Ciaran Harman
Associate Professor and Russell Croft Faculty Scholar

Johns Hopkins University
Department of Environmental Health and Engineering
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EDUCATION

PhD, Civil Engineering — 2011
University of Illinois at Urbana-Champaign

M. Sc., Geography — 2007
University of Illinois at Urbana-Champaign

B. Eng, Environmental Engineering (First Class Honours) — 2003
University of Western Australia, Perth, Australia

B. Arts, Asian Studies — 2003
University of Western Australia, Perth, Australia

PROFESSIONAL APPOINTMENTS

Associate Professor — 2019-present
Johns Hopkins University, Baltimore

Assistant Professor — 2012-2019
Johns Hopkins University, Baltimore

Postdoctoral Research Associate — 2011 - 2012
University of Arizona, Tucson

Research Assistant — 2003-2005
CRC for Catchment Hydrology, Univ. of Melbourne

Research Engineer — 2003
EarthTech Engineering, Melbourne, Australia

AWARDS & HONORS

Appointed Russell Croft Faculty Scholar, *Whiting School of Engineering, JHU* — 2017

CAREER Award *National Science Foundation* — 2017

Early Career Award *American Geophysical Union (Hydrology section)* — 2016

Editors Citation for Excellence in Refereeing for *Geophysical Research Letters* — 2015

Ross J. Martin Award for graduate research achievement — 2010
University of Illinois College of Engineering

Horton (Hydrology) Research Grant — 2010
American Geophysical Union

Mavis Future Faculty Fellowship — 2010
University of Illinois Engineering College

Excellence in Teaching 2008
Univ. of Illinois Dept. of Civil and Environmental Engineering

Beatty Fellowship 2005, 2006
University of Illinois Department of Geography

Undergraduate Groundwater Prize 2002
Centre for Groundwater Studies

PUBLICATIONS

Publication Metrics (Google Scholar):

- Total citations: 3513
- H-index: 30

Underline indicates the author is a student or postdoc supervised by Dr Harman

Peer-reviewed journal papers

2020

1. Wilusz, D. C., Harman, C. J., Ball, W. B., Maxwell, R. M., Buda, A. R. (2020), Using particle tracking to understand flow paths, age distributions, and the paradoxical origins of the inverse storage effect in an experimental catchment. *Water Resources Research*, 55. https://doi.org/10.1029/2019WR025140
2. Litwin, D. G., G. E. Tucker, K. R. Barnhart, C. J. Harman (2020), GroundwaterDupuit-Percolator: A Landlab component for groundwater flow. *Journal of Open Source Software*, 5(46), 1935, https://doi.org/10.21105/joss.01935

2019

3. Bedaso, Z.K., DeLuca, N.M., Levin, N.E., Zaitchik, B.F., Waugh, D.W., Wu, S.Y., Harman, C.J. and Shanko, D., 2019. Spatial and temporal variation in the isotopic composition of Ethiopian precipitation. *Journal of Hydrology*, p.124364.
4. Ward, A. S. et al. (2019), Co-located contemporaneous mapping of morphological, hydrological, chemical, and biological conditions in a 5th-order mountain stream network, Oregon, USA, *Earth System Science Data*, 11(4), 15671581, doi:10.5194/essd-11-1567-2019.
5. Ward, A. S. et al. (2019), Solute Transport and Transformation in an Intermittent, Headwater Mountain Stream with Diurnal Discharge Fluctuations, *Water*, 11(11), 2208, doi:10.3390/w11112208.
6. Ward, A. S. et al. (2019), Spatial and temporal variation in river corridor exchange across a 5th-order mountain stream network, *Hydrology and Earth System Sciences*, 23(12), 51995225, doi:10.5194/hess-23-5199-2019.
7. Knighton, J., V. S. Kline, T. Volkman, P. A. Troch, M. Kim, **C. J. Harman**, C. Morris, B. Buchanan, and M. T. Walter (2019), Seasonal and Topographic Variations in Ecohydrological Separation Within a Small, Temperate, SnowInfluenced Catchment, *Water Resources Research*, 55, 2019WR025174, doi:10.1029/2019WR025174.
8. **Harman, C. J.** (2019), Age-ranked storage-discharge relations – a unified description of spatiallylumped flow and water age in hydrologic systems, *Water Resources Research*, 2017WR022304, doi:10.1029/2017WR022304.

9. Evaristo, J., M. Kim, J. Haren, L. A. Pangle, **C. J. Harman**, P. A. Troch, and J. J. McDonnell (2019), Characterizing the Fluxes and Age Distribution of Soil Water, Plant Water, and Deep Percolation in a Model Tropical Ecosystem, *Water Resources Research*, 55(4), 33073327, doi:10.1029/2018WR023265.

10. **Harman, C. J.**, C. L. Cosans, A low-dimensional model of bedrock weathering and lateral flow coevolution in hillslopes: 2. Controls on weathering and permeability profiles, drainage hydraulics, and solute export pathways. *Hydrological Processes*. 2019; 1 23. https://doi.org/10.1002/hyp.13385

11. Fang, Z., R. W. H. Carroll, R. Schumer, **C. J. Harman**, D. Wilusz, and K. H. Williams, Streamflow partitioning and transit time distribution in snow-dominated basins as a function of climate, *Journal of Hydrology*, vol. 570, pp. 726738

12. Wang, C., C. P. McNew, S. W. Lyon, M. T. Walter, T. H. M. Volkman, N. Abramson, A. Sengupta, Y. Wang, A. A. Meira Neto, L. Pangle, P. A. Troch, M. Kim, **C. J. Harman**, and H. E. Dahlke (2019), Particle tracer transport in a sloping soil lysimeter under periodic, steady state conditions, *Journal of Hydrology*, 569, 6176, doi:10.1016/j.jhydrol.2018.11.050.

13. Zhao, S., H. Hu, **C. J. Harman**, F. Tian, Q. Tie, Y. Liu, and Z. Peng (2019), Understanding of Storm Runoff Generation in a Weathered, Fractured Granitoid Headwater Catchment in Northern China, *Water*, 11(1), 123, doi:10.3390/w11010123.

2018

14. **Harman, C. J.**, and M. Kim (2018), A low-dimensional model of bedrock weathering and lateral flow coevolution in hillslopes: 1. Hydraulic theory of reactive transport, *Hydrological Processes*, 0(0), doi:10.1002/hyp.13360.

15. Gall, H., D. Schultz, T. Veith, S. Goslee, A. Mejia, **C. J. Harman**, C. Raj, P. Patterson, (2018), The effects of disproportional load contributions on quantifying vegetated filter strip sediment trapping efficiencies, *Stochastic Environmental Research and Risk Assessment*, 15, 112. http://doi.org/10.1007/s00477-017-1505-x

16. Zhang, Q., **C. J. Harman**, J. Kirchner (2018), Evaluation of statistical methods for quantifying fractal scaling in water quality time series with irregular sampling, *Hydrology and Earth System Sciences*, 22(2), 11751192. http://doi.org/10.5194/hess-22-1175-2018

2017

17. Wilusz, D. C., **C. J. Harman** and Ball, W. E. (2017), Sensitivity of catchment transit times to rainfall variability under present and future climates, *Water Resources Research*, 53(12), 1023110256. http://doi.org/10.1002/2017WR020894

18. Volkmann, T. H. M., A. Sengupta, L. A. Pangle, K. Dontsova, G. A. Barron- Gafford, **Harman, C. J.**, G. Niu, N. Abramson, A. Alves Meira Neto, Y. Wang, J. R. Adams, D. D. Breshears, A. Bugaj, J. Chorover, A. Cueva, S. B. DeLong, M. Durcik, T. P. A. Ferre, E. A. Hunt, T. E. Huxman, M. Kim, R. M. Maier, L. K. Meredith, R. K. Monson, J. D. Pelletier, M. Pohlmann, C. Rasmussen, J. Ruiz, S. R. Saleska, M. G. Schaap, M. Sibayan, M. Tuller, J. L. M. van Haren, X. Zeng, P. A. Troch (2018), Controlled Experiments of Hillslope Coevolution at the Biosphere 2 Landscape Evolution Observatory: Toward Prediction of Coupled Hydrological, Biogeochemical, and Ecological Change, in *Hydrology of Artificial and Controlled Experiments*, IntechOpen.

19. **Harman, C. J.**, C. L. Cosans, and S. M. Putnam (2017), Comment on "A Simple Model for Regolith Formation by Chemical Weathering" by Braun et al.: Contradictory Concentrations and a Tale of Two Velocities, *Journal of Geophysical Research-Earth Surface*, doi:10.1002/2016JF004151.

20. Pangle, L. A., M. Kim, C. Cardoso, M. Lora, A. A. Meira Neto, T. H. M. Volkmann, Y. Wang, P. A Troch, and **C. J. Harman** (2017), The mechanistic basis for storage-dependent age distributions of water discharged from an experimental hillslope, *Water Resources Research*, 53, doi:10.1002/2016WR019901.

2016

21. Zhang, Q., **C. J. Harman**, and W. P. Ball (2016), An improved method for interpretation of riverine concentration-discharge relationships indicates longterm shifts in reservoir sediment trapping, *Geophysical Research Letters*, 43, 10,21510,224, doi:10.1002/2016GL069945.

