Investigation KITAB-TASHKENT baseline on the combination of different geodetic techniques

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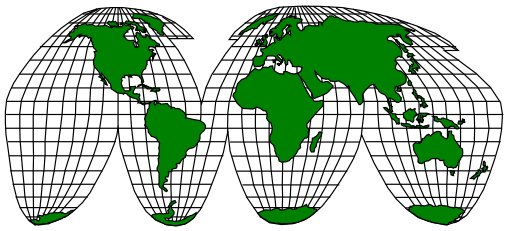
Presentation outline

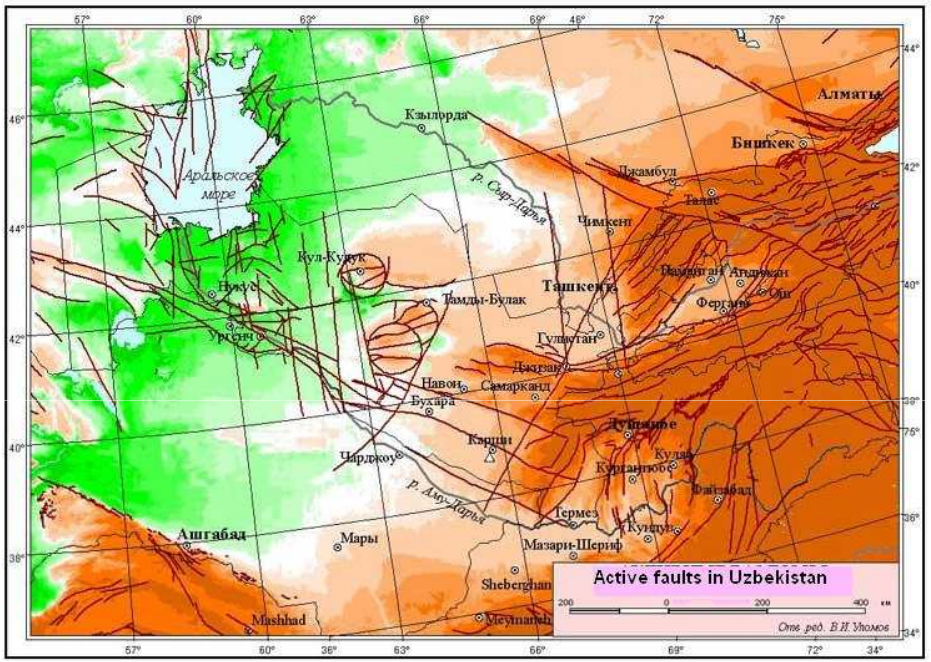


- Introduction
- Options for new network
- Perspectives
- Conclusions

1. Introduction

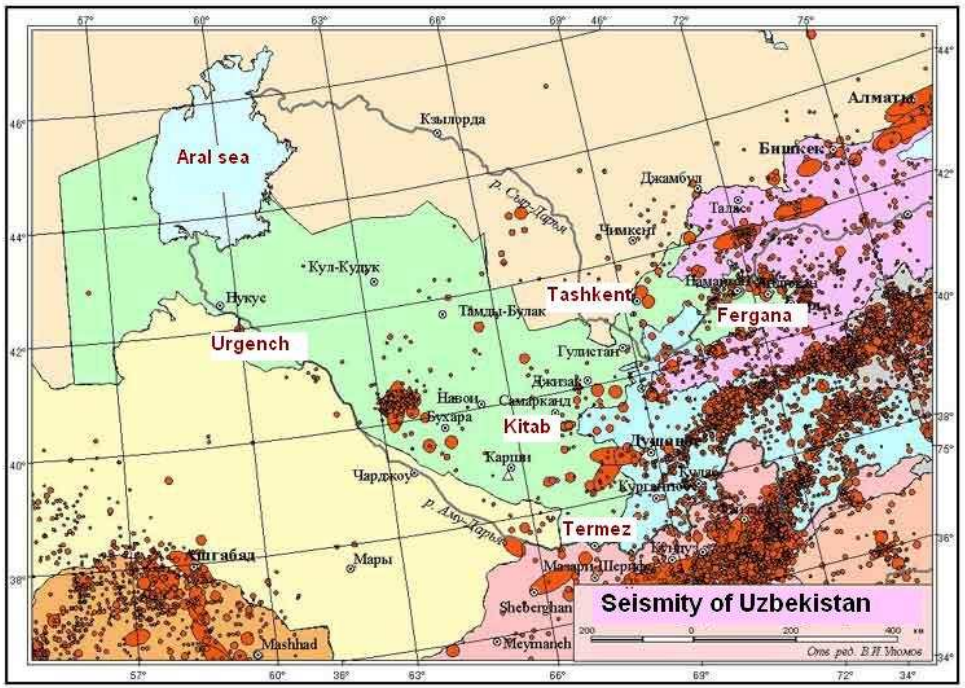
- State Geodetic Network of the former Soviet Union was developed by Krasovsky scheme more than 60 years ago
- The general regional deformations in the north and the east countries made 20-30 m, local deformations on border of blocks of up to 10 m and more have been recorded
- Density of network for the decision of geodynamic problems is insufficient
- Krasovsky ellipsoid, focused mostly for Russia, did not take into account relief features of other regions

This network is static, its points remain stationary!

