U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

A Bibliography of Geomorphometry, the Quantitative Representation of Topography—Supplement 1.0

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Provides over 450 additions and corrections to the 1993 Bibliography of Geomorphometry and a brief update of recent advances

OPEN-FILE REPORT 95-046

1995

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Abstract This report adds over 450 entries (and makes several corrections) to the 1993 literature review of topographic quantification (*geomorphometry*), briefly reviews recent advances in the field, and describes four new applications of morphometry: landscape ecology, wind-energy prospecting, soil surveys, and image understanding.

This is the first update of a bibliography and introductory essay on *geomorphometry* (or simply *morphometry*), the numerical characterization of topographic form (Pike, 1993). The supplement continues my drawing together the diverse and scattered literature on the subject and making it accessible to the research community. The need for such an effort remains evident from the rapidly growing use of square-grid digital elevation models (DEM's) to express topography for many different applications. Here I present over 450 additions to the initial 2100-item listing. Some two dozen references correct the most serious errors in Pike (1993). The new entries include both works overlooked previously and a good sampling of the voluminous material published since the original bibliography, which was current through 1992.

The appended listing follows the (unannotated) format of its predecessor. The 60-topic organization of geomorphometry developed in Pike (1993, Table 2) also accommodates the new entries. The same qualifications and caveats on accuracy and completeness stated therein apply equally to this supplement, which is current through about mid-1994. Preparations for distributing the combined bibliography (and subsequent updates) on-line over the Internet are underway but not yet complete.

Also highlighted here briefly are a few advances in established research areas of morphometry. Field applications of techniques, rather than just accounts of their development, appear more commonly than in Pike (1993), reflecting some maturing of the discipline. Finally, four areas related to morphometry have been identified since the release of Pike (1993): landscape ecology, wind-energy prospecting, soil surveys, and image understanding.

Four New Applications

Significant additions to geomorphometry include papers appearing over the last few years in the growing literature on landscape ecology (e.g., O'Neill and others, 1988; Li and Reynolds, 1993). This new discipline has quantified some of the fundamental spatial (X,Y) elements of landscape character. The attributes—outline shape, contiguity, interspersion, nesting, and adjacency—are mostly topological. Such characteristics need to be incorporated into geomorphometry to complement the more common relief measures, but thus far have proven difficult to express numerically (Pike, 1993). The computer techniques being developed by landscape ecologists to quantify these attributes use patterns and textures formed by mosaics of *patches*, defined as homogeneous units of landscape identified on multispectral images (McGarigal and Marks, 1994; Dillworth and others, 1994). With due caution, the measures ("metrics") calculated by the new algorithms are transferable to the characterization of topography. This adaptation can be accomplished by first creating topographic units that are the equivalents of landscape patches, probably subbasins (from drainage-net analysis) and terrain facets (from DEM-based analysis of elevation, slope angle, and aspect).

Other additions to the bibliography describe the role of morphometry in assessing the potential of a hitherto untapped natural resource in the United States, the generation of electricity from wind energy (Elliott and others, 1987, 1991; Wendell and others, 1993). Shaded-relief images made from coarse-scale (90 m) DEM's and morphometric parameters computed from fine-scale (10 m) DEM's (from 7.5' USGS maps and data) are being used to prospect for wind energy and to characterize near-surface air turbulence at potential sites for the installation of turbines ("giant windmills"). These and prior studies have shown that the configuration of topography upwind of a turbine is critical in locating these energy-gathering devices in the landscape. Local wind-flow characteristics, particularly fine-scale turbulence, governed by land-surface form determine a turbine's durability (e.g., wear characteristics and the resulting intervals for servicing) as well as its efficiency (and cost-effectiveness) in generating electricity.

Building on statistical relations between soil characteristics and land-surface form in drainage basins (e.g., Gerrard, 1981), recent experiments have mapped soil properties and taxonomic units with the aid of landform attributes derived from digital terrain data. Maps of ground slope, aspect, and elevation computed from DEM's were examined manually, together with aerial photographs and topographic maps, to conduct broad-scale (order-three) soil surveys in the western United States (e.g., Klingebiel and others, 1987). Field evaluations revealed that the DEM-based maps were accurate and helpful except in arid areas of sparse vegetation and low slopes (< 4°). Additionally, the geostatistical techniques of kriging and cokriging of slope curvature and other landform measures derived from DEM's, combined with multiple-regression analysis, have been used to predict specific properties (e.g., gravel content) of soils in Australia (Odeh and others, 1994). These experiments demonstrate certain advantages in using morphometric methods to more efficiently survey and evaluate soils in rough terrain and areas of dense vegetation.

A fourth area in which geomorphometry is emerging as an essential component is the general field of image understanding. Current work emphasizes software development for vision-based navigation as it relates to human and robot perception of terrain features and consequent AI (artificial intelligence) modeling (Pick and others, 1993; Thompson and others, 1993). The results apply to autonomous vehicles, navigation aids, mission planning, simulation, and training. The experiments address such perceptual aspects of way-finding in continuous topography as landmark identification, vision-based localization, and route-following. In contradistinction to most morphometric analysis, the required information describes terrain in profile or vistas, as seen by an observer on the ground—still a poorly understood element of topographic geometry. These studies of visual perception obtain viewsheds, terrain panoramas, and near-field, far-field, and horizon profiles from topographic maps by applying computer techniques of feature extraction to DEM's.

Updated work

Advances in the research areas in geomorphometry already identified (Pike, 1993) continue unabated. Among these are hazards modeling (Ellen and Mark, 1993; Pike and others, 1994), geographic information systems (GIS) implementation of topographic analysis (Wu and others, 1993; Tachikawa and others, 1993), refinement of the DEM-to-watershed transformation (Martz and Garbrecht, 1993), the many and varied application of DEM's to climatic and hydrologic modeling (Costa-Cabral and Burges, 1994; Daly and others, 1994; Wolock and Price, 1994), evaluation and improvement of DEM quality (Zebker and others, 1994; Bolstad and Stowe, 1994), delimitation of topographic regions from DEM's (Guzzetti and Reichenbach, 1994), compression and efficient storage of DEM's (Smith and Lewis, 1994; Hall, 1993), scale-dependence (including fractal properties) of topographic form (Sung and Tsaan, 1992; Weissel and others, 1994), modeling geomorphic process (Montgomery and Dietrich, 1994; Willgoose, 1994), and the geomorphic interpretation of planetary surfaces and Earth's sea floor (Komatsu and Baker, 1994; Little and others, 1993). The first book devoted wholly to DEM's has just been published (Felicísimo, 1994).

Complementary advances in the computer visualization of topographic form reflect improved technology and data sets. Among recent DEM-derived shaded-relief images, those of Israel (from 107 million terrain heights gridded at 25 m; Hall, 1994) and southern Somalia (U.S. Army, 1993) warrant particular mention. A balanced and aesthetically successful combination of color with relief shading, a goal that has thus far defied most attempts, has at last been achieved in recent work with the old Defense Mapping Agency 3-arc-second DEM of the United States (Chalk Butte Inc., 1994). Large-area maps derived from the recently released (on CD-ROM) Digital Chart of the World are starting to appear (Jenson and Larson, 1993). Finally, the increasing power of personal computers and workstations is enabling landform visualization to move from simple relief shading and other static forms of terrain rendering to the digital animation of scenes (Natural Graphics, 1993).

Two recent gatherings dealt variously with issues in geomorphometry. Papers presented at the 1992 Chapman Conference on tectonics and topography sponsored by the American Geophysical Union have been published in three issues of the Journal of Geophysical research (Merritts and Ellis, 1994). A proceedings volume resulting from the Geomorphometry Symposium I convened at the third meeting of the International Association of Geomorphologists in 1993 is currently being processed as a special issue of the *Zeitschrift für Geomorphologie*.

New Entries

Again, I welcome additions to this bibliography from its users. To ensure accuracy and reduce ambiguity, please send reprints or photocopies of proposed contributions rather than just the citations, if at all possible. However, I can entertain new entries if just the following information is provided:

1. photocopy of title page, or
    - title of the work, and
    - the name(s) of author(s); surname plus two initials (or, if one given name, then spelled out)
2. year of publication
3. the exact *and complete* citation of serial or other form of publication (book, conference proceedings, and so forth), including volume number, issue number, and inclusive page numbers. For meetings give location and dates; for books give name of city and publisher.

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Reference

Pike, R.J., 1993, A bibliography of geomorphometry, with a topical key to the literature and an introduction to the numerical characterization of topographic form: U.S. Geological Survey Open-file Report 93-262A, 132 p. Open-file Report 93-262B, one 3 1/2 inch 1.44 MB diskette. Formatted in Microsoft Word, version 5.0, for Macintosh. Open-file Report 93-262C, one 3 1/2 inch 1.44 MB diskette. Formatted in WordPerfect, version 5.0 for IBM-PC or compatible.

BIBLIOGRAPHY OF GEOMORPHOMETRY

ADDITIONS

A

Aandahl, A.R., 1948, The characterization of slope positions and their influence on the total nitrogen content of a few virgin soils in western Iowa: Soil Science Society of America Proceedings, v. 13, p. 449-454.

Adkins, K.F., and Merry, C.J., 1994, Accuracy assessment of elevation data sets using the global positioning system: Photogrammetric Engineering and Remote Sensing, v. 60, no. 2, p. 195-202.

Alexopoulos, J.S., and McKinnon, W.B., 1994, Large impact craters and basins on Venus, with implications for ring mechanics on the terrestrial planets, *in* Dressler, B.O., Grieve, R.A.F., and Sharpton, V.L., eds., Large Meteorite Impacts and Planetary Evolution: Boulder, CO, Geological Society of America Special Paper 293, p. 29-50.

Alias, (1st name unknown), 1992, Triangular network in digital terrain relief modelling: ITC, Enschede, Netherlands, unpublished M.Sc. thesis, paging unknown.

Ammanati, F., Benciolini, B., Mussio, L., and Sansó, F., 1983, An experiment of collocation applied to digital height model analysis, *in* International Colloquium on Mathematical Aspects of DEM, Stockholm, Department of Photogrammetry, Royal Institute of Technology: Proceedings, p. 1-9.

Anderson, R.S., 1994, Evolution of the Santa Cruz Mountains, California, through tectonic growth and geomorphic decay: Journal of Geophysical Research, v. 99, no. B10, p. 20,161-20,179.

Andrle, Robert, 1994, The angle measure technique—a new method for characterizing the complexity of geomorphic lines: Mathematical Geology, v. 26, no. 1, p. 83-97.

Argialas, D.P., 1990, Knowledge-based image interpretation—techniques and applications, *in* American Congress on Surveying and Mapping—American Society for Photogrammetry and Remote Sensing, annual convention, Denver, Colorado, March 18-23, Technical Papers, v. 4 (Image Processing/ Remote Sensing), p. 33-42.

Arnett, R.R., 1971, Slope form and geomorphological process—an Australian example, *in* Brunsden, Denys, ed., Slopes, Form and Process: Institute of British Geographers Special Publication no. 3, p. 81-92.

Arnett, R.R., and Conacher, A.J., 1973, Drainage basin expansion and the nine unit landsurface model: Australian Geographer, v. 12, p. 237-249.

Arnold, R.W., and Wilding, L.P., 1991, The need to quantify spatial variability, *in* Mausbach, M.J., and Wilding, L.P., eds., Spatial Variability of Soils and Landforms, proceedings of an international symposium, Las Vagas, NV, October 17, 1989: Madison, WI, Soil Science Society of America Special Publication 28, p. 1-8.

Auerbach, S., and Schaeben, H., 1990, Surface representation reproducing given digitized contour lines: Mathematical Geology, v. 22, no. 6, p. 723-742.

Austin, R.F., 1988, Measuring and comparing two-dimensional shapes, *in* Gaile, G.L., and Willmott, C.J., eds., Spatial Statistics and Models: Dordrecht, D. Reidel Publ., p. 293-312.

Austin, R.T., and England, A.W., 1993, Multi-scale roughness spectra of Mount St. Helens debris flows: Geophysical Research Letters, v. 20, no. 15, p. 1603-1606.

B

Band, L.E., 1993, Extraction of channel networks and topographic parameters from digital elevation data, *in* Beven, K., and Kirkby, M.J., eds., Channel Network Hydrology: New York, Wiley, p. 13-42.

Barnier, Bernard, and Le Provost, Christian, 1993, Influence of bottom topography roughness on the jet and inertial recirculation of a mid-latitude gyre: Dynamics of Atmospheres and Oceans, v. 18, nos. 1-2, p. 29-65.

Bayer, Ulf, 1985, Pattern Recognition Problems in Geology and Paleontology: Lecture notes in Earth sciences 2, Berlin and New York, Springer-Verlag, 229 p.

Beasom, S.L., Wiggers, E.P., and Giardina, J.R., 1983, A technique for assessing land surface ruggedness: Journal of Wildlife Management, v. 47, no. 4, p. 1163-1166.

Beaver, D.E., Eliason, J.R., and Thiessen, R.L., 1992, Regional digital analysis of major crustal structures in Washington State, *in* Mason, R., ed., Basement Tectonics 7: Kluwer Academic Publishers, p. 329-340.

Besl, P.J., and Jain, R.C., 1988, Segmentation through variable-order surface fitting: IEEE Transactions on Pattern Analysis and Machine Intelligence, v. 10, no. 2, p. 167-192. [reprinted *in* Kasturi, R., and Jain, R.C., 1991, p. 144-169.]

Blostein, Dorothea, and Ahuja, Narendra, 1989, Shape from texture—element extraction and surface estimation: IEEE Transactions on Pattern Analysis and Machine Intelligence, v. 11, no. 12, p. 1233-1251. [reprinted *in* Kasturi, R., and Jain, R.C., 1991, p. 325-343.]

Böhme, Rolf, compiler, 1993, Inventory of World Topographic Mapping, Volume 3, Eastern Europe, Asia, Oceania and Antartica: London, Elsevier Applied Science Publishers, *for* The International Cartographic Association, 447 p.

Bolstad, P.V., and Stowe, Timothy, 1994, An evaluation of DEM accuracy—elevation, slope, and aspect: Photogrammetric Engineering and Remote Sensing, v. 60, no. 11, p. 1327-1332.

Boundy, S.L., 1989, The use of numerical taxonomy for delimiting landform units from digital elevation models: Saskatoon, Canada, University of Saskatchewan, Department of Geography, unpublished M.Sc. thesis, 134 p.

Boundy, S.L., and Martz, L.W., 1988, Measuring topographic variables from digital elevation models—A discussion and listing of four FORTRAN programs: Saskatoon, Canada, University of Saskatchewan, Department of Geography, Resource Paper 11, 64 p.

