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Investigation of the Height Dependency of ZTD Using EOF Analysis

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Objectives

To investigate the topography dependency, accuracy, and systematic components of 75-day ZTD data collected from 11 CORS-TR stations between latitudes 40°–42° and longitudes 31°-35°.5 at one-hour intervals.

Dataset

- GNSS-ZTD estimates from Nevada Geodetic Laboratory (Blewitt et al. 2018)
- ZTD derived by GipsyX processing software. Parameters related to the tropsposhere is shown in Table 1 (URL-1)

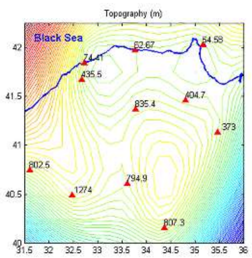
Table 1. GipsyX Software parameters related to the troposphere

Parameter	Input
Elevation cut-off angle	7 degrees
Sampling rate	5 minutes
Troposphere	
A priori model	VMF1
Mapping Function	VMF1

Data Preparation

- ZTD with an interval of 1 hour were selected.
- ZTD data gaps were interpolated with the linear interpolation.

Fig.1 Topography



Conclusions

- The average standard deviations computed for each PC are a representation of the systematic components (signals) contained in the component. The significant PCs and their average standard deviations validate each other.
- The standard deviation of ZTD was found to be ± 2.68 mm. ZTD has a topography-dependent component with 95% reliability and a scale of 30 mm/km, according to pattern, spectral, and correlation analyses of the largest fundamental component (PC1).
- As seen in Figure 3, the topography is comparable to the first three patterns, which display 70% of the data. This suggests that these similarities could be an example of how ZTD is dependent on station heights.

EOF Analysis

- A data matrix M is formed with the dimension of txp where p represent the number of stations, and t denotes the number of time series.

$$M_{txp} = \begin{bmatrix} m_{1,1} & \cdots & m_{1,p} \\ \vdots & \vdots & \vdots \\ m_{t,1} & \cdots & m_{t,p} \end{bmatrix}$$

- Trends are removed from the matrix.

$$F_{txp} = \text{detrend}(M,0)$$

- The covariance matrix of F is computed (N : # of observations).

$$R_{pxp} = (F' * F) / N$$

- The eigenvalues and eigenvectors of the covariance matrix R is computed.

$$[C,L] = eig(R)$$

- C_{pxp} : the eigenvector matrix and L_{pxp} : the diagonal eigenvalues matrix.
- Test value is computed by taking into account the correlation between the estimates (Preisendorfer and Mobley 1988; Hannachi 2004; Hannachi et al. 2007).

Fig.2 Results of EOF Analysis

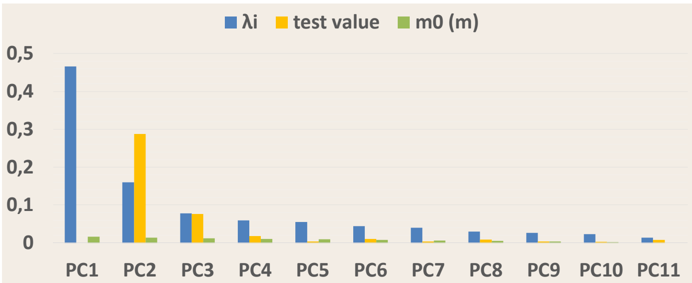
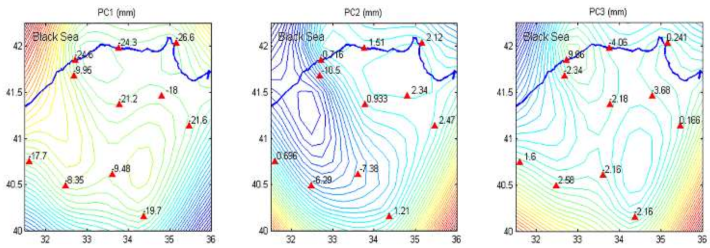


Fig.3 Patterns of PC1, PC2, and PC3



References

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