# GNSS Application trends in Central Asia

GIS Open 2014, April 15-17, 2014, Székesfehérvár, Hungary


Akylbek Chymyrov

***PhD Candidate, Faculty of Geoinformatics***

University of West-Hungary

***Docent of the Geodesy and Geoinformatics Department***

KSUCTA, Bishkek, Kyrgyzstan

E-mail: akylbek@geo.info.com,

akylbek2005@yahoo.com

# Outline

- About the Central Asia
- Traditional Reference Ellipsoid and Coordinate Systems
- GPS and GNSS Technologies
- Use of GNSS Technology in Central Asia today
- National Geodetic and GNSS Networks of Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan
- New National Coordinate Systems in Central Asia
- Analysis of GNSS trends in the region
- Conclusion and discussions

# About the Central Asia

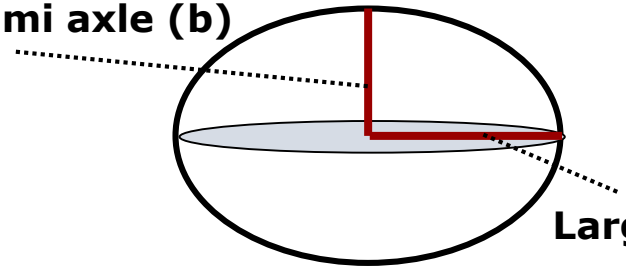

- Countries of the Central Asia: **Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan**
- Total area of the region: **3,994,300 km²**
- The population: >55 mln

# Traditional Local Reference Ellipsoid

| | |
|---|---|
| **Ellipsoid name** | **Krasovsky 1940** |
| **Large semi axle (a)** | 6 378 245 m |
| **Flattening, f** | 1/298.3 |
| **Regions** | Former USSR |

Prof. Feodosy Krasovsky

Kronstadt sea gauge



# Traditional Reference Systems

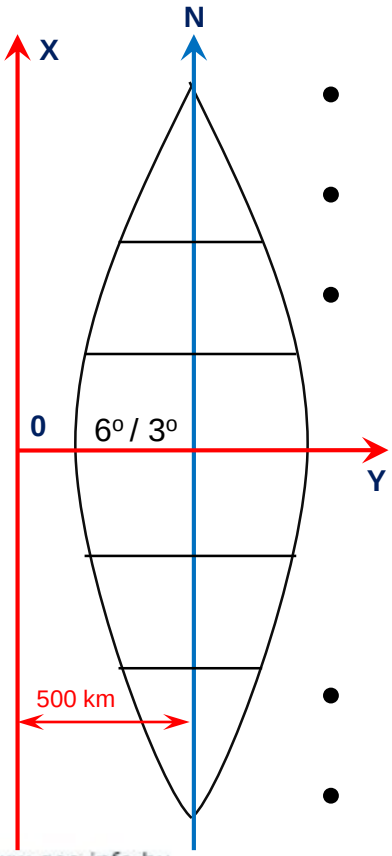
- Cartographic projection: Gauss-Kruger –

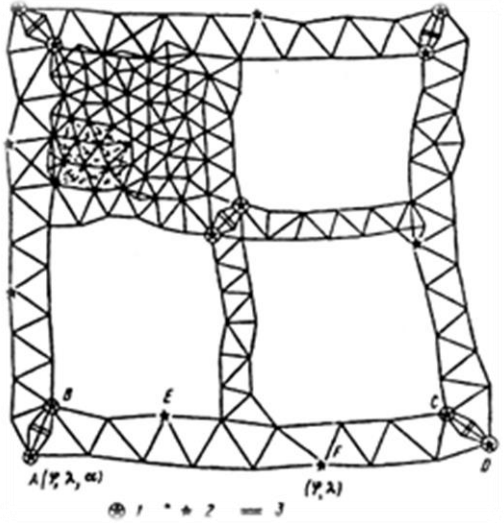
  $6^o$ and $3^o$ zones

- Geodetic, 2D Coordinate systems –

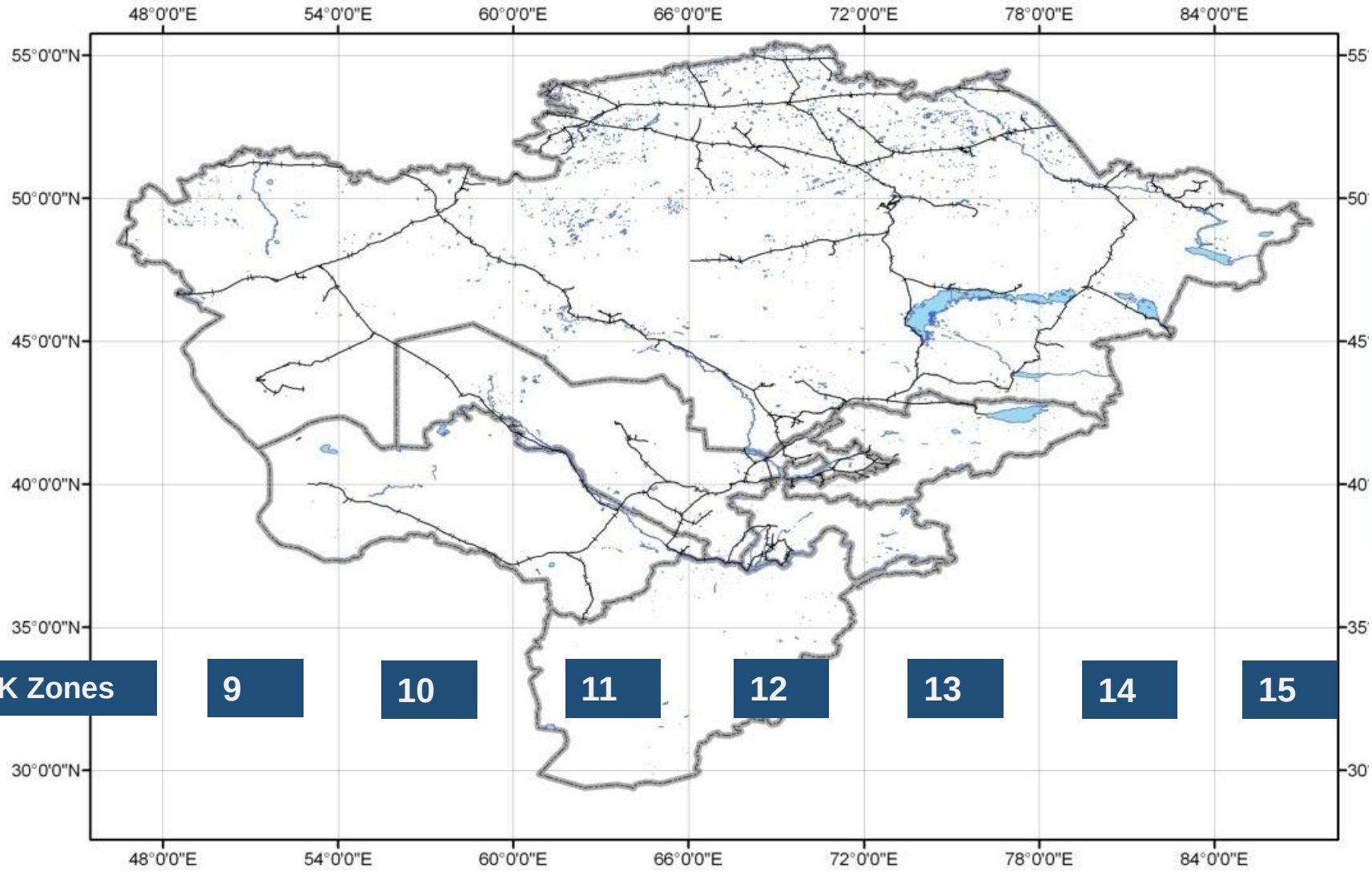
  SK 42, 63, 95 (Pulkovo 1942, 1963, 1995)

- Datum: Pulkovo 1942
- The altitude system: Baltic sea level
- State geodetic networks
  - ➢ Horizontal – 4 classes
  - ➢ Levelling – 4 classes
  - ➢ Gravimetric – 4 classes
- Limitation for civil use
- High secrecy of all coordinates!!!



