

Curriculum Vitae – Paul Martin Rich (4 June 2009)

500 Hawks Peak Rd
Aptos, CA 95003 USA
tel: 831-661-0161 cell: 650-804-4423
fax: 650-644-3355
e-mail: paul@creeksidescience.com
web: <http://www.creeksidescience.com>

Experience

- 2006–2007 **Senior Scientist/Vice President**, Creekside Center for Earth Observation: ecology, conservation biology, environmental modeling, climate change, geographical information systems (GIS), data/model integration, decision support systems. Currently on medical leave.
- 2001–2006 **GIS Team Leader/Research Scientist**, Los Alamos National Laboratory, GISLab, Earth and Environmental Science Division
- 1991–2001 **Associate Professor** (1996–2001, **tenured**), Assistant Professor (1991–1996), University of Kansas (KU), Department of Ecology & Evolutionary Biology, Environmental Studies Program, and Kansas Biological Survey (with adjunct appointment in Department of Geography)

Education

- 1979–85 **Harvard University**, **M.A.** in Biology 1981, **Ph.D.** in Biology 1985. Dissertation: Mechanical architecture of arborescent rain forest palms in Costa Rica
- 1974–79 **University of California at Santa Cruz (UCSC)**, **B.A.** in Biology and Environmental Studies (double major) 1979, **highest honors**. Senior Thesis: Vegetation and flora of the UC Big Creek Reserve

Postdoctoral Experience

- 1990–91 National Science Foundation (NSF) Postdoctoral Fellow, University of California at Davis (with S.L. Ustin) and Forest Research Institute, New Zealand (with D.Y. Hollinger): plant canopy architecture and function, remote sensing.
- 1988–90 Postdoctoral Fellow, Stanford University Department of Biological Sciences (with H.A. Mooney): plant ecophysiology, close-range remote sensing, image analysis.
- 1986–88 Postdoctoral Fellow, Los Alamos National Laboratory Environmental Science Group (with F.J. Barnes): canopy architecture, remote sensing, image analysis.

Professional Interests and Experience: ecology, land stewardship, environmental modeling, biogeography, conservation biology, climate change, GIS, ecoinformatics, decision support; Author of >85 professional publications and 4 commercial software programs; Principal or Co-Principal Investigator for >60 scientific grants and contracts.

Professional Skills

- **Biological field studies:** vegetation sampling, experimental design, field-deployed sensors.
- **Ecology and population biology:** vegetation dynamics, ecophysiology, plant demography.
- **Education and outreach:** science curriculum development, web-based tools.

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- **Environmental modeling:** solar radiation, topoclimate, eco-hydrology, climate change.
- **GIS and ecoinformatics:** information management, data/model integration, visualization.
- **Image processing:** advanced algorithms, applications for study of plant canopies.
- **Software development:** design, advanced algorithms, programming, project coordination.
- **Spanish:** near fluent.

Administration

- **Communication:** presentations, reports, briefings, newsletters, web development
- **Financial management:** budget preparation, tracking, reporting, audit coordination
- **Land Stewardship:** conservation planning, adaptive management
- **Project administration:** planning, implementation, review, reporting
- **Seminar and special event organization:** planning, implementation, logistics
- **Supervision:** mentoring, task planning, team building, conflict resolution
- **Personnel assessment:** interim and annual evaluations, pay raise recommendations
- **Personnel recruitment:** search committee logistics, interviews, hiring procedures
- **Program development:** proposal preparation and submission, strategic planning

Honors and Awards: Best Paper of the Year Award, Journal of Map and Geography Libraries/Geoscapes (2008); Los Alamos Award for exemplary leadership (2006); Special Commendation for leadership of DOE Geospatial Science Steering Committee (2006); Los Alamos Spot Award (2004); Special Achievement in GIS, ESRI (2002); Best of Conference Interactive Poster, International Conference on Geospatial Information in Agriculture & Forestry (2000); First Place Analytical Poster, ESRI User Conference (1999); Armitage teaching award (1997); Commendation for role as chair of KU Departmental Long-Range Planning Committee (1994); NSF Postdoctoral Fellowship (1990-91); Stanford University Postdoctoral Fellowship (1988-90); Los Alamos Postdoctoral Fellowship (1986-88); Smithsonian Postdoctoral Fellowship (1986, declined); Jessie Noyes Fellowship through the Organization for Tropical Studies (1984-87); Smithsonian Tropical Research Institute Graduate Fellowship (1985-86); NSF Dissertation Improvement Grant (1984-85); Fulbright Fellowship (1983-85); Organization for Tropical Studies Fellowship (1982-83); Atkins Fellowship, Harvard (1982-83); Sigma Xi Award (1981-82); President's Undergraduate Fellowship, UCSC (1978-79); Chancellor's Research Award, UCSC (1977-78); Natural History Honors Program, UCSC (1976-79); Piedra Blanca Scholarship, UCSC (1974-75).

Teaching Experience

University of California at Santa Barbara: Biogeography; Vegetation Analysis; **University of Kansas:** Principles of Environmental Studies; Field Work in Environmental Studies; Field Ecology, Principles of Ecology; Advanced Ecology; GIS for Biology & Environmental Studies; Advanced GIS; Conservation and Wildlife Biology; Advanced Conservation Biology; **Organization for Tropical Studies:** resource person for Tropical Biology courses; **Harvard University:** Resident Tutor in Biology (John Winthrop House); Evolutionary Biology (TA for E.O. Wilson); Population Biology: Ecology (TA for W.H. Bossert); Population Biology: Evolution (TA for T.J. Givnish); **University of California at Santa Cruz:** Instructor for student directed seminar on the natural history of Big Creek Reserve (with K.S. Norris).

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Additional Experience

- 2002–2005 Visiting Professor, University of California, Santa Barbara, Dept of Geography
2003–2005 Adjunct Professor, University of New Mexico, Dept of Geography
1995–2002 Director, Helios Environmental Modeling Institute (HEMI), Tech Transfer LLC
2000–2001 Visiting Professor, University of California, Berkeley
1997–98 Visiting Professor, University of California, Santa Cruz (Sabbatical)
1987–88 Consultant, NSF Grant, Stanford University, serpentine soil ecosystems.
1986–92 Consultant, NSF Grant, OTS, Costa Rica: regeneration of tropical forest trees.
1985–86 Research Associate, Harvard University, Harvard Forest.
1985 Consultant, NASA, NSTL: canopy characterization in tropical forests, Costa Rica.
1979–85 Graduate Student, Resident Tutor in Biology, Harvard University, Department of Organismic and Evolutionary Biology: evolutionary ecology, botany, canopy architecture, plant morphology, biomechanics of trees.
1983–85 Fulbright Scholar, Costa Rica: morphology and ecology of rain forest trees.
1984–85 Research Assistant, LANL (with Dr. J.S. George): image processing.
1983 Research Assistant, LANL (with A. Yamazaki): nucleotide/protein separation.
1981 Research Assistant, Rocky Mountain Biological Laboratory (with J.M. Pleasants): pollination ecology and bumblebee foraging.
1978–79 Research Assistant, UCSC (with K.S. Norris): floristics and vegetation mapping for UC Big Creek Reserve.
1977–78 Research Assistant, UCSC (with B.J. LeBoeuf): behavior and population biology of elephant seals, Año Nuevo Island.

Publications

- Huang, S., P.M. Rich, R.L. Crabtree, C.S. Potter, and P. Fu. 2008. Modeling monthly near-surface air temperature from solar radiation and lapse rate: application over complex terrain in Yellowstone National Park, USA. *Physical Geography* 29: 158-178.
- Zou, C.B., D.D. Breshears, B.D. Newman, B.P. Wilcox, M.O. Gard, and P.M. Rich. 2008. Soil water dynamics under low- versus high- ponderosa pine tree density: ecohydrological functioning and restoration implications. *Ecohydrology* 1: 309-315.
- Rich, P.M., D.D. Breshears, and A.B. White. 2008. Phenology of mixed woody-herbaceous ecosystems following extreme events: net and differential responses. Special Feature on Phenology. *Ecology* 89:342-352.
- Bollinger, J.S., P.M. Rich, P.M., B. Bhaduri, and D.R. Bleakly. 2007. A brief history of geospatial science in the Department of Energy. *Journal of Map and Geography Libraries*, "Special Issue on Department of Energy (DOE) Geospatial Science Innovations" 4:5-28.
- Carr, T.R., P.M. Rich, and J.D. Bartley. 2007. The NATCARB geoportal: linking distributed data from the Carbon Sequestration Regional Partnerships. *Journal of Map and Geography Libraries*, "Special Issue on Department of Energy (DOE) Geospatial Science Innovations" 4:131-147.
- Rich, P.M., J.S. Bollinger, B. Bhaduri, and D.R. Bleakly. 2007. Perspective on Department of Energy geospatial science: past, present, and future. *Journal of Map and Geography Libraries*, "Special Issue on Department of Energy (DOE) Geospatial Science Innovations" 4:29-58.

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- Witkowski, M.S., P.M. Rich, and G.N. Keating. 2007. Metrics of success for Enterprise GIS. *Journal of Map and Geography Libraries*, "Special Issue on Department of Energy (DOE) Geospatial Science Innovations" 4:59-82.
- Goodchild, M.F., P. Fu, and P.M. Rich. 2007. Geographic information sharing: the case of the Geospatial One-Stop portal. *Annals of the Association of American Geographers* 97: 250-266.
- Mynard, C.R., G.N. Keating, and P.M. Rich. 2007. GIS community mutualism pays off in a New Mexico fire emergency. Chapter 2. *Fostering Collaboration and Communication*, pp. 39-49 In: Christopher Thomas (ed). *Standards for Success: GIS for Federal Progress and Accountability*. ESRI Press, Redlands, CA.
- Breshears, D.D., N.S. Cobb, P.M. Rich, K.P. Price, C.D. Allen, R.G. Balice, W.H. Romme, J.H. Kastens., M.L. Floyd, J. Belnap, J.J. Anderson, O.B. Myers, and C.W. Meyer. 2005. Regional vegetation die-off in response to global-change type drought. *Proceedings of the National Academy of Sciences* 102(42):15144-15148.
- Mynard, C.R., G.N. Keating, and P.M. Rich. 2005. GIS emergency support for the May 2000 Cerro Grande Wildfire, Los Alamos, NM. *Journal of Emergency Management* 3:19-28.
- Rich, P.M., L.H.Z. Weintraub, M.E. Ewers, T.L. Riggs, and C.J. Wilson. 2005. Decision support for water planning: the ZeroNet water-energy initiative. *Proceedings of the American Society of Civil Engineers - Environmental & Water Resources Institute (ASCE-EWRI) "World Water and Environmental Resources Congress 2005: Impacts of Global Climate Change"*, May 15-19, Anchorage, AK. LA-UR-05-1068.
- Wang, J., P.M. Rich, K.P. Price and W.D. Kettle. 2005. Relations between NDVI, grassland production, and crop yield. *Geocarto International* 20:1-7.
- Weintraub, L.H.Z., L. Chen, P.M. Rich, J. Herr, and R. Goldstein. 2005. Assessment of climate change and water management in the San Juan Basin. *Proceedings of the AWRA Annual Water Resources Conference, Seattle, Washington, November 7-10, 2005*. LA-UR-05-5610.
- Wang, J., P.M. Rich, K.P. Price and W.D. Kettle. 2004. Relations between NDVI and tree productivity in the central Great Plains. *International Journal of Remote Sensing* 25:3127-3138.
- Keating, G.N., P.M. Rich, and M.S. Witkowski. 2003. Challenges for enterprise GIS. *URISA* 15:23-36.
- Mynard, C.R., G.N. Keating, P.M. Rich, and D. Bleakly. 2003. GIS emergency support for the May 2000 Cerro Grande Wildfire, Los Alamos, New Mexico. LA-14007-MS.
- Witkowski, M.S., P.M. Rich, and G.N. Keating. 2003. A Prototype for Enterprise GIS, Los Alamos National Laboratory Report, LA-14027, Los Alamos, NM.
- Wang, J., P.M. Rich, and K.P. Price. 2003. Temporal responses of NDVI to precipitation and temperature in the central Great Plains, USA. *International Journal of Remote Sensing* 24:2345-2364.
- Fu, P., and P.M. Rich. 2002. A geometric solar radiation model with applications in agriculture and forestry. *Computers and Electronics in Agriculture* 37:25-35.
- Keating, G.N., P.M. Rich, and M.S. Witkowski. 2002. Challenges for enterprise GIS in post-wildfire hazard mitigation and emergency response. Los Alamos National Laboratory Report. LA-13930-MS, Los Alamos, NM.
- Wang, J., K.P. Price, and P.M. Rich. 2001. Spatial patterns of NDVI in response to precipitation and temperature in the central Great Plains. *International Journal of Remote Sensing* 22: 3827-3844.

