**NASA DEVELOP National Program**

****NASA Goddard Space Flight Center/NASA Marshall Space Flight Center/

Wise County Clerk of Court’s Office

**Summer 2015**

**Short Title: Alto Orinoco Health & Air Quality**

**Subtitle:** Utilizing NASA Earth Observations to Locate Yanomami Villages in the Alto Orinoco Municipality for Targeted Eradication of River Blindness Disease

**VPS Title:** It Takes a Village: Eradicating Disease through Remote Sensing

**Project Team & Partners**

**Project Team:**

Goddard Space Flight Center

Amanda Rumsey (Project Lead), amanda.c.rumsey@nasa.gov

Kyle Sowder

Timothy Larson

Marshall Space Flight Center

Sara Amirazodi (Project Lead), sa0061@uah.edu

Wise County and City of Norton Clerk of Court's Office

Rajkishan Rajappan (Project Lead), rajkishan16@gmail.com

Zachary Tate

Annabel White

**Advisors & Mentors:**

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

Dr. Jim Tucker (NASA Goddard Space Flight Center)

Dr. Kenton Ross (NASA DEVELOP)

Dr. Robert Griffin (University of Alabama in Huntsville)

Dr. Tom Sever (University of Alabama in Huntsville)

Dan Irwin (SERVIR)

**Partner Organizations**

The Carter Center, End-User, POC: Dr. Frank Richards

The University of Minnesota, Collaborator, POC: Claire Porter

**Project Details**

**Applied Sciences National Applications Addressed:**

Health and Air Quality

**Study Area:** Alto Orinoco Municipality, Venezuela

**Study Period:**

GSFC and WC: January 2005 – June 2015

MSFC: January 2011 - Present; Nov - Feb & May - Aug

**Earth Observations & Parameters**

Landsat 8, OLI and TIRS - Cloud-Free Composite of Study Area and Normalized Difference Vegetation Index (NDVI)

Terra, ASTER - Land Cover and Digital Elevation Model

SRTM - Digital Elevation Model

WorldView-1,2,3 - Land Cover

IKONOS - Land Cover

GeoEye-1,2 - Land Cover

QuickBird - Land Cover

**Models Utilized**

* University of Minnesota Digital Globe Mosaic Model

**Software Utilized**

ENVI 5.1 and ENVI Classic - Image Analysis using Vegetation Indices and Unsupervised K-means Classification

ESRI ArcGIS 10.2.1 and 10.3 - Raster Manipulation, Analysis of ASTER DEM and Landsat Data, Land Cover Classification of Landsat Imagery, and Map Creation

**Project Overview**

**80-100 Word Objectives Overview**

Onchocerciasis, also known as river blindness, is a neglected tropical eye and skin disease that is present among the indigenous and nomadic Yanomami tribes who live within the Alto Orinoco Municipality in the Venezuelan state of Amazonas. This study aimed to use NASA Earth observations and DigitalGlobe data to identify remote villages in densely forested areas. Mapping village locations will allow The Carter Center to pinpoint areas for initial disbursement of medical treatment, as well as returning to these locations for follow-up treatments.

**Abstract**

Onchocerciasis, or River Blindness, is a treatable disease caused by the vector-borne parasite, *Onchocerca volvulus.* The parasite is transmitted through bites of infected black flies from the genus *Simulium*. Once inside the human host, *O. volvulus* migrate to the skin, various organs, and eyes, causing debilitating itching and rashes, disfigurement, visual impairment, and complete blindness. The Alto Orinoco Municipality of Venezuela is the last remaining area for active transmission of onchocerciasis in the Americas. Yanomami tribes occupy the Alto Orinoco Municipality in secluded rainforest villages and migrate frequently due to shifting cultivation, flooding, and food shortages. The remote locations of the Yanomami villages present a unique set of challenges to health workers when distributing regular treatments, collecting data, and locating groups of nomadic people whose survival depends on relocating regularly and living in isolation.

The NASA DEVELOP team analyzed data from NASA’s Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) and Terra Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) to map suspected locations of the Yanomami villages from 2005 to 2015. Spectral analysis, cloud masking, and classification techniques along with Digital Globe high-resolution data were utilized to locate villages. A suitability model was also created with Landsat 8 OLI/TIRS and Shuttle Radar Topography Mission (SRTM) data. Ultimately, this project assisted The Carter Center River Blindness Elimination Program in targeting its efforts to eliminate onchocerciasis in the Americas by the end of 2015.

**Community Concerns**

* Onchocerciasis is classified as one of 17 debilitating Neglected Tropical Diseases (NTD) that the World Health Organization (WHO) and The Carter Center are working to eradicate.
* Globally, there are an estimated 120 million people at risk of contracting onchocerciasis.
* The majority of cases occur in developing countries among the world’s poorest communities. This is, in part, due to lack of access to adequate health care and treatment.
* In the Alto Orinoco Municipality of Venezuela there are approximately 20,500 people in need of treatment for onchocerciasis.
* Onchocerciasis is the second leading cause of blindness due to infection, second only to trachoma.
* The crippling effects of this disease reinforce the cycle of poverty by dramatically impacting a person's quality of life, ability to work, and ability to visually learn survival skills and cultural practices.

**Current Management Practices & Policies**

Currently, The Carter Center’s Onchocerciasis Elimination Program for the Americas (OEPA) has been working with the Ministries of Health in Latin America and the 2013 World Health Organization mandate CD52/INF4 towards the elimination of onchocerciasis (river blindness) in the Americas by the end of 2015. The Yanomami territories have presented significant difficulties in distribution of effective treatment due to their remote physical locations, rigid political boundaries, and limited research options. In the past, village identification has been performed by costly helicopter field surveys that were ineffective in predicting the migrations of the villages. More recently, The Carter Center purchased high resolution data and partnered with the University of South Florida in an attempt to use remote sensing methods for village identification. The Carter Center operates primarily by training local health workers to deliver treatments, conduct population censuses and collect data; they are seeking assistance in identifying remote, nomadic villages to expand operations and achieve a threshold of treatment that will assure disease eradication.

**Decision Support Tools & Benefits**

|  |  |  |
| --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Yanomami Village Location Map | Landsat 8 OLI/TIRS  WorldView-1,2,3  IKONOS  GeoEye-1,2  QuickBird | Provides End-Users with accurate locations of targeted villages for efficient planning of disease eradication missions. |
| Yanomami Suitability Map | Landsat 8 OLI/TIRS | Helps identify suitable habitable locations of Yanomami villages. |
| Land Cover Change Detection | Terra ASTER | Shows the migratory patterns of the Yanomami. |
| “Forest vs Non-Forest” Classification Map | Landsat 8 OLI/TIRS Cloud-Free Composite | The “Forest vs Non-Forest” Classification Map provides The Carter Center with vegetation and soil properties of the study area. |

**Project Imagery**



**Caption:** Elevation, slope, NDVI, NBR, and distance to stream were evaluated using a fuzzy membership technique to create a habitat suitability model for the Yanomami people