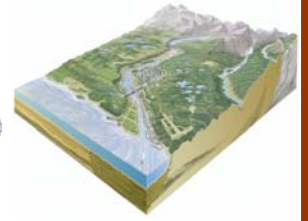




Hydropedology News

The Newsletter of *The Hydropedology Working Group of*
The International Union of Soil Sciences (IUSS)
and The Soil Science Society of America (SSSA)



June 2008 Volume 6, No. 1:1-50 *Issue 9*

Special Issue for the 1st International Conference on Hydropedology, July 28-31, 2008, Penn State Univ.

Dear Colleagues,

The program for the upcoming *1st International Conference on Hydropedology* is shaping up well (p. 2-7). A total of 107 abstracts has been received, with many exciting and cutting-edge presentations to be given by leading scientists – See highlights on p. 8-25, 33-34, and 46. Thus far, 113 people from 20 countries have registered. Please visit the conference web site (<http://hydropedology.psu.edu/>) and sign up for attending this meeting – if you have not done so. One of the conference agenda will be to discuss and foster a global alliance for *monitoring, mapping, and modeling* of the landscape-soil-water-ecosystem relationships across scales. This is in line with growing interests in international scientific communities to establish various observatory networks to monitor the ever-changing environment and to provide transformative platforms for scientific research. Your comments and suggestions on this are welcome. See p. 26-34 for more info.

An exciting and a sad news are noted here. After a 9-month journey, the Phoenix Mars Lander successfully landed in the northern polar region of Mars on May 25. The spacecraft performed a series of challenging tasks after entering Martian atmosphere and descended from 12,000 mph to a soft touchdown in 7 min! The watching of the nerve-breaking “soft landing” quickly turned into a burst of joy and relief, as the Phoenix team members celebrated the unfolding of a new chapter in Mars exploration. Believe or not, the very first thing and the focus of this mission is to dig into the frigid soil to look for signs of water and to check for conditions favorable to microbial life now or in the planet's past (a test called “soil habitability”). More exciting discoveries and images of what we may call *extraterrestrial hydropedology* (i.e., Martian landscape-soil-water-life relationships) can be found on p. 35-42, including a hot news released yesterday.

The devastating magnitude-7.9 earthquake near Chengdu, China shocked the world on May 12. The Monster earthquake killed nearly 70,000 people and caused countless damages and human suffering. The remarkable rescue efforts and worldwide donations (reached \$6.3 billion as of June 5) demonstrated heroic deeds and humanity. Sadly, earthquake prediction or pre-detection remains mysterious despite significant advances in modern technologies. The history of earthquake prediction is long but at most, fruitless. Thousands of earthquakes occur every day around the world, but only a few cause utter devastation. It is intriguing to ponder how, when, and where pieces of the earth's crust suddenly slip past each other in a massive release of pent-up stress (a threshold behavior?). People have tried to associate an impending earthquake with unusual events (such as water level in wells, radon or hydrogen gas content of soil or ground water, animal behavior, foreshocks, electromagnetic fields, or unusual weather). Like lightning flash reaches our eyes before a thunder is heard during a storm (not to mention the visibility of dark clouds gathering and pressure changing before a storm), wouldn't it be likely that big earthquakes would send out advanced signals that humans can detect using advanced technologies?! More on p. 43-46.

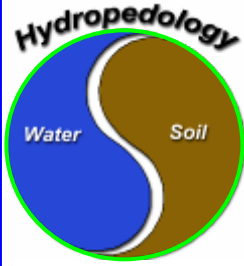
Both Mars exploration and landslide hazards (caused by earth quakes or other forcing) are to be featured at the upcoming hydropedology conference (see p. 8 and p. 46). These issues were considered as some of the frontiers of hydropedology research in April 2004 issue of this newsletter (2:10-11).

As always, I welcome your comments and suggestions. Welcome to the world of hydroped!

Sincerely, Henry Lin, *Editor*

INSIDE This Issue ...

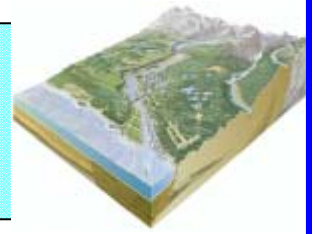
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The First International Conference on HYDROPEDOLOGY

<http://hydropedology.psu.edu/>

UPDATED PROGRAM



July 28-31, 2008

Penn State Univ., University Park, PA, USA

Conference Theme

Water and Soil: Key to Sustaining the Earth's CRITICAL ZONE

Conference Goal and Objectives

To advance the emerging interdisciplinary field of hydropedology and to promote its synergistic collaborations across scientific disciplines. Specific objectives are:

- *To take stock and analyze what has been accomplished so far in hydropedology and to identify where gaps are and how hydropedology can deliver unique contributions to soil & water sciences;*
- *To promote exciting breakthrough collaborations among soil science, hydrology, geomorphology, and other related bio- and geosciences, aiming at synergistic strategies for advancing one another;*
- *To charter a roadmap for international collaboration to advance the frontiers of hydropedology and its contribution to Critical Zone science, including fundamental research, practical applications, and interdisciplinary education and outreach.*

Categories of Targeted Topics (More details at the conference web site)

1. *Emerging concepts and theories in soil science, hydrology, and related disciplines*
2. *Frontiers of integrated and multiscale models of soils and hydrologic systems*
3. *Advanced monitoring, sensing, mapping, and visualization of the subsurface*
4. *Integrated studies of the earth's Critical Zone and its relations to hydropedology*
5. *Cutting-edge applications and innovative education/outreach related to hydropedology*

Sponsors (To Date)



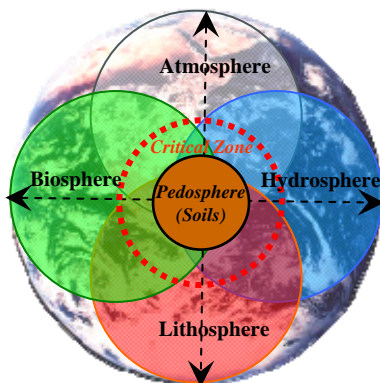
College of Ag. Sci.
Dept. of Crop & Soil
Inst. Energy. & Environ.
Environ. & Nat. Res. Inst.



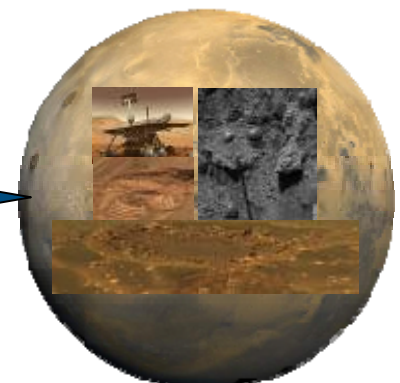
Soil Survey Div.
Nat. Geo. Dev. Center



Hydropedology WG
Commission 4.1



From Earth's Critical Zone



To Mars Exploration!

Presentors are in bold

7:00-8:00 am *Continental Breakfast*

Lobby of Life Sciences Building

Session 1: Opening and Big Pictures

Berg Auditorium, Life Sciences Building

Moderators: Henry Lin and Brent Clothier

Time	Speaker	Presentation Title
8:00-8:15 am	Henry Lin , Penn State Univ.	Conference introduction & overview
8:15-8:25	Graham Spanier , President of Penn State Univ.	Welcome remarks
8:25-8:35	Bob Steele , Dean of College of Agricultural Sciences, Penn State Univ.	Welcome remarks
8:35-8:40	TBD	Welcome remarks
8:40-9:20	Raymond Arvidson , Dept. of Earth and Planetary Sciences, Washington Univ. in Saint Louis	Frontiers of Mars exploration: Going after water by investigations of soils, rocks, and landforms
9:20-10:00	Bill Dietrich , Dept. of Earth and Planetary Sciences, Univ. of California-Berkeley	The dependence of watershed processes on the evolution of the critical zone
10:00-10:20	<i>Coffee Break</i>	Lobby of Life Sciences Building
10:20-11:00	Jeff McDonnell , Kellie Vache, Taka Sayama, Chris Graham, Oregon State Univ.	Re-thinking streamflow generation theory from the bottom-up: A hydropedology approach
11:00-11:40	Johan Bouma , Wageningen Univ., The Netherlands	Hydropedology as a foundation for environmental policy and regulations
11:40-12:15	Alex McBratney and Budiman Minasny, The University of Sydney, Australia	Digital soil mapping and hydropedology: putting the h into scorpan

12:15-1:15 pm *Lunch break (on your own)*

Opportunity for viewing posters on 3rd/4th Floor Bridge in Life Sciences Building.

Session 2: Emerging Concepts and Theories

Berg Auditorium, Life Sciences Building

Moderators: Phillip Owens and Roy Sidle

Time	Speaker	Presentation Title
1:15-1:35 pm	Michael Vepraskas , Dept. of Soil Science, North Carolina State Univ.	Future Directions for Hydropedology: Quantifying Impacts of Global Change on Wetlands
1:35-1:55	Lee Nordt , Steven Driese, Dept. of Geology, Baylor Univ., TX	Hydropedological Properties of a Vertisol Climosequence along the Coast Prairie of Texas
1:55-2:15	Victor O. Targulian , Institute of Geography, Russian Academy of Sciences and Moscow State Univ.; R.W. Arnold, USDA-NRCS, Washington, DC	Critical Zone Concept: Approach of A Pedologist
2:15-2:35	Roy Sidle , Tomomi Terajima, Disaster Prevention Research Institute, Kyoto Univ.; Takashi Gomi., Tokyo Univ. of Agriculture and Technology, Japan	Scaling phenomena related subsurface and surface storm runoff: new evidence from field investigations in Japan
2:35-2:55	Robert B. Jackson , Dept. of Biology and Nicholas School of the Environment, Duke Univ.	Ecohydrology: the Movement and Uptake of Water by Plants
2:55-3:15	Peter Groffman , Cary Institute of Ecosystem Studies	Coupling of hydropedology and biogeochemistry: The importance of hot spots and hot moments
3:15-3:35	<i>Coffee Break</i>	Lobby of Life Sciences Building
3:35-3:55	Timothy Allen , Department of Botany, Univ. of Wisconsin-Madison	Experiments with complexity, hierarchy, soil and water
3:55-4:15	Jayanth Banavar , Dept. of Physics, Penn State Univ.; Andrea Rinaldo, Amos Maritan, Univ. of Padova, Italy	Network theory and geometry of river networks
4:15-4:30	Luisa Hopp , J.J. McDonnell, College of Forestry, Oregon State Univ.	The role of soils on the generation of subsurface flow at the hillslope scale
4:30-4:45	Chris Graham , Jeff McDonnell, Department of Forest Engineering, Oregon State University	Forensic hillslope hydrology: from dissection to discovery
4:45-5:00	Erick Bestland , S. Milgate, D. Chittleborough, J. VanLeeuwen, M. Pichler, L. Soloninka, Earth Sciences, Flinders Univ.; School of Earth and Environ. Science, Univ. of Adelaide, Australia	The Significance and Lag-Time of Regolith Flow: An Example from a Small, Ephemeral Catchment with Contrasting Soil Types in the Adelaide Hills, South Australia
5:00-5:15	Christian Stamm , R. Siber, Swiss Federal Institute of Aquatic Science and Technology; M.K. Schneider, Agroscope Reckenholz-Tänikon Research Station; C. Leu, Syngenta Crop Protection	The Base Flow Index as a proxy for the susceptibility of catchments to diffuse herbicide losses and its prediction from soil map data
5:15-5:30	Thomas J. Nicholson and Mark Fuhrmann, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Washington, DC	Mobility of Radionuclides in the Smear Zone

5:30-6:30 pm *Poster Viewing & Social* (Drinks and snacks will be provided)Viewing posters on 3rd/4th Floor Bridge in the Life Sciences Building.
Vote for best posters!**Evening Session: Conference Banquet and Social**

Days Inn Penn State (240 S. Pugh St., State College)

Moderator: Jeff McDonnell

7:00-8:00 pm *Banquet Dinner*8:00-9:00 pm **Rick Hooper**, CUAHSI (Consortium of Universities for the Advancement of Hydrologic Science, Inc)*Featured Presentation* : A funny thing happened on the way to hydrologic observatories9:00-10:00 pm *Social*

Presentors are in bold

7:00-8:00 am Continental Breakfast

Lobby of Life Sciences Building

Session 3: Frontiers of Modeling and Soil Structure

Berg Auditorium, Life Sciences Building

Moderators: Hans-Joerg Vogel and Michael Gooseff

Time	Speaker	Presentation Title
8:00-8:20 am	Martinus van Genuchten , Department of Mechanical Engineering, Federal Univ. of Rio de Janeiro, Brazil	On estimating the unsaturated soil hydraulic properties at different scales
8:20-8:40	Hans-Joerg Vogel , Ulrich Weller, UFZ Helmholtz Center for Environmental Research; Olaf Ippisch, Institute for Parallel and Distributed Systems, Univ. of Stuttgart, Germany	Scale issues in soil hydraulic modelling - explicit and continuous representation of heterogeneity
8:40-9:00	Yakov Pachepsky , USDA-ARS; Daniel Gimenez, Rutgers Univ.; Allan Lilly, Macaulay Institute, Scotland; Atila Nemes, Univ. of Maryland	Soil Structure and Soil Hydrologic Functioning: A Hydrogeological Framework
9:00-9:20	Rabi Mohtar , Purdue Univ.	Modeling the Multi-Scale Non-Rigid Structured Soil Water Medium
9:20-9:40	Brent Clothier , Markus Deurer, Steve Green, Alec Mackay, Andrew Manderson, and Alistair Hall, HortResearch, AgResearch, Palmerston North, New Zealand	Plants as Hydrogeological Primers and Pumps
9:40-10:00	Jan Hopmans , Univ. of California Davis	Modeling of field-observed soil-plant root interactions
10:00-10:20	<i>Coffee Break</i>	Lobby of Life Sciences Building
10:20-10:40	Philippe Baveye , John Crawford, Ruth Falconer, Dmitry Grinev, Wilfred Otten, Andrew Spiers, and Iain Young, SIMBIOS, Univ. of Abertay Dundee, Scotland	Soil architecture: Formation, visualization, quantification, and modeling of its impacts across scales
10:40-11:00	Alvin Smucker , A. Tartakovsky, W. Wang, A. Kravchenko, ML Rivers, and WJ Sul, Michigan State University, Pacific Northwest National Lab, Argonne National Lab	Visualization and Modeling of Pore Flow Within the Soil Aggregate Black Box
11:00-11:15	Rainer Horn , S Peth, and AJM Smucker, Institute for Plant Nutrition and Soil Science, Christian Albrechts University of Kiel, Germany, and Michigan State University	Structure formation detected on macro- and microscale as a tool for the determination of gas and water transport in unsaturated arable and forest soils
11:15-11:30	Lifang Luo , Henry Lin, Chuck Walker, Penn State Univ.; John Schmidt, USDA-ARS	Quantitative relationship between soil macropore properties and preferential flow and transport using computed tomography
11:30-11:45	Mohammed Salahat , The Hashemite Univ., Jordan; Rabi Mohtar, Darrell Schulze, Purdue Univ.; Erik Braudeau, de Fort de France in Martinique	Field Scale Soil Characterization Using Pedostructural Properties
11:45-12:00	Ana Bertolino, Andrea P. de Souza, Rio de Janeiro State Univ.; Nelson F. Fernandes , Marcel L. Rocha, João P. de Miranda, Federal Univ. of Rio de Janeiro, Brazil	Plough Pan Formation in Tropical Soils: Micromorphological Evidences and Hydrological Effects
12:00-12:15	Patrick Drohan , B Bills, D. Miller, Penn State Univ.; S. Waltman, USDA-NRCS National Geospatial Development Center; S. Dadio, CPSS; E. White, USDA-NRCS	Topographic and parent material relationships of the fragi taxon across Pennsylvania

12:15-1:15 pm Lunch break (on your own)

Opportunity for viewing posters on 3rd/4th Floor Bridge in the Life Sciences Building.
Vote for best posters!

Session 4: Advances in Monitoring and Measurements

Berg Auditorium, Life Sciences Building

Moderators: David Chittleborough and Kamini Singha

Time	Speaker	Presentation Title
1:15-1:35 pm	Christopher Duffy , Dept. of Civil and Environmental Eng., Penn State Univ.	The Penn State Critical Zone Observatory
1:35-1:55	James A. Lynch , School of Forest Resources, Penn State Univ.	Hydrologic Response of a Small Basin to Simulated Rainfall Under Varying Antecedent Soil Moisture Conditions
1:55-2:15	Henry Lin , and Patrick Reed, Dept. of Crop and Soil Sciences and Dept. of Civil and Environmental Eng., Penn State Univ.	The HP_Net and RTH_Net in the Shale Hills Catchment
2:15-2:35	Philip Jardine , Oak Ridge National Laboratory	Research Highlights and Future Directions at the Oak Ridge Integrated Field Research Challenge
2:35-2:55	Garry Schaefer , Michael Strobel, Deb Harms, USDA-Natural Resources Conservation Service	SNOTEL (SNOWpack TELemetry) and SCAN (Soil Climate Analysis Network)
2:55-3:15	Heye Bogena , S. Huisman, T. Pütz, H. Vereecken, Agrosphere Institute, Research Center Jülich, Germany	TERENO - A Network of Terrestrial Observatories for Global Change Research
3:15-3:35	<i>Coffee Break</i>	Lobby of Life Sciences Building
3:35-3:55	Tom J. Jackson , USDA ARS Hydrology and Remote Sensing Lab	The SMAP and SMOS Satellite Missions: Needs and Opportunities
3:55-4:15	Michael Cosh , Thomas J. Jackson, Rajat Bindlish, USDA-ARS-Hydrology and Remote Sensing Laboratory	Surface soil moisture estimation at the watershed scale using in situ networks
4:15-4:30	Colin Campbell , Douglas R. Cobos, Gaylon S. Campbell, Decagon Devices, Inc.	Advances in Watershed Soil Moisture Monitoring Using a New, Dielectric-Based Soil Water Potential Sensor
4:30-4:45	John R. Nimmo , Kim S. Perkins, Kevin M. Schmidt, David M. Miller, Jonathan D. Stock, and Kamini Singha, USGS, Menlo Park, CA	Indexing of soil water availability for diverse water-limited ecosystems
4:45-5:00	James Doolittle , USDA-NRCS National Soil Survey Center; Henry Lin, Penn State Univ.	Hydrogeological investigations of a small, forested catchment with GPR and EMI.
5:00-5:15	Maria M. Nobles , Alabama A&M Univ; L.P. Wilding, Texas A&M Univ.; H. Lin, Penn State Univ.	Comparison of Brilliant Blue FCF dye and Br tracer behavior in caliche and related clayey soils of Central Texas
5:15-5:30	Wesley Miller , USDA-NRCS; Phillip R. Owens, Purdue Univ.	Soil Characterization and Hydrological Monitoring Project, Brazoria County, Texas, Bottomland Hardwood Vertisols
5:30-6:30 pm	<i>Poster Viewing & Social</i> (Drinks and snacks will be provided)	Viewing posters on 3rd/4th Floor Bridge in the Life Sciences Building. Vote for best posters!
6:30-7:30 pm	<i>Breakout Group Discussions</i> (Drinks and snacks will be provided)	Different rooms in the Life Sciences Building (TBD)
7:30-9:00 pm	<i>Dinner (on your own)</i>	

Evening Session: Featured Presentation (Coffee and dessert will be served)

Berg Auditorium, Life Sciences Building

Moderator: Michael Young

9:00-10:00 pm **Peter E. Black**, SUNY College of Environmental Science and Forestry*Featured Presentation* : Buffers for Life: Water, Soil, Carbon, & Everything!

Presentors are in bold

7:00-8:00 am Continental Breakfast

Lobby of Life Sciences Building

Session 5: Integrated Studies of the Critical Zone

Berg Auditorium, Life Sciences Building

Moderators: Phillip Jardine and Peter Groffman

Time	Speaker	Presentation Title
8:00-8:20 am	Murugesu Sivapalan and Ciaran Harman, Department of Geography and Department of Civil and Environmental Engineering, Univ. of Illinois at Urbana-Champaign	Pattern and Function in Soils: Pathways to Prediction
8:20-8:40	Phillip Owens , Laura C. Bowling, Perdue Univ.; Henry Lin, Penn State Univ.	Incorporating terrain attributes to understand the relationship between hydropedologic processes and landscape pedodiversity
8:40-9:00	Michael Young , Todd G. Caldwell, Eric V. McDonald, Desert Research Institute	Evolution of arid alluvial soils: Linking texture and structure to the partitioning of water at different spatial scales
9:00-9:20	Richard MacEwan , PG Dahlhaus, J Fawcett, Department of Primary Industries, Victoria, Australia	Hydropedology, geomorphology and groundwater processes hold the keys to land degradation - Case studies in SW Victoria, Australia
9:20-9:40	Michael Gooseff , Penn State Univ.; Breck Bowden, Univ. of Vermont; Andrew Balsler, Jay Jones, A. Rinehart, Univ. of Alaska, Fairbanks; Aurora Bouchier, Colorado School of Mines	Permafrost Degradation Impacts on Soils, Hydrology, and Aquatic Biogeochemistry in the Brooks Range, Alaska
9:40-10:00	Daniel Richter , Duke Univ.; Ryan Fimmen, Battelle; Dharni Vasudevan, Bowdoin College; Mark Williams, Mississippi State Univ.; Larry West, USDA-NRCS	Rhizogenic Fe Cycling: A Biogeochemical Process Linking Uplands and Wetlands
10:00-10:20	Coffee Break	Lobby of Life Sciences Building
10:20-10:40	Susan L. Brantley , Earth and Environmental Systems Institute, Penn State University	Designing a Critical Zone Exploration Network
10:40-11:00	Kyungsoo Yoo , Univ. of Delaware; Simon Marius Mudd, Univ. of Edinburgh, UK	Soil mass balance approach as an integrator of weathering processes in different scales
11:00-11:15	Lixin Jin and Susan L. Brantley, Dept. of Geosciences, Penn State Univ.	Rock-water interaction in the Shale Hills catchment
11:15-11:30	John Nieber , Roman Kanivetsky, Boris Shmagin, David Mulla, Heidi Peterson, and Bruce Wilson, Dept. of Bioproducts and Biosystems Engineering, Univ. of Minnesota	Regional hydrologic synthesis using system model of watersheds: a new integrative tool to advance knowledge and predictability of hydrologic systems
11:30-11:45	M. Iggy Litaor , Tel-Hai Academic College; Moshe Shenker, Rothem Sade, Hebrew University of Jerusalem, Israel	Hydrogeological characterization of an altered wetland
11:45-12:00	Xiao-Yan Li , College of Resources Science & Technology, Beijing Normal Univ., China; Sergio Contreras, Albert Solé-Benet, Estación Experimental de Zonas Áridas, Spain	Influence of soil surfaces on runoff and hydraulic properties in a Mediterranean limestone shrubland (Sierra de Gádor, SE Spain)
12:00-12:15	Kim Perkins , John Nimmo, USGS Branch of Regional Research, Menlo Park, CA; Richard Coupe, Claire Rose, Michael Manning, USGS Mississippi Water Science Center, Jackson, MS	Infiltration properties of aricultural soils of the Mississippi Delta

12:15-1:15 pm
1:15 pm

Lunch Break (on your own)
Poster voting closes (winners will be announced at the closing of the conference)

Opportunity for viewing posters on 3rd/4th Floor Bridge in the Life Sciences Building.
Vote for best posters!

