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Modification of vertical reference frame of Uzbekistan

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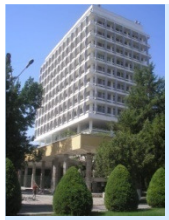
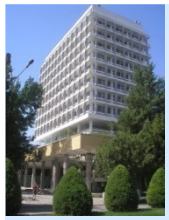
United Nations/Latvia Workshop on the Applications of Global Navigation Satellite Systems
14 – 18 may2012



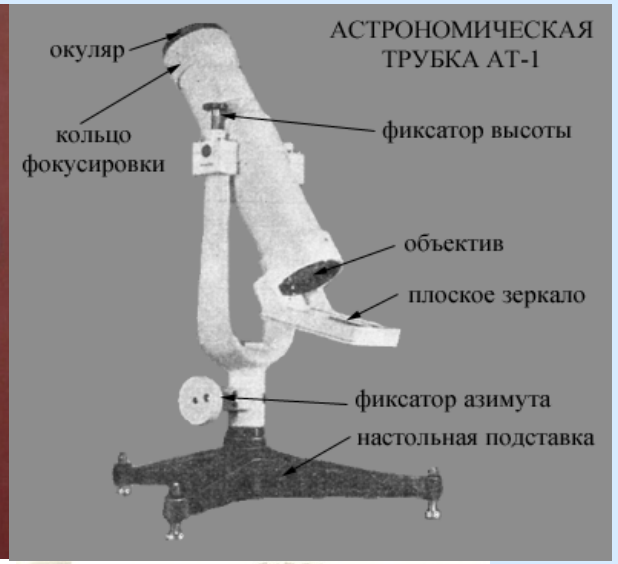
CONTENTS



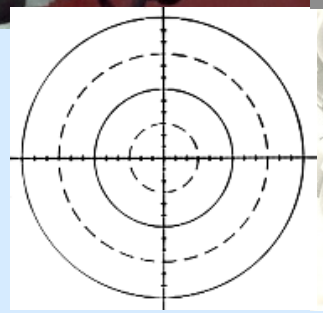
Optical method

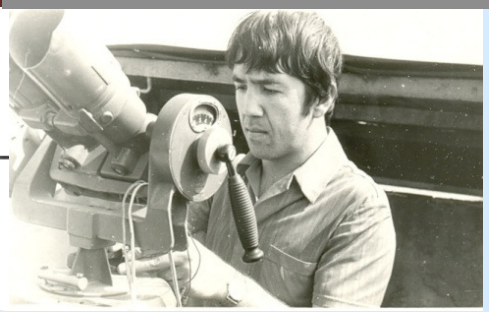
1. Visual observation
2. Photographic observation
3. Laser ranging

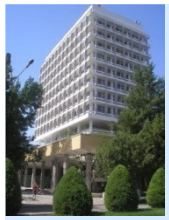
Visual observation



Rms error = ±1÷5 arcmin







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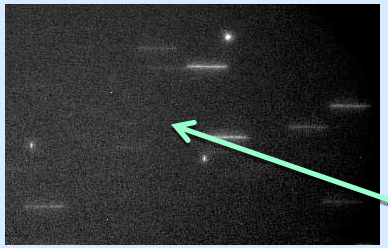
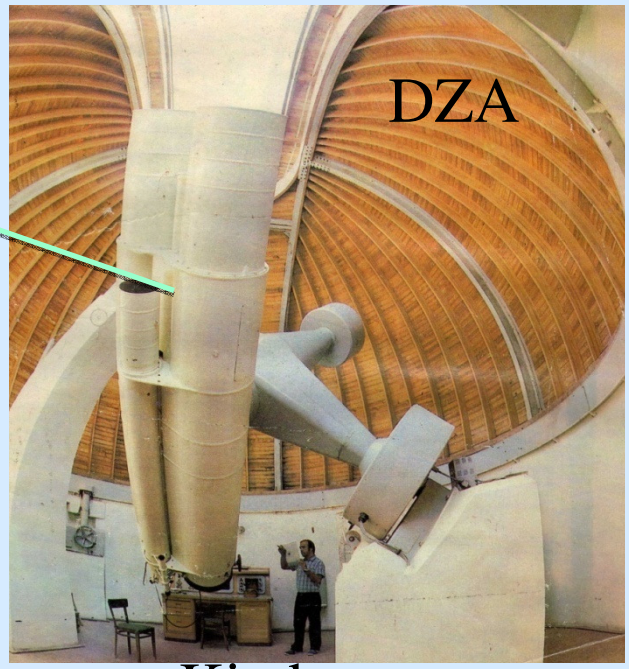
Photographic observation



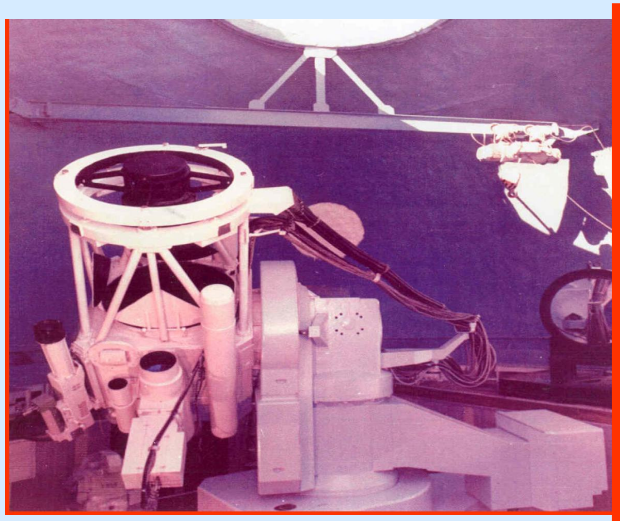
Rms error = ±1 ÷ 2 arcsec

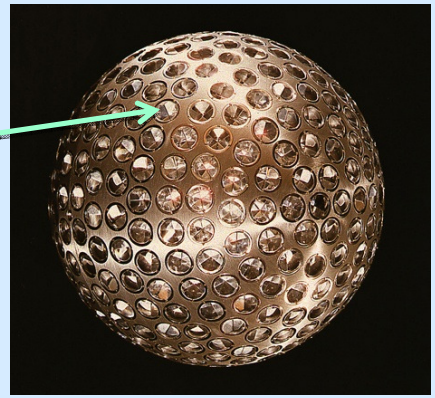


Kitab

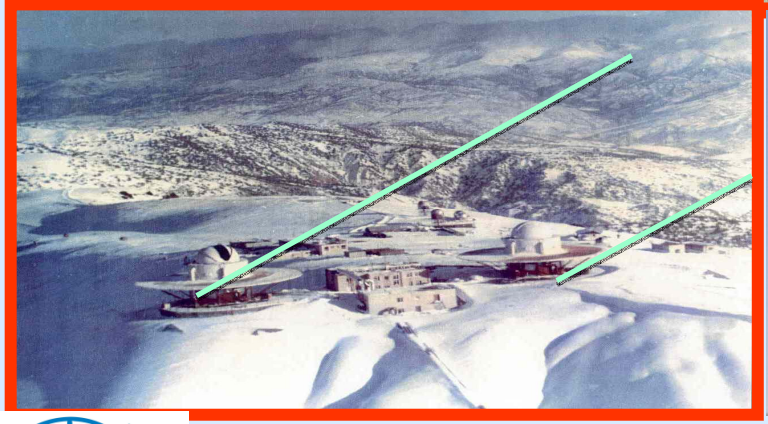
Tashkent

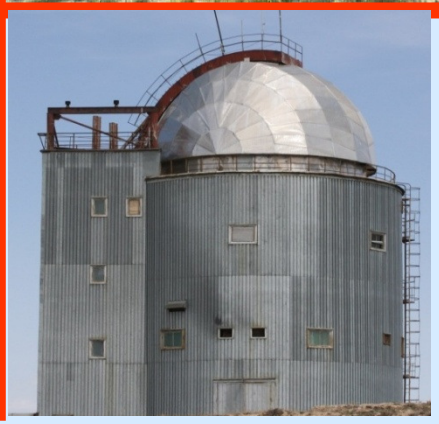
Laser ranging





Lageos -1





H=2700m (BSL)
B= 38°41′ N
L= 66°56′ E
RMS= ±5cm(Lageos)

