

# CURRICULUM VITAE

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## Michael A. Celia

*Theodora Shelton Pitney Professor of Environmental Studies  
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### EDUCATION:

- Ph.D., Civil Engineering, Princeton University, 1983.
- M.A., Civil Engineering, Princeton University, 1981.
- M.S., Civil Engineering, Princeton University, 1979.
- B.S., Civil Engineering, Lafayette College, 1978.

### POSITIONS HELD:

- Director, Princeton Environmental Institute, Princeton University, 2017-Present.
- Theodora Shelton Pitney Professor of Environmental Studies, 2008-Present.
- Professor of Civil and Environmental Engineering, Princeton University, 1997-Present.
- Director, Program in Environmental Engineering and Water Resources, Princeton University, 2013-2017.
- Chair, Department of Civil and Environmental Engineering, 2005-2011.
- Director, Program in Environmental Studies, 1998-2004.
- Director, Program in Environmental Engineering and Water Resources, Princeton University, 1997-2003.
- Associate Professor of Civil Engineering, Princeton University, 1993-1997.
- Assistant Professor of Civil Engineering, Princeton University, 1989-1993.
- Assistant Professor of Civil Engineering, M.I.T., 1985-1989.
- Lecturer, Dept. of Civil Engineering, Princeton University, 1984-1985.
- Research Associate, Dept. of Civil Engineering, Princeton University, 1983-1984.

### RESEARCH INTERESTS:

Groundwater Hydrology, Geological Sequestration of Carbon Dioxide, Simulation Methods for Multi-phase Flow in Porous Media, Studies of Methane Leakage from Abandoned Oil and Gas Wells, Contaminant Transport Simulations

### HONORS AND AWARDS:

- Distinguished Teacher Award, School of Engineering and Applied Sciences, Princeton University, 2017.
- Elected to the US National Academy of Engineering, 2016 (Citation: *For contributions to the development of subsurface flow and transport models in groundwater remediation and CO<sub>2</sub> sequestration*).
- Darcy Visiting Professorship, jointly at Utrecht University and the Technical University of Eindhoven, 2016-2017.
- Graduate Mentoring Award, Princeton University, 2016.
- 2015 Argyris Visiting Professorship awarded by the University of Stuttgart, including the inaugural Argyris Honorary Lecture, given 8 July 2015.
- 2014 Honorary Lifetime Membership Award, International Society of Porous Media (Interpore), presented May 2014.
- 2012 Hydrology Days Award, presented March 2012.
- Named to List of Best Reviewers from 2007-2011, *International Journal for Greenhouse Gas Control*, 2012.
- EWRI Pioneers in Groundwater Lecturer, American Society of Civil Engineers, 2010.
- Elected Fellow of the American Association for the Advancement of Science (AAAS), 2008.
- Named Theodora Shelton Pitney Professor of Environmental Studies, 2008-Present.

- Darcy Lecturer, National Ground Water Association, 2008 (Lecture Title: *Geological Storage as a Carbon Mitigation Option*; the lecture was given at 52 different venues in 12 countries across North America, Europe, Asia, and Australia).
- Engineering Council Award for Outstanding Teaching, Princeton University, 2008.
- One of many IPCC contributing authors who share in the 2007 Nobel Peace Prize (Contributing author to IPCC Working Group III *Special Report on Carbon Dioxide Capture and Storage*).
- Hydrologic Sciences Award, American Geophysical Union, 2005 (Award citation: *For fundamental research contributions to subsurface hydrology and numerical methods in water resources, and for providing a model of Academia at its best*).
- Fulbright Fellowship, 2003-2004 (*Sabbatical leave at the University of Bergen*).
- Elected Fellow of the American Geophysical Union, 2000.
- Howard B. Wentz, Jr. '52 Faculty Award in Engineering, Princeton University, 1992.
- Harold Willis Dodds Presidential Preceptorship, Princeton University, 1989–1992.
- Presidential Young Investigator Award, National Science Foundation, 1987–1992.
- Edgerton Endowed Junior Faculty Chair, M.I.T., 1987-1989
- Excellence in Teaching Award, Dept. of Civil Engineering, M.I.T., 1987.
- George van Ness Lothrop Honorary Fellowship, Princeton University, 1981-1982.

## PROFESSIONAL SOCIETIES:

American Geophysical Union, American Society of Civil Engineers, American Association for the Advancement of Science, National Ground Water Association, International Society for Porous Media (Interpore), Phi Beta Kappa, Tau Beta Pi

## PROFESSIONAL SERVICE:

- Member, External Advisory Committee, International Institute for Carbon-Neutral Energy Research, Kyushu University, Japan, 2015-Present.
- Member, Academic Advisory Council, Petronas Technical University, Malaysia, 2015-Present.
- Member, Interpore Honors and Awards Committee, 2014-Present.
- Member, TOTAL (the French oil company) Scientific Advisory Board for CCUS, 2017-Present.
- Member, Advisory Board for CO<sub>2</sub> Capture Project (Phases 2, 3, and 4), 2010-Present.
- Member, Scientific Advisory Board, In Salah CO<sub>2</sub> Injection Project, BP, 2006-2014.
- Member, Science Advisory Committee, Environmental Molecular Sciences Laboratory (EMSL), Pacific Northwest National Laboratory, 2013-2016.
- Chair, Selection Committee for AGU Hydrologic Sciences Award, 2006-2008; 2011-2014.
- Member, International Scientific Committee, Second International Conference on Nonlinearities and Upscaling in Porous Media, Bergen, Norway, 2013.
- Member, Organizing Committee, Joint Meeting of the IEA Wellbore Integrity Network and IEA Modeling Network, Perth, Australia, 2011.
- Chair, Interpore Honors and Awards Committee, 2009-2011.
- Member, SIAM Geosciences Award Selection Committee, 2008-2010.
- Member, NGWA Darcy Lecturer Selection Committee, 2008-2011.
- Member, Organizing Committee, IEA Wellbore Integrity Network Workshops, 2007, 2008, 2009, 2010, 2013.
- Member, Organizing Committee, Svalbard Workshop on Modeling and Risk Assessment of Geological Storage of CO<sub>2</sub>, Svalbard, Norway, August 2009.
- Member, Organizing Committee, Workshop on Numerical Models for Carbon Dioxide Storage in Geological Formations, University of Stuttgart, April 2008.
- Member, NGWA Committee for CCS Injection Regulation Review, January-December 2008.
- Co-leader, Panel on Carbon-related Research, DOE Workshop on Basic Research Needs in Geosciences, 2006-2007.
- Member, Editorial Board, *IES Journal A: Civil and Structural Engineering*, 2006-Present.
- Member, Expert Review Panel, International Energy Agency, Weyburn Phase II Project, Regina, Canada 2006-2009.

