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ADDRESS

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APPOINTMENTS

Northern Arizona University
School of Informatics, Computing and Cyber Systems (SICCS)
Center for Ecosystem Science and Society (Ecoss)
Professor 2017–

Harvard University
Department of Organismic and Evolutionary Biology
Associate Professor 2013–2017
Assistant Professor 2009–2013
Affiliated with the Harvard University Herbaria; Faculty associate of the Weatherhead Center for International Affairs and Harvard University Center for the Environment.

University of New Hampshire
Complex Systems Research Center; Institute for the Study of Earth, Oceans & Space
Research Assistant Professor 2007–2009
Research Scientist 2005–2007
Post-doctoral Research Associate 2003–2005

EDUCATION

Yale University, Ph.D. (with Distinction) 2003
Graduate School of Arts and Sciences
Program: Forestry & Environmental Studies

Yale University, M.F. (Master of Forestry) 1998
School of Forestry & Environmental Studies

Princeton University, A.B. degree (*summa cum laude*) 1992
Major in Economics

ACADEMIC HONORS AND PRIZES

ISI/Thompson Reuters

- Highly Cited Researcher in Environment/Ecology, 2015, 2016, 2017
- Highly Cited Researcher in Agricultural Sciences, 2014, 2015, 2016, 2017

Harvard University

- Nominee for the Star Family Prize for Excellence in Advising, 2013

Yale University

- Hutchinson Fellowship, Yale Institute of Biospheric Studies, 1999
- University Scholar, 1998–2002
- Forestry & Environmental Studies Fellowship, 1996–1998

Princeton University

- Phi Beta Kappa and Highest Honors, 1992
- Halbert White ’72 Prize (top student in the Economics Department), 1992
- Senior Thesis, “An Econometric Analysis of the Auction Market for Impressionist and Modern Pictures, 1980-1991,” awarded the American Studies Program’s Grace May Tilton Prize (for writing about fine arts) and the Economics Department’s Wolf Balleisen Memorial Prize (for top thesis in the Department), 1992

Upper Canada College

- Head Boy and Governor General’s Medal Winner, 1988

TEACHING

OEB 10: Foundations of Biological Diversity (2013–2016)

- lectures, co-taught with Brian Farrell and Elena Kramer
- 2016: 79 students — Student evaluation: Course 3.6/5.0; Instructor 3.9/5.0
- 2015: 80 students — Student evaluation: Course 3.3/5.0; Instructor 3.8/5.0
- 2014: 110 students — Student evaluation: Course 3.5/5.0; Instructor 3.8/5.0
- 2013: 98 students — Student evaluation: Course 3.7/5.0; Instructor 3.5/5.0

OEB 210: Writing Scientific Papers (2012–2016)

- graduate seminar
- 2016: 5 students — Student evaluation: Course 4.2/5.0; Instructor 4.5/5.0
- 2015: 7 students — Student evaluation: Course 4.6/5.0; Instructor 4.6/5.0
- 2013: 11 students — Student evaluation: Course 4.4/5.0; Instructor 4.5/5.0
- 2012: 9 students — Student evaluation: Course 4.4/5.0; Instructor 4.1/5.0

SLS 25: Trees, Forests and Global Change (2011–2013)

- lectures, field trips; co-taught with Donald Pfister
- 2013: 5 students — Student evaluation: Course 4.8/5.0; Instructor 5.0/5.0
- 2012: 30 students — Student evaluation: Course 3.3/5.0; Instructor 4.0/5.0
- 2011: 7 students — Student evaluation: Course 4.2/5.0; Instructor 4.5/5.0

FRSEM 22g: Plants and Climate Change (2010–2011)

- freshman seminar, field trips
- 2011: 3 students Student evaluation: Course, 4.3/5.0; Instructor, 4.3/5.0
- 2010: 7 students Student evaluation: Course, 3.9/5.0; Instructor, 3.9/5.0

GRADUATE AND POSTDOCTORAL ADVISORS AND ADVISEES

Graduate advisors

- G.P. Berlyn, P.M.S. Ashton, X. Lee (Yale Univeristy), A.J. Friedland (Dartmouth College)

Postdoctoral advisors

- J.D. Aber (UNH), D.Y. Hollinger (USDA Forest Service)

Postdoctoral researchers advised (14 total)

Current:

- Margaret Kosmala (2014–)
- David Basler (2016–; Harvard Forest Bullard Fellow and Swiss National Science Foundation Postdoctoral Fellow)
- Timothy Rademacher (2017–)
- Bijan Seyednasrollah (2017–)

Previous:

- Youngryel Ryu (2010–2011, now associate professor at Seoul National University)
- Oliver Sonnentag (2010–2011; now assistant professor at Université de Montréal)
- Trevor Keenan (2010–2013, now research scientist at Lawrence Berkeley National Lab)
- Michael Toomey (2011–2013; now government contractor with USDA Foreign Agricultural Service)
- Brett Huggett (2013–2014; now assistant professor at Bates College)
- Julie Shoemaker (2012–2014; now assistant professor at Lesley University)
- Min Chen (2013–2015; now scientist at Pacific Northwest National Laboratory)
- Graham Dow (2014–2016, NOAA Postdoctoral Fellow; now Research Assistant Professor at Boston University)
- Donald Aubrecht (2013–2016; now at Physical Sciences, Inc.)
- Koen Hufkens (2013–2017; now at INRA Bordeaux, France)

Graduate students advised (9 total, 3 as major advisor)

Current:

- Steve Klosterman (Harvard University, PhD candidate; NASA Earth System Science Fellowship; major advisor)
- Morgan Furze (Harvard University, PhD candidate; NSF GRFP and NSF GROW fellowships; major advisor)
- Meghan Blumstein (Harvard University, PhD candidate; NSF GRFP and DOE SCGSR fellowships; major advisor)
- Veronika Ceballos (Max Planck Institute for Biogeochemistry, Jena, PhD candidate; committee member)

Previous:

- Katie Berger (University of New Hampshire, M.S. 2008; committee member)
- Manish Verma (Boston University, PhD 2012; committee member)
- Eli Melaas (Boston University, PhD 2014; committee member)
- Tom Powell (Harvard University, PhD 2015; committee member)
- Caitlin McDonough (Boston University, PhD 2017; committee member)

Undergraduate theses advised (Harvard College) (5 total)

- Fiona Jevon (2013, "The importance of age, competition, and succession in *Acer rubrum* decline in a Northeastern mixed forest")
- Anika Petach (2013, "Near surface remote sensing of vegetation using the Stardot security camera")
- Min Lee (2013, "Impact of diffuse radiation measurements on modeling carbon budgets: A model-data fusion experiment at Bartlett Experimental Forest")
- Alexander Cunha (2014, "Salmon-derived nutrient flow in an impacted southern watershed")
- Claire Stolz (2016, "Nonstructural carbon reserves in trees at the limit of growth")
- Emma Borjigin-Wang (2017, "Nonstructural carbohydrate dynamics and wood anatomy in Quercus rubra")

REU students (Harvard Forest) and summer interns advised (17 total)

- 2009 Megan Bartlett (Harvard College, 2009; now PhD student at UCLA)
- 2010 Adam Young (SUNY ESF, 2011; now PhD student at University of Idaho)
  Andrea Garcia (Humboldt State, 2011)
  Cory Teshera-Sterne (Mt Holyoke, 2010)
- 2011 Bridget Darby (Boston University, 2013; now PhD student at Cornell)
  Libby Felts (Harvard College, 2014)
  Isaac Lavine (Lafayette College, 2014)
  Lakeitha Mitchell (Lincoln Univerity, 2012)
  Rachel Norman (UNC Chapel Hill, 2012)
- 2012 Min Lee (Harvard College, 2013)
  Dmitri Ilushin (Harvard College, 2014)
  Hannah Skolnick (Columbia University, 2015)
  Sascha Perry (Lincoln University, 2013)
- 2013 Dmitri Ilushin (Harvard College, 2014)
  Arturo Martinez (Carnegie Mellon University, 2015)
- 2014 Ivonne Trujillo (University of Texas–Brownsville, 2016)
  Sidni Frederick (Harvard College, 2017)

