

# References

- Abrahams, A. D. 1977. The factor of relief in the evolution of drainage basin networks with a digital computer, *Am. J. Sci.*, **277**, 626–630.
- Abrahams, A. D. 1984. Channel networks: A geomorphological perspective, *Water Resour. Res.*, **20**(2), 161–168.
- Abrahams, A. D., and A. J. Miller. 1982. The mixed gamma model for channel link lengths, *Water Resour. Res.*, **18**, 1126–1136.
- Aharony, A. 1986. Percolation. In *Directions in Condensed Matter Physics*. G. Grinstein and G. Mazenko editors, World Scientific, Singapore, pp. 1–50.
- Aharony, A. 1989. Measuring multifractals, *Physica D*, **38**, 1–4.
- Ahnert, F. 1976. Brief description of a comprehensive three-dimensional process–response model for landform development, *Z. Geomorphol. Suppl.*, **25**, 29–49.
- Ahnert, F. 1984. Local relief and the height limits of mountain ranges, *Am. J. Sci.*, **284**, 1035–1055.
- Ahnert, F. 1987. Process response models of denudation at different spatial scales. In *Geomorphological Models Theoretical and Empirical Aspects*. F. Ahnert editor. *Catena*, Suppl. **10**, 31–50.
- Allegre, C. J., J. L. Le Mouel, and A. Provost. 1982. Scaling rules in rock fracture and possible implications for earthquake prediction, *Nature*, **297**, 47–49.
- Allen, P. B., and J. W. Naney. 1991. Hydrology of the Little Washita river watershed: Data and analyses, *USDA Tech. Rep. ARS-90*.
- Alstrom, P. 1990. Self-organized criticality and fractal growth, *Phys. Rev. A*, **41**(12), 7049–7052.
- Amitrano, C., A. Coniglio, P. Meakin, and M. Zannetti. 1991. Multiscaling in diffusion-limited aggregation, *Phys. Rev. B*, **44**(10), 4974–4977.
- Andrews, D. J., and T. C. Hanks. 1985. Scarp degraded by linear diffusion: Inverse solution for age, *J. Geophys. Res.*, **90**, 10193–10208.
- Andrews, D. J., and R. C. Bucknam. 1987. Fitting degradation of shoreline scarps by a nonlinear diffusion model, *J. Geophys. Res.*, **92**(12), 857–867.
- Andrle, R. 1992. Estimating fractal dimensions with the divider method in geomorphology, *Geomorphology*, **5**, 131–142.
- Andrle, R., and A. D. Abrahams. 1989. Fractal techniques and the surface roughness of talus slopes, *Earth Surf. Proc. Landforms*, **14**(3), 197–209.
- Armanini, A., and G. Di Silvio, editors. 1992. *Hydraulics of Mountain Regions*, Springer-Verlag, Berlin.
- Athelougou, M., B. Merte', P. Deisz, A. Hubler, and E. Luscher. 1989. Extremal properties of dendritic patterns: Biological applications, *Helvetica Physica Acta*, **62**, 250–253.
- Athelougou, M., B. Merte', P. Poschl, A. Hubler, and E. Luscher. 1990a. Extremal properties of dendritic patterns: Biological applications, II, *Condensed Matter H. P. A.*, 908–909.
- Athelougou, M., B. Merte', P. Deisz, A. Hubler, and E. Luscher. 1990b. Extremal properties of dendritic patterns: Investigations on systems of blood-vessels, *Herbsttagung der SPG/SSP*, **63**, 539–540.
- Avissar, R., and R. Pielke. 1989. A parametrization of heterogeneous land surfaces for atmospheric numerical models and its impact on regional meteorology, *Mon. Weather Rev.*, **117**, 2113–2120.
- Bak, P. 1992. Self-organized criticality in non-conservative models, *Physica A*, **191**, 41–46.
- Bak, P. 1996. *How Nature Works*, Copernicus/Springer-Verlag, New York.
- Bak, P. 1994. Lectures on Self-Organized Criticality, Lecture Notes, Summer School on Environmental Dynamics, Istituto Veneto di Scienze, Lettere ed Arti, Venice, Italy, preprint.
- Bak, P., and K. Chen. 1989. The physics of fractals, *Physica D*, **38**, 5–12.
- Bak, P., and K. Chen. 1991. Self-organized criticality, *Sci. Am.*, **46**, 52–61.
- Bak, P., and C. Tang. 1989. Earthquakes as a self-organized critical phenomenon, *J. Geophys. Res.*, **94**, 15635–15637.

- Bak, P., and M. Creutz. 1993. Fractals and self-organized criticality. In *Fractals and Disordered Systems*. A. Bundle and S. Havlin editors, Springer-Verlag, Berlin, pp. 93–101.
- Bak, P., and K. Sneppen. 1993. Punctuated equilibrium and criticality in a simple model of evolution, *Phys. Rev. Lett.*, **71**(24), 4083–4986.
- Bak, P., and M. Paczuski. 1993. Why nature is complex, *Physics World*, **12**, 39–43.
- Bak, P., C. Tang, and K. Wiesenfeld. 1987. Self-organized criticality: An explanation of  $1/f$  noise, *Phys. Rev. Lett.*, **59**, 381–385.
- Bak, P., C. Tang, and K. Wiesenfeld. 1988. Self-organized criticality, *Phys. Rev. A*, **38**(1), 364–374.
- Bak, P., K. Chen, and M. Creutz. 1989. Self-organized criticality in the 'Game of Life', *Nature*, **342**, 780–784.
- Bak, P., K. Chen, and C. Tang. 1990. A forest-fire model and some thoughts on turbulence, *Phys. Lett. A*, **147**, 297–313.
- Bak, P., H. Flyvbjerg, and K. Sneppen. 1994. Can we model Darwin? *New Scientist*, **12**, 36–42.
- Bak, P., M. Paczuski, and S. Maslov. 1995. Complexity and extremal dynamics, Brookhaven Natl. Lab. preprint no. 62678.
- Band, L. E. 1986. Topographic partition of watersheds with digital elevation models, *Water Resour. Res.*, **22**(1), 15–24.
- Barenblatt, G. I., A. V. Zhivago, Y. P. Neprochnov, and A. A. Ostrovskij. 1984. The fractal dimension: A quantitative characteristic of ocean bottom relief, *Oceanology*, **24**, 695–697.
- Batchelor, G. K. 1953. *The Theory of Homogeneous Turbulence*, Cambridge University Press, Cambridge.
- Beer, T., and M. Borgas. 1993. Horton's laws and the fractal structure of streams, *Water Resour. Res.*, **29**(5), 1475–1487.
- Bell, T. H. 1975. Statistical feature of sea-floor topography, *Deep Sea Res.*, **22**, 883–892.
- Bellin, A., P. Salandin, and A. Rinaldo. 1992. Dispersion in heterogeneous porous formations: Statistics, first-order theories, convergence of computations, *Water Resour. Res.*, **28**(9), 2211–2227.
- Bennett, J. G. 1936. Broken coal, *J. Inst. Fuel*, **10**, 22–39.
- Benzi, R., G. Paladin, G. Parisi, and A. Vulpiani. 1984. On the multifractal nature of fully developed turbulence and chaotic systems, *J. Phys. A*, **17**, 3521–3531.
- Berkson, J. M., and J. E. Mathews. 1983. Statistical properties of sea floor roughness. In *Acoustics and the Sea-Bed*. N. G. Pace editor, Bath University Press, Bath, pp. 215–223.
- Beven K. J., and M. J. Kirkby. 1979. A physically based variable contributing area model of basin hydrology, *Hydrol. Sci. Bull.*, **24**(1), 43–49.
- Beven, K., and E. Wood. 1983. Catchment and geomorphology and the dynamics of the runoff contributing areas, *J. Hydrol.*, **65**, 139–158.
- Beven, K., and I. D. Moore, editors. 1993. *Terrain Analyses and Distributed Modelling in Hydrology*, J. Wiley, New York.
- Beven, K., and M. J. Kirkby, editors. 1993. *Channel Network Hydrology*, J. Wiley, New York.
- Bloom, A. L. 1991. *Geomorphology: A Systematic Analysis of Late Cenozoic Landforms*, Prentice Hall, New Jersey.
- Blumenfeld, R., Y. Meir, A. Aharony, and A. B. Harris. 1987. Resistance fluctuations in randomly diluted networks, *Phys. Rev. B*, **35**, 3524–3535.
- Bouchaud, J. P., and A. Georges. 1990. Anomalous diffusion in disordered media: Statistical mechanisms, models and physical applications, *Phys. Rep.*, **195**(4-5), 127–293.
- Bounds, D. 1987. New optimization methods from physics and biology, *Nature*, **329**, 215.
- Boyd, M. J. 1978. A storage-routing model relating drainage basin hydrology and geomorphology, *Water Resour. Res.*, **14**(5), 921–928.
- Bras, R. L. 1990. *Hydrology*, Addison-Wesley, Reading, MA.
- Bras, R. L., and I. Rodriguez-Iturbe. 1985. *Random Functions in Hydrology*, Addison-Wesley, Reading, MA.
- Breyer, S. P., and R. S. Snow. 1992. Drainage basin perimeters: A fractal significance, *Geomorphology*, **5**, 143–158.
- Brush, L. M. 1961. Drainage basins, channels and flow characteristics of selected streams in central Pennsylvania, *U.S. Geol. Surv. Prof. Paper* no. 282.
- Bunde, A., editor. 1992. *Fractals and Disorder*, North-Holland, Amsterdam.
- Burrough, P. A. 1983. Multiscale sources of spatial variation in soil. I, The application of fractal concepts to nested levels of soil variation, *J. Soil Sci.*, **34**, 577–591.
- Burrough, P. A. 1989. Fractals and geochemistry. In *The Fractal Approach to Heterogeneous Chemistry*, D. Avnir editor, J. Wiley, New York, pp. 383–406.
- Cabral, M., and S. J. Burges. 1994. Digital elevation model networks (DEMON): A model of flow over hillslopes for computation of contributing and dispersal areas, *Water Resour. Res.*, **30**(6), 1681–1692.
- Caldarelli, G., A. Maritan, J. R. Banavar, A. Giacometti, I. Rodriguez-Iturbe, and A. Rinaldo. 1996. Cellular models for river networks, preprint.
- Calver, C. W. 1978. Modelling headwater development, *Earth Surf. Proc.*, **3**, 223–241.
- Carlston, C. W. 1969. Downstream variations in the hydraulic geometry of streams: Special emphasis in mean velocity, *Am. J. Sci.*, **64**(2), 241–256.
- Carrara, A. 1988. Drainage and divide networks derived from high fidelity digital terrain models. In

