



# Annual Report

**2013-2014**

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# Message from the Director



2013-14 was yet another busy year for CATS on many fronts. The five-year “Munich Re Programme” (Evaluating the Economics of Climate Risks and Opportunities in the Insurance Sector) drew to a close at the start of this academic year, with an enjoyable and informative meeting to mark that and the end of phase I of the Centre for Climate Change Economics and Policy at the Royal Society in September 2013. The programme produced a tremendous body of work and insights, and we now look forward to compiling a report that will showcase the findings.

2013-14 saw us working more closely with new partners on “high impact” (and interesting) projects. These include working on operational risk management with the Royal National Lifeboat Institute, and a new Global Carbon Calculator project with DECC led by Erica Thompson. Details can be found in the report.

Professor Henry Wynn’s new multi-partner EU project CELSIUS (Combined Efficient Large Scale Integrated Urban Systems), led by the City of Gothenburg, began to pick up steam, and saw the appointment of a new research officer to CATS, Dr Ofer Engel. This promises to be a very exciting project with some real impacts on how cities and communities can make use of waste heat.

Locally, we are strengthening research ties with CPNSS: David Stainforth and I are working with Professor Roman Frigg developing a “philosophical” attitude and description of the use of real world models in support of real world decisions.

A handwritten signature in black ink, appearing to read 'Leonard Smith'.

**Professor Leonard Smith**  
*Director, CATS*

# About CATS

The Centre for the Analysis of Time Series (CATS) is a well-established research centre, which brings together the expertise of internationally recognised statisticians and physical scientists who have a common interest in non-linear analysis. CATS aims to promote awareness of the limitations of non-linear analysis and the dangers of confusing models with reality. Over the last few years CATS has focused 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 complex models (for instance those used in the IPCC reports).

CATS has a long track record of successful research grant funding from a variety of sponsors in the UK, EU and USA, as well as funding from industry, the latter usually for more discrete projects of specific interest to end users.

In addition, CATS has recently broadened its research footprint, with Professor Henry Wynn’s involvement in the EU multi-partner Smart Cities project “CELSIUS” (Combined Efficient Large Scale Integrated Urban Systems) which looks at maximising the efficient use of energy by cities.

Current projects also include a UK EPSRC-funded project on managing flood risk, “Delivering and Evaluating Multiple Flood Risk Benefits” (Blue-Green Cities), in which CATS plays a key role in the understanding and communication of issues of model uncertainty.

At LSE CATS works closely with a number of departments and centres: its “home department” Statistics, the Grantham Research Institute on Climate Change and the Environment, the ESRC Centre for Climate Change Economics and Policy, the Centre for Philosophy of Natural and Social Science, and, more recently, LSE Cities, among others.

CATS is led by director Professor Leonard Smith, co-directors Professor Pauline Barrieu (Statistics), Professor Roman Frigg (Philosophy) and Dr David Stainforth (Grantham Research Institute), and Chair of the centre Professor Henry Wynn. The centre benefits from the expertise of a range of Visiting Professors and Fellows from a number of disciplines, sectors and regions of the world.



# Research and researchers

## A look at a selection of the research undertaken by CATS in 2013-14



**Professor Pauline Barrieu**  
*Co-Director of CATS*

Over the academic year 2013-14, I have been working on various projects around model uncertainty, which have resulted in different publications. In these works, I have focused on the

assessment of model risk, when model risk is understood as the co-existence of various models or experts' opinions to describe the same phenomenon. In particular, I have considered the amount of provisions to put aside when there is some divergence of opinion regarding the particular choice of underlying risk distributions within a class of models. The robustness of this capital requirement with respect to the characterisation of the class of models has also been a primary focus.

More precisely, in a paper with Giacomo Scandolo, "Assessing financial model risk" (to appear in *European Journal of Operational Research*) we underline the fact that model risk has a huge impact on any risk measurement procedure and its quantification is therefore a crucial step. In a paper with Claudia Ravanelli, "Robust capital requirements with model risk" (to appear in *Economic Notes*) we have studied capital requirements when the bank's econometric model only approximately describes the dynamics of portfolio returns – which is virtually always the case in practice. Finally, in a paper with Luitgard Veraart, "Pricing q-forward contracts: an evaluation of estimation window and pricing method under different mortality models" (to appear in *Scandinavian Actuarial Journal*), we have focused on the study of the impact of various sources of uncertainty on the pricing of a special longevity-based instrument: a q-forward contract.



