A topographic map of a region, likely the western United States, showing elevation and terrain. The map uses a color scale from dark purple (low elevation) to yellow and orange (high elevation). A blue rectangular box with a white border is overlaid on the map, containing the title text.

NASA Applied Sciences' Capacity Building Program's  
**DEVELOP** National Program  
Summer 2014  
Project Booklet

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- p. 6 Coastal Mid-Atlantic Water Resources — *Patrick Henry Building & NASA Langley Research Center*
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- p. 7 Georgia Water Resources — *University of Georgia*

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## About DEVELOP

DEVELOP addresses environmental and public policy issues through interdisciplinary research projects that apply the lens of NASA Earth observations to community concerns around the globe. These rapid feasibility projects employ NASA Earth observations in novel applications and demonstrate practical uses of Earth science. Bridging the gap between NASA Earth Science and society, DEVELOP builds capacity in both participants and partner organizations to better prepare them to address the challenges that face our society and future generations. With the competitive nature and growing societal role of science and technology in today's global workplace, DEVELOP is serving the global community by cultivating the next generation of decision makers.

## About Partners

DEVELOP collaborates with a wide variety of end-user organizations each year to conduct rapid feasibility projects that generate methods for the incorporation of NASA Earth observing resources into decision making processes. Partnerships often occur with local, state, regional, federal, international, academic, and non-governmental organizations. By collaborating with DEVELOP, partners are introduced to NASA and its Earth Science Division, Applied Sciences Program, Capacity Building Program, and Earth observation resources. End-users gain insight into satellite and airborne Earth observation capabilities and how they can augment and enhance their current decision making practices—providing potential cost and time savings—as well as engage the next generation entering the workforce.

## About Participants

As an interdisciplinary feasibility project incubator, DEVELOP accepts participants with a variety of skills and backgrounds. Anyone with an interest in Earth science is welcome to apply, with currently enrolled students, recent graduates, early career professionals, transitioning career professionals, and U.S. military service members making up the DEVELOP population. The Program offers a unique opportunity for each individual to expand and enhance their personal and professional development.

## About Projects

As part of NASA's Applied Sciences Program, DEVELOP addresses environmental and policy concerns through the practical application of NASA Earth observations. DEVELOP projects apply Earth observations and remote sensing technology to the application areas of Agriculture, Climate, Disasters, Ecological Forecasting, Energy, Health and Air Quality, Oceans, Water Resources, and Weather. These projects highlight NASA Earth observation capabilities relative to environmental issues for enhanced policy and decision-making to improve life here on Earth.

Each project culminates in a final set of deliverables including technical paper, poster, presentation, and video. Many teams also create tutorials and trainings for their project's end-users to help with the orientation to NASA Earth science datasets and the project's methodologies.

Since 2011, DEVELOP has partnered with Earthzine.org to host 'virtual poster sessions' (VPS) each term that highlight DEVELOP projects through video storytelling. Each event includes a blogging question-and-answer period that engages the international community. Videos focus on how NASA Earth observations can be used to address community concerns relating to environmental issues around the globe. The VPS series has been a major outreach effort by DEVELOP to engage a global audience and successfully attracts thousands of viewers each term.

Visit the 2014 Summer VPS at <http://www.earthzine.org/vps-archive/>

- — Impacted area
- — DEVELOP node

### Domestic Impact

#### Study Areas (38)

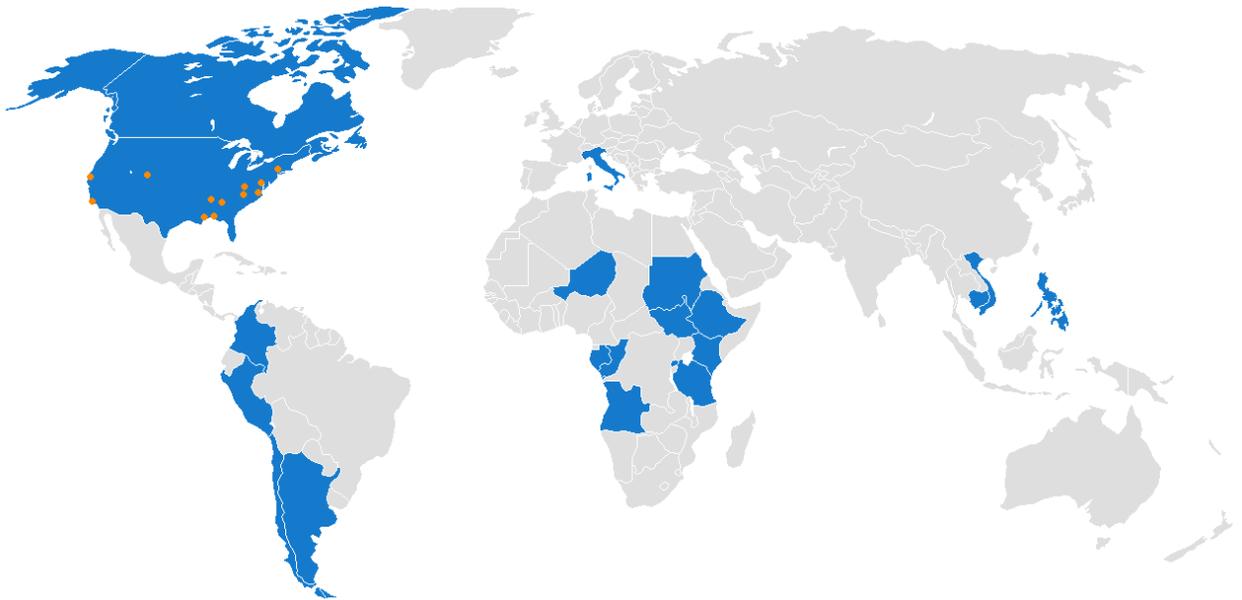
AK	MA	OH
AL	MD	OK (2)
AZ	ME	PA
CA (7)	MI	SD
CO (4)	MN	TN
CT	MT	TX (2)
FL	NC (2)	UT (2)
GA (2)	ND	VA (3)
ID	NE	VT (2)
IL	NH	WI
KS	NM	WV
KY	NV	WY
LA	NY (4)	



#### Study Areas (20)

- American Samoa
- Angola
- Argentina (2)
- Cambodia
- Canada (3)
- Chile
- Colombia (3)
- Congo
- Ethiopia (2)
- Gabon
- Italy
- Kenya
- Niger
- Peru
- Philippines
- Rwanda
- South Sudan
- Sudan
- Tanzania
- Vietnam

### International Impact



#### Participants: 155

Currently Enrolled: 81  
 Recent Graduates: 58  
 U.S. Military Service Members: 16

73 Female / 82 Male

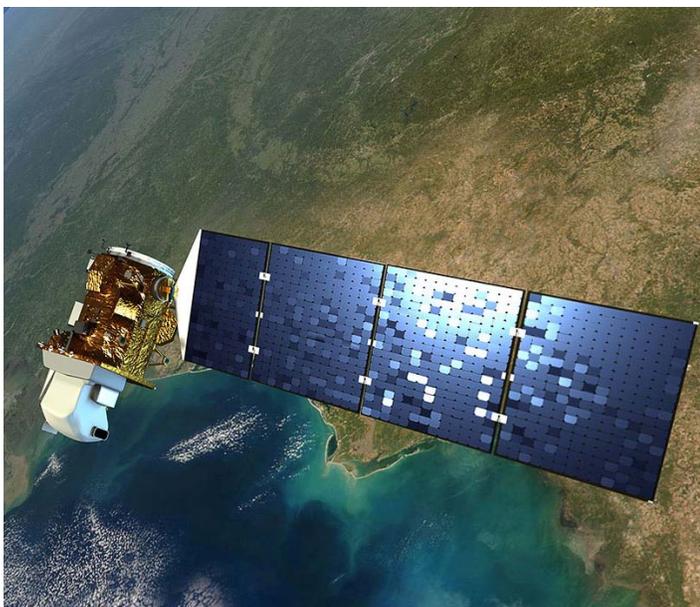
From 23 States & DC (AL, CA, CO, FL, GA, ID, KY, LA, MA, MD, ME, MO, MS, NC, ND, NY, OK, SC, TN, TX, UT, VA, WI)

#### Projects: 34

Ecological Forecasting: 8  
 Water Resources: 6  
 Oceans: 3  
 Agriculture: 3  
 Climate: 2  
 Disasters: 5  
 Energy: 2  
 Health & Air Quality: 3  
 Cross-Cutting: 2

#### Partners: 76

Local: 7  
 State: 8  
 Regional: 1  
 Federal: 21  
 NGO: 17  
 Academia: 9  
 International: 13



## Comprehensive Study Area List

### NASA Ames Research Center

**Oceans** - American Samoa

**Climate** - The Great Basin of the United States: NV, CA, CO, ID, UT, and AZ

**Ecological Forecasting** - Sierra Nevada, California

### USGS at Colorado State University

**Ecological Forecasting** - Alaska

**Water Resources** - Bale Mountains, Oromia, Ethiopia

### NASA Goddard Space Flight Center

**Oceans** - Peninsula Valdes, Argentina

**Disasters** - Lower Mekong Water Basin, specifically Phnom Penh, Cambodia, and the Lower Mekong Delta, Vietnam

**Ecological Forecasting** - Bird Conservation Region (BCR) 14, Atlantic Northern Forest (New England) - NY, MA, VT, NH, ME, and CT

### International Research Institute for Climate and Society

**Health & Air Quality** - Global; East Africa: Ethiopia, Sudan, South Sudan, Kenya, and Tanzania

### NASA Jet Propulsion Laboratory

**Ecological Forecasting** - Colombia

**Disasters** - Pasadena, California (2008 construction records based on building permits – control case); Front Range, Colorado, USA (2013 Floods); New York City, New York, USA (2012 Hurricane Sandy); Moore, Oklahoma, USA (2013 Tornado); L'Aquila, Italy (2009 Earthquake); and Visayas, Philippines (2013 Typhoon Haiyan)

**Health & Air Quality** - Ontario, Canada; California, USA; Colorado, USA; Utah, USA

**Oceans & Water Resources** - Southern California

### NASA Langley Research Center

**Disasters** - The Great Lakes, including the coastlines of Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, New York, and Pennsylvania; the project will also cover Quebec and Ontario in Canada

**Agriculture** - The Great Plains Region of the United States (as defined by the USDA) - MT, ND, SD, WY, CO, NM, TX, NE, OK, KS

**Water Resources** - Lake Champlain (New York, United States / Vermont, United States / Québec, Canada)

**Agriculture** - Maradi, Zinder, and Tahoua Regions of Niger

**Water Resources** - Ochape Sub-Basin, Gran Chimú Province, Libertad Region, Peru

**Cross-Cutting** - La Mosca Watershed in Colombia

**Cross-Cutting** - DEVELOP locations

**Health & Air Quality** - Houston, Texas, USA

### Mobile County Health Department

**Energy** - Angola, Gabon, Republic of Congo

### NSSTC at NASA Marshall Space Flight Center

**Disasters** - Copahue Volcano, Andes Mountains, Chile-Argentina Border, South America

**Water Resources** - Southeastern United States- Alabama and Georgia

### NOAA National Climatic Data Center / NASA Langley Research Center

**Climate** - The Sierra Nevada Mountains within California Climate Divisions 2 and 5

### Patrick Henry Building / NASA Langley Research Center

**Water Resources** - Coastal Plain region of Maryland, Virginia, and North Carolina

### NASA Stennis Space Center

**Disasters** - California — Rim & Aspen Wildfires

**Ecological Forecasting** - Louisiana (Terrebonne, Lafourche, Jefferson, and Plaquemines parishes in coastal Louisiana)

### University of Georgia

**Ecological Forecasting** - Northwest Colombia, Departments of Atlantico and Bolivar

**Water Resources** - Four inland reservoirs located in the Georgia Piedmont have been identified for analysis: Lake Oconee, GA; Lake Sinclair, GA; Lake Juliette, GA; Jackson Lake, GA

**Ecological Forecasting** - FL (Miami-Dade County)

### Wise County and City of Norton Clerk of Court's Office

**Energy** - Central Appalachian Mountains in the states of North Carolina, Virginia, West Virginia, Kentucky and Tennessee

**Agriculture** - Rwanda

**Ecological Forecasting** - Southwest Virginia

## Overview

DEVELOP's Water Resources projects address concerns and decision processes that are related to water availability, water forecasting, and water quality. The goal of the Water Resources theme is to apply NASA satellite data to improve the Decision Support Tools (DSTs) of user groups that manage water resources. DEVELOP's Water Resources projects partnered with local, state, federal, international, and private organizations, to improve water management around the globe.

### pp. 4-7 **Portfolio**

**p. 5 Ethiopia Water Resources**

*USGS at Colorado State University*

**p. 5 New England Water Resources III**

*NASA Langley Research Center*

**p. 6 Peru Water Resources**

*NASA Langley Research Center*

**p. 6 Coastal Mid-Atlantic Water Resources**

*Patrick Henry Building I*

*NASA Langley Research Center*

**p. 7 Southeast US Water Resources II**

*NSSTC at NASA Marshall Space Flight Center*

**p. 7 Georgia Water Resources**

*University of Georgia*

### **Partner Organizations**

Digital Harvest

Georgia Power Company

Geospatial Centroid at Colorado State University

Idaho Department of Water Resources

Lake Champlain Committee

The Murulle Foundation

University of Idaho

USGS Fort Collins Science Center

USGS Georgia Water Science Center

Vermont Department of Environmental Conservation

Virginia Department of Agriculture & Forestry

Virginia Department of Environmental Quality

Virginia Department of Natural Resources

Virginia Department of Technology

Water For People



## Ethiopia Water Resources

USGS at Colorado State University

*Application of Landsat 8, Topographic Variables, and MaxEnt for Mapping Critical Headwater Wetlands of Ethiopia*

**Team:** Stephen Chignell (lead), Ryan Anderson, Tewodros Wakie

**Advisors:** Dr. Paul Evangelista, Dr. Melinda Laituri

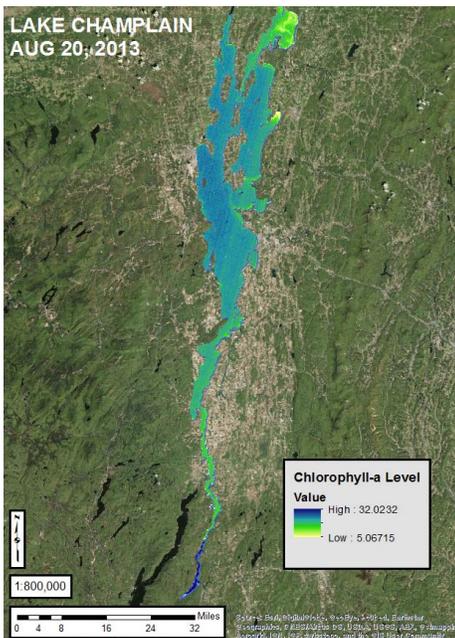
**Project Partners:** Geospatial Centroid at Colorado State University, The Murulle Foundation, USGS Fort Collins Science Center

**NASA Earth Observations Utilized:** Landsat 8 OLI, SRTM

**Modeling/Software/Scripting Utilized:** ENVI, ArcGIS, SAHM, MaxEnt



The Bale Mountains of south-central Ethiopia are home to the world-renowned Bale Mountains National Park. A designated Biodiversity Hotspot, the area also serves as the headwaters for five major rivers that flow out of the mountains, supporting 12 million people in the arid lowlands to the east. Recent development in the surrounding area has forced many agro-pastoralists into the highlands, and approximately 40,000 people now live within park boundaries. Mapping the location and extent of the region's water resources has been identified as a key research need for local park officials and conservation groups as they work to sustainably accommodate this massive influx of people and livestock. Of particular concern are the area's numerous alpine lakes and wetlands, as they are essential for wildlife habitat, water quality, and discharge timing for both upstream and downstream users throughout the dry season. This study used Landsat 8 OLI/TIRS data, topographic variables, and MaxEnt modeling to generate the first comprehensive maps of the region's perennial lakes and wetlands. The maps produced high classification accuracies, and will facilitate the targeting of future conservation and research. Additionally, the methodology is applicable in other regions around the world where field data are sparse and regular monitoring is needed.



