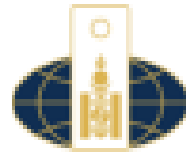
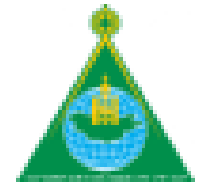




UNITED NATIONS
Office for Outer Space Affairs



МОНГОЛ УЛСЫН
ГАДААД ХАРИЛЦААНЫ ЯАМ



United Nations/Mongolia Workshop on the
Applications of Global Navigation Satellite Systems

GNSS NETWORK DEVELOPMENT IN MONGOLIA

MUNKHTSETSEG Dalkhaa

Head, Geodesy and Cartography division

AGENCY FOR LAND ADMINISTRATION AND MANAGEMENT,
GEODESY AND CARTOGRAPHY

Ulaanbaatar 25 October 2021

Улсын газар зүйн үйлчилгээний газар, Улаанбаатар, 2021 оны Октябер 25





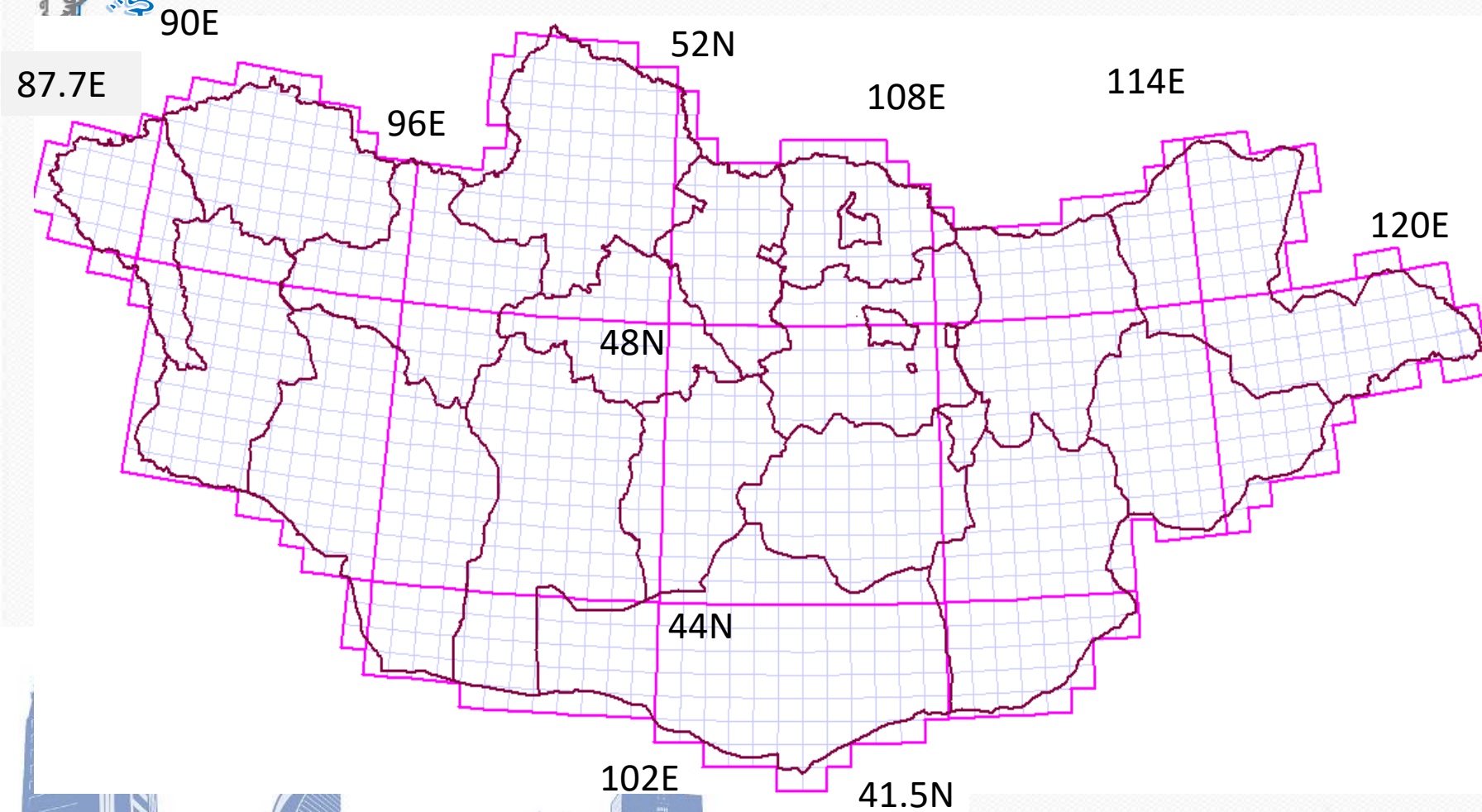
ᠮᠣᠩᠭᠣᠯ ᠤᠯᠤᠰ ᠶ᠋ᠢᠨ ᠭᠠᠰᠢ ᠬᠡᠷᠡᠭᠡᠵᠦᠯᠡᠭᠴᠢ ᠠᠭᠡᠨᠲᠤᠯᠠᠭ
ᠣᠬᠢᠨ ᠪᠠᠶᠢᠭᠦᠤᠯᠠᠯᠲᠤ, ᠭᠡᠣᠳᠡᠰᠢ, ᠵᠠᠷᠠᠭ ᠵᠢᠶᠢᠨ ᠭᠠᠰᠠᠷ

- 1 TRIANGULATION NETWORK
- 2 GNSS NETWORK
- 3 COORDINATE SYSTEM
- 4 GNSS NETWORK APPLICATION
- 5 FUTURE PLAN





6 DEGREES' ZONE - 5.5



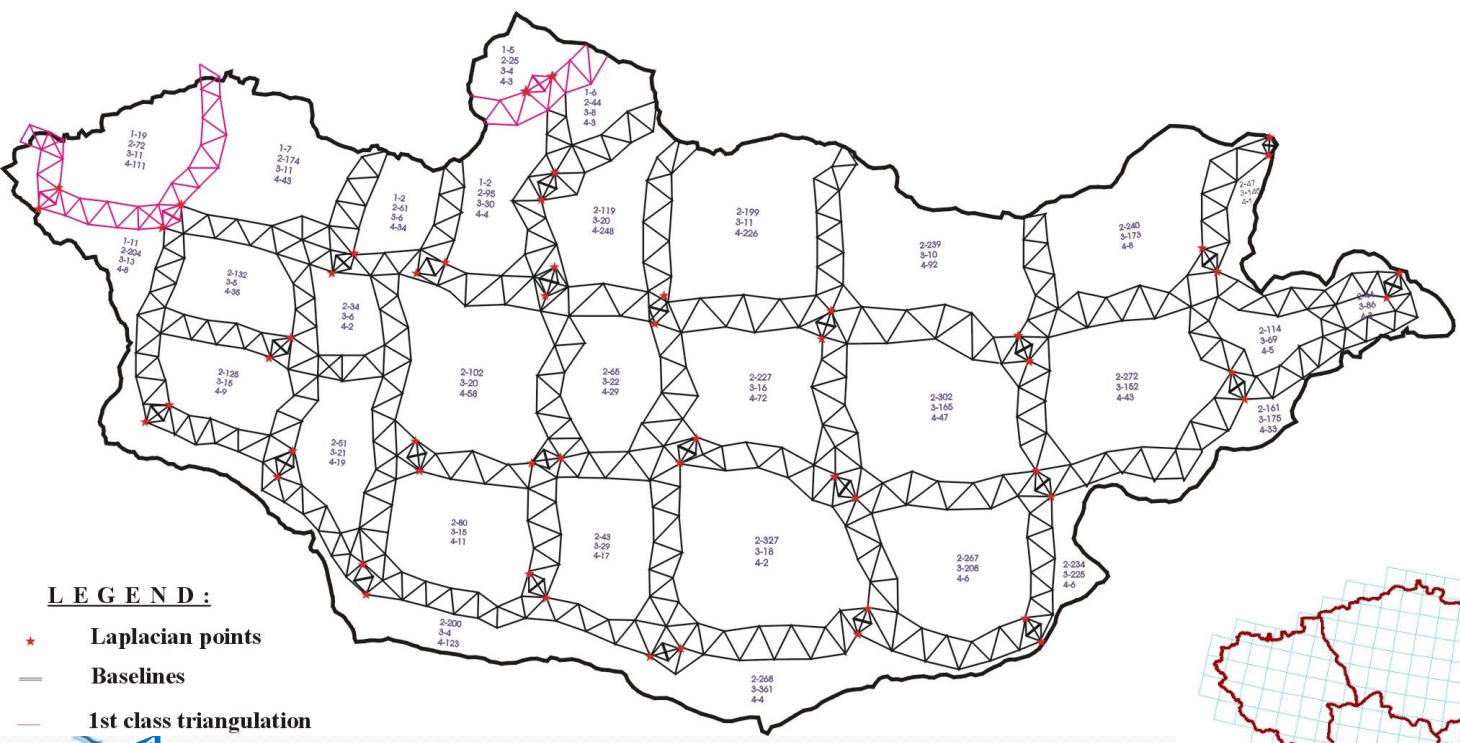
- Area - 1565000 sq.km
- Latitude 42 – 52 degrees
- Longitude 88 – 120 degrees





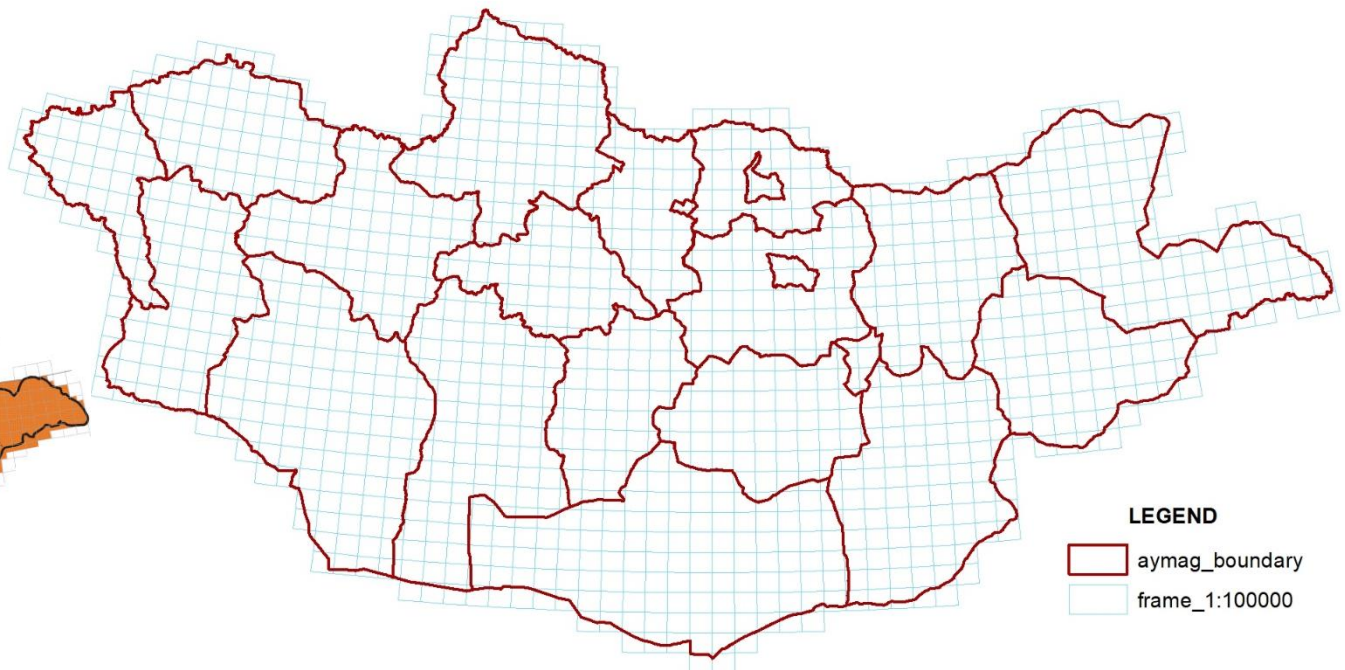
TRIANGULATION NETWORK

- 2nd, 3rd, 4th class of Triangulation network established in 1936-1961 connecting to Russian 1st class network
- More that 20000 points
- Krassovsky ellipsoid
- Pulkovo 1942
- For 1:25000-1:100000 scale mapping