**Dr Ofer Engel**  
*Research Officer*

Ofer is currently working on the **CELSIUS** project where he is studying facilitators and barriers for largescale district heating and cooling projects in urban settings. Cities consume an increasing proportion of the national demand for

energy, and about 50 per cent of the energy consumed in cities is used for heating or cooling. His research within this framework focuses on the social, economic and policy

aspects of this technology. Key questions include: what are the implications of wide social trends on the development of energy efficient heating and cooling solutions? How does public policy affect development and implementation of heating and cooling solutions, and what can be done to facilitate these processes? How can local communities become more involved in public debate around these issues and with what effect? To answer these questions, Ofer works in collaboration with Imperial College, the Greater London Authority, Gothenberg council and other private and public organisations to collect data, compile case studies, run simulations and develop practical methodologies to aid the development and implementation of smart heating and cooling technologies in European cities.









**Professor Roman Frigg**  
*Co-Director of CATS*

The year 2013-14 saw a continuation of the work started last year, with two crucial papers being finished. "Laplace's Demon and the Adventures of His Apprentices" was accepted and appeared in

*Philosophy of Science* early in 2014. "Why High-Resolution Climate Projections Fail: The Case of UKCP09" was finished and submitted. In this paper Leonard Smith, David Stainforth and I urge some caution about UKCP09's methodology.

Given the acknowledged systematic errors in all current climate models, treating model outputs as decision relevant projections can be seriously misleading. In extrapolatory situations, such as projections of future climate change impacts, there is little reason to expect that post-processing of model outputs can correct for the consequences of such errors. This casts doubt on our ability, today, to make trustworthy, high-resolution probabilistic projections out to the end of this century.

Laplace's Demon and the Adventures of His Apprentices, *Philosophy of Science* 81(1), 2014, 31–59, with Seamus Bradley, Hailiang Du and Leonard A. Smith.

"Why High-Resolution Climate Projections Fail: The Case of UKCP09", under review.



**Sarah Higgins**  
*Research Student*

In 2013-14 Sarah was working towards completion of her thesis entitled "Limitations to seasonal weather prediction and crop forecasting due to nonlinearity and model inadequacy". Her thesis examines the main issues

surrounding crop modelling by detailed studies of

(i) multi-model ensemble forecasting using a simple dynamical system as a proxy for seasonal weather forecasting, (ii) probabilistic forecasts for crop models, and (iii) an analysis of changes in US yield.

The ability to forecast crop yield accurately on a seasonal time frame would be hugely beneficial to society in particular farmers, governments and the insurance industry. In addition, advance warning of severe weather patterns that could devastate large areas of crops would allow contingency plans to be put in place before the onset of a widespread famine, potentially averting a humanitarian disaster.





**Alex Jarman**  
*Research Student*

Probabilistic forecasting plays a pivotal role both in the application and in the advancement of geophysical modelling. In my thesis, "On the Provision, Reliability, and use of Hurricane Forecasts on all Timescales", operational

techniques and modelling methodologies are examined critically and suggestions for improvement are made; potential improvements are illustrated in low-dimensional chaotic systems of nonlinear equations.

Atlantic basin hurricane forecasting and forecast evaluation methodologies on daily to multi-annual timescales provide the primary focus of application and real world illustration. Atlantic basin hurricanes have attracted much attention from the scientific and private sector communities as well as from the general public due to their potential for devastation to life and property, and speculation on increasing trends in hurricane activity. Current approaches to modelling, prediction and forecast evaluation employed in operational

hurricane forecasting are critiqued, followed by recommendations for best-practice techniques. The applicability of these insights extends far beyond the forecasting of hurricanes.

