

# Geographical Information Systems (GIS)

- *Welcome*

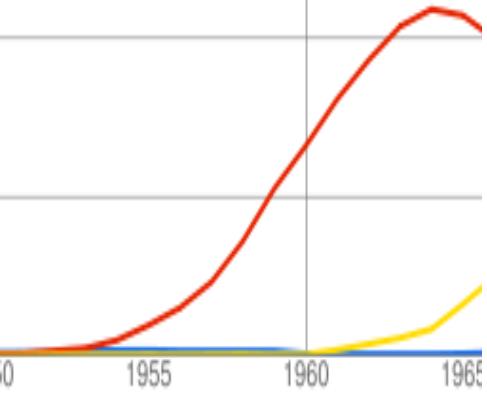
# What is GIS?



# Google Ngram Viewer

- 5 000 €
- 500 00

- ‘Popula



1950 →

THE ASTRONOMICAL JOURNAL							N°. 763					
Date	p	A and B	Seeing	Power	Obs.		Date	p	A and d	Seeing	Power	Obs.
1918.748	138.55	5.02	p	367	H.L.		1918.767	30.76	115.98	p	367	H.L.
1918.772	137.96	5.13	p	367	H.L.		1919.500	30.68	116.41	p	495	B
1919.500	134.69	5.49	p	495	B		1919.632	30.60	116.65	p	388	B
1919.577	135.23	5.43	p	388	B		1919.681	30.78	116.67	p	388	B
1919.610	134.80	5.37	p	388	B				A and e			
							1918.753	95.98	115.91	f	367	H.L.
1918.753	228.26	38.13	f	367	H.L.		1919.500	96.13	116.02	f	495	B
1919.495	228.76	37.84	p	388	B		1919.681	95.96	115.92	p	388	B
1919.577	228.74	37.47	p	388	B				A and f			
1919.744	229.07	37.08	f	495	B		1919.495	330.85	155.72	p	388	B
							1919.632	330.81	156.84	f	388	B
1919.495	263.23	60.18	p	388	B		1919.719	331.09	156.58	p	388	B
1919.577	263.26	68.72	p	388	B				A and g			
1919.744	262.76	68.00	g	388	B		1918.769	234.44	149.74	f	367	H.L.
							1919.495	234.47	148.91	p	388	B
1918.758	65.10	107.24	p	367	H.L.		1919.681	234.61	148.64	p	388	B
1919.500	64.95	108.02	f	495	B		1919.744	234.66	148.68	f	388	B
1919.632	64.77	108.42	f	388	B							

Observers, H.L. = A. HALI. B = ERNEST CLARE BOWER.  
Washington, D.C., 1919, Nov. 22.

## ELEMENTS AND EPHEMERIS OF 1903 NF.

By ERNEST CLARE BOWER.

[Communicated by Rear Admiral J. A. HOOSERWELL, U. S. Navy, Superintendent.]

G. Civil T.	Astrographic $\pi_{\text{apo}}$	$\dot{\pi}_{\text{apo}}$	$p_{\text{ap}}$	$p_{\text{ep}}$	$\frac{p_{\text{ep}} - p_{\text{ap}}}{p_{\text{ap}}}$	Comparison Stars Ast. Tel.	Observer	Res.	Residuals from orbit on $\Delta t$ , $\Delta \delta$
(1) Dec. 12.18231	80.27	7.7	+0.37	31.7	0.3246(0.645)	0.8	+9.05 48, 22, 27, 30, 32, 35, 39, 44	Peters	-0.1 -0.1
(2) 16.19163	83.26	7.7	+0.20	32.5	0.3276(0.636)			Dwinger	0.3 -0.8
(3) 16.21228	83.36	35.8	9.20	28.8	0.4796(0.635)			Dwinger	-0.5 0.0
(4) 17.21067	83.10	43.3	9.16	27.9	0.373(0.642)	0.7	+9.05 40, 08, 104, 106, 115, 123, 130, 131, 135	Peters	3.6 +1.6
(5) 18.24274	84.56	11.0	9.12	52.6	0.125(0.639)			Dwinger	1.9 +0.4
(6) 19.28500	84.40	30.0	9.11	61.6	0.396(0.659)			Dwinger	2.2 -0.1
(7) 19.30160	84.40	36.0	+0.9	8.19	0.384(0.651)			Dwinger	-0.1 -0.1

The only available observations of this asteroid have been obtained at Washington.

Observations (1) and (4) were made with a 6-inch Dallmeyer portrait lens attached to the 26-inch equatorial. The plates were measured and reduced by the writer using Wilson's Method. (Goddard Obs. Pub. No. 5).

The orbit by DR. A. ESTELLE GLANCY (A. J. 31, 56), corrected by LEUSCHNER's method (Lick Pub. 7), yields the above residuals.

## ELEMENTS AND RESIDUALS FOR

Epoch = 1903.0 G. C. T.

