

Andrew M. Fox

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Professional Appointments

- Research Scientist, 2016-present, University of Arizona, Tucson, AZ.
- Scientific Visitor, 2016-present, Data Assimilation Research Section, National Center for Atmospheric Research, Boulder, CO.
- Staff Scientist, 2012-2016, National Ecological Observatory Network, Boulder, CO.
- Integrated Science Program Fellow, 2011-2012. National Center for Atmospheric Research and National Ecological Observatory Network, Boulder, CO.
- Postdoctoral Research Associate, 2009-2011. Department of Biology, University of New Mexico, Albuquerque, NM.
- Postdoctoral Research Associate, 2008-2009. Department of Animal and Plant Sciences, University of Sheffield, UK.
- Postdoctoral Research Associate, 2005-2008. Centre for Terrestrial Carbon Dynamics, Department of Applied Mathematics, University of Sheffield, UK.
- Postdoctoral Research Associate, 2003-2005. School of Biological Sciences, University of Durham, UK.

Education

- PhD. 2003. Department of Geography, University of Cambridge, UK.
- MA. 1999. Department of Geography, University of Colorado, Boulder, CO, USA.
- BA (1st Class). 1997. Department of Geography, University of Oxford, UK.

Grants

- Natural Environment Research Council full PhD Studentship at Department of Geography, University of Cambridge, 1999-2002.
- *Improving the estimation of carbon stocks and fluxes in semi-arid ecosystems in the Southwestern US using full-waveform Lidar measurements.*
Principle Investigator: M. Litvak, UNM. Co-Investigators: A. Neuenschwander, UT-Austin; J. Heilman Texas A & M; A. Fox, NEON. 5/1/11 - 4/30/2014. NASA ROSES Carbon Cycle award \$1,347,293
- *Determining the impact of forest mortality in semi-arid woodlands on local and regional carbon dynamics.*
Principle Investigator: M. Litvak, UNM. Co-Investigators: R. Sinsabaugh, UNM; A. Fox, NEON; N. McDowell, LANL. 7/1/12 - 6/30/2015. DoE Biological and Environmental Research award: \$1,049,130

- *Estimating carbon flux and storage: constraint of the Community Land Model using observations at different temporal scales.*
Principal Investigator: D.J.P. Moore, UA. Co-Investigators: V. Trouet UA; A. Arellanno, UA; A.M.D. Richardson; A. Fox, NEON. 9/1/14 - 8/31/17. DoE Biological and Environmental Research award: \$970,020
- *Collaborative Research: Hydrological tipping points and desertification of semi-arid woodlands.*
Principle Investigator: M. Litvak, UNM. Co-Investigators: W. Pockman, UNM; S. Schwinning, TSU; Robert Pangle, UNM; A. Fox, NEON. 5/1/16 - 4/30/2019. NSF DEB \$1,006,743

Research Interests

- Global carbon cycle
- Ecological forecasting
- Data assimilation
- Earth System Science
- Arid lands
- Scaling and uncertainty in environmental measurements and models
- Micrometeorology

Scientific Expertise

- Principal developer of Data Assimilation Research Testbed for the Community Land Model – a freely available community tool for data assimilation with Earth System Models supported by the National Center for Atmospheric Research.
- Expertise in using complex Earth System Models, and a variety of carbon cycle models.
- Advanced statistical techniques for data assimilation.
- Strong programming skills in FORTRAN and MATLAB and use of scripting languages.
- Detailed knowledge of eddy covariance flux measurements, processing and analysis.
- A wide variety of ecological and hydrological fieldwork experience in arctic, alpine and arid environments. This includes extensive experience using, electronic data loggers, meteorological stations, trace gas flux measurements, differential GPS and spectroradiometers

Service

- Co-chair, North American Carbon Program Science Leadership Group, 2018-present
- Member, North American Carbon Program Science Leadership Group, 2015-2017

Summer School Instruction

- Instructor: CTCD Terrestrial Carbon Cycle and Earth Observation Natural Environment Research Council funded Summer School, August 2005, Malham, UK.
- Instructor: Flux Measurement and Advanced Modeling Course, a NSF funded summer school, annually in July 2011-2015, Boulder, CO.
- Instructor: Graduate Workshop on Environmental Analytics, a NSF funded summer school, annually in July 2014-2015, Boulder, CO.
- Instructor: ICOS-NEON Greenhouse Gas Data Training Workshop, a NSF and European Union funded summer school, June 2015, Haute-Provence, France.

