



National Report Presented to
the International Cartographic Association's
15th General Assembly 2015 Rio de Janeiro, Brazil
by the Swedish Cartographic Society

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Introduction 2011-2015

The national report of Sweden is published by the Swedish Cartographic Society (Kartografiska Sällskapet) addressed to the delegates of the General Assembly 2015 of the International Cartographic Association in Rio de Janeiro, Brazil.

In Sweden, maps and geographic data are produced by national and regional agencies, municipalities, commercial enterprises, scientific institutions, organizations, and individuals.

The focus in this report is geographic information displayed in a variety of presentations, but all of them using cartographic knowledge and design. The publishing of traditional maps and map series has been extended and added by production of more specialized map products, made possible through the use of new techniques for data capture, information processing, map production and presentation.

The articles in this report are produced by the contributing organizations and companies themselves, reflecting their points of view. The Swedish Cartographic Society is, apart for its own contribution, only responsible for the final editing and publishing of the report. The editing and layout was made of Margareta Elg (margareta.elg@mbox200.tele2.se), and Mats Halling, both of them members of the Swedish Cartographic Society.

Ann Eriksson
Chair, Kartografiska Sällskapet

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Kartografiska

The Swedish Cartographic Society (Kartografiska Sällskapet, KS)

The Swedish Cartographic Society, Kartografiska Sällskapet, was founded in 1908, and is most probably one of the oldest of its kind. The Society's goal is to increase the interest in cartography and other topics related to mapping or the use of maps in Sweden and to try to encourage a development in the area. One of the society's most important issues are to support the members in their daily professional role by assisting them with different kinds of opportunities to meet colleagues and to seek new networks and educational opportunities. In 2011-2015 KS has developed and improved the communication with members and stakeholders by working out a new communication strategy.

A main activity of the society is to organize an annual conference called "Kartdagarna" or the "Swedish Map days". On initiative from KS a bigger conference was arranged during the spring of 2015 together with four other sister organizations in Sweden. We all want to participate and encourage development in geographical information and so called geodata overall to increase different kinds of community benefits. By planning this year's event we decided that the main theme for the congress was housing, infrastructure and environment. The Congress was named *Position 2015* and were held in the end of March 2015 in the capital of Sweden, Stockholm, and arranged together with a fair that presented products and services from more than 40 companies and authorities. The conference program included seminars about techniques, visualization, education, management, pricing, politics and strategies in housing, infrastructure and environment. The conference also included map exhibitions. Social arrangements are an important part of the conference. In this year's congress and fair there were more than 1,800 participants.

In 2016 KS's annual "Swedish Map days" has been arranged for 40 years. This we will celebrate in April 2016 by arranging the conference in Gävle where the very first "Swedish Map days" took place.



Ann Eriksson, president of today, and Peter Wasström, president 2008-2013.

Committee board

The committee board consists of a president, a vice president, a secretary, a treasurer, seven members, and two deputies. In 2008-2013 Peter Wasström was president. In 2014-15 the president is Ann Eriksson and the secretary is Jan Wingstedt. The international contact person is Peter Wasström. The society and its six sections are governed by the rules of the society. KS represents Sweden in the International Cartographic Association (ICA), and has participated in all the General Conferences and Assemblies since in Paris 1961.

The 2,000 members are professionals, students, retired members, and individuals with a common interest for maps. About one hundred of these are members from abroad. Anyone who wants is accepted as a member of the Society. The annual fee is SEK 150, SEK 100 for retired, and SEK 50 for students.

Other activities

The Swedish Cartographic Society is organised in six sections: Cartography, Historical maps, Geographical Information Systems, Photogrammetry and Remote Sensing, Geodesy and Education. Each section has responsibility for its respective disciplines and among other things the sections arrange seminars, exhibitions and study visits in different places in Sweden.

Four times a year the Swedish Cartographic Society publishes the cartographic journal "Kart



The winners in the orienteering competition in Dresden where ICA met in 2013.

& Bildteknik”, English name “Mapping and Image Science”.

As mentioned earlier KS arranges map exhibitions every year together with the Swedish Map Days. The winning maps from Position 2015 together with the winning maps from the Map days of 2014 will be sent to the map exhibition at ICC 2015 in Rio de Janeiro, Brazil. The winning children’s maps in Position 2015 will compete for the Barbara Petchenik Award in Rio.

KS communicates with members through the site www.kartografiska.se, a newsletter called “E-aktuell” and social media, for example Facebook, over the year. Members of the board also visit the Nordic countries and it has become a tradition to organize joint courses in summertime. Over a couple of days every year there is an internal planning seminar to discuss strategic issues.



Jan Johansson with the Olaus Magnus award.

More than 100 students get every year scholarships to participate in the Map days. Scholarships are also given every year to members who want to join international conferences.

Awards

The medal of *Olaus Magnus* was founded in 1948. It is given to a deserved person who has made considerable work for the interests of KS.

In 2012 it was awarded to professor Staffan Helmfrid for his scientific work with the National atlas of Sweden, the Royal Swedish Academy of Letters, History and Antiquities and the support of editions of historical maps.

In 2014 Jan Johansson was awarded the medal for his methods to use GNSS-data to decide the displacement of land and calculation of the water contents in the atmosphere.

The award of *innovation* was in 2012 given to Hjärtstoppscentrum on Södersjukhusets Kar-



Staffan Helmfrid gets the award from Peter Wasström.



Roadroid AB was given the innovation award in 2013.

diologklinik for the SMS-lifesaver project that uses mobile location technologies by engaging civilians in order to improve survival after cardiac arrest outside the hospital.

In 2013 it was given to Roadroid AB Ljusdal for the cheap and quick data collection about roads quality in order to help both passengers and road constructors.

In 2014 it was given to Lotti Jivall for her work with

GPS-technique to establish both national reference systems and systems in other countries.

In 2012 the award of the best *organization* was given to DIS, the society of computer based genealogy.

KS also pays attention to good scientific and educational performances over the year. In 2013 and 2014 three persons each year got this attention.

On Position 2015 congress and fair, four awards were handed out:

The award for the best *Innovative* investment was given to the company Mapillary who have invested in creating a street view service built on local users photos. The result is a dynamic and live image representation of the world for all.

The award *Best E-service* within built environment was given to Riges (Regional Innovative GIS and e-service) which is a collaborative project in northern Sweden between five municipalities who have digitized their local plans and zoning regulations, and developed a wide range of user-friendly e-services for building permits on two completely open platforms.

The award *Best Built Environment application* (mobile app) went to the company Metria. They have developed the free app Hitta Fastighet (Find a real property/estate) with information and facts about Sweden's all 3.3 million real properties and its owners.

The award for the *best thesis* went to Kent Ohlsson for his thesis "Study of measurement uncertainty and time-correlation when measuring with network RTK in SWEPOS 35 km networks" at Royal Institute of Technology (KTH).

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Historical Section

The Historical Section of the Swedish Cartographic Society consists of a board of four persons, whose main duties are to arrange a session at the annual conference Kartdagarna and to acquire papers to the society journal Kart & Bildteknik. In addition, study visits are arranged, e.g. to the Stockholm City Archive in 2012 (see below).



Conference papers tend to be either on the history of cartography proper or on the use of "historic" maps as a source for research within quite diverse fields, ranging from urban agriculture, and the design of forestry plans, to family history, "liberty mile maps" displaying the extent of tax exemption of noble manors or civic liberties, and spatial models for the propagation of the Black Death in Sweden 1350. Articles from other

Earliest map of Stockholm, ca 1625. The northern and southern suburbs are still unregulated. Stockholm City Archive.





Detail of Georg Keller's Kalmar war map 1611, illustrating the Danish siege of Kalmar which was followed by a massacre May 26, 1611, and the Swedish revenge force approaching misplaced Christianopol, which led also to a massacre around Midsummer. <http://goran.baarnhielm.net/Messrelationen/>

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Cartography Section

The Cartography Section consists of a board of four members, whose main duties are to arrange sessions, map exhibitions and sometimes a cartographic quiz at the technical exhibition for the annual conference Kartdagarna. The section also acquires papers or proposals of papers to the society journal *Kart- och Bildteknik*. In addition, study visits are occasionally arranged. The Swedish National Report to the ICC is taken care of by members of the Cartography Section and also the cartography part of the society website.

sources do appear, e.g. conference reports, and essays on specific maps, e.g. a German news map of the Swedish-Danish war 1611, and a map of the Saami tax districts 1671.

Section members attend other conferences too, e.g. the International conference for the History of Cartography (Helsinki 2013), the 2012 Mercator conference at Sint Niklaas, Belgium, several ICA workshops on Digital approaches to cartographic heritage.

Members are occasionally consulted on matters of cartographic history and historical cartography.

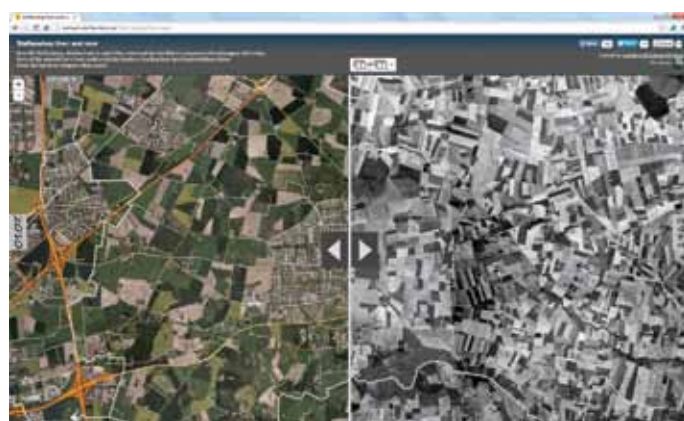
The Swedish Association for Map Archivists (*Kartarkivariieföreningen*) has been inactive as an organization for some years. But scholarly archival competence (including the still unsolved problem of long-term preservation of digital data) is available within the historical section, and presentations on archival matters and questions are regularly included in *Kartdagarna*.

Sweden is lacking a university chair in the history of cartography, so the field has a rather weak academic support. But some research is carried out within e.g. the National Archives including the Military Archives, university institutions in geography, and the Committee for the History of Cartography within The Royal Swedish Academy of Letters, History and Antiquities (*Kungl. Vitterhets Historie och Antikvitets Akademien*).

The most recent publication is a comprehensive guide to the maps in the National Archives including a short history of the mapping of Sweden: "Med kartan i fokus" 2013. <http://webbutik.riksarkivet.se/se/kategorier/geografi/med-kartan-i-fokus.html>.

Address

The present convener of the Historical Section is Göran Bäärnhielm and the address to the section is:
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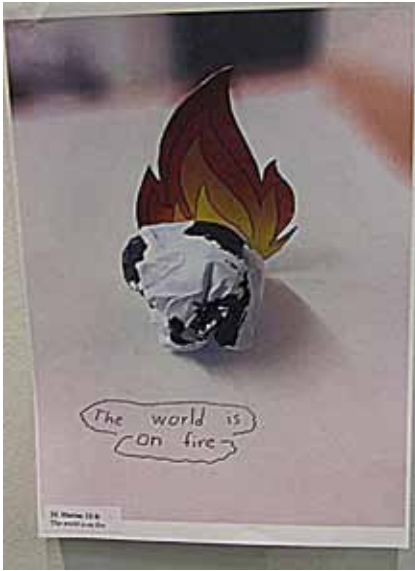
A digital comparison between an image of today and a historical aerial image.



Risk for flooding! The map of the year 2014

Members of the Cartography section regularly attend the ICA conferences and are also responsible for the Swedish contributions to the International Map Exhibition and to the Barbara Petchenik Map Competition for children at the ICC.

The section is cooperating with other sections when it comes to education in cartography. Swedish universities have no chair in cartography and the possibilities to learn cartography become scarcer and scarcer.



According to this child the world is on fire.

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The present convener of the Cartography Section is Kjell Börjesson and the address to the section is:
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The Geographical Information Systems Section

The section works with new techniques, and illustrates the advantage of geographic information in a variety of operations. Areas of high priority has been open source webGIS and activities to reach new audiences among decision makers. The GIS-section consists of a board of four people, with main duties to arrange sessions at the annual conference the Map Days and to acquire papers to the society journal "Kart & Bildteknik". In addition the section has arranged a successful regional GIS conference in Norrköping 2012 as a part of a global event. A mentoring program for students and young professionals has started, to give support from experienced professionals in the Cartographic Society. The section has also been involved in the new communication strategy plan for the society.

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Geodetical Section

RTK positioning with centimeter accuracy based on own reference stations or RTK based on Network-RTK services, is probably the most used geodetic survey technique in Sweden today. Within a few major road construction projects the fundamental network, consisting of fixed reference points, has been replaced by the GNSS-based densified network of reference stations and real-time data broadcasts for RTK survey.

Height measurement using GNSS is increasing and the benefit of an accurate geoid model is obvious. Due to the postglacial land uplift affecting Scandinavia there is also a need of land uplift models for adjusting GNSS ("geometric") heights to correspond with the height system ("gravimetric heights"). To get these technologies to function properly together requires knowledge of these methods. For a few years the geodetic section of the society has focused mostly on subjects related to geodetic reference systems and GNSS.

The section's focus has been on

- The operation, expansion and services of SWEPOS, the Swedish national network of permanent reference stations for GNSS. Several private RTK-services are more or less integrated with and in the network.
- The implementation of the Swedish national reference frame SWEREF 99 and the national height system RH 2000 (ETRS89 and EVRS realizations, respectively) and the ambition to replace local (municipal) coordinate systems.
- The improvement of Swedish geoid models and land uplift models.

Two examples of ongoing advanced scientific geodetic related activities at Onsala Space Observatory;

- Development of method and use of superconducting gravimeter for studying temporal variations in observed gravity.
- Construction and use of twin telescopes for VLBI (Very Long Baseline Interferometry) and along with corresponding international institutes improve the measured accuracy.

The number of educated surveyors, geodesists and engineers at the level of Master of Engineering does not fulfil the need on the market. This problem is not new and the Swedish Cartographic Society is conscious of the problem and supports efforts to turn this negative trend. The Cartographic Society continues to pay attention to this and support universities and students to participate at the annual conference "Kartdagarna". Prior to the retirement of professor of Geodesy at the Royal Institute of Technology (KTH), Lars Sjöberg, the future needs of a professorship has been evaluated and assessed to remain keen. The new professor, Anna Jensen, has been recruited from Denmark.



One of the lecturers in work, Anders Brandt.

Referring to geodetic knowledge we also try to make geodesy more accessible and understandable for a wider community and make geodesy lubricant (instead of an obstacle) in collaboration from local to global level. Cooperation between different local or national authorities has improved the efficiency in many building and infrastructure projects. The international projects, especially at the Nordic level and within the Baltic Sea Region, have benefited from that the geodetic infrastructure now has a sustainable design. It is also obvious that geodesy has a role in the discussion of global climate change.

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The Educational Section

The section for educational matters in the Swedish Cartographic Society (KS) was formed in 2006. The aims of the section include:

- work with educational matters relating to cartography, geodesy, GIS, photogrammetry and remote sensing on all levels, both nationally and internationally,
- promote increased competence development in cartography and related fields in Sweden, such as land surveying, spatial planning, geomatics, computer science, earth science and geography.

The Educational Section also actively takes part in the annual conference, Kartdagarna, the biggest conference of its kind in Scandinavia.

Among the recurring activities arranged by the educational section is an annual conference for lecturers and others, where educational matters are discussed. The aim is to facilitate the sharing of experiences, to improve collaboration opportunities, networking and competence development, and to enhance course quality and recruitment of new students. The location of the venue varies in order to encourage diversity among the hosting educational institutions and to reach new participants. Recent conferences have been held at Umeå University in 2011 (Bohlin, 2011), co-arranged with Kartdagarna in Jönköping 2012 and 2013 (Hauska, 2013), and in Stockholm in 2015. The presentations are normally published afterwards on the website of the Swedish Cartographic Society.

Cartography has a long standing tradition in Sweden. In school, geography is the classic subject to learn about maps, although the old school world atlases are more and more replaced by interactive e-learning map packages. Since 2011, primary to upper secondary schools have GIS and geographic information in the curriculum for geography. The availability of geodata for schools and universities has therefore been a prioritised subject in recent years (Ridefelt 2011; Harrie et al., 2014). Schools and universities get free access to basic geodata from Lantmäteriet, Statistics Sweden, The Swedish Maritime Administration and the Swedish Transport Administration financed by the Swedish research council (Harrie et al., 2014). Lantmäteriet has also a collaboration with teachers and municipalities, which has resulted in a web portal called the GeoSchool (Geodata, n.d.; Sweco, n.d). The aim is to give teachers and students access to geographic information and statistics based on interactive maps with readymade lectures.

However, despite the widespread use of maps there has never been a chair in cartography at any of the Swedish universities. In the last decade, the number of cartography courses has been waning, replaced by GIS. Although the demand for competency in GIS, geodata and related fields by the employers are increasing – and the universities do well to meet this demand – this development can in the long run cause concern that the handcraft and art of making maps will be known and maintained in the end by only a few enthusiasts. The educational section monitors this development and promotes awareness of cartographic values.