PUBLICATIONS IN PEER-REVIEWED JOURNALS

Google Scholar	h-index: 71
Thomson ISI (Researcher ID F-5691-2011)	h-index: 61
ResearchGate	RG Score: 44.93

*For papers from my lab group, * denotes undergraduate author, † denotes graduate student author, and ‡ denotes postdoc author.*

J160. **Richardson, A.D.**, K. Hufkens[‡], T. Milliman, D.M. Aubrecht[‡], M. Chen[‡], J.M. Gray, M.R. Johnston[†], T.F. Keenan, S.T. Klosterman[†], M. Kosmala[‡], E.K. Melaas, M.A. Friedl, and S. Frolking. Tracking vegetation phenology across diverse North American biomes using PhenoCam imagery. *Scientific Data*, in revision.

J159. Toda, M. and **A.D. Richardson**. 2017. Estimation of plant area index and phenological transition dates from digital repeat photography and radiometric approaches in a hardwood forest in the Northeastern United States. *Agricultural and Forest Meteorology*, in press.

J158. Robinson, N.P., B.W. Allred, M.O. Jones, A. Moreno, J. Kimball, D.E. Naugle, T. Erickson, and **A.D. Richardson**. 2017. A dynamic Landsat derived normalized difference vegetation index (NDVI) product for the conterminous United States. *Remote Sensing*, in press.

J157. Brown, L.A., J. Dash, B.O. Ogutu, and **A.D. Richardson**. 201x. On the relationship between continuous measures of canopy greenness derived using near-surface remote sensing and satellite-derived vegetation products. *Agricultural and Forest Meteorology*, in press.

J156. Teets, A., S. Fraver, D.Y. Hollinger, A.R. Weiskittel, R.S. Seymour, and **A.D. Richardson**. Linking annual tree growth with eddy-flux measures of net ecosystem productivity across twenty years of observation in a mixed conifer forest. *Agricultural and Forest Meteorology*, in press.

J155. **Richardson, A.D**., J.F. Weltzin, and J.T. Morisette. 2017. Integrating multiscale seasonal data for resource management. *EOS, Transactions of the American Geophysical Union,* 98, DOI:10.1029/2017EO065709.

J154. Liu, Y., M.J. Hill, X. Zhang, Z. Wang, **A.D. Richardson**, K. Hufkens, G. Filippa, D.D. Baldocchi, S. Ma, J. Verfaillie, and C.B. Schaaf. 2017. Using data from Landsat, MODIS, VIIRS and PhenoCams to monitor the phenology of California oak/grass savanna and an open grassland across spatial scales. *Agricultural and Forest Meteorology*, 237-238: 311-325. DOI: 10.1016/j.agrformet.2017.02.026

J153. Baumann, M., M. Ozdogan, **A.D. Richardson** and V.C. Radeloff. 2017. Phenology from Landsat when data is scarce: using MODIS and Dynamic Time-warping to combine multi-year Landsat imagery to derive annual phenology curves. *International Journal of Applied Earth Observation and Geoinformation*, 54: 72-83. DOI: 10.1016/j.jag.2016.09.005

J152. Crall, A.W., M. Kosmala, R. Cheng, J. Brier, D. Cavalier, S. Henderson, and **A.D. Richardson**. 2017. Volunteer recruitment and retention in online citizen science projects using marketing strategies: Lessons from Season Spotter. *Journal of Science Communication*, 16: A01 1-29.

J151. Hanson, P.J., J.S. Riggs, W.R. Nettles, J.R. Phillips, M.B. Krassovski, L.A. Hook, L. Gu, **A.D. Richardson**, D.M. Aubrecht, D.M. Ricciuto, J.M. Warren, and C. Barbier. 2017. Attaining whole-ecosystem warming using air and deep-soil heating methods with an elevated CO2 atmosphere. *Biogeosciences*, 14: 861-883. DOI: 10.5194/bg-14-861-2017.

J150. Melaas, E.K., D. Sulla-Menashe, J.M. Gray, T.A. Black, T.H. Morin, **A.D. Richardson** and M.A. Friedl. 2016. Multisite analysis of land surface phenology in North American temperate and boreal deciduous forests from Landsat. *Remote Sensing of Environment*, 186: 452-464. DOI: 10.1016/j.rse.2016.09.014

J149. Kosmala, M., A. Crall, R. Cheng, K. Hufkens, S. Henderson and **A.D. Richardson**. 2016. Season Spotter: Using citizen science to validate and scale plant phenology from near-surface remote sensing. *Remote Sensing*, 8: 726 1-22. DOI: 10.3390/rs8090726

J148. Carbone, M.S., **A.D. Richardson**, M. Chen, E.A. Davidson, H. Hughes, K.E. Savage, and D.Y. Hollinger. 2016. Constrained partitioning of autotrophic and heterotrophic respiration reduces

model uncertainties of forest ecosystem carbon fluxes but not stocks. *Journal of Geophysical Research—Biogeosciences*,121: 2476-2492. DOI: 10.1002/2016JG003386

J147. Filippa, G., E. Cremonese, M. Migliavacca, M. Galvagno, M. Forkel, L. Wingate, E. Tomelleri, U. Morra di Cella, and **A.D. Richardson**. 2016. Phenopix: An R package for image-based vegetation phenology. *Agricultural and Forest Meteorology*, 220: 141-150. DOI: 10.1016/j.agrformet.2016.01.006

J146. Aubrecht, D.M.[‡], B.R. Helliker, M.L. Goulden, D.A. Roberts, C.J. Still, and **A.D. Richardson**. 2016. Continuous, long-term, high-frequency thermal imaging of vegetation: uncertainties and recommended best practices. *Agricultural and Forest Meteorology*, 228-229: 315-326. DOI: 10.1016/j.agrformet.2016.07.017

J145. Chen, M.[‡], E.K. Melaas, J. Gray, M.A. Friedl, and **A.D. Richardson**. 2016. A new seasonal-deciduous spring phenology submodel in the Community Land Model 4.5: Impacts on carbon and water cycling under future climate scenarios. *Global Change Biology*, 22: 3675-3688. DOI: 10.1111/gcb.13326

J144. Wolf, S., T.F. Keenan, J.B. Fisher, D.D. Baldocchi, A.R. Desai, **A.D. Richardson**, R.L. Scott, B.E. Law, M.E. Litvak, N.A. Brunsell, W. Peters, and I.T. van der Laan-Luijkx. 2016. Warm spring reduced carbon cycle impact of the 2012 US summer drought. *Proceedings of the National Academy of Sciences U.S.A.*, 113: 5880-5885. DOI: 10.1073/pnas.1519620113

J143. Hufkens, K.[‡], T.F. Keenan, L.B. Flanagan, R.L. Scott, C.J. Bernacchi, E. Joo, N.A. Brunsell, J. Verfaillie and **A.D. Richardson**. 2016. Productivity of North American grasslands is increased under future climate scenarios despite rising aridity. *Nature Climate Change*, 6: 710-714. DOI: 10.1038/NCLIMATE2942

J142. Melaas, E.K., M.A. Friedl, and **A.D. Richardson**. 2016. Multiscale modeling of spring phenology across Deciduous Forests in the Eastern United States. *Global Change Biology*, 22: 792-805. DOI: 10.1111/gcb.13122

