BENJAMIN ZIND HOULTON

Curriculum Vitae

Email: bzhoulton@ucdavis.edu • Website: houlton.lawr.ucdavis.edu • Twitter: @BenHoulton

PROFESSIONAL PREPARATION

Ph.D., Princeton University (*Ecology and Evolutionary Biology*)	2005
M.S., Syracuse University (*Environmental Engineering Science*)	2000
B.S., University of Wisconsin – Stevens Point (*Aquatic Chemistry*)	1998

APPOINTMENTS

Chancellor's Fellow, University of California – Davis	2013 – present
Associate Professor, University of California – Davis	2012 – present
Assistant Professor, University of California – Davis	July 2007 – 2012
Postdoctoral Scholar, Stanford University and Carnegie Institution for Science, Department of Global Ecology	2005 – 2007
Visiting Scientist, CSIRO's Division of Marine and Atmospheric Research, Aspendale, Victoria, Australia	2006

PEER-REVIEWED RESEARCH ARTICLES ***(*POSTDOC OR STUDENT ADVISEE)***

1. **Houlton, B. Z.,** Marklein A. R.*, and Bai E.* Representation of nitrogen in climate change forecasts *Nature Climate Change* 5 (5): 398-401 (2015).

2. **Houlton, B. Z.,** and Morford S. L.* A new synthesis for terrestrial nitrogen inputs. *Soil* 1 (1): 381-397 (2015). (***Inaugural issue***)

3. Morford S.*, **Houlton B. Z.** and Dahlgren R. A. Direct quantification of long-term rock nitrogen inputs to temperate forests. *Ecology* doi.org/10.1890/15-0501 (2015).

4. Mnich M.*, and **Houlton B. Z.** Role of fie, grazing and forest clearing on $^{15}N/^{14}N$ balances of diverse terrestrial ecosystems. *Oecologia* (2015).

5. Hinckley, E., Bonan G., Bowen G., Colman B., Duffy P., Goodale C., **Houlton B. Z.,** Marín-Spiotta E., Ogle K., Ollinger S., Paul E., Vitousek P., Weathers K., Williams D. The soil and plant biogeochemistry sampling design for the National Ecological Observatory Network (NEON). *Ecosphere* (2015).

6. Fang, Y, Koba K., Makabe A., Takahashi C., Zhu W., Hayashi T., Hokari A. A., Urakawa R., Bai E., **Houlton B. Z.**, Xi C., Zhang S., Matsushita K., Tu Y., Liu D., Zhu F., Wang Z., Zhou G., Chen D., Makita T., Toda H., Liu X., Chen Q., Zhang D., Li Y., Muneoki Y. Microbial denitrification dominates nitrate losses from forest ecosystems. *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* 112: 1470-1474 (2014).

7. Zaehle, S., Jones C. D., **Houlton B. Z.**, Lamarque J-F, and Robertson E. Nitrogen availability reduces CMIP5 projections of 21st century land carbon uptake. *Journal of Climate* 28: 2494-2511 (2014).

8. Cleveland, C. C., **Houlton, B. Z.**, Smith, B., Marklein, A.*, Reed, S., Parton, W., Del Grosso, S., and Running, S. Patterns of new vs. recycled production in the terrestrial biosphere *Proceedings of the National Academy of Sciences of the United States of America (PNAS)*, 110 (31): 12733-12737 (2013).

9. Zhou, G, **Houlton, B. Z**., Wang, W, Huang, W, Xiao, Y, Zhang, Q, Liu, S, Cao, M, Wang, X, Wang, S, Zhang, Y, Yan, J, Liu, J, Tang, X, Zhang, D. Substantial reorganization of China's tropical and subtropical forests: Evidence from permanent plots. *Global Change Biology*, 20(1): 240-250 (2013).

10. Albarracín, M. V., Six, J., **Houlton, B. Z.,** Bledsoe, C. S. Nitrogen fertilization field study of carbon-13 and nitrogen-15 transfers in ectomycorrhizas of Pinus sabiniana. *Oecologia* 173(4): 1439-1450 (2013).

11. Izquierdo, J.*, **Houlton, B. Z.,** and van Huysen, T.*, Evidence for progressive phosphorus limitation during long-term ecosystem development: Evaluation of a biogeochemical paradigm. *Plant and Soil* 367: 135-147 (2013).

12. **Houlton, B. Z.**, Boyer, B., Finzi, A., Galloway, J., Leach, A., Liptzin, D.*, Melillo, J., Rosenstock, T. S., Sobota, D., and Townsend, A. R., Intentional vs. unintentional nitrogen use in the United States: Trends, efficiency, and implications. *Biogeochemistry* 114: 11-23 (2012).

