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BRUNEI DARUSSALAM

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Geodetic Control Network / Continuously Operating Reference Station (CORS) in Brunei Darussalam

Act. Surveyor General
Survey Department, Ministry of Development
Brunei Darussalam



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Presentation Outline

- Introduction
- History of Satellite Survey at Survey Department
- The new Geocentric Datum & CORS infrastructure in Brunei Darussalam
- Brunei CORS service
- Activities and Contribution
- Way Forward
- Concluding Remarks



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Introduction

- Brunei Darussalam has a total area of 5,765 sq.km
- Population is estimated 411,000 people with a growth rate of 1.9%.
- Oil and gas industries are the major contributor to the national economy.
- A new geocentric datum for Brunei Darussalam 2009 (GDBD2009) was established using GPS space geodetic technology based on the ITRF2005 reference frame.
- The GDBD2009 is related to ITRF2005 through the inclusion of the 8 GPS stations of the Brunei Darussalam Zero Order Network and have been processed together with more than fifty IGS stations around the world.



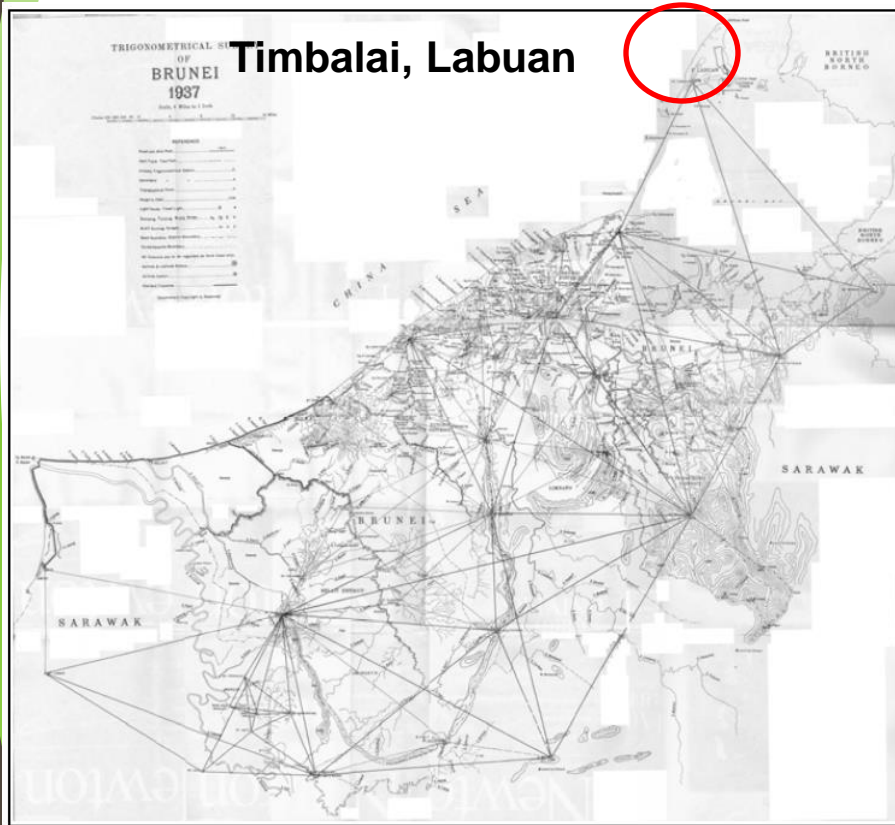
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History of Geodetic Control Survey

Borneo Triangulation 1948 (BT48)



1934 to 1937 : The original survey by Directorate of Colonial Surveys (DCS), Bridges 1937

In 1947: Readjustment of triangulation (including Sabah & Sarawak) was undertaken by the to establish a local geodetic reference system known as **Borneo Triangulation 1948 (BT48)**

This reference system had **its origin at Bukit Timbalai** and uses the **Modified Everest** as the reference ellipsoid.

Applicable for Northern Borneo



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Borneo Triangulation 1948 (BT48)

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Some of the Primary Triangulation Stations:(a) Bukit Agok; (b) Bukit Telingan; (c) Bukit Tunggulian; (d) Bukit Bedawan; (e) Bukit Sagan A; (f) Bukit Miri; (g) Bukit Lambir and, (h)Bukit Bub Rumah.



