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GNSS signal interference detection in LatPos base stations

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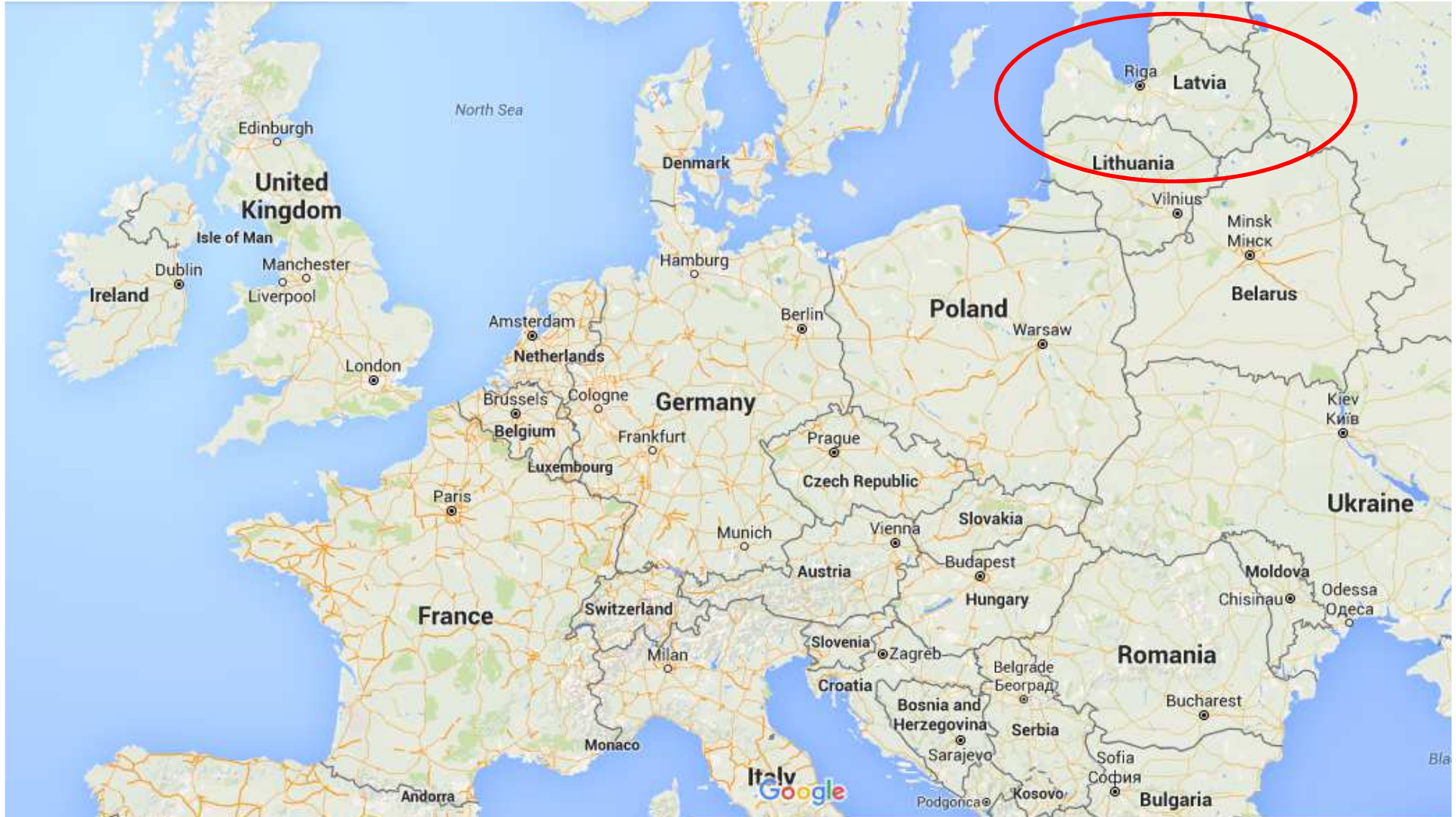
Presentation outline

