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Getting Started in Geospatial

Ozzy Campos - 26 March 2025

Outline

1. Understand Geospatial

2. Vector vs. Raster

3. Use Cases & Ideas

4. Tools and what they do

5. Google Earth Engine

6. Starting the journey

Understand Geospatial

What is Geospatial Data?

- Geospatial data is data that has a location component

  - Something that ties it to a specific place on Earth

This could be:

  - A street address

  - GPS coordinates

  - A region on a map (like a park boundary or zip code)

  - A satellite image showing a forest or city

Why Geospatial Matters

- Geospatial data powers maps and decisions

  - From your phone navigation to global climate models.

- It's used across nearly every field:

  - Environment:

    - Tracking deforestation, pollution, biodiversity

  - Urban planning

    - Analyzing zoning, development, green space

  - Agriculture

    - Monitoring crops and soil health

  - Logistics

    - Optimizing routes, deliveries, supply chains

  - Disaster response

    - Mapping flood zones, wildfires, damage assessment

Two Core Geospatial Disciplines

Understanding geospatial starts with two main formats:
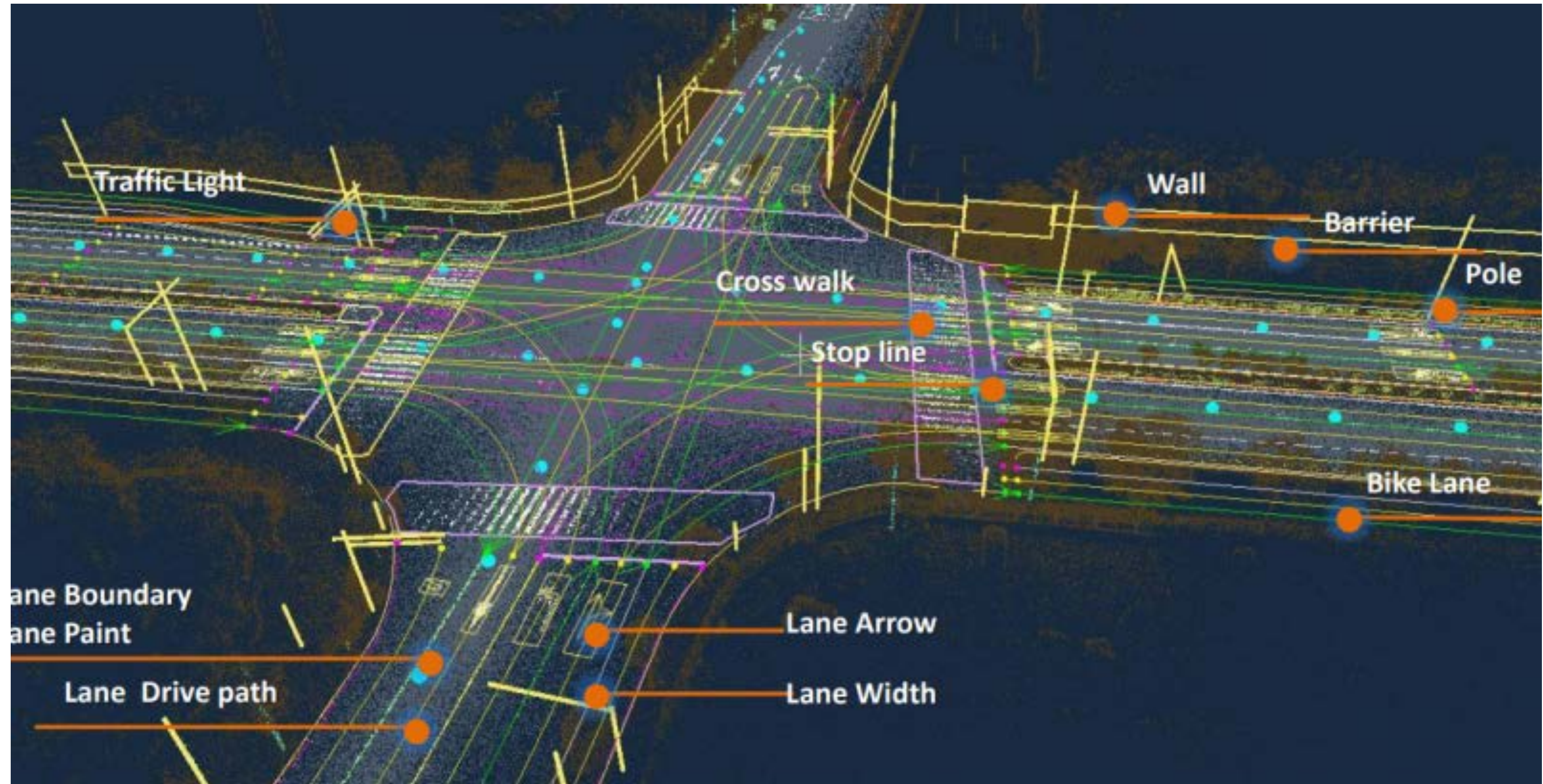
- Vector versus Raster

Vector Data

- Vector data represents **discrete features**

- Three basic types:

  - **Points**

    - Single locations (e.g. weather stations, bus stops)

  - **Lines**

    - Paths or networks (e.g. roads, rivers, hiking trails)

  - **Polygons**

    - Areas or boundaries (e.g. parks, building footprints, farmland)

Map of New York

High Definition Map

Raster Data

- Raster data represents **continuous surfaces**

  - Values that vary across space.

- Think of it like a photo made of pixels

  - Each pixel covers an area and holds a value.