J141. Brown, T.B., K.R. Hultine, H. Steltzer, E.G. Denny, M.W. Denslow, J. Granados, S. Henderson, D. Moore, S. Nagai, M. San Clements, A. Sánchez-Azofeifa, O. Sonnentag, D. Tazik, and **A.D. Richardson**. 2016. Using phenocams to monitor our changing Earth: towards a global phenocam network. *Frontiers in Ecology and the Environment*, 14: 84-93. DOI: 10.1002/fee.1222

J140. Yang, X. J.W. Tang, J.F. Mustard, J.E. Lee, M. Rossinii, J. Joiner, J.W. Munger, A. Kornfeld, and **A.D. Richardson.** 2015. Solar-induced chlorophyll fluorescence correlates with canopy photosynthesis on diurnal and seasonal scales in a temperate deciduous forest. *Geophysical Research Letters*, 42: 2977-2987. DOI: 10.1002/2015GL063201

J139. Keenan, T.F. and **A.D. Richardson**. 2015. The timing of autumn senescence is affected by the time of spring phenology: implications for predictive models. *Global Change Biology*, 21: 2634-2641. DOI: 10.1111/gcb.12890

J138. **Richardson, A.D.**, M.S. Carbone, B.A. Huggett[‡], M.E. Furze[†], C.I. Czimczik, J.C. Walker, X. Xu, P.G. Schaberg, and P. Murakami. 2015. Distribution and mixing of old and new nonstructural carbon in two temperate trees. *New Phytologist*, 206: 590-597. DOI: 10.1111/nph.13273

J137. Siniscalco, C., R. Caramiello, M. Migliavacca, L. Busetto, L. Mercalli, R. Colombo, and **A.D. Richardson**. 2015. Models to predict the start of the airborne pollen season. *International Journal of Biometeorology*, 59: 837-848. DOI: 10.1007/s00484-014-0901-x

J136. Migliavacca, M., M. Reichstein, **A.D. Richardson**, M.D. Mahecha, E. Cremonese, N. Delpierre, M. Galvagno, B.E. Law, G. Wohlfahrt, T.A. Black, N. Carvalhais, G. Ceccherini, J.Q. Chen, N.

Gobron, E. Koffi, J.W. Munger, O. Perez-Priego, M. Robustelli, E. Tomelleri, and A. Cescatti. 2015. Influence of physiological phenology on the seasonal pattern of ecosystem respiration in deciduous forests. *Global Change Biology*, 21: 363-376. DOI: 10.1111/gcb.12671

J135. Toomey, M.[‡], M.A. Friedl, S. Frolking, K. Hufkens[‡], S. Klosterman[†], O. Sonnentag, D.D. Baldocchi, C.J. Bernacchi, S.C. Biraud, G. Bohrer, E. Brzostek, S.P. Burns, C. Coursolle, D.Y. Hollinger, H.A. Margolis, H. McCaughey, R.K. Monson, J.W. Munger, S. Pallardy, R.P. Phillips, M.S. Torn, S. Wharton, M. Zeri, and **A.D. Richardson**. 2015. Greenness indices from digital cameras predict the timing and seasonal dynamics of canopy-scale photosynthesis. *Ecological Applications*, 25: 99-115. DOI: 10.1890/14-0005.1

J134. Klosterman, S.T.[†], K. Hufkens[‡], J.M. Gray, E. Melaas, O. Sonnentag, I. Lavine*, L. Mitchell*, R. Norman*, M.A. Friedl, and **A.D. Richardson**. 2014. Evaluating remote sensing of deciduous forest phenology at multiple spatial scales using PhenoCam imagery. *Biogeosciences*, 11: 4305-4320. DOI: 10.5194/bg-11-4305-2014

J133. Xiao, J.F., S.V. Ollinger, S. Frolking, G.G. Hurtt, D.Y. Hollinger, K.J. Davis, Y.D. Pan, X.Y. Zhang, F. Deng, J.Q. Chen, D.D. Baldocchi, B.E. Law, M.A. Arain, A.R. Desai, **A.D. Richardson,** G. Sun, B. Amiro, H. Margolis, L.H. Gu, R.L. Scott, P.D. Blanken, and A.E. Suyker. 2014. Data-driven diagnostics of terrestrial carbon dynamics over North America. *Agricultural and Forest Meteorology*, 197: 142-157. DOI: 10.1016/j.agrformet.2014.06.013

J132. Petach, A.R.*, M. Toomey[‡], D.M. Aubrecht[‡], and **A.D. Richardson**. 2014. Monitoring vegetation phenology using an infrared-enabled security camera. *Agricultural and Forest Meteorology*, 195: 143-151. DOI: 10.1016/j.agrformet.2014.05.008

J131. Tang, J.W., S. Luyssaert, **A.D. Richardson**, W. Kutsch, and I.A. Janssens. 2014. Larger declines in forest photosynthesis than respiration explain age-driven decreases in forest growth. *Proceedings of the National Academy of Sciences U.S.A.*, 111: 8856-8860. DOI: 10.1073/pnas.1320761111

J130. Friedl, M.A., J.M. Gray, E.K. Melaas, **A.D. Richardson**, K. Hufkens, T.F. Keenan, A. Bailey, and J. O'Keefe. 2014. A tale of two springs: Using recent climate anomalies to characterize the sensitivity of temperate forest phenology to climate change. *Environmental Research Letters*, 9: Art. No. 054006. DOI: 10.1088/1748-9326/9/5/054006

J129. Keenan, T.F.[‡], J. Gray, M.A. Friedl, M. Toomey[‡], G. Bohrer, D.Y. Hollinger, J.W. Munger, J. O'Keefe, H.P. Schmid, I. Sue Wing, B. Yang, and **A.D. Richardson**. 2014. Net carbon uptake has increased through warming-induced changes in temperate forest phenology. *Nature Climate Change*, 4: 598-604. DOI: 10.1038/NCLIMATE2253

J128. Verma, M, M.A. Friedl, **A.D. Richardson**, G. Kiely, A. Cescatti, B.E. Law, G. Wohlfahrt, B. Gielen, O. Roupsard, E.J. Moors, P. Toscano, F.P. Vaccari, D. Gianelle, G. Bohrer, A. Varlagin, N. Buchmann, E. van Gorsel, L. Montagnani, and P. Propastin. 2014. Remote sensing of annual terrestrial gross primary productivity from MODIS: An assessment using the FLUXNET La Thuile dataset. *Biogeosciences*, 11: 2185-2200. DOI: 10.5194/bg-11-2185-2014

J127. Keenan, T.F. [‡], D.Y. Hollinger, G. Bohrer, D. Dragoni, J.W. Munger, H.P. Schmid, and **A.D. Richardson**. 2014. Air pollution and forest water use [Reply]. *Nature*, 507: E2-E3. DOI: 10.1038/nature13114

J126. Shoemaker, J.K.[‡], T.F. Keenan[‡], D.Y. Holinger, and **A.D. Richardson**. 2014. Forest ecosystem changes from annual methane source to sink depending on late summer water balance. *Geophysical Research Letters*, 41: 673-679. DOI: 10.1002/2013GL058691

J125. Dietze, M.C., A. Sala, M.S. Carbone, C.I. Czimczik, J.A. Mantooth, **A.D. Richardson**, and R. Vargas. 2014. Nonstructural carbon in woody plants. *Annual Review of Plant Biology*, 65: 667-687. DOI: 10.1146/annurev-arplant-050213-040054

J124. Heffernan, J.B., P.A. Soranno, M.J. Angilletta, L.B. Buckley, D.S. Gruner, T.H. Keitt, J.R. Kellner, J.S. Kominoski, A.V. Rocha, J.F. Xiao, T.K. Harms, S.J. Goring, L.E. Koenig, W.H. McDowell, H. Powell, **A.D. Richardson**, C.A. Stow, R. Vargas, K.C. Weathers. 2014. Macrosystems ecology: Understanding ecological patterns and processes at continental scales. *Frontiers in Ecology and the Environment*, 12: 5-14. DOI: 10.1890/130017

