Using BeiDou System for precise positioning in Europe

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Motivation

Currently BeiDou System is the fastest developing navigation system. At present number of BDS satellites may allow to use that system for precise positioning in Europe. The aim of this test was to try to obtain precise position in Olsztyn in Poland using BDS.

About BeiDou System

BeiDou System is a Chinese navigation system whose full operability is foreseen for 2020. On December 27 2012 the full functionality over the area of Asia was announced. Full constellation will consist of:

- 5 Geostationary satellites GEO – orbits height 35 786 km;
- 3 Geosynchronous Satellites IGSO – orbits height 35 786 km, inclination 55º;
- 27 Medium Earth Orbit satellites MEO – orbits height 21 528 km, inclination 55º.

In 2015 the modernization of BDS system began.

Source: BeiDou Navigation Satellite System Open Service Performance Standard, 2013

About BeiDou System

Currently following satellites are providing navigational signals:

- 5 Geostationary Satellites GEO;
- 6 Geosynchronous Satellites IGSO;
- 3 Medium Earth Orbit satellites MEO.

There are also:

- 1 Geostationary Satellites GEO;
- 2 Geosynchronous Satellites IGSO (third generation satellites);
- 3 Medium Earth Orbit satellites MEO (third generation satellites);

Not used in this tests.

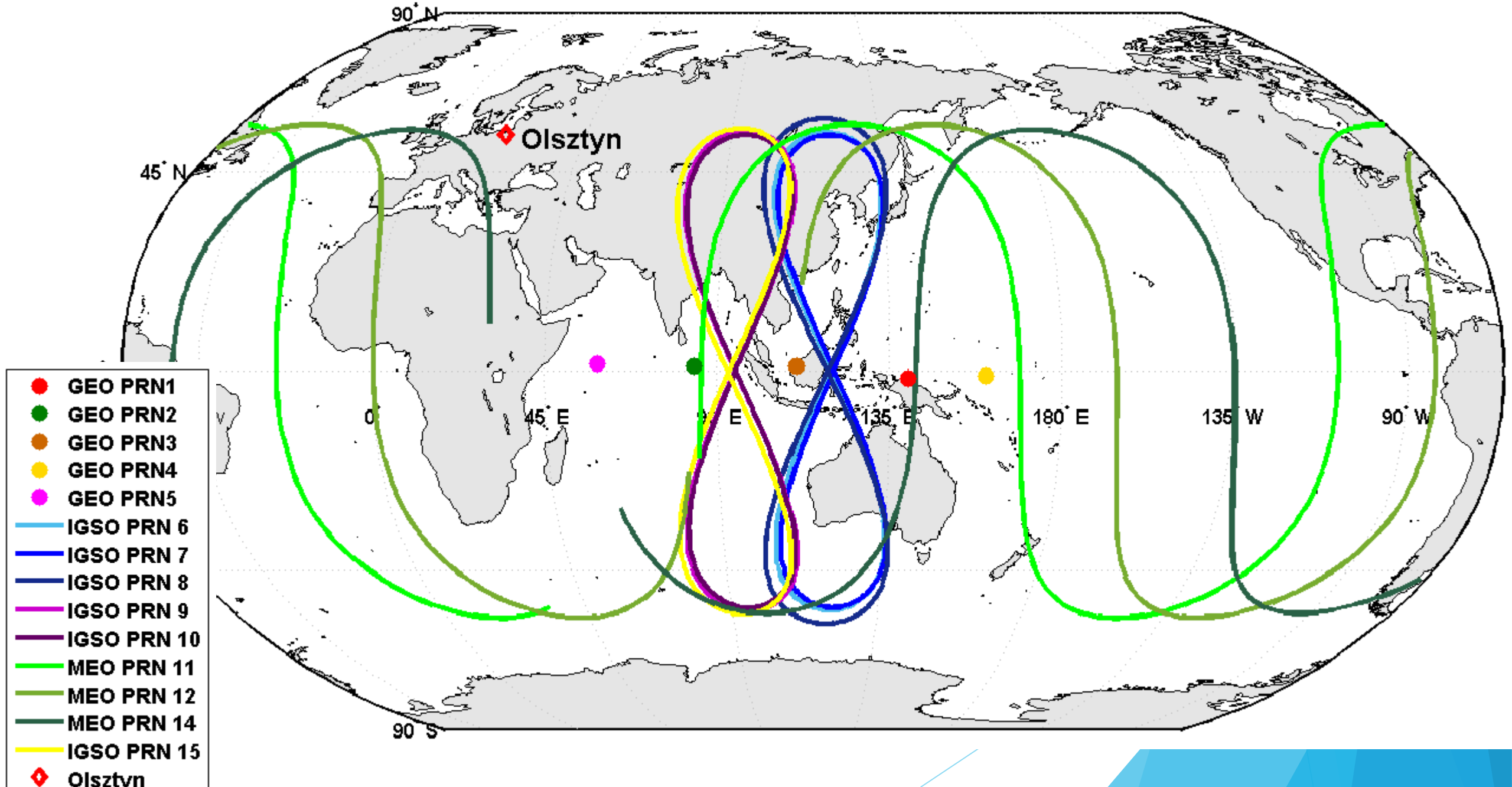
About BeiDou System

BeiDou system use the following frequencies[1]:

- B1 = 1561,098 MHz, from third generation 1575,42 MHz (shared with GPS L1 and Galileo E1);
- B2 = 1207,140 MHz, from third generation 1191.795 MHz (B2a = 1176.45 MHz shared with GPS L5 and Galileo E5a, B2b = 1207.14 MHz shared with Galileo E5b);
- B3 = 1268,520 MHz.