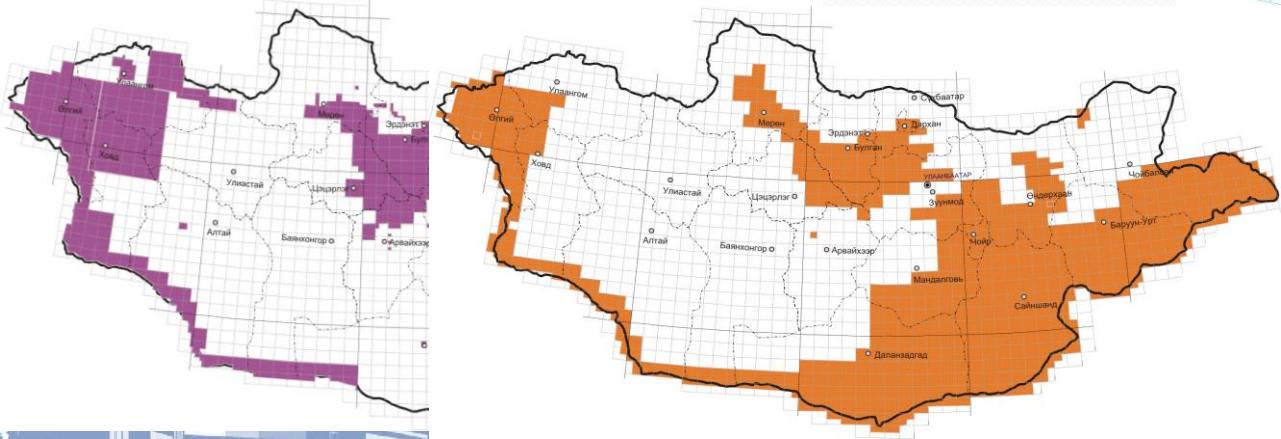
LEGEND:

- ★ Laplacian points
- Baselines
- 1st class triangulation



LEGEND

- aymag_boundary
- frame_1:100000



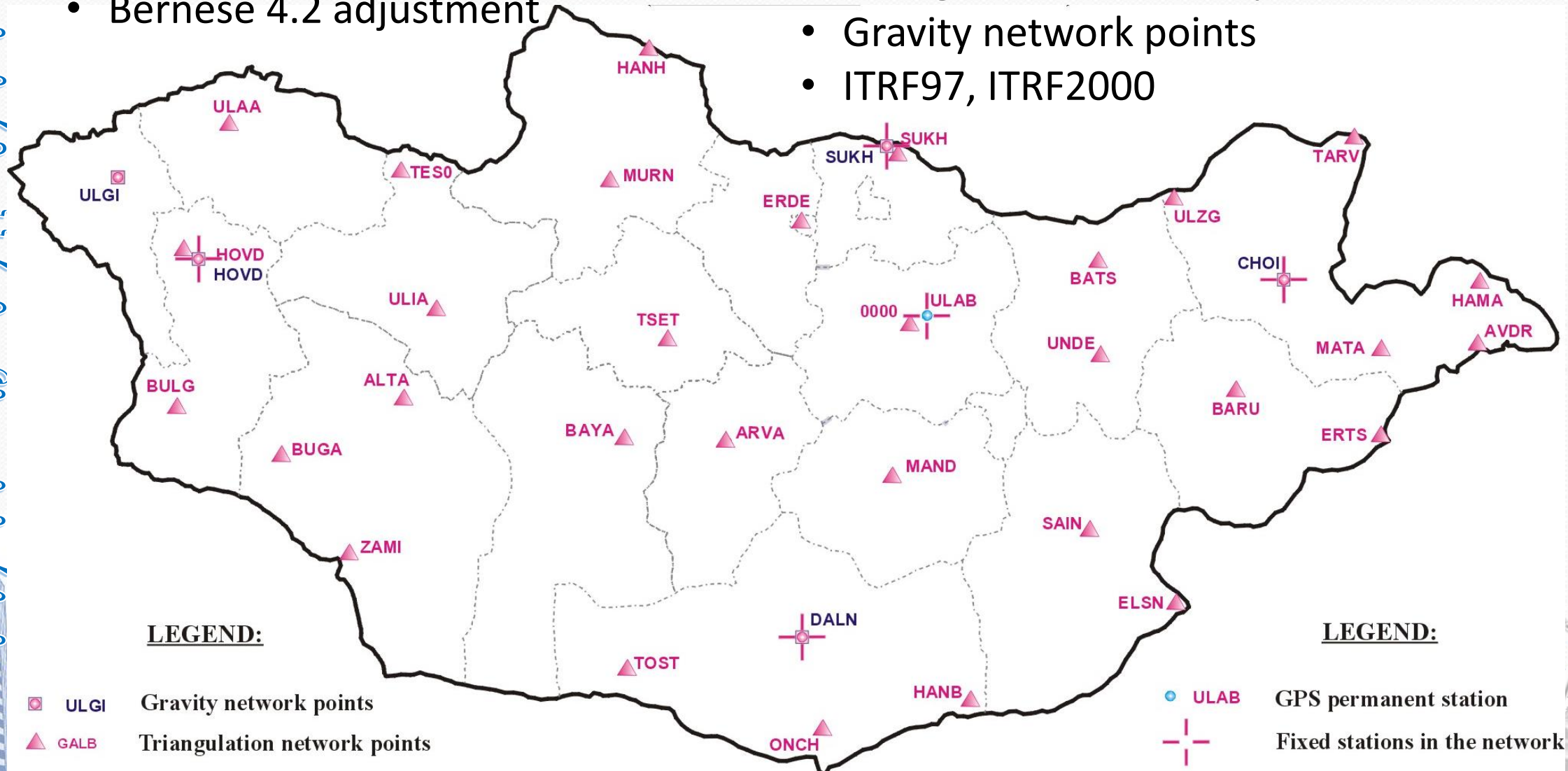


PRIMARY GPS NETWORK - MONREF97

МОНГОЛЫН ГАЗРЫН ХЭРЭГЖҮҮЛЭГЧ АГЕНТЛАГ
ОХИОН БАЙГУУЛАЛТ, ГЕОДЕЗИ, ЗУРАГ ЗҮЙН ГАЗАР

- Established in 1997-1998
- 34 points
- Bernese 4.2 adjustment

- Connected to IGS stations
- Triangulation network points
- Gravity network points
- ITRF97, ITRF2000



LEGEND:

- ◻ ULGI Gravity network points
- ▲ GALB Triangulation network points

LEGEND:

- ULAB GPS permanent station
- ⊕ Fixed stations in the network

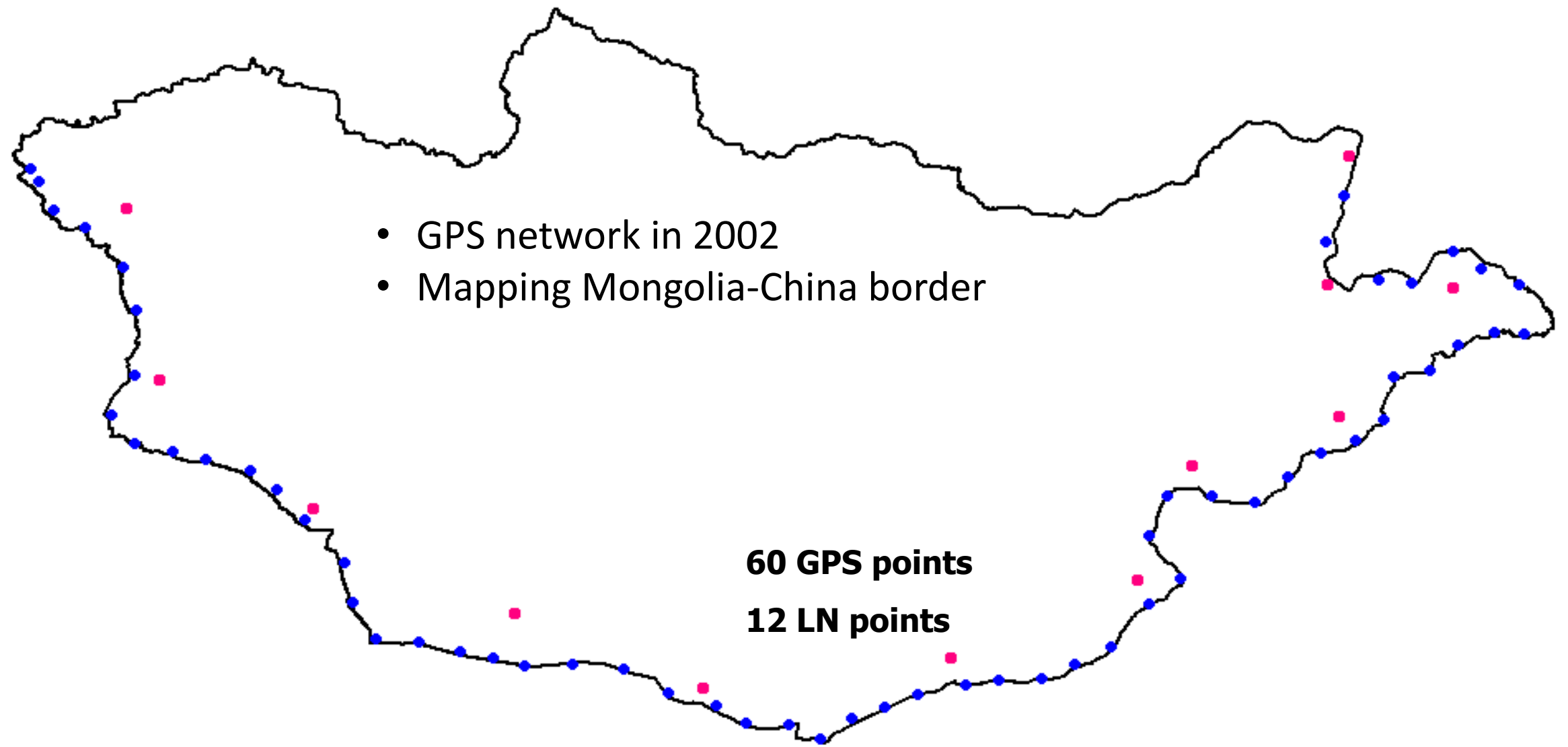


GPS NETWORK ALONG MONGOLIA-CHINA BORDER



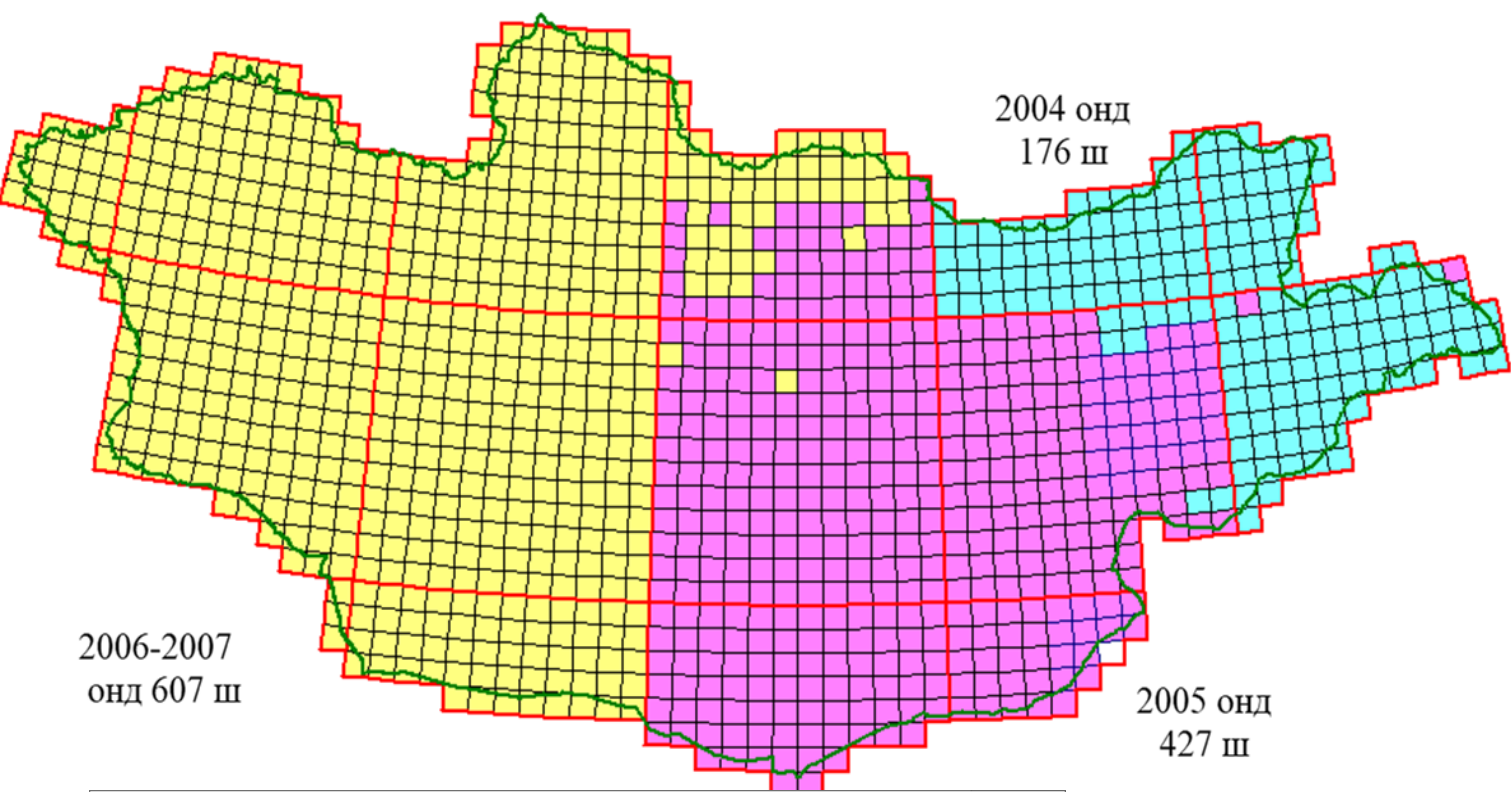
МОНГОЛЫН ГАЗРЫН ХЭРЭГЖҮҮЛЭГЧ АГЕНТЛАГ
ОХИОН БАЙГУУЛАЛТ, ГЕОДЕЗИ, ЗУРАГ ЗҮЙН ГАЗАР

МОНГОЛЫН ГАЗРЫН ХЭРЭГЖҮҮЛЭГЧ АГЕНТЛАГ
ОХИОН БАЙГУУЛАЛТ, ГЕОДЕЗИ, ЗУРАГ ЗҮЙН ГАЗАР





GPS NETWORK

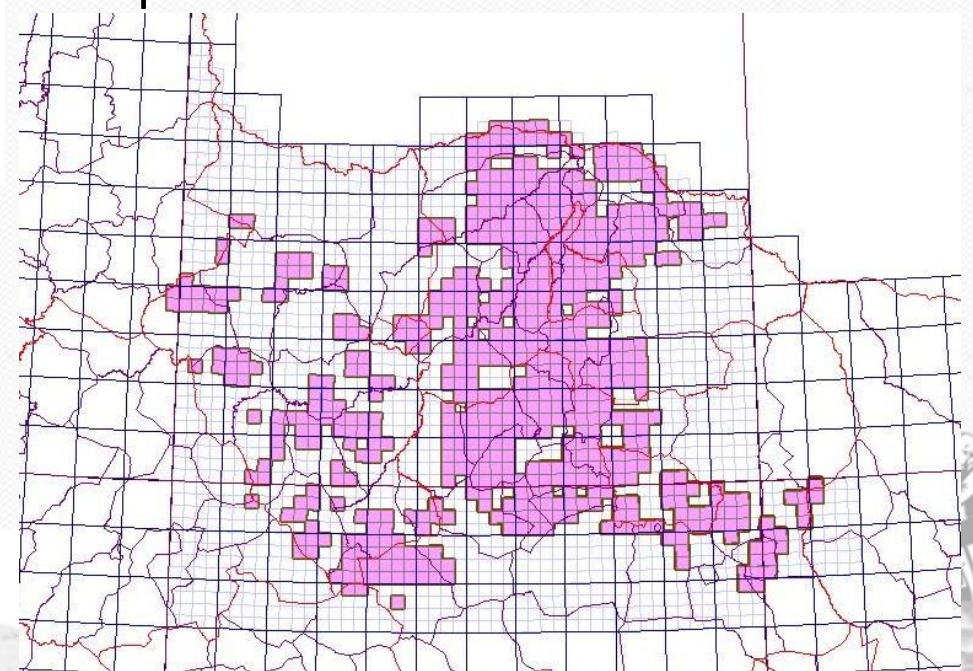


- Transformation parameter between
 - Pulkovo 1942 coordinate system and
 - WGS84 coordinate system
- Modcon application
- 1:100000 scale map conversion to digital form
- 1:25000 scale map conversion for cadastral mapping production in cropland area

Mongolian Datum Conversion Calculator MODCON Version 3.1

Manual transformation	File transformation
Latitude: <input type="text" value="48"/>	Latitude: <input type="text" value="48 00 01.7567"/>
Longitude: <input type="text" value="99"/>	Longitude: <input type="text" value="99 00 00.4390"/>
Degrees form: <input type="text" value="DD MM SS.N4"/> Zone: <input type="text" value="Aut"/>	Degrees form: <input type="text" value="DD MM SS.N4"/> Zone: <input type="text" value="Aut"/>
System: <input type="text" value="Geographic Coordinates"/>	System: <input type="text" value="Geographic Coordinates"/>
Datum: <input type="text" value="MK42 (Datum Pulkovo1942)"/>	Datum: <input type="text" value="WGS-84"/>
<input type="button" value="Transform >>"/>	<input type="button" value="<< Transform"/>