- Where and what is in Latvia
- Problems arise by GNSS signal jamming
- How to detect jammed regions
- Minimizing jamming affected region
- Help users to not collect bad data
- How to prevent GNSS signal jamming
- Conclusions



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Latvia
64 000 km²
2 mio population





Permanent base station system LatPos 25 stations Established 2005 GPS – GLONASS – GALILEO





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What can cause GNSS Signal Jamming in point of view of service provider

Can create interference and position error up to 200 meters
Or not fix solution at all
(Research of Finnish Geodetic Institute in 2012.)

It can cause:

- error – could not be detected in field... only in office
- no position fix – bad measurements will not be done

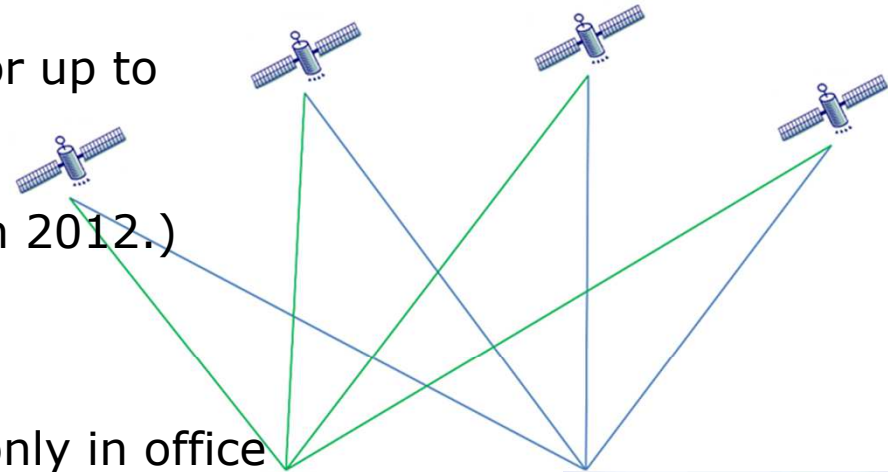
- agriculture – wrong track – pilot can correct manually

- surveying – not in field – control points – cadaster-topo maps

- forestry – not be detected – only in office – wrong fields or detection

- in fields field area detection – wrong money for European Support for agriculture

