Nathan Steiger

Senior Lecturer (Assistant Professor)
The Fredy & Nadin Herrman Institute of Earth Sciences
The Hebrew University of Jerusalem

Associate Research Scientist
Lamont-Doherty Earth Observatory
Columbia University

https://njsteiger.github.io • scholar.google.com
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Research Interests

Paleoclimate • Hydroclimate • Climate Dynamics • Climate Extremes

Appointments

2020-Now **Hebrew University**
Senior Lecturer (Assistant Professor)
Institute of Earth Sciences

2019-Now **Columbia University**
Associate Research Scientist
Lamont-Doherty Earth Observatory

2018 **Columbia University**
Postdoctoral Research Scientist
Lamont-Doherty Earth Observatory

2016-2017 **Columbia University**
NOAA Climate and Global Change Postdoctoral Fellow
Lamont-Doherty Earth Observatory

Education

2013-2015 **PhD in Atmospheric Sciences**
University of Washington
Dissertation research: multi-time-scale data assimilation, Arctic and Antarctic climate reconstruction.
Advisors: David Battisti, Greg Hakim, Gerard Roe, and Eric Steig

2010-2013 **MS in Atmospheric Sciences**
University of Washington
Thesis research: climate reconstruction via data assimilation.
Advisors: David Battisti, Greg Hakim, Gerard Roe, and Eric Steig

2007-2010 **BS in Physics, minor in Mathematics, with Honors**
Brigham Young University
Honors thesis research: quantum measurement theory and quantum information.
Advisor: Jean-François Van Huele

2009 **Pembroke-Kings Programme**
Cambridge University
Visiting student on academic scholarship at King's College. Obtained first class marks in all coursework. Conducted research in theoretical quantum information at the Department of Applied Mathematics and Theoretical Physics.
Advisor: Peter Pemberton-Ross

Grants, Honors & Awards

2020-2024 ISF (#2654/20) "Diagnosing the dynamical causes of megadroughts and megapluvials in North and South America" (PI)
Hebrew University

2020 ISF (#3067/20–Equipment) "High performance computing cluster for modeling past global climate" (PI)
Hebrew University

2019-2022 NSF-AGS (#1903465) "Collaborative Research: Quantifying Holocene climate variations through data assimilation using proxies and GCM output" (co-PI; Lead PI M. Erb, co-PIs N. McKay, S. Dee)
Columbia University

2019-2022 NSF-AGS (#1805490) "Diagnosing the Dynamics of Past and Future North American Megadroughts" (Lead PI; co-PI J. Smerdon)
Columbia University

2016-2017 NOAA Climate and Global Change Postdoctoral Fellowship (2 years)
Columbia University

2010 Top Scholar Award, academic scholarship (1 year)
University of Washington

2009 Robert K. Thomas Scholarship, academic Honors scholarship (1 semester)
Brigham Young University

2009 Mae Covey Gardner and University Honors Scholarships, for study at Cambridge University (1 semester)
Brigham Young University

2007-2010 Heritage Scholarship, academic full tuition scholarship (8 semesters)
Brigham Young University

Publications

In preparation or in review

Steiger, N.J., J.E. Smerdon, E.R. Cook, E. Tejedor, R. Orrison, M. Vuille. The Paleo Hydrodynamics Data Assimilation product (PHYDA) version 2. *In preparation.*

Tejedor, E., L. Polvani, N.J. Steiger, M. Vuille, J.E. Smerdon. Evidence from the Last Millennium for a winter cooling over Eurasia induced by large, low-latitude volcanic eruptions. *In prepration.*

Steiger, N.J., J.E. Smerdon. An efficient fixed-lag Kalman smoother algorithm for multi-timescale paleoclimate reconstruction. *In preparation.*

2022

[25] Luo, X., S.G. Dee, S. Stevenson, Y. Okumura, **N.J. Steiger**, L. Parsons. Last millennium ENSO diversity and North American teleconnections: new insights from paleoclimate data assimilation. *Paleoceanography and Paleoclimatology*, (2022). [HTML]

