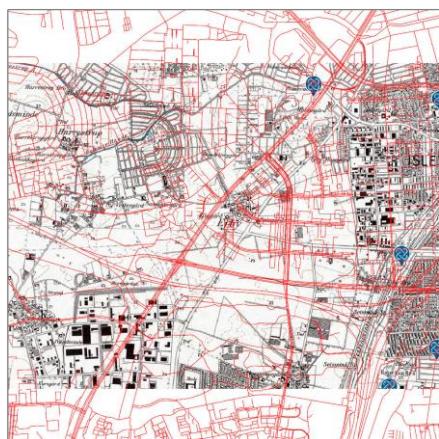
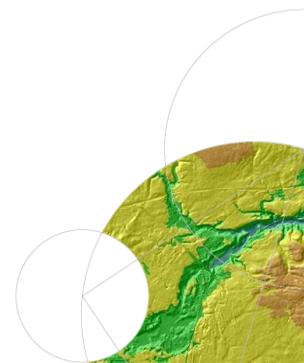




Map types

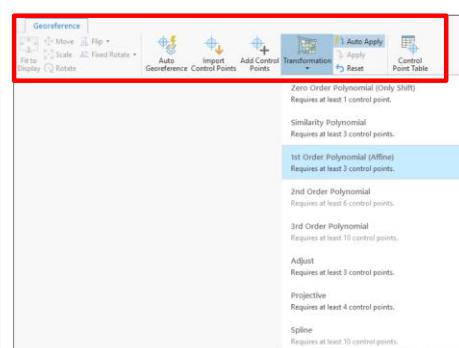
- A little bit about how ArcGIS Pro handles
 - Geo-rectification
 - And projection/transformation
- Searching and retrieving geodata
- (Danish) geodata
- Metadata
- ... and the Web

Hans Skov-Petersen (hsp@ign.ku.dk)
- Professor, PhD

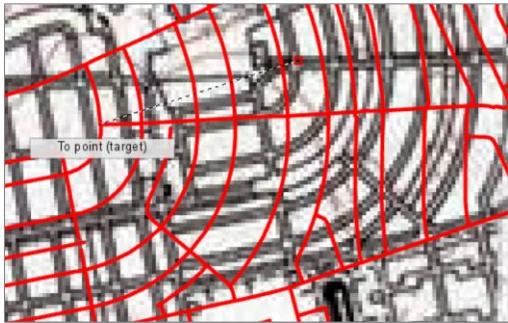


Geo-rectification

The process of transforming an image without Spatial Reference (SR, including projection) into a new one with SR.



Geo-rectification



To transform images, pairs of point – one from the image, one known location – is applied to establish parameters for the transformation
As points are applied residual values emerge

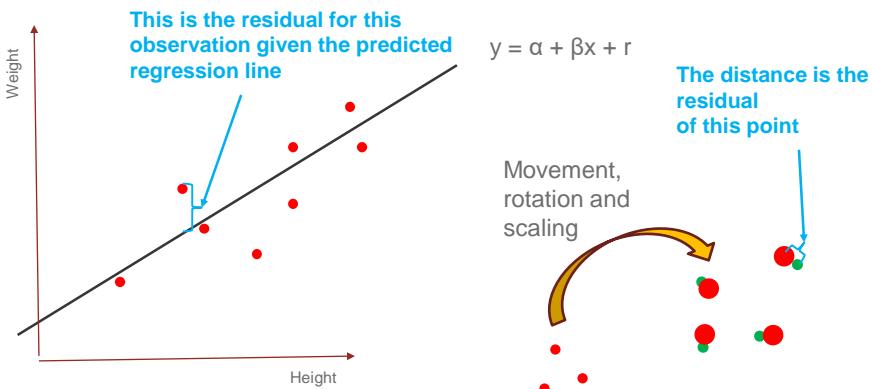
Link	Source X	Source Y	X Map	Y Map	Residual X	Residual Y	Residual
1	414.571025	-178.311112	719.225.405127	6178.128.303552	-1.423493	-2.080490	2.520867
2	470.091734	-197.017188	719.528.691004	6178.377.362165	3.401702	4.977119	6.024082
5	689.579532	-199.662425	714.723.699787	6178.091.957677	-2.933036	-4.286745	5.194119
6	1061.54717	-390.692724	716.786.444288	6177.164.728249	0.954827	1393516	1690905

Residual values expresses the difference – in distance units – between the location of a point and its ideal, predicted location....

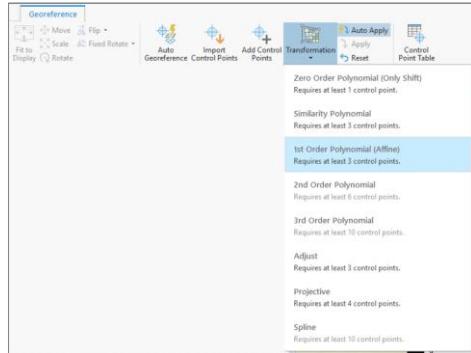


Residual values expresses the difference – in distance units – between the location of a point and its ideal, estimated location.... (◎)

Think of a regression line of two values, e.g. height vs weight...



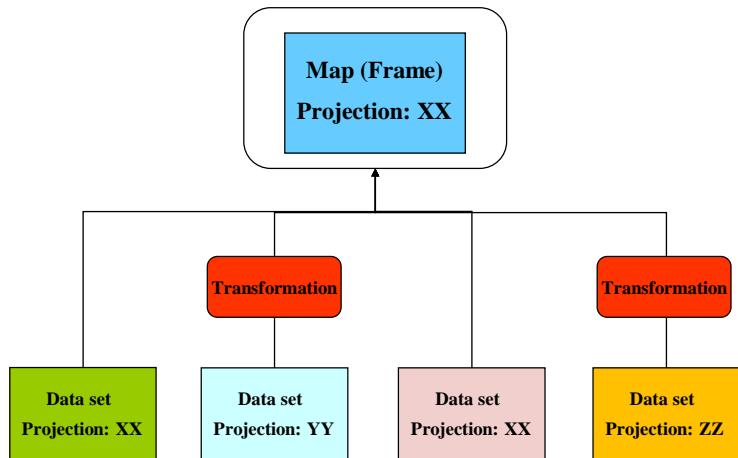
So, what is meant by the polynomial 'order'?