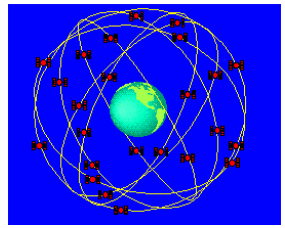


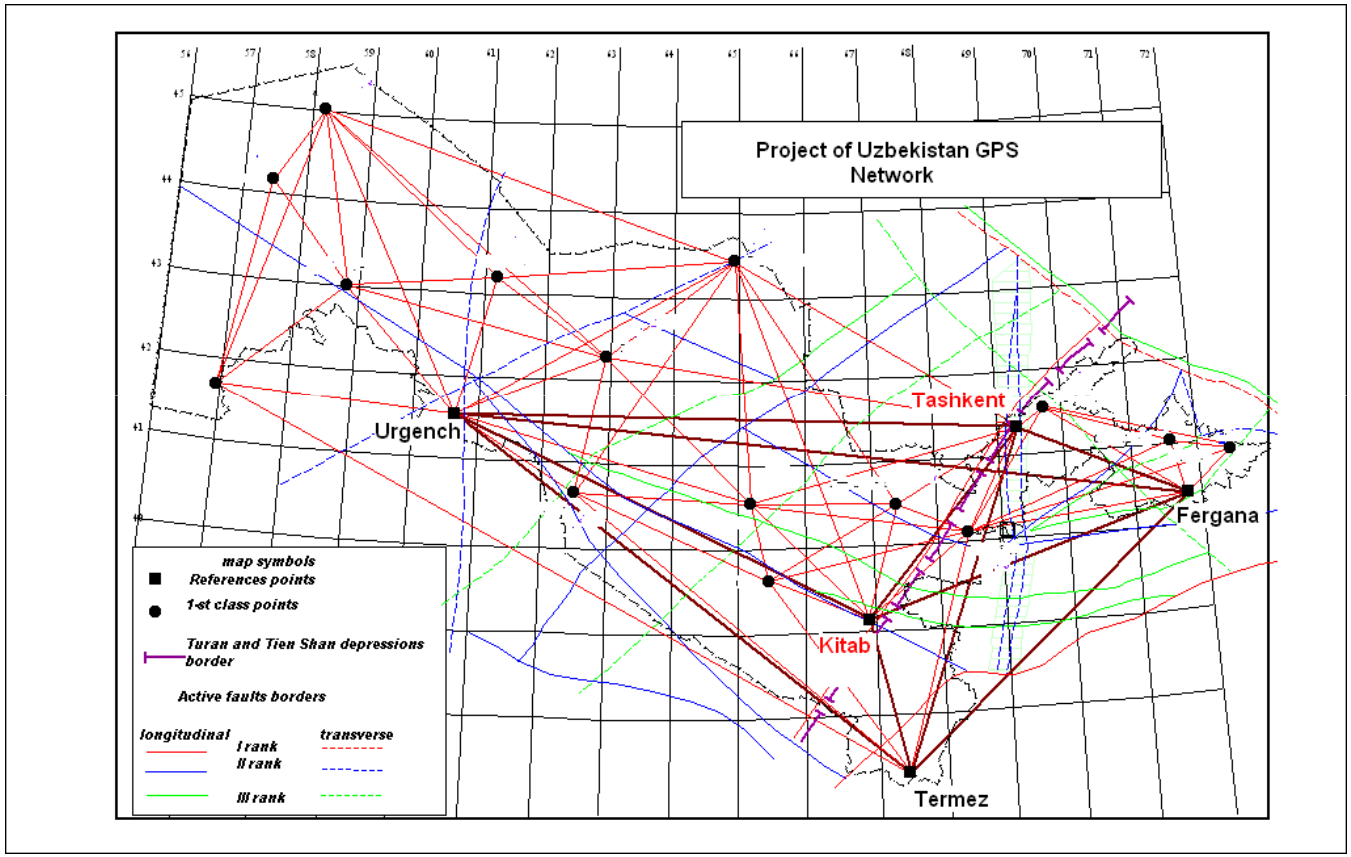
In this time there has also been the effect of large earthquakes, such as the 1966 (M=5.0) Tashkent Earthquake. Displacement reaches 4 cm.

Uzbekistan, lying across the Eurasia/India plate boundary, is subject to ground movements across the **country of 4-5 cm/year**, disregarding the effects of large earthquakes. This can amounts to 2 m in the last 50 years since CS-42 was established.



2. Options for new geodetic network
Project of GPS network





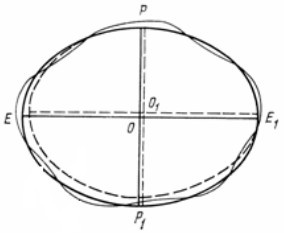
The new network consists of a hierarchy of stations, consisting of 5 reference stations, 15 1st Order stations. National satellite geodetic network in its structure is formed on the principle working “from the whole to the part”.

Reference stations network

- At present **reference stations network RGP** includes both permanently working points and passive points.
- The primary function of these stations will be to connect the Uzbekistan survey system to global geodetic networks (ITRF)
- Inter-station spacing in the reference network are 500 - 800 km.
- Two of these, Kitab and Tashkent are permanently active stations operated jointly by GeoForshugsZentrum (IGS and CHAMP projects).
- 6 Dual frequency tracking GPS receivers are operating at other three passive sites in Urgench, Termez and Fergana.

