

## Resume'

(Does not include reports, abstracts, committees or funded proposals)

John H. Cushman

Born: Ames, Iowa

### Academic Record

B.S.	1975	Mathematics, Iowa State University, Ames Iowa
M.S.	1976	Applied Mathematics and Environmental Physics, Iowa State University, Ames Iowa
Ph.D.	1978	Applied Mathematics and Environmental Physics, Iowa State University, Ames Iowa

### Appointments

2017-	President, Ifbattery, LLC
2015-2017	President of the International Society for Porous Media
2013-2015	President elect of the International Society for Porous Media
2005-	Distinguished Professor of Earth, Atmospheric and Planetary Sciences
2001(F)	Visiting Scholar, Dept. of Molecular and Cellular Biology, Harvard University
1998 (F)	Visiting Professor of Environmental Fluid Mechanics, University of Rome I
1995 (F)	Visiting Professor of Applied Mathematics, Departamento de Matematica, PUC-RIO, Brazil
1995 -	Professor of Mathematics, Purdue University
1994 - 1995	Visiting Professor of Applied Mathematics, Purdue University
1985 - 1988	President, Hydrosience Associates, Inc.
1984 - 1988	Director of the Indiana Water Resources Research Center
1985 -	Professor of Environmental Physics, Purdue University
1982 - 1985	Associate Professor of Environmental Physics, Purdue University
1978 - 1982	Assistant Professor of Environmental Physics, Purdue University

### Scientific Expertise

Confined nanofilms (clays and polymers), up-scaling, porous media and multi-phase physics, swelling porous media (clays and polymers), statistical physics, stochastic processes, stochastic hydrology, polar and classical continuum mechanics, electrostatics.

### Professional Recognitions

- 1) Nominated to NAE 2017 and 2018
- 2) Associate editor, Journal of Porous Media (2013-)
- 3) Associate editor, Special Topics and Reviews in Porous Media (2013-)

- 4) The Physics of Porous Media: A Four-part Special Session in Honor of John H Cushman, Society for Industrial and Applied Math, Long Beach, California (2011).
- 5) Procter and Gamble Int. Soc. Porous Media Award for contributions to swelling (soft) media and interfaces, Bordeaux, France (2011)
- 6) Fellow, Geological Society of America (2010)
- 7) Governing Council Member for the International Society of Porous Media (2009-2013)
- 8) Purdue University ,School of Science, Graduate Mentor Award (2006)
- 9) University Distinguished Professor (2005)
- 10) Fellow, American Geophysical Union (1996).
- 11) Purdue University Herbert Newby McCoy Award (1995) given in honor of the faculty member who made the most significant contribution to science during the previous year.
- 12) Editor-in-Chief: the International Journal of Stochastic Hydrology and Hydraulics (1992-1997).
- 13) Guest Editor: special volume on Fractal Porous Media for the Journal of Transport in Porous Media 13(1), (1993).
- 14) Member of the International Editorial Board of the journal: Transport in Porous Media (1991-2005 )
- 15) Member of the Editorial Board of the journal: Water Resources Research (1990 -1998 ).
- 16) Member of the International Editorial Board of the journal: Stochastic Hydrology and Hydraulics (1990 – 1992, 1997-).
- 17) Member of the International Editorial Board of the journal: Advances in Water Resources (1986-1988).
- 18) Fellow, Soil Science Society of America (1990).
- 19) Appointed by Secretaries of Energy Hodel and Herrington to be a member of the Secretary of Energy's Subcommittee on Ecology (1985-1986).
- 20) Appointed by Secretaries of Energy Hodel and Herrington to be a member of the Secretary of Energy's Health and Environmental Research Advisory Committee (1985-1988)
- 21) Purdue University Agriculture Research Award for development of a model to simulate uptake of ions by growing roots (1983).

H Index: 49

Former Students who have held or currently hold Faculty Positions: 21

Membership in Academic, Professional, and Scholarly Societies

Society for Industrial and Applied Math (special 4-part session in Cushman's honor)  
 American Geophysical Union (Fellow)  
 Geological Society of America (Fellow)  
 Society of Engineering Science  
 International Society of Porous Media (P&G award, Council member, President)  
 American Physical Society  
 Soil Science Society of America (Fellow)  
 Materials Research Society

Books

Cushman, J. H. and D. M. Tartakovsky, editors, (2016) Handbook of Groundwater Engineering, 3<sup>rd</sup> edition, CRC Press/Taylor and Francis, 1050 pages

Cushman, J.H. (1997) The Physics of Fluids in Hierarchical Porous Media: Angstroms to Miles, Kluwer Academic Press, 490 pages.

Cushman, J.H., editor (1990) Dynamics of Fluids in Hierarchical Porous Media, Academic Press, London, 500 pages.

Novels

Cushman, J.H. (2015) The Bandeirante's Stones: Discovery, 325 pages (Submitted).

Cushman, J.H. (2015) The Bandeirante's Stones: Origins, 315 pages (Submitted).

Short Stories

Cushman, J.H. (2015) The Bandeirante, 4000 words (submitted)

Cushman, J.H. (2015) Snowbank, 4000 words (submitted)

Patents

11 patents pending on single- and multiple- phase membraneless flow batteries.

Papers and Book Chapters (\* indicates current or former student)

- 1) O'Malley\*,D. and J. H. Cushman (2018) Nonlocal models for transport in fractal porous media, in Fractals: Concepts and Applications in Geosciences, (ed) B. Ghanbarian and A. Hunt, Taylor and Francis, pp 152-165.

- 2) Muetertheis\*, M. and J. H. Cushman (2017) Carbon nanotube electrode brushes: flow batteries. (in revision TIPM).
- 3) Park\*, M. and J. H. Cushman (2017) Homogenization of carbon nanotube electrode brushes (in revision TIPM).
- 4) Johnson\*, G., J. H. Cushman and D O'Malley (2017) Multi-dimensional effects of viscoelastic relaxation in asymmetrical swelling porous media. (in revision TIPM).
- 5) Cushman, J. H. and D. O'Malley\* (2016) Anomalous dispersion, Chapter 17 in Handbook of Groundwater Engineering, Third Edition, (ed) J. H. Cushman and D. M. Tartakovsky, CRC Press 1073 pages.
- 6) Park\*, M. and J. H. Cushman (2015) Upscaling interpretation of nonlocal fields, gradients and divergences. SIAM J Multiscale Modeling and Simulation 13(4), 1136-1145.
- 7) Cushman, J. H. and D. O'Malley\* (2015) Fickian Dispersion is Anomalous. J. Hydrology (doi:10.1016/j.jhydrol.2015.06.036).
- 8) O'Malley\*, D., V. V. Vesselinov and J. H. Cushman (2015) Dispersive flows and Tsallis entropy. Phys Rev E 9 (4): 042143.
- 9) Park\*, M., D. O'Malley\* and J. H. Cushman (2014) Generalized similarity/renormalization groups and nonlinear clocks for multiscaling. Phys Rev E. 89 (4) 042104
- 10) Park\*, M., J. H. Cushman and D. O'Malley\* (2014) Diffusion of spherical colloids in microstructural fluids is fractional Brownian run with a multi-scaling clock. Langmuir, 30(38), 11263-11266.
- 11) O'Malley\*, D., V.V. Vesselinov and J. H. Cushman (2014) A method for identifying diffusive trajectories with stochastic models. J Stat Phys., 156(3), 896-907.
- 12) O'Malley\*, D. and J. H. Cushman (2013) Ubiquity of, and geostatistics for, nonstationary increment random fields. Water Resources Research, 49(7): 4525-4529.
- 13) O'Malley\*, D., J. H. Cushman and G. Johnson\* (2013) Random renormalization groups and Bayesian scaling of dispersion/diffusion in Lake Michigan and the Gulf of Mexico. Geophy. Res. Lett. 40(17):4638-4642.
- 14) Cushman, J. H., D. O'Malley\* and M. Park\* (2013) Anomalous Diffusion, Renormalization Groups, Scaling Laws and Classification: A Reflection on Recent Efforts. Advances in Water Resources. 62:207-214.