13. Bai, E.*, **Houlton, B. Z.**, and Wang, Y. P., Isotopic identification of nitrogen hotspots across Earth's terrestrial ecosystems. *Biogeosciences* 9 (8): 3287-3304 (2012).

14. **Houlton, B. Z.**, Boyer, B., Finzi, A., Galloway, J., Leach, A., Liptzin, D.*, Melillo, J., Rosenstock, T. S., Sobota, D., and Townsend, A. R., The US Nitrogen Synthesis: N-use Efficiency among Economic Sectors and N by Climate Risks Nationwide. In: *The Role of Nitrogen in Climate Change...: A Technical Report Submitted to the US National Climate Assessment* Ed. Suddick, E.C., Davidson, E.A., Woods Hole Research Center, 149 Woods Hole Road, Falmouth, MA, 02540-1644 USA (2012). (peer reviewed)

15. Townsend, A. R., Vitousek, P. M., and **Houlton, B. Z.**. The climate benefits of better nitrogen and phosphorus management. *Issues in Science and Technology 28 (2): 85-91* (2012).

16. Marklein, A.*****, and **Houlton, B. Z.,** Nitrogen inputs accelerate phosphorus cycling rates across a wide variety of terrestrial ecosystems. *New Phytologist* 193 (3): 696-704 (2012).

- *Biology Faculty of 1000 selection*

17. Cleveland, C. C., Townsend, A. R., Taylor, P., Alvarez-Clare, S., Bustamante, M. M. C., Chuyong,G., Dobrowski,S. L., Grierson, P., Harms, K. E., **Houlton, B. Z.**, Marklein, A.*****, Parton, W., Porder, S., Reed, S. C., Sierra, C. A., Silver, W. L., Tanner, E. V. J., and Wieder, W. R., Relationships among net primary productivity, nutrients and climate in tropical rainforest: A pan-tropical analysis. *Ecology Letters* 14 (9): 939-947 (2011).

18. Morford, S.*****, **Houlton, B. Z.,** and Dahlgren, R. A., Increased forest nitrogen and carbon storage from nitrogen-rich bedrock. *Nature* 477, 78-81 (2011).

- *News and Views by E.A. Schuur, Nature*

- *Biology Faculty of 1000 selection*

- *Elizabeth Sulzman Award (best paper in the biogeosciences, ESA)*

- *Press Coverage by NPR (morning edition), BBC's "The Naked Scientist" among others*

19. **Houlton, B. Z.,** Biogoechemistry and nutrient cycles. In: Encyclopedia of Theoretical Ecology (2011). (peer reviewed book chapter)

20. Finzi, A. C., Austin, A. T., Cleland, E. E., Frey, S., **Houlton, B. Z.**, and Wallenstein, M. D., Alteration of coupled biogeochemical cycles in response to global change in the terrestrial biosphere. *Frontiers in Ecology and the Environment* 9 (1): 61-67 (2011).

21. Townsend, A. R., Cleveland, C. C., **Houlton, B. Z.**, Alden C. B., and White, J. W. C., Multi-element regulation of the tropical forest carbon cycle. *Frontiers in Ecology and the Environment* 9 (1): 9-17 (2011).

22. **Houlton, B. Z.,** and Driscoll, C. T., The effect of ice storms on the biogeochemistry and hydrology of forest ecosystems. In: Hydrology and Biogeochemistry: Synthesis and Future Research Directions (2011). (peer reviewed book chapter)

23. Vitousek, P. M., Porder, S., **Houlton, B. Z.**, and Chadwick, O., Terrestrial phosphorus limitation: Mechanisms, implications and nitrogen-phosphorus interactions. *Ecological Applications* 20 (1): 5-15 (2010).

24. **Houlton, B. Z.,** and Field, C. B., Nutrient limitations of carbon uptake: From leaves to landscapes in a California rangeland ecosystem. *Rangeland Ecology and Management* 63: 120-127 (2010).

25. Cleveland, C. C., **Houlton, B. Z.**, Neill, C., Reed, S., Townsend, A. R., and Wang, Y. P., Using indirect methods to estimate symbiotic nitrogen fixation: A case study from an Amazonian rain forest. *Biogeochemistry* DOI10.1007/s10533-009-9392-y (2010).

26. **Houlton, B. Z.,** and Bai, E.*****, Imprint of denitrifying bacteria on the global terrestrial biosphere. *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* 106 (51): 21713 - 21716 (2009).