Boundy, S.L., and Martz, L.W., 1989, A comparison of two surface functions for evaluating topographic variables directly from a digital elevation model, *in* Semple, R.K., and Martz, L.W., eds., Prairie Geography, Proceedings of the 12th Annual Meeting of the Prairie Division of the Canadian Association of Geographers, p. 149-155.

Bradbury, R.H., and Reichelt, R.E., 1983, Fractal dimension of a coral reef at ecological scales: Marine Ecology Progress, Series 10, p. 169-171.

Brewer, C.A., and Marlow, K.A., 1993, Color representation of aspect *and* slope simultaneously, *in* International Symposium on Computer-Assisted Cartography, 11th, AutoCarto 11, Minneapolis, MN, October 30-November 1: Proceedings, p. 328-337.

Brilly, M., Smith, M.B., and Vidmar, A., 1993, Spatially oriented surface water hydrological modelling and GIS, *in* Kovar, K., and Nachtnebel, H.P., eds., Application of Geographic Information Systems in Hydrology and Water Resources Management (Proceedings of the Vienna Conference, April 1993), International Association of Hydrological Sciences, Publ. no. 211, p. 547-557.

Brown, D.G., and Bara, T.J., 1994, Recognition and reduction of systematic error in elevation and derivative surfaces from 7 1/2-minute DEMs: Photogrammetric Engineering and Remote Sensing, v. 60, no. 2, p. 189-194.

Burrough, P.A., 1993, Fractals and geostatistical methods in landscape studies, *in* Lam, Nina Siu-Ngan, and De Cola, Lee, eds., Fractals in Geography: Englewood Cliffs, NJ, PTR Prentice-Hall, p. 87-121.

Butler, D.R., and Walsh, S.J., 1994, Site characteristics of debris flows and their relationship to alpine treeline: Physical Geography, v. 15, no. 2, p. 181-199.

C

Calmant, Stéphane, 1994, Seamount topography by least-squares inversion of altimetric geoid heights and shipborne profiles of bathymetry and/or gravity anomalies: Geophysical Journal International, v. 119, no. 2, p. 428-452.

Campbell, B.A., and Garvin, J.B., 1993, Lava flow topographic measurements for radar data interpretation: Geophysical Research Letters, v. 20, no. 9, p. 831-834.

Cao, Y.Z., and Coote, D.R., 1993, Topography and water erosion in northern Shaanxi Province, China: Geoderma, v. 59, nos. 1-4, p. 249-262.

Carter, J.R., 1990, Some effects of spatial resolution in the calculation of slope using the spatial derivative, *in* American Congress on Surveying and Mapping—American Society for Photogrammetry and Remote Sensing, annual convention, Denver, Colorado, March 18-23, Technical Papers, v. 1 (Surveying), p. 43-52.

Chairat, Sihem, and Delleur, J.W., 1993, Effects of the topographic index distribution on the predicted runoff using GRASS, *in* Harlin, J.M., and Lanfear, K.J., eds., 1993, Symposium on Geographic Information Systems and Water Resources, Mobile, AL, March 14-17, 1993: American Water Resources Association, Bethesda, MD, Proceedings, 285-292.

Chairat, Sihem, and Delleur, J.W., 1993, Effects of the topographic index distribution on the predicted runoff using GRASS: Water Resources Bulletin, v. 29, no. 6, p. 1029-1034.

Chairat, Sihem, and Delleur, J.W., 1993, Integrating a physically based hydrological model with GRASS, *in* Kovar, K., and Nachtnebel, H.P., eds., Application of Geographic Information Systems in Hydrology and Water Resources Management (Proceedings of the Vienna Conference, April 1993), International Association of Hydrological Sciences, Publ. no. 211, p. 143-150.

Chalk Butte, Inc., 1994, U.S. Digital Topography (24-bit color shaded-relief images of individual states exclusive of Alaska, computed from USGS 3" DEM's, on CD-ROM): 137 Steele Lane, Boulder, Wyoming 82923, Macintosh and PC versions.

Chen, Ganglin, and Spetzler, Hartmut, 1993, Topographic characteristics of laboratory induced shear fractures: Pure and Applied Geophysics, v. 140, no. 1, p. 123-135.

Christakos, George, 1992, Random Field Models in Earth Sciences: New York, Academic Press, 474 p.

Clark, C.D., and Wilson, Colin, 1994, Spatial analysis of lineaments: Computers and Geosciences, v. 20, no. 7/8, p. 1237-1258.

Clarke, K.C., Cippoletti, Richard, and Olsen, Greg, 1993, Empirical comparison of two line enhancement methods, *in* International Symposium on Computer-Assisted Cartography, 11th, AutoCarto 11, Minneapolis, MN, October 30-November 1: Proceedings, p. 72-81.

Clarke, K.C., Brass, J.A., and Riggan, P.J., 1994, A cellular automaton model of wildfire propagation and extinction: Photogrammetric Engineering and Remote Sensing, v. 60, no. 11, p. 1355-1367.

Cooper, A.P.R., 1994, A simple shape-from-shading algorithm applied to images of ice-covered terrain: IEEE Transactions on Geoscience and Remote Sensing, v. 32, no. 6, p. 1196-1198.

Corbley, K.P., 1994, Supercomputer technique revolutionizes automated stereo correlation: Earth Observation Magazine, April, p. 53-55.

Costa-Cabral, M.C., and Burges, S.J., 1994, Digital elevation model networks (DEMON)—a model of flow over hillslopes for computation of contributing and dispersal areas: Water Resources Research, v. 30, no. 6, p. 1681-1692.

Crampton, Jeremy, 1992, A cognitive analysis of wayfinding expertise: Cartographica, v. 29, nos. 3 & 4, p. 46-65.

D

D'Agostino, V., Puglisi, S., and Trisorio-Liuzzi, G., 1993, An integrated approach to the reconstruction of the drainage networks in soil conservation studies: MEDIT Journal of Economics, Agriculture and Environment, in press.

D'Agostino, V., Stranghellini, M., and Trisorio-Liuzzi, G., 1993, A FORTRAN-77 program for preliminary extraction of drainage networks based on a DEM: Computers and Geosciences, v. 19, no. 7, p. 981-1006.

Daly, Christopher, Neilson, R.P., and Phillips, D.L., 1994, A statistical-topographic model for mapping climatological precipitation over mountainous terrain: Journal of Applied Meteorology, v. 33, no. 2, p. 140-158.

Dawes, W.R., and Short, David, 1994, The significance of topology for modeling the surface hydrology of fluvial landscapes: Water Resources Research, v. 30, no. 4, p. 1045-1055.

De Cola, Lee, 1993, Multifractals in image processing and process imaging, *in* Lam, Nina Siu-Ngan, and De Cola, Lee, eds., Fractals in Geography: Englewood Cliffs, NJ, PTR Prentice-Hall, p. 282-304.

De Cola, Lee, and Lam, Nina Siu-Ngan, 1993a, Introduction to fractals in geography, *in* Lam, Nina Siu-Ngan, and De Cola, Lee, eds., Fractals in Geography: Englewood Cliffs, NJ, PTR Prentice-Hall, p. 3-22.

De Cola, Lee, and Lam, Nina Siu-Ngan, 1993b, A fractal paradigm for geography, *in* Lam, Nina Siu-Ngan, and De Cola, Lee, eds., Fractals in Geography: Englewood Cliffs, NJ, PTR Prentice-Hall, p. 75-83.

De Cola, Lee, and Montagne, Nalan, 1993, The pyramid system for multiscale raster analysis: Computers and Geosciences, v. 19, no. 10, p. 1393-1404.

Deffontaines, B., Lee, J.-C., Angelier, J., Carvalho, J., and Rudant, J.-P., 1994, New geomorphic data on the active Taiwan orogen—A multisource approach: Journal of Geophysical Research, v. 99, no. B10, p. 20,243-20,266.

Delay, Frederick, and Bracq, Pierre, 1993, A vectorial method for the study of the spatial distribution or morphological features applied to the needs of hydrogeology: Computers and Geosciences, v. 19, no. 7, p. 965-980.

Depraetere, Christian, 1989, LAMONT—Logiciel d'Application des Modèles Numériques de Terrain (in French): Montpellier, Notice OVNIh du Laboratoire d'Hydrologie de l'ORSTOM, no. 4, 128 p.

Depraetere, Christian, 1991, Démiurge, chaine de production et de traitement de M.N.T. (in French): *Orstom* Montpellier, Laboratoire d'Hydrologie, p. 1-144.

Devarajan, Venkat, and McArthur, D.E., 1993, Terrain modeling for real-time simulation: American Congress on Surveying and Mapping—American Society for Photogrammetry and Remote Sensing, annual convention, New Orleans, LA, February 15-18, 1993, Technical Papers, v. 1, p. 129-138. [also, *in* Clark, B.P., et al., eds., 1993, State-of-the-art Mapping: International Society for Optical Engineering meeting, Orlando FL, April 13-15, Proceedings, v. 1943, p. 325-333.]

Devdariani, A.S., 1950, Kinematics of relief (in Russian): Voprosy geogr., v. 21, p. 55-85.

Devdariani, A.S., 1966, Geomorphology—mathematical methods (in Russian): Izd. AN SSSR, ser. Itogi Nauki, Moscow, 150 p.

Devdariani, A.S., 1967, Mathematical analysis in geomorphology (in Russian): Izd. Nedra, Moscow, 155 p.

Dias, L.A.V., and Nery, C.E., 1992, Evaluation of interpolators for digital elevation models, *in* Proceedings of the ISPRS and OEEPE Joint Workshop on Updating Data by Photogrammetric Methods: Oxford, European Organisation for Experimental Photogrammetric Research (OEEPE) Publication No. 27, p. 201-212.

Dietler, D., and Zhang, Y., 1992, Fractal aspects of the Swiss landscape: Physica A, v. 191, p. 213-219.

Dikau, Richard, 1993, Geographical information systems as tools in geomorphology: Zeitschrift für Geomorphologie, Supplementband 92, p. 231-239.

Dillworth, M.E., Whistler, J.L., and Merchant, J.W., 1994, Measuring landscape structure using geographic and geometric windows: Photogrammetric Engineering and Remote Sensing, v. 60, no. 10, p. 1215-1224.

Dixon, T., 1994, SAR interferometry and surface change detection—workshop held: Eos, Transactions, American Geophysical Union, v. 75, no. 24, p. 269-270.

Dobson, J.E., 1993, A conceptual framework for integrating remote sensing, GIS, and geography: Photogrammetric Enginering and Remote Sensing, v. 59, no. 10, p. 1491-1496.

Dolan, Robert, and Ferm, J.C., 1968, Crescentic landforms along the Atlantic Coast of the United States: Science, v. 159, no. ---, p. 627-629.

Donahue, J.J., 1972, Drainage intensity in western New York: Annals of the Association of American Geographers, v. 62, no. 1, p. 23-36.

Donahue, J.J., 1974, Measuring drainage density with a dot planimeter: The Professional Geographer, v. 26, no. 3, p. 317-319.

Donnay, J.-P., 1992, Détermination en mode maillé du champ d'intervisibilité dans un modèle numérique de terrain (in French): Cartographica, v. 29, nos. 3 & 4, p. 75-82.

Dubayah, Ralph, Lavallee, D., and Peterson, P, 1993, A study of the multifractal properties of DEM topography for the major geomorphic regions of the USA (abs.): Eos, Transactions, American Geophysical Union, v. 74, no. 43, Fall meeting supplement, p. 302.

Dubuc, B., Quiniou, J.F., Roques-Carmes, C., Tricot, W., and Zucker, S.W., 1989a, Evaluating the fractal dimension of profiles: Physical Review A, v. 39, no. 3, p. 1500-1512.

Dubuc, B., Zucker, S.W., Tricot, W., Quiniou, J.F., and Wehbi, D., 1989b, Evaluating the fractal dimension of surfaces: Proceedings of the Royal Society of London, Series A, v. 425, p. 113-127.

Dury, G.H., 1971, Channel characteristics in a meandering tidal channel—Crooked Creek, Florida: Geografiska Annaler, v. 53A, no. 3-4, p. 188-197.

Dutch, S.I., 1993, Linear Richardson plots from non-fractal data sets: Mathematical Geology, v. 25, no. 6, p. 737-751.

Eash, D.A., 1993, Estimating design-flood discharges for streams in Iowa using drainage-basin and channel-geometry characteristics: U.S. Geological Survey Water-Resources Investigations Report 93-4062, 96 p.

Eash, D.A., 1993, A geographic information system procedure to quantify physical basin characteristics, *in* Harlin, J.M., and Lanfear, K.J., eds., 1993, Symposium on Geographic Information Systems and Water Resources, Mobile, AL, March 14-17, 1993: American Water Resources Association, Bethesda, MD, Proceedings, 173-182.

Eash, D.A., 1994, A geographic information system procedure to quantify physical basin characteristics: Water Resources Journal, v. 30, no. 1, p. 1-8.

E

Ebisemiju, F.S., 1994, The sinuosity of alluvial river channels in the seasonally wet tropical environment—case study of river Elemi, southwestern Nigeria: Catena, v. 21, no. 1, p. 13-25.

Ebner, Heinrich, and Eder, K., 1992, State of the art in digital terrain modelling, *in* European Conference and Exhibition on Geographical Information Systems, 3rd, Munich, Germany, March 23-26: Proceedings, p. 682-690.

Edwards, Kathleen, and Davis, P.A., 1994, The use of intensity-hue-saturation transformation for producing color shaded-relief images: Photogrammetric Engineering and Remote Sensing, v. 60, no. 11, p. 1369-1374.

Elgy, J., Maksimovic, and Prodanovic, D., 1993, Matching standard GIS packages with urban storm drainage simulation software, *in* Kovar, K., and Nachtnebel, H.P., eds., Application of Geographic Information Systems in Hydrology and Water Resources Management (Proceedings of the Vienna Conference, April 1993), International Association of Hydrological Sciences, Publ. no. 211, p. 151-160.

Ellen, S.D., and Mark, R.K., 1993, Mapping debris-flow hazard in Honolulu using a DEM, *in* Shen, H.W., ed., Hydraulic Engineering: 1993 National Conference on Hydraulic Engineering, Proceedings, p. 1774-1779.

Elliott, D.L., Holladay, C.G., Barchet, W.R., Foote, H.P., and Sandusky, W.F., 1987, Wind Energy Resource Atlas of the United States: Richland, WA, Pacific Northwest Institute, for the Department of Energy, Solar Energy Research Institute, Golden, CO, DOE/CH10094-4, 210 p.

Elliott, D.L., Wendell, L.L., and Gower, G.L., 1991, An assessment of the available windy land area and wind energy potential in the contiguous United States: Pacific Northwest Laboratory, Department of Energy, Report PNL-7789, 61 p. + appendices.

F

Fabbri, A.G., Van der Meer, F.D., Valenzuela, C.R., and Kushigbor, C.A., 1993, Shape analysis and multispectral classification in geological remote sensing: Mathematical Geology, v. 25, no. 7, p. 773-793.