- 15) O'Malley\*, D., J. H. Cushman and L. Flesch (2013) Global sensitivity analysis for a micropolar Stokes flow problem. *Int. J. Multiscale Computational Engineering*. 11(4):359-368.
- 16) O'Malley\*, D. and J. H. Cushman (2012) Random Renormalization Group Operators Applied to Stochastic Dynamics. *J. Stat. Phys.* 149:943-950.
- 17) O'Malley\*, D. and J. H. Cushman (2012) Two Scale Renormalization Group Classification of Diffusive Processes. *Phys. Rev. E*. 86 (1) Article Number: 011126.
- 18) O'Malley\*, D. and J. H. Cushman (2012) A Renormalization Group Classification of Nonstationary and/or Infinite Second Moment Diffusive Processes. *J. Stat. Phys.* 146(5): 989-1000.
- 19) Kleinfelter-Domelle\*, N. and J. H. Cushman (2012) The Role of Connectivity in the Theory of Saturated/Unsaturated Flow in Swelling Porous Media. *Water Res. Research*. (48): W001543, 1-16
- 20) O'Malley\*, D., J. H. Cushman and P. O'Rear\* (2012) Fractional Brownian Motion with Non-stationary Increments: Generation of Random Fields. *Water Resour. Res.* 48:W03201, 1-6.
- 21) Cushman, J. H., M. Park\*, and D O'Malley\* (2011) A Stochastic Model for Diffusion in Confined Nano-films Near a Strain Induced Critical Point. *Adv Water Resour.* 34(4): 490-494.
- 22) O'Malley\*, D., J. H. Cushman, and G. Johnson\* (2011) Scaling Laws for Fractional Brownian Motion with a Power-law Clock. *J Stat. Mech: Theory and Experiment* L01001:1-9.
- 23) Park\*, M. and J. H. Cushman (2011) The Complexity of Brownian Processes Run With Non-linear Clocks. *Mod. Phys. Lett. B*. 25(1), 1-10
- 24) Cushman, J.H., M. Park\*, M. Moroni\*, N. Kleinfelter-Domelle\* and D. O'Malley\* (2011) A Universal Field Equation for Dispersive Processes in Geophysics. *Stoch. Env. Research. and Risk Assesment* 25,1-10.
- 25) O'Malley\*, D. and J. H. Cushman (2010) Fractional Brownian Motion Run with a Non-linear Clock. *Phys. Rev. E*. 82(3),
- 26) Cushman, J. H., M. Park\* and D. O'Malley\* (2009) The Chaotic Dynamics of Super-Diffusion Revisited. *Geophys. Res. Lett.* 36, L08812,1-4.
- 27) Cushman, J.H., D. O'Malley\* and M. Park\* (2009) Anomalous Diffusion as Modeled by a Non-stationary Extension of Brownian Motion. *Phys Rev E*. 79, 032101: 1-4.

- 28) Park\*, M. and J. H. Cushman (2009) Operator-Stable Levy Motions and Renormalizing the Chaotic Dynamics of Microbes in Anisotropic Porous Media. *J Stat. Mech: Theory and Experiment*. P02039:1-11
- 29) Moroni\*, M., A. Cenedese and J.H. Cushman (2009) Application of 3D-PTV to Track Passive Scalars in Porous Media. *Transport in Porous Media*. 79(1), 43-65.
- 30) Moroni\*, M., N. Kleinfelter-Domelle\* and J. H. Cushman (2009) Novel Measures of Dispersion Applied to a Convolute Channel. *Advances in Water Resources* 32:737-749.
- 31) Parashar\*, R., D. O'Malley\* and J. H. Cushman (2008) Mean First Passage Time for Super-Diffusion in a Slit-Pore with Sticky Boundary. *Phys. Rev. E*, 78,052101-1,4.
- 32) Parashar\*, R. and J. H. Cushman (2008) Scaling the Fractional Advective-Dispersive Equation for Numerical Evaluation of Microbial Dynamics in Confined Geometries with Sticky Boundaries. *J Computational Physics* 227:6598-6611.
- 33) Weinstein\*, T., J. H. Cushman and L. S. Bennethum\* (2008) Two-Scale, Three-Phase Theory for Swelling Drug Delivery Systems. Part I: Mixture Theory. *J. Pharm Sci* 97(5): 1878-1903.
- 34) Weinstein\*, T., J. H. Cushman and L. S. Bennethum\* (2008) Two-Scale, Three-Phase Theory for Swelling Drug Delivery Systems. Part II: Flow and Transport. *J. Pharm Sci* 97(5): 1904-1915.
- 35) Parashar\*, R., and J. H. Cushman (2007) The finite-size Lyapunov exponent for Levy motions. *Phys Rev E*. 76, 017201-1 to 017201-4
- 36) Moroni\*, M., N. Kleinfelter\* and J. H. Cushman (2007) Analysis of dispersion in porous media via matched index particle tracking velocimetry experiments. *Advances in Water Resources*. 30: 1-15.
- 37) Kleinfelter\*, N., M. Park\* and J. H. Cushman (2007) Mixture theory for unsaturated flow in swelling soils. *Transport in Porous Media* 68 (1): 69-89.
- 38) Bonilla\*, F. A., N. Kleinfelter\* and J.H. Cushman (2007) Microfluidic Aspects of Adhesive Microbial Dynamics, *Advances Water Resources* 30: 1680-1695.
- 39) Kleinfelter\*, N. and J. H. Cushman (2007) Nonreactive contaminant transport in the saturated zone, Ch 18 in Handbook of Groundwater Engineering, 2<sup>nd</sup> addition., (ed) J. Delleur. CRC Press, pp18-1 to 18-18.
- 40) Cushman, J.H. and T. R. Ginn\* (2007) Reactive contaminant transport in the saturated zone, Ch 19 in Handbook of Groundwater Engineering, 2<sup>nd</sup> addition., (ed) J. Delleur. CRC Press, pp19-1 to 19-29.

