



UNITED NATIONS  
Office for Outer Space Affairs

وزارت ارتباطات و فناوری اطلاعات



سازمان فضایی ایران  
IRANIAN SPACE AGENCY

# GNSS Applications in Iran

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***Workshop on the Applications of GNSS***

11-15 May 2009, Baku, Azerbaijan

# Iran in a Glance

- **Area:** 1.648 million sq km
- **Population:** 71.5 million
- **Education:** 115,000 schools with 18 million students, +200 universities with about 3 million students





# Geomatics in Iran

- Development of Geomatics within the last half century in Iran has faced with considerable challenges in different aspects and was not possible without great efforts of spatial data producers and users as well as people in research and education area.
- The issues such as growing demand for cartographic products, great interest in Geomatics education, revolutionary movement towards digital technology, standardization efforts and popularity of GNSS, GIS and remote sensing applications can demonstrate development of the country in the field of Geomatics.





# Geomatics in Iran

- In Iran, national organizations, ministerial and municipal offices as well as private companies are active in the field of mapping and geographic information production needed by decision makers and general users.
- Most research in the fields of photogrammetry, remote sensing, GIS , Satellite Geodesy is carrying on in the national organizations, institutions and universities. However a few private companies have also made remarkable research for their commercial products and services.





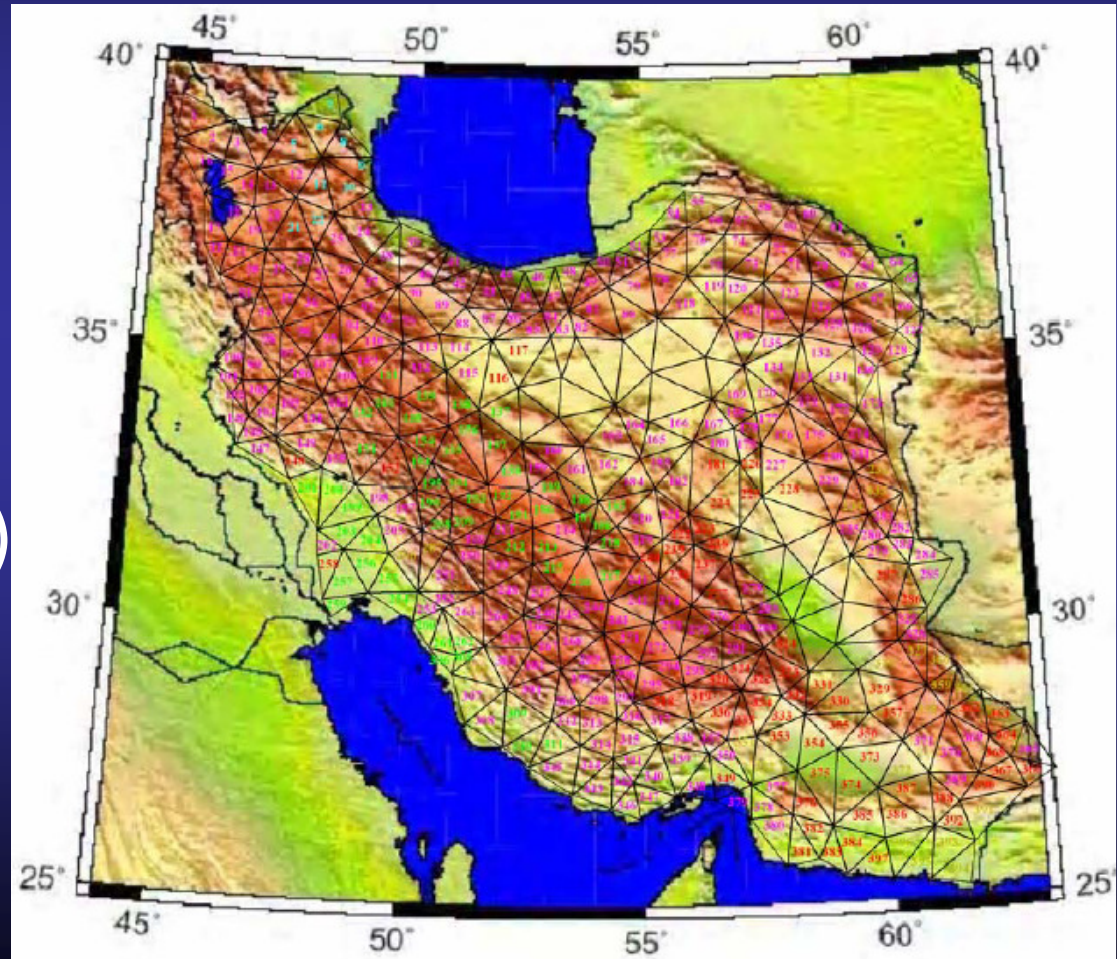
# Geomatics & Education

- In Iran there are more than 10 universities involve training and educating experts in the field of Geomatics.



