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

National Report

2016 / 2017

AMTLICHES DEUTSCHES VERMESSUNGSWESEN

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2016/2017

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German Association of Publicly Appointed Surveyors	www.bdvi.de
Bund and Laender Working Commitee for Sustainable Regional Development	www.landentwicklung.de
German Geodetic Commission	www.dgk.badw.de

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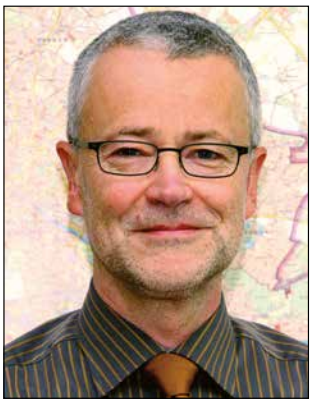


Dear Reader,

The digitisation of the world in which we live and work is ubiquitous. It is advancing rapidly and permeating more and more areas of administration and business. For the mapping and cadastre authorities, digitisation opens up completely new possibilities for service provision. The comprehensive use of the new digital information technologies makes it possible for the authorities to provide geographic reference data more efficiently and simultaneously gives users need-based access to the data anytime and from anywhere.

A stated goal of the mapping and cadastre authorities is to resolutely take advantage of the opportunities provided by digitisation. To this end, existing technical solutions need to be replaced, technical and organisational synergistic effects more intensively sought and users offered a product portfolio adapted to their needs with a standardised quality nationwide. The challenges associated with this currently dominate 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).

Back in 2015, AdV put forward the strategic principles for a coordinated approach to the provision of geographic reference data via new digital information technologies. The “AdV Geospatial Data Services Provision Strategy” contains the necessary stipulations and describes all the tasks needed to ensure a fast, efficient and also user-oriented provision of geographic reference data via Internet applications and standardised geospatial data services. The implementation of the “AdV Geospatial Data Services Provision Strategy” is underway and the first results are available.

With the increasing availability of new digital information technologies, the opportunities for users have increased significantly, as have users' requirements. The geographic reference data services of the mapping and cadastre authorities will only continue to be accepted in the long term if they succeed in offering technically standardised products with a currency and quality that are uniform nationwide. AdV has therefore further stepped up the debate about a modern product portfolio and realised that the current cartographic products can no longer meet changing user demands. A team has been commissioned to submit a concept on deriving a “map of the future” by the end of 2017 that will meet users’ future needs.

This national report gives an overview of the diverse range of activities of the official mapping and cadastre sector and provides information on recent results of 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) 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, representing the field of land consolidation, have guest status in AdV.

Mapping and cadastre 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 to provide a basis for infrastructural and spatial planning policy 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 SA***POS***®

- 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 approx. 53 million buildings and 64 million land parcels for the 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

bkg sehen. vermessen. verstehen.

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 Coordinates” 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 our geospatial data, maps, texts, reference systems and information services for their plans 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
- 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 the European and 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 – Wettzell (Germany), 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 processing, providing and updating topographic and cartographic information.

Through the DLZ, 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.

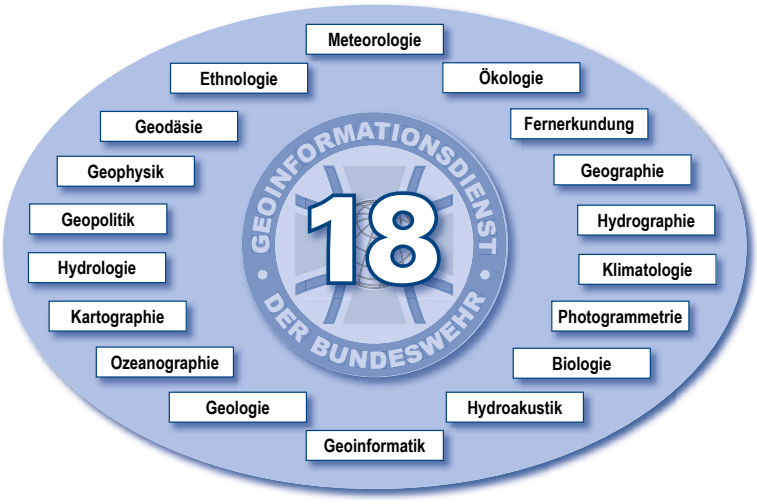


Fig. 1: Interdisciplinary approach – disciplines represented in the BGIS (credits: BGIC)

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:
www.kommando.streitkraeftebasis.de/portal/a/kdoskb

Federal Ministry of Transport and Digital Infrastructure (BMVI)

The Federal Ministry of Transport and Digital Infrastructure (BMVI) has been a member of AdV since 1950.

Bundesministerium für Verkehr und digitale Infrastruktur

The Division (Referat) DG 25 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, geo-referenced data processed into user-oriented products, e.g. regarding water depths and the bed topography 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 at a scale of 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 an essential basis 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 displayed 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” division of the Federal Institute of Hydrology (BfG) currently supports WSV in the fields of activity of Geodetic Reference Systems, Geokinematics, Hydrographic Surveying, Geotopography and Engineering Geodesy. When it comes to giving expert advice, the staff have the specialised knowledge required for 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 European Union's earth observation programme “Copernicus”. Through the implementation of a national “Copernicus programme of measures”, citizens and companies in Germany are to benefit tangibly from the European earth observation programme “Copernicus”. This is to be achieved by harnessing the potential arising from Copernicus for more effective and efficient public services.

Further details about the division's geoinformation 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.

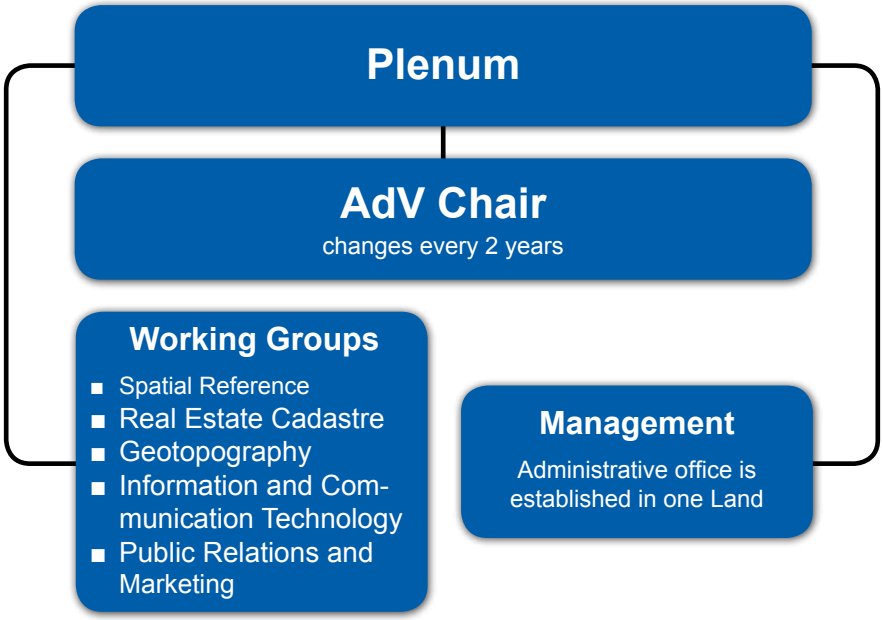


Fig. 2: Organisation of AdV

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 architecture

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

- creation and coordination of future-oriented collaborative concepts for the nationwide standardisation of the real estate cadastre, surveying and mapping and the geographic reference information system so as 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
- representing and presenting 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 should 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 progress, including compliance with the defined quality standards and norms
- analysis of potential for cooperation and devising proposals to realise this potential
- facilitating collaboration between individual or multiple Laender
- 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		Publicly Appointed Surveyors (ÖbVI)
				Laender authorities (and Laender enterprises)	Regional offices	
Baden-Württemberg	10.879.618	35.751	8.901	1	58	165
Bavaria	12.843.514	70.550	10.779	1	51	—
Berlin	3.520.031	892	401	1	12	56
Brandenburg	2.484.826	29.654	3.132	1	17	151
Bremen	671.489	420	207	1	1	6
Hamburg	1.787.408	755	254	1	—	8
Hesse	6.176.172	21.115	4.989	1	7	80
Mecklenburg-Western Pomerania	1.612.362	23.214	1.924	1	7	65
Lower Saxony	7.926.599	47.593	6.188	1	—	100
North Rhine Westphalia	17.865.516	34.113	9.296	1	53	417
Rhineland-Palatinate	4.052.803	19.854	6.604	1	6	78
Saarland	995.597	2.569	1.289	1	—	11
Saxony	4.084.851	18.449	2.733	1	13	101
Saxony-Anhalt	2.245.470	20.452	2.678	1	—	50
Schleswig-Holstein	2.858.714	15.802	1.906	1	—	41
Thuringia	2.170.714	16.202	3.155	1	—	65
Total for Germany	**82.175.684**	**357.386**	**64.436**	**16**	**225**	**1.394**

Tab. 1: Statistics:

Population figures – source: Federal Statistical Office, date: 31 December 2015. Results based on the 2011 census.
Land area – source: Federal Statistical Office, date: 31 December 2015.
Area in Rhineland-Palatinate: including the area "Joint German-Luxembourgian territory" of 6.20 km2.
Differences in area are possible due to rounding of figures.
Land parcels, number of authorities, Publicly Appointed Surveyors (ÖbVI), date: 31 December 2016.

2. Spatial Reference

“The coordinates do not appear from nowhere”

With the introduction of the “Spatial Reference 2016”, a new holistic, integrated way of looking at the previously separate, geometrically and physically defined components “position, 3D position, height or geopotential height, and gravity” has been established in practice in Germany. AdV‘s Spatial Reference Working Group has made this approach central to its directive for the geodetic spatial reference of the official surveying and mapping in Germany. This directive defines the reference framework for quality assurance. It additionally describes the collaboration between the geodetic reference networks run by the federal and Land authorities in the context of European and international requirements.

In the “classical viewpoint”, the geodetic reference frames were provided by more or less separate control point fields of position, height and gravity. This viewpoint has gradually changed since about the beginning of the 1990s with the increasing use of the GNSS measurement technique. It became possible to create control point fields that met the requirements of the new measurement technology and of a standardised Europe-wide reference system (ETRS89). Consequently, the classic triangulation networks were gradually replaced, i.e. they ceased to be used. By establishing permanent GNSS reference stations nationwide starting in the second half of the 1990s, it became possible, for the first time, to provide the spatial reference in the form of the operational satellite positioning service SA***POS***® High Precision Real-Time Positioning Service (SA***POS***®-HEPS) in real time, which allows a position to be determined with an accuracy range of 1 to 3 centimetres. Owing to the method used, the coordinates are here based on a mathematically defined model of the earth: the rotational ellipsoid. No direct connection exists between these coordinates and the earth‘s gravitational field. For elevation data related to the sea level, i.e. heights above an equipotential surface of the earth‘s gravitational field, it is essential to connect geometric measurements with those related to the gravitational field. The following figure presents the relationships between the different measurement units; the formula used for the relationship is:

$$H_E = H_N + U \quad \text{oder} \quad H_N = H_E - U$$

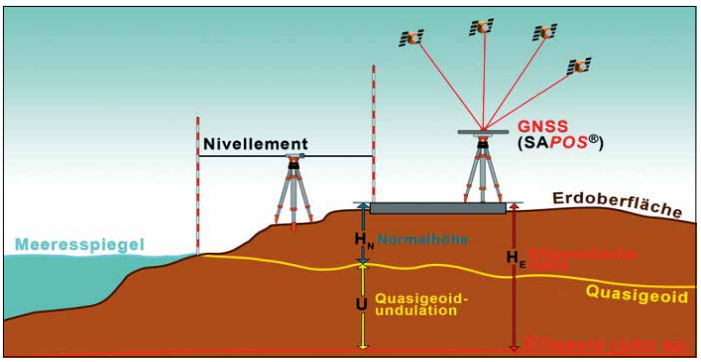


Fig. 3: Datum surfaces and measuring techniques

The AdV project “Repeat measurements in the German First Order Levelling Network (DHHN)” forms the metrological basis for this integrated understanding of the geodetic spatial reference. This geodetic spatial reference was introduced in the Federal Republic of Germany on 1 December 2016 with the following components:

Position

The recalculation of the 3D coordinates of the Geodetic Reference Network Points determined as part of the 2008 GNSS campaign and of the SA*POS*® reference station points valid at the time forms the basis for the 2016 Spatial Reference: “ETRS89/DREF91 in the 2016 implementation”. For the whole of Germany, the coordinate adjustments made in this context (maximum improvements to the network solutions) were a maximum of 4.8 or +3.6 mm for the position components and 12.8 mm for the height components. The introduction of the 2016

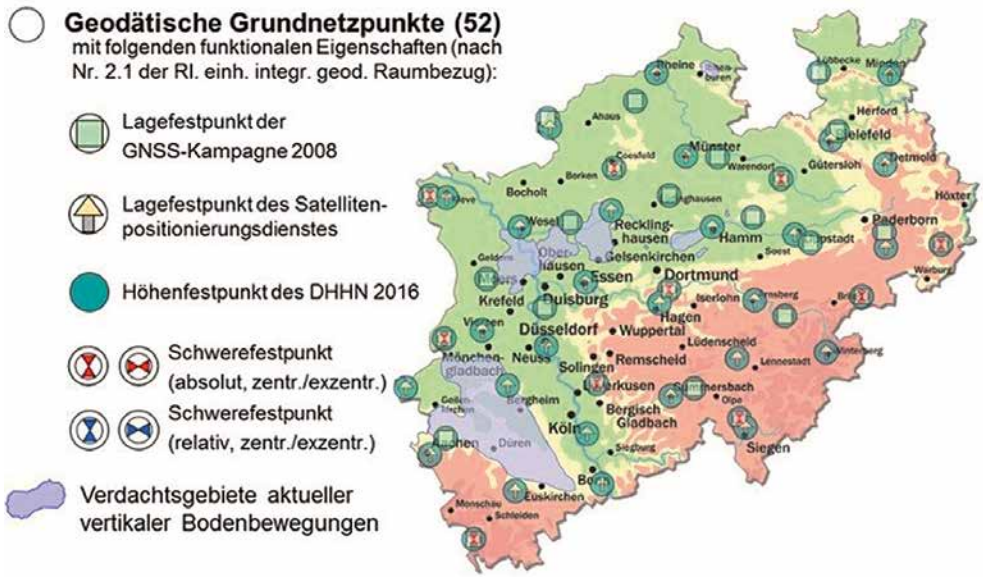


Fig. 4: Geodetic Reference Network Points with their functional characteristics, using North Rhine-Westphalia as an example

Spatial Reference therefore has no practical impact on the required measurement accuracy in the real estate cadastre.

Height

The new vertical reference frame DHHN2016 obtained from the repeated levelling is based on the model of normal heights. The vertical positioning is done here on 72 datum points that already existed as control points in DHHN92. The datum points are chosen according to criteria of geological stability, point location, point security and marking. Adjustment in relation to these datum points is unconstrained under the condition that the sum of the height adjustments of all the datum points be zero. In the adjustment, the 72 datum points have

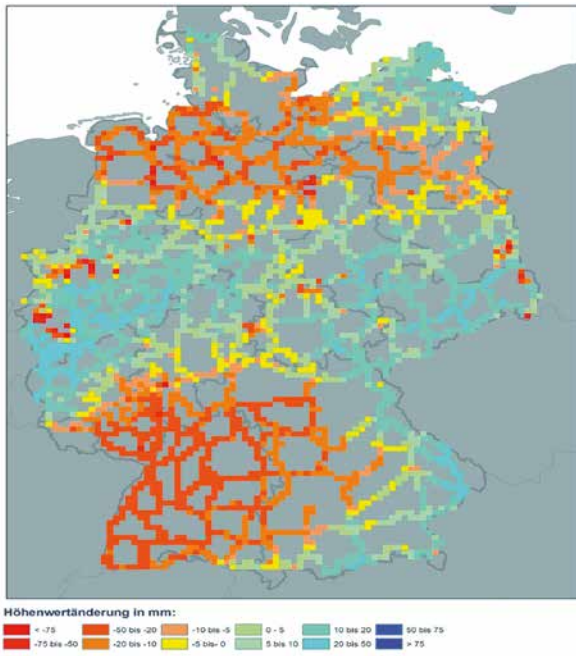


Fig. 5:
Height value adjustments in Germany
NHN heights in DHHN2016 minus
NHN heights in DHHN92

been given a height change of between 35 mm and +35 mm. The point “Kirche Wallenhorst”, which was the only datum point recorded in DHHN92, was given a height change of 1.7 mm in the new adjustment. In the transition from DHHN92 to DHHN2016 height value adjustments between 75 mm and +75 mm occur across Germany.

To transfer the heights from DHHN92 to DHHN2016, AdV made the web-based application “HOETRA2016” available on the website. With this application, users can transfer both individual points and lists of points to the DHHN2016 heights.

AdV-Quasigeoid GCG2016

The German Combined QuasiGeoid (GCG) was determined on a large scale using the “measured height anomalies”, i.e. using the difference between ellipsoid heights in ETRS89/DREF91 (2016 implementation) and normal heights in DHHN2016, while taking gravity measurements into consideration.

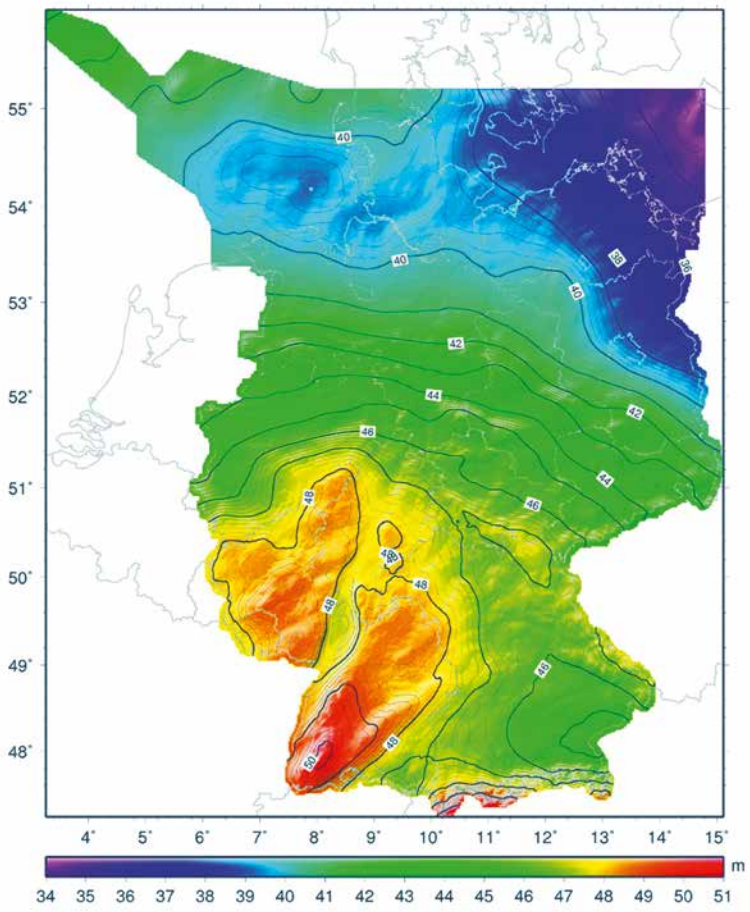


Fig. 6: GCG 2016 in Germany

The 2016 Spatial Reference demonstrates that the coordinate, height and gravity values are fundamentally subject to change over time. This must be taken into consideration in measures intended to assure the quality of the geodetic spatial reference for the long term. Geodetic measurements will thus continue to be indispensable in the future, too.

On the starting date of 1 December 2016, the 2016 Spatial Reference “went live” and is to be introduced comprehensively across Germany in all the components by 30 June 2017.

Thoughts on the 2016 Spatial Reference - from the point of view of the federal government, the Laender and the municipal level

"The integrated 2016 Spatial Reference is an important milestone for BKG. The provision of a consistent, integrated reference frame for Germany is a statutory obligation for BKG. The high quality of the 2016 Spatial Reference is unique in the world. It should serve as a model for future implementations of the Global Geodetic Reference System, the European reference system and the reference systems of other nations."

Prof. Dr.-Ing. Hansjörg Kutterer,
President and Professor of the Federal Agency for Cartography and Geodesy (BKG)

"The 2016 Spatial Reference not only provides the currently best possible geographic reference, it can also be regarded as the measurement to be used as a reference for future monitoring and has the potential to be used for all kinds of different work, such as for the purpose of environmental monitoring and other geosciences. . In North Rhine-Westphalia, for example, we were able to independently geodetically confirm the geologically predicted rises of the Eifel on a scale of about 1 mm/year."

Dr.-Ing. Jens Riecken,
Head of the Spatial Reference Working Group, Geobasis.NRW

"The integrated 2016 Spatial Reference is a large and logical step into the future for land surveying and mapping. Practical implementation with the 2D software products in the planning and construction sector shows that the distance-dependent scale factor of UTM projection is still a hindrance to interdisciplinary work on complex engineering projects. In individual cases it can be helpful, on the basis of the reference system ETRS89, to select a projection in which the influence of the scale factor becomes irrelevant. In the development towards integrated 3D planning in accordance with Building Information Modelling regulations (BIM regulations), the addition and system-related adaptation of the heights in DHHN2016 take on critical significance. Hence the integrated spatial reference has also reached the municipal level and is being put into practice there!"

Dipl.-Ing. Eberhard Ziem,
Mapping and Cadastre Agency of Düsseldorf, capital city of North Rhine-Westphalia

3. Real Estate Cadastre

The introduction of ALKIS® is now history. ALKIS® data has been available comprehensively all across Germany for a year. The way is clear for ALKIS® to be developed further.

Fig. 7: The way is clear for ALKIS® to be developed further *Image: Oliver Boehmer/Fotolia.com*

The task is to shape the ALKIS® future and reach the users. The relevant users here are those in the individual Laender as well as those requiring cross-Land data of the real estate cadastre, who value the nationally uniform cadastre standard.

Shaping the ALKIS® future means aligning it with the technological and social conditions. Ample potential for the future lies, above all, in the smart networking of data and services.

Fig. 8: Networking on behalf of the future

“Networking on behalf of the future” can be read in the image (Figure 8) and can be summed up as follows: citizens, companies, authorities, scientific bodies and politicians want to live, work, spend their leisure time and be mobile in forward-looking, liveable countries and cities. This requires smart solutions when it comes to collecting, providing and using geographic reference data.

However, shaping the ALKIS® future also means being aware of what the topics of the future are: climate, environment, energy, mobility and sustainability are at the top of the list here. Specific challenges are the growing volume of data, complex data exchange, managing the data and an optimum workflow with the goal of creating smart data out of huge data quantities.

ALKIS® – in the near future

The question “Where is ALKIS® headed?” is symbolised in the art piece (Figure 9), which can be seen in the transport and art museum of the city of Lucerne. Whether smart or not smart: the goal must be for the data and products to be of high quality! Therefore one key topic is quality management. No Audi, BMW, Mercedes or Porsche would be sold if high quality standards were not established and met.

