**NASA DEVELOP National Program**

**Fall 2015 Project Proposal**

University of Georgia

**Georgia Water Resources**

Assessing Groundwater Storage Change and Contamination Risk in Southwest Georgia

**Objective:**

Develop groundwater storage change and groundwater contamination risk maps to evaluate water resources trends and identify areas susceptible to groundwater contamination. Specifically, this project will utilize GRACE satellite datasets that cover Southwest Georgia to estimate groundwater storage changes and previously developed sinkhole inventory maps from a previous NASA DEVELOP project to produce a groundwater contamination risk map for Dougherty County, Georgia.

**Community Concern:**

Located in southwest Georgia, Dougherty County has a growing populace in an agricultural region with restrictions on surface water extraction due in part to recent drought conditions. Subsequently, demand for groundwater resources has increased. To sustainably manage water resources, it is important to quantify trends in groundwater storage change. This area has also experienced an increase in sinkhole development over the last decade. Sinkholes pose a threat to groundwater pollution, as they can quickly introduce contaminants to karst aquifer systems (i.e., the Upper Floridan Aquifer) which supply a large percentage of drinking and agricultural water in the study area (Gordon et al., 2012). This knowledge will be useful for farmers who rely on groundwater resources, land use and city planners responsible for infrastructure development, and municipalities responsible for delivering safe drinking water to consumers. This research is directly applicable to other regions experiencing active sinkhole formation underlain by stressed karst aquifer systems, such as Florida.

**Partner Organizations:**

City of Albany and Dougherty County Planning and Development Services (End-User/Boundary Organization, POC: Randy Weathersby, GIS Manager for the City of Albany and member of the Southwest Georgia Water Resources Task Force)

Southwest Georgia Water Resources Task Force (End-User, POC: Randy Weathersby, GIS Manager for the City of Albany and member of the Southwest Georgia Water Resources Task Force)

The primary contact for this project has been Randy Weathersby. So far, interactions have included gathering resources, specifically GIS data necessary to provide successful, verifiable answers to the research questions. Mr. Weathersby was instrumental in gathering elevation data for Dougherty County. After discussing this DEVELOP proposal with Mr. Weathersby, he has agreed to serve the dual purpose of research support and disseminating results to Dougherty County Planning and Development Services and the community through action groups. He is interested in gathering an up-to-date sinkhole database and inventory, sinkhole hazard analysis results, and a groundwater contamination risk map for future use in his work as a member of the Southwest Georgia Water Resources Task Force.

Given the long-term standing of Randy Weathersby in water resource management for the area and his position on the Southwest Georgia Water Resources Task Force, Mr. Weathersby is ideally suited and motivated to disseminate the results of this research for improved decision-making regarding future infrastructure and water resource development.

**Letters of Support:** City of Albany and Dougherty County Planning and Development Services, Randy Weathersby, Geographic Information System (GIS) affiliate.

**Decision Making Process:**

The historical role of the City of Albany and Dougherty County Planning and Development Services (PDS) is to promote the improvement, conservation, and revitalization of the physical and social environment. They are responsible for governing land use and development and providing resources to contractors, builders, and developers to ensure the built environment is safe. This department has recognized that to be successful, dangers associated with karst environments (i.e., sinkholes) must be considered to improve management in areas susceptible to sinkhole development. Recently, PDS has utilized GIS to generate maps and reports on natural hazards, particularly flooding hazards. To date, NASA datasets have not been used for these projects. However, the availability and temporal resolution of NASA products makes them ideal for natural hazard assessments which require ongoing monitoring.

The Southwest Georgia Water Resources Task Force (SWGWRTF) strives to provide a guide for the sustainable management of water resources within the framework of existing laws, support the region’s economy, and protect public health and natural systems. This project aims to provide the SWGWRTF with data to support sustainable water management decisions and protect the health of the public and groundwater system.

**Earth Observations:**

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| --- | --- | --- |
| **Platform** | **Sensor** | **Geophysical Parameter** |
| **Landsat 5 & 7** | TM and ETM+ | Land cover and land use |
| **GRACE** | GRACE | Regional groundwater changes |

**NASA Earth Observations to be highlighted:**

Landsat TM and ETM+ data will allow for detection of land use and land cover changes that influence groundwater contamination risk (i.e., agricultural pesticides). GRACE data will provide estimates of groundwater storage changes in the region from 2002 to 2011.