# Geodetic Networks

- Establishment of geodesic network by using GPS system
- 0 Order
- 1st Order
- 2nd Order (<25km)
- 3rd Order (<15 km)





# Digital Base Maps

- **1:25000 scale 3D base map series:**

This project was started in 1991 using analogue technology and then switched to digital products by using Digital Photogrammetry and Geodetic Networks using GPS instruments with the whole coverage of the country (10,000 sheets).





# Digital Base Maps

- **1:2000 scale 3D map series of the cities:**

There are more than 1000 cities in Iran, 70% have 1:2000 maps.







# GNSS & Geodynamics

- Iran is one of the most tectonically active zone in Alpine-Himalayan seismic belt where has been shaken by largely destroying earthquakes.
- Iran is located in the convergence zone between Arabia and Eurasia.
- Geodetic measurements can play an important role to understand the tectonic deformations

# Geographic Situation

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Iran is situated in a highly seismic part of the world and has been frequently struck by catastrophic disasters as earthquake, flood, draught, etc during her recorded history

# Iranian Permanent GPS Network for Geodynamics (IPGN)



- Since early 2005 Cartographic Centers of Iran have established a continuous GPS network with more than 113 stations which is named *Iranian Permanent GPS Network for Geodynamics (IPGN)*.

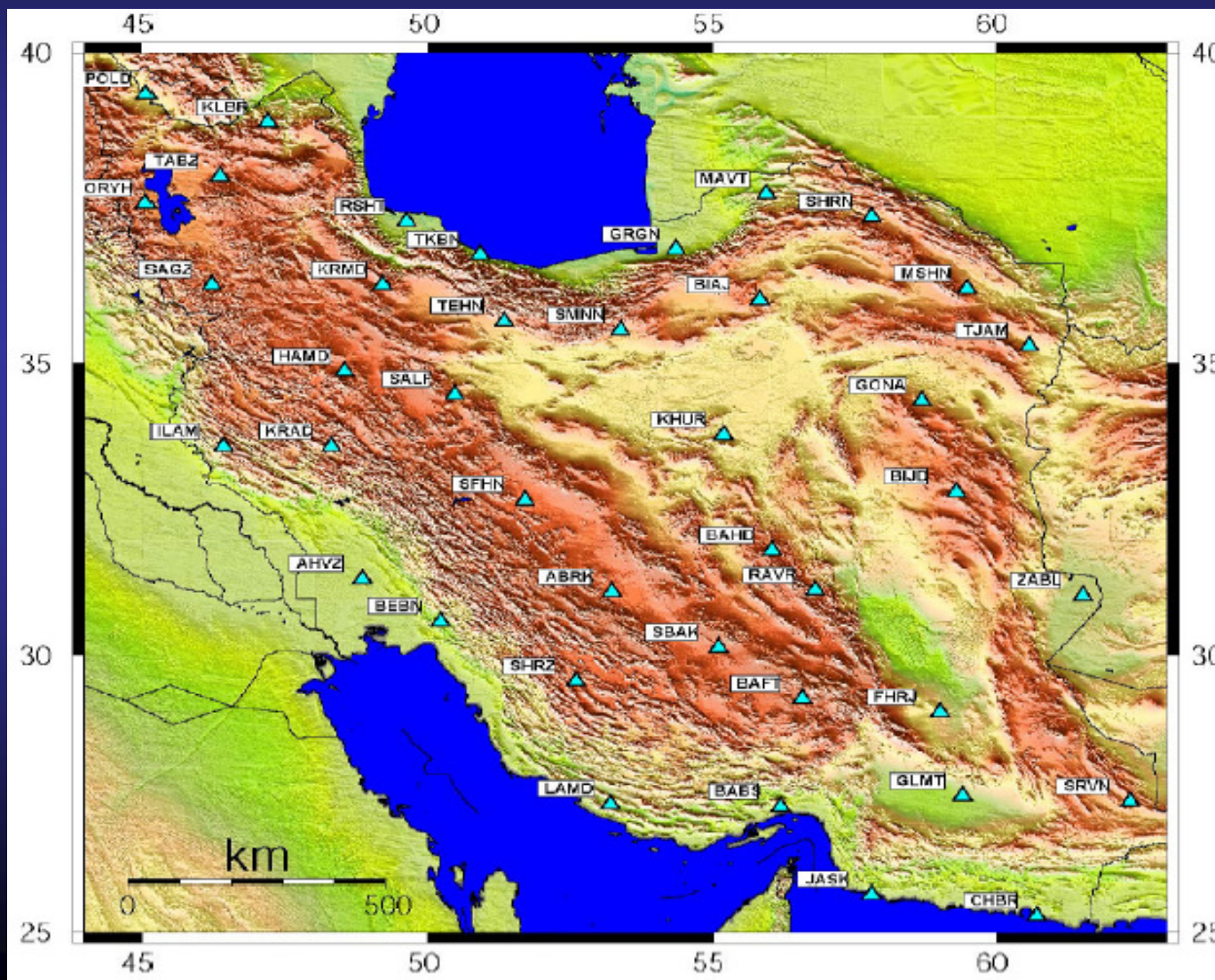
# Iranian Permanent GPS Network for Geodynamics (IPGN)