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- Rich, P.M. and P. Fu. 2000. Enlightenment for mapping systems: solar radiation models look to the sun for answers. *Resource Magazine* 6(2):7-8.
- Rich, P.M. and P. Fu. 2000. Topoclimatic habitat models. *Proceedings of the Fourth International Conference on Integrating GIS and Environmental Modeling*.
- Fu, P., P.M. Rich, and J. Wang. 2000. Integration of GIS with user models. *Proceedings of the Twentieth Annual ESRI User Conference*.
- Fu, P. and P.M. Rich. 2000. *The Solar Analyst user manual*. Helios Environmental Modeling Institute, USA.
- Fu, P. and P.M. Rich. 2000. A geometric solar radiation model and its applications in agriculture and forestry. *Proceedings of the Second International Conference on Geospatial Information in Agriculture and Forestry*. I-357-364.
- Kettle, W.D., P.M. Rich, K. Kindscher, G.L. Pittman, and P. Fu. 2000. Land-use history considerations in ecosystem restoration: a 40-year study in the prairie-forest ecotone. *Restoration Ecology* 8(3):307-317.
- Rich, P.M., J. Wood, D.A. Vieglais, K. Burek, and N. Webb. 1999. *Guide to HemiView: software for analysis of hemispherical photography*. Delta-T Devices, Ltd., Cambridge, England.
- Fu, P. and P.M. Rich. 1999. *TopoView user manual*. Helios Environmental Modeling Institute, USA.
- Fu, P. and P.M. Rich. 1999. Design and implementation of the Solar Analyst: an ArcView extension for modeling solar radiation at landscape scales. *Proceedings of the Nineteenth Annual ESRI User Conference*.
- Yao, J., R.D. Holt, P.M. Rich, and W.S. Marshall. 1999. Woody plant colonization in an experimentally fragmented habitat. *Ecography* 22:715-728.
- Sanchez, A., P.M. Rich, T. Peterson, J. Jimenez, and M. Anthony. 1998. *Proceedings of the Costa Rica Workshop on Management of Geospatial Metadata*, San Jose, Costa Rica.
- Breshears, D.D., P.M. Rich, F.J. Barnes, and K. Campbell. 1997. Overstory-imposed heterogeneity in solar radiation and soil moisture in a semiarid woodland. *Ecological Applications* 7:1201-1215.
- Chen, J.M., P.M. Rich, S.T. Gower, J.M. Norman, and S. Plummer. 1997. Leaf area index of boreal forests: theory, techniques, and measurements. *Journal of Geophysical Research, BOREAS Special Issue* 102(D24):29429-29444.
- Fournier, R.A., P.M. Rich, and R. Landry. 1997. Hierarchical characterization of canopy architecture for boreal forest. *Journal of Geophysical Research, BOREAS Special Issue* 102(D24):29445-29454.
- Bellingham, P.J., E.V.J. Tanner, P.M. Rich, and T.C.R. Goodland. 1996. Changes in light below the canopy of a Jamaican montane rain forest after a hurricane. *Journal of Tropical Ecology* 12:699-722.
- Clark, D.B., D.A. Clark, P.M. Rich, S.B. Weiss, and S.F. Oberbauer. 1996. Landscape-scale evaluation of understory light and canopy structure: methods and application in a neotropical lowland rain forest. *Canadian Journal of Forest Research* 26:747-757.
- Dubayah, R. and P.M. Rich. 1996. GIS-based solar radiation modeling. pp 129-134 In: M.F. Goodchild, L.T. Steyaert, B.O. Parks, C. Johnston, D. Maidment, M. Crane, and S. Glendinning (eds). *GIS and environmental modeling: progress and research issues*. GIS World Books. Fort Collins, CO.

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- Rich, P.M., N.M. Holbrook, and N. Luttinger. 1995. Leaf development and crown geometry of two iriarteoid palms. *American Journal of Botany* 82:328–336.
- Rich, P.M., W.A. Hetrick, S.C. Saving. 1995. Modeling topographic influences on solar radiation: a manual for the SOLARFLUX model. Los Alamos National Laboratory Report LA-12989M.
- Rich, P.M., J. Chen, S.J. Sulatycki, R. Vashisht, and W.S. Wachspress. 1995. Calculation of leaf area index and other canopy indices from gap fraction: a manual for the LAICALC software. Kansas Applied Remote Sensing Program Open File Report. Univ of Kansas. Lawrence, KS.
- Dubayah, R. and P.M. Rich. 1995. Topographic solar radiation models for GIS. *International Journal of Geographic Information Systems* 9:405–419.
- Fournier, R.A., P.M. Rich, Y.R. Alger, V.L. Peterson, R. Landry, and N.M. August. 1995. Canopy architecture of boreal forests: links between remote sensing and ecology. *American Society for Photogrammetry and Remote Sensing Technical Papers*, Vol. 2. pp 225–235.
- Price, K.P., P.M. Rich, and R.L. O'Neal. 1995. Deriving high resolution canopy digital elevation models. *American Society for Photogrammetry and Remote Sensing Technical Papers*, Vol. 2. pp 281–289.
- Rich, P.M., R. Dubayah, W.A. Hetrick, and S.C. Saving. 1994. Using viewshed models to calculate intercepted solar radiation: applications in ecology. *American Society for Photogrammetry and Remote Sensing Technical Papers*. pp 524–529.
- Saving, S.C., W.A. Hetrick, P.M. Rich, A.D. Weiss, S.B. Weiss. 1994. Physiographic inventory methodology. *Proceedings of the Fourteenth Annual ESRI User Conference*.
- Rich, P.M., D.A. Clark, D.B. Clark, and S.F. Oberbauer. 1993. Long-term study of solar radiation regimes in a tropical wet forest using quantum sensors and hemispherical photography. *Agricultural and Forest Meteorology* 65:107–127.
- Rich, P.M., G.S. Hughes, and F.J. Barnes. 1993. Using GIS to reconstruct canopy architecture and model ecological processes in pinyon–juniper woodlands. *Proceedings of the Thirteenth Annual ESRI User Conference*, Volume 2. pp 435–445.
- Chapman, S.B., W.D. Kettle, and P.M. Rich. 1993. Assessing shrub distribution and impact in tallgrass prairie using aerial and ground-based mapping. *American Society for Photogrammetry and Remote Sensing Technical Papers*, Vol 2, Remote Sensing. pp 13–20.
- Clark, D.B., D.A. Clark, and P.M. Rich. 1993. Comparative analysis of microhabitat utilization by saplings of nine tree species in neotropical rain forest. *Biotropica* 25:397–407.
- Hetrick, W.A., P.M. Rich, and S.B. Weiss. 1993. Modelling insolation on complex surfaces. *Thirteenth Annual ESRI User Conference*, Volume 2. pp 447–458.
- Hetrick, W.A., P.M. Rich, and F.J. Barnes, and S.B. Weiss. 1993. GIS-based solar radiation flux models. *American Society for Photogrammetry and Remote Sensing Technical Papers*, Vol 3 GIS Photogrammetry and Modeling. pp 132–143.
- Oberbauer, S.F., D.B. Clark, D.A. Clark, P.M. Rich, and G. Vega. 1993. Light environment, gas exchange, and annual growth of saplings of three species of rain forest trees in Costa Rica. *Journal of Tropical Ecology* 9:511–523.
- Saving, S.C., P.M. Rich, S.B. Weiss, and J.T. Smiley. 1993. GIS-based microclimate models for assessment of habitat quality in natural reserves. *American Society for Photogrammetry and Remote Sensing Technical Papers*, Vol 3 GIS Photogrammetry and Modeling. pp 319–330.
- Rich, P.M., S.B. Weiss, D.A. Debinski, and J.F. McLaughlin. 1992. Physiographic inventory of a tropical reserve. *Proceedings of the Twelfth Annual ESRI User Conference*. pp 197–208.

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- Galo, A.T., P.M. Rich, and J.J. Ewel. 1992. Effects of forest edges on the solar radiation regime in a series of reconstructed tropical ecosystems. American Society for Photogrammetry and Remote Sensing Technical Papers. pp 98–108.
- Lerdau, M.T., Holbrook, N.M., H.A. Mooney, P.M. Rich, and J.L. Whitbeck. 1992. Seasonal patterns of acid fluctuations and resource storage in the arborescent cactus *Opuntia excelsa* in relation to light availability and size. *Oecologia* 92:166–171.
- Lin, T., P.M. Rich, D.A. Heisler, and F.J. Barnes. 1992. Influences of canopy geometry on near-ground solar radiation and water balances of pinyon–juniper and ponderosa pine woodlands. American Society for Photogrammetry and Remote Sensing Technical Papers. pp 285–294.
- McLaughlin, J.F., S.B. Weiss, Rich, P.M., and D.A. Debinski. 1992. Roles of GIS in conservation. Proceedings of the Twelfth Annual ESRI User Conference. pp 237–247.
- Rich, P.M. and S.B. Weiss. 1991. Spatial models of microclimate and habitat suitability: lessons from threatened species. Proceedings of the 11th Annual ESRI User Conference. pp 95–99.
- Weiss, S.B., P.M. Rich, D.D. Murphy, W.H. Calvert, P.R. Ehrlich. 1991. Forest canopy structure at overwintering monarch butterfly sites: measurements with hemispherical photography. *Conservation Biology* 5:165–175.
- Rich, P.M. 1990. Characterizing plant canopies with hemispherical photographs. In: N.S. Goel and J.M. Norman (eds). Instrumentation for studying vegetation canopies for remote sensing in optical and thermal infrared regions. *Remote Sensing Reviews* 5:13–29.
- Larkin, T.H., P. A. Johnson, P.M. Rich, G. Eiseid, and W.S. Phillips. 1990. Cross-borehole elastic wave imaging of sediments. *IEEE Transactions on Geoscience and Remote Sensing* 28:922–931.
- Rich, P.M. 1989. A manual for analysis of hemispherical canopy photography. Los Alamos National Laboratory Report LA–11733–M.
- Rich, P.M., D.M. Ranken, and J.G. George. 1989. A manual for microcomputer image analysis. Los Alamos National Laboratory Technical Report LA–11732–M.
- Neufeld, H.S., D.T. Tingey, P.M. Rich, and D. Durall. 1989. A rootbox for quantitative observations on intact entire root systems. *Plant and Soil* 117:295–298.
- Rich, P.M. 1988. Video image analysis of hemispherical canopy photography. pp 84–95 In: P.W. Mausel (ed). First Special Workshop on Videography, Terre Haute, Indiana, May 19–20, 1988. American Society for Photogrammetry and Remote Sensing.
- Rich, P.M. 1987. Mechanical structure of the stem of arborescent palms. *Botanical Gazette* 148:42–50.
- Rich, P.M. 1987. Developmental anatomy of the stem of *Welfia georgii*, *Iriarteia gigantea*, and other arborescent rainforest palms: implications for mechanical support. *American Journal of Botany* 74:792–802.
- Rich, P.M., S. Lum, L. Muñoz, and M. Quesada. 1987. Shedding of vines by the palms *Welfia georgii* and *Iriarteia gigantea*. *Principes* 31:31–40.
- Rich, P.M. 1986. Mechanical architecture of arborescent rainforest palms. *Principes* 30:117–131.
- Rich, P.M., K. Helenurm, D. Kearns, S. Morse, M. Palmer, L. Short. 1986. Height and stem diameter relationships for dicotyledonous trees and arborescent palms of Costa Rican tropical wet forest. *Bulletin of the Torrey Botanical Club* 113:241–246.
- Rich, P.M. 1985. Mechanical architecture of arborescent rain forest palms in Costa Rica. Ph.D. Dissertation. Harvard University.
- Bickford, C. and P.M. Rich. 1979. Vegetation and flora of the Landels–Hill Big Creek Reserve, California. Environmental Field Program Publication 2. UCSC.

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Book Reviews

- Rich, P.M. 1995. Plant scaling analysis — book review of Plant allometry: the scaling of form and process, by Karl J. Niklas (1994). *Ecology* 76:2342.
- Rich, P.M. and P.D. Shemitz. 1992. Book review — the subsidy from nature: palm forests, peasantry, and development of an Amazon frontier, by A.B. Anderson, P.H. May, and M.J. Balick. *Plant Science Bulletin* 38:17–18.

Textbook

- Miller, G.T. and P.M. Rich. 1999. Ecology, ecosystems, and food webs. Chapters 4-10, pp. 80-250, Chapters 23-26, pp. 610-748 In: *Living in the Environment* (11th ed.). Brooks/Cole, Pacific Grove, CA. (the most widely used Environmental Studies text)

Popular Articles

- Rich, P.M. 2005. The basics of biodiversity. *Climate Education Update Newsletter*, January 2005 Special Issue.
- Rich, P.M. 2005. Why should we care about biodiversity? *Climate Education Update Newsletter*, January 2005 Special Issue.
- Rich, P.M. 2005. Teaching about biodiversity. *Climate Education Update Newsletter*, January 2005 Special Issue.

Web Sites

- Rich, P.M., and S.B. Weiss. 2006-2007. Web site for Creekside Center for Earth Observation (<http://www.creeksidescience.com>)
- Rich, P.M., T.J. McTighe, M.S. Witkowski, C.R. Mynard, and G.N. Keating. 2001–2006. Web site for GISLab, LANL.
- Rich, P.M., P. Fu, W. Marshall, and C. Hays. 1996–2001. Web site for the GIS & Environmental Modeling Laboratory (GEMLab), KU.
- Rich, P.M., P. Fu, W.D. Kettle, and C. Hays. 1998–2001. Web site for the Kansas Ecological Reserves (KER). and online GIS database, KU.
- Rich, P.M., P. Fu, C. Hays, and S. Geer. 1999-2001. Web site for the Kansas Biological Survey (KBS), KU.

Commercial Software/Technology Transfer

- ESRI. 2004-2007. collaborator on development of Solar Tools; GIS-based model of solar radiation incident on topographic surfaces (ArcGIS 9.x).
- Fu, P. and Rich, P.M. copyright 2000. The Solar Analyst; GIS-based model of solar radiation incident on topographic surfaces (ArcView extension).
- Fu, P. and Rich, P.M. copyright 1999/2000. TopoView; GIS-based model of solar radiation incident on topographic surfaces (stand-alone).
- Vieglais, D.A. and Rich, P.M. 1998. Hemiview (copyright 1998); hemispherical photography.

Scientific Software

- Rich, P.M., J.M. Chen, S.J. Sulatycki, R. Vashisht, and W.S. Wachspress. copyright 1995. LAICALC; calculation of leaf area index and other canopy indices.
- Hetrick, W.A. and P.M. Rich. copyright 1992. Solarflux; GIS-based insolation model.

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Rich, P.M. 1988. Canopy/Sun/Sky (copyright 1988-98); analysis of hemispherical photography.
Rich, P.M. and D.M. Ranken. copyright 1988-98. IMAGE; general image analysis.

