

Raymond T. Pierrehumbert

University of Oxford
Atmospheric, Oceanic and Planetary Physics
Parks Road
Oxford OX1 3PU
United Kingdom
+44 (0)1865 272892
raymond.pierrehumbert@physics.ox.ac.uk
<https://users.physics.ox.ac.uk/~pierrehumbert>

RESEARCH INTERESTS Physics of climate, especially regarding the long term evolution of the climates of solar system and extrasolar planets. Water vapor and global change. Baroclinic instability. Hamiltonian chaos and fluid mixing.

EDUCATION ♦ **Massachusetts Institute of Technology**, Cambridge, MA
Ph.D. March, 1980 (Dept. of Aeronautics and Astronautics)
♦ **University of Cambridge** Cambridge, England
Knox Fellow, 1976-1977 (Dept. of Applied Mathematics and Theoretical Physics)
♦ **Harvard College**, Cambridge, MA
A.B. Magna cum Laude in Physics June, 1975

POSITIONS AND FELLOWSHIPS ♦ **Halley Professor of Physics** University of Oxford, 2015-present
♦ **Professorial Fellow** Jesus College, Oxford, 2015-present
♦ **Kung Karl XVI Gustaf Professorship** (visiting), Stockholm 2014-2015
♦ **Louis Block Professor** University of Chicago, 2005-2015
♦ **Professor in Geophysical Sciences** University of Chicago, 1989-2015
♦ **Directeur de Recherche** Ecole Polytechnique, France (2003-2004, visiting position)
♦ **John Simon Guggenheim Fellow** Laboratoire de Meteorologie Dynamique, Ecole Normale Supérieure, Paris. 1996/1997 (sabbatical visit)
♦ **Professor of Geology and Geophysics** Princeton University 1988-1989
♦ **Guest Investigator** Stockholms Universitet, Meteorologiska Institutionen 1987/1988 (sabbatical visit)
♦ **Research Scientist** Geophysical Fluid Dynamics Laboratory/NOAA. 1982-1988.
Concurrent appointments at Princeton University: Visiting Lecturer with Rank of Associate Professor (Atmospheric & Oceanic Sciences Program), Affiliated Faculty Member, Applied & Computational Mathematics Program.
♦ **Assistant Professor of Meteorology** Massachusetts Institute of Technology, 1980-1982

AWARDS ♦ **John Simon Guggenheim Fellow**
♦ **Fellow, American Geophysical Union**
♦ **Chevalier de l'Ordre des Palmes Academiques**
♦ **Kung Karl XVI Gustaf Professorship (visiting), Stockholm 2014-2015**
♦ **Fellow, American Academy of Arts and Sciences**

◇ **PhD. *honoris causa*, Stockholms University**

SELECTED
PROFES-
SIONAL
ACTIVITIES

- ◇ Scientific Advisory Board, Bolin Center for Climate Research, Stockholm
- ◇ Science and Security Board, *Bulletin of the Atomic Scientists*
- ◇ Editorial board, *Annual Reviews of Earth and Planetary Science*.
- ◇ Co-organizer *Exoclines 2012*, Aspen, CO, *Exoclines 2014*, Davos, CH and *Exoclines 2016*, Vancouver, BC.
- ◇ Co-author National Research Council Report on Climate Intervention
- ◇ Co-author National Research Council Report on Climate Stabilization Targets
- ◇ Member, National Research Council Board on Atmospheric Science and Climate, 2009-2014
- ◇ Member, City of Chicago Mayor's Task Force on Climate Change, 2007-2008
- ◇ Co-organizer, 2008 Kavli Institute of Theoretical Physics Program on Physics of Climate.
- ◇ Lead Author, Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report (1997-2001)
- ◇ Member, National Research Council Panel on Abrupt Climate Change and its Societal Impacts (2000-2001).
- ◇ Editor, Journal of the Atmospheric Sciences (1988-1991)