M = 91°.5

$\mu = 0^{\circ}23'$

$\log a = 0.4156$

$e = 0.15448$

$i = 12^{\circ}45'$

$\Omega = 221^{\circ}14'28''$

$\omega = 122^{\circ}$

$x = r[9.995352] \sin \theta$

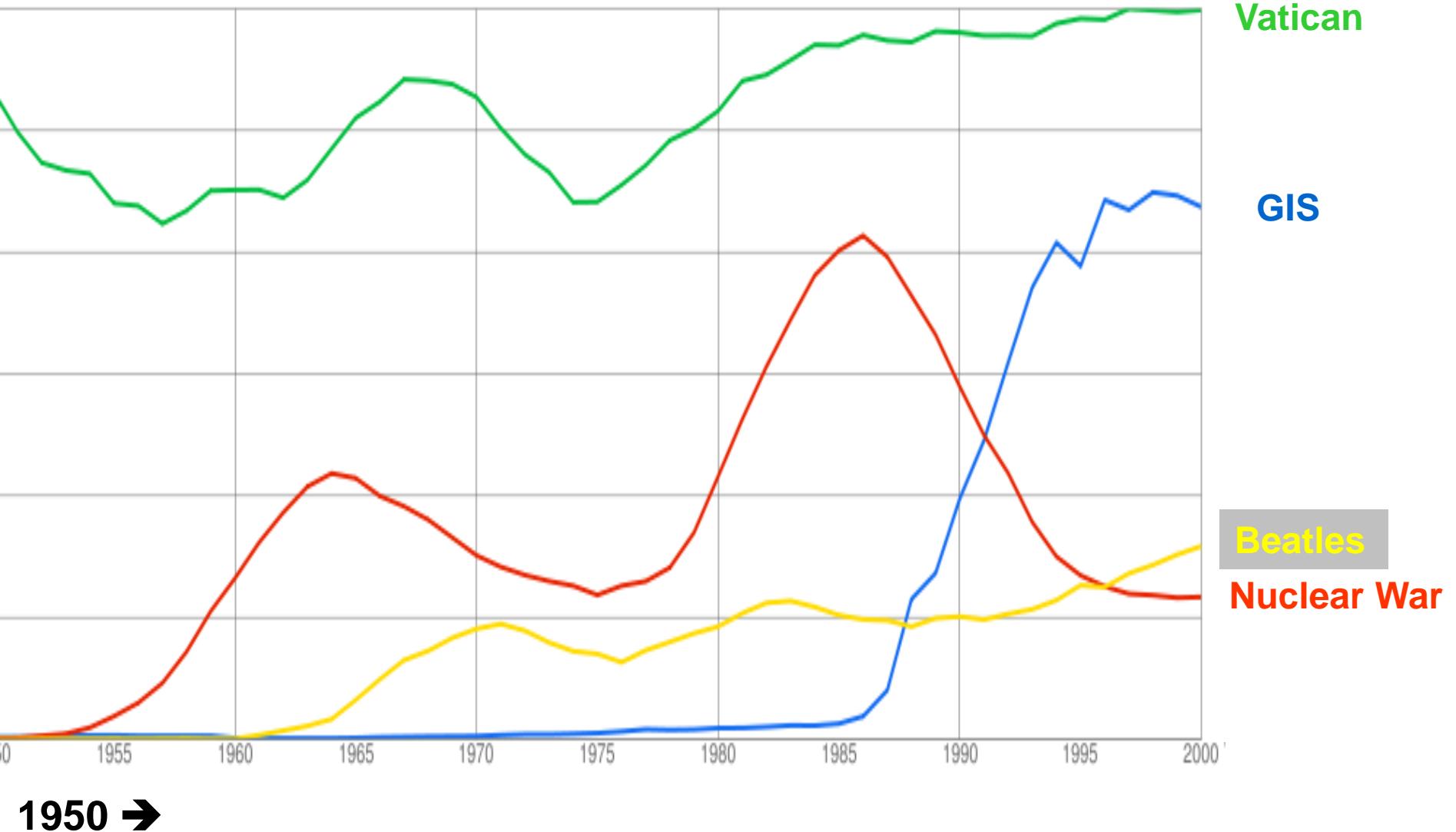
$y = r[0.987567] \sin \theta$

$z = r[0.442748] \sin \theta$

over time

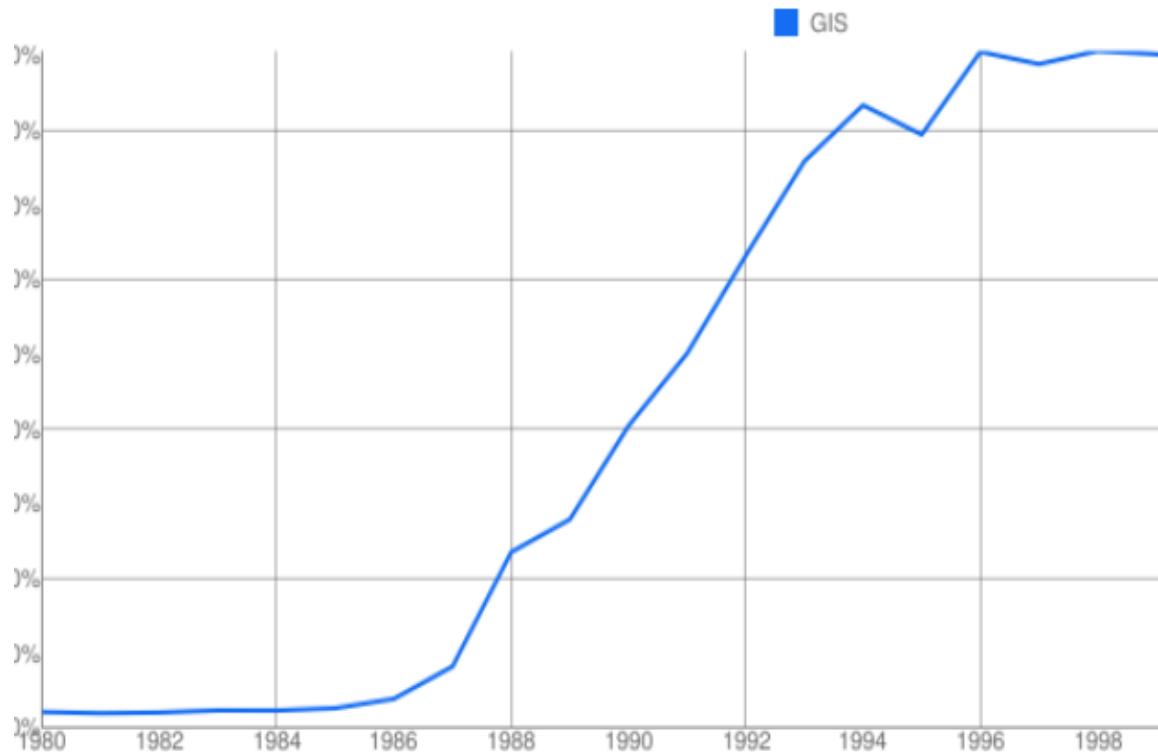
5 2000

# Google Ngram Viewer

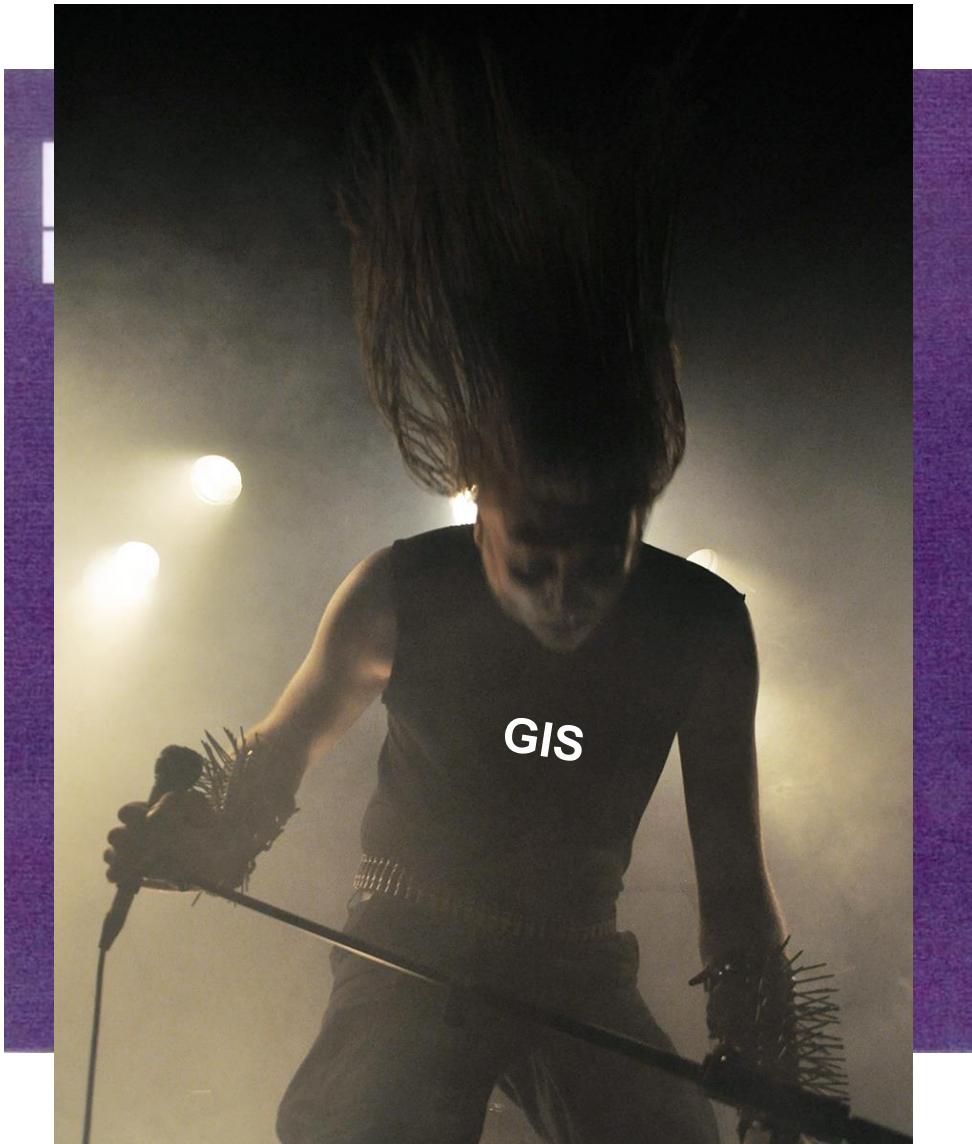


*"Lies, damned lies, and statistics"*

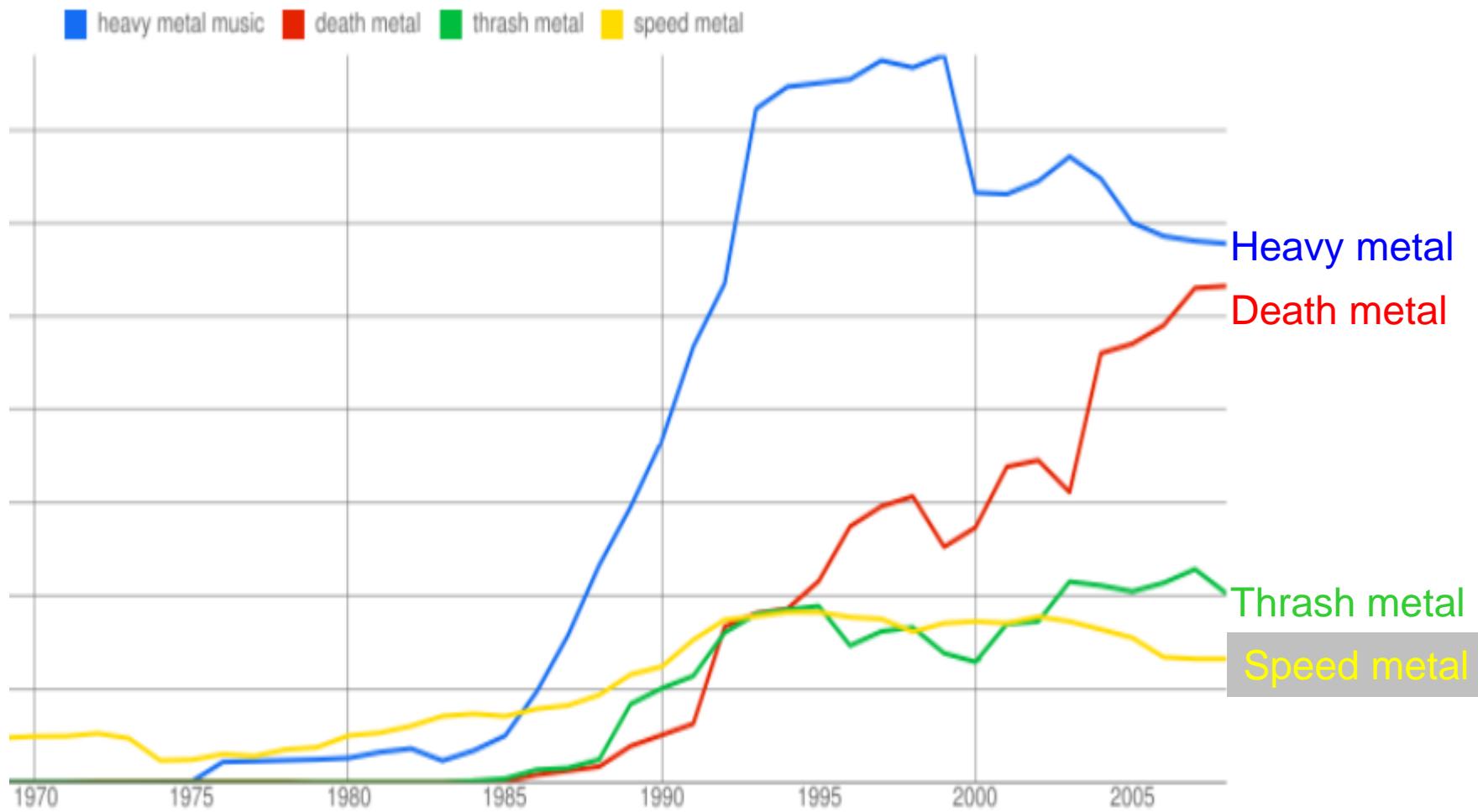
