

ACTIVITIES REPORT: JANUARY 1 – DECEMBER 31, 2018

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, the National Oceanic and Atmospheric Administration and (currently) the Department of the Interior 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 Retired

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

Personnel

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

Mr. Robert Jubach, General Manager

Mr. Randall Banks, Computer Programmer/Analyst I

Mr. Douglas Bennett, Computer Programmer/Analyst I

Dr. Zhengyang Cheng, Postdoctoral Associate

Dr. Rochelle (Graham) Campbell, Meteorologist III

Ms. Barbara Hansen, Administrative Associate

Dr. Theresa (Modrick) Hansen, Hydrologic Engineer II

Dr. Eylon Shamir, Hydrologic Engineer III

Mr. Cristopher Spencer, Computer Programmer/Analyst II

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

Dr. Nicholas E. Graham, Visiting Scientist

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

Projects Funded or Ongoing 2018

ACP, Autoridad del Canal de Panama: *Regular Maintenance*, 2018-2021.

California Department of Water Resources (DWR): *Implementation of Stand-Alone INFORM System for DWR*, 1/1/16 – 6/29/18 (with Georgia Tech as a subcontractor).

Goal Honduras: *Operationalizing a Neighborhood Approach to Reduce Urban Disaster Risk in Three High Risk Neighborhoods in Tegucigalpa*, 4/18/17 – 3/15/18.

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 – 4/30/19.

State of California, San Diego River Conservancy: *El Monte Sand Environmental Impact Report Review*, 9/14/18 – 10/31/18.

UCAR: *Advancing Impact-based Forecasting and Warning Services in El Salvador and Costa Rica*, 4/1/17 – 9/30/19.

UCAR: *Advancing Impact-based Forecasting and Warning Services in the Republic of South Africa*, 3/9/17 – 9/30/19.

UCAR: *Global Flash Flood Guidance Implementation Tasks*, 3/1/18 – 12/31/19.

UCAR: *Global Flash Flood Guidance Program Support Tasks*, 3/1/18 – 12/31/19.

UCAR: *Impact-based Forecasting and Warning Services: Barbados*, 2/2/17 – 12/31/18.

UCAR: *Impact-based Forecasting and Warning Services: Indonesia*, 1/19/18 – 8/31/19.

UCAR: *Advancing Impact-based Forecasting and Warning Services in Guatemala*, 12/4/17 – 12/4/19.

UCAR: *WRN Support Tasks*, 9/16/18 – 12/31/19.

UCAR: *Support for the Burma Department of Meteorology and Hydrology*, 2/22/17 – 9/30/18.

U.S. Bureau of Reclamation, Lower Colorado Region (cooperative agreement) (6/30/15): *A comparison of precipitation downscaling procedures to guide studies of climate change impacts on flooding and water resources*, 3/23/16 – 9/30/18.

U.S. Bureau of Reclamation: *Technical Consulting Services for Weather Generator for the Lower Santa Cruz River Basin Study*, 10/1/18 – 9/30/19.

WMO: *Development and Implementation of International Regional Flash Flood Guidance and Early Warning Systems*, Phase II, HRC Work Plans I – IX, 7/24/12 – 12/31/20.

Publications

Research Papers in Journals

Campbell, R., Beardsley, D., and S. Tokar, 2018: “Impact-based Forecasting and Warning: Weather Ready Nations,” *WMO Bulletin*. (Accepted)

Campbell, R., McCarroll, D., Robertson, I., Loader, N., Grudd, H., and B. Gunnarson, 2018: “Investigating climate over the last 800-years in Mora, Sweden using blue intensity in tree rings,” *The Holocene*. (In revision)

Cheng, Z., & G. Constantinescu, 2018: “Stratification effects on flow hydrodynamics and mixing at a confluence with a highly discordant bed and a relatively low velocity ratio,” *Water Resources Research*, 54, 4537–4562. <https://doi.org/10.1029/2017WR022292>.

Cheng, Z., Lee, K., Kim, D., Muste, M., Vidmar P. and J. Hulme, 2018: “Experimental Evidence on the Performance of Rating Curves for Continuous Discharge Estimation in Complex Flow Situations,” *Journal of Hydrology*, 568, 959-971. DOI: 10.1016/j.jhydrol.2018.11.021.
Georgakakos, K.P., 2018: Overview of the Global Flash Flood Guidance System and its application worldwide. *WMO Bulletin* 67(1), 41 – 46.

