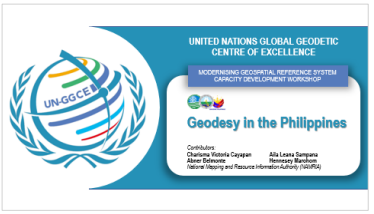
UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

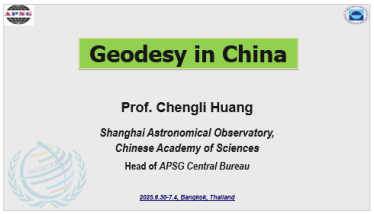
MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

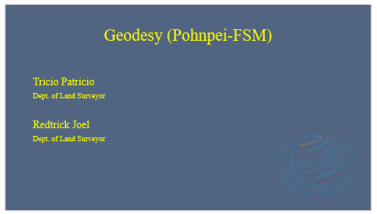
Geodesy country reports

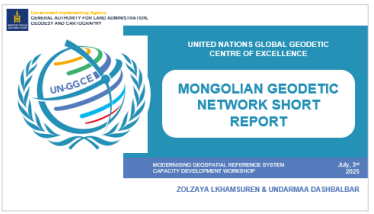
Fiji, Kiribati, Indonesia, Philippines, Singapore,
Cook Islands, China, PNG, Pohnpei-FSM, Timor-Leste,
Brunei Darussalam, Japan,
Sri Lanka, Mongolia, Samoa, Thailand, India, Nepal

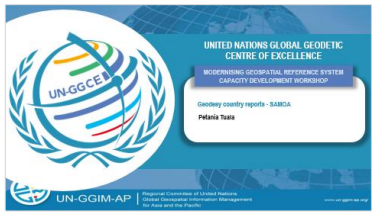
Summary of Countries' Presentations (18 Countries)

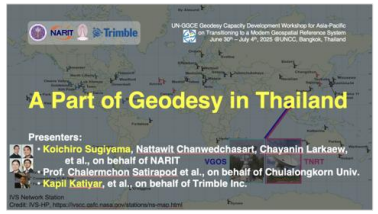


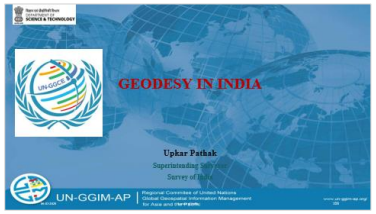


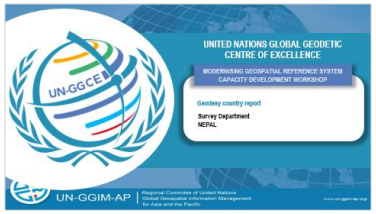












UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports

Presenters: Asakaia Tabua & Andrick Lal
Country: Republic of Fiji Islands

Bangkok, Thailand 30 June 2025

Ministry Lands and Mineral Resources

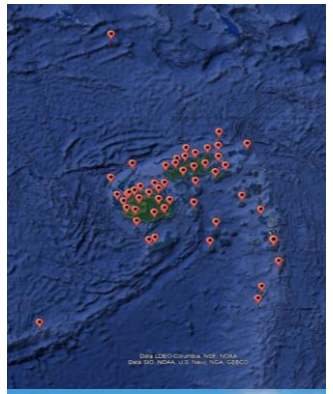
PGSC Pacific Geospatial and Surveying Council

Pacific Community Communauté du Pacifique

Geodesy in Fiji

- ***Global Geodetic Reference Frame***
  - Geodetic and Land Cadastre; Local (WGS72)
  - Spatial Data; Global (WGS84 and ITRF)
- ***Geodetic Infrastructure***
  - GNSS COR Stations
  - Sea Level (Tide Gauge) Stations
- ***Academic Institutes - Capacity***
  - University of the South Pacific – Geospatial Science
  - Fiji National University – Surveying

WHERE?



WHO?

- ***Ministry of Lands & Mineral Resources***
  - Survey Department
    - Surveyor General's Office - Control Office
- ***Fiji Navy***
  - Fiji Hydrographic Services
- ***Pacific Community (SPC) and the PGSC Partnership Desk***

STRONGER. TOGETHER.

Why Geodesy Matters ?

WHY?

Climate Action

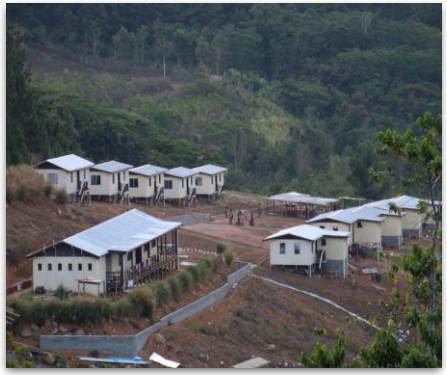
Geodetic data helps monitor the impacts of climate change, such as sea-level rise and glacier retreat, providing evidence for mitigation and adaptation strategies.

Life on Land

Geodesy supports the monitoring and management of forests, wetlands, and other ecosystems, contributing to biodiversity conservation and sustainable land use.

Sustainable Cities and Communities

Geodesy can help to plan and manage urban areas by providing data for infrastructure development and disaster risk reduction.



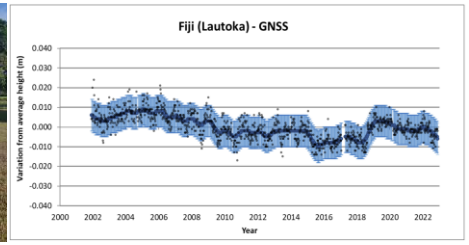
Life below Water

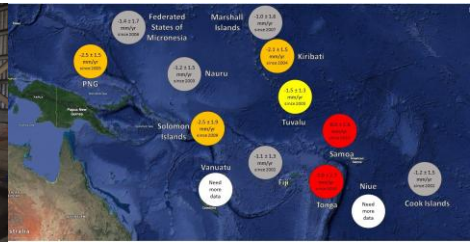
Geodesy helps to define and manage maritime jurisdictions for marine resources, biological diversity and fisheries management.

HOW?

Pacific Sea Level & Geodetic Monitoring (COSPPac)

- Sea Level Monitoring
- Vertical Land Motions





Climate and Oceans Support Program in the Pacific

30 YEARS 2023

Pacific Sea Level & Geodetic Monitoring

STRONGER. TOGETHER.

What's Next / Call to Action

WHAT?

- ✅ Framework; Roadmap – Fiji Geospatial Reference System
- ✅ Fiji Geodetic Infrastructure
- ✅ Capacity; Geodetic Operations, Geodetic Surveyors and technicians.
- ✅ Regional Collaboration and Partnerships

📣 **Call to Action:** data management, technology and geodetic standards.

STRONGER.
TOGETHER.

Thank You

Asakaia Tabua

Surveyor General

Ministry of Lands & Mineral Resources
PO Box 2222, Government Buildings, Suva.
Level 1 AMB Victoria Corner Building, Victoria Parade
Mobile: (679) 8921854
Email: asakaia.tabua@lands.gov.fj
Website: www.lands.gov.fj

Andrick Lal

Coordinator - PGSC Partnership Desk

Pacific Community (SPC)
SPC - Private Mail Bag - Suva, Fiji.
Level 2, Lotus Building, Ratu Mara Road, Nabua, Suva.
Mobile: (679) 9944 144
Email: andrickl@spc.int | Website: www.spc.int
Webpage: https://pgsc.gem.spc.int/

Ministry Lands and Mineral Resources

Pacific Community
Communauté du Pacifique

PGSC
Pacific Geospatial and Surveying Council

UN-GGIM
UNITED NATIONS INITIATIVE ON GLOBAL GEOSPATIAL INFORMATION MANAGEMENT

UN-GGCE

FIG

STRONGER. TOGETHER.

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY WORKSHOP

GEODESY COUNTRY REPORTS – KIRIBATI

- **Bwatiua Tenea – Land Surveyor LMD**
- **Tiraima - Land Surveyor LMD**
- **Romano Reo - Director, LMD**

Why Geodesy Matters in Kiribati

- Infrastructure Planning & Sustainable Developments – Roads, Bridges, Wharves, Causeway
- Accurate Mapping – resolve land disputes and supporting Land Management
- Sea Level Monitoring & Mitigating Natural Resources – rising seas & storm surges
- Navigation Safety – EEZ determination, Maritime Jurisdiction, Marine Geospatial Planning

The State of Geodesy in Kiribati

- Only 1 CORS station & 2 Tide Gauge in Kiribati
- 33 islands on different local datum – NOT well-defined datum

  Lacks elevation/height data information – inaccuracies in EGM2008 Geoid Model (400mm tilt in Tarawa) - Highest point is 3m!
- Vast dispersion of islands makes network expansion costly and complex.
- Absence of a unified national geodetic framework hampers large scale mapping efforts.
- Geodesy terminology remains a disaster in Kiribati - PEOPLE

What's Next/ Call to Action

- Training local staff in geodetic data collection and analysis - PEOPLE
- Establishing a national geodetic framework and sustainable funding - aligning to ITRF
- Strengthening partnerships with Pacific nations for data sharing and technical support.
- More accurate maps supporting land rights, disaster preparedness, climate resilience, and ongoing projects

Thank You

Ministry of Environment, Lands & Agricultural Development.

www.melad.gov.ki

Land Management Division

Surveying Technical Services

Lightning Talks

at UN-GGCE Geodesy Capacity Development Workshop for Asia

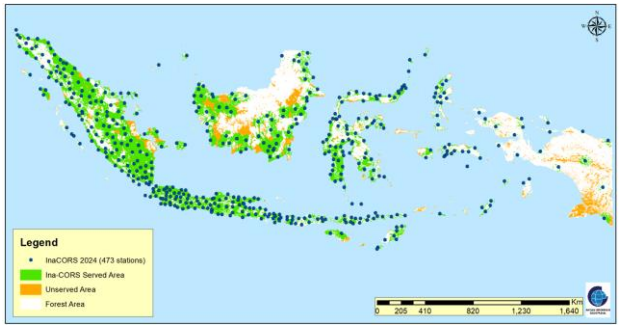
BAYU Triyogo Widyantoro
SIDIK Tri Wibowo
FEBRYLIAN Fahmi Chabibi
BAGAS Triarahmadhana

Indonesian Geospatial Information Agency

Bangkok, 30 June - 4 July 2025

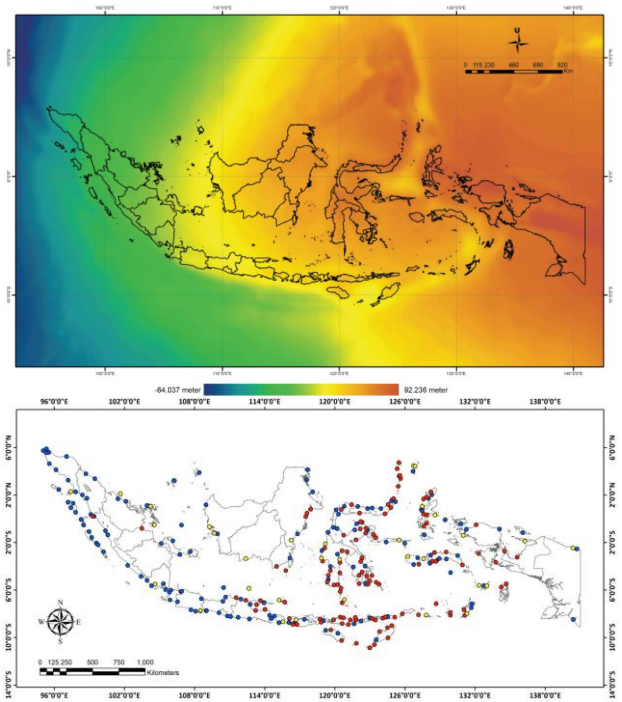
bayu.triyogo@big.go.id; sidik.tri@big.go.id; febrylian.fahmi@big.go.id; bagas.triarahmadhana@big.go.id

ONE MAP POLICY PROGRAM ACCELERATION



CORS - horizontal geospatial reference.

Capable to provide real time differential correction (RTK) covering 88% urban area, compatible with global reference frame ITRF2014,
and also to provide rinex download & online post processing.



INAGEOID2020 - vertical geospatial reference.

Developed using combination of terrestrial and airborne gravimetry with EGM2008, as well as co-sited GNSS/leveling to estimate the geoid accuracy.
The geoid model is served as vertical reference for height unification.

Tidal data - utilized to build chart datum

289 Tide Stations discrete sea level recordings can be accessed by users to obtain chart datum values using the model based.

WHY GEODESY MATTERS?

Our contribution to the Global Geodetic Community

Ina-CORS contribution to ITRF / APREF

- 5 CORS station are shared to IGS to define ITRF
- 8 CORS station for Asia - Pacific Reference Frame (APREF)

Ina-Tide contribution to Indonesian Tsunami Early Warning System (Ina-TEWS)

- 10 TG stations are cooperation with UHSLC
- 3 TG stations are cooperation with GFZ-Germany

Ina-Geoid as a part of global vertical reference systems

- INAGEOID2020, is a part of global vertical reference systems
- has been registered at **EPSG (ID: 20036)**

CHALLENGES: BUDGET CONSTRAINT

Limited Budget: Year-on-Year Nominal has declined

Defining which program is priority and thus will be funded is a politician task, not us.
Our job is to report to them and convince them to support our work.
So, a simple message must be delivered.

1st option

Common issue

Disaster mitigation issues as our basis for submitting funds, in addition to simply providing basemaps and references services.

This approach is also supported by other related agencies, therefore **collaboration** is mandatory, and is authorized through various legal **regulations**.

2nd option

Commercialization

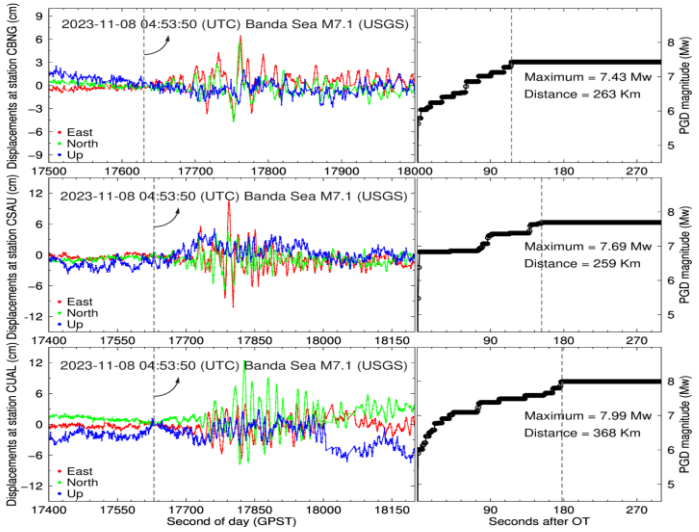
For countries that are less vulnerable to disasters, **commercializing** geospatial data and services could be an alternative source of external funding.

This approach can help cover operational expenses and **reduce reliance** on government budgets.

CALL TO ACTION - WHAT'S NEXT?

Linking geospatial works to critical societal needs

How positioning is used not only to provide large-scale base maps and references but also in many more aspects.
Offer **practical solution**. Increase **social awareness**. Gain **trust** from policy makers. Develop the **market**.



Earthquake magnitude detection and **volcanic** activity monitoring using **real-time** based displacement provided by CORS stations.

Monitoring of **sea level rise** and **land subsidence** in coastal areas to provide warnings to local communities.

Gravimetry key roles in **natural resources** management, geological hazard (**geohazard**) mitigation, **infrastructures** monitoring, and others.

BADAN INFORMASI GEOSPASIAL

#1 Peta Data Nusantara

55th Satu Peta Satu Data Satu Nusantara

Terima Kasih

www.big.go.id Badan Informasi Geospasial @infogeospasial

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM
CAPACITY DEVELOPMENT WORKSHOP

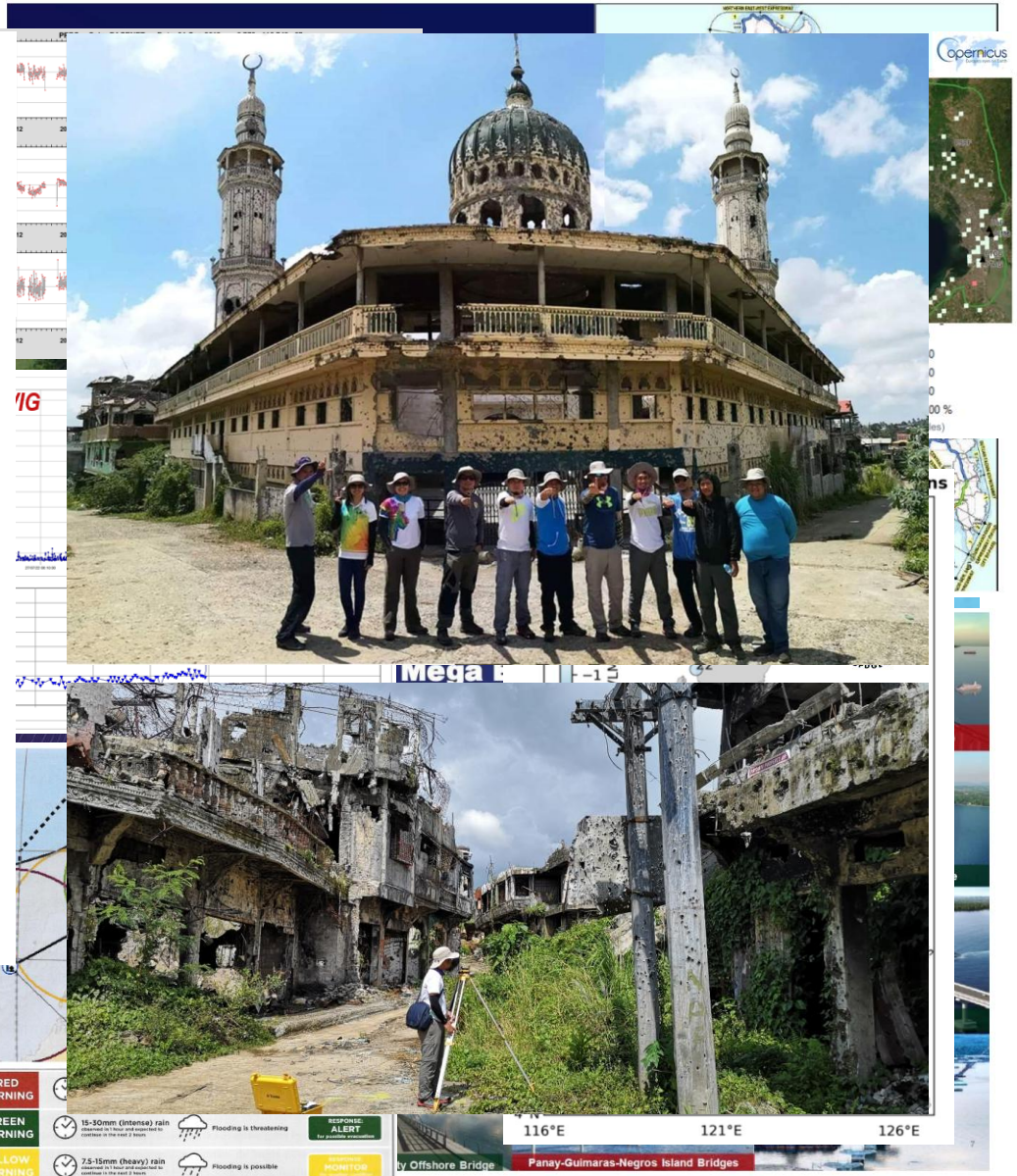
Geodesy in the Philippines

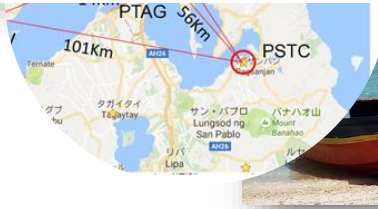
Contributors:
Charisma Victoria Cayapan **Aila Leana Sampana**
Abner Belmonte **Hennesey Marohom**
National Mapping and Resource Information Authority (NAMRIA)

Why Geodesy Matters

Underpinning sustainable development in the Philippines

- Fostering the environment
  - Resource mapping
  - Land administration
  - Charting of Philippine seas
- Driving economic growth
  - *Build-Build-Build* and *Build-Better-More* Infrastructure Development Program
  - Creating smart cities
- Building resilient communities
  - Monitoring Earth processes and climate change
  - Supporting recovery from man-made and natural disasters

