

National Land Survey of Iceland Annual Report 2016

English Summary



Svínafellsjökull

Address by the Director General

Has Iceland not already been mapped?

The National Land Survey of Iceland (the NLSI) has employees with specialized education and valuable experience in the fields of geodesy, spatial information, and mapping. The agency also has a great history, characterized by good cooperation with numerous individuals, businesses and agencies, domestic and abroad.

The year 2016 was an eventful one for the NLSI, for it was the 60th anniversary of the agency. To celebrate the anniversary there was a well-attended conference in the town of Akranes, the home of the agency, and an entertaining exhibition of the work of local school children with the subject "Iceland". There was also an open house at the agency for anyone interested and it was a pleasure to see how many people took the opportunity to learn about the work being done there.

At the 60th anniversary conference the question "Why does society need a mapping and geodetic agency?" was coined. A question with many answers, no doubt, but the short answer is that the society needs to know where things are, what they are called and who owns them. The best way to document these principal attributes is with geodesy and the production of various maps. To tend to these important fundamental projects, you need structure and specialized professional knowledge already available at the NLSI.

"But has Iceland not already been mapped?" is a frequent question. The answer is that the project is an endless one, e.g. because of the constant changes of the country made by nature and man alike. Amongst others the reasons are:

- The National Coordinate System has to be re-measured regularly because of massive tectonic movement of the country itself. These systems are the foundation of various patrolling, construction and guidance systems;



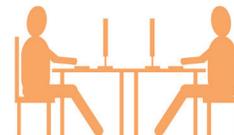
- Because of global warming, the glaciers of Iceland are retreating and "new" ground is being exposed. This needs to be mapped;
- Iceland still lacks detailed maps useful to e.g. travelers and search and rescue teams;
- There is a need to map in detail the coastline of Iceland for example to evaluate the dangers from the rising sea-level and the use and planning of coastal areas;
- There is still much work to be done in recording and making accessible the digital spatial information distributed throughout the Icelandic administration;
- The government need the know how to do business with the private sector that produce spatial information or provide services in that field.

The aforementioned list is not exclusive but rather gives an insight to the projects essential to fulfill in Iceland in the nearest future in the field of mapping and surveying.

Ahead are challenges the NLSI is expected to take on for the Icelandic society where requirements and technology are rapidly evolving. Good cooperation will continue to be the key to the success of the NLSI, but most important are, and will continue to be, well educated and qualified employees.

Magnús Guðmundsson
Director General

Employees



In 2016 the NLSI approved a new educational policy. In the policy it is stated that the institution wants to improve the professional knowledge and competence of employees by making it easy for them to get additional education and training. In 2016, 85% of the employees took courses and training which is in line with the objectives of the institute.

The dissemination of development and knowledge

Emphasis has been placed on employees registering their professional knowledge and share it in a way that colleagues can take advantage of such knowledge. This can be done e.g. with educational events on site, the use of software, and the execution of projects.

Institute of the Year

A powerful group of employees with years of experience and comprehensive knowledge is the reason the NLSI is now at the forefront in its field. The people take part in making the institution a better workplace by exercising good communication, being open minded and positive. In the Institute Of the Year survey of 2016 the NLSI placed third in the category of medium-sized organizations and is therefore, for the fifth time, an exemplary agency. Pleasure and well-being are reflected in employee turnover, which in recent years has been very low.



Green Steps

Since 2012 the NLSI has compiled and presented its results on "Green Accounting in Public Administration". During the same period the NLSI has been systematically considering ways to make the business more environmentally friendly.

In 2014, the NLSI became a participant in the project Green Steps for Public Organizations. In May 2016 the NLSI Director General received a recognition from the minister for the environment and natural resources for reaching all five Green Steps.

The main methods applied by the NLSI in the Green Steps are, among other things, keeping books in Green Accounting where goals can be set, an Environmental Team decides the next steps in environmental issues, the institution has an environmental policy, measurable environmental goals are set and kept in check, employees

are encouraged to recycle, reduce, and reuse, and also the employees are encouraged to use environmentally friendly means of transportation to and from work. All waste is sorted and goods and services bought are environmentally certified.



Dissemination



In 2016, considerable effort was put in the replacement of systems and software running the map viewer. That year three new map viewers were launched, all based on open source software and available on mobile devices. Using open source software aligns with the government's policy of increased use of open source software.

The new map viewers can be found on the agency's webpage and are among the most popular material on the website. The website also contains a map collection, aerial photo gallery and various other content that appeals to users.



