

Activities Report: 1 July 2005 - 30 June 2006

General Description of HRC

The Hydrologic Research Center (HRC) is a publicly-supported non-profit research corporation. HRC was established in July of 1993 in San Diego, California. In October 1998, the Internal Revenue Service affirmed the non-profit status of HRC beyond the advanced ruling period of 5 years. HRC's purpose is to advance the science and engineering of hydrology through research and science cooperation, and to provide technology transfer and hydrologic training services. The National Science Foundation and the National Oceanic and Atmospheric Administration have served as HRC's Oversight Agencies.

HRC realizes its purposes:

By performing basic and applied research in areas of hydrology, water resources, hydrometeorology and hydroclimatology.

By designing and implementing prototype hydrologic projects for technology transfer and science cooperation and by offering hands-on training for field personnel.

By publishing research and development results in technical reports, refereed journal papers, monographs, books, and written accounts of technical national and international meetings.

By organizing short courses, workshops, and summer schools on hydrologic topics for Government Agencies, graduate and undergraduate University students, and teachers of Science.

By providing research training for graduate and undergraduate students of collaborating Universities.

By offering post-doctoral research positions for advanced training of new Ph.D.'s.

By accepting visiting scholars, and establishing collaborative research and exchange programs with hydrologic research organizations in the U.S. and abroad.

HRC's Board of Directors consists of:

Dr. Konstantine P. Georgakakos

HRC and Scripps Institution of Oceanography, University of California, San Diego

Professor Witold F. Krajewski

Department of Civil and Environmental Engineering and IIHR-Hydroscience and Engineering, The University of Iowa.

Professor Anastasios A. Tsonis

Department of Mathematical Sciences, University of Wisconsin - Milwaukee

Areas of research, development, and technology transfer include:

Hydrologic Science and Engineering

- (a) Floods, Flood Warning and Flood Control
- (b) Droughts
- (c) Processes of the Global Hydrologic Cycle
- (d) Remote Sensing of Hydrologic State Variables and Fluxes
- (e) Hydrology of Environmental Pollution and Restoration
- (f) Energy Production by Hydrologic Systems
- (g) Hydrologic Applications of Artificial Intelligence

Hydrometeorology

- (h) Precipitation and Surface-Runoff Processes

Hydroclimatology

- (i) Land-Surface/Atmospheric Interactions
- (j) Hydrology of the Interaction of Land and Ocean
- (k) Hydrologic and Water Resources Impacts of Climate Variability and Change

Disaster Management Protocols

Personnel

Dr. Konstantine P. Georgakakos, Managing Director and Senior Research Scientist

Mr. Robert Jubach, Manager, International Technical Programs

Dr. Nicholas E. Graham, Climate Applications Manager, and Senior Research Scientist

Dr. Eylon Shamir, Research Specialist, Engineer, Hydrologic Modeling and Prediction

Dr. Jianzhong Wang, Research Specialist, Atmospheric Modeling

Ms. Theresa Carpenter, PhD Candidate and Hydrologic Engineer

Mr. Jason A. Sperflage, Systems Administrator and Software Engineer

Mr. Eric Meins, Software Engineer

Mr. Steven Taylor, PhD Candidate and Hydrologic Scientist

Ms. Corinne Shafer, Administrative Associate

Ms. Debra Champagne, HRC Senior Accountant (contractor)

Projects Funded

ACP, Autoridad del Canal de Panama: *Assistance for PMP and PMF Technical Specifications*, 01/01/06-02/28/06.

ACP, Autoridad del Canal de Panama: *PANMAP Upgrade to LINUX Operating System*, 05/05/05-09/03/05.

Arizona Department of Water Resources, *Projections of Future Streamflow for the Santa Cruz River at the USGS Gauging Station near Nogales*, 02/14/05- 02/13/06.

Barons Advanced Meteorological Services (subcontract from Lockheed Martin Corporation): *Support to the Romania DESWAT Project, Flash Flood Guidance Task*, 5/2005 – 2/2007.

