Working Committee of the Surveying Authorities
of the Laender of the Federal Republic of Germany

National Report

2015 / 2016

AMTLICHES DEUTSCHES VERMESSUNGSWESEN

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2015 / 2016

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Bund and Laender Working Committee for Sustainable Regional Development	www.landentwicklung.de
German Geodetic Commission	www.dgk.badw.de

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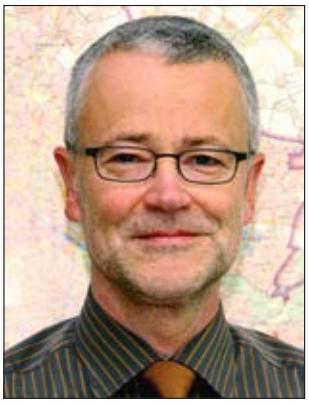


Dear Reader,

Geographic reference data is of fundamental importance for geospatial data infrastructures and e-government. Bearing this and the resulting nationwide responsibility in mind, the strategic cooperation between the federal government and the Laender in the Working Committee of the Surveying Authorities of the Laender of the Federal Republic of Germany (AdV) today focuses on safeguarding and ensuring a cross-Land provision of nationwide, standardised, quality assured geographic reference data.

With the "Strategy of AdV for the provision of geographic reference data via geospatial data services" (AdV Geospatial Data Services Provision Strategy) established in 2015, AdV has introduced a comprehensive overall strategic concept for the provision of geographic reference data via standardised internet services. This overall concept forms a basic framework that contains all the necessary requirements, defines work packages and assigns these to various players for implementation. Through this implementation, the geoinformation and surveying and mapping authorities can fulfil their role as central geospatial data service providers in a forward-looking way and meet the demands made of them in a modern information and knowledge society. Declining financial and human resources present a particular challenge in this context. Nevertheless, the mapping and cadastre authorities, and hence also the cooperation in AdV, will inevitably be judged according to how successful implementation is.

The ALKIS® migration has already successfully been completed. ALKIS® has been introduced in all 16 Laender since December 2015. There is already demand for the ALKIS® data, which is now available nationwide for the whole of Germany, from the German Federal Statistical Office in connection with preparations for the 2021 census and from the German Federal Revenue Administration against the background of the implementation of a real estate database relevant to taxation. In the years 2006 to 2012 the national levelling network was uniformly remeasured nationwide. The evaluation of the measurements was completed in 2015. All the quality requirements were fully met, meaning that in 2016 AdV can, among other things, make a resolution on the new reference frames for the German First Order Levelling Network 2016 (DHHN2016) and the German Primary Gravity Network (DHSN2016). In April 2016 the new version of the AdV Fee Directive came into effect. With this version, AdV's nationally standardised licence and fee model has been updated by adapting it in line with technical developments and taking into account current user requirements.

The milestones of cooperation presented here by way of example highlight the extent and diversity of the activities and thus the significance and responsibility of AdV. This national report gives detailed insight into all the current activities of the official mapping and cadastre sector and vividly documents the wide-ranging activities in the cooperation in AdV between the federal government and the Laender.

Thomas Luckhardt
Chair of AdV

1. Organisation and Performance of Tasks

In the Federal Republic of Germany, the Laender are responsible for accomplishing official surveying and mapping tasks. Since 1948, the appropriate authorities of the Laender and the Federal Ministries of the Interior, of Defence and of Transport, Building and Urban Development have been cooperating in the Working Committee of the Surveying Authorities of the Laender of the Federal Republic of Germany (AdV) in order to deal with technical matters of fundamental and national importance. The German Geodetic Commission (DGK), as a representative of geodetic teaching and research, and the Bund and Laender Working Committee for Sustainable Regional Development for the field of rural restructuring have guest status in AdV.

Surveying, mapping and real estate cadastral authorities of the Laender

The development of the surveying, mapping and cadastre sector into a modern geoinformation system is a process that has been accompanied by comprehensive reforms over the last decade. The key to modernising the administrative procedures of the mapping and cadastre authorities in the Laender is to open up the administrative bodies to adjacent areas in order for foundations for infrastructural and spatial planning policy to be provided in the network.

The mapping and cadastre authorities are split into various departments in the individual Laender, the department of the interior being most frequently represented. Structural changes have been made in many authorities. In certain Laender, the real estate cadastral authorities and in some cases also the regional development / farmland consolidation authorities are now integrated into the higher-level geoinformation authorities. In other Laender, local areas of responsibility have been expanded by the amalgamation of real estate cadastral authorities.

The key aspects of the geoinformation system – management of the real estate cadastre and geotopography as well as first order control and official reference systems – are the responsibility of the Laender. The original services offered include:

- the nationwide provision of spatial reference data via reference networks in the Authoritative Control Point Information System (AFIS®), consisting firstly of terrestrial control points and their documentation and secondly based on the satellite-supported positioning service SAPOS®
- the provision of a nationwide image of the surface of the earth through geotopographic products in the Authoritative Topographic-Cartographic Information System (ATKIS®) using landscape and terrain models, official topographic cartography and orthophotos
- the nationwide digital documentation of buildings and approx. 64 million land parcels in the official real estate cadastre for ownership rights in the land register, which will, in future, be managed throughout the Federal Republic using the Authoritative Real Estate Cadastre Information System (ALKIS®)
- the harmonisation of the data from the real estate cadastre and from surveying and mapping

Federal Agency for Cartography and Geodesy

The Federal Agency for Cartography and Geodesy (BKG) is a federal authority responsible to the Federal Ministry of the Interior. As a centre of expertise for geodesy, cartography and geoinformation, BKG is responsible for "Maps and Co-ordinates" within the sphere of the federal government. BKG is the central service of the federal government for topographic basic data, cartography and geodetic reference systems.

On the basis of the Federal Geographic Reference Data Act (Bundesgeoreferenzdatengesetz – BGeoRG), which came into effect in November 2012, BKG performs service and coordination tasks for federal authorities. In this context, the BKG Service Centre (DLZ) in Leipzig is the federal government's main location for official geospatial data.

Various federal institutions, public administration, the business and academic spheres – and almost every citizen in Germany – benefit from BKG's work. For example, the work of BKG forms the basis for efficient satellite navigation, such as via GPS or GALILEO. Experts from various sectors such as transport, disaster reduction, domestic security, energy and the environment make use of BKG geospatial data, maps, texts, reference systems and information services for their planning and research.

In cooperation with the Laender, BKG performs the following tasks in the field of geoinformation and geodesy:

- the provision and mapping of up-to-date analogue and digital topographic and cartographic information, as well as the advancement of the procedures and methods required for this purpose
- the provision and updating of the geodetic reference networks in the Federal Republic of Germany, including the requisite
    - surveying and mapping services and theoretical services for the acquisition and preparation of measurement data, and involvement in bilateral and multilateral activities for determining and updating global reference systems
    - advancement of the measurement and observation technology employed
- representing the interests of the Federal Republic of Germany in the field of geodesy and geoinformation at an international level

In the field of geodesy, BKG provides a standardised spatial reference framework (coordinate system) for all of Germany. To this end it operates three geodetic observatories in Wettzell, La Plata (Argentina) and O'Higgins (Antarctica) in cooperation with partner institutions. With various technologies, BKG here monitors, among other things, the movements of the earth satellites. With the aid of measurements carried out worldwide, satellite orbits, station coordinates and changes to the earth's surface are determined in the context of international cooperation.

The spatial reference for geospatial data is secured with various state-of-the-art geodetic technologies. For example, the calculated correction data of the Global Navigation Satellite Systems (GNSS) contributes to the greater precision and reliability of geo-referencing and of the satellite navigation systems in everyday use and also of Galileo in the future.

In the field of geoinformation and cartography, BKG is responsible for the processing, provision and updating of topographic and cartographic information.

Through the DLZ and the Central Office for Geotopography (ZSGT), BKG advises its customers and offers practice-oriented solutions and a multitude of geospatial data, web services and web applications. These include digital maps, terrain models, elevation models, aerial images, administrative boundaries, geographic names and additional topographic data. All the geospatial data is also made available as online services. In addition, the DLZ supports its customers by advising them and by means of needs-based applications.

The Spatial Data Infrastructure Germany (GDI-DE) represents the comprehensive networking of geospatial data at federal, Laender and municipal authorities. BKG coordinates the development, expansion and

maintenance of the federal part of the GDI-DE and operates its central components, such as Geoportal.de (**www.geoportal.de**).

Beyond Germany's borders, in close cooperation with its European and international partners in geodesy, BKG is contributing to the provision and implementation of a standardised spatial reference frame and with its partners in geoinformation to the development of a European and global geospatial data infrastructure.

Federal Ministry of Defence
Bundeswehr Geoinformation Service (BGIS)

Within AdV, the Federal Ministry of Defence (FMOD) is represented by the director of the Bundeswehr Geoinformation Service (BGIS) and Bundeswehr Geoinformation Centre (BGIC).

The mission of the BGIS is to ensure "GeoInfo support to the Bundeswehr" in and for military action and for domestic operations. In accordance with the policy of "geoinformation from a single-source provider", BGIS forces are responsible for the availability of quality-assured geoinformation in the theatre and for the identification and assessment of the impact of geofactors (e.g. terrain, weather, transportation, economy, climate, water).

On behalf of the Bundeswehr and at an inter-departmental level, the BGIC provides geoinformation covering crisis regions and areas of operations abroad.

It is the central agency of the BGIS which – taking an interdisciplinary approach – develops, shapes and implements the processes of GeoInfo data collection, GeoInfo data management and GeoInfo production that are relevant for GeoInfo support.

Fig. 1: Interdisciplinary approach – disciplines represented in the BGIS (credits: BGIC)

For the territory of the Federal Republic of Germany, comprehensive use is made of the data and products provided by the Federal Agency for Cartography and Geodesy (BKG) and the surveying and mapping authorities of the German Laender.

This civil-military cooperation ensures, among other things, that Bundeswehr forces operating on German territory have the same 1:50,000 and 1:100,000 maps as civilian relief or security personnel that may be deployed simultaneously. For digital geoinformation, the BGIS accordingly aims to transfer current geospatial data models and data for the German territory with a standardised structure in all Laender to the Bundeswehr GeoInfo Database in a single step so that they can be used for military purposes.

Further information about the geoinformation service/BGIC can be found under "KdoStratAufkl" at: **http://www.kommando.streitkraeftebasis.de/portal/a/kdoskb**

Federal Ministry of Transport and Digital Infrastructure (BMVI)

Bundesministerium für Verkehr und digitale Infrastruktur

The Federal Ministry of Transport and Digital Infrastructure (BMVI) has been a member of AdV since 1950, represented by the Geo-Coordination Agency. The latter coordinates the diverse use of the geographic reference information of the Laender in its area of responsibility with more than 15 high-level authorities and coordinates the transfer of expertise from the surveying and mapping units of the "wet section" to AdV.

The Federal Waterways and Shipping Administration (WSV) is responsible for the traffic-related and water-management-related maintenance of the German waterways (approx. 7,300 km of inland waterways and approx. 17,800 km² of sea waterways). Besides its maintenance duties, the legal duty to maintain safety on German waterways resides with WSV. The department of surveying/geoinformation provides, among other things, georeferenced data processed into user-oriented products, e.g. regarding water depths and the topography of the beds of bodies of water. Official surveying and mapping tasks are carried out throughout Germany that necessitate close consultation within AdV. Along the waterways, WSV has its own base network (position and elevation marks) and manages a digital map series (1:2,000), the content of which is used in updating the ATKIS® Basis-DLM.

For the offshore area, the Federal Maritime and Hydrographic Agency (BSH) conducts marine surveys in Germany's North and Baltic Seas as the most travelled waters of the world. Marine surveys and marine cartography provide essential foundations for environmental protection, the erection of offshore installations, coastal protection and hydraulic engineering. The survey region of BSH covers an area of some 57,000 km²,

equivalent to one sixth of Germany's land area. This is shown in a nautical chart series containing approx. 150 data records for electronic nautical chart systems, as well as 60 nautical charts in hard copy format. In addition, large volumes of data on the current and historical chemical, physical and biological condition of the water column in the German territorial sea as well as operational information and forecasting services for the water level, tides, waves and drift are available over an Internet-based geospatial data portal as a maritime component of the GDI-DE.

The "Geodesy" department of the Federal Institute of Hydrology (BfG) currently supports WSV in the fields of activity of Geodetic Reference Systems, Geokinematics, Hydrographic Surveying and Geotopography. For expert advice, the staff have the specialised knowledge required in the context of applied research and project execution. Intensive cooperation with universities and other research institutions is essential in this context.

All the agencies and higher-level authorities work closely with the surveying and mapping authorities of the German Laender and within the AdV working groups. The main emphases are on the exchange of information about topography, information technology and spatial reference, as well as the use of SA*POS*® services, especially in the reception range over the sea.

In addition, on behalf of the federal government, BMVI is responsible for coordinating the earth observation programme "Copernicus" of the European Union (formerly Global Monitoring for Environment and Security – GMES). Through the implementation of a national "Copernicus programme of measures", citizens and companies in Germany are to noticeably benefit from the European earth observation programme "Copernicus". This is to be achieved by realising the potential resulting from Copernicus for a more effective and efficient public service.

Further details about geoinformation in the sector can be found on our website **www.bmvi.de/EN**.

Organisation of AdV

Figure 2 shows the organisation of AdV. It is led by the Chair and the Plenum. AdV is supported by the working groups and the management.

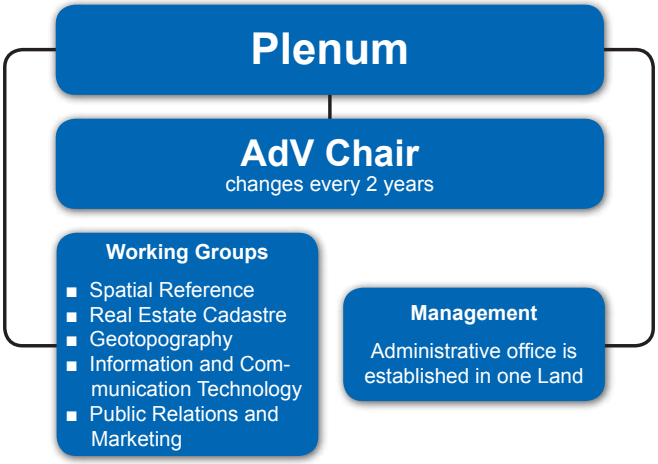


Fig 2: Organisation of AdV

Objectives and tasks of AdV

The member authorities collaborate in AdV to

- regulate field-related matters of fundamental and cross-regional importance for official surveying and mapping in a standardised manner
- create a pool of geographic reference data that is essentially standardised and geared towards meeting the requirements of the information society
- provide the infrastructure for geographic reference data as an important component for modern e-government architectures

In order to achieve these objectives, AdV performs the following tasks:

- creation and coordination of future-oriented joint concepts for the nationwide standardisation of the real estate cadastre, surveying and mapping and the geographic reference information system, to meet the needs of politicians, industry and administrative units
- promoting the joint execution of projects of cross-regional importance
- facilitating and coordinating, firstly, standardisation procedures for recording and managing geographic reference data and, secondly, methods of access and distribution

- support in establishing and developing the national and European geospatial data infrastructure and the corresponding electronic services
- representation and presentation of official surveying and mapping to the public
- involvement in international specialist organisations for promoting the transfer of expertise
- collaboration with organisations and agencies from related fields and with institutions of geodetic research and teaching
- coordination on issues of specialist training

Geobasis Steering Committee

The Geobasis Steering Committee, in which all Laender are represented, was established in 2010 under the administrative agreement for cooperation in the Official Surveying and Mapping in Germany. The administrative agreement aims to further improve the operational implementation of the strategies agreed on in AdV and to further optimise cooperation across Germany. Furthermore, the Geobasis Steering Committee is to ensure that the geographic reference data is provided in standardised form to all users in the quality required.