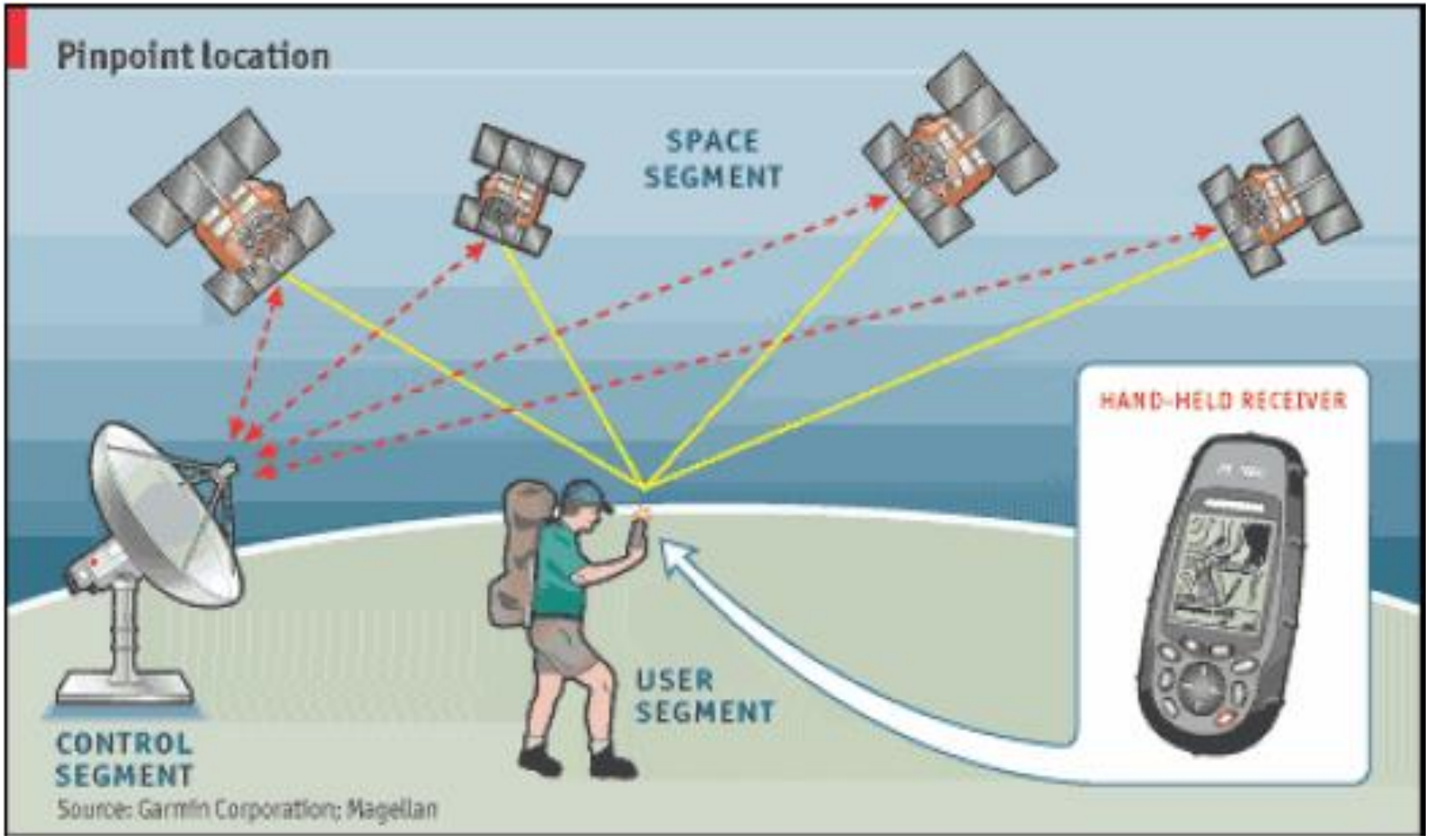



# 2D Coordinate system - Pulkovo 42

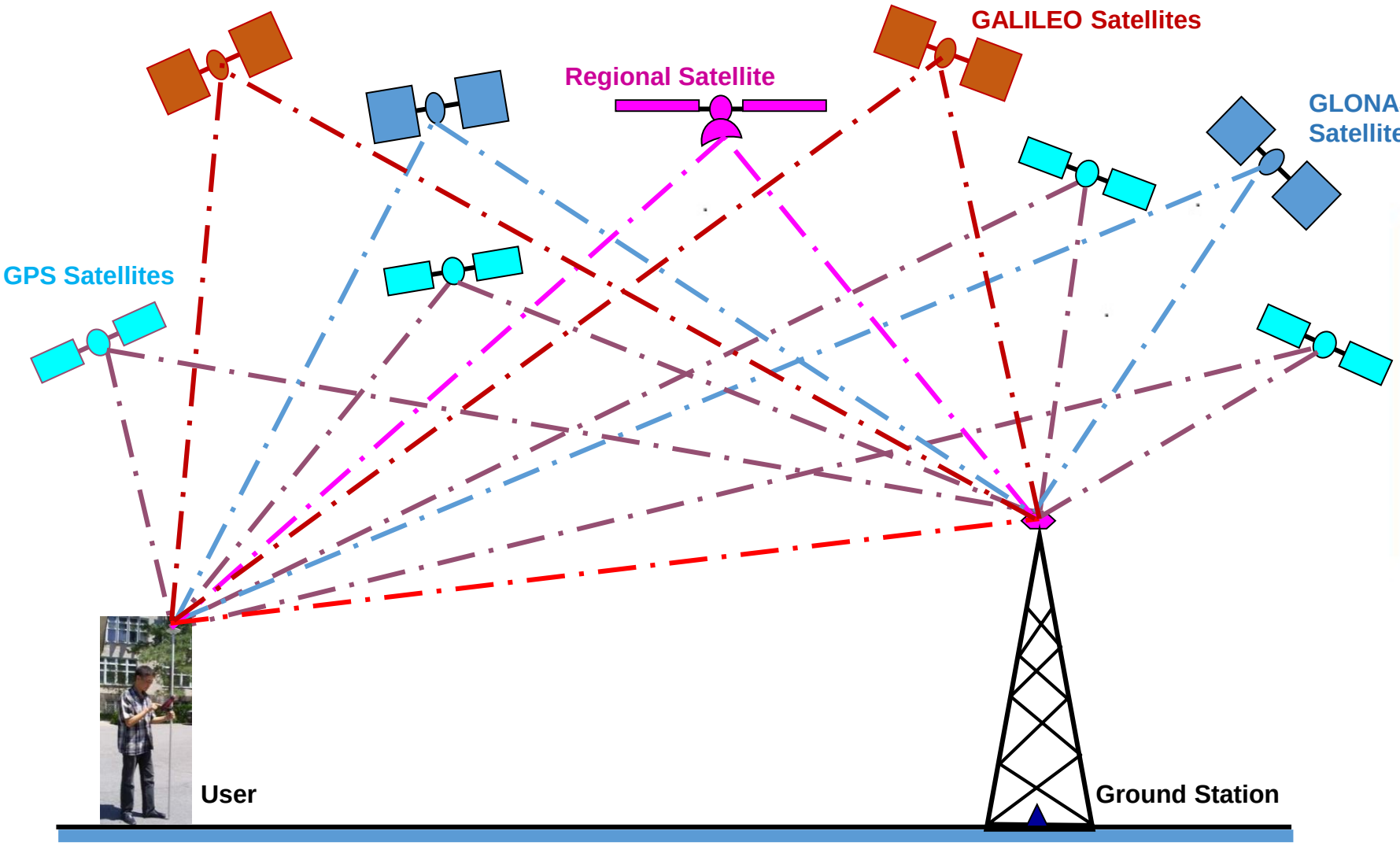



| GK Zones | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|

# GPS Technology



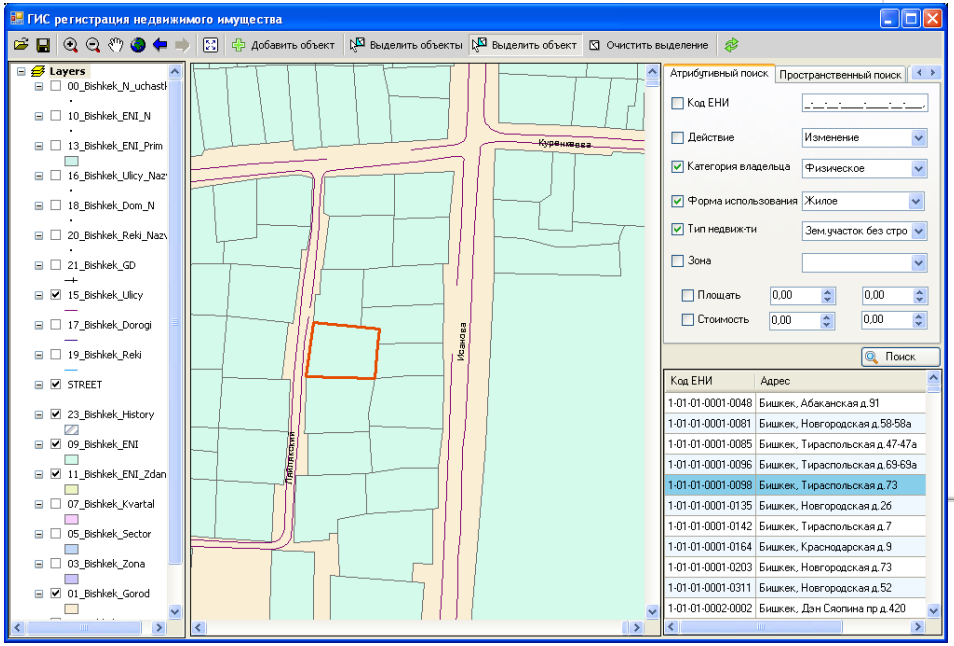
# GNSS Technology

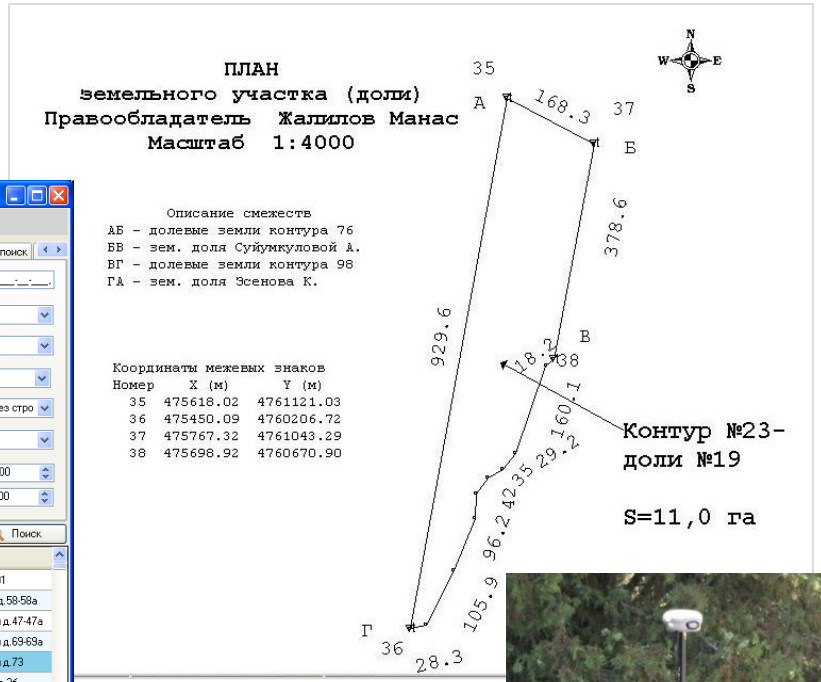


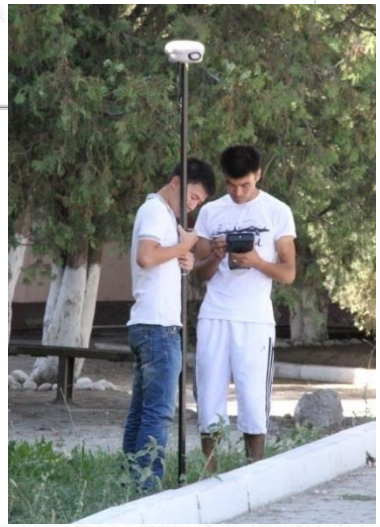
# GNSS in Central Asia

- Land Cadaster and Real Estate management (LIS)
- Digital mapping and Geoinformation systems
- Transportation and Logistics
- Engineering Survey (geodetic investigations, construction and monitoring of buildings, transport and hydro-technical facilities)
- Global and Regional Geodynamic studies
- Natural Risk management (risk assessment and early warning):
