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Research Interests

My research interests lie in Earth System Modeling and in the use of these models to understand and predict Earth sytem variability at spatial scales ranging from the planetary to the regional and on timescales from seasonal to multi-decadal. I seek to determine robust responses to external forcings and their implications through a deeper understanding of the processes and mechanisms involved and to understand the origins of Earth sytem variability in the historical record. I am also interested in the biases that occur in Earth System Models and how they may be alleviated and what the implications of these biases are for our ability to predict Earth System variability. To date, I have focussed on the dynamics of the tropospheric mid-latitude circulation, regional hydroclimate, the coupled stratosphere-troposphere system, land-atmosphere coupling, historical trends in the observational record and their representation in models, the use of emergent constraints, and sub-seasonal to decadal prediction.

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

2022-.... **Scientist 3** Climate and Global Dynamics Labroatory, National Center for Atmospheric Research, USA.

2019-2022 **Scientist 2** Climate and Global Dynamics Laboratory, National Center for Atmospheric Research, USA.

2015-2019 **Scientist 1** Climate and Global Dynamics Laboratory, National Center for Atmospheric Research, USA.

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)

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

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

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)

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

- Martin, Z. K., **Simpson, I. R.**, Lin, P., Orbe, C., Tang, Q., Caron, J. M., Chen, C.-C., Kim, H., Leung, L. R., Richter, J. R., Xie, S. (2023) The Lack of a QBO-MJO Connection in Climate Models with a Nudged Stratosphere, JGR Atmospheres, 128, e2023JD038722
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- **Simpson, I. R.**, Rosenbloom, N., Danabasoglu, G., Deser, C., Yeager, S. G., McCluskey, C. S., Yamaguchi, R., Lamarque, J.-F., Tilmes, S., Mills, M. J., Rodgers, K. B., The CESM2 single forcing large ensemble and comparison to CESM1: Implications for Experimental Design, Journal of Climate, 36, 5687-5711, https://doi.org/10.1175/JCLI-D-22-0666.1
- Frolov, S., Rousseaux, C. S., Auligne, T., Dee, D., Gelaro, R., Heimbach, P., **Simpson, I. R.**, Slivinski, L (2023) Road Map for the Next Decade of Earth System Reanalysis in the United States, BAMS, 104, 706-714.
- Dai, Y., Hitchcock, P. **Simpson, I. R.** (2022) Dynamics and Impacts of the North Pacific Eddy-Driven Jet Response to Sudden Stratospheric Warmings, J. Clim., 36, 865–884
- Smith, D. M. and Gillett, N. P. and **Simpson, I. R.**, Athanasiadis, P. J. Baehr, J., Bethke, I., Bilge, T. A., Bonnet, R., Boucher, O., Findell, K. L., Gastineau, G., Gualdi, S., Hermanson, L., Leung, L, R., Mignot, J., Muller, W. A., Osprey, S., Ottera, O. H., Persad, G. G., Scaife, A. A., Schmidt, G. A., Shiogama, H., Sutton, R. T., Swingedouw, D., Yang, S., Zhou, T., Ziehn, T. (2022), Attribution of multi-annual to decadal changes in the climate system: The Large Ensemble Single Forcing Model Intercomparison Project (LESFMIP), Frontiers, 4
- McKinnon, K. A. and **Simpson, I. R.** How Unexpected Was the 2021 Pacific Northwest Heatwave? GRL, 49, e2022GL100380
- Karpechko, A. Y., Afargan-Gerstman, H., Butler, A. H., Domeisen, D. I. V., Kretschmer, M., Lawrence, Z., Manzini, E., Sigmond, M., **Simpson, I. R.**, Wu, Z. (2022), Northern Hemisphere Stratosphere-Troposphere Circulation Change in CMIP6 Models. Part 1: Inter-Model Spread and Scenario Uncertainty, JGR, 127, e2022JD036992
- Chen, R., **Simpson, I. R.**, Deser, C., Wang, B., Du, Y. (2022), Mechanisms behind the springtime North Pacific ENSO teleconnection bias in Climate Models, J. Clim., 35, 7691–7710
- Seager, R., Ting, M., Alexander, P., Nakamura, J., Liu, H., Li, C. and **Simpson, I. R.** Mechanisms of a meteorological drought onset: summer 2020 to spring 2021 in southwestern North America, J. Clim., 35, 7367–7385
- Wieder, W. R., Kennedy, D., Lehner, F., Musselman, K. N., Rodgers, K. B., Rosenbloom, N., **Simpson, I. R.** and Yamaguchi, R. (2022), Pervasive alterations to snow-dominated ecosystem functions under climate change, PNAS
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- Yeager, S. G., Rosenbloom, N., Glanville, A. A., Wu, X., **Simpson, I.R.**, Li, H., Molina, M. J., Krumhardt, K., Mogen, S., Lindsay, K., Lombardozzi, D., Wieder, W., Kim, W. M., Richter, J. H., Long, M., Danabasoglu, G., Bailey, D., Holland, M., Lovenduski, N., Strand, W. G. (2022), The Seasonal-to-Multiyear Large Ensemble (SMYLE) Prediction System using the Community Earth System Model Version 2 , GMD, 15, 6451–6492
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- **Simpson, I. R.**, Lawrence, D. M., Swenson, S. C., Hannay, C., McKinnon, K. A., Truesdale, J. E. (2022) Improvements in wintertime surface temperature variability in the Community Earth System Model version 2 (CESM) https://doi.org/10.1029/2021MS002880
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- Charlton-Perez, A. J., Brocker, J., Karpechko, A. Y., Lee, S. H., Sigmond, M. and **Simpson, I. R.** (2021) A minimal model to diagnose the contribution of the stratosphere to tropospheric forecast skill, J. G. R. Atmospheres, https://doi.org/10.1029/2021JD035504
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- Cheng, W., MacMartin, D. G., Dagon, K., Kravitz, B., Tilmes, S., Richter, J. H., Mills, M. J.,**Simpson, I. R.**, Soil moisture and other hydrological changes in a stratospheric aerosol geoengineering large ensemble, JGR-Atmospheresi, 124, 12773-12793