Session 6: Cutting-edge Applications and Closing

Berg Auditorium, Life Sciences Building

Moderators: Johan Bouma and Mike Vepraskas

Time	Speaker	Presentation Title
1:15-1:35 pm	Larry T. West , P.A. Schoeneberger, USDA-NRCS; G.J. Kluitenberg, Department of Agronomy, Kansas State Univ.	The U.S. National Cooperative Soil Survey and Hydropedology Research
1:35-1:55	David Hammer , US EPA Western Ecology Division; J. L. Richardson, North Dakota State Univ.	Hydropedology in the Soil Science Institute: Building Skills for the Next Generation of Soil Survey
1:55-2:15	Thanos Papanicolaou , Mohamed Elhakeem, Chris Wilson, IIHR-Hydroscience and Engineering, Univ. of Iowa; Lee Burras, Brad O'Neal, Iowa State Univ.	Hydropedological Investigations & Training on a Benchmark Catena Formed in Complex Pleistocene Stratigraphy and Having Intensive Agriculture
2:15-2:35	Edoardo Costantini , Sergio Pellegrini, Pierluigi Bucelli, Nadia Vignozzi, Roberto Barbetti, CRA-ABP; Paolo Storchi, CRA-VIC, Italy	Influence of hydropedology on viticulture and oenology of Sangiovese vine in the Chianti area (central Italy)
2:35-2:55	Yi Wang, Lin Lin, Bin Zhang , Institute of Soil Science, Chinese Academy of Sciences; Chao Gao, Nanjing Univ.; Jialiang Tang, Chinese Academy of Sciences; Haral Zepp, Ruhr University	Effect of different land use system on water movement and nitrogen leaching along the hillslope in subtropical China
2:55-3:15	David Chittleborough , Univ. of Adelaide; J. van Leeuwen, Univ. of South Australia; J. Cox, CSIRO Land and Water; J. Varcoe, R. Smernik, Flinders Univ., Australia	Reducing phosphorus and carbon export from watersheds: the case of the Mt Lofty Ranges watershed
3:15-3:35	Coffee Break	Lobby of Life Sciences Building
3:35-3:55	Roy C. Sidle and Fumitoshi Imaizumi, Disaster Prevention Research Institute, Kyoto Univ., Japan	Triggering mechanisms of landslides and debris flows and their linkages: hydrogeomorphic and hydropedologic influences
3:55-4:10	David L. Cremeens , W. J. Wachter, GAI Consultants, Inc.	Fragipans, Episaturation, and Wetland Delineation on Utility Right-of-ways in southern New York and Northern Pennsylvania
4:10-4:25	Douglas Cobos , Colin S. Campbell, Gaylon S. Campbell, Martin Buehler, Decagon Devices, Inc.; Michael Hecht, Jet Propulsion Laboratory, NASA	Thermal and Electrical Conductivity probe (TECP) for the Phoenix 2007 Scout Mission to Mars
4:25-4:50	Group leaders (TBD)	Group reports & discussions (5' report for each of the five groups)
4:50-5:00 pm	Henry Lin and others	Conference wrap-up, announcement of poster winners, and thanks

Posters

Presentors are in bold

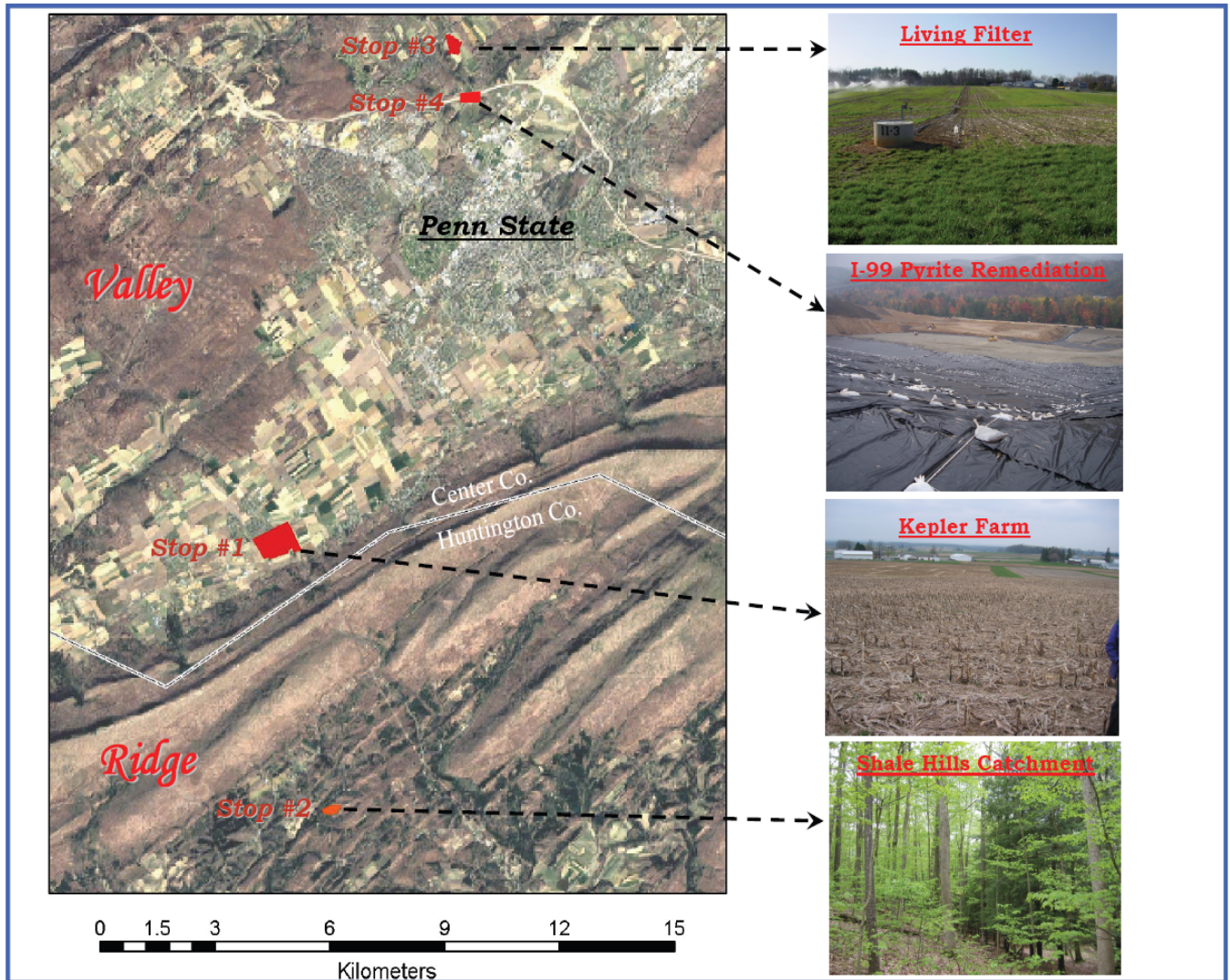
All posters are on display during the entire conference on the 3rd/4th Floor Bridge in the Life Sciences Building

1:15 pm on July 30, 2008 :
Poster voting closes (winners will be announced at the closing of the conference)

Poster #	Authors	Poster Title
1	Sergio Abit, Dept. of Soil Science, North Carolina State Univ.; Michael Vepřaskas , Aziz Amoozegar, Christopher Niewoehner, North Carolina State Univ.	Soil and hydrologic effects on reduction rates and nitrate fate in a vadose zone, capillary fringe and shallow groundwater continuum
2	Majdi R. Abou Najm , R. Mohtar, Dept. of Agricultural & Biological Eng., Purdue Univ.; D. Schulze, Dept. of Agronomy, Purdue Univ.; J. Weiss, Dept. of Civil Engineering, Purdue Univ.; E	Towards a better understanding of the cracking behavior in soils
3	Daniel Altdorff , Department Monitoring and Exploration Technologies, UFZ Helmholtz Centre for Environmental Research, Germany	MOSAIC (Model driven site assessment information and control)
4	Danielle Andrews , Jun Zhang, Henry Lin, Penn State Univ.	Using manual and automated monitoring systems to study soil water movement in a small forested watershed
5	Yaoling Bai , Thorsten Wagener, Patrick Reed, Dept. of Civil and Environmental Eng., Penn State Univ.	An uncertainty framework for downward modeling of watershed hydrology
6	John Barrett , Virginia Tech; Michael Gooseff, Penn State Univ.; Cristina Takacs-Vesbach, Univ. of New Mexico	Biogeochemical Cycling in Riparian Soils Bordering Cold Desert Lakes and Streams
7	Colin Campbell , Jennifer Strause, Douglas R. Cobos, Gaylon S. Campbell, Decagon Devices, Inc.	Field-Scale Distributed Wireless Network for Monitoring Dynamic Hydrologic Processes
8	Mike Castellano , Charles Walker, John Schmidt, Jason Kaye, Henry Lin, Curtis Dell, Penn State Univ., USDA-ARS	Predicting N ₂ O production in a ditch-drained agro-ecosystem
9	Annette Dathe , Penn State Univ.; Jean-Yves Parlange, Cornell Univ.	Can the pore size distribution of a soil be derived from the water retention curve?
10	Robert Dobos , H. Rayond Sinclair, Jr., and Sharon Waltman, USDA-NRCS	Modeling the Water-supplying Capacity of Soil
11	Tobias Doppler , Christian Stamm, Department Environmental Chemistry, Swiss Federal Institute of Aquatic Science and Technology (Eawag)	Reducing uncertainty in the prediction of diffuse herbicide losses with qualitative soil map data related to the water regime
12	Larry Fennessey , Office of Physical Plant, Penn State Univ	Penn State's Stormwater Program from a Soils Perspective
13	Horst Gerke , Michael Sommer, Sylvia Koszinski, Thomas Kaletka, ZALF-Institute of Landscape Hydrology, Germany	Structures and hydrologic function of soil landscapes with kettle holes
14	Andrey Guber , Yakov Pachepsky, EMSL-ARS-USDA; Timothy Gish, HRSL-ARS-USDA; Tom Nicholson, Ralph Cady, Adam Schwartzman, U.S. Nuclear Regulatory Commission	Hydropedologic Analysis of Ground-Water Recharge at the Field Scale
15	Andrey Guber , Y. Pachepsky, EMSL-ARS-USDA; M. Tuller, Univ. of Arizona, Tucson; M. Angel Martín, F. San José Martínez, Agrónomos Universidad Politécnica de Madrid, Spain	Using X-Ray Computed Tomography Visualizations of Large Soil Columns to Study Hydropedologic Relationships at the Horizon Scale
16	Hartmut Holländer , Hydrology and Water Resource Management, Brandenburg Univ. of Technology Cottbus, Germany; H. Flüßler, Dept. of Environmental Sci., ETH, Zürich,	A priori prediction in catchment hydrology
17	Samuel Indorante, J.A. Doolittle , M.A. Wilson, USDA-NRCS; H.S. Lin, Penn State Univ.; B.D. Lee, Purdue Univ.	High-Intensity Soil Survey and Hydropedologic Functional Map Units
18	Michael Jones , Stephen G. Carpenter USDA-NRCS; Michael B. Harman, James A. Thompson, Eugenia M. Pena-Yewtukhiw, West Virginia Univ.	Seasonal Infiltration and Subsurface Water Dynamics Across Benchmark Soil Catenas Of Eastern West Virginia
19	Charlene Kelly , Stephen Schoenholz, Dept. of Forestry and Virginia Water Resources Research Center, Virginia Tech; Mary Beth Adams, USFS Timber and Watershed Lab, WV	Vegetation controls on nitrogen cycling and retention: Soil and water characteristics of "tight" and "leaky" watersheds
20	Del Levia , Dept of Geography, Univ. of Delaware	The stemflow hydrology of a beech-yellow poplar forest in northeastern Maryland: implications for hydropedology
21	A. Lilly , Macaulay Land Use Research Institute, Scotland; B.C. Ball, Scottish Agricultural College, Scotland; I.P. McTaggart, Meiji Univ., Japan; and J. DeGroot, Univ. of Northern Iowa	National scale modeling of nitrous oxide emissions: the role of hydro pedology and land use
22	Henry Lin , Penn State Univ.	Frequency of Preferential Flow Occurrence in the Shale Hills Catchment
23	Lin Lin , Bin Zhang, Institute of Soil Science, Chinese Academy of Sciences	System coupling of water change of hillslope water cycle at the small catchment in red soil area of China
24	Lifang Luo , Henry Lin, Penn State Univ.	Quantification of 3-D soil macropore networks with different soil type-land use combinations using computed tomography
25	J. Miranda, L.M. da Silva, R. L. Lima, N. F. Fernandes , Federal Univ. of Rio de Janeiro; G. K. Donagemma, Brazilian Agri. Res. Center, E. Solos, Rio de Janeiro; A. V. F. A. Bertolino, Rio de	Tillage and Fallow Effects on Soil Physical and Hydrological Properties in Southeastern Brazil
26	Brandon M. Lehman, Jeffrey D. Niemann , Colorado State Univ.	Spatial Patterns of Soil Moisture in a Semi-Arid Montane Catchment with Aspect-Dependent Vegetation
27	Temitope A Okusami , Obafemi Awolowo Univ., Nigeria	Wetlands(Hydropedology);Landforms,Soils and Use in the Humid Tropics of SouthWes Nigeria
28	Guo Yu Qiu , State Key Laboratory of Earth Surface Processes and Resource Ecology, and College of Resources Science and Technology, Beijing Normal University, China	Retrieval of Soil Evaporation Information from Thermal Image and Three-Temperature Model
29	C. Welty, A. Miller, J. Smith, R. Maxwell, R. Shedlock, E. Doheny, T. Kerchkof, Christiane Runyan , K. Belt, M. McGuire, P. Larson, R. Ryan, N. Crook, M. L. Baeck, S. Kaushal, T.	The Baltimore WATERS Test Bed
30	Takahiro Sayama , Jeffrey McDonnell, Oregon State Univ.	The effect of soil depth distribution on the age, origin and flowpath of water at the catchment scale: A virtual experiment approach
31	Maxim Schlossberg , Andrew S. McNitt, Penn State Univ.; Michael A. Fidanza, Penn State Univ. Berks Campus; David R. Moody, Cornell Univ.	Comparison of ninety degree surface tension test and repellency index as measures of soil water repellency
32	P. Schoeneberger , G.J. Kluitenberg, A.J. Heitman, and M.E. Buckley, USDA-NRCS	A comparison of estimated and in-situ saturated hydraulic conductivity in Midwestern soils.
33	Kyongho Son , Dept. of Geography, State Univ. of New York at Buffalo; Ik-Jae Kim, Korea Environment Institute, Seoul, Korea; Jeongkon Kim, Korea Water Resources Corporation	The Impacts of Spatial Input Data Quality on Determination of Runoff and Suspended Sediment in the Imha Watershed using SWAT Model
34	Kenneth Takagi , Henry Lin, Department of Crop and Soil Sciences, Penn State Univ.; Jim Doolittle, USDA-NRCS, Newtown Square, PA	Feasibility of Using Electromagnetic Induction to Determine the Spatial and Temporal Patterns of Soil Moisture in a Steep Forested Catchment
35	Larry West , P.J. Schoeneberger, USDA-NRCS; G.J. Kluitenberg, Kansas State Univ.; D.E. Radcliffe, Univ. of Georgia	Saturated Hydraulic Conductivity: Relation to Horizon Properties and Assessment of Estimation Methods
36	Jennifer Z Williams , Joel Bandstra, David Pollard, and Susan Brantley, Dept. of Geosciences and Center for Environmental Kinetics Analysis, Penn State Univ.	Modeling Na Depletion in Peoria Loess Soils Developed along a Climate Gradient
37	Zhi-Peng Yang , State Key Lab of Earth Surface Processes and Resource Ecology, Beijing Normal Univ., China; Xiao-Yan Li, Institute of Land Resources, Beijing Normal Univ., China	Soil Water Recharge from stemflow of sand-fixed shrubs in Mu Us sandy land, Northwest China
38	Jun Zhang , Henry Lin, Dept. of Crop and Soil Science, Pennsylvania State Univ.; Jim Doolittle, USDA-NRCS, Newtown Square, PA	Identification of subsurface flow pattern using a combination of Ground Penetrate Radar and real-time soil moisture monitoring
39	Qing Zhu , Henry Lin, Penn State Univ.	Inferring Subsurface Flow Pathways in an Agricultural Landscape using Soil Hydrology Monitoring

Thursday (July 31, 2008): Optional Field Trip 8:00 am - 5:00 pm

The bus will begin loading in front of the Life Sciences Building at 7:45 a.m. and depart at 8:00 a.m. A field guidebook and the lunch will be provided. Morning visits: 1) the Kepler Farm and 2) the Shale Hills Critical Zone Observatory (see the map below). Lunch at the Stone Valley Recreation Area. Afternoon visits: 3) the Penn State Living Filter and 4) the I-99 pyrite remediation (see the map below). Demonstration of geophysical tools (such as Ground Penetrating Radar and Electromagnetic Induction) may be arranged during the trip.



Friday (Aug. 1, 2008): Optional additional discussions

Morning: Discussions of draft summary documents for the conference (Organizing committee members, advisory committee members, and anyone else who may be interested are welcome). Location: Room 11 in the Life Sciences Building.

Afternoon: Additional personal interactions for those who like to hang around a bit longer.

Frontiers of Mars Exploration: Going After Water by Investigations of Soils, Rocks, and Landforms

Raymond Arvidson

Dept. of Earth and Planetary Sciences, Washington University in Saint Louis

The exploration of Mars from orbit (Mars Express and Mars Reconnaissance Orbiter, in particular) and the surface (Spirit and Opportunity rovers) over the past 4 years has revolutionized our understanding of the role of water in shaping the surface and the production of aqueous minerals. In particular, the highly cratered and ancient Noachian crust has outcrops that expose phyllosilicate minerals, including Fe and Mg bearing phases and kaolinite. This older crust has also been highly dissected by fluvial processes. Layered hydrated sulfate deposits drape unconformably over the older crust in areas where extensive groundwater upwelling was expected (including the Meridiani deposits explored by Opportunity). This sequence suggests an open hydrologic system early in time, perhaps when Mars had an active internal magnetic dynamo that shielded the atmosphere from solar wind stripping. The transition to the layered sulfate deposits is consistent with increasing aridity and dominance by acid-sulfate aqueous evaporative systems. This period may have corresponded to loss of the internal dynamo and consequent solar wind stripping of the atmosphere. Further evidence for the interaction of water and crustal materials was found by Spirit when its wheels uncovered hydrothermal sulfates and opaline silica deposits next to Home Plate, an eroded tuff cone in Gusev Crater. Additional hydrated opaline deposits have been mapped in many locations from orbit by the CRISM spectrometer, demonstrating that hydrothermal activity was widespread. The investigation of water-bearing materials continues with the landing of Phoenix on May 25, 2008 at ~68 degrees north latitude, where water ice is expected only several centimeters beneath an aeolian soil cover. The lander will sample the soil and ice and conduct phase identification, aqueous chemistry, microscopy, and isotopic compositional measurements of retrieved materials.



Raymond Arvidson is the James S. McDonnell Distinguished University Professor and Chair of the Earth and Planetary Sciences Dept. at Washington Univ. in Saint Louis. He received his PhD from Brown Univ. in 1974. He is a Fellow of the Geological Society of America (GSA) and the American Geophysical Union (AGU) and recipient of the Age's 2007 Whipple Award. Ray is the head of NASA's Planetary Data System Geosciences Node and a director of NASA's Regional Planetary Image Center. Ray has participated in all Mars missions since Viking, and in Magellan Mission to Venus. He is the Deputy Principal Investigator for the 2003 Mars Exploration Rover Mission, and the Co-Investigator and "dig czar" for the 2007 Mars Phoenix Lander Mission. His research focuses on planetary surfaces with a particular interest in the geologic evolution of Mars and implications for habitability and life. He has nearly 200 peer-reviewed publications on Earth, Mars, Venus, and the Moon, many of which are considered pivotal to our understanding of planetary processes. He was the president of the AGU Planetary Sciences section, and has been an editor of *Geology*.

The Dependence of Watershed Processes on the Evolution of the Critical Zone

Bill Dietrich

Dept. of Earth and Planetary Sciences, Univ. of California-Berkeley

Hilly and mountainous landscapes are typically mantled with a thin colluvial soil under which to varying depths there exist fractured saprolite and weathered bedrock. The critical zone extends from the forest canopy to fresh underlying bedrock. Fracturing due to tectonism, topographic curvature, and weathering opens up the critical zone into the underlying bedrock. Three intensive field campaigns to understand coupled hydrologic and geomorphic processes in Oregon and California, reveal in all cases that shallow flow in near surface fractured bedrock dominates storm runoff, base flow, and landsliding. Hydrologic measurements between the base of the soil and the underlying perched water table in the bedrock, however, are rare in other studies. This “unmeasured zone” not only is crucial to runoff dynamics and pore pressure evolution, but it may play a central role in resiliency of vegetation to drought cycles because water in the fracture rock may be a crucial source of water during dry periods. We need geomorphic transport laws to predict the coevolution of the critical zone, landscapes, and ecosystems. Field hydrologic studies should be based upon a strong geomorphic context and models are needed that account for the influence of the hydrologic dynamics in the critical zone (specifically in the near-surface bedrock) on geomorphic and climatic processes.



Bill Dietrich is a Professor of Geomorphology in the Dept. of Earth and Planetary Science and the Dept. of Geography at the Univ. of California-Berkeley. He also serves as a Geological Science Senior Faculty in the Earth Science Division of Lawrence Berkeley National Laboratory. Bill obtained his MS (1975) and PhD (1982) in geology from the University of Washington and joined the UC Berkeley faculty in 1981. With his students and collaborators his research has focused on river mechanics, sediment transport processes, development of geomorphic transport laws, and coupling hillslope hydrology to geomorphic processes. He has published more than 165 papers, including several in *Nature* and *Science*. He is a Co-PI in the National Center for Earth-surface Dynamics and helped form the National Center for Airborne Laser Mapping as a co-founder. Bill has received numerous awards, among them was the prestigious AGU Horton Award in 1995. He is a fellow of AGU, GSA, and a fellow of National Academy of Sciences (2003) and American Academy of Arts and Sciences (2003). Bill has served as a Deputy Editor of *Water Resources Research* (1993-96) and has been on the editorial board of *Catena*, *Geology*, and *Annual Reviews of Earth and Planetary Sciences*.

Re-thinking Streamflow Generation Theory from the Bottom-up: A Hydrogeology Approach

Jeff McDonnell, Kellie Vache, Taka Sayama, Chris Graham
Dept. of Forest Engineering, Oregon State Univ.

Streamflow generation theory has remained largely unchanged since the 1960s despite numerous case studies from an ever-widening array of watersheds. Two broad classes of streamflow generation behavior have been described and conceptualized into widely used model structures: infiltration excess overland flow and saturation excess overland flow. These concepts rely on description of the spatial patterns of soil surface infiltration rates and “variable source areas” of saturation (from rising near-stream water tables). While subsurface stormflow during events is observed in many environments and sometimes associated with infiltration-excess and saturation-excess, its location and often threshold activation are poorly conceptualized and poorly predicted by the topography of the soil surface. Furthermore, mechanisms of subsurface stormflow are seemingly endless from lateral preferential flow, to flow along impeding layers, to flow in highly conductive soil and sub-soil layers—all largely unpredictable from conditions at the soil surface. So how can we conceptualize subsurface stormflow and its many manifestations? Can we cast it in a manner consistent with existing streamflow generation concepts? Here we adopt a hydrogeology approach to group all the manifestations of subsurface stormflow as “storage excess” subsurface flow. The concept forces a spatially explicit representation of the total and dynamic subsurface storage volume in the watershed both during and between precipitation events. We present data from watersheds distributed across a wide array of climate, geology, vegetation and topography to show how hydrogeology may play a useful role in describing storage excess subsurface flow and how this knowledge can in turn be used to predict streamflow, the geographic sources of streamflow and streamwater residence times.



Jeffrey McDonnell is Professor of Hydrology at Oregon State Univ. and Richardson Chair in Watershed Science in the Dept. of Forest Engineering. He has authored about 150 journal articles and edited several texts including the textbook (together with Carol Kendall) “*Isotope Tracers in Catchment Hydrology*.” Recently he has served as Senior Advisory Editor of the “*Encyclopedia of Hydrological Sciences*” and is currently Editor-in-Chief of the IAHS Book Series “*Benchmark Papers in Hydrology*.” Jeff has received the Gordon Warwick Award from British Geomorphological Research Group and is a Fellow of the International Water Academy. He has recently delivered the Penman Lecture to the British Hydrological Society, The Boussinesq Lecture to the Boussinesq Centre in The Netherlands, and the Frontier Lecture to the American Geophysical Union. He is a registered professional hydrologist with the American Institute of Hydrology. Jeff is past President of the International Commission on Tracers and outgoing Chair of the IAHS Decade on Prediction in Ungauged Basins. He has served as Associate Editor for *Water Resources Research*, *ASCE Journal of Hydrologic Engineering*, *Hydrological Sciences Journal* and *Hydrological Processes*. He is now Associate Editor for *Journal of Hydrology*, *Hydrology and Earth Systems Science* and Editorial Board Member for *Hydrological Processes*, *Geography Compass*, and *Ecology*.

Hydropedology as a Foundation for Environmental Policy and Regulations

Johan Bouma

Wageningen Univ., The Netherlands

Environmental policy and regulations are increasingly institutionalized in Europe in terms of laws and regulations. Examples are the water and soil guidelines with legal status. This offers excellent opportunities for soil science and hydrology but the fragmented character of our various subdisciplines turns out to be an unfortunate barrier for a comprehensive dynamic characterization of the natural soil-water system that should ideally form the basis for such laws and regulations. A framework has recently been proposed by the Royal Dutch Academy of Sciences to integrate various scientific disciplines into an operational scheme with the objective to define not only actual environmental conditions in a given landscape but also potential ones as a function of various future land-use scenario's. This framework was based on: (i) the so-called three-layer concept for regional planning used in the Netherlands, including one defining the dynamics of the soil-water system; (ii) the seven soil functions defined by the EU Soil Protection Strategy, and (iii) the DPSIR approach, defining Drivers, Pressures, Impacts and Responses to land use change leading to different States. The hydropedology concept is particularly suitable to define conditions of soil and water as a function of various types of land use as it focuses on real conditions in the field and links strongly correlated soil and water dynamics. An example will be discussed for a region in the Netherlands and suggestions will be made to adapt our scientific practices to be more in line with modern developments in society where stakeholders become more important and where at least some scientists have major impact by acting as knowledge-brokers. This all translates into a needed effort to define innovative Communities of Scientific Practice that reach beyond the classical rituals of the scientific community.