Barons Advanced Meteorological Systems, LLC (BAMS) / Lockheed Martin: *Destructive Waters (DESWAT) – Hydrological Model Calibration and Validation for Romania*, 05/01/05 – 03/31/07.

California Energy Commission (w/GWRI): *Integrated Forecast and Reservoir Management Demonstration for Northern California Water Resources*, 11/01/02 – 06/30/06.

CALFED (w/GWRI): *Integrated Forecast and Reservoir Management Demonstration for Northern California Water Resources*, 06/01/03 – 05/31/06.

Cemagref, Lyon, *Scientific Committee of the Rhone Consensus Conference*, 07/26/05-07/28/05.

Ministry of Finance of the Russian Federation, Bureau for Economic Analysis, National Hydromet Modernization Project, *Improvement of Hydrological Observation System Including Flood-Hazardous Regions, Project Examination for Modernization of Hydrological Networks in the Basins of Kuban and Ussuri Rivers*, 05/03/06-07/26/06.

NASA: *Seasonal Climate Predictions and Water Resources Management Theoretical and Numerical Research*, 04/15/04 – 04/14/07.

NOAA, Office of Global Programs: *INFORM: Integrated Forecast and Reservoir Management Demonstration for Northern California Water Resources*, 09/01/02 – 08/31/06.

NSF: *SGER: Surveying the Southern California Flash Floods of January 2005*, 04/15/05 – 03/31/06.

UCSD – NOAA/JIMO, California Applications Project (CAP): *Northern California Regional Water Resource Prediction Management*, 06/01/03 – 06/30/06.

University of Arizona: *Natural Spatiotemporal Variability of Climate over the Western United States in the Late Holocene*, 08/01/02 – 07/31/05.

U.S. Geological Survey FEWSNET: *Support to the Design of the Djibouti Flash Flood Warning System*, 02/01/06 – 04/30/06.

U.S. National Weather Service (subcontract to TecuLAN, inc.): *Support to USAID India Disaster Management Support Project, Climate Forecast System, 08/15/05 – 12/31/07.*

Waterway Research Institute, Sejong University, *Areal Flash Flood Guidance for Han River, Korea, Phase 2: Stand Alone System, 04/30/05 – 04/30/06.*

Publications and Presentations

Contributions to Books and Special Issues

National Research Council, 2006: *Completing the Forecast: Characterizing and Communicating Uncertainty for Better Decisions Using Weather and Climate Forecasts*, The National Academies Press, Washington, D.C., 178pp. (K.P. Georgakakos, contributing author)

Research Papers in Journals

Carpenter, T.M., and K.P. Georgakakos, 2006: “Discretization Scale Dependencies of the Ensemble Flow Range versus Catchment Area Relationship in Distributed Hydrologic Modeling,” *Journal of Hydrology*, (in press), doi:10.1016/j.jhydrol.2005.12.008.

Carpenter, T.M., and K.P. Georgakakos, 2006: “Intercomparison of Lumped versus Distributed Hydrologic Model Ensemble Simulations on Operational Forecast Scales,” *Journal of Hydrology*, (in press), doi:10.1016/j.jhydrol.2006.02.013.

Georgakakos, K.P., 2006: “Analytical Results for Operational Flash Flood Guidance,” *Journal of Hydrology* 317, 81-103.

Georgakakos, K.P., and T.M. Carpenter, 2006: “Potential Value of Operationally Available and Spatially Distributed Ensemble Soil Water Estimates for Agriculture,” *Journal of Hydrology*, (in press), doi:10.1016/j.jhydrol.2005.12.018.

Georgakakos, K.P., D.-H. Bae, and C.-S. Jeong, 2005: “Utility of Ten-Day Climate Model Ensemble Simulations for Water Resources Planning and Management of Korean Watersheds,” *Water Resources Management*, 19, 849-872.