M. Twain 1906



# Don't worry – GIS is still rocking!



# Don't worry – GIS is still rocking!



# GIS 1980-

1989

First consumer hand-held GPS



80 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000



**1990**  
**First automotive navigation system**

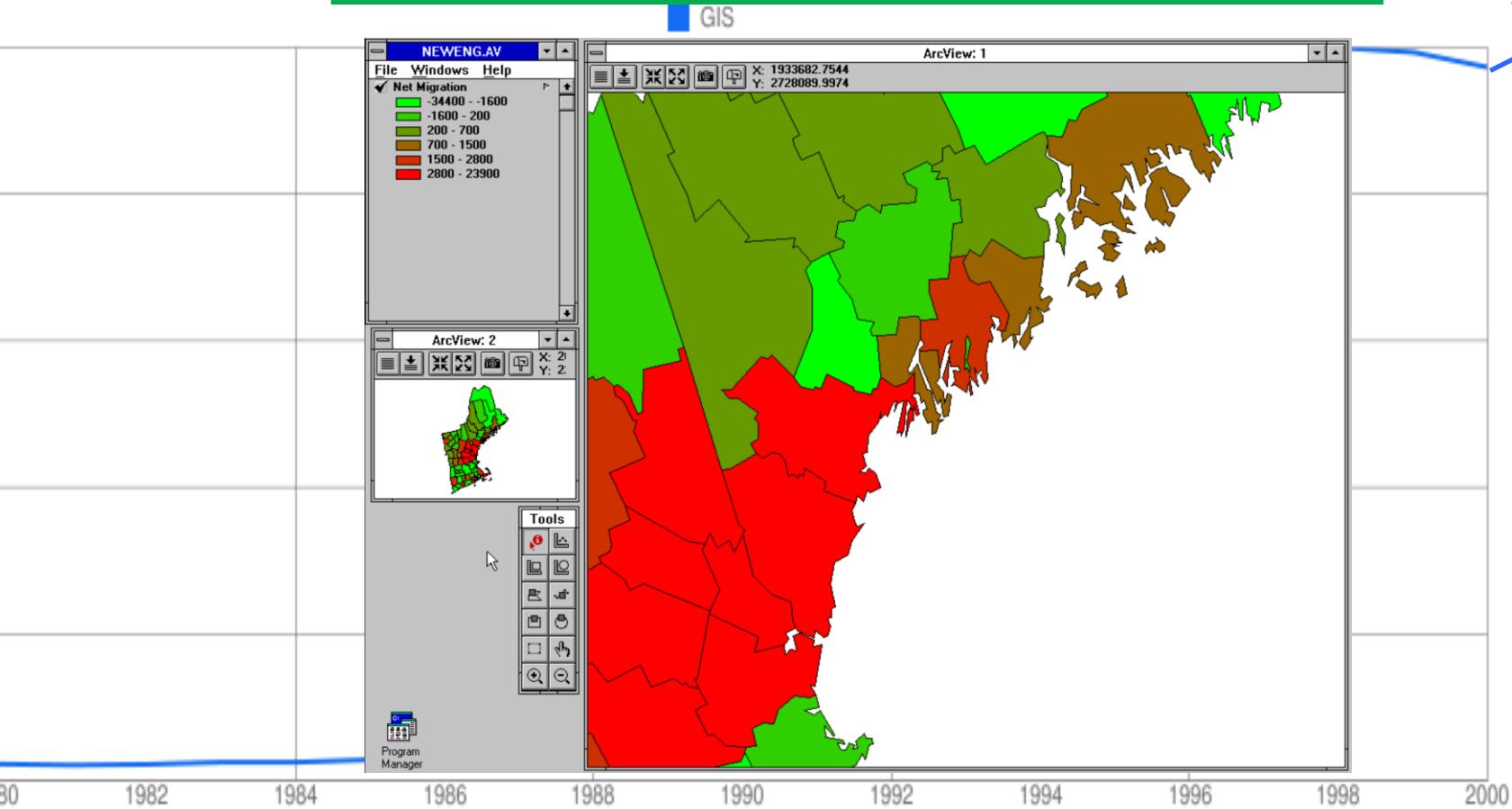


Getty Images

80 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000

# 1991

## GIS goes Windows (ArcView 1.0)



# 1995 - 1996

## WebGIS services

(e.g. [www.krak.dk](http://www.krak.dk))

