

ACTIVITIES REPORT: JANUARY 1 – DECEMBER 31, 2016

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 utilized the following methods of performing its mission:

- Publishing research and development results in technical reports, refereed journal papers, monographs, books, and written accounts of technical national and international meetings, and through the internet.
- Developing and participating in demonstration projects concerning science-based prototype observation and prediction systems in collaboration with universities, government agencies, and private industry.
- Organizing short courses and workshops on hydrologic and meteorological topics for government agencies, graduate and undergraduate university students and teachers of science.
- Providing research training for graduate and undergraduate students of collaborating universities.
- Offering post-doctoral research positions for advanced training of new Ph.D.s.
- Accepting visiting scholars from U.S. institutions and other countries, and establishing collaborative research and exchange programs with research institutions in the U.S. and abroad.

HRC's Board of Directors:

Dr. Konstantine P. Georgakakos	HRC and Scripps Institution of Oceanography, University of California, San Diego
Mr. Ray Ban	Managing Director Ban and Associates, LLC
Mr. Robert Hartman	Robert K. Hartman Consulting Services
Mr. Richard Kennedy	College of Professional Studies Northeastern University
Professor Anastasios A. Tsonis	Department of Mathematical Sciences, University of Wisconsin - Milwaukee

HRC's Officers of the Board:

Mr. Jason Sperflage, Treasurer
Mr. Robert Jubach, Secretary
Dr. Konstantine P. Georgakakos, President

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

Ocean Wave Modeling and Prediction Systems

Personnel

Mr. Randall Banks, Computer Programmer/Analyst I – started employment, 4/18/16

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

Dr. Nicholas E. Graham, Temporary Employee and Visiting Scientist

Dr. Rochelle C. Graham, Meteorologist II

Ms. Barbara Hansen, Administrative Associate

Mr. Robert Jubach, General Manager

Dr. Theresa Modrick, Hydrologic Engineer II

Dr. Ari Posner, Postdoctoral Associate – ended employment, 7/31/16

Dr. Eylon Shamir, Hydrologic Engineer III

Mr. Cristopher Spencer, Computer Programmer/Analyst II

Mr. Jason A. Sperflage, Computer Programmer/Analyst II

Ms. Sheila Ragan, Ocean Point Financial Systems, HRC Senior Accountant (contractor) beginning 10/3/06.

Projects Funded or Ongoing 2016

ACP, Autoridad del Canal de Panama: *Regular Maintenance 2016*.

ACP, Autoridad del Canal de Panama: *Regular Maintenance 2017*.

California Department of Water Resources (DWR): *Implementation of Stand-Alone INFORM System for DWR*, completion date: 1 April 2017 (with Georgia Tech as a subcontractor).

NSF, Hydrologic Sciences, in collaboration with the Laboratory of Tree Ring Research, University of Arizona: *Tree ring signal for interannual and seasonal variability of snow pack in the Sierra Nevada*, 5/1/15 – 4/30/18.

Sultanate of Oman: *Implementation of a Flash Flood Guidance System for the Sultanate of Oman*, 5/19/15 – 5/31/18.

UCAR: *Enhanced Flash Flood Guidance System Capability to Ingest and Display Multiple Mesoscale Model Precipitation Forecasts, Black Sea Middle East Flash Flood Guidance System*, 11/12/15 – 3/31/17.

UCAR: *Landslide Hazard Forecast Upgrade for Flash Flood Guidance Systems, Central America Flash Flood Guidance System*, 3/26/15 – 3/31/17.

UCAR: *Sensitivity Analysis Assessing the Impact of Gabion Dams and Vegetation on Flood Flows in the Ravine Millett in Haiti*, 9/1/15 – 4/30/16.

U.S. Bureau of Reclamation, Lower Colorado Region (subcontract) (6/30/15): *A comparison of precipitation downscaling procedures to guide studies of climate change impacts on flooding and water resources*, 3/23/16 – 5/31/18.

