**NASA DEVELOP National Program**

**2018 Summer Project Proposal**

**Alabama – Marshall**

**Hindu-Kush Himalayan Disasters**

*Integrating NASA Earth Observations to Monitor Intense Thunderstorms and Assess Lightning Exposure and Risk in the Hindu-Kush Himalayan Region*

**Project Overview**

***Project Synopsis*:** This project integrates multiple NASA Earth observations to develop tailored, regional products that promote high impact thunderstorm hazard awareness in developing countries of the Hindu-Kush Himalayan (HKH) region. The partners for this project, the NASA Global Hydrology Resource Center Distributed Acitve Archive Center, the Nepal Department of Hydrology and Meteorology (DHM), NASA SERVIR Science Coordination Office, and the International Centre for Integrated Mountain Development (ICIMOD), aim to bring awareness to lightning-prone areas, increase the research on lightning casualties, and help facilitate timely disaster response by partners in the HKH region.

***Community Concern:*** The HKH region experiences some of the most intense thunderstorms on Earth and is a lightning hotspot. Furthermore, populations in countries such as Nepal and Bangladesh have a history of casualties due to lightning strikes. The Nepali National Emergency Operation Centre reported that lightning was responsible for 553 deaths and 1,132 injuries in Nepal in a recent five-year period. The products developed for this project are needed to better equip local decision makers in prioritizing where aid is sent during extreme thunderstorm events as well as raise awareness of where lightning occurs.

***Source of Project Idea:*** This project originated during a discussion with Leigh Sinclair from the NASA GHRC DAAC who connected the DEVELOP leadership team with Dr. Patrick Gatlin of the NASA SERVIR Applied Sciences Team. A meeting between the parties was held during which the DHM expressed interest in partnering with DEVELOP to highlight and use GHRC DAAC lightning data for an applied Earth science application while aiding NASA SERVIR AST PIs in their efforts to provide useful resources for the people living in the Hindu-Kush Himalayan area concerned with lightning safety efforts.

***National Application Area Addressed:*** Disasters

***Study Location:*** Nepal, Bangladesh

***Study Period:*** January2000 – May 2017

***Advisors:*** Dr. Jeffrey Luvall (NASA Marshall Space Flight Center), Dr. Robert Griffin (University of Alabama in Huntsville), Leigh Sinclair (University of Alabama in Huntsville/Information Technology and Systems Center), Dr. Patrick Gatlin (NASA Marshall Space Flight Center), Maggi Klug (University of Alabama Huntsville)

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| **Ministry of Population and Environment, Department of Hydrology and Meteorology (Nepal)** | Dr. Rishi Ram Sharma, Director General | End User | No |
| **International Centre for Integrated Mountain Development (ICIMOD)** | Mir Matin, Science and Data Lead for SERVIR-HKH | Collaborator | Yes |
| **NASA SERVIR Science Coordination Office** | Lee Ellenburg, Research Associate | Collaborator | Yes |
| **NASA Global Hydrology Resource Center Distributed Active Archive Center** | Leigh Sinclair, Research Associate | Collaborator | No |

***End User Overview***

***End User’s Current Decision-Making Process:***The DHM is involved with extensive hydrologic and meteorological research in Nepal. They also serve as a focal point for the Intergovernmental Panel on Climate Change and meteorological activities of the South Asian Association for Regional Co-operation. The DHM primarily collects data from the over 600 collection stations they maintain. These stations include precipitation, hydrometric, sediment, climatic, agrometeorological, synoptic, and Aero-synoptic stations, which provide data for research and educational activities.

***End User’s Capacity to Use NASA Earth Observations:***

*Ministry of Population and Environment, Department of Hydrology and Meteorology (Nepal)* – The DHM primarily collects hydrological and meteorological *in situ* data from the collection stations that they manage. This data is disseminated to various organizations who use it for natural disaster mitigation and other water resources, agriculture, and energy development activities.

***Collaborator & Boundary Organization Overview***

***Collaborator Support:***

*International Centre for Integrated Mountain Development (ICIMOD)* – ICIMOD will participate in biweekly meetings with the team and will provide both expertise on the mountain ecosystems and will provide additional climatic data for the HKH region.

*NASA SERVIR Science Coordination Office* –SERVIR will be involved through biweekly meetings with the team where they will offer their expertise in remote sensing and experience with the HKH region. Additionally, they will facilitate communication with the SERVIR-Himalaya regional hub, ICIMOD.

*NASA Global Hydrology Resource Center Distributed Active Archive Center* – The GHRC DAAC hosts the data used in this project, develops instructional guides on how to use them, and can offer advice regarding the data and tools.