Lepley, K., Touchan, R., Meko, D., Shamir, E., Graham, R., and D. Falk, 2018: “Snowpack Reconstruction using Coniferous Tree Rings for North Fork American River Watershed, Sierra Nevada, California,” *Climate Dynamics*. (In revision)

Shamir, E., Halper, E., Modrick, T., Georgakakos, K.P., Chang, H.-J., Lahmers, T.J., and C. Castro, 2018: “Statistical and dynamical downscaling impact on projected hydrologic assessment in arid environment: A case study from Bill Williams River Basin and Lake Alamo, Arizona,” *J. of Hydrology*. (In revision)

Other Presentations

Tokar, A., Beardsley, D., and R. Graham: “Weather-Ready Nations: International Implementation,” AMS International Meeting, Austin, TX, 1/10-11/18.

Shamir E.: “Tree Radial Growth Dependence on the Spatial Variability of Snowpack and Soil Moisture,” 2018 California Extreme Precipitation Symposium, Davis, CA, 7/9/18.

HRC Technical Reports

Limited Distribution Reports

Cheng, Z. and K.P. Georgakakos, 2018: “Urban Flash Flooding and Community Mitigation Measures for three Districts in Tegucigalpa, Honduras,” sponsored by US Agency for International Development, Office of Foreign Disaster Assistance through GOAL Honduras, *HRC Limited Distribution Report No. 49*, Hydrologic Research Center, San Diego, CA, 60pp.

Technical Notes

Georgakakos, K.P., Cheng, Z., Modrick, T.M., Shamir, E., and C.R. Spencer, 2018: “Development of Hourly Quantitative Precipitation Estimates for the Cendere Basin Urban Modeling System,” *HRC Technical Note No. 100*, Hydrologic Research Center, San Diego, CA, 22pp.

Shamir, E. and K.P. Georgakakos, 2018: “Radar Mask and Climatological Biases Analyses for the Beit Dagan Radar, Israel,” *HRC Technical Note No. 99*, Hydrologic Research Center, San Diego, CA, 15pp.

Cheng, Z. and K.P. Georgakakos, 2018: “Trip Report for HRC Travel to Tegucigalpa for HRC Software Training (25 February – 2 March 2018),” *HRC Technical Note No. 98*, Hydrologic Research Center, San Diego, CA, 15pp.

Technical Communications

Shamir, E., Cheng, Z., Jubach, R. 2018; “Review of the Hydrology, Hydraulics, and Groundwater Analyses Performed for the Draft Subsequent Environmental Impact Report for the El Monte Sand Mining Project Prepared for the San Diego River Conservancy,” *HRC Technical Comment 20181012-1*, Hydrologic Research Center, San Diego, CA, 18pp.

Other

Cheng, Z., 2018: “Description of Simulation and Post-processing.” This tutorial summarizes the technical background of the models adopted in the software developed for the Tegucigalpa Flood Study Project and includes step-by-step instruction of the software.

Training and Educational Course Material

Georgakakos, K.P., 2018: “Elements of Characterizing Uncertainty in Hydrometeorological Monitoring and Forecasting.” On-line Training Video, Hydrologic Research Center, San Diego, CA, 7/18.

Hansen, T., 2018: “Numerical Weather Prediction.” On-line Training Course, Hydrologic Research Center, San Diego, CA, 7/18.

Shamir, E., 2018: “Elements of Snow Hydrology and Flash Floods.” On-line Training Course, Hydrologic Research Center, San Diego, CA, 7/18.

Shamir E., 2018: “Introduction to Landslide Hazard Threat in the Flash Flood Guidance System.” On-line Training Course, Hydrologic Research Center, San Diego, CA, 8/18.

Educational, Science Cooperation, and Technology Transfer Activities

January

- Twelve people from Belize, Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua came to HRC for flash flood training on the CAFFG system, 1/8 – 2/2/18.
- R. Campbell attended the AMS International Meeting, Austin, TX, 1/10-12/18.
- R. Campbell traveled to Mbabane, Swaziland to attend the SARFFG SCII meeting, 1/20-25/18.
- R. Campbell gave a Weather Ready Nations (WRN) Workshop in South Africa, 1/26 – 2/3/18.

