Curriculum Vitae

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EDUCATION

2005–2008 **Ph.D**. Biosystems Engineering and Soil Science, University of Tennessee (UT), Knoxville, TN, USA. **Dissertation Title: "**Flow and Transport in Unsaturated Porous Media: Fractal Modeling, Analytical Solutions and Experimentation"

2002– 2004 **M.S.** Geological Engineering Department, Middle East Technical University (METU), Ankara, Turkey. **Thesis Title**: "The Rise Velocity of an Air Bubble in Coarse Porous Media: Theoretical Studies"

1997–2002 **B.S.** Hydrogeological Engineering Department, Hacettepe University, Ankara, Turkey.

WORK EXPERIENCES

August 2012 – Present, Geological Scientist, Energy Geosciences Division, Earth and Environmental Sciences, Lawrence Berkeley National Laboratory, Berkeley, CA, USA

August 2010 – August 2012, Postdoctoral Fellow, Earth Sciences Division, Lawrence Berkeley National Laboratory, Berkeley, CA, USA

April 2008 – August 2010, Postdoctoral Research Associate, Center for Experimental Study of Subsurface Environmental Processes, Environmental Science and Engineering, Colorado School of Mines. Golden, CO, USA

August 2005 – April 2008, Research Assistant, Biosystems Engineering & Soil Science, University of Tennessee, Knoxville, TN, USA

PEER-REVIEWED JOURNAL PUBLICATIONS

Submitted

1. Siirila-Woodburn, E., **A. Cihan**, J. Birkholzer (2016), A risk map methodology to assess the spatial and temporal distribution of Geologic Carbon Storage leakage into groundwater, submitted to International Journal of Greenhouse Gas Control
2. Trevisan L, R. Pini, **A. Cihan**, J.T. Birkholzer, Q. Zhou, A. Gonzalez-Nicolas, T.H. Illangasekare (2016), Quantification of spreading and trapping of carbon dioxide in saline aquifers by means of meter-scale experiments, submitted to *Water Resources Research.*

3. **Cihan, A**., J. Birkholzer, L. Trevisan, A. Gonzalez-Nicolas, T. Illangasekare (2016), Investigation of representing hysteresis in macroscopic models of two-phase flow in porous media using intermediate scale experimental data, submitted to *Water Resources Research*.

4. Agartan, E., **A. Cihan**, T. H. Illangasekare, J. Birkholzer, and Q. Zhou (2016), Mixing and Trapping of Dissolved CO_2 in Deep Geologic Formations with Shale Layers, submitted to *Advances in Water Resources*.

5. González-Nicolás, A., L. Trevisan, T. H. Illangasekare, **A. Cihan**, Jens T. Birkholzer (2016). Enhancing Capillary Trapping Effectiveness through Proper Time Scheduling of Injection of Supercritical CO_2 in Heterogeneous Formations, submitted to *Greenhouse Gases: Science and Technology*.

6. Weijun Shen, W., L. Zheng, C. M. Oldenburg, **A. Cihan**, J. Wan, T. K. Tokunaga (2016), Methane Diffusion and Adsorption in Shale Rocks--A Numerical Study Using the Dusty Gas Model in TOUGH2/EOS7C-ECBM, submitted to *Transport in Porous Media*.

Published

7. Oldenburg, C. M., **A**. **Cihan,** Q. Zhou, S. Fairweather, and L.H. Spangler (2016), Geologic carbon sequestration injection wells in overpressured storage reservoirs: estimating area of review. *Greenhouse Gases: Science and Technology*, doi:10.1002/ghg.1607.

8. Oldenburg, C. M., S. Mukhopadhyay, and **A. Cihan** (2016), On the use of Darcy's law and invasion-percolation approaches for modeling large-scale geologic carbon sequestration, *Greenhouse Gases: Science and Technology*, 6, 19–33. doi:10.1002/ghg.1564.

9. Trautz, A.C., K.M. Smits, **A. Cihan**, (2015), Continuum-scale investigation of evaporation from bare soil under different boundary and initial conditions: An evaluation of nonequilibrium phase change, *Water Resources Research*, 51, doi:10.1002/2014WR016504.

10. **Cihan, A**., J.T. Birkholzer, M. Bianchi, (2015), Optimal Well Placement and Brine Extraction for Pressure Management during CO_2 Sequestration, *International Journal of Greenhouse Gas Control*, 42, 175-187.

11. Moradi, A., K. M. Smits, K. Massey, **A. Cihan**, J. McCartney (2015), Impact of coupled heat transfer and water flow in soil borehole thermal energy storage (SBTES) systems: Experimental and modeling investigation, *Geothermics*, 57, 56-72.

12. Bandilla, K. W., M. A. Celia, J. T. Birkholzer, **A. Cihan** and E. C. Leister (2015), Multiphase Modeling of Geologic Carbon Sequestration in Saline Aquifers. *Groundwater*, doi: 10.1111/gwat.12315

13. Agartan, E., L. Trevisan, **A. Cihan**, J. Birkholzer, Q. Zhou, and T. H. Illangasekare (2015), Experimental study on effects of geologic heterogeneity in enhancing dissolution trapping of supercritical CO_2, *Water Resources Research*, 50, doi:10.1002/2014WR015778.

