Professor Professor of Statistics, Ohio State University

Professor Keith Beven – Visiting Professor Professor of Hydrology and Fluid Dynamics at Lancaster Environment Centre

Dr Jochen Bröcker – Visiting Fellow Scientist at the Max Planck Institute for Physics of Complex Systems in Dresden

Dr Milena Cuellar – Visiting Fellow Adjunct Assistant Professor of City University of New York (CUNY) at Bronx Community College

Dr Jerome Ellepola – Visiting Fellow Shell Projects & Technology Organisation in the Netherlands

Dr David Frame – Senior Visiting Fellow Deputy Director of the Smith School of Enterprise and Environment, and a Hugh Price Fellow at Jesus College, University of Oxford.

Dr Neil Gordon – Senior Visiting Fellow General Manager, Science Research and Development, at Meteorological Service of New Zealand Limited

James A. Hansen – Visiting Senior Fellow Lead Scientist in the Probabilistic-prediction Research Office at the US Naval Research Laboratory, Monterey

Professor Nigel Harvey – Visiting Professor Professor of Judgment and Decision Research, UCL

Dr Ed Hawkins – Visiting Fellow NCAS-Climate, Department of Meteorology, University of Reading

Dr Kevin Judd – Senior Visiting Fellow Associate Professor at the School of Mathematics and Statistics, University of Western Australia.

Dr Reason L. Machete – Visiting Fellow Research Fellow, Department of Mathematics, University of Reading

Dr Simon Mason – Visiting Senior Fellow Research Scientist, Climate, Disasters, International Outreach at the International Research Institute for Climate and Society, The Earth Institute, Columbia University

Trevor Maynard – Visiting Senior Fellow Deputy head of exposure management, Lloyd's of London

Dr Patrick E. McSharry – Visiting Fellow Head of the Catastrophe Risk Financing Centre the Smith School of Enterprise and Environment

Dr Falk Nihörster – Visiting Fellow RPI (Risk Prediction Initiative) Science Program Manager at the Bermuda Institute of Ocean Science (BIOS)

Dave Parker – Visiting Senior Fellow Head of Forecasting, EDF Energy

Professor Arthur Petersen – Munich Re Programme Visiting Professor Director of the Methodology and Modelling Programme, Netherlands Environmental Assessment Agency (PBL)

Dr Mark Roulston – Visiting Senior Fellow Previously a Probability Forecast Applications Specialist at the UK Met Office

Dan Rowlands – Weather Analyst, Cumulus Asset Management/ PCE Investors

Dr Nicholas Watkins – Visiting Fellow British Antarctic Survey (BAS)

Dr Antje Weisheimer – Visiting Fellow The European Centre for Medium Range Weather Forecasts (ECMWF)

Roland Young – Visiting Fellow Postdoctoral researcher, Atmospheric Oceanic and Planetary Physics group, University of Oxford