- Quantitative Analysis of Mineral and Energy Resources*, NATO ASI Series C, Mathematical and Physical Sciences, vol. 223, C. F. Chuna et al. editors, D. Reidel, Hingham, MA, pp. 215–223.
- Cayley, A. 1859. On the analytical forms called trees, *Phil. Mag.*, **18**, 374–378.
- Chase, C. G. 1992. Fluvial land sculpting and the fractal dimension of topography, *Geomorphology*, **5**, 39–57.
- Chen, K., P. Bak, and S. P. Obukhov. 1991. Self-organized criticality in a crack-propagation model of earthquakes, *Phys. Rev. A*, **43**(2), 625–630.
- Chhabra, A. B., and R. V. Jensen. 1989. Direct determination of the  $f(\alpha)$  singularity spectrum, *Phys. Rev. Lett.*, **62**, 1327–1331.
- Chorley, R. J., editor. 1969. *Water, Earth and Man*, Methuen, London.
- Chorley, R. J., R. P. Beckinsale, and A. J. Dunn. 1973. *The History of the Study of Landforms*, Methuen, London.
- Chorley, R. J., S. A. Schumm, and D. E. Sugden. 1985. *Geomorphology*, Methuen, London.
- Chow, V. T. 1959. *Open-Channel Hydraulics*, McGraw-Hill, New York.
- Christensen, K., Z. Olami, and P. Bak. 1992. Deterministic  $1/f$  noise in nonconservative models of self-organized criticality, *Phys. Rev. Lett.*, **68**(16), 2417–2420.
- Churchill, R. V., and T. Brown. 1979. *Fourier Series and Boundary Value Problems*, 2nd edition, McGraw-Hill, New York.
- Cieplak, M., A. Giacometti, A. Maritan, A. Rinaldo, I. Rodriguez-Iturbe, and J. R. Banavar. 1996. Disorder-dominated river basins, preprint.
- Colaioni, F., A. Flammini, A. Maritan, and J. R. Banavar. 1996. Analytical solutions for optimal channel networks, *Phys. Rev. E*, in press.
- Coniglio, A. 1986. Multifractal structure of clusters and growing aggregates, *Physica A*, **140**, 51–62.
- Coniglio, A., and M. Zannetti. 1989. Multiscaling and multifractality, *Physica D*, **38**, 37–40.
- Coniglio, A., C. Amitrano, and F. Di Liberto. 1986. Growth probability distribution in kinetic aggregation processes, *Phys. Rev. Lett.*, **57**(8), 1016–1019.
- Cordova J. R., I. Rodriguez-Iturbe, and P. Vaca. 1982. On the development of drainage networks, Proc. Exter Symposium on Recent Developments in the Explanation and Prediction of Erosion and Sediment Transport, IAHS Publ. 137, 239–249.
- Cox, D. R., and H. D. Miller. 1965. *The Theory of Stochastic Processes*, Methuen, London.
- Cox, D. R., and V. Isham. 1980. *Point Processes*, Chapman and Hall, London, 182 pp.
- Cramér, H. 1946. *Mathematical Methods of Statistics*, Princeton University Press, Princeton, NJ.
- Culling, W. E. H. 1960. Analytical theory of erosion, *J. Geol.*, **68**, 336–344.
- Culling, W. E. H. 1963. Soil creep and the development of hillside slopes, *J. Geol.*, **71**, 127–161.
- Culling, W. E. H. 1965. Theory of erosion on soil-covered slopes, *J. Geol.*, **73**, 230–254.
- Culling, W. E. H. 1986. On Hurst phenomena in the landscape, *Trans. Jpn. Geomorphol. Union*, **7**(4), 221–243.
- Dagan, G. 1984. Solute transport in heterogeneous porous formations, *J. Fluid Mech.*, **145**, 151–177.
- Dagan, G. 1989. *Flow and Transport in Porous Formations*, Springer-Verlag, Berlin-Heidelberg.
- Dagan, G., V. Cvetkovic, and A. Shapiro. 1992. A solute flux approach to transport in heterogeneous formations. 1, The general framework, *Water Resour. Res.*, **28**(5), 1369–1376.
- Davis, W. N. 1899. The geographical cycle, *Geogr. J.*, **14**, 481–504.
- Davis, W. N. 1924. *Die erklärende Beschreibung der Landformen*, 2nd edition, Teubner, Leipzig.
- De Arcangelis, L., S. Redner, and A. Coniglio. 1985. Anomalous voltage distribution of random resistor networks and a new model for the backbone at the percolation threshold, *Phys. Rev. B*, **31**, 4725–4727.
- De Arcangelis, L., J. Koeplik, S. Redner, and D. Wilkinson. 1986. Hydrodynamic dispersion in network models of porous media, *Phys. Rev. Lett.*, **57**(8), 996–999.
- Delworth, T., and S. Manabe. 1988. The influence of potential evaporation on the variabilities of simulated soil wetness and climate, *J. Clim.*, **1**, 523–547.
- Delworth, T., and S. Manabe. 1989. The influence of soil wetness on near-surface atmospheric variability, *J. Clim.*, **2**, 1447–1462.
- De Boer, J., B. Derrida, H. Flyvbjerg, A. D. Jackson, and T. Wettig. 1994. Simple model of self-organized biological evolution, *Phys. Rev. Lett.*, **73**(6), 906–909.
- De Vries, H., T. Becker, and B. Eckhardt. 1994. Power law distribution of discharge in ideal networks, *Water Resour. Res.*, **30**(12), 3541–3543.
- Dhar, D., and S. N. Majumdar. 1990. Abelian sandpile model of the Bethe lattice, *J. Phys. A: Math. Gen.*, **23**, 4333–4350.
- Dhar, D. 1990. Self-organized critical state of sandpile automaton models, *Phys. Rev. Lett.*, **64**(14), 1613–1616.
- Dhar, D., and R. Ramaswamy. 1989. Exactly solved model of self-organized critical phenomena, *Phys. Rev. Lett.*, **63**(16), 1659–1662.
- Dietler, G., and Y. Zhang. 1992. Fractal aspects of the Swiss landscape, *Physica A*, **191**, 213–219.
- Dietrich, W. E., and T. Dunne. 1993. The channel head, In *Channel Network Hydrology*, K. Beven and M. J. Kirby editors, J. Wiley, New York, pp. 176–219.
- Dietrich, W. E., C. J. Wilson, and S. L. Reneau. 1986.

- Hollows, colluvium, and land slides in soil-mantled landscapes. In *Hillslope Processes*, E. D. Abrahams editor, Allen and Unwin, New York, pp. 361–388.
- Dietrich, W. E., S. L. Reneau, and C. J. Wilson. 1987. Overview: "Zero order basins" and problem of drainage density, sediment transport and hillslope morphology, *IAHS Publ.* no. 165, 49–59.
- Dietrich, W. E., D. R. Montgomery, S. L. Reneau, and P. Jordan. 1988. The use of hillslope convexity to calculate diffusion coefficients for a slope dependent transport law, *EOS Trans. AGU*, **69**(16), 316–317.
- Dietrich, W. E., C. Wilson, D. R. Montgomery, J. McKean, and R. Bauer. 1992. Erosion thresholds and land surface morphology, *J. Geol.*, **20**, 675–679.
- Dietrich, W. E., C. J. Wilson, D. R. Montgomery, and J. McKean. 1993. Analysis of erosion thresholds, channel networks and landscape morphology using a digital terrain model, *J. Geol.*, **3**, 161–180.
- Dietrich, W. E., R. Reiss, M. L. Hsu, and D. R. Montgomery. 1995. A process-based model for colluvial soil depth and shallow landsliding using digital elevation data, *Hydrol. Processes*, **9**, 383–400.
- Dolan, R., L. Vincent, and B. Hayden. 1974. Crescentic coastal landforms, *Z. Geomorph. N. F.*, **18**(1), 1–12.
- Dooge, J. C. I. 1973. Linear theory of hydrologic systems, *USDA Tech. Bull.* 1468.
- Drossel, B., and F. Schwabl. 1992. Self-organized criticality in a forest-fire model, *Physica A*, **191**, 47–50.
- Drossel, B., S. Clar, and F. Schwabl. 1993. Exact results for the one-dimensional self-organized critical forest fire model, *Phys. Rev. Lett.*, **71**(23), 3739–3742.
- Dubuc, B., J. F. Quiniou, C. Roques-Carmes, C. Tricot, and S. W. Zucker. 1989a. Evaluating the fractal dimension of profiles. *Phys. Rev. A*, **39**(3), 1500–1512.
- Dubuc, B., S. W. Zucker, W. Tricot, J. F. Quiniou, and D. Wehbi. 1989b. Evaluating the fractal dimension of surfaces, *Proc. Roy. Soc. London*, **a425**, 113–127.
- Dunne, T. 1978. Field studies in hillslope flow processes. In *Hillslope Hydrology*, M. J. Kirkby editor, J. Wiley, New York, pp. 227–294.
- Dunne, T. 1980. Formation and controls of channel networks, *Progr. Phys. Geogr.*, **4**, 211–239.
- Dunne, T., and W. E. Dietrich. 1980a. Experimental study of Horton overland flow on tropical hillslopes. 1, Soil conditions, infiltration and frequency runoff, *Zeits. fur Geomorph.*, Suppl. Bd., **35**, 40–58.
- Dunne, T., and W. E. Dietrich. 1980b. Experimental study of Horton overland flow on tropical hillslopes. 2, Hydraulic characteristic and hillslope hydrographs, *Zeits. fur Geomorph.*, Suppl. Bd., **35**, 59–80.
- Dunne, T., and B. F. Aubrey. 1986. Evaluation of Horton's theory of sheetwash and rill erosion on the basis of field experiments. In *Hillslope Processes*, A. D. Abrahams editor, Allen and Unwin, Winchester, pp. 31–53.
- Eagleson, P. S. 1970. *Dynamic Hydrology*, McGraw-Hill, New York.
- Eagleson, P. S. 1978. Climate, soil and vegetation. 6, Dynamics of the annual water balance, *Water Resour. Res.*, **5**, 749–755.
- Eagleson, P. S. 1994. The evolution of modern hydrology (from watershed to continent in 30 years), *Adv. Water Resour.*, **17**, 3–18.
- Eden, M. 1961. A two-dimensional growth process. In *Fourth Berkeley Symposium on Mathematical Statistics and Probability, Volume IV: Biology and Problems of Health*, J. Neyman editor, University of California Press, Berkeley, pp. 223–239.
- Eigen, M., and R. Winkler. 1993. *Laws of the Game*, Princeton University Press, Princeton, NJ.
- Entekhabi, D., and P. S. Eagleson. 1989. Land surface hydrology parametrization for atmospheric general circulation models including subgrid scale spatial variability, *J. Clim.*, **2**, 816–831.
- Entekhabi, D., and I. Rodriguez-Iturbe. 1994. Analytical framework for the characterization of the space-time variability of soil moisture, *Adv. Water Resour.*, **17**, 35–46.
- Fairfield, J., and P. Leymarie. 1991. Drainage networks from grid digital elevation models, *Water Resour. Res.*, **27**, 709–717. (Correction, *Water Resour. Res.*, **27**, 2809, 1991.)
- Falconer, J. 1985. *The Geometry of Fractal Sets*, Cambridge University Press, Cambridge, U.K.
- Falconer, J. 1990. *Fractal Geometry: Mathematical Foundations and Applications*, J. Wiley, New York.
- Family, F. and T. Vicsek, editors. 1991. *Dynamics of Fractal Surfaces*, World Scientific, Singapore.
- Feder, J. 1988. *Fractals*, Plenum, New York.
- Feller, W. 1971. *An Introduction to Probability Theory and Its Applications*, vol. 2, 2nd edition, J. Wiley, New York.
- Fisher, M. E. 1971. In *Critical Phenomena*, M. S. Green editor, Academic, New York.
- Flint, J. J. 1973. Experimental development of headward growth into channel networks, *Geol. Soc. Am. Bull.*, **84**, 1087–1095.
- Flint, J. J. 1974. Stream gradient as a function of order, magnitude, and discharge, *Water Resour. Res.*, **10**(5), 969–973.
- Flyvbjerg, H., K. Sneppen, and P. Bak. 1993. Mean field theory for a simple model of evolution, *Phys. Rev. Lett.*, **71**(24), 4987–4990.
- Fox, C. G. 1989. Empirically derived relationship between fractal dimension and power law from frequency spectra, *Pure Appl. Geophys.*, **131**, 307–313.
- Fox, C. G., and D. E. Hayes. 1989. Quantitative methods for analyzing the roughness of the seafloor, *Rev. Geophys.*, **23**, 1–48.
- Freeman, T. G. 1991. Calculating catchment area with

