Improving Performance of Navigation Service with new signals by reducing multipath

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Positioning with Multi-System GNSS receivers

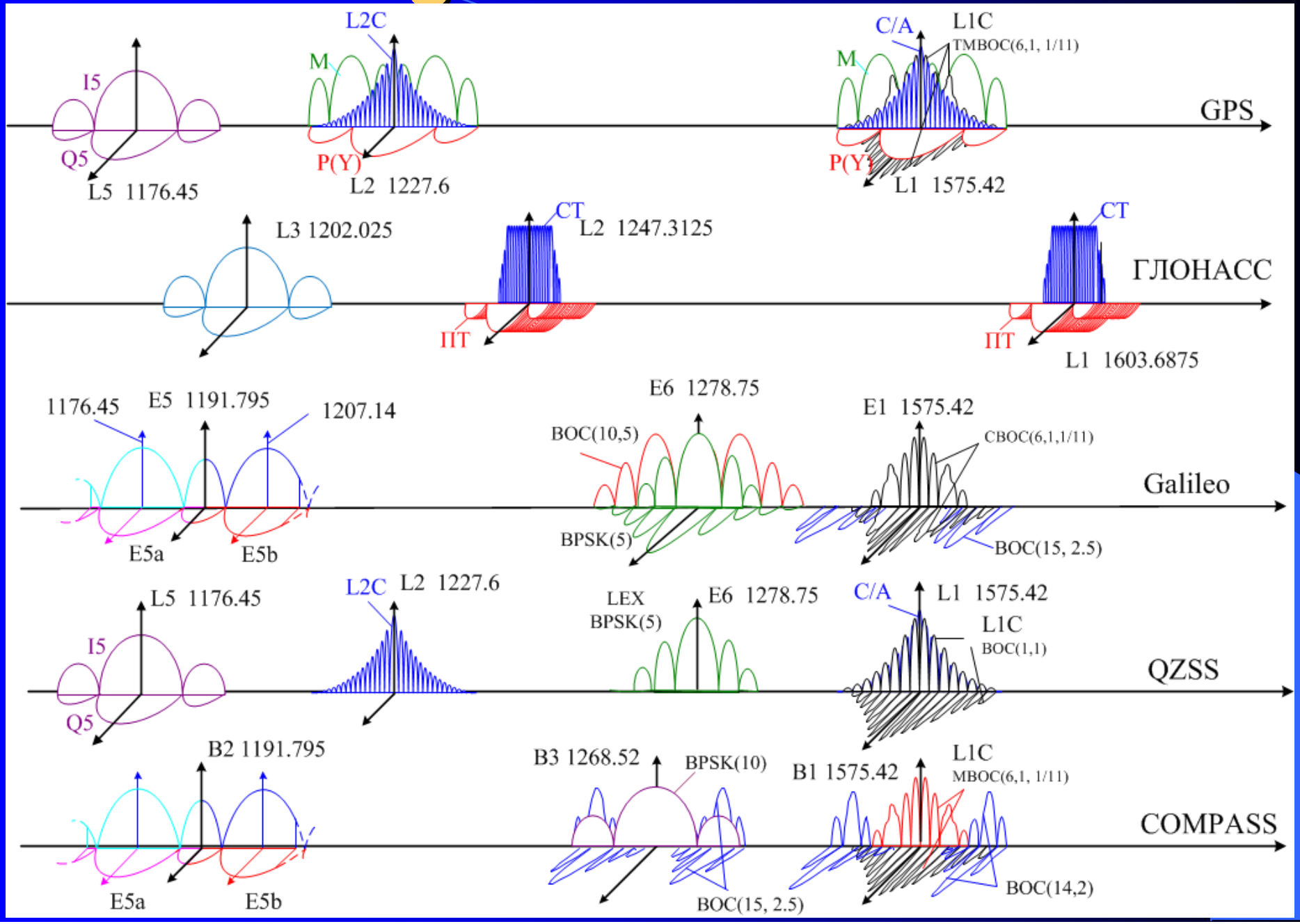
- - GIS application;
- DGPS, RTK
- - Survey application;
- RTK
- - Machine control application;

RTK

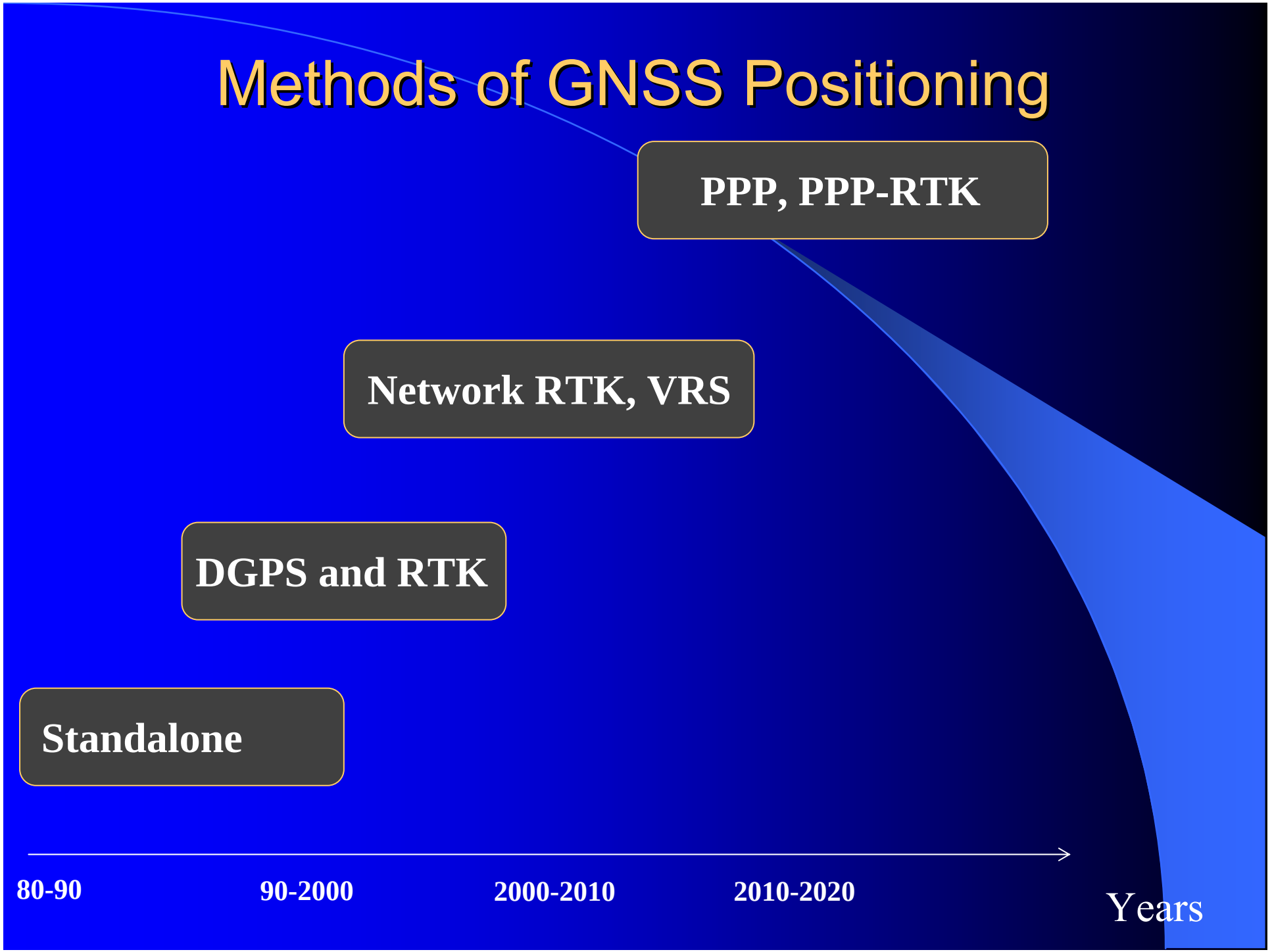
- - Agricultural application.