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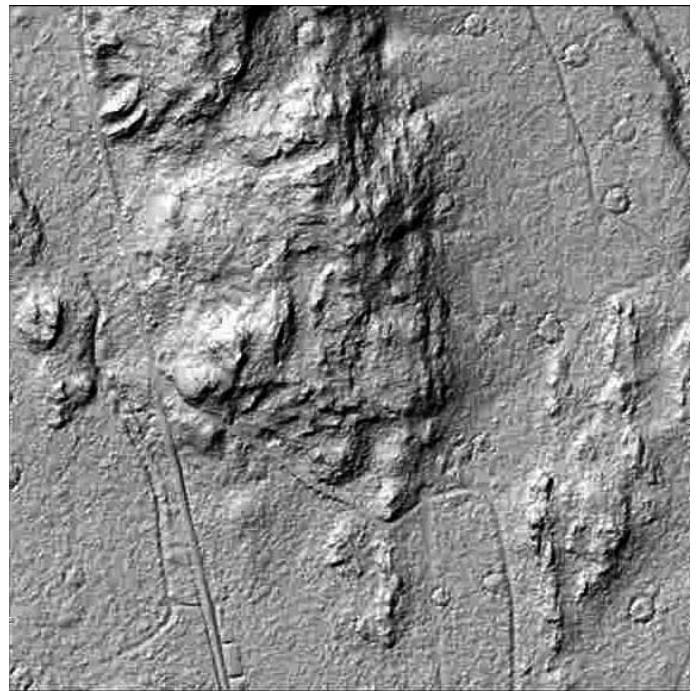
The Photogrammetric and Remote Sensing Section

The Photogrammetric and Remote Sensing Section consists of a board of four members. The main duties are to arrange sessions for the annual conference Kartdagarna and to acquire papers to the society journal Kart & Bildteknik.

The section also focuses on education and in the last few years, courses in photogrammetry have been held at Kartdagarna. The use of images from digital cameras has drastically increased the last few years. Hence courses have focused on photogrammetric accuracy, stereo mapping issues and understanding the radiometry aspects of digital aerial images.

Late 2012 the section once again arranged a seminar about digital photogrammetry including a technical exhibition. The interest for the seminar was larger than expected.

The production of a new national elevation model by Lantmäteriet using laser scanning has almost been completed. Many examples of the use of the new elevation model have been presented at Kartdagarna.



Traces of ancient charcoal stacks (upper right) detected by LIDAR

With the support of Swedish Cartographic Society different types of professionals have produced a new Swedish textbook in photogrammetry to enhance the possibilities for good education at university courses.

The use of aerial images has rapidly increased during the period. An image strategy at Lantmäteriet will result in a production of high resolution aerial images covering most of Sweden with an orbital period of two years. The use of UAS also produces a large amount of images. More companies in the areal photographic business have been established in Sweden which has led to lowered prices.

To use the images, the number of photogrammetric equipment and software has increased. About 15 % of the 290 Swedish municipalities have its own photogrammetric equipment and daily use stereo photogrammetry to up-date map databases.

Lantmäteriet, together with the Swedish Transport Administration and some municipalities and with support of companies within this field, have produced a number of textbooks concerning procurement of aerial images, LIDAR, orthophotos etc., under the name of HMK, Handbok i Mät- och Kartfrågor, a textbook concerning geodetic measurement and maps.

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Swedish Mapping, Cadastral and Land registration Authority (Lantmäteriet, LM)

Lantmäteriet, originating from 1628, is a government agency. The mission is to give support for creating an efficient and sustainable use of Sweden's real property, land and water. The organization has three main activities, which also form the organizational structure: the cadastral services division, the land and geographic information division and the land registration division. Support for these activities is provided by corporate functions.

The Cadastral services division

Lantmäteriet is the governmental cadastral authority. There is also 39 municipal authorities that carry out cadastral procedures and services. The cadastral services comprise real property formation through formal survey and maintenance of the real property register. Common tasks are sub-division of land into plots for new buildings and reallocation to ensure the availability of land for building roads, railways and public utilities.

At the head-office a unit has the responsibility to support the regional offices. The most important task is to support and develop the real estate formation process. That includes law amendment, quality control, competence development, and development of techniques and services in order to shorten the handling time and thus reducing the costs.

The Land and geographic information division

The land and geographic information division collects, stores and administrates geographic and real property information. It also includes the analysis and establishment of demands and the needs of such information in society. The collection is carried out by Lantmäteriet and often in co-operation with other public authorities including the local ones. An important task is to make the information available and used by a broad spectrum of users thereby contributing to efficiency, improvement and renewal in all sectors. Geographical information and real property data from Lantmäteriet help to benefit the society in many ways. For instance, it may be used in the production of data concerning the effects of climate change, or to provide expert knowledge for construction work. Maps and other geographical information have also taken on increasing significance on mobile and tablets, thanks to all the apps which describe the geographical locations of various phenomena. In this regard, Lantmäteriet perceives major social development potential and has for a couple of years been working on possibilities to open up geographical data and addresses for free use. Licensing costs and distribu-

tion conditions present the greatest restriction in the present system involving financing by users. Open, reliable geographical data would simplify matters for users and encourage market actors to develop innovative services. Lantmäteriet carried out an analysis of this in 2013, and this work continued in 2014 in cooperation with, among others, the aim to the Swedish Association of Local Authorities and Regions with the aim to devise a joint action plan.

The land and geographic information division is responsible for basic information subdivided into information areas for topography, geodesy, real property information and images. The operations also include dissemination activities and co-operation, advisory services and support to other producers and users in society.

Lantmäteriet's role as coordinator of the Swedish spatial data infrastructure (SDI) has gradually been strengthened.

Land registration

Lantmäteriet became the national land registration authority at 2008. The division is responsible for registration transactions with regard to ownership, mortgages and other rights and charges in the land register section of the real property register. The head office in Gävle is responsible for leading and coordinating registration activities.

The Swedish SDI

The SDI concept has been gradually developed since 1970's. The Land data bank system can be regarded as a forerunner. The system linked cadastral information from different state agencies and municipalities and made the information easily available.

Lantmäteriet is responsible for the co-ordination of the national infrastructure for geodata. The Swedish infrastructure for geodata is a part of corresponding information systems within EU. The national infrastructure for geodata, NSDI, will make it easier to access geodata, and thereby maximize the benefit for society from the geodata that exist in Sweden.

- Lantmäteriet aims to create the preconditions for increased use of geodata.
- Lantmäteriet will also make it possible to exchange and combine geodata from different sources, which is a precondition for efficient collaboration, both between users in the public sector and in the interaction between companies and the general public.
- By making greater use of geodata Lantmäteriet creates better preconditions for sustainable development and greater competitiveness in the business community, public administration and society in general.

The Geodata Advisory Board

The Geodata Advisory Board, established by the Swedish government, advises Lantmäteriet in its coordinating role regarding geodata. The Geodata Advisory Board will:

- contribute to the work with the National geodata strategy for the collective maintenance of geodata
- highlight issues of common national interest within the geodata field
- contribute to the development of the national and international infrastructure for geodata for example by supporting the implementation of standards
- contribute to increased coordination between authorities concerned in issues regarding development of information and providing information
- contribute to the coordination of the infrastructure for exchange and access to geodata

In Sweden a standardization programme for geodata has been running within the Swedish Standards Institute (SIS) since more than 20 years. Via this programme Sweden has been active in the international standardization work. The stakeholders have also developed a generic framework for carrying out standardization, which has been used to produce standards for many data themes, such as transport networks, hydrologic networks, utility networks, addresses and buildings.

The National Geodata Portal

The Geodata Portal is an entrance to web-based geodata and services. The portal offers the possibility to search, find and look at geodata from different sources.

It presents available geodata and where the users data can be found. Users can in an assembled way access services and geodata from many organizations.

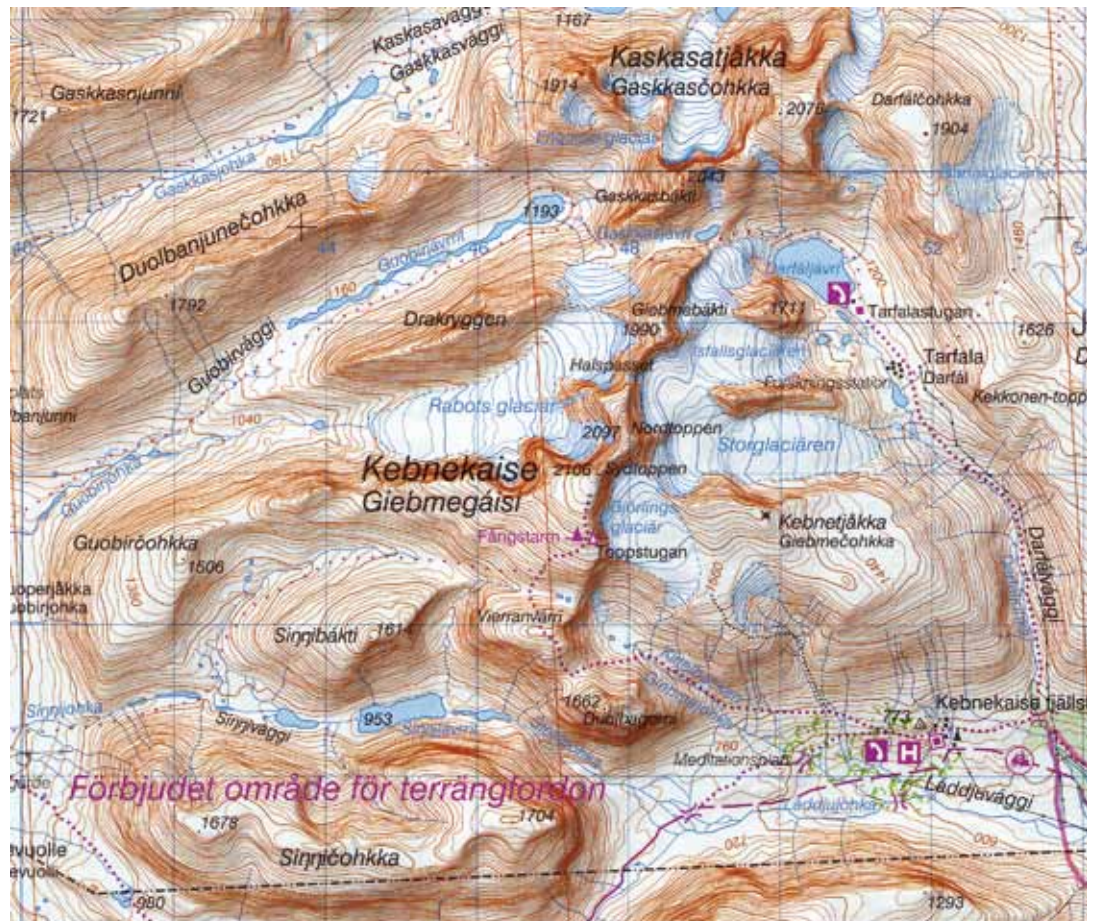
- The portal comprises a national metadata catalogue which describes available geodata, their quality and conditions for use. The catalogue is frequently updated by the producers.
- Geodata and services are accessed via the portal.
- The Geodata Portal is mainly aimed for professional users.
- The Geodata Portal is the entrance for Sweden's cooperation in Europe, according to the INSPIRE directive.

The Geodata Cooperation Agreement regulates a sustainable cooperation within the infrastructure for geodata, based on the completion of the National Geodata Strategy.

Parties in the cooperation can be:

- Authorities with an information responsibility according to the Swedish Act and Ordinance on spatial information, based on the INSPIRE-directive.
- Municipalities, government agencies and other organizations with official duties.

Portion from Lantmäteriets Mountain Map BD8 Kebnekaise – Saltoloukta, scale 1:100,000. The map text is mainly in Samish orthography



Map	Scale (number of map sheets)	Map image format	Use
Property map (Fastighetskartan)	1:12,500 (9,821)	Cover Sweden map sheet 80x40 cm	Detailed accounting of the property division and settlements. Replaces Economic and Yellow map.
Topographic map (Terrängkartan)	1:50,000 (244)	Southern and central Sweden, northern Sweden's coast. 75x80 cm, double-sided printing.	Detailed map of topography and land use with a lot of cultural symbols. A map suitable for excursions.
Road map (Väggkartan)	1:100,000 (79)	Cover Sweden except the mountain chain. 75x80 cm, double-sided printing.	Detailed road map with roads in many sizes. Even good as a bicycle map.
Mountain map (Fjällkartan)	1:50,000 (16)	Dalarna and Jämtland.	Current and reliable scale information. Well-defined trails, joints, bridges, houses, huts, emergency telephones etc.
Mountain map (Fjällkartan)	1:100,000 (25)	Covers the mountain chain.	Current and reliable scale information. Well-defined trails, joints, bridges, houses, huts, emergency telephones etc.
General map (Översiktskartan)	1:250,000 (21)	Sweden-wide map series. 75x80 cm, double-sided printing.	Map of regions, bigger roads, towns, lakes, rivers etc. Good for tour planning.
Sweden	1: 1 million	Sweden on one sheet.	Wall map
Sweden	1: 1,2 million	Sweden on one sheet	Wall map

The Geodata Cooperation Agreement presents how to handle organization, steering, coordination and responsibilities as well as technical prerequisites, forms of supply and terms of use of geodata.

The parties in the agreement offer each other their geodata for official use for an annual fee. Available geodata are presented and described in a product catalogue.

Municipalities, government agencies and other organizations which conduct official duties can join the geodata cooperation, and thereby get access to all geodata in the product catalogue, but only for official use.

Maps and geographic information

Lantmäteriet provides the society with maps, images and other fundamental geographic information. Land surveys, aerial photography and airborne laser scanning are carried out by Lantmäteriet. It cooperates with central and local authorities in order to collect fundamental data and reliable geographic information.

Nowadays maps are primarily packaged in various digital formats and very few maps are printed.

The geodata services are “machine to machine” services that allows to search, view and retrieve maps, images and property information into appropriate systems. The geodata services can be divided into two main types:

- Viewing services, aimed at users who only want to look at Lantmäteriet's maps and images in their own systems or applications.
- Direct access services, aimed at users who want to retrieve and show property information in their own systems or applications.

Aerial images, satellite images and digital elevation model (DEM)

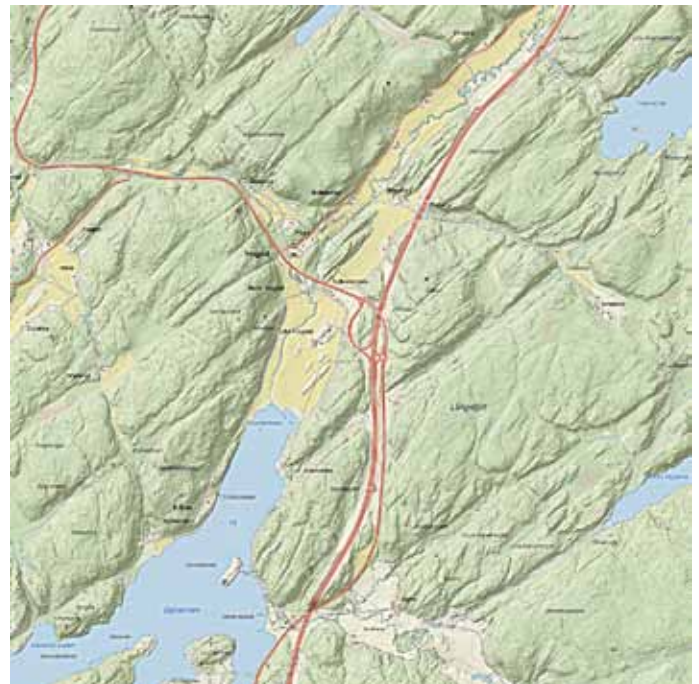
The nationwide aerial and satellite images provide valuable information about changes in the natural and built environment. Lantmäteriet has produced aerial photographs of Sweden since the 1930s and has produced satellite images since the 1970s.

Aerial photography

Aerial photography is mainly carried out in order to meet the needs for aerial photos and orthophotos within the national mapping program, but at the same time the activities are planned with the goal to provide other users with appropriate information.

New aerial photos cover approximately 30 percent of Sweden every year. The used sensors simultaneously photograph black/white, true colour and infrared data sets. They are furthermore the first step in a complete digital production line in the mapping process, ending in digital archives and in further dissemination.

The aerial photography season starts in April and ends in September. It takes approximately



Digital elevation model from SW Sweden, produced from recent laser scanning. The model has updated superimposed map data from Lantmäteriets Topographic web map service

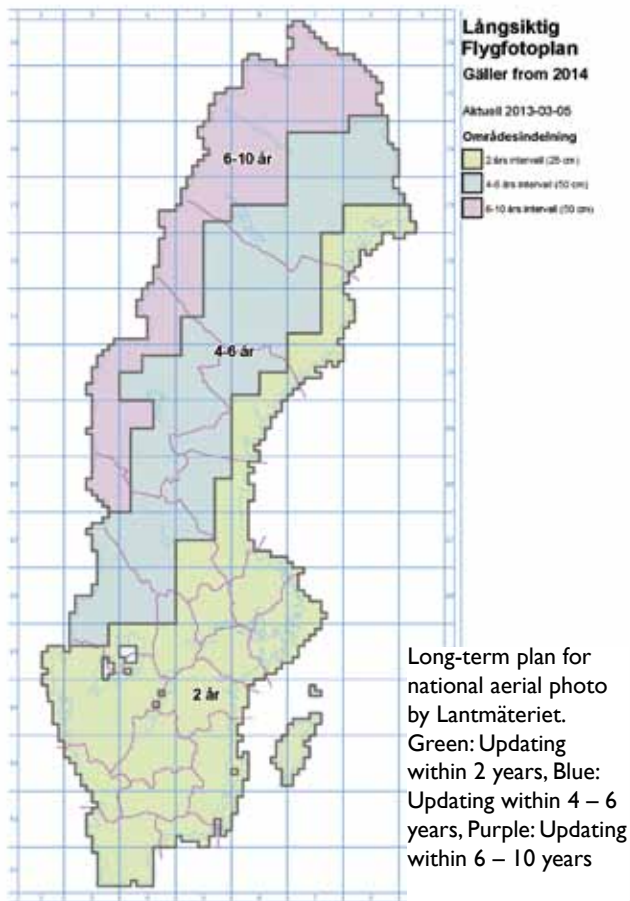
three months from the flight to ready processed orthophotos, both in colour and false colour infrared, to be provided to users. Today there is a national coverage of digital orthophotos with 0.5 m resolution. Since 2006 the most populated parts of the country, about 44 % of the total land surface, are also covered with a 0.25 m resolution coverage.

