Using GSM/GPRS Technology For Generation Of Precise Digital Terrain Model (DTM)

Adam Ciećko, Bartłomiej Oszczak, Stanisław Oszczak

www.kgsin.pl

Chair of Satellite Geodesy and Navigation,
University of Warmia and Mazury in Olsztyn, Poland

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Outline

- GSM/GPRS system for data teletransmission
- Static tests of designed system
- Dynamic DTM creation and dynamic tests of the system with centimeter level of accuracy
- Statistical analyses of various GPS techniques
- Precise DTM generation
- Conclusions

GSM/GPRS system for data teletransmission

The project is run and coordinated by the Chair of Satellite Geodesy and Navigation, Warmia and Mazury University in Olsztyn, Poland in cooperation with:

- Biatel S.A. in Bialystok,
- Polkomtel S.A. in Warsaw,
- Maritime Office in Gdynia,
- Naval Academy in Gdynia.

GSM/GPRS system for data teletransmission

Growing need of GPS real-time, precise and reliable applications, where stable and not expensive wireless connection is essential

- Precise navigation
- Land surveying
- Vehicle (fleet) monitoring

Limitations of classical UHF radio-modems

GSM / GPRS

General Packet Radio Service

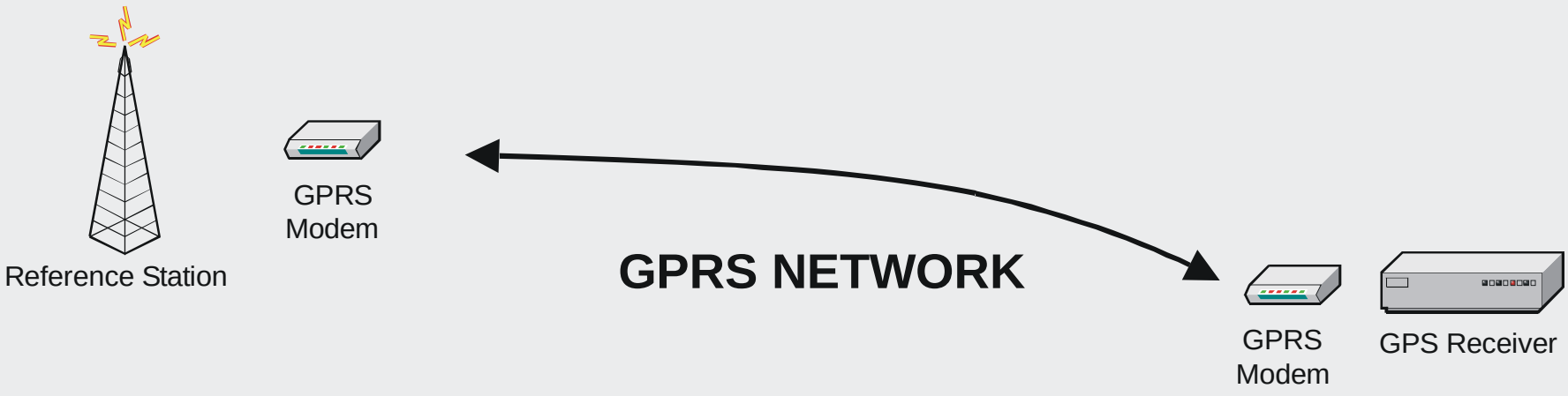
Advantages

- No costs of building a network
- Easy to define costs of using
- Low rates of data teletransmission
- Fast enough speed of transmission
- Rare breakdowns and redundancy (3 operators in Poland)
- Good coverage
- Low cost of the user equipment

GSM/GPRS system for data teletransmission

Phase 1 (P2P connection)

Direct Transmission



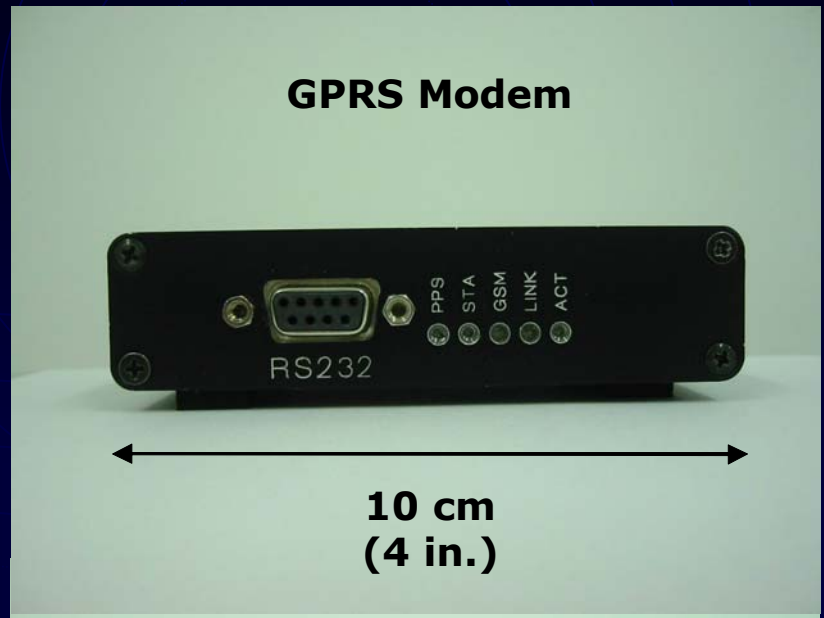
Sending DGPS/RTK corrections via direct transmission

» connection is limited to only two modems

GSM/GPRS system for data teletransmission

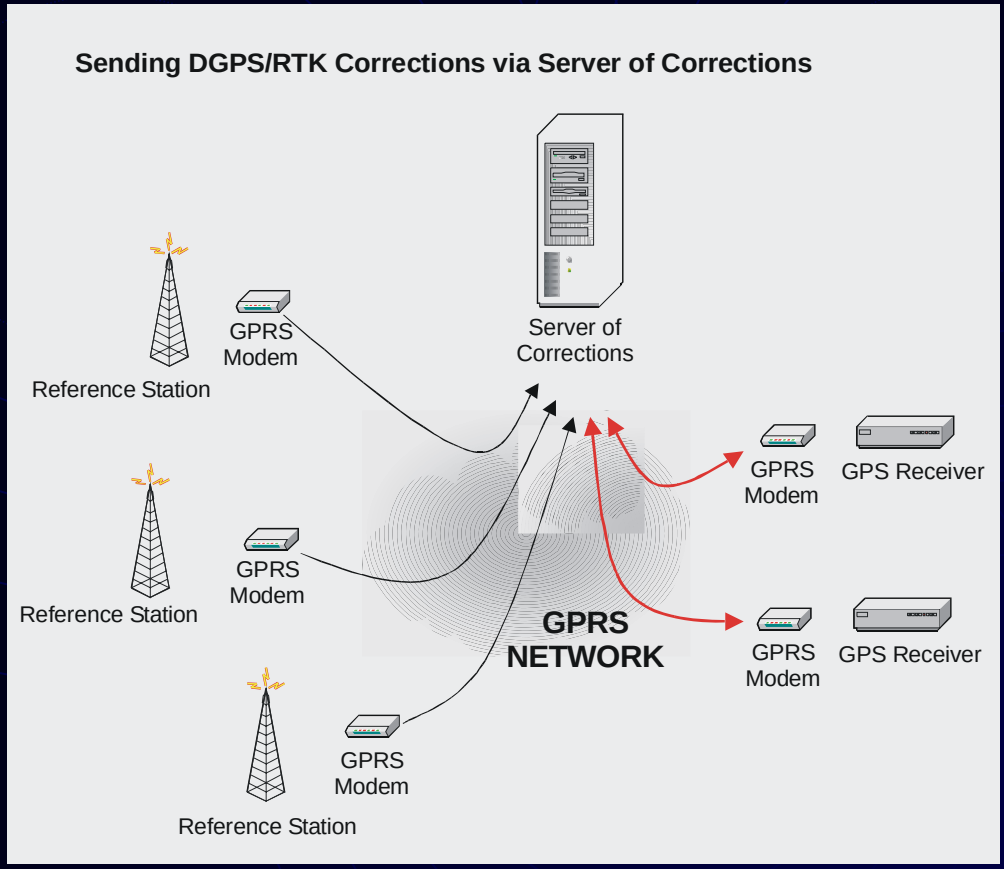
GPRS modem

- special, dedicated to our purposes GPRS modem
- compact in size
- not heavy
- operated by just one switch
- possibility of upgrading the modem's software



GSM/GPRS system for data teletransmission

Phase 2 (server of corrections)