- divergent flow based on a regular grid, *Comp. Geosci.*, **17**, 413–422.
- Frette, V., K. Christensen, A. Malthé-Sørensen, J. Feder, T. Jøssag, and P. Meakin. 1996. Avalanche dynamics in a pile of rice, *Nature*, **379**(6560), 49–52.
- Frisch, U., and G. Parisi. 1985. Fully developed turbulence and intermittency. In *Turbulence and Predictability in Geophysical Fluid Dynamics*, M. Ghil, R. Benzi, and G. Parisi editors, North Holland, New York, 84–92.
- Fujiwara, A., G. Kamimoto, and A. Tsukamoto. 1977. Destruction of basaltic bodies by high-velocity impact, *Icarus*, **31**, 277–288.
- Gilbert, G. K. 1877. Report on the geology of the Henry Mountains, Rep. U.S. Geological Survey of the Rocky Mountains Regions, Government Printing Office, Washington DC.
- Gilbert, G. K. 1909. The convexity of hilltops, *J. Geol.*, **17**, 344–350.
- Gilbert, L. E. 1989. Are topographic data sets fractals?, *Pure Appl. Geophys.*, 241–254.
- Gilbert, L. E., and A. Malinverno. 1988. A characterization of the spectral density of residual ocean floor topography, *Geophys. Res. Lett.*, **15**, 1401–1404.
- Glansdorff, P., and I. Prigogine. 1971. *Thermodynamic Theory of Structure, Stability and Fluctuations*, Wiley Interscience, London.
- Glock, W. S. 1931. The development of drainage systems: A synoptic view, *Geogr. Rev.*, **21**, 475–482.
- Gore, A. 1990. *Earth in the Balance*, Pergamon, Boston.
- Gould, S. J. 1989. *Wonderful Life*, W. W. Norton, Boston, MA.
- Gould, S. J., and R. Eldredge. 1977. Punctuated equilibrium: The tempo and mode of evolution reconsidered, *Paleobiology*, **3**, 114–122.
- Gould, S. J., and R. Eldredge. 1993. Punctuated equilibrium comes of age, *Nature*, **366**, 223–226.
- Grassberger, P., and I. Procaccia. 1983. Characterization of strange attractors, *Phys. Rev. Lett.*, **50**, 346–351.
- Gray, D. M. 1961. Interrelationships of watershed characteristics, *J. Geophys. Res.*, **66**(4), 1215–1223.
- Gregory, K. J., and D. E. Walling. 1973. *Drainage Basin Form and Process*, Edward, London.
- Grieger, B. 1992. Quaternary fluctuations as a consequence of self-organized criticality, *Physica A*, **191**, 51–56.
- Grinstein, G., D. H. Lee, and S. Sachdev. 1990. Conservation laws, anisotropy and self-organized criticality in noisy nonequilibrium systems, *Phys. Rev. Lett.*, **64**(16), 1927–1931.
- Groff, M. 1992. Implicationi idrologiche dells studio della funetione di-ampiezza in bacini reali, Thesis, Dipartimento di Ingegneria Civile ed Ambientale, Università di Trento.
- Gupta, V. K., and O. J. Mesa. 1988. Runoff generation and hydrologic response via channel network geomorphology – Recent progress and open problems, *J. Hydrol.*, **102**, 3–28.
- Gupta, V. K., and E. Waymire. 1983. On the formulation of an analytical approach to understand hydrological response and similarity at the basin scale, *J. Hydrol.*, **65**, 95–129.
- Gupta, V. K., and E. Waymire. 1989. Statistical self-similarity in river networks parameterized by elevation, *Water Resour. Res.*, **25**(3), 463–476.
- Gupta, V. K., and E. Waymire. 1990. Multiscaling properties of spatial rainfall and river flow distributions, *J. Geophys. Res.*, **95**, 1999–2009.
- Gupta, V. K., and E. Waymire. 1993. A statistical analysis of mesoscale rainfall as a random cascade, *J. Appl. Meteorology*, **32**, 251–267.
- Gupta, V. K., E. Waymire, and C. T. Wang. 1980. A representation of an IUH from geomorphology, *Water Resour. Res.*, **16**(5), 885–862.
- Gupta, V. K., E. Waymire, and I. Rodriguez-Iturbe. 1986. On scales, gravity and network structure in basin runoff. In *Scale Problems in Hydrology*, V. K. Gupta, I. Rodriguez-Iturbe, and E. F. Wood editors, Reidel, Dordrecht, pp. 159–184.
- Gutenberg, B., and C. F. Richter. 1954. *Seismicity of the Earth and Associated Phenomena*, Princeton University Press, Princeton, NJ.
- Gutjahr, A. L. 1989. Fast Fourier Transform for random field generation, Project Rep. for Los Alamos Grant to New Mexico, Contract no. 4 - r58 - 2690R.
- Hack, J. T. 1957. Studies of longitudinal profiles in Virginia and Maryland, *U.S. Geol. Surv. Prof. Paper*, 294-B.
- Hadley, R. F., and S. A. Schumm. 1961. Sediment sources and drainage basin characteristics in upper Cheyenne River Basin, *U.S.G.S. Water Supply Paper 1531-B*.
- Hadwich, G., B. Merte', A. Hubler, and E. Luscher. 1990. Stationary dendritic structures in an electric field, *Herbsttagung der SPG/SSP*, **63**, 487–489.
- Halsey, T. C., P. Meakin, and I. Procaccia. 1986a. Scaling structure of the surface layer of diffusion-limited aggregates. *Phys. Rev. Lett.*, **56**, 854–857.
- Halsey, T. C., M. H. Jensen, L. P. Kadanoff, I. Procaccia, and B. I. Shraiman. 1986b. Fractal measures and their singularities: The characterization of strange sets, *Phys. Rev. A*, **33**(2), 1141–1151.
- Hanks, T. C., and H. Kanamori. 1979. A moment-magnitude scale, *J. Geophys. Res.*, **84**, 2948–2980.
- Hanks, T. C., R. C. Buckman, K. R. Lajoie, and R. E. Wallace. 1984. Modifications of wave-cut and faulting-controlled, *J. Geophys. Res.*, **89**, 5771–5790.
- Havlin, S., and D. Ben-Avraham. 1987. Diffusion in disordered media, *Adv. Phys.*, **36**(6), 695–798.
- Henderson, F. M. 1963. Some properties of the unit

- hydrograph, *J. Geophys. Res.*, **68**(16), 4785–4793.
- Henderson, F. M. 1966. *Open Channel Flow*, MacMillan, New York.
- Hentschel, H. G. E., and I. Procaccia. 1983. The infinite number of dimension of fractals and strange attractors, *Physica D*, **8**, 435–444.
- Hjelmfelt, A. T. 1988. Fractals and the river length catchment-area ratio, *Water Resour. Bull.*, **24**, 455–459.
- Holley, R., and E. C. Waymire. 1992. Multifractal dimensions and scaling exponents for strongly bounded random cascades, *Ann. Appl. Probability*, **2**(4), 819–845.
- Horton, R. E. 1932. Drainage-basin characteristics, *EOS Trans. AGU*, **13**, 350–361.
- Horton, R. E. 1945. Erosional development of streams and their drainage basins; hydrophysical approach to quantitative morphology, *Bull. Geol. Soc. Am.*, **56**, 275–370.
- Hough, S. E. 1989. On the use of spectral methods for the determination of fractal dimension, *Geophys. Res. Lett.*, **16**(7), 673–676.
- Howard, A. D. 1971a. Optimal angles of stream junction: Geometric, stability to capture, and minimum power criteria, *Water Resour. Res.*, **7**, 863–873.
- Howard, A. D. 1971b. Simulation of stream networks by headward growth and branching, *Geogr. Anal.*, **3**, 29–50.
- Howard, A. D. 1971c. Simulation model of stream capture, *Geol. Soc. Am. Bull.*, **82**, 1355–1363.
- Howard, A. D. 1990. Theoretical model of optimal drainage networks, *Water Resour. Res.*, **26**(9), 2107–2117.
- Howard, A. D. 1994. A detachment-limited model of drainage basin evolution, *Water Resour. Res.*, **30**(7), 2261–2285.
- Howard, A. D., and M. J. Selby. 1994. Rockslopes. In *Geomorphology of Desert Environments*, A. D. Abrahams and A. J. Parsons editors, Chapman and Hall, London, pp. 123–172.
- Howard, A. D., W. E. Dietrich, and M. A. Seidl. 1994. Modelling fluvial erosion on regional to continental scales, *J. Geophys. Res.*, **99**(B7), 13971–13986.
- Huang, J., and D. L. Turcotte. 1989. Fractal mapping of digitized images: Application to the topography of Arizona and comparisons with synthetic images, *J. Geophys. Res.*, **94**, 7491–7498.
- Huang, K. 1963. *Statistical Mechanics*, J. Wiley, New York.
- Huber, G. 1991. Scheidegger's rivers, Takayasu's aggregates and continued fractions, *Physica A*, **170**, 463–470.
- Huggett, R. J. 1988. Dissipative systems: Implications for geomorphology, *Earth Surf. Proc. Landforms*, **13**, 45–49.
- Huse, A., and C. L. Henley. 1985. Pinning and roughening in domain walls in Ising systems due to random impurities, *Phys. Rev. Lett.*, **54**, 2708–2712.
- Hwa, T., and M. Kardar. 1992. Avalanches, hydrodynamics and discharge events in models of sandpiles, *Phys. Rev. A*, **45**(10), 7002–7023.
- Ikeda, S., G. Parker, and Y. Kimura. 1988. Stable width and depth of straight gravel rivers with heterogeneous bed materials, *Water Resour. Res.*, **24**, 713–722.
- Ijjasz-Vasquez, E. J., I. Rodriguez-Iturbe, and R. L. Bras. 1992. On the multifractal characterization of river basins, Proceedings of the 23rd Binghampton Geomorphology Conference, 24–27.
- Ijjasz-Vasquez, E. J., R. L. Bras, I. Rodriguez-Iturbe, R. Rigon, and A. Rinaldo. 1993a. Are river basins optimal channel networks?, *Adv. Water Resour.*, **16**, 69–79.
- Ijjasz-Vasquez, E. J., R. L. Bras, and I. Rodriguez-Iturbe. 1993b. Hack's relation and optimal channel networks: The elongation of river basins as a consequence of energy minimization, *Geophys. Res. Lett.*, **20**(15), 1583–1586.
- Ijjasz-Vasquez, E. J., R. L. Bras, and I. Rodriguez-Iturbe. 1994. Self-affine scaling of fractal river courses and basin boundaries, *Physica A*, **209**, 288–300.
- Jackson, T. J., E. T. Engman, and F. R. Schiebe. 1993. Washita '92 experiment description. In *Hydrology Data Report*, T. J. Jackson and F. R. Schiebe editors, National Agricultural Water Quality Laboratory, **93**, pp. 1–5.
- Jensen, M. H., L. P. Kadanoff, A. Libchaber, I. Procaccia, and J. Stavans. 1985. Global universality at the onset of chaos: Results of a forced Rayleigh–Benard experiment, *Phys. Rev. Lett.*, **55**, 2798–2801.
- Jensen, M. H., G. Paladin, and A. Vulpiani. 1991. Multiscaling in multifractals, *Phys. Rev. Lett.*, **67**(2), 208–211.
- Jin, C. 1992. A deterministic gamma-type GIUH based of path types, *Water Resour. Res.*, **28**, 479–486.
- Johnson, D. 1987. More approaches on the travelling salesman guide, *Nature*, **330**(10), 525.
- Kac, M. 1966. Can one hear the shape of a drum?, *Am. Math. Monthly* (Slaughter Memorial Papers, no. 11), 1–23.
- Kadanoff, L. P. 1995. A model of turbulence, *Physics Today*, **9**, 11–13.
- Kadanoff, L. P., S. R. Nagel, L. Wu, and S. M. Zhou. 1989. Scaling and universality in avalanches, *Phys. Rev. A*, **39**, 6524–6533.
- Kahane, J. P., and Peyrière. 1976. Sur certaines martingales de Benoit Mandelbrot, *Adv. Math.*, **22**, 131–145.
- Kardar, M. 1985. Roughening by impurities at finite temperature, *Phys. Rev. Lett.*, **55**, 2923–2927.
- Karlinger, M. R., and B. M. Troutman. 1985. Assessment of the instantaneous unit hydrograph derived from

