

# Michael P. Erb

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## RESEARCH INTERESTS

Climate dynamics, climate of the Common Era, paleoclimate, drought, monsoon circulations, climate modeling, proxy records, Milankovitch theory, and ENSO.

## EDUCATION

Ph.D., Rutgers, The State University of New Jersey, Atmospheric Science, 2014.  
Advisor: Dr. Anthony J. Broccoli

M.S., Rutgers, The State University of New Jersey, Atmospheric Science, 2011.  
Advisor: Dr. Anthony J. Broccoli

B.S., University of North Carolina at Asheville, Atmospheric Sciences, 2007.  
Graduated with honors.  
Advisor: Dr. Douglas K. Miller

## RESEARCH EXPERIENCE

2017-present          Postdoctoral Scholar, Northern Arizona University

2016-2017          Postdoctoral Scholar, University of Southern California

At the University of Southern California, I used data assimilation to combine information from proxy records and general circulation model output to reconstruct the climate of the past two thousand years. This project will produce a dynamically consistent record of climate during this period which can be used to investigate climate variability. I also investigated how drought in the United States has been influenced by large-scale patterns of climate variability like the Southern Oscillation.

2014-2016          Postdoctoral Fellow, University of Texas at Austin

At the Institute for Geophysics, I employed general circulation model simulations to study the causes of climate changes over the past several million years. A focus of the research was better understanding the individual effects of changes in orbit, greenhouse gases, and ice sheets, as well as making model-based reconstructions of past climate to test model sensitivity to these changes. Additional research explored past changes in monsoons, the seasonality of the equatorial Pacific Ocean, and the climate variations recorded in ice cores.

2007-2013 Graduate Research Assistant, Rutgers University

Funded by the National Science Foundation, I conducted modeling experiments in cooperation with the Geophysical Fluid Dynamics Laboratory (GFDL) in Princeton on the drivers of past climate, including how radiative feedbacks, equatorial seasonality, and wetlands have responded to past forcing. We used modeling experiments which focused on particular times in the Earth's past in addition to idealized experiments where obliquity or longitude of the perihelion were changed separately to explore how these forcings affect the climate system.

2005-2007 Research Assistant, University of North Carolina at Asheville

Conducted research with the National Environmental Modeling and Analysis Center (NEMAC), using the WRF mesoscale weather model to analyze severe storm events in western North Carolina. Additionally, conducted research on the rapid intensification of Hurricane Katrina in the Gulf of Mexico.

## TEACHING EXPERIENCE

2009-2012 Teaching Assistant, Rutgers University, for the following classes:

Meteorological Analysis I, a sophomore level class about how to interpret and present meteorological information.

Meteorological Analysis II, a continuation of the above.

Dynamics of the Atmosphere, a junior level class which focused on hydrodynamics, equations of motion on a rotating Earth, vorticity, and boundary layer dynamics.

Atmospheric Thermodynamics, a junior level class on heat and moisture processes in the Earth's atmosphere.

Fill in lecturer for Physical Principles of Climate Change, on the instrumental record and the greenhouse effect.

Fill in lecturer for a Byrne Seminar on global climate change.

Responsibilities for the above classes included preparing and presenting occasional lectures, proctoring exams, grading and going over homework, and helping students.

Additionally, I have received certificates for participating in the “Professional Development: Tips for Future Faculty” and “Creative Teaching Practices” workshops offered by the Rutgers Teaching Assistant Project.

## MEMBERSHIPS IN PROFESSIONAL ORGANIZATIONS

American Meteorological Society

American Geophysical Union

American Association for the Advancement of Science

European Geosciences Union

## FELLOWSHIPS AND AWARDS

2013 Postdoctoral Fellowship at the University of Texas at Austin.

2010 National Science Foundation (NSF) scholarship to the Urbino Summer School in Paleoclimatology.

2008 Graduate Assistance in Areas of National Need (GAANN) fellowship.

2007 School of Environmental and Biological Sciences (SEBS) Excellence Fellowship, Rutgers University.

## PAPER REVIEWS FOR JOURNALS

Climate Dynamics, Climate of the Past, Journal of Climate, Journal of Geophysical Research: Oceans, Nature Geoscience

# PUBLICATIONS

## In Preparation

PAGES2k Consortium members: Global temperature change over the past 2,000 years: internal and external contributions. *In preparation.*

Emile-Geay, J., M. P. Erb, G. J. Hakim, E. J. Steig, and D. C. Noone: Climate dynamics with the Last Millennium Reanalysis. *In preparation.*

