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

National Report

2018/2019

AMTLICHES DEUTSCHES VERMESSUNGSWESEN

Vorsitzender 2018/2019

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Federal Waterways and Shipping Administration	www.wsv.de
German Association of Publicly Appointed Surveyors	www.bdvi.de
German Federal Working Group Sustainable Rural Development	www.landentwicklung.de
German Geodetic Commission	www.dgk.badw.de

Composition, Layout and Production Bavarian Agency for Digitisation, High-Speed Internet and Surveying

Updated 08/2019

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Dear Readers,

Due to digitisation, the demands on the administrations are increasing dynamically. This especially applies to demands on the provisioning of information, data processing speeds and data transfers. It is the goal of the surveying and geoinformation authorities in Germany to provide reliable and high-quality geospatial reference data and products derived from it. It is expected that the geospatial information is made available in an increasing resolution, an up-to-date standardised format and automatically available for digital process chains of third-party applications. Therefore, demands on the administration are rising. It is supposed to become faster, more flexible and, last but not least, simpler.

The represented surveying and geospatial information authorities are pursuing a variety of innovative developments. With the Smart Mapping project, online-capable smart solutions for the topography are being worked out. Within the geotopography, value-added products, such as the Digital Terrain Model (DGM1) and the 3D-Building Model LoD2, will be made available to the users. In accordance to user demands, the continuation of the AAA® data model, source for the geospatial reference data, has been decided; simultaneously the "Actual Use" (Tatsaechliche Nutzung) has been transferred to the components of Land Cover and Land Use. The satellite positioning service (SA*POS*®) is opening itself up to new user groups; the conditions and the product policy of AdV underwent fundamental changes. The representation in international committees is also gaining importance.

The law for the improvement of online access (Onlinezugangsgesetz, OZG) is setting the frame conditions for the administrations. The OZG requires the federal government and the Laender to also offer their administrative services electronically by the end of 2022 at the latest.
Digitisation does mean for the administrations that all supporting documents are kept digitally and all business processes are winded-up online. All services are offered 24 hours a day, in order to meet user requirements in a citizen-friendly manner. As soon as that is accomplished, surveying and geoinformation authorities will be digital, online and moreover in touch with the people. Geospatial data is an essential driver of digitisation. Official Geospatial Reference Data is a fundamental source.

In order to face the partially rapidly changing requirements resulting from digitisation with convincing solutions, AdV is set to further develop existing technologies, products and services in a future-oriented manner.
AdV's strength lies within the transnational exchanges in coordination with the federal government – true to the motto – "Unity in Diversity". On the base of the coordinated approaches and uniform standards it is possible to fulfil the multifaceted requirements that transcend the borders of the country widely.
AdV's national report informs you about versatile development of the official surveying authorities in Germany.

Enjoy Reading!

Siegmar Liebig
AdV Chairman

1. Organisation and Performance of Tasks

In the Federal Republic of Germany, the Laender are responsible for performing official surveying and mapping tasks. Since 1948, the responsible authorities of the Laender and the Federal Ministries of the Interior, Building and Community, of Defence as well as for Transport and Digital Infrastructure have been cooperating together in the Working Committee of the Surveying Authorities of the Laender of the Federal Republic of Germany (AdV) to address technical matters of fundamental and national importance. The German Geodetic Commission (DGK), as a representative of geodetic teaching and research, and the German Federal Working Group Sustainable Rural Development, representing the field of land consolidation, have guest status in AdV.

Organisation of AdV

Figure 1 shows the organisation of AdV. Chair and plenum are its steering bodies. AdV is supported by the working groups and the management.

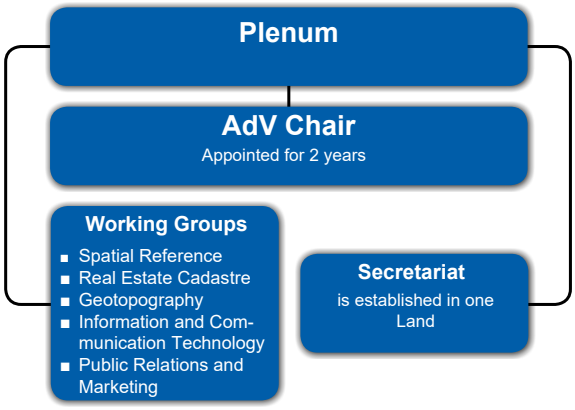

Figure 1: Organisation of AdV

Objectives and Tasks of AdV

The member authorities collaborate within AdV to:

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

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

- creation and coordination of future-oriented collaborative concepts for the nationwide standardisation of the real estate cadastre, surveying and mapping and the geographic reference information system in order to meet the needs of politics, industry and administration,
- promoting the joint execution of projects of cross-regional importance,
- steering and coordination of standardisation procedures in order to record and manage geospatial reference data as well as the corresponding access and distribution methods,
- support in the establishment and development of the national and European geospatial data infrastructure and the corresponding electronic services,
- external representation of the official Surveying and Mapping,
- participation in international specialist organisations for the transfer of know-how,
- 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

In 2010 the Geobasis Steering Committee (LA Geobasis), in which all Laender are represented, was established by 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, it is the objective that the Geobasis Steering Committee ensures that the geospatial reference data is provided in standardised form to all users in the required level of quality.

The Geobasis Steering Committee, in order to implement the strategic resolutions adopted by AdV, has the following tasks and competences:

- monitoring and analysis of work and developmental progresses, including compliance with the defined quality standards and norms,
- analysis of cooperation possibilities and processing proposals towards their realisation,
- steering and collaboration between various Laender,
- quality control based on AdV standards regarding content and format consistency.

Mapping and Cadastre Authorities of the Laender

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

The mapping and cadastre authorities are divided 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/land 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 the provision of 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®), based firstly on terrestrial control points and their documentation, secondly, on the satellite-supported positioning service SA*POS*®,
- maintaining a nationwide image of the surface of the earth through geotopographic products in the Authoritative Topographic-Cartographic Information System (ATKIS®) using landscape and terrain models, official topographic cartography and orthophotos,
- the nationwide digital documentation of buildings and approx. 64 million cadastral parcels for the property rights in the real estate cadastre, which will be managed throughout the Federal Republic using the Authoritative Real Estate Cadastre Information System (ALKIS®),
- the harmonisation of the real estate cadastre and surveying and mapping data.

The following table provides an overview over the statistical data in reference to the official Surveying and Mapping of the Laender.

Land	Inhabitants	Reference Area in km²	Cadastral Parcels in thousand	Number of authorities		ÖbVI
				State Offices (State enterprises)	Regional offices	
Baden-Wuerttemberg	11.023.425	35.674	8.896	1	58	161
Bavaria	12.997.204	70.542	10.810	1	51	—
Berlin	3.613.495	891	402	1	12	54
Brandenburg	2.504.040	29.654	3.139	1	17	147
Bremen	681.032	420	207	1	1	7
Hamburg	1.830.584	755	255	1	—	7
Hesse	6.243.262	21.116	4.974	1	7	77
Mecklenburg-Western Pomerania	1.611.119	23.293	1.929	1	7	60
Lower Saxony	7.962.775	47.710	6.206	1	—	97
North Rhine-Westphalia	17.912.134	34.113	9.314	1	53	390
Rhineland-Palatinate	4.073.679	19.858	6.287	1	6	78
Saarland	994.187	2.571	1.290	1	—	10
Saxony	4.081.308	18.450	2.765	1	13	96
Saxony-Anhalt	2.223.081	20.452	2.682	1	—	48
Schleswig-Holstein	2.889.821	15.802	1.921	1	—	41
Thuringia	2.151.205	16.202	3.183	1	—	62
Total for Germany	**82.792.351**	**357.503**	**64.261**	**16**	**225**	**1.335**

Table 1: Number of Inhabitants – source: Federal Statistical Office, as of 31.12.2017. results based on the 2011 census. Land area – source: Federal Statistical Office, as of 31.12.2016, area in Rhineland-Palatinate: including the area "Joint German-Luxembourgian territory of 6,20km². Differences in areas due to rounding of figures are possible. Cadastral parcels, number of authorities, ÖbVI: as of 31.12.2017

Federal Agency for Cartography and Geodesy

The Federal Agency for Cartography and Geodesy (BKG) is a federal authority that reports to the Federal Ministry of the Interior, Building and Community. As a competence centre for geodesy, cartography and geoinformation, BKG is responsible for “Maps and Coordinates” within the sphere of the federal government. BKG is the central service provider of the federal government for topographic base data, cartography and geodetic reference systems.

Mandated by the Federal Geospatial reference data Act (Bundesgeoreferenzdatengesetz – BGeoRG), which went into effect in November 2012, BKG performs service and coordination tasks for federal authorities. In this context, the BKG operates a Service Centre (DLZ) in Leipzig, which 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 the work of BKG. For example, the work of BKG forms the basis for efficient satellite navigation, such as via GPS or GALILEO. Experts from various sectors such as transport, disaster reduction, domestic security, energy and the environment make use of BKG’s geospatial data, maps, texts, reference systems and information services for their planning and research. Therefore, the absence of geoinformation, information with spatial reference, in our everyday life cannot even be contemplated. They are the foundation of strategic planning, informed decisions and political actions. They also are an elementary prerequisite for innovations. Here, reliable partnerships and networks are necessary in order to learn from one another, make use of synergies and to create something new together.

An elementary aspect in regard to the support of innovative developments is the intended provision of geoinformation of the federal government, the Laender and the municipalities on the basis of a standardised spatial reference from addresses to coordinates: easily accessible, completely linked, combinable, reliable and unrestricted. Furthermore, BKG is pursuing the simplification of rights of use for geoinformation of the federal government and the Laender.

Furthermore, BKG performs in cooperation with the Laender 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 appropriate procedures and methods
- the provision and maintenance of the geodetic reference networks in the Federal Republic of Germany
- the representation of interests of the Federal Republic of Germany in the field of geodesy and geoinformation on an international level

In the field of geodesy, BKG provides a standardised spatial reference framework (coordinate system) for all of Germany. Therefore, it operates three geodetic observatories with certain partner institutions – Wettzell (Bavarian Forest), La Plata (Argentina) and O'Higgins (Antarctica). By means of various technologies, BKG monitors here the movements of the earth satellites among other things. 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.

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, geographical names and additional topographic data. All the geospatial data is also made available as online services. In addition, the DLZ supports its customers via consulting services and needs-based applications.

The Spatial Data Infrastructure Germany (GDI-DE) represents the comprehensive networking of geospatial data within authorities of a federal, Laender and municipal level. The BKG coordinates the development, the expansion as well as the maintenance of the federal part of the GDI-DE and operates its central components, such as Geoportal.de (**www.geoportal.de**)

Beyond the German borders, in close cooperation with its European and international partners, BKG contributes to the implementation and provision of a standardised spatial reference frame and the development of a European and global geospatial data infrastructure.

Further information regarding the current work, services and products of the BKG can be found on the website **www.bkg.bund.de** as well as on the Twitter channel **https://twitter.com/BKG_Bund**.

All products from a single-source provider

Buying one's favourite music with only a few clicks online, paying comfortably via credit card and being able to immediately access the playlist, this is what resembles our idea of shopping at the age of the internet. Modern web shops accompany us in almost all areas of our everyday life.

Should this concept be applicable to digital geospatial data? Yes indeed! With its new web shop, the German Federal Agency for Cartography and Geodesy offers a transparent platform with multifaceted product information, individual possibilities of configuration and comfortable online payment.

Since the beginning of 2015, BKG's web presence has been revamped. With the redesigning of the information and ordering portal **www.geodatenzentrum.de**, the web pages of the Service Centre (DLZ) also have a new look. "All products from a single-source provider" – according to this motto, all of BKG's offers will be available on one domain – **www.bkg.bund.de**. Apart from Digital Geospatial Data and web services of the federal government and the Laender, users can also find paper maps, publications and software under the section products & services. Extended information and versatile web applications top off the product portfolio. This selection aims to reach federal facilities as well as economy, science, public administrations and private citizens. The customer of the Central Office for Geotopography (ZSGT) also benefit from the functional and information access to the transnational Official Geospatial Data of the Laender.

The model web shop of the federal government forms the basis for this new sales platform. The eCommerce solution based on Magento is intended to meet the requirements of the federal authorities. The web shop is an additional component of the payment transaction platform **ePayBL** (**ePay**ment **B**und-**L**aender) which supports payment processes in eGovernment solutions of the federal government. All payments are automatically forwarded to the federal treasury.

Further custom adjustments to the web shop have been made in order to fulfil the special requirements of the BKG. New article types support the ordering process of paper maps as well as individual configurations of digital geospatial data. A modern map viewer enables an intuitive graphical selection of the desired area. The licence manager, which has been especially designed for such transactions, organises all licencing agreements upon conclusion of an accompanying order. During the ordering process it generates the final licence document according to the specifications of the customer.

While paper maps and publications are intended to be shipped in the classical way, per post, data packages that have been ordered by the customer can be provided as a download. The automated production is taken care of by the **D**ata **P**rocessing **S**ervice (**DPS**) developed by the BKG. On the base of an internationally standardised **W**eb **P**rocessing **S**ervice (**WPS**), it then accepts web shop orders, controls the processing and delivers the final download URL back to the web shop. The modular structure enables optimised production methods for each product.

Starting from the order, to the data production and delivery, the new distribution portal provides the possibility to execute entire process chains automatically. Standard products with individual customer configuration can be provided at any time without the intervention of an employee into the handling process.

In later stages further contextual and functional expansions are supposed to follow. The development of an ordering module for data updates is in process. Furthermore, the extension of the product portfolio by events and services in the curse of this year is planned.

Magento

- **Magento** is after w3tech.com the most commonly used eCommerce solution worldwide. The online shop software is developed by the American company Magento Inc. which has been taken over by Adobe System in 2018. Magento is based on the programming language PHP. It is open source and under the roof of the free licencing Open Software Licence. Magento is used by well-known companies such as Bauhaus, Nestlé and Nintendo, for example.

ePayBL

- **ePayBL** (**epay**ment **B**und-**L**aender) is a transaction platform which supports payment processes in eGovernment solutions of the federal government. Beside the classical processes like payment in advance and invoice, customers now have the possibility to use modern payment methods such as credit card, giro-pay and SEPA Direct Debit. All payments are forwarded by the web shop automatically to the federal treasury. EPayBL enables the traceability of the status of a payment directly inside the web shop and to automatically release goods or services for delivery accordingly.

Federal Ministry of Defence
Bundeswehr Geoinformation Service (BGIS)

Within the Working Committee of the Surveying Authorities of the Laender of the Federal Republic of Germany (AdV), the Federal Ministry of Defence (FMOD) is represented by the Director of the Bundeswehr Geoinformation Service and the Comander of the Bundeswehr Geoinformation Centre.

The mission of the BGIS is to ensure “GeoInfo support to the Bundeswehr” in and for military action abroad 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 and for the identification and assessment of the impact of geofactors (e.g. terrain, weather, transportation, economy, climate, water) on the conduct of operations.

The BGIC is the central agency of the BGIS and under the direct administrative control of the German Cyber and Information Domain Service Headquarters. The Interministerial Committee for Geoinformation (IMAGI) designated it to have the federal responsibility for the release of geoinformation covering crisis regions and areas of operations abroad. For accomplishing its mission, the BGIC combines the expertise of approximately eighteen geoscientific disciplines to handle, in an interdisciplinary approach the processes of GeoInfo data collection, GeoInfo data management and GeoInfo production that are relevant for GeoInfo support.

