DETERMINATION AND STATISTICAL MODELING OF TROPOSPHERIC DELAY ERROR (ZTD) AND PRECIPITABLE WATER VAPOR CONTENT (PWV) IN ECUADOR

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ABSTRACT

Ecuador, by being located in the Intertropical Convergence Zone and due to the presence of the Pacific Ring of Fire, has a very special atmospheric dynamic, which is very difficult to model using traditional techniques, such as meteorological instrumentation or the use of aerological instruments, as well as the high purchase costs. The main goal of this study is to provide a first review of the results obtained in the last two years, in the determination, analysis, comparison and subsequent modeling of the total precipitable water vapor content in Ecuador, through the implementation of spatial prediction techniques and the use of the positional data obtained from the GNSS National Network, together with climatological information generated by a group of meteorological measurement systems interconnected with the geodetic infrastructure, and finally with the use of information obtained through the implementation of global and regional numerical weather models such as the renewed GPT2–GMF model and ECMWF–VMF1 one.

PROCESSING STRATEGY

TABLE 1. MODELS USED IN GNSS DATA PROCESSING

ORD	PARAMETER OR MODEL	VARIABLE
A. Analysis Controls		
1.	Choice of Experiment	BASELINE.
2.	Choice of Observable	L3
4.	Station Error	ELEVATION 10.5.
5.	Satellital Error	UNIFORM
B. Atmospheric Parameters		
6.	Interval. Zenith Delay Estimation	1 hour
7.	Zenith Model Estimation	Piecewise-Linear
8.	Zenith Constraints	0.5
9.	Atmospheric Gradients	2
10.	Mapping Function	VMF1
C. Models Parameters		
15.	Ocean tidal loading model	FES 2004
16.	Meteorological model	GPT2 & ECMWF
12.	Antenna-REC model correction	AZEL
13.	Antenna-SAT model correction	ELEV