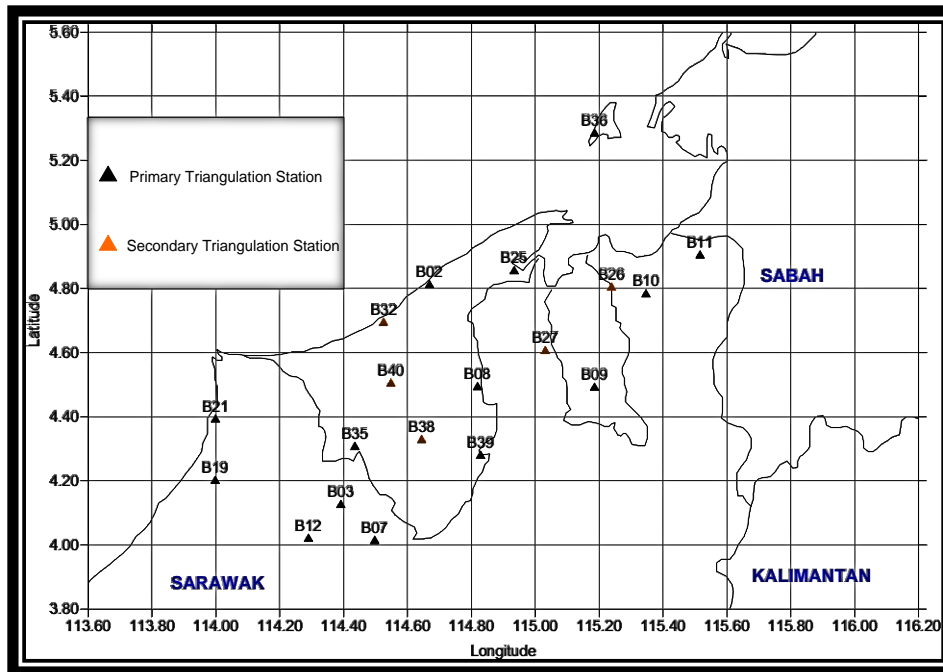
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2002 – 2003 : Establishment of new GPS network

- 2002 - 2003: GPS campaign was carried out on 17 stations which include some primary & secondary triangulation stations



(a) to establish a new GPS network, and monuments

(b) to analyze the existing geodetic network

(c) To determine the new **3 transformation parameters between WGS84 & BT48**



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The new Geocentric Datum & CORS infrastructure



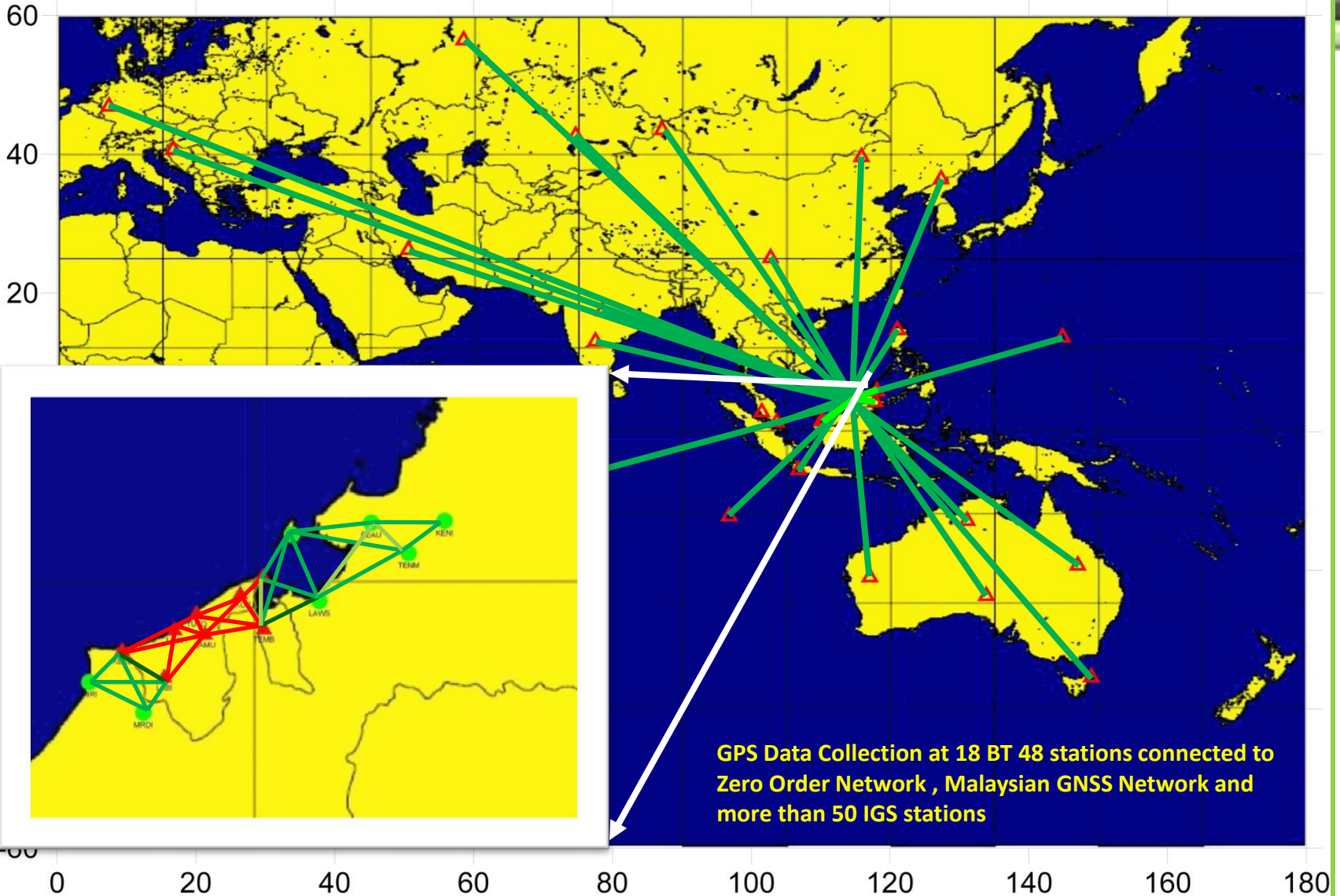
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2009: Establishment and Realization of GEOCENTRIC DATUM in Brunei Darussalam (GDBD2009)

