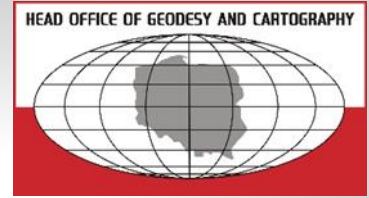


# Analysis of interferences in ASG-EUPOS

**Szymon Wajda**  
Prime specialist  
Geodesy and Reference Frames Division

9th EUPOS Council and Technical meeting, Riga, 22-23 November 2023

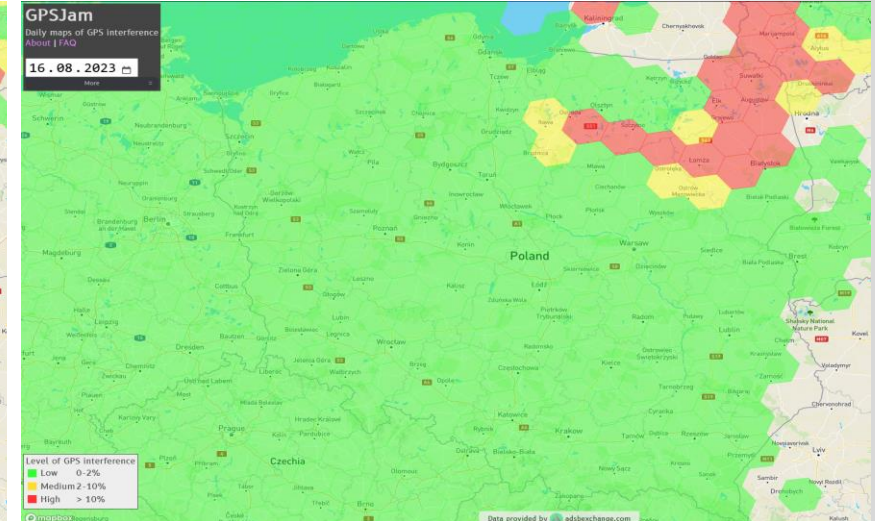
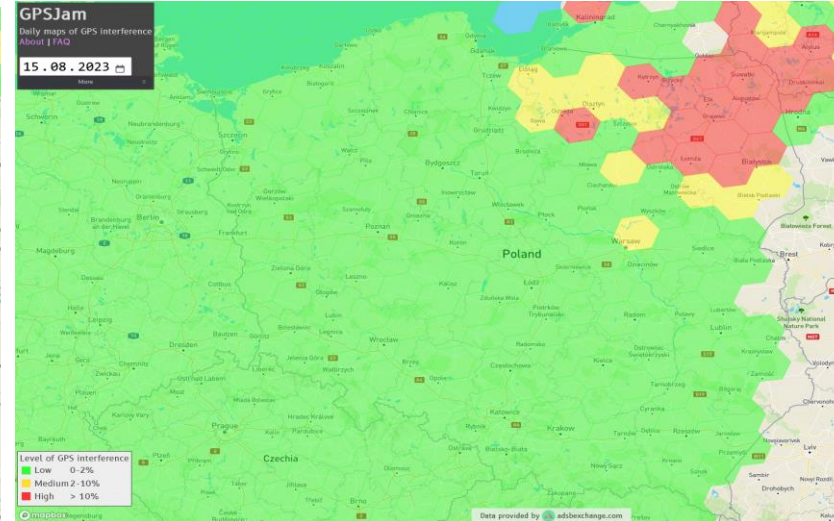
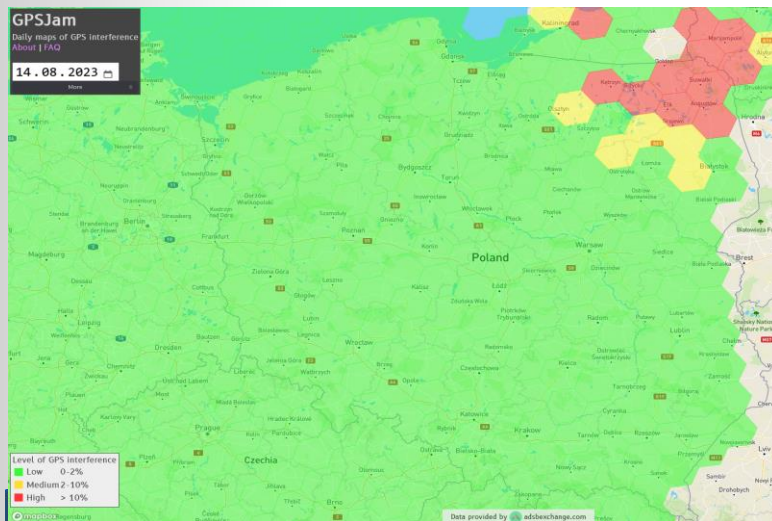
# Source of information