StandAlone, DGPS, RTK

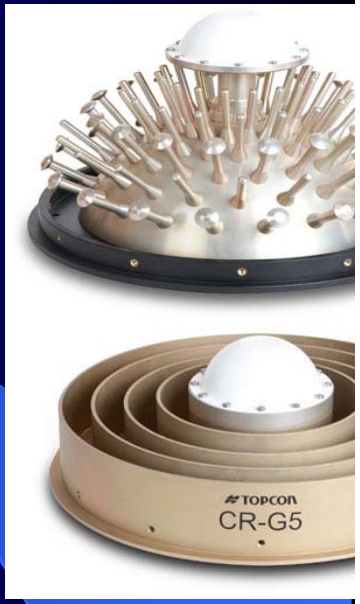
Signals of GNSS



Methods of GNSS Positioning

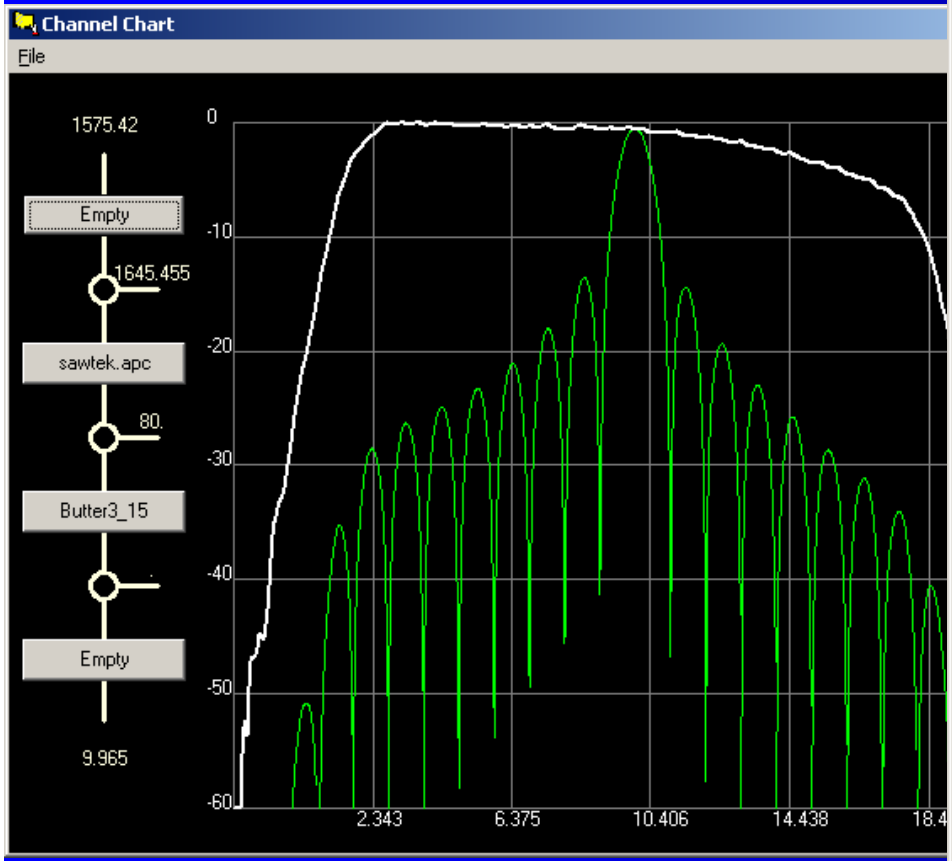


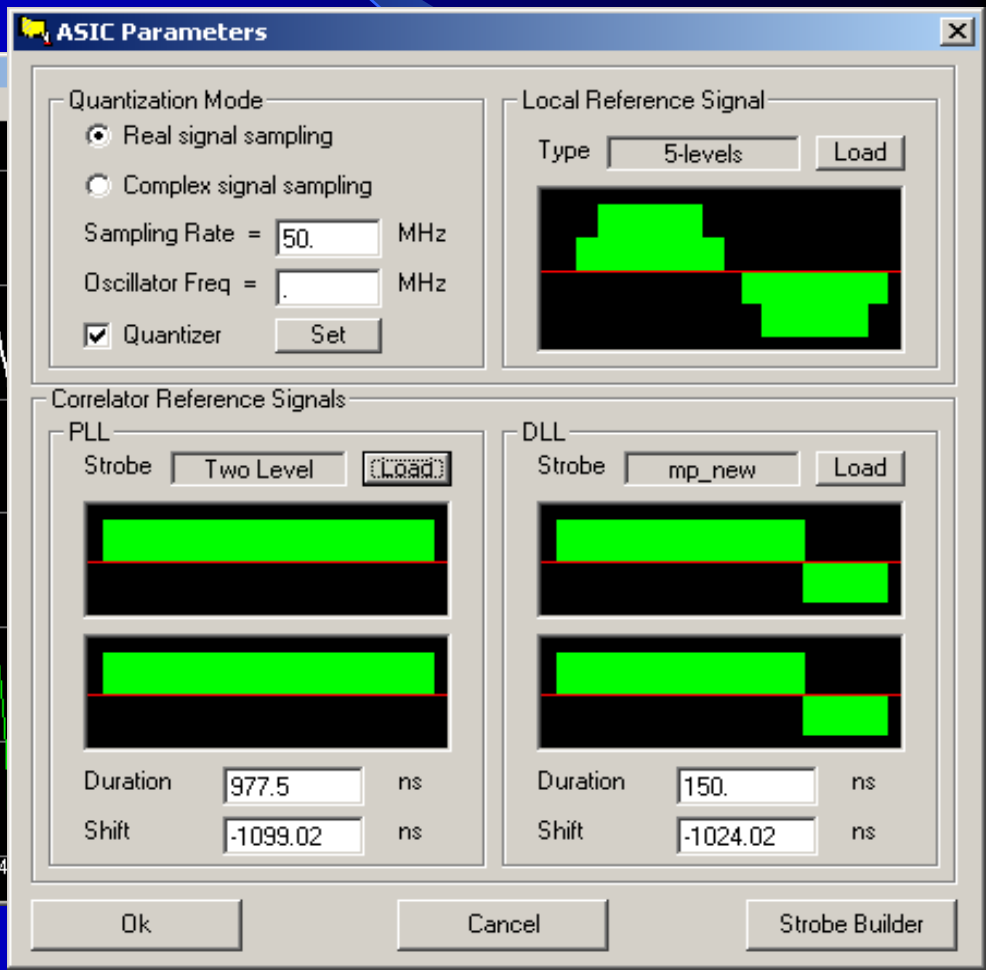
Methods of multipath mitigation



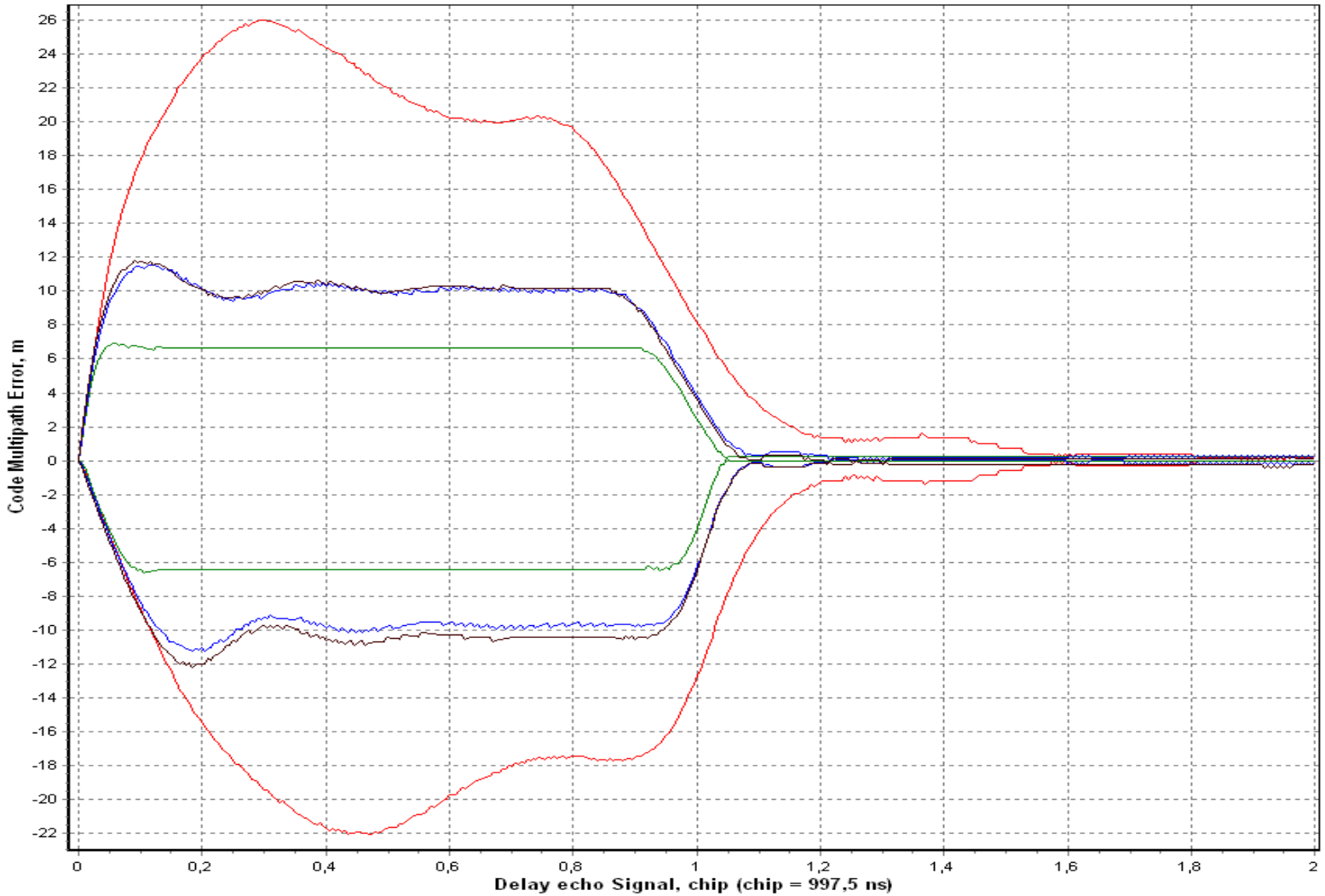
- - Antennas with special characteristics:
  groundplanes, choke-ring, multi-elements;
- - Receivers with special characteristics:
  anti-multipath correlators, estimation, smoothing;
- - GNSS signals:
  special modulation, wide band signals;