The Geobasis Steering Committee has the following tasks and powers for the implementation of strategic resolutions adopted by AdV:

- monitoring and analysis of work and development situations, including compliance with the defined quality standards and norms
- analysis of potential for cooperation and devising proposals as to how this can be realised
- facilitating collaboration between individual Laender or several of them
- quality control based on AdV standards regarding content and format consistency

Official surveying and mapping statistics

Land	Inhabitants	Land area in km²	Land parcels in thousands	Number of authorities		
				Laender authorities (and Laender enterprises)	Regional offices	Publicly Appointed Surveyors (ÖbVI)
Baden-Württemberg	10,716,644	35,751	8,891	1	59	169
Bavaria	12,691,568	70,550	10,754	1	51	—
Berlin	3,469,849	892	400	1	12	55
Brandenburg	2,457,872	29,654	3,125	1	17	151
Bremen	661,888	419	207	1	1	5
Hamburg	1,762,791	755	253	1	—	8
Hesse	6,093,888	21,115	4,991	1	7	81
Mecklenburg-Western Pomerania	1,599,138	23,214	1,912	1	7	68
Lower Saxony	7,826,739	47,615	6,180	1	—	99
North Rhine-Westphalia	17,638,098	34,110	9,296	1	53	424
Rhineland-Palatinate	4,011,582	19,854	6,324	1	6	79
Saarland	989,035	2,569	1,275	1	—	11
Saxony	4,055,274	18,420	2,719	1	13	105
Saxony-Anhalt	2,235,548	20,452	2,670	1	—	50
Schleswig-Holstein	2,830,864	15,802	1,898	1	—	41
Thuringia	2,156,759	16,202	3,137	1	—	65
Total for Germany	81,197,537	357,376	64,032	16	226	1,411

Tab. 1: Statistics:

Population figures – source: Federal Statistical Office, date: 2014-12-31. Results based on the 2011 census. Land area – source: Federal Statistical Office, date: 2014-12-31.

Area in Rhineland-Palatinate: including the area "Joint German-Luxembourgian territory" of 6.2 km2. Differences in area are possible due to rounding of figures.

Land parcels, number of authorities, Publicly Appointed Surveyors (ÖbVI), date: 2015-12-31.

2. Spatial Reference

The Spatial Reference Working Group handles the definition of reference systems and their implementation in reference frames at a national and international level. Here the AdV member authorities contribute in different ways. For example, the connection to the global reference systems is realised in part by the German geodetic observatories that are involved in international projects. The national geodetic spatial reference, which forms the basis of all geo-reference-related work in Germany, is realised through the implementation of resolutions and projects that are coordinated AdV-wide. Thus current data is made available for all kinds of different uses that form the basis of future-oriented work. Together the results are incorporated into the realisation of the uniform, integrated geodetic spatial reference.

Connection to the global reference systems

Fig. 3: The Argentinian-German Geodetic Observatory (AGGO)

The geodetic infrastructure, consisting of geodetic reference stations, and data and analysis centres, calls for an internationally coordinated, committed collaboration between institutions and states that guarantee the long-term safeguarding of the services.

Global climate change – with consequences such as the rise in sea level and the growing threat of natural disasters such as earthquakes and tsunamis – will have a particularly significant influence on future political

decisions. Scientifically sound statements based on observational data series over decades are of great importance for this.

The lack of long observational series in many places on earth makes it difficult for decision-makers to introduce sustainable measures for national development. The Group on Earth Observation (GEO), founded in 2005, has set itself the aim of countering this lack of information by steadily increasing earth observation. Besides this, the Global Geospatial Information Management initiative of the United Nations (UN) was founded in 2011, which regards the global availability and use of geoinformation as an urgent task. In this context, the UN General Assembly passed the resolution “Global Geodetic Reference Frame for Sustainable Development” in 2015.

With microwave observations of satellites and quasars, satellite laser observations and gravity measurements, geodetic observatories make significant contributions to the global geodetic reference systems. These are required, among other things, to operate satellite navigation systems such as GPS and Galileo. The high-precision atomic clocks guarantee the time reference.

As the only geodetic observatory of its kind in Latin America, the Argentinian-German Geodetic Observatory (AGGO) was inaugurated in La Plata (Argentina) on 23 July 2015 following its successful relocation across the Andes from its original position in Chile. At the new location the Federal Agency for Cartography and Geodesy (BKG) is running this fundamental station together with the National Scientific and Technical Research Council, “Consejo Nacional de Investigaciones Científicas y Técnicas” (CONICET), of the Argentinian Ministry of Science.

The inauguration took place on the premises of the observatory in the presence of Dr Lino Barañao, the Argentinian Minister of Science, Technology and Productive Innovation, and Cornelia Rogall-Grothe, State Secretary of the German Federal Ministry of the Interior. More than 100 guests came from scientific and governmental institutions of both nations.

In the future AGGO will provide measurement data to various international geodetic services that are supported by many institutions as a joint task for non-profit purposes. These are first and foremost state-run space agencies, administrative authorities, research institutes and universities, which voluntarily participate in the international services. AGGO makes it possible to reduce a gap in the global observation network in the southern hemisphere – a task that can now be safeguarded for the long term, since the observatory, which was originally designed to be transportable, now has a fixed location in La Plata.

AGGO is an important joint contribution of Argentina and Germany to the global geodetic observation infrastructure. This observatory is one of two fundamental stations for geodesy operated by BKG for the establishment of the Global Geodetic Observing System (GGOS). The preservation of the observatory serves the

purpose of global coverage with geodetic spatial observations on the South American continent. With technical, scientific expertise and long-term services, this joint project strengthens the position of Argentina and Germany in the global geoinformation sector and forms a significant contribution from both countries towards the implementation of the UN resolution of 18 February 2015 on global geodetic reference systems.

Contribution to the redefinition of the DHNN

In preparation for the recalculation of the quasigeoid in the scope of the renewal of the German First Order Levelling Network (DHHN), BKG is collecting and compiling the latest data. An important basis for safeguarding the geoid model German Combined Quasigeoid (GCG) in the north of Germany is precise data from off the coast.

Following the extremely successful measurement project "Relative gravity measurements in Schleswig-Holstein's Wadden Sea" in 2014, similar contacts in the Land of Lower Saxony were successfully established. In this way, an agreement regarding cooperation and logistic support by the participating Land and federal authorities was reached in February 2015 in the context of an extensive project meeting between BKG, the Lower Saxony Mapping and Cadastre Agency (LGLN), the Lower Saxony Agency for Water Management, Coastal Defence and Nature Conservation (NLWKN), the Federal Waterways and Shipping Administration (WSV), the Water and Shipping Authorities (WSA) of Bremerhaven, Wilhelmshaven and Cuxhaven, and the Lower Saxony National Park Authority.

Compared to the previous year, the greatest challenge no longer lay in the unproven measurement technology in the mudflats but rather in the fact that new cooperation agreements were necessary with up to four project partners (WSA Bremerhaven, NLWKN, WSA Wilhelmshaven and WSA Cuxhaven). These had to be coordinated with regard to both the logistic requirements and an optimum schedule for everyone concerned.

Thanks to the staffing contribution of various BKG departments, it was possible to complete measuring campaigns largely every 14 days (dependent on the tides) from the end of April to October 2015. The gravity measurements were made along the East Frisian Islands and in the estuaries of the Ems, Jade, Weser and Elbe.

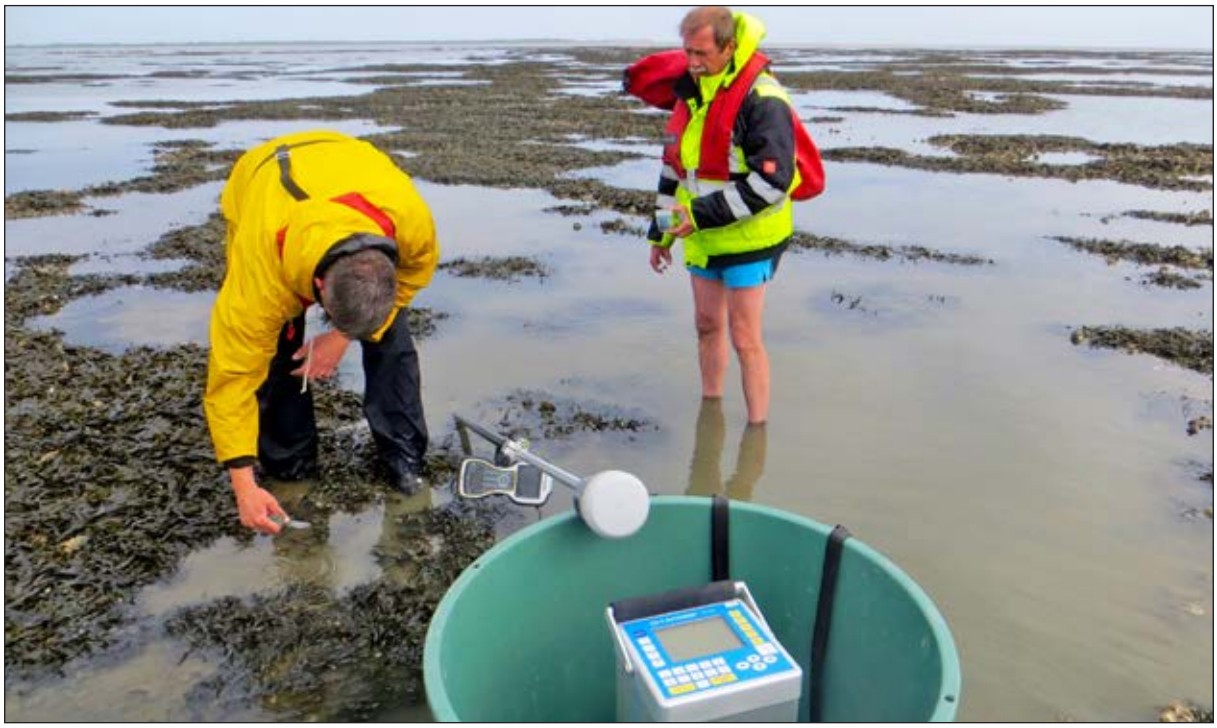


Fig. 4: Gravity measurements in the mudflats of the Lower Saxony coastal area (BKG).

Fig. 5: Gravity measurements in the mudflats of the Lower Saxony coastal area (BKG).

Gravity measurements to create further Geodetic Reference Network Points for surveying and mapping

As a result of the work on the new DHHN, within the responsibility of the surveying and mapping authorities of the Laender the conviction arose that the local geodetic reference should be consolidated by creating further Geodetic Reference Network Points (GGP) and that the network structure should be perfected. To this end – beginning in 2011 for the Mecklenburg-Western Pomerania Agency for Internal Administration (LAIV) and Bavarian Surveying and Mapping – further gravity measurements were made by BKG on the basis of bilateral administrative agreements. The A10 absolute gravimeter was also used for these gravity measurements. This work was conducted in the following years for additional authorities of the Laender, too. In 2015, measurements were made at a total of 53 points for the authorities of the Laender Rhineland-Palatinate, Saxony-Anhalt, Lower Saxony and Saxony. Thus a total of 236 gravity points have been provided to the surveying and mapping agencies.

Fig. 6: GGP Adelebsen, Lower Saxony

Fig. 7: GGP Wernigerode, Saxony-Anhalt

Gravity measurements in the context of the FAMOS project

The project FAMOS (Finalising Surveys for the Baltic Motorways of the Sea) has been running since 2014 in the context of the Connecting Europe Facility (CEF) transport scheme of the European Commission and will involve three phases up until 2020. In the context of CEF, the EU is co-financing transport infrastructure projects. A particular focus is on east-west connections. Management of the FAMOS project in the application phase and during the implementation of the project has been assumed by the Swedish Maritime Administration (SMA).

The main focus of the project will be on conducting large-scale hydrographic measurements of the Baltic Sea (particularly Sweden, Finland, Estonia and Latvia). A focus relevant to geodesy in the context of this project is the implementation of gravity measurements to improve the geoid as a height reference surface for hydrographic measurements in the Baltic Sea. This part of the project essentially aims to promote and standardise the geodetic infrastructure (here the vertical reference frame, vertical datum). As a result, an improved geoid model in the Baltic area / Europe is to be achieved as a basis for a uniform definition of the chart datum for GNSS-assisted depth measurements for all countries bordering the Baltic Sea.

The Federal Maritime and Hydrographic Agency (BSH) is supporting BKG in this on an ongoing basis in all aspects of improving the geoid in the Baltic Sea. In the context of the FAMOS project, BSH is providing appropriate ship capacities for conducting gravity measurements. The FAMOS project thus provides an excellent foundation on which the previous successful cooperation between BKG and BSH in this field (including gravity measurements near the coast of the Baltic Sea in 2013) can be continued and intensified with international coordination.

The Research Centre for Geosciences (GFZ) is participating in the project with gravimetric sea measurements. In April 2015 a measuring trip took place with the surveying, wreck-search and research vessel DENEB with the involvement of BSH, GFZ and BKG in the Adlergrund/Rønnebank area of the Baltic Sea (Figures 8 and 9).

