Realising CS42 with WGS84

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United Nations/Moldova/United States of America

Workshop on the Applications of Global Navigation Satellite Systems

Chisinau, Moldova

17 – 21 May 2010

Capital: **Tashkent**
Area: **447 400 sq.km**
Population: **25563441 people**
Density: **57.14 people/sq.km**

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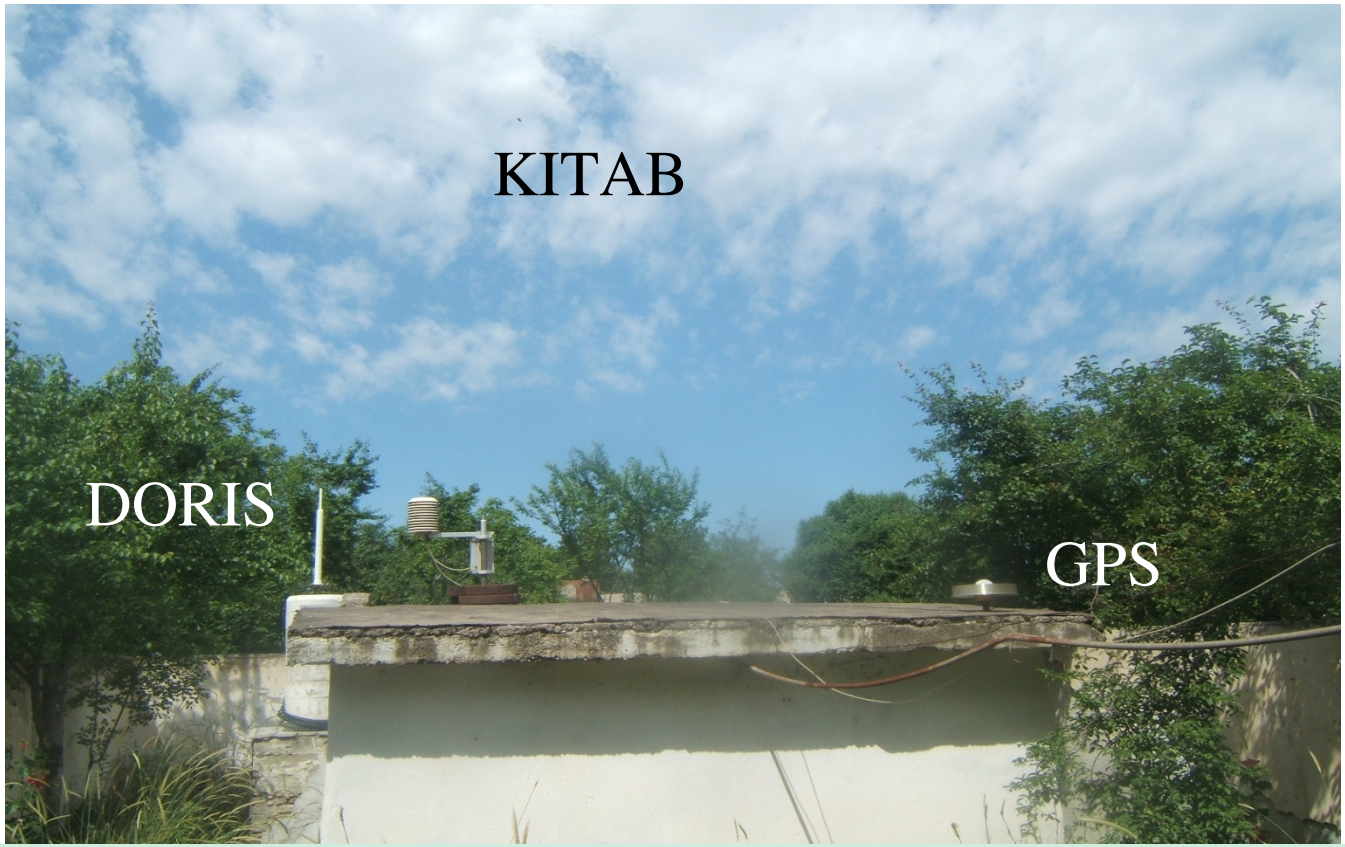
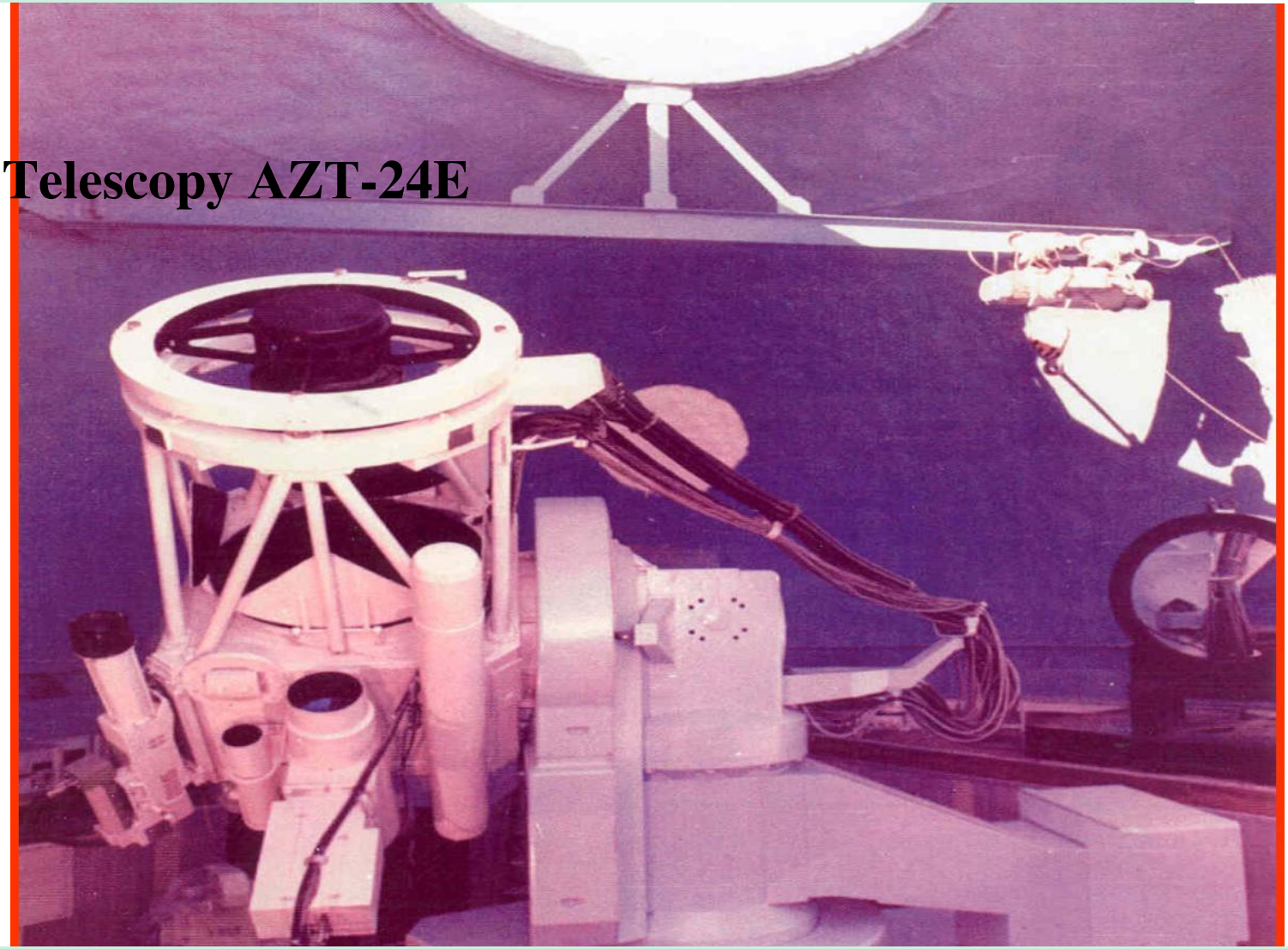

