

MATTHEW D. COVINGTON

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Education:

Ph.D. (2008) Physics, University of California, Santa Cruz

Dissertation: *The production and evolution of scaling laws via galaxy merging*

Advisor: Professor Joel Primack, Distinguished Professor of Physics

B.S. (2002) Physics, University of Arkansas, Fayetteville, *Summa Cum Laude*

Honors thesis: *The Trebuchet: Physics, numerics, and connections to millennia of human activity*

B.A. (2002) Philosophy, University of Arkansas, Fayetteville, *Summa Cum Laude*

Honors thesis: *Quantum mechanics and libertarian free will*

Appointments:

Assistant Professor (starting August 2012) Department of Geosciences, University of Arkansas, Fayetteville

NSF International Research Fellow (2010-2012) Karst Research Institute, ZRC SAZU, Postojna, Slovenia. Host: Dr. Franci Gabrovšek

NSF Earth Sciences Postdoctoral Fellow (2008-2009) Department of Earth Sciences, University of Minnesota, Twin Cities. Hosts: Professor Carol Wicks and Professor Martin Saar, Gibson Chair of Hydrogeology and Geofluids

Research Interests:

My research employs analytical mathematical models, numerical simulations, and field data in the study of hydrological and geomorphological processes near earth's surface, with a focus on karst hydrological systems. Current and recent projects explore:

- reactive transport, heat exchange, and hydraulics in karst conduits and their importance in the determination of spring signals
- the evolution and dynamics of subglacial hydrological systems
- incision processes in soluble bedrock channels and the relative importance of mechanical and chemical processes
- sediment transport in karst landscapes
- CO₂ dynamics in karst systems
- the origin and evolution of galaxy scaling relations

Awards and Fellowships:

NSF International Research Fellowship (2010 – 2012)
NSF Earth Sciences Postdoctoral Fellowship (2008 – 2009)
National Speleological Society Cave Diving Section Exploration Award (2009)
(awarded to U.S. Deep Caving Team for exploration in Cueva J2)
University of California Santa Cruz Physics Department Dissertation Year
Fellowship (2008)
Lawrence Livermore National Lab-Institute for Geophysics and Planetary Physics
Graduate Fellowship (2006 – 2007)
NSF Graduate Research Fellowship (2002 – 2005)
University of Arkansas's 2002 Phi Beta Kappa Distinguished Scholar

Research Funding:

Variable flow and sediment transport in speleogenetic models (OISE-0754495)

PI: Matthew Covington
Host: Franci Gabrovšek
Funding agency: National Science Foundation, Office of International Science and
Engineering
Amount: \$144,824
Duration: 9/1/2010 – 8/31/2012

*Modeling the effects of variable recharge and conduit geometry on flow through karstic
aquifers (EAR-0816472)*

PI: Matthew Covington
Hosts: Carol Wicks and Martin Saar
Funding agency: National Science Foundation, Division of Earth Sciences
Amount: \$80,000
Duration: 11/1/2008 – 10/31/2009

Institute for Geophysics and Planetary Physics Mini Grant

PI: Matthew Covington
Co-PIs: Joel Primack (advisor), Wil van Breugel, and Peter Anninos
Funding agency: Institute for Geophysics and Planetary Physics – Lawrence
Livermore National Laboratory
Amount: \$10,000
Duration: Sept 2006 – Aug 2007

Proposed funding:

*Modeling the influence of sediment, climate, and tectonics on the incision of bedrock
channels through highly soluble strata*

PI: Matthew Covington
Funding agency: National Science Foundation, Division of Earth Sciences,
Geomorphology and Land Use Dynamics Program
Amount: \$262,795
Duration: 9/1/2012 – 8/31/2015

Constraining karst conduit network properties using signals observed at springs

PI: Matthew Covington
Funding agency: National Science Foundation, Division of Earth Sciences,
Hydrologic Sciences Program
Amount: \$302,586
Duration: 9/1/2012 – 8/31/2015

Service and Synergistic Activities:

Professional affiliations:

American Geophysical Union
European Geosciences Union
Geological Society of America
National Speleological Society

Requested reviewer:

Water Resources Research (3), Acta Carsologica (3), Hydrogeology Journal (1),
Journal of Hydrology (1), Journal of Cave and Karst Studies (1), Geophysical and
Astrophysical Fluid Dynamics (1), and NSF Hydrologic Sciences (1)

Educational Outreach:

- Taught guest lectures: one in a geomorphology course (U.C. Santa Cruz), two in a karst hydrogeology course (U. of Arkansas), and three in a fluid mechanics in earth sciences course (U. of Minnesota), 2008-2009
- Developed presentations on cave science and exploration given to a number of elementary school, middle school, high school, and college students
- Gave public talks combining stories of cave exploration and a message about the importance of cave and karst aquifer conservation
- Led a cave field trip for a cave ecology summer camp at the Ozark Natural Science Center

Other synergistic activities:

- Served on AGU Hydrology Groundwater Technical Committee, 2010-present
- Convened sessions at: North-Central/South-Central Section GSA Meeting, 2010 (speleology), Fall AGU Meeting, 2009 (karst and fractured hydrology), Fall AGU 2011 Meeting (karst hydrology and geomorphology)
- Participated in numerous cave exploration and mapping expeditions in Alaska, Sumatra, Peru, Mexico, Svalbard, Lechuguilla Cave, and Jewel Cave (1999-present)
- Co-led an exploration and scientific expedition to Cueva J2, Oaxaca, Mexico (2010)

Peer-Reviewed Publications:

1. Luhmann, A.J., **Covington, M.D.**, Alexander, S.C., Chai, S.Y., Schwartz, B.F., Groten, B.S., and E.C. Alexander, Jr. (in review). Comparing conservative and non-conservative tracers in karst and using them to estimate flow path geometry. *Journal of Hydrology*.
2. Porter, L.A., Somerville, R.S., Croton, D.J., **Covington, M.D.**, Graves, G.J., Faber, S.M., and J.R. Primack (in review). The effect of major mergers on age and metallicity across the fundamental plane. *Monthly Notices of the Royal Astronomical Society*.
3. **Covington, M.D.**, Luhmann, A., Wicks, C.M., and M.O. Saar (accepted). Process length scales and longitudinal damping in karst conduits. *Journal of Geophysical Research – Earth Surface*.
4. **Covington, M.D.**, Banwell, A.F., Gulley, J., Saar, M.O., and C.M. Wicks (2012). Quantifying the effects of glacier conduit geometry and recharge on proglacial hydrograph form. *Journal of Hydrology*, **414-415**, 59-71.
5. **Covington, M.D.**, Luhmann, A., Gabrovšek, F., Saar, M.O., and C.M. Wicks (2011). Mechanisms of heat exchange between water and rock in karst conduits. *Water Resources Research*, **47**, W10514.
6. **Covington, M.D.**, Primack, J.R., Porter, L., Croton, D., Somerville, R. and A. Dekel (2011). The role of dissipation in the scaling relations of cosmological merger remnants. *Monthly Notices of the Royal Astronomical Society*, **415** (4), 3135-3152.
7. Luhmann, A.J., **Covington, M.D.**, Peters, A.J., Alexander, S.C., Anger, C.T., Green, J.A., Runkel, A.C. and E.C. Alexander, Jr. (2011). Classification of thermal patterns at karst springs and cave streams. *Ground Water*, **49** (3), 324-335.
8. **Covington, M.D.**, Kassin, S.A., Dutton, A.A., Weiner, B.J., Cox, T.J., Jonsson, P., Primack, J.R., Faber, S.M., and D.C. Koo (2010). Evolution of the Stellar Mass Tully-Fisher Relation in Disk Galaxy Merger Simulations. *Astrophysical Journal*, **710** (1), 279-288.
9. **Covington, M.D.**, Wicks, C.M. and M.O. Saar (2009). A dimensionless number describing the effects of recharge and geometry on discharge from simple karstic aquifers. *Water Resources Research*, **45** (11), W11410.
10. **Covington, M.D.**, Dekel, A., Cox, T.J., Jonsson, P. and J.R. Primack (2008). Predicting the Properties of the Remnants of Dissipative Galaxy Mergers. *Monthly Notices of the Royal Astronomical Society*, **384** (1), 94-106.