The amount of storage of aerial photos and orthophotos has reached 400 Tb and every year it increases by approximately 100 Tb. Added to this is the storage of scanned older aerial photographs from the 1930s onwards, currently containing about 75 TB, increasing annually by about 13



Two portions from Lantmäteriets Topographic web map service over the city Karlstad and surroundings, SW Sweden, approx. scales 1:10 000 and 1:250 000 respectively. All data is stored in one database, allowing seamless scaling with harmonised cartography and automatic adaptation of content and generalisation through the scaling process. Updating is made several times per year.





Aerial photo, the city of Karlstad. Lantmäteriet

There are more than a million aerial photo negatives in the analog image archive and there is an ongoing process to digitize all images.

Satellite imagery database

The database of satellite imagery, Saccess, was released to the general public in mid-2008. The contents of the database are national coverages from mainly Landsat and SPOT from the 1970s, 1980s, turn of the century, 2005 and yearly from 2007. The available data are either as satellite scenes or as mosaics in true colours or in IR-colours. Thanks to a unique cooperation between a number of governmental agencies and some private companies the data is available, free of charge, to organizations and the general public in in the Nordic countries.

Digital elevation model

In 2009 Lantmäteriet started to produce a new digital elevation model, replacing the model made some 35 years ago. The production is carried out by air-borne laser scanning from a flight altitude of 2,300 m. Up to 2014 88 % of Sweden was scanned with a height accuracy of less than 0,5 m. All Sweden will be covered in 2017, weather permitting. Already practising users are SGU, RAÄ, local and regional authorities. An important usage in the future will be identification and mitigation of natural disasters, apart from ordinary mapping.

Historical maps

All real property changes take place via a cadastral process. The results of any property changes are mapped and/or documented and archived for future reference in a cadastral file stored at the county office since the middle of the 1700's. The cadastral file includes all historical and current information describing a property's characteristics and corresponding cadastral procedures. All rights which have been granted and decisions which have been made regarding new plans and alterations can be found in these dossiers. Because of the abrasion of the dossiers in the archives, Lantmäteriet decided to digitise them. A project started in 2000 and with help from Media Conversion Center in Fränsta about 70 million documents were digitised under a period of nine years. Lantmäteriet's archives contain maps and documents dating from 1630 and onwards. There are more than 2.5 million dossiers from cadastral procedures and other mappings. These documents have been digitised and made accessible via the

Internet. The Historical Maps website is a presentation of large parts of Lantmäteriet's unique and invaluable collection of historical maps and cadastral dossiers. The collection comprises more than a million maps from all parts of Sweden and these are freely accessible in low resolution for the period prior to 1928. The archives contain not only Lantmäteriet's own dossiers, they also include decisions made by municipal authorities and county boards.

Historical orthophotos

Lantmäteriet's aerial photographs are used primarily for the production of maps. The images are also used in search services by directory companies such as Eniro and hitta.se. When aerial photographs are corrected geometrically, they are referred to as orthophotos. Today even older pictures can be transformed into orthophotos at the correct scale.

Being able to compare aerial photographs taken 50 years apart is not just an exciting prospect in visual terms. It also makes it possible to track changes in environments and communities to a detailed level. It is clear how a coastline has changed, but it is also easy to track old centres of pollution such as petrol stations and creosote factories. It is easy to see how vegetation has changed and map how waterways have become overgrown. Interest in these historical documents has grown over the past few years and expects to increase. In 2013, Lantmäteriet supplied over 25 % more historical orthophotos than in 2012.

Lantmäteriet launched a service on their website where visitors can monitor how the regions of Gothenburg, Stockholm and Malmö-Lund have changed by showing historical orthophotos alongside new photos. This initiative has aroused the interest of the media. Some examples:

- Fifty years ago Stockholm had a couple of football pitches on the site where the Globe Arena now stands. Sergels torg had not been built.
- Since the 1960s, Västra Hamnen in Malmö has been transformed from an industrial estate to a modern residential area.
- Residential area Angered in Gothenburg was covered of extensive forests in the 1960s.

The long-term objective is to scan the entire Lantmäteriet's image archive, consisting of 1.2 million negatives, including microfilm and meta-data, from the 1920s to 2006. By 2015, the aim is to have scanned 250,000 negatives and produced a collection of historical orthophotos from all over Sweden dating back to the period around 1960.

Geodetic infrastructure

Lantmäteriet provides both networks consisting of control points in the terrain and a network of permanent reference stations for GNSS position-

ing. SWEREF 99, which is connected to the global ITRF, is the national reference frame for three dimensional positioning in Sweden. A national height system, RH 2000, based on a nationwide levelling program, is available for accurate elevations. For the transformation of heights obtained from GNSS-measurements to levelled heights the geoid model SWEN08_RH2000 has been developed. Lantmäteriet recommends local authorities and other providers of local control networks to use the national reference frames.

SWEPOS is the Swedish network of permanent GNSS stations, providing real-time services on both meter level (DGPS/DGNSS) and centimeter level (Network-RTK), as well as data for post-processing. An automatic post-processing service is also available. SWEPOS has nationwide coverage and consisted in December 2010 of about 200 stations with inter-station distances of about 70 km. SWEPOS network-RTK-service has almost 2,000 users. Applications for SWEPOS services are eg. detail measurements, setting out, machine guidance. The SWEPOS users want higher accuracy in height and therefore the SWEPOS network was densified with another 200 stations in 2011–2015.

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Local Authorities and Regions (Sveriges Kommuner och Landsting, SKL)

Organization

The 290 local authorities in Sweden operate under a well-developed constitutional self-governance system. To perform their duties, they use geographical data and maps in several ways. There is also considerable need to use different maps for a variety of activities and operations.

The role of local authorities in providing basic large-scale geographic data becomes more important as its usage increases for both old and new applications, where GIS offers good support. There is also municipal co-operation within regions as well as between the municipalities and the state, in order to provide society with high quality controlled geographic data. The majority of local authorities produce and update geographical databases or maps within their individual organisation. In most cases, these organisations are part of the town planning committee. Other



A quite new City atlas of Malmö for the mobile is also useful for the computer.

national databases. A framework agreement for this arrangements was drawn up in 2001. This framework has been renegotiated twice in order to include more up to date higher quality data and to increase efficiencies. The co-operation concerns sharing of addresses, buildings, other topographic objects and cadastral index maps, among other matters. Normative agreements have also been developed which the local authorities may use as a base, while engaging in individual agreements with Lantmäteriet. There are a similar set of agreements in place with the Swedish Transport Administration concerning the roads network.

In 2011, Lantmäteriet, together with the Geodata Advisory Board (other Swedish public sector authorities and SALAR) created a national geodata infrastructure, which is also a part of the European infrastructure and the Inspire-directive. 195 of the 290 local authorities are now members which facilitates co-operation as well as easy and integrated access to information within the geodata sector.

Lantmäteriet, together with SALAR and local authorities, conducted a project, entitled Svensk geoprocess, to develop specifications for geodata on nine different data themes used in the planning and building process. Collaboration processes for updating the national database will also be developed. The project started in 2013 and will conclude in 2016. A factor for its success is the active involvement by the local authorities, which has been assured by part-financing their participation.

The expected outcome of the project will allow easier access to current and relevant geodata for local as well as regional and national players to assist in their work in the planning and building process.

local authorities purchase this service from commercial companies, while others do so in co-operation with other local authorities.

840,000 people are employed in the local authorities, which is equivalent to 17.5 % of the total sum of the national labour force. Of these, 6 % work within the technical field.

Co-operation

Most local authorities have formed groups which comprise the most frequent internal and external users of maps and GIS data and deal with matters of co-operation, technical development and financing. There are also regional groups which focus on mapping- and/or GIS-development.

There is also extensive co-operation between both the Swedish Association of Local Authorities and Regions (SALAR) and Lantmäteriet concerning for example, collaboration in constructing

With a responsive webdesign the city atlas of Malmö is useful on different medias.





In 3D Malmö City presents the plan for Hyllie as a second centre.

Part of the project involves the transition to the national reference-system SWEREF 99 and RH 2000.

A discussion is underway in Sweden on open data, particularly open geodata as other national mapping agencies in the Nordic countries have opened up access to all or part of their geodata as well as some municipalities. In Sweden, this issue on open data has been raised primarily by users, i.e. Lantmäteriet and some larger municipalities. A working group comprising representatives from Lantmäteriet, SALAR and municipalities has been appointed to review the effects for users and producers of open geodata in the Swedish context.

In recent years we have noticed the increasing use of software programs under the concept of open source for the development of various mapping applications. A number of municipal clusters have been formed to jointly develop these tools.

Development

E-government is of increasing importance for the delivery of all sorts of activities within the local authorities as well as the increase in applications. The issue of national specifications of requirements for common functionalities for adoption in various administrations is in focus.

Development of GIS-applications as e-services are constantly in progress.

GIS-technology is commonly used within municipalities. However, there are difficulties in the distribution of GIS technology outside of mapping organization to other administrations, such as schools, social services, and health care. Impedi-

ments to this may consist of poor resources, non-structured datasets, or pedagogical difficulties. Many local authorities have employed a GIS controller to stimulate and encourage the use of GIS in all sorts of activities within the organisation.

Today GPS technology is commonly used. Examples include aerial photography, digital aerial images, orthophotos and photogrammetric mapping systems are often purchased at intervals of several years. About 60 of the 290 municipalities have their own digital photogrammetric software for collecting data from aerial images. LIDAR has been adopted as the standard method for assembling data for growth areas as well as for studies of climate change problems. This method generates digital terrain models as well as digital surface models at a reasonable cost. Altitude data is used, for example, for three-dimensional city models and for production of orthophotos.

In order to provide a high-quality overview of proposals on spatial planning and infrastructure, some local authorities, have utilised virtual reality and augmented reality technology. Other authorities have commenced transforming their data into three dimensions models for the purpose of visualising the urban environment in a more natural manner. To facilitate the processes of planning and building permits, oblique aerial imaging systems have been introduced in the largest municipalities.

For smaller mapping projects and for the production of 3D-citymodels, small unmanned aerial vehicles (UAV), have been used. Some municipalities and several consultants offer now services using UAV.

The SWEPOS Network RTK Service has been expanded using regional year-long establishment projects which reached national coverage in 2010. Still under development, the network of reference stations had in December 2014 a total of 328 stations serving approximately 2,480 subscribers.

The changeover to SWEREF 99 and RH 2000, which are the Swedish realisation of the European reference systems ETRS89 and EVRS, is in progress within government authorities and the municipalities. Out of a total of 290 municipalities, 265 had in December 2014 changed to SWEREF 99 and 166 to RH 2000 (compared to relevant government authorities and state-owned companies of 80 % and 79 % respectively) have changed to SWEREF 99 and RH 2000.

Address

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Sweden's County Administrative Boards (Länsstyrelser)

Organization

Sweden is divided into 21 counties, each of which has its own County Administrative Board (Länsstyrelsen) and County Governor. The function of the County Administrative Boards is to be a representative of the national state in their respective counties, and to serve as a link between the inhabitants, the municipal authorities, the Central Government, the Swedish Parliament and the central state authorities.

GIS/GIT activities

Maps and databases are frequently used in many of the legislative tasks, such as permits or recommendations for a proposed expansion of some exploitation request etc, in the work carried out by officers in the administration. The County Administrative Boards are both data consumers and data producers. In the day-to-day work, officers make extensive use of background data from Lantmäteriet, the Geological Survey of Sweden, the Swedish Maritime Administration, Swedish Meteorological and Hydrological Institute and many other data providers. The access to all this background data is made possible by our membership in the national SDI collaboration. Internally produced data from surveys, analyses and processes, is also used to a large extent by our officers.

The 21 County Administration Boards share the same IT-platform which includes a common GIT-platform and storage of geographic information. To coordinate the use of GIS on the 21 authorities there is a GIS-policy which provides the framework for the use, production and administration of geographic information. The goal is providing standardized and harmonized geographic information with national coverage for both internal and external users.

A large part of the internally produced data is freely distributed through our website "Länsstyrelsernas GIS-tjänster". Via the website you get access to:

- About 500 regional GIS-related layers provided by the separate Counties
- Over 30 harmonized layers with national coverage of which many also are provided as OGC WebMapServices (WMS)
- Three datasets consisting of INSPIRE-specified information in WMS-format with ATOM-services
- Approximately 35 web map applications (regional, national and thematic)
- Metadata are provided using core components from ISO19115, INSPIRE, the Swedish national profile and some specific elements for the County Administrative Boards.

Technical development

Due to an enterprise agreement with ESRI our GIS environment is based on server and client software from ESRI.

- We use ESRI's ArcSDE for a "standardized" repository with internally produced Geodata.
- We provide Geoservices, both internal and external, by the use of ArcGIS Server.
- We have approximately 1,500 installations of ArcGIS Desktop.
- We base our web map applications on ArcGIS Servers API for Microsoft Silverlight.
- We are building a new metadata portal mainly based on the Open Source software GeoNetwork and the ISO standards 19139 and 19115, with the purpose of making access to our geodata easier, both for internal users and the public.
- We are building new public web map applications based on platform independent technology and responsive design.

Authority cooperation

- Participation in the national SDI collaboration and the National Geodata Advisory Board.
- Participation in a geodata exchange collaboration, with the purpose of improving the quality of web services for end users.

Addresses

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The Swedish Maritime Administration (Sjöfartsverket, SMA)

Organization and mandate

In Sweden the Hydrographic Office, responsible for hydrographic services, is organized under the Swedish Maritime Administration (SMA, Sjöfartsverket). The Hydrographic Office is responsible for hydrographic surveying in Swedish waters and publication of official nautical chart products in electronic and paper format and maritime safety information such as Notice to Mariners. Most of the Hydrographic Office 115 employees are located in Norrköping, but approximately 25 of the staff are on-board on the SMA's own survey ships which are operating in all Swedish waters. Most of SMA's activities are financed through dues on ships and cargoes.

As a coastal state Sweden has ratified the United Nations Convention on the Law of the Sea (UNCLOS) and the Conventions for the Safety of Life at Sea (SOLAS). Related to hydrography these two UN conventions require that the coastal state's waters must be charted so relevant nautical charts and publications can be published to secure navigation in and passage through the coastal state's waters. The Swedish government has mandated these tasks through its instruction to the SMA. Through these instructions the SMA is also representing Sweden in the International Hydrographic Organization (IHO).

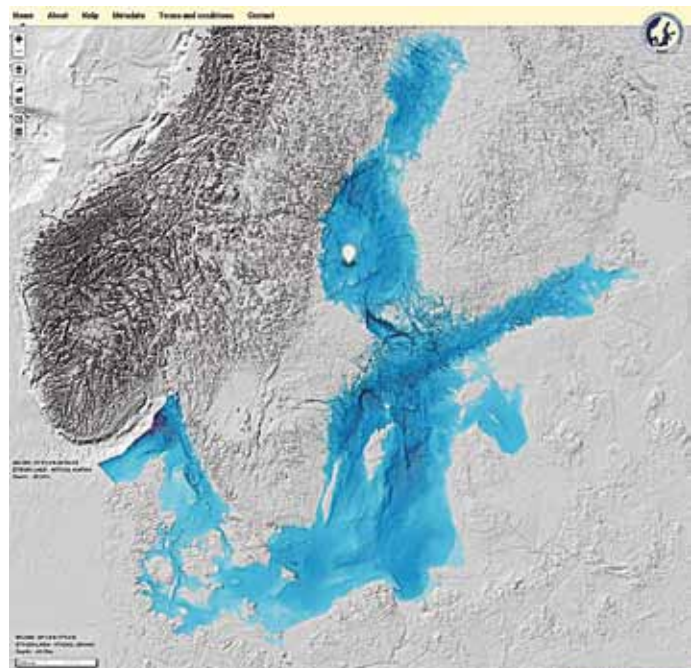
International co-operation

Shipping is a global market dependent on international standardised nautical products. Therefore a hydrographic office is totally dependent on international interaction. The intergovernmental co-operation in hydrography is done through the IHO, by the member states hydrographic offices and the bureau (IHB) in Monaco. Within the IHO the hydrographic offices co-operate on standardisation, development of exchange formats and distribution system in all matters related to hydrographic surveying, printed and electronic nautical

charts and other things related to hydrography in both global and regional aspects. Regional aspects are organised through regional hydrographic commissions such as the Baltic Sea Hydrographic Commission (BSHC). All countries surrounding the Baltic Sea are member states in the BSHC which is very active in international work and analyses.