» unlimited number of users

» delays in transmission

GSM/GPRS system for data teletransmission

Phase 3 (IPSEC tunnels) - Initial Operational Capability status

INTERNET

REFERENCE STATION 1

INTERNET

REFERENCE STATION 2

INTERNET

N-REFERENCE STATION

REPLICATOR DGPS/RTK SERVER

TERMINAL GPRS

USER RECEIVER 1

TERMINAL GPRS

N-USER RECEIVER

N - UP TO 65K USERS

» Fixed IP user number

Utilization of the GSM/GPRS system

Monitoring of rally cars – 62 Rally of Poland 2005 – B. Oszczak

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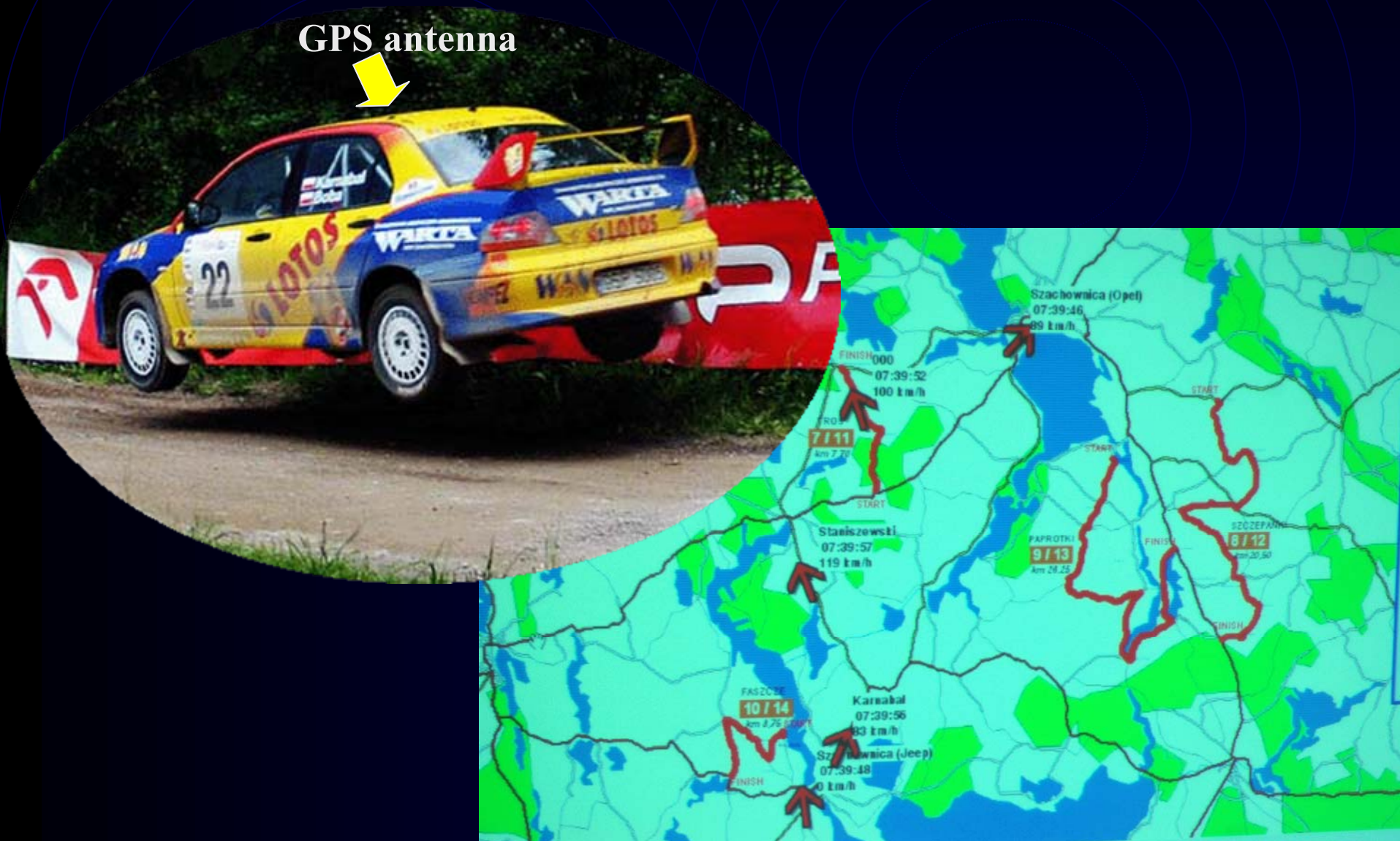
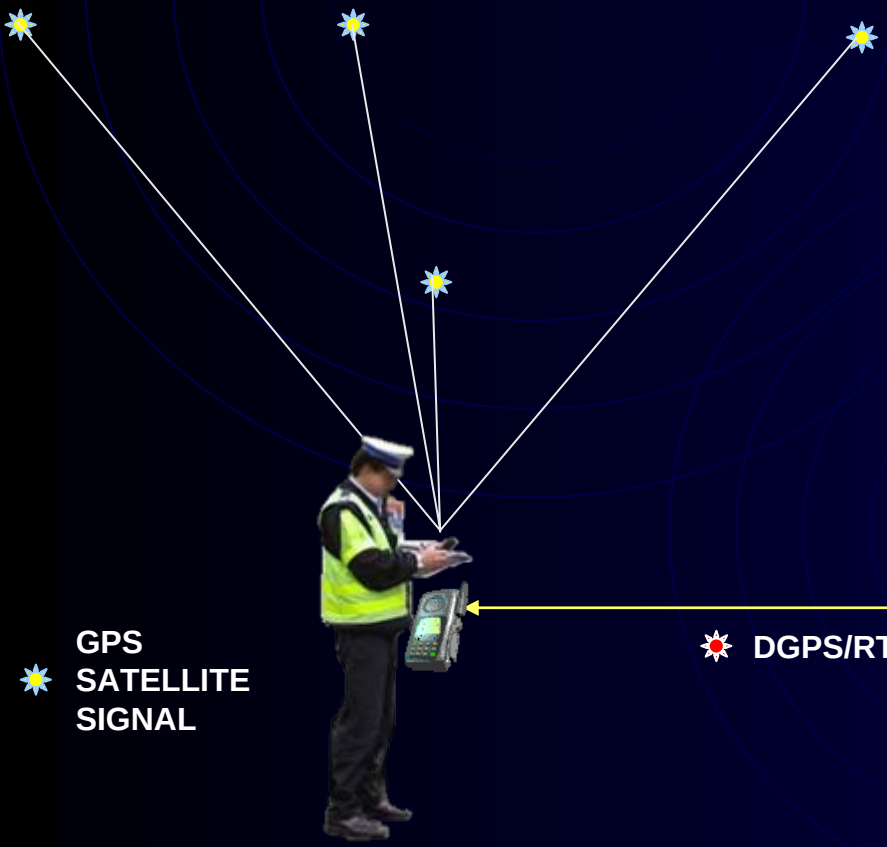


Utilization of the GSM/GPRS system

System of recording road accidents with DGPS/GPRS technique –
– S. Oszczak, T. Templin