Software for calculation of errors in navigation receiver





Multipath error for different receivers



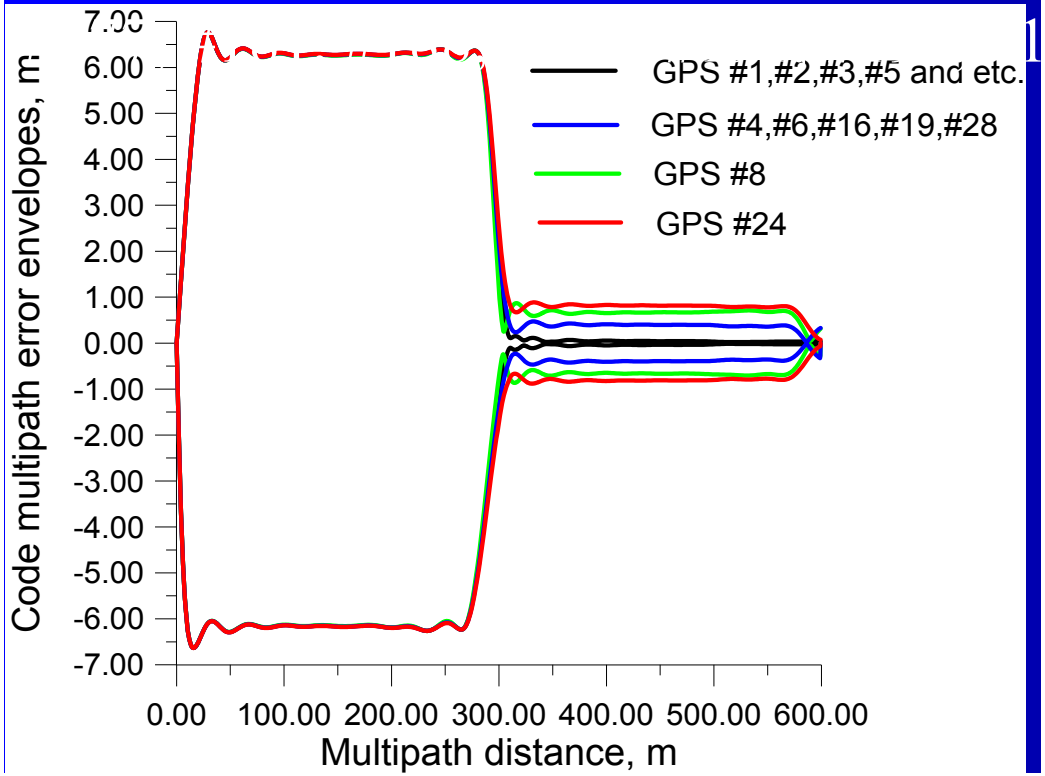
Multipath error for Gold codes

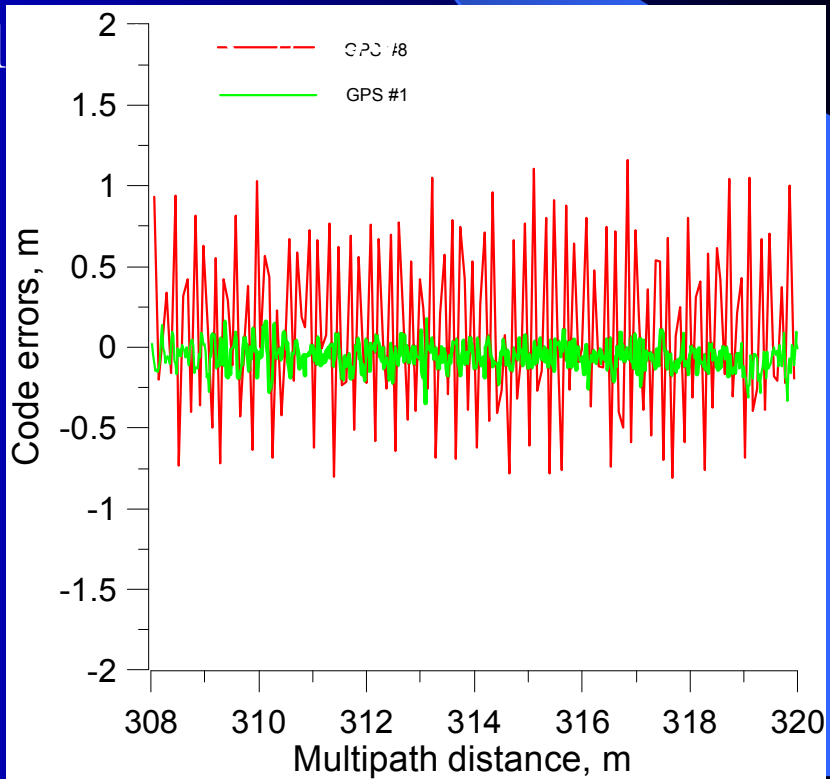
32 Gold codes for L1 C/A of GPS - 14 “irregular” codes :

#4 , #6 , #7 , #8 , #10 , #15 , #16 , #17 , #18 , #19 , #21 , #22 , #24 , #28

145 additional Gold codes from #65 for #210 – 48 ”irregular” codes:

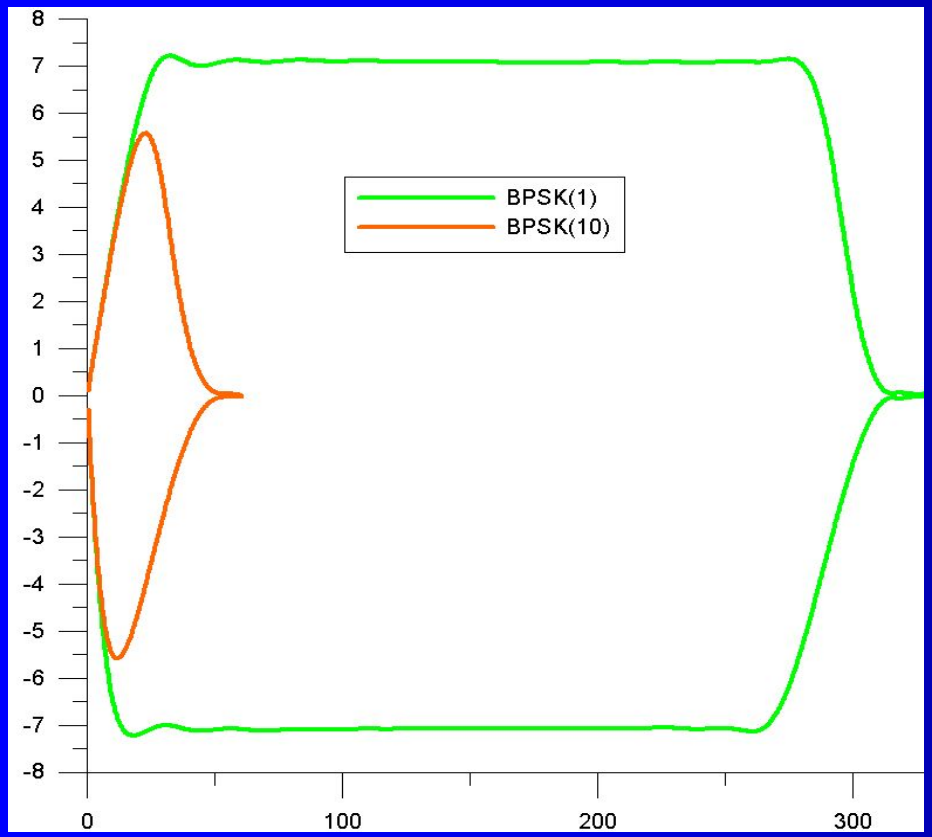
#65, #67, #73, #76, #78, ##81-83, ##92-95, #97, #100, #101, #107, ##112-114, #117, #119, #123, #124, #132, #137, ##147-149, ##167-175,