Johan Bouma is a Professor Emeritus of Soil Inventarisation and Land Evaluation at Wageningen Univ. and a member of the Royal Dutch Academy of Sciences, Arts and Letters (1989). Johan obtained his MSc (1966) and PhD (1969) at Wageningen Univ. He then joined the Soils Dept. at Univ. of Wisconsin-Madison first as a postdoc and later as a tenured Associate Professor. His work was focused on soil disposal of septic tank effluent and on relations between water movement in soils and soil structure/morphology. He returned to the Netherlands to become head of the Soil Physics Dept. of the Netherlands Soil Survey Institute in 1975 and later in 1983 as Deputy Director in charge of research. He worked on water movement in clay soils and on micromorphological analyses of flow patterns in soils. In 1986 he was appointed as Professor of Soil Science at Wageningen Univ., focusing on land evaluation and soil characterization, working not only in the Netherlands but also in many developing countries. He was a member of the Scientific Council for Government Policy in the Hague (a think-tank in the prime minister's office) from 1998-2003 and Scientific Director of the Environmental Sciences Group of the University from 2002-2004. He was the Editor-in-Chief of *Geoderma*. He is a fellow of the SSSA (1983) and an honorary member of the International Union of Soil Sciences (2006).

Digital Soil Mapping and Hydropedology: Putting the H into SCORPAN

Alex McBratney and Budiman Minasny

Dept. of Soil Science, The University of Sydney, Australia

Digital soil mapping is a label that my colleagues and I put on a growing body of work from the eighties until the turn of the century. The aim of the naming was to define, elucidate and foster interest in this approach to soil mapping and assessment. This has been successful in that interest worldwide is large and expanding. Hydropedology has a similar rationale and aspiration.

One of the ideas underlying digital soil mapping is the mnemonic model – scorpan – an extended Jenny list, but for spatial prediction rather than explanation. Nevertheless we agonised for a long time on whether scorpan should be scorphan – with the h hydrological factor separated out explicitly from the r relief or topographic factor. Ockham's razor won out and we went for the slightly more parsimonious model. We need to investigate whether h can be modelled explicitly for the spatial prediction of soil properties.

So we will talk about the history of, and rationale behind, digital soil mapping and assessment and its key challenges. We will then discuss the intersection and synergy between digital soil mapping and hydropedology and suggest research questions of mutual benefit.



Alex McBratney is a Professor of Soil Science and Pro-Dean of the Faculty of Agriculture, Food & Natural Resources at the Univ. of Sydney, Australia. He is also the Director of the Australian Centre for Precision Agriculture, Joint Editor-in-Chief of the global soil science journal, *Geoderma* and Vice-Chair of IUSS Division 1 (Soil in space and time). He has worked consistently over the last 25 years, from Rothamsted in the UK, to CSIRO and to the Univ. of Sydney in Australia, on the quantification of soil variation and applications, particularly soil mapping and precision agriculture. This has led to collaborations in many countries worldwide. He was instrumental in recognizing and developing pedometrics – the fastest growing sub-discipline of soil science. This effort has been reported in some 150 refereed journal articles which have been cited some 2400 times with an h index of 30. He has received the J.A. Prescott Medal in Soil Science from the Australian Society of Soil Science and the Richard Webster Medal from the International Union of Soil Sciences, and four best paper awards. Alex also recognized the concept of digital soil mapping in a seminal paper in 2003, then established and led the International Union of Soil Sciences Working Group on Digital Soil Mapping. He is co-editor of the recently published book *Digital Soil Mapping: an Introductory Perspective*.

A Funny Thing Happened on the Way to Hydrologic Observatories

Rick Hooper

Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI)

Hydrologic science, along with other related environmental sciences and engineering communities, has been developing community science plans over the past 5 to 10 years to justify large-scale investments in environmental observatories. This has been a challenging exercise, in part because it hasn't been done before, but also because the objectives of these science plans were unclear. Were they to be "manifestos" defining the great challenges of the field and inspiring concerted action towards solving them? Were they to be implementation plans laying out the most pressing problems in the near term? Were they to be marketing documents to secure large-scale funding from Congress? Most of the documents produced were a little of each and seldom could be considered inspirational or intellectually profound. In part because of the confusion about the objectives of these science plans, they did not always work to bring the communities together. Scientists or engineers whose specialties were not featured prominently in these documents feared that their research funding could be reduced if these reports had their desired impact on the funding agencies.

What, then, are we trying to accomplish by organizing the community and producing these reports? In reviewing the past five years and the difficulties that committees had in writing these documents, a few conclusions can be drawn.

First, hydrologic science is not sufficiently mature to have achieved a consensus on fundamental aspects of our science. This is commonly acknowledged by the difference between the "splitters," who seek "first principles" explanations (generally based on fluid mechanics) for hydrologic phenomenon and the "lumpers" who seek emergent properties to explain the same phenomenon. As Jim Kirchner has pointed out, both are seeking physically-based models, but the question is which physics is appropriate? This dichotomy, however, complicates how we, as a community, tackle (and even pose) our "three big questions" that we are supposed to organize around.

Second, although we aspire to large-scale observatories and to integrated models of the hydrologic cycle, there is a big gap between what we know how to do and where we would like to go. That's great as a challenge, but problematic when we are pressed to provide detailed justifications for large-scale capital investments.

Finally, the fit between funding opportunities presented to us, such as large-scale capital investment by the NSF and what we need isn't a good one, at least with our current knowledge and experience. An adaptive system with a longer build-out period so we can learn as we go is far preferable to having to lock in a continental-scale design immediately and then build it over 5 years. Substantial investments in prototyping activities are necessary to figure out how to do observatories "right."

What's the way forward? First, we must recognize that we are organizing to enable advances in hydrologic science that can't happen by working as individuals or small groups. Hydrologic science, like other environmental sciences, depends on observations rather than experiments as the basis for inferring controlling processes. Stronger inferences can be made using multidisciplinary approaches, by having denser data in space and time, by having "coherent" data that link stress and response, and by having longer term and larger scale data to improve the signal to noise ratio. Significant barriers exist in cost, scale, and expertise for single investigators to acquire such data sets. The various CUAHSI and CUAHSI-affiliated projects in informatics, instrumentation, synthesis, and observatories seek to lower those barriers through improved access to data, to advanced instrumentation, to venues for interdisciplinary scholarship, and to field facilities. The path has been longer than what we anticipated five years ago, but great progress has been made and we are poised, through initiatives planned in the coming five years, to make even greater strides. CUAHSI is exploring how a Community Hydrologic Modeling Platform (CHyMP) can accelerate model development and improve access to high-performance computing environments and how Community Measurement Campaigns can develop community data sets on integrated observations of the hydrologic cycle in different field settings. These are just two of the many services that we are developing to enable individual scientists to pursue their interests more efficiently. A network of hydrologic observatories remains a goal, but we can accomplish a lot of science on our way to achieving that goal.



Rick Hooper received A.B. in Applied Math (Harvard, 1979), MS (1984) and PhD (1986) in Environmental Engineering from Cornell. He held a NATO Postdoctoral fellowship during 1986 at the Center for Industrial Research, Oslo, Norway and the Ontario Ministry of the Environment, Dorset Research Lab. He was a research hydrologist at the USGS in Atlanta, GA from 1987 to 1998 where he was the co-PI on the Panola Mountain Research Watershed study. During that time, He and his colleagues in Britain and Norway developed End Member Mixing Analysis that has been widely used in small watershed studies. In 1998, he became a member of the Office of Water Quality of the USGS with responsibility for the National Stream Quality Accounting Network (NASQAN), a large-river water quality program and the Hydrologic Benchmark Network, a network of minimally disturbed reference sites. In 2003, he became the Director and the President of CUAHSI.

Buffers for Life: Water, Soil, Carbon, & Everything!

Peter E. Black

College of Environmental Science and Forestry, State Univ. of New York (SUNY)

This presentation identifies a structure for a sustainable approach toward resource protection and management. Research reveals that there is a common asymmetrical pattern to the distribution of (probably) everything in the universe, all duplicating the simplest atom's distribution of mass. *Nothing* that I have examined contradicts that pattern. It appears to be a universal characteristic of Earth's planetary support systems, the major resources on which we depend, water, air, land, and soil processes, biomes and their biodiversity, and a means for understanding the impact of our tampering with the carbon cycle. The pattern is clearly established in terms of the universe's mass, energy, space, and time as well. These support systems (natural resources), considered as *buffers*, are essential elements of sustainable resource management. Humans *violate* the pattern in our numbers where, according to the pattern and at the top of the food chain, we would occupy an infinitesimally small percentage of Earth's organic carbon. Humans also emulate the pattern in a surprising array of our cultural habits and customs. How *Homo Sapiens* will be sustained is dependent upon how well we understand and manage those support systems and natural resources.

Peter Black is a Distinguished Teaching Professor of Water and Related Land Resources, Emeritus, at the SUNY College of Environmental Science and Forestry in Syracuse, NY. He taught and conducted research at ESF since 1965. He retired "from a job, not a career" in Dec., 2000, and continues to write, teach short courses and workshops, advise students, and provide public services, representing ESF at local, regional, state, and national advisory committees involved in soil and water conservation. He received BSF and MF degrees in Forestry from The Univ. of Michigan in 1956 and 1958, and a PhD in Watershed Management from Colorado State Univ. in 1961. He was a Research Forester at the US Forest Service's Coweeta Hydrologic Laboratory in North Carolina from 1956 to 1959, and taught at Humboldt State College in Arcata, CA from 1961 to 1965. He holds Professional Hydrologist certification by the American Institute of Hydrology, and Environmental Professional Certification by the National Association of Environmental Professionals. Black has published an educational film, numerous articles on hydrology and water resources, and three books entitled *Environmental Impact Analysis* (Praeger, 1981), *Conservation of Water and Related Land Resources* (CRC Press/Lewis Publishers, 3rd Edition, 2001), and *Watershed Hydrology* (Ann Arbor Press, 2nd Edition, 1996). In 1974, he co-founded IMPACT CONSULTANTS, a private firm in Syracuse, for which he served as EIS project manager for twelve years. He served as President in and is a Fellow of the American Water Resources Association. He has served as an Associate Editor for the *Journal of American Water Resources Association* and *Water Resources IMPACT*. Black has served on the US Army Corps of Engineers' Environmental Advisory Board (1992-6), and as its Chair in 1995-6, for which he received the Commander's Award for Public Service in 1996. In 2006, he commenced broadcasting Water Drops, a series of weekly two-minute essays about water culture, history, law, organizations, policy, and science on NPR affiliate WRVO FM in Oswego, NY.



Towards a Better Understanding of the Cracking Behavior in Soils

Majdi R. Abou Najm, Rabi H. Mohtar, *Department of Agricultural & Biological Engineering, Purdue Univ.;*
Darrel Schulze, *Department of Agronomy, Purdue Univ.;* Jason Weiss, *Department of Civil Engineering, Purdue Univ.;*
Erik Braudeau, *Institut de recherché pour le développement (IRD), France;* Jay Jabro, *NPARL USDA-ARS, Sidney, MT.*

Understanding and modeling shrinkage-induced cracks helps bridge the gap between flow problem in the laboratory and at the field. Modeling flow at the field scale with Darcian fluxes developed at the laboratory scale is challenged with preferential flows attributed to the cracking behavior of soils. Understanding and characterizing the cracking behavior of soils present a much-needed area of research, the outcome of which will contribute towards filling major knowledge gaps in understanding soil behavior at the field scale, as well as shedding more light on the physical understanding of the shrinkage-induced preferential flow problem. In this study, we aim at providing a functional definition of the cracking behavior of soils through continuous monitoring of soils at the field scale. Series of field digital images were captured along with multi-layer water content and temperature measurements. In our methodology, we followed an upscaling approach in an attempt to understand the cracking behavior of soils starting with the micro scale constituting the primary soil particles. A functional approach assessing the soil's structure through its functional characteristics (shrinkage-swelling and stress-strain relationships) is adopted building on current novel approaches and tools including the pedostructure concept and the restrained ring method. Cracking dynamics are characterized as function of soil water content using the extracted cracking areas and water content profiles. An optimized methodology to quantify cracking area in soils through digital imagery analysis will be proposed. This study contributes towards filling a major knowledge gap in the understanding of the flow problem at the field scale. The field experiments were conducted on the Savage soil in the Northern Plains Agricultural Research Lab in Sidney, Montana.



Majdi received BE in Civil Engineering (1998) and ME in Environmental & Natural Resources Engineering (2000) from the American University of Beirut. He then worked on various environmental engineering and regional planning projects in the Middle East and Africa before joining the PhD Program of the Agricultural & Biological Engineering Dept. at Purdue Univ. in 2005. His current research focuses on the characterization of cracking behavior and scaling problems of soils. Recognizing the need to understand the stress evolution of soils undergoing shrinkage, Majdi has introduced an experimental approach (the restrained ring method) to assess the internal stress development in unsaturated soils. Using digital imagery analysis and the restrained ring method, he is currently extending the new methodology to obtain stress-strain relationships for drying soils subject to environmental loads like shrinkage. Moreover, he is currently working on establishing a functional definition of the cracking behavior of soils through coupling the state of art understanding of soil structure and its functional characteristics (including soil shrinkage and swelling properties) with digital imagery analysis (in the framework of remote sensing tools) to monitor and quantify surface cracks in soil. Majdi has also developed a teaching module titled "Scaling in Hydrologic Processes" that was tutored in different courses and various departments.

Reducing Uncertainty in Predicting Diffuse Herbicide Losses with Qualitative Soil Map Data related to the Water Regime

Tobias Doppler, Christian Stamm

Dept. Environmental Chemistry, Swiss Federal Institute of Aquatic Science and Technology (Eawag)

The vulnerability of agricultural fields to diffuse herbicide losses into surface waters is highly variable in space and strongly determined by soil hydrology. Hydrological models can be used to predict the spatial occurrence of fast flow processes, which mainly contribute to the herbicide loads in surface waters. Spatially distributed, process-based models need to be extensively parameterized and often the parameters needed for modeling carry high uncertainty. For example the parameters describing the transition from soil to geology are poorly known in many cases but important for the prediction of saturated areas generating overland flow. Consequently the uncertainties in the predictions are often too high for practical use and tools are needed to reduce these uncertainties without additional field measurements. A possibility that is explored here is the use of qualitative and semi-quantitative information on the soil water regime contained in soil maps. Soil attributes like soil type, gley horizons or redoximorphic features reflect the long term water regime of a soil. This water regime is also relevant for the short term response of the soil to rain events. By including these qualitative soil attributes into a short term predictive model, the prediction uncertainty can possibly be reduced. From attributes like e.g. soil types, hydrological soil classes and the depth of gley horizons the percentage of time a soil is saturated at a certain depth, or an average water table, can be estimated. This information is used to constrain the model parameters. As a proof of principle a characteristic hillslope in the Swiss plateau is modeled with the hydrological model CATFLOW. The hillslope is very heterogeneous in soil types ranging from well drained cambisols to gley soils within short distances. By means of Markov Chain Monte Carlo simulations the prior parameter distributions are constrained to parameter combinations that result in water table depths consistent with those derived from qualitative attributes contained in the soil map. Since soil attributes represent average situations over many years, long term simulations need to be run. However, the processes relevant for herbicide losses - our primary target - take place on much smaller time scales (single rain events). We assess the uncertainty reduction by comparing short term predictions based on the prior parameter distribution with the predictions based on the parameters constrained by pedologic attributes.



Tobias Doppler received BS in environmental science at ETH Zurich in 2006. In his diploma thesis he worked on groundwater flow and transport modeling, especially on the interactions between surface waters and groundwater. In 2007, he started PhD at ETH Zurich, with research being done at Eawag (Swiss Federal Institute of Aquatic Science and Technology). His project is about diffuse pollution of surface waters with pesticides. A field study is carried out in a small agricultural catchment in the Swiss plateau where herbicides are applied in a controlled manner on different fields and then herbicide concentrations are measured in different locations in the brook and in tile drains. Soil hydrology is a main factor that determines how much an area contributes to the total herbicide load in the surface water; therefore hydrological variables (groundwater level, discharge in the brook and in drainage tubes and soil moisture) are measured. In cooperation with field pedologists pedological information on the soil map are translated into a range of depths at which soil is saturated (or nearly saturated) in the course of a year.

The Role of Soils on the Generation of Subsurface Flow at the Hillslope Scale

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The links between pedology and hillslope runoff generation are poorly understood. Soils play a fundamental role for subsurface flow generation by controlling the infiltration, redistribution, storage, mixing and release of rainfall. Interactions between soil and topography lead to strongly non-linear behavior at the scale of hillslopes with threshold-like responses and hysteresis often observed in field studies. While field experiments have increased our understanding of hydropedological processes, such work is still of limited value because of the small number of places and events that have been characterized to date. This presentation explores how models can be used to study hydropedological processes and specifically, the generation of lateral subsurface flow - one of the core interfacial areas of pedology and hydrology. We present a number of virtual experiments from our well characterized experimental hillslopes with a 3D physically-based finite element model using the Richards equation. Model setups based on field data as well as hypothetical scenarios explore the interplay between soil, topography and hillslope geometry controlling subsurface flow generation. Implications for the hillslope storage-discharge relationship are discussed. The visualization of model results in 3D allows the study of the dynamics of subsurface saturation patterns, flow paths, velocities and spatial variability of flow, enhancing our understanding of how soils influence hydrology and how hydrology may shape soil development.



Luisa Hopp is currently a Postdoctoral Research Fellow in Jeffrey McDonnell's group at Oregon State Univ. in Corvallis. She received her diploma in Agricultural Sciences at the University of Kiel, Germany, with a focus on soil science, soil physics and ecosystem analysis. After a 7-month stay in Brisbane, Australia, working for CSIRO, Luisa worked as a research assistant at the Univ. of Bayreuth, Germany, receiving her PhD in Hydrology in 2005. In her PhD work, she investigated the environmental fate of arsenic and chromium in a podzolic soil, contaminated by wood preservatives, by sampling in-situ soil water and groundwater and studying the mobility and speciation of the metals in lab experiments. Before coming to the US, Luisa was a Postdoc at the Technical Univ. of Braunschweig, Germany, where she was involved in a national effort to standardize groundwater risk assessment procedures for heavy metals. Luisa's field of expertise is the modeling of variably-saturated flow from the column to the hillslope scale, with a particular interest in the role of soil properties for the generation of lateral subsurface flow. Her modeling work is grounded in field data, and she applies physics-based models to several natural and engineered hillslopes. In addition to modeling, Luisa also works in the field at a mine site in Southeast Alaska, investigating subsurface flow in an engineered soil cover system over waste rock.

Comparison of Brilliant Blue FCF Dye and Br Tracer Behavior in Caliche and Related Clayey Soils of Central Texas

Maria M. Nobles, *Alabama A&M Univ.*; L.P. Wilding, *Texas A&M Univ.*; H. Lin, *Penn State Univ.*

Visual tracers such as Brilliant Blue FCF dye are commonly used for the study of in-situ solute behavior in soil. Brilliant Blue FCF remains one of the most popular tracers for determining solute flow in the field. However, recent studies have shown that the mobility of Brilliant Blue FCF is relatively limited when compared to some inorganic tracers such as Br⁻. The objective of the study was to compare the movement of Brilliant Blue FCF dye and Br⁻ tracers through caliche and related clayey soils in Central Texas, including Brackett (loam and clay loam Udic Calcistolls), Volente (sandy clay loam Cummulic Haplustolls), and Speck series taxadjuncts (clayey Typic Argistolls). Both tracers were applied simultaneously to surface and subsurface horizons of eight selected sites, followed by the excavation of several vertical sections through each application site, resulting in a total of 20 vertical sections. Horizontal sections were also excavated at three of the sites for a total of 14 horizontal sections. Digital photos of Brilliant Blue FCF distribution were first taken, followed by spraying a chemical indicator of Br⁻ on soil surface, which allowed Br⁻ patterns to be photographed. Distribution patterns of both tracers were digitized, and stained areas determined by image analysis. While Brilliant Blue FCF demonstrated far more evidence of preferential flow along macropores, Br⁻ commonly dispersed to greater lateral and vertical depths than Brilliant Blue FCF. In 34 profile sections, 16% more of total section area was stained by Br⁻, as compared to area stained by Brilliant Blue FCF. Bromide generally dispersed to depths greater than Brilliant Blue FCF (1.0 m and 0.7 m, respectively). Deeper vertical dispersion of Br⁻ was evident in all sites except those with limiting Cr or R horizons, where Br⁻ distributions compared favorably to Brilliant Blue FCF. Bromide also moved to a greater lateral distances than Brilliant Blue FCF (0.3 m and 0.2 m, respectively). Single limestone fragments showed greater Br⁻ penetration into the fragment matrix, as compared to Brilliant Blue FCF. It is believed that Brilliant Blue FCF dye is a better proxy of how heavy metals and large soluble organic molecules might move in soil, while Br⁻ showed little retardation and is believed to be a better tracer of water transport.



Dr. Maria Nobles was born in Russia and received her undergraduate degree in soil science from Moscow State Univ. Her Ph.D. research at Texas A&M Univ. concentrated on solute flow paths characterization in structured soils of Texas. Dr. Nobles' work focused on morphological and micromorphological properties of structural aggregate surfaces such as slickensides and root channels and their influence on solute transport on macroscopic, microscopic and submicroscopic scales. This research also represented some of the first work on spatial association between roots and preferential flow in structured soils. The emerging knowledge of preferential flow in Vertisols was further applied to the studies of spatial variability in root systems and their correlation with solute flow pathways. Dr. Nobles is currently employed as a postdoctoral associate at Alabama A&M Univ., where her research focuses on the influence of prescribed forest management treatments on chemical, hydrological, and mineralogical properties of forest soils.

*The Effect of Soil Depth Distribution on the Age, Origin and Flowpath of Water at the Catchment Scale:
A Virtual Experiment Approach*

Takahiro Sayama, Jeff McDonnell

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The effect of soil depth and depth distribution at the catchment scale is an important, yet poorly understood control on the age, origin and flowpath of water at the catchment scale. We use a physically based hydrologic model together with field data from the well-studied Maimai watershed in Zealand and HJ Andrews Watershed in Oregon to explore how soil depth and depth distribution control the age and source of streamflow. Our model simulates unsaturated, saturated subsurface and surface rainfall-runoff processes. We first demonstrate the ability of the model to capture hydrographs and then confirm the ability of the model to simulate new/old water fractions of streamflow and mean residence time of streamflow and soil water. After demonstrating that the model is capturing flow and transport dynamics for the right process reasons, we conducted a series of virtual experiments (numerical experiments driven by a collective field intelligence) by switching soil depths between the two catchments to understand how soil depth and its distribution control water age and source. Results indicated that thicker soils increase mean residence time and concentrate the source of streamflow more in the near stream zone. In addition, the distribution pattern of soil water residence time was strongly affected by soil depth distribution. Our findings indicated that representative soil depth distribution at the catchment scale is necessary to identify spatio-temporal sources of streamflow. The strong correlation between mean residence time and soil depth imply that we may be able to estimate the representative soil depths from isotope-based mean residence time approaches.



Takahiro Sayama is an Assistant Professor at Disaster Prevention Research Institute at Kyoto Univ. He is currently visiting Oregon State Univ. on a JSPS Fellowship from Japan to work with Prof. Jeffrey McDonnell for 2 years period. He completed his Bachelor, Master and PhD degrees from Civil Engineering Program at Kyoto Univ. His PhD dissertation was "Distributed Modeling and Forecasting of Rainfall-Runoff Systems and Their Uncertainty Evaluation," from which he received two best paper awards from Japan Society for Civil Engineers. His recent study explores how soil depth and topography influence the mixing and aging of water at the catchment scale. In this study, he developed a time-space accounting scheme for a distributed rainfall-runoff model to analyze the age and source of water. He applied the method to two well studied watersheds to prove the concept with field observations and then used it for virtual experiment on assessing the effects of soil depth and climate variables on the time and source information on hydrograph.

Soil Water Recharge from Stemflow of Sand-Fixed Shrubs in Mu Us Sandy Land, Northwest China

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Stemflow is considered as an important source of available moisture for plant growth in the arid and semiarid ecosystems. It may change the spatial distribution pattern of soil moisture and affect both the direction and velocity of the water and nutrients circulations around the stem area. To examine the quantity and influence of stemflow on the soil water input in the semiarid shrubs of *Salix psammophila*, *Artemisia sphaerocephala* and *Hedysarum scoparium* in a desert ecosystem, we measured stemflow volumes as affected by rainfall amount and intensity from 18 mature plants representing the three shrub species (6 samples for each species) throughout the rainy seasons of 2006 and 2007. Time domain reflectometry (TDR) measurements at 20 cm intervals to 1 m depth were performed around the root area from 6 contrasting shrub samples representing the three species (2 samples for each species), one of which with stemflow input and the other without. We also quantified the canopy variables for the samples to identify factors affecting the stemflow generation.

