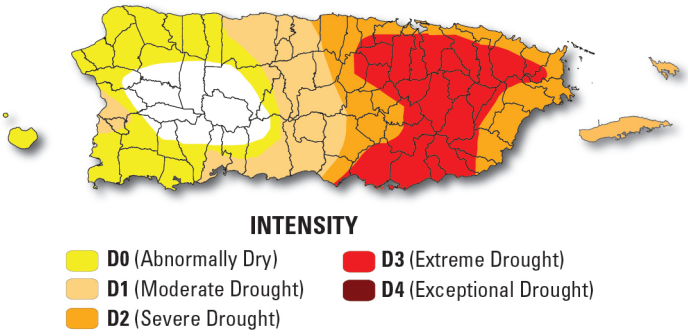
Caribbean-Florida Water Science Center Newsletter Volume 2, Summer 2015

U.S. Geological Survey
Caribbean-Florida Water Science Center Newsletter

USGS Helps Monitor Drought in Puerto Rico and the Caribbean

According to the U.S. Drought Monitor (*http://droughtmonitor.unl.edu/Home.aspx*), El Niño-enhanced dryness continues to affect the Caribbean region, and is reflected in below-normal precipitation and record to near-record low streamflows. San Juan, Puerto Rico, received only 1.59 inches of rain during July, which is about 3 inches below normal.

U.S. Drought Monitor Puerto Rico
August 11, 2015



United States Drought Monitor August 11, 2015 (Released Thursday August 13, 2015).

During April–July, rainfall in San Juan was 12.24 inches below normal for that period (38 percent of the normal total rainfall). Extreme drought (D3) expanded across the eastern third of Puerto Rico, severe drought (D2) expanded to reflect the record low streamflow, and abnormally dry to moderate drought (D0-D1) expanded further to the west. *http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?PR*

The U.S. Geological Survey (USGS) monitors streamflow and provides real-time data for gage height and discharge at 111 sites throughout Puerto Rico (*http://pr.water.usgs.gov/*).

Exposed shoreline resulting from continuing drought conditions at Lago La Plata, Toa Alta, Puerto Rico, May 7, 2015

Water levels are measured at 28 lakes or reservoirs throughout the island. USGS data can assist in the management of water resources particularly during times of drought.

USGS Assesses Flooding* in Central Florida

Streamgages are critical for measuring river levels and flows, providing emergency managers information they need as they consider their flood response. The USGS Caribbean-Florida Water Science Center (CFWSC) operates more than 500 streamgages throughout Florida, measuring water levels, streamflow, and rainfall.

The CFWSC Hydrologic Data staff from Tampa and Ft. Myers made more than 40 discharge measurements in west-central and southwest Florida during July 24–August 4. A weak area of low pressure caused heavy rains in the Tampa Bay area and southwest Florida. Precipitation at the USGS rain gage at Anclotte River near Elfers, Florida (USGS site identifier 02310000) recorded nearly 24 inches of rainfall during this period (*http://waterdata.usgs.gov/fl/nwis/uv/?site_no=02310000&PARAmeter_cd=00065,00060*).

Stage-discharge gage during high water at Brushy Creek (02306950)

The highest flows in the last 10 years were measured at several discharge stations, and 25 stations had discharges ranking in the top 5 for the period of record. The National Weather Service issued a flood advisory for the Anclotte River near Elfers for major flooding, and flood advisories for minor flooding at 6 other stations in the Tampa Bay area, including Hillsborough River near Hillsborough River State Park, and the Little Manatee River near Wimauma, Florida. The streamflow exceedance probability at the Anclotte River station and two other stations (USGS site identifier 02301900 and 02309848) is estimated to be 4–10 percent, which is equivalent to a 10–25 year recurrence interval. Streamflow at three other stations (02307200, 02307359, and 02310300) had an estimated exceedance probability of 2–4 percent (a 25–50 year recurrence interval).

*All data are provisional and subject to revision until they have been thoroughly reviewed and received final approval.