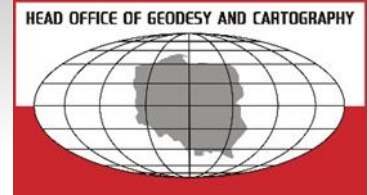
## Message from Polish Air Navigation Services Agency



Analysis at <https://gpsjam.org> where daily maps of GPS interferences are presented



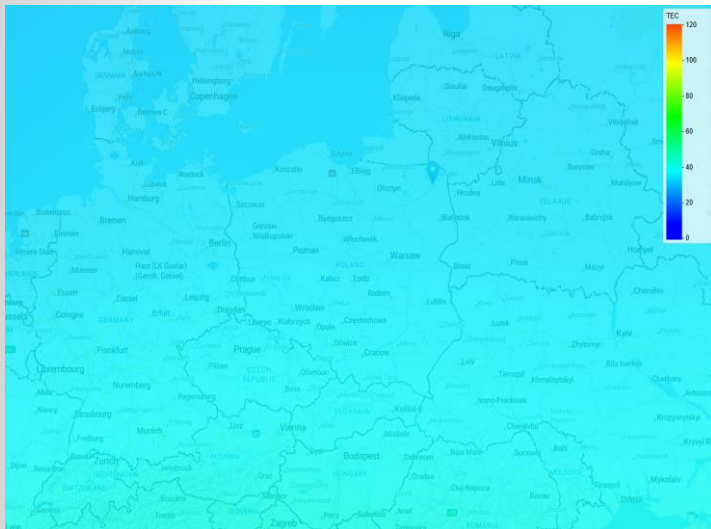
# Space weather conditions



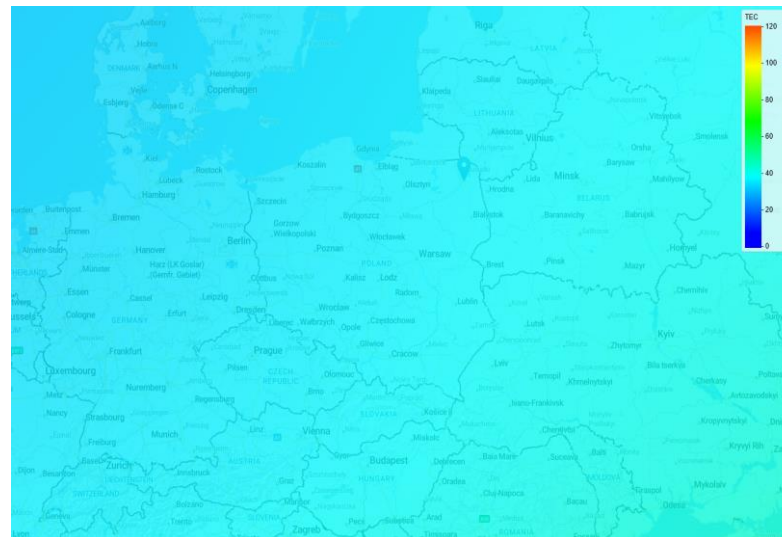
Total Electron Content (TEC) values from

