



# **NATIONAL REPORT OF TURKEY FOR 2007 EUREF SYMPOSIUM ENGLAND**

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# OUTLINE

1. Turkish National Fundamental GPS Network (TUTGA)
2. Episodic GPS Observations for Geodynamic Studies
3. Turkish Geoid 2007 (TG-07)
4. Turkish Permanent GPS Network (TUSAGA)
5. CORS-TR Project
6. Turkish Sea Level Monitoring System (TUDES)
7. MOMA Project

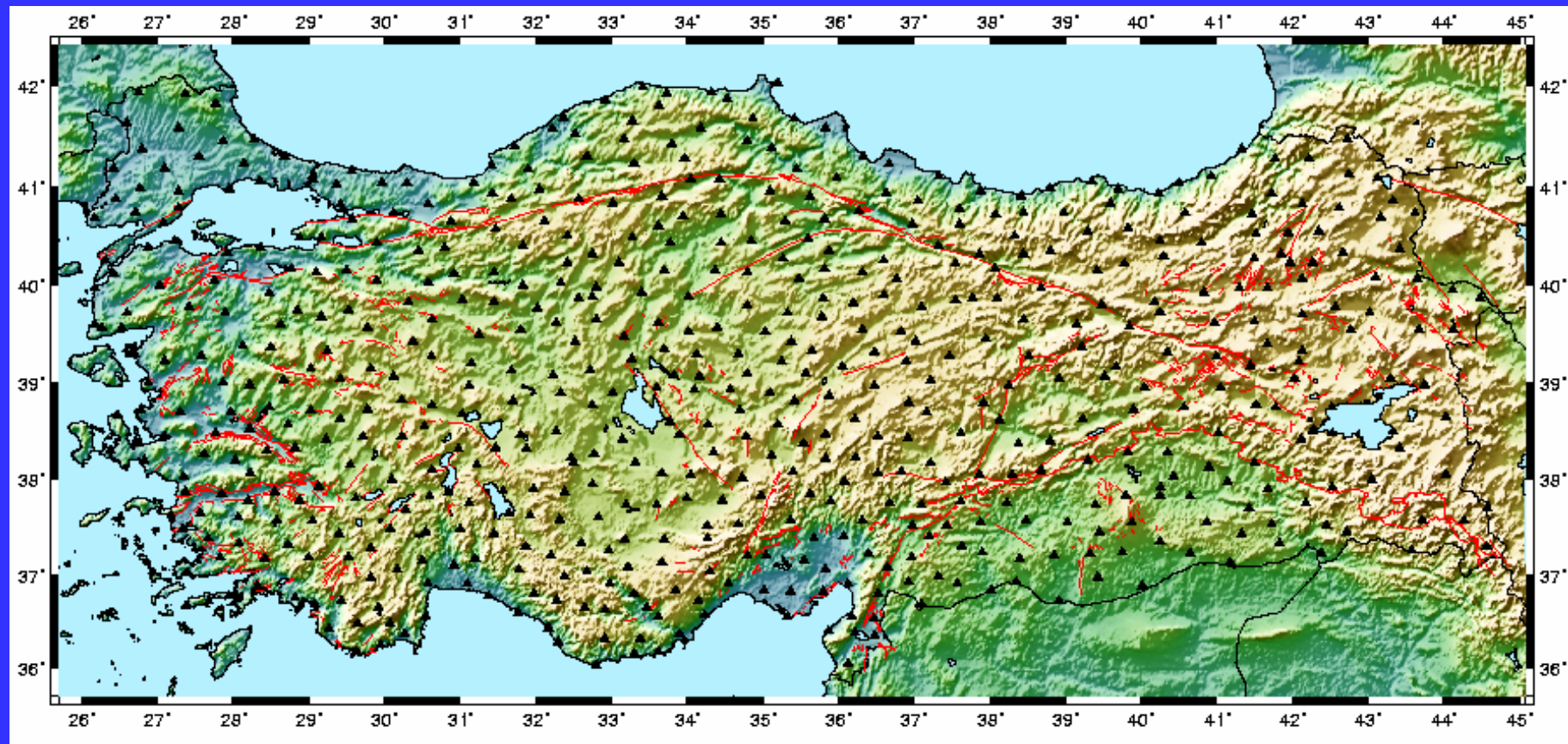
# INTRODUCTION

The establishment and monitoring of **4-Dimensional Geodetic Datum** throughout Turkey is the basic mission of General Command of Mapping under its responsibilities.