- At the first, in order to study general tectonic behavior in Iran, 41 stations which were distributed in whole of the country, selected.



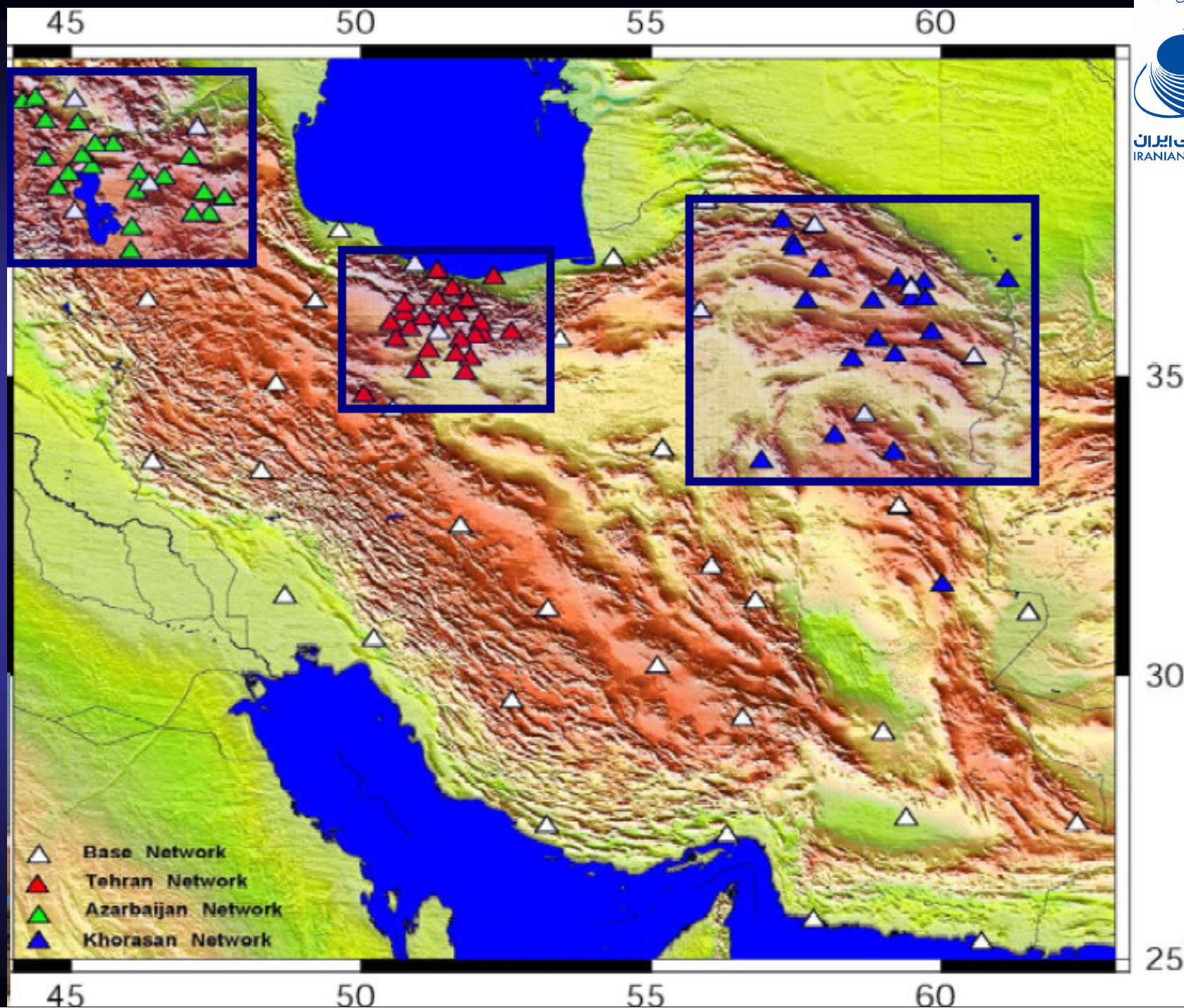
# Iranian Permanent GPS Network for Geodynamics (IPGN)



