

# National Geospatial Strategy Related to Natural Hazards and Disasters

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**Key words:** geospatial strategy, natural hazards, area management

## **SUMMARY**

In my paper I will shortly present the National geospatial strategy towards 2025, with its targets, actions, challenges, and measures. [Link to the strategy](#). The strategy was decided by the Norwegian Government first of November 2018. The strategy is based on that "everything happens somewhere" and it shows the direction of the work ahead.

Geospatial information is required to meet social challenges, such as climate change, environmental challenges, transport, resource management, emergency planning and urbanisation. Geospatial information is also part of many commercial offerings and is an integral part of the digital services we all use in everyday life. New threats and vulnerabilities arise. The requirements for good emergency planning for serious incidents are increasing, and the ability to handle crisis situations is becoming increasingly important. Updated geospatial information and tools are of great value for preparedness, resilience and recovery regarded natural hazard and disasters. It is also important for the assessment of threat situations and the ability to act quickly and appropriately. In my presentation I will also give some examples of important data and use of data in detecting and management of natural disasters.

## **SUMMARY in French**

Dans mon article, je présenterai brièvement la Stratégie géospatiale nationale à l'horizon 2025, avec ses objectifs, ses actions, ses défis et ses mesures. [Lien vers la stratégie](#). La stratégie a été décidée par le gouvernement norvégien le premier novembre 2018. La stratégie est basée sur le fait que "tout se passe quelque part" et indique la direction du travail à venir.

Des informations géospatiales sont nécessaires pour relever les défis sociaux, tels que le changement climatique, les défis environnementaux, les transports, la gestion des ressources, la planification d'urgence et l'urbanisation. Les informations géospatiales font également partie de nombreuses offres commerciales et font partie intégrante des services numériques que nous utilisons tous dans la vie de tous les jours. De nouvelles menaces et vulnérabilités apparaissent. La mise à jour des informations géospatiales est un outil important pour l'évaluation des situations de menace et la capacité d'agir rapidement et de manière appropriée. Dans ma présentation, je donnerai également quelques exemples de données importantes et d'utilisation des données dans la détection et la gestion des catastrophes naturelles.

# National Geospatial Strategy Related to Natural Hazards and Disasters

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## 1. NATIONAL GEOSPATIAL STRATEGY

### 1.1 Overall vision and objectives

Norway has an extensive and advanced foundation for access to geospatial information. This is our geospatial data infrastructure. It covers many needs in society and consists of various shared solutions for the management, distribution and use of geospatial information. This infrastructure has been developed to a great extent through the agreement-based administrative cooperation Norway Digital.

With this strategy, the Government will continue to develop the infrastructure. The strategy is based on the fact that “everything happens somewhere”, and it shows the direction of the work ahead. The strategy complements Report no. 27 to the Parliament (2015–2016), Digital Agenda for Norway – ICT for Simpler Everyday Life and Increased Productivity. This strategy essentially builds on a draft from the Coordination Group for Geospatial Information and the National Geodata Council. The strategy addresses the sectoral authorities at various administrative levels, data producers, technology providers, innovators and users in all sectors – and the Norwegian Mapping Authority as the national geospatial coordinator. The responsibility for implementing measures in the strategy’s action plan will essentially lie with the public sector in accordance with the Act on an infrastructure for geospatial information (the Spatial Data Act).

The vision is: *Norway shall be at the forefront in the use of geospatial information.*