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Results from establishments Brunei Geocentric Datum

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1. GDBD2009 coordinates for **18 stations** including 8 Brunei CORS stations

2. Computation of Transformation Parameters;

a. GDBD2009 to BT48 and Reverse Bursa-Wolf 7-Parameter

b. GDBD2009 to WGS84 and Reverse (3-Parameter)

c. WGS84 TO BT48 (Bursa-Wolf 7-Parameter)



| Parameter | Value |
|-----------|--------------|
| Dx | 689.59370 m |
| Dy | -623.84046 m |
| Dz | 65.93566 m |
| Rx | -0.02331" |
| Ry | 1.17094" |
| Rz | -0.80054" |
| Scale | -5.88536 ppm |

a

| Parameter | Value |
|-----------|-----------|
| Dx | 0.13513 m |
| Dy | 0.12670 m |
| Dz | 0.02497 m |

b

| Parameter | Value |
|-----------|-------------|
| Dx | 597.1257 m |
| Dy | -624.202 m |
| Dz | 2.1991 m |
| Rx | -1.45741" |
| Ry | -0.84837" |
| Rz | 1.79984" |
| Scale | -10.4358ppm |

c



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Brunei CORS service

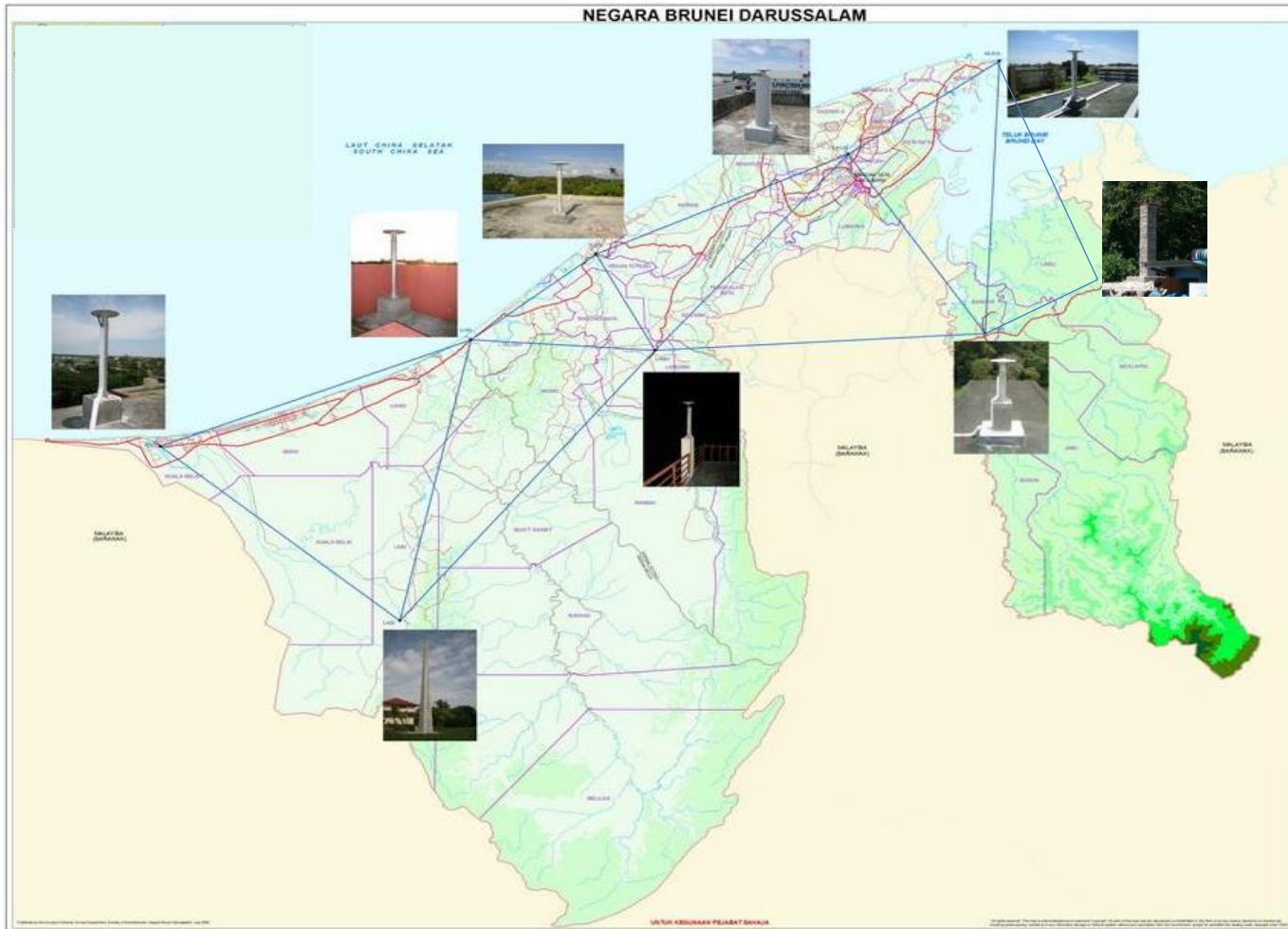


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Brunei Darussalam Zero order CORS network Infrastructure



