Federal Agency for
Cartography and Geodesy

2016 National Report of Germany

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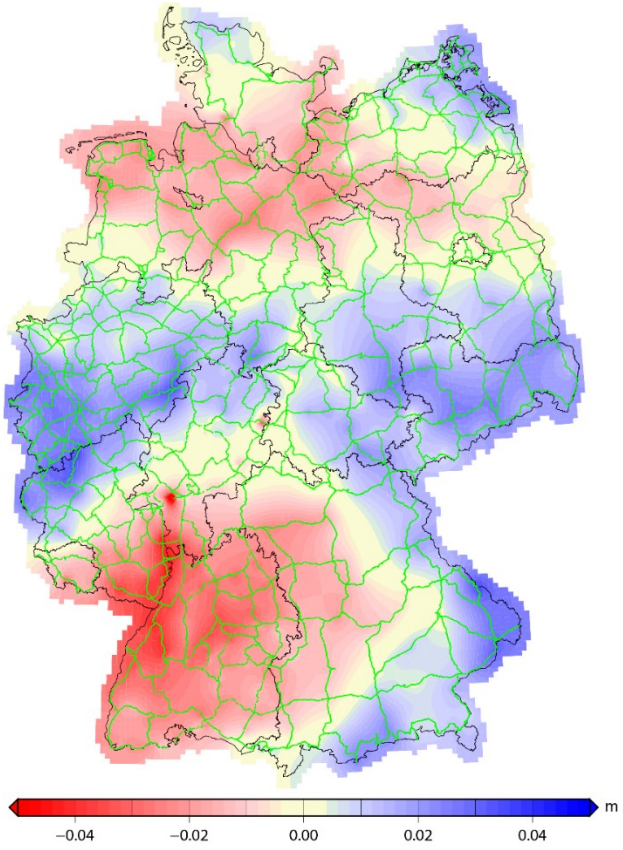
Preparation for the Introduction of DHHN2016



Preliminary transformation model

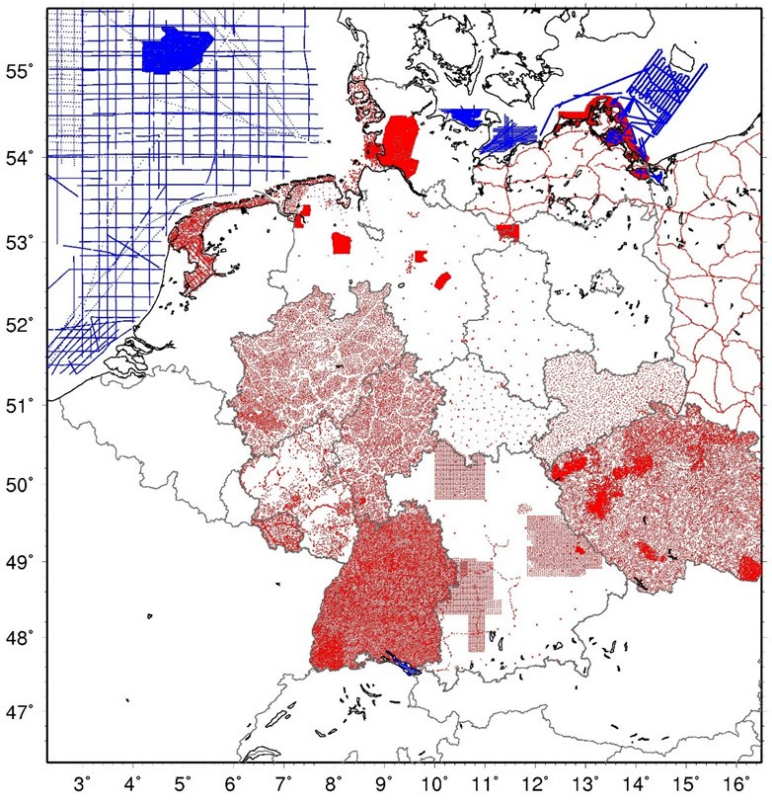
- **further measurements in 2nd order leveling networks by German countries**
- **inclusion of subordinated leveling networks (new or digital available old data) in the new reference frame**
- **Computation of a model for height transformation from old to new height reference frame by BKG (almost finished)**
- **Transformation model will be available free of charge in the internet**
- **2017: synchronized introduction of heights: DHHN2016, quasigeoid: GCG2016, gravity: DHSN2016 and coordinates: ETRS89/DREF91/2016**

New quasigeoid model GCG2016 in preparation

- **New digital elevation model (DGM25)**
- **Improvement of the software for terrain corrections and geoid modelling**
- **First results: Comparison of 450 GNSS/leveling points with a 1st gravimetric geoid solution (considering only a corrective plane):**