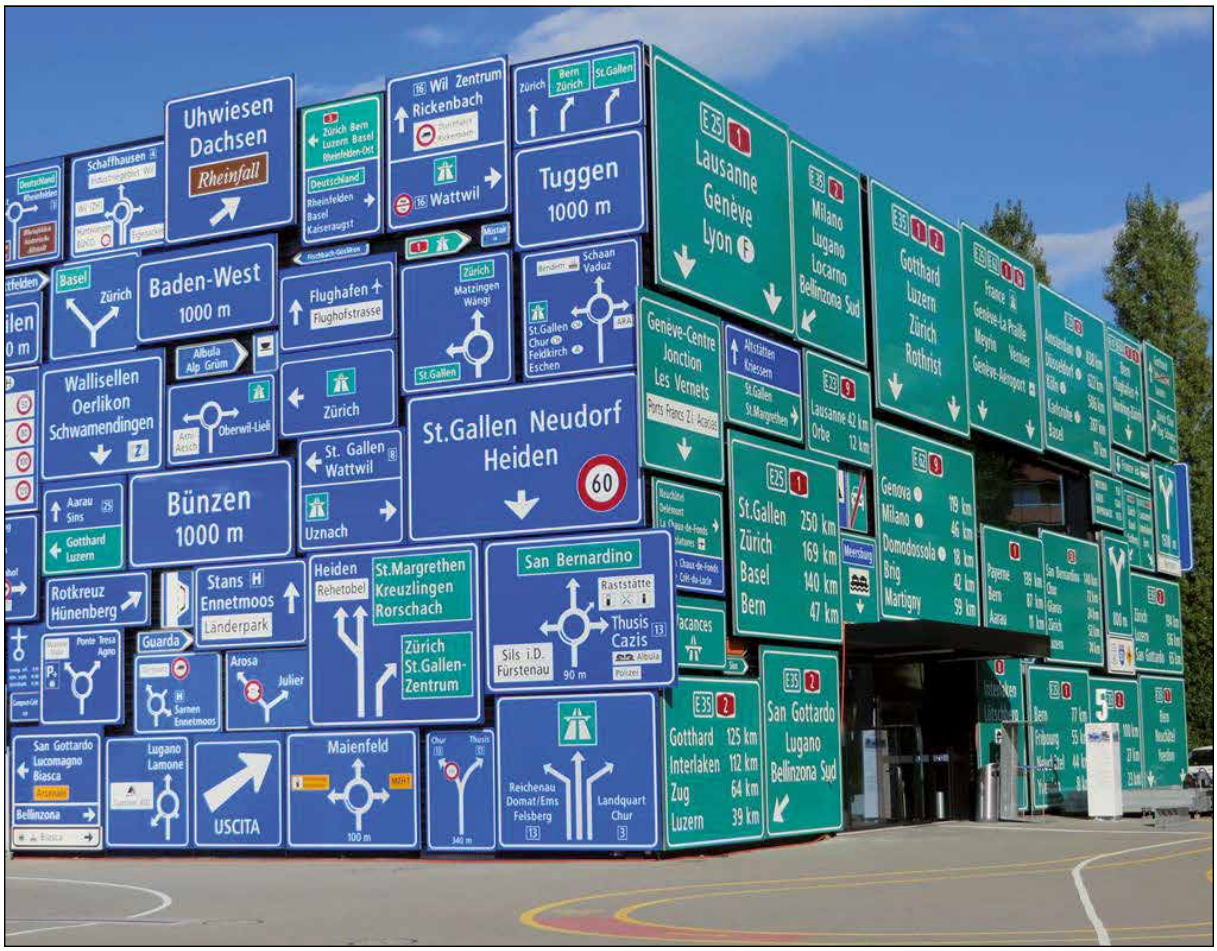


Fig. 9: Where are things headed? Museum of Transport in Lucerne

With ALKIS®, too, comprehensive quality management must be guaranteed in order for quality defects, which can come in many different forms, to be kept to a minimum. This covers everything from deficiencies in importing data to system failures and incorrect entries.

In a quality cycle, the data quality (DQ) is first defined, then measured, evaluated and finally, if necessary, proactively improved.

Furthermore, following the introduction of ALKIS®, the post-migration work, e.g. the subsequent recording of the regulations governed by public law, also needs to be undertaken. When it comes to the submitted surveying documents for updating the real estate cadastre, the process needs to be improved. Today the point data is still sufficient in some Laender. It is to be expected that the transition to complete updating drafts will soon be made there as well. And last but not least individual Laender are still faced with the challenge of transferring the Land coordinates in the real estate cadastre to ETRS89/UTM. This is the case, for example, in Baden-Württemberg, which will implement the data transfer at the end of 2017 in an ambitious project.

ALKIS® – the future

Provision of ALKIS® data via services

In the whole of Germany, around 64.4 million land parcels and 21.5 million buildings with geo-referenced addresses (house coordinates) are registered in the real estate cadastre. In addition, there are millions of owner details, TN objects and other objects.

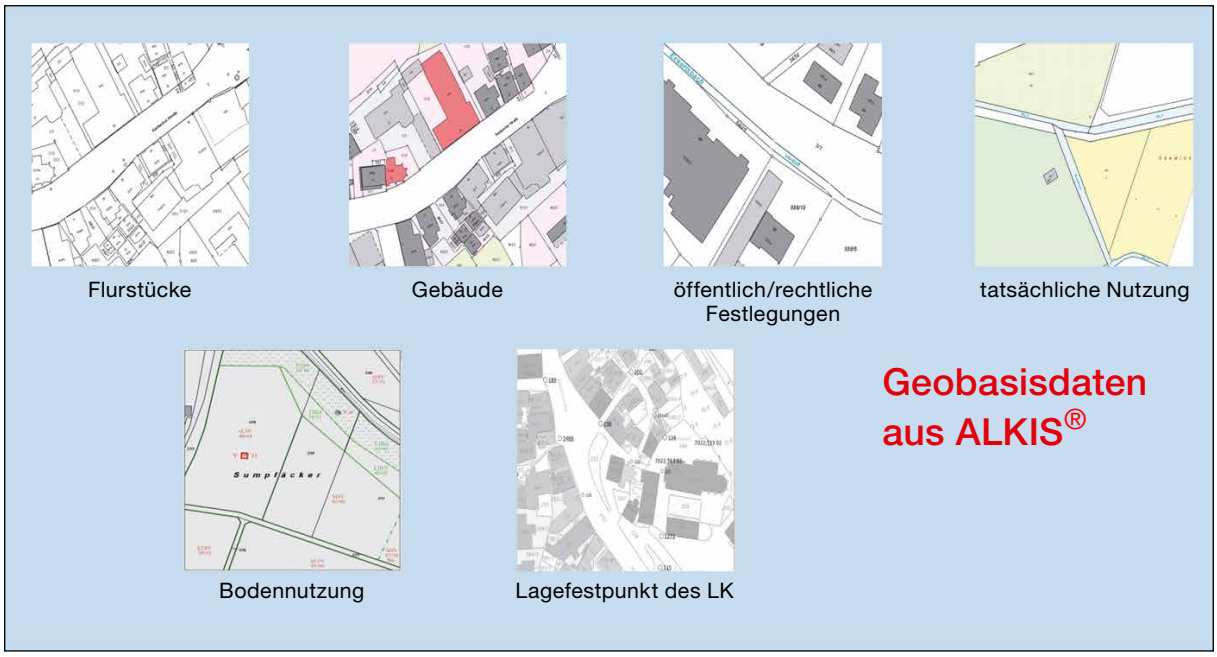


Fig. 10: ALKIS® data

AdV web profiles and AdV ALKIS® product specifications

Geographic reference data from ALKIS® forms the basis for a service-based geospatial data infrastructure. For this reason, the AdV Provision Strategy for the entire AAA model focuses on web technologies, taking the requirements of the INSPIRE process into account.

As for the implementation of the Provision Strategy, AdV has already created a series of technical web profiles for viewing and download services in the Web Map Service (WMS) and Web Feature Service (WFS). These profiles form the basis for the sector-specific versions of the thematic data to be provided (product specifications). The aim of this approach is to harmonise the provision of the data. With the focus on the users, these profiles are supplemented by the AdV Metadata Profile, in which the structure and semantics of the metadata are described.

Fig. 11: WMS example from Baden-Württemberg 1: 5000

Fig. 12: WMS example from Baden-Württemberg 1: 500

The WMS contains land parcel boundaries, land parcel numbers, buildings and descriptions of position. In the 1: 500 scale the house numbers are also included.

Central viewing service for land parcel information

At the first stage of implementation, AdV is aiming for a cross-Land central viewing service for land parcel information in the form of a cascading solution. For a nationwide central viewing service at the second stage, it will be necessary to address not only technical challenges but also various constraints and other requirements, such as performance, legal restrictions, data protection issues, ALKIS® portrayal catalogue conformity, conditions of use and user requirements.

ALKIS® and the INSPIRE Annex Themes

ALKIS® is affected by a total of nine of the so-called INSPIRE Annex Themes. These primarily include the cadastral parcels, buildings, addresses, land use and administrative units.

AdV INSPIRE product specifications

Based on the INSPIRE guidelines (data specifications), the AdV INSPIRE Profile is currently being developed. To follow are the AdV INSPIRE product specifications and the description of the model changeover with HALE alignments from AAA to INSPIRE.

The goal is to pass an AdV Plenum resolution on the AdV INSPIRE product specifications in the near future, related to the individual INSPIRE Annex Themes for ALKIS® and ATKIS®.

Fig. 13: INSPIRE Annex Themes

ALKIS®-ATKIS® harmonisation – division of Actual Use (TN) into Land Cover (LB) and Land Use (LN)!?

In the context of updating the AAA technical schemata, AdV is continuing to focus on the harmonisation of ALKIS® and ATKIS®, primarily in the area of Actual Use. The general rule that applies to geographic reference data: “collect once, use multiple times” can be implemented optimally if standardised data entry criteria for ALKIS® and ATKIS® are applied in the Laender. Changing the currently applicable lower limits for entries in ALKIS® and ATKIS® to common lower limits would release resources in the long term.

As the starting point for further analyses, the currently very heterogeneous quality across the Laender of the Actual Use in ALKIS® is summarised on a product sheet, combined with the product standard ALKIS®-TN. The latter is intended to provide transparency about the TN documentation in the Laender for users of cross-Land data.

In September 2016 AdV passed a resolution on an action and reference framework for further developing the AAA technical schemata. The AAA coordination committee, particularly the Geotopography and Real Estate Cadastre Working Groups, was assigned the task of analysing the division of Actual Use into Land Cover and Land Use, with the involvement of users from the fields of statistics, finance, the land register, land development, spatial planning, the environment, and science and research. Independently of one another, LB and LN could be arranged in levels, modified and adapted to user requirements. With automated evaluation processes on the basis of remote sensing and aerial image data, changes in the landscape could be ascertained efficiently and promptly. There would also be conformity with international developments such as INSPIRE and LUCAS (Land Use/Land Cover Area Frame Survey).

From a technical point of view, the criteria of INSPIRE compliance, harmonisation with other nomenclatures, unambiguity, non-redundancy and automatic pattern recognition all speak in favour of tackling as soon as possible the division of TN into LB and LN in the context of the ALKIS®-ATKIS® harmonisation — a harmonisation that has its roots in official land use statistics. This is also linked with the aim of the German government’s sustainability strategy to limit the utilisation of new areas for housing and transportation purposes by the year 2020. The division is an important topic for users from the statistics sector who have until now relied on the real estate cadastre database for the area indicator “housing and transportation area”.

Reaching ALKIS® users

Reaching ALKIS® users means: accommodating customers’ interests, maintaining relationships that have developed over time, involving institutions at an early stage and ensuring that we ourselves remain open and willing to talk.

At present four users, whom we are already serving now, are presenting us with challenges particularly with regard to networking and data exchange: the Federal Statistical Office with the project Zensus 21 (Census 21), the tax authorities with a real estate database relevant to taxation, the judicial and land register authorities with the database land register (DaBaG) and the land consolidation authorities with the topic of rural development (LEFIS).

Zensus 21

The issues related to Zensus 2021 (the population census) are already very relevant now. The Census Preparation Act has been passed. It is not only the population that is being examined closely but also, in the run-up to the census, ALKIS® with regard to its suitability. In comparison with the 2011 census, the 2021 census should be organised even more efficiently.

The basic unit in the census is the address, both the object address and the owner's address. The census requires address-related data about both building function and the owners for the whole of Germany. Important feature types can be provided from ALKIS®. Owners and addresses are obtained primarily from the sources of the land register, register of residents and property tax collection offices.

Fig 14: ALKIS® data for the Zensus 2021 population census *Image: Fiedels/Fotolia.com*

Between AdV and the relevant Land and federal statistics authorities an intensive exchange of information and coordination process is currently underway regarding the standardised provision of geographic reference data from the real estate cadastre. Land parcels, buildings (building functions), descriptions of position (addresses), etc., are being provided as basic data from ALKIS®. The owners from ALKIS® are being used for plausibility and quality assurance measures.

The data is being provided through the Norm-based Exchange Interface (NAS) and updated through the User-Oriented Inventory Data Updating (NBA). The aim is to achieve a standardised user order (data supply) through the statistical offices related to a specific date.