## Geodetic activities mainly involve;

- ⊕ the development of existing Turkish National Fundamental GPS Network (TUTGA),
- ⊕ establishment of new stations and maintenance of Turkish Permanent GPS Network (TUSAGA) and Turkish Sea Level Monitoring System (TUDES),
- ⊕ the achievement of new Turkish Geoid -2007 (TG-07).

# Turkish National Fundamental GPS Network (TUTGA)



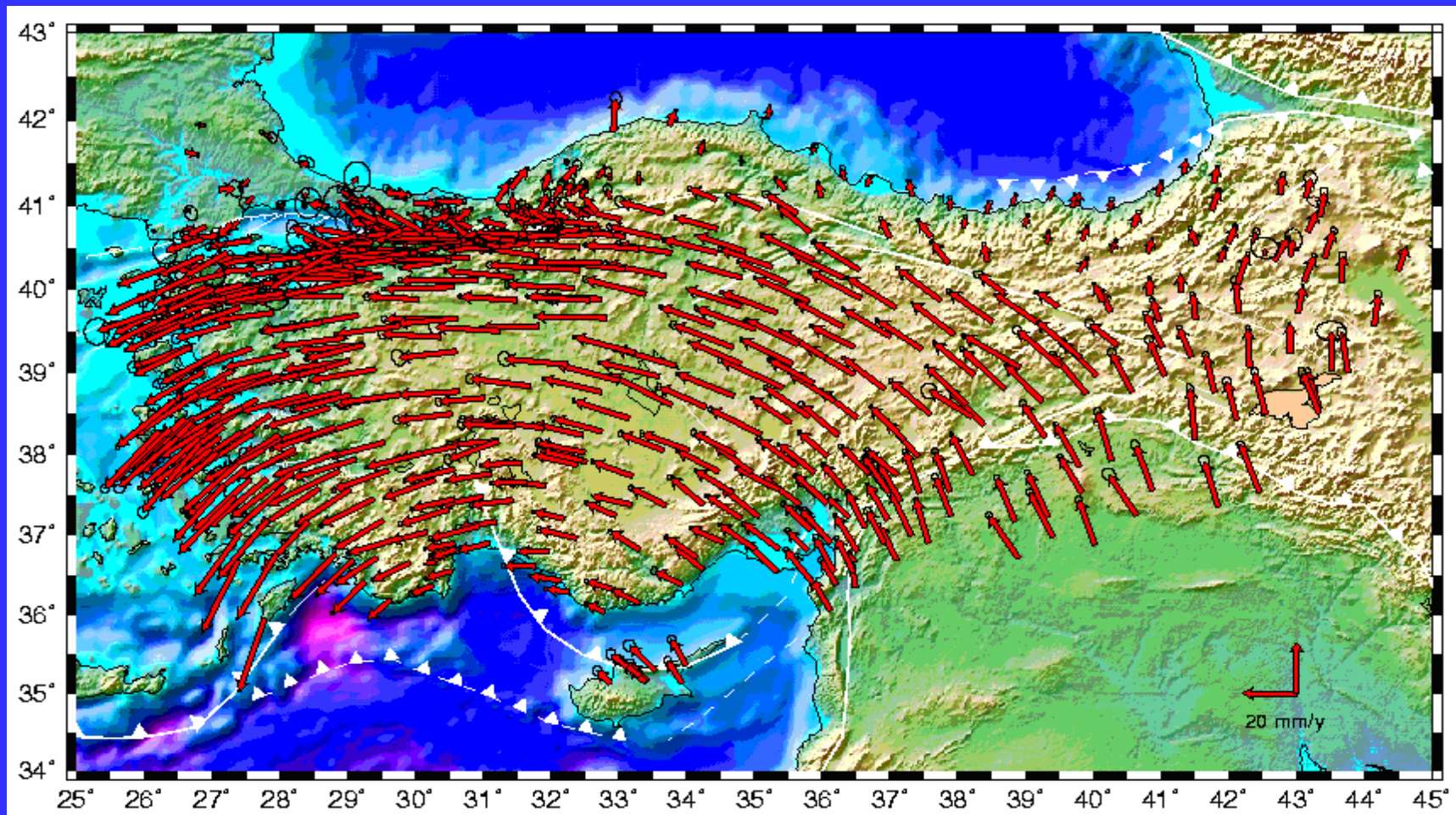
Distribution of TUTGA stations

- ❖ Establishment of TUTGA has been completed in 2001
- ❖ Some of the stations have been re-surveyed due to the earthquakes happened in 1999 ( $M_w = 7.5$  İzmit,  $M_w = 7.2$  Düzce), 2000 ( $M_w = 6.1$  Çankırı – Çerkeş), 2002 ( $M_w = 6.5$  Sultandağ) and 2003 ( $M_w = 6.4$  Bingöl)
- ❖ The total number of stations is about 600
- ❖ 3D Coordinates and their associated velocities were computed in ITRF2000 for each station.
- ❖ Positional accuracies of the stations are about 1-3 cm whereas the relative accuracies are within the range of 0.1 - 0.01 ppm.
- ❖ Detailed information about TUTGA can be found in [www.hgk.mil.tr](http://www.hgk.mil.tr) under the name TUTGA in Turkish.