[1] Source: Mingquan Lu, Zheng Yao, New Signal Structures For BeiDou Navigation Satellite System, 2014

BeiDou System constellation

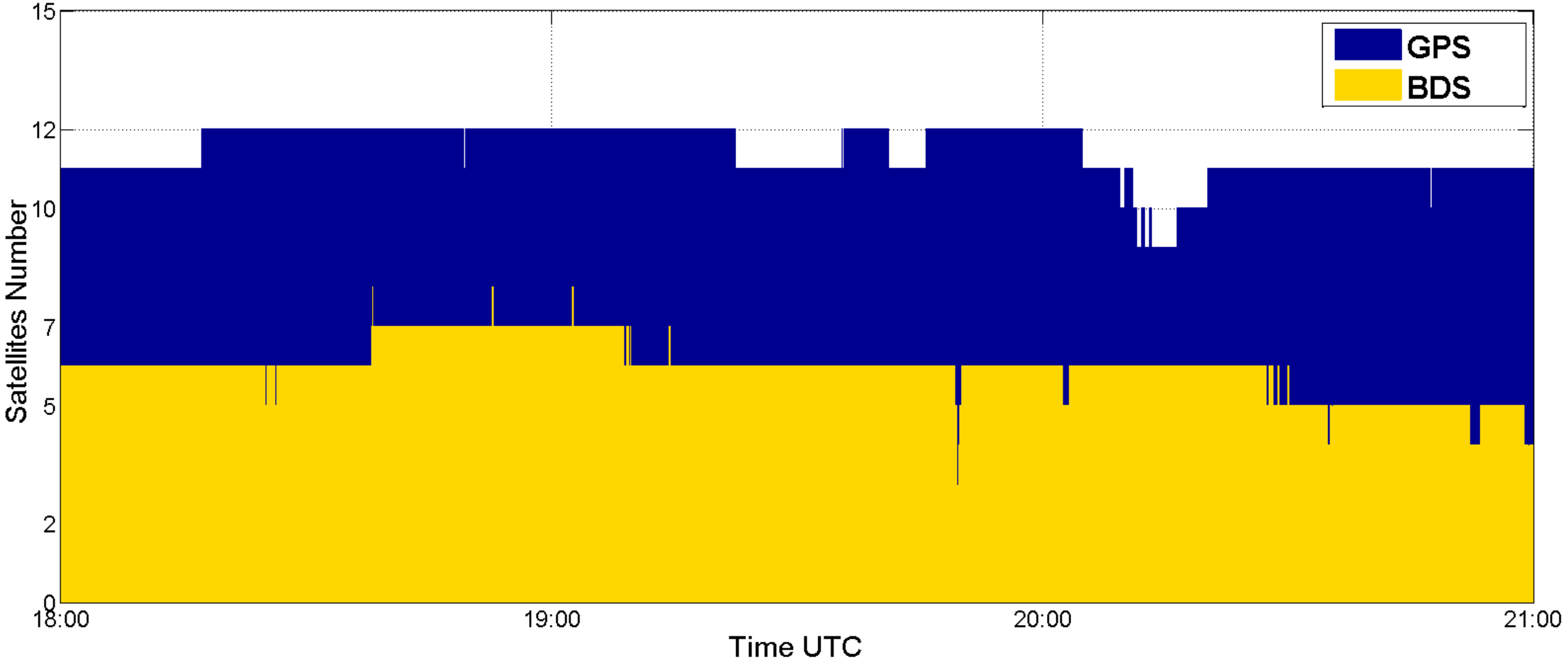


Test description

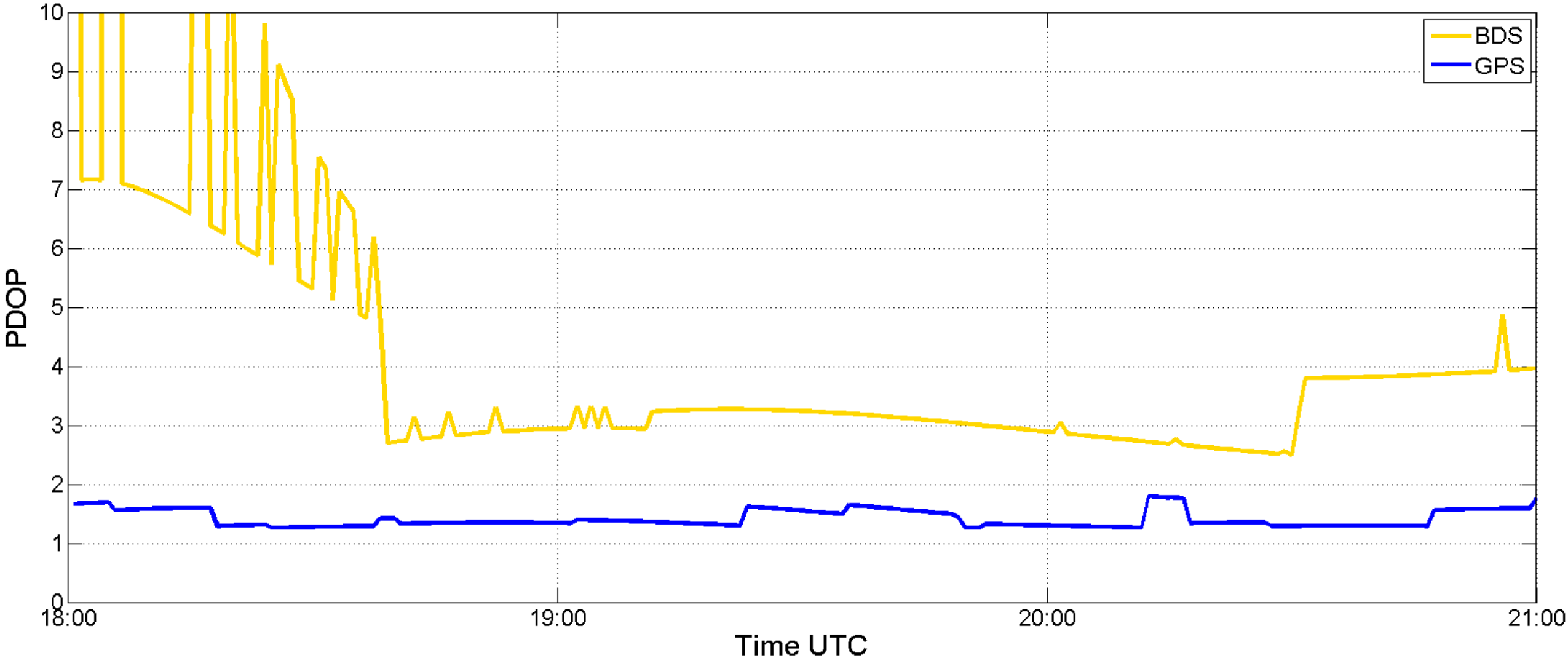
- Test were carried out on data from August 17 2016.
- 3h observation session (18:00-21:00 UTC) with 5 seconds interval was used.
- Data come from two stations in Olsztyn, KRO1 (reference station) and OPNT (rover).
- Baseline length: about 4300 m.
- MAFA method was used.
- Single-epoch positioning was used.

(The Modified Ambiguity Function Approach (MAFA) is a method of GNSS carrier phase data processing. In this method, the integer nature of the ambiguities is taken into account in the functional model of the adjustment).

