

ACTIVITIES REPORT: JANUARY 1 – DECEMBER 31, 2021

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 Adjunct Professor 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	UWM Emeritus Distinguished Professor 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

Personnel

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

Mr. Robert Jubach, General Manager

Mr. Randall Banks, Computer Programmer/Analyst I

Dr. Zhengyang Cheng, Engineer I

Dr. Rochelle Campbell, Meteorologist III

Ms. Barbara Hansen, Administrative Associate

Dr. Theresa Modrick Hansen, Hydrologic Engineer II

Mr. Robert Hetrick, Scientist/Engineer I

Dr. Eylon Shamir, Hydrologic Engineer III

Mr. Cristopher Spencer, Computer Programmer/Analyst II

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

Ms. Queen Tran, Computer Programmer/Analyst I (July 1, 2021 – October 29, 2021)

Ms. Sheila Ragan, Ocean Point Financial Systems, HRC Senior Accountant (contractor) beginning 10/3/2006.

HRC Office Space

On February 1, 2022, HRC moved its offices from 11440 West Bernardo Court Suite 375 to Suite 208. The office was downsized because the staff is working from home. In conjunction with office move, HRC also moved all its operating servers to an offsite colocation facility. The offsite facility provides the opportunity for a more secure and efficient location for its servers which support HRC programs globally.

Projects Funded or Ongoing 2021

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

ACP, Autoridad del Canal de Panama: *Panama Maintenance 2021, 5/17/2021 – 5/16/2024*.

Department of Infrastructure, Ports and Energy, Government of St, Lucia: *St. Lucia Flash Flood Guidance System, 10/24/2019 – 12/31/2022*.

U.S. Bureau of Reclamation: *Technical Consulting Services for Weather Generator for the Lower Santa Cruz River Basin Study, 10/1/2018 – 6/30/2022*.

U.S. Bureau of Reclamation, Upper Colorado Regional Office: *Software Tool Development to Generate Stochastic Hydraulic Simulations using HEC-RAS, 8/14/2019 – 06/30/2022*.

UCAR: *Advancing Impact-based Forecasting and Warning Services in El Salvador and Costa Rica, 4/1/2017 – 7/31/2021*.

UCAR: *Advancing Impact-based Forecasting and Warning Services in Guatemala, 12/4/2017 – 7/31/2021*.

UCAR: *Global Flash Flood Guidance Implementation Tasks, 3/1/2018 – 6/30/2022*.

UCAR: *Global Flash Flood Guidance Program Support Tasks, 3/1/2018 – 6/30/2022*.

UCAR: *Impact-based Forecasting and Warning Services: Bahamas, 8/5/2020 - 3/31/2022*.

UCAR: *Impact-based Forecasting and Warning Services: Dominica, 2/23/2021 – 3/31/2022*.

UCAR: *Impact-based Forecasting and Warning Services: Fiji, 8/3/2020 – 8/31/2021*.

UCAR: *Impact-based Forecasting and Warning Services: Indonesia, 1/19/2018 – 12/31/2021*.

UCAR: *Impact-based Forecasting and Warning Services: Sri Lanka, 1/6/2020 - 6/30/2022*.

UCAR: *Impact-based Forecasting and Warning Services: Support in the development of online courses, 5/22/2020 – 8/31/2021*.

UCAR: *Support for National Early Warning Systems in Select South Asian Countries (Part 1), 12/28/2021 - 6/30/2022*.

UCAR: *WRN Program Support Tasks, 9/16/2018 – 3/31/2022*.

WMO: *Development and Implementation of International Regional Flash Flood Guidance and Early Warning Systems (Phase II), Work Plans 8 and 9, Fiji and Southeast Asia, 4/01/2018 – 3/31/2022*.

WMO: *Flash Flood Guidance System with Global Coverage, (Phase III), HRC Work Plan 1, 7/8/2019 - 8/31/2022*.

WMO: *Flash Flood Guidance System with Global Coverage* (Phase III), HRC Work Plan 2, 7/1/2020 – 9/30/2022.

Publications

Contributions to Books and Special Issues

Tsonis, A.A., and C. Zerefos, 2020: Aristotle's Μετεωρολογικά Meteorology then and now, 130pp.

Research Papers in Journals

Cheng, Z., and G. Constantinescu, 2021: “Shallow mixing interfaces between parallel streams of unequal densities,” *Journal of Fluid Mechanics* (in review).

