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Education

Institution	Degree	Year	Concentration
Oak Ridge National Laboratory	Postdoc	1992	Spatial Modeling, GIS
University of Georgia	Postdoc	1991	GIS, UNIX
University of Georgia	PhD	1988	Ecosystem Ecology
University of Georgia	MS	1983	Entomology
Vanderbilt University	BS	1978	General Biology

Professional Employment

ORNL Research Scientist, ORNL Environmental Sciences Division, Ecosystem Sciences Group - 2003-present

Adjunct Faculty, University of Tennessee, Ecology and Evolutionary Biology Department - 2003-present

Adjunct Faculty, University of Tennessee, Forestry, Wildlife, and Fisheries Department - 2005-present

ORNL Research Scientist, ORNL Environmental Sciences Division, Computational and Data Management Technologies Group - 2001-2003

ORNL Research Scientist, ORNL Computational Physics and Engineering Division, Geographic Information and Spatial Technologies Group - 2000-2001

University of Tennessee, under subcontract to ORNL Computational Physics and Engineering Division, Geographic Information and Spatial Technologies Group - 1997-2000

University of Tennessee, under subcontract to ORNL Environmental Sciences Division, Clinch River Environmental Restoration Project - 1994-1997

Professional Experience—Current Projects

- Designing the National Ecological Observatory Network (NEON). Invited member of the 15-person NEON National Network Design Committee (NNDC). The NNDC is responsible for drafting the Integrated Science and Education Plan, the Networking and Informatics Baseline Design, and the Project Execution Plan (PEP) for NEON. These reports will be given to the National Science Foundation and the U.S. Congress for a funding decision in late 2006. Also an invited member of the 10-person Land Use Subcommittee of the NEON Science and Human Dimensions Committee.

- Determining the degree to which the existing network of AmeriFlux carbon eddy-flux towers are representative of flux environments across the conterminous U.S. Can be used to determine how many additional towers will be required, and where additional towers should be placed. The importance and uniqueness of each existing tower to the AmeriFlux network will also be calculated. Office of Biological and Ecological Research, DOE.

- Comparing Atmospheric Radiation Measurement (ARM) observations to the outputs of leading global climate models and reanalysis data. Statistically identifying recurring atmospheric/cloud states from measurements alone and models alone, transposing measurement states to models and model states to measurements, and statistically developing states for measurements and models taken together. Will achieve ARM's goal of improving atmospheric models with derived relationships observed in the ARM measurements. Office of Biological and Ecological Research, DOE.

- Developing a practical Map-Analysis Tool to predict corridors used by wildlife and plants as they disperse from one patch to another. Tracks large numbers of synthetic "walkers" which are imbued with the preference and dispersal characteristics of particular species as they travel over landscapes. Produces maps of potential dispersal corridors, a patch-to-patch transfer matrix, and a map of patch importance values for each map category desired. Joint sponsorship: Southern Appalachian Information Node (SAIN) of the National Biological Information Infrastructure (NBII), Army Corps of Engineers ERDC-CERL, and the National Petroleum Technology Office, DOE.

- Statistically producing a set of national biophysical regions for the LANDFIRE project to measure departure of ecosystems from their potential vegetation state for wildfire management. Constructed a 136-node, 272-processor parallel supercomputer for use within LANDFIRE. LANDFIRE results will determine funding levels for local Forest Service units. USDA Forest Service.

- Mapping the risk that Sudden Oak Death (SOD), *Phytophthora ramorum*, will spread to other parts of the U.S., based on statistical ecoregions created using national maps of conditions likely to be limiting for *P. ramorum*, including humidity, leaf-wetness, and cool temperatures. The quantitative similarity of each of these homogeneous SOD-regions with the worst outbreak areas will be used as a national SOD-susceptibility forecast. USDA Forest Service.

- Developing the first quantitative global ecoregion maps, in coordination with The Nature Conservancy. Ecoregions are being statistically generated for both current global environmental conditions and future environments, as predicted for 2050 and 2100 by two global climate models under two possible future scenarios. Preliminary results at http://research.esd.ornl.gov/~hnw/global/ORNL-TNC/index.simcolors.html Quantitative global ecoregions will be used to prioritize ecological preservation and restoration worldwide. The Nature Conservancy.

Professional Experience—Past Projects

- Organized a symposium on "New Approaches to Ecological Regionalization" at the US-IALE 2006 annual meeting. Invited ten leading scientists doing research on ecoregionalization to present results in an all-day symposium, including a panel discussion. San Diego, CA – 2006.

- Developed Mapcurves, a quantitative, region-based map comparison tool. Produces the best translation table between categories in each map, based on spatial overlay, as an output product rather than requiring a translation table as an input. Capable of comparing two or more maps, this tool makes it possible to compare alternative ecoregion schemes, even if they contain different numbers of ecoregions. Also useful for quantifying spatial uncertainty across multiple maps – 2005.

- Developed the first quantitative ecoregion maps for Papua, New Guinea and China, in coordination with The Nature Conservancy. Maps are being used to prioritize ecological preservation and restoration – 2005.

- Developed a new climate change impact analysis method, Minimum Required Migration Distances (MRM). Determines how far a species or community would have to move in order to return to the combination of conditions they had prior to a climatic change. ORNL Seed Funding – 2004.

- Investigated the use of AVIRIS hyperspectral remote sensing data to detect brine spills associated with exploration and pumping of petroleum. Used 224 spectral bands of information to develop a spectral "fingerprint" for spilled salt water separated from crude oil. National Petroleum Technology Office, DOE – 2004.