February

- K. Georgakakos and R. Jubach attended the WMO FFGS Program Management Meeting in Washington, D.C., 2/5-9/18.
- E. Shamir represented HRC in the 2nd Steering Committee Meeting of the Haiti and the Dominican Republic FFG Project, Dominican Republic, 2/12-14/18.
- H. McMillan, SDSU gave a presentation entitled Hydrologic Models and the Value of Data at HRC, 2/12/18.
- R. Campbell traveled to Jakarta and Yagakarta, Indonesia for UCAR Indonesia IDSS initial workshops, 2/17 – 3/2/18.
- K. Georgakakos traveled to Bogota, Colombia for training workshops for WMO FFGS NWSA, 2/20-22/18.
- K. Georgakakos traveled to Panama for meetings on potential future projects with ACP, 2/22-24/18.
- E. Shamir represented HRC at the Myanmar Stand Alone FFGS Initial Planning Meeting, Nay Pyi Taw, Myanmar, 2/26-28/18.
- Z. Cheng and K. Georgakakos gave a training workshop for GOAL, Tegucigalpa Municipality, Tegucigalpa, Honduras, 2/25 – 3/2/18.

March

- Nine people from Bangladesh, Bhutan, India, Nepal, and Sri Lanka traveled to HRC for flash flood training on the South Asia FFG system, 3/5-30/18.
- R. Campbell traveled to Zagreb, Croatia and Geneva, Switzerland for UCAR Indonesia IDSS workshops and meetings, 3/16-24/18.
- R. Jubach and R. Campbell attended the Development Partners Conference (co-hosted by WMO, World Bank Group, and GFDRR) and WRNs coordination with WMO, Geneva, Switzerland, 3/19-24/18.
- C. Spencer performed remote installation of the CARFFG System on an operational system server hosted at Kazhydromet in Astana, Kazakhstan. He traveled there to provide staff of the hosting agency with training on the operational administration of the system, 3/25 – 4/1/18.
- K. Georgakakos traveled to Oman for presentations and discussions with the Oman Department of Meteorology, 3/26-30/18.

April

- T. Modrick Hansen traveled to Jakarta, Indonesia for SAOFFG System Steering Committee Meeting #2, 4/3-5/18.

- R. Campbell gave a Weather Ready Nations (WRN) Workshop in Guatemala, 4/24-27/18.
- R. Campbell gave a Weather Ready Nations (WRN) Workshop in El Salvador, 4/28 – 5/5/18.

May

- C. Spencer traveled to Phnom Penh, Cambodia for MRCFFG System Administration Training, 5/13-20/18.
- R. Campbell gave a Weather Ready Nations (WRN) Workshop in Costa Rica, 5/13-17/18.
- K. Georgakakos traveled to Brasilia, Brazil to attend La Plata River Project Kick-off Meetings, 5/20-26/18.
- E. Shamir attended meetings with the Reclamation Project Manager in Phoenix, AZ and the project collaborators in Tucson, AZ, 5/30-6/1/18.

June

- R. Campbell traveled to New Delhi, India for Step Four FFG Training, 6/3-8/18.
- K. Georgakakos and J. Sperflage attended the DWR INFORM Training Workshop in Sacramento, CA, 6/14-15/18.
- Seventeen people from Malaysia, Papua New Guinea, Philippines, Timor-Leste, Israel, Brunei Darussalam, Indonesia, and Myanmar traveled to HRC for flash flood training for the WMO FFG Phase II.6 Israel, II.6 Myanmar, and II.6 SAO FFG projects, 6/18 – 7/13/18.
- Eliot Christian, Common Alerting Protocol trainer, gave presentations to our FFG trainees, 6/24-27/18.
- T. Modrick Hansen attended the WMO FFG HDRFFG Step 4 Training Workshop & SCM in Santo Domingo, Dominican Republic, 6/19-21/18.
- Forty participants from Palestine, Turkey, Afghanistan, Pakistan and WMO were trained in Kusadasi, Turkey by WMO Certified Hydrometeorological Trainers from South Africa, Jordan, Turkey, and Bosnia Herzegovina. HRC staff: R. Campbell, K. Georgakakos, T. Modrick Hansen, and E. Shamir participated in the training and gave presentations via GoToMeeting, 6/25 – 7/13/18.

July

- C. Spencer and R. Banks traveled to Santo Domingo, Dominican Republic for the purpose of providing training to the future hosting agency on the operational administration and management of the HDRFFG System, 7/2-6/18.
- R. Campbell gave a Weather Ready Nations (WRN) workshop and attended meetings in Jakarta and Semarang, Indonesia, 7/6-18/18.
- E. Shamir represented HRC in the Central America Flash Flood Guidance system (CAFFGS) Regional Operational Step 4 Training, San Jose, Costa Rica, 7/24-26/18.