Universiteit Gent, Belgian Federal Scientific Policy Office (Belspo): *Patterns and Mechanisms of Climate Extremes in East Africa*, 1/10/13 - 12/31/17.

Universiteit Gent has an agreement with the European Space Agency to perform a study on SMOS + hydrology and has involved HRC to perform part of the tasks of the project, 1/1/16 – 3/1/16.

University of Arizona' Board of Regents, on behalf of its Water Resources Research Center with funding from the Arizona Department of Water Resources, Santa Cruz AMA Augmentation and Conservation Fund: *Optimization of Water Resources Management in the Upper Santa Cruz River*, 1/29/15- 12/31/16.

Viet Nam Institute of Meteorology, Hydrology and Climate Change (IMHEN): *Development of Flash Flood Guidance Systems to Support Flash Flood Warning in Vietnam*, 10/9/15 – 4/15/16.

WMO: *Development and Implementation of a Flash Flood Early Warning System for the State of Chiapas, Mexico*, 10/22/10 – 12/31/16.

WMO: *Development and Implementation of International Regional Flash Flood Guidance and Early Warning Systems*, Phase II, HRC Work Plans I – V, 7/24/12 – 9/30/18.

Publications

Research Papers in Journals

Brookhouse, M., and R. Graham, 2016: “Application of the minimum blue-intensity technique to a southern-hemisphere conifer,” *Tree-Ring Research*, 72(2):103-107, DOI:10.3959/1536-1098-72.02.103.

Eden, S., Megdal, S.B., Shamir, E., Chief, K., and K. Mott Lacroix, 2016: “Opening the Black Box: Using a Hydrological Model to Link Stakeholder Engagement with Groundwater Management.” *Water* 8, 216 DOI:10.3390/w8050216.

Jubach, R., and A.S. Tokar, 2016: “International Severe Weather and Flash Flood Hazard Early Warning Systems—Leveraging Coordination, Cooperation, and Partnerships through a Hydrometeorological Project in Southern Africa,” *Water*, 8, 258; DOI:10.3390/w8060258.

Modrick, T.M., Georgakakos, K.P., Shamir, E., and C.R. Spencer, 2016: “Operational quality control and enhancement of radar data to support regional flood warning systems,” *Journal of Hydrologic Engineering*, 10.1061/(ASCE)HE.1943-5584.0001345, E4016001.

Posner, A.J., and K.P. Georgakakos, 2016: “Quantifying the impact of community-scale flash flood mitigation,” *International Journal of Disaster Risk Reduction*, 33pp. (In revision)

Shamir, E., 2016: “The value and skill of seasonal forecasts for water resources management in the Upper Santa Cruz River basin, southern Arizona,” *Journal of Arid Environments*, (accepted; It is scheduled for publication in February 2017)

Shamir, E., Rimmer, A., and K.P. Georgakakos: “The Use of an Orographic Precipitation Model to Assess the Precipitation Spatial Distribution in Lake Kinneret watershed,” *Water*, 8, 591, DOI:10.3390/w8120591.

HRC Technical Reports

Limited Distribution Reports

Spencer, C.R., Sperflage, J.A., and K.P. Georgakakos, 2016: “Black Sea Middle East Flash Flood Guidance System (BSMEFFG) User’s Guide,” *HRC Limited Distribution Report No. 42*, Hydrologic Research Center, San Diego, CA, 145pp.

Technical Notes

Shamir, E., Sperflage, J.A., Banks, R.J., and C.R. Spencer, 2016: “The Water Resources and Climate Assessment Tool (WARCAT) Developed for the Santa Cruz Active

Management Area (SCAMA),” *HRC Technical Note No. 88*, Hydrologic Research Center, San Diego, CA, 20pp.

Georgakakos, K.P., and A.J. Posner, 2016: “Estimating cumulative distribution function from large matrices of geomorphological data,” *HRC Technical Note No. 87*, Hydrologic Research Center, San Diego, CA, 8pp.