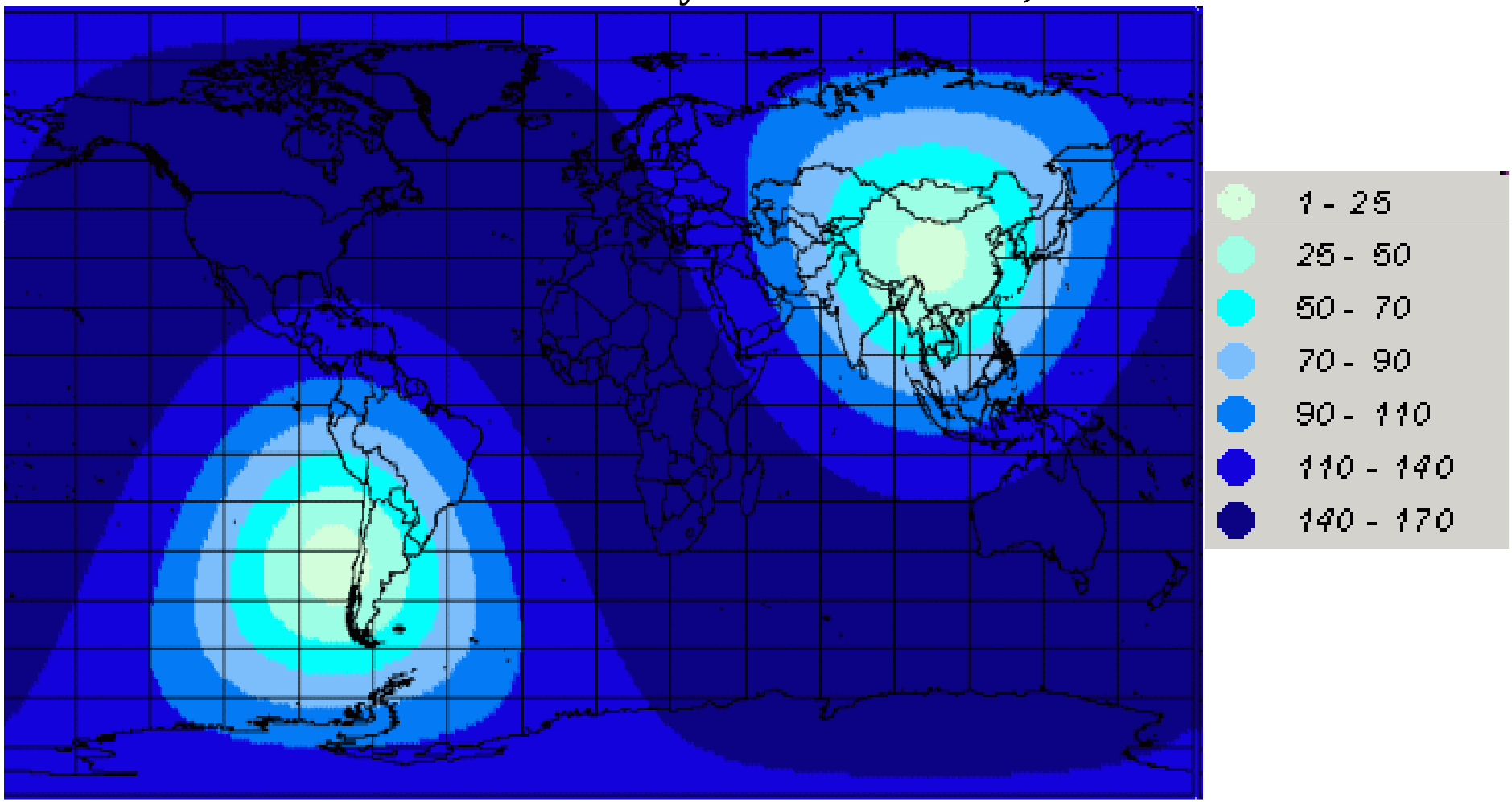
Reference point „Fergana“

Coordinates difference between WGS-84 and CK-42

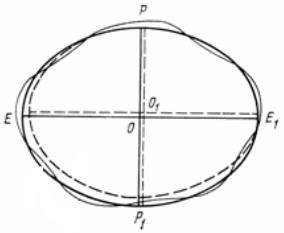


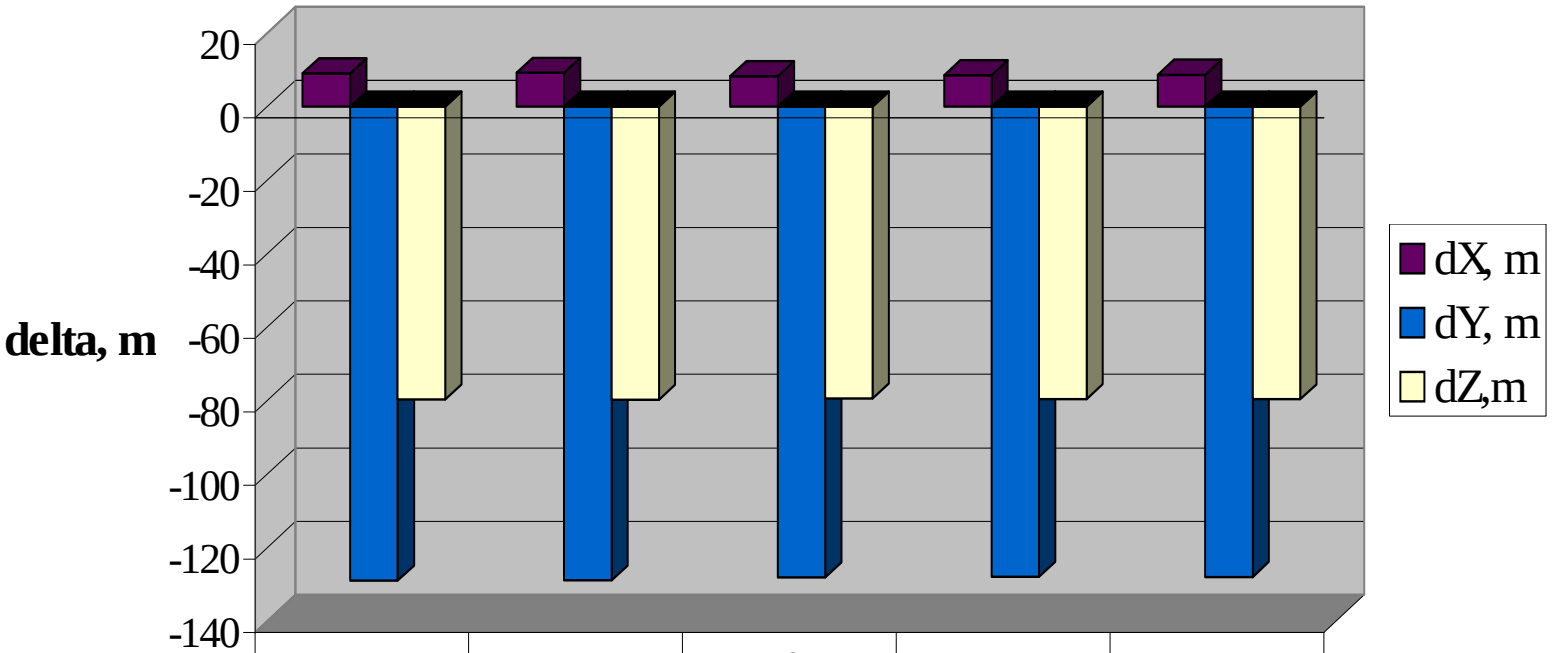
dx = 28, dy = -130, dz = -95

World Geodetic System 1984. NIMA, 2000



Transformation local and national coordinate system to and from GNSS geocentric coordinate reference systems





	angr	circ	kfir	mada	kit3
dX, m	9,102	9,236	8,305	8,544	8,666
dY, m	-128,97	-128,897	-128,085	-127,909	-127,936
dZ,m	-79,64	-79,72	-79,386	-79,542	-79,598

CATS stations

Coordinates difference between WGS-84 and CK-42 (cont.)

DATUM TRANS.	ΔX	ΔY	ΔZ	Method	Comments
CS42-WGS84	+15	-130	-84	Molodensky	NIMA
CS42-WGS84	+43	-108	-119	Helmert	NIMA (Caspian)
CS42-WGS84	+28	-130	-95	Molodensky	NIMA
CS42-WGS84	+25	-141	-80	Helmert	GOST(RU)
CS42-WGS84	+22	-123	-83	Molodensky	Bazlov(RU)
CS42-WGS84	+23	-125	-87	Molodensky	Fazilova(UZ)

Geometric Techniques - Basis for new network

1930 Kitab is one of six latitude stations of ILS

($\varphi=39^0\,07'\,59''$, $\lambda = 4^h\,27^m\,31.8^s$, H=690 m)

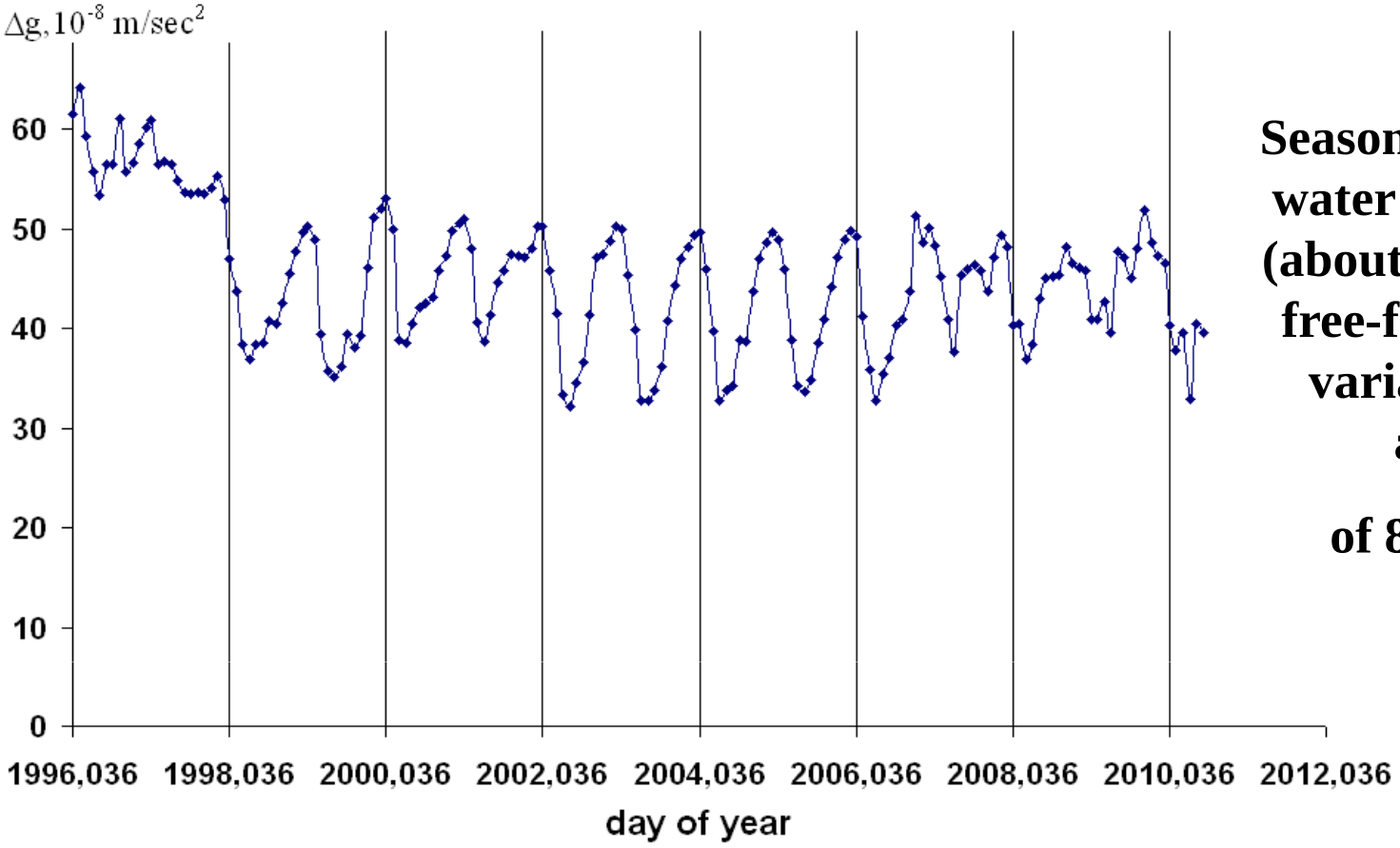
1990 Kitab Observatory became one of the stations of the International GPS Service for Geodynamics (IGS) and a permanent point of the DORIS network.

