

UNIVERSIDAD DE CANTABRIA



Facultad de Ciencias

DEPARTAMENTO DE CIENCIAS DE LA TIERRA Y
FÍSICA DE LA MATERIA CONDENSADA

TESIS DOCTORAL

**Desarrollo, aplicación y validación de
procedimientos y modelos para la evaluación
de amenazas, vulnerabilidad y riesgo debidos a
procesos geomorfológicos**

MEMORIA PRESENTADA POR

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PARA OPTAR AL GRADO DE DOCTOR POR LA
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BIBLIOGRAFIA



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- Alcántara-Ayala, I.**, 2002. Geomorphology, natural hazards, vulnerability and prevention of natural disasters in developing countries. *Geomorphology* 47, 107-124.
- Alcántara-Ayala, I.**, 2004. Hazard assessment of rainfall-induced landsliding in Mexico, *Geomorphology* 61 (1-2), 19-40.
- Aleotti, P., Chowdhury, R.**, 1999. Landslide hazard assessment: summary review and new perspectives. *Bulletin of Engineering Geology and the Environment* 58, 21-44.
- Aleotti, P., Balzelli, P. and De Marchi, D.**, 1996. Le reti neurali nella valutazione della suscettibilità da frana. *Geologia Tecnica & Ambientale* 5 (4), 37-47.
- Alexander, D.**, 1993. *Natural Disasters*. University College London Press, Londres.
- Araña, V., Badiola, E.R., Berga, L., Carracedo, J.C., Cendrero, A., Coello, J., Corominas, J., Dabrio, C., Díaz de Terán, J.R., Durán, J.J., Elízaga, E., Ferrer, M., García, M., Garzón, M.G., Goy, J.L., López, J., Martínez-Goytre, J. Mezcua, J., de la Nuez, J., Salinas, J.L., Soler, V., del Val, J., Zazo, C.**, 1992. Riesgos geológicos en España. Estado de la cuestión. III Congreso Geológico de España y VIII Congreso Latinoamericano de Geología, Tomo 2, 671-745.
- Archetti, R., Lamberti, A.**, 2003. Assessment of risk due to debris flow events. *Natural Hazards Review* 4 (3), 115-125.
- Ayala, F.J.**, 1993. Estrategias para la Reducción de Desastres Naturales. *Investigación y Ciencia* 200, 6-13.
- Ayala, F.J.**, 1995. Probabilidad y vulnerabilidad en movimientos de ladera. En: Reducción de riesgos geológicos en España. ITGE. Madrid, pp. 95-113.
- Ayala, F.J.**, 2002. Análisis de riesgos por movimientos de ladera. En: Ayala, F.J., Olcina, J. (Coord.), *Riesgos naturales*. Ed. Ariel, Barcelona, Chp. 18, pp. 379-409.
- Ayala, F.J., Corominas, J. (Eds.)**, 2002. Mapas de susceptibilidad a los movimientos de ladera con técnicas SIG. IGME, Serie Medio Ambiente N° 4, Madrid.
- Ayala, F.J., Elízaga, E., González de Vallejo, L.I., Durán, J.J., Beltrán de Heredia, F., Oliveros, M.A., Carbó, A., Guillamont, M.L., Capote, R.**, 1987. Impacto económico y social de los riesgos geológicos en España. IGME, Madrid.
- Ayala, F.J., Olcina, J., Vilaplana, J.M.**, 2004. Impacto social de los riesgos naturales en España en el periodo 1990-2000 (II). *Gerencia de riesgos XXI*, 17-29.
- Baeza, C., Corominas, J.**, 2001. Assessment of shallow landslide susceptibility by means of multivariate statistical techniques. *Earth Surface Processes and Landforms* 26, 1251-1263.
- Baioni, D., Gallerini, G., Rodrigues, D.**, 2005. Relationship between human activity and landslide development in Madeira island (Portugal). *Proceedings of Sixth International Conference on Geomorphology, Zaragoza (Spain)*.
- Ballabio, C., Remondo, J., Fabbri, A.G., Chung, C.F.**, 2005. Optimizing the spatial prediction of landslide hazard with database refinements. *Proceedings of Sixth International Conference on Geomorphology, Zaragoza (Spain)*.

- Beck, B.F.**, 1988. Environmental and engineering effects of sinkholes. The processes behind the problems. *Environmental Geology and Water Sciences* 12, 71-78.
- Beguería, S.**, 2006. Changes in land cover and shallow landslide activity: A case study in the Spanish Pyrenees. *Catena* 74, 196-206.
- Bell, R., Glade, T.**, 2004. Quantitative risk analysis for landslides - Examples from Bıldudalur, NW-Iceland. *Natural Hazards and Earth System Sciences* 4, 117-131.
- Benito, G., Pérez del Campo, P., Gutiérrez, M., Sancho, C.**, 1995. Natural and human-induced sinkholes in gypsum terrain and associated environmental problems in NE Spain. *Environmental Geology* 25, 156-164.
- Berggren, B., Berglund, C., (Eds.)**, 2000. Concerted Action on Forecasting, Prevention, and Reduction on Landslide and Avalanche Risks (CALAR). Final report. European Commission, Brussels.
- Bernknopf, R.L., Campbell, R.H., Brookshire, D.S., Shapiro, C.D.**, 1988. A probabilistic approach to landslide hazard mapping in Cincinnati, Ohio, with applications for economic evaluation. *Bulletin Association of Engineering Geologists* 25 (1), 39-56.
- Berz, G.A.**, 1999. Catastrophes and climate change: concerns and possible countermeasures of the insurance industry. *Mitigation and Adaptation Strategies for Global Change* 4, 283-293.
- Binaghi, E., Luzi L., Madella P., Rampini, A.**, 1998. Slope instability zonation: a comparison between certainty factor and fuzzy Dempster-Shafer approaches. *Natural Hazards* 17, 77-97.
- Blong, R.**, 2003. A new damage index. *Natural Hazards* 30, 1-23.
- Bonachea, J., Remondo, J., Cendrero, A.**, 2004. Evaluación y cartografía de riesgo de deslizamientos a partir del análisis de los movimientos ocurridos en el pasado reciente y de sus efectos. En: Benito, G., Díez Herrero, A., (Eds.), *Riesgos Naturales y Antrópicos en Geomorfología 2*. Sociedad Española de Geomorfología, Madrid, pp. 423-434.
- Bonachea, J., Bruschi, V.M., Remondo, J., González-Díez, A., Salas, L., Bertens, J., Cendrero, A., Otero, C., Giusti, C., Fabbri, A., González-Lastra, J. R., Aramburu, J.M.**, 2005. An approach for the incorporation of geomorphologic factors into EIA of transportation infrastructures; a case study in northern Spain. *Geomorphology* 66 (1-4), 95-117.
- Bonnard, Ch., Forlati, F., Scavia, C. (Eds.)**, 2004. Identification and mitigation of large landslide risks in Europe. Advances in risk assessment. European Commission, Fifth Framework Programme, IMIRILAND project. Balkema publishers, Londres.
- Brabb, E.E.**, 1984. Innovative approaches to landslide hazard and risk mapping. Proceedings of the Fourth International Symposium on Landslides, Canadian Geotechnical Society, Toronto, Canada, Vol. 1, pp. 307-323.
- Brabb, E., Harrod, B.**, 1989. Landslides. Extend and Economic Significance. Balkema, Rotterdam, The Netherlands.
- Brabb, E.E., Pampeyan, E.H., Bonilla, M.G.**, 1972. Landslide susceptibility in San Mateo County, California. U.S. Geological Survey Miscellaneous Field Studies Map, MF-360.
- Briceño, S.**, 2004. Dealing with risk and vulnerability - the role of the United Nations. CENAT Monte Verità Workshop 2004 Coping with Risk due to Natural Hazards in the 21st Century.
- Bromhead, E.N.**, 1996. Slope stability models. En: Dikau, R., Schrott, L., Dehn, M., Hennrich, K., Ibsen, M.-L., Rasemann, S. (Eds.), *The Temporal Stability and Activity of Landslides in Europe with Respect to Climatic Change (TESLEC)*, Final Report Part 1, Summary Report European Community, CEC Environment Programme, pp. 87-97.