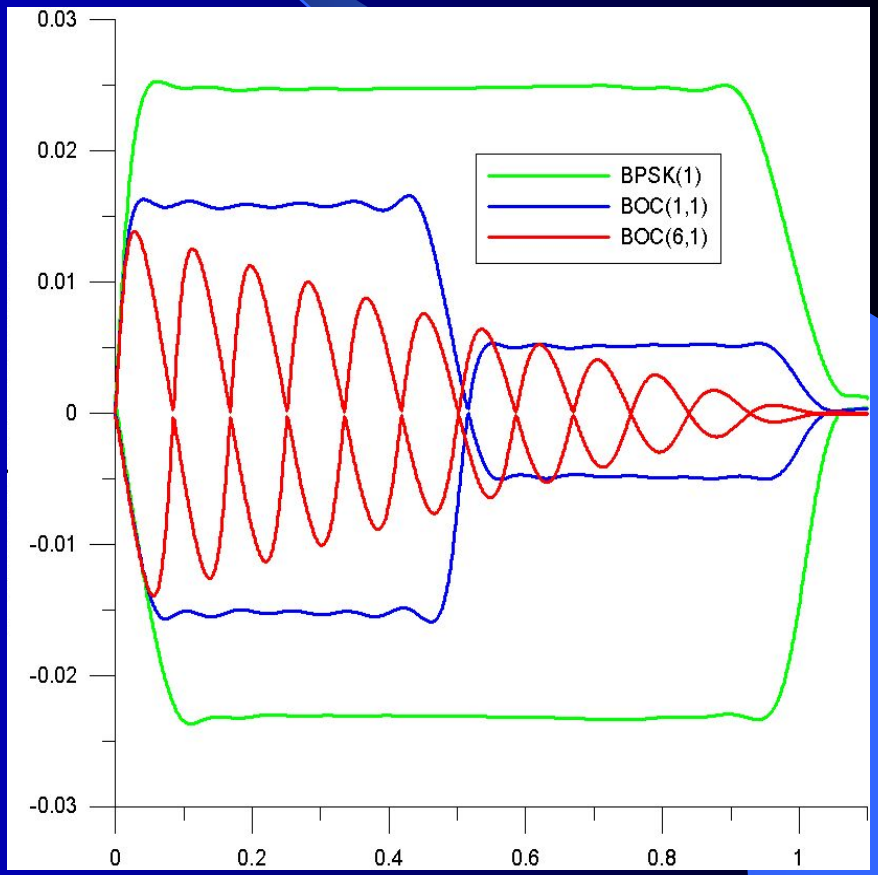




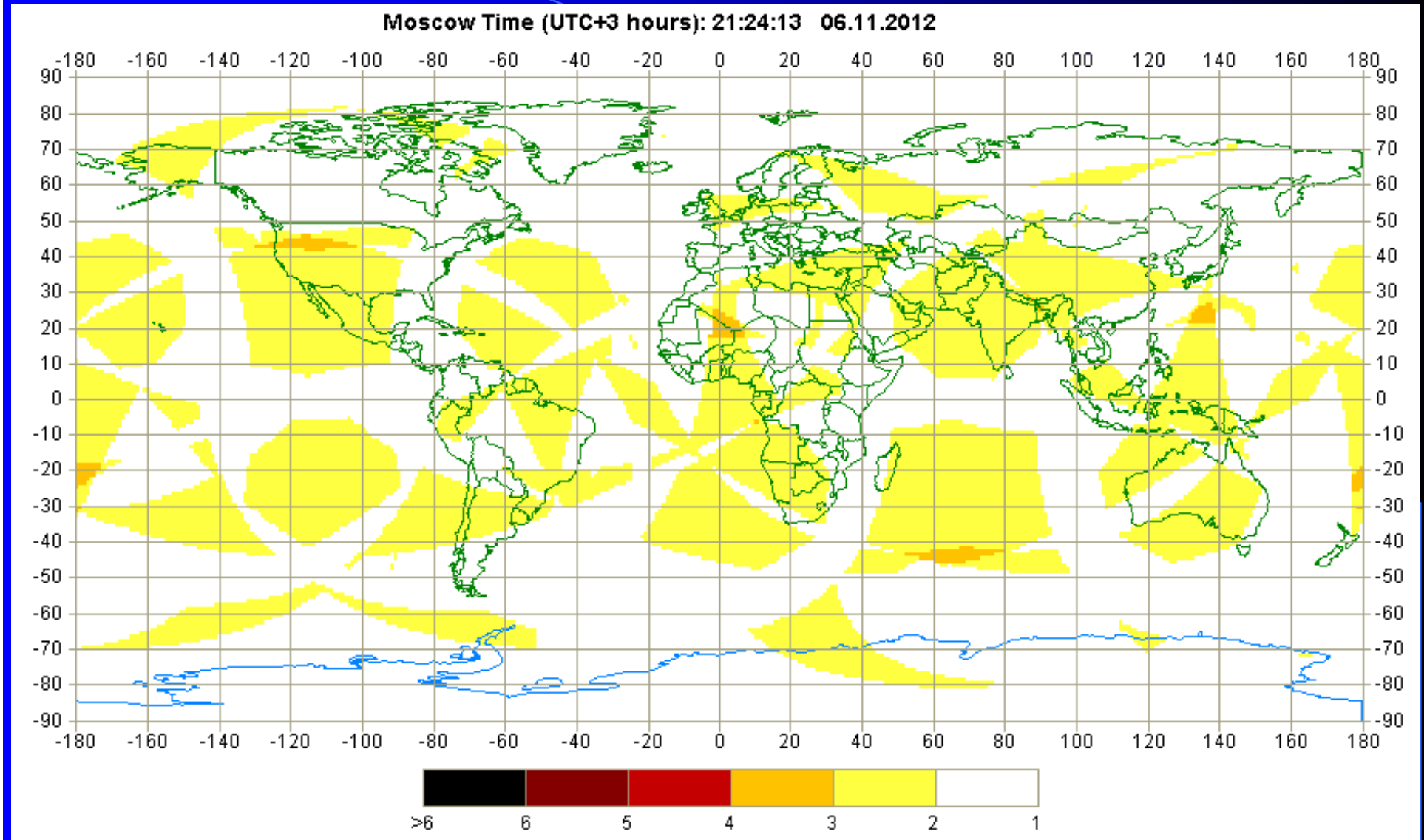
Multipath error for different signals

Envelop multipath error for RF band 20MHz and difference amplitude signals 0.5





Current status of GLONASS



Ref: http://www.glonass-center.ru

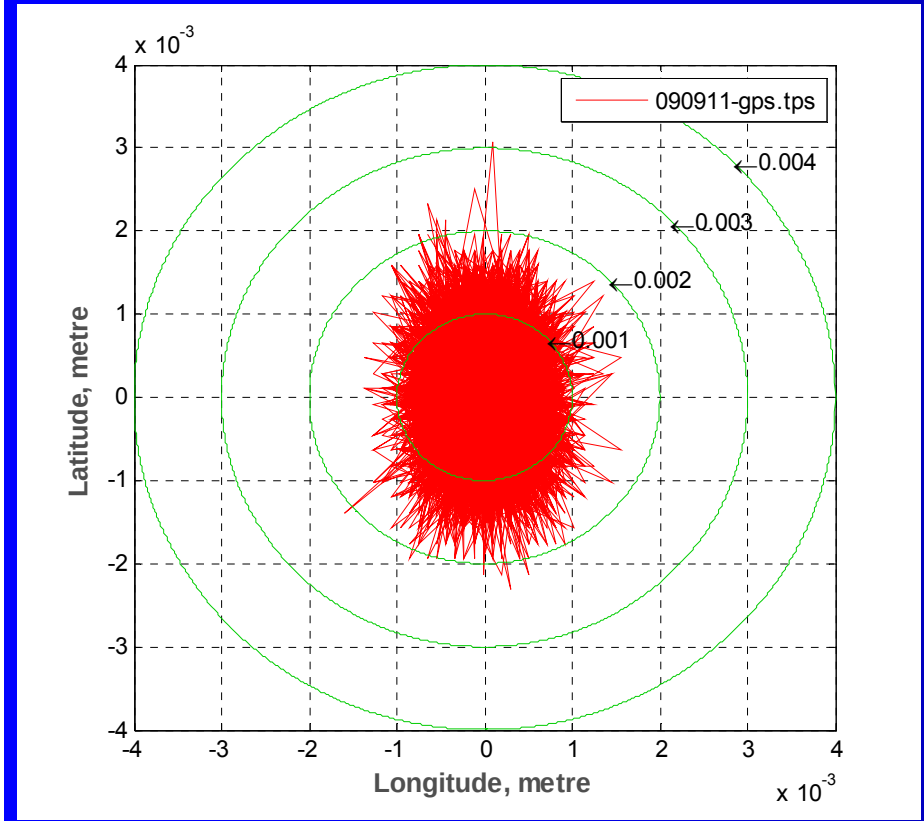
GLONASS RTK positioning performances

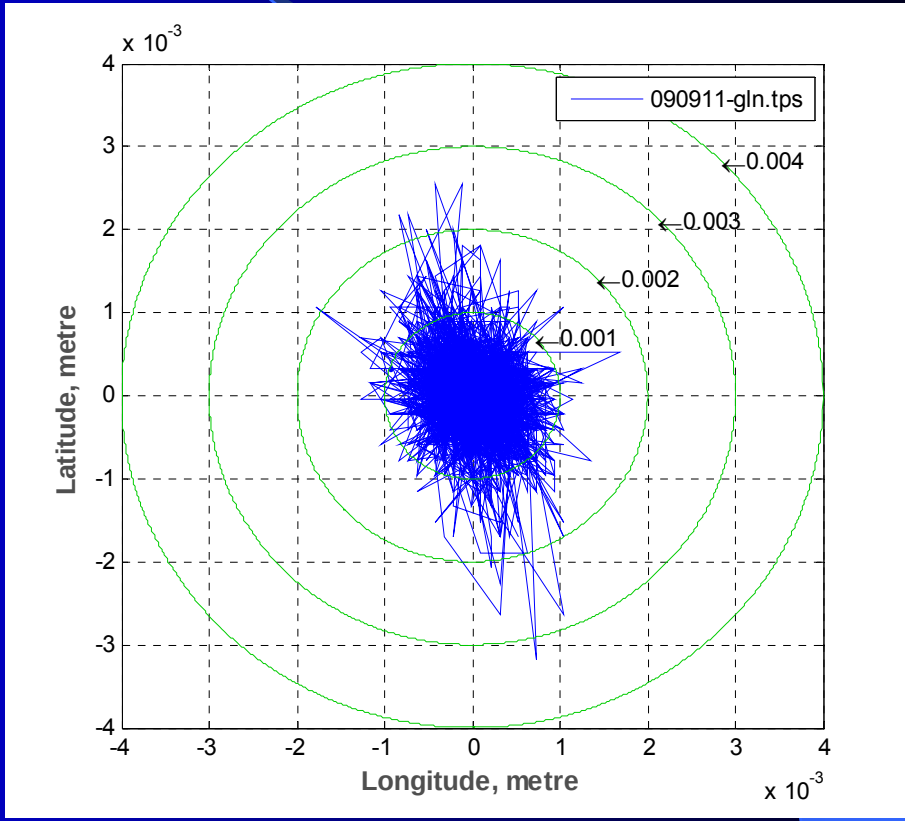
RTK GPS-only solution:

At all epochs (GPS SVs: $6 \leq SV \leq 12$)

RTK GLONASS-only solution:

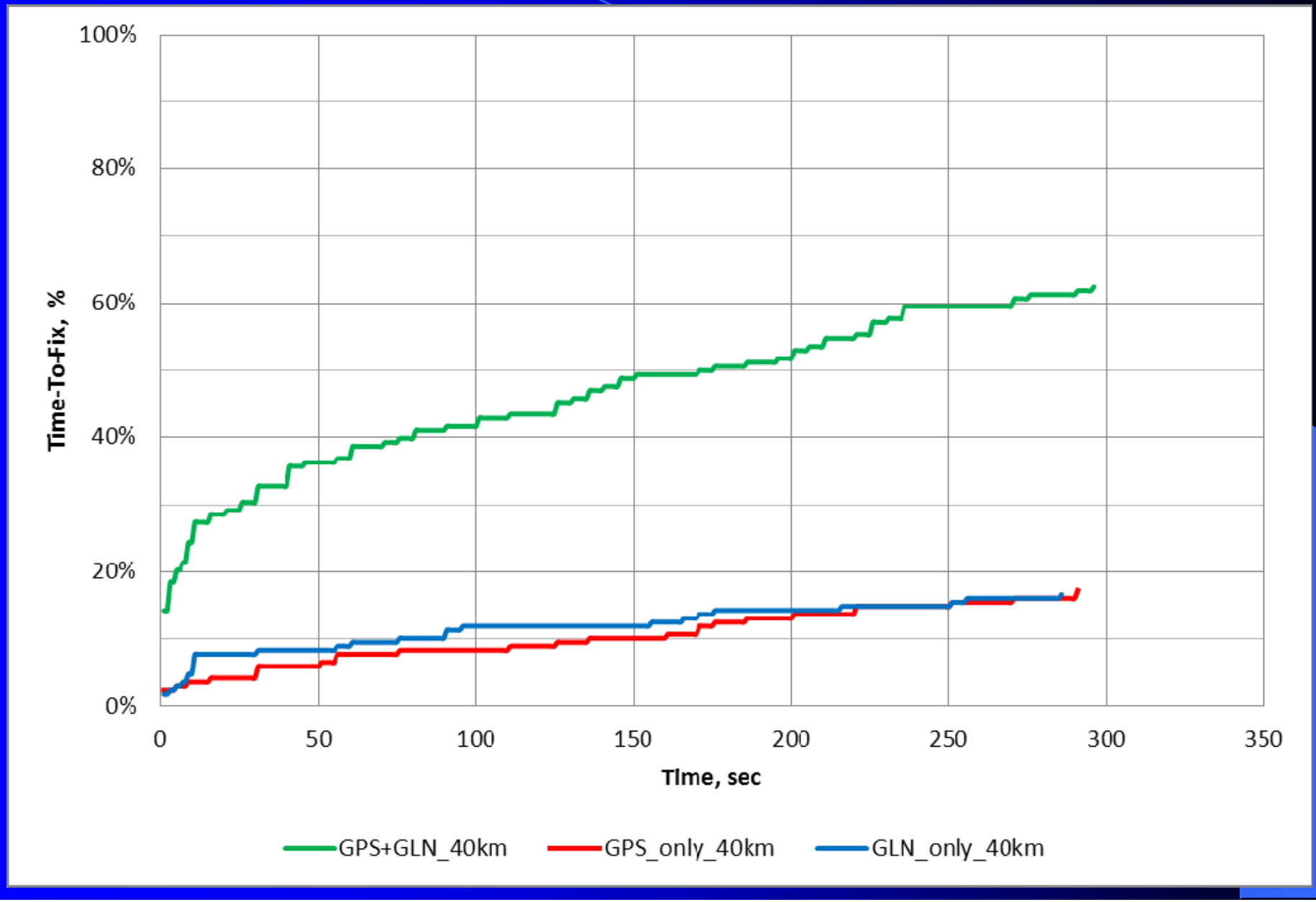
At a subset of all epochs when total number of GLONASS SVs ≥ 7



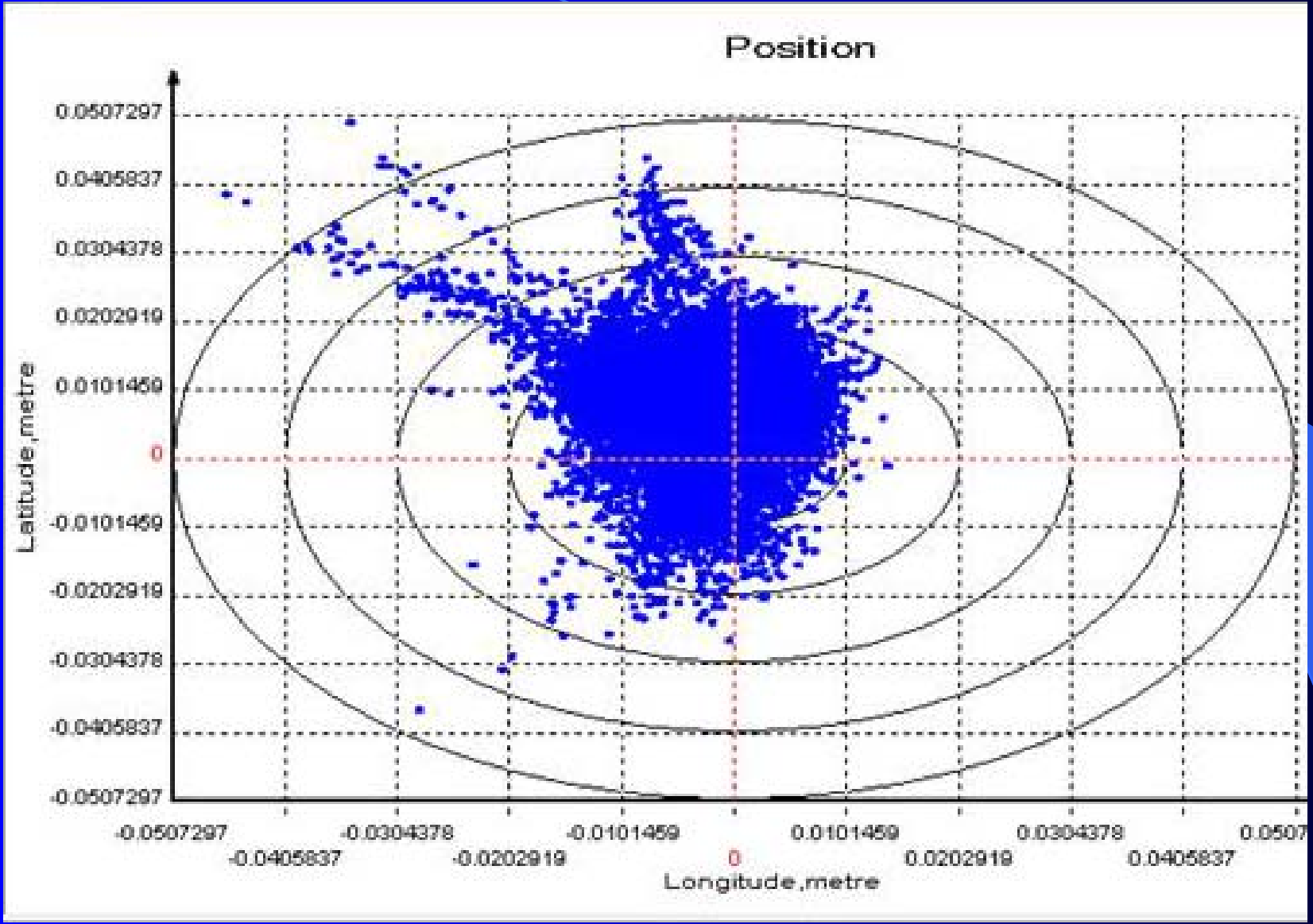


Accuracy of GLONASS RTK positioning is the same as GPS RTK accuracy provided enough number of GLONASS satellites are available for positioning