J123. Levy, O., B.A. Ball, B. Bond-Lamberty, K.S. Cheruvelil, A.O. Finley, N. Lottig, S.W. Punyasena, J.F. Xiao, J.Z. Zhou, L.B. Buckley, C.T. Filstrup, T.H. Keitt, J.R. Kellner, A.K. Knapp, **A.D. Richardson**, D. Tcheng, M. Toomey, R. Vargas, J.W. Voordeckers, T. Wagner, and J.W. Williams. 2014. Approaches to advance scientific understanding of macrosystems ecology. *Frontiers in Ecology and the Environment*, 12: 15-23. DOI: 10.1890/130019

J122. Keenan, T.F.[‡], B. Darby*, E. Felts*, O. Sonnentag[‡], M.A. Friedl, K. Hufkens[‡], J. O'Keefe, S. Klosterman[†], J.W. Munger, M. Toomey[‡], and **A.D. Richardson**. 2014. Tracking forest phenology and seasonal physiology using digital repeat photography: a critical assessment. *Ecological Applications*, 24: 1478-1489. DOI: 10.1890/13-0652.1

J121. Stoy, P.C., M. Dietze, **A.D. Richardson**, R. Vargas, A.G. Barr, R.S. Anderson, M.A. Arain, I.T. Baker, T.A. Black, J.M. Chen, R.B. Cook, C.M. Gough, R.F. Grant, D.Y. Hollinger, R.C. Izaurralde, C.J. Kucharik, P. Lafleur, B.E. Law, S. Liu, E. Lokupitiya, Y. Luo, J.W. Munger, C. Peng, B. Poulter, D.T. Price, D.M. Ricciuto, W.J. Riley, A.K. Sahoo, K. Schaefer, C.R. Schwalm, H. Tian, H. Verbeeck, and E. Weng. 2013. Evaluating the agreement between measurements and models of net ecosystem exchange at different times and time scales using wavelet coherence: an example using data from the North American Carbon Program Site-Level Interim Synthesis. *Biogeosciences*, 10: 6893-6909. DOI*:* 10.5194/bg-10-6893-2013

J120. Carbone, M.S., C.I. Czimczik, T.F. Keenan[‡], P.F. Murakami, N. Pederson, P.G. Schaberg, and **A.D. Richardson**. 2013. Age, allocation and availability of nonstructural carbon in mature red maple trees. *New Phytologist*, 200: 1145-1155. DOI: 10.1111/nph.12448

J119. Keenan, T.F.[‡], D. Hollinger, G. Bohrer, D. Dragoni, J.W. Munger, H.P. Schmid, and **A.D. Richardson**. 2013. Increasing forest water use efficiency as atmospheric CO_2 levels rise. *Nature,* 499: 324-327. DOI: 10.1038/nature12291

J118. Shuai Y., C. Schaaf, X. Zhang, A. Strahler, D. Roy, J. Morisette, Z. Wang, J. Nightingale, J. Nickeson, **A.D. Richardson**, D. Xie, J. Wang, X. Li, K. Strabala and J.E. Davies. 2013. Daily MODIS 500m reflectance anisotropy direct broadcast (DB) products for monitoring vegetation phenology dynamics. *International Journal of Remote Sensing*, 10: 5997-6016. DOI: 10.1080/01431161.2013.803169

J117. Ollinger, S.V., P.B. Reich, S. Frolking, L.C. Lepine, D.Y. Hollinger, and **A.D. Richardson**. 2013. Nitrogen cycling, forest canopy reflectance, and emergent properties of ecosystems. *Proceedings of the National Academy of Sciences U.S.A.*, 110: E2437. DOI: 10.1073/pnas.1304176110

J116. Raczka, B.M., K.J. Davis, D. Huntzinger, R.P. Neilson, B. Poulter, **A.D. Richardson**, J. Xiao, I. Baker, P. Ciais, T.F. Keenan, B. Law, W.M. Post, D. Ricciuto, K. Schaefer, H. Tian, E. Tomellieri, H. Verbeeck, and N. Viovy. 2013. Evaluation of continental carbon cycle simulations with North American flux tower observations. *Ecological Monographs*, 83: 531-536. DOI: 10.1890/12-0893.1

J115. Archetti, M., **A.D. Richardson**, J. O'Keefe, and N. Delpierre. 2013. Predicting climate change impacts on the amount and duration of autumn colors in a New England forest. *PLOS One*, 8: e57373. DOI: 10.1371/journal.pone.0057373

J114. Pisek, J., O. Sonnentag‡, **A.D. Richardson**, and M. Mõttus. 2013. Is the spherical leaf inclination angle distribution a valid assumption for temperate and boreal broadleaf tree species? *Agricultural and Forest Meteorology*, 169: 186-194. DOI: 10.1016/j.agrformet.2012.10.011

J113. Melaas, E.K., **A.D. Richardson**, M.A. Friedl, D. Dragoni, C.M. Gough, M. Herbst, L. Montagnani, and E. Moors. 2013. Using FLUXNET data to improve models of springtime vegetation activity onset in forest ecosystems. *Agricultural and Forest Meteorology*, 171-172: 46-56. DOI: 10.1016/j.agrformet.2012.11.018

J112. Barr, A.G., **A.D. Richardson**, D.Y. Hollinger, D. Papale, M.A. Arain, T.A. Black, G. Bohrer, D. Dragoni, M.L. Fischer, L. Gu, B.E. Law, H.A. Margolis, J.H. McCaughey, J.W. Munger, W. Oechel, and K. Schaeffer. 2013. Use of change-point detection for friction-velocity threshold evaluation in eddy-covariance studies. *Agricultural and Forest Meteorology*, 171-172: 31-45. DOI: 10.1016/j.agrformet.2012.11.023

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BOOK CHAPTERS

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OTHER PUBLICATIONS

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INVITED LECTURES, COLLOQUIA & DEPARTMENTAL SEMINARS

University of Utah, Global Change and Sustainability Center, Salt Lake City UT, November 2016.

National Ecological Observatory Network, Boulder CO, November 2016.

Northern Arizona University, College of Engineering, Forestry and Natural Sciences, Flagstaff AZ, May 2016.

Indiana University, Ecology, Evolution and Behavior Seminar Series, Bloomington IN, April 2016.

Harvard University, Department of Organismic and Evolutionary Biology, Cambridge MA, November 2015.

University of Nevada, Ecology Colloquium Series, Reno NV, October 2015.

Cornell University, Biogeosciences Seminar Series, Ithaca NY, April 2015.

University of Pennsylvania, Department of Biology, Philadelphia PA, April 2015.

Harvard University, Harvard University Herbaria, Cambridge MA, March 2015.

Harvard University, Harvard Forest, Petersham MA, March 2015.

Lund University, Department of Physical Geography and Ecosystem Sciences, Lund, Sweden, November 2014.

Harvard University, Center for the Environment, Cambridge MA, April 2014.

Massachusetts Institute of Technology, Lincoln Laboratory, Lincoln MA, March 2014 (Hosted by IEEE Boston, Geoscience and Remote Sensing Society).

IT-Universitetet i København, Copenhagen, Denmark, December 2013.

Planet Labs, Inc., San Francisco CA, December 2013.

Rutgers University/NJIT, Federated Department of Biological Sciences, Newark NJ, December 2013.

Yale University, School of Forestry and Environmental Studies, New Haven CT, November 2013.

National Institute of Environmental Studies, Tsukuba, Japan, October 2013.

Harvard University, Department of Organismic and Evolutionary Biology, Cambridge MA, October 2012.