22. **Harman, C. J.**, A. S. Ward, and A. Ball (2016), How does reach-scale stream-hyporheic transport vary with discharge? Insights from rSAS analysis of sequential tracer injections in a headwater mountain stream, *Water Resources Research*, 52, 71307150, doi:10.1002/2016WR018

23. Kim, M., L. Pangle, C. Cardoso, M. Lora, T. Volkmann, Y. Wang, **C. J. Harman**, and P. Troch (2016), Transit time distributions and StorAge Selection functions in a sloping soil lysimeter with time-varying flow paths: Direct observation of internal and external transport variability, *Water Resources Research*, 52, 71057129, doi:10.1002/2016WR018620.

24. Ward, A. S., N. M. Schmadel, S. M. Wondzell, **C. J. Harman**, M. N. Gooseff, and K. Singha (2016), Hydrogeomorphic controls on hyporheic and riparian transport in two headwater mountain streams during base flow recession, *Water Resources Research*, 52(2), 14791497, doi:10.1002/2015WR018225.

25. Clair, J. St, S. Moon, W. S. Holbrook, J. T. Perron, C. S. Riebe, S. J. Martel, B. Carr, **C. Harman**, and K. Singha. "Geophysical imaging reveals topographic stress control of bedrock weathering." *Science* 350, no. 6260 (2015): 534-538, doi:10.1126/science.aab2210

26. Rinaldo, A., P. Benettin, **C. J. Harman**, M. Hrachowitz, K. J. McGuire, Y. van der Velde, E. Bertuzzo, and G. Botter (2016), Reply to comment by Porporato and Calabrese on Storage selection functions: A coherent framework for quantifying how catchments store and release water and solutes, *Water Resources Research*, 52(1), 616618, doi:10.1002/2015WR018045.

2015

27. Rinaldo, A., P. Benettin, **C. J. Harman**, M. Hrachowitz, K. J. McGuire, Y. van der Velde, E. Bertuzzo, and G. Botter (2015), Storage selection functions: A coherent framework for quantifying how catchments store and release water and solutes, *Water Resources Research*, 51(6), 48404847, doi:10.1002/2015WR017273.

28. **Harman, C. J.** (2015), Time-variable transit time distributions and transport: Theory and application to storage-dependent transport of chloride in a watershed, *Water Resources Research*, doi:10.1002/2014WR015707.

2014

29. Ehret, U., H. V. Gupta, M. Sivapalan, S. V. Weijs, S. J. Schymanski, G. Bloschl, A. N. Gelfan, **C. J. Harman**, A. Kleidon, T. A. Bogaard, D. Wang, T. Wagener, U. Scherer, E. Zehe, M. F. P. Bierkens, G. Di Baldassarre, J. Parajka, L. P. H. van Beek, A. van Griensven, M. C. Westhoff, and H. C. Winsemius (2014), Advancing catchment hydrology to deal with predictions under change, *Hydrology and Earth System Sciences*, 18(2), 649671, doi:10.5194/hess-18-649-2014.

30. **Harman, C. J.**, and M. Kim (2014), An efficient tracer test for time-variable transit time distributions in periodic hydrodynamic systems, *Geophysical Research Letters*, 41, doi:10.1002/2013GL058980.

31. Li, H.-Y., M. Sivapalan, F. Tian, and **Harman, C. J.** (2014), Functional approach to exploring climatic and landscape controls of runoff generation: 1. Behavioral constraints on runoff volume, *Water Resources Research*, 50(12), 93009322, doi:10.1002/2014WR016307.

32. **Harman, C. J.**, K. Lohse, P. A. Troch, and M. Sivapalan (2014), Spatial patterns of vegetation, soils, and microtopography from terrestrial laser scanning on two semiarid hillslopes of contrasting lithology, *Journal of Geophysical Research - Biogeosciences*, 119, doi:10.1002/2013JG002507.

33. **Harman, C. J.**, and P. A. Troch (2014), What makes Darwinian hydrology "Darwinian"? Asking a different kind of question about landscapes, *Hydrology and Earth System Sciences*, 18(2), 417433, doi:10.5194/hess-18-417-2014.

2013

34. Montanari, A., Young, G., Savenije, H. H., Hughes, D., Wagener, T., Ren, L., Koutsoyiannis, D., Cudennec, C., Grimaldi, S., Bloschl, G., Sivapalan, M., Beven, K., Gupta, H., Arheimer, B., Huang, Y., Schumann, A., Post, D., Srinivasan, V., Boegh, E., Hubert, P., **Harman, C.**, Thompson, S., Rogger, M., Hipsey, M., Toth, E., Viglione, A., Di Baldassarre, G., Schaefli, B., McMillan, H., Schymanski, S., Characklis, G., Yu, B., Pang, Z., Belyaev, V. (2013), "Panta Rhei Everything Flows": Change in hydrology and society The IAHS Scientific Decade 2013-2022, *Hydrological Sciences Journal*, 58(6), doi:10.1080/02626667.2013.809088

35. Pelletier, J. D., G. A. Barron-Gafford, D. D. Breshears, P. D. Brooks, J. Chorover, M. Durcik, **C. J. Harman**, T. E. Huxman, K. A. Lohse, R. Lybrand, T. Meixner, J. C. McIntosh, S. A. Papuga, C. Rasmussen, M. Schaap, T. L. Swetnam, P. A. Troch (2013). Coevolution of nonlinear trends in vegetation, soils, and topography with elevation and slope aspect: A case study in the sky islands of southern Arizona. *Journal of Geophysical Research-Earth Surface*, doi:10.1002/jgrf.20046

36. Thompson, S. E., M. Sivapalan, **Harman, C. J.**, V. Srinivasan, M. R. Hipsey, P. Reed, A. Montanari, and G. Bloschl (2013), Developing predictive insight into changing water systems: use-inspired hydrologic science for the Anthropocene, *Hydrology and Earth System Sciences*, 17(12), 50135039, doi:10.5194/hess-17-5013-2013.

37. Gall, H. E., J. Park, **C. J. Harman**, J. W. Jawitz, and P. S. C. Rao (2012), Landscape filtering of hydrologic and biogeochemical responses in managed catchments. *Landscape Ecology*, 1-14, doi:10.1007/s10980-012-9829-x.

38. Troch, P., Berne, A., Bogaart, P., **Harman, C.**, Hilberts, A., Lyon, S., Paniconi, C., Pauwels, V.,Rupp, D., Selker, J., Teuling, A., Uijlenhoet, R., Verhoest N., (2013), The importance of hydraulic groundwater theory in catchment hydrology: The legacy of Wilfried Brutsaert and Jean-Yves Parlange, *Water Resources Research*, 49, 50995116, doi: 10.1002/wrcr.20407.

2012

39. Patil, S., M. Sivapalan, M. A. Hassan, S. Ye, **C. J. Harman**, X. Xu, (2012). A network model for prediction and diagnosis of sediment dynamics at the watershed scale. *Journal of Geophysical Research: Earth Surface*, 117, F00A04, doi:10.1029/2012JF002400

40. Zanardo, S., **C. J. Harman**, P. A. Troch, P. S. C. Rao, and M. Sivapalan (2012), Intra-annual rainfall variability control on interannual variability of catchment water balance: A stochastic analysis, *Water Resources Research*, 48(1), W00J16, doi:10.1029/2010WR009869.

2011

41. Carrillo, G., P. A. Troch, M. Sivapalan, T. Wagener, **C. J. Harman**, and K. Sawicz (2011), Catchment classification: Hydrological analysis of catchment behavior through process-based modeling along a climate gradient, *Hydrology and Earth System Sciences*, 15(11), 34113430.

42. **Harman, C. J.**, P. S. C. Rao, N. B. Basu, G. S. McGrath, P. Kumar, and M. Sivapalan, (2011), Climate, soil, and vegetation controls on the temporal variability of vadose zone transport, *Water Resources Research*, 47, W00J13, doi:10.1029/2010WR010194

43. Thompson, S. E., **C. J. Harman**, A. G. Konings, M. Sivapalan, A. Neal, and P. A. Troch, (2011), Comparative hydrology across AmeriFlux sites: The variable roles of climate, vegetation, and groundwater, *Water Resources Research*, 47, W00J07, doi:10.1029/2010WR009797

44. Sivapalan, M., M. A. Yaeger, **C. J. Harman**, X. Xu, and P. A. Troch (2011), Functional model of water balance variability at the catchment scale: 1. Evidence of hydrologic similarity and space-time symmetry, *Water Resources Research*, 47(2), W02522, doi:10.1029/2010WR009568

45. **Harman, C. J.**, P. A. Troch, and M. Sivapalan (2011), Functional model of water balance variability at the catchment scale: 2. Elasticity of fast and slow runoff components to precipitation change in the continental United States, *Water Resources Research*, 47(2), W02523, doi:10.1029/2010WR009656.

46. Schaefli, B., **C. J. Harman**, M. Sivapalan and S. J. Schymanski. HESS Opinions: Hydrologic predictions in a changing environment: behavioral modeling, (2011), *Hydrology and Earth System Sciences*, 15(2), 635-646, doi:10.5194/hess-15-635-2011

47. Thompson, S. E., **C. J. Harman**, R. Schumer, J. S. Wilson, N. B. Basu, P. D. Brooks, S. D. Donner, M. A. Hassan, A. I. Packman, and P. Rao (2011). Patterns, puzzles and people: implementing hydrologic synthesis. *Hydrological Processes*, 25(20), 3256-3266.