Presentations for Professional Meetings and Symposia

- Breshears, D.D., C.B. Zou, G. Barron-Garrod, H. Adams, T. Huxman, S. Miao, P.M. Rich, and A.B. White. 2007. An ecohydrological perspective of drought-triggered vegetation die-off and land-surface changes. American Geophysical Union, Fall Meeting, December 10-14, 2007, San Francisco, CA.
- Rich, P.M., S.B. Weiss, and A.E. Launer. 2007. Influence of solar exposure on stream water temperature: implications for conservation. American Geophysical Union, Fall Meeting, December 10-14, 2007, San Francisco, CA.
- White, A.B., D. Pasqualini, E.P. Springer, P.M. Rich, and D.D. Breshears. 2007. Dissecting the causes and effects of a climate-induced regional-scale tree mortality event. Ninth Biennial Conference of Research on the Colorado Plateau, October 29-November 1, 2007, Flagstaff, AZ.
- Rich, P.M., S.B. Weiss, and A.E. Launer. 2007. Steelhead, turtles, and frogs: Temperature dynamics of stream habitat. Ecological Society of America Annual Meeting, August 5-10, San Jose, CA.
- White, A.B., P.M. Rich, D. Pasqualini, N. McDonald, and D.D. Breshears. 2007. Causes and impacts of woody canopy dieoff in a semi-arid woodland: role of climate, pathogens, and phenology. Ecological Society of America Meeting, August 5-10, San Jose, CA.
- Rich, P.M., D.D. Breshears, and A.B. White. 2006. Impacts of extreme events on phenology: drought-induced changes in productivity of mixed woody-herbaceous ecosystems. American Geophysical Union Meeting, December 11-15, 2006, San Francisco, CA.
- White, A.B., P.M. Rich, and D. Pasqualini. 2006. Drought-induced tree mortality in piñon-juniper woodlands. American Geophysical Union Meeting, December 11-15, 2006, San Francisco, CA.
- Carr, T.R., P.M. Rich, J.D. Bartley, and G.N. Keating. 2006. Carbon cyberinfrastructure: the future of NatCarb. Fifth Annual DOE NETL Conference on Carbon Capture and Sequestration, May 8-11, 2006, Alexandria, VA.
- Keating, G.N., R.S. Middleton, M.S. Witkowski, T. McTighe, H.S. Viswanathan, P.H. Stauffer, and P.M. Rich. 2006. Integration of CO₂ sequestration system model and diverse geospatial data using stand-alone GIS applications. Fifth Annual DOE NETL Conference on Carbon Capture and Sequestration, May 8-11, 2006, Alexandria, VA. LA-UR-06-0676.
- Breshears, D.D., N.S. Cobb, P.M. Rich, K.P. Price, C.D. Allen, R.G. Balice, W.H. Romme, J.H. Kastens., M.L. Floyd, J. Belnap, J.J. Anderson, O.B. Myers, and C.W. Meyer. 2006. Regional vegetation die-off in response to global-change type drought. LANL Earth Day Poster Session, April 20-22, 2006. LA-UR-06-0957.
- Rich, P.M., L.H.Z. Weintraub, M.E. Ewers, L. Chen, C.J. Wilson, and V.C. Tidwell. 2006. Water management for energy: San Juan decision tools. LANL Earth Day Poster Session, April 20-22, 2006. LA-UR-05-2200.
- J.S. Bollinger, R.P. Addis, L.D. Koffman, C.H. Hunter, P.M. Rich, and R.L. Buckley. 2006. Geospatial science and atmospheric modeling for emergency response. Annual Information Management Conference (AIMC), March 22, 2006, Austin TX.

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- Rich, P.M. 2006. Los Alamos National Laboratory geospatial science portfolio. Contribution to DOE Geospatial Science Portfolio continuous-loop slide show, DOE Geospatial Science Expo, January 30 to February 10, 2006, Washington, DC. (multi-media)
- Rich, P.M., and T.R. Carr. 2006. "Carbon Sequestration Regional Partnerships" and "NATCARB Geoportal". Contribution to "DOE Geospatial Science Portfolio" continuous-loop slide show, DOE Geospatial Science Expo, January 30 to February 10, 2006, Washington, DC. (multi-media)
- Rich, P.M., L.H.Z. Weintraub, M.E. Ewers, L. Chen, C.J. Wilson, and V.C. Tidwell. 2006. Water management for energy: San Juan Decision Tools. DOE Geospatial Science Expo, January 30 to February 10, 2006, Washington, DC. LA-UR-05-5609.
- Rich, P.M., D.D. Breshears, K.P. Price, N.S. Cobb, J.H. Kastens, R.G. Balice, and C.D. Allen. 2006. Drought-induced mortality in semiarid woodlands. DOE Geospatial Science Expo, January 30 to February 10, 2006, Washington, DC. LA-UR-06-0957.
- Carr, T.R., and P.M. Rich. 2006. GIS support for DOE Regional Carbon Sequestration Partnerships. DOE Geospatial Science Expo, January 30 to February 10, 2006, Washington, DC.
- Rich, P.M. 2006. Mapping the mission: geospatial science at Los Alamos National Laboratory. Joint meeting of DOE Geospatial Science Program Management Office (GS-PMO) and the Geospatial Science Steering Committee (GSSC), January 30, 2006, Washington, DC.
- Rich, P.M., L.H.Z. Weintraub, L. Chen, J. Herr, and C.J. Wilson. 2005. Climate change impacts on hydrology and water management of the San Juan Basin. American Geophysical Union Meeting, December 5-9, 2005, San Francisco, CA. LA-UR-05-7096.
- Weintraub, L.H.Z., L. Chen, C.W. Chen, J.W. Herr, P.M. Rich, and R.A. Goldstein. 2005. Decision Support System (DSS) for the effects of climate change on water supply in San Juan River Basin. U.S. Climate Change Science Program Workshop, Arlington, Virginia, November 14-16, 2005. LA-UR-05-5610.
- Weintraub, L.H.Z., L. Chen, P.M. Rich, J. Herr, and R. Goldstein. 2005. Assessment of climate change and water management in the San Juan Basin. AWRA Annual Water Resources Conference, Seattle, Washington, November 7-10, 2005. LA-UR-05-5610.
- Breshears, D.D., N.S. Cobb, P.M. Rich, K.P. Price, C.D. Allen, R.G. Balice, W.H. Romme, J.H. Kastens, M.L. Floyd, J. Belnap, J.J. Anderson, O.B. Myers, and C.W. Meyer. 2005. Regional vegetation die-off in response to global-change type drought. Eighth Biennial Conference of Research on the Colorado Plateau, November 7-10, Flagstaff, CO.
- Rich, P.M., L.H.Z. Weintraub, M.E. Ewers, L. Chen, C.J. Wilson, and V.C. Tidwell. 2005. Water management for energy: San Juan decision tools. Border Energy Forum, October 15, Los Alamos, NM. LA-UR-05-2200.
- Rich, P.M., L.H.Z. Weintraub, M.E. Ewers, L. Chen, C.J. Wilson, and V.C. Tidwell. 2005. Decision support system for water management of the San Juan Basin. NM Office of the State Engineer 2005 Drought Summit, October 6, 2005, Santa Fe, NM. LA-UR-05-2200.
- Rich, P.M., D.D. Breshears, K.P. Price, N.S. Cobb, J.H. Kastens, R.G. Balice, and C.D. Allen. 2005.: Drought-induced mortality in semiarid woodlands. NM Office of the State Engineer 2005 Drought Summit, October 6, 2005, Santa Fe, NM. LA-UR-04-5144.
- Rich, P.M., L.H.Z. Weintraub, M.E. Ewers, L. Chen, C.J. Wilson, and V.C. Tidwell. 2005. Decision support system for water management of the San Juan Basin. Conference on "Managing Landscapes and Watersheds for Water Resources", September 21-22, Santa Fe, NM. LA-UR-05-2200.

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- Rich, P.M., M.E. Ewers, C.J. Wilson, L.H.Z. Weintraub, and J. Herr. 2005. Watershed and water planning Tools for the San Juan Basin: Outcomes from the ZeroNet Water for Energy Project. ZeroNet Stakeholder Meeting, September 7, 2005, Farmington, NM.
- Ewers, M.E., L.H.Z. Weintraub, Rich, P.M., L.Chen, C.J. Wilson, and V.C. Tidwell. 2005. Basin scale models of climate, hydrology, and water management: decision support tools for the San Juan Basin. New Mexico Water Research Symposium "Advances in Hydrology: Methods and Instruments", Socorro, NM, August 16, 2005. LA-UR-05-2200.
- Rich, P.M., L.H.Z. Weintraub, M.E. Ewers, and L.Chen. 2005. Basin scale models of climate, hydrology, and water management: the ZeroNet scenario library for the San Juan Basin. Ecological Society of America 90th Annual Meeting, August 7-12, 2004, Montréal, Canada. LA-UR-05-2200.
- Rich, P.M. 2005. GIScience approaches / earth and environment applications. UCSB/LANL Collaboration Workshop; Santa Barbara, CA; Aug 1-2, 2005. LA-UR-05-5711.
- Keating, G.N., P.M. Rich, M.S. Witkowski, and H.S.Viswanathan. 2005. GIS knowledge integration for carbon sequestration: the cyberinfrastructure approach. Fourth Annual Conference on Carbon Capture and Sequestration, May 2-5, 2005, Alexandria, VA.
- Rich, P.M., M.E. Ewers, T.L. Riggs, L.H.Z. Weintraub, and C.J. Wilson. 2005. Decision support for water planning: the ZeroNet water-energy initiative American Society of Civil Engineers - Environmental & Water Resources Institute (ASCE-EWRI) "World Water and Environmental Resources Congress 2005: Impacts of Global Climate Change", May 15-19, Anchorage, AK. LA-UR-04-7593.
- Keating, G.N., T.L. Riggs, P.M. Rich, M.S. Witkowski, and H.S. Viswanathan. 2005. GIS-Based Decision Support for Carbon Sequestration. Chapman Conference, The Science and Technology of Carbon Sequestration, January 16-20, 2005, San Diego, CA. LA-UR-04-7595.
- Rich, P.M., G.N. Keating, T.L. Riggs, and M.S. Witkowski. 2005. A vision for carbon cyberinfrastructure. Chapman Conference, The Science and Technology of Carbon Sequestration, January 16-20, 2005, San Diego, CA. LA-UR-04-7594.
- Bollinger, J.S., S.M. Hargrove, Rich, P.M., L. Brady-Sabeff, D. Collette, A. Guber, M. Klein, J. Kuiper, J. Lee, R. Lee, K. Mickus, D. Morehouse, K. Moore, A. Ramsdell, S. Rush, J. Stewart, H. Walker, R. Wells. 2004. The DOE GIS Core Team. DOE Annual Information Management Conference, Columbus, OH.
- Wilson, C.J., L.H.Z. Weintraub, M.E. Ewers, and P.M. Rich. 2004. ZeroNet water-energy initiative. ZeroNet Stakeholder Meeting, October 26, 2004, Farmington, NM. LA-UR-04-7532
- Cobb, N.S., D.D. Breshears, P.M. Rich, K.P. Price, L. Floyd-Hannah, W. Romme, J. Belnap, J. Anderson, R.G. Balice, and C.D. Allen. 2004. Rapid regional ecosystem reset: a first look at impacts of global change type drought. Ecological Society of America Annual Meeting, Portland, OR.
- Rich, P.M., R. Lee, and K. Updegraff. 2005. Big Sky GIS progress. DOE Regional Carbon Sequestration Partnerships Annual Program Review, Nov 16-17, 2004, Pittsburgh, PA. LA-UR-04-8229.

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- Rich, P.M., and M.S. Witkowski. 2004. Decision support tools. ZeroNet Kickoff Meeting, August 30-31, 2004, Albuquerque, NM. LA-UR-04-5991.
- Rich, P.M. and R.K. Neff. 2004. GIS at Los Alamos National Laboratory: the Role of the CIO Office. ESRI Federal GIS User Conference.
- Rich, P.M., D.A. Breshears, K.P. Price, N. Cobb, J. Kastens, C. Allen, and R. Balice. 2004. Drought-induced mortality in semiarid woodlands. NMGIC Fall Meeting, Conservation and Environmental GIS, October 8, 2005, Albuquerque, NM. LA-UR-04-7035.
- Rich, P.M., D.D. Breshears, and K.P. Price. 2004. Assessing drought-induced mortality in semiarid woodlands with remotely sensed NDVI: from local to regional scales. Ecological Society of America Annual Meeting. Portland, OR.
- Rich, P.M., D.D. Breshears, K.P. Price, N.S. Cobb, J.H. Kastens, R.G. Balice, and C.D. Allen. 2004. Drought-induced mortality in semiarid woodlands: assessing regional consequences of climate change. ESRI International User Conference, San Diego.
- Rich, P.M., J.S. Bollinger, S.M. Hargrove, L. Brady-Sabeff, D. Collette, A. Guber, M. Klein, J. Kuiper, J. Lee, R. Lee, K. Mickus, D. Morehouse, K. Moore, A. Ramsdell, S. Rush, J. Stewart, H. Walker, R. Wells. 2004. The DOE GIS Core Team. ESRI International User Conference, San Diego.
- Rich, P.M., T.L. Riggs, M.S. Witkowski, and G.N. Keating 2004. Toward enterprise GIS design for DOE. Invited talk for DOE GIS User Group Meeting. at ESRI International User Conference, San Diego.
- Rich, P.M. and R.K. Neff. 2003. Institutional GIS at Los Alamos National Laboratory: the Role of the CIO Office. LANL GIS Day.
- Fu, P., and Rich, P.M. 2003. Assessing topographic influences on incoming solar radiation at landscape scales. Symposium on the Gunnison Basin as a Model Ecosystem. Rocky Mountain Biological Laboratory, Gothic, CO.
- Rich, P.M., and P. Fu. 2003. Topoclimatic habitat models for complex terrain. Symposium on the Gunnison Basin as a Model Ecosystem. Rocky Mountain Biological Laboratory, Gothic, CO.
- Mynard, C.R., P.M. Rich, and G.N. Keating. 2003. Lessons from Adversity: GIS Response to the Cerro Grande Wildfire. ESRI User Conference, San Diego, CA.
- Rich, P.M., J. Dozier, S.B. Weiss, and J.I. Metz. 2003. Next generation solar models for ArcGIS. ESRI User Conference, San Diego, CA.
- Rich, P.M., T.L. Riggs, and M.S. Witkowski. 2002. Solar radiation interception, microclimate, and water balance in complex terrain. Chapman Conference, Eco-hydrology of Semiarid Landscapes: Interactions and Processes. Taos, NM, September 9-13, 2002.
- Rich, P.M., T.L. Riggs, and M.S. Witkowski. 2002. Solar radiation interception, microclimate, and water balance in complex terrain. American Geophysical Union, Fall Conference, San Francisco, CA, December 6-10, 2002.
- Weiss, S.B., Luth, D.C., Metz, J.I., P.M. Rich, and J. Dozier. 2003. Precision viticulture for fine wine: a grape's eye view. ESRI User Conference, San Diego, CA.
- Witkowski, M.S., and P.M. Rich. 2003. GIS as a way to integrate data and simulation. Earth and Environmental Science Prediction Workshop, Los Alamos National Laboratory.
- Witkowski, M.S., P.M. Rich, and G.N. Keating. 2002. Spatial data warehouse design for enterprise GIS. GIScience, Second International Conference on Geographic Information Science, Boulder, CO.