- Brunsdon, D., Doornkamp, P.G., Fookes, D.K.C., Kelly, J.M.H.**, 1975. Large scale geomorphology mapping and highway engineering design. *Engineering Geology* 8, 227-253.
- Brunsdon, D., Prior, D.B. (Eds.)**, 1984. Slope instability. John Willey and Sons, U.K.
- Bunce, C.M., Cruden, D.M., Morgenstern, N.R.**, 1997. Assessment of the hazard from rock fall on a highway. *Canadian Geotechnical Journal* 34, 344-356.
- Burton, I., Kates, R.W., White, G.F.**, 1978. *The Environment as Hazard*. Oxford Univ. Press. New York.
- Cardinali, M., Reichenbach, P., Guzzetti, F., Ardizzone, F., Antonini, G., Galli, M., Cacciano, Castellani, M., Salvati, P.**, 2002. A geomorphological approach to the estimation of landslide hazards and risks in Umbria, Central Italy. *Natural Hazards and Earth System Sciences* 2, 57-72.
- Carrara, A.**, 1983. Multivariate models for landslide hazard evaluation. *Mathematical Geology* 15, 403-426.
- Carrara, A., Cardinali, M., Detti, R., Guzzetti, F., Pasqui, V., Reichenbach, P.**, 1991. GIS techniques and statistical models in evaluating landslide hazard. *Earth Surface Processes and Landforms* 16, 427-445.
- Carrara, A., Cardinali, M., Guzzetti, F., Reichenbach, P.**, 1995. GIS technology in mapping landslide hazard. En: Carrara, A., Guzzetti, F. (Eds.), *Geographical Information Systems in Assessing Natural Hazards*, Kluwer Academic Publisher. The Netherlands, pp. 135-175.
- Carrara, A., Guzzetti, F., Cardinali, M., Reichenbach, P.**, 1998. Current limitations in modeling landslide hazard. En: Buccianti, A., Nardi, G., Potenza, R., (Eds.), *Proceedings of IAMG'98*, pp. 195-203.
- Carrara, A., Crosta G.B., Frattini, P.**, 2003. Geomorphological and historical data in assessing landslide hazard. *Earth Surface Processes and Landforms* 28 (10), 1125-1142.
- Casale, R., Fantechi, R., Flageollet, J.C. (Eds.)**, 1994. The temporal occurrence and forecasting of landslides in the European Community, Vol. I-II. European Commission. Program EPOCH, Contract 90 0025, Final Report.
- Cavallin, A., Marchetti, M., Panizza, M., Soldati, M.**, 1994. The role of geomorphology in environmental impact assessment. *Geomorphology* 9, 143-153.
- CCS (Consortio de Compensación de Seguros)**, 1999. Las catástrofes naturales y su cobertura aseguradora: un estudio comparativo. CCS, Madrid.
- CCS (Consortio de Compensación de Seguros)**, 2004. Pérdidas por terremotos e inundaciones en España durante el periodo 1987-2001 y su estimación para los próximos 30 años (2004-2033). CCS, Madrid.
- Cendrero, A.**, 1989. Mapping and evaluation of coastal areas for planning. *Ocean & Shoreline Management* 12, 427-462.
- Cendrero, A.**, 1997. Riesgos naturales e impacto ambiental. En: Novo, M., Lara, R. (coords.), *La interpretación de la problemática ambiental: enfoques básicos (II)*. Fundación Universidad-Empresa, Madrid.
- Cendrero, A., Díaz de Terán, J.R., Fernández, O., Garrote, R., González Lastra, J.R., Inoriza, I., Lütting, G., Otamendi, J., Pérez, M., Serrano, A.**, 1987a. Metodología para la elaboración de mapas de riesgo. *Geología Ambiental y Ordenación del Territorio, II Reunión Nacional, Comunicaciones II*, Valencia, pp. 1035-1051.
- Cendrero, A., Díaz de Terán, J.R., Fernández, O., Garrote, R., González Lastra, J.R., Inoriza, I., Lütting, G., Otamendi, J., Pérez, M., Serrano, A.**, 1987b. Establecimiento de tipos de estabilidad de laderas en función de parámetros objetivos, aplicación a escala 1:5.000 a un área de Vizcaya. *Geología Ambiental y Ordenación del Territorio, II*

Reunión Nacional, Comunicaciones II, Valencia, pp. 843-870.

Cendrero, A., Díaz de Terán, J.R., Fernández, O., Garrote, R., González Lastra, J.R., Inoriza, I., Lütting, G., Otamendi, J., Pérez, M., Serrano, A., Grupo Ikerlana., 1987c. Detailed geomorphological hazard mapping for urban and rural planning in Vizcaya (Northern Spain). En: Wolf, F.C. (Ed.), *Geology for environmental planning*. Geological Survey of Norway, Special Publ. 2, Trondheim, pp. 25-41.

Cendrero, A., Remondo, J., Bonachea, J., Rivas, V., Soto, J., 2006. Sensitivity of landscape evolution and geomorphic processes to direct and indirect human influence. *Geografía Física e Dinámica Cuaternaria*. (Aceptado).

Chacón, J., Irigaray, C., Fernández, T., 1992. Metodología para la cartografía regional de movimientos de ladera y riesgos asociados mediante un SIG. III Simposium Nacional de laderas y taludes inestables, Vol. 2, pp. 121-133.

Chacón, J., Irigaray, C., Fernández, T., 1994. Large to middle scale landslides inventory, analysis and mapping with modelling and assessment of derived susceptibility, hazard and risks in a GIS. 7th IAEG Congress, Lisboa, Vol. VI, Balkema, Rotterdam, pp. 4669-4678.

Champetier de Ribes, G., 1987. Le cartographie des mouvements de terrain: des ZERMOS aux PER. *Bull. Liaison, Lab. Ponts et Chaussees* 150-151, 9-19.

Chardon, A., 1999. A geographic approach of the global vulnerability in urban area: case of Manizales, Colombian Andes. *GeoJournal* 49, 197-212.

Chen, H., Lee, C.F., 2000. Numerical simulation of debris flows. *Canadian Geotechnical Journal* 37, 146-160.

Chung, C.F., Fabbri, A., 1993. The representation of geoscience information for data integration. *Nonrenewable Resources* 2 (2), 122-139.

Chung, C.F., Fabbri, A., 1998. Three Bayesian prediction models for landslide hazard. *Proceedings of the International Association for Mathematical Geology Annual Meeting IAMG 1998*, Ischia, Italy, pp. 204-211.

Chung, C.F., Fabbri, A., 1999. Probabilistic prediction models for landslide hazard mapping. *Photogrammetric Engineering and Remote Sensing* 65 (12), 1389-1399.

Chung, C.F., Fabbri, A., 2003a. On some weak points of quantitative landslide hazard zonation. *Proceedings of the International Association for Mathematical Geology Annual Meeting IAMG 2003*, Portsmouth, U.K., 8 p. CD.

Chung, C.F., Fabbri, A., 2003b. Validation of spatial prediction models for landslide hazard mapping. *Natural Hazards* 30 (3), 451-472.

Chung, C.F., Fabbri, A., 2004. On the requirements of landslide hazard/risk assessment. *Abstracts 32 International Geological Congress*, Florencia.

Chung, C.F., Fabbri, A., 2005. Systematic procedures of landslide hazard mapping for risk assessment using spatial prediction models. En: Glade, T., Anderson, M.G., Crozier, M.J. (Eds.), *Landslide Hazard and Risk*. New York, John Wiley & Sons, pp. 139-174.

Chung, C.F., Keating, P., 2002. Mineral potential evaluation based on airborne geophysical data. *Exploration Geophysics* 33 (1), 28-34.

Chung, C.F.; Fabbri, A., Van Westen, C.J., 1995. Multivariate regression analysis for landslide hazard zonation. En: Carrara, A., Guzzetti, F. (Eds.), *Geographical Information Systems in Assessing Natural Hazards*. Kluwer Academic Publishers, The Netherlands, pp. 107-133.

Clarke, C., Munasinghe, M., 1995. Economic aspects of disasters and sustainable development: an introduction. En: Munasinghe, M., Clarke, C. (Eds.), *Disaster*

Prevention for Sustainable Development, Economy and Policy Issues. IDNDR and the World Bank, Washington, pp. 1-10.

Clerici, A., Perego, S., Tellini, C., Vescovi, P., 2002. A procedure for landslide susceptibility zonation by the conditional analysis method. *Geomorphology* 48, 349-364.

Coburn, A.W., Spence, R.J.S., Pomonis, A., 1991. Vulnerabilidad y evaluación del riesgo. Programa de Entrenamiento para el Manejo de Desastres, PNUD, Cambridge Architectural Research Limited, Cambridge, U.K.

Consejería de Medio Ambiente y Ordenación del Territorio., 1999. Análisis, evaluación y zonificación de riesgos naturales en municipios de Cantabria. Memoria y mapas. Gobierno de Cantabria. Inédito.