A new statistical framework is proposed in this thesis for evaluating and interpreting forecast reliability, forecast skill, and forecast value to provide a sound basis for constructing and utilising operational event predictions. The framework is then illustrated in the specific context of hurricane prediction. Proposed methods of forecast recalibration in the context of both a low-dimensional dynamical system and operational hurricane forecasting are employed to illustrate methods for improving resource allocation distinguishing, for example, scenarios where forecast recalibration is effective from those where resources would be better dedicated towards improving forecast techniques. A novel approach to robust statistical identification of the weakest links in the complex chain leading to probabilistic prediction of nonlinear systems is presented, and its application demonstrated in both numerical studies and operational systems.

*Alex submitted his thesis and was awarded his doctorate in 2014.*



**Ewelina Sienkiewicz**  
*Research Student*

My thesis title is "Internal Consistency as a Tool in Analysis and Application of Nonlinear Simulation".

My research is focused on better understanding model error both when forecasting non-linear systems and in

decision support. Weather and climate models are used in this context.

In this research I quantify the predictability of a chaotic system, estimate how far in the future it is predictable for and identify the two main limitations. Sensitivity to initial conditions complicates the forecasting of chaotic dynamical systems, even when the model is perfect. Structural model inadequacy is a distinct source of forecast failure, failures which are sometimes mistakenly interpreted as due to chaos. These methods are demonstrated using a toy mathematical system (Ikeda Map) as an illustration and state-of-the-art climate models, where only access to archived runs are available. My recent visit to Columbia University allowed me to learn about the complex El Niño model developed there and apply my thesis research into a situation of economic interest, such as El Niño forecasting.





### **Dr David Stainforth** *Co-Director of CATS*

In August 2013 Dr Stainforth published two papers in *Environmental Research Letters*. One, with Joe Daron, used a low-dimensional nonlinear system to explore issues of ensemble size on the probabilistic reliability of

predictions of future climate within climate models. The other, with Sandra Chapman and Nick Watkins, considered how robust messages about changing local climatic distributions could be extracted from local observational temperature timeseries. During the 2013-14 academic year, amongst many other research directions,

Dr Stainforth presented these results and pursued research building on their foundations. They were presented and discussed at a joint Imperial College/Georgia Tech workshop in Atlanta (entitled "Climate Science Needed to Support Robust Adaptation Decisions") in February 2014, at the CIRCLE 2 Adaptation Frontiers conference in Lisbon in March 2014, and in seminars presented at Imperial College and Kings College London, amongst others. Research in these areas focused on how to develop the observational analysis so that it can be applied to precipitation timeseries to provide further information for practical planning support, and to the analysis of initial condition ensembles of global circulation models to better understand model-based climate predictability; this latter work was pursued with colleagues at the University of Reading.



### **Dr Erica Thompson** *Research Officer*

During 2013-14 Erica's work focused on the project "Visualisation of Climate Model Output and Uncertainties for the DECC 2050 Global Calculator" funded by the NERC PURE Associates scheme

(Probability, Uncertainty and Risk in the Environment). The project was a collaboration with Professor David MacKay, Chief Scientific Advisor to the UK's Department for Energy and Climate Change (DECC). Erica worked with DECC and other stakeholders in the 2050 Global Calculator, to provide more in-depth statistical analysis for the visualisation of uncertainties in the climate change outputs of the Calculator web tool. After discussion of the most appropriate visualisation tools, the available information, and the constraints of the web format, Erica produced a large set of map animations showing climate model temperature and precipitation output, based on the most recent CMIP5 model runs and the IPCC expert judgements about real-world probabilities. The innovative use of animation to illustrate complex aspects of uncertainty is one of the unique features of the Global Calculator. The project also resulted in some very productive conversations about the nature of

climate change uncertainty and has inspired further research directions for CATS. [The Global Calculator was a key outreach tool for DECC in the lead-up to the Paris climate change negotiations in December 2015].

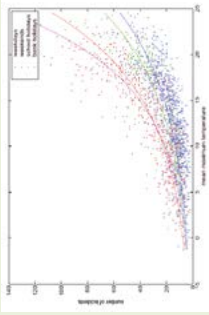
See poster page 7.