PHD
STUDENTS

- ◇ **B. Reinhold** (PhD, MIT 1981) Dynamics of Weather Regimes: Quasi-Stationary Waves & Blocking
- ◇ **D. Dritschel** (PhD, Princeton 1984) The Stability of Certain two dimensional and three dimensional Vortical Motions
- ◇ **J. Bacmeister** (Princeton GFD program, PhD 1987) Nonlinearity in Transient two dimensional flow over topography.
- ◇ **B. Carissimo** (Princeton GFD program, PhD Aug. 1987) Observation and modelling of drag during transient airflow over mountains
- ◇ **F. Parham** (Princeton Appl. Math. PhD. June 1988) Rossby wave critical levels in a baroclinic atmosphere.
- ◇ **S. Lin** (Princeton GFD program, PhD. July 1988) The instability mechanism of synoptic scale eddies
- ◇ **K. Lamb** (Princeton Appl. Math, PhD. July 1988) Nonlinear gravity wave critical levels
- ◇ **M. Dahleh** (Princeton Appl. Math 1989) Subject: Discrete vortex methods on the beta plane
- ◇ **J. Anderson** (Princeton GFD program 1989, jointly advised with Isaac Held) Subject: Numerical methods for large non Hermitian eigenvalue problems
- ◇ **Kyle Swanson** (U. of C. Geophysical Sciences, Ph.D 1995) Subject: Storm tracks and low frequency variability
- ◇ **Stefanella Boatto** (U. of C. Physics, Ph.D 1995) Subject: Chaotic mixing by aperiodic flows.
- ◇ **Yongyun Hu** (U. of C. Geophysical Sciences PhD 2001) Subject: Atmospheric stirring and mixing.
- ◇ **Hui Zhang** (U. of C. Geophysical Sciences PhD 2002) Tropical upper tropospheric water vapor distribution.
- ◇ **Jai Sukhatme** (U. of C. Geophysical Sciences PhD 2003) Subject: Multifractal and stochastic models in geophysics
- ◇ **Jude Sabado** (U. of C. Geophysical Sciences PhD 2006) Subject: Baroclinic instability on Early Mars

- ◇ **Jonathan Mitchell** (U. of C. Astrophysics PhD 2007) Subject: Climate Dynamics of Titan
- ◇ **Ian N. Williams** (U. of C. Geophysical Sciences PhD 2011) Subject: Tropical convection and Climate Sensitivity

- ◇ **Dawei Li** (U. of C. Geophysical Sciences PhD, in progress) Subject: Sea glaciers and neoproterozoic climate

- ◇ **Feng Ding** (U. of C. Geophysical Sciences PhD, in progress) Subject: GCM modeling of exoplanet climates

- ◇ **Andrew Malone** (co-supervised) (U. of C. Geophysical Sciences PhD, in progress) Subject: Mountain glaciers as climate proxies

- ◇ **Jonah Bloch-Johnson** (co-supervised) (U. of C. Geophysical Sciences PhD, in progress) Subject: Bifurcations and climate sensitivity
- ◇ **Mark Hammond** (Oxford DPhil, in progress) Subject: Atmospheric dynamics of tidelocked exoplanets
- ◇ **Claudia Jones** (Oxford DPhil, in progress) Subject: Climate of the Devonian: implications for evolution of tetrapods
- RJ Graham (Oxford DPhil, matriculating Michaelmas 2018)
- Ryan Boukrouche (Oxford DPhil, matriculating Michaelmas 2018)

RECENT
POSTDOCS

- ◇ **Huijun Yang**
- ◇ **Keith Ngan**
- ◇ **Chris Poulsen**
- ◇ **Gilles DeLaygue**
- ◇ **Jason Goodman**
- ◇ **Rodrigo Caballero**
- ◇ **Johnny Lin**
- ◇ **Christian Dieterich**
- ◇ **Yannick Donnadieu**
- ◇ **Helene Brogniez**
- ◇ **Dargan Frierson**
- ◇ **David McInerney**
- ◇ **Dorian Abbot**
- ◇ **Jung-Eun Lee**
- ◇ **Robin Wordsworth**
- ◇ **Graham Lee**
- ◇ **John Lynch**
- ◇ **Tim Lichtenberg**