- Member, Advisory Board of the Geological Storage Certification Framework Project (a CCP2 Project), 2006-2008.
- Member, Expert Panel on Groundwater and Vadose-zone Modeling at Hanford, Dept. of Energy, 2006.
- Local Organizer, IEA Wellbore Integrity Workshop, Princeton, March 2006.
- Member, Symposium Advisory Board, International Symposium on Site Characterization for CO<sub>2</sub> Geological Storage, Lawrence Berkeley Laboratory, March 2006.
- External Examiner for Civil Engineering Program, Technical University of Petronas, Malaysia, 2005-2008.
- Member, External Advisory Board, Department of Civil and Environmental Engineering, Lafayette College, 2005-Present.
- Member, Review Panel for Hydrologic Sciences Program, NSF, 2001-2005.
- Member, Review Panel for Earth Sciences Division, Lawrence Berkeley Laboratory, 2002.
- Member, Editorial Board, *Advances in Water Resources*, 1997-2012.
- Co-organizer of special session: "Thirty-Five Years of Groundwater Modeling: A Tribute to George F. Pinder", AGU Meeting, Fall 2001.
- Co-organizer of special session on "Eulerian-Lagrangian Localized Adjoint Methods", XIII International Conference on Computational Methods in Water Resources, Calgary, Canada, June 2000.
- Member, Langbein Lecture Award Committee, American Geophysical Union, 1998 - 2000.
- Member, Committee of Visitors (evaluation committee) for the Division of Earth Sciences at NSF, 1998.
- Member of the Organizing Committee for Water Quality '98, Tuebingen, Germany, September 1998.
- Member of the Advisory Committee for the International Workshop on Characterization and Measurement of Hydraulic Properties of Unsaturated Soils, Riverside, CA, October 1997.
- Co-Editor, *Advances in Water Resources*, 1987-1997.
- Chair for Gordon Conference on *Modeling of Flow in Permeable Media*, 1996.
- Vice Chair for Gordon Conference on *Modeling of Flow in Permeable Media*, 1994.
- Member of the Organizing Committee for the *SIAM* Conference on Mathematical and Computational Issues in the Geosciences, held in Houston, April 1993.
- Member, Groundwater Hydrology Committee, American Geophysical Union (1988-1992).
- Organizer of symposium on "Modeling Fluid Flow and Contaminant Transport in Heterogeneous Porous Media," *SIAM* Geosciences Conference, April 1993.
- Organizer of special session "Recent Advances in Numerical Modeling of Contaminant Transport," AGU Fall Meeting, 1989.
- Co-organizer of special session "Pore-scale Models for Multiphase Flow in Porous Media," AGU Spring Meeting, 1989.
- Local organizer for Seventh Int'l. Conference on Computational Methods in Water Resources, M.I.T., June 1988.
- Principal lecturer in the short course "Fundamentals of Unsaturated Zone Modeling," Princeton University, July 1990, June 1991, January 1993.
- Principal lecturer in the short course "Groundwater Contaminant Transport Modeling," Princeton University Jan. 1985-1990; U. of Vermont, Jan. 1991.

## UNIVERSITY SERVICE

- Director, Princeton Environmental Institute (2017-Present).
- Director, Program in Environmental Engineering and Water Resources (2013-2017).
- Chair, Department of Civil and Environmental Engineering (2005-2011)
- Member, Executive Committee, Princeton Environmental Institute (1996-Present)
- Member, Executive Committee, Program in Environmental Studies (2004-Present)
- Member, Executive Committee, Program in Urban Studies (2006-Present)
- Member, Executive Committee, Program in Architecture and Engineering (2006-Present)
- Member, Princeton Sustainability Steering Council (2017-Present).
- Member, Princeton Committee on the Future of Climate Research (2008-2010)
- Member, University Priorities Committee (2004-2007)
- Director of Graduate Studies, Civil and Environmental Engineering Department (2004-2005)
- Director, Program in Environmental Studies (1998-2004)
- Director, Program in Environmental Engineering and Water Resources (1997-2003)

- Chair, School of Engineering and Applied Science Committee on Environmental Engineering (1997-1999)
- Member, Curriculum Committee, Princeton Environmental Institute (1997-1998)
- Member, University Course of Study Committee (1994-1997)
- Chair, Committee to define and implement the new university-wide Quantitative Reasoning course requirement (1995-1997)
- Departmental Representative for Department of Civil Engineering and Operations Research (responsible for all aspects of undergraduate affairs; 1992-1995)
- Member, Culpeper Awards Committee (1995)
- Member, University Teaching Awards Committee (1995)
- Member, Engineering Physics Committee (1992-1995)