- Enhanced the utility of the DOE Atmospheric Radiation Measurement (ARM) Data Archive for use by carbon modelers. Although designed and continually stored to improve clouds and radiation within climate models, much of the data stored in the ARM Archive has utility beyond this purpose. Evaluated and demonstrated the value of these data for use in carbon simulations, filled measurement gaps using generalized imputation methods, and produced statistical data summaries which are more directly usable in models – see http://www.archive.arm.gov/Carbon – 2002 –2004.

- Programmed leaf area analyzer that autonomously measures percentage of leaf area removed from leaves by insect consumption - measures thousands of individual leaves automatically, without requiring operator intervention – separately measures edge holes and internal holes - a Visual Basic macro for SigmaScan Pro – 2002.

- Modeled noise of Apache Longbow Helicopter and Hellfire missile detonations for ecological risk assessment of tests at Yuma Proving Ground, AZ. Utilized and modified US Air Force NOISEMAP and MR_NMAP software. Conducted surface hydrological analysis of landscapes disturbed by tracked vehicles and/or missile impacts from military tests. Strategic Environmental Research and Development Program, DoD – 2002.

- Developed niche models for tree species and predicted changes in their geographic distribution under climate change scenarios. ORNL Seed Funding – 2001.

- Produced a national map of 1000 ecoregions created empirically by statistically clustering nine environmental variables, including physiographic, edaphic, and climatic variables at 1-km resolution. Created total soil Kjeldahl nitrogen map for the continental United States at 1-km resolution by combining non-agricultural data from the National Soils Characterization Database and STATSGO. Collaborated with others to link disparate tree physiology models to simulate tree growth across spatial scales (from leaf to regions of stands). Used forcing functions to drive models at larger scales. Integrated Modeling Project, USDA Forest Service – 1997-99.

- Utilized U.S. Forest Service WRENSS model and statistical clustering techniques to simulate change in water yield that would be produced by thinning fuel to produce fire breaks in northern California. Quincy Library Group, CA – 1999.

- Generated national maps of soil properties for use in Excel spreadsheet tools designed to recommend fertilizer application rates for desired Douglas-fir and loblolly pine productivity. DOE Agenda 2020 – 1999-2000.

- Co-developed pan/zoom/scroll (PZS) tool for dissemination of GIS raster maps over the Web - server-based cgi script for viewing raster map stacks - released into the public domain for free use – September 2000.

- Modeled mountain goat (*Oreamnos americanus*) and winter recreational habitat in the Sawtooth Wilderness, Idaho using GIS – 1999.

- Devised and programmed the Fractal Landscape Realizer - a synthetic map generator for the production of neutral models - evaluated on the Web in a Turing test by over 1000 ecologists and mapping specialists - 1996-97.

- Predicted spatial distribution of foragers over large fractal resource landscapes using a modeling analysis of Ideal Free Distribution theory - 1996-97.

- Constructed the Stone SouperComputer - ORNL's first Beowulf-style parallel supercomputer - built from 128 surplus 486 and Pentium personal computers at no cost - The Stone SouperComputer has been featured in many popular articles, and continues to be used by ORNL scientists from many divisions to solve a wide variety of scientific problems - 1997 to present.

- Designed and executed field testing and ground-truthing of remotely sensed maps for endangered species habitat on Ft. Knox Military Reservation, KY, using Global Positioning System as part of the Strategic Environmental Research and Development Program (SERDP) - 1996

- Created a series of animated multi-dimensional GIS animations to visualize spatial relationships between bathymetry, contaminants, sediment types, and erosion and deposition in the Clinch River, Tennessee - all animations available in MPEG format on the WWW at http://research.esd.ornl.gov/CRERP/SEDIMENT/INDEX.HTM - 1995.

- Interpolated 3-dimensional volumetric data set of sub-bottom sediments containing more than 15 million elements using Advanced Visual Systems (AVS) - Brashear Island, Clinch River - created 3 animations and an interactive 3-D WWW data browser - http://research.esd.ornl.gov/CRERP/SEDIMENT/BRASHEAR.HTM - 1995.

- Leapfrogged from known coordinates to establish a Global Positioning System base station in one of the most physically-remote locations in the conterminous U.S. at Yellowstone National Park - established differentially-corrected post-processed positions for remote experimental sites - July 1994.

- Developed a spatially-explicit grid-based forest fire model, EMBYR, for Yellowstone National Park - 5 factors influence fire spread: fuel class, fuel moisture, wind speed and direction, and firebrands - spatial resolution is 50m - easily parameterized, efficient to run, and shows interactions between landscape pattern and process - NSF sponsored research on "Causes and Consequences of Large-Scale Fires" - http://research.esd.ornl.gov/EMBYR/embyr.html - 1991-93.

- Used the EMBYR model to simulate the fire regime over the next millennium for the Yellowstone sub-alpine plateau under 3 alternative synthetic fractally-generated climate scenarios - fuel growth and tree succession simulated by Markov probabilities - 10 replications of 1000 years each - 1994.

- Developed a spatially-explicit simulation of gypsy moth population growth and spread down the eastern United States - evaluated 4 proposed spatial arrangements for a spray "barrier" to slow the spread of gypsy moth into the southern Appalachians - 1992-93.

- Conducted remote field research backpacking 6 weeks in 1991 and 2 months in 1992 in Yellowstone National Park back country - studying vegetation recovery following the 1988 fires - helped direct 25 undergraduate field assistants - compass and surveying work - measurements of plant re-establishment - July-Aug, 1991, 1992.