<http://www.gnssplanning.com>

14.08.2023



15.08.2023

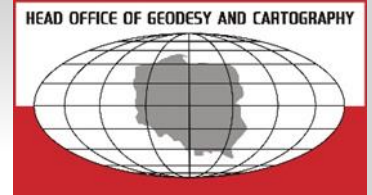


16.08.2023

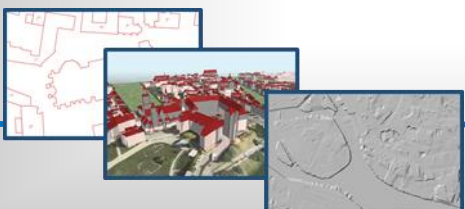
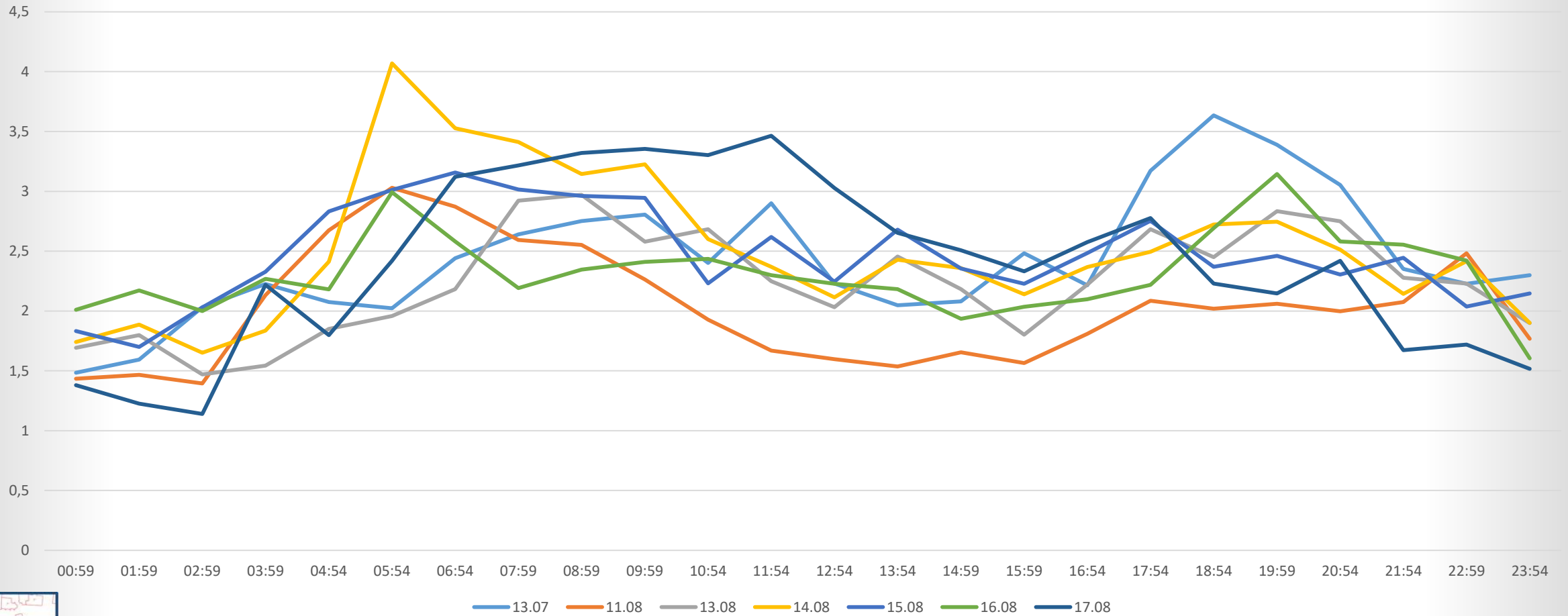