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- Rich, P.M., and P. Fu. 2002. Topoclimatic models for complex terrain. ESRI Annual User Conference. San Diego, CA.
- T.L. Riggs, D. Walther, P.M. Rich, B. Paul. 2002. GIS for post-wildfire forest management. ESRI Annual User Conference. San Diego, CA.
- Rich, P.M., G.N. Keating, C.R. Mynard, S. Rasmussen, T.L. Riggs, M.A. Jones, S.P. Linger, D. Walther, and M.S. Witkowski. 2001. Post-wildfire geospatial information management at Los Alamos National Laboratory. DOE, Technology Information Exchange Symposium, Albuquerque, NM.
- Fu, P. and P.M. Rich. 2001. Topographic influences on solar radiation. Twenty-First Annual ESRI User Conference. San Diego, CA.
- Fu, P. and P.M. Rich. 2001. Topographic influences on solar radiation at landscape scales. Ecological Society of America Annual Meeting.
- Rich, P.M., B. Greene, and P. McDonald. 2001. Topographic determinants of carbon balance and vegetation distribution in the Rocky Mountains. Ecological Society of America Annual Meeting.
- Rich, P.M., G.N. Keating, C.R. Mynard, S. Rasmussen, T.L. Riggs, M.A. Jones, S.P. Linger, D. Walther, and M.S. Witkowski. 2001. Post-wildfire geospatial information management at Los Alamos National Laboratory. ESRI Annual User Conference. San Diego, CA.
- Witkowski, M.S. and P.M. Rich, 2001. GISLab spatial information management. ESRI Annual User Conference. San Diego, CA.
- Rich, P.M. and P. Fu. 2000. Topoclimatic models for prediction of potential habitat. American Geophysical Union Fall Meeting.
- Rich, P.M. and P. Fu. 2000. Topoclimatic habitat models. Fourth International Conference on Integrating Geographic Information Systems (GIS) and Environmental Modeling.
- Fu, P., P.M. Rich, and J. Wang. 2000. Topoclimatic models for study of climate change at landscape scales. Twentieth Annual ESRI User Conference.
- Fu, P., P.M. Rich, and J. Wang. 2000. Integration of GIS with user models. Twentieth Annual ESRI User Conference.
- Fu, P. and P.M. Rich. 2000. Topoclimatic models for complex terrain in the Rocky Mountains of Colorado. Ecological Society of America Annual Meeting.
- Wang, J. and P.M. Rich. 2000. Links between local and landscape patterns of productivity in the Great Plains. Twentieth Annual ESRI User Conference.
- Wang, J., P.M. Rich, and K.P. Price. 2000. Relations between normalized difference vegetation index and productivity in the central Great Plains. Ecological Society of America Annual Meeting.
- Yao, J., and P.M. Rich. 2000. Woody canopy influences on understory plants during old field succession. Ecological Society of America Annual Meeting.
- Fu, P. and P.M. Rich. 2000. A geometric solar radiation model and its applications in agriculture and forestry. Second International Conference on Geospatial Information in Agriculture and Forestry. Winner of best poster presentation at conference.
- Rich, P.M. and R.D. Holt. 1999. A plants-eye perspective on experimental landscape ecology. Invited Seminar on Experimental Model Ecosystems. International Association for Landscape Ecology, Snowmass, CO.
- Fu, P., P.M. Rich, and S. Geer. 1999. Microclimate influences on vegetation in montane ecosystems. Annual Meeting of the Ecological Society of America.

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- Fu, P. and P.M. Rich. 1999. Design and implementation of the Solar Analyst: an ArcView extension for modeling solar radiation at landscape scales. Nineteenth Annual ESRI User Conference.
- Wang, J., P.M. Rich, and K.P. Price. 1999. Influences of temperature and precipitation on landscape-level indices of productivity in Kansas. Annual Meeting of the Ecological Society of America.
- Wang, J., P.M. Rich, and K.P. Price. 1999. Relations between climate and greenness indices in the Great Plains. Nineteenth Annual ESRI User Conference. Winner of best poster presentation in analytical category.
- Wang, J., K.P. Price, and P.M. Rich. 1998. Relationships between NDVI and Precipitation in Kansas During a Nine-Year Period (1989–1997). Association of American Geographers Great Plains/Rocky Mountains Annual Conference.
- Fu, P., P.M. Rich and W.D. Kettle. 1998. Geographic data management for the Kansas Ecological Reserves. Association of American Geographers Annual Conference.
- Rich, P.M., P. Fu, J. Wang, A. T. Peterson, N. Rice, A. Sanchez, J. Jimenez, and M. Anthony. 1998. Geospatial data clearinghouse nodes for natural resources and biodiversity of Costa Rica and Mexico. Eighteenth Annual ESRI User Conference and Society of Conservation GIS Annual Meeting. James Reserves, CA.
- Fu, P., W.D. Kettle, and P.M. Rich. 1998. A GIS database for research and management at the Kansas Ecological Reserves. Eighteenth Annual ESRI User Conference.
- Rich, P.M., D.A. Vieglais, S.B. Weiss, and S.C. Saving. 1997. Coupling geometric solar radiation models with microclimate and ecological process models. Annual Meeting of the Ecological Society of America.
- Vieglais, D.A. and P.M. Rich. 1997. Calculating optimal leaf orientation under different canopies. Annual Meeting of the Ecological Society of America.
- Rich, P.M., J. Wang, P. Fu, W. Marshall, and D.A. Vieglais. 1997. A GIS database for conservation biology research and management in Costa Rica. Association for Tropical Studies Annual Meeting, San Jose, Costa Rica.
- Alger, Y.R. and P.M. Rich. 1996. Topographic effects on forest structure at the forest/prairie ecotone. Annual Meeting of the Ecological Society of America.
- Yao, J., R.D. Holt, W.S. Marshall, and P.M. Rich. 1996. Woody plant colonization in an experimentally fragmented habitat. Annual Meeting of the Ecological Society of America.
- Kettle, W. D., G.L. Pittman, R. O'Neal, and P.M. Rich. 1996. Land-use history considerations in natural resource planning. North American Prairie and Natural Areas Conferences, Chicago, IL.
- O'Neal, R.L., W.D. Kettle, P.M. Rich, K.P. Price, and R.D. Holt. 1996. Environmental history of the Kansas Ecological Reserves: changes in vegetation at a forest/prairie ecotone. Sixteenth Annual ESRI User Conference.
- Fournier, R.A., P.M. Rich, and R. Landry. 1995. A hierarchical sampling approach for characterizing BOREAS sites. Poster for NASA Boreas Investigator Meeting, Greenbelt, MD.
- Rich, P.M., R.A. Fournier, Y.R. Alger, N.M. August, and V.L. Peterson. 1995. A hierarchical sampling approach for characterizing canopy architecture of boreal forests. Annual Meeting of the Ecological Society of America.

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- Rich, P.M. 1995. Solar radiation models and plant canopy measurement. NSF–Sponsored Workshop — Designing the Forest Canopy Researcher's Workbench: Computer Tools for the 21st Century.
- Wang, J., P.M. Rich, and R.D. Holt. 1995. GIS Database for Experimental Studies of Habitat Fragmentation at the Kansas Ecological Reserves. Fifteenth Annual ESRI User Conference.
- Fournier, R.A., P.M. Rich, Y.R. Alger, V.L. Peterson, R. Landry, and N.M. August. 1995. Canopy architecture of boreal forests: links between remote sensing and ecology. American Society for Photogrammetry and Remote Sensing Technical Papers. Annual Meeting of the American Society for Photogrammetry and Remote Sensing.
- Price, K.P., P.M. Rich, and R. O'Neal. 1995. Deriving high resolution canopy digital elevation models. Annual Meeting of the American Society for Photogrammetry and Remote Sensing.
- Rich, P.M., Y.R. Alger, D.A. Heisler, V.L. Peterson, D.M. Price, and J. Wang. 1995. GIS–Based Habitat Models: Applications for Conservation. University of Kansas Environmental Research Symposium.
- Rich, P.M., R.L. Chazdon, and J.S. Denslow. 1994. Spatial and temporal variation of solar radiation regimes in plant canopy gaps. Annual Meeting of the Ecological Society of America.
- Rich, P.M., W.A. Hetrick, S. C. Saving, and R. Dubayah. 1994. Using viewshed models to calculate intercepted solar radiation: applications in ecology. Annual Meeting of the American Society for Photogrammetry and Remote Sensing.
- Rich, P.M. and R. Dubayah. 1994. Spatial and temporal patterns of solar radiation along topographic surfaces: coupling with energy balance models. Ninth Annual U.S. Landscape Ecology Symposium.
- Price, K.P. and P.M. Rich. 1994. Development of digital canopy model using digital stereopairs. Annual Meeting of the American Association of Geographers.
- Price, K.P., P.M. Rich, and R. O'Neal. 1994. Measurement and three–dimensional modeling of plant canopies using remotely sensed data. 126th Kansas Academy of Science Meeting, Washburn University.
- Saving, S.C., W.A. Hetrick, P.M. Rich, A.D. Weiss, S.B. Weiss. 1994. Physiographic inventory methodology. Fourteenth Annual ESRI User Conference.
- Dubayah, R. and P.M. Rich. 1993. GIS–based solar radiation modeling. Second International Conference on Integrating Geographical Information Systems and Environmental Modeling.
- Rich, P.M., K.P. Price, R.D. Holt, and F.J. Barnes. 1993. Spatially explicit models of microclimate and ecophysiology within pinyon–juniper woodland canopies: a GIS and remote sensing approach. Annual Meeting of the Ecological Society of America.
- Rich, P.M., S.C. Saving, T.D. Sisk, H.R. Sparrow, and S.B. Weiss. 1993. Tropical Reserve Design and Biodiversity Sampling: a Physiographic Approach for La Amistad Biosphere Reserve, Costa Rica. Annual Meeting of the Association for Tropical Biology.
- Rich, P.M., F.J. Barnes, and K.P. Price. 1993. Spatial patterns of canopy architecture in pinyon–juniper woodlands: inferences from stand allometry and remote sensing. Eighth Annual U.S. Landscape Ecology Symposium.
- Rich, P.M., S.C. Saving, T.D. Sisk, H.R. Sparrow, and S.B. Weiss. 1993. Tropical Reserve Design and Biodiversity Sampling: a Physiographic Approach for La Amistad Biosphere Reserve, Costa Rica. Thirteenth Annual ESRI User Conference.
- Hetrick, W.A., P.M. Rich, and S.B. Weiss. 1993. Modelling insolation on complex surfaces. Thirteenth Annual ESRI User Conference.

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- Hughes, G.S. P.M. Rich, and F.J. Barnes. 1993. Using GIS to reconstruct canopy architecture and model ecological processes in pinyon–juniper woodlands. Thirteenth Annual ESRI User Conference.
- Saving, S.C., P.M. Rich, and J.T. Smiley. 1993. GIS Database for Big Creek Reserve: an Archetype for the University of California Natural Reserve System. Thirteenth Annual ESRI User Conference.
- Rich, P.M., H.A. Mooney, L.S. Guild, N. Luttinger, and A.E. Hartley. 1993. Close–range remote sensing of localized disturbance in serpentine soil grassland. Annual Meeting of the American Society for Photogrammetry and Remote Sensing.
- Chapman, S.B., P.M. Rich, and D. Kettle. 1993. Assessing shrub distribution and impact in tallgrass prairie using aerial and ground–based mapping. Annual Meeting of the American Society for Photogrammetry and Remote Sensing.
- Hetrick, W.A., P.M. Rich, and F.J. Barnes, and S.B. Weiss. 1993. GIS–based solar radiation flux models. Annual Meeting of the American Society for Photogrammetry and Remote Sensing.
- Rich, P.M., N.M. Holbrook, and N. Luttinger. 1992. Leaf development and crown geometry of two iriarteoid palms. Annual Meeting of the Association for Tropical Biology.
- Clark, D.B., D.A. Clark, P.M. Rich, and S.F. Oberbauer. 1992. Vertical and horizontal distributions of light environments and their relation to forest structure in a neotropical lowland rain forest. Annual Meeting of the Ecological Society of America.
- Rich, P.M., S.B. Weiss, D.A. Debinski, and J.F. McLaughlin. 1992. Physiographic inventory of a tropical reserve. Twelfth Annual ESRI User Conference.
- McLaughlin, J.F., S.B. Weiss, Rich, P.M., and D.A. Debinski. 1992. Roles of GIS in conservation. Twelfth Annual ESRI User Conference.
- Barnes, F.J., P.M. Rich, C. Lin, B. Wilcox, J. Nyhan, D. Breshears, and S. Tarbox. 1992. Spatial and temporal variability in water balance components in pinyon–juniper and ponderosa pine communities along an elevational gradient. Annual Meeting of the Society of Landscape Ecologists.
- Galo, A.T., P.M. Rich, and J.J. Ewel. 1992. Effects of forest edges on the solar radiation regime in a series of reconstructed tropical ecosystems. Annual Meeting of the American Society for Photogrammetry and Remote Sensing.
- Lin, T., D.A. Heisler, P.M. Rich, and F.J. Barnes. 1992. Influences of canopy geometry on near–ground solar radiation and water balances of pinyon–juniper and ponderosa pine woodlands. Annual Meeting of the American Society for Photogrammetry and Remote Sensing.
- Clark, D., D.A. Clark, and P.M. Rich. 1991. Juvenile light environments of nine canopy tree species in a neotropical lowland forest. Annual Meeting of the Ecological Society of America.
- Lerdau, M.T., N.M. Holbrook, H.A. Mooney, P.M. Rich, and J.L. Whitbeck. 1991. Partitioning of resource acquisition by the arborescent cactus *Opuntia excelsa* growing in a seasonal dry forest. Annual Meeting of the Ecological Society of America.
- Oberbauer, S.F., D.A. Clark, D.B. Clark, and P.M. Rich. 1991. *In situ* photosynthesis and light environments of saplings of four species of Costa Rican rain forest trees. Annual Meeting of the Ecological Society of America.
- Rich, P.M. and S.B. Weiss. 1991. Spatial models of microclimate and habitat suitability: lessons from threatened species. Eleventh Annual ESRI User Conference.
- Rich, P.M., H.A. Mooney, L.S. Guild, and N. Luttinger. 1990. Root growth of serpentine grassland annuals. Annual Meeting of the Ecological Society of America.