KITAB
DORIS
GPS

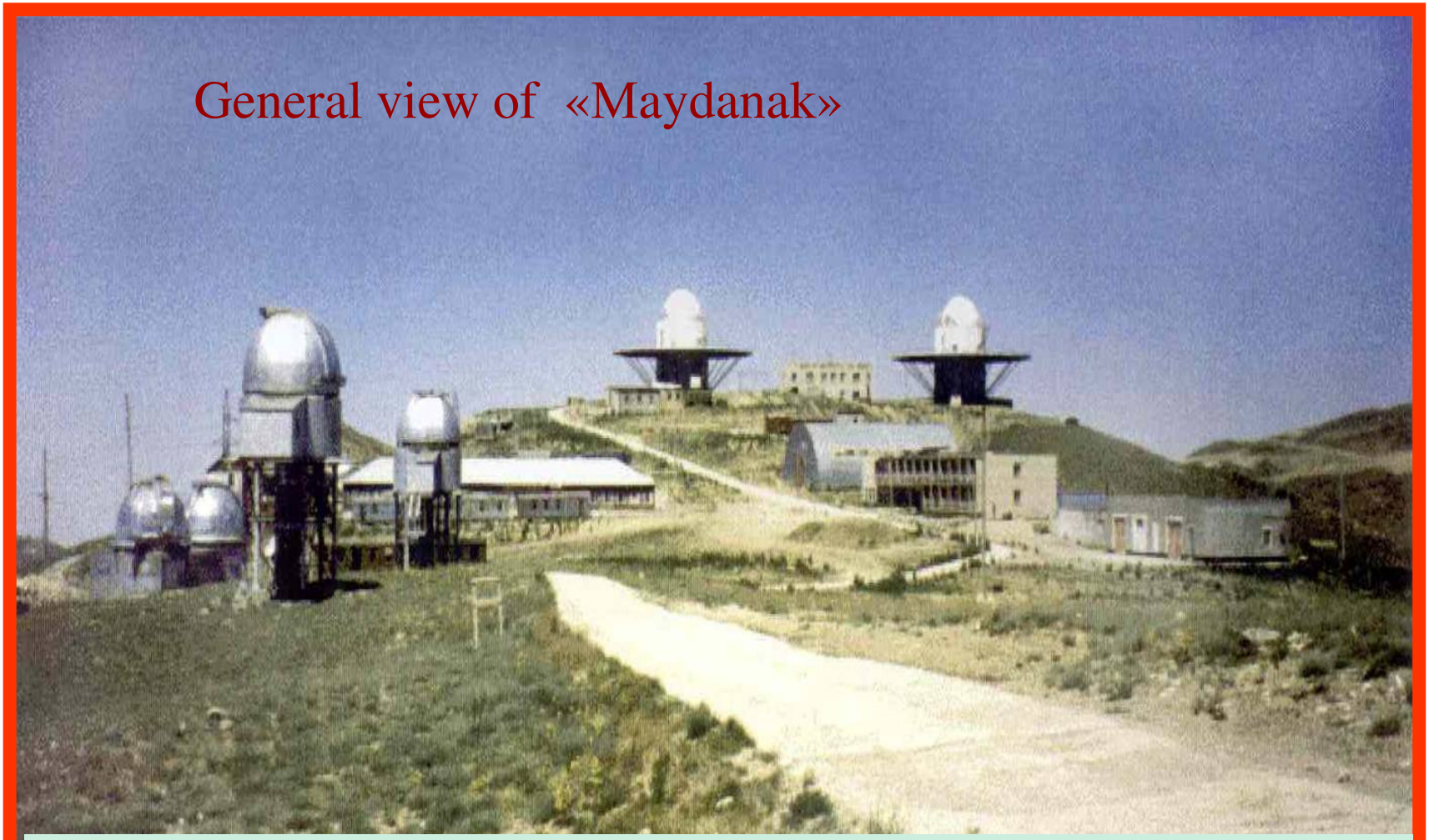

TASHKENT

Telescopy AZT-24E



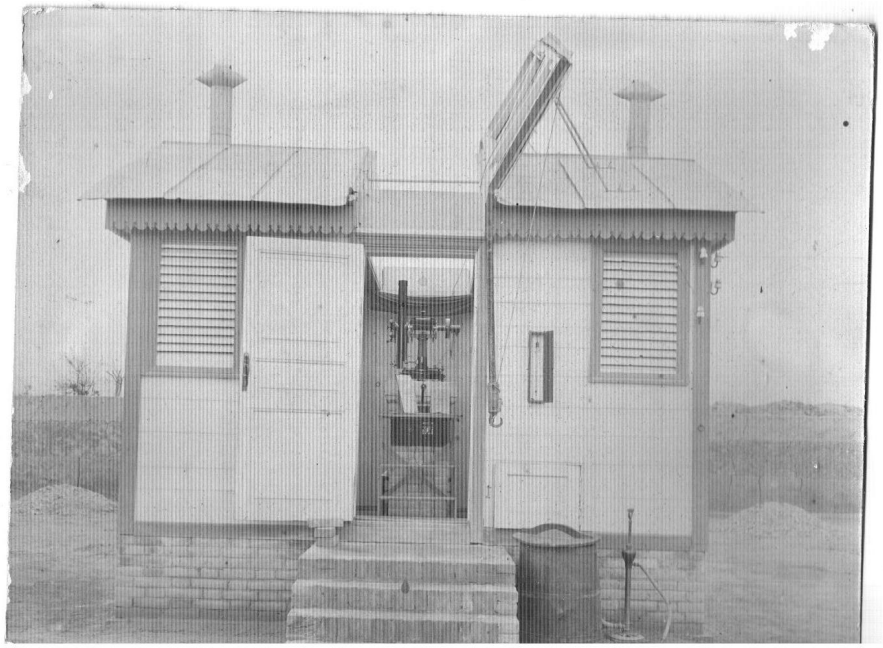

"MAYDANAK"

General view of «Maydanak»