## New England Water Resources III

NASA Langley Research Center

*Utilizing NASA Earth Observations to Monitor Historical Algal Blooms in Lake Champlain for Enhanced Water Resource Management*

**Team:** Bryan Burley (lead), Christopher Erickson, Christopher Ewers, Teresa Fenn, Bradley Gregory, Jacob Hope, Matthew Koslovsky

**Advisor:** Dr. Kenton Ross

**Project Partners:** Vermont Department of Environmental Conservation, Lake Champlain Committee

**NASA Earth Observations Utilized:** Landsat 4-5 TM, Landsat 7 ETM+, Landsat 8 OLI/TIRS

**Modeling/Software/Scripting Utilized:** ArcGIS, R, Excel

Lake Champlain is a vital resource to multiple communities, industries, and ecosystems. Recent environmental changes and societal development are believed to have created a nutrient-rich environment, in which cyanobacteria (blue-green algae) flourish. This causes a heightened algal bloom potential that threatens both ecological and economic productivity. In order to effectively expand research efforts, a cost-effective approach to monitoring and understanding algal bloom development is required. Currently, project end-users at the Vermont Department of Environmental Conservation (DEC) and Lake Champlain Committee monitor water quality and bloom presence through volunteer-based summer programs. Alternatively, NASA Earth observations allow a user to monitor chlorophyll-a concentration as a proxy for algal blooms with data that is publicly accessible. Thus, coupling remote sensing with current in-situ programs provides a cost-effective approach to monitoring water quality and understanding harmful algal bloom formation and migration. Data from the Landsat missions, the Vermont Monitoring Cooperative, and Vermont Department of Environmental Conservation monitoring project were utilized in this study to explore historical algal bloom trends. A side-by-side comparison of chlorophyll-a concentration and known natural environmental/societal changes allows a deeper understanding of algal bloom origins and offers water managers a cost-effective, supplementary data source to enhance monitoring activities and improve water resources.

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## Peru Water Resources

NASA Langley Research Center

*Integrating NASA Earth Observations into Water Resource Planning and Management in Peru's La Libertad Region*

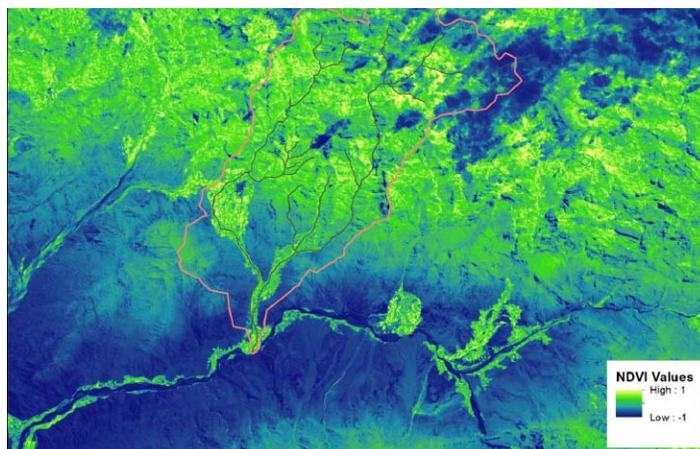
**Team:** Catherine Steentofte (lead), Abigail Holbrook, Steve Padgett-Vasquez, Christopher Love, Damita Wynne

**Advisor:** Dr. Kenton Ross

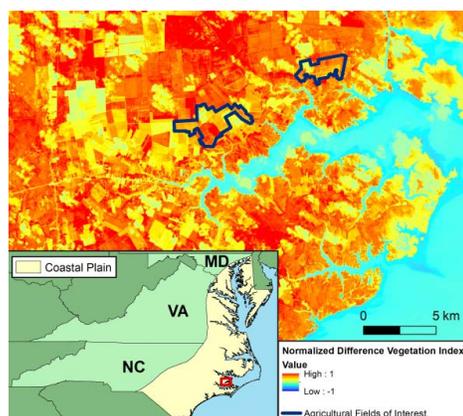
**Project Partners:** Water For People, University of Idaho, Idaho Department of Water Resources

**NASA Earth Observations Utilized:** Landsat 8 OLI, Terra ASTER

**Modeling/Software/Scripting Utilized:** ArcGIS, ENVI, Python, METRIC, MERRA



Developing countries often struggle with providing water security and sanitation services to their populations. An important aspect of improving security and sanitation is developing a comprehensive understanding of the country's water budget. Water For People, a non-profit organization dedicated to providing clean drinking water, is working with the Peruvian government to develop a water budget for the La Libertad region of Peru which includes the creation of an extensive watershed management plan. Currently, the data archive of the necessary variables to create the water management plan is extremely limited. This study integrated Landsat 8 OLI and Terra ASTER data with local weather data of Cajamarca from Peru's National Meteorological and Hydrological Service in the METRIC (Mapping Evapotranspiration at high Resolution and with Internalized Calibration) model to provide estimations of evapotranspiration values for the region. A script was created using Python that uses input variables and METRIC calculations to approximate the evapotranspiration values for the Ochape sub-basin of the Chicama River watershed. Once calculated, the evapotranspiration values and methodology were shared with Water For People to help supplement their decision support tools in the La Libertad Region of Peru and potentially apply the methodology in other areas of need.



## Coastal Mid-Atlantic Water Resources

Patrick Henry Building & NASA Langley Research Center

*Developing a Water Budget Using Evapotranspiration Measured with METRIC and Groundwater Storage Data in the Coastal Plain of Maryland, Virginia, and North Carolina*

**Team:** Lydia Cuker (lead), Steve Padgett-Vasquez, Bryce Kaw-uh, Kelsey Renoll, Shaun Clark, Paul Warner

**Advisors:** Dr. Kenton Ross, Jamie Favors

**Project Partners:** Digital Harvest, Virginia Department of Environmental Quality, Virginia Department of Agriculture & Forestry, Virginia Department of Natural Resources, Virginia Department of Technology

**NASA Earth Observations Utilized:** Landsat 8 OLI/TIRS, GRACE, Aqua MODIS

**Modeling/Software/Scripting Utilized:** ArcGIS, Python, METRIC

Accurate water management decisions and policies are vital to ensuring the reversal of groundwater depletion and saltwater intrusion in the aquifers underlying the coastal plain of Maryland, Virginia, and North Carolina. Current methods provide limited, inconsistent data for the area, leading to an incomplete assessment of the coastal aquifer conditions. Remote sensing analysis provides synoptic understanding of water consumption behavior, contributing to enhanced water management policies. Regional analysis of evapotranspiration using Landsat 8 has been shown to be a useful tool in understanding water consumption behavior. These data, combined with groundwater storage information acquired from the GRACE satellites, can help establish a water budget for the area and allows for enhanced water management decisions. Establishing a means to calculate evapotranspiration in the area using the METRIC model is a useful, accessible tool for water resource monitoring for both state agencies and private precision agriculture companies using UAVs to collect data analyze crops. METRIC outputs will enhance end-users' understandings of water usage and stress in the vegetated areas studied. Furthermore, calculating groundwater storage trends over the past decade will better inform water resource policy for state agencies. Utilizing remote sensing data in the area will contribute to a large-scale, more complete understanding of the water consumption behavior in the area.

## Southeast U.S. Water Resources

NASA Marshall Space Flight Center

*Development of an Alternative Water Withdraw Monitoring System for USGS using NASA Earth Observations to Aid in Irrigation Monitoring in the Southeastern United States*

**Team:** Carrea M. Dye (lead), Samira Daneshgar Asl, Cara Estes

**Advisor:** Dr. Jeffery Luvall

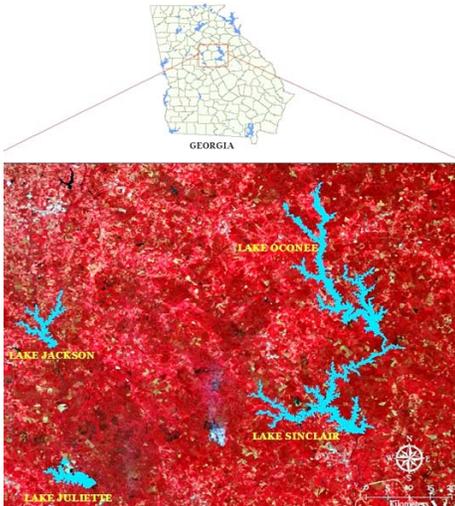
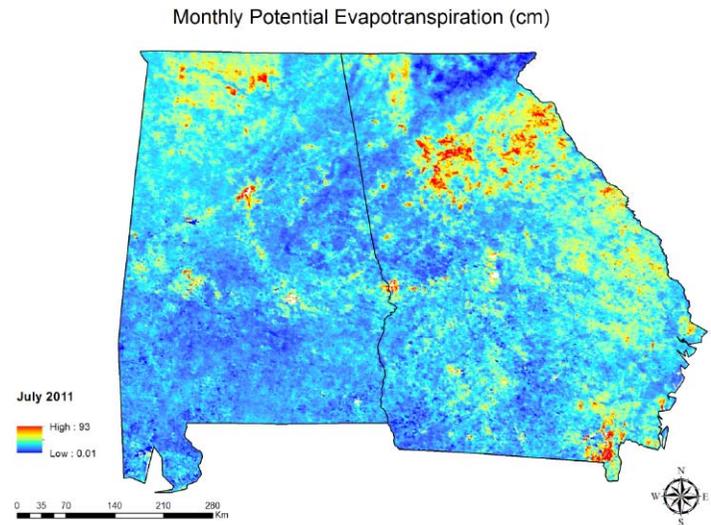
**Project Partners:** USGS Georgia Water Science Center

**NASA Earth Observations Utilized:** Aqua/Terra MODIS

**Modeling/Software/Scripting Utilized:** ArcGIS, Python

In 2012, drought impacted crop fields in the Midwest and southwestern United States making the western U.S. water scarcity a high priority concern, and increasing the need for the southeastern U.S. to develop more sustainable irrigation practices. Understanding and monitoring evapotranspiration is beneficial in determining areas more prone to drought and plays a vital role

in determining the effects of climate on agricultural ecosystems. This project developed an easily accessible tool to monitor drought via drought indices and calculate Arid Index (AI). This tool allows areas of high productivity to be mapped in order to increase crop yields. Corn, the largest crop in terms of production and consumption, is also a high priority. The Vegetation Drought Index (VDI) was used to monitor agricultural drought in corn fields and was derived from Terra and Aqua MODIS data from 2008 to 2013. Monthly precipitation and potential evapotranspiration were utilized to evaluate the potential water input and output of the soil. The purpose of this project was to assist end-users such as the USGS Georgia Water Science Center in developing a more efficient water withdrawal monitoring system, which in turn will protect future economic endeavors and promote more sustainable irrigation practices.



## Georgia Water Resources

University of Georgia

*Developing a Cyanobacteria Detection Tool for Georgia Inland Waters Using NASA LANDSAT 8 OLI Data for Water Quality Protection and Restoration*

**Team:** Bradley Bartelme (lead), Ike Sari Astuti, Elizabeth Benyshek, Shuvankar Ghosh, Danielle Haskett, Jiaying He, Benjamin Page

**Advisors:** Dr. Deepak Mishra, Dr. Susan Wilde

**Project Partner:** Georgia Power Company

**NASA Earth Observations Utilized:** Landsat 8 OLI/TIRS

**Modeling/Software/Scripting Utilized:** ENVI FLAASH, ERDAS IMAGINE, ArcGIS, MATLAB, Excel, NDCI, QAA

**NASA Earth Observations Utilized:** Landsat 8 OLI/TIRS, GRACE, Aqua MODIS

**Modeling/Software/Scripting Utilized:** ArcGIS, Python, METRIC

The effects of anthropogenic eutrophication are intensified in Georgia's watersheds due to increasing temperatures, higher frequency drought events and higher availability of nutrients that increase primary productivity in reservoirs. These factors may ultimately lead to the formation of toxic Cyanobacterial Harmful Algal Blooms (Cyano-HABs or HABs). The abundance of phycocyanin may be used as a proxy to assess the amount of cyanobacteria biomass that is present in a water body and is useful as a cyanobacterial bloom indicator. This study developed an early detection tool to aid in the identification and spatial distribution of phytoplankton and blue green algae (cyanobacteria) for Georgia inland waters using Landsat 8 OLI data paired with hyperspectral data, which was calibrated by multiple spectral band ratio models. In collaboration with Georgia Power Company, a model upscaling procedure demonstrated the feasibility of using Landsat 8 to detect cyanobacteria reflectance patterns. This procedure will assist in the maintenance of water quality throughout Georgia and is imperative due to the shortage of freshwater resources present in man-made reservoirs. From this research, spatial and temporal distribution maps were delineated for the early identification of CyanoHABs in order to rapidly monitor and respond to these systems in order to aid in water management decision-making for Georgia reservoirs.

## Overview

DEVELOP's Climate projects support activities associated with the implementation of climate standards, policy, and regulations for environmental, economic and human welfare. The projects apply NASA satellite and airborne data, model products, and scientific findings to climate mitigation and adaptation decisions. This summer, DEVELOP's Climate projects partnered with federal and academic organizations to improve adaptation and mitigation decisions around the globe.