- Coordinate system EUREF – EPN, IGS services



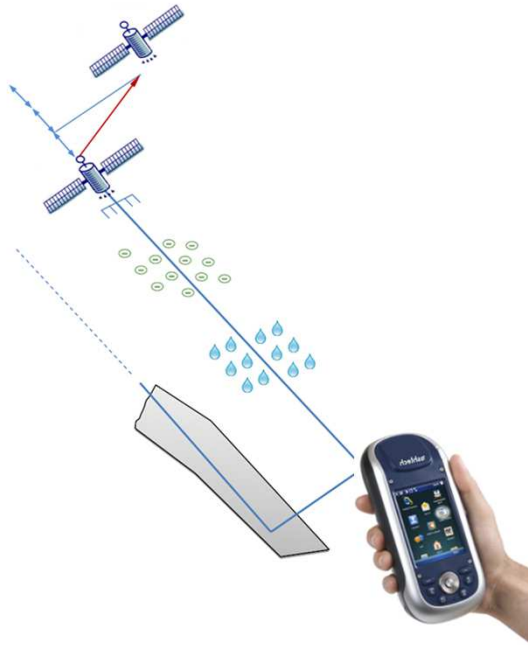
Centimeter solution



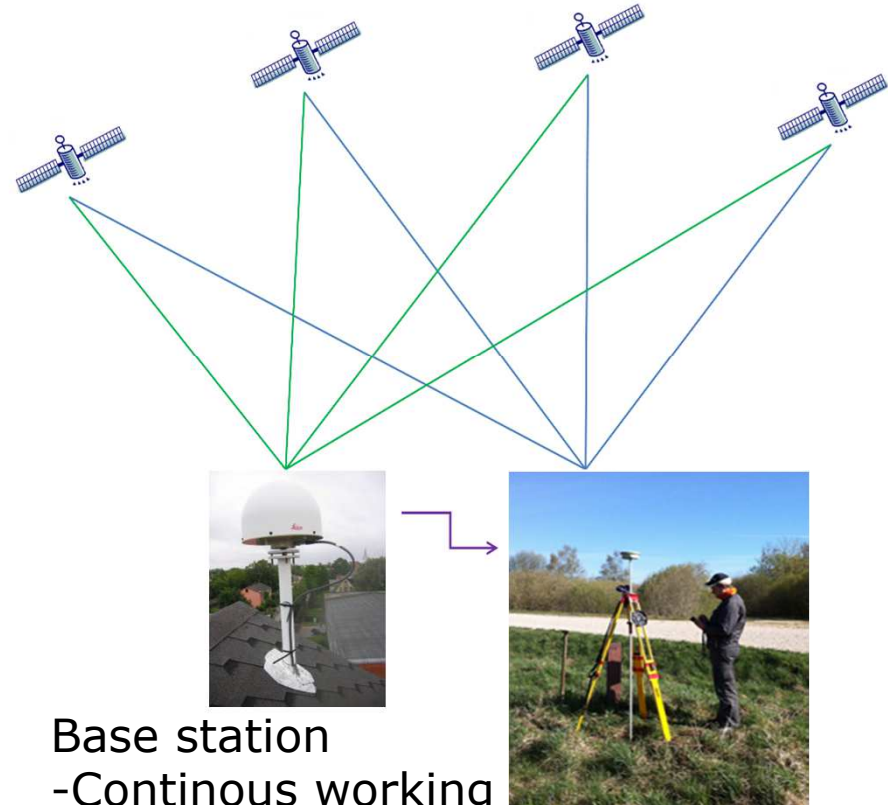


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Detection of Signal Jamming



Single positioning **3m – 10m**
Cannot not be detected
Unless coordinates very far away