48. Thompson, S. E., **C. J. Harman**, P. A. Troch, P. D. Brooks, and M. Sivapalan, (2011), Spatial scale dependence of ecohydrologically mediated water balance partitioning: A synthesis framework for catchment ecohydrology, *Water Resources Research*, 47, W00J03, doi:10.1029/2010WR009998

49. Guan, K., S. E. Thompson, **C. J. Harman**, N. B. Basu, P. S. C. Rao, M. Sivapalan, A. I. Packman, and P. K. Kalita, (2011), Spatiotemporal scaling of hydrological and agrochemical export dynamics in a tiledrained Midwestern watershed, *Water Resources Research*, 47, W00J02, doi:10.1029/2010WR009997

50. Sivapalan, M., S. E. Thompson, **C. J. Harman**, N. B. Basu, and P. Kumar (2011), Water cycle dynamics in a changing environment: Improving predictability through synthesis. *Water Resources Research*, 47(10), W00J01, doi:10.1029/2011WR011377

2010

51. Thompson, S. E., **C. J. Harman**, P. Heine and G. G. Katul (2010) Vegetation - infiltration relationships across climatic and soil type gradients, *Journal of Geophysical Research - Biogeosciences* 115, G02023, doi:10.1029/2009JG001134

2009

52. **Harman, C. J.**, D. M. Reeves, B. Baeumer, M. Sivapalan (2009) A Subordinated Kinematic Wave Equation for Heavy-Tailed Flow Responses from Heterogeneous Hillslopes, *Journal of Geophysical Research* 115, F00A08, doi:10.1029/2009JF001273.

53. Wagener, T., M. Sivapalan, P. A. Troch, B. L. McGlynn, **C. J. Harman**, H. V. Gupta, P. Kumar, P. S. C. Rao, N. Basu and J. S. Wilson (2009), The Future of Hydrology - An Evolving Science for a Changing World, *Water Resources Research* 46, W05301, doi:10.1029/2009WR008906.

54. **Harman, C. J.**, M. Sivapalan, (2009), Similarity framework to assess controls on shallow subsurface flow dynamics, *Water Resources Research*, 45,W01417, doi:10.1029/2008WR007067

55. Troch P. A. , G. F. Martinez, V. R. N. Pauwels, M. Durcik, M. Sivapalan, **C. J. Harman**, P. D. Brooks, H. Gupta, T. Huxman, (2009) Climate and vegetation water use efficiency

at catchment scales, *Hydrological Processes* 23, 16, doi:10.1002/hyp.7358

56. **Harman, C. J.**, M. Sivapalan (2009), Effects of hydraulic conductivity variability on hillslope-scale shallow subsurface flow response and storage-discharge relations, *Water Resources Research*, 45, W01421, doi:10.1029/2008WR007228

57. Hopp, L., **C. J. Harman**, S. L. E. Desilets, C. B. Graham, J. J. McDonnell, and P. A. Troch (2009), Hillslope hydrology under glass: confronting fundamental questions of soil-water-biota co-evolution at Biosphere 2, *Hydrology and Earth System Sciences*, 13, 2105-2118, doi:10.5194/hess-13-2105-2009

58. **Harman, C. J.**, M. Sivapalan, Kumar, P. (2009), Power law catchment scale recessions arising from heterogeneous linear small-scale dynamics, *Water Resources Research*, 45, 9, doi:10.1029/2008WR007392

59. **Harman, C. J.**, M. Sivapalan, and P. Kumar (2009), Reply to comment by J. Szilagyi on "Power law catchment-scale recessions arising from heterogeneous linear small-scale dynamics", *Water Resources Research*, 45, W12602, doi:10.1029/2009WR008750.

Pre-2009

60. De Rose, R. C., M. J. Stewardson and **C. J. Harman** (2008), Downstream hydraulic geometry of rivers in Victoria, Australia, *Geomorphology*, 99(1-4) p302-316, doi:10.1016/j.geomorph.2007.11.008

61. **Harman, C. J.**, M. Stewardson, and R. De Rose, (2008), Variability and uncertainty in reach bankfull hydraulic geometry, *Journal of Hydrology*, 351(1-2), p 13-25, doi:10.1016/j.jhydrol.2007.11.015

62. **Harman, C. J.** and M. Stewardson, (2005), Optimizing dam release rules to meet environmental flow targets, *River Research and Applications*, 21, 113-129

Non-refereed publications

1. **Harman, C.**, & Stewardson, M., (2003), Operating rules for the implementation of the Lederderg environmental flows recommendations, *Report to Southern Rural Water and the Department of Sustainability and Environment*, Project Number: 2003-095, Melbourne University, Vic Australia.

2. **Harman, C.**, & Stewardson, M., (2004) Post-fire coarse sediment yield in the upper Tambo river basin: results and analysis of a preliminary field survey and literature review, *Report to The East Gippsland Catchment Management Authority*, University of Melbourne, Australia.

3. **Harman, C.**, Stewardson, M. and De Rose, R. (2005) Regional models of stream channel metrics, *Co-operative Research Center for Catchment Hydrology*, Report No 5/16, Melbourne, Australia

PRESENTATIONS

Invited and keynote conference presentations

1. **Harman, C. J.** C. Cosans, M. Kim, 2018, Co-evolution, bedrock weathering, and lateral flow in hillslopes, Catchment Science Symposium, Washington DC, **Invited Keynote**, December 2018

2. **Harman, C. J.**, 2018, *Crosscutting watershed frontier challenges: watersheds as integrators of terrestrial processes*, Lawrence Berkeley National Lab Watershed Function SFA Retreat, Crested Butte, **Invited**, September 2018

3. **Harman, C. J.**, C. Cosans, M. Kim, 2018, *Subsurface geomorphology: hydrology and weathering in the silicate Piedmont – insights from hydraulic groundwater theory*, Wol-

man Club Meeting, University of Maryland Baltimore County, **Invited keynote**, June 2018

4. **Harman, C. J.**, C. Cosans, M. Kim, 2018, *Co-evolution of weathering and subsurface flow pathways in hillslopes - insights from hydraulic groundwater theory*, European Geosciences Union meeting, Vienna, Austria, **Invited**, April 2018
5. **Harman, C. J.**, 2017, *The control of critical zone architecture on water age and storage selection functions in hillslopes*, Critical Zone Observatories All-Hands Meeting, Arlington VA, **Invited**, June 2017
6. **Harman, C. J.**, 2017, *Flushing the saprolite: baseflow and quickflow age variability in the streamflow of a deeply-weathered piedmont watershed*, Geologic Society of America South East Regional Meeting, Richmond VA, **Invited**, March 2017
7. **Harman, C. J.**, 2015, *Internal versus external controls on age variability: Definitions, origins and implications in a changing climate*, American Geophysical Union Fall Meeting, San Francisco, CA, **Invited**, December 2015
8. **Harman, C. J.**, 2015, *Getting the tail to wag the dog: Incorporating groundwater transport into catchment solute transport models using rank StorAge Selection (rSAS) functions*, American Geophysical Union Fall Meeting, San Francisco, CA, **Invited**, December 2015
9. **Harman, C. J.**, 2015, *Upscaled solute transport theory as a frontier of understanding: Are StorAge Selection functions merely curve fitting?*, 2015, Workshop on "Terrestrial systems: Frontiers of our understanding", Freudenstadt, Germany, **Invited keynote**, September 2015
10. **Harman, C. J.**, 2015, *rank StorAge Selection (rSAS) functions: A unified framework for modeling solute transport at the catchment scale*, International conference on hydrobiogeochemical processes: mechanisms, coupling and impact, Wuhan, China, **Invited**, October 2015
11. **Harman, C. J.**, 2015, *StorAge Selection functions as a bridge between groundwater transport and integrated watershed models*, Workshop on Integrated Environmental Modeling of Estuarine Systems, University of California, Davis, CA, **Invited**, May 2015
12. **Harman, C. J.**, 2015, *Modeling unsteady lumped transport with time-varying transit time distributions*, National Water Quality Assessment, Integrated Watershed Studies Team Meeting, USGS National Center, Reston, VA, **Invited**, January 2015
13. **Harman, C. J.**, 2014, *StorAge Selection functions as a bridge between groundwater transport and integrated watershed models*, Workshop on Integrated Environmental Modeling of Estuarine Systems, Davis, CA, **Invited**, May 2015
14. **Harman, C. J.**, 2014, *Recent advances in transport modeling using transit time distributions*, 2014 Annual Public Meeting, Interagency Steering Committee on Multimedia Environmental Models (ISCMEM), U.S. Army Corps of Engineers, Baltimore, MD, **Invited**, October 2014
15. **Harman, C. J.**, 2014, *Recent advances towards a theory of catchment hydrologic transport: age-ranked storage and the rSAS-functions*, American Geophysical Union Fall Meeting, San Francisco, CA, **Invited**, 2014
16. **Harman, C. J.**, P. A. Troch, 2012, *Can co-evolved spatial patterns of soils and topography improve upscaled representations of hydrologic processes?*, 2nd International Conference on Hydropedology, Leipzig, Germany, **Invited**
17. **Harman, C. J.**, P. A. Troch, K. A. Lohse, M. Sivapalan, 2012, *Connections between transport in events and transport at landscape-structuring timescales*, American Geophysical

Union Fall Meeting, San Francisco, CA, **Invited**, 2012

18. **Harman, C. J.**, 2011, *Laplace's Demon and Dooge's Laws: Why hydrology is more than water running downhill*, Vienna Catchment Science Symposium, TU-Wien, Vienna, Austria, **Invited keynote**
19. **Harman, C. J.**, M. Sivapalan, 2010, *Scaling up hydrologic predictions from heterogeneous soils to heterogeneous catchments - challenges and new approaches*, CUAHSI Biennial Colloquium, Boulder Colorado, **Invited**
20. **Harman, C. J.**, M. Sivapalan, 2010, *Scaling up from heterogeneous soils to heterogeneous catchments*, Soil Science Society of America Annual Meeting, Long Beach, CA, **Invited**