- 41) Park\*, M. and J. H. Cushman (2006) On upscaling operator-stable Levy motions in fractal porous media. *J. Comp. Phys.* 217:159-165.
- 42) Park\*, M., N. Kleinfelder\* and J. H. Cushman (2006) Renormalizing chaotic dynamics in fractal porous media with application to microbe motility. *Geophysical Research Letters*, 33, L01401, 1-4.
- 43) Park\*, M., N. Kleinfelder\* and J. H. Cushman (2005) Scaling laws and Fokker-Planck equations for 3-dimensional porous media with fractal mesoscale. *SIAM Multiscale Modeling and Simulation*, 4(4): 1233-1244.
- 44) Park\*, M., N. Kleinfelder\* and J. H. Cushman (2005) Scaling laws and dispersion equations for Levy particles in 1-dimensional fractal porous media., *Physical Review E*, 72, 056305: 1-7.
- 45) Kleinfelder\*, N., M. Moroni\*, and J. H. Cushman (2005) Application of a finite-size Lyapunov exponent to particle tracking velocimetry in fluid mechanics experiments. *Physical Review E*, 72, 056306: 1-12.
- 46) Cushman, J. H., M. Park\*, N. Kleinfelder\*, and M Moroni\* (2005) Super-diffusion via Levy Lagrangian velocity processes. *Geophysical Research Letters*, 32 (19) L19816: 1-4.
- 47) Axtell\*, N.K., M. Park\* and J.H. Cushman (2005) Micromorphic fluid in an elastic porous body: Blood flow in tissues. *Int. J. Multiscale Computational Engineering*. 3(1): 71-83.
- 48) Cushman, J. H., L.S. Bennethum\* and P.P. Singh\* (2004) Toward rational design of drug delivery substrates: I. Mixture theory for two-scale biocompatible polymers. *SIAM J. Multiscale Modeling and Simulation* 2(2): 302-334.
- 49) Cushman, J. H., P.P. Singh\* and L.S. Bennethum\* (2004) Toward rational design of drug delivery substrates: II. Mixture theory for three-scale biocompatible polymers and a computational example. *SIAM J. Multiscale Modeling and Simulation* 2(2): 335-357.
- 50) Singh\*, P.P., D. Maier, J.H. Cushman and O.H. Campanella (2004) Effect of viscoelastic relaxation on fluid transport in foods. Part II: Imbibition and drying of seeds. *J. Math. Biol.* 49: 1-19.
- 51) Singh\*, P.O., D.E. Maier, J.H. Cushman, K. Haghighi and C. Corvalan (2004) Effect of viscoelastic relaxation on fluid transport in foods. Part I: Solution of the general transport equation. *J. Math. Biol.* 49: 20-34.

- 52) Cushman, J.H. and J.E. Curry\* (2004) The complex behavior of simple fluids in nanoscale restricted geometrics. In Dynamics and Friction in Sub-micron Scale Confined Systems (ed) Y. Braiman, ACS Symposium Series 882: 157.
- 53) Singh\*, P.P., J.H. Cushman and D.E. Maier (2003) Multiscale fluid transport theory for swelling biopolymers. *Chem. Eng. Sci.* 58: 2409-2419.
- 54) Moroni\*, M., J.H. Cushman and A. Cenedese (2003) 3D-PTV two-projection study of pre-asymptotic dispersion in porous media which are heterogeneous on the bench scale. *Int. J. Eng. Sci.* 41: 337-370.
- 55) Singh\*, P.P., J.H. Cushman, L.S. Bennethum\* and D.E. Maier (2003) Thermomechanics of swelling biopolymeric systems. *Trans. Porous Media* 53:1-24
- 56) Singh\*, P.P., J.H. Cushman and D. Maier (2003) Three scale thermomechanical theory for swelling biopolymeric systems. *Chem. Eng. Sci.* 58: 4017-4035
- 57) Su\*, Z., J.E. Curry\* and J.H. Cushman (2003) Computer simulation of anisotropic diffusion in monolayer films in mica slit pores. *J. Chem. Phys.* 118:1417-1422.
- 58) Cushman, J.H., L.S. Bennethum\* and B.X. Hu\* (2002) A primer on upscaling methods for porous media. *Adv. Water Resour.* 25:1043-1067.
- 59) Bonilla\*, A. and J.H. Cushman (2002) The effect of  $\alpha$ -stable adsorptive waiting times on microbial transport in slit-pores. *Phys. Rev. E* 66(3):1915-1 to 1915-17.
- 60) Hu\*, B.X., H. Huang\*, A.E. Hassan\* and J.H. Cushman (2002) Stochastic reactive transport in porous media: Higher order closures. *Adv. Water Res.* 25:513-531.
- 61) Bennethum\*, L.S. and J.H. Cushman (2002) Multicomponent, multiphase thermodynamics of swelling porous media with electroquasistatics I: Macroscale field equations. *Trans. Porous Media* 47(3):309-336.
- 62) Bennethum\*, L.S. and J.H. Cushman (2002) Multiphase, multicomponent thermodynamics of swelling porous media with electroquasistatics II: Constitutive theory. *Trans. Porous Media* 47(3):337-362.
- 63) Moroni\*, M. and J.H. Cushman (2002) Anomalous dispersion of conservative tracers: Theory and 3-DPTV experiments. In Stochastic Methods in Subsurface Hydrology, Ed. R.S. Govindaraju, Amer. Soc. Civ. Eng. pp.365-393.
- 64) Cushman, J.H., M. Moroni\* and T.R. Ginn\* (2001) Projection operators and fractal dispersion. In Scaling Laws in Ice Mechanics and Ice Dynamics (ed) J. Dempsey and H. Shen, Kluwer Acad. 427-438.



- 65) Stroud\*, W., J. Curry\*, and J.H. Cushman (2001) Capillary condensation and snapoff in nanoscale contacts. *Langmuir* 17(3):688-698.
- 66) Cenedese, A., J.H. Cushman and M. Moroni\* (2001) 3-D PTV experiments in porous media. *Euromech.* 411:1-10.
- 67) Moroni\*, M. and J.H. Cushman (2001) 3D-PTV studies of the transition from pore dispersion to Fickian dispersion for homogeneous porous media. *Water Resour. Res.* 37(4):873-884.
- 68) Bonilla\*, A. and J.H. Cushman (2001) On perturbative expansions to the stochastic flow problem. *Trans. Porous Media* 42:3-35.
- 69) Cushman, J.H. and M. Moroni\* (2001) Statistical mechanics with 3D-PTV experiments in the study of anomalous dispersion: Part I. Theory. *Phys. Fluids* 13(1):75-80.
- 70) Moroni\*, M. and J.H. Cushman (2001) Statistical mechanics with 3D-PTV experiments in the study of anomalous dispersion: Part II. Experiment. *Phys. Fluids* 13(1):81-91.
- 71) Cushman, J.H. and T.R. Ginn\* (2000) Fractional advective dispersion equation: A classical mass balance with convolution-Fickian flux. *Water Resour. Res.* 36(12):3763-3766.
- 72) Bonilla\*, F.A. and J.H. Cushman (2000) Role of boundary conditions on convergence and nonlocality of solutions to stochastic flow problems in bounded domains. *Water Resour. Res.* 36(4):981-997.
- 73) Murad\*, M.A. and J.H. Cushman (2000) Thermomechanical theories for swelling porous media with microstructure. *Int. J. Eng. Sci.* 38:517-564.
- 74) Bennethum\*, L.S., M.A. Murad\*, and J.H. Cushman (2000) Macroscale thermodynamics and the chemical potential for swelling porous media. *Trans. Porous Media* 39(2):187-225.
- 75) Kuo\*, R.K.H., N.C. Irwin\*, R.A. Greenkorn and J.H. Cushman (2000) Experimental investigation of mixing in a periodic heterogeneous porous media: Comparisons with stochastic transport theory. *Trans. Por. Media* 37(2):169-182.
- 76) Irwin\*, N.C., R.A. Greenkorn\*, S.A. Altobelli and J.H. Cushman (2000) Examination of stochastic dispersion theory by MRI in aperiodic porous media. *AICh.E* 46(2):2344-2351.
- 77) Hu\*, B.X., A.E. Hassan\* and J.H. Cushman (1999) Eulerian solutions of  $O(\sigma_v^N)$  for the stochastic transport problem for conservative tracers coupled with  $O(\sigma_f^2)$  solutions for the flow problem in a infinite domain. *Water Resour. Res.* 35(12):3685-3698.