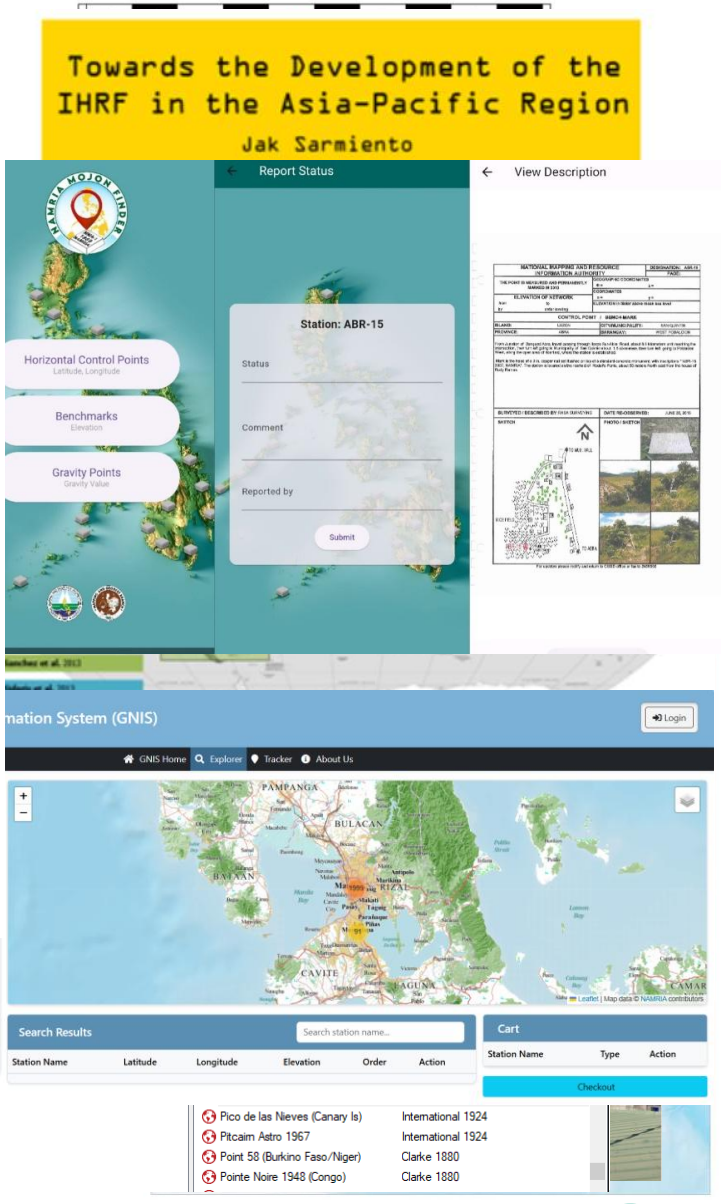


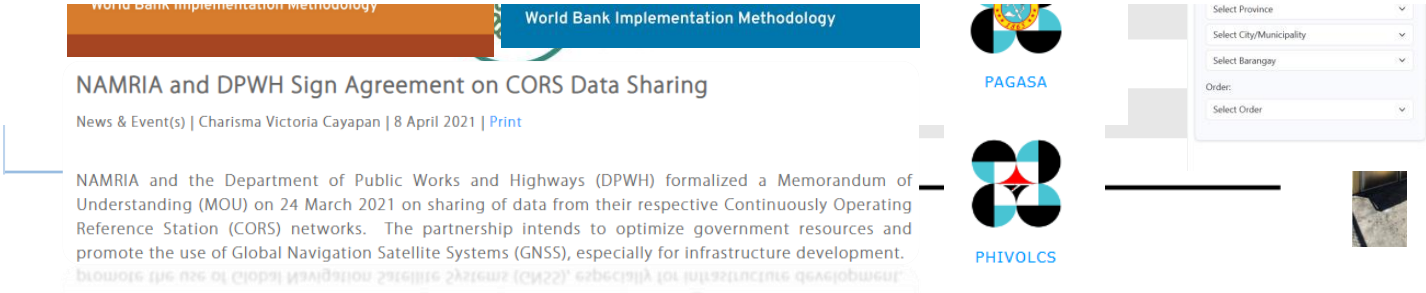


https://www.bsp.gov.ph/Pages/IFO-macro-pres/Build%20Better%20More_Jan%202023.pdf

State of Geodesy

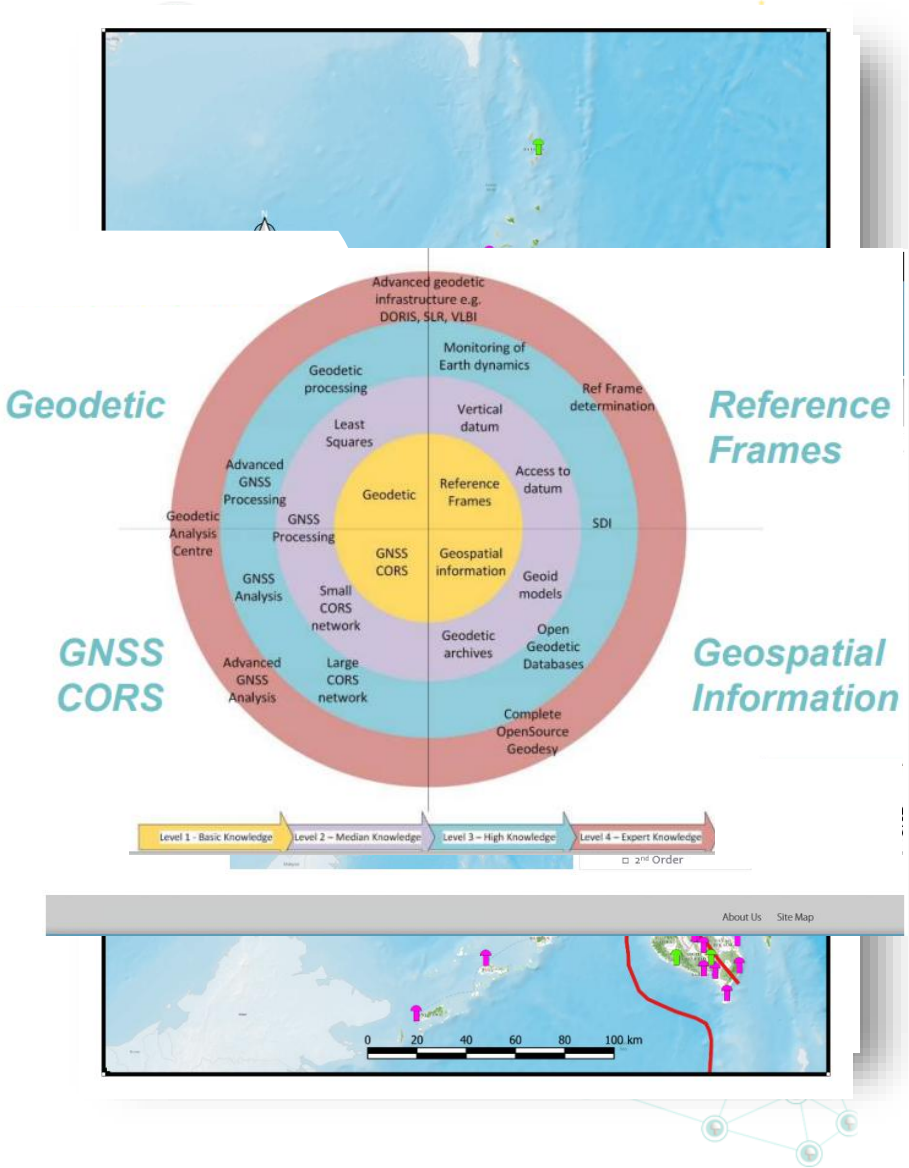
- Current Frames in Use and Geodetic Infrastructure
- Key Achievement: Modernization of the Philippine Geodetic Reference System (ongoing)
  - Infrastructure for the PGRS Modernization
    - Philippine Active Geodetic Network (PAGeNet)
    - Philippine Geoid Model
    - National Deformation Model
    - Methodology for connecting to the World Height System
    - Modern PGRS Geodesy Portal (beta)
  - Inclusion of PGRS Modernization in the IGIF Country Action Plan
  - Linkages with local and international partners
- Major Challenge
  - Limited buy-in among senior decision-makers
    - *Impacts all components of the project (i.e. infrastructure, capacity building, policy development)*





Call to Action / Next Steps

- Governance
  - Revival of the National Committee on Geodesy (IAG)
  - Policy Development
    - DENR Department Administrative Order (*Adoption of the Framework on the Development of the Modern Philippine Geodetic Reference System (PGRS) for Sustainable Environment and Natural Resources (ENR) Management)*
    - Proposed Executive Order (*Adoption of an Integrated Approach to Geospatial Information Management)*
- Geodetic Products and Services
  - Strengthening of the geodetic infrastructure
  - Continuing development of the Modern PGRS Geodesy Portal
- People
  - Competency-building
  - Organizational enhancement
  - Increased linkages with the academe as well as other local and international partners
- Communication
  - Creating more champions for geodesy



Maraming salamat po!

https://namria.gov.ph
geodesy@namria.gov.ph
+63 2 8884 2849

Land Area	735.4 sqkm
Population	6.04 million
Buildings	170,000
Residential Dwellings	1,563,000
Land Lots	146,542
Strata Lots	1,726,338
Highest Terrain	164.2m
Trees	7 million

SLA
SINGAPORE LAND AUTHORITY

Geodesy in Singapore

Victor Khoo (Director, Survey & Geomatics)

Why Geodesy Matters in Singapore

National Security & Sovereignty

- Boundary Delimitation
- Boarder Control
- Topographical Mapping

Risk Management & Public Safety

- Disaster Management
- Aviation Safety
- Flood Risk Management
- Safety Planning
- Land Motion Monitoring

Sustainability & Environmental Protection

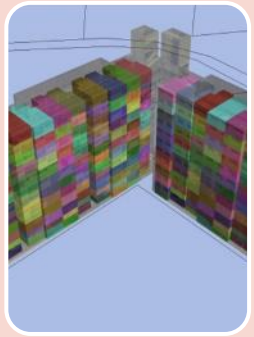
- Climate Resilience
- Coastal Protection

Urban & Infrastructure Planning

- Urban Planning

Infrastructure Development & Construction

- Digital Construction
- Underground Mapping



Real Estate & Property

- Authoritative land information
- Cadastral Survey

Maritime Navigation

- Hydrographic Survey
- Maritime Safety

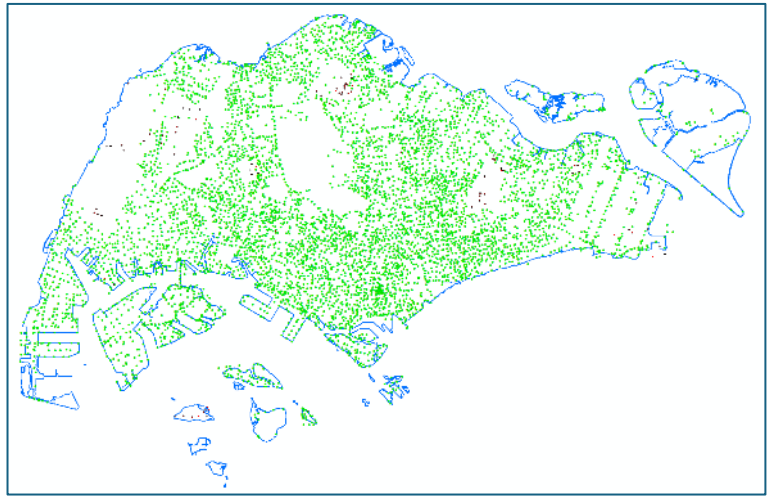
Smart City

- Urban Digital Twin Development
- Autonomous Mobility
- Robotics
- Smart Construction

SLA
SINGAPORE LAND AUTHORITY

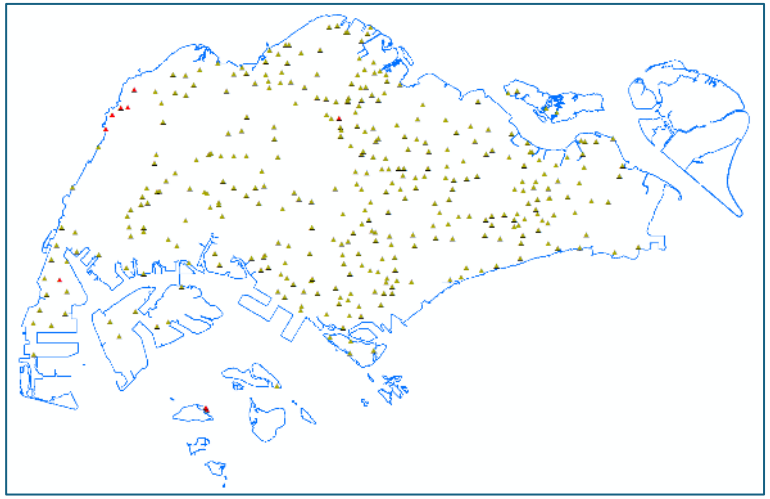
The State of Geodesy – National Survey Reference Infrastructure

Integrated Survey Network (ISN)



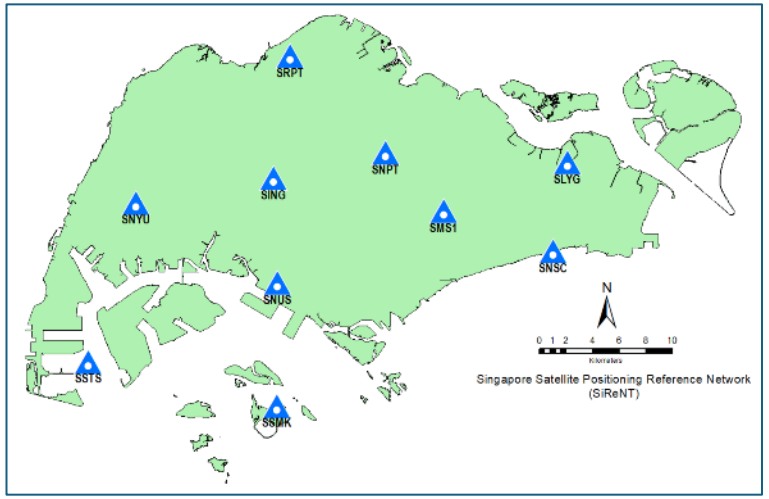
6,616 HCPs (Apr 2025) @ 300m interval

Vertical Control Point Network (VCP)



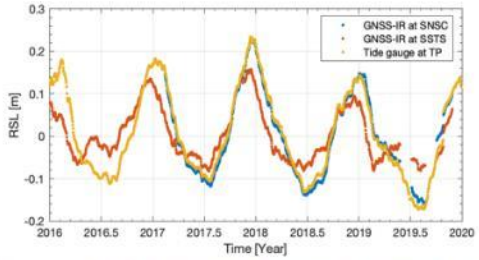
549 VCPs (Apr 2025) @ 1km interval

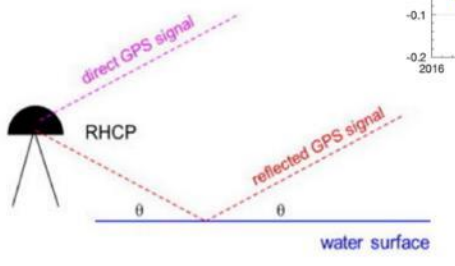
SiReNT

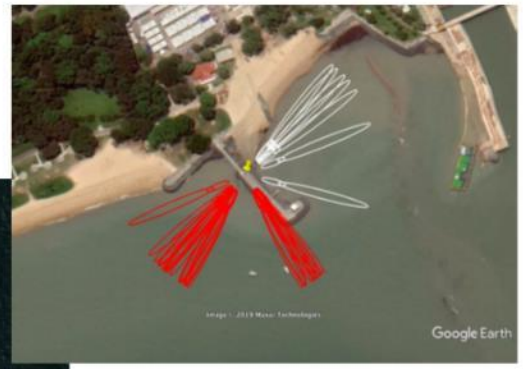


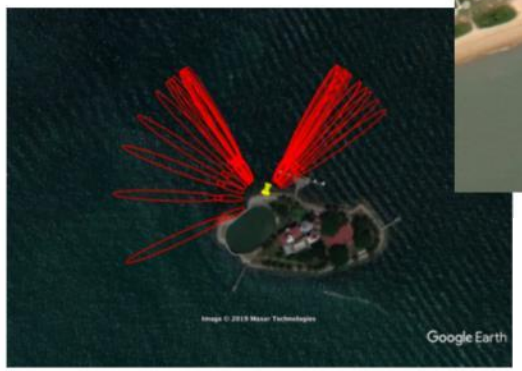
SINGAPORE
LAND AUTHORITY

The State of Geodesy – Collaboration with IHL and Private Sectors









Simultaneously monitoring of Land Motion and sea Level Rise through coastal SiReNT stations. A collaboration with Earth Observatory Singapore (EOS).

Applications of SiReNT in Singapore

Autonomous Vehicle

Autonomous Mobile Robot

GNSS Assisted Piling System

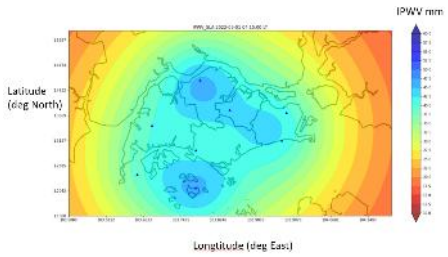
Machine Control

Autonomous UAV

Land Subsidence Monitoring

Mobile Mapping

Grass Cutting Management System

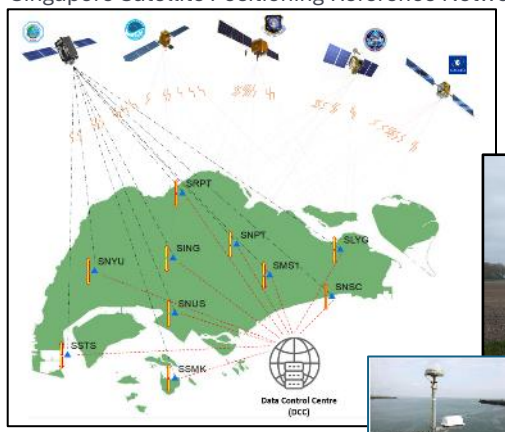


Integrated Precipitable Water Vapor monitoring

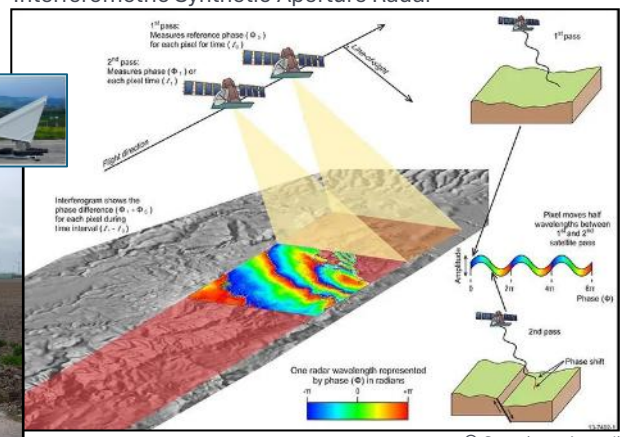
SLA
SINGAPORE LAND AUTHORITY

What is Next

Singapore Satellite Positioning Reference Network



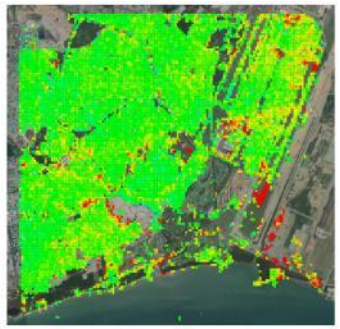
Interferometric Synthetic Aperture Radar



Patent # 2019103.21, June 2017, Patent Cooperation Treaty (PCT)

Geodetic Instrumentation
to integrate SiReNT, InSAR, etc.

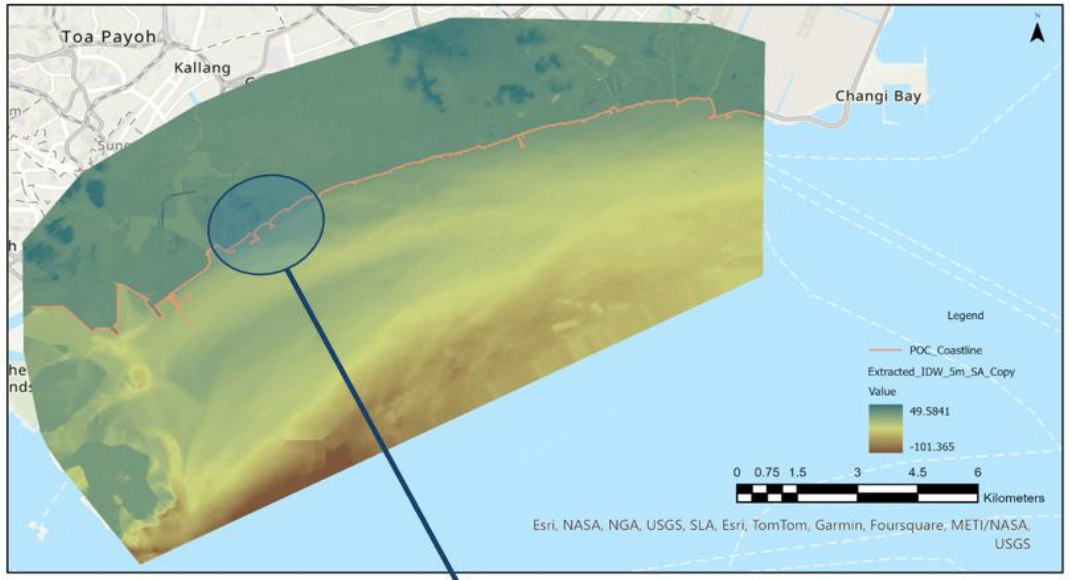
Integrated processing



Nationwide LMM information product, absolute, referenced, validated

Long-term Nationwide Land Motion Monitoring

Using GNSS (SiReNT), InSAR and Geodetic instrumentation



Integration of Land and Sea Domains

Development of TopoBathy data and guidelines


THANK YOU
SLA LIMITED LAND • UNLIMITED SPACE
victor_khoo@sla.gov.sg
SLA
SINGAPORE
LAND AUTHORITY

Geodesy in the Cook Islands

Vaipo Mataora
Deputy Secretary
Infrastructure Cook Islands

- The Deputy Secretary assists the Secretary in planning, overseeing, managing and directing all activities in the Civil Works Asset Management, **Geoscience and Hydrography**, and Pa Enua Support departments, as well as the Building Controller and Electrical Inspectorate.
- The Deputy Secretary must be able to account for furthering the accomplishment of ICI's planning, operational goals and objectives; as well as ensuring that assigned division goals and objectives are accomplished within general policy guidelines.
- Chair Cook Islands GIS Users Group
- Chair Pacific Geospatial and Surveying Council

Why Geodesy matters

Geodetic Reference Frame

Positioning & Navigation

Geodetic Infrastructure

Land Cadastre

Standards & Policy

Maritime Boundaries

Geospatial Data & Information

Land Motions

Digital Terrain Models

Risk Asessment & Monitoring

Topographic Mapping

Geodetic Reference Frame

Ocean Science

Tidal Infrastructure

Climate Change

Standards & Policy

Hydrography

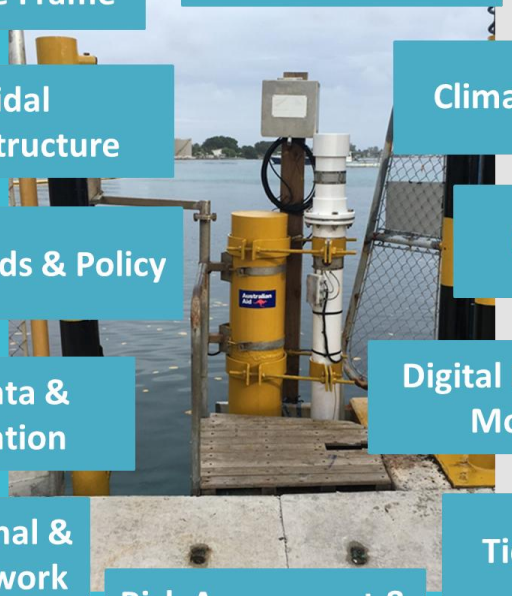
Tidal Data & Information

Digital Elevation Models

Global, Regional & National Network

Tidal Modelling

Risk Assessment & Monitoring



State of Geodesy

Why modernize the Cook Islands Geospatial Reference System?

- The demand for high integrity and high accuracy geospatial applications is increasing.
- This is largely driven by the wide spread use of GNSS for positioning and navigation. GNSS (e.g. GPS) constellations provide positions aligned to the International Terrestrial Reference System, the most recent realisation being the International Terrestrial Reference Frame 2020 (ITRF2020).
- The current geodetic datum is based on World Geodetic System 1986 (as opposed to the modern ITRF2020). It is therefore out-dated and not compatible with GNSS.

Avarua Town

WGS84 vs Non Earth projection

Challenges

- Lack of technical Assistance to progress developing the Cook Islands Reference Frame
- Government of the Cook Islands to invest in the project
- Lack of awareness from stakeholders, private and government line agencies of the importance of the project.
- SPC, Geoscience Australia, United Nations Global Geodetic Centre of Excellence Statistics Division, Department of Economic and Social Affairs United Nations, FIG to prioritize Small Island States to develop their Road Map.

What Next?

Road Map

The Roadmap for development of the Cook Islands Geospatial Reference System has a number of phases; This includes:

Thank you/Meitaki Ma'ata

- On behalf of the Cook Islands, we extend our sincere gratitude to the UN-GGCE Asia-Pacific Geodesy community for the kind invitation to participate in the Geodesy Capacity Development Workshop here in Bangkok.

- This opportunity has been invaluable in enhancing our technical capacity, fostering regional collaboration, and strengthening our understanding of geodetic infrastructure and applications. We look forward to continued partnerships and knowledge sharing in the spirit of sustainable development and geospatial resilience across the Pacific.

