The analysis of precise levelling data enables an accurate determination of vertical displacement rates at levelling benchmarks, if repeated measurements over a long time span at identical benchmarks are available.

In order to get detailed information on vertical crustal deformations in the Upper Rhine Graben (URG) area, a consistent analysis of levelling measurements from Germany, Switzerland and France has been done. The available data is inhomogeneous because of different measurement accuracies and measurement dates (from 1891 to 2011). To consider the measurement dates a kinematical analysis approach is used which combines different measurement epochs in a time-dependent adjustment and directly yields linear vertical displacement rates of the benchmarks. To consider different accuracies in the adjustment the data is divided into groups (dependent on country, date, levelling order) and iterative variance component estimation (VCE) is applied.

Vertical crustal deformations in the URG are expected to be small (less than 0.5 mm/a). Using the kinematic adjustment approach an average standard deviation of estimated velocities at levelling benchmarks less than 0.2 mm/a may be achieved. In mountain areas (black forest) gravity corrections have to be applied to the measured height differences. VCE leads to an improvement of estimated parameters, if all variance components of the chosen groups converge.

The analysis of precise levelling data is still the most accurate tool to determine vertical crustal deformations. To account for inhomogeneities in the data of big transnational levelling networks, kinematic adjustment in combination with VCE is an appropriate way.