National Ecological Observatory Network, Boulder CO, August 2011.

Penn State University, Interdepartmental Graduate Program in Ecology seminar series, State College PA, March 2011.

Max-Planck-Institut für Biogeochemie, Jena, Germany, June 2009.

Technische Universität München, Forstwissenschaften und Ressourcenmanagement, Fachgebiet für Ökoklimatologie, Freising, Germany, May 2009.

Massachusetts Institute of Technology, Lincoln Laboratory, Lincoln MA, March 2009.

Marine Biological Laboratory, Ecosystems Center, Woods Hole MA, January 2009.

Boston University, Department of Geography and Environment, Boston MA, November 2008.

University of Colorado, Boulder, Summer School on Flux Measurements, Niwot Ridge CO, July 2010, 2009, 2008.

Harvard University, Department of Organismic and Evolutionary Biology, Cambridge MA, March 2008.

Edinburgh University, School of GeoSciences, Edinburgh, Scotland, September 2007.

University of Minnesota, College of Food, Agricultural and Natural Resource Sciences, April 2007.

Woods Hole Research Center, Falmouth MA, March 2007.

University of New Hampshire, Institute for the Study of Earth, Oceans, and Space, Durham NH, March 2007.

Brown University, Environmental Change Initiative, Providence RI, February 2006.

University of New Hampshire, Complex Systems Research Center, Durham NH, March 2003.

INVITED PRESENTATIONS AT NATIONAL AND INTERNATIONAL MEETINGS

American Geophysical Union, Fall Meeting, San Francisco CA, December 2015 (Session B090: Understanding phenology across scales and improving linkages to ecosystem functions).

Phenology 2015 Conference, Kusadasi, Turkey, October 2015 (Keynote address).

American Geophysical Union, Fall Meeting, San Francisco CA, December 2014 (Session B53F: Global forest dynamics and interactions with a changing climate).

Ecological Society of America, Annual Meeting, Sacramento CA, August 2014 (Session SYMP 4. A toolbox for initiating and managing long-term data collections; Session IGN 13. Tree survival under stress: Does storage of labile carbon matter?)

Mountain Observatories: A Global Fair and Workshop, Reno NV, July 2014 (Keynote address).

US Regional Association of the International Association for Landscape Ecology, Annual Symposium, Anchorage AK, May 2014 (Symposium 6. Impacts of global change: Linking across scales).

European Geosciences Union, General Assembly, Vienna, Austria, May 2014 (Panelist, "More bang for your byte: An open forum on data sharing, standardization and publishing," hosted by Nature Publishing Group).

European Geosciences Union, General Assembly, Vienna, Austria, May 2014 (Session CL3.11. Phenology and seasonality in climate change and ecology).

American Geophysical Union, Fall Meeting, San Francisco CA, December 2013 (Session B11H. Biosphere-atmosphere greenhouse gas fluxes in terrestrial ecosystems).

American Geophysical Union, Fall Meeting, San Francisco CA, December 2012 (Session B13G. Phenology responses and feedbacks to biogeophysics, disturbance, and climate change).

American Geophysical Union, Fall Meeting, San Francisco CA, December 2011 (Session B11D. Observatory enabled science and the Earth System Modeling era).

Ecological Society of America, Annual Meeting, Pittsburgh PA, August 2010 (Session OOS 43. Combining experiments, process studies, and models to forecast the future of ecosystems, communities, and populations).

European Geosciences Union, General Assembly, Vienna, Austria, May 2010 (Session CL2.4. Shifting Seasons: Phenological evidence from observations, reconstructions, measurements and models).

Ecological Society of America, Annual Meeting, Albuquerque NM, August 2009 (Symposium 14. Phenology, the interdisciplinary canary: Linkages between ecology and sustainable decision making in a dynamic environment).

Fluxnet-Canada/Canadian Carbon Program Annual Meeting, Calgary AB, March 2008.

American Geophysical Union, Fall Meeting, San Francisco CA, December 2007 (Session B54A. Observing, analyzing, and modeling phenologies at multiple scales).

AmeriFlux Annual Science Meeting, Boulder CO, October 2007.

INVITED WORKSHOP PRESENTATIONS

Dagstuhl Seminar 17091 (Computer Science Meets Ecology), Wadern Germany, February 2017 (Oral presentation: Real-time monitoring of vegetation phenology with the PhenoCam network).

CEOS-LPV 3rd International Workshop on Phenology and VI Product Validation, Fort Collins CO, November 2016 (oral presentation: The PhenoCam Network).

NEON Plant Phenology Ontology Workshop, Fort Collins CO, January 2016 (oral presentation: Tracking vegetation across diverse North American biomes using PhenoCam imagery).

LTER All-Scientists Meeting Phenology Workshop, Estes Park CO, August 2015 (oral presentation: The PhenoCam network: Monitoring vegetation phenology with networked digital cameras)

NSF MacroSystems Biology PI Meeting, Arlington VA, August 2015 (oral presentation: Education and outreach opportunities through PhenoCam and Season Spotter).

FLUXNET Synthesis Workshop on Mining FLUXNET and other carbon data sources to inform Earth system models, Beijing China, July 2015 (oral presentation: Vegetation phenology: Variation in time and space, and implications for ecosystem feedbacks to the climate system).

Hubbard Brook Ecosystem Study, Committee of Scientists Meeting, Thornton NH, July 2015 (oral presentation: Model-data fusion applied to forecasting phenological responses to climate change).

NSF MacroSystems Biology PI Meeting, Arlington VA, June 2014 (oral presentation: Continental-scale monitoring, modeling, and forecasting of phenological responses to climate change).

BERMS (Boreal Ecosystem Research and Monitoring Sites) Research Workshop, National Hydrology Research Centre (NHRC), Saskatoon SK, April 2014 (presentation: The PhenoCam Network: Contributions of the BERMS sites to continental-scale monitoring of vegetation phenology; delivered on my behalf by A. Barr).

USA-National Phenology Network, External Program Review Workshop, Tucson AZ, April 2014 (oral presentation: Phenology as an integrative environmental science; remote participation).

Developing an Australian Phenology Monitoring Network Using Near Surface Remote Sensing, Moreton Bay Research Station, Australia, March 2014 (oral presentation: The PhenoCam Network: Evolution and lessons learned; remote participation).

Synthesis Workshop on the Carbon Budget and Forest Ecosystem in the Asian Monitoring Network (The 20th Anniversary of the Takayama Site), Takayama, Japan, October 2013 (oral presentation: Phenology, climate change, and phenological control of biosphere-atmosphere interactions: Insights from the PhenoCam network).

NEON/PhenoCam Workshop, Boulder CO, October 2013 (co-organizer; oral presentation: The PhenoCam network: Lessons learned, challenges and opportunities).

NOAA Climate Program Office Working Group, Boston MA, June 2012 (oral presentation: State of the science: Ecosystem responses to climate change).

PhenoAlp Final Meeting, Workshop on climate change, phenology and ecosystem processes from Alps to Globe, Torgnon, Italy, October 2011 (keynote lecture: Continental-scale phenological monitoring with networked digital cameras: what we are learning from PhenoCam).

EU CARBO-Extreme Second Annual Meeting, Montpellier, France, September 2011 (oral presentation: Forecasts of phenological responses to climate change—Quantifying the uncertainties).

FLUXNET and Remote Sensing Open Workshop: Towards Upscaling Flux Information from Towers to the Globe, Berkeley CA, June 2011 (oral presentation: Using digital cameras to monitor vegetation phenology: Insights from PhenoCam).

CEOS Working Group on Calibration and Validation, Land Product Validation Subgroup, Workshop on the Validation of Satellite-based Land Surface Phenology Products, Dublin, Ireland, June 2010 (oral presentation: PhenoCam: Monitoring vegetation phenology with networked digital cameras).

