Web based GNSS Data Processing Services as an Alternative to Conventional Processing Technique

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- *Introduction*
- *Motivation*
- *Case Study*
- *Evaluation of the Measurements*
- *Conclusion*

Introduction

Until recent years, it was necessary to obtain positioning with GPS using at least two receivers, and the collected data should be processed for high accurate positioning by using the GNSS data processing software whether scientific or commercial.

Introduction

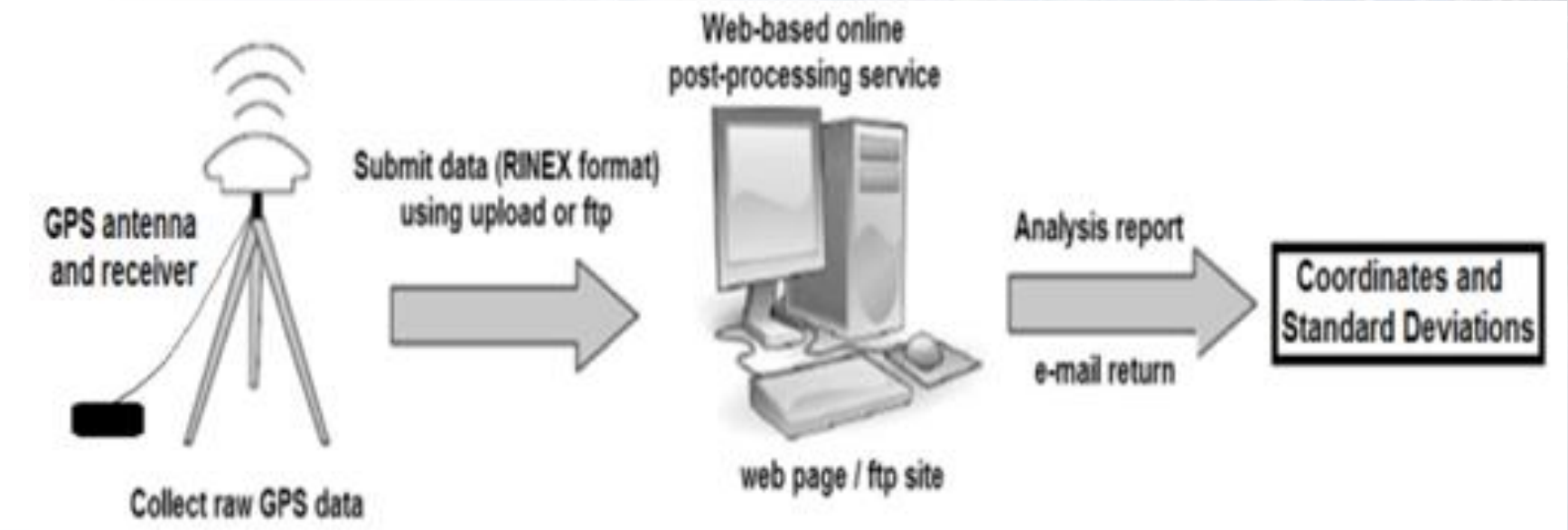
However, the usage of such software is also **quite difficult** because;

- *they generally require deep knowledge of the GNSS,*
- *experience in the processing,*
- *they mostly need a licensing fee.*

Regarding the improvements in information technology and GNSS data processing methodology, many new opportunities have been offered to the users.

In this respect, several institutions, research centres or organizations **have developed web-based online GNSS processing services** and **they have started to become a strong alternative to the conventional data processing method**.

The only requirement for using these services which are generally provided free of charge with limitless usage, is a **computer having an Internet connection** and **web browser**.



These services are designed to be as simple as possible for the user and with minimal input.

Users of such systems have to perform uploading/sending of their collected RINEX data by using the web site of these services, e-mail or ftp sites to the system and selecting a few options such as static/kinematic modes, datum, antenna and etc.

Some of these services process not only the GPS but also the data of other systems, particularly those of GLONASS, and provide resilience and a higher accurate positioning service in certain cases to their users.

As of today, there are several web-based online GNSS processing services, in which some of them calculate the coordinates;

- with a relative solution approach (e.g. Trimble RTX, AUSPOS, OPUS,);
- or with the PPP technique (e.g. CSRS-PPP, magicGNSS, APPS).