USGS Supports South Florida Ecosystem Restoration

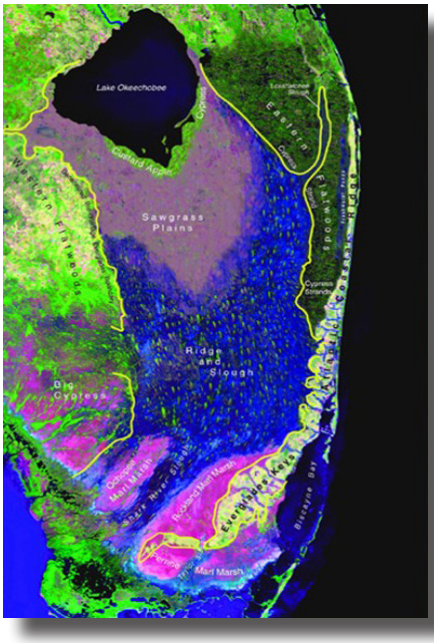
Restoration of the south Florida natural system is a massive and complex undertaking with numerous socio-ecological challenges. To balance the needs of the ecosystem and society, an adaptive management approach is an integral part of the Comprehensive Everglades Restoration Plan (CERP) *http://fl.water.usgs.gov/CERP/cerp.html*. The adaptive management approach uses best available science for planning, implementation, and modification as new information is obtained. The approach also addresses socio-ecological uncertainties that are specific or unique to a restoration project.

The Everglades peatland is the keystone of the south Florida natural system. The loss and degradation of this unique ecosystem has been driven by the interruption of sheet flow by hydrologic modifications (canals and levees) aimed to benefit societal needs, such as drainage, flood control, water retention, water supply, irrigation, and transportation. Considered by many to be the heart of CERP, the DECOMP project (short for decompartmentalization) aims to restore pre-development sheet flow to the central (water conservation areas 3A and 3B, see image below) and southern Everglades (Everglades National Park, see image below) by re-engineering the existing barriers to flow.

The development of the restoration plan has been guided by six major socio-ecological uncertainties. The DECOMP Physical Model (DPM) (*http://www.saj.usace.army.mil/Missions/Environmental/EcosystemRestoration/DecompPhysicalModel(DPM).aspx*) is an effort to use science to address two of the six uncertainties: the ecological need to completely backfill canals and the ecological benefit of sheet flow.

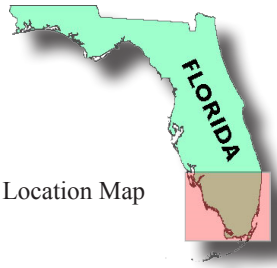
DPM culverts: opening day Nov. 5, 2013

USGS staff provide key support for the U.S. Army Corps of Engineers and the South Florida Water Management District's DPM project and research at several universities. In November 2013, 2014 and 2015, the agencies opened 10 culverts, allowing flow between two parts of the Everglades system that have been separated for decades by levees and canals. The project coupled the construction and operation of hydrologic features and design alternatives with a comprehensive hydrological and ecological monitoring plan. Approximately 20 USGS staff, many from the Caribbean-Florida Water Science Center Hydrologic Data Section in Davie, FL and USGS National Research Program staff in Reston, VA, worked on every aspect of this project, from field data collection of flow, installation of velocity sensors by scuba in the culverts, to detailed particle transport research (November thru January) and changes in the periphyton (attached algae) community structure. Overall science coordination for this effort and point of contact is Barry Rosen, (407) 803-5508. brosen@usgs.gov.



THEN
A "RIVER OF GRASS"

THE EVERGLADES



Location Map

NOW
HIGHLY COMPARTMENTALIZED

USGS Sponsors 2015 Greater Everglades Ecosystem Restoration (GEER) Conference

The 2015 Greater Everglades Ecosystem Restoration (GEER) conference (*http://conference.ifas.ufl.edu/geer2015/*) was held in Coral Springs, FL April 21-24. The conference theme was "Science in support of restoration." The GEER 2015 conference provided a valuable forum for scientists and engineers to showcase and communicate the latest scientific developments, and to facilitate information exchange that builds shared understanding among federal, state, local, and tribal scientists and decision-makers, academia, non-governmental organizations, the private sector, and private citizens.