Vaipo Mataora | Deputy Secretary
Core & Support Services
Infrastructure Cook Islands | Te Tango Angaanga o te Kuki Airani
Arorangi District, Rarotonga, Cook Islands | PO Box 102
phone: +(682) 20321 | fax: +(682) 24321 web: www.ici.gov.ck | email: vaipo.mataora@cookislands.gov.ck

Geodesy in China

Prof. Chengli Huang

Shanghai Astronomical Observatory,
Chinese Academy of Sciences

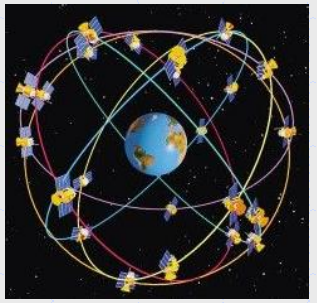
Head of *APSG Central Bureau*

2025.6.30-7.4, Bangkok, Thailand

Why Geodesy Matters

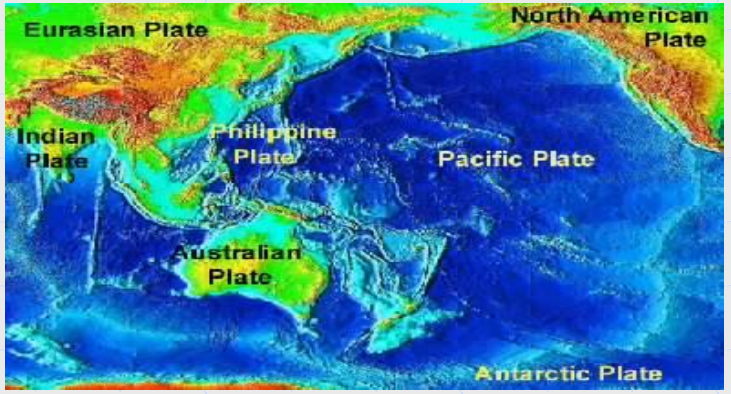
Navigation:

Geodesy provides the foundation for BDS & other systems, ensuring precise & reliable location data.



Disaster Risk Reduction

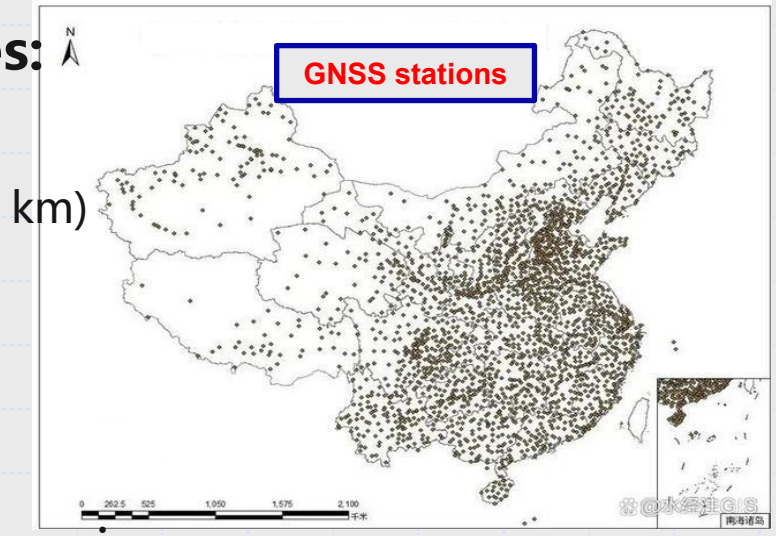
China is a rapid developing country with very dense population (1.4B), suffers from serious natural hazards, frequent & fierce earthquakes, landslides, etc.



- After the devastating 2008 Wenchuan earthquake, geodetic measurements were pivotal in assessing damage, predicting aftershocks, and guiding rescue operations.

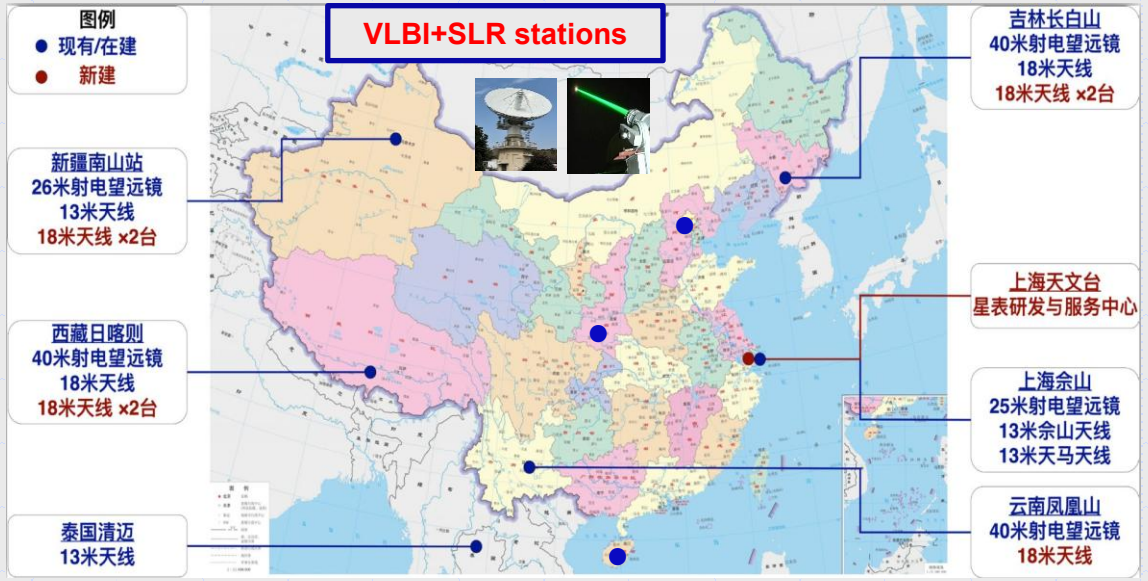
The State of Geodesy

- **The national geodetic networks includes:**
  - ✓ **Beidou System (BDS 1→2→3)**
  - ✓ 18K+ GNSS sites (geodesic line length ~13/47 km)
  - ✓ ~20 VLBI/VGOS telescopes
  - ✓ 10+ SLR stations



- **Mainly run by:**
  - Chinese Academy of Surveying and Mapping;
  - Shanghai Astron. Obs., Chinese Academy of Sciences
  - …

- **China Geodetic Coordinate System 2000 (CGCS2000),** aligned to ITRF1997, was adopted in 2008.



What's Next / Call to Action

- The national capacity-building (infrastructure, networks) is almost completed.
- Needed:
  - national coordination of these infrastructure/networks
  - coordination of these networks with regional & global geodetic networks
  - more data-mining and scientific research from these mega-data is encouraged
- E.g.: CGCS2000 is ongoing to be updated to CGCS2025.

Thank You

ขอบคุณ

Chengli Huang

Shanghai Astronomical Observatory (SHAO), CAS

CLHUANG@SHAO.AC.CN

http://english.shao.cas.cn

GEODESY IN PAPUA NEW GUINEA

Name: Edwin NIDKOMBU
Role: Assistant Surveyor General. Survey Coordination.
Office: Office of the Surveyor General.
Department: Lands & Physical Planning

Geodetic Advisor: Dr. Richard Stanaway.

1. PNG94 datum was introduced in 1997 and is almost 30 years now and requires a new datum for navigation, surveying and mapping and development.

2. PNG is in the pacific Ring of Fire. Earthquakes and Volcanoes occur frequently.

3. The Rabaul Volcanoes Observatory uses GNSS instruments and geodetic techniques to monitor the volcanic activities in the active regions and the country.

4.Tide gauges be monitored for the Sea level rise in the coastal regions and smaller islands where most parts is covered by sea.

Like the Atolls in the Bougainville region and the Manuus Province.

WHY GEODESY MATTERS.

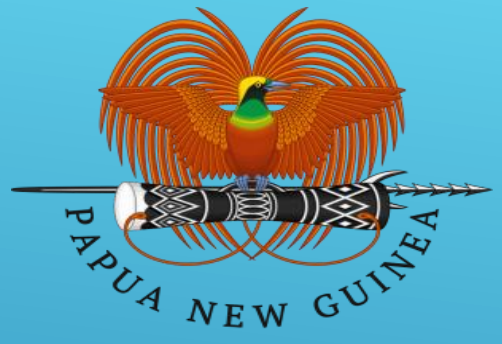
WHY IS GEODESY CRITICAL IN PNG.

THE STATE OF GEODESY.

- PNG94 datum and the PNG Geodetic Network is old. Meaning the positions should have been shifted by now and new position should be observed and assigned to the Permanent Survey Markers, (PSMs).
- The Geodetic section of the School of Surveying at the PNGUoT and the Geodetic section of the Office Surveyor General are working on a new Geodetic datum for Papua New Guinea called PNG2020.
- The funding has been made available, and the officers are doing the data acquisition for the new datum.
- Funds are released late, and time is the problem if we have to meet deadlines.

WHAT'S NEXT/CALL FOR ACTION.

- Capacity building- If CORS be set up in the Provincial Towns and new positions be assigned on the new epoch for the town grids upgrade.
- Geodesy be made prominent in rather than other variables which makes Geodesy of no effect.



- Office of the Surveyor General.
- Department of Lands & Physical Planning
- NATIONAL CAPITAL DISTRICT.
- P.O.Box 5665 BOROKO
- Webpage: http:/dlpp.gov.pg

THANK YOU.

WE APPRECIATE UN-GGCE_ASIA-PACIFIC GEODESY CAPACITY DEVELOPMENT WORKSHOP ORGANIZERS FOR INVITING US TO PARTICIPATE IN THIS VERY IMPORTANT WORKSHOP.

Geodesy (Pohnpei-FSM)

Tricio Patricio

Dept. of Land Surveyor

Redtrick Joel

Dept. of Land Surveyor

Why Geodesy Matters

- Geodesy is Critical in the FSM for many reasons:
  - Infrastructure Development
  - Disaster Risk Management
  - Sea Level Monitoring
  - Maritime Boundary Monitoring
  - Issuing Land Titles to our Citizens

- Help COSPPac and NOAA creating GNSS core stations for sea level monitoring in Pohnpei and using these benchmarks for Project Development such as renovation on Pohnpei's Airport runway and soon to be the expansion of Pohnpei Sea Port.

The State of Geodesy in Pohnpei

- The Pohnpei State Government is the only institution that:
  - Provides public services to its people for obtaining land title document
  - Its function include helping other organizations and non government entities for Environment Management Projects, Natural Resources Monitoring and Management, Conservation Projects , etc.
- Key Achievement:
  - Is becoming a member of the PGSC (Pacific Geospatial and Surveying Council)
- Key Challenge:
  - Funding/Grants

What's Next?

Pohnpei is tasked with creating FSM's Action Plan for its Geospatial Information Management Policies and seek Support in creating Rules and Regulations for the Division.

Thank You

Contact Info:

kohwakohl2022@gmail.com

rbjoel69@gmail.com

جابتن اوكور
JABATAN UKUR
KEMENTERIAN PEMBANGUNAN
BRUNEI DARUSSALAM
Tel : 2382171 Fax : 2382900
Website : http://mod.gov.bn/survey
E-mail : info@survey.gov.bn

Geodesy in Brunei Darussalam

Haji Khairul Abidin bin Haji Sulaiman
Acting Senior Surveyor /Surveyor
Geodetic Section
Survey Department of Brunei Darussalam

Haji Zool Hilmi bin Haji Matahir
Chief Technician Survey
Geodetic Section
Survey Department of Brunei Darussalam

جابتن اوكور
JABATAN UKUR
KEMENTERIAN PEMBANGUNAN
BRUNEI DARUSSALAM
Tel : 2382171 Fax : 2382900
Website : http://mod.gov.bn/survey
E-mail : info@survey.gov.bn

Why Geodesy Matters

Survey Department of Brunei Darussalam established the geocentric datum for Brunei Darussalam 2009 (GDBD2009) using space geodetic technology based on the International Reference Frame (ITRF) 2005. The GDBD2009 is related to ITRF2005 through the inclusion of 8 GPS Stations in Brunei Darussalam Zero Order Network and has been processed together with more than 35 IGS stations all over the world.

Large alignment between GDBD2009 and ITRF will decrease the positioning accuracy and realibility of any real-time positioning services such as RTK and VRS

Dynamic processes of the earth such as the long-term plate tectonic motion of Sunda move 3cm/year causing changes in the reference station coordinates. GDBD2009 is aged 15 years and has displaced 45cm from its actual position

The land displacement affects the realibility of the GDBD2009 for precise and accurate definitions of coordinates, modern geodetic datum needs to be updated to the latest ITRF using semi-dynamic approach

The benchmark (traditional levelling reference mark) typically deviates from the real position, necessitating ongoing maintenance and observation. To modernize leveling operations, Brunei Darussalam must set up aa new zero-order height system.

جابتن اوكور
JABATAN UKUR
KEMENTERIAN PEMBANGUNAN
BRUNEI DARUSSALAM
Tel : 2382171 Fax : 2382900
Website : http://mod.gov.bn/survey
E-mail : info@survey.gov.bn

The State of Geodesy

Empowering the geodesy for an efficient Survey Department Brunei Darussalam requires a combination of technical, human and infrastructural components to ensure accurate, reliable, as well as consistents and data collection.

Main Key Components to empower Geodetic Sections:

- Human Resources, Training and Capacity Building
- Geodetic Reference Framework
- Geodetic Infrastructure, Equipment and ICT Technology
- Precise Geodetic Software License
- Geodetic Field Operations Module Software
- Geodetic Data Quality and Accuracy Assuranse
- Collaboration with other relevant authority/agency and Academic Geodesy Instituitions.

By establishing these components , a land survey department enables an effective and reliable geodesy section supporting various surveying and mapping applications from land management to infrastructure development and scientific research.

جابتن اوکور
JABATAN UKUR
KEMENTERIAN PEMBANGUNAN
BRUNEI DARUSSALAM
Tel : 2382171 Fax : 2382900
Website : http://mod.gov.bn/survey
E-mail : info@survey.gov.bn

What's Next / Call to Action

- Experts in Geodesy and Geospatial sciences with knowledge of Global Positioning Systems (GPS)/ Global, Navigation Satellite System (GNSS), geodetic datums and coordinate systems
- To update and well-defined Geocentric Datum of Brunei Darussalam that aligns with the updated version of the current International Terrestrial Reference Frame
- To generate semi-dynamic model for Geocentric Datum of Brunei Darussalam
- To modernize zero-order height system in Brunei Darussalam

جابتن اوكور
JABATAN UKUR
KEMENTERIAN PEMBANGUNAN
BRUNEI DARUSSALAM
Tel : 2382171 Fax : 2382900
Website : http://mod.gov.bn/survey
E-mail : info@survey.gov.bn

Thank You / Terima Kasih

Contact :

Haji Khairul Abidin Haji Sulaiman
abidin.sulaiman@survey.gov.bn
+6737256652
Haji Zool Hilmi Haji Matahir
hilmi.tahir@survey.gov.bn
+6738631431

info@survey.gov.bn
www.mod.gov.bn/survey

SURVEY DEPARTMENT
MINISTRY OF DEVELOPMENT
BRUNEI DARUSSALAM

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Timor-Leste

Elisinha Nunes

Geodesy in Timor-Leste

1. Ministry of Justice

The Secretary of state of Land and Property,
The Directorate General of Land and Property,
The Directorate Nacional of Infrastructure and Geospatial

2. Ministry of Planning Strategic and Investment

The Directorate General of Planning and Territory

STRONGER.
TOGETHER.

Why Geodesy Matters in Timor-Leste

Timor-Leste is still developing its spatial developing;

1. Geodesy support on land administration

- Land Disputes
- Cadastral Mapping
- Land Titling

2. International and Regional Boundary

- International boundary with Indonesia
- Established village boundaries

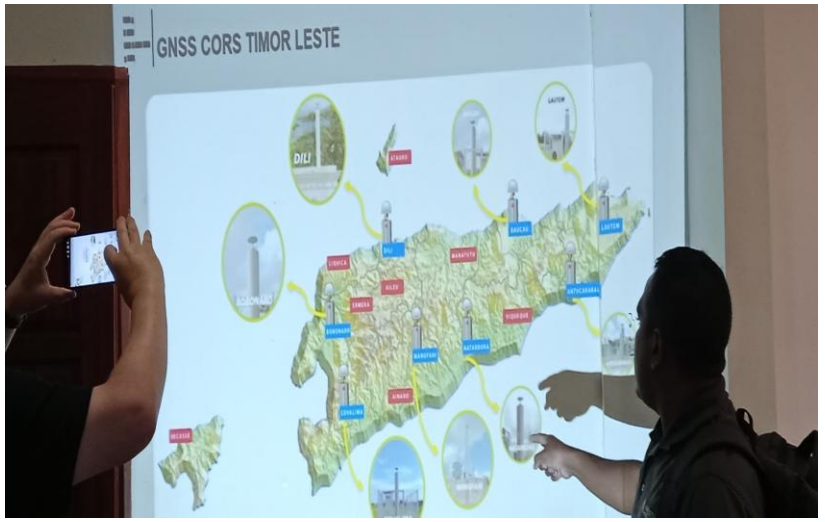
3. Infrastructure

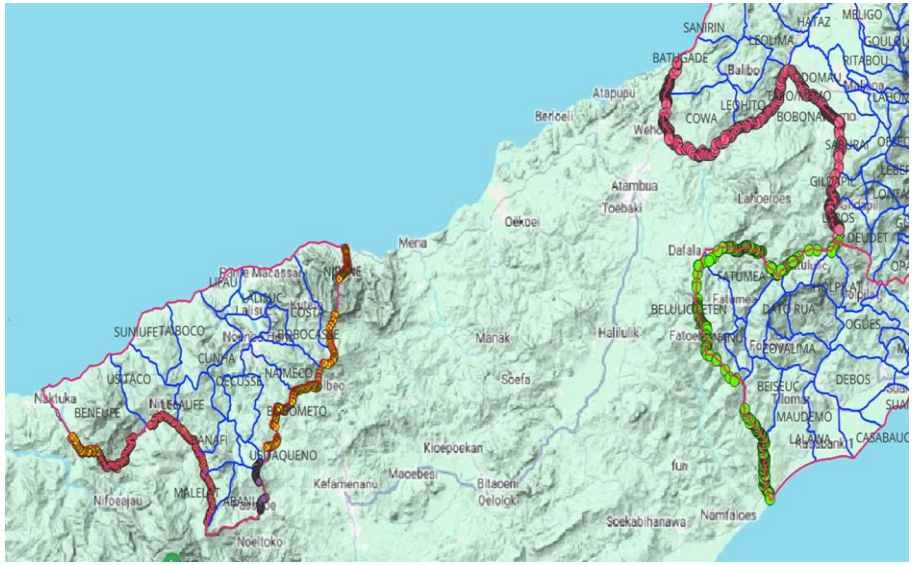
- Roads, subway and bridge
- Irrigations
- Airports and buildings

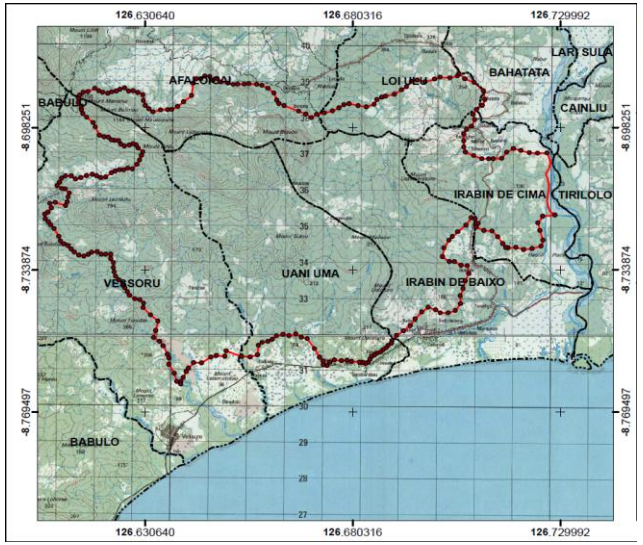
STRONGER.
TOGETHER.

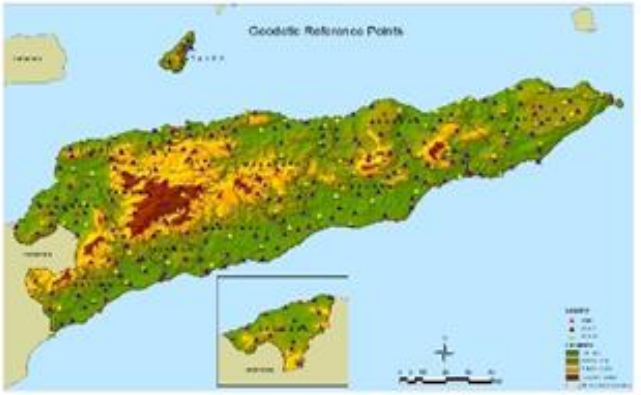
State of Geodesy in Timor-Leste

1. CORS was stablished 8 (blue), and another 8 (red) planned to establishing in 2025
2. Geodetic reference points; 314
3. Protected areas,
4. International boundary









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Geodesy Challenges in Timor-Leste

- Limited human resource in geodesy and geospatial
- Integrated geospatial data infrastructure
- Data sharing across government and agencies
- National geodetic framework link to global reference system (ITRF)
- Limited use geospatial data in the planning

STRONGER.
TOGETHER.

Plan and Needs

*** International boundary with Indonesia**

*** CORS network is still under development**

*** We need partnerships support for Capacity building**;

- geodetic professional
- surveying
- GIS specialist

*** Partnerships support to set up datum local**

STRONGER.
TOGETHER.

OBRIGADA

THANK YOU

STRONGER.
TOGETHER.

WHERE?

WHO?

Geodesy in Japan

Masafumi Ishigaki
Deputy Director of Space Geodesy division
Geospatial Information Authority of Japan (GSI)

国土地理院
Geospatial Information Authority of Japan

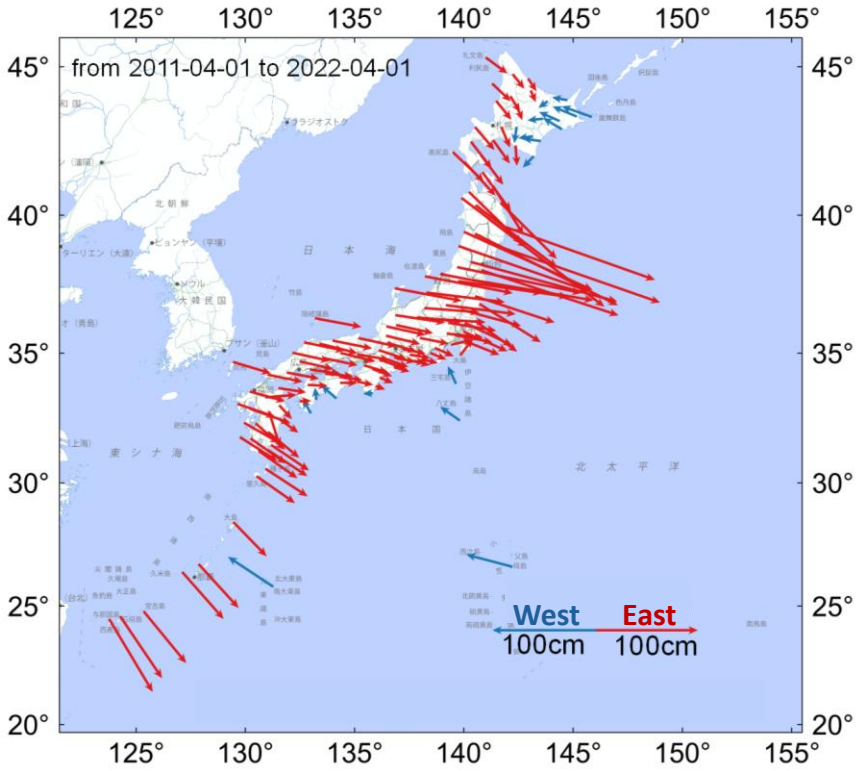
STRONGER.
TOGETHER.