14. Trevisan, L., R. Pini, **A. Cihan**, J.T. Birkholzer, Q. Zhou, T.H. Illangasekare (2015), Experimental analysis of spatial correlation effects on capillary trapping of supercritical CO_2 at the intermediate laboratory scale in heterogeneous porous media, *Water Resources Research*, **51(11),** 8791-805.

15. **Cihan, A**., J. Birkholzer, T.H. Illangasekare, and Q. Zhou (2014), A modeling approach to represent hysteresis in capillary pressure-saturation relationship based on fluid connectivity in void space, *Water Resources Research*, 50, doi:10.1002/2013WR014280.

16. Trevisan, L., **A. Cihan**, F. Fagerlund, E. Agartan, H. Mori, J. T. Birkholzer, Q. Zhou, T. H. Illangasekare (2014), Investigation of mechanisms of supercritical CO_2 trapping in deep saline reservoirs using surrogate fluids at ambient laboratory conditions, *International Journal of Greenhouse Gas Control*, 29, 35-49.

17. **Cihan, A**., Q. Zhou, J.T. Birkholzer, and S.R. Kraemer (2013), Flow in horizontally anisotropic multilayered aquifer systems with leaky wells and aquitards, *Water Resources Research*, 50, *doi:*10.1002/2013WR013867.

18. Birkholzer, J.T., **A. Cihan**, K. Bandilla (2013). A tiered area-of-review framework for geologic carbon sequestration. *Greenhouse Gas Science and Technology*, 1-16, 2013.

19. Smits, K.M., **A. Cihan**, T. Sakaki, S. Howington, J. Peters and T.H. Illangasekare (2013), Soil Moisture and Thermal Behavior in the Vicinity of Buried Objects Affecting Remote Sensing Detection: Experimental and Modeling Investigation, *IEEE Transactions on Geoscience and Remote Sensing*, 51(5), 2675-2688, DOI: 10.1109/TGRS.2012.2214485.

20. Sakaki, T., P. E. Schulte, **A. Cihan,** J. A. Christ, and T. H. Illangasekare (2013), Airflow pathway development as affected by soil moisture variability in heterogeneous soils, *Vadose Zone Journal*, doi:10.2136/vzj2011.0118.

21. **Cihan, A.,** J. Birkholzer, and Q. Zhou (2012), Pressure Buildup and Brine Migration during CO_2 Storage in Multilayered Aquifers, *Ground Water*, doi: 10.1111/j.1745-6584.2012.00972.x

22. Birkholzer, J., **A. Cihan,** and Q. Zhou (2012), Impact-Driven Pressure Management via Targeted Brine Extraction – Concept studies of CO_2 storage in saline formations with leakage pathways, *International Journal of Greenhouse Gas Control*, 7, 168.

23. Smits, K. M., V. V. Ngo, **A. Cihan**, T. H. Illangasekare, and T. Sakaki (2012), An evaluation of models of bare soil evaporation formulated with different land surface boundary conditions and assumptions, *Water Resources Research*, 48, W12526, doi:10.1029/2012WR012113.

24. Smits, K. M., **A. Cihan**, V. V. Ngo, and T. H. Illangasekare (2012), Reply to comment by Michael D. Novak on "Evaporation from soils under thermal boundary conditions: Experimental and modeling investigation to compare equilibrium and nonequilibrium based approaches," *Water Resources Research*, 48, W05550, doi:10.1029/2011WR011609.

25. Sakaki, T., A. Limsuwat, **A. Cihan,** C. C. Frippiat, and T. H. Illangasekare (2012), Water retention in a coarse pocket under wetting and drainage, *Vadose Zone Journal*, 11:223-230, doi:10.2136/vzj2011.0028.

26. **Cihan, A.,** Q. Zhou and J. Birkholzer (2011), Analytical Solutions for Pressure Perturbation and Fluid Leakage through Aquitards and Wells in Multilayered Aquifer Systems, *Water Resources Research*, doi:10.1029/2011WR010721.

27. **Cihan, A.** and J. S. Tyner (2011), 2-D radial analytical solutions for solute transport in a dual porous medium, *Water Resources Research*, 47, W04507, doi:10.1029/2009WR008969.

28. Smits, K. M., **A. Cihan**, T. Sakaki, and T. H. Illangasekare (2011), Evaporation from soils under thermal boundary conditions: Experimental and modeling investigation to compare equilibrium- and nonequilibrium-based approaches, *Water Resources Research*, 47, W05540, doi:10.1029/2010WR009533.

29. Phenrat, T., **A. Cihan**, K. Hye-Jin, M. Menka, T. Illangasekare, G. V. Lowry (2010), Transport and deposition of Polymer-modified Fe0 Nanoparticles in 2-D Heterogeneous Porous Media: Effects of Particle Concentration, Fe0 Content, and Coatings, *Environmental Sciences and Technology*, 44(23), 9086-9093.