Experimental results indicated that of the 313.5 mm of cumulative gross rainfall generated by 41 rainfall events, stemflow were 23.8 mm (7.6%), 9.3 mm (3.0%), and 11.3 mm (3.6%) for *S psammophila*, *A sphaerocephala* and *H scoparium*, respectively. Stemflow from the three shrub species was found to be moderately correlated with the gross rainfall, while the average funnelling ratio was 69.4 ± 38.2 , 41.5 ± 25.1 and 242.2 ± 118.6 for *S psammophila*, *A sphaerocephala* and *H scoparium*, respectively, indicating canopy architecture of the three shrubs is an effective funnel to channel stemflow to the root area. Relationship between funnelling ratio and rainfall suggested that there existed a rainfall depth threshold of 10 mm for *S psammophila* and 15 mm for both *A sphaerocephala* and *H scoparium*. The funnelling ratio values showed increasing trends with rainfall depth increasing before the threshold values had been reached but then declined. Moreover, the funnelling ratio values tended to increase quickly with the maximum rain intensity in 10 minutes (I_{10}) when it was less than 1 mmh⁻¹ and then decreasing with increasing of I_{10} . The results of the soil moisture measurements indicated that soil water content (VWC) was obvious higher in the root area of the samples with stemflow input than the samples without, average soil water content was 5.2% higher for *S psammophila* in soil layer between 60-80 cm and 1.2% higher for both *A sphaerocephala* and *H scoparium* in soil layers between 20-40 cm and 40-60, respectively.



Zhi-Peng Yang is a Ph.D. candidate of Natural Resources in the Institute of Land Resources at Beijing Normal Univ., China, under the supervision of Prof. Xiao-Yan Li. Zhi-Peng conducts research on the impact of shrub stemflow on soil water recharge and preferential flow in the soil profile in Mu Us sandy land in Northwest China. He is also interested in the water resources utilization, ecosystem construction and desertification control in arid areas. His dissertation research focuses on the quantitative relationships between rainfall characteristics (depth, intensity), stemflow, and the soil moisture status, in the hope of improving the understanding of the water movement in the soil profile and the recharge process in the arid and semiarid regions.

Pattern and Function in Soils: Pathways to Prediction

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In a recent meeting of the Predictions in Ungauged Basins (PUB) initiative it was resolved that soils represent the final frontier in terms of the limits to hydrological predictability in ungauged basins. Our current theories of water flow in soils are predicated on the assumption of homogeneity, yet soils exhibit enormous heterogeneity at all scales. Preferential flows, affected by the presence of various kinds of organized biotic and abiotic structures in the soil, impact on basin hydrological and biogeochemical responses in so fundamental ways that new approaches are needed to characterize and predict flow through such structured soils. While considerable progress has been made on capturing the effects of known forms of heterogeneity, the greatest problem that prevents predictions is our inability to map soil heterogeneity adequately everywhere. This prevents extrapolation of our understanding of observed structure and response to ungauged or unmapped locations. In this paper we will present an alternative approach to prediction that bypasses or reduces the need to characterize soil heterogeneity and instead appeals to organizing principles underpinning structure-forming biotic and abiotic mechanisms and their roles in maintaining ecosystem function. In this respect we consider catchments to be dynamical systems that are formed and maintained by co-evolving biotic and abiotic (flow and land forming) processes that help to organize the landscape and give rise to discernible patterns in landscape structures as well as responses. We present a new theoretical framework that makes explicit use of such organizing principles not only to describe and to understand the structure and response of catchments but also to help make hydrologic predictions in ungauged catchments. The key to this framework is to acknowledge that the history of system evolution that has led to the present observed state of catchment structure implies that some hydrologic behaviors are more probable than others. It follows that, subject to local constraints or boundary conditions, knowing the organizing principle underlying the co-evolution, we can infer (in a Bayesian sense) the most probable unobserved structure or response given all available observations. At a fundamental level prediction then involves making probabilistic statements about future (or unobserved) system behavior on the basis of observed behavior and the identified organizing principle(s). We will argue that the new theoretical framework, through the explicit use of such organizing principles, represents a significant advance over existing modeling approaches. We will illustrate these concepts through completed work in ecohydrology and ongoing but preliminary work in hydro pedology. Through the use of these organizing principles, this framework enables predictions to be based on more universal understanding as well as on local calibration, and as such is suitable for making predictions in ungauged basins as well as for global change applications.



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The SMAP and SMOS Satellite Missions: Needs and Opportunities

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Microwave remote sensing can provide information on the water content of the near surface soil layer, typically $\frac{1}{4}$ of the wavelength in depth. The basis of this technique lies in the changes in the dielectric properties of the soil as water content increases. In addition, temporal monitoring can be used to infer hydraulic properties of the soil profile. Longer wavelengths are desirable because the contributing soil layer is deeper and the effects of vegetation are minimized, however, the maximum is limited to ~ 21 cm (L-band) because beyond this galactic noise confuses the signal. The challenge to implementing this technique on a satellite has been overcoming spatial resolution constraints; long wavelengths required very large antennas. Since 2002, both NASA and Japan have been producing soil moisture products using a much shorter wavelength sensor (~ 2 cm) on the Aqua satellite. However, significant changes will occur over the next 5 years as two dedicated soil moisture satellites are launched. Each of these utilizes new technologies that are designed to overcome some of the spatial resolution constraints. In 2009, the European Space Agency will launch the Soil Moisture Ocean Salinity (SMOS) mission that utilizes synthetic aperture radiometry. NASA plans to launch the Soil Moisture Active Passive (SMAP) in 2013 that combines radar and radiometry. Both missions will offer new opportunities for soil water related research and applications. A particularly important and challenging aspect of these missions is implementing appropriate validation programs.

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Soil Architecture: Formation, Visualization, Quantification, and Modeling of Its Impacts across Scales Philippe Baveye, John Crawford, Ruth Falconer, Dimitry Grinev, Wilfred Otten, Andrew Spiers, and Iain Young *SIMBIOS, Univ. of Abertay Dundee, Scotland*

For roughly five decades, research on the spatial organization of primary particles in soils almost entirely focused on what was referred to as “soil structure”, and the methods used generally involved disassembling soils into collections of aggregates, whose geometrical characteristics and mechanical stability could be quantified. The last few years, roughly since the late 90s, have witnessed a sea change in the area, with the accent put instead on the in-situ observation of the assemblage, or “architecture”, of soil particles in their undisturbed state, and on the processes occurring in the voids or interstices of that architectural edifice. This radical change of perspective, in large measure, is due to the development of ever more powerful non-invasive measurement techniques, such as X-ray Computer Tomography instruments. In this general context, the goal of this presentation is to review in some detail the very significant progress achieved in recent years relative to a number of facets of soil architecture. The dynamic physical, chemical, and biological processes responsible for the formation and self-organization of soil architecture, for example, are beginning to get unraveled and described quantitatively. With spatial resolutions typically in the vicinity of 5 microns for table-top X-ray CT scanners, and far lower than that for synchrotron-based CT systems, the possibilities currently available to visualize the geometry of soil pores and the processes occurring within them are mind-boggling. The resulting data on soil architecture and pore geometry are currently being used as input in various mathematical models, ranging from fractal or multifractal models of the spatial organization of soils, to dynamical models of water and solute transport, chemical reactions, or microbial propagation in the interstitial spaces. Similar developments in molecular biology will enable a better understanding of how microbial activity can affect soil architecture and processes. This research is opening new avenues to grasp the complexity and heterogeneity of processes at the microscopic scale in soils, and to understand how they influence the response of soils at higher scales of observation.



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Coupling of Hydropedology and Biogeochemistry: The Importance of Hot Spots and Hot Moments

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Analysis of microbial and biogeochemical processes is complicated by the fact that small areas (hotspots) and brief periods (hot moments) often account for a high percentage of activity. In terrestrial environments, hotspot and hot moment phenomena are created and catalyzed by the convergence of hydrologic and pedologic factors that cause the factors regulating the activity in question to converge, creating optimal conditions for that activity. Hotspot and hot moment phenomena are important at multiple scales, from microsites in the soil (mm), to landscapes (km) and regions. I will illustrate the importance of hotspots and hot moments, and how these phenomena are driven by the coupling of hydropedologic and biogeochemical factors using denitrification, the anaerobic reduction of the nitrogen oxides nitrate and nitrite to the nitrogenous gases nitric oxide, nitrous oxide and dinitrogen, as an example. Denitrification is carried out by microorganisms but is of interest at larger scales; crop fields, mixed landscapes consisting of crop fields, forests, wetlands and streams, regional watersheds such as the Chesapeake Bay, Gulf of Mexico and Baltic Sea, and the entire globe. The interest in denitrification at large scales is due to its effects on soil fertility (nitrogen is a key nutrient limiting primary production in many ecosystems), water quality (nitrate is drinking water pollutant and an agent of eutrophication in salt waters) and air chemistry (nitrous oxide is a greenhouse gas and contributes to the destruction of stratospheric ozone, nitric oxide is a precursor to tropospheric ozone). I will describe how different hydropedologic and biogeochemical factors converge to create denitrification hotspots and hot moments at different scales and discuss approaches for addressing these phenomena in experimental designs and models.

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Future Directions for Hydropedology: Quantifying Impacts of Global Change on Wetlands

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Global warming is an accepted process but its impacts on soils and wetlands have been difficult to predict. The role that hydropedology can play in documenting the impact of global warming on wetlands will be proposed. Wetlands are defined primarily on the basis of hydrology and require that soils be saturated within 30 cm of the surface for 5% of the growing season in at least 50% of the years. Wetland boundaries are largely identified in the field by soil color characteristics that are related to a soil's drainage classification. Poorly and very poorly drained soils are normally in wetlands, while somewhat poorly and moderately well drained soils are not. If global warming increases water table levels, then soils that are currently somewhat poorly or moderately well drained may become wetlands over a 50-year time frame. Impacts of climate change on wetlands can be assessed by first calibrating hydrologic models to predict water table levels in toposequences of soils that range from moderately well to very poorly drained. The calibrated models can then be used with historic rainfall data to establish the current hydrologic signature for soils in each drainage class. The next step will be to re-run the simulation models using predicted changes in rainfall and temperature to establish the new signatures in hydrology for each soil group. By comparing the future to historic signatures, we should be able to establish whether the somewhat poorly drained soils, for example, will become wetter and meet the hydrologic requirements of wetlands. Soil survey data can then be used to estimate the areas of land that will likely become wetland in the future. This is the type of information that government planners need to identify challenges to future development projects. The process will be illustrated using studies from NC that have calibrated the water-table simulation model DRAINMOD for soils at two toposequences whose soils range from moderately well to very poorly drained. Current hydrologic signatures have been determined for each soil using historic rainfall data along with the calibrated models to compute 40-yr of daily water table data that range across wet and dry years. The same models will be used again, but with the addition that predicted changes in temperature and precipitation for the next 50 years will be used rather than historic data. Estimates of changes to wetland area in North Carolina will then be determined using soil survey data.



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Hydropedological Properties of a Vertisol Climosequence along the Coast Prairie of Texas

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We conducted the first Vertisol climosequence from a hydropedological perspective quantifying field morphological and characterization properties as a proxy for interpreting periods of saturation and reduction. A microlow and microhigh pedon were described and characterized from each of twelve pits excavated on co-linear, 0-1 % slopes of the late Pleistocene Beaumont Formation of the Coast Prairie of Texas. Mean annual precipitation (MAP) in the study area ranges from ~700 to 1450 mm within a Thermic to Hyperthermic soil temperature regime. Soils are mapped as Sodic Haplusterts (Victoria series), Typic Hapluderts (Laewest, Lake Charles series), and Oxyaquic Hapluderts (League series) with increasing MAP. The first appearance of iron soft masses and iron pore linings occur simultaneously in both microlows and microhighs at 900 and 1300 mm MAP, respectively. Soft iron masses with abrupt to diffuse boundaries tend to concentrate below depths of 20 cm on slickensides and ped faces and appear to be contemporaneous features. Iron pore linings tend to concentrate within the upper 20 cm along root channels and are also appear to be contemporaneous. Iron depletions covary with iron concentrations along slickensides deep in profiles and along ped faces and root channels in surface horizons. According to the distribution of redoximorphic features, the taxonomy of Vertisols in the study area show that in contrast to the mapped soils, when MAP is greater than 1300 mm Typic Epiaquerts occur in microlows and Aerlic Epiaquerts in microhighs. These same soils appear to classify as Hydric because of the Redox Dark Surface indicator in microlows and the Depleted Matrix indicator in microhighs. Accompanying aquic and hydric conditions is the first appearance of crayfish burrows within 100 cm of the surface, absence of crack infills, and Feo concentrations in surface horizons greater than 0.25 wt %. These results suggest that Vertisols with aquic soil moisture regimes and hydric properties are under mapped in the study area when MAP exceeds 1300 mm MAP and that by-pass flow along root channels and slickensides is the primary conduit of water where saturation and iron reduction occurs. Additional work is needed, however, to integrate field monitoring of saturation and reducing conditions with observed morphological and chemical characteristics.

Modeling of Field-Observed Soil-Plant Root Interactions

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Generally, there is a lack of information on soil-plant root water processes as controlled by environmental conditions near the plant-root interface. We present field experimental data that are coupled with a multi-dimensional unsaturated water flow model to better integrate scientific principles. The presented root water and nutrient uptake model links soil physical principles with plant physiological concepts, crossing disciplinary boundaries as required for advancing the science for the broad and complex study field of soil hydrology. The modeling approach will greatly improve scenario testing for soil-plant systems, by including plant uptake mechanisms such as compensated root water and active root nutrient uptake. Specifically, natural ecosystems often suffer from environmental stresses (water, nutrient, temperature), and the plant responses to such limiting factors are highly relevant for understanding their functioning and survival strategies. Field experimental results include 3-dimensional soil water content and water potential data around a single almond tree. These soil water data were coupled with a multi-dimensional soil water flow model, to infer the functional form of a 3-dimensional root water uptake model, using inverse modeling. In addition, by imposing a predetermined irrigation regime, the effect of soil water stress on tree root water uptake was determined, showing that tree roots can compensate for local water stress conditions. To improve the mechanistic description of environmental stress on root water and nutrient uptake, we present a new modeling approach that allows for inclusion of compensated root water and nutrient uptake, and provides for differentiation between passive and active nutrient uptake.



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Visualization and Modeling of Pore Flow within the Soil Aggregate Black Box

Alvin Smucker, *Michigan State Univ.*; A. Tartakovsky, *Pacific Northwest National Lab*; W. Wang, A. Kravchenko, *Michigan State Univ.*; M.L. Rivers, *Argonne National Lab*; and W.J. Sul, *Michigan State Univ.*

Soil clay and organic matter contents combined with natural dry/wet (D/W) cycling alters intra-aggregate pore connectivity, dead-end storage volumes, and tortuosity. These changes alter gaseous compositions, storage capacities of C, N, and other nutrients as well as microbial communities among different regions within soil aggregates. However, the majority of these studies have utilized models to describe these processes. Recent advances in X-ray microtomography enable the examination of intact pore networks within soil aggregates at resolutions as small as 3 microns. We hypothesize repeated and nondestructive quantitative visualizations of aggregates and soil volumes treated with multiple D/W cycles can be used to compare and identify the most ideal intra-aggregate pore structures for maximizing soil C sequestration in natural ecosystems. Geostatistical and multifractal methods provide concise characteristics of pore spatial distributions within the aggregates and are useful for comparing these alterations among soils. We compared similar air-dried aggregates from the same soil type which were subjected to multiple wetting and drying (WD) cycles. Soil aggregate samples were scanned at the bending beam 13-BM-D GSECARS in the APS at ANL. Geostatistical analyses confirmed our hypothesis of repeated WD cycles dramatically altered spatial arrangements of soil particles and associated pore geometries. Aggregates subjected to WD pretreatments developed greater spatial variability among the various aggregates measured. This variability increased ¹³C sorption in micro/nanosites which excluded microorganisms. T-RFLP electropherograms of PCR-amplified 16S rDNA microbial nucleotides demonstrated significant shifts in the abundance of unique microbial ribotypes within exterior and interior regions of macroaggregates subjected to 0 and 5 D/W cycles. Smoothed Particle Hydrodynamics (SPH), a fully Lagrangian meshless numerical method, was used to model WD cycles on the pore-scale. Pore-scale numerical investigations provide additional insight into the redistribution of water and air phases, transport and sorption of C during repeated WD cycles in soil aggregates. Modifications of intra-aggregate pores to reduce aerobic and anaerobic greenhouse gases will be described in greater detail.

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Experiments with Complexity, Hierarchy, Soil and Water

Timothy Allen, *Department of Botany, Univ. of Wisconsin-Madison*

Hierarchy theory is less a theory to be tested: it is more a metatheory that suggests tests of regular hypotheses for particular material systems. Hierarchy theory is a theory of observation for complex systems. Complexity involves emergence of new hierarchical levels, but that is insufficient in itself. Complex bio-social systems also have coded elements, which capture plans for development, behavior and stabilization of emergent levels. Experiments around complexity are difficult to perform, because, at a fundamental, level emergence changes unpredictably the identity of the thing studied. We have performed wind tunnel experiments that look at plants as functioning to take advantage of heat gradients, to move water from soil to the air. Latent heat of vaporization cools plants as they use evaporation to do the work of moving nutrients and water, and to achieve turgidity. While reductionist experimenters would be attracted to the precision of measuring leaf temperature, we explicitly measured whole canopy temperature, so as to allow emergence at that higher level. We use the radiative temperature of canopies to show that cooling is active and greater when the plant is adapted to its environment. In more complex canopies, where there are plants from different treatments with wind, the arrangement of plants that take account of the history of the vegetation allows for greater functionality, shown as greater cooling. Complexity works to increase function, but at a cost to some part of the system that protects the rest of the vegetation. If resources are abundant, then the price of complexity is paid by increased resource capture achieved by increased functionality. If resources are scarce, sometimes complexity is not worth the cost of the emergence of new levels. Then it is best to remain simple.



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The U.S. National Cooperative Soil Survey and Hydropedology Research

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Soil hydraulic properties are among those most often used to predict soil behavior and suitability for a variety of uses. Thus, it is extremely important that values and estimates reported in soil survey data bases that are used to develop interpretations of soil behavior and response to management are as accurate as possible. As the National Cooperative Soil Survey (NCSS) evolves beyond the initial inventory of the Nation's soil resource, an emerging objective is to develop greater understanding of soil properties, behavior, and landscape relationships. As such, each of the 146 MLRA Soil Survey Offices (SSOs) will be, with aid from cooperators, designing and implementing field-based research and investigations projects. Because of the great need for better and more complete data, these projects in many areas will include hydropedology studies. Hydropedological questions that need to be addressed include depth and duration of seasonal saturation as related to landscape setting and morphological properties, evaluation of landscape and mechanistic models to predict landscape redistribution of water and seasonal saturation, and field evaluation of Ks for major horizons, soils, and landscapes. Limitations on time and resources will not allow evaluation of all properties for all soils. Thus, the initial emphasis will be on benchmark series and other soils that are extensive and/or ecologically or geomorphically important in the region. The long-range goal is to develop extensive data sets that can be used to test accuracy and robustness of existing pedotransfer functions and to develop new functions that can be used to accurately estimate hydraulic properties from other soil and landscape properties. NRCS soil scientists cannot meet this challenge alone, however. Assistance is needed from all sectors of the NCSS and the larger soil science community. MLRA SSO staffs have the unique ability to identify suitable locations for short and long-term hydropedological studies on specific soils and to be engaged in field evaluation and monitoring. Additionally, they have access to a state-of-the-art laboratory to analyze properties needed to develop meaningful relationships. The broader need, however, is additional knowledge and expertise from university and other cooperators to aid in the design, evaluation, and analyses of the data. Only with cooperative efforts can meaningful solutions be developed to address the complex problems facing society today.

Editor's Note: One of the objectives of the 1st International Conference on Hydropedology is to charter a roadmap for international collaboration to advance the frontiers of hydropedology and Critical Zone science. Thus, one of the agenda items during the conference will be to discuss how we can best foster a global alliance for monitoring, mapping, and modeling of the Critical Zone. As a starting point, the forum article below is intended to facilitate such a discussion. Comments, suggestions, and debates are welcome.

Fostering A Global Alliance for Monitoring, Mapping, and Modeling of the Critical Zone

Henry Lin, Penn State University

With growing interests in international scientific communities to establish various observatory networks to monitor the ever-changing environment and to provide transformative platforms for scientific research, a synergistic effort to foster a global alliance for monitoring, mapping, and modeling (3M) of the Critical Zone (CZ) is suggested here. The CZ, extending from the top of the vegetation down to the bottom of the aquifer (NRC, 2001), relies on the soil and regolith as its foundation and water as its central circulatory forcing agent. Long-term monitoring, along with precise spatial mapping and process-based modeling, of the landscape-soil-water-ecosystem relationships across scales and geographic regions (Fig. 1) can serve many purposes of societal importance. Optimization of whole systems for multiple benefits rather than one benefit permit synergistic outcomes and is more cost-effective in the long-run. Since nature does not recognize man-made disciplinary divides, and artificially-fragmented knowledge hinders integrated understanding of the complex CZ, it is imperative that a systems approach be taken to achieve a comprehensive understanding and integrated management of natural resources. Consequently, while large-scale environmental observing networks are being developed in different parts of the world for various spheres of the earth system (e.g., atmosphere, biosphere, hydrosphere, and lithosphere), a more integrated one for observing, modeling, and sustaining the earth's CZ *as a whole* is desirable. The complex interdependence of climate, hydrology, biology, pedology, topography, lithology, chronology, and anthropogenic forcing at the *central juncture* of the CZ (i.e., soils) provides an excellent opportunity to study important interfaces, decisive moments, controlling mechanisms, and feedback loops at the *crossroad* of the CZ. However, no one team or organization can do that alone, and a diversity of funding sources supporting a heterogeneous mixture of overlapping programs is probably the best formula for long-term continuity of observational networks (Keeling, 2008). Therefore, a global alliance is suggested here.

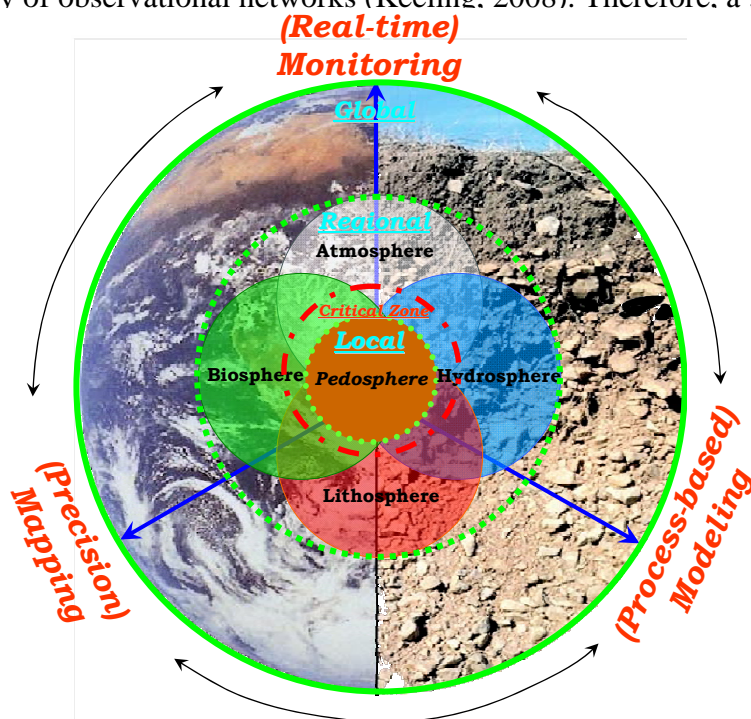


Fig. 1. Integrated monitoring (long-term, real-time), mapping (spatial heterogeneity, precision), and modeling (process-based, with feedback loops) of the landscape-soil-water-ecosystem in the Critical Zone across scales (from local to regional to global) and geographic regions (from tropic to temperate to arctic).

Large-scale monitoring networks are increasingly called for by various funding agencies and scientific consortia in order to address “big” science questions. On the other hand, long-term recording of the health of our land – through monitoring its “blood pressure,” temperature, respiration, and other vital signs of global change – is equally essential. The famous “Keeling Curve” of long-term CO₂ data (Fig. 2) demonstrated the value of continuous recording of a seemingly *routine* atmospheric measurement, which turned out to be a vital sign of the earth’s climate. According to Keeling’s son, the decision to place the instrument at Mauna Loa, Hawaii, was a gamble at the outset because of significant spatial and temporal variability of atmospheric CO₂ concentrations. There was a strong argument to place the priority on a one-time extensive global survey of CO₂ variability, with such a survey being repeated a decade or so later to look for long-term changes (Keeling, 2008). The value of the then newly-established Mauna Loa Observatory (Fig. 3) was soon apparent, providing convincing evidence that CO₂ was rising (Fig. 2). If CO₂ had been measured only as often as extensive surveys would permit, then it would have taken decades to obtain similarly convincing evidence (see the upper inset in Fig. 2).