REFERENCE STATION

GPS SATELLITE SIGNAL

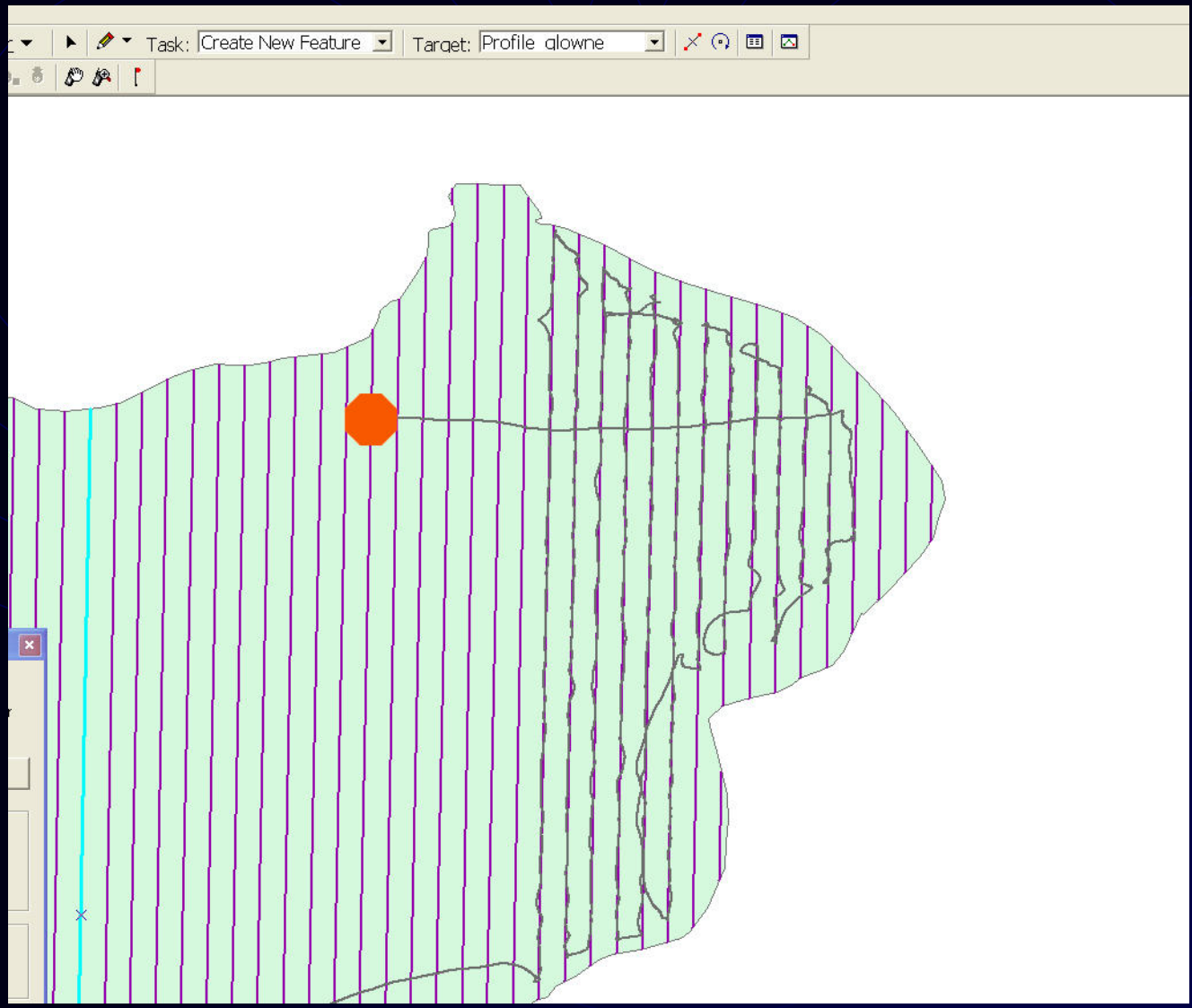
DGPS/RTK CORRECTIONS

Utilization of the GSM/GPRS system

IACS (Integrated Administration Control System) – subsidies for farmers

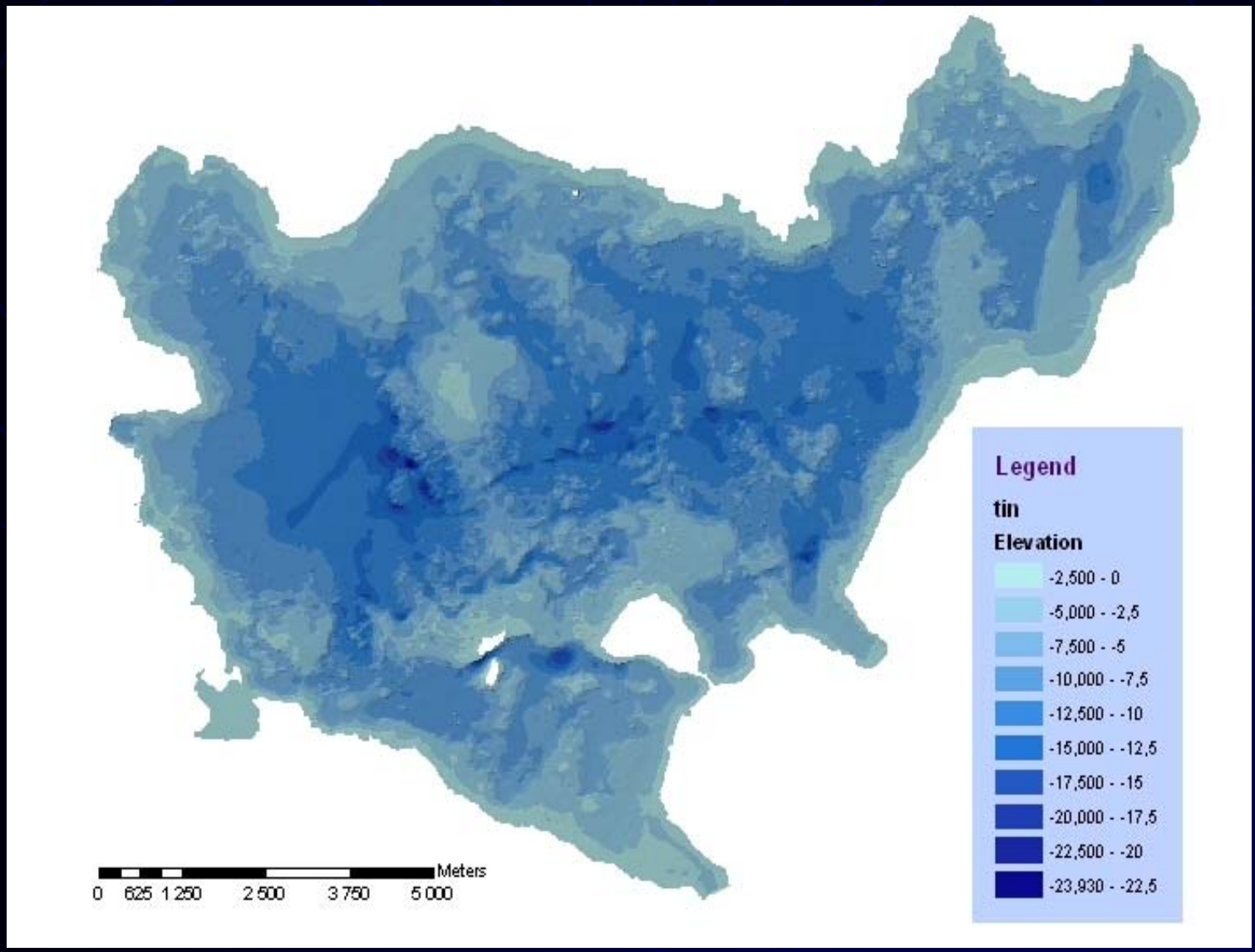
Utilization of the GSM/GPRS system

Navigation for bathymetric survey – D. Popielarczyk

