Bundesamt für
Kartographie und Geodäsie

Control networks and R2016

Yüksel Altiner

Bratislava, 21.11.2017

Outlines

1. Control networks
2. SA*POS*® - An overview
3. SA*POS*® - Monitoring
4. Realisierung 2016 (R2016)
5. Test field for GNSS

Control networks

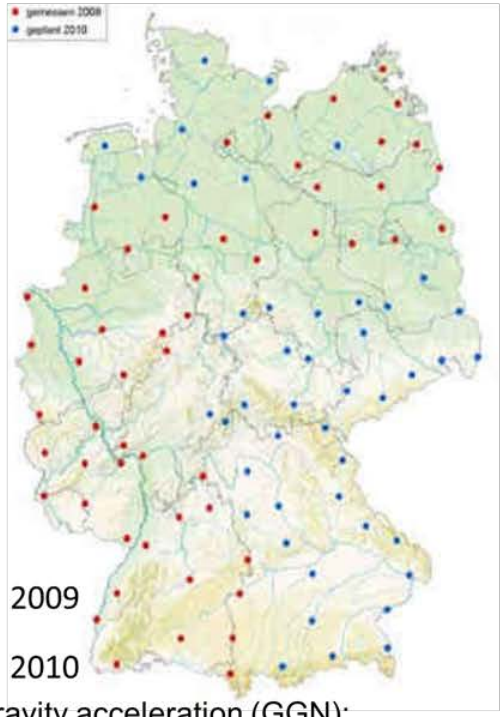
- The 1st order points for height (HFP) form the German main height network (DHHN),
- the 1st order gravity points (SFP) form the German main gravity network (DHSN),
- the reference stations (RSP) form the reference station network (RSN – ground marked stations only),
- the geodetic control stations (GGP) form the geodetic main network (GGN).

Networks of the R2016

Levelling (2006-2012)

- 7 Leveling main points
- 65 GNSS + RSP
- Wallenhorst (Datum DHHN92)

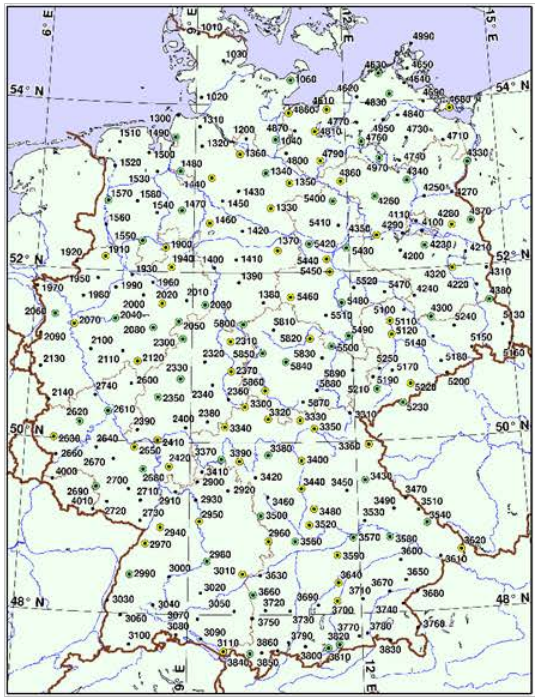
Gravity (2009-2010)



- 2009
- 2010

Gravity acceleration (GGN):
100 stations: by absolute gravimetry,
150 stations by relative gravimetry.

GNSS (2008)



GGN (250 stations)

SA*POS*® - An overview

- SA*POS*® is a positioning service and operated by the AdV (Surveying Authorities of the States of the Federal Republic of Germany),
- SA*POS*® provides the current official spatial reference for everyone with state-of-the-art technigue (ETRS89),
- SA*POS*® is the legal task of the state land surveying in Germany (real-estate cadaster, infrastructure).