Reviewing

- Panel reviewer for Atmospheric System Research (2014) and Terrestrial Ecosystem Science (2015) programs in Department of Energy: Climate and Environmental Science Division. NASA Carbon Cycle Science (2016)
- Reviewer for numerous journals including: Journal of Ecology; Global and Planetary Change; Agricultural and Forest Meteorology; Ecological Monographs; Journal of Geophysical Research - Biogeosciences; Geoscientific Model Development; Biogeosciences, Global Change Biology

Workshop Organized

- “Operationalizing Ecological Forecasts” 1/6/16 – 1/8/16, USGS Powell Center in Ft Collins, Colorado. Co-organized with Mike Dietze, BU. 21 participants funded by NSF through NEON.

Publications

1. Dietze, M. C., A.M. **Fox**, A. M. followed by 17 others (In press). Iterative near-term ecological forecasting: Needs, opportunities, and challenges. *Proceedings of the National Academy of Science*
2. Smith W.K., J.A. Biederman, R.L. Scott, D.J.P. Moore, M. He, J.S. Kimball, D. Yan, A. Hudson, M.L. Barnes, N. MacBean, A.M. **Fox**, M.E. Litvak (2018). Chlorophyll fluorescence better captures seasonal and interannual gross primary productivity dynamics across dryland ecosystem of southwestern North America. *Geophysical Research Letters*. DOI: 10.1002/2017GL075922
3. Morillas L., R.E. Pangle, G.E. Maurer, W.T. Pockman, N. McDowell, C.-W. Huang, D.J. Krofcheck, A.M. **Fox**, R.L. Sinsabaugh, T.A. Rahn, M.E. Litvak (2017). Tree mortality decreases water availability and ecosystem resilience to drought in piñon-juniper woodlands in the southwestern USA. *Journal of Geophysical Research: Biogeosciences*. DOI: 10.1002/2017JG004095
4. Montané F., M.R. Alexander, A. Dye, A.M. **Fox**, A.F. Arellano, V. Trouet, A. Hessler, N. Pederson, F. Babst, D.A. Bishop, N. MacBean, P. Blanken, G. Bohrer, C.M. Gough, M.E. Litvak, K.A. Novick, R.P. Phillips, J.D. Wood, D.J.P. Moore (2017). Evaluating the effect of alternative carbon allocation schemes in a land surface model on carbon fluxes, pools, and turnover in temperate forests. *Geoscientific Model Development*
5. Post, H., J. A. Vrugt, A.M. **Fox**, R. Baatz, P. Kumbhar, H. Vereecken, H. Hendricks Franssen (2017). Estimation of Community Land Model parameters for an improved assessment of net carbon fluxes at European sites. *Journal Of Geophysical Research: Biogeosciences*, 122, doi:10.1002/2015JG003297.
6. Liu, S., B. Bond-Lamberty, L. R. Boysen, J. D. Ford, A. M. **Fox**, K. Gallo, J. Hatfield, G. M. Henebry, T. G. Huntington, Z. Liu, T. R. Loveland, R. J. Norby, T. Sohl, A. L. Steiner, W. Yuan, Z. Zhang, and S. Zhao. (2017) Grand Challenges in Understanding the Interplay of Climate and Land Changes. *Earth Interactions*. doi.org/10.1175/EI-D-16-0012.1
7. Hinkley, E. S. and 15 others, including A. M. **Fox** (2016). Optimizing Available Network Resources to Address Questions in Environmental Biogeochemistry. *BioScience*
8. Boardman, C.P., V. Gauci, A.M. **Fox**, S. Blake and D.J. Beerling (2013) Reduction of the temperature sensitivity of minerotrophic methane emissions by simulated glacial atmospheric carbon dioxide starvation. *Journal of Geophysical Research: Biogeosciences*, **118**, 1-9.
9. Doria, G., Royer, D. L., Wolfe, A. P., **Fox**, A. M., Westgate, J. A. and Beerling, D. J. (2011) Declining atmospheric CO₂ during the late Middle Eocene climate transition. *American Journal of Science*, **311**, 63-75

