Paper ID: 59434
oral
student

IAF EARTH OBSERVATION SYMPOSIUM (B1)
Earth Observation Data Management Systems (4)

Author: Mr. Jack Reid
Massachusetts Institute of Technology (MIT), United States

Prof. Danielle Wood
Massachusetts Institute of Technology (MIT), United States

INTERACTIVE MODEL FOR ASSESSING MANGROVE HEALTH, ECOSYSTEM SERVICES, POLICY CONSEQUENCES, AND SATELLITE DESIGN IN RIO DE JANEIRO USING EARTH OBSERVATION DATA

Abstract

There is an increasing need for tools to translate Earth Observation (EO) data into societally relevant metrics to inform human decision-making. To address this need, we present a multi-disciplinary, interactive modeling framework to advance ecological forecasting and policymaking using EO data. This framework will integrate four model components into one tool: Earth Science, Social Impact, Human Behavior and Satellite Design. The capabilities provided by this framework will improve the management of EO and socioeconomic data in a format usable by non-experts, while harnessing cloud computing, machine learning, economic analysis, complex systems modeling, and model-based systems engineering.

This paper presents a prototype that demonstrates the viability of the framework via a case study: the mangrove forests in the Guaratiba area of Rio de Janeiro. These mangroves are vulnerable due to urbanization and rising sea levels. They provide a variety of ecosystem services, including serving as a mechanism for carbon sequestration, supporting subsistence fishing, preventing coastal erosion, and attracting an ecotourism industry.

The case study of mangrove and community health in Rio de Janeiro demonstrates all four model components. The Earth Science Model builds upon work by NASA biospheric scientists to use EO data, cloud computing and machine learning to track mangrove extent, health, and vulnerability over time for a 600 km^2 area, as well as work by the Espaço research group at the Universidade Federal do Rio de Janeiro on the local mangrove ecosystem. To create the Human Decision Making model, we have partnered with Instituto Pereira Passos (the data science office of the Rio de Janeiro municipal government) to understand the policy history and socioeconomic factors. To build the Social Impact model, we are collaborating with ecosystem services economists to explain how policies impact mangrove health and how mangroves impact socioeconomic wellbeing. The Satellite Design Model accounts for the types of data collection used by policy makers since 1985.

Through such collaborations, we are able to build an integrated, interactive model that policymakers can use to assess mangrove health, ecosystem services value, and policy consequences. The model helps answer such questions as: (a) What is the state of the mangroves over time? (b) How are human communities impacting the mangroves? (c) what is the value of the mangrove ecosystem services to human communities? and (d) what policies can improve human and mangrove outcomes? This case study is demonstrative of the viability of a similar approach for ecosystems around the world.