Maydanak observatory, H=2750m

1929




39 08
1970

GEODETIC PROBLEMS OF UZBEKISTAN

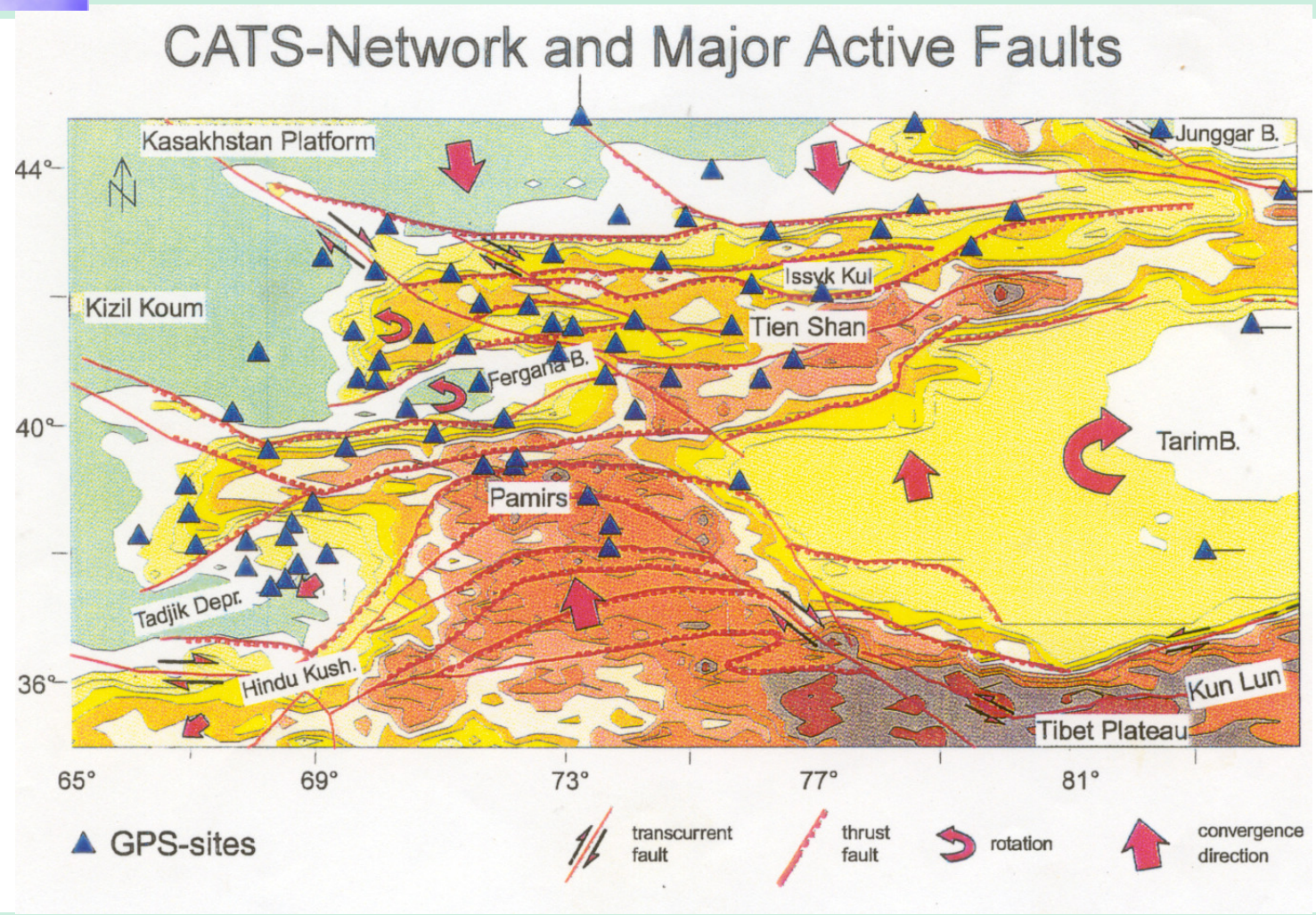
- **State Geodetic Network of the former Soviet Union was developed by prof. Krasovsky more than 60 years ago. The Republic of Uzbekistan was part of the former Soviet Union.**

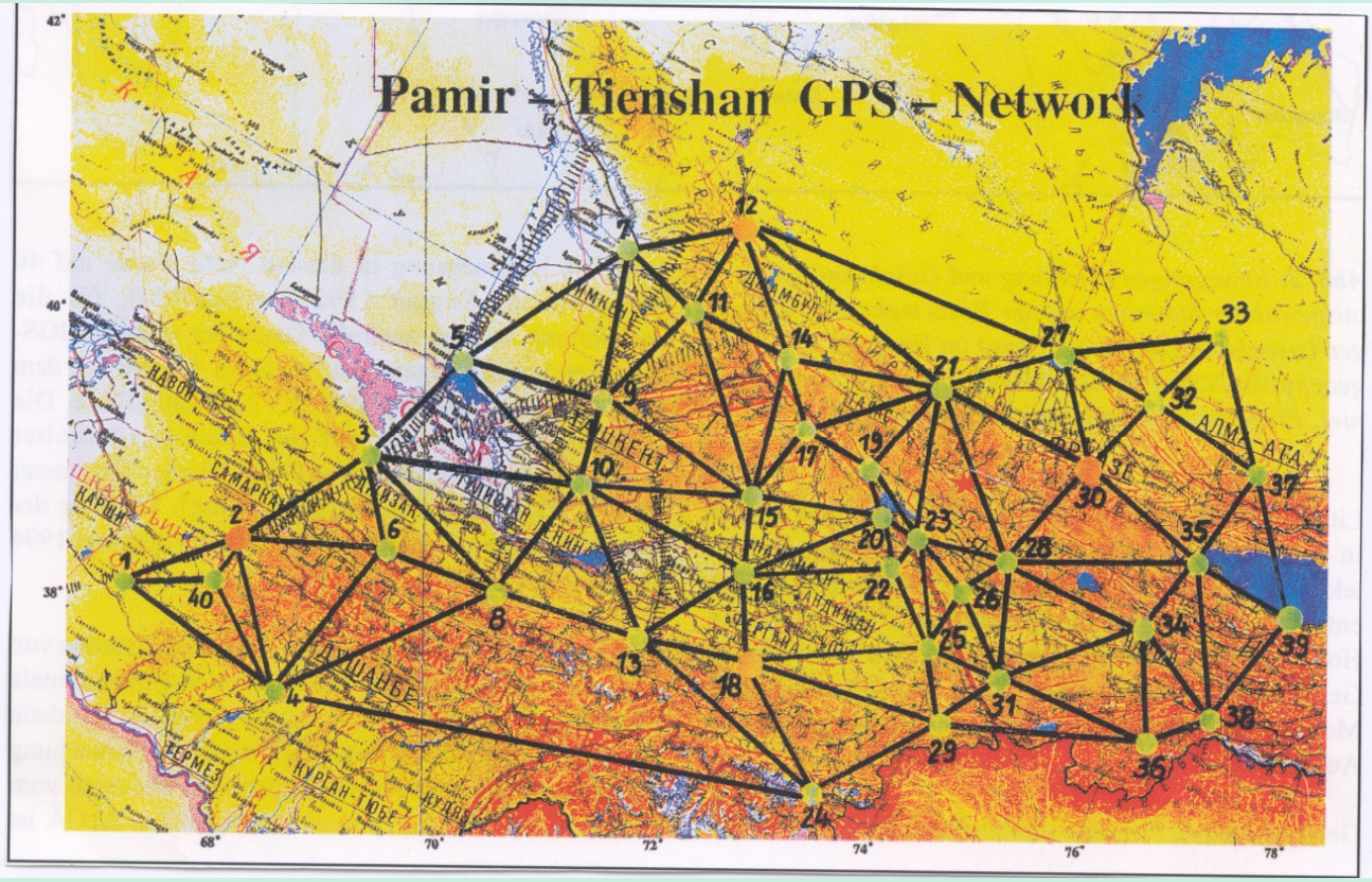
- **Geophysical services of Uzbekistan use the coordinate system of 1942 (SC-42, a starting point "PULKOVO").**

