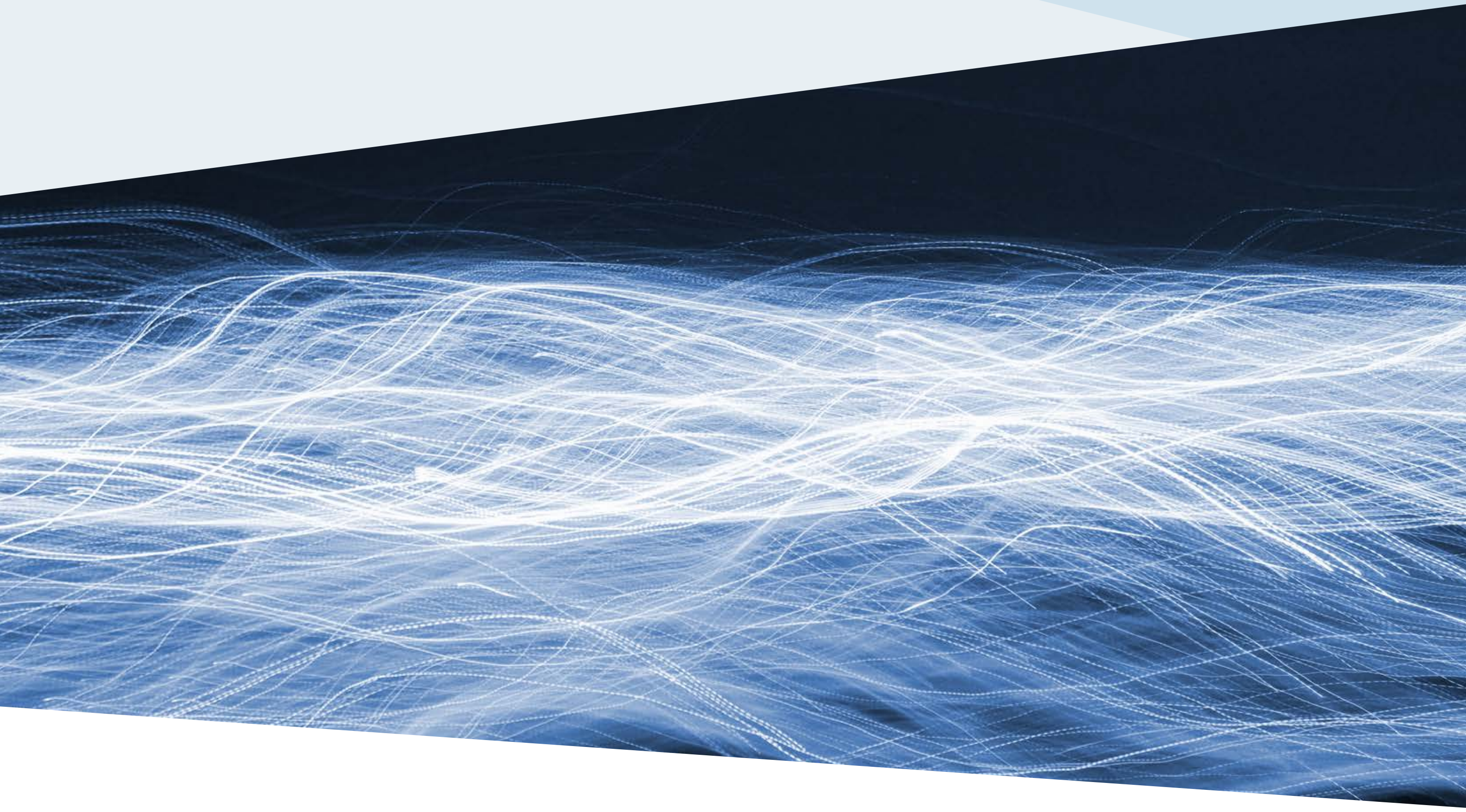
FLYNEX

GEODATA FOR THE DRONE MARKET

PROFESSIONAL GEODATA SOLUTION FOR MAPPING GROUND-BASED STRUCTURES IN LOWER AIRSPACE



SUMMARY

In the age of digitalization and Industry 4.0, data is the key to success. This also applies to the drone business to make complicated legal regulations regarding this tangible. The regulations to be observed all have an apparent spatial reference and can therefore be mapped as geodata. What exactly geodata is and its specific relevance for the UAV market will be discussed at the beginning of this white paper.

The problem being solved here is the procurement, generation, and provision of such geodata. Only then can important insights be gained from the data, and qualified decisions on the feasibility and implementation of drone projects can be made. The multi-layered process, from data acquisition to the complex preparation and processing, up to the provision for customers in form of geoservices will be explained.

The third chapter uses several examples to deal with the diverse, practical applications of geodata in various industries. In perspective to the new EU regulations, the paper concludes with a brief presentation of alternatives for the provision of geodata in addition to the geoservices presented to be able to respond even more flexibly to the needs of different organizations.

