Brno University of Technology
Faculty of Civil Engeneering
Institute of Geodesy
GNSS SEMINAR 2017

Institute of Geodesy
Brno University of Technology
Czech Republic

GNSS Research Activities at the Chair for Satellite Geodesy (Faculty of Geodesy - University of Zagreb)

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University of Zagreb – Faculty of Geodesy

2nd February 2017, Brno, Czech Republic

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Content:

1. Introduction (about Faculty of Geodesy, UNIZG)
2. CROPOS (Croatian Positioning System)
3. The Impact of Nonstandard CROPOS Network Configuration on the Accuracy of High Precision Positioning Service (**1st diploma thesis**)
4. Examination of visibility influence of GNSS satellites on HPPS CROPOS results (**2nd diploma thesis**)
5. Unmanned Aerial Vehicle GNSS sensor performance testing (**3rd diploma thesis**)
6. Conclusion

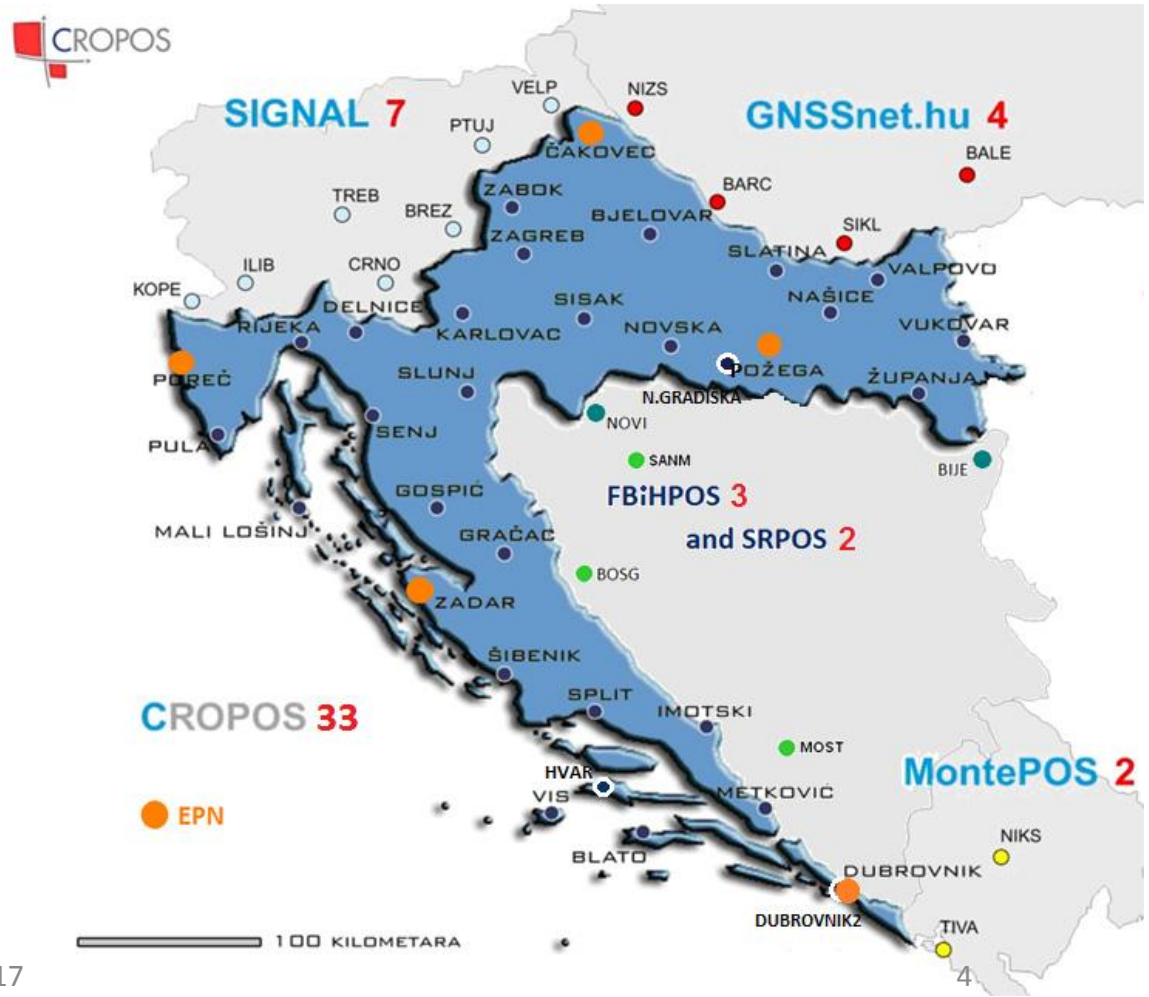
1. Introduction

- University of Zagreb (UNIZG), founded in 1669
- 34 constituents
- Faculty of Geodesy (GEOF), founded in 1962
  - ✓ 100 employees (60% teaching staff, 40% research, administrative and technical staff)
  - ✓ Studies: Bachelor, Master, Postgraduate (Specialist and Doctoral)
  - ✓ Institues → Chairs (e.g. Institute of Geomatics, Chair for Satellite Geodesy)
  - ✓ Master study → 4 semesters (2 years)