*Dr Erica Thompson presents findings from the project "Visualisation of Climate Model Output and Uncertainties for the DECC 2050 Global Calculator" at the NERC PURE Associates showcase event, 20 May 2014 at the Royal Academy of Engineering, London.*

# Improving the safety of RNLI operations through better use of probabilistic weather information

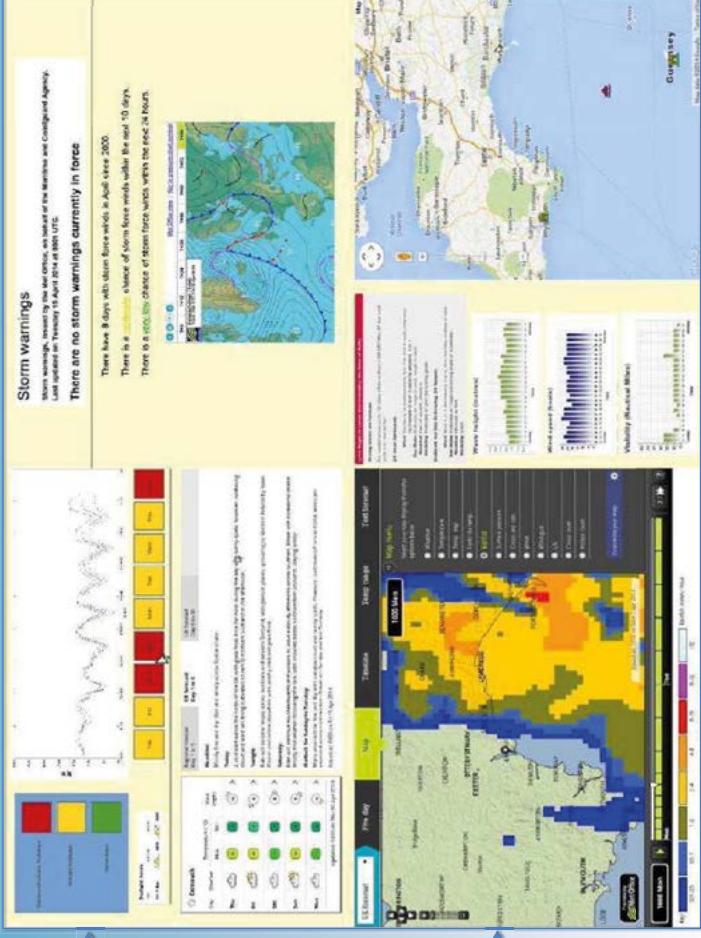
The RNLI is the charity that saves lives at sea. Every year, volunteer lifeboat crew are called out around 8,000 times.



Our analysis found that the number of incidents per day is highly dependent on the temperature with the impact varying between weekends and weekdays inside and outside of school term time.



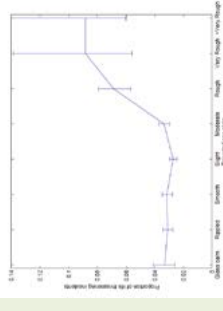
The weather conditions around the UK and Ireland can change very quickly. Radars can give warning of adverse weather not visible from the area around the lifeboat station.



Difficult operational decisions about what a lifeboat is capable of in rough seas sometimes have to be made. The LSE proposed the risk visualisation tool above to help inform these operational decisions by combining academic work around weather risk analysis with RNLI knowledge and data about incident rates.



Large storms can make conditions at sea extremely dangerous. Early warning of such events can help the RNLI make informed operational decisions such as when and where to target safety campaigns and where to position crew.



In our analysis we found that the proportion of incidents in which human life is endangered is twice as high when the reported sea state is rough or higher compared with when it is moderate or lower.

Tell me more

Link: scan the QR code below  
Email: [e.d.wheatcroft@lse.ac.uk](mailto:e.d.wheatcroft@lse.ac.uk)



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POLITICAL SCIENCE



SCIENCE OF THE  
ENVIRONMENT





### Edward Wheatcroft Research Student

Ed Wheatcroft, under the supervision of Leonard Smith, worked on a short NERC funded project with the Royal National Lifeboat Institution (RNLI) entitled "Improving the safety of RNLI operations through a better use of probabilistic weather information". The project was funded by the NERC PURE Associates Scheme. It focused on the formation and

dissemination of probabilistic forecasts of both the frequency and the severity of incidents given weather forecast information. The project also focused on how best to provide lifeboat crew with real time weather information before and during a callout. Ed gave a short presentation on the findings of the project at the Pure Associates showcase event on the 20 May 2014.