The Government will work for

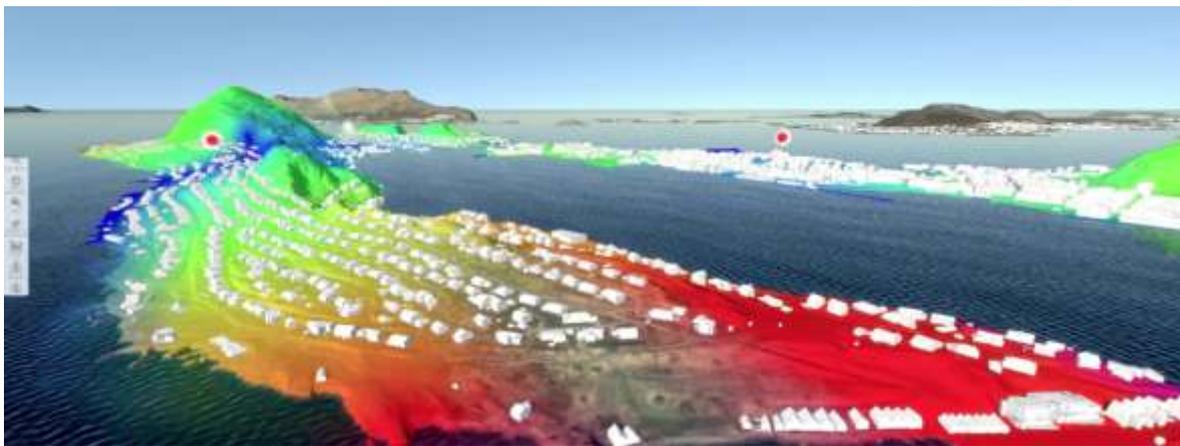
- A national knowledge base of geospatial information that meets important societal needs
- Shared solutions and technology that support effective problem solving and enable new application opportunities in society
- Well-functioning interaction with respect to management, sharing, development and innovation between both public and private actors
- Framework conditions that are predictable and well suited to the challenges of digital society

The strategy aims at an efficient flow of data between sectors and levels, streamlining data capture to the infrastructure, shared solutions for management and utilization of big data technology to acquire greater knowledge. The cooperation must meet the new demands and there must be appropriate arenas for public-private cooperation. The objectives focus on improvements of the basic knowledge foundation, of the technical infrastructure, of

cooperation models, of the framework and of the financing. To follow up the strategy there is set up an action plan with about 50 projects that involve several ministries and directorates and some private actors. Good interaction will be a success factor for this strategy.

## 1.2 Trends

We live in a digital era, where we rely on geospatial information every single day. Both professionals and private individuals use geospatial information to visualise physical phenomena and events and increase the value of other information. Geospatial information is required to meet social challenges, such as climate change, environmental challenges, transport, resource management, emergency planning and urbanisation. Geospatial information is also part of many commercial offerings and is an integral part of the digital services we all use in everyday life. The creation of value based on geospatial information is significant, but there is still a great unused potential here. The needs and demand change over time. The development of technology will offer new opportunities and applications such as digital twins, here from the city Aalesund developed by Offshore Simulator Centre AS.



The increased digitalisation in many areas of society provides new opportunities for collation, analysis and knowledge production – not to mention sharing, collaboration and interaction between actors. In the private sector, geospatial information provides opportunities for more efficient operation, digital innovation, and business development. Software solutions and services based on geospatial information represent a significant export potential for our knowledge-based industries. Global technology and content companies have at the same time become major actors in the field, offering many location-based services to the public. The United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) emphasises the importance of a good geospatial knowledge base, in order to achieve sustainable development goals. The United Nations has established guidelines on how the member states should develop geospatial information, including management solutions and infrastructures. The current Norwegian strategy agrees essentially with the United Nations initiative in this area.

### 1.3 Digital geospatial infrastructure

Norway already has a digital geospatial infrastructure. It consists of large amounts of data, collected by many actors from various sectors over a long period of time, and of tools, shared solutions, directory services, agreements and routines that have been established to manage, locate, distribute and use geospatial information efficiently. However, there is still a way to go before the infrastructure can be said to meet the needs of all the important areas of society. The amount of digital information in society is growing. Geospatial information is no exception.

Several actors in society use a great deal of resources to collect, maintain and analyse geospatial information. Municipal and central government mapping and surveying activities amount to more than NOK 2 billion. The private geomatics industry reported revenues of more than NOK 2.4 billion around the year 2000. Companies that are primarily aimed at special types of mapping, for example, geological and geophysical mapping, are not included in this number. Members of the trade association for geomatics companies reported revenues of NOK 5.0 billion in 2017, but this number also includes services outside the geomatics area.

The Norwegian geospatial data infrastructure shall observe the principles that are inherent to work on the geospatial data infrastructure in the EU, including, for example, that data shall only be collected once, that it shall be stored where it can be the most effective, and that it shall be possible to combine the data seamlessly between different application areas. This will simplify the reporting for the national, European and global needs.