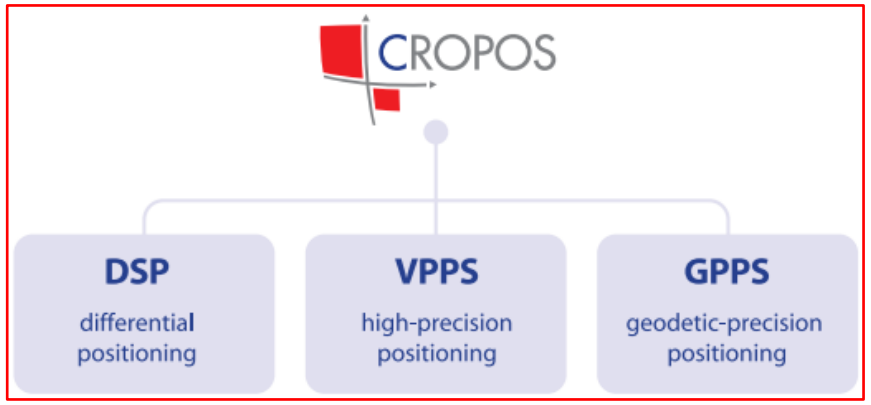
    → 2015/2016: three diploma theses related to the GNSS with research component

2. CROPOS

- CROPOS – state network of permanent GNSS stations of Croatia
- 33 stations on average distance 70 km
- Slovenia (7), Hungary (4), BiH (5), Montenegro (2) → 51 stations
- Two stations from Serbian AGROS (in future)
- 5 EPN stations
- Virtual Reference Station (Trimble)
- Services: DSP (0.3-0.5 m), HPPS (2 cm (2D) – 4 cm (3D)) GPPS (< 1 cm)



3. The Impact of Nonstandard CROPOS Network Configuration on the Accuracy of High Precision Positioning Service (1st diploma thesis)



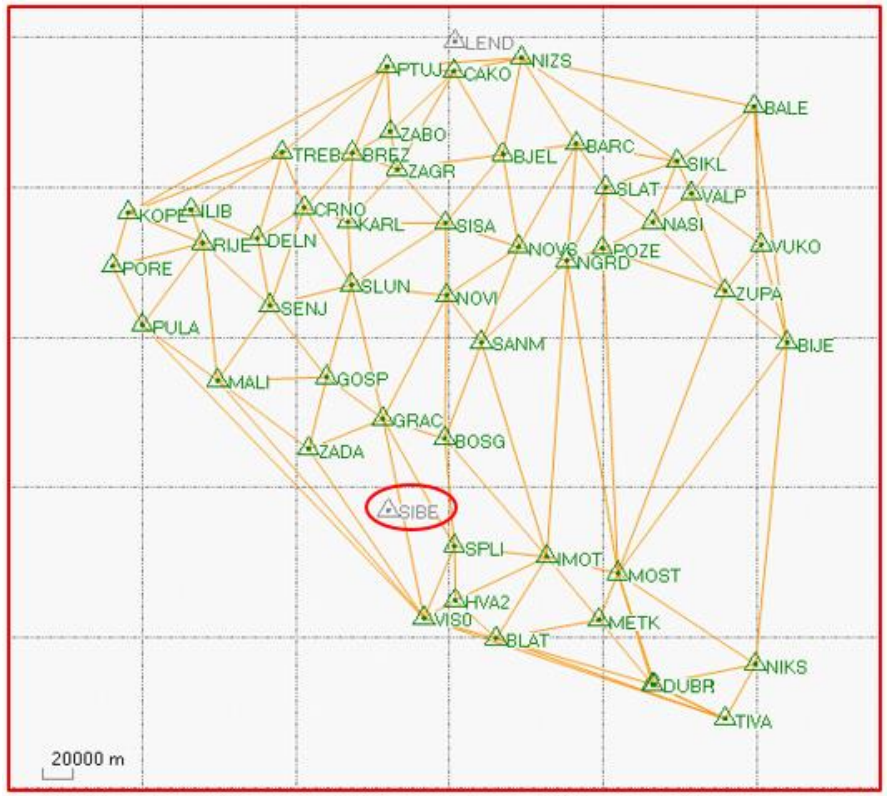
CROPOS SERVICES	METHOD SOLUTIONS	DATA TRANSFER	ACCURACY	DATA FORMAT
DSP	Network solution of code measurement in real time	Wireless Internet (GPRS, UMTS) NTRIP protocol GSM	±0.3 do ±0.5 m	RTCM
VPPS	Network solution of phase measurement in real time	Wireless Internet (GPRS, UMTS) NTRIP protokol GSM	±2 cm (2D) ±4 cm (3D)	RTCM
GPPS	post-processing	Internet (FTP, e-mail)	±1 cm (2D, 3D)	RINEX

