

# EGU21-2304: Comparison of Tropospheric Zenith Wet Delay from VLBI and GNSS Estimations

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## Introduction

- The tropospheric delay is one of the major error sources for space geodetic techniques.
- This delay depends on the atmospheric pressure, humidity and local temperature.
- The aims of this research are to investigate the seasonal variations of ZWD derived from VLBI and GNSS observations and to investigate how well the ZWD from VLBI and GNSS agree to each other.

## Materials and Methods

- The studied ZWD estimates have been derived from 8 VLBI stations (5 AUSTRAL stations, 3 European stations) that participated in the IVS R1 and R4 networks and GNSS stations that are co-located with them.
- The VLBI ZWD were estimated in least square adjustment as piecewise linear offset at 60 mins time intervals using the VieVS with Matlab.
- We obtained GNSS ZTD from the Center for Orbit Determination in Europe (CODE), from which we subtracted ZWD. The model ZWD were obtained from VMF Data Server.
- The equations for RMSE and bias are presented as:

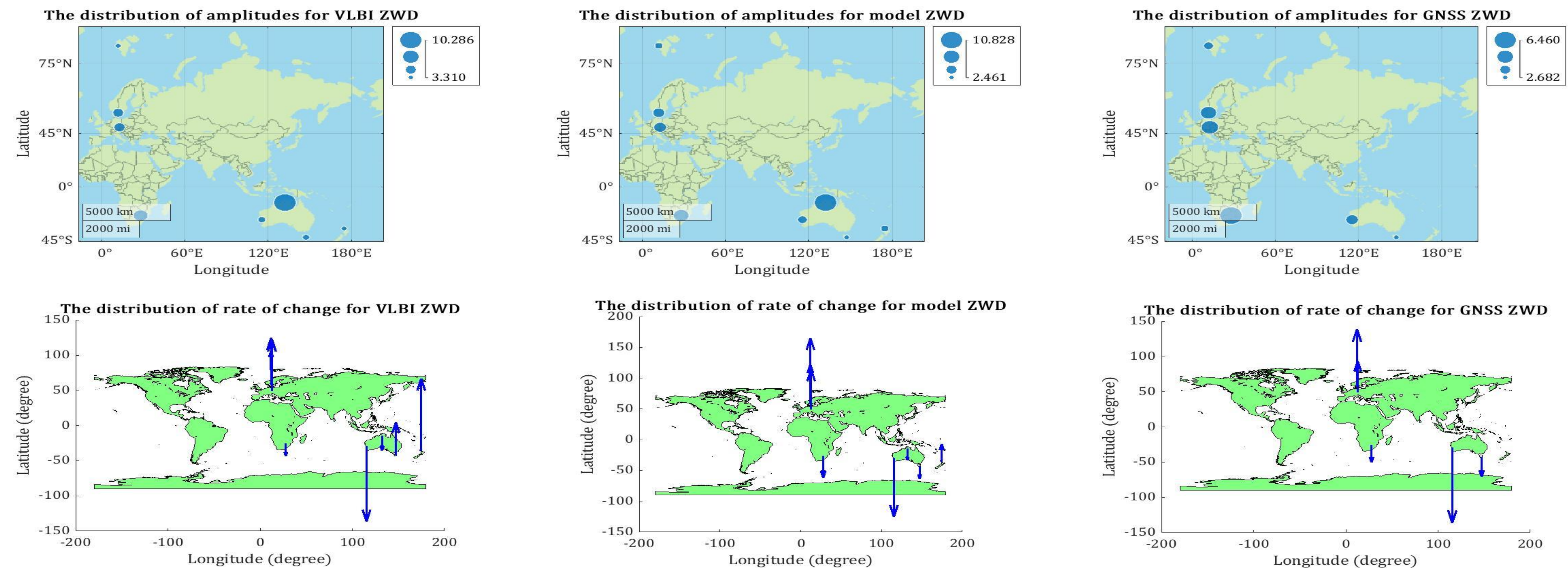
$$RMSE = \sqrt{\frac{1}{N} \sum_{i=1}^N (residual)^2}$$