Graham, N.E., K.P. Georgakakos, C. Vargas, and M. Echevers, 2006: “Simulating the Value of El Nino Forecasts for the Panama Canal,” *Advances in Water Resources*, (in press), doi:10.1016/j.advwatres.2005.12.005.

Koutsoyiannis, D., A. Efstratiadis, and K.P. Georgakakos, 2006: “Uncertainty assessment of future hydroclimatic predictions: A comparison of probabilistic and scenario based approaches,” *Journal of Hydrometeorology* (accepted).

Ntelekos, A.A., K.P. Georgakakos, and W.F. Krajewski, 2006: “On the Uncertainties of Flash Flood Guidance: Towards Probabilistic Forecasting of Flash Floods,” *Journal of Hydrometeorology*, (in press).

Shamir, E., T.M. Carpenter, P. Fickenscher, and K.P. Georgakakos, 2006: "Evaluation of the NWS Operational Hydrologic Model for the American River Basin," *ASCE Journal of Hydrologic Engineering*, (in press).

Shamir, E., and K.P. Georgakakos, 2006: "Derivation of Snow Depletion Curve from Distributed Snow Model in the American River Basin," *Journal of Hydrology*, (in press).

Shamir, E., and K.P. Georgakakos, 2006: "Distributed Snow Accumulation and Ablation Modeling in the American River Basin," *Advances in Water Resources*, (in press), doi:10.1016/j.advwatres.2005.06.010.

Wang, J., and K.P. Georgakakos, 2006: "Effects of Cold Microphysical Processes on the Surface Precipitation Variability of Nonsquall Tropical Oceanic Convection," *Journal of Geophysical Research*, 110, D22203, doi:10.1029/2005JD005787.

Wang, J., and K.P. Georgakakos, 2006: "Estimation of Potential Evapotranspiration in the Mountainous Panama Canal Watershed," *Hydrological Processes* (in press).

Abstracts, Presentations and Conference Proceedings

Georgakakos, K.P., 2005: "Modern Operational Flash Flood Warning Systems Based on Flash Flood Guidance Theory: Performance Evaluation," *Proceedings, International Conference on Innovation, Advances and Implementation of Flood Forecasting Technology*, 9-13 October 2005, Bergen-Tromsø, Norway, 1-10. (invited keynote lecture).

Georgakakos, K.P., "Contributions to Mesoscale Hydrometeorology of the American River," *Hydrometeorology Testbed Hydrology Planning Meeting for the American River*, NOAA-NWS, 1/6/06, Sacramento, CA (invited).

Georgakakos, K.P., "Central America Flash Flood Guidance System," *WMO-NOAA Flash Flood International Conference*, 13-17 March 2006, San Jose, Costa Rica (invited lecture).

Georgakakos, K.P., "Perspective on Regional Flash Flood Warning," *WMO Session on Flood Forecasting, World Water Forum*, 19-21 March 2006, Mexico City, Mexico (invited panel member and comment).

Georgakakos, K.P., "Uncertainty Assessment of Future Hydroclimatic Predictions, Methodological Framework and a Case Study in Greece," *European Geosciences Union General Assembly 2006*, 2-7 April 2006, Vienna, Austria (invited; w/ Demetris Koutsoyiannis).

Georgakakos, K.P., "Operational Precipitation Predictions in Support of real-Time Flash-Flood Prediction and Reservoir Management," *AGU Joint Assembly*, 23-26 May 2006, Baltimore, MD (invited; presented by N.E. Graham).

Georgakakos, K.P.: "Issues in the Forecast and Management of Natural Floods and Flash Floods," *7th International Conference on Hydroinformatics*, 4-7 September 2006, Nice, France, 1-11. (invited keynote lecture).