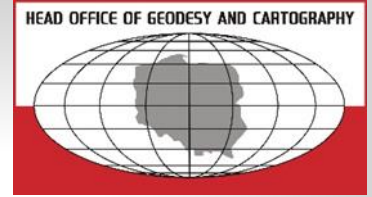
# Space weather conditions



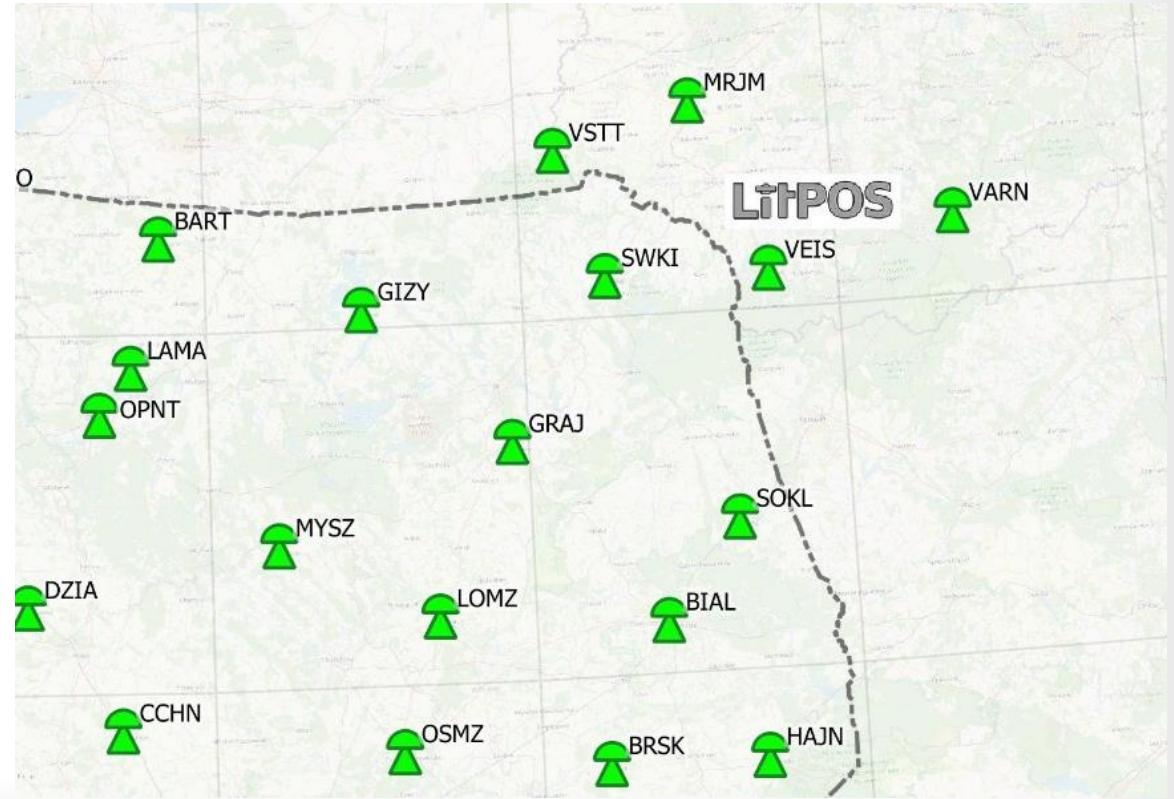
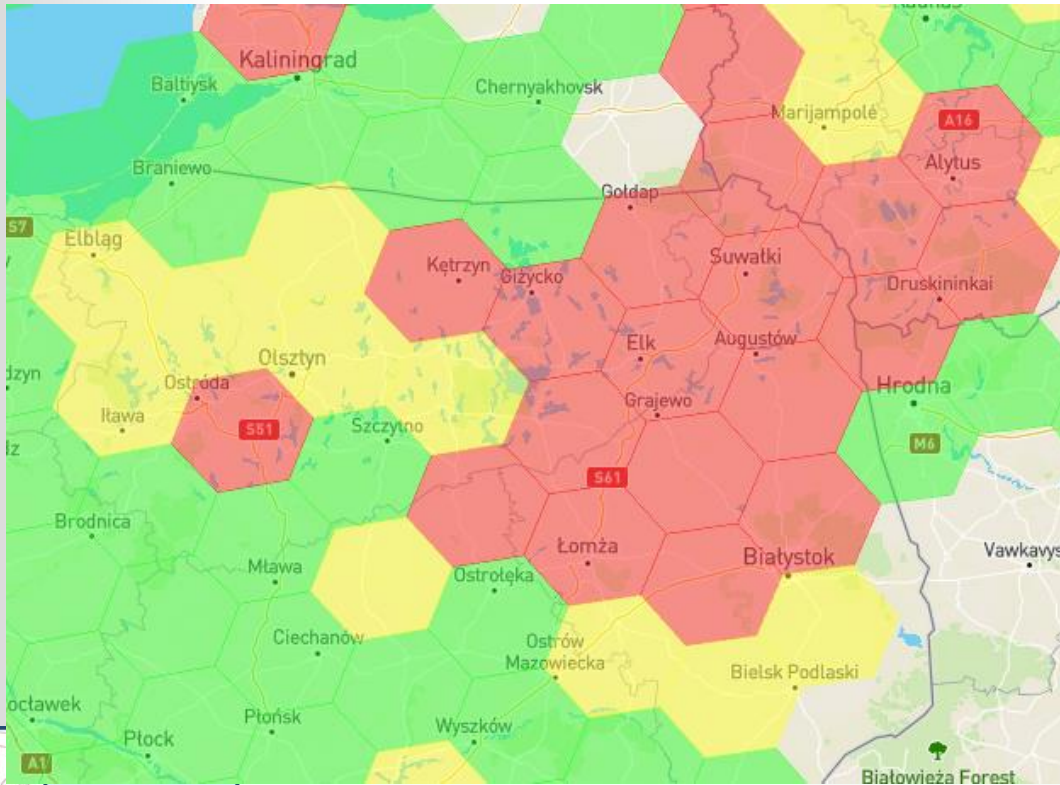
Index I95 from Trimble Pivot Platform



