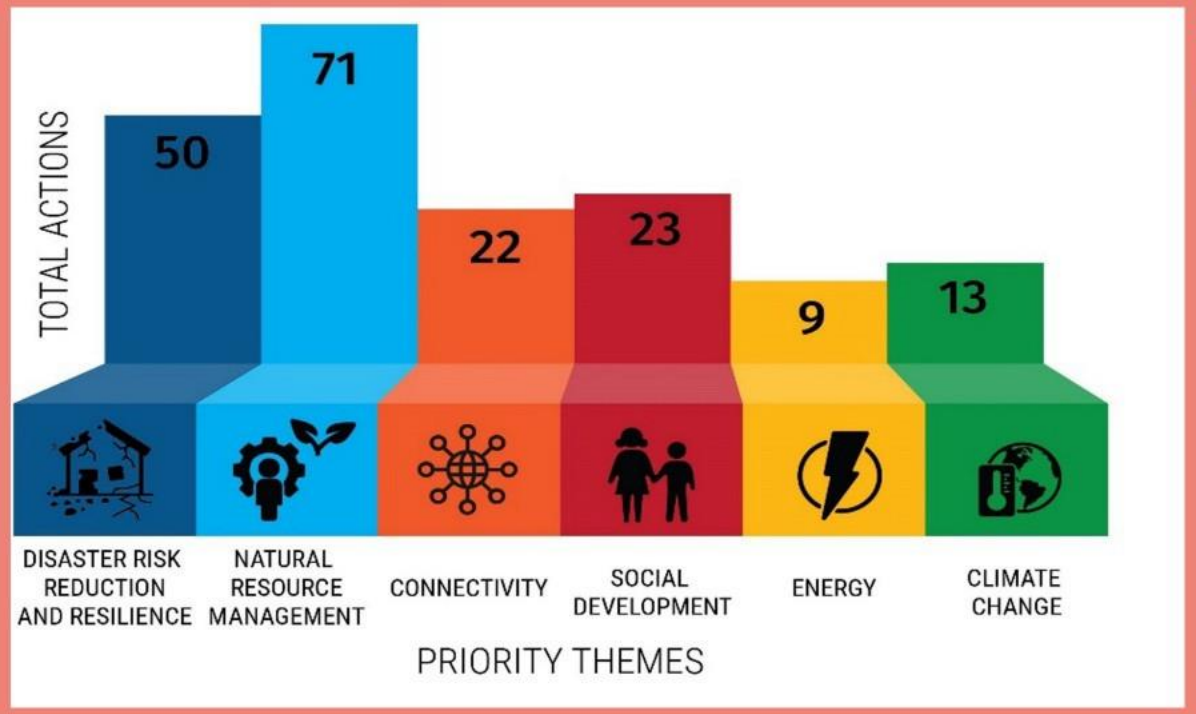
ESCAP
Economic and Social Commission for Asia and the Pacific

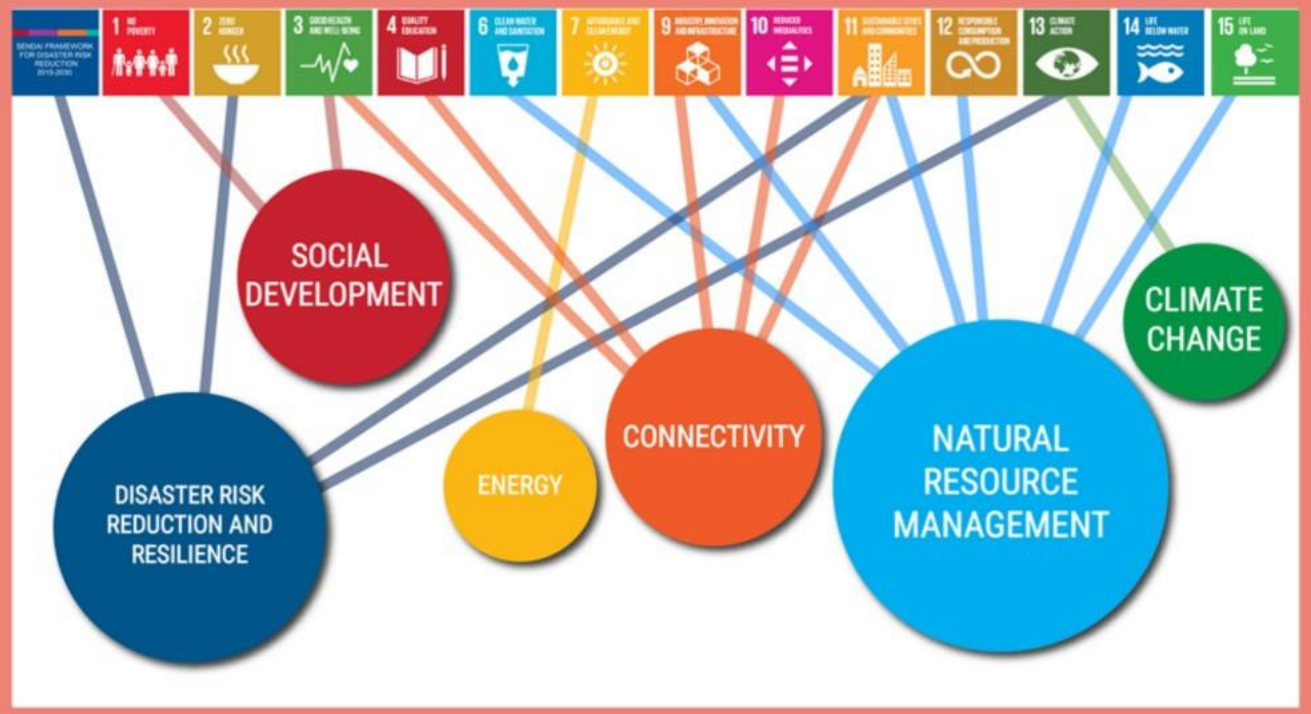
Leveraging LLMs for Advanced Geospatial Decision Support: The case of SatGPT

Hamid Mehmood

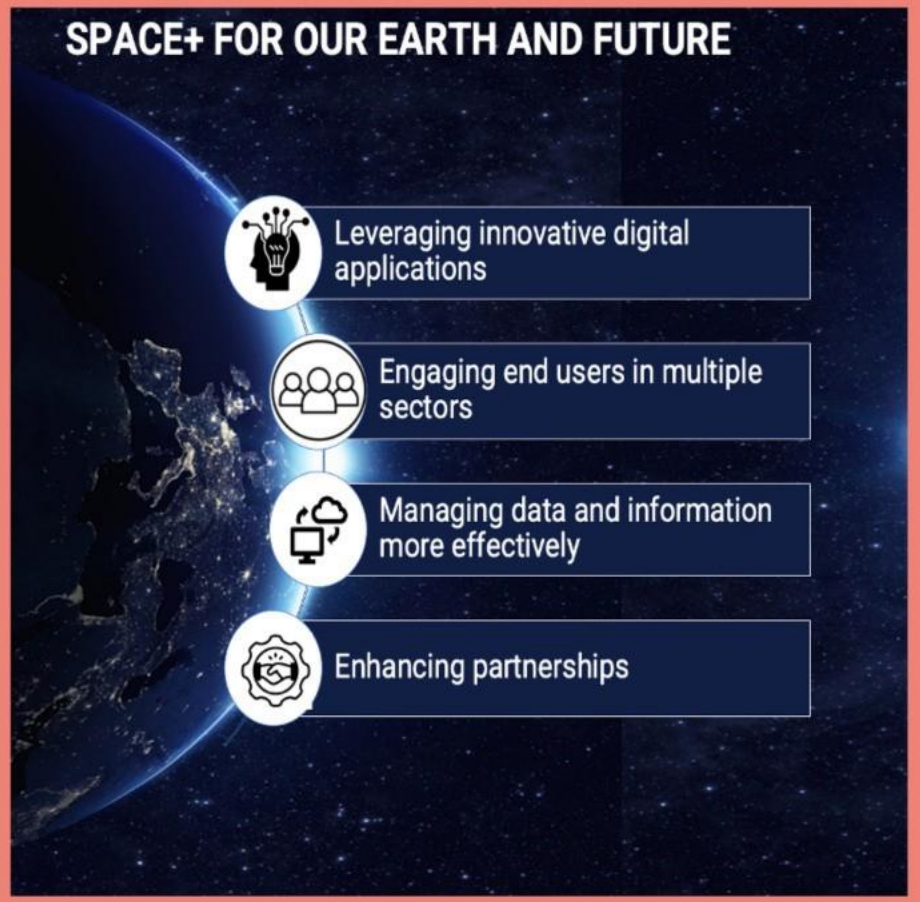
Economic Affaris Officer
Space Applications Section
United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)

Asia-Pacific Plan of Action on Space Applications for Sustainable Development (2018–2030)





Outcome of the 4th Ministerial Conference on Space Applications



Leveraging digital innovation for sustainable development in Asia and the Pacific

80th Commission Session

Seizing the Opportunity

DIGITAL INNOVATION FOR A SUSTAINABLE FUTURE

Evolution of SatGPT over 05 years

Types of Tools and Applications

HINDCAST

NOWCAST

FORECAST

- We need to look back to move forward
- Understand WHAT needs to be "built back better"
- Generate critical data to train artificial intelligence models