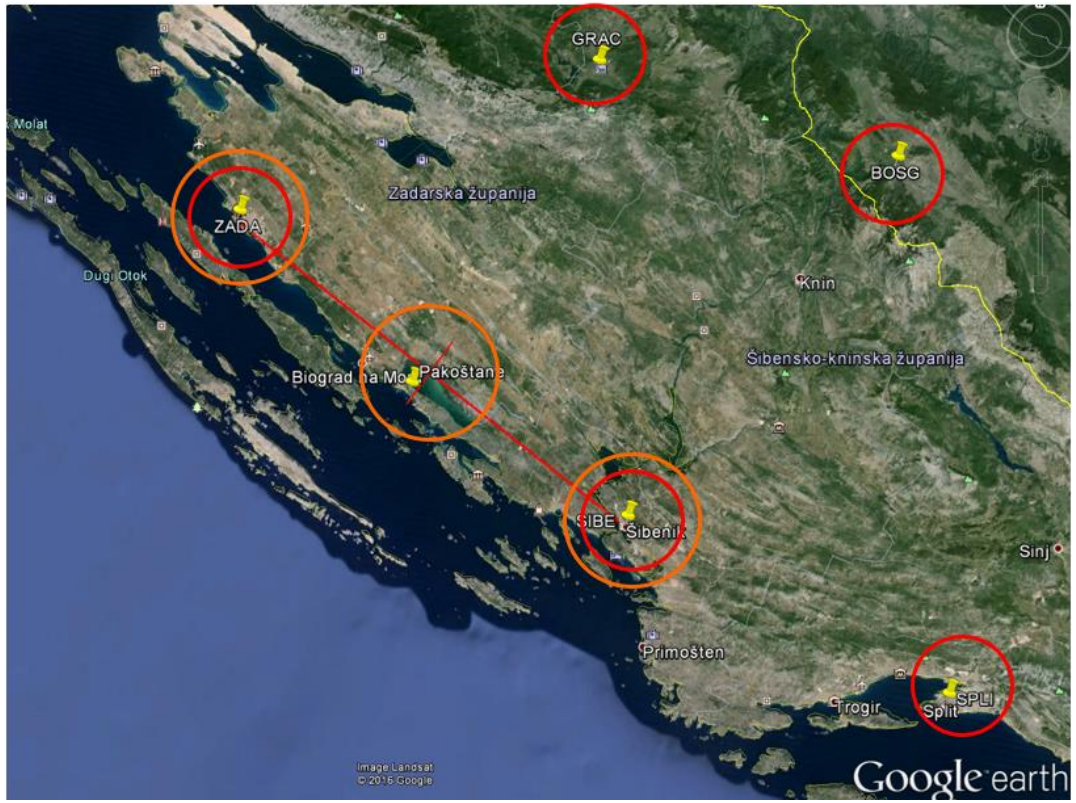
- declared accuracy provided under conditions

Question:

What happens when some of permanent stations stop functioning → Nonstandard Network configuration?

- April - August 2015 (SIBE out of service)
- 7th and 8th May 2016 (SIB2 disconnected)