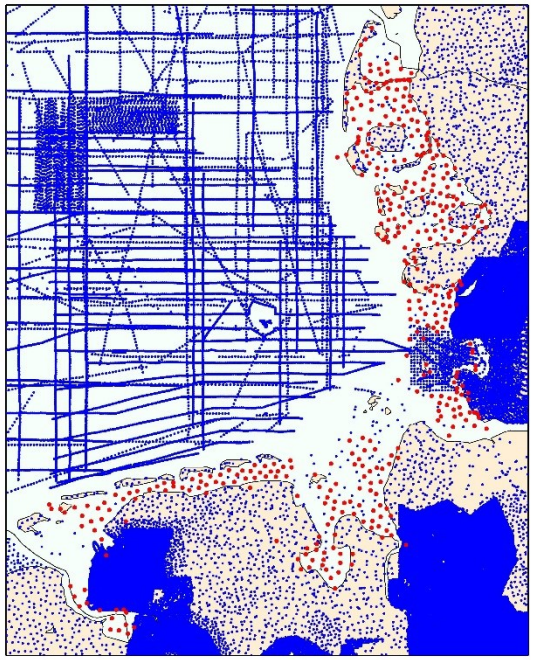
standard deviation	**1.0 cm**
min	**-3.6 cm**
max	**2.9 cm**

New gravity data:



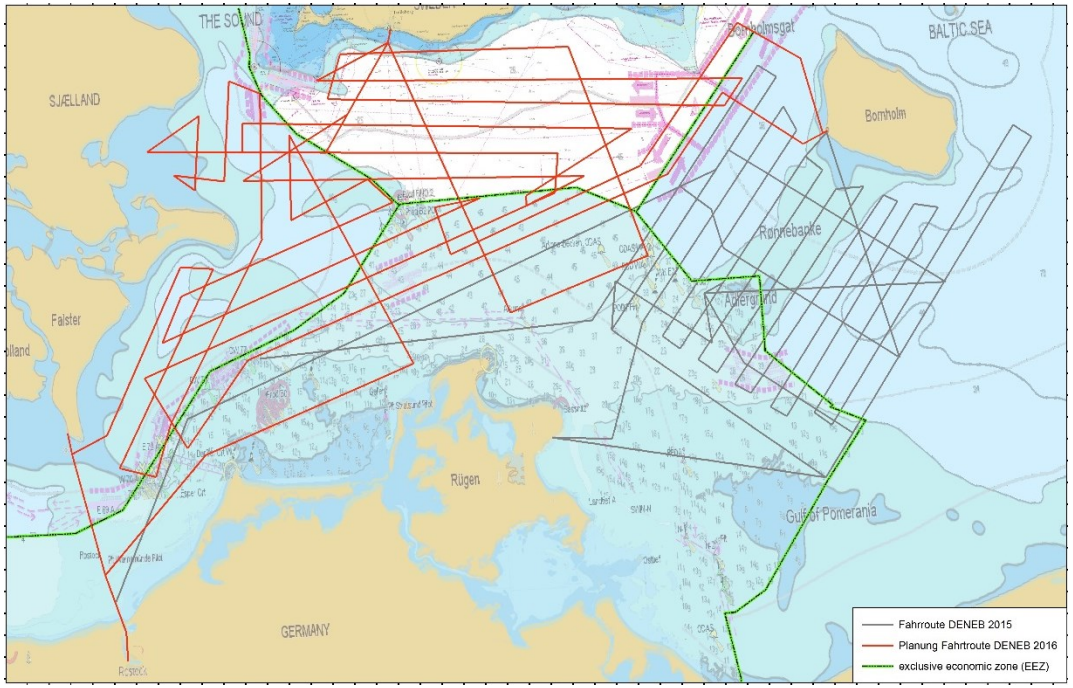
Gravimetric Survey of intertidal mudflats

- **Almost no gravity data in the intertidal mudflats so far**
- **Measurements 2014 (red points in the map) and 2015: 416 points**
- **Measurements 2016: 59 points**
- **in cooperation with**
  - ***Landesbetrieb für Küstenschutz, Nationalpark und Meeresschutz Schleswig-Holstein***
  - ***Landesamt für Vermessung und Geoinformation Schleswig-Holstein***
  - ***Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz***
  - ***Wasser- und Schifffahrtsverwaltung***
  - ***Landesamt für Geoinformation und Landesvermessung Niedersachsen***



Seaborne gravity measurements in the Baltic Sea and the North Sea

2013: Baltic Sea,
10 days, 1500 km
2015 (April): Baltic Sea
10 days, 1600 km
2015 (June): North Sea
2016 (May 24 – June 02): Baltic Sea, 2000 km (red lines in the picture)



Cooperation with

- Landmäteriet Sweden
- DTU (Technical University of Denmark)
- Geoforschungszentrum Potsdam (GFZ)
- Bundesamt für Seeschifffahrt und Hydrographie (BSH)
- FAMOS project

FAMOS – ODIN Subactivity 2.4

- EU co-financed project lead by Sweden
- Objective of Subactivity 2.4
  - Pilot study: GNSS-real time positioning of the German Surveying Vessel „Deneb“ owned by BSH using SSR correction data based on open standards
  - First campaign started May, 24

Modernization of German integrated geodetic reference network (GREF) – News since 2015

Titz (TIT2)

Sassnitz (SAS2)