Most importantly understand SYSTEMIC RISK, THE WHERE and THE HIDDEN LINKS

NOWCAST

- We need to look back to move forward
- Understand WHAT needs to be "built back better"
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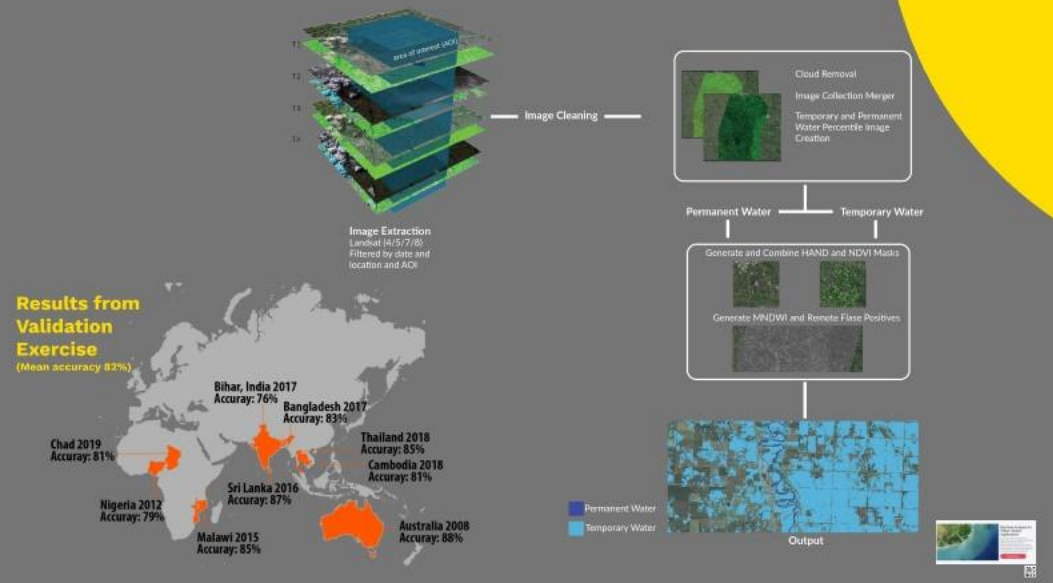
Most importantly understand SYSTEMIC RISK, THE WHERE and THE HIDDEN LINKS

2018

To develop a **web-based quantitative tool** that allows a user to spatially map any flood event from **1984-Present** in near-real-time, using cloud computing and big Earth data

- **Google Earth Engine** is used as the cloud computing platform
- Access to **20 petabyte** of Earth data
  1 petabye = 1 million gigabytes OR the whole of Amazon forest converted to A4 paper with single space print on both sides of the paper
- **600** lines of code computes **200-1000 GB** of data in **< 1 minute** to generate a **single flood map**



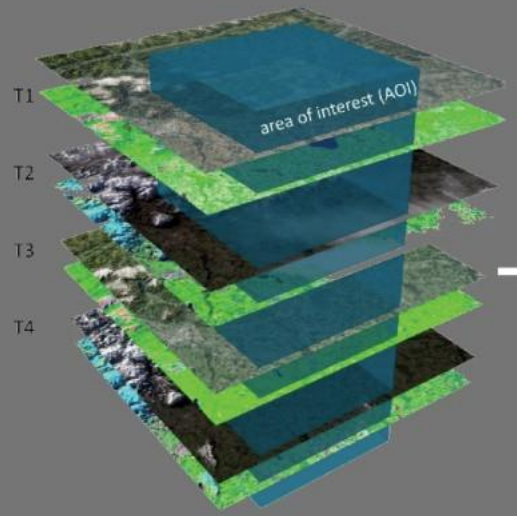
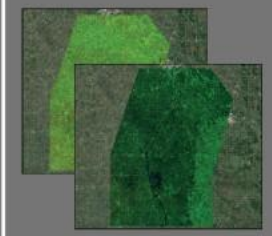


Image Extraction
Landsat (4/5/7/8)
Filtered by date and location and AOI

Image Cleaning



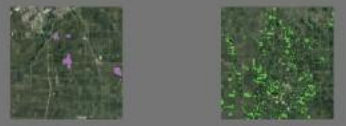
Cloud Removal

Image Collection Merger

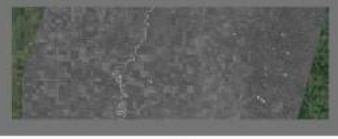
Temporary and Permanent Water Percentile Image Creation

Permanent Water | **Temporary Water**

Generate and Combine HAND and NDVI Masks



Generate MNDWI and Remote Flase Positives

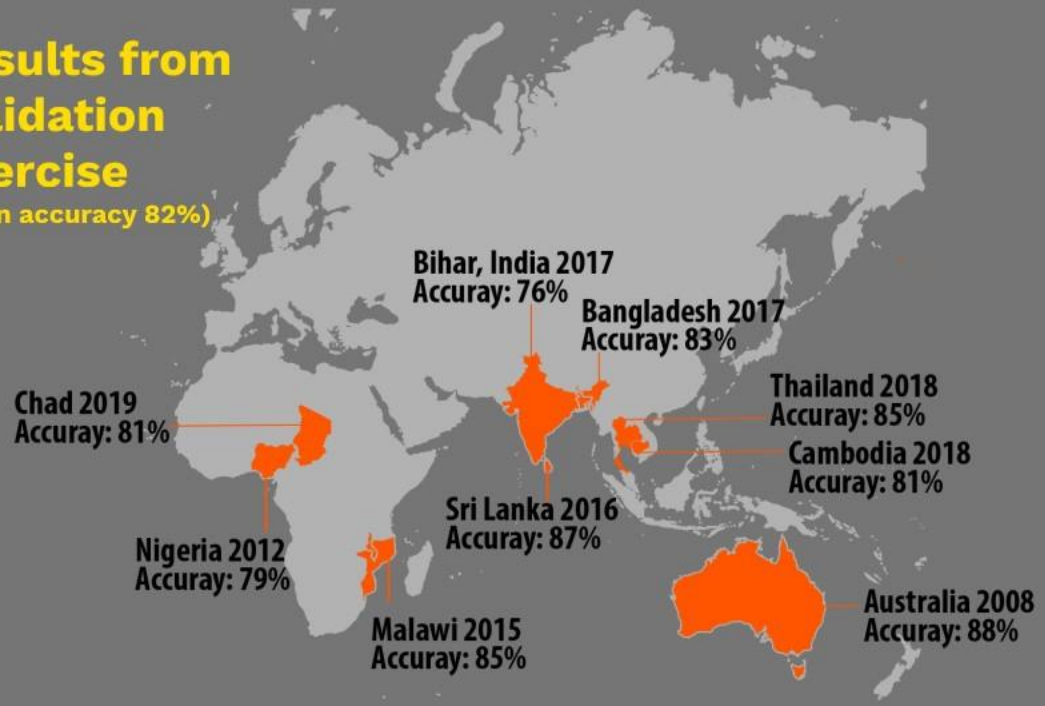


Permanent Water
Temporary Water

Output

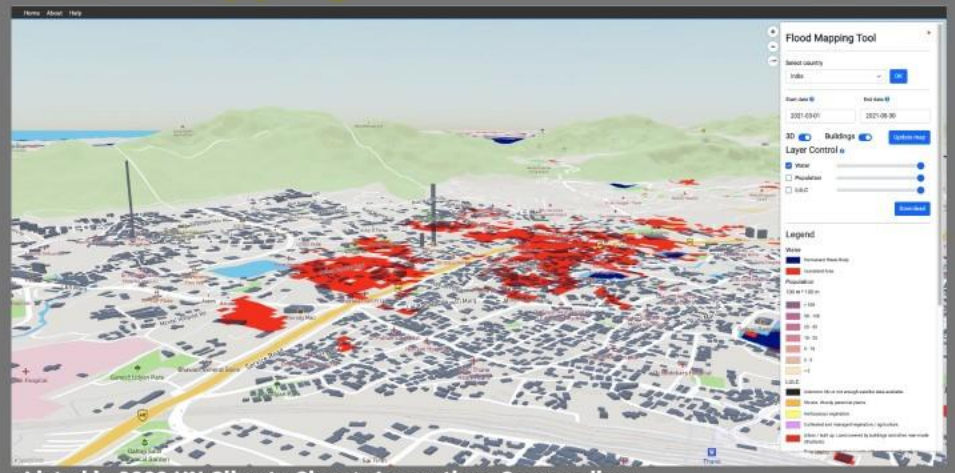
Results from Validation Exercise

(Mean accuracy 82%)

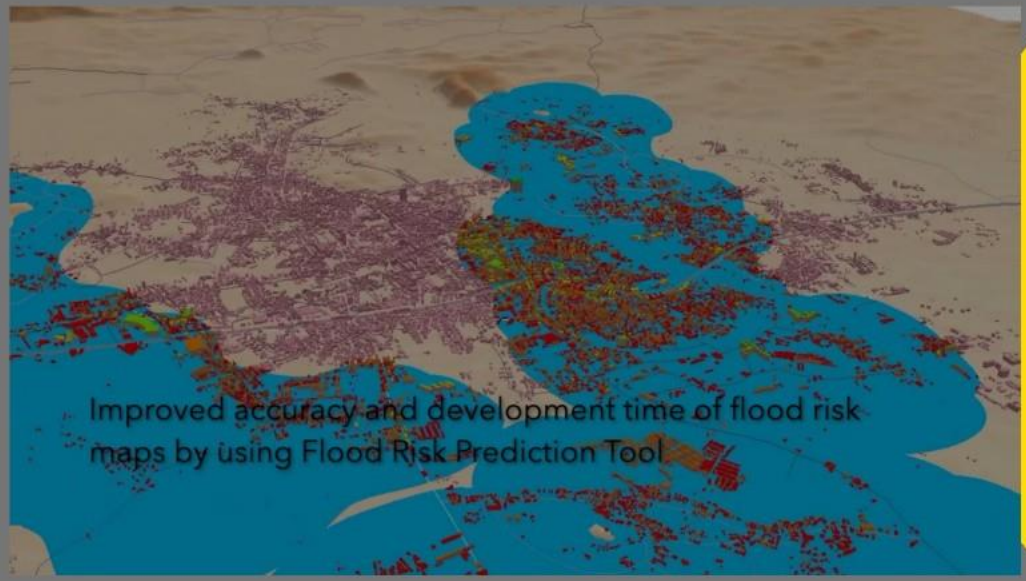


2020

Flood Mapping Tool (floodmapping.inweh.unu.edu)