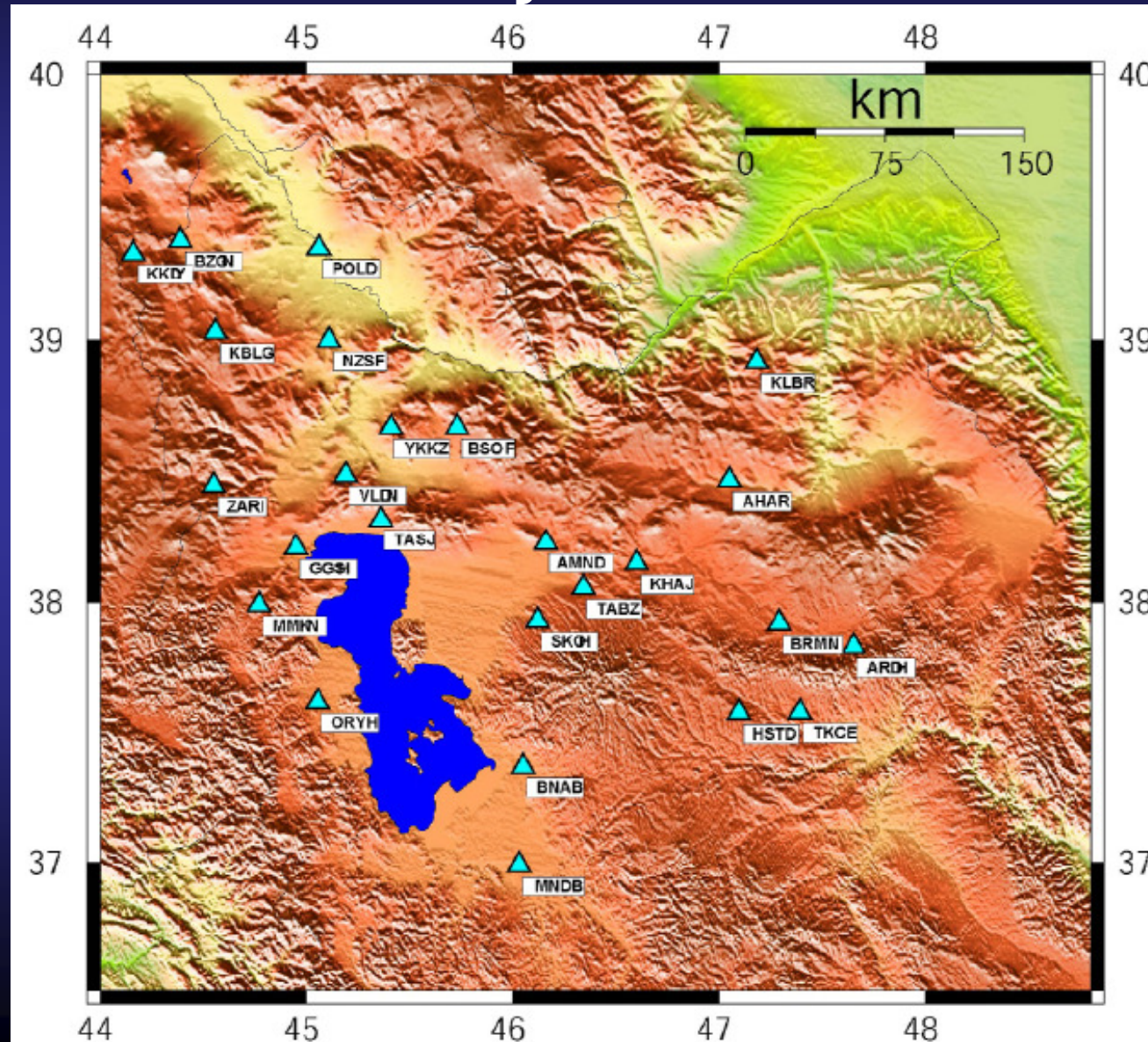
# Iranian Permanent GPS Network for Geodynamics (IPGN)



- Three other areas were:
  - Central Alborz and Tehran
  - North-West of Iran (Azerbaijan)
  - North-East of Iran (Khorasan).
- The rest of receivers, i.e. 72, were considered for these areas as local networks.