Cooper, A.H., Calow, R.C., 1998. Avoiding gypsum geohazards: guidance for planning and construction. BGS Technical Report WC/98/5.

Copons, R., Altimir, J., Amigó, J., Díaz, A., Vilaplana, J.M., 2000. EUROBLOC: un modelo de simulación de caída de bloques y su máxima adaptación a la realidad. *Geotemas* 1, 219-222.

Corominas, J., 1987. Criterios para la confección de mapas de peligrosidad de movimientos de ladera. *Riesgos Geológicos*. IGME, Serie Geología Ambiental, Madrid, pp. 193-201.

Corominas, J., 1996. The angle of reach as a mobility index for small and large landslides. *Canadian Geotechnical Journal* 33, 1059-1074.

Corominas, J., Moya, J., Ledesma, A., Gili, J.A., Lloret, A., Ruis, J. (Eds.), 1998. New technologies for landslide hazard assessment and management in Europe (NEWTECH). Contract ENV-CT96-0248, final report. European Commission: Environment Programme.

Corominas, J., Moya, J., Masachs, I., Baeza, C., Hürlimann, M., 2004. Reconstructing recent activity of Pyrenean landslides by means of dendrogeomorphological techniques. En: Lacerda, W., Ehrlich, M., Fontoura, S., Sayão, A. (Eds.), *Landslides: Evaluation and Stabilization*, vol. 1, pp. 363-369.

Corominas, J., Ayala, F.J., Cendrero, A., Chacón, J., Díaz de Terán, J.R., González, A., Moya, J., Vilaplana, J.M., 2005. Riesgo de inestabilidad de laderas. En: Moreno, J.M. (Coord.), *Evaluación Preliminar de los Impactos en España por Efecto del Cambio Climático*. Proyecto ECCE. Ministerio de Medio Ambiente. pp. 549-579.

Costa, J.E., Baker, V.R., 1981. *Surficial Geology. Building with the Earth*. Wiley. New York.

Crosta, G.B., Agliardi, F., 2004. Parametric evaluation of 3D dispersion of rockfall trajectories. *Natural Hazards and Earth System Sciences* 4, 583-598.

Crozier, M.J., 1986. *Landslides: causes, consequences, and environment*. Croom Helm. London.

Crozier, M.J., 1999. Frequency and magnitude of geomorphic processes. En: Crozier, M.J., Mausbacher, R. (Eds.), *Magnitude and Frequency in Geomorphology*. *Zeitschrift für Geomorphologie Supplementband* 115, pp. 35-50.

Cruden, D.M., 1991. A simple definition of a landslide. *Bulletin International Association Engineering Geology* 43, 27-29.

Cruden, D.M., Varnes, D.J., 1996. Landslide types and processes. En: Turner, A.K., Schuster, R.L. (Eds.), *Landslides-investigation and mitigation*, National Research Council, Washington D.C. Special Report 247.

Cruden, D.M., Thomson, S., Bomhold, B.D., Chagnon, J.Y., Locat, J., Evans, S.G., Heginbottom, J.A., Moran, K., Piper, D.J.W., Powell, R., Prior, D., Quigley, R.M., 1989. *Landslides: extent and economic*

significance in Canada. En: Brabb, E.E., Harrod, B.L. (Eds.), Landslides: extent and economic significance, Proc. 28th Int'l. Geol. Congr. Symp. on Landslides, Washington, D.C. pp. 1-23.

Cutter, S.L., 1996. Vulnerability to environmental hazards. *Progress in Human Geography* 20 (4), 529-539.

Dai, F.C., Lee, C.F., 2002. Landslide characteristics and slope instability modeling using GIS, Lantau Island, Hong Kong. *Geomorphology* 42, 213-228.

Dai, F.C., Lee, C.F., Ngai, Y.Y., 2002. Landslide risk assessment and management: an overview. *Engineering Geology* 64, 65-87.

Dana, J.D., 1864. *Manual of geology treating of the principles of the science with special reference to american geological history for the uses of colleges, academies and schools of science.* Theodore Bliss, Philadelphia.

Delmonaco, G., Ippolito F., Margottini C., 1996. The CEC Project "Meteorological Factors Influencing Slope Stability and slope movement types: evaluation of hazard prone areas" (MeFISSt). En: Casale, R. (Ed.), *Hydrological and Hydrogeological Risks*, EUR 16799 EN, Brussels, 259-283.

Departamento de Industria, Agricultura y Pesca., 1997. *Inventario Forestal del País Vasco de 1996.* CD, Gobierno Vasco.

Derbyshire, E., 2000. *Landslides in the Thick Loess Terrain of North-West China.* Wiley.

D'Ercole, R., 1996. Représentation cartographique des facteurs de vulnérabilité des populations exposées à une menace volcanique. Application à la région du volcan Cotopaxi (Equateur). *Bulletin de l'Institut Français d'Etudes Andines* 25 (3), 479-507.

Diario Oficial de la UE., 1989. Resolución del Consejo, de 16 de octubre de 1989, relativa a las orientaciones en materia de prevención de riesgos técnicos y naturales *Diario Oficial* n° C 273 de 26/10/1989, P.0001-0002.

Dikau, R., Brunsden, D., Schrott, L., Ibsen, M. (Eds.), 1996a. *Landslide Recognition. Identification, movement and causes.* Chichester, John Wiley & Sons Ltd.

Dikau, R., Schrott, L., Dehn, M., Hennrich, K., Rasemann, S., 1996b. The temporal stability and activity of landslides in Europe with respect to climatic change (TESLEC). European Community. CEC Environment Programme (Contract No. EV5V-CT94-0454). Final Report, Vols. I and II. Universität Heidelberg, Germany.

Diputación Foral de Guipúzcoa, 1986. *Estudio Geomorfológico de Guipúzcoa 1:25.000.* Hojas de Ondárroa, Eibar, Zumaya y Azcoitia. Compañía General de Sondeos, S.A. Memorias, Mapas y Anexos. Inédito.

Dorren, L.K.A., Berger, F., Putters, U.S., 2006. Real-size experiments and 3-D simulation of rockfall on forested and non-forested slopes. *Natural Hazards and Earth System Science* 6, 145-153.

Downton, M.W., Pielke, R.A., 2005. How accurate are disaster loss data? the case of U.S. flood damage. *Natural Hazards* 35 (2), 211-228.

Duque, A., Echeverría, G., Fernández, E., Kerejeta, A., Cendrero, A., Díaz de Terán, J.R., Tamés, P., 1991. A methodological approach for the development of predictive models for hazard assessment. En: Panizza, M., Soldati, M., Coltellacci, M.M. (Eds.), *Proceedings European Experimental Course on Applied Geomorphology.* Instituto di Geologia. Università degli Studi di Modena, Modena, Italia. Vol.2, pp. 13-25.

Durán, J.J., Martínez, J., Peña, J.L., 1985. *Mapas previsores de riesgo de inundaciones en los núcleos urbanos de Güimar y Playa de Las Américas (Tenerife).* Madrid: Instituto Geológico y Minero de España.

Durán, J.J., del Val, J., López-Martínez, J., 1989. El karst en las depresiones del Tajo y del Duero. En: Durán, J.J., López-Martínez, J. (Eds.), *El Karst en España.* Sociedad Española de Geomorfología, Monografía 4, 211-216.

