

ISLA SIMPSON

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Research Interests

My research interests lie in the use of global climate models of varying levels of complexity to understand dynamical mechanisms involved in the climate system. I am interested in understanding the current climate and its variability, at scales ranging from the planetary to the regional, as well as determining the robust responses to climate change and their implications, through a deeper understanding of the processes and mechanisms involved. I am also interested in the biases that occur in global climate models, how they may be alleviated and what the implications of these biases are for our ability to predict the future of the climate system. To date there has been a focus on the coupled stratosphere-troposphere system, the dynamics of the tropospheric mid-latitude circulation and its response to forcings, longitudinal variations in the mid-latitude circulation response to anthropogenic forcings and the importance of topography for the climate of the Mediterranean region.

Education

2005-2009 PhD in Atmospheric Physics, Department of Physics, Imperial College London, UK

2001-2005 MPhys in Astrophysics, 1st class honours, School of Physics and Astronomy, University of St Andrews, UK

Research Experience and Employment

2015-.... **Scientist 1** Climate and Global Dynamics Laboratory, National Center for Atmospheric Research, USA.

Synopsis: Working as a Scientist 1 in the Climate Analysis Section of the Climate and Global Dynamics Division of the National Center for Atmospheric Research. Research focus is on the dynamical mechanisms involved in climate variability and change and the representation of the relevant processes in Global Climate Models.

2014-2015 **Associate Research Scientist** Lamont-Doherty Earth Observatory, Columbia University, USA.

2012-2014 **Postdoctoral Fellow.** Lamont-Doherty Earth Observatory, Columbia University, USA.

Supervisors: Prof Richard Seager and Prof Tiffany Shaw (Lamont-Doherty Earth Observatory)

Synopsis: I was awarded a Lamont-Doherty Earth Observatory postdoctoral fellowship to perform research into mid-latitude climate change. I investigated longitudinal variations in the mid-latitude circulation response to anthropogenic forcing and the robust predicted circulation responses on the regional scale. I analyzed the longitudinally varying momentum budget of predicted future changes in model output from the Coupled Model Intercomparison Project, phase 5, and demonstrated robust stationary wave responses to climate change with important implications for regional scale climate. I then focused on the understanding the mechanisms involved in the stationary wave response over North America and the implications of this for North American hydroclimate. In addition to this, I worked on understanding the role of relatively small scale topography in the climate of the Mediterranean region and on determining the regional response to sudden stratospheric warmings and the mechanisms involved. Each of these involve idealized experiments with comprehensive global climate models.

2009-2012 **Postdoctoral Fellow.** Department of Physics, University of Toronto, Canada.

Supervisor: Prof Ted Shepherd (Department of Physics, University of Toronto)

Synopsis: I designed and performed experiments using a comprehensive general circulation model (the Canadian Middle Atmosphere Model) to gain a deeper understanding of the dynamical mechanisms involved in mid-latitude

atmospheric circulation variability and its biases in models as well as mechanisms in stratosphere-troposphere coupling. In particular, I made use of nudging and bias correction techniques in the model to pull apart the relevant processes that govern Southern Annular Mode variability and its bias in models. I also performed model experiments to determine the dynamics behind the lower stratospheric circulation response to ENSO variability.

2010 **Sessional lecturer in advanced atmospheric dynamics.** Department of Physics, University of Toronto, Canada.

I gained experience in teaching through a sessional lecturer position at the University of Toronto in which I taught a semester long (2 hours per week) graduate course in advanced atmospheric dynamics. This involved developing and delivering graduate level lectures, the preparation of problem sets, exams and the marking of research projects. For this course, the students rated my teaching ability with an average of 4.8 out of 5.

2005-2009 **PhD in Atmospheric Physics.** Imperial College London, UK.

Thesis title: Solar Influence on Stratosphere-Troposphere Dynamical Coupling

Supervisors: Prof Joanna Haigh (Department of Physics, Imperial College London) and Dr. Mike Blackburn (Department of Meteorology, University of Reading)

Synopsis: My PhD research involved the use of a simplified general circulation model to investigate the mechanisms whereby lower stratospheric temperature perturbations influence the tropospheric circulation. I proposed a mechanism whereby stratospheric heating perturbations result in a latitudinal shift of the mid-latitude westerlies through an influence on the propagation of synoptic scale atmospheric eddies. This is relevant for various climate forcings such as the 11 year solar cycle, ozone depletion and increased anthropogenic emissions of greenhouse gases. For this work I was awarded the Winton prize for the best PhD thesis in the physics department of Imperial College in 2009.