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- Rich, P.M. 1990. Relations between tree growth, crown geometry, and light availability within forest canopies. Second International Symposium on the Tree, Montpellier, France.
- Rich, P.M., H.A. Mooney, L.S. Guild, and A.E. Hartley. 1989. Localized Disturbance by Gopher Burrowing in Serpentine Soil Grassland. Annual Meeting of Ecological Society of America.
- Rich, P.M. 1989. Establishment Growth of *Welfia georgii*, a Mesoamerican Palm. Annual Meeting of Association for Tropical Biology.
- Rich, P.M. 1988. Microcomputer image analysis for study of plant canopies. Annual Meeting of Ecological Society of America.
- Clark, D.A., P.M. Rich, D.B. Clark, and S.F. Oberbauer. 1988. Long-term monitoring of photosynthetically active radiation in tropical wet forest understory. Annual Meeting of Ecological Society of America.
- Rich, P.M. 1988. Mapping light availability under forest canopies using hemispherical (fisheye) canopy photography. Organization for Tropical Studies Silver Anniversary Symposium.
- Rich, P.M. 1988. Video image analysis of hemispherical canopy photography. First Special Workshop on Videography. Terre Haute, Indiana. May 19–20, 1988. American Society for Photogrammetry and Remote Sensing.
- Rich, P.M. 1987. Prospects for remote sensing of vegetation. 4th Arid Lands Remote Sensing Workshop.
- Rich, P.M. 1987. Close-range remote sensing for study of plant canopies. 4th Arid Lands Remote Sensing Workshop.
- Rich, P.M., D.B. Clark, D.A. Clark, S.F. Oberbauer. 1987. Canopy photography for assessment of local light environment of tropical forest trees and palms. Annual Meeting of Ecological Society of America.
- Rich, P.M. 1986. Growth rates of arborescent rainforest palms in Costa Rica. Annual Meeting of Ecological Society of America.
- Rich, P.M. 1985. Mechanical architecture of arborescent rainforest palms in Costa Rica. Association for Tropical Biology Invited Symposium on Palm Ecology.
- Rich, P.M. 1985. Developmental anatomy of the stem in *Welfia georgii* Wendl. ex Burret, *Iriarteia gigantea* Wendl. ex Burret, and other arborescent rainforest palms: implications for mechanical support. Annual Meeting of Botanical Society of America, Developmental and Structural Section.
- Rich, P.M., S. Lum, and L. Muñoz. 1985. Shedding of vines by the palms *Welfia georgii* Wendl. ex Burret and *Iriarteia gigantea* Wendl. ex Burret. Annual Meeting of Association for Tropical Biology.
- Rich, P.M. 1985. Developmental changes in the stem of arborescent rainforest palms: consequences for mechanical support during height growth. Invited Workshop in Plant Population Biology and Physiological Ecology in Mesoamerican Forests.

Professional Service

Editorial Reviewer: *American Journal of Botany*, *Biotropica*, *Canadian Journal of Forest Research*, *Ecological Applications*, *Ecology*, *Evolution*, *Journal of Tropical Ecology*, *Photogrammetric Engineering and Remote Sensing*, *Selbyana*, and *Tree Physiology*.

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Grant Reviewer: NSF (Conservation, Database, Systematic Biology, Population Biology and Physiological Ecology, Ecology, Computation Programs); National Geographic; Organization for Tropical Studies.

Grant Review Panels: NSF Database.

Advisory Boards: Board of Directors, New Mexico Geographic Information Council (Speaker Coordinator) (2003-2005); University of New Mexico Geography Curriculum Committee (2004); Scientific Advisory Board, Institute of Natural Resource Analysis and Management (INRAM), New Mexico State University (2003); Rocky Mt. Biological Laboratory (RMBL) Data Management System Committee (1997-98).

Workshops and Symposia Organized:

"The Bio-Atmospheric N Cycle: N Emissions, Transformations, Deposition, and Terrestrial and Aquatic Ecosystem Impacts". Special Session, American Geophysical Union Meeting, December 10-14, 2007, San Francisco, CA, Co-organizers and Co-chairs: Stuart B. Weiss and Paul M. Rich.

"Impact of Climate Variability and Extreme Weather on Ecosystem structure and Function across Spatiotemporal Scales ". Special Session, American Geophysical Union Meeting, December 11-15, 2006, San Francisco, CA, Co-organizers and Co-chairs: Christian Blodau, David D. Breshears, Klaus-Holger Knorr, Paul M. Rich, and Amanda B. White.

"The Color of Snow and Its Interpretation from Remote Sensing". Seminar by Jeff Dozier (UCSB). July 31, 2006, LANL EES Frontiers in Geoscience Colloquium. Host: Paul Rich.

"Big Sky Carbon Sequestration GIS/Carbon Atlas Planning Workshop", April 2-4, 2006, Salt Lake City, UT, Co-Organizers: Paul Rich and Randy Lee.

"DOE Geospatial Science Expo", January 30 to February 10, 2006, Washington, DC, Co-organizers: Diane Timlin, Jeff Booth, James Bollinger, and Paul Rich.

"Temporal and Spatial Variability in Coupled Ecological - Hydrological Processes". Special Session, American Geophysical Union Meeting, December 5-9, 2005, San Francisco, CA, Co-organizers and Co-chairs: Kelly Caylor, Salvatore Manfreda, and Paul Rich.

"Multispectral Thermal Imagery and its Application to the Geologic Mapping of the Koobi Fora Formation, Northwestern Kenya". Seminar by M.K. Greene (LANL), November 22, 2005, LANL GIS Colloquium. Host: Paul Rich.

"GIS and Emerging Infectious Diseases" and "GIS Analysis of Stream Planform Dynamics". Seminars by Thomas J. McTighe, November 8, 2005, LANL GIS Colloquium. Host: Paul Rich.

Jemez Pueblo Walatowa High School presentations and hands-on experience with GIS, LANL GISLab. Session 1 "GISLab at LANL", October 19, 2005 -- Paul Rich/Rick Kelley/Doug Walther: "Welcome and Overview"; Doug Walther/M.Greene: "Production GIS and GIS for geomorphology"; Gordon Keating/Rick Kelley: "GIS for volcanology, Yucca Mountain Project"; Marc Witkowski: "GIS for critical infrastructure protection"; Tom McTighe: "GIS for Epidemiology"; Paul Rich: "GIS for water, carbon, and energy"; Paul Rich/Rick Kelley/Doug Walther: "GIS in our future" discussion. Session 2, GIS exercise, October 26, 2005 -- Doug Walther, Rick Kelley, M.Greene, and Tom McTighe: "Introduction to GIS Data Sources and Cartography". Co-organizers: Richard E. Kelley, Doug Walther, and Paul Rich.

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- "LandScan USA: High-Resolution Population Distribution Model", 27-June-2005, seminar by Budhendra Bhaduri (Oak Ridge National Laboratory), LANL EES Frontiers in Geoscience Colloquium, Co-hosts: Paul Rich and Marc Witkowski.
- "Location Decision Making: The Role of Uncertainty and GIS-Based Decision Support Systems", 26-May-2005, seminar by Richard Middleton (UCSB Geography), GISLab/EES-9 Seminar, Co-hosts: Gordon Keating and Paul Rich.
- "School Enrollment Projections: Incorporating Choice", 26-May-2005, seminar by Erin Middleton (UCSB Geography), GISLab/EES-9 Seminar; Co-hosts: Paul Rich and Gordon Keating.
- "Onsite Wastewater Treatment Systems: The Performance Effects of Process and Environmental Conditions", 24-May-2005, seminar by Sheila Van Cuyk (Colorado School of Mines), GISLab/EES-9 Seminar, Co-hosts: Paul Rich and Marc Witkowski.
- "Preference Learning of Geospatial Attributes Using a Neuro-Fuzzy Approach" and "Synergetic Use of Satellite Imagery and Ancillary Data for Impervious Surface Estimation in the Contiguous U.S.", 9-May-2005, seminars by Giorgos Mountrakis (USGS Fort Collins), GISLab/EES-9 Seminar, Co-hosts: Gordon Keating and Paul Rich.
- Jemez Pueblo Wallatowa High School presentations and hands-on experience with GIS, LANL GISLab. Session 1 "GISLab at LANL", April 13, 2005 -- Paul Rich: "Welcome and Overview "; Gordon Keating: "GIS for carbon sequestration"; Marc Witkowski/Donatella Pasqualini: "GIS for critical infrastructure protection"; Doug Walther/Rick Kelley: "Production GIS and GIS for geomorphology studies"; Rick Kelley/Frank Perry: "GIS for the Yucca Mountain Project"; M.Ewers: "GIS for water resource management"; Paul Rich: "GIS for microclimate and ecology"; Paul Rich: "GIS in our future". Session 2, GIS exercise, April 20, 2005 -- Rick Kelley and Doug Walther: "Introduction to GIS Data Sources and Cartography". Co-organizers: Richard E. Kelley, Doug Walther, and Paul M. Rich.
- "Geographic Information Systems (GIS) Data Implementation for the Analysis of Settlement Patterns in an Early Agricultural Society", 8-Feb-2005, Seminar by Jorge Sifuentes (UCSB Geography), GISLab/EES-9 Seminar, Co-hosts: Gordon Keating and Paul Rich.
- "Conservation and Environmental GIS". New Mexico Geographic Information Council (NMGIC) Fall Meeting, October 8, 2004, Albuquerque, NM; Paul Rich, Speaker Coordinator. Tom Giermakowski (UNM): "Spatial mapping the growth potential of juvenile Galápagos tortoises (*Geochelone nigrita*) via remotely sensed imagery"; Kurt Menke (EDAC, UNM) and Melissa Grigione (Bordercats Working Group and USF): "Identifying priority conservation areas in the U.S. - Mexico border region for America's neotropical cats: jaguar, jaguarundi, and ocelot"; Larry Layne (UNM) "Spatial modeling and simulation of selected habitat variables for sage grouse habitat assessment"; Dallas Bash (Fort Bliss), Jeff Herrick (Jornada Range ARS), and Judy Ward (Jornada Range ARS): "Use of first difference spectral ratios in evaluating ecological condition of semiarid lands"; Paul Rich (LANL), David Breshears (UA), and Kevin Price (KU), Neil Cobb (NAU), Jude Kastens (KU), Craig Allen (USGS), and Randy Balice (LANL), "Drought-induced mortality in semiarid woodlands"; John Barney (Sites Southwest & UNM); Joe Francis, Bill Jewell, and Thomas Whitlow (Cornell): "Visualizing ecosystem service values in GIS"; John F. Kennedy (NMSU), Richard Langford, and John W. Hawley: "Identification of recharge areas through paleohydrography reconstruction "; Leland J.S. Pierce (NMDGF) "What makes a great conservation map?"; Paul Neville (EDAC), Teri Neville (NHNM), and Kristine Johnson (NHNM): "Use of remote sensing and GIS to map lesser prairie chicken and sand dune lizard

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habitats in eastern New Mexico"; Natalie M. Runyan (NMSLO) "Species protection and land use management on State Trust Lands in the 'oil patch' of SE New Mexico"; Kevin Troutman (BCEH): "Use of GIS and GPS in the Bernalillo County Office of Environmental Health".

Co-organizer: Paul M. Rich.

"ZeroNet Kickoff Meeting", August 30-31, 2004, Albuquerque, NM. Cathy Wilson (LANL): "Welcome/Introduction"; Barbara Carney (NETL): "DOE Program Overview"; Cindy Murray (PNM): "Stakeholders in the Upper San Juan Basin"; All: "Stakeholder Communication Plan Discussion"; L. Weintraub (Systech): "WARMF Model"; Vince Tidwell (SNL): "Middle Rio Grande Model; Marc Witkowski and Paul Rich (LANL): "Decision Support Tools"; Kent Zammit (EPRI): "Wet Surface Air Cooling"; Kent Zammit (EPRI) and Matt Lavery (PNM): "Produced Water Pipeline Project"; Jeri Sullivan (LANL): "Produced Water Treatment"; Janie Chermak (UNM): "Economics in Integrated Models"; Mike Hightower (SNL): "Produced Water Treatment and Desalination"; All: "Technology Discussion"; All: "ZeroNet Work Plan Discussion". Co-Organizers: Paul M. Rich and Cathy J. Wilson.

"DOE GIS", August 9-13, 2004. Map Gallery Poster Session. ESRI International User Conference, San Diego. Co-organizers: James S. Bollinger and Paul M. Rich.

"Frontiers in Environmental GIScience", March 1, 2004, seminar by Richard Aspinal, Director, Geographic Information & Analysis Center, Montana State University. EES Frontiers in Geoscience Symposium. Paul Rich host.