- **Distortions in the current datum up to 10 m have been recognized**

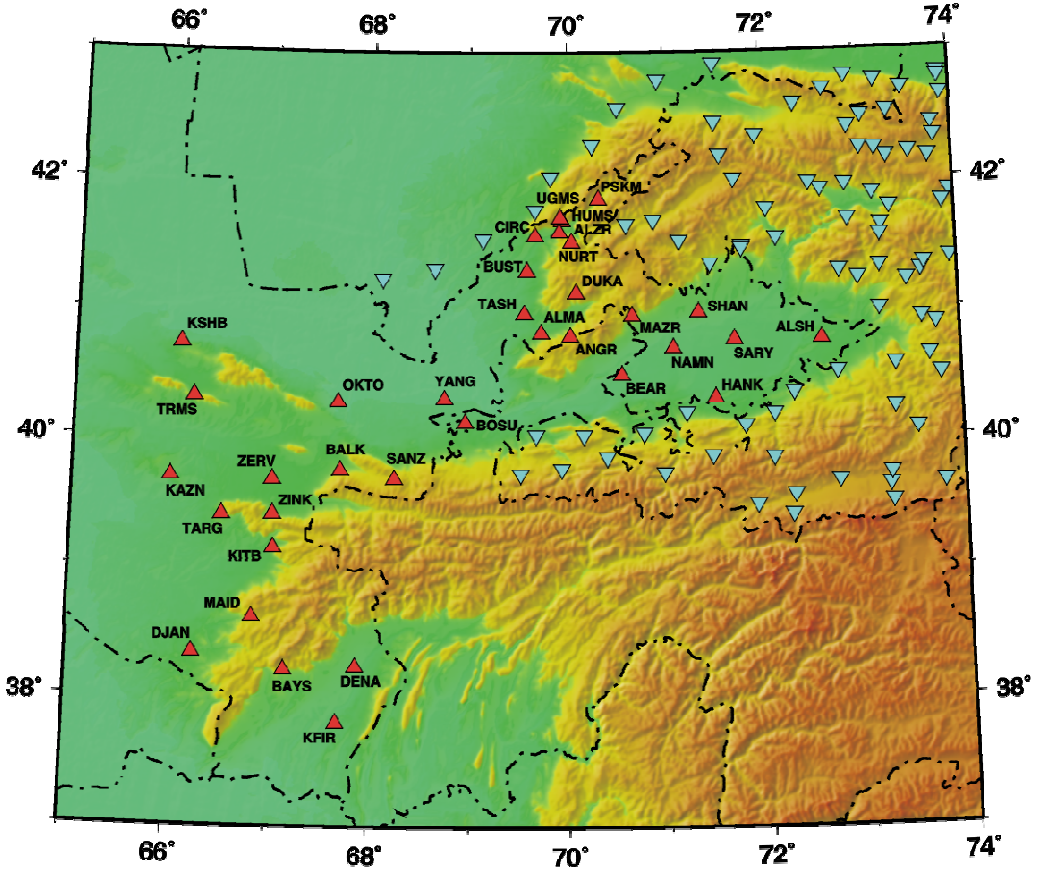
- **This network is static, its points remain stationary.**

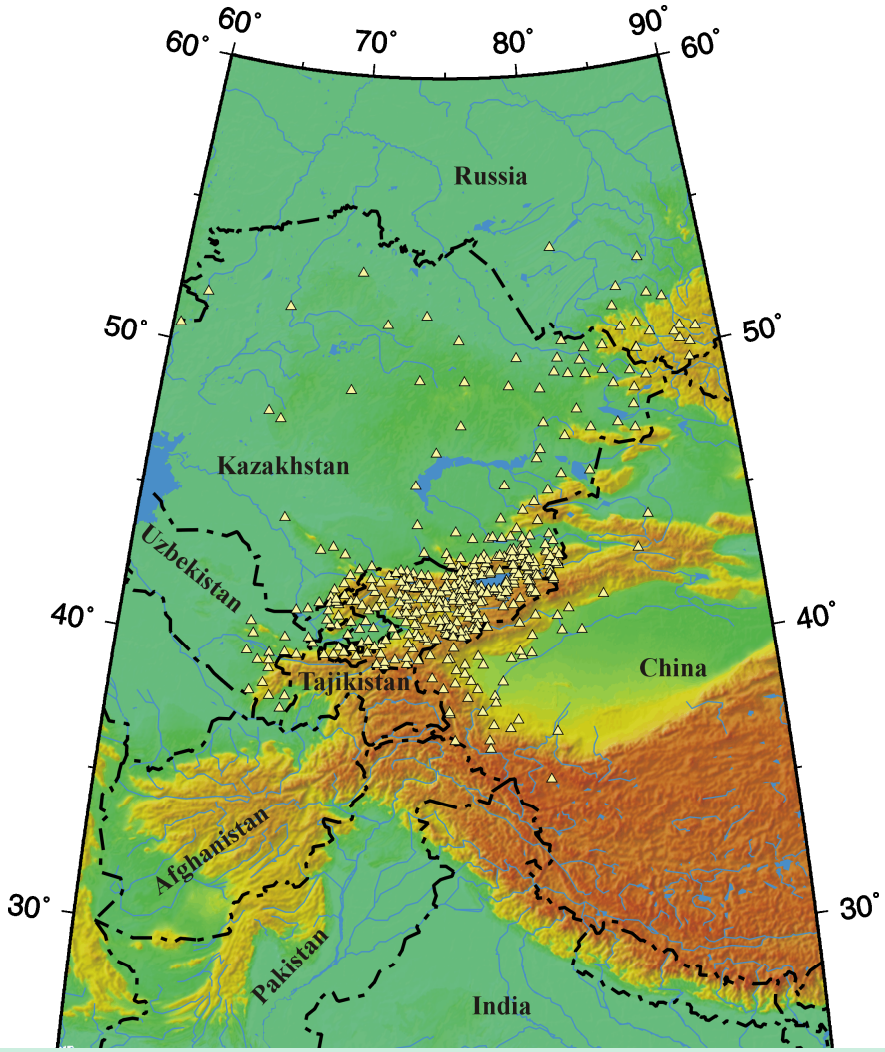
- **Insufficient density of network ITRF for the decision of geodynamic problems**


CATS-Network and Major Active Faults
Kasakhstan Platform
Junggar B.
Kizil Koum
Issyk Kul
Tien Shan
Fergana B.
TarimB.
Pamirs
Tadjik Depr.
Hindu Kush.
Kun Lun
Tibet Plateau
44°
40°
36°
65°
69°
73°
77°
81°
GPS-sites
transcurrent fault
thrust fault
rotation
convergence direction


Pamir – Tienshan GPS – Network
ТАШКЕНТ
САМАРКАНД
ДУШАНБЕ
ТЕРМЕЗ
КУРГАН-ТЮБЕ
АЛМА-АТА
42°
40°
38°
68°
70°
72°
74°
76°
78°

GPS network in Uzbekistan





Central-Asian GPS network

- Russia
- Kazakhstan
- Kyrgistan
- Uzbekistan
- China

The Molodensky method

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

$$\Delta B = \frac{\rho''}{M+H}[-T_X \sin B \cos L - T_Y \sin B \sin L + T_Z \cos B + \Delta a_E (Ne^2 \sin B \cos B)/a_E +$$
$$+ \frac{N\Delta e_E^2}{2}\left(\frac{N^2}{a_E^2}+1\right)\sin B \cos B] + (1+e_E^2 \cos 2B)(\omega_X \sin L - \omega_Y \cos L) - \rho'' e_E^2 \mu \sin B \cos B;$$