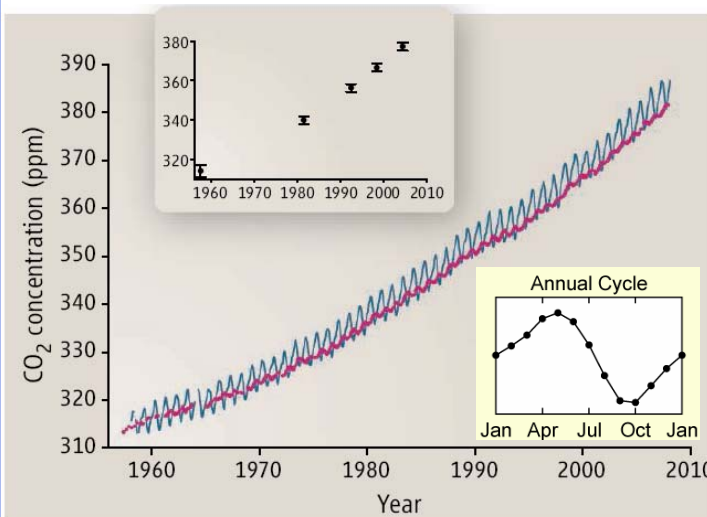


Fig. 2. The famous “Keeling Curve” of long-term continuous CO₂ data collected from Mauna Loa Observatory (blue), backed by the parallel record from the South Pole (red), which provided the 1st convincing evidence that atmospheric CO₂ was rising. The upper inset shows the survey results of the North Atlantic overturning circulation, which have taken decades to obtain convincing evidence (From: Keeling, 2008 and http://en.wikipedia.org/wiki/Charles_Keeling).

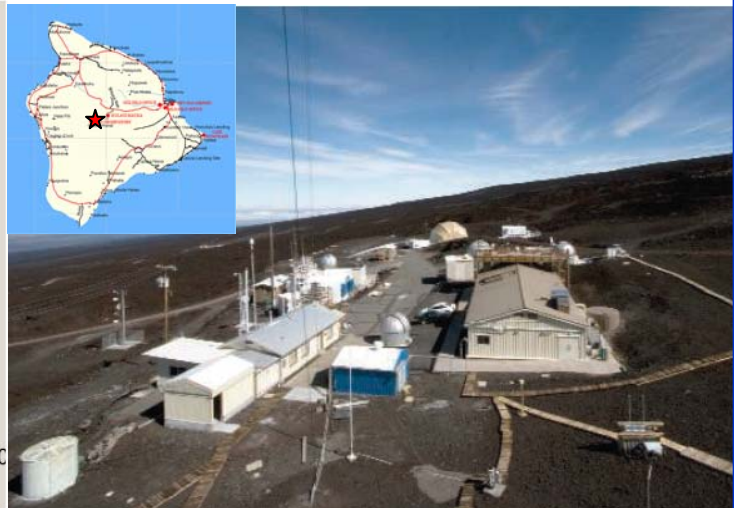


Fig. 3. The Mauna Loa Observatory (MLO), Hawaii, which is part of the NOAA’s Earth System Research Laboratory. The undisturbed air, remote location, high altitude, and minimal influences of vegetation and human activity at the MLO are ideal for monitoring climate change. The MLO is also known for its measurements of ozone, solar radiation, and aerosols. (From: Keeling, 2008 and <http://www.mlo.noaa.gov/home.html>).

This year marks the 50th anniversary of the start of the Mauna Loa CO₂ record – the longest continuous record that first alerted the world to the anthropogenic contribution to the “greenhouse effect” and global warming. Its story, as told by Keeling’s son (Keeling, 2008), provides an extremely valuable lesson on the importance of continuous earth observations in a time of accelerating global change:

- ✓ Long-term earth observations challenge the prejudice against science that is not directly aimed at hypothesis testing. Continuous observations have the potential to open our eyes for unexpected but relevant developments and processes
- ✓ In a program aimed at tracking long-term changes, “research” and “operations” cannot be separated cleanly
- ✓ The Mauna Loa experience illustrates the critical need for redundancy. It is an inescapable fact that tracking changes over time means that you only get one chance to measure each point. To prove you got it right, you must take measurements in multiple ways
- ✓ A point of diminishing scientific returns has never been realized in the “Keeling Curve”
- ✓ A diversity of funding sources supporting a mixture of programs is probably the best formula for sustaining long-term observations.

Similarly, the long-term studies at the Hubbard Brook Experimental Forest (HBEF) in New Hampshire, initially established in 1955 by the U.S. Forest Service for the study of the relationship between forest cover and water quality and supply, have led to the discovery of “acid rain” in North America. The Hubbard Brook Ecosystem Study pioneered the small watershed technique as a method of studying ecosystem processes. Research in this natural laboratory has produced some of the most extensive and longest continuous databases on the hydrology, biology, chemistry, pedology, and geology of a forest and its associated aquatic ecosystems. Since 1963, over 1,750 publications have been produced on HBEF, providing a wealth of information on the structure, function and development of forest, stream and lake ecosystems of the HBEF (<http://www.hubbardbrook.org/>).

It is indeed puzzling (and frustrating) to note that, over 500 years after Leonardo Da Vinci succinctly pointed out, “*We know more about the movement of celestial bodies than about the soil underfoot,*” soils – the crucible of terrestrial life – remain “mysterious” and underappreciated. Yet, it is this thin skin of the earth on which nearly every life-sustaining resource and all human activities depend! No wonder that *Science* magazine (Sugden et al., 2004) recognized the soil as the final frontier, and the U.S. National Research Council (2001) has identified the integrated studies of the earth’s CZ as one of the most compelling research areas for the 21st century. The emerging interests in CZ science brings a new hope of revealing the “secrets” underfoot, tapping into the treasures underground, embracing a focus on water as a unifying theme for understanding complex soil and environmental systems, and providing a promising framework for the holistic studies of water with soil, rock, air, and biotic resources in the earth’s surface and near-surface environments.

With advances in sensor technologies, data handling and transmission facilities, now is the right time to go for a global monitoring program of the CZ that should be realized in a coordinated way to maximize the benefit for environmental research. In particular, “hot” spots based on the projected global change should be selected to monitor the impacts of global climate change on the future landscape-soil-water-ecosystem relationships.

While numerous properties and processes in the CZ could be monitored, some fundamental signs of our land’s health should be included, such as 1) soil moisture (similar to the blood pressure of a living organism), 2) soil temperature (reflecting land surface energy and global warming), 3) soil air (particularly CO₂, CH₄, N₂O), 4) soil carbon (related to carbon sequestration), 5) soil redox potential (critical to many biochemical processes), 6) soil pH (foundation to chemical and biological reactions), and 7) soil microbes (vast “treasure” reserves underground). Long-term, ideally in (near) real-time, monitoring of these basic elements of soil systems would permit fundamental assessments of the health and productivity of our land, and allow the important recording of active exchanges among the atmosphere, biosphere, hydrosphere, lithosphere, and pedosphere in a time of accelerating global change.

Changes in many other soil properties are inherently long-term, undetectable in a short period of time, but irreversible and threshold-like in the long-term. This evolutionary process presents significant challenges to those designing and implementing scientific research and land management programs. However, ecosystem functions and watershed processes depend on the evolution of the soil. Therefore, long-term monitoring of soils is critical to global change and sustainability.

Monitoring, mapping, and modeling processes in the CZ (especially the landscape-soil-water-ecosystem relationships across scales) have clear distinction and connection. We normally monitor pedons to collect point data and model landscapes attempting to understand areal patterns. A key connecting the two is the mapping of various soils and landscape features and incorporating these into process-based investigations of developmental and driving functions. Relatively static properties of the soil and landscape (such as topography and soil texture) may be mapped to assist in modeling and scaling, whereas more dynamic properties (such as soil hydrology and land use) should be monitored to refine model predictions and to provide ground truthing for mapping. The fabric of soils over the landscape provides valuable clues to the selection of monitoring sites and the design of modeling experiments. Mapping also provides a means of diagnosing the landscape for possible hot spots and hot moments of biogeochemical cycles (McClain et al., 2003) that are increasingly recognized in the heterogeneous world underfoot.

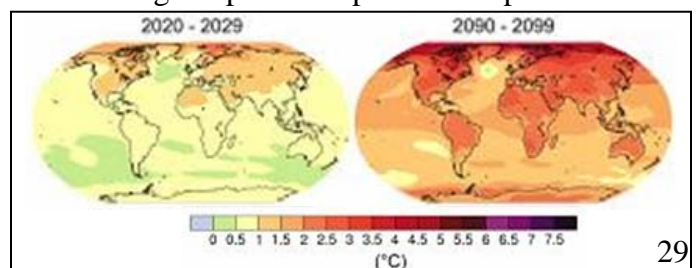
A major challenge in understanding the CZ is the inherent heterogeneity of three-dimensional spatial structures across scales. This spatial structure in the subsurface is believed to have hierarchical organization and have formed over diverse time scales. All processes within the subsurface are bound to this structural framework, which is typically unknown or difficult to quantify. This is a fundamental difference compared to atmospheric monitoring where the heterogeneity of the system can be explored at one sensor location or measurement point as demonstrated in Fig. 2. However, the signals of two sensors at nearby locations in many soils may be completely uncorrelated and may not be intermixed. This is why we need the mapping of the subsurface heterogeneity. Then, and only then, can the point-based monitoring of state variables provide the required observations to develop and improve predictive potential of process-based models. Unlike atmosphere and ocean, the land is not a continuous fluid; rather, it poses hierarchical heterogeneities with controlling structures that dictate discrete flow networks and reaction pathways embedded in both the land surface and its subsurface. This also means that a completely new foundation for subsurface flow and transport modeling is needed (Beven, 2006).

Another fundamental difference between soil monitoring and atmospheric monitoring is the varying timeframes needed to detect soil changes. Considering the multi-phase nature of the soil system (gaseous, liquid, solid, and biotic phases), it is impossible to determine soil change by only one characteristic. Each soil phase and property has its own response time. Very labile soil properties have characteristic response time almost coinciding with that of the atmosphere (such as soil air, soil moisture, and soil temperature), while very stable soil properties have long characteristic response time close to that of the lithosphere (such as soil mineralogy and particle density), but many soil properties have characteristic response time falling in between the above two ends of the spectrum (such as soil carbon, redox potential, and microbial biomass).

The CZ is recognized as “*the most heterogeneous and complex region of the earth*” (NRC, 2001). Understanding the complex, dynamic, and nonlinear nature of the landscape-soil-water-ecosystem relationships in the CZ have been plagued by the fact that the seemingly simple, but crucial, junction of all spheres on the earth surface is the product of five *interacting* soil-forming factors plus human perturbations. It is worth to stress that the pedosphere is a unique, somewhat immobile, patchy, and yet continuum sphere. In contrast to the other spheres of the earth system, the pedosphere can neither quickly intermix and circulate its own volume (as atmosphere), nor rapidly move laterally along the landscape (as water, except under severe erosional conditions), nor avoid undesirable environmental changes (as biota), nor escape quick biological and human perturbations (as lithosphere). So each soil, as somewhat immovable and formed *in situ* body, is fated to endure, react, and record almost all environmental changes at each location and to transform itself according to the interactions of climatic, biotic, and anthropogenic forcing, as conditioned by geologic and topographic setting, over various time scales. This makes the monitoring of soil change an excellent (albeit complex) environmental assessment, as every soil is a “block of memory” of past and present biophere-geosphere dynamics. Learning to “decode” soil properties and their changes over time into global environmental change information is likely to be as valuable for understanding human impacts as reading the records of ice cores for understanding changes in atmospheric CO₂ concentrations.

To proceed with the proposed global alliance, we should develop international monitoring protocols and key indicators around the world. Once the agreed general protocols and major indicators are developed, then selection of sites for major soils/landscapes/ecosystems of the world along heterogeneity gradients will be an important next step. Mapping and modeling should be used in assisting the selection of major monitoring sites. Once sites are chosen, the (near) real-time monitoring data should be continuously used in combination with precision mapping and process-based modeling to provide spatial extrapolations and temporal inferences about the trends of the CZ.

Predicted global temperature increase →
(Source: IPCC WG II 2007 Report)



Together, our capability to predict the behavior and evolution of the CZ at the time of accelerating global change, including the productivity of soil and the quality of water, will improve significantly if we can foster a global alliance for monitoring, mapping, and modeling of the Critical Zone.

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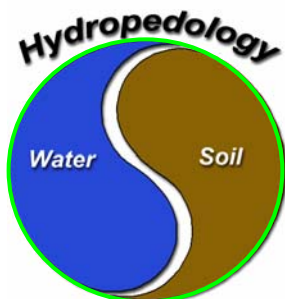
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Postscript

On June 17, the Heinz Center released *the State of the Nation's Ecosystems 2008* report (<http://www.heinzcenter.org/ecosystems/>), providing authoritative documentation of key environmental trends. A companion report (*Environmental Information: Roadmap to the Future*) calls for **bold** federal and state action to strengthen and integrate the nation's **environmental monitoring**. Key recommendations urge Congress to establish a national environmental indicator initiative, and suggest that Congress and the executive branch provide additional support for monitoring and related activities. On the same day, the White House issued a directive to multiple federal agencies to begin developing national environmental indicators (<http://www.whitehouse.gov/ceq/NEST-Indicators-Letter.pdf>).





*“Landscape-Soil-Water” Relationships
In Intensively-Studied Watersheds around the Globe*



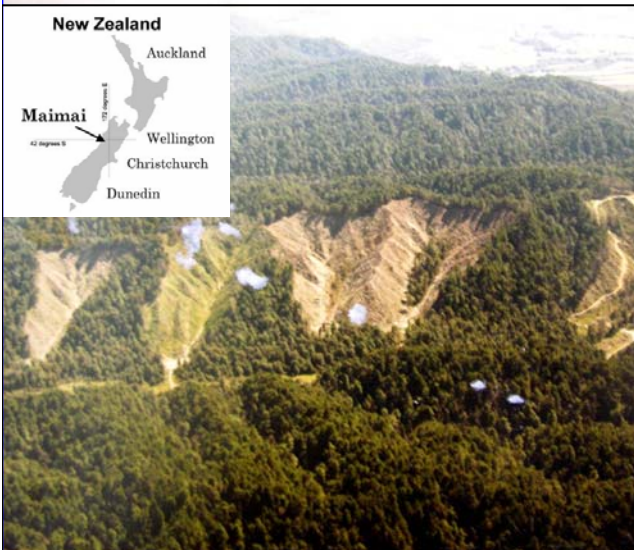
Editor’s Note: “Soil-landscape” relationship is the paradigm of pedology. We now reverse that order and add water into the picture to form “landscape-soil-water” relationship for hydropedology. Any difference? You be the judge. Since 2006, a showcase watershed has been selected from around the world to illustrate. In addition, integrated studies of the Earth’s Critical Zone, including mapping, monitoring, and modeling of coupled hydropedological and biogeochemical processes across scales, will be in greater demand.

The Maimai Watershed

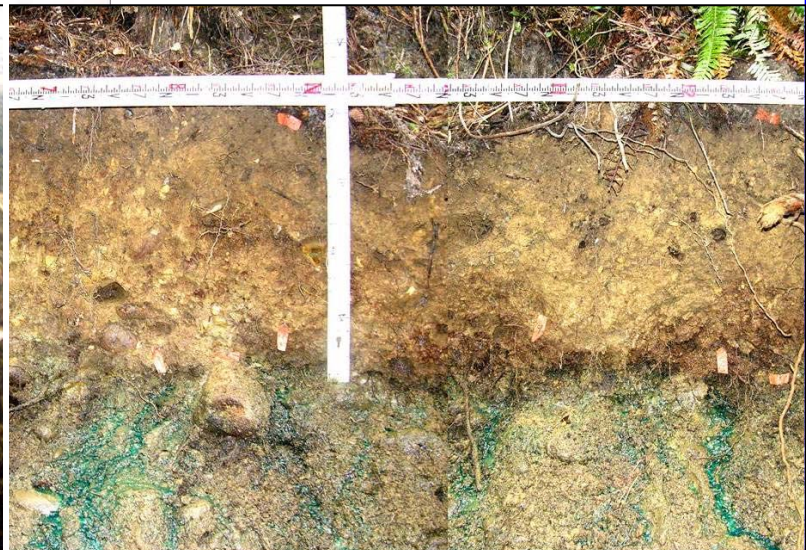
The Maimai Experimental Forest was established in 1974 as a paired watershed experiment designed to test the impacts of conversion from mixed native forests to Radiata Pine. The catchment is located on the South Island, New Zealand, 45 km inland of the Tasman Sea, 20 km from the town of Reefton. Maimai consists of 8 research catchments (1.63-8.26 ha), of which the M8 catchment has been the center of hillslope and zero order catchment research. Slopes at M8 and the forest in general are very steep (average 34°, 37%) and short (generally <300m). Mean annual rainfall is 2,450 mm/yr, distributed evenly throughout the year. Snow falls less than 2 days a year. Interception losses have been estimated at 650 mm/yr. Of the 1,950 mm throughfall, 39% (1,000mm) is streamflow in the form of quickflow, as defined by Hewlett and Hibbert (1967).

Soils are classified as Blackball Hill soils developed from a bedrock of Old Man Gravels, an early Pleistocene conglomerate of clasts of sandstone, granite and schist. Mineral soils are stony podzolized yellow brown earths, dominated by silt loam textures, and overlain by a 17 cm humic horizon. Soils are generally thin, with an average depth of 0.6 m, and range of 0.2 - 1.8 m. The hydraulic conductivity of the mineral horizon range from < 5mm/hr in poorly drained hollows to over 250 mm/hr on nose slopes, while the humic horizon exhibits much higher conductivities, ~6,000 mm/hr. Due to climatic and textural influences, nearly all soils remain within 10% of saturation year round. Driven by the chronically saturated conditions, steep slopes and low conductivity soils, an extensive preferential flow network has developed at the site, dominated by lateral subsurface flow at the soil-bedrock interface.

Maimai has been the site of considerable research into catchment scale hydropedological interactions for over 30 years, and where many of the important macroscale theories of catchment and hillslope scale



Aerial view of the Maimai watershed in New Zealand



Preferential flow along the soil-bedrock interface

hydrological process have been developed or tested. Maimai was one of the early sites where the predominance of lateral subsurface preferential flow paths was observed, calling into question the use of the Darcy's Law to predict velocities and discharge rates at the hillslope/catchment scales (Mosley 1982). Maimai was also one of the first field sites where the dominance of old water in storm flow was observed (Sklash *et al.*, 1986; Pearce *et al.*, 1986). This work was an exemplar of successful hypothesis testing of an established macroscale theory of hillslope function. When Mosley (1979) observed fast travel velocities in response to storm events in a tracer experiment, Pearce *et al.* (1986) monitored $d^{18}O$ and dD isotope ratios of rainfall and streamflow to show that the discharged water was dominated by old, pre-event water, disputing Mosley's theory of direct bypass flow from soil surface to his monitoring trench. These contradictory findings were later reconciled by the work of McDonnell (1990), who presented a theory of vertical bypass of new water, raised water tables with mixing of new and stored water in the soil profile, and preferential downslope flow in macropore networks.

In later work at the site, Woods and Rowe (1996) showed that lateral subsurface flow is spatially variable across the base of the hillslope, a finding that was shown to be ubiquitous at field sites around the world (e. g., Freer *et al.*, 2002; Kim *et al.*, 2004). While Woods and Rowe (1996) attributed the spatial variability to surface topography, analysis with a coarse map of bedrock topography showed a better correlation with flow data (Freer *et al.*, 1997).

Revisiting the Woods and Rowe hillslope, we have conducted a hillslope scale excavation and irrigation experiment to determine the role and nature of the preferential flow network at Maimai. At one site, irrigation was applied at the soil surface 4 m upslope of the collection trench, and at the other, irrigation was applied at depth 8 m upslope. Excavating upslope in 20 cm slices while at steady state flow conditions, the flow network was revealed from the hillslope base to the irrigation sites. Downslope flow was dominated by a connected network of preferential flow paths at the soil-bedrock interface, characterized by a connected pipe network at the bedrock surface filled with live and dead fine to medium roots. This network was capable of transmitting large volumes of water at rapid velocities (up to 20 m/hr). No lateral flow was observed in the soil matrix and macropores more than 5 cm above the bedrock surface, for either the surface or pit application of dye tracer.

For an excellent review of research done at the Maimai Experimental Forest, see McGlynn *et al.* (2002). Soils and catchment information are from McGlynn *et al.* (2002) and McDonnell (1990).

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1st International Conference on Hydropeology *Highlights of Presentations*

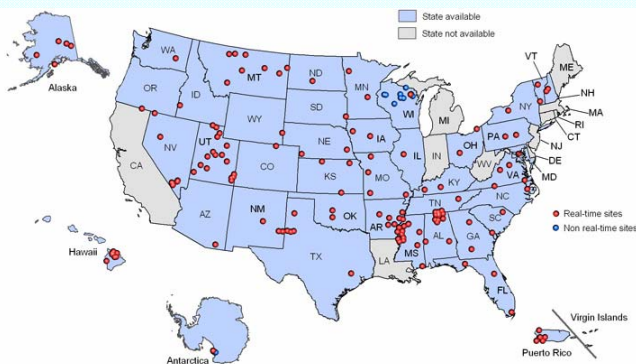
SNOTEL (SNOWpack TELEmetry) and SCAN (Soil Climate Analysis Network)

Garry Schaefer, Michael Strobel, Deb Harms, *USDA-NRCS National Water and Climate Center*

One of the missions of the Natural Resource Conservation Service (NRCS) is to monitor high elevation snow pack and climate information in order to forecast spring and summer streamflow volumes from more than 700 points across the western United States including Alaska. In order to monitor the winter conditions more effectively and because of increased demand for more frequent streamflow forecasts, the NRCS began automating the manual snow course network in 1978. This new system called SNOTEL uses meteor burst communication technology to transmit remote station data back to the Central Computer Facility located in Portland, Oregon. This system currently has more than 750 remote stations and provides up to hourly information from those stations on the snowpack and climate conditions.

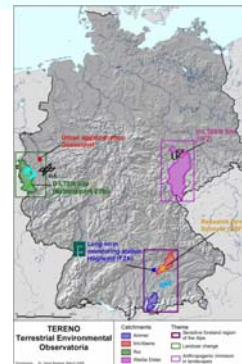
Because of the huge success of SNOTEL and the use of meteor burst communication technology, in 1991 the NRCS began a "pilot" project to monitor soil-climate information. The NRCS discovered that there were no networks in the United States that could provide near real-time soil moisture and temperature data combined with other climate information for the agency's use for natural resource planning, drought assessment, and water resource management. A 10-year pilot project was started to test the feasibility of such a project, along with an array of above and below ground sensors and to use the meteor burst communication technology to gather the remote stations data. The "pilot" project was a huge success that in 1999 the development of the SCAN program began. The network has 150 stations located in 39 states currently and has requests for 300 more stations. Funding for SCAN has largely come from NRCS and cooperator funds.

This paper will discuss how each of these two networks operate, the type of sensors that are used, the limitations of each of the networks, and how the data are used. The paper will also address the need to perform maintenance on remote stations in order to produce high quality information that can be used for natural resource planning.



← SCAN

TERENO →



TERENO - A Network of Terrestrial Observatories for Global Change Research

Heye Bogena, S. Huisman, T. Pütz, H. Vereecken, *Agrosphere Institute, Research Center Jülich, Jülich, Germany*

In order to address the challenges of global change, interdisciplinary research in terrestrial environmental science is of great importance. Although terrestrial systems are extremely complex, the terrestrial component in most process-based climate and biosphere models is typically represented in a very conceptual and often rudimentary way. Remedying this deficiency is therefore one of the most important challenges in environmental and terrestrial research, and we suggest that terrestrial observatories could be an important step towards a new quality in environmental and terrestrial research. The infrastructure activity TERENO (Terrestrial Environmental Observatoria) aims the establishment of a network of terrestrial observatories, defined as a system consisting of the subsurface environment, the land surface including the biosphere, the lower atmosphere and the anthroposphere. Hydrological units will be used as the basic scaling units in a hierarchy of evolving scales and structures ranging from the local scale to the regional scale for multi-disciplinary process studies.

The concept of TERENO is illustrated by the Lower Rhine Basin, one of three observatories planned in Germany, as a concrete example to serve as a hydrology-related prototype for terrestrial observatories. A monitoring concept for the Rur catchment - the largest catchment in the observatory - will be described that is capable of measuring the spatial-temporal variability of the main hydrological processes and interactions as well as the varying residence times of the terrestrial water stores. More detailed measurements (e.g. soil moisture network) and characterisation of smaller, focal catchments will be embedded within progressively larger catchments, allowing the critical evaluation and development of hydrologic scaling strategies. Specific attention will be given to install novel wireless sensor technology and hydrogeophysical measurement techniques combined with local scale remote sensing methods. At the catchment scale precipitation radar will be used in combination with flying remote sensing platforms.