MDI-BGC Workshop, Novel Data Mining Strategies for Exploring Biogeochemical Cycles and Biosphere-Atmosphere Interactions, Max-Planck-Institut für Biogeochemie, Jena, Germany, June 2009 (oral presentation: Why we need new approaches to extract ecologically relevant information from the FLUXNET database).

EU CARBO-Extreme IP Kick-off Meeting, Jena Germany, June 2009 (advisory board oral presentation: On the use of long-term observations for quantifying climate-biosphere interactions).

NACP Joint Workshop (Site-level Interim Synthesis, Regional and Continental Interim Synthesis), Oak Ridge National Laboratory, Oak Ridge TN, January 2009 (oral presentation: Uncertainties in flux measurements).

CarbonFusion Workshop on Improving Land Surface Models with FLUXNET, Edinburgh, Scotland, June 2008 (oral presentation: Errors and uncertainties in modeling and measuring surface-atmosphere exchanges).

NSRC Workshop on Coordinating a Northeastern Phenology Network, Durham NH, November 2007 (oral presentation: Instrument-based approaches to monitoring forest canopy phenology).

NSF Workshop on Data-Model Assimilation in Ecology: Techniques and Applications, Norman OK, October 2007 (oral presentations: Uncertainty in eddy covariance measurements, Data-model fusion for AmeriFlux).

TERACC Workshop on Analysis and Modeling of Automated Soil Respiration Measurements, Durham NH, September 2007 (oral presentation: Merging soil respiration and total ecosystem respiration measurements with data assimilation).

EU CarboEurope IP Workshop on Gap Filling of Eddy Flux Data, Jena, Germany, September 2006 (oral presentation: Why gap filling isn't always easy).

PUBLIC LECTURES AND OUTREACH

Participant at "What goes on at the Bartlett Experimental Forest" Science Pub Night, Sea Dog Brewing Company, North Conway NH. Presentation: "Tracking the rhythm of the seasons at Bartlett Experimental Forest" (April 2106).

Collaborated with the British Broadcasting Corporation (BBC) on the production of "Earth's Greatest Spectacles: New England" television show (Aired January 2016). http://www.bbc.co.uk/programmes/articles/4p2ssy3pz63rBMBKhCztJP8/

Contributed to Botany Library/Harvard University Herbaria exhibit in NW Labs Building, "The Woody Collections of the Harvard University Herbaria" (November–December 2012).

Public Lecture, Harvard University, Museum of Natural History, Cambridge MA, November 2011.

Contributed to Harvard Museum of Natural History exhibit, "New England Forests" (Opened Spring 2011).

Public Lecture, Concord Land Conservation Trust, Concord MA, April 2011.

Podcast, Ecological Society of America, Beyond the Frontier: "In Ecology, Timing is Everything" (June 9, 2009); available at http://www.esa.org/podcast/.

SERVICE

Harvard committees

- Harvard Plant Biology Initiative Symposium, May 2015, "Plants in a Changing World" (Lead Coordinator)
- OEB Graduate Program and Graduate Admissions Committee (2014–2017)
- Standing Committee on the Concentration in Environmental Science and Public Policy (2012–2017)
- Hoopes Prize Committee for the Natural Sciences (2011–2017)
- Harvard University Center for the Environment (HUCE) Biodiversity and Global Change Speaker Series, Planning committee (2010–2011)

Other/external committees

Examination committees:

- Lund University, Sweden, Faculty opponent for PhD defense (Cecilia Olsson, PhD 2014, Department of Physical Geography and Ecosystem Sciences)
- IT University of Copenhagen, Denmark, External examiner for PhD defense (Joel Granados, PhD 2013, Department of Computer Science)
- Swiss Federal Institute of Technology (ETH), Zurich, Switzerland, External examiner for PhD defense (Hella Ahrends, PhD 2010, Institute of Plant Sciences)

Advisory boards, steering committees, search committees, etc.:

- National Ecological Observatory Network (NEON) Fundamental Instrument Unit (FIU) Advisory Board (2009–2017)
- NSF "Forecasts Of Resource and Environmental Changes: data Assimilation Science and Technology (FORECAST)" RCN, Steering Committee (2009–2012)
- EU CARBO-Extreme Project ("The terrestrial Carbon cycle under Climate Variability and Extremes: a Pan European Synthesis"), Advisory Board (2009–2013)

- North American Carbon Program (NACP), Model-data comparison/Interim synthesis Coordinating Group (2007–2012)
- University of New Hampshire, Faculty Search (Research Assistant Professor) Committee (2009)
- Northeast Regional Phenology Network (NE-RPN), Organizing committee (2007–2008)
- TERACC Workshop on analysis and modeling of automated soil respiration measurements, Advisory committee (2007)
- NERC Climate Variability and Change study group, Steering committee (2005–2009)
- Hubbard Brook LTER, Committee of Scientists (2004–present; organized a one-day meeting: "Data-model fusion: What is it and why do we need it?" April 2008)

Conference session organization:
American Geophysical Union, Fall Meeting Session Co-Convener
- The fate of Carbon in plants and terrestrial ecosystems: From respiration to allocation, 2016
- Nonstructural carbon in plants: Observations, modeling and theory, 2012
- Interacting biogeochemical cycles: Linking carbon, water, and nutrient fluxes from organisms to globe, 2011, 2010
- Carbon and water cycles: interpreting and assimilating from leaf and soil column to globe, 2009

European Geosciences Union, General Assembly Session Co-Convener
- Carbon allocation in plants and ecosystems: mechanisms, responses and biogeochemical implications, 2014, 2015, 2016, 2017
- Interacting biogeochemical cycles: Linking carbon, water and nutrient fluxes from organisms to globe, 2011
- Biosphere-atmosphere interactions: Trends and spatio-temporal variability in biogeochemical surface fluxes, 2010
- Biosphere-Atmosphere interactions: Carbon and water cycles at multiple spatial and temporal scales, 2010
- Inter-annual variability of terrestrial ecosystem CO_2, H_2O and energy exchange, 2009

Editorial service
- Scientific Data (Nature Publishing Group), Editorial Board (2014–present)
- Agricultural and Forest Meteorology, Editorial Board (2008–present)
- Global Change Biology, Editorial Advisory Board (2007–2013)
- Ad-hoc handling editor: Ecology (2010), Ecological Applications (2012)

Reviewing
Manuscripts reviewed for
- Agricultural and Forest Meteorology (2003, 2005, 2006 3x, 2007 3x, 2008 3x, 2009 2x, 2010 5x, 2011 3x, 2012 3x, 2013, 2014 5x, 2015 2x, 2016, 2017 2x)
- Agronomy Journal (2003)
- American Journal of Botany (2005)
- Annals of Botany (2007)
- Applied Mathematics and Computation (2008)
- Biogeosciences Discussions (2010, 2009)
- BioScience (2007)
- Canadian Journal of Botany (2002)

- Canadian Journal of Forest Research (2003, 2004)
- Climate Research (2012 2x)
- Ecological Applications (2007, 2010, 2016)
- Ecologial Monographs (2016)
- Forest Ecology and Management (2006)
- Forest Science (2000, 2002)
- Geophysical Research Letters (2009)
- Global Biogeochemical Cycles (2007)
- Global Change Biology (2004, 2005, 2006 2x, 2007 4x, 2008 4x, 2009 4x, 2011 2x, 2012 2x, 2013 3x, 2014)
- Journal of Climate (2003)
- Journal of Atmospheric and Oceanographic Technology (2006)
- Journal of Geophysical Research–Atmospheres (2006, 2007 2x)
- Journal of Geophysical Research–Biogeosciences (2007, 2008 3x, 2010)
- Nature (2010 2x, 2012 4x, 2013 2x, 2014 2x)
- Nature Climate Change (2012, 2017)
- New Phytologist (2002, 2004, 2006, 2008, 2012, 2014 2x)
- Oecologia (2008 2x, 2009 2x)
- Proceedings of the National Academy of Sciences U.S.A. (2015, 2016 2x)
- Philosophical Transactions of the Royal Society (2013)
- Planta (2006)
- Remote Sensing of Environment (2004 2x, 2009)
- Scandinavian Journal of Forest Research (2005)
- Science (2014)
- Scientific Data (2015 5x, 2016, 2017)
- Tellus Series B (2005)
- Tree Physiology (2002, 2003, 2005, 2006, 2007, 2008)
- Trees: Structure and Function (2005)