Radiometric observation

KITAB

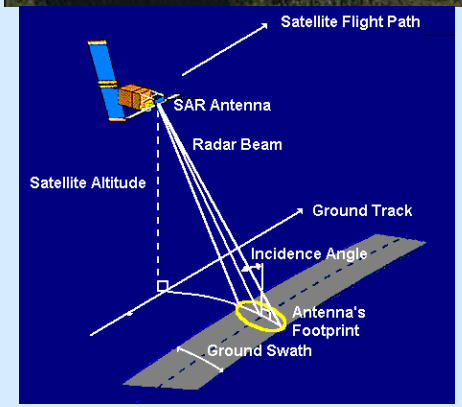
TASHKENT

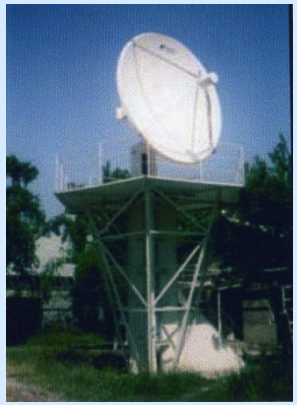
DJIZAK

Radiometric observation

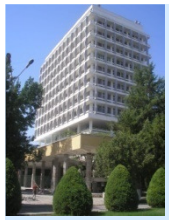
ERS -1

ERS -2



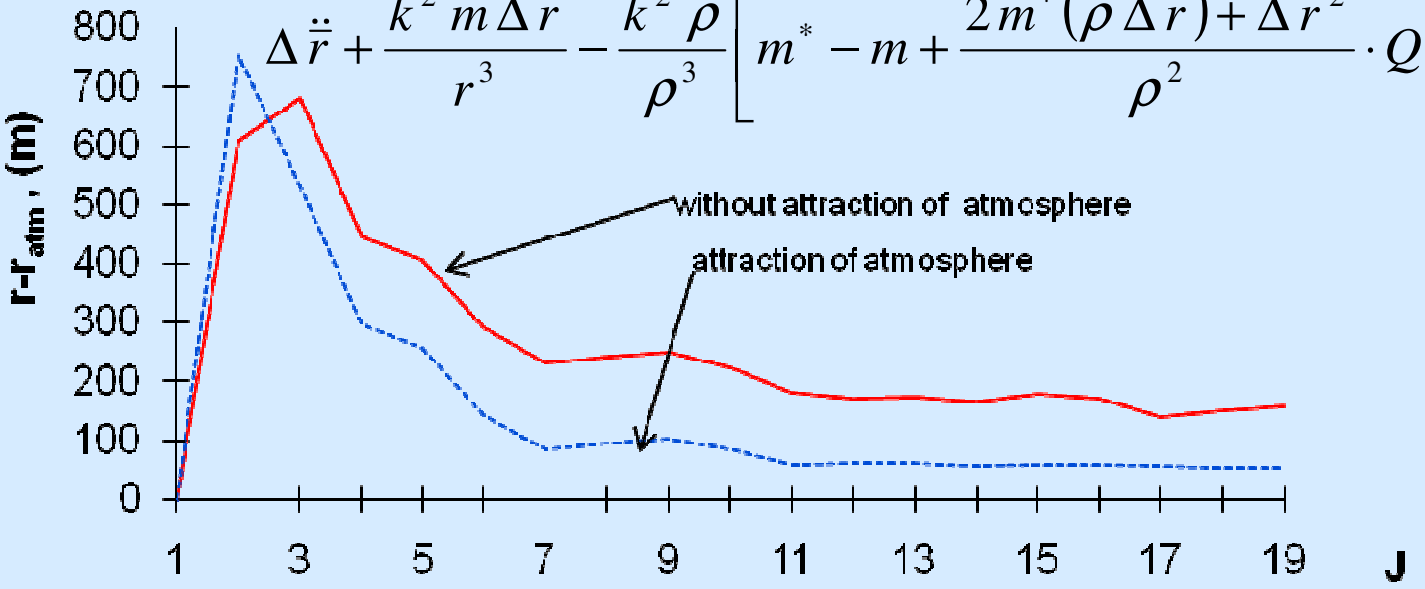


Tashkent city

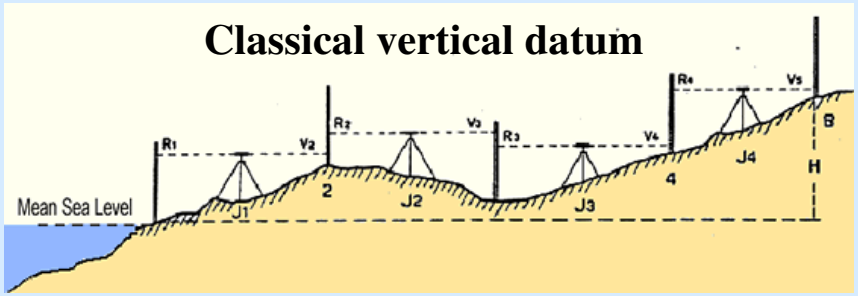


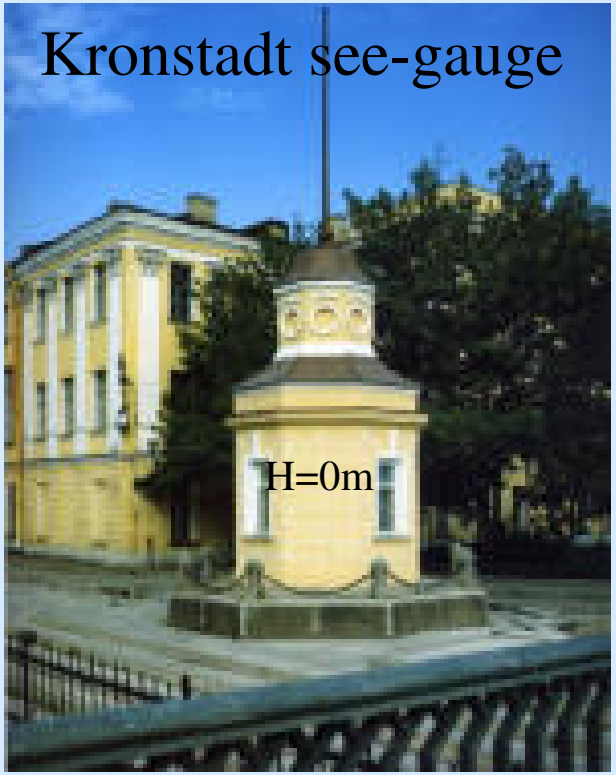
ERS -2.

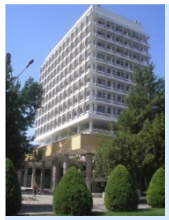
$$\Delta\ddot{\bar{r}} + \frac{k^2 m \Delta\bar{r}}{r^3} - \frac{k^2 \bar{\rho}}{\rho^3}\left[m^* - m + \frac{2m^*(\bar{\rho}\Delta\bar{r}) + \Delta\bar{r}^2}{\rho^2}\cdot Q\right] = \bar{F}$$



Differential leveling for height measurements
(Baltic Sea Level is the starting point for the height measurements)







The heights of Uzbek maps

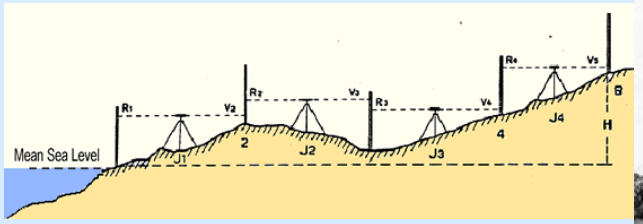
Kronstadt see-gauge

RUSSIA

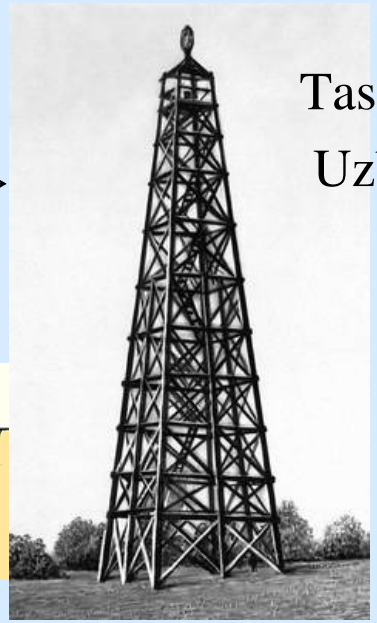
H=0 m (1942)

H=? m (2012)

D= 3500 km



1940-1960y

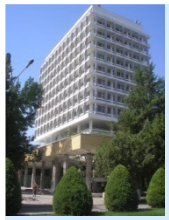


Tashkent-1

Uzbekistan

H =475m (1942)