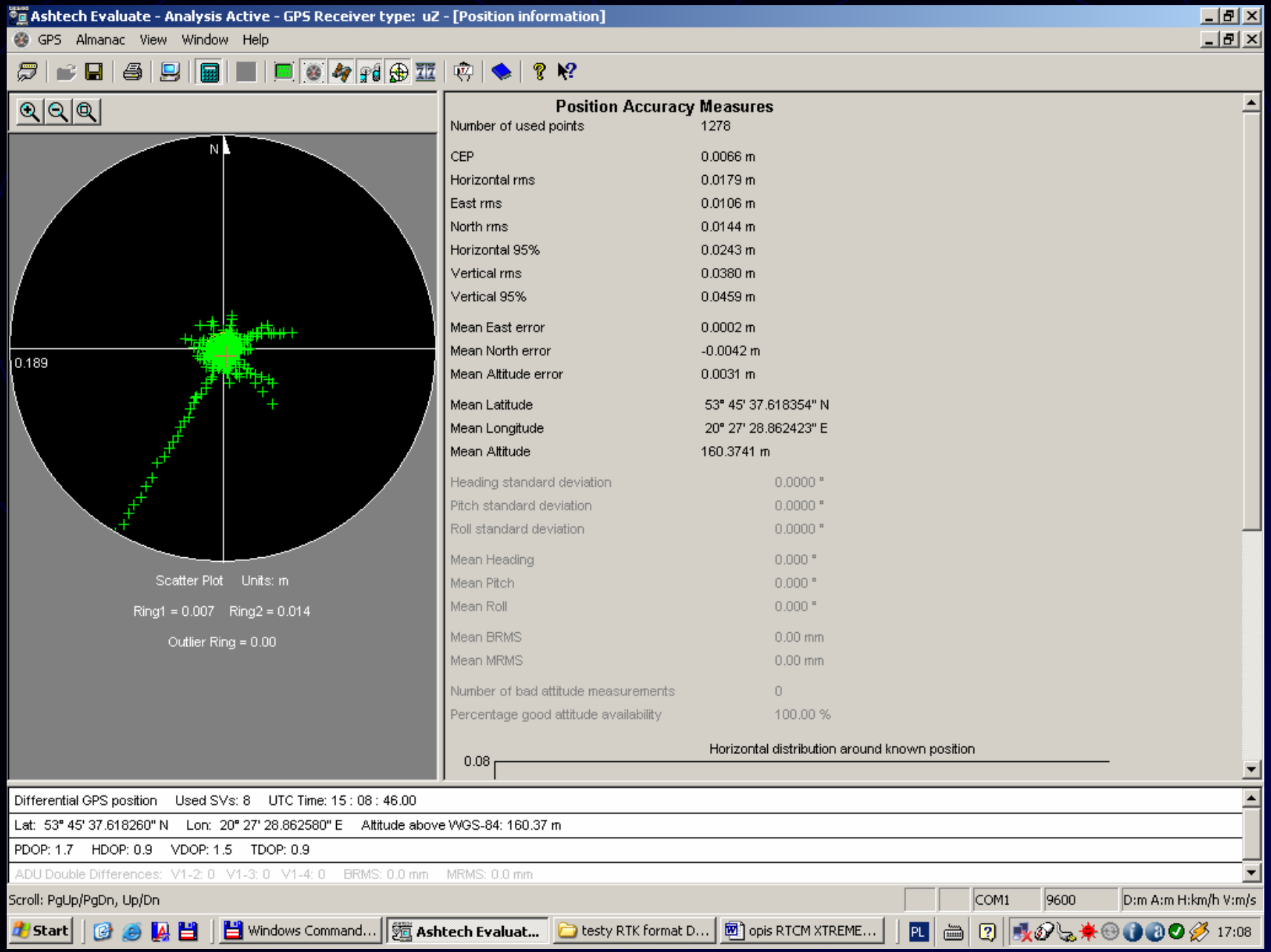


Utilization of the GSM/GPRS system

DTM creation of Sniardwy Lake – D. Popielarczyk



Static tests of RTK/GSM/GPRS teletransmission the system



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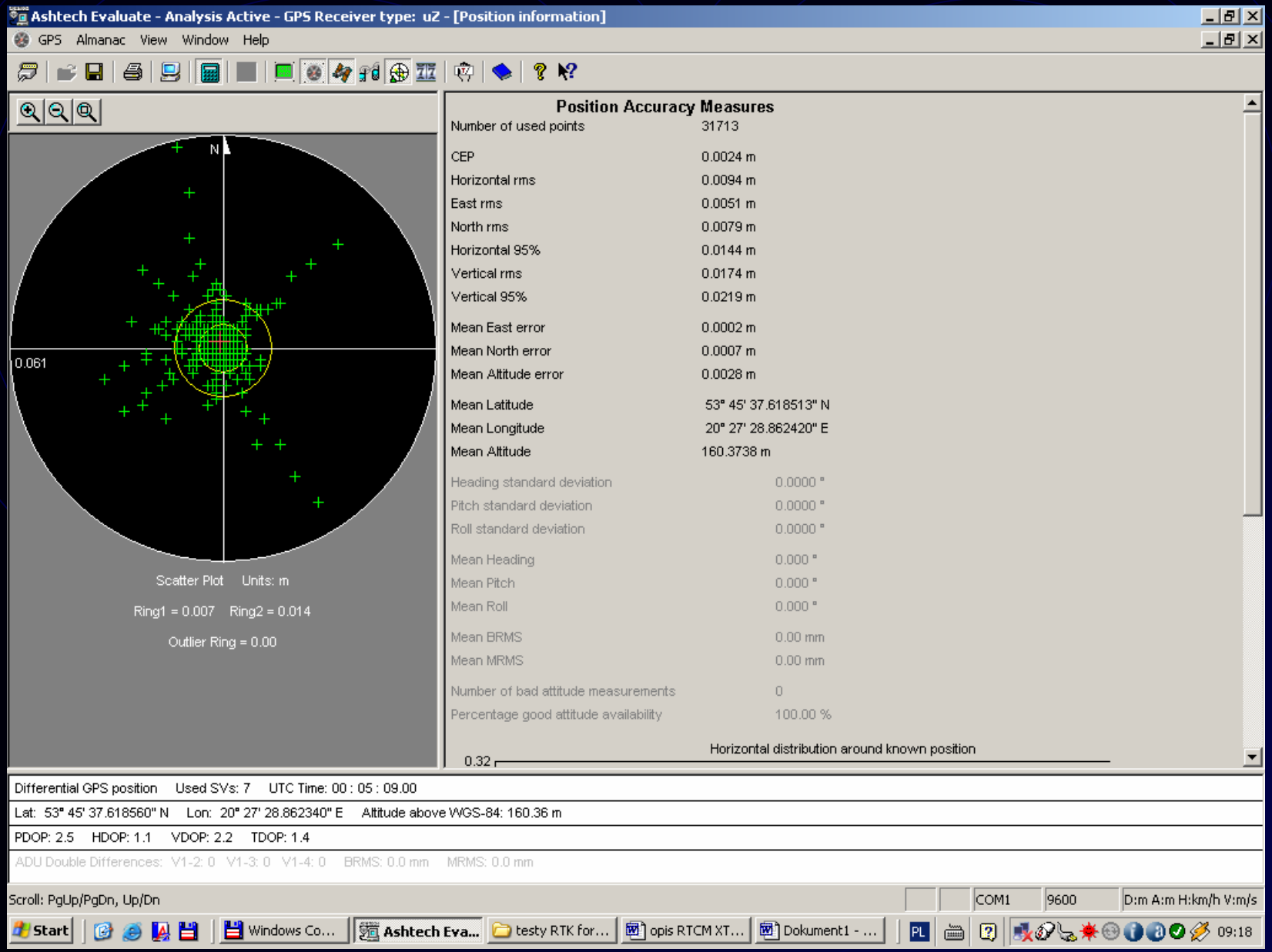
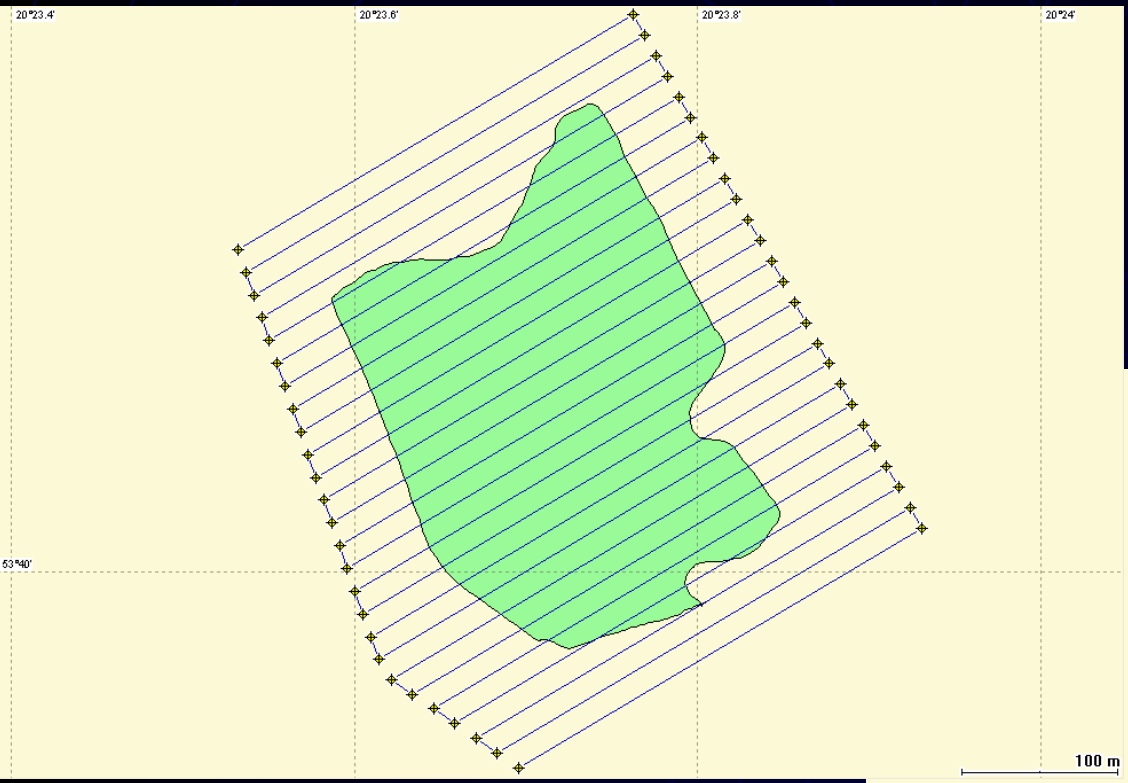
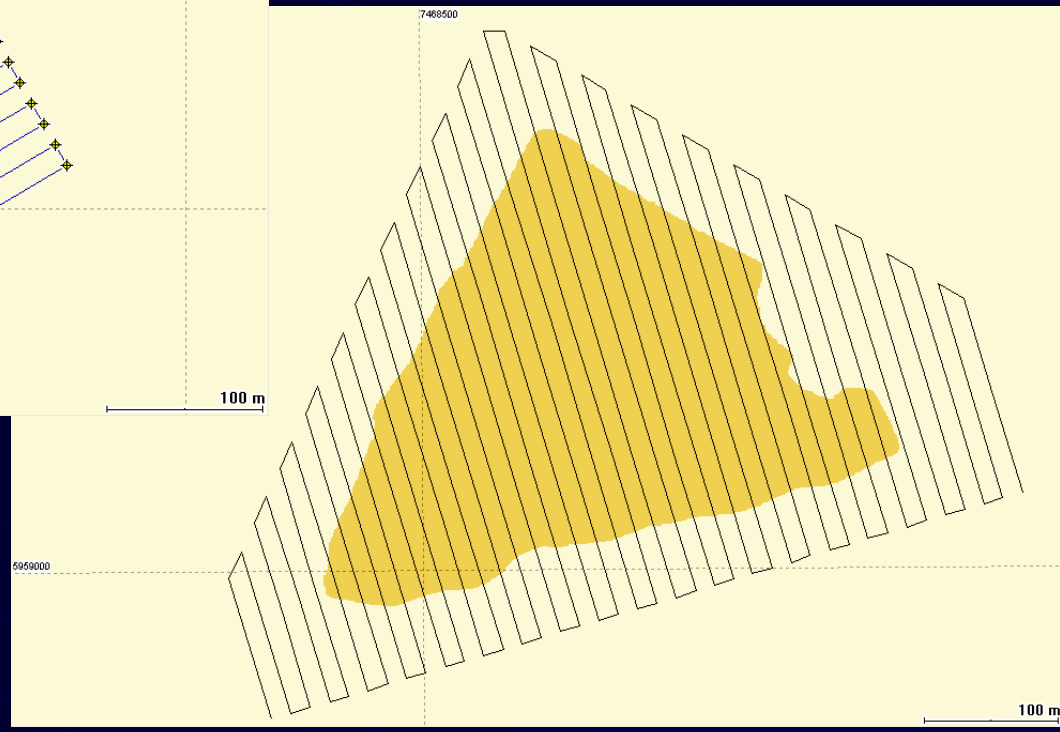