Real estate database relevant to taxation

To set up a real estate database relevant to taxation, the tax authorities require ALKIS® data. The reasons for setting up a database of this kind are current enforcement deficits in tax administration that have been detected by the Bundesrechnungshof (Federal Court of Auditors). About 35 million “economic units” nationwide are affected with which the tax authorities record the pieces of real estate to be taxed.

Fig. 15: Setting up a real estate database for the tax authorities *Image: Eisenhans/Fotolia.com*

In implementing their nationwide real estate database, the tax authorities are currently being advised and supported by representatives of the Real Estate Cadastre Working Group in the TRIANGEL working group under the direction of the Federal Ministry of Finance. The focus here is on the availability of geographic reference data from the real estate cadastre and on data transfer. The requirements for the data, its sources, use and transmission have been defined. Ultimately, the aim is for data from the surveying and mapping authorities of the Laender, the committees of valuation experts, the judicial authorities of the Laender and other bodies (e.g. notaries) to be pooled in a database and used as a source of information for all the fields of activity of the tax authorities.

Database land regist

An object-structured database land register is being implemented on the basis of the Act for the Introduction of a Database Land Register (DaBaGG), which came into effect in 2013. The development of a nationally standardised database land register of the judicial and land register authorities is currently being supported by the Real Estate Cadastre Working Group through intensive thematic and technical guidance. Here the Real Estate Cadastre Working Group is also working in close cooperation with the expert group LEFIS of ArgeLandentwicklung (Working Committee for Rural Development) with regard to adopting land consolidation processes.

Fig 16: Developing a nationally standardised database land register *Image: momius/Fotolia.com*

Stringent project organisation at the strategic, operational and technical level is to ensure that the time frame for the approval, pilot tests (in Bavaria and Lower Saxony) and productive use in the year 2022 is adhered to.

Data exchange

The current process solutions do not handle fully structured data. By means of a database management system, land register data in the legal sense and the geographic reference data from the real estate cadastre are to be linked logically with one another. Similarly, the electronic data exchange and electronic communication with the land registries are to be optimised. An online retrieval system is to be implemented, possibly including a nationwide land register portal.

The Real Estate Cadastre Working Group does not only concentrate on taxation, judicial, statistical, land development and spatial planning needs. The focus is also on the demands of many other users from business, from numerous federal and Land authorities, from cities and municipalities.

A position paper from the Association of German Cities on the use of geoinformation in cities makes it clear that the mapping, cadastre and geoinformation authorities of the Laender must supply high-quality geographic reference data to all users. The high standards relate above all to the currency, factuality, homogeneity and coverage of the data, which should additionally include historical information and the third dimension. High-quality metadata should provide more transparency and an up-to-date and relevant form of provision should make simple access possible for everyone.

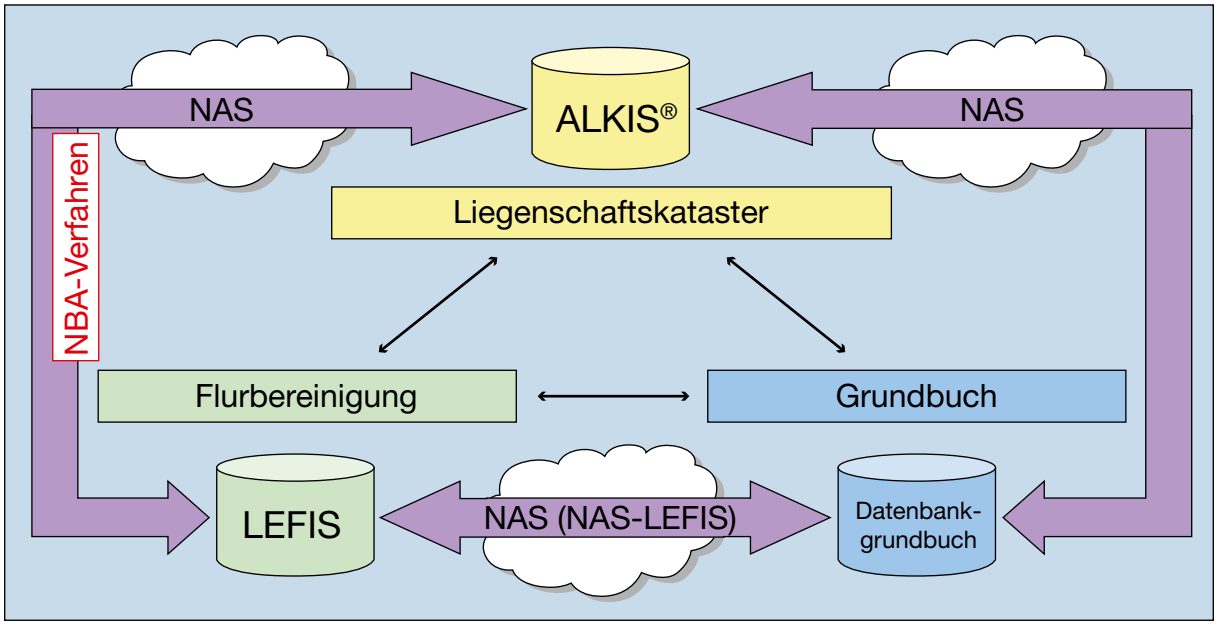


Fig. 17: ALKIS®, LEFIS and DaBaG data exchange

Fig. 18: Korean delegation in Stuttgart in December 2016

Interest in ALKIS® also at international level

The approaches used in the real estate cadastre in Germany are of great interest time and again at an international level. For example, in December 2016 a Korean delegation of the Korean Standards Association came to Stuttgart for more information. The meeting was organised through cooperation between the University of Stuttgart, Baden-Württemberg Agency for Geoinformation and Rural Development and the head of the Real Estate Cadastre Working Group.

Both subject-related and organisational questions were discussed in the context of Europe, Germany and the individual Laender. Here, again, the focus was on ALKIS® and the upcoming further developments.

4. Geotopographie

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. During the reporting period, 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 continued the in-depth discussion of the product portfolio of official geotopography that it had begun the previous year. After commissioning a whole range of tasks and in consultation with the department of Public Relations and Marketing, a resolution is to be passed on the final results in the short to medium term. At an inter-working-group level, a further key task lay in creating a concept for the division of Actual Use (TN) into Land Cover (LB) and Land Use (LN), with the goal of introducing these new feature type fields to the next reference version of the GeoInfoDok (see chapter 3)

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 business. 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, the production of official Digital Topographic Maps and the operation of 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 updated in the case of changes.

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 the Digital Topographic Maps 1: 50,000 (DTK50) and 1: 100,000 (DTK100), the corresponding automated, interactive processes were developed and put into practice. Given the increasingly demanding user requirements for up-to-date information along with shrinking human resources at all surveying and mapping authorities, this marked an important milestone in the effective and efficient provision of ATKIS® products.

The DLM250 and DLM1000 processed at BKG are available nationwide and updated on an annual basis. The contents are being continuously expanded for the production of the EuroGeographics products EuroRegionalMap (1: 250,000) and EuroGlobalMap (1: 1,000,000), for the purpose of linking 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. So with the concept commissioned by the AdV Plenum at its 128th meeting in September 2016 on the division of Actual Use (TN) into the fields of Land Cover (LB) and Land Use (LN) the aim is for new feature type fields to be introduced to the next reference version of the "Documentation on the Modelling of Geoinformation of Official Surveying and Mapping" (GeoInfoDok). The concept is to be developed with the involvement of users (statistics, tax authorities, land register, land development, spatial planning, the environment, etc.) and scientists. The practical implementation of the next reference version of the GeoInfoDok should meet requirements made of Germany's geotopographic reference data arising in part from the European projects CORINE Land Cover (CLC) and INSPIRE. A Plenum resolution on the time frame for the transition is planned for autumn 2017

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.

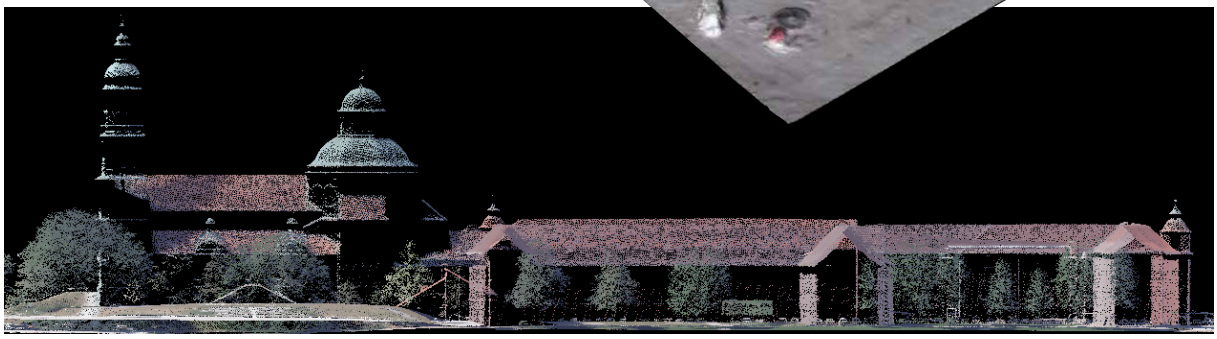
For the ATKIS® technical concept, the DGM feature catalogue is available in the GeoInfoDok. The data quality is documented in the ATKIS® product standard for Digital Terrain Models. For the DGM10, for example, this stipulates a terrain-type-related height accuracy of the grid points of +/- 0.60 m to +/- 2.10 m with a confidence level of 95 % (2 σ). A quality standard for DGM was decided on by the Geotopography Working Group in the spring of 2017.

Currently, DGM data sets with a grid size of 5 m (DGM5), 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. Since 2004, BKG in cooperation with AdV has been offering standardised Digital Terrain Models for the entire territory of the Federal Republic of Germany. Here BKG is taking on the task of harmonising the height data collected by the Laender in the overlap areas between the Laender, processing it appropriately (e.g. data formats, sections) and offering it to customers primarily from the fields of energy, the environment and conservation via the portal of the Service Centre (DLZ) at **www.geodatenzentrum.de**.

The current Digital Terrain Model of Germany, available with a top resolution of 10 metres, and all the other above-mentioned coarser resolutions are constantly updated and continuously improved by BKG on the basis of the data updates of the Laender.

Fig. 19 (right): Colourised Digital Surface Model (DOM) from laser data with vegetation point cloud

Fig. 20: Side view of laser data point cloud



In risk analyses for calculating tariffs, terrain models are made use of particularly by insurance companies. For this the German Insurance Association (GDV) uses the “Zoning System for Flooding, Backwater and Heavy Rain” (ZÜRS for short). To improve the precision of this geospatial database and particularly the assessment of hazard potential for various risk locations, GDV commissioned AdV with the production of a Germany-wide DGM with a resolution of five metres (DGM5). BKG took on the technical project management for this.

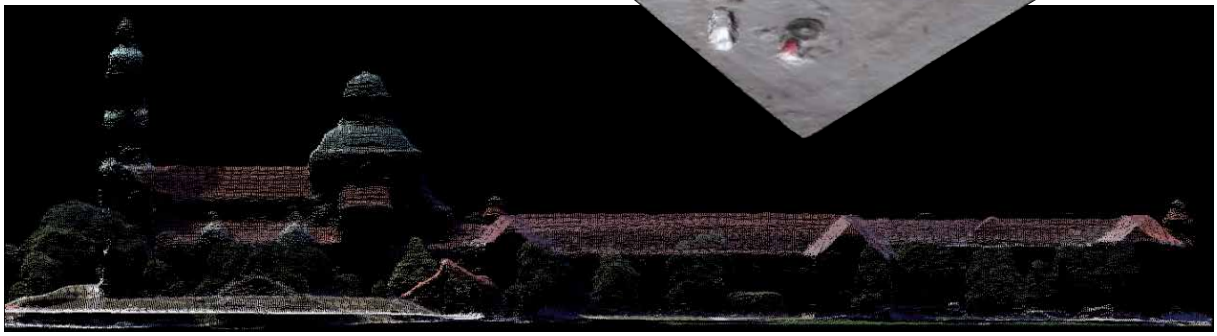
After completion of the harmonisation of the height data from the Laender, DGM5 was delivered to GDV in October 2016. The height accuracy is 0.3 to one metre, depending on the terrain slope and the vegetation. The basis for this high accuracy is high-precision airborne laser scanning through which about 90 per cent of the height data for DGM5 is now obtained.