CONTENTS

GLOSSARY

GIS	Geoinformation Systems, Geographic Information Systems
OGC	Open Geospatial Consortium
OSM	OpenStreetMap
PNG	Portable Network Graphics
TIFF	Tagged Image File Format
UAS	Unmanned Aerial System
UAV	Unmanned Aerial Vehicle
URL	Uniform Resource Locator
UTM	UAS Traffic Management
WFS	Web Feature Service
WMS	Web Map Service
WMTS	Web Map Tile Service
XML	Extensible Markup Language

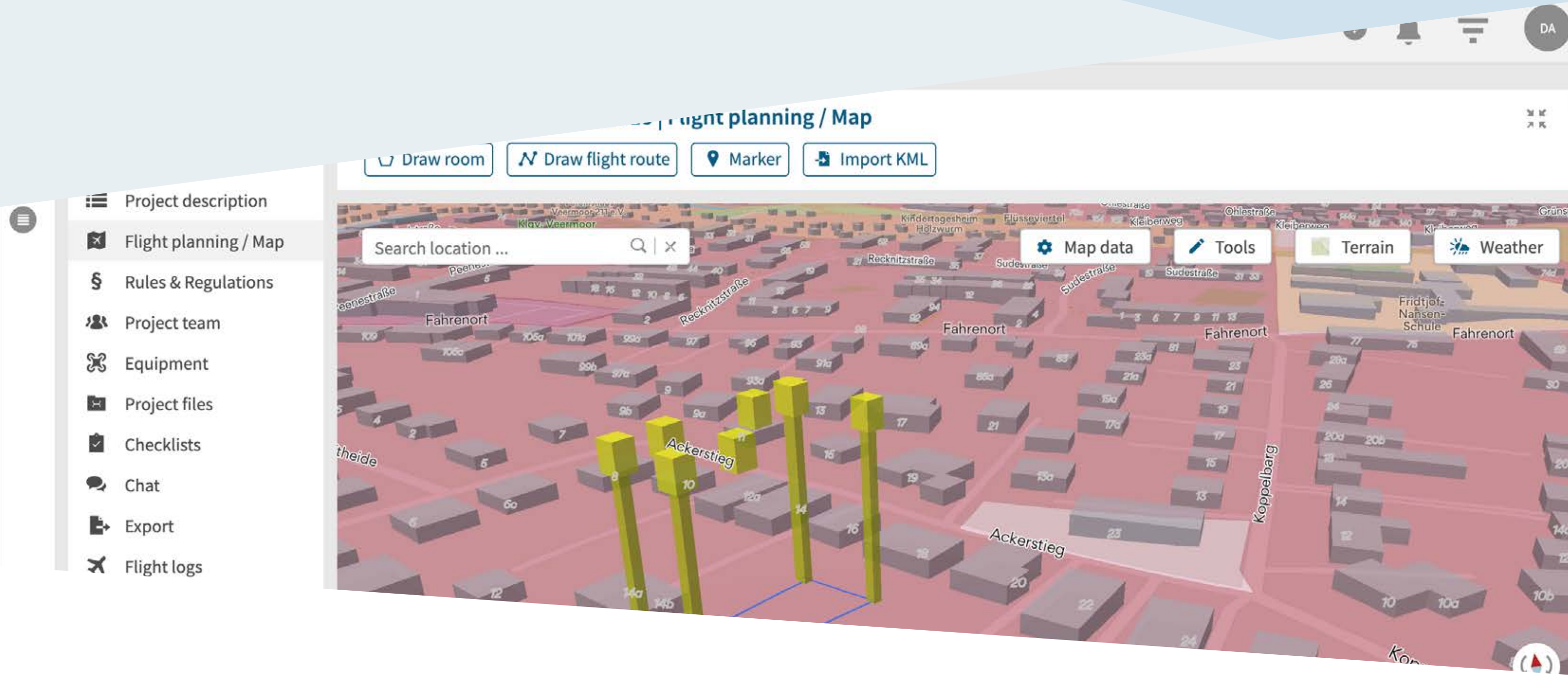
1. INTRODUCTION

The drone market is developing rapidly. For a long time now, UAVs (Unmanned Aerial Vehicles) have been interesting not only for military and hobby pilots. UAV technology has outgrown its niche existence, and the market for commercial and civil UAV applications is developing extremely dynamically. It is no secret that UAS (Unmanned Aerial Systems) will enable and promote revolutionary changes in some sectors of the economy, such as logistics, construction, agriculture, media, and entertainment, or the energy industry. However, the UAV market‘s immense growth potential and, in particular, of UAV-based services may be opposed by legal limitations.

When using UAS, a large number of regulations must be respected. Therefore it must be known which areas are affected by which rules. This condition sounds trivial but means high requirements in any operational step, such as flight planning, approval procedures, navigation, or project management.

Regulations like operating bans are always linked to an area‘s particular extent (or 3D space) in the real world. This information and how the respective spaces can be displayed digitally pose significant challenges for the drone market.

Therefore, the question of “where” is always to be answered not only in the field of UAV applications. This is also the fundamental question of geography and geoinformation. In the digitalization age, data – or more precisely, geodata – are the basis for answering these questions.



2. GEODATA SOLUTIONS

In almost all industries, location-based decisions have to be continuously made. With professional, digital geodata solutions, location-based and spatial tasks in the corporate context, including the drone market, can be performed using the latest technologies.

But what is geodata anyway? What is the source of geodata? How must it be prepared and processed to be made available for innovative geodata solutions? And in what form and for what purposes can this type of data be used in practice? All these questions will be answered in the following sections.

2.1 WHAT IS GEODATA?

Geodata[1] is data with spatial reference. Therefore, the data can be assigned a spatial position in the form of coordinates. This almost always refers to a digital, i. e. computer-readable format of geographical data in today‘s context.

On the one hand, geodata consists of geometry (e. g., a specific area in Germany) expressed by a combination of coordinates. On the other hand, it includes factual information (e. g., this area is a „forest,“ and the name of the forest is „Spreewald.“ Only this accurate information, so-called attributes, make the geometries usable for spatial analyses (e. g., where is the Spreewald in Germany and how large is it?).