**Nine (9) GNSS
CORS that form the
Zero Order
Network of Brunei
Darussalam are:**

- 1. KBEL**
- 2. LABI**
- 3. MURA**
- 4. LAMU**
- 5. LIAN**
- 6. TEMB**
- 7. TUTO**
- 8. UKUR**
- 9. LABU**

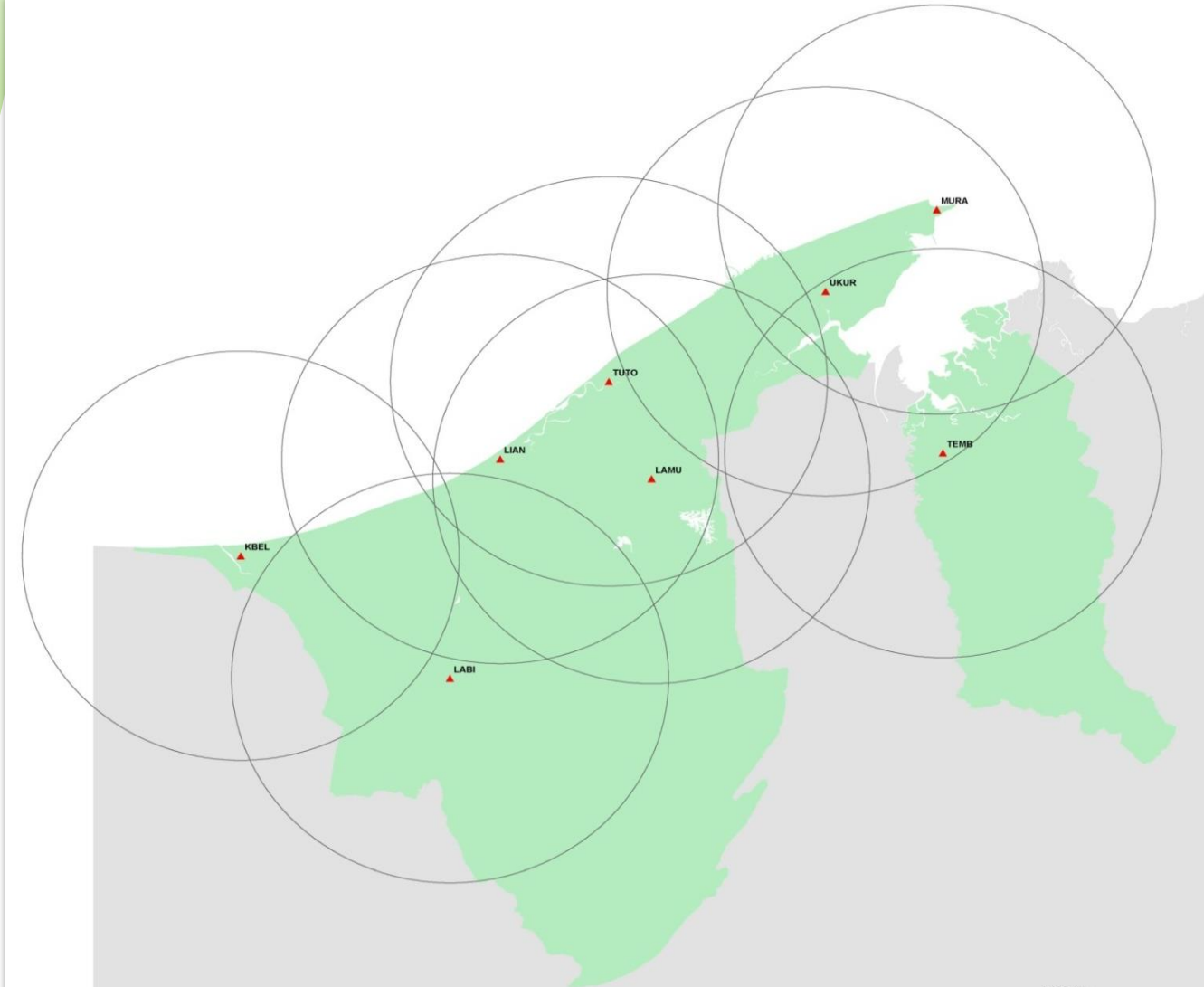