Why Geodesy Matters ?

WHY?

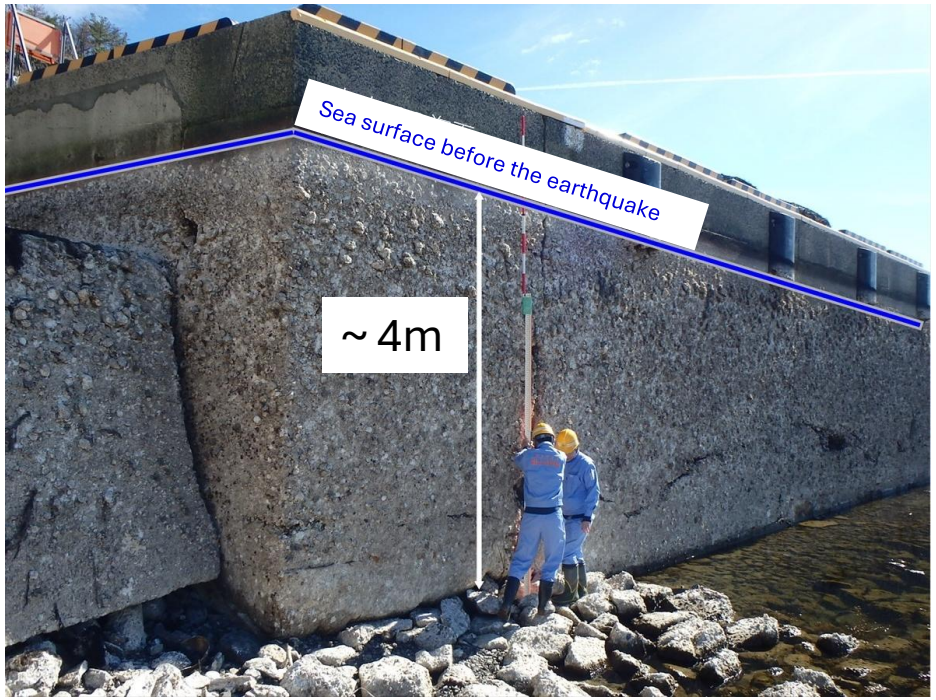
- The Japanese archipelago is frequently affected by natural disasters such as earthquakes and volcano eruptions
- A dense GNSS CORS network has been installed across Japan to monitor these disasters. This network also serves as a key component of the geodetic infrastructure
- Complex crustal movements make it challenging to maintain an accurate reference frame, requiring continuous monitoring

Crustal movement



Earthquakes

the 2024 Noto Peninsula Earthquake



国土地理院
Geospatial Information Authority of Japan

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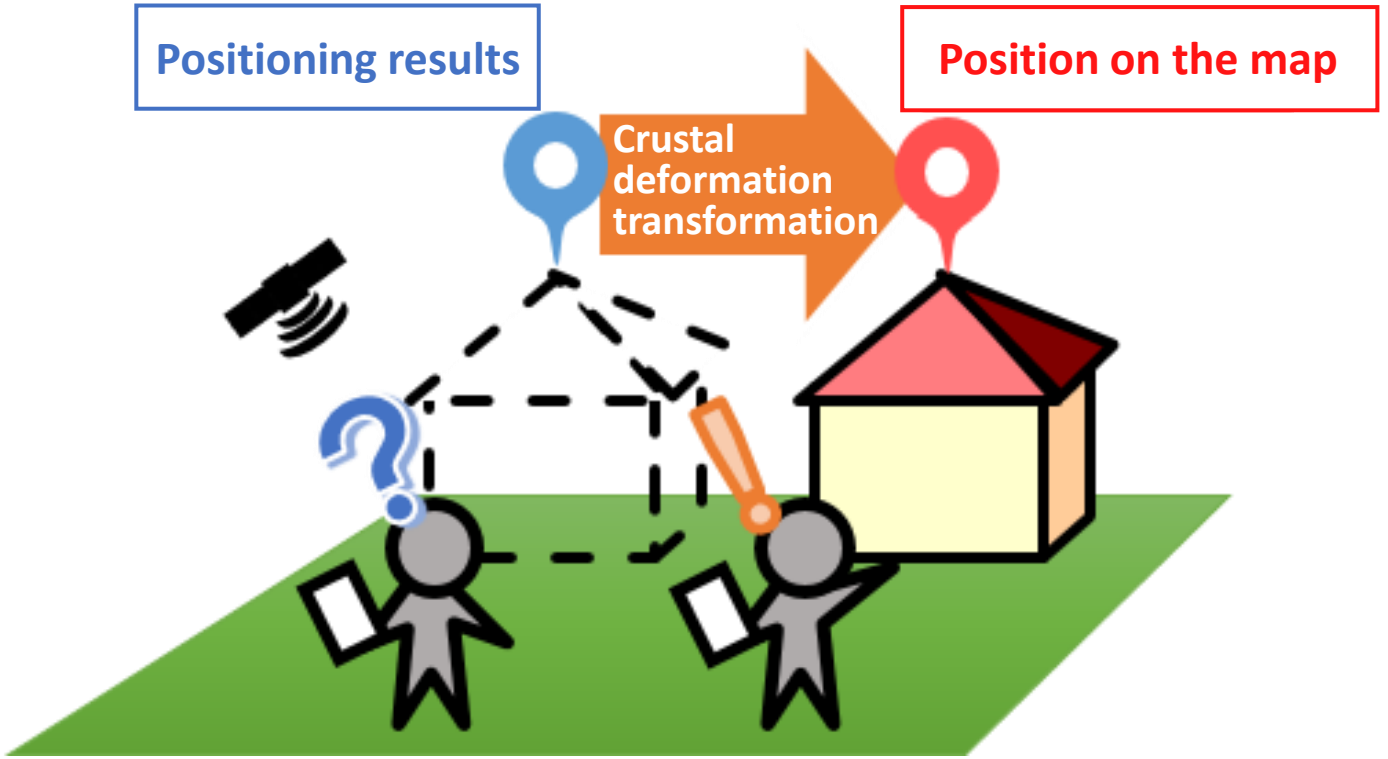
TOGETHER.

Why Geodesy Matters ?

WHY?

- Economic and social activities (construction, cadastral surveys, urban planning...) are based on the map in which positions are fixed at a certain point in the past
- Due to crustal movements, the position shown on maps does not correspond to that obtained by GNSS positioning, and this discrepancy accumulates and expands over time
- To reconcile the difference, “crustal deformation transformation” must be applied to the GNSS positioning data, which is made possible through continuous geodetic observation



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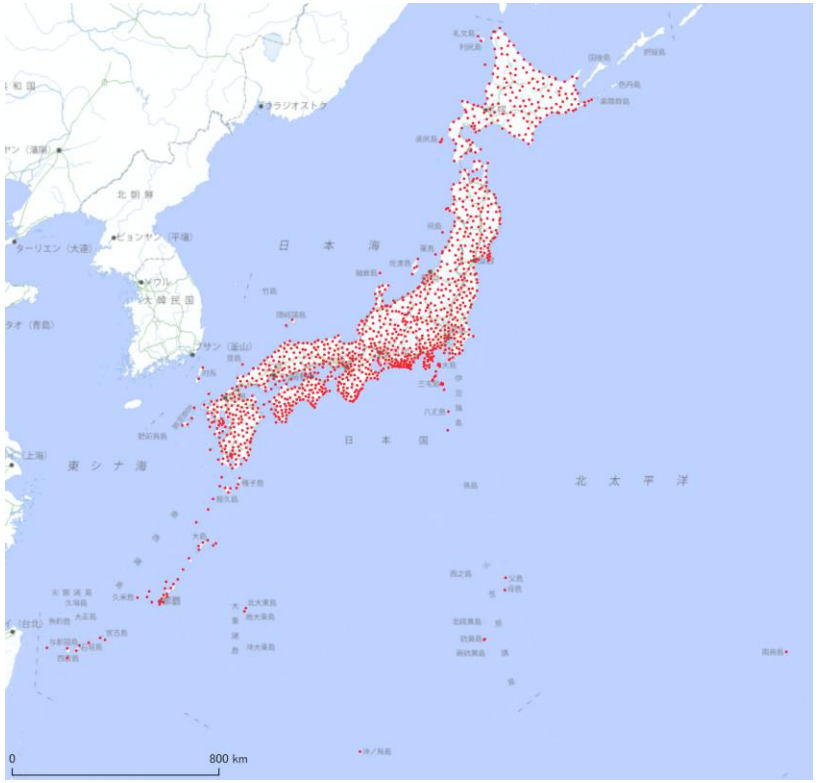
Why Geodesy Matters ?

HOW?

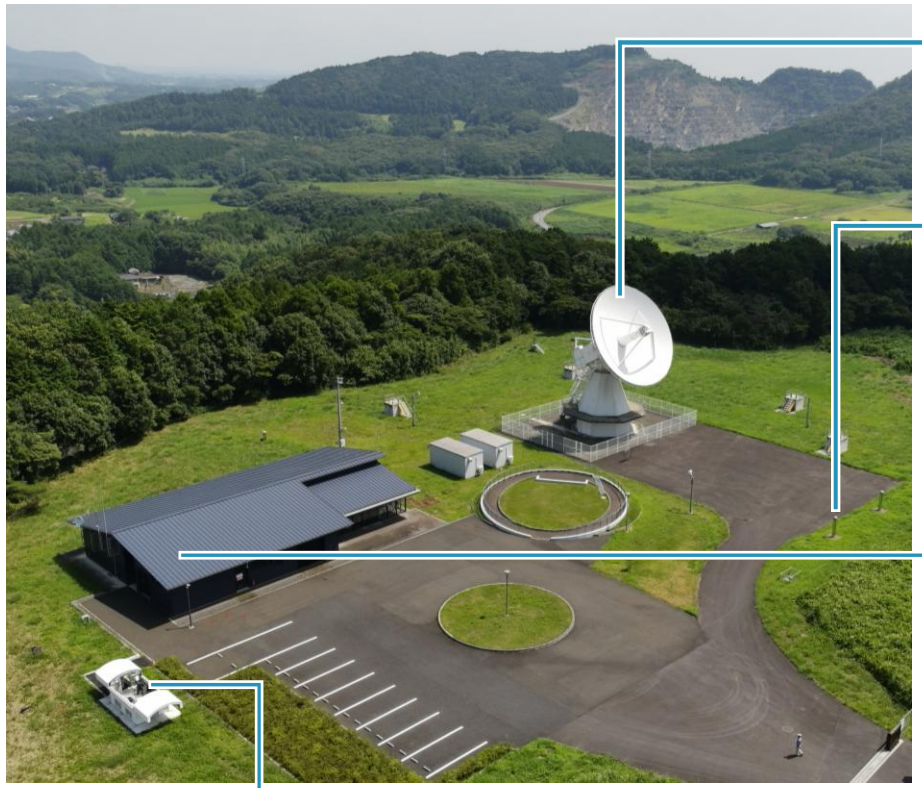
- GSI operates GNSS CORS network and Ishioka Geodetic Observing Station as geodetic infrastructure

GNSS CORS network



~1,300 stations at an average interval of ~20 km for crustal deformation monitoring and GNSS surveys

Ishioka Geodetic Observing Station



VLBI

GNSS

Gravity measurement

Omni-SLR (being developed under joint research between Hitotsubashi University and GSI)

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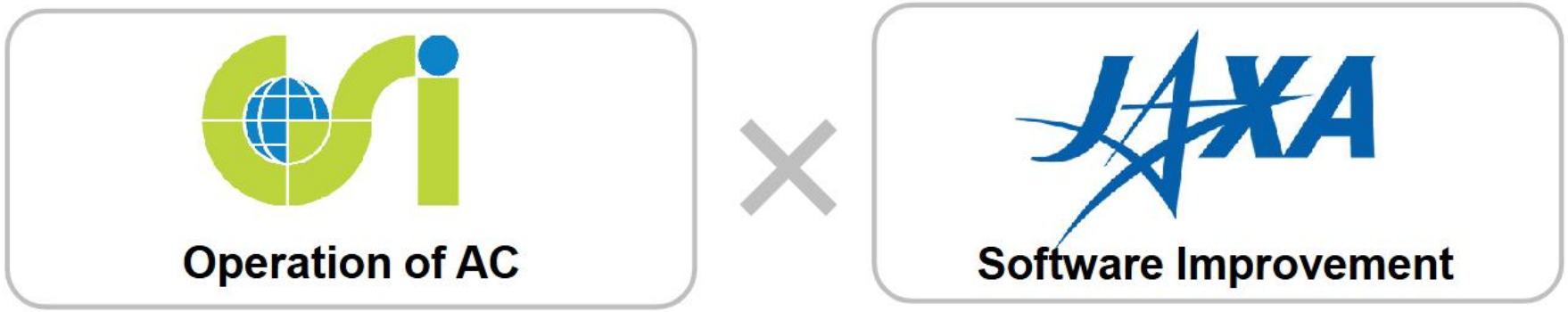
Why Geodesy Matters ?

HOW?

- IGS Analysis Center JGX (Japan, GSI, JAXA) has started its operation since Dec 2023
- They analyze daily precise ephemeris and contribute to IGS operational products



Institution	Abbreviation	Country/Region
Natural Resources Canada	EMR	Canada
Wuhan University	WHU	China
Geodetic Observatory Pecny	GOP-RIGTC	Czech Republic
Space geodesy team of the CNES	GRG	France
European Space Agency/ESOC	ESA/ESOC	Germany
GeoForschungsZentrum	GFZ	Germany
Geospacial Information Authority of Japan and Japan Aerospace Exploration Agency	JGX	Japan
Center for Orbit Determination in Europe	CODE	Switzerland
Jet Propulsion Laboratory	JPL	USA
Massachusetts Institute of Technology	MIT	USA
NOAA/National Geodetic Survey	NGS	USA
Scripps Institution of Oceanography	SIO	USA
U.S. Naval Observatory	USNO	USA

https://igs.org/acc/

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Geospatial Information Authority of Japan

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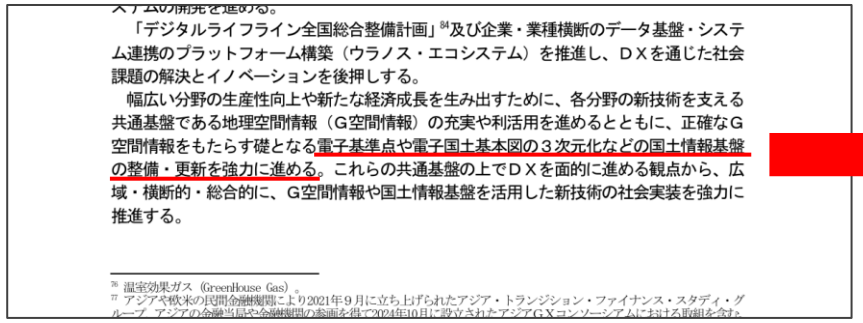
TOGETHER.

What's Next / Call to Action

WHAT?

Problems:
- Limited user awareness of GGSC vulnerabilities
- Insufficient operational sustainability of GGSC
  * GNSS CORS has been developed with supplementary budget after big earthquakes
    Update of CORS stations is largely covered with special budgets for national resilience

Needs:
- Raise awareness among users and decision-makers
- Develop a sustainable business model



「デジタルライフライン全国総合整備計画」[84]及び企業・業種横断のデータ基盤・システム連携のプラットフォーム構築（ウラノス・エコシステム）を推進し、ＤＸを通じた社会課題の解決とイノベーションを後押しする。

幅広い分野の生産性向上や新たな経済成長を生み出すために、各分野の新技術を支える共通基盤である地理空間情報（Ｇ空間情報）の充実や利活用を進めるとともに、正確なＧ空間情報をもたらす礎となる電子基準点や電子国土基本図の３次元化などの国土情報基盤の整備・更新を強力に進める。これらの共通基盤の上でＤＸを面的に進める観点から、広域・横断的・総合的に、Ｇ空間情報や国土情報基盤を活用した新技術の社会実装を強力に推進する。

[84] 温室効果ガス（GreenHouse Gas）。

https://www5.cao.go.jp/keizai-shimon/kaigi/cabinet/honebuto/2025/2025_basicpolicies_ja.pdf

"... promote maintenance and update of the national basic geospatial information infrastructure such as **GNSS CORS** and 3D Digital Japan Basic Map."

The word "GNSS CORS" has been mentioned for the first time in "Basic Policy on Economic and Fiscal Management and Reform" by the Cabinet Decision in 2025

国土地理院
Geospatial Information Authority of Japan

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TOGETHER.

Thank you

Contact:
Basara Miyahara:　miyahara-b96ip@mlit.go.jp
Masafumi Ishigaki: ishigaki-m96bd@mlit.go.jp

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Geospatial Information Authority of Japan

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TOGETHER.

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

H.D.C.Haputhanthiri
Sri Lanka

Geodesy in Sri Lanka

WHERE?

WHO?

Key Components:

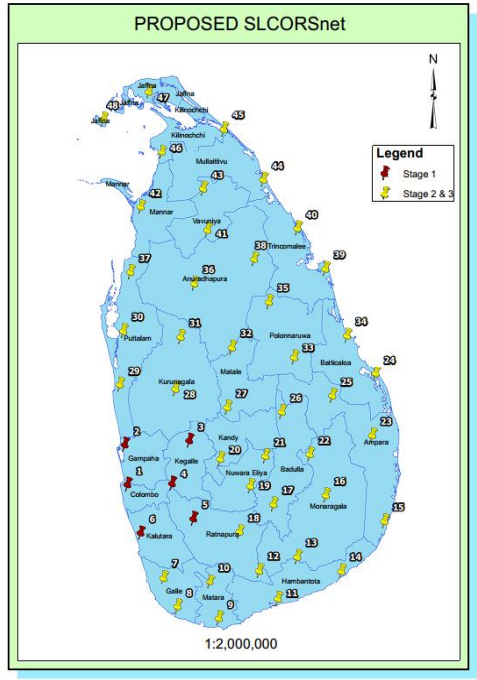
- **Survey Department of Sri Lanka (SDSL)**: Central authority for geodetic infrastructure.
- **Sri Lanka Geodetic Datum (SLD99)**: Adopted as the national horizontal reference frame.
- **CORS Network (SLCORSnet)**: Enables precise GNSS positioning across the country. Currently covering the western part of the country

Applications:

- Urban planning & land administration
- Disaster management & sea-level monitoring
- Infrastructure development (roads, dams, etc.)
- GPS/GNSS navigation & surveying

International Collaboration:

- **UN-GGIM** initiatives
- Cooperation with IGS & other regional geodetic networks



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Why Geodesy Matters ?

WHY?

Strategic Importance:

- **Island Nation** exposed to **tsunamis, coastal erosion, and sea-level rise**
- Dense infrastructure & transport require **precise positioning systems**

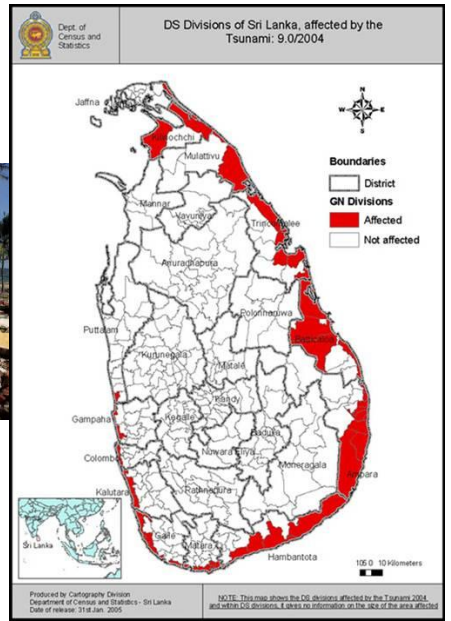
Critical Applications:

- **Infrastructure Development**: Accurate GNSS surveying for roads, rail, and smart cities
- **Disaster Risk Reduction**: Tsunami early warning systems rely on geodetic GPS & tide gauge data
- **Sea-Level Monitoring**: Detects coastal changes impacting fisheries, tourism, and low-lying communities
- **Navigation & Mapping**: Supports aviation, marine routes, and logistics with high-precision GNSS

Real-World Example:

2004 Indian Ocean Tsunami

- Lack of real-time geodetic monitoring delayed early warning
- Led to over **30,000 Sri Lankan lives lost**
- Post-2004: Sri Lanka invested in **CORS stations, tide gauges, GNSS networks** to prevent future disasters



HOW?

STRONGER.
TOGETHER.

State of Geodesy in Sri Lanka

Key Achievement:

Establishment of the SL-CORS Network to the entire country

- Provides **centimeter-level positioning accuracy**
- Supports surveying, agriculture, construction & navigation across the country

Major Challenge:

Lack of a Modern National Vertical Datum/ Geoid Model

- Limits precision in **elevation data**, affecting flood modeling, infrastructure design, and coastal planning

Strengthening geodetic systems is vital for resilience, development, and smart decision-making in Sri Lanka.

What's Next / Call to Action

WHAT?

Priority Areas:

Capacity-Building

- Train professionals in GNSS, geodetic data analysis, and geospatial technologies
- Invest in university programs and continuous professional development

Policy & Institutional Support

- Update legal frameworks to integrate modern geodetic standards
- Establish national guidelines for data sharing and GNSS infrastructure use

Regional & Global Coordination

- Collaborate with **UN-GGIM, IGS**, and **SAARC geospatial initiatives**
- Join **regional GNSS and sea-level monitoring networks** for disaster preparedness

Future Goal:

Develop a **fully integrated geodetic infrastructure** aligned with international standards to support **climate resilience, smart development, and digital governance**

STRONGER.
TOGETHER.