- the theory of topologically random networks, *Water Resour. Res.*, **21**, 1693–1702.
- Kardar, M., and Y. C. Zhang. 1987. Scaling of directed polymers in random media, *Phys. Rev. Lett.*, **58**, 2087–2090.
- Kardar, M., G. Parisi, and Y. C. Zhang. 1986. Dynamic scaling at finite temperature, *Phys. Rev. Lett.*, **56**, 889–893.
- Kashiwaya, K. 1987. Theoretical investigation of the time variation of drainage density, *Earth Surf. Proc. Landforms*, **12**, 39–46.
- Kauffman, S. 1993. *The Origins of Order*, Oxford University Press, New York.
- Kauffman, S. 1995. *At Home in the Universe*, Oxford University Press, New York.
- Kauffman, S. A., and S. J. Johnsen. 1991. *J. Theor. Biol.*, **149**, 467–506.
- Kennedy, J. F., P. D. Richardson, and S. P. Sutera. 1965. Discussion on geometry of river channels, *J. Hydraul. Div. Am. Soc. Civ. Eng.*, **91**(HY6), 332–334.
- Kent, C., and J. Wong. 1982. An index of littoral complexity and its measurement, *Can. J. Fish. Aquat. Sci.*, **39**, 847–853.
- Kenyon, P. M., and D. L. Turcotte. 1985. Morphology of a delta prograding by bulk sediment transport, *Geol. Soc. Am. Bull.*, **96**, 1457–1465.
- King, L. C. 1967. *The Morphology of the Earth*, Oliver and Boyd, Edinburgh.
- Kirkby, M. J. 1971. Hillslope process–response models based on continuity equation. In *Slopes: Form and Process*, M. J. Kirkby editor, Special Publication, 3, Institute of British Geographers, London, pp. 15–30.
- Kirkby, M. J. 1976. Tests of the random model and its application to basin hydrology, *Earth Surf. Proc. Landforms*, **1**, 197–212.
- Kirkby, M. J. 1993. Long term interactions between networks and hillslopes, In *Channel Network Hydrology*, K. Beven, and M. J. Kirkby editors, J. Wiley, New York, pp. 253–293.
- Kirchner, J. W. 1993. Statistical inevitability of Horton's laws and the apparent randomness of stream channel networks, *Geology*, **21**, 591–594.
- Kirkpatrick, S., G. D. Gelatt, and M. P. Vecchi. 1983. Optimization by simulated annealing, *Science*, **220**, 671–680.
- Kirshen, D. M., and R. L. Bras. 1983. The linear channel and its effect on the geomorphologic IUH, *J. Hydrol.*, **65**, 175–208.
- Kolmogorov, A. 1941. The local structure of turbulence in incompressible viscous fluid for very large Reynolds numbers, *Comptes Rendus, Dokl. Acad. Sci. USSR*, **30**, 301–305.
- Koons, P. O. 1989. The topographic evolution of collisional mountain belts: A numerical look at the Southern Alps, New Zealand, *Am. J. Sci.*, **289**, 1041–1069.
- Korcak, J. 1940. Deux types fondamentaux de distribution statistique, *Bull. Inst. Int. Stat.*, **30**, 295–307.
- Korvin, G. 1992. *Fractal Models in the Earth Sciences*, Elsevier, New York.
- Kramer, S., and M. Marder. 1992. Evolution of river networks, *Phys. Rev. Lett.*, **68**, 205–209.
- Kurths, J., and H. Hertzfel. 1987. An attractor in a solar time series, *Physica D*, **25**, 165–172.
- La Barbera, P., and R. Rosso. 1987. The fractal geometry of river networks, *EOS Trans. AGU*, **68**, 1276.
- La Barbera, P., and R. Rosso. 1989. On fractal dimension of streams networks, *Water. Resour. Res.*, **25**(4), 735–741.
- La Barbera, P., and R. Rosso. 1990. On fractal dimension of streams networks, Reply to Tarboton et al., *Water. Resour. Res.*, **26**(9), 2245–2248.
- La Barbera, P., and G. Roth. 1994. Invariance and scaling properties in the distributions of contributing area and energy in drainage basins, *Hydrol. Processes*, **8**, 125–135.
- Landahl, M. T., and E. Mollo-Christensen. 1987. *Turbulence and Random Processes in Fluid Mechanics.*, Cambridge University Press, Cambridge.
- Landau, L. D., and E. M. Lifschitz. 1959. *Fluid Mechanics*, Pergamon Press, Oxford.
- Langbein, W. B. 1947. Topographic characteristics of drainage basins, *U.S. Geol. Surv. Prof. Paper*, 968-C.
- Langbein, W. B. 1964. Geometry of river channels, *J. Hydraul. Div. Am. Soc. Civ. Eng.*, **90**(HY2), 301–312.
- Langbein, W. B., and L. B. Leopold. 1964. Quasi-equilibrium states in channel morphology, *Am. Sci. J.*, **262**, 782–794.
- Langbein, W. B., and S. A. Schumm. 1958. Yield of sediment in relation to mean annual precipitation, *EOS Trans. AGU*, **30**(6), 1076–1084.
- Lapidus, M. 1989. Can one hear the shape of a fractal drum? Partial resolution of the Weyl–Berry conjecture, Proc. Workshop on Differential Geometry, Calculus of Variations, and Computer Graphics, MSRI, Berkeley, May 1988, Mathematical Sciences Research Institute Publications, Springer–Verlag, New York.
- Lavallée, D., S. Lovejoy, D. Schertzer, and P. Ladoy. 1993. Nonlinear variability of landscape topography: Multifractal analysis and simulation. In *Fractals in Geography*, N. S. Lam and L. De Cola editors, Prentice Hall, Englewood Cliffs, NJ, pp. 158–192.
- Leheny, R. L., and S. R. Nagel. 1993. A model for the evolution of river networks, *Phys. Rev. Lett.*, **71**(9), 1470–1473.
- Leopold, L. B., and W. B. Langbein. 1962. The concept of entropy in landscape evolution, *U.S. Geol. Surv. Prof. Paper*, 500-A.