SELECTED
INVITED
LECTURES

- ◇ Haldane Lecture, Wolfson College, University of Oxford (2017)
- ◇ Lobanov-Rostovsky Lecture, University of Oxford (2016)
- ◇ Distinguished Planetary Science Lecturer, Bern University (2014)
- ◇ Tyndall Lecture, American Geophysical Fall Meeting (2012)

Raymond T. Pierrehumbert

- ◇ Distinguished Atmospheric Science Lecturer, Beijing University (2012)
- ◇ Invited lecturer, Swedish Royal Academy Bolin Symposium (2012)
- ◇ University Lecturer, Cornell University (2012)
- ◇ Niels Bohr Lecture, Copenhagen University (2011)
- ◇ Fairchild Lecture, University of Rochester (2010)
- ◇ Noble Lecturer, University of Toronto (Toronto, 2010)
- ◇ Invited lecturer, Vatican study group on astrobiology (Rome, 2009)
- ◇ Halley Lecture (Oxford University, 2009)
- ◇ Kibbe lecture (Bowdoin College, 2008)
- ◇ Berkeley Distinguished Atmospheric Science Lecture (Berkeley, 2008)
- ◇ Aggasiz Lectures (Harvard, 2008)
- ◇ Thompson Lectures (National Center for Atmospheric Research, 2008)
- ◇ "Low Order Models" Invited lecture at The Lorenz Symposium (MIT, Dec. 1987)

BOOK

- ◇ *Principles of Planetary Climate*, second edition (Cambridge)

PROJECTS IN

- ◇ *Python for Physical Sciences and Mathematicians* (Princeton)

PROGRESS

- ◇ *Planetary systems: A very short introduction* (Oxford)

Open access versions of most papers are available at
<https://users.physics.ox.ac.uk/~pierrehumbert/papers/publist.html>

- Pierrehumbert, R. & Hammond, M. (2018, in press), ‘Atmospheric circulation of tide-locked exoplanets’, *Annual Reviews of Fluid Mechanics* .
- Hörst, S. M., He, C., Ugelow, M. S., Jellinek, A. M., Pierrehumbert, R. T. & Tolbert, M. A. (2018), ‘Exploring the atmosphere of Neoproterozoic Earth: the effect of O₂ on haze formation and composition’, *The Astrophysical Journal* **858**(2), 119.
- Hammond, M. & Pierrehumbert, R. T. (2017), ‘Linking the climate and thermal phase curve of 55 Cancri e’, *The Astrophysical Journal* **849**(2), 152.
- Nilsson, J., Jakobsson, M., Borstad, C., Kirchner, N., Björk, G., Pierrehumbert, R. T. & Stranne, C. (2017), ‘Ice-shelf damming in the glacial arctic ocean: dynamical regimes of a basin-covering kilometre-thick ice shelf’, *The Cryosphere* **11**(4), 1745–1765.
- Williams, I. N. & Pierrehumbert, R. T. (2017), ‘Observational evidence against strongly stabilizing tropical cloud feedbacks’, *Geophysical Research Letters* **44**(3), 1503–1510.
- Mackintosh, A. N., Anderson, B. M. & Pierrehumbert, R. T. (2017), ‘Reconstructing climate from glaciers’, *Annual Review of Earth and Planetary Sciences* **45**, 649–680.
- Allen, M., Fuglestedt, J., Shine, K., Reisinger, A., Pierrehumbert, R. & Forster, P. (2016), ‘New use of global warming potentials to compare cumulative and short-lived climate pollutants’, *Nature Climate Change* **6**, 773–776.
- Clark, P., Shakun, J., Marcott, S., Mix, A., Eby, M., Kulp, S., Levermann, A., Milne, G., Pfister, P., Santer, B., Schrag, D., Solomon, S., Stocker, T., Strauss, B., Weaver, A., Winkelmann, R., Archer, D., Bard, E., Goldner, A., Lambeck, K., Pierrehumbert, R. & Plattner, G.-K. (2016), ‘Consequences of twenty-first-century policy for multi-millennial climate and sea-level change’, *Nature Climate Change* **6**, 360–369.
- Pierrehumbert, R. & Ding, F. (2016), ‘Dynamics of atmospheres with a non-dilute condensible component.’, *Proceedings. Mathematical, physical, and engineering sciences / the Royal Society* **472**, 20160107.
- Ding, F. & Pierrehumbert, R. (2016), ‘Convection in condensible-rich atmospheres’, *The Astrophysical Journal* **822**(1), 24.
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- Pierrehumbert, R. (2016), ‘How to decarbonize? look to sweden’, *Bulletin of the Atomic Scientists* **72**(2), 105–111.
URL: <http://dx.doi.org/10.1080/00963402.2016.1145908>
- Malone, A., Pierrehumbert, R., Lowell, T., Kelly, M. & Stroup, J. (2015), ‘Constraints on southern hemisphere tropical climate change during the little ice age and younger dryas based on glacier modeling of the Quelccaya ice cap, Peru’, *Quaternary Science Reviews* **125**, 106–116.
- McNutt, M. K., Abdalati, W., Caldeira, K., Doney, S. C., Falkowski, P. G., Fetter, S., Fleming, J. R., Hamburg, S. P., Morgan, M. G., Penner, J. E., Pierrehumbert, R. T., Rasch, P. J., Russell, L. M., Snow, J. T., Titley, D. W. & Wilcox, J. (2015a), *Climate Intervention Carbon Dioxide Removal and Reliable Sequestration*, National Academies Press.
- McNutt, M. K., Abdalati, W., Caldeira, K., Doney, S. C., Falkowski, P. G., Fetter, S., Fleming, J. R., Hamburg, S. P., Morgan, M. G., Penner, J. E., Pierrehumbert, R. T.,

