

Biomapper: A Mobile Map App for Viewing Geographic Data

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Problem Statement

The loss of tropical forests is a cause for global concern given that they play a vital role in large-scale environmental processes. By absorbing vast quantities of CO2, tropical forests provide oxygen and help stabilize the Earth's climate. Furthermore, tropical forests help to maintain the world's water cycle through transpiration, generating clouds that travel all over the world. As for biodiversity, "tropical forests contain over 30 million species of plants and animals... half of Earth's wildlife and at least two-thirds of its plant species!" These facts make it clear that tropical forests need to be preserved and protected.

The importance of environmental protection cannot be overstated. It is crucial that forest ecologists have access to and are able to interpret LIDAR-derived datasets such as canopy height, elevation, and biomass estimates. These datasets are important for determining where specific species of plants and animals may be found and studied. They also help gauge a forest's overall health and amount of carbon they store. The results of these studies help determine the environmental importance of the forest. Conclusions drawn by the ecologists allow policymakers and conservationists to better understand environmental changes and enact legislation to protect forests.

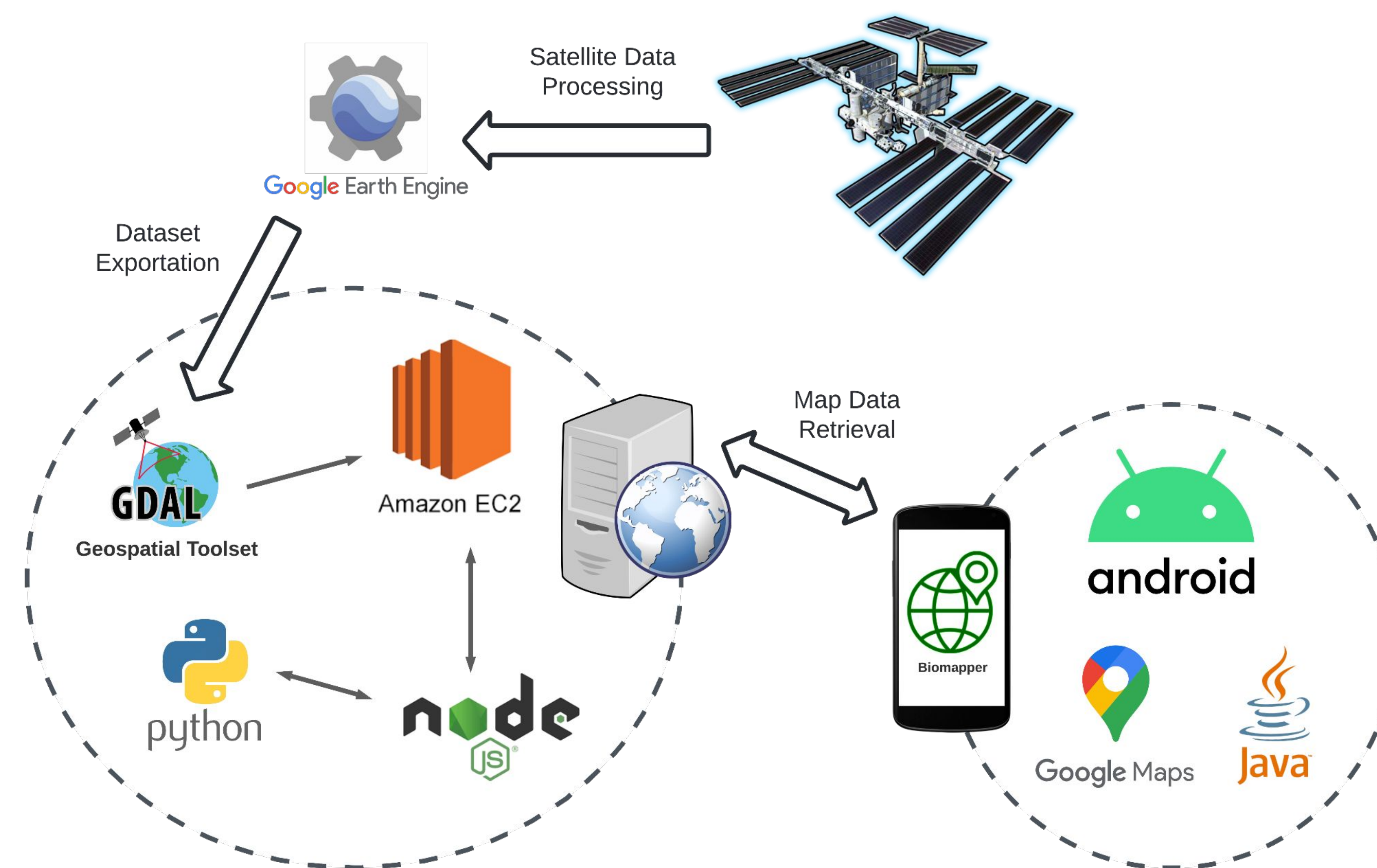
The aforementioned datasets can be obtained from LIDAR-equipped satellites, such as the International Space Station with its onboard GEDI sensor. However, processing this data and visualizing it is a non-trivial task. What forest ecologists need is an easy way to access the processed environmental data in real-time while conducting their fieldwork. Such a tool is what the clients of this project have tasked the team to create. They study megafauna within the forests of Africa and works closely with ecologists working there. Their business is focused on learning about the environment and ensuring that it is protected. Currently, the geographic data they use can be visualized using tools like Google Earth Engine, but it is difficult to use and requires an internet connection. So forest ecologists are still in need of a simple tool for visualizing environmental data and relevant maps while in the field.