H= ? (2012)



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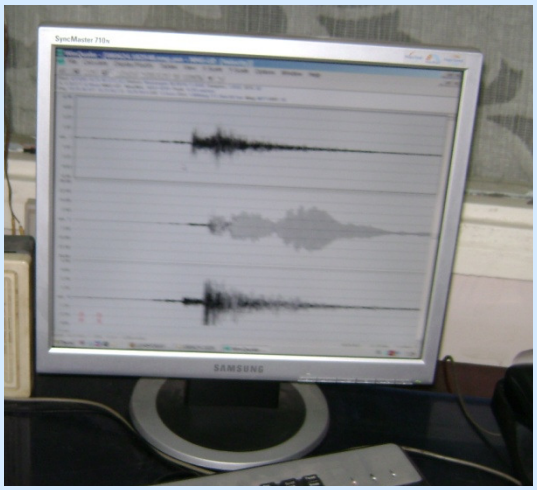
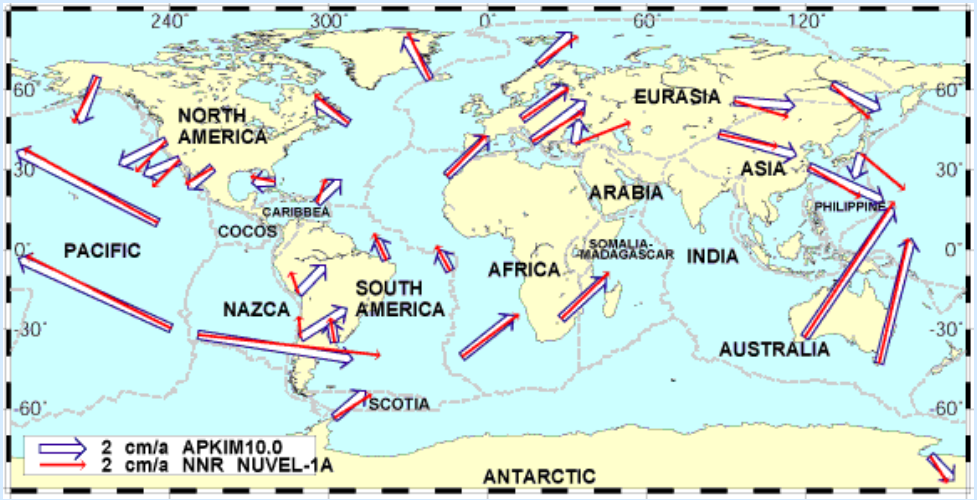
Uzbekistan, lying across the Eurasia/India plate boundary, is subject to ground movements across the **country of 4-5 cm/year**, disregarding the effects of large earthquakes. This can amounts to 2 m in the last 50 years since CS-42 was established. In this time there has also been the effect of large earthquakes, such as the 1966 (M=5.0) Tashkent Earthquake.





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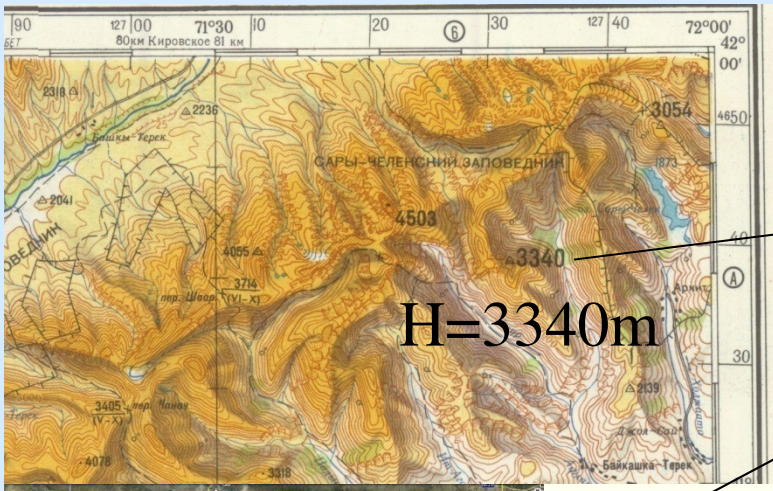
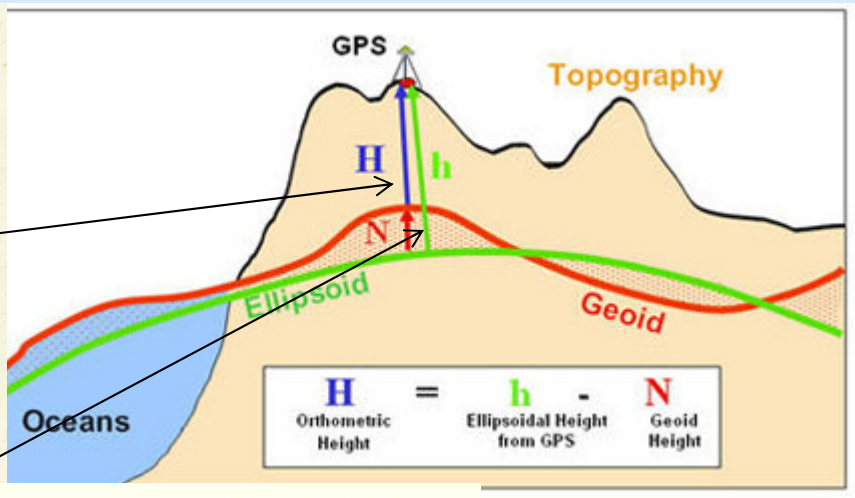
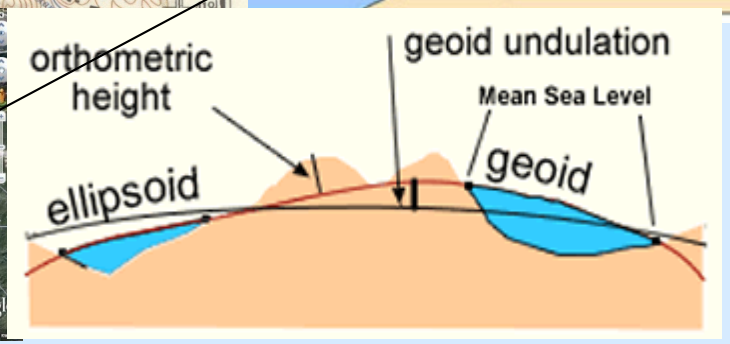
The fragment of Uzbek map

The 3 Heights (H,h,N)

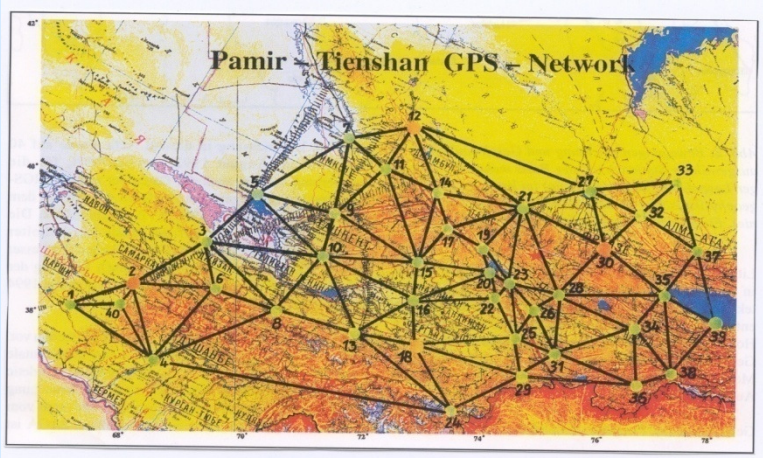




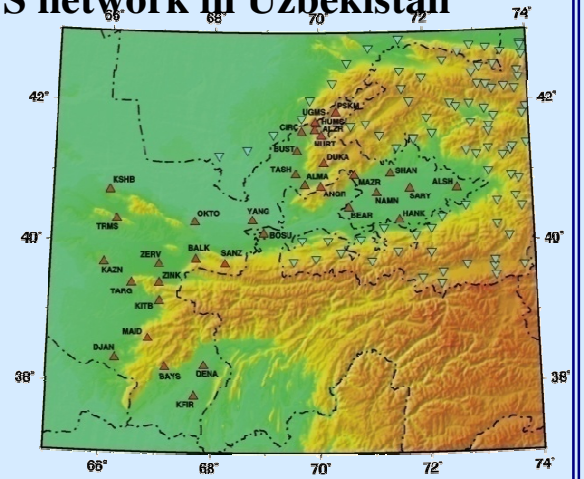


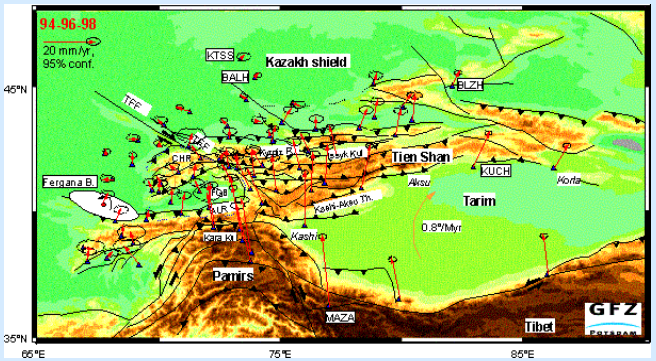
Height of Kitab station
(classic ,GPS and Doris)
H=590m. (CS-42)
H=657m. (CS-42)(calc)
h=622m. (GPS)
h=623m. (DORIS)