krak  Rolighedsvej 23, 1958 Frederiksberg C, Frederiksberg  Opgdag nærværende. Søg lokalt.

Ruteplan Udskriv Link til kortet Del på: [f](#) [t](#)

Rolighedsvej 23  
1958 Frederiksberg C

[Firmaer](#) (8) ved adressen  
[Tog, Bus & Metro](#) [Rejseplan](#)

Kort Luftfoto Hybrid Skråfoto Gadefoto



DTU Veterinærinsti

1982

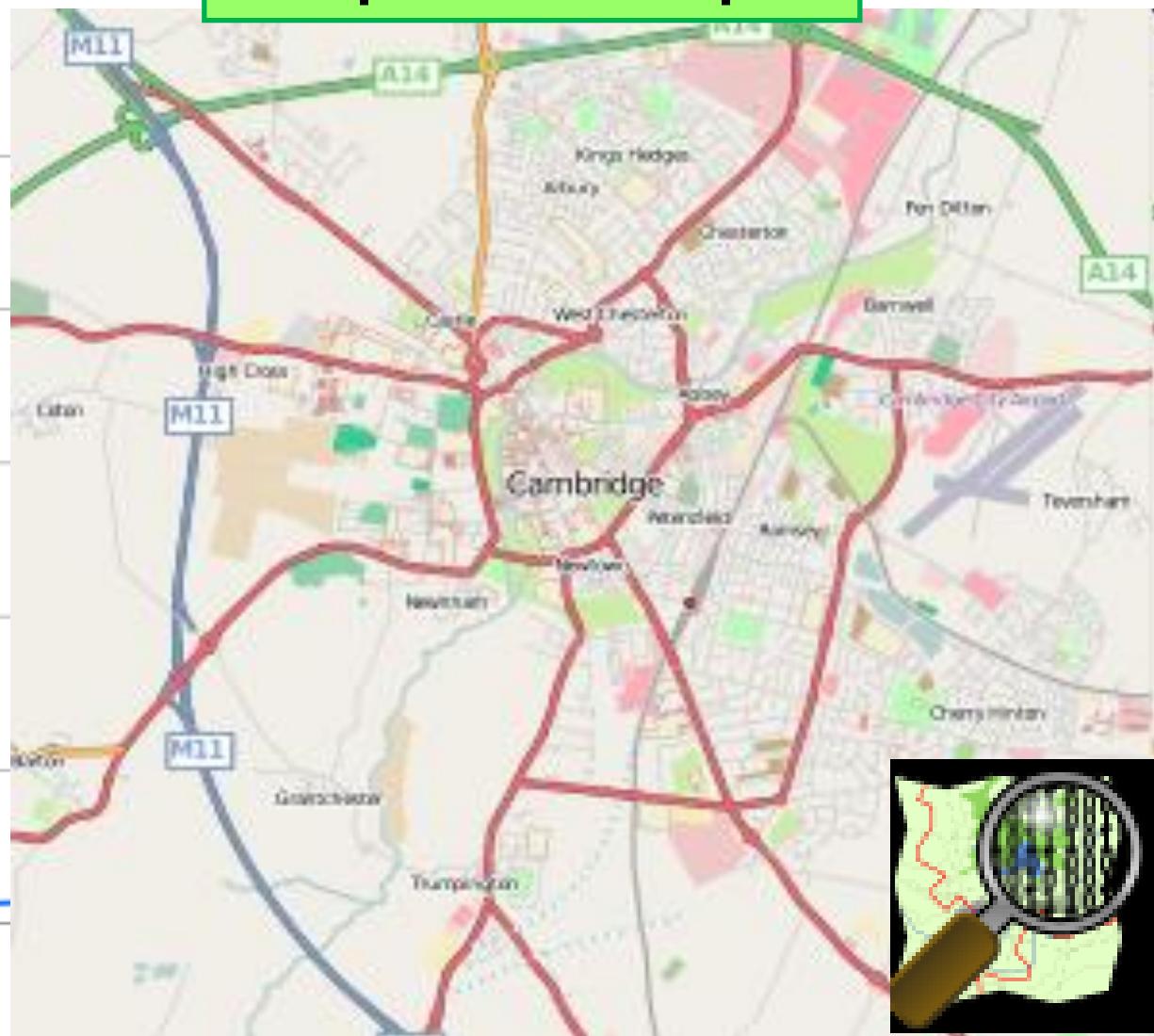
- 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 +