August

- HRC hosted the Management Meeting for the WMO FFGS Project, 8/7-9/18.
- Fourteen people from Turkey traveled to HRC for training on the WMO FFG Phase II.5 Routing and II.5 Urban projects, 8/6-24/18.
- R. Campbell gave a Weather Ready Nations (WRN) Workshop and a Tsunami Ready Workshop in San Salvador, 8/19-25/18.

- E. Shamir represented HRC in the BSMEFFGS Regional Operational Step 4 Training, Tel Aviv, Israel, 8/28-30/18.

September

- R. Campbell attended the Indonesia UK Met Collaboration Meeting, Exeter, UK, 9/5-7/18.
- C. Spencer traveled to DMH in Nay Pyi Taw, Myanmar for the purpose of providing training to the future hosting agency on the operational administration and management of the Myanmar FFG System, 9/7-15/18.
- E. Shamir represented HRC in the SAOFFGS Regional Operational Step 4 Training, Quezon City, Philippines, 9/12-14/18.
- R. Campbell gave a Weather Ready Nations (WRN) Workshop in Croatia, 9/22-29/18.
- K. Georgakakos traveled to Abidjan, Ivory Coast to attend WMO West Africa Meeting, 9/18-22/18.
- HRC's new website was activated.

October

- R. Campbell and R. Jubach traveled to Geneva, Switzerland for the Weather Ready Nations second steering committee meeting, 10/20-25/18.

November

- K. Georgakakos traveled to Nadi, Fiji to attend the Fiji FFGS Planning Meeting, 11/9-11/18.
- E. Shamir participated in the Sequoia and Kings Canyon Science Symposium in Three Rivers, CA, 11/14-15/18. He co-authored the following presentation: Touchan, R., Meko, D.M., Shamir, E., Hughes, M.K. and K. Lepley, "Seasonal Climate Change in Giant Sequoia Tree."
- R. Campbell traveled to Costa Rica for WRN workshop, 11/27 - 12/1/18.

December

- R. Campbell traveled to El Salvador for WRN workshop, 12/1-6/18.
- K. Georgakakos and R. Jubach attended the Management Meeting for the WMO FFGS Project in Geneva, Switzerland, 12/11-14/18.

Throughout the Year

- 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. The calibration target has been developed and compared with the original calibration card. The development of this new calibration target advances the technique further.

Community Outreach Activity

- R. Campbell mentored students in Dr. Domingo's lab, California State University at San Marcos.
- R. Campbell and T. Modrick Hansen mentored intern Sean Watson. The focus of the internship was to identify information needed to aid hydro-meteorological forecasters and disaster managers in making decisions regarding warning and response to natural/meteorological hazards.
- R. Campbell and E. Shamir mentored intern Kai Lepley. The goal of this internship was to investigate the procedures for analysis of anatomical wood attributes from tree rings of four conifer species sampled at two sites in the Sierra Nevada Mountains of California.
- Z. Cheng was a reviewer for *Journal of Hydrology and Water*.
- T. Modrick Hansen was a reviewer for proposals under the AAAS Basic Research Grant Program.
- E. Shamir organized the 2018 California Extreme Precipitation Symposium in Davis, CA, 7/9/18. The Symposium title was "Paleoclimate Insights for Planning Future Natural Resources."
- K.P. Georgakakos served as the Chief Editor for the Journal of Hydrology (Technical area: Surface Hydrology and Hydrometeorology; Impact factor 2013 – 2.964)
- E. Shamir served as an Associate Editor for the *Journal of Hydrology, Elsevier*.
- E. Shamir mentored Matan Ben Yona who is pursuing a Masters in Water Science at the Tel Hai College, Israel.