Thank You

Official website: www.survey.gov.lk

Contact Details:

email Address:

Phone No:

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Government Implementing Agency
GENERAL AUTHORITY FOR LAND ADMINISTRATION,
GEODESY AND CARTOGRAPHY

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

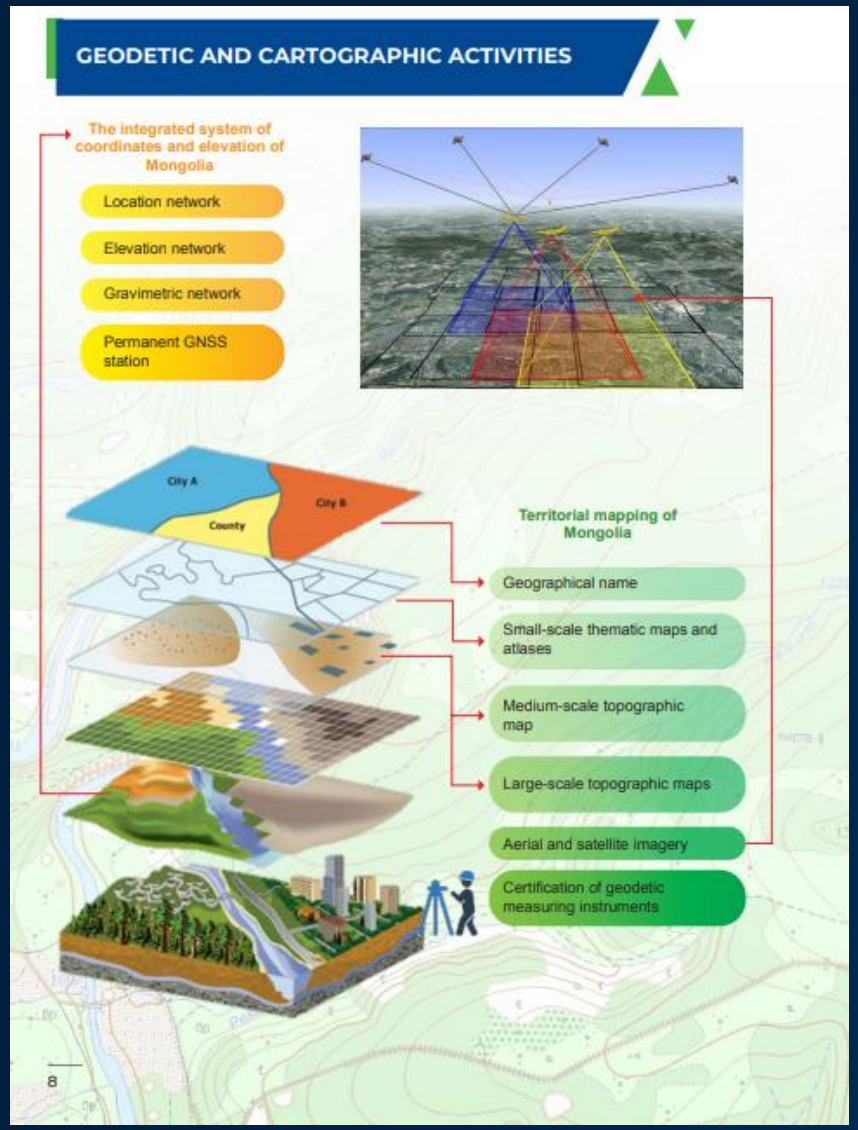
MONGOLIAN GEODETIC NETWORK SHORT REPORT

MODERNISING GEOSPATIAL REFERENCE SYSTEM
CAPACITY DEVELOPMENT WORKSHOP

July, 3rd
2025

ZOLZAYA LKHAMSUREN & UNDARMAA DASHBALBAR

MISSION AND ACTIVITIES OF GEODESY AND CARTOGRAPHY DIVISION



ESTABLISH ALL TYPES OF GEODETIC NETWORKS, TOPOGRAPHICAL AND THEMATIC DIGITAL MAPPING SYSTEMS THROUGHOUT THE TERRITORY OF MONGOLIA, ENSURE THEIR USE WITH METHODOLOGY, AND DETERMINE THE SHAPE AND SIZE OF THE TERRITORY IN ACCORDANCE WITH THE APPROVED COORDINATE SYSTEM.

THE INTEGRATED SYSTEM OF COORDINATE AND ELEVATION OF MONGOLIA

- POSITION NETWORK
- ELEVATION NETWORK
- GRAVIMETRIC NETWORK
- PERMANENT GNSS-CORS

TERRITORIAL MAPPING OF MONGOLIA

- GEOGRAPHICAL NAME
- SMALL SCALE THEMATIC MAPS AND ATLAS
- MEDIUM SCALE TOPOGRAPHIC MAP
- LARGE SCALE TOPOGRAPHIC MAP
- AERIAL AND SATELLITE IMAGE

LABORTORY FOR CALIBRATION GEODETIC INSTRUMENTS

- RELATIVE POLYGON
- HIGH ACCURACY GEODITIC INSTRUMENT CALIBRATION

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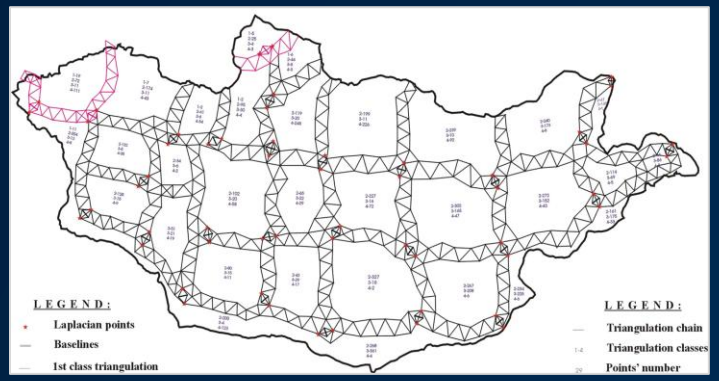
MONGOLIAN GEODETIC NETWORK

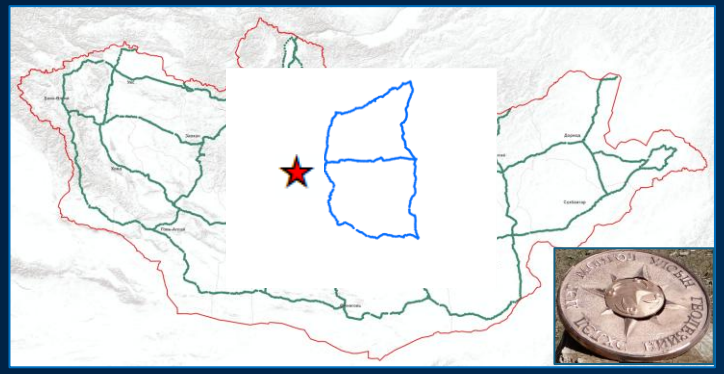
TRIANGULATION NETWORK
1936-1965

ABOUT 15000 POINT



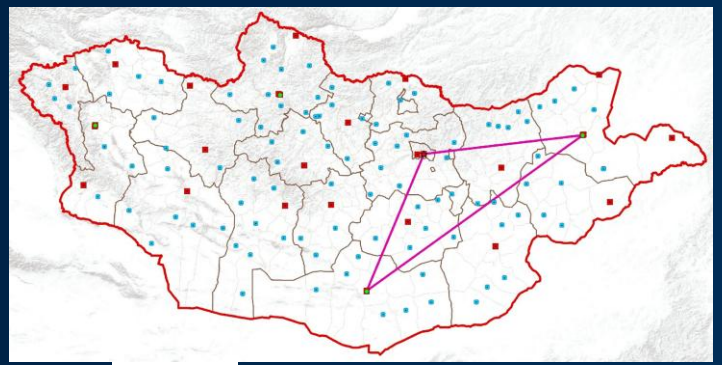
LEVELING NETWORK
1936-1954 II CLASS
2014-2024 I CLASS

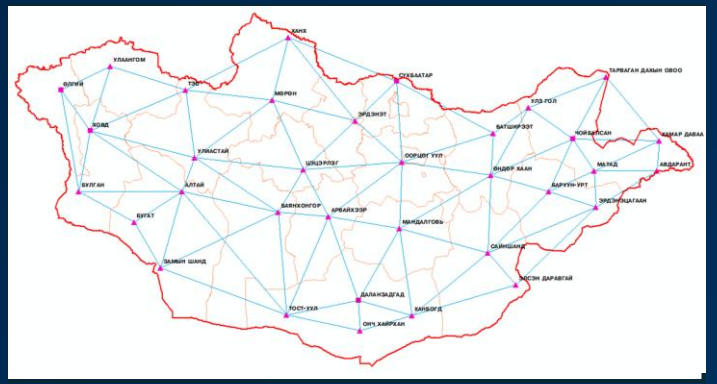
- Datum points of Mongolia was established in Tsetserleg city of Arkhangai aimag in 2019.
- Datum point was connected to 1st class leveling network in 2022-2023.



GRAVITY NETWORK
1983-1989

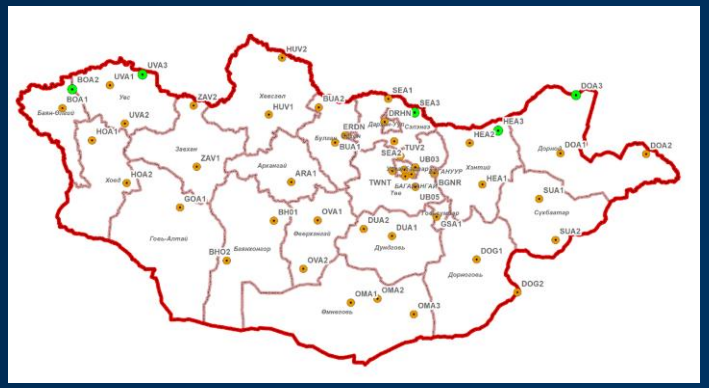
- 1st class Gravity network established in 1983-1985: 31 points
- 2nd class Gravity network established in 1985-1989: 103 points





GPS,GNSS NETWORK
1997-2014

GNSS network points 3760 adjusted by bernese software in ITRF2008 coordinate system \epoch 2005.01.01\ in 2014

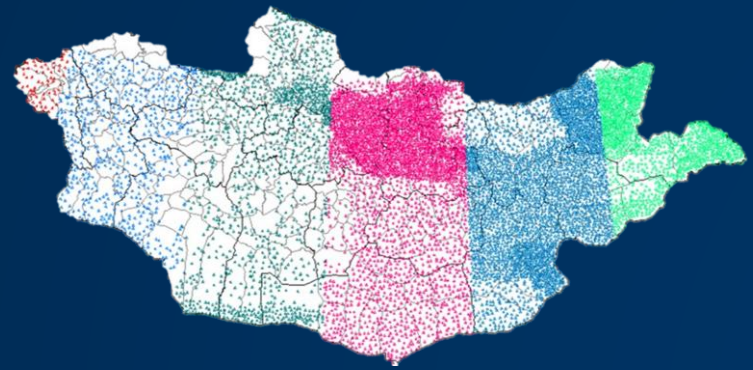


GNSS-CORS NETWORK
2010-2024

First GNSS-CORS established in 2005

NOW- 48 CORS

LOCATION:
- ULAANBAATAR – 6
- PROVINCE CENTER– 21
- SOUM AND VILLAGE– 16



GEODETIC POINT
1936-2024

GEODETIC PERMANENTLY POINT - 22977
USER SERVICE BY:

https://nsdi.gov.mn/

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MONGOLIAN GEODETIC INFORMATION

GEODETIC REFERENCE SYSTEM:

Ellipsoid		WGS84
Datum		WGS84
Projection	UTM	
False Northing	0.0	
False Easting	500000.0	
Latitude of origin		00 00 00.0 N
Longitude of origin /Zone/	45. 87 00 00.0 E /84-90/	
	46. 93 00 00.0 E /90-96/	
	47. 99 00 00.0 E /96-102/	
	48. 105 00 00.0 E /102-108/	
	49. 111 00 00.0 E /108-114/	
	50. 117 00 00.0 E /114-120/	

Scale factor at central meridian 0.9996

GOVERNMENT RESOLUTION (No 267) in 2022

To approve the Geodetic coordinate and height system, and projection

- ITRF2020 coordinate system
- UTM mapping projection
- Baltic Sea level height system

МОНГОЛ УЛСЫН ЗАСГИЙН ГАЗРЫН ТОГТООЛ

2022 оны 7 дугаар сарын 5-ны өдөр | Дугаар 267 | Улаанбаатар хот

ГЕОДЕЗИЙН СОЛБИЦОЛ, ӨНДӨР, ТУСГАГИЙН НЭГДСЭН ТОГТОЛЦООГ ШИНЭЧЛЭН БАТЛАХ ТУХАЙ

Геодези, зураг зүйн тухай хуулийн 5.2.1-д заасныг үндэслэн Монгол Улсын Засгийн газраас ТОГТООХ нь:

1. Монгол Улсын нутаг дэвсгэрийн хэмжээнд хийгдэж байгаа геодезийн хэмжилт, зураглалын ажилд олон улсын геодезийн солбицлын ITRF2020 тогтолцоо, өндрийн сүлжээнд Балтийн тэнгисийн тогтолцоог, газрын зураглалд дэлхийн хөндлөн меркаторын "UTM" тусгагийг тус тус хэрэглэж байхаар тогтсугай.

2. Геодезийн солбицлын ITRF2020 тогтолцоонд шилжсэнтэй холбогдуулан хэрэгжүүлэх арга хэмжээний төлөвлөгөө батлан, үе шаттайгаар зохион байгуулан ажиллахыг Барилга, хот байгуулалтын сайд Б.Мөнхбаатар, Газар зохион байгуулалт, геодези, зураг зүйн газар (А.Энхманлай)-т үүрэг болгосугай.

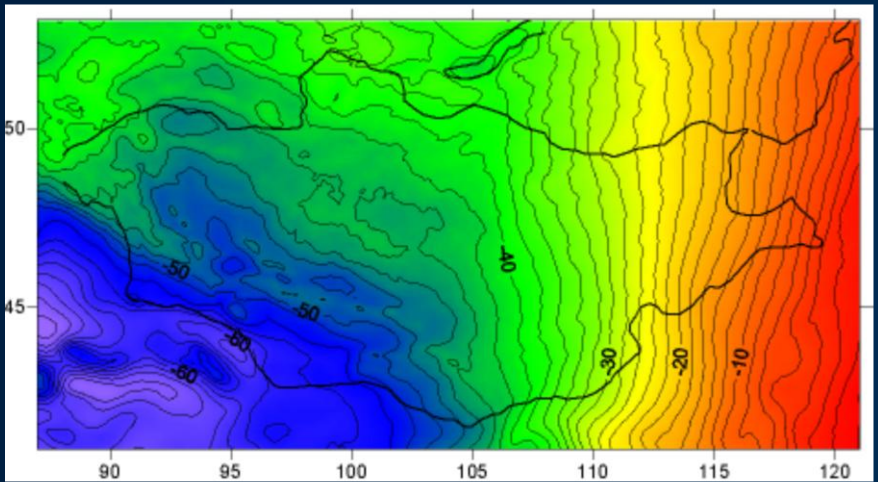
3. Геодезийн солбицлын ITRF2020 тогтолцоонд шилжсэнтэй холбогдуулан хэрэгжүүлэх төсөл, арга хэмжээнд шаардагдах зардлыг 2023-2025 оны төсвийн хүрээний мэдэгдэл, төсвийн төсөөлөл болон жил бүрийн улсын төсвийн төсөлд тусгаж байхыг Барилга, хот байгуулалтын сайд Б.Мөнхбаатар, Сангийн сайд Б.Жавхлан нарт тус тус даалгасугай.

4. Энэ тогтоол гарсантай холбогдуулан "Геодезийн солбицол, өндөр тусгагийн нэгдсэн тогтолцоог батлах тухай" Засгийн газрын 2009 оны 1 дүгээр сарын 28-ны өдрийн 25 дугаар тогтоолыг хүчингүй болсонд тооцсугай.

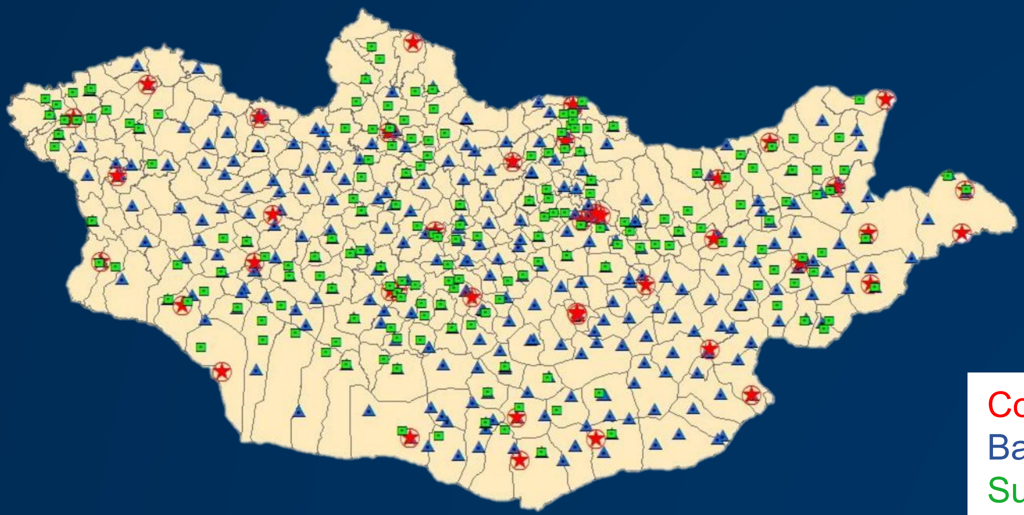
Монгол Улсын Ерөнхий сайд Л.ОЮУН-ЭРДЭНЭ

Барилга, хот байгуулалтын сайд Б.МӨНХБААТАР

THE GEOID MODEL:



THE SITUATION OF CONTROL POINTS :



Control network- 48
Basic network – 309
Sub network - 181

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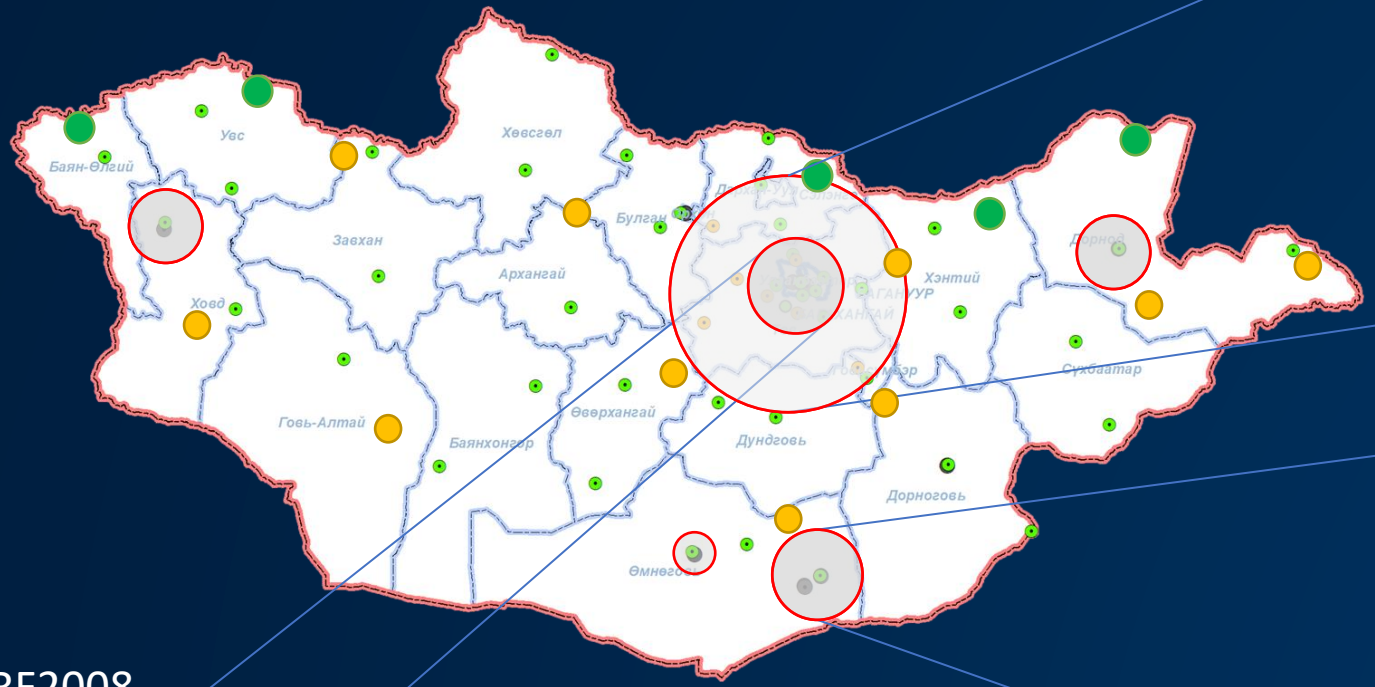
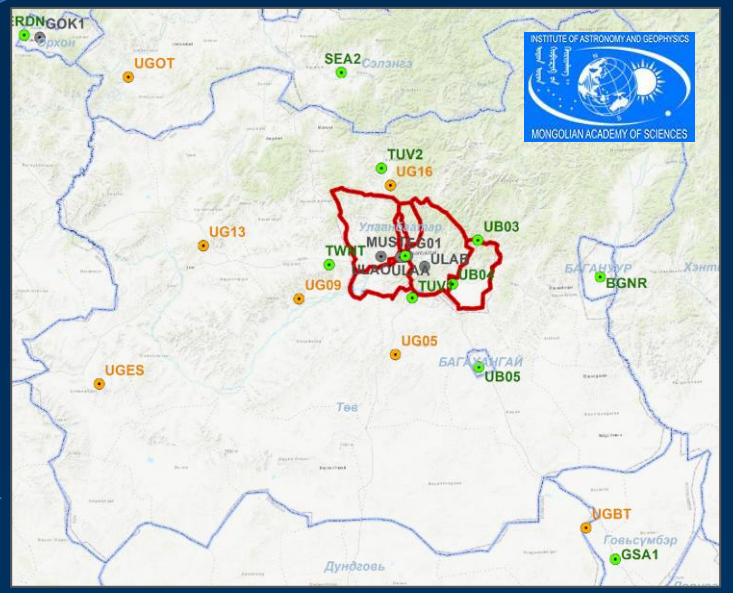
PUBLIC AND PRIVATE GNSS-CORS

- PUBLIC CORS – **48 (Agency)**
- PRIVATE CORS – **12 (Surveying company)**
- RESEARCH CORS (Institute Academy of Science)-**15**



ITRF2014

Geodynamic



Mining survey

Local coordinate system

ITRF2008

RTK for Topographic survey

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ONLINE POSITIONING PROCESSING SERVICES

1 PROCESSING
Adjustment of static data, observed by GNSS/GPS technology

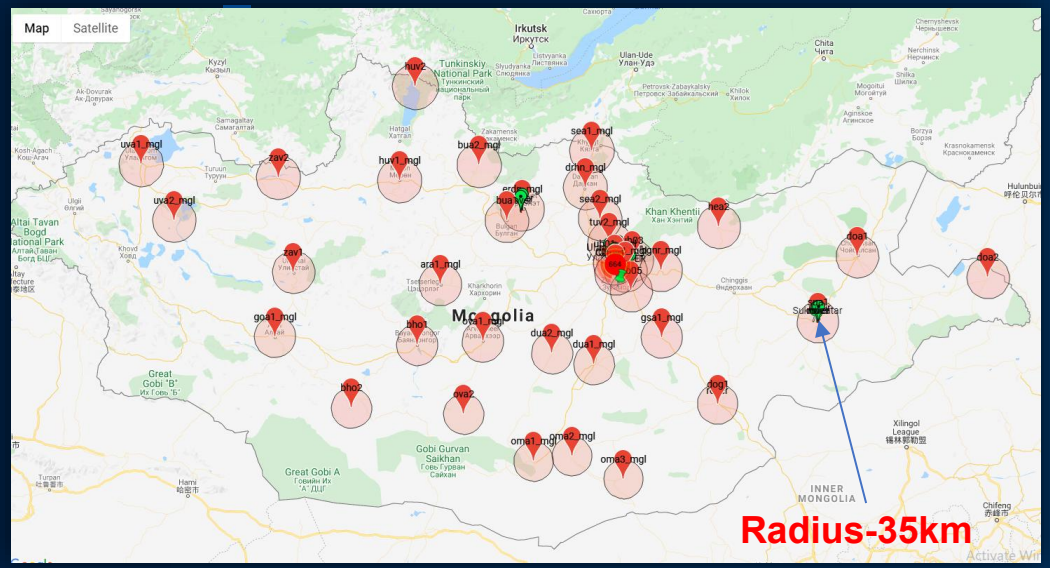
2 DOWNLOAD
Download GNSS-CORS static data