  - Earthquakes
  - Landslides
- Military and National Border Guard Services, etc.

# Land and Real Estate Registration Projects

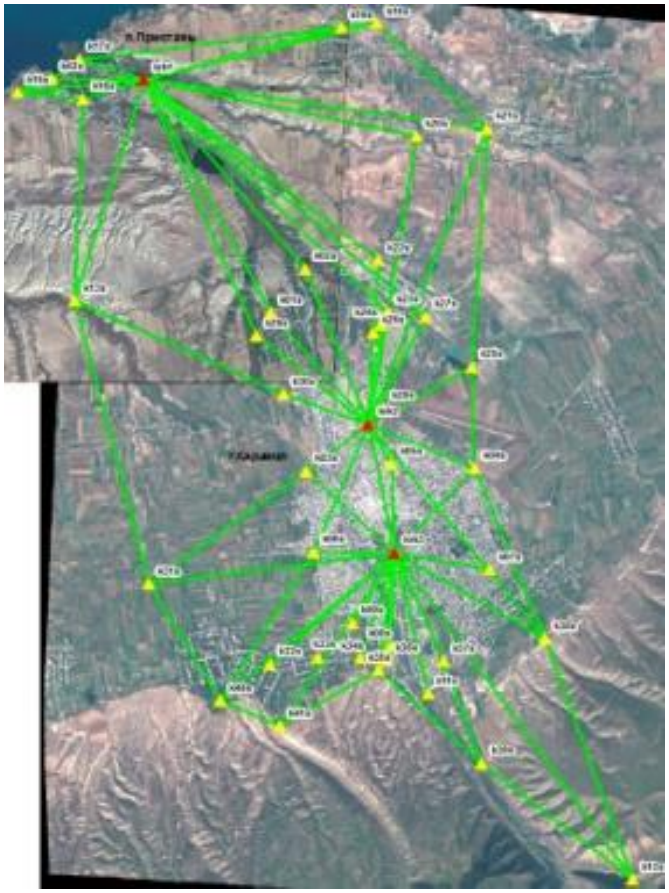


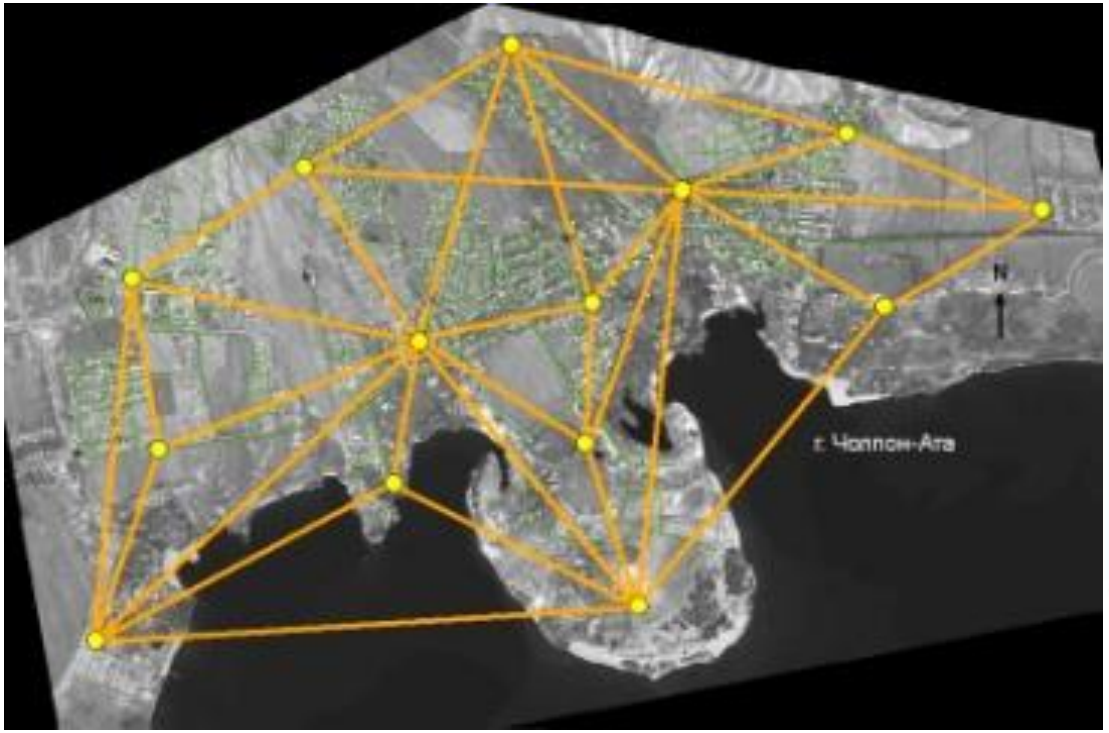



WB Projects “Registration of Land and Real Estate 1&2”,
2000-2012 ($15,2M)
Department of Cadastre and Real Estate Registration (DCR)
State Registration Service of the Kyrgyz Republic (SRS KR)

# Local GNSS Survey Networks for Urban Infrastructure mapping





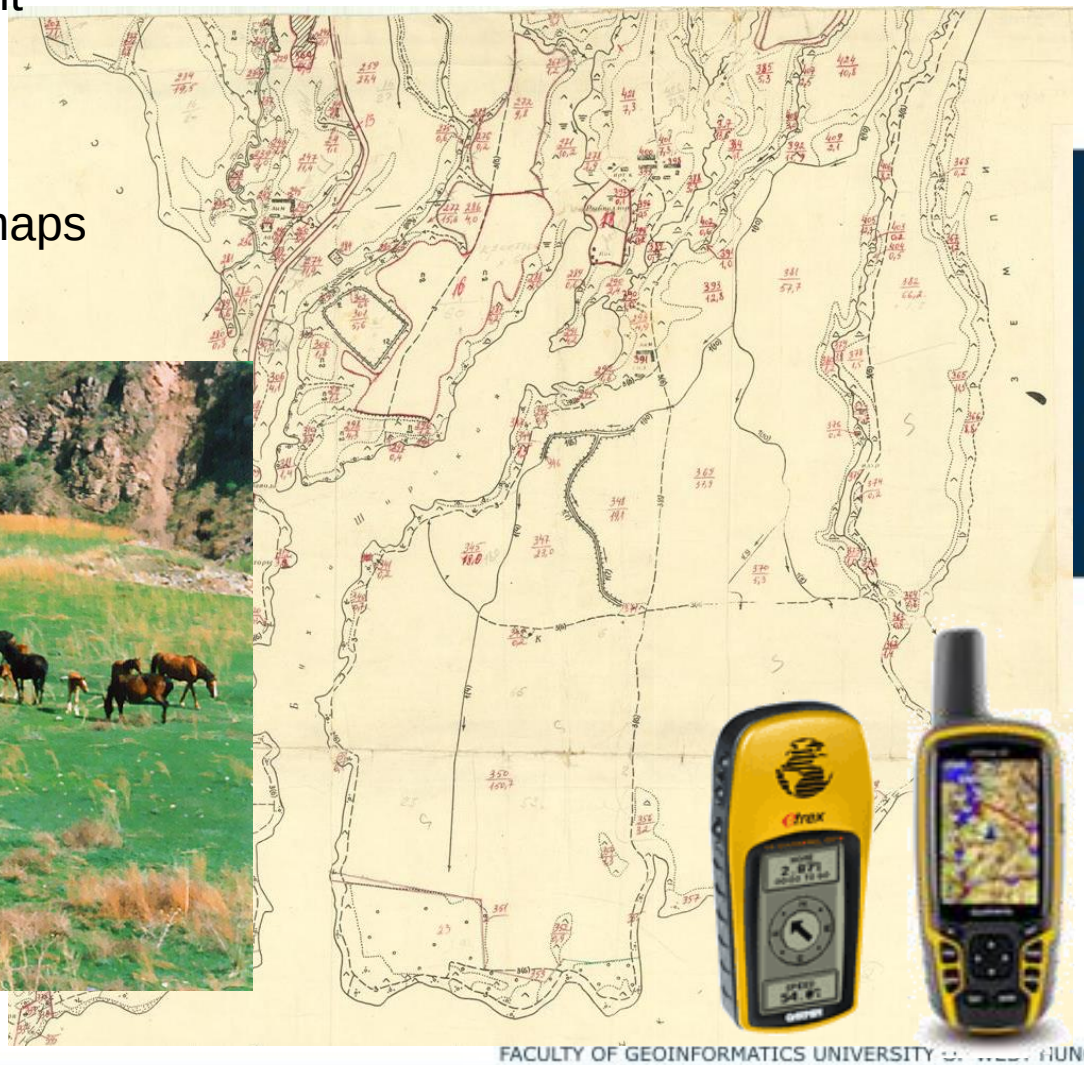

22 GNSS Ground Control Points (GCP) in the Balykchy city, 13 GCP in the Cholpon-Ata city and 55 GCP in the Karakol city. Combined topographic survey with GPS/GNSS receivers and totalstations. Number of Survey points - 4000.

