Leveraging Large Language Models for Advanced Geospatial Decision Support: The Case of SatGPT

Advancing Sustainable Development through AI and Earth Observation

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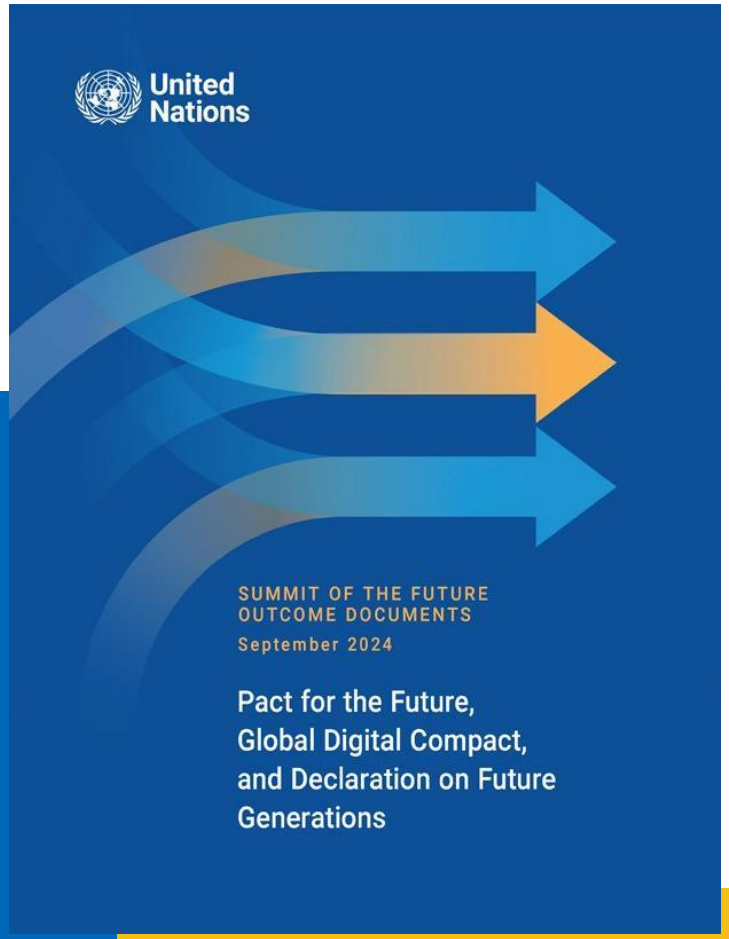
Contents

What are our mandates? — Exploring digitally-driven innovations as requested by countries through UN resolutions

How did SatGPT evolve? — Integrating traditional applications of space-based technologies with artificial intelligence to support decision-making and disaster risk management

What are the key use cases of SatGPT and actions taken? — Building institutional capacity for validation to improve and customize the tools for location-specific applications at country level

What is next? — Expand SatGPT applications for mapping diverse disaster hotspots

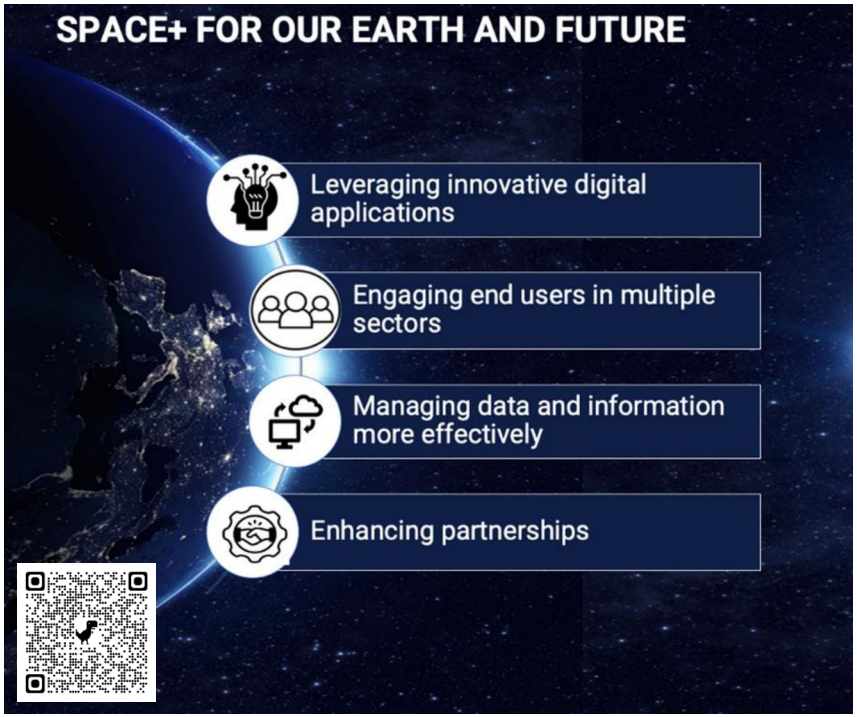


AI and SDGs

Mandates at the Global Level

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- ☑ In the Pact for the Future (Annex on **Global Digital Compact)**, AI is recognized as a transformative tool capable of accelerating progress toward the Sustainable Development Goals (SDGs).
- ☑ The **Declaration on Future Generations**, underscores the transformative potential of AI in achieving the SDGs.
- ☑ UN Resolution (A/RES/78/265): Seizing the opportunities of **safe, secure and trustworthy** artificial intelligence systems for sustainable development.
- ☑ UN Resolution (A/RES/78/311): Enhancing international cooperation on **capacity-building of artificial intelligence**.