- Einstein, H.**, 1988. Special lecture: Landslide risk assessment procedure. Proceedings of the 5th International Symposium on Landslides, Lausanne, Switzerland, Vol. 2, pp. 1075-1090.
- Einstein, H.**, 1997. Landslide risk-Systematic approaches to assessment and management. En: Cruden, D., Fell, R. (Eds.), Landslide risk assessment, Balkema, Rotterdam, pp. 25-49.
- EMA (Emergency Management Australia).**, 2001. Reducing the community impact of landslides. Australian Emergency Manuals Series, Part III, Manual 24. <http://www.ema.gov.au/>
- EM-DAT.**, 2005. The OFDA/CRED International Disaster Database. Web: www.em-dat.net - Université Catholique de Louvain - Brussels-Belgium.
- Ermini, L., Catani, F., Casagli, N.**, 2005. Artificial Neural Networks applied to landslide susceptibility assessment. *Geomorphology* 66 (1-4), 327-343.
- Estrela, T.**, 1999. Modelo Gisplana: aplicación de un SIG al análisis de inundaciones en planas costeras. En: Laín, L., (Ed.), Los Sistemas de Información Geográfica en los Riesgos Naturales y en el Medio Ambiente. ITGE, Madrid, pp. 35-45.
- Etkin, D., Haque, E., Bellisario, L., Burton, I.**, 2004. An assessment of natural hazards and disasters in Canada: A Report for Decision-Makers and Practitioners. The canadian natural hazards assessment project. Public Safety and Emergency Preparedness Canada.
- European Commission.**, 1997a. Proceedings of the European expert meeting on the Oder Flood 1997. Office for Official Publications of the European Communities, Luxembourg.
- European Commission.**, 1997b. Ribamod (River Basin Modelling, Management and Flood Mitigation. Concerted action. Proceedings of the first expert meeting. Office for Official Publications of the European Communities, Luxembourg.
- European Commission.**, 1999a. Report on risk assessment procedures used in the field of civil protection and rescue services in different European Union countries and in Norway. Final Report. Directorate General Enviroment. Brussels.
- European Commission.**, 1999b. Vademecum of Civil Protection in the European Union. Directorate General Enviroment. Brussels.
- European Commission.**, 2000. Prevention and forecast of floods: Floodaware Final Report. Cemagref Editions, Lyon, Francia.
- European Commission.**, 2006. European research on natural hazards. Catalogue of selected FP5 and FP6 projects Volume 2: Avalanches, Landslides, Multirisks, Earthquakes, Volcanoes, Forest Fires, Floods. Climate Change and Natural Hazard Research-Series 2. Directorate General for Research, Directorate I: Environment and Climate System. Brussels.
- EUSTAT**, 2003. Instituto vasco de estadística. <http://www.eustat.es/>
- Evans, S.G.**, 1997. Fatal landslides and landslides risk in Canada. En: Cruden, D., Fell, R. (Eds.), Landslide risk assessment, Balkema, Rotterdam, pp. 185-196.
- Evans, S.G.**, 1999. Landslides disasters in Canada 1840-1998. Geological Survey of Canada. Open File 3712.
- EVE**, 2003. Mapa Geológico del País Vasco. Mapa, memoria y bases de datos, E: 1/25.000. Ente Vasco de la Energía, Gobierno Vasco, Bilbao. CD-rom.
- Fabbri, A., Chung, C-J., Cendrero, A., Remondo, J.**, 2003. Is prediction of future landslides possible with a GIS?. *Natural Hazards* 30 (3), 487-499.
- Fell, R.**, 1994. Landslide risk assessment and acceptable risk. *Canadian Geotechnical Journal* 31, 261-272.
- Fell, R., Hartford, D.**, 1997. Landslide risk management. En: Cruden, D., Fell, R. (Eds.),

Landslide risk assessment, Balkema, Rotterdam, pp. 51-109.

FEMA., 1997. Multihazard: Identification and Risk Assessment. A Cornerstone of the National Mitigation Strategy. Mitigation Directorate. Washington.

FEMA., 2002. Disaster Costs 1990-1999. http://www.fema.gov/library/df_7.shtm

Ferrer, M., 1995. Los movimientos de ladera en España. En: Reducción de Riesgos Geológicos en España. ITGE, Madrid pp. 69-82.

Finlay, P.J., Fell, R., 1997. Landslides: risk perception and acceptance. Canadian Geotechnical Journal 34, 169-188.

Finlay, P.J., Mostyn, G.R., Fell, R., 1999. Landslide risk assessment: prediction of travel distance. Canadian Geotechnical Journal 36, 556-562.

Flax, L.K., Jackson, R.W., Stein, D.N., 2002. Community vulnerability assessment tool methodology. Natural Hazards Review 3 (4), 163-176.

Fuchs, S., Bründl, M. 2005. Damage Potential and losses resulting from snow Avalanches in settlements of the canton of Grisons, Switzerland. Natural Hazards 34 (1), 53-69.

Furdada, G., Vilaplana, J.M., 1998. Statistical prediction of maximum avalanche run-out distances from topographic data in western catalan Pyrenees (NE Spain). Annals of Glaciology 26, 285-288.

Galve, J.P., Gutiérrez, F., Remondo, J., Bonachea, J., Cendrero, A., Guerrero, J., Lucha, P., Gutiérrez, M., Sánchez, J.A., 2006. Development and validation of sinkhole susceptibility models in mantled karst settings. A case study from the Ebro Valley alluvial evaporite karst (NE Spain). European Geosciences Union, General Assembly 2006, Vienna, Austria.

Gendreau, N., Desbos, E., Gilard, O., 2000. The Inondabilité method. En: Floodaware Final Report: August, 1996-July, 1998

(Programme Environment and Climate 1994-1998, Contract ENV4-Ct96-0293), Cemagref Editions, Cedex, France.

Ghinoi, A., Chung, C.-J., 2005. STARTER: a statistical GIS-based model for the prediction of snow avalanche susceptibility using terrain features--application to Alta Val Badia, Italian Dolomites. Geomorphology 66 (1-4), 305-325.

Glade, T., 2002. Ranging scales in spatial landslide hazard and risk analysis. En: Brebbia, C.A. (Ed.), Third International Conference on Risk Analysis, Sintra, Portugal, pp. 719-729.

Glade, T., 2003a. Vulnerability assessment in landslide risk analysis. Die Erde 134, 121-138.

Glade, T., 2003b. Landslide occurrence as a response to land use change: a review of evidence from New Zealand. Catena 51, 297-314.

Glade, T., Anderson, M.G., Crozier, M.J. (Eds.), 2005. Landslide Hazard and Risk. John Wiley & Sons, New York.

Gobierno Vasco-Departamento de Agricultura y Pesca., 1997. Panorama forestal de Euskadi. CD-Rom.

González-Díez, A., 1995. Cartografía de movimientos de ladera y su aplicación al análisis del desarrollo temporal de los mismos y de la evolución del paisaje. Tesis Doctoral. Universidad de Oviedo. Inédita.

González-Díez, A., Remondo, J., Díaz de Terán, J.R., Cendrero, A., 1999. A methodological approach for the analysis of the temporal occurrence and triggering factors of landslides. Geomorphology 30 (1-2), 95-113.

González-Díez, A., Cardenal, J., Delgado, J., Remondo, J., Felicísimo, A., Chung, C.J., Fabbri, A., Soares, A., Díaz de Terán, J.R., Francés, E., Salas, L., Fernández-Maroto, G., García, S., Olague, I., Mata, E., Bonachea, J., Sánchez-Espeso, J., 2004. The Fodispil project: an improvement of the

landslide susceptibility maps. Abstracts 32 International Geological Congress, Florencia.

González de Vallejo, L., 1988. La importancia socioeconómica de los riesgos geológicos en España. Riesgos Geológicos. IGME, Serie Geología Ambiental, Madrid, pp. 21-36.

Graillet, D., Londiche, H., Dechomets, R., Batton-Hubert, M., 2000. Analyse multicritère spatiale pour l'identification de la vulnérabilité aux inondations. <http://www.cindy.ensmp.fr/graillet.pdf>.

Granger, K., Hayne, M. (Eds.), 2001. Natural hazards & the risks they pose to South-East Queensland. Commonwealth of Australia. Canberra, Australia.

Greenway, D.R., 1987. Vegetation and slope stability. En: Anderson, M.F., Richards, K.S. (Eds.), Slope Stability. John Wiley and Sons. New York, pp. 187-231.

Guerrero, J., Gutiérrez, F., Lucha, P., 2004. Paleosubsidence and active subsidence due to evaporite dissolution in the Zaragoza city area (Huerva River valley, NE Spain). Processes, spatial distribution and protection measures for linear infrastructures. *Engineering Geology* 72, 309-329.

Guthrie, R.H., Evans, S.G., 2004. Analysis of landslide frequencies and characteristics in a natural system, coastal British Columbia. *Earth Surface Processes and Landforms* 29 (11), 1321-1339.

Gutiérrez, F., 1996. Gypsum karstification induced subsidence: Effects on alluvial systems and derived geohazards (Calatayud Graben, Iberian Range, Spain). *Geomorphology* 16, 277-293.

Gutiérrez, F., 1998. Fenómenos de subsidencia por disolución de formaciones evaporíticas en las fosas neógenas de Teruel y Calatayud (Cordillera Ibérica). Universidad de Zaragoza. Tesis Doctoral.

Gutiérrez, F., 2004. El riesgo de dolinas de subsidencia en terrenos evaporíticos. Investigación y mitigación. Workshop: Stato dell'arte sullo studio dei fenomeni di

sinkholes e ruolo delle amministrazioni statali e locali nel governo del territorio. Roma, Italia.

Gutiérrez, F., Cooper, A.H., 2002. Evaporite dissolution subsidence in the historical City of Calatayud, Spain: damage appraisal and prevention. *Natural Hazards* 25, 259-288.