A large part of the geospatial information is collected by public actors. A lot of information is also created in the private sector on assignments for the public sector, through commercial activity or the behaviour of consumers. The rapid digitalisation of society and a growing demand brings up the question of how the collection, management, distribution and collation of geospatial information should be organised. In some areas, data from the public (crowdsourcing) emerges as an important source of data.

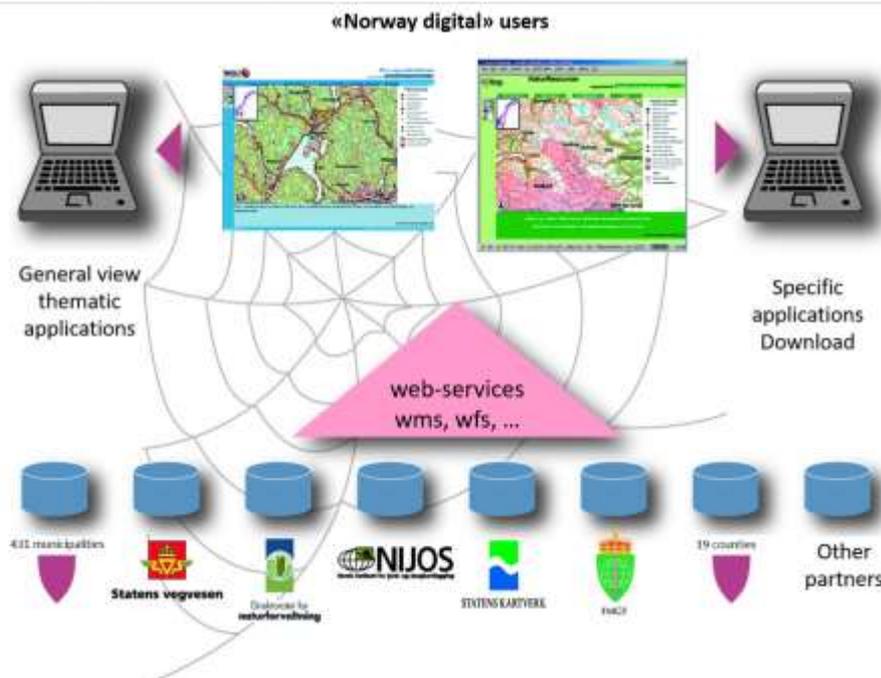
The requirements in and pursuant to the Spatial Data Act govern access to data in the geospatial data infrastructure. This applies, for example, to the requirements for documentation and open electronic access. Other laws and regulations also set out requirements for open data, such as the Freedom of Information Act and Environmental Information Act. The Ministry of Local Government and Modernisation's guidelines for the disclosure of public data apply to data in the geospatial data infrastructure. This implies essentially that the data is free and freely available for reuse. There are some exceptions, including the most detailed geospatial data (Joint Geospatial Database, "FKB") and precise position data, for example. The focus on open public data and reuse is about giving trade and industry, researchers and civil society access to data from the public sector in a way that allows the data to be used in new contexts.

There are three main reasons why access to open public data is important to society:

- Streamlining and innovation: When data is shared between enterprises, we obtain better interaction, more rational service development and better public services
- Business development: Trade and industry are given the opportunity to develop new services, products and business models based on access to public information
- An open and democratic society: Access to the basis for making decisions and priorities in the public sector provides a better opportunity for obtaining insight into how decisions are followed up and what the impact of political actions is

### 1.3.1 Public partnership

The central government and municipalities collect and manage geospatial information that represents the foundation of our national knowledge base. The information is used in various administrative procedures, but it is also included as part of various public services. Moreover, this information is the basis for the creation of value in trade and industry and benefits us all. The municipalities are important contributors to, premise providers for and users of the knowledge base. They establish, develop, partially finance, and maintain detailed geospatial data. The municipalities' administrative data capture covers most of the man-made changes to the physical environment. The Norwegian Public Base of Geospatial Data (DOK) is used to make decisions, approve applications, prepare and process plans in accordance with the Planning and Building Act and to develop local communities.



