Sustainable Environment

Dr. Natalie Chin, Data Manager, Arequipa Nexus Institute
Data Management and Sharing
Dr. Fariborz Daneshvar, Postdoctoral Research Associate, ABE
Dr. Andre De Lima Moraes, Postdoctoral Research Assistant, ABE
Sustainable Water Management
Dr. Zachary Brecheisen, Postdoctoral Research Assistant, Agronomy
Geospatial Analysis and Environmental Sensing
Dr. Jino Ramson, Postdoctoral Research Assistant, Polytechnic Institute
Long Range Sensor Network Solution for Soil Health Monitoring

AREQUIPA NEXUS INSTITUTE

SCIENCE FOR A SUSTAINABLE FUTURE

Capturing 40+ years of arid Peruvian agricultural development with Landsat in the NEXUS Institute

Zachary Brecheisen
Darrell Schulze
Timothy Filley

The Arequipa Nexus Institute for Food, Energy and the Environment (Nexus Institute) is located in Southwestern Peru, generally bounded by the city of Arequipa to the east, the Majes River to the west, the Pacific Ocean to the south, and the Andes mountains to the north. Though agriculture has been practiced in parts of this cool desert region (MAT~15°C, MAP <10cm) for centuries, there has been an explosion of agricultural development in the last 30 years. This project is focused on the spatial quantification of this agricultural expansion across a ~25,000km2 landscape over the last 40+ years using Landsat 1, 2, 3, 5, and 7 data accessed via USGS' Earth Explorer and Google Earth Engine Explorer. I am further investigating and contrasting several physiographic categories of agriculture currently defined as: alluvial floodplain agriculture, headwater mountainous agriculture, upland non-mountainous agriculture. These efforts are underway using Landsat data in conjunction with SRTM (Shuttle Radar Topography Mission) elevation data to categorize land cover using "random forest" supervised classification algorithms in the R statistical program. Future goals are to quantify urban agricultural change around Arequipa and also to study high elevation (>3500m) glacial melt marshes which are used for pasturing llamas and vicuñas which may be impacted by climate change.

Long Range Wireless Sensor Network solution for Soil Health monitoring in Arequipa region

Jino Ramson
W. Daniel Leon-Salas
Timothy Filley

Arequipa region is located in the southwestern part of Peru. The soil of Arequipa region is facing many challenges: contamination due mining activities, highland desertification due to overgrazing, toxic mineral deposits due to glacial departure and poor management of agricultural activities. Due to soil contamination, the people of Arequipa region face several challenges of sustainable use of soil resources. Technology-based decision making of soil characterization and monitoring and visualization will increase the agricultural productivity and human health of the citizens of Arequipa. Several wireless sensor network technologies such as Zigbee, Wi-Fi, SimpliciTI, Bluetooth, 6LoWPAN have been used to monitor soil health parameters such as soil temperature, moisture and electrical conductivity from local and remote location. The main limitation of the existing systems are short range and high power consumption. This work presents the development a sensor network based on LoRa (Long Range) technology to monitor soil health. The main advantage of this technology is that long transmission distances can be achieved with low power. The nodes of this wireless sensor network are called Soil Health Monitoring Units (SHMU) and are installed in every location where soil health needs to be monitored. An SHMU consists of a e soil sensor, a processing unit, a GPS module and a LoRa radio. The SHMU processes the sensor data and transmits it to a Gateway at the frequency of 915 MHz. The gateway receives data from several SHMUs and uploads it into a server for storage and analysis. The

users can view and analyze the location of the SHMUs, soil temperature, moisture and electrical conductivity by using an application software.