ADB Project “Sustainable Development of Issyk-Kul”, 2010-2011

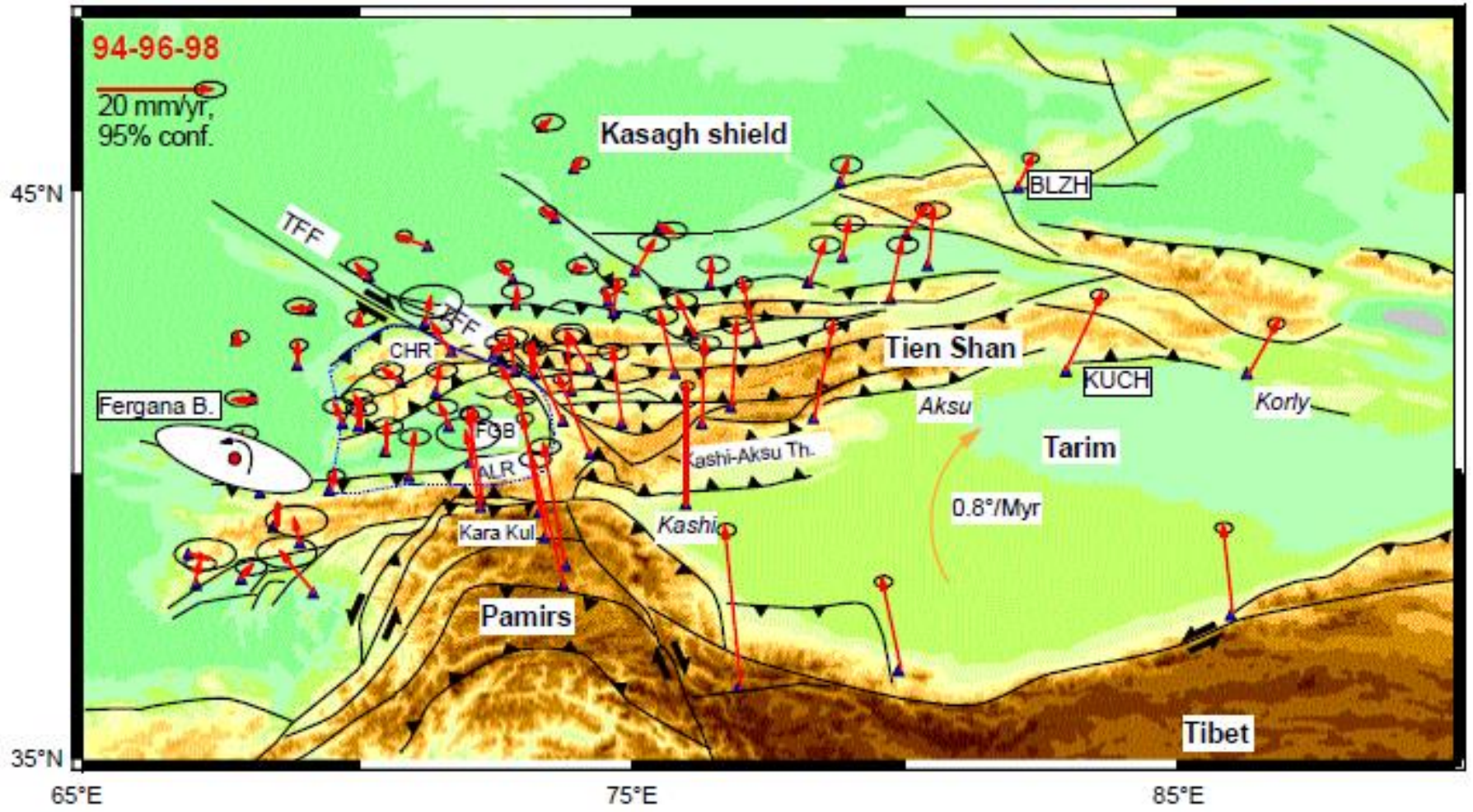
# Use of GPS in Pasture Mapping

Project “Agricultural Investments and Services’
Pasture Management Component
World Bank 2008-2013 ($34 M)