- *Biology Faculty of 1000 selection*

27. Bai, E.*****, and **Houlton, B. Z.**, Coupled isotopic and process-based modeling of gaseous nitrogen losses from tropical rainforests. *Global Biogeochemical Cycles* 23: (GB2011) (2009).

28. Wang, Y. P., and **Houlton, B. Z.**, Estimates of global nitrogen fixation: Implications for global climate change. *Geophysical Research Letters* 36: L24403 (2009).

- *Press coverage by Nature, MSNBC/Today, Discovery*

29. **Houlton, B. Z.**, Wang, Y. P., Vitousek, P. M., and Field, C. B., A unifying framework for dinitrogen fixation in the terrestrial biosphere. *Nature,* 454 (7202): 327-U34 (2008).

- News and Views by E.A. Davidson, Nature Geoscience

- Biology Faculty of 1000 selection

- Press coverage by Christian Science Monitor, Environmental Research Web, among others

30. Kaiser, J., Hastings, M. G., **Houlton, B. Z.,** Rockmann, T., and Sigman, D. M., Triple oxygen isotope analysis of nitrate using the denitrifier method and thermal decomposition of N_2O. *Analytical Chemistry,* 79: 599-607 (2007).

31. **Houlton, B. Z.**, Sigman, D. M., Schuur, E. A., and Hedin, L. O., A climate-driven switch in plant nitrogen acquisition within tropical forest communities. *Proceedings of the National Academy of Sciences of the United States of America (PNAS),* 104 (21): 8902 - 8906 (2007).

- Biology Faculty of 1000 selection

32. Wang, Y. P., **Houlton, B. Z.**, and Field, C. B., A model of biogeochemical cycles of carbon, nitrogen, and phosphorus including symbiotic nitrogen fixation and phosphatase production. *Global Biogeochemical Cycles* 21 (1), (2007).

33. **Houlton, B. Z.**, Sigman, D. M., and Hedin, L. O., Isotopic evidence for large gaseous nitrogen losses from tropical rainforests. *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* 103 (23): 8745-8750 (2006).

- Biology Faculty of 1000 selection

- Gene E. Likens Award (best paper in the biogeosciences, ESA)

34. **Houlton, B. Z.,** Driscoll, C. T., Fahey, T. J., Likens, G. E., Groffman P. M., Bernhardt, E., and Buso, D., Nitrogen dynamics in ice storm-damaged forest ecosystems: Implications for nitrogen limitation theory. *Ecosystems* 6 (5), 431-443 (2003).

On-line publications (peer-reviewed and citable)

35. Bai, E.*, **Houlton, B. Z.**, and Wang, Y. P. Isotopic identification of nitrogen hotspots across Earth's terrestrial ecosystems. *Biogeosciences Discussions* 8 (6): 12113 (2011).

36. Houlton, B. Z. and Morford S. L. A new synthesis for terrestrial nitrogen inputs. *Soil Discussion* 1 (1): 497-540 (2014).

In press or review

37. Marklein, A. R.*, Cookingham J. B.*, Enders S. K.*, Gonzalez D. J. X.*, van Huysen T. L.*, Izquierdo J. I.*, Light D. R.*, Liptzin D.*, Miller K. E.*, Morford S. L.*, Norton R. A.*, **Houlton B.**

Z. Global forest nutrient supply tracks leaf litter decomposition. *Global Ecology and Biogeography* (revision invited, revised, in review).

38. **Houlton, B. Z.**,. Influence of anthropogenic nitrogen on the global carbon balance (in revision).

39. Morford, S.*, Houlton B. Z., and Dahlgren R. A. Bedrock nitrogen weathering is widespread in the terrestrial biosphere. *Nature* (in review).

40. Wang C., **Houlton B. Z.**, Dai W., and Bai E.* Pre-industrial vs. contemporary nitrogen fluxes and fates as influenced by global cropland expansion. *Environmental Research Letters* (in review).

41. Wang, C, **Houlton B. Z.**, Liu, D., and Bai., E. Stable isotopic constraints on global soil organic carbon turnover. *Global Biogeochemical Cycles* (revision invited, revised, in review)

42. Huang, W., **Houlton B. Z.**, Marklein A. R.*, Liu J., and Zhou G. Elevated CO_2 decreases plant N/P across diverse terrestrial biomes. *Nature Scientific Reports* (revision invited, revised, in review)

43. Cookingham, J., Houlton B. Z. Iron regulation of di-nitrogen fixation in karst tropical forest. *Nature* (in review).

44. Morford, S., Houlton B. Z., and Dahlgren, R. A. Modeling geochemical and tectonic controls on rock nitrogen fluxes across temperate California ecosystems. *Global Biogeochemical Cycles* (in review).