Mandates at the Regional Level

The Fourth Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific



Supporting Countries by Leveraging AI and Digital Innovations in Geospatial Applications



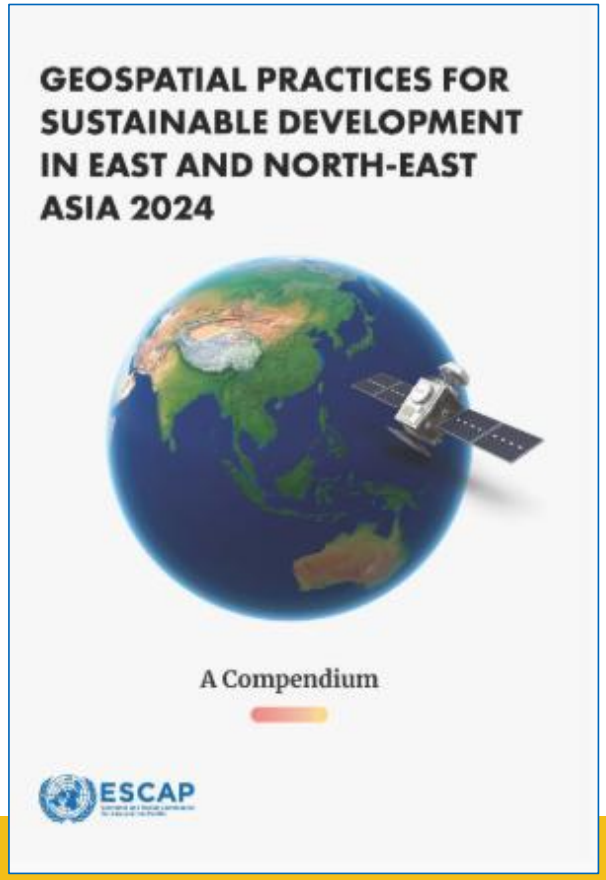
Enhancing Regional Cooperation in Digital Innovations for the SDGs

Mandates at the Regional Level

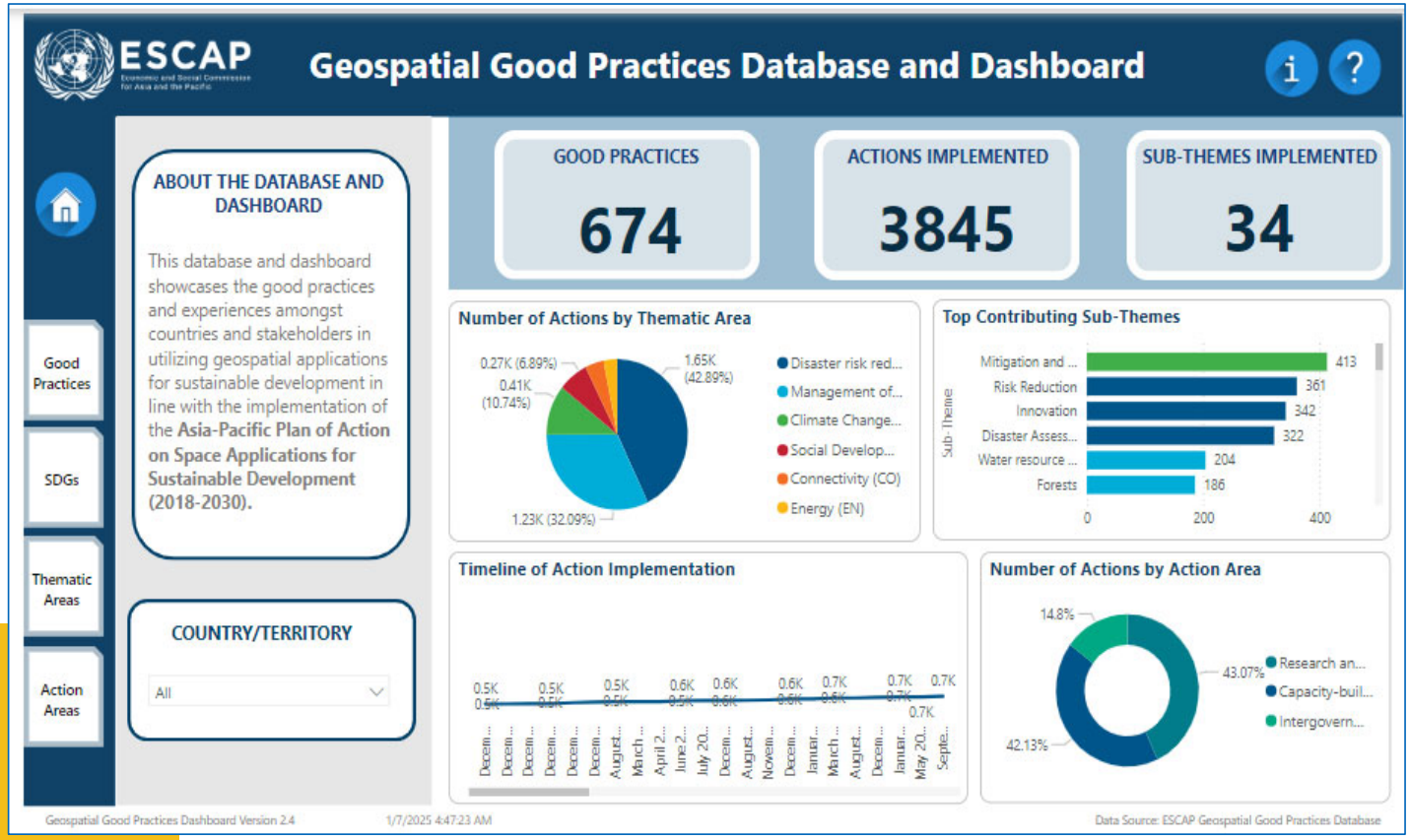
Theme topic of the 80th Session of the Commission



Resolution 80/1. Leveraging digital innovation for sustainable development in Asia and the Pacific



Actions Taken



Explore more

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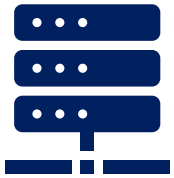
How did SatGPT evolve?