- 78) Irwin\*, N.C., R.A. Greenkorn, J.H. Cushman, and S.A. Altobelli (1999) Magnetic resonance imaging experiments for examination of solutions to the stochastic transport problem of  $O(\sigma_v^N)$ . *AIChE* 45(6):1351-1354.
- 79) Bennethum\*, L.S. and J.H. Cushman (1999) Coupled solvent and heat transport in a mixture of swelling porous particles and fluids: Single time-scale problem. *Trans. Por. Media* 36(2):211-244.
- 80) Hassan\*, A.E., J.H. Cushman, and J.W. Delleur (1998) The significance of porosity variability to transport in heterogeneous porous media. *Water Resour. Res.* 34(9):2249-2259.
- 81) Curry\*, J.E. and J.H. Cushman (1998) Structure in confined fluids: phase separation of binary simple liquid mixtures. *Tribology Letters* 4:129-136.
- 82) Hassan\*, A., J.H. Cushman, and J.W. Delleur (1998) A Monte Carlo assessment of Eulerian flow and transport perturbation models. *Water Resour. Res.* 34(5):1143-1163.
- 83) Mukhopadhyay\*, S. and J.H. Cushman (1998) Monte Carlo simulations of contaminant transport: I. Long-range correlations in fracture conductivity. *Trans. Porous Media* 31(2):145-181.
- 84) Mukhopadhyay\*, S. and J.H. Cushman (1998) Monte Carlo simulation of contaminant transport: II. Morphological disorder and percolation. *Trans. Porous Media* 31(2):183-211.
- 85) Mukhopadhyay\*, S. and J.H. (1998) Diffusive transport of organic vapors in nonaqueous-phase liquid contaminated soil: A fractal model. *Trans. Porous Media* 30(2):125-154.
- 86) Murad\*, M. and J. H. Cushman (1998) A generalized Biot model for non-isothermal consolidation of clays incorporating physical-chemical effects. *Poromechanics* 111-116.
- 87) Cushman, J.H. and T.R. Ginn\* (1998) Reactive contaminant transport in the saturated zone. In Ground Water Hydrology Handbook, (ed) J.W. Delleur, CRC Press. pp. 15-1 to 15-21.
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- 89) Deng\*, F.-W. and J.H. Cushman (1998) On higher order corrections to the flow velocity covariance tensor: Revisited. *Water Resour. Res.* 34(1):103-106.

- 90) Murad\*, M.A. and J.H. Cushman (1997) New directions for modeling consolidation of swelling clay soils. *Trends in Soil Science* 2:1-35.
- 91) Hu\*, X., F.-W. Deng\*, and J.H. Cushman (1997) Nonlocal reactive transport with physical and chemical heterogeneity: Linear nonequilibrium sorption with random rate coefficients. *Subsurface Flow and Transport: A Stochastic Approach*, (ed) G. Dagan and S.P. Neuman, Cambridge Press 146-156.
- 92) Cushman, J.H. and B.X. Hu\* (1997) Solutions to the stochastic transport problem of  $O(\sigma_v^N)$  for conservative solutes. *Stoch. Hydrol. Hyd.* 11(4):297-302.
- 93) Curry\*, J.E. and J.H. Cushman (1997) Normal-strain induced change in lattice-type for confined cyclohexane films. In *Dynamics in Small Confined Systems III*. (ed) J.M. Drake, J. Klafter, D.D. Awschalom, R. Kopelman, Materials Research Soc. 115-120.
- 94) Mukhopadhyay\*, S. and J.H. Cushman (1997) Monte Carlo simulation of radioactive contaminant transport in fractured geologic media: disorder and long-range correlations. In (W. Gray, ed.) *Scientific basis for nuclear waste management*. MRS publications, Vol. 465, Boston, 885-892.
- 95) Hassan\*, A.E., J.H. Cushman, and J.W. Delleur (1997) Monte Carlo studies of flow and transport in fractal conductivity fields: Comparison with stochastic perturbation theory. *Water Resour. Res.* 33(11):2519-2534.
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- 97) Murad\*, M.A. and J.H. Cushman (1997) A multiscale theory of swelling porous media: II. Dual porosity models for consolidation of clays incorporating physical chemical effects. *Trans. Porous Media* 28(1):69-108.
- 98) Bennethum\*, L.S., M. Murad\*, and J.H. Cushman (1997) Modified Darcy's law, Fick's law, and Terzaghi's effective stress principle for swelling clay soils. *J. Computers in Geotechniques* 20(3/4):245-266.
- 99) Hu\*, X. and J.H. Cushman (1997) Comparison of nonlocal-eulerian to lagrangian moments for transport in an anisotropic heterogeneous aquifer with deterministic linear nonequilibrium sorption. *Water Resour. Res.* 33(4):891-896.
- 100) Murad\*, M. and J.H. Cushman (1997) A three scale model for consolidation of swelling clay soils. *Numerical Modeling in Geomechanics* (ed.) S. Picruszczak and G.N. Pan de Balkema Press. Rotterdam:117-122.
- 101) Hu\*, X., J.H. Cushman, and F.-W. Deng\* (1997) Nonlocal theory of reactive transport with physical, chemical and biological heterogeneity. *Adv. Water Resour. Res.* 20:293-308.

- 102) Bennethum\*, L.S., M. Murad\*, and J.H. Cushman (1996) Clarifying mixture theory and the macroscale chemical potential for porous media. *Int. J. Eng. Sci.* 34(4):1611-1621.
- 103) Cushman, J.H., X. Hu\*, and F.-W. Deng\* (1996) Comparison of Eulerian to Lagrangian expected spatial moments for transport in a heterogeneous porous medium with deterministic linear nonequilibrium adsorption. *Chem. Eng. Com.* 148-150:5-21.
- 104) Sternberg\*, S.P.K., J.H. Cushman, and R.A. Greenkorn (1996) Laboratory observation of nonlocal dispersion. *Transport in Porous Media* 23(2):135-151.
- 105) Murad\*, M.A. and J.H. Cushman (1996) Multiscale flow and deformation in hydrophilic swelling porous media. *Int. J. Eng. Sci.* 34(3):313-338.
- 106) Sternberg\*, S.P.K., J.H. Cushman, and R.A. Greenkorn (1996) Random walks in prefractal porous media. *AIChE* 42(4):921-926.
- 107) Bennethum\*, L.S. and J.H. Cushman (1996) Multiscale hybrid mixture theory for swelling systems. Part I: Balance laws. *Int. J. Eng. Sci.* 34(2):125-145.
- 108) Bennethum\*, L.S. and J.H. Cushman (1996) Multiscale hybrid mixture theory for swelling systems. Part II: Constitutive theory. *Int. J. Eng. Sci.* 34(2):147-169.
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### Invited Presentations

Turned down all invited talks in 2015-2018 because of cancer in the family (including invitations in England, The Netherlands, China, Mexico, Greece, Cuba and Croatia, as well as AGU and GSA).