RESEARCH GRANTS *(>$4.1 million since initial appointment in July 2007)*

1. **Houlton, B. Z.** (Lead PI), Bookhagen B. (co-PI), Chadwick O. A. (co-PI), Dahlgren R. A. (co-PI), Treseder K. (co-PI), Wang Y-P. (co-PI). National Science Foundation (NSF), Integrated Earth Systems, *Bedrock nitrogen and the Earth system: from geobiological mechanisms to climate change forecasts* ($3,000,000; 2014 to 2017).

2. **Houlton, B. Z.** (Sole PI), National Science Foundation (NSF)-CAREER award, *Large-scale nitrogen cycles and underrepresented groups: A plan for advancement* ($637,000; 2012 – 2017).

3. **Houlton, B. Z.** (Sole PI), Andrew W. Mellon Foundation, Junior Faculty Research Grant, *An oceanographic-based approach to coupled nutrient cycles on land* ($290,000, no overhead; 2008 – 2015).

4. **Houlton, B. Z.** (Lead PI), Alissa K. (co-PI), Springborn M. (co-PI). David and Lucile Packard Foundation, *California nitroscapes: An environmental, social, and economic evaluation of the fate and consequence of excess nitrogen* ($120,000; 2009 – 2012).

5**. Houlton, B. Z.** (Sole PI), Kearney Foundation of Soil Science, Biogeochemical evolution of the pygmy forest ($89,000, no overhead; 2008 – 2011).

HONORS AND AWARDS

- Research covered by popular news outlets, including: *The Christian Science Monitor*, *Davis Enterprise*, *Discovery Channel*, *MSNBC*, *Nature*, *Science*, *Environmental Research Web, NPR "Morning Edition" (*national program*), BBC talk show "The Naked Scientists", CBS – Sacramento, and Progressive Radio Network.*

- *Chancellor's Fellow,* UC Davis, "In recognition of demonstrated excellence in research and teaching as evidenced by especially high quality and achievement." (title from 2013 – 2018)

- Six papers highlighted by *Biology Faculty of 1000* (**Houlton** et al., *PNAS*, 2006; **Houlton** et al., *PNAS*, 2007; **Houlton** et al., *Nature*, 2008; **Houlton** and Bai, *PNAS*, 2009; Morford, **Houlton**, Dahlgren, *Nature*, 2010; Marklein and **Houlton**, *New Phytologist*, 2011)

- Elizabeth Sulzman Award (ESA) for the most outstanding paper published in the Biogeosciences by a doctoral student (to advisee Morford for Morford, **Houlton**, and Dahlgren, *Nature*, 2011) (2012)

- Twice nominated for the UC Davis teaching award (2010, 2012)

- Waukesha South High School Hall of Fame (induction in 2008)

- Gene E. Likens Award (ESA) for the most outstanding paper published in the Biogeosciences (for **Houlton** et al., *PNAS*, 2006) (2007)

- Buell Award (best student paper award), honorable mention, The Ecological Society of America's Annual Meeting, Montreal (2005)

- University Fellowship, Princeton University (2001 – 2002)

- Best Student Paper Award, American Water Resources Association's National Meeting, Point Clear, Alabama (1998)

- Undergraduate Science Research Award, The Sigma Xi—The Scientific Research Society (1997)
- Best Student Paper Award, American Water Resources Association's Wisconsin State Meeting, Green Lake, Wisconsin (1997) (undergraduate)

SYNERGISTIC ACTIVITIES

- Co-director, UC Davis chapter of Strategies for Ecology, Education, Diversity and Sustainability (*SEEDS*), a science-education program developed by the Ecological Society of America (2008 – present). Our aim is to enhance and nurture opportunities for underrepresented groups in ecological science. (**Awarded "Chapter of Year" by ESA, 2014**)

- Co-director, *EnvironMentors (local AggieMentors chapter)*, an outreach program dedicated to enhancing research opportunities for High School students of ethnically diverse backgrounds in STEM fields (2010 – present)

- Editorial Board Member, *Ecology* (2011 – present)