The primary sponsors for the GEER conference were the USGS and the National Park Service. Other sponsors included the South Florida Water Management District, the U.S. Fish and Wildlife Service, Florida International University, the Ding Darling Wildlife Society, OTT Hydromet, Dewberry, and Eureka Water Products. The conference program committee was co-chaired by Nick Aumen, USGS, and Ramesh Reddy, University of Florida.

The conference was attended by 530 people. There were 31 sessions for invited papers, nine sessions for contributed papers, 97 posters, and three plenary sessions. A pre-conference Invasive Species Workshop was attended by about 80 people.

Speakers at the opening plenary session, titled "Science, Policy, and Decision-making for Everglades Restoration", included Jennifer Gimbel, Department of Interior Assistant Secretary for Water and Science; Suzette Kimball, acting USGS Director; and Shannon Estenoz, Director of the Department of Interior Office of Everglades Restoration Initiatives.

At the Earth Day plenary session, conference attendees were inspired and energized by a series of presentations from students in the South Plantation High School Everglades Restoration Magnet Program.

The final plenary session featured Don Boesch, President of the Center for Environmental Science, University of Maryland; and Colin Polsky, Director of the Center for Environmental Studies, Florida Atlantic University.

USGS participation included attendance and presentations by almost 70 employees and contractors, and several USGS employees moderated sessions. Dave Krabbenhoft organized a session on mercury cycling, bioaccumulation, and toxicity; Stephanie Romañach organized a session focusing on nail kites and Apple snails, and another session on ecological models and tools; Lynn Wingard organized a session on climate change, sea level rise, and natural hazards. Other session organizers included Paul Conrads, George Aiken, Bill Orem, Jud Harvey, Chris Bernhardt, and Dave Sumner.

The GEER conference is held every two years, and the next conference is scheduled in Coral Springs, FL on April 17-21, 2017.

10th NATIONAL MONITORING CONFERENCE

Working Together for Clean Water

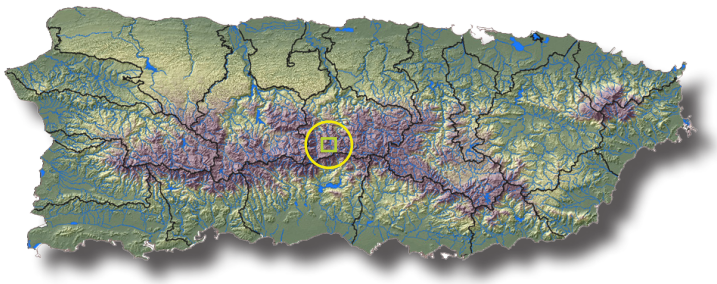
May 2 - 6, 2016 Tampa, Florida

NWQMC

Join us on May 2-6, 2016 in Tampa, Florida for the National Water Quality Monitoring Council's (NWQMC) 10th National Monitoring Conference – Working Together for Clean Water. This conference provides many opportunities for water stakeholders – federal, state, tribal and local water professionals, non-profits, academia, and volunteer citizen scientists – to network, develop new skills and partnerships, and exchange information. The conference is sponsored by the US Geological Survey, the US EPA, NALMS, and others. **http://acwi.gov/monitoring/conference/2016/CFA_2016v7.pdf**

USGS Completes Dam Failure Analysis for Lago de Matrullas Dam, Puerto Rico

The Puerto Rico Inspection and Regulation of Dams and Reservoirs Program and the National Dam Safety Program require each dam owner to prepare an Emergency Action Plan (EAP). The EAP must be prepared, maintained, and executed to provide immediate defensive action to prevent or minimize property damage, injury, or loss of life in the event of an emergency-flooding situation caused by dam failure.



Location of Lago de Matrullas, Orocovis, Puerto Rico.