2001

## First mobile phones with GPS



# 2004 OpenStreetMap

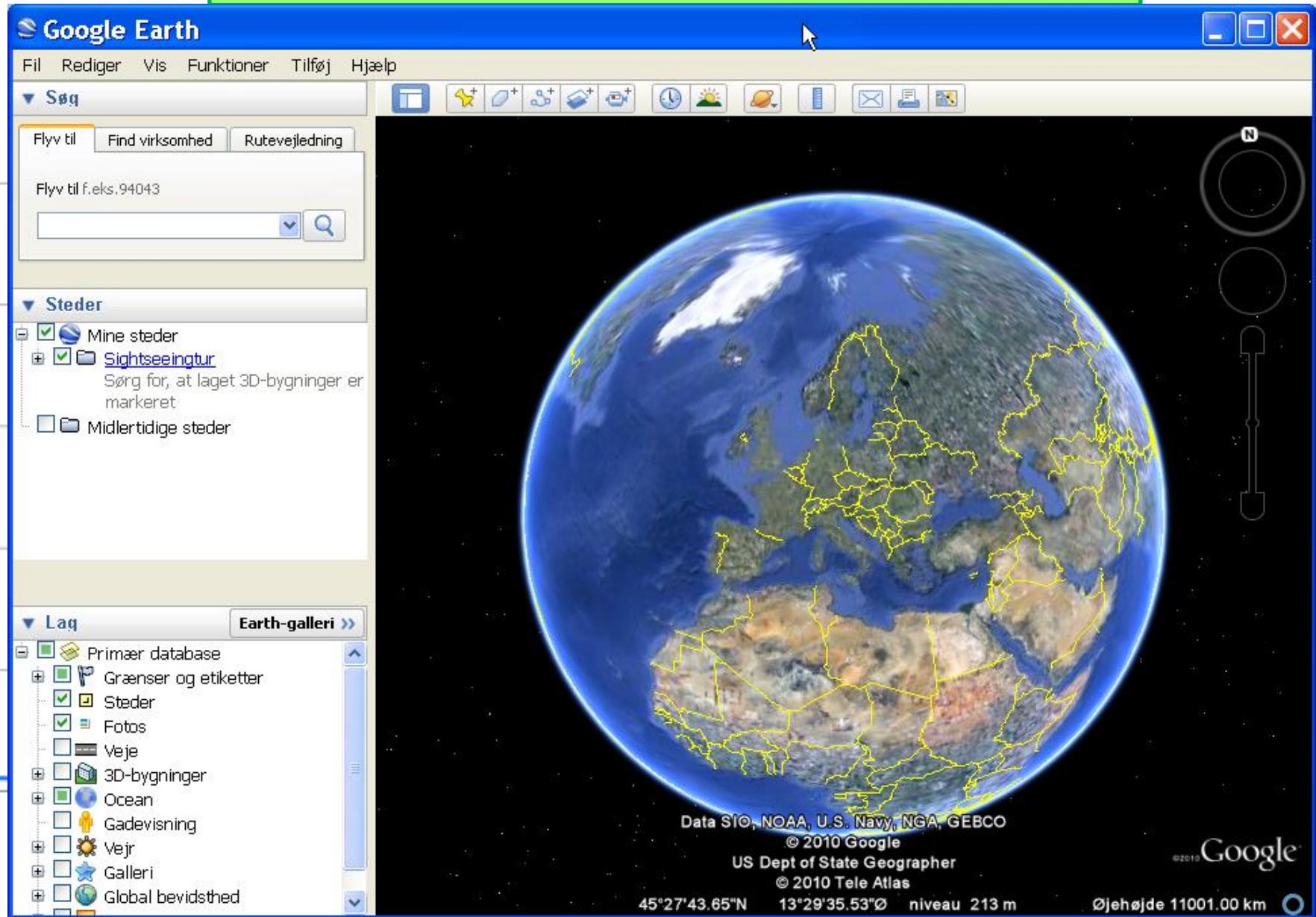


80 1982 1984

2000

# 2005

## GoogleEarth, GoogleMaps, Bing Maps



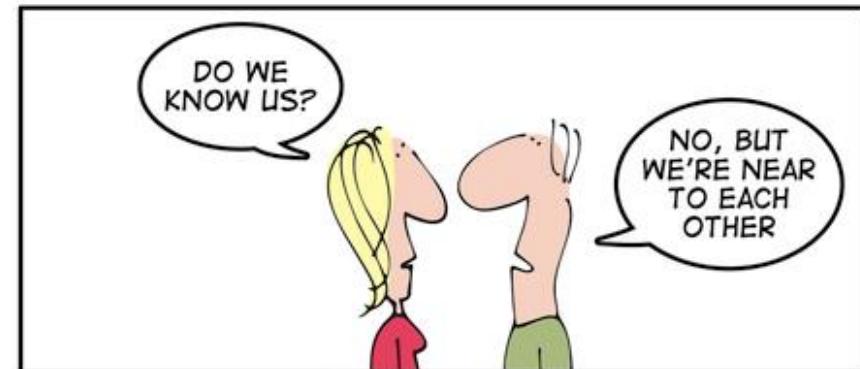
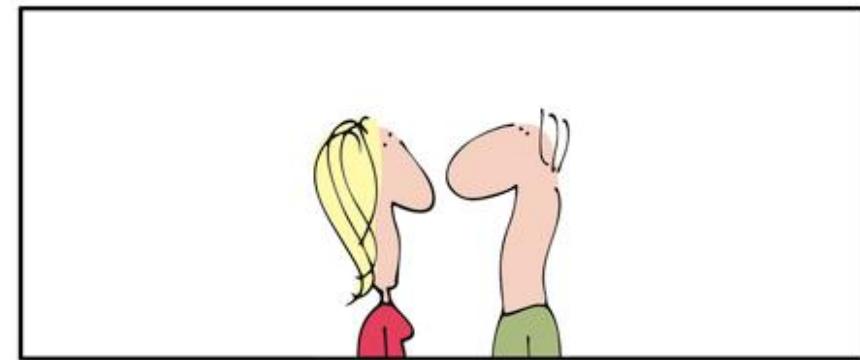
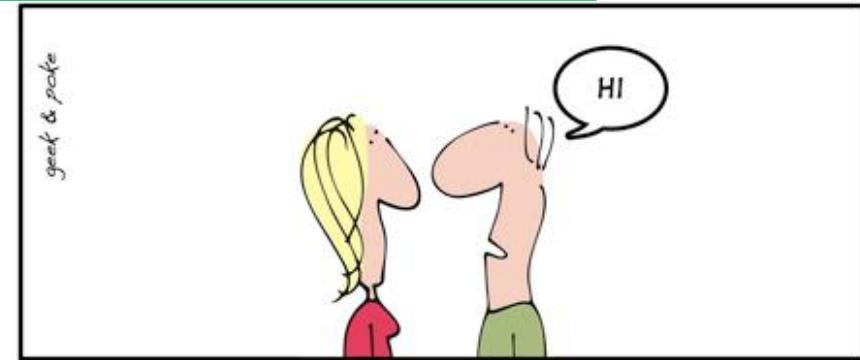
2006  
Location-based marketing