### pp. 8–9 **Portfolio**

#### p. 9 **Southern California Climate**

*NOAA National Climatic Data Center /  
NASA Langley Research Center*

#### p. 9 **Great Basin Climate**

*NASA Ames Research Center*

### **Partner Organizations**

Bureau of Land Management  
Cooperative Institute for Climate and Satellites, North Carolina  
Desert Research Institute  
Great Basin Landscape Conservation Cooperative  
NOAA National Climatic Data Center  
University of California Davis





## Southern California Climate

### NOAA National Climatic Data Center & NASA Langley Research Center

*Improving the Utility of Seasonal Outlooks of Anomalous Precipitation for California*

**Team:** Lance Watkins (lead), Eleanor Davis, Ashley Mendenhall, Anja Nothdurft

**Advisors:** Dr. DeWayne Cecil, Dr. Kenton Ross, Dr. Carl Schreck

**Project Partners:** NOAA National Climatic Data Center, Cooperative Institute for Climate and Satellites (North Carolina)

**NASA & NOAA Earth Observations Utilized:** GOES-8, GOES-10, GMS-5, Metsat-6, Metsat-7, TRMM PR

**Modeling/Software/Scripting Utilized:** R, ArcGIS, PERSIANN, NCAR NRCM

California's population grew by over 10 million from 1980 to 2000 and is expected to reach 48 million by 2030. This will create additional strain on a water supply already stretched by severe droughts that are expected to become more frequent in the region as the global climate changes. Predicting precipitation for the coming seasons can help water resource managers make decisions and mitigate the effects of severe drought or flood events. Due to

the need for better predictive abilities for water resources, this project aimed to improve the utility of seasonal climate outlooks through analysis of past climatic signals. Compared to forecasts with shorter lead times, 90-day to 2-year seasonal forecasts have the least level of skill and are often considered the most challenging to predict. Therefore, this project incorporated NOAA Climate Data Records (CDRs), NASA satellite data, and in-situ data to understand and identify the climatic indicators that lead to anomalous seasonal precipitation (i.e. extremely wet or dry seasons). The precipitation anomalies were defined via in-situ precipitation data from the NCDC's Global Historical Climatology Network in California Climate Divisions 2 and 5. This project identified climatic patterns that influence anomalously high or low precipitation, as well as compiled information from end-users that describes the degree to which NOAA CDRs and NASA Earth observations are used operationally. Results of this project can aid California resource managers and policy-makers in preparing for, and mitigating, the impacts of future extreme events.

## Great Basin Climate

### NASA Ames Research Center

*Evaluating Current and Future Rangeland Ecosystem Health in the Great Basin ecoregion Using NASA Earth Observing Systems and a Long-Term Ground Monitoring Network*

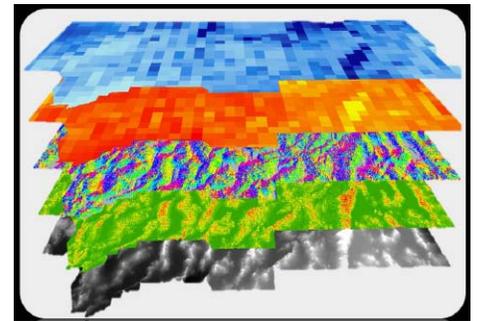
**Team:** Jeffrey Ely (lead), Esther Essoudry, Katie Wilson, Neeshi Patadia, Brittany Zajic

**Advisors:** Dr. Cindy Schmidt, Dr. Juan Torres-Pérez

**Project Partners:** Bureau of Land Management, Great Basin Landscape Conservation Cooperative, University of California Davis, Desert Research Institute

**NASA Earth Observations Utilized:** Aqua/Terra MODIS, Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI/TIRS

**Modeling/Software/Scripting Utilized:** ArcGIS, ENVI, MaxEnt, WEPP, MATLAB, RUSLE<sub>2</sub>, GAM, CMIP<sub>5</sub>



The Great Basin ecoregion in the western United States represents one of the last large expanses of wild lands in the nation and currently faces substantial challenges due to human impacts, drought, invasive species encroachment and climate change. Rangelands in the Great Basin have important ecological and economic significance for the United States; however, 40% of public rangelands fail to meet health standards set by the Bureau of Land Management (BLM). This project provided assessment tools for researchers and land managers to quantify and mitigate public land threats in the Great Basin. Present conditions were evaluated from vegetation indices, landscape features, hydrological processes, and atmospheric conditions derived from the remotely-sensed data and validated with available in-situ ground survey data provided by the BLM. Rangeland health metrics were developed, landscape change drivers identified, and projected climate conditions forecasted the impact of changing climatic conditions and delineate areas at risk for rangeland degradation on 30 year intervals for 2040, 2070, and 2100. Finally, vegetation health risk maps were provided to the project end-users to aid in future land management decisions in the Great Basin. These tools provide a low cost solution to assess landscape conditions, provide end-users with a metric to identify potential problematic areas, and mitigate serious threats to the ecosystems.

## Overview

DEVELOP's Ecological Forecasting projects assist decision makers with access to science-based tools in order to understand and predict the impacts of environmental change on the ecosystems that support the existence of life on Earth. The projects apply NASA remote sensing and technologies to topics like conservation, habitat health and suitability, land use practices and planning, and invasive species. This summer, DEVELOP's Ecological Forecasting projects partnered with state, local, federal, non-profit, international, and private organizations to provide reliable forecasts to improve natural ecosystem management.

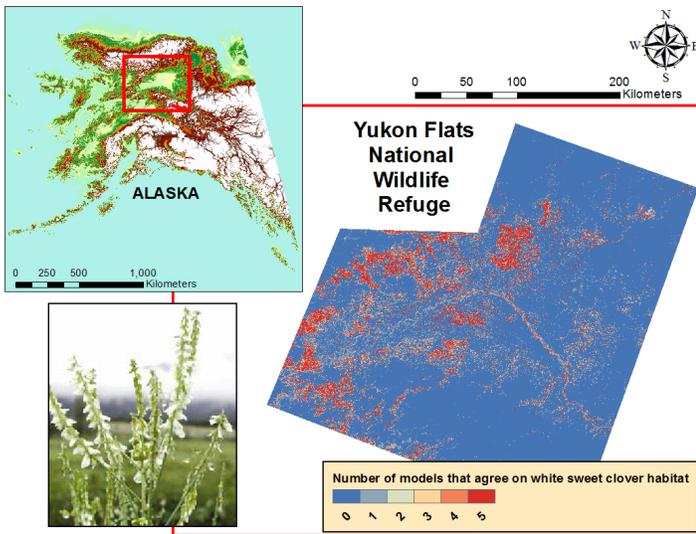
### pp. 10-14 **Portfolio**

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*University of Georgia*

### **Partner Organizations**

Alaska Department of Natural Resources  
Bayou Land Resource Conservation & Development Council  
Common Ground Relief  
Conservation International  
Department of Mines Minerals and Energy  
Disney Animal Kingdom  
ESRI  
Fundación Proyecto Tití  
Louisiana State University  
MarVivà  
Miami-Dade County Parks, Recreation and Open Spaces  
Department  
National Audubon Society  
Plotly  
Proyecto Tití  
Public Laboratory for Open Technology and Science  
The University of Virginia's College at Wise  
The Trust for Public Land  
Universidad Tecnológica del Chocó  
US Fish and Wildlife Service Yukon Flats National Wildlife Refuge  
USDA Forest Service  
Virginia Office of Surface Mining Reclamation & Enforcement  
Wetland Tree Foundation





## Alaska Ecological Forecasting USGS at Colorado State University

*Applying Novel Modeling Techniques for Invasive Species Risk Assessment in the Yukon Flats National Wildlife Refuge*

**Team:** Matthew Luizza (lead), Amanda West, Linnet Jose  
**Advisors:** Dr. Paul Evangelista, Dr. Catherine Jarnevic, Dr. Melinda Laituri

**Project Partners:** US Fish and Wildlife Service Yukon Flats National Wildlife Refuge, Alaska Department of Natural Resources

**NASA Earth Observations Utilized:** Landsat 8 OLI/TIRS, Aqua/Terra MODIS

**Modeling/Software/Scripting Utilized:** ENVI, ArcGIS, SAHM, BRT, GLM, MaxEnt, MARS, Random Forest

fastest warming places on the planet, and shifts in seasonality and temperature brought on by climate change are known to affect the spread of invasive species across geographic scales. This holds major implications for regional biosecurity, as such disturbances are known to negatively affect biodiversity, local livelihoods and overall ecosystem resilience. Time- and cost-effective approaches for assessing invasion risk are therefore a high priority for land managers and local communities. This study used Landsat 8 OLI and Terra MODIS imagery, in concert with ancillary geospatial and vegetation survey data, and correlative species distribution modeling, to produce risk assessment maps for invasive white sweet-clover (*Melilotus albus*) across the Yukon Flats National Wildlife Refuge and the state of Alaska. Maps were produced from an ensemble of five species distribution models and used to quantify the total area threatened by invasive white sweet-clover. This reveals the growing threat of invasive plants to the refuge and the state. These results suggest ensemble risk assessments can act as a powerful decision-support tool for land managers and local communities when developing invasive plant prevention and mitigation plans at different scales.

Invasive species are one of the most pressing environmental and economic threats of the twenty-first century. Alaska is one of the

## Virginia Ecological Forecasting II Wise County Clerk of Court's Office

*Using NASA Earth Observing Satellites and Statistical Model Analysis to Monitor Vegetation and Habitat Rehabilitation in Southwest Virginia's Reclaimed Mine Lands*

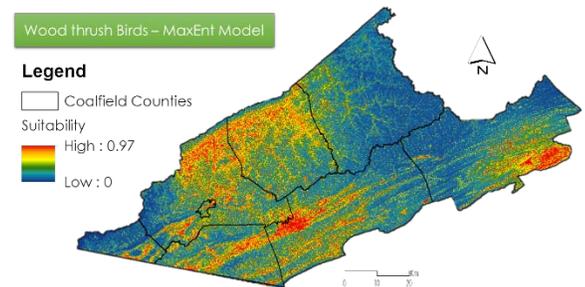
**Team:** Zachary Tate (lead), Talia Elliott, Patrick Hafashimana, Ryan Porter, Rajkishan Rajappan

**Advisors:** Dr. Kenton Ross, Dr. Robert VanGundy

**Project Partners:** Department of Mines Minerals and Energy, The University of Virginia's College at Wise, Virginia Office of Surface Mining Reclamation & Enforcement

**NASA Earth Observations Utilized:** Landsat 8 OLI, Landsat 5 TM, Aqua/Terra MODIS, TRMM PR

**Modeling/Software/Scripting Utilized:** ArcGIS, ENVI, Python, MRT, MaxEnt, STAR-FM



The MaxEnt model provided a habitat suitability assessment by incorporating environmental criteria and the locations of Woodthrush sightings

The majority of the population in Southwest Virginia depends economically on coal mining. In 2011, coal mining generated \$2,000,000 in tax revenue to Wise County, Virginia, alone. However, surface mining completely removes land cover, causing erosion and deforestation that impacts local species. Land reclamation efforts are in place to restore mined areas to their natural vegetated state or to transform these areas for economic purposes. This project's goal was to monitor the progress of land reclamation and the effects on the return of local species. By incorporating NASA Earth observations, such as Landsat 8 OLI and Landsat 5 TM, the re-vegetation process in reclaimed mine lands was estimated. STAR-FM was used to derive a series of ecological succession maps that integrate the high-frequency temporal information from MODIS and high-resolution spatial information from Landsat. MaxEnt eco-niche model was used to estimate the adaptation of animal species to the newly formed habitats. By combining factors such as land type, precipitation from TRMM, and slope from Terra ASTER, the MaxEnt model produced a statistical analysis on the probability of species habitat. The results from this project provide policy makers with ecological information that can be used to identify suitable habitats for local species in reclaimed mined areas.

## Colombia Ecological Forecasting

University of Georgia

*Utilizing NASA Earth Observations to Enhance the Conservation Efforts of Colombia's Most Endangered Primate, the Cotton-top Tamarin (Saguinus oedipus)*

**Team:** Caren Remillard (lead), Hillary Essig, Peter Hawman, Nikos Kavoori, Suravi Shrestha, Zennure Ucar, Xiaohe Yu

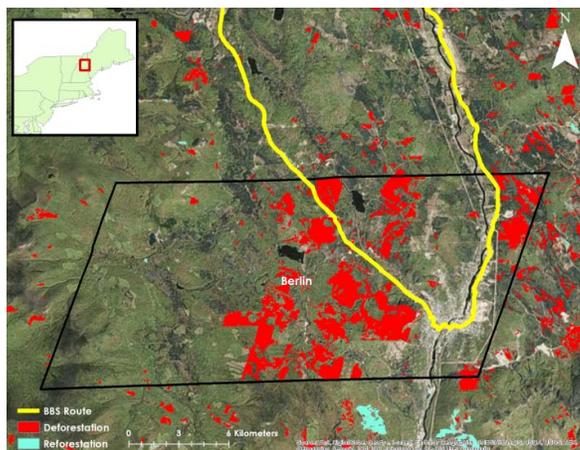
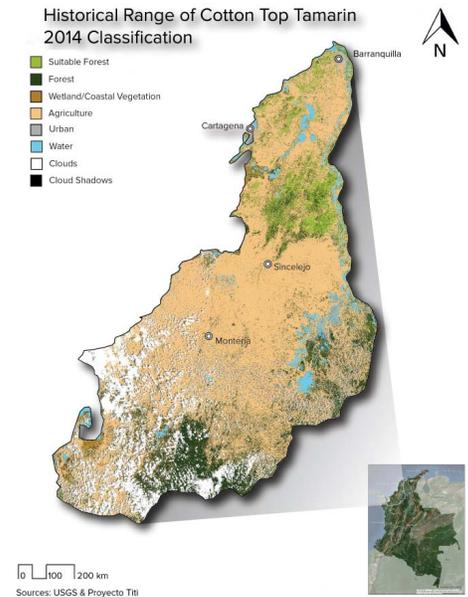
**Advisors:** Dr. Marguerite Madden, Dr. Thomas Jordan, Dr. Sergio Bernardes, Daniel Mesa, Steve Padgett-Vasquez

**Project Partners:** Disney Animal Kingdom, Proyecto Tití, Fundación Proyecto Tití

**NASA Earth Observations Utilized:** Landsat 8 OLI/TIS, Landsat 5 TM, Landsat 7 ETM+

**Modeling/Software/Scripting Utilized:** ENVI, ERDAS IMAGINE, ArcGIS

The cotton-top tamarin (*Saguinus oedipus*), a New World primate endemic to the forests of Northwest Colombia, is listed as critically endangered by the International Union for Conservation of Nature with approximately 6,000 individuals remaining. Major threats to these tamarins include deforestation from the logging industry, agriculture, and urbanization. This project partnered with Proyecto Tití, a conservation program that makes the preservation of natural resources feasible for local communities in Colombia through education, field work, and community outreach. This project utilized Landsat 5 TM, Landsat 7 ETM+ and Landsat 8 OLI for the years 1991, 2002, and 2014 respectively, and integrated vegetation field transect data within the historic range. A historical time series of deforestation and tamarin habitat, land use/land cover maps, suitable habitat maps, and a potential connectivity map for protection and restoration planning were created. Field data collected by Proyecto Tití were used to conduct an accuracy assessment and validate the forest type. The incorporation of NASA Earth observations and technology increases Proyecto Tití's efforts by providing end-users with visual tools and quantitative information regarding this critical animal habitat that can be used both internally, and shared with the local community.