Falcideno, Bianca, and Pienovi, Caterina, 1990, Natural surface approximation by constrained stochastic interpolation: CAD, Computer-Aided Design, v. 22, p. 167-253.

Falcideno, Bianca, and Spagnuolo, Michela, 1991, A new method for the characterization of topographic surfaces: International Journal of Geographical Information Systems, v. 5, no. 4, p. 397-412.

Fatale, Louis, 1994, DCAC employs new technology to keep pace with higher-fidelity elevation data: U.S. Army Corps of Engineers, Topographic Engineering Center, Digital Data Digest, v. 4, no. 2, p. 1-3.

Fatale, L.A., Ackeret, J.R., and Messmore, J.A., 1994, Impact of digital terrain elevation data (DTED) resolution on Army applications—simulation vs. reality: ASPRS/ACSM Annual Convention and Exposition, Reno NV, April 25-28, ASPRS Technical Papers, v. 2 (American Congress on Surveying and Mapping), p 89-104.

Fekete, George, and Treinish, L., 1990, Sphere quadtrees—A new data structure to support the visualization of spherically distributed data, *in* International Society for Optical Engineering symposium on Extracting Meaning from Complex Data, Santa Clara CA, February 1990: Proceedings, paging unknown.

Felicísimo, A.M., 1992, Aplicaciones de los modelos digitales del terreno en las ciencias ambientales (in Spanish): Universidad de Oviedo (España), Instituto de Recursos Naturales y Ordenación del Territorio (INDUROT), Tesis Doctoral, 235 p.

Felicísimo, A.M., 1994, Modelos Digitales del Terreno, introducción y applicaciones en las ciencias ambientales (in Spanish: "Digital terrain models, introduction and applications in the environmental sciences"): Oviedo (España), Pentalfa Ediciones, 222 p.

Felicísimo, A.M., 1994, Parametric statistical method for error detection in digital elevation models: ISPRS Journal of Photogrammetry and Remote Sensing, v. 49, no. 4, p. 29-33.

Felleman, J., and Griffin, C., 1990, The role of error in GIS-based viewshed determination—a problem analysis: U.S. Forest Service, North Central Experiment Station, Agreement No. 23-88-27, paging unknown.

Fielding, Eric, Isacks, Bryan, Barazangi, Muawia, and Duncan, Christopher, 1994, How flat is Tibet?: Geology, v. 22, no. 2, p. 163-167.

Fischler, M.A., and Wolf, H.C., 1993, Saliency detection and partitioning planar curves: Image Understanding Workshop, Washington, D.C., April 18-21, 1993, Defense Advanced Research Projects Agency, Proceedings, p. 917-931.

Foley, J.D., Van Dam, Andries, Feiner, S.K., and Hughes, J.F., 1992, Computer Graphics—principles and practice: Reading, MA, Addison-Wesley, 1175 p.

Ford, P.G., and Pettengill, G.H., 1994, Venus topography and kilometer-scale slopes: Journal of Geophysical Research, v. 97, no. E8, p. 13,103-13,114.

Forsythe, Peter, and Pasley, R.M., 1969, Terrace computer program—practical applications: Transactions of the American Society of Agricultural Engineers, v. 12, no. 4, p. 512-516.

Franceschetti, Giorgio, Migliaccio, Maurizio, and Riccio, Daniele, 1994, SAR raw signal simulation of actual ground sites described in terms of sparse input data: IEEE Transactions on Geoscience and Remote Sensing, v. 32, no. 6, p. 1160-1169.

Franklin, S.E., 1991, Topographic data and satellite spectral response in subarctic high-relief terrain analysis: Arctic, v. 44, supplement 1, p. 15-20.

Frederiksen, Poul, Jacobi, O., and Justesen, J., 1978, Fourier transformation von Höhenbeobachtungen: Zeitschrift für Vermessungenswesen, v. 103, p. 64-79.

G

Gallant, J.C., Moore, I.D., Hutchinson, M.F., and Gessler, Paul, 1994, Estimating Fractal dimensions of profiles—A comparison of methods: Mathematical Geology, v. 26, no. 4, p. 455-481.

Gao, Jay, 1993, Identification of topographic settings conducive to landsliding from DEM in Nelson County, Virginia, U.S.A.: Earth Surface Processes and Landforms, v. 18, no. 7, p. 579-591.

Garbrecht, Jurgen, and Martz, L.W., 1993, Case application of the automated extraction of drainage network and subwatershed characteristics from digital elevation models by DEDNM, *in* Harlin, J.M., and Lanfear, K.J., eds., 1993, Symposium on Geographic Information Systems and Water Resources, Mobile, AL, March 14-17, 1993: American Water Resources Association, Bethesda, MD, Proceedings, 221-229 and 606-607.

Garbrecht, Jurgen, and Martz, L.W., 1993, Network and subwatershed parameters extracted from digital elevation models—the Bills Creek experience: Water Resources Bulletin, v. 29, no. 6 p. 909-916.

Garbrecht, Jurgen, and Martz, L.W., 1994, Grid size dependency of parameters extracted from digital elevation models: Computers and Geosciences, v. 20, no. 1, p. 85-87.

Garbrecht, J., Martz, L.W., and Starks, P., 1994, Automated watershed parameterization from digital landscapes—capabilities and limitations, *in* American Geophysical Union Annual Hydrology Days, 14th, April 5-8, 1994, Fort Collins, Colo., Proceedings, p. 123-134.

García Asensio, L., Lumbreras Crespo, J. Javier, 1992, El modelo digital del terreno MDT200 del Instituto Geográfico Nacional—descripción general y resultados (in Spanish): Mapping, v. 1, no. 3, p. 38-42.

Garg, N.K., and Sen, D.J., 1994, Determination of watershed features for surface runoff models: Journal of Hydraulic Engineering (ASCE), v. 120, no. 4, p. 427-447.

Gerrard, A.J.W., 1978, Hillslope profile analysis: Area, v. 10, p. 129-130.

Gerrard, A.J.W., 1981, Soil relationships within drainage basins, *in* Soils and Landforms, an integration of geomorphology and pedology: London, Allen and Unwin, p. 80-91.

Giglio, Dominick, 1994, Synthetic aperture radar provides low-cost, high-accuracy digital elevation data: Earth Observation Magazine, April, p. 61-63.

Gilchrist, A.R., Summerfield, M.A., and Cockburn, H.A.P., 1994, Landscape dissection, isostatic uplift, and the morphologic development of orogens: Geology, v. 22, no. 11, p. 963-966.

Goff, J.A., 1992, Quantitative characterization of abyssal hill morphology along flow lines in the Atlantic Ocean: Journal of Geophysical Research, v. 97, no. B6, p. 9183-9202.

Goff, J.A., 1993, A utilitarian approach to modeling non-Gaussian characteristics of a topographic field: Journal of Geophysical Research, v. 98, no. B11, p. 19,635-19,647.

Goff, J.A., and Jordan, T.H., 1989, Stochastic modeling of seafloor morphology—resolution of topographic parameters by Sea Beam data: IEEE Journal of Oceanic Engineering, v. 14, no. 4, p. 326-337.

Goff, J.A., Malinverno, Alberto, Fornari, D.J., and Cochran, J.R., 1993, Abyssal hill segmentation—quantitative analysis of the East Pacific Rise flanks 7°S-9°S: Journal of Geophysical Research, v. 98, no. B8, p. 13,851-13,862.

Goldgof, D.B., Huang, T.S., and Lee, H., 1989, A curvature-based approach to terrain recognition: IEEE Transactions on Pattern Recognition and Machine Intelligence, v. 11, no. 11, p. 1213-1217.

Goodchild, M.F., and Klinkenberg, Brian, 1993, Statistics of channel networks on fractional Brownian surfaces, *in* Lam, Nina Siu-Ngan, and De Cola, Lee, eds., Fractals in Geography: Englewood Cliffs, NJ, PTR Prentice-Hall, p. 122-141.

Goodchild, M.F., and Lee, Jay, 1989, Coverage problems and visibility regions on topographic surfaces: Annals of Operations Research, v. 18, p. 175-186.

Graff, L.H., 1993, An approach to automated terrain classification from digital elevation model data: American Congress on Surveying and Mapping—American Society for Photogrammetry and Remote Sensing, annual convention, New Orleans, LA, February 15-18, 1993, Technical Papers, v. 3, p. 112-121.

Gregory, K.M., and Chase, C.G., 1994, Tectonic and climatic significance of a late Eocene Low-relief, high-level geomorphic surface, Colorado: Journal of Geophysical Research, v. 99, no. B10, p. 20,141-20,160.

Griffin, M.W., 1990, Military applications of digital terrain models, *in* Petrie, Gordon, and Kennie, T.J.M., eds., Terrain Modelling in Surveying and

Civil Engineering: Caithness (UK), Whittles Publ., p. 277-289.

Guindon, B., Goodenough, D.G., and Teillet, P.M., 1982, The role of digital terrain models in the remote sensing of forests: Canadian Journal of Remote Sensing, v. 8, no. 1, p. 4-16.

Gurnis, Michael, 1993, Depressed continental hypsometry behind oceanic trenches—a clue to subduction controls on sea-level change: Geology, v. 21, no. 1, p. 29-32.

Guth, P.L., 1992, Microcomputer application of digital elevation models and other gridded data sets for geologists, *in* Merriam, D.F., and Kürzl, Hans, eds., Use of Microcomputers in Geology: New York, Plenum Press, p. 187-206.

Guzzetti, Fausto, and Reichenbach, Paola, 1994, Towards a definition of topographic divisions for Italy: Geomorphology, v. 11, no. 1, p. 57-74.

H

Haigh, M.J., Rawat, J.S., Bartarya, S.K., and Rawat, M.S., 1993, Environmental influences on landslide activity—Almora Bypass, Kumaun Lesser Himalaya: Natural Hazards, v. 8, no. 2, p. 153-170.

Håkanson, Lars, 1994, How many lakes are there in Sweden?: Geografiska Annaler, v. 76A, no. 3, p. 203-205.

Hall, G.F., and Olson, C.G., 1991, Predicting variability of soils from landscape models, *in* Mausbach, M.J., and Wilding, L.P., eds., Spatial Variability of Soils and Landforms, proceedings of an international symposium, Las Vagas, NV, October 17, 1989: Madison, WI, Soil Science Society of America Special Publication 28, p. 9-24.

Hall, J.K., 1993, DEMpack—DEM data storage in a two-byte integer: Computers and Geosciences, v. 19, no. 10, p. 1567-1569.

Hall, J.K., 1994, Digital shaded-relief map of Israel and environs: Geological Survey of Israel, one sheet, scale 1:500,000.

Hallam, C.A., 1993, The effect of data generalization on the prediction of hydrologic response: U.S. Geological Survey, Open-file Report 93-354, 64 p.

Hampton, M.A., Wong, F.L., Lugo, R.V., and Steele, W.C., 1993, Map of seafloor declivity and fall lines on the continental slope, Gulf of the Farallones, central California: U.S. Geological Survey, Open-file Report 93-298, scale 1:250,000.

Harding, D.J., Bufton, J.L., and Frawley, J.J., 1994, Satellite laser altimetry of terrestrial topography—vertical accuracy as a function of surface slope, roughness, and cloud cover: IEEE Transactions on Geoscience and Remote Sensing, v. 32, no. 2, p. 329-000.

Harlin, J.M., and Lanfear, K.J., eds., 1993, Symposium on Geographic Information Systems and Water Resources, Mobile, AL, March 14-17, 1993: American Water Resources Association, Bethesda, MD, Proceedings, 640 p.

Heermann, D.F., Wenstrom, R.J., and Evans, N.A., 1969, Prediction of flow resistance in furrows from soil roughness: Transactions of the American Society of Agricultural Engineers, v. 12, no. 4, p. 482-485, & 489.

Hegg, CH., and Kienholz, H., 1993, Slope processes—limits and possibilities of simulation, *in* Reichenbach, Paola, Guzzetti, Fausto, and Carrara, Alberto, eds., Workshop on Geographical Information Systems in Assessing Natural Hazards, Perugia, Italy, September 20-22: Abstracts Volume, p. 71-77.

Heller, Martin, 1993, A synthesis of triangulation algorithms: University of Zürich, Department of Geography, Technical Report, 22 p.

Helmlinger, K.R., Kumar, Praveen, and Foufoula-Georgiou, Efi, 1993, On the use of digital elevation model data for Hortonian and fractal analyses of channel networks: Water Resources Research, v. 29, no. 8, p. 2599-2613.

Herzfeld, U.C., 1993, A method for seafloor classification using directional variograms, demonstrated for data from the western flank of the Mid-Atlantic Ridge: Mathematical Geology, v. 25, no. 7, p. 901-924.

Herzfeld, U.C., Eriksson, M.G., and Holmlund, Per, 1993, On the influence of Kriging parameters on the cartographic output—a study in mapping subglacial topography: Mathematical Geology, v. 25, no. 7, p. 881-900.

Hiura, Hiromasa, 1991, Morphological study on the prediction of the site of surface slides, *in* Rice, R.M., ed., International Union of Forestry Research Organizations, World Congress, 19th, August 5-11, 1990, Montreal, Canada, technical session on geomorphic hazards in managed forests, Proceedings, Gen. Tech. Rep. PSW-GTR-130, p. 42-47.

Höhle, J., 1992, The object-oriented height model and its application: International Archives of Photogrammetry and Remote Sensing, v. 29, no. B4, p. 869-873.

Holle, A., 1909, Einteilung und Orometrie des Tatragebirges nebst einem Beitrag zur Wald- und Knieholzgrenze (in German): Diss. Univ. Vienna, 135 p. [also published 1909, as Abhandlungen der K.K. geogr. Ges. Wien, v. 8, no. 2]

Holmgren, Peter, 1994, Multiple flow direction algorithms for runoff modelling in grid based elevation models—an empirical evaluation: Hydrological Processes, v. 8, no. 4, p. 327-334.

Holsapple, K.A., 1993, The size of complex craters, *in* Abstracts of papers submitted to the Lunar and Planetary Science Conference, 24th, March 1993, Houston, TX, The Lunar and Planetary Institute: Lunar and Planetary Science XXIV, p. 665-666.

Horn, B.K.P., 1977, Understanding image intensities: Artificial Intelligence, v. 8, no. 2, p. 201-231. [reprinted *in* Kasturi, R., and Jain, R.C., 1991, p. 10-35.]

Hottier, P., 1977, Etude mathématique des modèles numériques de terrain—Conséquences practiques (in French) (Comission III, Congrès d'Helsinki): Bull. Soc. Fr. Photogramm., v. 66, p. 9-36.

Hovanec, Denise, 1994, DMA digital terrain elevation data multiservce product review evaluates customer satisfaction: U.S. Army Corps of Engineers, Topographic Engineering Center, Digital Data Digest, v. 4, no. 2, p. 5-6.