## LIST OF PUBLICATIONS

1. Pinder, G.F., E.O. Frind, and M.A. Celia, "Groundwater Flow Simulation using Collocation Finite Elements," *Proc. Second Int. Conf. Finite Elements in Water Resources*, Brebbia et al. (eds.), 1.171-1.185, Pentech Press, 1978.
2. Celia, M.A., G.F. Pinder, and L.J. Hayes, "Alternating Direction Collocation Simulation to the Transport Equation," *Proc. Third Int. Conf. Finite Elements in Water Resources*, Wang et al. (eds.), 3.36-3.48, Univ. of Miss., 1980.
3. Pinder, G.F., M.A. Celia, and W.G. Gray, "[Velocity Calculations from Randomly Located Hydraulic Heads.](#)" *Groundwater*, 19(3), 262-264, 1981.
4. Hayes, L.J., G.F. Pinder, and M.A. Celia, "[Alternating-Direction Collocation for Rectangular Regions.](#)" *Computer Methods in Applied Mechanics and Engineering*, 27(3), 265-277, 1981.
5. Celia, M.A. and G.F. Pinder, "Transport Simulation using Three-dimensional Alternating Direction Collocation," *Proc. Fourth Int. Conf. Finite Elements in Water Resources*, Holz et al. (eds.), 14.9-14.19, Springer-Verlag, 1982.
6. Celia, M.A., *Collocation on Deformed Finite Elements and Alternating Direction Collocation Methods*, Ph.D. Dissertation, Princeton University, 1983.
7. Celia, M.A. and W.G. Gray, "[An Improved Isoparametric Transformation for Finite Element Analysis.](#)" *International Journal for Numerical Methods in Engineering*, 20(8), 1443-1459, 1984.
8. Celia, M.A., "Density-dependent Transport Simulation using Alternating Direction Collocation," *Bull. Inst. Groundwater Studies*, 12, (Bloemfontein, South Africa), 1984.
9. Celia, M.A. and G.F. Pinder, "Collocation Solution of the Transport Equation using a Locally Enhanced Alternating Direction Formulation," Chapter 13, *The Unification of Finite Elements, Finite Differences, and Calculus of Variations*, Kardestuncer (ed.), 303-320, North-Holland, 1984.
10. Celia, M.A. and G.F. Pinder, "[An Analysis of Alternating-Direction Methods for Parabolic Equations.](#)" *Numerical Methods for Partial Differential Equations*, 1(1), 57-70, 1985.
11. Celia, M.A. and W.G. Gray, "[Improved Coordinate Transformations for Finite Elements: The Lagrange Cubic Case.](#)" *International Journal for Numerical Methods in Engineering*, 23(8), 1529-1545, 1986.
12. Celia, M.A., W.G. Gray, and L.A. Ferrand, "A Preprocessor for the Improved Isoparametric Element," *Proc. Sixth Int. Conf. Finite Elements in Water Resources*, Sa da Costa et al. (eds.), 735-746, Springer-Verlag, 1986.
13. Celia, M.A. and G.F. Pinder, "An Alternating-Direction Collocation Solution for the Unsaturated Flow Equation," *Proc. Sixth Int. Conf. Finite Elements in Water Resources*, Sa da Costa et al. (eds.), 395-410, Springer-Verlag, 1986.
14. Celia, M.A. and I. Herrera, "[Solution of General Ordinary Differential Equations using the Algebraic Theory Approach.](#)" *Numerical Methods for Partial Differential Equations*, 3(2), 117-129, 1987.
15. Celia, M.A., L.R. Ahuja, and G.F. Pinder, "[Orthogonal Collocation and Alternating-Direction Methods for Unsaturated Flow.](#)" *Advances in Water Resources*, 10(4), 178-187, 1987.

16. Hess, K., S. Wolf, D.R. LeBlanc, S.P. Garabedian, and M.A. Celia, "Natural-Gradient Tracer Test in Sand and Gravel: Preliminary Results of Laboratory and Field Measurements of Hydraulic Conductivity," *Proc. Third Tech. Meeting U.S.G.S. Program on Toxic Waste - Groundwater Contamination (USGS Open File report 87-109)*, B23-B24, 1987.
17. Celia, M.A., L.A. Ferrand, C.A. Brebbia, W.G. Gray, and G.F. Pinder, (editors), *Computational Methods in Water Resources, Volume 1: Modeling Surface and Subsurface Flows*, Proceedings of the Seventh International Conference, 389 pp., Elsevier, 1988.
18. Celia, M.A., L.A. Ferrand, C.A. Brebbia, W.G. Gray, and G.F. Pinder, (editors), *Computational Methods in Water Resources, Volume 2: Numerical Methods for Transport and Hydrologic Processes*, Proceedings of the Seventh International Conference, 465 pp., Elsevier, 1988.
19. Celia, M.A. and L.A. Ferrand, "Parameter Estimation for Multiphase Porous Media Systems," *Invited Paper, Proc. ASCE National Conf. on Hydraulic Engineering*, 558-563, 1988.
20. Celia, M.A. and E.T. Bouloutas, "Analysis of Optimal Test Function Methods for Advection-Dominated Flows," *Invited Paper, Proc. Int. Conf. on Computational Engineering Science*, Atluri and Yagawa (eds.), pp. 50.iii.1-50.iii.4, Springer-Verlag, 1988.
21. Celia, M.A. and R. Zarba, "A Comparative Study of Numerical Solutions for Unsaturated Flow," *Invited Paper, Proc. Int. Conf. on Computational Engineering Science*, Atluri and Yagawa (eds.), pp. 58.ii.1-58.ii.4, Springer-Verlag, 1988.
22. Soll, W.E., L.A. Ferrand, and M.A. Celia, "An Enhanced Percolation Model for the Capillary Pressure-Saturation Relation," *Proc. Seventh Int. Conf. Comp. Meth. Water Resources, Vol. 1: Modeling Surface and Subsurface Flows*, Celia et al. (eds.), 165-171, Springer, 1988.
23. Bouloutas, E.T. and M.A. Celia, "An Analysis of Some Classes of Petrov-Galerkin and Optimal Test Function Methods," *Proc. Seventh Int. Conf. Comp. Meth. Water Resources, Vol. 2: Numerical Methods for Transport and Hydrologic Processes*, Celia et al. (eds.), 15-20, Springer, 1988.
24. Herrera, I. and M.A. Celia, "Localized Adjoint methods as a New Approach to Advection Dominated Flows," *Proc. National/International Conf. on Adv. in Groundwater*, Tampa, Fla, November 1988.
25. Garabedian, S.P., L.W. Gelhar, and M.A. Celia, "Large-scale Dispersive Transport in Aquifers: Field Experiments and Reactive Transport Theory," Parsons Lab Report 315, R88-01, M.I.T., 1988.
26. Hess, K., S. Wolf, and M.A. Celia, "Spatial Variability of Hydraulic Conductivity in a Sand and Gravel Aquifer, Cape Cod, Massachusetts," *Proc. Fourth Tech. Meeting, USGS Program on Toxic Waste - Groundwater Contamination*, 1988.
27. Celia, M.A., I. Herrera, E.T. Bouloutas, and J.S. Kindred, "[A New Numerical Approach for the Advection-Diffusion Transport Equation](#)," *Numerical Methods for Partial Differential Equations*, 5(3), 203-226, 1989.
28. Celia, M.A., J.S. Kindred, and I. Herrera, "[Contaminant Transport and Biodegradation: 1. A Numerical Model for Reactive Transport in Porous Media](#)," *Water Resources Research*, 25(6), 1141-1148, 1989.
29. Kindred, J.S. and M.A. Celia, "[Contaminant Transport and Biodegradation: 2. Conceptual Model and Test Simulations](#)," *Water Resources Research*, 25(6), 1149-1160, 1989.
30. Soll, W.E. and M.A. Celia, "Pore-scale Modeling of Immiscible Three-Phase Flow in Porous Media," *Proc. Multiphase Transport in Porous Media Symposium, ASME Winter Meeting*, December 1989.
31. Herrera, I. and M.A. Celia, "Advances in the Simulation of Steep Fronts," *Finite Element Analysis in Fluids*, Chung and Karr (eds.), 965-970, UAH Press, 1989.
32. Celia, M.A., I. Herrera, and E.T. Bouloutas, "Adjoint Petrov-Galerkin Methods for Multi-dimensional Flow Problems," *Finite Element Analysis in Fluids*, Chung and Karr (eds.), 953-958, UAH Press, 1989.
33. Ferrand, L.A. and M.A. Celia, "Development of a Three-Dimensional Network Model for Quasi-Static Immiscible Displacement," *Proc. Int. Symp. on Contaminant Transport in Groundwater*, Kobus and Kinzelbach (eds.), A.A. Balkema (Rotterdam), 397-403, 1989.