30. **Cihan, A.**, M. Sukop, J. S. Tyner, E. Perfect, and H. Huang (2009), Analytical and Lattice Boltzmann Predictions of Intrinsic Permeability for Mass Fractal Porous Media, *Vadose Zone Journal*, 8(1): 1-10.
31. **Cihan, A.**, J. S. Tyner, and E. Perfect (2009), Predicting Relative Permeability from water retention: A direct approach based on fractal geometry, *Water Resources Research*, 45, doi:10.1029/2008WR007038.
32. **Cihan, A.**, and M. Y. Corapcioglu (2008), Effect of compressibility on the rise velocity of an air bubble in porous media, *Water Resources Research*, 44, W04409, doi:10.1029/2006WR005415.
33. **Cihan, A.**, E. Perfect, and J. S. Tyner (2007), Water Retention Models for Scale-Variant and Scale-Invariant Drainage of Mass Prefractal Porous Media, *Vadose Zone Journal*, 6: 786-792.
34. **Cihan, A.**, J. S. Tyner, and W. Wright (2006), Seal Formation Mechanism beneath Animal Waste Holding Ponds, *Transactions of the ASABE*, 49(5): 1539-1544.
35. Corapcioglu, M. Y., **A. Cihan**, and M. Drazenovic (2004), Rise velocity of an air bubble in porous media: Theoretical studies, *Water Resources Research*, 40, W04214, doi:10.1029/2003WR002618.

CONFERENCE PROCEEDING PAPERS

1. Shen, W., L. Zheng, C.M. Oldenburg, **A. Cihan**, J. Wan, T.K. Tokunaga (2015), Methane diffusion and adsorption in shale rocks – A numerical study using the Dusty Gas Model in TOUGH2/EOS7CO̅ECBM, Tough2 Symposium 2015, Berkeley CA, September 28-30, 2015.
2. Deepagoda, C., K. Smits, T. Illangasekare, C.M. Oldenburgh, **A. Cihan** (2015), Multiphase flow and transport of methane in soil under varying subsurface and atmospheric conditions: Bench-scale experimental and numerical studies, Tough2 Symposium 2015, Berkeley CA, September 28-30, 2015.
3. **Cihan, A**., J. Birkholzer, M. Bianchi (2015), Pressure management during geological CO_2 sequestration: Optimal well placement and brine extraction in a heterogeneous reservoir, Tough2 Symposium 2015, Berkeley CA, September 28-30, 2015.
4. Oldenburg, C. M., **A. Cihan**, Q. Zhou, S. Fairweather, L. H. Spangler (2014), Delineating Area of Review in a System with Pre-Injection Relative Overpressure, *Energy Procedia*, 63, 3715-3722.
5. **Cihan, A.**, J. Birkholzer, M. Bianchi (2014), Targeted Pressure Management during CO_2 Sequestration: Optimization of Well Placement and Brine Extraction, *Energy Procedia*, 63, 5325-5332.
6. **Cihan, A**., J. Birkholzer, L. Trevisan, M. Bianchi, Q. Zhou, and T. Illangasekare (2014), A Connectivity-Based Modeling Approach for Representing Hysteresis in Macroscopic Two-Phase Flow Properties, *Energy Procedia*, *63*, 3456-3463.
7. Trevisan, L., R. Pini, **A. Cihan**, J. T. Birkholzer, Q. Zhou, T. H. Illangasekare (2014), Experimental Investigation of Supercritical CO_2 Trapping Mechanisms at the Intermediate Laboratory Scale in Well-defined Heterogeneous Porous Media, *Energy Procedia*, 63, 5646-5653.

8. Agartan, E., T.H. Illangasekare, **A. Cihan**, J. Birkholzer, Q. Zhou, L. Trevisan (2013), A Fundamental Study of Convective Mixing of CO_2 in Heterogeneous Geologic Media using Surrogate Fluids and Numerical Modeling, MODFLOW and More 2013: Translating Science into Practice, June 2-5, Colorado School of Mines, Golden, CO., 467-471.
9. Trevisan, L., **A. Cihan**, T.H. Illangasekare, E. Agartan, H. Mori, J.T. Birkholzer, Q. Zhou. (2013), Investigation of multiphase modeling approaches for behavior of super critical CO_2 in deep formation using analog fluids in the laboratory, MODFLOW and More 2013: Translating Science into Practice, June 2-5, Colorado School of Mines, Golden, CO., 422-425.
10. Trevisan, L., T.H. Illangasekare, D. Rodriguez, T. Sakaki, **A**. **Cihan,** J.T. Birkholzer, Q. Zhou (2011), Improved Understanding of Migration and Entrapment of Supercritical CO_2 in Deep Geologic Formations: Intermediate Scale Testing and Modeling, MODFLOW 2011 Meeting, Golden, CO, June 5-8, 2011
11. Smits, K., **A. Cihan**, T. Sakaki, and T.H. Illangasekare (2011), Numerical Simulation on the Effect of Heterogeneity on Evaporation/Condensation in Soils, MODFLOW 2011 Meeting, Golden, CO, June 5-8, 2011
12. Sakaki, T., P.E. Schulte, A. Cihan, J. E. Chirst, and T. H. Illangasekare (2011), Airflow pathway dynamics in heterogeneous subsurface influenced by land surface boundary conditions, MODFLOW 2011 Meeting, Golden, CO, June 5-8, 2011
13. Corapcioglu, M. Y., **A. Cihan**, and M. Drazenovic (2005), Hydrodynamics of an air bubble motion in porous media, Poromechanics III - BIOT CENTENNIAL (1905–2005), edited by Y.N. Abousleiman, A.H.-D. Cheng, and F.-J. Ulm, April, University of Oklahoma, Oklahoma, USA.