[1]ESRI (2016)

INFO | GEODATA AND META DATA

Geodata are data relating to a geographical place or area. It is based on geometry and associated factual information (attributes).

Metadata contain descriptive information on the geodata.

So-called **metadata**[2] is also essential, which can be described as data about data. For example, this descriptive information contains information about the actuality, the creator, or the coordinate system. They are particularly essential to assess whether certain data sets are suitable for a particular question. For example, if you want to know which is currently the largest commercial airport in Germany in terms of area, a ten-year-old data set is not suitable.

Geodata serves as a basis for decision-making in a wide range of areas. The following section explains why they are also relevant to the UAV market.

2.2 RELEVANCE FOR THE UAV MARKET

Since the **drone regulation**[3] of 2017, drone flights in Germany have been subject to many different areas with particular requirements. These include control zones of airfields, industrial plants, constitutional bodies, nature reserves, residential areas, crowds of people, hospitals, or places where police and rescue services operate. However, the requirements described in the regulation are purely textual information. The difficulty lies in making this information available to interested and affected parties. When all these areas have an apparent spatial reference, it is geodata.

[2]Bundesamt für Kartographie und Geodäsie (2017)

[3]BMVI (2017)

Making geodata usable means, first and foremost, making it visible.

If you don‘t know where and how far away the nearest airfield is, you risk violating regulations. Therefore, the drastic increase in the number of drones in Germany often leads to increased cases of abuse due to (unwilling) ignorance of regulated areas.

It raises the question: Where do you get the geodata associated with the text information? Questions about the topicality and quality of this data accompany linking data and related information. Geodata can only ever be a momentary image of the real world. Since the physical world is continually changing, the information is, strictly out of date as soon as it is recorded.

To make valid statements about where areas and objects are located, which have to be considered, the most pertinent data from reliable sources must be identified, extracted, and processed.

2.3 DATA SOURCES FOR GERMANY

One of the first steps in developing your geodata solutions is data acquisition. The topic of geodata and its sources in Germany is a complex one. A distinction must be made between official and non-official geodata. Official data has the advantage that it is valid and reliable at the time of its acquisition and guarantees a high level of uniform acquisition criteria within a data set.

Apart from the sometimes very long update cycles, one of the disadvantages is that in a country like Germany, with its federal system, various authorities collect these data sets. It can result in some geodata being collected in some federal states but not others. Therefore, there are only a few uniformly recorded data sets covering the whole of Germany. In some subject areas, the administrative responsibility for collecting geodata is distributed to the municipal or local authority level, which can also lead to heterogeneity and data gaps.

Data heterogeneity is often an even more significant problem with non-official data. The best-known free, non-official geodata acquisition project is **OpenStreetMap**[4] (OSM). The crowdsourcing method implies that every volunteer worldwide can contribute to the project. It leads to a very flexible geodata collection, which, in contrast to official geodata, is not subject to fixed update cycles. Therefore, real-world changes often become visible in the data more quickly. Another great advantage of such data is its free usability. Although there are specifications to be observed here, there is no need to pay for the data, and it may be used and processed in any way. However, there is no guarantee for the quality and timeliness of the data. Even uniform recording criteria are virtually impossible to implement in such a project.

Validating a data source concerning a specific question is always associated with considerable effort. This applies regardless of whether the source is official or unofficial. As a rule, many secondary sources are required to clarify facts and circumstances unambiguously, identify errors or gaps in data sets, and correct them if necessary.

The quality and, thus, geodata suitability for a specific application can be checked with the help of various **quality features**[5]. Depending on the definition, these include, for example, completeness, topicality, geometric accuracy, factual information accuracy, and the geodata's logical consistency.

Another critical aspect of the use of geodata is the licensing issue. This is about who has what rights to the data and how it may be used. The possible licensing models are manifold. Free geodata offers almost unlimited and often free-of-charge application possibilities. Other geodata can be subject to licenses with specific conditions for use and regulations on usage fees.

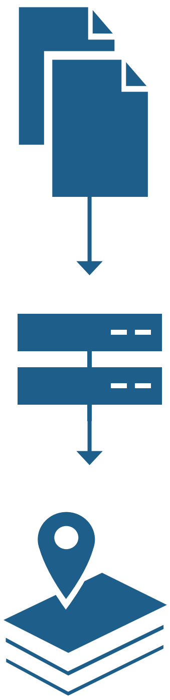
[4]OSM (2018)

[5]GDI-NI (o.D.)

FlyNex uses far more than 180 different data sources. These include both official and non-official data sources, which are used for validation purposes. The pure research of available data is an essential and often tedious task. However, it is only the first of many steps to a professional geodata solution. In the following, we will explain what requirements the data must meet in terms of content and how it must be prepared and processed.

2.4 DATA CONTENT

Which factual content geodata must reflect depends primarily on the question to be answered. Besides the identification of relevant content, however, it is equally important to eliminate redundant content. This applies to selecting the individual object categories and the attributes (s.section 2.1) they contain. Example: If the question is „How much smaller than the Black Forest is the Spreewald?“ the number of animal species living there is irrelevant. Unnecessary attributes can lead to an unnecessarily large amount of data, which is difficult to manage.



Derivation of Data From Texts

In the case of areas affected by drone flight-specific requirements, the required data content is derived from the legally applicable regulations available in text form. A problem described in Section 2.3 is that the associated geodata must be researched, acquired, and merged from many different sources. Also, there is a need to keep this data as up-to-date and valid as possible, which involves a very high administrative effort.