- Associate Editor, *Global Biogeochemical Cycles* (2014 – present)
- NSF-NEON biogeochemistry steering committee (2012 – present)
- Participant in Research Coordination Network, INTERFACE (2011 – present)
- Participant in National Center for Ecological Analysis and Synthesis (NCEAS) workshop on nutrient limitation in the tropics (led by Cleveland C. C. and Townsend A. R.) (2007 – 2012)
- Invited Lecturer, NCAR Advanced Study Program, Carbon-Climate Connections in the Earth System (July 29 – August 16, Boulder, CO)
- Participant in Research Coordination Network on Nitrogen and Climate Change (led by Davidson E. A.) (2011 – present)
- Chair of report on nitrogen x climate interactions report submitted to the National Climate Assessment (**Houlton, B. Z.**, Boyer, B., Finzi, A., Galloway, J., Leach, A., Liptzin, D., Melillo, J., Rosenstock, T. S., Sobota, D., and Townsend, A. R., The US Nitrogen Synthesis: N-use Efficiency among Economic Sectors and N by Climate Risks Nationwide. In: *The Role of Nitrogen in Climate Change and the Impacts of Nitrogen-Climate Interactions...: A Technical Report Submitted to the US National Climate Assessment* Ed. Suddick, E.C., Davidson, E.A., Woods Hole Research Center, 149 Woods Hole Road, Falmouth, MA, 02540-1644 USA.(2012)
- **Ad hoc journal reviewer** (from 2007 – present): *Nature, Nature Climate Change, Nature Geoscience, Nature Plants, PNAS, PLOS, Ecology, Ecological Applications, Ecological Monographs, New Phytologist, Ecology Letters, Oecologia, Global Biogeochemical Cycles, Global Change Biology, Ecosystems, Plant and Soil, Biogeochemistry, Biogeosciences, Soil Science Society of America Journal, Journal of Ecology, Geochimica et Cosmochimica Acta, Environmental Science and Technology, Southern African Journal of Botany*
- **Proposal reviewer** (2007 – present): NASA (Remote Panelist, Carbon Cycle), NSF Ecosystems, NSF Geosciences, US-Israel Bi-national Science Foundation, Kearney Foundation (Panelist and reviewer)
- **Invited talks/seminars**: University of Pennsylvania (2004), St. Lawrence University (2004), University of California – Berkley (2007), Indiana University (2007), Miami University (2007), Penn State University (2008), California Academy of Sciences (2008), Boston University (2009), University of Colorado – Boulder (2009), University of California – Davis (2009), University of California – Merced (2010), EU COST Action Meeting (2010; invited plenary, Slovenia), Northern Arizona University (2011), INTERFACE/CLIMMANI Meeting (2011; Iceland), National Academy of Sciences meeting on Carbon Sequestration (2011; Irvine, CA), Carnegie Institution of Science at Stanford University (2012), Biogeomon Meeting (2012; invited plenary, Maine, USA), Southern California Coastal Water Research Project (SCCWRP), a meeting-grounds for scientists, municipalities and decision makers (2012), NCAR (2013), University of Western Ontario (Canada) (2013; invited by graduate students), Tokyo University of Agriculture and Technology (2014; one week of lectures to Global Studies Program, and keynote talk at Japanese Research Symposium), Science Europe, Models in Science (2014, Brussels, Belgium)

PUBLISHED ABSTRACTS

1. **Houlton. B. Z.**, and B. A. Browne. 1998. Age-dating the groundwater discharge to the Little Plover River. American Water Resources Association Wisconsin State Section Meeting, Green Lake, Wisconsin. **(Received Best Student Paper Award)**

2. **Houlton, B. Z.**, and B. A. Browne. 1998. Age-dating the groundwater discharge to the Little Plover River. American Water Resources Association National Meeting, Point Clear, Alabama. **(Received Best Student Paper Award)**

3. **Houlton, B. Z.**, and C. T. Driscoll. 1999. The effects of ice storm damage on drainage water chemistry at the Hubbard Brook Experimental Forest. Gordon Research Conference on Forested Catchments: Hydrological/Geological/Biological Processes, Andover, New Hampshire.

4. **Houlton, B. Z.**, C. T. Driscoll, T. J. Fahey, and G. E. Likens. 2000. The effects of ice storm damage on the biogeochemistry of northern forest ecosystems. The Long-Term Ecological Research National Meeting, Snowbird, Utah.

5. **Houlton, B. Z.**, C.T. Driscoll, and T. J. Fahey. 2000. The effects of ice storm damage on drainage water chemistry at the Hubbard Brook Experimental Forest—Linking natural disturbance to nutrient loss and acidification of drainage water. The Ecological Society of America Annual Meeting, Snowbird, Utah.

6. **Houlton, B. Z.**, D. M. Sigman, and L. O. Hedin. 2003. Stable isotope constraints on internal nitrogen cycles, input-output balances, and the nitrogen fertility of forests The Ecological Society of America Annual Meeting, Savannah, Georgia.

