Laure Zanna

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Research Interests: ocean and climate dynamics; predictability and prediction of the climate system and uncertainty quantification; and the (stochastic) parameterization of ocean turbulence. *Tools*: Advanced analytical, numerical and statistical methods, a hierarchy of numerical models, and analysis of available observations.

Education

2009   PhD, **Harvard University**, Earth & Planetary Sciences. Subject: Climate Dynamics.
Title: Predictability and variability of the Atlantic ocean circulation. Adviser: Eli Tziperman.

2003   MSc, **Weizmann Institute of Science**, Environmental Sciences.

2001   BSc, **Tel Aviv University**, Atmospheric Physics, *Magna Cum Laude*.

Professional Appointments

Oct 2011-present: **Associate Professor** (prev. University Lecturer), University of Oxford, Department of Physics (tenured in July 2016).
Sep 2018- Aug 2019:   David Richards' Fellow and Tutor in Physics, Wadham College.
Oct 2011-2018:   Fellow, St Cross College.
Oct 2014-2017:   Lecturer in Physics, Christ Church College.

2017-2018:   **Visiting Research Scholar**, Princeton Univ., AOS and GFDL, USA.

2018- :   **Visiting Academic**, NYU, USA.

Apr 2009-Oct 2011: **James Martin Research Fellow**, Oxford Martin School; **Junior Research Fellow**, Balliol College; **Postdoctoral Research Associate**, Atmospheric, Oceanic & Planetary Physics, University of Oxford.

Oct 2003-Mar 2009: **Graduate Research Assistant**, Earth & Planetary Sciences, Harvard University.

Awards and Fellowships

2017-2018:   **Visiting Research Scientist Fellowship**, Princeton Univ., AOS and GFDL, USA.

2009-2012:   **Oxford Martin School Fellowship**, University of Oxford.

2009-2012:   **Balliol College Junior Research Fellowship**, University of Oxford.

2008:   **Outstanding Student Paper Award**, American Geophysical Union, Fall Meeting.

2005, 2006, 2007:   **Bertram J. Cohn Fellowship for Environmental Studies**, Harvard University.

2006:   **Young Scientist Outstanding Paper Award**, European Geosciences Union, General Assembly.

2005-2008: $3 \times$ **Certificate of Distinction in Undergraduate Teaching**, Harvard University.

2003:   **Beni Landau Fellowship**, Weizmann Institute of Science.

2001:   **Magna Cum Laude**, Tel Aviv University.

Funding

2017-2022: **NERC - Large Grant**, Oxford PI. Transient tracer-based Investigation of Circulation and Thermal Ocean Change (TICTOC), £3,342,981.

2017-2019: **Royal Society, International Exchanges Scheme**, PI. Quantifying the Variability of Tracer Transport across the Gulf Stream. £11,830.00.

2017-2020: **NERC**, Co-I. Addressing the Grand Challenge of regional sea level change prediction (UKFAFMIP), £584,852.

2014-2018: **NERC - Directed**, Co-I. Summer: Testing Influences and Mechanisms for Europe (SummerTIME), £764,189.

2014-2017: **NERC**, PI. Modelling the Ocean Circulation with Random Numbers, £301,109.

2012-2016: **NERC - Directed**, Co-I. Representing uncertainty in ocean observations and the ocean model, for coupled ensemble data assimilation and ensemble extended-range prediction, £378,722.

2013-2017: **NOAA- Earth System Science Program**, Co-PI. Variability, stochastic dynamics, and compensating model errors of the Atlantic Meridional Ocean Circulation in coupled IPCC models, $287,032.

2011-2014: **John Fell OUP Fund**, PI. Dynamical Impacts of Unresolved Ocean Processes in Climate Models: Lessons from Stochastic Physics, £98,538.

2015-2016: **Met Office- Oxford Academic Partnership**, Undergraduate Research Experience Placement. PI, 2016: two proposals funded; 2015: one proposal funded, each for £2,000.

Teaching & Mentoring

Teaching Activities

2010-present: *Lecturer and College Tutor*, **University of Oxford**

    2013-present: *Lecturer*, Physics of the Oceans & Atmospheres (undergrad).

    2014-present: *Lecturer*, Climate Dynamics and Variability (grad).

    2016-present: *Lecturer*, Advanced Math and Numerical Methods (grad).

    2010-present: *College Tutor* (undergrad): Mechanics & Special Relativity, Circuit Theory & Electromagnetism, Flows, Fluctuations & Complexity (Nonlinear Dynamics, Chaos, Stochastic Processes, Biophysics).

2009: *Invited Lecturer*.

    Joint UW-MIT-Bjerknes Advanced Climate Dynamics Course, Bergen, Norway.

    MIT Course on Adjoint methods: from large scale optimization to climate modeling.

