



# INTRODUCTION

- ❖ Global Navigation Satellite Systems (GNSS) are used for
  - ground mapping
  - transportation
  - precision agriculture
  - aerial photogrammetry
  - precise geodetic point positioning
  - determining crustal deformations
  - vehicle monitoring systems
  - meteorological applications etc.

GNSS have gained great improvements on the accuracy of measurement techniques. For this purpose, almost all over the world has been established GNSS reference stations.

# INTRODUCTION

- ❖ GNSS reference station consists
  - GNSS receiver
  - Stable antenna
- ❖ The receiver stores GNSS raw observations to FTP server and controlled by remote system.
- ❖ There are many GNSS reference station networks
  - European Reference Frame (EUREF)
  - GNSS Earth Observation Network System (GEONET)
  - Australian Regional GNSS Network (ARGN)
  - South Pacific Regional GNSS Network (SPRGN)
  - AuScope Network
  - International GNSS Service (IGS Network)

# TRAB GNSS REFERENCE STATION (Historical Information)

- ❖ The receiver of TRAB got broken in November 2007. Eventhough EUREF site and some colleagues from geodesy division of KTU intended to install a new GPS+GLONASS equipment in TRAB, unfortunately authority of Karadeniz Technical University could not found a solution for import new receiver. TRAB GPS Permanent Tracking Station were closed down in January 2012.
- ❖ Finally in 2015, colleagues from geodesy division submit an proposal to Dean Office of KTU Engineering Faculty to reactivate TRAB permanent GNSS station as a newborn candidate of IGS and EUREF. With this project proposal new receiver has been installed to reactivate TRAB GNSS station by using same antenna of previous TRAB IGS station.



# TRAB GNSS REFERENCE STATION (Current Situation)

- ❖ Karadeniz Technical University GNSS reference station (TRAB) has been operational since February 2015.
- ❖ There are not any physical obstacles affecting the signal quality around the station. Spectra Precision Ashtech Proflex 800 GNSS receiver and ASH700936D\_M + SNOW GNSS antenna is used on TRAB reference station. The online archive of GNSS data available through the TRAB site includes data with 15-min latency at a 30-second sampling rate for real time analysis purposes.

# TRAB GNSS REFERENCE STATION (Current Situation)

- ❖ TRAB permanent station is provided GNSS data for Turkish National Fundamental GPS Network (TUTGA) to determine International Terrestrial Reference Frame (ITRF) based datum.
- ❖ TUTGA network constitutes 147 Continuously Operating Reference Stations controlled by two control stations, the Master Control Station at the Photogrammetry and Geodesy Administration of the General Directorate of Land Registration and Cadastre and the Auxiliary Control Station at the Headquarters of the General Command of Mapping of Turkey.



TUTGA Stations

# TRAB GNSS REFERENCE STATION (Future Plan)

- ❖ Current TRAB Permanent GNSS station operated by KTU intend to be part of EUREF Permanent GNSS Network and IGS network.
- ❖ The observed GNSS data has been stored on central FTP server will processed and analyzed continuously within some national (two TUBİTAK projects) and international projects (TropNET analysis center and E-GVAP analysis center) for monitoring tropospheric products.



# TRAB and KTU Analysis Centre

- ❖ The GNSS derived Zenith Tropospheric Delays (ZTDs) play an important role in meteorological studies, by using ZTDs at GNSS sites into numerical weather prediction models.
- ❖ The Trop-NET system (reference) developed at the Geodetic Observatory Pecny (GOP, RIGTC) in order to facilitate near real-time troposphere monitoring using groundbased GNSS data (based on the Bernese GNSS Software) has been installed and been routinely used in KTU AC since September 2014.
- ❖ KTU AC were established a cooperation with GOP within the COSTES1206 Action (GNSS4SWEC, WG1).
- ❖ About 33 sites from IGS and EUREF permanent networks in entire Europe have been selected for an initial setting and testing (Douša 2010).
- ❖ Currently TropNET analysis at the KTU AC includes two IGS sites, ANKR(Ankara) and ISTA(Istanbul), from Turkey and we intends to increase the number of Turkish GNSS stations in analysis. The first attempt for this task is to include TRAB which was active only during 1047-1456 GPS weeks (2000-2007) as IGS network station.

# TRAB and KTU Analysis Centre

## Project (1/3)

- ❖ According to hazard management data of last 20 years, Black sea Region has been affected by hydrological origin severe weather events.
- ❖ Moreover, according to climate change scenarios (until 2100) for future, it has been foreseen that East Black sea Region will be one of the region where severe weather events especially heavily rain and flood will increased related to climate change (URL 3).
- ❖ This situation states a necessity of reliable weather monitoring and prediction system.
- ❖ The capacity of prediction and monitoring of severe weather events formation depends on accurate water vapor information (Wu vd., 2014). The project titled “Using Regional GNSS Networks to Strengthen Severe Weather Prediction” was accepted by the scientific and technological research council of Turkey (TUBITAK) in December 2016.

# TRAB and KTU Analysis Centre Project (2/3)

- ❖ To determine of atmospheric water vapor distribution by GNSS meteorology and GNSS tomography software developed by ourselves using observation data of network designed with 2 new constructed GNSS reference station.
- ❖ Therefore, it is targeted to perform accuracy analysis of water vapor distributions derived by GNSS meteorology and GNSS tomography.
- ❖ To compare water vapor distributions derived by GNSS tomography with those derived by rawinsonde and NWM (MM5, ALADIN, ECMWF, etc.) at dates which severe weather events recorded according to Turkish State Meteorological Service data .



Rawinsonde  
Stations of TURKEY

# TRAB and KTU Analysis Centre Project (3/3)

- ❖ Near real time water vapor distribution will be determined by Trop-NET software installed at Analysis Center of Karadeniz Technical University (KTU) Department of Geomatics Engineering within a collaboration with Geodetic Observatory Pecny (Czech Republic) within COST Action ES1206 (Advanced Global Navigation Satellite Systems Tropospheric Products for Monitoring Severe Weather Events and Climate-GNSS4SWEC) to provide support The EUMETNET EIG GNSS water vapor programme (E-GVAP) and also KTU AC was accepted as E-GVAP Analysis Centre in December 2016.
- ❖ Water vapor distribution derived with two software will be compared.
- ❖ It is targeted to evaluate the possible contribution of GNSS tomography to predict severe weather events by monitoring near real time water vapor distribution.

# CONCLUSION

- ❖ New born TRAB GNSS reference station has been operational since February 2015. Increasing number of stations including national and international networks in our country, interoperability and beneficial use of country resources will be beneficial for our country to include Karadeniz Technical University TRAB GNSS reference station in EUREF / IGS networks.
- ❖ Since the location and type of antennas have not changed in order to be included in EUREF / IGS networks, it is estimated that the existing station can be replaced with the same 4 character abbreviation.
- ❖ KTU reference station is aimed to be a member of the EUREF / IGS networks with these studies.

# References

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*Thank you for your patience.*