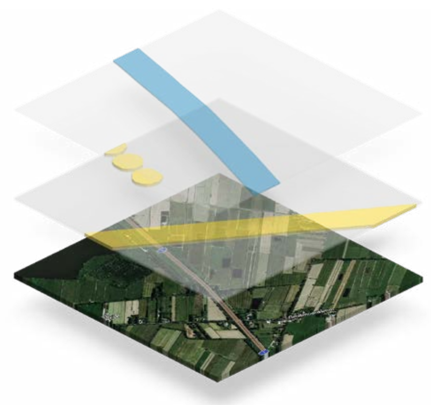
A further challenge is the often necessary interpretation of the texts of regulations. The required geodata is not always explicitly named. The required geodata include, for example, nature reserves, energy facilities, various airspaces such as restricted areas, or settlement and infrastructure data that are explicitly or implicitly relevant according to the regulation.

Explicitly named and therefore needed are, for example, federal highways, which is also a collective term for several types of roads. Implicitly relevant data can be schools, for example. This results indirectly from the prescribed distance to crowds of people. The derivation and integration of data that is not directly named but are nevertheless necessary to answer the question make such a data collection incredibly valuable.

The problem: Neither at authorities nor elsewhere was a data collection available that contained all the required geodata within acceptable quality and prepared for the drone market.

For this reason, FlyNex decided to build up its data stock. Apart from the individual object classes (motorways, nature reserves, restricted areas, railway lines, etc.), this database also includes areas derived from them, including the prescribed distances to them (e. g., 100 m around motorways). Currently, this pervasive database covers all of Germany.

Relevant data is extracted and derived from a continuously growing data collection, which is now more than 50 gigabytes.


Composition of a Map

isometric-perspective-mock-up: GraphicBurger

So-called base maps are not part of these data sets. Such maps serve as background information for the specialist data to be presented.

Depending on the context, this includes the following contents: Water bodies, land areas, streets, buildings, borders, place names, and satellite images. Basemaps can be obtained from various providers, some free of charge and adaptable design, if they are not already available.

After the required contents have been carefully defined and the data acquired, the next step is comprehensive data preparation. The aim is to make the wealth of collected data usable in the first place concerning the subject area of drone flight.

2.5 DATA PREPARATION

Following data acquisition, the available geodata must be prepared for a specific purpose. It has to be realized for the best possible results in a complex, multi-layered process.

The validation of the data (s.section 2.3), which is often very time-consuming, is carried out parallel to filtering according to the required content (s.section 2.4). The challenge is to draw the correct conclusions for data preparation by interpreting the drone flight regulations.

For example, more is needed to know where a wind turbine is located if the geodata does not explicitly indicate its distance. After validating the source data and extracting the relevant content, extensive semantic and geometric changes must be made. For this filtering and modification of the data, among other things, Geoinformation systems **(GIS)** are used.

INFO | GIS

Geographic information systems (GIS) collect, process, analyze, and present geodata (s.section 2.1). The central element in a GIS is the data. With their help, spatial relationships can be recognized and made visible. Users can analyze, modify, and present spatial information in maps through interactive queries. Geometric data are combined with tabular data, the attributes. This results in a useful problem-solving tool.

Data is grouped in a GIS in the form of so-called layers. A layer typically contains an object class, for example, „water bodies." Similar to the principle of partially transparent transparencies on an overhead projector, layers can be overlaid as desired and digitally and interactively brought into logical contexts. Coordinates relate each layer to its real location on earth or relative to the other layers within a GIS.

GIS help to recognize and understand spatial patterns and trends. On this basis, critical decision-making processes can be supported. Spatial analysis possibilities increase the value and usefulness of geoinformation, and it is easy to understand and effective presentation.

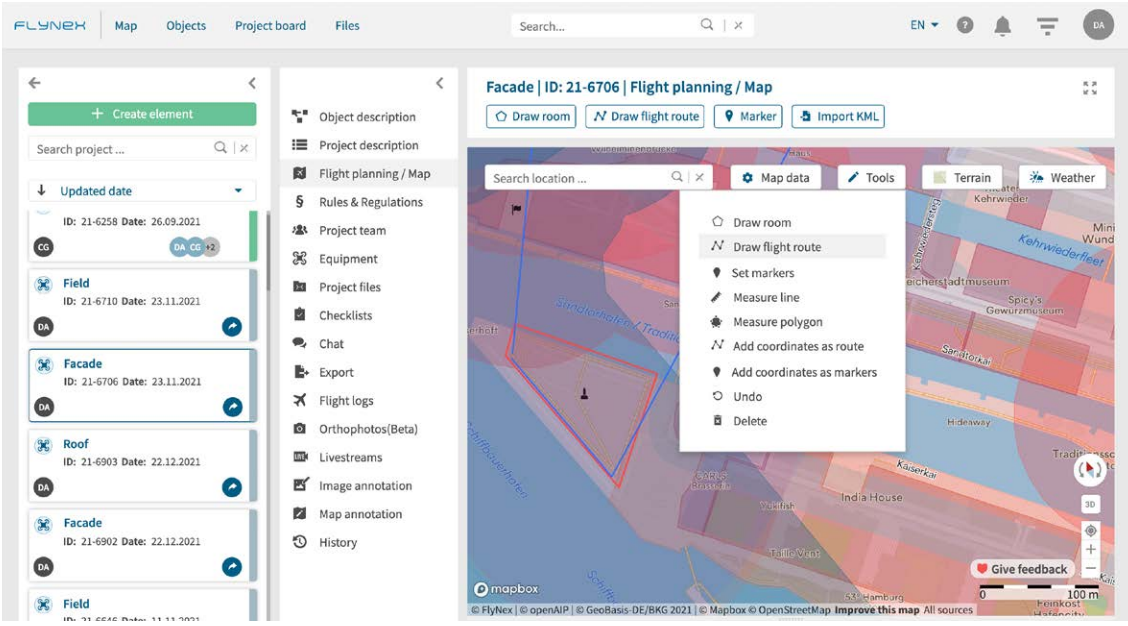
The result of the GIS-supported preparation process is officially validated geodata suitable for answering the respective questions (e. g., Where are airports, and in which areas am I not allowed to use a drone because of their proximity?).