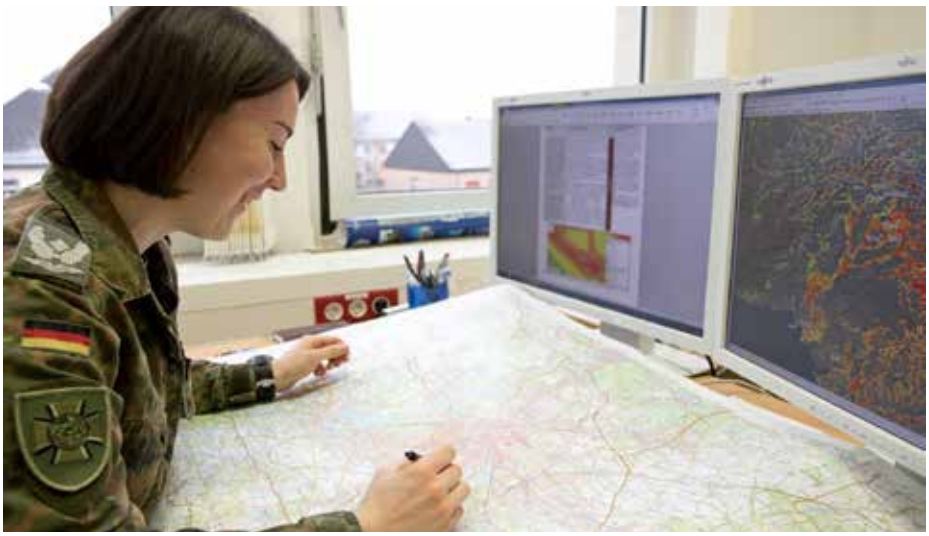

Figure 2: BGIS in Euskirchen *Source: Bundeswehr/Martina Pump*

With the view to GeoInfo data collection, the BGIC works closely together with a large variety of civilian institutions from the domains of industry, research and teaching as well as public administration. Aiming at the same goal, the BGIC is involved in technical cooperation programmes (e.g. TanDEM-X) at the national and international levels. The essential aim is to otain and maintain a standardised, current and detailed three-dimensional picture of all areas of operations and supplement it with mission-relevant information on outer space and the cyber and information space. This will allow providing a full picture of the situation.

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 (FACG) and the land survey organisations in the German Laender. This cooperation also includes the purposeful involvement in relevant working groups of AdV.

This map production in a civil-military effort also ensures that Bundeswehr forces operating on the German territory have the same 1:50,000 and 1:100,000 maps as civilian relief or security organisations that may be committed simultaneously. For digital geoinformation, the BGIS accordingly aims at transferring current geodata models and data over the German territory to the Bundeswehr GeoInfo Database with a Laender-wide standardised structure and in a single step, so that they can be used for military purposes.

For further information about the BGIS and the BGIC, see **cir.bundeswehr.de/ZGeoBw**.

Federal Ministry of Transport and Digital Infrastructure

Bundesministerium für Verkehr und digitale Infrastruktur

The Federal Ministry of Transport and Digital Infrastructure (BMVI) has been a member of AdV since 1950. Division DG 21 coordinates the multi-layered use of federal Laender geospatial reference information within the Ministry and its executive agencies with more than 16 higher level authorities and the transfer of know-how from surveying units of the “wet” directorates-general (i.e. waterways and shipping) to AdV.

The Federal Waterways and Shipping Administration (WSV) is responsible for the maintenance (in terms of traffic and water-management) the federal waterways (around 7,300 km of inland waterways and around 17,800 km² of waterways navigable by sea-going ships).

In addition to its maintenance obligations, the WSV is also responsible for ensuring traffic safety of federal waterways. The surveying/geospatial information section provides, inter alia, geo-referenced data, processed to form user-focused products, for instance data on water depths and the topography of the river bed. Official surveying functions are performed nationwide, and they require close coordination within AdV. The WSV provides its own basic network along the waterways (location and elevation benchmarks) and keeps a set of 1:2,000 scale digital charts whose contents inform the evolution of the ATKIS® basis digital landscape model.

For the maritime sector, the Federal Maritime and Hydrographic Agency (BSH) performs marine surveys in the Germany North Sea and Baltic Seas – the most heavily navigated waters in the world. Maritime surveys and maritime cartography provide necessary basic information for environmental protection, the construction of offshore installations, coastal protection and hydraulic engineering. The area surveyed of the BSH covers around 57,000 km², which is equivalent to one sixth of the land area of Germany. This area is displayed on a set of nautical charts with around 150 datasets for electronic navigational chart systems plus 60 nautical charts in paper format. In addition, comprehensive datasets on the current and historical chemical, physical and biological condition of the water column in the German territorial sea plus operational information and forecasting services for the water levels, the tides, sell and drift are provided via web-based spatial data portal as a maritime component of the GDI-DE.

The “Geodesy” division of the Federal Institute of Hydrology (BfG) currently supports WSV in performing functions in the fields of geodetic reference systems, geokinetics, surveying of water bodies, geotopography and construction surveying. The expertise required for the provision of specialist scientific advice is present within the scope of applied research and project implementation. In this context, intensive cooperation with universities and other research establishments is obligatory.

All agencies and higher level authorities cooperate closely with the surveying authorities of the federal Laender and in the AdV working groups. Their activities focus on the exchange of information regarding topography, information technology and spatial reference, as well as the use of SA*POS*® services, especially in the oversea reception range.

In addition, the BMVI has lead responsibility in coordinating the European Union's Copernicus earth observation programme within the Federal Government. The Federal Government's Copernicus strategy, which was adopted by the Federal Cabinet in September 2017, defines Germany's objectives and fields of action for Copernicus so that government, public authorities, industry, academia but also our citizens can benefit substantially from the programme. The measures resulting from these fields of action fall under the responsibility of different government departments. To support coordination, concrete national activities are formulated and adopted in regular work programmes of the Federal government.

More detailed information on geospatial information of the Ministry and its executive agencies can be found on our website **www.bmvi.de** in the section: "Themen"/"Digitales"/"Digitale Gesellschaft"/"Geoinformationen" (in German only).

Location-based information service for inland navigation

The Electronic Waterway Information Service (ELWIS) has been extended by a mobile, location and route-based information service. Shipping-related ELWIS information is now for the first time displayed on a digital map: **https://www.elwis.de/DE/Karte/** (in German only). The focus is on professional and recreational inland waterway shipping; waterway users can quickly and intuitively gain an overview of the shipping-related restrictions on the inland waterways via table or smartphone.

Figure 3: The new ELWIS map viewer in the hands of skippers (symbolic image). Source: Federal Information Technology Centre (ITZBund)

The new service simplifies access to the Notices to Skippers (NtS), ice messages and further shipping-related information on bridges, locks, berths or water levels. Even without knowing the exact name and kilometre of the federal waterway, the new map application makes it possible to set a starting point and destination by clicking on the map and to display the desired information for the determined or the current location. This makes it simpler for skippers to find – among the over 1,000 notices at national level – the notices that are relevant for the time and route travelled, along with the location they concern.

The application function independently of the user's terminal and has been optimised for mobile terminal such as tablets and smartphones. This is reflected in the operating concept and the low hardware requirements. As part of the project, the ITZBund developed special high-performance interfaces for the routing on inland waterways and for the optimised display of the Notices to Skippers. The systematic use of services moreover permits the synergetic use of various horizontal services of the Federal Waterways and Shipping Administration permits the synergetic use of various horizontal services of the Federal Waterways and Shipping Administration (WSV) and third parties that are already in place, for example for displaying the Inland Electronic Navigational Chart, searching locations and routes, determining the position on the waterway or for water level information.

The new service was developed by the ITZBund on behalf of the Federal Waterways and Shipping Administration (WSV). With it, the WSV improves the range of free-of-charge information it provides for professional and recreational shipping on federal waterways.

Figure 4: QR code for the new ELWIS map viewer.

V GeoBund: Contract between Federal Government and Laender opens up new horizons for the use of geospatial data

Geospatial data is a key driver in digitalisation. An important base for it is the official geospatial data of the Laender which are provided with a high level of timeliness and accuracy in a nationwide and quality assured manner. The Service Centre (**http://www.geodatenzentrum.de**) of the Federal Agency for Cartography and Geodesy (BKG) is providing the entire Federal Administration with geospatial data.

Within the past years the parameters for the use of these data sets have changed. For digital process chains, the data must be able to be made automatically available. This especially applies to the licencing of the data and the terms of use. These modified parameters have been included in the new "Contract about the continuous transmission of official geospatial data of the Laender for its use throughout Germany" (short VGeoBund 2019).

The significant innovations over the former V GeoBund 2016 are a flexible extension to the product range, additional terms of use and greater flexibility on account of open data policy of the Laender. For example, the product portfolio now contains a high-precision digital area model. The extended rights for federal institutions and third parties in regard to the exploitation of derivates are, for example, useful for noise, environmental or weather maps. V GeoBund 2019 went into effect on 1 July 2019.

The chair of the Working Committee of the Surveying Authorities of the Laender and the German Federal Republic (AdV) Siegmar Liebig commented: "With the help of the new V GeoBund, the geoinformation authorities ensure a flexible and demand-driven use of geospatial data for a broad use in Germany. Contemporaneously, AdV responds to changes resulting the German Open Data Policy."

The geospatial data of the Laender has been licenced for all of Germany by the BKG since 1999. "With the new agreement we are enabling, in the spirit of the Open Date Policy, all federal institutions the unrestricted transmission of digital products based on geospatial data. This is an elementary condition for progressing digitalisation in Germany", Prof. Dr. Paul Becker, president of BKG, accentuates.

Figure 5: Word cloud V GeoBund 2019

V GeoLaender: Contract about the reciprocal use of official digital geospatial data of the Laender simplifies the cooperation on a comprehensive administrational level

V GeoLaender regulates the transnational use of geospatial data of multiple Laender. The progressing digitalisation entails an increase in collaborations of federal and Laender institutions in professional and technical overall systems. On the base of standardised and nationally harmonised geospatial data sets all parties of the Federal Government and in the respective Land involved in a project may work transnationally with identic data sets within an overall system.

A key condition is that each institution on Laender level involved in a transnational task has licenced its appropriate geographic reference data for its area of responsibility at the surveying and geoinformation authority or that a licencing under the federal Land's law is dispensable. Due to the V GeoLaender, the regulations made on a case-by-case basis will become unnecessary and the use of geospatial data of the Laender will be further encouraged.

2. Working Group Spatial Reference

Innovational developments within the geodetic spatial reference

Quality assurance within the official spatial reference

Through the measurement campaign 2020 with the global navigation satellite system (GNSS), the periodic approach of the quality assurance through re-measurements are supplemented by an approach of a continuous quality assurance by reference station network monitoring. The GNSS campaign 2020 is, as a link between periodic and continuous quality assurance, significant for the sustainability of the geodetic infrastructure.

The "Guidelines for the standardised integrated geodetic spatial reference of the official Surveying and Mapping of the Federal Republic of Germany" is understood as the product definition and quality assurance framework for the integrated geodetic spatial reference. On this basis the GNSS campaign 2020 is executed as periodic re- or control measurements respectively with regards to the 250 points comprising Geodetic Backbone Network.

The GNSS campaign 2020 is, with regard to its scope, an extraordinary project and makes high demands on resources and technical know-how. A successful realisation of the campaign can only be achieved by solidary support of all parties of Federal Government and the Laender involved. This way, Germany ensures the base for a geodetic infrastructure which is equipped for high-precision applications for centimetre-level accurate vehicle navigation as well as for applications regarding the safeguarding of real estate property within the real estate cadastre.

Dr.-Ing. Bernd Krickel, Head of the project group GNSS campaign 2020

As a part of the SA*POS*® quality management, BKG regularly provides, via "DREF-online", a standardised updated frame of reference which serves as a link between national and international GNSS reference stations. This conceptional step serves as access point to a continuous quality assurance of the integrated geodetic spatial reference under consideration of the SA*POS*® reference station network, the so-called "RNS-Monitoring". By placing a sufficient number of SA*POS*® reference stations throughout Germany as ground points prior to the GNSS measuring campaign 2020, an interlinking with the Geodetic Backbone Network is ensured. By means of the designed reference station network, the introduction to a continuous quality assurance for this geodetic infrastructure is then made possible.

SA*POS*® embraces new user groups and opens up to new technologies

For a centimetre-level accurate positioning within the official spatial reference, the SA*POS*® reference station network is the crucial component, and thereby the stand-out feature, of the official Surveying and Mapping authorities.

So far, all SA*POS*® services are based on differential GNSS positioning procedures and the provision of correction data by means of bidirectional communication. Consequentially, the number of simultaneous users is limited by the performance of technical components of the reference station network provider.

The use of SA*POS*® was previously primarily limited to only real estate measurements. This changed in 2017 when at the Conference of the Minsters of Agriculture it was decided that in order to strengthen innovation and digitalisation in the agricultural sector, "just like geo, weather and satellite data, data and correction signals of the official satellite positioning service SA*POS*® needed to be made available to economic operators free of charge in order to implement the potential of Smart Farming like for example the improvement of resource efficiency and security in a short amount of time, in the sense of the Open Data directive."

Because of this the provision of SA*POS*® is linked to a significantly changed user behaviour in the agricultural sector.

The impulse from this significant user community has resulted in SAPOS® correction data being provided today by the appropriate Federal Laender to the agricultural sector increasingly free of charge or at special rates. By that, the Surveying and Geoinformation authorities demonstrate that they meet the political requirements.

Siegmar Liebig, Chairman of AdV, Lower Saxonian Ministry for the Interior and Sport

Future down-marked applications, such as autonomous driving, cannot be implemented via bidirectional communication due to the high number of users. Here, the broadcast provision of correction data via for instance satellite, mobile internet or digital radio (DAB+) is needed. The technical basis is that signal data is modelled along the signalling path and that the entire error budget is transmitted to the user via broadcast communication.

Due to the developments of global satellite systems and communication technologies, the Official German Surveying and Mapping authorities acknowledge the need for SAPOS® to develop a nationwide SAPOS® broadcast service with centimetre-level accuracy and short convergence times inside the official geospatial reference of the Federal Republic of Germany. With this innovative lead SAPOS® overcomes existing restrictions (e.g. increasing data volume due to increasing number of satellites) and also opens up the advantages of broadcast communication to the official Surveying and Mapping and generally speaking also to the georeferencing with reference to property boundary lines (for example in agriculture).

Regardless whether SAPOS® is going to have an impact on future down-markets or not, SAPOS® could still be used for monitoring and quality assurance of “non-official services” (monitoring function).

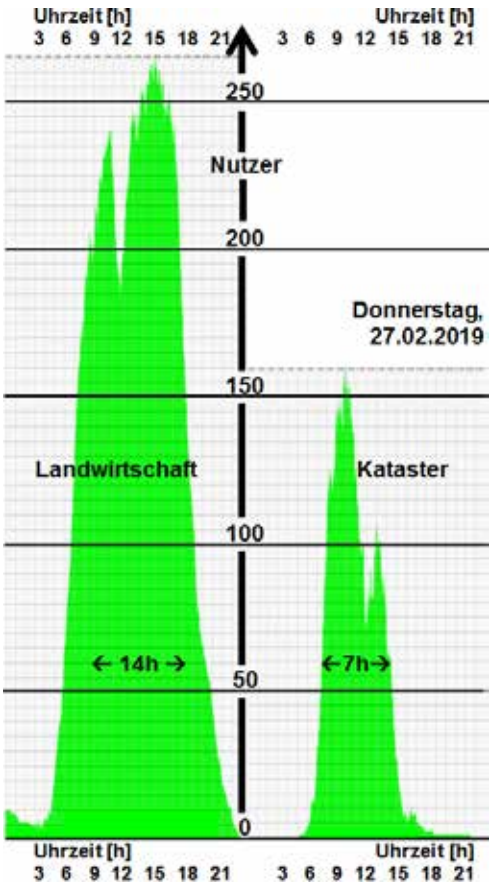

Figure 6: SAPOS® usage in agriculture and the real estate cadastre in North Rhine-Westphalia Source: Geobasis NRW

From one end of Germany to the other: Radar interferometry presents itself as a new method of measurement

The data provided free of charge by the Copernicus satellites enables, for the first time, the economic use of astronomical interferometry measuring for large-scale monitoring within the official spatial reference.

The exploitation of resources, geo-thermal energy or water withdrawal cause in Germany large-scale, anthropogenically induced soil motion with immediate effect on the geodetic spatial reference. Federal Laender, such as North Rhine-Westphalia or Saarland for example, have been monitoring the occurrence of vertical movement via the terrestrial measurement method of levelling and are documenting them in so-called surface elevation time series for decades now.