Rebuilding of the stations Titz and Sassnitz. Both stations were now marked by deep founded pillars

BKG Ntrip Client (BNC) 2.12

- **BNC's application areas are for example:**
  - **Decoding of RTCM, RTNET (exchange format for SSR data) streams**
  - **RINEX and SP3 or ASCII file input and output**
  - **Encoding and Upload of State Space Representation (SSR) messages**
  - **Encoding and Upload of ephemeris messages**
  - **Precise Point Positioning (PPP)**
  - **Combining of SSR messages from various real-time sources**
  - **Merging ephemeris messages from various real-time sources**
  - **RINEX file based Quality Check**

BKG Ntrip Client (BNC) 2.12

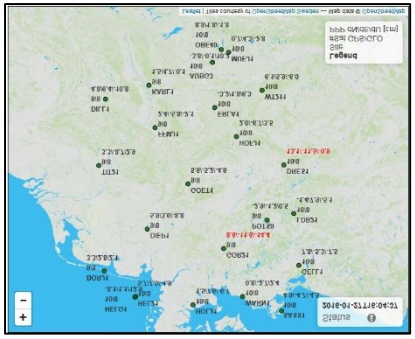
- **New or extended features:**
  - **Support of new GNSS signals (BDS, Galileo, and QZSS and SBAS)**
  - **Simultaneous multi-station Precise Point Positioning**
  - **Comparison of satellite orbit files in SP3 format**
  - **Broadcast Ephemeris Data Check**
  - **Full support of all BNC options via Command-line User Interface (CUI)**
  - **Support of RINEX v3 (long) filenames**

BKG Ntrip Client (BNC) 2.12

Multi GNSS Support

GNSS	RTCM Message #	RTCM Decoding	RINEX ASCII In- & Out put, QC	RTCM Encoding & Upload	PPP	Combination
Observations						
GPS	1001 – 1004 1071 – 1077	X X	X X		X X	
GLONASS	1009 - 1012 1081 – 1087	X X	X X		X X	
Galileo	1091 – 1097	X	X		X	
SBAS	1101* – 1007*	X	X			
QZSS	1111 – 1117	X	X			
BDS	1121* – 1127*	X	X		X	
Ephemerides						
GPS	1019	X	X	X	X	X
GLONASS	1020	X	X	X	X	X
Galileo	1045 1046*	X X	X X	X X	X	
SBAS	1043*	X	X	X		
QZSS	1044	X	X	X		
BDS	63*	X	X	X	X	
SSR Orbits, Clocks, Combined Orbits and Clocks						
GPS	1057, 1058 1060	X X	X X	X X	X X	X X
GLONASS	1063, 1064 1066	X X	X X	X X	X X	X X
Galileo	1240*, 1241* 1243*	X X	X X	X X	X X	
SBAS	1246*, 1247* 1249*	X X	X X	X X		
QZSS	1252*, 1253* 1255*	X X	X X	X X		
BDS	1258*, 1259* 1261*	X x	X X	X X	X X	
SSR Code Biases, Phase Biases						
GPS	1059 1265*	X X	X X	X X	X (X)	
GLONASS	1065 1266*	X X	X X	X X	X (X)	
Galileo	1242* 1267*	X X	X X	X X	X (X)	
SBAS	1248* 1268*	X X	X X	X X		
QZSS	1254* 1269*	X X	X X	X X		
BDS	1260* 1270*	X X	X X	X X	X (X)	
SSR VTEC						
GNSS	1264*	X	X	X	(X)	

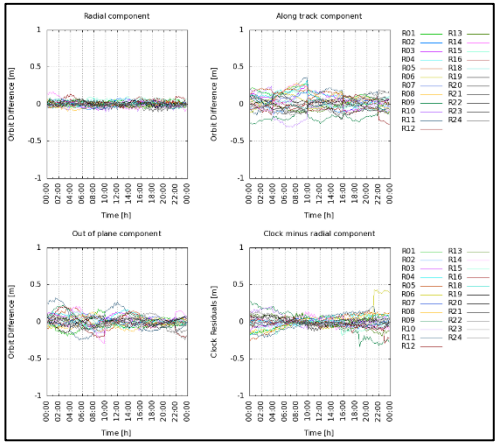
Multi station PPP



Real-time displacement-monitoring of the Integrated Geodetic Reference Network of Germany (GREF).

North, East and Up displacements referring to a XYZ reference coordinate; Number of GPS/GLONASS satellites.

Comparison of Satellite Orbits and Clocks



Visualization example of an orbit and clock data comparison:

SP3 file generated from BKG's GPS+GLONASS SSR

Combination IGS03 versus ESA's rapid solution; DOY 23, 2016.

IGS Real-Time Working Group

- In 2016, BKG (in person of Axel Rülke) took over the position as IGS RT WG chair
- Main goals and tasks are
  - Development of open RTCM standards
  - Extension of estimated RTCM SSR parameters (phase biases, VTEC, additional constellations) to improve global PPP
  - Clear product policy for IGS RT product
  - Completion of set of primary broadcasters
  - Reduction of latency of combined products