1st International Conference on Hydrogeology *Highlights of Presentations*

The Baltimore WATERS Test Bed

Claire Welty¹, Andrew Miller¹, James Smith², Reed Maxwell³, Robert Shedlock⁴, Ed Doheny⁴, Tracy Kerchhof¹, **Christiane Runyan¹**, Kenneth Belt⁵, Michael McGuire¹, Philip Larson¹, Robert Ryan⁶, Nigel Crook⁷, Mary Lynn Baeck², Sujay Kaushal⁸, Todd Scanlon⁹, Larry Band¹⁰ and Peter Groffman¹¹.

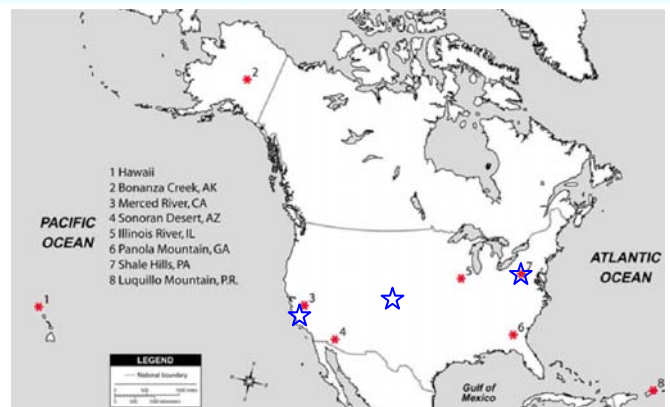
¹UMBC, ²Princeton University, ³Lawrence Livermore National Laboratory, ⁴USGS MD-De-DC Water Science Center, ⁵USDA Forest Service, ⁶Temple University, ⁷Stanford University, ⁸UMCES, ⁹University of Virginia, ¹⁰University of North Carolina-Chapel Hill, ¹¹Cary Institute of Ecosystem Studies

The goal of this project is to establish a near-real-time observing system with wireless telemetry and advanced visualization tools for simultaneous display of the temporal and spatial patterns of all components of the hydrologic cycle at sites throughout the Baltimore metropolitan area, using the 171 sq-km Gwynns Falls watershed as a focus for test-bed activities. This end-to-end system will be integrated with a fully coupled groundwater/surface water/land surface model to close the urban water budget.

Project work to date includes equipment deployment and data collection that will enable refinement of our understanding of the urban hydrologic system at both the larger watershed scale and the sub-watershed scale. At the larger watershed scale, a coarse-grid MODFLOW model has been set up to begin to quantify groundwater flow magnitude and direction. Data from three wet and dry season water level synoptics, stream seepage transects, and existing hydraulic conductivity data are being used to calibrate the model. Boring logs for the entire metropolitan area are being used to define the third dimension of the geologic and soil framework. At the sub-watershed scale, multiple campaign-style stream tracer tests under both higher-base flow and low flow conditions have been conducted, with the most recent of the tests completed in May 2008. These tests enable an understanding of the groundwater-surface water exchange as a function of land cover type and stream position in the watershed. In order to refine our understanding of subsurface processes, 14 pairs of saprolite and bedrock wells are to be drilled in the Gwynns Falls watershed in Fall 2008. Real-time soil moisture and soil tension clusters will be co-located with the wells. All data will be telemetered along with other real-time data via the USGS GOES satellite system and be available for viewing on the web. Related efforts include: (1) the deployment of eight In-Situ Level Trolls throughout Baltimore County and Baltimore City in our "adopt-a-well" program, to build a permanent groundwater monitoring system on a continuous-time basis, and (2) deployment of an eddy covariance station for quantifying evapotranspiration fluxes.



WATERS Test Bed Sites



*** CZEN Seed Sites ☆ CZO Sites**

Designing a Critical Zone Exploration Network

Susan L. Brantley, *Earth and Environmental Systems Institute, Penn State University*

As the science of geology enters its third century, scientists now have easy access to maps of climate, topography, soil orders, and vegetation for many regions of the globe including the U.S. However, we have at best a fragmented understanding of the spatial distribution of the chemical nature and thickness of the weathered mantle of Earth down to bedrock – the regolith. This zone is a large part of the Critical Zone – the zone that hosts terrestrial life on Earth. Depending upon characteristics of vegetation, climate, lithology, topography, land use, land cover, and tectonic and sedimentary history and activity, this active zone consists of soil, saprolite, alluvial material, fragments of bedrock, and weathered bedrock. The regolith ultimately supports the food supply for humans, but we currently cannot predict the depth of regolith, how this depth is spatially distributed, nor the rate of regolith generation. To understand these questions requires an integration of data and sciences that is difficult under the current paradigms of access to funding, data, and sites. We need to design and implement a network of sites that provide access to observations about regolith as a function of important environmental variables.



PHOENIX MARS MISSION



NASA's Phoenix spacecraft landed in the northern polar region of Mars at 4:53 p.m. Pacific Time, May 25, 2008 to begin three months of examining a site (called Vastitas Borealis) chosen for its likelihood of having frozen water within reach of the lander's robotic arm. Anticipated pace of operations is below:

- The first 8-10 days after landing is a "characterization phase" of checking out and understanding the performance of the spacecraft's power and thermal systems, as well as the robotic arm and other instruments.
- At the end of the characterization phase, the first sample of surface soil will be delivered to the Thermal and Evolved-Gas Analyzer onboard Phoenix.
- Analysis of soil from the surface in both the Thermal and Evolved-Gas Analyzer and in the Microscopy, Electrochemistry and Conductivity Analyzer will likely take 10-15 days if all processes go well. After that, each additional sampling cycle will reach a deeper subsurface level, in increments of ~2-3 cm. At each different layer, collecting and analyzing samples is expected to take 10-15 days, barring operational difficulties.
- How soon the digging reaches the expected icy layer will depend on how far below the surface that layer lies. Estimates in advance of landing range from 2-5 cm. If the ice is at the deeper end of that range, the first analysis of an icy sample could be in July or later.



The Phoenix Mission has two bold objectives: (1) to study the history of water in the Martian arctic in all its phases and (2) to search for evidence of a habitable zone and assess the biological potential of the ice-soil boundary. The Phoenix lander will use a robotic arm to dig through the protective top soil layer to the water ice below and ultimately, to bring both soil and water ice to the lander platform for sophisticated analysis.

Recent discoveries have shown that life can exist in the most extreme conditions. It is possible that bacterial spores can lie dormant in bitterly cold, dry, and airless conditions for millions of years and become activated once conditions become favorable. Such dormant microbial colonies may exist in the Martian arctic, where due to the periodic wobbling of the planet, liquid water may exist for brief periods about every 100,000 years making the soil environment habitable.

Soil analysis to be performed by the Phoenix includes: the soil's composition of life-giving elements such as carbon, nitrogen, phosphorus, and hydrogen; reduction-oxidation (redox) potential, pH, saltiness; organic signatures; temperature, thermal properties, and electrical conductivity.

For more info about the Phoenix Mars Mission, visit the mission home page: <http://phoenix.lpl.arizona.edu/>

Phoenix Returns Treasure Trove for Science

Editor's Note: The following news release is taken directly from the NASA press release in its entirety, viewable at <http://www.jpl.nasa.gov/news/news.cfm?release=2008-121>.



Jet Propulsion Laboratory
California Institute of Technology

Just released yesterday!
Just released yesterday!

HOT!

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EDUCATION

SCIENCE & RESEARCH

ABOUT JPL

News: Phoenix Returns Treasure Trove for Science

6/26/08

NASA's Phoenix Mars Lander performed its first wet chemistry experiment on Martian soil flawlessly yesterday, returning a wealth of data that for Phoenix scientists was like winning the lottery.

"We are awash in chemistry data," said Michael Hecht of NASA's Jet Propulsion Laboratory, lead scientist for the Microscopy, Electrochemistry and Conductivity Analyzer, or MECA, instrument on Phoenix. "We're trying to understand what is the chemistry of wet soil on Mars, what's dissolved in it, how acidic or alkaline it is. With the results we received from Phoenix yesterday, we could begin to tell what aspects of the soil might support life."

"This is the first wet-chemical analysis ever done on Mars or any planet, other than Earth," said Phoenix co-investigator Sam Kounaves of Tufts University, science lead for the wet chemistry investigation.

About 80 percent of Phoenix's first, two-day wet chemistry experiment is now complete. Phoenix has three more wet-chemistry cells for use later in the mission.

"This soil appears to be a close analog to surface soils found in the upper dry valleys in Antarctica," Kounaves said. "The alkalinity of the soil at this location is definitely striking. At this specific location, one-inch into the surface layer, the soil is very basic, with a pH of between eight and nine. We also found a variety of components of salts that we haven't had time to analyze and identify yet, but that include magnesium, sodium, potassium and chloride."



This image shows a microscopic view of fine-grained material at the tip of the Robotic Arm scoop aboard NASA's Phoenix Mars Lander on June 20, 2008. The image shows small clumps of fine, fluffy, red soil particles.
[Go to animation](#)
[+ Larger image](#)

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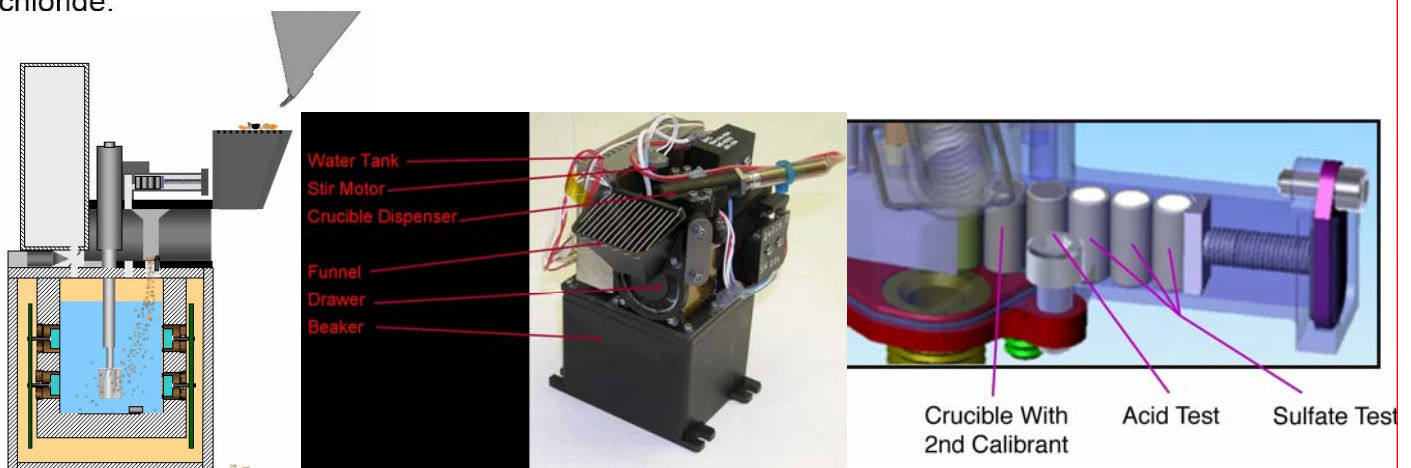
[Raw images](#)

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[JPL Phoenix site](#)

[NASA Phoenix site](#)

[Univ. of Arizona Phoenix site](#)



View animation of MECA at work at: http://phoenix.jpl.arizona.edu/video/Sol_31/WCL-d80.gif

"This is more evidence for water because salts are there. We also found a reasonable number of nutrients, or chemicals needed by life as we know it," Kounaves said. "Over time, I've come to the conclusion that the amazing thing about Mars is not that it's an alien world, but that in many aspects, like mineralogy, it's very much like Earth."

Another analytical Phoenix instrument, the Thermal and Evolved-Gas Analyzer (TEGA), has baked its first soil sample to 1,000 degrees Celsius (1,800 degrees Fahrenheit). Never before has a soil sample from another world been baked to such high heat.

TEGA scientists have begun analyzing the gases released at a range of temperatures to identify the chemical make-up of soil and ice. Analysis is a complicated, weeks-long process.

But "the scientific data coming out of the instrument have been just spectacular," said Phoenix co-investigator William Boynton of the University of Arizona, lead TEGA scientist.

"At this point, we can say that the soil has clearly interacted with water in the past. We don't know whether that interaction occurred in this particular area in the northern polar region, or whether it might have happened elsewhere and blown up to this area as dust."

Leslie Tamppari, the Phoenix project scientist from JPL, tallied what Phoenix has accomplished during the first 30 Martian days of its mission, and outlined future plans.

The Stereo Surface Imager has by now completed about 55 percent of its three-color, 360-degree panorama of the Phoenix landing site, Tamppari said. Phoenix has analyzed two samples in its optical microscope as well as first samples in both TEGA and the wet chemistry laboratory. Phoenix has been collecting information daily on clouds, dust, winds, temperatures and pressures in the atmosphere, as well as taking first nighttime atmospheric measurements.

Lander cameras confirmed that white chunks exposed during trench digging were frozen water ice because they sublimated, or vaporized, over a few days. The Phoenix robotic arm dug and sampled, and will continue to dig and sample, at the 'Snow White' trench in the center of a polygon in the polygonal terrain.

"We believe this is the best place for creating a profile of the surface from the top down to the anticipated icy layer," Tamppari said. "This is the plan we wanted to do when we proposed the mission many years ago. We wanted a place just like this where we could sample the soil down to the possible ice layer."

The Phoenix mission is led by Peter Smith of The University of Arizona with project management at JPL and development partnership at Lockheed Martin, located in Denver. International contributions come from the Canadian Space Agency; the University of Neuchatel, Switzerland; the universities of Copenhagen and Aarhus, Denmark; Max Planck Institute, Germany; and the Finnish Meteorological Institute. For more information on the Phoenix mission, link to <http://www.nasa.gov/phoenix> and <http://phoenix.lpl.arizona.edu>.

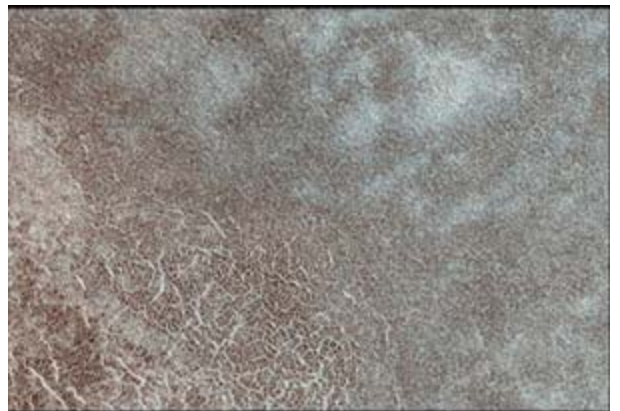


Solar System

Martian Landscape!

See the movie of vast Martian polar plains at:
<http://www.jpl.nasa.gov/news/phoenix/images.php?fileID=6206>

← This approximately true color image was among the first taken by the Phoenix shortly after landing. It shows the vast plains of the northern polar region of Mars. The flat landscape is strewn with tiny pebbles and shows polygonal cracking, a pattern seen widely in Martian high latitudes and also observed in permafrost terrains on Earth. The polygonal cracking is believed to have resulted from seasonal freezing and thawing of surface ice. (Image credit: NASA/JPL-Caltech/University of Arizona)



Martian winter



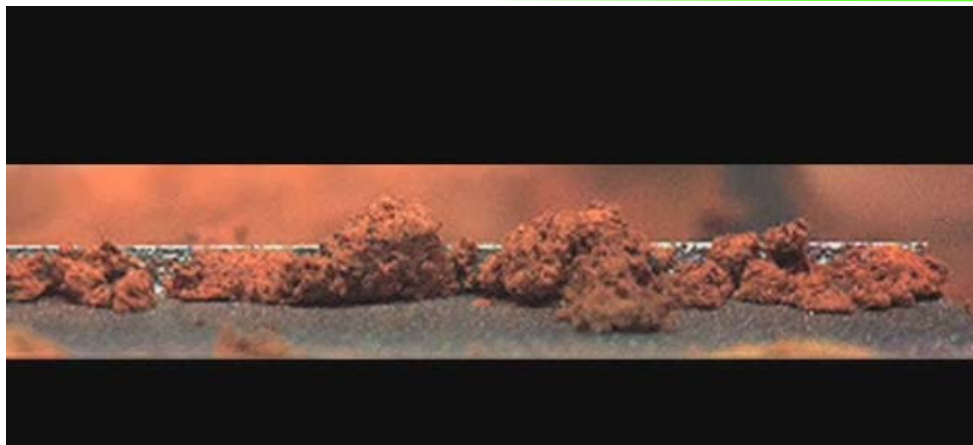
Antarctic summer

Similar patterned ground on Mars (**upper**) and Earth (**lower**), where shallow fracturing has drawn polygons on the surface. The upper image was taken in March 2008 by NASA's Mars Reconnaissance Orbiter, showing bright ice in shallow crevices accentuates the area's polygonal fracturing pattern. The polygons are a few meters across. The lower image is an aerial view of Antarctica. (Image credit: NASA/JPL-Caltech/UA)

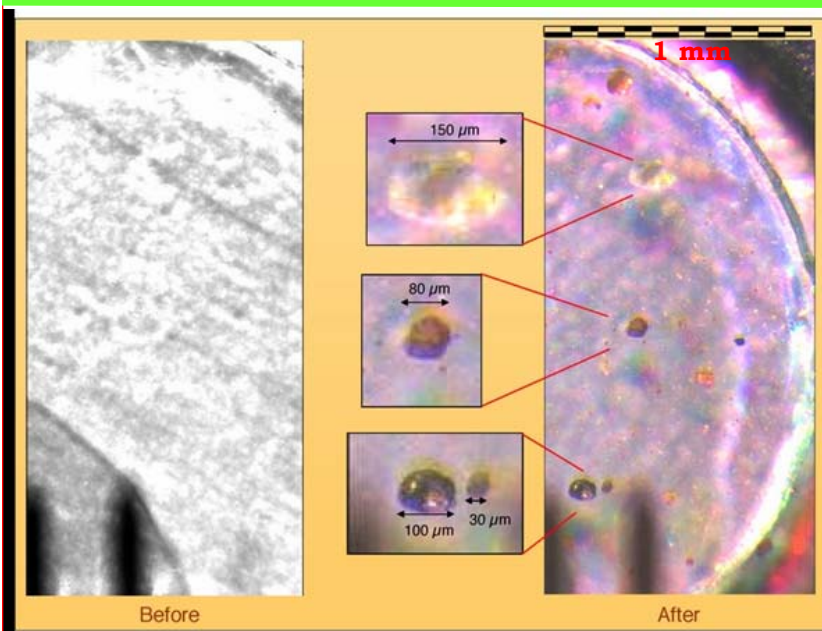
Martian Soils !!



This is the 1st scoop of Martian soil from the Phoenix's Robotic Arm (RA) during its first test dig and dump on Sol 7 (June 1). The test sample shown was taken from the digging area informally known as "Knave of Hearts." (Image credit: NASA/JPL-Caltech/Univ. of Arizona/Max Planck Inst.)



This pan and zoom image shows a microscopic view (at a resolution of 30 microns) of fine-grained material at the tip of the Robotic Arm scoop as seen by the Phoenix's Robotic Arm Camera (RAC) on Sol 26 (June 20, 2008). The image shows small clumps of fine, fluffy, red soil particles collected in a sample called 'Rosy Red.' The sample was dug from the trench named 'Snow White' in the area called 'Wonderland.' Some of the Rosy Red sample was delivered to Phoenix's Optical Microscope and Wet Chemistry Laboratory for analysis. (Image Credit: NASA/JPL-Caltech/Univ. of Arizona/Max Planck Institute). See the animation at: <http://www.jpl.nasa.gov/news/phenix/images.php?fileID=14293>.

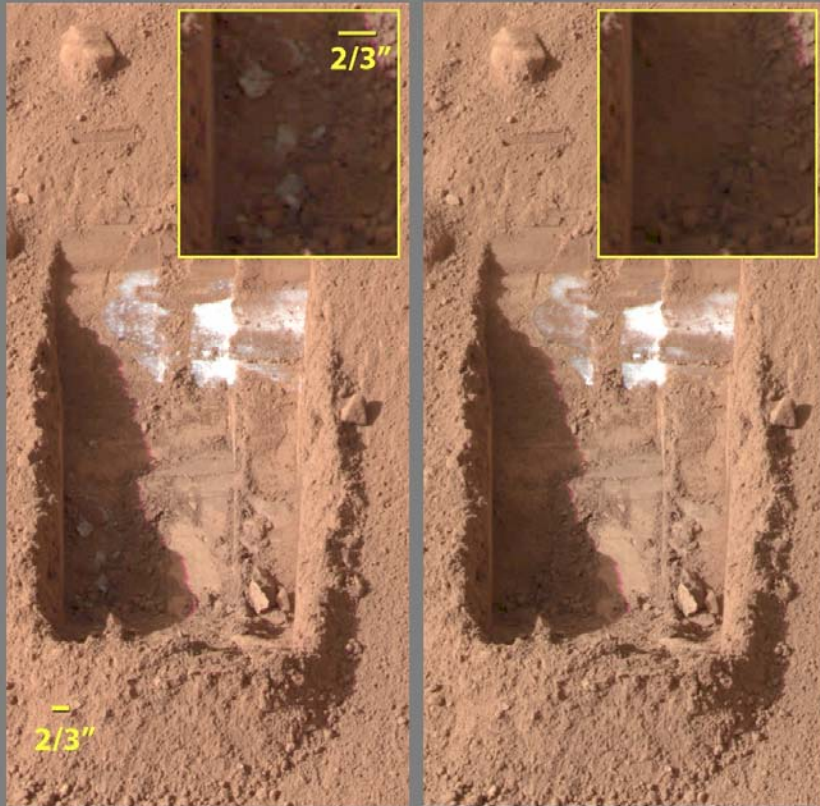


The color composite image acquired on Sol 9 (June 3) by the Optical Microscope on the Phoenix. Comparison with a B&W image (left) acquired during Phoenix's flight to Mars, identifies new particles deposited during the landing. The particles are presumably samples from the Martian surface (dust kicked up by landing). Most particles are the typical reddish-brown of the Martian surface, but some are translucent. The particles are on a silicone substrate target, which provides a sticky surface for holding the particles while the microscope images them. Blow-ups of four of the larger particles are shown in the center. It is the highest resolution image of dust and sand ever acquired on Mars (Image credit: NASA/JPL-Caltech/UA)

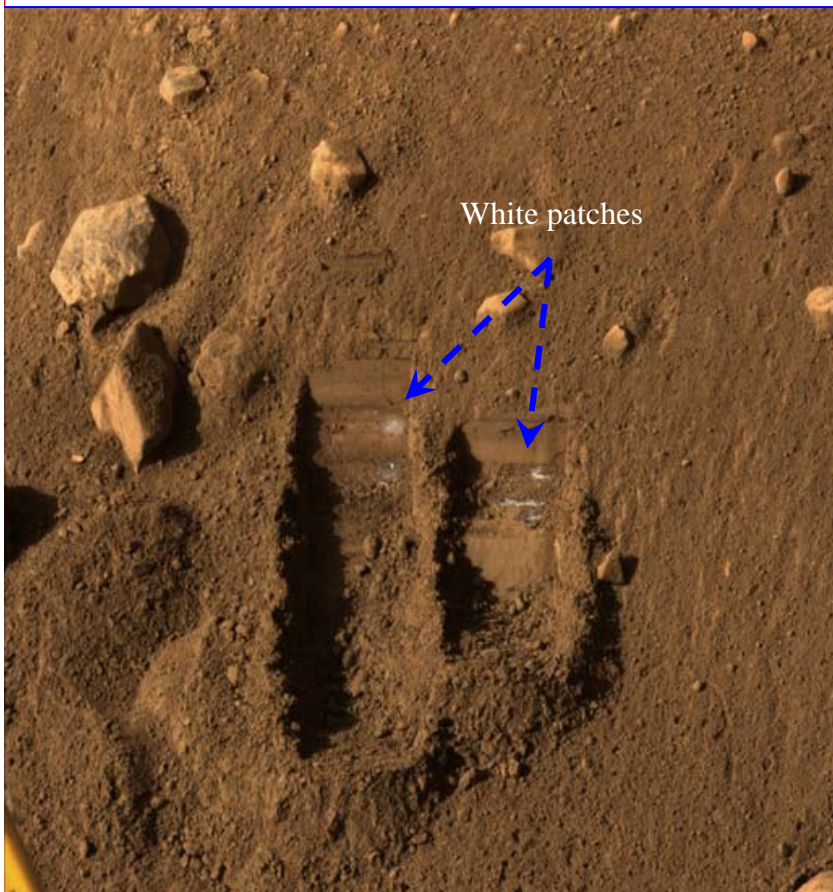
Martian Water?!