- 1) Fickian Dispersion is Anomalous, AGU, San Francisco (2014).
- 2) Theories of Anomalous Diffusion: Non-Linear Clocks, Renormalization Group Classification and Multi-Scaling with Application to Real-World Data, 2014 International Conference on Mathematics, Computation and Information Science, Beihang University, Beijing, China. Plenary (2014).
- 3) 25 years of swelling porous media research, 6<sup>th</sup>-Interpore Annual Meeting, Milwaukee (2014)
- 4) Anomalous Dispersion and Classification of Diffusive Processes. UNAM, Mexico City (2014).
- 5) Numerical Simulation of Swelling Porous Media, UNAM, Mexico City (2014)
- 6) Homogenization and Super Capacitance in Carbon Nanotube Brushes. Instituto de Energias Renovables, Temixco, MX (2014)
- 7) Anomalous Dispersion and Fractals. Instituto Mexicano del Petroleo, Mexico City. (2014).
- 8) Homogenization of Nano-scale Electrodynamics for Carbon Nanotube Brushes with Defects. 5<sup>th</sup> Int Conference on Porous Media, Prague (2013)
- 9) Applications of Random Renormalization Group Operators. AMMCS-2013, Waterloo (2013)

- 10) Adaptive Renormalization of Stochastic Dynamics with Application to Data Assimilation and Numerical Modeling, EGU Annual Meeting, Vienna (2012).
- 11) Stochastic Multiscale Renormalization Group Application to Porous Media, NUPUS Symposium on Flow and Transport in Porous Media, Poros Island, Greece (2012).
- 12) Renormalizing Multiscale Diffusive Processes, International Conference on Multiscale Modeling and Applications, Abu Dhabi (2012).
- 13) Multiscale Dynamics and Renormalization, Chalmers University, Sweden (2012).
- 14) A Renormalization Group Classification of Nonstationary and/or Infinite Second Moment Diffusive Processes. 4<sup>th</sup> Int. Meeting on Porous Media, Purdue Univ. (2012)
- 15) Unsaturated Swelling Porous Media, EUROMECH, Utrecht, The Netherlands (2012)
- 16) Thirty Years of Porous Media Research at Purdue, SIAM Meeting on Geoscience, Long Beach (2011).
- 17) Swelling Systems: Nanoscale to Field Scale, Third Annual Interpore Conference, Bordeaux France (2011).
- 18) Stochastic Processes Run With Non-linear Clocks as Models for Anomalous Dispersion: Complexity and Ergodicity. Second Annual InterPore Conference, Texas A&M (2010).
- 19) Thirty Five Years of Stochastic Hydrology in Cushman's Program, International Meeting on Stochastic Hydrology, Ascona, Switzerland (2010).
- 20) Stochastic Processes Run with Non-linear Clocks, Inform's Annual Meeting, Austin Texas (2010).
- 21) A Novel Model for the Chaotic Dynamics of Superdiffusion European Geophysical Union, Vienna (2009).
- 22) The Chaotic Dynamics of Anomalous Dispersion as Modeled by a Nonstationary Extension of Brownian Motion, European Geophysical Union, Vienna (2009)
- 23) Renormalizing Operator-Stable Lagrangian Velocities for Microbial Dynamics Simulations, AGU Meeting of the Americas, Joint Assembly, Fort Lauderdale, FL (2008).
- 24) Renormalizing the Chaotic Dynamics of Motile Particles in Fractal Porous Media, International Conference on Statistical Physics, Kolympari, Crete, Greece (2008)
- 25) Upscaling  $\alpha$ -stable Levy Motions in Turbulence and Porous Media, SIAM Conference on Applications of Dynamical Systems, Snowbird Utah (2007)

- 26) The FSLE in Geophysics, Union of Mexican Geophysicists, Puerto Vallarta, MX. (2007)
- 27) A Universal Field Equation for Dispersive Processes in Geophysics, SAMSI Meeting on Heterogeneous Media, Raleigh, NC (2007)
- 28) Novel Measures of Dispersive Processes, AGU, San Francisco, CA (2007).
- 29) A Universal Nonlocal Field Equation for Dispersion, International Meeting on Stochastic Transport and Emergent Scaling on the Earth's Surface, Lake Tahoe, NV (2007)
- 30) Universality in Theories of Dispersion, 7<sup>th</sup> North American Workshop on the Applications of the Physics of Porous Media, Puerto Vallarta, MX (2007)
- 31) Dispersion of Microbes in Porous Media, SIAM Conference on Mathematical and Computational Issues in Geosciences, Santa Fe NM (2007)
- 32) Anomalous Dispersion: Angstroms to Kilometers, SIAM Conference on Mathematical and Computational Issues in Geosciences, Santa Fe NM (2007) Plenary
- 33) Dispersion Revisited: Generalized Hydrodynamics, Renormalization, Fractional Equations and the CTRW, Center for Stochastic and Chaotic Processes, Case Western Reserve University, Cleveland, Oh (2007)
- 34) Three-Phase Theory for Swelling Drug Delivery Systems, IUTAM Conference on Swelling and Shrinking Porous Media, Petropolis, Brasil (2007)
- 35) Levy Motions and Applications to Microbial Dynamics in Fractal Porous Media, 7th World Congress on Computational Mechanics, LA, Ca (2006)
- 36) Understanding and Modeling Anomalous Diffusion and Dispersion in Porous Media, Confined Nano-films and Turbulence, Nacional de Matemática Aplicada e Computacional XXIX, CNMAC, Campinas Brazil (2006) Plenary
- 37) Mixture Theory for Multi-scale Swelling Polymers, Nacional de Matemática Aplicada e Computacional XXIX, CNMAC, Campinas Brazil (2006)
- 38) Fractional Equations, Levy Motions and Generalized Hydrodynamics, International Meeting on Fractional Calculus, Dunedin, NZ (2006)
- 39) Renormalizing Chaotic Dynamics in Fractal Porous Media: Application to Microbial Transport, 6<sup>th</sup> North American Workshop on the Applications of the Physics of Porous Media, Puerto Vallarta, Mx (2005)
- 40) Fractional Dispersion and Renormalized Levy Motions, Dept. Mathematics, UNC (2005)

- 41) Dispersion Revisited: Generalized Hydrodynamics, Renormalization, Fractional Equations and the CTRW, AGU Fall Meeting SF (2005)
- 42) Upscaling Levy Motions and Anomalous Dispersion, Western Pacific Geophysics Meeting, Honolulu (2004)
- 43) Polar Continuum Models of Heavy Organics, Int. Conf. Heavy Organic Depositions, Cabo San Lucas, Mx (2004)
- 44) Chaotic Dynamics of Motile Microbes and Upscaling, SIAM Annual Meeting, Portland, Or (2004)
- 45) Swelling Biopolymers and Other Viscoelastic Media: Theory and Numerics, SIAM Meeting on Geoscience, Austin, TX (2003).
- 46) Genetic Evolution in Microbial Communities in Porous Media: Multiscale Physics and Upscaling, ARO Symposium on Science and Complex Adaptive Systems, Durham NC (2003) Plenary
- 47) On the Relation Between Anomalous Dispersion, the Finite-Size Lyapunov Exponent and the Intermediate Scattering Function, SIAM Meeting of Geoscience, Austin, TX (2003).
- 48) Anomalous Dispersion in Porous Media: Theory and 3D-PTV Experiments, IUTAM, Netherlands (2003).
- 49) 3D-PTV Experiments on Preasymptotic Dispersion, American Society of Civil Engineering, San Francisco, CA (2003).
- 50) Anomalous Dispersion, Finite Size Lyapunov Exponents, the Full Intermediate Scattering Function and 3D-PTV, American Geophysical Union Fall Meeting, San Francisco, CA (2002).
- 51) Saturated–Unsaturated Flow in Swelling Systems, American Geophysical Union Fall Meeting, San Francisco, CA (2002).
- 52) 3D-PTV Two-Projection Study of Pre-Asymptotic Dispersion in Porous Media Which are Heterogeneous on the Bench Scale, Eringen Symposium, 39<sup>th</sup> Annual Meeting Society Engineering Science, University Park, PA (2002).
- 53) Size Affects on Nanoscale Contacts, Capillary Adsorption and Snapoff Animations. American Chemical Society, Orlando, FL (2002).
- 54) The Effect of Load and Shear on Confined Nanofilms. SIAM 50<sup>th</sup> Annual Meeting, Philadelphia, PA (2002).

