**NASA DEVELOP National Program**

Goddard Space Flight Center

**Summer 2015**

**Himalayan Disasters II**

*Utilizing a Landslide Identification Product and a Hazard Assessment Model for Enhanced Landslide Detection*

**Project Team:**

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**Partner Organizations**

International Centre for Integrated Mountain Development (ICIMOD), Partner

POC 1: Sebastian Wesselman

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**Applied Sciences National Applications Addressed:**

Natural Disasters

**Study Area:**

Nepal

**Study Period:**

February 2000 - June 2015

**Earth Observations & Parameters**

Landsat 8 OLI – Landslide Identification

TRMM TMPA, GPM IMERG – Rainfall

SRTM, 1 Arc-Second Global – Topography

ASTER, Global DEM - Topography

Aqua and Terra, MODIS – Land Cover, Permanent Water, and Leaf Area Index (LAI)

**80-100 Word Objectives Overview**

The objective of this study is to better characterize landslide hazards within the Nepal and Himalaya region in the wake of the Gorkha earthquake, which occurred on April 25, 2015. This study seeks to use the plethora of high resolution remote sensing data and international landslide mapping efforts carried out following the Gorkha earthquake in order to develop a landslide identification product by using data analysis and evaluation techniques as well as monitoring and reporting tools. We hope to develop near real-time identification products to help inform on the ground landslide risk management.

**Abstract**

Nepal and the Himalaya region is a hotspot for landslide activity due to its mountainous topography, complex terrain, and monsoon rains. There have been few regional or global efforts that document where landslide have occurred and estimate potential landslide conditions in near-real time. This study utilizes NASA Earth observations including Landsat 5 and 8, MODIS, SRTM, ASTER, TRMM and GPM information along with various ancillary datasets to create a sudden landslide identification product (SLIP) and validate the model results in Nepal, Brazil, and Central America. The hazard assessment model and SLIP will be used by the International Centre for Integrated Mountain Development (ICIMOD) to protect and manage ecosystems and villages in Nepal and to reduce poverty through integrated natural resource management and regional cooperation.

**Community Concerns**

Landslides cause hundreds of fatalities and millions of dollars in losses in the Nepal and Himalaya region annually. This is often due to landslides impacting poorly constructed buildings, vulnerable settlement locations and significant landslide susceptibility. In the wake of the M7.8 Gorkha earthquake, which occurred on April 25, 2015, landslides arose as a significant induced hazard that are likely to increase in frequency and severity during the upcoming monsoon season. The devastating Gorkha earthquake has caused increased scrutiny on the region resulting in an influx of international organizations mapping landslides and providing high-resolution imagery of the area. This presents an exciting research opportunity to develop near real-time automatic detection products from superior data, as well as improve and disseminate a hazard assessment and decision support tool for end-users. Additionally, landslides often obstruct valley bottoms, which dams rivers and exacerbates flood potential. With current underestimation of landslide impacts and the increasing trend in frequency and intensity of landslide events due to anthropogenic factors, this work is critical even outside the scope of the earthquake.

**Current Management Practices & Policies**

The International Centre for Integrated Mountain Development (ICIMOD) is an intergovernmental organization that serves eight regional entities located within the Hindu Kush Himalayan region, including Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. Through partnerships with regional institutions, ICIMOD is able to serve as a regional knowledge hub that provides its end-users with insight on how climate change and globalization impacts the fragile mountainous ecosystems. ICIMOD oversees a variety of programs that were constructed to generate innovative forecasting products. While ICIMOD has a variety of resources and projects, few efforts have been made to use remotely sensed information to document precise landslide locations and estimate potential landslide conditions in the region. Many existing models rely on reporting which can reduce the spatial accuracy as well as introduce underreporting biases. The hazard model produced in this study will be used by ICIMOD to protect and manage the river basin ecosystem and to reduce poverty through integrated natural resources management and basin-wide cooperation.

**Decision Support Tools**

* Sudden Landslide Identification Product (SLIP) – Using imagery from Landsat 8, large landslides can be identified from satellite imagery to help track the changes of landslide scars and to validate existing landslide databases
* Landslide Susceptibility Map- A static map created using bivariate analysis that details susceptibility levels

**Benefit to End-User:**

* Near-real time visualization of current landslides and highly susceptible areas
* Database detailing the spatial and temporal characteristics of landslides in the Nepal and Himalaya Region

**Models Utilized**

* NASA Landslide Hazard Assessment Model
* NASA Susceptibility Model

**Ancillary Datasets Utilized**

* (Source) Brazil Landslide Dataset (Date)
* (Source) Central America Landslide Dataset 1998
* ICIMOD Landslide Dataset 1992-2010 – visually assessed manually digitized landslides
* ICIMOD Lithology Dataset- geology
* USGS Landscan 2011- population
* USGS HydroSHEDS- rivers
* OpenStreetMap - roads
* ISRIC SoilGrids 1km – soil properties

**Software Utilized**

Python – Automation of Landslide Detection, Dynamic Landslide Model

R – Statistical analysis of LANDSAT imagery

ArcGIS - Raster Manipulation/Analysis, Image Enhancement & Map Creation of Landsat TM, NPP VIIRS, Aqua/Terra MODIS

MATLAB- TRMM/GPM processing