Gutiérrez, F., Calaforra, J.M., Cardona, F., Ortí, F., Durán, J.J., Garay, P., 2004a. El karst en las formaciones evaporíticas españolas. En: Andreo, B., Durán, J.J. (Eds.), Investigaciones en sistemas kársticos españoles. IGME. Madrid, pp. 49-87.

Gutiérrez, F., Lucha, P., Guerrero, J., 2004b. La dolina de colapso de la casa azul de Calatayud (noviembre de 2003). Origen, efectos y pronóstico. En: Benito, G., Díez Herrero, A., (Eds.), Riesgos Naturales y Antrópicos en Geomorfología 2. Sociedad Española de Geomorfología, Madrid, pp. 477-488.

Gutiérrez-Santolalla, F., Gutiérrez-Elorza, M., Marín, C., Maldonado, C., Younger, P.L., 2005a. Subsidence hazard avoidance based on geomorphological mapping. The case study of the Ebro River valley mantled karst (NE Spain). *Environmental Geology* 48, 370-383.

Gutiérrez-Santolalla, F., Gutiérrez-Elorza, M., Marín, C., Desir, G., Maldonado, C., 2005b. Spatial distribution, morphometry and activity of a sinkhole field in the Ebro River valley (NE Spain). Applied aspects for hazard zonation. *Environmental Geology* 48, 360-369.

Gutiérrez, F., Galve, J.P., Guerrero, J., Lucha, P., Cendrero, A., Remondo, J., Bonachea, J., Gutiérrez, M., Sánchez, J.A., The origin, typology, spatial distribution, and detrimental effects of the sinkholes developed in the alluvial evaporite karst of the Ebro River valley downstream Zaragoza city (NE Spain). *Earth Surface Processes and Landforms*. Enviado.

Gutiérrez, M., Gutiérrez, F., 1998. Geomorphology of the Tertiary gypsum

formations in the Ebro Depression (Spain). *Geoderma* 87, 1-29.

Guzzetti, F., 2000. Landslide fatalities and the evaluation of landslide risk in Italy. *Engineering Geology* 58, 89-107.

Guzzetti, F., Cardinali, M., 1990. Landslide inventory map of the Umbria Region, Central Italy. ALPS 90, Alpine Landslide Practical Seminar, Proc. 6th ICFL, pp. 273-284.

Guzzetti, F., Tonelli, G., 2004. Information system on hydrological and geomorphological catastrophes in Italy (SICI): a tool for managing landslide and flood hazards. *Natural Hazards and Earth System Sciences* 4, 213-232.

Guzzetti, F., Carrara, A., Cardinali, M., Reichenbach, P., 1999. Landslide hazard evaluation: a review of current techniques and their application in a multi-scale study, Central Italy. *Geomorphology* 31 (1-4), 181-216.

Guzzetti, F., Reichenbach, P., Cardinali, M., Galli, M., Ardizzone, F., 2005. Probabilistic landslide hazard assessment at the basin scale. *Geomorphology* 72 (1-4), 272-299.

Hamilton, R., 1997. Report on Early Warning Capabilities for Geological Hazards. IDNDR Early Warning Programme. IDNDR Secretariat, Geneva.

Hansen, A., 1984. Landslide hazard analysis. En: Brunsden, D., Prior, D.B. (Eds.), *Slope Instability*, Wiley & Sons, New York, pp. 523-602.

Harp, E.L., 2001. Landslide hazards in Honduras triggered by Hurricane Mitch. En: Proc., 3rd Panamerican Symposium on Landslides, Cartagena, Colombia.

Harp, E.L., Wilson, R.C., Wieczorek, G.F., 1981. Landslides from the February 4, 1976, Guatemala earthquake, U.S. Geol. Survey Prof. Paper 1204-A.

Harp, E. L., Castañeda, M., Held, M. D., 2002. Landslides Triggered by Hurricane Mitch in Tegucigalpa, Honduras. U.S.

Geological Survey Open-File Report 02-0033. <http://pubs.usgs.gov/of/2002/ofr-02-0033/>

Hayne, M., Michael-Leiba, M., Gordon, D., Lacey, R., Granger, K., 2001. Landslide risks. En: Granger, K., Hayne, M. (Eds.), *Natural hazards & the risks they pose to South-East Queensland*. AGSO Cities Project record, AGSO-Geoscience Australia. <http://www.agso.gov.au/>.

Heijmans, A., 2001. Vulnerability: a matter of perception. Disaster Management Working Paper 4/2001, Benfield Greig Hazard Research Centre, University College of London.

Hervás, J., 2003. NEDIES Project: Lessons learnt from landslides disasters in Europe. European Commission, Brussels.

Hubert, T., 2004. Les Plans de Prévention des Risques naturels PPR. Direction de la prévention des pollutions et des risques. Ministère de l'Ecologie et du Développement durable. Inédito.

Humbert, M., 1977. La cartographie ZERMOS. Modalités d'établissement des cartes des zones exposées à des risques liés aux mouvements du sol et du sous-sol. *Bulletin Bureau Recherche Géologique et Minière* 3, 5-8.

Hungr, O., 1997. Some methods of landslide hazard intensity mapping. En: Cruden, D., Fell, R. (Eds.), *Landslide risk assessment*, Balkema, Rotterdam, pp. 215-226.

Hungr, O., 1995. A model for the runout analysis of rapid flow slides, debris flows and avalanches. *Canadian Geotechnical Journal* 32 (4), 610-623.

Hungr, O., Evans, S.G., 1996. Rock avalanche runout prediction using a dynamic model. En: Senneset, K., (Ed.), *Landslides-Glissements de terrain*. VII International Symposium on Landslides, Trondheim, Norway. Balkema, Rotterdam: pp. 233-238.

Hutchinson, J.N., 1988. Morphological and geotechnical parameters of landslides in relation to geology and hydrogeology. Proc.

5th Int. Symp. on Landslides, Lausanne, Switzerland, Vol. 1, pp. 3-35.

Ibsen, M.-L., Brunsten, D., 1996. The nature, use and problems of historical archives for the temporal occurrence of landslides, with specific reference to the south coast of Britain, Ventnor, Isle of Wight. *Geomorphology* 15, 241-258.

IDNDR (International Decade for Natural Disaster Reduction), 1995. The Yokohama strategy and plan of action for a safer world. World Conference on Natural Disaster Reduction, Yokohama, 1994.

IFRC (International Federation of Red Cross and Red Crescent Societies), 1996. World Disasters Report 1995, International Federation of Red Cross and Red Crescent Societies.

IGME., 1974. Mapa Geotécnico General E.1:200.000; hoja 5, Bermeo. Madrid: Instituto Geológico y Minero de España.

IGME., 1986. Estudio geológico para la previsión de riesgos por inundaciones en el País Vasco (Álava y Vizcaya) y Condado de Treviño. Madrid: Instituto Geológico y Minero de España.

IGME., 1987. Mapas previsores de riesgos de inundaciones en núcleos urbanos. Puerto Lumbreras, Lorca, Totana y Archena. Madrid: Instituto Geológico y Minero de España.

IGME., 1988a. Riesgos Geológicos. Madrid: Instituto Geológico y Minero de España.

IGME., 1988b. Impacto económico y social de los riesgos geológicos en España. Madrid: Instituto Geológico y Minero de España.

INE., 2003. Instituto nacional de estadística. <http://www.ine.es/>

Innes, J.L., 1983. Lichenometric dating of debris-flow activity in the Scottish highlands: *Earth Surface Processes and Landforms* 8, 579-588.

International Sabo Association., 2004. <http://www.sabo-int.org/law/index.html>.

Irigaray, C., 1995. Movimientos de ladera: inventario, análisis y cartografía de susceptibilidad mediante un Sistema de Información Geográfica. Aplicación a las zonas de Colmenar (Málaga), Rute (Córdoba) y Montefrío (Granada). Tesis doctoral. Universidad de Granada.

ITGE., 1990. Estudio de riesgos naturales en la ciudad de Alcoy. E.1:5.000 (Inundaciones y terremotos). Madrid: Instituto Geológico y Minero de España y Ayuntamiento de Alcoy, 214 p.

ITGE., 1991a. Riesgos naturales en Castilla y León. Madrid: Instituto Geológico y Minero de España, 91 p. y mapa escala 1:400.000.

ITGE., 1991b. Mapa geotécnico y de peligrosidad natural de la ciudad de León y su aglomeración urbana. Instituto Tecnológico Geominero de España, Diputación de León.

ITGE., 1995a. Reducción de riesgos geológicos en España. Madrid: Instituto Geológico y Minero de España, 204 p.