- Rasch, P. J., Russell, L. M., Snow, J. T., Titley, D. W. & Wilcox, J. (2015b), *Climate Intervention: Reflecting Sunlight to Cool Earth*, National Academies Press.
- Wordsworth, R., Kerber, L., Pierrehumbert, R., Forget, F. & Head, J. (2015), ‘Comparison of “warm and wet” and “cold and icy” scenarios for early mars in a 3-d climate model’, *Journal of Geophysical Research E: Planets* **120**, 1201–1219.
- Bloch-Johnson J , Pierrehumbert RT and Abbot DS 2015: Feedback temperature dependence determines the risk of high warming, *Geophys. Research Lett.* **42**(12), 4973-4980.
- Wordsworth R and Pierrehumbert RT 2014: Abiotic Oxygen-dominated Atmospheres on Terrestrial Habitable Zone Planets. *Ap. J. Lett.*, **785** 785 L20. doi:10.1088/2041-8205/785/2/L20
- Glotter M, Pierrehumbert RT, Elliott J and Moyer, EJ 2014: A Simple Carbon Cycle Representation for Economic and Policy Analyses. *Climatic Change*, **126**, 319-335.
- Pierrehumbert RT 2014: Short Lived Climate Pollution. *Annual Reviews of Earth and Planetary Sciences* **42**, doi:10.1146/annurev-earth-060313-054843
- Pierrehumbert RT 2013: Hot Climates, High Sensitivity. *Proc. Nat. Acad. Sci.*, **110**,14118-14119, doi:10.1073/pnas.1313417110
- Wordsworth R and Pierrehumbert RT 2013: Water loss from terrestrial planets with CO₂-rich atmospheres. *Astrophysical J.*, **778** doi:10.1088/0004-637X/778/2/154
- Abbot DS, Voigt A, Li D, Le Hir G, Pierrehumbert RT *et al* 2013: Robust elements of Snowball Earth atmospheric 2 circulation and oases for life. *J. Geophys. Res. – Atmospheres*, **118**(12),6017-6027, doi:10.1002/jgrd.50540
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- Pierrehumbert RT 2013: Strange news from other stars. *Nature Geoscience* **6**, 81-83. doi:10.1038/ngeo1711
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- Pierrehumbert RT 2012: Cumulative Carbon and Just Allocation of the Global Carbon Commons. *Chicago Journal of International Law*, **13.2** pp 527-548 .
- Pierrehumbert RT 2012: *Computation in Python for the Mathematical and Physical Sciences*. Princeton University Press (under contract).
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- Solomon S, Pierrehumbert RT, Matthews D Daniel JS and Friedlingstein P 2012: Atmospheric composition, irreversible climate change, and mitigation policy. in *Climate Science for Serving Society: Research, Modelling and Prediction Priorities*, Hurrell, J. and Asrar, G., eds., Springer.
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- Pierrehumbert RT 2011: A palette of climates for Gliese 581g. *Ap. J. Lett.*, **726** doi: 10.1088/2041-8205/726/1/L8.
- Pierrehumbert RT 2011: Infrared radiation and planetary temperature. *Physics Today* **64**, 33-38.

