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Bias on Rapid Static GPS Velocity Estimates due to Large Inter-station Height Differences: Examples from Koyulhisar Landslide in Central Turkey

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GPS is frequently used in monitoring of natural hazards and other geophysical phenomena. Various modes of GPS positioning have been tested so far to find efficient surveying and evaluation methods in such studies. Rapid Static GPS attracts researchers since occupation time of geodetic points is relatively much shorter hence field coverage is much wider and radio link is not necessary for obtaining precise positions. Recently, Hastaoglu and Sanli (2008) showed that the accuracy of rapid static GPS positioning entirely depends on the inter-station height difference. This is mainly because the troposphere between GPS stations decorrelates when the height difference is large, and tropospheric errors become harder to model.

The fact that the station height difference is always large in studies such as landslide and volcano monitoring, the positioning accuracy is degraded accordingly. In this study, we show that the large station height difference hence the systematic bias on position estimates from rapid static surveying also affects the GPS velocity field. In order to demonstrate the influences, we used GPS measurements from Koyulhisar landslide, central Turkey. We have solutions from 6 GPS campaigns covering about 1.5-year period. The GPS sites were occupied in a static surveying mode about 12 hours. We subdivided the data into shorter segments (i.e. 5 to 30 min) and attempted to obtain deformation rates from rapid static positioning. Comparing these solutions with static GPS solutions using BERNESE 5.0 indicates that GPS velocity estimates (i.e. deformation rates) are also affected by large station height differences, and systematic biases occur in the estimated GPS deformation rates. The effect is more significant on the vertical component whereas it is negligible or a factor of 2 or so smaller in the horizontal components. When reducing the height difference between the reference station and the rover stations, rapid static solutions from 15 min sessions show high correlation (i.e. > 90%) and similar deformation rates with static positioning solutions.

References

Hastaoglu, K. and D.U. Sanli (2008), Accuracy of GPS Rapid Static Positioning: Application to Koyulhisar Landslide, Central Turkey, Survey Review, in press