- That value could be:

  - Visible and near-infrared reflectance in a satellite image

  - Elevation

  - Temperature

  - Vegetation index (NDVI)

- Raster data usually comes from **satellite imagery** or sensors capturing surface information

Satellite Image (Landsat)
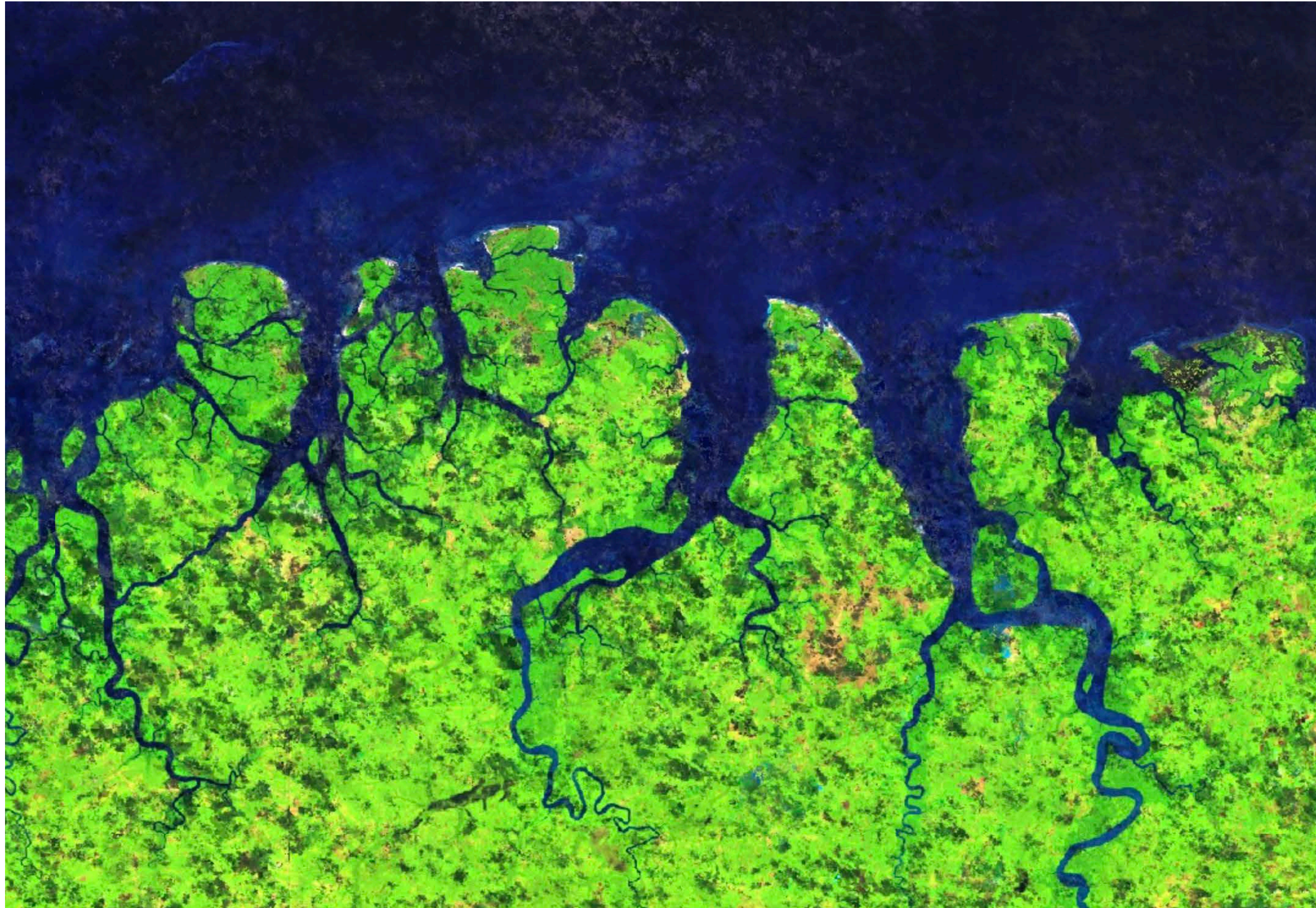
Why This Matters

- These two types of data are the foundation of geospatial work.

- **Vector** data tells us **where things are**

  - A forest boundary, a city outline, a sensor location.

- **Raster** tells us **what's happening there**

  - How green the forest is, how hot the city is.

- Fundamental Principle: GIS is about **bringing these two together**

  - Knowing how they fit together is key.

Tools and What They Do

Common Geospatial Tools:

- QGIS - Open-source desktop GIS

- ArcGIS - Proprietary, but full-featured software for GIS

- Open Street Map - Open source, crowdsourced global mapping

- GDAL - low-level raster/vector processing

- Leaflet / Mapbox / kepler.gl - Interactive mapping

- Python libraries:

  - *geopandas* for vector

  - *rasterio*, *xarray* for raster

  - *folium, ipyleaflet* for maps in notebooks

- Massive Ecosystem

  - Suggestion: Start with QGIS

Google Earth Engine

- Cloud platform for geospatial analysis

- Free access to huge datasets: satellite imagery, climate, terrain, land cover, etc.

- JavaScript + Python APIs

- Built-in tools for filtering, visualizing, and analyzing imagery

- **Key features**:

- Petabyte-scale satellite archives (Landsat, Sentinel, MODIS)

- Data Catalog - very easy to use

- Run computations across time and space very quickly

Google Earth Engine

Quick Demo

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Getting Started

Vast Ecosystem

- **Don't try to learn everything**

- **Use case - develop your idea first**

  - **Then explore what tools and data that you would need**

  - **Get experience**

Questions

- **Contact:**

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