- Honored by having a new species of Proturan named after me: *Eosentomon hargrovei* (Bernard) (Protura, Eosentomidae) – One of many new species of litter microarthropods found from material that I collected at the Savannah River Site in South Carolina – Specimens were examined by Dr. Ernest Bernard, who named one of the new species after me – 1990

- Installed, managed, and maintained RAIN, a Remote Automated Intelligence Network - a regional network of small computers that measures up to 7 meteorological parameters - used to test and implement models, including spray timing for Nantucket pine tip moth, late leaf-spot in peanuts, and pecan scab - RAIN links growers, researchers, and county agents at more than 100 sites in 10 states - 1987-1990

- Hired, supervised, and directed 4 student technicians working on Patterns of Canopy Herbivory project - measured areas consumed by chewing insects in over 47,000 leaves of four deciduous tree species using the Video Digitizer - 1984-1986

- Invented and programmed the Video Digitizer - a computer-controlled image analyzer for rapidly measuring the percentage of leaf area removed from leaves by chewing insects - described in Annals of the Entomological Society of America 81(4):593-598.

- Sailed across Pacific Ocean on square-rigged gaff topsail schooner "Eye of the Wind" studying *Halobates* marine water-strider distribution - April-August 1979

Honors and Advisory Committees

- Participated in National Science Foundation High-Performance Computing Advisory Workshop, as invited expert. Advised NSF about upcoming supercomputer hardware procurements - September 2005.

- Reviewed interim goals and targets for the Everglades Restoration Project, the largest ecosystem restoration project in the world. One of seven invited reviewers. Review results were reported to Congress along with request for next increment of funding – August 2005

- Served on invited panel of conservation GIS experts at the Society for Conservation GIS meeting – Shepherdstown, WV – May 2004

- Awarded Outstanding Landscape Ecology Paper by the International Association of Landscape Ecology (IALE) for Hargrove, W.W., F.M. Hoffman, and P.M. Schwartz. 2002. A Fractal Landscape Realizer for generating synthetic maps. *Conservation Ecology* 6(1): 2. [online]: http://www.consecol.org/vol6/iss1/art2 – April 2004

- Selected as author of one of 48 "key" papers in landscape ecology – current and former editors-in-chief of *Landscape Ecology* selected 48 papers published from 1987 to 1992 which they considered most influential in the field, including Hargrove and Pickering (1992) – paper was scanned and made available as a PDF file on the web – http://landscape.forest.wisc.edu/landscapeecology – March 2002.

- Selected for excellence in technical publications by the Society for Technical Communication for "Constructive contrasts between modeled and measured climate responses over a regional scale. – March 2001.

- Selected for excellence in technical art by the Society for Technical Communication for stacked perspective maps of the United States shown on the cover of *Ecosystems* Vol. 3, Issue 4 (July/August 2000) – March 2001.

- Invited as one of three speakers at Horizon Day, an annual symposium sponsored by the Computer Science Department at Indiana University where distinguished extramural speakers present perspectives on the future of Computer Science: "Linking Computers to Solve Environmental Problems: Optimistic Clairvoyance from an Applied Perspective." More information at www.cs.indiana.edu/horizon - Bloomington, Indiana, March 10, 2000

- Invited and funded to attend closed workshop on "Harnessing Remote Sensing to Accomplish Full Carbon Accounting" at the International Institute for Advanced Systems Studies (IIASA) in Laxenburg, Austria, Dec. 9-11, 1999

- Awarded Honorable Mention for the Most Outstanding Paper of the Year in the Discipline of Landscape Ecology for 1999 by the International Association of Landscape Ecology for Hargrove and Hoffman (1999), April 2000

- Served on Review Panel for the U.S. EPA's Office of Research and Development (ORD) STAR Exploratory Research to Anticipate Future Environmental Issues, Wildlife Toxicology – March 13-14, 2001.

- Served on Review Panel for the U.S. EPA's Office of Research and Development (ORD) STAR Exploratory Research to Anticipate Future Environmental Issues, Part 3: Futures Research in Sustainability: Regional Scale Assessments - 2000-STAR-K3 - September 28-29, 2000

- Serve on the GIS Advisory Committee for the GIS Certification Program at Pellissippi State Technical Community College, Knoxville, TN - 1999-present

Peer-reviewed Publications

Hargrove, W.W., and F.M. Hoffman. 2005. Minimum Required Migration Distances: A new tool for estimating climate change impacts. *Journal of Geophysical Research - Biogeosciences* (submitted).

Hargrove, W.W., F.M. Hoffman, and P.F. Hessburg. 2005. Mapcurves: a generalized algorithm for quantitative comparison of categorical maps. *Journal of Geographical Systems* (in press).

Hargrove, W.W., F.M. Hoffman, and R.A. Efroymson. 2005. A practical map-analysis tool for detecting potential dispersal corridors. *Landscape Ecology* 20(4):in press.

White, M.A., F.M. Hoffman, W.W. Hargrove, and R.R. Nemani. 2005. A global framework for monitoring phenological responses to climate change. *Geophysical Research Letters* 32(4):L04705, doi:10.1029/2004GL021961.

Saxon, E., B. Baker, W.W. Hargrove, F.M. Hoffman, and C. Zganjar. 2005. Mapping environments at risk under different global climate change scenarios. *Ecology Letters* 8:53-60.

Hoffman, F.M., W.W. Hargrove, D.J. Erickson, III, and R. Oglesby. 2005. Using clustered climate regimes to analyze and compare predictions from fully coupled general circulation models. *Earth Interactions* 9:1-27.