Non peer-reviewed articles:

11. **Covington, M.D.**, Doctor, D.H., King, J.N., and C.M. Wicks (2011). Research in karst: A model for future directions in hydrologic science. *AGU Hydrology Section Newsletter*, Summer 2011 Issue.
12. **Covington, M.D.** (2010). Sistema J2-Last Bash: the 2010 J2 Expedition. *Association for Mexican Cave Studies Activities Newsletter*, **33**, 39-44.
13. **Covington, M.D.** (2010). J2: The Journey to Camp 4 – Beyond the Sump. *National Speleological Society News*, **68** (1), 11-14.

14. **Covington, M.D.** and M. Minton (2008). How to make a major cave connection in two weeks, or the shifting sands of time. *Association for Mexican Cave Studies Activities Newsletter*, **31**, 52-63.

Conference Presentations:

(* - indicates presenting author, † - indicates invited contribution)

Oral:

- Covington, M.D.***, Prelovšek, M. and F. Gabrovšek (2011). Longitudinal variation in dissolution rates in a cave stream: lessons from length scales. *2011 GSA Annual Meeting in Minneapolis (9–12 Oct)*.
- Luhmann, A.J.*, **Covington, M.D.**, and E.C. Alexander, Jr. (2011). Using a multi-tracer experiment to estimate flow path geometry. *2011 GSA Annual Meeting in Minneapolis (9–12 Oct)*.
- Covington, M.D.**, Luhmann, A.J., Saar, M.O., Wicks, C.M., and F. Gabrovšek (2011). Dimensionless metrics that characterize the relationships between signals observed at springs and karst aquifer geometry. *Proceedings of the 9th Conference on Limestone Hydrogeology, Besançon, France*, 107-110.
- Covington, M.D.**, Luhmann, A.J., Gabrovšek, F., Saar, M.O., and C.M. Wicks (2011). The relative importance of heat exchange mechanisms in karst conduits. *EGU General Assembly*, **13**, EGU2011-10017.
- Luhmann, A.J.*, **Covington, M.D.**, Alexander, S.C., Chai, S.Y. and E.C. Alexander, Jr. (2011). Comparison of discharge, conductivity, temperature, dye, deuterium, and turbidity responses from a multiple tracer test in karst. *12th Interdisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst*.
- Covington, M.D.***, Banwell, A., Gulley, J., Saar, M.O., Wicks, C.M., Willis, I.C. and N. Arnold (2010). Recharge-discharge relations for glacial conduit systems: a simple theoretical approach. *Eos Trans. AGU*, **91** (52), *Fall Meet. Suppl.*
- Covington, M.D.***, Luhmann, A.J., Wicks, C. M. and M.O. Saar (2010). Process length scales: a conceptual tool for karst hydrogeology, geomorphology, and hydroecology. *2010 GSA Annual Meeting in Denver (31 Oct – 3 Nov)*.
- Luhmann, A.J.*, **Covington, M.D.**, and E.C. Alexander, Jr. (2010). Thermograph recessions. *2010 GSA Annual Meeting in Denver (31 Oct–3 Nov)*.
- Covington, M.D.***, Myer, J., Luhmann, A.J., Wicks, C.M. and M.O. Saar (2010). Comparison of observed and modeled storm responses in a Minnesota cave stream: Connections between geometry and response. *North Central/South Central GSA Meeting in Branson (11-13 Apr)*.
- Covington, M.D.***, Wicks, C.M. and M.O. Saar (2009). Thermal signals as a means of characterizing karst aquifers. *Eos Trans. AGU*, **90** (52), *Fall Meet. Suppl.*
- Covington, M.D.*** (2007). Stellar-Mass Tully-Fisher Relation Evolution in Galaxy Merger Simulations. *Santa Cruz Galaxy Formation Workshop*.
- Covington, M.D.*** (2006). Predicting the Sizes of Merger Remnants. *Santa Cruz Galaxy Formation Workshop*.

