

Neil Lewis

Leverhulme Trust Early Career Fellow

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The aim of my research is to develop a general understanding of the fluid flows that occur in planetary and stellar environments, using a combination of theory and numerical simulation. I am particularly interested in synthesising approaches to studying geophysical and astrophysical fluids that have been developed by different, independent communities working on problems across meteorology and climate science, planetary science, and astrophysics.

EMPLOYMENT HISTORY

Present April 2026	Leverhulme Trust Early Career Fellow, Department of Mathematics and Statistics, University of Exeter <i>Project Title:</i> A New Approach to Studying Polar Atmospheric Dynamics on Jupiter. <i>Topic:</i> I am developing a numerical model of Jupiter's atmospheric dynamics that embeds high-resolution simulation of the polar regions within a global atmospheric model. Using this technique, I will interrogate theories and idealised models proposed to explain observations of geometric clusters of cyclones at Jupiter's poles. <i>Collaborators:</i> Prof. Juan Lora and Caleb Keaveny (Yale), Dr. Lucas Harris (GFDL, Princeton). <i>Other active research areas:</i> ➤ Dynamics and scaling properties of rotating, thermal convection (w/ Prof. Matthew Browning, Exeter). ➤ Properties of shallow water turbulence on the sphere (w/ Dr. Richard Scott, St. Andrews).
March 2026 April 2024	Postdoctoral Research Fellow, Department of Physics and Astronomy, University of Exeter <i>Topic:</i> Investigating the mechanisms that generate zonal flows in the Solar convection zone, using novel simulations of 'internally heated and cooled' spherical shell convection, constructed using the PDE solver <i>Dedalus</i> . <i>Advisor:</i> Prof. Matthew Browning.
March 2024 May 2022	Postdoctoral Research Fellow, Department of Mathematics and Statistics, University of Exeter <i>Topic:</i> Connecting the climate response to Arctic sea-ice loss —as predicted by sophisticated climate models— to basic theory in geophysical fluid dynamics using idealised simulations of atmospheric circulation. <i>Advisor:</i> Prof. James Screen.

EDUCATION

2022	DPhil Atmospheric, Oceanic and Planetary Physics, University of Oxford <i>Thesis:</i> Atmospheric Circulation on Slowly Rotating Planets in the Solar System, and Beyond. PDF . <i>Supervisor:</i> Prof. Peter Read.
2018	MSci Mathematics, University of Exeter (1st Class) <i>Dissertation:</i> Climate Dynamics of Planets with Elliptical Orbits. <i>Supervisor:</i> Prof. Geoffrey Vallis.

FUNDING

Application Submitted		
2026	Software Sustainability Institute Research Software Maintenance Fund.	(Co-I; £100,000)
Funding Awarded		
2026	High performance compute time on STFC DiRAC Facility.	(PI; 8.8 MCPUh)
2026	High performance compute time on STFC DiRAC Facility.	(Co-I; 15.8 MCPUh)
2025	Leverhulme Trust Early Career Research Fellowship.	(PI; £102,000)
2024	Funding from Institute for Pure and Applied Mathematics to attend workshop in Los Angeles, USA.	(PI; £1,200)
2023	Observing time on James Webb Space Telescope (GTO 3838).	(Co-I; 49.21 Primary Spacecraft Hours)
2019	Fujihara Foundation travel award to attend International Venus Conference in Hokkaido, Japan.	(PI; £1,500)
2017	London Mathematical Society Undergraduate Research Bursary.	(PI; £2,000)

AWARDS

- 2025 Awarded Leverhulme Trust Early Career Fellowship.
- 2024 Recognised amongst *Best Reviewers of the Year* for the journal *Icarus* during 2023-2024. [🔗](#)
- 2021, 2022 Graduate Scholarship, Trinity College, University of Oxford.
- 2020 Graduate Prize, Trinity College, University of Oxford.
- 2018 Mathematics Research Institute Prize, University of Exeter.

TEACHING AND SUPERVISION

I have given lectures on introductory vector calculus, geophysical fluid dynamics, and mathematical aspects of climate science. To deliver engaging lectures, I have incorporated programming and results from numerical simulations alongside traditional derivation of analytical results. Alongside lecturing, I have experience supervising bachelor's and master's research projects, and have co-supervised three PhD students.