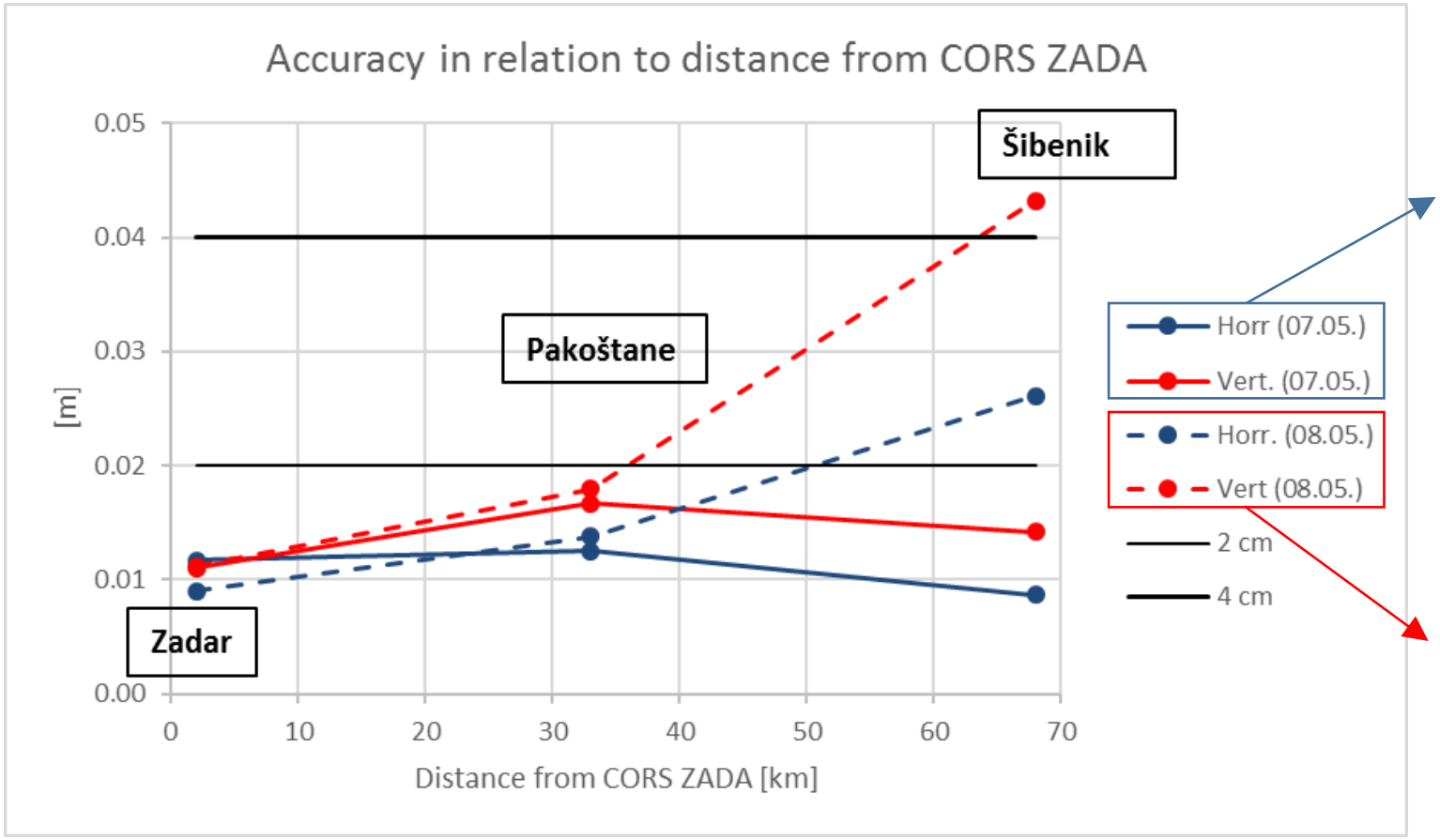


- 7th May 2016: Standard configuration
- 8th May 2016: Nonstandard configuration (SIBE out of service)

- 2 x Trimble R8 Model-2 & 1 x Trimble R8 Model-3
- STATIC & CROPOS HPPS observations
- *Regulations on the fundamental geodetic works performance*

Day	7 May 2016					8 May 2016				
Activity	VPPS	STAT	VPPS	VPPS	VPPS	VPPS	STAT	VPPS	VPPS	VPPS
Time (UTC+2h)	11:00-11:40	11:40-13:00	13:00-13:40	15:00-15:40	17:00-17:40	7:00-7:40	7:40-9:00	9:00-9:40	11:00-11:40	13:00-13:40

3. The Impact of Nonstandard CROPOS Network Configuration on the Accuracy of High Precision Positioning Service (1st diploma thesis)