Cheng, Z., and G. Constantinescu, 2021: “Shallow mixing layers between non-parallel streams in a flat-bed wide channel,” *Journal of Fluid Mechanics*, 916, A41. doi:10.1017/jfm.2021.254.

Georgakakos, K.P., Modrick, T.M., Shamir, E., Campbell, R., Cheng, Z., Jubach, R., Sperflage, J., Spencer, C.R., and R. Banks, 2021: “The Flash Flood Guidance System Implementation Worldwide: A Successful Multidecadal Research-To-Operations Effort”, co-author, Bulletin of the American Meteorological Society, Published-online 09 Nov 2021 doi.org/10.1175/BAMS-D-20-0241.1 (Printed Publication Pending).

Kravtsov S. and A.A. Tsonis, 2021: “Lorenz-63 model as a metaphor for transient complexity in climate,” *Entropy*, 23, 951. doi.org/10.3390/e23080951.

Shamir E, Tapia-Villaseñor, E.M., Cruz-Ayala M-B, Megdal S.B., 2021: “A Review of Climate Change Impacts on the USA-Mexico Transboundary Santa Cruz River Basin,” *Water*, 2021; 13(10):1390. doi.org/10.3390/w13101390.

Stathopoulos, S., Tsonis, A.A., and K. Kourtidis, 2021: “On the cause-and-effect relations between aerosols, water vapor, and clouds over East Asia,” *Theoretical and Applied Climatology*, doi.org/10.1007/s00704-021-03563-7.

Tsonis, A.A., Wang, G., Lu, W., Kravtsov, S., Essex, C., and M. Asten, 2021: “On time scales of intrinsic oscillations in the climate system,” *Entropy*, 23(4), 459, doi:10.3390/e23040459.

Tsonis, A.A., Wang, G., Zhang, L., Lu, W., Kayafas, A., and K. Del Rio-Tsonis, 2021: “An application of slow feature analysis to the genetic sequences of coronaviruses and influenza viruses,” *Human Genomics*, 15:26, doi:10.1186/s40246-021-00327-2.

Yang, P., Wang, G., Xiao, Z., Tsonis, A.A., Feng, G., Liu, S., and X. Zhou, 2021: “Climate: a dynamical system with mismatched space and time domains,” *Climate Dynamics*, doi.org/10.1007/s00382-021-05646-7.

Conference Proceedings

Cheng, Z., Georgakakos, K.P., Spencer, C., and R. Banks: “Numerical Modeling of Flash Floods in Urban Areas: from a Case Study to an Operational Warning System,” 11th Conference on Transition of Research to Operations, 101st AMS Annual Meeting.

Conference Abstracts

Cheng, Z., Georgakakos, K.P., Spencer, C., and R. Banks, 2021: Numerical modeling of flashfloods from urban areas, from a case study to an operational warning system. *Abstract submitted for oral presentation at the American Meteorological Society (AMS) Annual Meeting, January 2021.*

De Biasio, E., and K.P. Georgakakos, 2021: Is upstream CAPE a potential precursor to extreme precipitation in the mountainous regions of Southern California? *Abstract submitted (and accepted for oral presentation) at the AMS 2022 Annual Meeting, 36 Hydrology Conference, Paper 1B.6.*

Georgakakos, K.P., Modrick-Hansen, T.M., Shamir, E., Cheng, Z., Sperflage, J., Spencer, C., and R. Banks, 2020: Data needs and realizable exchange strategies on global scales for high-resolution operational land-surface forecasts. *Abstract submitted for oral presentation at the World Meteorological Organization (WMO) Data Conference, Hydrology and Water Resources, 19 October 2020.*

Jubach, R.: Co-author on an abstract titled “Challenges and Strategy in Sustainable Operations of the Flash Flood Guidance System with Global Coverage” submitted for the 2021 American Meteorological Society Annual Meeting.

Modrick-Hansen, T.M., Shamir, E., and K.P. Georgakakos, 2021: Impact of data availability and resolution of gauge precipitation on bias-corrected satellite-based estimates of QPE. *Abstract submitted for oral presentation at the American Meteorological Society (AMS) Annual Meeting, January 2021.*

Modrick Hansen, T.M., Watson, S.R., and J.A. Sperflage, 2021: Investigation of GIS-derived watershed properties and delineated stream location for regional flash flood warning. *Abstract submitted for oral presentation at the American Meteorological Society (AMS) Annual Meeting, January 2021.*

Other Presentations

Campbell, R., 2021: Shifting Paradigm of Climate Services with Impacted Based Forecasts. Invited keynote speaker. The Meteorology, Climatology and Geophysics Agency (BMKG) - Indonesia National Meeting 2021 Dry Season Forecast, 02/25/2021.