2020 → 2024 → **2025**

SatGPT: a **web-based quantitative tool** that allows a user to *spatially map any flood event* from **1984 to present** in near-real time, using cloud computing, big Earth data and large language models



- **Google Earth Engine** is used as the cloud computing platform



- Access to **a massive data catalog of Earth observation data**



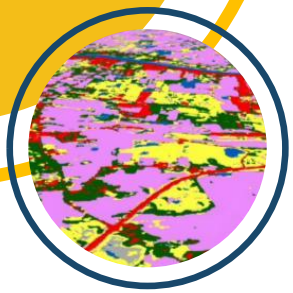
- **Large language models generate the code** to *process data in less than* **1 minute to** *generate a* **single flood map**

SatGPT for Flood Hotspot Mapping

- Flooding has affected **over 3 billion people** and caused over $**900 billion in losses** in the past 30 years in the **Asia and the Pacific**.
- **SatGPT is a flood mapping expert accessible to every user in the region.**



Historical flood maps in less than 1 minute at a minimal cost



SATGPT

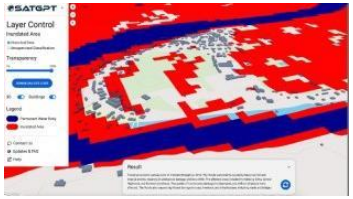
How SatGPT Works

Ethical AI

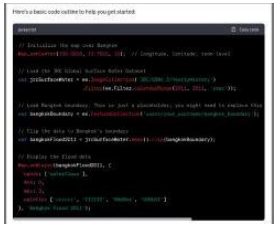
Participatory AI Modelling

End User

Customized UI



ChatGPT Query to Generate Code



Computing on GEE

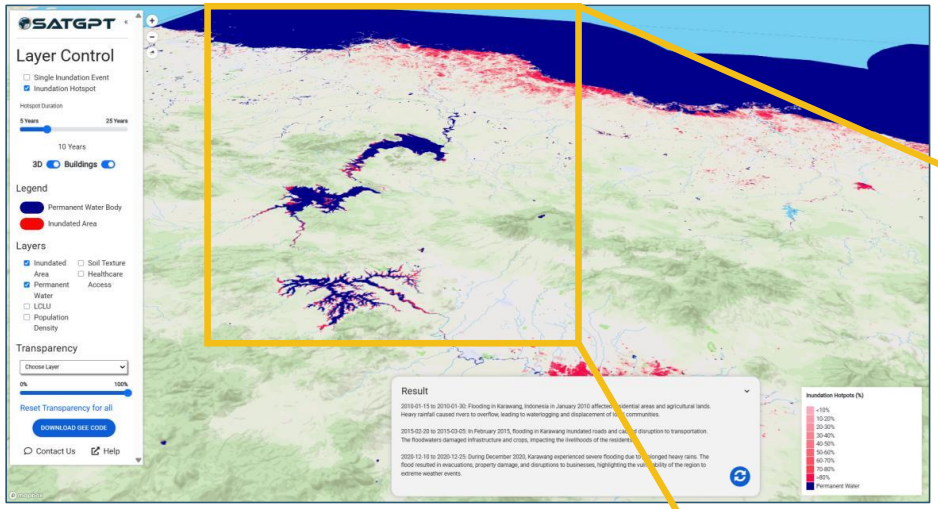


Infrastructure

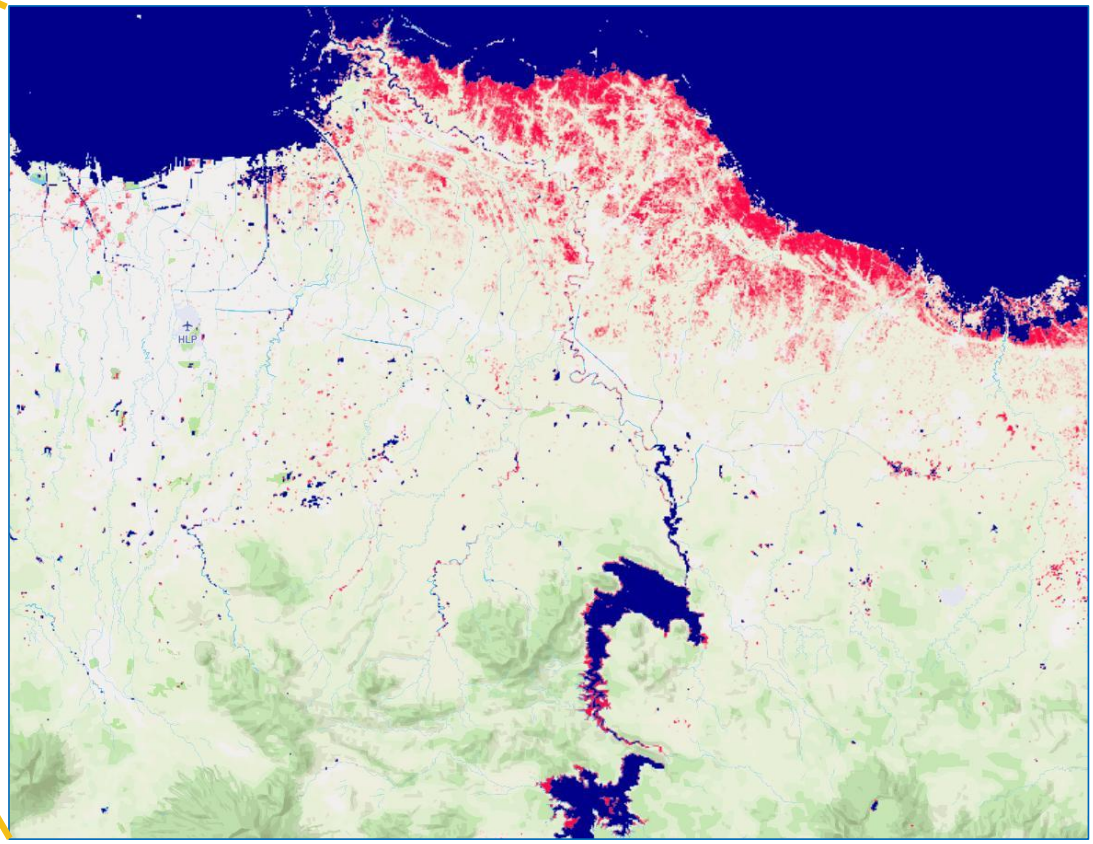
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SatGPT Interface