Some of the BSHC activities are co-ordinated with HELCOM which is the governing body of the "Convention on the Protection of the Marine Environment of the Baltic Sea Area" – more usually known as the Helsinki convention. Since major parts of the Baltic Sea waters have never been surveyed with modern methods a common plan, the HELCOM Hydrographic Re-survey plan, has been developed for the purpose of re-surveying shipping routes and ports of the Baltic Sea. This survey plan, with time schedules, was decided upon by the member states environmental ministers in October 2013 in the HELCOM ministerial declaration. In the case of Sweden this means that all waters used by commercial shipping must be surveyed, according to the IHO-standard, in the year 2020. Other actions within the BSHC includes coordination of vertical reference levels for nautical products and water level information, coordination of international paper and electronic charts in the Baltic Sea and co-operation on a bathymetry portal. The Baltic Sea Bathymetry Database <http://data.bshc.pro/> has been developed by the hydrographic offices of the countries surrounding the Baltic Sea under the leadership of the SMA. A 500 m grid of depth data is available for viewing and downloading at the portal.

The Baltic Sea Bathymetry Database developed by the Hydrographic Offices from countries surrounding the Baltic Sea under the lead of the Swedish Maritime Administration.



National co-operation

Co-operation with other Swedish Authorities as well as the private shipping sector is essential for the SMA. There is an established successful co-operation with the Swedish mapping, cadastral and land registration authority (Lantmäteriet) where one important example is the compilation of a common coastline for use in both parties' official products. Successful co-operation is also established with the Swedish Agency for Marine and Water Management, the Geological Survey of Sweden as well as the Swedish Meteorological and Hydrological Institute and others involved in marine environmental and spatial planning issues.

Hydrographic surveying

Bathymetry is primarily used for nautical products to secure safe shipping, however many other sectors of society are dependent on bathymetry. Examples are mapping of the marine environment, marine spatial planning and efficient preventive measures for protection from the effects of expected future climate change in the coastal zone. Also in the shipping sector high resolution bathymetry can be used in other ways than just nautical charts. The fuel consumption of a vessel is strongly influenced by its speed and the depth of water under the keel. Fuel consumption begins to increase in water seven times the vessel's draught. A vessel with 10 m draught begins to be affected at a depth of 70 m. In a comparatively shallow area such as the waters around Sweden there would be a possibility of reducing fuel consumption by finding deeper routes in the Baltic Sea. Providing the shipping sector with high resolution bathymetry in order to find these deeper routes will help shipping to be more cost efficient and at the same time reduce the environment impact, but a precondition is new hydrographic surveys.

Swedish waters cover an area of 165,000 km², mostly comparatively shallow, with 2,700 km of coastline. Archipelagos are widespread and are a challenge to seafarers and especially challenging to surveyors. As a result of a successful project

The SMA survey vessels.



co-financed by the European Commission TEN-T programme the Swedish and Finnish Hydrographic Offices managed to speed up the surveying of its waters up to the applicable IHO standard. In the beginning of 2011 only 25 % of Swedish waters were charted according to this standard, increasing normally with 2 % per year. However in 2015 as much as 50 % of the Swedish waters have been surveyed up to the standard thanks to the co-financing from the European Commission.

The IHO Standard for Hydrographic Surveying (S-44) means surveying with full seafloor coverage. Specific harbour areas where the margin between vessel and bottom (dynamic clearance) can be very small are controlled to a greater accuracy by bar sweeping which is a mechanical method of detection. The main method of surveying elsewhere is multi beam echo sounding which gives a wide, complete and accurate picture of the seafloor. Developments to this method have meant that footprints are smaller and more numerous giving improved resolution and a higher probability of detecting small objects. Improvements in positioning, acoustics, movement sensors, analysis etc. have resulted in an increase in the reliability, accuracy and amount of data produced. Improved analysis methods applied directly on-board mean that anomalies can be identified and eliminated whilst the ship is still in the operation area. The SMA has four vessels at its disposal with a staff of 25 surveyors which is sufficient to crew three vessels continuously. The two largest vessels run 24 hours per day, 7 days per week, weather permitting.

The challenge of charting Swedish waters to meet modern standards continues and the SMA is taking the lead in a project where partners from all EU member states surrounding the Baltic Sea, except Poland, are involved and are seeking support from the European Commission's new CEF programme (Connecting Europe Facility).

Below the surface – the film

Swedish Maritime Administration has during this period been engaged in a co-operation project with the Norrköping Visualisation Centre. The result is a 28 minute film ("Under Ytan" in Swedish) produced for the dome theatre in Norrköping. The film had its grand premiere in January 2014 and is now shown as part of the public program of the Visualisation Centre. The message that the film conveys is that our seas and especially the Baltic Sea are very sensitive environments. The film is predominantly made with animations but bathymetry data from the SMA has been used in the production. At the Swedish Cartographic Society annual conference the film was shown in a portable inflatable dome.



The Dome film production 'Below the Surface', revealing the secrets of the sea.

Cartographic activities

In order to produce user friendly nautical products for commercial mariners, the leisure craft market, navy users, the fishing industry etc. complex information must be compiled into a fully readable and understandable chart. When selecting the most important information from a high resolution depth data set generating readable depth contours and the most important depth figures nautical cartographic skills are essential. Mariners are totally dependent on the nautical chart when navigating, since the dangerous obstacles below the surface are invisible and only revealed in the chart. The nautical chart is in that sense more of an infrastructure than just a map. Cartographic judgement must be applied when all type of products are being produced; paper charts as well as electronic charts.

Paper nautical charts

Paper charts covering Swedish and adjacent waters are produced by the SMA, i.e. Skagerrak and the Baltic Sea, including Kattegat and the Gulf of Bothnia. Paper charts are also published covering the four largest lakes in Sweden (Vänern, Mälaren, Vättern and Hjälmaren) as well as the three largest Swedish canals. The charts are divided and designated according to their scales and areas of use. Users are urged to navigate using charts of the largest possible scale as essential navigational information may have been omitted in the smaller scale chart depending on the purpose of the chart. Printed nautical charts are designated as the following scale ranges:

- 1:300,000 – 1:1,500,000. The scale is usually 1:500,000. Charts are used for planning and navigation in open seas.
- 1:180,000 – 1:300,000. The scale is usually 1:250,000. Charts are used for navigation in coastal waters.
- 1:40,000 – 1:180,000. The scale is usually 1:50,000. Charts are used for inshore- and coastal navigation.

- 1:10,000 – 1:40,000. The scale is usually 1:25,000. The charts cover areas of heavy traffic, narrow archipelagos, harbours and approaches.

Small craft charts

The SMA also supply charts in a smaller format mainly for the leisure craft market. Each edition contains 36-66 pages in size A3 and are attached with a spiral-binder and printed on a water-proof paper (Pretext). The contents are the same as in ordinary charts with some additional information about marinas.

Electronic Navigational Charts

The vector based Electronic Navigational Chart (ENC) are used in the Electronic Chart and Display Information System (ECDIS) which is the approved system on-board on commercial ships. On the electronic chart display the ship's position is shown as well as other ships positions using GNSS and AIS (Automatic Identification System). The UN agency the International Maritime Organization (IMO) has decided upon carriage requirements of ECDIS being implemented and the regulation require ships engaged on international voyages to be fitted with ECDIS according to a timetable meaning that most ships will have an ECDIS on-board 2018.

Swedish official ENCs are produced by the SMA in usage bands similar to the scale areas described for paper charts above. The use of electronic charts is steadily increasing as an alternative to or a complement to paper charts. In order to use ENC instead of paper charts the system must fulfil the requirements specified in the IMO Performance Standards for ECDIS. Swedish waters are completely covered by ENCs which is also the case in all neighbouring countries. Official Swedish ENCs are distributed via a global distribution centre, PRIMAR, which is a part of the Norwegian Hydrographic Service with head office in Stavanger, Norway. PRIMAR serves as a centre for ENC-distribution to the shipping sector and the end users receive continuously updated ENCs. In the case of Sweden the SMA distributes 1,500 updated ENCs in a typical year. Examples are changes in harbours and fairways, new under water cables and pipelines or changed depth information as a result of the hydrographic surveying. Updates are available for the end user by both an online service and a weekly produced CD.

Quality improvement

The nautical chart of today is a comprehensive and complex document showing a detailed shoreline, detailed information on depths, characteristic landmarks, fixed and floating navigational aids etc. In addition a navigator is provided with

necessary navigational, traffic and port information, compass charts with deviations, chart limits etc. A navigator needs as much information as possible but at the same time not too much information since it would overload the chart with misleading information of lesser use for navigation. This is valid for paper charts as well as electronic charts. The ability to show the vessels position, given from GNSS, on top of the electronic chart requires an improved accuracy of the chart information than was the case when charts were only available as a paper product. Quality improvement of the content in the chart products is one of the major challenges and where SMA puts in a lot of effort.

Improvement of accuracy is concentrated on the most crucial themes for mariners. As described previously hydrographic surveys are performed in all areas used by commercial shipping and will result in updated and accurate depth information in the charts. The coastline is continuously improved through the co-operative project with Lantmäteriet where the old coastline in charts is replaced with new photogrammetric surveyed coastline. The joint coastline project is a part of a larger challenging project, which makes a major quality improvement, and its goal is to change the vertical reference level in all chart products. A common vertical reference level for the whole Baltic Sea has been agreed upon in the BSHC. Due to post glacial land uplift since the end of the last ice age, there is a need to refer the depth information to a more up to date vertical reference level. The current situation could be confusing; with a depth figure in the chart saying 8 m which in reality is only 7.5 m. Improvement in positioning of nautical objects such as lighthouses and buoys also contributes to greater accuracy of the nautical chart products.

Publications

In spite of the fact that a modern nautical chart contains a large amount of information there is still a need of supplementary information in the form of publications containing information which usually cannot be presented on a chart. The following are the essential ones for merchant shipping produced by the SMA:

- Swedish Notices to Mariners (NtM, Swe: Underrättelser för sjöfarande, Ufs) gives information in the form of updates or warnings so the end users are able to update their paper charts. The publication is available as a downloadable pdf at www.sjofartsverket.se/ufs.
- Notices to Mariners volume A (Swe: Ufs A) is a compilation of general information of nautical interest.

- Kort 1/ INT 1 contains symbols, abbreviations and terms used on Swedish and international charts.
- NAVTEX Warnings in the Baltic Sea area: As a supplement to in particular the Ufs, special navigational warnings are broadcasted.

Address

Swedish Maritime Administration
Hydrographic Office
SE-601 78 Norrköping
Sweden
Web: www.sjofartsverket.se
E-mail: sma@sjofartsverket.se

Geological Survey of Sweden (Sveriges geologiska undersökning, SGU)

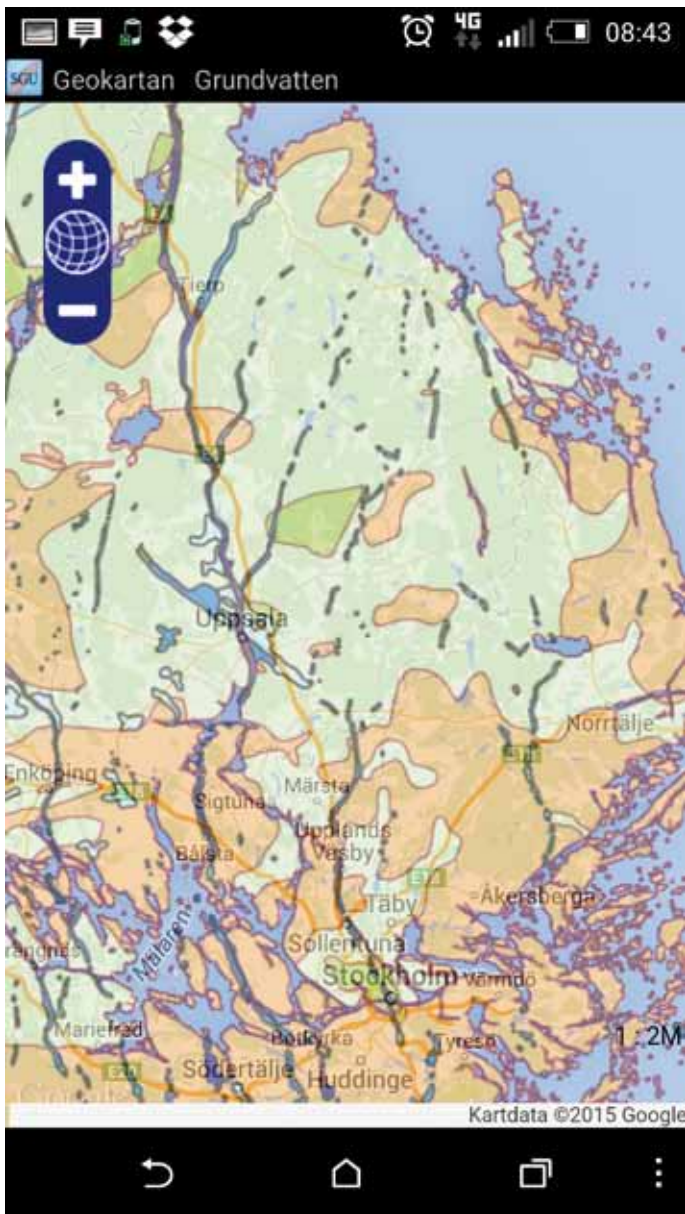
Organization

The Geological Survey of Sweden (SGU) is the central government agency responsible for questions relating to soil, bedrock and groundwater in Sweden. SGU is organized to meet society's need for geological information. Our five internal departments reflect the broadness of SGU's expertise. We have an economic-political as well as an environmental-political task from the government. The SGU head office is located in Uppsala. We also have branch offices in Falun, Göteborg, Luleå, Lund, Malå and Stockholm.

Web services and apps

In recent years we have seen map production undergo the transformation from hardcopy maps to web services. During the past two years, we have also developed apps for mobile devices. The first app to be released was Geokartan, which currently allows the user to view maps of bedrock, soil, soil depth, groundwater, wells and springs, and mineralisations. The app will be expanded to contain additional layers in the future. This application was awarded a price for best mobile app in 2012. Geokartan is platform independent, which means that you can use it on any type of equipment and with all operating systems. It is available from <http://maps2.sgu.se/geokartan/#mappage>.

GeoTreat is an international portal designed to help you to find points of geological interest. It started as a cooperation between the Nordic countries Denmark, Finland, Norway and Sweden, but the aim is to include more countries. It is currently also available in Australia. GeoTreat allows you to study geologically interesting sites directly in your mobile phone, either at home or directly in the field. GeoTreat is an android app available on Google Play.



Example of a groundwater map viewed in the app Geokartan.

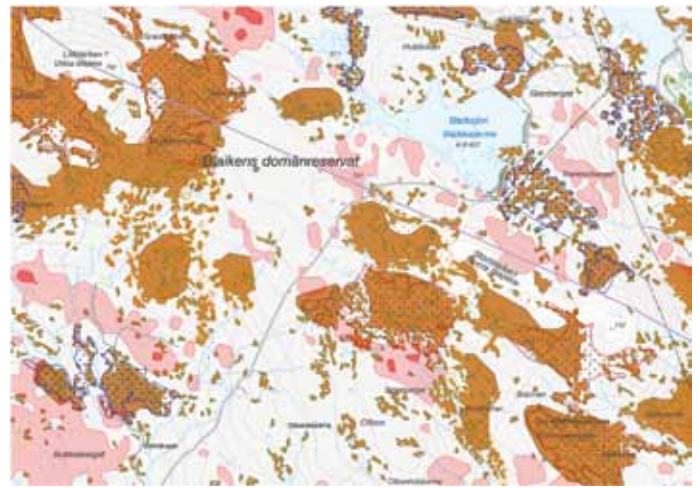
Open data

In 2014, SGU has published groundwater related data and marine geological data as open data with a Creative Commons Attribution license. The data on groundwater contain wells, springs, environmental monitoring of groundwater, groundwater levels, groundwater occurrences and monthly maps of the groundwater level. Marine geological data that have been published include environmental monitoring of sediments from seas and lakes.

In March 2015, geochemical analyses of 58 chemical elements from the Geochemical Atlas of Sweden were published in two open formats, CSV and JSON as file downloads and API requests.

Hack for Sweden

SGU has been involved in Hack for Sweden, which is a national hackathon organized by around twenty national government agencies. Hack for Sweden was first held in 2014 and re-



The map-viewer Peat shows information which can be used in the planning and inventory of peatlands suitable for extraction of energy and horticultural peat. The map-viewer shows peatlands identified during SGU's mapping of Quaternary deposits, and also contains e.g. information on areas with high radiation from uranium, energy peat extraction sites and land areas previously situated below the marine limit.

peated in 2015. All agencies have contributed with their specific open data to the project and developers were invited to participate during a weekend to develop applications using the data. The winners were awarded with the "Hack for Sweden Award" for the most creative combination of different data sets.

Web cartography

Web viewers and services provide great possibilities to present geological information at different scales and at different levels of detail. They also allow the combination of data sets that have not traditionally been combined, and a variation in which data sets are shown depending on the map scale. The visualisation of geological information on screen, however, also provides challenges, and the migration from paper to computer screen has provided more user-friendliness but also fewer opportunities to produce advanced cartography. SGU's geological data consists of a combination of geological surfaces, lines and points which needs to be shown together with topography. Some of the map viewers, e.g. bedrock maps, share the principles of cartography with our printed maps. Other map viewers have been more adapted to on-screen viewing. The symbols and colours used build mainly on our own long tradition of symbolising geological features but have in some instances been adapted to international standards.