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The CORS Signal Coverage for RTK users



CORS signal
coverage
within 35 km
radius



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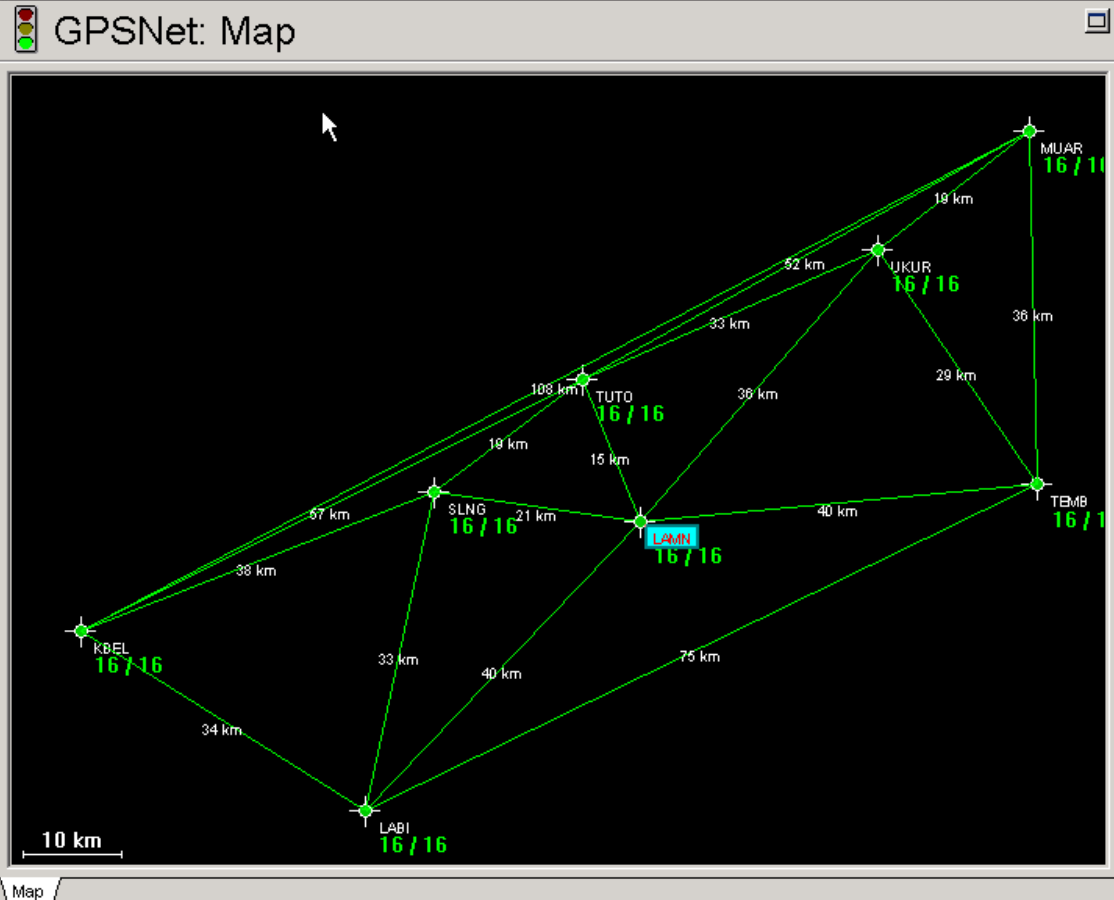
CORS Monitoring infrastructure