PRESENTATIONS AND ABSTRACTS

Selected Presentations

1. *Development and testing of a hysteresis modeling approach for the two-phase flow capillary pressure-saturation-relative permeability relationship: Laboratory-scale analyses*, Computational Methods in Water Resources (CMWR) Conference, University of Toronto, Canada, June 19-25, 2016
2. *Determining the Area of Review (AoR) in Carbon Capture and Storage: A tiered, probabilistic methodology to generate risk maps*, AGU Fall Meeting, December 14-18, 2015.
3. *Optimization of fluid injection and extraction in deep subsurface reservoirs: Examples from CO_2 sequestration* (**Invited talk)**, Technical Workshop on Enhanced Water Recovery, Livermore CA, September 14, 2015.
4. *Multiscale Investigation of CO_2 Trapping and Leakage in Geological formations* (**Invited talk),** Seminar in Department of Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh PA.
5. *Pressure Perturbation and Fluid Leakage Through Aquitards and Wells in Multilayered Aquifer Systems* (**Invited talk)**, Seminar in Department of Geology and Geological Engineering, Colorado School of Mines, Golden CO.
6. *Prediction of Relative Permeability: Fractal Modeling,* The 2008 Kirkham Conference, University of California Davis, CA, February 24-26, 2008
7. *Seal Formation Mechanism Beneath Animal Waste Holding Ponds* **(Invited Talk),** The 2006 Tennessee Section American Society of Agricultural and Biological Engineers (ASABE) Meeting, Knoxville, TN, June 13, 2006

8. *An overview of reservoir working group studies during Phase I*, National Risk Assessment Partnership (NRAP) Annual Technical Meeting, Pacific Northwest National Laboratory (PNNL), April 26-27, 2016.
9. *A Connectivity-Based Upscaling Approach for Modeling Two-Phase Flow in Heterogeneous Geological Formations*, 12th International Conference on Greenhouse Gas Control Technologies, November 2014, Austin, TX.
10. *Validation of Models Simulating Capillary and Dissolution Trapping During Injection and Post-Injection of CO_2 in Heterogeneous Geological Formations Using Data from Intermediate Scale Test Systems*, National Energy Technology Laboratory Carbon Storage R&D Project Review Meeting, Pittsburgh, Pittsburgh PA, August 21-23, 2012
11. *A Theoretical Approach Representing Hysteresis in Capillary Pressure-Saturation Relationship Based on Connectivity in Void Space*, AGU Fall Meeting 2013, San Francisco, CA, December, 2013
12. *A New Connectivity-Based Upscaling Methodology for Multi-Scale Two-Phase Flow Processes in Heterogeneous Geological Formation*, 12th Annual Conference on Carbon Capture, Utilization and Sequestration, Pittsburgh, PA, May 13-16, 2013
13. *Analytical Solutions for Pressure Perturbation and Fluid Leakage through Aquitards and Wells in a Multilayered System*, AGU Fall Meeting, 2011
14. *A Numerical Modeling Study of Effect of Heterogeneity on Capillary Trapping of Geologically Sequestrated CO_2, AGU* Fall Meeting, 2011
15. *Analytical Solutions for Pressure Perturbation and Leakage through Aquitards and Wells in Multilayered Aquifer-Aquitard Systems*, Geological Society of America (GSA) Annual Meeting in Minneapolis, 9-12 October 2011
16. *Intermediate-Scale Investigation of Capillary and Dissolution Trapping during CO_2 Injection and Post-Injection in Heterogeneous Geological Formations*, AGU Fall Meeting, 2010
17. *A Preliminary Description of the Moisture Moment Method to Describe Unsaturated Soil Hydraulic Properties*, AGU Fall Meeting, 2007
18. *Analytical and Lattice Boltzmann Predictions of Intrinsic Permeability for Deterministic and Randomized Fractal Porous Media*, AGU Fall Meeting, 2007
19. *Seal Formation Mechanism Beneath Animal Waste Holding Ponds, AGU* Fall Meeting, 2005