GENERAL PARAMETERS AND STRATEGY

A. Processing Software

GAMIT – GLOBK. VERSION 10.5

B. Processing Interval

112 GPS Week – 1123 GPS Week

C. Number of Stations

35 GNSS Stations. GNSS Network of Ecuador

10 GNSS Stations. IGS International Network

D. Reference Frames of Solutions

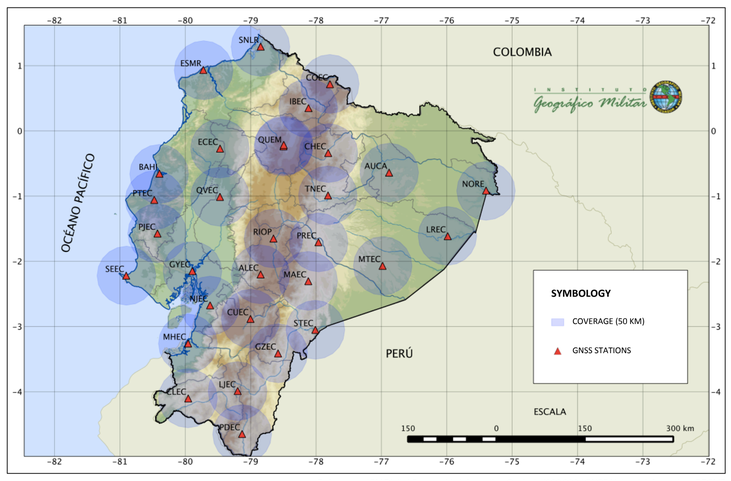
IGb08 Reference Frame

E. Number of Solutions Obtained

80 weekly solutions

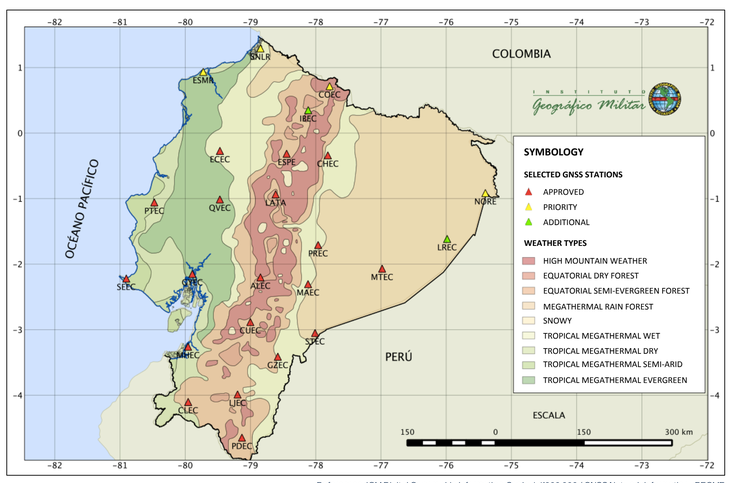
LOCATION

MAP 1. GNSS INFRAESTRUCTURE OF ECUADOR - REGME EC



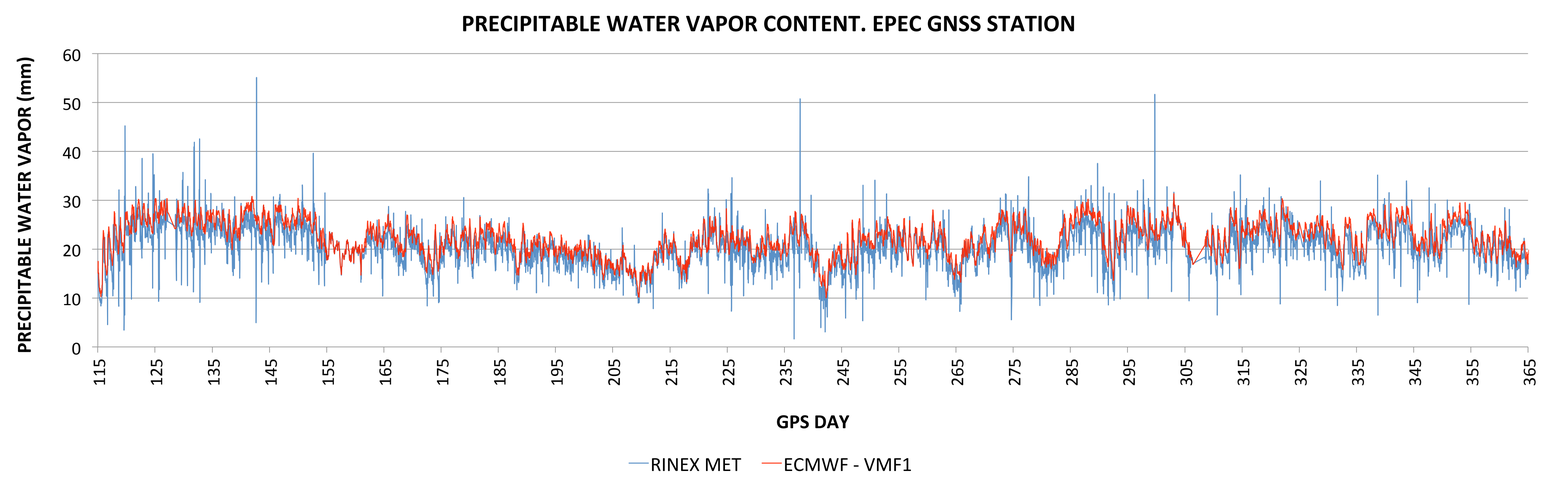
References. IGM Digital Geographic Information. Scale 1:1'000.000 / GNSS Network Information - REGME

