First results of GPS water vapour and its comparison with radiosondes and ERA-Interim reanalysis in Algeria

Houarina Namouati1, Salem Kahlouche1, Ahmed Hafidh Belbachir3, Roeland Van Malderen1, Hughes Breton2, Eric Pottiaux2

1Division of Space Geodesy, Center of Space Techniques (CTS), Arczew, Algeria, 2Department of Physical Engineering, University of Science and Technology of Oran (USTO), Oran, Algeria, 3Royal Meteorological Institute of Belgium (RMIB), Uccle, Belgium, 4Royal Belgian Institute for Space Aeronautics (BISA), Uccle, Belgium, 5Royal Observatory of Belgium (ROB), Uccle, Belgium

Abstract
This study presents the estimation of precipitable water from GPS observations and meteorological data in Algeria, over three stations located at Algiers, Bechar and Tamarasset. The objective of this study is to analyze the sensitivity of the GPS Precipitable Water (PW) estimates for the three sites mentioned above to the weighted mean temperature (Tm) and other parameters. The Boviota and Lahcene (2013) Tm-T regression developed for Algeria, and calculated directly from ERA-Interim reanalysis. This study shows that the Tm are derived from the Tm estimation of the order of 18 K producing differences of 1.8 mm in the final evaluation of PW. A good agreement is found between PW GPS and PW calculated from radiosondes with a small mean difference with Vaisala radiosondes (RS 90). A comparison with GPS and ERA-Interim shows a large difference of 4 mm in the region of highlands. This difference is possibly due to the Earth's topography. These first results are encouraging, in particular for meteorological applications in this region, with great hope to extend our dataset analysis to a more complete, global coverage over Algeria.

Validation of PW GPS with radiosondes and ERA-Interim

1. PW GPS and radiosondes
We compare the PW GPS retrievals with the PW calculated from the integration of the vertical profiles measured with radio soundings (PW R).

A good agreement can be observed between the PW GPS and PW over all stations, except for the Algiers station, where the correlation coefficient is only around 0.60. This station has a strong outlier with a too low PW value of around 5 mm measured by the radiosonde.

This GPS station is also characterized by a large daytime dry bias of around 5 mm, compared to the RS observations.

The origin of these large mean differences might be related to the PW GPS (multipath near the GPS antenna and minor quality of the radiosonde type MODMEM MK2X-D at this station.).

References

Conclusions
• This study gives some results of comparing different precipitable water data sources for three stations in Algeria (Algiers, Bechar and Tamarasset). In particular, we analyzed the impact of the weighted mean temperature Tm on the retrieved PW GPS by comparing three different Tm parameterizations (the Tm-T linear regression of Bevis et al. (1992), the Tm-T linear regression for Algeria from Boutiouta & Lahcene (2013), and Tm calculated from ERA-Interim).

• The results indicate that the differences in Tm are of the order of 18 K producing differences of 1.8 mm in the final evaluation of PW.

• A good agreement between PW GPS and radiosondes has been evaluated with mean differences less than 2 mm, except at the Algiers station (MODMEM MK2X-D) radiosonde launches.

• The comparison between PW ERA-Interim and PW GPS shows differences in the magnitude and the sign of the bias that vary from station to station.

Comparison of the different PW GPS

The different time series of water vapour are presented in Figure 3. The values of water vapour vary with the location of the station.

The maximum value of 51 mm was reached in August at the Algiers station, which is close to the sea, and the minimum value (of the order of 3.7 mm) was observed for the Tamarasset station in November.

For the Bechar station, the mean values of water vapour are in the order of 18 mm, so in between the Algiers and Tamarasset ranges.

The uncertainty in PW GPS was calculated from the formula (1) and we have find , the difference of 18 K produce a small difference in GPS PW (2mm). This study is agree with Fernández et al., (2010) were difference of 15 K produce a small difference in GPS PW.

Questions
1. How do the authors compare the PW GPS retrievals with the PW calculated from the integration of the vertical profiles measured with radio soundings (PW R)?
2. What is the main difference found between PW GPS and PW calculated from radiosondes for Algiers station? For Bechar station?
3. Are there any significant differences in the PW GPS retrievals between the stations? If yes, what are the main factors that contribute to these differences?