34. Bouloutas, E.T. and M.A. Celia, "Efficient Finite Element Methods for Modeling Fluid Flow in Partially Saturated Porous media," *Proc. Fifth Int. Symp. Num. Meth. in Eng.*, Gruber et al. (eds.), Springer, 673-678, 1989.
35. Gray, W.G. and M.A. Celia, "On the Use of Generalized Functions in Engineering Analysis," *Int. J. of Applied Engineering Education*, 6(1), 89-96, 1990.
36. Celia, M.A. and G.F. Pinder, "[Generalized alternating-direction collocation methods for parabolic equations. I. Spatially varying coefficients.](#)" *Numerical Methods for Partial Differential Equations*, 6(3), 193-214, 1990.
37. Celia, M.A. and G.F. Pinder, "[Generalized alternating-direction collocation methods for parabolic equations. II. Transport equations with application to seawater intrusion problems.](#)" *Numerical Methods for Partial Differential Equations*, 6(3), 215-230, 1990.
38. Celia, M.A. and G.F. Pinder, "[Generalized alternating-direction collocation methods for parabolic equations. III. Nonrectangular domains.](#)" *Numerical Methods for Partial Differential Equations*, 6(3), 231-243, 1990.
39. Celia, M.A., E.T. Bouloutas, and R.L. Zarba, "[A General Mass-Conservative Numerical Solution for the Unsaturated Flow Equation.](#)" *Water Resources Research*, 26(7), 1483-1496, 1990.
40. Celia, M.A., T.F. Russell, I. Herrera, and R.E. Ewing, "[An Eulerian-Lagrangian Localized Adjoint Method for the Advection-Diffusion Transport Equation.](#)" *Advances in Water Resources*, 13(4), 187-206, 1990.
41. Ferrand, L.A., M.A. Celia, and W.E. Soll, "Percolation-Based Models for Pore-to-Lab-Scale Calculations in Multifluid Porous media," Chapter XVI in *Dynamics of Fluids in Hierarchical Porous Formations*, Cushman (ed.), Academic Press, 463-483, 1990.
42. Celia, M.A. and S. Zisman, "An Eulerian-Lagrangian Localized Adjoint Method for Reactive Transport in Groundwaters," *Invited Paper, Proc. Eight Int. Conf. Comp. Meth. Water Resources*, Gambolati et al. (eds.), Springer, 383-392, 1990.
43. Ferrand, L.A. and M.A. Celia, "A Numerical Investigation of the Effects of Heterogeneity on the Pressure-Saturation Relation," *Proc. Eight Int. Conf. Comp. Meth. Water Resources*, Gambolati et al. (eds.), Springer, 181-186, 1990.
44. Celia, M.A., E.T. Bouloutas, and P. Binning, "Numerical Modeling of Nonlinear Flows in Porous Media," *Proc. Eight Int. Conf. Comp. Meth. Water Resources*, Gambolati et al. (eds.), Springer, 145-151, 1990.
45. Ewing, R.E. and M.A. Celia, "Multiphase Flow Simulation in Groundwater Hydrology and Petroleum Engineering," *Invited Paper, Proc. Eight Int. Conf. Comp. Meth. Water Resources*, Gambolati et al. (eds.), Springer, 195-204, 1990.
46. Garabedian, S.P., D.R. LeBlanc, L.W. Gelhar, and M.A. Celia, "[Large-scale Natural Gradient Tracer Test in Sand and Gravel, Cape Cod, Massachusetts: 2. Analysis of Spatial Moments for a Nonreactive Tracer.](#)" *Water Resources Research*, 27(5), 911-924, 1991.
47. Wolf, S.H., M.A. Celia, and K. Hess, "[Evaluation of Hydraulic Conductivities Calculated from Multiport-Permeameter Measurements.](#)" *Ground Water*, 29(4), 516-525, 1991.
48. Bouloutas, E.T. and M.A. Celia, "[An Improved Cubic Petrov-Galerkin Method for Simulation of Transient Advection-Diffusion Processes in Rectangularly Decomposable Domains.](#)" *Computer Methods in Applied Mechanics and Engineering*, 92(3), 289-308, 1991.
49. LeBlanc, D.R. and M.A. Celia, "Density-Induced Downward Movement of Solutes During a Natural-Gradient Tracer Test, Cape Cod, Massachusetts," in *U.S.G.S. Toxic Substances Hydrology Program: Proc. of the Technical Meeting*, Mallard (ed.), Monterrey, CA, March 11-15, 1991, 1991.
50. LeBlanc, D.R., D.L. Rudolph, R.G. Kachanoski, and M.A. Celia, "Design and Operation of an Infiltration Experiment in the Unsaturated Zone, Cape Cod, Massachusetts," in *U.S.G.S. Toxic Substances Hydrology Program: Proc. of the Technical Meeting*, Mallard (ed.), Monterrey, CA, March 11-15, 1991, 1991.
51. Hess, K.M., S.H. Wolf, and M.A. Celia, "Estimation of Macrodispersivities from the Spatial Variability of Hydraulic Conductivity in a Sand and Gravel Aquifer, Cape Cod, Massachusetts," in *U.S.G.S. Toxic Substances Hydrology Program: Proc. of the Technical Meeting*, Mallard (ed.), Monterrey, CA, March 11-15, 1991, 1991.