# Azerbaijan Network





# Iranian Permanent GPS Network for Geodynamics (IPGN)



- These four networks are daily processed and show us a continuous monitoring of any surface deformation.



# A Permanent Station





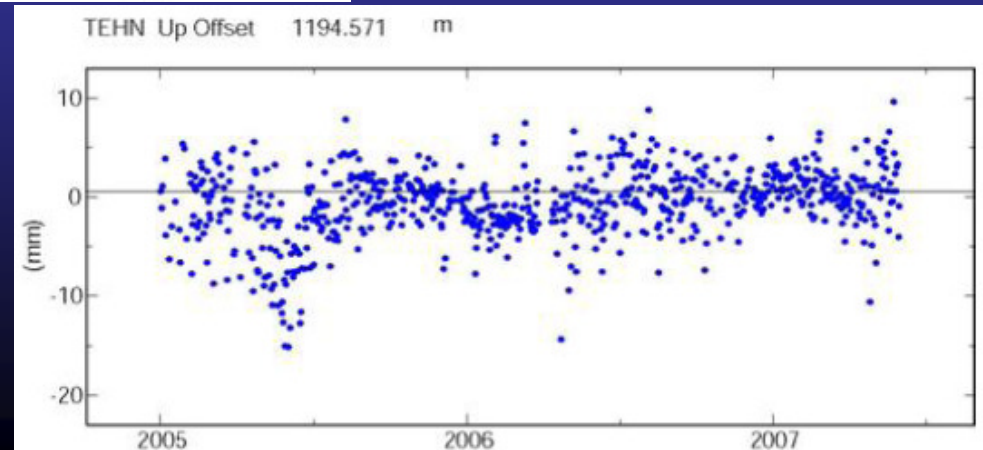
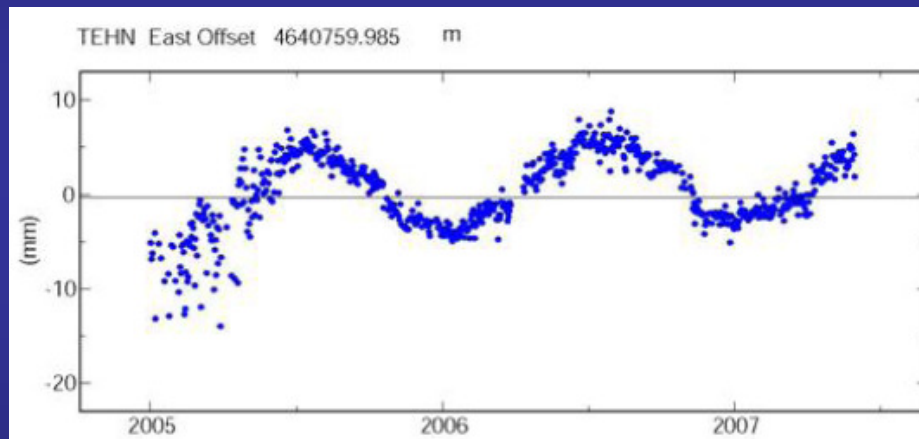
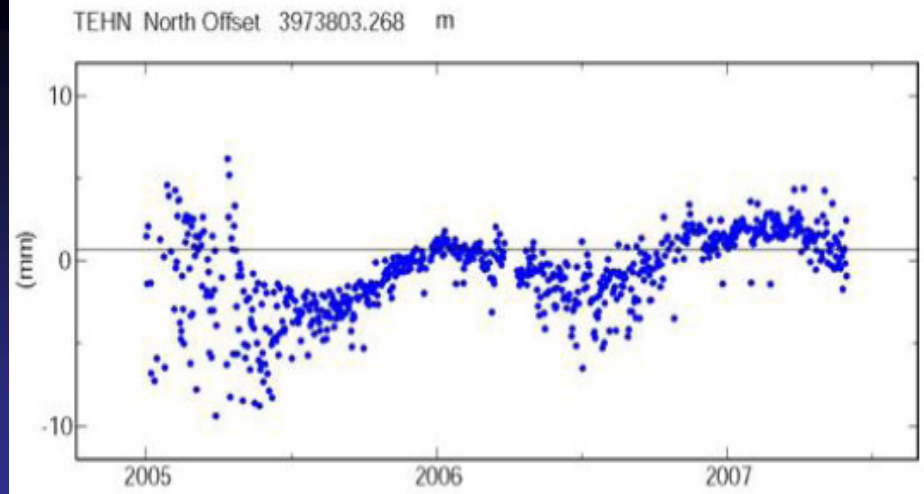
# A Permanent Station





# A Permanent Station





We can quantify shortening and strike-slip rate in Iran as horizontal movements, and also we can talk about subsidence and uplift as vertical movements.



