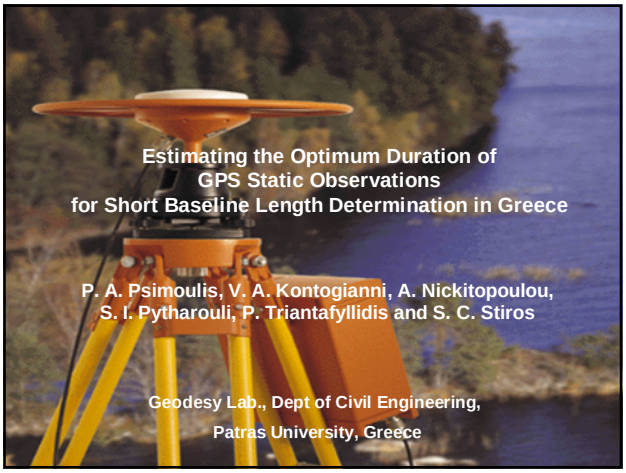

Estimating the Optimum Duration of GPS Static Observations for Short Baseline Length Determination in Greece

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Structural Monitoring

Until recently conventional methods (accelerometers, strain gauges etc) were used for structural monitoring

GPS is a new **cost–effective** method for monitoring safety and performance of structures (bridges, dams, buildings)

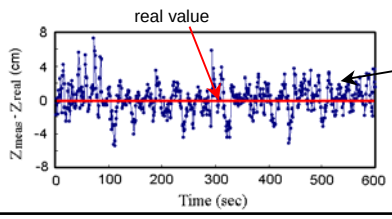
An example of GPS structural monitoring is the monitoring of Kastraki dam, Greece

ACCURACY OF GPS MEASUREMENTS

GPS measurements are affected by:

- Systematic errors and
- Random errors

which reduce the precision and the accuracy of the measurements



Basic Sources of GPS measurements errors

- Satellite Constellation
- Atmosphere effect on GPS signal propagation (ionosphere and troposphere)
- Multipath effect

How can we reduce the influence of the above sources?

The **duration of the observations** is one of the main factors that may reduce the role of these factors and thus reduce the errors.

Longer measurements duration → Smaller errors

But which is the optimum duration of GPS observations minimizing errors?

This is a question this presentation tries to answer

Aim of this study:

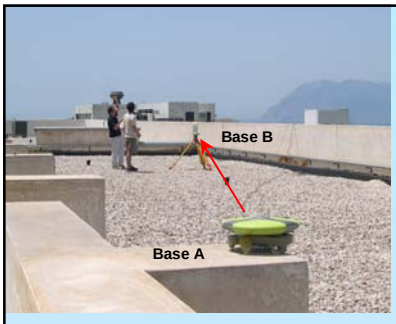
Estimating the optimum duration of GPS static measurements for the precise determination of baseline length in Greece

Data: Recordings from the Gercop Project

Gercop-2 Project

Geodynamic Research of Central and Eastern Europe

- >10 European countries
- >60 GPS stations
- Participants from Greece: University of Patras and University of Thessaloniki



Two dual frequency GPS stations defining a short (~**20m**) baseline were established in the Patras University

Sampling data every **30 sec**

Total duration of observations **6 full days**

> 17,000 observations were recorded

Methodology

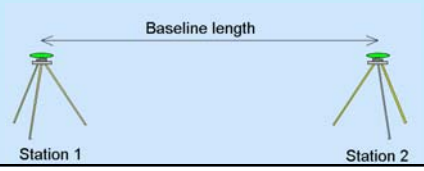
We compare sets of data of various duration with the real value of a baseline

Assumption:

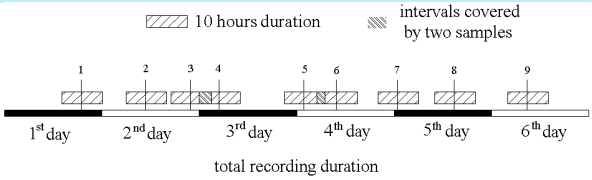
Due to the large number of observations the whole set of the 6 days observation provides the "real" baseline length

We followed three steps:

1. We produced shorter sets of data of variable duration
2. We computed the baseline length of each set
3. We compared the estimated baseline length of each set with the "real" baseline length of the 6 days set



Selection of the examined sets



Samples with a duration ranging between 15min to 3 days were selected

(15min, 30min, 1hr, etc., 12 in total different sample duration)

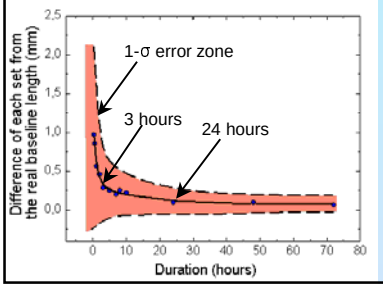
Using a random number generator for each determined set duration (i.e 15min, 30min, 1hr, etc) 9 subsets were selected

Inevitably, some sets were overlapping

Data analysis

For each set of selected duration (15min, 30 min, 1hr, etc) we computed:

1. The mean difference between the baseline length of the set and the "real" baseline length
2. The standard deviation of the differences of the baseline length estimate of each set
3. The max difference of each set from the "real" baseline length



Characteristic durations

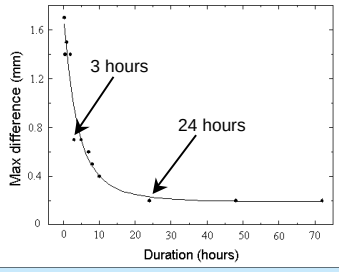
- **3 hours**

For observations longer than 3 hours there was not significant improvement of the accuracy

- **24 hours**

For observations longer than 24 hours practically there was no improvement of the accuracy

maximum difference in each set-duration from the best estimate of the baseline length



- For observations longer than 3 hours the difference from the real baseline length was less than 1 mm
- For observations longer than 24 hours practically there is no difference from the real baseline length

Conclusions

☑ Observations longer than 3 hours permit an accurate (less than 1mm) determination of baseline length in Greece

☑ For observations longer than 24 hours practically there was no improvement in the accuracy of our results

☑ **The optimum duration for short baseline lengths is 3 hours**

Questions to be answered in the future

- What is the effect of the sampling rate on the accuracy of the baseline length
- What happens with long baselines?
- What happens with baselines on other parts of Greece?

Hope to answer these questions in a next FIG Conference!