Campbell, R., 2021: Weather ready Nations: The Human Impact of Floods. Asia-Pacific Economic Community (APEC) - Enhancing Participation in Flood Disaster Preparedness through Community-based Hazard Mapping, 06/15/2021.

Cheng, Z., Georgakakos, K.P., Spencer, C., and R. Banks, 2021: Numerical modeling of flashfloods from urban areas, from a case study to an operational warning system. Abstract submitted for oral presentation at the American Meteorological Society (AMS) Annual Meeting, January 2021.

Georgakakos, K.P., Modrick, T.M., Spencer, C.R., 2021: Operational microwave-adjusted hydro-estimator to support flash flood assessments worldwide. Oral presentation at the AGU 2021 Annual Meeting, Session H113, Utilizing Precipitation Datasets and Quantifying Associated Uncertainties in Hydrometeorological and Climate Impact Applications, 13 December 2021

Georgakakos, K.P., Modrick-Hansen, T.M., Shamir, E., Cheng, Z., Sperflage, J., Spencer, C., and R. Banks, 2020: Data needs and realizable exchange strategies on global scales for high-resolution operational land-surface forecasts. Abstract submitted for oral presentation at the World Meteorological Organization (WMO) Data Conference, Hydrology and Water Resources, 19 October 2020.

Hetrick, R: Microwave Adjusted Global Hydroestimator for FFGS – Video presentation (16:10_ at the AGU 2021 Fall Meeting. Paper No. H13H-01).

Modrick-Hansen, T.M., Shamir, E., and K.P. Georgakakos, 2021: Impact of data availability and resolution of gauge precipitation on bias-corrected satellite-based estimates of QPE. Abstract submitted for oral presentation at the American Meteorological Society (AMS) Annual Meeting, January 2021.

Shamir, E., 2021: Flash Flood Guidance System (FFGS) snow hydrology. The webinar, organized by World Meteorological Organization (WMO) was presented on 1 July, 2021 to forecasters from countries that are part of the South Asia and South East Europe FFGS

Spencer, C.R., 2021: Leveraging the WHOS-Plata broker for the acquisition of real-time information in the La Plata Data Assimilation and Quality Control System (Plata-DAQCS). Webinar on WHOS organized by UN WMO, September 2021.

HRC Technical Reports

Limited Distribution Reports

Spencer, C.R., Sperflage, J.A., Banks, R., Modrick, T., Shamir, E., and K.P. Georgakakos, 2021: Fiji Flash Flood Guidance System (FIJIFFGS) System Administration User's Guide. *HRC Limited Distribution Report No. 63*, Hydrologic Research Center, San Diego, CA, 141pp.

Spencer, C.R., Sperflage, J.A., Banks, R., Modrick, T., Shamir, E., and K.P. Georgakakos, 2021: Southern Africa Regional Flash Flood Guidance (SARFFG) System Administration User's Guide. *HRC Limited Distribution Report No. 64*, Hydrologic Research Center, San Diego, CA, 158pp.

Technical Report Series

Georgakakos, K.P., 2021: “Analysis of Weather Radar Volume-Scan Elements for the Estimation of Georeferenced CAPPI Precipitation,” *HRC Technical Report Series No. 104*, Hydrologic Research Center, San Diego, CA, 58pp.

Technical Communications

Cheng, Z., and K.P. Georgakakos, 2021: “Development of Probabilistic Simulations in HEC-RAS Flow and Sediment Transport – Progress Report,” *HRC Technical Communications 20210819HECRAS*, Hydrologic Research Center, San Diego, CA, 25pp.

Cheng, Z., 2021: “Discussion of Hydrologic Research Center Staff with the Science Manager of Streamflow Hydraulics of the Department of Water and Sanitation of South Africa,” *HRC Technical Communications VAAL20210419*, Hydrologic Research Center, San Diego, CA, 7pp.

Cheng, Z., 2021: “Landslide Module for the Southeast Asia Flash Flood Guidance System (SeAFFGS),” *HRC Technical Communications VNLSL-20210802*, Hydrologic Research Center, San Diego, CA, 14pp.

Georgakakos, K.P., 2021: “Implementing Susceptibility Mapping for a Region in India to Enhance the South Asia Flash Flood Guidance System (SAsiaFFGS) A Concept Note,” *HRC Technical Communications IMD-20210923*, Hydrologic Research Center, San Diego, CA, 6pp.