Base station
-Continuous working
-Fixed coordinates

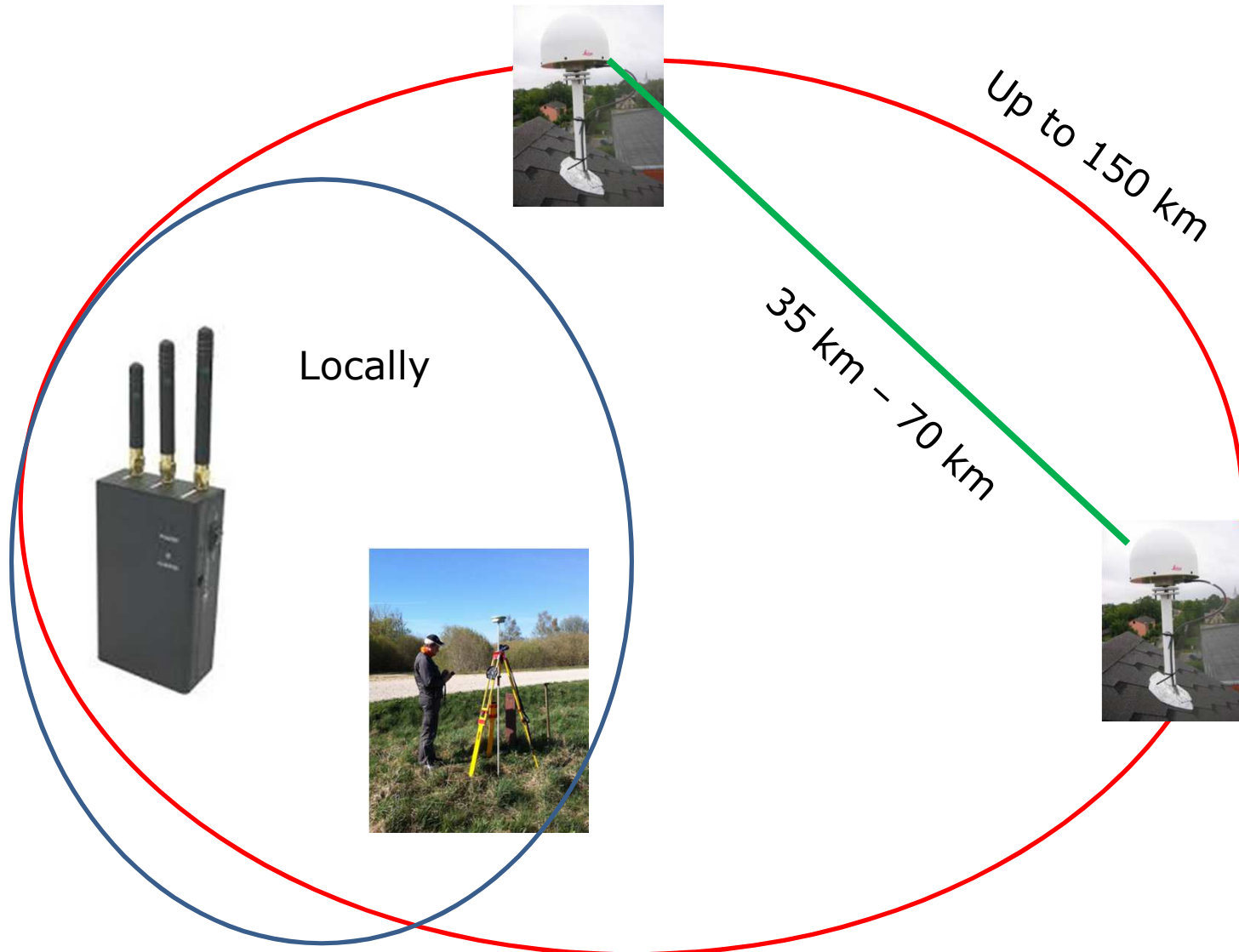
Precise positioning **2cm**

Error can be detected in base stations
Online coordinate control



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Jammer influence radius Detection in permanent base stations





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Detection in permanent base stations

- Uninterrupted data flow
- Data link down
- Receiver do not have FIX solution
- Each Satellite signal strength

