SIMPOSIO SIRGAS 2021

Del 29 de noviembre al 01 de diciembre de 2021

Analysis of water vapor variation calculated from different models over the Brazilian territory

Afonso Marques Albuquerque, Daniele Barroca Marra Alves, Tayná Aparecida Ferreira Gouveia, Viviane Aparecida dos Santos

Faculdade de Ciências e Tecnologias - Campus Presidente Prudente

INTRODUCTION

The neutral atmosphere is a layer that extends from the Earth's surface to approximately 50km in altitude, it is composed of hydrostatic gases and water vapor. PWV (Precipitable Water Vapor) is the amount of water vapor integrated into the atmosphere, obtained based on atmospheric parameters such as temperature, pressure and humidity. Until we get to PWV to calculations are performed using constants given by refractivity models, which according to the reference have different results.

OBJECTIVE

The aim of this study is to evaluate the refractivity modeling in PWV results, evaluating how each model influences the results, also observing the interaction of models according to location and period in search of a pattern, in order to obtain higher quality values for the region and date studied.

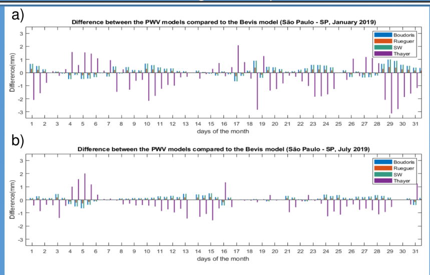
MATERIAL AND METHODS

The location chosen for the study was the city of São Paulo, in Brazil. The data refer to the year 2019 (chosen for its stability and availability), where the most prominent months were January, in summer, and July, in winter. The months of January and July were chosen due to their different intensity in PWV, as January has maximums close to 40mm, while July the maximum value is close to 20mm. Temperature, pressure and humidity data collected from observations made through radiosonde, where calculations and implementations were made in MATLAB software. The models evaluate the variation according to the refractivity constants $(k_1, k_2\ e\ k_3)$, used during calculations from the implementation of the wet component to the PWV. The models used in the study were: Smith and Weintraub (1953), Boudoris (1963), Thayer (1974), Bevis (1994) and Rueguer (2002).

RESULTS

Figure 1 below shows the preliminary results obtained in the study, we can identify that the models show a difference of up to a few millimeters between them. In this analysis, the Bevis refractivity model is used as a parameter, it was chosen because it is conventionally used and is present in many PWV analyses. Observing the month of January (a) we see that Thayer's model exceeds ±3mm of difference compared to Bevis, while the others are below ±1mm of difference, with emphasis on Rueguer, which has the smallest variation among the evaluated models.

Figure 1. Difference between refractivity models in millimeters in PWV, in relation to the Bevis model in the city of São Paulo - SP, in January (a) and July (b) of 2019.



Based on the month of July, we see that the same occurs for the order of magnitude of the models, with Thayer being the model with the greatest difference and Rueguer the smallest. However, the amplitude of the difference in January is greater if compared to July, since July has a maximum difference close to ±2mm.

Figure 2. Monthly average of PWV values based on refractivity models in the city of São Paulo – SP, in January (a) and July (b) in 2019.

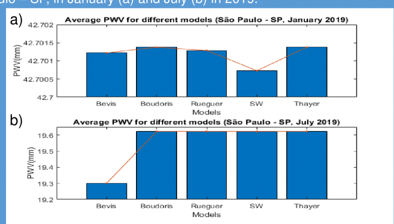


Figure 2 shows the average monthly PWV values as per the refractivity model used, so each model is represented by a value as shown in the image.. Although this average presents values that vary in a small order of magnitude, it helps to visualize the difference between the models without adopting one of them as a parameter.

Thus, we can see in January (a) the Thayer model representing the highest values for PWV, while the Smith and Weintraub model representing the lowest. In July (b) this scenario is different, as the average PWV value in the Bevis model is 0.3mm smaller compared to the others, which obtained a very small variation.

CONCLUSION

Evaluating the preliminary results, we can conclude that the constants have an influence on the PWV values, being this variation in order of millimeters among the studied models. Knowing that the PWV has higher values in January, (as can be seen in Figure 2), based on Figure 1, we can see that the month of January also presents a greater difference (close to 1mm) when the observations are evaluated individually using a model as a parameter (Bevis, in this case). This is visible knowing that the Thayer variation in January had a variation peak close to ±3mm, while in July the same model had a maximum difference close to ±2mm with less maximums. Defining whether a better model for PWV goes beyond seeing if its variation tends to larger or smaller values, as these values can vary according to real weather conditions. Thus, we understand that there is a need to assess local precipitation parameters to see the proximity of values, which is the next step in the research process.

Initially, this analysis only addressed the city of São Paulo for the months of January and July of the year 2019. For a more solid comparison, it is necessary to evaluate the impact of constants at more times in search of a pattern. Obtaining a pattern, it is possible to define how much a specific constant influence can define its impact on the values of the region, and consequently assess the difference of this variation depending on the location.

FINANCING

PROPe (Pró-Reitoria de Pesquisa) for the opportunity to participate in the event. To the Institutional Program for Scientific Initiation Scholarships at UNESP (PIBIC - Reitoria).

REFERENCES

Estimativa do vapor d'água atmosférico e avaliação da modelagem do atraso zenital troposférico utilizando GPS - Sapucci, Luiz Fernando (2001).

GPS METEOROLY: Mapping Zenith Wet Delays onto Precipitable Water (BEVIS. 1994)

The Constants in the Equation for Atmospheric Refractive Index at Radio Frequencies (Ernest K. Smith, Jr., and Stanley Weintraub. 1953).

Estimation of Tropospheric delay for microwaves from surfaces weather data (J. Askne and H. Nordius. 1986.