## New England Ecological Forecasting

NASA Goddard Space Flight Center

*Utilization of Ground-Based Annual Avian Survey and Habitat Classification Data to Demonstrate and Predict Songbird Population Trends*

**Team:** Alexander Nelson, Sam Weber, Kiersten Newtoff

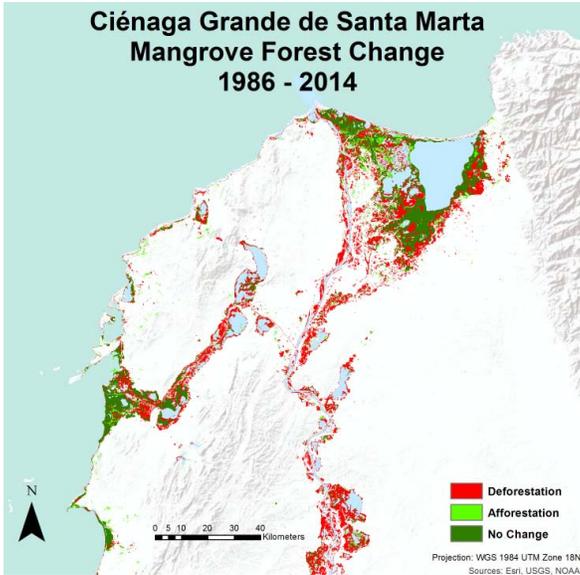
**Advisors:** Dr. Morgan Tingley, Dr. Jim Nichols, Fritz Policelli

**Project Partner:** National Audubon Society

**NASA Earth Observations Utilized:** Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI, Aqua/Terra MODIS

**Modeling/Software/Scripting Utilized:** ArcGIS, R, ENVI, PRESENCE, MARXAN, DMSOM

Songbirds (order Passeriformes) are especially notable for their scientific status as excellent indicators of ecological change, as they interact with a diverse set of organisms in their trophic relationships. Changes in songbird population size and distribution are often indicative of underlying changes in their habitats such as vegetation composition, primary productivity, and climate. Recent trends in many areas of North America show decreasing abundance and diversity of songbirds with forest fragmentation as a potential driver. This study utilized an occupancy model using songbirds to analyze the effects of various fragmentation metrics, which were derived from NASA Earth observation-based measurements and combined with large-scale, multi-year USGS Breeding Bird Survey data. The focal area was Bird Conservation Region (BCR) - 14 in the northeast United States. Representative species were chosen as models to predict the probability that a species will occupy, emigrate, or colonize various habitats given its habitat forest cover, degree of fragmentation, and quality of vegetation. These end-products facilitate the National Audubon Society's conservation efforts and enhance management actions on a landscape scale, as well as provide a strong foundation for the future of songbirds and their habitats in North America.



## Coastal Colombia Ecological Forecasting

NASA Jet Propulsion Laboratory

*Utilizing Spaceborne and Airborne Sensors to Monitor the Health of Coastal Wetlands in Colombia*

**Team:** Daniel Jensen (lead), Scott Barron, Gwen Miller, Steve Flores

**Advisor:** Dr. Marc Simard

**Project Partners:** Conservation International, Louisiana State University, MarVivà, Universidad Tecnológica del Chocó

**NASA Earth Observations Utilized:** Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI, Terra ASTER, SRTM

**Modeling/Software/Scripting Utilized:** QGIS, GRASS, Fmask, R, Python, Mangal, Random Forests

Colombia's coastline is home to widespread mangrove forests that are ecologically and economically important to the country's well-being. Mangroves are severely threatened by direct human activity and climate change, causing significant deforestation and degradation in recent years. Using NASA Earth observations, including Landsat 5 TM, Landsat 7 ETM+,

Landsat 8 OLI, Shuttle Radar Topography Mission (SRTM) and Terra ASTER data, changes in mangrove extent were mapped in six intervals from 1986 to 2014. This analysis was conducted using a combination of open-source GIS software and data processing tools, including Quantum GIS, Geographic Resources Analysis Support System (GRASS), and R statistical program. The resultant land-cover and deforestation data were then combined with watershed boundaries and used as inputs into the Mangal model to assess and predict the mangrove forests' ecosystem productivity.

## Louisiana Ecological Forecasting

NASA Stennis Space Center

*Utilizing NASA Earth Observations to Identify Suitable Reforestation Sites in Louisiana's Coastal Parishes*

**Team:** Shelby Barrett (lead), Brittany Howell, Ben Beasley, Alahna Moore

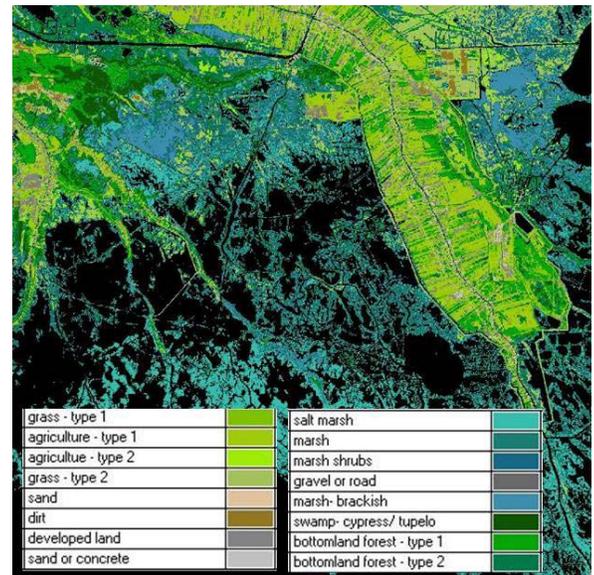
**Advisors:** Joseph Spruce, Doc Smoot

**Project Partners:** Bayou Land Resource Conservation & Development Council, Wetland Tree Foundation, Public Laboratory for Open Technology and Science, Common Ground Relief

**NASA Earth Observations Utilized:** Landsat 8 OLI, Terra ASTER, Landsat 5 TM, ER-2 AVIRIS

**Modeling/Software/Scripting Utilized:** ERDAS IMAGINE, ArcGIS, IDRISI LCM, LUCIS

Louisiana's wetlands, including coastal forests and barrier islands, are the state's first defense against severe weather events, effectively buffering impacts from seasonal flooding, tropical storms, and hurricanes. These events, along with anthropogenic and natural modifications to coastal Louisiana's hydrology, greatly contribute to wetland habitat degradation and loss. According to the EPA, although it contains only approximately 40% of America's remaining wetlands, Louisiana alone accounts for 90% of the total U.S. coastal wetland loss from 1932 to 2010. Continued degradation of coastal Louisiana forests and wetlands causes Louisiana to lose the natural protective barriers, endangering communities and destroying essential wildlife habitats. Hurricanes Katrina and Rita in 2005, Hurricane Gustav in 2008, and Hurricane Isaac in 2012 were detrimental to many coastal ecosystems that provide natural storm protection to citizens inhabiting coastal Louisiana. This project produced planting suitability maps for several coastal Louisiana parishes and communities for a number of wetland tree species including sand live oak (*Quercus geminata*), water oak (*Quercus nigra*), black willow (*Salix nigra*), red maple (*Acer rubrum*), water tupelo (*Nyssa aquatic*), sweetgum (*Liquidambar styraciflua*), and hackberry (*Celtis laevigata*). These suitability maps enable end-users to determine where to focus planting efforts based on individual species' suitability to a particular area, and contribute to enhanced coastal restoration efforts.



## Sierra Nevada Ecological Forecasting III

NASA Ames Research Center

*Implementing a Web-Based Decision Support System to Spatially and Statistically Analyze Ecological Conditions of the Sierra Nevada*

**Team:** Chase Mueller (lead), Amber Brooks, Emily Kisilk, Oliwia Baney, Andrew Nguyen

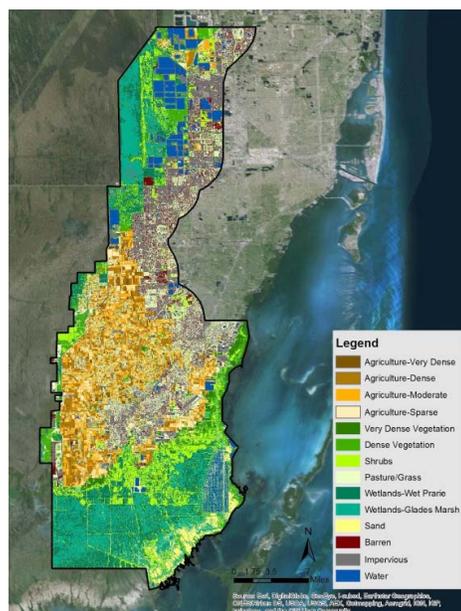
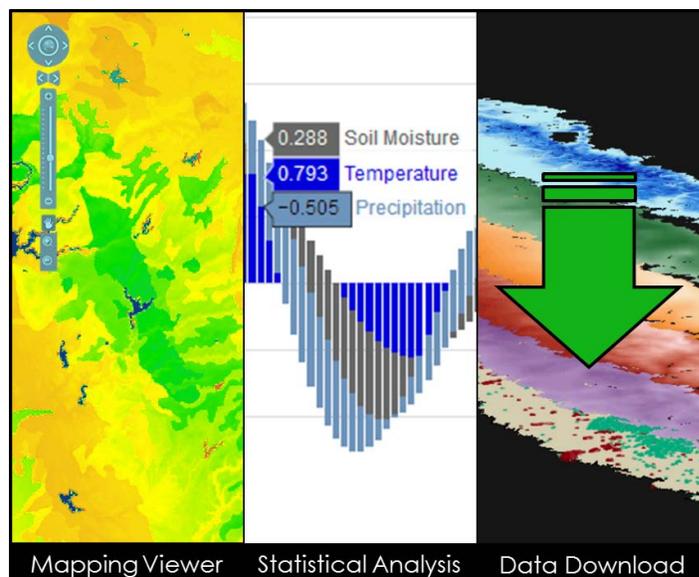
**Advisors:** Carlos Ramirez, Dr. Cindy Schmidt, Dr. Juan Torres-Pérez

**Project Partners:** USDA Forest Service, ESRI, Plotly

**NASA Earth Observations Utilized:** Aqua/Terra MODIS, Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI/TIRS, Suomi NPP VIIRS/CERES

**Modeling/Software/Scripting Utilized:** ArcGIS, ArcOnline, Plotly, Dreamweaver, BCM, LPJ

The Sierra Nevada is experiencing changes in hydrologic regimes, such as decreases in snowmelt and peak runoff, which affect forest health and the availability of water resources. Currently, the USDA Forest Service Region 5 is undergoing Forest Plan revisions to include climate change impacts into mitigation and adaptation strategies, but few processes are in place to conduct quantitative assessments of forest conditions in relation to mountain hydrology and easily deliver information to forest managers. This project contributed to the creation of a Decision Support System (DSS) to allow ease of access to historical and forecasted hydrologic, climatic, and terrestrial conditions for the entire Sierra Nevada. The DSS consists of three components: 1) the Mapping Viewer utilizing ArcGIS Online to visually analyze areas of interest, 2) the Statistical Analysis Portal using a web-based data analysis and visualization tool called Plotly for sub-basin level statistics, and the Geospatial Data Gateway to download datasets. This term's project focused on Python-based data processing, the adaptation of the multiple capabilities of ArcGIS Online and Plotly, and the integration of the three Sierra DSS components within a website designed specifically for the USDA Forest Service to allow ease of access to historical and forecasted conditions for the entire Sierra Nevada.



## Miami-Dade Ecological Forecasting II

University of Georgia

*Utilizing NASA Imagery and GIS Modeling for the Design and Implementation of the Miami-Dade Western Greenway*

**Team:** Ning Chen (lead), Mohamed Amin, Lauren Anderson, Erick Braun, Tunan Hu, Linli Zhu

**Advisors:** Dr. Rosanna G. Rivero, Dr. Sergio Bernardes, Dr. Marguerite Madden

**Project Partners:** The Trust for Public Land, Miami-Dade County Parks, Recreation and Open Spaces Department

**NASA Earth Observations Utilized:** Terra ASTER

**Modeling/Software/Scripting Utilized:** ENVI, ArcGIS, LUCIS

Miami is a city of rapid and constant change, some of which is at the expense of its neighboring wetland area, the Everglades. As the largest subtropical ecosystem in the United States, the Everglades are located along avian migratory routes and are home to many endemic plant and animal species. The protection and restoration of this region is critical, not only for ecological reasons, but also for the protection of water recharge resources for future urban water consumption by the 2.5 million residents of Miami-Dade County. The Miami-Dade County Parks, Recreation and Open Spaces Department

(MDC-PROS) has embarked on an ambitious planning effort in partnership with The Trust for Public Land to develop a Western Greenway system of trails and recreational destinations along the county's western edge. To assist with Greenway planning efforts, this project used NASA satellite imagery to derive a vegetation index and a land cover classification map. Additional in-situ land use data provided details for the model on current urban development. Land most suitable for recreation, conservation, and agritourism were identified. This project contributed to decision support tools of MDC-PROS and The Trust for Public Land for planning green infrastructure corridors preserving the Everglades.

## Overview

DEVELOP's Disasters projects utilize NASA's capabilities in spaceborne, airborne, surface observations, modeling, and data analysis to improve natural disaster forecasting, mitigation and response. The projects contribute to improved understanding of the natural processes that produce hazards, the vulnerability of local communities, and development of hazard mitigation technologies. This summer, DEVELOP's Disasters projects partnered with regional, federal, international and private organizations to provide hazard and disaster information where and when it is needed.