$$bias = \frac{1}{N} \sum_{i=1}^N (residual)$$

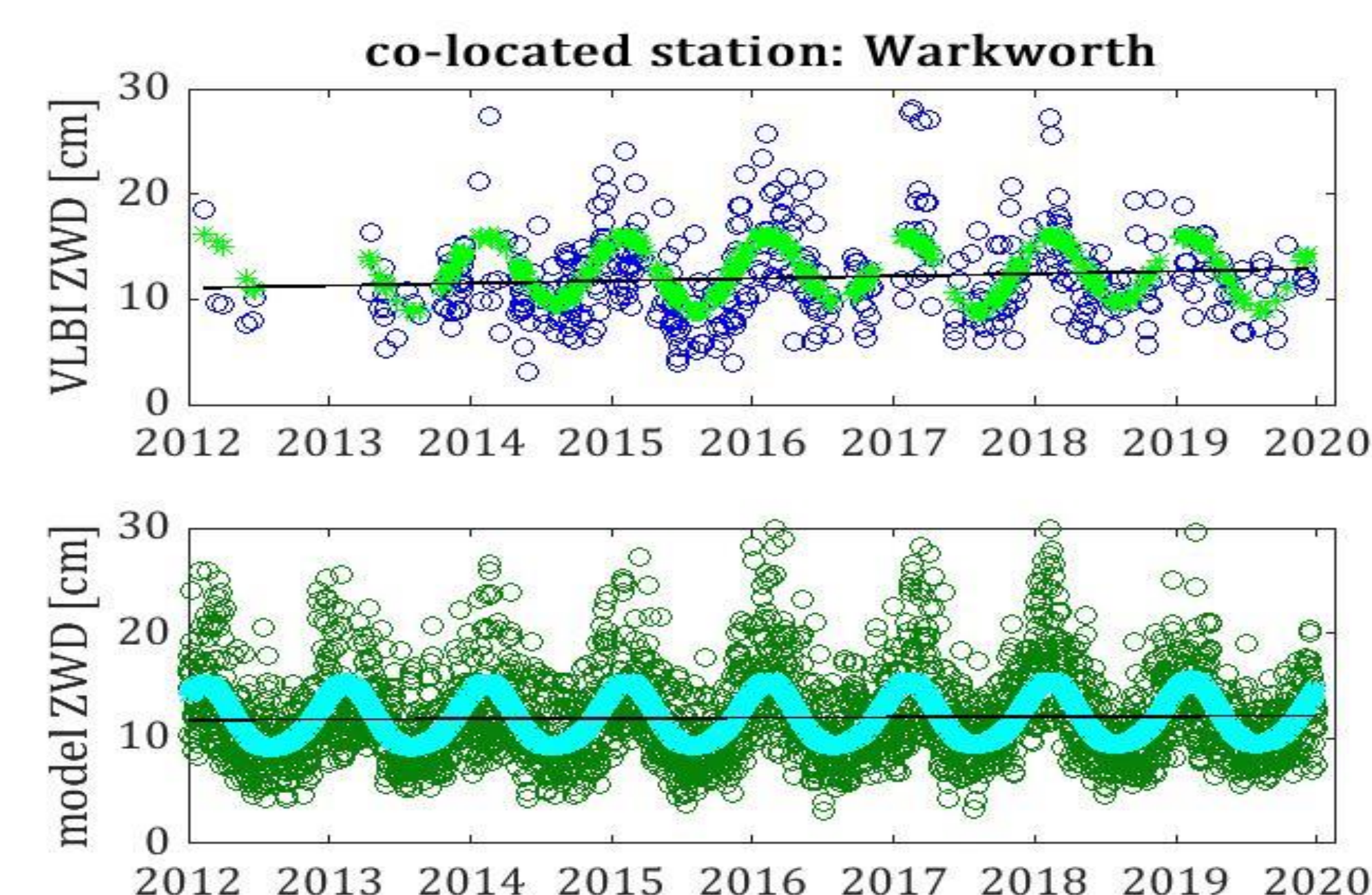
- N is the number of observations

## Results

1. Fig. 1: the distribution of the amplitudes (cm) (upper panel) and trend (cm/yr) (lower panel). VLBI (left), model (middle) and GNSS (right).



2. Fig. 2: seasonal variation and trend for VLBI and GNSS ZWD time series at Warkworth, NZ



3. Table 1: statistical results of residuals after removing seasonal fit model and linear trends. In VLBI\_m ΔZWD and VLBI\_G ΔZWD, the seasonal fit was computed using model and GNSS data, respectively. Unit: in cm.

	VLBI ΔZWD		model ΔZWD		GNSS ΔZWD		VLBI_m ΔZWD		VLBI_G ΔZWD	
Stations	RMSE	bias	RMSE	bias	RMSE	bias	RMSE	bias	RMSE	bias
Warkworth	3.68	-0.03	3.62	-0.00	---	---	3.66	0.07	---	---
Hobart	3.40	0.78	2.67	-0.01	2.66	-0.01	3.35	-0.19	3.34	0.27
Katherine	5.44	0.56	5.49	-0.01	---	---	5.40	0.27	---	---
Yarragadee	4.08	0.13	4.00	0.03	4.09	0.03	3.89	0.18	3.89	0.14
Hartebeethoek	3.20	-0.14	3.08	0.09	3.11	0.10	3.17	0.42	3.14	-0.01
Wetzell	2.97	0.16	2.77	0.05	2.79	0.05	3.02	-0.27	3.01	0.18
Onsala	2.70	-0.02	2.59	-0.03	2.63	-0.03	2.67	-0.43	2.64	-0.16
Ny Ålesund	1.96	0.05	1.73	0.00	1.76	0.00	1.74	-0.14	1.73	0.06

## Conclusion

- Clear seasonal variations of ZWD are found for all co-located VLBI/GNSS stations (Fig. 1 upper panel and Fig. 2).
- A good agreement is found between VLBI ZWD and GNSS ZWD (Fig. 2).
- The stations located in the tropical regions have typically larger yearly amplitude than stations at temperate or polar regions (Fig. 1 upper panel). Larger statistical results are found at low-latitudes stations (Table 1). As shown also in Jin et al., 2007.
- Some stations in the Southern Hemisphere show negative trend, whereas the stations in the Northern Hemisphere present positive trend (Fig. 1 lower panel). As shown also in Jin et al., 2007 and Klos et al., 2018.