

Introduction

Marking the start of CATS' second decade, 2010-11 has seen both the fruits of past work and fresh buds in new directions. I think we have made significant breakthroughs in our understanding of how to best model nonlinear dynamical systems, both in the academic case where a perfect model is in hand and in the real world case where we know our models are imperfect, but perhaps not quite how imperfect they really are. These ideas will play a role in one major aspect of modelling that is rarely spoken of plainly: tuning. In addition to how to tune models to get them running smoothly, we have made progress in getting them started and moving in the right direction, illustrating CATS' research in data assimilation around the world from Reading, England to Bangalore, India. And as applications are made in practice, Ana Lopez is working to enhance consistency tests, so that decision makers can see whether the assumptions required to complete an analysis hold together in practice. Our wider work in decision making also continues, with our Chair's shepherding of MUCM2 and continuing work with those in the Grantham Research Institute and Centre for Climate Change Economics and Policy, including a paper with Nick Stern discussing scientific uncertainty in policy making to appear later this year. Work within the Munich Re program continues apace, both across academia and with our colleagues in Munich Re itself.

CATS has also opened new doors. One rich connection is with CPNSS working with Seamus Bradley and Roman Frigg on epistemological issues of what model-based probability forecasts mean, questioning if it is rational to treat them as probabilities at all. This collaboration has proven both enjoyable and productive, so much so that Roman Frigg will soon become a co-Director of CATS. We expect papers relevant to and submitted before the 2013 IPCC Working Group I deadlines. On the assumption that we know what we are talking about, David Stainforth and Emma Suckling have been documenting the advantage of being very clear of what we mean in multidisciplinary research, as different specialties use the same words to mean rather different things: what is "a trend" exactly? Even the definition of climate has changed over the last fifty years. Finally, assuming that we know what we are talking about and are speaking the same language, work on evaluating how well we are modelling the future has entered a new stage, more clearly distinguishing forecast value from forecast skill, and judging the judges (evaluating the efficacy of the myriad of skill scores employed in practice). Hailiang Du and Alex Jarman have lead our advance of theoretical and practical aspects, respectively.

CATS' eye for detail, from mathematical chaos to Capitol Hill, continues to help us aid a wide variety of users in academia, industry and government, exploiting the common thread of modelling time series in the widest variety of applications. As we enter our second decade, we find ourselves benefiting from our successes in the past, while our work is in demand for the future.

Professor Leonard Smith, CATS Director

Talks, presentations and workshops

Members of CATS and the Munich Re programme presented talks at a large number of conferences, seminars and workshops across the world – from India to the USA and across Europe. Details can be found at: lse.ac.uk/CATS/talksPresentations/TalksAndPresentations.aspx

Other activities and awards

David Stainforth led the preparation of an exhibit at the Royal Society Summer Science exhibition, 5-10 July 2011, which had over 13,000 visitors. The exhibit was entitled "Confidence from Uncertainty: Interpreting Climate Predictions". The interactive exhibit can be found at: ConfidenceInClimate.net

Henry Wynn was awarded the Box Medal by the European Network for Business and Industrial Statistics (ENBIS). The Box Medal is named after George Box and "recognises each year an extraordinary statistician who had remarkably contributed with his or her work to the development and the application of statistical methods in European business and industry".

Henry Wynn was also awarded a Leverhulme Emeritus fellowship for a two year project entitled "Advances in algebraic statistics".

In January 2011 CATS director, Leonard Smith, became a member of the American Statistical Association's Advisory Committee on Climate Change Policy (ACCCP). As part of this Leonard took part in the ASA annual "Climate Science Day" at Capitol Hill, Washington DC in February. These visits are an opportunity to provide Members of Congress with the best possible access to scientific information on climate science when making policy decisions.

Research projects

(see: lse.ac.uk/CATS/researchGrants/researchGrants.aspx)

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.

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.

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 socio-economic 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.

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.

Managing Uncertainty in Complex Models (MUCM) is a Research Councils UK funded project that started in 2006. It is held by a consortium of five 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 first phase of MUCM drew to a close in September 2010 and is now into a second two-year phase (MUCM2).

Publications

(see: lse.ac.uk/CATS/publications/Publications_CATS.aspx)

K Beven, PJ Smith and A Wood (2011) On the colour and spin of epistemic error (and what we might do about it) *Hydrology and Earth System Sciences Discussion*, 8, 5355-5386.

K J Beven (2011) I believe in climate change but how precautionary do we need to be in planning for the future? *Hydrological Processes*, Vol. 25, Issue 9, pp: 1517-1520.