7. **Houlton, B. Z.**, D. M. Sigman, and L. O. Hedin. 2004. 15N/14N as a proxy for gaseous nitrogen losses across a forest rainfall gradient. The Ecological Society of America Annual Meeting, Portland, Oregon.

8. Kaiser, J., M. G. Hastings, **B. Z. Houlton**, T. Röckmann, and D. M. Sigman. 2004. Online method for oxygen triple isotope analyses of nitrate. American Geophysical Union Fall Meeting, San Francisco, California (invited).

9. **Houlton, B. Z.**, D. M. Sigman, and L. O. Hedin. 2005. Isotopic constraints on nitrogen acquisition by plant communities across tropical rainforests. The Ecological Society of America Annual Meeting, Montreal, Canada. **(Buell Award, Honorable Mention)**

10. **Houlton, B. Z.**, D. M. Sigman, and L. O. Hedin. 2005. Climate-dependence of plant-soil 15N/14N interactions. American Geophysical Union Fall Meeting, San Francisco, California.

11. Wang, Y.-P., **B. Z. Houlton**, and C. B. Field. 2006. A new biogeochemical model of carbon, nitrogen, and phosphorus cycles. American Geophysical Union Fall Meeting, San Francisco, California.

12. Wang, Y.-P., **B. Z. Houlton**, C. B. Field, and P. M. Vitousek. 2007. What determines the abundance of symbiotic N2 fixers within the tropical biome? The Ecological Society of America Annual Meeting, San Jose, California.

13. **Houlton, B. Z.**, Y.-P. Wang, P. M. Vitousek, and C. B. Field. 2007. Toward a biogeochemical framework of nitrogen fixation in the terrestrial biosphere. The Ecological Society of America Annual Meeting, San Jose, California.

14. Chiariello, N. R., T. Tobeck, Y. O. Estrada, A. Appling, **B. Z. Houlton**, N. P. Gurwick, and C. B. Field. 2007. Interacting effects of elevated carbon dioxide, nitrate, and phosphate on plant growth and spectral reflectance of California grassland. The Ecological Society of America Annual Meeting, San Jose, California.

15. Wang, Y. P., **B. Z. Houlton,** C.B. Field, and P.M. Vitousek. 2007. Global N2 fixation and its response to global climate change and increasing CO2 level. American Geophysical Union Fall Meeting, San Francisco, California. (Invited).

16. **Houlton B. Z.,** and R. A. Dahlgren. 2007. Nitrogen in bedrock: A significant component of the global nitrogen cycle? International Nitrogen Initiative, Brazil.

17. **Houlton B. Z.**, Y.P. Wang, P.M. Vitousek and C. B. Field. 2007. An economic perspective of N fixation in the terrestrial biosphere. International Nitrogen Initiative, Brazil. (Invited).

18. **Houlton B. Z.**, P. M. Vitousek, C. B. Field, and M. Alyono. 2008. Nitrogen fixation accelerates phosphorus cycling rates under elevated CO2. The Ecological Society of America Annual Meeting, Milwaukee, WI.

19. Albarracin, V. M., **B. Z. Houlton,** J. Six, and C. S. Bledsoe. 2008. Balancing resources from plants and soil – Ectomycorrhizas as switch-hitters? The Ecological Society of America Annual Meeting, Milwaukee, WI.

20. **Houlton B. Z.** and E. Bai. 2008. Isotopic constraints on the global terrestrial N cycle. American Geophysical Union Fall Meeting, San Francisco, California.

21. **Houlton B. Z**. 2009. A working framework for global nitrogen fixation on land. Penn State University Plant Biology Symposium. (Invited keynote).

22. **Houlton B. Z.**, E. Bai, and Y.P. Wang. 2009. Isotopic Imprint of denitrification on the natural terrestrial biosphere. American Geophysical Union Fall Meeting, San Francisco, California. (Invited).

23. Bai, E., **B. Z. Houlton**, Y.P. Wang. 2009. Global distribution of gaseous nitrogen losses from the unmanaged terrestrial biosphere: results from a stable isotope model. Ecological Society of America Annual Meeting, Albuquerque, New Mexico.

24. Cleland, E. E., H. A.L. Henry, **B. Z. Houlton**, D. N.L Menge, and C. B. Field. 2009. Could ecosystem responses to rising CO2 be co-limited by nitrogen and phosphorus? Evidence from the Jasper Ridge Global Change Experiment. Ecological Society of America Annual Meeting, Albuquerque, New Mexico.