SA*POS*® - A short history

Developing	Installation	Production	Innovation
1994-1998	1999-2003	2003	2015
Network test	Cadastral surveying	Quality management	Galileo, PPP

Decision by the AdV in 1995 (96. plenum) for the setting up the SA*POS*®

Certificate of the German Patent and Trademark Office from 20.01.1997

BUNDESREPUBLIK DEUTSCHLAND

URKUNDE

über die Eintragung der Marke

Nr. 396 30 023

SAPOS

Markeninhaber:
Das Land Nordrhein-Westfalen vertreten durch das Landesvermessungsamt Nordrhein-Westfalen, Bonn

Tag der Anmeldung: 10.07.1996 Tag der Eintragung: 20.01.1997

Der Präsident des Deutschen Patentamts

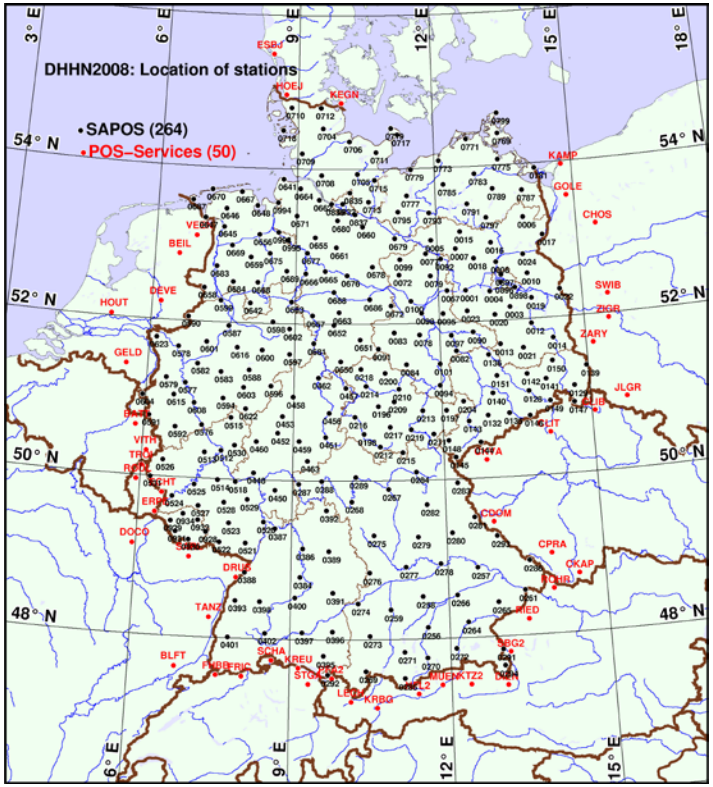
N. Haugg

Bundesamt für Kartographie und Geodäsie

SA*POS*® -Positioning Services

- ~270 reference stations
- Cross border networking
- Interoperability
  (International standard definition –
  RTCM, RINEX, NMEA, NTRIP)
- Standardized fees (AdV-catalogue)
- Standardized quality management
- GPS, GLONASS ➡ Galileo ➡ Beidou

EPS (Real-time)
HEPS (High precision real-time)
GPPS (Geodetic postprocessing)



http://www.sapos.de

Bundesamt für Kartographie und Geodäsie

SA*POS*® - Service characteristics

http://www.sapos.de

SA*POS*®	EPS	HEPS	GPPS
Procedure	Real-time	Real-time	Post-processing
Accuracy-position	3 - 8 cm	1 - 2 cm	≤ 1 cm
Accuracy-height	50 - 150 cm	2-3 cm	1-2 cm
Transmission technique	Ntrip over Internet (GPRS, UMTS, LTE)	Ntrip over Internet (GPRS, UMTS, LTE), GSM	Internet (Web Server)
Clocking unit	1 second	1 second	1 second
Unit	Inapplicable	1 minute	1 minute
Fee per unit	150 € p. a.	0,10 €	0,20 €
Standard, format	RTCM 2.3	RTCM 2.3, RTCM 3	RINEX 2.1