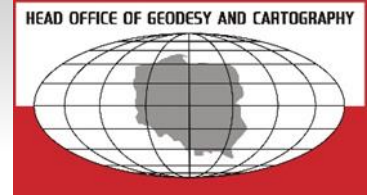
# Area of interest



## Stations GIZY, GRAJ and SWKI were taken for detailed analysis

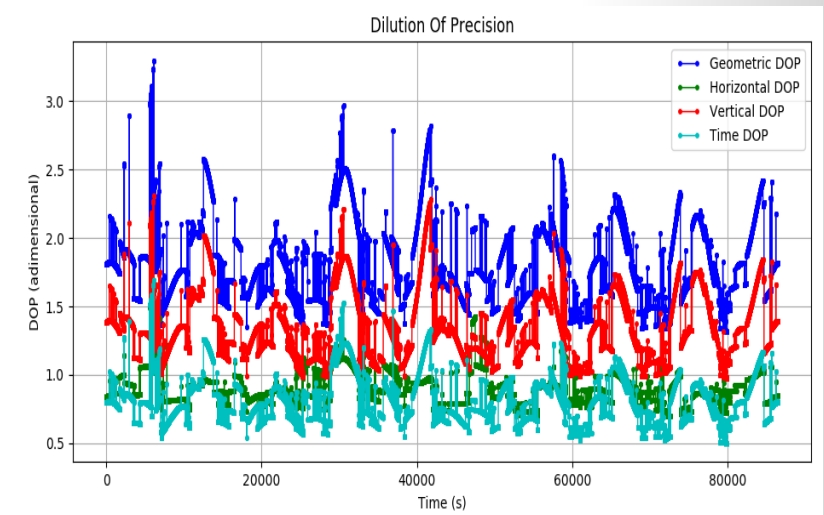
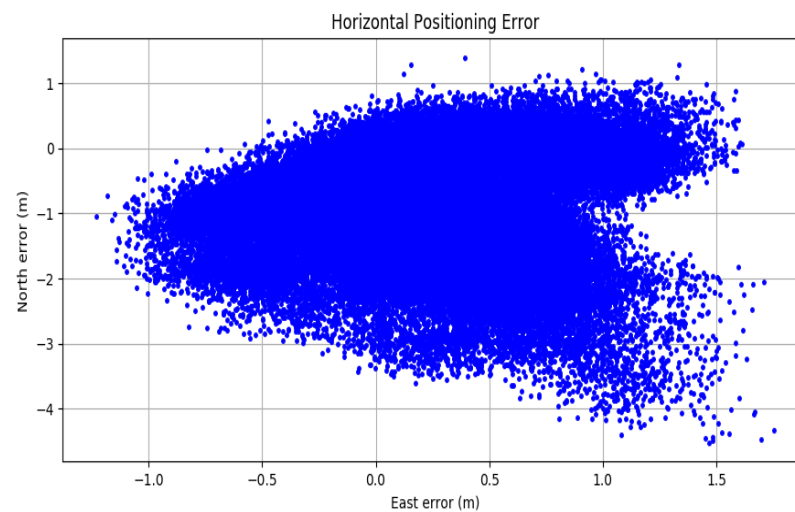
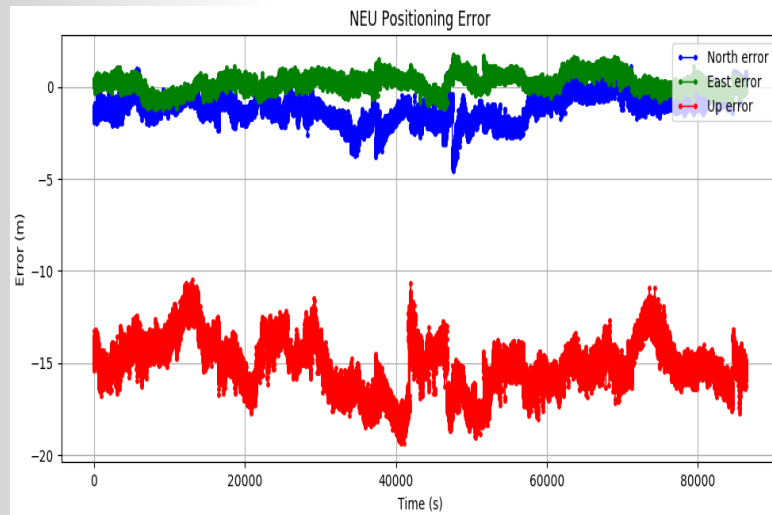


