**NASA DEVELOP National Program**

****National Centers for Environmental Information (NCEI)

**Summer 2015**

**Short Title: Southwest United States Disasters**

**Subtitle:** Incorporating CDRs and MODIS to Create a Predictive Model of Post-Burnout Vegetation Regrowth in Relation to Flood Risk

**VPS Title:** Establishing Correlations between Flooding and NDVI to Enhance Predictive Modeling of Post-Burnout Flood Risk

**Project Team & Partners**

**Project Team:**

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**Advisors & Mentors:**

DeWayne Cecil (Chief Climatologist and Program Manager, Global Science & Technology (GST) National Centers for Environmental Information (NCEI))

Gregg Garfin (Investigator, Climate Assessment for the Southwest (CLIMAS))

Tim Brown (Director, Western Regional Climate Center (WRCC))

Dennis Staley (Research Physical Scientist, USGS Landslide Hazards Program)

Jason Kean (Research Hydrologist, USGS Landslide Hazards Program)

**Partner Organizations**

Climate Assessment for the Southwest (CLIMAS), Collaborator, POC: Gregg Garfin

Western Regional Climate Center (WRCC), Collaborator, POC: Tim Brown

**Project Details**

**Applied Sciences National Applications Addressed:**

Disasters

**Study Area:** Lower Colorado River Basin, Tucson, Arizona

**Study Period:** June 2002 – August 2014, May - October

**Earth Observations & Parameters**

PERSIANN-CDR, GridSat-B1 – Infrared water vapor

CMORPH-CDR, Passive microwave and infrared from several geostationary satellites – Precipitation rate

Terra, ASTER – Digital Elevation Model (DEM)

Terra, MODIS – Normalized Difference Vegetation Index (NDVI)

**Ancillary Datasets Utilized**

* Burned Area Emergency Response (BAER) Burned Area Reflectance Classification (BARC) Imagery – Soil Burn Severity
* US Department of Agriculture (USDA) Arizona General Soil Map – Soil Classification
* USGS National Land Cover Dataset (NLCD) - Land Cover
* USGS Gaging Stations

**Models Utilized**

* USGS Landslide Hazards Program Post-Fire Debris Flow Hazards tool

**Software Utilized**

ERDAS IMAGINE – deriving NDVI from Landsat imagery, Image Enhancement

ArcGIS – Raster Manipulation/Analysis, Image Enhancement & Map Creation of Landsat OLI and TM multispectral imagery

Python – Data Processing and Data Conversion

R – Stepwise Regression, Logistic Regression

**Project Overview**

**80-100 Word Objectives Overview**

This project seeks to establish a spatio-temporal relationship between vegetation regrowth as a function of NDVI and post-fire flood hazard over a 10-year period for Tucson, Arizona in the Lower Colorado River Basin. The MODIS NDVI product will be used to create a raster surface indicating vegetation regrowth rate on a per-pixel basis. The additional measure of vegetation regrowth will enhance the usefulness of the current USGS Landslide Hazards Program Post-Fire Debris Flow Hazards tool by incorporating it with the current parameters such as rainfall history, soil type, morphology, and burn severity. This study demonstrates the usefulness of these products by utilizing NOAA Climate Data Records (CDRs), NASA Earth Observations, and in-situ data as alternative sources for input parameters.

**Abstract**

Annual post-wildfire flooding events have fatigued land management teams in the Southwest United States as the cyclical events increase in intensity and frequency across the region. This study investigates the relationship between the vegetation regrowth process and flooding over a ten-year period following wildfire events in Tucson, Arizona within the Lower Colorado River Basin. Extensive studies have been conducted on post-burnout debris-flows or post-burnout vegetation regeneration, but few establish a relationship between both processes. In this study, MODIS-NDVI Earth Observations were first used to create a surface indicating vegetation regrowth rate on a per-pixel basis following historical wildfire events. Next, a multivariate regression was employed to establish the relationship between the vegetation regrowth product, NOAA CMORPH precipitation Climate Data Records, soil type, burn severity, and elevation to identify areas susceptible to post-burnout flooding. By incorporating vegetation regrowth, this analysis provides an additional predictor of post-fire flooding which can improve long-term predictive capability of tools currently available for managing future post-fire hazards.

**Community Concerns**

* Wildfires and flooding are two major disasters which cause economic damage and loss of life in the Southwest.
* Flood events that occur after periods of wildfires can lead to an increase in soil erosion and larger debris in flood waters.
* Incorporating this influence can lead to improved predictive capability of the potential for post-burn-out flood events.

**Current Management Practices & Policies**

Currently, the Burn Area Emergency Response (BAER) Imagery Support program, in coordination with the USGS Center for Earth Resources Observation and Science and USDA Forest Service Remote Sensing Applications Center provide satellite imagery on burn severity. USGS programs then incorporate the burn severity data into the current USGS Debris-Flow tool to assess potential debris-flow volumes after wildfire events. With limited in-situ data in the Southwest US, post-burnout flood modeling is limited.

**Decision Support Tools & Benefits**

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| --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| NDVI Extended Post-Burnout Flood Risk | PERSIANN-CDR GridSat-B1, CMORPH-CDR, Terra ASTER, MODIS NDVI | This tool allows the end-user to estimate vegetation regrowth post-burnout over an extended period of time. This can be used to improve post-fire risk of the previous and existing tools.  |
| NDVI-Based Vegetation Regrowth Rate | Terra MODIS NDVI | This will be a set of maps depicting average vegetation regrowth rate on a per-pixel bases for a series of fires in the study area. The accompanying python script allows for the replication and future development of the product to further advance post-fire flooding tools. |

**Project Imagery**

**[Insert image here]**

**Caption:** [We will use a raster from our vegetation regrowth analysis against a burn severity map] Image Credit: Southwest United States Disasters Team.

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