[24] Dee, S.G., **N.J. Steiger**. ENSO's response to volcanism in a data assimilation-based paleoclimate reconstruction over the Common Era. *Paleoceanography and Paleoclimatology*, (2022). [HTML]

[23] **Steiger, N.J.**, W.J. D'Andrea, J.E. Smerdon, R.S. Bradley. Large infrequent rain events dominate the hydroclimate of Rapa Nui (Easter Island). *Climate Dynamics*, (2022). [HTML]

2021

[22] **Steiger, N.J.**, J.E. Smerdon, A.P. Williams, R. Seager, A. Varuolo-Clarke. ENSO-driven coupled megadroughts in North and South America over the last millennium. *Nature Geoscience*, 14 (9), (2021). [HTML][Selected press: Science]

[21] Tejedor, E., **N.J. Steiger**, J.E. Smerdon, R. Serrano-Notivoli, M. Vuille, Global Temperature Responses to Large Tropical Volcanic Eruptions in Paleo Data Assimilation Products and Climate Model Simulations Over the Last Millennium. *Paleo-*

ceanography and Paleoclimatology, 36, e2020PA004128, (2021). [HTML]

[20] Huston, A., N. Siler, G.H. Roe, E. Pettit, **N.J. Steiger**, Understanding drivers of glacier length variability over the last millennium. *The Cryosphere*, 15, 1645-1662, (2021). [HTML]

[19] Tejedor, E., **N.J. Steiger**, J.E. Smerdon, R. Serrano-Notivoli, M. Vuille, Global hydroclimatic response to tropical volcanic eruptions over the Last Millennium. *PNAS*, 118 (12), e2019145118, (2021). [HTML]

2020

[18] Erb, M.P., J. Emile-Geay, G.J. Hakim, **N.J. Steiger**, E.J. Steig, Atmospheric Dynamics Drive Most Interannual U.S. Droughts over the Last Millennium. *Science Advances*, 6, eaay7268, (2020). [HTML]

[17] Harris, T., B. Li, **N.J. Steiger**, J.E. Smerdon, N. Narisetty, J.D. Tucker, Testing Exchangeability of Two Spatiotemporal Processes with Applications to Data Assimilation Methods. *Journal of the American Statistical Association*, (2020). [HTML]

[16] Dätwyler, C., M. Grosjean, **N.J. Steiger**, R. Neukom, Teleconnections and relationship between ENSO and SAM in reconstructions and models over the past millennium. *Climate of the Past*, 16, 743-756, (2020). [HTML]

2019

[15] Neukom, R., **N.J. Steiger**, J.J. Gómez-Navarro, J. Wang, J. Werner, No evidence for globally coherent warm and cold periods over the pre-industrial Common Era. *Nature*, 571, 550-554, (2019). [HTML] [News & Views] [Editorial] [Selected press (over 1000 outlets): BBC, The Guardian, Reuters, USA Today, New York Times, LA Times, The Atlantic, Axios, FiveThirtyEight, NBC, CBC, Smithsonian, Science, EOS, Scientific American, Discover Magazine, Haaretz, Le Monde, Der Spiegel, El País]

[14] **Steiger**, **N.J.**, J.E. Smerdon, B.I. Cook, R. Seager, A.P. Williams, E.R. Cook, Oceanic and radiative forcing of Medieval megadroughts in the American Southwest. *Science Advances*, 5, eaxx0087, (2019). [HTML] [Selected press: BBC, National Geographic, USA Today, Mashable, Newsweek, The Weather Channel, Live Science, Phys.org, Vice, The Hill]

[13] Baek, S.H., **N.J. Steiger**, J.E. Smerdon, R. Seager, Oceanic drivers of widespread drought in the United States over the Common Era. *Geophysical Research Letters*, 46, 8271-8280, (2019). [HTML]