Furthermore, 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 2 m (DGM2) and even 1 m (DGM1). Nation-wide coverage will be achieved in a few years with DGMs with a grid size of 2 m or better.

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 size 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.

Fig. 21 (right): Digital Surface Model, created with the aid of image matching

Fig. 22: Side view of image matching point cloud



DOMs are based on the technique of airborne laser scanning or digital image correlation (image matching). Figures 19, 20, 21 and 22 show results of this kind using St. Lorenz Basilica in Kempten (Bavaria) as an example. An increasing demand for these DOMs can be observed among users. The data quality is to be documented using the ATKIS® standard for Digital Surface Models.

3D Building Models

The surveying and mapping authorities within AdV have been offering the product 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.

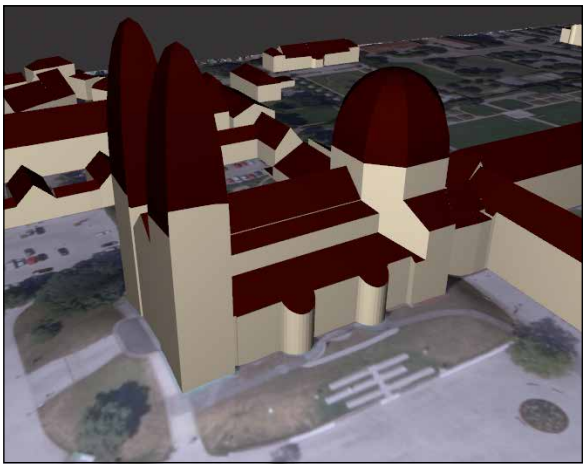


Fig. 23: 3D Building Model with the Level of Detail 2 (LoD2),St. Lorenz Basilica in Kempten (Bavaria)

3D Building Models are available nationwide with the Level of Detail 1 (LoD1). Here all buildings and structures are given a flat roof (“block model”). A total of more than 53 million building objects in LoD1 are now available for users. The Central Office for House Coordinates and Building Polygons (ZSHH) provides this data for cross-Land use.

IIn the next level of detail, Level of Detail 2 (LoD2), all buildings and structures will in future be modelled by the surveying and mapping authorities using standard roof shapes (Figure 23). In some Laender the production of the data sets in LoD2 is already well advanced or even complete. In autumn 2016 the AdV Plenum set the beginning of 2019 as the deadline for nationwide coverage to be available.

Owing to user requirements, it is also planned to incorporate significant structures into the database in addition to the buildings. Modelling examples for the identified feature types are available. The effort required to generate this data still needs to be determined, however, in order to be able to set a release date for this addition as well.

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. Since 31 October 2016 the current portrayal catalogues have been available in a formalised form 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.

Fig. 24: "Wittlich (Rhineland-Palatinate)" map sample of DTK50 with representation of individual buildings

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. Focused on the needs of the Bundeswehr and other users, future versions of DTK50 will again show a representation of individual buildings, created by means of automated generalisation processes. A model map sample is shown in Figure 24.

DTK100 has been available with nationwide coverage and in standardised form for Germany since back at the end of 2012; since 2015 the same has been true of the raster data set of the Digital Topographic Map 1: 250,000 (DTK250), which is derived from DLM250. The data set was updated during the reporting period and, together with the foreign part of DLM250, made available as a seamless Web Map Service at the BKG Service Centre. The technical procedure employed 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 automated cartographic generalisation of the various map series are available and in operation. This makes a highly 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 continue to be increasingly used.

AdV has realised, however, that despite all the progress in creating the DTKs, the changed user requirements cannot be fully and adequately met by the current products. Therefore, on the basis of extensive preliminary work by the Geotopography Working Group, an AdV team dealt with the task of compiling requirements and implementation options for a “map of the future” during the reporting period. The finalisation of the concept development with a resolution by the AdV Plenum is planned for autumn 2017. Development is then to be carried out in a two-year project (2018/19) by the member authorities so that it can go live in 2020.

ATKIS® geospatial data services

Also in the provision of geographic reference data via web technologies, a necessary harmonisation must be taken into account. AdV has therefore created non-sector-specific web profiles for viewing and download services. Building on this, in the area of geotopography, the web product specifications required 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, the corresponding AdV product specification for DLM data has been available for several years now.

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

In addition to this, the main emphasis of the work during the reporting period was on compiling the documents necessary for the implementation of the INSPIRE Directive. These are to be available in their finalised form in the course of 2017 so that implementation for the INSPIRE Annex I Themes can be ensured by November 2017.

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 comprehensive 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” and 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.

IIn particular, the complete presentation of all the buildings recorded 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. During the reporting period, following the relevant Plenum resolution, an expansion beyond the official reference system ETRS89/UTM was carried out to include the coordinate reference system “Pseudo Mercator”, which is used by many 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.

In this way the Digital Orthophotos product group (ATKIS®-DOP) 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 have been producing DOP10 for some years now.

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. The

stipulations in the product and quality standard for the Digital Orthophotos provide the necessary conditions e.g. for the pooling of the Laender data 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 firmly established as a standard product for virtually all technical applications with a spatial reference within and outside of the surveying and mapping authorities.

Modern technologies, such as the computer-controlled dense image matching in which a pixel-based surface model combined with radiometric image data is created from oriented stereo aerial image pairs, make it possible to produce so-called TrueOrthophotos. This method is currently being carefully analysed in individual Laender as part of AdV's work. These kinds of orthophotos no longer contain any tilting effects, meaning all the objects displayed are shown in the correct position and no occluded areas remain. The difference can be clearly seen in the example in Figure 25.

Fig. 25: Comparative view of a classic orthophoto and the corresponding TrueDOP in an example from Schwerin (Mecklenburg-Western Pomerania)

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 makes it possible to combine demands 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 questions of 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

Fig. 26: Example of an aerial image time series: Commerzbank Arena in Frankfurt am Main (Hesse); (additional examples at www.adv-online.de)

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, in this segment, meets customers' requirements for time series to a special degree. By means of historical orthophotos derived from older aerial images, users are given the possibility of comparing the current situation with other timestamps, e.g. so as to take landscape development into consideration in current decision processes and, in this context, to make use of the geometric possibilities of orthophotos as compared to aerial images. An example with a time difference of more than 50 years is presented in Figure 26.

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; initial procedures are still 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 generally 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.

In accordance with the specifications of the Open Geospatial Consortium (OGC), the GN-DE database is available as a standardised Web Feature Service (WFS) at the BKG Service Centre. Since 2015 this data set has been provided in INSPIRE-compliant form as a service for the European Open Data Portal.

In accordance with the relevant resolutions of the United Nations Group of Experts on Geographical Names (UNGEGN), StAGN has now compiled the sixth edition of the "Toponymic Guidelines — Federal Republic of Germany". This document is intended to provide information in cases of uncertainty about the use of geographical names and serve as a set of rules to achieve the necessary standardisation. One of its chapters is dedicated to the consideration and treatment of geographical names in the official minority languages in Germany.

Download: **www.stagn.de/empfehlung-schreibweise-gn**

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) on the basis of official geographic reference data by using networks and geospatial data services. 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 on coordinating the information technology of the SDI activities for AdV at a national level.

AAA®-Modell

With the work on the AAA® model, AdV has designed an integrated and harmonised modelling of all the geographic reference data of the mapping and cadastre authorities – split into a basic schema and an AFIS®, ALKIS® and ATKIS® common technical schema. This modelling is implemented by the AdV member authorities. The AAA® basic schema (Figure 27) 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 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 Consolidation and

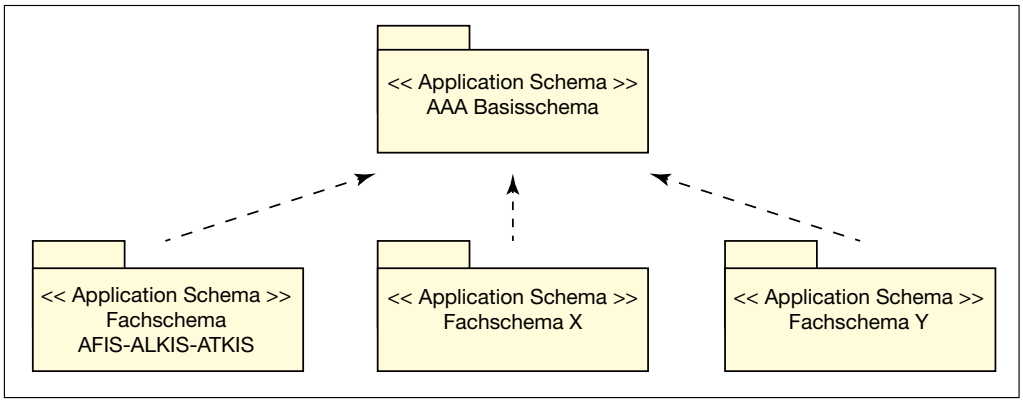


Fig. 27: The non-sector-specific AAA® basic schema as a basis for modelling application-specific thematic schemata (e.g. AFIS®-ALKIS®-ATKIS®)

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.

Since 2015, the geographic reference data from ALKIS® and ATKIS® has been maintained Germany-wide in accordance with the modelling of GeoInfoDok version 6.0. The AFIS® changeover is well advanced and will be complete in 2018 at the latest. 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**, under "AAA®-Modell > Dokumente der GeoInfoDok". The revision notifications that have already been transmitted have been evaluated by the AAA® revision committee and will be included in version 7.0.3 of the GeoInfoDok. The publication of GeoInfoDok 7.0.3 is planned for the second half of 2017.

In autumn 2016, AdV commissioned the expansion of the GeoInfoDok to include the division of Actual Use into the new feature type fields of Land Cover and Land Use in order to meet the national and international demands of various groups of users. These functional changes should be included in the revision notifications in 2017 and result in a functional update of the GeoInfoDok (probably version 8.0, see chapter 3, section: "ALKIS®-ATKIS® harmonisation – division of Actual Use [TN] into Land Cover [LB] and Land Use [LN]!?").

Over the past few years some basic and technical approaches of the previous portrayal catalogues of AFIS®, ALKIS® and ATKIS® have been revised and implemented as formalised AAA® portrayal catalogues (fSK). In the future, the AAA® portrayal catalogue object model will be recorded with additional interdisciplinary information in a main document on the AAA® portrayal catalogue in the GeoInfoDok. The advantages of formalisation stem, among other things, from the homogeneity and integration of the output from AFIS®, ALKIS® and ATKIS®, and the automatic processing of the signature system in areas such as quality assurance, deriving documentation and revision lists, and updating. The status of the fSK coordinated at the level of AdV's work

is published at www.adv-online.de, under "AAA®-Modell > Dokumente der GeoInfoDok", and represents the basis for action for the AdV project groups in their further work on maintaining and assuring the quality of the portrayal catalogues. Furthermore, tests can be conducted by companies on their own implementation and any necessary adjustments to the AAA® portrayal catalogue object model can be reported.

Geospatial data infrastructure

Fulfilling 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 for the AdV member authorities. The interoperability of geospatial data required by INSPIRE can be achieved with a data schema transformation (AAA® source data set --> INSPIRE target data set). 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 guarantee a homogeneous procedure among the AdV member authorities in this process, first of all basic conditions and parameters were agreed on within AdV. Based on this, definitions for INSPIRE product specifications were developed that describe the contents of the INSPIRE-compliant data sets and services. A significant result of this work is the establishment of coordinated and tested mapping tables (alignments) with the aid of which an unequivocal, complete and largely formalised version of the AAA® mapping rules in accordance with GeoInfoDok 6.0.1 can be created and maintained compliant with INSPIRE (Figure 28).