Spatial Data Infrastructure (SDI)

The NLSI is responsible for the implementation of INSPIRE and the law on spatial data infrastructure in Iceland. The implementation involves granting access to spatial data that are owned and/or supervised by public organizations. In 2016, the goal was to reach the 40 agencies responsible for such data and push the metadata registration into the geoportal. Several organizations were assisted in the registration of metadata and data setup.

Booklet on spatial data infrastructure

A booklet on spatial data infrastructure (SDI) was released on the website of the NLSI in the autumn 2016. The booklet is intended to explain in a simple way what SDI is and what it means to the public bodies in Iceland.

Harmonization of spatial data

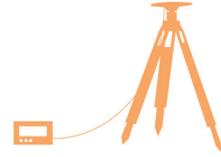
Through the year of 2016 much effort was put into changing between softwares and the structure for data harmonization and dissemination at the NLSI. These changes were, among others, made to

facilitate the coordination of Icelandic spatial data to the requirements of the INSPIRE Directive of the European Union. With this approximation, the data from Iceland is on par with other European countries and the requirements on data access according to the INSPIRE Directive is complied.

The technology facilitates implementation

In connection with the structural changes at the NLSI a new software for map windows was introduced to users, built on an open source platform called Oskari. Furthermore, GeoNetwork, a metadata platform, was implemented to register metadata as a part of the Icelandic Spatial data Geoportal. With the new map window it is easier for users to connect metadata and view the data. The new map window also gives users the opportunity to combine, in one map window, data from different government agencies. With easy access to spatial data from different sources one can assemble information that would not be easily obtained otherwise.

Surveying



Re-measurement of the Icelandic Geodetic Reference System

In the summer of 2016 the NLSI re-measured the national geodetic reference system. The Icelandic Geodetic Reference System is the basis for all other surveys in Iceland and is used for example in construction, detailed mapping or monitoring volcanoes. In addition to data from about 100 permanent stations, the NLSI surveyed 150 benchmarks during the campaign.

The initial results of these surveys were available at the end of December and revealed that the country continues to drift apart at a very steady rate of about 1 cm per year in each direction. This is though not always the case in the most active geological areas in Iceland where this movement is not as



homogenous in speed or direction. Movements north of Vatnajökull glacier stand out as a result of the Holuhraun eruption in 2014-2015.

Significant elevation changes are also seen in that 12-year period. The greatest land uplift was surveyed in Jökulheimar on Vatnajökull glacier, about 40 cm. It can be presumed that the reasons are thinning of the icecap and there is also evidence of increased magma in the magma chambers underneath the glacier. In comparison, the uplift in the period 1993 to 2004 was 20 cm. It is also interesting to note that around the geothermal power plants in Hengill and Reykjanes there is a subsidence of 1.5 cm per year,

or 18 cm since 2004. Elevation changes along the beach are also important as they can either work with or against the effects of rising sea level.

It is very important that the new datum is made available as soon as possible because it can be assumed that the distortion in the current datum (ISN2004) is 20-60 cm and distortion of ISN93 is 40-90 cm.

The IceCORS Network

The IceCORS Network at the NLSI will play a key role in making it possible to have a semi-dynamic datum in Iceland. The permanent stations are essential to improve the quality of geodetic work, whether it is for construction or for monitoring natural hazards such as volcanoes. Users can use the data from the permanent stations, free of charge, to correct their own data, either in real time or for post-processing. Two stations were added to the IceCORS Network in 2016. Both stations are operated by the Icelandic Meteorological Office, one is at Selfoss airport and the other at Nýlenda farm in Reykjanes. In total, the network now has 18 stations connected, but to ensure demands for accuracy 13 more are planned for a network with 31 permanent stations in service.

Sea-level Monitoring and the Vertical Reference System

Rising temperatures and melting of the Arctic icecap is something which will inevitably contribute to sea level rise in the world. In order to monitor sea level, it is important to have a network of tide gauges in the country and connect it to the Icelandic Vertical Reference System ISH2004. The NLSI has emphasis on determining the mean sea level of Iceland and that an accurate coastline will be calculated. Functioning and calibrated network of sea level gauges around the whole country is one of the prerequisites for that to be possible.



Spatial data

IS 50V database

The geodatabase IS 50V has for many years been one of the most widely used spatial databases of the country and a number of maps and map services are based in whole or in part on data from the IS 50V database. The database is regularly updated and in 2016 the main modification was in place name registrations.

In order to bring these updates to the users, the IS 50V database is published biannually, in early summer and at the end of the year.