Invited seminars and lectures

1. **Harman, C. J.**, 2018, *Modern Transit Time Theory and its Discontents*, Civil and Environmental Engineering, Cornell University
2. **Harman, C. J.**, 2018, *Modern Transit Time Theory and its Discontents*, Intensively Managed Landscapes CZO, University of Illinois Urbana-Champaign
3. **Harman, C. J.**, 2018, *Modern Transit Time Theory and its Discontents*, Global Institute for Water Security, School of Environment and Sustainability, University of Saskatchewan
4. **Harman, C. J.**, 2017, *A unified approach to hydrologic flow and transport in the evolving critical zone*, Department of Earth and Planetary Science, Washington University of St Louis
5. **Harman, C. J.**, 2017, *Scalar Transport in Complex Hydrodynamic Systems using a Lumped-Lagrangian Approach*, Center for Environmental and Applied Fluid Mechanics, Johns Hopkins University
6. **Harman, C. J.**, 2016, *A unified approach to hydrologic flow and transport in the critical zone*, Department of Civil and Environmental Engineering, University of California, Irvine, CA
7. **Harman, C. J.**, 2016, *A unified approach to hydrologic flow and transport in the critical zone*, Department of Earth and Environmental Science, Temple University, Philadelphia, PA
8. **Harman, C. J.**, 2016, *The age structure of flows through hydrologic systems across scales*, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Science, Beijing, China
9. **Harman, C. J.**, 2016, *The age structure of flows through hydrologic systems across scales*, Department of Hydrology and Hydraulics, Tsinghua University, Beijing, China
10. **Harman, C. J.**, 2016, *rSAS: The new theory of water age, and what it can teach us about how catchments function*, Department of Biological and Ecological Engineering, Oregon State University, Corvallis, OR
11. **Harman, C. J.**, 2015, *rSAS: The new theory of water age, and what it can teach us about how catchments function*, Department of Geology Seminar, Kent State University, Kent, OH
12. **Harman, C. J.**, 2015, *Upscaled solute transport theory as a frontier of understanding: Are StorAge Selection functions merely curve fitting?*, UFZ, Leipzig, Germany, September 2015
13. **Harman, C. J.**, 2015, *Solute transport in a non-stationary world: New theory for hydrologic transit times in transient flows*, Towson University, April 2015

14. **Harman, C. J.**, 2015, *Transit time distributions in a changing world: New theory for hydrologic transport under non-stationarity*, University of Minnesota, March 2015
15. **Harman, C. J.**, 2015, *Transit time distributions in a changing world: New theory for hydrologic transport under non-stationarity*, US Geological Survey, National Research Program Seminar, Feburary 2015
16. **Harman, C. J.**, 2015, *Modeling unsteady lumped transport with time-varying transit time distributions*, Chesapeake Bay Program Office, Modeling Workgroup, Annapolis MD, January 2015
17. **Harman, C. J.**, 2014, *Modeling unsteady lumped transport with time-varying transit time distributions*, University of Delaware, Department of Geological Sciences Seminar, October 2014
18. University of Melbourne, 2014
19. University of Western Australia, 2014
20. University of Maryland Baltimore County, Center for Urban Environmental Research and Education seminar, 2014
21. Johns Hopkins University, Department of Geography and Environmental Engineering, Environmental Engineering and Chemistry seminar, 2014
22. Johns Hopkins University, Earth and Planetary Sciences Bromery Lecture, 2014
23. University of Iowa, Department of Earth & Environmental Sciences seminar, 2013
24. Johns Hopkins University, Department of Geography and Environmental Engineering Wolman seminar, 2012
25. Johns Hopkins University, Center for Environmental and Applied Fluid Mechanics lecture series, 2012
26. University of Arizona, Hydrology and Water Resources lecture series, 2012
27. Penn State University, Civil Engineering department seminar, 2011
28. Duke University, Civil and Environmental Engineering department seminar, 2011
29. Johns Hopkins University, Department of Geography and Environmental Engineering Wolman seminar, 2011

Conference presentations & posters

* indicates presenting author if not first author
Underline indicates supervised student or postdoc

1. Liu, T., **Harman, C. J.**, Bowen, B.B., Kipnis, E.L. and Bernau, J.A., 2019. *Diurnal and seasonal pattern of vertical brine and energy transfer on Bonneville Salt Flat.* Presented at the American Geophysical Union, Fall Meeting, 9-13 Dec 2019
2. Cosans, C., Carr, B. and **Harman, C. J.**, 2019. *Which way is downhill? Structure that controls flow in the deeply weathered Piedmont Critical Zone.* Presented at the American Geophysical Union, Fall Meeting, 9-13 Dec 2019
3. Litwin, D., **C. J. Harman**, G. E. Tucker, K. R. Barnhart, (2019), *A Numerical Exploration of Coevolution Between Runoff Pathways, Climate, and Landscape Morphology.* Presented at the American Geophysical Union, Fall Meeting, 9-13 Dec 2019
4. Xu, F., **Harman, C. J.**, Maggioni, M. and Lu, F., 2019. *Learning from the data: manifold learning in interpreting tracers of the landscape hydrologic system.* Presented at the American Geophysical Union, Fall Meeting, 9-13 Dec 2019

5. Eppinger, B., Hayes, J.L., Cosans, C., **Harman, C. J.**, Holbrook, S., Moon, S., Putnam, S.M. and Dean, R., 2019. *Variations in deep critical zone weathering revealed by 2-D and circular seismic refraction surveys in a Northern Maryland Piedmont catchment.* Presented at the American Geophysical Union, Fall Meeting, 9-13 Dec 2019

6. **Harman, C. J.**, (2019), *Can we learn more from hydrologic tracer data?*, Presented at the American Geophysical Union, Fall Meeting, 9-13 Dec 2019

7. **Harman, C. J.**, M. Kim, C. Cosans, (2018), *EP14A-03: Lateral flow and bedrock weathering in hillslopes: a simple steady-state model of how stream incision rates might control subsurface relief, porosity and permeability*, Presented at the American Geophysical Union, Fall Meeting, 10-14 Dec 2018

8. Wilusz, D . C., **C. J. Harman**, W. P. Ball, R. M. Maxwell, A. R. Buda, (2018), *H11G-03: Using flowpath decomposition to understand time-varying transit time distributions and storage selection with an integrated surface-groundwater model of a small watershed*, Presented at the American Geophysical Union, Fall Meeting, 10-14 Dec 2018

9. Fang, Z., R. W. H. Carroll, R. Schumer, **C. J. Harman**, D. C. Wilusz, K. H. Williams, (2018), *H11G-04: Hydrologic connectivity in snow-dominated basins as a function of climate*, Presented at the American Geophysical Union, Fall Meeting, 10-14 Dec 2018

10. Ward, A. S., **C. J. Harman**, N. M. Schmadel, M. J. Kurz, P. Blaen, S. M. Wondzell, J. D. Drummond, D. M. Hannah, J. L. A. Knapp, S. Krause, A. Li, E. M. Roca, M. Miller, A. Milner, K. Neil, S. Plont, K. R. Roche, A. I. Packman, N. Wisnoski, J. P. Zarnetske, (2018), *H13C-05: How do evapotranspiration-driven discharge fluctuations alter reach-scale ecosystem function? (Invited)*, Presented at the American Geophysical Union, Fall Meeting, 10-14 Dec 2018

11. Putnam, S. M., **C. J. Harman**, (2018), *H13J-1866: The Structure of Storage within a Deeply Weathered, Piedmont Catchment and its Response to a Decadal Drought*, Presented at the American Geophysical Union, Fall Meeting, 10-14 Dec 2018

12. Peralta-Tapia, A., D. C. Wilusz, **C. J. Harman**, K. J. McGuire, H. Laudon, R. Sponseller, (2018), *H13J-1867: Transit Time Distributions on a Boreal Catchment Using a 14 Year Data Time Series.*, Presented at the American Geophysical Union, Fall Meeting, 10-14 Dec 2018

13. Kim, M., T. H. M. Volkmann, N. Abramson, A. Bugaj, E. Hunt, K. Matos, A. A. Meira Neto, A. Sengupta, Y. Wang, L. K. Meredith, K. Dontsova, **C. J. Harman**, J. Chorover, P. A. A. Troch, (2018), *H13N-1958: Experimental observation of a hillslope-scale rank StorAge Selection function: Process controls on its functional form, time variability, and hysteresis*, Presented at the American Geophysical Union, Fall Meeting, 10-14 Dec 2018

14. Cosans, C., J. Moore, M. Gomes, **C. J. Harman**, (2018), *H23E-09: More than a Concentration-Discharge Curve: Looking at Detailed Event Concentration Dynamics to Understand Changing Stream Sulfate Sources Across Flow Conditions and Land Use Gradients*, Presented at the American Geophysical Union, Fall Meeting, 10-14 Dec 2018

15. Wlostowski, A. N., **C. J. Harman**, N. P. Molotch, (2018), *H23N-2149: Hydrologic Storage and Partitioning Across the CZO Network*, Presented at the American Geophysical Union, Fall Meeting, 10-14 Dec 2018

16. Chang, S., D. C. Wilusz, **C. J. Harman**, (2018), *H31F-05: Effects of Seasonal and Long-term Climate Variability on Nitrate Export in the Chesterville Branch Catchment of the Eastern Shore, MD*, Presented at the American Geophysical Union, Fall Meeting, 10-14 Dec 2018