There is well-functioning cooperation for the coordinated establishment, management, and maintenance of detailed data through cooperative structures such as Geovekst and the National Programme for Aerial Photography. In the area of marine mapping, the Mareano

Programme and Marine Coastal Mapping are corresponding examples. Cooperation is both socio-economically sensible and necessary. In addition, several international programmes in environmental and resource monitoring also contribute a large amount of new data. It is expected that international joint initiatives will be of greater importance in the future. Copernicus, Europe's major satellite and sensor-based programme for environmental monitoring, climate and civil protection, provides us with data on land use, vegetation changes, water quality, weather conditions, air quality, pollution and greenhouse gases. This concerns large amounts of data that are now available and must be utilised in a good way, which entails new major requirements for the infrastructure for geospatial information.

### 1.3.2 External data sources

Colleges, universities, research institutions and national and international R&D programmes create data that will be valuable to decision-making processes and for the creation of value. In general, this information is currently not very accessible for reuse. It must be possible to link the geospatial data infrastructure to research data to a greater degree. Geo-referenced research data could thus become part of our common knowledge base, and the geospatial data infrastructure could support research more efficiently in accordance with the national strategy for the disclosure and sharing of research data. This goes both ways: The geospatial data infrastructure shall be suitable as a source of data for research, and for the archiving and disclosure of geospatial related research data.

Private actors contribute to the production of data through development plans, licence applications, impact assessments, environmental assessments or other statutory interaction with central government agencies or municipalities. This data must also become an integral part of our overall knowledge base to a greater extent. Private companies also establish databases for various special purposes, which may encompass general maps of roads, topographies, etc. Examples of major global actors who have done this include Google, Apple and the map service Here. These actors do not just use detailed basic maps and aerial images, they also use three-dimensional terrain models and various types of thematic information.

Organisations, the voluntary sector and the general public also contribute to the production of geo-referenced data, through online voluntary work and interaction with the public sector. The infrastructure shall facilitate the utilisation of these contributions in the infrastructure, as well as innovation.

### 1.3.3 Users' needs and access to data

The needs of the users and adaptation for a digital first choice must be key to the development of the national infrastructure. Authoritative and prioritised data shall be structured, documented and offered in accordance with the expectations and user requirements, including international requirements. Data that is included in the national infrastructure, but is not necessarily defined as part of the prioritised "core data", shall also be adapted for use by the fulfilment of certain requirements (formats, metadata, quality labelling, etc.). Such data may have completely different qualities or coverage. Some data may be adapted to the simple

needs of specific user groups, while other data may be used by more groups and subject to greater requirements. The infrastructure shall offer three-dimensional data, dynamic data, historical data and processed information. Broad utilisation of new technologies shall also be facilitated, which also can make the utilisation of big data possible. There shall be a complete overview of geospatial information, including the properties and related services in the map directory [www.geonorge.no](http://www.geonorge.no).

A good geospatial knowledge base is essential for well-functioning cities and local communities. The building industry is a billion kroner industry that can achieve greater predictability, better engineering support and more efficient interaction with the municipalities through integrated use of geospatial information. In some areas, new needs arise for data other than what has traditionally been used. In other areas, data with an even higher degree of detail may be required to solve the tasks or realise the services. Society needs good, up-to-date data in private and public activities, within all the specialist areas and sectors. Data must be available in ways that meet the needs. The data must have known coverage and a quality adapted to the needs of the various actors, so that it can support their specific applications and be part of the relevant decision-making processes.

#### 1.3.4 Technology and tools

Good tools, methods and a well-functioning technical infrastructure must be in place in order to convert data to information and knowledge for practical use.

The infrastructure must be further developed. The use of standards is key to the infrastructure. National standards for geospatial information have long been in widespread use. The national standardisation efforts must be developed in accordance with new societal needs, the development of new technologies and new international standards. Standards, harmonised data formats and concepts, for example, are prerequisites for international cooperation, research and problem solving across sectors and national borders.