Howard. Alan D., 1994, A detachment-limited model of drainage basin evolution: Water Resources Research, v. 30, no. 7, p. 2261-2285.

Hsieh, C.M., Ho, C.R., and Shih, T.T., 1975, The statistical map of altitude of Taiwan, scale 1:400,000, and analytical slope maps of Taiwan: N.S.C. and Nat. Taiwan Normal University.

Hutchinson, M.F., 1993, Development of a continent-wide digital elevation model (DEM) with applications to terrain and climate analysis, *in* Goodchild, M.F., Parks, B.O., and Steyaert, L.T., eds., Environmental Modeling with GIS: New York, Oxford Univ. press, p. 00-00.

I

Ichoku, Charles, and Chorowicz, Jean, 1994, A numerical approach to the analysis and classification of channel network patterns: Water Resources Research, v. 30, no. 2, p. 161-174.

Ijjász-Vásquez, E.J., Bras, R.L., and Rodríguez-Iturbe, Ignacio, 1993, Hack's relation and optimal channel networks—the elongation of river basins as a consequence of energy minimization: Geophysical Research Letters, v. 20, no. 15, p. 1583-1586.

Ijjász-Vásquez, E.J., Bras, R.L., Rodríguez-Iturbe, I., Rigon, R., and Rinaldo, A., 1993, Are river basins optimal channel networks?: Advances in Water Resources, v. 16, no. 1, p. 69-79.

Isaaks, E.H., and Srivastava, R.M., 1989, The Walker Lake data sets, Appendix A *to* An Introduction to Applied Geostatistics: New York, Oxford University Press, p. 542-547.

J

Jaggi, S., Quattrochi, D.A., and Lam, Nina Siu-Ngan, 1993, Implementation and operation of three fractal measurement algorithms for analysis of remote-sensing data: Computers and Geosciences, v. 19, no. 6, p. 745-767.

Jarrett, Joni, and Stoltz, Vernon, 1993, The Airland Battlefield Environment Program and the visibility model: American Congress on Surveying and Mapping—American Society for Photogrammetry and Remote Sensing, annual convention, New Orleans, LA, February 15-18, 1993, Technical Papers, v. 1, p. 251-260.

Jenson, S.K., 1993, Large-area digital elevation data and their derivatives, *in* Kelmelis, J.A., and Snow, Mitchell, eds., Proceedings of the Global Change Research Forum, Herndon, VA, March 18-20, 1991: U.S. Geological Survey Circular 1086, p. 90-91.

Jenson, S.K., and Larson, K.S., 1993, Availability of global digital topographic data: U.S. Geological Survey Yearbook 1992, p. 78-79.

Jeton, A.E., and Smith, J.L., 1993, Development of watershed models for two Sierra Nevada basins using a geographic information system, *in* Harlin, J.M., and Lanfear, K.J., eds., 1993, Symposium on Geographic Information Systems and Water Resources, Mobile, AL, March 14-17, 1993: American Water Resources Association, Bethesda, MD, Proceedings, p. 251-258. [also published 1993, as Watershed modeling—spatial partitioning using GIS, *in* Burton, J.S., compiler, Proceedings of the Federal Interagency Workshop on Hydrologic Modeling Demands for the 90's, Fort Collins, CO, June 6-9, 1993: U.S. Geological Survey Water-Resources Investigations Report 93-4018, p. 5-81 to 5-88.]

K

Kaba, James, Matey, James, Stoll, Gordon, Taylor, Herbert, and Hanrahan, Patrick, 1992, Interactive terrain rendering and volume visualization on the Princeton Engine, *in* Kaufman, A.E., and Nielson, G.M., eds., Visualization '92, Boston, MA, October 19-23, 1992, Proceedings: IEEE Computer Society Press, p. 349-355.

Kanakubo, Tositomo, ed., 1993, The selected main theoretical issues facing cartography—report of the ICA Working Group to Define the Main Theoretical Issues on Cartography for the 16th ICA Conference, Cologne, 1993: Cartographica, v. 30, no. 4, p. *v-x*, 1-20.

Kappraff, J., 1986, The geometry of coastlines—a study in fractals: Computers and Mathematics with Applications, v. 12B, p. 655-671.

Kasturi, Rangachar, and Jain, R.C., eds., 1991, Computer Vision—Principles: Los Alamitos, CA, IEEE Computer Society Press, 712 p.

Kent, C., and Wong, J., 1982, An index of littoral zone complexity and its measurement: Canadian Journal of Fisheries and Aquatic Science, v. 39, p. 847-853.

Kim, J.J., 1994, High target visibility analysis: ASPRS/ACSM Annual Convention and Exposition, Reno NV, April 25-28, ASPRS Technical Papers, v. 1 (American Society for Photogrammetry and Remote Sensing), p 301-306.

Kirchner, J.W., 1993, Statistical inevitability of Horton's laws and the apparent randomness of stream channel networks: Geology, v. 21, no. 7, p. 591-594. [Comments and replies: Geology, v. 22, no. 4, p. 380-381, v. 22, no. 6, p. 573-575.]

Kirchner, J.W., 1994a, Statistical inevitability of Horton's laws and the apparent randomness of stream channel networks—reply: Geology, v. 22, no. 4, p. 380-381.

Kirchner, J.W., 1994b, Statistical inevitability of Horton's laws and the apparent randomness of stream channel networks—reply: Geology, v. 22, no. 6, p. 573-575.

Kirk, R.L., Soderblom, L.A., and Lee, E.M., 1994, Enhanced visualization for interpretation of Magellan radar data—suuplement to the Magellan special issue: Journal of Geophysical Research, v. 97, no. E10, p. 16,371-16,380.

Kiuti, S., 1935, Hypsographic curves of Japanese volcanoes: Geographical Review of Japan (Tokyo), p. 688-702.

Kliewe, H., 1960, Relief, Reliefenergie und Glaziärgenese des Spätglazials im Kartenbild (in German): Geogr. Berichte, v. 3, p. 139-151.

Klingebiel, A.A., Horvath, E.H., Moore, D.G., and Reybold, W.U., 1987, Use of slope, aspect, and elevation maps derived from digital elevation model data in making soil surveys, *in* Reybold, W.U., and Peterson, G.W., eds., Soil Survey Techniques: Soil Science Society of America Special Publication 20, Madison, WI, p. 77-90.

Klingebiel, A.A., Horvath, Reybold, W.U., Moore, D.G., Fosnight, E.A., and Loveland, T.R., 1988, A guide for the use of digital elevation model data for making soil surveys: U.S. Geological Survey, Open-file Report 88-102, 18 p.

Klinkenberg, Brian, 1994, A review of methods used to determine the fractal dimension of linear features: Mathematical Geology, v. 26, no. 1, p. 23-46.

Kobashi, Sumiji, 1985, ------- (in Japanese; long report or monograph, on the Rokko Mt. area?): no. 60; 12 color plates, 68 p.

Kobashi, Sumiji, 1987, ------- (in Japanese; article with color illustrations): -----, v. 20, no. 3, p. 138-145.

Komatsu, G., and Baker, V.R., 1994, Meander properties of Venusian channels: Geology, v. 22, no. 1, p. 67-70.

Köthe, R., and Lehmeier, F., 1991, Digitale Reliefanalyse—ein Projekt zur geomorphologischen Auswertung Digitaler Geländemodelle (DGM) (in German), *in* Gossmann, H., and Saurer, H., eds., GIS in der Geographie: Frieburg, Freiburger Geogr. H., v. 34, p. 99-109.

Kousal, J., 1968, Maps of the relative relief in Moravia at 1:200,000: Brno, Institute of Geography, Czechoslovak Academy of Sciences.

Kozin, F., Cote, L.J., and Bogdanoff, J.L., 1963, Statistical studies of stable ground roughness: U.S. Army Land Locomotion Laboratory, ATAC, Warren, Michigan, Rept. No. 8391 (LL 95), paging unknown.

Krajewski, S.A., and Gibbs, B.L., 1994, Computer contouring generates artifacts: Geotimes, v. 39, no. 4, p. 15-19.

Krcho, Jozef, 1964, On the problem of construction of maps of slope gradients, isoclines, isalumclines and isalumchrones (in Slovak): Geograf. Cas., v. 16, no. 1, p. 61-75.

Krcho, Jozef, 1991, Georelief as a subsystem of landscape and the influence of morphometric parameters of georelief on spatial differentiation of landscape-ecological processes: Ekológia (CSFR), v. 10, no. 2, p. 115-157.

Krcho, Jozef, 1993, Georelief and its cartographic modelling by complex digital model (CDM) from geographical information system (GIS) point of view: Universitas Comeniana, Univerzita Komenského, Bratislava, Geographica Nr. 33, p. 1-131.

Krist, F.J., Jr., and Brown, D.G., 1994, GIS modeling of Paleo-Indian period caribou migrations and viewsheds in northeastern Lower Michigan: Photogrammetric Engineering and Remote Sensing, v. 60, no. 9, p. 1129-1137.

Krzystek, P., and Wild, D., 1992, Experimental accuracy analysis of automatically measured digital terrain models, *in* Förstner, W., and Ruweidel, S., eds., Robust Computer Vision: Karlsruhe, Wichmann Verlag, p. 372-392.

Kudrnovská, O., 1948, Kartometrické stanovení krajinnych typu Ceskoslovenka (in Czech): Kartogr. prehled (Praha), v. 3, p. 52-60.

Kudrnovská, O., 1968a, Maps of the relative relief in Bohemia at 1:200,000: Brno, Institute of Geography, Czechoslovak Academy of Sciences.

Kudrnovská, O., 1968b, Slope maps of Bohemia at 1:200,000: Brno, Institute of Geography, Czechoslovak Academy of Sciences.

Kumler, M.P., 1992, An intensive comparison of TIN's and DEM's: University of California, Santa Barbara, Department of Geography, unpublished Ph.D. dissertation, paging unknown.

L

La Barbera, Paolo, and Roth, G., 1994, Invariance and scaling properties in the distributions of contributing area and energy in drainage basins: Hydrological Processes, v. 8, no. 2, p. 125-135.

La Barbera, Paolo, Lanza, L., and Siccardi, F., 1993, Hydrologically oriented GIS and applications to rainfall-runoff distributed modelling—case study of the Arno basin, *in* Kovar, K., and Nachtnebel, H.P., eds., Application of Geographic Information Systems in Hydrology and Water Resources Management (Proceedings of the Vienna Conference, April 1993), International Association of Hydrological Sciences, Publ. no. 211, p. 171-179.

Lam, Nina Siu-Ngan, 1983, Spatial interpolation methods—a review: The American Cartographer, v. 10, no. 2, p. 129-149.

Lam, Nina Siu-Ngan, and De Cola, Lee, 1993b, Fractal measurement, *in* Lam, Nina Siu-Ngan, and De Cola, Lee, eds., Fractals in Geography: Englewood Cliffs, NJ, PTR Prentice-Hall, p. 23-55.

Lam, Nina Siu-Ngan, and De Cola, Lee, 1993c, Fractal simulation and interpolation, *in* Lam, Nina Siu-Ngan, and De Cola, Lee, eds., Fractals in Geography: Englewood Cliffs, NJ, PTR Prentice-Hall, p. 56-74.

Lam, Nina Siu-Ngan, and De Cola, Lee, eds., 1993a, Fractals in Geography: Englewood Cliffs, NJ, PTR Prentice-Hall, 308 p.

Lam, Nina Siu-Ngan, and Qiu, Hong-Lie, 1992, The fractal nature of the Louisiana coast, *in* Janelle, D.J., ed., Geographical Snapshots of North America: New York, Guilford Press, p. 270-274.

Lam, Nina Siu-Ngan, and Quattrochi, D.A., 1992, On the issues of scale, resolution, and fractal analysis in the mapping sciences: The Professional Geographer, v. 44, no. 1, p. 88-98.

Lanyon, L.E., and Hall, G.F., 1983a, Land-surface morphology: 1. Evaluation of a small drainage basin in eastern Ohio: Soil Science, v. 136, no. 5, p. 291-299.

Lanyon, L.E., and Hall, G.F., 1983b, Land-surface morphology: 2. Predicting potential landscape instability in eastern Ohio: Soil Science, v. 136, no. 6, p. 382-386..

Lapen, D.R., and Martz, L.M., 1993, The measurement of two simple topographic indices of wind sheltering-exposure from raster digital elevation models: Computers and Geosciences, v. 19, no. 6, p. 769-779.

Larsgaard, M.L., 1984, Topographic mapping of the Americas, Australia, and New Zealand: Western Association of Map Libraries Occasional Paper, Littleton, CO, Libraries Unlimited, 180 p.

Larsgaard, M.L., 1992, Topographic mapping of Africa, Antarctica, and Eurasia: Western Association of Map Libraries Occasional Paper No. 14, Littleton, CO, Libraries Unlimited, 264 p.

Larson, C.L., 1969, Geometry of broad-based and grassed-backslope terrace cross sections: Transactions of the American Society of Agricultural Engineers, v. 12, no. 4, p. 509-511.

Lavallée, Daniel, Lovejoy, Shaun, Schertzer, Daniel, and Ladoy, Philippe, 1993, Nonlinear variability of landscape topography—multifractal analysis and simulation, *in* Lam, and De Cola, Lee, eds., Fractals in Geography: Englewood Cliffs, NJ, PTR Prentice-Hall, p. 158-192.

Lay, J.-G., 1993, Experiments on errors of digital elevation models: GIS/LIS '93 Conference, Minneapolis, MN, November 2-4, 1993, Proceedings, v. 1, p. 389-397.

Lawton, D.T., Levitt, T.S., McConell, C., and Glicksmann, J., 1987, Terrain models for an autonomous land vehicle, *in* Fischler, M.A., and Firschein, O., eds., Readings in Computer Vision: San Mateo, CA, Morgan Kaufmann Publishers, p. 483-491.

Leberl, F.W., 1993, How to extract topographic information from Magellan radar images, *in* Clark, B.P., et al., eds., State-of-the-art Mapping: International Society for Optical Engineering meeting, Orlando FL, April 13-15, Proceedings, v. 1943, p. 33-44.

Leberl, F.W., Maurice, Kelly, Thomas, J.K., and Millot, Michel, 1994, Automated radar image matching experiment: ISPRS Journal of Photogrammetry and Remote Sensing, v. 49, no. 3, p. 19-33.

Lee, D.R., and Sallee, G.T., 1970, A method of measuring shape: Geographical Review, v. 60, no. 4, p. 555-563.

Lee, Jay, 1991, Analyses of visibility sites on topographic surfaces: International Journal of Geographical Information Systems, v. 5, no. 4, p. 413-429.