25. **Houlton B. Z.** and Y. P. Wang. 2009. Climatic controls on dinitrogen fixation: Links to N and P cycles. ESA. Ecological Society of America Annual Meeting, Albuquerque, New Mexico. (Invited)

26. **Houlton B. Z.**, S. Morford, T. van Huysen, and I. Fischer. 2010. On the biogeochemical evolution of the pygmy forest. Ecological Society of America Annual Meeting, Pittsburgh, Pennsylvania.

27. Marklein, A. and **B. Z. Houlton**. 2010. N inputs accelerate P mineralizing enzymes across a wide variety of terrestrial ecosystems. Ecological Society of America Annual Meeting, Pittsburgh, Pennsylvania.

28. **Houlton B. Z.** 2010. Carbon-nutrient interactions and climate change: Towards an even warmer world? COST Action on Belowground Complexity. Ljubljana, Slovenia. (Invited keynote).

29. **Houlton B. Z.**, E. Bai, and Y.P. Wang. 2010. Global N cycling: Isotopic and C, N, P constraints on worldwide patterns. American Geophysical Union Fall Meeting, San Francisco, California. (Invited).

30. Marklein, A. and **Houlton B. Z.** 2010. Nitrogen Inputs Stimulate Phosphorus Mineralizing Enzymes across a Wide Variety of Terrestrial Ecosystems. American Geophysical Union Fall Meeting, San Francisco, California.

31. Morford S., **Houlton B. Z.** and R.A. Dahlgren. 2010. Bedrock Nitrogen Contributes to Increased Carbon Storage in Temperate Conifer Forests of Northern California, USA. American Geophysical Union Fall Meeting, San Francisco, California.

32. Cleveland C.C. **et al.** 2011. Climate and nutrient regulation of the tropical forest carbon cycle. Ecological Society of American Annual Meeting, Austin, Texas.

33. Morford S., **Houlton B. Z.** and R. A. Dahlgren. 2011. Bedrock nitrogen contributes to nitrogen fertility and carbon storage across temperate forest ecosystems. Ecological Society of America Annual Meeting, Austin, Texas.

34. **Houlton B.Z.** 2011. Spatial couplings between nitrogen fixation and denitrification in the terrestrial biosphere: An earth system hypothesis. Ecological Society of America Annual Meeting, Austin, Texas.

35. Liptzin D., E. Bai, **Houlton B. Z.**, R.A. Dahlgren. 2011. A land-based nitrogen mass balance for California: Partitioning nitrogen surplus. Ecological Society of America Annual Meeting, Austin, Texas.

36. Gonzalez, D. J.X., **Houlton B. Z.**, and K. Suding. 2011. Global change effects on alpine microbial communities and nitrogen cycling. Ecological Society of America Annual Meeting, Austin, Texas.

37. Enders, S.K., and **Houlton B. Z**. 2011. Isotopic evidence for shifts in N cycling across rain/snow transitions in the Sierra Nevada. Ecological Society of America Annual Meeting, Austin, Texas.

38. Cleveland C. C., **Houlton B. Z.**, and S. Reed. 2012. Have we greatly overestimated nitrogen (N) inputs via biological N fixation in tropical forests? Ecological Society of America Annual Meeting, Portland, Oregon.

39. Marklein A.R., and **Houlton B. Z.**. 2012. N:P remineralization ratios across global forests. 2012. Ecological Society of America Annual Meeting, Portland, Oregon.

40. Morford S., **Houlton B. Z.**, and R.A. Dahlgren. 2012. Regional distribution and weathering of nitrogen-rich rock across the Pacific Northwest. American Geophysical Union Fall Meeting, San Francisco, California.

41. **Houlton, B. Z.**, Boyer, B., Finzi, A., Galloway, J., Leach, A., Liptzin, D.*, Melillo, J., Rosenstock, T. S., Sobota, D., and Townsend, A. R. 2013. Intentional vs. unintentional nitrogen use in the United States: Trends, efficiency, and implications. American Geophysical Union Fall Meeting, San Francisco, California.

42. Enders S.K., **Houlton B. Z.**, and K.H. Freeman. 2012. Terrestrial N constraints on the global C cycle: Exploring the potential for reconstruction from isotopic measurements on chlorophyll degradation products in soil. American Geophysical Union Fall Meeting, San Francisco, California.

43. Marklein A.R., and **Houlton B. Z.**. 2012. N:P remineralization ratios across forests worldwide. 2012. American Geophysical Union Fall Meeting, San Francisco, California.

44. Cookingham J. Brewer S. **Houlton B. Z.** 2013. Free-living nitrogen fixation rates in lowland tropical rainforests in Southern Belize with contrasting parent material. Ecological Society of America annual meeting, Minneapolis, MN, USA.