SA*POS*® -Quarterly monitoring

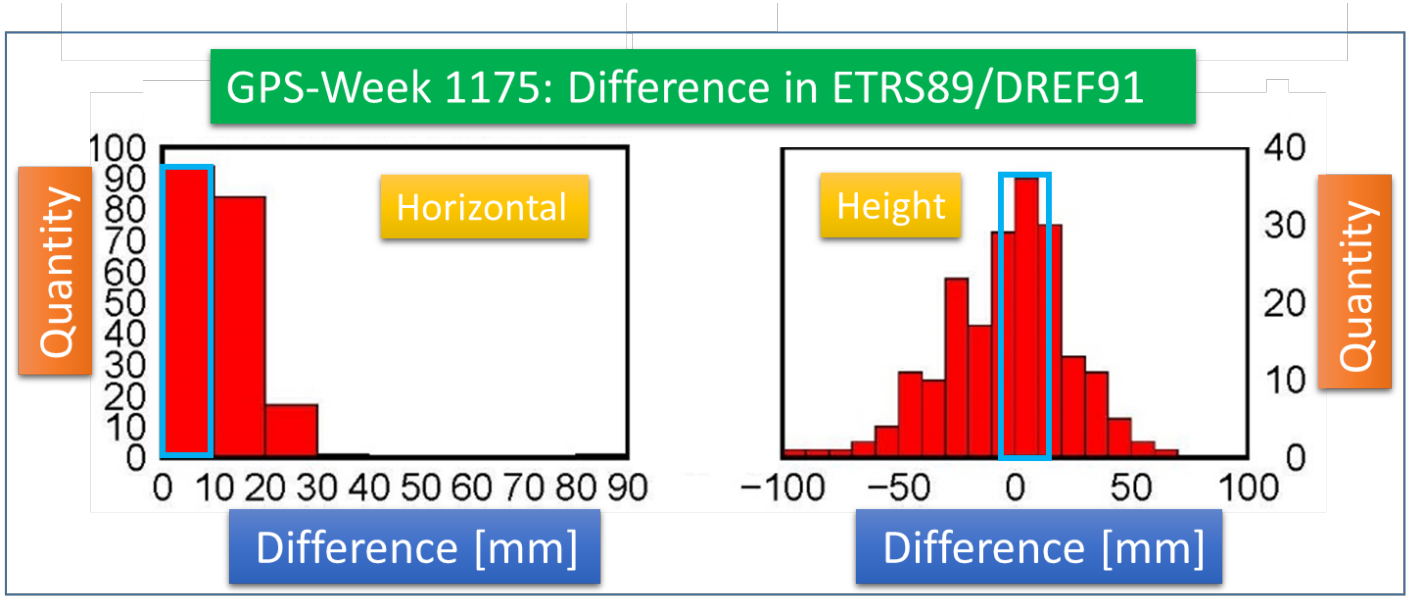
Precursor of the DREF-Online

From the GPS-Week 0991 (03.01.1999) to 2005

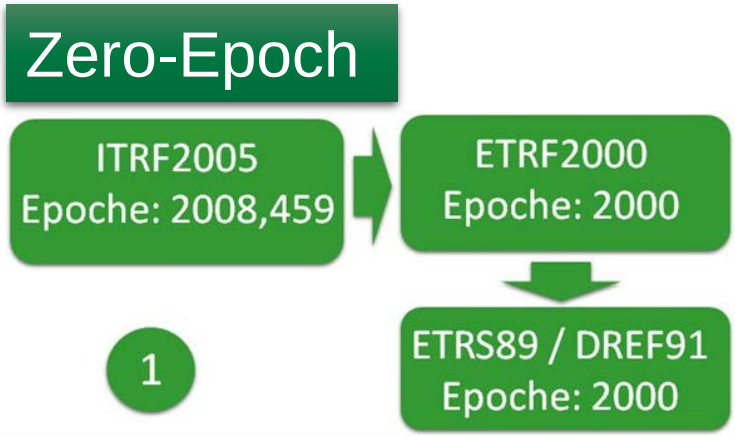
Variation of differences

GPS-Week 1175 (14.7.2002)