Integration between infrastructures, data and services is becoming increasingly important. Geospatial information is currently integrated to varying degrees with the available IT solutions. The lack of suitable user applications is one of our challenges. Global actors now offer a growing number of services and information in the “cloud”, which helps increase availability and can lower the user threshold. New user platforms and mobile devices, however, will entail new requirements for standards and user-oriented services in the infrastructure. Geospatial information from the national infrastructure needs to be better integrated in the work processes and user tools that are used. The infrastructure and shared solutions must interact with commercial software, while the technology is at the same time adapted so that it is independent of the platform. The infrastructure shall facilitate fully digital and efficient processes, as well as service innovation and good utilisation of the knowledge base. As a platform for access to all geospatial information, Geonorge.no will be a source of innovative applications for the data content. It must be possible to integrate geospatial

information with other infrastructures and with commercial software, and to handle new data capture methods and new types of data.



Geospatial information systems do not automatically interact with the municipal administrative processing and archiving systems. The administrative processing and archiving systems are not automatically able to utilise information on geospatial conditions either. The Norwegian Mapping Authority and the Norwegian Association of Local & Regional Authorities (KS) are cooperating on developing and maintaining common standards and principles of this type for interaction between geospatial information systems, other professional systems and administrative processing and archiving systems. This applies in particular to integration with the land register (cadastre) and systems that the municipalities use for building applications and land-use planning. The standards have been developed and tested in broad cooperation between the municipalities, suppliers and central government agencies.

Geospatial information will concern more and more actors and must be seen in a broader perspective than in the past. To develop content and technology for the benefit of the public sector, trade, industry and society as a whole, there is a need for greater cooperation between all actors than has previously been achieved.

#### **1.4 Framework conditions**

Development of the geospatial data infrastructure is part of the Government's efforts to digitalise and streamline the public sector. Collecting and managing data is often associated with high costs. This means that as much as possible must be gained from the combined efforts through cooperation. Central government agencies have a self-defined need for specific data within their areas of responsibility and manage their own investments

accordingly. The municipalities establish data to exercise their role as a service provider and exerciser of authority, for example in the form of municipal master plans, detailed technical maps.

The financing of the infrastructure is partly through ordinary appropriations, government charges for acts by public authorities and revenue from the sale of data. In addition, various forms of co-financing by the participants in the infrastructure play a large role, through structures such as Geovekst and Norway Digital, for example. A new elevation data model is a recent example of broad co-financing from several sectors. These agreement-based co-financing schemes have been effective because it has contributed to the ownership of needs, and that they have distributed the risk among several actors. However, it is a question of whether such measures alone are sufficient as funding mechanisms for critical societal infrastructure. The funding mechanisms that support the strategy and provide security for all the actors will be studied more closely.

The public sector will continue to bear the brunt of the financing of the geospatial data infrastructure. Collecting, maintaining, and managing geospatial data is associated with relatively large costs. This is especially true regarding the most detailed data. At the same time, the demand for such data is increasing because of the digitalisation of society. Even though new data capture methods and new technologies streamline data production, we must expect that the cost of data collection, maintenance and management will increase compared to today's levels.

The fact that the geospatial data infrastructure is critical for many societal functions calls for assurance of the necessary financing of new data, ongoing operations and maintenance of the data content and related services. This is safeguarded today to a great extent through the budgets of the public sectoral agencies or through a sharing of expenses by the actors who see a common benefit of the investments. From experience, cooperation, sharing expenses and joint investments in data capture and maintenance programmes have proven to safeguard the priorities of key users and provide good utilisation of the actors' combined resources. It is not given that this is a sufficiently predictable structure for the future.

A fundamental problem is that the benefits of high-quality data are often realised by parties other than those who have incurred the expenses. Even though free access to the best data is expected in isolation to be socio-economically beneficial, the actor in question does not necessarily have the economy to pay for all the costs associated with collecting and maintaining data with a high level of detail or quality.

## **2. NATURAL HAZARDS, DISASTERS AND GEOSPATIAL INFRASTRUCTURE**

New threats and vulnerabilities arise. The prerequisites for food production and food safety are gradually changing. Climate change affects the probability and consequences of natural

events such as floods, landslides, extreme weather, and storm surges. Local authorities must take this into account, including in spatial plans. The municipalities and counties have obligations in ensuring a climate-adapted society. The requirements for good emergency planning for serious incidents are increasing, and the ability to handle crisis situations becomes more and more important. Risks and vulnerability analyses is important for preparedness for climate-related natural damage.