We have now developed a designated web cartography for about 20 of our 30 map viewers. Unique for the web cartography is, for example, that a certain feature may be shown with one symbol at a small scale but with a different symbol, or even several symbols to provide more detail, on a large scale. The use of patterns on polygons is a traditional way to visualise geologi-

cal surfaces, and this has also been implemented in our map viewers.

In 2014 we documented our work in web cartography and made it available on our web site in order to contribute our efforts to others who are working with similar issues.

SGU is a member of the Technical Committee which is co-ordinated by the Swedish Standardisation Institute (SIS) and is participating in a national standardisation project on web cartography. One aim of the project is to increase the awareness of cartographic opportunities on the web. Secondly, the project aims to provide guidelines for maintaining the quality of web-based cartography when presenting data subsets in combination with subsets provided by external geodata producers.

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E-mail: sgu@sgu.se

Swedish Civil Contingencies Agency (Myndigheten för samhällsskydd och beredskap, MSB)

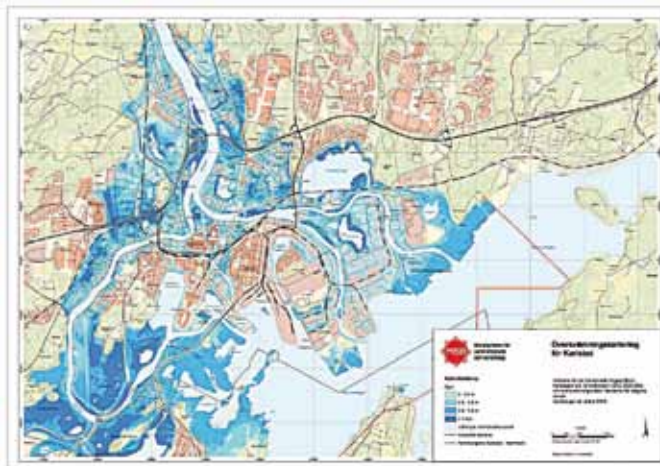
MSB is responsible for issues concerning civil protection, public safety, emergency management and civil defense as long as no other authority has that responsibility. Responsibility refers to measures taken before, during and after an emergency or crisis. We work

- via knowledge enhancement, support, training, exercises, regulation, supervision and our own operations
- in close cooperation with the municipalities, county councils, other authorities, the private sector and various organizations
- to achieve greater security and safety at all levels of society, from local to global

The Swedish Government steers the MSB via a body of instructions and an annual appropriation. The instructions specify the MSB's responsibilities and tasks. The appropriation specifies the objectives and reporting requirements, as well as the resources allocated for MSB administration and MSB activities.

MSB offers a range of products, systems and services in the field of civil contingencies. These are for individuals, organizations and companies working with or interested in our issues.

In the field of GIS is MSB both user and producer of spatial data. As a part of the Swedish Spa-



MSB produces maps over threats in case of floodings.

tial Data Cooperation, MSB can both use spatial data from other authorities and make the own spatial data accessible for others.

As a prevention of crisis MSB makes country-wide assessment and risk identification of the consequences of floods in Sweden. There are more than 75 rivers already mapped with calculation of a hydrologic model based on measurements and extrapolated to 50, 100, 200 years and the ever highest flood measures.

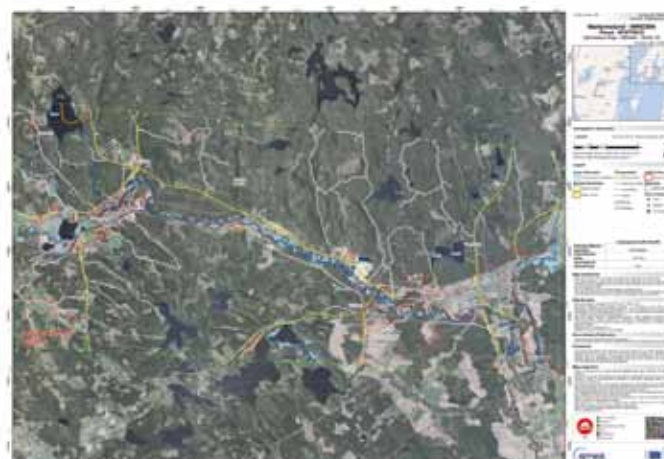
The European SDI, Inspire harmonizes spatial interregional data for the whole community. MSB contributes with data of e.g. floods, wildfire and other fire events, landslides, oil leakages, natural catastrophes, major accidents, fire stations.

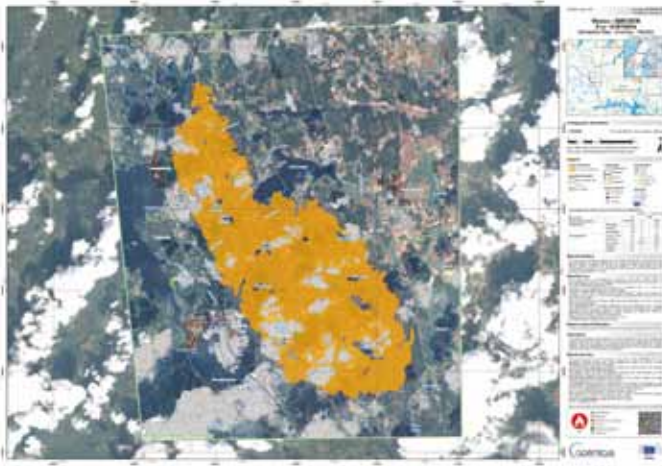
MSB contributes under major crisis in both national and international missions with maps based on satellite images and orthophotos.

Personal on national or international missions working for MSB is supplied regularly with updated maps and data.

The European Earth Observation Program, Copernicus, provides information about the actual environmental situation of the earth and detects the climate changes. The program is divided in six thematic services: Land Monitoring, Marine Monitoring, Atmosphere Monitoring, Emergency

During a weekend in July there was a heavy rainfall in Småland which caused some floodings. The flood in Målilla was mapped by MSB.





A heavy wildfire in Västmanland took place in 2014. MSB was responsible for different types of usable maps.

Sundsvall, Stockholm/Upplands Väsby, Göteborg and Malmö. Half of SMHI's income comes from commission work and business enterprise and the rest from government grants.

Operational mapping

The state of the atmosphere, current and forecasted, is mapped on a daily basis using numerical models and observations from several sources. HIRLAM (High Resolution Limited Area Model) and AROME (Applications of Research to Operations at Mesoscale) are the most important models. The resulting maps of different weather factors are presented to the public through media and on the Internet. Another mapping on a daily basis is done using the MESAN system (Mesoscale Analysis). MESAN provides gridded map information. The system uses optimal interpolation of observations from different sources with results from the AROME model as a first guess. Among the data sources is information from both geostationary and polar orbiting satellites within the European co-operation EUMETSAT. The system is under development and contains at present several variables describing the lower part of the atmosphere, the ground and sea surface. The grid sizes are 2.5 km and 11 km respectively. Within oceanography the HIROMB model (High Resolution Oceanographic Model for the Baltic) gives daily forecast maps on sea levels, currents, ice concentration, ice thickness, salt content and water temperature. The SWAN (Simulating Waves Near shore) model gives forecasts on wave heights and wave periods. The Seatrack Web system makes forecasts and backtracks of oil and pollution spills. Hydrologic maps are produced daily based on the results of the HYPE and HBV models. The maps show the variation of variables such as runoff, snow cover and soil water content. The hydrologic model is also a tool in the production of maps showing the risk of forest fires. Daily forecasts are produced during the spring and summer seasons. The system includes the use of the AROME, ECMWF, and the MESAN system. Precipitation and cloudiness are mapped daily with a Nordic weather radar network, NORDRAD. The maps are used in presentations of the weather development. They are also used to support the production of meteorological and hydrologic forecast maps. The weather and water conditions during the past month are mapped and reported monthly at SMHI's website. The report contains hydrologic, meteorological and oceanographic maps. There is also a ground-water map from the Swedish Geological Survey.

Management, Security and Climate Change. MSB makes use of support from the Emergency Management Mapping Service and has responsibility to initiate a mapping process both in rush and non-rush mode, as a national focal point.

For flood mapping in an emergency situation satellite maps can aid detection of damaged areas.

In summer 2014 a wildfire, the biggest ever in Sweden, occurred, the data captured from the space played an important role in firefighting activities. MSB collected and produced daily data and maps about the enlargement of the fires affected area from both back office and on the field. This activity is still under evaluation.

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Swedish Meteorological and Hydrological Institute (Sveriges Meteorologiska och Hydrologiska Institut, SMHI)

Organization

The Swedish Meteorological and Hydrological Institute, SMHI, is a government agency within the Ministry of Environment and the national authority for meteorology, hydrology, and oceanography. The institute's core activities focus on public requirements for forecasting, early warning, monitoring, research and international co-operation. One of SMHI's main objectives is to secure a basis for planning and decisions in activities dependent on atmospheric, inland water and sea conditions. SMHI is organized into six departments: Core Services, Environment & Safety Services, Business & Media Services, Research, IT, Administration. SMHI has 600 employees. SMHI's headquarter is located in Norrköping with branches in

General Mapping

SMHI has created and maintains a number of national maps. Basic maps are those on 30-year averages of precipitation, runoff and evaporation. In addition there are a number of map categories available. Several maps concern climate variables describing averages for the period 1961–1990. The number of hydrographical maps is extensive. Examples are the map of water divides for about 50,000 drainage basins, the map of digitised rivers and more than 8,000 lake depth maps.

Lantmäteriet and SMHI are working together to create hydrographic products for customers ready to use in 2017. The nationwide map data will show lakes and streams in a network and how the water flows from start of the water source to the sea. The project starts producing data in southern Sweden in defined catchment areas. Hydrographic data is produced in scale 1:10,000 which gives a more detailed description of waterways and surface water bodies compared to current hydrographic data that is available in Sweden. Standardised web services will be developed to enable the use of the network.

Address

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Swedish Transport Administration (Trafikverket, TRV)

Organization

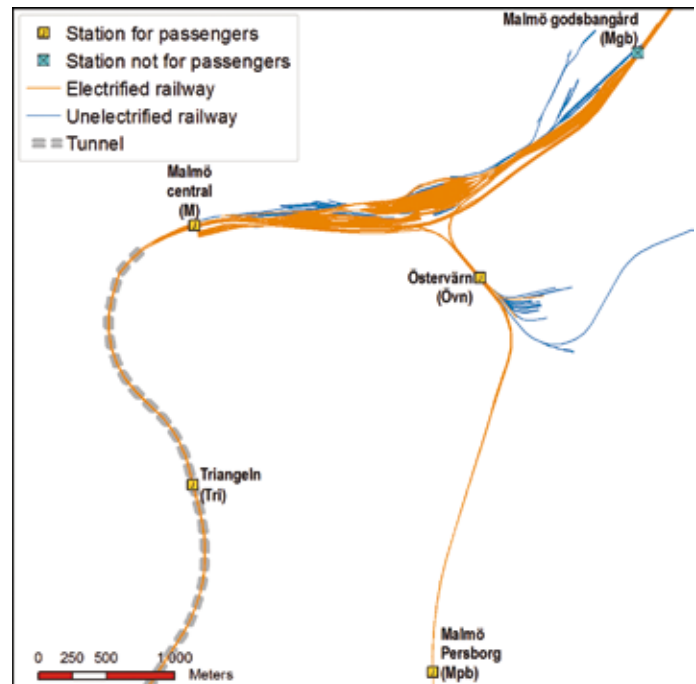
Trafikverket, Swedish Transport Administration (TRV), was formed in 2010 when the former Swedish Road Administration and Swedish Rail Administration merged.

TRV is responsible for the construction, operation and maintenance of the state road network and national railway network. TRV is also responsible for the planning of the transport system for road and rail traffic, and for developing long-term plans for the entire transport system – roads, railways, flights, and sea transports.

The main office is located in Borlänge, there are regional offices in Kristianstad, Göteborg, Eskilstuna, Stockholm, Gävle and Luleå, and local offices in several other places around the country.

Geodata

TRV is maintaining a lot of geodata, primarily describing features of the physical roads and railways, but also data such as traffic information and traffic quantities.



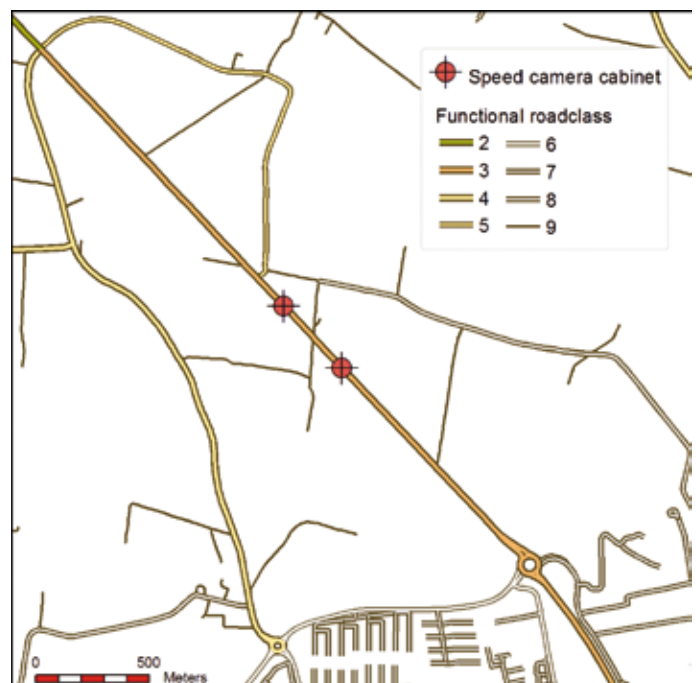
Example of railway data features

The Swedish legislation supporting the implementation of the Inspire directive, states that TRV is responsible for providing data describing the Swedish railway and road networks. The data served according to the Inspire directive is based on the national road database and the railway data that is maintained in the administration's railway database. Metadata on railway data, road data and web services are available in the national geodata portal, www.geodata.se.

Railway data

TRV's railway database consists of the railway network and railway data feature types related to the network. Not long ago the database covered

Example of road data features





Clip from the Road Information Map (Väginformationskartan)

the state owned railway and a few other main railway lines connected to the state network. But since 2014 the railway database is being extended because of an ongoing work building a national railway database, NJDB. This means that data describing railways owned by private companies, municipalities or associations is being collected and registered in the database. This also means that other types of railway such as narrow gauge railways, metro or tram will be included.

Road data

The Swedish national road database (NVDB) consists of the road network and road data feature types related to the network. The road network covers all roads in Sweden where motor vehicles are allowed to drive, with the exception of tractor roads, including ferry lines as considered a part of the road network. To a high degree it also covers bicycle paths and in a near future the first parts of pedestrian networks will be added. Road data features are road or traffic data that are related to the road network along a stretch of a road or at a specific point. The features can be either physical objects, e.g. a railing or a bridge, or some kind of property, e.g. speed limit or street name.

Cartographic profile

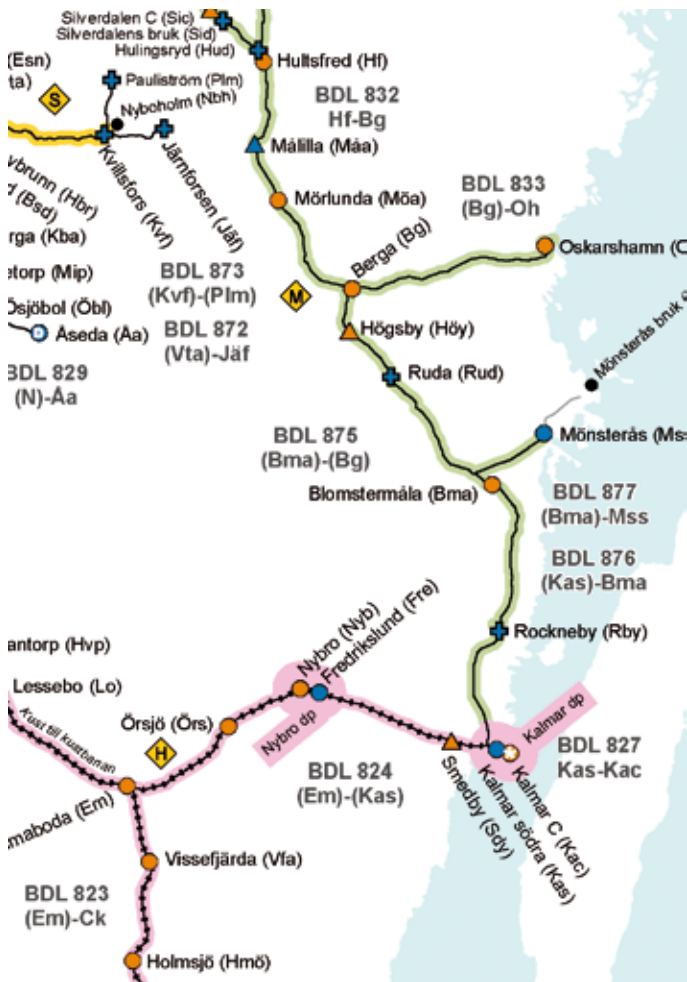
In 2013 TRV published a cartographic profile. The aim is to support map production in TRV so that maps published by TRV should be well recognized, produced effectively and match the graphic profile. A manual, layout templates, background map symbology and a palette of TRV's profile colours are available for map producers working inside TRV as well as outside.