3 COMPUTING
GNSS-CORS coordinate changes depending on time

4 MONITORING
Monitoring of CORS RTK correction transmission service

5 CONVERT
Coordinate conversion tool
Geoid model for height conversion

https://monpos.gazar.gov.mn



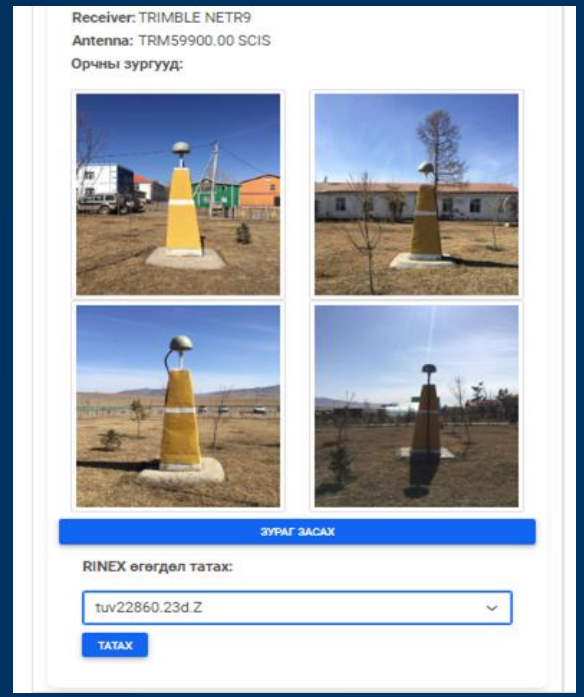
GEODETIC FUNDAMENTAL NETWORK

LAND DISPUTE

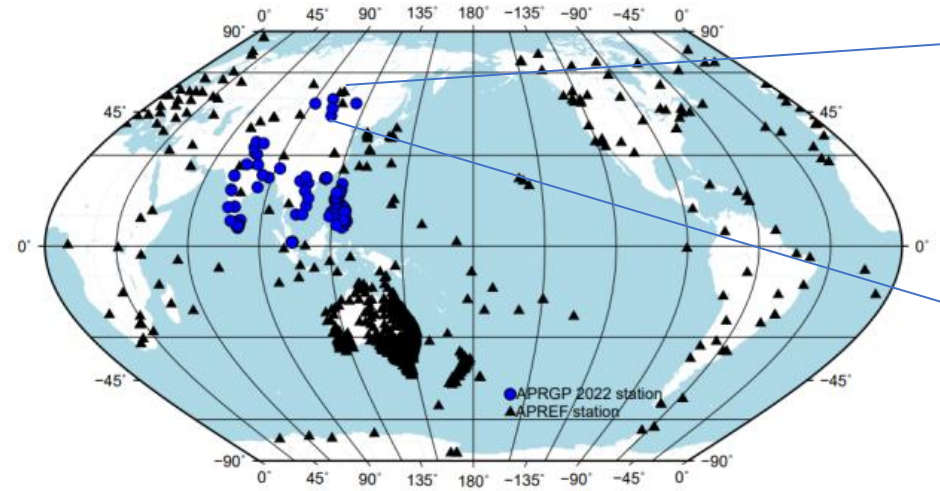
TOPOGRAPHIC MAPPING

CADASTRAL MAPPING

RTK DRONE



MONGOLIAN GEODETIC NETWORK INTERNATIONAL COOPERATION



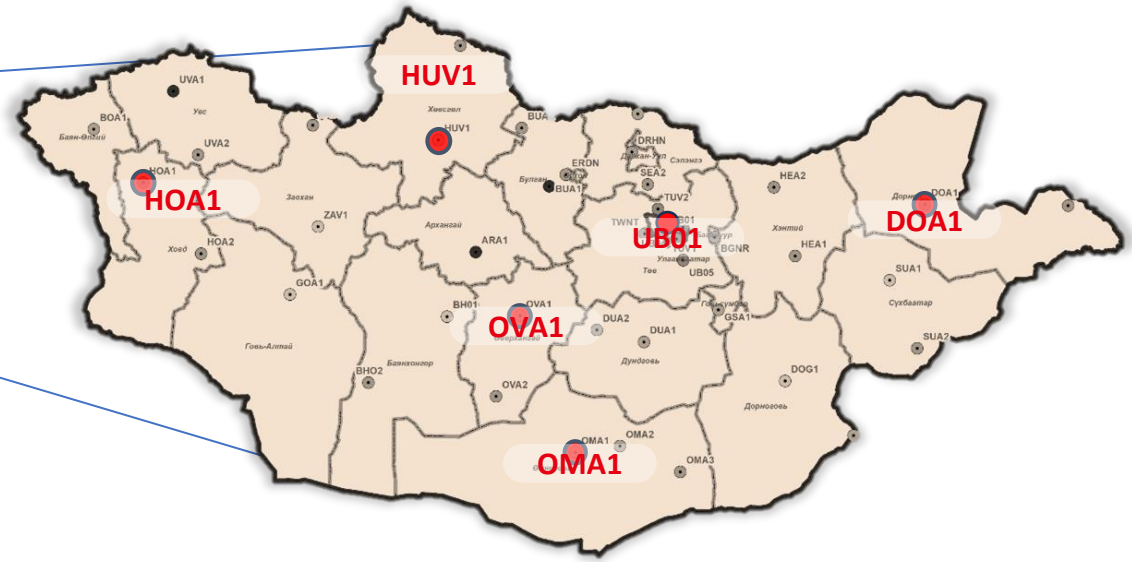


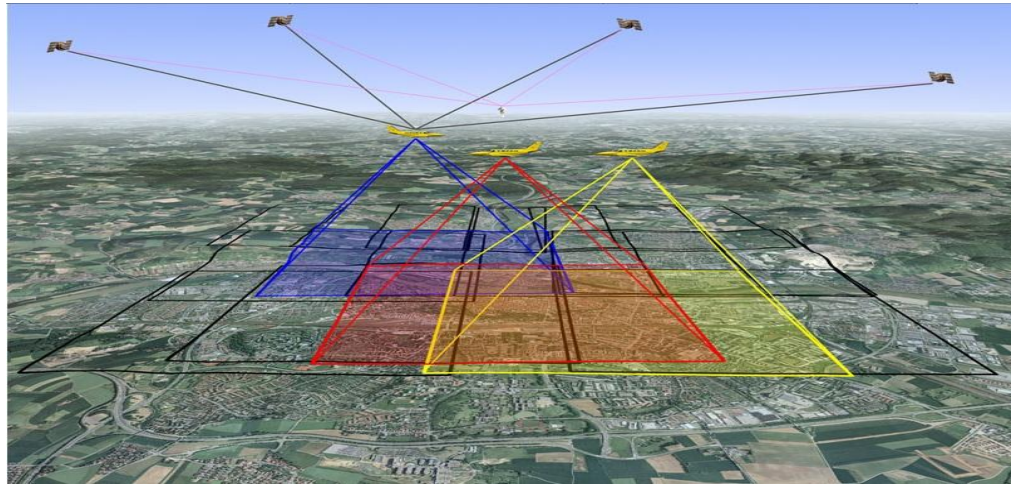
Figure 1 APRGP stations in the APRGP 2022 GPS campaign analysis along with the APREF stations and IGS stations, blue circles are APRGP campaign sites, and black triangles are APREF stations.

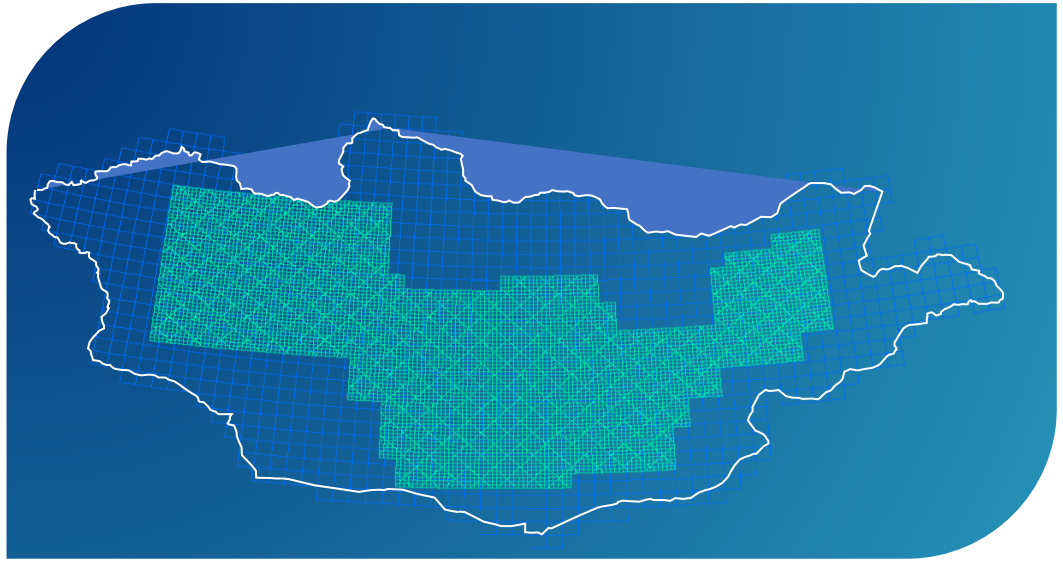
Station	LONGITUDE (DMS)			1 std (m)	LATITUDE (DMS)			1 std (m)	ELLIPSOID HEIGHT (m)	1 std (m)
DOA1	114	31	26.08757	0.0003	48	4	28.00265	0.0004	731.6646	0.0011
HOA1	91	40	5.64190	0.0003	48	0	31.57610	0.0003	1378.6624	0.0010
HUV1	100	9	57.06656	0.0003	49	38	9.81222	0.0004	1243.4418	0.0012
OMA1	104	22	14.62723	0.0003	43	36	19.29986	0.0004	1416.5275	0.0011
OVA1	102	46	39.02807	0.0003	46	15	59.73632	0.0003	1816.9366	0.0008

APRGP – Asian Pacific Region Geodetic Project

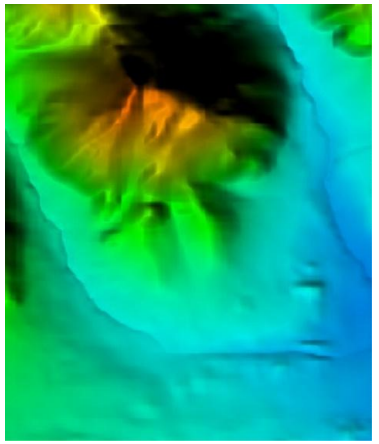
Mongolia joined the campaign since
1999 - 2023

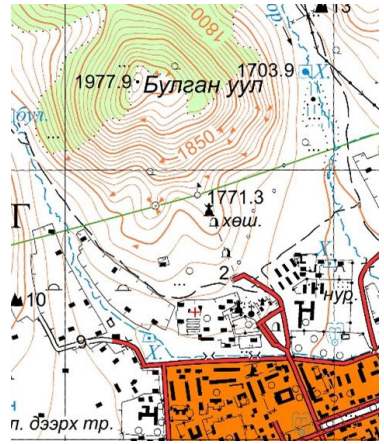
MONGOLIAN TOPOGRAPHIC MAPPING (1:25000)





1.Digital Elevation Model (DEM)	2. Aerial orthophoto mapping	3.Digital Topographic Mapping





AERIAL ORTHOPHOTO MAPPING → 7328 sheet DEM → Topographic Mapping GIS DATABASE

2011-2020 → Total Territory 45 % → 15 billion

Government Implementing Agency
GENERAL AUTHORITY FOR LAND ADMINISTRATION, GEODESY AND CARTOGRAPHY

DENSIFYING GNSS-CORS NETWORK

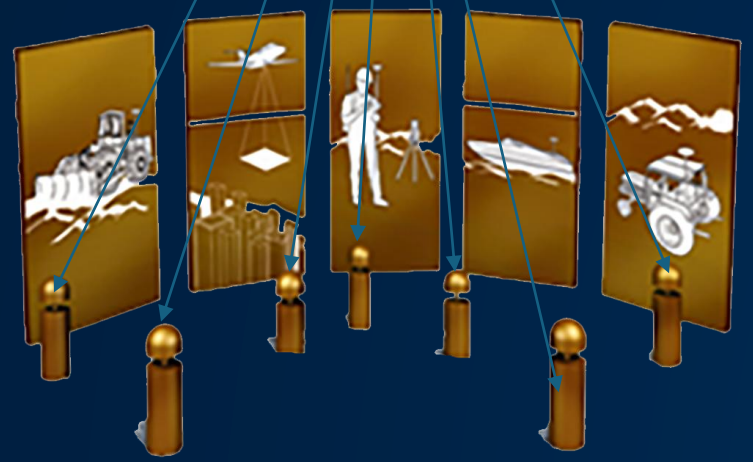
1. CURRENT SITUATION

GEODETIC FUNDAMENTAL NETWORK

EARTHQUAKE RESEARCH AND ANALYSIS

CADASTRAL MAPPING (RTK)

TOPOGRAPHIC MAPPING



AGENCY GNSS-CORS 48

2. DECISION

THE FEASIBILITY STUDY REVISED AND APPROVED IN 2023

Planned GNSS-CORS

20

REQUIRED BUDGET

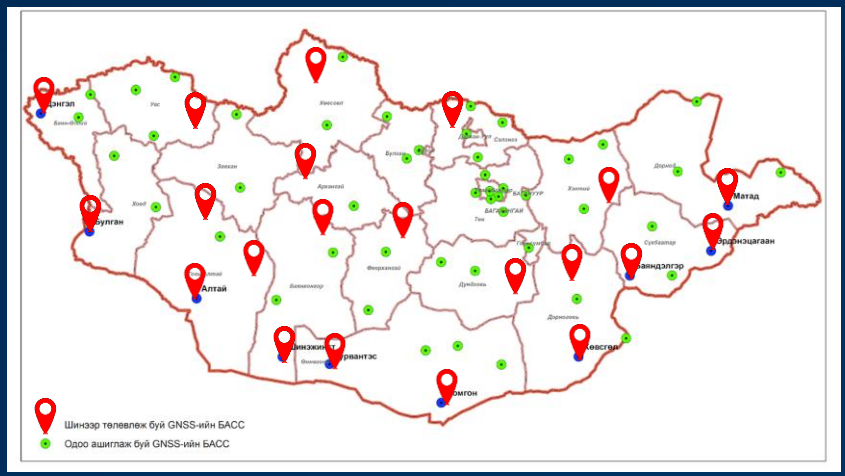
750’000 USD

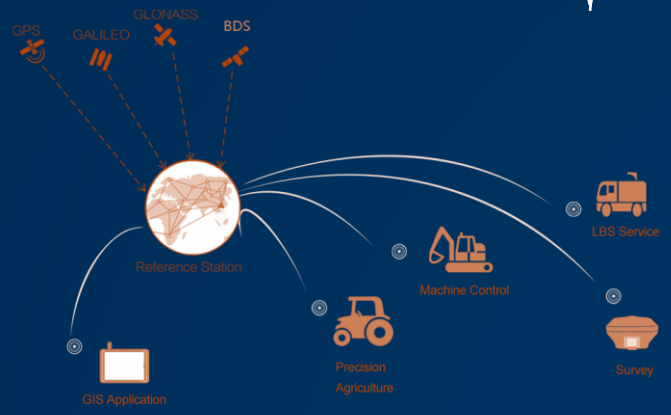
JOIN THE NEW CORS to IGS

3. RESULT AND SIGNIFICATION

GOVERNMENT RESOLUTION (No 267) in 2022

- ITRF2020 coordinate system
- UTM mapping projection
- Baltic Sea level height system





The adoption of advanced technology will enhance the productivity of around **300** individuals and organizations in the surveying and mapping sector, while lowering labor costs and boosting economic returns.

Expanding ground stations receiving navigation satellite data will enhance the positional accuracy of the national geodetic network to within **2 cm**, supporting precise geodetic surveys and mapping operations.

CHALLENGES in MONGOLIA

BUDGET and FINANCIAL

- GNSS-CORS **2.5 billion**
- GRAVITY NETWORK – **13.6 billion**
- LEVELING NETWORK – **18.2 billion**
- TOPOGRAPHIC MAPPING - **97.5 billion**

INTEGRATED EPOCH ITRF2020

- MONREF97- local
- ITRF2008 – private
- ITRF2014 – research
- ITRF2020 – public

TO JOIN NEW TECHNOLOGY

- MAINTENANCE – 48 GNSS-CORS
- ADD CONSTELLATION SYSTEM SERVICE – (GALILEO, BEIDOU, QZSS) in ALL CORS
- GNSS NAVIGATION TECHNOLOGY SERVICE

HUMAN RESOURSE & CAPACITY BUILD

- UNIVERSITIES' GEODESY TEACHING STAFF'S TRAINING
- TO INCREASE CREDIT IN GEODESY STUDY PROGRAM IN THE UNIVERSITIES
- SHORT AND LONG-TERM TRAINING FOR GOVERNMENT SPECIALISTS

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

THANK YOU FOR YOUR ATTENTION

EMAIL: zolzayamust@gmail.com
dh.undraa@gmail.com

XII Government building, Khoroo 4, Chingeltei district, Ulaanbaatar, Mongolia

976 - 51 - 260203

info@gazar.gov.mn

ГАЗАР ЗОХИОН БАЙГУУЛАЛТ, ГЕОДЕЗИ, ЗУРАГ ЗҮЙН ЕРӨНХИЙ ГАЗАР

www.gazar.gov.mn

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - SAMOA

Petania Tuala

Geodesy in SAMOA

Petania Tuala - Principal Surveyor, Spatial Information Agency

MINISTRY OF LANDS AND SURVEY

MATAGALUEGA O ELEELE MA FUAGAFANUA
MINISTRY OF LANDS AND SURVEY
info@mls.gov.ws www.mls.gov.ws +685 -24881 | 24882 |24883 P.O. Box 845
Please address all correspondences to the Chief Executive Officer

FAAVAE ILE ATUA SAMOA
Government of Samoa

Why Geodesy Matters for Samoa

1. **Samoa Geodetic Reference System** – upgrade of Horizontal and Vertical Geodetic Control Network
2. **Land Administration and Cadastral Survey** - accurate boundary survey and land registration
3. **National Mapping -** topographic maps of Samoa
4. **Infrastructure Development** - construction of road, seawall, bridges
5. **Disaster Management** - disaster risk reduction and emergency responses
6. **Climate Change Resilience** - sea level rise monitoring

The State of Geodesy in Samoa

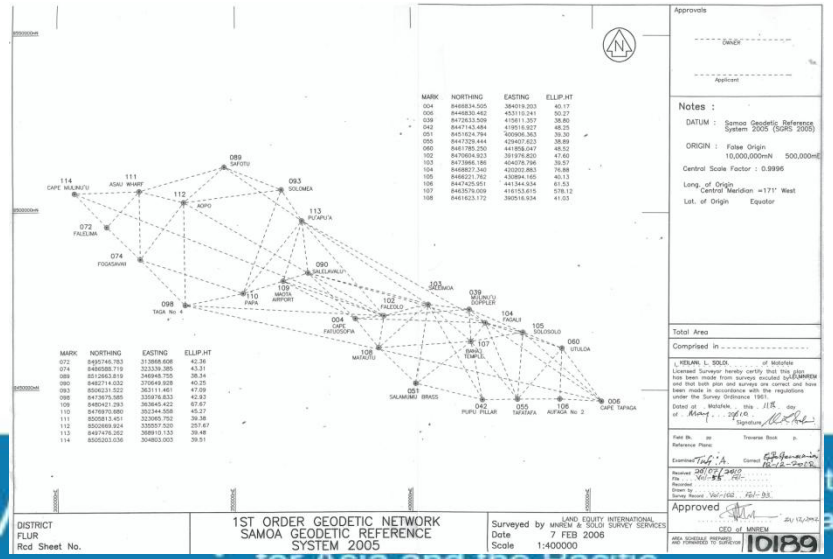
1. One CORS Station - Geoscience Australia
2. International Terrestrial Reference Frame 2000
3. Outdated Horizontal and Vertical Control – need upgrade
4. Outdate topographic map – need upgrade
5. No geoid model – precise elevation
6. Funding constrain – equipment's and infrastructure

The Samoan Geodetic Reference System

Horizontal Datum	Samoa Geodetic Reference System 2005 (SGRS2005)	
Reference Frame	International Terrestrial Reference Frame 2000 (ITRF2000)	
Epoch	2016.0	
Ellipsoid	GRS80	
Semi-major axis (a)	6,378,137.0 metres	
Inverse flattening (1/f)	298.257222101	

Reference Frame - The Samoa Geodetic Reference System 2005 is realised by the coordinates of the following high precision fundamental geodetic stations referred to the GRS80 ellipsoid determined within the International Terrestrial Reference Frame 2000 (ITRF2000) at the epoch of 2016.0.

102 – Faleolo CGPS	Latitude	S 13° 49' 55.95916"
	Longitude	W 171° 59' 58.32189"
	Ellipsoidal Ht	47.600m
104 – Fagalii CGPS	Latitude	S 13° 50' 57.14900"
	Longitude	W171° 44' 18.34120"
	Ellipsoidal Ht	76.875m



What's Next / Call to Action

1. Government support
2. Establish new CORS stations around Samoa islands
3. Control Centre for geodetic data
4. Capacity Building – technical training
5. Policy Support – develop a national geodetic data policy
6. Funding support – CORS station (equipment's, site conditions and operational requirements)
7. Regional coordination

Fa’afetai lava \ Thank You

1. Ulugia Petelo Kavesi – CEO, Ministry of Lands and Survey (MLS)
Email: p.kavesi@mls.gov.ws

2. Asi Peleiupu Fuatai – ACEO, Spatial Information Agency, MLS
Email: p.fuatai@mls.gov.ws

3. Petania Tuala – Principal Surveyor, Spatial Information Agency, MLS
Email: p.tuala@mls.gov.ws

MATAGALUEGA O ELEELE MA FUAGAFANUA
MINISTRY OF LANDS AND SURVEY

info@mls.gov.ws www.mls.gov.ws +685 -24881 | 24882 |24883 P.O. Box 845

*Please address all correspondences to the Chief Executive Officer

UN-GGCE Geodesy Capacity Development Workshop for Asia-Pacific
on Transitioning to a Modern Geospatial Reference System
June 30th – July 4th, 2025 @UNCC, Bangkok, Thailand

A Part of Geodesy in Thailand

Presenters:

- **Koichiro Sugiyama**, Nattawit Chanwedchasart, Chayanin Larkaew, et al., on behalf of NARIT
- Prof. Chalermchon Satirapod et al., on behalf of Chulalongkorn Univ.

- **Kapil Kativar**, et al., on behalf of Trimble Inc.