Lecturing

- Since 2022 Guest Lecturer (7 one-hour lectures to date) on masters level (MMath and MSc) modules covering Geophysical Fluid Dynamics and Climate Science (Univ. Exeter). ~20 students.
- 2026 Guest Lecturer (1 one-hour lecture) for BSc/MPhys Physics 3rd year module *Fluid Dynamics in Physics and Astronomy* (Univ. Exeter). ~40 students.

Supervision of PhD Students

Formal Co-supervision:

- 2025 – Zexi Sun (Mathematics, Univ. Exeter; primary supervisor: Dr. S. Thomson).

Informal Co-supervision:

- 2024 – 2026 Tom Joshi–Hartley (Astrophysics, Univ. Exeter; primary supervisor: Prof. M. Browning).
- 2024 – 2025 Michele Filippucci (visiting student) (Mathematics, Univ. Exeter; co-supervisor: Dr. S. Thomson; primary supervisor: Prof. S. Bordoni, Univ. Trento, Italy). *Graduated with Honours* (2026).

Supervision of bachelor's / master's research projects

- Since 2022 I have supervised six students to date (two as lead supervisor, four as co-supervisor).
One MSci Natural Sciences student in 2022 – 2023; one MSc Weather and Climate student in 2024; two MPhys Physics students in 2025 – 2026; two BSc Natural Sciences students in 2024 – 2025 (all Univ. Exeter).

Other teaching

- 2019 – 2020 Tutorial leader for final year Atmospheric Physics course, Univ. Oxford. ~6 students.
- 2019 – 2020 Atmospheric Physics lab demonstrator, Univ. Oxford.

LEADERSHIP AND MANAGEMENT

- Since 2026 Co-lead, Early Career Researcher Network, Dept. Mathematics & Statistics, Univ. Exeter.
- Since 2024 Organiser, *Geophysical and Astrophysical Fluids* seminar series, Dept. Mathematics & Statistics, Univ. Exeter.
- 2024 Session Co-convenor, PS5.2 Obs. and Modeling of Planets within the Solar System and Beyond, *EGU*, Vienna.
- 2023 Session Chair, A43J Polar Amplification and Connection to Weather and Climate (abridged), *AGU*, San Francisco.
- 2023 Attended *Leadership Essentials* course, Univ. Exeter.

CITIZENSHIP

- Since 2024 Volunteer, *Exeter Scholars* widening participation programme, Univ. Exeter.
I lead a 'real or fake planet?' exercise, where groups of school students discuss images of planetary environments and determine whether they are real, or computer generated.
- 2022, 2023 Judge for Outstanding Student Presentation Awards, *AGU Fall Meeting*, Chicago (2022) and San Francisco (2023).
- 2019 Local Organising Committee, *Exoclines V Conference*, Oxford.
- 2019 Outreach Volunteer, *Stargazing*, Univ. Oxford.

Peer Review

I have reviewed articles for: *J. Geophys. Res. (Planets)*, *Planet. Space Sci.*, *Astrophys. J.*, *Quart. J. Roy. Meteorol. Soc.*, *Icarus*, *Geophys. Res. Lett.*, *J. Atmos. Sci.*, *Planet. Sci. J.*, *Nature Geosci.*, and *Nature*.

LIST OF PUBLICATIONS

23 peer reviewed publications (eight as lead author) cited 690 times . A further five publications are currently in preparation or submitted. A † denotes a student for which I was a co-supervisor.