***Dissemination by Boundary Organizations*:**

*International Centre for Integrated Mountain Development (ICIMOD)* – ICIMOD serves as the NASA SERVIR hub in the HKH region. ICIMOD and NASA SERVIR AST will partner together and use these methodologies and results created from this project to assist in future research as well as disseminating it to local decision makers, such as Nepal’s Ministry of Homeland Affairs, and to those in lightning prone areas of Nepal and Bangladesh.

*NASA SERVIR Science Coordination Office* –NASA SERVIR is connected with ICIMOD through the SERVIR-Himalaya hub. NASA SERVIR and ICIMOD will partner together and use the methodologies and results created from this project to assist risk managers in locating lightning prone areas of Nepal and Bangladesh. This will broaden the community’s understanding of lightning risk in their region.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** The Project Lead will be the POC for the project partners. The team will meet with the partners via telecon once every one or two weeks. During the first meeting, the partners will be introduced to the team and discuss any changes to the desired end products.

***Transition Plan*:** The end products will be handed off to ICIMOD via email or Google Drive. This will occur after the team presents their results to the partners either through a virtual presentation or through virtual means. The tools will be available immediately to be used and implemented by the project partners.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter** | **Use** |
| **TRMM LIS** | Lightning flashes | TRMM LIS climatology data will be utilized to identify lightning strikes throughout the HKH during the study period.  |
| **TRMM TMI** | Precipitation | TMI information will be correlated with LIS data to determine if heavier precipitation can be used as an early warning indicator of increased lightning strikes. |
| **GPM IMERG** | Precipitation | GPM information will be correlated with LIS data to determine if heavier precipitation can be used as an early warning indicator of increased lightning strikes. |

***Ancillary Datasets:***

NASA SERVIR ClimateServ – correlate TRMM LIS data to GPM IMERG precipitation measurements

NASA Socioeconomic Data and Application Center (SEDAC) Population dataset – calculate statistics of members of the population who are exposed to higher percentages of lightning strikes

Oak Ridge National Laboratory (ORNL) Population Dataset – calculate statistics of members of the population who are exposed to higher percentages of lightning strikes

***Software & Scripting:***

Esri ArcGIS 10.4 – raster manipulation and analysis, image enhancement, and map creation

R – statistical analysis

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| **Precipitation and Lightning Correlation** | This correlation will be used to predict lightning strikes in the area. If it is determined that higher precipitation implies a higher risk of lightning strikes, project partners can put out more early warning notices that include the level of lightning risk as well. | Precipitation data from GPM IMERG will be compared to TRMM LIS datato determine if higher precipitation rate in this area correlates with a higher rate of lightning strikes. | N/A |
| **Lightning Exposure Maps for Nepal and Bangladesh** | The exposure to lightning maps will show which areas in Nepal and Bangladesh historically experienced higher lightning counts. | TRMM LIS data will be averaged and mapped across study area for each region in Nepal and Bangladesh. This will show historical areas of lightning flashes. | N/A |
| **Lightning Risk Maps for Nepal and Bangladesh** | Lightning Risk Maps will allow the partners to identify areas that are prone to high occurrences of strikes that impact the most vulnerable members of Nepal and Bangladesh. Using these data, the partners can prioritize where aid is needed the most. | Socioeconomic data will be intersected with the Lightning Exposure Maps in order to calculate statistically which regions of the study area have more high-risk members of the population exposed to high rates of lightning strikes. | N/A |

***End-User Benefit*:** The end products created from this project will aid DHM in facilitating research on the density and occurrence of lightning in the area (i.e., enrich lightning safety awareness). Additionally, they will promote a greater understanding and increase use of data available through the GHRC DAAC to aid in future disaster research.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Terms: 2018 Summer

***Related DEVELOP Work:***

Spring 2016 (VA) – Africa Great Lakes Weather: Utilizing NASA Earth Observations to Identify Indicators to Help Predict Deadly Storms over the African Great Lakes

Spring 2017 (NC) – Philippines Disasters: Utilizing NASA and NOAA Earth Observations to Enhance the United Nation’s Office for the Coordination of Humanitarian Affairs Storm Preparation and Disaster Relief Planning Methods

**Notes & References:**

***Notes*:** Dr. Patrick Gatlin met with the Bangladesh Meteorological Department (BMD) at the end of April 2018 and will arrange a teleconference with Marshall node leadership prior to the beginning of the Summer 2018 term if the BMD would like to be involved in the project as an end user. The Bangladesh Meteorological Department facilitates socio-economic development, academic research and public safety through providing meteorological data to academics, corporations, and other government offices.

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