Geometric Techniques - Basis for new network

1873 **Foundation of Tashkent Astronomical Observatory for topography works in Central Asia and first determination of latitude of Tashkent**

($\varphi = 41^0\ 19'\ 36''$,
$\lambda = 4^h\ 37^m\ 10.5^s$ H=478 m)

2000 **GPS/CHAMP station at Tashkent station was installed**



Seasonal underground water level variations (about 3.2 m) lead to a free-fall acceleration variations with an amplitude

of $80 \cdot 10^{-8}$ m/sec ^{2}

$$\Delta g = 2\pi f \sigma h$$

Δg – *free – fall acceleration* var*iation*

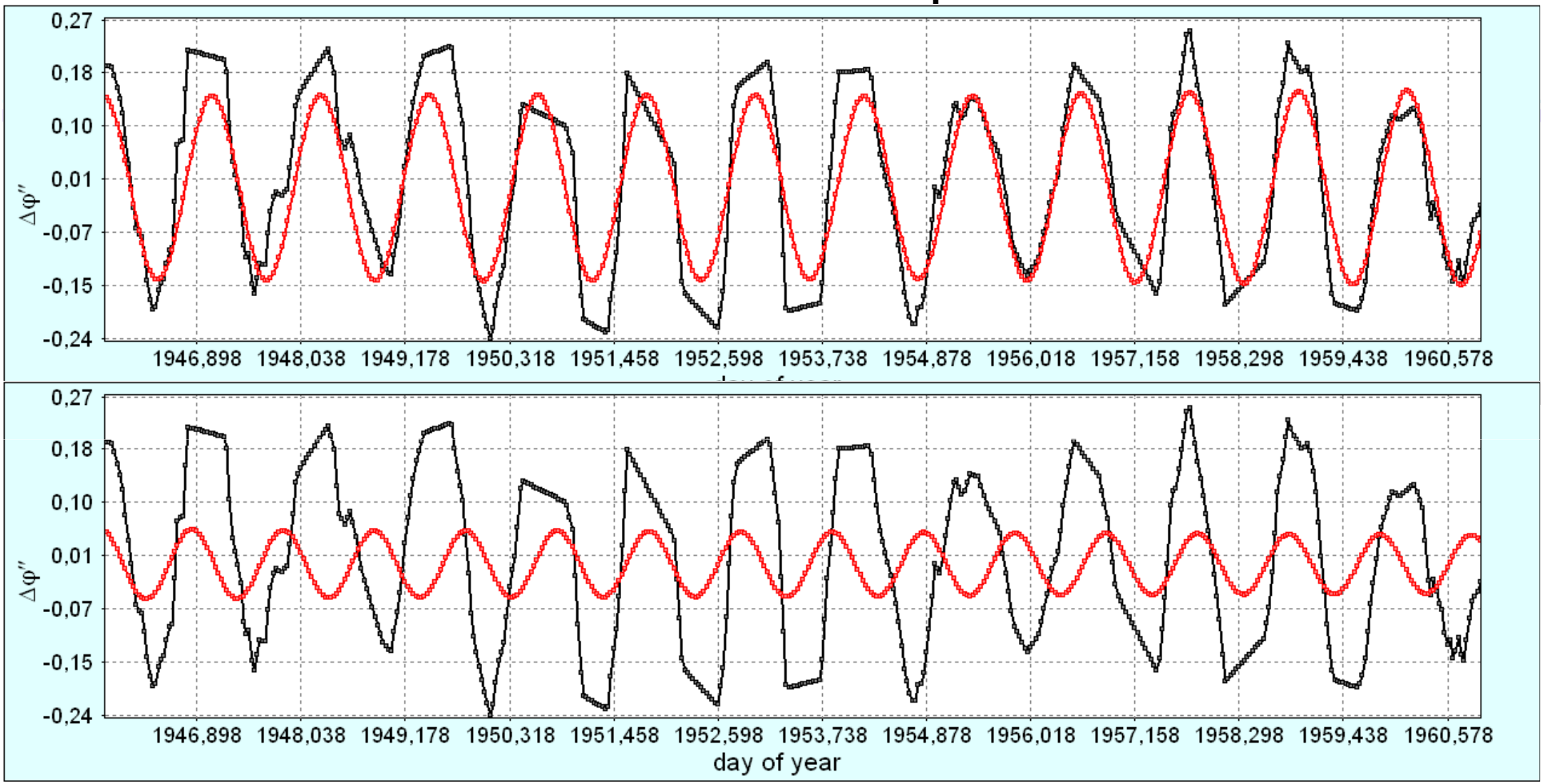
f – *gravitational const*

σ – *coefficient of dehydration of rock*

Development of new “dynamic datum”