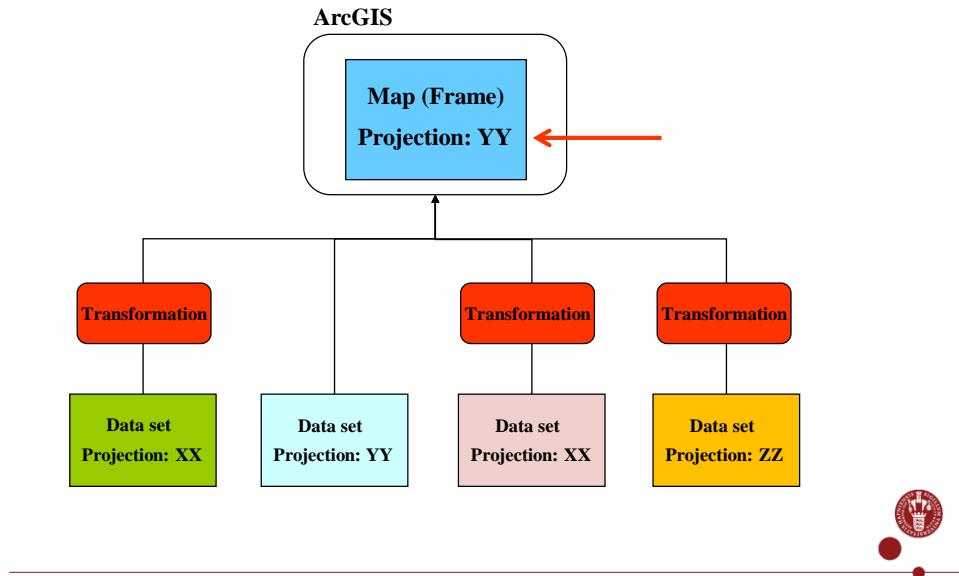
- 1st order means shift, scale and rotate. E.g. transforming from one 'flat' representation to another
- 2nd order means that the scaling can change at a constant rate at different locations. E.g. transforming an image of a fairly flat surface, taken from an oblique angle
- 3rd order means that scale change at different rates at different locations. E.g. transforming an image of a hilly terrain, captured from an oblique angle.



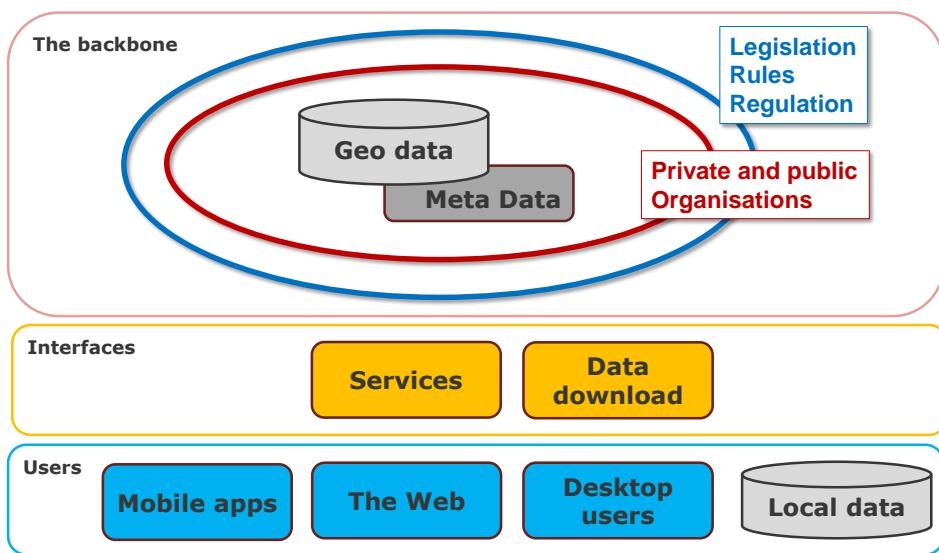
Projections and ArcGIS (1)



Projections and ArcGIS (2)



Organisation of geodata: The big picture



What are Meta data?

- Metadata – or data tags - is data about data
- Metadata is often required to find (and document) data
- It can be information about:
 - (production-) scale, resolution of other indicators of spatial quality
 - Data type
 - Owner
 - Content/attributes
 - Production method and expected accuracy
 - Link to further documentation
- Meta data can be both :
 - External, general purpose bases on products
 - Internal, listing location of files
- (Ideal), minimum requirement on map layout or report:
 - Data name
 - Producer
 - Production scale/resolution
 - Year of production

Examples:

Ortofoto. COWI. 12 cm, 2015

Soiltypes. GEUS. 1:25.000. 1999 (varies per map sheet)



Hint: If using layers from the I-drive, most of the required metadata is in the name of the individual layer

e.g. I:\SCIENCE-IGN-GIS\Geodata\English\5. Land use & Landscape

Name	Type
Dansk	Folder
English	Folder
Eskrimaps	Folder
IGG - Geodata Library	Folder
world	Folder

Look in: Geodata

Add

Cancel

1. Administration & Border
2. Building, Plant & Cadastre
3. Elevation
4. Geology
5. Land use & Landscape
6. Aerial & Orthophoto
7. Environment, Protection & Planning
8. Statistics
9. Topographic maps (recent and historical)
10. Traffic
11. Tourism & Recreation
12. Water
13. Copenhagen

FieldCrop_10k_FVM_2019.jyr
FieldCrop_10k_FVM_2020.jyr
Forest_Sk_Driftplan-NST_2012.jyr
Forest_Sk_NST_2004.jyr
Forest_10k_FOT_GeoDanmark-GST_2016.jyr
Forest_10k_FOT_Kort10-GST_2014.jyr
Forest_10k_FOT_Kort10-GST_2015.jyr
Forest_10k_FOT-GST_2012.jyr
Forest_10k_GeoDanmark-SDFE_2017.jyr
Forest_10k_GeoDanmark-SDFE_2018.jyr
Forest_10k_GeoDanmark-SDFE_2019.jyr
Forest_10k_GeoDanmark-SDFE_2020.jyr
Forest_10k_GeoDanmark-SDFE_2021.jyr
Forest_10k_Kort10-GST_2011.jyr



INSPIRE: <https://inspire.ec.europa.eu/>

The INSPIRE Directive aims to create a European Union *spatial data infrastructure* for the purposes of EU environmental policies and policies or activities which may have an impact on the environment. This European Spatial Data Infrastructure will enable the sharing of environmental spatial information among public sector organisations, facilitate public access to spatial information across Europe and assist in policy-making across boundaries.