As a result, the preparation process leads to creating entirely new data sets, which did not exist in the form and abundance before.

Another challenge is keeping the prepared data as up-to-date as possible and adapting it according to legal regulations and changes. The former means that the processing must occur theoretically, at least in the cycle of official data collection. However, since such processes can take too long compared to UAV applications' required timeliness, the aim is to review and optimize the data regularly. Since the natural world, the associated geodata, and the legal requirements can change, new data sources must always be checked for their possible future relevance. In the event of changes, it is thus possible to act quickly to integrate unique aspects.

The totality and diversity of data requirements mean a great deal of time and effort and a high level of technical and content know-how to generate the best possible results.

To make the prepared data usable for customers, FlyNex processes it more sophisticatedly.



The GIS of the FlyNex Platform

2.6 DATA PROCESSING

Once the required geodata has been prepared in a targeted manner, it must be made available in a suitable form for your applications. A prerequisite for this is the sensible storage of the data in databases. Besides the actual geometry, which is defined by a combination of coordinates, the attributes (s.section 2.1) are also stored there.

This enables efficient queries of the data based on their position in space. Such fast, precise, and result-oriented queries are crucial for answering questions such as: „What constraints do I have to observe as a drone pilot at my current location? Therefore, it is not enough to know that regulations apply at a particular location. Based on the data and their integration into software systems, it must also be possible to extract their type, number, and extent.

In addition to sufficient storage and retrieval, the visual presentation is also a decisive factor for geodata‘s successful use. A presentation should be interactive and combined with suitable base maps that support the user‘s orientation without distorting the actual statement. Here it has to be decided which information in which type of presentation is helpful and valuable for most users.

In most cases, color-coded overlays in front of a satellite base map are more suitable for a drone pilot and his questions than monochrome, indistinguishable overlays in front of a brightly colored background map, distracting from the actual data.

The elaborately collected and processed (s. section 2.1 and 2.5) geodata, combined with their targeted storage in queryable databases and presentation in interactive web applications or GIS systems (s.section 2.5), enable a wide variety of spatial analyses. This benefit is not limited to the context of drone applications.

You must evaluate external data provision possibilities to provide valuable and useful data and make it usable by a customer's existing application or system. Disks or hard drives are useless because of a very high data volume, which occurs and prolonged update cycles, and complicated and slow transmission of large files.

Data provision must be carried out so that customers can integrate professional and future-oriented geodata solutions into their own systems.

2.7 PROVISION OF GEODATA

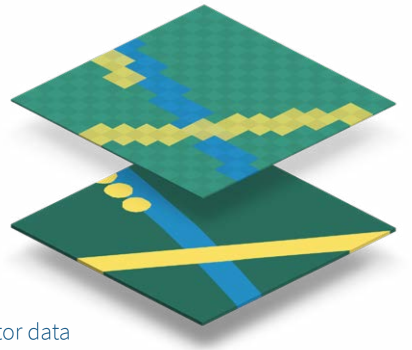
Data, in general, and geodata, in particular, can be made available in various ways. There is a high demand for a professional solution, especially regarding update possibilities and interoperability. The latter means that the data must be transmitted to allow for uncomplicated use and further processing across system boundaries.

To meet both requirements in the best possible way, it is advisable to provide the geodata in a standardized format within a client-server structure. Standards in this area are developed by the internationally active **Open Geospatial Consortium** (OGC)[6].

This non-profit organization has been working since 1994 on freely available standards and specifications to improve the distribution of geodata worldwide.

[6]The Open Geospatial Consortium

Even though the data formats‘ standards are freely usable for everyone, geodata is often subject to complex licensing models. Under certain conditions, specific user rights are given to a user or group of users. These licenses must be formulated clearly and without contradiction so that data can be used effectively while respecting providers‘ and users‘ rights and obligations.



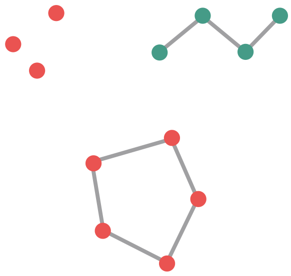
isometric-perspective-mock-up: GraphicBurger

The standards of the OGC, which are also applied in the FlyNex Platform, are so-called geo-services, which are discussed in more detail in the following section. A distinction is made between display and download services. To understand them, background knowledge about geodata‘s fundamental distinction in raster and vector data is necessary.

In its simplest form, raster data consist of individual, equally sized, square picture elements, which are evenly arranged in rows and columns. A single picture element is called a pixel. Each pixel contains a specific value that represents factual information. In the context of geoinformation, the pixels are located in relation to their actual position in space via coordinates.