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Trimble RTKNet - [BSD150509]

File GPSNet View Help

- GPSNet
 - Almanac
 - Ephemeris
 - Receivers
 - TUTO
 - RINEX Storage
 - Storage Integrity
 - Raw Data Analysis
 - RTCM TUTO-RTCM23
 - RTCM TUTO-CMR
 - Single Point Position (SPP)
 - Split to TUTO_Raw_14000
 - TEMB
 - Raw Data Analysis
 - RTCM TEMB-RTCM23
 - RTCM TEMB-CMR
 - Single Point Position (SPP)
 - RINEX Storage
 - Storage Integrity
 - Split to TEMB_Raw_14001
 - UKUR
 - MURA
 - Raw Data Analysis
 - RTCM MURA_RTCM23
 - RTCM MURA_CMR
 - Single Point Position (SPP)
 - RINEX Storage
 - Storage Integrity
 - Split to MURA_Raw_14003
 - LAMU
 - KBEL
 - Raw Data Analysis



5/25/2009 6:01:37 AM Processor (RTKNet): 1533 79312.0 79312.0 GPS 26 orbit type predicted (was predicted) AODE 54 -> 69 orbit diff 2 m clk diff -1.34 m
 5/25/2009 6:01:40 AM Processor (RTKNet): 1533 79315.0 79315.0 GLN 19 orbit type predicted (was predicted) AODE 3 -> 5 orbit diff 4 m clk diff -46.69 m
 5/25/2009 6:01:40 AM Processor (RTKNet): 1533 79315.0 79315.0 GLN 06 orbit type predicted (was predicted) AODE 3 -> 5 orbit diff 5 m clk diff -31.84 m

Output



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- Data Availability
- The CORS data are available in RINEX 2.0 format.

With accuracies of 1 to 3 cm horizontally and 3 to 6 cm vertically

Data rate – Optional 0.1- 60 sec.

Data from the CORS are available in 24/7

The operational status of the CORS will be available on its webserver-

<http://202.160.30.98/>

Data download is made through Internet FTP only and need to be subscribe





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GNSS CORS NetWork Services and products

Current Pricing

| No | Types of Service | Price (BND) | Remarks |
|----|---------------------------|-------------|--|
| 1 | Virtual RINEX data | 50.00 | For 1 day, unlimited file size |
| 2 | Real Time Kinematic (RTK) | 1,000.00 | Annual fees, need to register to Survey Dept. |
| 3 | Real Time Kinematic (RTK) | 100.00 | Monthly fees, need to register to Survey Dept. |
| 4 | Fitted Geoid | 5.00 | For per station |



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RTK system provides the following levels of GNSS correction & data

a) VRS Correction

Within the limits of RTK network: provide RTK GNSS corrections with accuracies of **1 to 3 cm horizontally and 3 to 6 cm vertically**. Distance dependent errors are considerably minimised with utilisation of the RTK network

b) Single Base Real-Time Correction

This correction is provided for area within **30 km from the RTK single reference station with an accuracy of 1 to 3 cm horizontally and 3 to 6 cm vertically**.