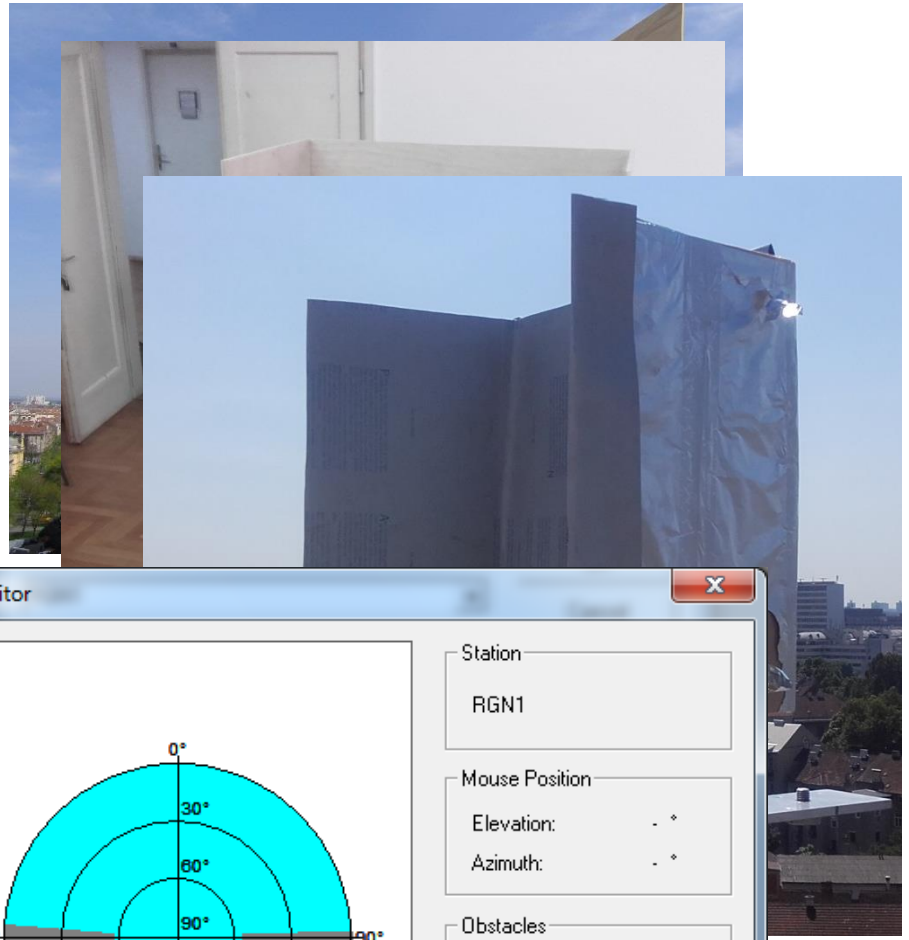


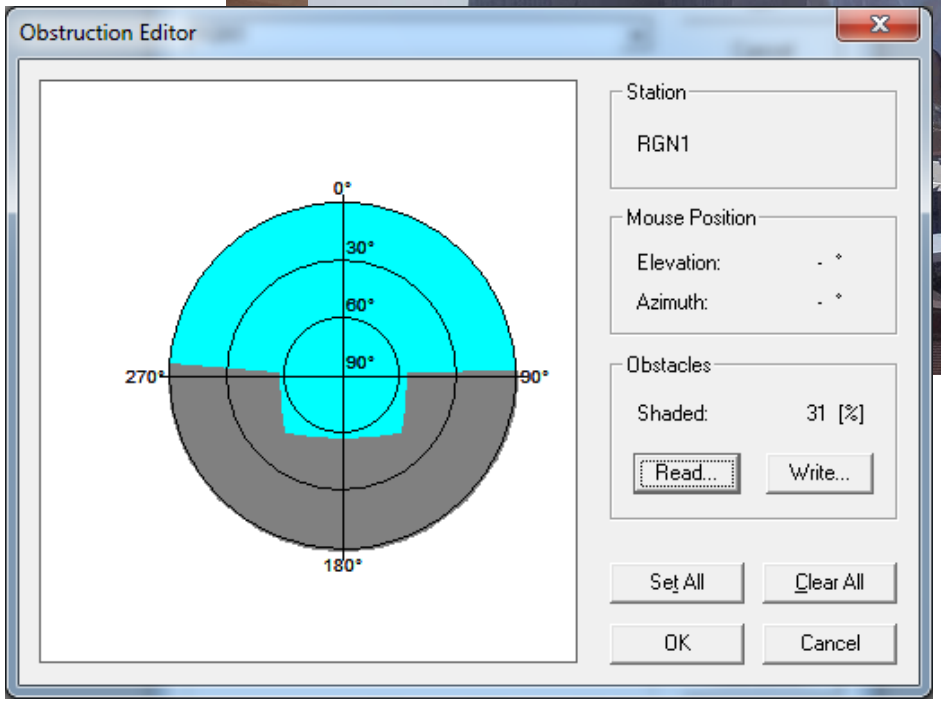
Declared accuracy was reached under Standard network configuration (7th May 2016)

Results obtained under Nonstandard network configuration show a clear trend of accuracy degradation

4. Examination of visibility influence of GNSS satellites on HPPS CROPOS results (2nd diploma thesis)

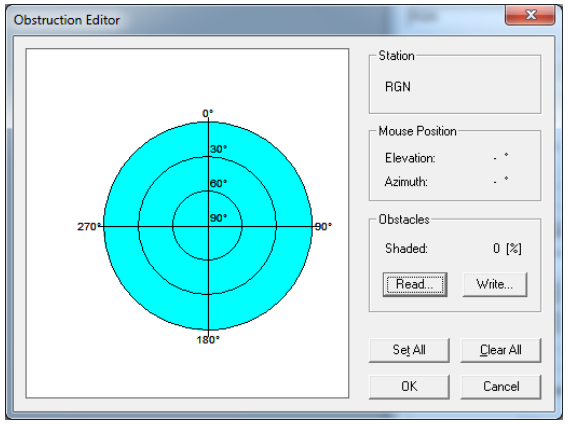
- Different obstruction models were designed and tested
- Final model was rather ‘virtual’
- Trimble Planning Tool → Satellite visibility (GPS + GLONASS)
- Almanac data and obstruction geometry led to…. virtual obstruction

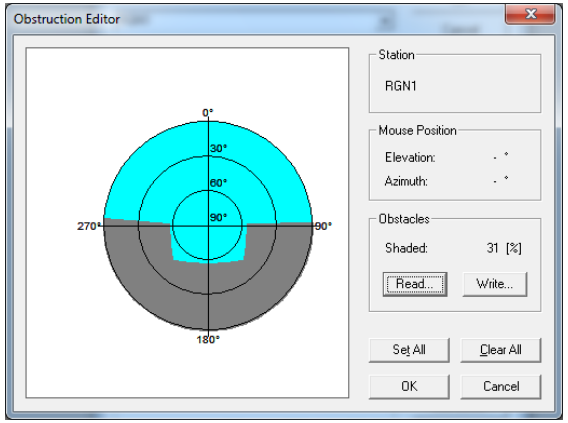




4. Examination of visibility influence of GNSS satellites on HPPS CROPOS results (2nd diploma thesis)

- Simultaneous observations were performed with two GNSS receivers Trimble R8
- 12 hours → plenty of data