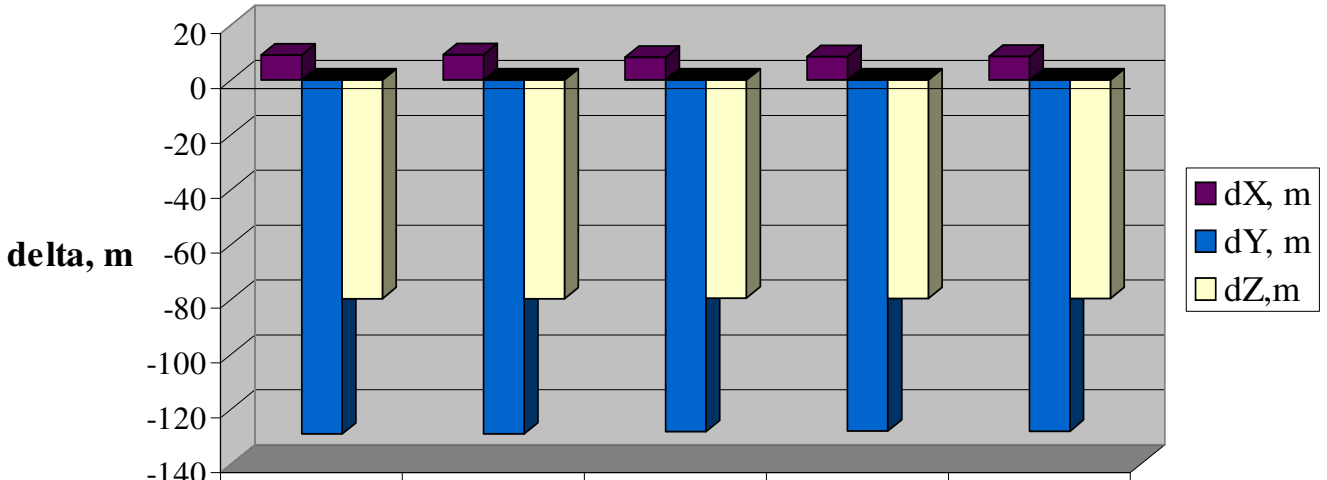
$$\Delta L = \frac{\rho''}{(N+H)\cos B}(-T_X \sin L + T_Y \cos L) - tgB\,(1-e_E^2)(\omega_X \cos L + \omega_Y \sin L) + \omega_Z;$$

$$\Delta H = T_X \cos B \cos L + T_Y \cos B \sin L + T_Z \sin B - \frac{a_E \Delta \alpha_E}{N} + \frac{\Delta^2_E N \sin^2 B}{2} +$$
$$+ e_E^2 N \sin B \cos B\left(\frac{\omega_X}{\rho''}\sin L - \frac{\omega_Y}{\rho''}\cos L\right) + \mu(N + H - e_E^2 \sin^2 B).$$

The Helmert method

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{CK-42} = \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{WGS-84} + \begin{bmatrix} T_X \\ T_Y \\ T_Z \end{bmatrix} + \begin{bmatrix} m & \omega_Z & -\omega_Y \\ -\omega_Z & m & \omega_X \\ \omega_Y & -\omega_X & m \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{WGS-84}$$

Coordinates difference between WGS-84 and SC-42 for CATS points in Uzbekistan

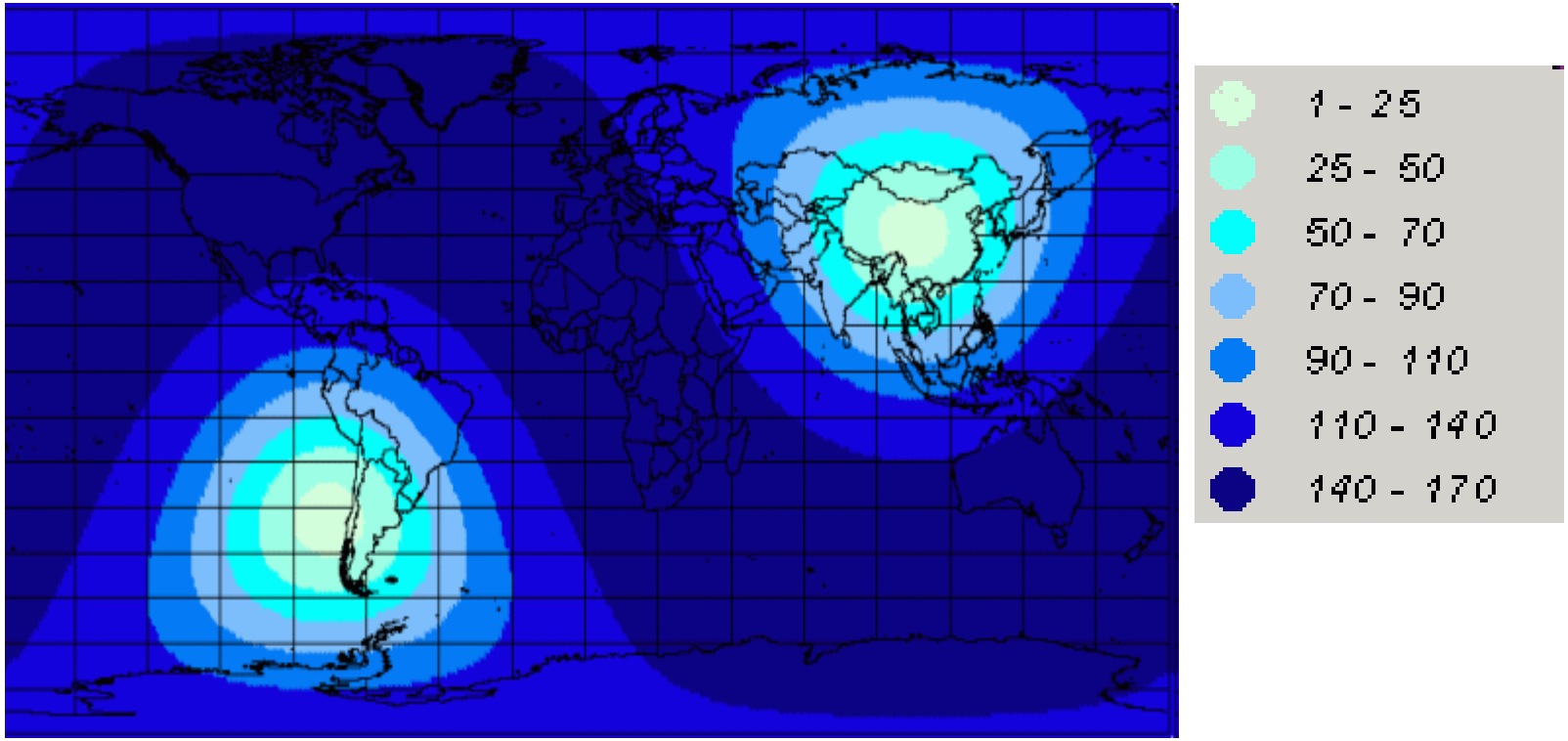


	angr	circ	kfir	mada	kit3
dX, m	9,102	9,236	8,305	8,544	8,666
dY, m	-128,97	-128,897	-128,085	-127,909	-127,936
dZ,m	-79,64	-79,72	-79,386	-79,542	-79,598