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- p. 16 **California Disasters**  
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- p. 16 **Andes Mountains Disasters**  
*NASA Marshall Space Flight Center*
- p. 17 **Global Disasters III**  
*NASA Jet Propulsion Laboratory*
- p. 17 **Great Lakes Disasters**  
*NASA Langley Research Center*

### Partner Organizations

Committee on Earth Observation Satellites (CEOS)  
 ESRI Disaster Response Program  
 GISCorps of Urban and Regional Information Systems Association  
 Great Lakes and St. Lawrence Cities Initiative  
 Mekong River Commission  
 My Community Our Earth (MyCOE)  
 NASA SERVIR  
 US Coast Guard  
 US Coast Guard Research and Development Center  
 US Environmental Protection Agency  
 USDA Forest Service Eastern Forest Environmental Threat Assessment Center  
 USDA Forest Service Remote Sensing Applications Center  
 USGS National Earthquake Information Center



## Southeast Asia Disasters II

NASA Goddard Space Flight Center

*Utilizing NASA Earth Observations to Enhance Flood Impact Products and Mitigation in the Lower Mekong Water Basin*

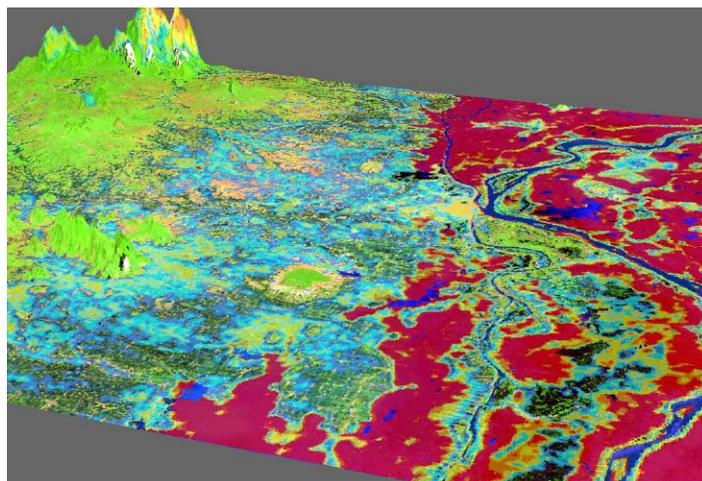
**Team:** Colin Doyle (lead), Michael Gao

**Advisors:** Dr. John Bolten, Stu Frye, Joe Spruce, Matt Handy, Fritz Policelli

**Project Partners:** Mekong River Commission, My Community Our Earth (MyCOE), Committee on Earth Observation Satellites (CEOS)

**NASA Earth Observations Utilized:** Landsat 5 TM, Landsat 7 ETM+, Aqua/Terra MODIS, TRMM PR, ISS ISERV

**Modeling/Software/Scripting Utilized:** ENVI, ArcGIS, Python, R, Geoserver



Extreme floods in the Lower Mekong Water Basin (LMB) during typhoons and excessive rainfall events have cost millions of dollars in damages, affecting the well-being of LMB residents. This study assessed the ability to use the Aqua/Terra MODIS 250 m resolution derived Normalized Difference Vegetation Index (NDVI) changes to map flood and drought impact across the entire LMB. Leveraging the lower NDVI values of water, the NDVI of the January dry season is compared to the wet season flood events reveals drastic decreases in NDVI due to flooding, allowing for the visualization of the degree of flood impact in the region. In addition, the NDVI change product was automated to update in near-real time and integrated into the Committee on Earth Observing Satellites Disaster Risk Management Observation Strategy (CEOS DRM) within a web-based 'Flood Dashboard,' along with other flood mapping and weather data products. This flood dashboard provides all of the necessary data to monitor floods and flood impacts in near-real time, as well provide a platform for further data aggregation for flood prediction modeling and post-event assessment.

## California Disasters

NASA Stennis Space Center

*Assessing the Effectiveness of Simulated HypsIRI Data in USDA Forest Service Post-Fire Vegetation Assessment and Decision Support*

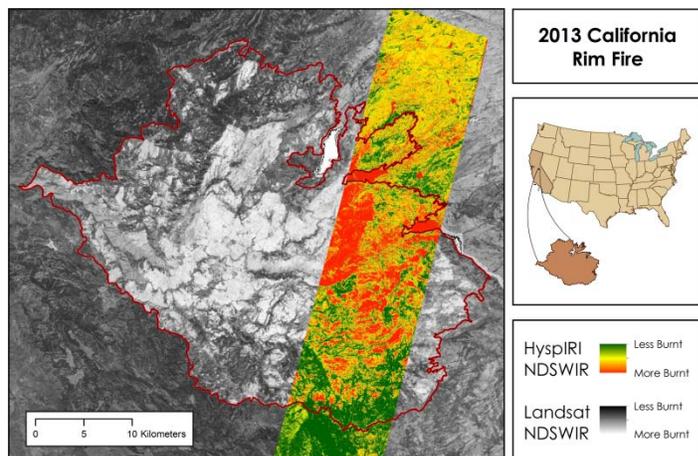
**Team:** Timothy Sutherlin (lead), Erick Mack, Heather Nicholson, Caitlin Ruby, Luke Wylie

**Advisors:** Joseph Spruce, James Smoot

**Project Partners:** USDA Forest Service Remote Sensing Applications Center, USDA Forest Service Eastern Forest Environmental Threat Assessment Center

**NASA Earth Observations Utilized:** ER-2 AVIRIS, ER-2 MASTER, Landsat 8 OLI, Landsat 5 TM

**Modeling/Software/Scripting Utilized:** ENVI, ERDAS IMAGINE, ArcGIS, BARC, RAVG



Currently, the USDA Forest Service has remote sensing application programs in place to rapidly map and characterize vegetation and soil impacts due to major wildfires (e.g., the Burned Area Reflectance Classification (BARC) and the Rapid Assessment of Vegetation Condition (RAVG)). These programs use Landsat-based burn severity indices to generate needed change products, including the differenced Normalized Burn Ratio (dNBR) and the Relative differenced Normalized Burn Ratio (RdNBR). When HypsIRI is launched its hyperspectral reflectance and multispectral thermal data will enable new tools for assessing natural disaster impacts to ecosystems, such as wildfire damage to forests. This project assessed the potential of HypsIRI data for calculating comparable and complementary several burn severity products (e.g., dNBR), using simulated HypsIRI data gathered over central California in 2013. Results suggest HypsIRI can produce post-fire vegetation burn severity maps similar to those currently being produced by the USDA Forest Service with Landsat. This study also assessed HypsIRI's hyperspectral and thermal capabilities for generating alternative burn severity products that may enhance and augment needed information obtained from current BARC and RAVG products.

## Andes Mountains Disasters

NASA Marshall Space Flight Center

*Utilizing NASA Earth Observations to Model Volcanic Hazard Risk Levels in Areas Surrounding the Copahue Volcano in the Andes Mountains*

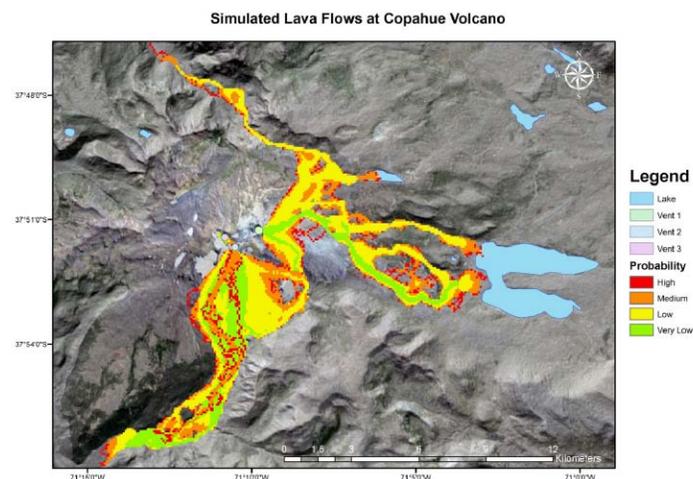
**Team:** Amanda Weigel (lead), Amberle Keith, Jonathan Rivas

**Advisors:** Dr. Jeff Luvall, Eric Anderson

**Project Partner:** NASA SERVIR

**NASA Earth Observations Utilized:** Aura OMI, EO-1 ALI, ISS ISERV, Landsat 7 ETM+, Landsat 8 OLI, SRTM, Terra ASTER

**Modeling/Software/Scripting Utilized:** ArcGIS, ENVI, SRTM, MATLAB, CSIC VORIS, USGS LAHARZ



been active for the last 2 million years. Several small towns are located within 10km of the volcano, but the isolated region has steep topography and little vegetation, rendering it poorly monitored. During its eruptive history, it has produced numerous lava flows, pyroclastic flows, ash deposits, and lahars, with the most recent activity in December 2012 and May 2013. Ash emitted during these eruptions canceled hundreds of flights and forced the evacuations of thousands of people from their homes reinforcing the need to model volcanic hazard risk. This project studied Copahue to determine areas that have the highest potential of being affected in the event of an eruption. A suite of NASA Earth observation data products were used to analyze volcanic hazards, examine and identify volcanic activity, and identify areas vulnerable to volcanic hazards including volcanic ash, SO<sub>2</sub> gas, lava flow, pyroclastic density currents and lahars. These datasets were used to create a historic lava flow map of the Copahue volcano, a volcanic risk and hazard map for future eruptions, as well as identification of areas that should be prioritized for disaster relief and evacuation orders.

## Global Disasters III

NASA Jet Propulsion Laboratory

*Prototype Algorithm and Interface Development for Rapid Damage Validation*

**Team:** Sara Lafia (lead), Judy Cheng, Lan Nguyen

**Advisor:** Dr. Sang-Ho Yun

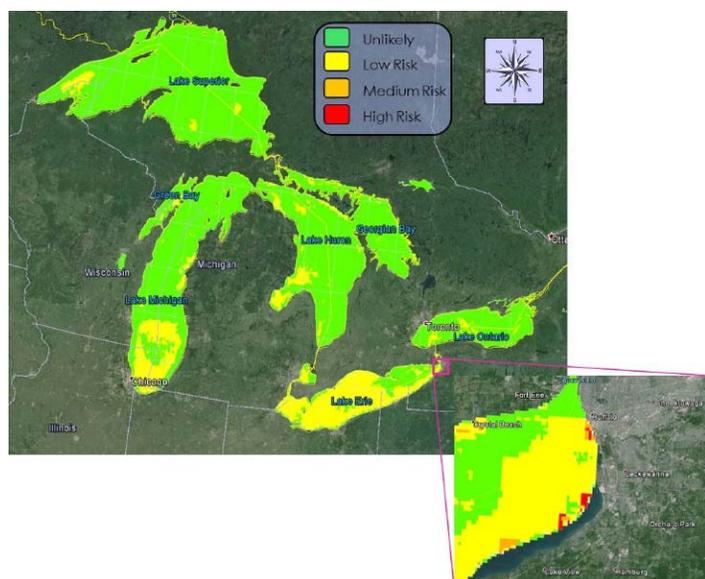
**Project Partners:** USGS National Earthquake Information Center, ESRI Disaster Response Program, GISCorps of Urban and Regional Information Systems Association

**NASA & Partner Earth Observations Utilized:** UAVSAR, ALOS PALSAR, COSMO-SkyMed

**Modeling/Software/Scripting Utilized:** ArcGIS, ArcGIS API, Google Maps API, Google Earth Engine, MATLAB



Natural disasters such as fires, floods, and hurricanes claim many lives and result in economic losses. In the aftermath of such devastating events, an accurate and comprehensive assessment of damage is needed for rapid rescue response to minimize loss of life and to begin the recovery process. This project collaborated with NASA Jet Propulsion Laboratory's Advanced Rapid Imaging and Analysis (ARIA) team and California Institute of Technology to develop a prototype damage-detection algorithm using NASA's Gulfstream G3 L-band SAR products and Japan's Aerospace Exploration Agency's ALOS PALSAR data to produce Damage Proxy Maps (DPMs) of urban area building damage in affected regions. Data from the Italian Space Agency's COSMO-SkyMed X-band SAR products also provided building damage information. These DPMs indicate areas that have undergone changes in surface conditions due to different natural disasters. They can be used to identify damaged structures and assess the extent of damage in a region, particularly in remote regions where ground access can be difficult. Developing a web-based validation interface will eliminate time-consuming data conversions in the DPM validation process, supporting disaster response agencies in rapid rescue and emergency supply logistics.



## Great Lakes Disasters

NASA Langley Research Center

*Mapping Environmental Weathering Factors to Plan for Diluted Bitumen Submergence*

**Team:** Merna Saad (lead), Nathan Qian, Frederick Aulwes, Denise Lawn

**Advisors:** Dr. Kenton Ross, Ralph Dollhopf

**Project Partners:** US Coast Guard, US Coast Guard Research and Development Center, US Environmental Protection Agency, Great Lakes and St. Lawrence Cities Initiative

**NASA Earth Observations Utilized:** Aqua/Terra MODIS

**Modeling/Software/Scripting Utilized:** ArcGIS, ENVI, ADIOS, GLCFS

oil sands will submerge when spilled into the Great Lakes. Using data from NASA's MODIS and NOAA's Great Lakes Environmental Research Laboratory's water surface temperature, suspended sediment concentration, and current speed data a risk factor was created. This risk factor was used to highlight areas in the Great Lakes where diluted bitumen submergence is more likely to occur. In addition, a tool was created which incorporates this data and provides an updating map service showing near real-time conditions to allow responders to plan for diluted bitumen submergence.

## Overview

DEVELOP's Agriculture projects promote innovative use of NASA satellite data, model products, and scientific findings to assist with agricultural monitoring and management. The projects focus on topics associated with the production and availability of food products around the globe. This summer, DEVELOP's Agriculture projects partnered with federal and international organizations to support agricultural management and policy and global food security.

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*NASA Langley Research Center*

**p. 19 Great Plains Agriculture**

*NASA Langley Research Center*

**p. 19 Rwanda Agriculture II**

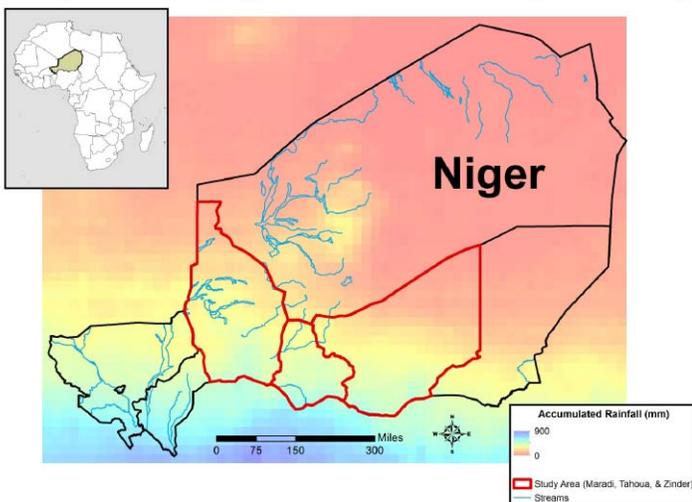
*Wise County Clerk of Court's Office*

### Partner Organizations

Rwanda Ministry of Agriculture and Animal Resources  
 USDA Agricultural Research Services Rangeland Resources Research Unit  
 World Bank Institute  
 World Bank Open Data Initiative



Rainy Season Average Accumulated Rainfall (1999 - 2013)



### Niger Agriculture

NASA Langley Research Center

*Assessing Irrigation Potential in the Maradi, Zinder, and Tahoua Regions of Niger for Infrastructure Construction Decision-Making*

**Team:** Merna Saad (lead), Georgina Crepps, Tim Courtney, Allison Kunz, Jamerson Jones

Advisor: Dr. Kenton Ross

Project Partner: World Bank Institute

NASA Earth Observations Utilized: TRMM PR/TMI/VIRS, Landsat 8 OLI, SRTM

Modeling/Software/Scripting Utilized: Python, ENVI, ArcGIS

NASA DEVELOP partnered with the U.S. Coast Guard Auxiliary University Program to create a response planning tool for the U.S. Coast Guard. This tool addresses a major potential concern in American energy policy: whether diluted bitumen from Canadian oil sands will submerge when spilled into the Great Lakes. Using

data from NASA's MODIS and NOAA's Great Lakes Environmental Research Laboratory's water surface temperature, suspended sediment concentration, and current speed data a risk factor was created. This risk factor was used to highlight areas in the Great Lakes where diluted bitumen submergence is more likely to occur. In addition, a tool was created which incorporates this data and provides an updating map service showing near real-time conditions to allow responders to plan for diluted bitumen submergence.