The image of a map is created by assigning a color to the contained information values. Such information is measured temperature values or altitude data, for example. The color value itself can also be the included information. This is the case with satellite images, for example.

Raster data are particularly suitable for the representation of phenomena that are continuously distributed in space. This applies, for example, to pollutant loads. Vector data consist of geometric combinations of pairs of coordinates (x, y), each of which results in a (supporting) point. Such points can already represent a geo object in a GIS. Several support points, which are connected in a specific order, result in line objects.



Primitives of Vector Graphics

Polygons can be created from closed lines. Points, lines, and polygons are the three basic primitives with which real-world objects can be represented. In contrast to raster data, the clarity of vector objects' representation does not depend on the zoom level.

Geoservices[7] also transmit data in either vector or raster format. It only plays a minor role in which of these types the data is stored initially. Vector data can also be transmitted in the form of map images as raster data. Which data format is required depends on the intended use. What geoservices are and how data transmission is realized will be explained in the following.

2.8 WHAT ARE GEOSERVICES?

INFO | GEOSERVICES

Geoservices, also known as OGC web services or geodata services, are standardized web services with which geodata can be made interoperably accessible via the Internet. The client-server model is applied here.

The data is often stored in a local database and made available via a server, e. g., a **geo server**[8]. The service can then be accessed via an Internet address (URL). To do this, a user requests the service with a client, specifying various parameters, and can subsequently receive the data.

The required parameters can be the desired operation, the service version, the map section, the desired data format, the layer to be queried, or the required coordinate system. Interfaces for geoservices can be browsers, special web applications, or locally installed GIS.

[7]GDI-DE(2015)

[8]Geoserver(2014)

A simple subdivision of geoservices can be made into display and download services.

Provision of geodata using geoservices

With visualization services, geodata is transmitted in the form of georeferenced images. The best-known OGC-compliant geoservice for this is the so-called Web Map Service (WMS). The geodata, which can be in vector or raster formats, is converted into a raster image format, such as TIFF or PNG, and made available georeferenced. Suppose these images are displayed via an interface with a graphical user interface, e. g., in a geoportal or GIS. In that case, often, no detailed knowledge of the technical functioning of the service is required. Nevertheless, the basic operations of the WMS standard are presented here for a better understanding.

INFO | WMS AND WFS

WMS is a web service that provides geodata in form of raster images. **WFS** is a web service that provides geodata in vector format.

Usually, the client makes a GetCapabilities request to the service first. In response, the service delivers an XML document in which necessary metadata about the service is transferred.

This contains information about the available geodata, the publisher, the output formats, or the available coordinate systems, among other things. The client requests the actual map data using the GetMap operation. Various parameters must be defined in this request so that the server can supply the required data in the desired manner. These can include the map section, the coordinate system, the image format, the image size, or the required layers. Besides, attributes for individual objects in the geodata can be queried with the GetFeatureInfo operation.

This standard is a variation of the Web Map Tile Service (WMTS). Here, the image data is transferred in the form of precalculated tiles. Since these tiles are already prepared and stored on the server, retrieving the data is faster than a WMS. However, the tiles assembled into so-called tile sets must be individually calculated for each scale level and coordinate system. In contrast to the WMS, spontaneous transformations of the coordinates into other coordinate systems are impossible. This would require a new image data set to be calculated on the server.

In contrast to WMS or WMTS, the Web Feature Service (WFS) is a download service. In contrast to display services, the actual geo-objects are transmitted with it. This means that the objects are not just mapped images but object geometries with associated attributes. The output for a WFS is, therefore, always vector data.

In addition to pure visualization based on the data, the client can perform spatial queries and analyses. But, the user of a WFS can not only view the geodata but also process it. In the simplest case, a WFS also has three basic operations. The GetCapabilites query works similarly to a WMS. The DescribeFeatureType operation provides information about the structure and properties of the vector data in an XML document. Based on a GetFeature request to the server, the client receives the actual geo objects with their attributes.

In summary, this means: while a WMS transmits geodata as static map images, the data itself can be accessed via WFS.

Whether the latter is necessary depends on the respective application. There are other types of geoservices. In the context of the pure transmission of geodata, WMS/WMTS and WFS are the most important ones, which is why we will limit ourselves to their presentation here. In this chapter, the technical basics of geoservices have been explained briefly. The question arises of how the use of such services can look like in practice, and which advantages it offers.

2.9 ADVANTAGES OF GEOSERVICES

Decisive advantages accompany web services compared to the data transmission on physical data carriers or the provision through downloads.

- Maintenance, data maintenance, and updates can run entirely in the background. It makes data transfer exceptionally fast and flexible.
- Because international standards are used, the geodata can be integrated into your systems quickly and interoperably.
- The provision of the data via its own geoservers enables the data to be offered in various coordinate systems. Error-prone and often tedious transformations are thus eliminated.
- Since the often very large geodatabases are connected using a client-server structure, hardly any storage space is required.
- Thanks to professional role and rights systems, data access can be individually adapted for each customer. Both the number of accesses to the service and the release of specific subsets of the data can be set up customer-specific. Thus, only what is needed is made available.
- It is possible to react flexibly to legal regulations changes and the associated adjustments in the data situation without additional customer expense.
- Users of a geoservice always have technical contacts and the possibility of continuous support.

With geoservices, geodata can be transferred quickly and in a highly flexible manner. In the form of a simple URL and individual login data, users receive specially adapted access to the required data in the desired way. The following section shows the use of such geodata in practice and what it can contribute.