# SPP from Leica Infinity and ESA gLAB



## In Leica Infinity and ESA gLAB calculation of SPP in different variants of signals

**No anomalies**





**gLAB is complete GNSS analysis tool with many calculation strategies.**

**It is available free of charge.**



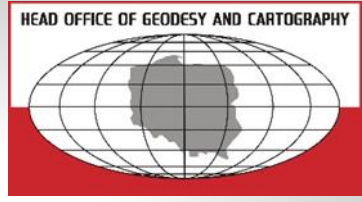
esa **gLAB** gAGE/UPC www.gage.es

Input Preprocess Modelling Filter Output

**gLAB**

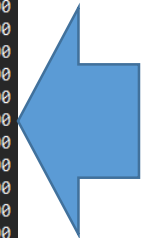
*Developed by gAGE : Research group of Astronomy & GEomatics  
Technical University of Catalonia (UPC)*

# Comparison of orbits and clocks in ESA gLAB

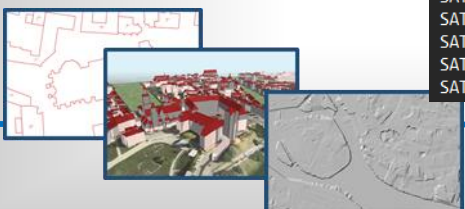


## Comparison of ephemeris stored on affected station and from another part of Poland (Katowice).

```
INFO gLAB version v5.5.1, built on Dec 9 2022 17:47:40
INFO Compare orbits & clocks mode
INFO OC Product 1: RINEX navigation message input file: C:\Users\user\Desktop\PAZP\Export_RINEX24h_15_08_2023\GIZY2270.23n
INFO OC Product 2: RINEX navigation message input file: C:\Users\user\Desktop\PAZP\Export_RINEX24h_15_08_2023\KATO2270.23n
INFO INFO MODELLING Check transmission time of navigation message is behind current epoch: ON
INFO INFO MODELLING Use satellite 'SV Health' flag of navigation message: ON
INFO MODELLING Comparison of satellite clock correction: ON
INFO MODELLING Discard satellites under eclipse condition: OFF
INFO StartTime: 2023 226 86384.00 EndTime: 2023 228 7200.00 IntervalTime: 300.00
SATDIFF 2023 227 0.00 GPS 2 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 3 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 4 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 5 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 6 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 7 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 8 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 9 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 10 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 11 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 12 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 13 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 14 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 15 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 16 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 17 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 18 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 19 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 20 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 21 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 23 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 24 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 25 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SATDIFF 2023 227 0.00 GPS 26 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
```