- Leopold, L. B., and T. Maddock. 1953. The hydraulic geometry of stream channels and some physiographic implications, *U.S. Geol. Surv. Prof. Paper*, 252.
- Leopold, L. B., and J. P. Miller. 1956. Ephemeral streams—Hydraulic factors and their relation to the drainage net, *U.S. Geol. Surv. Prof. Paper*, 282-A.
- Leopold, L. B., and M. G. Wolman. 1957. River channel patterns: Braided, meandering and straight, *U.S. Geol. Surv. Prof. Paper*, 282-B.
- Leopold, L. B., M. G. Wolman, and J. P. Miller. 1964. *Fluvial Process in Geomorphology*, Freeman, San Francisco.
- Liao, K. H., and A. E. Scheidegger. 1968. A computer model for some branching type phenomena in hydrology, *Bull. Int. Ass. Sci. Hydrol.*, **13**(1), 5–13.
- Lienhard, J. H. 1964. A statistical mechanical prediction of the dimensionless unit hydrograph, *J. Geophys. Res.*, **69**(24), 330–334.
- Lin, S. 1965. Computer solutions for the travelling salesman problem, *Bell Syst. Tech. J.*, **44**, 2245–2258.
- Lin, S., and B. W. Kernighan. 1973. An effective heuristic algorithm for the traveling salesman problem, *Oper. Res.*, **21**, 498–516.
- Lovejoy, S. 1982. The area–perimeter relation for rain and cloud areas, *Science*, **216**, 185–187.
- Lovejoy, S., and D. Schertzer. 1985. Generalized scale invariance in the atmosphere and fractal models of rain, *Water Resour. Res.*, **21**, 1233–1250.
- Lovejoy, S., and D. Schertzer. 1988. Scaling, fractals and nonlinear variability in geophysics, *EOS Trans. AGU*, **69**, 143–145.
- Lovejoy, S., and D. Schertzer. 1990. Multifractals, universality classes and satellite and radar measurements of cloud and rain fields, *J. Geophys. Res.*, **95**, 2021–2034.
- Lovejoy, S., D. Schertzer, and P. Ladoy. 1986. Fractal characterization of inhomogeneous measuring networks, *Nature*, **319**, 43–44.
- Lovejoy, S., D. Schertzer, and A. A. Tsonis. 1987. Functional box counting and multiple elliptical dimensions in rain, *Science*, **235**, 1036–1038.
- Lowenherz, D. S. 1991. Stability and the initiation of channelized surface drainage: A reassessment of the short wavelength limit, *J. Geophys. Res.*, **96**, 8453–8464.
- Lubowe, J. K. 1964. Stream junction angles in the dendritic drainage pattern, *Am. J. Sci.*, **262**, 325–339.
- Luke, J. C. 1972. Mathematical models of landform development, *J. Geophys. Res.*, **77**, 2460–2470.
- Luke, J. C. 1974. Special solutions for nonlinear erosion equations, *J. Geophys. Res.*, **79**, 4035–4044.
- Malinverno, A. 1989. Testing linear models of sea-floor topography, *Pure Appl. Geophys.*, **131**, 139–155.
- Mandelbrot, B. B. 1963. The variation of certain speculative prices, *J. Bus. U. Chicago*, **36**, 394–419.
- Mandelbrot, B. B. 1967. How long is the coast of Britain? Statistical self-similarity and fractional dimension, *Science*, **156**, 636–638.
- Mandelbrot, B. B. 1972. Possible refinement of the lognormal hypothesis concerning the distribution of energy dissipation in intermittent turbulence. In *Statistical Models and Turbulence*, M. Rosenblatt and C. Van Atta editors, Lecture Notes in Physics 12, Springer, New York, pp. 333–351.
- Mandelbrot, B. B. 1974. Intermittent turbulence in self-similar cascades: Divergence of high moments and dimension of the carrier, *J. Fluid Mech.*, **62**, 331–358.
- Mandelbrot, B. B. 1975. Stochastic models of the Earth's relief, the shape and the fractal dimension of the coastlines, and the number–area rule for islands, *Proc. Natl. Acad. Sci. USA*, **72**, 3825–3828.
- Mandelbrot, B. B. 1977. *Fractals: Form, Chance and Dimension*, Freeman, San Francisco.
- Mandelbrot, B. B. 1983. *The Fractal Geometry of Nature*, Freeman, New York.
- Mandelbrot, B. B. 1985. Self-affine fractals and fractal dimension, *Physica Scripta*, **32**, 257–260.
- Mandelbrot, B. B. 1990. Multifractal measures, especially for the geophysicist, *Pure Appl. Geophys.*, **131**(1/2), 5–42.
- Mandelbrot, B. B., and J. W. Van Ness. 1968. Fractional Brownian motions, fractional noises and applications, *SIAM Rev.*, **10**, 422–437.
- Mandelbrot, B. B., and V. R. Wallis. 1968. Noah, Joseph and operational hydrology, *Water Resour. Res.*, **4**, 909–918.
- Mantoglu, A., and J. L. Wilson. 1988. The turning bands method for the simulation of random field using line generation by a spectral method, *Water Resour. Res.*, **18**(5), 1379–1394.
- Marani, A., R. Rigon, and A. Rinaldo. 1991. A note on fractal channel networks, *Water Resour. Res.*, **27**, 3041–3049.
- Marani, M. 1994. Sulla funzione di ampiezza dei bacini idrografici naturali, *Quaderni di Informazione e di Studio*, **4**, Centro Internazionale di Idrologia “Dino Tonini,” Università di Padova.
- Marani, M., A. Rinaldo, R. Rigon, and I. Rodriguez-Iturbe. 1994. Geomorphological width functions and the random cascade, *Geophys. Res. Lett.*, **21**(19), 2123–2126.
- Marder, S. P. 1993. Nonlinear models of river networks, Ph.D. Dissertation, University of Texas at Austin.
- Mareschal, J. C. 1989. Fractal reconstruction of sea floor topography, *Pure Appl. Geophys.*, **131**, 197–210.
- Maritan, A., A. Rinaldo, A. Giacometti, R. Rigon, and I. Rodriguez-Iturbe. 1996a. Scaling in river networks, *Phys. Rev. E*, **53**, 1501–1512.
- Maritan, A., F. Colaiori, A. Flammini, M. Cieplak, and J.



- R. Banavar. 1996b. Universality classes of optimal channel networks, *Science*, **272**, 984–986.
- Mark, D. M. 1983. Relation between field-surveyed channel networks and map-based geomorphic measures, Inez, Kentucky, *Ann. Am. Geogr.*, **73**(3), 358–372.
- Mark, D. M. 1988. Network models in geomorphology. In *Modelling in Geomorphological Systems*, M. G. Anderson editor, J. Wiley, New York, pp. 73–95.
- Mark, D. M., and P. B. Aronson. 1984. Scale-dependent fractal dimensions of topographic surfaces: An empirical investigation with applications in geomorphology and computer mapping, *Math. Geol.*, **16**(7), 671–683.
- Maslov, S., M. Paczuski, and P. Bak. 1994. Avalanches and  $1/f$  noise in evolution and growth models, *Phys. Rev. Lett.*, **73**, 2162–2166.
- Matsushita, M., and S. Ouchi. 1989. On the self-affinity of various curves, *Physica D*, **38**, 246.
- Meakin, P. 1987a. Scaling properties for the growth probability measure and harmonic measure of fractal structures. *Phys. Rev. A*, **35**, 2234–2245.
- Meakin, P. 1987b. Fractal aggregates and their fractal measures. In *Phase Transitions and Critical Phenomena*, C. Domb and J. L. Lebowitz editors, Academic Press, New York, pp. 141–160.
- Meakin, P. 1991. Fractal aggregates in geophysics, *Rev. Geophys.*, **29**(3), 335–382.
- Meakin, P., H. E. Stanley, A. Coniglio, and T. A. Witten. 1985. Surfaces, interfaces and screening of fractal structures, *Phys. Rev. A*, **32**, 2364–2369.
- Meakin, P., A. Coniglio, H. E. Stanley, and T. A. Witten. 1986. Scaling properties for the surfaces of fractal and nonfractal objects: An infinite hierarchy of critical exponents, *Phys. Rev. A*, **34**, 3325–3340.
- Meakin, P., J. Feder, and T. Jossang. 1991. Simple statistical models of river networks, *Physica A*, **176**, 409–429.
- Mei, C. C. 1995. *Mathematical Analysis in Engineering*, Cambridge University Press, New York.
- Meinhardt, H. A. 1976. Morphogenesis of lines and nets, *Differentiation*, **6**, 117–123.
- Meinhardt, H. A. 1982. *Models of Biological Pattern Formation*, Academic, San Diego.
- Melton, M. A. 1958. Geometric properties of mature drainage systems and their representation in an  $E_4$  phase space, *J. Geol.*, **66**, 35–54.
- Melton, M. A. 1959. A derivation of Strahler's channel ordering system, *J. Geol.*, **67**, 345–346.
- Meneveau, C., and K. R. Sreenivasan. 1987. Simple multifractal cascade for fully developed turbulence, *Phys. Rev. Lett.*, **59**(13), 1424–1427.
- Meneveau, C., and K. R. Sreenivasan. 1991. The multifractal nature of turbulent energy dissipation, *J. Fluid Mech.*, **224**, 420–484.
- Merte', B., P. Gaitzsch, M. Fritzenwanger, W. Kropf, A. Hubler, and E. Luscher. 1988. Stable stationary dendritic patterns with minimal dissipation, Rapport de la Reunion d'automne de la SSP, 76–79.
- Merte', B., G. Hadwisch, B. Binias, P. Deisz, A. Hubler, and E. Luscher. 1989. Formation of self-similar dendritic patterns with extremal properties, *Helvetica Physica Acta*, **62**, 294–297.
- Merte', B., J. Muller, R. Ruckerl, P. Hildebrand, and E. Luscher. 1990. Comparison of three different numerical methods to characterize the geometry of dendritic structures, *Fruhjahrstagung*, **63**, 821–822.
- Mesa, O. J. 1986. Analysis of channel networks parametrized by elevation, Ph.D. Dissertation, Dept. of Civ. Eng., University of Mississippi.
- Mesa, O. J., and V. K. Gupta. 1987. On the main channel length–area relationships for channel networks, *Water Resour. Res.*, **23**(11), 2119–2122.
- Mesa, O. J., and E. R. Mifflin. 1988. On the relative role of hillslope and network geometry in hydrologic response. In *Scale Problems in Hydrology*, V. K. Gupta, I. Rodriguez-Iturbe, and E. F. Wood editors, Dordrecht, Holland, pp. 181–190.
- Metropolis, N., M. Rosebluth, M. Teller, and E. Teller. 1953. Equations of state calculations by fast computing machines, *J. Chem. Phys.*, **21**, 1087–1096.
- Miramontes, O., R. V. Solé, and B. C. Goodwin. 1993. Collective behaviour of random-activated mobile cellular automata, *Physica D*, **63**, 145–160.
- Mock, S. J. 1971. A classification of channel links in stream networks, *Water Resour. Res.*, **7**, 1558–1566.
- Monin, A. S., and A. M. Yaglom. 1972. *Statistical Fluid Mechanics*, MIT Press, Cambridge, MA.
- Montgomery, D. R. 1991. Channel initiation and landscape evolution, Ph.D. Dissertation, 421 pp., University of California, Berkeley.
- Montgomery, D. R., and W. E. Dietrich. 1988. Where do channels begin?, *Nature*, **336**, 232–234.
- Montgomery, D. R., and W. E. Dietrich. 1989. Source areas, drainage density, and channel initiation, *Water Resour. Res.*, **25**, 1907–1918.
- Montgomery, D. R., and W. E. Dietrich. 1992. Channel initiation and the problem of landscape scale, *Science*, **255**, 826–830.
- Montgomery, D. R., and W. E. Dietrich. 1994. Landscape dissection and drainage-slope thresholds. In *Process Models and Theoretical Geomorphology*, M. J. Kirby editor, J. Wiley, New York, pp. 221–246.
- Montgomery, D. R., and E. Foufoula-Georgiou. 1993. Channel networks source representation using digital elevation models, *Water Resour. Res.*, **29**(12), 1925–1934.
- Moore, I. D., and G. J. Burch. 1986. Sediment transport capacity of sheet and rill flow: Application of unit stream power theory, *Water Resour. Res.*, **22**(8), 150–1360.