Developed by : MONMET ENGINEERING Co.,Ltd 2009 English Монгол

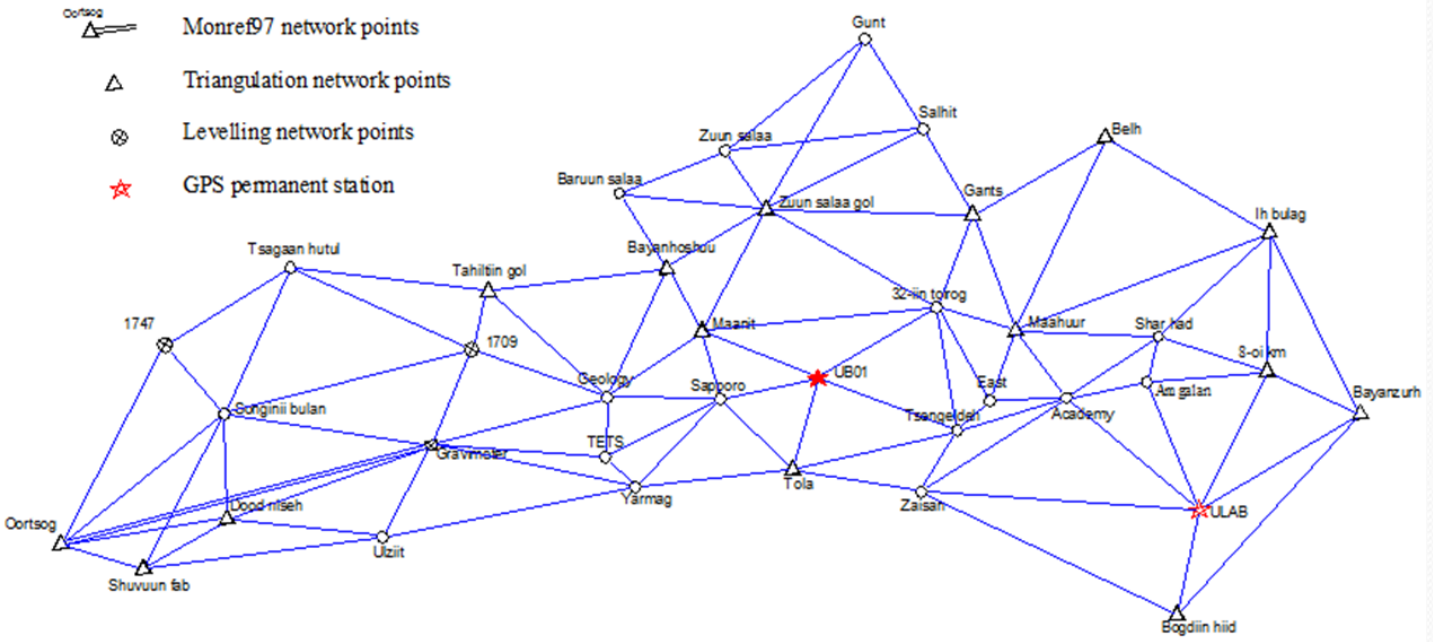




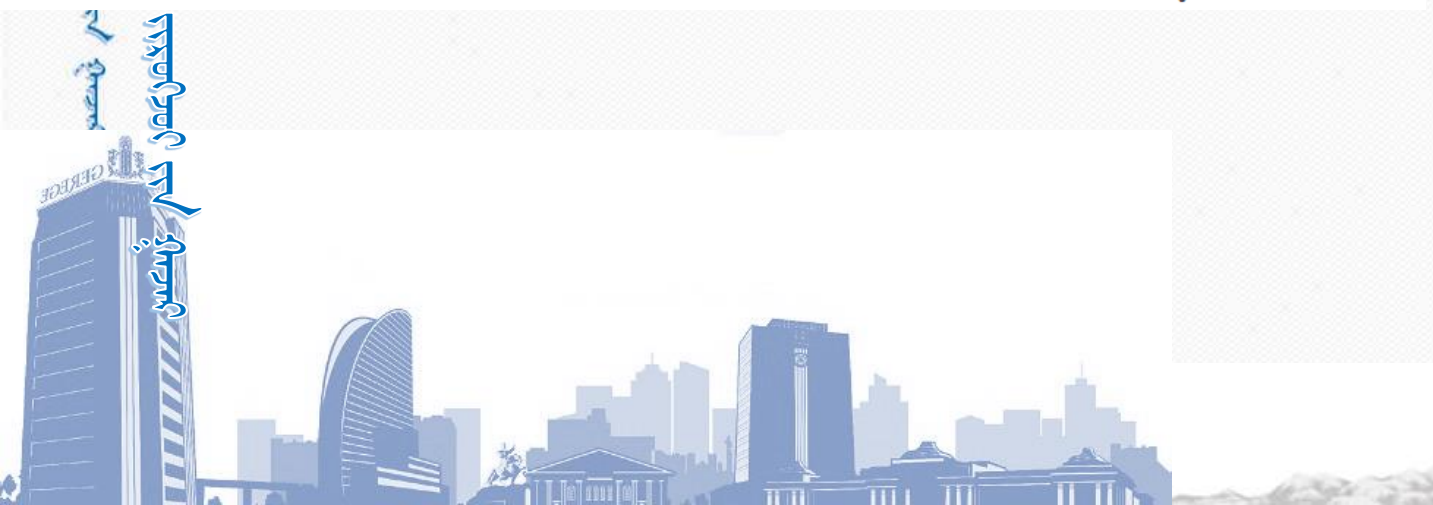
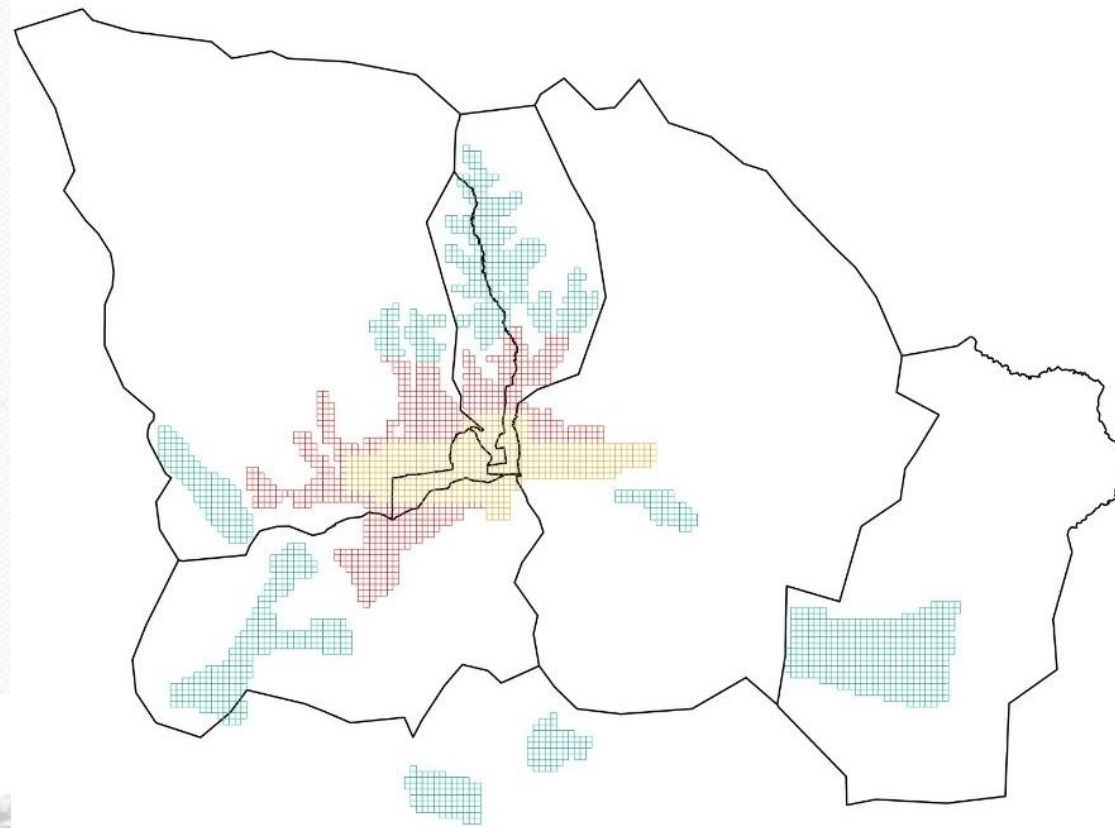
DENSIFICATION OF MONREF97 NETWORK

LEGEND

- Monref97 network points
- Triangulation network points
- Levelling network points
- GPS permanent station



- ULAANBAATAR CITY'S NETWORK IN 2002
- 38 POINTS
- BERNESE ADJUSTMENT
- 1:1000 SCALE CADASTRAL MAPPING
- 1:1000 SCALE TOPOGRAPHICAL MAPPING

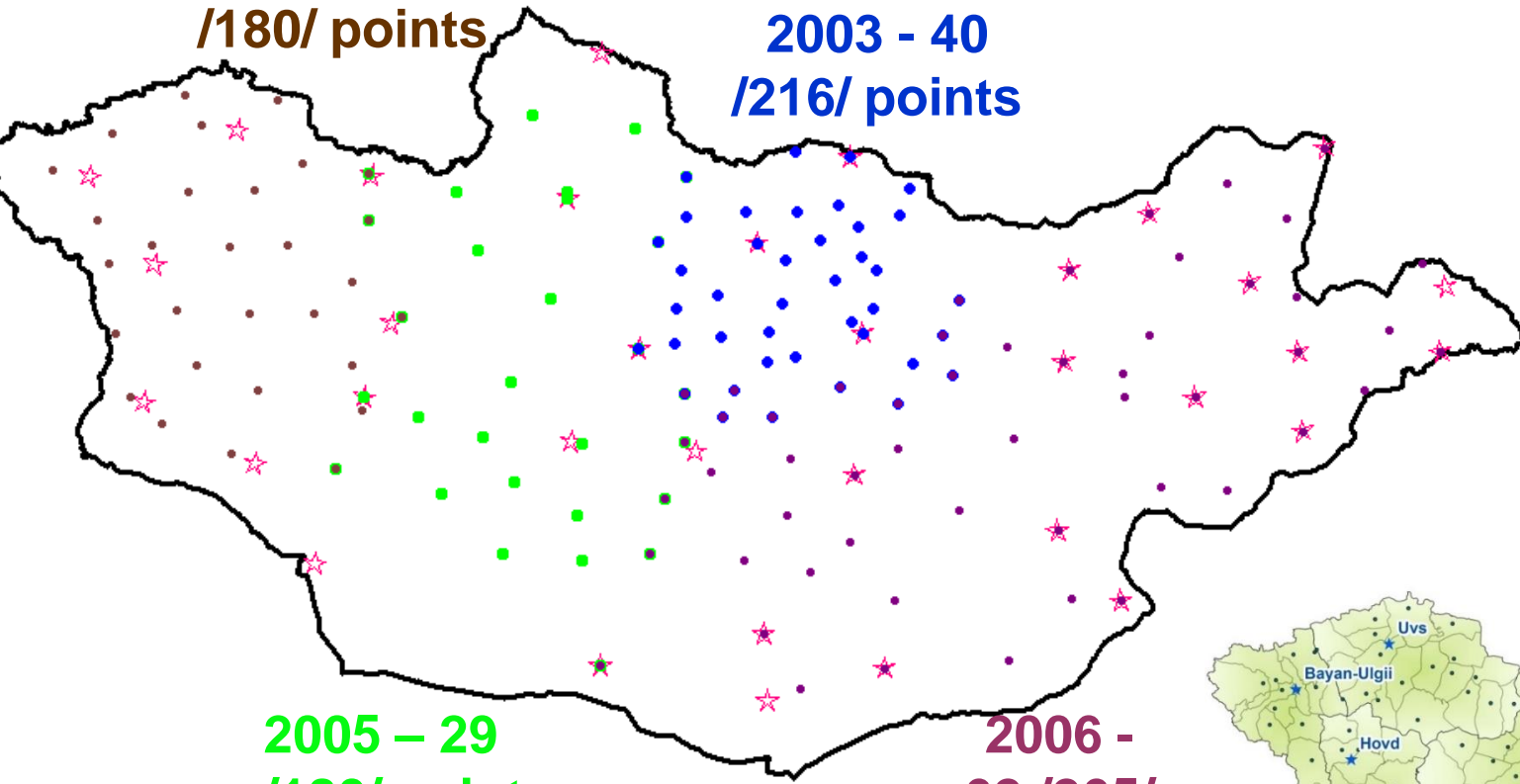




DENSIFICATION OF MONREF97 NETWORK

2004 - 28
/180/ points

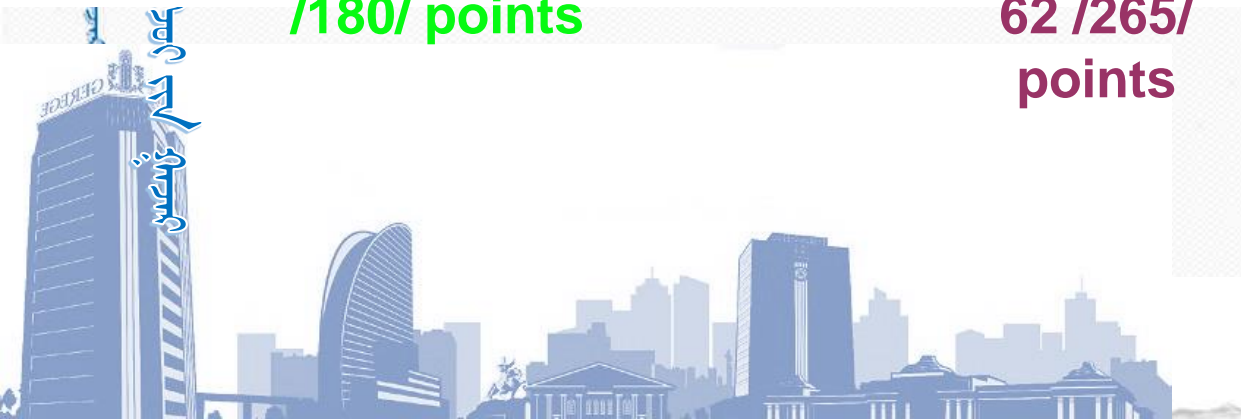
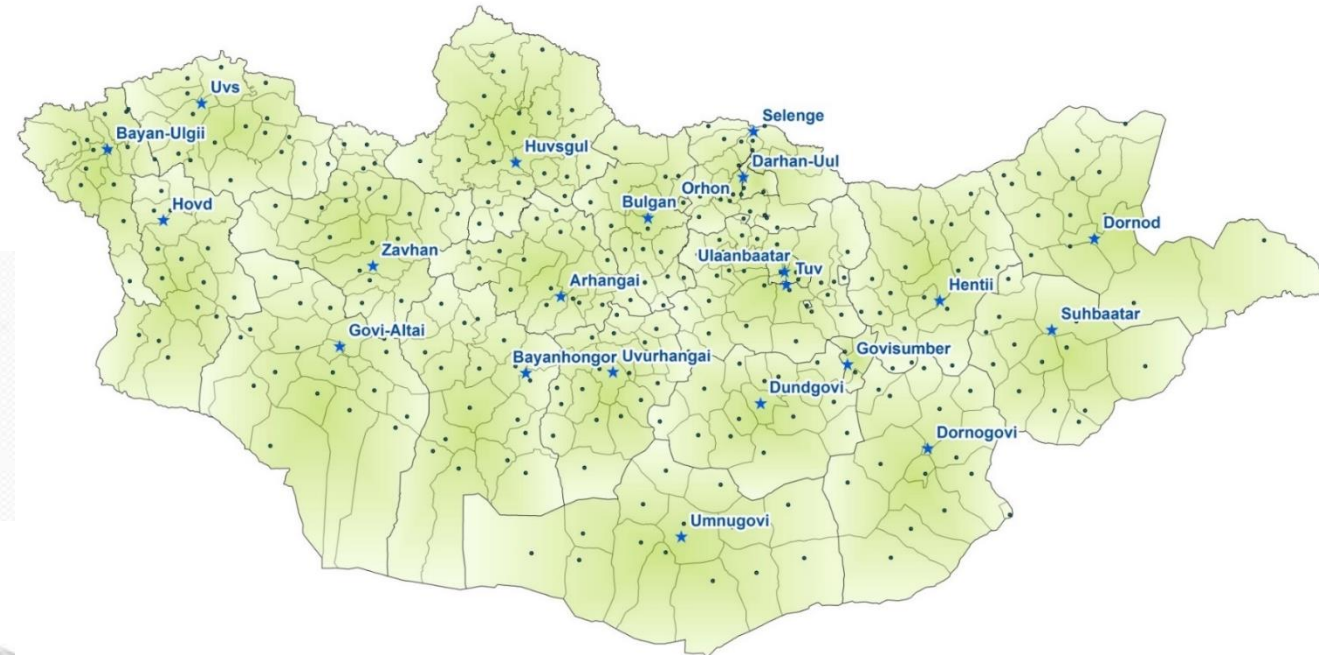
2003 - 40
/216/ points