Minus - Cannot detect wrong data

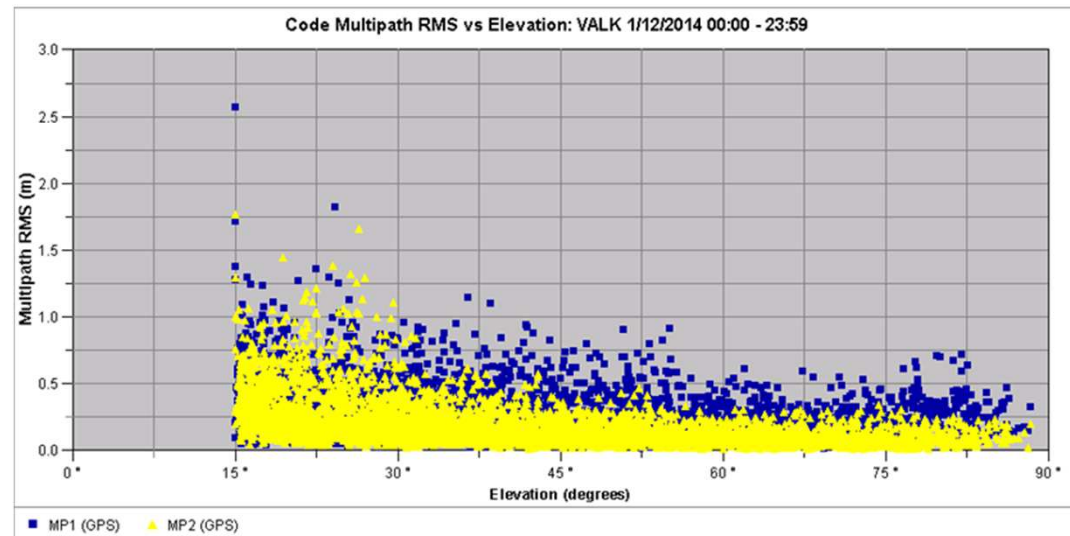
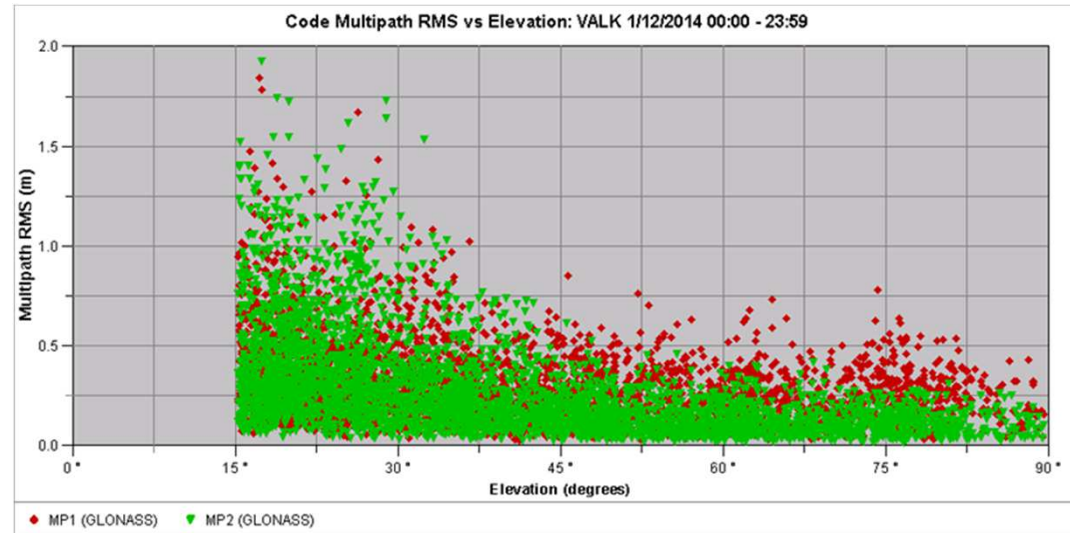
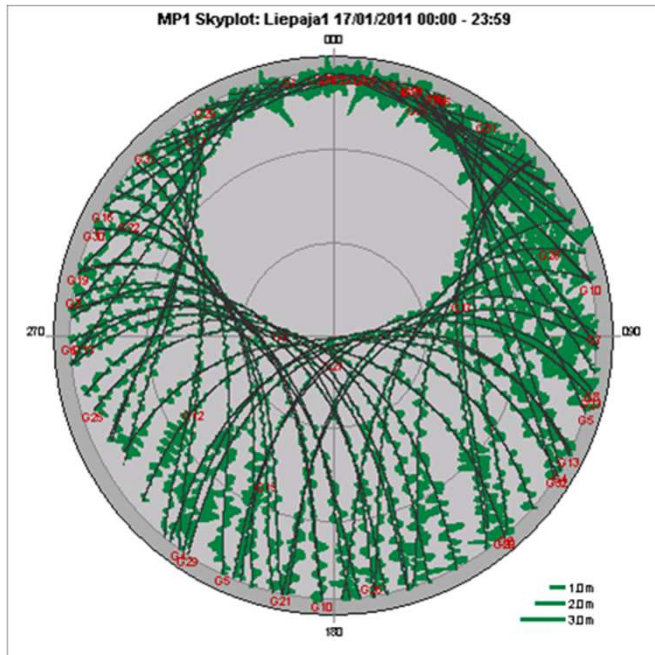




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Detection in permanent base stations