ITGE., 1995b. Atlas inventario de riesgos naturales de la Comunidad Autónoma de la Región de Murcia. Madrid: Instituto Geológico y Minero de España, 330 p.

IUGS Working group on landslides-Committee on Risk Assessment., 1997. Quantitative risk assessment for slopes and landslides. En: Cruden, D., Fell, R. (Eds.), *Landslide risk assessment*, Balkema, Rotterdam, pp. 3-12.

Jibson, R.W., 2006. The 2005 La Conchita, California, landslide. *Landslides* 3, 73-78.

Keylock, C.J., Barbolini, M., 2001. Snow avalanche impact pressure-vulnerability relations for use in risk assessment. *Canadian Geotechnical Journal* 38, 227-238.

Kilburn, C.R.J., Pasuto, A., 2003. Major risk from rapid, large-volume landslides in Europe (EU Project RUNOUT). *Geomorphology* 54 (1-2), 3-9.

- Klaus, J., Pflugner, W., Schmidtke, R., Wind, H., Green, C.,** 1995. Models for flood hazard assessment and management. En: Penning-Rowsell, E.C., Fordham, M. (Eds.), *Floods Across Europe. Hazard Assessment, Modelling and Management*. Middlesex University Press, Londres. pp. 69-106.
- Klimchouk, A., Forti, P., Cooper, A.,** 1996. Gypsum karst of the World: a brief overview. En: Klimchouk, A., Lowe, D., Cooper, A., Sauro, U. (Eds.), *Gypsum karst of the World*. International Journal of Speleology, Italy. pp.159-181.
- Kong, W.K.,** 2002. Risk assessment of slopes. *Quarterly Journal of Engineering Geology and Hydrogeology* 35, 213-222.
- Lamoreaux, P.E., Newton, J.G.,** 1986. Catastrophic Subsidence: an environmental hazard, Shelby County, Alabama. *Environmental Geology and Water Sciences* 8, 25-40.
- Lang, A., Moya, J., Corominas, J., Schrott, L., Dikau, R.,** 1999. Classic and new dating methods for assessing the temporal occurrence of mass movements. *Geomorphology* 30 (1-2), 33-52.
- Larsen, M.C., Torres-Sánchez, A.J.,** 1998. The frequency and distribution of recent landslides in three montane tropical regions of Puerto Rico., *Geomorphology* 24 (4), 309-331.
- Lateltin, O., Raetzo, H., Zanetta, P.,** 2004. Recent catastrophic landslides in Switzerland. En: Lacerda, W. A., Ehrlich, M., Fontoura, S., Sayão, A. (Eds.), *Landslides: Evaluation and Stabilization*, vol. 1, pp. 131-135.
- Ledoux, B.,** 1994. Les études de la vulnérabilité dans la cartographie des inondations à la Réunion: approche méthodologique, études de cas et réflexion sur leur finalité. *Revue de Géographie Alpine* 4 (LXXXII), 167-177.
- Lee, S., Talib, J.A.,** 2005. Probabilistic landslide susceptibility and factor effect analysis. *Environmental Geology* 47 (7), 982-990.
- Lee, S., Chwae U., Min, K.,** 2002. Landslide susceptibility mapping by correlation between topography and geological structure: the Janghung area, Korea. *Geomorphology* 46 (3-4), 149-162.
- Leone, F.,** 1995. Concept de vulnérabilité appliqué à l'évaluation des risques générés par les phénomènes de mouvements de terrain. Thèse de doctorat de l'Université Joseph Fourier, Grenoble I.
- Leone, F., Velásquez, E.,** 2002. La catástrofe del deslizamiento de La Josefina (Ecuador, 1993): algunas enseñanzas sobre la vulnerabilidad. En: Hubp, J.L., Inbar, M., (Eds.), *Desastres naturales en América Latina, México*. Ch XXIV, pp. 429-445.
- Leone, F., Asté, J.P., Leroi, E.,** 1996. Vulnerability assessment of elements exposed to mass-movement: working toward a better risk perception. En: Senneset, K., (Ed.), *Landslides-Glissements de terrain*. VII International Symposium on Landslides, Trondheim, Norway. Balkema, Rotterdam: pp. 263-269.
- Leroi, E.,** 1996. Landslide hazard-Risk maps at different scales: Objectives, tools and developments. En: Senneset, K., (Ed.), *Landslides-Glissements de terrain*. VII International Symposium on Landslides, Trondheim, Norway. Balkema, Rotterdam: pp. 35-51.
- Leroi, E.,** 1997. Landslide risk mapping: Problems, limitations and developments. En: Cruden, D., Fell, R., (Eds.), *Landslide risk assessment*, Balkema, Rotterdam, pp. 239-250.
- Liu, X., Lei, J.,** 2003. A method for assessing regional debris flow risk: an application in Zhaotong of Yunnan province (SW China). *Geomorphology* 52, 181-191.
- Liu, X., Qi Yue, Z., Tham, L.G., Lee, C.F.,** 2002. Empirical assessment of debris flow risk on a regional scale in Yunnan province, Southwestern China. *Environmental Management* 30 (2), 249-264.

- Luzi, L., Pergalani, F.**, 1996. Applications of statistical and GIS techniques to slope instability zonation. *Soil Dynamics and Earthquake Engineering* 15, 83-94.
- Macau, F., Riba, O.**, 1962. Situación, características y extensión de los terrenos yesíferos en España. I Coloquio Internacional sobre las Obras Públicas en los terrenos yesíferos. Madrid, 5, 157-184.
- Maidment, D.R.**, 1993. GIS and Hydrologic Modeling in Environmental Modeling with GIS. En: Goodchild, M.F., Parks, B.O., Steyaert, L.T., (Eds.), Oxford University Press, New York, pp. 147-167.
- Manche, Y.**, 1997. Propositions pour la prise en compte de la vulnérabilité dans la cartographie des risques naturels prévisibles. *Revue de Géographie Alpine* 2 (LXXXIII), 49-62.
- Mantovani, F., Soeters, R., Van Westen, C.J.**, 1996. Remote sensing techniques for landslide studies and hazard zonation in Europe. *Geomorphology* 15 (3-4), 213-225.
- Marcato, G., Moretto, S., Pasuto, A., Silvano, S., Tagliavini, F., Zannoni, A. (Eds.)**, 2005. Assessment of Landslide Risk and Mitigation in Mountain Areas (ALARM). Final report, Contract EVG1-CT-2001-00038. 85 p.
- Mark, R.K., Ellen, S.D.**, 1995. Statistical and simulation models for mapping debris-flows hazard. En: Carrara, A., Guzzetti, F. (Eds.), *Geographical Information Systems in Assessing Natural Hazards*. Kluwer Academic Publisher, Dordrecht, The Netherlands, pp. 93-106.
- Mayoraz, F., Cornu T., Vuillet, L.**, 1996. Using Neural networks to predict slope movements. En: Senneset, K., (Ed.), *Landslides-Glissements de terrain*. VII International Symposium on Landslides, Trondheim, Norway. Balkema, Rotterdam: pp. 295-300.
- Mejía-Navarro, M., Wohl, E.E., Oaks, S.D.**, 1994. Geological hazard, vulnerability, and risk assessment using GIS: model for Glenwood Springs, Colorado. *Geomorphology* 10 (1-4), 331-354.
- Mejía-Navarro, M., García L.A.**, 1996. Natural hazard and risk assessment using Decision Support Systems. Application, Glenwood Springs, Colorado. *Journal of Environmental and Engineering Geoscience* 2 (3), 299-324.
- Melchiorre, C., Matteucci, M., Bonachea, J., Remondo, J., Zanchi, A.**, 2005. Comparison of multivariate analysis and artificial neural networks methods in landslide susceptibility modeling. *Proceedings of Sixth International Conference on Geomorphology, Zaragoza (Spain)*.
- Mercado, M.**, 2002. La erupción del Nevado del Ruiz, Colombia, de 1985. En: Hubp, J.L., Inbar, M., (Eds.), *Desastres naturales en América Latina, México*. Ch II, pp. 67-84.
- Michael-Leiba, M., Baynes, F., Scott, G., Granger, K.**, 2003. Regional landslide risk to the Cairns Community. *Natural Hazards* 30, 233-249.
- Ministerio de Agricultura, Pesca y Alimentación (MAPA)**, 2002. Precios de la Tierra. En: *Hechos y cifras de la agricultura, la pesca y la alimentación en España*.
- Ministerio de Fomento**, 2001. Boletín estadístico del Ministerio de Fomento.
- Ministerio del Interior**, 2000. Balance del Ministerio del Interior 1999. Madrid, 55 pp.
- Ministry of Civil Defence & Emergency Management Civil**, 2004. National Civil Defence Emergency Management Strategy 2003-2006. <http://www.civildefence.govt.nz>.
- Moon, A.T., Olds, R.J., Wilson, R.A., Burman, B.C.**, 1992. Debris flow zoning at Montrose, Victoria. En: Bell, D.H. (Ed.), *Landslides, Proc. Sixth Int. Symp. on Landslides, Christchurch, New Zealand*. A.A. Balkema, The Netherlands, Vol. 2, pp. 1015-1022.
- Moreno, J.M. (coord.)**, 2005. Principales conclusiones de la evaluación preliminar de

los impactos en España por efecto del cambio climático. Proyecto ECCE. Ministerio de Medio Ambiente.