INSPIRE is based on the infrastructures for spatial information established and operated by the Member States of the European Union. The Directive addresses 34 spatial data themes needed for environmental applications.

The Directive came into force on 15 May 2007 and will be implemented in various stages, with full implementation required by 2021.

This video provides an overview of why INSPIRE is needed and what types of spatial are covered by INSPIRE



<https://youtu.be/xew6ql-6wNk>

INSPIRE is based on a number of common principles:

- Data should be collected only once and kept where it can be maintained most effectively.
- It should be possible to combine seamless spatial information from different sources across Europe and share it with many users and applications.
- It should be possible for information collected at one level/scale to be shared with all levels/scales; detailed for thorough investigations, general for strategic purposes.
- Geographic information needed for good governance at all levels should be readily and transparently available.
- Easy to find what geographic information is available, how it can be used to meet a particular need, and under which conditions it can be acquired and used.



INSPIRE Themes

ANNEX: 1	
	Addresses
	Cadastral parcels
	Geographical grid systems
	Hydrography
	Transport networks
ANNEX: 2	
	Elevation
	Land cover
ANNEX: 3	
	Agricultural and aquaculture facilities
	Atmospheric conditions
	Buildings
	Environmental monitoring facilities
	Human health and safety
	Heterological geographical features
	Natural risk zones
	Population distribution and demography
	Sea resources
	Species distribution
	Utility and governmental services

Forest land (INSPIRE)

Download Options | View Options | Data set Metadata

Resource Title: Forest land (INSPIRE) | Resource Abstract: Geospatial information of the forest plots in the country. Geospatial data of the national forest register. | Usage: Made available by register, register meda inventarjag (geopointer unifikat id). | Unique Resource Identifier: Code: 10200901-4A00-4E00-B0E0-E0C770005A | Namespace: [not available] | Spatial Data Theme: Forest land | Topic Category: insygen/land/forestCover

Reporting Tags: Priority interest, Strategic interest | Conditions Applying To Access And Use: no conditions apply | Limitations On Public Access: no limitations | Geographic Bounding Box: | Responsible Party: Organization name: Lata mēroga dienests | E-mail: mrd@lmd.gov.lv | Metadata Point Of Contact: Organization name: Lata mēroga dienests | E-mail: mrd@lmd.gov.lv | Metadata Language: In: Latvian | Metadata Identifier: DA41127-4250-471F-A2D2-03441183C1 | Metadata Date: 2016-01-18 | Download metadata: [http://www.lmd.gov.lv/10138.html](#)



The Danish GI legislation

<https://inspire-danmark.dk/media/gst/76937/The%20GI-law.pdf>



The act defines terms

- ... and states that
- All relevant authorities must comply
- Data must be made publicly and freely available
- Metadata must be available
- Search engines must be established
- Data must be referred to the INSPIRE portal

Bill 12 (as presented): Infrastructure for Spatial Information Bill

Presented on 8 October 2008 by the Minister for the Environment (Troels Lund Poulsen)

Infrastructure for Spatial Information Act

Passed by the Danish parliament, Folketinget, 9 December 2008



A screenshot of the GeoDanmark website. The page features a large image of a person working at a computer with multiple monitors displaying GIS software. Overlaid on the right side is a dark blue sidebar with white text containing a navigation menu and a search bar. The sidebar includes links like 'Gå direkte til Bestyrelsen', 'GeoDK', 'Arbejdsprogram', 'At være medlem', 'Status på vektorproduktion', and 'Status på fotoflyvning'. At the bottom left of the sidebar is a button labeled 'Læs mere her'.

GeoDanmark

- Is a coordinated action between Danish Municipalities and the Danish State
- Who set standards for the quality, production and update frequency of Danish Geodata
- And makes data and metadata available for free use by public and private individuals and organisations

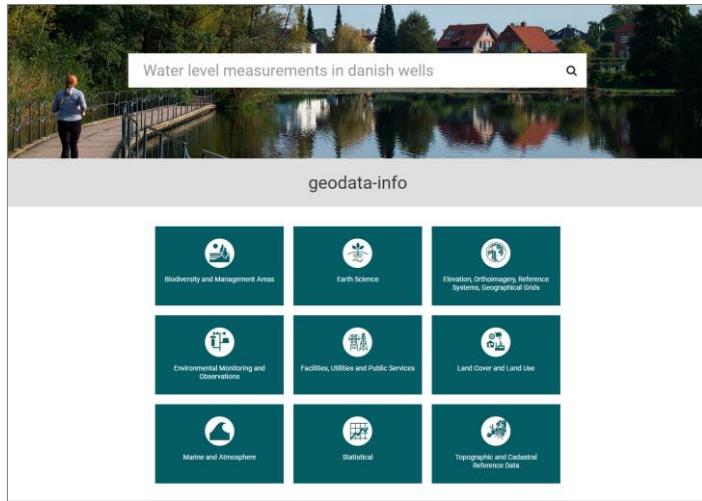
To list layers google 'geodanmark specifikation'



Searching the Web for Danish geo data

<http://geodata-info.dk>

.. Sorry. Mostly in Danish



Dataforsyningen (the Data supplier)

Previously known as Kortforsyningen (the Map Supplier)



Welcome to the Danish data
and map supply.
Denmarks public geodata and maps
are now available online in English.
We hope you will find what you
are looking for here.



Search results

Categories

Copernicus Land - corine land cover DNK - version 1, Oct. 2014

Copine Land Cover (CLC) 2012 and CLC change 2006-2012 are two of the datasets produced within the frame of the Initial Operations of the Copernicus programme (the European Earth monitoring programme previously known as GMES) on land monitoring. Corine Land Cover (CLC) provides consistent information on land cover and land cover changes across Europe. This inventory was initiated in 1985 (reference year 1990) and established a time series of land cover information with updates in

WMS for ELF BaseMap

WMS BaseMap is a pyramid of digital maps, at different zoom levels, built from the ELF harmonised data, which in turn is to be used as a data source for a WMTS service

Categories

Officielle adresser (BBR)

Datasættet repræsenterer de officielle vejnavne- og adressebetegnelser i Danmark. Datasættet inkluderer adressepunkter, der repræsenterer hver adressens geografiske placering. Datasættes formål er at fungere som den grundlæggende, fælles reference til de officielle adresser som fastsættes af kommunerne og registreres i Bygnings- og Boligregisteret, BBR, samt i CPRs vejeregister, i overensstemmelse med reglerne i BBR-loven og adressebekendtgørelsen.