Efroymson, R.A, T.M. Carlsen, H.I. Jager, T. Kostova, E.A. Carr, W.W. Hargrove, J. Kercher, and T.L. Ashwood. 2004. Toward a framework for assessing risk to vertebrate populations from brine and petroleum spills at exploration and production sites. Pp. 261-285 in: Landscape Ecology and Wildlife Habitat Evaluation: Critical Information for Ecological Risk Assessment, Land-Use Management Activities, and Biodiversity Enhancement Practices, ASTM STP 1458, L. Kapustka, H. Galbraith, M. Luxon, and G.R. Biddinger (eds.), American Society for Testing and Materials, West Conshohocken, PA.

Hargrove, W.W., and F.M. Hoffman. 2004. The potential of multivariate quantitative methods for delineation and visualization of ecoregions. *Environmental Management* 34(5):S39-S60, doi: 10.1007/S00267-003-1084-0.

Martinez-Meyer, E., A. Townsend Peterson, and W.W. Hargrove. 2004. Ecological niches as stable distributional constraints on mammal species, with implications for Pleistocene extinctions and climate change projections for biodiversity. *Global Ecology and Biogeography* 13:305-314.

Peterson, A.T., R. Scachetti-Pereira, and W.W. Hargrove. 2004. Potential geographic distribution of *Anoplophora glabripennis* (Coleoptera: Cerambycidae) in North America. *American Midland Naturalist* 151(1):170-178.

Hargrove, W.W., F.M. Hoffman, and B.E. Law. 2003. New Analysis Reveals Representativeness of the AmeriFlux Network. *Eos* 84(48):529-535.

Hargrove, W.W., and F.M. Hoffman. 2003. An analytical assessment tool for predicting changes in a species distribution map following changes in environmental conditions. *Proceedings, GIS/EM4 Conference*, Banff, Alberta, Canada, Sept. 2-8, 2000. CD-ROM, ISBN: 0-9743307-0-1.

Hargrove, W.W., F.M. Hoffman, and P.M. Schwartz. 2002. A Fractal Landscape Realizer for generating synthetic maps. *Conservation Ecology* 6(1): 2. [online]: http://www.consecol.org/vol6/iss1/art2

Huff, D.D., W.W. Hargrove, R.L. Graham, N.T. Nikolov, and M. Lynn Tharp. 2002. A GIS/simulation framework for assessing change in water yield over large spatial scales. *Environmental Management* 29(2):164-181.

Luxmoore, R.L., W.W. Hargrove, M. Lynn Tharp, W. Mac Post, M.W. Berry, K.S. Minser, W.P. Cropper, Jr., D.W. Johnson, B. Zeide, R.L. Amateis, H.E. Burkhart, V.C. Baldwin, Jr., and K.D. Peterson. 2002. Addressing multi-use issues in sustainable forest management with signal-transfer modeling. *Forest Ecology and Management* 165:295-304.

Chen, L., M.W. Berry, and W.W. Hargrove. 2001. Using dendronal signatures for feature extraction and retrieval. *International Journal of Imaging Systems and Technology* 11(4):243-253.

Clark, M.E., K.A. Rose, D.A. Levine, and W.W. Hargrove. 2001. Predicting climate change effects on Appalachian trout: combining GIS and individual-based modeling. *Ecological Applications* 11(1):161-178.

Hargrove, W.W., F.M. Hoffman, and T.L. Sterling. 2001. The do-it-yourself supercomputer. *Scientific American* 256(2):72-79.

Hargrove, W.W., R.H. Gardner, M.G. Turner, W.H. Romme, and D.G. Despain. 2000. Simulating fire patterns in heterogeneous landscapes. *Ecological Modelling* 135(2-3):243-263.

Huff, D.D., W.W. Hargrove, M.L. Tharp, and R.L. Graham. 2000. Managing forests for water yield: the importance of scale. *Journal of Forestry* 98(12):15-19.

Jager, H.I., W.W. Hargrove, C.C. Brandt, A.W. King, R.J. Olson, J.M.O. Scurlock, and K.A. Rose. 2000. Constructive contrasts between modeled and measured climate responses over a regional scale. *Ecosystems* 3(4):396-411.

Gwo, J.P., F.M. Hoffman, and W.W. Hargrove. 2000. Mechanistic-based genetic algorithm search on a Beowulf cluster of Linux PCs. *Proceedings of the High-Performance Computing 2000 (HPC 2000) Conference*, Washington, DC. http://www.pdv.cs.tu-berlin.de/HPC/hpc2000.html

Luxmoore, R.J., W.W. Hargrove, M.L. Tharp, W.M. Post, M.W. Berry, K.S. Minser, W.P. Cropper, D.W. Johnson, B. Zeide, R.L. Amateis, H.E. Burkhart, V.C. Baldwin, Jr., and K.D. Peterson. 2000. Signal-transfer modeling for regional assessment of forest responses to environmental changes in the southeastern United States. *Environmental Modeling and Assessment* 5(2):125-137.

Mahinthakumar, G., F.M. Hoffman, W.W. Hargrove, and N.T. Karonis. 2000. Multivariate Geographic Clustering in a metacomputing environment using Globus. *Proceedings of the ACM/ IEEE Supercomputing '99 (SC99) Conference*, Nov. 13-15, Portland, OR. http://climate.ornl.gov/~forrest/sc99/

Mann, L.K., A.W. King, R.A. Washington-Allen, W.W. Hargrove, V.H. Dale, T.L. Ashwood, and L.R. Pounds. 2000. The role of soil classification in GIS modeling of habitat pattern: threatened calcareous ecosystems. *Ecosystems* 2(6):524-538.