"Map the flooding in Karawang, Indonesia from 2010 to 2020"



Finalist
2024 ITU SDG Digital GameChangers Awards

SDG Digital

ITU

UNDP

SatGPT Case Studies

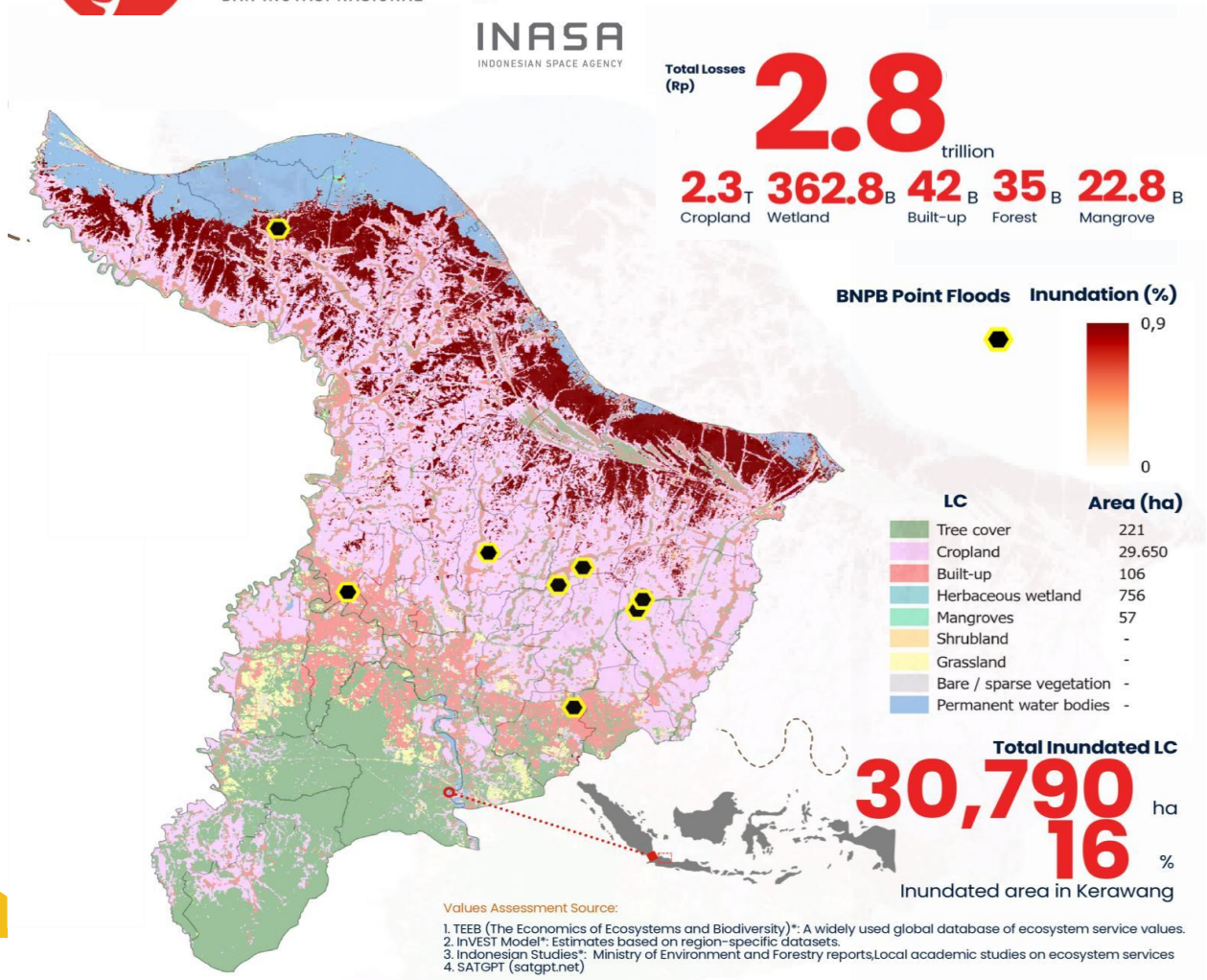
This case study was developed during the training hosted in November 2024 in Jakarta, Indonesia.

Participants proceeded to publish this as a conference paper, which showcased **the use of SatGPT with socioeconomic data for estimating economic losses**.

