



## Prof. Ignacio Rodríguez-Iturbe Professor



### Most important awards, prizes and academies

**Awards:** 'Máxima Calificación' Graduation Prize of the Engineering Class of 1963, Universidad del Zulia, Venezuela, 1963; Research Prize, Venezuelan Society of Hydraulic Engineers, Caracas, 1968; Plaque for Outstanding Teaching, Civil Engineering School, Universidad del Zulia, 1969; 'Conspicuously Effective Teaching Award', Civil Engineering Department, M.I.T., 1974; Huber Research Prize, American Society for Civil Engineers, 1975; Hydrologic Sciences Award, American Geophysical Union, 1975; James B. Macelwane Award, American Geophysical Union, 1977; 'Orden 27 de June' Medal for Merits in Education, Government of Venezuela, 1977; 'Francisco J. Torrealba' prize awarded by the Universidad Simón Bolívar for outstanding research accomplishments, Caracas, Venezuela, 1985; National Prize for best research paper in all branches of Engineering, National Council for Sciences and Technological Research, Caracas, 1987; Order 'Andrés Bello' 1st Class, Venezuela, 1988; National Science Prize, National Council for Sciences and Technological Research, Venezuela 1991; Academic Medal of the University of Florence, Italy, 1991; Academic Medal of the University of Padua, Italy, 1992; Premio México de Ciencia y Tecnología 1994, República de México, 1994; Robert E. Horton Medal, American Geophysical Union, 1998; National Engineering Research Prize. Venezuela, 1998; Order Francisco Miranda (1st Class) for academic merits, Government of Venezuela, 1998; Ven Te Chow Award for lifetime achievements in the field of hydrology, awarded by the Environmental

Water Resources Institute/American Society of Civil Engineers, 2001; Hydrology Days Award 2002, Colorado State University, 2002; Stockholm Water Prize, 2002; Blusa del Agua, awarded by the Tribunal de las Aguas, Valencia, Spain, 2007; Bowie Medal, American Geophysical Union. *Academies*: American Geophysical Union, 1977; Vice President, International Commission on Water Resources Systems, International Association of Hydrological Sciences, 1980-1983; First Vice President, International Association of Hydrological Sciences (IAHS), 1983-1986; Latin American Academy of Sciences, 1983; United States National Academy of Engineering, 1988; Third World Academy of Sciences, 1988; American Meteorological Society, 1992; Real Academia de Ciencias Exactas, Físicas y Naturales, Spain, 2003; Academia de Ingeniería de México, 2004; Istituto Veneto di Scienze, Lettere ed Arti, 2004; National Academy of Engineering of Venezuela, 2006; USA National Academy of Sciences, USA American Academy of Arts and Sciences.

### **Summary of scientific research**

The dynamics of the interaction between climate, soil, and vegetation are the main focus of Rodríguez-Iturbe's research group. These dynamics are crucially influenced by the scale at which the phenomena are studied as well as by the type of climate, the physiological characteristics of the vegetation, and the pedology of the soil. Moreover, not only the temporal aspects but also the spatial aspects of the dynamics are crucially dependent on the above factors. Soil moisture plays a key role in the above dynamics, and his group is involved in its space-time characterization. This involves a range of approaches that include challenging problems in the physics of the interaction as well as on its mathematical description. It is necessary to account for the random character of precipitation, both in occurrence and intensity, as well as for the nonlinear dependence of infiltration, evapotranspiration, and leakage on the soil moisture state. His group's approach has been to understand and model first the balance of soil moisture at a point under the above conditions. The solution of the stochastic differential equations corresponding to the point dynamics have provided the probabilistic description of the soil-plant-climate interaction at a site. The spatial interaction between different sites with the same or with different types of vegetation is being implemented via cellular automatas operating under rules governed by the characteristics of the stress existing in the vegetation. At larger spatial scales, precipitation itself is influenced by the soil moisture present in the region and this phenomenon needs to be incorporated into the modeling scheme. At intermediate scales involving river basins, the geomorphologic characteristics of the drainage network is a commanding factor in the spatial organization of soil moisture. Rodríguez-Iturbe's group is trying to link the recent advances on the scaling characteristics of the network with the dynamics of the soil moisture. With the above framework the group hopes to elucidate some of the most fundamental issues of the climate-soil-atmosphere interaction that lie at the heart of hydrology.