2004-2008: *Teaching Fellow*, **Harvard University**: Climate & Physical Oceanography (undergrad/grad); The Atmosphere (undergrad); Ordinary and Partial Differential Equations (undergrad/grad); Nonlinear Dynamical Systems (undergrad/grad).

1999-2002: *Special Educator, Teacher and Tutor,* **Balfour High School**, Mathematics.

2015, 2016: *Organizer and Speaker*, **University of Oxford**, Atmospheric Physics Research Experience Day for NERC DTP incoming graduate students.

Supervision ([+] = co-advised)

Postdoctoral Scholars:

    2015- : Chris O'Reilly ([+] with T. Woollings)

    2016- 2017: Joakim Kjellsson, now researcher at Kiel.

    2015-2017: Stephan Juricke ([+] with T. Palmer), now researcher at Bremen Univ.

    2015-2016: Markus Huber (funded by a S-NSF fellowship)

    2014-2015: James Anstey, now permanent researcher at CCCma

    2012-2015: Fenwick Cooper ([+] with T. Palmer), now postdoc at Oxford

    2011-2013: Mirek Andrejczuk ([+] with T. Palmer), now permanent researcher at UK-Met Office

    2011-2013: Luca Porta Mana, now researcher at Kavli Institute

PhD/DPhil Students:

    Apr 2018-: Matthias Aengenheyster

    Apr 2016-: Thomas Bolton (won best prize for 2nd yr PhD research report)

    2013-2018: Robert Fraser

    2013-2017: Tomos David ([+] with D. Marshall), now postdoc at Oxford

    2011-2015: Ben Bronselaer, now postdoc at GFDL/Princeton

MPhys Students = senior thesis: (*=*won a prize for best project in Atmospheric, Oceanic and Planetary Physics*). 2016-2017: Jonny Ison; Kirill Mikhaylov. 2014-2015: Thomas Bolton*. 2013-2014: Andrew Bailey*; Michael Walker*. 2013: Tomos David. 2012: Shaomin Cai. 2011: Brodie Pearson.

Summer Students: Alex Gyoffry, Arnaud de Larturiere, Benjamin Huddart, Twm Jonathan, Andrey Orkney.

College Graduate Supervision (St Cross and Christ Church): I act or acted as College supervisor for about 15 students in Physics, Earth Sciences, Engineering, Materials, Genomic Medicine & Statistics, Musculoskeletal Sciences, Physiology, Anatomy & Genetics, Organic Chemistry, Life Sciences, Healthcare Innovation, Bioscience.

Additional Service and Examination

Examiner for 1 external and 2 internal PhD defence, and 1 MRes defence.

Internal Examiner/Graduate Committee for 9 first-year and 6 second-year students.

Physics Teaching Faculty, **Invigilator**, Physics of the Oceans & Atmospheres, 2015.

Physics Teaching Faculty, **Assessor**, Flows, Fluctuations & Complexity, 2016-present.

Judge for students presentations: Ocean Modeling 2011, 2012, 2014; AGU Ocean Sciences and Fall Meetings various dates 2012-2018; AMS AOFD 2017.

Presentations (as first author only)

Invited Departmental Seminars (52 since 2009):

2018: Caltech, Flatiron Institute/Simons Foundation, UW, NYU/Courant (APM), Harvard, U. Chicago, UCSD/Scripps, NCAR.

2017: Lamont Doherty Earth Observatory - LDEO (colloquium), GFDL, Columbia University/LDEO (Ocean and Climate), NYU/Courant (CAOS) , George Mason University, U. of Edinburgh, U. of Reading.

2016: ANU, U. Tasmania, U. of Copenhagen, Imperial College London (Physics), Leeds.

2014: UCLA, Caltech, Scripps Institute of Oceanography, British Antarctic Survey, UCL, NOC/Southampton, Weizmann Institute of Science, Tel Aviv University.

2013: Imperial College London (Math), Harvard, MIT, U. of Cambridge (DAMTP), Hebrew University of Jerusalem, Weizmann Institute of Science, Reading.

2012: LPO/IFREMER Brest; New York University; U. of Hamburg/Max Planck Institute of Meteorology.

before 2012: Imperial College London (Physics); U. of Reading; U. of Oxford; U. Cambridge (Earth Sciences); European Centre for Medium-Range Weather Forecast; Proudman Oceanographic Laboratory, Liverpool; U. of East Anglia; National Oceanography Centre, Southampton; MIT; Columbia University/LDEO; Princeton/GFDL; Tel Aviv University; Beer Sheva University.

Invited Workshops and Conferences (33 Invited since 2009):

Upcoming 2018-2019: US AMOC/RAPID (Miami), Regional Atlantic Circulation and Global Change (Bremen, keynote) AGU fall meeting, Equadiff 2019 minisymposium,

2018: AIMS Conference on Dynamical Systems (Taipei), Caltech - ESM Workshop, AGU Ocean Sciences (Portland), Understanding the relationship between coastal sea level and large-scale ocean circulation (ISSI, Bern), Oceans in Weather and Climate (Exeter, OiWC2018).