# Episodic GPS Observations for Geodynamic Studies

- Interseismic deformation is monitored by **periodic GPS** and **leveling measurements** across Turkey while specifically densified networks are established for local and regional secular deformation in certain regions like İsmetpaşa in Marmara Area and İzmir in Aegean part of Anatolia.
- Velocity solution of GPS data over the interval 1992-2006 gives the information for tectonic nature of Anatolia and its surrounding in a Eurasia-fixed frame (**Aktuğ, 2003; Aktuğ, 2004**)
- Due to high seismic activity, co-seismic and post-seismic deformation is also monitored by independent GPS campaigns.



Horizontal velocity field of Turkey and surrounding regions in a Eurasia-fixed frame.

# TURKISH GEOID-2007 (TG-07)

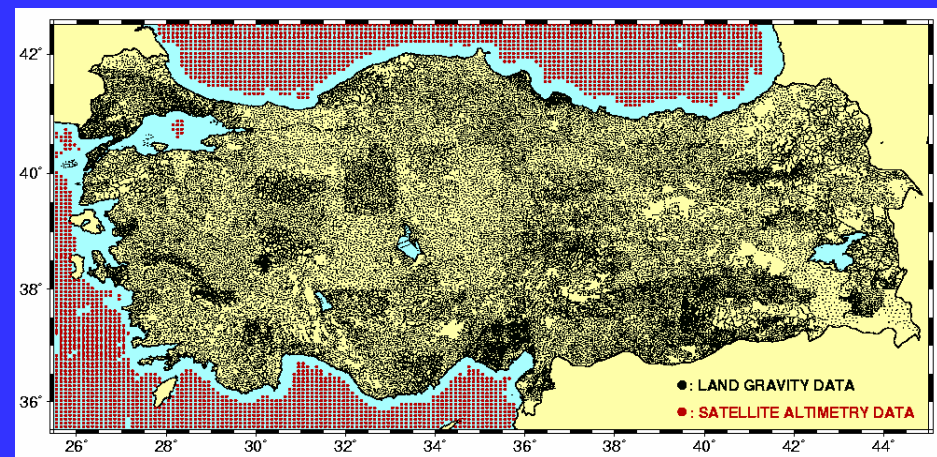
The high resolution geoid height model for Turkey (TG-07) has been recently computed based on

- spherical FFT approach by using land (~ 65000 stations)
- marine (KMS02) free air gravity anomalies,
- SRTM high resolution (SRTM3) Digital Elevation Model
- GRACE GGM02S Global Geopotential Model combined with EGM96 (Yıldız et al., 2006).