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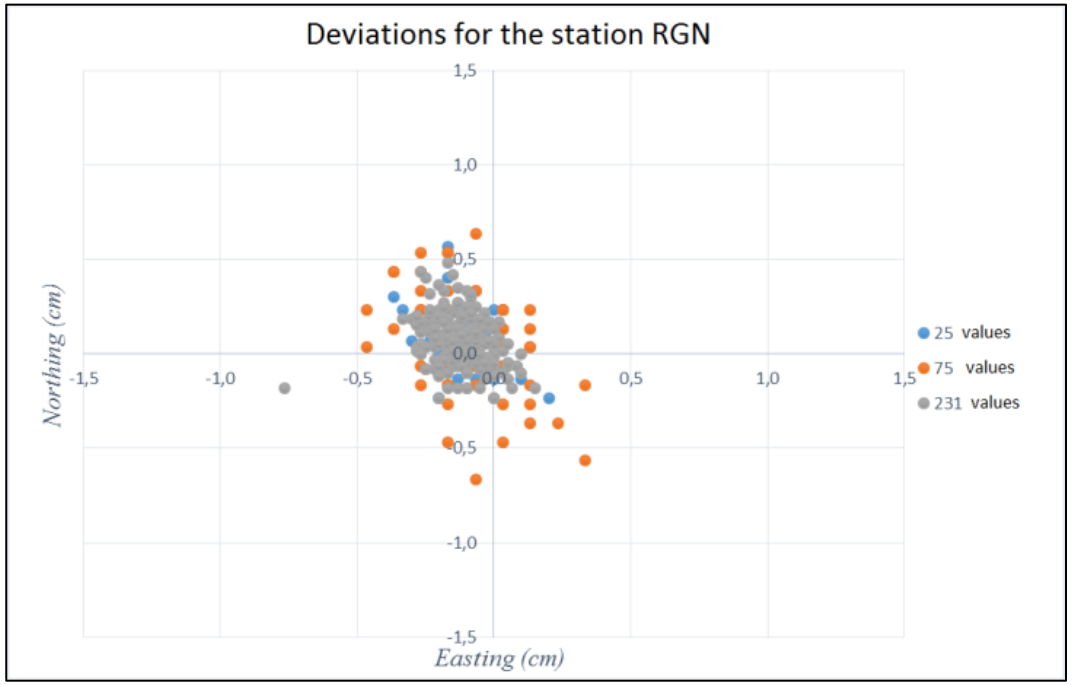
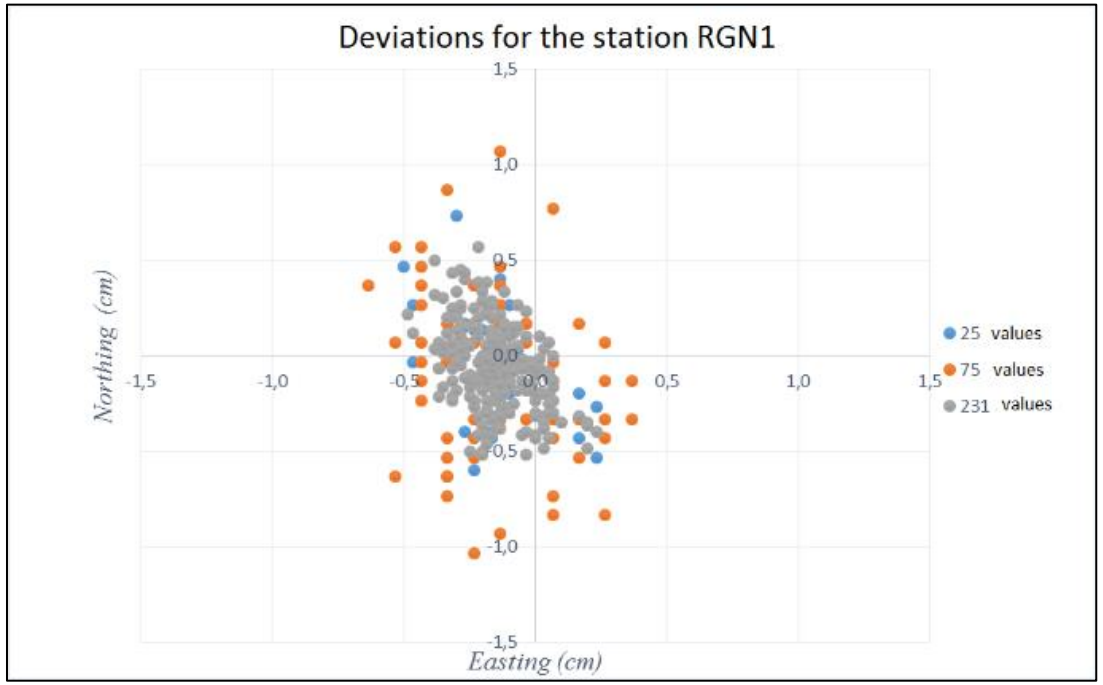
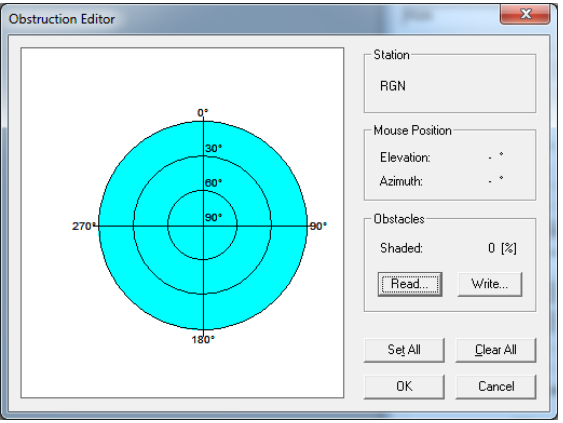
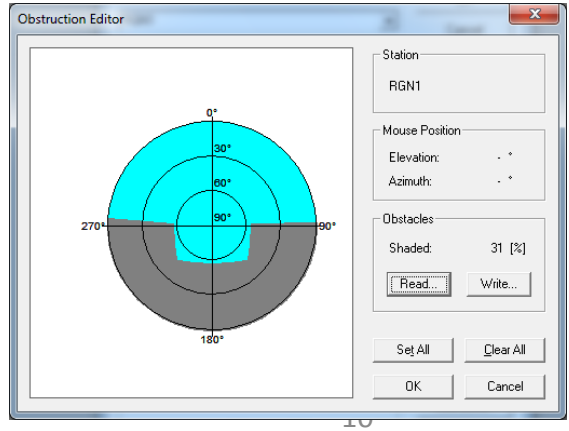