Conference Abstracts

1. **Cihan, A.,** J. Birkholzer, L. Trevisan, A. G.-N. Alvarez, T. Illangasekare, T. Tokunaga, S. Wang (2016), Development and testing of a hysteresis modeling approach for the two-phase flow capillary pressure-saturation-relative permeability relationship: Laboratory-scale analyses, Computational Methods in Water Resources (CMWR) Conference, University of Toronto, Canada, June 19-25, 2016
2. Siirila-Woodburn, E.R., **Cihan, A.,** J. T. Birkholzer (2015), Determining the Area of Review (AoR) in Carbon Capture and Storage: A tiered, probabilistic methodology to generate risk maps, AGU Fall Meeting, December 14-18, 2015.
3. Shen, W., T. K. Tokunaga, **A. Cihan**, J. Wan, L. Zheng, C. M. Oldenburg (2015), Experimental and Numerical Simulation of Water Vapor Adsorption and Diffusion in Shale Grains, AGU Fall Meeting, MR41C-2665, December 14-18, 2015

4. Smits, K. M., A. Trautz, **A. Cihan**, and B. Wallen (2015), Heat and Water Transfer at the Land-Atmosphere Interface – Interweaving Experimental and Modeling Approaches, AGU Fall Meeting, H54B-01, December 14-18, 2015

5. **Cihan, A.**, J.T. Birkholzer, M. Bianchi, L. Trevisan, Q. Zhou, T. Illangasekare (2014), A Connectivity-Based Upscaling Approach for Modeling Two-Phase Flow in Heterogeneous Geological Formations, 12th International Conference on Greenhouse Gas Control Technologies, November 2014, Austin, TX, 2014.

6. Birkholzer, J.T., **A. Cihan**, M. Bainchi (2014), Targeted Pressure Management during CO_2 Sequestration: Optimization of Well Placement and Brine Extraction in a Heterogeneous Reservoir, 12th International Conference on Greenhouse Gas Control Technologies, November 2014, Austin, TX, 2014.

7. Birkholzer, J.T., **A. Cihan**, M. Bainchi (2014), Optimization of Well Placement and Brine Extraction for Pressure Control Along Critically Stressed Faults, 13th Annual Conference on Carbon Capture, Utilization and Sequestration, Pittsburgh, PA, April 28-May 1, 2014.

8. Birkholzer, J.T., **A. Cihan**, K. Bandilla (2014), A Tiered Area-of-Review Framework for Geologic Carbon Sequestration, 13th Annual Conference on Carbon Capture, Utilization and Sequestration, Pittsburgh, PA, April 28-May 1, 2014.

9. **Cihan, A.**, J.T. Birkholzer, T. Illangasekare, Q. Zhou (2013), A Theoretical Approach Representing Hysteresis in Capillary Pressure-Saturation Relationship Based on Connectivity in Void Space, AGU Fall Meeting 2013, San Francisco, CA, December, 2013.

10. **Cihan, A.**, J.T. Birkholzer, M. Bianchi, Q. Zhou (2013), A New Connectivity-Based Upscaling Methodology for Multi-Scale Two-Phase Flow Processes in Heterogeneous Geological Formation, Abstract submitted to 12th Annual Conference on Carbon Capture, Utilization and Sequestration, Pittsburgh, PA, May 13-16, 2013.

11. Agartan, E., T. Illangasekare, **A. Cihan**, J.T. Birkholzer, Q. Zhou, L. Trevisan (2013), Investigation of Multi-Phase Modeling Approaches for Behavior of Supercritical CO_2 in Deep Formations Using Analog Fluids in the Laboratory, Abstract submitted to Modflow and More Conference 2013, Golden, CO, June 2013.

12. Trevisan, L., **A. Cihan**, T. Illangasekare, E. Agartan, H. Mori, J.T. Birkholzer, Q. Zhou (2013), A Fundamental Study of Convective Mixing of CO_2 in Heterogeneous Geologic Media using Surrogate Fluids and Numerical Modeling, Abstract in Modflow and More Conference 2013, Golden, CO, June 2013.

13. Agartan, E., T. Illangasekare, **A. Cihan**, J.T. Birkholzer, Q. Zhou, L. Trevisan (2013), A Fundamental Study of Convective Mixing Contributing to Dissolution Trapping of CO_2 in Heterogeneous Geologic Media using Surrogate Fluids and Numerical Modeling, Abstract submitted to European Geophysical Conference, Vienna, Austria, April 2013.

14. Birkholzer, J.T., **A. Cihan**, Q. Zhou, (2012), Impact-Driven Pressure Management Via Targeted Brine Extraction – Conceptual Studies on Reservoir Performance Optimization, Abstract in Proceedings 11th Annual Conference on Carbon Capture, Utilization and Sequestration, Pittsburgh, PA, April 30 – May 3, 2012.

15. Illangasekare, T.H., L. Trevisan, D. Rodriguez, T. Sakaki, **A. Cihan,** J.T. Birkholzer, Q. Zhou (2012), Multiple scale physical and numerical modeling for improved understanding of mechanisms of trapping and leakage of CO_2 in deep geologic formations, Abstract in EGU 2012 Meeting, Vienna, Austria, April 22-27, 2012.