2007



# 2008 Location-based social networking



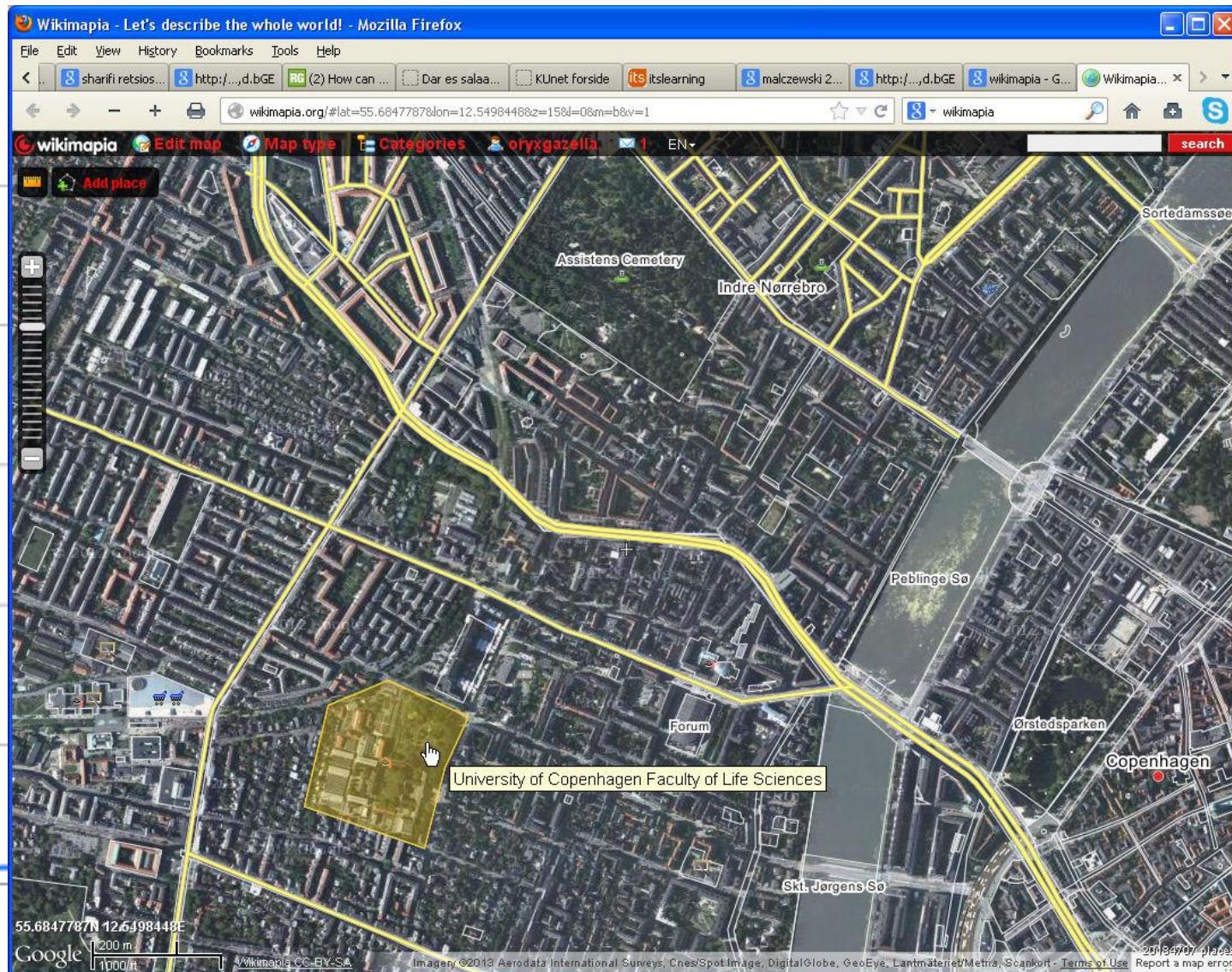
LOCATION BASED SOCIAL NETWORKING

# 2009

## Augmented Reality



# 2010 (2006) WikiMapia



# Etc. etc. etc.



Klimatilpasningsplaner

Data er vejledende

Spørgsmål

Vælg indhold i kort

Baggrundskort

Adm. grænser

Kyst

Nedbør

NY lavningskort  
(bluespot)

Lavningsoplante

Lavninger

Lavningsdybder

Hydraulisk  
ledningsevne

Befæstelsesgrad

Nedbørsstatistik

Forhøjet risiko  
for sætning

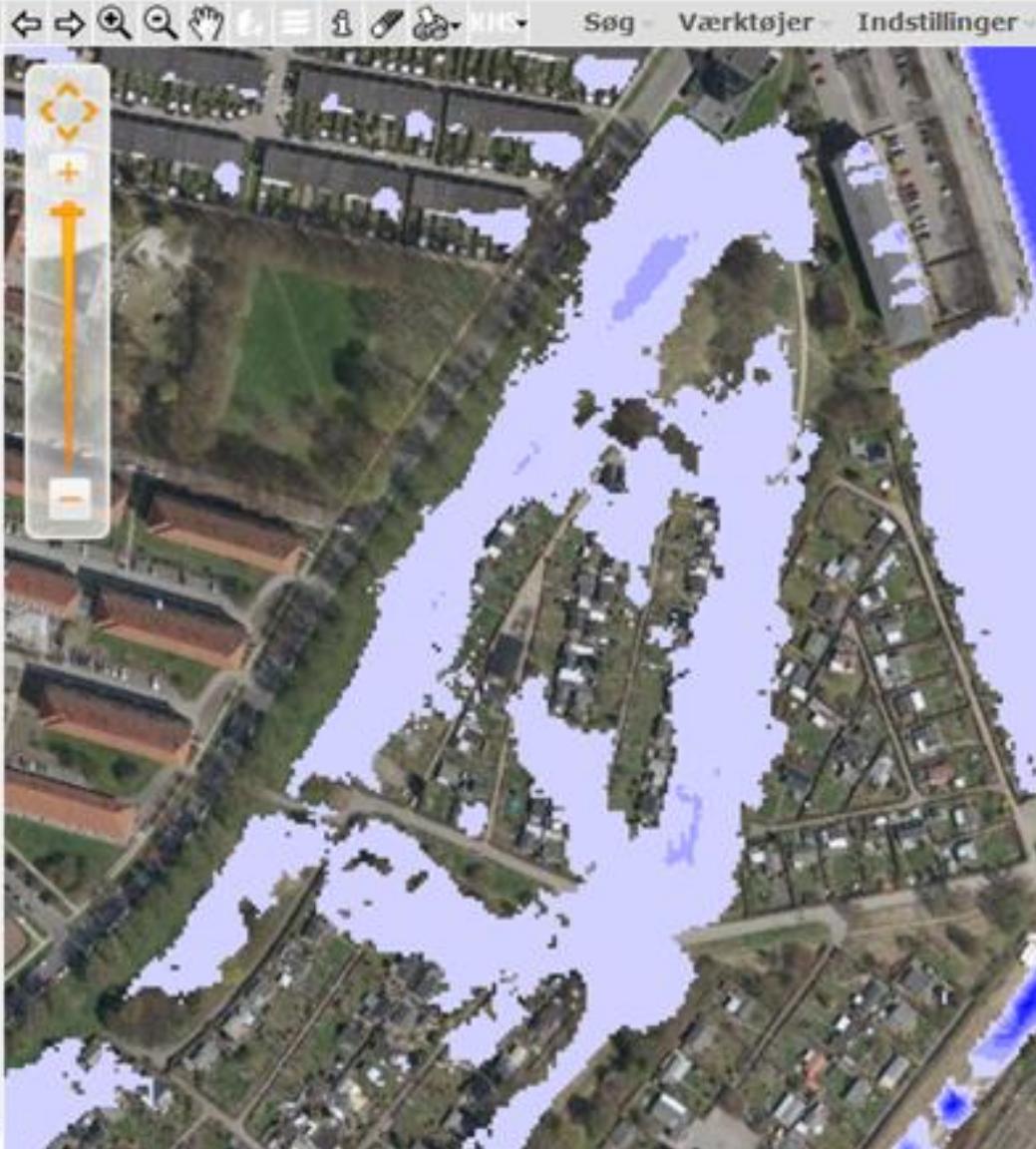
Grundvand

Vandløb

Værdikort

Havstigning

Vandløbsstigning



Etc. etc. etc.