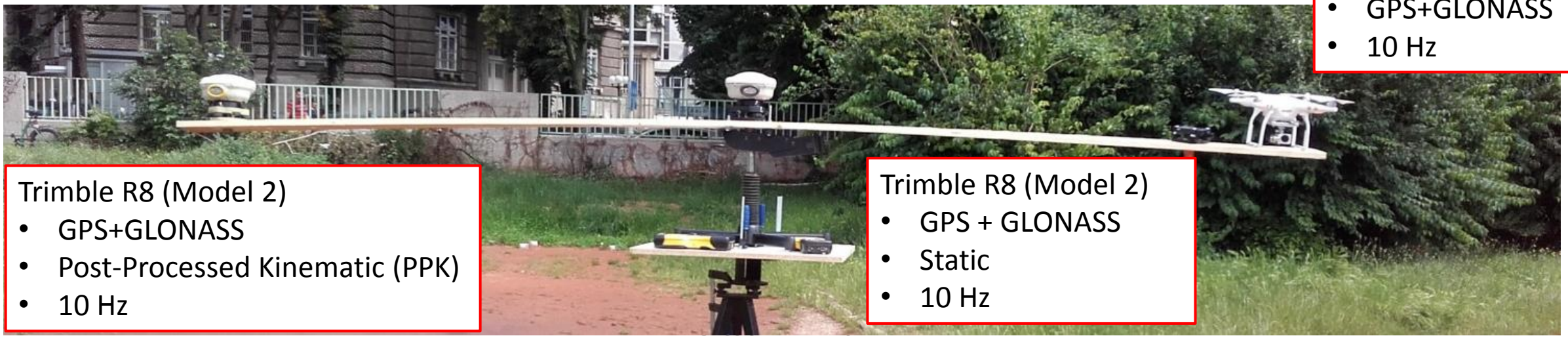
Regulations on the fundamental geodetic works performance:

- Three independet repetitions (each 30 epochs)
- procedure have to be repeated after at least two hours
- *25, 75, 231 values*



5. Unmanned Aerial Vehicle GNSS sensor performance testing (3rd diploma thesis)

- UAV's manufacturers usually provide very few or even no information about accuracy of the GNSS receivers
- This fact was the motivation for the development of testing platform and procedure
- The testing platform had to fulfill two basic requirements:
  - ✓ (1st) having physical dimensions larger that accuracy attainable by the GNSS receiver on the UAVs and
  - ✓ (2nd) enabling precise position determination in every moment.



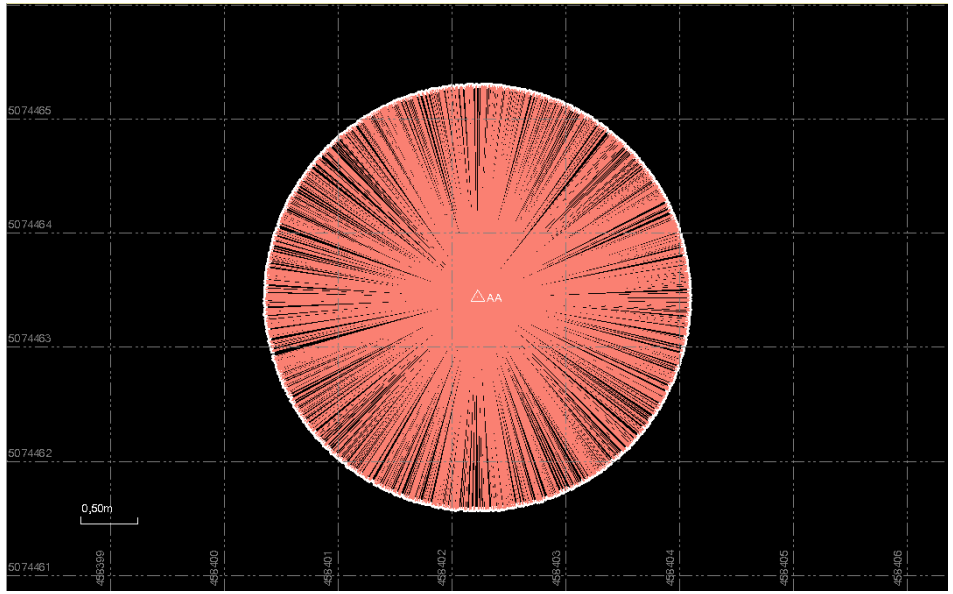
Trimble R8 (Model 2)
- GPS+GLONASS
- Post-Processed Kinematic (PPK)
- 10 Hz