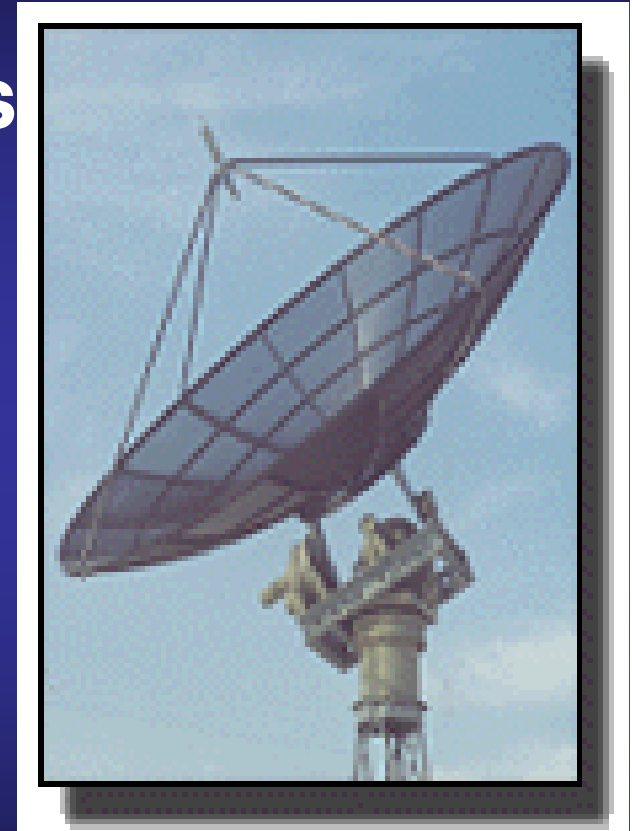
# GNSS & Remote Sensing

## 1) Ground Receiving Stations

- Finding Location of Antenna
- Measuring the Time

## 2) Obtaining Field Work Data

- Geometric Correction
- Training or Making a Model
- Checking: Accuracy Assessment



# Ground Receiving Stations

We have two steps for direct receiving of Satellite Imagery as follows:

- 1) **Using Orbital Elements** (as like as TLE format Data), for finding the location of each satellite on its orbit (for any time)
- 2) **Moving the antenna** in order to track the satellite to receive signals, in which we need accurate position and time of the station to calculate satellite zenith and azimuth angle