- Listed in 2022 UN Climate Change Innovations Compendium
- Won the 2021 Popular Science Best of Whats New Award



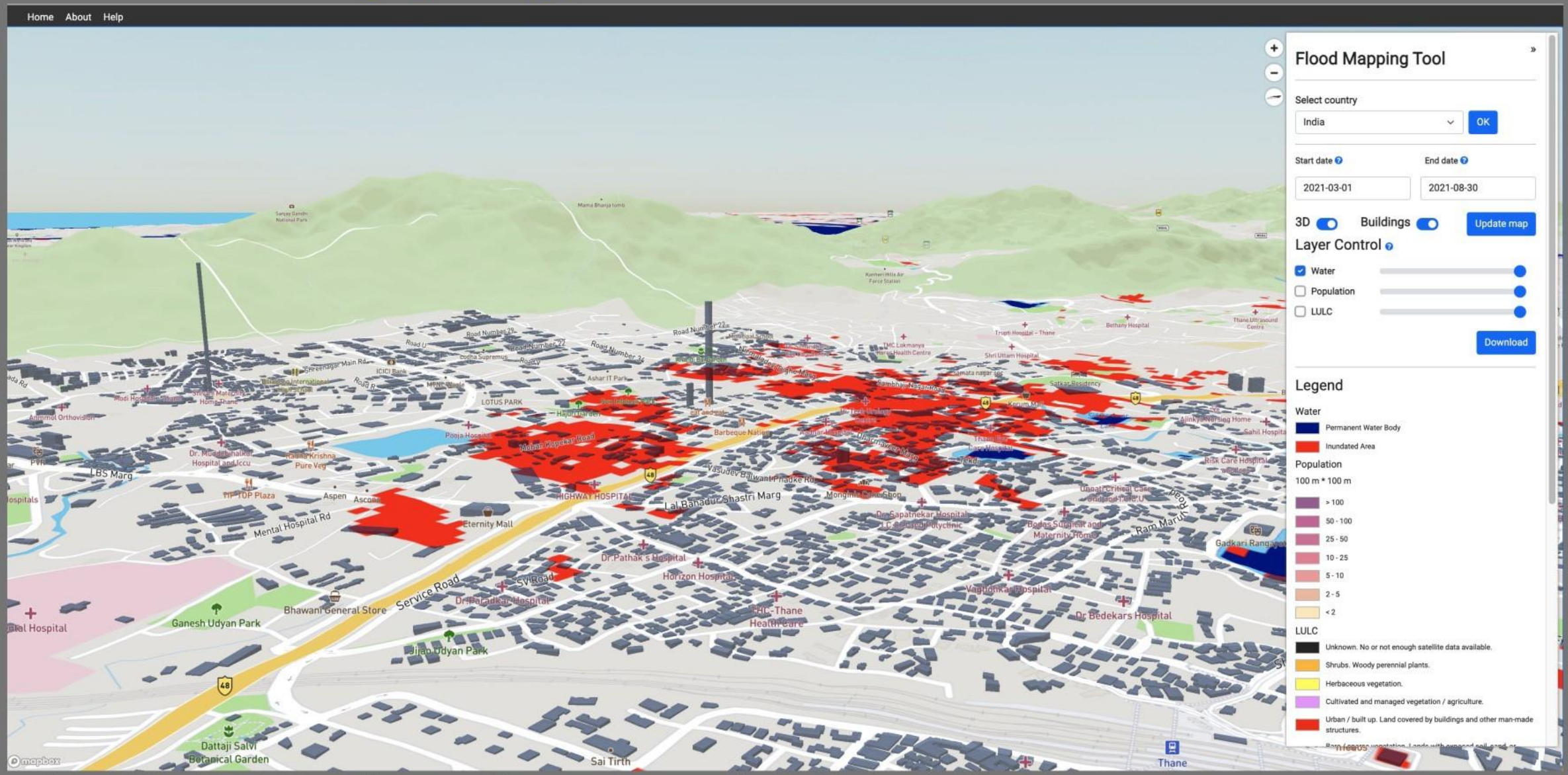
Google Cloud

Hosting

mapbox

Basemap and 3D services

Flood Mapping Tool (floodmapping.inweh.unu.edu)



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- **Won the 2021 Popular Science Best of Whats New Award**

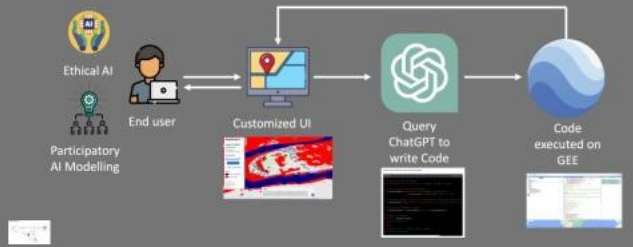
Big Data Analysis for Water-related Applications

This online course introduces the participants to Earth Engine Code Editor platform, explore some basic programming concepts, Earth Engine data structures and methods, functions, and algorithms, and implementation of surface water detection algorithm.

Enroll Now

023-24

SATGPT



2024-25

Multi-modal system (voice input, data integration, analysis)

"Here is a picture of the data collected in the field, use this to map the children impacted by the 2024 floods in Afghanistan, you will have to map the flood as well; use all the available sensors; also create a Power BI siutation dashboard and use the UN base maps, pick up the authentications from my Keychain"

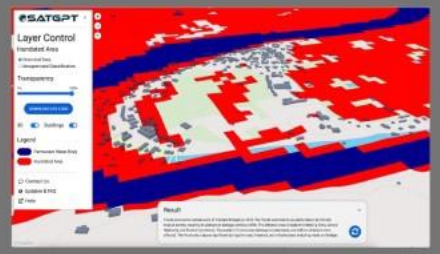
SATGPT

Ethical AI

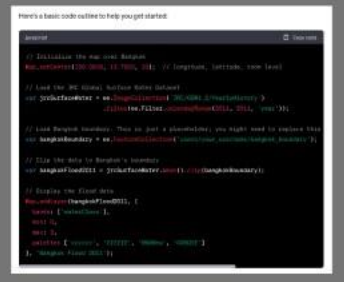
Participatory AI Modelling

End user

Customized UI



Query ChatGPT to write Code



Code executed on GEE

SATGPT

explore more at:
satgpt.net


SATGPT
Layer Control
Single Inundation Event
Inundation Hotspot
Hotspot Duration
5 Years
25 Years
10 Years
3D
Buildings
Legend
Permanent Water Body
Inundated Area
Layers
Inundated Area
Permanent Water
LCLU
Population Density
Soil Texture
Healthcare Access
Transparency
Bang Pa-in
LCLU
Tree cover
Shrubland
Grassland
Cropland
Built-up
Bare/sparse vegetation
Snow and ice
Permanent water bodies
Herbaceous wetland
Mangroves
Moss and lichen
Inundation Hotpots (%)
<10%
10-20%
20-30%
30-40%
40-50%
50-60%
60-70%
70-80%
>80%
Permanent Water
Result
2010-07-10 to 2011-01-16: The 2010-2020 Bangkok floods were a series of devastating floods that occurred in Thailand. The floods started on July 10, 2010, and lasted until January 16, 2011. The flooding affected various provinces in Thailand, including Bangkok, Nonthaburi, and Ayutthaya. Thousands of homes, businesses, and agricultural fields were inundated, causing significant economic losses and displacing thousands of people. The floodwaters receded slowly, prolonging the impact on the affected areas.
mapbox