Solution Overview

Android Mobile Application: Biomapper

Biomapper is an easy-to-use tool that's intended to assist ecologists with their work in Africa. They no longer need to have an understanding of programming and data processing to view the geographic data they need. Instead, Biomapper displays preprocessed datasets on a navigable map. It also features tools that help understand the map and locate regions of interest. Since it is a mobile application, users can access the data wherever they go. This includes the ability to view maps offline. For datasets that are included with the application, ecologists no longer need to print maps in advance of their fieldwork or use their own sensors for data collection. Biomapper prevents the need for these rather involved tasks. Finally, since many African countries containing tropical forests include French as an official language, the application will include translations for both English and French.

Architecture



Data Acquisition

- Raw satellite LIDAR datasets are processed and added to Google Earth Engine
- We then export the datasets from Google Earth Engine, create sets of map tiles, and store these on our server

Back-end Server

- For the back-end, we use an Amazon Web Services EC2 instance as our server
- A Node JS environment helps process map tiles requested by the app
- Node JS runs a Python script when filtered map tiles are requested

Front-end Mobile Application

- For the front-end, we use the development platform Android Studio and Java programming language to create the Android app
- The Google Maps Platform is used to create a map and display the map tiles retrieved from the server

Technologies

- Android Studio**
Helps develop Android apps
- Google Maps Platform**
Provides the underlying map
- Google Earth Engine**
Geographic dataset catalog
- Amazon EC2 Instance**
Virtual server that stores map data
- Node JS**
Environment that helps with map data requests
- Python**
Script used to filter map data

Feature Highlights

- **A Dynamic Map** - Can be scrolled and zoomed. There are 3 available datasets: Canopy Height Model, Digital Elevation model, and Above-ground Biomass.
- **Tools for Locating Regions of Interest** - The user can get the data value for a selected point, as well as specify a filter for the data shown on the map.
- **Download Maps for Offline Use** - Users can specify a region of interest, a radius, and the datasets they wish to download. The datasets will then be available offline for that region.
- **Multilingual Capability** - The user can pick between English and French in-app text.