Posner, A.J., and K.P. Georgakakos, sponsored by University Corporation for Atmospheric Research, 2016: “Quantifying the Impacts of Community-Scale Flood Mitigation Projects: A Case Study in Port-au-Prince, Haiti,” *HRC Technical Note No. 86*, Hydrologic Research Center, San Diego, CA, 34pp.

Georgakakos, K.P., 2016: “Improving Operational SARFFG Soil Water Estimates Using SMOS, Ensemble Flash Flood Guidance Generation and Analysis,” *HRC Technical Note No. 85*, Hydrologic Research Center, San Diego, CA, 14pp.

Georgakakos, K.P., Sperflage, J.A., and C.R. Spencer, sponsored by University of Ghent, 2016: “Improving Operational SARFFG Soil Water Estimates Using SMOS, Basin Selection, Time Series Extraction and Initial Analyses,” *HRC Technical Note No. 84*, Hydrologic Research Center, San Diego, CA, 31pp.

Shamir, E., Modrick, T.M., Spencer, C.R., and K.P. Georgakakos, 2016: “Development of a flash flood guidance system for the Zarumilla transboundary river basin in Ecuador and Peru,” *HRC Technical Note No. 83*, Hydrologic Research Center, San Diego, CA, 37pp.

Georgakakos, K.P., and A.J. Posner, 2015: “Kinematic Routing in a Steep Ravine, Determinants of High-Inflow Peak Attenuation,” *HRC Technical Note No. 82*, Hydrologic Research Center, San Diego, CA, 32pp.

Other Reports

Georgakakos, K.P., Modrick, T.M., Sperflage, J.A., Spencer, C.R., Banks, R.J., Georgakakos, A.P., Kistenmacher, M., Yao, H., and X. Liu, 2016: “Integrated Forecast and Reservoir Management (INFORM-III): Implementation of a Stand-Alone INFORM System for DWR – Phase I Report,” HRC-GWRI Project Report, 15 July 2016, 53 pp.

Technical Communications

Graham, R., Thaele, C., and A. Sayin, 2016: “Flash Flood Forecasting and Warnings: The Flash Flood Guidance System Approach,” *HRC Technical Communication 20160720*, Hydrologic Research Center, San Diego, CA, 13 pp.

Modrick, T.M., Sperflage, J.A., and K.P. Georgakakos, 2016: “Analysis of PANWRF Forecast Precipitation Bias and Sensitivity of Forecast Precipitation to PANWRF Microphysics Parameterization,” *HRC Technical Communication 20160428*, Hydrologic Research Center, San Diego, Revised 28 July 2016, 22 pp + Appendices.

Educational, Science Cooperation, and Technology Transfer Activities

January

- K.P. Georgakakos attended a SAOFFG Planning Meeting in Jakarta, Indonesia, 1/30 – 2/5/16.

February

- Twelve forecasters and hydrologists from Russia, Lebanon, Tajikistan, Kazakhstan, Uzbekistan, and Kyrgyzstan came to HRC for advanced operations training on the Central Asia Region Flash Flood Guidance (CARFFG) system, 2/1-26/16.
- K.P. Georgakakos and J. Sperflage attended a DWR/CNRFC (INFORM) meeting in Sacramento, CA, 2/9/16.

March

- J. Sperflage and R. Graham traveled to Muscat, Oman. J. Sperflage provided training, and worked on deployment planning and implementation refinement activities with local staff. R. Graham provided technical and operations training of forecasters and hydrologists on the South Africa Region Flash Flood Guidance (SARFFG) system, 3/3-12/16.
- Nghia Le Tuan and Dung Luong Huu from Vietnam worked on review of delineation and hydrologic modeling, and also on completing and review of precipitation bias analysis for MWGHE. There were several meeting on the Vietnam Analysis FFG system design at HRC, 3/7 – 4/1/16.
- T. Modrick participated with technical presentations of hydrologic modeling components via GoToMeeting to support HRC in-country team for Oman FFG system, 3/26-28/16.
- Forecasters Khalifa Al Sudairi and Jamal Al Hinai came to HRC for advanced operations training on the Oman Flash Flood Guidance (Oman FFG) system, 3/28 – 4/22/16.
- E. Shamir attended the Santa Cruz River Conference in Tucson, AZ, 3/31 – 4/1/16.