Dynamic DTM creation

Design of the profiles





Dynamic DTM creation

Measurement of the profiles

Dynamic DTM creation

Vehicle taking part in the measurements

Dynamic DTM creation

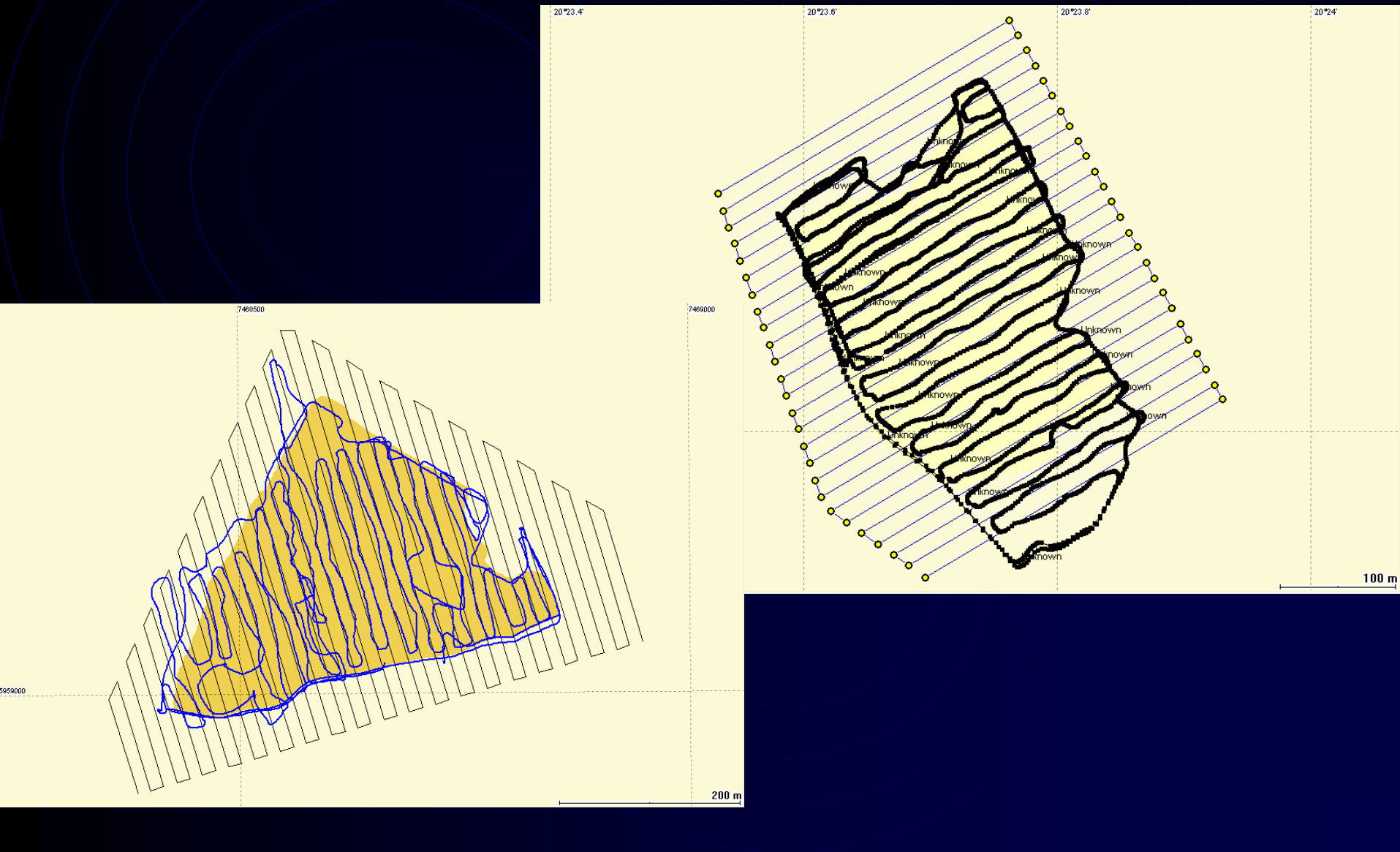
Equipment taking part in the measurements

Dynamic DTM creation

Real time navigation along measurement profiles

Dynamic DTM creation

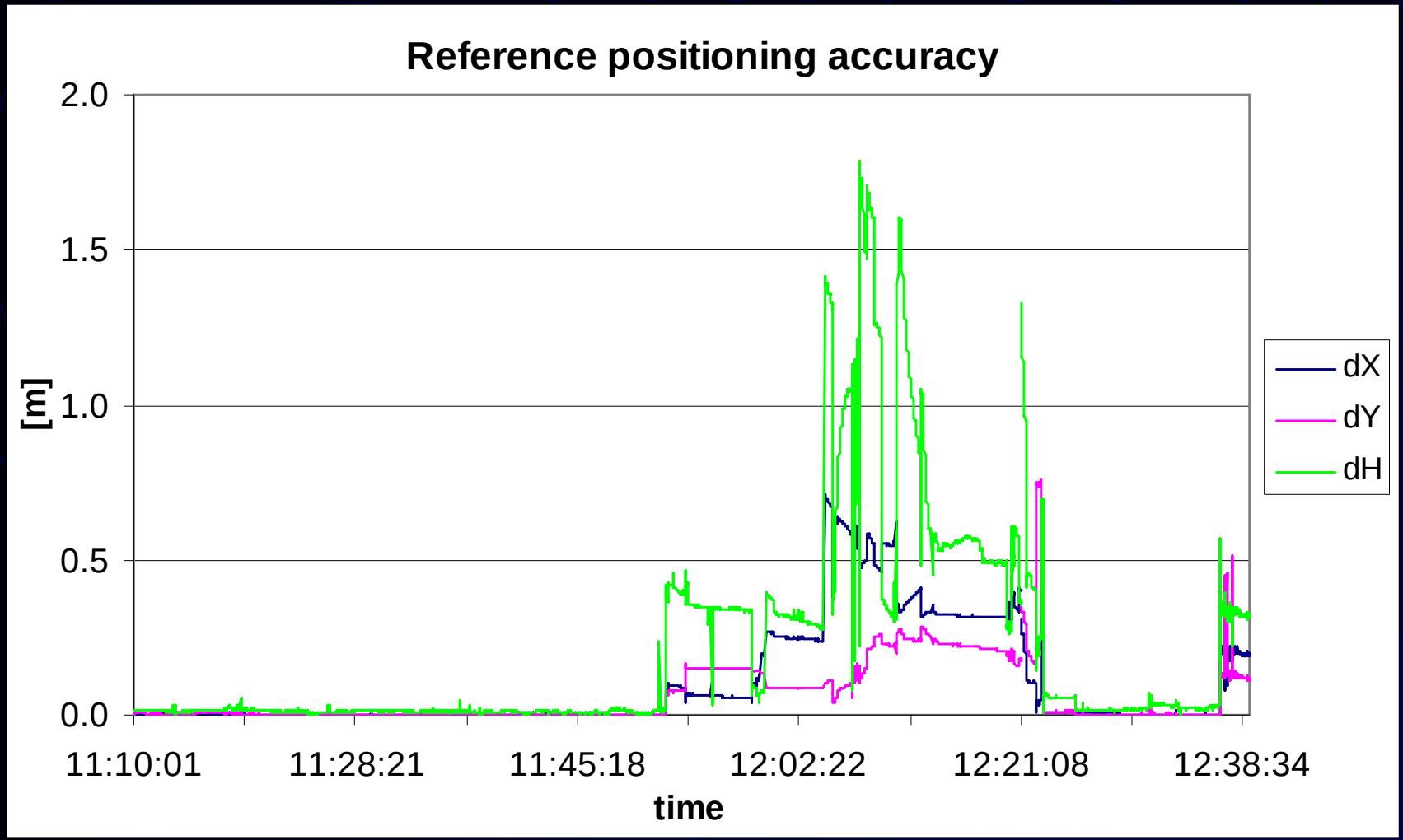
Designed profiles and actual track of the vehicle



Dynamic DTM creation

Measurement of the profiles

Statistical analyses of various GPS techniques



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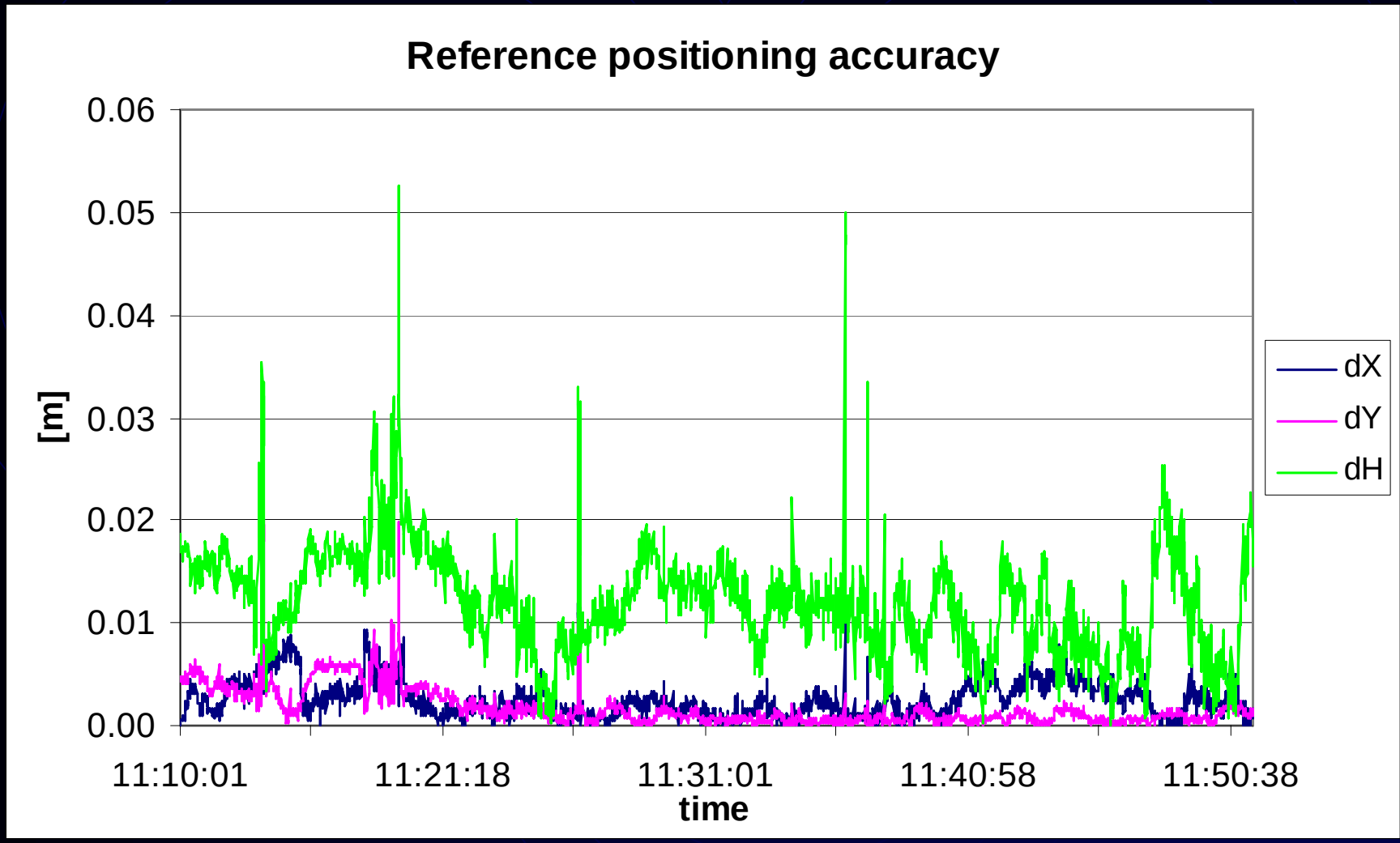