# Today's buzzwords

AI Artificial Intelligence

VR - VR

Sa

IoT  
-  
Internet  
of Things

Big

Data

GIS and AI (pdf) – NOT pensum



# GIS is moving indoors!

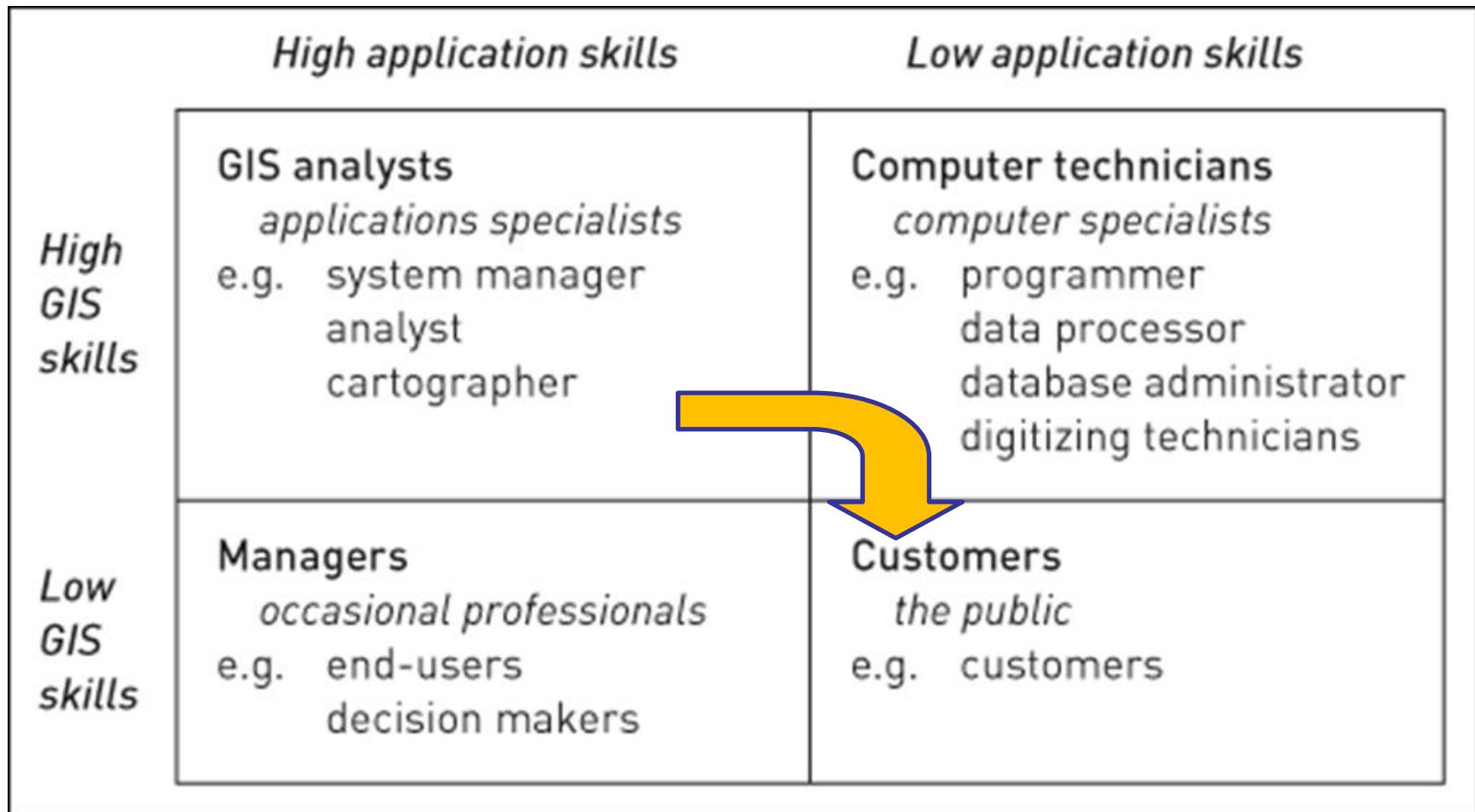


Indoor beacon

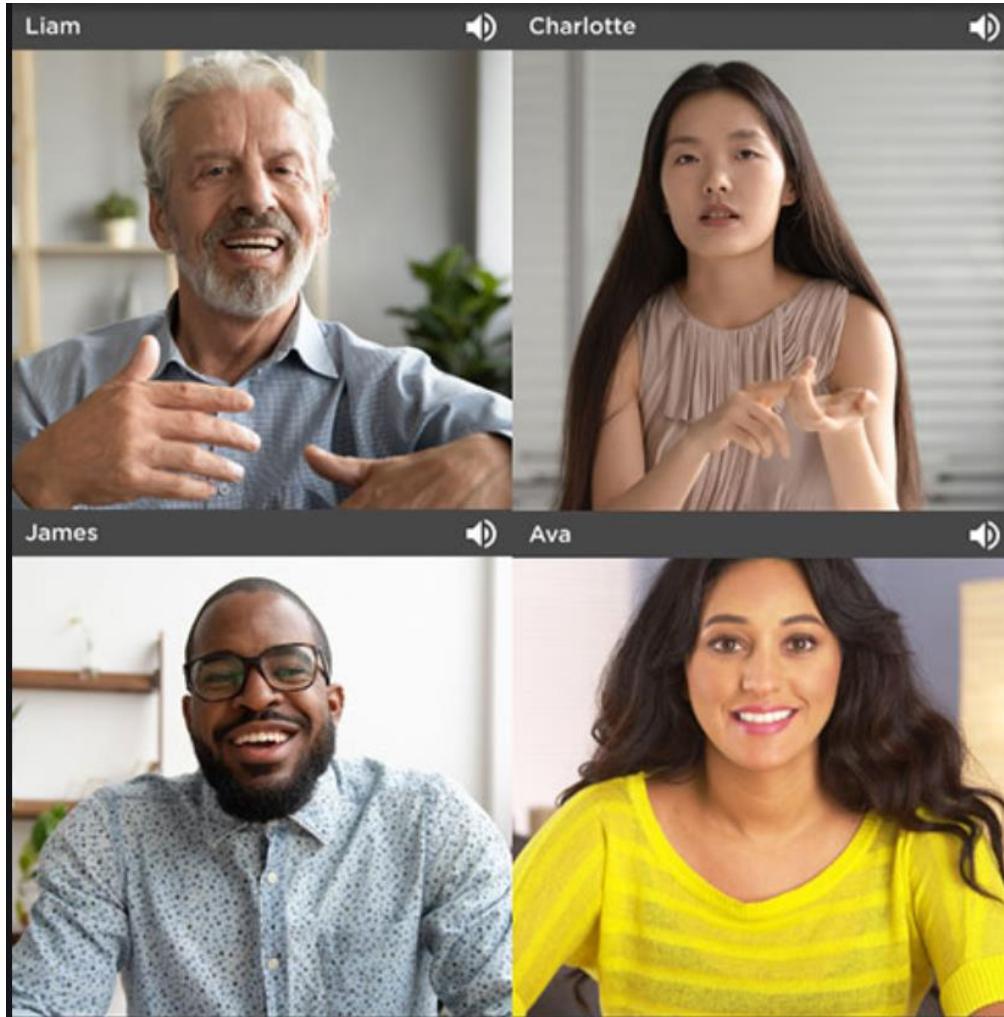
## Applications:

- Wayfinding (+AR)
- Crime scene investigation (+VR)

