**NASA DEVELOP National Program**

NASA Marshall Space Flight Center

**Summer 2015**

**Short Title: East Africa Disasters**

**Subtitle:** Using NASA Satellite Data to Predict Landslide Hazard in Uganda and Rwanda

**VPS Title:** Look Out! The Ground is Moving

**Project Team & Partners**

**Project Team:**

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**Advisors & Mentors:**

Dr. Jeffrey Luvall (NASA at NASA Space Science and Technology Center)

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**Partner Organizations**

NASA SERVIR Coordination Office at MSFC, Collaborator/Boundary Organization/End-User, POC: Eric Anderson

SERVIR Applied Sciences Team at NASA GSFC, Collaborator/End-User, POC: Dr. Dalia Kirschbaum

Regional Centre for Mapping of Resources fro Development (RCMRD), Collaborator/End-User, POC: Denis Macharia

**Project Details**

**Applied Sciences National Applications Addressed:**

Disasters

**Study Area:** Rwanda and Uganda

**Study Period:** Jan 1998 - present

**Earth Observations & Parameters**

Landsat 5, Thematic Mapper (TM) - Visible and Near Infrared Reflectance

Landsat 7, Enhanced Thematic Mapper Plus (ETM+) – Visible and Near Infrared Reflectance

Landsat 8, Operational Land Imager (OLI) – Visible and Near Infrared Reflectance

TRMM, Multi-satellite Precipitation Analysis (TMPA) – Precipitation

GPM, Dual-frequency Precipitation Radar (DPR) – Precipitation

SRTM2, C-Band – Digital Elevation Models

Google Earth, various – Visible and Infrared Reflectance

**Ancillary Datasets Utilized**

* NASA/SERVIR Global Landslide Catalog – dates and locations of landslides
* NASA’s Socioeconomic Data and Applications Center (SEDAC) Population Data – population density and locations
* USGS Climate Hazards Group InfraRed Precipitation and with Station Data (CHIRPS) – rainfall measurements

**Software Utilized**

ArcGIS – Raster Processing/Manipulation, Vector Data Processing, Map Creation of Landsat 5 TM, Landsat 8 ETM+, Landsat 8 OLI, TRMM TMP, GPM DPR, and SRTM2

ENVI – Raster Processing/Manipulation of Landsat and other imagery

R, MyStat or similar, statistical analysis of landslide points and potential explanatory factors

**Project Overview**

The East African countries of Uganda and Rwanda have a history of landslide disasters due to a combination of intense rainfall events and populations living on or near steep slopes. This project aims to assess and map landslide prone regions of Uganda and Rwanda by utilizing a host of geospatial datasets along with historical landslide accounts recorded in the Global Landslide Catalog (GLC). A more refined understanding of regional landslide triggers can air local mitigation efforts and help educate those living in susceptible areas on signs of imminent landslides.

**Abstract**

There are several hotspots for landslides throughout Rwanda and Uganda. This is due to local conditions such as topography, intense rainfall events, and populations living on or near steep slopes. Totals for individual countries are poorly tracked, but a total of 2,620 fatal landslides caused the death of 32,322 people worldwide between 2004 and 2010. Few efforts utilize satellite imagery to collect information regarding landslides in order to help estimate areas susceptible to landslides in this region. This project utilized Landsat 5, Landsat 7, and Landsat 8 to depict landslides that were added to SERVIR’s Global Landslide Catalog (GLC). The Landsat series, the Tropical Rainfall Measuring Mission (TRMM), the Global Precipitation Measurement (GPM), and Shuttle Radar Topography Mission-Level 2 (SRTM2) were used to create a Landslide Hazard Potential Map and gave a preliminary assessment of the relative performance of GPM and TRMM in identifying landslide conditions. The additions to the GLC, the Landslide Hazard Potential Map, and the preliminary assessment of satellite rainfall performance will be used by SERVIR and the Regional Centre for Mapping of Resources for Development (RCMRD) for disaster risk management, land use planning, and determining landslide conditions and moisture thresholds.

**Community Concerns**

* Landslides threaten life and infrastructure in Uganda and Rwanda
* A lack of spatial and temporal information make landslide risk management difficult for Ugandan and Rwandan officials
* A means of predicting landslide susceptibility is needed in Uganda and Rwanda since many vulnerable people are unwilling to relocate for cultural reasons

**Current Management Practices & Policies**

Due to their high elevation and precipitation amounts, the East African countries of Rwanda and Uganda are both extremely prone to landslides. Currently, both national governments have disaster preparedness policies and programs, but these efforts are limited in scope and are more focused on disaster response than prevention or early warning. These countries lack the spatial and temporal information required to accurately and effectively identify hazardous areas and properly warn at-risk populations. SERVIR’s Global Landslide Catalog (GLC) will aid disaster management teams and foreign governments, such as those of Rwanda and Uganda, in identifying at-risk areas. However, the catalog currently only collects data through online media reports, meaning that it only has information on major landslides affecting large numbers of people. In order to give a more accurate representation of the most at-risk areas, the catalog must incorporate data from other avenues and must be supplemented by additional materials.

**Decision Support Tools & Benefits**

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| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Landslide Hazard Potential Map | Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI, TRMM TMPA, GPM DPR, SRTM2 C-Band | This map will give government agencies and support groups information on where landslides may strike within the study areas |
| Improvements/Updates to Global Landslide Catalog (GLC) | Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI | Additions to the GLC will provide a more comprehensive list of landslide occurrences, enabling SERVIR to more effectively support landslide monitoring efforts |
| Preliminary Assessment of Satellite Rainfall Performance in Identifying Landslide Conditions | TRMM TMPA, GPM DPR | This assessment will highlight how satellite PR products characterize conditions needed for a landslide to occur, including moisture thresholds |

**Project Imagery**

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**Caption:** [Insert Caption Here. Max of 25 words.] Image Credit: [Insert project short title] Team.

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