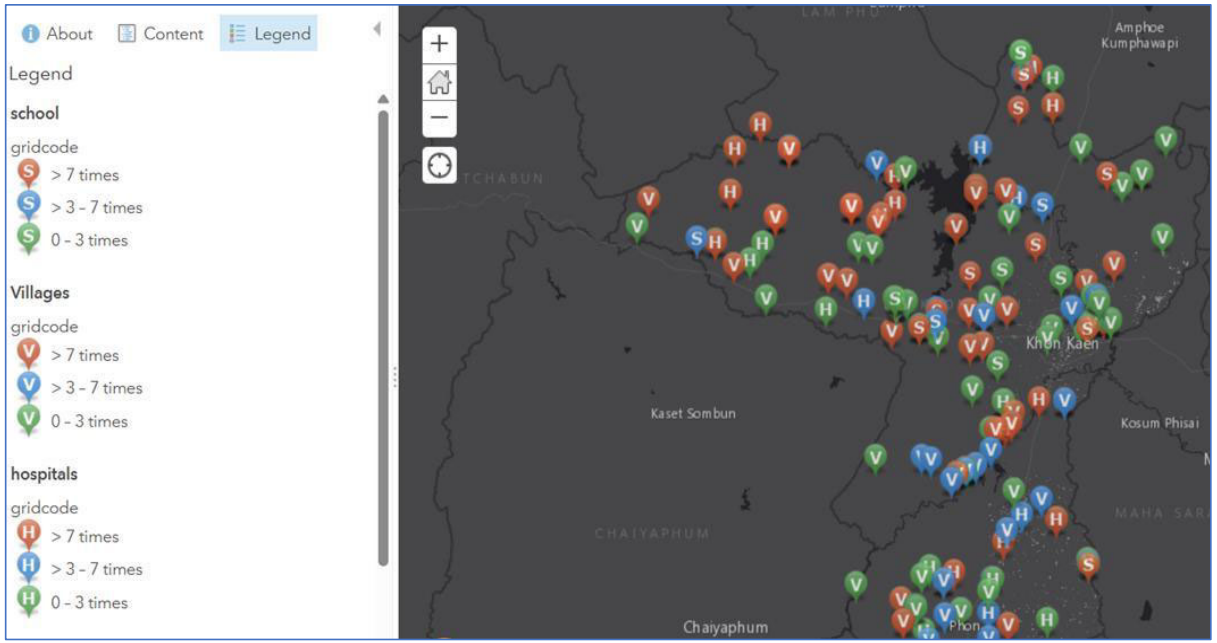
2024 Best Paper Award of the IEEE Aerospace & Electronics Systems and Geoscience and Remote Sensing Joint Chapter

0.1109/AGERS65212.2024.10932922

Flood Impact Analysis: Karawang, Indonesia



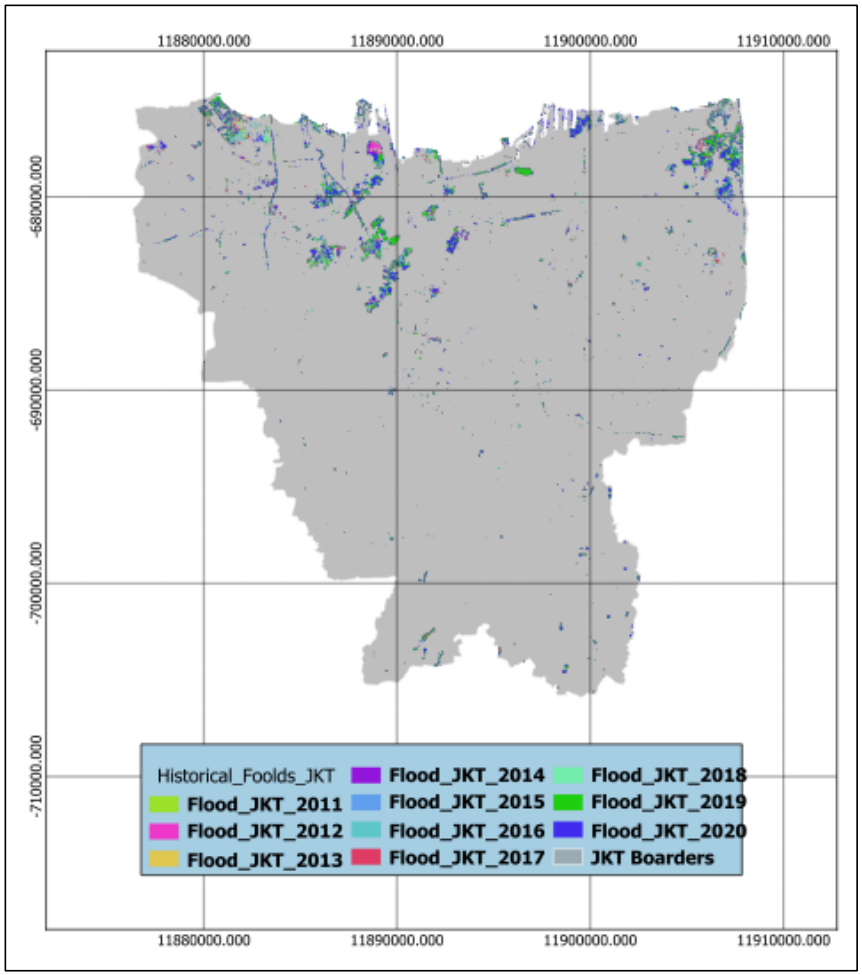
SatGPT Case Studies



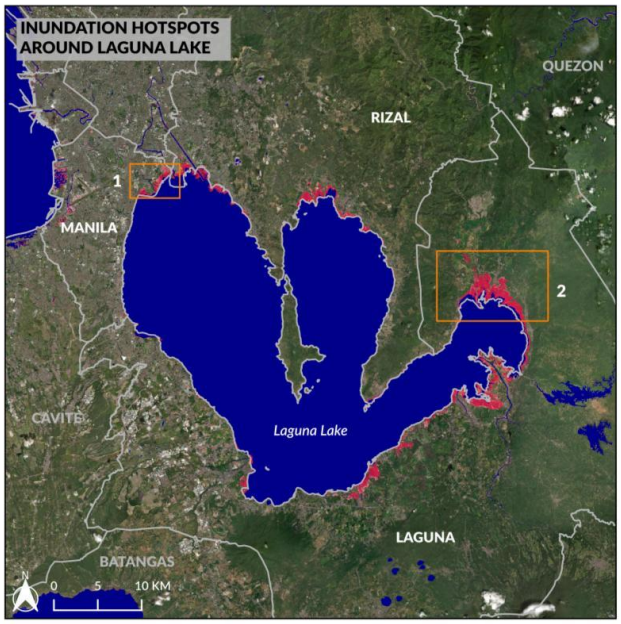
▲ SatGPT inundation hotspot data can help in **identifying villages, schools, and critical infrastructure that can support disaster preparedness and recovery**.