10. Beerling, D.J., A.M. **Fox**, D. Stevenson and P J. Valdes (2011) Elevated concentrations of trace greenhouse gases during ancient 'super-greenhouse' climates. *Proceeding of the National Academy of Science*, **108**, 9770-9775
11. K.J. Anderson-Teixera, J.P. DeLong, **Fox**, A.M., Brese, D. and M.E. Litvak. (2010). Differential responses of production and respiration to temperature and moisture drive the carbon balance across a climatic gradient in New Mexico. *Global Change Biology*, **17**, 410-424.
12. **Fox**, A.M. followed by 10 others, (2009) Characterising uncertainty in modelling terrestrial C dynamics using an intercomparison of data-fusion techniques. *Agricultural and Forest Meteorology* Vol. 149, 1597-1615. doi: 10.1016/j.agrformet.2009.05.002
13. Beerling, D.J., A.M. **Fox**, and C.W. Anderson. (2009). Quantitative uncertainty analyses of ancient atmospheric CO₂ estimates from fossil leaves. *American Journal of Science*, **309**, 775-787
14. **Fox**, A. M., B. Huntley, C.R. Lloyd, M. Williams and R. Baxter. (2008) Net ecosystem exchange of heterogeneous arctic tundra: Scaling between chamber and eddy covariance measurements. *Global Biogeochemical Cycles*, Vol. 22, GB2027, doi:10.1029/2007GB003027, 2008
15. **Fox**, A. M., I.C. Willis and N.S. Arnold. (2008) Modification, validation and sensitivity analysis of a 1-dimensional layer snow model for supraglacial snowpacks. *Hydrological Processes*. doi: 10.1002/hyp.6908.
16. Shiklomanov, A., B. Bradley, K. Dahlin, A.M. **Fox**, C. Gough, F. Hoffman, E. Middleton, S. Serbin, L. Smallman, W.K. Smith (In review). Enhancing global change experiments through integration of remote sensing techniques. *Frontiers in Ecology and the Environment*
17. **Fox**, A. M., N. McDowell, T. Rahn, M. Ryan, R. Sinsabaugh, M. E. Litvak (In Prep). Quantifying the transient dynamics of ecosystem-scale carbon cycle responses to piñon pine mortality using a large-scale experimental manipulation and model-data fusion. *Journal of Geophysical Research: Biogeosciences*
18. **Fox**, A.M., T.J. Hoar, J.L. Anderson, A.F. Arellano, W.K. Smith, M.E. Litvak, N. MacBean, D.S. Schimel and D.J.P. Moore (In prep). Evaluation of data assimilation system for land surface models using CLM4.5. *Journal of Advances in Modeling Earth Systems*

Invited Workshop Participation (funding from)

1. NSF MacroSystems Paleon Project Inter-group Workshop. 1/2/12 - 1/4/12, Chicago, IL (NSF)
2. NEON Data Assimilation and Ecological Modeling Framework Spatial & Temporal Scaling in Continental-Scale Ecology Workshop. 06/11/12 - 06/12/12, Boulder, CO (NSF)
3. Estimating Uncertainty and Detecting Trends in Ecological Data Workshop. 8/5/12, Portland, Oregon (NSF)
4. NSF MacroSystems Paleon Project Berkeley Annual Meeting. 12/1/12 - 12/2/12, Berkeley, CA (NSF)
5. NASA-JPL Carbon Roadmap Workshop. 7/8/13 - 7/9/13, Caltech, Pasadena, CA (NASA)
6. NSF MacroSystems Paleon Project Berkeley Annual Meeting. 12/7/13 - 12/8/13, Berkeley, CA (NSF)
7. NEON-Accelerating the integration of NEON data in isotope ecology research. 1/5/14-1/6/14, Boulder, CO (NSF)
8. A data assimilation system for the Community Land Model: a Tern-eMAST, NCAR and NEON DART-CESM setup workshop. 02/10/14 - 02/21/14, Canberra, Australia (NCRIS, Australia)
9. NSF MacroSystems Paleon Modeling Working Group Workshop. 03/08/14 - 03/10/14, Boston, MA (NSF)