- Signal analysis – multipath
- Can be near real time analysis

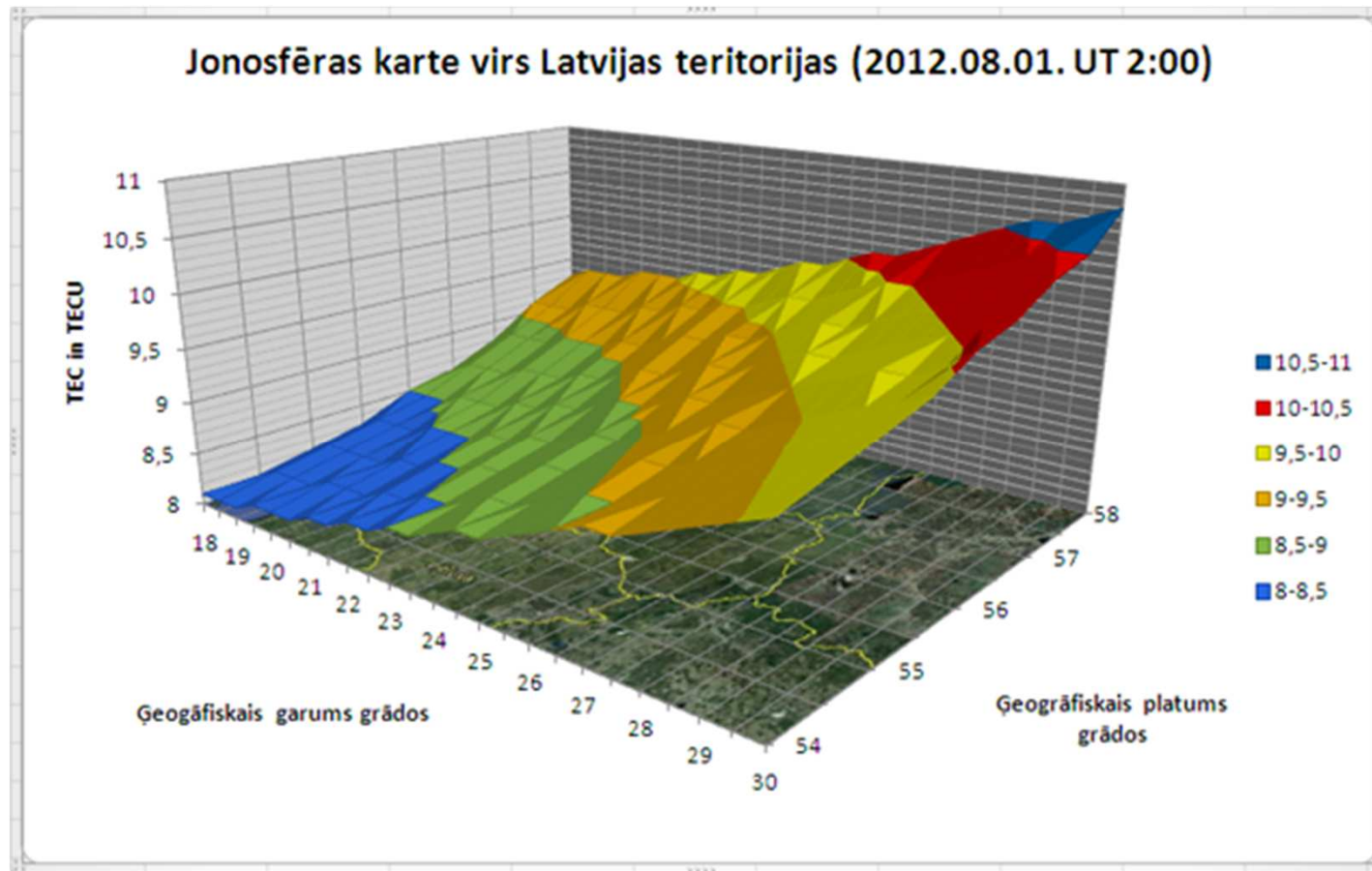




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Detection in permanent base stations

