**NASA DEVELOP National Program**

NASA Marshall Space Flight Center

*Summer 2017*

**Short Title: Thailand Cross-Cutting**

**Subtitle:** Utilizing Suomi NPP’s Day-Night Band to Assess Energy Consumption and Investigate its Suitability as a Proxy for Poverty in Thailand

**VPS Title:** In the Spotlight: Using Night Time Light Emissions to Assess Energy Consumption and Poverty

**Project Team**

**Project Team:**

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**Project Overview**

**80-100 Word Objectives Overview:**

Partnering with the Asian Disaster Preparedness Center (ADPC), Royal Thai Embassy, and NASA SERVIR Coordination Office, the project aimed to measure night-time light across Thailand to utilize as an input to poverty analyses. Light emissions are measured with Suomi National Polar-orbiting Partnership Visible Infrared Imaging Radiometer Suite’s Day/Night Band (Suomi NPP VIIRS DNB). Analyses of energy consumption in Thailand include the degree to which electricity decreases outside of a city, distance of lights from major highways, and seasonality of light. The resulting enhanced poverty indices, combined with other census demographics, will help inform and support poverty reduction and aid efforts.

**Abstract:**

While poverty in Thailand has decreased from 67% in 1986 to 13% in 2012, 6.7 million people were still living within 20% of the poverty line in 2014. Economic uncertainty caused by recurring droughts and decreasing agricultural prices puts this vulnerable part of the population at risk of dropping below the national poverty line in the future. In order to address this issue, the DEVELOP team worked with the Office of Science and Technology (OSTC) at the Royal Thai Embassy, Asian Disaster Preparedness Center (ADPC), and the NASA SERVIR Coordination Office to formulate a new method of analyzing poverty within Thailand. This project utilized the monthly composite product for 2012-2015 produced by the Earth Observations Group (EOG) at National Oceanic and Atmospheric Administration (NOAA) and National Geophysical Data Center (NGDC). Additionally, this project incorporated socio-economic data from Thailand’s Ministry of Information and Communication Technology’s National Statistical Office and Ministry of Education’s National Education Information System to create an enhanced poverty index. This new poverty index will provide the Thai government a cost-effective way to analyze changes of poverty within the nation and inform policy making.

**Keywords:**

Night-time lights, poverty, Suomi, remote sensing, Visible Infrared Imaging Radiometer Suite (VIIRS), energy consumption, light emission, Thailand

**Partner Organizations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Asian Disaster Preparedness Center (ADPC) | Peter Cutter, SERVIR Mekong Science & Data Co-Lead  Peeranan Towashiraporn, Chief of Party | End User | Yes |
| Royal Thai Embassy, Office of Science and Technology | Gam Bunyakiat Petri, Project Consultant and Policy Analyst | Collaborator | Yes |
| NASA SERVIR Science Coordination Office | Eric Anderson, SERVIR-Mekong Science Coordination Lead  Kel Markert, SERVIR -Mekong Research Associate | Collaborator | No |

**Community Concerns:**

* Currently 13% of the population is impoverished—however, recurring droughts, decreases in agricultural prices, and, therefore, an unstable economy, all contribute to a rise in poverty over the next few decades.
* According to the World Bank, 6.7 million people live within 20% above the national poverty line and are at risk of becoming impoverished if the economy slows; therefore, it is important to determine new methods to identify areas of, as well as at risk of, poverty.
* According to project partners, conducting surveys takes substantial manpower and generates economic costs, leading to calls from the media for the Royal Thai Government to incorporate more Geographic Information Systems (GIS) and remote sensing into their decision making.

**Current Decision-Making Practices & Policies**:

The Asian Disaster Preparedness Center (ADPC) and the NASA SERVIR Coordination Office improves disaster resilience in the Asia-Pacific region. After identifying and quantifying risk through remote sensing, Geographic Information Systems (GIS), economic modeling, and other methods, ADPC strengthens institutions by assisting decision-makers and decision support systems with using data to address risks associated with disaster. The ADPC frequently uses remotely sensed data, with about 50% of that data originating from NASA. This includes extensive use of Landsat and Moderate Resolution Imaging Spectroradiometer (MODIS) data products, as well as Global Precipitation Measurement (GPM) products. ADPC currently uses some layers relating to poverty. Currently, the Royal Thai Embassy uses survey data to create poverty maps in Thailand. These survey data are from the National Statistical Office.