"GIT: Then and Now, NMGIC's 20th Anniversary Celebration", April 15, 2004. New Mexico Geographic Information Council Fall Meeting, Paul Rich, Speaker Coordinator. Amy Budge/Mike Inglis (UNM-EDAC): "20 Years of NMGIC: A Guided Tour through Time"; Keith Clarke (UCSB) "GIT: Past, Present, and Future" (keynote address); Stan Morain (UNM): "A Historical Perspective on GIT"; Dennis Fitzsimons (California State Humboldt): "Patience and Holistic Mapping: Pre-GIS Cartography"; Bill Stone: "New Mexico Then and Now"; Jack Dangermond (ESRI): "A Vision for the Future of GIT" (special guest speaker); Vendors Panel (Mick Garrett, Trimble, Jim Reilly, NMSU, Dennis Sandin, Bohannon Huston, Inc. BHI, John Steffenson, ESRI) "Evolution of the Industry"; Gar Clarke (NM OSE): "GIT Walk: the Evolutionary Junket of a User". Co-organizer: Paul Rich.

"GIS: What's the Big Picture? Adventures in Web Mapping", November 20, 2003, New Mexico Geographic Information Council Fall Meeting, Paul Rich, Speaker Coordinator. Nathaniel Todea (USDA-NRCS): "Estimating Runoff Using NEXRAD Radar Data in Rural New Mexico"; Mark Romero (NMSU): "A Crime Mapping Study at the El Paso/Juarez Border"; Emily Clary (UNM-EDAC): "Mapping Potential Mosquito Habitat and at Risk Populations for West Nile Virus in Monterey, CA"; Marc Witkowski (LANL): "Enterprise GIS Design"; Jill Williams (Bernalillo County): "An ArcIMS Implementation"; John Lovato (Qwest): "Communications Planning Applications"; Karl Benedict (UNM-EDAC) "RGIS Web Interface"; Gar Clark (OSE): "Statewide Perspectives in GIS: OSE Viewpoints"; Steve Lime (MDNR) - "UMN MapServer, OpenSource Web Mapping"; Jack Lloyd (Pima County, AZ) - "Data on Demand: Delivering GIS Information Over The Internet". Co-organizer: Paul Rich.

"A Research Agenda for Environmental Science Collaboration", 10-11 June 2003, two-day workshop under the University of California at Santa Barbara - LANL Cooperative Agreement on Research and Education (CARE); day one: "The UCSB-LANL Cooperative Agreement: Past, Present, and Future of Environmental Science Collaborations"; day two:

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- "Use of Science-Based Predictive Models to Inform Environmental Management". Organizers: K. Eggert and P. Rich (LANL), A. Keller and J. Dozier (UCSB).
- "Modeling Land Use Change with Cellular Automata: Issues and Challenges", 15 May 2003, seminar by Keith Clarke, chair of Geography at UC Santa Barbara. EES Frontiers in Geoscience Symposium. organized by P. Rich.
- "CORONA: The Missing Decade in the History of Remote Sensing", 15 May 2003, seminar by Keith Clarke, chair of Geography at UC Santa Barbara. NIS/EES joint seminar. organized by P. Rich.
- "Where's the Water", 24-25 April 2003. New Mexico Geographic Information Council Spring Meeting, Co-sponsored by Los Alamos National Laboratory, Paul Rich, Speaker Coordinator. John D'Antonio (NM State Engineer and Secretary of NMISC): "New Mexico Water Issues"; Everett Springer (LANL): "NM Water for Energy Initiative"; John Kennedy (NMWRRRI): "Creating a Digital Hydrogeologic Framework Model of the Mesilla Basin"; Larry Winter (NCAR): "Virtual Watersheds: Coupled Basin-Scale Water Resource Models for Arid and Semiarid Regions; Randy Balice (LANL) "Drought Effects on Vegetation: Tree Mortality in Arid Woodlands"; Frank Titus (New Mexico Bureau of Geology and Mineral Resources): "Water Management for Really Smart People"; David Jordan (INTERA) and Peggy Barroll (Office of State Engineer): "Evaluation of Potential Riparian Evapotranspiration Rates for the Carlsbad Area Groundwater Model Using GIS"; Lara Wood (TNC): "Classifying Canopy Closure and Successional Stage Using Landsat TM Imagery"; Kate Krause and Janie Chermak (UNM Dept of Economics): "Assessing Tradeoffs in Water Policy Using Integrated Modeling"; Jeff Simley (USGS NHD Program): "The National Hydrography Dataset for New Mexico"; Steve Hansen (Bureau of Reclamation): "Where's the Water Going?"; John Barney (Sites Southwest) and April Fitzner (U.S. Army Corps of Engineers): "Imaging and Coordinating Ecosystem Restoration Planning: the U.S. Army Corps of Engineers Middle Rio Grande Bosque Ecosystem Restoration Projects". Co-organizer/Speaker Coordinator: Paul Rich.
- "Augmenting geographic reality: origins and evolution of geographic information systems (GIS)", 18 April 2002, lecture by M. Goodchild, associated presentations and discussion, Los Alamos National Laboratory, organized by P. Rich.
- "Geospatial Metadata Training", 28 August 2002, taught by Amy Budge (Manager of Clearinghouse Services, UNM Earth Data Analysis Center), and Rich Friedman (McKinley County GIS Center). Co-organizer: Paul Rich.
- "GIS and hydrologic modeling", 26 March 2002, one-day workshop in Los Alamos, NM, panelists: D. Djokic (ESRI), E. Keating, S. McLin, B. Robinson, and E. Springer, organized by P. Rich.
- "GIS for homeland security", 28 February 2002, lecture by J. Dangermond (President, ESRI), associated presentations, GIS poster session, and discussions, Los Alamos National Laboratory, co-organized by P. Rich and K.S. Fenimore.
- "University of California Natural Reserve System (UC-NRS): land stewardship, science, education, information management", 18 October 2001, lecture by A. Glazer (Director, UC-NRS), associated presentations and discussions, Los Alamos National Laboratory, organized by P. Rich.
- "Costa Rica workshop on management of geospatial metadata", 9–10 March 1998, workshop in San Jose, Costa Rica, co-organized by P.M. Rich, T. Peterson, A. Sanchez, and M. Anthony.

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- "Establishment of a National Geospatial Data Node and metadata preparation" — 13 January 1997, workshop at KU, co-organized by P.M. Rich, W. Marshall, and M. Anthony.
- "Managing geospatial data on the web" — 11 June 1996, one-day workshop at KU, co-organized by P.M. Rich, J. Whistler, D. Vieglais, M. Anthony, J. Klaver, and R. Quenzer.
- "Techniques of hemispherical photography for analysis of canopy architecture and calculation of insolation" — April 1996, workshop at Oxford University, co-organized by P.M. Rich, D.A. Vieglais, and T.C. Whitmore.
- "Design of the hemispherical photography analysis program Hemiview", April 1996, workshop at Delta-T, Cambridge, England, co-organized by P.M. Rich, D.A. Vieglais, and R. Driver.
- "Future of GIS for OTS", 7 February 1996, workshop at La Selva Biological Station, Costa Rica, organized by P.M. Rich.
- "Planning the future of conservation biology activities for the 'Coto Brus corridor', Costa Rica", 14–15 October 1995, workshop at KU, co-organized by P.M. Rich and D. Stone.
- "Hemispherical Photography for Characterizing Canopy Architecture and Understory Light Regimes", February 1995, workshop at Duke University, organized by P.M. Rich.
- "Integrative Modeling of Pinyon–Juniper Woodland Ecology", February 1994, workshop in Santa Fe, NM, co-organized by P.M. Rich and S. Martens.
- "Remote Sensing of Vegetation Properties", 6 March 1992, symposium at Environmental Science Group, Los Alamos National Laboratory, co-organized by P.M. Rich and F.J. Barnes.

Los Alamos National Laboratory and Department of Energy Committees and Service:

Vice-Chair, DOE Geospatial Science Steering Committee (2005-2006); Water Roadmap, Health and Environment subcommittee (2004), EES-2 Deputy Group Leader Search (2003), EES Deputy Division Leader Search (2004), GIS Technical Steering Committee (2002-present); DOE GIS Core Team (2002-2005); EPSCoR representative from LANL for NM universities (2002-2003), Knowledge Discovery and Dissemination Working Group (2002); EES Science & Engineering Leadership Team (SELT) (2001-2003); initiated effort to build LANL institutional GIS; CIO GIS Working Group (2001-2002); Co-Chair, DOE GIS User Group (2001-2006).

University of Kansas Committees and Service: Kansas Ecological Reserves "Publicity"/Web Committee (1999-2000); Environmental Studies Principles Course Committee (1999-2000); Environmental Studies Graduate Teaching Assistant Committee (1999–2000); Chair of Environmental Studies Minor Committee (1999); Environmental Studies Instructional Technology Committee (1998–2000). Chair of Ecology & Evolutionary Biology Publicity Committee (1999–2000); Regional (Kansas Regents Institutions & Big 12) Environmental Program Committee (1999-2000); Chair of Ecology & Evolutionary Biology Endowment Committee (1998–99); Chair of Environmental Studies Research and Graduate Studies Committee (1999); Chancellor's Costa Rica Symposium Planning Committee (1996–2000); Chair of Kansas Biological Survey Web Site Development Committee (1999–2000); Organization for Tropical Studies Board of Directors (1993, 1997–2000); Environmental Studies Advisory Board (1991–2000); Environmental Studies Long-Range Planning (1994–2000); Computer Equipment Committee, Systematics & Ecology (1996–97); Environmental Studies Director Job Search (1993–94); Chair of Systematics & Ecology Long-Range Planning Committee (1993–95); Systematics & Ecology Graduate Training (1993–95);

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Environmental Studies Aquatic Ecologist Job Search (1992–93); Kansas Biological Survey Reorganization (1992–95); Field Facilities Committee (1991–2000); Instrumentation and Laboratory Improvement for Undergraduate Teaching in Ecology Team (1992–93); Latin American Studies (1992–99); Systematics & Ecology Admissions Committee (1991–92); Kansas Biological Survey Community Ecologist Job Search (1991–92); Environmental Studies Undergraduate Curriculum Committee (1991).

University of California at Santa Cruz Committees and Service: student representative for the UC Natural Reserve System Committee (1977-79).

Public Service: Environmental education program development: traditional/science integration, for DOE climate change program and for Native Americans in northern New Mexico (2003-2004); respond to approximately 20 telephone inquiries per year from the general public concerning environmental issues (1990–present); respond to approximately 40 inquiries per year about the use of hemispherical photography and image processing techniques (1990–present); "Environmental Minute", radio interview concerning global warming (1998); participant in public forum on the future of OTS (1996). Earth Day Presentation for Topeka High School, "Environmental awareness and individual responsibility" (1995). KU Students for Wildcare presentation, "Effects of Habitat Destruction on Biodiversity" (1995); KJHK Earth Day radio interview concerning recycling (1995); Kaw Valley High School Regional Presentation, "Rainforest conservation and restoration", teacher workshop, with D. Luckey (1993); compilation of resources concerning rainforest conservation and development for high school teachers (1992–93).

Consulting and Software Beta Testing

Environmental Systems Research Institute: beta testing for GIS software, 1992–2006.

Delta-T Devices, Ltd. – beta testing and consultation for scientific software, 1996–2003.

Jandel Scientific (now part of SPSS, Inc.), beta testing for image analysis and graphing software, 1989–97.

Brooks-Cole Publishing, 1998-2003: 1) technical writing for G.T. Miller, *Living in the Environment* and *Environmental Science* texts; 2) development of web-based environmental education resources (lecture notes, "Info-Trac", and "Web Tutor"), 3) technical review of scientific and educational content.

Professional Organizations

DOE GIS User Group, LANL GIS User Group, American Society for Photogrammetry & Remote Sensing, Association for Tropical Biology, Botanical Society of America, Ecological Society of America, International Association of Landscape Ecology; North American Association for Environmental Education, Palm Society, Sigma Xi, Society for Conservation Biology, Society for the Study of Evolution.

Students Advised

Postdoctoral Fellows (2):

Amanda White: "Impacts of extreme weather events: drought-induced tree dieoff" 2006.

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M.Ewers: "Decision support for San Juan Basin: ZeroNet water for energy project", 2004-05.

Students Advised - University of Kansas

PhD students graduated (4):

Jin Yao, dissertation: "Patterns and impacts of woody plant colonization in a fragmented old field", 2001.

Pinde Fu, dissertation: "A geometric solar radiation model with applications in landscape ecology", 2000.

Jue Wang, dissertation: "Relations between productivity, climate, and normalized difference vegetation index in the central Great Plains", 2000.

Dana M. Price, dissertation: "Population ecology and economic botany of *Echinacea angustifolia*, a native prairie medicinal plant", 1999.

MA students graduated (4):

Yvette R. Alger, thesis: "Disturbance history and topography in a midwestern ravine forest: influences on community structure", 1996.

Claudia B. Mattos, thesis: "Environmentally sound packaging design at a small economic scale", 1994.

Shawn C. Saving, project: "GIS-based microclimate habitat models for the Big Creek Reserve", 1994.

Gregory S. Hughes, project: "GIS based studies of arid woodlands", 1993.

honors undergraduate students graduated (4):

Venessa L. Peterson, thesis: "Spatial patterns in understory vegetation of boreal forests". 1995.

William A. Hetrick, thesis: "GIS-based solar radiation flux models", 1994.

Wendy Marshall, thesis: "Distribution and dispersal capabilities of woody plant species surrounding the experimental fragmentation facility", 1994.

Stephen B. Chapman, thesis: "Assessing shrub distribution and impact in tallgrass prairie using aerial and ground-based mapping", 1993.

committees for PhD students graduated (7): Jay Diffendorfer, John W. Dunham, Xulin Guo, Diana A. Heisler, Teng-Chiu Lin, Megan H. Mehaffey, James Pritchard;

committees for MA students graduated (4): Melissa Ball, Kathy Egbert, Elizabeth Haine, Jack Livingston.

Additional Research Activity

Historical/conservation biology research for book about life of Rafael (Feynner) Arias and formation of Corcovado National Park, Costa Rica, conducted interviews and visited field sites in Costa Rica since 1991; completed transcriptions of approximately 26 hours of taped interviews; completed draft of major chapters of book.