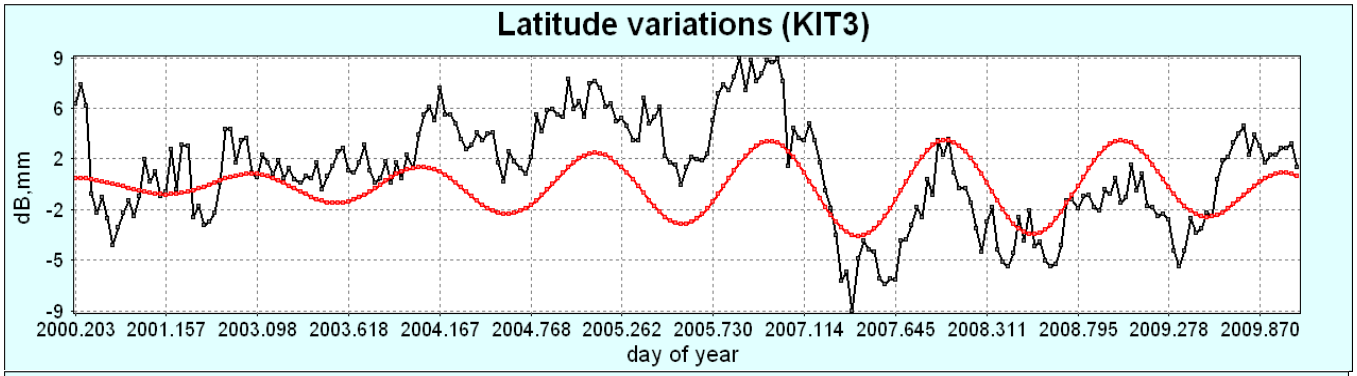
- **Development and investigation of kinematical models of stations**
- **Interpretation of physical causes of coordinate secular and periodical changes**
- **Methodology - Singular Spectrum Analysis of time series (finding trends of different resolution; smoothing; extraction of seasonality components; extraction of periodicities with varying amplitudes; simultaneous extraction of complex trends and periodicities)**

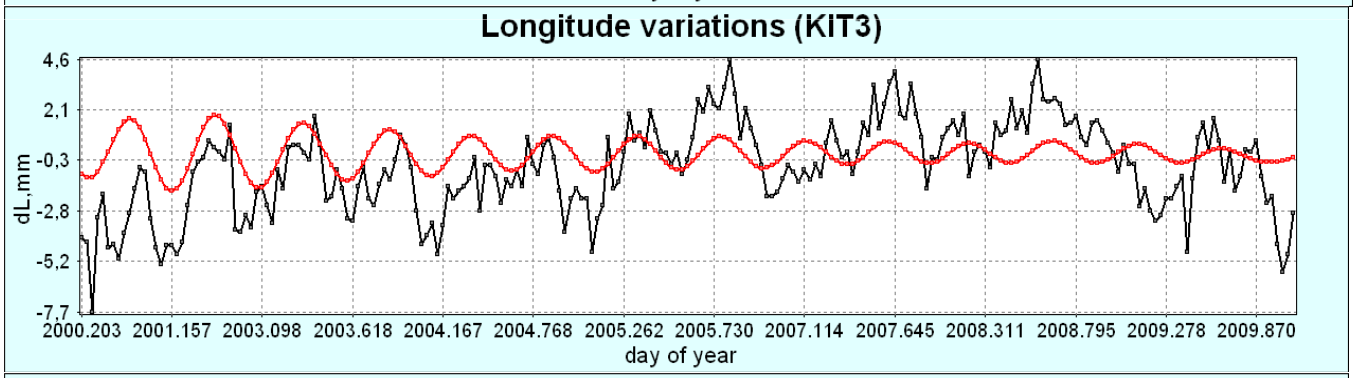
Kitab latitude variations (1930-1978)
Zenith Telescope

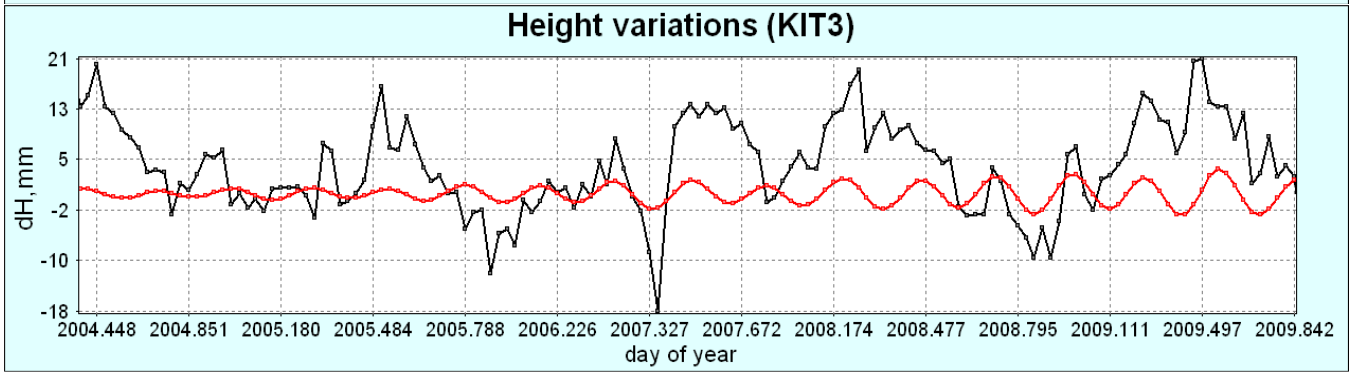


	Period (T), months	Amplitude (A),"
$\Delta\varphi$	14 (=405,7 days)	0.29
	12,2	0.11

GPS stations coordinates variations (KIT3)