Urban Flooding: Khon Kaen, Thailand and Jakarta, Indonesia

► **SatGPT can help map annual historical flooding and determine its relationship with weather related events**. It also allows the identification of healthcare facilities that are frequently affected by floods.

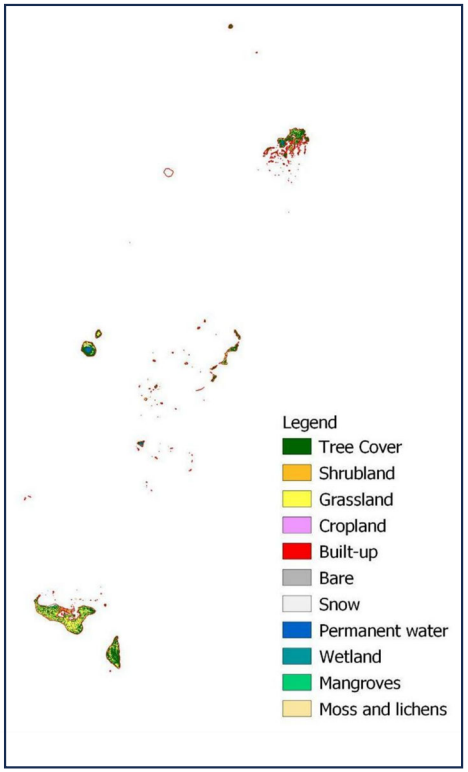


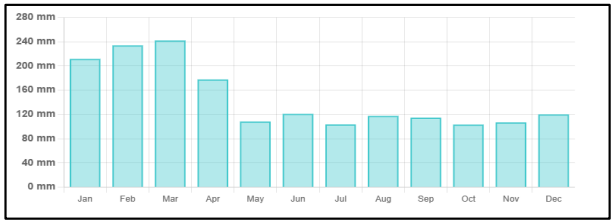
SatGPT Case Studies



▲ Mapping inundation hotspots around **Laguna Lake (2010–2020)** with SatGPT **helps inform spatial planning and infrastructure development.**

Effect of Flooding in Land Use and Land Cover: Laguna Lake, Philippines and Tonga





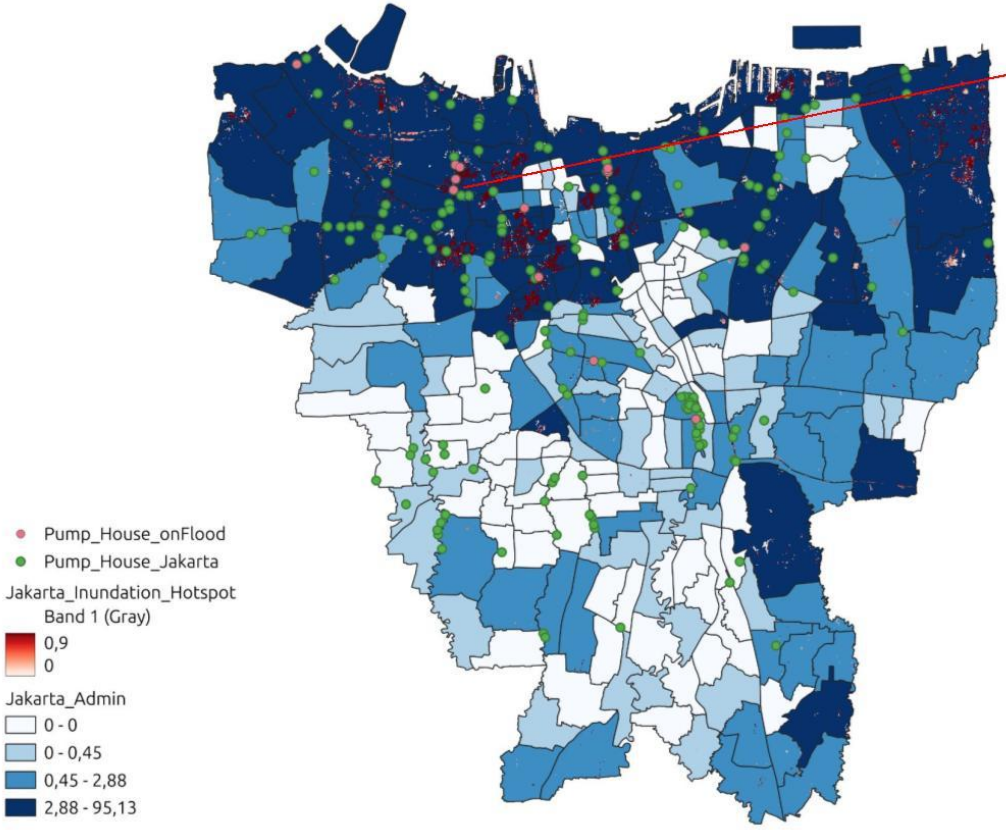


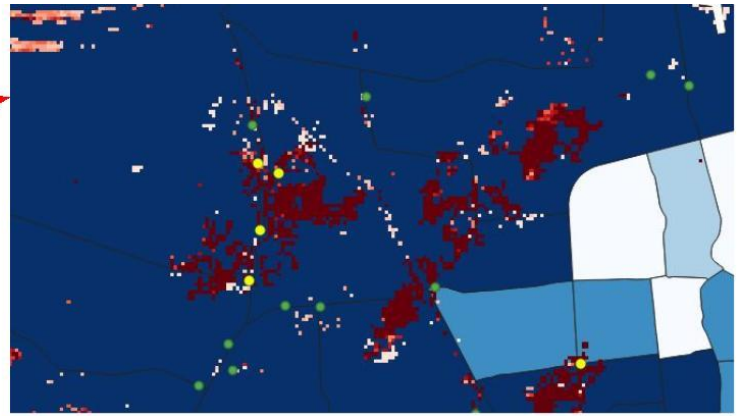




▲ Using the inundation hotspot generated by SatGPT, **the impact of heavy rainfall events in poorly drained lowland and urban areas can be determined.**