## Great Plains Agriculture III

NASA Langley Research Center

*Utilizing NASA Earth Observations to Monitor Drought Conditions for Enhancement of Rangeland Management*

**Team:** Joseph Novak (lead), John Lingenfelter, Shani Kent Hall, Ashley Garner, Megan Laurine

**Advisor:** Dr. Kenton Ross

**Project Partner:** USDA Agricultural Research Services, Rangeland Resources Research Unit

**NASA Earth Observations Utilized:** Terra/Aqua MODIS

**Modeling/Software/Scripting Utilized:** ArcGIS, Python, R, DEVELOP's DSI

Drought in the U.S. Great Plains is a matter of constant concern for ranchers and land managers in the region. Every rancher must respond to drought conditions and approximately 80% actively prepare for drought. Since 2011, the Great Plains region has been severely impacted by drought, including \$400 million in losses in the state of Oklahoma alone. Drought conditions can make rangelands more susceptible to disease, insect pests, weed invasions, and overgrazing. The USDA and other organizations currently track drought severity through the Vegetation Drought Response Index (VegDRI) and the U.S. Drought Monitor. However, these resources have limitations due to a large spatial scale. The Drought Severity Index (DSI), created in a previous DEVELOP term, utilizes MODIS and NOAA's Multisensor Precipitation Estimator data. This project validated the DSI against VegDRI, Palmers Drought Severity Index (PDSI), and in-situ data collected from several meteorological locations throughout the Great Plains region, to provide a sustainable methodology for calculating the DSI. The methods and results produced by this project were presented to the USDA Agricultural Research Service Rangeland Resources Research Unit for future use throughout the region and benefit the end-users with higher spatial resolution monitoring tools.

## Rwanda Agriculture II

Wise County Clerk of Court's Office

*Utilizing NASA Earth Observations to Estimate Rice Yield and Study Soil Erosion in Rwanda*

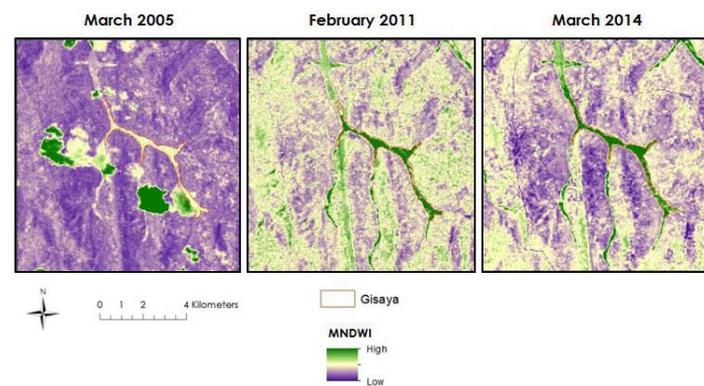
**Team:** Daria Blach (lead), Manzi Roger Dusabimana, Emmanuel Muzungu, Faith Mwiza

**Advisors:** Dr. Kenton Ross, Dr. DeWayne Cecil

**Project Partners:** Rwanda Ministry of Agriculture and Animal Resources, World Bank Open Data Initiative

**NASA Earth Observations Utilized:** Landsat 8 OLI, Landsat 5 TM, Terra ASTER

**Modeling/Software/Scripting Utilized:** ArcGIS, Python, DSSAT, GEOS-5, MERRA, POWER



Agriculture is the backbone of Rwanda's economy, accounting for a third of the country's GDP. Agriculture also constitutes the main economic activity for rural households, acting as the main source of income. The sector meets 90% of the national food needs and generates more than 70% of the country's export revenues. In an effort to reduce poverty and grow the economy, the government has outlined a number of programs which include the Rural Sector Support Program (RSSP) and National Rice Policy (NRP). The goal of the NRP is to attain self-reliance and competitiveness in rice production whereas the RSSP's purpose is the development of marshlands to rice fields in order to increase rice cultivation and yields. This project utilized NASA Earth observations to monitor rice fields and DSSAT crop production models to estimate rice yields in identified RSSP sites. Soil erosion susceptibility maps were created at Land Husbandry, Water Harvesting, and Hillside Irrigation developmental sites across Rwanda before and after the implementation of modern practices. Partnering with the Rwanda Ministry of Agriculture and Animal Resources and the World Bank, the team derived meaningful maps to monitor agriculture and provide information to policy decision makers.

## Overview

DEVELOP's Oceans projects improve understanding of ocean systems through the application of NASA satellite data, model products, and scientific findings. The projects focus on topics like sea level change, climate variability, coral reef monitoring, and coastal water quality. This summer, DEVELOP's Oceans projects partner with local, federal, and non-profit organizations to assist with preparedness and mitigation of issues relating to oceanic systems.

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#### p. 20 **Southern California Oceans**

*NASA Jet Propulsion Laboratory*

#### p. 21 **American Samoa Oceans**

*NASA Ames Research Center*

#### p. 21 **Argentina Oceans**

*NASA Goddard Space Flight Center*

### Partner Organizations

American Samoa Coral Reef Advisory Group  
 City of Los Angeles Hyperion Treatment Plant  
 National Oceanic and Atmospheric Administration  
 Ocean Alliance  
 Orange County Sanitation District  
 Southern California Coastal Water Research Project



## Southern California Oceans

NASA Jet Propulsion Laboratory

*Remote Sensing Detection of Wastewater Plumes to Assess Public Water Quality in Los Angeles and Orange Counties*

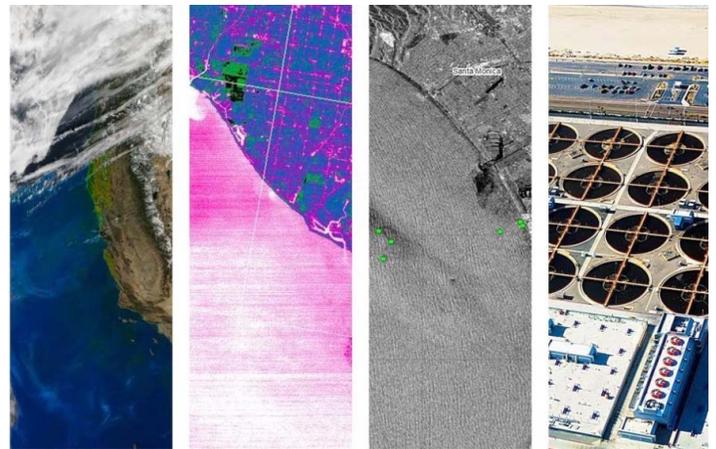
**Team:** Boyang “Jack” Pan (lead), Christine Rains, Rebecca Trinh

**Advisors:** Benjamin Holt, Michelle Gierach

**Project Partners:** City of Los Angeles Hyperion Treatment Plant, Orange County Sanitation District, Southern California Coastal Water Research Project

**NASA & Partner Earth Observations Utilized:** Terra ASTER, Aqua/Terra MODIS, ISS HICO, EnviSat MERIS/ASAR, Radarsat-1 SAR, ALOS PALSAR

**Modeling/Software/Scripting Utilized:** ENVI/IDL, NEST, SeaDAS, ArcGIS, Panoply, MATLAB, Python



Daily operations of the City of Los Angeles Hyperion Wastewater Treatment Plant and the Orange County Sanitation District include releasing treated sewage into the coastal waters of Southern California. Sewage is released at depths of approximately 60 m through outfall pipes that are about 5 miles (8 km) long. Periodically, repair and maintenance on the outfall pipes require temporary diversion of treated sewage to shorter pipes that drain into shallow coastal zones where buoyant, freshwater plumes of effluent may reach the surface and be transported to nearby beach areas. Two such events took place in November 2006 and October 2012, where treated wastewater was diverted to 1-mile (1.6 km) pipes that discharge at a depth of about 20 m. Diversion events can potentially impact coastal ecosystems and public health; thus comprehensive monitoring and tracking of plumes is a high priority to project end-users. This study focused on the 2006 and 2012 events and produced an assessment of the plumes' thermal signature, impact on coastal biogeochemistry, and surface movement based on analysis of remote sensing data from NASA satellite sensors. The results were validated with in-situ data. These results enhance understanding of the diverted outfall plume, and assist the development of a strategy for improved satellite detection during future diversion events.

## American Samoa Oceans

NASA Ames Research Center

*Monitoring Watershed Water Quality Impacts on Near-Shore Coral Reef Ecosystems in American Samoa using NASA Earth Observations*

**Team:** Aimee Teaby (lead), Jessica Sutton, David Minovitz, Lauren Makely

**Advisors:** Dr. Juan Torres-Pérez, Dr. Liane Guild, Dr. Sherry Palacios, Dr. Cindy Schmidt

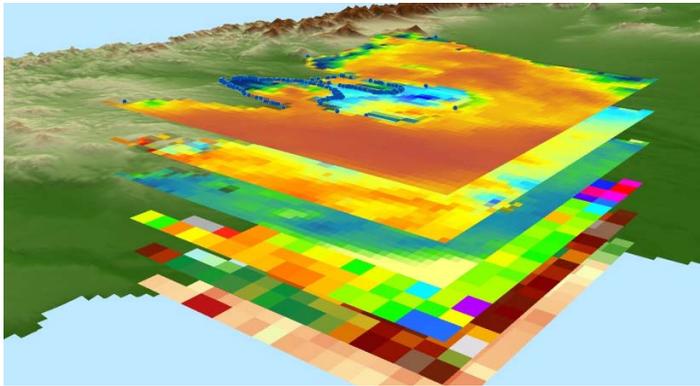
**Project Partner:** American Samoa Coral Reef Advisory Group

**NASA Earth Observations Utilized:** Landsat 7 ETM+, Landsat 8 OLI/TIRS, Terra MODIS

**Modeling/Software/Scripting Utilized:** ArcGIS, ENVI, HEC-GeoHMS, OpenNSPECT



Coral reef ecosystems are considered to be some of the most ecologically and economically important habitats in the world. Located in the South Pacific, American Samoa's coral reef ecosystems provide benefits to the local economy estimated at approximately \$5 million per year and support nearly 3,000 marine species. However, these reefs are at risk due to a number of anthropogenic impacts, including runoff and land-based pollution resulting in negative consequences to the local water quality. This project quantified coral reef vulnerability by assessing the impact of land management practices on water quality, with a primary objective to integrate NASA Earth observations of land cover change and ocean parameters to identify the linkage between land use and water quality. The project also provided site-specific implications for coral reef vulnerability in American Samoa through the spatial representation of water quality parameters. Final products were distributed to the project end-user, the American Samoa Coral Reef Advisory Group, for enhanced water quality management and community outreach. The results will aid end-users in improving land and ocean management policies in American Samoa, and contribute to improved coral reef health.



## Argentina Oceans

NASA Goddard Space Flight Center

*Analyzing Harmful Algae Blooms in Southern Right Whale Habitat Using a Suite of Satellite Earth Observations*

**Team:** Emily Voelker (lead), James Morrow, Talia Smith

**Advisors:** Dr. Cara Wilson, Dr. Victoria Rowntree, Dr. Jeremy Werdell, Fritz Policelli

**Project Partners:** Ocean Alliance, NOAA

**NASA & Partner Earth Observations Utilized:** Aqua MODIS, QuikSCAT SeaWiFS, MetOp ASCAT

**Modeling/Software/Scripting Utilized:** ArcGIS, Python, Excel

Península Valdés, Argentina is the largest southern hemisphere nursing ground for the Southern Right Whale (*Eubalaena australis*), with three to four hundred calves taking refuge in the World Heritage Site each spring. However, over the past decade whale mortality has leapt from 4.7 deaths a year (1971–2002), to 59.3 deaths a year (2003–2012). Conservationists suspect toxins from Harmful Algal Blooms (HABs) are contributing to the deaths, but the topic remains understudied, impeding remediation. To give conservationists a more in-depth look at the peninsula's changing conditions, this project used a long-term temporal analysis of satellite imagery to examine assess water quality variables before, during, and after HAB events. Factors studied include sea surface temperature, chlorophyll-a, Fluorescence Line Height, and sea surface wind during 2003–2013 for late winter to spring months. These environmental parameters were used to create extensive time series, and were tested for correlation with whale death. Techniques were also adapted from the University of California, Santa Cruz to create abundance probability maps for the toxin-producing plankton *Pseudo-nitzschia*. The results and methodology will be incorporated into the conservation research and decision-making of marine conservationists, as they work to inform policy makers and protect these threatened whales.

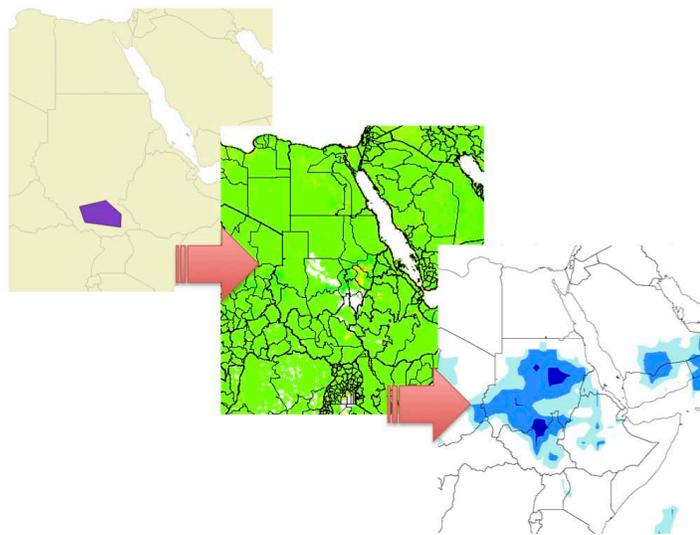
## Overview

Description: DEVELOP's Health and Air Quality projects utilize satellite and airborne Earth observations, model products, and scientific findings to support air quality and public health management and policy making. This summer, DEVELOP's Health and Air Quality projects partnered with local, state, federal, international, and academic organizations to address topics like the monitoring of air quality and infectious disease to improve global health.