Categories

WFS for INSPIRE/ELF Statistical Units Vector

Web Feature Service providing access to Statistical Units Vector from Denmark. The contents are data from the data set "Danmarks Administrative Geografiske Inddelinger (DAGI)", transformed to the INSPIRE Statistical Units Vector GML application schema v4.0.



Meta data

Copernicus Land - corine land cover DNK - version 1, Oct. 2014 (Dataset)

Corine Land Cover (CLC) 2012 and CLC change 2006-2012 are two of the datasets produced within the frame of the Initial Operations of the Copernicus programme (the European Earth monitoring programme previously known as GMES) on land monitoring.

Corine Land Cover (CLC) provides consistent information on land cover and land cover changes across Europe. This inventory was initiated in 1985 (reference year 1990) and established a time series of land cover information with updates in 2000 and 2006 being the last one the 2012 reference year.

CLC products are based on photointerpretation of satellite images by national teams of participating countries - the EEA member and cooperating countries – following a standard methodology and nomenclature with the following base parameters: 44 classes in the hierarchical three level Corine nomenclature; minimum mapping unit (MMU) for status layers is 25 hectares; minimum width of linear elements is 100 metres; minimum mapping unit (MMU) for Land Cover Changes (LCC) for the change layers is 5 hectares. The resulting national land cover inventories are further integrated into a seamless land cover map of Europe.

Land cover and land use (LCLU) information is important not only for land change research, but also more broadly for the monitoring of environmental change, policy support, the creation of environmental indicators and reporting. CLC datasets provide important datasets supporting the implementation of key priority areas of the Environment Action Programmes of the European Union as protecting ecosystems, halting the loss of biological diversity, tracking the impacts of climate change, assessing developments in agriculture and implementing the EU Water Framework Directive, among others.

More about the Corine Land Cover (CLC) and Copernicus land monitoring data in general can be found at <http://land.copernicus.eu/>.

Download and links

./data/copern_v_2100_100_k_clc-gr_2011-2012_rev01.shp	Open link
http://kontforsyningen.kms.dk/corine_dissemination?ignoreIllegalLayers=TRUE&transparent=TRUE&REQUEST=GetMap&SERVICE=WMS&VERSION=1.1.1&LAYERS=CHA12_DK&STYLES=&FORMAT=image/png&BGCOLO R=0xFFFF&RS=EPSG:25832&BBOX=192470.588235294,5872588.23529412,072470.58823529,6534313.7254902&WIDTH=800&HEIGHT=600	Open link



USGS: Earth Explorer

USGS science for a changing world

EarthExplorer

Home 2 New System Messages

Search Criteria Data Sets Additional C Home About Products Advanced Very High Resolution Radiometer (AVHRR)

2. Select Your Data Set(s)
Check the boxes for the data set(s) you want to search.
When done selecting data set(s), click the Additional Criteria or Results button next to the category name.

Use Data Set Prefilter

Data Set Search:

Aerial Imagery

- AVHRR
- AVHRR Global 1
- AVHRR Compos
- AVHRR Orbital S

CEOS Legacy

Commercial Satellites

Declassified Data

Digital Elevation

The Advanced Very High Resolution Radiometer (AVHRR) provides four- to six-band multispectral data from the NOAA polar-orbiting satellite series. There is fairly continuous global coverage since June 1979, with morning and afternoon acquisitions available. The resolution is 1.1 kilometer at nadir.

The number of available bands will depend on the satellite.

The USGS produces a series of derived [AVHRR NDVI composites](#) and [Global Land Cover Characterization \(GLCC\) data](#).

Raw (Level 1b) data consists of a single scene that was collected by a single AVHRR satellite on a specific date and time. The approximate scene size is 2400 x 6400 kilometers (1491 x 4000 miles). Public distribution is via the [NOAA Satellite Active Archive](#).



The Danish Environmental portal

Miljøportalen: <https://arealinformation.miljoeportal.dk/>

Beskyttede vandløb (NBL § 3)

- Zoom til fuld kortudsnit
- Zoom til det fulde kortudsnit af laget.
- Zoom til synlig skala
- Zoom til en skala, hvor laget er synligt.
- Fjern lag
- Fjern dette brugertilpassede lag fra kortet.
- Vis metadata BES_VANDLOEB

Tilføj/fjern kort information

Sej... registreringer

- Natur og Miljøudvikling
- Naturtyper og kulturmiljø
- vigtige miljø
- Naturtyperne og naturarealet, lejte- og VIMR (Ingen vægt)
- Miljøværdier
- Beskyttede vandløb (NBL § 3)
- Naturlige vandløb (NBL § 3)
- Naturlige 2000 – vegetationslysliste
- Naturlige 2000 – vandsystemer
- Naturlige vandløb
- Natur- og vildsmiljøer
- Frødrag og kulturmiljø
- Jordbrug og kulturmiljø
- Bygge- og bebyggelsesområder
- Brude- og beskæmmelsestyper (SØF)

Beskyttede naturtyper (Dataset)

Registrering af naturtyper, som er beskyttet efter naturbeskyttelægeslovens § 3.

Dato: 2015-09-01

Det er et vandløb med et areal på mindst 100 m2, moser, enge, strandenge, strandsande, heder og overdrev med et areal på mindst 2500 m2, "mosskær" af overvænende naturtyper med et areal på mindst 2500 m2, vesse udpegede vandløb & andre vandløb, der ikke er vandløb, spær eller vandløb.

Beskyttelsen gælder uanset om der er en eller flere ejere. Tiltaksendring af beskyttet natur kræver tilladelser (dispensation).

Et beskyttet areal kan i lønnes løb ændre sig så meget, at det ikke længere er beskyttet. Omvendt kan et areal som i dag ikke er beskyttet, ændre sig, så det bliver et beskyttet areal.

Der er faktisk forskel på arealer (størrelse, botanik, omkringliggende omgivelser m. m.) der afgør, om det er beskyttet eller ej. Registreringen er derfor vejdledende.

Hvis et areal er beskyttet eller ej, vil vi hvitvælde blåe afgort ved en besigtigelse og vurdering af arealset.