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- **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 award 2311376: Sustainability: Atmospheric Physics Needs for Community Climate Modeling (998 699 USD)
PI on NOAA award NA23OAR4310634: Understanding and resolving a global discrepancy in near surface water vapor trends between models and observations (748 436 USD)
Co-PI on NOAA award: Confronting climate model trends with observations: extratropical storm tracks and their associated extreme events" (Unfunded at NCAR, 573 358 USD to U. Chicago)
PI on NOAA award NA20OAR4310413: An improved understanding of the interacting factors that influence the evolution and severity of droughts in the USA in present and future climates (509 960USD)
Co-PI on NSF award 2004575: Cyberinfrastructure for streamlining coupled, simplified climate modeling within the Community Earth System Model (599 969USD)
Co-PI (Karen McKinnon PI) on NSF award 1939988: The factors governing the daily near-surface air temperature variability over land (619 945 USD)
PI on NSF award 000057-00414: Extending the atmospheric model hierarchy within CESM (274,091USD)
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

AGU Atmospheric Sciences Ascent Award, 2021
AMS Bernhard Haurwitz memorial lecturer, 2021
AMS Clarence Leroy Meisinger Award, 2021
Editors award, Journal of Climate, 2019
Editors citation for excellent in refereeing, Geophysical Research Letters, 2018
Outstanding reviewer award, Environmental Research Letters, 2018
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 1^{st}, 2^{nd}, 3^{rd} and 4^{th} year Astrophysics, 1^{st} year Maths and 2^{nd} year Physics, William David Brodie prize for Junior Honours Physics, Scott Lang Prize for proficiency in Astrophysics, JF Allen prize for 2^{nd} level Physics, Margaret Stewart Prize for 1^{st} year Astronomy and Astrophysics

Invited talks and seminars

University of Illinois, Urbana-Champaign seminar, Sept 2023
ACCESS model science meeting, invited plenary speaker, Sept 2023
Gordon conference on climate and radiation, invited presentation, July 2023
Max-Plank Insitute for Meteorology colloquium, Hamburg, June 2023
Ludwig Maximillian University seminar, Munich, June 2023
National Academies of Science Engineering and Medicine, BASC board meeting panel member, May 2023
Wgener Center seminar, University of Gratz, April 2023
Scripps Intitute for Oceanography, seminar and journal club, April 2023
Purdue University atmospheric science seminar, April 2023
CU Applied Math Colloquium, Feb 2023
GFDL seminar, Feb 2023
AMS annual meeting invited townhall panelist, Jan 2023
SPARC General Assembly plenary talk, Oct 2022
NASA GMAO seminar, Oct 2022
Haurwitz Lecture, AOFD, June 0222