2005 - 29
/180/ points

2006 - 62 /265/ points

- NETWORK DENSIFICATION IN 2003-2006
- 1:1000 SCALE TOPOGRAPHICAL MAPPING
- 1:1000 SCALE CADASTRAL MAPPING
- ALL SETTLEMENT AREAS /362 PLACES/



UNIQUE COORDINATE AND HEIGHT SYSTEM, PROJECTION



ინფორმაციის ტექნოლოგიების განვითარების ხელშეწყობისა და მათი გამოყენების ხელშეწყობის მიზნით
საქართველოს რესპუბლიკის ეროვნული აგენტობა
საგეოდეზიო, გეოდეზიისა და სურათების განყოფილება

საგეოდეზიო, გეოდეზიისა და სურათების განყოფილება
საქართველოს რესპუბლიკის ეროვნული აგენტობა
ინფორმაციის ტექნოლოგიების განვითარების ხელშეწყობისა და მათი გამოყენების ხელშეწყობის მიზნით

- Government decree No25 on 28 January 2009
- WGS-84 ellipsoid, coordinate system
- Baltic sea height system
 - Geoidal height model
- UTM projection
 - 6 degrees





GNSS NETWORK



- GNSS network in 2010 on leveling network nodal points
- For Mongolian geoid model development

ГЕОИДИЙН ӨНДӨР БОДОХ

Геоидийн өндөр бодох (гараар)

Өгөгдлийн формат (WGS84 системд):*

Градус минут секунд (DMS)

47 56 23

108 25 47

1856

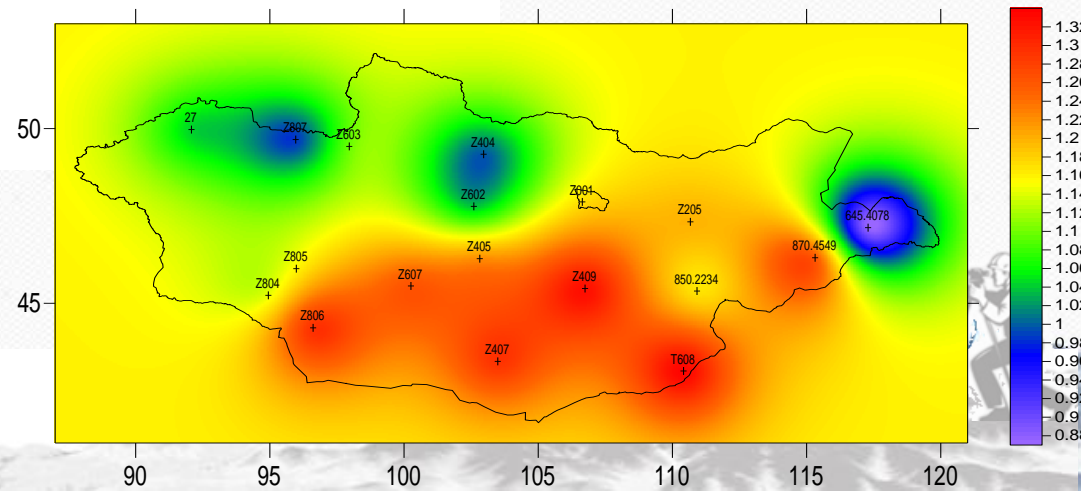
Бодох

Квазигеоид /Mongeoid/, м: -32.815

EGM2008, м: -33.6619

EGM96, м: -33.7931

<http://geocalc.gazar.gov.mn/insert-egm>



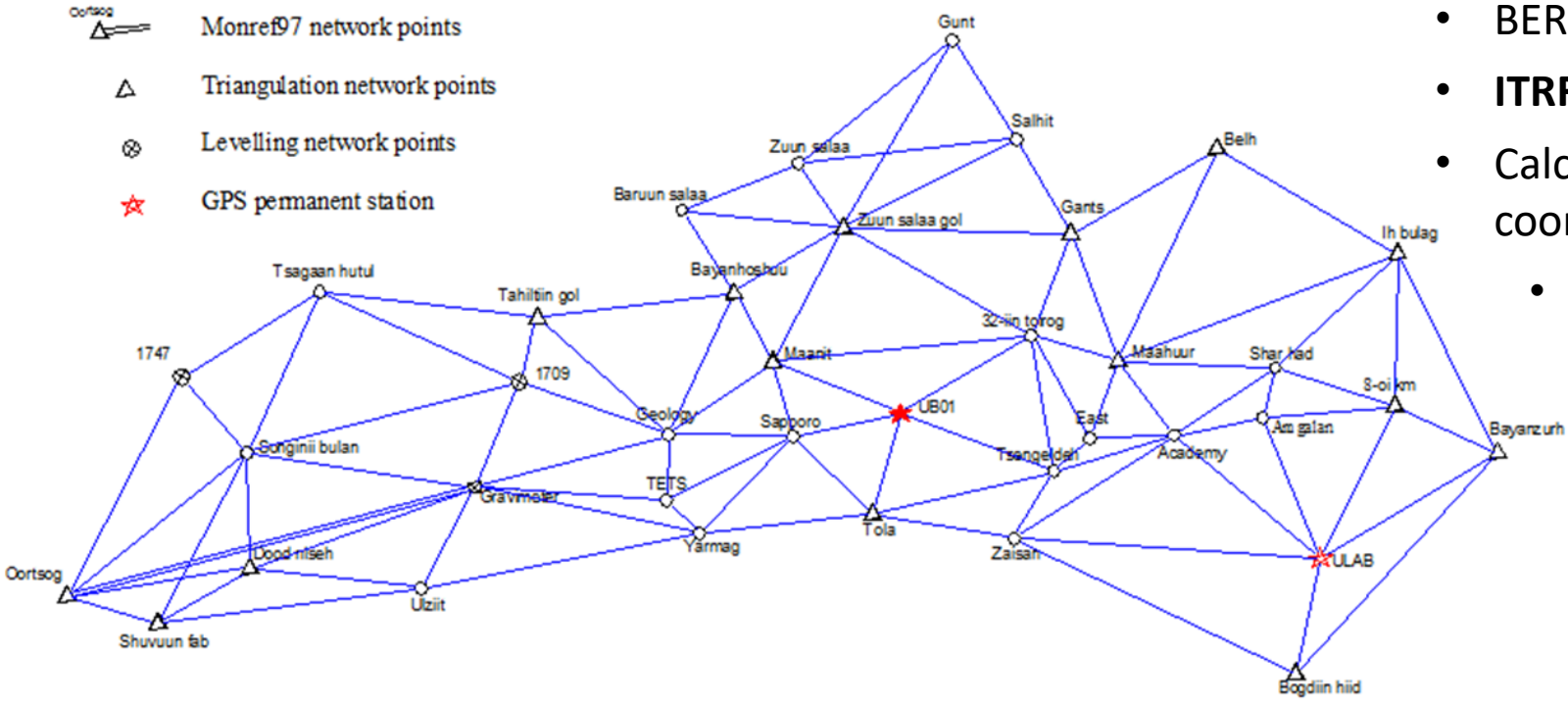


GNSS NETWORK

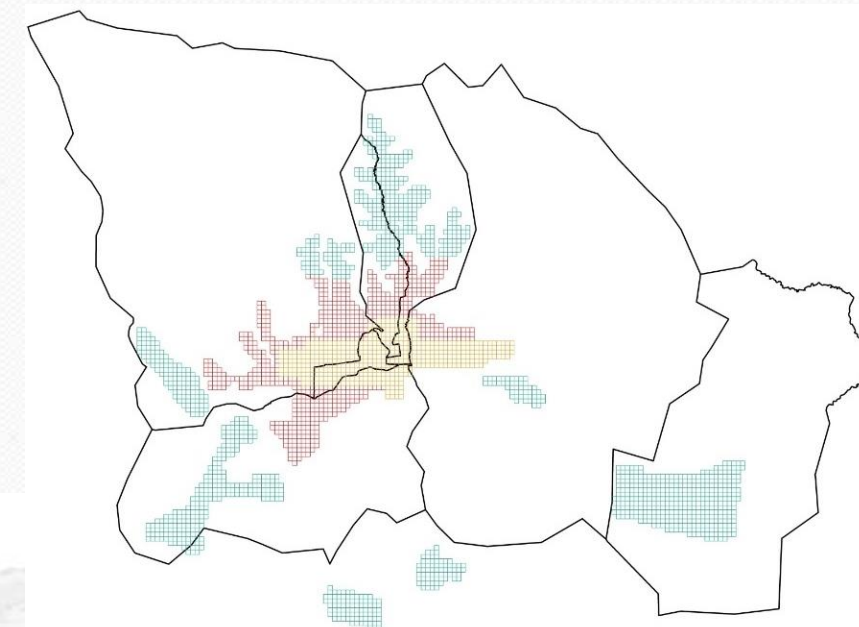


LEGEND

- Monre97 network points
- Triangulation network points
- Levelling network points
- GPS permanent station

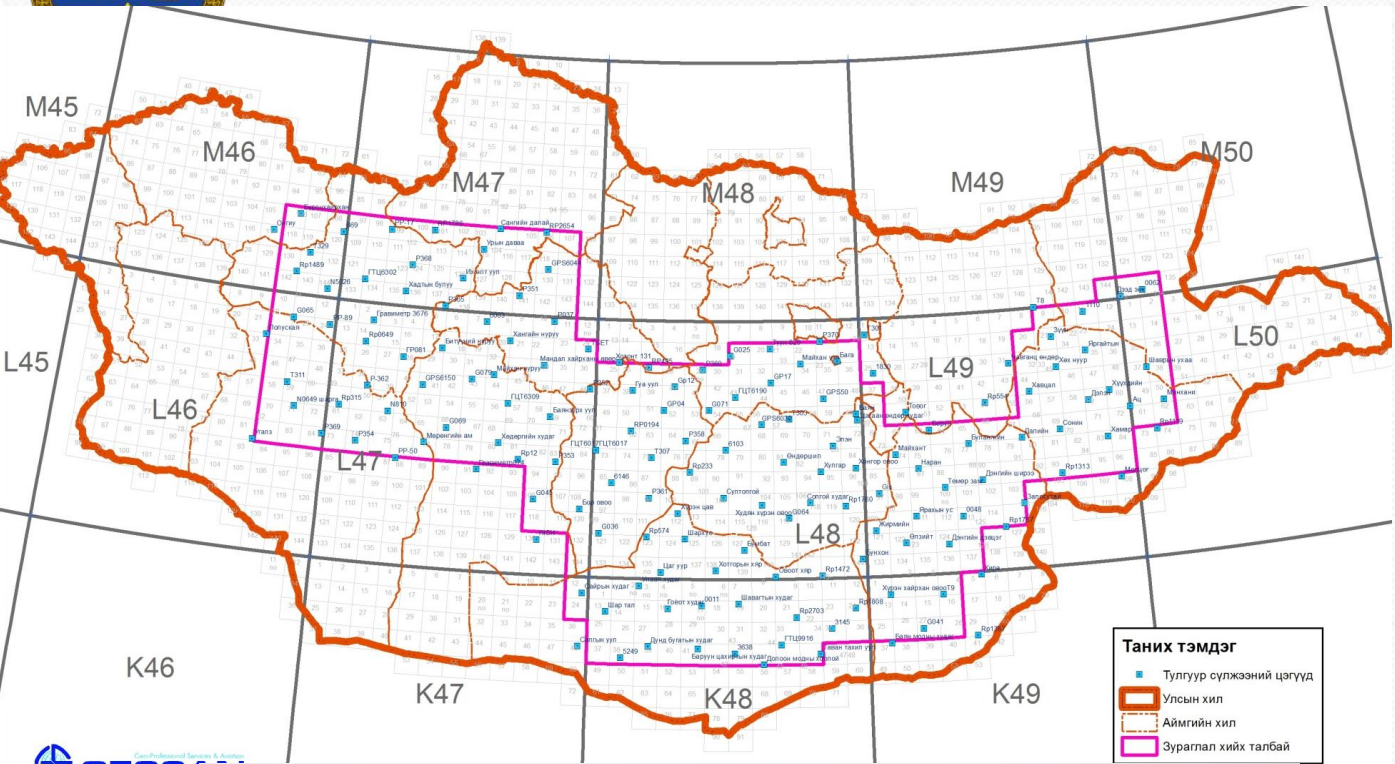


- ULAANBAATAR CITY'S GNSS NETWORK IN 2011
- 38 POINTS
- BERNESE ADJUSTMENT
- **ITRF2008**
- Calculated transformation parameter between local coordinate system and WGS84 coordinate system
 - 1:500 scale topographical mapping conversion