52. Hess, K.M., S.H. Wolf, M.A. Celia, and S.P. Garabedian, *Macrodispersion and Spatial Variability of Hydraulic Conductivity in a Sand and Gravel Aquifer, Cape Cod, Massachusetts*, EPA Environmental Research Brief EPA/600/M-91/005, 1991.
53. Celia, M.A. and W.G. Gray, *Numerical Methods for Differential Equations: Fundamental Concepts for Scientific and Engineering Applications*, Prentice Hall, 436 pp., 1992.
54. Celia, M.A. and W.G. Gray, *Solution Guide to accompany "Numerical Methods for Differential Equations,"* 90 pp., 1992.
55. Ferrand, L.A. and M.A. Celia, "[The Effect of Heterogeneity on the Drainage Capillary Pressure - Saturation Relation.](#)" *Water Resources Research*, 28(3), 859-870, 1992.
56. Hess, K.M., S.H. Wolf and M.A. Celia, "[Large-scale natural gradient tracer test in sand and gravel, Cape Cod, Massachusetts: 3. Hydraulic conductivity variability and calculated macrodispersivities.](#)" *Water Resources Research*, 28(8), 2011-2027, 1992.
57. Celia, M.A. and P. Binning, "[A Mass-Conservative Numerical Solution for Two-Phase Flow in Porous Media with Application to Unsaturated Flow.](#)" *Water Resources Research*, 28(10), 2819-2828, 1992.
58. Soll, W.E., M.A. Celia, and J.L. Wilson, "Quantitative Comparison of Computational and Experimental Models for Three-Phase Immiscible Transport," *Subsurface Contamination by Immiscible Fluids*, K.U. Weyer (ed.), A.A. Balkema, Rotterdam, 229-238, 1992.
59. Celia, M.A. and L.A. Ferrand, "A Percolation-Based Model for the Soil Water Retention Function," *Indirect Methods for Estimating the Hydraulic Properties of Unsaturated Soils*, van Genuchten and Leij (eds.), University of California, Riverside, 71-79, 1992.
60. Celia, M.A. and P. Binning, "Multiphase Models of Unsaturated Flow: Approaches to the Governing Equations and Numerical Methods," Invited Paper, *Computational Methods in Water Resources IX Vol. 2: Mathematical Modeling in Water Resources* (Russell et al., eds.), Elsevier Applied Science, 257-272, 1992.
61. Forkel, C. and M.A. Celia, "Numerical Simulation of Unsaturated Flow and Contaminant Transport with Density and Viscosity Dependence," *Computational Methods in Water Resources IX Vol. 2: Mathematical Modeling in Water Resources* (Russell et al., eds.), Elsevier Applied Science, 351-358, 1992.
62. Ewing, R.E. and M.A. Celia, "Numerical Methods for Reactive Transport and Biodegradation," *Computational Methods in Water Resources IX Vol. 1: Numerical Methods in Water Resources* (Russell et al., eds.), Elsevier Applied Science, 51-58, 1992.
63. Guarnaccia, J.F., P.T. Imhoff, B.C. Missildine, M. Oostrom, M.A. Celia, J.H. Dane, P.R. Jaffe, and G.F. Pinder, *Multiphase Chemical Transport in Porous Media*, EPA Environmental Research Brief EPA/600/S-92/002, 1992.
64. Celia, M.A., H. Rajaram, and L.A. Ferrand, "[A Multi-Scale Computational Model for Multiphase Flow in Porous Media.](#)" *Advances in Water Resources*, 16(1), 81-92, 1993.
65. Soll, W.E. and M.A. Celia, "[A Modified Percolation Approach to Simulating Three-Fluid Capillary Pressure-Saturation Relationships.](#)" *Advances in Water Resources*, 16(2), 107-126, 1993.
66. Soll, W.E., M.A. Celia, and J.L. Wilson, "[Micromodel Studies of Three-Fluid Porous Media Systems: Pore-Scale Processes relating to Capillary Pressure-Saturation Relationships.](#)" *Water Resources Research*, 29(9), 2963-2974, 1993.
67. Herrera, I., R.E. Ewing, M.A. Celia, and T.F. Russell, "[Eulerian-Lagrangian Localized Adjoint Methods: The Theoretical Framework.](#)" *Numerical Methods for Partial Differential Equations*, 9(4), 431-458, 1993.
68. Sweed, H.G., P. Binning, and M.A. Celia, *Vapor Phase Transport of Low-Level Radioactive Waste in the Unsaturated Zone*, Water Resources Program Report, Princeton University, 1993.
69. Celia, M.A. and L.A. Ferrand, "A Comparison of ELLAM Formulations for Simulation of Reactive Transport in Groundwater," Invited Paper, *Proc. 1993 Intl. Conf. on Hydrosience and Engineering*, Wang, S.Y.Y. (ed.), University of Mississippi, 1829-1836, 1993.

70. Ewing, R.E., M.A. Celia, P. O'Leary, J. Pasciak, and A. Vassilev, "Parallelization of Multiphase Models for Contaminant Transport in Porous Media," *Proc. SIAM Conf. on Parallelization*, 1993.
71. Celia, M.A., "Eulerian-Lagrangian Localized Adjoint Methods for Contaminant Transport Simulations," Featured Paper, *Proc. X Int. Conf. Computational Methods in Water Resources*, Peters et al. (Eds.), Kluwer Publ., 207-216, 1994.
72. Ferrand, L.A., M.A. Celia, H. Rajaram, and P.C. Reeves, "A Pore-scale Algorithm for Simulation of Dissolution in Porous Media," *Proc. X Int. Conf. Computational Methods in Water Resources*, Peters et al. (Eds.), Kluwer, 457-464, 1994.
73. Binning, P. and M.A. Celia, "Two-dimensional Eulerian-Lagrangian Localized Adjoint Method for the Solution of the Contaminant Transport Equation in the Saturated and Unsaturated Zones," *Proc. X Int. Conf. Computational Methods in Water Resources*, Peters et al. (Eds.), Kluwer Publ., 165-172, 1994.
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231. Bandilla, K.W., B. Guo, and M.A. Celia, “[Applicability of Vertically Integrated Models for Carbon Storage in Structured Heterogeneous Domains](#)”, *Energy Procedia*, 114, 3312-3321, 2017.
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233. Edwards, R.W.J., F. Doster, M.A. Celia, and K.W. Bandilla, “[Numerical Modeling of Gas and Water Flow in Shale Gas Formations with a Focus on the Fate of Hydraulic Fracturing Fluids](#)”, *Env. Sci. and Tech.*, 51, 13779-13787, 2017.
234. Becker, B., B. Guo, K. Bandilla, M.A. Celia, B. Flemisch, and R. Helmig, “[A Pseudo Vertical Equilibrium Model for Slow Gravity Drainage Dynamics](#)”, *Water Resources Research*, 53, <https://doi.org/10.1002/2017WR021644>, 2017.