Fig. 8: DENEB surveying vessel

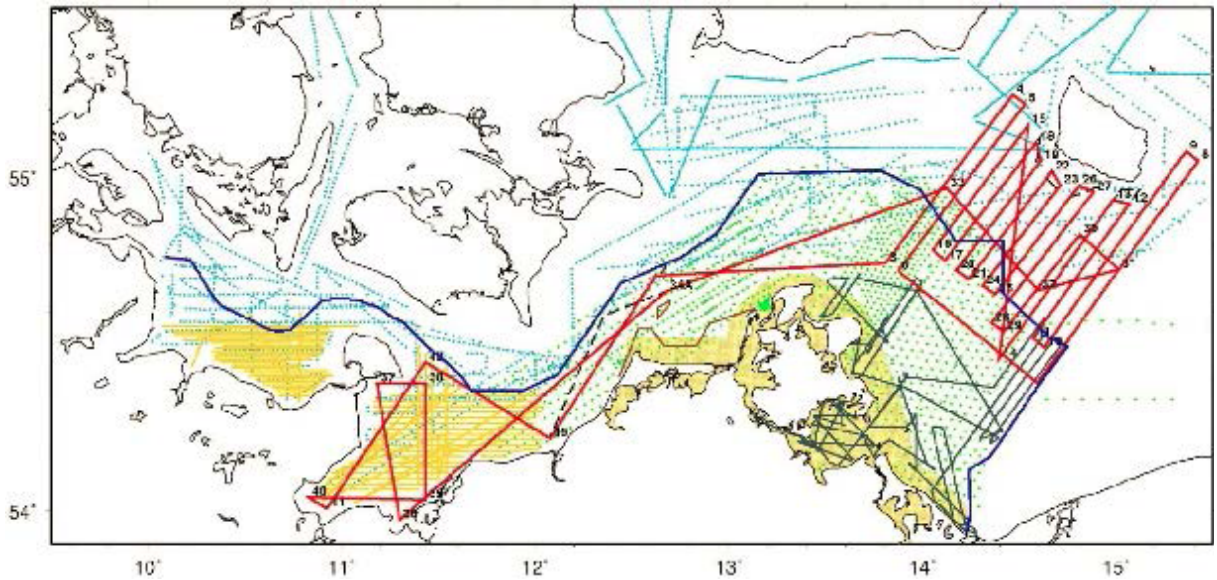


Fig. 9: Profile planning for the gravimetric sea surveying work with the DENEB in the Adlergrund and Rønnebank area in April 2015 with the previous gravimetric data basis in the background.

DHHN renewal

The renewal of the German First Order Levelling Network (DHHN92) in the years 2006 to 2012 formed a further milestone in the geodetic spatial reference for German surveying and mapping. For the first time since the German reunification, the national levelling network was uniformly remeasured Germany-wide. Besides the precision levelling with a line length of almost 30,000 km, simultaneously 250 GNSS / levelling points (Geodetic Reference Network Points, GGP) and 100 absolute gravity points were also determined and all 272 SA*POS*® reference stations were measured (see Figure 10).

The analyses of all the geodetic measurements were carried out until 2015 at various data centres of the Laender (Department 7 of Cologne Regional Administration, Geobasis NRW; Lower Saxony Mapping and Cadastre Agency) and of the federal government (Federal Agency for Cartography and Geodesy). In this process they were able to fully meet the high quality requirements imposed on the various measuring procedures by the Spatial Reference Working Group at the beginning of the project.

Worthy of particular mention here is the simultaneous (meaning in this context the measuring phase between 2006 and 2012) measurement with all the geodetic measurement methods, which means that the results of this project form a first-rate era measurement for the future that reaches new quality standards and could be described as the reference era for integrated geodetic spatial reference.

The decision made by AdV in 2013 to introduce all the results of the DHHN renewal project simultaneously is to be implemented in 2016. For this, it necessary for the AdV committees to make a resolution on the new reference frames for the German First Order Levelling Network 2016 (DHHN2016), the German Primary Gravity Network (DHSN2016), the new height reference surface, the German Combined Quasigeoid 2016 (GCG2016), the new coordinates of the Geodetic Reference Network (GGN) and the improved coordinates of the SA*POS*® reference stations, as well as the height transformation module HOETRA2016 for the transition between the DHHN92 and DHHN2016 reference frames.

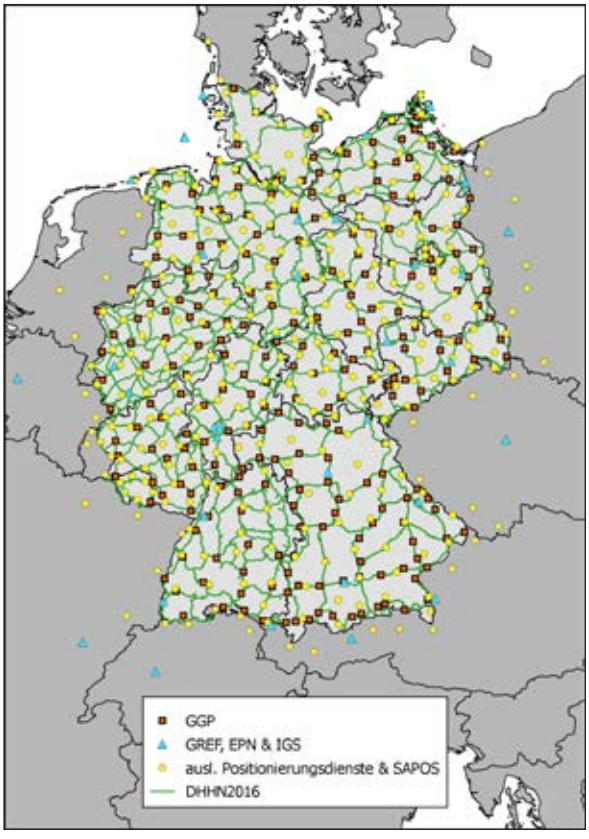


Fig. 10: Network image of the DHHN renewal project between 2006 and 2012

AdV is planning to introduce the new reference frames and coordinates within a short transition phase of, for example, six months, so as to provide the users with nationally standardised, up-to-date spatial reference information and to achieve the best possible uniformity. The introduction of improved coordinates and ellipsoid heights of the SA*POS*® reference stations, on the other hand, has to be carried out on specific dates since it is tied to technical conditions.

The introduction of the new reference frames and coordinates will require follow-up work. The subordinate height networks are to be transferred to the DHHN2016 by means of transformation or calculation. The coordinates of the GGP and the SA*POS*® reference stations are to be transferred to the documentation of the spatial reference (Authoritative Control Point Information System, AFIS®), although the coordinates of the SA*POS*®reference stations will only change to a minor extent and an impact on the real estate cadastre is avoided. The monitoring of the SA*POS*® coordinates is to be adapted to the new implementation. The new AdV quasigeoid must be integrated into daily operations (control point field, SA*POS*®) by the member authorities. Overall, the necessary coordinate reference systems (CRS) must be available for all reference frames.

Satellite Positioning Service of the Official German Surveying and Mapping, SA*POS*®

The launches of additional Galileo satellites during the reporting period validate the work of the Working Group for SA*POS*® Development in recent years (Figure 11). The systematic renewal of the reference stations with new receiver technology and participation in the standardisation body Radio Technical Commission for Maritime Services (RTCM) mean that SA*POS*® can keep up with current developments and face up to the new challenges. A large number of the SA*POS*® reference stations can already now receive all the existing satellite navigation systems, meaning that besides the GPS and GLONASS satellites, the European Galileo and the Chinese BDS satellites can also be received (including QZSS). These developments are ultimately also reflected in the ongoing updating of the SA*POS*® product definition, which is adapted to current developments and can be viewed at **www.adv-online.de**.

Furthermore, the developments within the SA*POS*® services also involve the inclusion of new methods of data communication, further developments within the standardised interfaces and the respective datum adjustments in line with the international reference systems. The developments within the SA*POS*® services since operations began in 2003 are presented in Figure 11.

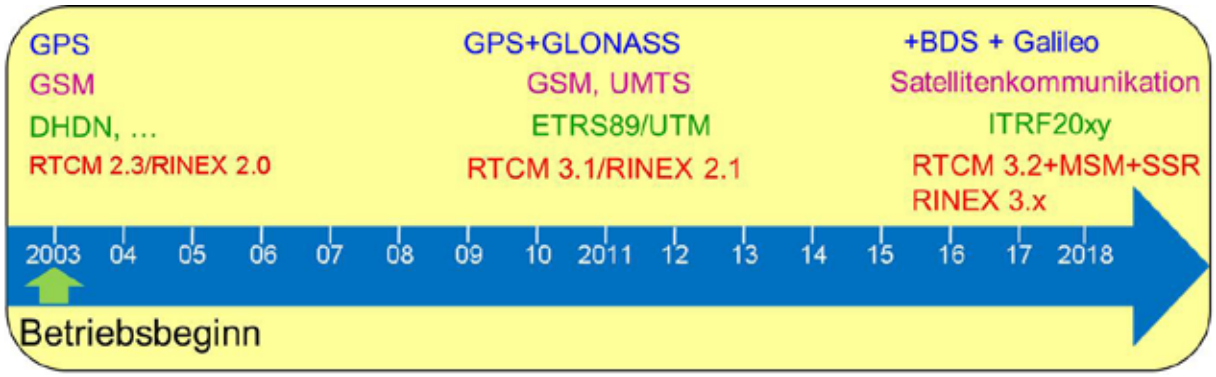


Fig. 11: Further development of the SA*POS*® *Services*

To improve the quality information from SA*POS*® (see the quality report from SA*POS*® at: adv-online.de > AdV-Produkte > SAPOS > Veröffentlichungen SAPOS) the Laender have decided to introduce a new statistic with the "SA*POS*®-HEPS integrity monitoring" that is based on its own monitoring stations and is intended to verify the quality of the Land-specific network services. Autonomous rover stations are here fed with correction data and simulate fully fledged user stations. Through the 24/7 operation of these stations, the SA*POS*® operators can judge not only the availability of the correction data but also, in particular, the solution behaviour of the rovers. In this way, users can discuss any difficulties with their own positioning both during operating hours and in retrospect. Some member authorities have also made this information available on the Internet so that interested users have quality information available to them at all times. Figure 12 shows a 24-hour overview of this kind with time series of coordinate differences in the north, east and height components and of the speed of the ambiguity solution (time to fix ambiguity, TTFA).

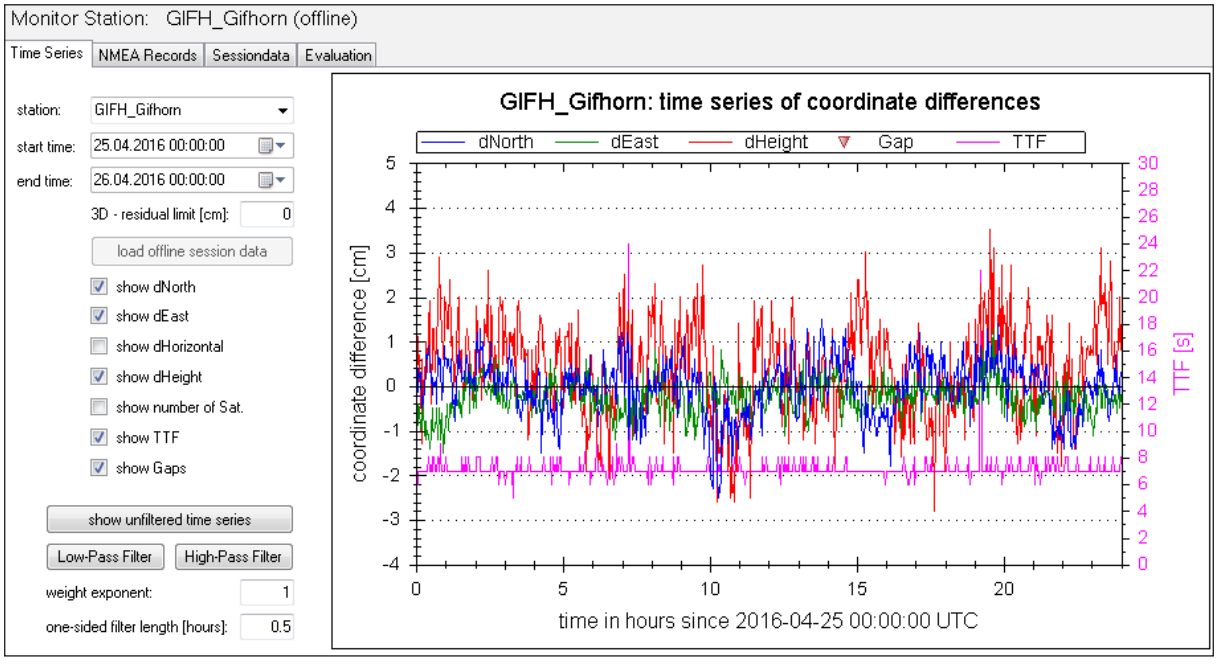


Fig. 12: Solution behaviour of a SA*POS*® *monitoring station in Lower Saxony*

The further development of the SA*POS*® services also involves implementing new standards that are to facilitate the incorporation of the high number of satellites from different systems in the future, while maintaining the very high quality of the current SA*POS*® services (particularly with regard to the HEPS service). To this end, a project group of the working group has made nationwide networking available, initially internally to AdV (Figure 13), which is used by the member authorities for forward-looking analyses. With selected test scenarios, various options are being analysed for transferring the GNSS error components and the solution behaviour on the field. Besides the first stage of data transfer approved by the standardisation body RTCM, the tests also include development stages that are to be deployed in the future development of the SA*POS*® service.

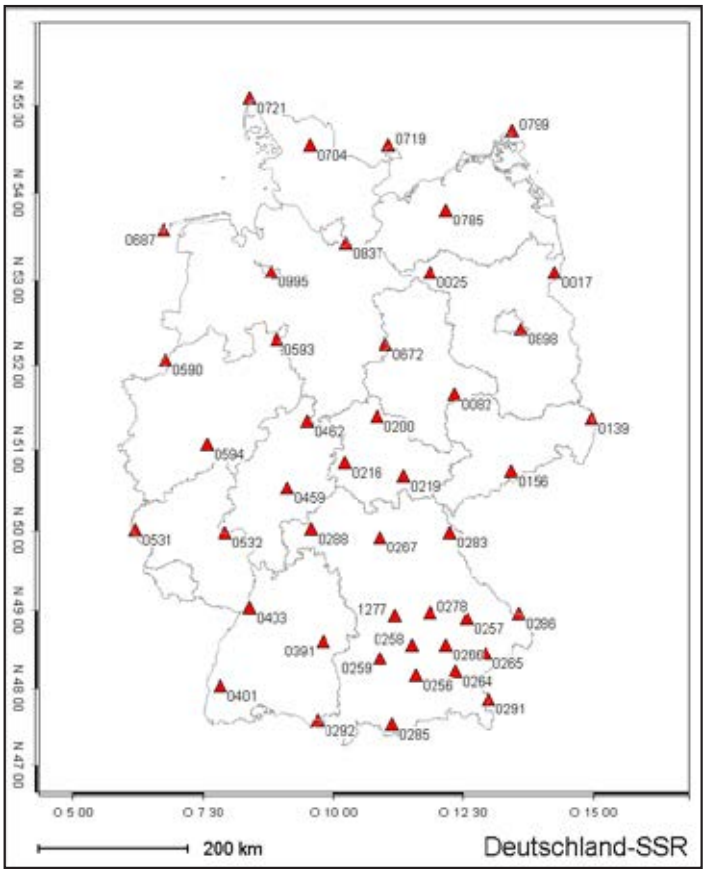


Fig. 13: Nationwide SSR-PPP networking

Since at the present time no GNSS receivers fit for the field are available that can process the State Space Representation (SSR) data, the analyses are being conducted with various software implementations on the basis of Precise Point Positioning (PPP) clients. Simultaneously, talks are being held with hardware manufacturers to obtain terminals for test purposes that are suitable for use in the field.