Pastures – 9,15 mln Ha
GPS survey, georeferencing of maps
Digital pasture maps

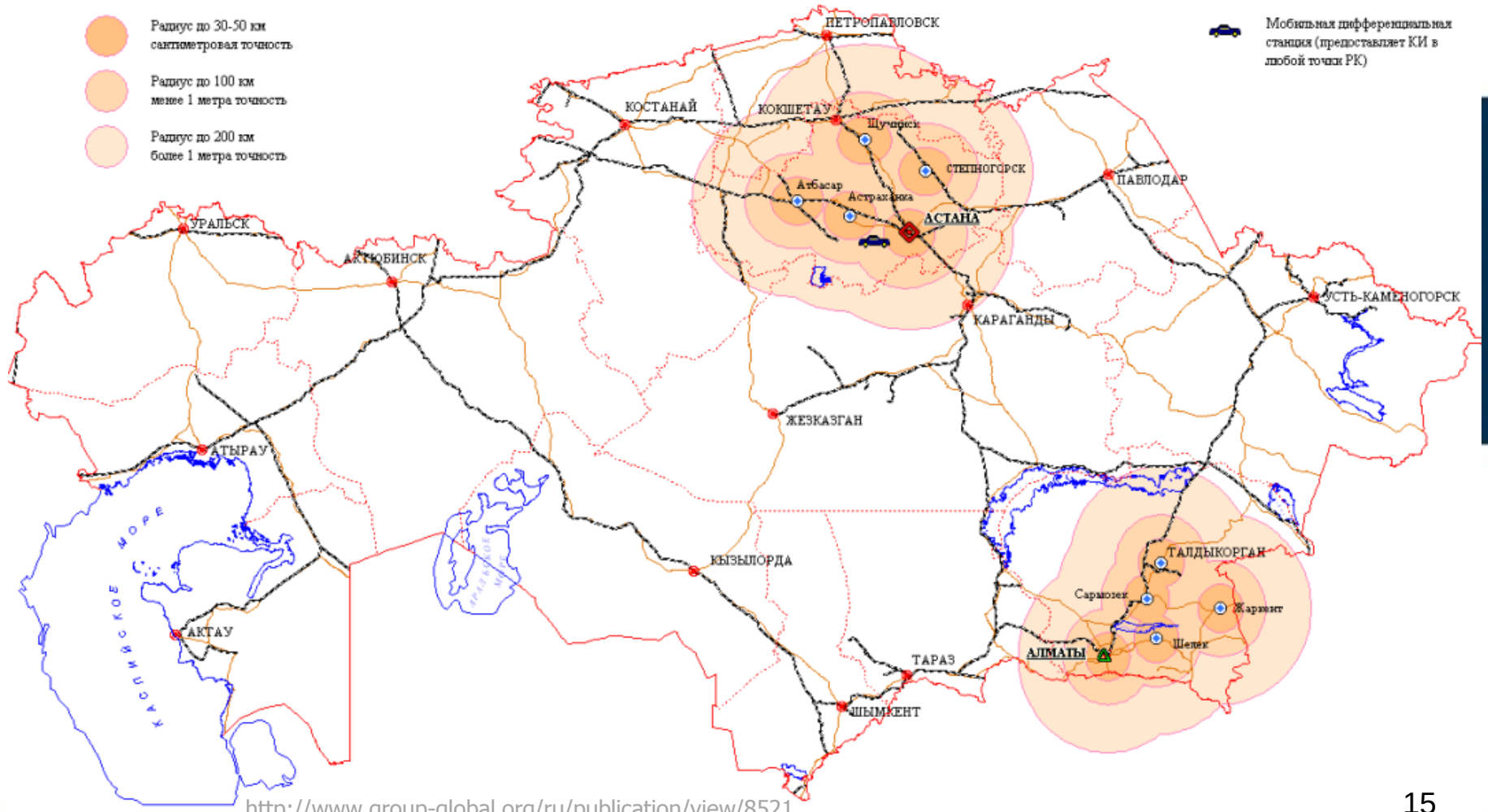


# Central Asian Tectonic Science Project (CATS, GFZ, 1994-1998)



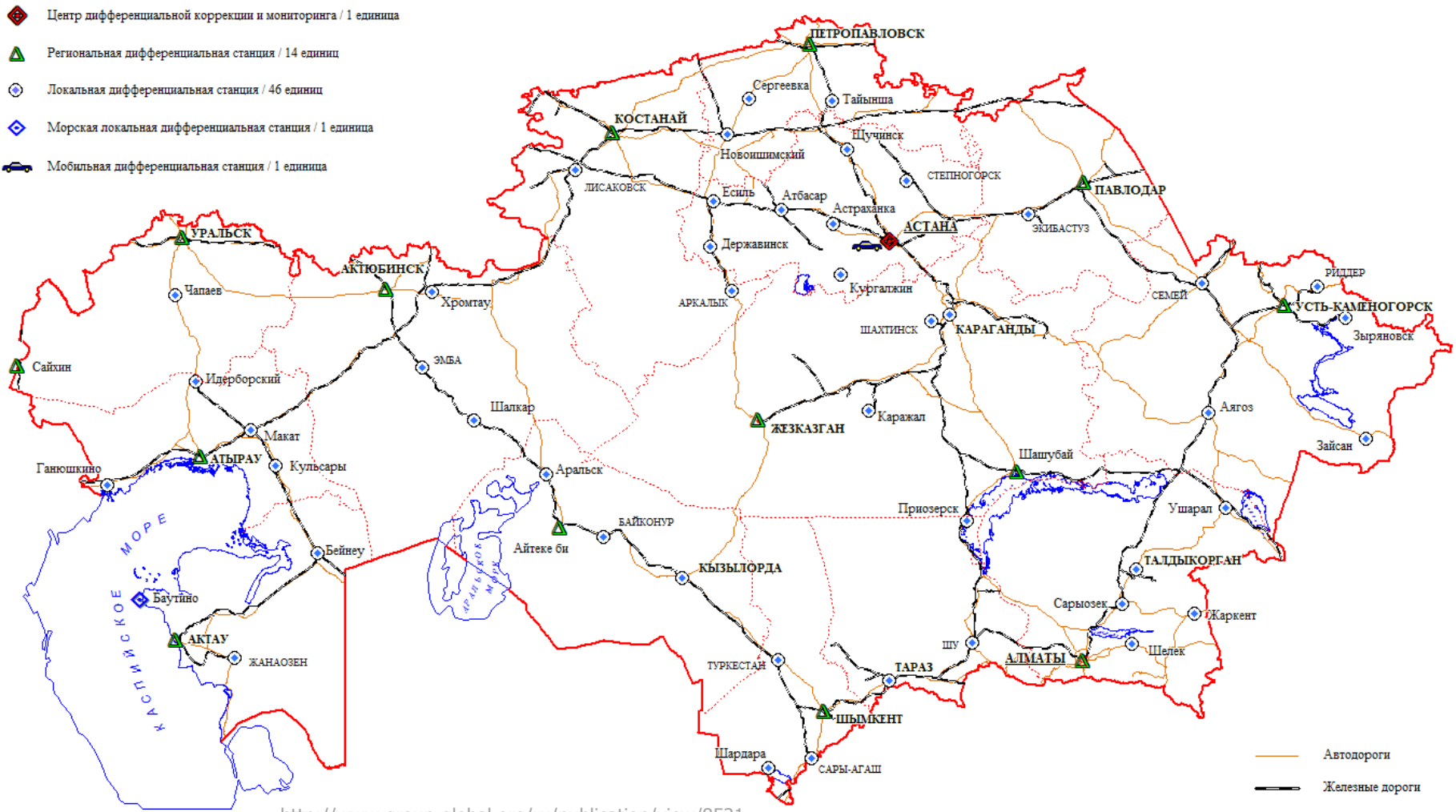
# National GNSS Networks of the Central Asian countries

# National GNSS Network of Kazakhstan (10 CORS in 2013)



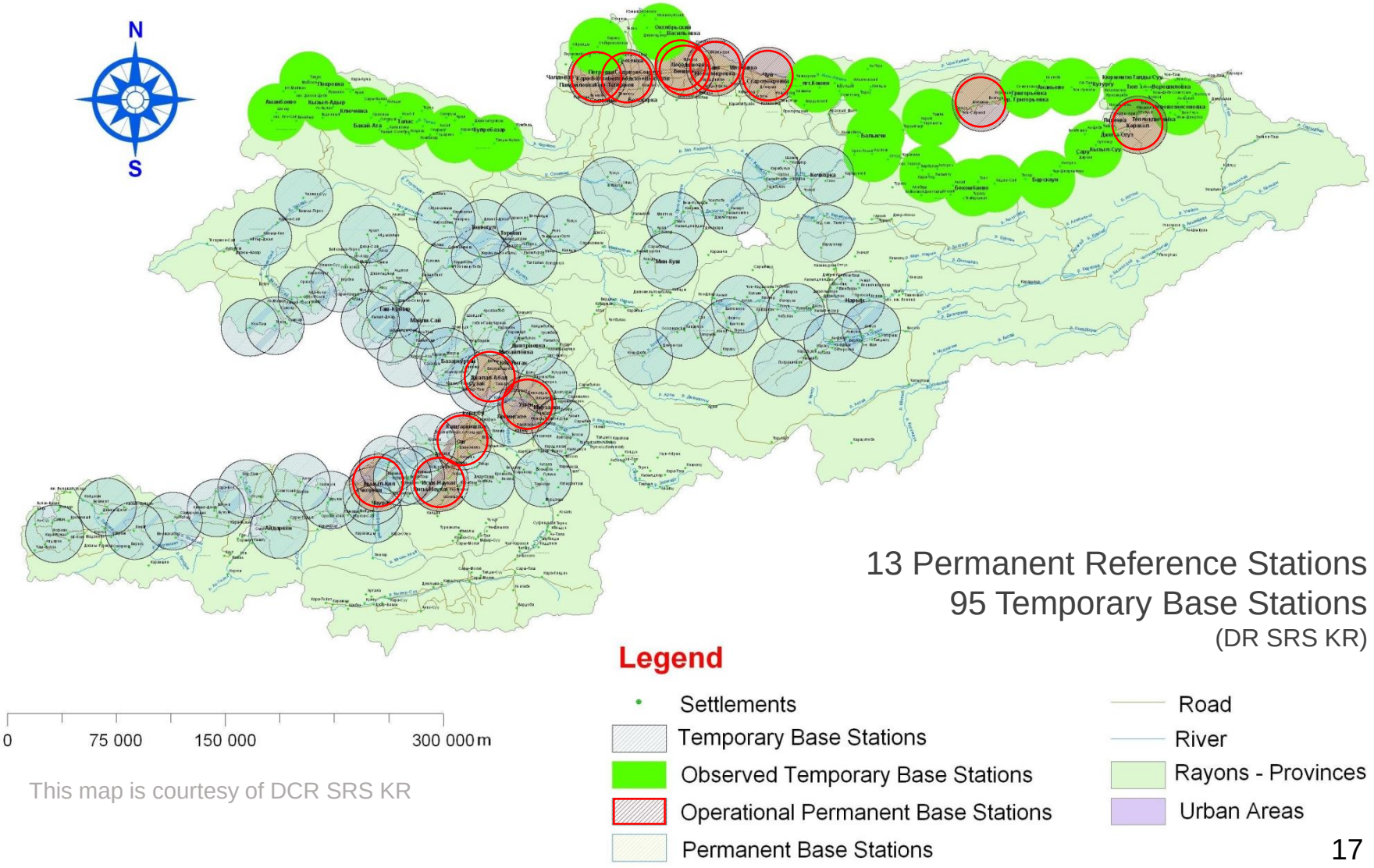

http://www.group-global.org/ru/publication/view/8521

# National GNSS Network of Kazakhstan (60 CORS in 2014-15)




http://www.group-global.org/ru/publication/view/8521

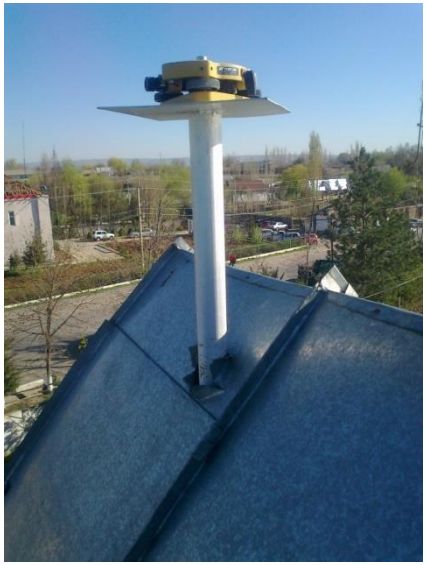
# National GNSS Network of Kyrgyzstan (13 CORS in 2014)



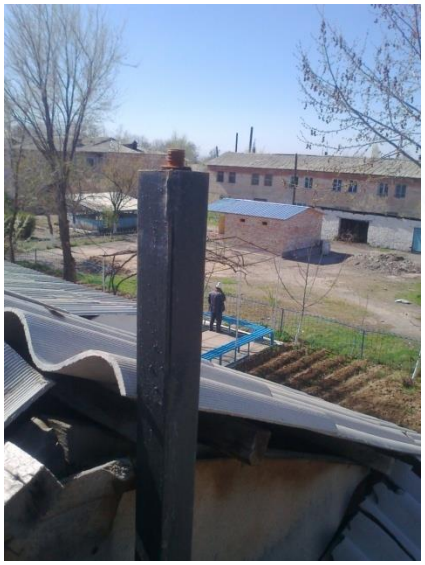

This map is courtesy of DCR SRS KR

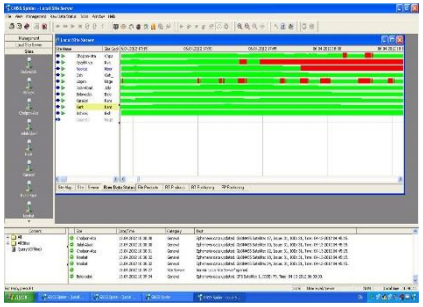
# Base Stations of the National GNSS Network of Kyrgyzstan

Temporary Base Stations



KYRPOS





Continuously Operating Reference Stations (CORS)