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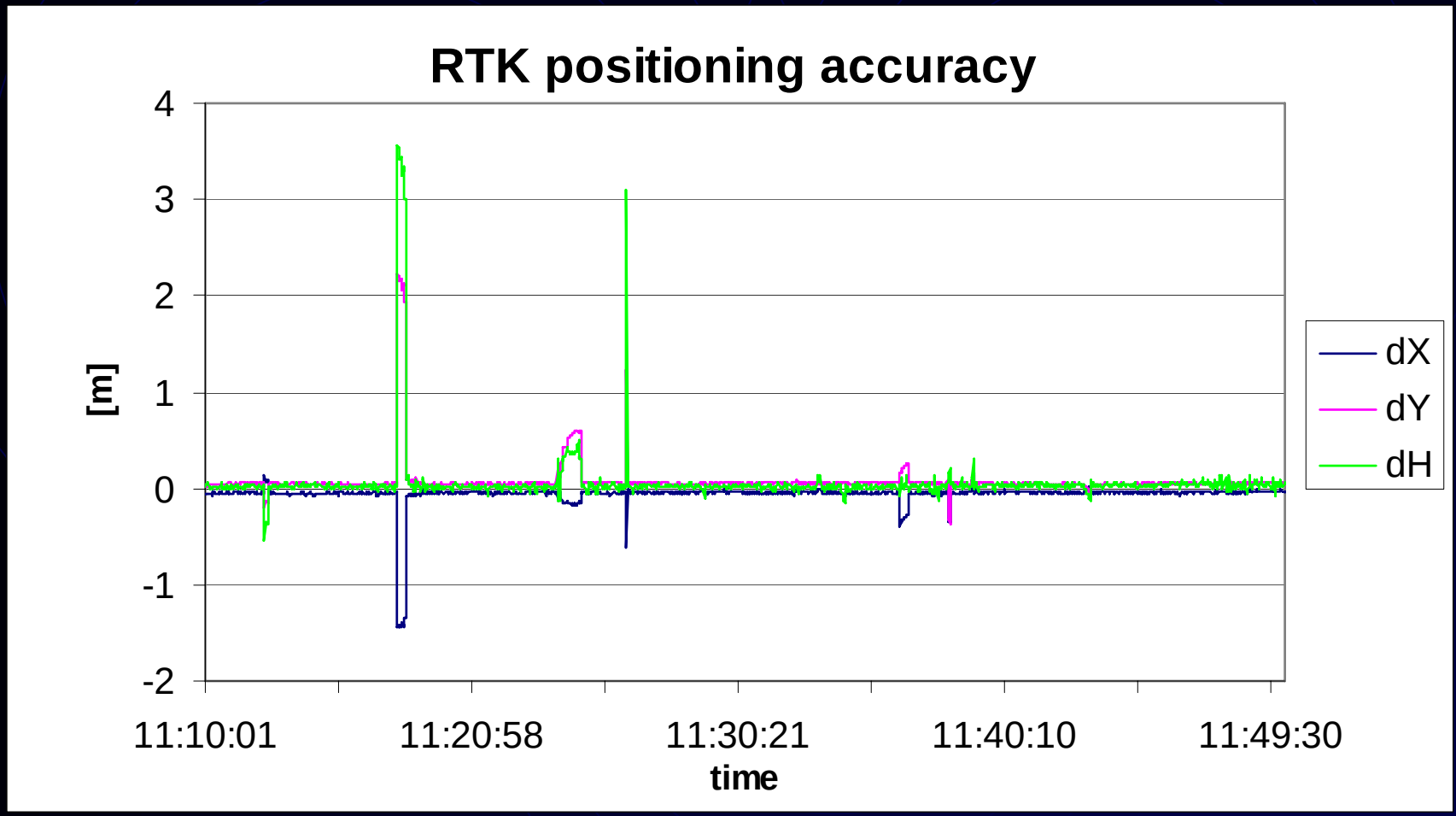

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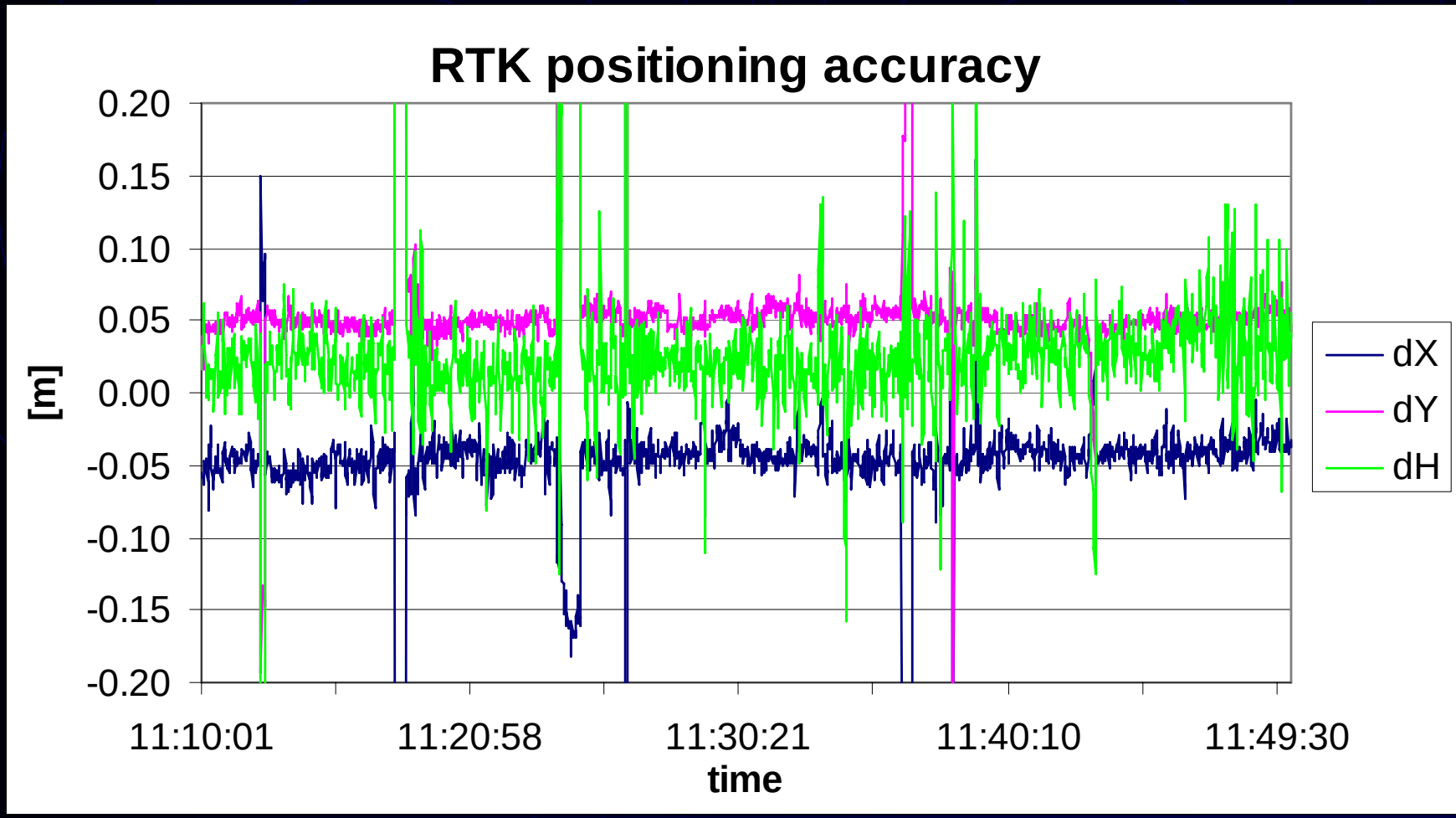