3. Real Estate Cadastre

With ALKIS® being available nationwide for all of Germany, there is an increase in the demand for the geographic reference data of the real estate cadastre. Currently, in-depth talks are being held, firstly, with the German Federal Statistical Office in connection with the 2021 census and secondly with the German Federal Revenue Administration with regard to the upcoming property tax reform. For both areas of administration, the real estate cadastre has always been an important information source. Now it is necessary to clarify which data is actually needed, whether it is comprehensively available in the Laender and how it could be provided where applicable.

For the development of a nationally standardised database land register, the ALKIS/LEFIS/Electronic Land Register project group of the Real Estate Cadastre Working Group will be available to the judicial authority as a partner on the subject of ALKIS®.

To update the AAA® technical schemata and particularly for harmonisation between ALKIS® and ATKIS® regarding Actual Use (TN), a workshop was conducted in January 2016 with over 50 attendees from the AdV member authorities. The further course of action was adapted on the basis of the results of the workshop. Key topics here are uniform collection criteria and a joint basic data stock for the TN, the definition of an ALKIS-TN product standard, the development of an ALKIS-TN product sheet, converting the TN into Land Cover and Land Use and determining the content and scope of a non-application-specific geospatial data stock (GeoBasisDE). Here the user requirements are always to be taken into account, particularly those of the official land use statistics sector, which annually determines the land use from the residential and traffic areas.

With regard to transferring the real estate cadastre in its entirety – with the ALKIS® and real estate cadastre file components – to the digital realm, the working group “Archiving of Real Estate Cadastre Files” has described the starting situation (the needs), ascertained and presented the status (conception, implementation) in the individual Laender and developed guidelines and recommendations for the procedure.

Further development of ALKIS®

The ALKIS® migration is complete. Since December 2015 ALKIS® has been introduced in all 16 Laender. ALKIS® data is thus now available nationwide for all of Germany. This is particularly advantageous for those users requiring cross-Land data from the real estate cadastre since as of now only one interface is necessary for data import.

Now it is necessary to address the post-migration work, for example the subsequent recording of the regulations governed by public law and the recording of two-dimensional land valuation objects. A few Laender are also still faced with the challenge of transferring the data of the real estate cadastre into the official positional reference system ETRS89 with UTM projection. Most of the Laender made the change at the same time as the changeover to ALKIS®.

Fig. 14: Status of the introduction of ALKIS® on 31 December 2015

The ALKIS® software components used for collection and qualification, for data management and for information and presentation are subject to permanent development and optimisation. Here the focus is often on introducing features that have not yet been implemented and improving the workflow and performance, e.g. the automated transfer of cadastre amendments on the basis of land management procedures.

The Laender are adopting different approaches to updating the data of the real estate cadastre owing to surveying documents submitted. In some cases, complete survey data is to be submitted in the Norm-based Exchange Interface (NAS format), while in some cases digital point data of the new and changed points is sufficient (e.g. in NAS format, occasionally also in csv format or as txt list), although the object formation in these cases is then performed by the real estate cadastral authority. In the long term it is to be expected that complete updating drafts will be submitted in the Laender.

The data exchange with the land register and the tax authorities is to be further optimised. In some cases reverse migrations continue to be necessary for that. There are now Laender that are putting much thought into how ALKIS® could remain operational if the entire ALKIS® production environment should fail sometime. The Land of Brandenburg has already conducted several so-called emergency exercises for this purpose. In the process of introducing ALKIS®, individual administrative regulations were amended or newly introduced in the Laender. Some of these processes have not yet been completed.

Availability of geographic reference data from the real estate cadastre

The nationwide availability of ALKIS® since December 2015 makes the geographic reference data of the real estate cadastre even more attractive to many users. Individual Laender and AdV are currently in close contact with the German Federal Statistical Office in connection with the plans and preparations for the 2021 census. From the point of view of official land use statistics, ALKIS® seems to be a suitable data stock through which a relationship could be established with the census data. The interest of the German Federal Statistical Office also shows that an up-to-date building inventory, at least with regard to residential buildings, is extremely important for serving the interests of users. Hence processes must be developed that keep the time period between the erection of a building and its measurement and documentation in the real estate cadastre as short as possible.

The availability of geographic reference data from the real estate cadastre is – alongside valuation information – of great importance to the tax authorities both against the background of implementing a property database relevant to taxation and with regard to the forthcoming property tax reform, irrespective of the future property tax model. At the invitation of the German Federal Ministry of Finance, an exchange of information took place at the beginning of 2016, in which representatives of AdV and the Hessian surveying and mapping authority also participated. The focus was on the close cooperation that has developed over time between financial and real estate cadastral administration. Everyone agreed that the surveying and mapping authorities were an enormously important data provider for property tax collection.

Developing a nationally standardised database land register

In November 2015, the judicial authority accepted a tender to develop a nationally standardised database land register. The implementation phase has begun. The project will pass through several phases. At the end of 2019, two pilot tests are planned in Bavaria and Lower Saxony. From a current perspective, the productive use of the database land register is to be expected in the year 2022.

In the context of the development of the database land register, AdV has indicated that the ALKIS / LEFIS / Electronic Land Register project group of the Real Estate Cadastre Working Group is available as a partner and specialist consultant. As a logical step, this builds on the previous joint compilation of the “Principles for the interaction and technical data exchange between the database land register, the Authoritative Real Estate Cadastre Information System (ALKIS®) and the Information System for Rural Development (LEFIS)”.

The migration of the data stocks from the process solutions FOLIA and SOLUM-STAR will take years. For the migration of the land registers, the involvement of the surveying and mapping authorities will be necessary.

Updating the AAA® technical schemata – ALKIS®-ATKIS® harmonisation

The joint working group of the AdV Real Estate Cadastre and Geotopography Working Groups, called "ALKIS®-ATKIS® Harmonisation" (AG HarmAA), was commissioned by the AdV Plenum to outline the current situation regarding the problem areas in the harmonisation of ALKIS® and ATKIS®, analyse the facts in detail particularly in the area of Actual Use (TN) and prepare proposals for decisions on the harmonisation from a content-related point of view and present these in a master plan.

50 participants from 16 AdV member authorities and individual federal authorities met for a workshop called "Updating the AAA® technical schemata – ALKIS®-ATKIS® harmonisation" in Fulda on 14 and 15 January 2016.

They discussed in depth the development and introduction of a product standard on Actual Use (TN), the further development of uniform collection criteria and a joint basic data stock, the future separation of the TN into the fields Land Cover and Land Use and an up-to-date, largely non-application-specific geographic reference data stock (GeoBasisDE).

The results of the workshop will be incorporated into specific proposals for decisions for the AdV Plenum.

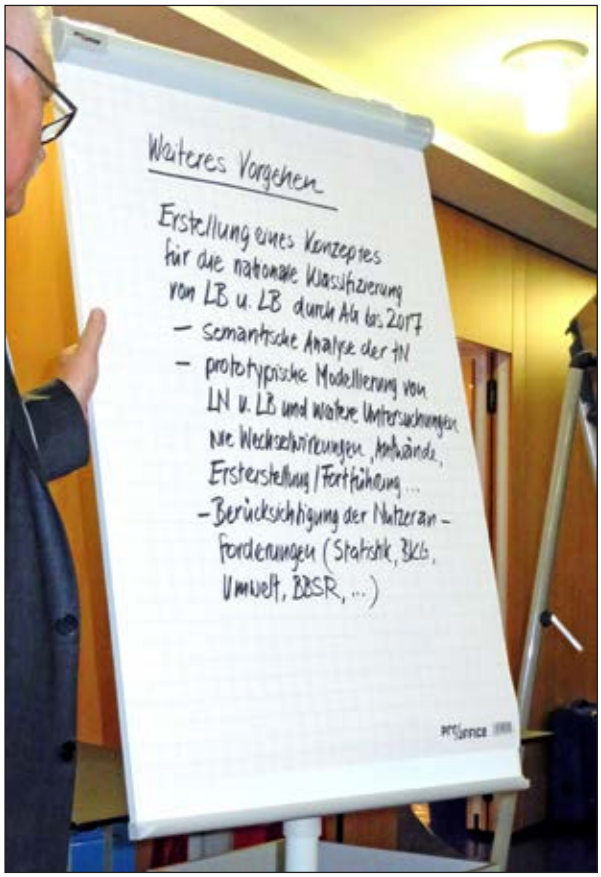


Fig. 15: ALKIS®-ATKIS® harmonisation workshop on 14-15 January 2016

Digitisation of real estate cadastre files

The majority of surveying and mapping authorities of the Laender have been digitising the real estate cadastre files with varying intensity for years now. The tools, procedures and regulations used for this have developed independently of one another in the respective Laender. The aim of all the Laender is to maintain the real estate cadastre files only digitally in the future. In the process of digitisation, online access to these data stocks for the Publicly Appointed Surveyors should also be set up in order to make it unnecessary, as a rule, to inspect the files on site at the agencies that maintain them. Furthermore, many of the real estate cadastre files were created more than 200 years ago and have been in use ever since. Some of the real estate cadastre files are in bad condition, meaning the documents need to be protected from further damage or destruction both for the sake of their contents and from a cultural historical point of view.

Against this background the Real Estate Cadastre Working Group launched a working group during its 62nd meeting in 2014. This working group consisting of representatives of the four AdV member authorities Baden-Württemberg, Brandenburg, Lower Saxony and Schleswig-Holstein has meanwhile compiled its final report.

This final report contains the starting situation and the state of digitisation in the individual member authorities as well as recommendations and principles for handling analogue and digitised real estate cadastre files. Forming the basis of the report was a survey carried out in all the Laender in the spring of 2015 on the status of digitisation, the collection, geo-referencing, checking, management, provision and archiving of real estate cadastre files.

The detailed findings from the analysis of the questions are attached to the final report as an appendix. The report was presented in the Real Estate Cadastre Working Group at their 64th meeting in Mainz in May 2016 and can be viewed at **www.adv-online.de**.

Fig. 16: Final report on the archiving of real estate cadastre files

4. Geotopography

Using the Authoritative Topographic-Cartographic Information System (ATKIS®), the surveying and mapping authorities of the Laender manage geographic reference data that describes landscape in the product groups Digital Landscape Models, Digital Terrain Models, Digital Topographic Maps and Digital Orthophotos. The individual products of these product groups are kept current with regular updates. For key topographic features in the Digital Landscape Models, the updates take no more than a few months. So as to be able to continue providing the data from the ATKIS® product range in the future in a customer-oriented way, with contents that are sufficiently up-to-date and of the required quality, and within the scope of the staffing and financial capacities of the AdV member authorities, the Geotopography Working Group began an in-depth discussion of the product portfolio of official geotopography during the reporting period. The final results are not yet available, but they are to be finalised in the short to medium term. Together with the Real Estate Cadastre Working Group an additional focus of the activities was the high-priority efforts towards harmonising the ALKIS® and ATKIS® technical schemata.

Digital landscape models

One of the key tasks of the surveying and mapping agencies in the field of geotopography is to manage and update the Digital Basic Landscape Model (Basis-DLM) as the basis for establishing various thematic information systems in administration and businesses. The database of the ATKIS® Basis-DLM additionally serves as the basis for the derivation of the small-scale Digital Landscape Models ATKIS®-DLM50, DLM250 and DLM1000, for the production of official Digital Topographic Maps and the joint web-based map service of the federal government and the Laender (WebAtlasDE).

The regular updating of the Basis-DLM database takes place in different time frames. These cover the period from the emergence of change in the landscape to the release of the updated database. A distinction is made between a key update of three, six or twelve months for feature types or attributes of greatest importance for the customers and the basic update of the entire database within a maximum of a five-year period during which the Basis-DLM is checked and, if there are changes, updated. As an example of a key update of three months, Figure 17 shows the final section of the Schweinfurt-Sangerhausen A 71 federal motorway with the Kölleda junction (Thuringia), which was opened in September 2015, in the visualised Basis-DLM. Another key update of the Basis-DLM was in the context of the opening of the Erfurt-Leipzig/Halle ICE train line in December 2015 (German Unity Transport Project [VDE] no. 8.2), see Figure 18 (red arrow) against the background of a Digital Orthophoto.

Fig. 17: Example of a key update: the section of the A 71 motorway opened in September 2015 with the Kölleda junction (Thuringia) in the visualised Basis-DLM.

Fig. 18: Example of a key update: Erfurt-Leipzig/Halle ICE train line (red arrow) against the background of a Digital Orthophoto.

With the joint project “ATKIS® Generalisation” the conditions were created to derive the DLM50 fully automatically from the Basis-DLM using generalisation (model generalisation and automatic cartographic generalisation). The DLM50 exhibits a simpler form of structuring and a lower data volume than the Basis-DLM. For the production of Digital Topographic Maps 1:50,000 (DTK50) and 1:100,000 (DTK100), the corresponding automated, interactive processes were developed and put in practice. Given the increasingly demanding user requirements for up-to-date information along with shrinking human resources in all surveying and mapping authorities, this marked an important milestone in the effective and efficient provision of ATKIS® products.

The DLM250 and the DLM1000 processed at BKG are available nationwide and updated on an annual basis. The contents are being continuously expanded to create the EuroGeographics products EuroRegionalMap (1:250,000) and EuroGlobalMap (1:1,000,000) and also to link thematic data and for reporting at the European level (main user: European Commission). The requirements of the users also continue to increase in this area.

The Digital Landscape Models of the ATKIS® technical schema must be continuously adapted to the changing requirements for geotopographical core data. The aim of the conception commissioned by the AdV Plenum for updating the joint AFIS®-ALKIS®-ATKIS® data model is thus to improve the harmonisation of the data in the real estate cadastre and in geotopography, so that data is captured only once and can then be made available for as many products as possible.

The practical implementation of Version 7.0 of the “Documentation on the Modelling of Geoinformation of Official Surveying and Mapping (GeoInfoDok)” will make it possible to meet requirements made of Germany’s geotopographic reference data arising in part from the European projects Copernicus and CORINE Land Cover (CLC) and from INSPIRE. At its 126th meeting in September 2014, the AdV Plenum agreed by means of a resolution to the contents stipulated by the GeoInfoDok 7.0 including for the ATKIS® area. Implementation was begun in the member authorities in the reporting period. A Plenum resolution on the period of implementation is planned for autumn 2016.