A set of cartographic representations for some of the most common road and railway data products has also been defined, and are on its way of getting implemented.

Maps

TRV produces a variety of maps. The maps are in general intended for communicating construction projects, for supporting maintenance and operations of the transport system or to visualize some characteristics of the transport system in Sweden. Some of the most demanded maps that are produced on a regular basis are described below.

The Road Information Map (Väginfokartan) is a map intended to give information about the road network that is relevant for truck drivers and other kinds of commercial traffic. The map is displaying road data feature types such as bearing capacity, gravel roads and prohibitions for vehicles carrying dangerous goods. The maps are produced annually for each county in Sweden and for each of TRV's regions and they are available in digital and printed form from TRV's web shop.



Clip from The Operations Management Area Map (Trafikcentralområdeskartan)

The Operations Management Area Map (Trafikcentralområdeskartan) is intended to support the railway control centers. The map is displaying railway data feature types such as traffic control system, number of tracks and classification and identification of operating sites. Along with the new annual timetable, the maps are produced for each traffic control center areas. The maps are published on TRV's website.

The Swedish Transport Mode Map (Sverigekarta för de fyra trafikslagen) is a large format map displaying railways, roads, airports and harbours. The map is intended to give an overview of the entire transport system in Sweden. The map is available in digital and printed form from TRV's web shop.

Address

Swedish Transport Administration/Trafikverket
 SE-781 89 Borlänge
 Sweden
www.trafikverket.se
 E-mail: trafikverket@trafikverket.se

Clip from the Swedish Transport Mode Map (Sverigekarta för de fyra trafikslagen), reduced scale.



Statistics Sweden (Statistiska centralbyrån, SCB)

Organization

Statistics Sweden is a governmental agency responsible for producing and communicating statistics for decision making, debate and research. Statistics Sweden is mainly assigned these tasks by the government and different agencies, but customers in the private sector and in the research community are also important target groups. Besides producing and communicating statistical data, the agency is tasked with supporting and coordinating the Swedish system for official statistics as well as participation in international statistical cooperation.

Geospatial data in production of statistics

Statistics Sweden has a longstanding tradition of geographical applications in the production of official statistics. The first steps towards usage of georeferenced information as a regular component of the statistics portfolio were taken already in the 1980s. In late 1980s, real property coordinates together with data from the population register were used to produce the first machine generated population grid of Sweden. Today, GIS and geospatial information are integral parts of the production chain in many statistical products, especially in the field of land use statistics.

The use of geospatial information within Statistics Sweden can be broadly divided into two different categories depending on the purpose of the usage and the properties of the end-use product.

- Production of geospatial statistics, such as gridded statistics or other small area statistics, where the geospatial statistics itself is released as the end-use product or at least forms an essential part of the result. This category also includes delimitation of localities etc. In general, geospatial statistics is not part of the official statistics in Sweden. Products created within this category are available for use either within the Geodata Cooperation or for purchase.
- Production of official statistics where geospatial information and/or geospatial processing is involved at some stage of the production chain but not essentially part of the disseminated result. Stages of production may concern design of surveys, sampling, data collection, processing, analysis and dissemination. The majority of the data produced within this category are available as open data.

In a broad sense, most statistical products retrieved from administrative records have a geospatial component as many of them rest upon an un-

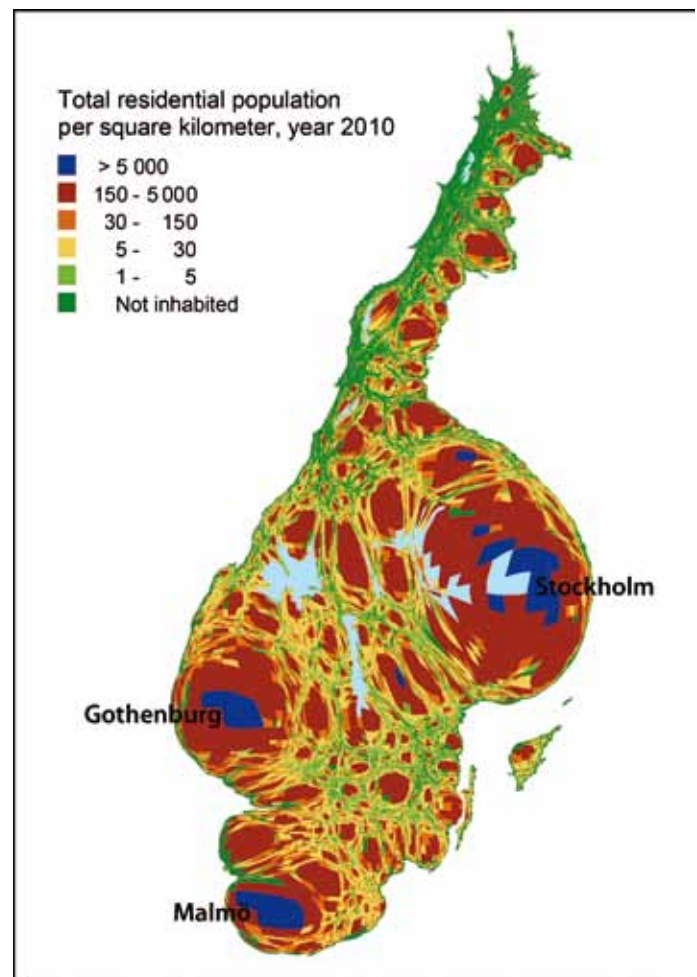
derlying framework of georeferenced records. However, in terms of production setting, such as data sources used, tools, methods for data processing and analysis, the most “geography intense” field of statistics is land use statistics. Accordingly, the impact of the Geodata Cooperation has been most significant in the production of land use statistics.

The Swedish Geodata Cooperation

Since 2011 Statistics Sweden has been member of the Swedish Geodata Cooperation, both as a provider of data and as a user. Statistics Sweden’s contribution to the Geodata Cooperation is gridded population data and delimitation of localities and other statistical units.

The Geodata Cooperation was launched as a response to the INSPIRE directive in Sweden, yet it goes beyond the aspirations of INSPIRE as it reaches further than the scope of environmental information. For Statistics Sweden the Geodata Cooperation has encompassed a paradigmatic shift of the production of land use statistics, and other geospatial statistics, due to the widely extended access to geodata.

The shape of Sweden according to population density. This is what Sweden would look like, if mapped from a population point of view. Every square in the population grid has been rescaled in proportion to the number of inhabitants it holds. The Swedish population is unevenly distributed across the country, 85 percent of the population is concentrated to localities which occupy only 1.3 percent of the land area.



Land use statistics

As of today, Statistics Sweden is responsible for some twenty official products concerning use of land and water, comprising statistics on land use, land cover, land ownership, protected nature, urban green areas, coastal settlement and development, urban development etc. In all of them, external geodata and geospatial processing plays a key role.

Hack for Sweden

The national hackathon, Hack for Sweden, was successfully arranged by Statistics Sweden and twelve other Swedish agencies and organizations in 2014. During 2015 it was organised by around twenty national government agencies. All agencies have contributed with their specific open data to the project and developers were invited during a weekend to develop new and innovative applications using the data. The winners were awarded with the "Hack for Sweden Award" for the most creative combination of different data sets. A total of 27 different teams competed and 20 of these used data from Statistics Sweden in the applications based on open data

International cooperation for a better integration of geography and statistics

During recent years, Statistics Sweden has taken active part in several international initiatives aiming at better integration of geography and statistics. During the preparatory work of the INSPIRE directive, Statistics Sweden took part in working groups responsible for specifications of Annex II & III regarding population distribution and statistical units. Currently Statistics Sweden is committed to the work of UN GGIM Europe and since February 2015 it is also coordinating a European project called GEOSTAT 2 aiming at a better foundation for creation of spatial statistics in a pan-European perspective.

Interactive maps and visualizations

The Statistical Atlas at Statistics Sweden's webpage is a thematic atlas for interactive visualization of regional statistics. The Atlas shows several different views that are all interrelated. Among other things, these views include thematic maps, tables, bubble charts and bar graphs. It is possible to animate time series to see development over time. Interactivity allows you to freely select the statistical variables that are available in the Statistical Atlas and analyze them in different views. The Statistical Atlas also includes short analyses of the statistics in the form of descriptive texts known here as stories.

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Swedish Forest Agency (Skogsstyrelsen)

Organization

The Swedish Forest Agency is the national authority in charge of forest-related issues. Our main function is to promote the kind of management of Sweden's forests that enables the objectives of forest policy to be attained.

The forest policy places equal emphasis on two main objectives: production goals and environmental goals. As being the administrative body in charge of implementing the forest policy, we cooperate with representatives from the forest industries and environmental sector towards the goals of economically and ecologically sustainable forestry.

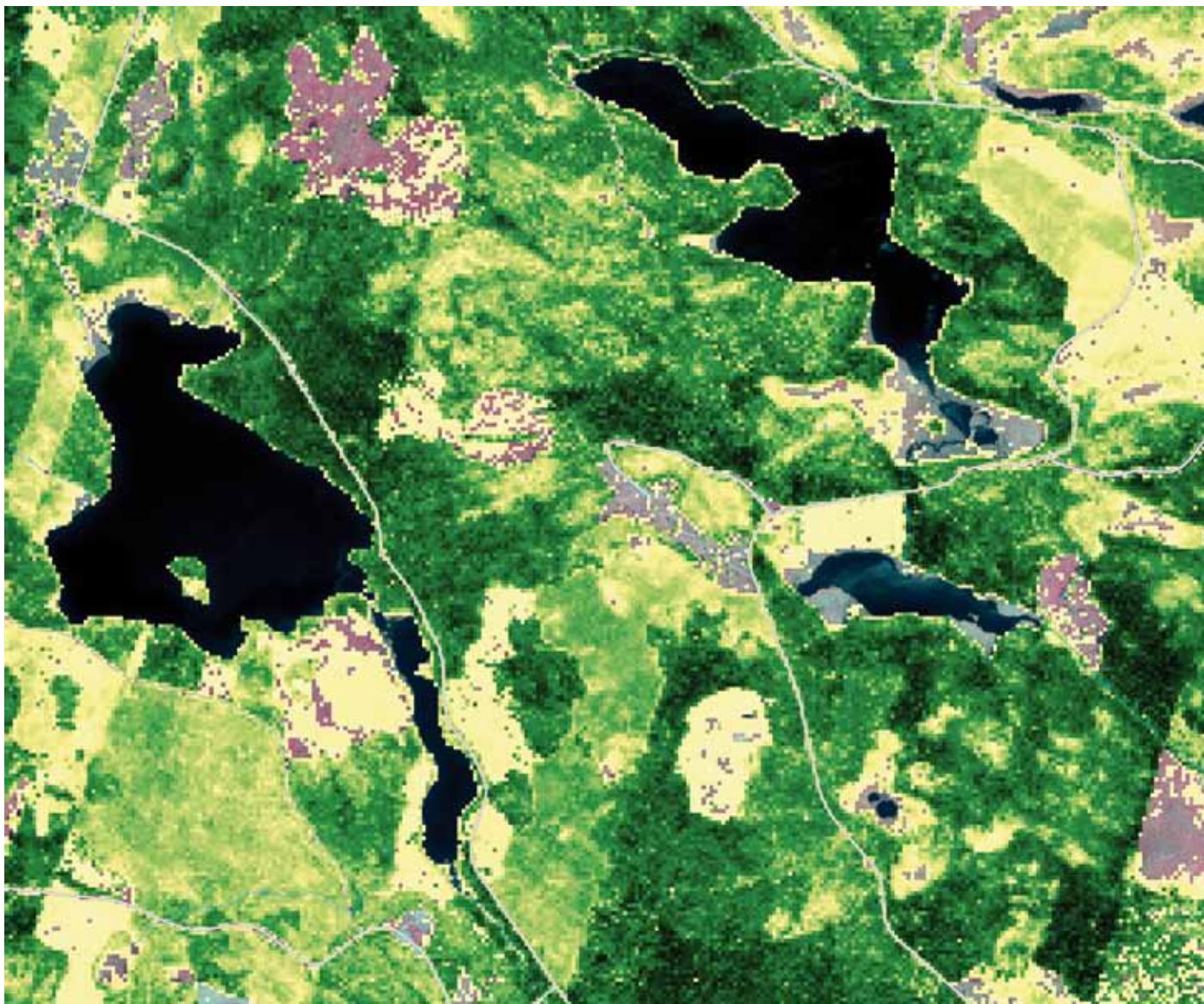
Our use of maps and GIS

Maps have always been important in forestry, and nowadays that means access to digital maps and information for our employees and for the public. This includes background maps, such as aerial photos and satellite images, information from natural and cultural heritage surveys, and protected areas. The forest agency's main task is the administration of notifications of final felling. The forest owner notifies us when they plan to log their forest, either through a manual (paper) application or electronically (My Pages or e-avverka, an xml-service). The system checks if the area to be logged is near any areas of special value (such as key habitats or cultural heritage sites). When the administrator controls the notification they are alerted by a red light if the system has identified that the area to be logged affects sites of special value.

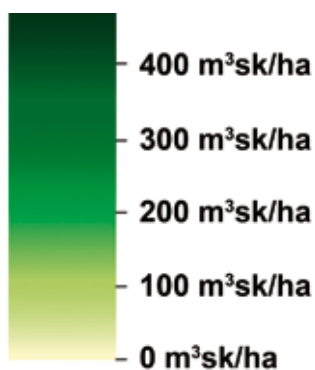
Production of a forest attribute map of Sweden using airborne laser scanning and national forest inventory data

The production of a nationwide forest data base in Sweden using laser scanning started in 2013 and will continue through 2015. The project is financed by the Swedish government and managed by the Swedish Forest Agency.

The forest variables are estimated by the Swedish University of Agricultural Sciences (SLU) for 12.5x12.5 meter grid cells using linear regression



Digital map stem volume



and the area based method. The estimates are based on laser scanning echos and data from field surveyed plots from the National Forest Inventory.

Estimations are made for:

- Stem volume (m³/ha)
- Above ground tree biomass (tonne/ha)
- Basal area (m²/ha)
- Mean tree height, basal area weighted (dm)
- Mean stem diameter, basal area weighted (cm).

At present (March 2015), estimations have been completed for an area which covers 85-90 % of Sweden's land area.

The forest variables are published as digital maps on the public website www.skogsstyrelsen.se/skogligagrunddata and on the E-service "My pages" www.skogsstyrelsen.se/minasidor which can be accessed by individual private forest owners. The data can also be downloaded from the Forest Data Portal www.skogsstyrelsen.se/skogsdataportalen or the ftp-server on the public website.

Use of remote sensing for monitoring and follow up conservation measures

During the last years a lot of interesting geographic data has become available in Sweden. For example, high resolution aerial photos, a new high resolution DTM, forest estimations from LIDAR data in combination with data from the national forest inventory (NFI). In May 2014 the Swedish Forest Agency (SFA) started to look at the possibilities to use some of these data sets for

monitoring and follow up of conservation measures and of damages caused by forestry machines. Visual interpretation at the office is a very cost efficient method compared to field visits or using a helicopter. Another benefit is that field visits will be concentrated to sites with potential damages in a greater degree than before.

In November 2014 a pilot study started up to use the new data sets for visual interpretation. The objects of interest were based on recent clear fellings detected by change detection analysis in satellite images (a technique used by SFA on annual basis since 2001).

The clear fellings of interest are those which may affect running waters, cultural heritage remains, forest protection areas, key woodland habitats etc. GIS is used in the selection of these objects.

The objects of interest are visually interpreted one by one using all the available geographical data, especial high resolution aerial photos. For each object the type of damage, degree of damage and the date of the aerial photos is registered. Even if no damage is detected, a registration is done for statistical information.

This method provides a possibility to follow up a greater number of clear fellings than traditional site visits. The results are given as feedback in discussion with forestry companies regarding improvements when it comes to conservation measures.

e-services for everyone

Forest owners have access to “My pages” where they can look at their own property. On My pages they can both see information that the Forest Agency has got and do their own planning. The map is the central part in My Pages where you can get information about results from inventories and your own errands. One example is the potential need of precommercial thinning. It is based on an analysis of satellite images where the vegetation index is high. From My pages it is possible to get a summary of data that the Forest Agency has registered on the property. It is done by a GIS analysis where objects that intersect the property are gathered. The forest owner gets both different overviews and detailed maps.

For the general public there are different e-services. Most used is Skogens Pärlor, which shows results from surveys. Special viewers are put together when needed. For example there was a big forest fire in central Sweden in summer 2014. The Forest Agency gathered all information both on the web and in a mail to forest owners. Maps generated included aerial photos of the fire area and forest variables from laser scanning.

Companies and other government agencies can use the Forest Agency data on-line or download it through Forest Data Portal, which was launched in May 2014. The main development from similar earlier services is that every dataset that can be downloaded can also be connected to by WFS. During 2014 the first open API was published, to increase the possibilities for the public to use the data. The first version has three methods, search data by extent, search data by radius and search key habitats by type of habitat.

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Swedish University of Agricultural Sciences (Sveriges Lantbruksuniversitet, SLU)

Organization

The Swedish University of Agricultural Sciences, SLU, is a university with comprehensive knowledge of the sustainable use and management of biological natural resources, as well as of environmental and life sciences. SLU’s mission is achieved by research, education and environmental monitoring and assessment (EMA), in collaboration with the surrounding community and provides knowledge to both decision-makers and the green sector (agriculture, forestry, fisheries etc.).