- pp. 22–23 **Portfolio**
- p. 22 **East Africa Health & Air Quality**  
*International Research Institute for Climate and Society*
  - p. 23 **Texas Health & Air Quality**  
*NASA Langley Research Center*
  - p. 23 **North America Health & Air Quality**  
*NASA Jet Propulsion Laboratory*

## Partner Organizations

City University of New York  
 Firestone Institute of Respiratory Health  
 NASA Air Quality Applied Sciences Team  
 NASA DISCOVER-AQ Team  
 NOAA Center for Satellite and Applications Research (MD & CA)  
 Red Cross Red Crescent Climate Centre  
 South Coast Air Quality Management District  
 Texas Commission on Environmental Quality



## East Africa Health & Air Quality

International Research Institute for Climate and Society  
*Creating a Flood Forecasting Tool Using NASA Earth Observations  
 Built on the Understanding of the Relationship between Rainfall  
 Extreme Events, Inundation, and Epidemic Dynamics in East Africa*

**Team:** Jerrod Lessel (lead)

**Advisor:** Dr. Pietro Ceccato

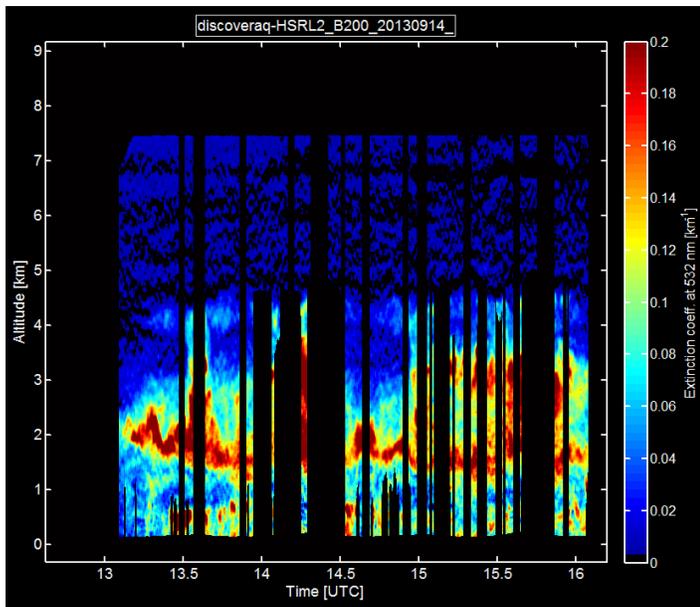
**Project Partners:** Red Cross Red Crescent Climate Centre,  
 City University of New York

**NASA Earth Observations Utilized:** Aqua AMSR-E,  
 QuikSCAT SeaWinds, Terra/Aqua MODIS

**Modeling/Software/Scripting Utilized:** Excel, ArcGIS, QGIS,  
 IRI Data Library, SWaMPS, IFRC

Globally, floods are one of the most devastating natural disasters affecting human and economic systems. East Africans are not immune to experiencing this type of tragedy. Along with

flooding, recent epidemics of vector borne diseases such as Leishmaniasis have caused an estimated 100,000 deaths in the East Africa region, renewing the impetus for defining the ecological boundaries of the vector. It has previously been demonstrated that climate and environmental factors including flood inundation are reliable predictors for outbreaks of vector borne diseases. This project aimed to improve forecasting of flood events by comparing the SWaMPS inundation anomalies product to heavy rainfall forecasts developed by the International Federation of the Red Cross and Red Crescent Societies (IFRC). There is also a potential for a well-calibrated flood-forecasting tool to be used as a predictor for vector borne disease outbreaks in the region. Therefore, the validation of the current IFRC extreme rainfall forecasting maps does not only improve the region's ability to predict where and when to allocate emergency flood resources but could also act as a useful predictor for vector-borne disease outbreaks.



## Texas Health & Air Quality

NASA Langley Research Center

*Evaluating the Application of DISCOVER-AQ Data to Monitor Air Quality in Houston, Texas*

**Team:** Lisa Waldron (lead), Justin Roberts-Pierel, Melanie Barker, James Gundy

**Advisors:** Dr. Richard Ferrare, Dr. Kenton Ross, Dr. Patricia Sawamura, Amy Jo Scarino

**Project Partners:** Texas Commission on Environmental Quality, NASA DISCOVER-AQ Team

**NASA & Partner Earth Observations Utilized:** HSRL, TSI SMPS, DMT UHSAS, Aqua/Terra MODIS

**Modeling/Software/Scripting Utilized:** MATLAB, ArcGIS

Surface-level particulate matter, specifically PM<sub>2.5</sub>, strongly impacts air quality and, other than surface-level ozone, is known for being the most destructive pollutant to both a person's lungs and overall health. Because of its small size, PM<sub>2.5</sub> is able to travel deep enough into a person's lungs to cause substantial damage.

PM<sub>2.5</sub> monitoring is executed primarily through ground monitors, but the readings are limited to only the specific area where the ground monitors are located. Satellite data can sample a larger area, and therefore provides a more comprehensive reading. This study utilized multiple measurements of aerosol data including Moderate Resolution Imaging Spectroradiometer (MODIS), airborne in-situ and LIDAR readings collected by the DISCOVER-AQ team, and ground monitoring stations in the Houston, Texas area. Comparing measurements from these sources produced a more robust understanding of near-surface air pollution. Analyzing measurements from the aircraft and from ground-based monitoring sites can help in evaluating future ground-level pollution measurements from space. Increased accuracy when monitoring can help officials assess and forecast air quality. Efficient air quality forecasts will help the general public take the necessary health precautions, such as avoiding prolonged outdoor activity, when PM<sub>2.5</sub> levels are high.

## North America Health & Air Quality

NASA Jet Propulsion Laboratory

*Utilizing Remotely Sensed Atmospheric Infrared Sounding Data for Near-Real-Time Air Quality Applications in Health Assessments and Pollutant Regulation*

**Team:** Amanda Schochet (lead), Julie Sanchez, Mark Barker

**Advisors:** Tom Pagano, Eric Fetzer, Sharon Ray, Bjorn Lambriksen

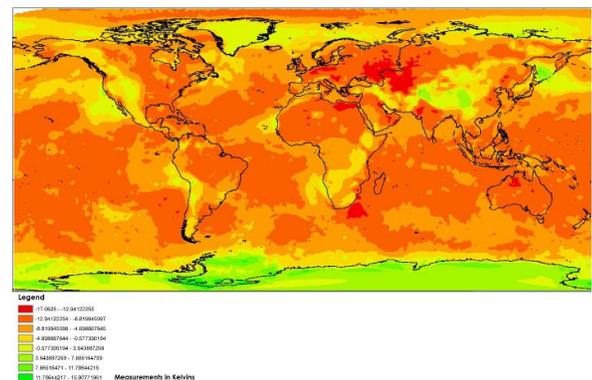
**Project Partners:** South Coast Air Quality Management District, Firestone Institute of Respiratory Health, NASA Air Quality Applied Sciences Team, NOAA Center for Satellite and Applications Research (MD & CA)

**NASA Earth Observations Utilized:** Aqua AIRS, Aqua MODIS

**Modeling/Software/Scripting Utilized:** ArcGIS

Large cities and urbanized areas tend to have significant substantial air pollution problems. While it is known to the average citizen that most cars and factories are a source of these pollutants, very few know about the hidden atmospheric phenomena that concentrate this pollution. Two of the most significant important pollution-focusing processes are temperature inversions (TI) and ozone intrusions (OI). TI prevent vertical atmospheric mixing, leading to higher concentrations of aerosol pollution at a given locale, which when accompanying TI, can lead to acute respiratory problems for sensitive individuals. Stratospheric OI result in high ozone levels in the troposphere, which can damage lung tissue and cause other respiratory problems, as well as vegetation damage. This study focused on areas within North America with known high levels of pollution, such as Los Angeles, California and Hamilton, Ontario. Aqua AIRS data products were used to investigate these phenomena, incorporating TI factors such as the weekend effect and seasonal variations. By processing AIRS data in ArcMap, and increasing spatial resolution with local radiosondes and data from Aqua MODIS, maps were developed highlighting areas that can potentially be hazardous to human health. Final maps were designed to be simple and easily accessible to the general public while maintaining information that is relevant to health and policy decision-makers to improve air quality management and monitoring capabilities.

June 6 2014 - Temperature Inversions at 850mb



## Overview

DEVELOP's Energy projects promote the application of NASA Earth observations and model products for societal benefit through improved techniques in locating and utilizing energy sources. This summer, DEVELOP's Energy projects partnered with local, state, federal, international, and private organizations to increase efficiency, use of non-traditional energy sources, and best energy practices.

- pp. 24–25 **Portfolio**  
p. 25 **Appalachia Energy**  
*Wise County Clerk of Court's Office*
- p. 25 **Central Africa Energy**  
*Mobile County Health Department*

## Partner Organizations

EnviraCarbon Incorporated  
Planet Earth Institute  
USDA Forest Service  
Virginia Department of Agriculture and Forestry  
Virginia's Wise County  
World Bank Global Gas Flaring Reduction



## Appalachia Energy

Wise County Clerk of Court's Office

*NASA Earth Observation Detection of Burned and Blighted Areas for Creation of an Unhealthy Forest Index to Prioritize Forest Harvest for Biofuel Production*

**Team:** Dieudonne Dusenge (lead), Asongayi Venard, Andrew Foxx, Jessica Huff, Rohini Swaminathan

**Advisor:** Dr. Kenton Ross

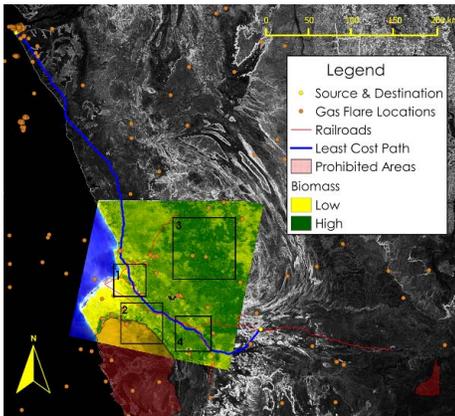
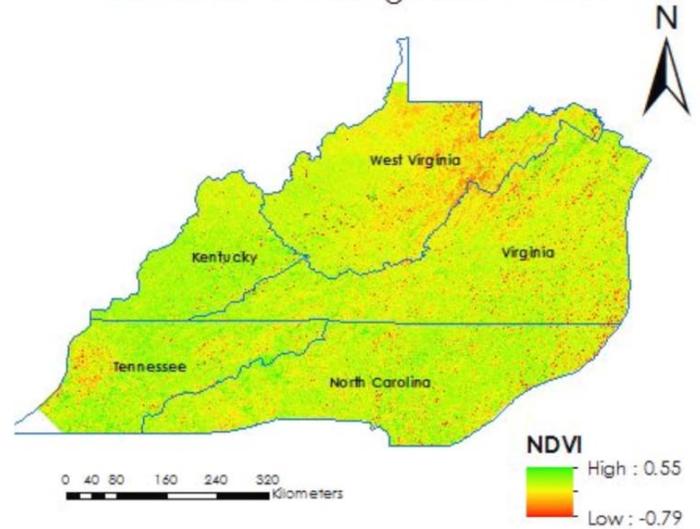
**Project Partners:** USDA Forest Service, Virginia Department of Agriculture and Forestry, EnviraCarbon Incorporated, Wise County (Virginia)

**NASA Earth Observations Utilized:** Landsat 8 OLI, Landsat 5 TM, Aqua/Terra MODIS, Suomi NPP VIIRS

**Modeling/Software/Scripting Utilized:** ArcGIS, Python, MRT

The Appalachian Mountains are known for their natural forests. However, these forests are under pressure from human activities such as residential development, agriculture and logging. The forests are also increasingly affected by forest fires, invasions of pests such as the gypsy moth and other natural factors. In addition, biomass energy production destroys a large amount of healthy trees. During the last 20 years, tens of thousands of acres of natural forest have been logged, many of them replanted as pine tree plantations. As a result of these threats, ecosystems are collapsing and species are being rendered extinct. This project utilized data from Landsat 8's OLI for forest monitoring to derive indices like Normalized Differential Vegetation Index (NDVI) and Relative Differenced Normalized Burn Ratio (RdNBR) to identify unhealthy forests. Pan-sharpened Landsat 8 imagery provided targeted higher resolution analyses for areas demonstrated by Aqua and Terra's MODIS and Suomi NPP VIIRS to have potential for harvest. MODIS and VIIRS provided vegetation dynamics and phenology products, along with fire-related datasets like fire occurrences and scarring. Partnering with Virginia's County of Wise and the Virginia Department of Agriculture and Forestry, this project facilitated the use of NASA Earth observations to identify unhealthy forests in this region.

MODIS NDVI Changes 2004 - 2014



## Central Africa Energy

Mobile County Health Department

*Utilizing NASA Earth Observations to Explore Flared Gas as an Energy Source Alternative to Biomass in Central Africa*

**Team:** Amber Jones (lead), Charles White, Christopher Castillo, Emmanuel Hitimana, Kenny Nguyen, Shikher Mishra, Walt Clark

**Advisors:** Bernard Eichold, M.D., Dr.PH, Joe Spruce, James Smoot, Dr. Kenton Ross, Dr. Maria Kalcic, Dr. Feng Chi Hsu, Dr. Mikhail Zhizhin

**Project Partners:** Planet Earth Institute, World Bank Global Gas Flaring Reduction

**NASA Earth Observations Utilized:** Aqua/Terra MODIS, Suomi NPP VIIRS, Landsat 5 TM, Landsat 8 OLI/TIRS, SRTM

**Modeling/Software/Scripting Utilized:** ArcGIS, QGIS

Much of Central Africa's economy is centered on oil production. Oil deposits in this region tend to lie below vast amounts of compressed natural gas. The latter is often flared off during oil extraction due to a lack of the infrastructure needed to utilize it for productive energy generation. Though gas flaring is discouraged by many due to its contributions to greenhouse emissions, it represents a waste process and is rarely tracked or recorded in the region. In contrast to this energy waste, roughly 80% of Africa's population lacks access to electricity and in turn uses biomass such as wood for heat and light. The objective of this project was to investigate domestic energy usage in Angola, Gabon, and the Republic of Congo, through deforestation analysis, estimation of gas flared, and a suitability study for the infrastructure needed to realize the natural gas resources. A suite of NASA Earth observations were utilized to compare potential natural gas production to biomass harvested, conduct a site suitability test for natural gas pipeline routes, monitor deforestation and decreases in biomass, and estimate gas flaring volumes. Analyses, in terms of methods and results, were shared with project end-users, as well as this project's open source approach to assessing components of the region's energy sector.