Sol 20

Sol 24

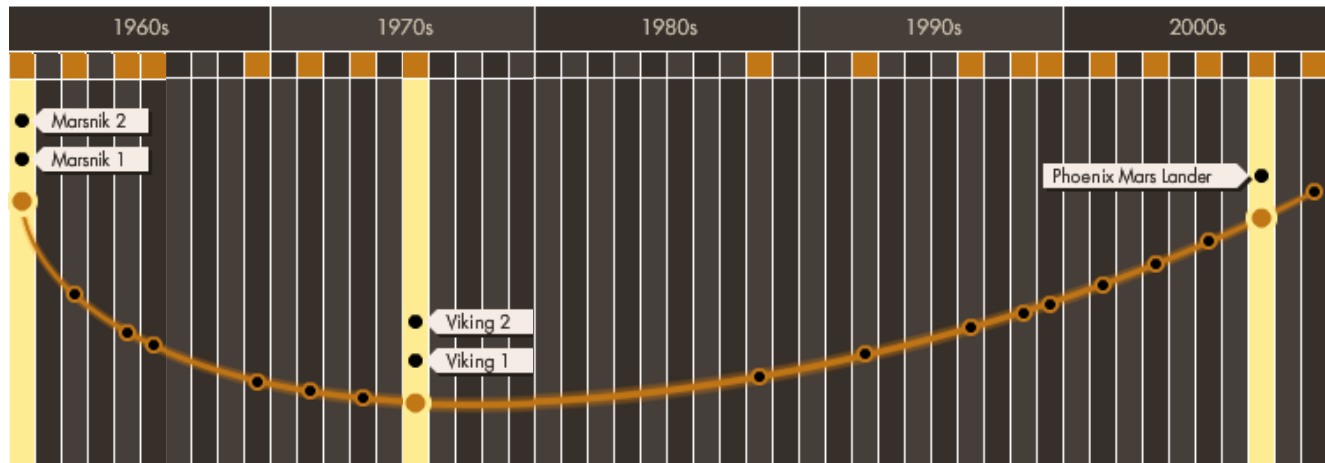


These color images were acquired by NASA's Phoenix Mars Lander's Surface Stereo Imager on the 21st and 25th days of the mission, or Sols 20 and 24 (June 15 and 19, 2008). These images show sublimation of ice in the trench informally called "Dodo-Goldilocks" over the course of four days. In the lower left corner of the left image, a group of lumps is visible. In the right image, the lumps have disappeared, similar to the process of evaporation. (Image credit: NASA/JPL-Caltech/Univ. of Arizona/Texas A&M Univ.)

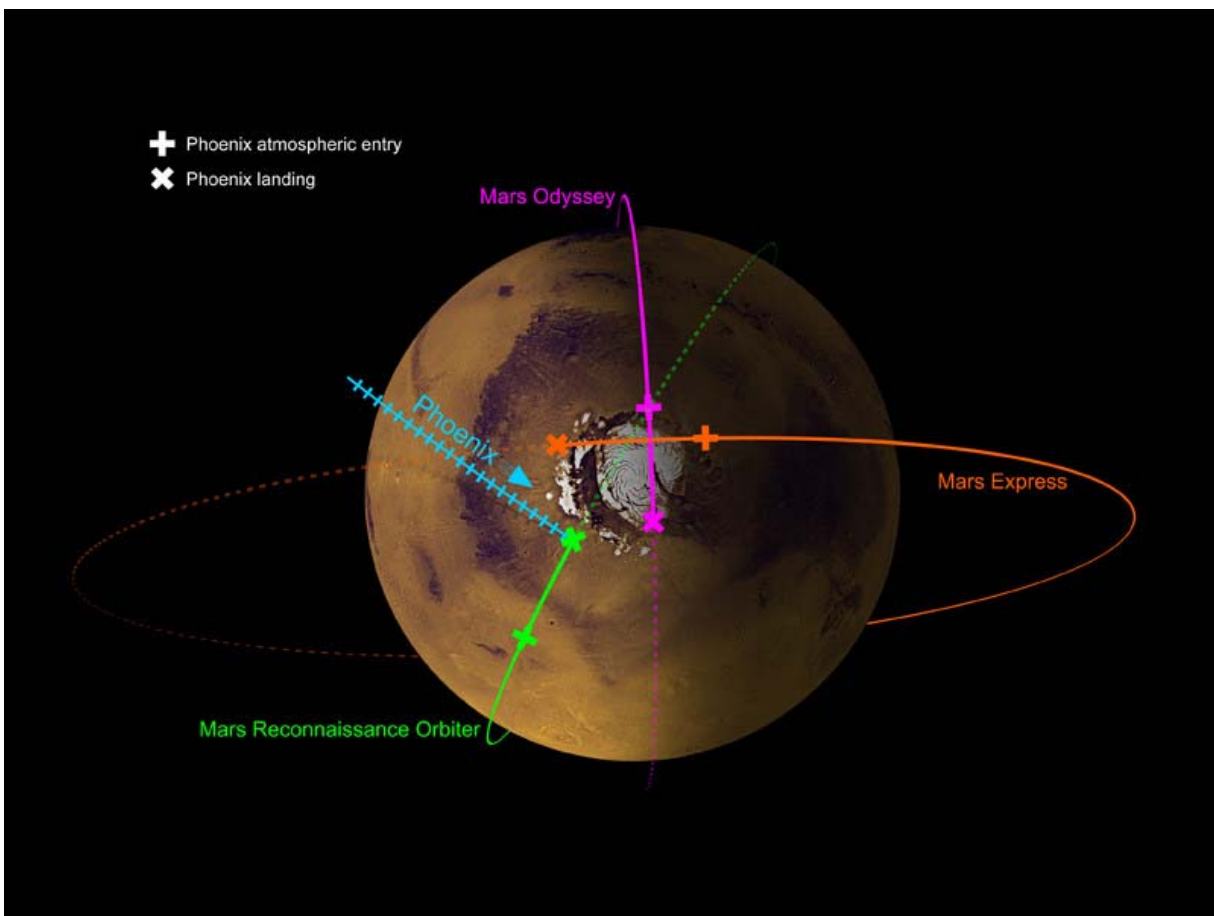


This image, presented in approximately true color and taken on Sol 14 (June 8), shows two trenches dug by Phoenix's Robotic Arm. The white patches could possibly be ice or salts that precipitated into the soil. It is speculated that this white material is probably the same material seen in previous images from under the lander in which an upper surface of a possible ice table was observed. Soil from the right trench, informally called "Baby Bear," was delivered to Phoenix's Thermal and Evolved-Gas Analyzer on Sol 12 (June 6) and will be analyzed. The trench on the left is informally called "Dodo" and was dug as a test. Each of the trenches is about 9 cm wide. (Image credit: NASA/JPL-Caltech/Univ. of Arizona/Texas A&M Univ.)

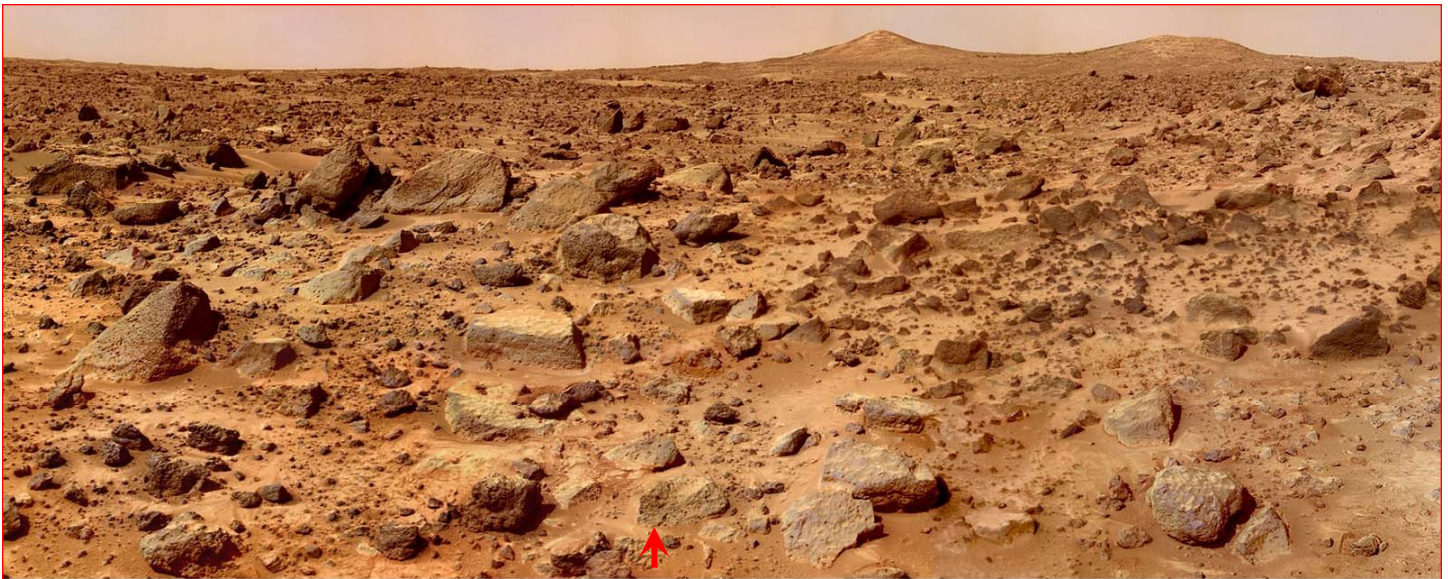
FROM EARTH TO MARS: The history of Mars exploration



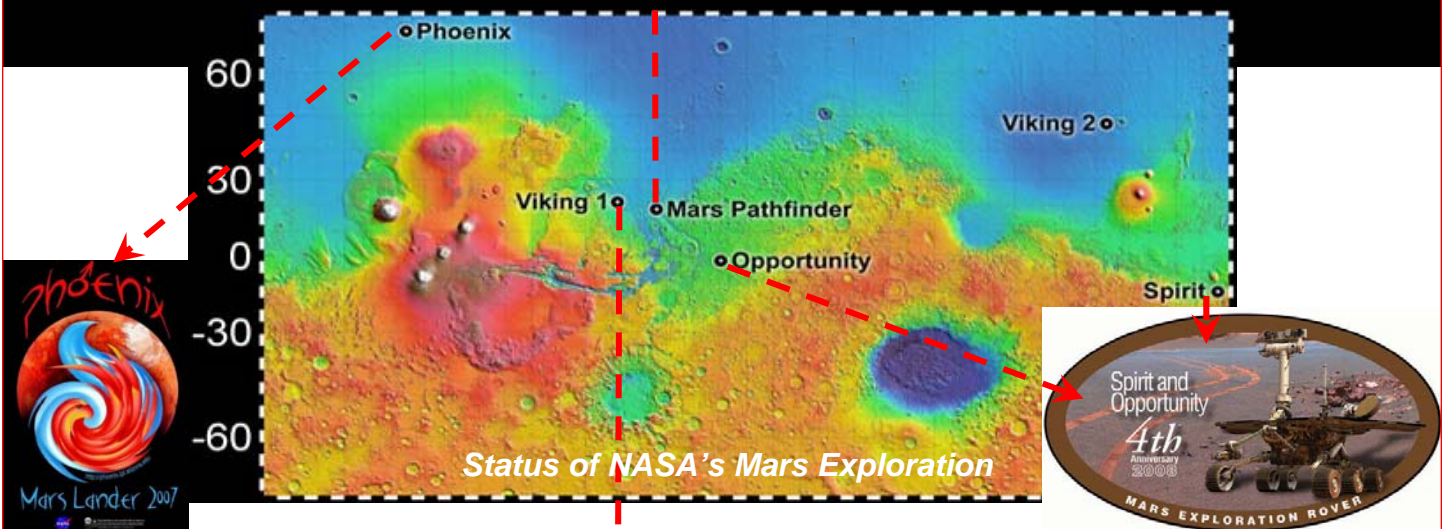
Visit the interactive version of this history: <http://phoenix.lpl.arizona.edu/timeline.php>



This image shows the paths of three spacecraft currently in orbit around Mars, as well as the path by which NASA's Phoenix Mars Lander approached and landed on the planet. The t-shaped crosses show where the orbiters were when Phoenix entered the atmosphere, while the x-shaped crosses show their locations at landing time. All three orbiters, NASA's Mars Reconnaissance Orbiter, NASA's Mars Odyssey and the European Space Agency's Mars Express, have been “watching” Phoenix during the final steps of its journey to the Red Planet. (Image credit: NASA/JPL-Caltech)



This image, taken during NASA's 1997 Pathfinder mission to Mars, shows uneven and rocky terrain. The "Twin Peaks" hills can be seen in the background. NASA's Phoenix landed in the northern arctic plains of Mars, where the landscape is much smoother with fewer rocks. (Image credit: NASA/JPL)



This image, which has been flipped horizontally, was taken by Viking Lander 1 on August 1, 1976, 12 sols after landing. Much like images that have returned from Phoenix, the soil beneath Viking 1 has been exposed due to exhaust from thruster engines during descent. This is visible to the right of the struts of Viking's surface-sampler arm housing, seen on the left. (Image credit: NASA/JPL)

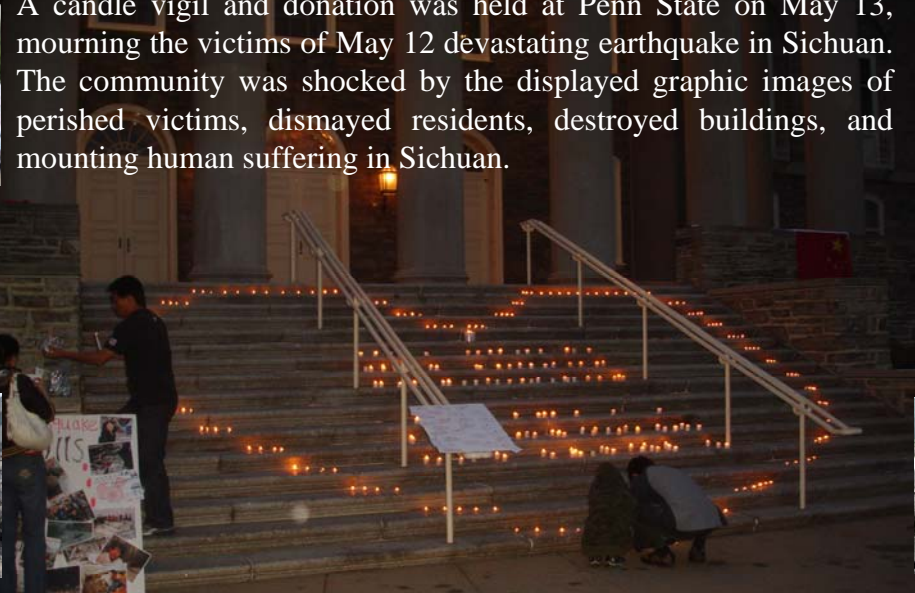
Our Thoughts and Prayers Go to the Victims of Devastating M7.9 Sichuan Earthquake

Hundreds of aftershocks have rattled Sichuan province following May 12 devastating 7.9 magnitude quake. Go to <http://www.msnbc.msn.com/id/24583362/> to view the animation.

China earthquake: Impact and aftermath



A candle vigil and donation was held at Penn State on May 13, mourning the victims of May 12 devastating earthquake in Sichuan. The community was shocked by the displayed graphic images of perished victims, dismayed residents, destroyed buildings, and mounting human suffering in Sichuan.



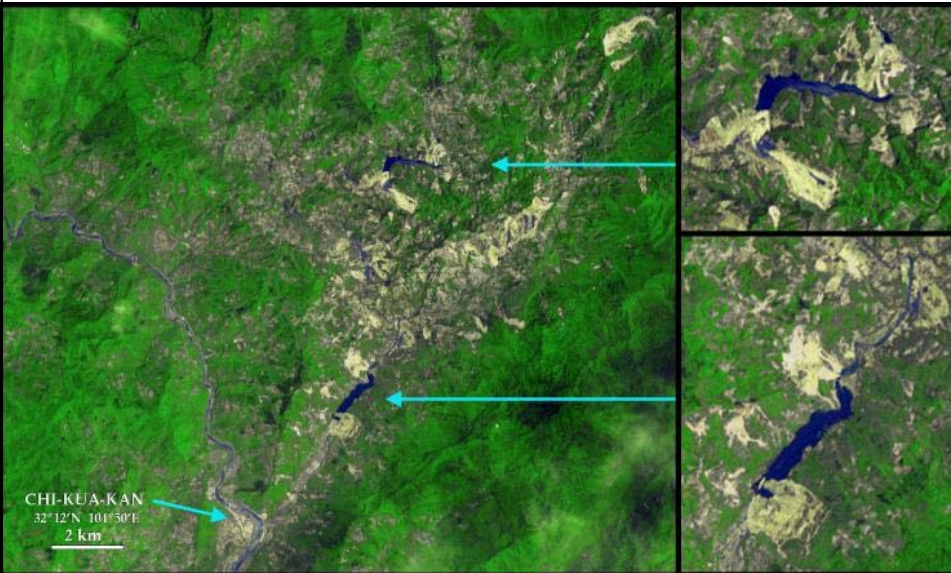
Thus far, earthquake prediction is controversial as data are sparse, and little evidence or verified physical theory exists to link observable phenomena to subsequent seismicity. *Soil tectonics* (the study of what faults do to soils and what soils do to faults) is on its infancy and will benefit from pedology and soil physics, particularly regarding what soils will produce landslides as a result of earthquake and the mechanisms/preventions of soil/construction failure during shaking.



An expressway buried by a landslide triggered by the quake (from msnbc)

Wang Jianhua / AP

The Sichuan earthquake occurred along faults within the mountains, but near and almost parallel the mountain front. Aftershocks pose a continuing danger, and another continuing hazard is the widespread occurrence of landslides that have formed new natural dams and consequently new lakes. These lakes are submerging roads and flooding previously developed lands. An even greater concern is the possible rapid release of water as the lakes eventually overflow the new dams. The dams are generally composed of disintegrated soil and rock debris that may easily erode, leading to greater release of water, which may then cause faster erosion and an even greater release of water. This possible "positive feedback" between increasing erosion and increasing water release could result in catastrophic debris flows and/or flooding. Spillways are being built by the rescue teams over the new natural dams.



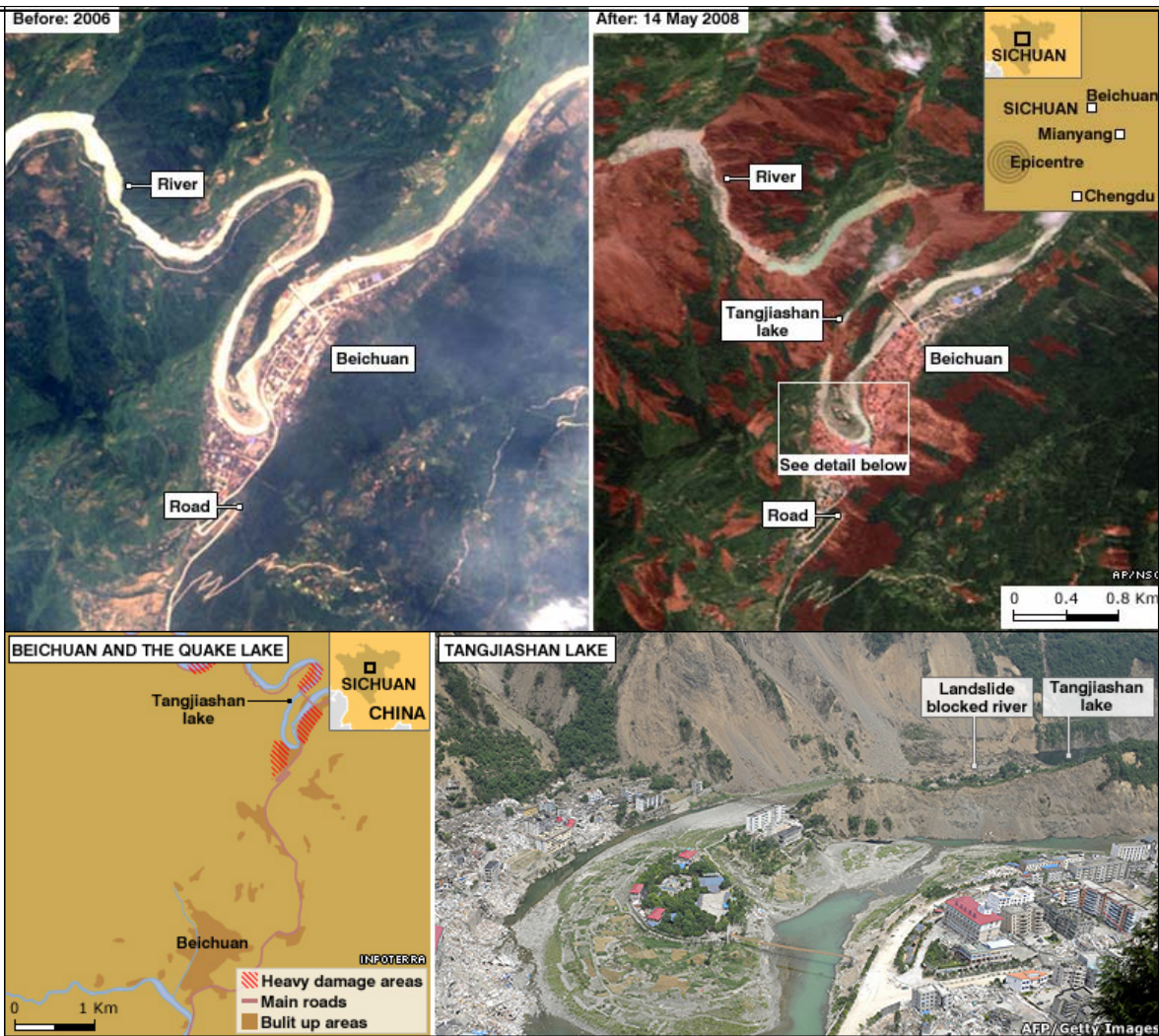
This ASTER image, acquired on June 1, 2008, shows two of the new large landslide dams and lakes upstream from the town of Chi-Kua-Kan. Vegetation is green, water is blue, and soil is grayish brown. New landslides appear bright off-white. The northern (top) lake is upstream from the southern lake. Close inspection shows a series of much smaller lakes in an elongated "S" pattern along the original stream path. (Image Credit: NASA/GSFC/METI/ERSDAC/JARO S, and U.S./Japan ASTER Sci. Team)

Collapsed bridge (from msnbc)



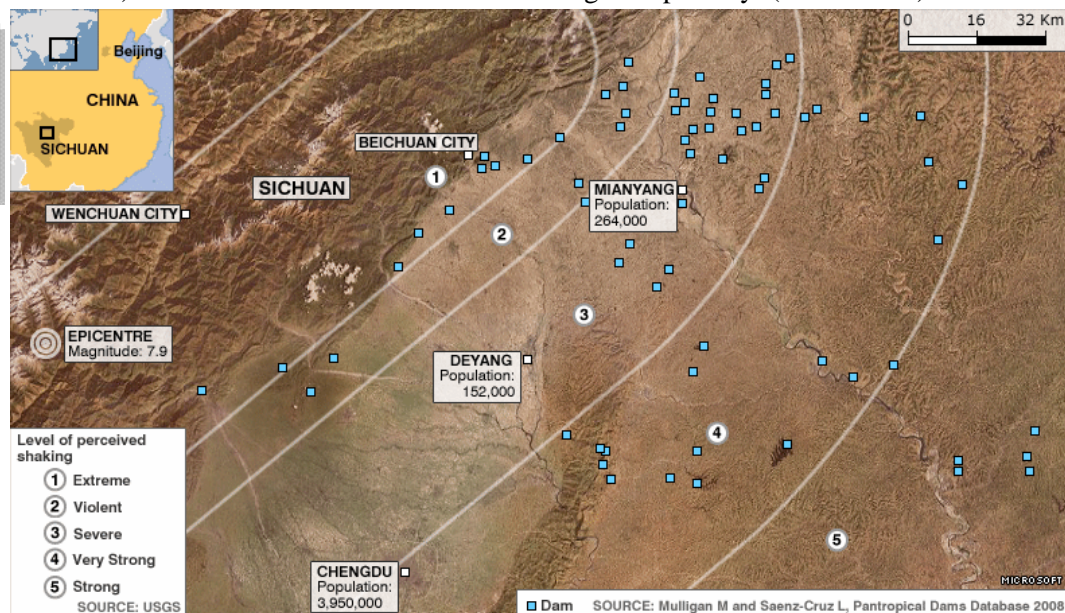
Collapsed road (from msnbc)

The Extent of Landslide Damages at the Epicenter



Taiwan's National Space Organisation has released satellite images of the Beichuan area of Sichuan, showing how the earthquake has caused huge landslides. The river running down from the mountains through Beichuan has been blocked by earth (seen as brown). Roads have been covered and buildings swept away. (From: BBC)

The Extent of Possible Dam Problems near the Epicenter



Large areas are under threat from floods and landslides after the massive earthquake and aftershocks. This map shows dams in the area devastated by the earthquake. Some have been damaged by the shocks, sparking fears that thousands more homes could be swamped. The problem is given added urgency by the fact that many of the dams are in areas considered most susceptible to the imminent rainy season. (From: BBC)



*Triggering Mechanisms of Landslides and Debris Flows and Their Linkages:
Hydrogeomorphic and Hydrogeological Influences*

Roy C. Sidle and Fumitoshi Imaizumi

Disaster Prevention Research Institute, Kyoto Univ., Japan

Annually landslides and debris flows kill an average of 170 people and cause >\$4 billion US in damage in Japan (excluding indirect costs) despite the huge expenditures on countermeasures made by the Japanese government to control landslides and prevent damage by debris flows. This problem is linked to the way that these disasters are studied and a fundamental lack of knowledge of the processes controlling the initiation and interrelationship of these events. Herein we present examples of slope instabilities caused by both a rapid accretion of pore water pressure and by loss of soil suction and increase of overburden weight. In many cases, peak pore water pressure occurs just after maximum rainfall intensity facilitated by preferential flow in soils and regoliths. In contrast, landslides triggered by loss of suction occur after significant total amounts of rainfall percolate deep into the soil mantle. Additionally, our studies in steep (> 20°) channels in Japan reveal important differences related to the interconnection between sediment supply and debris flow initiation, as well as hydrogeomorphic conditions that exacerbate debris flow occurrence. Sediment linkage to stream channels in steep terrain and subsequent transport can generally be characterized into three categories: (1) landslides that supply sediment directly to channels, which immediately mobilize as debris flows; (2) landslides that deposit sediment in headwater stream junctions, which later mobilize as debris flows; (3) landslides that terminate on hillslopes that later supply sediment to channels via mass wasting and surface erosion. The Ohya landslide area (a huge landslide that occurred during an earthquake in 1707) is one of the most active debris flow sites in Japan. In one monitored channel, frequent debris flows (39 within a 6-yr period) were attributed to the rapid supply of sediment from steep (40 – 50°) adjacent, virtually unvegetated, hillslopes. Most of this sediment was supplied by dry ravel and rock fall promoted by freeze-thaw processes. Fluvial processes, important in debris flow initiation in low gradient channels, were minimal and some debris flows occurred during unsaturated conditions, affected by channel gradient. In Miyagawa catchment, percentages of landslides reaching channels varied from 56% to 75% and were correlated with maximum hourly rainfall. The mobility of debris flows was higher during periods with high maximum instantaneous discharge compared to lower discharge, suggesting that water content in initially failed materials and transported sediment controlled their mobility. More than 70% of the landslide sediment that reached channels terminated at hillslope-channel junctions. In catchments > 10 ha, the percentage of stream channel impacted by debris flows declined with increasing catchment size due to gentler gradients. These findings are important to develop prediction methods, real-time warning systems, and countermeasures against sediment disasters in steep, unstable terrain.