c) Network Base DGPS Correction

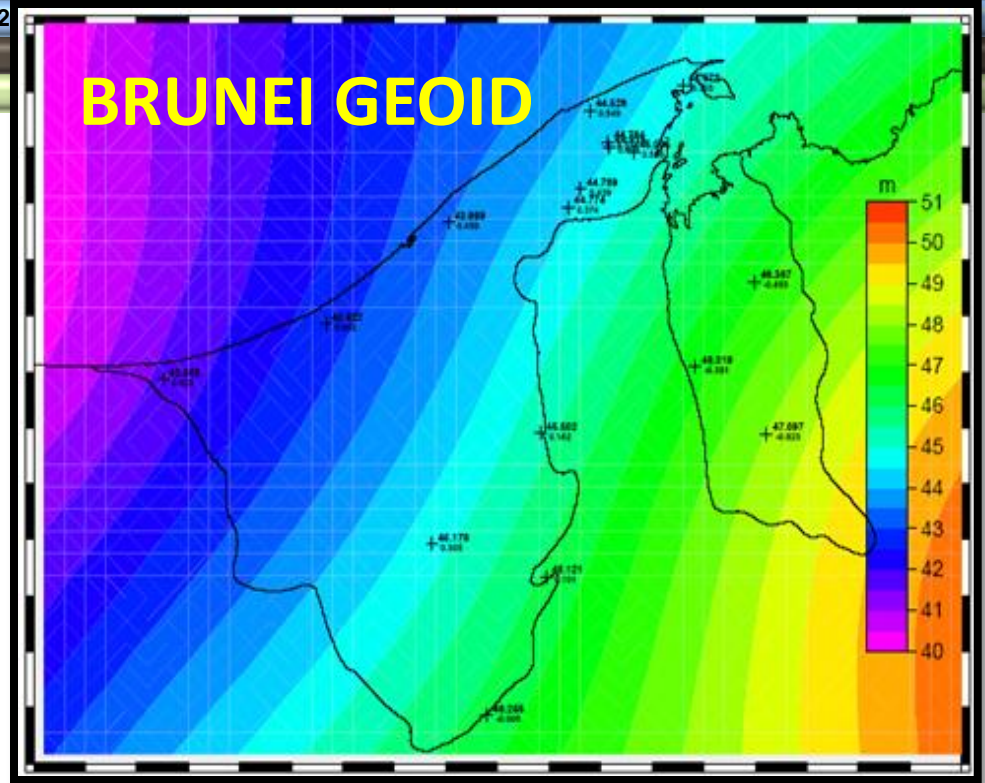
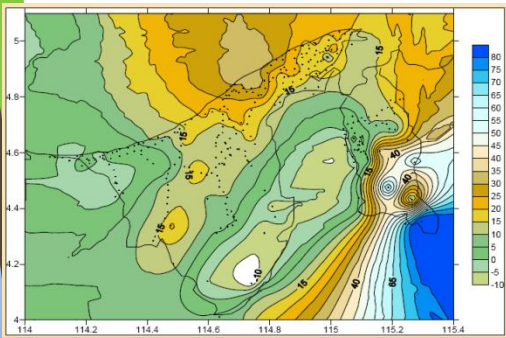
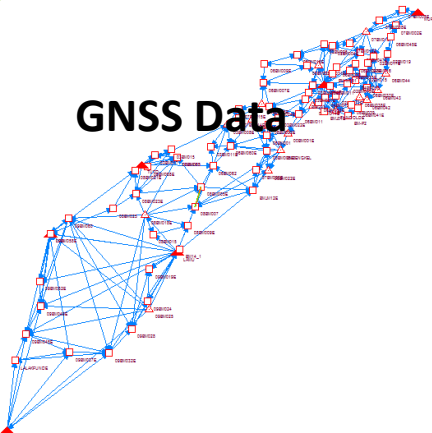
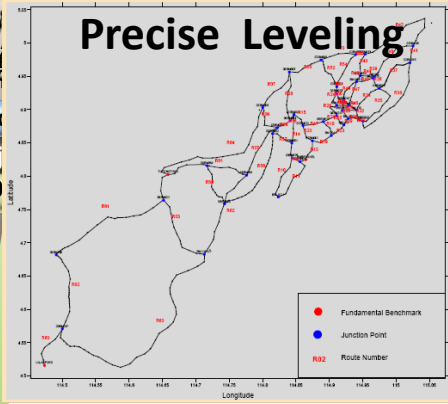
This correction provides better than **50 cm accuracy** for the whole of Brunei Darussalam.