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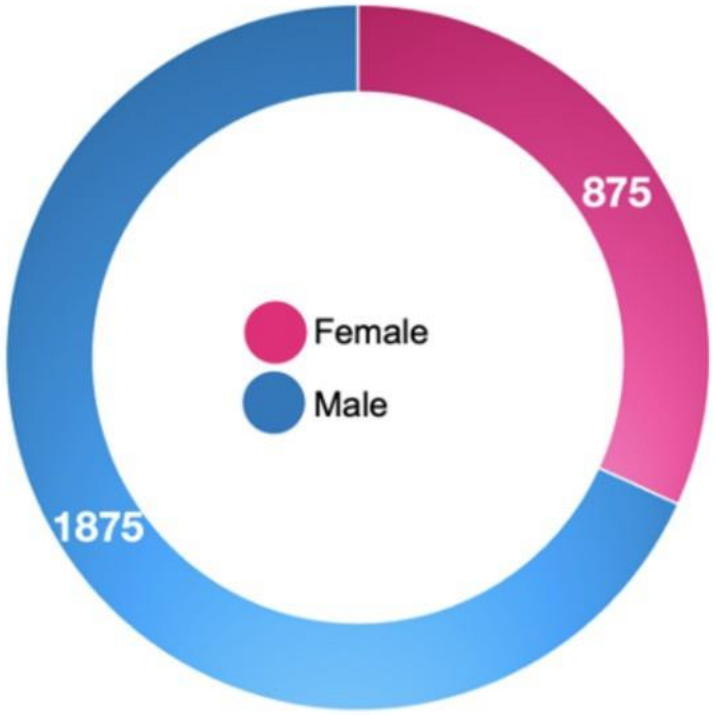
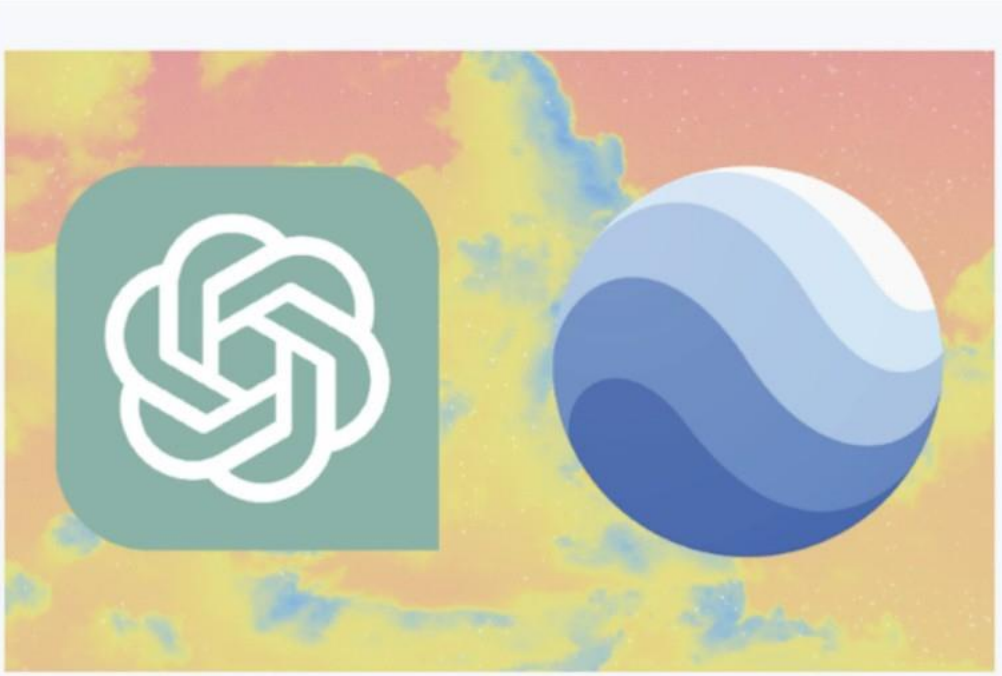
Online Course

Introduction to Geospatial Data Analysis with ChatGPT and Google Earth Engine



Gender-based distribution of the participants



Introduction to Geospatial Data Analysis with ChatGPT and Google Earth Engine

This online course introduces the participants to ChatGPT and Earth Engine Code Editor platform to process and interpret geospatial data.

ENROLL NOW

Total number of participants 2750

Total number of countries 110

wlc.unu.edu

Learning Outcomes

- Understand Geospatial Data Analysis Fundamentals: Grasp the core concepts and significance of geospatial data, its applications across various domains, and the basic datasets involved.
- Utilize Google Earth Engine: Set up and navigate the Google Earth Engine environment, leveraging it as a powerful platform for geospatial analysis.
- Leverage ChatGPT for Geospatial Tasks: Understand the capabilities, benefits, and limitations of ChatGPT in the context of geospatial data analysis.
- Master Prompt Engineering: Learn the art of crafting effective prompts to guide ChatGPT in producing desired outputs for geospatial tasks.
- Integrate ChatGPT with Google Earth Engine: Seamlessly combine the capabilities of both tools for efficient geospatial data processing.

Four modules

- Introduction to Geospatail Data Analysis
- **Understanding ChatGPT for Geospatial Data Analysis**
- Hands-on Practice: Basic Geospatial Analysis with ChatGPT
- Real-world Applications and Case Studies

Understanding ChatGPT for Geospatial Data Analysis

- Introduction to GeoPrompt Engineering
- Benefits and limitations of using ChatGPT for geospatial analysis
- Integrating ChatGPT with GEE

Introduction to GeoPrompt Engineering

What is a Prompt?

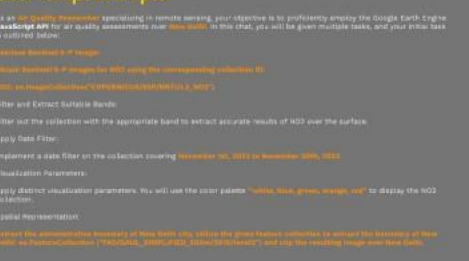
What is Prompt Engineering?

Input: Right words, Context, and Format in the Prompt Output: Most Accurate and Relevant Information

What is Prompt Pattern?

Elements of GeoPrompt

Be specific: persona, language, functionality
Provide technical, spatial and temporal context: libraries, AoI, analysis date range
Define inputs and outputs: sensor type/ bands, visulatization parameters



GeoPrompt Example:

As an **Air Quality Researcher** specializing in remote sensing, your objective is to proficiently employ the Google Earth Engine **JavaScript API** for air quality assessments over **New Delhi**. In this chat, you will be given multiple tasks, and your initial task is outlined below:

Retrieve Sentinel 5-P Image:

Obtain Sentinel 5-P images for NO2 using the corresponding collection ID:

NO2: ee.ImageCollection("COPERNICUS/S5P/NRTI/L3_NO2")

Filter and Extract Suitable Bands:

Filter out the collection with the appropriate band to extract accurate results of NO2 over the surface.

Apply Date Filter:

Implement a date filter on the collection covering **November 1st, 2023 to November 30th, 2023**

Visualization Parameters:

Apply distinct visualization parameters. You will use the color palette **“white, blue, green, orange, red”** to display the NO2 collection.

Spatial Representation:

Extract the administrative boundary of New Delhi city, utilize the given feature collection to extract the boundary of New Delhi: ee.FeatureCollection ("FAO/GAUL_SIMPLIFIED_500m/2015/level2") and clip the resulting image over New Delhi.

We are working with countries and cooperation partners to build an ARRAY of tools and apps to address the data and information needs in Asia and the Pacific

2024

Flood Hotspot Mapping

Wildfire Hotspot Mapping

2026

Evolution of SatGPT over 05 years

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Leveraging LLMs for Advanced Geospatial Decision Support: The case of SatGPT

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Projects

Building institutional capacity to use artificial intelligence and spatiotemporal data for SDGs monitoring and assessment

Objective: To establish the use of artificial intelligence and integrated spatiotemporal data for local SDG monitoring and decision-making.

Phase I

Target Countries

Digital Technologies / Innovations

AI | Integrated Spatiotemporal Data | SDSS

Target SDGs

Activities

Local Capacity Development | Institutional Capacity Development

Phase II

Target Countries

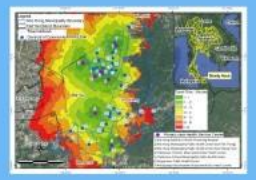
Digital Technologies / Innovations

Ethical AI | Participatory AI Modelling | Sex and Age Disaggregated Data (SAAD) | Integrated Spatiotemporal Data | SDSS | Large Language Models

Target SDGs

Activities

Local Capacity Development | Institutional Capacity Development | Knowledge Platforms



Building the Pan-Asia Partnership for Geospatial Air Pollution information

Objective: To enhance the capacity of government agencies in target countries to strengthen national level air pollution monitoring and management.

Outcomes: Access to and utilize space applications to monitor and introduce measures to improve air quality; Enhance capacity to utilize remote sensing data for air pollution monitoring; Engage in cooperative dialogue; Support evidence-based decisions for improving national and subregional air quality.

Bangladesh	Cambodia	Indonesia	Lao PDR	Mongolia	Philippines	Thailand	Viet Nam
SPARRSO	MoE	BRIN	MONRE	IRIMHE	PhilSA	GISTDA	MONRE

Subject Area	#	Member States
Space	4	BG, IN, PH, TH
Envir.	4	KH, LA, MN, VT

ESCAP

Building resilient agricultural practices by integrating geospatial information for agricultural monitoring in the Lower Mekong Basin

Objective: To strengthen the capacity of the lower Mekong countries to implement the recommendations contained in the Asia-Pacific Plan of Action on Space Application for Sustainable Development 2018-2030 particularly those related to disaster risk management, natural resource management and climate change.

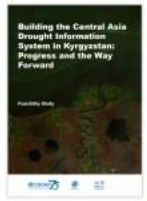
Outcome: Government officials at the national and sub- national levels use the cloud-based crop monitoring system for the effective development of climate resilient agricultural practices in rice crop production.