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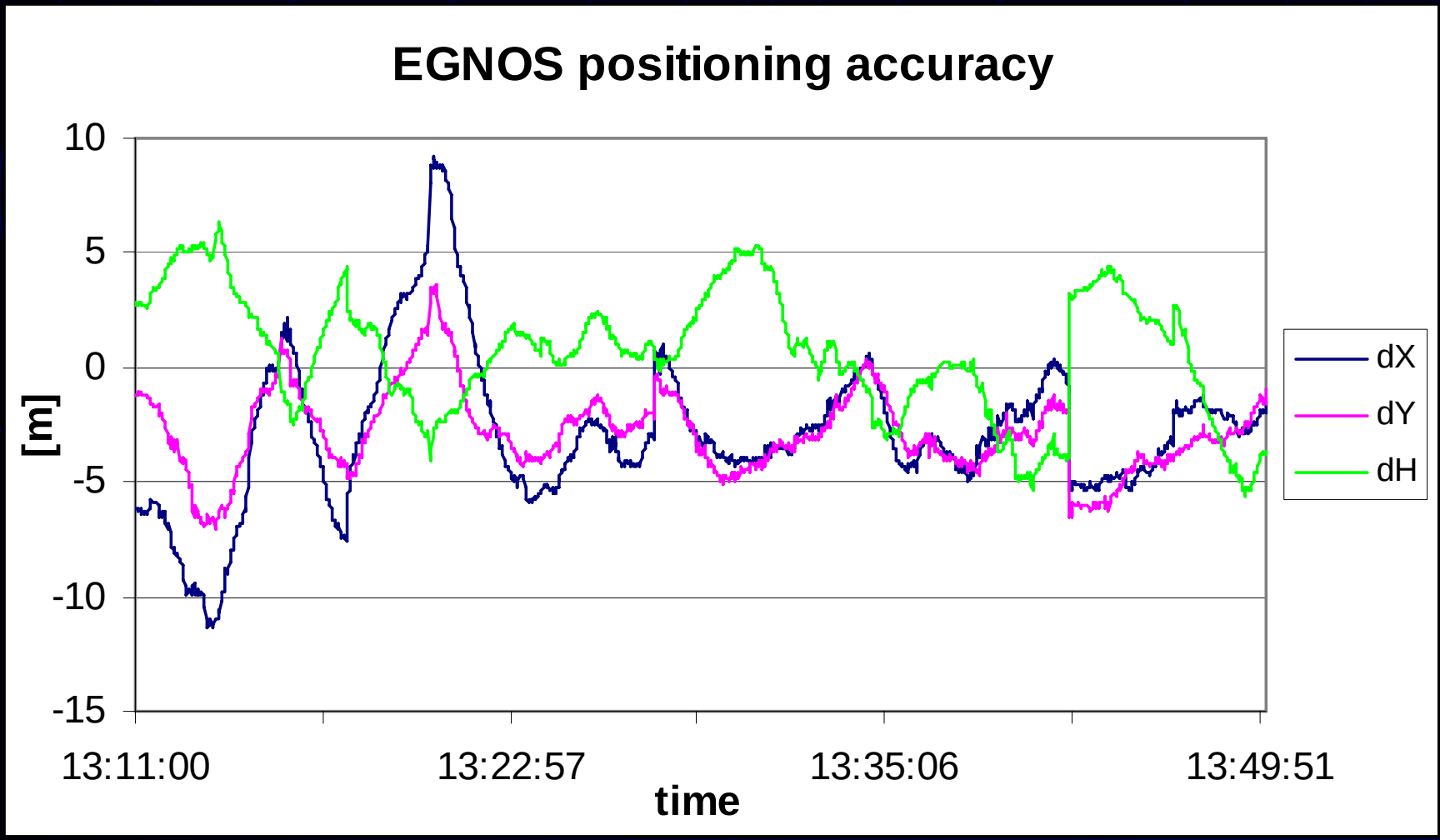

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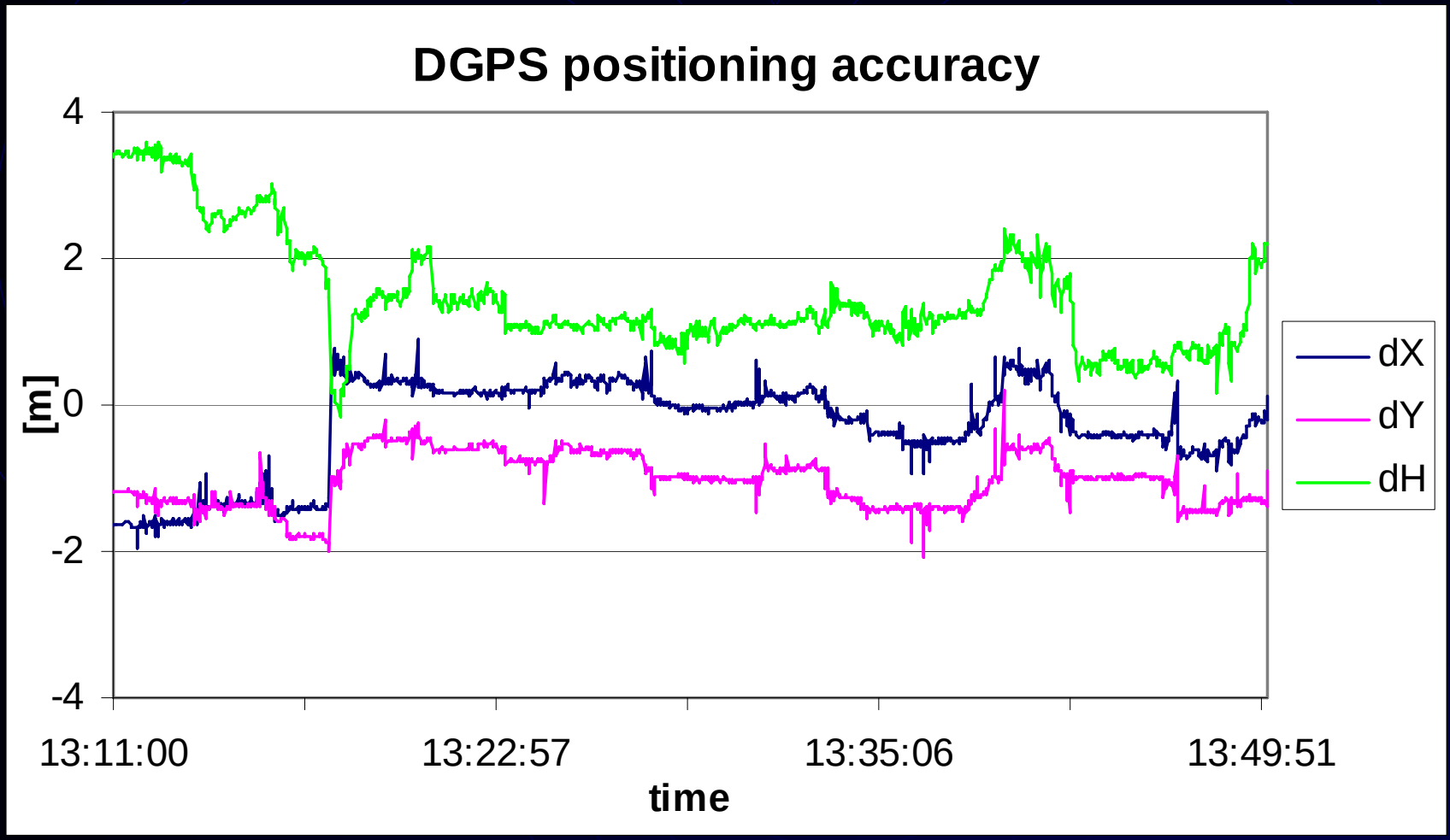
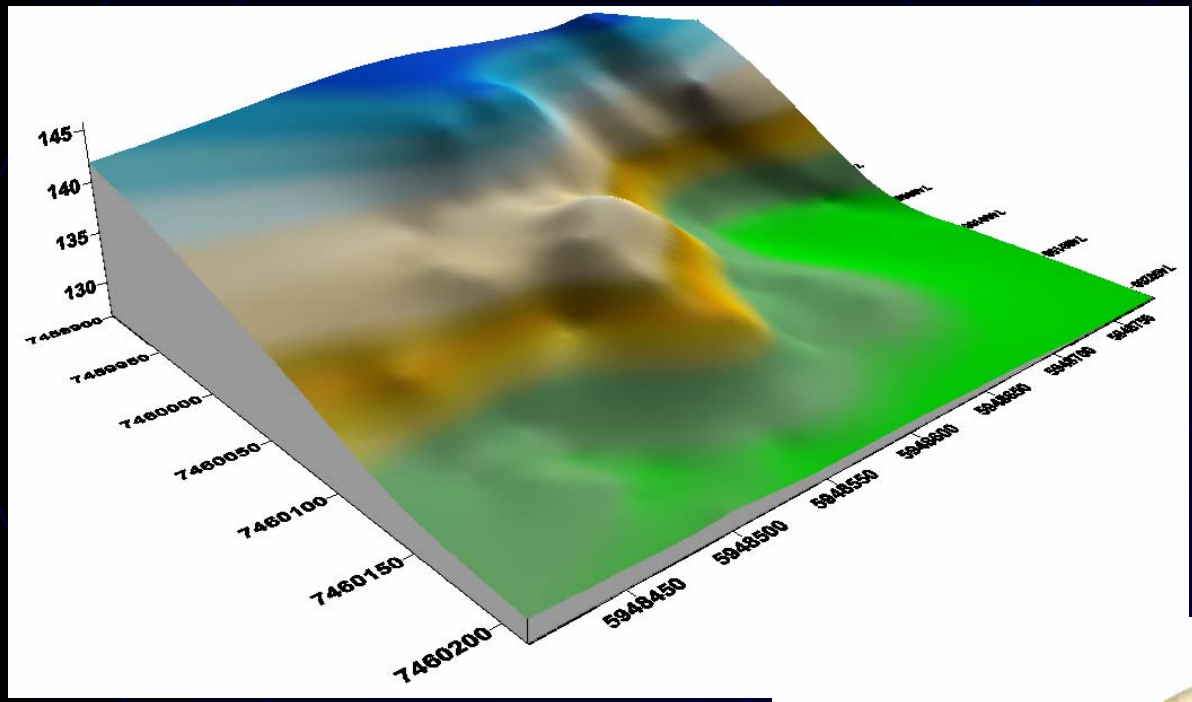
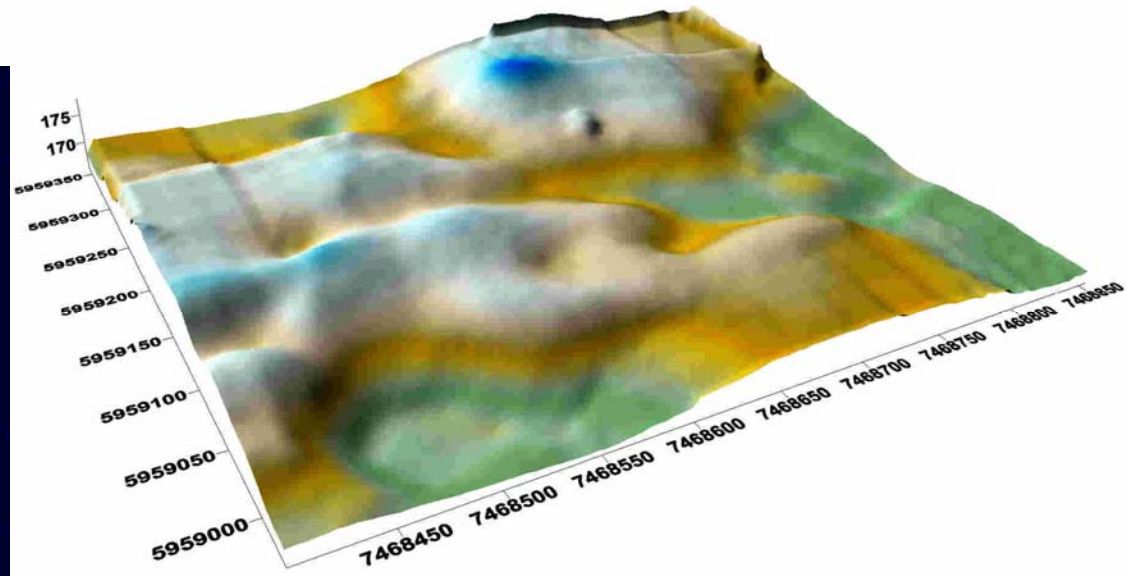
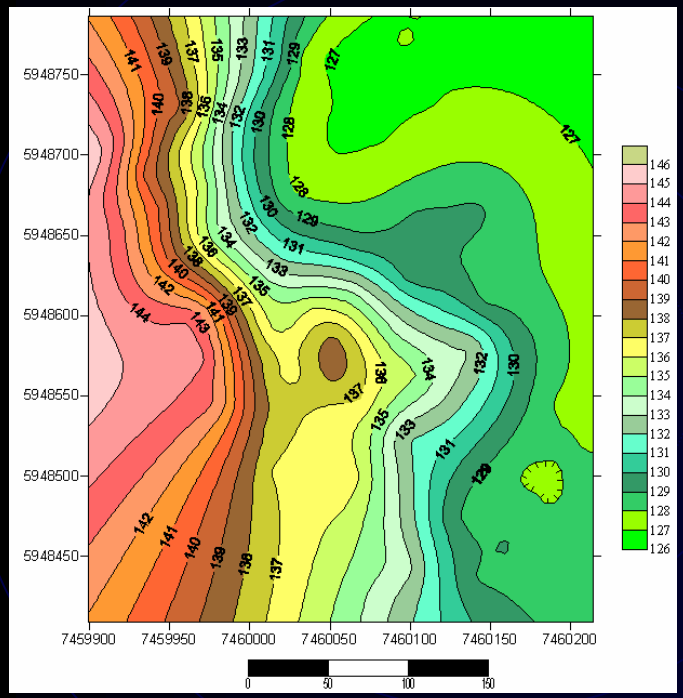