Georgakakos, K.P., 2021: “Summary of Video Conference Discussions between IMD and HRC on the 6th of August 2021,” *HRC Technical Communications IMD-20210806*, Hydrologic Research Center, San Diego, CA, 4pp.

Modrick Hansen, T.M., 2021: “The BSMEFFGS High-Resolution Redelineation for Use with Radar Data: Comments and Responses,” *HRC Technical Communications 20210312*, Hydrologic Research Center, San Diego, CA, 4pp.

Modrick Hansen, T.M., 2021: “The SASIAFFGS Watershed Delineation for Coastal Urban Areas: Evaluation of Coverage from the High-Resolution Re-delineation for use with Radar Data,” *HRC Technical Communication 20210324*, Hydrologic Research Center, San Diego, CA, 62pp.

Modrick Hansen, T.M. and R. Hetrick, 2021: “Watershed Delineation Review for the La Plata Hydrometeorological Forecast System (LaPlata HMFS): Country Comments and Responses,” *HRC Technical Communications LaPlata-2021-08-31*, Hydrologic Research Center, San Diego, CA, 11pp.

Modrick Hansen, T.M., Shamir, E., Cheng, Z., and K.P. Georgakakos, 2021: “Summary Report on the FFGS Step 3 Operational Training Course for the South East Asia Flash Flood Guidance System (SEAFFGS),” *HRC Technical Communications SEA-20210223*, Hydrologic Research Center, San Diego, CA, 10pp.

Modrick Hansen, T.M., Shamir, E., Cheng, Z., and K.P. Georgakakos, 2021: “Summary Report on the National Radar Hydrology Workshop Online Training Course for the Fiji Flash Flood Guidance System (FijiFFGS),” *HRC Technical Communications Fiji-20210730*, Hydrologic Research Center, San Diego, CA, 11pp.

Modrick Hansen, T.M., Shamir, E., Cheng, Z., and K.P. Georgakakos, 2021: “Summary Report on the Regional Radar Hydrology Online Training Course for the South Asia Flash Flood Guidance System (SAsiaFFGS),” *HRC Technical Communication SASIA-20211210*, Hydrologic Research Center, San Diego, CA, 13pp.

Modrick Hansen, T.M., Shamir, E., Cheng, Z., and K.P. Georgakakos, 2021: “Summary Report on the Regional Radar Hydrology Workshop Online Training for the South Asia Flash Flood Guidance System (SAsiaFFGS),” *HRC Technical Communication SASIA-20211215*, Hydrologic Research Center, San Diego, CA, 10pp.

Modrick Hansen, T.M., Shamir, E., Cheng, Z., and K.P. Georgakakos, 2021: “Summary Report on the Regional Radar Hydrology Workshop Online Training Course for the South East Asia Flash Flood Guidance System (SEAFFGS),” *HRC Technical Communications SEA-20210528*, Hydrologic Research Center, San Diego, CA, 10pp.

Shamir, E., Spencer, C.R., and K.P. Georgakakos, 2021: “Masks and Climatological Bias Analyses of Radar CAPPI Data from Georgia,” *HRC Technical Communications TC-20211214*, Hydrologic Research Center, San Diego, CA, 13pp,

Educational, Science Cooperation, and Technology Transfer Activities

January

- Saint Lucia Forecast Operations Training, 1/4 - 15/2021.
- AMS Virtual Meeting, 1/10 - 14/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in El Salvador, 01/06/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Indonesia, 01/11/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Costa Rica, 01/13/2021.
- Saint Lucia FFGS IT Administration Training, 1/18 - 25/2021.
- WMO FFG CREWS SE Asia Step 3 Forecaster Training, 1/20 – 2/19/2021.
- WMO FFG CREWS Fiji FFGS IT Systems Administration Training, 1/26 – 2/10/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Guatemala, 01/27/2021.

February

- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Guatemala, 02/5/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in El Salvador, 02/12/2021.
- T.M. Modrick Hansen gave the NWSAFFGS Demonstration, 1-Day online session, 2/17/2021.

- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Bahamas, 02/18/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Indonesia, 02/24/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Costa Rica, 02/25/2021.

March

- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Bahamas, 03/04/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Indonesia, 03/18/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Costa Rica, 03/25/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in El Salvador, 03/25/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Guatemala, 03/25/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Indonesia, 03/31/2021.