17. Ward, A. S., S. Herzog, S. M. Wondzell, N. M. Schmadel, P. Blaen, J. D. Drummond, D. M. Hannah, **C. J. Harman**, J. L. A. Knapp, S. Krause, M. J. Kurz, A. Li, E. Mart Roca,

M. Miller, A. Milner, K. Neil, S. Plont, K. R. Roche, A. I. Packman, N. Wisnoski, J. P. Zarnetske, (2018), *H34E-08: Spatial and temporal relationships between hydrologic forcing, geologic setting, and river corridor exchange in a mountain stream network*, Presented at the American Geophysical Union, Fall Meeting, 10-14 Dec 2018

18. Eppinger, B., J. Hayes, C. Cosans, S. M. Putnam, **C. J. Harman**, S. Holbrook, S. Moon, (2018), *NS41B-0836: Deep Critical Zone Architecture of Perpendicular Ridges in a Northern Maryland Piedmont Catchment as Imaged by Seismic Tomography*, Presented at the American Geophysical Union, Fall Meeting, 10-14 Dec 2018

19. **Harman, C. J.**, D. Wilusz, StorAge Selection functions as a subgrid parameterization of groundwater transport in watersheds – progress and challenges, Computational Methods in Water Resources meeting, Saint-Malo, France, 3-7 June 2018

20. **Harman, C. J.**, D. Wilusz, M. Kim, EGU2018-11548 Normal isnt better: why normalizing the support of StorAge Selection functions is unnecessary and inhibits catchment intercomparison, European Geosciences Union meeting, Vienna, Austria, April 2018

21. Bowen, B. B., **Harman, C. J.**, Kipnis, E. L., Liu, T., Bernau, J. A., and Horel, J. (2017). *H44F-08:Hydrologic connections between environmental and societal change at the Bonneville Salt Flats, Utah*. Presented at the American Geophysical Union, Fall Meeting, 11-15 Dec 2017.

22. Cosans, C., Moore, J., and **Harman, C. J.** (2017). *B43E-2181:Merging Hydrologic, Geochemical, and Geophysical Approaches to Understand the Regolith Architecture of a Deeply Weathered Piedmont Critical Zone*. Presented at the American Geophysical Union, Fall Meeting, 11-15 Dec 2017.

23. Fang, Z., Carroll, R. W. H., **Harman, C. J.**, Wilusz, D. C., and Schumer, R. (2017). *H21O-03:Effects of snowmelt on watershed transit time distributions*. Presented at the American Geophysical Union, Fall Meeting, 11-15 Dec 2017.

24. Gall, H. E., Schultz, D., Mejia, A., **Harman, C. J.**, Raj, C., Goslee, S., et al. (2017). *H51A-1255:The importance of temporal inequality in quantifying vegetated filter strip removal efficiencies*. Presented at the American Geophysical Union, Fall Meeting, 11-15 Dec 2017.

25. **Harman, C. J.**, Cosans, C., and Kim, M. (2017). *B43E-2179: Flow pathways in the evolving critical zone – insights from hydraulic groundwater theory*. Presented at the American Geophysical Union, Fall Meeting, 11-15 Dec 2017.

26. Kim, M., **Harman, C. J.**, and Troch, P. A. (2017). *H21O-01:Does age matter? Controls on the spatial organization of age and life expectancy in hillslopes, and implications for transport parameterization using rSAS*. Presented at the American Geophysical Union, Fall Meeting, 11-15 Dec 2017.

27. Liu, T., **Harman, C. J.**, Kipnis, E. L., and Bowen, B. B. (2017). *EP11C-1568:Modeling Episodic Ephemeral Brine Lake Evaporation and Salt Crystallization on the Bonneville Salt Flats, Utah*. Presented at the American Geophysical Union, Fall Meeting, 11-15 Dec 2017.

28. Nanry, S. C., Cosans, C., and **Harman, C. J.** (2017). *H41I-1556:Does Variability in Shallow Hydraulic Conductivity Explain Subsurface Electrical Resistivity Anomalies in a Piedmont Hillslope*. Presented at the American Geophysical Union, Fall Meeting, 11-15 Dec 2017.

29. Putnam, S. M., and **Harman, C. J.** (2017). *H43U-01:Using Emergent and Internal Catchment Data to Elucidate the Influence of Landscape Structure and Storage State on Hydrologic Response in a Piedmont Watershed*. Presented at the American Geophysical Union, Fall Meeting, 11-15 Dec 2017.

30. Stoll, E., Putnam, S. M., Cosans, C., and **Harman, C. J.** (2017). *H13D-1417:Determining hyporheic storage using the rSAS model in urban restored streams*. Presented at the American Geophysical Union, Fall Meeting, 11-15 Dec 2017.

31. Volkmann, T. H. M., Sengupta, A., Pangle, L., Abramson, N., Barron-Gafford, G., Breshears, D. D., et al. (2017a). *B43A-2105:Controlled experiments of hillslope co-evolution at the Biosphere 2 Landscape Evolution Observatory: toward prediction of coupled hydrological, biogeochemical, and ecological change (Invited)*. Presented at the American Geophysical Union, Fall Meeting, 11-15 Dec 2017.

32. Volkmann, T. H. M., Van Haren, J. L. M., Kim, M., **Harman, C. J.**, Pangle, L., Meredith, L. K., and Troch, P. A. (2017b). *H22A-04:Real-time isotope monitoring network at the Biosphere 2 Landscape Evolution Observatory resolves meter-to-catchment scale flow dynamics*. Presented at the American Geophysical Union, Fall Meeting, 11-15 Dec 2017.

33. Wilusz, D. C., Fuka, D., Cho, C., Ball, W. P., Easton, Z. M., and **Harman, C. J.** (2017a). *U21B-08:Using StorAge Selection Functions to Improve Simulation of Groundwater Nitrate Lag Times in the SWAT Modeling Framework. (Invited)*. Presented at the American Geophysical Union, Fall Meeting, 11-15 Dec 2017.

34. Wilusz, D. C., **Harman, C. J.**, Ball, W. P., Maxwell, R. M., and Buda, A. R. (2017b). *H23E-1742:What Can Catchment Transit Time Distributions Tell Us About Runoff Mechanisms? Exploring Age Equifinality with an Integrated Surface-Groundwater Model*. Presented at the American Geophysical Union, Fall Meeting, 11-15 Dec 2017.

35. Wlostowski, A. N., **Harman, C. J.**, and Molotch, N. P. (2017). *H43O-01:Hydrologic Synthesis Across the Critical Zone Observatory Network: A Step Towards Understanding the Coevolution of Critical Zone Function and Structure*. Presented at the American Geophysical Union, Fall Meeting, 11-15 Dec 2017.

36. Volkmann, T. H. M., J L. M. van Haren, L. K. Meredith, M. Kim, L. A. Pangle, **C. J. Harman**, P. A. Troch, (2017), *A real-time isotope monitoring network at the Biosphere 2 Landscape Evolution Observatory*, International workshop on Isotope-based studies of water partitioning and plant-soil interactions in forested and agricultural environments, 27-29 September 2017, Villa Montepaldi, San Casciano in Val di Pesa, Tuscany, Italy

37. Putnam, S. M., C. J. Harman, 2017, *The Influence of Catchment Structure on Hydrologic Response in a Small Forested Piedmont Watershed*, Gordon Research Conference on Catchment Science: Interactions of Hydrology, Biology & Geochemistry, Lewiston, ME

38. Wilusz, D. C., Maxwell, R. M., Buda, A., Ball, W. P., **C. J. Harman**, (2017) *How Does Spatial Variability in Rainfall and ET Affect Catchment Flow Velocities?*, Gordon Research Seminar, June 24-25, Bates College, Lewiston, ME

39. Putnam, S. M., C. J. Harman, 2017, *Model-Data Learning to Identify Runoff Generation Mechanisms in a Small Forested Piedmont Watershed*, Critical Zone Observatories All-Hands Meeting, Arlington VA, June 2017

40. Cosans, C., C. J. Harman, 2017, *Weathering in hillslopes* , Critical Zone Observatories All-Hands Meeting, Arlington VA, June 2017

41. Cosans, C., C. J. Harman, 2017, *Weathering in hillslopes*, AGU-SEG Hydrogeophysics Workshop, Stanford, CA, July 24-27 2017

42. Cosans, C., J. Moore, **C. J. Harman**, (2016) *Cleaves Revisited: Consequences of Inverted Bedrock Topography on Chemical Weathering Rates in a Classic Study Watershed (EP43C-0988)*, American Geophysical Union Fall Meeting, San Francisco, CA

43. Cosans, C., **C. J. Harman**, (2017) *Shaping the Critical Zone : Lateral flow controls on feedbacks between deep drainage and weathering front slopes*, Critical Zone All-Hands

Meeting, Arlington, VA

44. Wong, C. I., **C. J. Harman**, J. Banner, (2016) *Assessing a novel approach to proxy system modeling of speleothem 18O values (H12A-04)*, American Geophysical Union Fall Meeting, San Francisco, CA

45. McDonnell, J., J. A. Evaristo, M. Kim, J. L. M. Van Haren, L. A. Pangle, **C. J. Harman**, P. A. A. Troch, (2016) *Soil, Water, Plants and Preferred Flow in All Directions: A Biosphere-2 Experiment (H13E-1417)*, American Geophysical Union Fall Meeting, San Francisco, CA