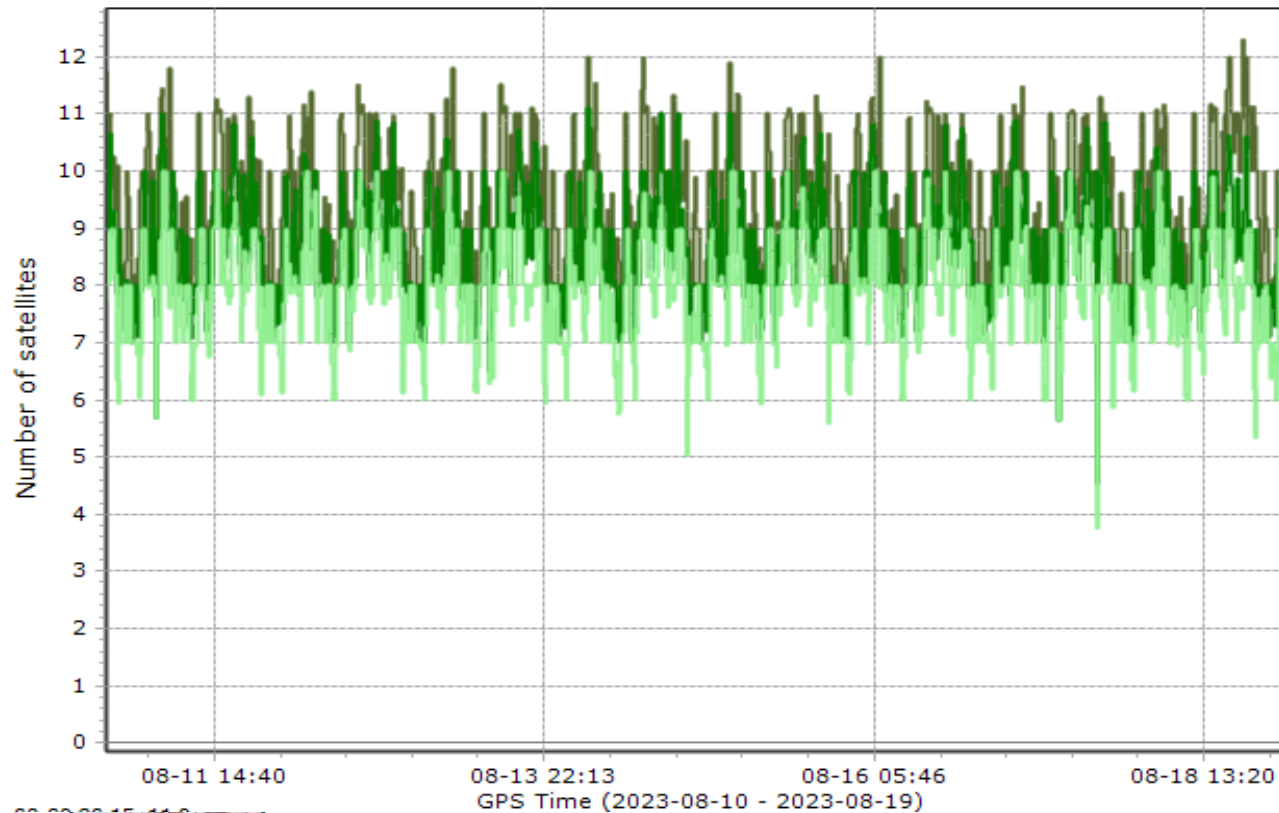
No difference





## Check of performance in RTX Processor in Trimble Pivot Platform

RTXNetProcessor [RTX\_BDSIII]



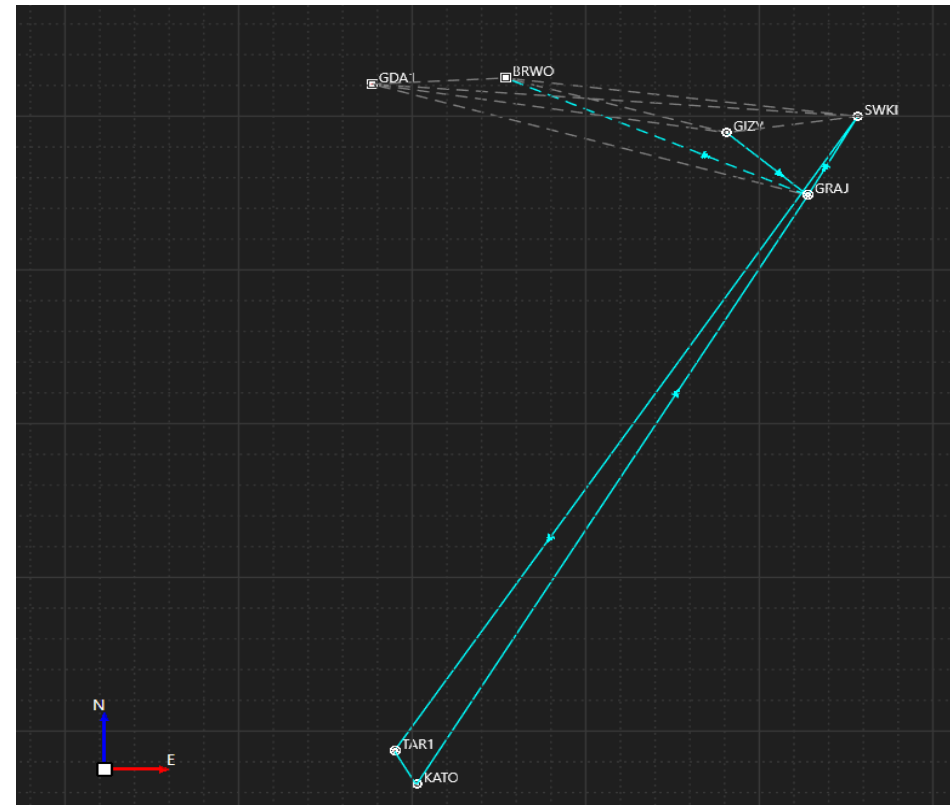
- Performance
- Perf. GPS
- Perf. GLN
- Perf. QZSS
- Perf. BeiDou
- Perf. GALILEO
- Tracked
- Processed
- Solved
- GPS Tracked
- GPS Processed
- GPS Solved
- GLONASS Tracked
- GLONASS Processed
- GLONASS Solved
- QZSS Tracked
- QZSS Processed
- QZSS Solved
- BeiDou Tracked
- BeiDou Processed
- BeiDou Solved
- GALILEO Tracked
- GALILEO Processed
- GALILEO Solved



**Similar performance in comparison to surrounding days**

Calculation of vectors between stations in affected region and with stations external station.

