Evaluating the uncertainties of the estimated vertical velocities of Bezymianny GPS network

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The Bezymianny GPS network has been installed in 2006 in order to monitor this volcano that has suffered several eruptions in the last 50 years. The GPS network consisted of 10 permanent sites distributed around the volcano edifice. However, due to the extreme difficult conditions, two of the stations acquired very few days of observations and most of other eight also contain large periods with no observations – mainly caused by power failures.
In this study, we start by focus on the sensitivity of the vertical estimations to different processing parameters. We have processed the entire dataset acquired until the summer of 2010 (4 years for most stations) using the GIPSY-OASIS software package. We analyze the time-series obtained using state-of-art mapping functions (GMF and VMF1) at different elevation angles in order to investigate how much the selection of the mapping function together with the cut-off angle can affect the estimated trend and associated uncertainties. This provides us upper limits on the variation of the vertical velocities in function of the used models.
In addition, we compute more realistic trend errors for the vertical motions by taking into account the temporal correlations that exists within the data. The necessity of using something more realistic than a white noise model in the least-squares solution of the GPS derived motion is obvious when different parts of the time-series produce rates that are significantly more diverging than one should expect from the formal errors. We use here an algorithm based on the Maximum Likelihood Estimation method that takes into account the existence of significant number of gaps in the time-series without destroying the symmetric structure of the matrices involved. The use of temporal correlations between the associated uncertainties of the time-series is mainly based on the fact that we are concentrated on a small spatial network.