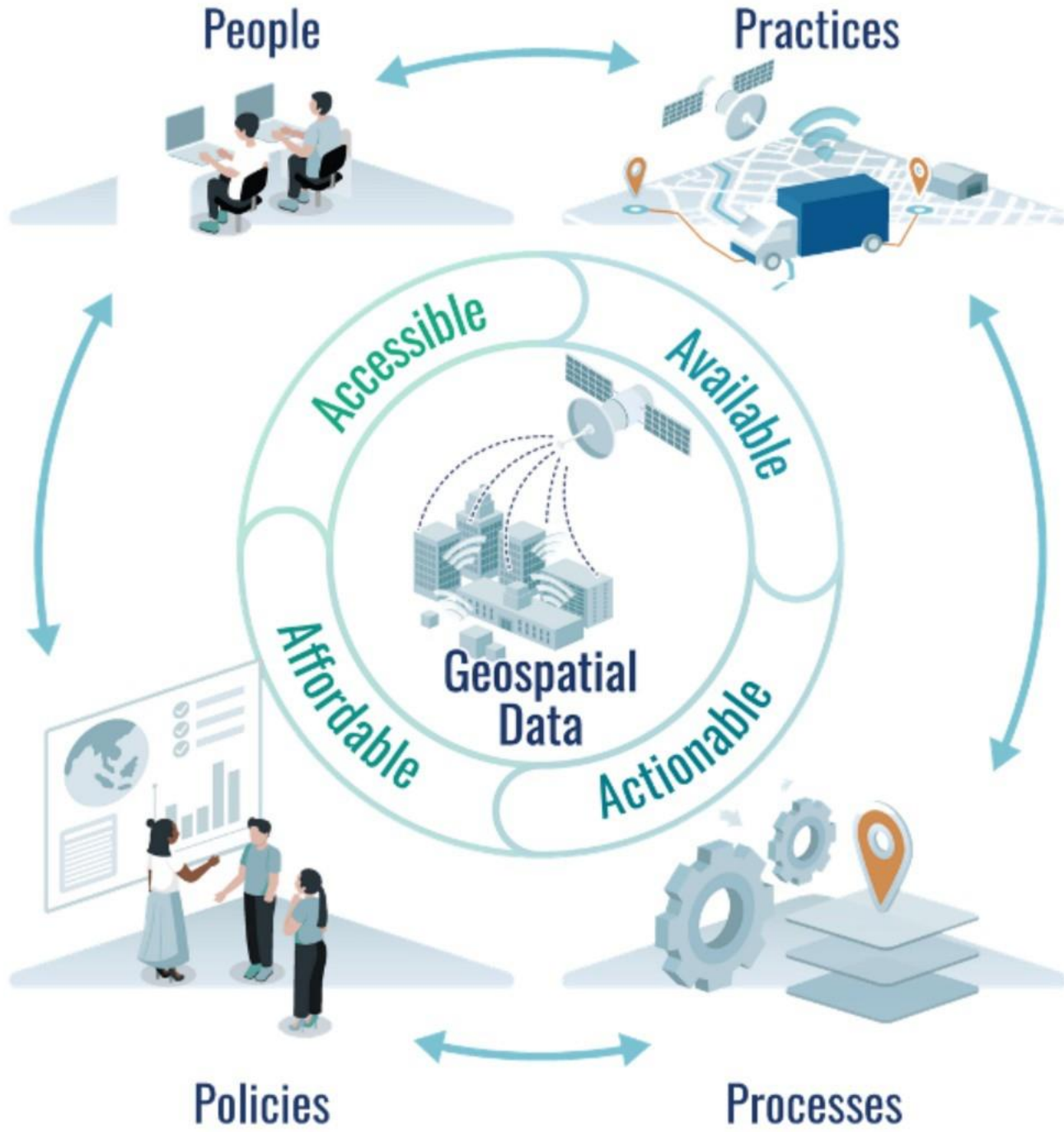
GISTDA | GIC | NECTEC

Central Asia Drought Information System (CADIS) Pilot Project

Objective: To strengthen the capacity of target Central Asian countries to use satellite data and geospatial information for effective drought monitoring and early warning.

Outcome: Target Central Asian countries use the pilot drought information system for drought monitoring and early warning.




People
Practices
Accessible
Available
Affordable
Actionable
Geospatial Data
Policies
Processes

Building institutional capacity to use artificial intelligence and spatiotemporal data for SDGs monitoring and assessment

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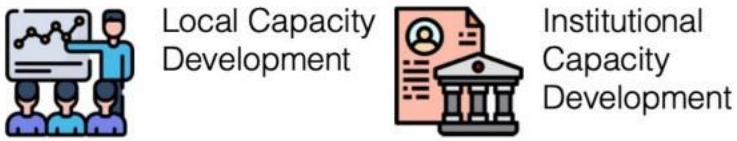
Target SDGs

Activities

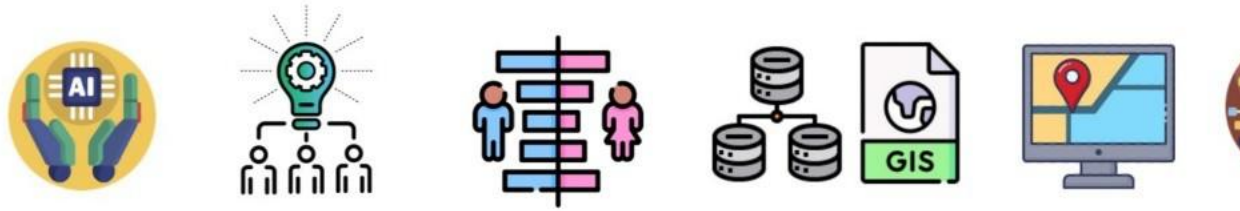


Local Capacity Development | Institutional Capacity Development

Phase II

Target Countries

Digital Technologies / Innovations



Ethical AI | Participatory AI Modelling | Sex and Age Disaggregated Data (SAAD) | Integrated Spatiotemporal Data | SDSS | Large Language Models

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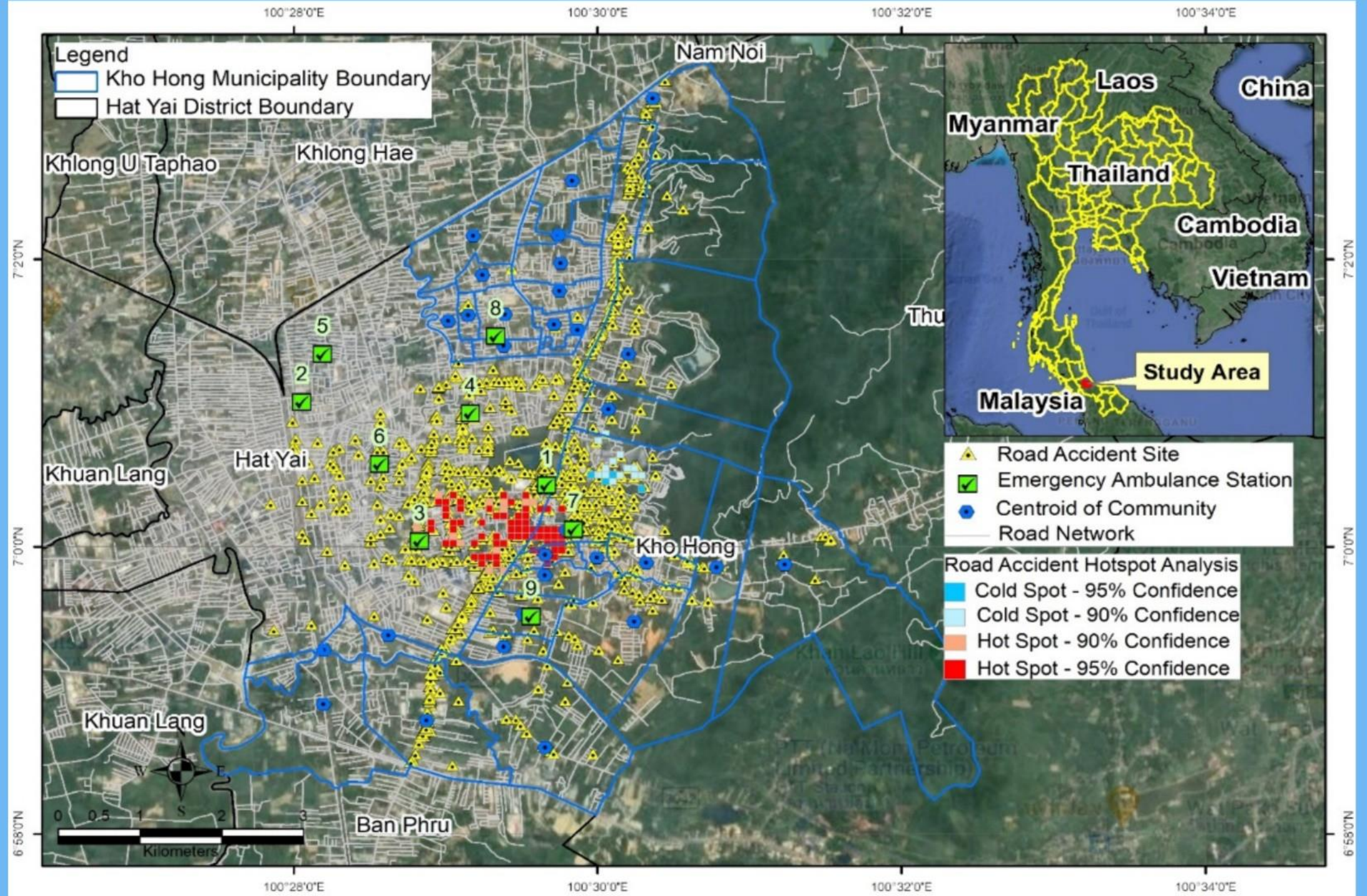
Local Capacity Development | Institutional Capacity Development | Knowledge Platforms