Figure 7: Levelling *Source: Geobasis NRW*

Against the backdrop of constantly decreasing resources, innovative methods of measurement from remote sensing are supposed to partially replace the more cost-intensive terrestrial measurements or to supplement them in a mix of methods in the future. With regards to the Copernicus programme (Sential-1A), for the first time, data of the satellite supported astronomical interferometry will be implemented as a source of information for land surveying in order to optimise the statutory tasks and the existing process chains in a resource-friendly way and to extend the informational content.

The assurance of the quality of satellite data through terrestrial reference data whilst projecting into the official spatial reference is the crux why several Laender started with prototypical developments.

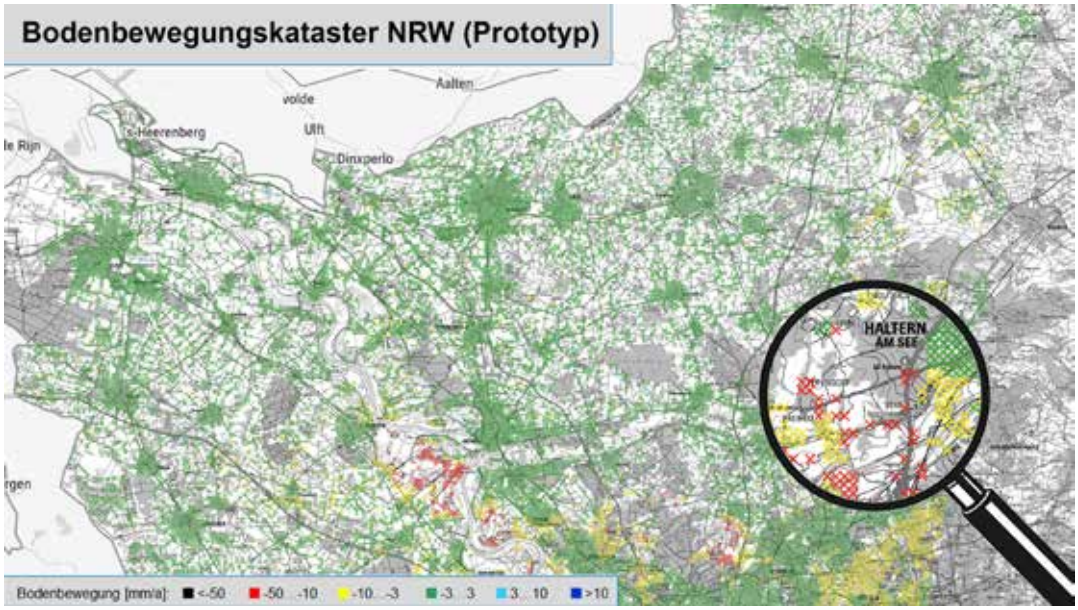

Figure 8: Soil Movement Register NRW *Prototype, source: Geobasis NRW*

With the prospective Soil Movement Register North Rhine-Westphalia, this surveying authority shows the benefit of the remote sensing method of radar interferometry for the detection and monitoring of large-scale vertical movements. As a result, a new product of the land surveying authority NRW within the scope of the statutory tasks has been defined. This development has been supported by the German Aerospace Centre (DLR) as a part of the national Copernicus projects.

Dr. Jens Riecken, Bezirksregierung Köln, Geobasis NRW

First commercial quantum gravimeter in use in Wettzell

BKG is responsible for the definition and implementation of the national gravity reference system. For this purpose, high-precision measurements of reference points of the German Gravity Reference Network are carried out throughout Germany. The results are forming the basic structure for the main gravity network of the Laender and with that for the physical spatial reference in Germany which, among other things, is necessary to determine natural elevations.

For measurements of the absolute gravity which call for the highest level of accuracy possible, absolute gravimeters, in practice worldwide, are being used. Here, the measurement of freefalling macroscopic test mass in a vacuum tube is carried out. The falling distance is measured by means of the laser interferometer and a rubidium atomic clock.

Figure 9: Quantumgravimeter AQG
Source: Uwe Hessels, BKG

In a quantum gravimeter the macroscopic test mass is replaced with a ultracold atomic cloud. Here, the falling distance is determined by using the interference of matter waves of atoms under the exploitation of their quantum physical properties by means of high-precision laser pulses. Since mechanical components are irrelevant in this procedure, the quantum gravimeter basically refrains from showing any abrasion and can be used for long-term experiments with high repetition rates and consistency.

On Tuesday, 19 December 2018 the Federal Agency for Cartography and Geodesy (BKG) put the first commercially available quantum gravimeter of the French manufacturer Muquans in operations at the Geodetic Observatory Wettzell in the Bavarian Forest - the absolute quantum gravimeter (AQG). It is the first device of this type which has been shipped outside of France.

Quantum gravimetry has made a dynamic development during the last years and is now in the transition phase from the laboratory stage to a real-life operation. With AQG the BKG is the first national surveying and mapping authority worldwide to use the advantages of this high technology in practice and to promote its establishment. These measurements will significantly improve the stability of the gravitational reference which means, that long-term gravity variations and with that, shifts of matter in the system earth – caused for example by the global change – can also be proven reliably.

Dr. Axel Rülke, Head of division Metrology of Gravity, BRK

Smart Mapping

Smart Mapping is going to lead the topographic products into the future and will conduct trials on, and implement, new methods of transitional collaboration and development. That way a joint and swift response to new technologies to provide data, in order to create AdV standard products expeditiously, is made possible by:

- adoption of streamlined concepts and AdV standard products after technical trials,
- technical trials and development of relevant software modules are carried out in the context of agile software development,
- establishment of a joint process for the creation of modern and future-oriented topographic maps and presentation graphics,
- highest degree of automaton in order to minimize production times,
- free parameterisation (with regard to scale, context, detail, symbolic encoding, georeferencing, …) in order to generate different joint products consistently and to enable the creation of customised products of the member authority at the same time,
- investigation and utilisation of technologies of the future (mobile applications, 3D/4D, vector tiles…) for AdV standard products,
- development of a joint development platform which makes transnational programming and the installation of relevant software possible.

In order to quickly produce visible results, a multi-step approach was decided upon at the beginning of the project. The presented concept therefore includes the immediate implementation of step 1 with the basic functions that include a new kind of joint cooperation and the online map with a print function for a topographic map 1:10,000. Whether, and to which extent, the creation of DTKs will be possible at a later stage will be investigated.
The online map workflow is of modular design and ranges from the entry of official and non-official data, the transformation into a flat data model, generalisation functions, symbolic encoding to the provision as a raw map for customised products and for the rendering of customised or coordinated AdV products. A distinction is made here between minimum standards (AdV standards), optional additions as well as customised creations of additional products (figure 10).

The online map contains nationwide, official data and additional data for worldwide coverage. With that, the requirements of both WebAtlasDE and the TopPlus procedure are combined. After a transition period, both processes are going to be replaced by the Smart Mapping online map.

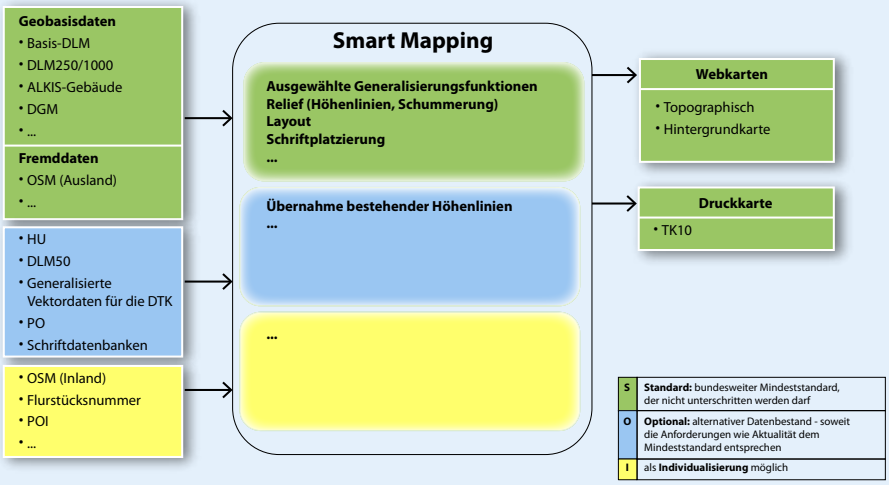

Figure 10: First implementation step of Smart Mapping

A key component of Smart Mapping will be the central development platform on which modules are developed and stored which are relevant for the production of existing and especially new maps. The development platform therefore provides software and hardware components necessary for the development of these modules.

The modular approach of Smart Mapping is therefore going to ensure a flexible use and expansion for future products and process requirements. A module is defined as a technical and functional delimited remit within a process which is usually mapped by various software products. In later expansion stages further software components will be added and completed respectively to the appropriate requirements of the AdV products. Setting up such a development platform which is available to all Laender and is operated centrally is far from trivial and requires considerable amounts of time, coordination and resources. The LA Geobasis has been assigned with the set up of such a platform and is supported by the State of Brandenburg and the working group Smart Mapping.

The modules are created within the scope of agile software development in the context of the Smart Mapping project. The goal of agile development is to make the process more flexible, faster and streamlined in comparison to the classical development models. This approach is also adopted at the OGC for the creation of new specifications for instance. Thereby, it is vitally important to not only analyse and discuss the questions theoretically but to also gather practical experiences through individual developments and the creation of prototypes. This should be the essential foundation for the decision-making process. Also important is here, to not only think through and experiment with the subject matter up to the point of the provision of the data, but to also involve interested developers/users as early as possible in order to collect experiences from their point of view. For that, it might be useful to carry out work “publicly” or to make prototypes available to the public. Agile software development requires special expertise of the participants. It is the declared goal of Smart Mapping to fall back on the expertise of the AdV member authorities whenever possible and to supplement it with external know-how when appropriate.

3. Working Group Real Estate Cadastre

What has already been achieved

The real estate cadastre safeguards, in connection with the land registry, the ownership of land and property by making the owned property identifiable by means of measurements, coordinates, a designation with a cadastral parcel number and with boundary markers on site. The real estate cadastre has always fulfilled this task successfully.

As an engineering discipline, the real estate cadastre is subject to constant change. In the past years new technical principles have been worked out. The implementation of a further developed data model for the real estate cadastre has been prepared; two entirely new data bases – Land Cover and Land Use – are under development. That had been the final decision of the AdV plenum in 2019.

The real estate cadastre seems to be in a phase that would allow some resting: The most important task – the safeguarding of property – is fulfilled; the technical conceptual work has been completed. Now all that is left is the realisation.

What remains to be done

Only just the realisation? Fact is, the actual work is just starting. The migration of the real estate cadastre into a new data model is, in terms of database management, comparable to an open-heart surgery. The function of the ownership protection must never be in doubt. Experiments are therefore out of the question. It will therefore be the task of the cadastre authorities to translate the technical requirements of AdV into action in a way in which the legal certainty is ensured at all times.

The new data model was not only introduced in order to optimise, or in other words, automate, the working process between the cadastral authorities and its classical partners – land register and land consolidation. A good cooperation between different institutions – which needs to be understood here in the sense of a data exchange without any media discontinuation – does not come naturally, which has been proven by experience. It is to be expected that, in practice, there will be phases that need to be worked out through trial and error. Here also, it is the cadastral authorities who are responsible for saying in the end: Now that it is working, we can rely on the automation.

Alongside all these advancements, the user must not be forgotten. For the user, the surveying and mapping authorities implement Land Cover (LB) and Land Use (LN) as new official databases; but the user will still retain the Actual Use (TN) as traditional and established dataset for the description of the earth's surface. The hereby occurring redundancy is intended. On one side the added values of a semantically strict distinction between cover and use can be realised while on the other side time series based on the TN keep their validity.

Due to its particular history the official Surveying and Mapping is still compartmentalising by keeping real estate cadastre and land surveying and with that ALKIS® and ATKIS® separate. While the real estate cadastre has a rather detailed look on the world, in land surveying the details blur together to big homogenous areas. ALKIS® and ATKIS® are therefore quite different in the regards to their level of granularity but they are still basically using the same kind of information. That is, when put to scrutiny, not very surprising since both are used for describing the earth's surface. Both need the Actual Use, both need buildings. All surveying authorities and cadastral authorities in Germany will have to answer the question in the near future as to how both sides of the geoinformation system can work together on an optimal level in order to avoid duplicate recording of mutually needed information.

All of this is merely portraying the internal perspective of the official real estate cadastre. At the same time digitisation is finding its way into the authorities. Grouped under the term eGovernment, the authorities are facing a transformational process which is going to reform the real estate cadastre in large parts. The law for the improvement of online access requires all authorities to offer their services online by the end of the year 2022 at the latest. The challenge is to, on one side, grant the people an easier access to the authorities that is adjusted to their individual situation whilst on the other side leading them in the end precisely to the desired service or to at least a suitable contact person.

Framework

Significant social topics like climate, energy, mobility, sustainability or demography are affecting the demands on geospatial information and determine according to economic and social requirements current and standardised geospatial reference data. It is therefore, on the backdrop of increasingly complex user requirements indispensable to divide geospatial reference data into the aspects of LB and LN, which has been done on a European statistics level for many years now. The following example displays this demand graphically (Figure 11). The landscape shown on the aerial image consists of traffic areas, various types of vegetation and buildings.

Figure 11: Landscape situation of the example

This landscape can be depicted by means of the objects of the existing TN either by regarding the covering aspects or the aspects of use. With the implementation of LN and LB this problem is solved. Figure 12 shows this division by means of a modelling example. The land cover level depicts buildings and vegetation. The land use level marks existing commercial services (testing grounds for automobiles). Users are now able to make evaluations with reliable results which also leads to an unequivocal (correct) data use.

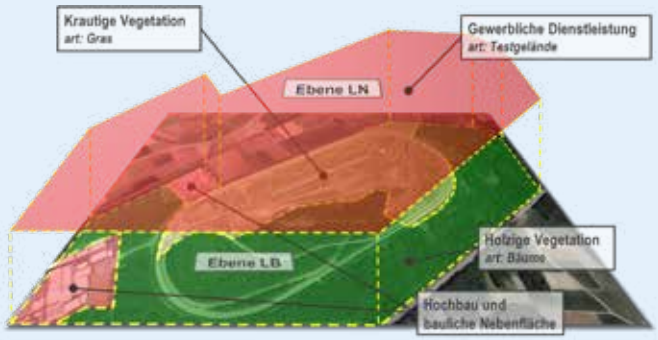

Figure 12: Realistic landscape image with LN and LB

On the basis of this demand AdV designed automatic derivable AAA®-compatible nomenclatures in order to keep LB and LN separate on the base of the AAA® basic schema.

Implementation

In order to ensure a complete derivation of the LN from the current data pool it is indispensable to not only keep the existing feature type section of the TN but to also supplement it with attribute and value types. In order to make a clear derivation of all feature types of the LN technical schema of the TN possible, various attribute and value types that had so far not been included in the master data pool have now been partially recorded to the master data. The majority of these value types are already available in the GeoInfoDok 6.0 which is why these can be currently recorded or have been recorded by various member authorities already. Alongside the expansion of the feature type section of TN the feature type section of the buildings value types has been equally supplemented and renamed in order to stay semantically consistent. Furthermore, the possibility for the documentation of quality criteria was introduced. That way, for example, it is possible for statistical and other users, as well as the data managing authorities themselves, to understand the reasons for shifts in the TN. To consistently derive the LN from the TN and to manage usage information it is therefore necessary to model overlappingly various situations within the TN. This is for instance necessary in regard to water bodies which as cover elements originally do not contain any usage information.

The Land Cover is supposed to be mainly determined via mostly automatic remote sensing methods. This is why the master data pool of the Land Cover comprises feature and value types which, according to the current information available to science, can be derived ably from the remote sensing method. A strategy for a national implementation is presently being worked on.