See poster page 11.



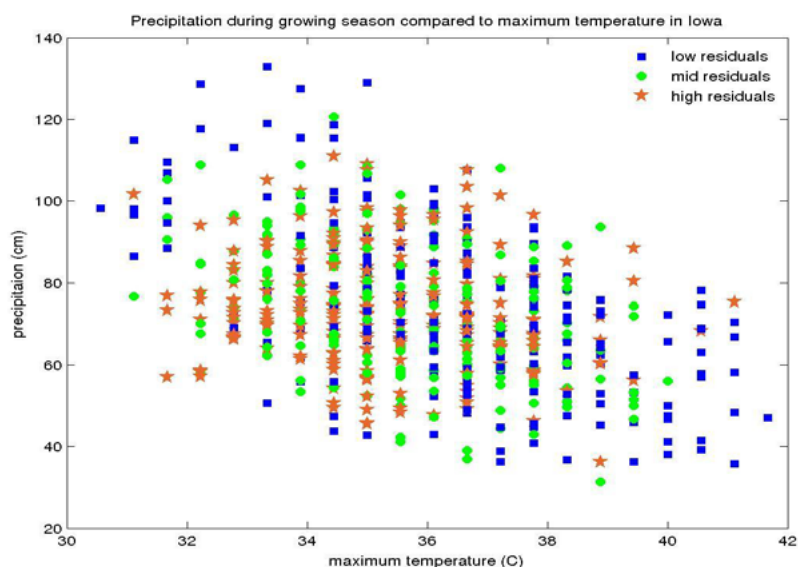
### Professor Henry Wynn Chair of CATS

CATS has been developing, over some time, a wider interest in decision-making under uncertainty. Under the title "Workshop on Model (in)adequacy in policy making" CATS held a meeting on 7-8 November 2013 covering uncertainty in modelling when, as with climate models and models in finance, a lot hangs on the results and use of the model. On the one hand detailed expert knowledge of the field is important and on the other it is hoped that there are common methodological threads. A challenge is that there are many such areas, which do not always speak the same language. A deliberate effort was made

to cover different areas of application and also methodologies. Brian Hoskins (Imperial College) and Jason Lowe (Met Office) covered weather and climate and Paul Embrechts (ETH) and Sujoy Mukerji covered finance; Joe Halpern (Cornell) and Nabil Al-Najjar (Northwestern) covered hard methodology, game-theoretic and Bayesian approaches and much else. If a theme emerged during the round table discussions (chaired by Leonard Smith and Henry Wynn) it was the need for a cross-disciplinary and practical common language for risk and uncertainty which would provide an interface between the often difficult to interpret model outputs and the decision-maker and interested member of the public.

**Comparing the maximum temperature and precipitation during the maize growing season in Iowa with yield residuals. Notice how the blue dots cluster at the extreme ends of the weather variables.**

From: S. Higgins thesis  
"Limitations to seasonal weather predictions and crop forecasting due to nonlinearity and model inadequacy"





# New and ongoing projects 2013-14

## Evaluating the Economics of Climate Risks and Opportunities in the Insurance Sector (the “LSE-Munich Re Programme”)

This project was funded by Munich Re as the 5th research programme of the Centre for Climate Change Economics and Policy (CCCEP). The programme 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.

**Funded by:** Munich Re

**Project duration:** October 2008 – September 2013

## Visualisation of Climate Model Output and Uncertainties for the DECC 2050 Global Calculator

Dr Erica Thompson and Professor Leonard Smith are working on visualisation and communication of the IPCC's climate projections, in partnership with the UK Department for Energy and Climate Change (DECC). This is part of the 2050 Global Calculator project which aims to inform the debate about energy and climate systems in the run up to the UNFCCC Paris COP in 2015.