Morgan, G.C., Rawlings, G., Sobkowitz, J., 1992. Evaluating total risk to communities from large debris flows. Proc. Geohazards '92 Sym., Can. Geotech. Soc., Vancouver, BC.

Moya, J., Corominas, J., Gutiérrez, E., Vilaplana, J.M., 1992. Datación de movimientos de ladera mediante la dendrocronología. Ejemplos de aplicación en el Pirineo Oriental. III Simposio Nacional de Taludes y Laderas Inestables. La Coruña, Vol. 1, pp. 27-38.

Munich Re., 2005. Topics Geo Annual review: Natural catastrophes 2004. Munchener Ruckversicherungs-Gesellschaft, Munchen.

Odeh, D.J., 2002. Natural hazards vulnerability assessment for statewide mitigation planning in Rhode Island. Natural Hazards Review 3 (4), 177-187.

Olague, I., Gonzalez-Díez, A., Chung, C-J., Remondo, J., Bonachea, J., 2005. Effect of resolution of DEM for landslide hazard mapping. Geophysical Research Abstracts, Vol. 7, 08953.

Oliver-Smith, A., 2002. El gran terremoto del Perú, 1970: el concepto de la vulnerabilidad y el estudio y la gestión de los desastres en América Latina. En: Hubp, J.L., Inbar, M., (Eds.), Desastres naturales en América Latina, México. Ch VI, pp. 147-160.

Ortí, F., Salvany, J.M., 1997. Continental evaporitic sedimentation in the Ebro Basin during the Miocene. En: Sedimentary Deposition in Rift and Foreland Basins in France and Spain. Columbia University Press. New York, pp. 420-429.

O'Tousa, J., 1995. La Conchita landslide, Ventura County, California. Association of Engineering Geologists AEG News 38 (4), 22-24.

Palmquist, R.C., Bible, G., 1980. Conceptual modelling of landslide distribution in time and space. Bulletin

Association Engineering Geologists 21, 178-186.

Panizza, M., 2005. Manuale di geomorfologia applicata. FrancoAngeli, Milano.

Panizza, M., Corsini, A., Marchetti, M., Pasuto, A., Silvano, S., Soldati, M., 2002. Landslide risk mapping in Italy: an example of pilot study for a municipality of South Tyrol. Meeting on "Natural risks and National development in Europe", 22-25 October, Paris (France).

Petak, W.J., Atkisson, A.A., 1982. Natural hazard risk assessment and public policy. Springer Verlag, New York.

Raetzo, H., Lateltin, O., Tripet, J.P., 2002. Hazard assessment in Switzerland - Codes of practice for mass movements. Bulletin of Engineering Geology and the Environment 61, 263-268.

Reid, L.M., 1998. Calculation of average landslide frequency using climatic records. Water Resources Research 34 (4), 869-877.

Remondo, J., 2001. Elaboración y validación de mapas de susceptibilidad de deslizamientos mediante técnicas de análisis espacial. Tesis Doctoral, Universidad de Oviedo.

Remondo, J., González, A., Díaz de Terán J.R., Cendrero, A., 2003a. Landslide susceptibility models utilising Spatial Data Analysis techniques. A case study from the Lower Deba Valley, Guipúzcoa (Spain). Natural Hazards 30 (3), 267-279.

Remondo, J., González, A., Díaz de Terán J.R., Cendrero, A., Fabbri, A., Chung, C-J., 2003b. Validation of Landslide Susceptibility Maps; Examples and Applications from a Case Study in Northern Spain. Natural Hazards 30 (3), 437-449.

Remondo, J., Bonachea, J., Cendrero, A., 2004. Probabilistic landslide hazard and risk mapping on the basis of occurrence and damages in the recent past. En: Lacerda, W., Ehrlich, M., Fontoura, S., Sayão, A. (Eds.),

Landslides: Evaluation and Stabilization, vol. 1, pp. 125-130.

Remondo, J., Bonachea, J., Cendrero, A., 2005a. A statistical approach to landslide risk modelling at basin scale: from landslide susceptibility to quantitative risk assessment. *Landslides* 2 (4), 321-328.

Remondo, J., González, A., Chung, C-J., Bonachea, J., Olague, I., Fabbri, A., 2005b. The influence of changes of hazard and vulnerability on landslide risk assessment. Proceedings of Sixth International Conference on Geomorphology, Zaragoza (Spain).

Remondo, J., Soto, J., González-Díez, A., Díaz de Terán, J.R., Cendrero, A., 2005c. Human impact on geomorphic processes and hazards in mountain areas in northern Spain. *Geomorphology* 66 (1-4), 69-84.

Rubiera Torres, J., 2002. El huracán Mitch: el más desastroso en la historia centroamericana. En: Hubp, J.L., Inbar, M., (Eds.), *Desastres naturales en América Latina*, México. Ch XIV, pp. 289-299.

Sah, M.P., Mazarí, R.K., 1998. Anthropogenically accelerated mass movement, Kulu Valley, Himachal Pradesh, India. *Geomorphology* 26 (1-3), 123-138.

Santacana, N., 2001. Análisis de la susceptibilidad del terreno a la formación de deslizamientos superficiales y grandes deslizamientos mediante el uso de SIG. Aplicación a la cuenca alta del río Llobregat. Tesis Doctoral, Universidad Politécnica de Catalunya. 399 p.

Santacana, N., Baeza, C., Corominas, J., De Paz, A., Marturià, J., 2003. A GIS-based multivariate statistical analysis for shallow landslide susceptibility mapping in La Pobla de Lillet Area (Eastern Pyrenees, Spain). *Natural Hazards* 30 (3), 281-297.

Schoeneich, P., 1991. La datacion des glissements de terrain. En: Bell, D.H. (Ed.), *Landslides*, Proc. Sixth Int. Symp. on Landslides, Christchurch, New Zealand. A.A. Balkema, The Netherlands, Vol. 2, pp. 205-212.

Schuster, R.L., 1996. Socioeconomic significance of landslides. En: Turner, A.K., Schuster, R.L. (Eds.), *Landslides: investigation and mitigation*. National Research Council, Washington, D.C., Special report 247, pp. 12-35.

Schuster, R.L., Fleming, R.W., 1986. Economic losses and fatalities due to landslides. *Association of Engineering Geologists Bulletin* 23 (1), 11-28.

Scott, K.M., 2000. Precipitation-triggered debris-flow at Casita Volcano, Nicaragua: Implications for mitigation strategies in volcanic and tectonically active steeplands. En: Wiczorek, G.F., Naeser, N.D., (Eds.), *Proc. 2nd Int'l. Conf. on Debris-Flow Hazards Mitigation*, Taipeh, pp. 3-13.

Semenza, E., Ghirotti, M., 1998. Vaiont-Longarone, 34 anni dopo la catastrofe. *Università degli studi di Ferrara, Sezione Scienze della Terra*, Vol. 7, N.4, Ferrara.

Shaban, A., Khawlie, M., Bou Kheir, R., Abdallah, C., 2001. Assessment of road instability in a typical mountainous road using GIS and aerial photos, Lebanon-Eastern Mediterranean. *Bulletin of Engineering Geology and the Environment* 60, 93-101.

Sharpe, C.F.S., 1938. *Landslides and related phenomena: a study of mass-movements of soil and rock*. Columbia University Press, New York.

Singhroy, V., Mattar, K.E., 2000. SAR image techniques for mapping areas of landslides. *Proceedings ISPRS Congress*, Amsterdam.

Soeters, R., Van Westen, C.J., 1996. Slope instability recognition, analysis, and zonation. En: Turner, A.K., Schuster, R.L. (Eds.), *Landslides: investigation and mitigation*. National Research Council, Washington, D.C., Special report 247, pp. 129-177.

Soriano, A., Simón, J.L., 1995. Alluvial dolines in the central Ebro Basin, Spain: a

spatial and developmental hazard analysis. *Geomorphology* 11, 295-309.