Digital elevation models

In addition to the Digital Landscape Models that describe position, the surveying and mapping authorities manage Digital Terrain Models (DGM) with varying levels of precision to represent height as a third dimension. These models are available to authorities and businesses as part of the geotopographical core data for setting up Geographic Information Systems (GIS).

Digital Terrain Models are digital, numerical models of the terrain heights and shapes of the earth's surface reduced to a regular grid. DGMs can also include additional information (e.g. terrain edges, skeleton lines or distinctive terrain points). They do not contain any information about structures (e.g. bridges) and vegetation.

The products of the product group Digital Terrain Models (ATKIS®-DGM) are structured according to their grid size. DGMs with a larger grid size are generally derived automatically from the DGM with the smallest available grid size. For the ATKIS® technical concept, the DGM feature catalogue is available in the GeoInfoDok.

Currently, DGM data sets with a grid size of 10 m (DGM10), 25 m (DGM25), 50 m (DGM50), 200 m (DGM200) and 1,000 m (DGM1000) are available nationwide for the whole of Germany. The data quality is documented in the ATKIS® product standard for Digital Terrain Models. For the DGM10, for example, this stipulates a terrain-type-related height accuracy of the grid points of ± 0,60 m to 2,10 m with a confidence level of 95 % (2 σ).

In the reporting period, work has proceeded in almost all the German Laender on the set-up, completion or updating of high-precision DGMs with grid sizes of 5 m (DGM5), 2 m (DGM2) and even 1 m (DGM1). Meanwhile, nationwide coverage has been achieved with DGMs with a grid size of 5 m or better. The Central Office for Geotopography (ZSGT) at BKG offers the DGMs to customers in collaboration with the Laender.

In the surveying and mapping agencies, Digital Surface Models (DOMs) are created in addition to DGMs. DOMs are digital, numerical models of the heights and shapes of the earth's surface, including structures and vegetation, reduced to a regular grid. As with the DGMs, DOMs are structured according to their grid sizes and DOMs with a larger grid size are automatically derived from the DOM with the lowest available grid size using new interpolation. DOMs do not constitute an AdV standard product, however. DOMs are based on the technique of airborne laser scanning or digital image correlation (image matching). An increasing demand for these DOMs among users can be observed. The data quality is to be documented using the ATKIS® standard for Digital Surface Models.

3D building models

The surveying and mapping authorities have been offering the product of 3D Building Models since 2013. The data is collected on the basis of the AdV product standard for 3D Building Models and the data format description in AdV-CityGML version 1.0. The AAA® model has been expanded to include 3D buildings and 3D structures as part of the GeoInfoDok 7.0.

Nationwide, 3D Building Models are being created with the Level of Detail 1 (LoD1). Here all buildings and structures are given a flat roof ("block model"). With more than 51 million building objects nationwide LoD1 data is now comprehensively available. The Central Office for House Coordinates and Building Polygons (ZSHH) provides this data for cross-Land use.

In the future, all buildings and structures will be modelled by the surveying and mapping authorities in the next level of detail, Level of Detail 2 (LoD2), using standard roof shapes. In some Laender the production of the data sets in LoD2 is already well advanced or even complete. It is not yet possible to name a date for nationwide coverage, however, which will not be before 2018.

Digital topographic maps

Based on the Digital Landscape and Terrain Models, the surveying and mapping authorities create the Topographic Maps in modern map graphics. This is documented in the ATKIS® portrayal catalogues as part of the GeoInfoDok of the AFIS®-ALKIS®-ATKIS® project. In the future these portrayal catalogues will be available in a form that has been formalised and is aligned with all the above-mentioned information systems. The latter are based on an object model that was integrated into the AFIS®-ALKIS®-ATKIS® model world. The first publication of the ATKIS® portrayal catalogues on the basis of this object model is planned for mid-2016. Figure 19 shows an extract from the modelling.

Fig. 19: Extract from the AAA® modelling with AAA® portrayal catalogues

Digital Topographic Maps (ATKIS®-DTK) are already available in many Laender for the entire Land. For DTK50 and DTK100, the surveying and mapping authorities have made an agreement with the German Federal Ministry of Defence that they should be maintained and published as joint civilian and military maps.

By way of example, Figure 20 shows a DTK50 map section of the western slopes of the northern Black Forest. DTK100 has been available for the whole country and in standardised form for the Federal Republic since back at the end of 2012.

Fig. 20: Digital Topographic Map 1:50,000 (DTK50), section of the L7314 Baden-Baden map sheet

The raster data set of the Digital Topographic Map 1:250,000 (DTK250, Figure 21), which is derived from the DLM250, has been updated and made available as a sheet-line-free web map service at the BKG Service Centre. Thanks to the high level of automation, in future it will be possible to make the map series and the related web map service available three months after the release of the current DLM250. As a result, it was possible to discontinue the previous map series DTK200-V. The corresponding technical procedure is also successfully used at BKG to produce the Digital Topographic Map 1:1,000,000 (DTK1000) and in the print-on-demand procedure for raster maps.

Also in the Laender, techniques for a mostly EDP-supported cartographic generalisation of the various map series are available and increasingly in operation. This makes a considerably more efficient derivation from the Digital Landscape and Terrain Models possible.

So far as DTKs are not yet being created on the basis of the ATKIS® portrayal catalogues, the Laender will continue the conventional topographic map series to the extent required in each case and keep them available in printed form and as a raster data set. The proportion of these provisional DTKs has decreased further during the reporting period. To meet customer requirements, the possibilities of web-based presentations are increasingly being used.


Fig. 21: Digital Topographic Map 1:250,000 (DTK250)

ATKIS® geospatial data services

Based on the awareness of necessary harmonisation also in the provision of geographic reference data via web technologies and building on the web profiles for viewing and download services created in a non-sector-specific way by AdV, in the area of geotopography the web product specifications necessary here (WebAtlasDE-WMS, WebAtlasDE-WMTS and ATKIS®-DLM-WFS) have been agreed to by the AdV Plenum and will be updated as needed by the working group.

Besides the NAS format as AdV's standard output format, a standardised structure of the widely used Shape format has been defined in order to be able to deliver data in the AAA® model to customers in this format as well. Based on the AdV Shape profile version 1.0.0, a corresponding AdV product specification for DLM data was compiled, which was agreed to by the AdV Plenum in autumn 2015.

The above-mentioned production specifications, like all the other AdV standards in the field of geotopography, can be viewed at all times in their current form on the website **www.adv-online.de**.

WebAtlasDE

The need for official map services among all kinds of different users has risen dramatically in recent years. In addition to good performance, aspects that are expected are, in particular, preferably "continuous" zooming, high availability, provision both in the viewer and as a service, font and signature adjustment at every scale level, a simple, standardised map style and provision throughout Germany and across the Laender.

DLM and DTK were unable to fully meet these requirements. Based on the activities of several member authorities, in 2012 a common web-based map service was therefore implemented by the federal government and the Laender under the name "WebAtlasDE" which has already been linked on the federal and Laender geoportals in multiple cases. To this end raster map tiles of various scales are created from the Digital Landscape Models and made available via a Web Map Tile Service (WMTS) with good performance and high reliability. In particular, the complete presentation of all buildings available in the real estate cadastre, including their house numbers, and the periodic comprehensive update of the geotopographic data, similar to the DLM updating, are unique features of WebAtlasDE. The service has been linked, for example, on the home page of adv-online.de and can be accessed there. In the context of making the resolution on the AdV product specification WebAtlasDE-WMTS mentioned in the above section, the AdV Plenum decided that WebAtlasDE would also be offered in future, alongside the official reference system ETRS89/UTM, in the coordinate reference system "Pseudo Mercator", which is used by many non-governmental users.

Digital orthophotos

The surveying and mapping authorities of the German Laender commission aerial imagery flights at regular intervals in order to provide up-to-date aerial photographs to external customers, and for internal use in updating the Digital Landscape Models and Digital Topographic Maps. These aerial photos are oriented and orthophotos are calculated from them. The Digital Orthophotos product group (ATKIS®-DOP) thus rounds off the ATKIS® concept. Thanks to the image-based documentation of the landscape, DOPs are suitable for all view-based applications. DOPs with a ground resolution of 20 cm (DOP20) are available in colour for all of Germany. Individual Laender are already producing DOP10.

Because the results of aerial photography are crucial to the prompt updating of the geotopographical core data of ATKIS®, the high-resolution DOP20 is subject to an updating cycle of no more than three years. Setting a product standard for the Digital Orthophotos provides the necessary conditions for the data of the Laender to be pooled at the Central Office for Geotopography (ZSGT) located at BKG. Along with the Laender, ZSGT provides the DOPs and visualises them together in a DOP viewer available online. The DOP20 is now established as a standard product for virtually all technical applications with a spatial reference within and outside of the surveying and mapping authorities.

The introduction of digital aerial survey camera systems presents new challenges for the surveying and mapping authorities, while simultaneously providing new opportunities. The high efficiency of multi-channel photography permits the simultaneous use of black-and-white (PAN), colour (RGB) and infrared (CIR) aerial image data. The addition of the infrared channel meets the criterion for merging the requirements ensuing from the surveying and mapping, forestry, agriculture and environmental authorities in the aerial photography flight projects of the Laender.

Besides questions regarding the quality requirements for digital photography flights and regarding data transmission and analysis, the surveying and mapping authorities are focusing on the issues of long-term data security and history management, as time series of aerial photographs are an indispensable tool for the work of more and more users. The protection of aerial image data files should therefore also meet uniform minimum standards in the future. Through this long-term preservation of historical aerial images in digital databases, the AdV member authorities offer a data stock that meets the requirements that customers in this segment have for time series to a special degree.

The digital aerial photographs as the basis for deriving ATKIS®-DOP are increasingly being provided to specialist users as Oriented Aerial Images by the surveying and mapping authorities. Oriented Aerial Images are aerial images that contain all the parameters required for stereoscopic analysis. Rapid IT developments and

the cost-efficient provision of user software are making stereoscopic aerial image analysis and presentation an economically viable option for users.

The high data quality combined with the diverse information in the digital aerial imagery additionally offers the possibility of image-based classification. Looking to the future, the aim is to identify change information of various kinds in an automated process and utilise it in the topographical information systems; to this end, initial procedures are being used prototypically.

Toponymy

In collaboration with the Permanent Committee for Geographic Names (StAGN), BKG offers a standardised (gazetteer) service that provides the toponymy (GN-DE) from the vector data of the products DLM250, VG250 and GN250. GN250 (Geographic Names 1:250,000) is available in a classification of names corresponding to the ATKIS® feature types in the AFIS®-ALKIS®-ATKIS® data model. The raw database comprises around 164,000 entries of geographic names, including names of municipalities, parts of municipalities, landscapes, mountain ranges, mountains, islands, rivers, canals, lakes and seas.

The GN-DE database is available as a standardised Web Feature Service (WFS) according to the specification of the Open Geospatial Consortium (OGC) at the BKG Service Centre. In 2015 this data set was converted to make it INSPIRE-compliant and was made available as a service for the European Open Data Portal.

5. Information and Communication Technology

Information and Communication Technology forms the technical interface between activities in the fields of spatial reference, the real estate cadastre and geotopography. It helps to establish the Spatial Data Infrastructure (SDI) based on official geographic reference data using networks and geoservices. The activities focus on the maintenance and advancement of the AFIS®-ALKIS®-ATKIS® (AAA®) concept for modelling the geoinformation of the official surveying and mapping and for the information technology coordination of the SDI activities for AdV at a national level.

AAA® model

With the work on the AAA® model, AdV has designed an integrated and harmonised modelling of all geographic reference data of the mapping and cadastre authorities – split into a basic schema and a common technical schema AFIS®, ALKIS® and ATKIS®. This is implemented by the AdV member authorities. The AAA® basic schema (Figure 22) forms the basis for the technical application schema for modelling the AFIS®, ALKIS® and ATKIS® objects as well as for data exchange via the Norm-based Data Exchange Interface NAS. The procedure is described in detail in the "Documentation on the Modelling of Geoinformation of Official Surveying and Mapping (GeoInfoDok)", the latest version of which is published at **www.adv-online.de**.

It should be emphasised that international norms and standards are consistently observed and implemented in the AAA® project. Through the fully non-sector-specific modelling of the AAA® basic schema, other technical information systems can also use the classes defined in the AAA® basic schema for their own modelling, which has been done, for example, through the establishment of the Information System for Rural Development (LEFIS) as an object-oriented thematic data model by the authorities for agricultural structure. LEFIS is a planning system for the continuous processing of land management measures under the Farmland Conso-

lidation and Agricultural Adjustment Act. To support an extensive use of the AAA® model in sector-specific information systems, the software scripts behind the modelling are available to third parties free of charge.

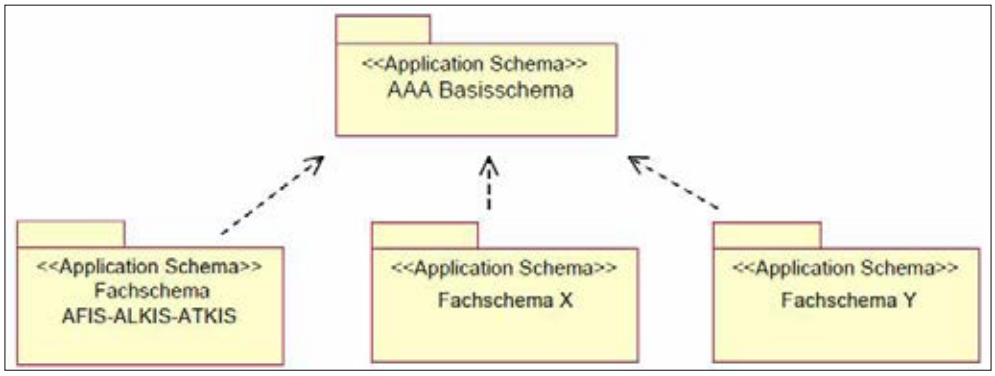


Fig. 22: The non-sector-specific AAA® basic schema as a basis for modelling application-specific thematic schemata (e.g. AFIS®, ALKIS® and ATKIS®)

Since 2015, the migration of the geographic reference data from ALKIS® and ATKIS® to management in accordance with the modelling of GeoInfoDok version 6.0 is complete Germany-wide. The migration of AFIS® is well advanced and should be completed in 2017. In addition to this, however, further developments to the AAA® model are being continued in an ongoing process in order to keep meeting the demands of users and GIS producers. To this end, the GeoInfoDok is being updated on the basis of revision notifications that can be entered through a web-based ticket system at **www.adv-online.de** (in the section "AAA®-Modell"). The revision notifications are evaluated by the AAA® revision committee and classified in a threetier system so that each revision notification can be assigned to a future version of the GeoInfoDok; see Table 2.