Lov om naturbeskyttelse, §3, lovtekstindgåvise nr. 933 af 24. september 2009

Download and links

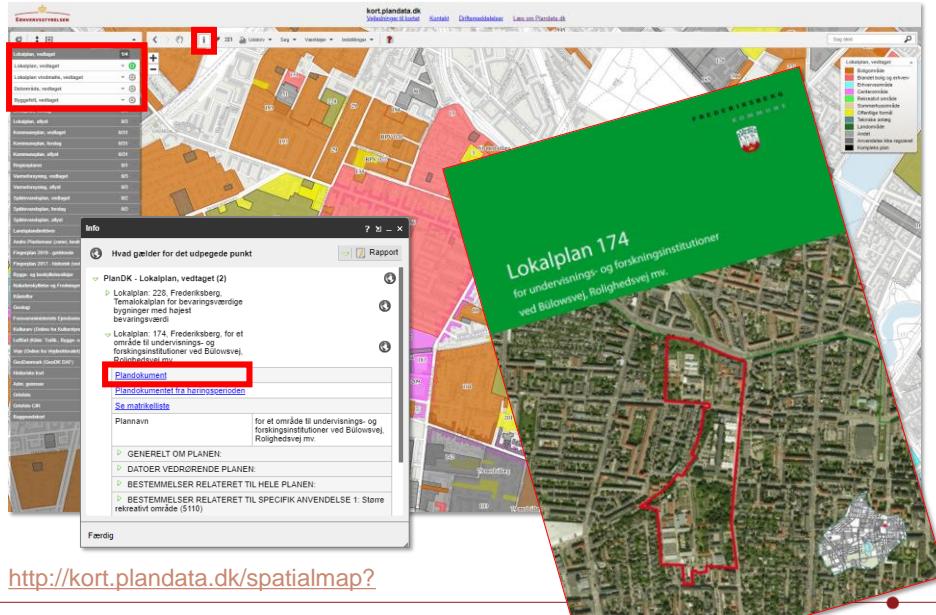
<https://arealinformation.miljoeportal.dk/> Open link

Associated resources

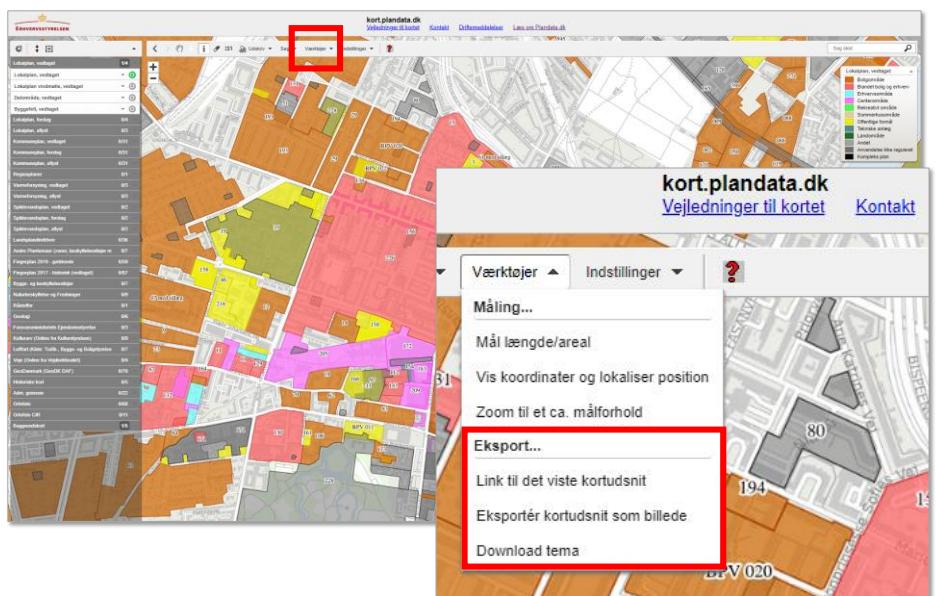
- WFS-service DÅdb (Related service)
- WFS-service fra Danmarks Arealinformation som udstiller alle lag som ligger i Arealinformations database. servicenavnet er DÅdb. Meer...
- Related service

The Danish Plan System

Plandata.dk



Plandata.dk



The Danish Plan System

The screenshot shows a web-based application for managing local plans in Denmark. On the left, a sidebar lists various types of plans and their counts, such as 'Lokalplan, vedtaget' (0/4), 'Kommuneplan, vedtaget' (0/3), and 'Andre Plantemaer (zoner, beskyttelseslinjer m.m.)' (0/7). A red box highlights the 'Fingoplan 2019 - gældende' item. On the right, a map viewer titled 'kort.plandata.dk' displays a map of a specific area with various colored regions and labels. Below the map, a text box contains legal text regarding the plan's validity and its relation to other plans like 'Natura 2000-plan'. At the bottom, there are links for 'Påkrævet' and 'Om denne ressource'.

Data structure and search facilities at IGN

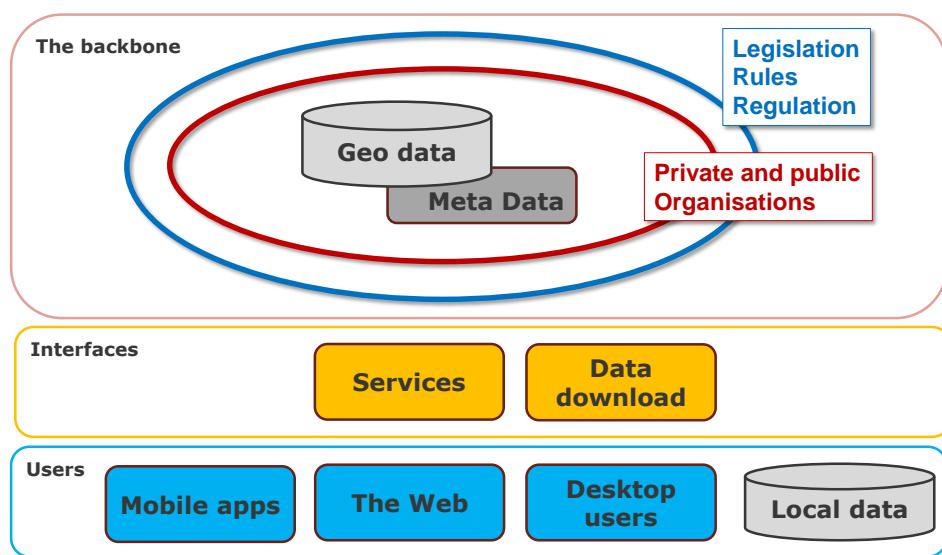
The screenshot shows the 'Add Data' interface of the IGN Geodata Library. A red box highlights the 'English' folder. Another red box highlights the 'IGG - Geodata Library' folder. A red arrow points from the 'IGG - Geodata Library' box to a sidebar on the right containing a hierarchical list of 13 categories: 1. Administration & Border, 2. Building, Plant & Cadastre, 3. Elevation, 4. Geology, 5. Land use & Landscape, 6. Aerial & Orthophoto, 7. Environment, Protection & Planning, 8. Statistics, 9. Topographic maps (recent and historical), 10. Traffic, 11. Tourism & Recreation, 12. Water, and 13. Copenhagen. Below the sidebar, a secondary red arrow points to a detailed list of geographical datasets, including continent and country level data for Africa, Asia, Europe, North America, Oceania, South America, and World.