Pre-2005 In summer 2003 I undertook a research project investigating the accretion of material from the protoplanetary discs around young stars along their magnetic fields and for this work I was awarded the Cormack undergraduate astronomy research prize which led to me presenting my work at the Royal Society of Edinburgh. In summer 2004 I investigated the possible use of laser light scattering spectroscopy for the non-invasive early diagnosis of cervical cancer and I wrote an MPhys thesis on the use of Optical Gravitational Lensing to determine exoplanetary systems.

Publications

- Hitchcock, P. and **Simpson, I. R.** Quantifying eddy feedbacks and forcings in the tropospheric response to stratospheric sudden warmings, submitted to J. Atmos. Sci.
- Shaw, T. A., Baldwin, M., Barnes, E. A., Caballero, R., Garfinkel, C. I., Hwang, Y.-T., Li, C., O’Gorman, P., Riviere, G., **Simpson, I. R.** and Voigt, A. Understanding storm tracks and their response to climate change, submitted to Nature Geoscience
- **Simpson, I. R.** and Polvani, L. M. (2016) Revisiting the relationship between jet position, forced response and annular mode variability in the southern mid-latitudes. *Geophys. Res. Lett.*, 43, 2896–2903
- **Simpson, I. R.** (2016) Climate change predicted to lengthen transatlantic travel times. *Env. Res. Lett.*, 11, 024008 *Perspective Article*
- **Simpson, I. R.**, Seager, R., Ting, M. and Shaw, T. A. (2015) Causes of change in Northern Hemisphere winter meridional winds and regional hydroclimate. *Nature Climate Change*, 6, 65-70
- **Simpson, I. R.**, Seager, R., Shaw, T. A. and Ting, M. (2015) Mediterranean summer climate and the importance of Middle East Topography. *J. Clim.*, 27, 7921-7948
- Seager, R., Neelin, D., **Simpson, I. R.**, Liu, H., Henderson, N., Shaw, T. A., Kushnir, Y., Ting, M., Cook, B. (2014) Dynamical and thermodynamical causes of large-scale changes in the hydrological cycle over North America in response to global warming. *J. Clim.*, 27, 7921–7948
- Hitchcock, P. and **Simpson, I. R.** (2014), The Downward Influence of Stratospheric Sudden Warmings. *J. Atmos. Sci.*, 71, 3856–3876

- Seager, R., Liu, H., Henderson, N., **Simpson, I. R.**, Kelley, C., Shaw, T. A., Kushnir, Y., Ting, M. (2014) Causes of increasing aridification of the Mediterranean in response to rising greenhouse gases. *J. Clim.*, 27, 4655–4676, 4655–4676
- **Simpson, I.R.**, Shaw, T. A. and Seager, R. (2014) A diagnosis of the seasonally and zonally varying mid-latitude circulation response to global warming. *J. Atmos. Sci.*, 71, 2489–2515
- **Simpson, I. R.**, Shepherd, T. G., Hitchcock, P. and Scinocca, J. F. (2013) Southern Annular Mode dynamics in observations and models, part 2: eddy feedbacks, *J. Clim.*, 26, 5220-5241
- **Simpson, I. R.**, Hitchcock, P., Shepherd, T. G. and Scinocca, J. F. (2013) Southern Annular Mode dynamics in observations and models, part 1: the influence of climatological zonal wind biases in a comprehensive GCM, *J. Clim.*, 26, 3953-3967
- **Simpson, I. R.**, Blackburn, M. and Haigh, J. D. (2012) A mechanism for the effect of tropospheric jet structure on the annular mode-like response to stratospheric forcing. *J. Atmos. Sci.*, 69, 2152-2170
- **Simpson, I. R.**, Hitchcock, P., Shepherd, T. G. and Scinocca, J. F. (2011) Stratospheric variability and tropospheric annular mode timescales. *Geophys. Res. Lett.*, 38, L20806
- **Simpson, I. R.**, Shepherd, T. G. and Sigmond, M. (2011) Dynamics of the lower stratospheric circulation response to ENSO. *J. Atmos. Sci.*, 68, 2537-2556
- **Simpson, I. R.**, Blackburn, M., Haigh, J. D. and Sparrow, S. N. (2010) The impact of the state of the troposphere on the response to stratospheric heating in a simplified GCM. *J. Clim.*, 23, 6166-6185
- **Simpson, I. R.**, Blackburn, M. and Haigh, J. D. (2009) The role of eddies in driving the tropospheric response to stratospheric heating perturbations. *J. Atmos. Sci.*, 66, 1347-1365
- Gregory, S. G., Jardine M., **Simpson, I** and Donati, J.-F. (2006) Mass accretion onto T Tauri stars. *Mon. Not. Roy. Astron. Soc.*, 371