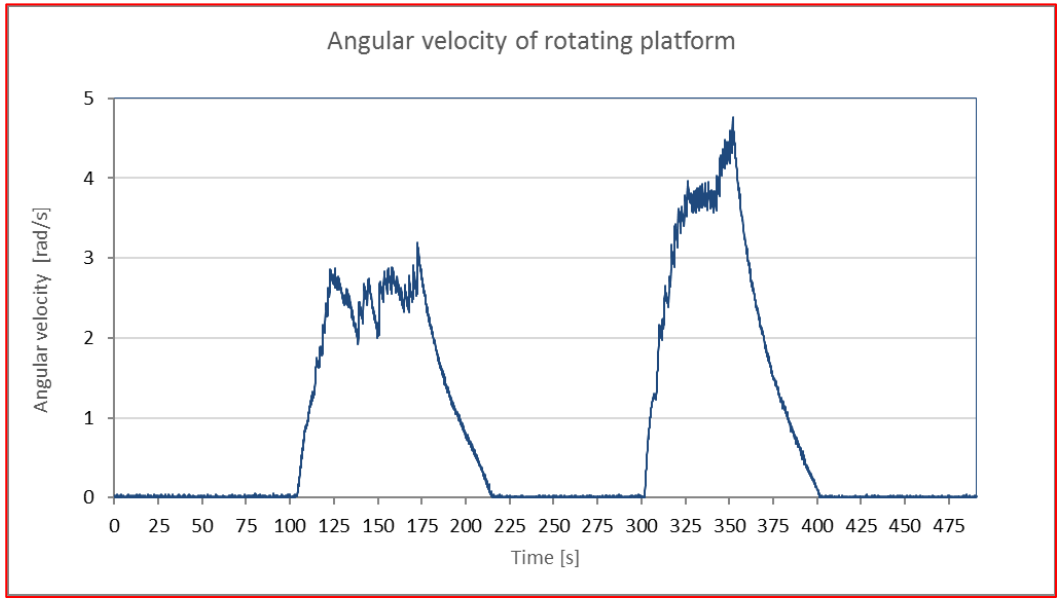
Trimble R8 (Model 2)
- GPS + GLONASS
- Static
- 10 Hz

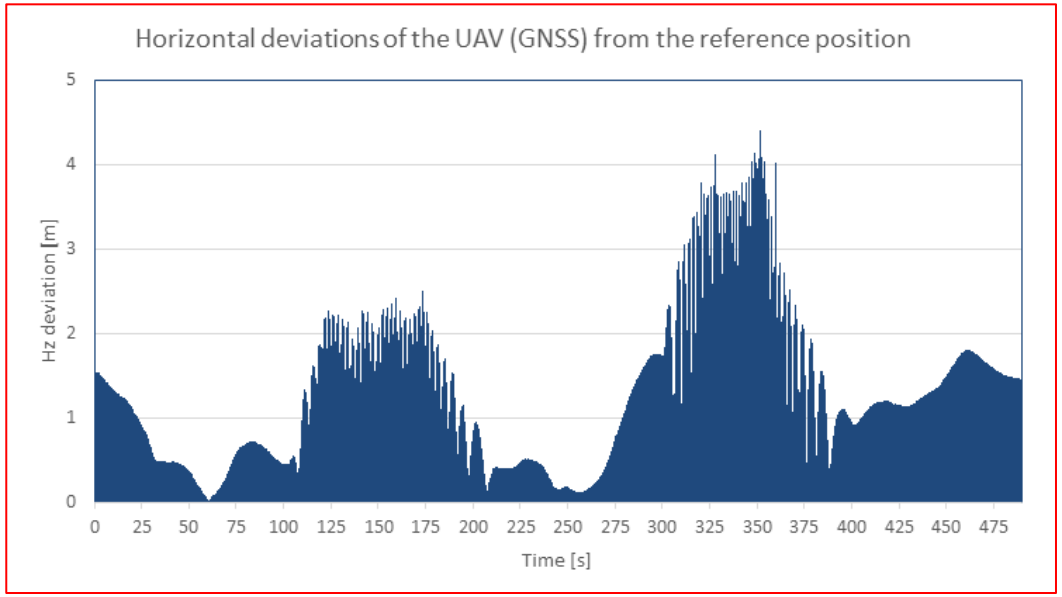
DJI Phantom 3
- GPS+GLONASS
- 10 Hz

5. Unmanned Aerial Vehicle GNSS sensor performance testing (3rd diploma thesis)

- PPK method → 2-cm level accuracy







- Static test: Horizontal accuracy < 2 m
- Kinematic test: Horizontal accuracy < 4 m
- Production of 3D models, Digital Orthophoto, DSM... → Ground Control Points (GCP) is required.

6. Instead of Conclusion

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- Diploma theses were realized within the research activity of the Chair of Satellite Geodesy
- Through diploma theses research activities, the students have acquired additional knowledge and skills
- All three diploma theses and research activities and results were presented on International scientific meetings
- Former student Jelena Gabela (today Mag. Eng. Geod. et Geoinf.) has been awarded the scholarship from the University of Melbourne (Australia) → Doctoral study

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