10. NASA-JPL Coupled Carbon & Water Cycles Workshop. 3/18/14 - 3/19/14, Caltech, Pasadena, CA (NASA)
11. RCN-FORECAST Advancing Software for Ecological Forecasting. 03/24/14 - 03/27/14, Champaign, IL (NSF)
12. CoopEUS Annual Meeting. 9/24/13 - 9/27/14, Boulder, CO (NSF & European Union)
13. NEON-Scaling ecological processes: theoretical, empirical, modeling, and remote sensing perspectives Workshop. 10/22/14, Boulder, CO (NSF)
14. Department of Energy - Climate and Environmental Sciences Division: Aerial Needs Workshop. 5/13/15 - 5/14/15, Gaithersburg, MD (DoE)
15. Frontiers in Ensemble Data Assimilation for Geoscience Application. 8/3/15 - 8/7/15, Boulder, CO (NSF)
16. INTERFACE Workshop: Frontiers in terrestrial climate feedbacks. 1/31/16 – 2/3/16, St Pete's Beach, FL (NSF)
17. Sustained Observations to Support Carbon Cycle Science and Management. 4/14/16 – 4/14/16, Boulder, CO
18. Paleon-Project State Data Assimilation Hackathon, 11/1/16 – 11/4/16, Berkeley, CA (NSF)

Conference Presentations

1. *Determining the sensitivity of New Mexico biomes to predicted climate change scenarios of the Southwest* [Invited]. Ameriflux Principal Investigators Workshop, 9/10/09 - 9/14/09, Washington DC
2. *Linking Ecosystem Scale Vegetation Change to Shifts in Water and Carbon Cycling: the Consequences of Widespread Piñon Mortality in the Southwest*. American Geophysical Union Chapman Conference, 10/4/09 - 10/8/09, Sun Valley, ID
3. *Quantifying the impacts of piñon mortality ecosystem-scale carbon and water cycling*. American Geophysical Union Fall Meeting, 12/13/10 - 12/17/10, San Francisco, CA
4. *Using a large-scale experimental manipulation and model-data fusion techniques to quantify the transient dynamics of carbon cycle responses to piñon pine mortality*. Ameriflux Science Meeting and 3rd NACP All-Investigators meeting, 1/31/11 - 2/4/11, New Orleans, MS
5. *Parameter estimation in the Community Land Model using the Data Assimilation Research Testbed*. World Climate Research Program: Open Science Conference, 10/24/11 - 10/28/11, Denver CO
6. *A model-data fusion approach to integrate National Ecological Observatory Network Observations into an Earth System Model*. American Geophysical Union Fall Meeting, 12/5/11 - 12/9/11, San Francisco, CA
7. *Ensemble-based Data Assimilation for the Community Land Model*. Land Model & Biogeochemistry Working Group Meeting, 2/27/12 - 3/2/12, Boulder, CO
8. *Data Assimilation with CLM & DART*. CESM Working Group Annual Meeting, 6/18/12 - 6/21/12, Breckenridge, CO
9. *Quantifying uncertainty in projections of continental fluxes of carbon and energy using the NEON platform* [Invited]. Ecological Society of America Annual Meeting, 08/05/12 - 8/10/12, Portland, OR
10. *The impacts of uncertainty in observations on a Data Assimilation System for ecological forecasting*. Ecological Society of America Annual Meeting, 08/05/12 - 8/10/12, Portland, OR