**Decision Support Tools & Benefits:**

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Earth Observations Used** | **Partner Benefit & Use** | **Software**  **Release** |
| Night-Time Light Seasonality Time Series | Suomi NPP VIIRS DNB | This time series will show light emissions of different seasons throughout the year. This will be useful for determining the seasonality of energy consumption in Thailand. | N/A |
| Energy Consumption Analyses | Suomi NPP VIIRS DNB | Factors such as the degree at which light emissions decrease further away from cities and roads as well as light emissions over different land types will aid in the studies of how energy consumption in Thailand relates to socioeconomic conditions. | N/A |
| Socioeconomic Analysis of Poverty in Thailand | Suomi NPP VIIRS DNB | This is a correlation of normalized NTL with poverty index applicable to Thailand produced by Principle Component Analysis (PCA). | N/A |

**Project Benefit to End User**:

These products are beneficial to the end user by identifying areas where aid should be directed for members of the population that are impoverished. This study offers a less costly and time-intensive survey of poverty in Thailand. These products will also increase the partners’ capacity to use remote sensing methods of analyzing socioeconomic issues throughout Southeast Asia.

**Project Details**

**Applied Sciences National Application Addressed:** Cross-Cutting

**Study Area:** Thailand

**Study Period:** Jan 2013 – Dec 2015

**Earth Observations & Parameters:**

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| Suomi NPP VIIRS | Day/Night Band (DNB) | Suomi NPP’s DNB is used to identify areas that lack high light emissions as a proxy for poverty occurrence. |

**Ancillary Datasets Utilized:**

* Number of Students, Ministry of Education’s National Education Information System – number of students per educational level on the provincial level in 2013 and 2015
* Fatal Occupational Injuries, Ministry of Labour’s Labour Welfare Fund Office – number of occupational injuries on the provincial level from 2013 to 2015
* Unemployment Rate, Ministry of Information and Communication Technology’s National Statistical Office’s Labor Force Survey – unemployment rate for 2007 through 2016 on the provincial level, Bueng Kan Province is excluded before March 23, 2011
* Population Density, Ministry of Interior’s Department of Provincial Administration – population density on the provincial level for 2006 to 2015
* Medical Service Rate, Ministry of Information and Communication Technology’s National Statistical Office’s Economic Survey – number of times each person visits a doctor each year through the social security system on the provincial level from 2013 to 2015
* Average Monthly Expenditure, Ministry of Information and Communication Technology’s National Statistical Office’s Socio-Economic Survey – average monthly expenditure per household on the provincial level for alternate years from 1998 to 2015
* Average Monthly Income, Ministry of Information and Communication Technology’s National Statistical Office’s Socio-Economic Survey – average monthly income per household on the provincial level from 2006 to 2015. Bueng Kan Province is excluded before March 23, 2011
* Gross Provincial Product (GPP), Office of the Prime Minister’s Office of the National Economic and Social Development Board – gross provincial product on the provincial level from 2005 to 2015. Bueng Kan Province is excluded before March 23, 2011
* Electricity Usage, Metropolitan Electricity Authority (MEA) & Provincial Electricity Authority (PEA) for all other provinces – electricity usage on the provincial level from 2006 to 2015; MEA provides electricity usage data for Bangkok, while PEA provides data for all other provinces; Bueng Kan Province is excluded before March 23, 2011
* Water Usage, Metropolitan Waterworks Authority & Provincial Waterworks Authority – water usage on the provincial level from 2006 to 2015; the Metropolitan Waterworks Authority provides water usage data for Bangkok, Samut Prakan and Nonthaburi, while the Provincial Waterworks Authority provides data for all other provinces; Bueng Kan Province is excluded before March 23, 2011
* Poverty Line, Office of the Prime Minister’s Office of the National Economic and Social Development Board – minimum level of income determined necessary to secure the necessities of life on the provincial level from 2000 to 2015; Bueng Kan Province is excluded before March 23, 2011

**Software Utilized:**

* Esri ArcGIS 10.4 – raster manipulation and analysis, image enhancement, and map creation of Suomi NPP DNB
* IBM SPSS Statistics 24 – conduct Principle Component Analysis (PCA) of socio-economic factors

**Project Handoff Package**

**Transition Plan:**

The handoff of project end products for local partners will occur via flash drive during an in-person presentation. For non-local partners, end products will be delivered virtually in conjunction with a teleconference or Google Hangout presentation of the project’s findings. The partners will use this information during their decision making in Thailand. A software release is not needed for this project.

**Team POC:** Helen Baldwin, helenbluebaldwin@gmail.com

**Handoff Package:**

* Night-Time Light Seasonality Time Series
* Energy Consumption Analyses
* Socioeconomic Analysis of Poverty in Thailand
* All final deliverables
* Link to VPS video
* All shapefiles and ArcMap Documents