- Signal analysis – ionosphere map calculations

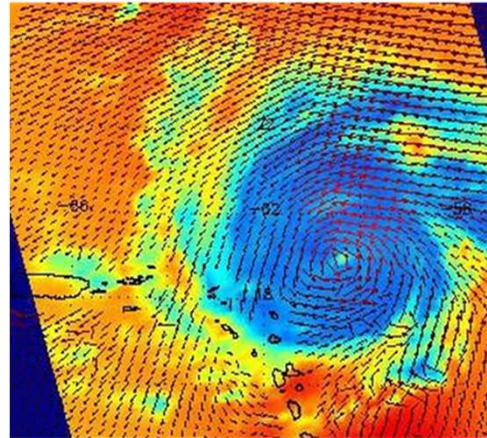




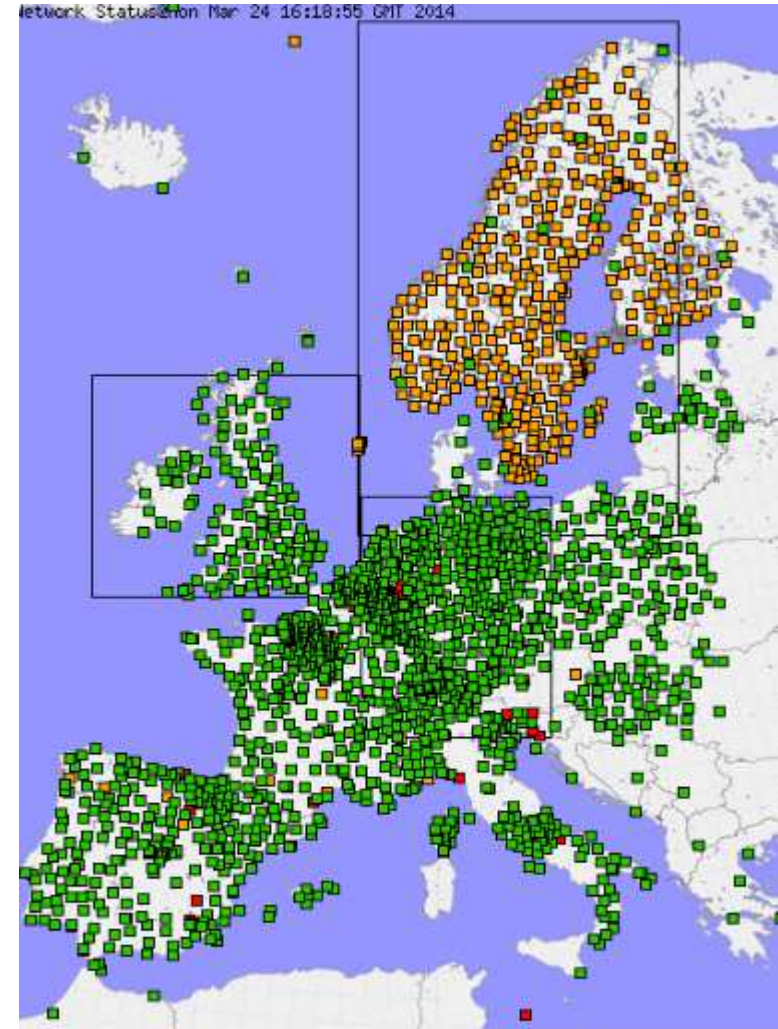
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Detection in permanent base stations

- Signal analysis – Water vapour



ES1206: Advanced GNSS tropospheric products for monitoring severe weather and climate
Start date: 17/05/2013
End date: 16/05/2017