The USGS, in cooperation with the Puerto Rico Electric Power Authority, completed a hydrologic and hydraulic study to assess the potential hazard to human life and property associated with the hypothetical failure of the Lago de Matrullas Dam, located within the headwaters of the Río Grande de Manatí (*http://dx.doi.org/10.3133/sir20155065*). The hydrologic study yielded outflow hydrographs and peak discharges for Lago de Matrullas and other subbasins in the Río Grande de Manatí hydrographic basin for three extreme rainfall events: (1) a 6-hour probable maximum precipitation (PMP) event, (2) a 24-hour PMP event, and (3) a 100-year-recurrence, 24-hour rainfall event. The hydraulic study simulated the hypothetical dam failure of Lago de Matrullas using hypothetical flood hydrographs generated from the hydrologic study and selected dam breach parameters.

The flood wave resulting from the failure was downstream-routed through the lower reaches of the Río Matrullas, the Río Toro Negro, and the Río Grande de Manatí for determination of water-surface profiles developed from the event-based hydrologic scenarios and "sunny day" (no precipitation) conditions. The Hydrologic Modeling System (HEC–HMS) and the River Analysis System (HEC–RAS) computer programs, developed by the Hydrologic Engineering Center (HEC) of the U.S. Army Corps of Engineers, were used for the hydrologic and hydraulic modeling, respectively. The flow routing in the hydraulic analyses was performed using the unsteady-state flow module available in the HEC–RAS model.

Results from the simulated dam failure of the Lago de Matrullas Dam using the HEC–RAS model for the 6- and 24-hour PMP events showed simulated peak discharges at the dam of 3,149 and 3,605 cubic meters per second (m^3/s), respectively. Dam failure during the 100-year-recurrence, 24-hour rainfall event resulted in a simulated peak discharge of 2,103 m^3/s directly downstream from the dam. Dam failure under sunny day conditions produced a simulated peak discharge of 1,696 m^3/s at the dam assuming the antecedent lake level was at the spillway invert elevation. Flood-inundation maps prepared as part of the study depict the flood extent and provide valuable information for preparing an EAP.

Downstream view of Lago de Matrullas reservoir.

Analysis indicated that a failure of the Lago de Matrullas Dam could result in flooding of many of the inhabited areas along stream banks from the Lago de Matrullas Dam to the mouth of the Río Grande de Manatí. Among the areas most affected are the low-lying regions in the vicinity of the towns of Ciales, Manatí, and Barceloneta. The delineation of the flood boundaries near the town of Barceloneta considered the effects of a levee constructed during 2000 at Barceloneta in the flood plain of the Río Grande de Manatí to provide protection against flooding to the near-by low-lying populated areas. The results showed overtopping in the aforementioned levee during 6- and 24-hour probable-maximum-precipitation dam failure scenarios. No overtopping of the levee was simulated, however, during dam failure scenarios under the 100-year recurrence, 24-hour rainfall event or sunny day conditions.

Floridan Aquifer System (FAS) Groundwater Availability Study

The USGS Groundwater Resources Program is assessing groundwater availability in areas of critical importance across the Nation. The Floridan Aquifer System (FAS) Groundwater Availability Study (*http://fl.water.usgs.gov/floridan/*) is a part of this program. This study will provide numerous benefits, including an updated hydrogeologic framework, regional and subregional water budgets, and a modern, system-wide, groundwater flow model that may be used to quantitatively assess the effects of human and environmental stresses. The Floridan Aquifer System Water Availability Model (FASWAM) will be a key tool developed during the study.

Floridan aquifer system in Florida and parts of Georgia, Alabama, Mississippi, and South Carolina

Potential benefits of the FAS groundwater availability study:

Revised regional hydrogeologic framework: A revised hydrogeologic framework of the FAS will replace the disparate local and subregional frameworks that have been developed since the Regional Aquifer-System Analysis (RASA) study published in 1986. Publication of databases of hydrogeologic properties will be a valuable resource for current and future studies.

Development of a modern, system-wide, groundwater flow model: A groundwater flow model of the entire FAS has not been developed since the RASA study. Development of this newer model will advance regional understanding of the aquifer system and could provide the platform for multi-state and multi-jurisdictional resource management.