- Graham, N.E.: "Changes in North Pacific Wave Climate," *Conference on Impacts of Climate Extremes* (Risk Prediction Initiative hosted), October, 2005, Bermuda.
- Graham, N.E.: "Panama Canal Use of Climate Predictions." *2006 NOAA Climate Prediction Applications Science Workshop*, March, 2006, Tucson, AZ.
- Graham, N.E.: "Medieval Droughts in California," *Pacific Climate Workshop (PACLIM)* (USGS hosted), Asilomar, CA. ([Keynote address](#)).
- Graham, N.E.: "Mono Lake Paleo-Hydrology." *European Geosciences Union General Assembly 2006*, 2-7 April 2006, Vienna, Austria.
- Graham, N.E.: "Proxy Based Reconstructions, Modeling and Methodology," *PAGES/CLIVAR Workshop on Past Millennia Climate Variability*, (EPRI sponsored) June 2006, Wengen, Switzerland.
- Shamir, E., K.P. Georgakakos: "Hydrologic Model for Water Resources Planning in Arid Southern Arizona." Invited seminar at the University of Arizona, Department of Hydrology and Water Resources. Co-sponsored by Institute for the Study of Planet Earth and Sustainability of Semi-Arid Hydrology Riparian Area (SAHRA) NSF center at the University of Arizona. February 2006.
- Shamir E., N.E. Graham, A. Georgakakos, and K.P. Georgakakos: "Integrated forecast and reservoir management in Northern California –The INFORM project." *NOAA Climate Prediction Applications Science Workshop*, March 21-24, 2006, Tucson, AZ.
- Shamir E., J Wang, N.E. Graham, D.M. Meko, and K.P. Georgakakos: "Incorporating Climate Variability Uncertainty in Water Resources Planning for the Upper Santa Cruz River." *4th Annual NOAA Climate Prediction Applications Science Workshop*, March 21-24, 2006, Tucson AZ.
- Shamir E., J. Wang, N.E. Graham, D.M. Meko, and K.P. Georgakakos: "Stochastic Streamflow prediction for alluvial recharge estimation in the Santa Cruz River Southern Arizona." *American Geophysical Union*, December 5-9, 2005, San Francisco.
- Wang J., and K.P. Georgakakos: "Effects of cold microphysical processes on the surface precipitation variability of Nonsquall Tropical Oceanic Convection," *IAMAS 2005*, August 2-11, 2005, Beijing, China.
- Wang J., and K.P. Georgakakos: "Cold Microphysical Influences on Sierra Nevada Winter Storm Precipitation," *12th Conference on Cloud Physics*, 10-14 July 2006, Madison, Wisconsin.

HRC Technical Reports

- Carpenter, T.M., and K.P. Georgakakos, 2006: "Characterizing Southern California Flash Flood Occurrence Frequency Under Climatic Variability and Change," *HRC Limited Distribution Report No. 25*, Hydrologic Research Center, San Diego, CA, June 2006.

Georgakakos, K.P., J.A. Sperflage, T.M. Carpenter, E. Shamir, and J. Wang: "Demonstration of Hydrologic Modeling and Flash Flood Prediction for the Han River Basin, Korea," *HRC Technical Note No. 26*, Hydrologic Research Center, San Diego, CA, 54pp., March 2006.

Georgakakos, K.P., N.E. Graham, E. Shamir, T.M. Carpenter, J. Wang, S. Taylor, and J. Sperflage, in collaboration with A. P. Georgakakos, and H. Yao: "Integrated Forecast and Reservoir Management (INFORM) for Northern California: System Development and Initial Demonstration," *PIER Final Project Report*, California Energy Commission, Public Interest Energy Research Program, Contract No: 500-02-008, Sacramento, CA, 268pp. + 9 Appendices, July 2006.

O'Hara, J.K., and K.P. Georgakakos, 2006: "Quantifying the Urban Water Supply Impacts of Climate Change," *HRC Limited Distribution Report No. 24*, Hydrologic Research Center, San Diego, CA, 50pp., June 2006.

