VIRTUAL COURSE:

Satellite Data to Monitor Regional Environmental Change

Introduction

As environmental degradation and climate variability intensify across the globe, satellite-based remote sensing has become an essential tool for analyzing and responding to complex environmental challenges. Using remote sensing, researchers can analyze historical trends, current crises, and future projected environmental changes from hyper-local to global scales, and build decision-support tools to translate these findings into informing targeted, data-driven policy. This beginner course is designed for Latin American scientists and researchers seeking to develop practical and theoretical expertise in the use of satellite imagery for environmental monitoring, particularly for tropical forest and environmental health analyses.

Main Objective

Participants will learn to interpret multi-decadal satellite records to detect environmental change, monitor real-time land surface dynamics, and identify regions of emerging vulnerability. The curriculum covers a broad spectrum of regional applications, including climate modeling, deforestation and land-use change analysis, forest fire monitoring, and extreme weather event analysis. Participants will also learn how to translate their analyses to publicly available applications. Through case studies and applied exercises focused on Latin America and the Caribbean, the course equips participants with the analytical skills and tools needed to translate geospatial data into actionable insights for science, policy, and sustainable development.

Course Modality

The self-paced online course spans an estimated 20 hours of activities, including lectures, reading materials, exercises, and synchronous expert connect sessions. The course includes six primary technical modules:
1) Introduction to Google Earth Engine;
2) Image Processing and Visualization;
3) Time Series Analysis;
4) Calculations with Vector Data;
5) Forest Fire Assessment;
6) Land Cover Change Monitoring;
7) Climate Projection Analysis; and
8) Creating Public Applications.

Course Structure

The course consists of 6 sessions. The learning objectives of each module are described below:

MODULE I: IMAGE PROCESSING AND VISUALIZATION

Participants will learn how to search for relevant satellite-based datasets in the Google Earth Engine data catalog to model the environmental changes they are most interested in. They will explore changes in either deforestation or surface water change over time by generating layered maps and histograms, interpret spatial patterns of environmental change, and quantify these changes over a defined region using pixel-based characteristics. Participants will choose from one of two case studies to demonstrate the process of processing, visualizing, and analyzing pre-set datasets: mapping forest change using the Hansen Global Forest Change dataset and mapping surface water change using the Joint Research Commission Surface Water Change dataset.

MODULE 2: TIME SERIES ANALYSIS

Participants will learn how to analyze changes in environmental variables of their choice over a set region and period of time. They will filter imagery by specified properties and learn how to derive new environmental variables (such as forest greenness) from existing satellite datasets using band math. Participants will learn to visualize changes in these environmental variables over time, create charts to plot these changes, and export their visualizations outside of Google Earth Engine. Participants will choose from one of two case studies to learn time series analysis: forest health analysis and drought modeling.

MODULE 3: CALCULATIONS WITH VECTOR DATA

Vector data is a type of geographic data that represents real-world features using lines, points, and polygons, where each feature is associated with certain information stored in a table. Vector data analysis is important because it allows scientists to analyze, combine, and clean map information for statistical analyses. Participants will learn how to select and visualize satellite imagery within pre-specified geographic borders, extract relevant statistics within these regions, and visualize satellite imagery within regions of interest. Participants will choose from one of two case studies to learn these vector manipulation skills: biomass analysis in protected areas and air pollution monitoring across cities.

MODULE 4: LAND COVER CHANGE ANALYSIS

Mapping land cover and land use is crucial to identifying regions of landscape change over time. In this module, participants will learn how to use the

Dynamic World land cover classification dataset to automatically generate land cover classifications over a region of interest. They will learn how to visualize land cover maps effectively and perform basic statistical calculations to identify the proportions of certain regions that are covered in particular land type classes.

MODULE 5: PRESENTING BEFORE/AFTER CHANGE

In many cases, quantifying and visualizing environmental change before and after an event can be crucial to communicating the implications of a crisis. Participants will choose from two case studies of quantifying and visualizing key environmental changes in their region of interest: forest fire damage assessment and climate change projection. They will then learn to create a basic before/after interactive slider application to display the results of the change analysis, and publish the application for a public audience.

Learning Strategies

Each module consists of a recorded video of an expert live-coding the technical case study, articles on conceptual topics covered in the coding video, reflection questions, and practice activities. Participants will also have the capacity to engage with experts and other course participants throughout the duration of the course.

Evaluation and Course Certificate

Upon completion of the five modules, participants will be able to access the Final Evaluation.

The Final Evaluation is a quiz with 10 questions that covers the content of all the modules. To pass the course, a score of 70% or higher is required. You will be able to take the Final Evaluation multiple times until you obtain the required score.

Participants who meet these requirements and fill out the course survey will be able to download their course certificate of completion.