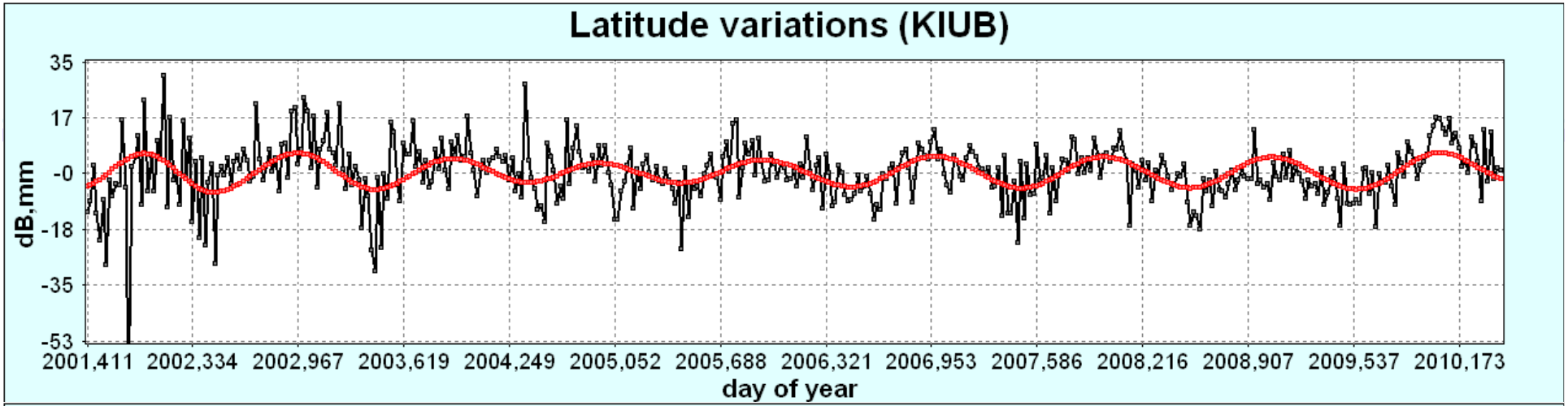


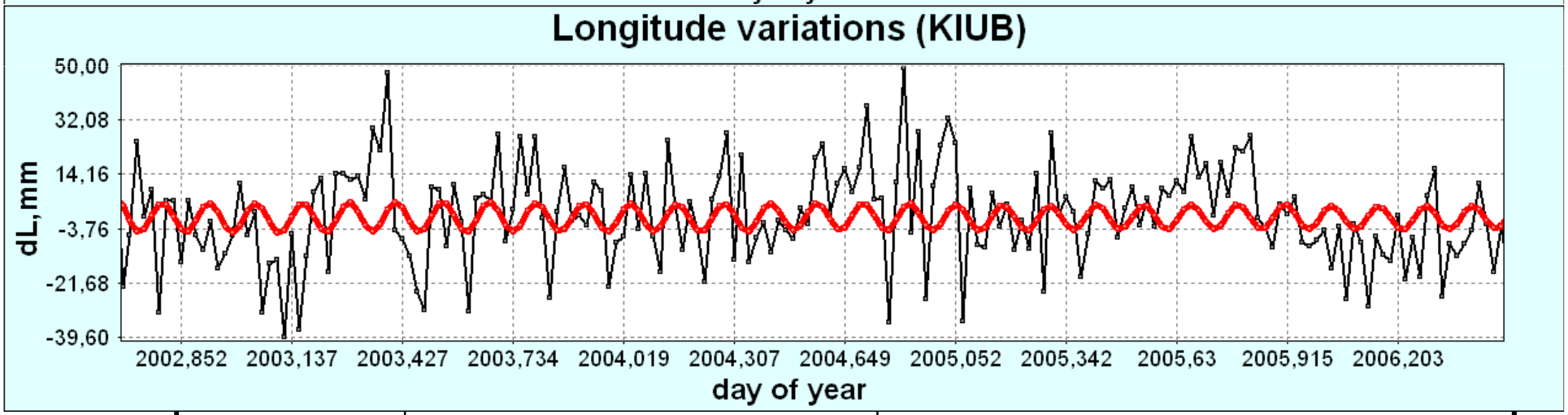




	Period (T), Months	Amplitude (A), mm
B	11,5	6
L	5.8	4
H	3,6	4

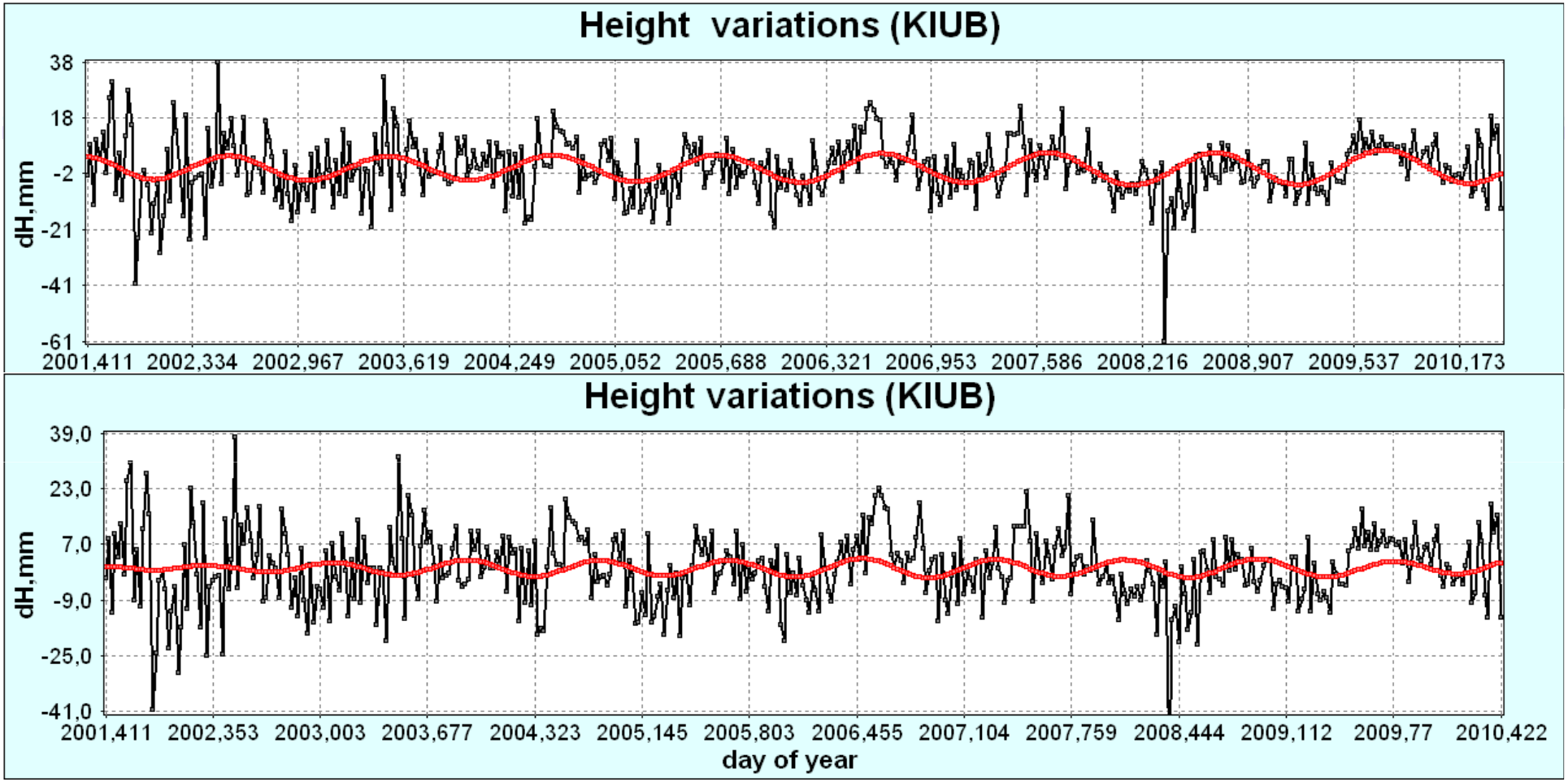
DORIS station coordinates variations (KIUB)





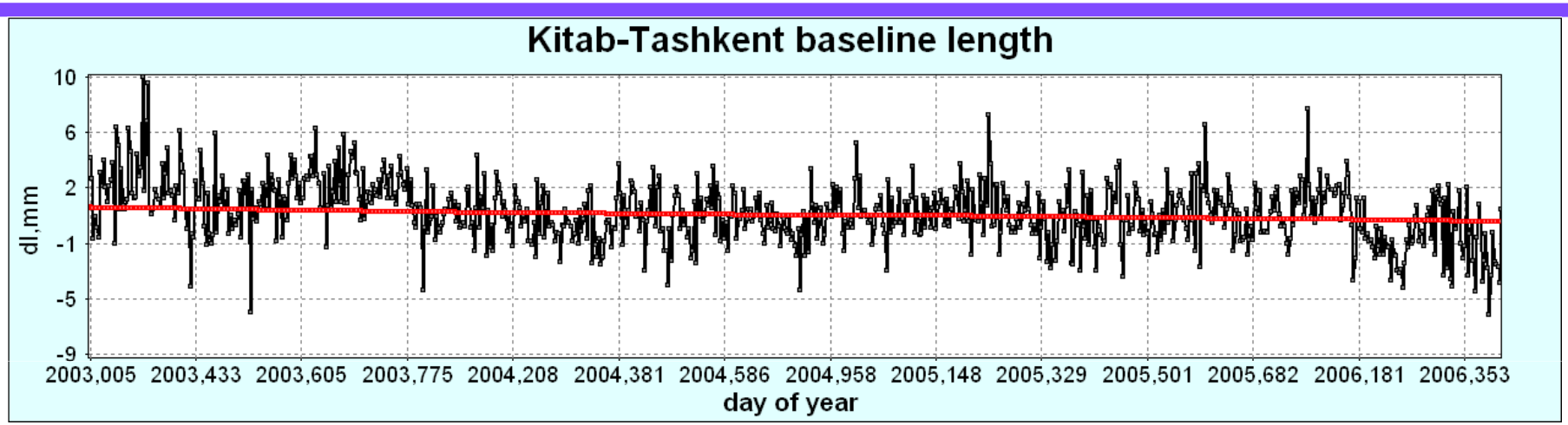
	Period (T), Months	Amplitude (A), mm
B	**14**	**9**
L	**1.5**	**9.2**