April

- J. Sperflage attended a DWR/CNRFC (INFORM) meeting in Sacramento, CA, 4/6-7/16.
- R. Graham attended WMO FFG Phase II.4A SARFFG-SWFDP meetings in Washington, D.C., 4/18-20/16.
- K.P. Georgakakos traveled to New Delhi, India to attend a project meeting for South Asia FFG, 4/23-29/16.
- A. Posner traveled to Port-au-Prince, Haiti to present the Flooding Mitigation Analysis Findings, 4/25-28/16.

May

- T. Modrick participated in the Southeast Europe FFG System Step 4 Training Workshop in Zagreb, Croatia, 5/9-13/16.
- E. Shamir conducted the third operational workshop at CONAGUA CHMR Offices in Tuxtla-Gutierrez, Chiapas, Mexico, for the Mozotal-Mexico FFG system, 5/24-25/16.

June

- E. Shamir participated in the First Steering Committee Meeting and Step-4 Training for the Black Sea and Middle East Flood Guidance (BSMEFFG) System in Tbilisi, Georgia 6/28-30/16.

- R. Graham traveled to Vancouver, Canada to do a comparative study using SilviScan and optical imaging measurements on wood density for the NSF Tree Ring Project, 7/26 - 8/3/16.

August

- R. Graham traveled to Truckee, California to complete the collection of samples for the NSF Tree Ring Project, 8/12-16/16.
- E. Shamir traveled to Lima, Peru and participated in the WMO Initial Meeting for the establishment of a Flash Flood Guidance System for South America, 8/16-18/16.

September

- R. Graham and T. Modrick prepared presentations and participated in three-day Initial Planning Meeting organized by WMO for the HDRFFG Upgrade to WMO GFFG Program, 9/7-9/16.
- E. Shamir attended workshops of the Water Resources Climate Assessment Tool (WARCAT) for the Santa Cruz Active Management Area in Tucson and Nogales AZ, 9/28-29/2016.

October

- K.P. Georgakakos and T. Modrick participated in the Steering Committee Meeting Two and training workshop in Astana, Kazakhstan for the Central Asia Regional Flash Flood Guidance (CARFFG) System, 10/4-6/16. Participants included operational forecaster and managers from the national meteorological and hydrologic services of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, as well as an observer from the Russian Hydromet Service, WMO and USAID.
- R. Graham traveled to Pretoria, South Africa as part of the training workshop for the SARFFG-SWFDP twinning project, 10/22-28/16.

November

- E. Shamir attended the 4th operational workshop in Tuxtla Gutierrez, Mexico, 11/16-19/16.
- E. Shamir attended the First Steering Committee Meeting (SCM1) of the Mekong River Commission Flash Flood Guidance (MRCFFG) System in Phnom Penh, Cambodia, 11/26 – 12/2/16.

December

- R. Graham attended the WRN Barbados organization meeting in Boulder, Colorado, hosted by UCAR, 12/7-9/16.
- K. Georgakakos attended the Flash Flood Guidance Review meeting in Geneva, Switzerland, 12/17-23/16.
- R. Graham is a member of the PAGES (Past Global Changes) working group NAM2K Tree-Ring Chapter. Her focus is on the assimilation of available data sources and exploration of spatiotemporal analysis tools with the goal of producing a high-resolution reconstruction of key North American climate variables.
- R. Graham is leading a team of researchers from Regents Inc., Laboratory of Tree-Ring Research, Tucson and WSL in Switzerland in the development of a new calibration technique for blue intensity method for paleoclimate studies.