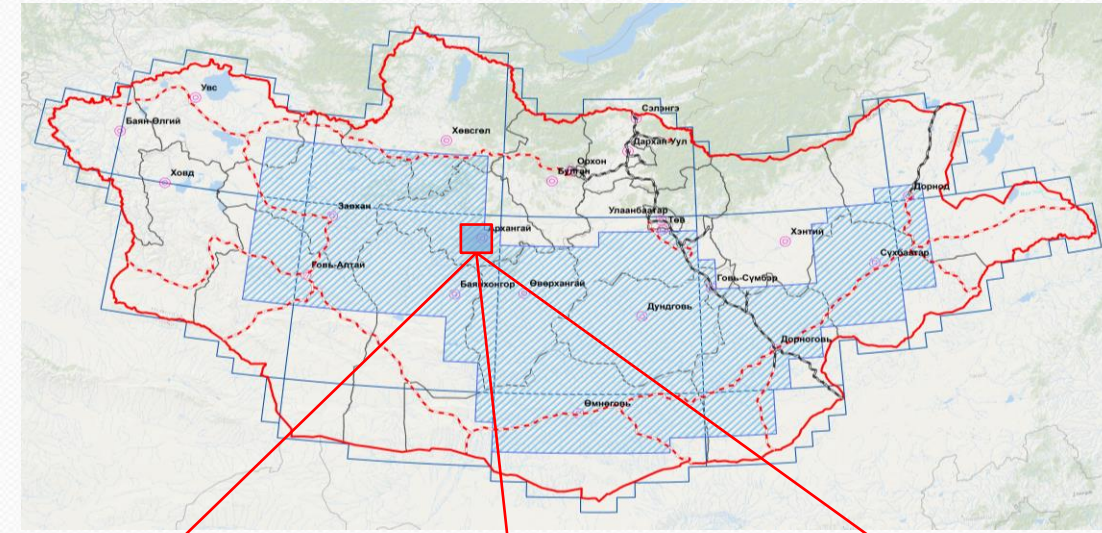




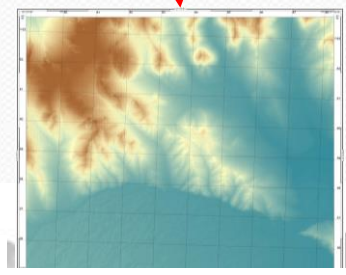
1:25 000 SCALE MAPPING for railway line planning



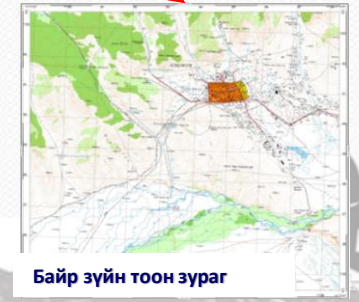
- GNSS network in 2011-2012
- 265 points
- 1:25000 scale mapping
- Aerial photos
- Orthophotos
- DEM
- Digital maps
- Spatial data