Improved understanding of the groundwater budget: Independent and model-simulated water budgets for the FAS will provide more highly resolved (in space and time) estimates of aquifer recharge, discharge (groundwater withdrawals, evapotranspiration, spring flow, baseflow), and changes in storage compared to existing system-wide estimates.

Improved understanding of regional surface impacts: The effects of meteorological conditions, such as spatial and temporal rainfall patterns, and groundwater withdrawals from the FAS can impact wetland, lake, stream, spring flow, and water-table dynamics. Better understanding of how such effects are manifest at the regional scale will help resource managers develop more effective guidelines and regulations, and provide information for mitigation of potential threats to the sustainable management of the aquifer system.

Assessment of the potential impact of climate and landscape change: The effects of potential climate change and sea-level rise as well as changing water-use practices attributable to landscape change may affect patterns of groundwater flow and storage. The effects of these potential future stresses on the FAS will be assessed at the regional scale.

Recent activity

Technical Team meetings of the North Florida Regional Water Supply Partnership (NFRWSP) (*http://northfloridawater.com/*) are ongoing. The purpose of the Technical Team is to provide guidance on the development of a regional groundwater flow model of north Florida and southeast Georgia (NFSEG) that will be used to assess regional effects of groundwater withdrawals and provide a framework for development of subregional models. Discussions focus on development of a watershed model using the Hydrological Simulation Program—Fortran (HSPF), which will be used to provide estimates of groundwater recharge to the NFSEG groundwater model. The USGS has provided approved data and participated in discussions about hydrogeologic mapping. Collaboration and the exchange of data between State of Florida Water Management District (WMD) scientists working on the NFSEG model and USGS scientists working on the Floridan Aquifer System Groundwater Availability Study are ongoing and will continue as a means of enhancing the success of both efforts. The NFRWSP is a collaborative process—among the St. Johns River and Suwannee River WMDs, Florida Department of Environmental Protection, local governments, concerned residents, and other stakeholders—to help address regional water-supply issues.

USGS
science for a changing world

Recent Publications from the Caribbean-Florida Water Science Center

Banta, E.R., 2014, Two graphical user interfaces for managing and analyzing MODFLOW groundwater-model scenarios: U.S. Geological Survey Techniques and Methods, book 6, chap. A50, 38 p. (Software Download)

Cunningham, K.J., 2015, Seismic-sequence stratigraphy and geologic structure of the Floridan aquifer system near "Boulder Zone" deep wells in Miami-Dade County, Florida: U.S. Geological Survey Scientific Investigations Report 2015–5013, 28 p.

Hughes, J.D., and White, J.T., 2014, Hydrologic conditions in urban Miami-Dade County, Florida, and the effect of groundwater pumpage and increased sea level on canal leakage and regional groundwater flow: U.S. Geological Survey Scientific Investigations Report 2014–5162, 175 p.

Lohman, M., 2014, Estimated effects of radial well pumpage near Turkey Point nuclear Facility, Miami-Dade County, Florida: U.S. Geological Survey Administrative Report, 41 p.

Marella, R.L. and Dixon, J.F., 2015, Agricultural irrigated land-use inventory for Osceola County, Florida, October 2013-April 2014: U. S. Geological Survey Open-File Report 2014-1257, 8 p.

McBride, W.S., and Wacker, M.A., 2015, Depth-dependent groundwater quality sampling at City of Tallahassee test well 32, Leon County, Florida, 2013: U. S. Geological Survey Open-File Report 2014-1255, 13 p.

Molina-Rivera, W.L., 2015, Source, use, and disposition of freshwater in Puerto Rico, 2010: U. S. Geological Survey Fact Sheet 2015-3044, 6 p.

Patino, E., 2014, The Caloosahatchee River Estuary: a monitoring partnership between Federal, State, and local governments, 2007-13: U.S. Geological Survey Fact Sheet 2014-3121, 4 p.