Central Asian Tectonic Sciences (CATs),GFZ,GERMANY



GPS network in Uzbekistan





CATS

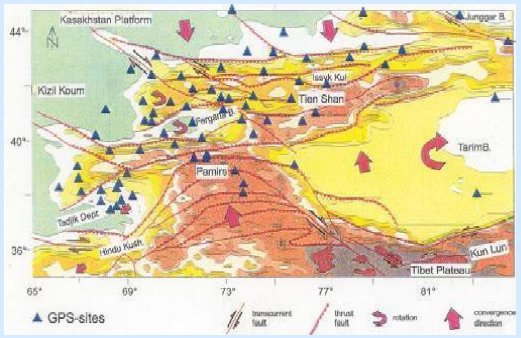
~~Russia~~

~~Kazakhstan~~

~~Kyrgistan,~~

~~Uzbekistan~~

~~China~~



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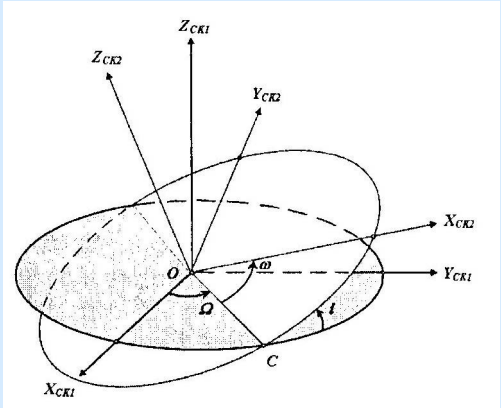
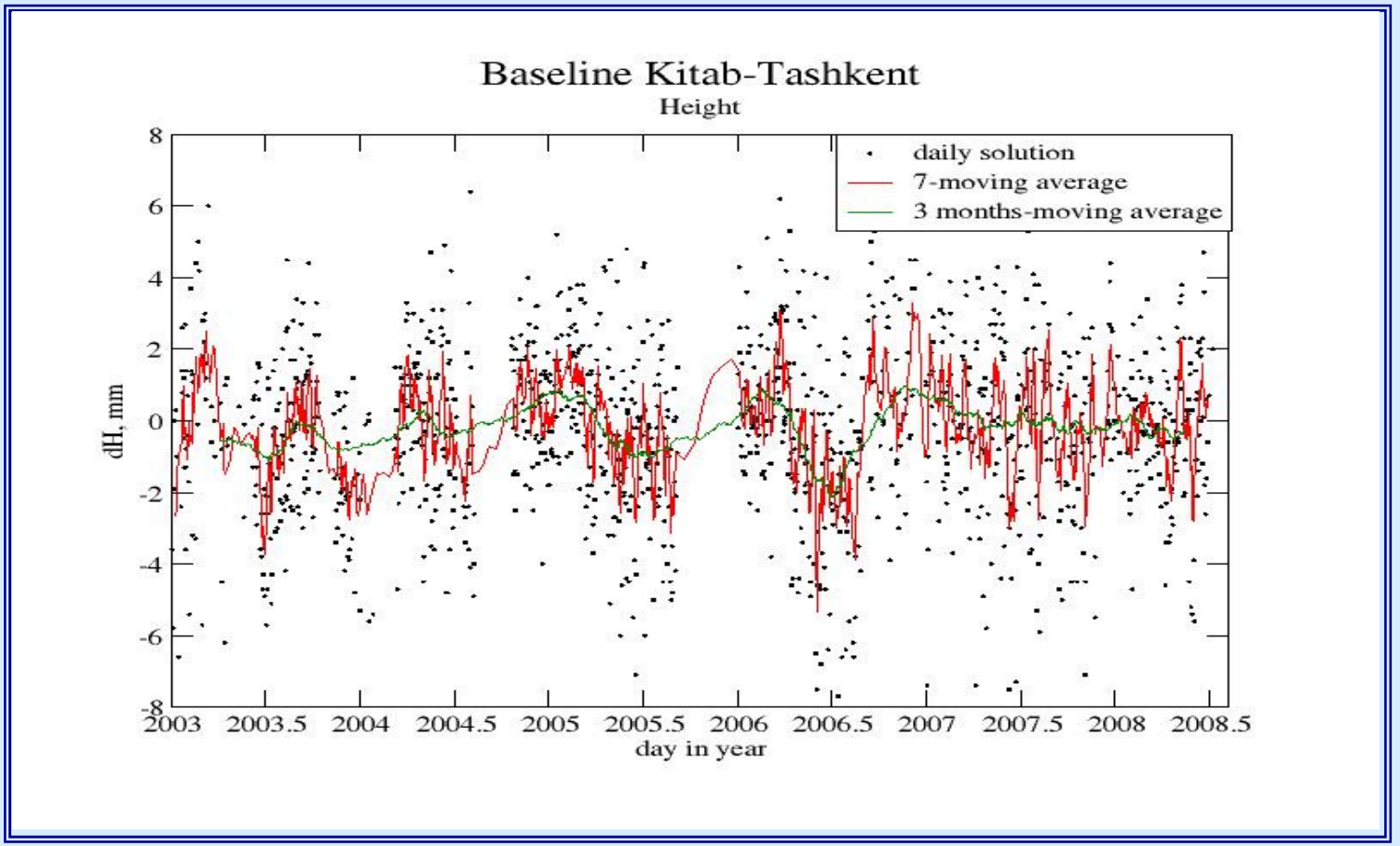
CATS network in Uzbekistan (WGS 84)

№	Обозн.	B	L	h, м	H, м (CS42
1	DJAN	38°20′16″.1	66°6′21″.7	790.5	?
2	KITB	39°8′5″.2	66°53′7″.6	622.6	?
3	OKTO	40°17′25″.7	67°40′11″.3	334.5	?
4	DENA	38°14′6″.7	67°52′48″.8	477.5	?
6	SANZ	39°41′37″.7	68°14′46″.1	1942.5	?
9	CICR	41°34′20″.8	69°39′39″.0	771.2	?
10	ALMA	40°49′42″.9	69°43′49″.0	737.9	?
16	SARY	40°46′25″.2	71°42′2″.3	351.0	?
40	MADA	38°41′4″.1	66°56′29″.3	2690.7	?
54	ANGR	41°6′7″.7	70°4′53″.7	1307.3	?
55	ADRA	40°48′1″.3	70°1′21″.6	1556.0	?
56	BESH	40°21′24″.0	70°31′25″.2	421.7	?
58	BAYS	38°10′31″.0	67°2′45″.6	1061.3	?
59	KFIR	37°50′17″.3	67°52′5″.5	590.9	?
79	BOZB	41°28′44″.6	71°47′7″.9	1758.7	?