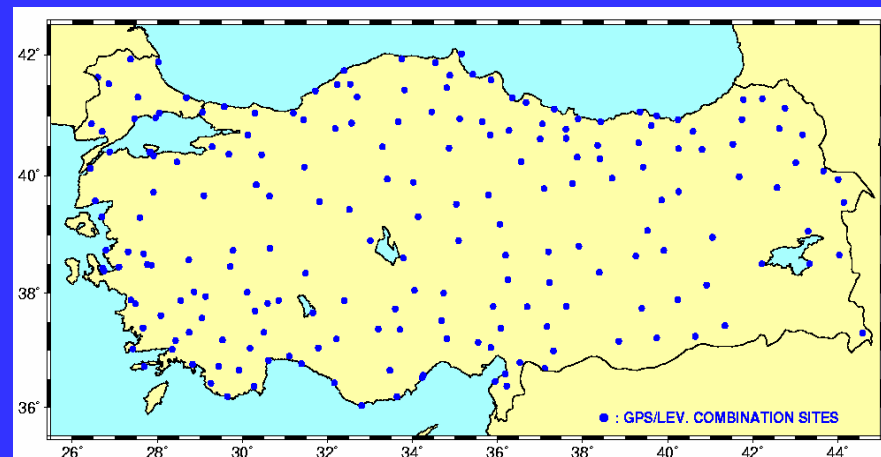


- In order to define an accurate and a reliable corrector surface for GPS users to convert orthometric heights into Turkish National Height Datum, high resolution gravimetric geoid height model is combined with data from GPS/leveling by using a corrector surface constructed based on **203 GPS/leveling points** and evaluated at **116 independent GPS/leveling points**.
- Ellipsoidal heights of the GPS/leveling points refer to well-established **Turkish National GPS Network (aligned to ITRF96)**, while orthometric heights refer to **Turkish National Vertical Datum (fixed to mean sea level)**.
- Surface gravity values are in **Modified Potsdam Datum**, and the free air anomalies were computed in **GRS80**.
- The post-fit residuals of this corrector surface have a standard deviation of **8.8 cm** for Turkey.

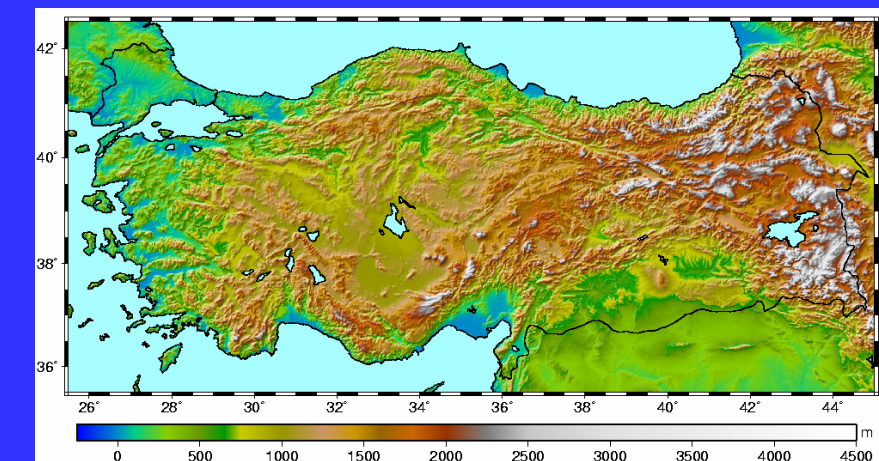
# TG-07



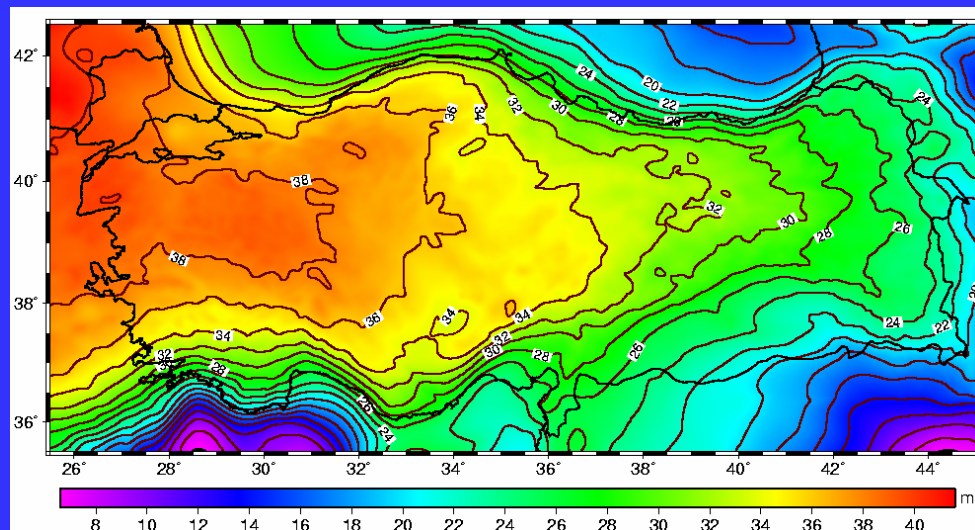
The gravity data used in TG07 geoid determination