46. **Harman, C. J.**, (2016) *Age-ranked storage-discharge relationships across diverse hydrologic systems (H14D-03)*, American Geophysical Union Fall Meeting, San Francisco, CA

47. Wilusz, D. C., R. M. Maxwell, A. R. Buda, W. P. Ball, **C. J. Harman**, (2016) *Can a simple lumped parameter model simulate complex transit time distributions? Benchmarking experiments in a virtual watershed. (H21B-1385)*, American Geophysical Union Fall Meeting, San Francisco, CA

48. Kim, M., **C. J. Harman**, L. A. Pangle, P. A. Troch, (2016) *Age-ranked storage and age-ranked discharge relationships at a hillslope scale: controls of physical processes, boundary conditions, climate variability, and hillslope shape (H21B-1386)*, American Geophysical Union Fall Meeting, San Francisco, CA

49. Pangle, L. A., M. Kim, C. Cardoso, M. Lora, A. Meira, T. Volkmann, Y. Wang, P. A. A. Troch, **C. J. Harman**, (2016) *Physical Basis for Storage-Dependent Age Distributions of Water Discharged from an Experimental Hillslope (H21B-1387)*, American Geophysical Union Fall Meeting, San Francisco, CA

50. Zhang, Q., **C. J. Harman**, W. Ball , (2016) *An Improved Method for Interpretation of Concentration-Discharge Relationships in Riverine Water-Quality Data (H43A-1393)*, American Geophysical Union Fall Meeting, San Francisco, CA

51. Wilusz, D. C, W. Ball., **C. J. Harman**, (2016) *Modeling the sensitivity of shallow subsurface catchment transit times to rainfall variability under present and future climate. (H43M-02)*, American Geophysical Union Fall Meeting, San Francisco, CA

52. Putnam, S. M., **C. J. Harman**, (2016) *Water Balance Modeling to Identify the Time-Variable Contribution of Hillslope and Riparian Fluxes to Discharge in a Small Forested Piedmont Watershed (H54E-06)*, American Geophysical Union Fall Meeting, San Francisco, CA

53. DeLuca, N. M., Z. K. Bedaso, N. E. Levin, B. F. Zaitchik, D. Waugh, **C. J. Harman**, D. Shanko, (2016) *Spatial and Temporal Variation in the Isotopic Composition of Ethiopian Rainfall (PP31D-2334)*, American Geophysical Union Fall Meeting, San Francisco, CA

54. Wilusz, D. C., R. M. Maxwell, A. Buda, W. P. Ball, **C. J. Harman**, 2016, *The accuracy of steady-state transit time estimates in a non-steady climate: Modeling experiment setup in a Valley and Ridge agricultural watershed*, CUAHSI Biennial Colloquia on Water Science, Shepherdstown, WV

55. Putnam, S., **C. J. Harman**, 2016, Combining Multi-Scale Observations and Modeling to Better Understand the Influence of Landscape Structure and Hydrologic Processes on Transport in Piedmont Landscapes, Johns Hopkins University Environmental Engineering and Chemistry Seminar, Baltimore, MD

56. Ball, W. P., L. Wainger, **C. J. Harman**, D. Brady, A. Ortiz-Bobea, M. W. Kemp, J. M. Testa, L. Murray, D. C. Wilusz, 2016, *Project overview: Impacts of climate change on the phenology of linked agriculture-water systems*, Chesapeake Modeling Symposium, Williamsburg, VA

57. Putnam, S., **C. J. Harman**, 2015, *The Relative Importance of Time-Variable Transport through Hillslope and Riparian Hydrogeomorphic Units on the Emergent TTD of a Small Forested Piedmont Watershed*, American Geophysical Union Fall Meeting, San Francisco, CA

58. Kim, M., L. Pangle, C. Cardoso, M. Lora, A. Meira, T. Volkmann, Y. Wang, **C. J. Harman**, P. A. Troch, 2015, *Relative controls of external and internal variability on time-variable transit time distributions, and the importance of StorAge Selection function approaches*, American Geophysical Union Fall Meeting, San Francisco, CA

59. Ward, A., N. Schmadel, S. Wondzell, **C. J. Harman**, M. Gooseff, K. Singha, 2015, *Hyporheic transport in headwater mountain streams is time-invariant in locations where geologic controls dominate hydrologic forcing*, American Geophysical Union Fall Meeting, San Francisco, CA

60. Wilusz, D., **C. J. Harman**, W. Ball, 2015, *Implications of an "Inverse Storage Effect" on the Sensitivity of Watershed Transit Times to Rainfall Variability at Plynlimon, Wales*, American Geophysical Union Fall Meeting, San Francisco, CA

61. **Harman, C. J.**, 2015, *Observation and physical interpretation of the rank storage selection (rSAS) function of a weighing lysimeter*, Gordon Conference on Catchment Science: Interactions of Hydrology, Biology & Geochemistry, Andover, NH

62. Putnam, S. M., **Harman, C. J.**, *Combining multiscale observations and new transport theory to explore time variability in hydrologic transport processes operating in nested Piedmont watersheds*, Geological Society of America, Northeastern Section Meeting, Bretton Woods, NH

63. Wilusz, D. C., **Harman, C. J.**, Ball, W. P., 2015 *Modeling the linkages between transit time distributions, nitrate transport, and climate variability: opportunities and challenges in the Chesapeake Bay watershed (poster)*, Geological Society of America, Northeastern Section Meeting, Bretton Woods, NH

64. **Harman, C. J.**, 2014, *Distinguishing sources of variability in catchment transit time distributions: climate, water balance partitioning, and flow-path dynamics*, American Geophysical Union Fall Meeting, San Francisco, CA

65. Zhang, Q, **Harman, C. J.**, Ball, W, 2014, *Evaluation of Methods for Estimating Long-Range Dependence in Water Quality Time Series with Missing Data and Irregular Sampling (Poster)*, American Geophysical Union Fall Meeting, San Francisco, CA

66. Ball, A, **Harman, C. J.**, Ward, A, 2014, *Modeling hyporheic exchange and in-stream transport with time-varying transit time distributions (Poster),* American Geophysical Union Fall Meeting, San Francisco, CA

67. Wilusz. D, **Harman, C. J.**, Ball, W, 2014, *Modeling of Time-Varying Stream Water Age Distributions: Preliminary Investigations with Non-Conservative Solutes*, American Geophysical Union Fall Meeting, San Francisco, CA

68. Pangle. L, Cardoso, C, Kim, M, Lora, M, Wang, Y, Troch, P, **Harman, C. J.**, 2014, *An experimental application of the Periodic Tracer Hierarchy (PERTH) method to quantify time-variable water and solute transport in a sloping soil lysimeter (Poster)*, American Geophysical Union Fall Meeting, San Francisco, CA

69. Putnam, S, **Harman, C. J.**, 2014, *Combining New Theory and Multi-Scale Observations to Explore Hydrologic Transport Processes and Their Relationship to Catchment Structure in a Small Piedmont Watershed (Poster)*, American Geophysical Union Fall Meeting, San Francisco, CA

70. Kim, M, Pangle, L, Cardoso, C, Lora, M, Wang, Y, **Harman, C. J.**, Troch, P, 2014, *Using New Theory and Experimental Methods to Understand the Relative Controls of Storage, Antecedent Conditions and Precipitation Intensity on Transit Time Distributions through a Sloping Soil Lysimeter (Poster)*, American Geophysical Union Fall Meeting, San Francisco, CA

71. **Harman, C. J.**, M. Kim, 2013, *The PERiodic Tracer Hierarchy (PERTH) - an experimental method for observing time-variable transit-time distributions through long-memory systems and transient flows*, American Geophysical Union Fall Meeting, San Francisco, CA

72. **Harman, C. J.**, M. Kim, 2013, *Dynamic Age Functions and the PERiodic Tracer Hierarchy (PERTH)*, Gordon conference on Catchment Science: Interactions of Hydrology, Biology & Geochemistry, Andover, New Hampshire

73. **Harman, C. J.**, M. Kim, 2013, *PERTH and the Dynamic Age Function: A theoretical and experimental framework for understanding residence and transit times in transient, complex flows*, AGU Chapman Conference on Soil-mediated Drivers of Coupled Biogeochemical and Hydrological Processes Across Scales, Tucson, Arizona

74. **Harman, C. J.**, P. A. Troch, 2012, *Darwinian Hydrology: can the methodology Charles Darwin pioneered help hydrologic science?*, Prediction in Ungauged Basins (PUB) Symposium, Delft, Netherlands

75. **Harman, C. J.**, P. A. Troch, J. Pelletier, C. Rasmussen, J. Chorover, 2012, *Critical zone evolution and the origins of organised complexity in watersheds*, European Geophysical Union General Assembly, Vienna, Austria

76. Zapata-Rios, X., P. Troch, P. Broxton, J. Mcintosh, **C. J. Harman**, A. Harpold, P. D. Brooks , 2012, *Water storage dynamics in high elevation semi-arid catchments (Poster)*, Geological Society of America, Rocky Mountain Section, Albuquerque, NM

77. **Harman, C. J.**, P. A. Troch, K. A. Lohse, M. Sivapalan, 2011, *Co-evolution of Vegetation, Sediment Transport and Infiltration on semi-arid hillslopes (Poster)*, American Geophysical Union Fall Meeting, San Francisco, CA