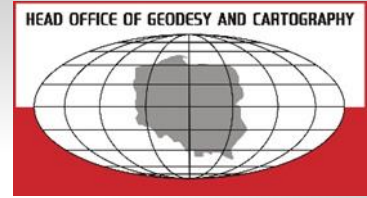
Suspected vectors were solved but with big number of rejected observations for few SV's.



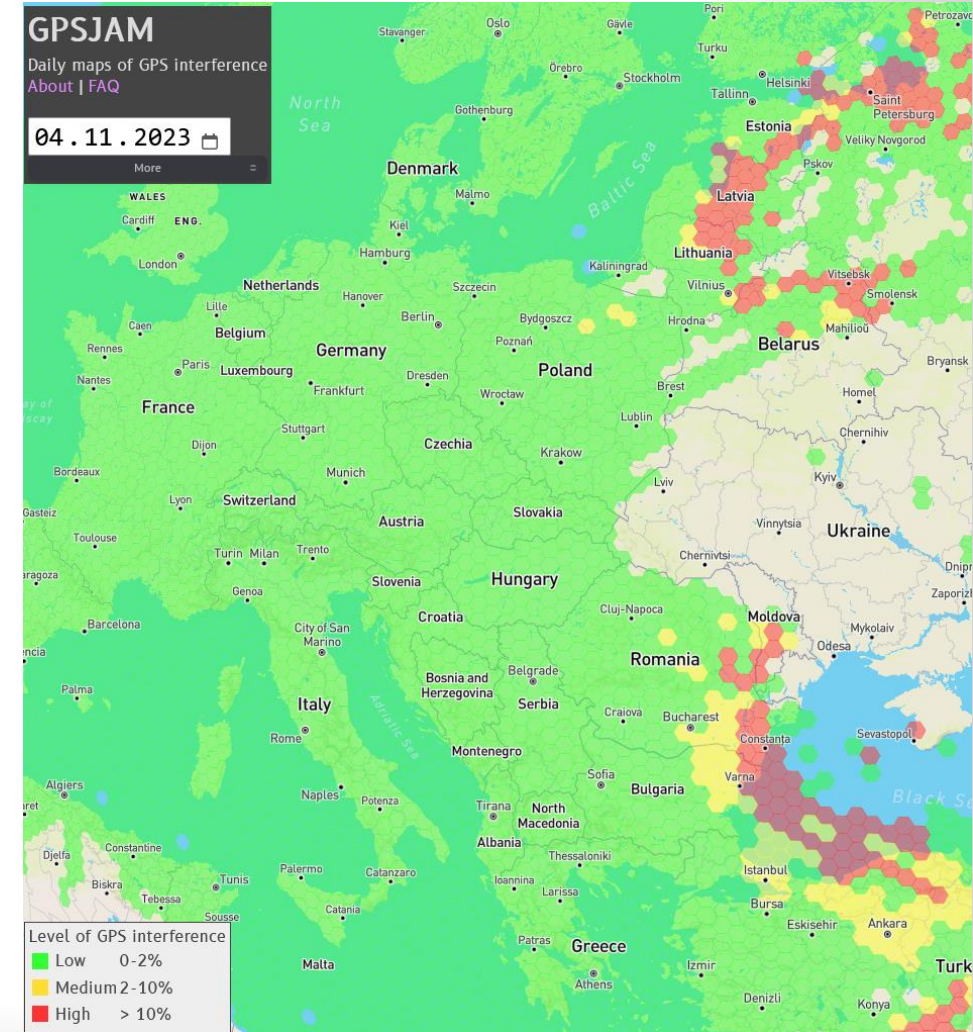
- **It is hard to detect interference of GNSS signals at ground reference stations**
- **There is not clear how to analyze observations to confirm interference in postprocessing**
- **There are different ways to interfere GNSS signals and every case can be different**



# Recommendations



- Track <https://gpsjam.org>
- Consider to install receivers with interference detection:
  - Trimble Alloy
  - Leica GR30/GR50 + Interference Toolbox
  - Septentrio PolaRx5 with AIM+



# Thank you for your attention

**Szymon Wajda**