Visitors

January

- James Purpura, NOAA, National Weather Service, San Diego, CA
- Ye Ye Nyein, Ministry of Transport and Communications, Myanmar
- Rosario Alfaro, UCAR/IA NWS, Silver Spring, MD
- Derrick Rudon, National Meteorological Service of Belize
- Michelle Smith, National Meteorological Service of Belize
- Jeffry Luna Gutierrez, Instituto Costarricense de Electricidad, Costa Rica
- Juan Diego Naranjo Díaz, National Meteorological Institute, Costa Rica
- David Pichinte-Quele, MARN, El Salvador
- Jacqueline Rivera Ayala, Ministry of Environment and Natural Resources, El Salvador
- Laura Paola Orellana, Ministry of Environment and Natural Resources, El Salvador
- Eva Gramajo, INSIVUMEH, Guatemala
- Manuel de Jesús Sales Rodriguez, INSIVUMEH, Guatemala
- Mario Alonso Centeno Paz, COPECO, National Weather Service of Honduras
- Jose Lenin Chavarría Cruz, Nicaraguan Institute of Territorial Studies, Nicaragua
- Manuel Antonio Prado Idiaquez, INETER, Nicaragua

February

- Board Members: Raymond Ban, Robert Hartman, Richard Kennedy, Anastasios Tsonis
- Hilary McMillan, SDSU

March

- Mohammad Arifuzzaman Bhuyan, Bangladesh Water Development Board
- Tahiya Tarannum, Bangladesh Water Development Board
- Sonam Tashi, National Center for Hydrology and Meteorology, Bhutan
- Asok Raja Subbarayan Kumarasamy, Government of India
- Hemlata Motiram Bharwani, India Meteorological Department
- Bikash Nepal, Government of Nepal
- Sunil Pokharel, Department of Hydrology and Meteorology, Nepal
- Malinda Millangoda, National Meteorological Centre, Sri Lanka
- Prema Hettiarachchi, Irrigation Department, Sri Lanka
- Liz Page, UCAR, Boulder, Colorado

June

- Arifin Yussof, Brunei Darussalam Meteorological Department
- Carla Maria Freitas, Directorate National Meteorological and Geopgysic, East Timor
- Osorio Belo da Piedade, Ministry of Public Works, Timor Leste
- Alif Adiyasa, Indonesia Agency for Meteorology, Climatology, and Geophysics
- Iddam Hairuly Uman, Agency for Meteorology Climatology and Geophysics, Indonesia
- Levina Levina, Research and Development Agency, Ministry of Public Works and Housing, Indonesia
- Anat Cohen, Israeli Hydrological Service
- Elyakom Vadislavsky, Israel Meteorological Service (IMS)
- Mohd. Zaharifudin Muhamad Ali, Department of Irrigation and Drainage, Malaysia
- Sharifah Faridah Syed Mahbar, Malaysian Meteorological Department, Malaysia
- Khin Wah Wah Win, Department of Meteorology and Hydrology, Myanmar
- Tim Mar Htay, Department of Meteorology and Hydrology, Myanmar
- Lipan Raphael Toyung, Papua New Guinea National Weather Service
- Ruben Wamuni, Papua New Guinea National Weather Service
- Renito Paciente, Philippine Atmospheric Geophysical and Astronomical Services Administration, Philippines
- Roy Badilla, Philippine Atmospheric, Geophysical and Astronomical Services Administration, Philippines
- Anthony Emigh, University of Iowa College of Engineering
- Eliot Christian, Common Alerting Protocol Trainer, WMO

August

- Ali İhsan Akbaş, General Directorate of Water Management, Turkey
- Bahattin Aydın, Republic of Turkey
- Bekir Ragip Yurtseven, General Directorate of State Hydraulics Works, Turkey
- Emel Ünal, Republic of Turkey
- Hasan Gürbüz, Istanbul Meteorology Regional Directorate, Turkey
- Mehmet Aksoy, Turkish State Meteorological Service, Turkey
- Mehmet Soylu, General Directorate of State Hydraulics Works, Turkey
- Ömer Faruk Ciba, Turkish State Meteorology Service, Turkey
- Osman Çaylak, Istanbul Disaster Coordination Center, Turkey
- Özgüven Altun, State Water Hydraulics and Works, Turkey
- Satuk Buğra Findik, General Directorate of Water Management, Turkey
- Selçuk Tütüncü, Istanbul Disaster Coordination Center, Turkey
- Tunay Çarpar, Istanbul Water and Sewage Administration, Turkey
- Dan Beardsley, National Weather Service, Silver Spring, Maryland
- Curt Barrett, United States Agency for International Development (USAID), Silver Spring, Maryland
- Fatih Kaya, World Meteorological Organization, Switzerland
- Jay Wilson, World Meteorological Organization, Switzerland
- Paul Pilon, World Meteorological Organization, Switzerland
- Petra Mutic, World Meteorological Organization, Switzerland