DORIS station coordinates variations (KIUB)

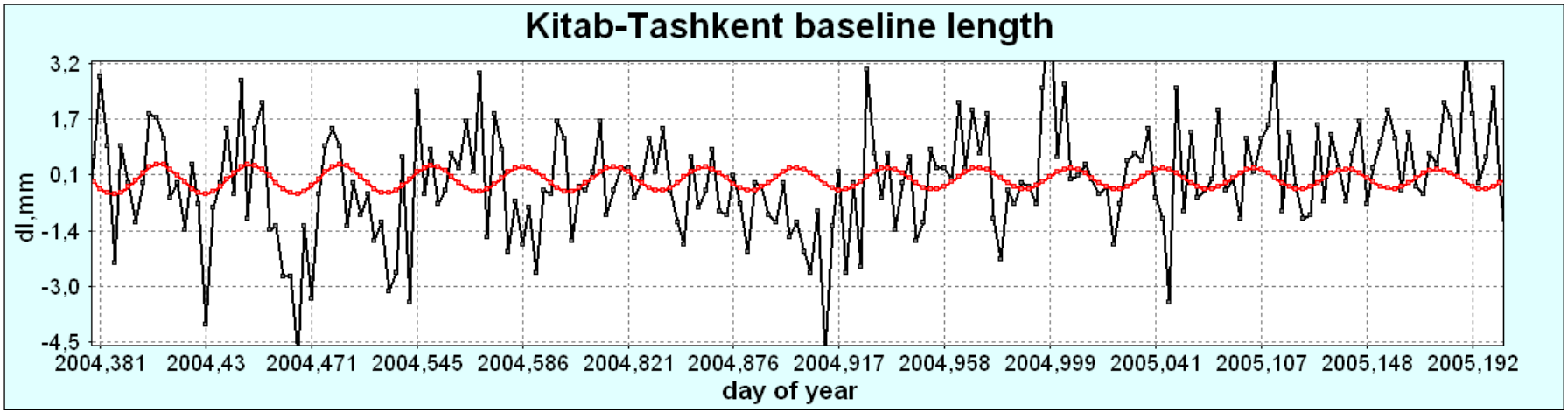


	Period (T), Months	Amplitude (A), mm
H (harm1)	13.44	10
H (harm2)	11	6

Baseline Kitab-Tashkent construction (l=318 km)

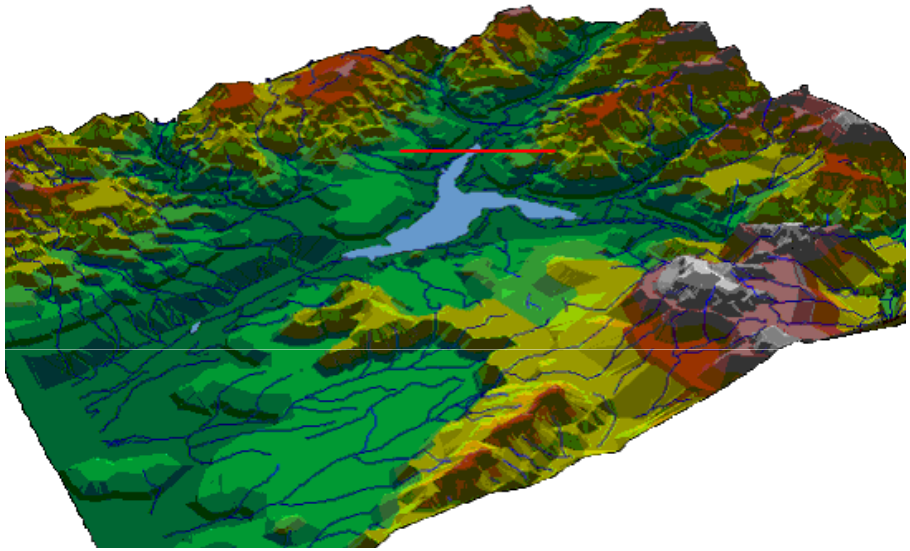


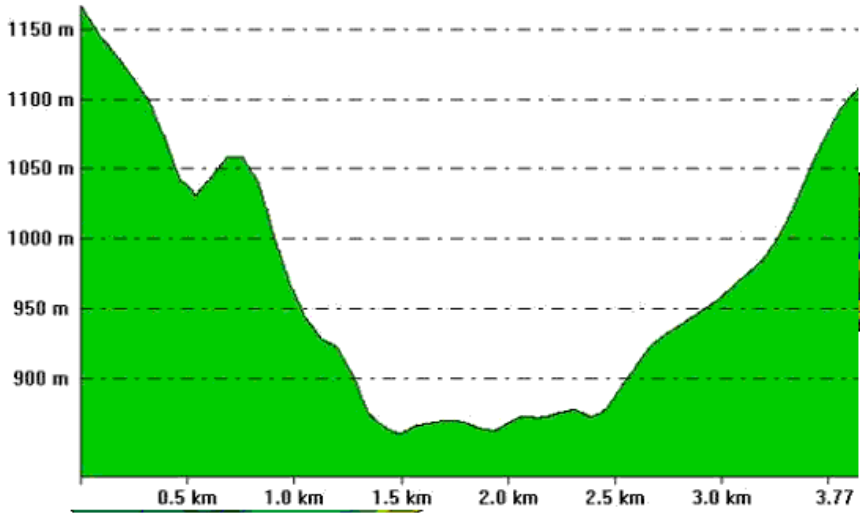
$\mathbf{v_{kita}}$=1cm/year (NE)