Satellites number

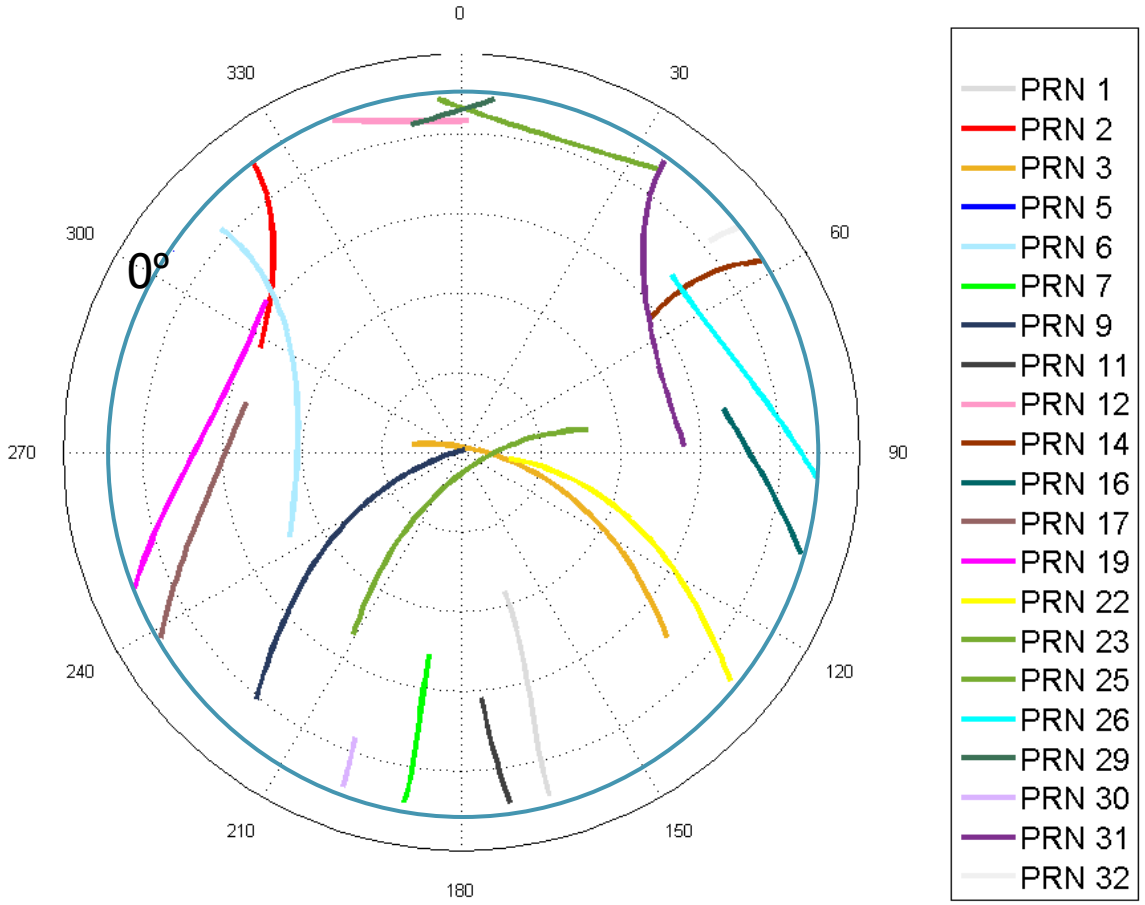


PDOP factor

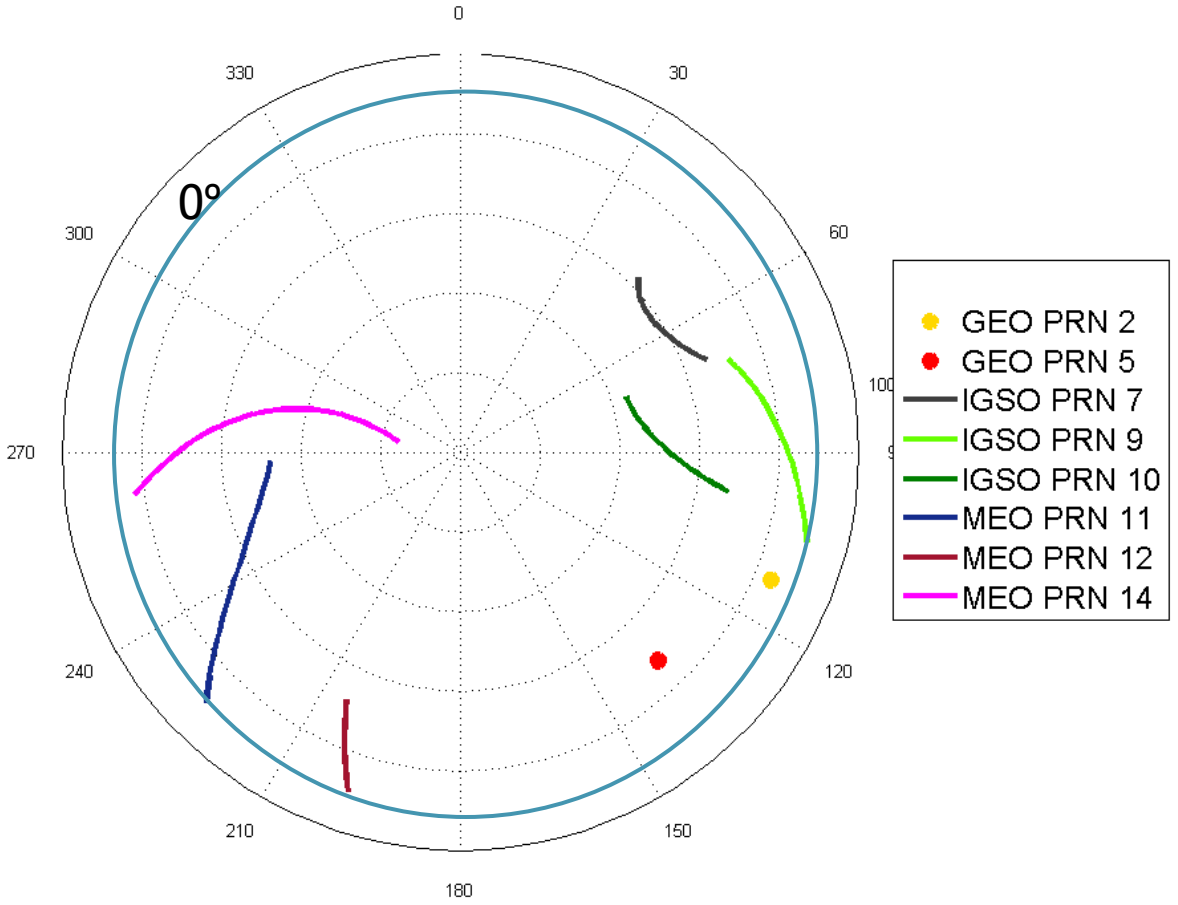


Skyplot

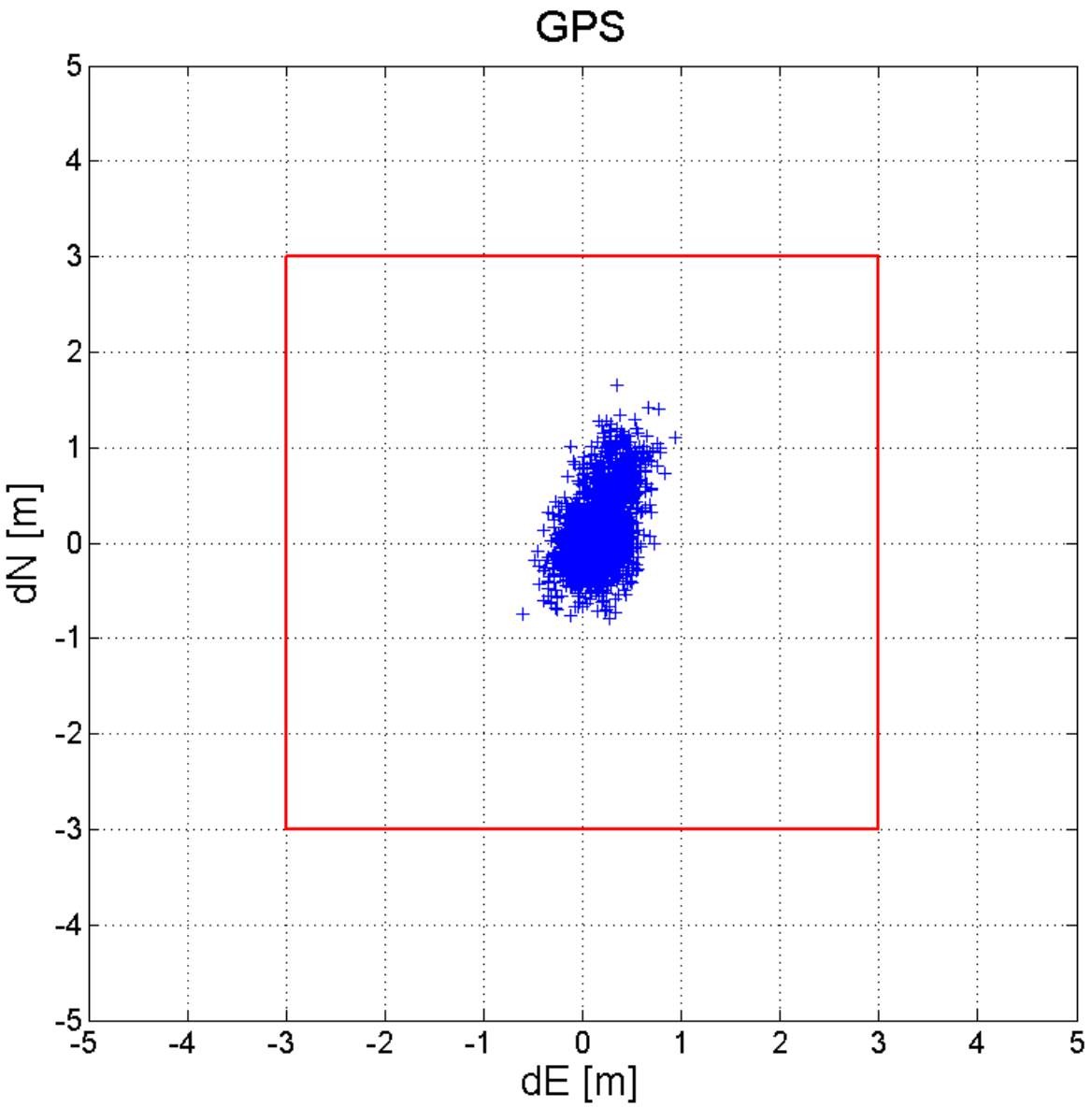
GPS

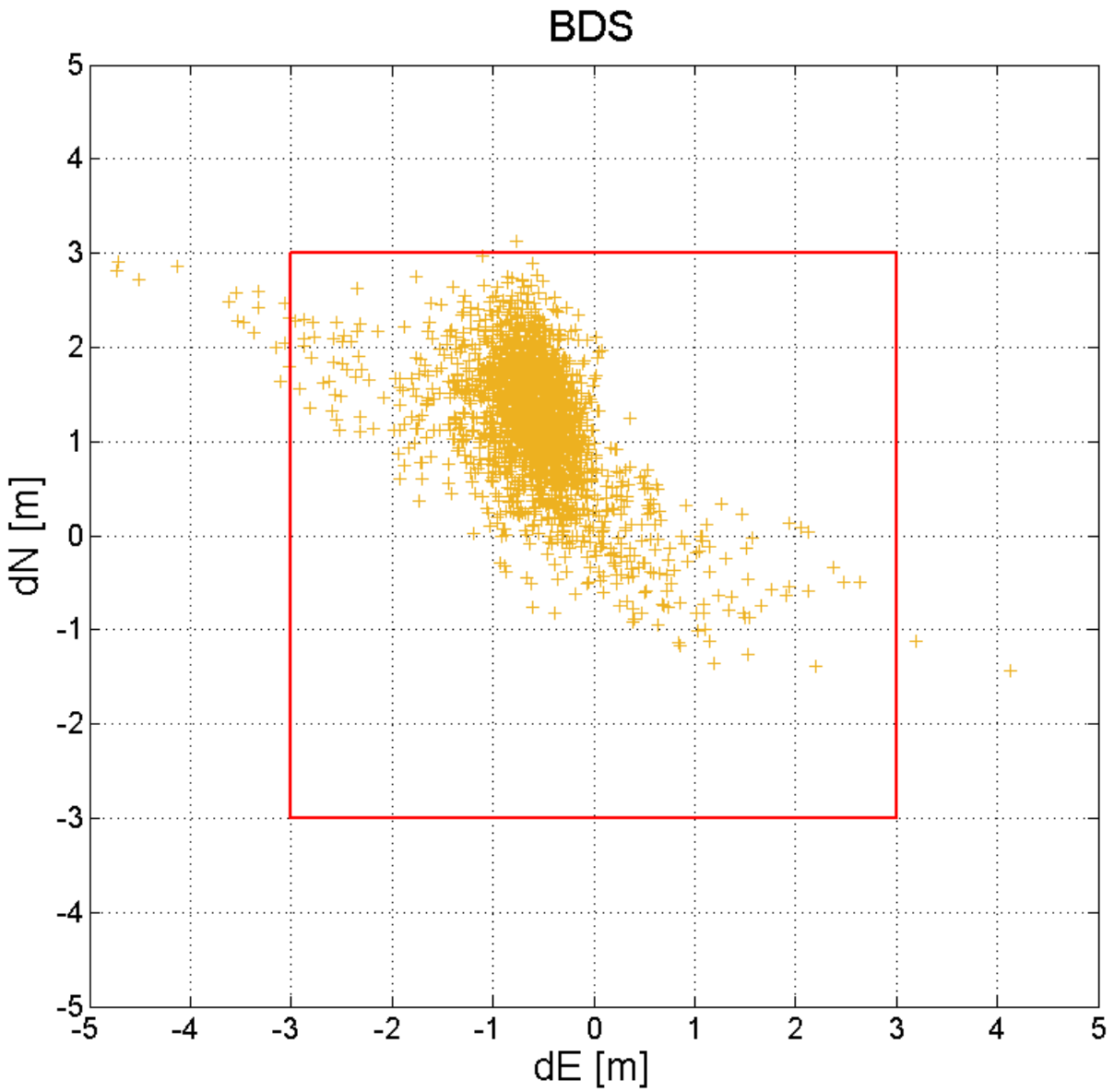


BDS

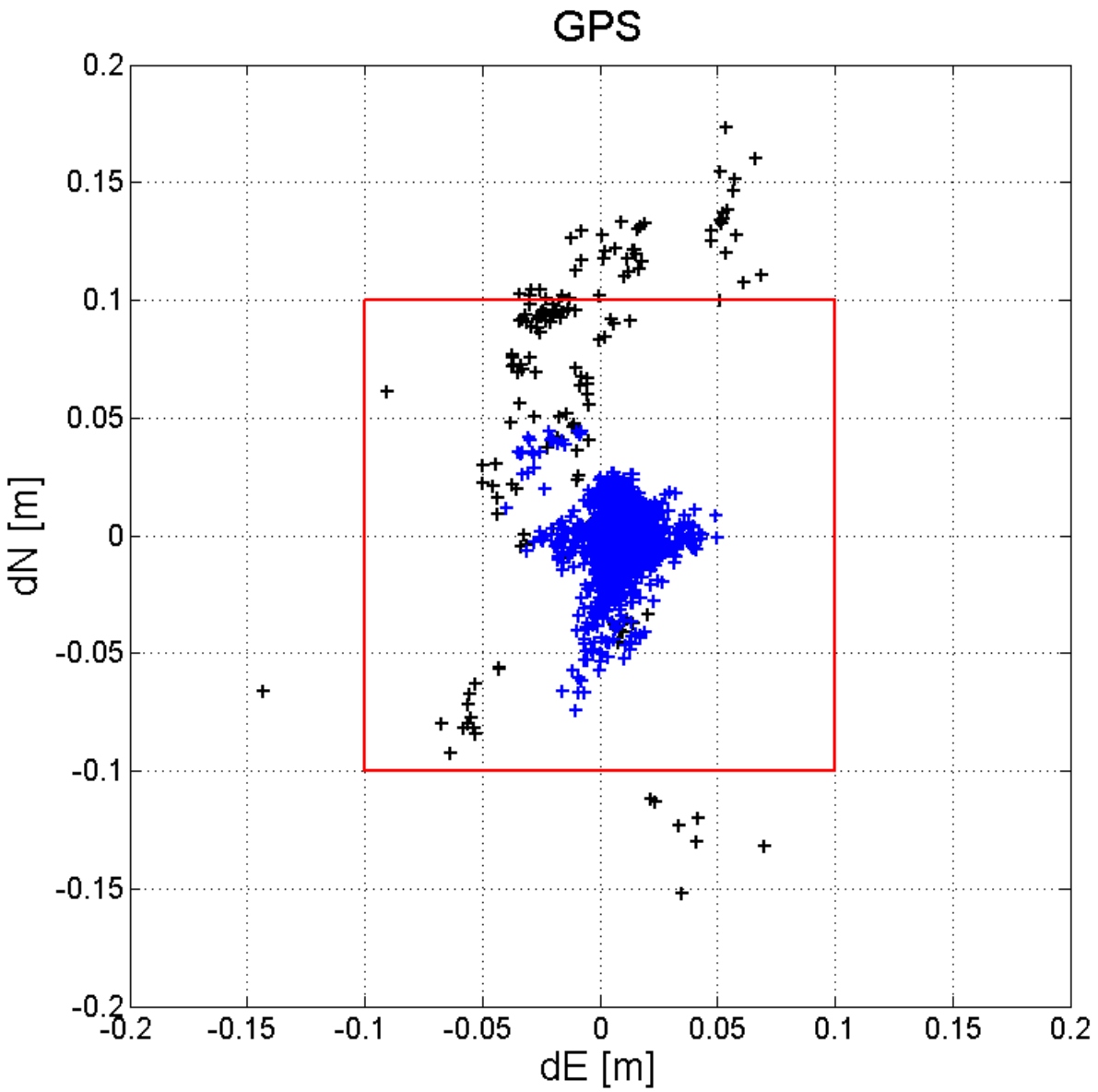