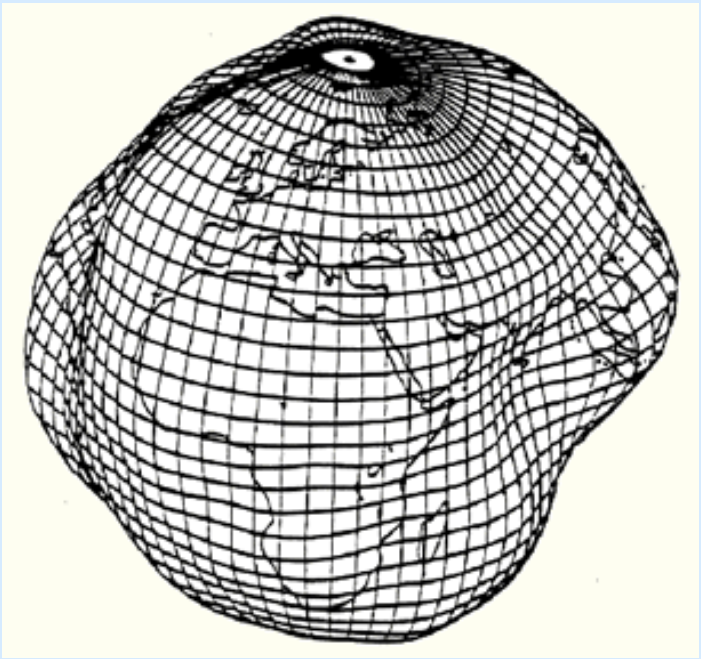


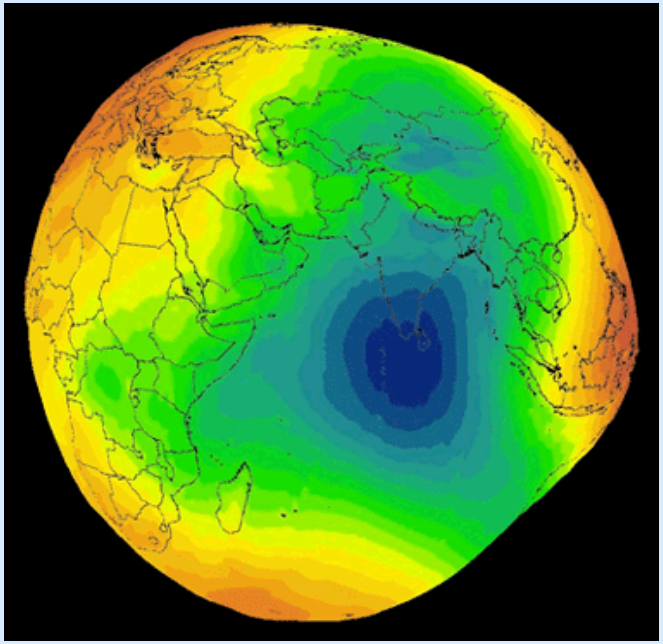
$$\left.\begin{aligned} B_{84} &= B_{42} + \Delta B \\ L_{84} &= L_{42} + \Delta L \\ H_{84} &= H_{42} + \Delta H \end{aligned}\right\}$$

1992-1996 **The international program CATs(GFZ,Germany)**
RMS = ±1-3mm. for x, y
RMS = ± 5mm. for H.
RMS = ±1-2cm. for Global network


Baseline Kitab-Tashkent
Height
daily solution
7-moving average
3 months-moving average
dH, mm
8
6
4
2
0
-2
-4
-6
-8
2003
2003.5
2004
2004.5
2005
2005.5
2006
2006.5
2007
2007.5
2008
2008.5
day in year

The Geoid

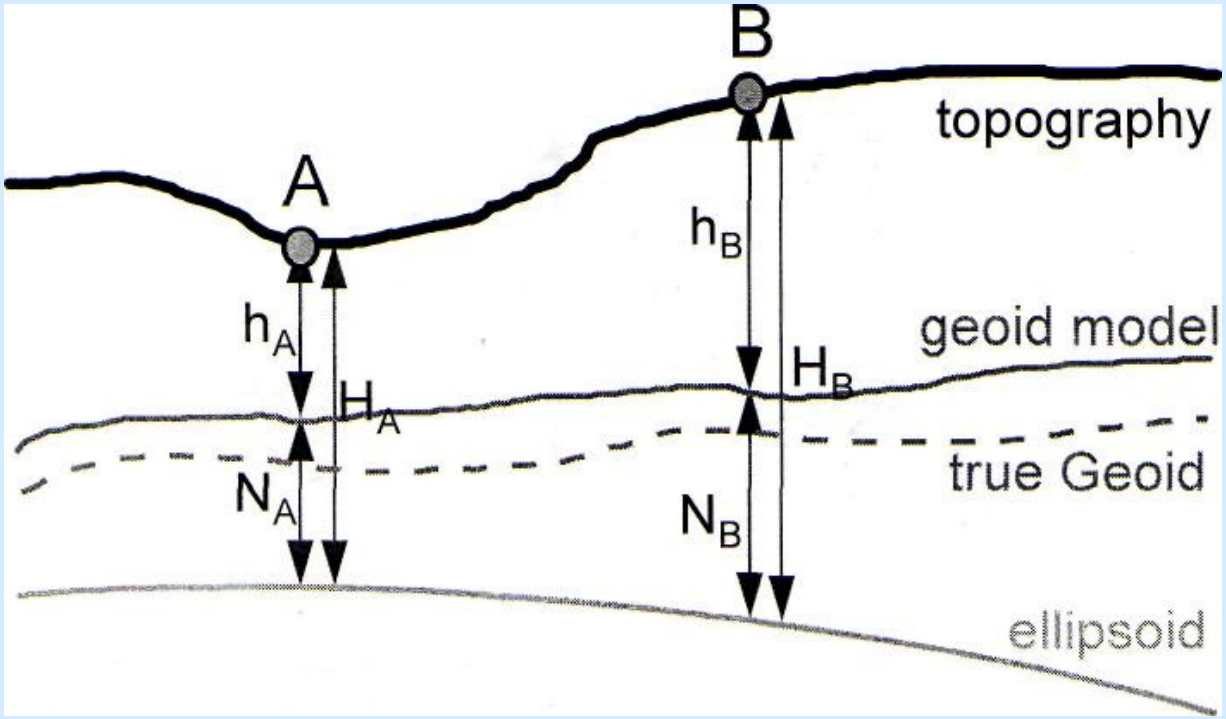




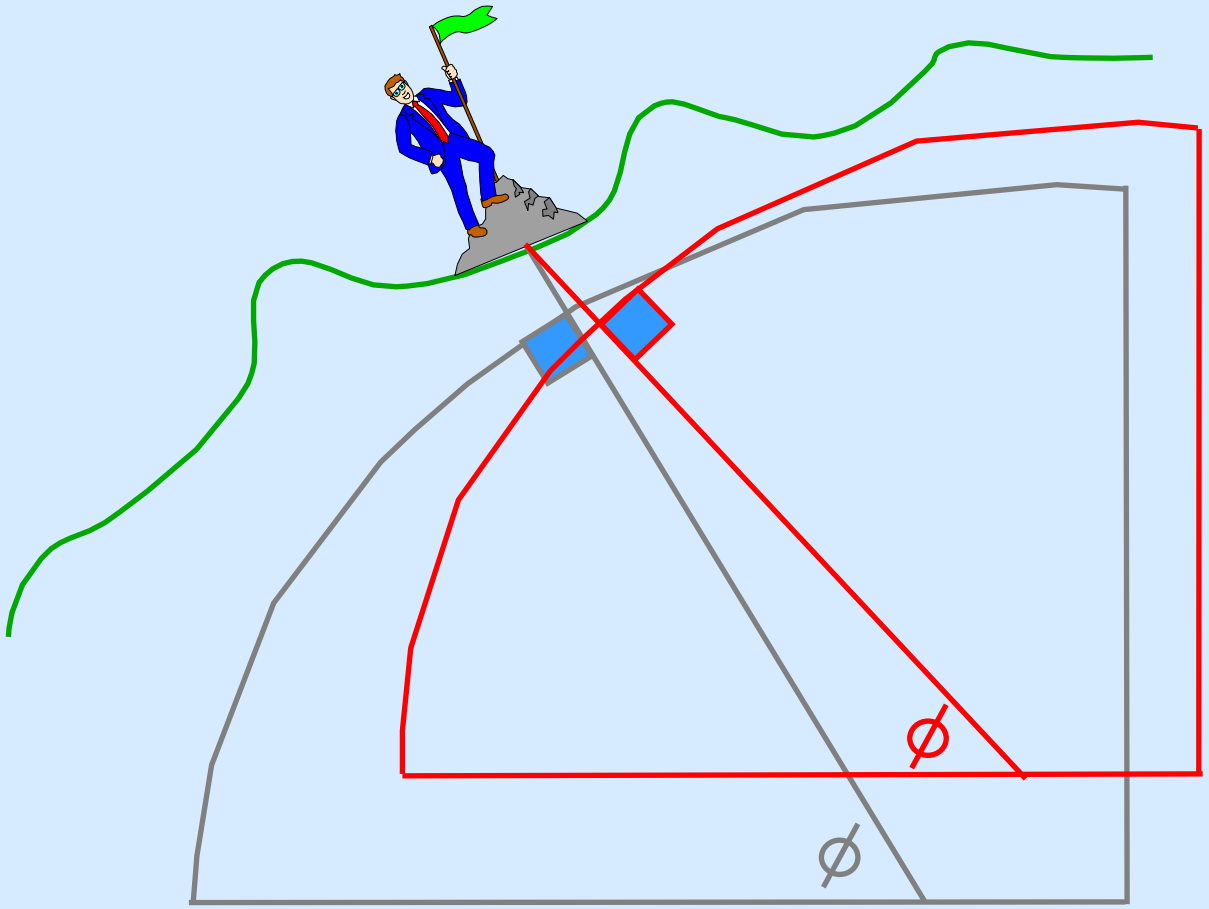
The geoid is an equipotential surface which most closely relates to mean sea level.