- Pierrehumbert RT, Abbot DS, Voight A and Koll D 2011: Neoproterozoic Climate. *Annual Reviews of Earth and Planetary Sciences* 39:417-60, doi:10.1146/annurev-earth-040809-152447.
- Abbot DS, Silber M, and Pierrehumbert RT 2011: Cloud Feedbacks and Arctic Sea Ice Tipping Points. *J. Geophys. Res.- Atmospheres* **116**, D19120, doi:10.1029/2011JD015653 .
- Abbot DS and Pierrehumbert RT 2010: Mudball: Surface dust and Snowball Earth deglaciation, *J. Geophys. Res.-Atmospheres* **115**, doi: 10.1029/2009JD01200
- Pierrehumbert RT 2010: *Principles of Planetary Climate*. Cambridge University Press, 652pp.
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- Mitchell JL, Pierrehumbert RT, Frierson DMW and Caballero R 2009: The impact of methane thermodynamics on seasonal convection and circulation in a model Titan atmosphere. *Icarus* **203**, 250-264. doi:10.1016/j.icarus.2009.03.043
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Mitchell J, Pierrehumbert RT, Frierson D and Caballero R 2006: The dynamics behind Titan's tropospheric methane clouds. *Proc. Nat. Acad. Sci.* **103 (49)**,18421-18426.

Pierrehumbert RT 2006: Climate change: A catastrophe in slow-motion. *Chicago Journal of International Law* **6**, 573-596.

Donnadieu Y, Pierrehumbert R, Jacob R and Fluteau F 2006: Modelling the primary control of paleogeography on Cretaceous climate. *Earth Plan Sci Lett* **248**, 426-437.

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- Pierrehumbert RT 2004: High levels of atmospheric carbon dioxide necessary for the termination of global glaciation *Nature* **429**, 646-649. doi:10.1038/nature02640
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- Poulsen CJ, Pierrehumbert RT, and Jacob RL 2001: Impact of ocean dynamics on the simulation of the Neoproterozoic Snowball Earth; *Geophysical Research Letters* , **28** ,1575-1578.
- Hu Y and Pierrehumbert RT 2001: The Advection-Diffusion Problem for Stratospheric Flow: Part II. Probability distribution function of tracer gradients. *J. Atmos. Sci.* **59**, 2830-2845.
- Hu Y and Pierrehumbert RT 2001: The Advection-Diffusion Problem for Stratospheric Flow: Part I. Concentration probability distribution function. *J. Atmos. Sci.* **58** ,1493-1510.
- Ngan K and Pierrehumbert RT 2000: Spatially inhomogeneous and intermittent random advection. *Phys. Fluids* **12** , 822-834.
- Pierrehumbert RT 2000: Climate change and the Tropical Pacific: The Sleeping Dragon Wakes. *Proc. Nat. Acad. Sci.* **97**, 1355-1358.

- Pierrehumbert RT 2000: Lattice models of advection-diffusion *Chaos* **10** , 61-74.
- Pierrehumbert RT 1999: Huascarán $\delta^{18}O$ as an indicator of tropical climate during the Last Glacial Maximum. *Geophysical Research Letters* , **26** , 1341-1344.
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- Pierrehumbert, RT 1996: Anomalous scaling of high cloud variability in the tropical Pacific. *Geophysical Research Letters* **23** , 1095-1098.
- Swanson K and Pierrehumbert RT 1997: Lower-tropospheric heat transport in the Pacific storm track. *J. Atmos. Sci* **54** , 1533 - 1543 .
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- Pierrehumbert, R. T. 1995: Thermostats, Radiator Fins, and the Local Runaway Greenhouse. *J. Atmos. Sci.* **52** , 1784-1806.
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