Timeline

A realisation of the elucidated concepts is carried out in the context of the implementation of the AFIS®-ALKIS®-ATKIS® application schema of the version 7.1.0. This is why a provision of both reference data pools in Germany like in the form of the master data pool will be available nationwide by 31 December 2023 at the latest. Appropriate informational events during which data profiles will be implemented and introduced will take place prior to the provision.

4. Working Group Geotopography

Using the Authoritative Topographic-Cartographic Information System (ATKIS®), the surveying and mapping authorities of the Laender manage geospatial 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. In order to continuously provide the data from the ATKIS® product range in a customer-oriented way, with contents that are sufficiently up-to-date; of the desired quality, and within the scope of the staffing and financial capacities of the AdV member authorities, the Working Group Geotopography closed, for the time being, the in-depth discussions of the product portfolio of the Official Geotopography that had begun in the previous years, with the AdV plenum final resolution regarding the increase of the topicality of the Digital Landscape Model and the initial introduction of basal and peak topicalities in Digital Terrain Models. Furthermore, a number of documents accounted for by the Working Group Geotopography was revised and standardised during the working period in order to make standardised product and quality standards available for producing member authorities as well as the product-benefiting users, in the future.

Digital Landscape Models

One of the key tasks of the surveying agencies in the field of geotopography is to manage and update the Digital Basic Landscape Model (Basis-DLM) as the basis for the establishment of various specialized information systems in administration and business. The ATKIS® Basis-DLM data pool also serves as the basis for the derivation of the small-scale Digital Landscape Model ATKIS®-DLM50, -DLM250, -DLM1000, the production of official Digital Topographic Maps, and the joint web-based map service of the Federal Government and the Laender (WebAtlasDE).

The regular updating of the Basis-DLM database takes place in different time frames. These cover the period from the emergence of change in the landscape up 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, in the case of changes, updated. The AdV plenum accounted for the increased user requirements by means of a resolution made in autumn 2018 on which it was agreed to now reduce the existing period for basic updates from five to three years.

Figure 13 shows a visualised DLM section of parking areas at the motorway service station "Leubinger Fürstenhügel" alongside the motorway A 71 Schweinfurt-Sangerhausen which is going to be opening its doors in the course of the year 2019. The matching aerial image (figure 14) was taken during and overflight in the year 2018.

Figure 13: Visualised Basis-DLM of the service station "Leubinger Fürstenhügel" at the federal motorway A 71

Figure 14: Service station "Leubinger Fürstenhügel" as aerial image, overflight April 2018

With the joint project "ATKIS® Generalisation" the conditions were created to derive the DLM50 from the Basis-DLM using model generalisation fully automatically. 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 (cartographic generalisation) were developed and put into practice.

This marked an important milestone in the effective and efficient provision of ATKIS® products given the increasingly demanding user requirements for up-to-date information and shrinking human resources at all surveying and mapping authorities.

The DLM250 and DLM1000 processed at the BKG are available nationwide and are updated on an annual basis. The contents are being continuously expanded for the production of the small-scale DTK250 and DTK1000 as well as for the EuroGeographics products EuroRegionalMap (1:250,000) and EuroGlobalMap (1:1,000,000) and additionally, for the linking of technical data and for the reporting at a European level (main user: European Commission). The requirements of the users in this area are also continuing to increase.

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 geotopographic 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. 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 usually automatically derived from DGMs with the lowest available grid size. For the ATKIS® technical concept, the DGM feature type catalogue is available in the GeoInfoDok. The data quality is documented in the product and quality standard for Digital Terrain Models. For the DGM5, for example, this stipulates a terrain-type-related height accuracy of the grid points of +/– 0.35 m to +/– 1.10 m with a confidence level of 95 % (2σ). The foundation for this high precision is usually the high precision Airborne Laser Scanning, which generates data for the DGM mostly automatically by now. A point cloud created by data obtained during Airborne Laserscanning depicts the area around the Cologne Cathedral and the adjoining Central Station.

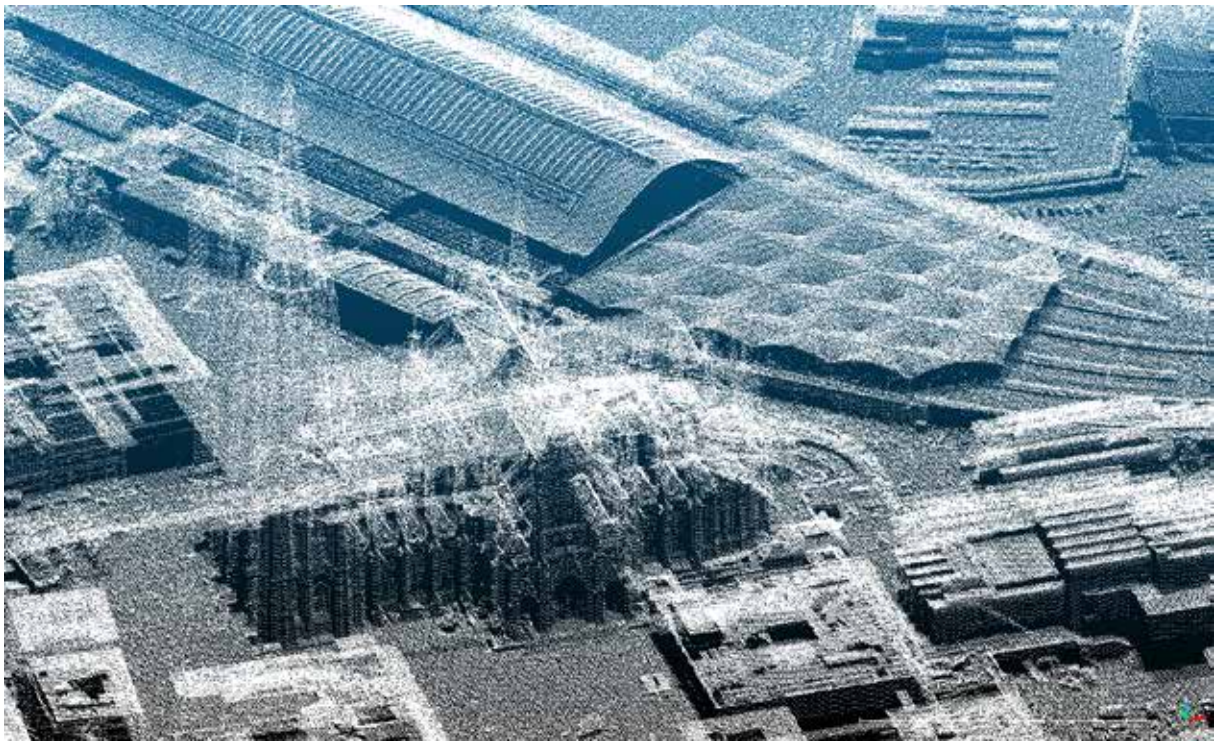

Figure 15: Point cloud from Airborne Laserscanning: Cologne, Cathedral and main train station

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 grid size of 5 m, and all the other above-mentioned lower resolutions are constantly updated and continuously improved by the BKG on the basis of the data updates of the Laender. Figure 16 shows a section of the DGM1 of Drachenfels, located near Bonn with the Rhine on the lower left-hand side, in a shaded view.

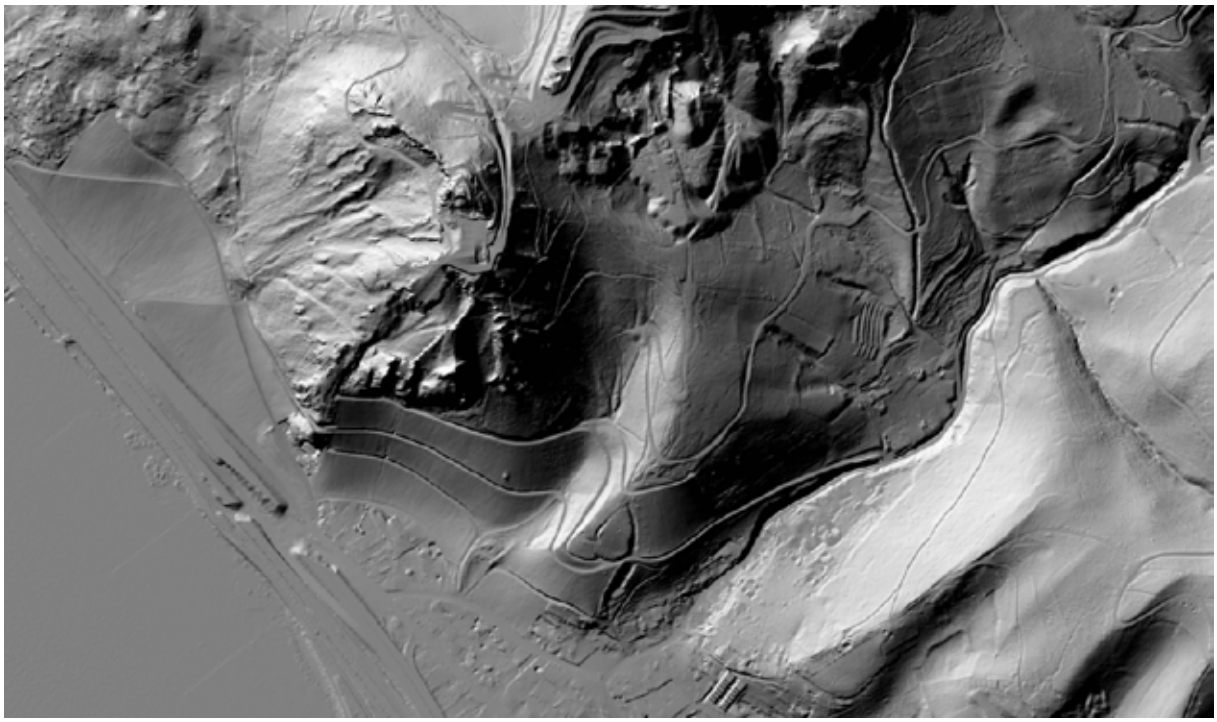

Figure 16: Digital Terrain Model grid size 1 m (DGM1), Drachenfels near Bonn in a shaded view

For risk analyses in calculating insurance rates, terrain models are used by insurance companies in particular. For this purpose, the German Insurance Association (GDV e. V.) uses the "Zoning System for Flooding, Backwater and Heavy Rain" (ZÜRS for short) in connection with the geospatial reference data of the DGM5 as a basis.

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 1 m (DGM1). Nationwide coverage with DGM1 will presumably be achieved at the end of the year 2019.

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.

DOMs are based on the method of Airborne Laser Scanning or the digital image correlation (image matching). An increasing demand for these products can be observed amongst the users. The DOM and their data quality are defined by the ATKIS® standards for Digital Surface Models.

2D and 3D modelling of geoscientific and hydrological questions have long been used in the administrative practice of water management as a consulting and decision support tool, like the recent example of the designation of Hamburg's flooded areas. Digital Landscape Models which are provided in a highly precise form are an indispensable input variable for the implementation of these models.

Dr. Renate Taugs, Director of the Office Water, Wastewater and Geology at the Agency for Environment and Energy, Hamburg

3D Building Models

The surveying and mapping authorities within the AdV have been offering the product 3D Building Models since 2013. The data is collected on the basis of the product and quality standards for 3D Building Models and the data format description in the AdV CityGML profile. The AFIS®-ALKIS®-ATKIS® model has been expanded to include 3D buildings and 3D structures as part of the GeoInfoDok 7.0.

3D Building Models are available ubiquitously with the Level of Detail 1 (LoD1), for several years now. 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) at the Bavarian Agency for Digitisation, High-Speed Internet and Surveying provides this data to customers who need the data for more than one particular land.

In the next level of detail, Level of Detail 2 (LoD2), all buildings and structures are currently being modelled by the surveying and mapping authorities using standard roof shapes. In Figure 17 an oblique view of the 3D Building Model of the inner city of Münster/Westphalia in LoD2 is displayed. In most Laender the production of the data sets is already complete, at the end of the year 2019 the nationwide coverage will have been accomplished.

Owing to user requirements, the AdV further decided to incorporate significant structures into the database in addition to the buildings. Modelling examples for the identified feature types such as towers, bridges and masts are available. These supplementary objects should be available nationwide at the beginning of the year 2021.

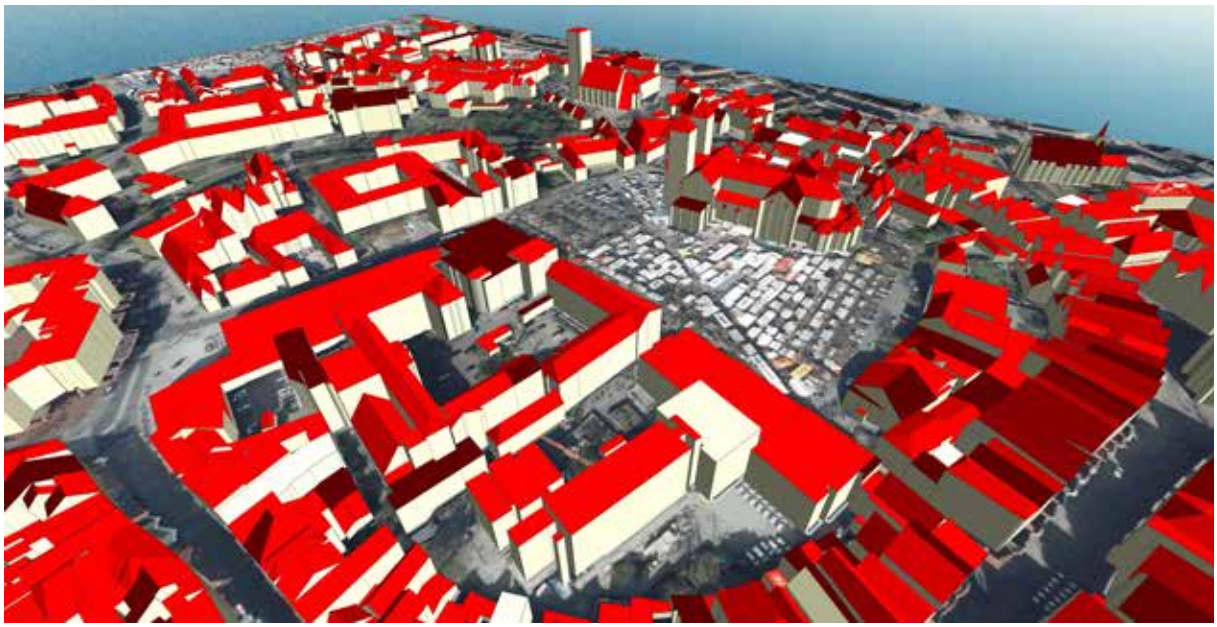

Figure 17: 3D Building Model with the Level of Detail 2 (LoD2), inner city of Münster/Westphalia

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 the end of 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. For the Digital Topographic Maps (ATKIS®-DTK) section, portrayal catalogues have been integrated into the new product and quality standard which combines all existing internal AdV regulations regarding DTK.

Digital Topographic Maps are available now extensively in almost all Laender on the scales of 1:25,000, 1:50,000 and 1:100,000. 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 starting 2017 will again show a representation of individual buildings, created by means of automated generalisation processes.

Based on the needs of the German Armed Forces and other users, DTK50 again includes since 2017 the single-house representation created by means of automated generalisation processes.

The raster data set of the Digital Topographic Maps on a scale of 1:250,000 (DTK) and 1:1,000,000 (DTK1000) have been updated in the course of the reporting period. Both map series are derived from the scale-related Digital Landscape Models DLM250 or DLM1000 and are processed cartographically. Since 2017 a printed 30-page DTK250 map series (TK250) is available. The DTK1000 is also available in different print versions. This overview and landscape map is available as a folded map in a scale of 1:1,000,000.

Furthermore, at the BKG the preparatory work for a new map in the scale of 1:500,000 (DTK500) has started. This map is going to be aligned to the design of BKG's small-scaled maps (DTK250 and DTK1000). It will join the range of scales seamlessly and be identifiable as such. This is owed to the harmonisation of the colour scheme, the graphic display of topographic icons, the categorisation of traffic as well as colour and size of the font.