Stoms, D.M., and W.W. Hargrove. 2000. Modeling potential NDVI to monitor environmental stress. *International Journal of Remote Sensing* 21(2):401-407.

Hargrove, W.W., and F.M. Hoffman. 1999. Using multivariate clustering to characterize ecoregion borders. *Computers in Science and Engineering* 1(4):18-25.

Zartman, R., R.J. Luxmoore, and W.W. Hargrove. 1999. Climate. pp. 14-19 In: H. Don Scott (ed.), *Water and Chemical Transport in Soils of the Southeastern United States*. Special Report 197, Arkansas Agricultural Experiment Station, University of Arkansas, Fayetteville, Arkansas. 388 pgs.

Turner, M.G., W.H. Romme, R.H. Gardner, and W.W. Hargrove. 1997. Effects of fire size and pattern on early succession in Yellowstone National Park. *Ecological Monographs* 67(4):411-433.

Tyler, J.A., and W.W. Hargrove 1997. Predicting spatial distribution of foragers over large resource landscapes: a modeling analysis of the Ideal Free Distribution. *Oikos* 79(2):376-386.

Romme, W.H., M.G. Turner, R.H. Gardner, W.W. Hargrove, G.A. Tuskan, D.G. Despain, and R. Renkin. 1997. A rare episode of sexual reproduction in Aspen (*Populus tremuloides* Michx.) following the 1988 Yellowstone fires. *Natural Areas Journal* 17(1):17-25.

Gardner, R.H., W.W. Hargrove, M.G. Turner, and W.H. Romme. 1996. Climate change, disturbances, and landscape dynamics. Pages 149-172 In: B. Walker and W. Steffen (eds.). *Global Change and Terrestrial Ecosystems*. International Geosphere-Biosphere Programme Book Series - Book # 2. Cambridge University Press, Cambridge, Great Britain. 619 pgs.

Plotnick, R.E., R.H. Gardner, W.W. Hargrove, K. Prestegaard, and M. Perlmutter. 1996. Lacunarity analysis: A general technique for the analysis of spatial patterns. *Physical Review* E 53(5):5461-5468.

Tinker, D.B., W.H. Romme, W.W. Hargrove, R.H. Gardner, and M.G. Turner. 1994. Landscape-scale heterogeneity in lodgepole pine serotiny. *Canadian Journal of Forest Research* 24:897-903.

Turner, M.G, W.W. Hargrove, R.H. Gardner, and W.H. Romme. 1994. Effects of fire on landscape heterogeneity in Yellowstone National Park, Wyoming. *Journal of Vegetation Science* 5:731-742.

Hargrove, W.W., and J. Pickering. 1992. Pseudoreplication: a *sine qua non* for regional ecology. *Landscape Ecology* 6(4):251-258.

Pickering, J., W.W. Hargrove, J.D. Dutcher, and HC Ellis. 1989. RAIN - a novel approach to computer-aided decision making in agriculture and forestry. *Computers and Electronics in Agriculture* 4(4):275-285.

Hargrove, W.W. 1988. A photographic technique for tracking herbivory on individual leaves through time. *Ecological Entomology* 13:359-363.

Hargrove, W.W., and D.A. Crossley, Jr. 1988. Video digitizer for the rapid measurement of leaf area lost to herbivorous insects. *Annals of the Entomological Society of America* 81(4):593-598.

Hargrove, W.W., and J.R. O'Hop. 1988. A computer algorithm to estimate leaf area removal (LAR) by insects. *Laboratory Microcomputer* 7(1):36-40. Errata: 7(2):76.

Crossley, D.A., Jr., C.S. Gist, W.W. Hargrove, L.S. Risley, T.D. Schowalter, and T.R. Seastedt. 1987. Foliage Consumption and Nutrient Dynamics in Canopy Insects. Chapter 14, pp. 193-205 In: W.T. Swank and D.A. Crossley, Jr. (eds.), *Forest Hydrology and Ecology at Coweeta*. Proc. symp. in Athens, Ga., Oct. 15-17, 1984. Springer-Verlag Ecological Studies Series, Vol. 66, New York. 469 pgs.

Schowalter, T.D., D.A. Crossley, Jr., and W.W. Hargrove. 1986. Herbivory in Forested Ecosystems. *Annual Review of Entomology* 31:177-196.

Hargrove, W.W., D.A. Crossley, Jr., and T.R. Seastedt. 1985. Shifts in insect herbivory in the canopy of black locust, *Robinia pseudoacacia* L., following fertilization. *Oikos* 43(3):322-328.

Seastedt, T.R., D.A. Crossley, Jr., and W.W. Hargrove. 1983. The effects of low-level consumption by canopy arthropods on the growth and nutrient dynamics of black locust and red maple trees in the southern Appalachians. *Ecology* 64(5):1040-1048.

Non-peer-reviewed Publications

Efroymson, R.A., M.J. Peterson, N.R. Giffen, M.G. Ryon, J.G. Smith, W.K. Roy, C.J. Welsh, D.L. Druckenbrod, W.W. Hargrove, and H.D. Quarles. 2005. Investigating habitat value in support of remedial decisions: a case study of six sites at the East Tennessee Technology Park. Technical Report BJC/OR-2268. Bechtel Jacobs Company, Oak Ridge, TN.