- 55) Statistical Mechanics of Anomalous Dispersion with 3D-PTV Experiments in Porous Media. 31<sup>st</sup> Statistical Physics Meeting, Taxco, Mexico (2002). Plenary
- 56) The Effect of Symmetry Breaking Structures on Fluid Nanofilms: Application to Nanorheology, Nanochromatography and Nanotribology. Harvard University (2001).
- 57) An Overview of Porous Media Science, Harvard University (2001).
- 58) Statistical Mechanics,  $\alpha$ -Stable Processes and Continuous-Time Random Walks. 2<sup>nd</sup> North American Workshop on Application of Physics to Porous Media, Puerto Velarta, Mexico (2001).
- 59) Scale Invariant Theories of Dispersion with Experiments. Fluid Flow and Transport in Porous Media: Mathematical and Numerical Treatment, IMS, AMS, SIAM, South Hadley, MA (2001).
- 60) Mixture Theories of Multiscale Viscoelastic Porous Media. SIAM Geosciences Conference, SIAM, Boulder, CO (2001).
- 61) Theories of Anomalous Dispersion with Experimental Results. Env. Eng. Dept., Johns Hopkins University (2001).
- 62) Statistical Mechanics of Preasymptotic Dispersion, Physics Dept., Univ. of Rome, La Sapienza (2001).
- 63) Anomalous Dispersion in the Environment, Env. Engr., University of South Florida (2001).
- 64) 3D-PTV Experiments for Preasymptotic Dispersion, US-Mexico-Canada Meeting on Physics in Porous Media, Puerto Velarta, Mexico (2001).
- 65) A Scale-Invariant Theory of Dispersion. Univ. Paris, France (2000).
- 66) A Scale-Invariant Theory of Dispersion. IFP, Rueil, France (2000).
- 67) A Scale-Invariant Dispersion Theory with Examples on the Scale of Nanometers and Meters. GSA, Reno, NV (2000).
- 68) Statistical Mechanical Theories of Anomalous Transport in Soils. Kirkham Conference, Iowa State University (2000).
- 69) Anomalous Dispersion. IUTAM Scaling Laws in Ice Dynamics Symposium, Fairbanks (2000). Plenary
- 70) Statistical Mechanical Theories and 3-DPTV Experiments on Anomalous Dispersion in Porous Media. European Geophysics Society Millennium Meeting, Nice France (2000).



- 71) Anomalous Transport of Conservative Chemicals: Theory and 3-DPTV Experiments. Multiscale Modeling and Simulation of Flow and Transport in Porous Media, Los Alamos (1999).
- 72) Capillary Adsorption and Snapoff. Mexican-Canada Meeting on Applications of Physics to Porous Media, Puerto Vallarta, MX (1999).
- 73) Capillary Snapoff. SIAM Conference on Geosciences, San Antonio, TX (1999).
- 74) The Physics of Fluids in Microporous Media. University of Rome I, Italy (1998).
- 75) Modern Stochastic Approaches to Subsurface Flow and Transport. Lab. Env. Fluid Mechanics, University of Rome I, Rome, Italy (1998).
- 76) Coupled Heat and Moisture Transport in Unsaturated Soils: Mixture Theory. SSSA, Baltimore, MD (1998).
- 77) Fluids in Colloids. Workshop on Nonlinear Dynamics, Los Alamos, NM (1998).
- 78) The Physics of Fluids in Hierarchical Porous Media: Angstroms to Miles – A Survey. Department of Civil Engineering, University of Michigan (1997).
- 79) Fluids in Micropores. Canada-Mexico Workshop on Application of Physics to Porous Media, Alberta, Canada (1997).
- 80) The Physics of Fluids in Porous Media: Angstroms to Miles. SIAM Meeting on Geosciences, Albuquerque, NM (1997).
- 81) Nonlocal Dispersive Transport: Theory vs. Experiment. 27th ASCE/IHAR Congress, San Francisco (1997).
- 82) Stochastic Perturbation and Reactive Chemical Transport. Brasilian Soc. Appl. Comp. Math., Goiania, Brazil (1996).
- 83) Stochastic PDE's in Hydrology. Stochastic Methods in Applied Sciences, Los Alamos (1996).
- 84) Traction on Deformable Porous Media. Second North American Workshop on Mobility Modeling, USACE-WES (1996).
- 85) Stochastic Perturbation Theories of Transport: Monte Carlo Verification. Army High Performance Computing Research Center, Univ. of Minnesota (1996).
- 86) Nonlocal Theories of Reactive Chemical Transport in Porous Media. Int. Meeting on Math Models for Porous Media, Oberwolfach, Germany (1996).

- 87) Multiscale Transport. Instituto Politecnico, Univ. de Estado do Rio de Janeiro (1995).
- 88) Physics of Fluids in Porous Media: Angstroms to Miles. Lab. National Comp. Sci., Rio de Janeiro (1995).
- 89) Nonlocal Eulerian Transport with Physical, Chemical and Biological Heterogeneity. Geol. Soc. Am., New Orleans (1995).
- 90) Multiscale Flow and Deformation in Swelling Porous Media. Find Particles Society, Chicago (1995).
- 91) Comparison of Eulerian Nonlocal Models to Lagrangian Models of Chemical Transport in Heterogeneous Media. Sur la Modelisation Mathematique des Enconlements en Milreu porous, St. Etienne, France (1995) Plenary
- 92) Nonlocal Dispersion: Theory and Confirmation. UNESCO/IAHS, Paris, France (1995).
- 93) Classical-, quasi-, convolution-fickian and more general dispersive fluxes: regions of validity. SIAM Conference on Geophysics, San Antonio, TX (1995).
- 94) Theories of Dispersion: A Critical Discussion. AGU, San Francisco (1994).
- 95) Supercomputing in Soil Physics. SSSA, Seattle (1994).
- 96) A Hierarchy of Nonlocal Dispersion Theories. Brasilian Soc. Appl. Comp. Math, Victoria, Brazil (1994).
- 97) Nonlocal Dispersion Revisited. Lab. National Comp. Sci., Rio de Janeiro, Brazil (1994).
- 98) Scales of Measurement. Division of Water Resources, CSIRO, Perth, Australia (1994).
- 99) Overview of Mesoscale Phenomena. Gordon Conference on Flow in Porous Media, Proctor Academy (1994).
- 100) Nanotribology and the formation and destruction of nano capillaries. Materials Research Soc., Boston (1994).
- 101) Chemical Dispersion in Porous Media: A Modern Perspective. Dept. of Environmental Mechanics, CSIRO, Canberra, Australia (1994).
- 102) Dispersion Revisited. Dept. of Environmental Engineering, University of Western Australia (1994).
- 103) Quasistatic computational molecular tribology. 8th International Conference of Surface and Colloid Chemistry, Adelaid, Australia (1994).

