**NASA DEVELOP National Program**

****International Research Institute for Climate and Society

**Summer 2015**

**Short Title: Malawi Disasters**

**Subtitle:** Applications of Flood Definitions and NASA Earth Observations to Create a Flood Forecasting Methodology

**VPS Title:** The Flash Factor: Creating a Flood Forecasting Framework

**Project Team & Partners**

**Project Team:**

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**Advisors & Mentors:**

Dr. Pietro Ceccato (Lead, Environmental Monitoring Program, international Research Institute for Climate and Society, The Earth Institute, Columbia University).

**Past or Other Contributors:**

Jerrod Lessel

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**Partner Organizations**

Red Cross/Red Crescent Climate Centre (RCRCCC), Boundary Organization, POC: Erin Coughlan

Malawi Red Cross Society, End-User, POC: Hastings Kandaya

**Project Details**

**Applied Sciences National Applications Addressed:**

Disasters

**Study Area:** Malawi

**Study Period:** December 2014 to February 2015

**Earth Observations & Parameters**

* Aqua and Terra, MODIS - Water body delineation (DFO flood product)
* Aqua and Terra, LANCE MODIS - Flood detection (NRT-GFM flood product)
* TerraSAR-X, Synthetic Aperture Radar (SAR) - Flood detection
* RADARSAT, Synthetic Aperture Radar (SAR) - Flood detection
* RADARSAT-2, Synthetic Aperture Radar (SAR) - Flood detection
* TRMM, Precipitation Radar (PR) - Rainfall
* TRMM, TRMM Microwave Imager (TMI) - Rainfall
* TRMM, Visible and Infrared Scanner (VIRS) - Rainfall
* Aqua, Advanced Microwave Scanning Radiometer Earth Observing System (AMSR-E) - Rainfall
* Defense Meteorological Satellite Program (DMSP) satellites, Special Sensor Microwave Imager (SSM-I) - Meteorological data
* Aqua, Microwave precipitation Estimates (AMSU-A) - Rainfall
* ESA SMOS (Soil Moisture and Ocean Salinity), Microwave Imaging Radiometer using Aperture Synthesis (MIRAS) radiometer - Soil Moisture
* EUMETSAT METOP, Advanced Scatterometer (ASCAT) Soil Water Index

**Ancillary Datasets Utilized**

Provider & Dataset - Parameter (*examples below, please bulletize*)

* USGS National Land Cover Dataset (NLCD) - Land cover
* NOAA Coastal Change Analysis Program (C-CAP) - Regional land cover
* EPA AIRNow PM2.5 dataset - PM2.5 measurements

**Models Utilized**

* University of Maryland/University of Washington Dominant river tracing-Routing Integrated with VIC Environment (DRIVE) model

**Software Utilized**

ArcGIS - Raster manipulation/analysis, map creation of Dartmouth Flood Observatory, NASA NRT-GFM Flood Mapping Products, TerraSAR-X, RADARSAT, RADARSAT-2, and ground truth data

**Project Overview**

During extreme climate events, such as the January 2015 Malawi flood disaster, humanitarian organizations rely on Earth observation (EO) data to evaluate impact and design response programs. This project built on the previous analysis of various EO flood detection products and incorporated specific flood definitions to better identify impacts of flash floods versus riverine floods. These definitions will then be incorporated into a methodology to better monitor and forecast flash flood events in vulnerable areas.

**Abstract**

In January 2015, Malawi, in southern Africa, experienced a series of flood events, which resulted in the displacement of over 230,000 residents and left 276 people reported dead or missing. During the disaster, the combination of extreme rainfall on a short time scale, but large spatial area resulted in both river-overflow floods and flash floods. Differences between these distinct flood types affected communities in Malawi differently, and the resulting relief effort was hampered by insufficient information provided to responders. From a partnership with the Malawi Red Cross and supported by a review of media reports, it was shown that there were challenges in order to reach the affected population in a timely manner. A previous comparative analysis of several spatial inundation products by the Malawi Disasters Spring 2015 team concluded the following; 1) There is inconsistency in the spatial distribution of a flood signal across flood products relative to a specific flood type and 2) Some flood products seem to be useful in detecting flash floods while others seem useful for detecting riverine floods. This project aims to produce a framework for analyzing flood detection skill relative to flash floods to inform a framework for better monitoring and forecasting those events in vulnerable areas. Along with previous flood products and NASA Earth observing satellites, this project will incorporate several ESA (European Space Agency) satellites to incorporate soil moisture as an important variable in flash flood detection. It is expected that the results of this study will increase the ability to monitor different types of flood events, which will benefit organizations involved with disaster relief efforts in Malawi; allowing for a quicker response and more appropriate allocation of emergency flood relief efforts.

**Community Concerns**

* January 2015 floods in Malawi resulted in 276 deaths, 153 people missing, and over 230,000 people displaced. The affected population is in urgent need of nutritional supplies, shelter, and drinkable water.
* Due to the spatial and temporal characteristics of flash floods, flood detection products are rarely able to identify them. Communities affected by the flash floods may be overlooked by disaster responders, or delay relief aid.
* Potential to improve flash flood detection and prediction using satellite products is not only vital for local preparation, but also for enhancing the efficiency of relief aid delivery.

**Current Management Practices & Policies**

Remote regions in Africa often have sparse meteorological and ecological satellite and ground data. Project partners in this region rely heavily on remotely sensed data as it increases the temporal and geospatial scales of projects. Data from NASA satellites and sensors (e.g. Aqua MODIS, Terra MODIS and TRMM) enable project partners working in these regions to better evaluate the impact extent and develop response programs.

**Decision Support Tools & Benefits**

|  |  |  |
| --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Flash Flood Monitoring Framework | TRIMM, MODIS, Aqua, Terra, TerraSAR-X, RADARSAT, RADARSAT-2, SMOS, EUMETSAT METOP, | Malawi Red Cross and other humanitarian decision makers will be better equipped to develop more effective response programming. |

**Project Imagery**

**TO BE COMPLETED**

**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)