Version	Explanation
Version X.Y.Z, (e.g. 8.0.0)	technical changes • existing elements of the AAA® model are changed • the schema files and namespace change • the new data (e.g. version 8.0.0) is no longer valid against a valid reference version of the GeoInfoDok (e.g. 7.0)
Version X.Y.Z, (e.g. 7.1.0)	technical extensions • existing elements of the AAA® model remain unchanged, but technical extensions are made • the schema files and namespace change • the new data (e.g. version 7.1.0) is valid against a valid reference version of the GeoInfoDok (e.g. 7.0)
Version X.Y.Z, (e.g. 7.0.3)	Corrections • errors that hinder implementation and those of an editorial nature • no technical developments • schema files may change • namespace remains unchanged

Tab. 2: Version classification of the GeoInfoDok; the examples in the first column show changes in relation to a GeoInfoDok version 7.0.2

Owing to the numerous changes and developments in the overall context of the GeoInfoDok, the AFIS®-ALKIS®-ATKIS® revision committee conducted three workshops (see Figure 23) with

- institutions that develop components for managing and communicating geographic reference data on the basis of the GeoInfoDok
- the mapping and cadastre authorities
- the agricultural structure authorities

Fig. 23: GID7 workshop with the AdV member authorities in Erfurt

Geospatial data infrastructure

The AAA® data model's compliance with the requirements ensuing from the INSPIRE Directive and its implementation in the geospatial data access laws and geospatial data infrastructure laws of the federal government and the Laender is of central importance. To guarantee a homogeneous procedure among the AdV member authorities in the further implementation of the INSPIRE Directive on the provision of interoperable services of the geographic reference data in the INSPIRE data model, fundamental basic conditions and parameters have been developed within AdV.

To support this, a newly established AdV project group is dealing in detail with the further developments of the INSPIRE guidelines. This includes analysing reports and stipulations developed by the EU Commission's

Maintenance and Implementation Group (MIG) regarding their relevance and feasibility for the AdV member authorities. If necessary, consultation is held with other AdV bodies regarding specific fundamental or overriding aspects of INSPIRE implementation.

The interoperability of geospatial data required by INSPIRE means a data schema transformation is necessary (source data set AAA® → target data set INSPIRE). The release of the target data sets will take place in the following two steps

- target data sets according to Annex I by 23 November 2017
- target data sets according to Annex II and III by 21 October 2020

To support the AdV member authorities in the work on the data schema transformation, a feasibility study was conducted. The target data sets resulting from the data schema transformation (AAA® → INSPIRE) will form new, nationwide AdV products. These will be described in product specifications that contain the mapping tables (template of the conversion of the AAA® data to the INSPIRE data model) that have already been compiled.

Harmonised provision of geographic reference data

In light of the developments in the provision of geospatial data via web technologies and the requirements ensuing from the INSPIRE process, AdV has created a series of technical web profiles for viewing and download services (Web Map Service – WMS, Web Map Tile Service – WMTS, Web Feature Service – WFS). These technical profiles form the basis for each sector-specific structure regarding the thematic data to be provided (product specification). With the approach of defining general technical profiles and differentiated subject-specific product specifications, the goal being pursued is to harmonise, standardise in terms of contents and further expand the services and data formats produced by the AdV member authorities for the purpose of a nationwide provision of geographic reference data as the basis for geospatial data infrastructures in Germany and in Europe. These profiles are supplemented by the AdV metadata profile, which describes the structure and semantics of the metadata for the geographic reference data and geospatial data services of the member authorities. The latest versions of the profiles are uploaded to **www.adv-online.de**.

Particularly the stipulations on profiles as of and with the definition of the Norm-based Data Exchange Interface NAS in the AAA® model (see above) constitute a major contribution on the part of the AdV member authorities to the implementation of the National Geoinformation Strategy (NGIS) for the field of geographic reference data. The NGIS as part of the National E-Government Strategy was decided on by the GDI-DE steering committee. It defines for Germany, among other things, the framework for the interoperable and useful data exchange of available geoinformation.

Due to the advancements and updates occurring with standardisation and in the INSPIRE process, the AdV profiles are regularly updated in order to guarantee the interoperability of the web services of the AdV member authorities. These activities are seamlessly embedded in the overall strategic concept of the AdV Geospatial Data Services Provision Strategy. With this concept, AdV defines an overall strategy for the comprehensive provision of geographic reference data that actively contributes to a modern information, knowledge and civil society in Germany, with the mapping and cadastre authorities assuming their national responsibility. To this end, fundamental strategic, functional, technical, organisational and sales-related specifications are made and tasks defined, which can also serve as examples for use in the provision of geospatial data in other fields.

In accordance with the AdV Geospatial Data Services Provision Strategy, AdV has begun the design and development of an AdV test suite in order to support the quality assurance of geographic reference data, geographic reference data services and metadata by means of tests on the technical stipulations and conditions of AdV specifications – see Figure 24. In order to harness synergies, the developments in the GDI-DE Test Suite are to be taken into consideration.

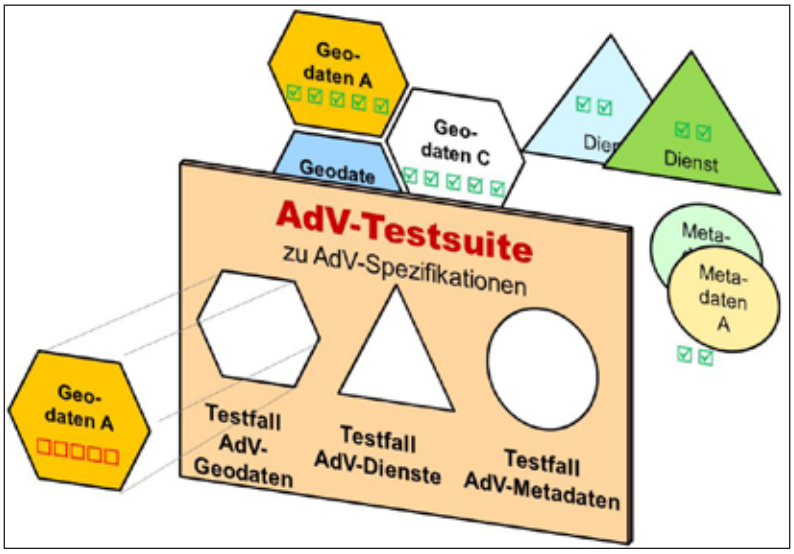


Fig. 24: Test cases of an AdV test suite

6. Public Relations and Marketing

All spatial planning and decision-making processes require geographic reference data to link the relevant sector-specific information with the corresponding location on the earth's surface. This geographic reference data is any non-interest-specific, non-application-specific description of the topography of the earth's surface (surveying and mapping) and of real estate (real estate cadastre). In order to ensure the availability of geographic reference data and geospatial data services for the government, for business, for scientific purposes and for the public, the surveying and mapping authorities of all the German Laender are under a legal obligation to collect, manage and provide geographic reference data. For modern, technical authorities, the provision of highly up-to-date geographic reference data around the clock in the form of services and online shops has long since become part of everyday business. One of AdV's core tasks lies in continuing this development, recognising the current and future demand for geospatial data products and facilitating and promoting the use of official geographic reference data.

Requirements

The responsibility for official surveying and mapping lies with the German Laender according to constitutional law. Because the need for a multitude of spatial applications goes beyond the provision of geographic reference data within one Land and because users are increasingly making greater demands in terms of geographic reference data being technically standardised across Laender and the contents being of high quality, it is necessary for nationally standardised, up-to-date and high-quality products and services to be provided and made accessible to expert users and the public. In addition to digital output on data storage devices, web-based data offerings are now standard. The surveying and mapping authorities provide digital databases for searching, viewing and downloading via geoportals, geospatial data services and geoviewers. A meta-information system provides information on availability, characteristics and points of contact for the products.

AdV has realised that a strategically important goal is for geographic reference data to be also provided via geospatial data services by the appropriate agencies. With these standardised Internet services, the Official Surveying and Mapping in Germany wants to actively contribute to the development of the geospatial data infrastructure and e-government and thus promote a modern information, knowledge and civil society in Germany.

Fig. 25: Official geospatial data is used in many fields (conservation, infrastructure, safety and security, planning). Images: mojolo – Fotolia.com, osterwelle – Fotolia.com, LDBV Bayern

To allow for a nationally standardised product range, the distribution points are being networked and what they provide is being standardised. Currently, certain product groups are being provided across Laender and in harmonised form at three central distribution points: at the Central Office for House Coordinates and Building Polygons (ZSHH), the SA*POS*® Central Office (ZSS) and the Central Office for Geotopography (ZSGT) at the Federal Agency for Cartography and Geodesy (BKG). BKG also supplies the national government institutions with geographic reference data.

To achieve the goals of optimally satisfying the cross-Land demand for the long term and standardising the provision of products for the Official Surveying and Mapping in Germany, the Public Relations and Marketing Working Group (AK PRM) of AdV performs both operational and strategic PRM tasks for the nationally available geographic reference data products and services, with the involvement of the member authorities and the other working groups of AdV. In this process, the following subject areas are to be covered:

- collection and documentation of the requirements of the state and the public regarding the collaboration and comparing these with the geographic reference data products and services (product policy)
- maintenance of the licence and fee models and model licence agreements, as well as execution of model-based licensing for the use of the geographic reference data and geospatial data services (conditions policy)
- networking of the central and decentralised distribution points and their involvement in implementing new strategies for providing geographic reference data (distribution policy)
- implementation of measures to provide information on the availability and usability of the geographic reference data and geospatial data services (product information)
- implementation of measures for the positive perception of the Official Surveying and Mapping in Germany and its cross-Land geographic reference data products and services (public relations)

Services

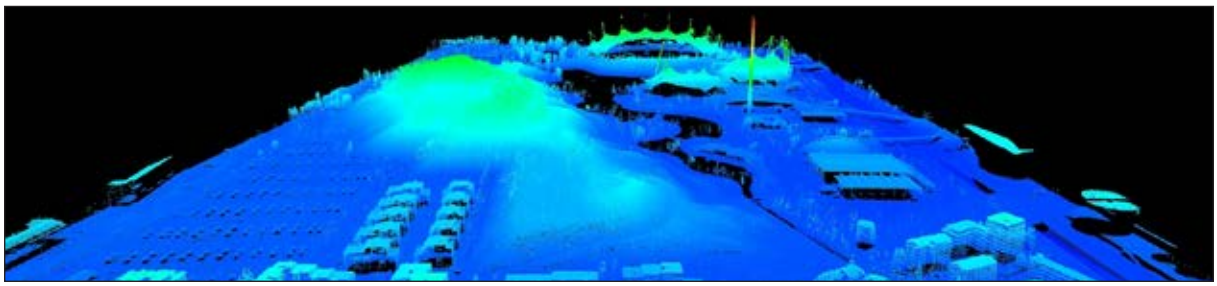


Fig. 26: Modern geospatial data focuses on the users' needs. Image: LDBV Bayern

Product policy

To achieve optimum distribution of the geographic reference data, user and purpose-oriented geographic reference data products are to be produced and made available as part of the official activities of the surveying and mapping authorities. For this purpose, information is required about the demand and requirements of users regarding geographic reference data (product, intended use, product satisfaction) and regarding conditions of provision and product information (information channels and contact channels to the surveying and mapping authorities). Together with the central distribution points, the AK PRM coordinates and conducts user surveys and analyses on the current range of official geographic reference data. The goal is to consistently be able to meet the current needs of even innovative users with the product portfolio of official geographic reference data.

Conditions policy

To regulate rights of use in connection with the provision of the geographic reference data and geospatial data services, there is a need for a nationally standardised licence and fee model. This must satisfy current requirements, be as clear and simple as possible and regulate the use of all the currently offered geographic reference products. For this reason, the Official Surveying and Mapping in Germany has approved the directive on fees for the provision and use of geographic reference data of the surveying and mapping authorities of the Laender of the Federal Republic of Germany (AdV Fee Directive) and published it at www.adv-online.de. It is used by the central distribution points and the individual German Laender are recommended to implement it. The AK PRM updates the licence and fee model according to AdV's requirements and in consultation with the other working groups if the AdV Fee Directive has to be adapted to keep abreast of the technical advancement of the products and to be in line with user requirements. In September 2015, the AdV Plenum agreed to the AdV Fee Directive being updated to version 3.0. Customers benefit from extensive improvements: it makes fee regulations for the provision of data and services as well as the calculation of fees for use cases significantly simpler. The new version of the AdV Fee Directive came into effect on 1 April 2016. The AK PRM is currently developing price models for future geospatial data products, such as a central viewing service and a geocoding service for land parcels.

Uniform sample agreements are indispensable for transparency and the cross-Land use of geographic reference data. The AK PRM maintains the standardised model licence agreements for complex applications, the small contract template for geoproduct licensing and the General Terms and Conditions of Business and Use (AGNB). To supplement this, web-enabled, brief and easily understandable sample text blocks for the licensing of geospatial data services have been developed. These sample agreements are used at the central distribution points and are also recommended for licensing within the individual Laender. They are available at **www.adv-online.de** and are free for further use.

Distribution policy

Furthermore, the AK PRM sees itself as a communication platform for the distribution points of all the surveying and mapping authorities and for the central distribution points and it supports the exchange of experience regarding the application of the AdV Fee Directive. To this end, the AK PRM annually conducts a two-day sales manager conference. Besides purely providing information about the activities of the various AdV committees and the central distribution points, the event serves as a platform to discuss new approaches to data usage and product development.

Fig. 27: In 2015 Dresden was the location of the sales manager conference. Image: LDBV Bayern

The AK PRM is actively involved in developing and implementing new strategies for the provision of geographic reference data. For example, they are currently considering the further development of the AdV distribution point structure in cooperation with the Geobasis Steering Committee.

To this end, a central AdV workshop was held at the Bavarian Agency for Digitisation, High-Speed Internet and Surveying in Munich at the beginning of 2016 (Figure 28).

Fig. 28: Participants of the 2016 workshop during a short tour of the print shop of the Bavarian Agency for Digitisation, High-Speed Internet and Surveying in Munich. Image: LDBV Bayern

Product information

To ensure that the Official Surveying and Mapping in Germany has a uniform appearance and a uniform presentation in text and image, AdV has adopted a common corporate design and made it available to all member authorities. AdV's corporate design is regularly adapted to suit the technical advancements and the requirements of the distribution points.

AdV's information materials are created uniformly according to the design rules defined by the corporate design. The purpose of the materials is to provide the interested public with information on the applicability and availability of the geographic reference products in the language of the geomarket.

