

COMMITTEE MEMBERSHIP - SERVICE

- Chair, Selection Committee for AGU Hydrologic Sciences Award, 2006-2008; 2011-Present.
- Member, Organizing Committee, Joint Meeting of the IEA Wellbore Integrity Network and IEA Modeling Network, Perth, Australia, 2011.
- Member, Advisory Board for CO₂ Capture Project (Phase 3), 2010-Present.
- 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.
- Member, Organizing Committee, Svalbard Workshop on Modeling and Risk Assessment of Geological Storage of CO₂, 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, Scientific Advisory Board, In Salah CO₂ Injection Project, BP, 2006-Present.
- 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.
- Member, Symposium Advisory Board, International Symposium on Site Characterization for CO₂ Geological Storage, Lawrence Berkeley Laboratory, March 2006.
- 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-Present.
- 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.
- Co-Editor, *Advances in Water Resources*, 1987-1997.

AUTHORSHIP

- Author and co-author of more than 189 publications in refereed journals.
- Author of two books

MULTI-SCALE MODELS FOR CO₂ INJECTION INTO DEEP SALINE AQUIFERS

HYDROLOGY DAYS AWARD LECTURE

COLORADO STATE UNIVERSITY

MARCH 22, 2012

MICHAEL A. CELIA

Theodora Shelton Pitney Professor of Environmental Studies

Professor of Civil and Environmental Engineering

Princeton University

Princeton, NJ

In recognition of outstanding contributions to hydrologic science in the areas of physics of multi-phase flow in porous media and its mathematical representation, computational subsurface flow hydrology, contaminant transport simulation, and eco-hydrology



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MULTI-SCALE MODELS FOR CO₂ INJECTION INTO DEEP SALINE AQUIFERS

MICHAEL A. CELIA

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Princeton University
Princeton, NJ

Abstract. Geological storage of carbon dioxide, as part of a Carbon Capture and Storage (CCS) strategy, is a promising technology for large-scale carbon mitigation. One of the many interesting challenges associated with this technology involves quantitative modeling of the injection, migration, long-term fate, and possible leakage of the CO₂ as well as fluids displaced by the injected CO₂. While several different kinds of formations may be targets for injection, deep saline aquifers have the largest storage capacity and are globally ubiquitous. As such, they are likely to be used for large-scale injection operations. Injection into deep saline aquifers involves two-phase flow with interphase mass transfer, strong gravity override, and unfavorable viscosity ratios. While the resulting problem can become quite complex mathematically, it may also be possible to simplify the system by taking advantage of characteristic length and time scales associated with the problem. These simplifications can be incorporated into a multi-scale modeling framework suitable for the CO₂ injection problem. In this presentation, multi-scale approaches that are specific to the CO₂ problem will be discussed, with a focus on models that take advantage of the strong buoyancy in the system. Example calculations will include injection studies for an aquifer underlying the North Sea, and injection and leakage studies for a specific set of formations in the Alberta Basin.

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

- Theodora Shelton Pitney Professor of Environmental Studies, 2008-Present.
- Chair, Department of Civil and Environmental Engineering, 2005-2011.
- Director, Program in Environmental Studies, 1998-2004.
- Director, Environmental Engineering and Water Resources Program, Princeton University, 1997-2003.
- Professor of Civil and Environmental Engineering, Princeton University, 1997-Present
- 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.

RECOGNITION AND AWARDS

- 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.