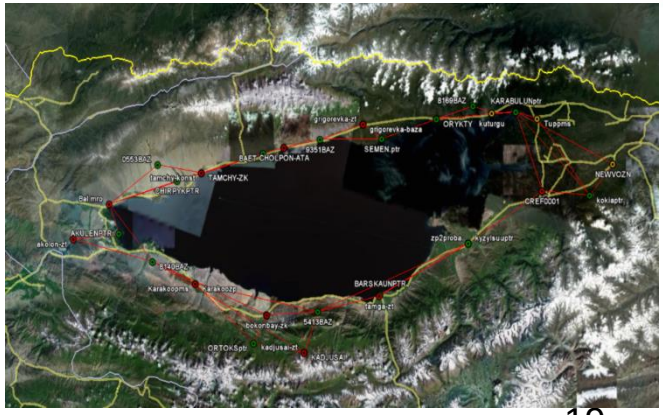
The pictures are courtesy of DC SRS KR

# ITRF Coordinates of the Base Stations in Issyk-Kul oblast, Kyrgyzstan

| GEOGRAPHIC | | | |
|---|---|---|---|
| • 0553BAZ | 42° 35' 20.77843" N | 76° 26' 18.35856" E | 2002.1263 |
| • BAET | 42° 37' 38.89097" N | 76° 58' 22.39561" E | 1641.4578 |
| • BARSKAUNptr | 42° 11' 01.55023" N | 77° 33' 50.75999" E | 1581.9695 |
| • CHIRPYKptr | 42° 32' 21.45448" N | 76° 32' 15.05950" E | 1674.2178 |
| • KARABULUNptr | 42° 45' 23.32103" N | 78° 15' 03.27141" E | 1579.2903 |
| • KOKKIAptr | 42° 29' 27.73543" N | 78° 37' 23.18126" E | 2925.4069 |
| • KYZYL-SUU | 42° 20' 38.73700" N | 78° 00' 25.74384" E | 1723.5680 |
| • ORTOKSptr | 42° 01' 46.23753" N | 76° 55' 50.92933" E | 2808.8346 |
| • SEMENptr | 42° 40' 28.37018" N | 77° 34' 22.92119" E | 1580.5445 |

| GEOCENTRIC | X | Y | Z |
|---|---|---|---|
| • 0553BAZ | 1103144.0091 | 4573270.9850 | 4295362.1137 |
| • BAET | 1059726.8239 | 4580291.7040 | 4298255.4786 |
| • BARSKAUNptr | 1019559.1202 | 4623406.1161 | 4261812.9869 |
| • CHIRPYKptr | 1096049.0390 | 4578578.0305 | 4291063.7106 |
| • KARABULUNptr | 955316.6731 | 4593227.4060 | 4308749.4967 |
| • KOKKIAptr | 929594.4708 | 4619889.5809 | 4287956.7072 |
| • KYZYL-SUU | 981309.9123 | 4619535.1514 | 4275091.3911 |
| • ORTOKSptr | 1073402.5529 | 4623936.1352 | 4249919.7244 |
| • SEMENptr | 1010920.8694 | 4587635.5058 | 4302061.5621 |

KYRPOS

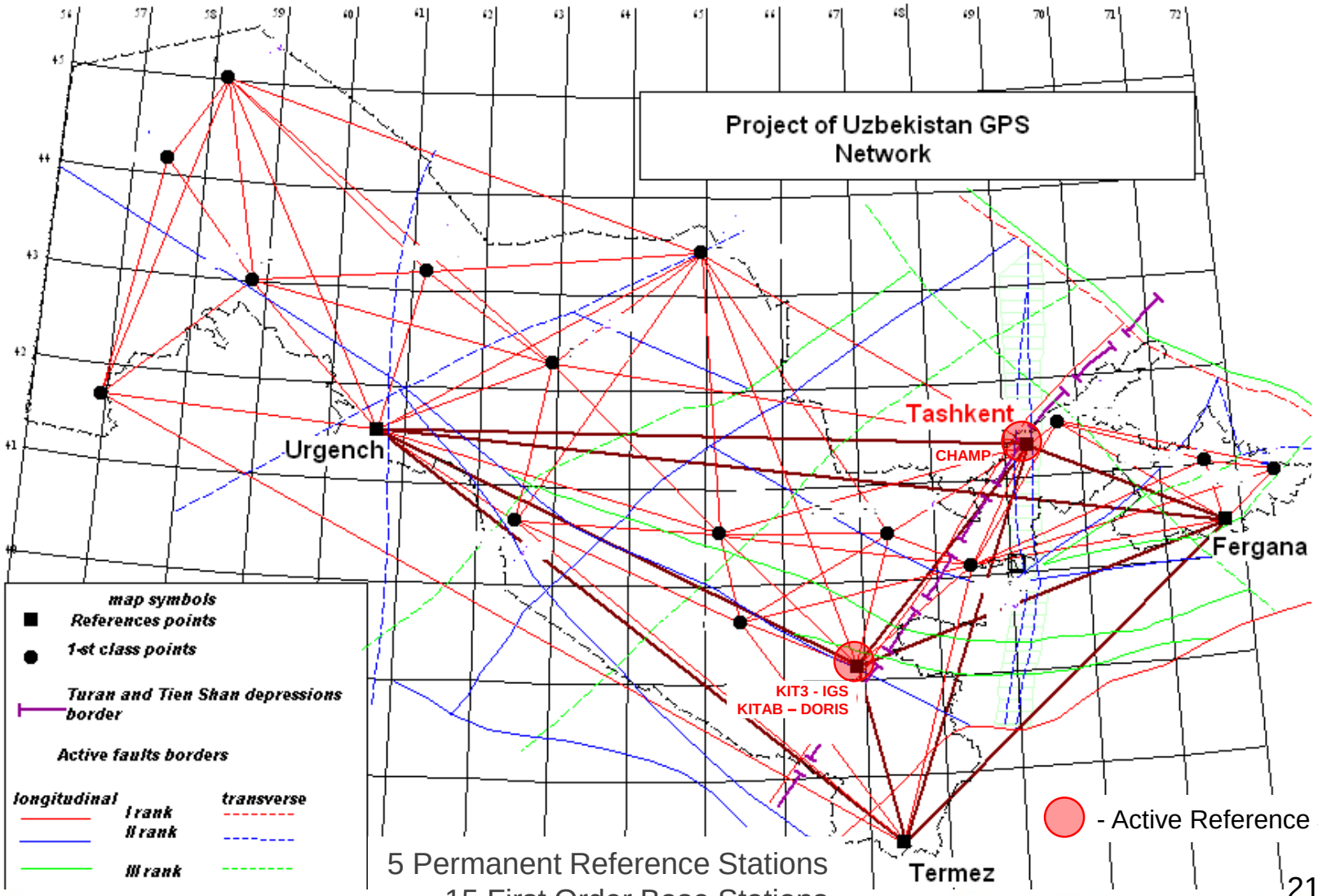


http://gosreg.kg/index.php?option=com_content&view=article&id=+336&Itemid=214

# GNSS in Tajikistan (planning stage of the National GNSS Network )


- Active Reference Station

# Project of the National GNSS Network of Uzbekistan




5 Permanent Reference Stations
15 First Order Base Stations

http://www.oosa.unvienna.org/pdf/sap/2013/croatia/3.6.pdf (modified)

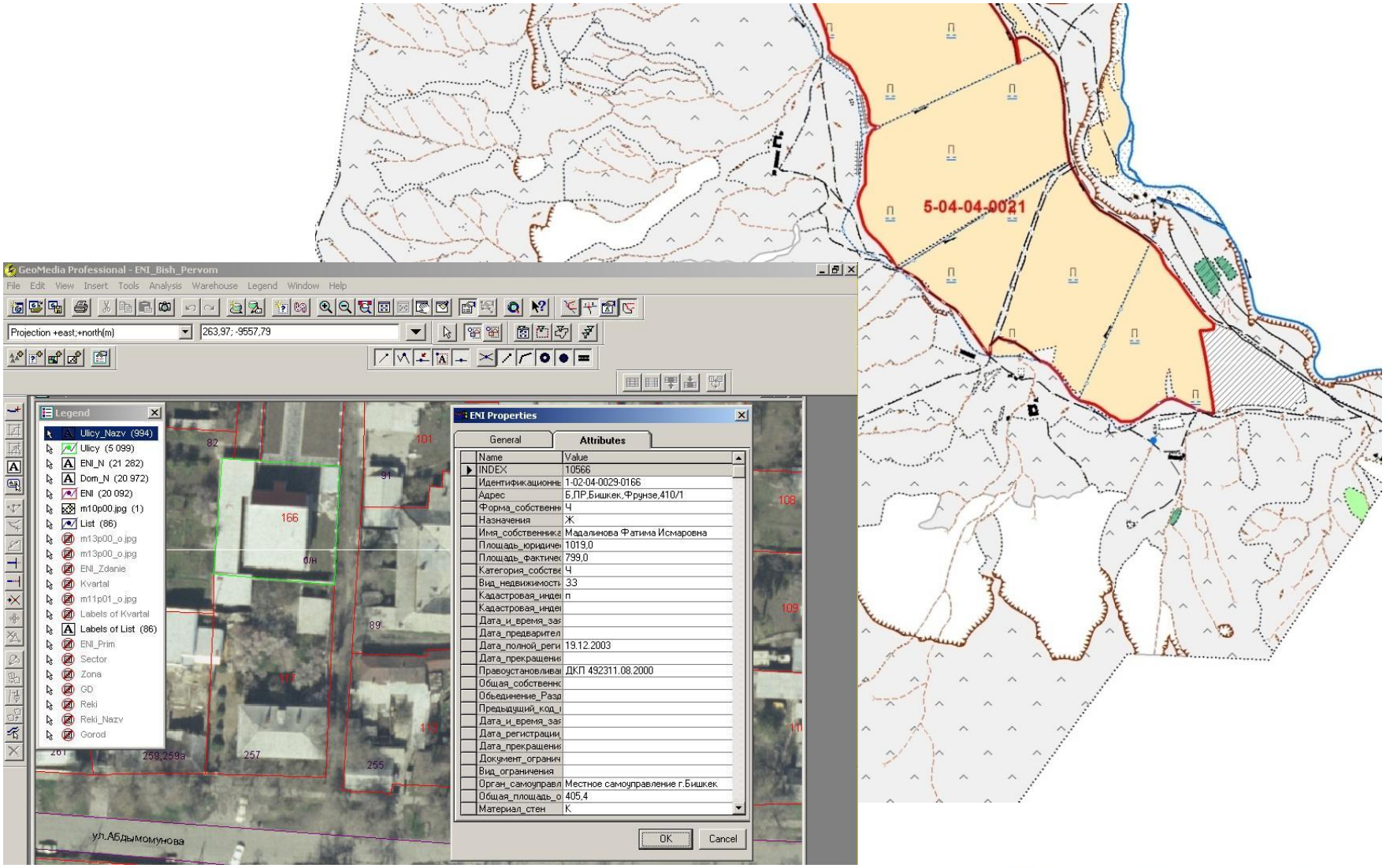
# New National Coordinate Systems of the Central Asian countries

- Kazakhstan (planning stage)
- Kyrgyzstan has implemented new National Coordinate System “Kyrg06” in 2010 (ITRF 2005, UTM, 3º)
- Tajikistan (planning stage)
- Uzbekistan (planning stage)

The World Geodetic System 1984 (WGS 84) and the Universal Transverse Mercator (ITRF based UTM) projected coordinate system have been widely used today in all countries of the region.