100°28'0"E
100°30'0"E
100°32'0"E
100°34'0"E
7°2'0"N
7°0'0"N
6°58'0"N
Legend
Kho Hong Municipality Boundary
Hat Yai District Boundary
Nam Noi
Khlong U Taphao
Khlong Hae
Hat Yai
Khuan Lang
Kho Hong
Ban Phru
Khuan Lang
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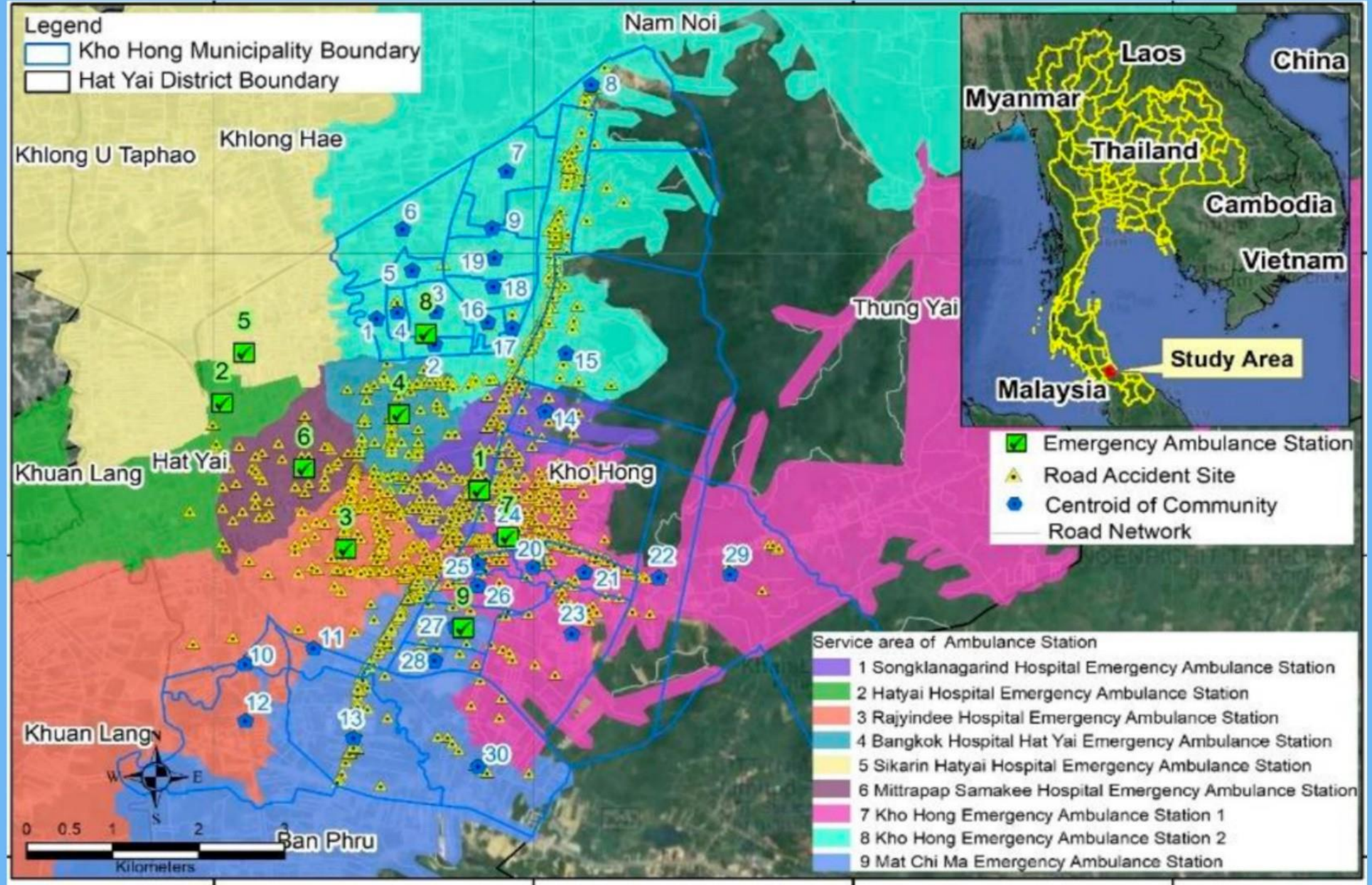
China
Myanmar
Thailand
Cambodia
Vietnam
Malaysia
Study Area
Road Accident Site
Emergency Ambulance Station
Centroid of Community
Road Network
Road Accident Hotspot Analysis
Cold Spot - 95% Confidence
Cold Spot - 90% Confidence
Hot Spot - 90% Confidence
Hot Spot - 95% Confidence


Legend
Kho Hong Municipality Boundary
Hat Yai District Boundary
Nam Noi
Khlong U Taphao
Khlong Hae
Thung Yai
Khuan Lang
Hat Yai
Kho Hong
Khuan Lang
Ban Phru
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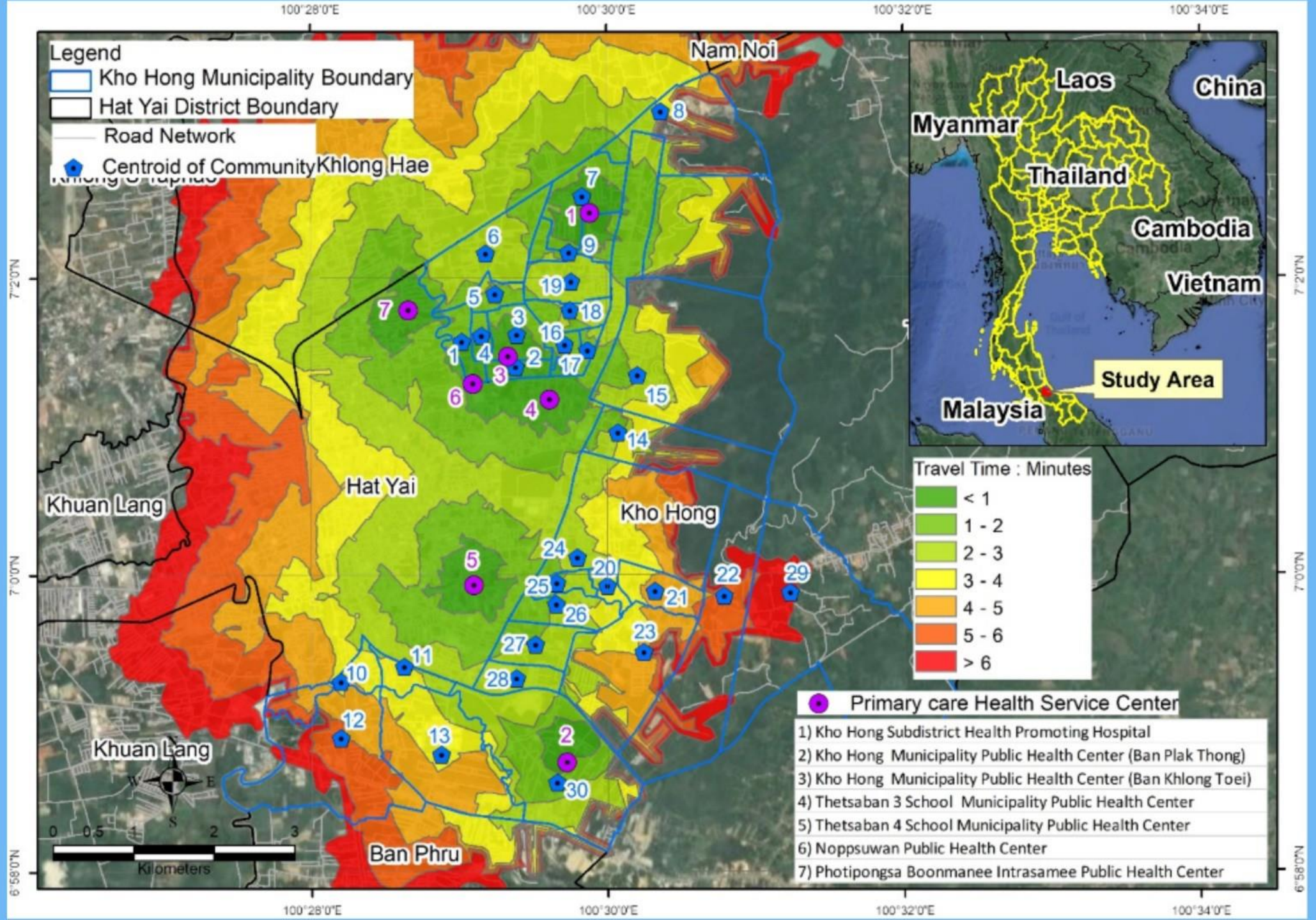
Laos
China
Myanmar
Thailand
Cambodia
Vietnam
Malaysia
Study Area
Emergency Ambulance Station
Road Accident Site
Centroid of Community
Road Network
Service area of Ambulance Station
1 Songklanagarind Hospital Emergency Ambulance Station
2 Hatyai Hospital Emergency Ambulance Station
3 Rajyindee Hospital Emergency Ambulance Station
4 Bangkok Hospital Hat Yai Emergency Ambulance Station
5 Sikarin Hatyai Hospital Emergency Ambulance Station
6 Mittrapap Samakee Hospital Emergency Ambulance Station
7 Kho Hong Emergency Ambulance Station 1
8 Kho Hong Emergency Ambulance Station 2
9 Mat Chi Ma Emergency Ambulance Station