In Preparation

28. **Lewis, N. T.**, T. Joshi–Hartley†, M. K. Browning, et al. Heat and Momentum Transport in Internally Heated and Cooled Rotating Spherical Shell Convection, for submission to *Astrophys. J.*
27. Joshi–Hartley, T.†, M. K. Browning, **N. T. Lewis**, et al. Thermal Convection Driven by Internal Heating and Cooling Layers: Sensitivity to Layer Thickness, for submission to *Mon. Not. Roy. Astronom. Soc.*
26. Boukrouche, R., R. Caballero, and **N. T. Lewis**. Infrared Atmospheric Heating Hampers the Habitability of M-star Planets, for submission to *Astrophys. J.*

Submitted

25. Dang, L., J. K. Teske, R. T. Pierrehumbert, et al. (incl. **N. T. Lewis**). NIRSPEC Phase Curve Reveals a Highly Reflective Atmosphere on the USP Super-Earth TOI-561 b, submitted to *Astrophys. J.*
24. Filippucci, M.†, S. I. Thomson, **N. T. Lewis**, and S. Bordonni. The Response of Atmospheric Blocking to Arctic Warming (abridged), submitted to *J. Adv. Model. Earth Sys.*, preprint: arXiv:2606.21503.

Published (Lead author)

23. **Lewis, N. T.**, T. Joshi–Hartley†, L. K. Currie, S. M. Tobias, and M. K. Browning. Diffusion-free Dynamics in Rotating Spherical Shell Convection (abridged), *Astrophys. J.*, 2026, doi: 10.3847/1538-4357/ae2ea8.
22. **Lewis, N. T.**, M. R. England, J. A. Screen, et al. Spurious Impacts of Ice-Constraining Methods on the Climate Response to Sea-Ice Loss (abridged), *J. Clim.*, 2024, doi: 10.1175/JCLI-D-24-0153.1.
21. **Lewis, N. T.**, H. E. Roberts–Straw†, W. J. M. Seviour, and J. A. Screen. The Response of Surface Temperature Persistence to Arctic Sea-Ice Loss, *Geophys. Res. Lett.*, 2024, doi: 10.1029/2023GL106863.
20. **Lewis, N. T.**, P. L. Read, N. A. Lombardo, and J. M. Lora. Equatorial Waves and Superrotation in the Stratosphere of a Titan General Circulation Model, *Planet. Sci. J.*, 2023, doi: 10.3847/PSJ/ace76f.
19. **Lewis, N. T.**, and M. Hammond. Temperature Structures Associated with Different Components of the Atmospheric Circulation on Tidally Locked Exoplanets, *Astrophys. J.*, 2022, doi: 10.3847/1538-4357/ac8fed.
18. Hammond, M., and **N. T. Lewis**. The Rotational and Divergent Components of Atmospheric Circulation on Tidally Locked Planets, *Proc. Nat. Acad. Sci.*, 2021, doi: 10.1073/pnas.2022705118.
(authors listed in alphabetical order with equal contribution.)
17. **Lewis, N. T.**, G. J. Colyer, and P. L. Read. Characterizing Regimes of Atmospheric Circulation in Terms of Their Global Superrotation, *J. Atmos. Sci.*, 2021, doi: 10.1175/JAS-D-20-0326.1.
16. **Lewis, N. T.**, F. H. Lambert, I. A. Boutle, et al. The Influence of a Sub-stellar Continent on the Climate of a Tidally-locked Exoplanet, *Astrophys. J.*, 2018, doi: 10.3847/1538-4357/aaad0a.

Published (Contributing author)