Example for Probability Time-to-Fix of ambiguities for medium baseline RTK

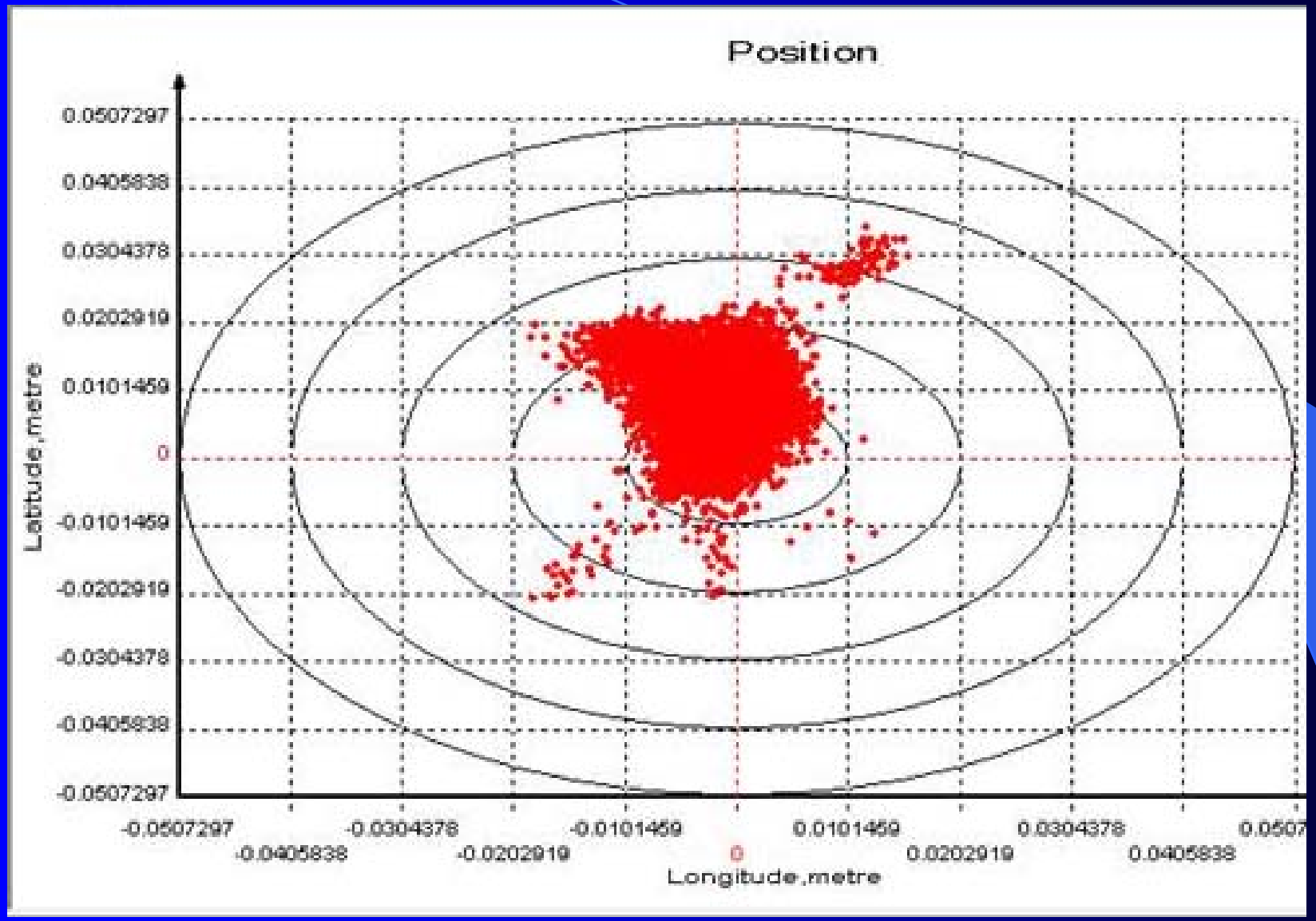


Example for RTK solution with GLONASS only



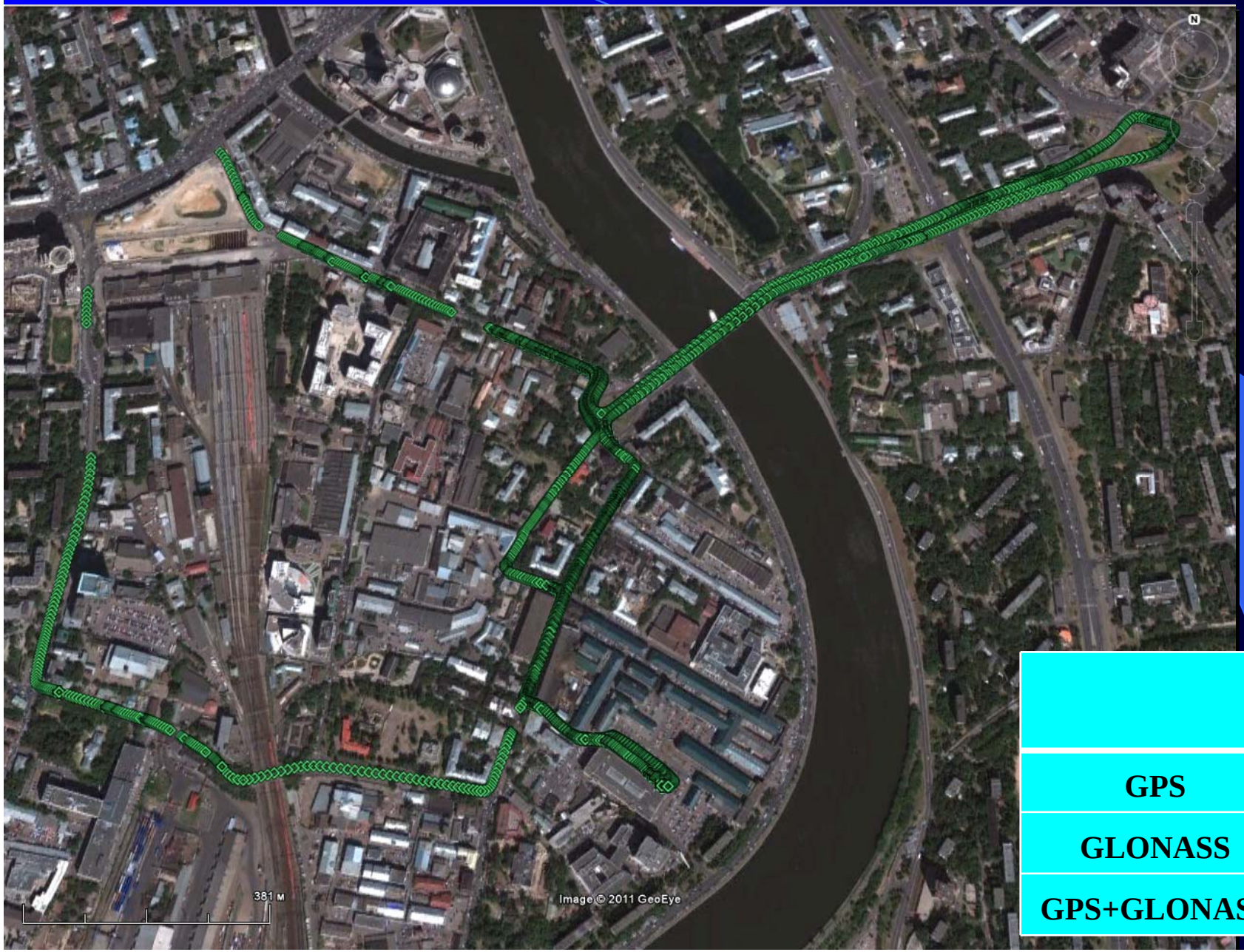
HRMS=0.0067m

Example for RTK solution with GPS only