In 2018 first tests for the derivation from the DLM1000 with a following pre-update of the traffic layer were run. In 2019 the DTK500 is supposed to be finished and also be printed as TK500. Figure 18 shows a first extract from the project.

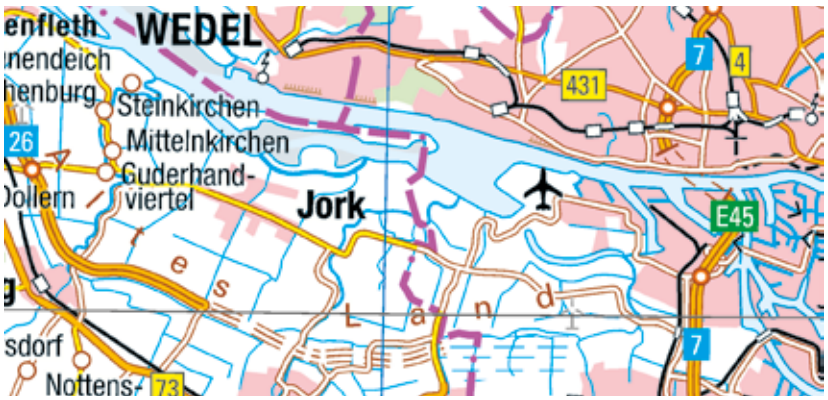

Figure 18: Map extract DTK500

Also, techniques for a mostly automated cartographic generalisation of the various map series are available and in operation in the Laender. This makes a highly efficient derivation from the Digital Landscape and Terrain Models possible.

Official Map Services

The demand for official map services has increased tremendously from users of various types over the past years. In addition to high performance, the availability of, preferably, infinitely variable zooming, high uptime, availability in a viewer and as a service, font and signature adjustments for every scale, a simple standardised characteristic map style as well as nationwide availability at a minimum and inter-Laender provision are particularly expected.

DLM and DTK could not entirely fulfil these demands. Based upon the activities of several member authorities, a joint web-based map service of the name „WebAtlasDE“ was implemented jointly by the Federal Government and the Laender in 2012 which was embedded in the geographic portals of the Federal Government and the Laender. In this process, Digital Landscape Model raster map tiles of different scales are created and then made available via the Web Map Tile Service (WMTS) on a performant and highly reliable level.

In particular, the complete presentation of all buildings registered in the real estate cadastre, including their house numbers, and the regular comprehensive update of the geotopographic data analogously to the DLM continuation are stand-out features of WebAtlasDE. The service was for example then embedded into the homepage of **www.adv-online.de** and can be retrieved there. Along with the official reference system ETRS89/UTM, the coordinate reference system used by many non-governmental users, ”Pseudo Mercator”, is also offered.

With the product TopPlus-Open, BKG offers a consistent, free content worldwide web map based on free and official data sources. For this purpose, many different data sources were merged, processed and combined, to obtain the best possible map presentation. Official geospatial data of the Laender Berlin, Brandenburg, Hamburg, Mecklenburg-Western Pomerania, North Rhine-Westphalia, Rhineland-Palatinate and Thuringia are presented in the product. With this endeavour BKG shows to what extend new products with new added values can be created by combining different Open Data offers and free sources. Figure 19 gives and overview about the different levels of detail of this product.

This web map is available as an internet service via the standardised Open Geospatial Consortium (OGC)-conform interfaces Web Map Service (WMS) and Web Map Tile Service (WMTS), can be easily integrated into common GIS systems and web map applications like ArcGIS, QGIS, OpenLayers or Leaflet and can be used on diverse devices ranging from smartphone to the desktop PC. In 2018 TopOpenPlus as well as its “official counterpart” TopPlus, which in Germany are entirely based on AdV data, have been completely updated. Both products are now based on current data from the year 2018.

Figure 19: The different levels of detail of TopPlus-Open ranging from world maps to more detailed city map in Germany.

ATKIS®-Geospatial Data Services, INSPIRE

In the provision of geospatial reference data via web technologies, harmonisation throughout Germany is also necessary. AdV has therefore created non-sector-specific web profiles for viewing and download services. Built upon this, for the area of geotopography, product specifications for services (WebAtlasDE-WMS, WebAtlasDE-WMTS and ATKIS®-DLM-WFS) exist for several now. During the working period regulations for DOP20-WMS and DTK-WMS have been added to it. Further product specifications are supposed to follow in the future.

Besides the NAS format as the 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 the corresponding AdV product specification for DLM data has been available for several years now.

The above-mentioned production specifications, as with the other AdV geotopographic standards, can be looked up in their latest version on the website **www.adv-online.de**.

Furthermore, documents necessary for the implementation of Annex I of the INSPIRE directive have been available since 2017. BKG has fulfilled this legal requirement in time to be able to also implement it for their own geospatial data products. During the working period, the main emphasis was on the drafting of the product specifications for geotopographic topics regarding the annexes II and III. Decisions about that need to be made in such a timely manner, that in this subject area the key date, set by INSPIRE can be kept by the AdV member authorities.

Digital Orthophotos

The provision of geospatial reference data via web technologies also requires nationwide harmonisation. AdV has therefore created neutral web profiles for presentation and download services. Based on this, the necessary web product specifications in the area of geotopography (WebAtlasDE-WMS, WebAtlasDE-WMTS and ATKIS®-DLM-WFS) have been approved by the plenum of AdV. If necessary, they will be updated by the Working Group Geotopography. In future, further product specifications will follow.

The surveying 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. Due 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 imagery are crucial to the prompt continuation of the geotopographic reference data of ATKIS®, the high-resolution DOP20 is subject to an update 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 the BKG. Along with the Laender, the ZSGT provides the DOPs and visualises them, as a nationwide data pool, 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 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 True Orthophotos, which has been picked up by individual Laender, already. TrueDOP no longer contain any tilting effects, meaning all the objects displayed are shown in the correct position and no occluded areas remain. The member authorities of AdV decided in 2017 that a nationwide extensive data pool of the same quality level will be available by the beginning of the year 2023, at the latest.

The switch to digital aerial survey camera systems has been completed for some time now. The high efficiency of multi-channel photography permits the simultaneous use of black-and-white (PAN), colour (RGB) and infrared (CIR) aerial image data. Since the near infrared channel has been made available, urgent requirements of surveying, forestry, agriculture and environmental authorities could be met.

Besides questions regarding the quality requirements for digital photography flights and questions of data transmission and analysis, the surveying authorities are focusing on the challenges of long-term data storage and history management, as time series of aerial photographs are an indispensable tool for the work of an ever-growing number of users. The protection of aerial image data files should 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 pool that often dates back decades and meets customers' requirements in this segment, for time series to a special degree. Historical aerial images by itself do usually not offer a georeferencing and are therefore limited in terms of analysability. By means of historical orthophotos derived from older aerial images, the georeference is produced and faults originating from projective and perspective distortions are eliminated in the process, for the most part. 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. In order to produce these historic orthophotos in the highest quality possible while keeping the workload manageable, the Working Group Geotopography has, during the working period, conducted a benchmark with interested software companies and, following this, created a guideline for the derivation of historical orthophotos.

The digital aerial images as the basis for deriving ATKIS®-DOP are increasingly made available to professional users additionally as Oriented Aerial Images by the surveying authorities. Oriented Aerial Images are aerial images that contain all the parameters required for stereoscopic analysis of the internal and external orientation. 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 multifaceted information comprised 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; this is also true for the evaluation of additional data obtained through remote sensing. Initial procedures are being used prototypically.

The orthophotos of the official Surveying and Mapping authorities have been a reliable source for identifying eligible agricultural areas for many years now.

The agricultural administrations in Thuringia are using the official image data in the scope of their administration and controlling processes as a reliable, highly precise and current data source which is then integrated into their processes.

The image data in connection with the Thuringian field parcels is made available to the farmers in Thuringia in order to support an application for areal subsidies of the right quality.

Thomas Lettau, Head of division at the Thuringian Ministry for Infrastructure and Agriculture, Erfurt

Toponymy

In collaboration with the Permanent Committee on Geographical Names (StAGN), BKG offers a standardised (gazetteer) service that provides the toponymy (GN-DE) from the vector data pool of the products DLM250, VG250 and GN250. GN250 (Geographical Names 1:250,000) is generally available in a classification of names corresponding to the ATKIS® feature types of ATKIS® in the AAA® data model. The raw data pool comprises around 187,000 entries of geographical 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. This data set has been provided in INSPIRE-compliant form as a service for the European Open Data Portal, since 2015.

In accordance with the relevant resolutions of the United Nations Group of Experts on Geographical Names (UNGEGN), in 2018, the StAGN has compiled "Toponymic Guidelines for Traffic Areas in Germany". This document is available for download at the StaGN website **http://www.stgn.de/empfehlung-verkehrsflaechen**. The German and Dutch-speaking and Nordic division of the UNGEGN held a symposium about the role and importance of standardisation of geographical names, which took place in Brussels from the 10 to 12 October 2018. In addition to the meeting of the two divisions, meetings of the working groups

- for toponymical data bases (Head: BKG)
- regarding the cultural heritage
- for the evaluation and implementation of the UN resolutions as well as
- regarding public relations and financing

took place. Furthermore, the event was used to discuss, in depth, the consequences of the new United Nations Economic and Social Council (ECOSOC) rules of procedures for UNGEGN, released in July 2018. The first meeting of the new UNGEGN took place in the headquarters of the United Nations in New York (USA) from 29 April to 3 May 2019[1]. The spring meeting 2018 of the StaGN took place at the BKG in Frankfurt/Main at the end of February, while the autumn meeting 2018 took place in the state library Oldenburg (Oldb.).

[1] On 17 July 2018 the United Nation Social and Economic Council (ECOSOC) accepted the new rules of procedure of UNGEGN as well as the provisional agenda for the next (first) meeting of the – on the basis of the ECOSOC resolutions 2017 – newly aligned UNGEGN: **https://unstats.un.org/unsd/geoinfo/UNGEGN/docs/11th-uncsgn-docs/E_Conf.105_165_11th_UNCSGN_report_e.pdf**

Subject-specific qualifications framework (FQR_GG) describes competences in the degree programmes geodesy and geoinformation

As part of the European higher education reform (Bologna reform) a two-tier model with Bachelor's and Master's degree programmes has been established. The higher education reform had the goal of a Europe-wide harmonisation of the degree programmes and is counting on an international mobility of the student. In order to acquire transparency regarding the degrees earned in a national or international context the European Qualifications Framework (EQR) and the German Qualifications Framework (DQR) were put in place. With the subject-specific Qualifications Framework Geodesy and Geoinformation (FQR_GG) university committees, associations and institutions of the geodetic and geospatial information sector worked out and published the technical and personal competencies gained in connection with a Bachelor's and Master's degree as well as a PhD in the study fields of geodesy and geoinformation. The FQR_GG is based on the established qualifications framework for German university degrees (HQR 2017; Figure 20). For the first time now, a nationwide harmonised and standardised description and classification of the available educational degrees in the field of Geodesy and geoinformation exists.

In regard to the competencies to be acquired, the FQR_GG adjudges, due to its requirements, the professional designation "engineer" of the Federal Chamber of Engineers in 2015 as suitable. Alongside the engineering disciplines of mathematics, computer science, natural science and technology (MINT), subject-specific contents are to be imparted. In the FQR_GG it is assumed that contents of the areas geodesy and geoinformation need to be predominant.

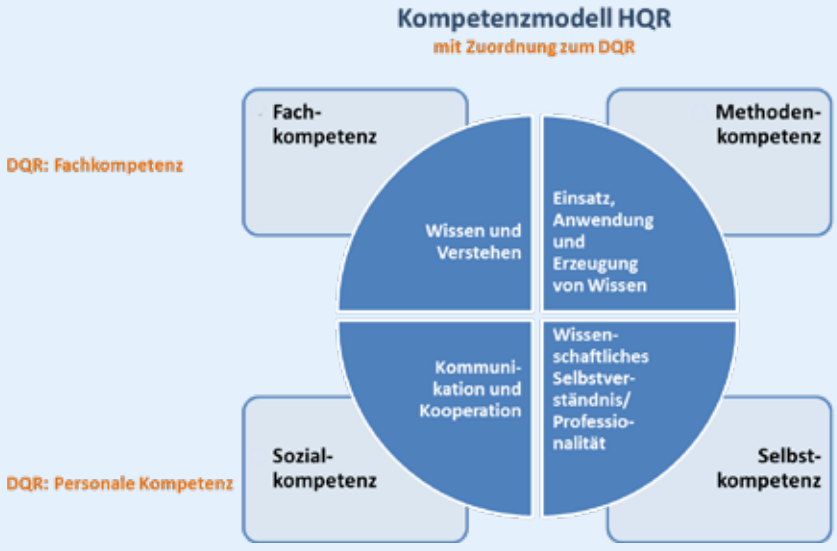

Figure 20: Competence model of the qualifications framework for German university degrees (HQR 2017). *Source: FQR_GG, München 2018*

The Bachelor's degree is understood here as the initial scientific professional qualification in which labour-market relevant competences are conveyed. At Master level a distinction is made between consecutive and post-graduate Master courses. For a PhD, independent research work is constitutive.

The description of the competences is based on the DQR and the HQR. The social and self-competence categories were described in broad terms. The professional and methodical competences are aligned with the study course Geodesy and Geoinformation. FQR_GG is supposed to support accreditation procedures; simultaneously it is supposed to keep the competences transparent and in communication and is therefore supposed to contribute the quality of the degrees. The FQR_GG has been worked out and adopted by:

- Committee for Geodesy of the Bavarian Academy for Sciences (DGK)
- Fachbereichstag Geoinformation, Surveying and Cartography (FGVK)
- Working Committee of the Surveying Authorities of the Laender of the Federal Republic of Germany (AdV)
- German Federal Working Group Sustainable Rural Development (Arge Landentwicklung)
- German Association of Publicly Appointed Surveyors (BDVI)
- Society for Geodesy, Geoinformation and Land Management (DVW)
- Association of German Surveying Engineers (VDV)
- Federal Chamber of Engineers, division construction

The FQR_GG is available online under **www.dgk.badw.de**

5. Working Group Information and Communication Technology

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® as source data set, INSPIRE as target data set). The release of the target data sets will take place according to the INSPIRE guideline in two steps:

- Annex I by 23 November 2017 and
- Annex II and III by 21 Oktober 2020

To guarantee a homogeneous procedure among the AdV member authorities, 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 standardised version of the AAA® mapping rules in accordance with GeoInfoDok 6.0.1 can be created and maintained compliant with INSPIRE version 7.1 in the future (Figure 21).

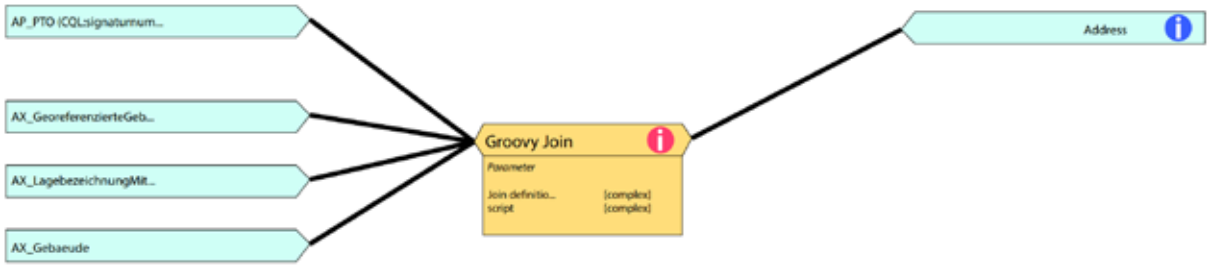

Figure 21: Derivation rule – AX_Georeferenzierte Gebaeudeadresse, AX_LagebezeichnungMitHausnummer and AX_Gebaeude to Address

The advantages of this formalised description of the derivation rules are the uncovering of technical inadequacies in the mapping, the automated transfer of the mapping results to a transformation tool and, additionally, automatic documentation. Moreover, these alignments can be imported and further processed by software products for data schema transformation so that the conditions at the AdV member authorities are met for creating INSPIRE data sets and services that are uniform throughout Germany. The alignment for Annex I topics is completed and work for the creation of alignments and product specifications of the Annex II and III topics has been picked up.