Legend
Kho Hong Municipality Boundary
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Nam Noi
Khlong Hae
Hat Yai
Khuan Lang
Kho Hong
Ban Phru
Laos
China
Myanmar
Thailand
Cambodia
Vietnam
Malaysia
Study Area
Travel Time : Minutes
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5 - 6
> 6
Primary care Health Service Center
1) Kho Hong Subdistrict Health Promoting Hospital
2) Kho Hong Municipality Public Health Center (Ban Plak Thong)
3) Kho Hong Municipality Public Health Center (Ban Khlong Toei)
4) Thetsaban 3 School Municipality Public Health Center
5) Thetsaban 4 School Municipality Public Health Center
6) Noppsuwan Public Health Center
7) Photipongsa Boonmanee Intrasamee Public Health Center
Kilometers
100°28'0"E
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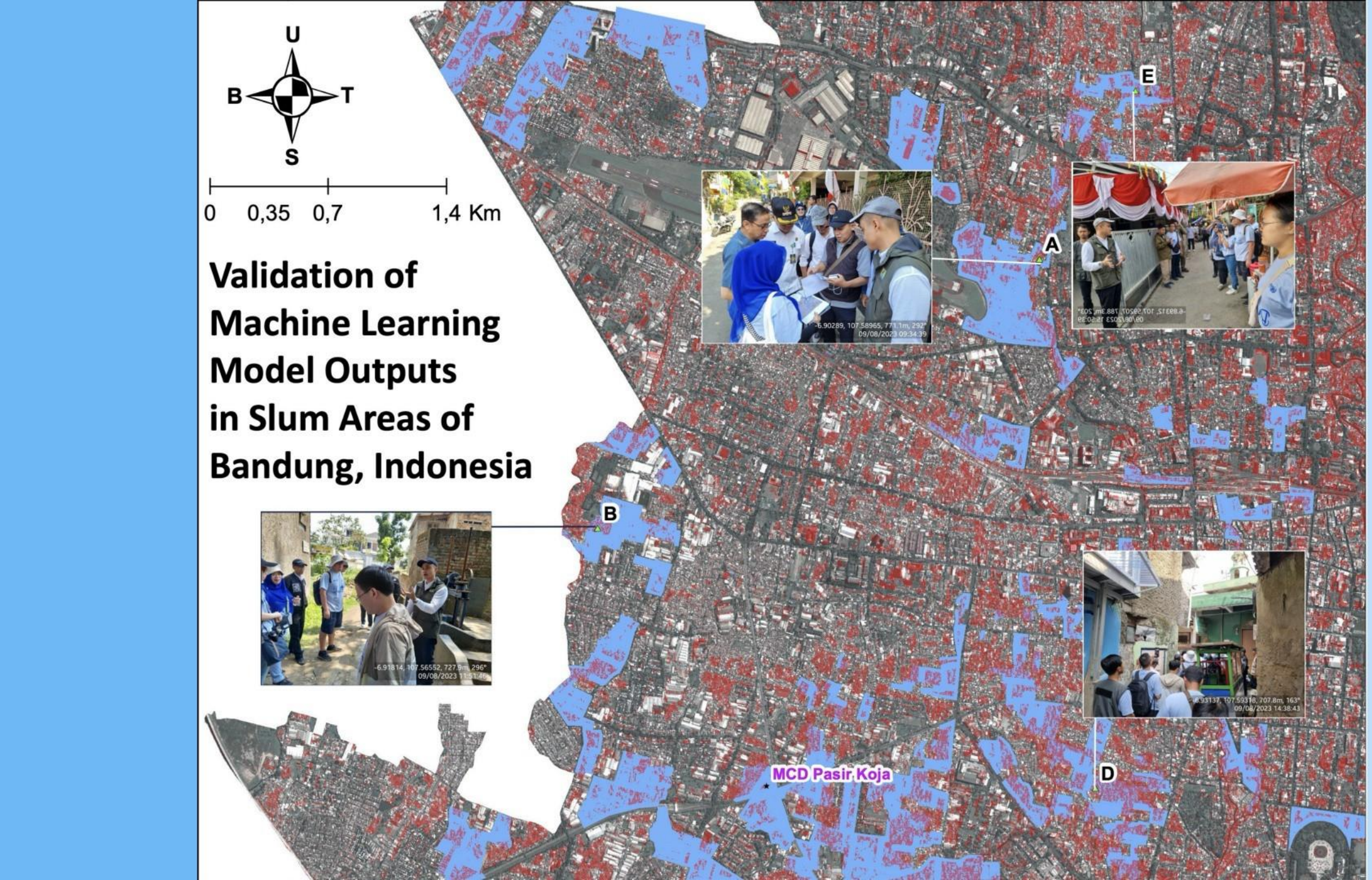
100°34'0"E
7°2'0"N
7°0'0"N
6°58'0"N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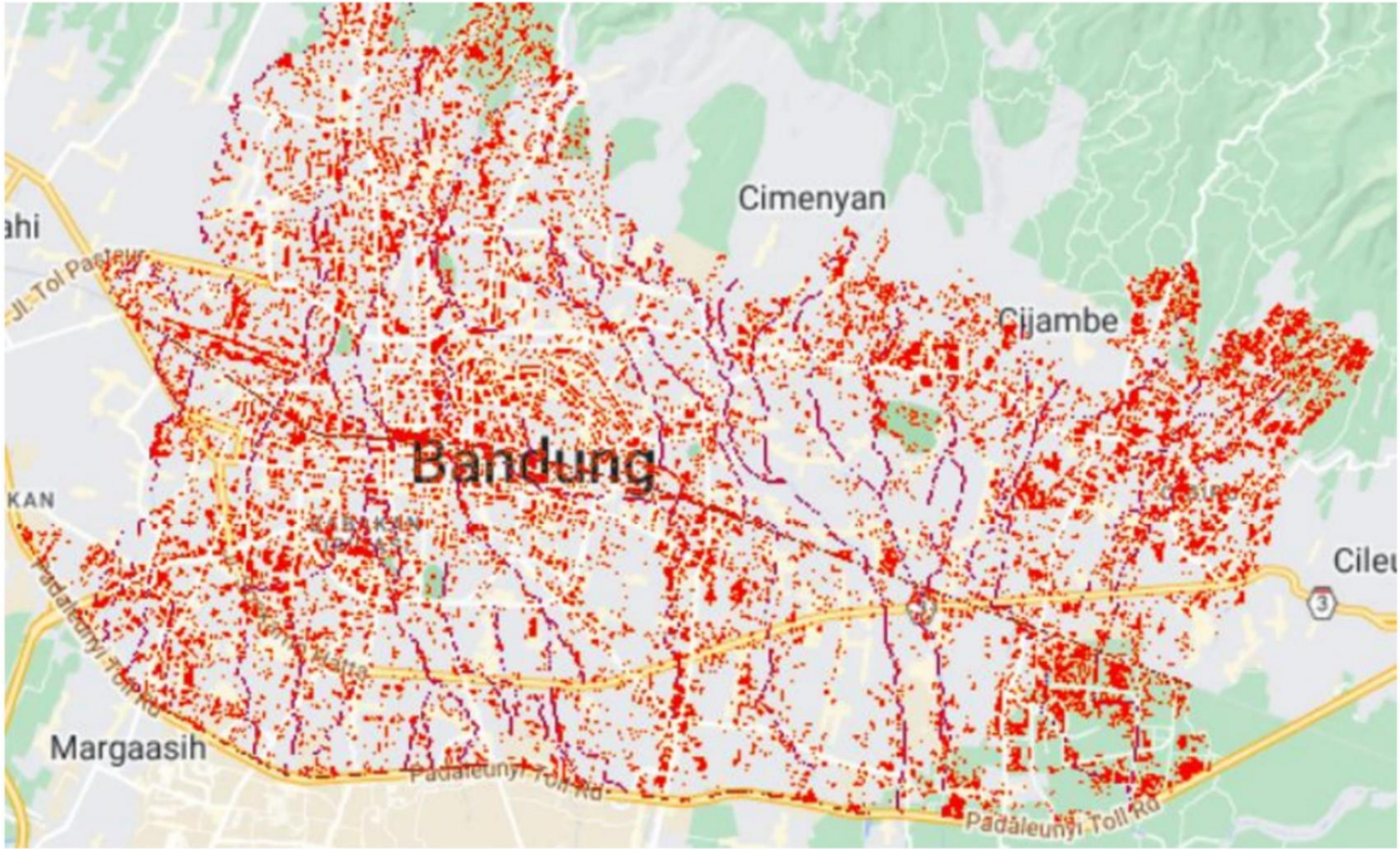
Validation of Machine Learning Model Outputs in Slum Areas of Bandung, Indonesia
A
B
D
E
MCD Pasir Koja


Cimenyan
Cijambe
Bandung
Margaasih
Padaleunyi Toll Rd
Padaleunyi Toll Rd
Padaleunyi Toll Rd
3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10/08/2023 09:57:23


-6.90289, 107.58965, 771.1m, 290°
09/08/2023 09:34:35

Building resilient agricultural practices by integrating geospatial information for agricultural monitoring in the Lower Mekong Basin