VGOS

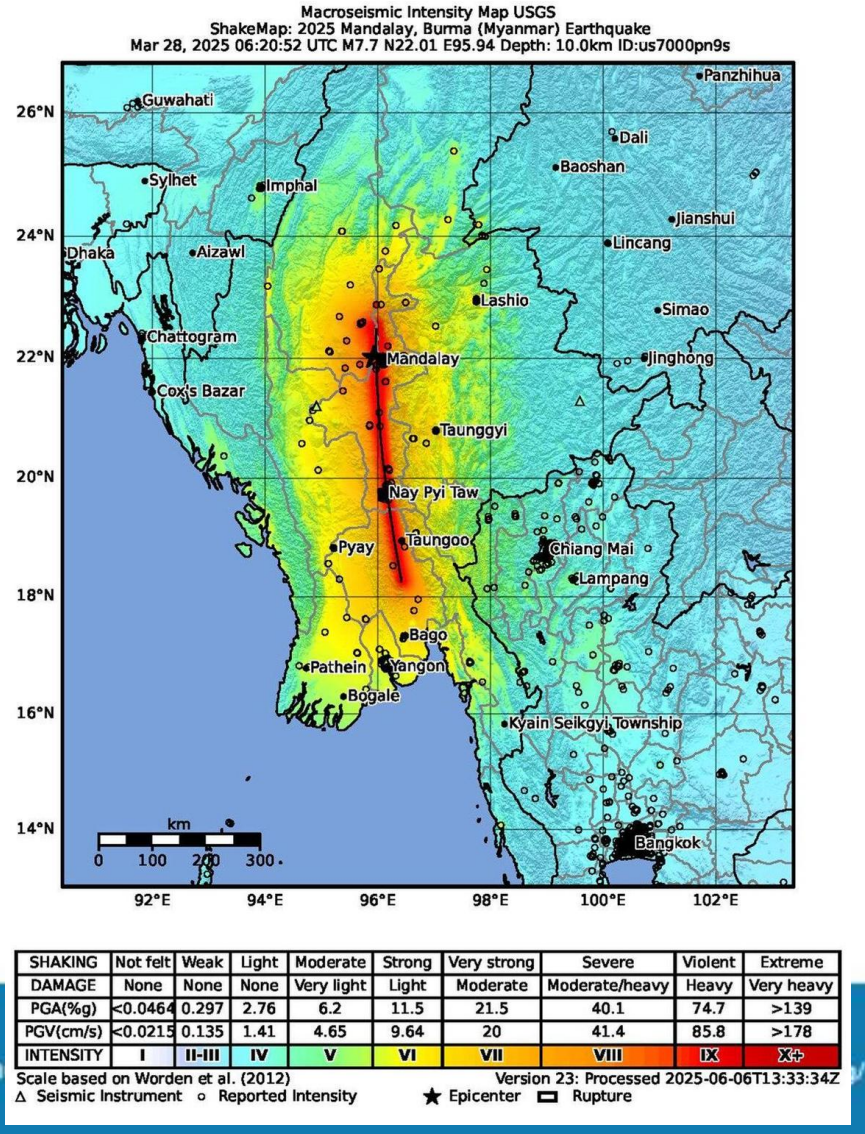
TNRT

IVS Network Station
Credit: IVS-HP, https://ivscc.gsfc.nasa.gov/stations/ns-map.html

Why Geodesy Matters

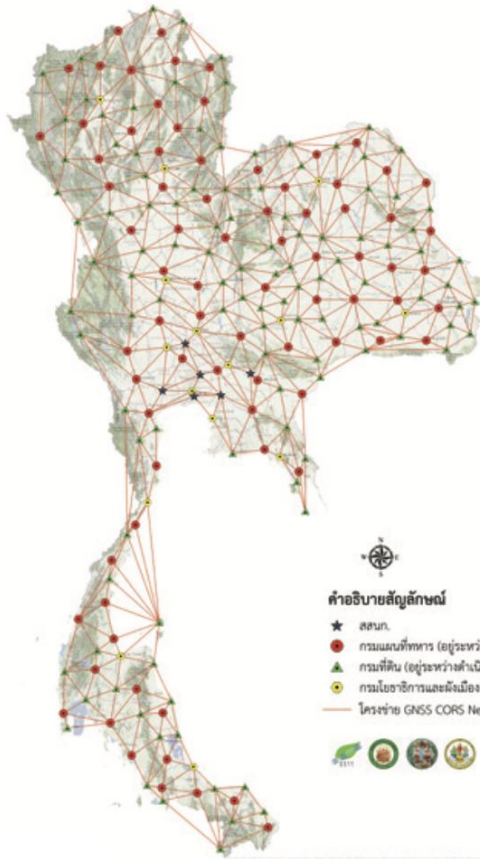
The Royal Thai Survey Department (RTSD) is central to,

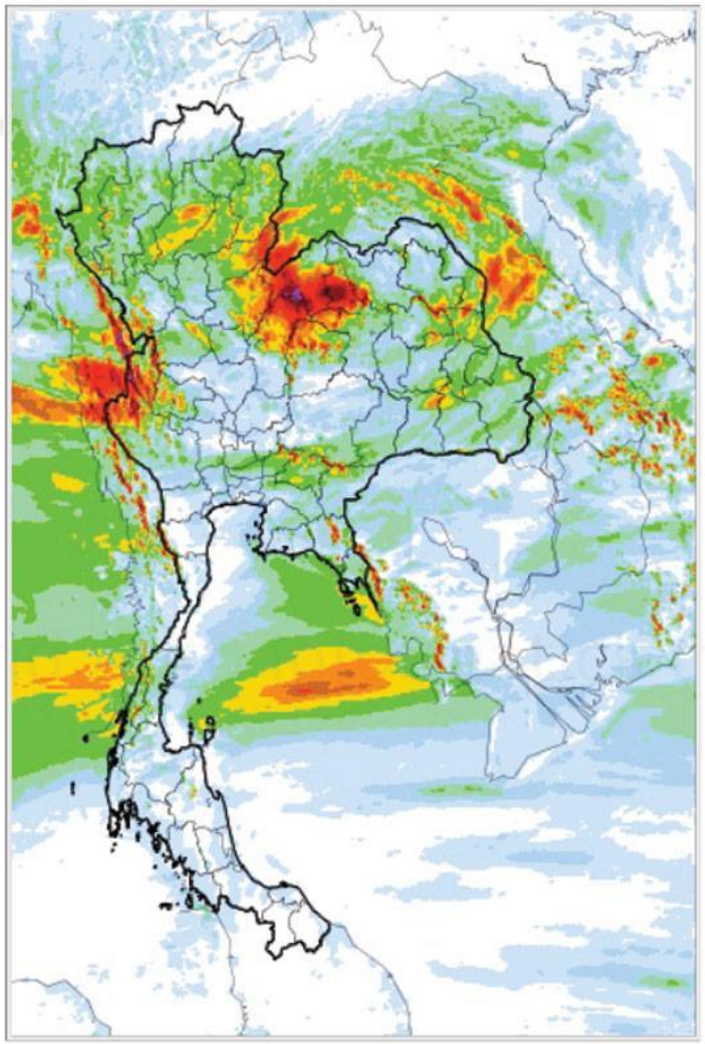
- Enabling Accurate Mapping and Land Management
- Disaster Preparedness and Mitigation
- Infrastructure Development and Engineering
- Scientific Research and Environmental Monitoring
- Enhanced Data Sharing and Integration



Earthquake shakemap on March 28, 2025: M7.7 in Mandalay, Myanmer ©Wikipedia, provided by USGS

The State of Geodesy





- Established CORS (Continuously Operating Reference Stations of various government agencies across the country)
  - Network of permanent, ground-based stations equipped with GNSS
- National CORS Data Center
  - Provide services by integrating data from CORS,
    1. Network Real Time Kinematics surveying
    2. Satellite data service for continuous navigation of the coordinate reference station
    3. Post processing service
- By-product: Applied for water volume and humidity calculations, supporting the weather and flood forecasting models

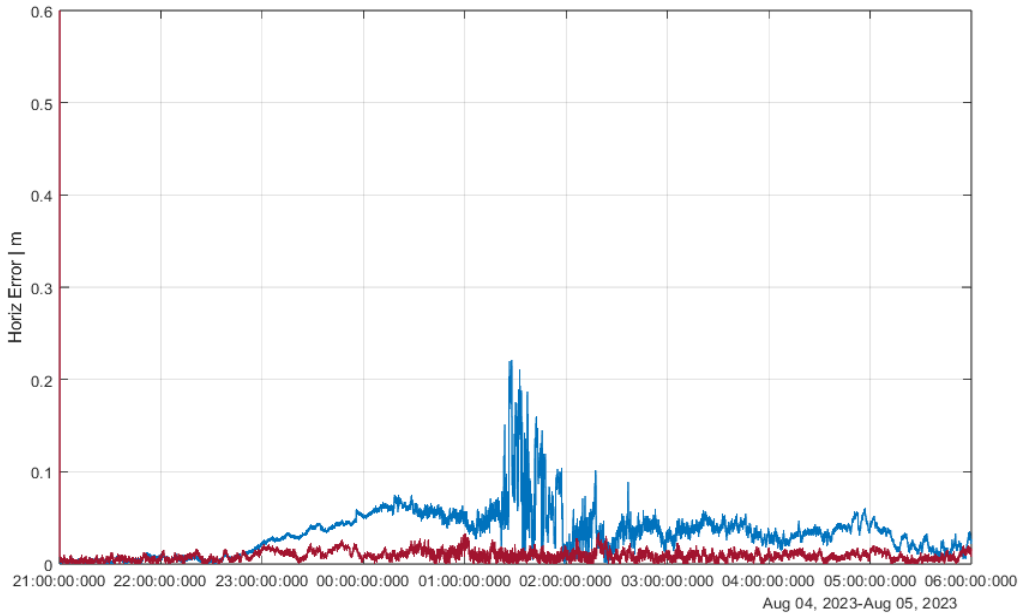
GNSS CORS Network

Slide Credit: Kapil Katiyar (Trimble Inc.)

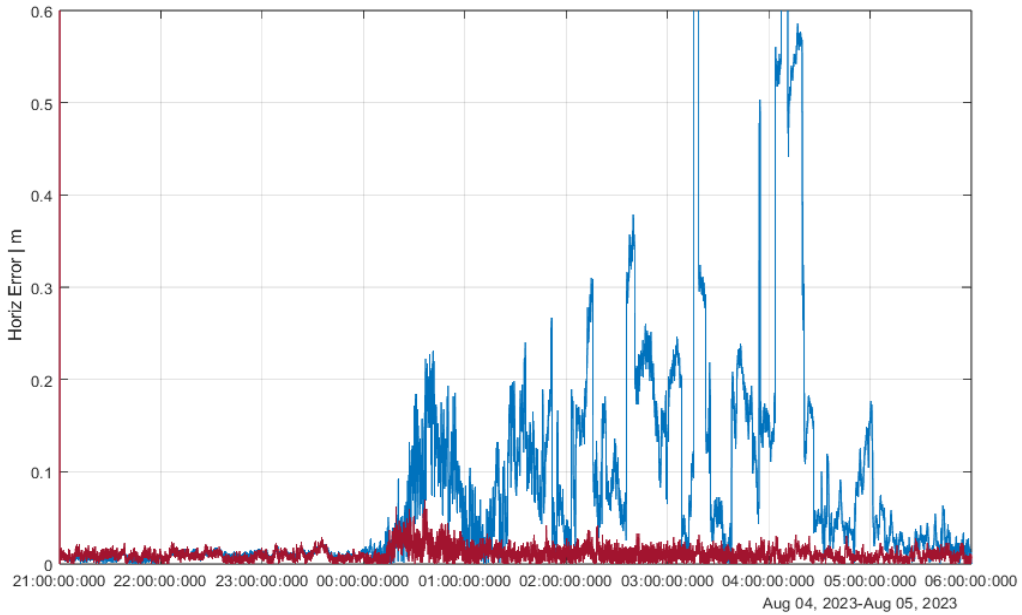
Trimble IonoGuard™ in Alloy

Examples (single-base)

Brazil



Peru



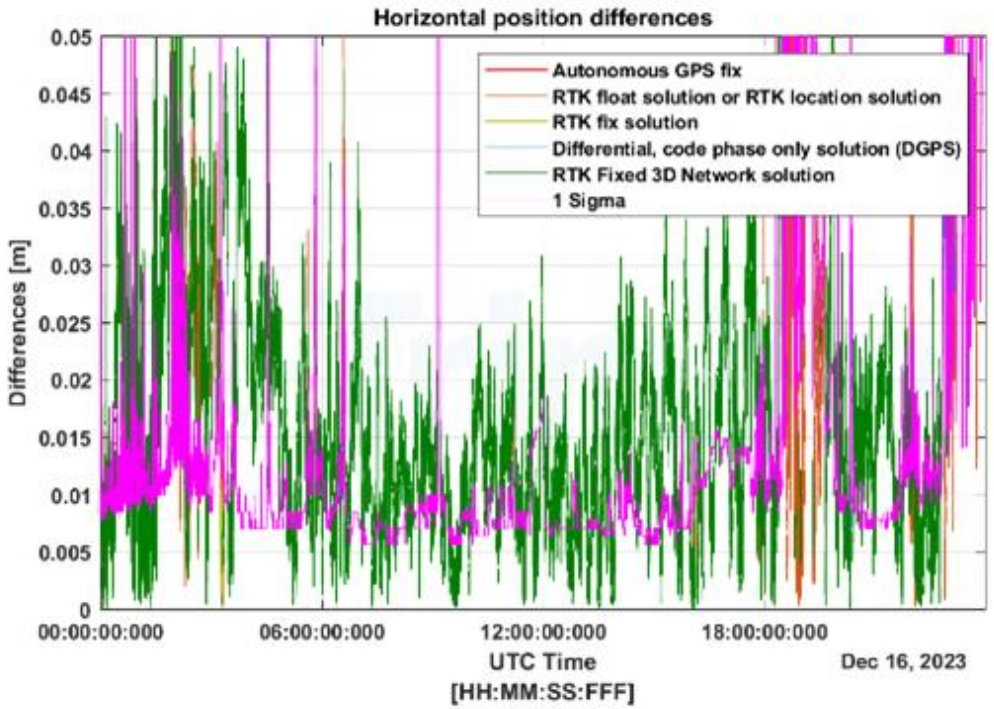
Horizontal position error with **IonoGuard™ enabled**
IonoGuard™ **disabled**

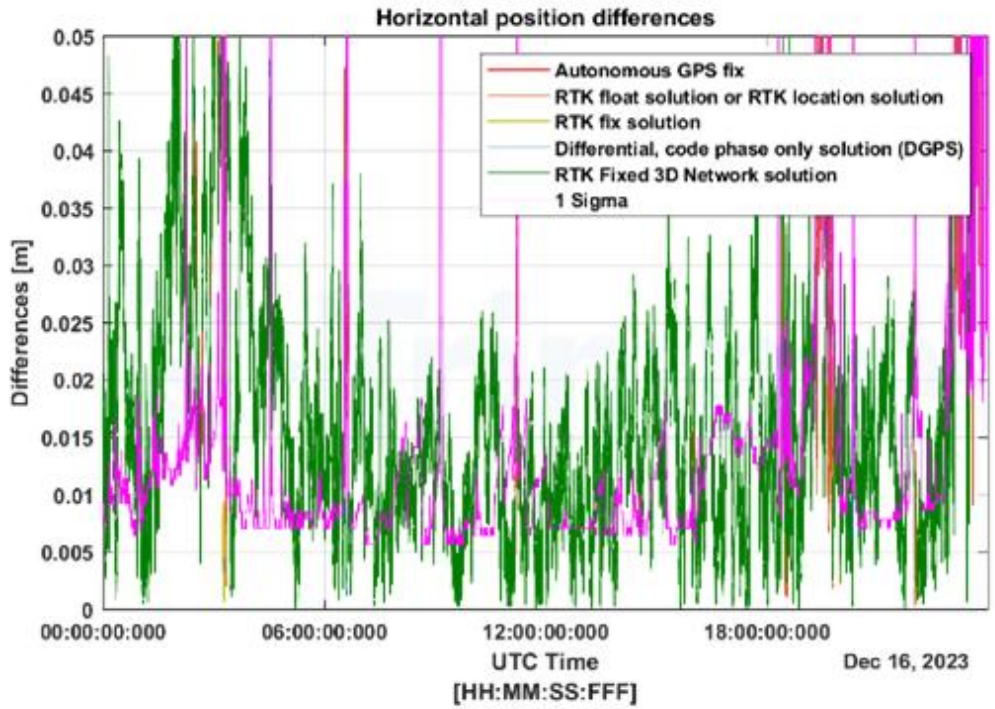
Slide Credit: Kapil Katiyar (Trimble Inc.)

Trimble IonoGuard™ in Pivot

Test results during high iono activity (in Brazil) - Dec. 16, 2023

- 95% horizontal: 0.102m (IonoGuard **disabled**) / 0.047m (IonoGuard **enabled**)





Thai National Radio Astronomy Observatory

Thailand © NordNordWest in Wikipedia

- 40 km away toward NE from NARIT head quarters
- Site is a part of Huai Hong Khrai Royal Development Study Center
- Radio Quiet Zone: less RFI, & Relatively lower water vapor area

Image credit: P. Jaroenjittichai & TNRO/CROE members (NARIT)

The 40 m Thai National Radio Telescope (TNRT)

since 2022~

L-band
(1.0-1.8 GHz)

K-band
(18-26.5 GHz)

Gundolf
©LinkedIn

© D. Singwong

"Upgraded" version of IGN's Yebes 40-m Radio Telescope

With Prime-Focus Tetrapod Head Unit (THU)

0.3 – 115 GHz : **P/L/C/X/Ku/K/Q/W**-bands

150 um (rms) total surface accuracy

Pointing: 2" (no wind), 6" (5 m/s wind)

Beam size: 13.4 arcsec – 1.43 degree

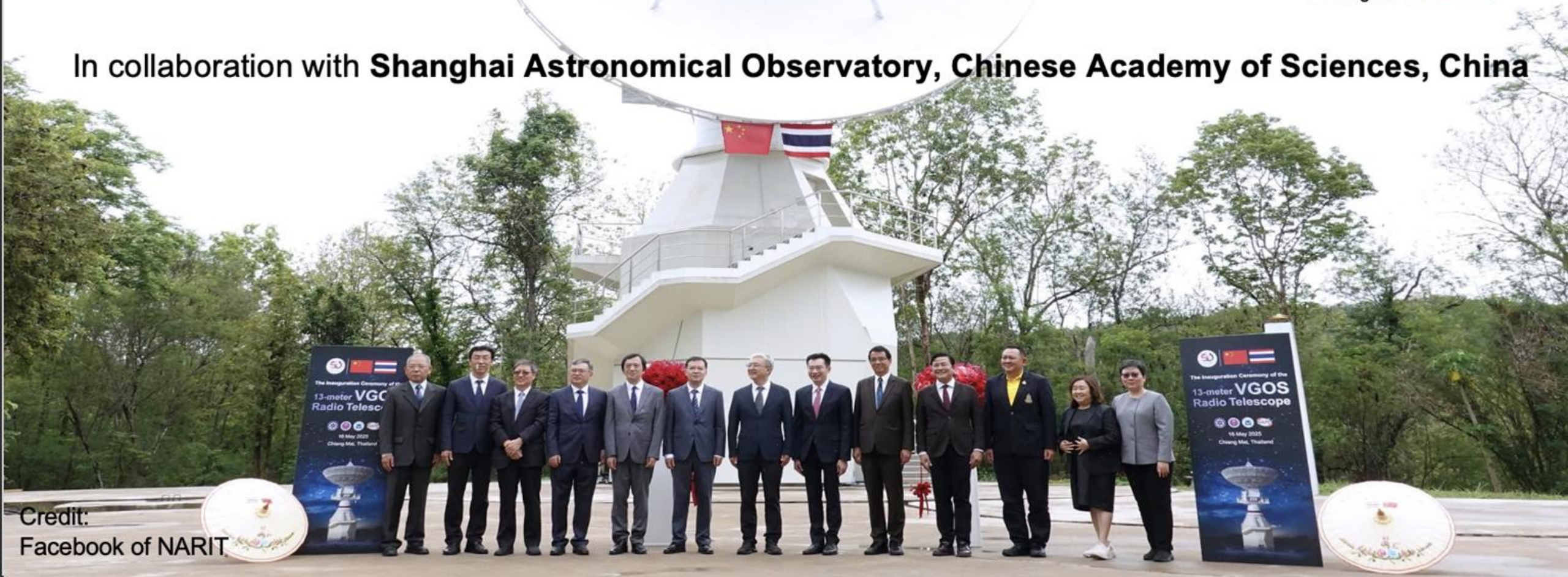
Slew: AZ 3 deg/s, EL 1 deg/s

YEBES

Grand Opening of VLBI Global Observing System (VGOS) telescope in Chiang Mai, on **16 May 2025!!**

Apichat Leckngam

In collaboration with **Shanghai Astronomical Observatory, Chinese Academy of Sciences, China**



Credit:
Facebook of NARIT

Contribution to The International VLBI Service for Geodesy and Astrometry (IVS) as the first stations in SE Asia

Ny Alesund
Onsala
Svetloe
Effelsberg
Wettzell
Medicina
Simeiz
Zelenchukskaya
Matera
Madrid
Yebes
Noto
Azores
Canary
Badary
Changchun
Nanshan
Tsukuba
Sejong
Seshan
Mizusawa
Kashima34
Kashima 11
Koganei
Brewster
Hancock
North Liberty
Westford
Owens Valley
Los Alamos
Goldstone
Pie Town
Kitt Peak
Greenbelt
Fort Davis
Kokee Park
Mauna Kea
St. Croix
Fortaleza
Concepción
O'Higgins
Syowa
Katherine
Parkes
Warkworth
Tidbinbilla
Hobart

VGOS

TNRT

IVS Site
Cooperating VLBI Site
Future IVS Site

IVS Network Station
Credit: IVS-HP, https://ivscc.gsfc.nasa.gov/stations/ns-map.html

แผนดำเนินการติดตั้งกล้องโทรทรรศน์วิทยุแบบวีกอสในประเทศไทย
Thai VLBI Network (TVN) , Phase 1

กล้องโทรทรรศน์วิทยุแห่งชาติ

Thai National Radio Telescope (TNRT)

ขนาดเส้นผ่านศูนย์กลาง 40 เมตร

รับสัญญาณได้ในช่วงความถี่ 0.3 - 115 GHz

MoU Signing Walailak Univ. - NARIT, 2 Sep 2024
Constructing the Nakhon Si Thammarat station.

VGOS telescopes

เชียงใหม่ **Chiang Mai**

ที่ตั้ง: หอสังเกตการณ์ดาราศาสตร์วิทยุแห่งชาติ
ภายในศูนย์ศึกษาการพัฒนาห้วยฮ่องไคร้
อันเนื่องมาจากพระราชดำริ
อ. ดอยสะเก็ด จ. เชียงใหม่

Nakhon Si Thammarat

นครศรีธรรมราช

ที่ตั้ง: มหาวิทยาลัยวลัยลักษณ์
ต. ไทยบุรี อ. ท่าศาลา จ. นครศรีธรรมราช

Songkhla

สงขลา

ที่ตั้ง: หอดูดาวเฉลิมพระเกียรติ
7 รอบ พระชนมพรรษา สงขลา
ต. เขารูปช้าง อ. เมืองสงขลา จ. สงขลา
มีกำหนดติดตั้งกล้องในเดือนธันวาคม 2568

Slide Credit: Division of Public Relations, & Executive Director Saran Poshyachinda, NARIT.