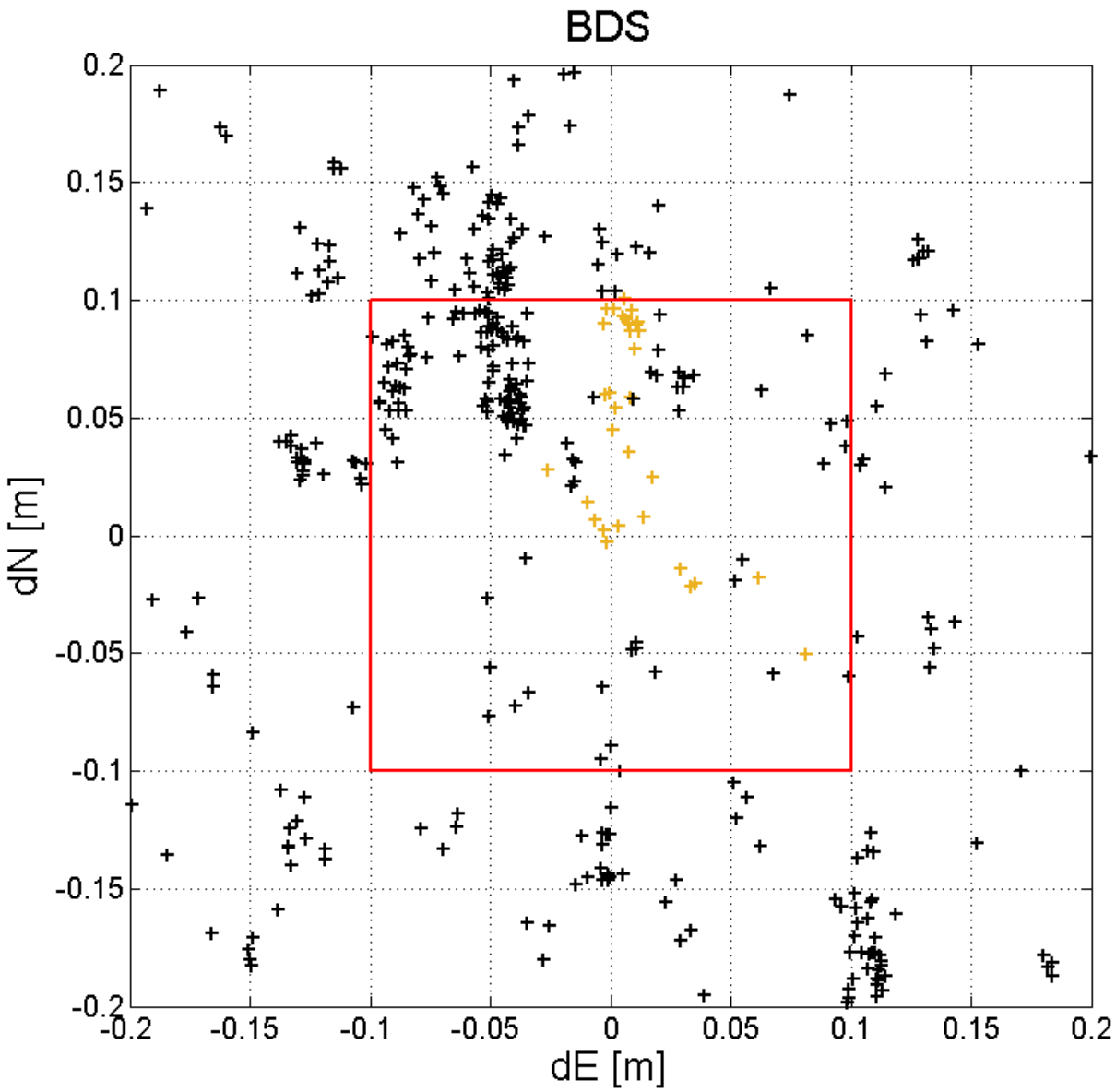
DGNSS Results



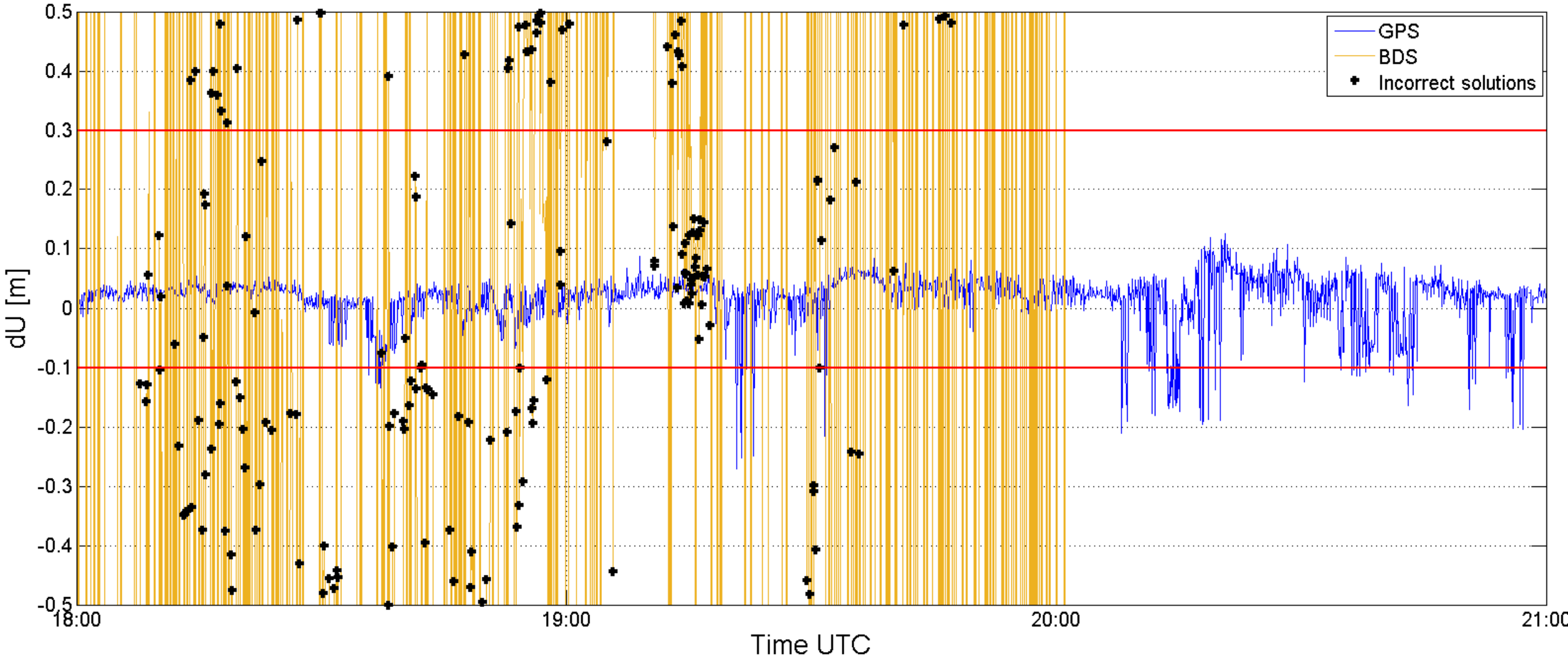


Precise positioning Results dE and dN





Precise positioning Results
dU



Results

	GPS		BDS	
	DGNSS			
dN	0,15	0,38	1,19	0,73
dE	0,16	0,20	-0,59	0,77
dU	-0,16	0,56	-0,90	3,65
	Precise positioning			
dN	-0,004	0,013	0,091	0,156
dE	0,010	0,010	-0,086	0,318
dU	0,026	0,026	-0,306	1,463
Solutions	Correct	Incorrect	Correct	Incorrect
	2007	153	752	1408
	93%	7%	35%	65%

Summary

- In Central Europe, it is possible to obtain precise position using only BeiDou System. However, it is possible only in short period of time.
- The number of obtained correct solutions and precision are still low.
- PDOP factor for BDS is still hight in Europe.
- However still increasing number of satellites give us a hope that in short period of time it will be possible to use BDS for precise positioning not only in short periods of time.

Thank you for your attention!

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