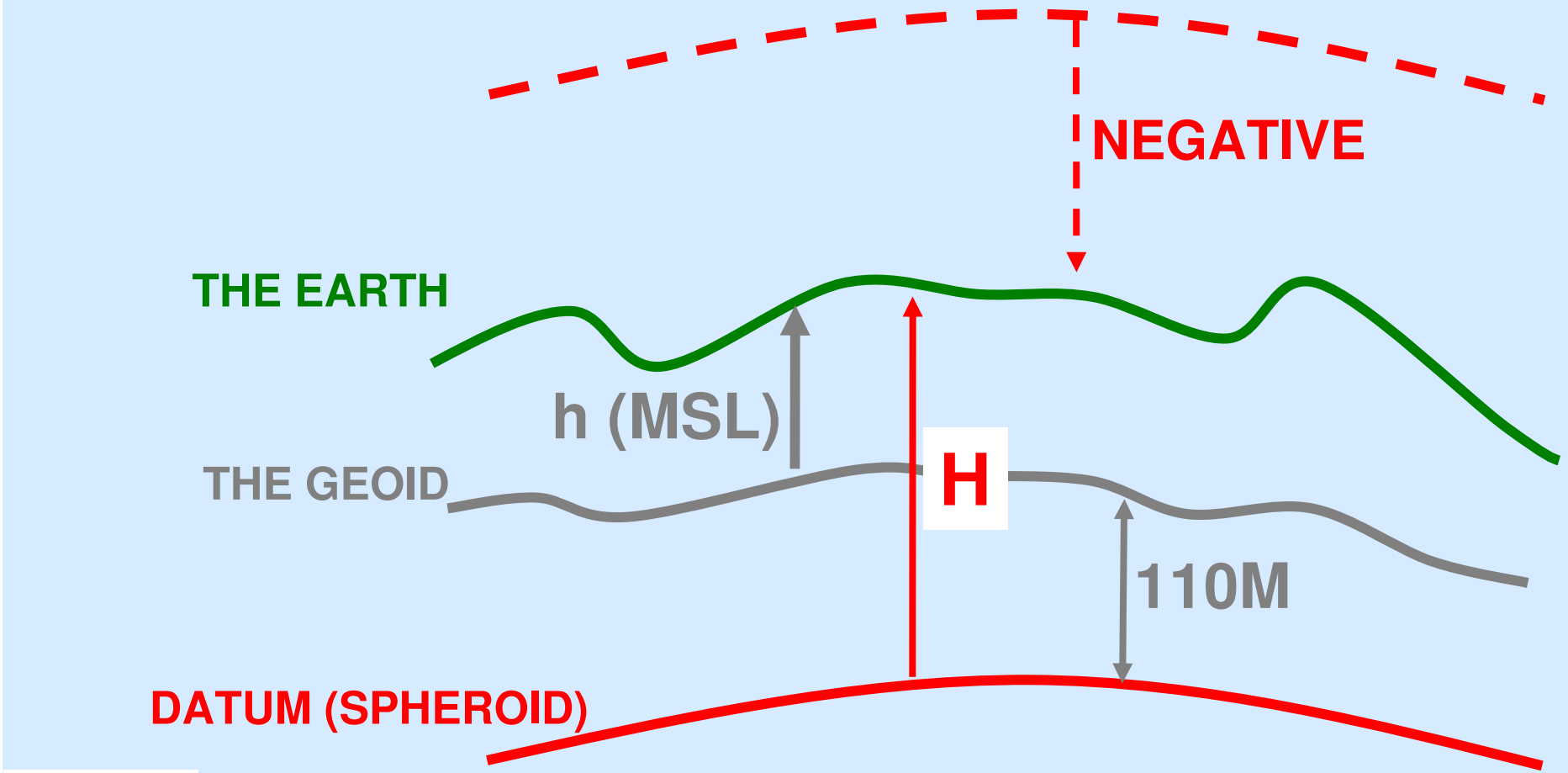
Derived by approximating size and shape of the world using mathematical figures.

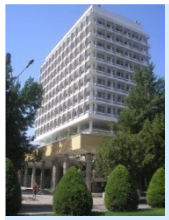
Ellipsoid height H and orthometric height h of two points A and B related by a model of Geoid-ellipsoid separation N



$$H = h + N \qquad \Delta h_{AB} = h_B - h_A = \Delta H_{AB} - \Delta N_{AB}$$


DATUM 2
CS42
41° 10´ 12"N
DIFFERENT
DATUM
1
WGS84
41° 10´ 10"N


NEGATIVE
THE EARTH
h (MSL)
THE GEOID
H
110M
DATUM (SPHEROID)



In the world of GPS we have to remember one critical thing, and that is that the datum used by the GPS satellites is wgs84. So all datum changes will be from wgs84 to your selected or defined datum.