AdV's AAA® project

For the fulfilment of their tasks, geoinformation authorities are traditionally using the most current methods of information technology. Therefore, it was only natural that in the early 1970s and 1980s processes for the digital management and storage of factual data and graphic information of the land surveying authorities and the real estate cadastre were already developed. Whilst graphic data and point information was kept in the "Automated Real Estate Map (ALK)" process, in the process "Automated Real Estate Book (ALB)" factual data of the real estate cadastre were stored in a simple data structure. Even then, the greater goal was an integrated interdisciplinary management of the geospatial reference data of the real estate cadastre which failed due to the lack of efficient software and hardware. Built on the developments in the real estate cadastre, the "Authoritative Topographic-Cartographic Information System (ATKIS®)" was designed for topographic applications between 1985 and 1989 and implemented starting in 1989. ATKIS® is used, among other things, to derive Topographic Real Estate Map Series but also serves as a base for the implementation of various technical information systems in administration and economy (for example the national emissions reporting at the Thünen Institute for Climate-Smart Agriculture). This process was the reaction of the geoinformation authorities to the increasing distribution of geoinformation systems (GIS) and the rising demands for official digital geospatial reference data.

From the development, which took part rather independently due to the IT-related conditions, and the separate operation of both processes, some disadvantages arose (for example redundant acquisition and storage of data) however. In order to make improvements, a new and modern concept was worked out at the end of the 1990s which overcame the limitations from earlier and which was based on international norms and standards, defined new data structures for geospatial reference data and which has been implemented in the meantime via GIS with prevailing market terms. The implementation of this concept was especially demanding for the basic surveying and the real estate cadastre, since in addition to the development of the new AFIS® process, data from two different information system (ALB and ALK) needed to be combined into the ALKIS® process. As a result, the present management of geoinformation of the official Surveying and Mapping follows in all of Germany these following processes:

- Authoritative Control Point Information System (AFIS®),
- Authoritative Real Estate Cadastre Information System (ALKIS®),
- Authoritative Topographic-Cartographic Information System (ATKIS®), which was adapted to the new concept.

In the „Documentation on the Modelling Geoinformation of official Surveying and Mapping (GeoInfoDok) version 6.0.1“, published in 2009 under **www.adv-online.de**, AFIS®, ALKIS® and ATKIS® are described together in continuous form and are brought into correlation. GeoInfoDok is the current reference version for the national definition of AAA® data contents and the interfaces of AAA® data delivery, which is only based on the initial two figures of the version number. Every further development needs to necessarily be displayed on the interfaces of this AdV reference version which means that only error corrections with relevance to implementation are permitted and that any further developments can only be carried out as long as they can be displayed without any changes to the interfaces of the AdV reference version.

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 technical 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 Agricultural Adjustment Act. To support the 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.

Further development

Alongside the now completed national implementation of the AAA® processes in version 6.0.1, the conceptual basis has, due to new technical requirements, been continuously developed further. The display of 3D-Bulding Models, the adaptation to land appraisal law, the data exchange with systems used in law and agricultural authorities and especially the provision of geospatial reference data for the display of land cover and land use, see p. 30 f. have to be mentioned in this regard. With the modularisation of the GeoInfoDok into components (inter alia, the AAA® application schema, application schema land use) that can be carried forward individually and independently, a simple and clear modelling was achieved (Figure 22).

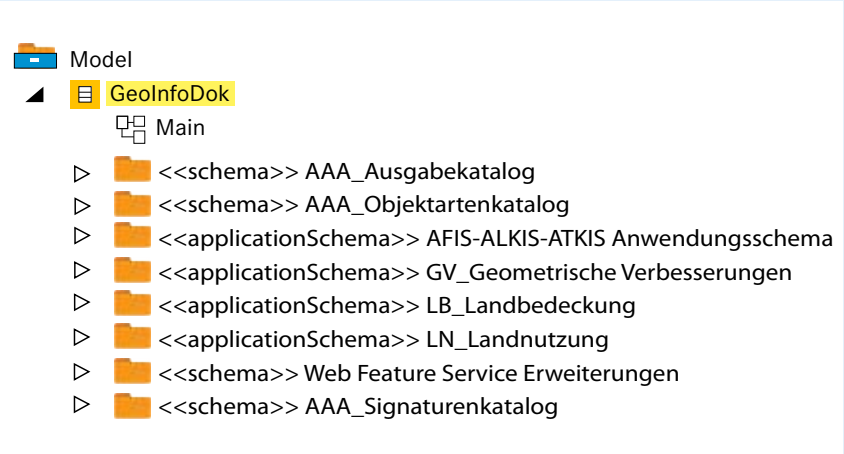

Figure 22: Schemata of the GeoInfoDok

In addition to this, modelling requirements for an improved backward compatibility, especially in regard to existing previewed or historical data were designed. In order to be able to make further use of declining elements and to clarify that certain information is only kept in the AAA® application schema due to the backward compatibility, effected feature, attribute, relation and value types are labelled “retired” in the UML data model following the ISO 1935-1.

Version numbers

In 2018 the new modelling was extensively reviewed by the geoinformation authorities and the software manufacturers known to AdV. In the AAA® revision ticketing system at **www.adv-online.de** all changes made in connection with the GeoInfoDok 6.0.1 are documented. In total these changes led to the following version statuses of the individual modules:

- AFIS®-ALKIS®-ATKIS® application schema version 7.1.0
- Land Use version 1.0.0
- Land Cover version 1.0.0
- Geometrical Improvement version 1.0.0
- AFIS®-ALKIS®-ATKIS® output catalogue version 1.0.0
- Web Feature Service expansions version 2.0.0
- Meta models for
  - AAA® feature type catalogue version 1.0.0
  - AAA® portrayal catalogue version 1.1.0

What is GeoInfoDok? Renaming of the main document!

The modularisation of the GeoInfoDok 6.0.1 described modelling resulted in the change of meaning of the term GeoInfoDok. Up to this point, GeoInfoDok stood for both, the AAA® application schema and the main document. In the future, the term GeoInfoDok – as originally intended – refers to all data modelling of the official Surveying and Mapping and, therefore, also to those application schemata that exist next to the AAA® application schema, like for instance the AAA® output catalogue or the Land Cover. GeoInfoDok is a designation with a reference to neither version nor date for the whole of all modelling. A continuation or addition of an application schema does not change the term GeoInfoDok. In order to differentiate between earlier versions, it is going to be necessary in the future, to look at the individual versions of the different application schemata.

Because of the modularisation the overall concept now defines all modelling and technical principles for all modules (schemata) of the GeoInfoDok and cannot refer to just one specific version of the AAA® application schema (for example version 7.1.0). In the overall concept, version numbering disappears since the exclusive relation to a version is no longer given. In the future, the document “overall system” will only show the date of publication. The overall concept is part of the GeoInfoDok. The overall concept still describes the AAA® basic schema, the AAA® versioning schema and the NAS operations as central and generic module for random application schemata within the official Surveying and Mapping. AAA® basic schema, the AAA® versioning schema and the NAS operations are part (UML packages) of the application schema (current version 7.1.0) and will be in the future which is why these schemata do not have any version information. For clarification purposes, information about which version of the AAA® basic schema, the AAA® versioning schema, the NAS operations and the application schema of the GeoInfoDok is specified, is supposed to be stated in the overall concept.

Implementation of the new modelling

The implementation of the new modelling for the geospatial information of the official Surveying and Mapping is supposed to be completed nationwide by 31 December 2023. Up to this date the geoinformation authorities guarantee the nationwide data supply on the base of the GeoInfoDok version 6.0. As of the 31 December 2023 the AAA® application schema version 7.1.0 will be the new AdV reference version with the result that AAA® data in Germany is only submitted in this version. No more data based on the GeoInfoDok version 6.0 is going to be supplied as of 2024, regardless of the practices of individual geoinformation authorities.

6. Working Group Public Relations and Marketing

Geospatial reference data describes and documents the space we live in. It is the non-interest-specific and 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 environment. They have a spatial reference! Geospatial 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 authorities of all the Laender are responsible for collecting, managing and providing geospatial reference data. 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 geospatial 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 standardised and transnational official geospatial reference data throughout Germany.

Requirements

The responsibility for official surveying lies with the German Laender according to constitutional law. Because the need for a multitude of spatial applications goes beyond the provision of geospatial reference data within one Land and because users are increasingly making greater demands in terms of geospatial 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. With such extensively standardised Internet services, the official Surveying and Mapping in Germany actively contributes to the development of the geospatial data infrastructure and eGovernment and thus promotes a modern information, knowledge and civil society in Germany.

To allow for a nationwide standardised product range, the distribution points are being networked and the product provision harmonised. Currently, certain product groups are being provided transnationally and in harmonised form by three central distribution points: the Central Office for House Coordinates and Building Polygons (ZSHH) at the Bavarian Agency for Digitisation, High-Speed Internet and Surveying, the SA*POS*® Central Office (ZSS) at the Lower Saxony Mapping and Cadastre Agency and the Central Office for Geotopography (ZSGT) at the Federal Agency for Cartography and Geodesy (BKG), which also provides the federal institutions with geospatial reference data.

Figure 23: Participants of the 5th conference of the AK PRM in April 2019 *Source: LDBV*

To achieve the goals of optimally satisfying the transnational demand in 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 nationallyavailable geospatial 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 aligning them with the geospatial reference data products and services **(product policy)**,
- maintaining the licence and fee models, licence agreements and model-based licensing for the use of the geospatial reference data and geospatial data services **(conditions policy)**,

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

Services

Product policy

To achieve optimum distribution of the geospatial reference data, geospatial 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 the geospatial reference data (product, intended use, customer satisfaction) as well as 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 AK PRM coordinates and conducts user surveys and analyses of the current range of official geospatial reference data. It is the goal to be able to consistently meet the current needs of also the innovative users with the product portfolio of official geospatial reference data.

Figure 24: Modern geospatial data follow the need of the users *Source: LDBV*

Current open topics at the AK PRM regarding the expansion of the product portfolio of the official Surveying and Mapping, relate to the users' need and the form of provision for 3D geospatial reference data, in particular the 3D Building Model in the Level of Detail 2 (LOD2) which is going to be available nationwide and which is supposed to be supplied transnationally by the Central Office for House Coordinates and Building Polygons. The conditions for a nationwide distribution of Digital Surface Models (DOM) are currently being analysed.

Conditions policy

To regulate usage rights in connection with the provision of the geospatial reference data and geospatial data services a nationally standardised licence and fee model is necessary. This must satisfy current requirements, be as clear and simple as possible and also regulate the use of all the currently offered geospatial reference products. For this reason, the official Surveying and Mapping in Germany has approved the Directive on Fees for the Provision and Use of Geospatial 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 encouraged to implement it. The AK PRM updates the license and fee model according to the requirements of the AdV.

At the suggestion of the AK PRM the plenum of AdV agreed in autumn 2018 on a continuation of the AdV charging directive. It was the goal of this continuation to turn customers' attention to the fact that the increasing provision of the geospatial reference data caused by the Open Data policy in the Laender, is also taken into account at the AdV charging directive This is attained by yearly adjustments to the fees and by making maximum amounts dynamic by introducing a service fee schedule which is compared to the applicable charges according to the AdV charging directive and which is reduced on a percentual basis for so-called "non-fee Laender".

Standardised sample agreements are indispensable for transparency and the use of geospatial reference data across national borders. The AK PRM maintains the standardised model licence agreements for complex application scenarios, the contract template for geospatial product licencing and theGeneral Terms and Conditions of Use (AGNB). In addition to this, internet-enabled, brief and easily understandable sample text modules 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 Laender-internal licensing. They are available at **www.adv-online.de** and are free for further use.

Distribution policy

The AK PRM defines itself as a communication platform for the distribution points of all the surveying authorities and for the central distribution points and it supports their exchange of experience. To this end, the AK PRM annually conducts a sales manager conference. Besides providing basic 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. The AK PRM is actively involved in developing and implementing new strategies for the provision of geospatial reference data. The AK PRM is for instance involved in the revision of the contract regarding the continuous transmission of official digital geospatial reference data of the Laender for their use within the federal sector (V GeoBund). Furthermore, the AK PRM works as part of a working group of the plenum on the positioning of the AdV towards a European and international collaboration.

Figure 25: Participants of the sales manager conference of the AK PRM in November 2018 in Cologne *Source: LDBV*

Product information

To ensure that the official Surveying and Mapping in Germany appears and presents itself in text and image in a uniform way, 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 publications 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 geospatial 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 the AdV, the official AdV logo is also protected as a registered trademark, since 2016.

Web portals and works of reference

Particular significance is attached to the central portal of the AdV, in order to pool the nationwide information concerning geospatial reference data in a user-oriented manner. The AdV website **(www.adv-online.de)** provides information regarding tasks, product range and developments. Visitors should be able to access the AdV's Internet information in a user-friendly way and within just a few clicks. This includes:

- information about current topics and innovations in official surveying,
- current product information,
- terms of purchase and licence regulations,
- access to the distribution points of the Laender,
- information about and access to the central distribution points,
- vacancy notices in the member authorities of AdV.

Figure 26: Via the AdV website the visitor gains access to the distribution points of the Laender, as well as the central distribution points of the AdV for transnational-related data (access function)

The web contents are maintained by editors of the individual working groups. The AK PRM undertakes the coordination of the structural work.

Public relations and trade fair appearances

In the course of establishing geospatial data infrastructures in the Federal Republic of Germany, the AdV is endeavouring to raise awareness of the geospatial reference data and geospatial data services of the surveying authorities of the Laender and to maintain direct contact with national and international customers. As in previous years, the official Surveying and Mapping was represented by the AdV with an exhibition stand at INTERGEO® 2018 in Frankfurt, the world's leading fair for surveying and mapping (Figure 27 and 28). In addition to the presentation of the products and capabilities of the official Surveying and Mapping in Germany, accompanying lectures took place. The three central offices of the AdV were present at AdV's stand and provided information about „geospatial reference data from a single-source provider".

Figure 27: Meeting with the customer at AdV's joint exhibition stand at the INTERGEO® 2018 in Frankfurt/Main
Source: AdV

Figure 28: Specialist lecture at AdV's joint exhibition stand at the INTERGEO® 2018 in Frankfurt/Main *Source: AdV*

Open Data – A challenge for Central Offices

Geoinformation is becoming more and more a key resource in our modern-day society and has become an integral part for every-day applications of economy, politics, administration and civil-society. The member authorities of AdV assume a central role within this context due to their provision of official geospatial reference data in a nationally standardised, high-quality, up-to-date data model that is aligned to standardised product standards. In addition to the range of data of the Laender, AdV set up three central distribution points for the transnational provision of official geospatial reference data and services:

- the Central Office Geotopography (ZSGT) at the Federal Agency for Cartography and Geodesy in Leipzig,
- the Central Office SA*POS*® (ZSS) at the Lower-Saxonian State Office for Geoinformation and Land Surveying in Hanover and
- the Central Office House Coordinates, Building Polygons and 3D Models (ZSHH) at the Bavarian Agency for Digitisation, High-Speed Internet and Surveying in Munich.

The Central Offices are serving supra-regional operating customers as competent contact and contract partners who have been authorised by the Laender with respect to AdV products available in Germany. This is the response from the official Surveying and Mapping to the need of the numerous users for the central competence pools for selected data contents of the land surveying and the real estate cadastre as well as for high-precision correction services for satellite-based positioning and navigation.

The products and services are offered at standardised rates and licencing models as well as in a transnational homogenous form. In order to achieve this, AdV enacted a directive for provision and usage fees for geospatial reference data of the surveying authorities of the Laender in Germany (AdV – Gebührenrichtlinie – AdV-GR). This directive applies for the transnational provision of geospatial reference data and geospatial data services and products derived from it, as far as they are offered by the Central Offices.