Lee, Meemong, and Lorre, Jean, 1994, Generating planetary topography maps: Science Information Systems Newsletter, NASA, Office of Space Science, Issue 32, May, p. 32-36.

Legendre, Pierre, and Fortin, M.-J., 1989, Spatial pattern and ecological analysis: Vegetatio, v. 80, no. –, p. 107-138.

Lewis, J.E., Budkewitsch, P., Newton, G., Sayed, M., and Frederking, R.M.W., 1994, Two-dimensional analysis of ice ridging in the Beaufort Sea using aerial photography: Annals of Glaciology, No. 19, p. 25-32.

Lewis, M., and Smith, D.H., 1993, Optimal predictors for the data compression of digital elevation models using the method of Lagrange multipliers, *in* International Symposium on Computer-Assisted Cartography, 11th, AutoCarto 11, Minneapolis, MN, October 30-November 1: Proceedings, p. 246-256.

Li, Habin, and Reynolds, J.F., 1993, A new contagion index to quantify spatial patterns of landscapes: Landscape Ecology, v. 8, no. 3, p. 155-162.

Li, Zhilin, 1993b, Mathematical models of the accuracy of digital terrain model surfaces linearly constructed from square gridded data: Photogrammetric Record, v. 14, no. 82, p. 661-674.

Li, Zhilin, 1993a, Theoretical models of the accuracy of digital terrain models—an evaluation and some observations: Photogrammetric Record, v. 14, no. 82, p. 651-660.

Li, Zhilin, 1994, A comparative study of the accuracy of digital terrain models (DTMs) based on various data models: ISPRS Journal of Photogrammetry and Remote Sensing, v. 49, no. 1, p. 2-11.

Lin, H.C., Jorgeson, J.D., Richards, D.R., and Martin, W.D., A comprehensive system for surface water and groundwater modeling, *in* Burton, J.S., compiler, Proceedings of the Federal Interagency Workshop on Hydrologic Modeling Demands for the 90's, Fort Collins, CO, June 6-9, 1993: U.S. Geological Survey Water-Resources Investigations Report 93-4018, p. 5-47 to 5-54.

Linke, M., 1968, Bodenerosion und Bodenerosionsgefährdung im östlichen Harz (in German): Mittg. Geograph. Inst. Martin-Luther-Univ., Halle-Wittenberg, v. 10, p. 19-43.

Little, S.A., 1994, Wavelet analysis of seafloor bathymetry—An example, *in* Foufoula-Georgiou, Efi., and Kumar, Praveen, eds., Wavelets in Geophysics: New York, Academic Press, p. 167-182.

Little, S.A., Carter, P.H., and Smith, D.K., 1993, Wavelet analysis of a bathymetric profile reveals anomalous crust: Geophysical Research Letters, v. 20, no. 18, p. 1915-1918.

Liu, Z.J., Naar, D.F., Zhong, X., and Ji, H., 1994, Extracting drainage networks from digital elevation models based on catchment areas (abs.): 1994 Western Pacific Geophysics Meeting, Hong Kong, July 25-29, American Geophysical Union, Eos Supplement, June 21, 1994, p. 28.

Lovejoy, S., 1982, Area-perimeter relation for rain and cloud areas: Science, v. 216, no. 4542, p. 185-187.

M

Mackay, D.S., Robinson, V.B., and Band, L.E., 1992, Classification of higher order topographic objects on digital terrain data: Computers, Environment,and Urban Systems, v. 16, p. 473-496.

MacMillan, R.A., Furley, P.A., and Healy, R.G., 1993, Using hydrological models and geographic information systems to assist with the management of surface water in agricultural landscapes, *in* Haines-Young, Roy, Green, D.R., and Cousins, Steven, eds., Landscape Ecology and Geographic Information Systems: London, Taylor and Francis, 288 p.

Maidment, D.R., 1993, Developing a spatially distributed unit hydrograph by using GIS *in* Kovar, K., and Nachtnebel, H.P., eds., Application of Geographic Information Systems in Hydrology and Water Resources Management (Proceedings of the Vienna Conference, April 1993), International Association of Hydrological Sciences, Publ. no. 211, p. 181-193.

Malinverno, Alberto, 1990, A simple method to estimate the fractal dimension of a self-affine series: Geophysical Research Letters, v. 17, no. 11, p. 1953-1956.

Marchi, Lorenzo, Pasuto, Alessandro, and Tecca, P.R., 1993, Flow processes on alluvial fans in the eastern Italian Alps: Zeitschrift für Geomorphologie, v. 37, no. 4, p. 447-458.

Markus, Bela, 1986, Terrain analysis in consideration of surface curvature conditions: Periodica Polytechnica (Budapest), v. 30, p. 71-81.

Martz, L.W., and Garbrecht, Jurgen, 1993, DEDNM—a software system for the automated extraction of channel network and watershed data from raster digital elevation models, *in* Harlin, J.M., and Lanfear, K.J., eds., 1993, Symposium on Geographic Information Systems and Water Resources, Mobile, AL, March 14-17, 1993: American Water Resources Association, Bethesda, MD, Proceedings, p. 211-220.

Martz, L.W., and Garbrecht, Jurgen, 1993, Automated extraction of drainage network and watershed data from digital elevation models: Water Resources Bulletin, v. 29, no. 6, p. 901-908.

Masek, J.G., and Turcotte, D.L., 1994, Statistical inevitability of Horton's laws and the apparent randomness of stream channel networks—comment: Geology, v. 22, no. 4, p. 380.

Mayer, Larry, 1994, Quantitative analysis of landforms—a way to delineate active tectonic structures: Oxford, OH, Miami University, Department of Geology, Award No. 1493-92-G-

2229 from the U.S. Geological Survey, Annual Technical Report, 48 p.

Mazúr, E., and Mazúrová, A., 1965, Karte der Reliefenergie der Slowakei und ihre Ausnutzung bei der geographischen Rayonirung (in Slovak): Geograficky casopis (Bratislava), No. 1, p. 3-18.

McArthur, D.S., and Hope, A.S., 1993, The role of perimeter shape in estimating annual runoff from small Sierra Nevada basins: Physical Geography, v. 14, no. 4, p. 394-403.

McEwen, R.B., and Jacknow, H.R., 1979, USGS digital cartographic data base, *in* Aangeenbrug, R.T., ed., International Symposium on Cartography and Computing, 4th, AutoCart IV, Reston, VA, November 4-8, 1979, ACSM/ASP, Proceedings, v. 1, p. 225-235.

McGarigal, Kevin, and Marks, B.J., 1994, FRAGSTATS—Spatial pattern analysis program for quantifying landscape structure (version 2.0): Corvallis OR, Forest Science Department, Oregon State University, 141 p.

McKeown, D.M., Jr., Harvey, W.A., Ford, S.J., Cochran, S.D., McGlone, J.C., Gifford, S.J., Polis, M.F., and Shufelt, J.A., 1993, Research in automated analysis of remotely sensed imagery: Image Understanding Workshop, Washington, D.C., April 18-21, 1993, Defense Advanced Research Projects Agency, Proceedings, p. 231-251.

McLean, R., 1967, Plan shape and orientation of beaches along the east coast, South Island: New Zealand Geography, v. 23, no. 1, p. 16-22.

McNab, W.H., 1989, Terrain shape index—quantifying effects of minor landforms on tree height: Forest Science, v. 35, no. --, p. 91-104.

McNab, W.H., 1993, A topographic index to quantify the effect of mesoscale landform on site productivity: Canadian Journal of Forest Research, v. 23, no. --, p. 1100-1107.

Mead, R.A., Sharik, T.L., Prisley, S.P., and Heinen, J.T., 1981, A computerized spatial analysis system for assessing wildlife habitat from vegetation maps: Canadian Journal of Remote Sensing, v. 7, no. 1, p. 34-40.

Merkel, Broder, and Sperling, Barbara, 1993, Raster based modelling of watersheds and flow accumulation, *in* Kovar, K., and Nachtnebel, H.P., eds., Application of Geographic Information Systems in Hydrology and Water Resources Management (Proceedings of the Vienna Conference, April 1993), International Association of Hydrological Sciences, Publ. no. 211, p. 193-199.

Merritts, Dorothy, and Ellis, Michael, 1994, Introduction to special section on tectonics and topography: Journal of Geophysical Research, v. 99, no. B6, p. 12,135-12,141.

Merritts, Dorothy, and Hesterberg, Tim, 1994, Stream networks and long-term surface uplift in the New Madrid Seismic Zone: Science, v. 265, no. 5175, p. 1081-1084.

Meyer, L.D., and Wischmeier, W.H., 1969, Mathematical simulation of the process of soil erosion by water: Transactions of the American Society of Agricultural Engineers, v. 12, no. 6, p. 754-758, & 762.

Miklanek, P., 1994, The application of a simple digital elevation model for the determination of areal evapotranspiration, *in* Seuna, P, Gustard, A., Arnell, N.W., and Cole, G.A., Flow Regimes from International Experimental and Network Data (proceedings of the Braunschweig, Germany, conference; October 11-15, 1993): IAHS Publication No. 221, p. 103-108.

Miller, B., compiler, 1990, Geosoftware—digital elevation models: Geotimes, v. 35, no. 8, p. 28.

Milton, L., 1965, Quantitative expression of drainage net patterns: Australian Journal of Science, v. 27, no. 8, p. 238-240.

Milton, L., 1966, The geomorphic irrelevance of some drainage net laws: Australian Geographical Studies, v. 4, no. 1, p. 89-95. [comment and reply, 1967, v. 5, no. 1, p. 81-83]

Minár, Jozef, 1993, The principles of the elementary geomorphological regionalization: Universitas Comeniana, Univerzita Komenského, Bratislava, Geographica Nr. 33, p. 185-198.

Mitásová, Helena, 1992, New capabilities for interpolation and topographic analysis in GRASS: GRASSclippings, Champaign, Illinois, U.S. Army Corps of Engineers, Construction Engineering Research Laboratory, V. 6, P. 13.

Mitásová, Helena, and Mitás, Lubos, 1993, Interpolation by regularized spline with tension—I, theory and implementation: Mathematical Geology, v. 25, no. 6, p. 641-655.

Mitášová, Helena, and Mitás, Lubos, 1993, Interpolation by regularized spline with tension—II, application to terrain modeling and surface geometric analysis: Mathematical Geology, v. 25, no. 6, p. 657-669.

Montgomery, D.R., 1991, Channel initiation and landscape evolution: University of California, Berkeley, Ph.D. dissertation, 421 p.

Montgomery, D.R., 1994, A physically based model for the topographic control on shallow landsliding: Water Resources Research, v. 30, no. 4, p. 1153-1171.

Montgomery, D.R., 1994, Road surface drainage, channel initiation, and slope instability: Water Resources Research, v. 30, no. 6, p. 1925-1932.

Montgomery, D.R., and Dietrich, W.E., 1994, Landscape dissection and drainage area-slope thresholds, *in* Kirkby, M.J., ed., Process Models and Theoretical Geomorphology: New York, Wiley, p. 221-246.

Montgomery, D.R., and Dietrich, W.E., 1994, A physically based model for the topographic control on shallow landsliding: Water Resources Research, v. 30, no. 4, p. 1153-1171.

Montgomery, D.R., and Foufoula-Georgiou, Efi, 1993, Channel network source representation using digital elevation models: Water Resources Research, v. 29, no. 12, p. 3925-3934.

Moore, I.D., Gallant, J.C., Guerra, L., and Kalma, J.D., 1993, Modelling the spatial variability of hydrological processes using GIS, *in* Kovar, K., and Nachtnebel, H.P., eds., Application of Geographic Information Systems in Hydrology and Water Resources Management (Proceedings of the Vienna Conference, April 1993), International Association of Hydrological Sciences, Publ. no. 211, p. 161-169.

Morin, R.L., 1993, Digital terrain in the Bethel, Russian Mission, and Goodnews Bay 1° X 3° quadrangles, Alaska, including improved terrain for parts of these quadrangles: U.S. Geological Survey, Open-file Report 93-0702-A (9 p.) and B (two 3 1/2 inch DOS diskettes).

Morisita, M., 1959, Measuring the dispersion of individuals and analysis of distributional patterns: Mem. Fac. Sci. Kyushu Univ., Series E (Biology), v. 2, p. 215-235.

Morselli, M.G., Buizza, R., Finardi, S., and Brusasca, G., 1992, ICARO—a package for wind field studies over complex terrain: Environmental Software, v. 7, no. 4, p. 241-254.

Mouginis-Mark, P.J., and Garbeil, Harold, 1993, Digital topography of volcanoes from radar interferometry—an example from Mt. Vesuvius, Italy: Bulletin of Volcanology, v. 55, no. 8, p. 566-570.

Moussa, R., and Bocquillon, C., 1993, Morphologie fractale du réseau hydrographique (in French): Hydrological Sciences Journal, v. 38, no. 3, p. 187-201.

Moussa, R., and Bocquillon, C., 1994, TraPhyC-BV—a hydrologic information system: Environmental Software, v. 9, no. 4, p. 217-226.

Mower, J.E., 1993, Implementing GIS procedures on parallel computers—a case study, *in* International Symposium on Computer-Assisted Cartography, 11th, AutoCarto 11, Minneapolis, MN, October 30-November 1: Proceedings, p. 424-433.

Murray, K.J., 1993, Ordnance Survey explores new heights: The Cartographic Journal, v. 31, no. 1, p. 45-49.

N

Naidu, P.S., and Mathew, M.P., 1994, Correlation filtering—a terrain correction method for aeromagnetic maps with application: Journal of Applied Geophysics, v. 32, nos. 2/3, p. 269-277.

Nair, H., 1988, A high-level description of digital terrain models using visibility information: Troy, NY, Department of Electrical, Computer and System Engineering, Rensselaer Polytechnic Institute, unpublished M.S. thesis, paging unknown.

Nakano, T., 1984, A systematics of "transient fractals" of rias coastline; an example of rias coast from Kamaishi to Shizugawa, Northeastern Japan: University of Tsukuba, Annual Reports of the Institute of Geoscience, v. 10, p. 66-68.

Natural Graphics, 1993, User manual *for* Scenery Animator: P.O. Box 1963, Rocklin, California, 76 p.

[software package for 3-D terrain rendering and animation]

Neel, E.E., Stuttz, S.J., and Tysszka, R.J., 1982, Digital terrain analysis data—a critical element in future tactical C3I: Signal (U.S. Army), March, p. 51-54.

Nelson, E.J., Jones, N.L., and Miller, A.M., 1994, Algorithm for precise drainage-basin delineation: Journal of Hydraulic Engineering (ASCE), v. 120, no. 3, p. 298-312.

Nesje, Atle, and Sulebak, J.R., 1994, Quantification of late Cenozoic erosion and denudation in the Sognefjord basin, western Norway: Norsk Geografisk Tidsskrift, v. 48, no. 3, p. 85-92.