The advantages of this formalised description of the derivation rules are, firstly, the disclosure of technical inadequacies in the mapping, secondly, the automated transfer of the mapping results to a transformation tool and, thirdly, automatic documentation. Moreover, these alignments can be imported and further processed

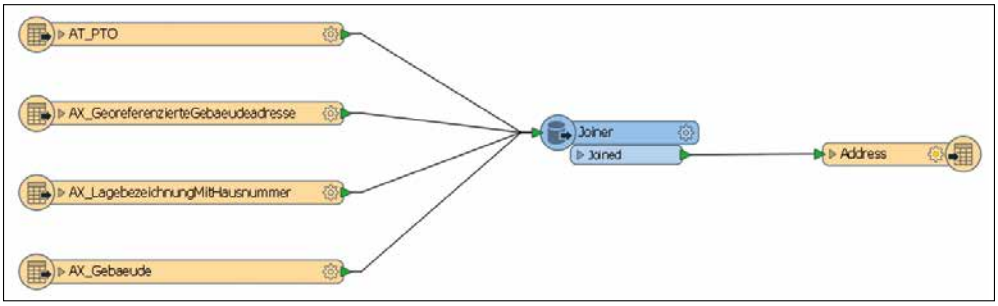


Fig. 28: Derivation rule – AX_GeoreferenzierteGebaeudeadresse, AX_LagebezeichnungMitHausnummer and AX_Gebaeude to Address

by software products for data schema transformation. This means that at the AdV member authorities the conditions are met for creating INSPIRE data sets and services that are uniform nationwide. At present, work on the Annex I Themes is about to be completed. After this, the alignments and product specifications of the Annex II and Annex III Themes will be created.

Furthermore, AdV is addressing the further developments of the INSPIRE guidelines by the EU and the consequences that result for AdV's work. This includes analysing reports and stipulations that are being developed by the EU Commission's Maintenance and Implementation Group (MIG) regarding their relevance and feasibility for the AdV member authorities.

Harmonised provision of geographic reference data

Coordinating the user-oriented provision of geographic reference data in Germany was identified by AdV early on as one of its key tasks and was established as a focus in its strategic statements of principles. With the use of modern information technology and online distribution channels, web-based applications and geospatial data services make it possible nowadays to supply geographic reference data quickly, efficiently and thus, at the same time, in a user-oriented way. To this end the "AdV Geographic Reference Data Provision Strategy" forms AdV's common framework for action regarding the provision of geographic reference data. Furthermore, it contains basic stipulations for the implementation of this framework in the form of a plan of action. AdV thus defines an overall strategy for the comprehensive provision of geographic reference data that actively contributes to promoting a modern information, knowledge and civil society in Germany, with the mapping and cadastre authorities assuming their national responsibility.

Fundamental strategic, functional, technical, organisational and sales-related specifications are made and tasks defined that can also be used as examples in the provision of geospatial data in other fields. As components of the AdV Provision Strategy, among other things an interoperability framework, geospatial data services and geo-applications, such as the AdV Metadata Information System, the AdV Registry and the AdV Test Suite, are described. Also, with the AdV Provision Strategy the framework for meeting the requirements of the National Geoinformation Strategy (NGIS) is already defined for the geographic reference data and applications of the AdV member authorities. 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 requirements for the interoperable and useful data exchange of available geoinformation.

In accordance with the AdV Provision Strategy, AdV has created a series of technical web profiles for viewing and download services (Web Map Service [WMS], Web Map Tile Service [WMTS] and Web Feature Service [WFS]). These technical profiles form the basis for each of the sector-specific versions regarding the thematic data to be provided (product specification). With the approach of defining general technical profiles and diffe-

rentiated 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 AdV member authorities. The latest versions of the profiles are uploaded to www.adv-online.de, under AdV-Produkte > Standards und Produktblätter > AdV-Profile.

To monitor compliance with the specifications of geographic reference data and geospatial data services, the AdV Provision Strategy describes the development and operation of an AdV Test Suite (Figure 29). The AdV Test Suite is of particular importance for guaranteeing the interoperability of the geographic reference data and geospatial data services of the AdV member authorities and is a prerequisite for establishing a cross-Land quality management system. The work so far has focused initially on data tests and includes

- the development of a concept for data and metadata
- the implementation of data tests as part of a pilot implementation with regard to acceptable performance behaviour
- the development of so far more than 600 test criteria for AAA® data

This work forms the basis of the forthcoming implementation of data tests in a test suite by the Geographic Reference Steering Committee. To achieve this, the steering committee has already begun the necessary work. One first milestone is the compilation of the functional specification on the basis of the work to date.

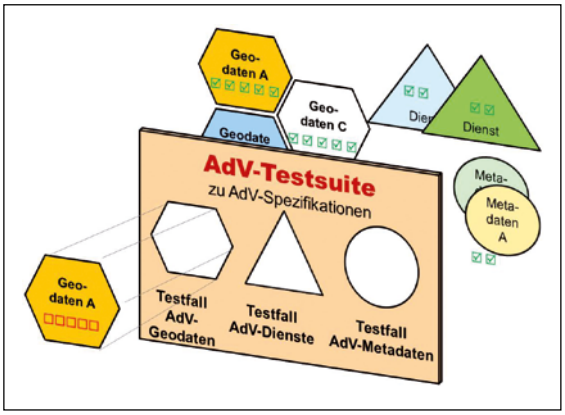


Fig. 29: Test cases of an AdV Test Suite

6. Public Relations and Marketing

Geographic reference data describes and documents the space in which we live. It is the non-interest-specific, non-application-specific description of the topography of the earth's surface (surveying and mapping) and real estate (real estate cadastre). Almost all planning and decision-making processes are related to a specific place and have an impact on our surroundings. They have a spatial connection or "reference"! Geographic reference data forms the link between the relevant sector-specific information and the corresponding location – and its surroundings – on the earth's surface. This makes it easier to recognise spatial connections and allows activities and phenomena to be precisely located. A comprehensible map is just as useful for knowledge transfer as it is for visualising complex situations. In Germany the surveying and mapping authorities of all the Laender are responsible for collecting, managing and providing geographic reference data. Doing this, they are working with a clear legal mandate. As modern, technical authorities, they thus guarantee that the state, the business sphere, scientists, researchers and the public are provided with highly up-to-date geographic reference data. Efficient data services and modern online shops ensure needs-based access anytime and from anywhere. 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 Germany-wide.

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. 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.

To allow for a nationally standardised product range, the distribution points are being networked and the provision of the products harmonised. Currently, certain product groups are being provided across Laender and in harmonised form by three central distribution points: the Central Office for House Coordinates and Building Polygons (ZSHH) at Bezirksregierung Cologne, the SA***POS***® Central Office (ZSS) at Lower Saxony

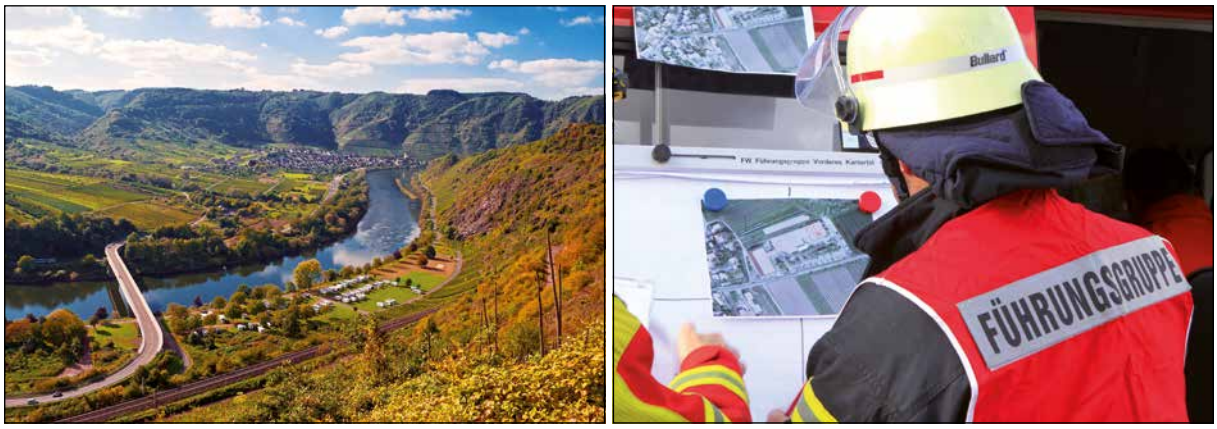


Fig. 30: Official geospatial data is used in many fields (conservation, infrastructure, planning, public safety). Images: mojolo/Fotolia.com; osterwelle/Fotolia.com

Mapping and Cadastre Agency 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. The plan is to move ZSHH to the Agency for Digitisation, High-Speed Internet and Surveying in Bavaria at the turn of the year (2017/2018). Preparations for this are already underway in close consultation between the current distribution point and the new one.

To achieve the goals of optimally satisfying the cross-Land demand for the long term and standardising the provision of products in 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:

- ascertaining and documenting the requirements of the state and the public regarding this collaboration and comparing them with the geographic reference data products and services (product policy)
- maintaining the licence and fee models, model licence agreements and model-based licensing for the use of the geographic reference data and geospatial data services (conditions policy)

- networking of the central and local distribution points and their involvement in implementing new strategies for providing geographic reference data (distribution policy)
- measures to provide information on the availability and usability of the geographic reference data and geospatial data services (product information)
- measures to promote a positive perception of the Official Surveying and Mapping in Germany and its cross-Land geographic reference data products and services (public relations)

Services

Product policy

To achieve optimum distribution of the geographic reference data, geographic reference data products are to be produced and made available in a user and purpose-oriented way as part of the official activities of the surveying and mapping authorities. For this purpose, information is required about users' demand and requirements regarding, firstly, the geographic reference data (product, intended use, product satisfaction) and,

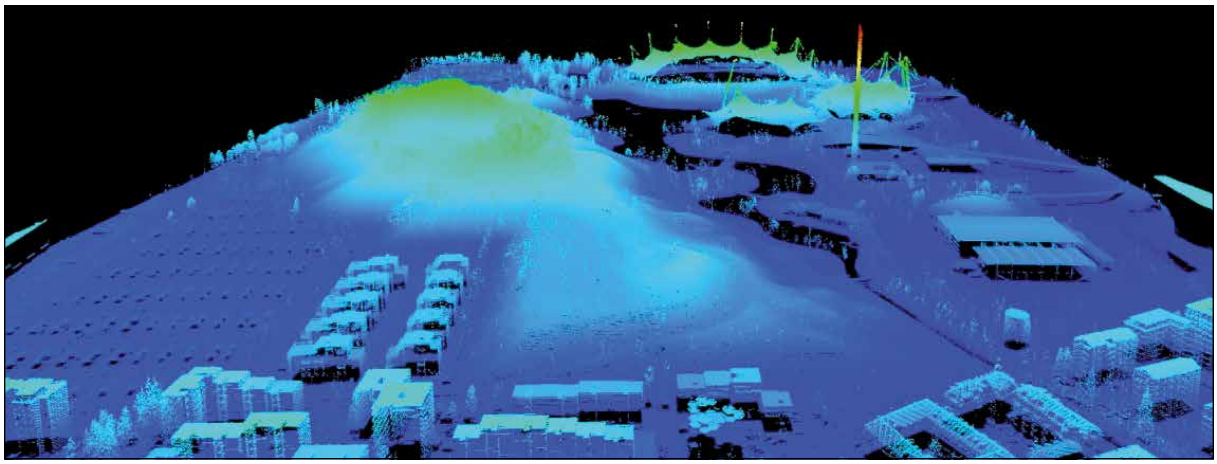


Fig. 31: Modern geospatial data focuses on the users' needs. *Image: LDBV Bayern*

secondly, the conditions of provision and product information (information channels and contact channels to the surveying and mapping authorities). Together with the central distribution points, the PRM Working Group (AK PRM) coordinates and conducts user surveys and analyses of 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 stipulations and in consultation with the other working groups when the AdV Fee Directive needs to be adapted to stay in line with both the technical advancement of the products and the user requirements. In September 2015 the AdV Plenum passed a resolution to extensively update the AdV Fee Directive to version 3.0. Customers benefit from substantial improvements: it considerably simplifies both fee regulations for the provision of data and services and the calculation of fees for use cases. In September 2016, with the expansion of the price model for the joint geocoding service to include land parcel coordinates, and the modification of the utilisation conditions and features, the AdV Fee Directive was updated by the AdV Plenum to version 3.1. It came into effect on 1 January 2017. The AK PRM is currently working on price models for future geospatial data products, such as a cross-Land central viewing service for land parcel information. Similarly, the AK PRM will examine the impact that the changeover to open data offerings in some Laender will have on the cross-Land licence and fee model.