Geospatial information is required to meet social challenges, such as climate change, environmental challenges, transport, resource management, emergency planning and urbanisation. Geospatial information is an important element of work with adaptation to climate change and other environmental challenges, including land-use planning by the municipalities. Updated geospatial information is necessary for the assessment of threat situations and the ability to act quickly and appropriately.

## **2.1 Risk management:**

Norway is exposed for natural disasters like landslide, rockslide, snowslide, underwater slide and slide as a cause of flood or tsunami. 2000 killed by natural disasters the last 150 years. It is expected 10 bigger slides in the coming 50 – 100 years, each with 10 – 100 persons dead

The municipalities in Norway have great responsibility and authority to develop the local society and the framework to secure the inhabitants. The situation varies from big cities with air pollution, mountain areas with avalanches, built up areas on quick clay, coastal areas where weather conditions can be a challenge and where grounding or oil spill can create local pollution. It is important to build on knowledge about local conditions and make the spatial planning, preparedness work and climate adaption suitable for the local situation.

Evaluation of Risk and Vulnerability are obligatory tasks for the municipalities and are integrated in Spatial Planning and Environment Impact Assessment. Mapping of potential risks is essential and must build on updated knowledge and experience. Risk and vulnerability analyses may help avoiding building in area exposed for flood, avalanche, radon, and pollution. The Norwegian Public Base of Geospatial Data (DOK) is central for the knowledge and it is of great importance that the data is updated and easily available.

Some causes for unexpected occurrences are nature conditions as extreme weather, natural hazards and pandemics. Several datasets and actors play important roles to prevent natural disasters. If a civil emergency system is implemented, The Norwegian Mapping Authority is collaborating with regional authorities through its regional offices and directly with the Armed Forces' military geographical service. Following flood and landslide events, the Mapping Authority assists with new data capture and uses its framework agreements to order aerial photography or laser scanning of affected areas. This was done during some flood and landslide disasters the last years. The picture here is a model of the actual landslide area in 2016, measured with laser shortly after the landslide. It shows that large masses have collapsed and we can also discover vegetation and high voltage lines in the model.



## **2.2 Relevant datasets and services for natural hazards and disasters**

There will be a need for documentation on possible exposed areas to be available for preparedness and prevention. If a situation occurs there will be a need for a quick overview of the situation and especially about the possibility of saving life and property.

### 2.2.1 Laser data

Laser data gives new opportunities to evaluate the risk for landslide, it shows rivers and streams more exactly and gives better knowledge for future protection against rock and landslides. Laser data is used to create detailed elevation model and also terrain model. Such measurements are carried out with aircraft flying at low altitude or drones sending laser beams down to the ground and measuring altitude and position with very high precision. This dataset is, like the rest of the model, freely available online in Norway at <https://hoydedata.no>

The need for such models is to get an overview of landslide volume and distribution for original terrain. A detailed model is also relevant to look for victims and during a rescue situation to overview changes in the masses. Furthermore, the laser data are useful for the work of reopening the river course.

### 2.2.2 The Norwegian Public Base of Geospatial data (DOK)

DOK consists of basic datasets that are defined as central for all spatial planning, risk management, building and construction. It is defined in the Plan- and building Act with additional regulations. The list of datasets is updated every year and approved by the Ministry of Local Government and modernisation. For 2020 it consists of 148 datasets. The most basic datasets are a collection of the most detailed map data in Norway also called the Core Database (FKB). This database is collected and managed in close cooperation between the municipalities and various governmental institutions. Also, various thematic datasets are

included in DOK. Datasets of more importance for Risk management is administrative units, lakes and rivers, groundwater, roads, buildings, addresses, properties, power lines, orthophoto, bathymetric data, utilities, facilities with dangerous substances, facilities with explosives. Also, special caution maps are included in DOK like caution maps for flood, quick clay, avalanche, and landslide.