[12] Klein, F., N.J. Abram, M.A.J. Curran, H. Goosse, S. Goursaud, V. Masson-Delmotte, A. Moy, R. Neukom, A. Orsi, J. Sjolte, **N.J. Steiger**, B. Stenni, M. Werner, Assessing the robustness of Antarctic temperature reconstructions over the past two millennia using pseudoproxy and data assimilation experiments. *Climate of the Past*, 15, 661-684, (2019). [HTML]

2018

[11] **Steiger, N.J.**, J.E. Smerdon, E.R. Cook, B.I. Cook, A reconstruction of global hydroclimate and dynamical variables over the Common Era. *Scientific Data*, 5:180086, (2018). [HTML]

[10] Neukom, R., A.P. Schurer, **N.J. Steiger**, G.C. Hegerl, Possible causes of data model discrepancy in the temperature history of the last Millennium. *Scientific Reports*, 8:7572, (2018). [HTML]

2017

[9] Hydro2k Consortium: Smerdon, J.E., J. Luterbacher, S. Phipps, K.J. Anchukaitis, T.R. Ault, S. Coats, K.M. Cobb, B.I. Cook, C. Colose, T. Felis, A. Gallant, J.H. Jungclaus, B. Konecky, A. LeGrande, S. Lewis, A.S. Lopatka, W. Man, J.S. Mankin, J.T. Maxwell, B.L. Otto-Bliesner, J.W. Partin, D. Singh, **N.J. Steiger**, S. Stevenson, J.E. Tierney, D. Zanchettin, H. Zhang, A. Atwood, L. Andreu-Hayles, S.H. Baek, B. Buckley, E.R. Cook, R. D'Arrigo, S.G. Dee, M. Griffiths, C. Kulkarni, Y. Kushnir, F. Lehner, C. Leland, H.W. Linderholm, A. Okazaki, J. Palmer, E. Piovano, C.C. Raible, M.P. Rao, J. Scheff, G.A. Schmidt, R. Seager, M. Widmann, A.P. Williams, E. Xoplaki, Comparing proxy and model estimates of hydroclimate variability and change over the Common Era. *Climate of the Past*, 13(12), 1851-1900, (2017). [HTML]

[8] **Steiger, N.J.**, J.E. Smerdon, A pseudoproxy assessment of data assimilation for reconstructing the atmosphere-ocean dynamics of hydroclimate extremes. *Climate of the Past*, 13(10), 1435-1449, (2017). [HTML]

[7] **Steiger, N.J.**, E.J. Steig, S.G. Dee, G.H. Roe, and G.J. Hakim, Climate reconstruction using data assimilation of water-isotope ratios from ice cores. *Journal of Geophysical Research: Atmospheres*, 122(3), 1545-1568, (2017). [HTML]

2016

[6] Dee, S.G., **N.J. Steiger**, J. Emile-Geay, and G.J. Hakim, On the utility of proxy system models for estimating climate states over the Common Era. *Journal of Advances in Modeling Earth Systems*, 8(3), 1164-1179, (2016). [HTML] [JAMES Commentary]

[5] **Steiger, N.J.**, and G.J. Hakim, Multi-time scale data assimilation for atmosphere–ocean state estimates. *Climate of the Past*, 12(6), 1375-1388, (2016). [HTML]

[4] Hakim, G.J., J. Emile-Geay, E.J. Steig, D. Noone, D.M. Anderson, R. Tardif, **N.J. Steiger**, and W.A. Perkins, The last millennium climate reanalysis project: framework and first results. *Journal of Geophysical Research: Atmospheres*, 121(12), 6745-6764, (2016). [HTML]

2015 AND PRIOR

[3] Steig, E.J., K. Huybers, H.A. Singh, **N.J. Steiger**, Q. Ding, D.M.W. Frierson, T. Popp, and J.W.C. White, Influence of West Antarctic Ice Sheet collapse on Antarctic surface climate. *Geophysical Research Letters*, 42(12), 4862-4868, (2015). [HTML]

[2] **Steiger, N.J.**, G.J. Hakim, E.J. Steig, D.S. Battisti, and G.H. Roe, Assimilation of time-averaged pseudoproxies for climate reconstruction. *Journal of Climate*, 27, 426-441, (2014). [HTML]

[1] **Steiger, N.J.** and J.F. Van Huele, Quantifying Incompatibility: The Ramifications of Extending Angular Momentum Uncertainty Relations. *Utah Academy of Sciences, Arts, and Letters*, 86, 197-209, (2010).