This led, in the environment of the Open Data Initiative of some Laender (so far those are Berlin, Hamburg, North Rhine-Westphalia and Thuringia) to an increase in inquiries of the customers of the Central Offices. On the one hand customers appreciate the quality assurance and data harmonisation of geospatial reference data of the Laender as well as the transnational provision from a single source offered by the Central Offices and are willing to pay for it, but do however, expect to benefit financially of the Open Data Initiative of some Laender in the fees calculation.

AdV reacted to this in its plenary meeting in the autumn of 2018 and further advanced AdV's Fee Directive by implementing a standard service provider fee. This development sent a strong signal to the customers that the increasing gratuitous provision of geospatial reference data as a result of the Open Data Initiatives of some Laender taken into account by the AdV's Fee Directive.

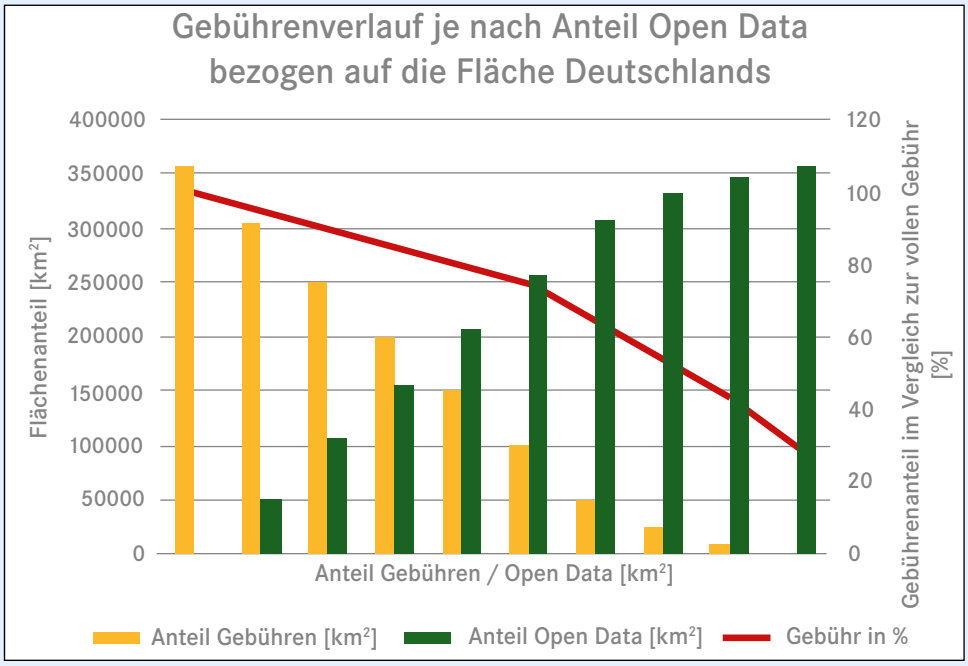

Figure 29: Development of fees for a national provision of an AdV product, calculated by area in dependence on the Open Data area section

The new charging model can be explained best through a comparison to the regulation of a heating bill. Here also exists a proportion of basic and fixed costs (30% to 50%). On the basis of a new regulation in the AdV Fee Directive only a 30% service fee is charged for the geospatial reference data of a Land that is free of charge according to the schedule of fees in this Land. This results for one, in reduced maximum amounts for the German-wide data provision in dependence to the percentage of Open Data Laender, but also secures the continued existence of the Central Offices despite of expectedly shrinking profits due to the introduction of minimum fees. The remaining regulations of the AdV Fee Directive have only marginally changed. By that AdV's Fee Directive continues to be compact, transparent and futureproof.

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-related tasks. The collaboration in terms of EuroGeographics includes the development of cross-national, 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. Furthermore, the president of the BKG is a permanent member of the Management Board. Currently this role is being filled by the head of the department Geoinformation.

EBM, ERM, EGM und EuroDEM

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

- EuroBoundaryMap (EBM) – the data set with all 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 39 data producers.

- EuroRegionalMap (ERM) – the topographic reference data set in the scale 1:250,000 ERM is currently being compiled by 35 data producers.
- EuroGlobalMap (EGM) – the topographic reference data set in the scale 1:1,000,000 is automatically being derived and has been available on the Internet as Open Data on EuroGeographics' website since 2013.
- European Digital Elevation Model (EuroDEM60) – a digital terrain model computed by the BKG in 2008 from the national data sets with a position resolution of approx. 2'' (approx. 60 m) and a height accuracy of 8 – 10 m.

The scope of tasks covers the organisation of the entire production process as well as its strategic planning and technical implementation. 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 Federal Service Centre for Geoinformation and Geodesy at BKG serves as a distribution centre for EuroGeographics and delivers the European data sets to both German and international customers.

On the basis of the specifications for EBM and ERM, the BKG and its partner authorities in Europe produce official national data corresponding to the annual production plan. This data is checked for EBM by the BKG and for ERM be the regional coordinators and BKG. They then are respectively merged to one data set. EBM and ERM are published once a year.

Figure 30: Members EBM (EuroBoundaryMap)

Figure 31: Menbers ERM (EuroRegionalMap)

Knowledge Exchange Networks

The Knowledge Exchange Networks (KENs) provide platforms for an exchange of experiences on various topics between experts from the EuroGeographics members. One example is the INSPIRE KEN, in which members can present 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 Services

With the European Location Service (ELS), EuroGeographics strives towards the strategic objective to harmonise the geospatial reference data of its members across boarders and to make it available for global, European (e.g. Copernicus and tasks of the European Commission) and regional applications, tailored to suit demand. In particular this includes, the support of the implementation of the INSPIRE Directive at a national level and the promotion of applications based on INSPIRE data on a European level.

The European Location Framework (ELF) project created a conceptual and technical foundation. During a 2-year transitional phase, which officially ended in October 2018, the operationalisation of the in ELF developed platform and website was pursued. These tasks had to be carried on. It has proven to be difficult on one side to find a management structure suitable for the platform, on the other side the provision of national ELS services is not given sufficiently. Germany is also affected, since due to complex licencing conditions of AdV, a simple provision of the needed ALKIS® data (for the ELS Cadastral Index Map as cadastral online map) or ATKIS® data (for the ELS Topographic Base Map as a topographic online map) is complicated.
A part of the activities is the successor-project Open ELS which is supported by the European Commission. The project started on 1 Mai 2017 and covers the period of two years. Open ELS is managed by EuroGeographics. Alongside the BKG nine additional surveying authorities are involved. The Open ELS project puts an emphasis on the open data aspect. This includes the free of charge provision of the official geospatial data via services as well as the further development of required platforms and central tools.

In the scope of the Open ELS project, BKG is currently involved in deriving a European index (gazetteer) from the ERM and EBM products. BKG is coordinating this task and is also involved in discussions with the Joint Research Centre (JRC) of the European Commission. Amongst other things, it is being examined whether the European gazetteer should be also provided as linked data. The works on the gazetteer are far progressed. For example, foreign names of settlements (exonyms) have been linked to local names of settlements (endonyms) taken from national data bases, also a prototype for testing (web feature service) has been set up. The European gazetteer was published in April 2019.

Further information regarding ELS and the Open ELS can be found under:
https://eurogeographics.org/products-and-services/european-location-services/
http://openels.eu/about/

Copernicus – the European Earth Observation Programme

With Copernicus, the European Union – together with the European Space Agency (ESA) and the Member States – has created an independent infrastructure that will, on a long-term and sustainable basis, provide data and information for knowledge-based European and national policies. Copernicus supports measures in the field of environmental protection, civil protection and humanitarian aid, maxims socio-economic benefits, promotes the European space industry and ensures autonomous and reliable access to earth observation information and corresponding key technologies. An important part of the Copernicus information services is based on satellite observations. Copernicus is a flagship initiative of European space policy.

The operational Copernicus European earth observation programme consists of a unique family of earth observation satellites, in situ monitoring systems and information services for data and information products dealing with land surfaces, the marine environment, the atmosphere and climate change as well as supporting disaster management and civil security. By 2020, Copernicus is to be upgraded to become the most powerful infrastructure worldwide for the provision of global environmental information. As a civil, user-focused industry and public authorities in Germany and Europe with real-time information for environmental and security-related issues.

Within the framework of Copernicus, information products as well as satellite data are made available free of charge (Commission Delegated Regulation (EU) No 1159/2013). These can be processed for use with various applications. More information can be found at **www.d-copernicus.de**.

With the establishment of the Copernicus programme, the availability of satellite data and services is improving significantly. However, public institutions are in many cases still not adequately prepared to integrate satellite information into their work processes. In 2012, the Federal Ministry of Transport and Digital Infrastructure adopted the "National Copernicus Integration Measure" funding programme to help authorities with the implementation of Copernicus data. The national projects are carried out in three different areas: support of technical coordination, technical implementation and validation projects as well as establishment and pilot operation of a national Copernicus IT infrastructure (CODE-DE– **https://code-de.org/)**.

Copernicus – uses in the state surveying agencies

Individual federal state agencies for geoinformation are using their "geo-competence" and have set up corresponding centres of excellence for remote sensing to unlock, for example, the potential remote sensing data holds for other public institutions with regard to using remote sensing products, developing procedures and refining these high-quality, complex satellite data by providing advice. Here, the Satellite Data Field of Competence project at the Centre of Excellence for Remote Sensing at the State Agency for Geoinformation and Rural Development of Baden-Württemberg (Landesamt für Geoinformation and Landesentwicklung Baden-Württemberg, LGL), the Copernicus Contact Point of the State Surveying and Geoinformation Agency of Brandenburg (Landesvermessung und Geobasisinformation Brandenburg, LGB) as well as the Copernicus Control Centre for Schleswig-Holstein deserve particular mention.

Since the end of 2018, the Baden-Württemberg Centre of Excellence for Satellite Data, which is currently being set up, has been making available, for the first time, Copernicus satellite scenes as visualisation service (WMS) on the Geoportal BW. Thus, an important milestone has been reached. Sentinel 2 satellite data plus refined data (indices, band composites) with a geometric resolution of 10 m and 20 m are made available for eight selected half-month periods, namely April and May of 2017 and 2018. The service is available at **http://www.geoportal-bw.de/themenkarten** (in German only) under "Themenkarte"/"Fernerkundung" (thematic maps/remote sensing).

According to a Cabinet decision, the State Agency for Surveying and Geoinformation of Schleswig-Holstein (Landesamt für Vermessung und Geoinformation Schleswig-Holstein, LVermGeo SH) is to function as central "Copernicus Control Centre" for Schleswig-Holstein and to pool the geo-competence for the use of these data.

In this role, it is to provide information on the possibilities of using geodata and creating added value, but it is also to coordinate local activities and provide uniform points of access to processed Copernicus data of the State of Schleswig-Holstein. The LVermGeo SH made a start by making available the online viewing service for Sentinel 2 image data and the corresponding web map service in June 2018. With this approach, pre-processed Copernicus Sentinel 2 satellite images are made available to the public. Using the link **https://danord.gdi-sh.de/view/copernicus** (in German only), both citizens, for private purposes, and public authorities, for example from the fields of road construction, agriculture or flood protection, can view the data relevant for them and embed them in their GIS.

In September 2018, the LVermGeo SH together with the Federal Agency for Cartography and Geodesy organized two workshops on the subject of “Copernicus in public authorities – getting to know it, testing it and using it”. Forty participants from local and regional authorities were given an overview of the Copernicus programme and the approach envisaged by the applications using the programmes SNAP and ArcGis for obtaining, visualizing and processing Sentinel 2 satellite data.

For the future, further information events and specialised practical workshops are planned in order to promote a broad use of Copernicus also in Schleswig-Holstein.

Figure 32: Sentinel 2 image of the island of Fehmarn dated 17 May 2018

Documenting movement with Copernicus. In the North Rhine-Westphalia Soil Movement Register (Bodenbewegungskataster NRW), the surveying authority shows the benefits of the interferometric radar remote sensing method for the detection and monitoring of large-scale vertical movement. The result is the definition of a new product of the State Surveying Agency of North Rhine-Westphalia (Landesvermessung NRW at Bezirksregierung Köln) withing the framework of the statutory functions. The development is funded by the German Aerospace Centre (DLR) as part of the national Copernicus projects. The North Rhine-Westphalia Soil Movement Register defines the interface between data source/remote sensing (Sentinel 1A) and data refinement (State Surveying Agency) as well as the associated processes of “collection - qualification – further processing – presentation”.

Based on the State Surveying Agency’s terrestrial reference data, several new approaches for assuring the quality of an official product in the official 2016 Spatial Reference are derived and assessed. Interferometric radar observations are available in the form of PSI values of region”; they were calculated by the Clausthal University of Technology.

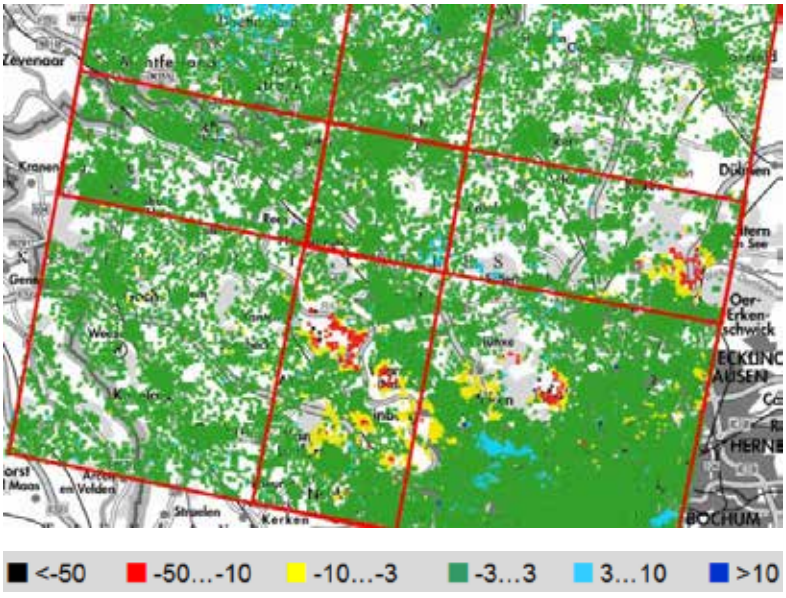

Figure 33: Soil movement in the test area in [mm/a]

Each segment refers to an individual reference point. Each segment has an overlapping area of 15 km. The total area is around 75 km x 75 km. Bezirksregierung Köln combines the observations in tiles with discretization intervals of 250 m x 250 m, using a temporal assessment interval of 1 calendar year ± 6 months. This step this represents a spatial and temporal generalization. Within the tiles, the statistical assessment takes place by means of signal analysis in conjunction with outlier detection.

The merging of the tiles is effected by balancing redundant observations in the overlapping areas of the segments while, at the same time, transferring them to the official Spatial Reference (mating process).

The unique features of this project are characterized by the following two quality assurance steps:

Q1: The transfer to the official Spatial Reference (geodetic datum) is ensured by re-aligning the segments including a homogenization of the transitions and matching segments using the temporal sequences of the elevation benchmarks of the official Spatial Reference.

Q2: The second quality assurance or quality control takes the form of an independent comparison with reference data of the State Surveying Agency, in concrete terms with the independent terrestrially determined soil movements.