Elevation model

The digital elevation model of the NLSI was updated for about 38% of the country or just over 39,000 km². The new data comes from various sources, e.g. Lidar data covering almost all the glaciers and their surrounding area, and data collected over the past decades due to energy production planning in the highlands. The older elevation model had a 20-meter resolution, i.e. each pixel covered 20 × 20 meters on land but the new model has a 10-meter resolution.



The Icelandic place name database

In 2016, two employees of the NLSI were full-time registering place names and helping registrants and sources outside the organization. Local, and mainly, elderly people play a key role in mapping the locations of known place names in Iceland. The place names are from documents called “place names descriptions”. Locating them with as much certainty and speed as is done today would be near-impossible without the local help.

The place name database is publicly available without charge and it already contains around 110,000 place names.

The Polar Geospatial Center in the United States published a digital elevation model (DEM) of Iceland with 2-meter resolution at the end of 2016. It is based on satellite images and produced with state-of-the-art technology. The DEM is the United States’ contribution to Arctic research and Arctic SDI related cooperation of eight mapping agencies from the Arctic Council member states.



International cooperation

European Cooperation

Cooperation between national mapping authorities and land registries in Europe has a long history. In many places mapping authorities and land registries are combined into one organization. This is mainly because of the connections between land registries and map databases and their connections to taxation throughout the centuries. The NLSI is a member of EuroGeographics together with Registers Iceland. EuroGeographics has been leading in the field of the harmonization of spatial data in Europe and have, among other things, been in the forefront in the implementation of the INSPIRE Directive of the European Union.

Nordic Partnership

Collaboration with other mapping authorities is important for the NLSI. The NLSI has a close partnership with the Nordic national mapping authorities and land registries. A group of experts from those countries has worked on joint projects such as in the field of surveying, standards, remote sensing, and cartography. Various Nordic working groups are ongoing within the Nordic partnership as it is directed very effectively according to a mutual covenant.

Arctic Cooperation - Arctic SDI

Cooperation in the development of spatial information in the Arctic has been a major factor in international cooperation of the NLSI in recent years. Increased interest in changes that are occurring in the Arctic with relation to global warming has put greater demands on the sharing of spatial information available from the area. The increased interest has also highlighted the importance of

collecting more data about the area and make better use of the data each nation, who owns territory in the Arctic, may have. A collaboration between the US, Russia, Canada, Finland, Norway, Sweden, Denmark (including Greenland and the Faroe Islands), and Iceland for the development of infrastructure of spatial data in the Arctic under the name Arctic SDI has already provided access to improved spatial data and increased access to integrated map data.

EFTA Development Fund

In connection with the EFTA Development fund the NLSI participated in two projects in recent years, one in Slovenia and the other in Portugal. Both projects relate to infrastructure of spatial information.

In Slovenia, the focus of the project was threefold; to improve the geodetic system of the country, to improve the country's spatial data in terms of flooding, and to have better access to spatial information to reduce flooding due to increased precipitation. The name of the project is "Modernization of spatial data infrastructure to reduce risks and impacts of floods". The project in Slovenia was completed by the end of 2016 and the main objectives set in the beginning of the work were completed (<http://www.gurs-egp.si/eng/>).

In Portugal, the project was to interconnect the spatial data of the ocean to the name SNIMAR. The Portuguese have very large territories in the ocean. The infrastructure of spatial data of the sea is even more important than on land because the waters are very big and little is known about them. Interconnection and access to the data that already exist are therefore an important task.



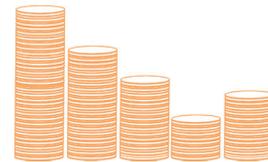
Copernicus

The NLSI represent Iceland in the EEU Copernicus program. The Copernicus program is the most comprehensive monitoring system in the world regarding environmental information. The goal of Copernicus is to monitor the state of the environment on land, sea, and air and thereby contribute to greater safety of earthlings e.g. by predicting floods or storms and planning emergency work due to forest fires or earthquakes. To collect the necessary information Copernicus runs a number of satellites and permanent stations on the ground but also uses data from others. It is clear that the program will be important for Iceland in the coming years, for example when monitoring the waters around the country and to assess the impact of global warming. The program covers the monitoring of the air quality on Earth, marine monitoring, monitoring of land surface, climate change, response to disaster, and security.

The United Nations and Spatial Data

Since 2011 the UN has been working towards cooperation in the field of geodesy and spatial data with other member nations under the GGIM (Global Geospatial Information Management) signs. Membership has mainly consisted of map and cadaster agencies, statistical institutes, and ministries in the member states. The aim is to increase cooperation, coordinated responses and the understanding of the importance of spatial data and maps e.g. to respond to increased frequency of natural disasters and other catastrophies in the world and to support the UN goals of sustainability in 2030. The NLSI has been an active participant in this project from the beginning and has been watching the progress of the GGIM project closely.