Presentations

Feb 2022 (Invited) "Global climate reconstruction through the fusion of climate models and proxy data", *PAGES Speleothem Isotopes Synthesis & Analysis Workshop*, *The Hebrew University*, Jerusalem, Israel.

Jan 2022 (Invited) "What controls the hydroclimate of Easter Island?", *The Hebrew University*, Jerusalem, Israel.

Nov 2021 (Invited) "What caused megadroughts in North and South America?", *Ben-Gurion University*, Be'er Sheva, Israel.

Sep 2021 (Invited) "What caused megadroughts in North and South America?", *The Israel Meteorological Service*, Beit Dagan, Israel.

Aug 2021 (Invited) "Annual Reconstructions of Global Hydroclimate Fields over the Common Era using Data Assimilation", *PAGES 2k Seminar*, online. [YOUTUBE]

Nov 2020 (Invited) "What caused megadroughts in North and South America?", *The Weizmann Institute of Science*, Rehovot, Israel.

Feb 2020 (Invited) "How the climate has changed and why", *Touro College*, New York, NY.

Feb 2020 (Invited) "Coupled megadrought risk in North and South America", *Goddard Scientific Colloquium: NASA Goddard Space Flight Center*, Greenbelt, MD.

Dec 2019 (Oral) "Coupled megadrought risk in North and South America", *American Geophysical Union Meeting*, San Francisco, CA.

Sept 2019 (Invited) "What caused megadroughts in North and South America?", *The State University of New York at Albany*, Albany, NY.

Jan 2019 (Invited) "What caused the Medieval megadroughts of the American Southwest?", *The Hebrew University*, Jerusalem, Israel.

Jan 2019 (Invited) "A requiem for the Little Ice Age and the Medieval Warm Period", *The Hebrew University*, Jerusalem, Israel.

Dec 2018 (Oral) "ENSO forcing of medieval megadroughts in the American Southwest", *American Geophysical Union Meeting*, Washington, DC.

Dec 2018 (Poster) "No evidence for globally synchronous cold and warm epochs during the pre-industrial Common Era", *American Geophysical Union Meeting*, Washington, DC.

Jun 2018 (Invited) "What caused the Medieval megadroughts of the southwestern US?", *Massachusetts Institute of Technology*, Endicott House, Dedham, MA.

Apr 2018 (Oral) "No evidence for globally synchronous cold and warm periods during the pre-industrial Common Era", *European Geosciences Union Meeting*, Vienna, Austria.

Dec 2017 (Oral) "Indices and dynamics of global hydroclimate over the past millennium from data assimilation", *American Geophysical Union Meeting*, New Orleans, LA.

Oct 2017 (Invited) "What caused the Medieval megadroughts of western North America?", *Massachusetts Institute of Technology*, Cambridge, MA.

Oct 2017 (Invited) "A global and millennial perspective on the dynamics of hydroclimate extremes", *3rd Annual Last Millennium Reanalysis Workshop, National Center for Atmospheric Research*, Boulder, CO.

May 2017 (Poster) "Reconstructing the global atmosphere-ocean dynamics of hydroclimate extremes with data assimilation", *Past Global Changes Open Science Meeting*, Zaragoza, Spain.

May 2017 (Oral) "Temperature field reconstructions and method inter-comparison over the past 2000 years", *Past Global Changes Open Science Meeting*, Zaragoza, Spain.

Apr 2017 (Invited) "Reconstructing the global atmosphere-ocean dynamics of hydroclimate extremes with data assimilation", *Brown University*, Providence, RI.

Jan 2017 (Invited) "Reconstructing the global atmosphere-ocean dynamics of hydroclimate extremes with data assimilation", *Tel Aviv University*, Tel Aviv, Israel.