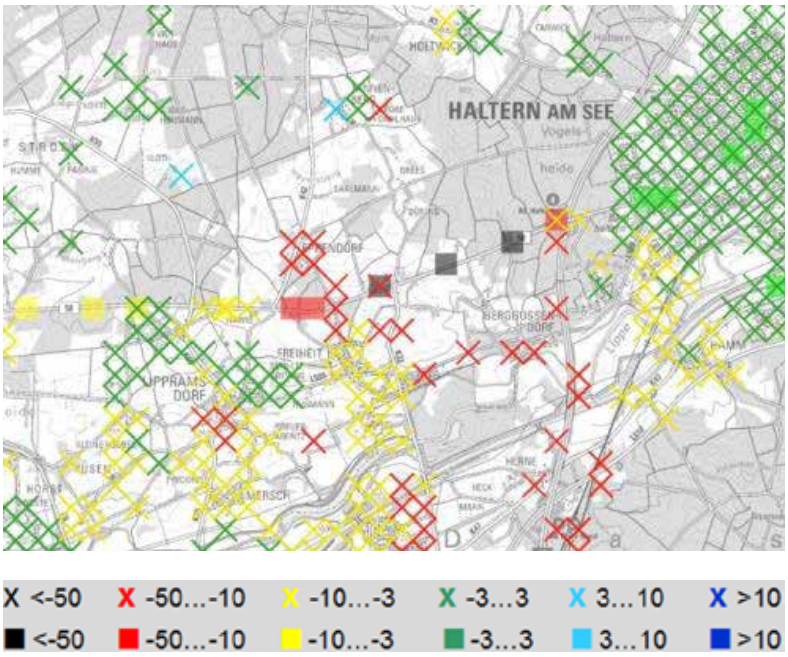

Figure 34: Soil movement in the test area [mm/a]
X = PSI tile (interferometric radar)
■ *= terrestrial reference value (levelling campaign)*

Interferometric radar provides significant area information for around for around 1/3 of all tiles in the area raster. The comparison with independent terrestrial reference values confirms the expected precision of the interferometric Sentinel 1A radar data. From the geodetic perspective of the State Surveying Agency, this confirms the potential of remote sensing for supplementing terrestrial measurements.

Copernicus – access to data and data processing on the CODE-DE platform

The many current and planned satellite mission (until 2025, over 600 additional EO satellites are envisaged) imply great challenges in terms of data management and data processing. In the age of Big Data, there is a need for solutions that allow for the extraction of the relevant information from the enormous amounts of data.

This is exactly what the COpernicus Data and Exploitation platform – Deutschland (Germany) (CODE-DE) makes possible: users have cloud-based access to satellite data and can choose to either download these data or, alternatively, to further process them themselves to create more sophisticated products and to only obtain the result or to make the procedure available to the user community. To do so, users merely need Internet access and do not have to invest a lot of resources into storing the data themselves and into their computing capacity.

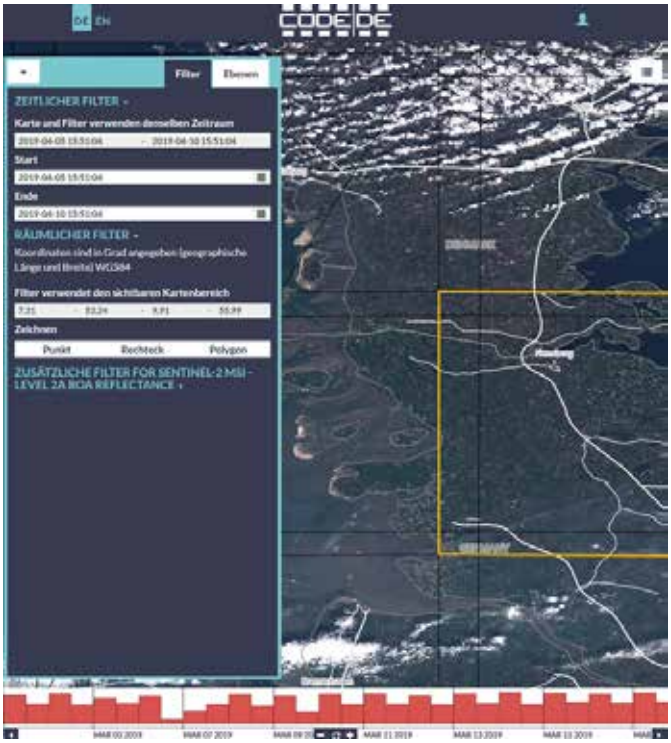

Figure 35: CODE-DE portal for the spatial and temporal search of satellite data. Here, optical Sentinel 2 data from March 2019 are displayed as tiles covering northern Germany (ground reflection with atmospheric correction).

With CODE-DE, national access to all Copernicus programme data is ensured. All data of the data hubs of the European Space Agency (ESA) are mirrored on CODE-DE and made available in a user-friendly as well as easily searchable and accessible manner. Data from further national and international earth observation satellites are offered via interfaces.

These are data from the Sentinel 1, Sentinel 2, Sentinel 3 and Sentinel 5P satellites. Data from further national and international earth observation satellites are offered via interfaces.

The catalogue service permits data searches in full spatial and temporal resolution. The selected satellite image can either be downloaded directly from the cart or fed into online processing. In online processing, several pre-defined modules can be selected: they contain typical level 2 processing methods, such as atmospheric correction, cloud masking and various indices (e.g. for the recognition of green vegetation as shown in the following figure). These procedures can be extended by users providing their own input.

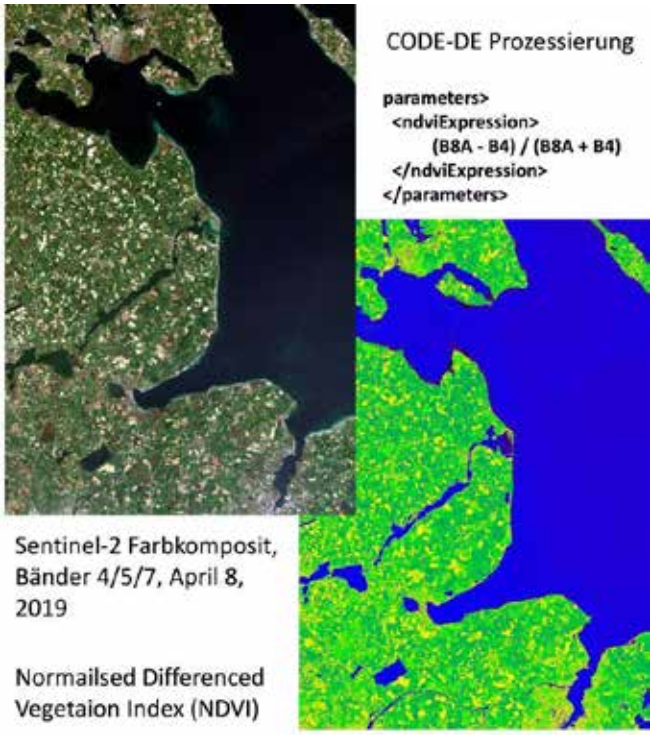

Figure 36: Multispectral and NDVI display of a Sentinel 2 image dated 8 April 2019 processed with CODE-DE. The Normalized Difference Vegetation Index (NDVI) is calculated from Sentinel 2 band 8 in the red spectrum and band 4 in near infrared (for sample script, see upper right).

CODE-DE also enables users to create user-defined image mosaics or to temporally combine images to show a phenological development (level 3 processing).

In processing, a query is added to a job list and processed as soon as possible, and the user is informed upon completion.

You can find ready-made products such as the monthly cloudless nationwide Sentinel 2 mosaic at **https://code-de.org/de/marketplace**.

By setting up a virtual machine, users can create a private environment on CODE-DE, in which they can implement their own developments just like with their PC at home and access all data and software on CODE-DE. Here, users can work in a protected environment and, for example, upload their own supplement data (such as in situ measurements), develop models and apply them to satellite data. If desired, the result can then be made available as a web service for subsequent use.

In CODE-DE, recurring work steps can be operationalized and executed externally using docker scripts. One example could be the weekly search, processing and automated collection of satellite data on a certain piece of arable land to track the temporal course of development of green vegetation by means of NDVI processing and to thus draw conclusion regarding the state of health of the arable crops.

UN-GGIM: Europe – establishing efficient geospatial data management

Integrating national geospatial data into the European and international environment is increasingly coming into focus. Significant in this context is the "United Nations Global Geoinformation Management (UN-GGIM)", an initiative of the United Nations (UN) that has taken on the task of coordinating the global geoinformation management. An important part of UN-GGIM is the integration of statistical and geospatial information, particularly regarding their significance for the 17 UN Sustainable Development Goals (SDGs).

A regional body at the European political level that dealt with questions of geodesy and geoinformation at a comprehensive level, had previously been lacking. To close this gap UN-GGIM: Europe was formally put in place in September 2014 by UN-GGIM (global) to act as such a political body for Europe. A great opportunity for UN-GGIM: Europe lies in the stronger networking of the national surveying and cadastre authorities with the national statistical offices.

The BKG has taken over the leadership of the working group on the topic of data integration (Working Group "Data Integration"). Very pleasing is the agreed close cooperation between the BKG and the German Federal Statistical Office (Destatis). Through this, 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 and geoinformation on the one side and statistics one the other can be merged.

The working group has published user needs for the combination of data and regarding methods for an improved networking of geospatial data as well as the cooperation of statistical offices and the surveying and cadastral authorities. In 2018, the analysation and evaluation of "Geo Dimensions" of the Sustainable Development Goals (UN SDGs) has been pushed forward by the working group. In particular, indicators for the monitoring of goal attainment were examined, which can only be determined with the help of geospatial data or which require geospatial data as baseline information for the analysis. Furthermore, a strategy paper for the integration of data for political decision-makers has been worked out, which is being published in 2019.

For further information regarding the UN-GGIM: Europe Working Group "Data Integration" as well as the already published reports please go to:
http://un-ggim-europe.org/content/wg-b-data-integration

Open Geospatial Consortium

Geospatial data infrastructures like GDI and INSPIRE, which mainly pave the way for the provision of geospatial reference data of the AdV, are essentially built on the Open Geospatial Consortium standards. The standards form a solid foundation for product-independent handling of geographic information and its distributed provision/use through the internet.

The use of this data and appropriate interfaces usually require GSI tools and sufficient time for the familiarisation of them, as well as of the standards and specifications they are based on, which, due to the extensive material and functional scope, represents a large obstacle for non-experts. For developers that have no need for the full range of extensive functionalities of the GGC online services or the full scope of complexly structured geospatial data, respectively, it would in most cases suffice, to have more simple data with less functionalities at hand.

The World Wide Web Consortium (W3C) and the OGC worked together intensively over the past years, in order to document, from the current vantage point, recommended methods for an online-friendly publication of geospatial data. The specification of open programming interfaces (Open API) is the objective of this course of action. Since this new approach can be built upon the existing infrastructures, the GDI in Germany as well as the official Surveying and Mapping could take this technology into account and, at comparatively short notice, gear the provision of data towards it. Alongside, the download services for vector data (WFS) the expansion for all other services (WCS, WMS, etc.) is being investigated and pushed forward.

The developmental process for specifications is currently also changing. While up to this point the work of the expert groups (Standards Working Group) had been continued until a standard was, in their judgement, finished, it is planned to henceforth also involve the professional public (for example users, developers, GSI companies) in the scope of a review process at an earlier stage. This means, that a reasonably stable draft version will be open for testing and comments. Following this the standard will be revised and afterwards adopted. The early involvement of the interested groups is supposed to result in stable standards that are in line with the market.

These developments have a direct impact on a variety of specifications of AdV and with that on the current future provision of geospatial reference data. This is why the AdV, represented by the Information and Communication Technology Working Group, is actively working with the OGC, on these developments in particular, as a technical member and is a long-term voting member.

ISO/TC 211

The Geoinformation/Geoinformatics Technical Committee develops and maintains formal geoinformation standards. Fundamental standards important for AdV and GeoInfoDok are the most part stable and only further developed with caution.

Currently activities on an ISO level are taking place in order to improve the coaction of standards and geoinformation and the digital planning method called Building Information Modelling (BIM). The purpose of this is in particular the definition of an interface in order to transfer GIS data into the BIM world and vice versa. Especially the transfer of CityGML building data to a BIM project is conceivable.

Establishing and maintaining the compliance of the AdV standards, especially the GeoInfoDok, 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.

Permanent Committee on Cadastre in the European Union

On 1 July 2018 Austria 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 2018. At the conclusion of the presidency, the PCC General Assembly was held in the city of Vienna on 20 and 21 November 2018. The main focus of the conference was on the topic "Let's talk about (legal) reliability of the Cadastre", which means on the legal certainty of the real estate cadastre.

On 1 January 2019 Rumania assumed the presidency of the EU for the first half of the year 2019. The Rumanian authority for surveying, cartography and cadastre organised the spring General Assembly of the PCC in Bucharest. The situation in Rumania and the question of social-economic value of the cadastre were discussed in depth.

On 1 July 2019 the presidency of the EU, and thus of the PCC, for the second half of 2019 was transferred to Finland; the autumn PCC General Assembly is planned to take place in the city of Helsinki.

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, Building and Community
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	Central Office SA*POS*®

AdV Chairpersons

from-to	Name	Title	Ministry	Land
1948–1958	Kurandt, Friedrich	Dr.-Ing. E. h., Ministerialrat	Hessian Ministry of Finance	HE
1959–1960	Pinkwart, Ernst	Prof. Dr. phil., Ministerialrat	Ministry of the Interior, North Rhine-Westphalia	NW
1960–1971	Nittinger, Johannes	Prof. Dr.-Ing. habil., Dr. Ing. E.h., Ltd. Ministerialrat	Lower Saxonian Ministry of the Interior	NI
1972–1973	v. d. Weiden, Adam	Dr.-Ing. Ministerialdirigent	Ministry of the Interior, Rhineland-Palatinate	RP
1974–1975	Graf, Franz Xaver	Prof. Dr.-Ing. Ministerialdirigent	Bavarian State Ministry of Finance	BY
1976–1977	Grundt, Werner	Leitender Ministerialrat	Ministry of the Interior of Baden-Wuerttemberg	BW
1978–1979	Hübner, Günter	Prof., Senatsdirigent	Senator for building and housing, Berlin	BE
1980–1981	Watermann, Helmut	Leitender Ministerialrat	Ministry of the Interior, North Rhine-Westphalia	NW
1982	Lämmerhirt, Erich	Erster Baudirektor	Free and Hanseatic City of Hamburg -building authority-	HH
1983–1984	Lucht, Harald	Dr.-Ing., Direktor der Kataster- und Vermessungsverwaltung	Free and Hanseatic City of Bremen, Senator for Building and Construction	HB
1985–1988	Schröder, Wulf	Ministerialrat	Hessian Ministry of Science and Technology	HE
1989–1990	Schlehuber, Jürgen	Ministerialrat	Lower Saxonian Ministry of the Interior	NI
1991–1992	Herzfeld, Günter	Ministerialdirigent	Ministry of the Interior and Sports, Mainz	RP
1993–1994	Engelsberger, Max	Dr., Ministerialdirigent	Bavarian State Ministry of Finance	BY
1995–1996	Vetter, Hans	Leitender Ministerialrat	Ministry of Economics, Baden-Wuerttemberg	BW
1997–1998	Graeff, Hagen	Erster Baudirektor	Free and Hanseatic City of Hamburg -building authority-	HH
1999	Rokahr, Friedrich	Leitender Senatsrat	Senate Administration for Urban Development	BE
2000–2001	Tilly, Heinrich	Ministerialrat	Ministry of the Interior, Brandenburg	BB
2002–2003	Vogel, Friedrich Wilhelm	Leitender Ministerialrat	Ministry of the Interior, North Rhine-Westphalia	NW
2004–2005	Klöppel, Reinhard	Ministerialrat	Hessian Ministry of Economy, Transport and Urban and Rural Development	HE
2006–2007	Kummer, Klaus	Prof. Dr.-Ing., Präsident	State Office for Surveying and Geoinformation, Saxony-Anhalt	ST
2008–2009	Stoffel, Hans Gerd	Leitender Ministerialrat	Ministry of the Interior and Sports, Rhineland-Palatinate	RP
2010–2011	Draken, Wolfgang	BVermGeo	Lower Saxonian Ministry of the Interior	NI
2012–2013	Püß, Ulrich	Ministerialrat	Thuringian Ministry for Building, Rural and Urban Development and Transport	TH
2014–2015	Schleyer, Andreas	Ministerialrat	Ministry of Rural Affairs and Consumer Protection, Baden-Wuerttemberg	BW
2016–2017	Luckhardt, Thomas	Leitender Senatsrat	Senate administration for Urban Development and Environment, Dep. III Geoinformation	BE
2018–2019	Liebig, Siegmar	Ministerialrat	Lower Saxonian Ministry of the Interior and Sports	NI

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