Hargrove, W.W., and F.M. Hoffman. 2004. A Flux Atlas for Representativeness and Statistical Extrapolation of the AmeriFlux Network. ORNL Technical Memorandum ORNL/TM-2004/112. Available at http://geobabble.ornl.gov:/flux-ecoregions

Lozar, R.C., W.W. Hargrove, and F.M. Hoffman. 2004. Use of the Corridor Tool in Support of Threatened and Endangered Species Habitat Fragmentation: Input Procedure and Initial Results. U.S. Army Corps of Engineers, Engineer Research and Development Center, Technical Report ERDC/CERL TR-04, 60 pgs. Available at http://www.cecer.army.mil

Hargrove, W.W., C.C. Brandt, H.I. Jager, and R.A. McCord. 2002. A "make-a-difference" experiment to assess the value of ARM data in carbon cycle models. Twelfth ARM Science Team Meeting Proceedings, St. Petersburg, Florida, April 8-12, 2002. Available at http://www.arm.gov/publications/proceedings/conf12/extended_abs/hargrove-ww.pdf

Efroymson, R.A., W.W. Hargrove, M.J. Peterson, D.S. Jones, W.H. Rose, L.L. Pater, G.W. Suter II, and K.A. Reinbold. 2001. Demonstration of the Military Ecological Risk Assessment Framework (MERAF): Apache Longbow-Hellfire missile test at Yuma Proving Ground. ORNL Technical Memorandum ORNL/TM-2001/211. 119 pgs.

Hargrove, W.W. 2001. Book review *of Terrestrial Ecoregions of North America. Quarterly Review of Biology* 76(2):256-257.

King, A.W., L.K. Mann, W.W. Hargrove, T.L. Ashwood, and V.H. Dale 2001. Assessing the persistence of an avian population in a managed landscape: A case study with Henslow's Sparrow at Ft. Knox, Kentucky. ORNL. Technical Memorandum ORNL/TM-13734.

Hoffman, F.M., and W.W. Hargrove. 2000. High performance computing: an introduction to parallel programming with Beowulf. *Open Source Developers Journal* 1(1)24-31. Available at http://climate.ornl.gov/~forrest/osdj-2000-11/

Hoffman, F.M., and W.W. Hargrove. 1999. Multivariate Geographic Clustering using a Beowulf-style parallel computer. In: Parallel and Distributed Processing Techniques and Applications (PDPTA '99), Vol. III, H.R. Arabina, Ed., ISBN 1-892512-11-4, CSREA Press, pp. 1292-1298.

Hoffman, F.M., and W.W. Hargrove. 1999. Parallel computing with Linux. Fall, 1999. *Crossroads: Association for Computing Machinery* 6(1) Available at http://www.acm.org/crossroads/xrds6-1/parallel.html

Hoffman, F.M., and W.W. Hargrove. 1999. Cluster computing: Linux taken to the extreme. *Linux Magazine* 1(1):56-59.

Huff, D.D., W.W. Hargrove, and R.L. Graham. 1999. *Adaptation of WRENSS Fortran 77 for a GIS application for water-yield changes.* ORNL Technical Memorandum ORNL/TM-13747.

Hargrove, W.W. 1998. Maps are not paper! Readers' Forum, *GEOWorld* 11(11):11.

Hargrove, W.W. 1996. Visualization techniques aid environmental restoration efforts. *Scientific Computing and Automation*, October 1996:35-36.

Hargrove, W.W. 1996. Over the horizon - Perspectives on future directions in GIS. Readers' Forum, *GIS World* 9(3):28.

Hargrove, W.W. 1987. A video digitizer for the rapid measurement of leaf area removed by herbivorous insects. Technological Tools, *Bulletin of the Ecological Society of America* 68(2):185.

Hargrove, W.W. 1986. An annotated species list of insects associated with black locust, *Robinia pseudoacacia* L., in the southern Appalachians. *Entomological News* 97(1):36-40.

Web Publications

Hargrove, W.W., and F.M. Hoffman. 2005. ORNL-TNC Quantitative Global Ecoregions Using Similarity Colors. Available at http://research.esd.ornl.gov/~hnw/global/ORNL-TNC/index.simcolors.html

Hargrove, W.W., and F.M. Hoffman. 2004. A Flux Atlas for Representativeness and Statistical Extrapolation of the AmeriFlux Network. Available at http://geobabble.ornl.gov:/flux-ecoregions

Hargrove, W.W., and F.M. Hoffman. 2004. A Practical Map-Analysis Tool for Detecting Potential Dispersal Corridors. Available at http://research.esd.ornl.gov/~hnw/walkers/presentation6

Hargrove, W.W., and F.M. Hoffman. 2003. Dynamic Oceanic Water-Masses for the World's Oceans Based on Quantitative Ecoregions. Available at http://research.esd.ornl.gov/~hnw/oceans

Hargrove, W.W., and F.M. Hoffman. 2002. Recent changes in the configuration of the DOE AmeriFlux network and their effects on network representation.. Available at http://research.esd.ornl.gov/~hnw/networks2

Hargrove, W.W., and F.M. Hoffman. 2002. Representativeness and network site analysis based on quantitative ecoregions. Available at http://research.esd.ornl.gov/~hnw/networks

Hargrove, W.W., C.C. Brandt, H.I. Jager, and R.M. McCord. 2002. A "make-a-difference" experiment to assess the value of ARM data in carbon cycle models. Available at http://www.archive.arm.gov/Carbon

Hargrove, W.W., and F.M. Hoffman. 2002. New high-resolution national map series of vegetation ecoregions produced empirically using multivariate spatial clustering. Available at http://research.esd.ornl.gov/~hnw/ecoregions/ecoregions.html