15. Boukrouche, R., R. Caballero, and **N. T. Lewis**. Near the Runaway: The Climate and Habitability of Teegarden’s Star b, *Astrophys. J. Lett.*, 2025, doi: 10.3847/2041-8213/ae122a.
14. Joshi–Hartley, T.†, M. K. Browning, L. K. Currie, **N. T. Lewis**, et al. Heat Transport in Rotating Internally Heated and Cooled Convection (abridged), *Mon. Not. Roy. Astronom. Soc.*, 2025, doi: 10.1093/mnras/staf1131.
13. McKim, B. A., N. Jeevanjee, G. K. Vallis, and **N. T. Lewis**. Water Vapor Spectroscopy and Thermodynamics Constrain Earth’s Tropopause Temperature, *AGU Adv.*, 2025, doi: 10.1029/2024AV001206.
12. Hammond, M., **N. T. Lewis**, S. Boone, et al. Identifying and Fitting Eclipse Maps of Exoplanets with Cross-Validation, *Mon. Not. Roy. Astronom. Soc.*, 2024, doi: 10.1093/mnras/stae1761.
11. Hammond, M., T. J. Bell, R. C. Challener, **N. T. Lewis**, et al. Two-Dimensional Eclipse Mapping the Hot-Jupiter WASP-43b with JWST MIRI/LRS, *Astronom. J.*, 2024, doi: 10.3847/1538-3881/ad434d.
10. Mudhar, R., W. J. M. Seviour, J. A. Screen, et al. (incl. **N. T. Lewis**). Exploring Mechanisms for Model-Dependency of the Stratospheric Response to Arctic Warming, *J. Geophys. Res. (Atmos.)*, 2024, doi: 10.1029/2023JD040416.
9. Bell, T. J., N. Crouzet, P. E. Cubillos, et al. (incl. **N. T. Lewis**). Nightside Clouds and Disequilibrium Chemistry on the Hot Jupiter WASP-43b, *Nature Astronom.*, 2024, doi: 10.1038/s41550-024-02230-x.
8. Geen, R., S. I. Thomson, J. A. Screen, et al. (incl. **N. T. Lewis**). The Midlatitude Jet-Waviness Response to Polar Warming (abridged), *Geophys. Res. Lett.*, 2023, doi: 10.1029/2023GL105132.
7. Hammond, M., N. J. Mayne, W. J. M. Seviour, et al. (incl. **N. T. Lewis**). Shallow-Water Modelling of the Atmospheres of Brown Dwarfs (abridged), *Mon. Not. Roy. Astronom. Soc.*, 2023, doi: 10.1093/mnras/stad2265.
6. Coulombe, L.–P., B. Benneke, R. Challener, et al. (incl. **N. T. Lewis**). A Broadband Thermal Emission Spectrum of the Ultra-Hot Jupiter WASP-18b, *Nature*, 2023, doi: 10.1038/s41586-023-06230-1.

5. Sergeev, D., **N. T. Lewis**, F. H. Lambert, et al. Bistability of the Atmospheric Circulation on TRAPPIST-1e, *Planet. Sci. J.*, 2022, doi: 10.3847/PSJ/ac83be.
4. Patterson, M., T. Woollings, T. Bracegirdle, and **N. T. Lewis**. Southern Hemisphere Jet Streams Shaped by Interaction of Transient Eddies and Orography (abridged), *J. Clim.*, 2020, doi: 10.1175/JCLI-D-20-0153.1.
3. Lambert, F. H., P. G. Challenor, **N. T. Lewis**, et al. Continuous Structural Parameterization: A Proposed Method for Representing Different Model Parameterizations Within One Structure Demonstrated for Atmospheric Convection, *J. Adv. Model. Earth. Sys.*, 2020, doi: 10.1029/2020MS002085.
2. Read, P., D. Kennedy, **N. Lewis**, et al. Baroclinic and Barotropic Instabilities in Planetary Atmospheres: Energetics, Equilibration and Adjustment, *Nonlin. Proc. Geophys.*, 2020, doi: 10.5194/npg-27-147-2020.
1. Ruan, T., **N. T. Lewis**, S. R. Lewis, et al. Investigating the Semiannual Oscillation on Mars using Data Assimilation, *Icarus*, 2019, doi: 10.1016/j.icarus.2019.06.012.

EXTERNAL PRESENTATIONS

Seminars and Colloquia (Upcoming)

28. Investigating the Atmospheric Circulation Response to Sea-Ice Loss with Idealised Model Experiments. *Department of Earth and Planetary Sciences, Yale University, 2026.*
27. GFDL Goes to the Stars! Applying GFDL Models to Study Solar System Atmospheric Dynamics. *Weather and Climate Dynamics Division, NOAA Geophysical Fluid Dynamics Laboratory, 2026.*