Prinos, S.T., and Valderrama, Robert, 2015, Changes in the saltwater interface corresponding to the installation of a seepage barrier near Lake Okeechobee, Florida: U.S. Geological Survey Open-File Report 2014–1256, 24 p.

Rodriguez-Martinez, Jesus and Soler-Lopez, Luis, 2014, Hydrogeology and hydrology of the Punta Cabullones wetland area, Ponce, Southern Puerto Rico, 2007-08: U. S. Geological Survey Scientific Investigations Report 2014-5102, 58 p.

Shoemaker, W.B., Anderson, F., Barr, J.G., Graham, S.L., and Botkin, D.B., 2015, Carbon exchange between the atmosphere and subtropical forested cypress and pine wetlands: http://www.biogeosciences.net/12/2285/2015/bg-12-2285-2015.pdf.

Sukop, M.C. and Cunningham, K.J., 2015, Geostatistical Borehole Image-Based Mapping of Karst-Carbonate Aquifer Pores: Groundwater, http://onlinelibrary.wiley.com/doi/10.1111/gwat.12354/full.

Sukop, M.C. and Cunningham, K.J., 2014, Lattice Boltzmann methods applied to large-scale three-dimensional virtual cores constructed from digital optical borehole images of the karst carbonate Biscayne aquifer in southeastern Florida: Water Resources Research, v. 50, no. 11, p. 8807-8825. http://onlinelibrary.wiley.com/doi/10.1002/2014WR015465/full.

Swain, E.D., Krohn, Dennis, and Langtimm, C.A., 2015, Numerical computation of hurricane effects on historic coastal hydrology in Southern Florida: Ecological Processes, v. 4, no. 4, http://link.springer.com/article/10.1186/s13717-014-0028-3

Telis, P.A., Xie, Zhixiao, Liu, Zhongwei, Li, Yingru, and Conrads, P.A., 2015, The Everglades Depth Estimation Network (EDEN) Surface-Water Model, Version 2: U.S. Geological Survey Scientific Investigations Report 2014–5209, 42 p.

Torres-Sierra, Heriberto, and Gómez-Fragoso, Julieta, 2015, Dam failure analysis for the Lago de Matrullas Dam, Orocovis, Puerto Rico: U.S. Geological Survey Scientific Investigations Report 2015–5065, 54 p.,

Wacker, M.A., Cunningham, K.J., Williams, J.H., 2014, Geologic and hydrogeologic frameworks of the Biscayne aquifer in central Miami-Dade County, Florida: U.S. Geological Survey Scientific Investigations Report: 2014-5138, 66 p.,

Williams, L.J., and Dixon, J.F., 2015, Digital surfaces and thicknesses of selected hydrogeologic units of the Floridan aquifer system in Florida and parts of Georgia, Alabama, and South Carolina: U. S. Geological Survey Data Series 926, 24 p.

Williams, L.J., and Kuniansky, E.L., 2015, Revised hydrogeologic framework of the Floridan aquifer system in Florida and parts of Georgia, Alabama, and South Carolina: U. S. Geological Survey Professional Paper 1807, 140 p., 23 pls.

The USGS Water Mission Area (WMA) has the principal responsibility within the Federal Government to provide the hydrologic information and interpretation needed by others to achieve the best use and management of the Nation's water resources. The WMA actively promotes the use of its information products by decision makers to:

- Minimize loss of life and property as a result of water-related natural hazards, such as floods, droughts, and land movement.
- Effectively manage groundwater and surface-water resources for domestic, agricultural, commercial, industrial, recreational, and ecological uses.
- Protect and enhance water resources for human health, aquatic health, and environmental quality.
- Contribute to wise physical and economic development of the Nation's resources for the benefit of present and future generations.

If you have an environmental or resource-management issue that you would like to investigate in partnership with the USGS, please contact any of our senior management staff (listed below). Projects are supported primarily through the USGS Cooperative Water Program (*http://water.usgs.gov/coop/*). This is a program through which any State, County, local, or regional agency may work with the USGS to fund and conduct a monitoring or investigation project.

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