April

- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Bahamas, 04/06/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Guatemala, 04/14/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Costa Rica, 04/16/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Indonesia, 04/21/2021.
- T.M. Modrick Hansen gave the NWSAFFGS Step 1 Training, 1-Day online session, 4/21/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Indonesia, 04/22/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in El Salvador, 04/29/2021.

May

- WMO FFG CREWS SE Asia Regional Radar Hydrology Workshop, 5/9-21/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Indonesia, 05/10/2021
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Bahamas, 05/11/2021
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Jamaica, 05/14/2021
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Costa Rica, 05/17/2021

- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in El Salvador, 05/24/2021
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Guatemala, 05/21/2021

June

- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Indonesia, 06/03/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Bahamas, 06/08/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Guatemala, 06/10/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Jamaica, 06/11/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in El Salvador, 06/22/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Costa Rica, 06/25/2021.
- T.M. Modrick Hansen attended WAFFGS Steering Committee Meeting 1 (SCM1), held online session, 6/30/2021.

July

- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Bahamas, 07/06/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Jamaica, 07/09/2021.
- WMO CREWS FijiFFGS National Radar Hydrology Workshop, 7/11-23/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Guatemala, 07/21/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Indonesia, 07/26/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Costa Rica, 07/27/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in El Salvador, 07/29/2021.

August

- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Bahamas, 08/ 3, 17, 31 /2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Jamaica, 08/13/2021.
- WMO CREWS FijiFFGS Step 4 Training Workshop, 8/23-27/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Indonesia, 08/ 24, 25, 31 /2021.

September

- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Indonesia, 09/ 01, 07, 08, 14, 15, 21, 22, 28 /2021.

- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Jamaica, 09/ 03, 17 /2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Bahamas, 09/ 14, 28 /2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Palau 09/27/2021.

October

- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Jamaica, 10/ 01, 19 /2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Indonesia, 10/4-6/2021.
- WMO FFGS Phase III.1 SAsiaFFGS Radar Hydrology Training, 10/24 – 11/12/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Bahamas, 10/26/2021.

November

- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Bahamas, 11/ 09, 23 /2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Jamaica, 11/12/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Indonesia, 11/16/2021.
- WMO FFGS Phase III.1 SAsiaFFGS Radar Hydrology Workshop, 11/28 – 12/10/2021.

December

- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Jamaica, 12/03/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Indonesia, 12/06/2021.
- Z. Cheng, invited seminar, Evolution of Shallow Mixing Layers at Confluences with Idealized Geometries, Hohai University, China, 12/13/2021.
- R. Campbell gave on-line Weather Ready Nations Workshops (WRN) in Bahamas, 12/21/2021.

Community Outreach Activity

- R. Campbell mentored Jaqueline Rivera (El Salvador) and Nora Machuca Mejía (Guatemala). The focus of the internship is to identify information needed to aid hydro-meteorological forecasters and disaster managers in making decisions regarding warning and response to natural/meteorological hazards. The goal is to identify specific information (or parameters) and a framework for evaluating such information which is comprehensive yet flexible and scalable such that this could be adapted to different regions with varying but data-sparse environments. A key part of this evaluation is the incorporation of social and economic dimensions into the hazard risk assessment.
- Z. Cheng served as reviewer for *Journal of Hydrology*, *Journal of Hydraulic Research*, *Journal of Hydraulic Engineering*, *Water Resources Research* and *Geomorphology*.

- E. Shamir served as an Associate Editor for the *Journal of Hydrology, Elsevier* since May 2017
- E. Shamir reviewed manuscripts for the following peer reviewed journals: *Heritage Science, Environmental Research Letters, Journal of Hydrology, and Water*.
- E. Shamir was a member of the County of San Diego Technical Peer Review Panel (Panel) for the Updated Hydrology and Water Quality Guidelines, December 2020.
- E. Shamir was a technical consultant to the Water Resources Research Center, University of Arizona on the binational United States-Mexico Transboundary Aquifer Assessment Program
- E. Shamir assisted in editing and reviewing two digital books in Hebrew: Chapters in Surface Hydrology, and Chapters in Groundwater Hydrology. These books are dedicated to the memory of the late Dr. Alon Rimmer and are based on meticulous notes that were taken by him over the years. These books are freely available online.
- K.P. Georgakakos served as an academic thesis advisor for Ms. Erica De Biasio (Ph.D. Candidate) at the Scripps Institution of Oceanography, UCSD, with weekly on-line research progress meetings.

Visitors

There were no visitors due to the COVID-19 pandemic.