Web portals and works of reference

The AdV website (**www.adv-online.de**) provides information about the tasks, product range and developments. Visitors should be able to access AdV's Internet information in a user-friendly way and with just a few clicks. This includes:

- current production information
- terms of purchase and licence regulations
- information on contacts and distribution points

Via a contact form, enquiries and specific questions can be addressed to AdV directly. The web contents are maintained by editors of the individual working groups. The AK PRM assumes coordination of the structural work. Within the scope of the AdV Provision Strategy, the AdV's Internet presence is gradually being added to and further expanded.

Image promotion

For the surveying and mapping authorities to be perceived in a positive light, public relations activities must be actively pursued, making use of appropriate media and an effective presence at events. The AK PRM has produced a short film describing the organisation, role and product range of the Official Surveying and Mapping in Germany in an easy-to-understand form. For it to be used widely and effectively, the film can be found on the AdV website (www.adv-online.de) and has subtitles in German, English and sign language. Furthermore, the surveying and mapping authorities regularly provide information events for the interested public.

Public relations and trade fair appearances

In the process of establishing geospatial data infrastructures in the Federal Republic of Germany, AdV is endeavouring to raise awareness of the geographic reference data and geodata services of the surveying and mapping authorities in the Laender and to maintain direct contact with national and international customers. As in previous years, the official surveying and mapping was represented by AdV with an exhibition stand at INTERGEO® 2015, the world's leading fair for surveying and mapping, in Stuttgart (Figure 29). Besides the presentation of the products and capabilities of the Official Surveying and Mapping in Germany, accompanying lecture and discussion forums took place.

Fig. 29: Attentive visitors at the joint stand of AdV during an expert lecture at INTERGEO® 2015 in Stuttgart. Image: AdV

7. Involvement in National and International Organisations

EuroGeographics

EuroGeographics is the non-profit association of the national institutions in Europe that are responsible for performing geodesy, cartography and real estate cadastre tasks. Collaboration within the context of EuroGeographics includes the development of transnational, harmonised products, as well as joint working groups and projects. The members of EuroGeographics (**www.eurogeographics.org**) particularly aim to support the European Commission in establishing the European geospatial data infrastructure in connection with the INSPIRE framework directive and the earth observation programme Copernicus.

AdV is an associated member and the Federal Agency for Cartography and Geodesy (BKG) a regular member of EuroGeographics. Both are actively involved in the work on products, in projects and in expert groups. Moreover, the president of BKG is a permanent member of the Management Board and currently also Vice President of EuroGeographics.

EBM, ERM, EGM and EuroDEM

EuroGeographics offers the following official European data sets in standardised form, harmonised across national borders and with data currency in line with demand:

- EuroBoundaryMap (EBM) – the administrative units of all national administrative levels in Europe, with names, unique code numbers and a reference to the statistical classifications NUTS/LAU of Eurostat, the Statistical Office of the European Union. The data set in the scale 1:100,000 currently covers 43 European countries (Figure 30).
- EuroRegionalMap (ERM) – the topographic reference data set in the scale 1:250,000. ERM covers a region of 36 European countries (Figure 31).

- EuroGlobalMap (EGM) – the topographic reference data set in the scale 1 : 1,000,000. EGM covers a region of 37 European countries and has been available free of charge on the Internet since 2013. EGM is derived automatically from ERM (Figure 32).
- European Digital Elevation Model (EuroDEM60) – a digital terrain model computed by BKG from the national data records with a position resolution of 2'' (approx. 60 m) and a height accuracy of 8 – 10 m.

The experts at BKG provide the German contributions to the products. Furthermore, BKG is responsible for merging the national contributions and for the creation, updating and development of the products EBM and EuroDEM. With ERM, BKG is very actively involved in the technical team and will assume additional responsibility for the long-term maintenance and further development of the product in the future. The Service Centre at BKG is the distribution centre for EuroGeographics and delivers the European data sets to both German and international customers.

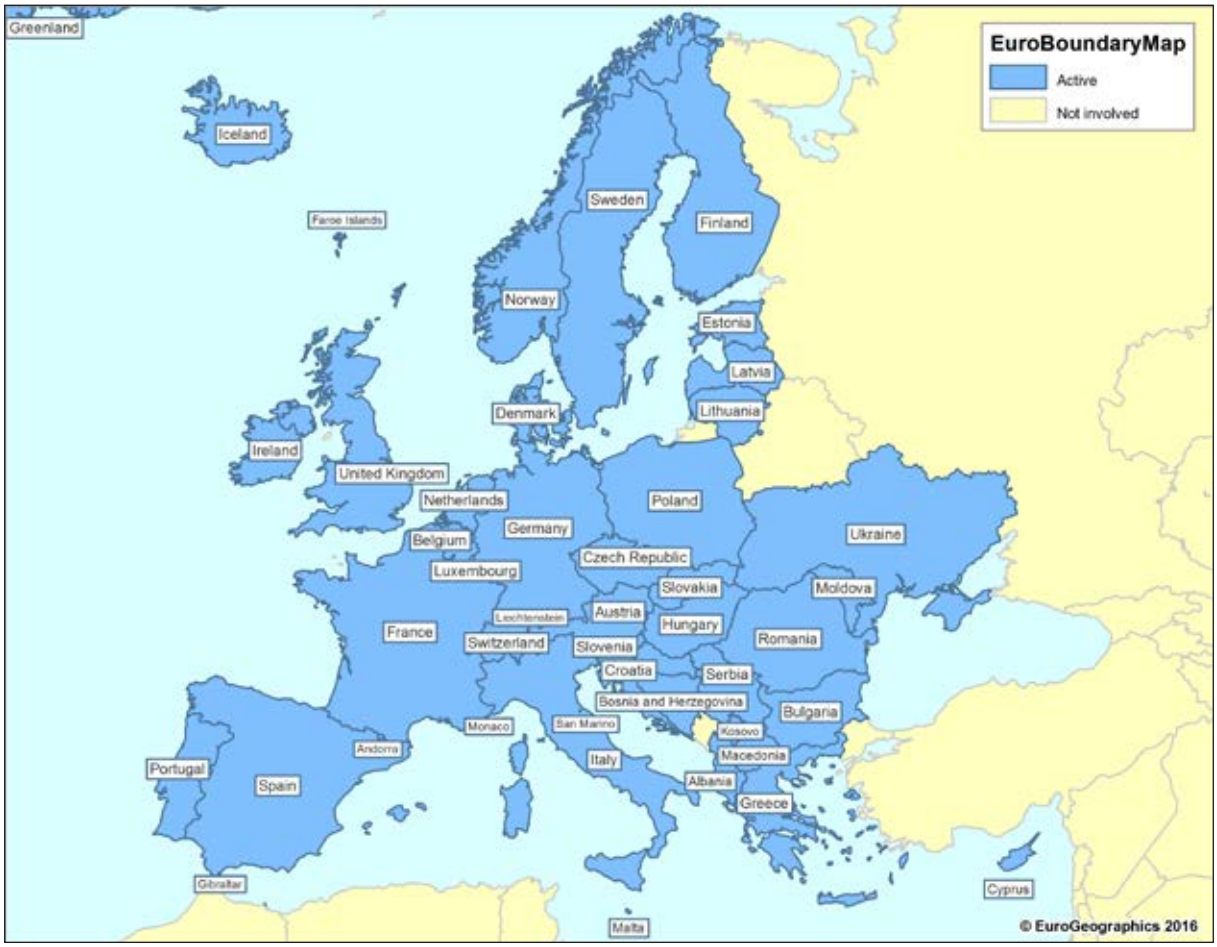


Fig. 30: Members of EBM (EuroBoundaryMap)

Fig. 31: Members of ERM (EuroRegionalMap)

Fig. 32: Members of EGM (EuroGlobalMap)

Knowledge Exchange Networks (KENs)

The Knowledge Exchange Networks (KENs) provide platforms for a discussion forum on various topics between experts from the EuroGeographics members. One example is the INSPIRE KEN, in which members can describe their experiences with INSPIRE implementation and discuss solutions for implementation. BKG is represented in most of the KENs and is actively contributing to the work.

European Location Framework

BKG is involved in the project European Location Framework (ELF), which was initiated by EuroGeographics. The project serves to further the target of EuroGeographics to harmonise across borders the geographic reference data of its members and make this available for global, European (e.g. Copernicus and tasks of the European Commission) and regional applications, tailored to suit the demand. ELF supports the implementation of the INSPIRE Directive at a national level, above all in the cross-border harmonisation of the geographic reference data through the development of geospatial data services and tools.

The project started in March 2013. The duration has been extended from 36 to 44 months. As of 1 January 2016, 40 partners from the administrative, academic and business spheres – including 25 European mapping and cadastre authorities – are working on establishing a high-performance service platform that makes it possible to merge national geographic reference data and geospatial data services and make them available for a wide range of services. The cooperation is being funded within the scope of the "Competitive and Innovation Framework" programme of the European Commission with 50 % of the project budget.

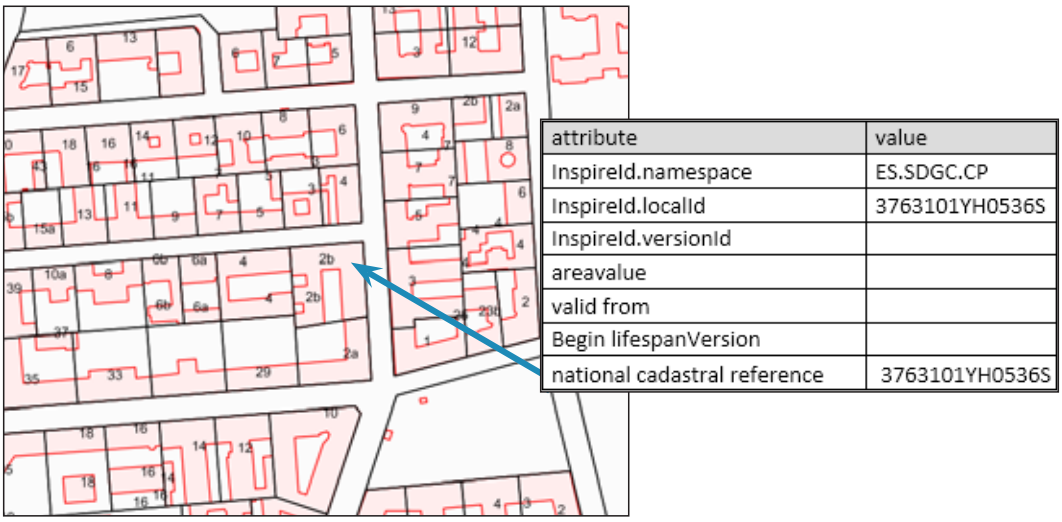
The core of the technical infrastructure is the ELF platform. This flexible cloud-based, tiered architecture supplies INSPIRE-compliant, cross-border geographic reference data that is harmonised Europe-wide. First examples are the geospatial data services "ELF Topographic Basemap" and "ELF Cadastral Index Map".

The geospatial data service "ELF Topographic Basemap" merges geographic reference data of various countries and scales into a map of Europe in a viewing service. In the project, a map display that is uniform across Europe and with zoom levels from an individual building to a map of Europe has been developed and implemented on the basis of international standards. The national geographic reference data and the pan-European data sets EuroRegionalMap and EuroGlobalMap from EuroGeographics are the data basis for the viewing service. The project partners display this data according to a uniform signature catalogue and create a Web Map Service (WMS). These are made into a high-performance Internet map – Web Map Tile Service (WMTS) – in Norway.

Further information on the project is available at **www.elfproject.eu**.

Fig. 33: ELF Basemap in the tri-border region of Germany, the Czech Republic and Poland

The Internet map "ELF Cadastral Index Map" was designed as an interface to the national land parcel information. In the project, a map display that is uniform across Europe and with zoom levels from an individual building to a base map has been developed. This viewing service is based on the national geographic reference data of the land parcels, address data, building polygons and administrative units. The Web Map Service (WMS) offers the user an interface to more detailed information on the national land parcel reference.



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InspireId.localId	3763101YH0536S
InspireId.versionId	
areavalue	
valid from	
Begin lifespanVersion	
national cadastral reference	3763101YH0536S

Fig. 34: Example of the ELF Cadastral Index Map

Copernicus – the European earth observation programme

The political, business and academic spheres constantly require reliable and up-to-date information. Copernicus, the earth observation programme of the European Union (EU), will contribute towards tapping the huge potential of remote sensing for social and political issues. To reach this goal, Copernicus links satellite-based earth observation with terrestrial, aircraft and maritime in situ data and modern data processing.

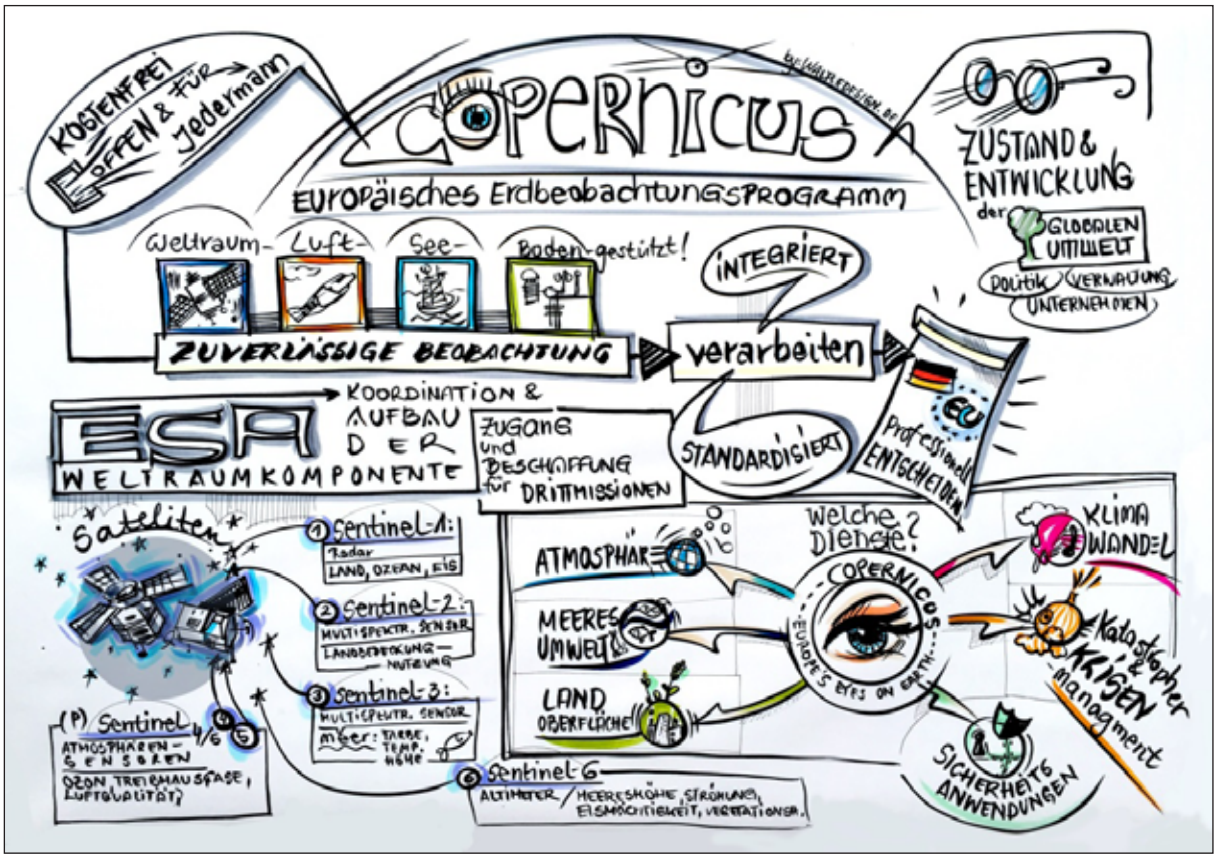

Fig. 35: Copernicus programme – background and components
(© Illustration Sabine Müller-Waltle / WaltleDESIGN / GIW-Geschäftsstelle)

The basis of the programme is the space component. This consists of six satellite families, the so-called Sentinels, specially developed by ESA for Copernicus. The Sentinel missions include radar, spectral and altimeter systems for land observation and for monitoring the oceans and the atmosphere. The data from the Sentinels is supplemented by images from additional national and commercial missions.