**Funded by:** NERC PURE Associates

**Project duration:** November 2013 – January 2015

## Improving the Safety of RNLI Operations through a better use of Probabilistic Weather Information

Research student Edward Wheatcroft and Professor Leonard Smith are working with the RNLI to provide support for lifeboat operators with respect to both current and potential meteorological conditions. By providing guidance to develop

tools that give real time information on the weather outlook, the target is to help provide decision-makers with better support to make the right choices with regards to the safety of both the lifeboat crew and the general public.

**Funded by:** NERC PURE Associates

**Project duration:** November 2013 – May 2014

## CELSIUS – Combined Efficient Large Scale Integrated Urban Systems

This project 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.

**Funded by:** EU

**Lead Research Organisation:** City of Gothenburg

**Principal Investigator at LSE:** Professor Henry Wynn

**Project duration:** April 2013 – March 2017



*Edward Wheatcroft, Leonard Smith and Erica Thompson at the NERC PURE Associates showcase event, 20 May 2014 at the Royal Academy of Engineering, London where they presented findings from their NERC-funded projects with RNLI and DECC.*

## Delivering and Evaluating Multiple Flood Risk Benefits (Blue-Green Cities)

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.

**Funded by:** EPSRC

**Lead Research Organisation:** University of Nottingham

**Principal Investigator at LSE:** Professor Leonard Smith

**Project duration:** January 2013 – January 2016

## Communicating the Character of Climate Change Uncertainty

The project aims to encourage a wider and more informed public discourse around the challenges of understanding and responding to the problems of climate change. It will build on the exhibition materials produced for the Royal Society Summer Science Exhibition in 2011.

**Funded by:** HEIF5

**Grant holder:** Dr David Stainforth

**Project duration:** January 2013 – December 2015

## Integrated Ocean Observing System

Dr Ralph Rayner is 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.

**Funded by:** US National Oceanographic and Atmospheric Administration (NOAA)

**Principal Investigator:** Dr Ralph Rayner

**Project duration:** 2007 – ongoing

## RAPID-RAPIT – Risk Assessment, Probability and Impact Team

A collaborative project that is attempting to quantify the likelihood of a shut down in the Meridional Overturning Circulation (MOC) in the North Atlantic. At LSE this project has funded research student Edward Wheatcroft and his thesis “Improving predictability of the future by grasping probability less tightly”.

**Funded by:** NERC

**Lead Research Organisation:** National Oceanography Centre, Southampton

**Grant holder:** Dr David Stainforth

**Projection duration:** October 2009 – ongoing

# Research students

## Ongoing doctoral research

**Sarah Higgins** (part-time): thesis, entitled "Limitations to seasonal weather prediction and crop forecasting due to nonlinearity and model inadequacy", on the link between weather and global cereal prices.

**Trevor Maynard**: thesis on the robustness of general insurers to trends and cycles including climate change.

**Ewelina Sienkiewicz**: thesis entitled "Internal Consistency as a Tool in Analysis and Application of Nonlinear Simulation".

**Edward Wheatcroft**: thesis, entitled "Improving predictability of the future by grasping probability less tightly", on the relationship between models and reality in the context of climate change, funded by NERC as part of the RAPID-RAPIT project.

## Theses submitted in 2013-14

**Alex Jarman** (sponsored by reinsurance company, Munich Re) "On the Provision, Reliability, and Use of Hurricane Forecasts on all Timescales".

CATS theses can be found at: [lse.ac.uk/CATS/Publications/CATS%20Theses.aspx](http://lse.ac.uk/CATS/Publications/CATS%20Theses.aspx)

# CATS research income 2013-14

Funder	2013-14 Project Income
UK Research Councils	120,217
European Commission	87,453
US government funding	30,349
Industry (overseas)	260,343
<b>Total:</b>	<b>498,362</b>