Posters:

- Covington, M.D.* and F. Gabrovšek** (2011). Models of dissolution and mechanical erosion in bedrock channels in soluble strata. *Eos Trans. AGU*, **92** (52), *Fall Meet.*

Suppl.

Myre, J.M.*, **Covington, M.D.**, Luhmann, A.J., and M.O. Saar (2011). A GPGPU accelerated modeling environment for quantitatively characterizing karst systems. *Eos Trans. AGU*, **92** (52), *Fall Meet. Suppl.*

Covington, M.D.*† and A.J. Luhmann (2011). Water temperatures and heat transport in karst: a review of recent advances. *2011 GSA Annual Meeting in Minneapolis (9–12 Oct)*.

Myre, J.M.*, **Covington, M.D.**, Luhmann, A.J., and M.O. Saar (2011). Accelerating the characterization of karst aquifer systems. *2011 GSA Annual Meeting in Minneapolis (9–12 Oct)*.

Covington, M.D.*, Luhmann, A.J., Gabrovšek, F., Saar, M.O., and C.M. Wicks (2011). Water temperatures in cave streams and karst springs. *19th International Karstological School*.

Myre, J.M.*, **Covington, M.D.**, Walsh, S.D., Saar, M.O., Luhmann, A.J. and D. Lilja (2010). A GPU powered investigation of the relationship between observed and modeled storm responses of a Minnesota cave stream. *Eos Trans. AGU*, **91** (52), *Fall Meet. Suppl.*

Covington, M.D.*, Wicks, C.M. and M.O. Saar (2009). What's in a spring hydrograph? *2009 GSA Annual Meeting in Portland (18–21 Oct)*.

Covington, M.D.*, Walsh, S.D.C., Wicks, C.M. and M.O. Saar (2008). Modeling the effects of variable recharge and conduit geometry on flow through karstic aquifers. *Eos Trans. AGU*, **89** (52), *Fall Meet. Suppl.*

Covington, M.D.*, Dekel, A., and J.R. Primack (2007). Predicting the Properties of the Remnants of Galaxy Merger Simulations,” *Structure Formation in the Universe, Chamonix, France*.

Other Presentations:

Invited Departmental Seminars:

Université de Neuchâtel, Centre d'hydrogéologie, Jan 2012.

Technische Universität Dresden, Department of Hydrosociences (Dresdener Wasserseminar), June 2011.

University of Texas – Austin, Jackson School of Geosciences, Mar 2011.

University of Arkansas, Dept. of Geosciences, Jan 2011.

University of Minnesota – Twin Cities, Dept. of Geology and Geophysics, Feb 2010.

Louisiana State University, Dept. of Geology and Geophysics, Sept 2009.

University of Arkansas, Dept. of Geosciences, Oct 2009.

Max Planck Institute für Astrophysik, May 2007.

Public lectures on cave science and exploration:

Covington, M.D. (2009). Arduous exploration in one of the world's deepest cave systems. *Outdoor Adventure Expo*, Minneapolis, November 2009. (a version of this talk was also given at the University of Arkansas, LSU, the University of Ljubljana, and the University of Zagreb).

Covington, M.D. J2 2009: Beyond the Sump (2009). *International Congress of Speleology*.

Covington, M.D. and M. Minton (2007). The 2007 Huautla Expedition: Connecting Rio

- Iglesia to Sistema Huautla, *National Speleological Society Convention*.
- Covington, M.D.** (2007). High and Low Places in Lechuguilla Cave. *Stanford Alpine Club*.
- Covington, M.D.** (2005). Caving at High Altitude in the Peruvian Andes. *National Speleological Society Convention: International Exploration Session*.
- Covington, M.D. and Lane, J.** (2001). Gunung Ngalu Seribu, Sumatra: Mountain of 1000 Caves. *National Speleological Society Convention*.