Erb, M. P., J. Emile-Geay, N. Steiger, K. Horlick, G. J. Hakim, E. J. Steig, D. Noone, and D. M. Anderson: Constraints on U.S. drought dynamics from paleoclimate data assimilation. *In preparation.*

Erb, M. P., C. S. Jackson, A. J. Broccoli, D. W. Lea, and P. N. DiNezio: Detection and attribution of paleoclimate forcings in long proxy records. *In preparation.*

Partin, J. W., M. P. Erb, T. M. Quinn, C.-C. Shen, C. S. Jackson, M. B. Cardenas, F. P. Siringan, J. L. Banner, K. Lin, Y. Okumura, H.-M. Hu, and F. W. Taylor: Insolation driven interactions between the land and ocean monsoons. *In preparation.*

## Submitted

Routson, C., N. McKay, D. Kaufman, M. P. Erb, H. Goosse, B. Shuman, J. Rodysill, and T. Ault: Mid-latitude net precipitation decreased with Arctic warming during the Holocene. *Submitted.*

## Refereed Journal Articles

[2018] Tabor, C. R., B. L. Otto-Bliesner, E. C. Brady, J. Nusbaumer, J. Zhu, M. P. Erb, T. E. Wong, Z. Liu, and D. Noone: Interpreting precession-driven  $\delta^{18}\text{O}$  variability in the South Asian monsoon region. *J. Geophys. Res.-Atmos.*, **123**, 20 pp, doi:10.1029/2018JD028424.

[2018] Bosmans, J. H. C., M. P. Erb, A. M. Dolan, S. S. Drijfhout, E. Tuenter, F. J. Hilgen, D. Edge, J. O. Pope, and L. J. Lourens: Response of the Asian summer monsoons to idealized precession and obliquity forcing in a set of GCMs. *Quaternary Sci. Rev.*, **188**, 121-135, doi:10.1016/j.quascirev.2018.03.025.

[2018] Erb, M. P., C. S. Jackson, A. J. Broccoli, D. W. Lea, P. J. Valdes, M. Crucifix, and P. N. DiNezio: Model evidence for a seasonal bias in Antarctic ice cores. *Nature Communications*, **9**, 10 pp, doi:10.1038/s41467-018-03800-0.

- [2015] Erb, M. P., C. S. Jackson, and A. J. Broccoli: Using single-forcing GCM simulations to reconstruct and interpret Quaternary climate change. *J. Climate*, **28**, 9746-9767, doi:10.1175/JCLI-D-15-0329.1.
- [2015] Erb, M. P., A. J. Broccoli, N. T. Graham, A. C. Clement, A. T. Wittenberg, and G. A. Vecchi: Response of the equatorial Pacific seasonal cycle to orbital forcing. *J. Climate*, **28**, 9258-9276, doi:10.1175/JCLI-D-15-0242.1.
- [2014] Mantsis, D. F., B. R. Lintner, A. J. Broccoli, M. P. Erb, A. C. Clement, H.-S. Park: The response of large-scale circulation to obliquity-induced changes in meridional heating gradients. *J. Climate*, **27**, 5504-5516, doi:10.1175/JCLI-D-13-00526.1.
- [2013] Erb, M. P., A. J. Broccoli, and A. C. Clement: The contribution of radiative feedbacks to orbitally-driven climate change. *J. Climate*, **26**, 5897-5914, doi:10.1175/JCLI-D-12-00419.1.
- [2013] Mantsis, D. F., A. C. Clement, B. Kirtman, A. J. Broccoli, and M. P. Erb: Precessional cycles and their influence on the North Pacific and North Atlantic summer anticyclones. *J. Climate*, **26**, 4596-4611, doi:10.1175/JCLI-D-12-00343.1.
- [2011] Mantsis, D. F., A. C. Clement, A. J. Broccoli, and M. P. Erb: Climate feedbacks in response to changes in obliquity. *J. Climate*, **24**, 2830-2845, doi:10.1175/2010JCLI3986.1.

## Other Publications

- [2017] Emile-Geay, J., M. P. Erb, G. J. Hakim, E. J. Steig. And D. C. Noone: Workshop Report: Climate dynamics with the Last Millennium Reanalysis. *PAGES Magazine*, **25**, 1 pp.
- [2006] Erb, M. P., and C. C. Hennon: A case study of Hurricane Katrina: rapid intensification in the Gulf of Mexico. *Proceedings of the National Conference of Undergraduate Research (NCUR)*, 8 pp.