Grants and Fellowships

PI on NSF Large Scale Dynamics award AGS-1317469: Stratospheric and Tropical influences on the mid-latitude circulation response to global warming (661,453USD)

Lamont-Doherty Earth Observatory Postdoctoral Fellowship

Awards

Editors citation for excellence in refereeing, *Geophysical Research Letters*, 2014

Winton prize for best PhD thesis in Physics, Imperial College London.

Miller prize for highest degree mark in faculty of science, University of St Andrews.

Royal Society of Edinburgh, Cormack undergraduate astronomy research prize.

University of St Andrews Class medals in 1st, 2nd, 3rd and 4th year Astrophysics, 1st year Maths and 2nd year Physics,

William David Brodie prize for Junior Honours Physics, Scott Lang Prize for proficiency in Astrophysics, JF Allen prize for

2nd level Physics, Margaret Stewart Prize for 1st year Astronomy and Astrophysics

Invited talks and seminars

EGU general assembly, April 2016

Regional climate change workshop, University of Reading, April 2016

AGU Fall meeting, Dec 2015

Colorado State University, Department of Atmospheric Science colloquium, Dec 2015

University of Reading, Workshop on Atmospheric Angular Momentum Budgets, April 2014

Yale University, AOCD seminar series, Jan 2015

Stony Brook University, TAOS seminar series, May 2014

Massachusetts Institute of Technology, Dec 2013, EAPS MASS seminar series

Cornell University, Earth and Atmospheric Sciences, Sept 2013, seminar

NASA GISS, May 2013, seminar

Princeton University/GFDL, May 2013, seminar
SPARC DynVar workshop, April 2013, invited speaker
Australian Meteorological and Oceanographic Society Annual Meeting, Feb 2013, invited plenary speaker
Lamont-Doherty Earth Observatory, Jan 2013, OCP seminar
McGill University, Atmospheric and Oceanic Sciences, August 2012, seminar
University of Cambridge, DAMTP, April 2012, seminar
University of Oxford, AOPP, April 2012, seminar
University of Reading, Department of Meteorology, April 2012, NCAS seminar
Columbia University, October 2009, Applied Mathematics Colloquium
MOCA-09, July 2009, invited speaker
University of Toronto, Dec 2008, seminar
University of Oxford, AOPP, November 2008, seminar
ETH Zürich, August 2008, seminar
PMOD-WRC, August 2008, seminar
UK Met Office, July 2008, seminar
University College London, Department of Mathematics, May 2008, seminar
Massachusetts Institute of Technology, April 2008, EAPS, Mass seminar series
Royal Meteorological Society, March 2008, Postgraduate student evening
University of Reading, Department of Meteorology, May 2007, Strat-hour seminar series

Other skills, experience and community activities

Member of US Clivar working group on the expansion of the tropical belt
Convenor of AGU session, 2015
Member of the Scientific Organizing Committee for SPARC workshop on storm track processes, 2015
Highly proficient at Fortran 77/90 and IDL programming languages, UNIX, Windows and LaTeX.
Departmental seminar series organizer.
Teaching assistant in 2nd year undergraduate physics.
Editor of the Stratospheric Processes and their Role in Climate (SPARC) newsletter, autumn 2010
Attended the Geophysical and Environmental Fluid Dynamics summer school, University of Cambridge, UK
Attended the European Research Course on Atmospheres, Université Joseph Fourier, Grenoble, France