**NASA DEVELOP National Program**

University of Georgia

**Summer 2015**

**Short Title: Georgia Disasters & Water Resources**

**Subtitle:** Utilizing NASA Earth Observations to Monitor Sinkhole Development and Identify Risk Areas in Dougherty County, GA

**VPS Title:** When the Truth Sinks In: Assessing Sinkhole Development in Georgia

**Project Team & Partners**

**Project Team:**

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**Advisors & Mentors:**

Dr. Adam Milewski (Department of Geology, University of Georgia)

**Partner Organizations**

City of Albany and Dougherty County Planning and Development Services, End-User, POC: Randy Weathersby and Paul Forgey

Southwest Georgia Water Resources Task Force, Boundary Organization, POC: Randy Weathersby

Albany Utilities, Collaborator, POC: Jim Stolze

**Project Details**

**Applied Sciences National Applications Addressed:**

Disasters, Water Resources

**Study Area:** Dougherty County, GA

**Study Period:** January 1999 - December 2011

**Earth Observations & Parameters**

Terra, ASTER- Elevation data

Space Shuttle, SRTM- Elevation data

European Remote-Sensing (ERS)-1 & 2, list sensor - Elevation data

**Ancillary Datasets Utilized**

* USGS National Water Information System - groundwater and surface water measurements
* PRISM - gridded, interpolated precipitation
* USGS National Land Cover Datasets (NLCD) from 2001, 2006, and 2011 - land cover
* USGS National Hydrography Dataset (NHD) - linear hydrography
* USFWS National Wetlands Inventory (NWI) - local wetlands extent
* U.S. Census Bureau - Dougherty County roads layout
* Brook and Allison, 1983 - fracture traces/lineaments
* USGS borehole log data and cross-sections - bedrock depth/overburden thickness

**Models Utilized**

* PRISM Climate Group Precipitation Interpolation model

**Software Utilized**

ArcGIS – sinkhole inventories production and geospatial analysis of NASA SRTM, NASA ASTER, and ERS-1 and 2 derived elevation datasets

ENVI SARscape – advanced processing of ERS-1 and 2 radar images for elevation data acquisition

**Project Overview**

**80-100 Word Objectives Overview**

Sinkholes are a risk to human safety, environmental health, and infrastructure in the coastal plain of the Southeastern United States. The overall objective of this research was to develop sinkhole inventories between 1999 and 2011 using a time-series of digital elevation models (DEM’s) to determine environmental risk to human health, infrastructure, and water supply. Additionally, this research improved the understanding of and predictive capabilities for sinkhole development. Specifically, this research identified and mapped sinkholes, analyzed the factors influencing the development of newly formed sinkholes, and produced a sinkhole susceptibility map for Dougherty County, Georgia.

**Abstract**

Located in southwest Georgia, Dougherty County has a growing populace in an agricultural region that relies heavily on groundwater resources. Partly due to escalated groundwater extraction, this area has experienced an increase in sinkhole development over the last decade. Sinkholes pose a threat to infrastructure development, groundwater pollution, and land use operations. The NASA DEVELOP Georgia Disasters and Water Resources team partnered with the City of Albany and Dougherty County Planning and Development Services (PDS) and the Southwest Georgia Water Resources Task Force (SGWRTF) to assess past sinkhole development and identify areas susceptible to future sinkhole formation. Sinkhole mapping was completed utilizing a time-series of elevation data (1999 – 2011) from NASA’s SRTM and ASTER missions, as well as European Remote-Sensing (ERS-1 and 2) satellite-derived elevation data. The sinkhole inventory maps and spatial statistical techniques (i.e., geographically-weighted regression) were employed to quantify the factors most influential in sinkhole development. With those results, the susceptibility of every area within Dougherty County to future sinkhole formation was identified. The results of this applied science project will enable the PDS and SGWRTF to make informed decisions on current and future land use, safe infrastructure development, and sustainable water resource management.

**Community Concerns**

* Sinkholes are a risk to human safety, environmental health, and infrastructure (i.e., roads and buildings) in the coastal plain of the Southeastern United States.
* Sinkholes pose a threat to groundwater pollution, as they quickly introduce contaminants into karst aquifer systems with high transmissivity, or ability to disperse contaminants through advection processes.

**Current Management Practices & Policies**

The City of Albany and Dougherty County Planning and Development Services (PDS) is responsible for governing land use and development and ensuring the built environment is safe. The PDS has recognized that to successfully fulfill their responsibilities, risks associated with sinkholes must be considered. However, the PDS does not actively maintain a sinkhole inventory for Dougherty County. The Southwest Georgia Water Resources Task Force provide a guide to the sustainable management of water resources within the framework of existing laws and protect public health and natural systems. Utilizing NASA Earth observations will enable the production of spatial data on sinkhole density and a sinkhole susceptibility map to aid in management of land use, infrastructure, and water resource development in identified high-risk areas.

**Decision Support Tools & Benefits**

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| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Sinkhole Inventory Maps | 2000 SRTM DEM, 2011 ASTER DEM, satellite-derived (ERS) DEM’s | Current and future land use decisions, water resource management, and infrastructure development to reduce risks associated with sinkholes |
| Sinkhole Susceptibility Map | 2000 SRTM DEM, 2011 ASTER DEM, satellite-derived (ERS) DEM’s | City and county government management of current and future land use and infrastructure development; sustainable management of groundwater by reducing contamination risk |

**Project Imagery**



**Caption:** Density measurements of sinkholes formed between 1999 and 2011 in Dougherty County, Georgia. The sinkholes were identified using a mapping algorithm developed by the team. Image Credit: Georgia Disasters and Water Resources Team.