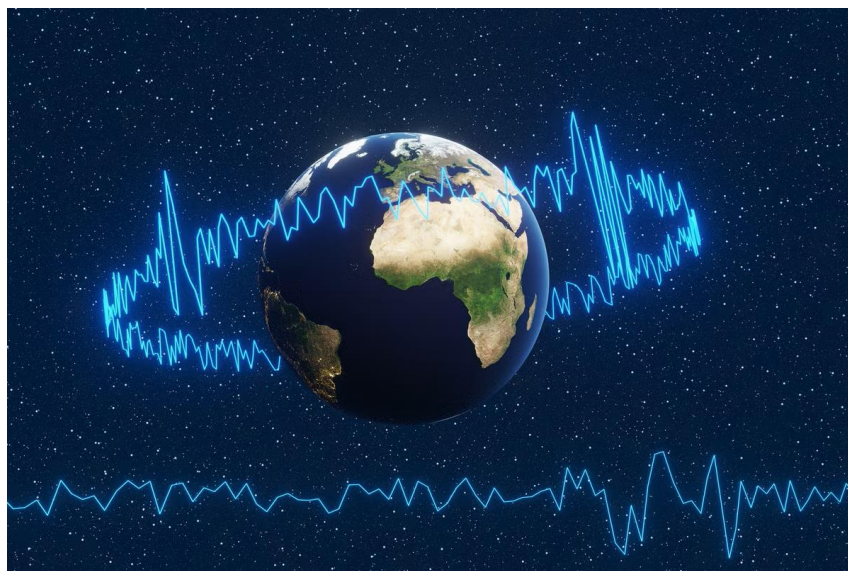


Humming of the Earth

Dr. Kusala Rajendran
Professor (retired) Centre for Earth Sciences;
Indian Institute of Science, Bengaluru

On September 16, 2023, seismographs worldwide registered a weird reverberating signal emanating from Eastern Greenland. At first it was thought to be the free oscillations of the earth. Have you ever heard of the free oscillations of the earth? They are the undulating vibrations of the earth that come as an aftermath of huge earthquakes or explosions. The effect can be compared to the ringing of bells or the quivering of guitar strings.



Representative Getty image

So, the seismologists regarded this strange "humming of the earth" recorded on September 16, 2023 as free oscillations of the earth. But as they analyzed it further, they realized that there were no variations in frequency that is typical of such signals. The signal emanating from Greenland that lasted 9 days was "monochromatic"... consistent and invariant like the monotonous ringing of a bell. Puzzled by its peculiar features and not knowing its exact source, it was registered as a UFO (Unidentified Flying Object like a Flying Saucer) or an USO (Unidentified Seismic Object)

Later, a team of 68 scientists, 40 Institutions and 18 countries nailed the culprit as a rockslide in Dickson Fjord on the central east coast of Greenland, 200 km inland from the Greenland Sea. This was no small rockslide! It was the dislodging of a 1.2 km high mountain peak that collapsed into a gully in the Fjord. This mighty collapse triggered a tsunami with its initial splash about 200

metres high. The subsequent waves were also roughly half the height of the first splash. It was reported that the height of the tsunami measured 4 meters or higher as far as 72 km away from the site of the initial impact. What was unique was the apparent persistence of the sloshing of waves measuring about 7 metres, continuously lashing against the sides of the mountains in the narrow sea inlet. These waves are like the seismic seiches or the series of standing waves that occur in a body of water such as a lake, reservoir, pond or river, when seismic waves of an earthquake pass through it.



Greenland's Dickson Fjord, where last year a 1.2-kilometre-high mountain peak collapsed into the Fjord triggering a far-reaching seismic signal. Credit: Jane Rix/Alamy

As the motion gradually declined, everything returned to normal, and the "humming" stopped. So what was the real trigger? Scientists say that the collapse of the mountain triggered the waves, but the real culprit cause for the collapse of the mountain. And that is global warming. In fact, the global climate change is causing many direct and indirect effects and melting of ice is one of the gravest consequences of climate change. The rising atmospheric temperatures has thinned and weakened the lower part of the Greenland glacier. The melt led to the huge slide. As we read about such events we ask: Are we going to witness many more such events in future? Perhaps yes, because we live on a planet that is continuously and steadily warming up. The rising temperatures would melt the glaciers, will cause rise in the sea level, change the ocean circulation patterns, and climatic patterns. It is time for climate action before it is too late. Because we need to save our earth.