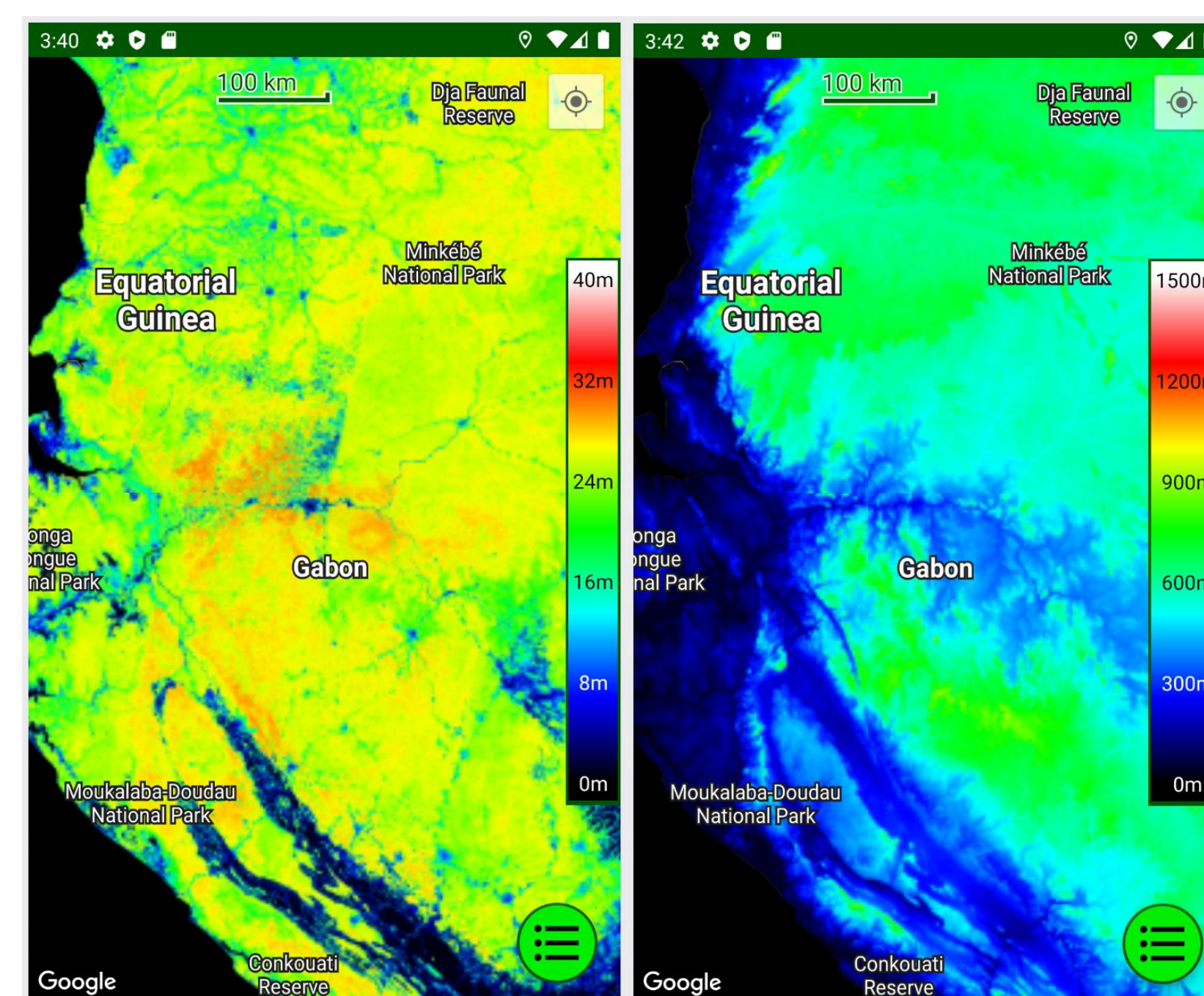
Future Work

In addition to the described features, the project could be taken further by completing the following:

- **iOS Version** - An iOS version of the app would allow anyone with Apple mobile devices and tablets to also easily access the datasets.
- **South American Maps** - The datasets will be expanded to include the tropical forests of South America.
- **Server Upgrade** - Upgrading the server will make it respond to map data requests faster.