Thermal and Electrical Conductivity probe (TECP) for the Phoenix 2007 Scout Mission to Mars

Douglas Cobos, Colin S. Campbell, Gaylon S. Campbell, Martin Buehler, *Decagon Devices, Inc.*;
Michael Hecht, *Jet Propulsion Laboratory*



In August 2007, NASA launched the Phoenix Scout Mission to Mars. By the time of this presentation, the mission will have landed near the northern polar ice cap and begun collecting data on the Martian soil and atmosphere. The two goals of this mission are to study the icy Martian soil and to search for evidence of liquid water on Mars in the past or possibly in the present, and to analyze the chemistry of Martian regolith. We (Decagon Devices) have developed an instrument to measure physical properties of the Martian regolith in situ in support of these mission goals. This probe, the Thermal and Electrical Conductivity Probe (TECP), will measure regolith thermal properties (temperature, thermal conductivity, and heat capacity), regolith electrical properties (conductivity and dielectric permittivity), and atmospheric properties (relative humidity and wind speed). This presentation will include an overview of the TECP instrument and also discuss how various Phoenix measurements might be used to elucidate the Martian hydrologic cycle and regolith morphology. Preliminary findings from the mission will be presented if available.

Symposium (PES-02): The Earth's Critical Zone and Hydropedology
-- A Major Geoscience Program for the International Year of Planet Earth (IYPE)
to be held at the Geoscience World Congress 2008 (33rd IGC), Oslo, Norway, August 9, 2008



The Congress
Science Programme

Conveners: Henry Lin¹, Alexander Gennadiyev², Michael Sommer³

¹ Dept. of Crop and Soil Sciences, The Pennsylvania State University, USA

² Faculty of Geography, Moscow State University, Moscow, Russia

³ Leibniz-Centre for Agricultural Landscape Research (ZALF), Institute of Soil Landscape Research, Müncheberg, Germany



UN Year of Planet Earth

Time	Speaker	Abstract Title
08:30	<u>Lin, Henry</u> ; Chittleborough, David; Singha, Kamini; Vogel, Hans-Joerg; Mooney, Sacha	The outcomes of the first international conference on hydropedology
09:00	<u>Ragnarsdottir, Vala</u> ; Mankasingh, Utra; Nikolaidis, Nikolaos; Banwart, Stephen; Leake, Jonathan; Gaillardet, Jerome; Novak, Martin; van Gaans, Pauline; Rousseva, Svetla; Blum, Winfried; Aagaard, Per; White, Tim; Brantley, Susan	SoilCritZone - towards understanding the life cycle of soils
09:30	<u>Vereecken, Harry</u>	Terrestrial environmental research and geophysics: Quo vadis
10:00	<i>Coffee break</i>	
10:30	<u>Young, Iain</u> , Crawford, John; Grinev, Dmitry; Spiers, A; Dello Sterpaio, Patsy	Inner space: Biota sense and react to their soil environment
11:00	<u>de Jonge, Lis Wollesen</u> ; Moldrup, Per; Schjønning, Per	Soil Infrastructure, Interfaces and Translocation Processes in Inner Space (Soil-it-is)
11:30	<u>Sommer, Michael</u>	Soil landscapes - the need for a new paradigm in soil science
12:00	<i>Lunch</i>	
14:00	Hüttl, Reinhard; Kögel-Knabner, Ingrid; Zeyer, Josef; Raab, Thomas	Structures and processes of the initial ecosystem development phase in an artificial water catchment
14:30	<u>Lin, Henry</u> ; Jun, Zhang; Takagi, Kenneth	Soil moisture spatial-temporal patterns and subsurface preferential flow network at the Shale Hills catchment
15:00	<u>Stolte, Jannes</u> ; French, Helen K.; Ritsema, Coen J.	Water infiltration in soil at catchment scale: Consequences for cold-climate regions
15:30	<i>Coffee break</i>	
16:00	<u>Wilding, Larry P.</u> ; Woodruff, Jr., Charles M.; Wilcox, Bradford P.	Hydropedology in stepped hillslopes weathered from Glen Rose Limestone of Lower Cretaceous age
16:30	Discussions	

Variably Saturated Flow in Soil and Rock: What's the Same, What's Different?

-- A joint session at the 2008 annual meeting of GSA and SSSA, October 5-9, Houston, TX

Wednesday, 8 October 2008: 8:00 AM-12:00 PM, George R. Brown Convention Center 351BE

Sponsor: S01 Soil Physics; S05 Pedology; GSA Hydrogeology Division

Conveners: John Nimmo, USGS; Boris Faybishenko, Lawrence Berkeley National Lab; Henry Lin, Penn State

8:00 AM
Introductory Remarks

(See online version: <https://www.acsmeetings.org/programs/>)

8:15 AM (Abstract ID#145163)

Transport of Gas across Interfaces: Cracked Soils and Fractured Rocks

[WEISBROD, Noam](#)¹, [DRAGILA, Maria](#)², [NACHSHON, Uri](#)¹, [GRAHAM, Chris](#)³, [PILLERSDORF, Modi](#)¹, and [KAMAI, Tamir](#)¹,
(1) Department of Environmental Hydrology & Microbiology, Zuckerberg Institute for Water Research, Jacob Blaustein
Institutes for Desert Research, Ben-Gurion University of the Negev, Sede Boker Campus, Midreshet Ben-Gurion, 84990,
Israel, weisbrod@bgu.ac.il, (2) Crop and Soil Science, Oregon State University, Crop & Soil Science, 3135 Ag Life Sciences
Bldg, Corvallis, OR 97331, (3) Department of Forest Engineering, Oregon State University, 004 Peavy Hall, Corvallis,
97331

8:30 AM (Abstract ID#143596)

Unstable flows in Soil and Fractured Rock – Similarities and Differences

[OR, Dani](#), Department of Environmental Sciences, Swiss Federal Institute of Technology (ETHZ), Zurich 8092
Switzerland, dani.or@epfl.ch

8:45 AM (Abstract ID#143289)

Gravity-driven viscous infiltration - common to flow in unsaturated rocks and soils

[GERMANN, Peter F.](#), Geography, University of Bern, Hallerstrasse 12, Bern 3012 Switzerland, germann@giub.unibe.ch

9:00 AM (Abstract ID#142378)

Imbibition into Soil and Rock: What's the Same, What's Different?

[EWING, Robert P.](#), 2101 Agronomy Hall, Iowa State University, Ames, IA 50011, ewing@iastate.edu and [HU, Qinhong](#),
Department of Earth and Environmental Sciences, University of Texas at Arlington, Arlington, TX 76019

9:15 AM (Abstract ID#140118)

Simultaneous Water Flow and Contaminant Transport in Unsaturated Rock

[HU, Qinhong](#), Department of Earth and Environmental Sciences, University of Texas at Arlington, Arlington, TX 76019,
huqinhong@yahoo.com and [EWING, Robert P.](#), Department of Agronomy, Iowa State University, Ames, IA 50011

9:30 AM (Abstract ID#140829)

Relationship Between Radionuclide Transport, Water Content, and Flowpaths in Anisotropic Layered Unsaturated Sands

[MAYES, M.A.](#)¹, [YIN, Xiangping](#)¹, [TANG, Guoping](#)¹, [PARKER, Jack C.](#)², and [HINKEL, Kelly](#)³, (1) Environmental Sciences
Division, Oak Ridge National Laboratory, PO Box 2008, MS 6038, Oak Ridge, TN 37831, mayesma@ornl.gov, (2) Institute
for a Secure and Sustainable Environment, University of Tennessee, Knoxville, TN 37996, (3) University of Kentucky,
Lexington, KS 40506

9:45 AM

Break

10:00 AM (Abstract ID#142603)

Mind the gap: Variably-saturated lateral flow at the soil-bedrock interface

[MCDONNELL, Jeffrey J.](#)
and [GRAHAM, Chris](#), Department of Forest Engineering, Oregon State Univ, Corvallis, OR 97331-5706,
Jeff.McDonnell@orst.edu

10:15 AM (Abstract ID#146158)

Contaminant Travel Time Estimates through a Thick Unsaturated Zone at Rainier Mesa and Shoshone Mountain, Nevada

[EBEL, Brian A.](#), U.S. Geological Survey, 345 Middlefield Rd, MS 420, Menlo Park, CA 94025, bebel@usgs.gov and
[NIMMO, John R.](#), Water Resources, USGS, 345 Middlefield Road, MS-421, Menlo Park, CA 94025

10:30 AM (Abstract ID#146934)

Subsurface Initiation of Film Flow In Rock Fractures and Soil Macropores

[NIMMO, John R.](#), U.S. Geological Survey, 345 Middlefield Road, MS 421, Menlo Park, CA 94025, jnimm@usgs.gov

10:45 AM (Abstract ID#145899)

Multiphase Inverse Modeling In Structured Soils and Fractured Rocks

[FINSTERLE, Stefan](#), Earth Sciences Division, Lawrence Berkeley National Lab, One Cyclotron Road, MS 90-1116,
Berkeley, CA 94720, SAFinsterle@lbl.gov

11:00 AM (Abstract ID#150175)

Comparative Analysis of Nonlinear Dynamics of Water Flow through Variably Saturated Soil and Rocks

[FAYBISHENKO, Boris](#), Earth Sciences Division, Lawrence Berkeley National Laboratory, 1 Cyclotron Road, MS 90-1116,
Berkeley, CA 94720, bafaybishenko@lbl.gov

11:15 AM (Abstract ID#146439)

Unsaturated Hydraulic Properties of Rocks: How to Measure Them In the Laboratory and In the Field?

[CAPUTO, Maria Clementina](#), Water Research Institute, National Research Council (CNR), via F. De Blasio, 5, Bari,
70123, Italy, maria.caputo@ba.irs.cnr.it and [NIMMO, John Robert](#), U.S. Geological Survey, 345 Middlefield Road, MS
421, Menlo Park, CA 94025

11:30 AM (Abstract ID#149428)

Modelling Unsaturated Flow and Transport of Pollutant in a Fractured Limestone Affected by Industrial Sludge Deposits at
the Altamura Site (South Italy)

[MASCIOPIATO, Costantino](#)¹, [CAPUTO, Maria Clementina](#)¹, [DE CARLO, Lorenzo](#)¹, and [NIMMO, John Robert](#)², (1) Earth
and Environment of the National Research Council, Water Research Institute, via Francesco De Blasio, 5, Bari, 70123,
Italy, costantino.masciopinto@ba.irs.cnr.it, (2) U.S. Geological Survey, 345 Middlefield Road, MS 421, Menlo Park, CA
94025

11:45 AM

Discussion



Hydrogeomorphology and Hydropedology: Emerging Disciplines that Embrace Earth and Soil Sciences

– A joint session at the 2008 annual meeting of GSA and SSSA, October 5-9, Houston, TX

Wednesday, 8 October 2008: 1:30 PM-5:30 PM, George R. Brown Convention Center 350DEF

Sponsor: GSA Quaternary Geology and Geomorphology Div; S01 Soil Physics; S05 Pedology; S06 Soil & Water Mangt. & Conser.

Conveners: Roy C. Sidle, Kyoto Univ.; David R. Montgomery, University of Washington; Henry Lin, Penn State

1:30 PM
Introductory Remarks

(See online version: <https://www.acsmmeetings.org/programs/>)

1:35 PM (Abstract ID#149242)

Beyond Hydric Soils: Applying Process to Soil Patterns through Hydropedological Research in the Coastal Temperate Rainforest of Southeastern Alaska

D'AMORE, David V., USDA Forest Service, Pacific Northwest Research Station, 2770 Sherwood Lane, Suite 2A, Juneau, AK 99801, ddamore@fs.fed.us, EDWARDS, Rick, USDA Forest Service, Pacific Northwest Research Station, 2770 Sherwood Lane, Suite 2A, Juneau, AK 99801, PING.Chien-Lu, Palmer Research Center, University of Alaska, Fairbanks, 533 E. Fireweed Ave, Palmer, AK 99645, BERKOWITZ, Jacob, USDA Forest Service, Pacific Northwest Research Station, 2770 Sherwood Lane, Suite 2A, Juneau, AK 99645, and VALENTINE, David, Forest Sciences, University of Alaska, Fairbanks, P.O. Box 757200, Fairbanks, AK 99775

1:50 PM (Abstract ID#140938)

Geomorphic Relationships in the Fragil Taxon across Pennsylvania: Clues to Genesis and Cementation Mechanisms

DROHAN, Patrick¹, WALTMAN, Sharon², BILLS, Brian³, DADIO, Stephen⁴, MILLER, Douglas⁵, and WHITE, Ed⁵, (1) Department of Crop and Soil Sciences, The Pennsylvania State University, 116 ASI Bldg, University Park, PA 16802, pj7@psu.edu, (2) USDA, NRCS, National Geospatial Development Center, West Virginia University, 157 Clark Hall Annex, Morgantown, 26505, (3) Center for Environmental Informatics, The Pennsylvania State University, Earth and Environmental Systems Institute, 2217 Earth-Engineering Sciences Building, University Park, 16802-6813, (4) CMX Engineering, 1555 Bustard Road, Kulpville, PA 19443, (5) USDA, NRCS, Pennsylvania State Office, One Credit Union Place, Suite 340, Harrisburg, PA 17110-2993

2:05 PM (Abstract ID#140920)

Chemical and Mineralogical Cementing Agents in Fragipans from Pennsylvania Parent Materials

DADIO, Stephen¹, DROHAN, Patrick², CLARK, Trevor³, and OGDEN, Sarah², (1) CMX Engineering, 1555 Bustard Road, Kulpville, PA 19443, SDadio@cmxengineering.com, (2) Department of Crop and Soil Sciences, The Pennsylvania State University, 116 ASI Bldg, University Park, PA 16802, (3) Materials Characterization Laboratory, The Pennsylvania State University, 208 MRL Bldg, University Park, PA 16802

2:20 PM (Abstract ID#149071)

New Methods for Identifying and Quantifying Soil Redoximorphic Features

O'DONNELL, T. Kevin¹, GOYNE, Keith W.¹, BAFFAUT, Claire², ANDERSON, Stephen H.¹, MILES, Randall J.¹, and SUDDUTH, Kenneth A.², (1) Department of Soil, Environmental, and Atmospheric Sciences, University of Missouri-Columbia, 302 ABNR Building, Columbia, MO 65211, tot24@mizzou.edu, (2) USDA-ARS, Cropping Systems and Water Quality Research Unit, 269 Agricultural Engineering Building, Columbia, MO 65211

2:35 PM (Abstract ID#140173)

Main Controls of Soil Moisture Dynamics in an Agricultural Landscape in Central Pennsylvania

ZHU, Qing and LIN, Henry, Crop and Soil Sciences, Penn State University, 116 ASI Building, University Park, PA 16802, qxz121@psu.edu

2:50 PM (Abstract ID#150533)

Weathering in the Himalayan Foreland

REYNOLDS, Amanda Christine, Department of Geosciences, University of Arizona, Gould-Simpson Bldg, #77, 1040 East Fourth Street, Tucson, AZ 85721, areynold@email.arizona.edu, QUADE, Jay, Geosciences, University of Arizona, Tucson, AZ 85721, and ACHYUTHAN, Hema, Centre for Geoscience and Engineering, Anna University, Sardar Patel Road, Chennai, 600 025, India

3:05 PM (Abstract ID#144860)

Scaling Phenomena Related to the Transfer of Storm Water from Forested Hillslopes to Headwater Channels

SIDLE, Roy C.¹, GOMI, Takashi², and TERAJIMA, Tomomi¹, (1) Geohazards Division, Disaster Prevention Research Institute, Kyoto University, Gokasho, Uji-shi, Kyoto, 611-0011, Japan, sidle@slope.dpri.kyoto-u.ac.jp, (2) Department of International Environmental and Agricultural Science, Tokyo University of Agriculture and Technology, 3-5-8 Saiwaicho, Fuchu, Tokyo, 183-8509, Japan

3:20 PM

Break

3:35 PM (Abstract ID#141732)

Different response on land-use changes and channel management in two headwater catchments of the Nysa Szalona catchment (SW Poland): channel morphology, riparian vegetation and hydrology

KEESSTRA, Saskia D., Erosion, Soil and Water Conservation Group, Wageningen University, Droevendaalsesteeg 4, Wageningen 6708PB Netherlands, saskia.keesstra@wur.nl

3:50 PM (Abstract ID#151585)

Vadose Zone Pseudokarst and Holocene Pedogenic Implications for Geomorphic Evolution of the White River Badlands, South Dakota

BURKHART, Patrick, Geography, Geology, and the Environment, Slippery Rock University, Slippery Rock, PA 16057, patrick.burkhart@sru.edu, KOWALCZUK, Ranae, Slippery Rock, PA 16057, JAHN, Michael, EnviroGroup Ltd, and COFFMAN, David, Geology, Baylor University, Waco, TX 76706

4:05 PM (Abstract ID#143866)

Effect of forest harvesting on hydrogeomorphic processes in steep terrain of central Japan

IMAIZUMI, Fumitoshi, Ikawa University Forest, AFRC, University of Tsukuba, 1621-2 Ikawa, Aoi, Shizuoka, 428-0504, Japan, imaizumi@sakura.cc.tsukuba.ac.jp and SIDLE, Roy C., Disaster Prevention Research Institute, Kyoto University, Geohazards Division, Gokasho, Uji, Kyoto, 6110011, Japan

4:20 PM (Abstract ID#149607)

Late Pliocene (?) Landforms in the Subsurface, Sussex County Delaware

STEPHENS, William E. Jr., Stephens Environmental Consulting, Inc, 11 Ailsa Court, Rising Sun, MD 21911, bstephens@stephensenv.com and LOSCO, Russell, West Grove, PA 19390

4:35 PM (Abstract ID#146002)

Categorization of Flow Components in a Sloping Permeable Domain for an Assessment of Rainfall-Runoff Responses

TANI, Makoto, Forest Hydrology, Graduate School of Agriculture, Kyoto University, Kitashirakawa, Sakyo, Kyoto 606-8502 Japan, tani@kais.kyoto-u.ac.jp

4:50 PM (Abstract ID#146376)

Soil Moisture, Ground Water, and Streamflow Response to Rainfall in a Slope and Watershed Underlain by Paleozoic Sedimentary Rocks

HOSODA, Ikuhiro, Kansai research center, Forestry and forest products research institute, 68 Nagai-Qtaro, Momoyama, Fushimi, Kyoto 612-0855 Japan, hosodaik@affrc.go.jp

5:05 PM (Abstract ID#140117)

Shallow Landslide and Debris Flow Behavior and Linkages in Steep Terrain: Hydrogeomorphic Influences

SIDLE, Roy C., Disaster Prevention Research Institute, Kyoto University, Geohazards Division, Gokasho, Uji, Kyoto, 6110011, Japan, sidle@slope.dpri.kyoto-u.ac.jp and IMAIZUMI, Fumitoshi, Graduate School of Life and Environmental Sciences, University of Tsukuba, 1621-2 Ikawa, Aoi, Shizuoka, 428-0504, Japan



Jobs!

Faculty

Assistant Professor in Pedology at Univ. of Georgia. A 70% research/30% instruction responsibilities in the Dept. of Crop and Soil Sciences, Athens Campus. Qualifications: Ph.D. degree in Soil Science with a specialization in Pedology. Research activities should address basic and applied aspects of soil genesis, morphology, and classification. Potential focus areas might include studies on weathering and genesis of soils in Southeastern U.S. landscapes; soil-landscape modeling using GIS; *hydropedology*; effects of soil morphological properties on urban and agriculture use of soils; or other appropriate areas. Teaching responsibilities include a junior/grad level course in Pedology and co-teach a junior/graduate level service course in soils for non-majors annually. Also teach a graduate-level course every other year in an appropriate specialty area. Salary will be commensurate with qualifications and experience. See the full job description online at http://www.cropsoil.uga.edu/dept_info/pedology.php. Application deadline: **July 30, 2008**.

Endowed FRBC Chair in Forest Hydrology (Assistant or Associate Professor level) at the University of British Columbia. This Chair is supported by the Provincial Government, Ministry of Advanced Education, to enhance the University's strong interdisciplinary program of research and extension in issues of watershed management and forest engineering. The position will be a joint appointment between the Department of Forest Resources Management (2/3) and the Department of Geography (1/3). Although the precise area of research is not fixed, a person with expertise in one or more of the following areas would complement existing strengths within the University: water quality, water chemistry, *hydrogeomorphology*, *ecohydrology*, and water policy. The ideal candidate will have interests in linking water, land use and environmental change, integrating across a range of spatial and temporal scales, with emphasis on broader landscape scale analyses. In addition, the ideal candidate would have interest in both theoretical and field components of forest hydrology. Candidates with expertise in quantitative analysis (particularly spatial statistics and spatial modeling) and data acquisition using emerging technologies are particularly encouraged to apply. Closing date: **October 15, 2008**.

Assistant Professor: Water Resources Specialist at Texas A&M Dept. of Soil & Crop Sciences. The incumbent will work closely with Extension faculty, research scientists, water suppliers, the ag and greenscape industries; and agencies charged with the protection and conservation of water resources to develop and implement high quality educational programs, applied field research as well as relevant publications to inform the public on issues related the protection of water quality and environmental stewardship including issues associated with water contamination from bacteria, pesticides and other organic contaminants at the local and watershed scale; the conservation of surface and ground water resources and sustainable crop and forage production systems. Closing Date: **July 1, 2008** or until a suitable applicant is found.

Staff Soil Scientist

Desert Research Institute. The Division of Earth and Ecosystem Sciences (DEES) seeks a Staff Soil Scientist to manage the activities of the Soil Characterization and Quaternary Pedology Laboratory, report analytical results, assist in the preparation of technical reports and publications, perform a variety of physical and chemical analyses on soil and sediment samples, maintain analytical equipment, develop/implement new laboratory methods, oversee the fiscal affairs of the laboratory, supervise and train under-/graduate assistants, and promote the capabilities of these laboratories by seeking additional contract work. Position also will require occasional work (5-10% of time) on field-based projects and work in conjunction with DRI's Director of Environmental Health and Safety to maintain safe laboratory working conditions and processes. More info on http://jobs.dri.edu/cgi-bin/JobPostProd/jobPost?url_rec_num=232.

Graduate Assistantship

Ph.D. Assistantship in Hydropedology and Hillslope/Catchment Hydrology at Penn State. A highly motivated student is sought to conduct an interdisciplinary research in the areas of mapping, monitoring, and modeling (3M) of subsurface preferential flow network and soil moisture spatial-temporal patterns across scales using advanced techniques. Interests in instrumentation, sensor network, field survey/mapping, and geospatial technologies are particularly welcome. Contact Dr. Henry Lin at henrylin@psu.edu for more info.