Grant proposals reviewed for

- DOE Office of Science Graduate Student Research (DOE SCGSR) program (2015)
- ETH Zurich Research Commission (2008)
- Fonds Wetenschappelijk Onderzoek/Research Foundation Flanders (2010)
- Keck Institute for Space Studies (2014)
- M. J. Murdock Charitable Trust (2011)
- Maine Agricultural and Forest Experiment Station (2006)
- NASA (2009, Terrestrial Ecology)
- National Geographic Society, Conservation and Exploration (2015)
- NSF (2004, Integrative Biology; 2008, 2009, 2010, 2012, 2013, Ecosystem Studies; 2009, Hydrologic Sciences; 2015, Dimensions of Biodiversity; 2016, Geography and Spatial Sciences)
- NOAA (2011, 2013 Climate Program Office–Global Carbon Cycle)
- PSC-City University of New York (2008).
- U.S.-Israel Binational Science Foundation (2015)

Book proposals reviewed for

- Sinauer Associates (2007)

Books reviewed for

- Choice: Current Reviews for Academic Libraries (2013–current; typically, ≈3 reviews per year)

Referee for Belgian FWO (Research Foundation Flanders) Excellence Prize (2015)

Other service

- Upper Canada College, Common Ties Mentorship program (2013–)
- Princeton University, Alumni Schools Committee interviewer (2003–2009)
- Princeton University, Class of 1992 Annual Giving campaign volunteer (2006–2009)

RESEARCH GRANTS AND CONTRACTS

National Aeronautics and Space Administration, Advanced Information Systems Technology (AIST) Program, "Advanced Phenological Information Sytem (APIS)," $1,244,387 (total budget) to PI J. Morisette and Co-PIs **A.D. Richardson**, K. Gerst, and D. Theobald. NAU Budget $215,851 (July 2017).

National Science Foundation, Emerging Frontiers, MacroSystems Biology Program, "Collaborative Proposal: MSB-FRA: Improved Understanding of Feedbacks between Ecosystem Phenology and the Weather-Climate Nexus at Local-to-Continental Scales" $1,015,095 (NAU Budget) to PI **A.D. Richardson** and Co-I D. Foster. Collaborating Co-PIs M. Friedl, T. Ault, S. Frolking, B. Braswell. Total budget (5 y) $2,232,930 (July 2017).

National Science Foundation, Division of Environmental Biology/Natural Environment Research Council (NSF/NERC), International Collaboration, "Addressing the plant growth C source-sink debate through observations, experiments, and modelling," $498,291to **PI A.D. Richardson** (via NSF) and £360,917 to PI A.D. Friend (Cambridge University, via NERC) (July 2017).

Department of Energy SBIR, "Ultracompact laser ceilometer for boundary layer and cloud height retrievals", $10,470 subcontract to PI **A.D. Richardson** from Physical Sciences Inc. (January 2017).

National Ecological Observatory Network, "PhenoCam Network Proposal to archive, process, and serve NEON digital camera imagery" $656,564 (4 years) to PI **A.D. Richardson** (November 2016).

National Science Foundation, Division of Environmental Biology, Long Term Ecological Research Program, "Long Term Ecological Research at the Hubbard Brook Experimental Forest" $6,762,000 (6 y) to PI G. Lovett; numerous co-PIs including **A.D. Richardson**. Richardson budget $108,000 (June 2016).

United States Geological Survey, Office of Acquisition and Grants, "Incorporating USGS web cameras into the Phenocam Network to enhance scientific understanding of phenological trends and variability," $24,000 (1 year) to P.I. S. Frolking; Co-PI: **A.D. Richardson** (June 2016).

National Science Foundation, Division of Environmental Biology, Population and Community Ecology Program, "EAGER-NEON: Scaling up terrestrial plant phenology from individuals to Continental scale," $298,641 (2 years) to P.I. **A.D. Richardson** (July 2015).

Northeastern States Research Cooperative, "Cracking the code of a northern forest carbon cycle: an integrated analysis using data, models and assessment of uncertainties," $127,415 to PI S.V.

Ollinger; Co-PIs: **A.D. Richardson**, D.Y. Hollinger. Subcontract to Harvard: $49,218 (March 2015).

National Science Foundation, Research Experience for Undergraduates Program, "A forest full of big data: The Harvard Forest Summer Research Program 2015-2019," $791,983 to PI A. Ellison; Co-PI: **A.D. Richardson (**February 2015).

United States Department of Agriculture, Interagency Carbon Cycle Science Program, "Integrated belowground greenhouse gas flux measurements and modeling," $982,000 to P.I. E.A. Davidson; Co-PIs: D.Y. Hollinger and **A.D. Richardson**. Harvard Budget: $171,307 (September 2014).

Department of Energy, Terrestrial Ecosystem Science Program, "Modeling the temporal dynamics of nonstructural carbohydrate pools in forest trees," $150,000 to PI **A.D. Richardson** (August 2014).

National Science Foundation, Emerging Frontiers, MacroSystems Biology Program, "Exploring collaborations between a MacroSystems Biology Program project and NEON Education: PhenoCam and NEON Citizen Science"; supplement to "Collaborative Research: Continental-scale monitoring, modeling and forecasting of phenological responses to climate change," $473,425 to PI **A.D. Richardson;** Co-PIs: Sandra Henderson and Robert Pless (September 2013).

Department of Energy, Terrestrial Ecosystem Science Program, "The utility of multiple ecological data streams in constraining the Community Land Model," $970,020 to PI D.J.P. Moore; Co-PIs: V.M. Trouet, A. Avelino, and **A.D. Richardson**. Subcontract to Harvard: $149,521 (August 2013).

National Aeronautics and Space Administration, Earth and Space Science Fellowship, "Improving predictions of terrestrial carbon, water, and energy cycling using novel plant phenology observation and modeling," $90,000 to PI: **A.D. Richardson**, Co-PI: S. Klosterman (3 y PhD fellowship to Klosterman) (June 2013).

National Science Foundation, Emerging Frontiers, MacroSystems Biology Program, "Collaborative Research: Thermal controls on ecosystem metabolism and function: scaling from leaves to canopies to regions," PI: C. Still; Co-PIs B. Helliker, R. Powell, D. Roberts, P. Kyriakidis, M. Goulden and **A.D. Richardson**. Total Budget (2 years): $1,005,867; Harvard budget: $130,977 (November 2012).

Department of Energy, Division of Biological and Environmental Research, Climate and Environmental Sciences, "Improving models to predict phenological responses to global change," $40,560 to PI **A.D. Richardson** (June 2012).

National Science Foundation, Division of Environmental Biology, Long Term Ecological Research Program, "HFR LTER V: New Science, Synthesis, Scholarship, and Strategic Vision for Society," $5,879,997 (6 y) to PI D. Foster; numerous co-PIs including **A.D. Richardson**. Richardson budget $119,994 (June 2012).