Pause



Organisation of geodata: The big picture



Locally stored data vs. web services

Local data are

- Data stored directly on your computer or at a company-specific server
- They are often proprietary formats
- e.g. data on the IGN I: drive

Data supplied via the Web

- With or without its own client
- Primarily servers facilitate downloading (in proprietary formats)

Web services

- Will be based on Open standards
- Can serve both GIS software and other types of (web-) clients
- Can be static or live data (real time data)



OGC

So, who's taking care of this mess?

The **Open Geospatial Consortium (OGC)**, an international voluntary consensus [standards organization](#), originated in 1994.

In the OGC, more than 400 commercial, governmental, nonprofit and research organizations worldwide collaborate in a consensus process encouraging development and implementation of **open standards** for [geospatial](#) content and services, [GIS data processing](#) and data sharing.



Source: Wikipedia and <http://www.opengeospatial.org/>



WMS

A **Web Map Service (WMS)** is a standard protocol for serving georeferenced map images over the Internet that are generated by a map server using data from a GIS database

WMS specifies a number of different request types, two of which are required by any WMS server:

- GetCapabilities - returns parameters about the WMS and the available layers
- GetMap - with parameters provided, returns a map image

Example:

```
http://nsidc.org/cgi-bin/atlas_north?service=WMS&version=1.1.1
&request=GetMap&srs=EPSG:32661&format=image/gif&width=1000&height=1000
&bbox=-2700000,-2700000,6700000,6700000
&layers=sea_ice_extent_01,land,snow_extent_01,permafrost_extent,country_borders,treeline,north_pol_geographic,
arctic_circle,country_labels,geographic_features_sea
```

Source: Wikipedia



WFS

A **Web Feature Service (WFS)** is a standard protocol for serving geographical features over the Internet that are generated by a map server using data from a GIS database

The WFS specification defines interfaces for describing data manipulation operations of geographic features. Data manipulation operations include the ability to:

- Get or Query features based on spatial and non-spatial constraints
- Create a new feature instance
- Delete a feature instance
- Update a feature instance

Source: Wikipedia

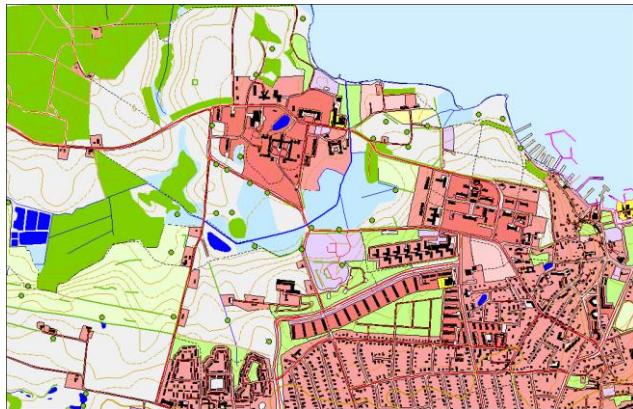
```
<gml:LineString gml:id="p21" srsName="urn:ogc:def:crs:EPSG:6.6:4326">
  <gml:coordinates>45.67, 88.56 55.56,89.44</gml:coordinates>
</gml:LineString >
```



Geo-danmark works for the establishment of a **unified public topographic mapping** of Denmark with the aim to become one of the main elements in the national strategy for eGovernment in Denmark.

The purpose of Geo-danmark is to create a coherent mapping so that **all Danish authorities – state as well as municipal** – have a common understanding and a solid base for cooperation on a local and national scale

Geo Denmark data



Geo Denmark data

BUILDINGS	TECHNICAL	NATUR
Building	Technical area	Forest
Building_bbrpoint	Runway	Heath
BUILDING AREA	Churchyard	Wetland
Town centre	Basin	Scrub vegetation
Commercial area	Telemast base	Sand_dune
Low building area	High tension wire forundation	Quarry
High building area	High tension wire	Fence
TRAFFIC	Structure	Boundary line
Road centre line	Other small structures	Slope
Railway	Groyne	Dyke
System line	Parking	Tree
Road edge	Chimney	Treegroup
Traffic island	Telemast	HYDRO
Speed bump	Wind turbine	Lake
Crash barrier	Mast	Stream centre line
Train halt	Gully	Drainage ditch
ADMINISTRATIVE	Manhole	Stream edge
Town polygon	Statue_Memorial stone	Harbour
Municipality	Installation cabinet	Coastline
Historical area		Jetty_Bathingbridge
Historical point		MISCELLANEOUS
Place name		Area type polygon
		Ortho polygon
		Orthophoto



Cadastre maps

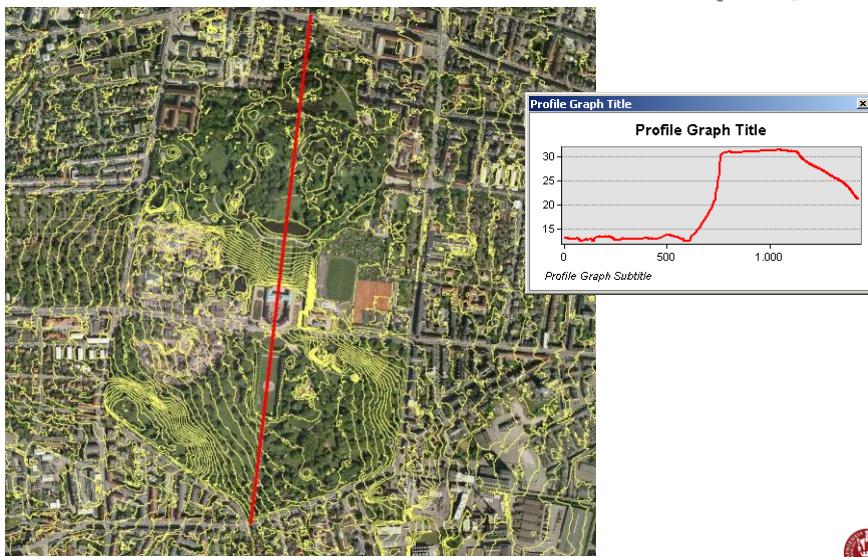


DDM:

- **Scale:** 1:500-1:5.000
- **Authority:** SDFE/municipalities
- **Type:** Vektorer
- **Content:** Cadastral parcels etc.