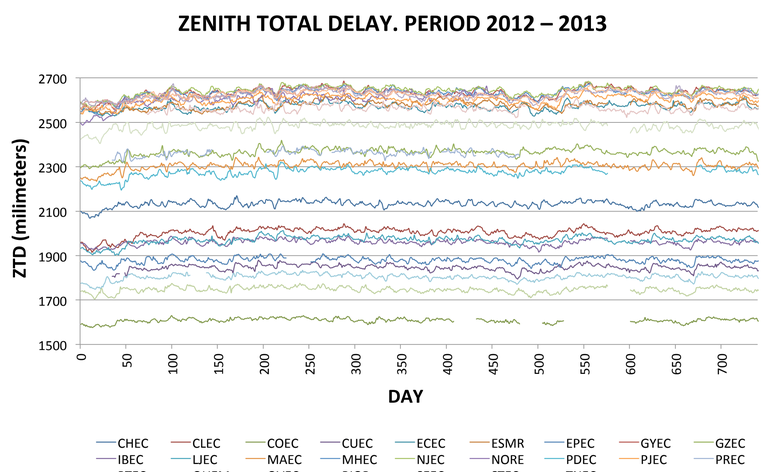
MAP 2. GNSS - MET INFRAESTRUCTURE OF ECUADOR - REGME-MET EC

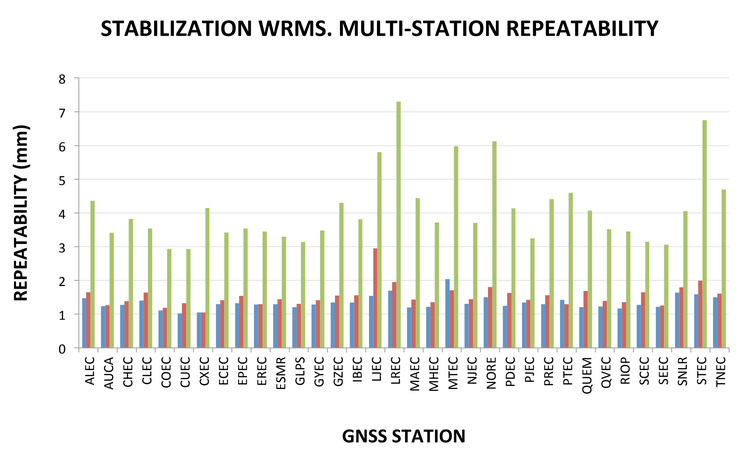


References. IGM Digital Geographic Information. Scale 1:1'000.000 / GNSS Network Information - REGME

MAIN RESULTS







REFERENCES

- Böhm, J. & Schuh, H. (eds.) 2013. "Atmospheric Effects in Space Geodesy". Springer Atmospheric Sciences. DOI: 10.1007/978-3-642-36932-2_3. Springer-Verlag Berlin Heidelberg.
- Herschke, P. 2002. "Modeling and Extrapolation of Path Delays in GPS signals". Master Thesis. Department of Physics – Swiss Federal Institute of Technology. Zurich – Switzerland.
- Hurter, F. & Maier, O. 2013. "Tropospheric profiles of wet refractivity and humidity from the combination of remote sensing data sets and measurements on the ground". Atmospheric Measurement Techniques Journal. Copernicus Publications. DOI: 10.5194/amt-6-3083-2013.
- Troller, M. 2004. "GPS based Determination of the Integrated and Spatially Distributed Water Vapor in the Troposphere. Vol. 67 of Geodätisch-geophysikalische Arbeiten in der Schweiz. Swiss Geodetic Comission.

CONCLUSION

Preliminary results obtained when comparing PVW values calculated with and without the implementation of the information generated by meteorological measurement systems and numerical weather models denote on average variability among its values, close to 30 centimeters in the case of stations over the 2300 meters high and 52 centimeters in the case of stations located at mean sea level, with an internal precision for each of the cases of 0.80 millimeters and 0.94 millimeters respectively.

Finally, the analysis and comparison of the repeatability of solutions demonstrates a good internal stability of the network, with a mean horizontal precision close to 1 millimeters and a mean vertical precision of 2 millimeters.

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