Forming the core of Copernicus are the six services that deal with the topics of land monitoring, marine environment monitoring, disaster and crisis management, security, atmosphere monitoring and climate change monitoring.

Within the context of these services, freely accessible information products are made available free of charge (Commission Delegated Regulation [EU] no. 1159/2013), which can be further processed for many different applications. Further information can be found at **www.d-copernicus.de**.

With the establishment of the Copernicus programme, the availability of satellite data and services is hugely improved. In many cases, however, public institutions are not yet sufficiently prepared to integrate satellite information into their work processes. In order to assist public authorities in implementing Copernicus data, in 2012 the German Federal Ministry of Transport and Digital Infrastructure (BMVI) decided to supplement and support the establishment of Copernicus with its own national activities. These national projects are to be conducted in three areas: support of the technical coordination; technical implementation and validation projects; and the definition, set-up and pilot operation of a national Copernicus IT infrastructure (Code-DE).

The technical implementation and validation activities involve the validation, adaptation and integration of Copernicus services and data in the business processes of the authorities. In October 2013 and again in November 2014 the Space Administration of the German Aerospace Center (DLR) issued a publication with the title "Development and implementation preparation of Copernicus services for public sector requirements in Germany". In total, BMVI is so far funding seven applicant bodies with four joint projects. 13 applicant bodies with their individual and joint projects are currently in the approval phase. The DLR Space Administration is responsible for the technical and administrative support of the projects. By way of example, a Copernicus project conducted by Bezirksregierung Köln is presented below.

In the mining-focused Land of North Rhine-Westphalia, about a quarter of the area is subject to changes in the altitude of the earth's surface. In the future, an interferometric radar technique based on the data of the Copernicus satellite Sentinel-1 is to be used to determine these changes. To test this method, the Surveying and Mapping Authority of North Rhine-Westphalia (NRW) initiated the Copernicus project "Establishing a Ground Movement Cadastre", funded by BMVI.

The NRW Surveying and Mapping Authority has always had the statutory mandate of documenting the movement of the earth's surface. This is based on precise levelling (in areas of vertical ground movements due to mining activities), which is conducted at intervals of several years. For these complex survey campaigns, up to two dozen measuring squads are mustered, who are supplied by the Surveying and Mapping Authority itself as well as by the mine operators or the affected municipalities. The data obtained is centrally quality-tested

and analysed at the Surveying and Mapping Authority. The result is an updated geodetic height reference, which, as an official, neutral reference frame, serves as a reference for further measurements.

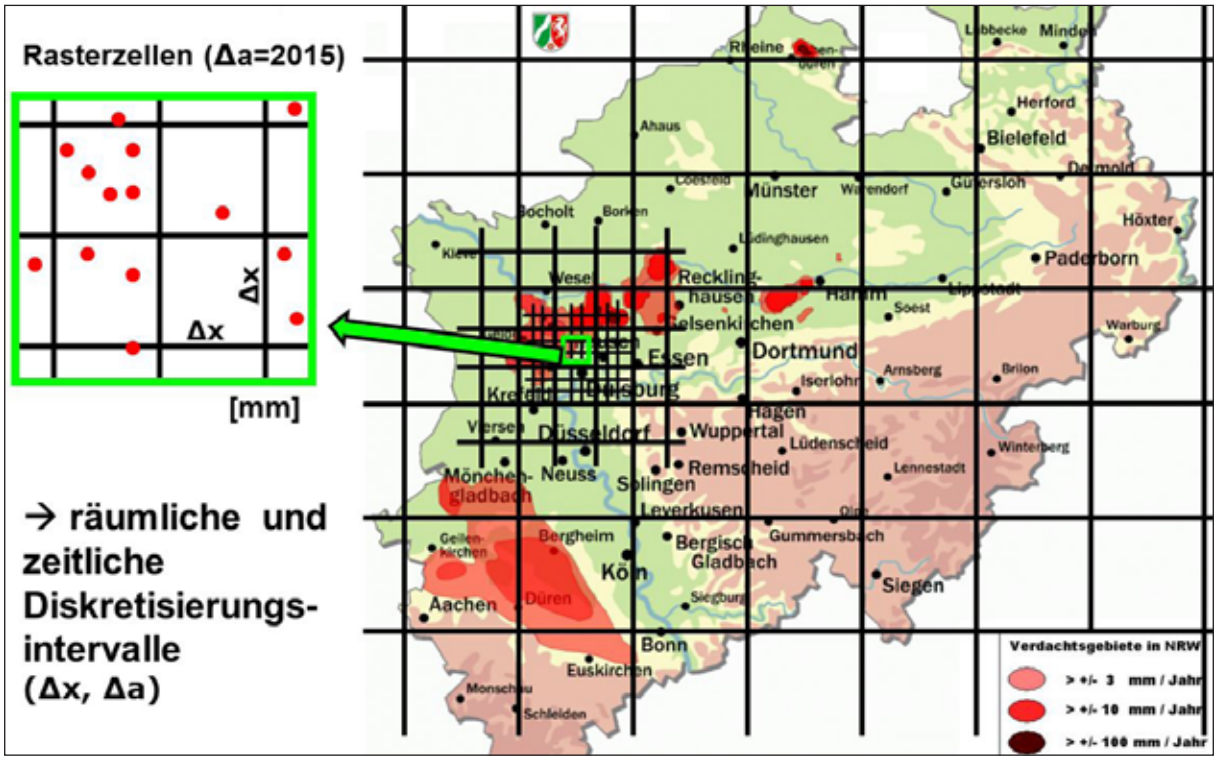

Fig. 36: Ground movement cadastre: Vertical changes in altitude with spatial and temporal resolution.

The precise levelling procedure has proved successful to this day and provides high-precision, reliable data. Nonetheless, the potential for improvement is obvious:

- Owing to the time-consuming measurement method, the measurement readings are obtained over a time period of several weeks and can only be related to the same point in time to a limited extent.
- Owing to the complexity, levelling campaigns can only take place at intervals of several years.
- The results relate to individual points. To obtain information related to an area, it must be interpolated across large distances.

At this point, radar interferometry promises results with almost blanket coverage, with a high update frequency and with a grade of accuracy that comes close to levelling. These advantages are to be harnessed for surveying and mapping. At the same time, in the end, the Surveying and Mapping Authority has to be able to vouch for the accuracy of the results with the same level of reliability as is the case today with the time-tested levelling.

With this target it is evident that the project cannot solely deal with the mere evaluation of the radar data. Equally important is the examination of which quality criteria are available and how significant they are. In this context, it must also be decided which tasks are to be carried out by a service provider and where the quality assurance work of the Surveying and Mapping Authority begins. In other words, in the process chain from the data collection to the end result it is necessary to find a suitable interface between the service provider and the authority.

Initial data was recently evaluated and compared with the findings of precise levelling. The result was so promising that the targets that have been set for the project seem achievable. The end of the project is in 2018.

UN-GGIM: Europe – establishing efficient geospatial data management

Integrating national geospatial data into the European and international sphere is increasingly becoming a focus. Significant in this context is "United Nations Global Geospatial Information Management (UN-GGIM)": an initiative of the United Nations (UN), which has taken on the responsibility of coordinating global geoinformation management. Important topics in UN-GGIM are the integration of statistical and geographic information, particularly regarding their significance for the 17 UN Sustainable Development Goals (SDG).

At a European political level, a regional body has so far been lacking that deals with the questions of geodesy and geoinformation at a universal level. To close this gap, a political body of this kind for Europe was formally put in place by UN-GGIM (global) in September 2014 in the form of UN-GGIM: Europe. A great opportunity for UN-GGIM: Europe lies in the stronger networking of the national mapping and cadastre authorities with the national statistical offices.

BKG has assumed leadership of the working group on the topic of geospatial data integration (Working Group B "Data Integration"). Very encouraging is the close cooperation agreed between BKG and the German Federal Statistical Office (Destatis). In this way, synergies between UN-GGIM: Europe and expert groups from statistics can be created and, overall, procedures and methods from the spheres of geodesy / geoinformation and statistics can be merged.

The first report of Working Group B on "User needs for combinations of data" has been published on the website **http://un-ggim-europe.org/content/wg-b-data-integration** since July 2015. The report deals with use cases and requirements on the part of political decision-makers regarding the combination of geospatial (reference) data and statistical data.

By mid-2016, Working Group B will propose methods for a better linking of geospatial data and release recommendations for handling various issues in Europe, for example, for quality management in linking open data from non-government sources.

Open Geospatial Consortium (OGC)

The OGC specifications play a decisive role in the interoperable provision of official geospatial data. For example, all the AdV profiles and AdV product specifications for geoservices are based on specifications from OGC. For the analysis and later implementation of the technical standards currently in development, ongoing support of the work of these bodies is necessary and – when the need arises – specific influence must even be exercised. For this reason AdV, represented by the Information and Communication Technology Working Group, is actively involved in OGC and, as a Technical Member, is also a long-standing voting member.

The OGC standards used in the GeoInfoDok and in the AdV profiles are, as a rule, of interest to AdV from two perspectives. Firstly, there is a need for investment protection, i.e. for AdV solutions to be included in the standardisation process so that AdV solutions are in line with new or updated standards. Secondly, there is a need to create the conditions that make it possible for new standards to be used later as a basis for new components of the architecture in the SDIs of the AdV member authorities. For example, a promising 3D visualisation service is currently being developed on which a corresponding AdV profile is then to be created in accordance with the AdV Provision Strategy.

At OGC technical standards are also increasingly being developed (so-called domain specification). For example, in March 2016 a “Land Administration Domain Working Group” was established, which is to deal with standards in the field of real estate cadastre and land management. Through the cooperation agreement between OGC and ISO/TC 211, many OGC standards are initially developed at OGC and only then adopted as a formal ISO standard.

ISO/TC 211

The Geographic Information / Geoinformatics Technical Committee develops and maintains formal geoinformation standards. The chairmanship and secretariat are moving from Norway to Sweden at the end of the year after more than 20 years.

Establishing and maintaining the compliance particularly of the AAA® data model with the ISO standards is the stated goal of AdV and has meanwhile become a permanent task. However, the standardisation projects are becoming increasingly complex, making it ever more difficult to assess the relevance of individual standards and further developments.

Here again, the Information and Communication Technology Working Group has proven itself as an expert body. With the available resources it represents the interests of AdV and implements the relevant standards within AdV, in particular through technical profiles and product specifications.

Besides the standards relevant to the AdV specifications, a new standards project could be of interest to AdV that deals with the archiving of geospatial data under German leadership.

Permanent Committee on Cadastre in the European Union

On 1 July 2015 Luxembourg assumed the EU Council Presidency and thus also the Presidency of the Permanent Committee on Cadastre in the European Union (PCC) for the second half of 2015. To conclude the presidency, the PCC General Assembly was held in the city of Luxembourg on 13 and 14 November 2015. The focus of the conference was on lectures about the real estate cadastre and land register sector in Luxembourg, the Europe-wide networking of land registers, open data, maritime spatial planning and the maritime cadastre.

On 1 January 2016 the Netherlands assumed the presidency for the first half of the year. The Dutch real estate cadastral authority together with EuroGeographics, the European Land Registry Association (ELRA), the European Land Information Service (EULIS) and the Council of European Geodetic Surveyors (CLGE) invited the spring PCC General Assembly to Amsterdam.

For the first time, this general assembly was organised as a “Common Vision Conference” on the basis of the “vision document” signed by the above-named institutions in 2013. The theme was “Migration to a smart world” and particular focus was placed on the field of the maritime cadastre. Additional lectures and discussions dealt, for example, with the question as to what the cities of the future would look like and what impact this would have on real estate cadastre and land register systems.

On 1 July 2016 the presidency of the EU, and thus of the PCC, for the second half of 2016 is being transferred to Slovakia; the autumn PCC General Assembly is planned in the city of Bratislava.

Explanation of frequently used abbreviations

AdV	Working Committee of the Surveying Authorities of the Laender of the Federal Republic of Germany
AAA®	AFIS® – ALKIS® – ATKIS®
AFIS®	Authoritative Control Point Information System
ALKIS®	Authoritative Real Estate Cadastre Information System
ATKIS®	Authoritative Topographic-Cartographic Information System
BKG	Federal Agency for Cartography and Geodesy
BMI	Federal Ministry of the Interior
BMVg	Federal Ministry of Defence
BMVI	Federal Ministry of Transport and Digital Infrastructure
DGK	German Geodetic Commission
DGM	Digital Terrain Model
DLM	Digital Landscape Model
DLZ	BKG Service Centre
DOP	Digital Orthophoto
ELF	European Location Framework
GDI-DE	Spatial Data Infrastructure Germany
GeoInfoDok	Documentation on the Modelling of Geoinformation of Official Surveying and Mapping
INSPIRE	Infrastructure for Spatial Information in Europe
NAS	Norm-based Exchange Interface
ÖbVI	Publicly Appointed Surveyors
OGC	Open Geospatial Consortium
SA*POS*®	Satellite Positioning Service of the Official German Surveying and Mapping
TN	Actual Use
WFS	Web Feature Service
WMS	Web Map Service
WMTS	Web Map Tile Service
ZSGT	Central Office for Geotopography
ZSHH	Central Office for House Coordinates and Building Polygons
ZSS	SA*POS*® Central Office

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