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### **Main publications**

*Books: Ecohydrology of Water Controlled Ecosystems: Soil Moisture and Plant Dynamics*, by I. Rodríguez-Iturbe and A. Porporato, Cambridge University Press, 450 pp., Dec. 2004; *Fractal River*

*Basins: Chance and Self-Organization*, by I. Rodríguez-Iturbe and A. Rinaldo, Cambridge University Press, 580 pp., May 1997; *Rainfall Fields: Estimation Analysis and Prediction*, edited by H.R. Cho, M. Fritsch, V.K. Gupta, I. Rodríguez-Iturbe, and M. Taqqu, published as a special volume by the American Geophysical Union from the *Journal of Geophysical Research*, Vol. 92, D8, Aug. 1987; *Scale Problems in Hydrology: Runoff Generation and Basin Response*, edited by V.K. Gupta, I. Rodríguez-Iturbe, and E.F. Wood, FD. Reidel Publishing Company, 244 pp., May 1986; *Random Functions and Hydrology*, by R.L. Bras and I. Rodríguez-Iturbe, Addison-Wesley Publishing Company, Reading, MA, 590 pp., January 1985; Unabridged Dover republication of this edition, 1993; *Scale Problems in Hydrology*, edited by I. Rodríguez-Iturbe and V.K. Gupta, published as a double issue of the *Journal of Hydrology*, Elsevier Publishing Company, 257 pp., Aug. 1983. *Video*: Willgoose, G., R.L. Bras, and I. Rodríguez-Iturbe, *A Model of Catchment Evolution: A Computer Animation*, 1990. *Most recent papers in journals*: Botter, G., Porporato, A., Rodríguez-Iturbe, I., and A. Rinaldo, Basin-scale and moisture dynamics and the probabilistic characterization of carrier hydrologic flows: Slow, leaching-prone components of the hydrologic response, *Water Resources Research*, Vol. 43, W02417, 2007; Bertuzzo, E., Azaele, S., Maritan, A., Gatto, M., Rodríguez-Iturbe, I., and A. Rinaldo, On the space-time evolution of a cholera epidemic, *Water Resources Research*, 2007; Muneepeerakul, R., Rinaldo, A., and I. Rodríguez-Iturbe, Effects of river flow scaling properties on riparian width and vegetation biomass, *Water Resources Research*, 2007; Muneepeerakul, R., Rinaldo, A., Levin, S.A., and I. Rodríguez-Iturbe, Signatures of vegetation functional diversity in river basins, *Water Resources Research*, 2007; Convertino, M., R. Rigon, A. Maritan, I. Rodríguez-Iturbe, A. Rinaldo, Probabilistic structure of tributaries in river networks, *Water Resources Research*, Vol. 43, W11418, 2007; Botter, G., F. Peratoner, A. Porporato, I. Rodríguez-Iturbe, A. Rinaldo, Signatures of large-scale soil moisture dynamics on streamflow statistics across U.S. climate regions, *Water Resources Research*, Vol. 43, W11413, 2007; Scanlon, T.M., K.K. Caylor, S.A. Levin, I. Rodríguez-Iturbe, Positive feedbacks promote power-law clustering of Kalahari vegetation, *Nature*, Vol. 449, Sept. 2007; Rodríguez-Iturbe, I., *et al.*, Challenges in humid land ecohydrology: interactions of water table and unsaturated zone with climate, soil, and vegetation, *Water Resources Research*, Vol. 43, 2007; Manfreda, S., M.F. McCabe, M. Fiorentino, I. Rodríguez-Iturbe, E. Wood, Scaling characteristics of spatial patterns of soil moisture from distributed modelling, *Advances in Water Resources*, Vol. 30, 2145-50, 2007; Grimaldi, S., I. Rodríguez-Iturbe, L. Ubertini, (2007), Recent developments in hydrologic analysis, *Advances in Water Resources*, Vol. 30, 2007; Mueepeerakul, R., J.S. Weitz, S.A. Levin, A. Rinaldo, and I. Rodríguez Iturbe, A neutral metapopulation model of biodiversity in river networks, *Journal of Theoretical Biology*, 245, 351-63, 2007; Nordbotten J.M., I. Rodríguez-Iturbe, M.A. Celia, Stochastic coupling of rainfall and biomass dynamics, *Water Resources Research*, 43, W01408, 2007; Bertuzzo, E., A. Maritan, M. Gatto, I. Rodríguez-Iturbe, A. Rinaldo, River networks and ecological corridors: Reactive transport on fractals, migration fronts, hydrochory, *Water Resources Research*, 43, W04419, 2007; Botter G., A. Porporato, E. Daly, I. Rodríguez-Iturbe, A. Rinaldo, Probabilistic characterization of base flows in river basins: Roles of soil, vegetation, and geomorphology, *Water Resource Research*, 43, W06404, 2007; Muneepeerakul R., S.A. Levin, A. Rinaldo, I. Rodríguez-Iturbe, On biodiversity in river networks: A