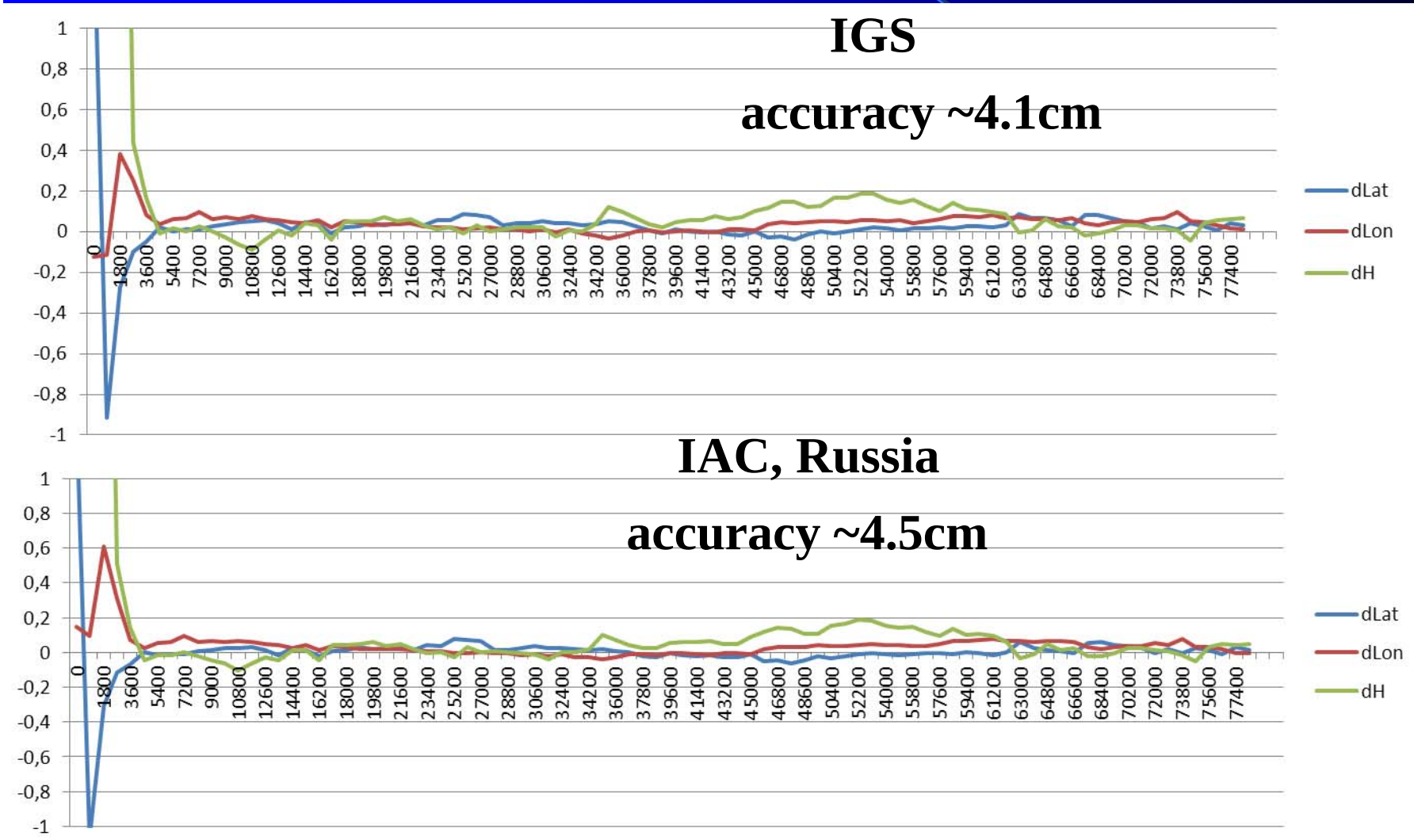
HRMS=0.0048m

GPS/GLONASS RTK solution in the town

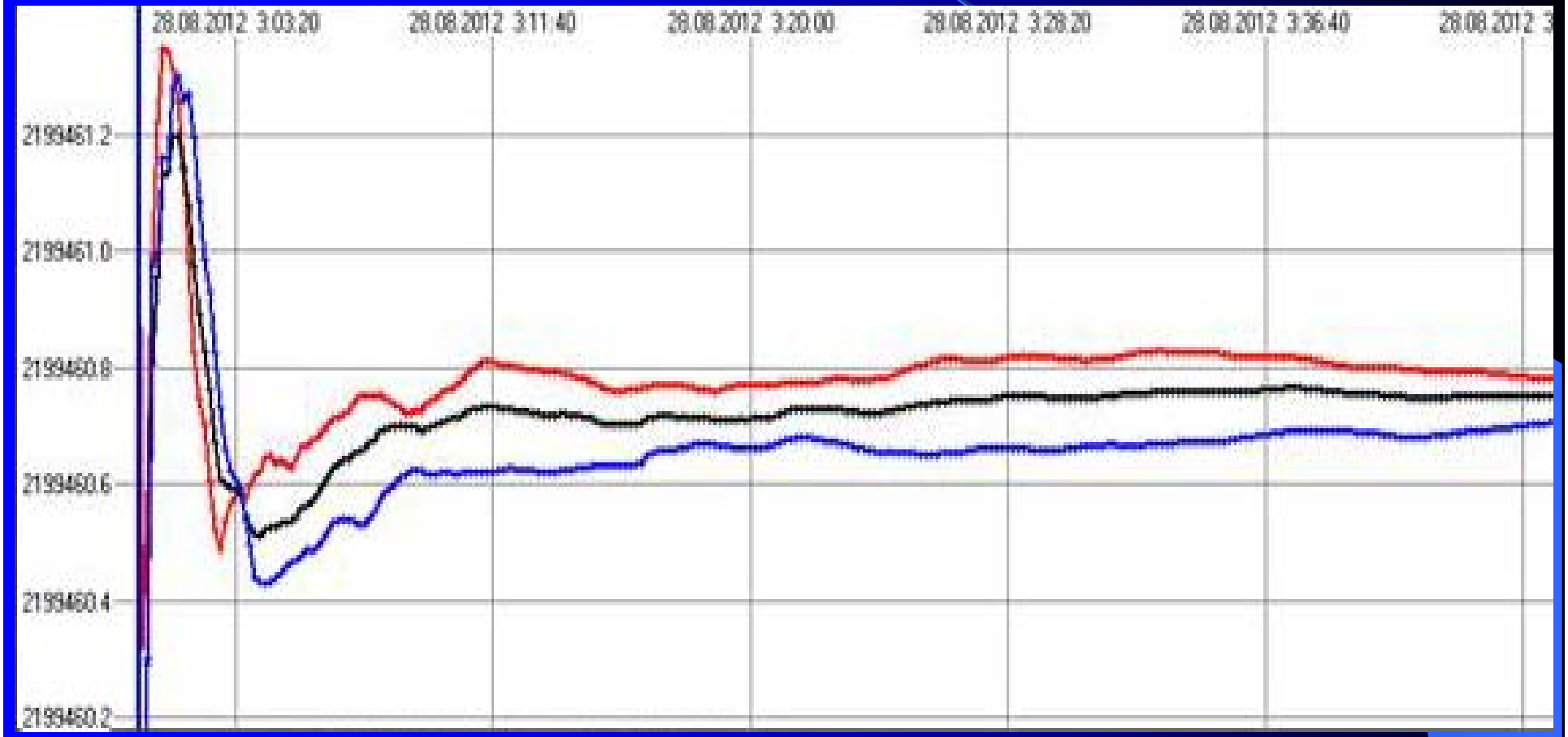


	% fix solution
GPS	52
GLONASS	39
GPS+GLONASS	92

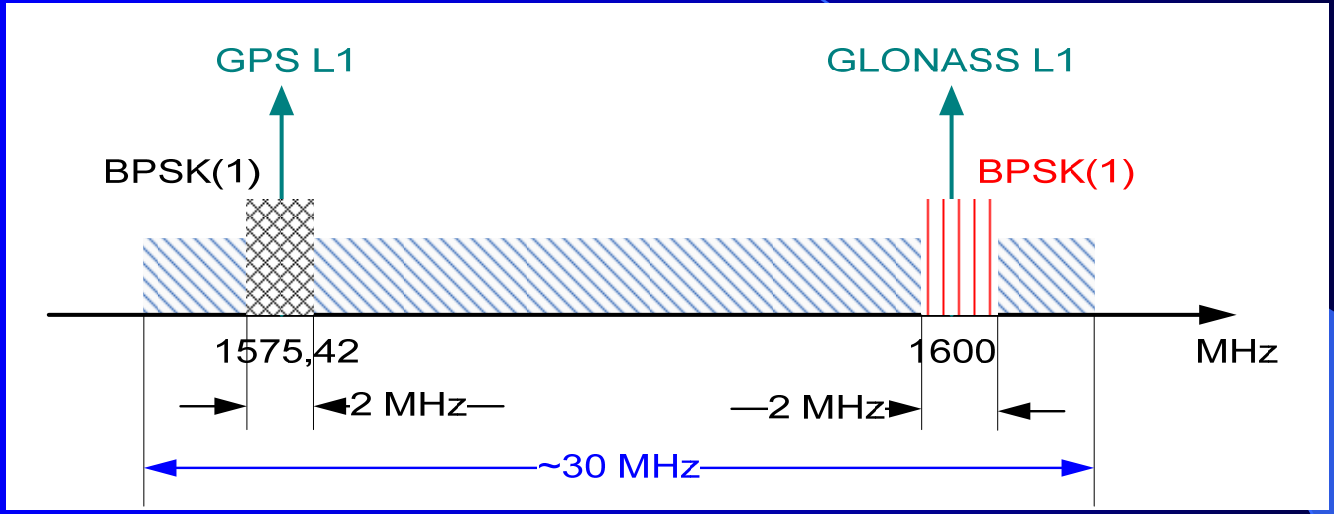
Precise Point Position with final precise orbits and clocks