ETH Zurich Colloquium, May 2022
Princeton University atmospheric science colloquium, April 2022
University of Wisconsin Madison, Atmospheric science colloquium, Feb 2022
Haurwitz Lecture, AMS, Jan 2022
UC Berkeley atmospheric science seminar, Nov 2021
Colorado State University Colloquium, Oct 2021
NOAA/NIDIS southwest drought forum, Sept 2021
American Water Works Association, Aug 2021
Cornell University seminar series, Feb 2021
Lamont-Doherty Earth Observatory seminar series, Feb 2021
NCAR-USACE meeting on Earth System Model selection, Feb 2021
AGU, invited presentation, Dec 2020
University of Washington, Atmospheric sciences colloquium, Oct 2020
Stanford university seminar, June 2020
Imperial college london seminar, June 2020
University of Reading seminar series, June 2020
USClivar webinar on simpler models within CESM, May 2020
WCRP/SPARC SATIO-TCS stratosphere-troposphere coupling in the tropics workshop, Kyoto, Japan, Feb 22nd
CSU Atmospheric science seminar series, Jan 2020
UT Austin Institute of Geophysics seminar series, Jan 2020
AGU Fall meeting 2019 Centennial speaker
AGU Fall meeting 2019
FSU Earth, Oceanic and Atmospheric sciences colloquium, November 2019
Harvard EPS colloquium, September 2019
CMIP6 session, USClivar summit, Aug 2019 (presented remotely)
Panelist on National Academies meeting for geoengineering report, Aug 2019
ACSIS summer science meeting, Plenary Speaker, Cambridge UK, July 2019
NYU, CAOS colloquium March 2019
Workshop on high resolution modelling, Feb 2019, (presented remotely)
Heldfest, Oct 2018
Stormtracks workshop, Stockholm, Sept 2018
University of Utah, Department of Atmospheric Science seminar series, Feb 2018
AGU Fall meeting, Dec 2017
ASPEN Global Change Institute workshop on Earth System Model Evaluation, Aug 2017
ESIP summer meeting, Invited plenary speaker and panelist, July 2017
Denver-Boulder Chapter of the American Meteorological Society, monthly meeting March 2017
Geophysical Fluid Dynamics Laboratory Seminar, Dec 2016
University of Toronto, Brewer Atmospheric Physics Seminar, Sept 2016
ECMWF workshop on drag processes and their role in the large scale circulation, Sept 2016
NOAA physical sciences division seminar series, July 2016
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

Synergistic Activities

Co-chair of Detection and Attribution Model Intercomparison Project for CMIP7
Co-lead of the strategic ensemble design task team for CMIP7
Editorial board member of Environmental Research Climate
Lead the re-write of the AMS statement on geoengineering, 2021-2022
Co-chair of CESM climate variability and change working group (2021-present)
Co-lead of NOAA drought task force 4 (2020-present)
Editor, Journal of Climate (2020-present)
Member of the NOAA CPO/EESM council (2020-present
AGU member of the selection committee for the Ascent award (2023)
AGU chair of the climate communication prize selection committee (2022-2023)
AMS Haurwitz lecturer selection committee (2020), Walter Orr Roberts selection committee (2023)
Member of SPARC strategy task team
Section editor, Current Climate Change Reports on “Advances and future directions in Earth System Modelling”, 2020
Program chair, Climate Variability and Change, AMS 2020
Organizing committee member of USClivar CMIP6 hackathon, 2019
Conference organizing committee member, USClivar workshop on large ensembles, 2019
Contributing author to Mediterranean Assessment Report 1 (MAR1) 2019
Section editor, Current Climate Change Reports on “Mid-latitude processes and climate chnage”, 2019
Lead CESM tutorials at AGU 2018 and AMS 2019
Reviewer on NSF panel
Associate editor, Journal of Climate
Member of the SPARC Stratospheric Network for the Assessment of Predictability (SNAP) committee
Member of US Clivar working group on the expansion of the tropical belt
Member of US Clivar working group on large ensembles
Member of AMS Atmospheric and Oceanic Fluid Dynamics Committee
Member of AMS Climate Variability and Change Committee
Convenor of AGU sessions, 2015, 2016, 2017, 2018, 2019
Member of the Scientific Organizing Committee for SPARC workshop on storm track processes, 2015
Editor of the Stratospheric Processes and their Role in Climate (SPARC) newsletter, autumn 2010
NSF panel reviewer
Reviewer for J. Clim., J. Atmos. Sci., Clim. Dyn., GRL, ERL, Atmospheric Science Letters, QJRMS, JAMES, JGR, Nature, Nature Geoscience, Nature Climate Change, Nature Scientific Reports, Science, Science Advances

Other skills and experience

Highly proficient at Python, Fortran 77/90, IDL and NCL programming languages, UNIX, Windows and LaTeX.
Departmental seminar series organizer (Imperial College, LDEO and NCAR).
Teaching assistant in 2nd year undergraduate physics.
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