203 GPS/leveling stations



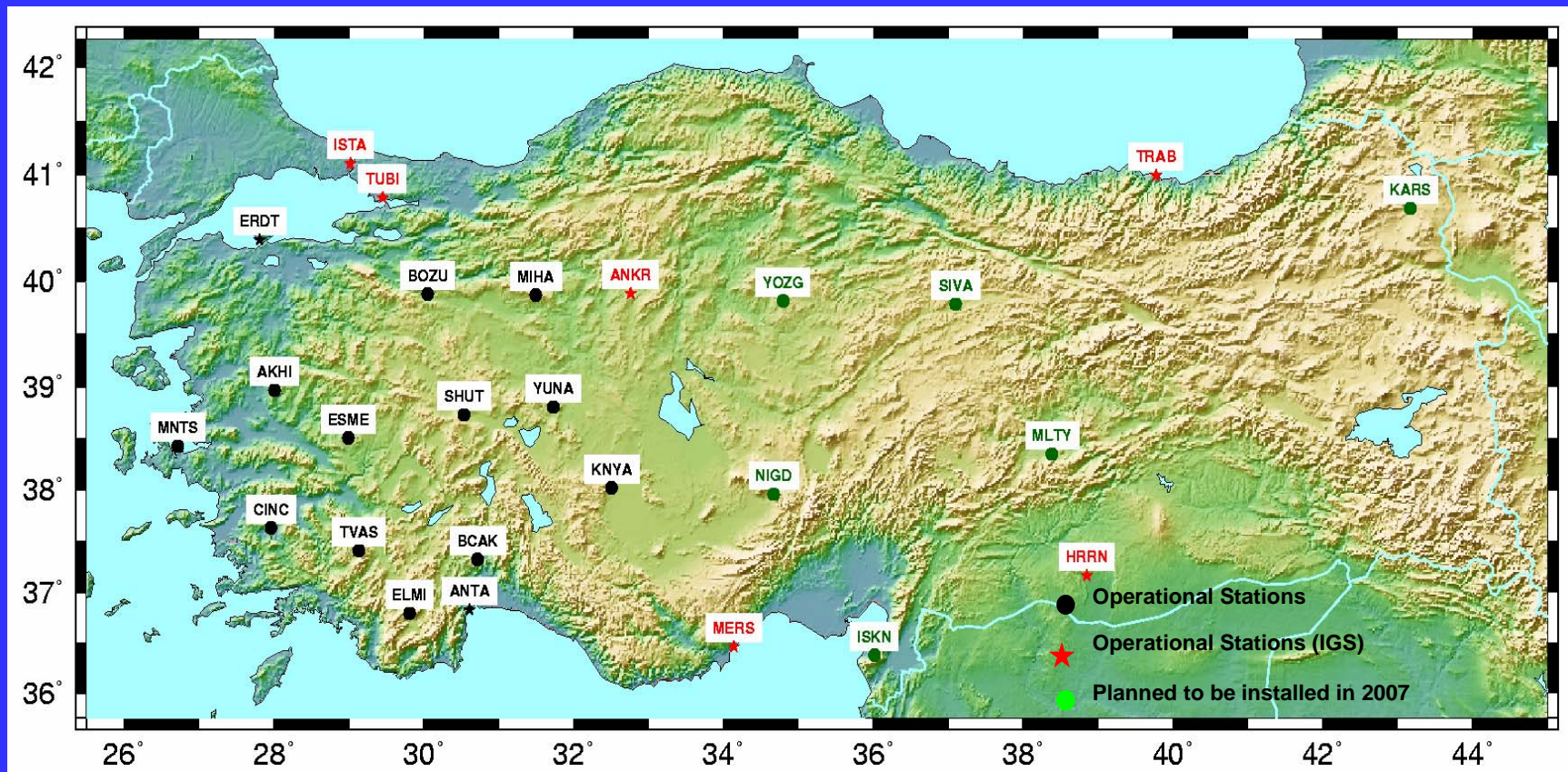
SRTM3 Digital Elevation Model (DEM)  
used for TG07 geoid determination