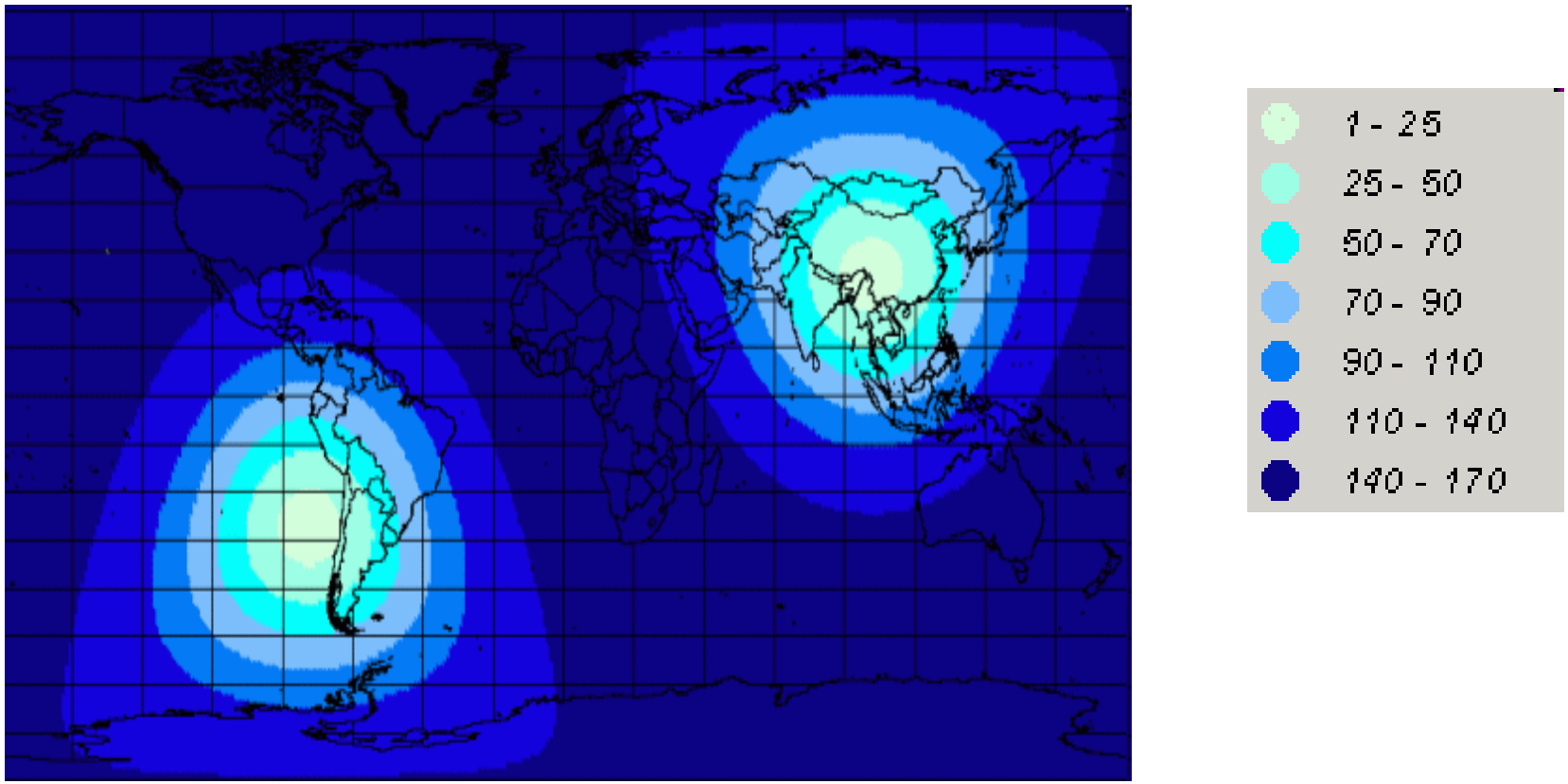
CATS stations

Coordinates difference between WGS-84 and CK-42

dx = 28, dy = -130, dz = -95
World Geodetic System 1984. NIMA, 2000



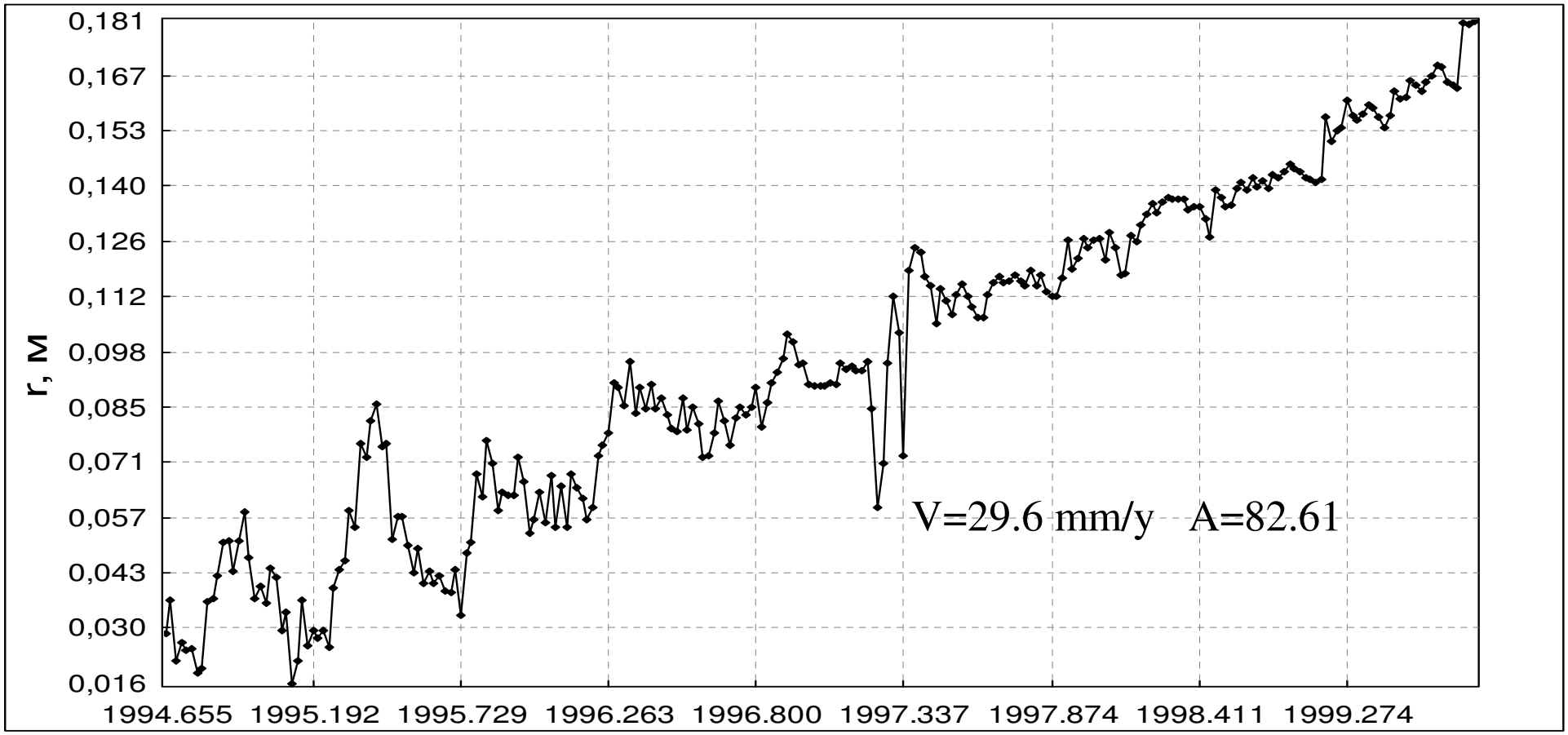
dx = 24, dy = -141, dz = -81
GOST 51794-2001