Invited Seminars (since 1990)

Homeland Infrastructure Foundation-Level Database (HIFLD) Working Group, "Cyberinfrastructure and Decision Support Design for Homeland Security". Invited

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- presentation with co-authors Marc Witkowski and Richard Middleton, April 18, 2006, Santa Fe, NM.
- Department of Energy Annual Information Management Conference (AIMC). "Case for the DOE Enterprise Geospatial Science Program". Invited presentation, co-author James Bollinger, DOE Systems of Labs' Computing Coordination Committee (SLCCC) Meeting. March 23, 2006, Austin TX.
- Department of Energy Geospatial Science Expo, VIP Walkthrough. "Impacts of Extreme Events". Invited presentation and demonstration for DOE Secretary Samuel Bodman, January 31, 2006, Washington, DC.
- New Mexico Office of the State Engineer 2005 Drought Summit, Santa Fe, NM. "Impacts of Drought on Energy Production". October 6, 2005.
- United States Geological Survey, Western Geographic Science Center, Menlo Park. "Decision support for water planning: the ZeroNet water-energy example ". April 26, 2005.
- Department of Energy, Headquarters, Chief Information Officer Council, Washington, DC. "DOE GIS corporate strategy: enterprise geographic information system (GIS) solutions". authors: J.S. Bollinger, P.M. Rich, and S.M. Hargrove (presented by S. Hargrove, DOE OCIO). February 15, 2005.
- Los Alamos National Laboratory, GIS Day. "Enterprise GIS". Invited seminar by P.M. Rich, M.S. Witkowski, and G.N. Keating. November 19, 2004.
- New Mexico Geographic Information Council Fall Meeting. "Enterprise GIS Design". Invited seminar by M.S. Witkowski, P.M. Rich, and G.N. Keating. November 20, 2004.
- National Center for Atmospheric Research, Boulder, CO. "Topography, Microclimate, and Vegetation: GIS-Based Modeling Approaches". September 11, 2003.
- National Center for Atmospheric Research, Boulder, CO. "Enterprise GIS Design". September 12, 2003.
- University of California at Santa Barbara. Workshop on the UCSB-LANL Cooperative Agreement: Past, Present, and Future of Environmental Science Collaborations. "Influences of Topography and Plant Canopies on Surface Climate Variability". (with Jeff Dozier). June 10, 2003.
- University of Redlands/Environmental Systems Research Institute, Redlands, CA. "GIS-Based Algorithms for Calculation of Solar Radiation and Energy Balance, with Applications in Ecology and Precision Viticulture". October 23, 2002.
- University of California at Santa Barbara, Department of Geography Colloquium. "Topography, Microclimate, and Vegetation". October 24, 2002.
- University of California at Santa Barbara, National Center for Geographic Information and Analysis. "Topography, Microclimate, and Vegetation: Reflections, Cogitations, and Some Lessons from Big Creek Reserve". May 2002.
- United States Geological Survey, Western Geographic Science Center, Menlo Park. "Topography, Microclimate, and Vegetation: Reflections, Cogitations, and Some Lessons from Big Creek Reserve". May 2002.
- Biosphere 2, Columbia University. "Biosphere 2: Regional and Global Perspective". Dec 2001.
- Northern Arizona University, Department of Biology. "Insolation, Microclimate, and Potential Habitat in Mountainous Regions". Feb 2001.
- Los Alamos National Laboratory, Earth & Environmental Science Division. "Environmental Modeling and the Future of GIS". Jan 2001.

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- University of California, Santa Cruz, Department of Environmental Studies. "GIS: Applications, Modeling, and the Future". Nov 2000.
- University of California, Berkeley, Department of Environmental Science, Policy, & Management. "Topoclimatic Habitat Models". Nov 2000.
- University of California, Berkeley, Jepson Herbarium (Botany Lunch). "Topography, Microclimate, & Vegetation Patterns: Cogitations & Some Lessons from the UC Big Creek Reserve". Oct 2000.
- Rocky Mt. Biological Laboratory: "Topographic Influences on Microclimate and Habitat: Map-Based Studies in the Rocky Mountains". Jul 2000.
- University of California, Berkeley, Center for Assessment & Monitoring of Forest & Environmental Resources (CAMFER). "Geometric Solar Radiation Models for Study of Plant Canopies and Landscape Ecology". Oct 1998.
- University of California Big Creek Reserve 20th Anniversary Symposium, "Topography, Microclimate, and Vegetation of Big Creek Reserve: Reflections, Musings, and Some Lessons". Jul 1998.
- Institute for Forest Ecology, Universitat fur Bodenkultur, Vienna, Austria, "Perspectives on Light Ecology in Forested Ecosystems". Apr 1997.
- Institute for Forest Ecology, Universitat fur Bodenkultur, Vienna, Austria, "Light Ecology in Forested Ecosystems". Two-week intensive course/lecture series. 14–25 Apr 1997.
- Organization for Tropical Studies, La Selva Biological Station, Costa Rica. "Spatially Explicit Models in Ecology: palms, canopies, and life histories". Feb 1997.
- Environmental System Research Institute (ESRI), Redlands, CA. "GIS tools for bioinformatics: a partnership between ESRI and KU". Jan 1997.
- Ecoloe Normale Superior, Paris, France. Laboratoire de Ecologie. "Plant canopies: characterization and implications". Apr 1996.
- Delta-T, Cambridge, England. "Advances in hemispherical photography analysis". Apr 1996.
- Oxford University, Oxford, England. "Solar radiation models: applications for ecology". Apr 1996.
- Henan Institute of Geography, Zheng Zhou, China. "GIS: spatially explicit models". May 1996.
- Henan University, Department of Geography, Kaifeng, China. "Spatially explicit models in ecology". May 1996.
- Golfito Field Station, Costa Rica. "Implications of habitat fragmentation in the tropics." February 1996. Feb 1996.
- La Selva Biological Station, Costa Rica. "Canopy architecture". February 1996.
- University of Kansas. "Plant canopies: characterization and implications". Tenure seminar for Department of Systematics & Ecology. Oct 1995.
- University of New Mexico. "Incorporating topographic solar radiation models in water balance models: application for the Sevilleta Long-Term Ecological Research Area". Aug 1995.
- Evergreen State College, Washington, "Solar radiation models and plant canopy measurement". NSF-Sponsored Workshop, Designing the Forest Canopy Researcher's Workbench: Computer Tools for the 21st Century. Mar 1995.
- Duke University. seminar: "Applications of solar radiation models at a range of ecological scales". workshop: "Hemispherical Photography for Characterizing Canopy Architecture and Understory Light Regimes". Feb 1995.
- National Biological Service. "GIS Applications in Conservation Biology". February 1995.

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- University of Kansas Environmental Colloquium, "Corcovado National Park: conservation issues in the tropics". Apr 1994.
- Canada Centre for Remote Sensing, Ontario, "Canopy architecture: links between remote sensing and ecology". Feb 1994.
- Petawawa Forestry Research Institute, Ontario, "Reconstruction of Canopy Surface Topography". BRDF Remote Sensing Workshop, Feb 1994.
- Workshop on Integrative Modeling of Pinyon–Juniper Woodland Ecology, Santa Fe, NM, "Biophysical factors in the ecology of pinyon–juniper woodlands". Feb 1994.
- University of Kansas Second Annual Waggoner Research Colloquium, panel discussion on "Conservation and development issues in Latin America". Nov 1993.
- Stanford University, "Spatially Explicit Models of Insolation in Arid Woodlands: Ecological Implications of Microsite Heterogeneity". Center for Conservation Biology. May 1993.
- Organization for Tropical Studies, Las Cruces Field Station: "GIS–based studies of habitat & biodiversity at La Amistad Biosphere Reserve, Costa Rica". Mar 1993.
- American Society for Photogrammetry and Remote Sensing Meeting in New Orleans, Moderator for Session on GIS Data Management for Conservation Applications. Feb 1993.
- Los Alamos National Laboratory, "A GIS–Based Model of Canopy Architecture in Arid Woodlands: Implications for Energy and Water Balances". Jun 1993.
- University of Washington, "Spatial and temporal patterns of resource availability in tropical and temperate forests: relations between plant architecture and solar radiation". College of Forest Resources and Department of Zoology. Dec 1992.
- Stanford University, "GIS database for La Amistad Biosphere Reserve". Center for Conservation Biology. Aug 1992.
- Organization for Tropical Studies, La Selva Biological Station, "Hemispherical photography for study of canopy architecture and microclimate". May 1992.
- University of Kansas. "Hemispherical photography and image analysis". Kansas Applied Remote Sensing Seminar. Jan 1991.
- University of Kansas, Department of Botany Seminar, "Rain forest palm trees: how they grow up and why they don't fall down". Oct 1991.
- University of Kansas, Department of Systematics and Ecology Seminar, "Patch dynamics and resource heterogeneity: principles from canopy dynamics applied down under". Nov 1991.
- University of Kansas, "From tropical forest to annual grassland: plant architecture and close–range remote sensing". Job Seminar for Environmental Studies Program and Kansas Biological Survey. Apr 1990.
- Organization for Tropical Studies, La Selva Biological Station, Costa Rica. "Hemispherical photography for study of plant canopies". Oct 1990.
- Forest Research Institute, Christchurch, New Zealand, "Remote sensing and image analysis for study of plant canopies". Nov 2, 1990.

Additional Invited Seminars (1987–90)

- Carnegie Institution of Washington, Department of Plant Biology. 1988.
- Department of Energy, Office of Health and Environmental Research. 1987.
- Los Alamos National Laboratory, Environmental Science Group. 1987, 1988.
- Los Alamos National Laboratory, Remote Sensing & Image Analysis Interest Group, 1987, 1988.
- NASA Ames, Ecosystem Science and Technology Branch, 1988.

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Organization for Tropical Studies La Selva Biological Field Station, Costa Rica, 1987, 1988.
Pennsylvania State University, Department of Biology, 1989.
Pennsylvania State University, Environmental Resources Research Institute, 1989.
Smithsonian Tropical Research Institute, Panama, 1987.
Stanford University, Department of Biological Sciences, 1988, 1989, 1990.
University of Arizona at Tucson, Department of Ecology and Evolutionary Biology, 1987.
University of California at Berkeley, Department of Botany, 1987.
University of California at Davis, Department of Botany, 1989.
University of California at Davis, Department of Land, Air, and Water Resources, 1989.
University of California at Santa Cruz, Department of Biology, 1987.

Grants and Contracts (since 1990)

Army Corps of Engineers, Waterways Experimental Station, MS. \$2,000. 7/95–12/95. Analysis of hemispherical photographs of southern swamplands. P.M. Rich, PI.
Brooks–Cole Publisher. \$10,800. 5/99–12/2000. Development of computer–aided and web–based teaching materials for Environmental Studies. P.M. Rich, PI.
Calcomp Corporation. \$30,000. Donation of two tablet digitizers and two vector pen plotters. Joint award with Stanford University Center for Conservation Biology. P.M. Rich and P.R. Ehrlich, co–PIs.
Canada Centre for Remote Sensing. \$12,000. 6/94–5/95. Auxiliary site characterization and acquisition of hemispherical photography in support of the BOREAS project. P.M. Rich, PI.
Department of Energy, Zero Emissions Research and Technology (ZERT). 10/1/05 to 9/30/06. \$285K. "Continued GIS Support for Zero Emissions Research and Technology". Gordon N. Keating and Paul M. Rich (Co-Is for GISLab), George Guthrie (PI).
Department of Energy, National Energy Technology Laboratory. 10/1/2006 to 9/30/2010. \$17.9M (\$1.5M to LANL). "Big Sky Regional Carbon Sequestration Partnership - Phase II". Susan Capalbo (Overall PI), John Kaszuba, (LANL PI), P.M. Rich, Co-Lead for GIS/Carbon Atlas.
Department of Energy, National Energy Technology Laboratory (NETL). "Southwest and Big Sky Regional Partnerships for Carbon Sequestration". 5/1/2004 to 9/30/2005. \$60K. New Mexico Tech (lead institution for Southwest partnership, B.J. McPherson, PI), Montana State (lead institution for Big Sky partnership, S. Capalbo, PI), Los Alamos National Laboratory (Richard Benson and Rajesh Pawar, PIs), and >70 other institutions: Paul Rich (Lead for GIS at LANL).
Environmental Systems Research Institute (ESRI). \$112,000. 5/91–12/96. ARC/INFO GIS software, training, and support for SUN workstation. Joint award with the Center for Conservation Biology, Stanford University. P.M. Rich and P.R. Ehrlich, co–PIs.
Helios Environmental Modeling Institute (HEMI). \$23,038. 1/97–12/97. Integration of geometric solar radiation models with synthetic environmental models. E. Martinko, Administrative PI, P.M. Rich and D.A. Vieglais, Co–PIs.
KTEC Center for Excellence in Computer Aided Systems Engineering. \$171,530. 1/94–6/97. Helios project: integrated solar radiation modeling. P.M. Rich, PI.
Los Alamos National Laboratory / University of New Mexico Memorandum of Understanding on Research and Education. 5/15/2006 to 9/30/2007. \$90K. "Enabling distributed network sensing of arid ecosystem adaptation resulting from global climate change". PIs: S.L. Collins