3. GEODATA IN ACTION

The previous chapter deals with the complex process of developing geodata solutions. From data acquisition to geodata provision, technical and content aspects are explained in detail. Data prepared, especially in drone deployment, enables customers to access information that has yet to exist in this form before. This allows the creation and improvement of business activities using the latest technologies. Existing (GIS) applications, services, and processes can be enriched, and new ones can be created. The provision is made with the long-term goal of creating a functional airspace infrastructure for all.

The possible applications of geodata are manifold. There are virtually no limits to its usability for a wide range of applications, even beyond the drone business. New tools and products can be created based on geodata or derived knowledge. The processed data can be used as additional information for the presentation of own data. However, geoinformation can also be used to conduct your analyses to answer spatial questions.

Examples from the set of possible use cases for the utilization of the presented geodata are:

- The integration into existing geoinformation systems in the energy sector
- The integration into operational software for drone management systems
- The development of navigation software for Urban Air Mobility and air cabs
- Creating a coherent and valid information base for UTM service providers

3.1 GEOGRAPHIC INFORMATION SYSTEMS IN THE ENERGY SECTOR

Energy companies work daily with geoinformation systems. The systems guarantee the security of supply and meet the requirements of the German Energy Industry Act. Therefore, they form the basis for managing the infrastructure to be operated. These systems map the network topology and control the maintenance and service cycles. For network documentation, GIS is an integral part of daily work. Using unmanned aerial systems allows network documentation to be effectively improved and costs reduced. The operation, maintenance, and repair can be supported quickly and reliably by the data consistency of drones. Uniform information management in the GIS is the key to cost-efficient procedures: the systems still need to be designed to operate unmanned aerial vehicles. Network and construction planning also benefit from the use of this technology. They do not include the relevant airspace information generated by the network infrastructure.

To extend GIS for the use of drones, the geoinformation services of FlyNex can be easily integrated. Based on the already maintained systems, information is extended to the airspace below 150 m. The objects, conditions, and areas are immediately displayed. The use of unmanned aerial systems is supported thereby without media break. Established working methods and processes in the company do not have to be changed. Integrating geoinformation into the network infrastructure‘s airspace structures enables network operators and energy companies to manage unmanned aerial systems.

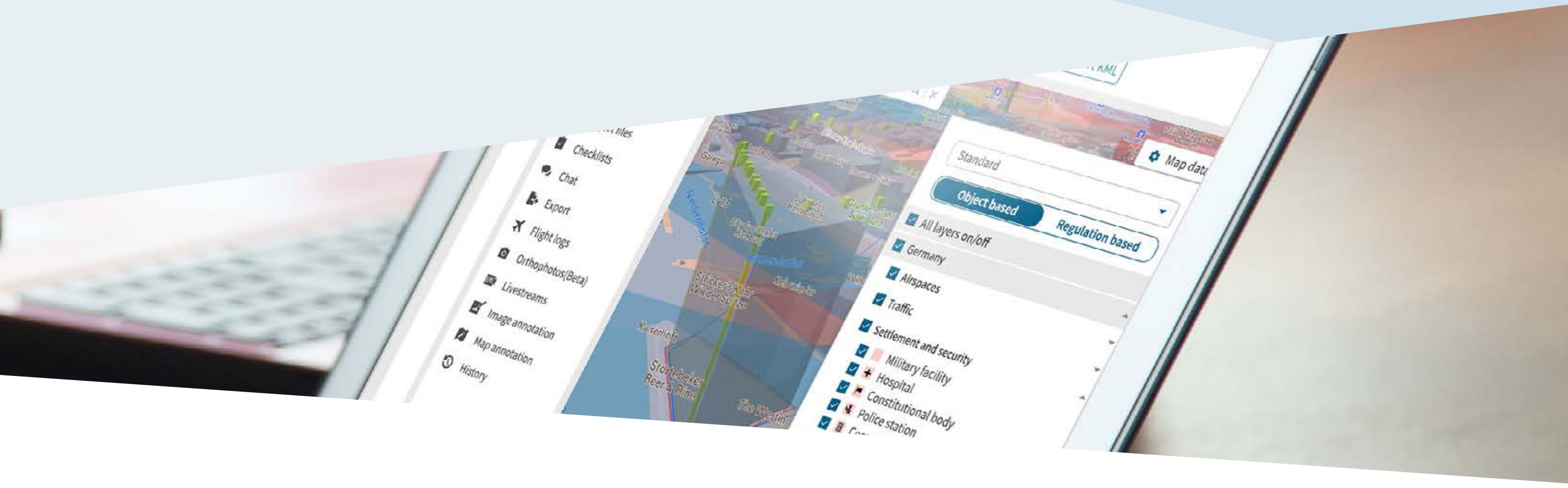
3.2 OPERATIONAL SOFTWARE FOR UAV MANAGEMENT SYSTEMS

Drone deployment and flights are ground-based operations. More than 90 % of the data generation applications are located at ground level below 150 m. Operators of unmanned aerial systems are subject to a large number of regulations. A large amount of information must be obtained for flight planning. Existing regulations and bans must be reviewed. Local conditions and the conditions of the infrastructure for collision avoidance must also be taken into account. This is especially true when drones are to be operated semi-automatically and permanently in a certain area.