11. *A data assimilation system for the Community Land Model*. RCN FORECAST Conference 10/9/12 - 10/9/12, Woods Hole, MA
12. *Using a network of eddy covariance flux measurements to inform a land surface model at regional scales*. American Geophysical Union Fall Meeting, 12/3/12 - 12/07/12 San Francisco, CA
13. *Using data assimilation to reduce uncertainties in carbon stocks and fluxes in an Earth System Model*. North American Carbon Program, 4th All-investigators meeting, 2/4/13 - 2/7/13, Albuquerque, NM
14. *Spatial scaling of waveform lidar data within Eddy-flux tower fetch to characterize heterogeneity of semi-arid ecosystems*. NASA Terrestrial Ecology Science Team Meeting 4/30/13 - 5/2/13, San Diego, CA
15. *Improving ecological forecasting with hyperspectral data: A data assimilation system for the Community Land Model* [Invited]. NASA HypsIRI Science Symposium 5/29/13 - 5/30/13 Greenbelt, MD
16. *Carbon and energy balance consequences of widespread mortality in piñon-juniper woodlands* [Invited]. Ecological Society of America Annual Meeting, 8/4/13 - 8/9/13, Minneapolis, MN
17. *Estimating continental scaling of ecological driver-response feedbacks through model-data fusion*. Ecological Society of America Annual Meeting, 8/4/13 - 8/9/13, Minneapolis, MN
18. *Assimilating Biogeochemical and Biophysical Observations into a Land Surface Model Using the Data Assimilation Research Testbed*. 6th WMO Symposium on Data Assimilation, 10/7/13 - 10/11/13, College Park, MD
19. *Improving carbon cycle predictions in an Earth System Model using a data assimilation system for state estimation*. American Geophysical Union Fall Meeting, 12/9/13 - 12/13/13 San Francisco, CA
20. *Linking NEON data and Biogeochemical Models*. CESM Working Group Annual Meeting, 6/16/14 - 6/19/14 Breckenridge, CO
21. *Preparing Land surface models for the next generation of hyperspectral data* [Invited]. Ecological Society of America Annual Meeting, 8/10/14 - 8/15/14 Sacramento, CA
22. *Model data fusion: Merging NEON data and Biogeochemical models*. Ecological Society of America Annual Meeting, 8/10/14 - 8/15/14 Sacramento, CA
23. *Informing carbon dynamics in Earth System Models with observations from the National Ecological Observatory Network* [Invited]. American Geophysical Union Fall Meeting, 12/15/14 - 12/19/14 San Francisco, CA
24. *Informing carbon dynamics in the Community Land Model with Data Assimilation*. NACP Principal Investigators and Ameriflux Principal Investigators Meeting, 1/26/15 - 1/29/15, Washington DC
25. *NEON: the ground network for the next generation of carbon cycle and ecosystems missions*. NASA Carbon Cycle and Ecosystems Joint Science Workshop, 4/20/15 - 4/24/15, College Park, MD
26. *Catalyzing carbon cycle science through synergies among research networks*. Ecological Society of America Annual Meeting, 8/9/15 - 8/15/2015, Baltimore, MD
27. *Big Data and Big Models: Using NEON Data to Inform the Community Land Model*, American Geophysical Union Fall Meeting, 12/14/15 - 12/18/15 San Francisco, CA
28. *Detecting hydrological tipping points in semi-arid woodlands*. Ecological Society of America Annual Meeting, 8/7/16- 8/12/2016, Fort Lauderdale, FL

29. *Combining Ecosystem Observations, Manipulations and the Data Assimilation Research Testbed to Provide New Insights into Community Land Model Performance.* American Geophysical Union Fall Meeting, 12/12/16 - 12/16/16 San Francisco, CA
30. *Challenging the Community Land Model with Observations from a Network of Flux Towers in Semi-Arid Ecosystems.* 2017 Joint NACP and AmeriFlux Principal Investigators Meeting, 03/27/17 – 03/30/17, North Bethesda, MD
31. *Challenging CLM with observations in semi-arid ecosystems – and then what?* Land Model Working Group Annual Meeting, 02/27/17 – 03/03/17, Boulder, CO
32. *Initializing carbon cycle predictions from CLM by assimilating biomass and LAI observations.* American Geophysical Union Fall Meeting, 12/11/17 – 12/15/17, New Orleans, LA