Turkish Geoid (TG07) 10/26



# Turkish Permanent GPS Network (TUSAGA)



Distribution of TUSAGA stations (as of MAY 2007)

# TUSAGA

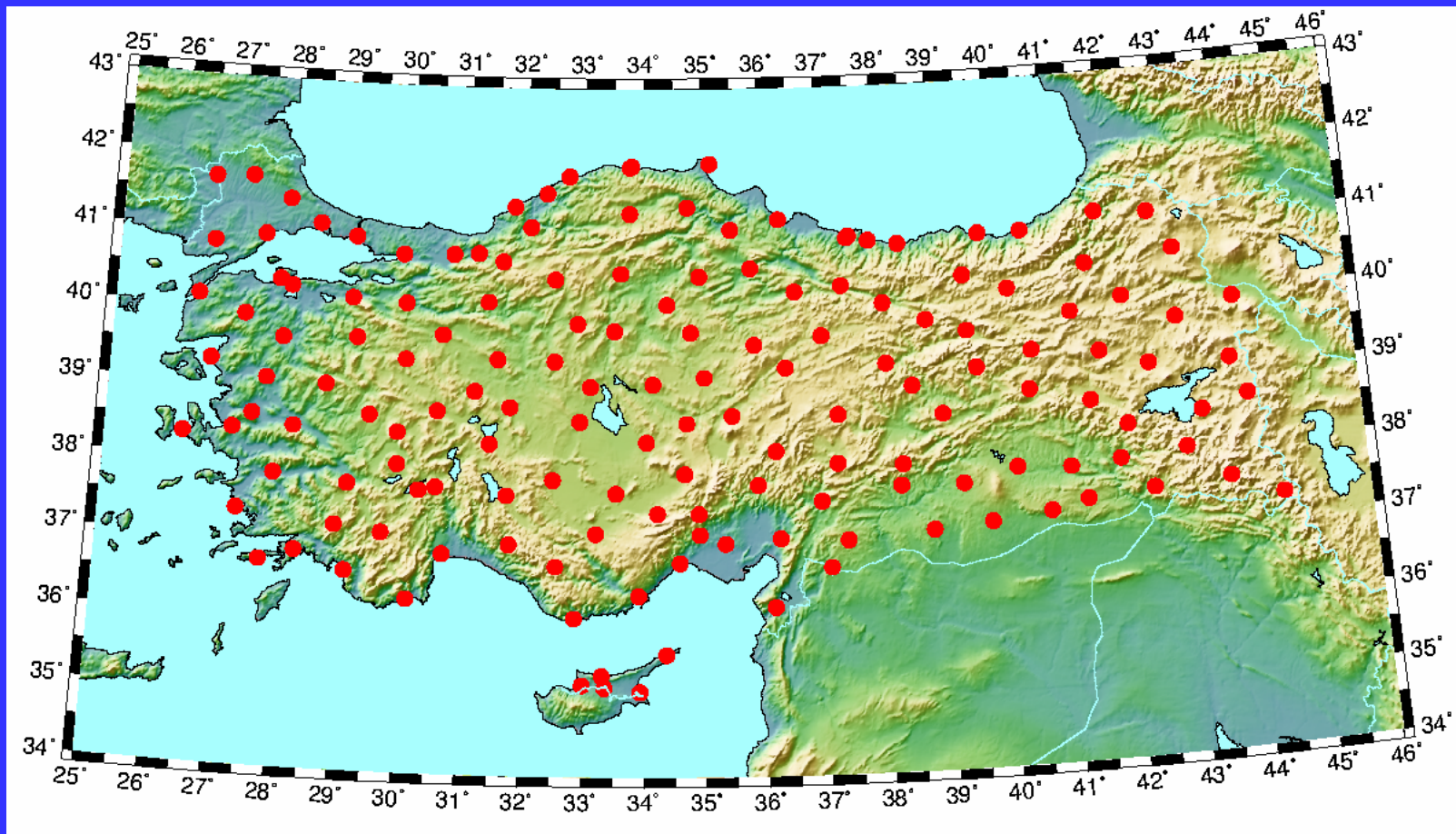
- ✓ The number of the sites forming TUSAGA is 20 as of May, 2007.
- ✓ The planned stations will be installed in 2007.
- ✓ Except these stations, the data from 10 additional stations around Marmara Sea, established under a scientific project with TUBITAK Marmara Research Center (TUBITAK – MAM), is being utilized by scientific community.
- ✓ The time-series analyses of TUSAGA stations are performed at General Command of Mapping on monthly basis.
- ✓ Besides their usage as master stations for a wide range of surveying activities, TUSAGA stations are going to be utilized as geodetic control and for real time monitoring the crustal movements in geodynamical activities within their continuous data collection and analyses cycle.