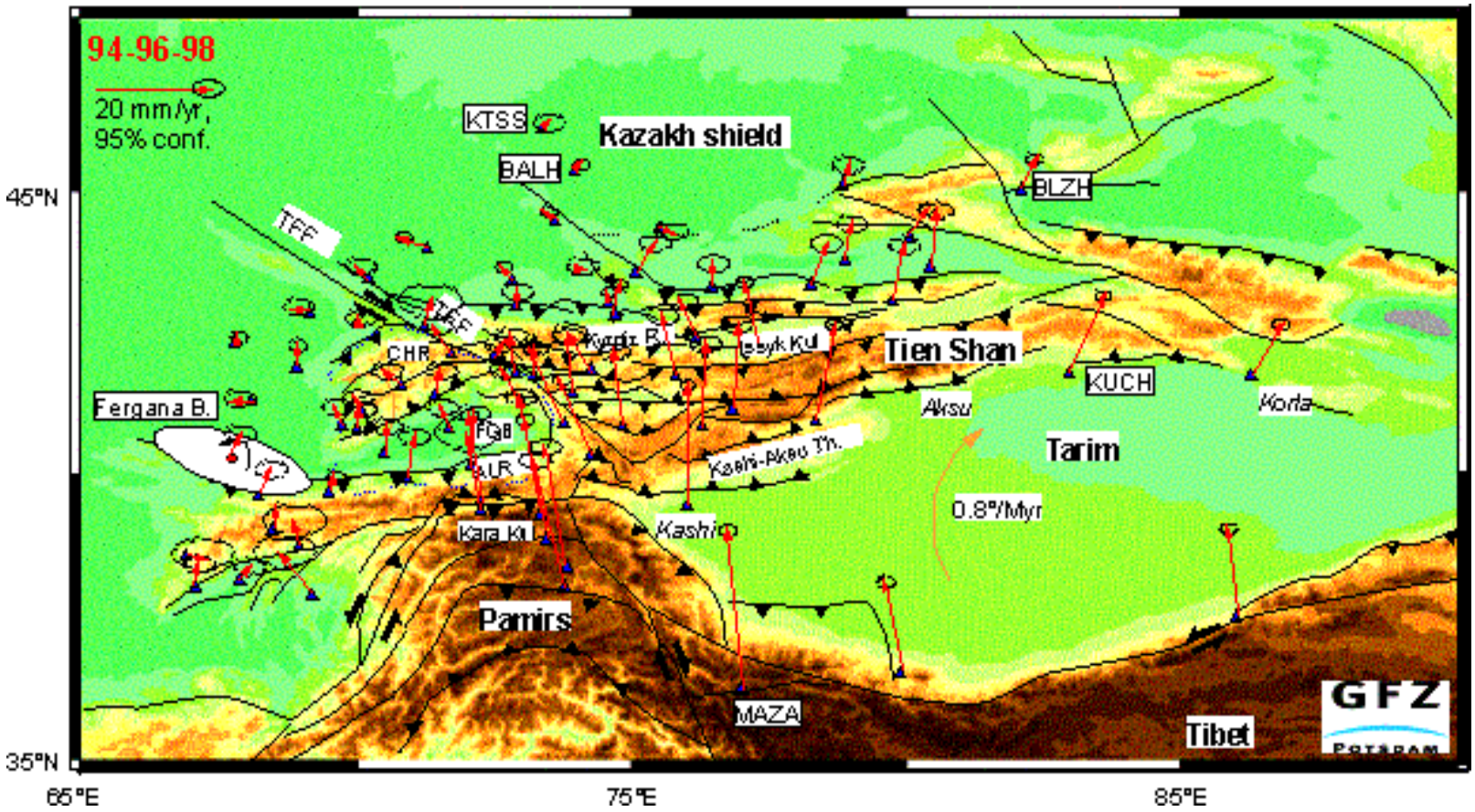


Coordinates difference between WGS-84 and CK-42

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)