# TLE: Two Line Elements

http://celestrak.com/NORAD/elements/resource.txt - Windows Internet Explorer

http://celestrak.com/NORAD/elements/resource.txt Yahoo! Search

File Edit View Favorites Tools Help

CelesTrak CelesTrak:... http://... x

```

LANDSAT 5
1 14780U 84021A 09121.84063215 -.00000340 00000-0 -65344-4 0 6135
2 14780 98.2453 189.8447 0001784 239.6757 120.4258 14.57091608338639
SPOT 2
1 20436U 90005A 09121.78873767 .00000170 00000-0 10000-3 0 3025
2 20436 98.6650 192.8158 0001015 79.4327 69.0723 14.20060803999103
ERS-2
1 23560U 95021A 09121.73829313 .00000037 00000-0 30069-4 0 478
2 23560 98.5561 197.5547 0001004 79.8147 280.3147 14.32241815733561
RADARSAT-1
1 23710U 95059A 09121.81597222 .00000214 00000-0 10000-3 0 1746
2 23710 98.5794 129.2707 0001191 83.9523 263.5728 14.29978592704175
TOMS EP
1 23940U 96037A 09120.69827141 .00000105 00000-0 36289-4 0 521
2 23940 98.0366 354.9975 0030108 140.8908 219.4478 14.52236594682536
MIDORI (ADEOS)
1 24277U 96046A 09121.44614803 -.00000034 00000-0 28897-5 0 471
2 24277 98.3601 87.9741 0002093 60.8828 299.2563 14.28595498662255
ORBVIEW 2 (SEASTAR)
1 24883U 97037A 09121.40223340 -.00000013 00000-0 72630-5 0 7785
2 24883 98.3365 245.0193 0001860 28.0026 332.1267 14.59985784625612
IRS-1D
1 24971U 97057A 09121.85430036 -.00000080 00000-0 -14094-4 0 2493
2 24971 98.2414 160.2079 0055449 73.3751 287.3507 14.32968702606197
TRMM
1 25063U 97074A 09120.89424843 .00002937 00000-0 41694-4 0 526
2 25063 34.9668 291.3377 0001029 288.3938 71.6687 15.55923796652728
SPOT 4
1 25260U 98017A 09121.77684301 .00000135 00000-0 83680-4 0 628
2 25260 98.7000 195.3802 0001188 71.2520 76.6165 14.20040469575743
FASAT B
1 25395U 98043B 09121.54909598 .00000069 00000-0 47586-4 0 4398

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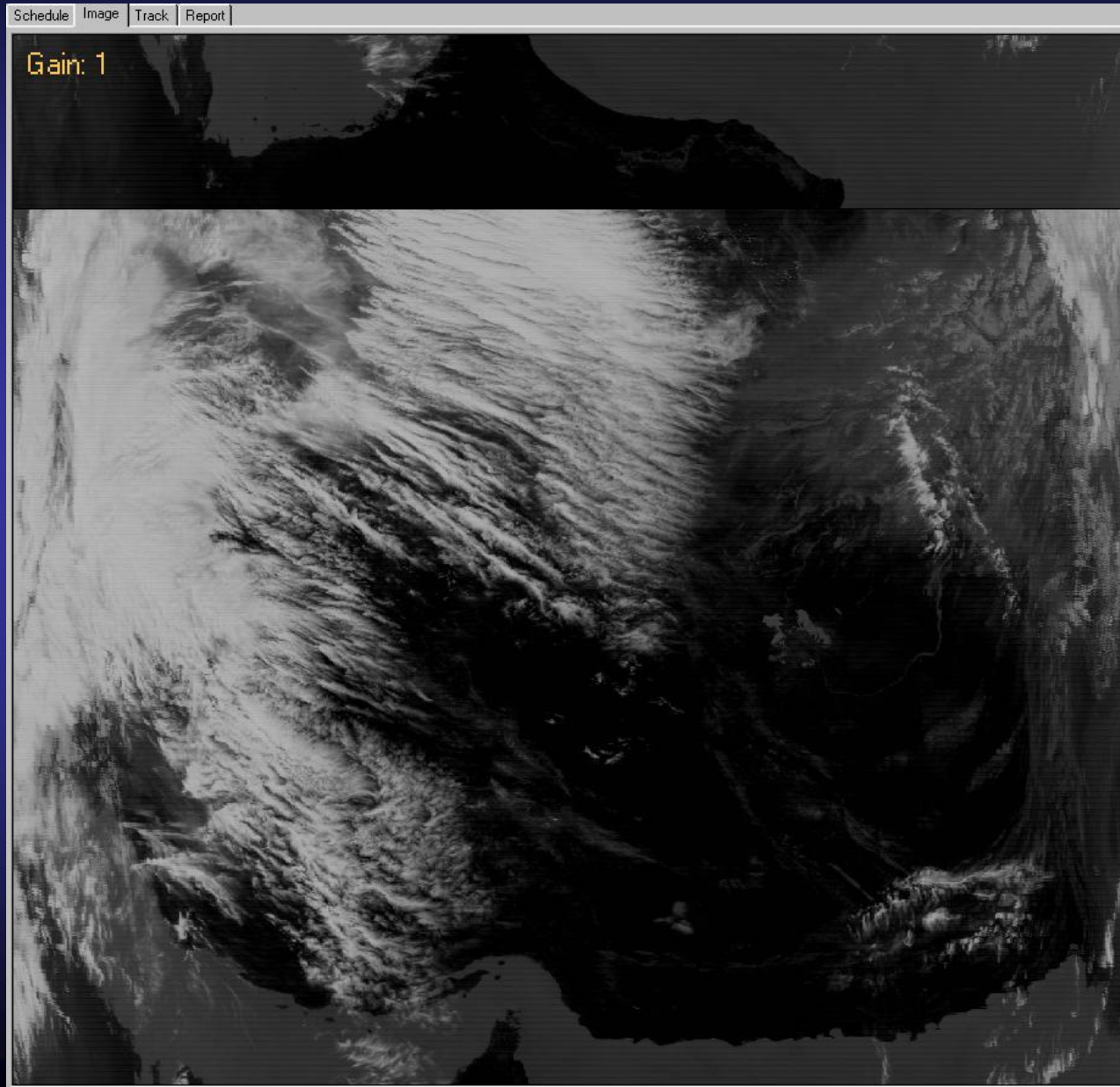
Internet 100%



# Finding Satellite Position with respect to the Station Position (for any time)

Schedule							
Sat. name	Format	Date	Time	Culm.	Azim.	Asc/Des	Session status
IRS-1D	PAN	May 05 (125)	08:19:46 - 08:33:05	20	095	Des	Enabled
IRS-1D	PAN	May 05 (125)	09:58:41 - 10:13:07	40	285	Des	Enabled
TERRA	MODIS	May 05 (125)	11:19:13 - 11:32:52	36	098	Des	Enabled
TERRA	MODIS	May 05 (125)	12:57:18 - 13:09:41	20	292	Des	Enabled
IRS-1D	PAN	May 05 (125)	19:34:24 - 19:47:20	21	067	Asc	Enabled