Neumann, Jan, 1976, Digitální model terénu pro území Ceskoslovenska (in Slovak): VUGTK (Praha), 600, 76.

Neumann, Jan, 1994, The topological information content of a map/ an attempt at a rehabilitation of information theory in cartography: Cartographica, v. 31., no. 1, p. 26-34.

Nikora, V.I., 1994, On self-similarity and self-affinity of drainage basins: Water Resources Research, v. 30, no. 1, p. 133-137.

Nikora, V.I., and Sapozhnikov, V.B., 1993, River network fractal geometry and its computer simulation: Water Resources Research, v. 29, no. 10, p. 3569-3575.

Nikora, V.I., Sapozhnikov, V.B., and Noever, D.A., 1993, Fractal geometry of individual river channels and its computer simulation: Water Resources Research, v. 29, no. 10, p. 3561-3568.

Nuorteva, Jouko, 1994, Topographically influenced sedimentation in Quaternary deposits—a detailed acoustic study from the western part of the Gulf of Finland: Geologian Tutkimuskeskus (Geological Survey of Finland), Tutkimusraportti (Report of Investigation) 122, Espoo, 88 p.

O

Oakey, Gordon, 1994, A structural fabric defined by topographic lineaments—Correlation with Tertiary deformation of Ellesmere and Axel Heiberg Islands, Canadian Arctic: Journal of Geophysical Research, v. 99, no. B10, p. 20,311-20,321.

Odeh, I.O.A., McBratney, A.B., and Chittleborough, D.J., 1994, Spatial prediction of soil properties from landform attributes derived from a digital elevation model: Geoderma, v. 63, nos. 3/4, p. 197-214.

Offer, Z.Y., and Goossens, Dirk, 1994, The use of topographic scale models in predicting eolian dust erosion in hilly areas—field verification of a wind tunnel experiment: Catena, v. 22, no. 4, p. 249-263.

Ohmori, Hiroo, 1993, Changes in the hypsometric curve through mountain building resulting from concurrent tectonics and denudation: Geomorphology, v. 8, no. 4, p. 263-277.

Okabe, Atsuyuki, Boots, Barry, and Sugihara, Kokichi, 1992, Spatial Tessellations—concepts and applications of Voronoi diagrams: New York, Wiley, 532 p.

Olsen, E.R., Ramsey, R.D., and Winn, D.S., 1993, A modified fractal dimension as a measure of landscape diversity: Photogrammetric Engineering and Remote Sensing, v. 59, no. 10, p. 1517-1520.

O'Neill, R.V., Krummel, J.R., Gardner, R.H., Sugihara, G., Jackson, B., DeAngelis, D.L., Milne, B.T., Turner, M.G., Zygmunt, B., Christensen, S.W., Dale, V.H., and Graham, R.L., 1988, Indices of landscape pattern: Landscape Ecology, v. 1, no. 3, p. 153-162.

Ongley, E.D., 1970, Determination of rectilinear profile segments by automatic data processing: Zeitschrift für Geomorphologie, Supplementband 14, p. 383-391.

Orange, D.L., Anderson, R.S., and Breen, N.A., 1994, Regular spacing in the submarine environment—the link between hydrology and geomorphology: GSA Today, v. 4, no. 2, p. 29, 36-39.

Overton, D.E., 1969, Eigenvector analysis of geomorphic interrelations of small agricultural watersheds: Transactions of the American Society of Agricultural Engineers, v. 12, no. 4, p. 506-508.

P

Panuska, J.C., Moore, I.D., and Kramer, L.A., 1991, Terrain analysis—integration into the agricultural nonpoint source (AGNPS) pollution model: Journal of Soil and Water Conservation, v. 46, no. 1, p. 59-64.

Parsons, C.L., Walsh, E.J., and Vandermark, D.C., 1994, Topographic mapping using a multibeam radar altimeter: IEEE Transactions on Geoscience and Remote Sensing, v. 32, no. 6, p. 1170-1178.

Paskevich, Valerie, 1993, Rasterizing vector and discrete data with the Woods Hole Image Processing System Software: U.S. Geological Survey, Open-file Report 93-530, 61 p.

Peled, Ammatzia, and Fradkin, Kiril, 1994, Automatic aquisition of hypsographic maps: ASPRS/ACSM Annual Convention and Exposition, Reno NV, April 25-28, ASPRS Technical Papers, v. 2 (American Congress on Surveying and Mapping), p 245-249.

Peltz, L.A., Smith, J.L., and Cartier, K.D., 1994, Slope and aspect classifications of Lake Tahoe basin, California and Nevada: U.S. Geological Survey, Open-file Report 94-105, scale 1:100,000.

Perez, Juan, and Lukes, George, 1994, STOW-E (synthetic theater of war-Europe) combines live, virtual and constructive simulation: Tech-Tran, Alexandria, VA, U.S. Army Corps of Engineers, Topographic Engineering Center, v. 19, no. 1, p. 1, 8-11.

Petrie, Gordon, 1990, Modelling, interpolation and contouring procedures, *in* Petrie, Gordon, and Kennie, T.J.M., eds., Terrain Modelling in Surveying and Civil Engineering: Caithness (UK), Whittles Publ., p. 112-127.

Peucker, T.K., and Johnston, E.G., 1972, Detection of surface-specific points by local parallel processing of discrete terrain elevation data: College Park, Univ. Maryland Computer Science Center, Technical Report 206, paging unknown.

Phillips, J.D., Brian, 1993, Interpreting the fractal dimension of river networks, *in* Lam, Nina Siu-Ngan, and De Cola, Lee, eds., Fractals in Geography: Englewood Cliffs, NJ, PTR Prentice-Hall, p. 142-157.

Phillips, L.F., and Schumm, S.A., 1987, Effect of regional slope on drainage networks: Geology, v. 15, no. 9, p. 813-816.

Piasek, Zbigniew, 1993, Numeryczny model powierzchni spadku—Czesc pierwsza (in Polish: Digital slope surface models—First part): Zeszyty Naukowe Akademii Górniczo-Hutniczej im. Stanislawa Staszica, Geodezja z. 118 (Scientific Bulletins of AGH. Geodesy, B. No. 118; Kraków), p. 61-74.

Pick, H.L., Jr., Yonas, Albert, Gentile, Douglas, Melendez, Patricia, Wagner, Douglas, and Wegesin, Dominick, 1993, Perceptual aspects of navigation: Image Understanding Workshop, Washington, D.C., April 18-21, 1993, Defense Advanced Research Projects Agency, Proceedings, p. 481-483.

Pike, R.J., 1993, Modeling surface processes—issues in tests for equifinality of form by signatures (abs.): Eos, Transactions of the American Geophysical Union, v. 74, no. 43 (Supplement), p. 140.

Pike, R.J., 1993, The scope of modern geomorphometry (abs.): International Geomorphology Conference, 3rd, McMaster Univ., Hamilton, Ont., Canada, August, Programme With Abstracts, p. 221.

Pike, R.J., 1993, Walter F. Wood's geomorphic legacy (abs.): International Geomorphology Conference, 3rd, McMaster Univ., Hamilton, Ont., Canada, August, Programme With Abstracts, p. 221.

Pike, R.J., 1994, A quarter century of DEM research at USGS (abs.): Annual meeting of the Association of American Geographers, 90th, San Francisco, CA, March 29-April 2, Abstracts volume, p. 299-300.

Pike, R.J., Bernknopf, R.L., Tinsley, J.T. III, and Mark, R.K., 1994, Hazard of earthquake-induced lateral-spread ground failure on the central California coast modeled from earth-science map data in a geographic information system: U.S. Geological Survey, Open-file Report 94-662, 46 p.

Pilkey, O.H., Jr., 1994, Mathematical modeling of beach behavior doesn't work: Journal of Geological Education, v. 42, no. 4, p. 358-361

Pilouk, M., and Tempfli, Klaus, 1992, A digital image processing approach to creating DTMs from digitized contours: International Archives of Photogrammetry and Remote Sensing, v. 29, no. B4, p. 956-961.

Pilouk, M., and Tempfli, Klaus, 1993, An integrated DTM-GIS data structure—a relational approach, *in* International Symposium on Computer-Assisted Cartography, 11th, AutoCarto 11, Minneapolis, MN, October 30-November 1: Proceedings, p. 278-287.

Plotnick, R.E., Gardner, R.H., and O'Neill, R.V., 1993, Lacunarity indices as measures of landscape texture: Landscape Ecology, v. 8, no. 3, p. 201-211.

Polis, M.F., and McKeown, D.M., Jr., 1992, Iterative TIN generation from digital elevation models, *in* Proceedings of the DARPA Image Understanding Workshop: San Mateo, CA, Morgan Kaufmann Publishers, p. 885-897.

Polis, M.F., and McKeown, D.M., Jr., 1993, Issues in iterative TIN generation to support large scale simulations, *in* International Symposium on Computer-Assisted Cartography, 11th, AutoCarto 11, Minneapolis, MN, October 30-November 1: Proceedings, p. 267-277.

Power, W.L., Tullis, T.E., Brown, S.R., Boitnott, G.N., and Scholz, 1987, Roughness of natural fault surfaces: Geophysical Research Letters, v. 14, no. 1, p. 29-32.

R

Raggam, J., Almer, A., and Strobl, D., 1994, A combination of SAR and optical line scanner imagery for stereoscopic extraction of 3-D data: ISPRS Journal of Photogrammetry and Remote Sensing, v. 49, no. 4, p. 11-21.

Rastogi, R.A., and Jones, B.A., Jr., 1969, Simulation and hydrologic response of a drainage net of a small agricultural drainage basin: Transactions of the American Society of Agricultural Engineers, v. 12, no. 6, p. 899-908.

Rees, W.G., and Lin, I.-I., 1993, Texture-based classification of cloud and ice-cap surface features: Annals of Glaciology, v. 17, p. 250-254.

Regnauld, H., and Thomas, Y.F., 1990, Analyse numérique de la morphologie du canyon de Nazaré (Marge continentale du Portugal) (in French): Finisterra, v. 25, no. 50, p. 245-260.

Regnauld, H., Chauveau, E., Gouery, P., Louat, R., and Malod, J.A., 1993, Modélisation géomorphologique et implications sédimentaires—une comparaison entre le versant du bassin avant arc de Sumatra et un versant transtensif au large de la Côte d'Ivoire (in French): Bulletin Inst. Géol. Bassin d'Aquitaine, Bordeaux, No. 53, paging unknown (preprint).

Reincke, Leopold, 1916, Average regional slope, a criterion for the subdivision of old erosion surfaces: Journal of Geology, v. 24, no. 1, p. 27-46.

Richter, Hans, 1962, Eine neue Methode der großmaßstäblichen Kartierung des Reliefs (in German): Petermanns geographische Mitteilungen, v. 106, no. 4, p. 309-312.

Rieger, Wolfgang, 1992, Automated river line and catchment area extraction from DEM data: International Congress of the ISPRS, Washington, D.C., Comission IV, 1992, Proceedings, paging unknown.

Rieger, Wolfgang, 1992, Hydrologische Anwendungen des digitalen Geländemodelles (in German; Hydrologic applications of the DEM): Dissertation, The Vienna University of Technology, Austria, paging unknown.

Rieger, Wolfgang, 1993, Hydrological terrain features derived from a pyramid raster structure, *in* Kovar, K., and Nachtnebel, H.P., eds., Application of Geographic Information Systems in Hydrology and Water Resources Management (Proceedings of the Vienna Conference, April 1993), International Association of Hydrological Sciences, Publ. no. 211, p. 201-210.

Rigon, Riccardo, and Rinaldo, Andrea, 1993, Optimal channel networks—a framework for the study of river basin morphology: Water Resources Research, v. 29, no. 6, p. 1635-1646.

Rigon, Riccardo, Rinaldo, Andrea, and Rodriguez-Iturbe, Ignacio, 1994, On landscape self-organization: Journal of Geophysical Research, v. 99, no. B6, p. 11,971-11,993.

Riley, Christopher, and Moore, J.McM., 1993, Digital elevation modelling in a study of the neotectonic geomorphology of the Sierra Nevada, southern Spain: Zeitschrift für Geomorphologie, Supplementband 94, p. 25-39.

Ritchie, J.C., Grissinger, E.H., Murphey, J.B., and Garbrecht, J.D., 1994, Measuring channel and gully cross-sections with an airborne laser altimeter: Hydrological Processes, v. 8, no. 3, p. 237-243.

Ritchie, J.C., Jackson, T.J., Garbrecht, J.D., Grissinger, E.H., Murphey, J.B., Everitt, J.H., Escobar, D.E.,, Davis, M.R., and Weltz, M.A., 1993, Studies using an airborne laser altimeter to measure landscape properties: Journal of Hydrological Sciences, v. 38, no. 5, p. 403-416.

Ritter, Paul, 1986, A computationally simple slope and aspect generation algorithm, *in* American Society for Photogrammetry and Remote Sensing, Fall convention, Anchorage, Alaska, Technical Papers, p. 72-76.

Roach, D.E., and Fowler, A.D., 1993, Dimensionality analysis of patterns—fractal measurements: Computers and Geosciences, v. 19, no. 6, p. 849-869.

Roach, D.E., Fowler, A.D., and Fyson, W.K., 1993, Fractal fingerprinting of joint and shatter-cone surfaces: Geology, v. 21, no. 8, p. 759-762.

Robert, André, and Roy, A.G., 1990, On the fractal interpretation of the mainstream length-drainage area relationship: Water Resources Research, v. 26, no. 5, p. 839-842.

Robert, André, and Roy, A.G., 1993, La modélisation fractale et la varibilité spatiale des phénomènes naturels (in French): Géographie Physique et Quaternaire (Montreal, Canada), v. 47, no. 1, p. 3-19.

Roberts, P.O., and Suhrbier, S.H., 1962, DTM location system, 20k program manual: Cambridge, MA, Massachusetts Institute of Technology, Department of Civil Engineering, Research Report R 62-8, paging unknown.

Robinove, C.J., 1986, Spatial diversity index mapping of classes in grid cell maps: Photogrammetric Engineering and Remote Sensing, v. 52, no. 8, Part 1, p. 1171-1173.

Robinson, G., 1967, The geomorphic irrelevance of some drainage net laws—comment: Australian Geographical; Studies, v. 5, no. 1, p. 81-82.

Robinson, G.J., 1994, The accuracy of digital elevation models derived from digitised contour data: Photogrammetric Record, v. 14, no. 83, p. 805-814.

Rodriguez-Iturbe, Ignacio, Marani, Marco, Rigon, Riccardo, and Rinaldo, Andrea, 1994, Self-organized river basin landscapes—fractal and multifractal characteristics: Water Resources Research, v. 30, no. 12, p. 3531-3539.