Rise of GIS and Remote Sensing: A Comprehensive Exploration

Mr. Shubham Yadav
Project Researcher ISRO,
Young entrepreneur in space research,

The fields of GIS (Geographic Information System) and Remote Sensing have experienced tremendous growth over the last few decades. With technological advancements, these tools have become integral in various industries like agriculture, urban planning, environmental monitoring, disaster management, and more. This article delves into the rise of GIS and Remote Sensing, their applications, the role of Digital Image Processing, and their significance in the modern world.

Introduction to GIS and Remote Sensing What is GIS?

Geographic Information Systems (GIS) allow users to visualize, analyze, and interpret spatial data to understand relationships, patterns, and trends in various contexts. GIS integrates hardware, software, and data to capture, manage, analyze, and display geographically referenced information.

Key Components of GIS:

- **Hardware:** Computers, servers, and networks that process and store spatial data.
- **Software:** Tools for spatial data collection, visualization, and analysis (e.g., QGIS, ArcGIS).
- **Data:** Geospatial datasets such as satellite imagery, vector, and raster data.
- **People:** GIS professionals who use and analyze the data to make decisions.

GIS Application	Description
Urban Planning	Helps in land-use planning and infrastructure development.
Environmental Monitoring	Tracks deforestation, climate change, and conservation efforts.

Public Health	Maps disease outbreaks and health services distribution.
Disaster Management	Assists in disaster risk assessment and recovery planning.

What is Remote Sensing?

Remote Sensing is the acquisition of information about an object or phenomenon without making physical contact. The most common form involves satellite or aerial imagery, which captures data about the Earth's surface.

Types of Remote Sensing:

1. **Active Remote Sensing:** Systems like RADAR and LiDAR that emit their own signal and measure its reflection from the Earth's surface.
2. **Passive Remote Sensing:** Utilizes natural energy (typically sunlight) to capture images, such as traditional satellite imagery.

Key Uses of Remote Sensing:

- Environmental monitoring
- Land-use and land-cover mapping
- Disaster management
- Agriculture (precision farming)

Remote Sensing Technology	Application
RADAR	Topographic mapping, weather prediction.
LiDAR	Elevation modelling, forest structure analysis.
Multispectral Imaging	Agricultural health monitoring, water body assessment.

The Interplay of GIS and Remote Sensing

GIS and Remote Sensing are deeply interconnected. Remote sensing provides a wealth of spatial data that GIS can then process, analyze, and visualize for decision-making purposes. Together, they create powerful tools for mapping and spatial analysis, enabling industries to address complex challenges related to natural resource management, urbanization, environmental degradation, and much more.

How GIS and Remote Sensing Work Together:

- **Data Collection (Remote Sensing):** Satellites, drones, and sensors capture data over a large geographic area.
- **Data Processing (Digital Image Processing):** This step involves analyzing raw data using algorithms to extract meaningful information.

- **Data Visualization (GIS):** The processed data is layered into maps, graphs, and other visual tools to provide actionable insights.

Digital Image Processing in Remote Sensing

Digital Image Processing (DIP) is crucial for transforming the raw data obtained from remote sensors into useful, analyzable information. This involves techniques like:

- **Image Enhancement:** Improving image quality for better visualization.
- **Image Classification:** Categorizing pixels into land cover classes (e.g., forest, water, urban).
- **Feature Extraction:** Identifying specific patterns or features (e.g., roads, buildings).

Digital Image Processing Technique	Function
Image Filtering	Removes noise from the image data.
Geometric Correction	Adjusts distortions caused by sensor movements.
Radiometric Correction	Ensures consistency in image pixel values.
Spectral Analysis	Assesses spectral bands for vegetation, water, etc.

Applications of GIS and Remote Sensing Across Sectors

1. Agriculture and Precision Farming

GIS and Remote Sensing technologies are transforming agriculture through precision farming, which allows farmers to monitor crop health, optimize irrigation, and improve productivity. Remote sensing provides real-time data on soil moisture, crop stress, and temperature variations. GIS tools help in planning planting patterns, water distribution, and harvesting schedules.