16. Smits, K. M., V.V. Ngo, **A. Cihan**, T. Sakaki, T. H. Illangasekare (2011), An Experimental and Modeling Study of Evaporation from Bare Soils Subjected to Natural Boundary Conditions At The Land-Atmospheric Interface, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract H41J-01.

17. J. Birkholzer, **A. Cihan,** and Q. Zhou (2011), Impact-Driven Pressure Management for Leaky CO_2 Storage Systems, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract H41K-02.

18. **Cihan, A**., Q. Zhou, J.T. Birkholzer (2011), Analytical Solutions for Pressure Perturbation and Fluid Leakage through Aquitards and Wells in a Multilayered System, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract H33G-1401.

19. **Cihan, A.**, J.T. Birkholzer, Q. Zhou, L. Trevisan, T.H. Illangasekare, D. Rodriguez, T. Sakaki, (2011), A Numerical Modeling Study of Effect of Heterogeneity on Capillary Trapping of Geologically Sequestrated CO_2, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract H54D-02.

20. **Cihan, A**., Q. Zhou, J.T. Birkholzer (2011), Analytical Solutions for Pressure Perturbation and Leakage through Aquitards and Wells in Multilayered Aquifer-Aquitard Systems, Geological Society of America Abstracts with Programs, Vol. 43, No. 5, p. 81, GSA Annual Meeting in Minneapolis, 9-12 October.

21. **Cihan, A**., Q. Zhou, J.T. Birkholzer (2011), Analytical Solutions for Leakage through Aquitards and Abandoned Wells in Multilayered Aquifer-Aquitard Systems, submitted to 10th Annual Conference on Carbon Capture and Sequestration, Pittsburgh, PA, May 2-5, 2011.

22. Trevisan, L. T.H. Illangasekare, D. Rodriguez, T. Sakaki, **A. Cihan,** J.T. Birkholzer, Q. Zhou, (2011), Experimental methods for the simulation of supercritical CO_2 injection at laboratory scale aimed to investigate capillary trapping, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract H51G-1280.

23. Illangasekare, T.H., K. Smits, T. Sakaki, **A. Cihan** (2011), Soil Moisture Processes in the Shallow Subsurface Near Land/Atmospheric Interface-Challenges and New Research Approaches, Geophysical Research Abstracts, Vol. 13, EGU2011-4853.

24. Trevisan, L., T.H. Illangasekare, D. Rodriguez, T. Sakaki, **A. Cihan,** J.T. Birkholzer, Q. Zhou (2011), Improved Understanding of Migration and Entrapment of Supercritical CO_2 in Deep Geologic Formations: Intermediate Scale Testing and Modeling, MODFLOW 2011 Meeting, Golden, CO, June 5-8, 2011.

25. Illangasekare, T.H., Trevisan, L., D. Rodriguez, T. Sakaki, **A. Cihan,** J.T. Birkholzer, Q. Zhou (2011), A Fundamental Study of Migration and Entrapment of Supercritical CO_2 in Heterogeneous Deep Geologic Formations: Intermediate Scale Testing and Modeling, submitted to EGU 2011 Meeting, Vienna, Austria, April 10-14, 2011.

26. Smits, K., **A. Cihan**, T. Sakaki, and T.H. Illangasekare (2011), Numerical Simulation on the Effect of Heterogeneity on Evaporation/Condensation in Soils, MODFLOW 2011 Meeting, Golden, CO, June 5-8, 2011

27. Sakaki, T., P.E. Schulte, **A. Cihan**, J. E. Chirst, and T. H. Illangasekare (2011), Airflow pathway dynamics in heterogeneous subsurface influenced by land surface boundary conditions, MODFLOW 2011 Meeting, Golden, CO, June 5-8, 2011

28. Smits, K. M., **A. Cihan**, T. Sakaki, and T.H. Illangasekare (2010), Evaporation from Soils Under Thermal Boundary Conditions: Experimental and Modeling Investigation to Compare Equilibrium and Nonequilibrium Based Approaches, *Eos Trans. AGU,* Fall Meet. Suppl., Abstract

29. Illangasekare, T.H., T. Sakaki, P.E. Schulte, **A. Cihan**, J.E. Chirst (2010), Air Flow Path Dynamics in the Vadose Zone Under Various Land Surface Climate Boundary Conditions, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract

30. **Cihan A**., T. Illangasekare, J. Birkholzer, Q. Zhou, and R. Derrick (2010), Intermediate-Scale Investigation of Capillary and Dissolution Trapping during CO_2 Injection and Post-Injection in Heterogeneous Geological Formations, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract.

31. Mittal, M., T. Phenrat T., F. Fagerlund, H. Kim, **A. Cihan**, G.V. Lowry, T.H. Illangasekare (2009), Use of an Intermediate-Scale Tank to Study Strategies for Modified NZVI Emplacement for Effective Treatment of DNAPL Source Zones, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract

32. Smits, K.M., **A. Cihan**, T. Sakaki, and T.H. Illangasekare (2009), Heat-induced evaporation in the shallow subsurface: Experimental and Modeling investigation, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract

33. **Cihan, A.,** T. Phenrat, T.H. Illangasekare, and G.V. Lowry (2009), Modeling Tools to Design in Situ Nanoscale Zerovalent Iron (NZVI) Emplacement Strategies, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract.