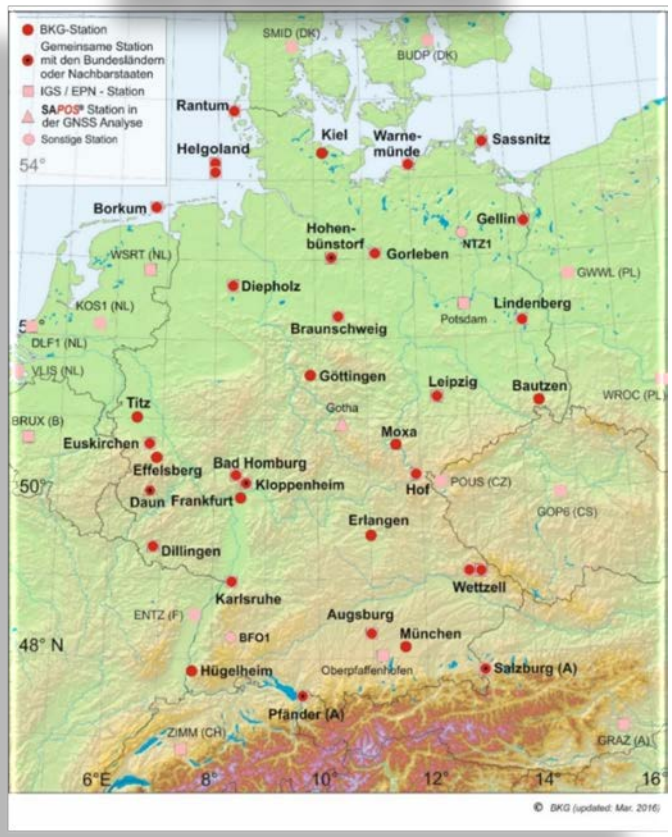
Limits: 2D-Position 10 mm, Height 15 mm



DREF-Online for monitoring the SA*POS*® reference stations



As of March 2016

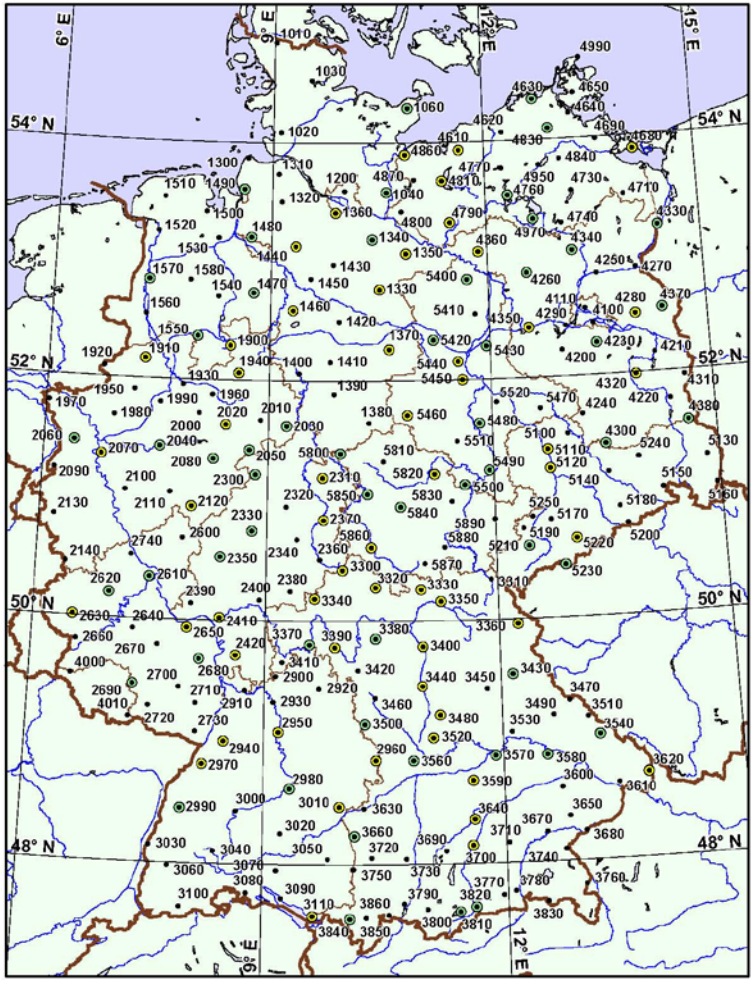


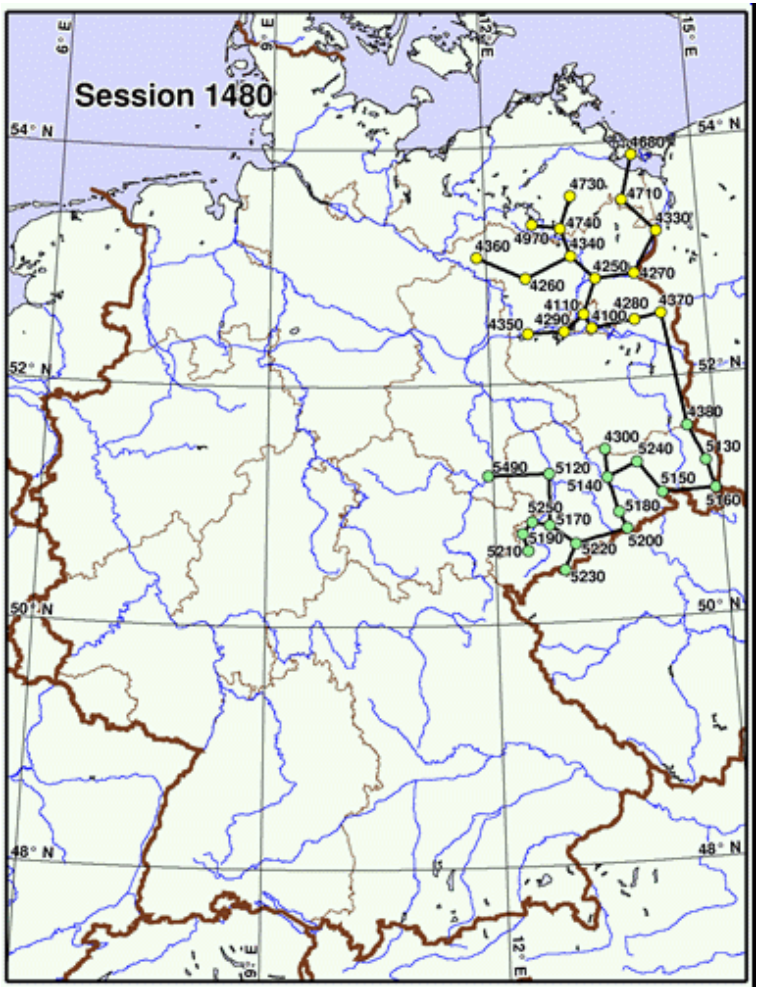
DREF-Online (as of 20.09.2017):
61 stations from the
GREF, SA*POS*®, IGS and
EUREF permanent networks.

Realisations of the geodetic spatial reference frames in Germany

Campaign	Coordinates at IGS/ITRF Reference	Reference frame Realisation
1991: German Reference Network (DREF91)	ITRF91 (1991,3) (Lindstrot, W., 1999, BKG/Band 9)	ETRS89/DREF91 Realisation 1994
2002: SA*POS*® Diagnostic adjustment	ITRF2000 (2002,8) (Altiner, Y., *ZfV* 4/2005)	ETRS89/DREF91 Realisation 2002
2008: DHHN-GNSS-Campagne	IGS05 (2008,5) (in preparation, 2018)	ETRS89/DREF91 Realisation 2016

R2016: GGN





Trimble

Leica

Bundesamt für
Kartographie und Geodäsie

Equipments

Adapter for measurement of the antenna height FG-ANA 100B (Source: FPM 2008).