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 application scenarios, 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 sales manager conference. Besides 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. 32: In 2016 Bremen 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. In cooperation with the Geobasis Steering Committee, they submitted an analysis report on the further development of AdV's distribution point concept to the AdV Plenum in September 2016. In this report, one of the key questions to be solved proved to be that of the future of the central distribution points in the light of the open data development.

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 keep it in line with technical advancements and the requirements of the distribution points.

AdV's information materials are uniformly produced 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.

The logos of the AdV products also form part of the corporate design. Many of these AdV "brands" are protected as word or figurative marks, having been entered in the trademark register of the German Patent and Trademark Office. These lists are constantly being updated. To strengthen the umbrella brand of AdV, the official AdV logo is also to be protected as a trademark.

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:

- information about current topics and innovations in official surveying and mapping
- current product information
- terms of purchase and licence regulations
- exchange of information and networking among the distribution points of the Laender
- information about and access to the Central Distribution Points

Fig. 33: Via AdV's website, visitors can access the distribution points of the Laender and AdV's Central Distribution Points for cross-Land data (access function)

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. One team of the AK PRM is currently working on creating a concept for the design of an AdV portal.

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 with effective participation 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. To enable it to be used widely and effectively, the film is presented 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 geospatial data 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® 2016, the world's leading fair for surveying and mapping, in Hamburg (Figure 34). Besides the presentation of the products and capabilities of the Official Surveying and Mapping in Germany, accompanying lectures took place. A key topic was the introduction of a new Germany-wide vertical reference system, DHHN2016, by 30 June 2017.

Fig. 34: Joint stand of AdV at INTERGEO® 2016 in Hamburg. *Image: AdV*

7. Involvement in National and International Organisations

EuroGeographics

EuroGeographics (www.eurogeographics.org) 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 particularly aim to support the European Commission in establishing the European geospatial data infrastructure in connection with the INSPIRE framework directive and the Copernicus earth observation programme.

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 records 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 is currently being compiled by 38 data producers.
- EuroRegionalMap (ERM) – the topographic reference data set in the scale 1: 250,000. ERM is currently being compiled by 34 data producers.

- EuroGlobalMap (EGM) – the topographic reference data set in the scale 1: 1,000,000. EGM is currently being compiled by 35 data producers and has been available on the Internet as open data since 2013. EGM is derived automatically from ERM.
- European Digital Elevation Model (EuroDEM60) – a digital terrain model computed by BKG in 2008 from the national data records with a position resolution of 2" (approx. 60 m) and a height accuracy of 8–10 m.

At the EuroGeographics Extraordinary General Assembly in Leuven, Belgium, on 11 May 2016, an agreement was signed between EuroGeographics and BKG concerning the takeover of the production management of ERM and the continuation of the production management of EBM.

The production management tasks of EBM and ERM include the organisation, strategic planning and technical implementation of the entire production process. An additional key task for the product managers is communicating with the data producers and regional coordinators. In cooperation with them, the production process is constantly monitored and optimised if necessary. The Service Centre at BKG serves as a distribution centre for EuroGeographics and delivers the European data sets to both German and international customers.

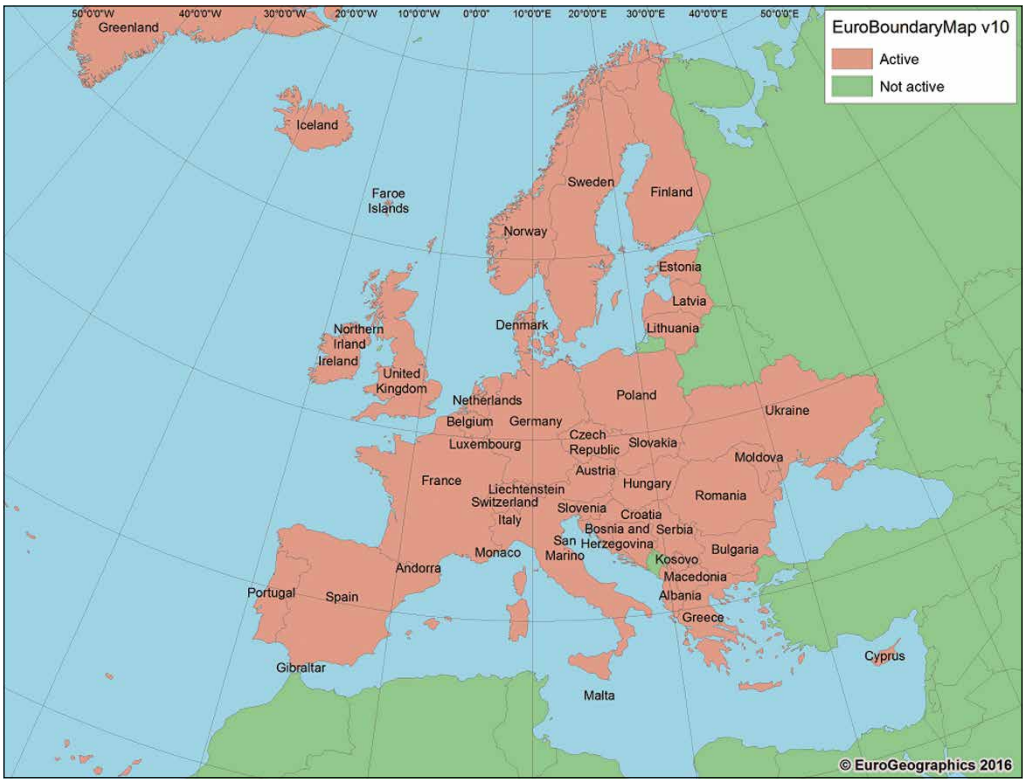


Fig. 35: Members of EBM (EuroBoundaryMap)

On the basis of the specifications for EBM and ERM, BKG and its partner authorities in Europe produce official national data corresponding to the annual production plan. For EBM this data is checked and summarised in a data set by BKG and the same is done for ERM by the regional coordinators and BKG. EBM and ERM are published once a year.

Fig. 36: Members of ERM (EuroRegionalMap)

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 its execution. BKG is represented in most of the KENs and actively contributes 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 implement 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 was launched in March 2013 and completed according to plan after a duration of 44 months on 31 October 2016. The cooperation was funded within the scope of the "Competitive and Innovation Framework" programme of the European Commission with 50% of the project budget.

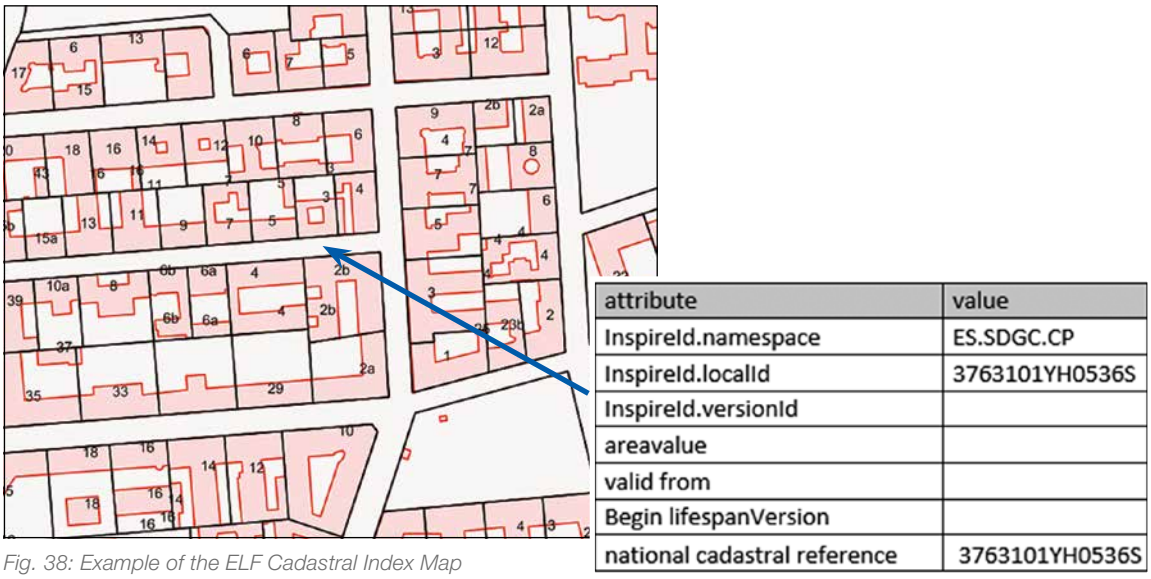
In the context of the project, under the responsibility of BKG, various specifications were compiled, e.g. the central ELF data specification, which summarises the INSPIRE data specifications that are important from a topographic point of view and describes additional requirements regarding data quality, scale range and edge matching.

Here examples are shown of the geospatial data services implemented in the ELF project:

- "ELF Topographic Basemap" geospatial data service based on the EuroGeographics data sets EuroGlobalMap and EuroRegionalMap and topographic geographic reference data from 15 countries. The provision of German geographic reference data is proving difficult since AdV's approval for the use of the BasisDLM has not yet been decided on.

Fig. 37: ELF Basemap

- “ELF Cadastral Index Map” geospatial data service based on land parcels, address data, building polygons and administrative units. At present, corresponding national viewing services have been set up and made available by 12 countries..



attribute	value
InspireId.namespace	ES.SDGC.CP
InspireId.localId	3763101YH0536S
InspireId.versionId	
areavalue	
valid from	
Begin lifespanVersion	
national cadastral reference	3763101YH0536S

Fig. 38: Example of the ELF Cadastral Index Map

The technical infrastructure was implemented in two variants: as an ELF platform and additionally on ArcGIS Online. Based on the geoservices made available via the ELF platform, example applications for the fields of health statistics, real estate, insurance, emergency mapping and telecommunications were tested.

Following completion of the ELF project, it was continued under a slightly modified name as European Location Services (ELS). Responsibility for this will be handed over to EuroGeographics. There a suitable management structure is being set up to facilitate the maintenance of the project results and the operational control of ELS. BKG will still be involved in ELS in the future and is expected to take on the role of data specification coordinator.

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

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), contributes towards tapping the huge potential of remote sensing for social and political interests. To reach this goal, Copernicus links satellite-based earth observation with terrestrial, aircraft and maritime data using modern data processing and modelling techniques. The basis of the programme is the space component.

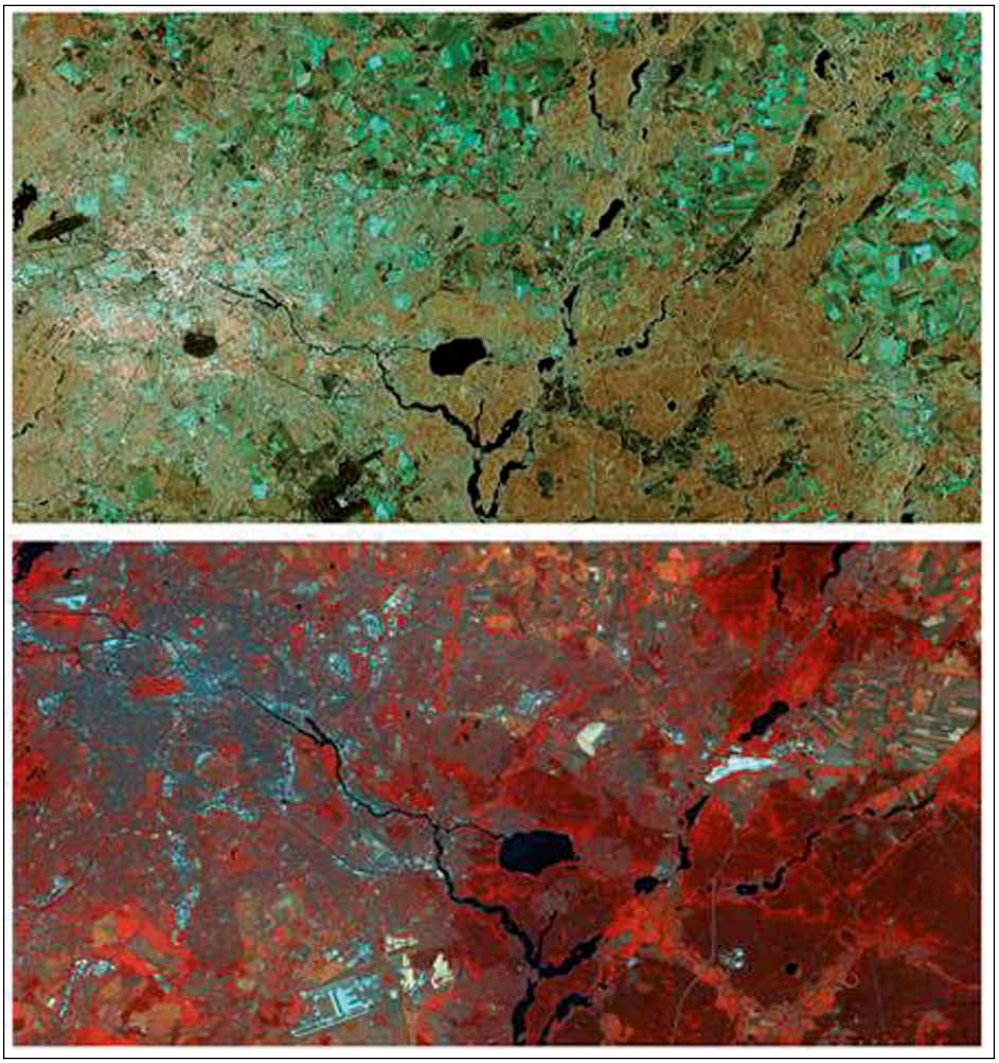


Fig. 39: top: Sentinel-1A (28 November 2014) and bottom: Sentinel-2A (9 July 2015) of Berlin (@ Copernicus Sentinel data ESA).

