

GNSS METEOROLOGY AND WATER VAPOUR ESTIMATION IN TURKEY

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Distribution of Radiosonde Stations

There are 8 radiosondes in Turkey providing upper atmospheric data for meteorology and climate research.



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CORS and GPS-Met

• There are 146 TUSAGA-Active network stations (Turkey National Permanent GPS Network – Active) which provide satellite data with coarse vertical resolution. Continuous GPS networks can be converted into GPS MET networks with a very small cost. Thus, for the entire country or region, the information of continuous precipitable water vapour at the accuracy of radiosonde will be accessible.



- Studies in producing the basic parameters of the estimation of precipitable water vapour by GPS for Turkey and in obtaining precipitable water vapour at the accuracy of radiosondes are qualifications for creating an infrastructure.
- They will be the first studies in this area.
- This will lead TUSAGA-active which is already running for different purposes to be used for GPS meteorology purposes
- The precipitable water vapour data obtained continuously at the accuracy of radiosonde for all of Turkey will be used as a basis data for research on the weather and hydrological disaster prediction, long-time hydrological cycle, atmospheric chemistry and global climate.

Zonguldak, Bulent Ecevit University

- First study on GNSS Meteorology is "Preliminary results of GPS meteorology within Turkish National Permanent GPS Network" by Turkish General Command of Mapping.
- Bevis model is used to compute precipitable of water vapour by TUSAGA-active data. The empirical model Global Pressure and Temperature is used to determined the meteorological data in these calculations.

THE PROJECT

- "THE ESTIMATION OF ATMOSPHERIC WATER VAPOUR USING GPS PROJECT" IS SUPPORTED BY THE SCIENTIFIC AND TECHNOLOGICAL RESEARCH COUNCIL OF TURKEY (TUBITAK) AND BEGAN IN MAY 2013.
 - THE PROJECT IS ALSO THE PART OF COST ACTION_GROUP ES1206 (GNSS4SWEC))

 THE AIMS OF THIS PROJECT ARE TO DETERMINE THE TOTAL ZENITH DELAYS AND THE PRECIPITABLE WATER VAPOUR ACCURATELY AND RELIABLY FROM TUSAGA-AKTIF (CORS-TR) DATA AND TO PRODUCE NUMERICAL MODELS BASED ON TIME AND POSITION.

So far...

In this context, a radiosonde analysis algorithm has been developed to define empirical model of the weighted mean temperature T_m and the conversion factor Q.

8 radiosonde profiles will be analysed for the year 2011. Istanbul, Ankara, Samsun, Diyarbakir, Izmir and Erzurum have been analyzed so far.



- Coefficients a and b have been calculated according to the Bevis model.
- The conversion factor Q model has also been computed.



 Two Continuously Operating Reference Stations have been established near the radiosonde stations in Istanbul and Ankara. Simultaneous GPS and radiosonde data are being taken from these stations. Approximately 9 months of data have been recorded.



- To compute total zenith delays with better than 1 mm precision, an optimal GNSS network was designed. The stations were chosen from EUREF network.
- The chosen GNSS network is being processed by GAMIT/GLOBK and Bernese software.
- Obtained total zenith delays are converted into PW.
- Validity of the T_m and Q models will be tested by comparing the estimated PW using the models with those obtained from radiosondes.

Near future

- O To obtain meteorological data for TUSAGA-active stations from the observations of meteorological stations around these stations, the numerical temperature, pressure and humidity models will be investigated and created.
- The spherical harmonics will be used to interpolate unknown meteorological data.
- O The total tropospheric zenith delay values and precipitable water vapour will also be modelled from these numerical models.

Trabzon, Blacksea Technical University

Performed Activities

- ► Type of Activity: Research Visit
- Researcher : Dr. Emine TANIR KAYIKÇI, Department of Geomatics Engineering, Karadeniz Technical University, Trabzon, TURKEY
- **Duration:** July 12 August 17, 2014
- Place: Department of Civil and Environmental Engineering of Politecnico di Milano (Italy)
- Financial Support: TUBITAK (Turkish National Scientific and Techjnical Research Council)
- International Postdoctoral Research Scholarship Programme

Aim of Research:

- to analyse the delay of the satellite-receiver signal, in order to assess the amount of water vapour in the troposphere,
- prepare all the tools and data necessary to estimate the GNSS tropospheric Zenith Wet Delays (ZWD) from the adjustment of a regional network of permanent stations (Italy, Turkey),
- Compare tropospheric parameters from VLBI and GNSS.

Sotware: Bernese 5.2 GNSS Software (Linux),

VieVS 2.1 VLBI Software (Windows)

Data: Daily RINEX observation files from the network of including three Italian IGS, EPN and IVS stations; GRAS (Caussols), MATE (Matera), MEDI (Mediciana), NOT1 (Noto), SOFI (Sofia), WTZR (Bad Koetzting), ZIMJ (Zimmerwald), ZIMM (Zimmerwald),

Methodology: BERNESE 5.2 software was used to analyse GNSS data to extract PW (Precipitable water) estimates from a network covering Italian co-located sites including Matera, Medicina and Noto.

Research Results: Due to the limited time period for this research stay at host institution (1 month), only some steps of processing could be finished through BPE processing.

- * The experience gained in this project will be used for further processing as a test set for the implementation of appropriate data analysis strategy for other networks and for longer time period.
- * *Dr. Vincenza Tornatore led this part of research work.

* Planned Activities

*Analyses on the Turkish CORS Network (TUSAGA-Aktif) by BERNESE software to estimate the Zenith Tropospheric Delay (ZTD), and to derive Precipitable Water Vapor (PWV) in different periods.

the short-term scientific-mission (STSM) by Dr. Jan Douša, Geodetic Observatory Pecny, Research Institute of Geodesy, Czech Republic, September 14-24, 2014