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. *Scandinavian actuarial journal*, ISSN 0346-1238

N Ranger, S Hallegatte, S Bhattacharya, M Bachu, S Priya; K Dhore, F Rafique, P Mathur, N Naville, F Henriot, C Herweijer, S Pohit, J Corfee-Morlot (2011) An Assessment of the Potential Impact of Climate Change on Flood risk in Mumbai, *Nature Climate Change*, 104 (1), 139-167

S Hallegatte, N Ranger, O Mestre, P Dumas, J Corfee-Morlot, C Herweijer, R Muir Wood (2011) Assessing Climate Change Impacts, Sea Level Rise and Storm Surge Risk in Port Cities: a case study on Copenhagen, *Nature Climate Change*, 104 (1), 113-137

S Hanson, R Nicholls, N Ranger, S Hallegatte, J Corfee-Morlot, C Herweijer, J Chateau (2011) A Global Ranking of Port Cities with High Exposure to Climate Extremes, *Nature Climate Change*, 104 (1), 89-111

N Oreskes, D A Stainforth and L A Smith (December 2010) Adaptation to Global Warming: Do Climate Models Tell Us What We Need to Know? *Philosophy of Science*, 77 (5): 1012-1028

M Ghil, P L Read and L A Smith (2010) Geophysical flows as dynamical systems: the influence of Hide's experiments *Astronomy & Geophysics*, 51 (4): 28-35

M Fehr and J Hinz (2010) Storage costs in commodity option pricing, *SIAM Journal on Financial Mathematics*, 1: 729-751

L A Smith, M C Cuéllar, H Du and K Judd (2010) Exploiting dynamical coherence: A geometric approach to parameter estimation in nonlinear models, *Physics Letters A*, 374, 2618-2623.

E Riccomagno and H P Wynn (2010) An introduction to regression and errors in variables from an algebraic viewpoint. *Approximate Commutative Algebra, Texts and Monographs in Symbolic Computation*, 193-203.

R F Rayner (2010) The US Integrated Ocean Observing System in a global context. *Journal of the Marine Technology Society*, 44 (6)

Financial statement 2010-11

Funding Awards Received – Financial Year 2010-11		Amount £
– UK Research Councils, NOAA, LSE Annual Fund		186,121
Income & Expenditure Statement – Financial Year 2010-11		Amount £
Income:		
Research Councils		226,225
UK Industry and Commerce		10,161
European Commission		0
Other		388,430
LSE Funding		50,371
Total Income		675,187
Expenditure		
Total Direct Costs		571,975
Overheads		105,294
Total Expenditure		677,269
Overhead Recovery Rate as a % of Staff Costs		27.6
Overhead Recovery Rate as a % of Total Costs		18.4

People

Directors & management

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

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

Professor Henry Wynn – Chair of CATS
Professor of Statistics

Lyn Grove – Centre manager

Research Staff

Dr Hailiang Du – Postdoctoral Research Assistant

Dr Max Fehr – Postdoctoral Research Assistant

Dr Ana Lopez – Research Officer

Dr Falk Niehörster – Postdoctoral Research Assistant

Dr Nicola Ranger – Research Fellow

Dr Ralph Rayner – Professorial Research Fellow

David Stainforth – Senior Research Fellow

Dr Swenja Surminski – Senior Research Fellow

Emma Suckling – Postdoctoral Research Assistant

Noha Youssef – Research Officer

Research students

Roman Binter

PhD, sponsored by EPSRC/Lloyds, on how informative climate models are to decision making in the insurance industry

Joe Daron

PhD, sponsored by EPSRC/Lloyd's, on extracting decision-relevant information from climate models for the insurance industry

Daniel Hawellek

PhD, sponsored by EPSRC/Lloyd's and the Grantham Research Institute, on i-Shadowing in Dynamical Systems

Sarah Higgins

PhD on the link between weather (seasonal forecasts) and global cereal prices

Alex Jarman

PhD, sponsored by Munich Re, on quantitative applied climate economics for the insurance industry

Trevor Maynard

Thesis on the topic of robustness of general insurers to trends and cycles including climate change

Ed Wheatcroft

PhD, sponsored by NERC as part of the RAPID-RAPIT project, on the relationship between models and reality in the context of climate change

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

Dr Roman Frigg – Senior Lecturer in Philosophy, Department of Philosophy, Logic and Scientific Method; Deputy Director of the Centre for Philosophy of Natural and Social Science (CPNSS)

Professor Conor Gearty – Director of the 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 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 at Lloyd's of London

Dr Patrick E. McSharry – Visiting Fellow
Head of the Catastrophe Risk Financing centre at the Smith School of Enterprise and Environment, University of Oxford

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
Dr Roulston was recently a Probability Forecast Applications Specialist at the UK Met Office.

Dr Antje Weisheimer – Visiting Fellow
Dr Weisheimer currently works at the European Centre for Medium Range Weather Forecasts (ECMWF).

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

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