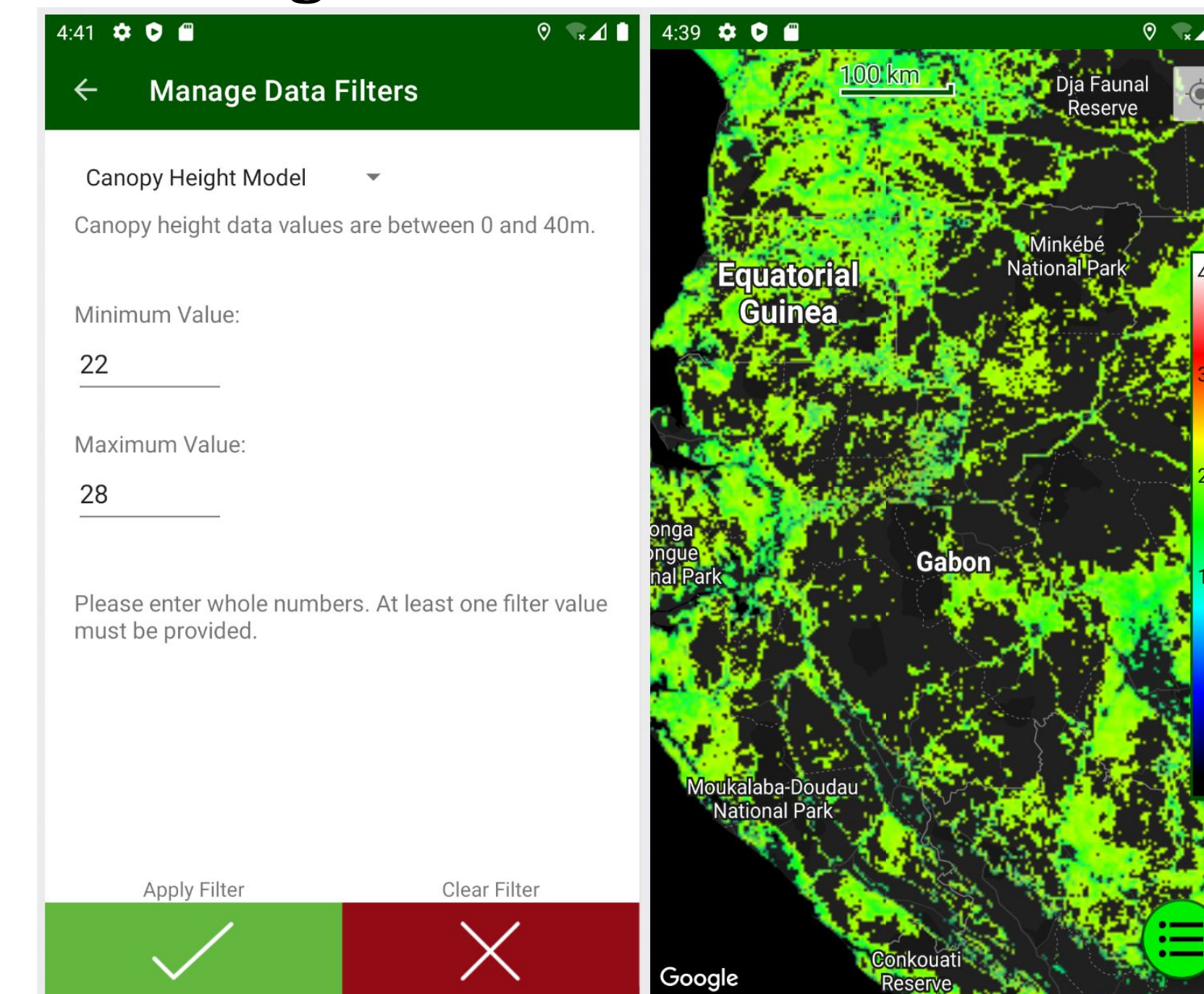
Example Use Cases

Changing The Current Dataset



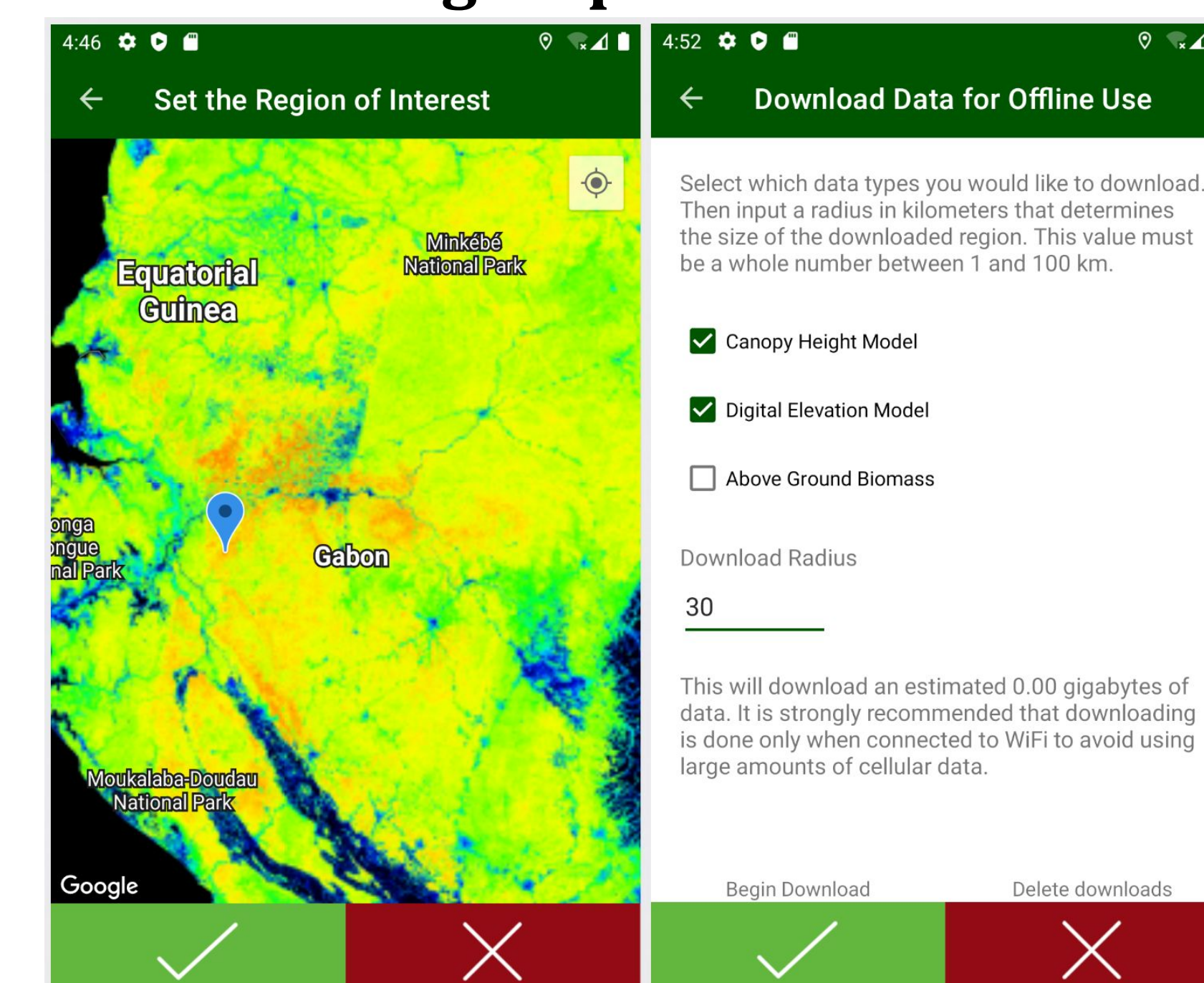
The dataset currently displayed on the map can be switched from the Main Menu. The left image shows canopy height data while the right image shows elevation data.

Filtering the Datasets



The datasets can be filtered so that only data values between the minimum and maximum will be shown. The left image shows the filtering of canopy height data. The right image shows the map after applying the filter.

Downloading Maps for Offline Use



Limited maps can be downloaded for offline use. The left image shows the selection of the region of interest. The right image shows the selection of which data types to download and the radius.