trade-off metapopulation model and comparative analysis, *Water Resources Research*, 43, W07426, 2007; Puma, M.J. Rodríguez-Iturbe, I., *et al.*, Implications of rainfall temporal resolution for soil moisture and transpiration modeling, *Transport in Porous Media*, 2006; Rodríguez-Iturbe, I., *et al.*, Space-time modeling of soil moisture: stochastic rainfall forcing with heterogeneous vegetation, *Water Resources Research*, Vol. 42 W06D05, 11 p., 2006; Paola, C. Foufoula-Georgou, E. Dietrich, W.E., Hondzo, M. Mohrig, D., Parker, G., Power, M.E., Rodríguez-Iturbe I., *et al.*, Towards a unified science of the earth's surface: opportunities for synthesis among hydrology, geomorphology, geochemistry and ecology, *Water Resources Research*, Vol. 42, W03S10, 6 p., 2006; Caylor, K.K., D'Odorico, P., and I. Rodríguez-Iturbe, On the ecohydrology of structurally heterogeneous semi-arid landscapes, *Water Resources Research*, Vol. 42, W07424, 13 p., 2006; Grimaldi, S., I. Rodríguez-Iturbe, L. Ubertini (2005), New frontiers of hydrology, *Advances in Water Resources*, Volume 28, issue 6, June 2005, pp 541-2; Caylor, K. Manfreda, S. and I. Rodríguez-Iturbe, On the coupled geomorphological and ecohydrological organization of river basins, *Advances in Water Resources*, 28, pp. 69-86, 2005; Manzoni S., Porporato A., D'Odorico P., Laio F., Rodríguez-Iturbe I., Soil nutrient cycles as a nonlinear dynamical system, *Nonlinear Processes in Geophysics*, 11 (5-6), 2005; Daly, E., Porporato, A. and I. Rodríguez-Iturbe, Coupled dynamics of photosynthesis, transpiration and soil water balance: I. Upscaling from hourly to daily level, *Journal of Hydrometeorology*, Vol. 5. No. 3, 546-58, 2004; Daly, E., Porporato, A., and I. Rodríguez-Iturbe, Coupled dynamics of photosynthesis, transpiration and soil water balance: II. Stochastic analysis and ecohydrological significance, *Journal of Hydrometeorology*, Vol. 5 No. 3 559-66, 2004; Caylor, K.K., Scanlon, T.M., and I. Rodríguez-Iturbe, Feasible optimality of vegetation patterns in river basins, *Geophysical Research Letters*, Vol. 31, L13502, 1-4, 2004.