- 104) Scaling in hierarchical systems. Chapman Conference on Building and Testing Atomistic-to-Basin-Scale Models, Lincoln, NH (1994).
- 105) Stochastic Adaptive Estimation Techniques. Environmental Sciences Program, BPNL, Richland (1993).
- 106) Adsorption and Phase Transitions in Micropores. Applications of Computational Chemistry to Soils, SSSA Cincinnati (1993).
- 107) Clay Swelling: A Thermomechanical Derivation of Low's Empirical Equation. Special Session in Honor of P.F. Low's 70th Birthday, ASA Cincinnati (1993).
- 108) Nonlocal Constitutive Models for Chemical Transport in Porous Media. Joint ASME-ASCE-SES meeting, Charlottesville, VA (1993).
- 109) Information Propagation Over Scales. NATO/ASI on Transport in Porous Media, Grenoble, France (1993). (Canceled because of travel arrangement problems.)
- 110) A Kalman-Like Estimator for the Conductivity Field Using Tracer Data. Int. Conference on Stochastic and Statistical Methods in Hydrology and Environmental Engineering, University of Waterloo, Canada (1993).
- 111) A FFT/Stochastic Theory of Contaminant Transport. Int. Conference on Stochastic and Statistical Methods in Hydrology and Environmental Engineering, University of Waterloo, Canada (1993).
- 112) Nonlocal Dispersion Theories Based on Rigorous Theories of Statistical Mechanical Correlation Functions. Dept. of Environmental Engineering, University of North Carolina (1993).
- 113) Hierarchical Problems: From the Molecular to the Field Scale. Workshop on Environmental Chemistry: Soils and Groundwater, Battelle Conference Center, Seattle, WA (1992).
- 114) Nonlocal Diffusion and Fractional Flow. Dept. of Hydrology, Univ. of Arizona, Tucson (1992).
- 115) Fractal Brown Diffusion in Porous Media. 23rd Annual Meeting of the Fine Particle Society, Las Vegas, NV (1992).
- 116) On the Statistical Mechanics of Granular Flows. Nonlinear Dynamics Program, Dept. of Physics, Clarkson University, Potsdam, NY (1992).
- 117) Surface Forces in Molecularly-Thin Films. Dept. of Civil Engineering, Duke University (1992).

- 118) Nonlocal Diffusion in Porous Media. Dept. Chem. Eng., Worcester Polytech., Worcester, MA (1992).
- 119) Information Propagation Over Scales in Porous Media. Environmental Studies Workshop, Institute for Math and It's Application, Minneapolis, MN (1992).
- 120) Non-local Stochastic Transport Theories. Oberwolfach Conference on Porous Media, (Cancelled because of travel conflicts) Oberwolfach, Germany (1992).
- 121) Fractional Brownian Diffusion in Molecularly Thin Films. Molecular Sciences Research Center, BPNL (1991).
- 122) Multiscale Transport Processes in Porous Media. IMACS, Dublin, Ireland (1991).
- 123) On Diffusion and Dispersion in Fractal Porous Media. Dept. of Civil Engineering, University of California at Berkeley (1991).
- 124) Transport with Evolving Heterogeneities. Dept. of Mathematics, Clemson University (1991).
- 125) Fluids in Micropores. Dept. of Civil Engineering, Duke University (1991).
- 126) Fluids in Microfractures. Flow and Transport in Unsaturated Fractured Rock -- Related to High-Level Radioactive Waste Disposal, V, Tucson, AZ (1991).
- 127) The Behavior of Fluids in Microporous Media. American Chemical Society, Atlanta (1991).
- 128) Hierarchical Transport in Porous Media. NSF-Micromechanics of Granular Materials, Clarkson University, Potsdam, NY (1991).
- 129) Nonlocal Continuum Theories of Porous Media Transport. American Society of Mechanical Engineers, Columbus, OH (1991).
- 130) Hierarchical Problems: Some Conceptual Difficulties in the Development of Transport Equations. International Meeting on Heat and Mass Transport in Porous Media, Dubrovnik, Yugoslavia (1991).
- 131) Transport in Fractals. Center for Energy and the Environment, Rice University, Houston, TX (1990).
- 132) Diffusion in Fractals. Desert Research Institute, University of Nevada Reno and Las Vegas (1990).
- 133) Diffusion in Fractal Porous Media. Western Pacific Geophysics Meeting, Kanazawa, Japan (1990).

- 134) Nonlocal Transport Theories. International Meeting on Transport and Mass Exchange Processes in Sand and Gravel Aquifers: Field and Model Studies, Ottawa, Canada (1990).
- 135) On Dispersion in Porous Media. Departments of Chemical and Civil Engineering, University of California, Davis (1990).
- 136) On the Behavior of Fluids Near Surfaces. Institute for Theoretical Dynamics, University of California, Davis (1990).
- 137) Fluids in Small Pores. Environmental and Molecular Sciences Research Center, Battelle Pacific Northwest Lab, Richland, WA (1990).
- 138) Molecular Dynamics and Monte Carlo Studies of Fluids in Structured Micropores. Supercomputer Institute, University of Minnesota (1989).
- 139) Subsurface Stochastic Models. Department of Civil Engineering, Universitat Stuttgart, West Germany (1989).
- 140) Fluids in Microporous Soils. Department of Soils, Universitat Hohenheim, West Germany (1989).
- 141) Application of Statistical Mechanics to Study the Behavior of Fluids in Clays. Agronomic Institute, Versailles, France (1989).
- 142) Stochastic Processes in Hydrology. International Workshop on Mathematical Modeling for Flow and Transport in Porous Media, Irsee, Bavaria, Federal Republic of Germany (1989).
- 143) Modern Approaches to Porous Media Transport Theory: Molecular to Field Scale. Molecular Science Research Center, PNL, Richland, WA (1988).
- 144) Recent Computational Results on Fluids in Micropores. Department of Chemical Engineering, Cornell University, Ithaca, NY (1988).
- 145) Theories of Stochastic Multiphase Processes. Mathematical Sciences Institute, Cornell University, Ithaca, NY, (1988).
- 146) Molecular-Scale Physics of Fluids Near Surfaces with Biotechnological and Soils Applications. USDA-ARS, Washington, DC (1988).
- 147) Stochastic PDE's for Transport in Heterogeneous Media. Applied Mathematics Research Center, Cornell University, Ithaca, NY (1988).

- 148) Structure and Dynamical Properties of Simple Fluids in Microporous Media. Illinois State Geological Survey, Champaign, IL (1987).
- 149) Applications of Stochastic Functional Analysis to Multiphase Transport. Society of Engineering Science, Salt Lake City, Utah (1987).
- 150) Organic Chemical Interaction with Clays. Department of Civil Engineering, University of Illinois, Urbana, IL (1986).
- 151) Organic and Water Interaction with Clays. Am. Inst. Ch. Eng., Chicago (1985).
- 152) Supercomputers in the Study of Clay-Organic-Water Interactions. WRRC-DOE Seminar on Supercomputers in Hydrology: Future Directions, Purdue University (1985).
- 153) Stochastic Filtering of Multiphase Transport Equations. International Union of Theoretical and Applied Mechanics Symposium on Multiphase Flow Through Heterogeneous Porous Materials. University of Waikata, New Zealand (1985).
- 154) Unifying Theories in Multiphase Transport. Department of Civil Engineering, Princeton University (1984).
- 155) Stochastic Problems in Porous Media Transport. Water Resources Program, Department of Civil Engineering, Princeton University, sponsored by DOE (1984).
- 156) Quantum and Statistical Mechanics for Clay Swelling; Preliminaries. NATO Advanced Study Institute on Mechanics of Fluids in Porous Media, University of Delaware (1982).
- 157) Toward a Theoretical Explanation of Swelling. Department of Hydrology, University of Arizona (1982).
- 158) Nutrient Movement and Absorption by Plants. ASA Symposium on Ion Transport (1981).
- 159) On the Proofs of the Volume Averaging Theorems for Multiphase Flow. Department of Environmental Engineering, Johns Hopkins University (1981).
- 160) Continuous Families of Finite Difference Schemes. Water Resources Program, Department of Civil Engineering, Princeton University (1980).
- 161) Analytical Modeling of Nutrient Movement to Roots. Department of Agronomy, Iowa State University (1980).