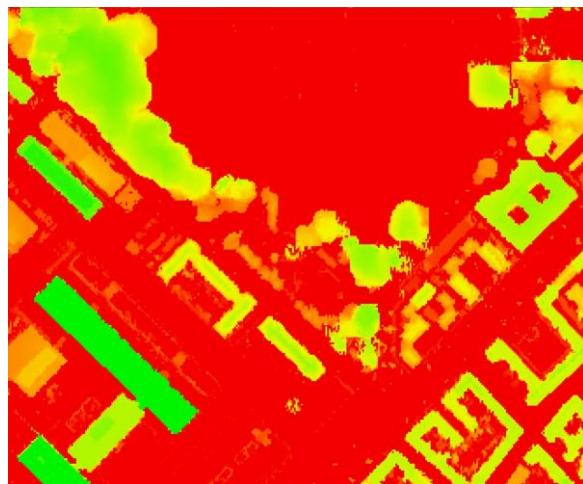
Digital Terrain model/Digital Surface model (DTM/DSM)



Digital Terrain model/Digital Surface model (DTM/DSM)

Authority: SDFE

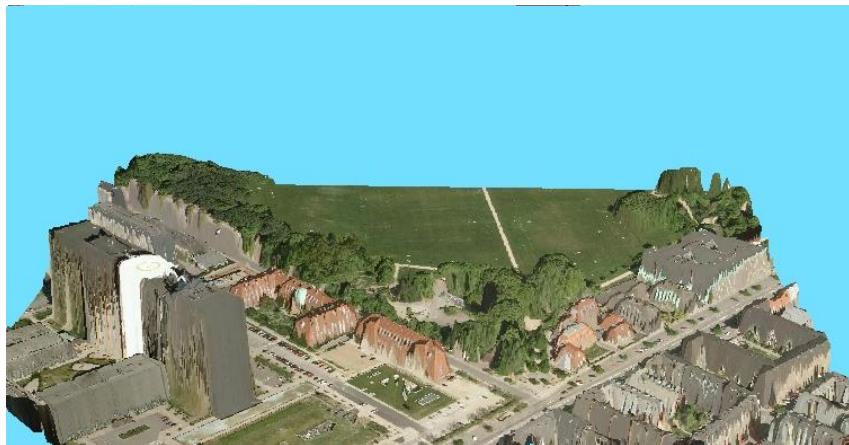
Type: Raster, 0.44x0.44 m



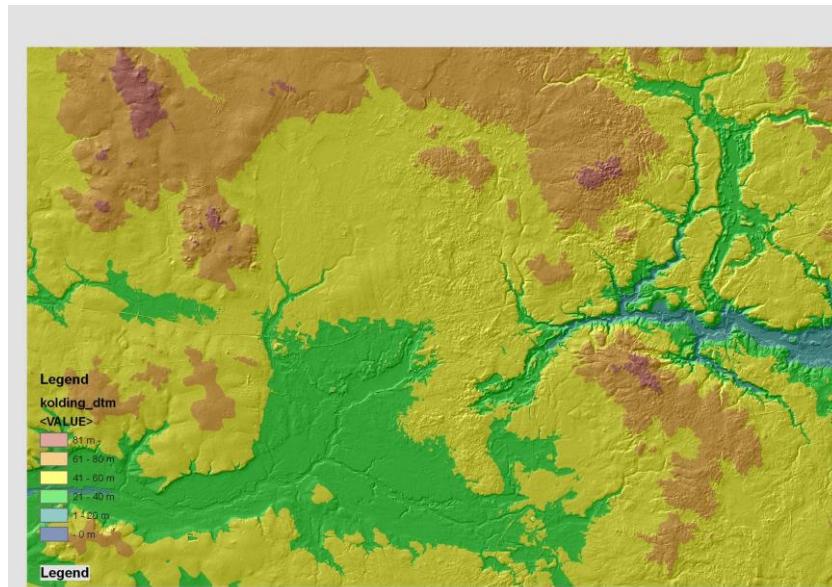
Digital Terrain model/Digital Surface model (DTM/DSM)

Authority: SDFE

Type: Raster, 0.44x0.44 m



Shadowed and classified DSM



AIS – Depth of the sea

Scale: 1:10.000, Authority: Miljøministeriet/DMU

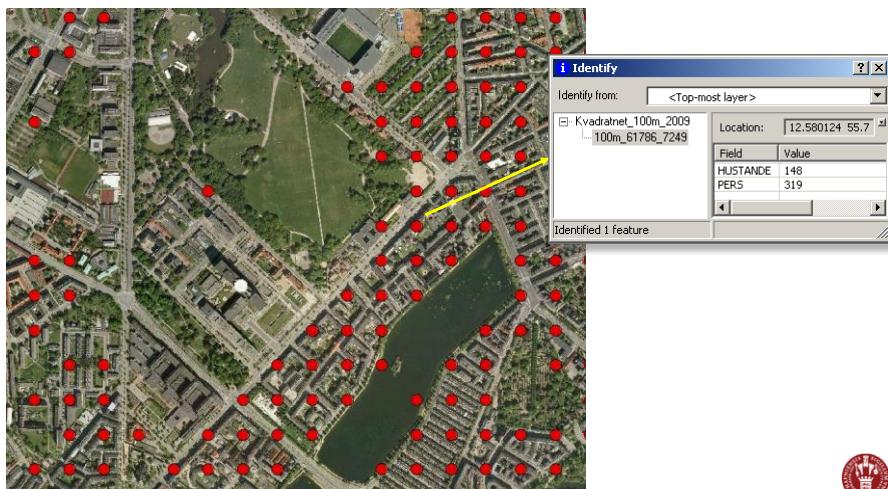
Type: Trianguleret Irregulært Network (TIN), Content: Depth of the Danish inner sea-areas



100x100 square net (Population)

