Geospatial Intelligence for Natural Resources: The Power of Google Earth Engine

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ABSTRACT

Google Earth Engine (GEE) is a powerful cloud-based platform for geospatial analysis, enabling users to access, process, and visualize vast amounts of satellite imagery. Its extensive data catalog and robust JavaScript and Python APIs allow for efficient analysis of environmental and Earth observation data, supporting applications such as agricultural monitoring, deforestation detection, land cover classification, and environmental monitoring. By leveraging cloud computing through Google's infrastructure, GEE handles massive datasets without the need for expensive hardware or local storage. With free access to both data and computing resources, GEE has become an essential tool in scientific research, sustainable development, and evidence-based policymaking.

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INTRODUCTION

Over the last decade, the number of earth observation satellites has increased significantly, providing a massive amount of remote sensing observations and data (Pham-Duc *et.al*.,2023) Timely, precise, and extensive geospatial data analysis is necessary for the monitoring and management of Earth's natural resources. Google Earth Engine is a cloud-based platform that makes it easy to access high-performance computing resources for processing very large geospatial datasets, without having to suffer the IT pains currently surrounding either (Gorelick *et.al*, 2017). The Google Earth Engine (GEE) is a web portal providing global time-series satellite imagery and vector data, cloud-based computing, and access to software and algorithms for processing such data (Moore & Parsons, 2011). Google Earth Engine (GEE) has become a game-changing platform for cloud-based geospatial analysis in order to address these issues. Google Earth Engine combines robust cloud computing capabilities with a multi-petabyte library of satellite imagery and geographical datasets. From local environmental assessments to the detection of global land cover change, users can access historical and near-real-time data from satellites like Landsat, MODIS, Sentinel, and many more. The availability of data sets and innovative data processing algorithms provided by GEE or shared by other users of GEE should help to improve our capability to process earth observation data to support management decisions, irrespective of where we reside (Kumar & Mutanga, 2018). A Researchers, developers, and policymakers can carry out intricate spatial studies and visualize the results immediately in a web interface or through custom applications thanks to GEE's JavaScript and Python APIs. Users in academic research, environmental monitoring, urban planning, agriculture, disaster management, and other fields can now access large-scale earth observation thanks to the platform's significant reduction in entry barriers. Google Earth Engine is therefore significantly contributing to the advancement of data-driven decision-making for climate resilience and sustainable development.

What is Google Earth Engine?

- **Platform:** platform for geospatial analysis at the planetary scale that runs on the cloud.

- **Data:** contains petabytes of climate data, land cover maps, satellite imagery (such as Sentinel and Landsat), and more.

- **Processing Power:** uses the cloud infrastructure of Google to perform extensive calculations.

- **Languages:** mostly uses Python and JavaScript APIs.

- Research and non-commercial use are free.

How Google Earth Engine in Natural Resource Management:

1. **Forest Monitoring**

o Track deforestation, forest degradation, and illegal logging.

o Example: Real-time alerts for forest loss (e.g., Global Forest Watch).

2. **Water Resource Management**

o Map surface water bodies and changes over time.

o Monitor droughts and assess water availability in watersheds or reservoirs.

3. **Soil and Land Degradation**

o Identify areas affected by soil erosion or land degradation.

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o Monitor land cover changes that affect soil health.

4. **Agriculture**

o Assess crop health using NDVI and other vegetation indices.

o Detect crop patterns, fallow lands, and irrigation needs.

5. **Disaster Management**

o Monitor floods, wildfires, and landslides using satellite data.

o Assess damage and plan rehabilitation.

6. **Urban Expansion & Land Use Change**

o Analyse urban sprawl and its impact on surrounding ecosystems.

o Track encroachments on forests or wetlands.

7. **Climate and Weather Monitoring**

o Access long-term climate datasets (rainfall, temperature).

o Study climate change impacts at regional levels.

Example Applications in Practice

- **India's NRSC/ISRO** uses remote sensing for land use and resource inventory.

- **FAO's SEPAL platform** runs on GEE to support forest monitoring.

- NGOs use it for **community-based resource management** in dryland areas.

CONCLUSION

- Google Earth Engine represents a significant advancement in the field of geospatial analysis, offering unparalleled access to satellite imagery and computational resources through a cloud-based platform. By simplifying the process of acquiring, processing, and visualizing large-scale environmental data, GEE empowers users across disciplines to make informed decisions backed by real-time and historical insights.

- Whether applied to monitoring deforestation, tracking urban growth, assessing crop health, or studying climate change, GEE enables scalable, reproducible, and transparent analysis. Its user-friendly interface, extensive data library, and integration with open-source tools make it an essential resource for researchers, governments, NGOs, and developers working toward sustainable and data-informed solutions.

- As global challenges such as climate change and resource management grow in complexity, platforms like Google Earth Engine will continue to be critical in advancing scientific understanding and driving impactful action.

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