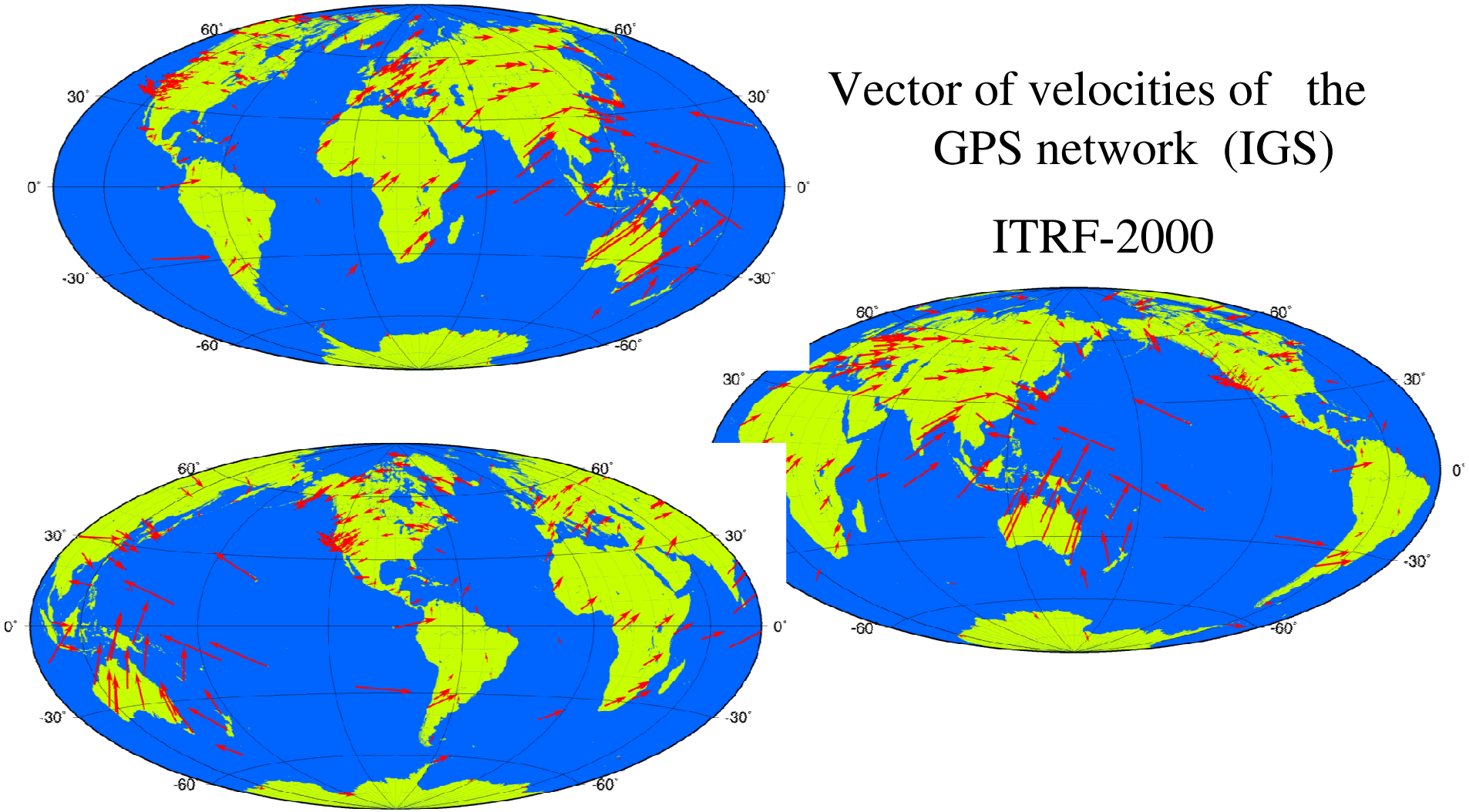
Velocity of Kitab station in 1994-2000



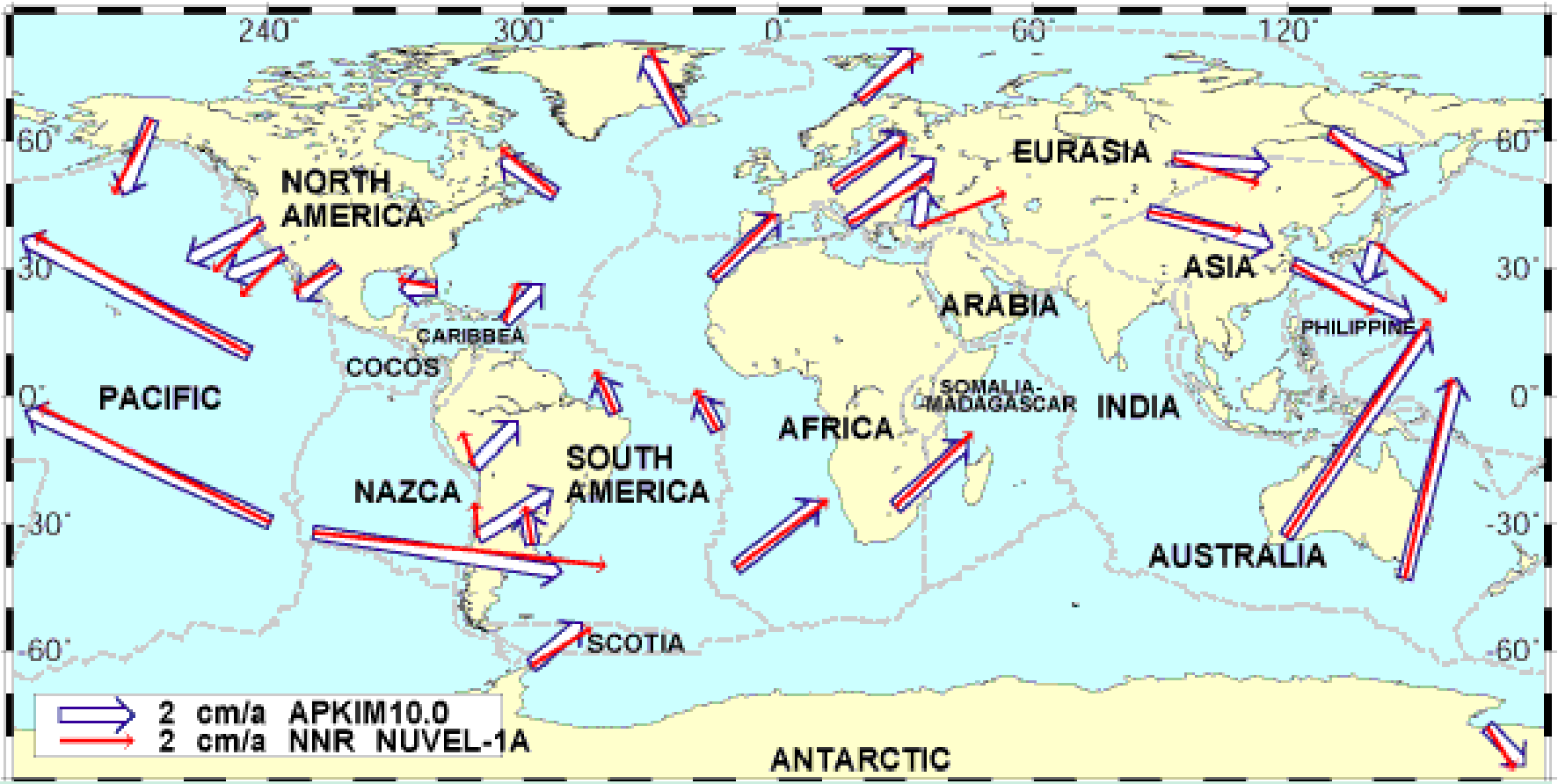

94-96-98
20 mm/yr,
95% conf.
KTSS
Kazakh shield
BALH
BLZH
TFF
CHR
Issyk Kul
Tien Shan
KUCH
Fergana B.
Aksu
Korla
Tarim
Kashi-Aksu Th.
0.8°/Myr
Kara Kul
Kashi
Pamirs
MAZA
Tibet
GFZ
45°N
35°N
65°E
75°E
85°E

Vector of velocities of the GPS network (IGS)

ITRF-2000



Continental moving



DORIS network

GPS station in Kitab

φ=39° 07′ 59″, λ=66⁰ 52/ 57.0//, H=657м. (CS-42)

φ=39° 08′ 05″, λ=66⁰ 53/ 07.6//, H=622м.(WGS-84)

1992-1996

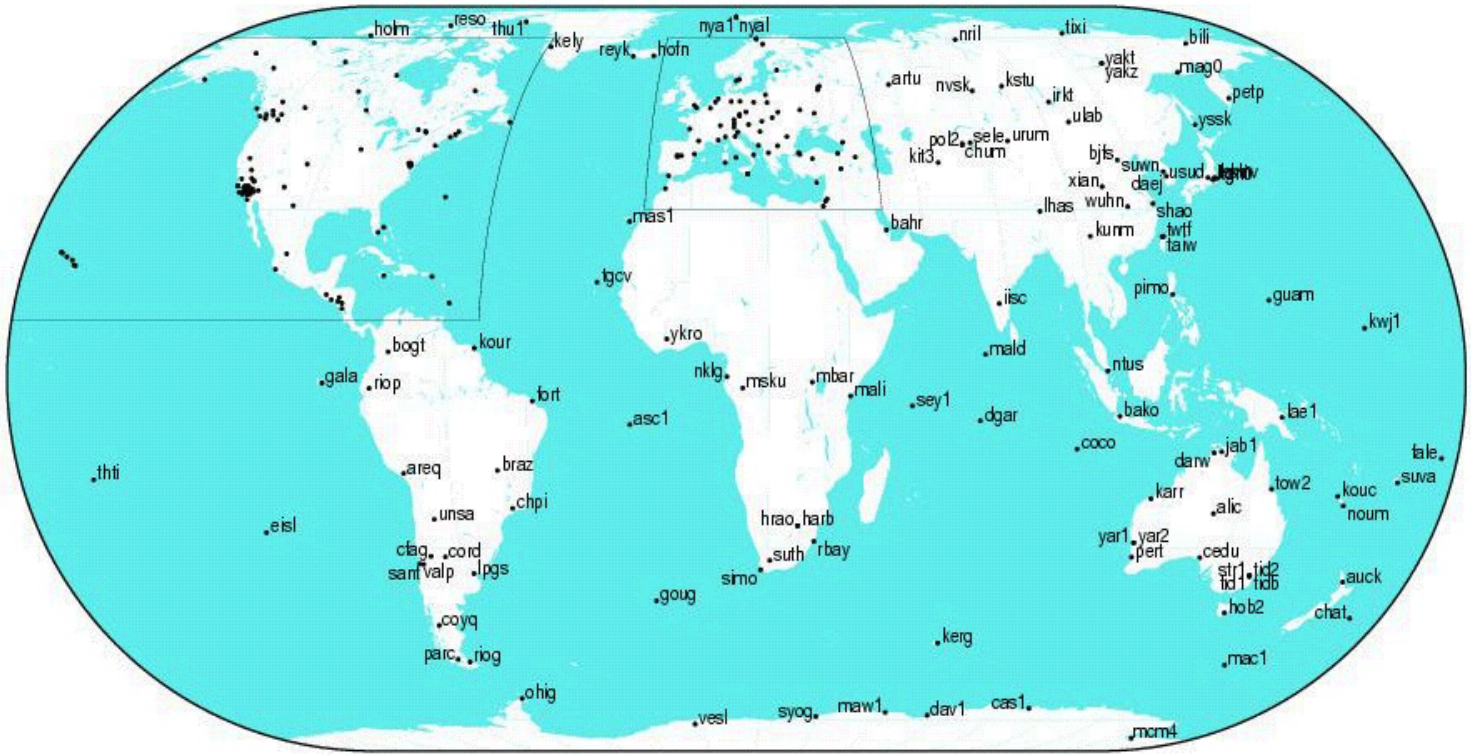
The international program CATs(GFZ,Germany)

RMS: 1-3mm. for x, y

RMS: 5mm. for H.

RMS: 1-2cm. for Global network

IGS network



GMT Dec 26 16:10:01 2001

THANK YOU
for attention