2017: ECMWF Annual Seminar on Ensemble Prediction, Intrinsic & Forced Ocean Variability Workshop, Max Planck Institute for the Physics of Complex Systems, Banff International Research Station for Mathematical Innovation and Discovery, MFO Oberwolfach Research Institute for Mathematics.

2016: Data Analysis and Modeling in Earth Sciences, Uncertainty Quantification SIAM.

2015: Future Lagrangian Ocean Modeling, ICIAM Beijing, Turbulence Days, Europe Dynamics Days, Workshop on Stochastic Physics in Climate, Theoretical Advances in Planetary Flow and Climate Dynamics, Met Office Academic Partnership, Ice2Ice (keynote).

2014: AGU Fall Meeting, ClimathNet (plenary).

2013: AGU Fall Meeting, IMA Workshop on Stochastic Modeling of the Oceans and Atmosphere.

2012: AGU Fall Meeting, ESA workshop on model uncertainty.

before 2012: Workshop on Representing Model Uncertainty in Weather and Climate Prediction (2011), EGU General Assembly (2009), Advanced Climate Dynamics Course (2009).

Selected Contributed Presentations (total 28 since 2009): The Earths Energy Imbalance and its implications 2018 Model Hierarchies Workshop, Princeton 2016; AGU Ocean Sciences 2018, 2016, 2014, 2012; Workshop on Energy transfers in the atmosphere and in the ocean 2016, 2015; RAPID/ US AMOC annual meeting 2015, 2013; Latsis Symposium on Climate Dynamics 2014; AGU Fall Meeting 2013, 2012; American Met. Soc. AOFD 2013, 2017; APS General Meeting 2013.

Selected Academic Service

<u>External Committees</u>

2018- : **Lorenz Lecture Committee Member**, American Geophysical Union, Nonlinear Geophysics Section.

2018: **Panel Member**, National Academy of Sciences.

2017-2018 : **Schmidt Fellowship Panel Member**, Schmidt Foundation, Earth Sciences Division.

2014- : **International Scientific Council Member**, European Institute for Marine Studies (IUEM), Brest.

2016: **Scoping Group on the Role of Southern Ocean in the Earth System**, NERC.

2015-2016: **Belmont Forum and JPI Climate, Panel of Experts**, "Climate predictability and inter-regional linkages".

2011-2016: **Peer Review College Member**, NERC.

<u>Convener and Organizer</u>

2018: **Session Co-organizer:** APS - GPC Focus Session, Los Angeles, *Multi-Scale Flows and Pathways in the Climate System*.

2017: **Invited Organizer,** Workshop on Transport in Unsteady Flows, Banff International Research Station.

2016: **Invited Convener,** Ocean Section IUGG Conference on Mathematical Geophysics.

2012, 2014: **Session Co-organizer:** AGU Ocean Sciences, Salt Lake City 2012, *Oceanic Uptake of heat and greenhouse gases: dynamic and thermodynamic controls and inferences from tracers*; AGU Ocean Sciences, Hawaii, 2014 *North Atlantic ocean dynamics: from natural fluctuations to externally forced response*.

2012: **Session Co-chair:** IUGG, Mathematical Geosciences 2012. Ocean processes: from small scale to global circulation

<u>Additional Service</u>

Reviewer: *Proposals*: National Academy of Science, NSF, NOAA, NERC, ISF, BSF, KAUST/CRG, Irish Research Council. *Articles*: J. of Climate, Nature, Science, GRL, Clim. Dyn., Ocean Modelling, J. Phys. Ocean., J. of Physics A, ERL, Q. J. Roy. Met. Soc., Phil. Trans. of the Royal Society. *Books*: SIAM, Cambridge University Press.

Organizer, Atmospheric, Oceanic and Planetary Seminar Series, Nov 2012-Aug 2016; Physical Oceanography & Climate Meetings, 2010-2011.

Physics, **Personnel Committee**, 2012- present; **Parking Committee**, 2017- present.

Oxford Colleges: **Governing body**, Balliol College, 2009-2011; **Executive Committee**, Balliol College, 2010-2011; **Governing body**, St Cross College, 2011-present, **Fellowship Committee**, St Cross College, 2014-present.

<u>Selected Outreach</u>

Wadham College, Foundation Fellows Event, 2017: Sea Level Rise.

Royal Society, Physics Alumni Event, 2015: Oceans in Climate Change.

Oxford Physics Society, 2016: Physics of Climate Change.

Oxford Physics Alumni Weekend, 2013: Ocean Physics.

Since 1992 (in France, Israel, USA and UK): Various activities and tutoring for middle- and high-school students with learning disabilities and from disadvantaged backgrounds.

Publication List

List and PDFs: https://laurezanna.github.io/publication/

Academic References

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