**NASA DEVELOP National Program**

****University of Georgia

**Summer 2015**

**Short Title: Costa Rica Water Resources**

**Subtitle:** Utilizing NASA Earth Observations to Develop a Comprehensive Water Budget for the Arenal-Tempisque Irrigation District of Costa Rica

**VPS Title:** Budgeting for the Future: Modeling the Hydrological Processes of the Arenal-Tempisque Irrigation District

**Project Team & Partners**

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**Partner Organizations**

Costa Rica’s National Service of Underground Water, Irrigation, and Drainage (SENARA), End-User/Boundary Organization, POC: Javier Artiñano Guzmán, Agronomist for the Arenal- Tempisque Irrigation District

University of Georgia Costa Rica, Collaborator/Boundary Organization, POC: Dr. Quint Newcomer, Director of the University of Georgia Costa Rica Campus

Costa Rican Embassy to the United States, End-User, POC: HE Ambassador Roman Macaya and Alejandra Solano, Minister Counselor

**Project Details**

**Applied Sciences National Applications Addressed:**

Water Resources

**Study Area:** The Arenal-Tempisque Irrigation District (DRAT), Guanacaste, Costa Rica

**Study Period:** January 2000 - July 2014

**Earth Observations & Parameters**

Landsat 5, TM – Land cover

Terra, ASTER – Digital Elevation Model (DEM)

**Ancillary Datasets Utilized**

* Climate Forecast System Reanalysis (CFSR) - weather parameter data sets (relative humidity, solar radiation, precipitation, temperature, and wind speed)
* Costa Rica Digital Atlas - geospatial datasets (watersheds, roads, political boundaries, and census data)
* World Harmonized Soil Database (WHSD) - Digital Soil Map
* Costa Rica’s National Service of Underground Water, Irrigation, and Drainage (Servicio Nacional de Aguas Subterráneas Riego y Avenamiento, SENARA) - stream gauge data, land cover data, and calculated evapotranspiration in situ data

**Models Utilized**

* The Soil and Water Assessment Tool (SWAT) Model
* The Soil and Water Assessment Tool - Calibration and Uncertainty Procedures (SWAT-CUP)
* Mapping Evapotranspiration with high Resolution and Internalized Calibration (METRIC)

**Software Utilized**

ArcGIS and QGIS - raster and vector data manipulation/analysis, image enhancement & map creation, and ArcSWAT tool usage

SWAT-CUP - integrate calibration/uncertainty analysis program for SWAT Model

Python - scripting language for METRIC Model

**Project Overview**

The goal of this project was to provide Costa Rica’s National Service of Underground Water, Irrigation, and Drainage (Servicio Nacional de Aguas Subterráneas Riego y Avenamiento, SENARA) with datasets and tools derived from NASA Earth observations to help guide their decision-making process as they modify their water resource management plan for the Arenal-Tempisque Irrigation District. Incorporating NASA Earth observations into their policy decisions will help increase efficient water management to provide partners with a more continuous data source.

**Abstract**

For the past three years, the Arenal-Tempisque irrigation district (or DRAT), governed by SENARA, has experienced drought conditions complicating water management and agricultural production. To facilitate a responsive water management decision-making process, the Costa Rica Water Resources team collaborated with SENARA, UGA Costa Rica, and the Costa Rican Embassy. The team created a SWAT Model based on NASA Earth observations, ancillary data sources, and in situ data. The model’s results were calibrated and validated through the use of SWAT-CUP. Additionally, the METRIC model was used to offer another source of continuous data. This model derived the evapotranspiration (ET) data used to supplement the SWAT model’s outputs. The results obtained from the SWAT and METRIC models provided greater insight into the region’s hydrologic processes, which allowed for the development of a water resource inventory for the study area. Upon receiving this continuous data, SENARA will be able to construct a more efficient water management plan for this region, benefitting the local inhabitants and stakeholders.

**Community Concerns**

* The Arenal-Tempisque Irrigation District (DRAT) in Costa Rica has experienced more than three consecutive years of drought which not only negatively affected local people’s daily life but also limited local agricultural production.
* The demand of available water resources for all uses will increase from 5% to 35% (until 2020). Rapid urbanization and overexploitation of water resources have made the use of surficial water and groundwater more complex.
* DRAT’s water management policies impact the livelihoods and the socioeconomics of 1,125 families that live and grow their agricultural products in this district. These families produce products such as sugarcane, rice, and fodder; they gross roughly $163.7 million for this region.
* The DRAT region of Guanacaste experiences an extensive dry season (5 months). In order to sustain the region’s agriculture, it depends heavily on its water management plan to help maintain its irrigation practices and infrastructure.
* An effective water management policy is also important for this region because roughly a quarter of Costa Rica’s annual electric power is produced in the DRAT district.

**Current Management Practices & Policies**

SENARA is responsible for water management and helps coordinate water usage with the agricultural and environmental agencies of Costa Rica. In an effort to increase efficiency in water usage, SENARA has begun to incorporate GIS into their data management and decision support tools. Even though remote sensing is not currently being used, SENARA is interested in incorporating NASA Earth observations into their decision support tools. SENARA currently calculates certain in-situ parameters. NASA Earth observations will not only give them better datasets (DEM, Evapotranspiration etc.) of the whole country, but will allow the utilization of more continuous spatio-temporal data. Their field measurements will help validate and calibrate derived models.

**Decision Support Tools & Benefits**

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| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Watershed & Sub-Basin Delineation Map | Terra, ASTER - DEM | The SWAT Model creates a map to visualize the location of the watershed, its sub-basins, and its outlets. Knowing the location of these boundaries and outlets allows end-uses to create more informed water management plans for the entire district. |
| SWAT Model hydrological simulation data | Terra, ASTER - DEM | The SWAT Model produces simulation tables, datasets, and ancillary images that will enable the end-user to obtain a better understanding of the area’s hydrological processes, subsequently resulting with more efficient water management. |

**Project Imagery**

**[Insert image here]**

**Caption:** [Insert Caption Here. Max of 25 words.] Image Credit: [Costa Rica Water Resources] Team.

**Image:** File Name (Please submit your image as a separate .jpeg as well as inserting it in this document)