This consists of six satellite families, the so-called Sentinels, specially developed for Copernicus by the European Space Agency (ESA). 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. From the data, six Copernicus core services with many different products are derived, dealing with the topics of land monitoring, marine environment monitoring, disaster and crisis management, security, atmosphere monitoring and climate change monitoring. As part of Copernicus, information products and satellite data are made available to everyone free of charge (Commission Delegated Regulation [EU] no. 1159/2013). These can be further processed for diverse applications. Further information can be found at **www.d-copernicus.de**.

With the ongoing expansion of the Copernicus programme, the availability of satellite data and services is continually improving. Public institutions are not sufficiently prepared for integrating satellite information into their work processes in order to make them more efficient where appropriate. In 2012 the German Federal Ministry of Transport and Digital Infrastructure (BMVI) decided to supplement the establishment of Copernicus with its own national activities in order, for example, to assist public authorities in implementing Copernicus data. These national projects are being conducted in three areas: support of the technical coordination; technical implementation and validation projects; and the set-up and pilot operation of a national Copernicus IT infrastructure (CODE-DE – **https://code-de.org/**). This technical access has been enabled since March 2017. It provides all interested parties with free access to the Copernicus data and services.

Below two projects with a direct link to AdV are reported on.

Updating the ATKIS® Landscape Model with Copernicus

The use of Sentinel-2 data to update the ATKIS® Basis Digital Landscape Model (BasisDLM) can be categorised under the term Copernicus@Work. The software resulting from the completed development project "DLM-Update" is now being used not only at Schleswig-Holstein Agency for Surveying and Geoinformation. There it is being utilised to update the ATKIS® BasisDLM. Using the remote sensing data, update information can be generated in an automation-supported process, meaning that only a quarter of the "Actual Use" objects still need to be checked to see if they are up to date. The update information produced can be easily integrated into the procedure of the ATKIS® top currency in Schleswig-Holstein.

The second user of the software is Thuringia Agency for Surveying and Geoinformation. There remote sensing data from the Sentinel-2 satellites is utilised to identify changes in land use. For this process, the update information identified by means of "DLM-Update" is stored in the update service and is thus available for updating the Actual Use in ALKIS® and ATKIS®. The two agencies (Schleswig-Holstein and Thuringia) are having the application "DLM-Update" developed further by EFTAS Fernerkundung Technologietransfer GmbH in consultation with

the agencies so as to further improve the efficiency of the procedure. This will make it possible to include digital surface models as an additional data source before the end of 2017. The “DLM-Update” application will also be incorporated into AED SICAD’s software “3A-Editor” in the future and will thus be widely used in the mapping and cadastre authorities of the Laender of the Federal Republic of Germany.

Establishing a ground movement cadastre

In the Land of North Rhine-Westphalia with its longstanding mining history, large parts of the land surface are affected by changes in altitude. For determining these changes, interferometric radar monitoring based on the data of the Copernicus satellite Sentinel-1 is to be tested. To try out this method, the Surveying and Mapping Authority of North Rhine-Westphalia (NRW) initiated the Copernicus project “Establishing a Ground Movement Cadastre”, funded by BMVI.

Sentinel-1A data was evaluated for the first time at the beginning of 2017. The calculations confirm the suitability of the Sentinel-1A satellite. Quality assurance, the focus of the NRW project, is ensured by means of a comparison with terrestrial surveying and mapping reference values.

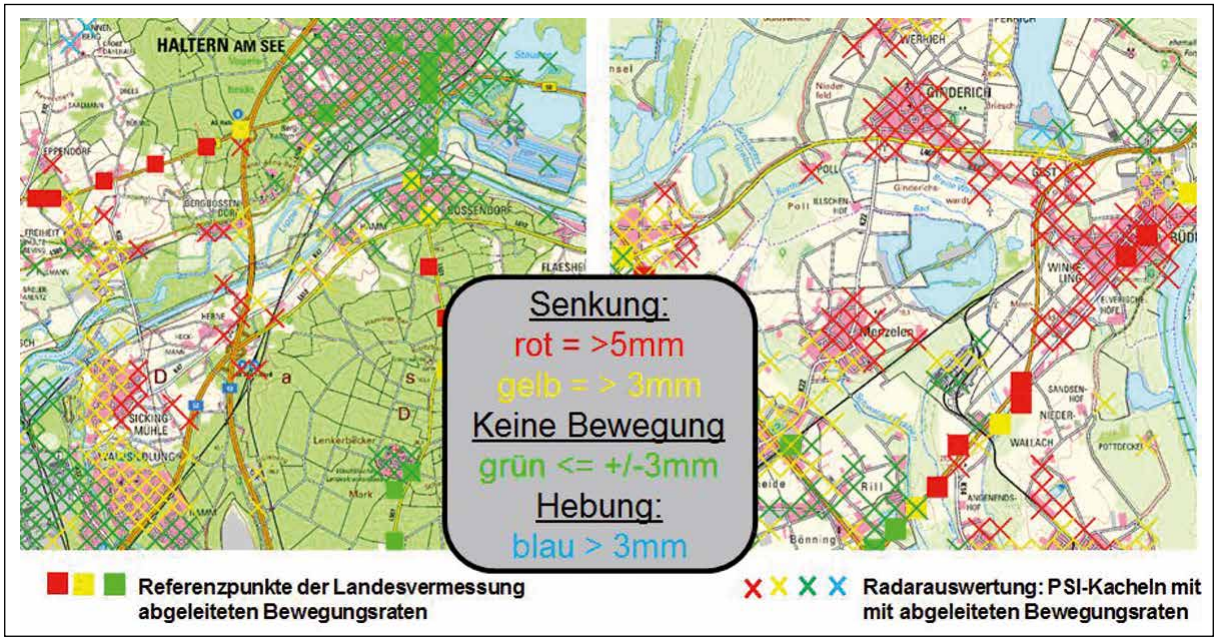


Fig. 40: Test areas in North Rhine-Westphalia: Sentinel-1A radar analyses are confirmed with reference data from surveying and mapping.

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) that 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 had previously been lacking that dealt with 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, at the overall level, procedures and methods from the spheres of geodesy/geoinformation and statistics can be merged.

In July 2015 the first report of Working Group B (WG B) on “User needs for combinations of data” was published on the website (**www.un-ggim-europe.org/content/wg-b-data-integration**). 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. In mid-2016, Working Group B proposed methods for a better linking of geospatial data and for cooperation between the statistical offices and the mapping and cadastre authorities. At the end of 2016 they released recommendations for handling various issues in Europe, for example, for quality management in linking open data from non-government sources. Working Group B’s new task for 2017–2020 focuses on analysing and evaluating the “geospatial dimension” of both the Sustainable Development Goals (UN SDGs) and the defined indicators for monitoring the attainment of the goals.

Open Geospatial Consortium (OGC)

To ensure interoperability in the provision of official geospatial data, all the AdV profiles and AdV product specifications for geoservices are based on OGC specifications. For the analysis and later implementation of the technical standards currently in development, ongoing support of the work of these bodies is necessary. 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 both the GeoInfoDok and 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 they are in line with new or updated standards. Secondly, there is a constant need for further development towards new technologies, which, once their usability has been proved, can then be used as components of the architecture in the SDIs of the AdV member authorities.

After several years of development work, a first OGC standard for a 3D visualisation service was adopted last year on the basis of which a corresponding AdV profile as defined in the AdV Provision Strategy is now to be created. The new data exchange standard GeoPackage could likewise be of interest to AdV. For efficient data transfer, the GeoPackage standard specifies a non-application-specific, self-describing data container and is often regarded as a successor to the "shape" format. It is an open, non-proprietary, platform-independent standard based on already existing standards that is used to save geospatial data (vector and raster data) to a file.

ISO/TC 211

The Geographic Information / Geoinformatics Technical Committee develops and maintains formal geoinformation standards. As of the beginning of this year, the chair and secretariat are provided by the Swedish Standards Institute.

Besides the standards relevant to the AdV specifications, a standards project that, under German leadership, deals with the archiving of geospatial data is of interest to AdV. This standard has already been drafted.

One important topic for the future is seen to be the combination of geoinformation standards with the digital planning method Building Information Modelling (BIM). Particularly against the background that the German Federal Ministry for Economic Affairs and Energy has put forward a Bauen 4.0 (Construction 4.0) master plan to promote the use of BIM, this is also in Germany's interests. BIM represents a universal digitisation of all building and structure-related information relevant to planning and implementation as a virtual building model. It has been decided to create an ISO standard for mutual data exchange.

Establishing and maintaining the compliance of the AdV standards with the ISO standards has become an important ongoing task in AdV's project groups. Here again, the Information and Communication Technology Working Group has proved itself as an expert body. With the available resources it represents the interests of AdV and introduces the relevant standards to AdV, particularly as technical profiles. Equally crucial is the question as to how to handle changing ISO standards. An appropriate concept is to be drawn up on this.

Permanent Committee on Cadastre in the European Union

On 1 July 2016 the Slovak Republic 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 2016. To conclude the presidency, the PCC General Assembly was held in the city of Bratislava on 17 and 18 November 2016, again in the context of a Common Vision Conference of PCC, EuroGeographics, ELRA, EULIS and CLGE. The focus of the conference included lectures on the real estate cadastre and land register sector in Slovakia, the Europe-wide cooperation with UN-GGIM, the progress of the "Interconnection of Land Registers Programme" (ILR) through which a connection is to be made possible between the (electronic) land register of one EU Member State with that of another within the e-Justice Portal, and the use of the bitcoin procedure in the real estate cadastre and land register sector (pilot project of Sweden). In an expert lecture, a representative of the AdV Real Estate Cadastre Working Group provided information on the completion of the introduction of ALKIS in Germany and on the next plans (AAA harmonisation). In the discussion that followed, the participants showed great interest in the developments in Germany.

On 1 January 2017 Malta assumed the presidency for the first half of the year. The Maltese registration authority ("Identity Malta", which besides the land register also issues passports, etc.) together with EuroGeographics and the European Land Information Service (EULIS) invited the spring PCC General Assembly to Malta. The lectures and discussions dealt, among other things, with the question of the publicness of the real estate cadastre and land register, although in England and Wales, for example, the land register has been publicly accessible since 1990 and accessible online since 2005, which has proved a success there. Cyprus is working on a spatially referenced street view system with shots of all building facades of virtually all streets, which is to be used, among other things, as a basis to improve the representation of buildings in the real estate cadastre and for the 3D representation of buildings.

On 1 July 2017 the presidency of the EU, and thus of the PCC, for the second half of 2017 is being transferred to Estonia; the autumn PCC General Assembly is planned in the city of Tallinn.

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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