### Land slide disposed areas



### 2.2.3 Other important datasets for hazard and disaster management.

In addition to the Digital Elevation Model (DEM) and the caution maps, the mapping of catchment areas, river network and runoff is of great value. Earth observation is another source and Norway is a large consumer of earth observation from sea, land and air. We use earth observation for weather and climate prediction, for ship detection, for oil spill detection, to follow the outspread for snow, ice, glacier, and permafrost and to monitor landslide.

### **2.3 Public and private services to assist in disaster prevention and management.**

The Norwegian Water Resource and Energy Directorate (NVE) has a special role for preparedness for avalanche, flood and landslide and produce regularly forecast at a webpage [www.varsom.no](http://www.varsom.no). NVE has the responsibility for mapping and map services regarding avalanche, floods and landslides. They make caution maps for quick clay with several levels. Level 1 show all areas under marine border, level 2 shows potential marine clay based on the quaternary geology maps. Level 3 is the regional mapping program with new mapping to point out zones of potential danger for quick-clay and for bigger quick-clay avalanche. Included in the mapping here is also ground drilling based on terrain evaluation. Level 4 is more detailed mapping of the zones exposed for quick clay. This include an assessment of the real security for the zones with more ground drilling and stability calculations in several critical cut. The main objectives for the mapping is to be used in Spatial planning and assessment of construction activities and for assessment of security precautions in existing built-up area. The Caution mapping have the objective to define areas where the danger must

be closer assessed before new constructions and for observation for terrain intervention. The detailed mapping serves as knowledge base for NVEs advice to municipalities and constructors in spatial planning and engineering.

Some private companies have developed systems and tools to assist disaster management, both with data capture, data management, data connect and integrate and systems for detection and analyses. One example is the online viewer MAPSPACE from Terratec AS. This system gives the possibility to look at orthophoto, vertical picture, street views, laser data, point clouds, mapping etc. [www.mapspace.com](http://www.mapspace.com). The system offers a wide set of APIs, GPS plug-in and tools for combining data from various sources. They have made demonstrations of how they captured new laser data and assisted with management tools for geologists with combined information in the days after the latest quick clay land slide in Gjerdrum December 30, 2020.

### 2.3.1 Risk reduction, preparedness and management.

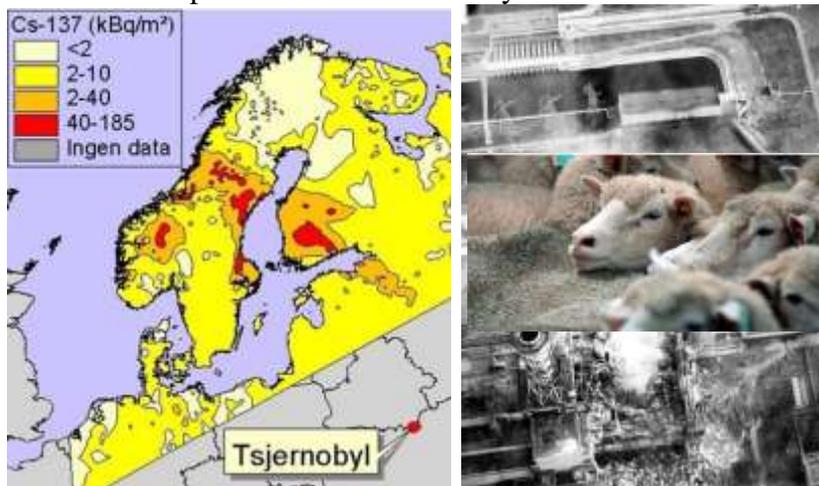
There is little to do to prevent the natural hazards, however, we can be prepared for situations and for reducing the impact of natural hazards. By modelling potential scenarios and assessment for localization of high exposed risk areas. There can be made risk reducing actions including warning systems. Decisions made today will influence the future vulnerability of the society. Greater emphasis is needed on a good knowledge base and regional climate profiles with information. When planning new areas for development, densification and transformation, there must be realistic mapping of potential danger, risk and vulnerability. Good spatial planning is important to avoid constructions in areas that are exposed for flood, landslide, avalanches, acute pollution, or other natural threats.