## Books

- [2012] “Kelvin McCloud and the Seaside Storm” by Michael Erb, *Tumblehome Learning, Inc.*, 244 pp. – A fiction book for kids, ages 9-12, which discusses real weather and other science, written to get kids interested in these topics.

## WORKSHOPS

- [2017] “LMR Hackathon,” Third Annual LMR Workshop, Boulder, CO, October. A one day hands-on workshop for attendees to become more familiar with the Last Millennium Reanalysis

(LMR) output and code. I ran the Hackathon, showing attendees how to analyze LMR output and run the code.

## SCIENTIFIC PRESENTATIONS

[2018] “Exploring drought and climate over the past 1000 years through paleoclimate data assimilation,” SESES Seminar, Northern Arizona University, Flagstaff, AZ, February, *invited talk* with J. Emile-Geay, G. J. Hakim, R. Tardif, K. Horlick, W. A. Perkins, D. Noone, E. J. Steig, and D. M. Anderson.

[2017] “Is recent warming unprecedented in the Common Era? Insights from PAGES2k v.2 data and the Last Millennium Reanalysis,” American Geophysical Union Fall Meeting, New Orleans, LA, December, *talk* with J. Emile-Geay, N. McKay, G. Hakim, E. Steig, and K. Anchukaitis.

[2017] “Constraints on U.S. drought dynamics from the Last Millennium Reanalysis,” Third Annual LMR Workshop, Boulder, CO, October, *talk* with J. Emile-Geay, G. J. Hakim, R. Tardif, K. Horlick, W. A. Perkins, D. Noone, E. J. Steig, and D. M. Anderson.

[2017] “Climate and drought over the past 1000 years in the Last Millennium Reanalysis,” 5<sup>th</sup> Past Global Changes (PAGES) Open Science Meeting (OSM), Zaragoza, Spain, May, *poster* with J. Emile-Geay, G. J. Hakim, R. Tardif, K. Horlick, W. A. Perkins, D. Noone, E. J. Steig, and D. M. Anderson.

[2017] “Climate and drought over the past 1000 years in the Last Millennium Reanalysis,” European Geosciences Union General Assembly 2017, Vienna, Austria, April, *talk* with J. Emile-Geay, G. J. Hakim, R. Tardif, K. Horlick, W. A. Perkins, D. Noone, E. J. Steig, and D. M. Anderson.

[2016] “Climate and drought over the past 1000 years in the Last Millennium Reanalysis,” American Geophysical Union Fall Meeting, San Francisco, CA, December, *talk* with J. Emile-Geay, G. J. Hakim, R. Tardif, K. Horlick, W. A. Perkins, D. Noone, E. J. Steig, and D. M. Anderson.

[2016] “Climate and drought over the past 1000 years in the Last Millennium Reanalysis,” Paleoenvironmental seminar, University of Southern California, Los Angeles, CA, November, *talk* with J. Emile-Geay, D. M. Anderson, G. J. Hakim, K. Horlick, D. Noone, W. A. Perkins, E. J. Steig, and R. Tardif.

[2015] “Obliquity and Precession in the Quaternary: Analyzing Climate Responses Using Single-Forcing GCM Simulations and Bayesian Model-Proxy Comparison,” American Geophysical Union Fall Meeting, San Francisco, CA, December, *poster* with C. S. Jackson, A. J. Broccoli, and D. W. Lea.

[2015] “Simulating the Response to Astronomical Forcing with a Coupled Atmosphere-Ocean Model,” American Geophysical Union Fall Meeting, San Francisco, CA, December, *poster* with A. J. Broccoli and B. Raney.

[2015] “Using single-forcing simulations and proxy data to explore Quaternary climate change,” Pacific Northwest National Laboratory, Richland, WA, October, *invited talk* with C. S. Jackson, A. J. Broccoli, and D. W. Lea.

[2015] “Impacts of orbital, greenhouse gas, and ice sheet variations on Quaternary climate change,” University of Texas Institute for Geophysics Brown Bag talk, Austin, TX, October, *talk* with C. S. Jackson, A. J. Broccoli, and D. W. Lea.

[2015] “Is linearity a sufficient model for interpreting long-term climate variability of the late Quaternary?” XIX INQUA 2015, Nagoya, Japan, July-August, *poster* with C. S. Jackson, A. J. Broccoli, and P. J. Valdes.