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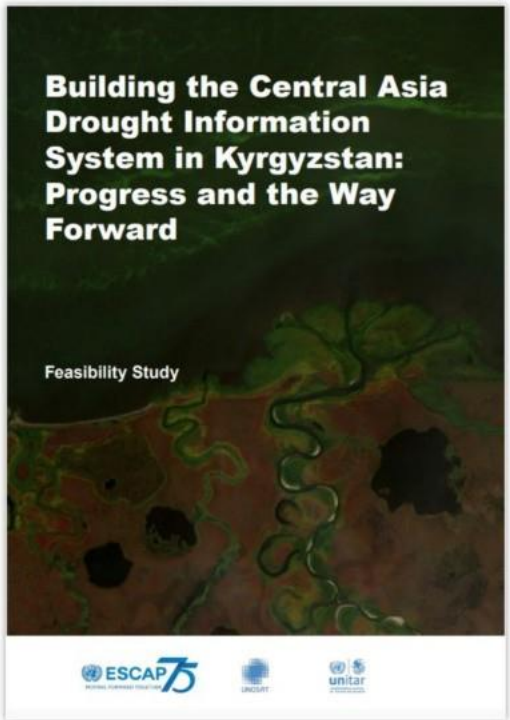
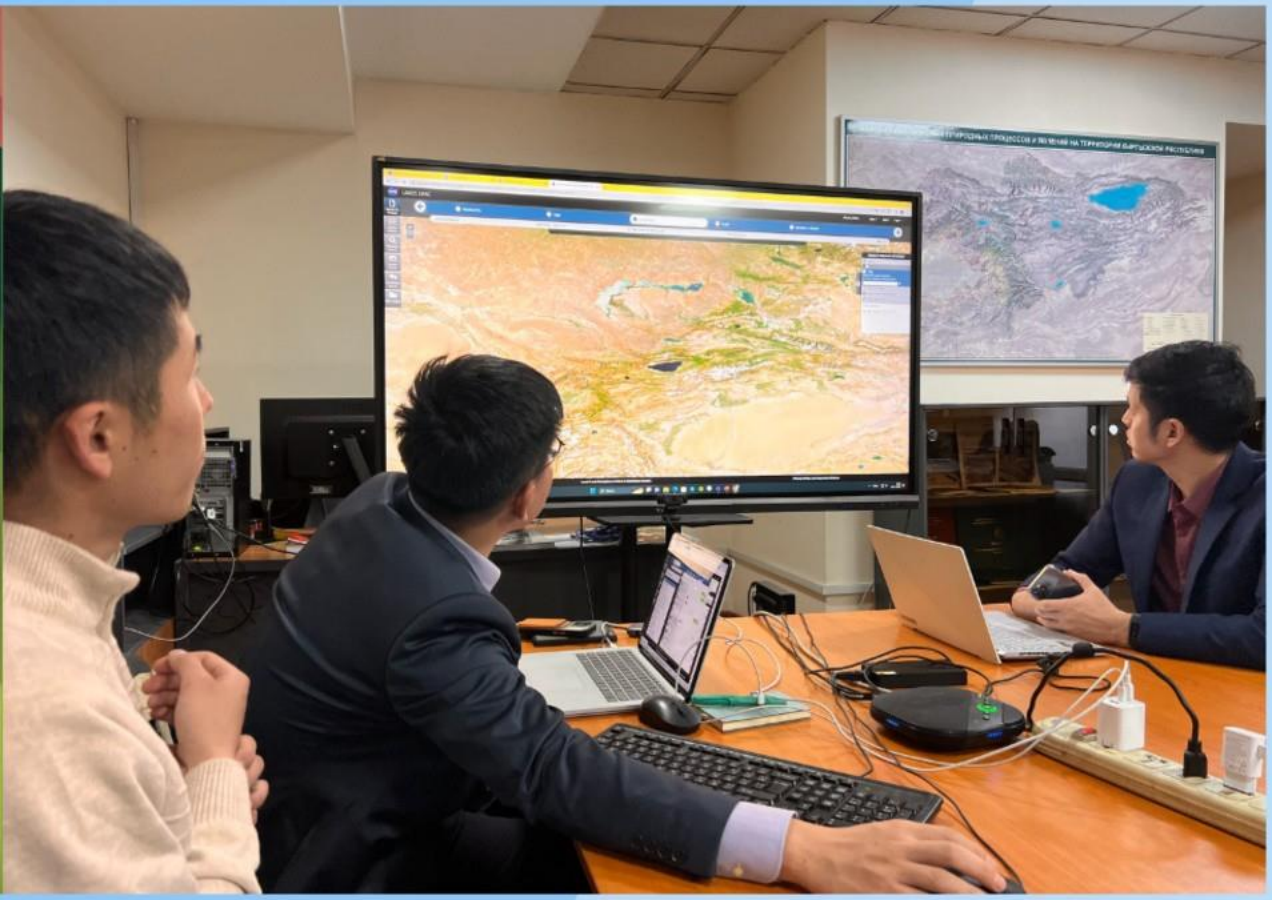
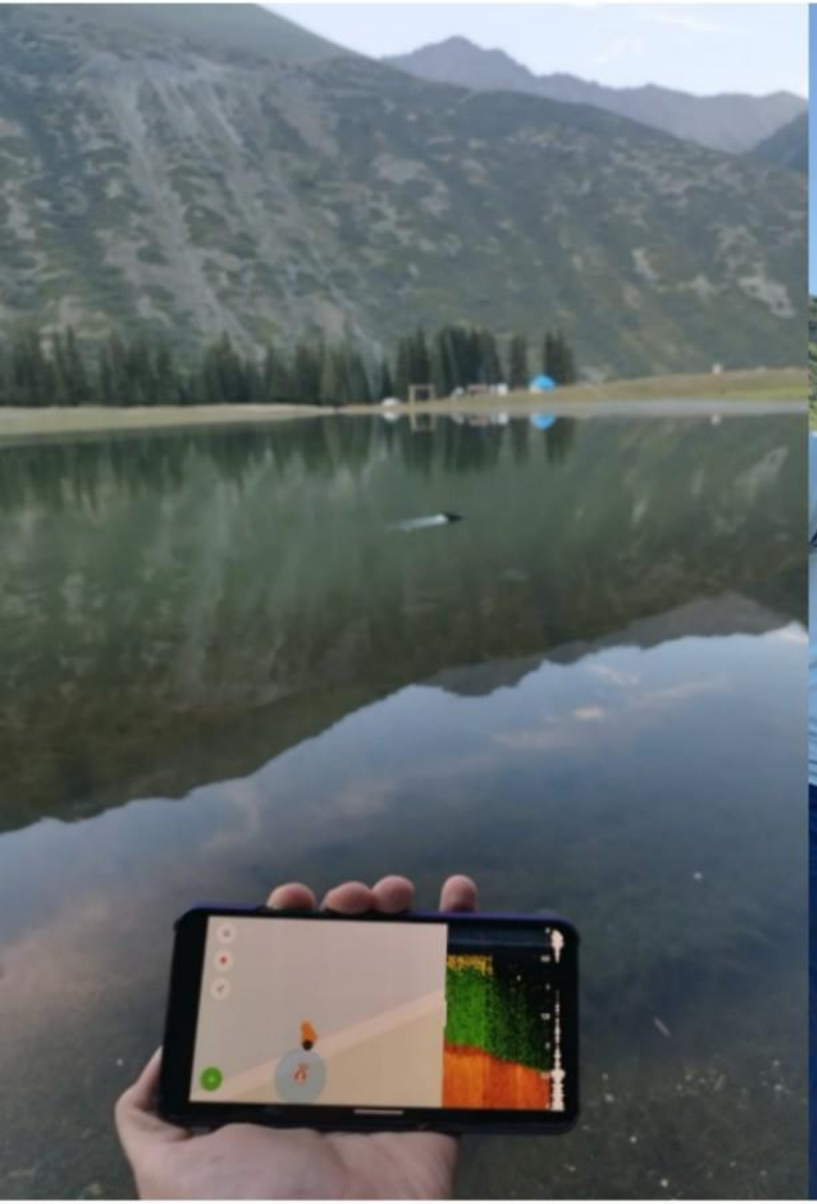





ӨЗГӨЧӨ ҚЫРДААЛДАРГА
МОНИТОРИНГ ЖҮРГҮЗҮҮ ЖАНА БОЖОМОЛДОО
БОРБОРУ
ЦЕНТР



Building the Pan-Asia Partnership for Geospatial Air Pollution information

Objective: To enhance the capacity of government agencies in target countries to strengthen national level air pollution monitoring and management.

Outcomes: Access to and utilize space applications to monitor and introduce measures to improve air quality; Enhance capacity to utilize remote sensing data for air pollution monitoring; Engage in cooperative dialogue; Support evidence-based decisions for improving national and subregional air quality.

Bangladesh
SPARRSO

Cambodia
MoE

Indonesia
BRIN

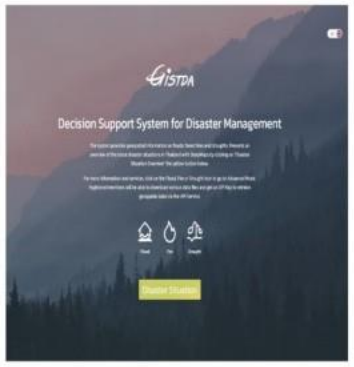
Lao PDR
MONRE

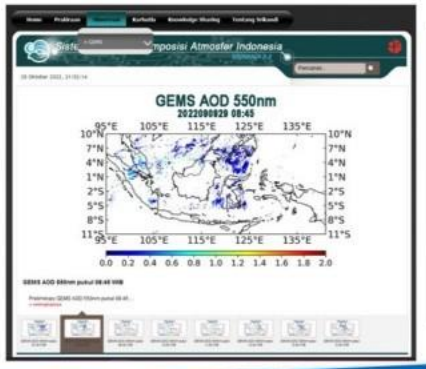
Mongolia
IRIMHE

Philippines
PhilSA

Thailand
GISTDA

Viet Nam
MONRE





Subject Area	#	Member States
Space	4	BG, IN, PH, TH
Envir.	4	KH, LA, MN, VT

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Leveraging LLMs for Advanced Geospatial Decision Support: The case of SatGPT

Hamid Mehmood

Economic Affaris Officer
Space Applications Section
United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)