78. Troch, P. A., G. A. Carrillo, M. Sivapalan, **C. J. Harman**, T. Wagener, K. A. Sawicz, 2011, *Hydrological Analysis of Catchment Behavior through Process-based Modeling along a Climate Gradient*, American Geophysical Union Fall Meeting, San Francisco, CA

79. **Harman, C. J.**, P. S. C. Rao, N. B. Basu, G. McGrath, P. Kumar, and M. Sivapalan, 2011, *Climate, soil and vegetation controls on the temporal variability of recharge and solute delivery to groundwater*, European Geophysical Union General Assembly, Vienna, Austria

80. **Harman, C. J.**, K. A. Lohse, P. A. Troch, M. Sivapalan, 2011, *Vegetation controls on soil hydraulic properties and and co-evolution in semi-arid hillslopes: fieldwork and modelling (Poster)*, European Geophysical Union General Assembly, Vienna, Austria

81. Sivapalan, M., S. Patil, M. Hassan, S. Ye, **C. J. Harman**, 2011, *Process controls on scaling behavior of sediment delivery: Exploration with a physically based network scale coupled flow and sediment model*, European Geophysical Union General Assembly, Vienna, Austria

82. Thompson, S. E., **C. J. Harman**, R. Schumer, J. Wilson, and M. Sivapalan, 2011, *Hydrologic Science for a Changing World: A Learning Framework Based on Hydrologic Synthesis and Team Science*, European Geophysical Union General Assembly, Vienna, Austria

83. Rao, P. S. C., N. B. Basu, S. Zanarado, **C. J. Harman**, M. Sivapalan, A. Rinaldo, 2010, *Modelling hydrologic and geochemical filtering of reactive solute transport in catchments*, GQ10: Groundwater Quality Management in a Rapidly Changing World (Proc. 7th International Groundwater Quality Conference held in Zurich, Switzerland, 1318 June 2010). IAHS Publ 342, 2011, 451-454.

84. **Harman, C. J.**, K. A. Lohse, P. A. Troch, M. Sivapalan, 2010, *Vegetation controls on soil hydraulic properties and implications for the hydrologic variability of soils: observations and modeling. (Poster)*, American Geophysical Union Fall Meeting, San Francisco, CA

85. Lohse, K. A., J. E. McLain, **C. J. Harman**, M. Sivapalan, P. A. Troch, 2010, *Role of vegetation and edaphic factors in controlling diversity and use of different carbon sources in semi-arid ecosystems, (Poster)*, American Geophysical Union Fall Meeting, San Francisco, CA

86. Ran, L., T. Garcia, S. Ye, **C. J. Harman**, M. A. Hassan, A. Simon, 2010, Reach Scale Sediment Balance of Goodwin Creek Watershed, Mississippi (Poster), American Geophysical Union Fall Meeting, San Francisco, CA

87. Patil, S., S. Ye, X. Xu, **C. J. Harman**, M. Sivapalan, M. A. Hassan, 2010, *A network model for simulating sediment dynamics within a small watershed (Poster)*, American Geophysical Union Fall Meeting, San Francisco, CA

88. Sivapalan, M., **C. J. Harman**, 2010, *Classification of recharge regimes based on measures of hydrologic similarity*, European Geophysical Union General Assembly, Vienna, Austria

89. Sivapalan, M., M. A. Yaeger, **C. J. Harman**, X. Xu, and P. A. Troch, 2010, *A functional model of annual water balance variability and similarity for regionalization studies: Horton, Budyko and L'vovich revisited*, European Geophysical Union General Assembly, Vienna, Austria

90. **Harman, C. J.**, N. B. Basu, P. S. C. Rao, M. Sivapalan, 2009, *HEIST: An eventscale model of cascading water and solute fronts through the vadose zone*, American Geophysical Union Fall Meeting, San Francisco, CA

91. Zanardo, S., **C. J. Harman**, P. D. Brooks, M. Durcik, M. Sivapalan, P. A. Troch, 2009, *Landscape and climate controls on the Horton index revealed through a stochasticanalytical model (Poster)*, American Geophysical Union Fall Meeting, San Francisco, CA

92. Guan, K., **C. J. Harman**, N. B. Basu, P. S. C. Rao, M. Sivapalan, P. K. Kalita, A. I. Packman, 2009, *Biogeochemical Signatures of Contaminant Transport at the Watershed Scale: Spectral and Wavelet Analysis (Poster)*, American Geophysical Union Fall Meeting, San Francisco, CA

93. Yaeger, M. A., **C. J. Harman**, P. A. Troch M. Sivapalan, 2009, *A functional model of watershed-scale annual water balance partitioning: Lvovich, Ponce and Shetty revisited (Poster)*, American Geophysical Union Fall Meeting, San Francisco, CA

94. Thompson, S. E., **C. J. Harman**, K. Guan, A. Neal, P. Troch and M. Sivapalan, 2009, *Predicting seasonal evapotranspiration: comparative hydrology across FLUXNET sites*, American Geophysical Union Fall Meeting, San Francisco, CA, *Invited speaker*

95. **Harman, C. J.**, P. S. C. Rao, N. B. Basu, M. Sivapalan, 2009, *Cascading water and solute transport through the vadose zone: advection, dispersion, and transformations in highly non-steady flow*, Stochastic Transport and Emergent Scaling in Earth-surface Processes Workshop, Incline Village, NV

96. Hopp, L., P. A. Troch, T. Huxman, **C. J. Harman**, S. Desilets, K. Dontsova, J. Chorover, S. Edin, J. Pelletier, C. Paniconi, V. Ivanov, D. Jenerette, M. Sivapalan, J. J. McDonnell,

2009, *Artificial Hillslopes at Biosphere 2: Exploring Soil-Water-Atmosphere-Plant Interactions in a Changing Environment*, European Geophysical Union General Assembly, Vienna, Austria

97. **Harman, C. J.**, Reeves D. M., Baeumer B., Sivapalan, M., 2009, *Time subordination: a way forward for the closure problem in hydrologic prediction?*, European Geophysical Union General Assembly, Vienna, Austria

98. **Harman, C. J.**, Sivapalan, M. A, Kumar, P., 2009, *Emergent effects of heterogeneity on discharge at hillslope and catchment scales, and implications for prediction*, European Geophysical Union General Assembly, Vienna, Austria

99. **Harman, C. J.**, Sivapalan, M. A, Kumar, P., 2009, *Dimensionless classification of modes of hydrologic behavior based on characteristic rates and timescales of processes and inputs*, European Geophysical Union General Assembly, Vienna, Austria

100. **Harman, C. J.**, Sivapalan, M. A, Kumar, P., 2009, *Potential feedbacks between hydrology, ecosystem dynamics and soil properties (Poster)*, MYRES Meeting of Young Researchers in Earth Sciences, New Orleans, LA

101. **Harman, C. J.**, & Sivapalan M., 2008 *Classification and the role of topography, recharge and boundary conditions on the effects of heterogeneity on subsurface flow in hillslopes*, European Geophysical Union General Assembly, Vienna, Austria

102. **Harman, C. J.**, *Reeves D. M., Baeumer B., Sivapalan, M., 2009, *Subordinated Kinematic Subsurface Flow in Hillslopes*, American Geophysical Union Fall Meeting, San Francisco, CA

103. Sivapalan, M., and **Harman, C. J.**, 2007 *The closure problem in watershed hydrology*, Stochastic Transport and Emergent Scaling in Earth-surface Processes, Incline Village, NV

104. **Harman, C. J.**, & Sivapalan M., 2007 *The effects of spatial structure and connectivity on hdrologic response: non-linear response timescales as an emergent property in subsurface hillslope runoff*, American Geophysical Union, Acapulco, Mexico

105. Sivapalan, M., Schaefli, B. & **Harman, C. J.**, 2007, *Behavioral modeling: a new theoretical framework for hydrological prediction*, European Geophysical Union General Assembly, Vienna, Austria

106. **Harman, C. J.**, & Sivapalan, M., 2006 *What effect does subsurface variability have on flows? Using storm response regimes to characterize the effect of spatial heterogeneity within a hillslope (Poster)*, American Geophysical Union Fall Meeting, San Francisco

107. Sivapalan M. & **Harman, C. J.**, 2006 *Interactions of spatial heterogeneity in bedrock elevation, soil depth and permeability with climate variability: A regime approach to assessing process complexity at hillslope or catchment scale*, Preferential flow and transport processes in soil, Centro Stefano Franscini, Monte Verit Ascona, Switzerland

108. **Harman, C. J.**, Stewardson, M. & De Rose, R. 2005, *Regional Models of Stream Channel Metrics (Poster)*, American Association of Geographers 2006 Annual Meeting, Chicago, Illinois, May 7-11 2006

109. **Harman, C. J.** & Stewardson, M. J., 2004 Casting spells: high flow spells analysis methodology and parameterising the frequency distribution, 4th Australian Stream Management Conference, Launceston, Australia, Oct 19 22 2004

110. **Harman, C. J.** & Stewardson, M. J., 2005 *Improving spells analysis: methodology and parameterising the frequency distribution*, Proceedings of the 29th Hydrology and Water Resources Symposium, Canberra, Australia

RESEARCH FUNDING

Grants and contracts awarded and pending *Budget numbers on collaborative proposals are for JHU component only*