- Moore, I. D., E. M. O'Loughlin, and G. J. Burch. 1988. A contour-based topographic model for hydrological and ecological applications, *Earth Surf. Proc. Landforms*, **13**, 305–320.
- Morisawa, M. E. 1964. Development of drainage systems on an upraised lake floor, *Am. J. Sci.*, **262**, 340–354.
- Morse, T., and R. Feshback. 1967. *Mathematical Methods for Theoretical Physics*, vol. I, McGraw-Hill, New York.
- Mosley, M. P. 1972. An experimental study of rill erosion, M.S. Thesis, Colorado State University, Fort Collins, CO.
- Muir, J. 1873. A geologist's winter walk, *Overland Monthly*, **10**, 1873.
- Muller, J. E. 1973. Re-evaluation of the relationship of master streams and drainage basins: Reply, *Geol. Soc. A. Bull.*, **84**, 3127–3130.
- Murray, C. D. 1926. The physiological principle of minimum work. I, The vascular system and the cost of blood volume, *Proc. Natl. Acad. Sci. USA*, **12**, 207–214.
- Nagatani. 1993. Kinetic growth transitions in a simple aggregation of charged particles with injection, *J. Phys. A*, **26**, 489–496.
- Nakano, T. 1983. A fractal study of some rias coastlines in Japan, *Ann. Rep. Inst. Geosci. Univ. Tsukuba*, **9**, 75–80.
- Nash, E. 1957a. The form of the instantaneous unit hydrograph, Proc. IAHS, Toronto, Tome III, 114–121.
- Nash, E. 1957b. Systematic determination of unit hydrograph parameters, *J. Geophys. Res.*, **64**, 111–115.
- National Research Council. 1991. *Opportunities in the Hydrologic Sciences*, National Academy Press, Washington DC.
- Neill, W., and P. Murphy. 1993. *By Nature's Design*, Chronicle Books, San Francisco.
- Newman, W. I., and D. L. Turcotte. 1990. Cascade model for fluvial geomorphology, *Geophys. J. Int.*, **100**, 433–439.
- Nikora, V. I. 1991. Fractal structure of river plan forms, *Water Resour. Res.*, **27**(6), 3569–3575.
- Nikora, V. I. 1994. On self-similarity and self-affinity of drainage basins, *Water Resour. Res.*, **30**(1), 133–137.
- Nikora, V. I., and V. B. Sapozhnikov. 1993a. River network fractal geometry in computer simulation, *Water Resour. Res.*, **29**(10), 1327–1333.
- Nikora, V. I., and V. B. Sapozhnikov. 1993b. Fractal geometry of individual river channel and its computer simulation, *Water Resour. Res.*, **29**(10), 3561–3568.
- O'Callaghan, J. F., and D. M. Mark. 1985. The extraction of drainage networks from digital elevation data, *Comput. Vision Graphics Image Process.*, **28**, 323–344.
- O'Loughlin, E. M. 1986. Prediction of surface saturation zones in natural catchments by topographic analysis, *Water Resour. Res.*, **22**(5), 794–804.
- Ouchi, S., and M. Matsushita. 1992. Measurement of self-affinity on surfaces as a trial application of fractal geometry to landform analysis, *Geomorphology*, **5**, 115–130.
- Paczuski, M., and P. Bak. 1993. Theory of the one-dimensional forest fire model, *Phys. Rev. E*, **48**, 321–332.
- Paczuski, M., S. Maslov, and P. Bak. 1994. Field theory for a model of self-organized criticality, *Europhys. Lett.*, **27**(2), 97–102.
- Paczuski, M., S. Maslov, and P. Bak. 1995a. Laws for stationary states in systems with extremal dynamics, *Phys. Rev. Lett.*, **74**, 4253–4256.
- Paczuski, M., S. Maslov, and P. Bak. 1995b. Avalanche dynamics in evolution, growth and depinning models, *Phys. Rev. E.*, **53**, 414–418.
- Paola, C. 1989. A simple basin-filling model for coarse-grained alluvial systems. In *Quantitative Dynamic Stratigraphy*, T. A. Cross editor, Prentice-Hall, Englewood Cliffs, pp. 363–374, NJ.
- Paola, C., P. L. Heller, and C. L. Angevine. 1992. The large-scale dynamics of grain-size sorting in alluvial basins. 1, Theory, *Basin Res.*, **4**, 73–90.
- Parker, G. 1978. Self-formed straight rivers with equilibrium banks and mobile bed. 2, The gravel river, *J. Fluid Mech.*, **89**, 127–146.
- Parker, G. 1979. Hydraulic geometry of active gravel bed rivers, *ASCE J. Hydr. Eng.*, **105**, 1185–1194.
- Parker, R. S. 1977. Experimental study of drainage basin evolution and its hydrologic implications, Ph.D. Dissertation, 353 pp., Colorado State University, Fort Collins, CO.
- Patton, P. C., and S. A. Schumm. 1975. Gully erosion, Northwestern Colorado: A threshold phenomenon, *Geology*, **3**, 88–90.
- Peano, G. 1890. Sur une courbe qui remplit toute une aire plane, *Matematische Annalen*, **36**, 157–160.
- Peckham, S. 1995. New results for self-similar trees with applications to river networks, *Water Resour. Res.*, **31**(4), 1023–1030.
- Peckham, S., and E. Waymire. 1992. On a symmetry of turbulence, *Comm. Math. Phys.*, **147**, 365–370.
- Peitgen, H. O., and D. Saupe, editors, 1988. *The Science of Fractal Images*, Springer-Verlag, New York.
- Peitgen, H. O., H. Jurgens, and D. Saupe. 1992. *Chaos and Fractals, New Frontiers of Science*, Springer-Verlag, New York.
- Penck, W. 1953. *Morphological Analysis of Landforms*, MacMillan, London.
- Pilgrim, D. H. 1976. Travel times and nonlinearity of flood runoff from tracer measurements on a small watershed, *Water Resour. Res.*, **12**(4), 487–496.
- Pilgrim, D. H. 1977. Isochrones of travel time and distribution of flood storage from a tracer study on a small watershed, *Water Resour. Res.*, **13**(3), 587–595.

- Press, W. H., S. A. Teukosky, W. T. Vetterly, and B. P. Flannery. 1992. *Numerical Recipes*, Cambridge University Press, New York.
- Quinn, P., K. Beven, and O. Plachon. 1991. The prediction of flow paths for distributed hydrological modeling using digital terrain models, *Hydrol. Processes*, **5**, 59–79.
- Rammal, R., C. Tannous, P. Breton, and A. M. S. Tremblay. 1985. Flicker ( $1/f$ ) noise in percolation networks: A new hierarchy of exponents, *Phys. Rev. Lett.*, **54**, 1718–1721.
- Raup, D. M. 1991. *Bad Genes or Bad Luck*, W. W. Horton and Co., New York.
- Rawls, W., D. L. Brakensiek, and K. E. Saxton. 1982. Estimation of soil properties, *Trans. ASAE*, **25**(5), 1316–1326.
- Rényi, A. 1970. *Probability Theory*, North-Holland, Amsterdam.
- Richards, K. 1988. Fluvial geomorphology, *Progr. Phys. Geogr.*, **12**(3), 433–456.
- Richardson, R. L. 1961. The problem of contiguity: An appendix of statistics of deadly quarrels, *General Systems Yearbook*, **6**, 139–187.
- Rigon, R. 1992. Il clima é scritto nella forma del reticolo idrografico?, *Istituto Veneto di Scienze, Lettere ed Arti, Rapporti e studi*, vol. CLI, 1–21.
- Rigon, R. 1994. Principi di auto-organizzazione nella dinamica evolutiva delle reti idrografiche, Ph.D. Dissertation, Dipartimento di Ingegneria Civile e Ambientale, Università di Trento.
- Rigon, R., A. Rinaldo, I. Rodriguez-Iturbe, E. Ijjasz-Vasquez, and R. L. Bras. 1993. Optimal channel networks: A framework for the study of river basin morphology, *Water Resour. Res.*, **29**(6), 1635–1646.
- Rigon, R., A. Rinaldo, and I. Rodriguez-Iturbe. 1994. On landscape self-organization, *J. Geophys. Res.*, **99**(B6), 11971–11993.
- Rigon, R., I. Rodriguez-Iturbe, A. Giacometti, A. Maritan, D. Tarboton, and A. Rinaldo. 1996. On Hack's law, *Water Resour. Res.*, **32**, 3367–3374.
- Rinaldo, A., and A. Marani. 1987. Basin scale model of solute transport, *Water Resour. Res.*, **23**(11), 2107–2118.
- Rinaldo, A., and I. Rodriguez-Iturbe. 1996. The geomorphological theory of the hydrologic response, *Hydrol. Processes*, **10**, 803–829.
- Rinaldo, A., A. Marani, and A. Bellin. 1989a. On mass response functions, *Water Resour. Res.*, **25**(7), 1603–1617.
- Rinaldo, A., A. Marani, and A. Bellin. 1989b. A study of solute  $\text{NO}_3\text{-N}$  transport in the hydrologic response by a MRF model, *Ecological Modelling*, **48**, 159–191.
- Rinaldo, A., R. Rigon, and A. Marani. 1991. Geomorphological dispersion, *Water Resour. Res.*, **27**(4), 513–525.
- Rinaldo, A., I. Rodriguez-Iturbe, R. Rigon, R. L. Bras, E. Ijjasz-Vasquez, and A. Marani. 1992. Minimum energy and fractal structures of drainage networks, *Water Resour. Res.*, **28**, 2183–2195.
- Rinaldo, A., I. Rodriguez-Iturbe, R. Rigon, E. Ijjasz-Vasquez, and R. L. Bras. 1993. Self-organized fractal river networks, *Phys. Rev. Lett.*, **70**, 822–826.
- Rinaldo, A., W. E. Dietrich, R. Rigon, G. K. Vogel, and I. Rodriguez-Iturbe. 1995a. Geomorphological signatures on varying climate, *Nature*, **374**, 632–636.
- Rinaldo, A., G. Vogel, R. Rigon, and I. Rodriguez-Iturbe. 1995b. Can one gauge the shape of a basin?, *Water Resour. Res.*, **31**(4), 1119–1127.
- Rinaldo, A., A. Maritan, A. Flammini, F. Colaiori, R. Rigon, I. Rodriguez-Iturbe, and J. R. Banavar. 1996a. Thermodynamics of fractal networks, *Phys. Rev. Lett.*, **76**, 3364–3368.
- Rinaldo, A., A. Maritan, F. Colaiori, A. Flammini, J. R. Banavar, and I. Rodriguez-Iturbe. 1996b. On feasible optimality, *Attie Memorie, Istituto Veneto di Scienze, Lettere ed Arti*, Venice, vol. LXI, in press.
- Robert, A., and A. G. Roy. 1990. On the fractal interpretation of the mainstream length–drainage area relationship, *Water Resour. Res.*, **26**, 839–842.
- Rodriguez-Iturbe, I. 1993. The geomorphologic unit hydrograph. In *Channel Network Hydrology*, K. Beven and M. J. Kirkby editors, J. Wiley, New York, pp. 226–241.
- Rodriguez-Iturbe, I., and J. B. Valdes. 1979. The geomorphologic structure of hydrologic response, *Water Resour. Res.*, **15**(6), 1409–1420.
- Rodriguez-Iturbe, I., G. Devoto, and J. B. Valdes. 1979. Discharge response analysis and hydrologic similarity: The interrelation between the geomorphologic IUH and storm characteristics, *Water Resour. Res.*, **5**(6), 1435–1444.
- Rodriguez-Iturbe, I., M. Gonzales-Sanabria, and R. L. Bras. 1982a. A geomorphoclimatic theory of the instantaneous unit hydrograph, *Water Resour. Res.*, **18**(4), 877–886.
- Rodriguez-Iturbe, I., M. Gonzales-Sanabria, and G. Caa-mano. 1982b. On the climatic dependence of the IUH: A rainfall-runoff analysis of the Nash model and the geomorphoclimatic theory, *Water Resour. Res.*, **18**(4), 887–903.
- Rodriguez-Iturbe, I., B. Febres de Power, M. H. Sharifi, and K. P. Georgakakos. 1989. Chaos in rainfall, *Water Resour. Res.*, **25**(7), 1667–1675.
- Rodriguez-Iturbe, I., D. Entekhabi, and R. L. Bras. 1991. Nonlinear dynamics of soil moisture at climate scales. 1, Stochastic Analysis, *Water Resour. Res.*, **27**(8), 1899–1906.
- Rodriguez-Iturbe, I., E. Ijjasz-Vasquez, R. L. Bras, and D.