National Science Foundation, Improvements in Facilities, Communications, and Equipment at Biological Field Stations and Marine Laboratories (FSML) Program, "FSML: Walk-up towers for research, education, communication, and outreach at the Harvard Forest," $347,764 to PI A. Ellison; Co-PIs **A.D. Richardson**, J.W. Munger, D. Orwig (June 2012).

Department of Energy, Terrestrial Carbon Cycle Research Program, "Supporting carbon cycle and earth systems modeling with measurements and analysis from the Howland AmeriFlux site," $1,048,730 to PI D.Y. Hollinger; Co-PIs: E. Davidson, D.B. Dail, **A.D. Richardson**, N. Scott, C.-T. Lai. Subcontract to Harvard: $284,357 (June 2011).

National Oceanic and Atmospheric Administration, Climate Program Office, Global Carbon Cycle Program, "Improving process-level understanding of the factors underlying long-term trends and year-to-year variability in carbon sequestration of Northeastern forests," $389,736 to PI **A.D. Richardson**; Co-PIs: J.W. Munger, G. Bohrer, D. Dragoni, D. Hollinger, P. Moorcroft. Total budget: $524,736 (June 2011).

National Science Foundation, Emerging Frontiers, MacroSystems Biology Program, "Collaborative research: Continental-scale monitoring, modeling, and forecasting of phenological responses to climate change," $758,169 to PI **A.D. Richardson**; Co-PIs: M. Friedl, S. Frolking, R. Pless. Total budget (5 y): $1,525,009 (May 2011).

National Science Foundation, Division of Environmental Biology, Long Term Ecological Research Program, "Long-Term Ecological Research at the Hubbard Brook Experimental Forest," $4,900,000 (6 y) to PIs T. Fahey and C. Driscoll; numerous co-PIs including **A.D. Richardson**. Subcontract to Harvard: $90,000 (March 2011).

Milton Fund, Harvard University, "Nonstructural carbohydrate reserves in forest trees: How does tree size impact the capacity for resilience to stress factors?" $39,984 to PI **A.D. Richardson** (December 2010).

National Aeronautics and Space Administration, Global Climate Change Education Program, "Data-model fusion and forecasting 21st-Century environmental change in northeastern North America," $420,715 to PI A. Ellison; Co-PI: **A.D. Richardson** (August 2010).

Department of Energy, Terrestrial Carbon Cycle Research Program, "Evaluating the contribution of climate forcing and forest dynamics to accelerating carbon sequestration by forest ecosystems in the northeastern U.S.," $305,000 to PI J.W. Munger; Co-PIs: D. Fitzjarrald, D. Foster, P. Moorcroft, **A.D. Richardson**, and S.C. Wofsy (June 2010).

National Science Foundation, Research Experience for Undergraduates Program, "Harvard Forest Summer Research Program in Forest Ecology 2010-2014: Ecological data-model fusion and environmental forecasting for the 21st Century," $524,612 to PI A. Ellison; Co-PI: **A.D. Richardson (**February 2010).

United States Geological Survey/National Parks Monitoring Project, "Integrated phenological monitoring, analysis, and synthesis to track ecosystem responses to climate change," $197,000 to PIs J. Weltzin and Brian Mitchell; Co-PI: **A.D. Richardson.** Harvard budget: $75,126 (January 2010).

Department of Energy, National Institute of Climate Change Research (NICCR), "Extension of Funding: Reducing uncertainty about the effects of climatic variation on forest ecosystems by measuring, modeling, and analyzing intermediate-turnover carbon pools," $80,000 to PI **A.D. Richardson**; Co-PIs: D.B. Dail, D.Y. Hollinger, P. Schaberg. Total budget: $125,000 (November 2009).

Northeastern States Research Cooperative, "Synthesis of data from the PhenoCam network: Phenological Controls on Forest Productivity," $69,180 to P.I. **A.D. Richardson** (June 2009).

Department of Energy, Carbon Sequestration Program, "Renewal of Collaborative Research: Economically viable forest harvesting practices that increase carbon sequestration," $200,000 to PIs E.A. Davidson and D.B. Dail; Co-PIs: D.Y. Hollinger, **A.D. Richardson**, N.A. Scott (June 2009).

Department of Energy, National Institute of Climate Change Research (NICCR), "Coupling carbon, water and nutrient cycles with data assimilation and multiple constraints", $249,396 to P.I. B.H. Braswell; Co-PIs: S.V. Ollinger and **A.D. Richardson** (November 2008).

Northeastern States Research Cooperative, "Carbon benefits of fuel switching from oil to wood across the Northern Forest", $43,785 to P.I. A.J. Friedland; Cooperator: **A.D. Richardson**. Subcontract to UNH: $20,000 (May 2008).

National Aeronautics and Space Administration, ROSES Program, Carbon Cycle Science, "Exploring relationships among carbon cycling, vegetation nitrogen status and surface albedo across North American ecosystems to improve land surface models," $796,000 to PI S.V. Ollinger; Co-PIs: M.E. Martin, **A.D. Richardson**, D.Y. Hollinger (November 2007).

United States Department of Agriculture, CSREES NRI, "Soil calcium and reproduction of sugar maple in northeastern forests," $397,391 to PI T.J. Fahey; Co-PIs: J. Blum, G. Hawley, **A.D. Richardson**, P. Schaberg. Subcontract to UNH: $40,000 (May 2007).

Northeastern States Research Cooperative, "Climate change consequences of forest management practices," $30,000 to PI D.Y. Hollinger; Co-PI: **A.D. Richardson** (May 2007).

Northeastern States Research Cooperative, "Phenological monitoring across the Northern forest region using a network of digital webcams," $74,000 to PI **A.D. Richardson**; Co-PI: D.Y. Hollinger (May 2007).

Department of Energy, National Institute of Climate Change Research (NICCR), "Reducing uncertainty about the effects of climatic variation on forest ecosystems by measuring, modeling, and analyzing intermediate-turnover carbon pools," $374,478 to PI **A.D. Richardson**; Co-PIs: D.B. Dail, E.A. Davidson, D.Y. Hollinger, P. Schaberg. UNH budget: $179,478 (March 2007).

Department of Energy, Terrestrial Carbon Processes Program, "Using model analyses and surface-atmosphere exchange measurements from the Howland AmeriFlux site to improve understanding of forest ecosystem C cycling," $900,000 to PI D.Y. Hollinger; Co-PIs: E.A. Davidson, D.B. Dail, **A.D. Richardson**. Subcontract to UNH: $153,962 (January 2007).

Department of Energy, Carbon Sequestration Program, "Economically viable forest harvesting practices that increase carbon sequestration," $652,000 to PIs E.A. Davidson and D.B. Dail; Co-PIs: D.Y. Hollinger, **A.D. Richardson**, N.A. Scott. Subcontract to UNH: $25,518 (July 2006).

Northeastern States Research Cooperative, "A Synthesis of Climate Change Research in the Northeastern U.S. and Eastern Canada," $55,828 to PI L. Rustad; Co-PIs: J.S. Dukes, A. Magill, **A.D. Richardson**, B. Rock, M. Watson, and N. Willard (June 2005).

International Society of Arboriculture, "Non-invasive detection of drought stress in paper birch," $5,000 to PIs G.P. Berlyn and **A.D. Richardson** (May 2002).

Andrew Mellon Foundation, "Sun/shade plasticity of two conifers along elevational gradients," $28,000 to PIs G.P. Berlyn and **A.D. Richardson** (May 2000).

American Alpine Club Research Fund, "Ecophysiology of red spruce and balsam fir along elevational gradients," $800 to PI **A.D. Richardson** (March 1999).

British Columbia Ministry of Forests, "Root studies of Douglas-fir," CDN$20,000 contract to **A.D. Richardson** (May 1998).

Carpenter/Sperry Fund, Yale School of Forestry & Environmental Studies, numerous small grants $300-$500 to **A.D. Richardson** (1998-2001).