**Ancillary Datasets:**

This study will utilize the sinkhole inventories, identification of newly formed sinkholes, and sinkhole susceptibility map outputs from the Summer 2015 Georgia Disasters NASA DEVELOP project to achieve a robust groundwater contamination risk map. Archived and current USGS National Water Information System (NWIS) surface water, groundwater, spring, and stream data will be used alongside the GRACE groundwater storage maps to analyze water resource trends. NOAA National Centers for Environmental Information (NCEI) precipitation data will be used for further analysis of hydrologic changes. The Natural Resources Conservation Service (NRCS) land use and orthoimagery data will be used for verifying land cover changes.

**Decision Support Tools & Analyses:**

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| --- | --- | --- |
| **Proposed End Products** | **Decision to be Impacted** | **Current Partner Tool/Method** |
| Groundwater Contamination Risk Map | Locations for safe water resource extraction and subsequent allocation | Groundwater quality monitoring based on surficial analyses |
| Groundwater Storage Change Map | Locations for efficient water wells and proper land use practices that will limit groundwater depletion | Local field observations, which are limited in space and time |

*Groundwater Contamination Risk Map* – The results of the sinkhole susceptibility map based on ASTER, SRTM, and ERS-1/2 elevation data will be coupled with the land use and land cover development analysis derived from Landsat Earth Observations to determine which areas (e.g., urban, agricultural, etc.) exhibit the greatest risk of future groundwater contamination. This is based on the concept that sinkholes act as an immediate conduit to the local groundwater system. Thus, areas with greater probability of sinkhole development pose a higher risk to groundwater contamination.

*Groundwater Storage Change Map* – Launched by NASA in March 2002, the GRACE satellite will provide estimates of groundwater storage change trends in Dougherty County and the surrounding southwest Georgia region. These results will be analyzed in conjunction with surface water datasets (i.e., stream discharge) and climatic datasets (i.e., precipitation) to aid in sustainable water management decisions.

**Project Details:**

**National Application Areas Addressed:** Disasters, Water Resources

**Source of Project Idea:** This project’s motivations are concurrent with the goal of NASA Earth Science of developing a scientific understanding of the Earth as an interconnected system and to better predict variability and trends in natural hazards. The project’s science advisor, Dr. Adam Milewski, and team lead of the Georgia Disasters project, Matthew Cahalan, collaborated to organize the project’s goals, objectives, and methodologies.

**Advisor:** Dr. Adam Milewski, Assistant Professor, Department of Geology, University of Georgia

**Number of Participants Requested:** 5-6

**Project Timeline:** 2015 Fall

**Study Location:** Dougherty County, Georgia

**Period being Studied:** January 2000 to December 2011

**Multi-Term Objectives:**

* **Term 1 (Proposed Term)** – Utilizing the results of the Summer 2015 Georgia Disasters project, the goal of this Water Resources project is to produce a groundwater contamination risk map for the study area to help improve groundwater quality used for municipal, agricultural, and industrial purposes, as well as a groundwater storage change map from GRACE to quantify groundwater storage variations, specifically the Upper Floridan Aquifer. The results of the groundwater storage change maps and groundwater contamination risk map will be distributed amongst the end-users for decision-making purposes to reduce groundwater contamination and its associated risks.

**Previous Related DEVELOP Work:**

Summer 2015 (UGA) – Georgia Disasters and Water Resources: Utilizing NASA Earth Observations to Monitor Sinkhole Development and Identify Risk Areas

**Software & Scripting Utilized:**

* ArcGIS – raster manipulation/analysis, map creation, spatial statistic modeling for ASTER and Landsat TM and ETM+ data
* ENVI – geospatial analysis and spectral image processing for ASTER and Landsat TM and ETM+ data
* ENVI SARscape – advanced processing of radar images

**References:**

Gordon, D.W., Painter, J.A., McCranie, J.M., 2012. Hydrologic Conditions, Groundwater Quality, and Analysis of Sinkhole Formation in the Albany Area of Dougherty County, Georgia, 2009. USGS-SIR 2012-5018: pg. 1-60.