# CORS-TR PROJECT

- Particularly for the applications ranging from large-scale mapping, GIS and cadastral surveys, new project under the name **CORS-TR (Continuously Operating Reference Stations-Turkey)** has been initiated collaboratively with governmental institution and funded by TÜBİTAK.
- The stations will serve as real-time kinematic basis enabling all users to get differentially corrected positional information as well as updated geoid and datum transformation parameters.

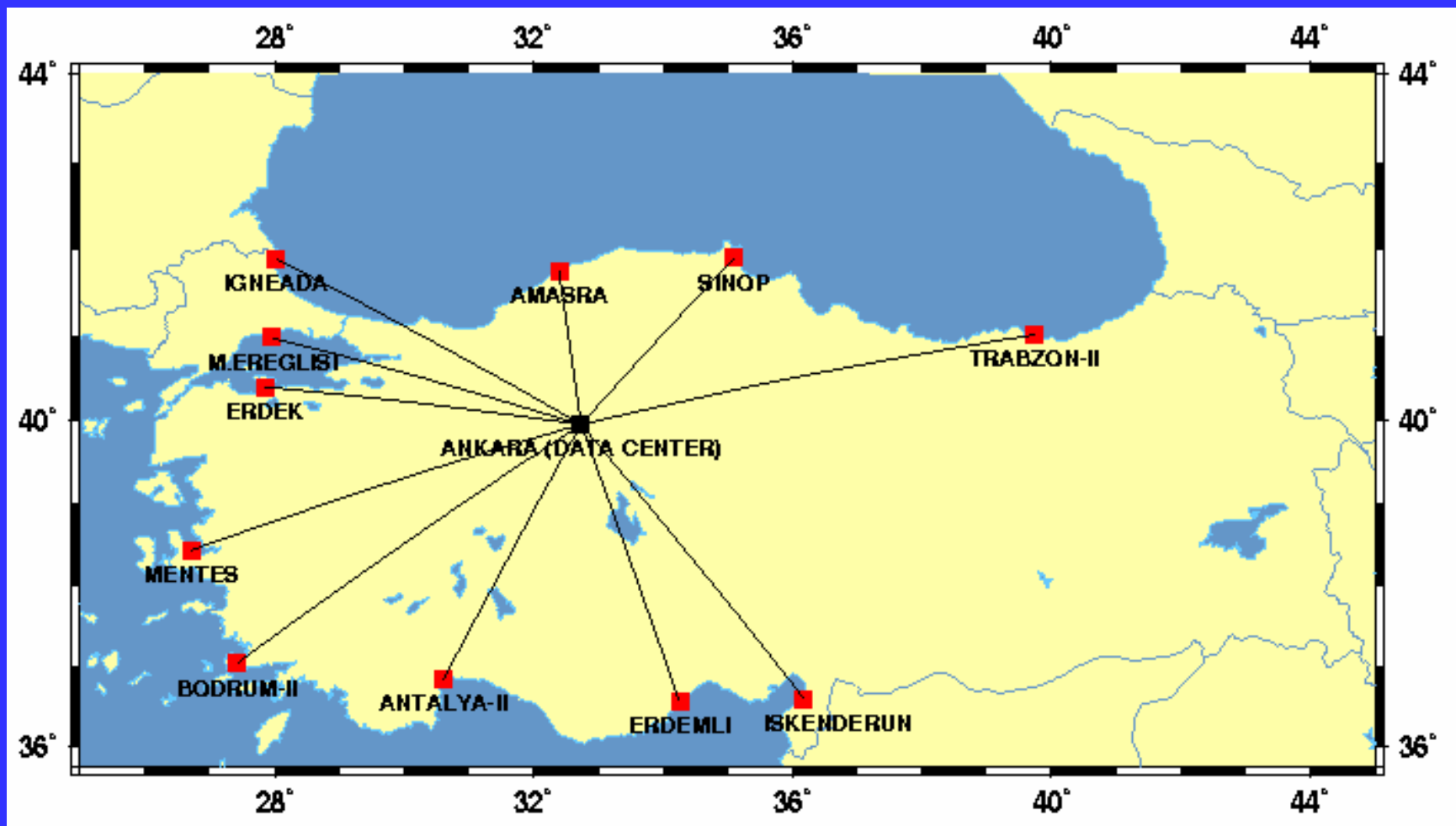
# CORS-TR PROJECT



The planned distribution of CORS-TR stations (145 stations)