SLU has 3 900 full-time equivalent staff, close to 4 000 full-time equivalent students in courses and degree programmes and around 700 doctoral students. Research and doctoral education accounts for 71 per cent of total costs (2014) and SLU’s share of total scientific publication in Sweden is just under six per cent. Main campuses are located in Alnarp (outside of Lund), Uppsala and Umeå along with several educational centres, research stations and experimental parks all over the country.

Monitoring of Natural Resources

EMA at SLU produces scientifically-based advice on sustainable management of natural resources and ecosystem services. SLU describes the state of Swedish ecosystems by means of extensive inventories and analyses of agricultural landscapes, forests, inland waters, coastal and sea areas and of species. These geographic data on our environment are gathered in databases, analysed and often presented as maps. Some data, including that from the National Forest Inventory (NFI), go as far back as 1923. Closely associated with research

SLU also develops new monitoring methods and calculation models for environmental assessment in both space and time. Access to digital geographic data, such as national map series, aerial photos and satellite images, and use of GIS is thereby of vital importance for EMA and research at SLU.

Swedish forests are continually monitored by the NFI and the information is used as a basis for forestry, energy and environmental policy in Sweden. The NFI data is part of Sweden's official statistics and accessible via the national Geodata portal as part of the Inspire Directive. SLU also operates several national monitoring programmes commissioned by the Swedish Environmental Protection Agency and by the Swedish Agency for Marine and Water Management.

Researchers at the Section of Remote Sensing in Umeå develop methods of monitoring forests and other vegetation remotely. Using data from digital cameras, laser scanning instruments and radar equipment installed in satellites or aircraft, they are producing digital maps that are used by environmental authorities and researchers, among others. For instance, the research team has developed methods that can be used to monitor how the mountain tree line moves in a warmer climate, habitats of alpine and sub-alpine areas and how shrubs establish on former farmland.

Forest Map of Sweden

SLU Forest Map contains spatial information with a high degree of detail over most of Sweden's forestland. SLU Forest Map is based on a combination of field plot data from the NFI, satellite imagery (Landsat, SPOT) and map data. Continuous estimates have been made for several forest parameters such as stem volume by tree species, age and height and tree biomass. The output format is raster data with a resolution of 25×25 m. The SLU Forest Map has been produced for years 2000, 2005 and 2010. SLU Forest Map is primarily intended for assessing larger areas, more than a hundred hectares, of forestland (<http://skogskarta.slu.se/>). SLU is also engaged in the production of a forest database using laser scanning and NFI data, managed by the Swedish Forest Agency.

SDI for Swedish universities

An early SDI for the educational sector – the Digital Map Library – was closed down in December 2011. To replace this service, SLU decided to develop its own internal web-based geodata distribution service, GET (Geodata Extraction Tool). With support from the Swedish Research Council SLU was then asked to expand GET for use by all universities. This made it possible for staff and students from 29 Swedish universities and col-

leges (2015) to download free geodata for research and educational purposes. The Swedish Research Council finances development work, costs of operation and support, as well as license fees to the authorities that contribute geodata to the SDI. GET distributes geodata (15 TB) from four Swedish authorities: Lantmäteriet, the Geological Survey of Sweden, the Swedish Maritime Administration and Statistics Sweden. The service is well used. Since GET's inception in September 2012, more than 150,000 downloads have been made and the current rate is about 1,500 downloads per week. A planned development is to use open source software to an even greater extent.

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Swedish National Heritage Board, SNHB (Riksantikvarieämbetet, RAÄ)

Organization

The Swedish National Heritage Board (SNHB) is the central authority in Sweden for matters regarding heritage and historic environment issues. The mission is to play a proactive, coordinating role in heritage promotion efforts and to ensure that the historic environment is preserved in the most effective manner possible. The SNHB is under the auspices of the Ministry of Culture. The objectives for the Board include encouraging:

- preservation and protection of the historic environment
- respect for the heritages of different groups
- the appreciation of, commitment to, and the assumption of responsibility for one's own heritage.

The SNHB serves as the administrative authority, along with the county administrations and regional museums, responsible for ensuring that our entire cultural heritage is both preserved and used. The work of the SNHB includes for example heritage management, research and development, education and information.

Mapping and charting

A geographical approach has a long history in Swedish heritage management starting already in the 1660s with field studies, archaeological documentation and surveys. Between 1937 and 2002 a national monuments survey was coordinated with the general mapping of Sweden by



Archaeologists bound for work in 1928. Photo Berit Wallenberg

Lantmäteriet. Although the SNHB is not involved in the actual production of official maps, it is responsible for keeping a national record of ancient monuments, and provides Lantmäteriet with basic information for their cartographic products, such as the land use map of Sweden. Today this record contains more than 1.8 million geographical objects in more than 700,000 sites. The heritage legislation has a strong position in Sweden and the information in the national record is widely used in and has a considerable impact on land use and planning activities.

Digital resources – databases, applications etc.

The SNHB develops and manages several digital resources containing information about the cultural heritage. The Archaeological Sites and Monuments database (FMIS) has been in use since 2003. The database is updated with new information on a daily basis. The public gets access to the information through a web application, Fornsök (www.raa.se/cms/fornsok). Another resource is the database of built heritage (www.bebyggelseregistret.raa.se). New information is added in cooperation between local authorities, county administrative boards, regional museums and the Church of Sweden. It contains information about approximately 97,000 buildings, dating from the medieval period to recent times (about 13,500 is listed buildings). The information (about buildings and about ancient sites) is also available through data download, wms-services and the SOCH API. The SNHBs photographic database contain almost 200,000 photographs including depictions of heritage sites and heritage management. The work to locate positions for them is being carried out continuously. Platsr (www.platsr.se/platsr), is a community for sharing location based, subjective stories. Users are able to create a geographical location and add media, tags, links etc. to their stories. Fornsök, Bebyggelseregistret and Platsr all have integrated maps made available by Lantmäteriet through the Geodata Cooperation Agree-



Using palm computer and GPS when doing field survey. Photo Rikard Sohlenius

ment (Geodatasamverkan). Kringla (www.kringla.nu) is a web application displaying linked data from some 50 different sources, mainly museum collections and historic landscape objects. Kringla allows users to add semantic links between some 170 million objects from the Europeana portal, Wikipedia and SOCH (Swedish Open Cultural Heritage, www.ksamsok.se) the national aggregator for museums and historic landscape data. The SOCH API is available for developers to create applications.

Beginning in 2014, and running until 2019, the SNHB is responsible for a project aiming to develop a fully digital flow of archaeological information within heritage management. The mission of DAP (Digital arkeologisk process) is that planning and other measures with impacts on the landscape should be based on up-to-date archaeological information of adequate quality. As part of this project the SNHB is also looking at the possibilities of using LIDAR to improve the quality of the geographical information in FMIS, primarily using the digital elevation model of Lantmäteriet. The SNHB promotes the use of this data in archaeological practice.

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Cartesia

Organization

Cartesia GIS AB was founded in 1995 by former employees of Lantmäteriet in Sweden. The company initially focused on the early steps of bringing digital map production and wide spread use into everyday PC and Windows environment. Our customers are mainly from the public sector and municipalities. In many ways Cartesia introduced GIS and digital maps as early “commodity” to a number of customers and new users. Another early customer segment was the forest industry, where Cartesia developed planning and production tools. With its own product line called Solen, based on MapInfo software platform, the number of customers in a couple of years rose to over one hundred with thousands of users.

Today Cartesia is an IT company that focuses on providing specialist expertise, products and solutions in the areas of GIS, geographical data and positioning technologies. Cartesia is part of Addnode Group, which is listed on the OMX Nordic List, Small Cap. Cartesia GIS AB currently has some 50 employees with expertise and experience in various fields of GIT and industry segments. Offices are located in Lycksele, Gävle, Stockholm and Gothenburg.

Activities

Cartesia offers products, services and consultancy in the field of Geographic IT. Through innovation, technical excellence and the close relationships with our customers we create long-term improvements for businesses, the environment, for society. One obvious trend is that photographic mapping is growing. With the help of low flying small satellites and as in this case a small UAV, better and more up-to-date and mapping is available. Also a 3D model is generated. Good for city planning and modeling. (Flown by our partner www.airfoto.se) and the general public.

Our vision is to be the Nordic leader in the development and application of customer and business adapted Geographic IT. Every day we assist companies and organizations to achieve sustainable and efficient living and thus provide opportunities for a better world.

Cartesia has two major business areas. One is the GIS/Public sector where most of our customers are municipalities and public administrations. Here we serve our GIS centric customers with tools for efficient and modern maintenance and distribution of spatial and spatially enabled data. We also have products for specific tasks as school transports, customer service and many other areas. Our major product range consists of Solen and ISM. Today our new market leading web based



Missing People Sweden with thousands of volunteers are using Cartesia ProSmart for planning and tracking their activities in real time. With ProSmart that consists of cloud, position aware apps and Web clients with integration of Google and national Lantmäteriet map series as OGC/WMS MPS quality ensure every mission successfully.

open source solution with Cartesia Spatial Map as front is growing very fast.

The other area is industry and logistics where we have a number of large forest companies and general mobile work forces as a major customer base. With GIS as an enabler for better decisions and daily operation we help our customers by providing a product range suited for higher efficiency in many different ways. Examples are Cartesia TimberTrack for timber and forest acquisition support, GPS Timber – sawmill logistics and Cartesia ProSmart for planning and quality assurance of mobile production and work forces.

To make our offer complete, we team up with international market leaders as partners. As a general GIS supplier we offer off the shelf solutions and basic development platforms, foremost from Google and Pitney Bowes MapInfo. 75 % of our development of new product development is based on distributed and open technology. We focus on responsive interfaces that adapts to its user and device. Thin clients and smart mobile devices are in today's focus.

Cartesia also delivers;

- Geographic data and software, partner and retailer to e.g. Google, MapInfo, Oracle, Grontmij, AdTollo, Lantmäteriet and more.
- Hosting of data, application, software, platform, mobile solutions and web/geo data services.
- Support and training

Future and directions

There are some major and important GIS and spatial data trends in Sweden and internationally.



One obvious trend is that photographic mapping is growing. With the help of low flying small satellites and as in this case a small UAV, better and more up-to-date and mapping is available. These pictures are registered from 130 m altitude and gives 4 cm accuracy in colour. Also a 3D model is generated. Good for city planning and modeling. (Flown by our partner www.airfoto.se)



Maps want to be free

This is the truth and trend in some different ways. On one hand, as an authorized partner with Google, the situation is very clear. The new GIS market and users are assuming maps to be freely available. As consumer technology and solutions are making way for business use many people and private Google Map users tend to have the knowledge that awesome maps and coverage is to be available for free. As we all know, there is very few maps that are free per say. This counts for both private and public data. So, when we sell and develop from Google for Works API's there sometimes is an economic threshold for new customers not used to this. As major suppliers as Google withhold their business direction, this will be our truth for some time. Cartesia is certain that this is a good thing for our entire market development. The awareness of maps and GIT rises as it is being used by everyone as an every-day decision support.

On the other hand we have another interesting situation in Sweden and Europe right now. As

many of our neighboring countries now adapts to the EU's Inspire, and other directives, our central and local governments now have to make geodata more available. Not only in technical form by publishing data to the cloud with sustainable services to it. In Sweden, where national public geodata has been very good, it also has been and still is quite expensive. Cartesia both supplies tools for good spatial data management and availability as services, but have also for a long time been a large re-seller of national data. This business is transforming. The first datasets have from Lantmäteriet been put out there for free. Step by step we will see good data being more available in many ways. This also gives our industry new possibilities.

Anywhere, anytime, anyplace

Traditional GIS software tools as PC applications are still here, and will be here for some time. But the real change today is that almost everyone, as a private person and consumer, today have powerful geographic technology, data and computer power in their hands. As the evolution gave us smart mobile phones, where almost everyone can utilize the power of everyday fun and decision support. By making our geodata and solutions available in the cloud, apps and alike, millions – instead of a few professionals – are using maps, navigation, GPS to make life easier. The consumer market is leading business usage into the realm of personalized and easy to use solutions.

As a software developer we today see about 75 % of our development leading to pure cloud, web and app solutions. And these are all business solutions. Only 3 years ago the same number was lower than 40 %. The challenge is now to package our complex data structures and graphical map environments into services in the cloud with adaptive smooth and smart applications. Business users tend to want the same tools at work, as they have at home and as a private person. It is going fast.

GIS/GIT as a commodity

The GIS market does not really seem to grow. What is growing is the use of geographic data and technology as it becomes more available. Today every software developer easily can make awesome map solutions by using web APIs from Google and other suppliers. GIS sort of gets into every other segment.

This does not mean that the GIS market is dead. But it will change. Many more will be implementing GIS/GIT every day. And we will still need the “white-coat-specialist”. Some of us will still have to keep track of developing the underlying science and provide the tools for making complex structures available and easy to use – for everyone.

Spatial data management

The era of making solutions, tools available as apps in the cloud and on the web still develops. But at the same time, as local governments and others are publishing their spatial data to more users and environments, it is very clear that we need to bring forward and follow standards for storing and communicating geo data. Awareness of the need of keeping good control over data quality is growing. Spatial data will still have complex data structures and contains large data volumes, changing as time goes on.

One part of the Cartesia success has always been that we have provided both tools and know-

ledge on how to quality ensure spatial data. This is now getting even more interesting and popular. Metadata and standards on how to handle your geodata is the key to success.

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T-Kartor

T-Kartor is a privately owned Swedish company enjoying a rapid growth phase. Currently we are 140 employees in six countries. With our head office in Kristianstad, Sweden, our intention to best serve our customers from a local office has led us to establish offices in St Louis, New York, London, Helsinki, Oslo and throughout the Czech Republic.

T-Kartor provides meaningful cartographic information by building and maintaining a bespoke cartographic database designed for specific purposes, for example pedestrian wayfinding. Our speciality is to create effective production workflows for customers needing to create and update numerous map-based products.

Years of domain experience and a focus on solving our customers’ problems on an individual basis has given T-Kartor a world-wide reputation for expertise and customer care. Today we can count among our customers US and NATO defence clients, Transport for London and New York City Department of Transport.

Our strategy is to focus on defence & security and smart cities, allowing us to offer considerable domain expertise and experience resulting in our world-respected client list.

Security & Defence

Mapping for security & defence has a requirement for flexibility, scalability and rapid response. A high amount of accuracy is required for products such as aeronautical charts, from which symbology can be crucial to high risk low-flying missions. Our database-centric solution enables us to update complete data layers in a very short time whilst maintaining high quality assurance.

Building a map base in support of foreign missions can involve collation and validation of limited and diverse sources. T-Kartor has developed our own software to solve this challenge, called Source Data Manager, and we have a high reputation for satellite recognition and geospatial analysis.



Cock-pit map, a military aircraft cock-pit using T-Kartor's electronic maps. Photo Ivona Kacmarcik, T-Kartor

High update frequency is also important for defence clients, including the ability to create rapid outputs in multiple formats. Our clients require maps in a number of formats and media, for example digital maps supplied to fighter aircraft cock-pits, or printed maps supplied simultaneously in three different scales with slightly different symbology on each. Our online search and distribution portal allows powerful search functionality for forces in the field, who need the latest up-to-date intelligence.

Smart Cities

To face the challenges of sustainable urban environments for the future, cities are creating visions of world class transport systems and high quality public spaces, improving sustainable mobility by encouraging walking, cycling and increased use of public transport. An essential component in this sustainable mobility strategy is information.

Wayfinding and public transport information based on maps can drive behavioural change by encouraging exploration, supporting journeys by foot or cycle, publishing innovations and infrastructure improvements or simplifying a complex public transport network.

T-Kartor sees the provision of wayfinding and public transport information as an essential core activity to the success of a city's sustainable mobility strategy. As such we provide mapping information as a core system supporting the entire city's wayfinding needs. One seamless wayfinding basemap is created and maintained while automated production tools within our platform allow the output of hundreds of map products for a very low unit cost. This means a huge increase to the number of information products, more regular updates and an overview of the whereabouts of products in existence.

Legible London

T-Kartor has been producing wayfinding and public transport information for Transport for London since 2000. The range of information products includes 350 bus 'spider' maps, schematic bus route diagrams displaying available routes and destinations from a hub of bus stops, and vicinity maps covering 750 x 750 m around 500 underground and mainline stations in London.

Coinciding with the introduction of London's Cycle Hire scheme in 2010 T-Kartor rolled out the multi-award winning Legible London database. Legible London is a pedestrian wayfinding map base built as a seamless database covering 1,600 km² of Greater London. The map is specially designed to encourage walking, including 20,000 carefully researched and field checked landmark buildings, 3D illustrations of 600 noteworthy landmarks, 5 minute walking circles illustrating short journey times on foot and a 'heads up' rotation making maps easier to read and navigate from.

The Legible London database is scalable and flexible enough to host a large and growing family of information products. Some of them are produced in great numbers and all are updated as required. Over 20,000 Legible London map prod-

Legible London wayfinding, a Legible London pedestrian wayfinding totem on London's South Bank. Photo: Tony Pearce, T-Kartor





Legible London wayfinding, a London Cycle Hire docking station, including Legible London mapping. Photo Tony Pearce T-Kartor

ucts have been created from the system, including many short notice bespoke products for the Olympic Games in London, 2012.