Shamir E., N.E. Graham, J. Wang, D.M. Meko, and K.P. Georgakakos: "Stochastic Streamflow Scenarios for the Santa-Cruz River at the Nogales Gauge," *HRC Technical Report No. 4*, Hydrologic Research Center, San Diego, CA, December 2005.
http://www.hrc-lab.org/projects/dsp_projectSubPage.php?subpage=santacruz

Shamir E., and K.P. Georgakakos: "GENFLOW: Program for the Generation of Likely Streamflow Scenarios for the Santa-Cruz River at the Nogales Gauge, User's Manual," *HRC Technical Note No. 24*, Hydrologic Research Center, San Diego, CA, August 2005.

Sperflage J., E.C. Meins, and K.P. Georgakakos: "Korea Flash Flood Guidance (KoFFG) Stand-Alone System User's Outline," *HRC Technical Note No. 27*, Hydrologic Research Center, San Diego, CA, 34pp., May 2006.

Sperflage J., and K.P. Georgakakos: "Linux Implementation of the Panama Mean Areal Precipitation (PANMAP) Forecast System," *HRC Technical Note No. 25*, Hydrologic Research Center, San Diego, CA, 33pp., September 2005.

Educational, Science Cooperation and Technology Transfer Activities

- As part of its educational program, HRC continues to support two Ph.D. candidates at UCSD: Ms. Theresa Carpenter and Mr. Stephen Taylor. Ms. Carpenter's dissertation proposal on flash floods was accepted by her Ph.D. Thesis Committee. Mr. Taylor continues his PhD Thesis research on wind wave interactions in the California Bight.
- Dr. Georgakakos was invited by WMO to join the Committee for Compiling the WMO Manual for Flood Forecasting (2005-2007).
- Dr. Georgakakos was a member of two National Research Council Committees: (a) Committee on Estimating and Communicating Uncertainty in Weather and Climate Forecasts, and (b) Committee on Integrated Observations for Hydrologic and Related Sciences. The deliberations of the first NRC Committee concluded with the development of a road map for the adoption of full probabilistic forecasting by the U.S. National Weather

Service based on sound science. The Committee's refereed report is listed in the Contributions to Books section of the present Activities Report. The second NRC Committee continues deliberations.

- HRC had a very successful seminar season at HRC for our staff, visitors and guests from other institutions (mainly from the Scripps Institution of Oceanography). Dr. Shamir served as the seminar coordinator.

Guest presenters:

Demetris Koutsoyiannis - Department of Civil Engineering, National Technical University of Athens

Jessica Lundquist - NOAA, CIRES Boulder Colorado

Hamid Moradchani – University of California, Irvine

Mike Dettinger – USGS Scripps Institution of Oceanography, UCSD

Melisa Menendez - Universidad de Cantabria, Spain

HRC presenters:

Theresa Carpenter

Jeff O'Hara

Eric Meins

Eylon Shamir

- Dr. Shamir organized a session titled "Observations and Modeling of Snow Processes at the River Basin Scale" together with Hamid Moradchani and Jessica Lundquist to be held in the American Geophysical Union, San Francisco, December 2006.
- One week Flash Flood Guidance Training for Romanian scientists took place at HRC in November 2005. Workshop sessions were led by Dr. Georgakakos, Dr. Shamir, Ms. Carpenter and Mr. Sperflage.
- Professor Demetris Koutsoyiannis from the National Technical University of Athens, was a Visiting Scholar at HRC for the period October – November 2005 as part of his sabbatical leave from the home Institution. Professor Koutsoyiannis collaborated with Dr. Georgakakos on the assessment of impacts of climatic variability and change on hydrology and water resources.
- Ms. Melisa Menendez, a Ph.D. candidate at the University of Cantabria, Ocean & Coastal Research Group, was a student visitor for the period April - August 2006 under the supervision of Dr. Graham. Melisa's research pertains to the statistical characterization of sea waves.
- Mr. Jeffrey O'Hara, a Ph.D. candidate with the UCSD Department of Economics, was a frequent student visitor at HRC, and collaborated with Dr. Georgakakos on urban water supply economic issues under climatic variability and change. Mr. O'Hara and Dr. Georgakakos had several meetings with staff from the city of San Diego Water Department at HRC and downtown San Diego to discuss Water Department concerns that Mr. O'Hara's thesis may address. Mr. O'Hara formulated his Ph.D. Thesis proposal this past year, and passed his Ph.D. Thesis proposal exam this summer. Dr. Georgakakos serves as his Thesis Co-Advisor.