Community Outreach Activity

January

- R. Graham and E. Shamir attended a public meeting of the Governing Board of The San Diego River Conservancy on 1/14/16 and continue to provide technical assistance to conservancy through evaluation of proposals.
- R. Graham and E. Shamir mentored Nate Reynolds, California State University – San Marcos. His project title was “Forensic Hydrology of Sycamore Creek.” Nate presented his results at a HRC research symposium. HRC colleagues, Julia Richards, and Dustin Harrison of the San Diego River Conservancy were present. 1/21/16.

February

- E. Shamir attended a presentation by the Bureau of Reclamation on their progress with Climate Study for San Diego at the County of San Diego, 2/2/16.
- E. Shamir attended a meeting of the San Diego Integrated Regional Water Management (IRWM) Regional Advisory Committee, 2/3/16.

April

- R. Graham attended a meeting at CSU-San Marcos to discuss course development, using the lab facilities and hiring an intern for the tree ring project, 4/26/16.

May

- E. Shamir was a presenter at the Sonoran Institute Santa Cruz River Research Days, Pima Community College, Tucson AZ, 3/31/16.

June

- R. Graham met with Julia Richards of the San Diego River Conservancy (SDRC) to discuss providing guidance on the Alvarado Creek Project. The SDRC has requested technical expertise on hydrological and ecohydrological matters relating to the San Diego River Conservancy’s Proposition 1 Grant program, 6/9/16.

July

- R. Graham mentored students in dendrochronology and image analysis in Dr. Domingo’s lab at California State University San Marcos.
- K.P. Georgakakos continues to serve as the Chief Editor for the Journal of Hydrology (Technical area: Surface Hydrology and Hydrometeorology; Impact factor 2015 – 3.043)
- E. Shamir was Co-Guest Editor with Dr. Sharon Megdal and Dr. Susanna Eden from the University of Arizona for the journal of Water Special Issue on Water Governance, Stakeholder Engagement, and Sustainable Water Resources Management. The special issue was published in December 2016 and includes more than 20 manuscripts.
- E. Shamir was a member on the San Diego Basin Study Technical Advisory Committee, a study by the Bureau of Reclamation and the City of San Diego to assess the impact of projected future climate on the region’s water resources.
- E. Shamir - Peer Review of more than 10 journal manuscripts for the Journal of Hydrology, Water, JGR-Atmosphere, Water, Remote Sensing, and Atmosphere.

Visitors

January

- Julia Richards, San Diego River Conservancy
- Dustin Harrison, San Diego River Conservancy
- Nathaniel Reynolds, California State University - San Marcos
- Yuri Siminov, Russia

February

- CARFFG Training February 1-26. Attendees:
 - Mr. Yuri Siminov, Russia
 - Ms. Gulmira Akisheva, Kazakhstan
 - Mr. Adlet Jazykeldinov, Kazakhstan
 - Mr. Sergey Myagkov, Uzbekistan
 - Ms. Irina Dergacheva, Uzbekistan
 - Ms. Elvira Omorova, Kyrgyzstan
 - Mrs. Makhbuba Kasymova, Kyrgyzstan
 - Mr. Vohidjon Hamidov, Tajikistan
 - Mr. Abbas Obeid, Lebanon
 - Mr. Fadi Doumit, Lebanon

March

- Vietnam training March 7 – April 1. Attendees:
 - Nghia Le Tuan and Dung Luong Huu
- Oman FFG Training March 28 – April 22: Attendees:
 - Khalifa Al Sudairi and Jamal Al Hinai

April

- Mandira Shrestha, Nepal
- Eugene Poolman, South Africa
- Ezekiel Sebego, South Africa
- Aurel Apostu, Romania

May

- Dr. David German Gonzalez Lanteri, Universidad de Concepción Chile

June

- Ms. Sylvia DuBeau, Scripps Institute of Oceanography
- Dr. Dino Bellugi

August

- Dr. Netra Regmi

September

- Professor Ashish Sharma, University of New South Wales, Sidney, Australia

November

- Dr. Jeffrey Bradley, WEST Consultants

- Mr. Martin Teal, WEST Consultants
- Farrah Beattie, UC San Marcos

December

- Dr. Mohamad Nasr-Azadani
- Wei Shao, DELFT