WGS84 – CS42

Tx= -22.56 m

Ty=+125.03 m

Tz=83.81 m

Errors up to 0.04 m

NEW SPHEROID

WGS84 Centre

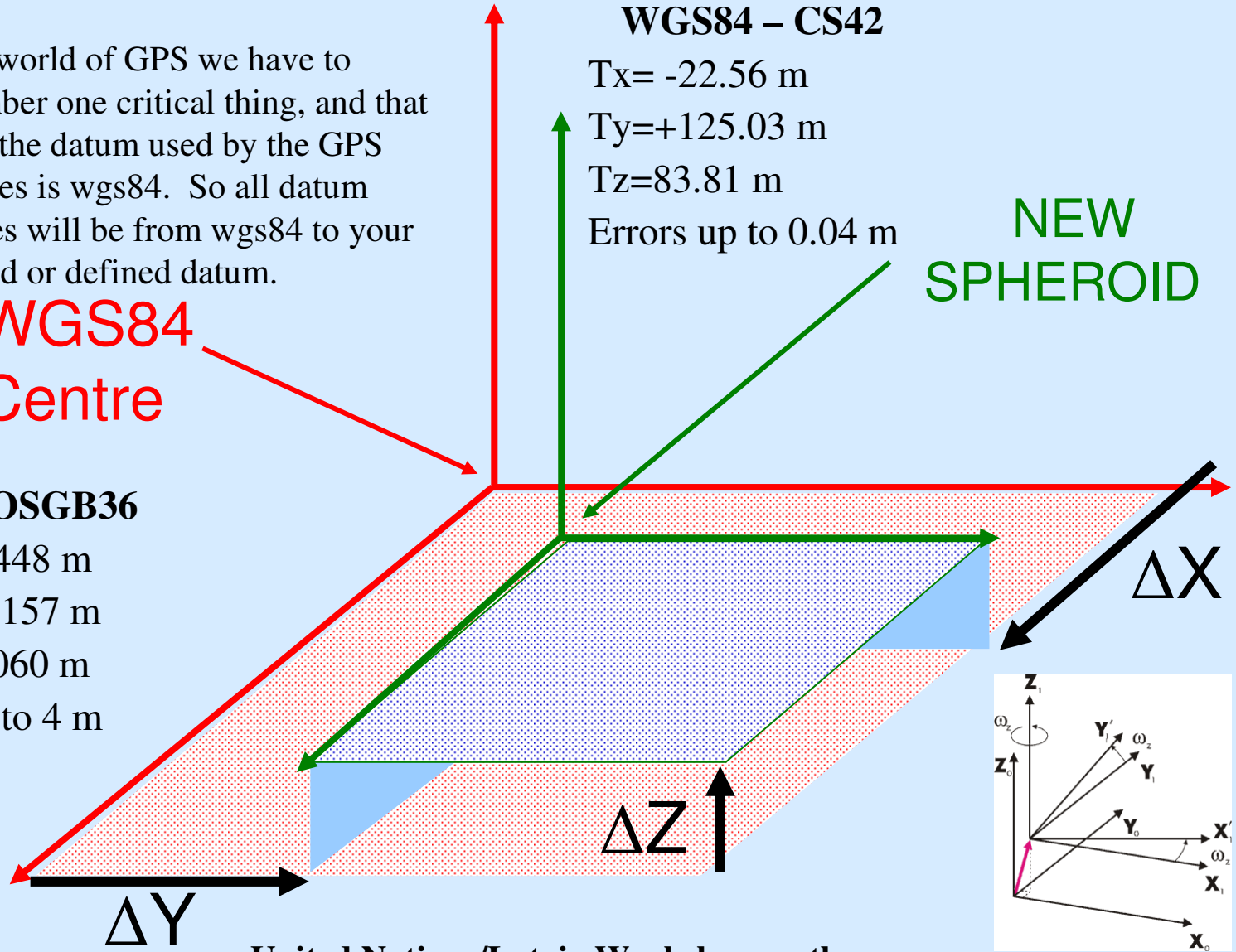
WGS84-OSGB36

Tx=-446.448 m

Ty=+125.157 m

Tz=-542.060 m

Errors up to 4 m



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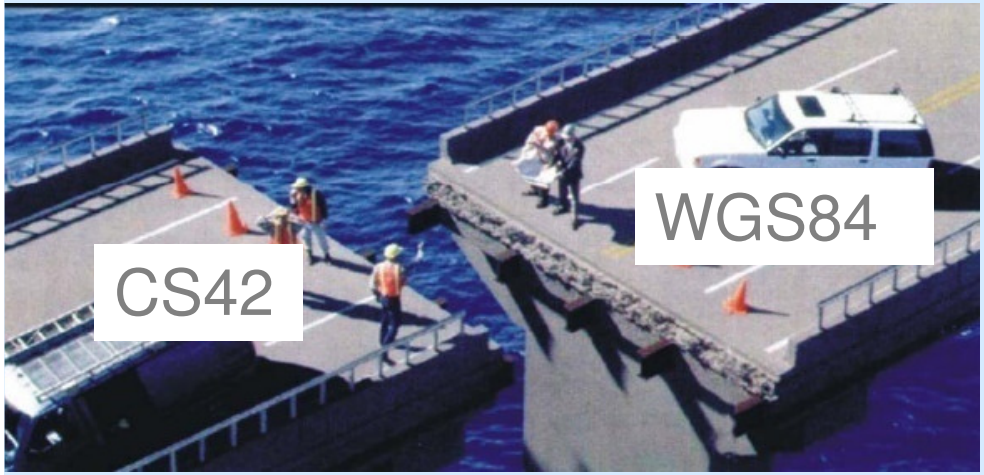
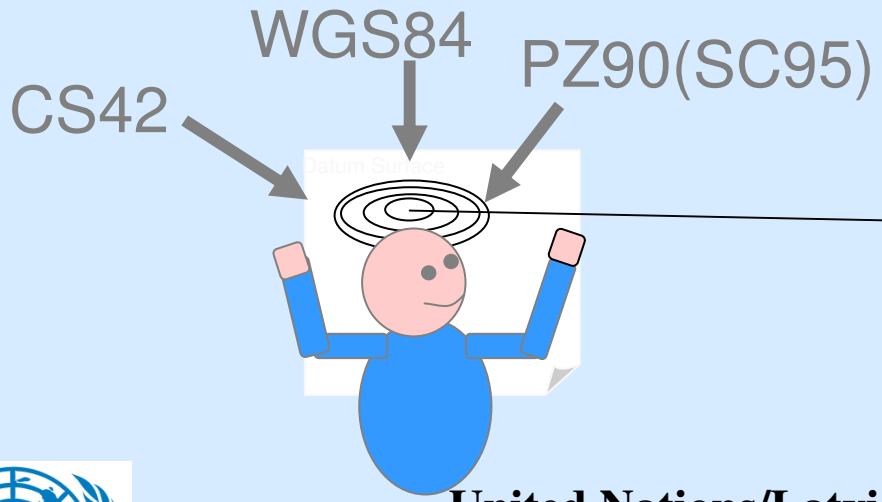
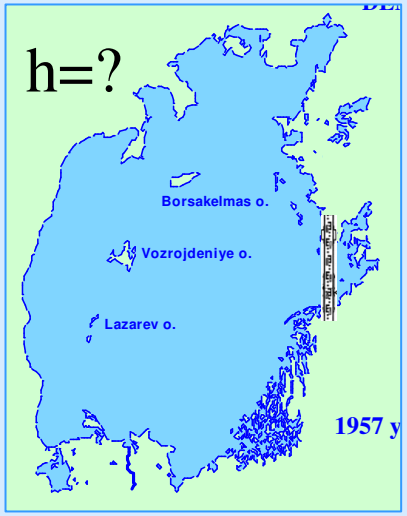
What is reference system for our region