- G. Tarboton. 1992a. Power-law distributions of mass end energy in river basins, *Water Resour. Res.*, **28**(4), 988–993.
- Rodriguez-Iturbe, I., A. Rinaldo, R. Rigon, R. L. Bras, and E. Ijjasz-Vasquez. 1992b. Energy dissipation, runoff production and the three-dimensional structure of channel networks, *Water Resour. Res.*, **28**(4), 1095–1103.
- Rodriguez-Iturbe, I., A. Rinaldo, R. Rigon, R. L. Bras, and E. Ijjasz-Vasquez. 1992c. Fractal structures as least energy patterns: The case of river networks, *Geophys. Res. Lett.*, **19**(9), 889–892.
- Rodriguez-Iturbe, I., M. Marani, R. Rigon, and A. Rinaldo. 1994. Self-organized river basin landscapes: Fractal and multifractal characteristics, *Water Resour. Res.*, **30**(12), 3531–3539.
- Rodriguez-Iturbe, I., G. K. Vogel, R. Rigon, D. Entekhabi, and A. Rinaldo. 1995. On the spatial organization of soil moisture, *Geophys. Res. Lett.*, **22**(20), 2757–2760.
- Rodriguez-Iturbe, I., R. Rigon, A. Maritan, W. E. Dietrich, and A. Rinaldo. 1996. Space/time dynamics of channel networks, preprint.
- Rodriguez-Iturbe, I., G. Caldarelli, A. Maritan, A. Rinaldo, 1997. Evolutionary active self-organized critical landscapes, preprint.
- Rosso, R. 1984. Nash model relation to Horton order ratios, *Water Resour. Res.*, **20**(7), 914–920.
- Rosso, R., B. Bacchi, and P. La Barbera. 1991. Fractal relation of mainstream length to catchment area in river networks, *Water Resour. Res.*, **27**(3), 381–387.
- Roth G., F. Siccardi, and R. Rosso. 1989. Hydrodynamical description of the erosional development of drainage patterns, *Water Resour. Res.*, **25**(2), 319–322.
- Roy, A. G. 1983. Optimal angular geometry models for river branching, *Geogr. Anal.*, **15**, 87–96.
- Roy, A. G. 1984. Optimal models of river branching angles. In *Models in Geomorphology*, M. A. Woldenberg editor, Allen and Unwin, Boston, pp. 269–280.
- Ruhe, R. V. 1952. Topographic discontinuities of the Des Moines lobe, *Am. J. Sci.*, **250**, 46–50.
- Russ, J. C. 1994. *Fractal Surfaces*, Plenum, New York.
- Salvadori, G. 1992. Multifrattali stocastici: Teoria ed applicazioni, Ph.D. Dissertation, Universita degli Studi di Pavia.
- Saupe, D. 1988. Discrete versus continuous Newton's method, *Acta Appl. Math.*, **13**, 59–80.
- Scheidegger, A. E. 1964. Some implications of statistical mechanics in geomorphology, *IASH Bull.*, **9**(1), 12–16.
- Scheidegger, A. E. 1967. A stochastic model for drainage patterns into an intramontane trench, *Bull. Ass. Sci. Hydrol.*, **12**, 15–20.
- Scheidegger, A. E. 1979. The principle of antagonism in the Earth's evolution, *Tectonophys.*, **55**, 7–10.
- Scheidegger, A. E. 1991. *Theoretical Geomorphology*, 3rd edition, Springer-Verlag, Berlin.
- Schenck, H. 1963. Simulation of the evolution of drainage basin networks with a digital computer, *J. Geophys. Res.*, **68**(20), 5379–5745.
- Schertzer, D., and S. Lovejoy. 1987. Physical modeling and analysis of rain and clouds by anisotropic scaling multiplicative processes, *J. Geophys. Res.*, **92**, 9693.
- Schertzer, D., and S. Lovejoy, editors, 1989a. *Scaling, Fractals and Non-linear Variability in Geophysics*, D. Reidel, Hingham, MA.
- Schertzer, D., and S. Lovejoy. 1989b. Generalized scale invariance and multiplicative processes in the atmosphere, *Pure Appl. Geophys.*, **130**, 57–81.
- Scholz, C. H., and B. B. Mandelbrot editors. 1989. *Fractals in Geophysics*, Birkhauser, Basel.
- Schoutens, J. E. 1979. Empirical analysis of nuclear and high-explosive cratering and ejecta. In *Nuclear Geoplosic Sourcebook*, Def. Nuclear Agency, Rep. DNA OIH-4-2, vol. 55, part 2.
- Schroeder, M. 1991. *Fractal, Chaos and Power laws*, Freeman, New York.
- Schumm, S. A. 1956. Evolution of drainage systems and slopes in badlands at Perth Amboy, New Jersey, *Geol. Soc. Am. Bull.*, **67**, 597–646.
- Schumm, S. A. 1977. *The Fluvial System*, J. Wiley, New York.
- Schumm, S. A., and H. R. Khan. 1971. Experimental study of channel patterns, *Nature*, **233**, 407–411.
- Schumm, S. A., H. R. Khan, B. R. Winkley, and L. G. Robins. 1972. Variability of river patterns, *Nature*, **237**, 75–76.
- Schumm, S. A., M. P. Mosley, and W. E. Weaver. 1987. *Experimental Fluvial Geomorphology*, J. Wiley, New York.
- Seginer, I. 1969. Random walk and random roughness models of drainage networks, *Water Resour. Res.*, **5**, 591–599.
- Shapiro, A. M., and V. D. Cvetkovic. 1988. Stochastic analysis of solute arrival time in heterogeneous porous media, *Water Resour. Res.*, **24**, 1711–1718.
- Sherman, T. F. 1981. On connecting large vessels to small, *J. Gen. Physiol.*, **78**(4), 431–453.
- Shreve, R. L. 1966. Statistical law of stream numbers, *J. Geol.*, **74**, 17–37.
- Shreve, R. L. 1967. Infinite topologically random channel networks, *J. Geol.*, **77**, 397–414.
- Shreve, R. L. 1969. Stream lengths and basin areas in topologically random channel networks, *J. Geol.*, **77**, 397–414.
- Shreve, R. L. 1974. Variation of mainstream length with basin area in river networks, *Water Resour. Res.*, **10**, 1167–1177.

- Sinclair, K., and R. C. Ball. 1996. A mechanism for global optimization of river networks from local erosion rules, *Phys. Rev. Lett.*, **76**, 3359–3363.
- Smalley, R. F., D. L. Turcotte, and S. A. Sola. 1985. A renormalization group approach to the stick-slip behavior of faults, *J. Geophys. Res.*, **90**, 1884–1900.
- Smart, J. S. 1968. Statistical properties of stream lengths, *Water Resour. Res.*, **4**, 1001–1014.
- Smart, J. S. 1969. Topological properties of channel networks, *Geol. Soc. Am. Bull.*, **80**, 1757–1774.
- Smart, J. S. 1972. Channel networks, *Adv. Hydroscience*, **8**, 305–345.
- Smart, J. S. 1973. The random model in fluvial geomorphology, *IBM Res. Tech. Rep. RC 4504*, 40 pp.
- Smart, J. S. 1978. The analysis of drainage network composition, *Earth Surf. Proc. Landforms*, **3**, 129–170.
- Smart, J. S., and V. L. Moruzzi. 1971a. Random walk model of stream network development, *IBM J. Res. Develop.*, **15**(3), 197–203.
- Smart, J. S., and V. L. Moruzzi. 1971b. Computer simulation of Clinch Mountain drainage networks, *J. Geol.*, **79**, 572–565.
- Smart, J. S., and C. Werner. 1976. Applications of the random model of drainage basin composition, *Earth Surf. Proc.*, **1**, 219–233.
- Smart, J. S., A. J. Surkan, and J. P. Considine. 1967. Digital simulation of channel networks, *IAHS Publ. No. 75*, 87–98.
- Smith, T. R. 1950. Standards for grading texture of erosional topography, *Am. J. Sci.*, **248**, 655–658.
- Smith, T. R. 1974. A derivation of the hydraulic geometry of steady-state channels from conservation principles and sediment transport laws, *J. Geol.*, **82**, 98–108.
- Smith, T. R., and F. P. Bretherton. 1972. Stability and the conservation of mass in drainage basin evolution, *Water Resour. Res.*, **8**(6), 1506–1529.
- Snell, J. D., and M. Sivapalan. 1994. On geomorphological dispersion in natural catchments and the geomorphological unit hydrograph, *Water Resour. Res.*, **30**(7), 2311–2324.
- Sneppen, K., P. Bak, H. Flyvbjerg, and M. H. Jensen. 1995. Evolution as a self-organized critical phenomenon, *Proc. Natl. Acad. Sci. USA*, **92**, 5209–5213.
- Solé, R. V., and O. Miramontes. 1995. Information at the edge of chaos in fluid neural networks, *Physica D*, **80**, 171–180.
- Solé, R. V., O. Miramontes, and B. C. Goodwin. 1993. Oscillations and chaos in ant societies, *J. Theor. Biol.*, **161**, 343–357.
- Spivak, M. 1965. *Calculus on Manifolds*, Benjamin, New York.
- Stanley, E. H. 1985. Fractal concepts for disordered systems: The interplay of physics and geometry. In *Scaling Phenomena in Disordered Systems*, R. Pynn and A. Skjeltop editors, Plenum, New York, pp. 49–69.
- Stanley, E. H., and P. Meakin. 1988. Multifractal phenomena in physics and chemistry, *Nature*, **335**, 405–409.
- Stanley, E. H., and N. Ostrowsky. 1986. *On Growth and Form*, M. Nijhoff, Dordrecht.
- Stark, C. P. 1991. An invasion percolation model of drainage network evolution, *Nature*, **352**, 423–427.
- Stauffer, D. 1985. *Introduction to Percolation Theory*, Taylor and Francis, London.
- Stevens, P. S. 1974. *Patterns in Nature*, Little, Brown, and Co., Boston.
- Strahler, A. N. 1950. Equilibrium theory of erosional slopes approached by frequency distribution analysis, *Am. J. Sci.*, **248**, 673–696.
- Strahler, A. N. 1952. Hypsometric (area altitude) analysis of erosional topography, *Geol. Soc. Am. Bull.*, **63**, 1117–1142.
- Strahler, A. N. 1957. Quantitative analysis of watershed geomorphology, *EOS Trans. AGU*, **38**, 912–920.
- Strahler, A. N. 1964. Quantitative geomorphology of drainage basins and channel networks. In *Handbook of Applied Hydrology*, V. T. Chow editor, McGraw-Hill, New York, pp. 39–76.
- Summerfield, M. A. 1991. *Global Geomorphology*, Longman, Singapore.
- Sun, T., P. Meakin, and T. Jossang. 1994a. A minimum energy dissipation model for river basin geometry, *Phys. Rev. E*, **49**, 4865–4872.
- Sun, T., P. Meakin, and T. Jossang. 1994b. The topography of optimal drainage basins, *Water Resour. Res.*, **30**, 2599–2611.
- Sun, T., P. Meakin, and T. Jossang. 1994c. A minimum energy dissipation model for drainage basins that explicitly differentiates between channel networks and hillslopes, *Physica A*, **210**, 24–47.
- Sun, T., P. Meakin, and T. Jossang. 1995. Minimum energy dissipation river networks with fractal boundaries, *Phys. Rev. E*, **51**(6), 5353–5359.
- Takayasu, H. 1989. Steady-state distribution of generalized aggregation systems with injection, *Phys. Rev. Lett.*, **63**, 2563–2568.
- Takayasu, H. 1990. *Fractals in the Physical Sciences*, Manchester University Press, Manchester.
- Takayasu, H., and H. Inaoka. 1992. New type of self-organized criticality in a model of erosion, *Phys. Rev. Lett.*, **68**, 966–969.
- Takayasu, M., and H. Takayasu. 1989. Apparent independence of an aggregation system with injection, *Phys. Rev. A*, **39**, 4345–4347.
- Takayasu, H., I. Nishikawa, and H. Tasaki. 1988. Power-law mass distribution of aggregation systems with injection, *Phys. Rev. A*, **37**, 3110–3117.
- Takayasu, H., M. Takayasu, A. Provata, and G. Huber.

