JAMES KIRCHNER
Professor of Physics of Environmental Systems (WSL)

PROFESSOR

James Kirchner is the Director of the Swiss Federal Institute for Forest, Snow, and Landscape Research (WSL, with offices in Birmensdorf, Davos, Lausanne, Bellinzona, and Sion, Switzerland), and also serves as professor of the Physics of Environmental Systems in the Department of Environmental Sciences of the Swiss Federal Institute of Technology (ETH), Zurich, Switzerland.

He earned a bachelor's degree in physics (while also completing a major in philosophy) at Dartmouth College in 1980, and was awarded a master's degree in systems analysis from Dartmouth's Thayer School of Engineering in 1982. He received his PhD from the Energy and Resources Group at the University of California, Berkeley, in 1990. Following postdoctoral work at Caltech, he returned to Berkeley as an assistant professor. He was promoted to full professor in 2002, was named the Goldman Distinguished Professor for the Physical Sciences in 2003, and also served as the director of Berkeley's Central Sierra Field Research Stations. In 2008 he was named as a Fellow of the American Geophysical Union.

His research interests span the fields of hydrology, geochemistry, geomorphology, evolutionary ecology, and paleobiology. His recent research has focused on developing simple, tractable mathematical models and time-series analysis methods for understanding the behaviour of complex environmental systems.

MISSION

Mission Statement of Group

We explore complex environmental systems, often using approaches developed in physics. We seek to answer questions such as: How does rainfall become runoff? How is the chemistry of natural waters shaped by subsurface transport and mixing, by chemical reactions with soils and rocks, and by biological processes? Conversely, what can we learn about these processes at the scale of the whole landscape, by observing the signals that they impart to streams? How do ecological interactions among organisms shape their evolutionary development? What processes control rates and patterns of physical erosion and chemical weathering? And how do they, in turn, regulate the topographic evolution of mountains and valleys, as well as the physical and chemical environment in which we (and all other organisms) live? We explore connections between terrestrial and aquatic environments, and linkages between physical, chemical, and biological processes. Our work typically combines field observations, simple mathematical models, and novel analyses of environmental data.

RESEARCH

Research Activities and Achievements

Recent work by Kirchner and colleagues has illustrated how chemical tracer time series can be used to infer how solutes are stored and mixed in the subsurface of terrestrial landscapes. This work has provided a proof-of-concept study for measuring chemical retardation at the scale of whole landscapes [1], and has demonstrated that weathering processes regulate the composition of stream waters much more tightly than had previously been recognized [2]. Recent work has also shown that many catchments can be usefully characterized by simple functional relationships between subsurface storage and discharge [3]; this approach can also be extended to „do hydrology backward", using streamflow fluctuations to infer rates of precipitation and evapotranspiration at the scale of whole landscapes. Geochemical analyses coupled with cosmogenic radionuclide concentrations can be used to estimate long-term rates of physical erosion and chemical weathering, and to measure their dependence on topographic and climatic factors [4]. Weathering and erosional processes can create self-organized landforms characterized by the emergence of regularly spaced ridges and valleys. The characteristic wavelength of these ridge-valley systems can now be directly predicted from erosional mechanics [5].

Table 1. Research achievements of professor 2004-2009.

ISI peer-reviewed publications*	28
Citations	309
h-factor	9
Books, book chapters, monographs	0
Miscellaneous publications	0
Invited talks	~35
Reviews: projects, papers, people...	~50

* Total publications of professor: 90, total citations: 2648 (h= 32)

[1] Feng X, Kirchner JW, Neal C. 2004. Measuring catchment-scale chemical retardation using spectral analysis of reactive and passive chemical tracer time series. Journal of Hydrology 292:296-307.

[2] Godsey SE, Kirchner, JW, Clow, DW. 2009. Concentration-discharge relationships reflect chemostatic characteristics of catchments. Hydrological Processes 23:1844-1864.

[3] Kirchner JW. 2009. Catchments as simple dynamical systems: catchment characterization, rainfall-runoff modeling, and doing hydrology backward. Water Resources Research 45:W02429, doi:10.1029/2008WR006912.

[4] Riebe CS, Kirchner JW, Finkel RC. 2004. Erosional and climatic effects on long-term chemical weathering rates in granitic landscapes spanning diverse climate regimes. Earth and Planetary Science Letters 224:547-562.

[5] Perron JT, Kirchner JW, Dietrich WE. 2009. Formation of evenly spaced ridges and valleys. Nature 460:502-505, doi:10.1038/nature08174.

TEACHING

Teaching Activities

Kirchner has taught courses in water resources, catchment hydrology, geochemistry, geomorphology, and analysis of environmental data. He currently supervises several PhD students conducting their dissertation research at WSL, and two who are finishing their dissertations at Berkeley.