Scale: 1:25.000 , Authority: Stastics Denmark

Type: Pseudo raster, Content: Population in 100x100 m 'cells'

**Put more effort into KvNet**

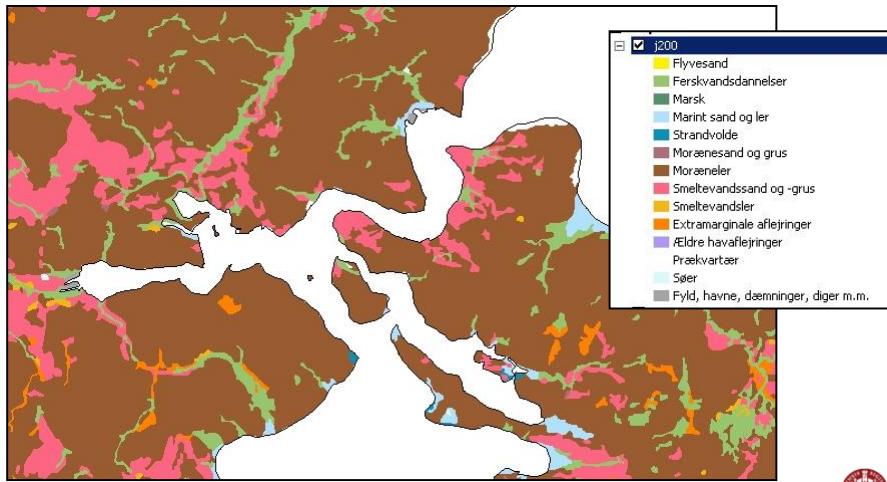
- in general and specifically
- with respect to population
- describe nomenclature
- other cell sizes available



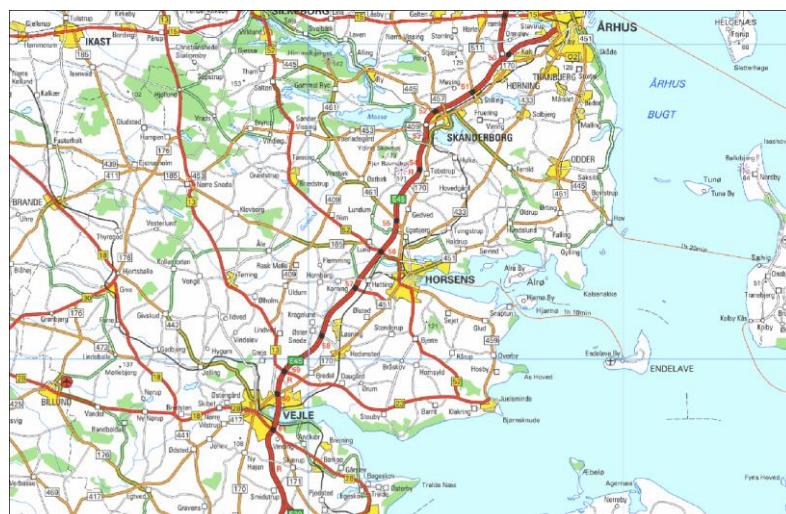
Geological base-maps

Scale: 1:25.000 and 1:200.000, Authority: GEUS

Type: Vector, Content: Quaternary geological soil types



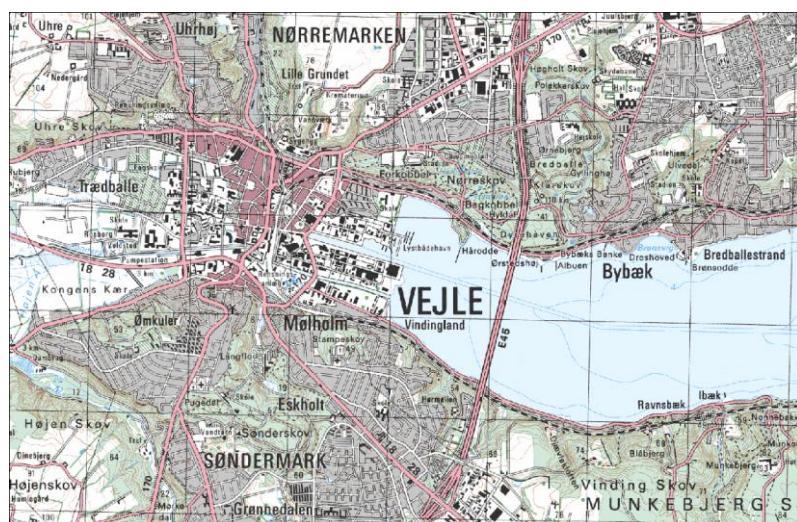
Topographic raster base maps – 1:500.000



Topographic raster base maps – 1:100.000 (1 cm)



Topographic raster base maps – 1:50.000 (2 cm)



Topographic raster base maps – 1:25.000 (4 cm)

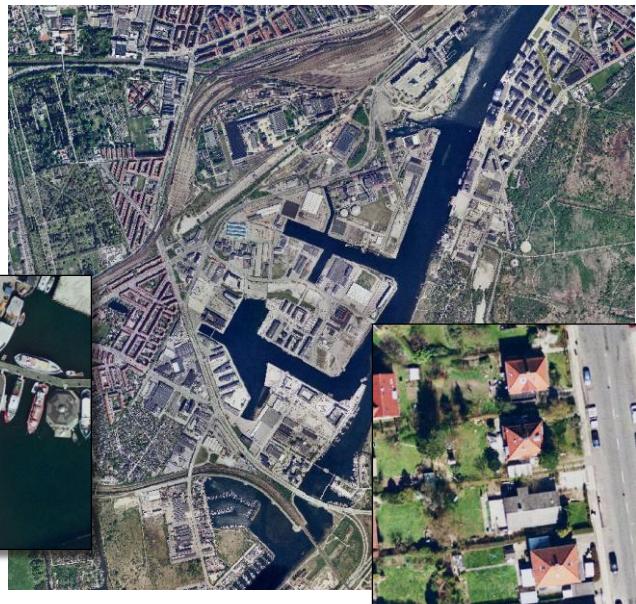


**Historic topographic raster base maps – 1:20.000
1842-1899.**



Digital orto fotos

.. 2010 10 cm
2006 10 cm
2005 10 cm
2004-BY 10 cm
2006 25 cm
2004 25 cm
2002 40 cm
1999 40 cm
1995 40 cm
1954 40 cm



Thank you for your attention...

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