1991. Statistical models of river networks, *J. Stat. Phys.*, **65**, 725–740.
- Tarboton, D. G., R. L. Bras, and I. Rodriguez-Iturbe. 1988. The fractal nature of river networks, *Water Resour. Res.*, **24**(8), 1317–1322.
- Tarboton, D. G., R. L. Bras, and I. Rodriguez-Iturbe. 1989a. Scaling and elevation in river networks, *Water Resour. Res.*, **25**(9), 2037–2051.
- Tarboton, D. G., R. L. Bras, and I. Rodriguez-Iturbe. 1989b. The analysis of river basins and channel networks using digital terrain data, Tech. Rep. no. 326, Ralph M. Parsons Lab., Massachusetts Institute of Technology, Cambridge, MA.
- Tarboton, D. G., R. L. Bras, and I. Rodriguez-Iturbe. 1990. Comment on the fractal dimension of stream networks, by La Barbera and Rosso, *Water Resour. Res.*, **26**(9), 2243–2244.
- Tarboton, D. G., R. L. Bras, and I. Rodriguez-Iturbe. 1991. On the extraction of channel networks from digital elevation data, *Hydrol. Processes*, **5**, 81–100.
- Tarboton, D. G., R. L. Bras, and I. Rodriguez-Iturbe. 1992. A physical basis for drainage density, *Geomorphology*, **5**, 59–76.
- Taylor, G. I. 1921. Diffusion by continuous movements, *Proc. London Math. Soc. Ser. A*, **20**, 196–211.
- Taylor, G. I. 1954. The dispersion of matter in turbulent flow through a pipe. *Proc. R. Soc. London Ser. A*, **223**, 446–468.
- Tel, T. 1988. Fractals, multifractals and thermodynamics, *Z. Naturforsch. A. Phys. Sci.*, **43**, 1154–1174.
- Tessier, Y., S. Lovejoy, and D. Schertzer. 1993. Universal multifractals: Theory and observation for rain and clouds, *J. Appl. Meteorology*, **32**, 223–250.
- Tokunaga, E. 1978. Consideration on the composition of drainage networks and their evolution, Geograph. Rep. of Tokio Metropolitan University, no. 13.
- Toy, T. J., and R. F. Hadley. 1987. *Geomorphology and Reclamation of Disturbed Lands*, Academic Press, Orlando, FL.
- Tricot, C. 1989. *Rectifiable and Fractal Sets*, C. R. M., Montreal.
- Tricot, C. 1995. *Curves and Fractal Dimensions*, Springer-Verlag, Berlin.
- Tricot, C., J. F. Quiniou, D. Wehbi, C. Roques-Carmes, and B. Dubuc. 1988. Evaluation de la dimension fractale d'un graphe, *Rev. Phys. Appl.*, **23**, 111–124.
- Troendle, C. A. 1985. Variable source area models. In: *Hydrological Forecasting*, M. G. Anderson and T. P. Burt editors, J. Wiley, New York, pp. 347–403.
- Troutman, B. M., and M. R. Karlinger. 1984. On the expected width function for topologically random channel networks, *J. Appl. Prob.*, **22**, 836–849.
- Troutman, B. M., and M. R. Karlinger. 1985. Unit hydrograph approximations assuming linear flow through topologically random channel networks, *Water Resour. Res.*, **21**(5), 743–754.
- Troutman, B. M., and M. R. Karlinger. 1992. Gibbs' distribution on drainage networks, *Water Resour. Res.*, **28**(2), 563–577.
- Troutman, B. M., and M. R. Karlinger. 1994. Inference for a generalized Gibbsian distribution on channel networks, *Water Resour. Res.*, **30**(7), 2325–2334.
- Tsonis, A. A. 1990. Some probabilistic aspects of fractal growth, *J. Phys. A*, **20**, 5025–5028.
- Turcotte, D. L. 1989. Fractals in geology and geophysics, *Pure Appl. Geophysics.*, **131**, 171–196.
- Turcotte, D. L. 1992. *Fractals and Chaos in Geology and Geophysics*, Cambridge University Press, New York.
- Uylings, H. B. M. 1977. Optimization of diameters and bifurcation angles in lung and vascular tree structures, *Bull. Math. Biol.*, **39**, 509–520.
- Valdes, J. B., Y. Fiallo, and I. Rodriguez-Iturbe. 1979. A rainfall-runoff analysis of the geomorphological IUH, *Water Resour. Res.*, **15**(6), 1421–1434.
- Van der Tak, L. D., and R. L. Bras. 1988. Stream length distributions, hillslope effects and other refinements of the geomorphologic IUH, Ralph M. Parsons Laboratory Tech. Rep. no. 301, Massachusetts Institute of Technology, Cambridge, MA.
- Veneziano, D., G. E. Moglen, and R. L. Bras. 1995. Multi-fractal analysis: Pitfalls of standard procedures and alternatives, *Phys. Rev. E*, **52**(2), 1387–1398.
- Vicsek, T. 1989. *Fractal Growth Phenomena*, World Scientific, Singapore.
- Voss, R. F. 1986. Random fractal forgeries. In *Fundamental Algorithms for Computer Graphics*, A. Earnshaw editor, Springer-Verlag, Berlin, pp. 805–835.
- Voss, R. F. 1988. Fractals in nature: From characterization to simulation. In *The Science of Fractal Images*, H. O. Peitgen and D. Saupe editors, Springer-Verlag, New York, pp. 21–70.
- Wallace, R. E. 1977. Profiles and age of young fault scarps, north-central Nevada, *Geol. Soc. Am. Bull.*, **88**, 1267–1281.
- Wang, S. X., and E. C. Waymire. 1991. A large deviation rate and central limit theorem for Horton ratios, *SIAM J. Disc. Math.*, **4**(4), 575–588.
- Waymire, E. 1989. On the main channel length-magnitude formula for random networks: A solution to Moon's conjecture, *Water Resour. Res.*, **25**(5), 1049–1050.
- Waymire, E. 1992. On network structure function computations. In *New Directions in Time Series Analysis*, D. Billinger et al. editors, Springer-Verlag, Berlin, pp. 365–373.
- Wejchert, J. 1989. Optimally collecting networks, *Europhys. Lett.*, **9**(6), 503–508.
- Werner, C. 1991. Several duality theorems for interlocking ridge and channel networks, *Water Resour. Res.*, **27**(12), 3237–3247.

- Werner, C., and J. S. Smart. 1973. Some new methods of topological classification of channel networks, *Geogr. Anal.*, **5**, 271–295.
- Whittle, P. 1962. Topographic correlation, power-law covariance functions and diffusion, *Biometrika*, **49**, 305–314.
- Willgoose, G., R. L. Bras, and I. Rodriguez-Iturbe. 1989. A physically based channel network and catchment evolution model, Ralph M. Parsons Laboratory, Tech. Rep. no. 322, Massachusetts Institute of Technology, Cambridge, MA.
- Willgoose, G. R., R. L. Bras, and I. Rodriguez-Iturbe. 1990. A model of river basin evolution, *EOS Trans. AGU*, **71**, 1806–1808.
- Willgoose, G. R., R. L. Bras, and I. Rodriguez-Iturbe. 1991a. A coupled channel network growth and hillslope evolution model. 1. Theory, *Water Resour. Res.*, **27**, 1671–1684.
- Willgoose, G. R., R. L. Bras, and I. Rodriguez-Iturbe. 1991b. A coupled channel network growth and hillslope evolution model. 2. Nondimensionalization and applications, *Water Resour. Res.*, **27**, 1685–1696.
- Willgoose, G. R., R. L. Bras, and I. Rodriguez-Iturbe. 1991c. A coupled channel network growth and hillslope evolution model. 3. A physical explanation of an observed link area–slope relationship, *Water Resour. Res.*, **27**, 1697–1702.
- Willgoose, G. R., R. L. Bras, and I. Rodriguez-Iturbe. 1991d. Results from a new model of river basin evolution, *Earth Surf. Proc. Landforms*, **16**, 237–254.
- Willgoose, G. R., R. L. Bras, and I. Rodriguez-Iturbe. 1992. The relationship between catchment and hillslope properties: Implications of a catchment evolution model, *Geomorphology*, **5**, 21–38.
- Witten, T. A., and L. M. Sander. 1981. Diffusion-limited aggregation, a kinetic critical phenomenon, *Phys. Rev. Lett.*, **47**, 1400–1404.
- Wittmann, R., T. Kautzky, A. Hubler, and E. Luscher. 1991. A simple experiment for the examination of dendritic river systems, *Naturwissenschaften* **78**, 23–27.
- Woldenberg, M. J., and K. Horsfield. 1986. Relation of branching angles to optimality for four cost principles, *J. Theor. Biol.*, **122**, 204.
- Wolfram, S. 1988. *Mathematica: A System for Doing Mathematics by Computer*, Addison–Wesley, Reading, MA.
- Wolman, M. G. 1955. The natural channel of Brandywine Creek, PA, USA, *U.S. Geol. Surv. Prof. Paper*, no. 271.
- Wood, E. F. 1994. Scaling, soil moisture and evapotranspiration in runoff models, *Adv. Water Resour.*, **17**, 25–34.
- Wyss, J. 1988. Hydrologic modelling of New England river basins using radar-rainfall data, M.S. Thesis, Massachusetts Institute of Technology, Department of Earth, Atmospheric and Planetary Sciences, Cambridge, MA.
- Yang, C. T. 1971a. Formation of riffles and pools, *Water Resour. Res.*, **7**(6), 1567–1574.
- Yang, C. T. 1971b. Potential energy and stream morphology, *Water Resour. Res.*, **7**(2), 311–322.