Height Modernization System (HMS) Project in 2010

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Geoid Computation – Computation of Geoid for determination N value (Geoid height) are based on combination of Precise Levelling data, GNSS and Gravity data.

WEB BASE GEOID INTERPOLATION CALCULATOR



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BRUNEI FITTED GEOID INTERPOLATION CALCULATOR



Survey Department Brunei Darussalam

Home | Product Features | Welcome back GDK_KHALIQ | Personal page | Logout

Products

- Batch Points Calculation
- Single Point Calculation**

Information

- Contact us

Single Point Calculation

Please enter your coordinates:

Latitude: ° ' " (?)

Longitude: ° ' " (?)

Ellipsoidal Height: m

I agree with the terms and condition.

Process

Latitude: 4° 42' 38.5823" (4.7107)
Longitude: 115° 4' 22.9738" (115.0730)
Geoid height = 45.574m
MSL height = 19.607m

Ellipsoidal Height: 65.181m

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WAY FORWARD

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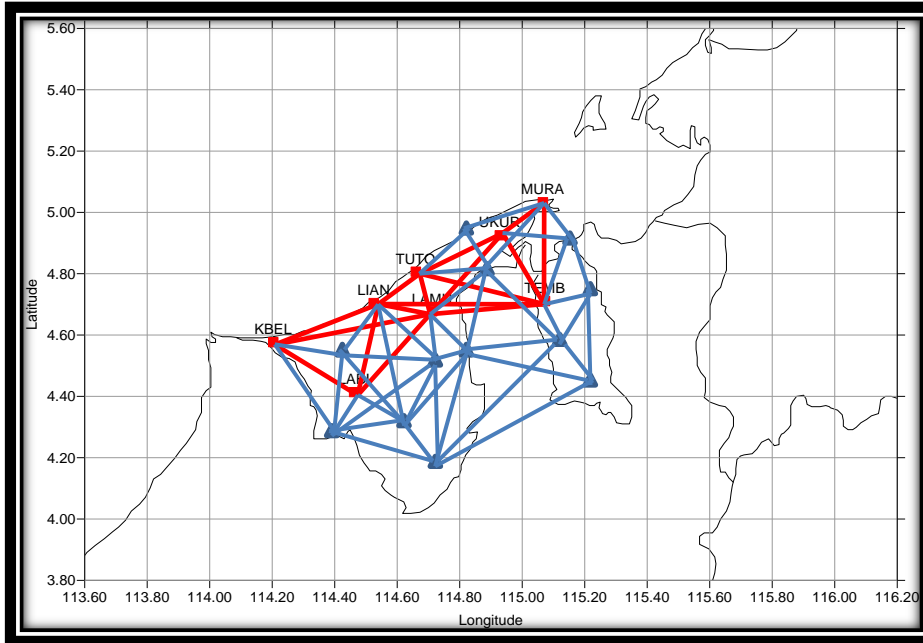
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- Future Brunei CORS Extension - 1 CORS per year till 2025
- Migration to One Government Network (OGN) – to avoid communication problem



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Regional Participation

- **ASIA – PACIFIC REFERENCE FRAME PROJECT**
(Campaign Date : 4/10 to 10/10 2009)
(Campaign Date : 12 to 18 Sept 2010)
(Campaign Date : 11 to 17 Sept 2011)
(Campaign Date : 06 to 13 Sept 2015)
(Campaign Date: 18 to 25 Sept 2016)



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challenges .

- **Require long term maintenance : enclosure to house power supplies, batteries, a computer and telecommunications equipment .**
- **Communication Problem (Internet Interruption) - Migrate to One Government Network (2016)**
- **Invites private sectors to work together with the Survey Department (PPP).**



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Conclusion

- Brunei GNSS- CORS is the current available infrastructure for application that require high level of positioning accuracy.
- GNSS CORS need to be utilized fully, to benefit local Government and Private Agencies
- GNSS education should be a better choice for Long Term Strategic Plan 2035 which include education, Economy, Security, Institutional development, Business development, Infrastructure and Environmental



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Thank You