Calibration of antennas in Garbsen und Berlin

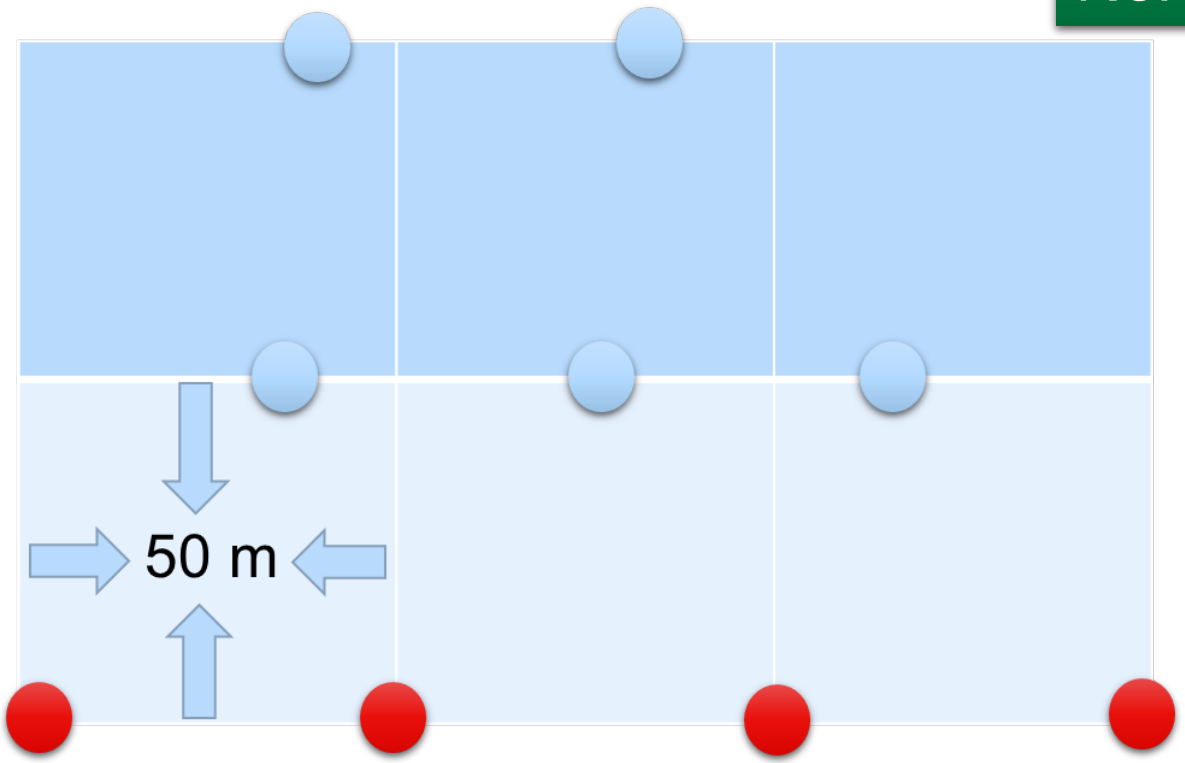
Company	Receiver (Quantity)	Firmware	Antenna (Quantity)
Leica Geosystems	GX1230GG (16) GRX1200GGPRO (2)	5,62	LEIAT504GG (17)
Trimble Navigation	Net R5 (15) R7 GNSS (4)	3,5	TRM29659.00 (18)

R2016: Network extended

Network	Sta.	Network	Sta.
GGN	250	EXAGONE (FR)	6
GREF	29	GPSnet.dk (DK)	3
IGS	8	GUGIK (PL)	8
SAPOS (D)	264	SPSLUX (L)	4
06GPS (NL)	5	SWIPOS (CH)	5
APOS (A)	10	WALCORS (B)	2
CZEPOS (CZ)	7	Total	601

MATE at BKG only

NRW: Test field for GNSS



North Rhine Westphalia

GNSS:
Max. horizontal difference = 1.5 cm

Control point

Connection point

Tachymeter:
Max. horizontal difference = 1.0 cm

Determination of GNSS control points

- Calibration of antenna in the calibration chamber,
- Each point must be measured at least twice,
- Session length ≥ 90 min. with an observation interval of 15 s,
- Coordinates at UTM derived from ETRS89.

Thank you very much for your attention!

Contact

Federal Agency for Cartography and Geodesy
Richard-Strauss-Allee 11
60598 Frankfurt

Dr. Yüksel Altiner
yueksel.altiner@bkg.bund.de
www.bkg.bund.de
Tel. +49 (0) 69 6333-276