PPP-based services used the GNSS data collected with only a single receiver with precise satellite ephemerides and clock data by taking into account corrections like carrier phase wind-up, satellite antenna phase offset, solid and ocean tides.

The services evaluated with the relative solution, use the fixed station points which relate to International GNSS Service (IGS) and/or CORS Networks as reference points and calculates the coordinates of the points with the relative method.

The use of these systems saves time and labour by eliminating the need for a reference station and knowledge, training and usage of the GNSS processing software.

Canadian Spatial Reference System-Precise Point Positioning (CSRS-PPP)

- operated by Natural Resources Canada, Canadian Geodetic Survey since 2003,
- free, but need registration
- static or kinematic (single or dual-frequency data from GPS and GLONASS-if available),
- reference frame as NAD83 or ITRF,
- geoid model and an Ocean Tidal Loading (OTL) file.

magicGNSS

-service supports not only GPS but also other GNSS satellites, i.e. GLONASS and GALILEO,

-users can send the dual-frequency observation files via the service's web site or e-mail,

-the PPP-derived coordinates can be estimated in static or kinematic modes.

Automatic Precise Positioning Service (APPS)

-for basic service, there is no registration needed,

-user can send their observation files via web site, e-mail or service's ftp site,

-the PPP-based service provides static and kinematic processing modes by using JPL's GPS orbit and clock products.

Trimble CenterPoint RTX (Real Time eXtended)

-process dual-frequency data collected in static sessions,

-not only GPS but also GLONASS, QZSS satellite systems,

-in ITRF2008 current epoch,

-users can submit his/her dual frequency data files through the service's web page,

-when the processing is complete, a report will be sent via e-mail to the user.

AUSPOS-Online GPS Processing Service

- accepts only dual-frequency GPS data in static mode for more than 1-hour data span (preferably 2-hour).
- the data can be sent to the service through the web site or using ftp site.
- the service utilizes a relative method for positioning by establishing a network consisting of the nearest 15 IGS and APREF stations using the best available IGS products.

Online Positioning User Service (OPUS)

- operated by the US National Geodetic Survey (NGS),
- dual-frequency GPS data collected in static mode,
- can process the data as static or rapid-static modes (< 2 hours data span),
- utilizes relative positioning for positioning with respect to three nearby CORS stations,
- solution will be sent via the e-mail within a few minutes.

The main goal of this study is to make a comparison of the world-wide web-based online GNSS processing services with respect to accuracy as a function of the measurement time.

Case Study

In order to investigate the static accuracy performance of the common online GNSS processing services as a function of the measurement time, a 24-hour data set collected in the Çorum Province, of Turkey on December 03, 2014 (GPS Week: 1821; GPS Day: 337) at CORU was used.

Case Study

The CORU station is one of the 146 stations of Turkish RTK Continuously Operating Reference Stations Network (TUSAGA-Aktif). The interval of the observation data was 1-second.

Case Study

The CORU station was equipped with the Trimble NetR5 receiver and TRM55971.00 geodetic-grade antenna and situated on the roof of the Engineering Faculty at the Hitit University, in Çorum with a clear sky view.

The Trimble NetR5 is a multi-channel, multi-frequency GNSS receiver that supports the modernized GPS L2C and L5 signals as well as GLONASS L1/L2 signals.

The 24-hour collected data was downloaded from the related Internet site of the TUSAGA-Aktif System.

In order to investigate how long, it takes the online processing services' solutions to reach the best accuracy, the 24-hour data was divided into different shorter sessions as follows:

- 24 consecutive 1-hour sessions,
- 12 consecutive 2-hour sessions,
- 6 consecutive 4-hour sessions,
- 4 consecutive 6-hour sessions,
- 2 consecutive 12-hour sessions.

The 24-hour-data including the sub-sessions were sent to the web-based online GNSS processing services via e-mail or the service's web page.