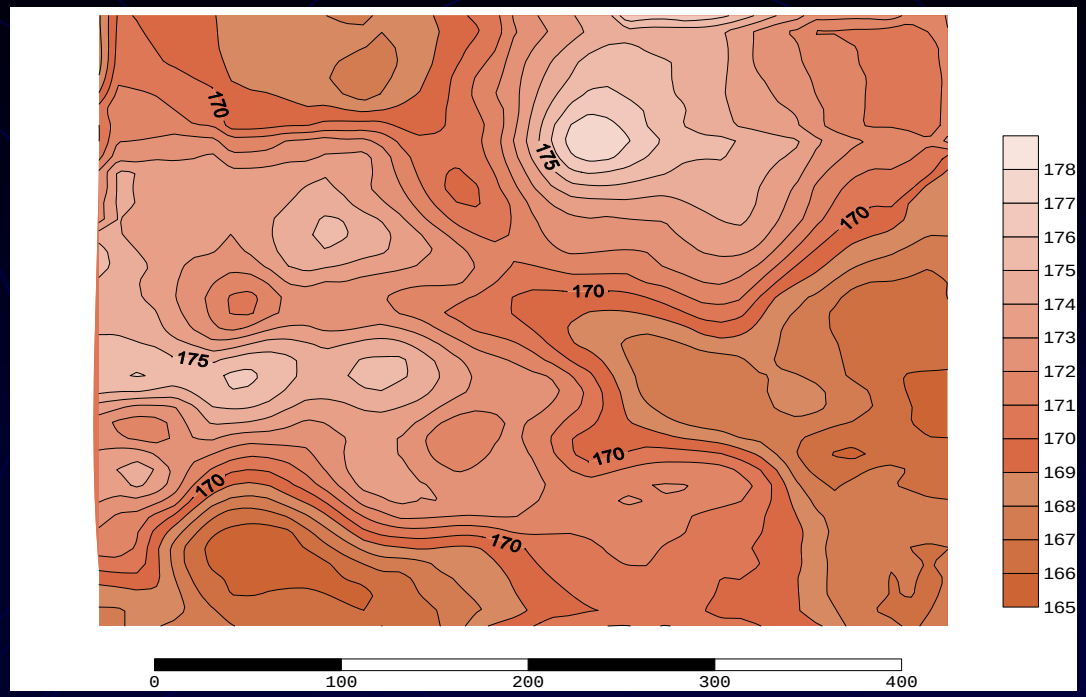
Generation of DTM

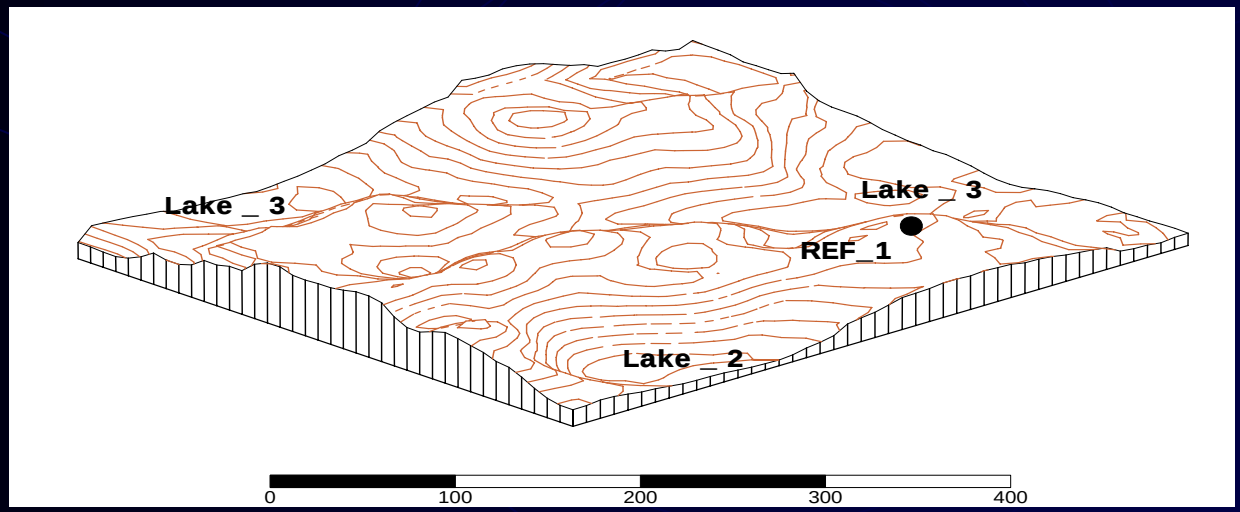




Generation of DTM







Conclusions

- Possibility of receiving of DGPS/RTK data by n-users from freely chosen reference station.
- Corrections can be received at any place of Polish territory with the GSM coverage.
- Distribution of corrections is possible using freely chosen any GSM operator in Poland.
- The system is open to any further updates, improvements and modifications.

Conclusions

The cost of using GSM/GPRS system is quite reasonable:

- 1 hour of DGPS corrections receiving (with 2 sec. interval) is around 0.06 €
- 1 hour of RTK corrections receiving (with 2 sec. interval) is around 0.30 €

Conclusions

- Very efficient and cost-effective generation of DTM (5 ha = 90 min) with centimeter level of accuracy.
- Using ATV allows driving in any kind of terrain quickly and effectively.
- The whole process concerning preparation phase and actual measurement phase can be done by just one person.

Thank you for your attention

www.kgsin.pl

e-mail: adam.ciecko@uwm.edu.pl