Jan 2017 (Invited) "Reconstructing the global atmosphere-ocean dynamics of hydroclimate extremes with data assimilation", *The Weizmann Institute of Science*, Rehovot, Israel.

Jan 2017 (Invited) "Reconstructing the global atmosphere-ocean dynamics of hydroclimate extremes with data assimilation", *The Hebrew University*, Jerusalem, Israel.

Jan 2017 (Oral) "Using atmosphere-ocean dynamics to make more consistent and useful reconstructions of past climate", *GFD Days 2017, Ben Gurion University of the Negev*, Sede Boqer, Israel.

Dec 2016 (Poster) "Global hydroclimate reconstructions over the last millennium using data assimilation", *American Geophysical Union Meeting*, San Francisco, CA.

Oct 2016 (Invited) "Climate reconstruction using data assimilation of water-isotope ratios from ice cores", *2nd Annual Last Millennium Reanalysis Workshop*, Friday Harbor, WA.

Jul 2016 (Oral) "The dynamics of global hydroclimate over the past millennium", *Summer Institute of the NOAA Climate and Global Change and PACE Postdoctoral Fellowship Programs*, Steamboat Springs, CO.

Jun 2016 (Invited) "Hydroclimate reconstructions using data assimilation", *Workshop: PAGES2k-PMIP3: Comparing Data and Model Estimates of Hydroclimate Variability and Change over the Common Era, Lamont-Doherty Earth Observatory, Columbia University*, Palisades, NY.

Apr 2016 (Invited) "What can ice cores tell us about past climate?", *Lamont-Doherty Earth Observatory, Columbia University*, Palisades, NY.

Nov 2015 "What can ice cores tell us about past climate?", *Dissertation defense, University of Washington*, Seattle, WA.

May 2015 (Invited) "Paleoclimate reconstructions with Proxy System Models", *1st Annual Last Millennium Reanalysis Workshop: Proxy System Modeling*, Catalina Island, CA.

Apr 2015 (Oral) "What climate variables are reconstructable over the past 2000 years? A data-assimilation perspective", *European Geosciences Union Meeting*, Vienna, Austria.

Dec 2014 (Oral) "Reconstruction of Dynamical Fields of the Common Era", *American Geophysical Union Meeting*, San Francisco, CA.

Sep 2014 (Poster) "AMOC reconstruction for paleoclimate across multiple time scales", *US AMOC Science Team Meeting*, Seattle, WA.

Apr 2014 (Invited) "Reconstructions with Data Assimilation", *PAGES2k Climate Field Reconstruction Workshop, Woods Hole Oceanographic Institution*, Woods Hole, MA.

Dec 2013 (Poster) "A data-assimilation-based multiproxy reconstruction of the past 2000 years", *American Geophysical Union Meeting*, San Francisco, CA.

Aug 2013 (Oral) "A data-assimilation-based approach to climate field reconstruction", *Advanced Climate Dynamics Course*, Nyksund, Norway.

Feb 2013 (Oral) "Assimilation of time-averaged pseudoproxies for climate reconstruction", *Past Global Changes Open Science Meeting*, Goa, India.

Dec 2012 (Oral) "Climate Field Reconstruction via Data Assimilation", *American Geophysical Union Meeting*, San Francisco, CA.

Oct 2012 "Climate Field Reconstruction via Data Assimilation", *Masters thesis presentation, University of Washington*, Seattle, WA.

Sep 2011 "Paleoclimate Reconstruction via Data Assimilation", *First Year Reports, University of Washington*, Seattle, WA.

Sep 2011 (Oral) "Initial Work Towards Paleoclimate Reconstruction via Data Assimilation", *Advanced Climate Dynamics Course*, Friday Harbor, WA.

Mar 2010 (Oral) "Fidelity of Arbitrary Single-Qubit Gates", *Brigham Young University Spring Research Conference*, Provo, UT.

Oct 2009 (Oral) "Fidelity of Arbitrary Single-Qubit Gates", *Meeting of the Four Corners Section of the American Physical Society, Colorado School of Mines*, Golden, CO.