IRS-1D	PAN	May 05 (125)	21:12:52 - 21:27:01	37	260	Asc	Enabled
TERRA	MODIS	May 05 (125)	22:22:24 - 22:35:37	29	070	Asc	Enabled
TERRA	MODIS	May 06 (126)	00:00:11 - 00:13:13	24	264	Asc	Enabled
IRS-1D	PAN	May 06 (126)	09:26:35 - 09:41:33	84	249	Des	Enabled
TERRA	MODIS	May 06 (126)	12:01:48 - 12:15:52	75	283	Des	Enabled
IRS-1D	PAN	May 06 (126)	19:04:00 - 19:14:39	10	062	Asc	Enabled
IRS-1D	PAN	May 06 (126)	20:40:39 - 20:55:15	81	251	Asc	Enabled
TERRA	MODIS	May 06 (126)	23:04:33 - 23:18:37	85	073	Asc	Enabled
IRS-1D	PAN	May 07 (127)	08:54:43 - 09:09:28	45	101	Des	Enabled
IRS-1D	PAN	May 07 (127)	10:34:37 - 10:47:33	19	292	Des	Enabled
TERRA	MODIS	May 07 (127)	11:07:07 - 11:20:22	27	095	Des	Enabled
TERRA	MODIS	May 07 (127)	12:44:52 - 12:57:52	26	290	Des	Enabled
IRS-1D	PAN	May 07 (127)	20:08:56 - 20:23:13	46	074	Asc	Enabled
IRS-1D	PAN	May 07 (127)	21:49:26 - 22:01:52	16	266	Asc	Enabled
TERRA	MODIS	May 07 (127)	22:10:31 - 22:23:13	22	068	Asc	Enabled
TERRA	MODIS	May 07 (127)	23:47:39 - 00:01:09	32	262	Asc	Enabled
IRS-1D	PAN	May 08 (128)	08:23:11 - 08:36:48	22	095	Des	Enabled
IRS-1D	PAN	May 08 (128)	10:02:13 - 10:16:37	37	286	Des	Enabled
TERRA	MODIS	May 08 (128)	11:49:35 - 12:03:39	80	103	Des	Enabled
IRS-1D	PAN	May 08 (128)	19:37:48 - 19:50:54	22	068	Asc	Enabled
IRS-1D	PAN	May 08 (128)	21:16:30 - 21:30:30	34	262	Asc	Enabled
TERRA	MODIS	May 08 (128)	22:52:24 - 23:06:22	63	074	Asc	Enabled
TERRA	MODIS	May 09 (129)	00:32:01 - 00:42:56	10	268	Asc	Enabled
IRS-1D	PAN	May 09 (129)	09:30:05 - 09:45:07	78	271	Des	Enabled
TERRA	MODIS	May 09 (129)	10:55:07 - 11:07:46	20	094	Des	Enabled
TERRA	MODIS	May 09 (129)	12:32:31 - 12:45:58	35	288	Des	Enabled

# Receiving Step





# GNSS & Photogrammetry

- Integration of GPS & IMU (Inertial Measurement Unit), provides the potential for in-flight control for aerial triangulation
  - enabling to reduce the amount of GCPs
  - direct geo-referencing without GCPs with approximate external orientation parameters

# GNSS & Photogrammetry



Geo-referencing without any GCPs using GPS/IMU system

# GNSS & Photogrammetry



True Ortho-photo using GPS/IMU system and GCPs

# AVL

- All public vehicles and also fuel carrier trucks are equipped with GPS receivers.





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**Thanks For Your Attention**