Seminars and Colloquia

26. Adventures with Isca: A Framework for Modeling the Atmospheres of the Earth and Other Planets. *Climate Dynamics Group, DICAM, Università di Trento, 2026.*
25. Diffusion-Free Dynamics in Rotating Spherical Shell Convection Driven by Internal Heating and Cooling. *Solar Physics Group, Joint SwRI / University of Colorado Boulder (online), 2025.*
24. Diffusion-Free Dynamics in Rotating Spherical Shell Convection Driven by Internal Heating and Cooling. *Department of Mathematics, University of Bath, 2025.*
23. Adventures with Isca: A Framework for Modeling the Atmospheres of the Earth and Other Planets. *Department of Meteorology, Stockholm University, 2025.*
22. Equatorial Jet Streams in the Atmospheres of Solar System Planets, the Sun, and Exoplanets. *Department of Astronomy, Stockholm University, 2025.*
21. Equatorial Jet Streams in the Atmospheres of Solar System Planets, the Sun, and Exoplanets. *Department of Physics, University of Bristol, 2025.*
20. Equatorial Superrotation in Solar System Atmospheres, and Beyond. *Atmosphere–Ocean Dynamics Group, DAMTP, University of Cambridge, 2025.*
19. Atmospheric Circulation on Tidally Locked Planets: From Theory to Observations in the Era of JWST. *Department of Earth and Planetary Sciences, Yale University (online), 2022.*
18. The Dependence of Global Superrotation on Planetary Rotation Rate. *Institut des Géosciences de l'Environnement, Université Grenoble Alpes (online), 2020.*

Conference Presentations (Oral)

17. Diffusion-Free Dynamics in Rotating Spherical Shell Convection Driven by Internal Heating and Cooling. *Fluid Flow and Magnetic Dynamos, Congressi Stefano Franscini, Ascona, 2025.*
16. The Response of Surface Temperature Persistence to Arctic Sea-Ice Loss. *ArctiCONNECT Consortium Meeting, University of Exeter, 2024.*
15. What is the 'True' Impact of Sea-Ice Loss on Northern Hemisphere Weather and Climate? *AGU Fall Meeting, Moscone Centre, San Francisco, 2023.*
14. What is the 'True' Contribution of Sea-Ice Loss to Climate Change? *ArctiCONNECT Consortium Meeting, Dartington Hall, Totnes, 2023.*
13. Rotational and Divergent Components of Circulation on Tidally Locked Terrestrial Exoplanets (abridged). *Exoplanet Atmospheres Discussion Meeting, Royal Astronomical Society (online), 2022.*
12. Planetary and Atmospheric Properties Leading to Strong Superrotation in Terrestrial Atmospheres (abridged). *EGU General Assembly (online), 2021.*
11. Rotational and Divergent Components of Atmospheric Circulation on Tidally Locked Planets. *UK Exoplanet Community Meeting (pre-recorded, online), 2021.*
10. The Dependence of Global Superrotation on Planetary Rotation Rate. *The Dynamics of Rotating Fluids, Department of Mathematics, UCL, 2020.*

Conference Presentations (Poster)

9. A New Approach to Studying Polar Atmospheric Dynamics on Jupiter.
Fluid Flow and Magnetic Dynamos, Congressi Stefano Franscini, Ascona, 2025.
8. Spherical Shell Rotating Convection Driven By Internal Heating and Cooling.
Rotating Turbulence: Bulk and Boundary Dynamics, Institute for Pure and Applied Mathematics, UCLA, 2025.
7. Rotational and Divergent Components of Atmospheric Circulation on Tidally Locked Planets.
AGU Fall Meeting, Moscone Centre, San Francisco, 2023.
6. What is the 'True' Impact of Sea-Ice Loss on Northern Hemisphere Weather and Climate?
EGU General Assembly, Austria Center Vienna, Vienna, 2023.
5. Response of the Midlatitude Jet and Atmospheric Waves to Arctic Amplification (abridged).
AGU Fall Meeting, McCormick Place Convention Center, Chicago, 2022.
4. The Dependence of Global and Local Metrics of Superrotation on Planetary Rotation Rate.
EGU General Assembly (online), 2020.
3. What Controls Superrotation in Planetary Atmospheres? (abridged)
Exoclines V, Merton College, Oxford, 2019.
2. What Controls the Strength of Superrotation in Terrestrial Atmospheres?
International Venus Conference 2019, Hilton Niseko Village, Hokkaido, 2019.
1. The Influence of a Sub-Stellar Continent on the Climate of a Tidally Locked Exoplanet.
Met Office Academic Partnership Poster and Presentation Event, Met Office, Exeter, 2018.