Soto, J., Gómez, J., González, A., Remondo, J., Díaz de Terán, J. R., Cendrero, A., Alcaide J., 2002. Evolución de los deslizamientos de ladera mediante su caracterización con Cs-137. *Cuaternario y Geomorfología* 16 (1-4), 73-81.

Spang, R.M., Sönsner, T., 1995. Optimized rockfall protection by "ROCKFALL". Proceedings of the 8th International Conference on Rock Mechanics, Tokyo, pp. 1233-1242.

Spatial Prediction Modelling (SPM), 2004. Spatial Prediction Modeling System: User's Guide, version 1.1. Spatialmodels Inc. Ottawa, Canadá.

Spiker, E.C., Gori, P.L., 2003. National Landslide Hazards Mitigation Strategy-A Framework for Loss Reduction. U.S. Department of the Interior & U.S. Geological Survey.

Swiss Re, 2001. Catástrofes de la naturaleza y antropogenias en el 2000: menos daños asegurados a pesar de las devastadoras inundaciones. *Sigma*, nº 2, Zurich.

Tamés, P., Elosegui, J.M., Salazar, A., Almoguera, J., Albert, J., Solesio, J., Fernández Areces, J.L., López Vilchez, L., 1986. Estudio de riesgos naturales del territorio de Guipúzcoa (2a fase). Términos municipales de Deba, Motrico, Mendaro, Elgoibar y Eibar, 5 Vols., Diputación Foral Guipúzcoa. Inédito.

Terlien, M.T.J., van Asch, T.W.J., Van Westen, C.J., 1995. Deterministic modelling in GIS-based landslide hazard assessment. En: Carrara, A., Guzzetti, F. (Eds.), *Geographical Information Systems in Assessing Natural Hazards*, Kluwer Academic Publishing, The Netherlands, pp. 57-77.

Terzaghi, K., Peck, R.B., 1948. Soil mechanics in engineering practice. Wiley, New York.

Tianchi, L., Shumin, W., 1992. Landslide hazards and their mitigation in China. Beijing: Science Press.

Turner, A.K., Schuster, R.L., 1995. Landslide, investigation and mitigation. Transportation Research Board Special Report 247. National Academy Press, WA.

Uitto, J. I., 1998. The geography of disaster vulnerability in megacities. *Applied geography* 18 (1), 7-16.

UNDP (United Nations Development Programme), 2001. Human Development Report 2001: making new technologies work for human development. New York.

UNDRO, 1991. Mitigation Natural Disaster: Phenomena, Effects and Action- A manual for Policy makers and Planners. Geneva. Office of the UN Disaster Relief Coordinator.

United Nations., 2002. Living with Risk - a global review of disaster reduction initiatives. Versión preliminar, Geneva.

Val (del), J., Delgado, J., Eguiguren, E., García, I., Garrote, R., 1996. Ejemplo de análisis de inestabilidades del terreno para la atención de emergencias, el caso del País Vasco. *Actas del VI Congreso Nacional y Conferencia Intern. de Geología Ambiental y Ordenación del Territorio*, Granada, Vol. 1.

Vanacker, V., Vanderschaeghe, M., Govers, G., Willems, E., Poesen, J., Deckers, J., De Bievre, B., 2003. Linking hydrological, infinite slope stability and land-use change models through GIS for assessing the impact of deforestation on slope stability in high Andean watersheds. *Geomorphology* 52 (3-4), 299-315.

Van Asch, T., Malet, J.P., Remaître, A., Maquaire, O., 2004. Numerical modelling of the run-out of a muddy debris-flow. The effect of rheology on velocity and deposit thickness along the run-out track. En: Lacerda, W.A., Ehrlich, M., Fontoura, S., Sayão, A. (Eds.), *Landslides: Evaluation and Stabilization*, vol. 2, pp. 1433-1438.

- Van Dijke, J.J., Van Westen, C.J.**, 1990. Rockfall hazard : a geomorphologic application of neighbourhood analysis with ILWIS. ITC Journal 1, 40-44.
- Vandine, D.F., Bovis, M.**, 2002. History and Goals of Canadian Debris Flow Research, A Review. *Natural Hazards* 26 (1), 67-80.
- Van Westen, C.J.**, 1993. Application of geographic information system to landslide hazard zonation. ITC-Publications n° 115. Enschede.
- Van Westen, C.J.**, 2000. The modelling of landslide hazards using GIS. *Surveys in Geophysics* 21, 241-255.
- Van Westen, C.J.**, 2004. Geo-information tools for landslide risk assessment: an overview of recent developments. En: Lacerda, W.A., Ehrlich, M., Fontoura, S., Sayão, A. (Eds.), *Landslides: Evaluation and Stabilization*, vol. 1, pp. 39-56.
- Van Westen, C.J., Rengers, N., Terlien, M.T.J., Soeters, R.**, 1997. Prediction of the occurrence of slope instability phenomena through GIS-based hazard zonation. *Geologische Rundschau* 86, 404-414.
- Van Westen, C.J., Seijmonsbergen, A.C., Mantovani, F.**, 1999. Comparing landslide hazard maps. *Natural Hazards* 20, 137-158.
- Varnes, D.J.**, 1978. Slope movements, type and processes. En: Schuster, R.L., Krizek, R.J. (Eds.), *Landslide Analysis and Control*. Transportation Research Board, National Academy Sciences, Washington, DC, Special report 176.
- Varnes, D.J.**, 1981. Slope-stability problems of the Circum-Pacific Region as related to mineral and energy resources. En: Halbouty, M.T., (Ed.), *Energy resources of the Pacific Region*, Am. Assoc. Petroleum Geologists Studies in Geology, No. 12, pp. 489-505.
- Varnes, D.J.**, 1984. *Landslide hazard zonation: a review of principles and practice*. UNESCO, Paris.
- Viberg, L.**, 2000. Session Report. Lessons learned from landslides in Sweden. En: Bergreen, B., Berglund, C. (Eds.), *Concerted Action on Forecasting, Prevention and Reduction of Landslide and Avalanche Risks (CALAR)*. Appendices to Final Report: appendix A3. European Commission, Brussels.
- Weichselgartner, J.**, 2001. Disaster mitigation: the concept of vulnerability revisited. *Disaster Prevention and Management* 10 (2), 85-94.
- Weichselgartner, J., Bertens, J.**, 2000. Natural disasters: acts of God, nature or society? - On the social relation to natural hazards. En: Brebbia, C.A. (Ed.), *Risk Analysis II*. WIT Press, Southampton, pp. 3-12.
- Westgate, K.N., O'Keefe, P.**, 1976. Some definitions of disaster. Disaster research unit occasional. Paper n° 4. Department of Geography, University of Bradford.
- White, W.B.**, 1998. *Geomorphology and Hydrology of Karst Terrains*. Oxford University Press. Oxford, 464 p.
- Wieczorek, G.F.**, 1984. Preparing a detailed landslide-inventory map for hazard evaluation and reduction. *Bulletin of the Association of Engineering Geologists* 21 (3), 337-342.
- Winchester, V., Harrison, S.**, 1994. A development of the lichenometric method applied to dating glacially influenced debris flows in southern Chile. *Earth Surface Processes and Landforms* 19, 137-151.
- Wold, R.L., Jochim, C.L.**, 1989. *Landslide Loss Reduction: A Guide for State and Local Government Planning*. Denver, CO: Colorado Geological Survey, Department of Natural Resources.
- Wong, H.N., Ho, K.K.S., Chan, Y.C.**, 1997. Assessment of consequence of landslides. En: Cruden, D., Fell, R. (Eds.), *Landslide risk assessment*, Balkema, Rotterdam, pp. 111-149.
- Yamamoto, A.**, 2003. Prevention of landslide disasters by farming activities in monsoon Asia. *Proceedings of the Expert*

Meeting on Land Conservation Indicators, Kyoto.

Yong, C., Qi-Fu, C., Ling, C., 2001. Vulnerability analysis in earthquake loss estimate. *Natural Hazards* 23 (2-3), 349-364.

Zêzere, J.L., 2002. Landslide susceptibility assessment considering landslide typology. A case study in the area north of Lisbon (Portugal). *Natural Hazards and Earth System Sciences* 2 (1-2), 73-82.

Zêzere, J.L., Ferreira, A.D., Rodrigues. M.L., 1999. The role of conditioning and triggering factors in the occurrence of landslides: a case study in the area north of Lisbon (Portugal). *Geomorphology* 30 (1-2), 133-146.

Zuloaga, I., 1995. Venezuela-estimation of the economic losses due to geological hazards. *Primeras Jornadas Venezolanas de Ingeniería Civil*, Caracas.