- As part of HRC's facility and staff expansions, Mr. Sperflage designed and coordinated the implementation of enhancements to HRC's information technology infrastructure. In this effort, HRC completely rewired its local data network with Category 6 cabling and upgraded to all gigabit bandwidth while more than doubling the number of dedicated ports. HRC also migrated from independent phone and asymmetrical DSL services to integrated voice/data services on two bonded T-1 lines. The new integrated service provides HRC's telephone lines and 2.3Mbps of symmetric external data bandwidth for use with both local and remote research and technology transfer activities.
- Mr. Eric C. Meins continues to research the use of WMS (Web Map Services), WFS (Web Feature Services) and WCS (Web Coverage Services) for the distribution of our model output. Map Server and Geo Server have been identified as potential server technologies that can publish data in the WxS format and thus enable the widest variety of clients to consume and analyze our various products. He has combined 3D virtual earths such as Google Earth and ArcGis Explorer with these web-based services to maximize the data's ability to communicate.
- HRC launched its new website and unified domain (web and email addresses now use the same domain). The new site prominently features our projects, research, educational outreach, publications, and implemented systems. The site also features links to real-time Central American Flash Flood Guidance data. Best of all, the site has an appealing appearance and it is easy to maintain. HRC employed the services of Mr. Wayne Suiter, a freelance consultant and the webmaster for Scripps Institution of Oceanography, to cooperate with HRC Staff while leading the development of the site's overall cosmetic design, organizational infrastructure and integrated databases. After several months of collaboration and additional in-house content development, the redesigned HRC web site was officially deployed and publicized in December 2005. Visit <http://www.hrc-lab.org>
- The first funded phase of the Integrated Forecast and Reservoir Management (INFORM) project for Northern California is now complete. The project brought together researchers and developers from HRC (led by Drs. Georgakakos and Graham) and Georgia Tech (led by Professor Aris Georgakakos) with forecasters and managers from operational forecast and management agencies (NOAA NWS, US Bureau of Reclamation, California Department of Water Resources) to demonstrate science-based approaches for increasing efficiencies of operational water management in the region. Meeting reports and interim technical reports are available at the HRC's web site (<http://www.hrc-lab.org>) under the project entry of the INFORM Project. The draft final report is available on line at: http://www.hrc-lab.org/projects/dsp_projectSubPage.php?subpage=inform-report. The HRC and Georgia Tech researchers and developers gratefully acknowledge the foresight of funding agencies program managers for their foresight in supporting this prototype, multidisciplinary, multi-agency, demonstration program. Funding agencies were: NOAA Climate Program Office, California Energy Commission and CALFED Bay Delta Authority.
- As part of HRC's technology transfer program, Drs. Shamir and Georgakakos participated in various meetings with the Arizona Department of Water Resources and the Ground Water Users Advisory Council in Nogales, Arizona, to discuss science-based strategies for establishing sustained yield for Santa Cruz River surficial aquifers.
- Mr. Sperflage traveled to Panama City, Panama in August 2005 for onsite implementation and training activities relating to the Linux implementation of the Panama Mean Areal

Precipitation (PANMAP) forecast system for Staff of the Meteorological and Hydrological Section of the Autoridad del Canal De Panama (ACP).