Агаарын ортофото зураг



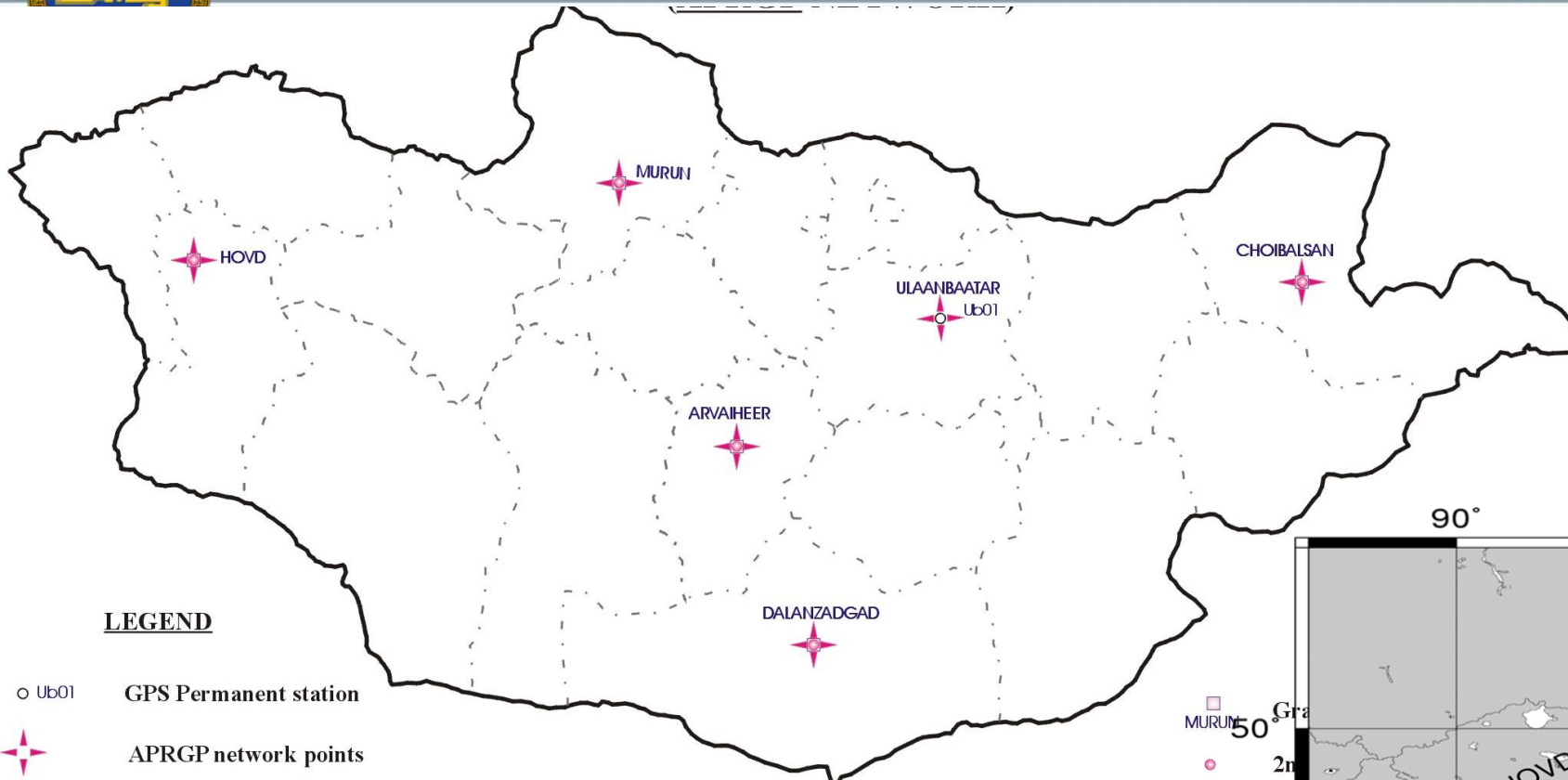
Өндрийн тоон загвар



Байр зүйн тоон зураг



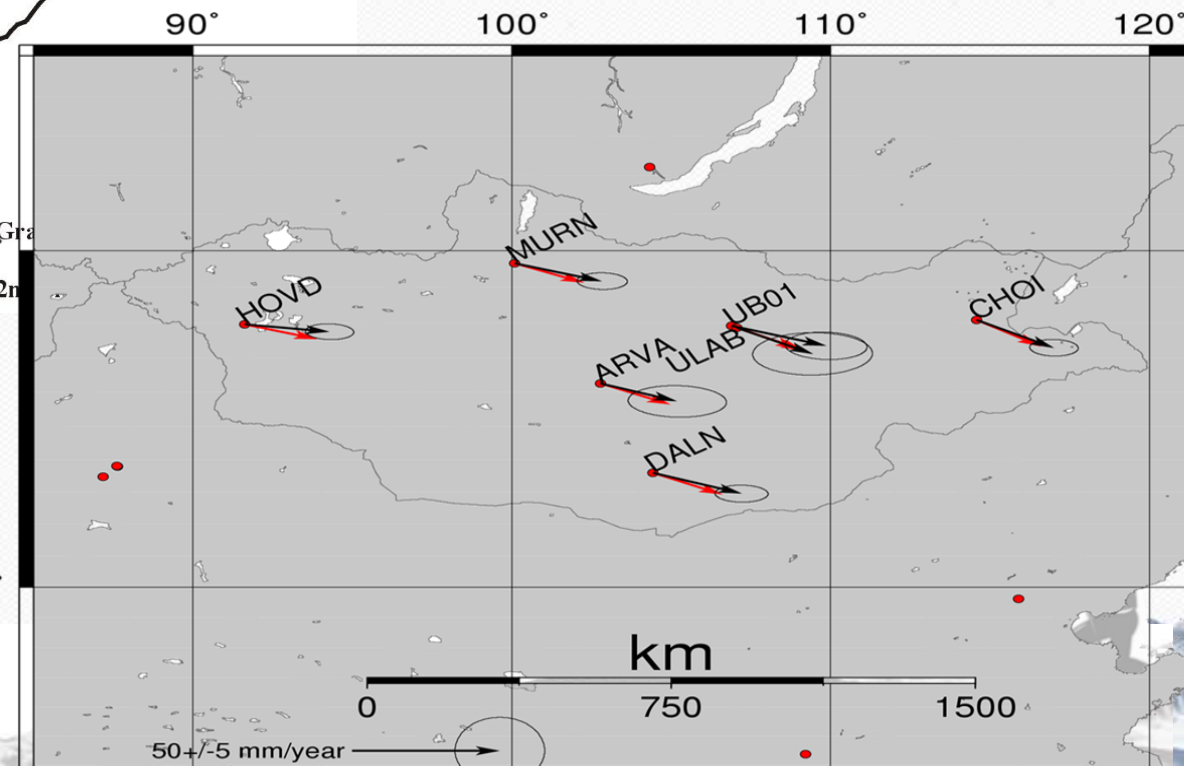
ASIA-PACIFIC GPS\GNSS NETWORK

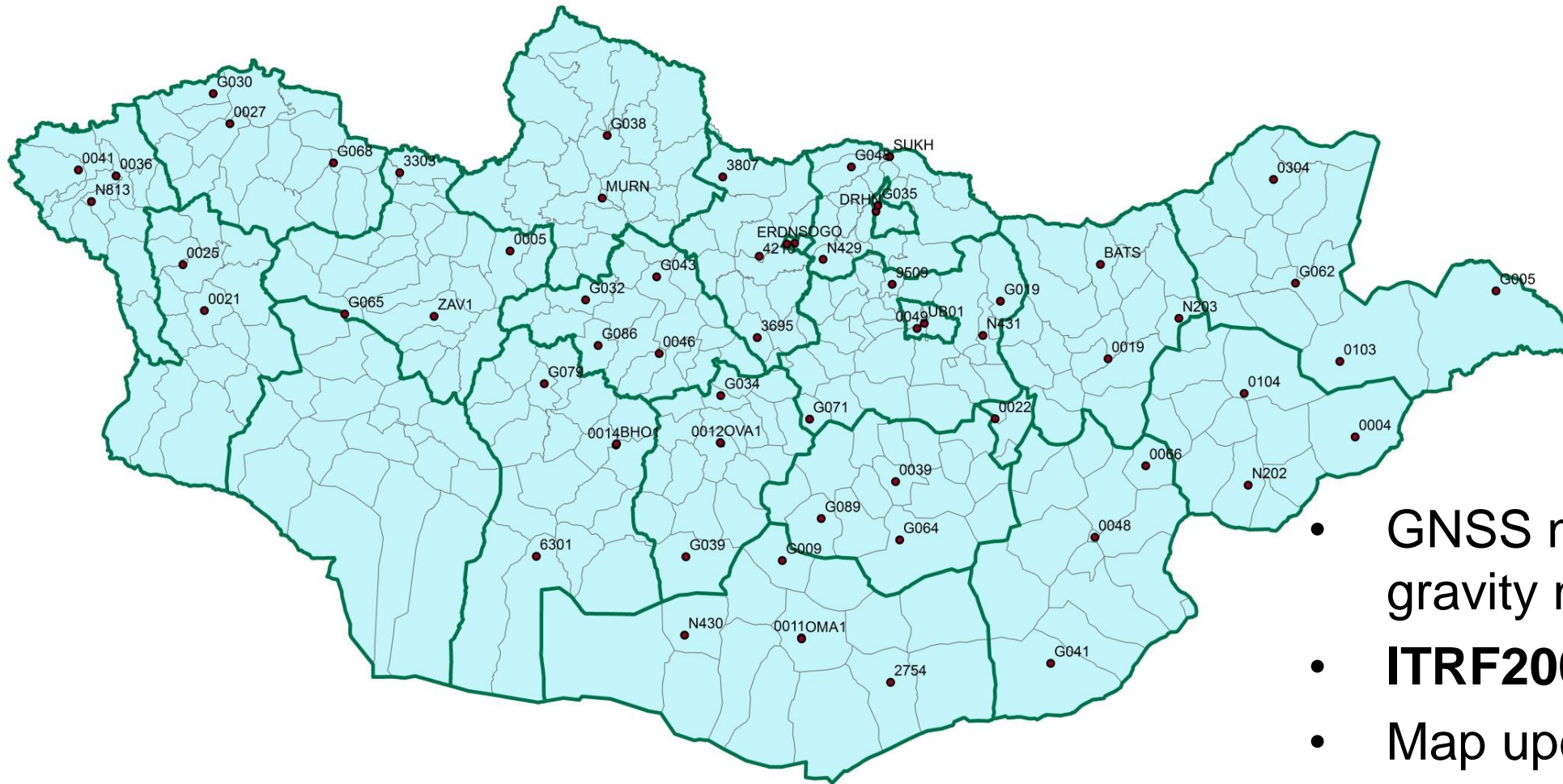


LEGEND

- Ub01 GPS Permanent station
- ★ APRGP network points

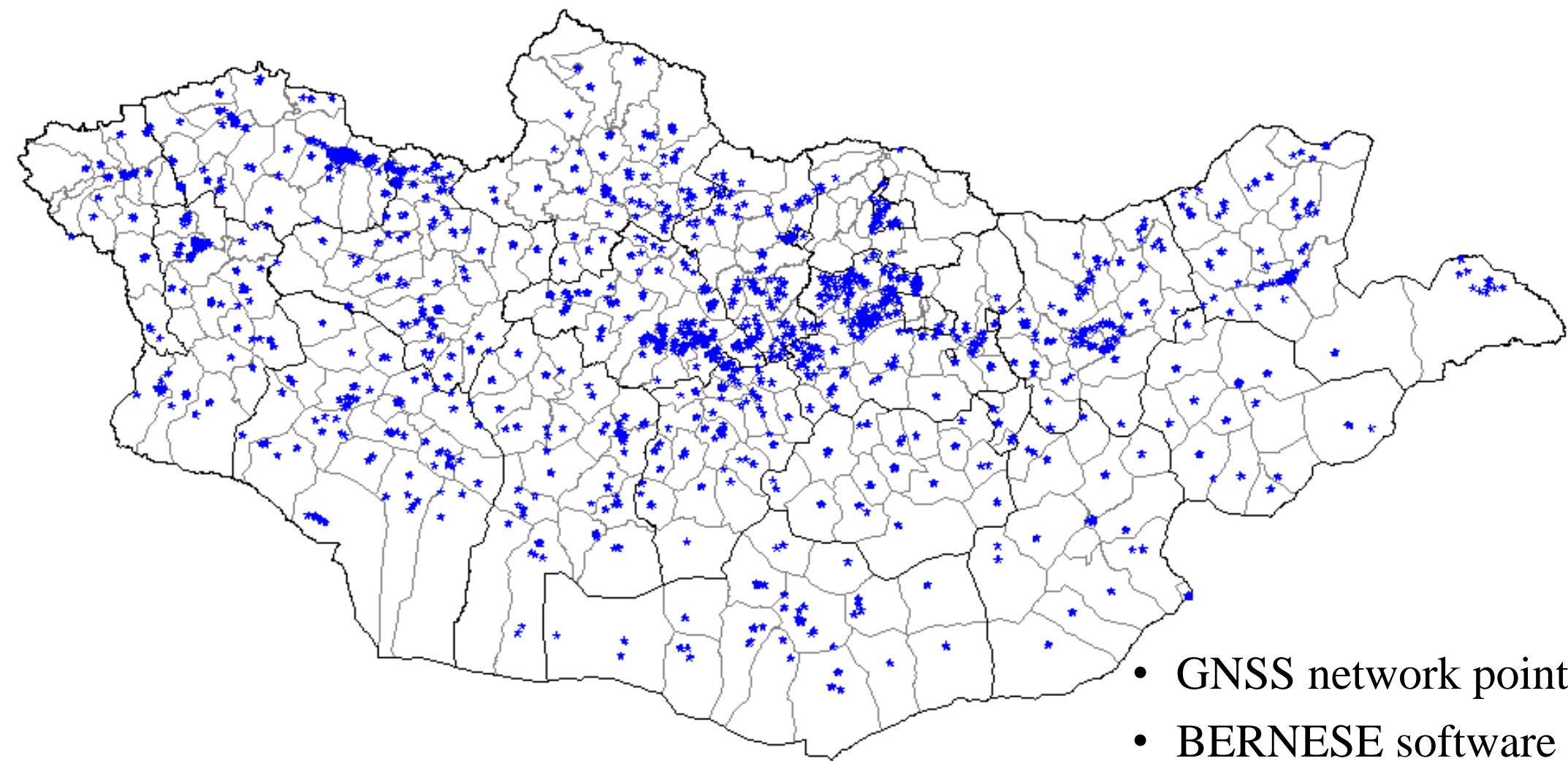
- REGIONAL NETWORK MEASUREMENT IN 1999, 2000, 2001, 2002, 2004, 2009, 2013, 2017-2021
- 3-4 cm SE per year





- GNSS network in 2013 on gravity network points \65\
- **ITRF2008** epoch
- Map update in 375 settlement areas
 - 1:1000 topographic
 - 1:1000 cadastral



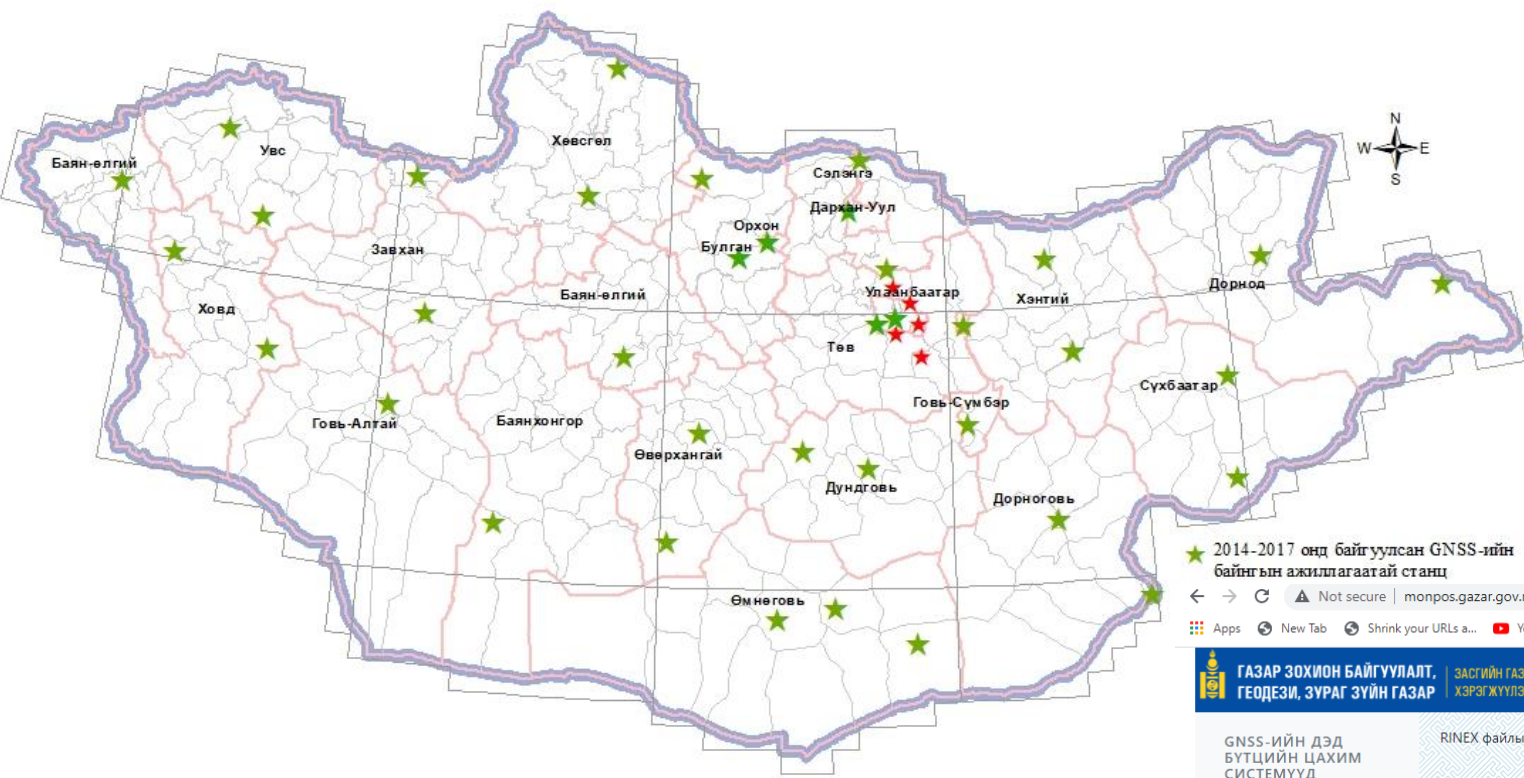


- GNSS network points – 3760
- BERNESE software adjustment
 - ITRF2008
- Connected to IGS and Mongolian CORS stations





GNSS PERMANENT STATIONS



- 43 stations ALAaMGaC
- Developed MONPOS system
- GNSS measurement data processing
 - With IGS stations data or
 - Mongolian CORS data

★ 2014-2017 онд байг уулсан GNSS-ийн байнгын ажиллагаатай станц

Not secure | monpos.gazar.gov.mn/monpos

ГАЗАР ЗОХИОН БАЙГУУЛАЛТ, ГЕОДЕЗИ, ЗУРАГ ЗҮЙН ГАЗАР | ЗАСГИЙН ГАЗРЫН ХЭРЭГЖҮҮЛЭГЧ АГЕНТЛАГ

Сайн байна уу? Зочин [Нэвтрэх](#)