### INVITED PRESENTATIONS (LAST 5 YEARS)

- Multi-scale Modeling Approaches for CO<sub>2</sub> Injection, Migration, and Leakage*  
TNO, Utrecht, The Netherlands, January 2012.
- Multi-scale Modeling for CO<sub>2</sub> injection into Deep Saline Aquifers*  
CASA Program, Technical University of Eindhoven, The Netherlands, January 2012.
- Modeling Options for Multi-phase Flows in Porous Media*  
Institute for Computational Physics, University of Stuttgart, February 2012.
- Reflections of Performance Assessment Activities in CO<sub>2</sub>ReMoVe Project*  
IFP Energies Nouvelles, Rueil-Malmaison, France, February 2012.
- Review Comments on Subsurface Modeling*  
“Fracking Technology for the Extraction of Natural Gas from Unconventional Reservoirs – Criteria for Safety and Environmental Compatibility”, Scientific Status Conference of the Neutral Expert Group in the Info Dialogue on Fracking, Berlin, Germany, March 2012.
- Multi-scale Models for CO<sub>2</sub> Injection into Deep Saline Aquifers*  
Hydrology Days Award Lecture, Colorado State University, March 2012.
- Modeling Options for Multi-phase Flows in Porous media*  
Workshop for 60<sup>th</sup> Birthday of S. Majid Hassanizadeh, Poros, Greece, April 2012.
- Sustainability, Energy, and Civilization: Issues and Options*  
Opening Keynote Lecture, World Engineering, Science, and Technology Congress (ESTCON), Kuala Lumpur, Malaysia, June 2012.
- Practical Multi-scale Models for Large-scale CO<sub>2</sub> Sequestration*  
Opening Plenary Lecture, 19<sup>th</sup> International Conference on Computational Methods in Water Resources, Univ. of Illinois, June 2012.
- Multi-scale Modeling and Model Complexity in CO<sub>2</sub> Sequestration Simulations*  
Special Session titled “Advances in Geochemical and Hydrogeological Studies of CO<sub>2</sub> Fate and Transport at Geological CO<sub>2</sub> Sequestration Sites”, AGU Fall Meeting, December 2012.
- Geochemistry in Pore Network Models*  
Shell Research Center, Rijswijk, The Netherlands, January 2013.

*Can We Live Sustainably?*

Annual Conference on Renewable Energy, University of Bergen, Norway, April 2013.

*Practical Multi-scale Models for Large-scale CO<sub>2</sub> Sequestration*

Penn State University, April 2013.

*Dynamics and Hysteresis in Two-phase Flows over Different Scales*

University of Utrecht, The Netherlands, May 2013.

*Hysteresis and Trapping in a Two-phase Pore network Model*

Invited lecture, Annual Interpore Conference, Prague, Czech Republic, May 2013.

*Can CCS Find Synergies with Geothermal Energy and Shale Gas?*

Bi-annual SIAM Geosciences Conference, Padova, Italy, June 2013.

*The Oil and Gas Industry in a Carbon-constrained World*

Skolkovo Institute of Science and Technology, Moscow, Russia, July 2013.

*Geological Carbon Storage: Models for Leakage Risk and Large-scale Deployment*

American Chemical Society National Meeting, Indianapolis, Indiana, September 2013.

*Geological Carbon Storage: Models for Leakage Risk and Large-scale Deployment*

University of Wyoming, September 2013.

*Some Thoughts on Saturation Overshoot*

Utrecht University, Utrecht, The Netherlands, November 2013.

*Computational Investigation of Carbon Dioxide Injection into Depleted Shale Gas Formations*

Interpore Conference, Milwaukee, Wisconsin, USA, May 2014.

*Computational Models for Subsurface Flows: Four Decades of Advances as Reflected in the FEWR/CMWR Conference Series*

20<sup>th</sup> International Conference on Computational Methods in Water Resources, Stuttgart, Germany, June 2014.

*Geological Carbon Storage: Models for Injection, Migration, and Leakage*

Department of Mathematical Sciences, Fudan University, Shanghai, China, July 2014.

*Practical Multi-scale Models for Large-scale CO<sub>2</sub> Sequestration*

Department of Mathematics, Shandong University, Jinan, China, July 2014.

*Practical Multi-scale Models for Large-scale CO<sub>2</sub> Sequestration*

Department of Mathematical Sciences, Shandong Normal University, Jinan, China, July 2014.

*Greenhouse Gases: Engineering Solutions (CO<sub>2</sub>) and Source Characterization (CH<sub>4</sub>)*

Workshop on Reactive Flows in Deformable Complex Media, Oberwolfach, Germany, September 2014.

*Model Complexity and Simulation Approaches for Geological Sequestration of Carbon Dioxide*

Department of Applied Mathematics, City University of Hong Kong, January 2015.

*Model Complexity and Simulation Approaches for Geological Sequestration of Carbon Dioxide*

Department of Applied Mathematics, Polytechnic University of Hong Kong, January 2015.

*Energy and Sustainability in a Carbon-Constrained World*

University of Macau, January 2015.

*Leakage along Old Wells with Applications to CO<sub>2</sub> Sequestration and Methane Emissions*

Department of Geology, University of Kansas, February 2015.

*Leakage along Old Wells with Applications to CO<sub>2</sub> Sequestration and Methane Emissions*

Distinguished Scientist Lecture Series, Division of Earth Sciences, Lawrence Berkeley National Laboratory, April 2015.