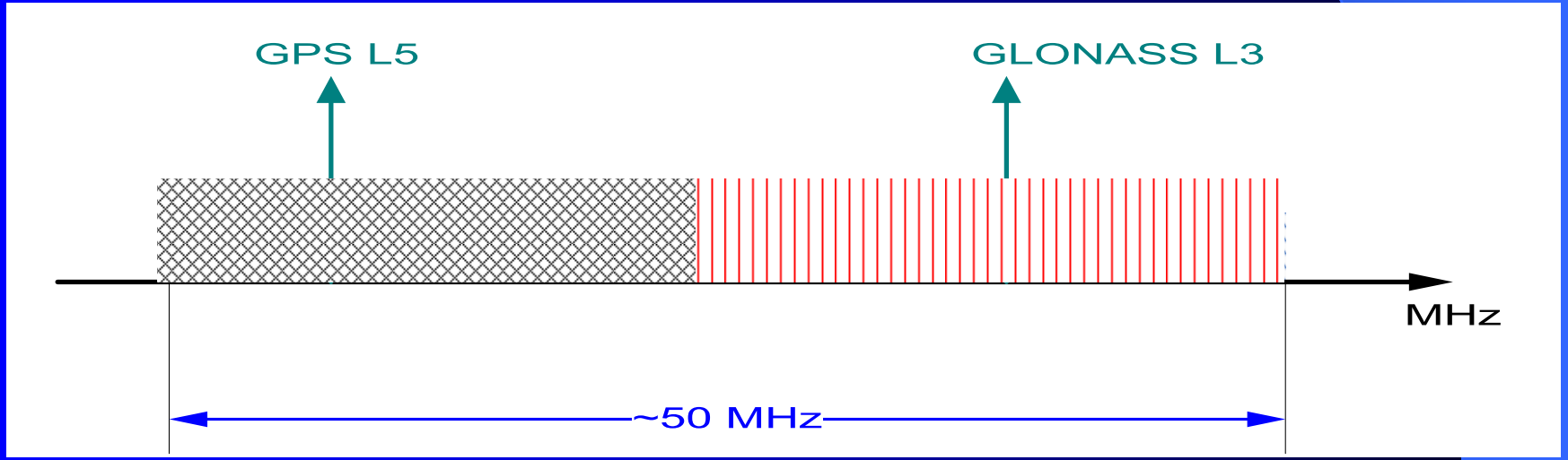


Precise Point Position with GPS, GLONASS, GPS/GLONASS

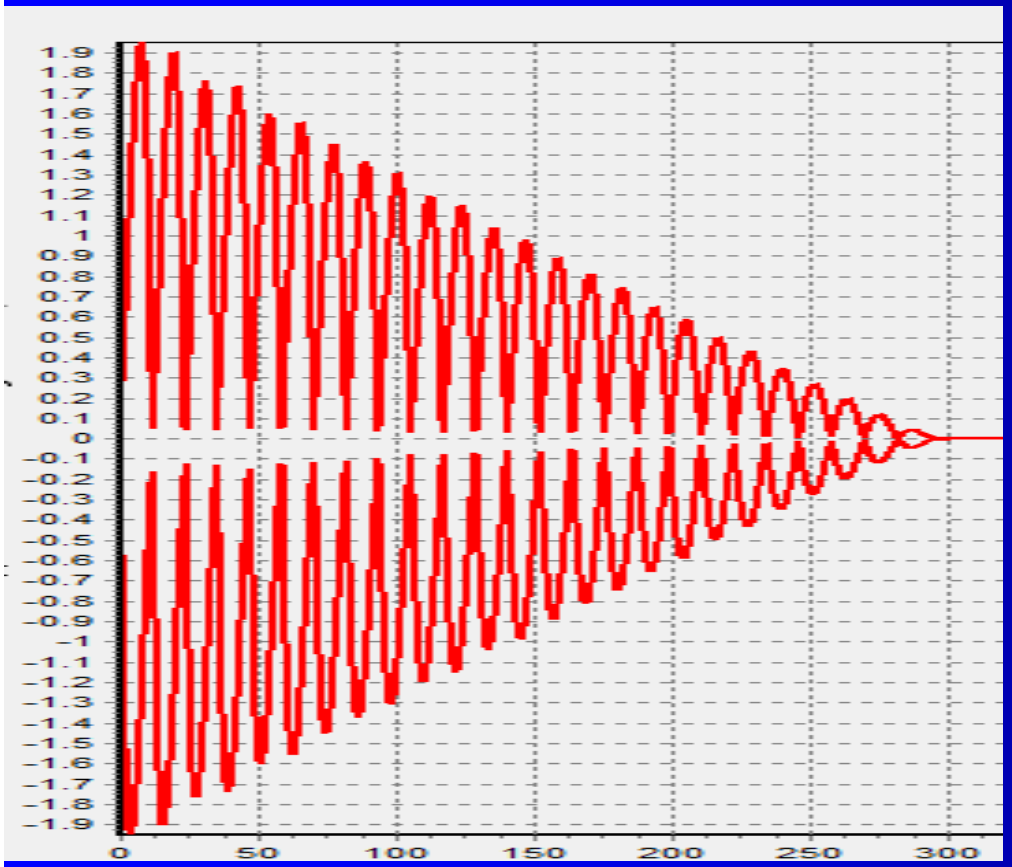


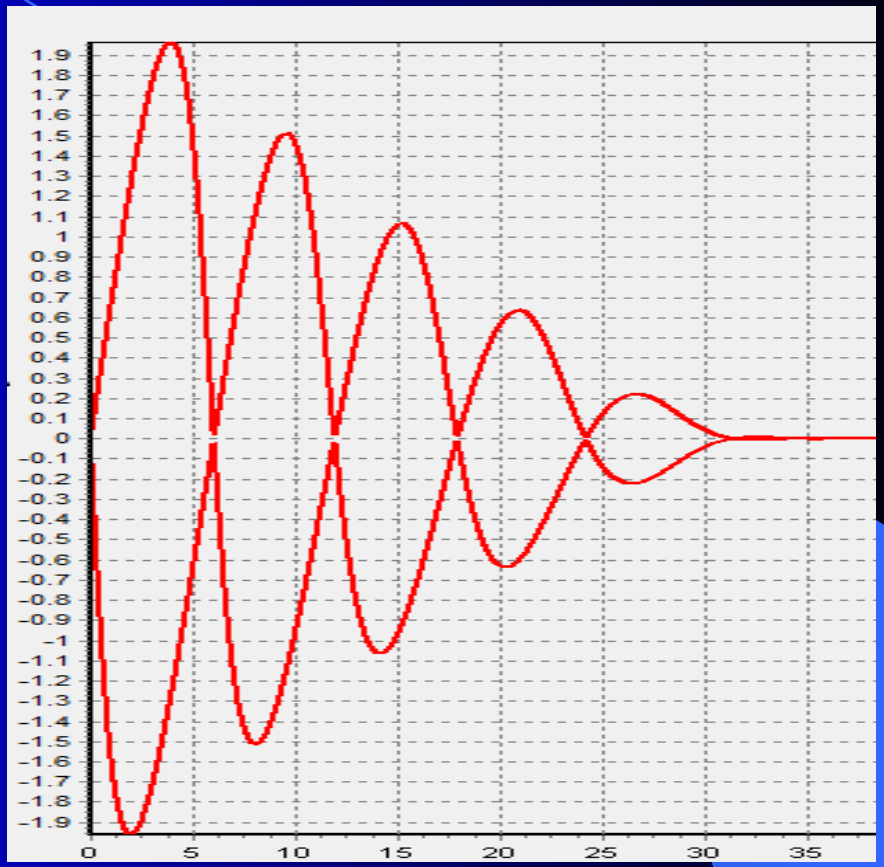
Example of wideband signal for L1 and L5/L3 band





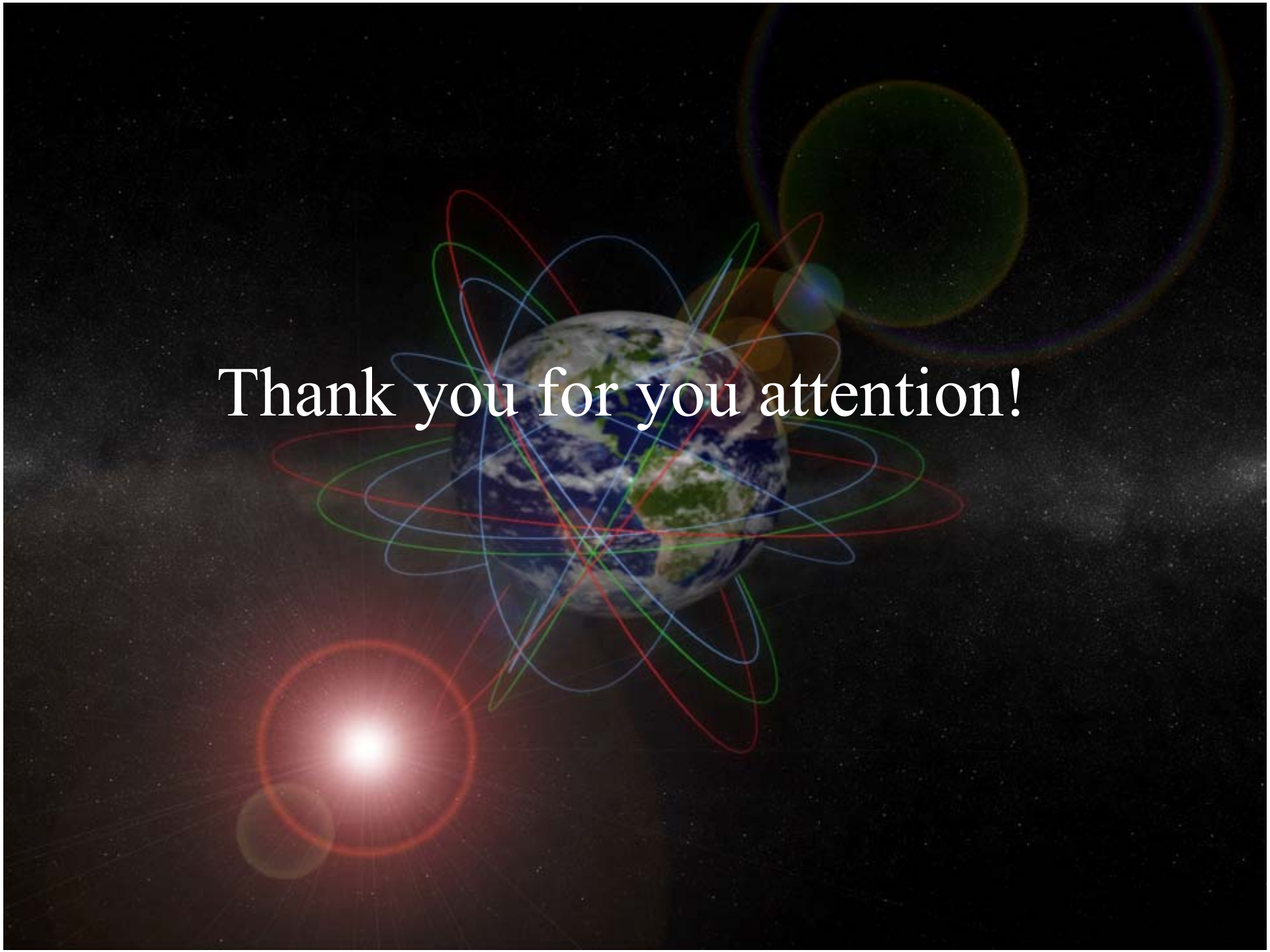
Wideband signals





Summary

- Multipath reduction can be implemented in the navigation equipment with the capabilities of current signals.
- Navigation signals can reduce multipath error for all types of navigation service. The use of wideband signals in multiple GNSS frequency bands can significantly reduce the multipath error.
- Current results show similar accuracy for high-precision applications with using GPS and GLONASS.
- As it was predicted in 2005, GLONASS has achieved a great progress over last seven years. The GLONASS have full constellation with 24 GLONASS-M satellite and 31 satellites in orbiting. The first GLONASS-K with CDMA signals in L3 band is launched.


Thank you for you attention!