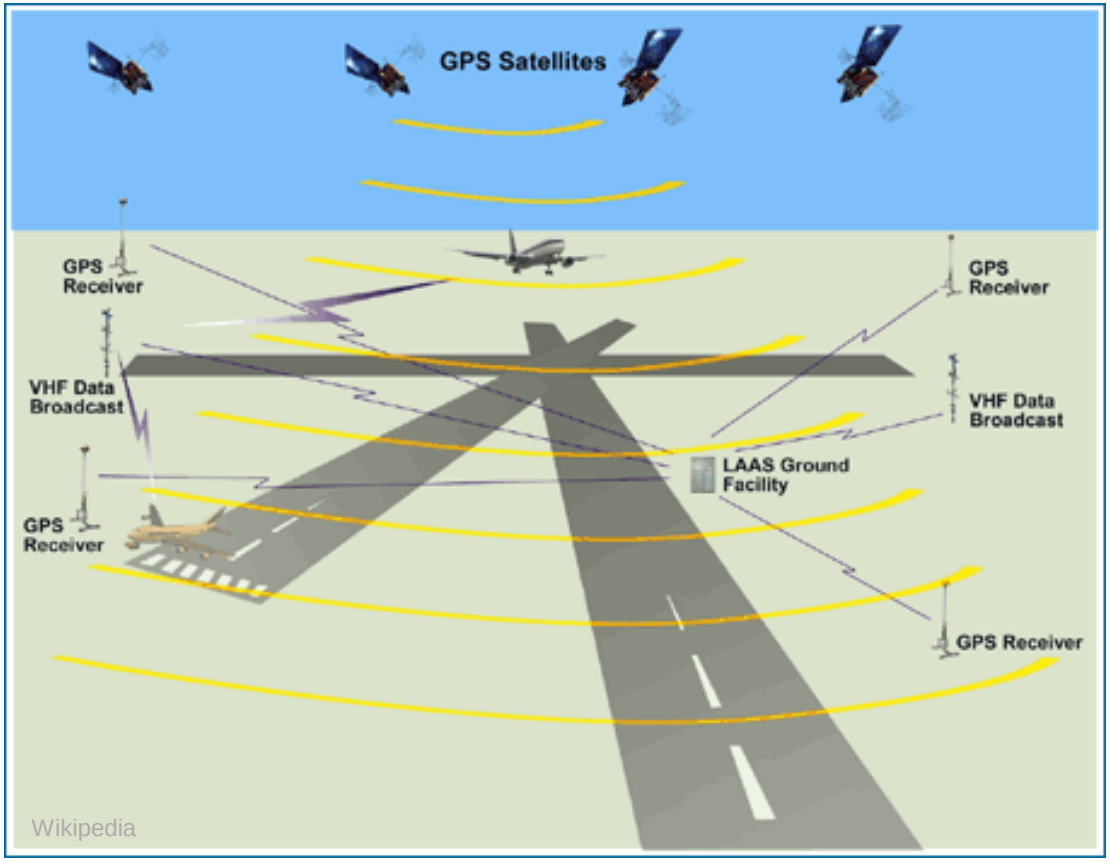
# Perspectives and trends of GNSS applications in the Central Asian countries