*Modeling CO<sub>2</sub> Injection in Depleted Shale Gas Formations*

Special Session to Honor the Career of Michael Celia, Interpore Conference, Padua, Italy, May 2015.

*Groundwater and the Subsurface: Water, Energy, Climate*

Nassau Hall Society International Conference on Water, Amsterdam, The Netherlands, June 2015.

*Energy and Sustainability in a Carbon-constrained World*

Plenary Lecture, University of Bergen Summer School on Sustainability, Bergen, Norway, June 2015.

*Carbon Capture and Storage*

University of Bergen Summer School on Sustainability, Bergen, Norway, June 2015.

*Modeling Approaches for CO<sub>2</sub> Sequestration in Conventional and Unconventional Reservoirs*

Inaugural Argyris Honorary Lecture, University of Stuttgart, July 2015.

*Modeling Approaches for CO<sub>2</sub> Sequestration in Conventional and Unconventional Reservoirs*

Invited lecture, PetroChina, Beijing, China, August 2015.

*CO<sub>2</sub> Sequestration in Conventional and Unconventional Reservoirs*

Department of Hydraulic Engineering, Tsinghua University, Beijing, China, August 2015.

- CCS: Current Status, Future Prospects, and the Role of NUPUS*  
NUPUS Annual Meeting, Freudenstadt, Germany, September 2015.
- Modeling Approaches for CO<sub>2</sub> Sequestration in Conventional and Unconventional Reservoirs*  
Department of Chemical Engineering, University of Houston, October 2015.
- Modeling Approaches for CO<sub>2</sub> Sequestration in Conventional and Unconventional Reservoirs*  
International Institute for Carbon-Neutral Energy Research, Kyushu University, Japan, January 2016.
- Geological Storage as a Carbon Mitigation Option*  
National Ground Water Association Summit, Denver Colorado, April 2016.
- Measurement of Methane Fluxes from Abandoned Wells in Pennsylvania*  
Penn State University, May 2016.
- The Role of Public Policy in Science, Engineering, and Mathematical Modeling*  
University of Bergen, Norway, September 2016.
- Geological Carbon Storage in Conventional and Unconventional Reservoirs*  
The National Academy of Engineering, Washington DC, October 2016.
- Carbon Capture and Storage (CCS): Is it Feasible? Will it Happen?*  
FEST Lecture Series, Utrecht University, The Netherlands, October 2016.
- Carbon Capture and Storage (CCS): Is it Feasible? Will it Happen?*  
DARSim Lecture Series, Delft University of Technology, The Netherlands, November 2016.
- Models for Fluid Flow in Shale Gas Reservoirs*  
The Technical University of Eindhoven, November 2016.
- An Overview of the Princeton Environmental Institute*  
University of Bergen, Norway, February 2017.
- Modeling Geological Storage of Carbon Dioxide with a Focus on Groundwater Protection*  
School of Environment, Tsinghua University, March 2017.
- Models for Fluid Flow in Shale Gas Reservoirs*  
Department of Hydraulic Engineering, Tsinghua University, March 2017.
- Quantitative Estimation of CO<sub>2</sub> Leakage in Large-scale CCS*  
Special Symposium for Retirement of Robert Williams, Princeton University, April 2017.
- Energy and Sustainability in a Carbon-constrained World*  
Public Lecture, University of Hong Kong, April 2017.
- Large-scale Models for Fluid Flow in Shale Gas Reservoirs*  
Department of Civil Engineering, Univ. of Hong Kong, April 2017.
- Modeling Geological Storage of Carbon Dioxide with a Focus on Leakage along Old Wells*  
Department of Civil Engineering, Univ. of Hong Kong, April 2017.
- Modeling Geological Storage of Carbon Dioxide with a Focus on Leakage along Old Wells*  
Department of Geography, Chinese University of Hong Kong, April 2017.
- Models for Fluid Flow in Shale Gas Reservoirs*  
Department of Civil Engineering, Delft University of Technology, May 2017.
- Modeling Geological Storage of Carbon Dioxide with a Focus on Model Complexity and Practical Simulations*  
Opening Plenary lecture, Math for Industry Conference, Univ. of Hawaii, October 2017.
- Quantitative Estimation of CO<sub>2</sub> Leakage in Large-scale CCS*  
National Academy of Sciences Workshop on Negative Emissions and CCS, Stanford Univ., November 2017.

## THESES SUPERVISED

### PhD Theses:

Bouloutas, E.T., "Improved Numerical Methods for Flow and Transport in Partially Saturated Porous Media," Ph.D. Thesis, Dept. of Civil Engineering, M.I.T., 1989.

Soll, W.E., "Development of a Pore-Scale Model for Simulating Two and Three Phase Capillary Pressure - Saturation Relationships," Ph.D. Thesis, Dept. of Civil Engineering, M.I.T., 1991.

Binning, P.J., "Modeling Unsaturated Zone Flow and Contaminant Transport in the Air and Water Phases", PhD Thesis, Department of Civil Engineering and Operations Research, Princeton University, 1994.

Reeves, P.C., "The Development of Pore-scale Network Models for the Simulation of Capillary Pressure - Saturation - Interfacial Area - Relative Permeability Relationships in Multi-fluid Porous Media", PhD Thesis, Department of Civil Engineering and Operations Research, Princeton University, 1997.

Goode, D.J., "Ground-water Age and Atmospheric Tracers: Simulation Studies and Analysis of Field Data from the Mirror Lake Site, New Hampshire", PhD Thesis, Department of Civil Engineering and Operations Research, Princeton University, 1998.

Held, R.J., "Pore-Scale Modeling of Extended Two-Phase Flow and Mass Transfer in Porous Media". PhD Thesis, Department of Civil Engineering and Operations Research, Princeton University, 2000.

Puma, M.J., "Space-time Scaling Properties of Soil Moisture and Evapotranspiration in Water-limited Ecosystems", PhD Thesis, Department of Civil and Environmental Engineering, Princeton University, 2006.

Duguid, A., "The Effect of Carbonic Acid on Well Cements", PhD Thesis, Department of Civil and Environmental Engineering, Princeton University, 2006.

