**NASA DEVELOP National Program**

**Summer 2016 Project Proposal**

**NASA Langley Research Center and the University of Georgia**

**Perú Climate III**

Monitoring and Forecasting Shifting Climate and Land Use Change Impacts in Perú’s Parque de la Papa for Enhanced Agricultural Management

**Project Overview**

***Objective:*** To conduct a spatio-temporal analysis using NASA Earth observations to monitor and measure parameters (precipitation, temperature, land cover, elevation, and evapotranspiration) to quantify and forecast suitable potato crop extent, as well as disease and pest risk, in Perú’s Parque de la Papa for agricultural management and improved food security.

***Community Concern:***

In response to changing growing seasons, irregular precipitation, and increased pest issues, local farmers have moved their potato crops to higher elevations, thereby decreasing the amount of available cropland. Indigenous farmers work to maintain traditional farming practices and conserve thousands of native potato varieties. However, variable growing conditions have threatened the conservation of potato diversity within the park.

***National Application Areas Addressed:*** Climate, Ecological Forecasting, Agriculture

***Study Location:*** Parque de la Papa, Perú

***Study Period:*** January 1980 to June 2015; Forecasting to 2020 & 2045

***Advisors:*** Dr. Marguerite Madden (Department of Geography, University of Georgia)

***Source of Project Idea:*** Communication between DEVELOP and CIP was initiated by SERVIR management when a prior telecon identified synergies. CIP seeks to foster new partnerships and projects that ensure access to the most advanced technologies and skills for developing nations. Through a joint telecon, project objectives were identified.

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| International Potato Center (CIP) | Dr. Noelle Barkley  Dr. David Ellis | End-user/ Collaborator | Yes |
| Asociación para la Naturaleza y el Desarrollo Sostenible (ANDES) | Genesis Abreu  Alejandro Argumedo | Collaborator | No |

***End-User Overview***

***End-User’s Current Decision Making Process:***

Farmers in Parque de la Papa use traditional agricultural practices to control pests and maintain yields. For example, in response to increased crop damage by weevils, farmers plant a barrier of root and tuber crops that contain an anti-weevil compound as a form of integrated pest management (IPM). In addition, “improved” potato varieties are available and used in lower lands by CIP; however, CIP’s primary concern is to ensure that communities within the park are able to maintain potato biodiversity and continue to use traditional practices in order to conserve indigenous traditions and culture. Additionally, CIP purchased commercial aerial images in 2007 to map locations of potatoes and other crops. The CIP has limited their remote sensing practices to land cover classifications and have not used any climatology data to assess potato suitability.

***End-User’s NASA Earth Observations Capacity:***

CIP – CIP was not familiar with or used NASA Earth observations prior to their collaboration with DEVELOP.

***Collaborator & Boundary Organization Overview***

***Collaborator Support:***

Asociación para la Naturaleza y el Desarrollo Sostenible (ANDES) – ANDES will be providing expert knowledge regarding the specifics of potato growth and important parameters to take into consideration when determining suitability. Additionally, they will assist the team by obtaining field data and media for the VPS.

***Boundary Organization Dissemination:***

International Potato Center (CIP) – CIP collaborates with ANDES, to determine potato planting in the Parque de la Papa. In 2002, CIP started repatriating potato back to communities in Peru and extended their efforts to more communities in recent years. In collaboration with ANDES, they will disseminate the results to the community to assist them in recommended locations for potato planting based on the created suitability forecasts.

***Project Communication & Transition Overview***

***In-Term Communication Plan:***

The team will send a weekly project update to the partners and have video conferences as needed to answer any questions the partner may have or ask questions to the partner. The primary point of contact for this communication will be the team lead and Noelle Barkley from CIP.

