The Building of a Regional Geodetic Network of Uzbekistan

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Since 1930 Kitab Observatory ($\varphi = 39^0\,07'\,59''$, $\lambda = 4^h\,27^m\,31.8^s$, H=690 m) has had one of five International Latitude Stations and during this period a very long latitude series was received. Systematic observations at the Kitab were started on 14 November 1930. From 1930 to the present near 160000 latitude values have been received with the help of classical tools (ZTB,ZTL,FZT). The Root mean square error value of a latitude is $0.16''$ for ZTB and ZTL-180 and $0.12''$ for FZT. Vondrak produced calculations of the series of earth parameters between 1930-1978 in the Hipparcos reference frame, where the velocity of Kitab station is $0.''0122$ for latitude direction and is 0.00779^s for longitude direction . At present, of the 3 tools, only FZT is accurate enough to predict tectonic motions. In spite of the fact that the classical results are less accurate than are the modern ones, the optic observations will continue for the determination of long term periodic parameters of earth's motion and for the building of a regional geodetic network.

In order to build a regional network in Uzbekistan, it is necessary to have geodetic, gravity and space measurements of the earth's surface. In early 1990, Kitab Observatory became one of the stations of the International GPS Service for Geodynamics (IGS) and a permanent point of the DORIS network. The GPS program of the GeoForschungsZentrum (GFZ, Potsdam) between 1992 and 1996

provides a valuable data set. The quality of the network geometry of the CATs network is in the order of 1-3 mm for the horizontal components and about 5mm for the height. This is derived from the Helmert transformations between the daily solutions and the program solution. The global network accuracy is in the order of 1-2cm. We have used combination coordinates from these techniques as reference for the definition of the network elements orientation, with respect to WGS or ITRF, and to calculate parameters of connection between them and local terrestrial system SC-42.

For building the local geodetic network, the WGS-84 coordinates have been transformed to the local terrestrial system using the Molodensky method.

$$H - H_ц = -\Delta X \cos B \cos L - \Delta Y \cos B \sin L - \Delta Z \sin B - (a\Delta f + f\Delta a)\sin^2 B + \Delta a;$$

$$B - B_ц = \frac{\Delta X \sin B \cos L + \Delta Y \sin B \sin L - \Delta Z \cos B - (a\Delta f + f\Delta a)\sin 2B}{R_b \sin 1''};$$

$$L - L_ц = \frac{\Delta X \sin L - \Delta Y \cos L}{R_m \cos B \sin 1''};$$

Where:

$H_ц, B_ц, L_ц$ are geodetic coordinates in WSC-84 system;

H, B, L are geodetic coordinates in SC-42 system;

$\Delta X, \Delta Y, \Delta Z$ - corrections to SC-42 system;

$$R_m = \frac{a}{\sqrt{1 - e^2 \sin^2 B}},$$

$$R_b = \frac{a(1 - e^2)}{\sqrt{(1 - e^2 \sin^2 B)^3}},$$

$$e^2 = 2f - f^2.$$

Below in Table 1,the initial results of SC-42 geodetic coordinate corrections of 11 GPS points in Uzbekistan are given.

Table 1.

Correction to latitude and longitude
with regard to WSC-84 system

station	$\delta B''$	$\delta L''$
DENA	-0.120	-0.514
DJAN	-0.115	-0.511
KITB	-0.117	-0.508
OKTO	-0.119	-0.505
SANZ	-0.120	-0.508
ADRA	-0.125	-0.507
CIRC	-0.124	-0.503
ALMA	-0.124	-0.506
SARY	-0.129	-0.510
MADA	-0.117	-0.510
ANGR	-0.125	-0.506

In order to transfer from $(X,Y,Z)_{42}$ to $(X,Y,Z)_{wgs84}$ we used the following parameters , ΔX, ΔY, ΔZ, α, β, γ, k with the help of equations:

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{84} = \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{42} + \begin{bmatrix} \Delta X \\ \Delta Y \\ \Delta Z \end{bmatrix} + \begin{bmatrix} k & \gamma & -\beta \\ -\gamma & k & \alpha \\ \beta & -\alpha & k \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{42}$$

Where ΔX, ΔY, ΔZ, α, β, γ, k are given in Table 2

Table 2

Transfer parameters (m)			scale	Rotation angles		
ΔX	ΔY	ΔZ	k	α	β	γ
-22.52	126.59	78.84	$0.89 \cdot 10^{-6}$	0.165″	0.089″	0.627″

On the basis of the calculated data, we can reach these initial conclusions:

1. The results of transformed coordinates will be the basis for building a local geodetic network; the Helmert method and corrections to WGS-84 can be used for geodetic works.

2. The Kitab station will be the origin of all network designs in Uzbekistan.

3. On the basis of the WGS84 and SC42 systems, it is necessary to work out our reference-ellipsoid, which will more accurately suit Uzbekistan.