34. Illangasekare, T.H., T. Phenrat, **A. Cihan**, and G.V. Lowry (2009), Roles of Particle Properties, Subsurface Geochemical/Geophysical/ Hydrological Conditions, and Delivery Strategies on the Emplacement of Polymeric Modified Nanoscale Zerovalent Iron (NZVI) for In situ Subsurface Remediation, *Eos Trans. AGU*, 90(22), Jt. Assem. Suppl., Abstract H34A-03

35. Dean, D., T.H. Illangasekare, **A. Cihan** (2008), Use of Stochastic Differential Equation Solution Methods for Bubble Migration in Porous Media, *Eos Trans. AGU*, 89(53), Fall Meet. Suppl., Abstract H31F-0941

36. Illangasekare, T.H., F. Fagerlund, M. Mittal, **A. Cihan**, G.V. Lowry, T. Phenrat, H. Kim (2008), Effects of DNAPL source Morphology on Contaminant Mass Transfer and the Zone of Effective Treatment Using Nano-Scale Zero-Valent Iron, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract

37. Tyner, J. S., **A. Cihan**, J. Lee, and R.W. Gentry (2007), A Preliminary Description of the Moisture Moment Method to Describe Unsaturated Soil Hydraulic Properties, *Eos Trans. AGU*, 88(52), Fall Meet. Suppl., Abstract H53F-1491

38. **Cihan, A.**, J. S. Tyner, M. Sukop, E. Perfect, and H. Haibo (2007), Analytical and Lattice Boltzmann Predictions of Intrinsic Permeability for Deterministic and Randomized Fractal Porous Media, *Eos Trans. AGU*, 88(52), Fall Meet. Suppl., Abstract H53E-1465

39. **Cihan, A.**, J. S. Tyner, and W. C. Wright (2005), Seal Formation Mechanism Beneath Animal Waste Holding Ponds, *Eos Trans. AGU*, 86(52), Fall Meet. Suppl., Abstract H21E-1401

SCHOLARSHIPS and AWARDS

- Best graduate student award, with professional promise in Biosystems Engineering, Biosystems Engineering and Soil Science Department, University of Tennessee Knoxville, April 2008.
- Graduate student grant to attend the Kirkham Conference, University of California Davis in February 24-26th, 2008.
- Graduate student travel fund to attend the 2007 American Geophysical Union Fall meeting, by Office of the Dean of Students, University of Tennessee
- Scholarship for attending the summer school in Geophysical Porous Media, Purdue University in July 17-28th, 2006.
- Graduate student scholarship, the Scientific and Technical Research Council of Turkey (TUBITAK), 2004.

PROJECTS (Served as an investigator or Co-PI)

1. "*DOE-BEST Phase II Field Demonstration at Plant Smith Generating Station*," 2017-2020, in partnership with EPRI. Total Funding: ~$3 M. Sponsor: U.S. Department of Energy, Office of Fossil Energy.
2. "*National Risk National Risk Assessment Partnership (NRAP) Project, National Laboratory Consortium for the development of quantitative risk assessment methods for geologic carbon sequestration*," since 2010. Average Annual Funding: $ 1,400 K. Sponsor: U.S. Department of Energy, Office of Fossil Energy.
3. "*Optimization Framework for Improved CO_2 Injectivity, Storage Permanence, Monitoring, and Utilization*," Core Carbon Storage and Monitoring Research (CCSMR) Program, 2015-2016. Total Funding: $400 K. Sponsor: U.S. Department of Energy, Office of Fossil Energy.
4. "*Gulf Coast Field Demonstration at a Flagship Power Plant Site: Assessment of Opportunities for Optimal Reservoir Pressure Control, Plume Management and Produced Water Strategies* (DOE-BEST Phase I)," 2015-2016, in partnership with EPRI. Total Funding: $375 K. Sponsor: U.S. Department of Energy, Office of Fossil Energy.
5. "*Understanding Water Controls on Shale Gas Mobilization into Fractures*," 2014-2015. Served as a **Co-PI**. Total Funding: $428 K. Sponsor: U.S. Department of Energy, Office of Fossil Energy.
6. "*Model Complexity and Choice of Model Approaches for Practical Simulations of CO_2 Injection, Migration, Leakage, and Long-term Fate*," 2013-2015, in partnership with Princeton University, Professor Mike Celia. Total Funding for LBNL: $200 K. Sponsor: U.S. Department of Energy, Office of Fossil Energy.
7. "*Regional Modeling of CO_2, Pressure Management and Stochastic Inversion*," 2010-2014, Average Annual Funding: $350 K, Sponsor: U.S. Department of Energy, Office of Fossil Energy.
8. "*Analytical and Numerical Modeling in Support of Zone-of-Potential-Endangerment Estimates and Geologic Sequestration Modeling Framework*," 2010-2013. Total Funding: $500 K. Sponsor: U.S. EPA
9. "*Intermediate Scale Laboratory Testing to Understand Mechanisms of Capillary and Dissolution Trapping during Injection and Post-Injection of CO_2 in Heterogeneous Geological Formations*," 2011-2013, served as a **Co-PI** in partnership with Colorado School of Mines, Professor Tissa Illangasekare. Total Funding for LBNL: $150 K, Sponsor: U.S. Department of Energy, Office of Fossil Energy.
10. "*Fundamental Study of Processes Associated with Stable Trapping and Potential Leakage of Sequestrated Carbon Dioxide in Deep Geologic Formations*," 2011-2014. Served as a **Co-PI**. Total funding: $327 K. Sponsor: National Science Foundation (NSF), Award number-1045282
11. "*Vapor Intrusion from Entrapped NAPL Sources and Groundwater Plumes: Process Understanding and Improved Modeling Tools*," 2009-2014. Sponsor: Strategic Environmental Research and Development Program (SERDP) ER-1687.
12. "*Land Mine Detection by Using Thermal and Moisture Content Anomalies in shallow subsurface*". Sponsor: U. S. Army Research Office Award W911NF-04-1-0169, the Engineering Research and Development Center (ERDC).
13. "*Fundamental study of delivery of nanoiron to DNAPL source zones in naturally heterogeneous field systems*," 2008-2012. Sponsor: Sponsor: Strategic Environmental Research and Development Program (SERDP) ER-1485.