# Turkish Sea Level Monitoring System (TUDES)

- ❖ General Command of Mapping operates Turkish Sea Level Monitoring System (TUDES).
- ❖ Sea level and meteorological parameters are observed under the frame of TUDES that consists of **eleven digital and automatic tide gauges**
  - at Mediterranean Sea (Antalya, Erdemli and İskenderun),
  - at Aegean Sea (Bodrum and Menteş/İzmir),
  - at Sea of Marmara (Erdek and Marmara Ereğlisi)
  - at Black Sea (Amasra, İğneada, Trabzon and Sinop)
  - data center in Ankara





- ❖ TUDES is one of the unique tide gauge networks at GLOSS (Global Sea Level Observing System) standards in the Mediterranean and Black Sea.
- ❖ The data collected from digital and automatic tide gauge are used for
  - the determination of vertical datum of Turkish Vertical Control Network,
  - long term sea level changes,
  - vertical land movements along Turkish coasts
  - engineering purposes such as harbor design and tidal information generation.

In order to monitor the vertical land movements at tide gauges, episodic GPS campaigns and periodic first order precise leveling measurements are performed at local benchmark networks of the tide gauges.

Two continuous GPS stations; one at Erdek and the other one at Menteş tide gauges were installed in June 2002 and in August 2003 respectively in order to better estimate the vertical land movements.



# TUDES & ESEAS-RI PROJECT

- GCM has participated in European Sea Level Service (ESEAS) and became one of the partners of the ESEAS Research Infrastructure (ESEAS-RI) project which was funded for 3 years in the period of 2002-2005.
- In this project, GCM acted as an ESEAS CGPS analysis center responsible for analysis of GPS data obtained at ESEAS tide gauge CGPS stations.
- GCM also participated in determination of the inter-annual and inter-decadal sea level variations in Black Sea and Eastern Mediterranean Sea by using tide gauge data within this project.
- For the time being, GCM is a member of ESEAS which has become a continuous service since 2005.





# TUDES & MOMA PROJECT



GCM has recently participated in a national project called as

**“Meteorology/ Oceanography Network of Excellence (MOMA) Pilot Project: Integrated Meteorology/Operational Oceanography, Satellite and In-situ Observation, Data Assimilation, Prediction, Early Warning and User Services”**

has been initiated under the coordination of Middle East Technical University Erdemli Institute of Marine Sciences and funded by Turkish National Science Foundation (TUBİTAK).

## PROJECT AIMS

- To establish fundamental meteorological and oceanographic observing systems (wind velocity and direction, atmospheric pressure, humidity, air temperature, sea level, salinity, sea surface temperature, current etc.),
- To integrate remote sensing satellite data used in sea, atmosphere and earth sciences and in-situ data,
- To develop models (hydrodynamic, medium scaled atmosphere, aerosol transport, interaction of coastal region ocean and sea-atmosphere etc. models) and prediction systems,
- To verify the mutual validation of data and the prediction systems and to develop early warning systems using these data and prediction systems,
- Management of data and presentation to the users.

# TUDES & MOMA PROJECT

Through this project;

- 9 new tide gauges providing real time sea level and ancillary meteorological data for operational oceanography and meteorology will be installed in the area of **Turkish Straits and in Eastern Mediterranean Sea** (pilot study areas) and
- some TUDES stations will be modernized so as to provide real time sea level data.

# TUDES & MOMA PROJECT

It is anticipated that;

- ❖ The future status of coastal systems will be predicted,
- ❖ Users have real time information about the sea status,
- ❖ Observation and early warning systems, sources which will also be basis for long term climate research will be used in the management of long term risks and crises,
- ❖ Climate change scenarios will be formed, oceanographic and meteorological early warning systems will be developed through the MOMA project in the study areas.



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**THANK YOU!**