SatGPT Case Studies





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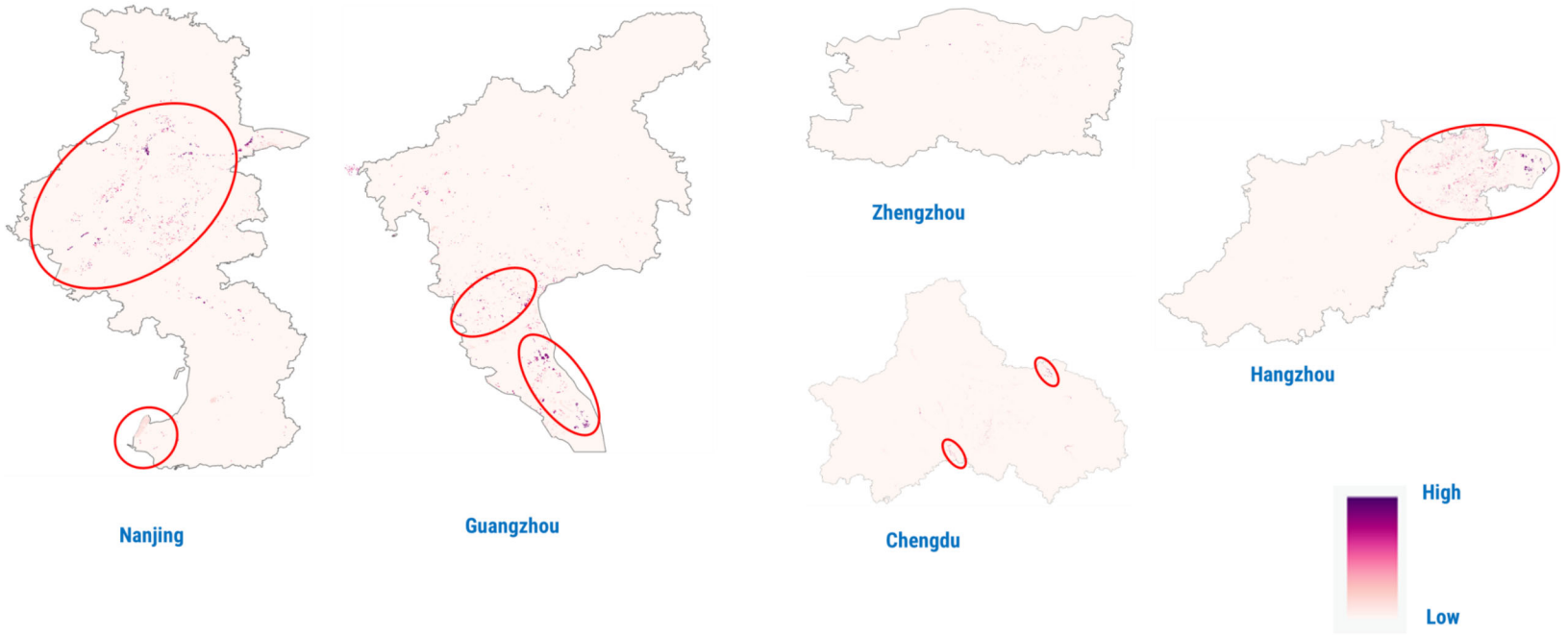
13	Pump Station Affected

Urban Flooding: Pump Exposure in Jakarta

▲ Pump houses are critical infrastructure to evacuate excess water from low-lying areas. Improper pump capacity may lead to inefficiency or failure in flood response. **By mapping the inundations hotspots in Jakarta using SatGPT, a total of 13 pumps and 30 pump houses were revealed to be at risk due to flooding.**

SatGPT Case Studies

GDP – Flood Frequency Exposure



◀ Using SatGPT flooding data coupled with economic parameters such as Gross Domestic Product (GDP), economic losses can be estimated. **In this example, the cities of Nanjing, Guangzhou, and Hangzhou show the highest potential economic losses caused by flooding.**

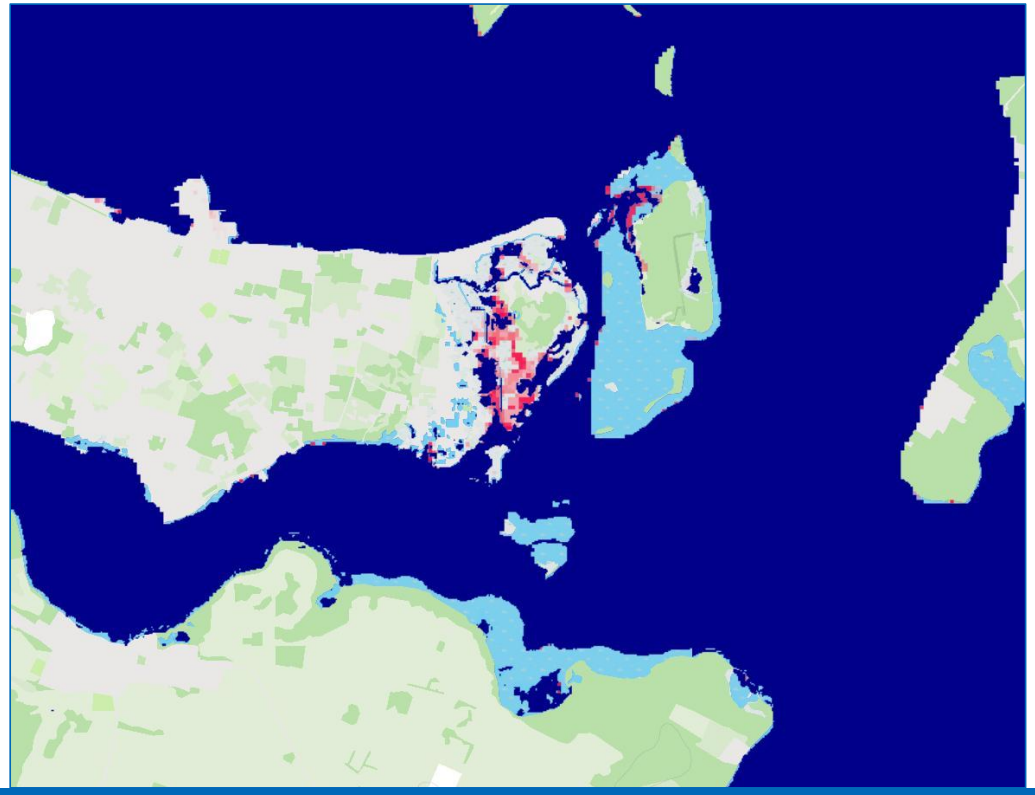
Urban Flooding: Economic Losses in Chinese Cities