# Events, seminars and discussion groups 2013-14

## Frontiers in climate change economics and policy research: Taking stock, moving forward

**Munich Re Programme final event, Royal Society, London, 24 September 2013**

In September 2013 a two-day event was held at the Royal Society, London, to mark the end of phase I of the Centre for Climate Change Economics and Policy (CCCEP), including the Munich Re Programme. The event began with an afternoon dedicated to the Munich Re Programme, with speakers from both LSE and Munich Re, and Professor Howard Kunreuther (Munich Re Programme visiting professor). In the evening a keynote talk was given by Professor Lord Nicholas Stern. This concluding event of the programme was geared towards making the research accessible to broader stakeholders. A wide range of industry representatives and policy-makers attended the event and contributed to the discussion of the key findings showcased. The day's programme can be found at: <http://bit.ly/1oED6PO>

## Model (in)adequacy in policy making

**LSE, 7-8 November 2013**

For the second year CATS organized a workshop on Uncertainty Quantification. This workshop included sessions on climate and also financial applications. Each session discussed modelling concepts and how model uncertainty is taken into consideration, followed by a discussion on the use of models and the role of regulations. Details of the programme and speakers can be found at:

<http://www.lse.ac.uk/CATS/Events/workshops/13-0968-CATS-Conference-Prog-final-UQ2013.pdf>

## Blue-Green Cities: Uncertainty Workshop

**LSE, 11 November 2013**

As part of the Blue-Green Cities project, CATS hosted this workshop aimed at early career researchers. The workshop aimed to investigate uncertainty in greater detail, considering a number of questions including: What types of uncertainties are inherent in each model? How can these uncertainties be

quantified? How do unquantifiable uncertainties propagate throughout the model cascade? How will we tackle uncertainty in climate change models and future scenarios?

## Understanding Uncertainty in Environmental Modelling

**London, 8-10 January 2014**

This workshop was funded as part of NERC's Postgraduate and Professional Skills Development Programme. For information and slides see:

<http://www.lse.ac.uk/CATS/Events/NERC-Understanding-Uncertainty-in-Environmental-Modelling.aspx>

## Conference presentations

CATS researchers gave a number of conference presentations throughout the year. Details can be found at:

<http://www.lse.ac.uk/CATS/Talks%20and%20Presentations/TalksAndPresentations.aspx>



Above: Professor Leonard Smith and panel members (L-R) Dr Eberhard Faust, Dr Ernst Rauch, Dr Swenja Surminski, Professor Peter Höpfe, Professor Howard Kunreuther, Dr Simon Dietz, concluding the afternoon's event at the Royal Society.

# Publications 2013-14

Barrieu, P. and Veraart, L. (2014) "Pricing q-forward contracts: an evaluation of estimation window and pricing method under different mortality models", *Scandinavian Actuarial Journal*, DOI:10.1080/03461238.2014.916228.

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.

Visser, H., Petersen, A.C. and Ligtoet, W. (2014) "On the relation between weather-related disaster impacts, vulnerability and climate change", *Climatic Change*, DOI: 10.1007/s10584-014-1179-z.

Smith, L.A., Du, H., Suckling, E.B. and Niehoerster, F. (2014) "Probabilistic skill in ensemble seasonal forecasts", *Quarterly Journal of the Royal Meteorological Society*, DOI: 10.1002/qj.2403.

Daron, J. and Stainforth, D.A. (2014) "Assessing pricing assumptions for weather index insurance in a changing climate", *Climate Risk Management*, DOI: 10.1016/j.crm.2014.01.001.

Bradley, S., Frigg, R., Du, H. and Smith, L.A. (2014) "Model Error and Ensemble Forecasting: A Cautionary Tale", in Guichun C. Guo and Chuang Liu (ed.) *Scientific Explanation and Methodology of Science*, Singapore: World Scientific, pp.58-66.

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, pp. 137-156.

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.

Du, H. and Smith, L.A. (2014) "Pseudo-orbit Data Assimilation Part I: The Perfect Model Scenario", *Journal of the Atmospheric Sciences*. DOI: 10.1175/JAS-D-13-032.1

Du, H. and Smith, L.A. (2014) "Pseudo-orbit Data Assimilation Part II: Assimilation with Imperfect Models", *Journal of the*

*Atmospheric Sciences*. DOI: 10.1175/JAS-D-13-033.1

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.

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.

Calel, R., Stainforth, D.A., and Dietz, S. (2013) "Tall tales and Fat tails: The science and economics of extreme warming", *Climatic Change*. DOI: 10.1007/s10584-013-0911-4.