The use of mapping and GIS analysis is important to know about avalanche danger, potential release and outlet area, tidal waves etc. Further geodata it is important for R&V analysis and for spatial planning. It is needed to be on alert and for evacuation planning. In an actual occurrence there is a need to know about spare roads, detours and load capacity. Measures to secure electricity and telecommunication, including power to base stations. There is also a need for communication staff to have access to, and to be able to utilize the map systems for location of events, coordination of measures and delimitation of areas with different levels of danger. Mapping and GIS is also used to assist the geologists' work after a landslide. Some challenges is still to be looked into. How is the data access, which data are available, what is the quality. Is there restriction for use, how can the data be easily shared.

### 2.3.2 Map, geodata and GIS in disaster management – some examples.

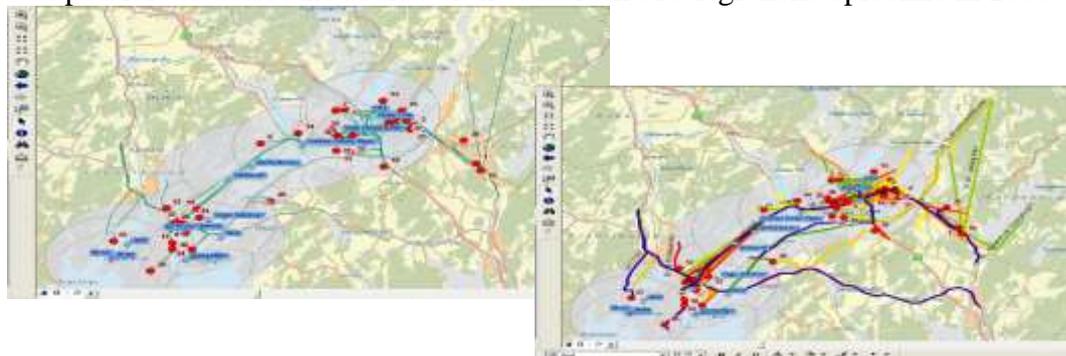
*The Chernobyl disaster* in April 1986 was the worst nuclear disaster both in terms of cost and casualties. It involved more than 500.000 people. The outspread of Caesium-137 caused contamination also in Norway. The contamination is expected to be seen for further 100 years. To be able to follow the outspread at an early stage GIS analysis were used based upon weather conditions, wind directions, rainfall in the days after the accident it was possible to find the most exposed areas. With these analyses supplied with in site measures it was

possible to find which area were most contaminated and put up measures to secure healthy sheep meat. Shortly after the accident, it was increasing levels of caesium in sheep, goats and cows in some places in Central Norway. Reindeer were also affected.



*Location of source of infection - Legionella-epidemic 2005*

By use of geoinformation and GIS analysis, information on addresses for patients and possible sources of infection within a 3 km buffer, and movements pattern for actual patients it was possible to detect the source of the outbreak of a legionella epidemic in 2005.



*The landslide in Gjerdrum* 30. December 2020. It was one of the largest quick clay slides in Norway. The slide started several hundred meters south of the built-up area and came step by step closer to the built-up area. 100 meters of the road was also gone. Almost 1000 people were evacuated, and 10 people lost their lives in the avalanche area. The slide took 10 houses with 31 family units. It was close to a home for elderly people. Three farms were affected. The following days there were also smaller slides.

The home for elderly people were evacuated, the children school, the medical centre, the city hall, and the kindergarten were closed. Electricity, water supply and sewage were out of order as caused by the slide. Many experts were involved in the management and search for lost people and several of the data and tools mentioned were used to assist the management.



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The Norwegian Water Resources and Energy Directorate (NVE) - [Map services - NVE](#)

Terratec AS, system [MAPSPACE](#) launched 11/2020 [Mapspace User Manual](#)

## BIOGRAPHICAL NOTES

Educated surveyor with additional education in architecture and law studies.

Delegate to commission 3 since 201 with several papers at congresses and WW.

Editor of several publications about Map and use of Maps.

Leading positions from municipalities, regional planning and Norwegian Mapping Authority.

Deputy director general at Ministry of Local Government and Modernization

Chaired exchange program for young surveyors between Vietnam, Laos and Norway 2001-2009 and have worked with Norwegian Agency for Development Cooperation.

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