Finances



The operation of the NLSI went well in 2016. The administration of the NLSI monitors the operation of the institution and makes monthly deviation analysis of operations. This way, the managers are given the opportunity to take action if necessary. Service revenues in 2016 were ISK 22.4 million. The

state's contribution was ISK 307.7 million. The largest cost item in the operation of the NLSI is the payroll expenses that make up 71% of the total turnover. Other major expenses include housing costs and services of computer and software. During 2016, the NLSI used over ISK 4 million of its principal.

National Land Survey of Iceland

A Brief History

1900-1956 The Story Before

The history of National Land Survey of Iceland (NLSI) can be traced back to 1900, when the surveying department of the Danish General Staff (later the Geodetic Institute of Denmark) began surveying and mapping in Iceland. The project lasted from 1900 to 1940 and resulted among other things in 670 map titles, of which 227 were published. Ágúst Böðvarsson, later director of the NLSI, took the initiative in 1951 to start taking aerial photographs for mapping. In 1955, NATO initiated and carried out surveying in Iceland which included a new geodetic



reference system of the whole country (Hjörsey 1955) and new maps on a scale of 1:50 000.

1956-1998 National Land Survey of Iceland in Reykjavík

The NLSI was founded in 1956. The main tasks of this new organization were in the field of land surveying, aerial photography and cartography. In 1963, the Geodetic Institute in Denmark quit doing mapping work for Iceland and two years later Iceland bought both stock and films for all maps of the country. In 1973, the NLSI got publication- and copyrights of the maps as well. In 1991, the NLSI acquired equipment for processing satellite images and, a year later, satellite images of the whole country. In the summer of 1993, a new Icelandic geodetic reference system (ISN93) was measured since the older, Hjörsey 1955, did not comply with requirements.

1999-2016 National Land Survey of Iceland in Akranes

In 1999, the NLSI moved to Akranes. One year earlier, the NLSI had started working on a new digital map database for Iceland and in 2003, the first version of IS 50V database was issued. In 2000, the NLSI stopped taking aerial photographs of Iceland and thereby ending almost a half a century history of aerial photography at the institution. The NLSI owns around 140 thousand aerial photographs. In 2004, the geodetic reference system (ISN93) was once again re-measured followed with the release of the ISN2004 reference.

In 2002-2006, the NLSI and other institutions joined hands and purchased SPOT-5 satellite images together. The result included an image cover of the whole country. With increased international



cooperation more remote sensing data has been added.

In 2006, the NLSI celebrated its 50 years anniversary. That same year, the minister for the environment submitted a new bill on land surveying and mapping which took effect on January 1, 2007. The law stated that the NLSI was prohibited from producing and selling printed maps making it the first year since its creation in 1956 that the NLSI did not sell printed maps.



The NLSI became a member of the CORINE program (Coordination of Information on the Environment) in 2007. CORINE is a pan-European classification project in which the same methodology and criteria are used to classify concurrently land types all over Europe. The CORINE program has given a clear picture of land changes in Iceland since 2006, such as around construction sites and due to glaciers' retreat.

In 2007, the European Union directive known as INSPIRE (Infrastructure for Spatial Information in the European Community) came into effect. The key goal of INSPIRE is to ensure the society's accessibility of spatial information. In 2011, the Althingi passed an act of law on spatial data infrastructure in Iceland.



The purpose of the act is to develop and maintain access to digital spatial information for government authorities and the act is linked to the INSPIRE Directive. The NLSI carries out the implementation of the act.

In 2011, the work on the first edition of a common vertical reference system for Iceland was completed. A common vertical reference system is an important component in providing society with a reliable foundation for elevation surveys. The development of the IceCORS Network plays an important role in

the maintenance and surveillance of the vertical and geodetic reference systems for Iceland and now consists of 18 stations.

In 2013, the former minister for the environment decided, in cooperation with the NLSI, to make all data owned by the NLSI accessible free of charge. As a result, the demand for the Institute's spatial data has increased significantly.

The enjoyable breakthrough of 100.000 geographical names in the NLSI's Geographical Names Database was reached in December 2015. The first Act, encompassing geographical names, was passed through Parliament in 2015. The NLSI, in liaison with The Árni Magnússon Institute for Icelandic Studies, will maintain, register and disseminate the database.