All these observation files were processed in static mode;

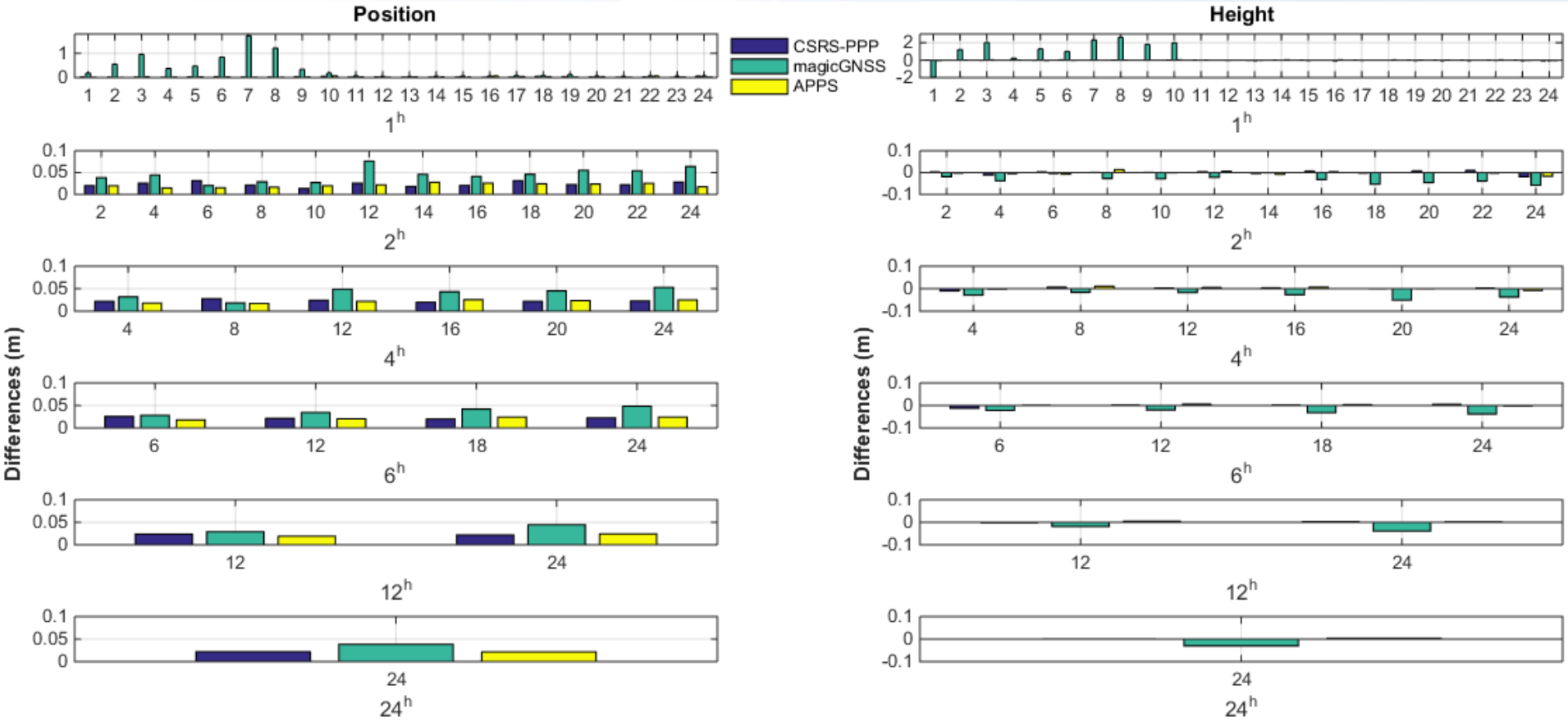
- *with differential technique* ***by using the Trimble RTX, AUSPOS and OPUS***,
- *with the PPP technique* ***using CSRS-PPP, magicGNSS and APPS***

online processing services.