Maintaining the Legible London database on T-Kartor's production platform allows us to add a range of services including automated production outputs and an online management overview interface for tracking products and update requirements.

New York Department of Transport

T-Kartor and partners have also created a wayfinding and public transport information system for New York City DoT. Based on the success of the Legible London database, similar requirements were identified. Demand was driven initially by pedestrian and cycle wayfinding, then further expanded to include bus and subway information products.

T-Kartor's success is based on our skills in an integrated staff of cartographers, GIS experts and computer programmers working together in project teams. This, in combination with deep domain knowledge, enables us to focus on effective production workflows and advanced problem solving on an individual scale for each customer. Our lasting customer relationships are built up over many years which has driven our growth from a small local company in the South of Sweden to an international company with some of the biggest and most respected defence and city clients.

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Esri Sverige

Organization

Esri Sverige is the distributor of Esri's ArcGIS software in Sweden. The company has 100 employees in Gävle, Stockholm, Falun, Malmö, Karlskrona, Jönköping and Växjö. The head office is situated in Gävle. For 2014, the turnover was SEK 214 millions. Esri Sverige is a part of a larger Swedish group of companies – S-GROUP. This group also owns Esri Finland, Esri Polska, S-GROUP Solutions and S-GROUP Lietuva. All these companies have business focus on geography. Thus, the group has business in Sweden, Poland, Finland and Lithuania, where the major customers are within GIS-solutions for local government, forestry, industry, defense, security, environment, infrastructure, health, energy and telecommunications.

Main activities

Esri Sverige creates value and benefit for our customers and their businesses from a geographic perspective. A major part of the customers are GIS centric, where our products is used to capture data, store and maintain data, distribute data, and use data (analyze, visualize etc.). These GIS centric customers use ArcGIS to a large extent. The other customers see GIS as an enabler. GIS is just a supporting system to make their own business to work more efficient. These customers see the benefits in taking better decisions for higher efficiency, better environment, higher safety/security, and for better co-operation.

Esri Sverige has three major businesses. In order to GIS-enable the customer the company delivers:

- Software, e.g. ArcGIS, GEOSECMA, ArcCadastré, Cityworks, CityEngine, FME, sdi.suite and Routesmart.
- Geographic data, from our partners Lantmäteriet, SCB, Trafikverket, TomTom and HERE
- Professional services, support and training

Main objective

Now and coming years our main objective is to make GEO and GIS available to new user groups and new businesses. The consumption of IT is a major trend that affects the use of GIS. Maps are now a natural part of everyday life. People use maps privately – in Smartphones and iPads – discover the benefits and want the same opportunity professionally, at work. The technology is ready and Esri Sverige guides organizations to discover and introduce GIS into the entire operation.

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Sverige vägatlas is a popular road atlas in Sweden.

Norstedts

Norstedts is a Swedish map company with a publishing that includes map production and even a specialty store in Stockholm (Kartbutiken) for maps, atlases, travel guides, charts and globes.

Maps are produced in different scales and configurations. We produce customized atlases, tourist maps, local maps, traffic and flight maps and more. Our maps are used by companies as well as municipalities, counties and schools. We produce atlases of Sweden, Europe and the world. Each atlas is completely customized according to the customer requirements and it can be made in different map scales, colours, format and content and of course with a customized cover.



A map for cyclists in Sweden

Our most well-known atlas is the road atlas: Motormännens Sverige vägatlas. The road atlas has been published yearly since 1991 and is by far the most popular road atlas of Sweden.

Together with the cycling association, Cykelfrämjandet, we have produced the map for cyclists in Sweden: a series of maps consisting of 30 sheets which cover the south of Sweden. They are printed on water resistant material, yearly updated and translated into English and German. The maps are detailed and clearly show suggestions of suitable cycling routes and their road conditions – gravel or asphalt. The printed cycling map is supplemented with further information on www.cykelkartan.se

We also produce different kinds of wall maps of the world, Europe and Sweden.

We also distribute Lantmäteriet maps and we are the Swedish agency for Michelin and we stock and sell a wide selection of their maps and



A wall map over the world.

travel guides, for example: Guide Michelin Hotel and Restaurant guide also known as Le Guide Rouge, or Red Guide. As the Swedish agency for Legind, we have a wide range of maps, atlases and city maps within Europe as well as the Destination Guide, a guide to popular destinations in the world. We have a wide range of city maps and country maps of Europe and the world from Hallwag Kümmery + Frey. Our wide range of products also includes practical and decorative wall maps and globes in many different models and designs.

The maps can be found in bookstores, at tourist offices and petrol stations and on the internet www.kartbutiken.se.

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Hydrographica

Hydrographica is a highly specialized private company producing nautical charts exclusively for pleasure cruising purposes. Hydrographica charts are complementary to the official Swedish HO charts, in areas where a more detailed product is needed.

Organization

Hydrographica is privately owned, and employs at present 6 persons. Three of them are qualified cartographers with a background as lecturers in cartographic education at Stockholm University. Hydrographica was founded in 1983, and is based upon a surveying technique using aerial photointerpretation/photogrammetry in bathymetric mapping.

Chart production

Hydrographica produces charts over marine and coastal areas as well as over inland lakes. Production of inland lake charts are normally initialized by local yacht clubs or local authorities wanting a professional chart over Swedish inland waters where no ordinary HO chart exists. From 2000 Hydrographica also have a permission from military authorities to survey coastal areas where ordinary surveys are old and/or unreliable. Hydrographica now produces large scale marine charts, and at sea the Hydrographica charts are a parallel to the orienteering maps on land. At present, Hydrographica have produced about 30 Swedish inland lake charts at various scales, and 85 marine charts at a scale of 1:10,000. All charts are planned, produced and published within Hydrographica. The in-house competence spans over the whole

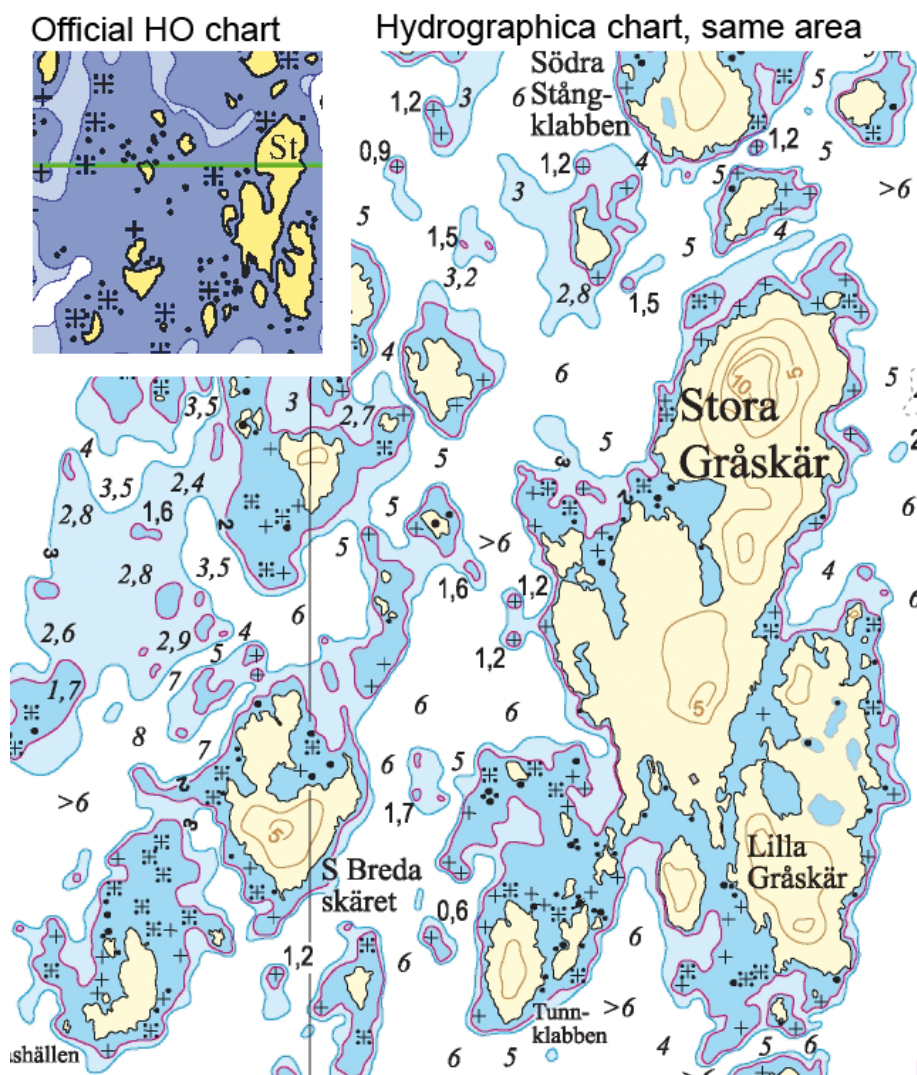
production chain. All Hydrographica marine charts are printed on polyart, a synthetic paper with excellent properties for use at sea.

Surveying techniques

Chart production starts indoor with aerial photo interpretation and photogrammetry. Hydrographica have developed a technique where water depth down to 4-5 meters normally can be penetrated and measured with high accuracy through stereoscopic analysis of aerial photos. Bathymetric contours for 2 and 3 meters can be drawn and water depth on separate shoals can be established. All photo interpreted data must be confirmed through field surveys, but the field work can be considerably more efficient since the positions of all shoals are already mapped with high precision. For field surveys Hydrographica owns 6 boats for shallow water mapping specially equipped with suitable echo-sounders, side scan sonar, positioning tools and other nav-aids.

Cooperation

Hydrographica cooperates with the Swedish Maritime Administration, and supplies data to international chart producing companies such as Garmin, Navionics, Jeppesen a.o. Hydrographica



is a MapTech acknowledged partner in producing digital raster versions in BSB-format. Paper charts published by Hydrographica reach the market through a substantial amount of retailers in Sweden, but also through Hydrographica's own website, a system that is highly appreciated and well-functioning. Digital versions of Hydrographica charts can be downloaded directly from the website. Hydrographica also cooperates with a nautical publisher in producing guide books for pleasure cruising along the Swedish coast.

Adresses

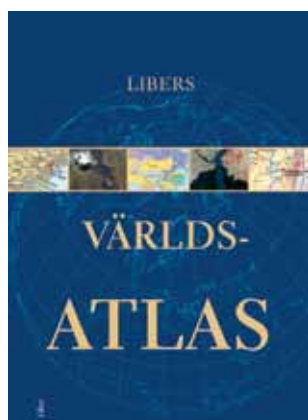
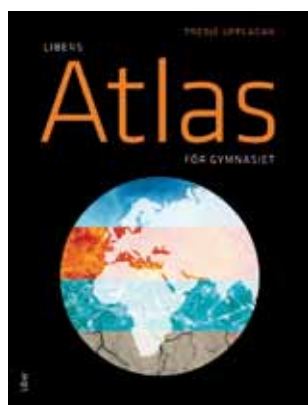
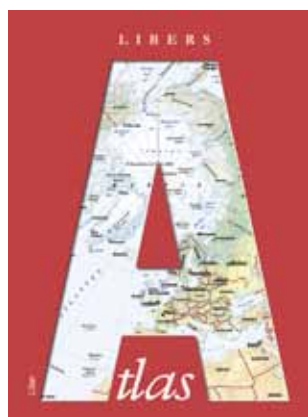
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Liber

Organization

Liber has a cartographic editorial unit within the Liber Group. Liber produces and markets maps, atlases and electronic map products for both the domestic and international markets. Our primary focus is the educational market.

All our own map products and maps produced for other publishers, as well as maps for schools and the consumer market, are marketed and sold by the central sales and marketing department within the Liber Group.



Technical development

The basis for Liber's map production are our own databases, which are stored as vector databases in Adobe Illustrator using a cartographic GIS plug-in called Avenza MAPublisher. In addition, we have a wide selection of pixel data in TIFF format and name databases.

GIS databases

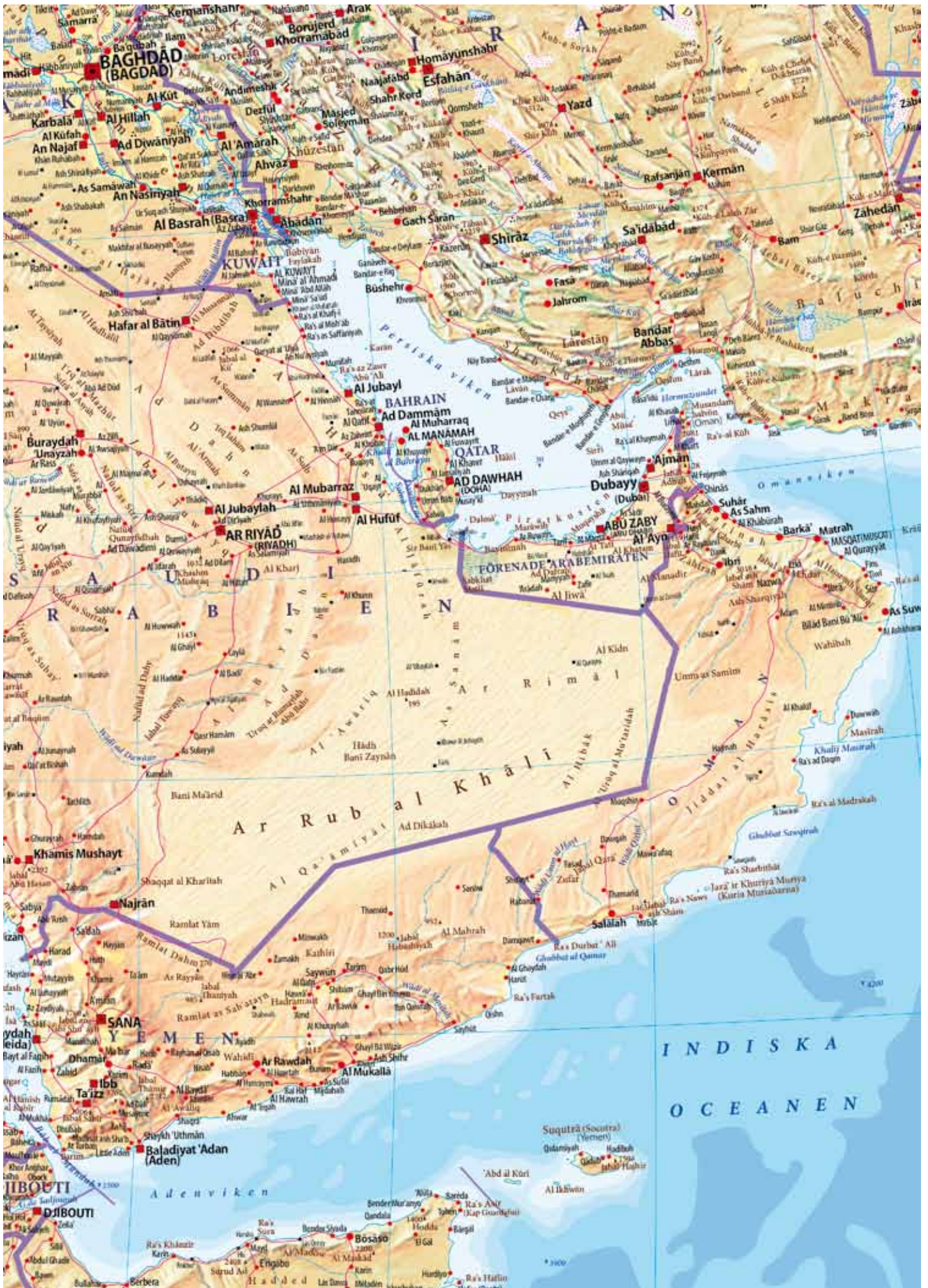
MAPublisher introduces rule-based cartography concepts into Adobe Illustrator. Graphic styles, symbols and text styles are joined with category codes and attributes in the map data. Thematic maps can also be created from statistical information imported into the databases. MAPublisher allows us to freely choose map projections and to make very flexible classifications of data. In-house development has been focused on automating the process from database to final files. Software has also been developed to create indexes from our name databases.

In the last step in the production process, layout software like Adobe InDesign is used to make the final map design and create files for printing. Normally output to prepress is platform independent Adobe Acrobat PDF files.

Liber maps can be found in our Internet site at www.liber.se and ordered at several Internet bookstores as well as in bookstores in Sweden. Cartographic activities

The following fully owned databases are used for cartographic production:

- Stockholm 1:10 000 - 1:30 000
- Malmö 1:10 000
- Swedish town plans 1:30 000
- Scandinavia 1:750 000
- Europe 1:2–1:5 million
- Africa, Asia, Australia, North and South America 1:10–1:25 million
- The World 1:30–1:60 million





Other databases from municipalities and from Lantmäteriet are also used for cartographic production. Many of the map products which Liber sells are designed and produced in collaboration with our clients, with whom we discuss content, map design, and layout.

Liber produces a world atlas for the consumer market.

Within the schools program, Liber produces a variety of school atlases and sheet maps for educational publishers in Scandinavian countries. New products are developed in collaboration with each client, who provides information about the educational needs in their own country. The number of thematic maps available for use in atlases and sheet maps are approximately 500. We also publish a Taxi map for the Stockholm region which is widely used by taxi companies as well as public services such as police, fire departments and ambulances.

Future activities

Liber will continue to produce maps as traditional printed products, print on demand-maps and maps for Internet use. GIS for schools is also a new area of product development in coming years.

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