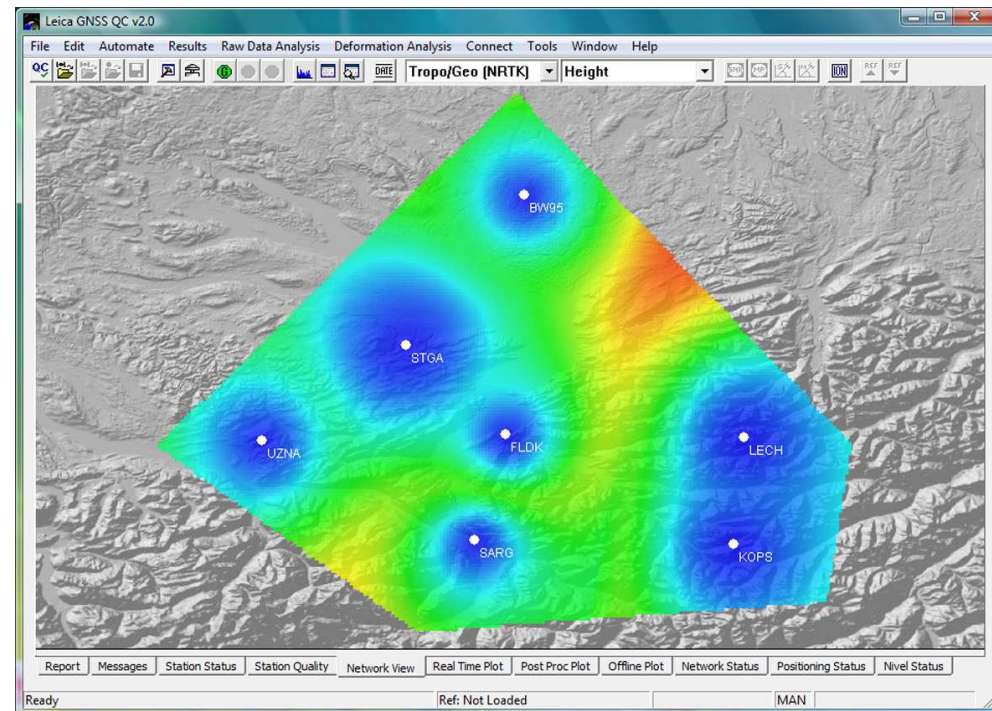




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Detection in permanent base stations

- Commercial solutions – NOVA MAPS
- Leica Spider Quality Control





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Detection in permanent base stations

- Commercial solution
- base station stability monitoring Leica Quality Control software



Leica
Geosystems



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User position error detection

Users with defined region;

For all users - define Latvia as region

Result: user cannot get FIX position – no measurements allowed





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Actions to take to prevent wrong position

- Disable exact base station
- Inform users in field - changing
- Check Post processing data
- Inform international services on possible error in data – EPN, IGS





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Conclusions

- GNSS data monitoring
- Disabling bad data distributing
- Informing Users
- Legislation should be more specific to GNSS data integrity



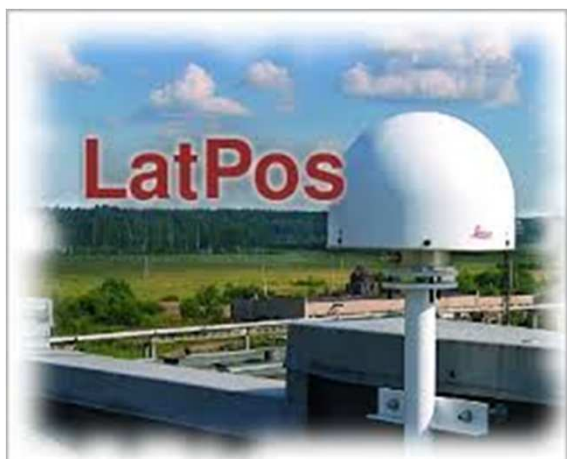
Inside GNSS



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References

1. Effects of GNSS Jammers and potential mitigation approaches Dr. H.Kuusniemi, Finnish Geodetic Institute, 2012;
2. GNSS Interference detection and Mitigation for UAV navigation, Loctronix Corporation, 2014;
3. COST project ES1206: Advanced GNSS tropospheric products for monitoring severe weather and climate
4. WWW.leica-geosystems.com;



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Questions?



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