**NASA DEVELOP National Program**

****International Research Institute for Climate and Society (IRI)

**Summer 2015**

**Short Title:** Indonesia Disasters

**Subtitle:** Creating an Enhanced Methodology for Mapping Burn Scars in Indonesia by Transforming Red Green Blue False Color Composites to Hue Saturation Value (HSV) Images using Landsat

**VPS Title:** Finding Your Inner Hue: Mapping Burn Scars In Indonesia

**Project Team & Partners**

**Project Team:**

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**Advisors & Mentors:**

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

**Partner Organizations**

Bogor Agricultural University (IPB), Collaborator, POC: Rizaldi Boer

Center for International Forestry Research (CIFOR), Boundary Organization, POC: Louis Verchot

**Project Details**

**Applied Sciences National Applications Addressed:**

Disasters

**Study Area:** Central Kalimantan, Indonesia

**Study Period:** June - November 2006

**Earth Observations & Parameters**

Landsat 5, Thematic Mapper (TM) – Land Cover

Landsat 7, Enhanced Thematic Mapper Plus (ETM+) – Land Cover

Terra, MODIS - Active Fire Product and Normalized Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI), and Normalized Difference Water Index (NDWI)

Aqua, MODIS - Active Fire Product and NDVI, EVI, and NDWI

**Ancillary Datasets Utilized**

* NASA Active Fire Product - Burn scar confirmation

**Models Utilized**

* Hue Saturation Value (HSV) model (Pekel et al., 2011)

**Software Utilized**

ArcGIS - Raster Manipulation/Analysis, Image Enhancement & Map Creation of Landsat TM and ETM+, Aqua/Terra MODIS Active Fire Product

ENVI - Landsat image analysis and color transformation

IRI Data Library - Access and manipulation of climate variables

Excel - Statistical Analysis to assess skill of products

**Project Overview**

**80-100 Word Objectives Overview**

This project tested a new methodology for effectively mapping burn scars from fires in Central Kalimantan, Indonesia using Earth observations. Red Green and Blue (RGB) false color composites derived from Landsat images were transformed to Hue Saturation Value (HSV) in order to determine whether it was a more effective procedure for identifying burn scars.

**Abstract**

Fires associated with land use conversion activities such as agricultural expansion, palm and pulp plantations, peat land alteration, and industrial deforestation are significant in the country of Indonesia. The use of remotely sensed data to assess deforestation and carbon emissions over Indonesia is crucial in the monitoring of fires, as ground-based methods are not viable. Fires are currently mapped using data from the MODIS sensors, but its spatial resolution (500 m) is not ideal for accurate mapping of burn scars in the region. Thus, researchers have sought to map burn scars at a higher spatial resolution. We proposed using Landsat to accomplish this task, given its spatial resolution of 30 m. This study tested a new methodology for identifying burn scars utilizing remotely sensed products over Central Kalimantan, Indonesia using scenes from Landsat’s Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+). These scenes were used to assess a technique of transforming Red, Green, and Blue (RGB) color space to Hue, Saturation, and Value (HSV) space to decouple the hue from the saturation and value. When this technique was applied to a mid-infrared (MIR), near-infrared (NIR), and red false color composite, it enhanced the discrimination between vegetation, soil, and water – distinguishing burn scars from their surroundings. A hue value range for burn scars was determined; however, clouds were a limiting factor in the analysis. The approach was a good first step in reducing the amount of information one must sift through to isolate burn scars; however, more work is needed to improve this technique and develop a more automated approach for their detection.

**Community Concerns**

* Forest fires across Indonesia have increased over recent years endangering forests, communities, and wildlife. The impact from this has become so severe that in September of 2014, Indonesia finally ratified an agreement signed in 2002, which decided to concentrate efforts to reduce pollution from forest fires caused primarily by the mismanagement of land clearing activities.
* Current methods for mapping forest fires throughout the region involve using data from the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument, but given its limited spatial resolution (500 m) mapping burn scars at a higher resolution has been sought by numerous professionals in the field.
* The methodology for developing these burn scar maps at higher spatial resolution will be useful in assessing deforestation and carbon emissions within the Kalimantan region, as well as identifying regions that are prone to future fires based on previous fire activity within that area, as areas that have previously burned are more susceptible to future fires.
* Overall, the use of remotely sensed products to monitor fire damage in remote regions of Indonesia will be a valuable asset for areas that are otherwise inaccessible and cumbersome to monitor on the ground.

**Current Management Practices & Policies**

IPB, the Ministry of Forestry and CIFOR currently use the Fire Early Warning System developed by IRI to monitor and forecast risks of active fires based on climate information. Climate information is based on precipitation anomalies derived from NOAA’s Climate Prediction Center (CPC) Morphing Technique (CMORPH) data, active fires are monitored using MODIS hotspots (at moderate spatial resolution), fire vulnerability is derived from a Landsat land cover map created by IRI and IPB, vegetation status is monitored using MODIS, and fire risk is created by combining a fire vulnerability map with precipitation anomalies. Additionally, burn scar maps are used to assess deforestation and carbon emissions in Kalimantan.

**Decision Support Tools & Benefits**

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| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Methodology for mapping burn scars | Landsat TM and ETM+; Aqua and Terra MODIS | The use of remotely sensed products to monitor fire damage in remote regions of Indonesia is a valuable asset for areas that are otherwise inaccessible. Additionally, using Landsat will provide mapping methods at a higher spatial resolution over current methods. |

**Project Imagery**



**Caption:** MIR, NIR, and Red false-color composite (left) compared to an image with selected and isolated hues (greyscale), corresponding to burn scars (right) in Central Kalimantan. Image Credit: Indonesia Disasters Team.

**Image:** RGB\_Hue\_Clouds\_Burnscar\_sidexside.jpg

**Reference**

Pekel, J. F., Ceccato, P., Vancutsem, C., Cressman, K., Vanbogaert, E., & Defourny, P. (2011). Development and application of multi-temporal colorimetric transformation to monitor vegetation in the desert locust habitat. *Selected Topics in Applied Earth Observations and Remote Sensing, IEEE Journal of*, *4*(2), 318-326.