***Transition Approach:***

The decision support tools will be handed off to the partner via a Skype call with all of the partners and teams. In this meeting, the UGA and Langley teams will discuss with the partners in CIP what the results are and explain any tutorials or additional resources to them. A software release will be needed in order to hand-off the code for the analysis of the data. The software release will take place during the start of the term to ensure that it can be completed in a timely manner.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Landsat 5 – 8 TM, ETM+, OLI** | Spectral vegetation indices | Measure Red and Infra-red bands to analyze vegetation |
| **Aqua/Terra MODIS** | Temperature | Temperature data will be used to create Growing Degree days and Chill Hours maps |
| **TRMM TMI** | Precipitation | Precipitation data will be used to create an index which will determine the best locations based on rainfall |
| **Terra ASTER** | Elevation | Since potatoes cannot grow past a specific elevation, this will be used to create a mask and identify areas above the elevation as unsuitable |

***Ancillary Datasets:***

CIP - QuickBird Imagery- high resolution imagery for classification validation

CIP - HOBO Transportable Weather Stations - temperature, relative humidity, dew point

CIP/ANDES – Ground Truth Points – GPS coordinates for creation of training set

***Models:***

NASA Land Data Assimilation Systems (POC: Dr. Kenton Ross, NASA DEVELOP National Program)

Clemson University Chill Hours Calculation Regression Model (POC: Dr. Kenton Ross, NASA DEVELOP National Program)

TerrSet Land Change Modeler (POC: Dr. James Toledano, Clark Labs)

METRIC – Mapping EvapoTranspiration at high Resolution and Internalized Calibration (POC: Jeff Ely, DEVELOP)

**Decision Support Tool & End-Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product(s)** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| Refined Time-Series Analysis Maps | This will quantify changes in spatial distribution and abundance of land under cultivation | Landsat 4 TM, 5 TM, and 8 OLI/TIRS, QuickBird will be used to perform a series of supervised classifications | N/A |
| Potato Crop Suitability Forecasts | This will identify areas with the most potential for future agricultural use | Landsat 4 TM, 5 TM, and 8 OLI/TIRS, Terra ASTER, QuickBird, meteorological data will be used in a weighted overlay performed using the Raster Calculator tool in ArcGIS | N/A |

***End-User Benefit:***

This project will benefit the end-user by providing them with information regarding suitable locations for potatoes within the Parque de la Papa, as well as a replicable methodology that can be updated and potentially applied to other areas in Perú. This project will allow the partners to efficiently monitor the park and provide recommendations regarding suitable planting locations to the indigenous communities by using freely available NASA data.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 3 Terms: Fall 2015 (Start) to Summer 2016 (Completion)

***Multi-Term Objectives:***

* **Term 1:** Fall 2015 (LaRC)–Focused on the use of climatic variables, creation of growing degree days, rainfall analysis, elevation/slope map, and land cover analysis.
* **Term 2:** Spring 2016 (UGA)–Focused on land cover analysis, ecological forecasting, begin the suitability mapping.
* **Term 3 (Proposed Term):** Summer 2016 (UGA)–Focus on combining all parameters and previous products into a final suitability map and forecasts. Creation of tutorials and hand-off materials. Conduct the hand-off.

***Related DEVELOP Work:***

2015 Summer (LaRC) – Northwest US Agriculture III: Assessing Current and Future Plant Hardiness Zones for Apple Production in Washington State using Climate Models and NASA Earth Observations

2015 Spring (UGA) – Colombia Eco Forecasting III: Utilizing NASA Earth Observations to Enhance the Conservation Efforts of Colombia’s Most Endangered Primate, the Cotton-top Tamarin (Saginus oedipus)

**Project Needs/Requests**

***Participants Requested:*** 4-5

***Software & Scripting:***

ArcGIS – map creation and model

ENVI – image classification

**Notes & References:**

***References:***

<http://dialogues.cgiar.org/blog/the-colorful-value-of-potatoes/>

[www.cgiar.org/consortium-news/improved-potato-varieties-ensure-peruvian-communities-have-enough-to-eat/](http://www.cgiar.org/consortium-news/improved-potato-varieties-ensure-peruvian-communities-have-enough-to-eat/)

[www.cgiar.org/cgiar-consortium/research-centers/international-potato-center-cip/](http://www.cgiar.org/cgiar-consortium/research-centers/international-potato-center-cip/)

<http://parquedelapapa.org/eng/01visitanos_01.html>