- Mr. Sperfslage traveled to the NWS offices at CNRFC in Sacramento, California in November 2005 for meetings, development exploration and training relating to the NWSRFS with Mr. Scott Staggs as part of the INFORM project. This visit provided HRC with an up-to-date and functional installation of the Linux version of NWSRFS, through which a new stand-alone data extraction utility was subsequently designed and developed.
- Mr. Jubach traveled to Phnom Penh, Cambodia and Lhasa, China with the USAID/Office of Foreign Disaster Assistance (OFDA) and the National Weather Service to make presentations on the FFG system to personnel at the Flood Monitoring and Mitigation Center in Phnom Penh and at the International Workshop on Flash Floods and Sustainable Development in Lhasa. After both meetings, OFDA agreed to fund FFG programs in the regions as support to the development of a global FFG system.
- Mr. Jubach traveled with USAID/OFDA to the Mekong Annual Flood Forum in Siem Reap, Cambodia to make a presentation and do a poster session on the FFG system. An output of the forum was a request for the FFG system for the Lower Mekong River Basin.
- Dr. Georgakakos and Mr. Jubach attended the International Workshop on Flash Floods in San Jose, Costa Rica. Dr. Georgakakos presented information on the CAFFG. Dr. Georgakakos and Mr. Jubach met with the NOAA Deputy Under Secretary, NWS and OFDA to discuss collaborations on the Global FFG.
- Mr. Jubach attended the Global Earth Observations Systems of Systems Seminar at UCSD. The seminar was pertinent to GFFG implementation.
- Mr. Jason Sperfslage traveled to Seoul, South Korea in March 2006 to install and demonstrate the newly-developed Korea Flash Flood Guidance (KoFFG) stand-alone system at both Sejong University and at the offices of the Korean Meteorological Administration (KMA) as part of HRC's technology transfer program.
- Mr. Jubach traveled the country of Djibouti to assist USAID/Djibouti with the design of a flash flood warning system for Djibouti City, the capital.
- Mr. Jubach traveled with the National Weather Service to New Delhi and Calcutta, India to cyclone forecasting and warning systems.
- Staff of the San Diego National Weather Service Weather Forecast Office, led by Jim Purpura (Meteorologist in Charge), met with HRC staff for a half-day symposium of presentations and discussion on various topics of hydrometeorology of common interest.
- Mr. Jubach and other HRC staff met with Mr. Kazuhide Akaishi, Chief of Disaster Prevention Planning, Japan Meteorological Agency, to discuss flash flood warning systems and possible collaboration.

Visitors

Kazuhide Akaishi, Japan Meteorological Agency

Aurel Apostu, Lockheed Martin Romania

Dan Ciobotaru, Romania National Institute of Hydrology and Water Management

Wayne Suiter Matamoros, SIO, UCSD, San Diego, California

Lucina González Orozco, SIO, UCSD, San Diego, California

Larry Dale, University of California, Berkeley

Jinhoon Kim, Sejong University, Seoul, Korea

Abelardo Bal, Autoridad del Canal De Panama, Panama City, Panama

Demetris Koutsoyiannis, Department of Civil Engineering, National Technical University of Athens

Jessica Lundquist, NOAA, CIRES Boulder, Colorado

Marius Matreata, Romania National Institute of Hydrology and Water Management

Jesus Meda, San Diego Water Department

Sharon Megdal, Water Resources Research Center, University of Arizona

Melisa Menendez, University of Cantabria, Spain, Ocean & Coastal Research Group

Hamid Moradchani, University of California, Irvine

Carmen Nedelcu, Romania National Institute of Hydrology and Water Management

Ana Nitu, Romania National Institute of Hydrology and Water Management

Amelia Pirvulescu, Romania National Institute of Hydrology and Water Management

Jim Purpura, National Weather Service, San Diego Weather Forecast Office

Aurora Stan-Sion, Romania National Meteorological Administration

Sebastian Vicuna, University of California, Berkeley