#### Conferences or Sessions Organized and Chaired

- 1) Supercomputers in Hydrology: Future Directions. West Lafayette, 1985.

- 2) Physics and Chemistry of Fluids Near Surfaces and Mass Transport. AGU Fall Meeting, San Francisco, 1987.
- 3) Hierarchy of Scales in Subsurface Transport. AGU Fall Meeting, San Francisco, 1988.
- 4) The Structure and Dynamics of Fluids in Microporous Media, Society for Industrial and Applied Mathematics, Houston, 1989.
- 5) Western Pacific Geophysical Meeting - Hydrology Section, Kanazawa, Japan, 1990.
- 6) Multiscale Transport in Porous Media, IMACS World Congress on Computational and Applied Math, Dublin, 1991.
- 7) Foundational Theories for Multiphase Mixtures, Soc. Eng. Sci., La Jolla, CA, 1992.
- 8) Hierarchical Problems, Mathematical and Computational Issues in Geosciences, Houston, Soc. Ind. Appl. Math, 1993.
- 9) Multiscale-Phenomena: Session on Mesoscale Processes, Gordon Conference, Procter Academy, 1994.
- 10) Multiscale Processes in Porous Media, Soc. Ind. Appl. Math, San Antonio, 1995.
- 11) Theoretical, Computational, and Experimental Modeling of Multiscale Phenomena in Porous Media, SIAM, Albuquerque, 1997.
- 12) Joint Canada, USA, Mexico Meeting on Applications of Physics to Porous Media, Puerto Vallarta, Mexico, 1999.
- 13) Joint Canada, USA, Mexico Meeting on Applications of Physics to Porous Media, Puerto Vallarta, Mexico, 2001.
- 14) European Geophysical Meeting Special Session on Nondestructive Methods for Porous Media, Nice, France, 2003.
- 15) Workshop on Modern Mathematical/Physical Tools that May Lead to Improved models in Subsurface Hydrology, NSF/Purdue University, 2003.
- 16) Joint Canada, USA, Mexico Meeting on Applications of Physics to Porous Media, Puerto Vallarta, Mexico, 2003.
- 17) North American Workshop on Applications of the Physics of Porous Media, Puerto Vallarta, Mx (2005)

- 18) North American Workshop on Applications of Physics to Porous Media, Puerto Vallarta, Mx (2007)
- 19) Statistical Mechanics in Geophysics and Environmental Sciences, International Conference in Statistical Physics, Kolympari, Crete, Greece (2008)
- 20) 4<sup>th</sup> Annual International Conference on Porous Media, Purdue (2012)
- 21) Electrochemistry of Nano-scale Porous Media at 5<sup>th</sup> Int. Meeting on Porous Media, Prague (2013).
- 22) From Geoscience to Industrial Applications: Frontiers of Flow and Transport in Porous Media, Fall AGU (2013).

#### NSF Sponsored Summer Schools Organized

2006 Summer School in Geophysical Porous Media: Multidisciplinary Science from Nano to Global Scale , Purdue University

#### Serves as Reviewer of Manuscripts for:

- 1) Computational Geosciences
- 2) Physical Review A
- 3) Physical Review E
- 4) Physical Review Letters
- 5) J. Solids and Structures
- 6) SIAM J Mult Mod Sim
- 7) Geothermics
- 8) J. Statistical Mechanics
- 9) Environmental Science and Technology
- 10) J Statistical Mechanics: Theory and Experiment
- 11) International Journal of Solids and Structures
- 12) Biotechnology and Bioengineering
- 13) Mathematical Geosciences
- 14) Computers and Chemical Engineering
- 15) Numerical Methods for PDE's
- 16) J. Fluid Mechanics
- 17) J. Chemical Physics
- 18) Physics of Fluids
- 19) Water Resources Research
- 20) Transport Theory and Statistical Physics
- 21) Soil Science Society of America Journal
- 22) International Journal of Numerical Methods in Fluids
- 23) International Journal of Numerical Methods in Engineering
- 24) J. Computational Physics
- 25) Agronomy Journal



- 26) J. Soil Science
- 27) J. Colloid and Interface Science
- 28) Plant and Soil
- 29) Transport in Porous Media
- 30) Advances in Water Resources
- 31) Chemical Engineering Science
- 32) SIAM Journal of Applied Mathematics
- 33) IMA Journal of Applied Mathematics
- 34) J. Stochastic Hydrology and Hydraulics
- 35) J. Numerical Functional Analysis and Optimization
- 36) Langmuir
- 37) Science
- 38) Int. J. Num. Meth. Eng.
- 39) Nature
- 40) National Science Foundation
- 41) Department of Energy
- 42) Department of Agriculture
- 43) BARD-US/ISRAEL
- 44) National Science Engineering Research Council, Canada
- 45) Army Research Office
- 46) National Science Foundation, Hong Kong

Served as Reviewer for Programs at:

- 1) Oak Ridge National Lab
- 2) Los Alamos National Lab
- 3) Pacific Northwest National Lab
- 4) Argonne National Lab

Courses Taught:

Mathematical Continuum Physics (Math/EAPS)  
 Stochastic Differential Equations (Math)  
 Geohydrology (EAPS)  
 Dinosaurs (EAS)  
 Stochastic Differential Equations (Math/EAPS)  
 Micromorphic Continuum Physics (Math/EAS)  
 Mathematics of Diffusion (Math/EAS)  
 Nonlinear Differential Equations (Math)  
 Introduction to Ordinary and Partial Differential Equations (Math)  
 Analysis of Spatial/Temporal processes in Geophysics (EAS)  
 Spatial Variability (Math/EAS)  
 Mathematical Tools for Upscaling (Math/EAS)  
 Controlled Release (Math)  
 Polar Field Theories (Math)  
 Numerical Statistical Mechanics (Math)

Dispersion in Porous Media (Chem Eng/Math)  
 Advanced Topics in Continuum Mechanics (Math)  
 Stochastic Hydrology (Math/Civil Eng)  
 Continuum and Statistical Mechanics of Elasticity (Math)  
 Stochastic Transport Processes (Math/Agri Bio Eng)  
 Physics of Fluids in Porous Media (Agron/Civil Eng)  
 Advanced Soil Physics (Agron)  
 Stochastic Soil Physics (Agron/ Agr Biol Eng)  
 Multiphase Transport (Agron)  
 Numerical Methods in Hydrology (Agron/ Civil Eng)  
 Statistical Mechanics with Applications to Clay-Water Systems (Agron)  
 Soil Physical Properties (Agron)

## SERVICE

From 1984 to 1988 Dr. Cushman served as the Director of the Indiana Water Resources Research Center. His administrative responsibilities included 1) receive, disburse, account for and report on federal funds received; 2) administer and conduct research, investigations, technology transfer, and related activities as submitted to and approved by OWP; 3) provide an organized forum for the discussion and exchange of information among scholars and scientists; 4) provide the mechanism to promote the free and continuous exchange of information among teachers and workers, leaders of industry, agriculture, and private citizens and to encourage exchange of information between public and private research laboratories and state and federal agencies; 5) seek funding via proposals to industrial, state, and federal institutions.

## Current Graduate Students and Post Docs:

M. Park	EAPS	Advisor	Post Doc
G. Johnson	Mathematics	Major Professor	Ph.D.
M. Mueterthies	Physics	Co-major Professor	Ph.D.