Benefits of Precision Farming Using GIS and Remote Sensing:

- Optimized resource usage (water, fertilizers)
- Early detection of crop diseases
- Efficient land management
- Real-time monitoring of field conditions

2. Environmental Conservation and Management

GIS and Remote Sensing are critical for tracking environmental changes over time. From monitoring deforestation in the Amazon to mapping coral reef degradation, these tools provide valuable insights for conservationists and policy-makers.

Key Areas of Application:

- **Biodiversity mapping:** Identifying and preserving habitats.
- **Climate change monitoring:** Tracking rising sea levels and glacier retreat.
- **Water resource management:** Assessing the quality and availability of water resources.

3. Urban Planning and Infrastructure Development

Cities are expanding rapidly, and GIS helps urban planners manage this growth. By integrating remote sensing data with GIS, planners can map out land-use patterns, manage infrastructure development, and reduce the environmental impact of urban sprawl.

Role of GIS in Urban Planning:

- Zoning and land-use management
- Transportation network analysis
- Monitoring air and water quality
- Disaster preparedness and risk assessment

4. Disaster Management and Risk Assessment

Remote sensing and GIS play a crucial role in disaster risk assessment, mitigation, and response. They can predict natural disasters like floods, hurricanes, and earthquakes, allowing authorities to take preventive measures. Post-disaster, they assist in damage assessment and recovery planning.

GIS and Remote Sensing in Disaster Management:

- **Before Disaster:** Risk assessment, early warning systems.
- **During Disaster:** Real-time monitoring of affected areas.
- **Post-Disaster:** Damage assessment, recovery planning.

Disaster Type	GIS/Remote Sensing Application
Earthquakes	Mapping fault lines, monitoring seismic activity.
Floods	Predicting flood zones, monitoring water levels.
Hurricanes	Tracking storm paths, assessing damage.

Future Trends in GIS and Remote Sensing

1. Integration with Artificial Intelligence (AI)

AI and machine learning are increasingly being integrated into GIS and Remote Sensing applications. These technologies can analyze vast amounts of data more efficiently, providing more accurate predictions and insights.

2. Cloud-based GIS Solutions

The future of GIS is moving towards cloud-based platforms, making spatial data more accessible and easier to share. This allows real-time collaboration among teams spread across different locations.

3. Expansion into the Private Sector

While traditionally used by government agencies and environmental organizations, GIS and Remote Sensing are becoming more prevalent in the private sector, particularly in fields like marketing, retail, and logistics, where location data is critical for decision-making.

Conclusion

The rise of GIS and Remote Sensing has revolutionized how we interact with and understand the world around us. From precision farming and urban planning to disaster management and environmental conservation, these technologies are indispensable in tackling some of the most pressing challenges facing society today. As technological advances continue to shape these fields, we can expect GIS and Remote Sensing to play an even more significant role in the future.

Space Science Education

Dr. Pushpendu Rakshit
Program Director, KCSA

Space science education plays a crucial role in fostering a deeper understanding of the universe and our place within it. From an early age, students are introduced to fundamental concepts through engaging curricula that explore topics such as astronomy, astrophysics, and planetary science. Hands-on activities, such as building model rockets or simulating planetary orbits, spark curiosity and encourage critical thinking. Additionally, technology integration, like virtual reality and simulations, enhances learning experiences by allowing students to explore distant planets and galaxies.

Field trips to observatories and planetariums provide real-world context, helping students connect classroom knowledge with tangible experiences. The growing accessibility of online resources and educational platforms has made space science more approachable, enabling learners from diverse backgrounds to engage with cutting-edge research. Collaborative projects, such as citizen science initiatives, allow students to contribute to actual scientific studies, fostering a sense of community and purpose.

Interdisciplinary approaches also enhance space science education, integrating physics, mathematics, and even art to create a holistic learning environment. Furthermore, mentorship programs that connect students with professionals in the field can inspire future careers in science, technology, engineering, and mathematics (STEM). As the importance of space exploration continues to grow, educational institutions are increasingly recognizing the need to prepare students for careers in aerospace, robotics, and environmental science.

Public outreach initiatives, like science fairs and community workshops, help demystify space science, making it accessible to everyone. As we face global challenges, understanding space science is vital for addressing issues like climate change and resource sustainability. Ultimately, a robust space science education empowers students to think critically, innovate, and contribute to our collective knowledge of the universe. By nurturing curiosity and passion for the cosmos, we can inspire the next generation of explorers and scientists who will continue to push the boundaries of human understanding.