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.

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.

Capparelli, V., Franzke, C., Vecchio, A., Freeman, M.P., Watkins, N.W. and Carbone, V. (2013) "A spatiotemporal analysis of U.S. station temperature trends over the last century", *Journal of Geophysical Research: Atmospheres*, Vol. 118, 1-8. DOI:10.1002/jgrd.50551.

A list of all CATS publications can be found at:  
<http://www.lse.ac.uk/CATS/Publications/CATS%20Publications%20Homepage.aspx>

# Staff and Associates 2013-14

## Directors and management

**Professor Leonard Smith** – Director of CATS  
Professor of Statistics; Senior Research Fellow of  
Pembroke College, Oxford

**Professor Pauline Barrieu** – Co-Director of CATS  
Professor of Statistics

**Professor Roman Frigg** – Co-Director of CATS  
Senior Lecturer in Philosophy

**Dr David Stainforth** – Co-Director of CATS  
Principal Research Fellow, GRI

**Professor Henry Wynn** – Chair of CATS  
Professor of Statistics

**Lyn Grove** – Centre Manager

**Jill Ramsay** – Administrator

## Research staff

**Dr Hailiang Du** – Research Officer

**Dr Ana Lopez** – Research Officer

**Dr Nicola Ranger** – Research Fellow

**Dr Ralph Rayner** – Professorial Research Fellow

**Dr David Stainforth** – Senior Research Fellow

**Dr Emma Suckling** – Research Officer

**Dr Swenja Surminski** – Senior Research Fellow

**Dr Erica Thompson** – Research Officer

## Research students

**Sarah Higgins**

**Alex Jarman**

**Trevor Maynard**

**Ewelina Sienkiewicz**

**Edward Wheatcroft**

## Associate members from across LSE

**Dr Simon Dietz** – Co-Director, Grantham Research Institute on  
Climate Change and the Environment; Director of the Centre  
for Climate Change Economics and Policy; Associate Professor  
in the Department of Geography and Environment

**Professor Sam Fankhauser** – Co-Director, Grantham Research  
Institute on Climate Change and the Environment

**Professor Conor Gearty** – Director, Institute of Public Affairs,  
LSE; Professor of Human Rights Law

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

**Professor Nicholas 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, Lancaster  
Environment Centre

**Dr Jochen Bröcker** – Visiting Fellow  
Lecturer, School of Mathematical and Physical Sciences,  
University of Reading

**Dr Milena Cuellar** – Visiting Fellow  
Assistant Professor LaGuardia Community College, New York



**Dr Joshua Elliot** – Senior Visiting Fellow  
Research Scientist and Fellow at the Computation Institute,  
University of Chicago and Argonne National Lab

**Professor Nigel Harvey** – Visiting Professor  
Professor of Judgement and Decision Research, UCL

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

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

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

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

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

**Dr Mark Roulston** – Senior Visiting Fellow  
Senior Scientist, Winton Capital

**Dr Dan Rowlands** – Visiting Fellow  
Weather Analyst, Cumulus Asset Management/PCE Investors

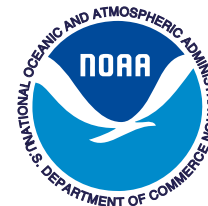
**Dr Nicholas Watkins** – Visiting Fellow  
Senior Visiting Scientist, Max Planck Institute for the Physics  
of Complex Systems

**Dr Antje Weisheimer** – Visiting Fellow  
Senior NCAS Research Fellow, Department of Physics,  
University of Oxford

**Professor Mary Lou Zeeman** – Visiting Professor  
Professor of Mathematics, Bowdoin College, Brunswick,  
Maine, USA

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## Centre for the Analysis of Time Series

The London School of Economics and Political Science  
Houghton Street  
London WC2A 2AE

Tel: +44 (0)20 7955 6015

Email: [l.grove@lse.ac.uk](mailto:l.grove@lse.ac.uk)

Web: [www.lse.ac.uk/CATS/Home.aspx](http://www.lse.ac.uk/CATS/Home.aspx)



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