# Land Information Systems and GIS



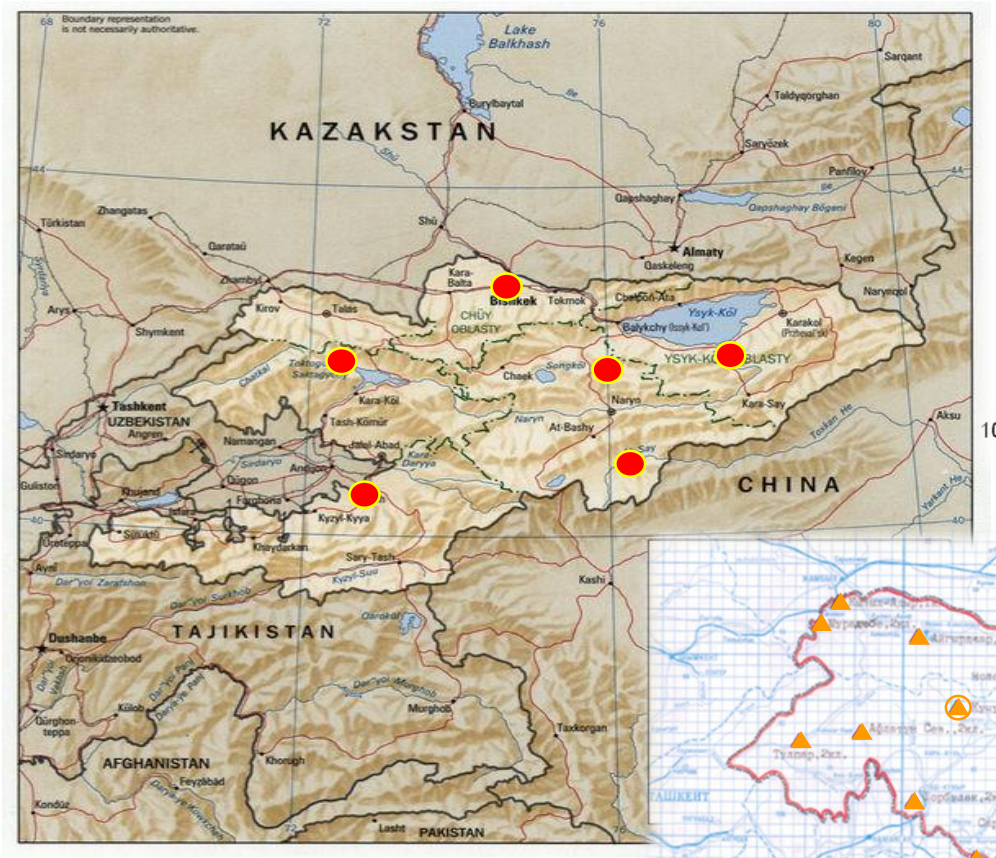
# Engineering Survey and Mapping

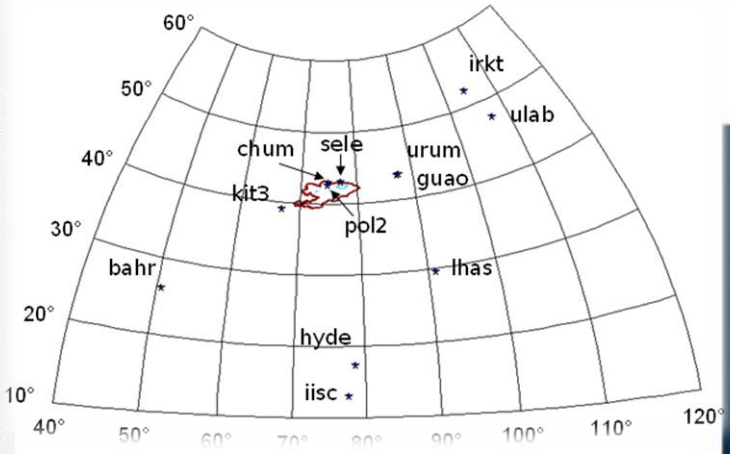
# Air traffic, transport and logistics

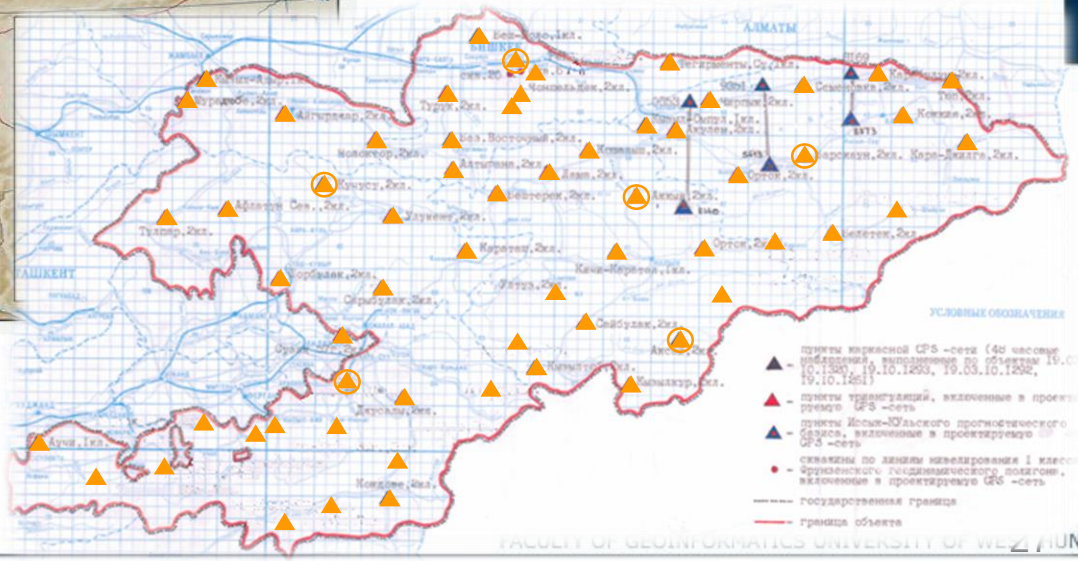





# GNSS Observations for the new National Geodetic Networks (Kyrgyzstan)



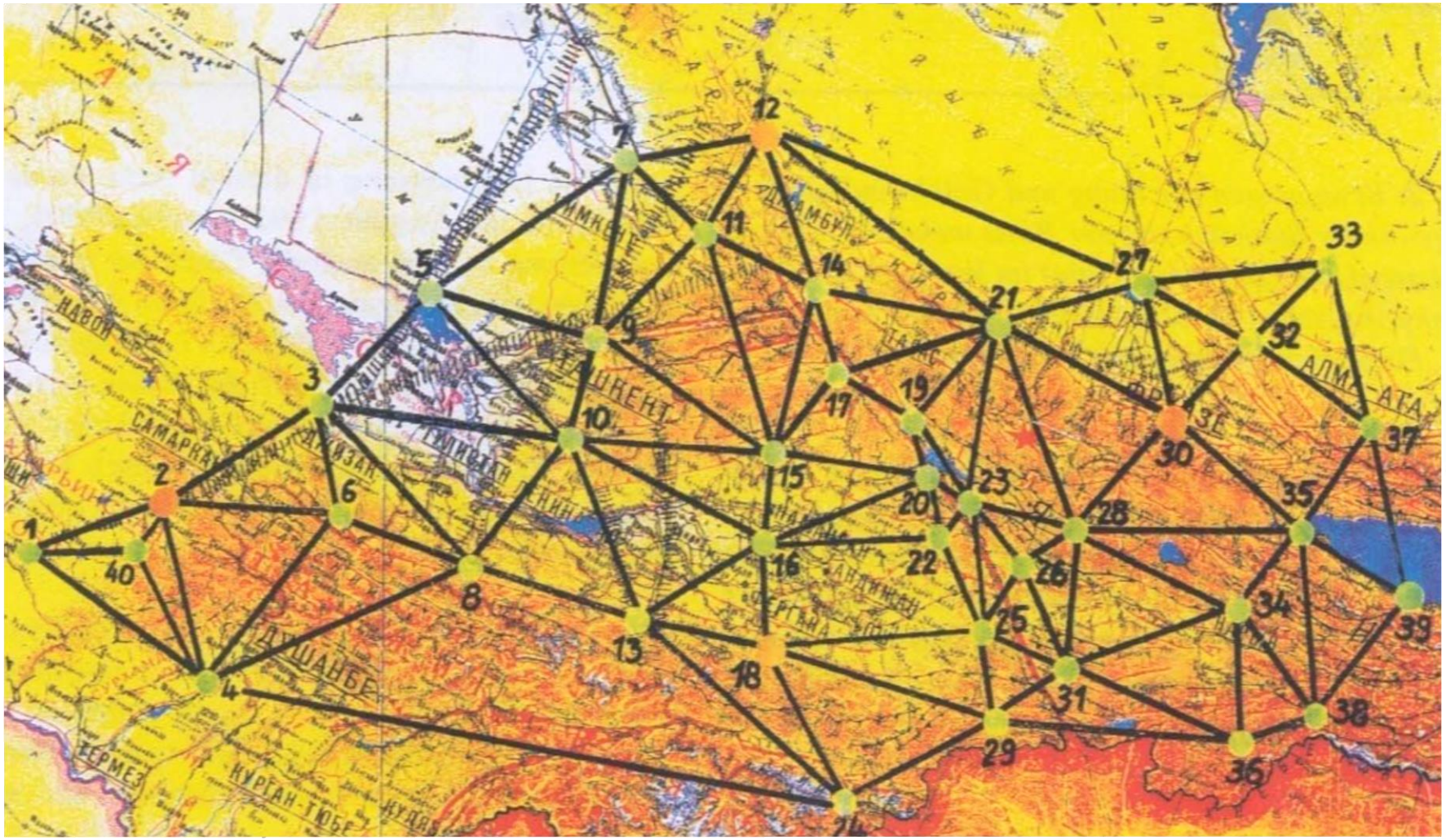



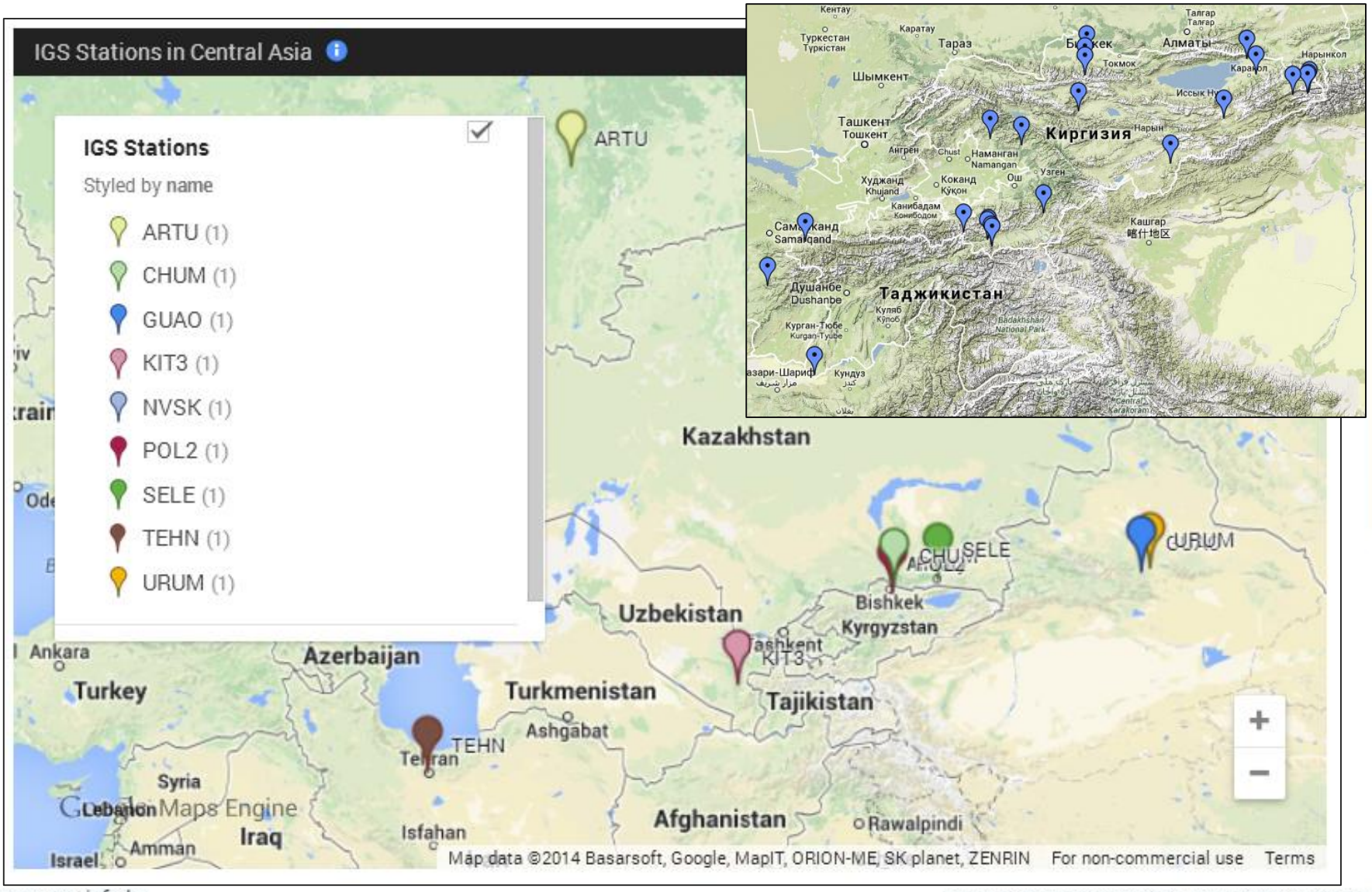
Zero Order 6 Geodetic Points
First Order 67 Geodetic Points

SGCS KR, 2007

# Geodynamic and Environmental Studies in the Central Asian (CATS, GFZ)



# Globalization and Regional cooperation



# Conclusion and discussions

- LIS and GIS
- Surveying and Mapping (GNSS technology is replacing the traditional surveying based on the old state geodetic networks; ITRF / Pulkovo)
- Air traffic, transport and logistics (commercial navigation and LBS services)
- Development of the new National coordinate systems (GNSS Observations and International Reference Systems)
- Geodynamic and Environmental Studies (seismic active region)
- Active GNSS Networks (all countries are implementing, but network management is weak because of the weak economies and underestimation)
- Development of the common Central Asian geodetic datum and interoperable reference networks, NSDI and open data sharing

# Acknowledgment

My participation at GIS Open 2014 and PhD study visit
to the University of West Hungary were funded
by “gSmart” project of the Erasmus Mundus Programme


Very appreciated:
the kindest scientific advises from Dr. György Busics, UWH,
very helpful input into my research work by Prof.Dr. Bela Markus, UWH
as well as valuable comments of my colleagues from
Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan

Thank you for your attention!

Köszönöm a figyelmet!

Чоң рахмат!