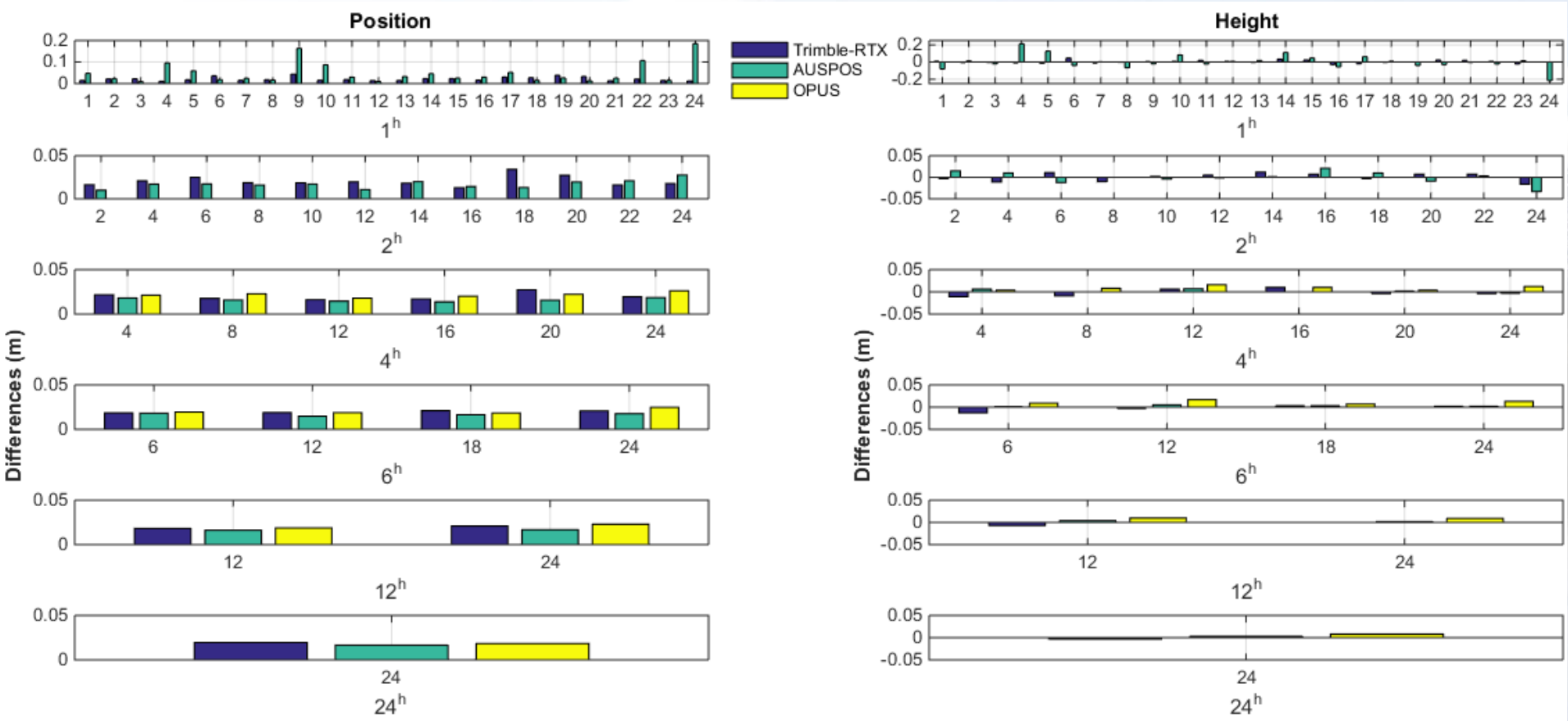
The corresponding coordinates including some additional information about the process retrieved via e-mail or placed into the service web site.

The coordinates were then compared with the reference coordinates, i.e. published coordinates values, to analyse the online processing service's accuracy performance.

Differences between the **PPP-derived solutions** and **Known Coordinates**



Differences between the **Differential-solutions** and **Known Coordinates**



Conclusions and Results

The study shows that, any user that collects GNSS data with only a single receiver, he/she can make positioning very accurate, easy and cost-effective with the online processing service which utilize the PPP technique or relative methods without requiring data from any reference stations for simultaneous observations.

Conclusions and Results

The results show that, when considering the PPP-based services, CSRS-PPP and APPS services produced very similar and the best results.

The Trimble RTX and AUSPOS online GNSS processing services that make positioning with relative methods provide a very high-level of accuracy results even from the 1-hour data sessions.

Conclusions and Results

In general, according to the processing of the 24-hour lasting observation files and its sub-datasets consist of 1, 2, 4, 6 and 12 hour with different online GNSS processing services, **it can be concluded that the services all can provide a cm-level of accuracy especially from 2-hour and more of observations.**

Conclusions and Results

The findings reveal that these services can be used in many surveying applications in a cost-effective manner and very easily without knowledge and training of any GNSS processing software.

Conclusions and Results

- the use of these systems saves time and labour by eliminating the need for station points(s) and GNSS software,
- these services are very useful for users who do not have detailed knowledge of the GNSS method and the experience in commercial or scientific GNSS processing packages.

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Thank you very much for your interest and attention…

Contributions, Questions???

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