Romanowicz, Renata, Beven, Keith, and Freer, Jim, 1993, TOPMODEL as an application module within WIS, *in* Kovar, K., and Nachtnebel, H.P., eds., Application of Geographic Information Systems in Hydrology and Water Resources Management (Proceedings of the Vienna Conference, April 1993), International Association of Hydrological Sciences, Publ. no. 211, p. 211-223.

Romero Díaz, M.A., and López Bermúdez, F., 1987, Morfometría de redes fluviales—revisíon crítica de los parámetros más utilizados y aplicación al alto Guadalquivir (in Spanish): Papales de Geografía (Física), v. 12, p. 47-62.

Rosgen, D.L., 1994, A classification of natural rivers: Catena, v. 22, no. 3, p. 169-199.

Roushannejad, A.A., 1993, Mathematical morphology in automatically deriving skeleton lines from digitized contours: ITC, Enschede, Netherlands, M.Sc. thesis, paging unknown.

Roy, A.G., 1983, Optimal angular geometry models of river branching: Geographical Analysis, v. 15, no. 2, p. 87-96.

Roy, A.G., 1985, Optimal models of river branching angles, *in* Woldenberg, M.J., ed., Models in Geomorphology, Binghamton Symposia in Geomorphology 14: London, George Allen Unwin, p. 269-285.

Roy, A.G., and Roy, René, 1988, Changes in channel size at river confluences with coarse bed material: Earth Surface Processes and Landforms, v. 13, no. 1, p. 77-84.

Roy, A.G., and Woldenberg, M.J., 1986, A model for changes in channel form at a river confluence: Journal of Geology, v. 94, no. 3, p. 402-411.

S

Sagar, Daya, and Rao, Prakasa, 1993, Usage of fractals in drainage environment, *in* Clark, B.P., et al., eds., 1993, State-of-the-art Mapping:

International Society for Optical Engineering meeting, Orlando FL, April 13-15, Proceedings, v. 1943, p. 368-374.

Saleh, Ali, 1993, Soil roughness measurement—chain method: Journal of Soil and Water Conservation, v. 48, no. 6, p. 527-529.

Saunderson, H.C., 1994, Multiquadric surfaces in C: Computers and Geosciences, v. 20, no. 7/8, p. 1103-1122.

Savory, D.J., Ventura, S.J., Scarpace, F.L., McSweeney, Kevin, and Usery, E.L., 1993, Digital terrain classification via scale-sensitive edge detection—automated delineation of soil-landscape units (abs.): American Congress on Surveying and Mapping—American Society for Photogrammetry and Remote Sensing, annual convention, New Orleans, LA, February 15-18, 1993, Technical Papers, v. 2, p. 324-325.

Scarlatos, L.L., and Pavlidis, Theo, 1992, Optimizing triangulations by curvature equalization, *in* Kaufman, A.E., and Nielson, G.M., eds., Visualization '92, Boston, MA, October 19-23, 1992, Proceedings: IEEE Computer Society Press, p. 333-339.

Scarlatos, L.L., and Pavlidis, Theo, 1993, Real-time manipulation of 3D terrain surfaces: American Congress on Surveying and Mapping—American Society for Photogrammetry and Remote Sensing, annual convention, New Orleans, LA, February 15-18, 1993, Technical Papers, v. 3, p. 331-339.

Scarlatos, L.L., and Pavlidis, Theo, 1993, Techniques for merging raster and vector features with 3D terrain models in real time: American Congress on Surveying and Mapping—American Society for Photogrammetry and Remote Sensing, annual convention, New Orleans, LA, February 15-18, 1993, Technical Papers, v. 1, p. 372-381.

Schaake, J.C., Ragan, R.M., and Van Blargan, E.J. 1993, GIS structure for the Nile River forecast project, *in* Kovar, K., and Nachtnebel, H.P., eds., Application of Geographic Information Systems in Hydrology and Water Resources Management (Proceedings of the Vienna Conference, April 1993), International Association of Hydrological Sciences, Publ. no. 211, p. 427-431.

Schaber, G.G., and Berlin, G.L., 1993, Death Valley, California—surface micro-relief statistics and radar scatterometer data: U.S. Geological Survey, Open-file Report 93-272, 232 p.

Schlatter, T.W., and Benjamin, S.G., 1994, A mesoscale data assimilation system adapted for trajectory calculations over Alaska, *in* Casadevall, T.J., ed., Volcanic ash and aviation safety—Proceedings of the first International Symposium on Volcanic Ash and Aviation Safety: U.S. Geological Survey, Bulletin 2047, p. 269-275.

Scholz, E., 1968, Topographische Karten als Hilfsmittel für physisch-geographische Untersuchungen, *in* Arbeitsmethoden in der physischen Geographie: Berlin, p. 17-57.

Seko, Katsumoto, Furukawa, Teruo, Nishio, Fumihiko, and Watanabe, Okitsugu, 1993, Undulating topography on the Antarctic ice sheet revealed by NOAA AVHRR images: Annals of Glaciology, v. 17, p. 55-62.

Shannon, C.E., and Weaver, W., 1962, The Mathematical Theory of Communication: Urbana, University of Illinois Press, 125 p.

Sharpton, V.L., 1994, Evidence from Magellan for unexpectedly deep complex craters on Venus, *in* Dressler, B.O., Grieve, R.A.F., and Sharpton, V.L., eds., Large Meteorite Impacts and Planetary Evolution: Boulder, CO, Geological Society of America Special Paper 293, p. 19-27.

Shearer, J.W., 1990, The accuracy of digital terrain models, *in* Petrie, Gordon, and Kennie, T.J.M., eds., Terrain Modelling in Surveying and Civil Engineering: Caithness (UK), Whittles Publ., p. 315-336.

Shelton, C.H., and Sewell, J.I., 1969, Parameter screening for watershed analysis: Transactions of the American Society of Agricultural Engineers, v. 12, no. 4, p. 533-536, & 539.

Shimazu, Hiroshi, 1994, Segmentation of Japanese mountain rivers and its causes based on gravel transport processes: Transactions, Japanese Geomorphological Union, v. 15, no. 2, p. 111-128.

Short, N.M., Jr., and seven others, 1994, AI challenges within NASA's Mission to Planet Earth, *in* Workshop for AI Technologies for Environmental Applications, in the 1994 National Conference on Artificial Intelligence, AAAI, Seattle WA, July 31-August 4: Proceedings, p. 1-15.

Shoshany, Maxim, Inbar, Moshe, Begin, Z.B., and Hall, J.K., 1993, Analysis of facet and regional structure relationships in determining digital terrain model (DTM) grid density: Israel Journal of Earth Science, v. 41, nos. 2-4, p. 217-225.

Siegburg, Werner, 1994, The relationship between altitude and relief intensity in high mountain drainage basins: Zeitschrift für Geomorphologie, v. 38, no. 1, p. 59-73.

Smart, J.S., 1978, The analysis of drainage network composition: Earth Surface Proceses, v. 3, no. 2, p. 129-170.

Smart, J.S., and Surkan, J., 1967, The relation between mainstrean length and area in drainage basins: Water Resoirces Research, v. 3, no. 4, p. 963-974.

Smith, D.H., and Lewis, Michael, 1994, Optimal predictors for compression of digital elevation models: Computers and Geosciences, v. 20, no. 7/8, p. 1137-1141.

Smith, W.H.F., 1993, On the accuracy of digital bathymetric data: Journal of Geophysical Research, v. 98, no. B6, p. 9591-9603.

Snell, J.D., and Sivapalan, Murugesu, 1994, On geomorphological dispersion in natural catchments and the geomorphological unit hydrograph: Water Resources Research, v. 30, no. 7, p. 2311-2323.

Snell, J.D., and Sivapalan, Murugesu, 1994, Threshold effects in geomorphological parameters extracted from DEM's: Transactions, Japanese Geomorphological Union, v. 15-A, p. 67-93.

Sonntag, Karl, 1932, Studien über de hypsographische Kurve: Leipzig, paging unknown.

Sorensen, P.A., and Lanter, D.P., 1993, Two algorithms for determining partial visibility and reducing data structure induced error in viewshed analysis: Photogrammetric Engineering and Remote Sensing, v. 59, no. 7, p. 1149-1160.

Sornette, Didier, and Zhang, Yi-Cheng, 1993, Non-linear Langevin model of geomorphic erosion processes: Geophysical Journal International, v. 113, no. 2, p. 382-386.

Souriot, Thierry, 1993, Cinematique de l'Extension post-Pliocene en Afar—Imagerie SPOT et modélisation analogique (in French): Université de Rennes, Mémoires de Géosciences Rennes, No. 50, 225 p.

Spiridonov, A.J., 1935, Sur les cartes d'énergie du relief (in French): Izvestya Gosud. Geogr, Obsch. (USSR), p. 607-610.

Steiner, Alfred, 1939, Morphometrische Studien unter besonderer Berücksichtigung des Aargauer Jura, Dissertation, Univ. Zürich, 83 p.

Stone, R.O., 1963, Quantitative expression of microgeometry, *in* Military Evaluation of Geographic Areas reports on activities to April 1963: Vicksburg, Mississippi, U.S. Army Corps of Engineers Waterways Experiment Station, Miscellaneous Paper No. 3-610, p. 9-14.

Strawbridge, Fiona, and Laxon, Seymour, 1994, ERS-1 Altimeter fast delivery data quality flagging over land: Geophysical Research Letters, v. 21, no. 18, p. 1995-1998.

Sugai, Toshihiko, Ohmori, Hiroo, and Hirano, Masashige, 1994, Rock control on magnitude-frequency distribution of landslide: Transactions, Japanese Geomorphological Union, v. 15, no. 3, p. 233-251.

Summerfield, M.A., and Hulton, N.J., 1994, Natural controls of fluvial denudation rates in major world drainage basins: Journal of Geophysical Research, v. 99, no. B7, p. 13,871-14,883.

Sun, T., Meakin, P., and Jøssang, 1994, The topography of optimal drainage basins: Water Resources Research, v. 30, no. 9, p. 2599-2610.

Sung, Quocheng, and Tsaan, David, 1992, Fractal dimension of topographic surface of Taiwan and its geomorphic implications: Journal of the Geological Society of China, v. 35, no. 4, p. 389-406.

Sweeney, T.L., Fread, D.L., and Georgakakos, K.P., 1993, GIS application for NWS (National Weather Service) flash flood guidance model, *in* Burton, J.S., compiler, Proceedings of the Federal Interagency Workshop on Hydrologic Modeling Demands for the 90's, Fort Collins, CO, June 6-9, 1993: U.S. Geological Survey Water-Resources Investigations Report 93-4018, p. 5-94 to 5-101.

T

Tachikawa, Yasuto, Shiiba, Michiharu, and Takasao, Takuma, 1993, Development of a basin geomorphic information system using a TIN-DEM data structure, *in* Harlin, J.M., and Lanfear, K.J., eds., 1993, Symposium on Geographic Information Systems and Water Resources, Mobile, AL, March 14-17, 1993: American Water Resources Association, Bethesda, MD, Proceedings, 163-172.

Tachikawa, Yasuto, Shiiba, Michiharu, and Takasao, Takuma, 1994, Development of a basin geomorphic information system using a TIN-DEM data structure: Water Resources Bulletin, v. 30, no. 1, p. 9-17.

Takara, K., and Takasao, Takuma, 1991, Fractal dimensions of river basins based on digital terrain maps: Proceedings of Hydraulic Engineering, Japan Society of Civil Engineers, v. 35, p. 135-142.

Takasao, Takuma, and Takara, K., 1991, A basic analysis of geomorphologic features of drainage basins and channel networks based on the digital national land information: Annals of the Disaster Prevention Research Institute, Kyoto Unbiversity, no. 32, B-2, p. 435-454.

Tempfli, Klaus 1992, DTM and differential modelling, *in* Proceedings of the ISPRS and OEEPE Joint Workshop on Updating Data by Photogrammetric Methods: Oxford, European Organisation for Experimental Photogrammetric Research (OEEPE) Publication No. 27, p. 193-200.

Thiessen, R.L., Rieken, E.R., and Neves, D.S., 1992, The use of stream drainage networks in a GIS program package for the delineation of geologic faults and fractures, *in* O'Reilly, Donal, ed., Annual GIS Symposium, 6th, GIS'92, Forestry Canada FRDA Report 173, p. D2:1-11.

Thiessen, R.L., Soofi, Khalid, and Sheline, Hans, 1994?, A new, expandable detector applied to digital topography and TM image data in support of petroleum exploration: Photogrammetric Engineering and Remote Sensing, in-press.

Thompson, W.B., Henderson, T.C., Colvin, T.L., Dick, L.B., and Valiquette, C.M., 1993, Vision-based localization: Image Understanding Workshop, Washington, D.C., April 18-21, 1993, Defense Advanced Research Projects Agency, Proceedings, p. 491-498.

Thomson, J.W., and Cooper, A.P.R., 1993, The SCAR Antarctic digital topographic database: Antarctic Science, v. 5, no. 3, p. 239-244.

Thornhill, G.D., Rothery, D.A., Murray, J.B., Cook, A.C., Day, T., Muller, J.P., and Iliffe, J.C., 1993, Topography of Apollinaris Patera and Ma'adim Vallis—automated extravtion of digital elevation models: Journal of Geophysical Research, v. 98, no. E12, p. 23,581-23,587.

Troutman, B.M., and Karlinger, M.R., 1994, Inference for a generalized Gibbsian distribution on channel networks: Water Resources Research, v. 30, no. 7, p. 2325-2338.

Troutman, B.M., and Karlinger, M.R., 1994, Statistical inevitability of Horton's laws and the apparent randomness of stream channel networks—comment: Geology, v. 22, no. 6, p. 573-574.

Tsai, V.J.D., 1993, Fast topological construction of Delaunay triangulations and Voronoi diagrams: Computers and Geosciences, v. 19, no. 10, p. 1463-1474.

Tuladhar, A., and Makarovic, Branko, 1988, Digital terrain models (DTM) from contour lines upgraded by photogrammetric selective sampling: International Archives of Photogrammetry and Remote Sensing, v. 27, no. B8, p. 94-103.

Turcotte, D.L., 1992, Fractals and chaos in geology and geophysics: Cambridge University Press, UK, 221 p.

Turcotte, D.L., 1994, Fractal aspects of geomorphic and stratigraphic processes: GSA Today, v. 4, no. 8, p. 201, 211-213.

Turner, M.G., O'Neill, R.V., Krummel, J.R., Gardner, R.H., and Milne, B.T., 1989, Effects of changing spatial scale on analysis of landscape pattern: Landscape Ecology, v. 4, no. 1, p. 21-30.

Turner, M.G., and Gardner, R.H., 1991, Quantitative methods in landscape ecology—an introduction, in Turner, M.G., and Gardner, R.H., eds., Quantitative Methods in Landscape Ecology, the analysis and interpretation of landscape heterogeneity: New York, Springer-Verlag, Ecological Studies Series, p. 3-14.