Acknowledgement

Koichiro Sugiyama, Manager of Center for Radio Astronomy and Engineering, koichiro.sugiyama.th@gmail.com; koichiro@narit.or.th

Kapil Katiyar, Regional Sales Manager for Southeast Asia, kapil_katiyar@trimble.com

विज्ञान एवं प्रौद्योगिकी विभाग
DEPARTMENT OF
SCIENCE & TECHNOLOGY

GEODESY IN INDIA

Upkar Pathak

Superintending Surveyor

Survey of India

Why Geodesy Matters

- Vast expanse with varying topography
- Navigation
- Disaster risk reduction
- Infrastructure projects
- Sea-level monitoring
- Climate change

The State of Geodesy

- Infrastructure:
  - Horizontal Reference Frame: CORS Network, GCPs
  - Vertical Reference Frame: (Levelling >225,000 km)
  - Gravity: Geoid models developed regionally by SoI
  - Tidal: 36 Tidal observatories
  - 1 Magnetic Observatory

The State of Geodesy

Key Achievement in the past few years:

- Establishment of network: 1045 CORS.
- Modernization of 6 Tidal Observatories.
- Levelling more than 0.25M KM
- Geoid: 10 States of India

Challenge/Gap:

- Reliability of CORS Network: Urban & Hilly Region
- Gravity stations at high altitudes and islands
- Uniform National Geoid

Way Ahead

- Strengthening of National Geodetic Infrastructure under the National Geospatial Mission, incl VLBI, DORIS & SLR.
- Densification of CORS Network.
- Upgradation of 6 CORS into IGS for contribution to ITRF.
- Integration of CORS installed by different agencies into a single National Network.
- National Gravity Campaign.
- Modernization of all conventional tidal observatories.
- Capacity building.

विज्ञान एवं प्रौद्योगिकी विभाग
DEPARTMENT OF
SCIENCE & TECHNOLOGY

Thank You..!!

surveyofindia

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india_soi

Contact us at:

0135-2744064

sgi.soi@gov.in | sgo.technical.soi@gov.in

www.surveyofindia.gov.in

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country report

Survey Department
NEPAL

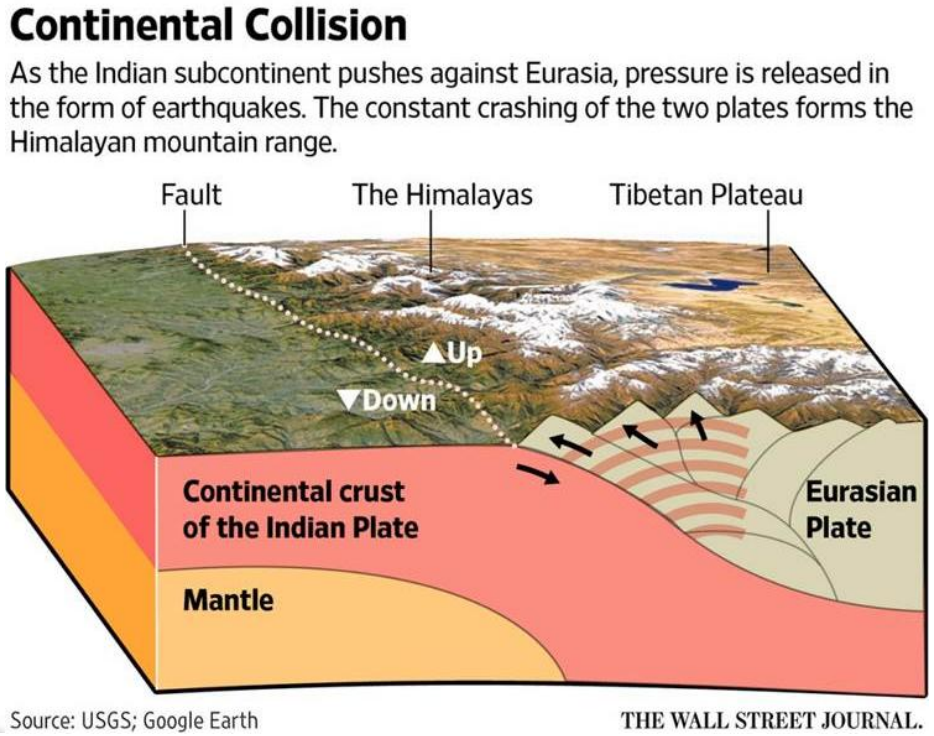
Title Slide

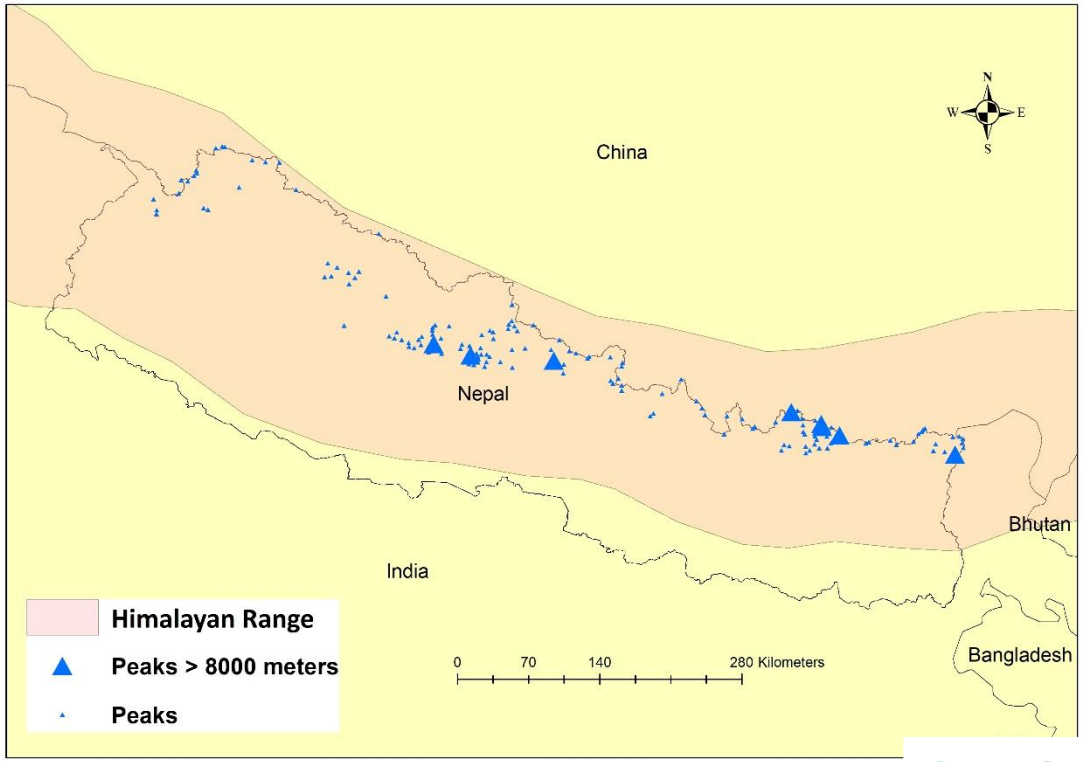
WHERE?

WHO?

Geodesy in NEPAL

Nepal – A country of converging tectonic plates





Why Geodesy Matters ?

WHY?

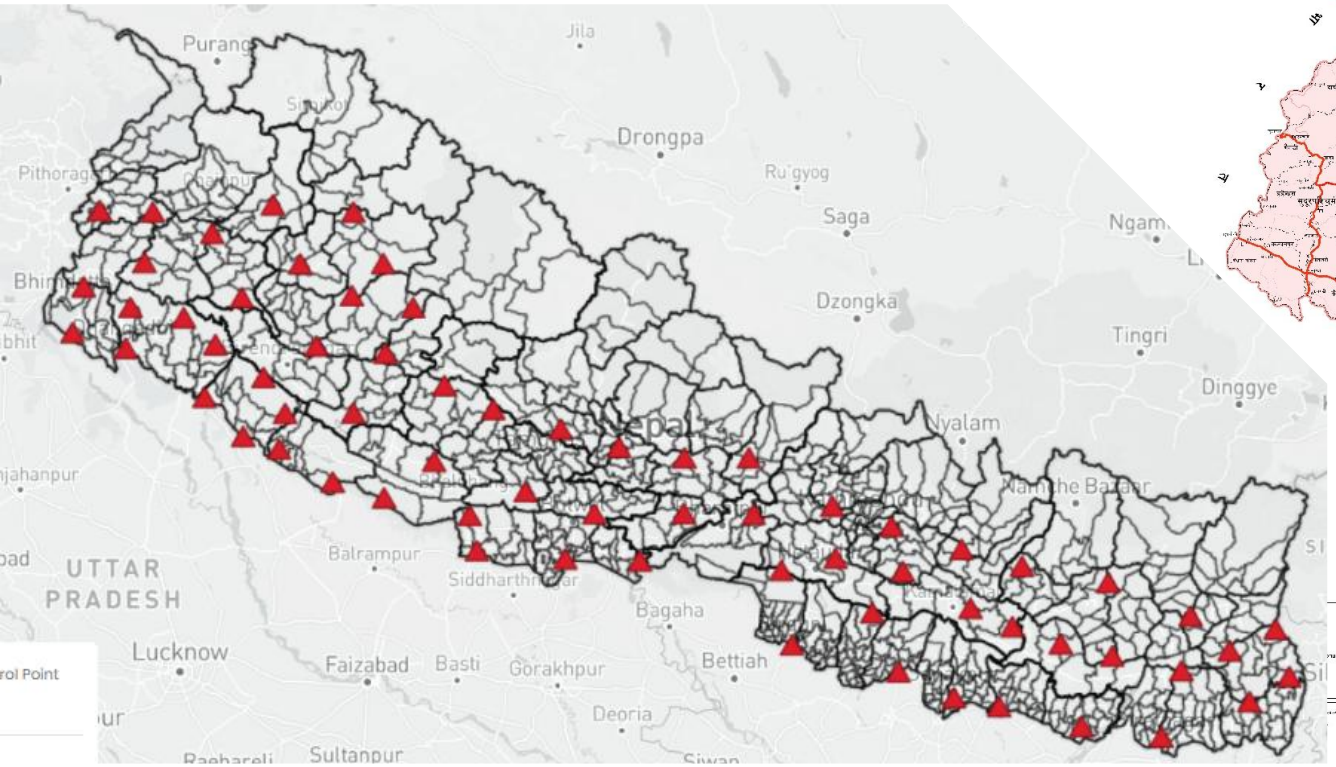
HOW?

- All kind of Surveying and Mapping are based on Geodetic Control Network
- Nepal's classical National Datum is based on local ellipsoid which is not interoperable with modern state of art surveying technique like LiDAR and UAVs etc.
- Modern Surveying techniques like GNSS is not directly compatible with our classical datum which has led to ineffectiveness in control survey of Land Commission works

State of Geodesy in Nepal

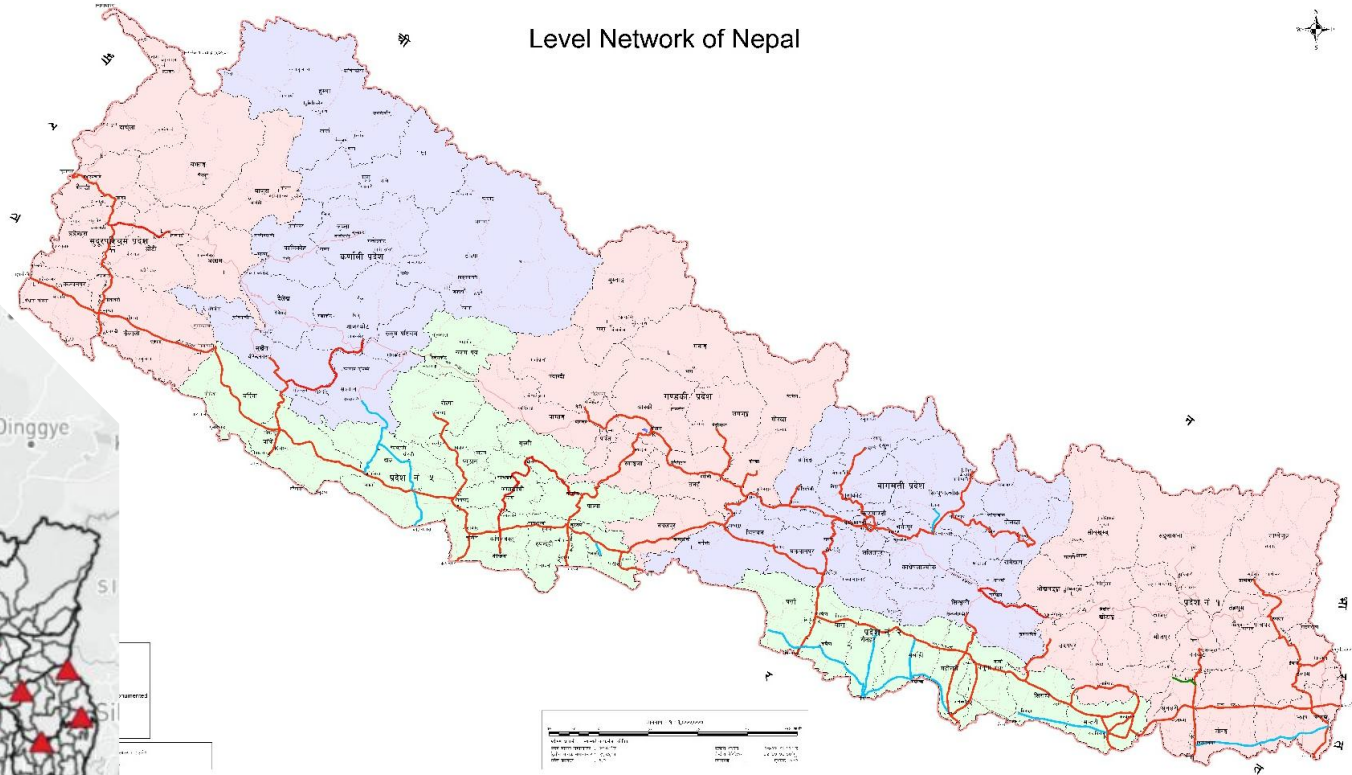
HOW?

Horizontal Reference Frame



- 68 First Order Control Stations were established across Nepal, spanning its east-west extension.
- This rigorous framework served as the foundation for national-scale surveying and mapping activities.

Vertical Reference Frame



- Nepal is not connected to the sea, so in collaboration with Government of India height were transferred to 8 stations along-side Nepal- India border.
- Approximately 8000 km of levelling network is established till date.

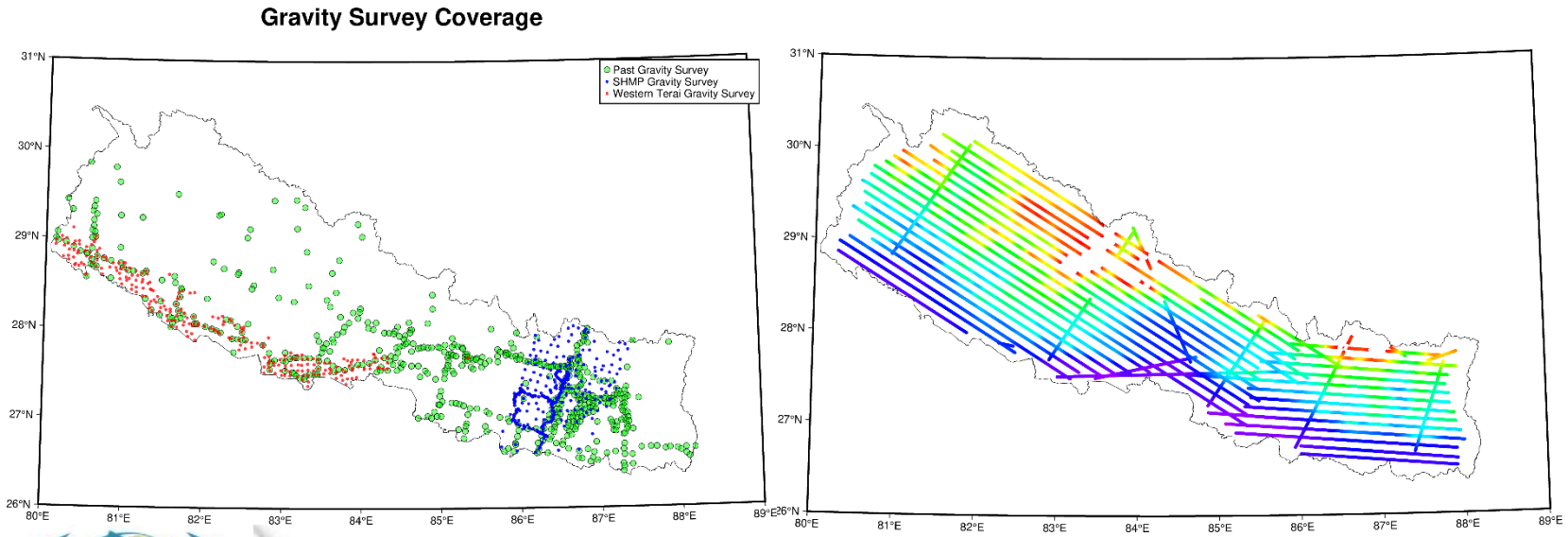
State of Geodesy in Nepal

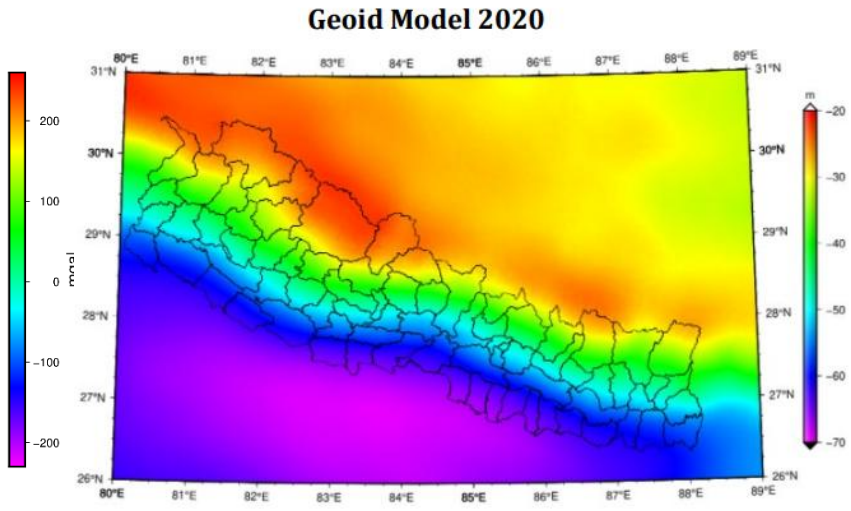
HOW?

Gravity Network and Geoid Model

- Surface Gravity Points, around 750 till date
- Airborne gravity, 2010

Partner Agency	Work	Product	Accuracy	Purpose
SD, DTU, NGA, USA	Airborne gravity survey	NPG2011	10-20cm RMSE 3.3mgal	Gravity data for global gravity models (EGM2020)

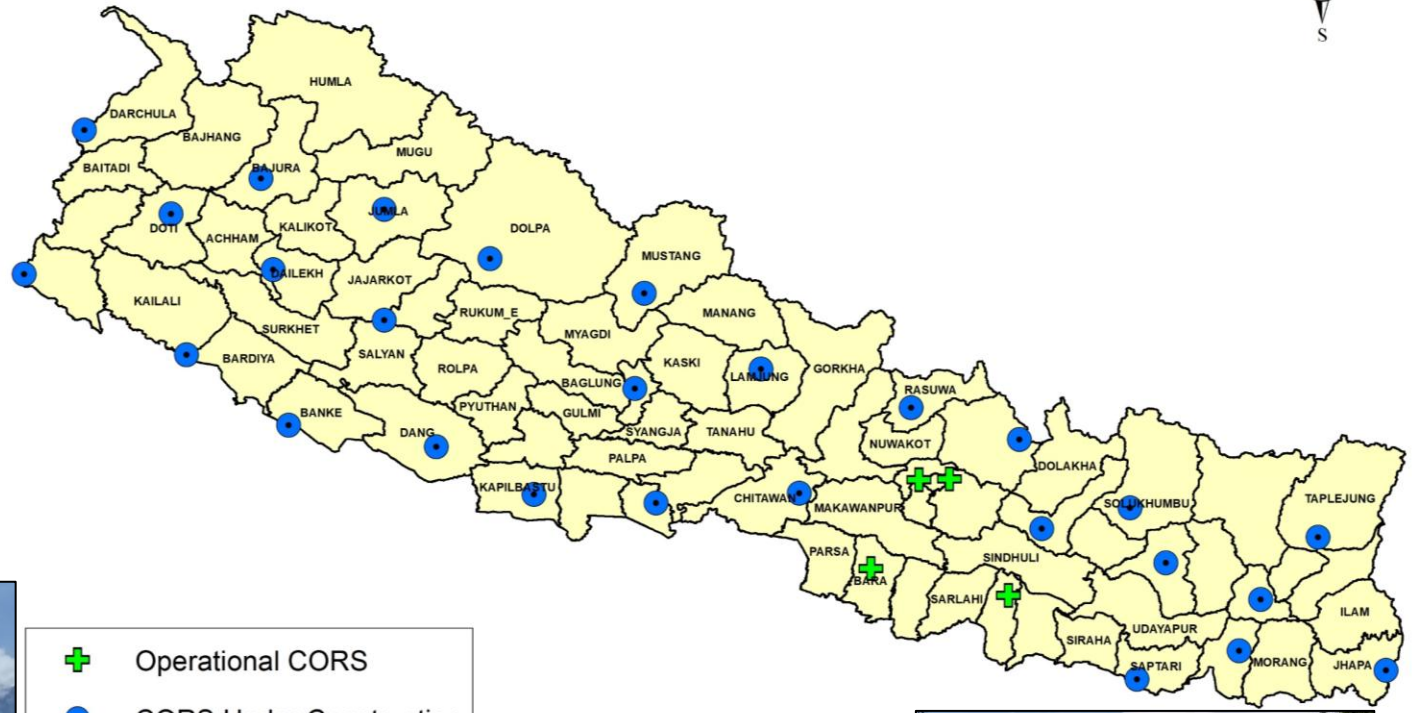




What's Next / Call to Action

WHAT?

- Nepal Datum Modernization
- Network of CORS with 31 stations covering whole Nepal
- 4 CORS running, 27 in pipeline



What's Next / Call to Action

WHAT?

- **Capacity development** is required for implementing new national datum based on Global TRF.
- **Regional Coordination and Guided Expertise** is required for effective implementation
- **International Aid/Technical Suppport**

Thank You

Survey Department, Nepal
geodetic@dos.gov.np

Mahesh Thapa (mahesh.thapa@nepal.gov.np)
Dipesh Suwal (dipesh.suwal@nepal.gov.np)
Sandesh Upadhyaya (sandesh.upadhyaya@nepal.gov.np)
Binita Shahi (shahiii.binita@gmail.com)