14. "*Enhanced Gas Production from Coal: Modeling, Model Validation and Upscaling, Center for Experimental Study of Subsurface Environmental Processes*," 2008-2009. Sponsor: CIRIS Energy.
15. "*Piceance Basin Groundwater Flow Model Development and Calibration*," 2008-2009. Sponsor: Chevron.
16. "The rise velocity of air bubbles and transport of volatile organic compounds in gravel during the Air Sparging Operations," 2004-2006. Sponsor: The Scientific and Technological Research Council of Turkey (TUBITAK).

PROFESSIONAL ACTIVITIES AND SERVICE

Manuscript Reviewer:

Water Resources Research, Chemical Engineering Science, Transport in Porous Media, Advances in Water Resources, International Journal of Greenhouse Gas Control, Journal of Fluid Mechanics

Membership

- American Geophysical Union (AGU), Gamma Sigma Delta, **American Association for the Advancement of Science (AAAS)**

Graduate Student Committee Member

- Colorado School of Mines, Department of Civil and Environmental Engineering, Ph.D. Committee, Elif Agartan Karacer, Thesis Title: A fundamental study on the effects of heterogeneity on trapping of dissolved CO_2 in deep geological formations through intermediate-scale testing and numerical modeling, 2015.
- Colorado School of Mines, Department of Civil and Environmental Engineering, Master Thesis Committee, Michael Plampin, Thesis Title: "A fundamental study of a carbon dioxide gas phase formation and migration in shallow subsurface environments during leakage from a geological sequestration site," 2013.

NRAP Reservoir Working Group Lead, coordinating reservoir modeling studies for risk assessment during CO_2 storage, 2014-2015.

CODE DEVELOPMENT

- Brine flow simulator, Mix3d_H2O_NaCl (The Finite Volume Method-based numerical solution of water and NaCl mixing in porous media). This code has been used for NRAP project studies for the DOE-BEST project.
- MDPD, Many-body dissipative particle dynamics simulator. This is a computer code solving Newton's equations for fluid particles/molecules at pore-scale. The code has been used for the project 'Understanding Water Controls on Shale Gas Mobilization into Fractures' funded by NETL.
- CDE, Constrained differential evolution algorithm for optimization. The code has been used for CCSMR, NRAP and DOE-BEST projects.
- TP3D_HYST, Hysteretic two-phase flow modeling code. The code, including new hysteretic capillary pressure-saturation-relative permeability models has been used for multiple CO_2 storage projects.
- ASLMA, Analytical Solution for leakage in multilayered aquifers. Its development was funded by EPA. The code has been used in multiple projects.

- MIP, Macroscopic invasion percolation simulator. The code was used for the DOE project in partnership with Princeton University.
- MIPDLA- Numerical solution of two-phase flow in heterogeneous systems combining diffusion-limited aggregation and macroscopic invasion percolation methods. The code was used for investigations during the DOE project in partnership with Princeton University.
- IP3D- Computer code simulating quasi-steady multiphase flow processes at pore-network systems. The code was used for upscaling studies in the DOE project in partnership with CSM and NRAP projects.
- UPSCALE2PF- Upscaling two-phase flow parameters for large-scale simulations using subgrid scale measurements. Software developed for upscaling two-phase flow properties in heterogeneous large-scale reservoirs using invasion percolation method, analytical methods and numerical solution of flow equations. Funded through 'NRAP, National Risk Assessment Partnership' project by DOE-FE.