$$GDP\ flood\ exposure = f * GDP$$

$$Economic\ losses = f * V * D * (1 + I)$$

f - Flood frequency (SatGPT)
V - Economic value per unit area

D - Direct flood loss rate
(based on Land Use Type & flood Depth, set as 0.5)
I - Indirect flood loss rate
(based on Land Use Type & flood Depth, set as 0.25)



“Map the flooding in Tonga from 2010 to 2020”

According to SatGPT:

2013-01-11 to 2013-01-16: In January 2013, Tonga experienced significant flooding, affecting several areas across the country. The flooding started on January 11th and lasted until January 16th. The impacted regions included Nuku'alofa, Vava'u, Ha'apai, and Eua. The heavy rains caused widespread flooding, damaging infrastructure and disrupting daily life for the local communities. Relief efforts were mobilized to provide assistance to the affected population.

2018-02-12 to 2018-02-17: In February 2018, Tonga faced another round of flooding, with the event starting on February 12th and ending on February 17th. This flooding event impacted various regions in Tonga, including 'Eua, Ha'apai, Vava'u, and Nuku'alofa. The heavy rainfall led to flash floods, causing damage to homes, roads, and agricultural lands. The affected communities received support from local authorities and international aid organizations to help them recover from the disaster.

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What is next?

Map hotspots across a range of disasters



Develop SatGPT for forest fires, coastal ecosystem monitoring (mangroves, sea level rise), crop, and urban areas

Training and Validation



Conduct training and country-level validation on AI applications in geospatial analytics, with a specific emphasis on SatGPT

Partnerships and Collaborations



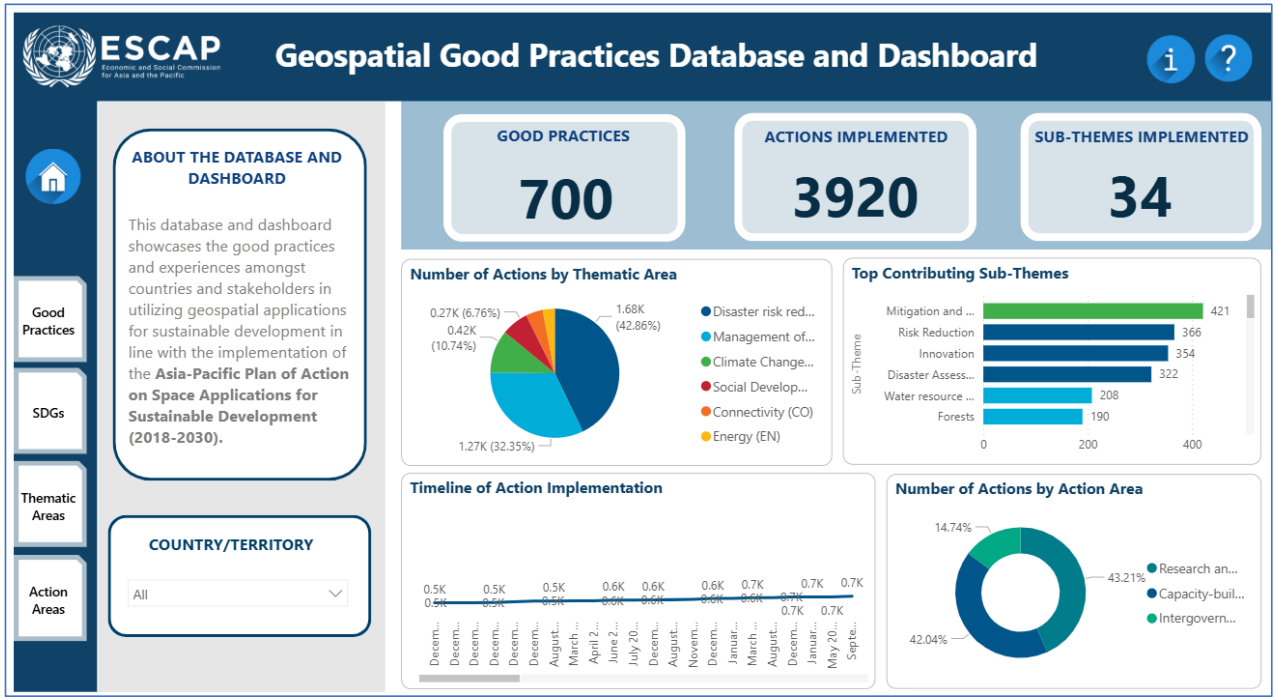
Strengthen partnerships in UN system, interested research entities, policy think tanks with objective of enabling integration of AI solutions, particularly SatGPT, into existing systems for disaster risk management and resource monitoring

Engage the Youth



Inspire the youth through knowledge exchanges to promote the independent usage of SatGPT

Geospatial Good Practices and Needs Assessment





SCAN ME

If you have any geospatial good practices to share with us, please do not hesitate to get in touch – sheryl.reyes@un.org

Help us improve SatGPT and upcoming digital innovations through this survey!

Thank you

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