Apr 2009 (Oral) "Quantifying Incompatibility: The Ramifications of Extended Angular Momentum Uncertainty Relations", *Utah Academy of the Sciences, Arts, and Letters, Brigham Young University*, Provo, UT.

Mar 2009 (Oral) "Quantifying Incompatibility: The Ramifications of Extended Angular Momentum Uncertainty Relations", *Brigham Young University Spring Research Conference*, Provo, UT.

Oct 2008 (Poster) "Explorations Into the Schrödinger Uncertainty Relation", *Meeting of the Four Corners and Texas Sections of the American Physical Society, University of Texas at El Paso*, El Paso, TX. Awarded first prize at the conference for the top poster presentation.

Teaching

2021-Now **Global Warming Science (82508)**
Textbook with Mnemonic Interface
Institute of Earth Sciences, Hebrew University

2021-Now **Workshop on English Usage for Graduate Students in Science (82851)**
Institute of Earth Sciences, Hebrew University

2012, 2014 **Global Warming (ATMS 111)**
Department of Atmospheric Sciences, University of Washington

Programming Skills

Scientific computing: Julia, Matlab, Python, Mathematica
Markup languages: HTML, CSS
Revision control: Git

Modifying and running climate models: GFDL-AM2, GFDL GRaM, CESM2, CESM1, CCSM3, ECHAM5-wiso

Professional Activities

Workshops and Summer Schools

Feb 2022 PAGES Speleothem Isotopes Synthesis & Analysis Workshop, The Hebrew University, Jerusalem, Israel.

Oct 2021 Drought Risk in the Anthropocene, The Royal Society, Oxford, UK.

Feb 2020 Disentangling the Drivers of Migration in West Africa, Columbia University, New York, NY.

Jun 2018 Water and Climate Change: Connecting the Paleoclimate Record to Future Projections, Massachusetts Institute of Technology, Endicott House, Dedham, MA.

Oct 2017 Third Annual Last Millennium Reanalysis Workshop: Climate Dynamics with the Last Millennium Reanalysis, National Center for Atmospheric Research, Boulder, CO.

Feb 2017 Middle East and North Africa (MENA) Climate, Water, Livelihoods, and Governance Workshop, University of Maryland, College Park, MD.

Jan 2017 GFD Days 2017: The Symposium on Geophysical Fluid Dynamics, Ben Gurion University of the Negev, Sede Boqer, Israel.

Oct 2016 Second Annual Last Millennium Reanalysis Workshop: Water-Isotope Modeling for Paleoclimate Reconstruction and Data assimilation, Friday Harbor, WA.

Jul 2016 The 2016 Summer Institute for the NOAA Climate and Global Change and PACE Postdoctoral Fellowship Programs, Steamboat Springs, CO.

Jun 2016 PAGES2k-PMIP3: Comparing Data and Model Estimates of Hydroclimate Variability and Change over the Common Era Workshop, Lamont-Doherty Earth Observatory, Palisades, NY.

May 2015 First Annual Last Millennium Reanalysis Workshop: Proxy System Modeling, Catalina Island, CA.

Apr 2014 PAGES2k Climate Field Reconstruction Workshop, Woods Hole Oceanographic Institution, Woods Hole, MA.

Aug 2013 Advanced Climate Dynamics Course: "Dynamics of the Last Deglaciation," Nyksund, Vesterålen, Norway.

Aug 2011 Advanced Climate Dynamics Course: "Dynamics of Past Warm Climates," Friday Harbor, WA.

Journal Reviewer

Nature, Nature Communications, Scientific Data, Scientific Reports, Geophysical Research Letters, Journal of Climate, Journal of Geophysical Research: Atmospheres, Climate Dynamics, Climate of the Past, Quarterly Journal of the Royal Meteorological Society, International Journal of Climatology, WIREs Climate Change, Geoscientific Model Development, Earth System Science Data, Atmosphere.

Memberships

2015-Now European Geosciences Union

2012-Now American Geophysical Union

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