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- and L.M.A. Bettencourt. Co-Investigators: A. Hagberg, D. Pasqualini, P.M. Rich, A.B. White, et al.
- Los Alamos National Laboratory Tribal Outreach. 10/1/2005 to 9/30/2006. \$30K. "Geographic Information System (GIS) Support for Accord Pueblos" and \$10K "GIS Science Education for the Jemez Pueblo". PI: Paul Rich.
- Los Alamos National Laboratory, Advanced Chemical Identification Technology (ACIT). 5/1/04 to 9/30/05. \$270K. "ACIT GIS". P.M. Rich and T.L. Riggs (Co-Is for GIS).
- Los Alamos National Laboratory, Laboratory Directed Research and Development (LDRD-DR). "Scaling relationships in biology: developing and applying a unifying theory from molecular through biosphere scales". 10/2003-9/2005. \$3.1M. D.D. Breshears (PI), P.M. Rich, et al. (Co-Is).
- Los Alamos National Laboratory, Cerro Grande Rehabilitation Project. \$1,200,000. 10/00-9/02. Post-wildfire geospatial information management. P.M. Rich, PI.
- Los Alamos National Laboratory, Director's Discretionary Project. "Science Education Consortium: Los Alamos and Accord Pueblos". 1/2004 to 9/2004. \$50,000. M.H. Ebinger (PI), J.C. Echohawk, and P.M. Rich (Co-PIs).
- Los Alamos National Environmental Research Park Grant. \$131,638. 7/91–9/93. Remote sensing and canopy modeling of pinyon–juniper and ponderosa pine woodlands along an elevational gradient: studies of canopy geometry and solar radiation flux. P.M. Rich, PI.
- Los Alamos National Environmental Research Park Grant. \$7,000. 10/93–9/94. Remote sensing and canopy modeling: studies of canopy architecture and solar radiation flux. P.M. Rich, PI.
- Los Alamos National Laboratory, Environmental Restoration Program. \$317,000. 10/01-9/02 GIS support for environmental restoration. P.M. Rich, PI.
- NASA BOREAS Program. \$137,638. 8/93–7/96. Studies of microwave scattering and canopy architecture of boreal forests. P. Gogineni and P.M. Rich, Co–investigators.
- NASA BOREAS Program. \$220,359. 9/93–6/98. Canopy architecture of boreal forests: using hemispherical photography for study of radiative transport and leaf area index. P.M. Rich and P. Gogineni, Co–Investigators.
- NASA BOREAS Program. \$5,000. 5/94–9/94. Supplement for travel expenses in support of BOREAS field research. P.M. Rich, PI.
- National Park Service, Sequoia and Kings Canyon. \$2,500. 7/95–12/95. Analysis of hemispherical photographs for quantification of the light regime of giant forest canopy gaps. P.M. Rich, PI/
- Nature Conservancy. \$40,490. 1/97–6/99. Development of a GIS database for the Flint Hills – Osage Plains Ecoregion. K. Kindscher, PI, P.M. Rich, Co–PI.
- National Science Foundation (NSF). 6/1/2004 to 5/31/2009. \$1.2M. "Drought Impacts on Regional Ecosystems Network (DIRENET): Coordinating Studies on Southwest Forests and Woodlands". Neil Cobb (PI), P.M. Rich et al. (CO-Is, Core Participants). funded.
- NSF Facilities Program. \$112,000. 4/96–3/98. Enhancement of facilities for the Kansas Ecological Reserves. R.D. Holt, PI, P.M. Rich, K.P. Price, D. Kettle, and H. Alexander, co–PIs.
- NSF Facilities Program. \$30,000. 9/98–2/2000. Enhancing data management at the Rocky Mountain Biological Laboratory. T.D. Allison, PI, D. Inouye and P.M. Rich, Co–PIs.
- NSF Grant BSR89–013185. \$142,000. 1/90–6/92. Demography and ecophysiology of regeneration of tropical rain forest trees. Consultant on Project. Through Duke University.

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- NSF Grant BSR90-02326. \$58,000. 8/90-8/92. Turbulent exchange at vegetated surfaces: canopy geometry and gas exchange. Through University of California at Davis. P.M. Rich, PI.
- NSF Long-Term Research in Environmental Biology Program. \$100,000. 9/2000-8/2002. Long-term studies of population and community ecology in an experimentally fragmented landscape (renewal). R.D. Holt, PI, B. Foster, K.P. Price, P.M. Rich, and N. Slade, co-PIs.
- NSF Long-Term Research in Environmental Biology Program. \$269,567. 9/93-6/2000. Long-term studies of population and community ecology in an experimentally fragmented landscape. R.D. Holt, PI, P.M. Rich, K.P. Price, R. Pierotti, and D.M. Debinski, co-PIs.
- NSF Research Experience for Undergraduate Students Program. \$5,000. 4/97-3/98. \$5,000. 4/96-3/97. \$14,724. 4/95-3/96. \$4,025. 4/94-3/95. \$5,000. 4/98-3/99. supplement to Long-term studies of population and community ecology in an experimentally fragmented landscape. R.D. Holt, PI, P.M. Rich, K.P. Price, R. Pierotti, and D.M. Debinski, co-PIs.
- Organization for Tropical Studies. \$24,000. 1/96-2/97. Development of a geographical information system database for Las Cruces Biological Station and vicinity, Costa Rica, P.M. Rich, PI.
- Stanford University Center for Conservation Biology grant and University of Kansas Matching Funds. \$18,000. 4/92-9/92. Establishment of a geographical information system for scientific study in La Amistad Biosphere Reserve, Costa Rica. P.M. Rich, PI.
- Stanford University Center for Conservation Biology Grant. \$1,000. 2/95-12/95. Analysis of canopy architecture and solar radiation regimes for Australian Eucalyptus Forests. P.M. Rich, PI.
- Stanford University Center for Conservation Biology Grant. \$16,694. 1/93-12/94. A GIS-based pilot study of Lepidoptera biodiversity in the Spring Range, Nevada. P.M. Rich, PI.
- Sun Microsystems. \$76,000. Donation of two SUN SPARCstation 2 GX workstations and peripherals. Joint award with Stanford University Center for Conservation Biology. P.M. Rich and P.R. Ehrlich, co-PIs.
- University of California at Santa Barbara/Los Alamos National Laboratory Cooperative Agreement on Research and Education (CARE) Program. "Influences of Topography and Plant Canopies on Surface Climate Variability". 10/02 to 9/04. \$85,000 (+ \$100,000 in-kind match from ESRI to implement Solar Tools). J. Dozier and P.M. Rich (PIs).
- University of Kansas Experimental and Applied Ecology Program Research Grant. \$7,847. 6/94-8/94. Enhancement of terrestrial ecology research at the Kansas Ecological Reserves. P.M. Rich, D.M. Debinski, R.D. Holt, D. Kettle, and K.P. Price, Co-PIs.
- University of Kansas Experimental and Applied Ecology Program Research Grant. 6/93. \$2,600. GIS, remote sensing, and data management infrastructure to enhance multidisciplinary research at the Kansas Ecological Reserves. P.M. Rich, R.D. Holt, D. Kettle, and K.P. Price, Co-PIs.
- University of Kansas General Research Fund Grant for New Faculty. \$5,000. 1/91-6/91. An integrated image analysis system and GIS for ecological studies. P.M. Rich, PI.
- University of Kansas General Research Fund Grant. \$4,316. 7/93-6/94. Spatially explicit models of microclimate and ecophysiology within plant canopies: a GIS and remote sensing approach. P.M. Rich, PI.
- University of Kansas General Research Fund Grant. \$6,300. 7/91-6/92. Close-range remote sensing of vegetation structure and flux properties. P.M. Rich, PI.

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- University of Kansas General Research Fund Grant. \$7,650. 7/92–6/93. Hemispherical photography for study of canopy geometry. P.M. Rich, PI.
- University of Kansas General Research Fund Grant. \$8,842. 7/98–6/99. A geometric solar radiation model with applications in ecology. P.M. Rich, PI.
- University of Kansas General Research Fund Grant. \$8,911. 7/94–6/95. Restoration of a fragmented tropical forest. P.M. Rich, PI.
- University of Kansas General Research Fund Grant. \$9,650. 7/95–6/96. Conservation biology of trees in a fragmented tropical forest. P.M. Rich, PI.
- University of Kansas General Research Fund Grant. \$9,901. 7/99–6/2000. Climatic influences on vegetation patterns in mountain regions. P.M. Rich, PI.
- University of Kansas Instruction Technology Fund. \$67,400. 12/2000–6/2000. Computer laboratory and geographic information system capabilities for enhancement of Environmental Studies courses. P.M. Rich PI.
- University of Kansas Instruction Technology Fund. \$14,500. 12/98–6/99. Computer presentation and geographic information system capabilities for enhancement of Environmental Studies courses. P.M. Rich and S. Ashworth, Co-PIs.
- University of Kansas Research Development Fund Grant. \$124,904. 10/2000–8/2001. Development of a LIDAR Altimeter Sensor. M.S. Ewing, S. Gogineni, M. Jakabauskis, P.M. Rich, et al. co-PIs.
- University of Kansas Research Development Fund Grant. \$124,904. 10/2000–8/2001. Development of a LIDAR Altimeter Sensor. M.S. Ewing, S. Gogineni, M. Jakabauskis, P.M. Rich, et al. co-PIs.
- University of Kansas Research Development Fund Grant. \$60,000. 7/93–6/95. Remote sensing and GIS approaches to understanding ecological consequences of global change. P.M. Rich, S. Gogineni, S.F. Hamburg, R.D. Holt, and K. P. Price, co-PIs.
- University of Kansas Research Development Fund Grant. \$93,817. 1/97–6/99. Enhancement of GIS & environmental modeling capabilities for research concerning global change and bioinformatics. P.M. Rich, PI.
- University of Kansas Techology Grant. \$4,771. 1/99–5/99. Development of the TopoView model. P.M. Rich, PI.
- USGS. \$34,946. 9/96–8/97. Establishment of a National Geospatial Data Clearinghouse (NGDC) Node for Biological Resource Geospatial Data. P.M. Rich, PI, D. Luckey, Co-PI.
- USGS. \$49,862. 9/97–8/98. Enhancement of a National Geospatial Data Clearinghouse (NGDC) Node for Biological Resource Geospatial Data. P.M. Rich, PI, T. Peterson, Co-PI.
- ZeroNet Water-Energy Initiative. "Decision Support Tools for the San Juan Watershed". 4/15/04 to 9/30/05. \$175K. Cathy Wilson (PI), Paul M. Rich (Lead for GIS subproject).

Personal Interests and Activities

bicycling, chi kung, hiking, natural history (botany, ecology), swimming, yoga (Iyengar certified instructor)

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References

Fairley Barnes, PhD, Ecologist (retired) and former Environmental Sciences Group Leader at Los Alamos National Laboratory (LANL); address: 2 Camino Anatacio, Santa Fe, NM 87508, tel: 505-466-1260; e-mail: fairley@swcp.com; role: mentor/colleague/collaborator; former group leader/supervisor.

David D. Breshears, PhD, Professor, University of Arizona (UA); address: Biological Sciences East 325, Tucson, AZ 85721; tel: 520-621-7259, e-mail: daveb@email.arizona.edu; colleague at Los Alamos National Laboratory (LANL); role: colleague/collaborator, since 1986.

James Bollinger, Fellow Engineer and Geospatial Science Program Manager, Savannah River National Laboratory; address: Building 735-A Room B-126, Aiken, SC 29808; tel: 803-725-1417, e-mail: james02.bollinger@srnl.doe.gov; role: colleague/collaborator, since 1992, chair of DOE Geospatial Science Steering Committee, co-chair of DOE GIS User Group.

John Carothers, PhD, Professor, Cabrillo College, Aptos, CA, Department of Biology; address: 6500 Soquel Dr., Aptos, CA 95003. tel: 831-479-6456, e-mail: jocaroth@cabrillo.edu; role: colleague/collaborator/friend, since 1977.

Keith Clarke, PhD, Professor, University of California at Santa Barbara (UCSB), Department of Geography; address: 3626-A Ellison Hall, Santa Barbara, CA 93106. tel: 805-893-7961, e-mail: kclarke@geog.ucsb.edu; role: colleague/collaborator, since 2002.

Jack Dangermond, President, Environmental Systems Research Institute (ESRI); address: 380 New York St, Redlands, CA 92373; tel: 909-793-2853, e-mail: jdangermond@esri.com; role: colleague/collaborator, since 1989.

Jeff Dozier, PhD, Professor; University of California at Santa Barbara (UCSB), Donald Bren School of Environmental Science & Management, UCSB, Santa Barbara, CA 93106 tel: 805-893-5889; e-mail: dozier@bren.ucsb.edu; role: colleague/collaborator, since 2002.

Pinde Fu, PhD, Senior GIS Developer, Environmental Systems Research Institute (ESRI); address: 380 New York St, Redlands, CA 92373; tel: 909-793-2853; e-mail: pfu@esri.com; role: PhD advisee at University of Kansas (1997-2000), colleague/collaborator at ESRI (2000 to present).

Michael F. Goodchild, PhD, Professor, University of California at Santa Barbara (UCSB), Department of Geography and National Center for Geographic Information and Analysis; address: 5707 Ellison Hall, Santa Barbara, CA 93106. tel: 805-893-8049, e-mail: good@geog.ucsb.edu; role: colleague/collaborator, since 2002.

Robert D. Holt, PhD, Professor (endowed chair), University of Florida (UFL), Gainesville; tel: 352-392-6917; e-mail: rdholt@zoo.ufl.edu; role: colleague/collaborator, since 1991.

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G. Tyler Miller, PhD, Author of major environmental science textbook (Thomson, Brooks/Cole Publishing); address: 100 Dolores St, PMB 139, Carmel, CA 93923; tel: 831-624-7619; e-mail: mtg89@hotmail.com; role: colleague/collaborator on writing projects and environmental science communication, since 1996.

Harold Mooney, PhD, Professor (endowed chair), Stanford University, Department of Biological Sciences; address: Rm 477 Herrin Labs, Stanford, CA 94305; tel: 650-7231179; e-mail: hmooney@stanford.edu; role: postdoc mentor (1988-90), mentor/colleague/collaborator, since 1988.

Kevin Price, PhD, Professor, University of Kansas (KU) Dept of Geography, and Associate Director Kansas Applied Remote Sensing Program; address: 213 Lindley Hall, Lawrence, KS 66047; tel: 785-864-1506; e-mail: price@ku.edu; role: colleague/collaborator, since 1991.

Stuart Weiss, PhD, Consulting Ecologist; Creekside Center for Earth Observation (CCEO), address: 27 Bishop Lane, Menlo Park, CA 94025, tel: 650-854-9732, e-mail: stubweiss@netscape.net); role: colleague/collaborator at Stanford University and co-worker for CCEO, since 1989.

Marc Witkowski, GISLab Team Leader; Los Alamos National Laboratory (LANL); address: Earth and Environmental Sciences Division, EES-9, LANL; Los Alamos, NM 87545; tel: 505-665-8332, e-mail: witk@lanl.gov; role: colleague/collaborator, since 2001; successor as team leader for GISLab.