45. Morford S., **Houlton B. Z.**, Dahlgren R.A. 2013. Widespread and ecologically meaningful rock nitrogen contributions to terrestrial ecosystems. Ecological Society of America annual meeting, Minneapolis, MN, USA.

46. Marklein A., **Houlton B. Z**. 2013. Plant-microbe competition for nitrogen and phosphorus in tropical and temperate forests. Ecological Society of America annual meeting, Minneapolis, MN, USA.

47. **Houlton B. Z**. Human-era increases in the global CO2 burden of new nitrogen creation: An alternative hypothesis. 2013. Ecological Society of America annual meeting, Minneapolis, MN, USA.

48. Cleveland C.C., **Houlton B. Z.**, Smith W. Marklein A. Reed S. Parton W. Del Grosso S. Running S. 2013. Patterns of new vs. recycled production in the terrestrial biosphere. American Geophysical Union Fall Meeting, San Francisco, CA, USA.

49. **Houlton, B. Z.**, Boyer, B., Davidson, E. A., Finzi, A., Galloway, J., Leach, A., Liptzin, D.*, Melillo, J., Rosenstock, T. S., Sobota, D., Townsend, A. R. 2013. Intentional vs. unintentional nitrogen use in the United States: Trends, efficiency, and implications. Meeting of the International Nitrogen Initiative, Kampala, Uganda, Africa.

50. Marklein, A. R., **Houlton B. Z.** Net mineralization ratios of nitrogen and phosphorus in forest ecosystems worldwide. 2013. Meeting of the International Nitrogen Initiative, Kampala, Uganda, Africa.

51. Cookingham, J., **Houlton B. Z.** State-factor regulation of nitrogen fixation in lowland tropical forest, Belize. 2013. Meeting of the International Nitrogen Initiative, Kampala, Uganda, Africa.

52. Enders, S. K., **Houlton B. Z.,** Freeman K., Ohkouchi N., Chikaraishi Y., Ogawa N., Suga H. 2014. Development of a new proxy for past terrestrial nitrogen cycles from chlorophyll degradation products in soil. Goldschmidt, Sacramento, CA.

53. Cookingham, J., Brewer S., **Houlton B. Z.** 2014. Biogeochemical controls on nitrogen fixation vary between rock types in a lowland tropical rainforest. Ecological Society of America Annual Meeting, Sacramento, CA.

54. Marklein, A., **Houlton B. Z.** 2014. Nitrogen isotopes improve IPCC model predictions of nitrogen losses and climate change. Ecological Society of America Annual Meeting, Sacramento, CA.

55. Lennon, E., **Houlton B. Z.** 2014.Scaling terrestrial denitrification: Natural N isotopes and NirS gene abundance across terrestrial biomes. Ecological Society of America Annual Meeting, Sacramento, CA.

56. **Houlton, B. Z.**, Wang, C., and Bai, E. 2014. Nitrogen isotope composition of the biosphere: Excess nitrogen and the global nitrogen balance. Ecological Society of America Annual Meeting, Sacramento, CA.

57. Mnich, M., **Houlton B. Z.** 2014. Role of fire, herbivory and forest clearing in 15N/14N balances across diverse terrestrial ecosystems. Ecological Society of America Annual Meeting, Sacramento, CA.

58. Enders, S. K., **Houlton B. Z.,** Freeman K., Ohkouchi N., Chikaraishi Y., Ogawa N., Suga H. 2014. In search of a soil-based, compound specific proxy for plant leaf nitrogen isotope ratios. Ecological Society of America Annual Meeting, Sacramento, CA.

POSTDOCTORAL AND GRADUATE ADVISEES: E. Bai (postdoc, 2008 - 2010), T. van Huysen (postdoc, 2010 - 2012), D. Liptzin (postdoc, 2010 - 2012), Pawlok Das (postdoc, 2015 – present) A. Marklein (graduate student, doctorate conferred 2014, postdoc, 2014), S. Morford (graduate student, doctorate conferred 2014, postdoc, 2014 - present), J. Cookingham (doctorate conferred 2015), S. Enders (graduate student, current), J. Izquierdo (graduate student, M.S. conferred 2013), E. Lennon (graduate student, M.S. conferred 2014), M. Mnich (graduate student, M.S. conferred 2014), S. Mitchell (graduate student, current), K. Dynarski (graduate student, current), R. Walker (graduate student, current).

ACADEMIC ADVISORS: C. T. Driscoll (M. S.), L. O. Hedin (Ph. D.), P. M. Vitousek (postdoc), C. B. Field (postdoc)