Flights out of visual range (BVLOS) are of additional importance. Here, accurate airspace maps are indispensable and legally required. It is why large companies are increasingly relying on the installation of drone management systems to plan and coordinate ascents and flights. FlyNex's geoinformation services can directly connect the necessary interfaces and map modules. Thus the relevant geoinformation can be displayed. Own flight planning tools can be developed and automated on this basis. Therefore, controllers are provided with an easy-to-use interface, including all necessary information and requirements that make the safe operation of the systems controllable.

3.3 NAVIGATION SOFTWARE

Valid geodata is essential to enable the operation of delivery drones or flight cabs and implement Urban Air Mobility concepts in urban areas. With the geoinformation services of FlyNex, an awareness for geodata is created, and geo-guiding or routing solutions are also enabled.



Based on the comprehensive information navigational software can be realized in airspace below 150 m. It is the only way to enable unmanned aerial systems and flight cabs to fly automatically from A to B. Based on geoinformation, routing algorithms can be mapped in three-dimensional spaces that take relevant objects and constraints into account. Thus, 4D trajectories can be derived from the routing, which maps the planned flight routes. Both the existing infrastructure and the resulting airspaces are objects that significantly influence the flight route. The geoinformation serves as the basis for object-based, scalable navigation algorithms for different aircraft in the lower airspaces.

3.4 GEODATA FOR UTM SERVICE PROVIDERS

In particular, UTM service providers depend on the processing of valid geodata. This data forms the basis for a uniform information situation of the resulting rooms, including airspace requirements under 150 m. Various UTM services can be built upon this data.

The uniform situation picture based on official and valid geodata includes newly created objects that are legally mandatory. 97 % of the requirements result from ground-based infrastructure. With the associated meta-information, the relevant geoinformation can be mapped.

Flight planning, strategic conflict-avoidance, and geofencing become possible. The airspace maps, which are used as an interface for the UTM service, must map the functional system‘s airspace structures. With the integration of the geoinformation services of FlyNex, this is guaranteed quickly and reasonably.

The simple data connection with automatic updates creates a uniform situation picture of the airspace structure through relevant, processed, and valid geodata.

4. CONCLUSION

Valid and detailed geodata is not only essential for the UAV market. On their basis, important political and economic decisions have to be made in various areas. Collecting information is not enough. Geodata must be validated, referenced, classified, attributed, stored, and maintained with the necessary technical and content know-how. Only then can they be made available in a professional and up-to-date manner so that a wide variety of actors can access them. The customer can access the data quickly and easily using a simple URL.

Only in this way is it possible for various industries to benefit from the data and gain new insights. The focus of every geodata solution is the data itself. The data quality plays a decisive role, depending on the problem and application. Geodata products always reflect the accuracy of the collection of source data. To minimize inaccuracies and deficiencies in data acquisition, very precise and complex processing is necessary.

For the UAV sector, and especially for the development of UTM applications, generally valid, uniform, and accurate data is therefore required. Norms and international standards could also contribute to this in regard to the collection and processing of geodata. The presented development of a customizable geodata solution by FlyNex shows how complex such processes are.

As a result, geodata can be transferred quickly and flexibly. Thus, direct answers to questions regarding the feasibility of drone flights can be provided throughout Germany. However, its application field can also be extended to include spatial analyses for a wide range of industries. Such geoinformation services can be integrated sustainably and effectively within logistics, construction, agriculture, the media, the entertainment sector, or the energy industry.

5. OUTLOOK

As a result of the new EU Regulation on establishing standard rules in the field of civil aviation and aviation safety (2018/1139), in the future, it will be necessary for airspace structures to be designed appropriately, measured, and validated. With this information's help, ensuring safe operation and compliance with specified distances will be mandatory. An unmanned aerial vehicle operator must ensure the aircraft has the necessary navigation, communication, surveillance, detection, and evasion equipment. The type of operation and the air traffic rules and regulations to be considered for the respective flight phase are decisive for the required equipment.

FlyNex offers a way of geodata provisioning that makes geodata available in a professional manner and with up-to-date technology. In the sense of the EU regulation, FlyNex provides the crucial components to ensure safe operations in the future and creates a uniform geodata layer that maps the airspace structure.

To offer even more flexible options to even more customers for their specific needs, an API (Application Programming Interface) and the installation of dedicated servers provide alternatives to the geoservices presented. With the API, spatially limited requests can also be made on-demand without keeping the data in-house. This allows the integration of geodata functions into your own applications. With a dedicated server, the geodata can be integrated into internal organizational and IT infrastructures. This makes it possible to process and hold the data within the organization to feed its own systems. Data sovereignty can thus be guaranteed. Large organizations, in particular, can use it to implement a variety of services and applications.

CONTACT US,

if you would like to learn more about our geoinformation services, or have questions about the FlyNex Platform

(by mail: info@flynex.de oder by phone: **+49 (0) 341 331 760**).

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FlyNex, based in **Leipzig, Hamburg, Rotenburg** and **San Francisco,** is the leading software solution for commercial drone projects. Through its cloud platform, FlyNex covers the full range of commercial applications for data collection by unmanned aerial systems.

Its solution enables companies and organizations to digitally capture thousands of assets, facilities, and buildings using drones. The complete integration of drones and Artificial Intelligence helps companies not only to collect data but also to analyze it automatically.

FlyNex is successfully used as a drone and data management solution by renowned companies and technology leaders in the construction, real estate, energy, and telecommunications sectors. In addition, FlyNex is involved in innovation projects across Europe for the successful integration of drones, e.g., for medical transport, intelligent air traffic management, or air cab navigation.

More info at: https://www.flynex.io/

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