Hargrove, W.W., R.A. Efroymson, M. Peterson, and D.S. Jones. 2001. Hydrologic and Noise Assessment of Apache Longbow Hellfire Training at Yuma Proving Ground. Available at http://research.esd.ornl.gov/~hnw/ypg

Hargrove, W.W., and F.M. Hoffman. 2000. National clustered ecoregion products and the input layers from which they were statistically derived Available at http://geobabble.ornl.gov/cgi-bin/pzs

Hargrove, W.W., and F.M. Hoffman. 1999. Optimizing Master/Slave Dynamic Load-Balancing in Heterogeneous Parallel Environments. Available at http://research.esd.ornl.gov/~hnw/sc99

Hargrove, W.W., and F.M. Hoffman. 1999. Using multivariate clustering to characterize ecoregion borders. Available at http://research.esd.ornl.gov/~hnw/borders

Hargrove, W.W., and J. Adams. 1999. Estimating temperature and precipitation at the Last Glacial Maximum. Available at http://research.esd.ornl.gov/~hnw/valdai

Hargrove, W.W. 1997. Interpolation of Rainfall in Switzerland using a Regularized Spline with Tension, Available at http://research.esd.ornl.gov/~hnw/sic97

Hoffman, F.M., and W.W. Hargrove. 1997. The Stone SouperComputer - the first Beowulf-style parallel supercomputer at Oak Ridge National Laboratory. Available at http://stonesoup.esd.ornl.gov

Hargrove, W.W., and R.J. Luxmoore. 1997. A Clustering Technique for the Generation of Customizable Ecoregions. Proceedings, ESRI Arc/INFO Users Conference, Palm Springs, Ca. Available at http://gis.esri.com/library/userconf/proc97/proc97/TO250/pap226/p226.htm

Hargrove, W.W., D.A. Levine, M.R. Miller, P.R. Coleman, D.L. Pack, and R.C. Durfee. 1996. GIS and Risk Assessment: A fruitful combination. Proceedings, ESRI Arc/INFO Users Conference, Palm Springs, Ca. Available at http://gis.esri.com/library/userconf/proc96/TO50/PAP028/P28.HTM

Hargrove, W.W., R.F. Winterfield, and D.A. Levine. 1995. Dynamic Segmentation and Thiessen polygons: a solution to the River Mile problem. Proceedings, ESRI Arc/INFO Users Conference, Palm Springs, Ca. Available at http://gis.esri.com/library/userconf/proc95/to150/p114.html

Hargrove, W.W. 1994. Using EMBYR, a large-scale probabilistic fire model, to re-create the Yellowstone Forest Lake fire. Environmental Research News, http://research.esd.ornl.gov/EMBYR/embyr.html

Recent Presentations (of more than 150)

March 2006
21st Annual U.S. International Association of Landscape Ecology Meeting – San Diego, CA
Developing a Map of Domains for the National Ecological Observatory Network (NEON)

January 2006
1st Integrated Land Ecosystem – Atmosphere Processes Study (iLEAPS) Science Conference– Boulder, CO
Quantifying Representativeness Importance Values for AmeriFlux Tower Locations.

December 2005
American Geophysical Union – San Francisco, CA
Quantifying Representativeness Importance Values for AmeriFlux Tower Locations.

October 2005
AmeriFlux Science Team Meeting – Boulder, CO
Quantifying Representativeness Importance Values for AmeriFlux Sites.

April 2005
University of Tennessee Environmental Semester – Knoxville, TN
A Practical Map-analysis Tool for Potential Corridor Detection (invited).

March 2005
20th Annual U.S. International Association of Landscape Ecology Meeting – Syracuse, NY
Mapcurves: A Quantitative Method for Comparing Categorical Maps.

March 2005
ARM Science Team Meeting – Daytona Beach, FL
Using Clustering to Establish Climate Regimes for PCM Output.

December 2004
American Geophysical Union – San Francisco, CA
Quantifying Representation and Using Representation Weights to Interpolate Flux Tower Measurements across the United States.

October 2004
AmeriFlux Science Team Meeting – Boulder, CO
Representativeness of the AmeriFlux Network.

September 2004
Society for Conservation GIS – National Conservation Training Center, WVa
Panel Discussion – Evaluation of Conservation Strategies and Systems (invited).

September 2004
Society for Conservation GIS – National Conservation Training Center, WVa
A Practical Map-analysis Tool for Potential Corridor Detection.

September 2004
CERL Army Corps of Engineers – Champaign, IL
Using a Corridor Tool to Define Threatened and Endangered Species FOR Areas near Military Bases (invited).

August 2004
Innovative Computing Laboratory (ICL) Colloquium – Knoxville, TN
Why Linux Clusters are Good for the Environment (invited).

August 2004
NACP Remote Sensing Workshop – Missoula, MT
No formal presentation.

August 2004
MODIS Vegetation Workshop – Missoula, MT
Improving Representativeness of the AmeriFlux Network based on MODIS Vegetation Information.

April 2004
19th Annual U.S. International Association of Landscape Ecology Meeting – Las Vegas, NV
A Practical Map-analysis Tool for Potential Corridor Detection.

December 2003
American Geophysical Union Meeting – San Francisco, CA
Using Clustering to Establish Climate Regimes from PCM Output.

December 2003
American Geophysical Union Meeting – San Francisco, CA
Environmental Representativeness of the AmeriFlux Network.