1. Completed (PI): EAR-1344664 Collaborative Research: Hillslope hydrology under glass: Controlled experimental testing of hillslope-scale hydrologic transport theories at Biosphere2, NSF Hydrologic Sciences (Co-PI Peter Troch, U Arizona), $230,056, 2014-03-01 – 2017-03-01
2. Completed (Co-PI): EAR-1417175 Collaborative Research: Coupled Hydrological And Geochemical Process Evolution At The Landscape Evolution Observatory, (PI Peter Troch, U Arizona; Co-PIs Jon Chorover, U Arizona; Katerina Dontsova, U Arizona; Guo-Yue Niu, U Arizona), $188,855.00, (2014-09-01 – 2017-09-01)
3. Completed (PI): NSF-CZO, EAR-1554463 Hydrologic Partitioning Across the CZO Network: Transforming Knowledge of Water and Energy Fluxes Through Earths Living Skin, (Co-PI Noah Molotch; University of Colorado), $10,000.00, (2016-10-01 – 2018-09-30)
4. Current (Co-PI): EAR-1360415 WSC Category 3 Collaborative: Impacts of Climate Change on the Phenology of Linked Agriculture-Water Systems, (PI William Ball, JHU; Co-PIs Damian C. Brady, U Maine; Lisa Wainger, UMCES; Ariel Ortiz Bobea, Resources for the Future; Michael Kemp, UMCES; Jeremy Testa, UMCES), $790,689.00, (2014-09-01 – 2018-09-01 – NCE)
5. Current (Co-PI): CNH-L: Adaptation, Mitigation, and Biophysical Feedbacks in the Changing Bonneville Salt Flats, (PI Brenda Bowen, Utah; Co-PIs Matthew Brownlee, Utah; Betsy Kleba, Westminster College), $343,377.00, (2016-07-01 – 2020-07-01)
6. Current (PI): NSF-EAR, CAREER: proposal to link catchment hydrologic transport to the evolved architecture of the critical zone, $599,377.00, (2017-06-01 – 2022-06-01)
7. Pending (Co-PI): NASA NEWS : The Hydrologic Connectivity And Residence Time (HydroCART) Study, (Stephen Good, Oregon State; Gabriel Bowen, University of Utah; Nathan Chaney, Duke; Augusto Getirana, UMCP; David Noone, Oregon State), $350,153 (2019-09-01 – 2022-08-31)
8. Pending (PI): DOE SBR: Letting the data guide us: A toolchain for statistical multi-scale modeling of StoraAge Selection to enhance sampling design and interpretation of tracer data in hydrologic systems, (Mauro Maggioni, JHU; Fei Lu, JHU), $599,979 (2019 – 2022)

TEACHING ACTIVITIES

Courses

Title	*Enrollment*	*Year*
570.353 Hydrology	29	2018
570.412 Landscape hydrology and watershed analysis	6	2018
570.353 Hydrology	27	2017
570.647 Hydrologic transport in the environment	10	2017
570.353 Hydrology	17	2016
570.412 Landscape hydrology and watershed analysis	8	2016
570.353 Hydrology	18	2015
570.647 Hydrologic transport in the environment	11	2015
570.353 Hydrology	23	2014
570.412 Landscape hydrology and watershed analysis	12	2014
570.353 Hydrology	15	2013
570.521 Landscape hydrology and watershed analysis	10	2013

Teaching assistant

U. Illinois, Water Resources Engineering (awarded Excellence in Teaching)	2008
U. Illinois, Engineering Risk and Uncertainty	2007

Workshops and short courses

Catchment Transport Masterclass, Tsinghua University, Beijing, China	August 2016
CUAHSI Watershed Science Master Class, Biosphere2, Tucson, Arizona	January 2016
CUAHSI Watershed Science Master Class, Biosphere2, Tucson, Arizona	January 2019
CUAHSI Virtual Short Course: Theory and application of time-variable transit times, online (`http://www.cuahsi.org/harman\_transittimes`),	July 2015
River Analysis Package - Advanced Users Workshop, Brisbane, Australia	2004

Development and Pedagogy

Technology Fellowship Grant, JHU Center for Educational Resources 2014 - 2015

Awarded a CER Technology Fellowship to work with an undergraduate student on a project entitled "IPython Notebooks on Landscape Hydrology: Synthesizing Theory and Applications with Interactive Code".

MENTORING AND ADVISING ACTIVITIES

Graduate student supervision

Present	*Degree*	*Start year*	
Cassandra Consans	PhD	2015	
Tianqi Liu	PhD	2015	
David Litwin	PhD	2018	
Fei (Esther) Xu	PhD	2018	
Shuyu Chang	MSE	2017	
Past	*Degree*	*Start year*	*Graduated*
Minseok Kim	PhD	2012	2018
Shane Putnam	PhD	2012	2018
Dano Wilusz (co-advise with B. Ball)	PhD	2012	2018
Christina Cho	MSE	2017	2017
Amadan Darrow	MSE	2015	2016
Ashley Ball	MSE	2013	2015
Holly Guest	MSE	2014	2015
Yifan Zhou	MSE	2013	2015

Undergraduate independent study / research

Peter Bai	Design and construction of a field-portable rainfall simulator	2012
Tiffany Wei	Stable water isotope variability in an urban stream	2013
Celine Cua	Time-variable transit time distribution theory and modeling	2013
Joshua Barza	Hydrologic transport using stable water isotopes in an urban stream	2015
Emily Stoll	Measuring hyporheic volume of urban streams using tracer injections and rSAS analysis	2015-2018
Shannon Nanry	Characterizing hydraulic conductivity and soil texture along a forest transect	2017-

August Weinbren	Solute space-time dynamics in a suburban stream	2017

Graduate board exam committee membership

Mariah Baker	EPS	2018
Xinzhi Xue	MechE	2018
Gaige Kerr	EPS	2018
Liang Chen (alt)	EHE	2018
Huang Chen	MechE	2018
Wanshu Nie	EPS	2018
Chi Zhu	MechE	2017
Mattia Almansi	EPS	2017
Jin Wang (alt)	MechE	2017
Fengwei Hung	EPS	2017
Xu Yang	EPS	2017
Minseok Kim	EHE	2017
Shane Putnam	EHE	2017
Dano Wilusz	DoGEE	2016
Dana Brenner	EPS	2016
Nathan Towles	EPS	2016
Jihua Hao	EPS	2016
Xiaokang Wu	EPS	2016
Huanting Hu	EPS	2015
Grace Kim	EPS	2015
Kirby Runyon	EPS	2015
Se Jong Cho	DoGEE	2014
Fisseha Berhane	EPS	2014
Qian Zhang	DoGEE	2013
Scott Pitz	EPS	2013
Shuning Li	EPS	2012

Department qualifying exam

Cassandra Cosans	EHE	2018
Liang Chen	EHE	2017
Minseok Kim	EHE	2017
Shane Putnam	EHE	2017
Dano Wilusz	DoGEE	2016
Chris Kelley	DoGEE	2015
Gina Tonn	DoGEE	2014
Andrea Staid	DoGEE	2014
Qian Zhang	DoGEE	2013
Se Jong Cho	DoGEE	2013
Julie Shortridge	DoGEE	2013

PROFESSIONAL AND PUBLIC SERVICE ACTIVITIES

Service to the department

Department fellowship committee	2013
Department fellowship committee	2014
Department fellowship committee	2015
Department fellowship committee	2016

Faculty search committee	2016
Faculty search committee	2017
Undergraduate Curriculum committee	2017

Service to the university

E^2SHI fellowship committee	2013
Committee on DoGEE-EHS Collaboration	2014-2015
WSE IT faculty advisory group	2015
EPS Faculty search committee	2014
WSE Design Center Vision Committee	2015
Vredenburg Selection Committee	2017, 2018
WSE Graduate Committee	2017-
Design Day working group	2017-

Service to the profession

Invited panelist for AGU session on *Advances in Hydrologic Science by Early Career Scientists: A Discussion of the Publishing Process*, American Geophysical Union Fall Meeting, December 2017	2017
Reveiw panelist for National Science Foundation	WSC 2014
	INFEWS 2017
	Hydrology 2017
Panelist for Department of Energy	SBE 2017
Invited panelist for Biosphere2 Earth Day	2017
Selection committee for new Editor-in-Chief of Water Resources Research	2016
International Association of Hydrologic Sciences "The New Scientific Decade of IAHS" task force	2012-13
NSF Center for Hydrologic Synthesis "Predictions Under Change (PUC)" working group member	2009-11
Student Leader/Mentor, Hydrological Synthesis Summer Schools, Vancouver, BC	2009-10
Biosphere2 hillslope experiment working group member (now B2 Landscape Evolution Observatory)	2007-8

Journal editorial appointments

Associate Editor *Water Resources Research*	2017-
Editor *Hydrology and Earth Systems Science*	2012-15

Journal reviewer

Journal of Geophysical Research - Earth Surface	2012-
Hydrologic Sciences Journal	2012-
Editor for Hydrology and Earth Systems Science	2011-

Journal of Hydrology	2011-
Hydrological Processes	2011-
Water Resources Research	2009-
Groundwater	2009-
Hydrology and Earth Systems Science	2009-
Vadose Zone Journal	2007-

Outreach

YES-Connect program (helping connect disadvantaged Baltimore City PSS Elementary students with summer STEM programing)	2018-
City Springs Science Outreach Program, Center for Educational Outreach, Johns Hopkins University (teaching science curricular to elementary students in inner-city Baltimore)	2012-14
STEM Achievement in Baltimore Elementary Schools (SABES) - (Curriculum review 2013, STEM Academy program 2014, teacher interviews 2017)	2014-2017
Bryn Mawr Summer internship program	2016-
Barclay school campus visit program	2017-

Professional association membership

European Geosciences Union
American Geophysical Union
Geologic Society of America
International Association of Hydrologic Sciences