Gasda, S.E., "Numerical Models for Evaluating CO<sub>2</sub> Storage in Deep Saline Aquifers: Leaky Wells and Large-scale Geological Features", PhD Thesis, Department of Civil and Environmental Engineering, Princeton University, 2007. Available at <http://dspace.princeton.edu/jspui/handle/88435/dsp01j098zb09n>.

Franz, T.E., "Characterizing Dryland Surface Hydrological Dynamics using Ecohydrological Modeling and Geophysical Observations", PhD Thesis, Department of Civil and Environmental Engineering, Princeton University, 2010.

Court, B., "Safety and Water Challenges in CCS: Modeling Studies to Quantify CO<sub>2</sub> and Brine Leakage Risk and Evaluate Promising Synergies for Active and Integrated Water Management", PhD Dissertation, Department of Civil and Environmental Engineering, Princeton University, 2011. Available at <http://dspace.princeton.edu/jspui/handle/88435/dsp01ms35t861f>.

Nogues, J., "Investigations in Upscaling Transport and Geochemistry in Porous Media: Modeling CO<sub>2</sub> at the Pore, Continuum, and Reservoir Scales" PhD Dissertation, Department of Civil and Environmental Engineering, Princeton University, 2012.

Kang, M., "CO<sub>2</sub>, Methane, and Brine Leakage through Subsurface Pathways: Exploring Modeling, Measurement, and Policy Options", PhD Dissertation, Department of Civil and Environmental Engineering, Princeton University, 2014.

Guo, B., "Fluid Injection and Migration in the Subsurface: Reduced-order Models and Multiscale Modeling Approaches", PhD Dissertation, Department of Civil and Environmental Engineering, Princeton University, 2016.

Huang, X., "Modeling Subsurface Porous Media Flows in Conventional and Unconventional Formations: Carbon Sequestration, Shale Gas, and Policy Implications", PhD Dissertation, Department of Civil and Environmental Engineering, Princeton University, 2016.

NOTE: Three recent Phd graduates - Mary Kang, Juan Nogues, and Trenton Franz - each received Best Student Paper Awards for presentations made at the annual Fall Meetings of the American Geophysical Union.

#### **MS Theses:**

Kindred, J.S., "A Numerical Investigation of Transport and Biodegradation of Groundwater Contaminants," M.S. Thesis, Dept. of Civil Engineering, M.I.T., 1987.



Zarba, R.L., "A Numerical Investigation of Unsaturated Flow," M.S. Thesis, Dept. of Civil Engineering, M.I.T., 1988.

Wolf, S.H., "Spatial Variability of Hydraulic Conductivity in a Sand and Gravel Aquifer," Civil Engineer Degree, Dept. of Civil Engineering, M.I.T., 1988.

Zisman, S., "Simulation of Contaminant Transport in Groundwater Systems using Eulerian-Lagrangian Localized Adjoint Methods," M.S. Thesis, Dept. of Civil Engineering, M.I.T., 1989.

Stevens, J., "Analysis and Modeling of Unsaturated-zone Flow and Transport Experiments, Cape Cod, Massachusetts," M.S. Thesis, Department of Civil Engineering and Operations Research, Princeton University, 1994.

Blackburn, E.A., "Modeling the Dissolution and Transport of a Multicomponent NAPL", M.S. Thesis, Department of Civil Engineering and Operations Research, Princeton University, 1998.

LeBlanc, D.R., "Analysis and Simulation of Density and Recharge Effects on Plume Migration at the Cape Cod Experimental Site", Department of Civil and Environmental Engineering, MIT, 2001.

Gasda, S.E., "CO<sub>2</sub> Sequestration into a Mature Sedimentary Basin: Determining the Capacity and Leakage Potential of a Saline Aquifer Formation", M.S. Thesis, Department of Civil and Environmental Engineering, Princeton University, 2004.

Faulkner, A., "Soil Biogeochemistry Changes due to Elevated CO<sub>2</sub> Concentrations", M.S. Thesis, Department of Civil and Environmental Engineering, Princeton University, 2005.

Franz, T.E., "Ecohydrology of the Upper Ewaso Ngiro River Basin, Kenya", M.S. Thesis, Department of Civil and Environmental Engineering, Princeton University, 2007.

Janzen, A., "Development and Application of a Multi-scale, Multi-layer Model for CO<sub>2</sub> Injection", M.S. Thesis, Department of Civil and Environmental Engineering, Princeton University, 2010. Available at [http://dspace.princeton.edu/jspui/bitstream/88435/dsp01np193917f/1/Thesis\\_Janzen.pdf](http://dspace.princeton.edu/jspui/bitstream/88435/dsp01np193917f/1/Thesis_Janzen.pdf).

Wang, J.Z., "Development of a Parameter Estimation Software Package to Determine CO<sub>2</sub> Leakage Potential from Abandoned Wells", M.S.E. Thesis, Department of Civil and Environmental Engineering, Princeton University, 2011.

Leister, E.C., "Evaluation of Model Complexity: CO<sub>2</sub> Plume Modeling at Sleipner", M.S.E. Thesis, Department of Civil and Environmental Engineering, Princeton University, 2014.

Edwards, R.W.J., "Understanding the Shale Gas System and Modeling Carbon Dioxide and Water Injection", M.S.E. Thesis, Department of Civil and Environmental Engineering, Princeton University, 2014.

Tao, Y., "Vertically-integrated Dual-continuum Models for CO<sub>2</sub> Injection in Fractured Geological Formations", M.S.E. Thesis, Department of Civil and Environmental Engineering, 2017.

#### **BS Theses:**

Total of 40 Senior Theses Supervised.

Two of my undergraduate advisees have received the award for the best thesis in the School of Engineering and Applied Science. The more recent one was Kyle Meng, Class of 2005. His work focused on identification of the most promising options for a large-scale low-cost carbon-capture-and-storage demonstration project in China.

#### **CURRENT EXTERNAL FUNDING**

BP: *Extension of The Carbon Mitigation Initiative*, Total funding \$2.1 Million per year for 5 years (2016-2020; extended from earlier grant that was 2001-2015), Multiple PI's.

Department of Energy: *Multiscale Modeling of CO<sub>2</sub> Migration and Trapping in Fractured Reservoirs with Validation by Model Comparison and Real-Site Applications*, Total funding to Princeton is \$400,000 for three years (2014-2018). Project is joint with Lawrence Berkeley National Laboratory and Heriot Watt University (Scotland).