GNSS-ИЙН ДЭД БҮТЦИЙН ЦАХИМ СИСТЕМҮҮД

- Monpos
- MonStatic
- MonRTK
- MonGeoCalc
- MonGeoid

СИСТЕМИЙН ХАНДАЛТ

- Санал хүсэлт илгээх

RINEX файлын тоо: 1 Тулгуур CORS-г сонгох: IGS-ийн CORS

RINEX файл: Choose Files No file chosen Багажны өндөр /метр/ Багажны өндөр, (м) Хүлээн авагчийн төрөл: AERAT1675_120 GNSS-ийн антены төрөл: ACC123CGNSSA_XN NONE

e-mail хаяг Нэмэлт системийг сонгоно уу: Glonass Galileo Beidou [Хуулах](#)

Таны GNSS-ийн өгөгдөл нь:

1. Статик горимд хэмжигдсэн байх
2. Хамгийн багадаа 2 ба түүнээс дээш цагийн өгөгдөл байх
3. Геодезийн сүлжээний шаардлага хангасан хос долгионы хүлээн авагчаар хэмжсэн байх
4. RINEX форматаар байх
5. IGS-ийн файл дугаарлалтын стандартад заасны дагуу нэрлэгдсэн байх

XXXXDDDS.YyO
 - XXXX – Хэмжсэн цагийн нэр
 - DDD-Жилийн өдөр (GPS-ийн өдөр, 001-365)
 - S-хэмжсэн хугацааны урт (0-9, a-Z)
 - YY-хэмжилт хийсэн оны сүүлийн 2 орон (2018 үед 18) Жишээ нь: gunt2170.18o

Country_report_M....ppt orshil_Dugnelt.doc IIL_buleg1 (1).doc IIL_buleg1.doc I_buleg1 (1).doc





МОНГОЛЫН ГАЗРЫН ХЭРЭГЖҮҮЛЭГЧ АГЕНТЛАГ
ОХИОН БАЙГУУЛАЛТ, ГЕОДЕЗИ, ЗУРАГ ЗҮЙН ГАЗАР

GEODETIC NETWORK POINTS' DISTRIBUTION



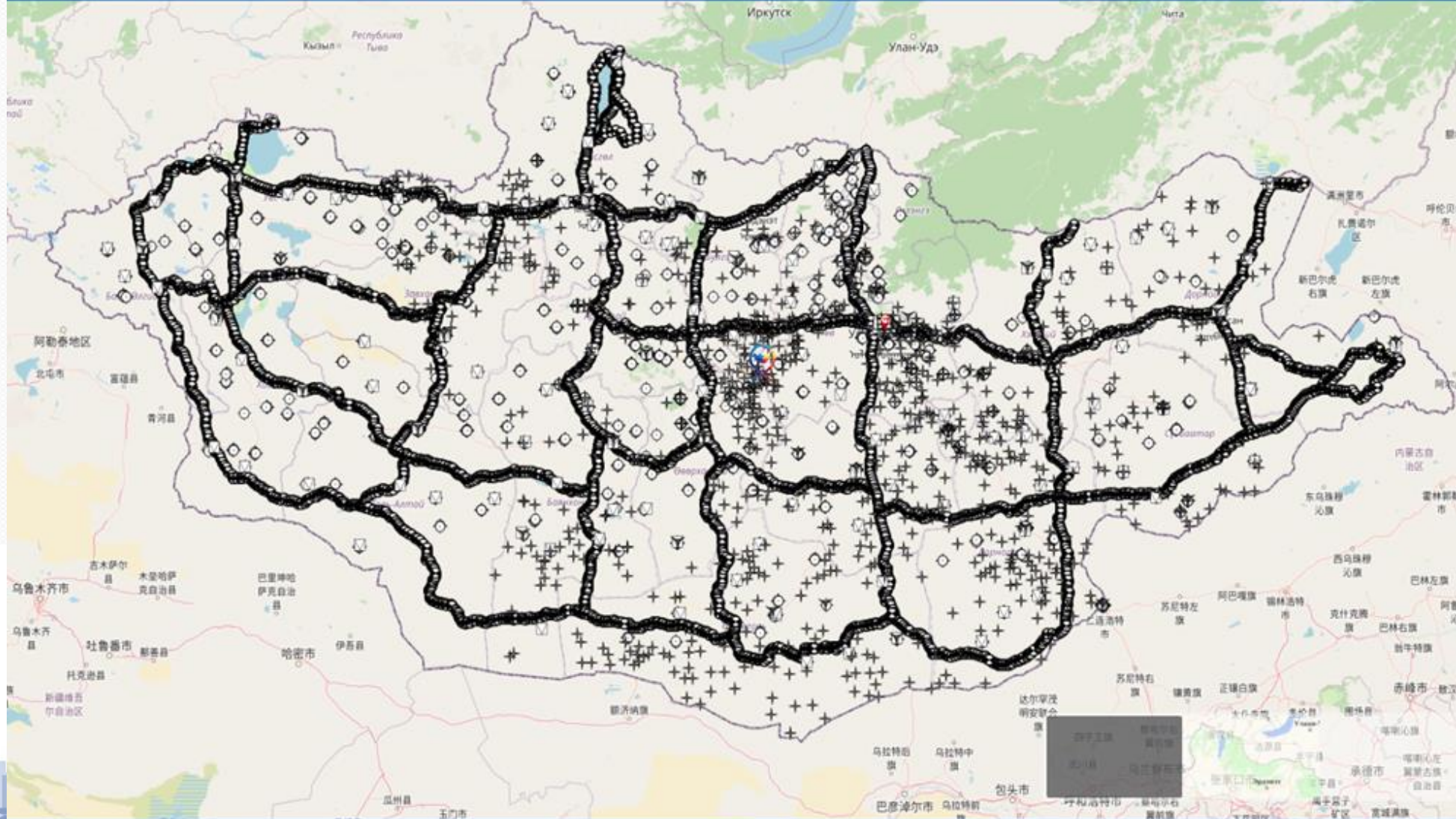
Хайх үг Хайх

БҮРТГҮҮЛЭХ НЭВТРЭХ

[HTTPS://NSDI.GOV.MN/](https://nsdi.gov.mn/)

ГЕОПОРТАЛ / Геодезийн тулгуур сүлжээ

ҮЙЛЧИЛГЭЭ | МЕТА ДАТА | ТУСЛАМЖ | СТАТИСТИК | ПРОФИЙЛ



МОНГОЛЫН ГАЗРЫН ХЭРЭГЖҮҮЛЭГЧ АГЕНТЛАГ
ОХИОН БАЙГУУЛАЛТ, ГЕОДЕЗИ, ЗУРАГ ЗҮЙН ГАЗАР





МОНГОЛЫН ГАЗРЫН ХЭРЭГЖҮҮЛЭГЧ АГЕНТЛАГ
ОХИОН БАЙГУУЛАЛТ, ГЕОДЕЗИ, ЗУРАГ ЗҮЙН ГАЗАР

- Companies with special permission on Geodetic activities
 - More than 300 companies
 - GNSS equipment
 - Total stations

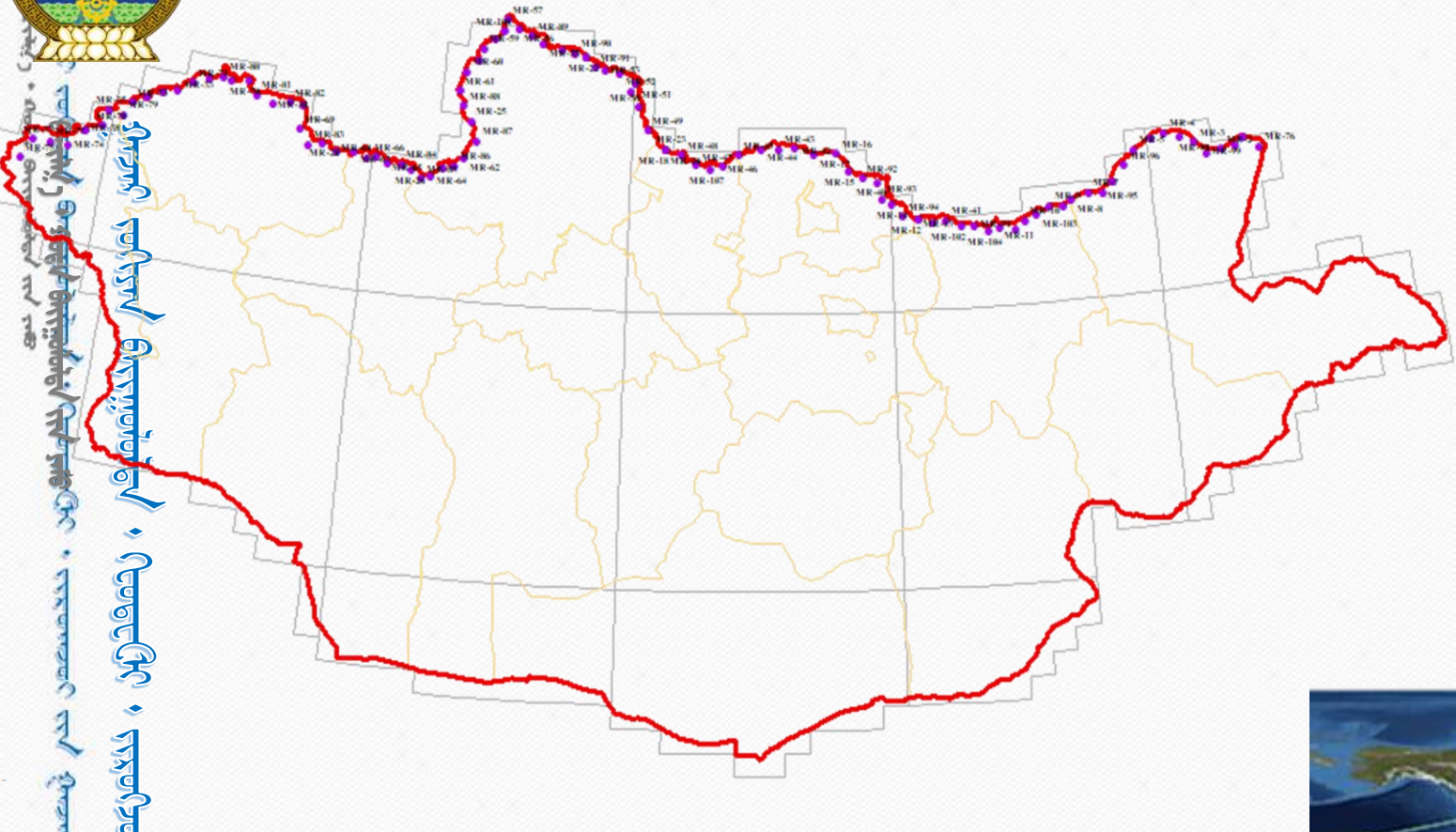
Used as base points for:

1. Topographical and cadastral mapping
2. Geodetic measurement for construction and building
3. Geodetic measurement for railway and road construction
4. Mining cadastre and agriculture
5. Defense and emergency





FUTURE PLAN



1. ITRF2020 \Government decree in 2022\
2. GNSS CORS as primary network \increase number of CORS\
3. GNSS network along Mongolia-Russia boundary
4. VLBI \2050 development plan\





Засгийн газрын хэрэгжүүлэгч агентлаг
ГАЗАР ЗОХИОН БАЙГУУЛАЛТ, ГЕОДЕЗИ, ЗУРАГ ЗҮЙН ГАЗАР



ᠮᠣᠩᠭᠣᠯ ᠤᠯᠤᠰ ᠤᠨ
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ᠭᠠᠵᠠᠷ ᠵᠣᠬᠢᠨ ᠪᠠᠶᠢᠭᠤᠯᠠᠯᠤᠯᠤᠰ
ᠭᠡᠭᠡᠳᠡᠵᠢ ᠵᠢᠷᠠᠭ ᠵᠢᠶᠢᠨ ᠭᠠᠵᠠᠷ



THANK YOU FOR YOUR ATTENTION

CONTACT US:

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Tel: 976 51-260638, 51-262270

Fax: 976 11-322683

Web: WWW.GAZAR.GOV.MN

Email: info@gazar.gov.mn