[2015] “Using idealized GCM simulations and proxy data to investigate the Quaternary response to obliquity,” XIX INQUA 2015, Nagoya, Japan, July-August, *talk* with C. S. Jackson, A. J. Broccoli, and D. W. Lea.

[2015] “The influence of obliquity on Quaternary climate,” 20<sup>th</sup> Annual CESM Workshop, Breckenridge, CO, June, *talk* with C. S. Jackson and A. J. Broccoli.

[2014] “Using idealized GCM simulations to reconstruct and interpret past precipitation and temperature changes,” American Geophysical Union Fall Meeting, San Francisco, CA, December, *poster* with C. S. Jackson, A. J. Broccoli, and D. W. Lea.

[2014] “Climate change in the United States: Findings of the U.S. National Climate Assessment and the IPCC,” Rotary Club, Austin, TX, June, *talk*.

[2014] “Using idealized GCM simulations to reconstruct (and interpret) past climate change,” 19<sup>th</sup> Annual CESM Workshop, Breckenridge, CO, June, *talk* with C. S. Jackson, A. J. Broccoli, and D. W. Lea.

[2014] “The response of radiative feedbacks and equatorial Pacific seasonality to orbital forcing,” University of Texas Institute for Geophysics Seminar Series, Austin, TX, March, *talk* with A. J. Broccoli, B. R. Lintner, N. T. Graham, A. C. Clement, A. T. Wittenberg, and G. A. Vecchi.

[2013] “The response of radiative feedbacks, equatorial Pacific seasonality, and wetlands to orbital forcing in model simulations,” Rutgers University Ph.D. defense, New Brunswick, NJ, November, *talk* with A. J. Broccoli, B. R. Lintner, N. T. Graham, Y. F. Reinfeldler, H. Li, A. C. Clement, A. T. Wittenberg, G. A. Vecchi, and Y. Rosenthal.

[2012] “Response of the Equatorial Pacific Seasonal Cycle to Orbital Forcing,” American Geophysical Union Fall Meeting, San Francisco, CA, December, *talk* with A. J. Broccoli, A. T. Wittenberg, and G. A. Vecchi.

[2012] “The Influence of Orbital Forcing on Past Climate Change,” The Rutgers Climate Symposium, New Brunswick, NJ, November, *poster* with A. J. Broccoli, A. C. Clement, A. T. Wittenberg, and G. A. Vecchi.

[2012] “The Effect of Orbital Forcing on Seasonality in the Equatorial Pacific,” Paleoclimate Modelling Intercomparison Project, Phase 3, 2<sup>nd</sup> General Meeting, Crewe, UK, May, *talk* with A. J. Broccoli, G. A. Vecchi, A. T. Wittenberg, D. W. Oppo, and M. Khodri.

[2011] “The Role of Feedbacks in Precession and Obliquity-driven Climate Change,” American Geophysical Union Fall Meeting, San Francisco, CA, December, *poster* with A. J. Broccoli and A. C. Clement.

[2011] “The Role of Feedbacks in Precession and Obliquity-driven Climate Change,” Princeton Geosciences Graduate Research Symposium, Princeton, NJ, November, *invited talk* with A. J. Broccoli and A. C. Clement.

[2011] “The Role of Feedbacks in Precession and Obliquity-driven Climate Change,” Graduate Climate Conference, Woods Hole, MA, October, *talk* with A. J. Broccoli and A. C. Clement.

[2011] “4.5 Billion Years of Extremes: A (Brief) Introduction to the Study of Past Climates,” Rutgers University, New Brunswick, NJ, May, *talk*.

[2010] “The Astronomical Forcing of Climate Change: Forcing and Feedbacks,” Paleoclimate Modelling Intercomparison Project, Phase 3, 1<sup>st</sup> General Meeting, Kyoto, Japan, December, *poster* with A. J. Broccoli and A. C. Clement.

[2010] “Orbital Forcing of Climate: The Role of Obliquity in Driving Natural Climate Change,” Urbino Summer School in Paleoclimatology, Urbino, Italy, July, *poster* with A. J. Broccoli and A. C. Clement.

[2009] “Orbital Forcing of Climate: The Role of Obliquity in Driving Natural Climate Change,” American Geophysical Union Fall Meeting, San Francisco, CA, December, *poster* with A. J. Broccoli and A. C. Clement.

[2006] “A Case Study of Hurricane Katrina: Rapid Intensification in the Gulf of Mexico,” National Conference on Undergraduate Research, Asheville, NC, April, *talk* with C. C. Hennon.