Geophysical Research Letters, v. 20, no. 19, p. 2139-2141.

U

U.S. Army, 1963, Military Evaluation of Geographic Areas (MEGA)—reports on activities to April 1963: presentations at meeting of the Board of Consultants, Project 1-T-0-25001-A-131, 17-18, 1963, Vicksburg, Miss., U.S. Army Corps of Engineers Waterways Experiment Station, Miscellaneous Paper No. 3-610, 237 p.

U.S. Army, 1993, Relief of southern Somalia: Fort Belvoir, VA, U.S. Army Topographic Engineering Center, scale 1:2,000,000.

U.S. Geological Survey, 1992, Standards for Digital Elevation Models: National Mapping Division, National Mapping Program, Technical Instructions, 77 p.

U.S. NGDC, 1993, Global relief CD-ROM data set (NOAA data announcement 93-MGG-01): National Geophysical Data Center, National Oceanic and Atmospheric Administration, Boulder, CO, one disc. [five gridded topographic data sets: ETOPO5, Old Topo, FNOC, USGS, and NOSEEZ]

V

Van Blargan, E.J., Ragan, R.M., and Schaake, J.C., 1990, Hydrologic geographic information system: Transportation Research Record, No. 1261, p. 44-51.

Van Deursen, W.P.A., and Kwadijk, J.C.J., 1993, RHINEFLOW—an integrated GIS water balance model for the river Rhine, *in* Kovar, K., and Nachtnebel, H.P., eds., Application of Geographic Information Systems in Hydrology and Water Resources Management (Proceedings of the Vienna Conference, April 1993), International Association of Hydrological Sciences, Publ. no. 211, p. 507-519.

Van Westen, C.J., 1993, Training package for geographic information systems in slope instability zonation (GISSIZ): Enschede, Netherlands, International Institute for Aerospace Survey and Earth Sciences, ITC Publication No. 15, v. 1, Theory, 245 p.

Vergne, Maxime, and Souriau, Marc, 1993, Quantifying the transition between tectonic trend and meso-scale texture in topographic data: Geophysical Research Letters, v. 20, no. 19, p. 2139-2141.

Vening Meinesz, F.A., 1951, A remarkable feature of the Earth's topography: Proc. K. Ned. Akad. Wet., Series B Phys. Sci., v. 54, p. 212-228.

Volkov, N.M., 1950, Printsipy i metody cartometrii (in Russian: Fundamentals and methods of Cartometry): Moscow, paging unknown.

Vortman, L.J., 1958, Earth moving with nuclear explosives, *in* Zodtner, Harlan, ed., Industrial Uses of Nuclear Explosives: Plowshare Series, Report No. 1, Livermore, CA, University of California Radiation Laboratory, Publication UCRL-5253, p. 42-70.

W

Wagner, Hermann, 1904, Orometrie des ostfälischen Hügellandes links der Leine (in German): Diss. ersch. *in* Kirchhoff, A., ed., Forschungen zür. deutschen Landes- und Volkskde., v. 15, Stuttgart, p. 296-344.

Walton, D.J., and Meek, D.S., 1993, Interpolation by cubic segments with no local curvature maxima: Cartographica, v. 30, no. 4, p. 45-49.

Webster, Richard, and Oliver, M.A., 1990, Statistical methods in soil and land resource survey: Oxford University Press, UK, 316 p.

Weibel, Robert, 1993, On the integration of digital terrain and surface modeling into geographic information systems, *in* International Symposium on Computer-Assisted Cartography, 11th, AutoCarto 11, Minneapolis, MN, October 30-November 1: Proceedings, p. 257-266.

Weissel, J.K., Pratson, L.F., and Malinverno, Alberto, 1994, The length-scaling properties of topography: Journal of Geophysical Research, v. 99, no. B7, p. 13,997-14,012.

Wells, A.J., and Chisholm, N.W.T., 1993, Effects of slope morphology on airborne multispectral scanner data: ISPRS Journal of Photogrammetry and Remote Sensing, v. 48, no. 3, p. 32-40.

Wendell, L.L., Gower, G.L., Birn, M.B., and Castellano, C.C., 1993, Applicability of digital terrain analyses to wind energy prospecting and siting, *in* Windpower '93 Conference, San

Francisco, CA, July 12-16, 1993, American Wind Energy Association, Proceedings, in press.

Werner, Christian, 1993, Ridge/channel path interdependence in drainage basins: Geografiska Annaler, v. 75A, no. 3, p. 73-81.

Werner, Christian, 1994, Explorations into the formal structure of drainage basins: Earth Surface Processes and Landforms, v. 19, no. 8, p. 747-762.

White, Marvin, 1979, A survey of the mathematics of maps, *in* Aangeenbrug, R.T., ed., International Symposium on Cartography and Computing, 4th, AutoCarto IV, Reston, VA, November 4-8, 1979, ACSM/ASP, Proceedings, v. 1, p. 82-96.

Wigmosta, M.S., Vail, L.W., and Lettemaier, D.P., 1994, A distributed hydrology-vegetation model for complex terrain: Water Resources Research, v. 30, no. 6, p. 1665-1679.

Willgoose, Garry, 1994 A physical explanation for an observed area-slope-elevation relationship for catchments with declining relief: Water Resources Research, v. 30, no. 2, p. 151-159.

Willgoose, Garry, 1994, A statistic for testing the elevation characteristics of landscape simulation models: Journal of Geophysical Research, v. 99, no. B7, p. 13,997-14,012.

Williams, P.W., 1966, Morphometric analysis of temperate karst landforms: Irish Speleology, v. 1, no. 1, p. 23-31.

Wilson, B.N., 1993, Small-scale link characteristics and applications to erosion modeling: Transactions of the American Society of Agricultural Engineers, v. 36, no. 6, p. 1761-1770.

Wolf, G.W., 1990, Metric surface networks, *in* International Symposium on Spatial Data Handling, 4th, Zürich, Switzerland, July 23-27: 1990, Proceedings, v. --, p. 844-856.

Wolff, R.S., and Yaeger, Larry, 1993, Visualization of Natural Phenonema: New York, TELOS: Springer-Verlag, 374 p. [includes CD-ROM]

Wolock, D.M., 1993, Simulating the variable-source-area concept of streamflow generation with the watershed model TOPMODEL: U.S. Geological Survey, Water-Resources Investigations Report 93-4124, 33 p.

Wolock, D.M., 1993, TOPMODEL, a topography-based watershed model, *in* Burton, J.S., compiler, Proceedings of the Federal Interagency Workshop on Hydrologic Modeling Demands for the 90's, Fort Collins, CO, June 6-9, 1993: U.S. Geological Survey Water-Resources Investigations Report 93-4018, p. 8-50 to 8-57.

Wolock, D.M., and Price, C.V., 1994, Effects of digital elevation model map scale and data resolution on a topography-based watershed model: Water Resources Research, v. 30, no. 11, p. 3041-3052.

Wood, W.F., 1970, Lunar roving vehicle mobility inferred from maps and photographs, *in* Off-road Mobility Symposium, 7th, November 3-4, 1970, Los Angeles, CA, International Society for Terrain-Vehicle Systems and TRW Systems Group: Proceedings, p. 129-148.

Wright, J.R., and Hsieh, J.C.L., 1992, A voxel-based, forward projection algorithm for rendering surface and volumetric data, *in* Kaufman, A.E., and Nielson, G.M., eds., Visualization '92, Boston, MA, October 19-23, 1992, Proceedings: IEEE Computer Society Press, p. 340-348.

Wu, Lun, Wang, Nailang, Han, Mukang, Ren, Fuhu, and Chen, Youcai, 1993, Methods and applications of a geomorphological GIS—a case study in the Ordos region of China: ISPRS Journal of Photogrammetry and Remote Sensing, v. 48, no. 6, p. 38-45.

XYZ

Xu, Tingbao, Moore, I.D., and Gallant, J.C., 1993, Fractals, fractal dimensions and landscapes—a review: Geomorphology, v. 8, no. 4, p. 245-262.

Yen, H.-Y., Yeh, Y.-H., and Chen, C.-H., 1994, Gravity terrain corrections of Taiwan: Terrestrial, Atmospheric and Oceanic Sciences, v. 5, no. 1, p. 1-10.

Zebker, H.A., and Goldstein, R.M., 1986, Topographic mapping from interferometric synthetic aperture radar observations: Journal of Geophysical Research, v. 91, no. B5, p. 4993-4999.

Zebker, H.A., Werner, C.L., Rosen, P.A., and Hensley, Scott, 1994, Accuracy of topographic maps derived from ERS-1 interferometric radar: IEEE

Transactions on Geoscience and Remote Sensing, v. 32, no. 4, p. 823-836.

Zhang, Weihua, and Montgomery, D.R., 1994, Digital elevation model grid size, landscape representation, and hydrologic simulations: Water Resources Research, v. 30, no. 4, p. 1019-1028.

CORRECTIONS

Ahuja, Narendra, and Schachter, B.J., 1983, Pattern Models: New York, Wiley, 309 p.

Bocharov, M.K., and Nikolayev, S.A., 1957, Matematiko-statisticheskiye metody v kartografii (in Russian; Methods of Mathematical Statistics in Cartography; 227-page translation): Moscow, Publishing House of Geodetic Literature, 158 p.

Burrough, P.A., 1984, The application of fractal ideas to geophysical phenomena: Bulletin of the Institute of Mathematics and its Applications, v. 20, no. 3-4, p. 36-42.

Cholnoky, Jeno, 1938, On slopes: Bull. Int'l. de la Soc. Hongroise de Geogr. (International Review of the Hungarian Geographical Society), v. 66, p. 77-89.

Clarke, K.C., 1993, One thousand Mount Everests?, *in* Lam, Nin Siu-Ngam, and De Cola, Lee, eds., Fractals in Geography: Englewood Cliffs, NJ, PTR Prentice-Hall, p. 265-281.

Cressie, Noel, 1993, Statistics for Spatial Data (revised edition): New York, Wiley, 900 p.

Einstein, Albert, 1926, Über die Ursachen der Mäanderbildung der Flusse und des Baer'schen Gesetzes (The cause of the formation of meanders in the courses of rivers and of the so-called Baer's law: Naturwissenschaften, v. 14, p. 223-225.

Ellen, S.D., Mark, R.K., Cannon, S.H., and Knifong, D.L., 1993, Map of debris-flow hazard in the Honolulu District of Oahu, Hawaii: U.S. Geological Survey Open-file report OF 93-0213, scale 1:30,000, 28 p.

Environmental Systems Research Institute, (ESRI) Inc., 1993, Understanding GIS, the ARC/INFO method: Redlands, CA, ESRI, 480 p. (workstation version 6.0), and 525 p. (PC version).

Graff, L.H., and Usery, E.L., 1993, Automated classification of generic terrain features in Digital elevation models: Photogrammetric Engineering and Remote Sensing, v. 59, no. 9, p. 1409-1417.

Haralick, R.M., Watson, L.T., and Laffey, T.J., 1983, The topographic primal sketch: International Journal of Robotics Research, v. 2, no. 1, p. 50-72. [reprinted *in* Kasturi, R., and Jain, R.C., 1991, p. 195-217.]

Helmlinger, K.R., Kumar, Praveen, and Foufoula-Georgiou, Efi, 1993, On the use of DEM data for Hortonian and fractal analyses of channel networks: Water Resources Research, v. 29, no. 8, p. 2599-2613.

Hsu, Shin-Yi, 1978, Texture analysis—a cartographic approach and its applications in pattern recognition: The Canadian Cartographer, v. 15, no. 2, p. 151-166.

Kobashi, Sumiji, and Hirano, Masashige, 1985, Sabo-engineering and geomorphic information—data base for controlling disasters on Rokko Mountains, Japan (in Japanese with English abstract and figure captions): Transactions, Japanese Geomorphological Union, v. 6., no. 3, p. 205-224.

Kobashi, Sumiji, and Hirano, Masashige, 1985, Data-base for controlling disasters on Rokko Mountain region, *in* International Symposium on Erosion, Debris Flow and Disaster Prevention, September 3-5, 1985, Tsukuba, Japan: Proceedings, p. 463-468.

Krcho,, Jozef, 1964, Morphometric analysis of the slope conditions of the Kosice Basin (in Slovak): Bratislava, Acta Geol. et Geogr. Univ. Com., Geographica, No. 4, p. 23-44.

Matsuda, H., 1980, Digital national land information (on Japan): GeoJournal, v. 4, no. 4, p. 313-318.

Milne, B.T., 1988, Measuring the fractal geometry of landscapes: Applied Mathematics and Computation (UK), v. 27, p. 67-79.

Mitchell, C.W., 1991, Terrain Evaluation, an introductory handbook to the history, principles, and methods of practical terrain assessment (2nd edition): New York, Halsted Press (Wiley), 441 p.

Montgomery, D.R., and Foufoula-Georgiou, Efi, 1993, Channel network source representation from digital elevation models (abs.): Eos Transactions of the American Geophysical Union, v. 74, no. 16 (Supplement), p. 152.

Riazanoff, Serge, Julien, P., Cerville, Bernard, and Chorowicz, Jean, 1992, Extraction et analyse automatiques d'un réseau hiérachisé de talwegs—Application à un modèle numérique de terrain dérivé d'un couple stéreoscopique SPOT (in French): International Journal of Remote Sensing, v. 13, no. 2, p. 337-364.

Richardson, L.F., 1961, The problem of contiguity, *an appendix to* Wright, Quincy, and Lienau, C.C., eds., The statistics of deadly quarrels: Pittsburgh, Boxwood Press, 373 p. [reprinted 1961, *in* Rapaport, Anatol, von Bertalanfy, Ludwig, and Meier, R., eds., General Systems: Yearbook of the Society for General Systems Research, v. 6, p. 139-187.

Scholz, E., and Kudrnovská, O., 1972, The construction of morphographic and morphometric maps, *in* Demek, Jaromir, ed., and Embleton, C., Gellert, J.F., and Verstappen, H.Th., co-eds., Manual of Detailed Geomorphological Mapping: International Geographical Union Commission on Geomorphological Surveying and Mapping, Prague, Academia Press, sect. 5.2.3, p. 50-74.

Sonklar, K.A. von, 1873, Allgemeine Orographie, die Lehre von den Reliefformen der Erdoberfläche (in German), Vienna, W. Braumüller, 254 p.

U.S. Defense Mapping Agency, 1994, Digitizing the Future, 4th ed.: Fairfax, VA, Defense Mapping Agency, DMA stock No. DDIPDIGITALPAC, 131 p. [catalog of summary information on DMA digital data and related subjects]

Young, Anthony, 1971, Slope profile analysis—the system of best units, *in* Brunsden, Denys, ed., Slopes, Form and Process: Institute of British Geographers Special Publication no. 3, p. 1-13.