## Overview

DEVELOP's Cross-Cutting projects advance applications of Earth observations and the efficiency of DEVELOP projects through the use of cutting-edge technology. These projects support the program with innovative ways to enhance the technical capabilities and improve capacity building efforts. This summer, DEVELOP's Cross-Cutting projects partnered with international and federal organizations to improve Earth science projects and technologies available.

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### Portfolio

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#### DEVELOPedia

*NASA Langley Research Center*

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#### GEO AIP-7 Colombia Application Development

*NASA Langley Research Center*

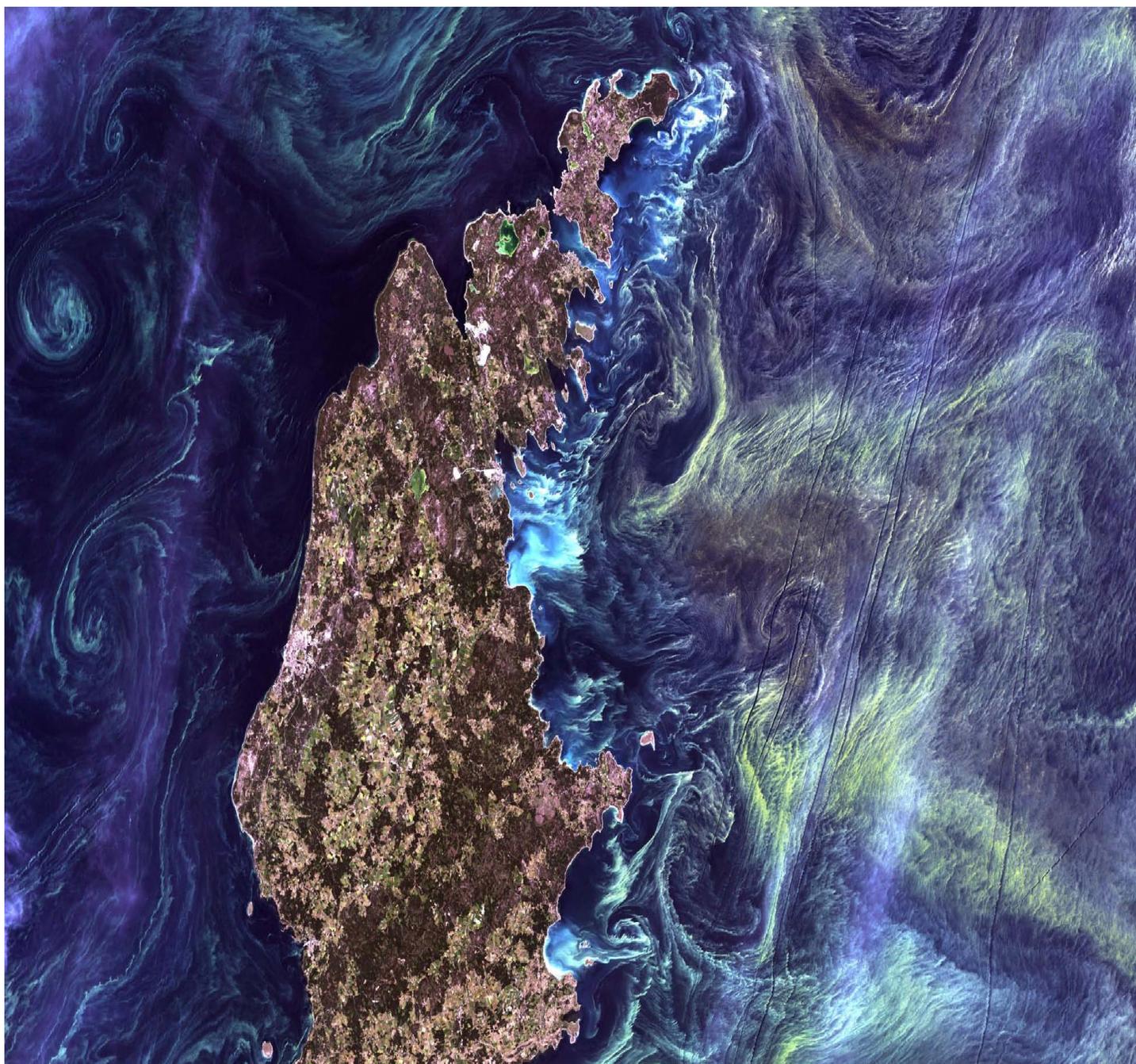
### Partner Organizations

Group on Earth Observations (GEO)

Instituto de Hidrologia Meteorología y Estudios Ambientales (IDEAM)

NASA DEVELOP National Program

National Oceanic and Atmospheric Administration





## DEVELOPedia

NASA Langley Research Center

*DEVELOPedia: NASA DEVELOP's Wiki — An Internal Resource for DEVELOPERS*

**Team:** Stephanie Rushley (lead), Matthew Carter, Charles Chiou, Rick Farmer, Kevin Haywood, Anthony Pototzky, Adam White, Daniel Winker

**Advisors:** Michael Bender, Lauren Childs-Gleason, Dr. Kenton Ross

**Project Partner:** NASA DEVELOP National Program

**Modeling/Software/Scripting Utilized:** MediaWiki

NASA DEVELOP tackles approximately 80 projects every year. Projects are stored on an internal system called the DEVELOP Exchange with no search function and limited user interactivity. With the objective of creating a useful and intuitive database, DEVELOPedia was designed to service the mass amounts of information and data related to DEVELOP. The initial framework was already in place, but the wiki was not complete. Extensions were added to grant users the ability to upload multiple files at once and display category trees for search assistance. Forms and templates were updated to display correctly and properly so DEVELOP participants can browse with ease. Sections to add data and search data were appropriately placed to greet users when they enter the front page. DEVELOPedia even allows users to view, upload, and edit data on DEVELOP application areas, locations, participants, and projects. Projects will be added each term providing a centralized and user-friendly location to serve DEVELOPERS and share institutional knowledge more easily between project teams to increase productivity, efficiency, and the quality of DEVELOP projects.

## GEO AIP-7 Colombia Application Development

NASA Langley Research Center

*Updating and Improving the Mi Pronostico Flood Web Application to Include an Assessment of Flood Risk*

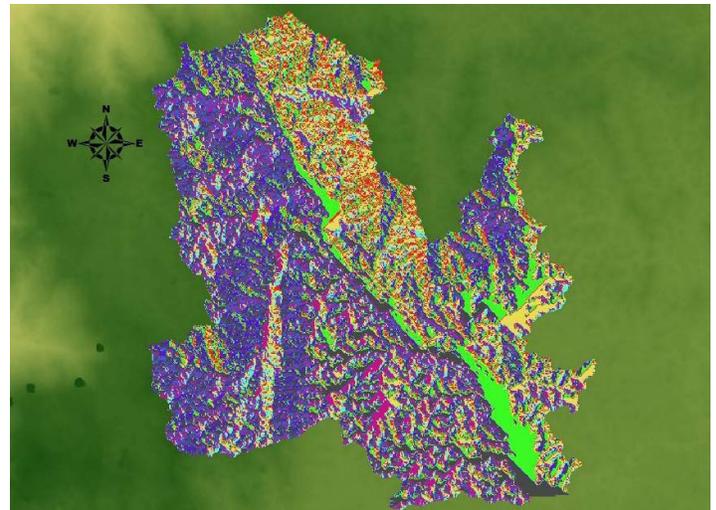
**Team:** Stephanie Rushley (lead), Matthew Carter, Charles Chiou, Rick Farmer, Kevin Haywood, Anthony Pototzky, Adam White, Daniel Winker

**Advisors:** Dr. Angelica Gutierrez-Magness, Ricardo Quiroga, Pilar Galindo, Michael Bender, Lauren Childs-Gleason, Dr. Kenton Ross

**Project Partners:** Instituto de Hidrología Meteorología y Estudios Ambientales (IDEAM), NOAA, NASA DEVELOP National Program, Group on Earth Observations (GEO)

**NASA Earth Observations Utilized:** Terra ASTER, TRMM PR

**Modeling/Software/Scripting Utilized:** ArcGIS, Oracle, SQL



Colombia's terrain is highly variable, ranging from the Andes Mountains' peaks to low-lying coastal areas, with many areas at risk of flooding. To identify risk, NASA's Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) data were used to construct a digital elevation model (DEM) for the study region. Precipitation data from the Tropical Rainfall Measuring Mission's (TRMM) near-real-time rainfall products and precipitation data from the Colombian Instituto de Hidrología, Meteorología y Estudios Ambientales (Institute of Hydrology, Meteorology and Environmental Studies — IDEAM) and stations in the La Mosca River Basin were used to create rainfall distribution maps for the region. The preliminary risk assessment was applied to a pilot study area of the La Mosca River basin. Using the precipitation data and the ASTER DEM, the web application, Mi Pronóstico, run by IDEAM, was updated to include an interactive map which allows users to search for a location and view the vulnerability and current conditions in rainfall and flood warnings. The geospatial information was linked to an early warning system in Mi Pronóstico that can alert the public of flood warnings and identify locations of nearby shelters.

## DEVELOP Participants

Anyone 18 and over who is interested in pursuing experience in the Earth sciences and remote sensing, including currently enrolled students, recent college graduates, early and transitioning career professionals, and current and former U.S. Military service members are eligible to apply. Applicants must have a minimum 3.0 GPA on a 4.0 scale at their current or last institute of higher learning), and the ability to transport themselves to and from the DEVELOP location.

- ▶ **U.S. Citizens** - Are eligible to apply to all DEVELOP locations.
- ▶ **International Applicants** - Foreign nationals who are currently enrolled or recently graduated from a U.S. accredited university are eligible to apply to DEVELOP's regional and academic locations, but not NASA Center locations. Acceptances for foreign nationals are conditional upon proof of a valid visa, I-20 form, and an approved CPT/OPT that will allow them to legally work within the United States. Applicants who do not meet these requirements are not eligible to participate.

## DEVELOP End-Users and Partners

Any organization that is making decisions relating to environmental concerns and is interested in incorporating NASA Earth observations into that decision making process, is welcome to contact DEVELOP to discuss potential collaboration. For more information on partnering with DEVELOP, please visit the DEVELOP website's Partner page.

<http://develop.larc.nasa.gov/partners.html>

## DEVELOP Advisors

A broad spectrum of advising supports DEVELOP projects, ranging from remote sensing experts to specialists relating to specific project topics. If you are interested in volunteering your time advising a DEVELOP project, please contact the DEVELOP National Program Office to discuss potential opportunities at [NASA-DL-DEVELOP@mail.nasa.gov](mailto:NASA-DL-DEVELOP@mail.nasa.gov)

## Stay in Touch



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<https://plus.google.com/+NASADEVELOP/posts>



[https://twitter.com/NASA\\_DEVELOP](https://twitter.com/NASA_DEVELOP)



<https://www.facebook.com/developnationalprogram>

**DEVELOP Alumni** — Keep an eye out for the annual alumni survey conducted by Wise County in relation to the Cooperative Agreement with NASA. The survey goes out by email in July and August.



<http://www.linkedin.com/groups?gid=4343498>

## Comprehensive Partner Organization List

Alaska Department of Natural Resources  
 American Samoa Coral Reef Advisory Group  
 Bayou Land Resource Conservation & Development Council  
 Bureau of Land Management  
 City of Los Angeles Hyperion Treatment Plant  
 City University of New York  
 Committee on Earth Observation Satellites (CEOS)  
 Common Ground Relief  
 Conservation International  
 Cooperative Institute for Climate and Satellites North Carolina  
 Department of Mines Minerals and Energy  
 Desert Research Institute  
 Digital Harvest  
 Disney Animal Kingdom  
 EnviraCarbon Incorporated  
 ESRI  
 Firestone Institute of Respiratory Health  
 Fundación Proyecto Tití  
 Georgia Power Company  
 Geospatial Centroid at Colorado State University  
 GISCorps of Urban and Regional Information Systems Association  
 Great Basin Landscape Conservation Cooperative  
 Great Lakes and St. Lawrence Cities Initiative  
 Group on Earth Observations (GEO)  
 Idaho Department of Water Resources  
 Instituto de Hidrología Meteorología y Estudios Ambientales (IDEAM)  
 Lake Champlain Committee  
 Louisiana State University  
 MarVivà  
 Mekong River Commission  
 Miami-Dade County Parks Recreation and Open Spaces Department  
 My Community Our Earth (MyCOE)  
 NASA Air Quality Applied Sciences Team  
 NASA DEVELOP National Program  
 NASA DISCOVER-AQ Team  
 NASA SERVIR  
 National Audubon Society  
 NOAA Center for Satellite and Applications Research (MD & CA)  
 NOAA National Climatic Data Center  
 Ocean Alliance  
 Orange County Sanitation District  
 Planet Earth Institute  
 Plotly  
 Proyecto Tití  
 Public Laboratory for Open Technology and Science  
 Red Cross Red Crescent Climate Centre  
 Rwanda Ministry of Agriculture and Animal Resources  
 South Coast Air Quality Management District  
 Southern California Coastal Water Research Project  
 Texas Commission on Environmental Quality  
 The Murulle Foundation  
 The Trust for Public Land  
 The University of Virginia's College at Wise  
 Universidad Tecnológica del Chocó  
 University of California Davis  
 University of Idaho  
 US Coast Guard Research and Development Center  
 US Environmental Protection Agency  
 US Fish and Wildlife Service Yukon Flats National Wildlife Refuge  
 USDA Agricultural Research Services Rangeland Resources Research Unit  
 USDA Forest Service Region 5  
 USDA Forest Service Eastern Forest Environmental Threat Assessment Center  
 USDA Forest Service Remote Sensing Applications Center  
 USGS Fort Collins Science Center  
 USGS Georgia Water Science Center  
 USGS National Earthquake Information Center  
 Vermont Department of Environmental Conservation  
 Virginia Department of Agriculture & Forestry  
 Virginia Department of Environmental Quality  
 Virginia Department of Natural Resources  
 Virginia Department of Technology  
 Virginia Office of Surface Mining Reclamation & Enforcement  
 Virginia's Wise County  
 Water For People  
 Wetland Tree Foundation  
 World Bank Global Gas Flaring Reduction  
 World Bank Institute  
 World Bank Open Data Initiative



# Dream Discover DEVELOP

**DEVELOP**  
National Program

National Aeronautics and  
Space Administration

<http://develop.larc.nasa.gov>

NP-2014-07-541-LaRC