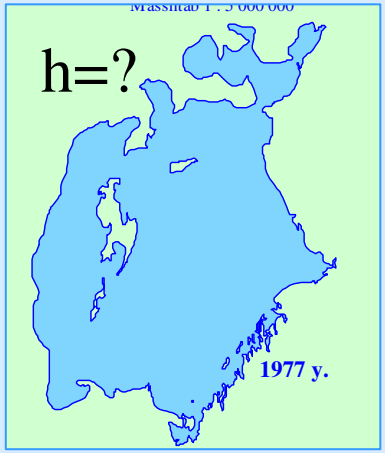


Aral sea level

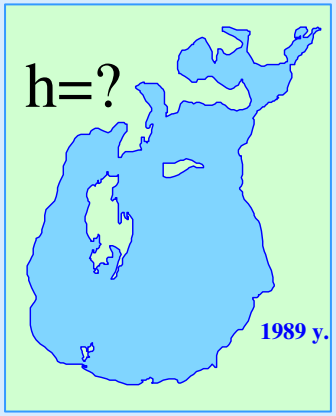
1957



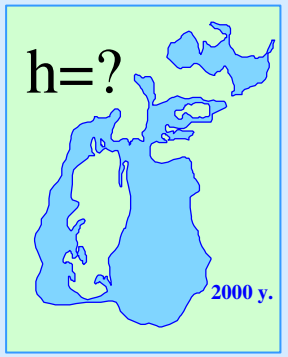
1977



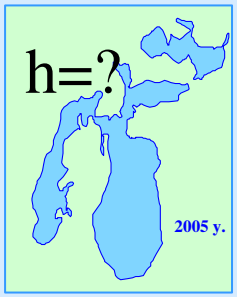
1989

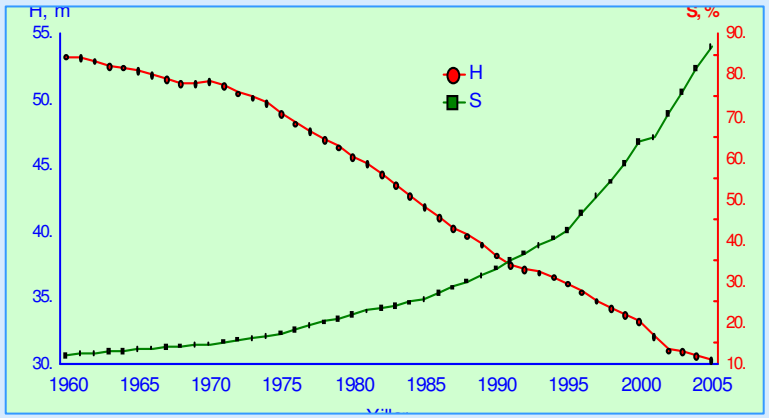


2000



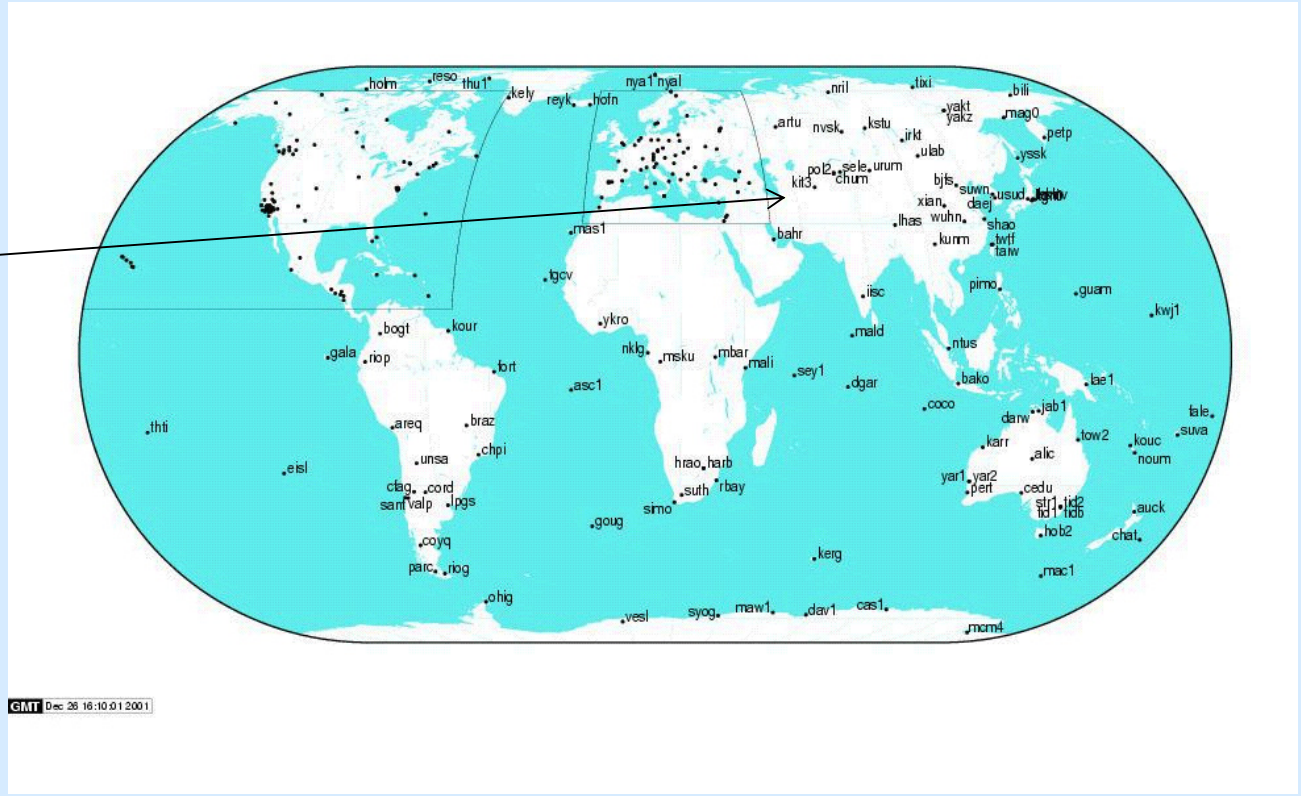
2005





IGS network

Kitab(kit3)



National University of Uzbekistan
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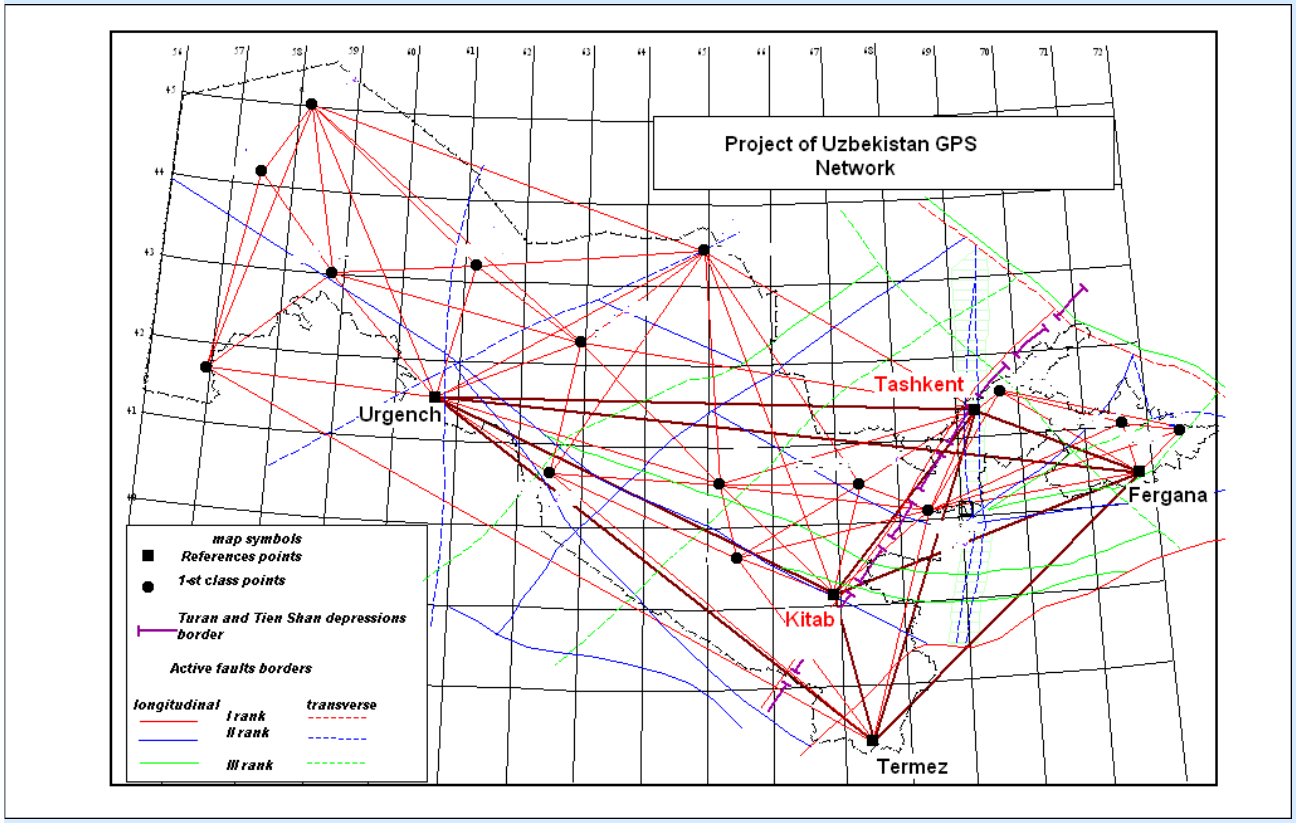
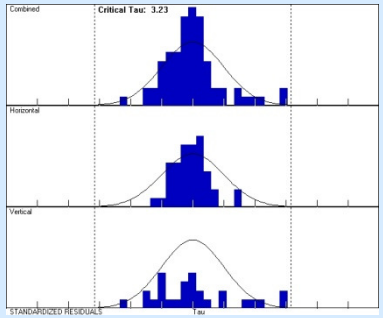
Project of Uzbekistan GPS network





The new network consists of a hierarchy of stations, consisting of 5 reference stations, 15 1st Order stations.

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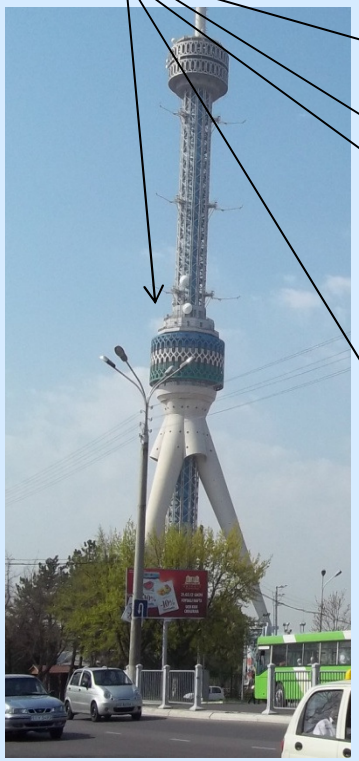
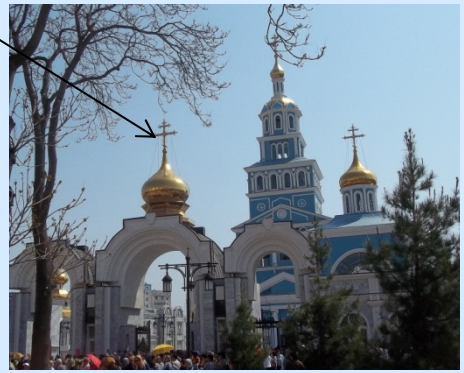
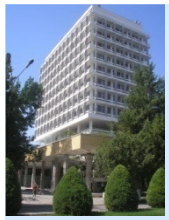
In the future

Accurately measuring and modeling the geoid of Uzbekistan and its gravity field to precisely determine the position and velocity of points or objects at the surface.







Thank you
for your attention!

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