November 2003
AmeriFlux Meeting – Boulder, CO
Optimization of the AmeriFlux Network Based on Environmental Clustering.

July 2003
NBII Biodiversity Modeling Meeting – Maui, HI
Statistical Location of Hutchinsonian Environmental Niche Hypervolumes using Fixed-Radius Multivariate Geographic Clustering.

June 2003
USDA Forest Service NACP Tier III Meeting – Portsmouth, NH
Representativeness and Network Site Analysis Based on Quantitative Ecoregions.

May 2003
North American Carbon Program Planning Meeting – Washington, D.C.
Optimization of Sampling Network-design Within a Quantitative Ecoregion Framework.

April 2003
ASTM Symposium on Landscape Ecology and Wildlife Habitat Evaluation – Kansas City, MO
A Practical Map-analysis Tool for Corridor Detection.

April 2003
ASTM Symposium on Landscape Ecology and Wildlife Habitat Evaluation – Kansas City, MO
Toward a Framework for Assessing Risk to Vertebrate Populations from Brine and Petroleum Spills at Exploration and Production Sites.

March 2003
Atmospheric Radiation Measurement Science Team Meeting – Broomfield, CO
Characterizing and Filling Temporal Gaps in Hour-Aggregated ARM Measurements for Use in Carbon Models.

March 2003
Atmospheric Radiation Measurement Science Team Meeting – Broomfield, CO
Multivariate Spatio-Temporal Clustering of Time-Series Data: an Approach for Diagnosing Cloud Processes and Understanding ARM Site Representativeness.

February 2003
83rd Annual Meeting of the American Meteorological Society– Long Beach, CA
Using Clustered Climate Regimes for Understanding Water Cycle Variability.

December 2002
American Geophysical Union Meeting – San Francisco, CA
A "Make-a-Difference" Experiment to Assess the Value of ARM Data in Carbon Cycle Models.

December 2002
American Geophysical Union Meeting – San Francisco, CA
Using Clustering to Establish Climate Regimes from PCM Output.

November 2002
NASA Marshall Space Flight Center – Huntsville, AL
Using Clustering to Establish Climate Regimes from PCM Output.

October 2002
Carbon Data Assimilation Meeting – College Park, MD
No formal presentation.

September 2002
Southern Appalachian Information Node, NBII – Knoxville, TN
A Map-Analysis Tool for Corridor Detection.

August 2002
Insurance catastrophe-modeling workshop – Peoria, IL
EMBYR, a Probabilistic Model of Wildfire Propagation Risk. (invited)

August 2002
Fish and Wildlife Service Regional GIS workshop, Management track.– Cookeville, TN
Computer-generated Ecoregions as a Basis for Sampling-network Design. (invited)

July 2002
National GAP Program annual meeting – Shepardsville, Wva
Statistical Delineation of Ecoregions of Nebraska using GAP Data.

July 2002
USDA Agricultural Research Service Germplasm Research Information Network – Beltsville, MD
Computer-generated Ecoregions as a Basis for Sampling-network Design. (invited)

July 2002
MODIS Vegetation workshop – Missoula, MT
A "Make-a-difference" Experiment to Assess the Value of ARM Data in Carbon Cycle Models.

June 2002
Climate Change and Assessment Working Group – Breckenridge, CO
Animations and Early Clustering Results using PCM Model Output. (invited)

May 2002
Nashville Linux Users Group – Nashville, TN
The Stone SouperComputer: a Beowulf-style Cluster for Tackling Ecological Computational Problems. (invited)

April 2002
17th Annual U.S. International Association of Landscape Ecology Meeting – Lincoln, NE
Computer-generated Ecoregions as a Basis for Sampling-network Design.

April 2002
Atmospheric Radiation Measurement (ARM) Science Team Meeting – St. Petersburg, FL
A "Make-a-difference" Experiment to Assess the Value of ARM Data in Carbon Cycle Models.

August 2001
ORNL Physics Division Colloquium – Oak Ridge, TN
The Stone SouperComputer: a Beowulf-style Cluster for Tackling Ecological Computational Problems. (invited)

May 2001
Applications of GIS to Bioinformatics - Blacksburg, VA
No formal presentation.

April 2001
16th Annual U.S. International Association of Landscape Ecology Meeting – Tempe, AZ
Multivariate Ecoregions of the United States: a Statistical Delineation.

March 2001
2001 North Carolina GIS Conference – Winston-Salem, NC
Multivariate Spatio-Temporal Clustering (MSTC) using a Beowulf-style parallel supercomputer. (invited)

November 2000
Supercomputing '00 - Dallas, TX
Climate Change Effects Predicted by Two Leading Global Circulation Models Compared to Present-day Climate.

October 2000
Friends of ORNL – Oak Ridge, TN
From Fable to Beowulf: the Legend of the Stone SouperComputer. (invited)

September 2000
Fourth International Conference on Integrating GIS and Environmental Modeling - Banff, Alberta, CANADA
An Analytical Assessment Tool for Predicting Changes in a Species Distribution Map Following Changes in Environmental Conditions.

July 2000
Synthetic Aperture Radar Workshop - Los Angeles, CA
Southern California Earthquake Center/NASA/NSF

April 2000
15th Annual U.S. International Association of Landscape Ecology Meeting - Ft. Lauderdale, FL
An Analytical Assessment Tool for Predicting Changes in a Species Distribution Map Following Changes in Environmental Conditions.

March 2000
Horizon Day - Bloomington, IN
Linking Computers to Solve Environmental Problems: optimistic Clairvoyance from an Applied Perspective (invited).