T=0.5 month A=0.6mm

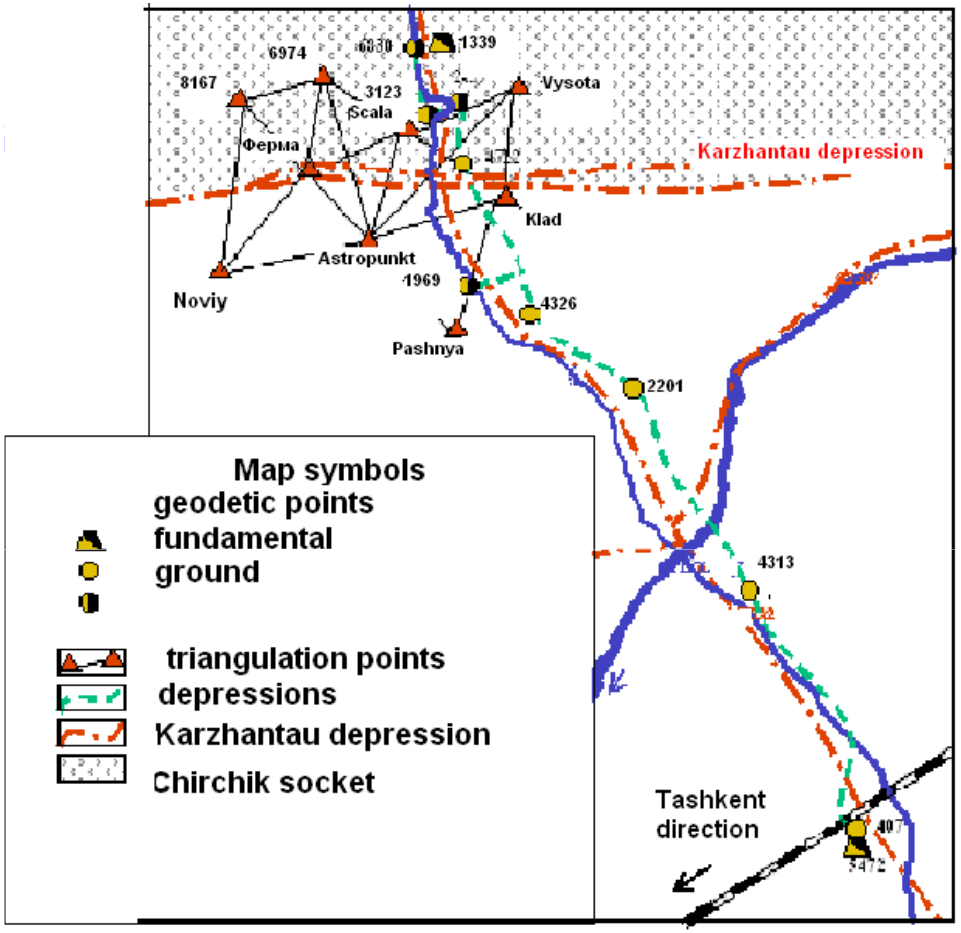
3. Perspectives: Tavaksay geodynamical poligon

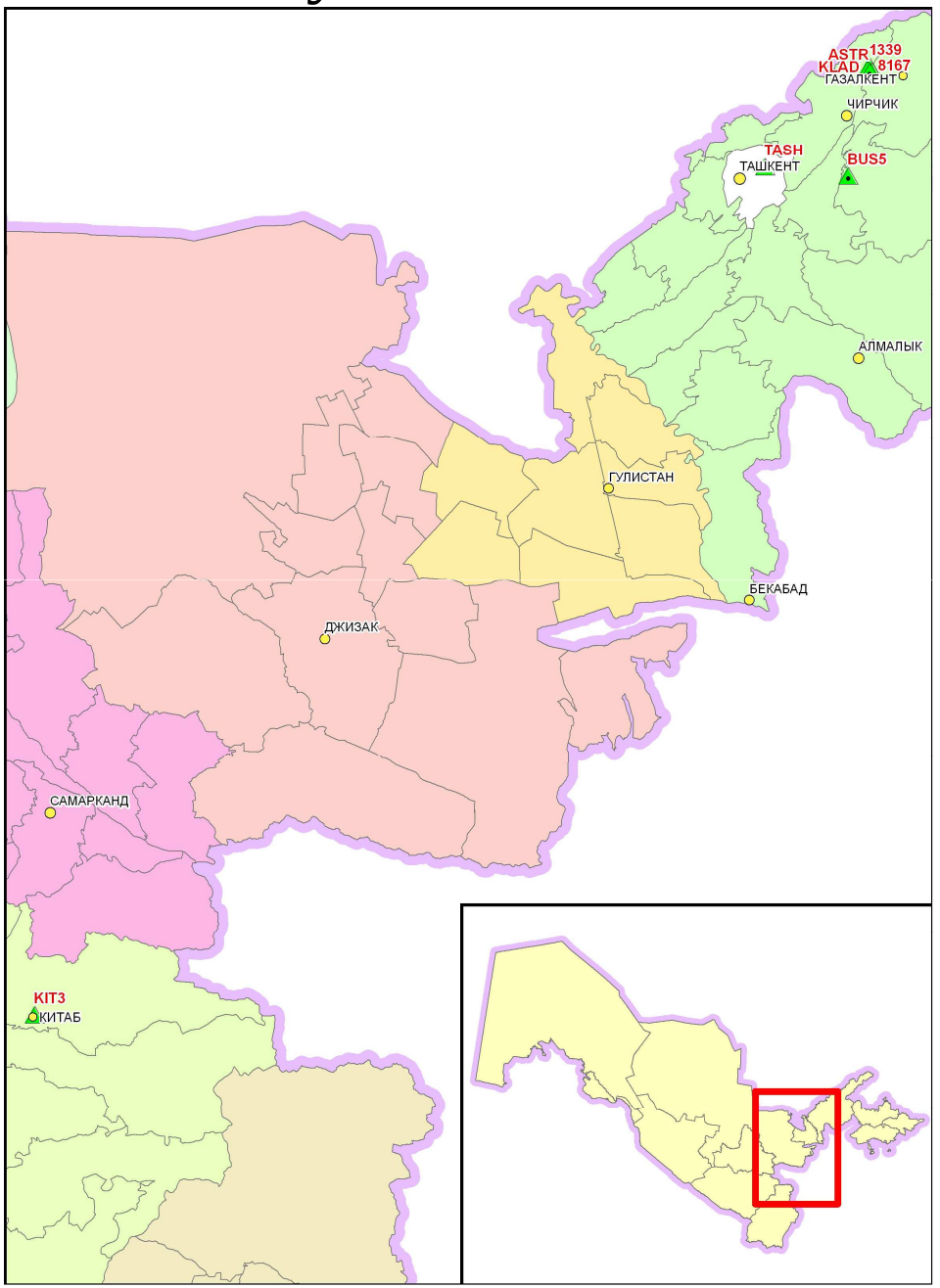




Tavaksay geodynamical poligon was created in south-west part of Karzhantau depression after strong eathquake in 1977 (M=5.3) for geodynamical purpose. Large sities (Tashkent, Chirchik), Charvak hydro-electric station (about 40 km), industrial enterprises are located here also.

Tavaksay GPS network





[Ergeshov et.all. Investigation of Tavaksay deformation with space geodesy methods. Vestnik Cadastra.1,2010. In russian]

Displacement of Tavaksay geodynamical poligon (2003-2005)

Station „Astropunkt“ on Tavaksay poligon

Station	Horizontal displacement, mm	Vertical displacement,mm
1339	28	-41
8167	28	-47
6974	30	-50
Scala	27	-56
Vysota	32	-43
Ferma	36	-24
Klad	23	-50
Astropunkt	27	-33
Noviy	27	-62

4. Conclusions

- **The use of new technology such as GPS and DORIS is ideally suited to the development of a dynamic coordinate cadastre.**

- **A dynamic coordinate cadastre is a possible outcome of recently started projects.**

- **This datum will provide an accurate spatial survey infrastructure across Uzbekistan that will meet user needs, be of a suitable accuracy, and will be flexible.**

Acknowlegements

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THANK YOU !