# Development of GIS users



# Introduce yourselves!



# What's next?



PPGIS =  
Public Participatory GIS



Report  
graffiti  
#VANCONN

# What's next?

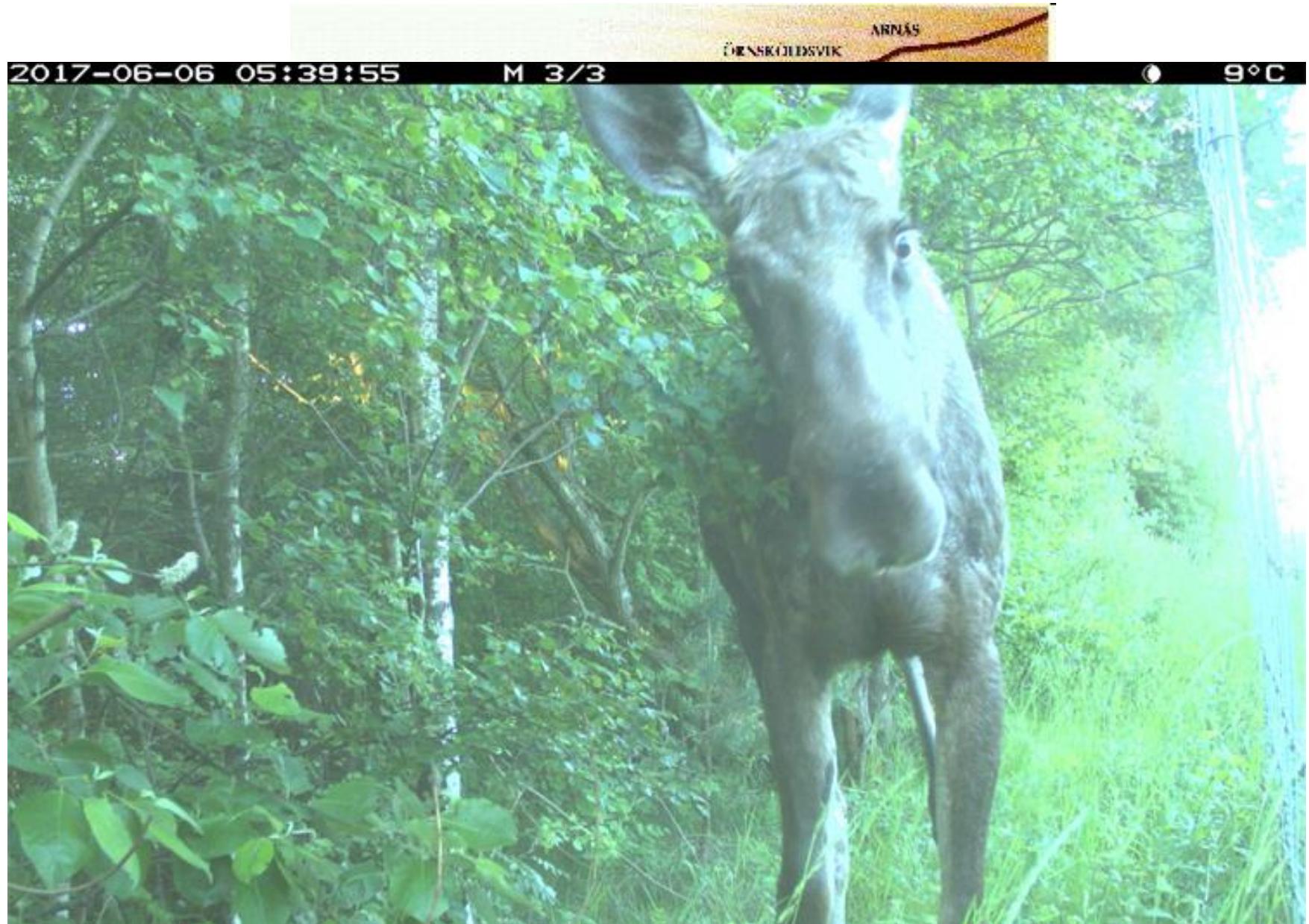
- Government 2.0

- Benefits

Democracy (citizen empowerment)

Economy

# Who is using GIS professionally?



# Who is using GIS professionally?

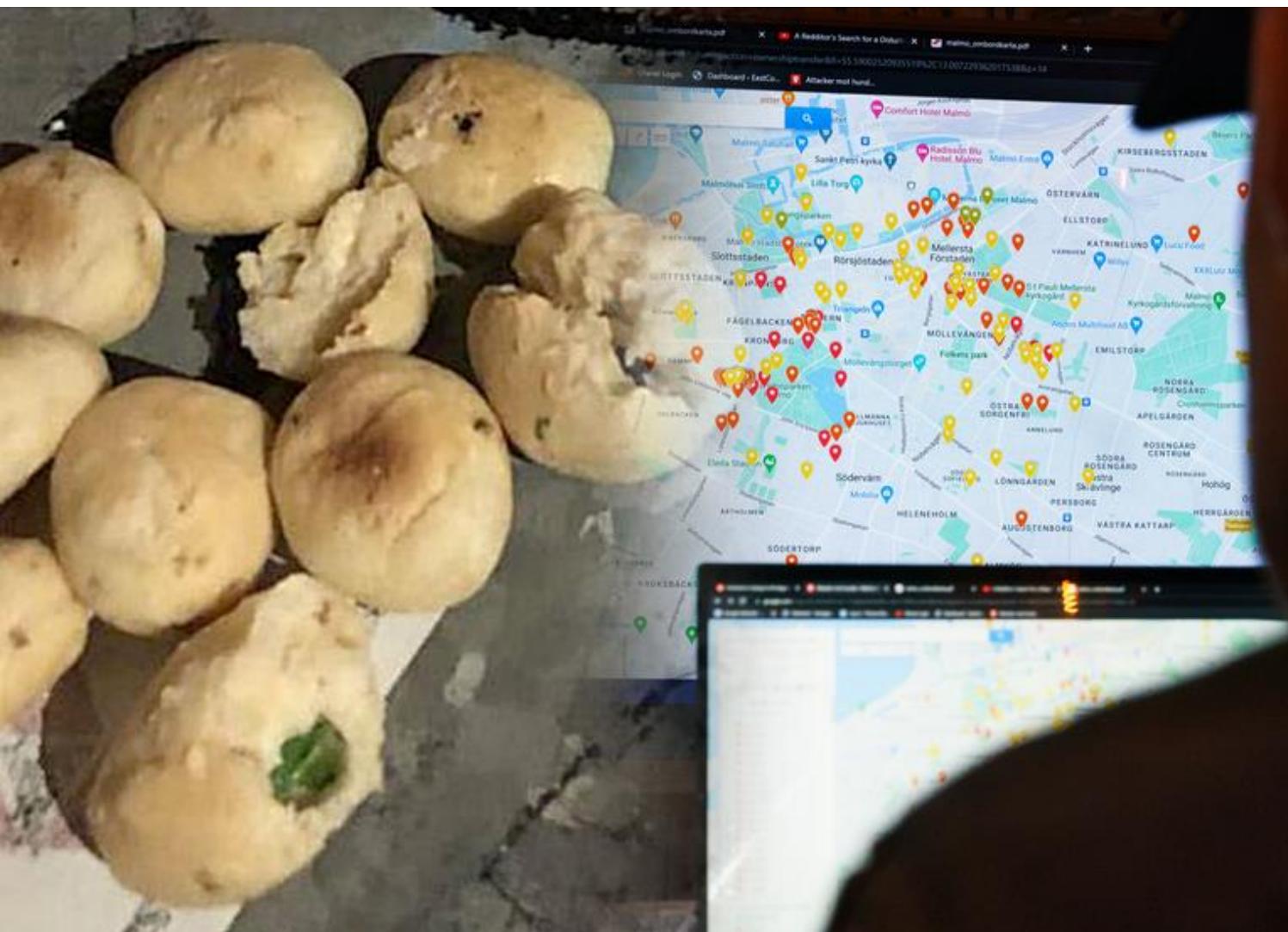


Business allocation



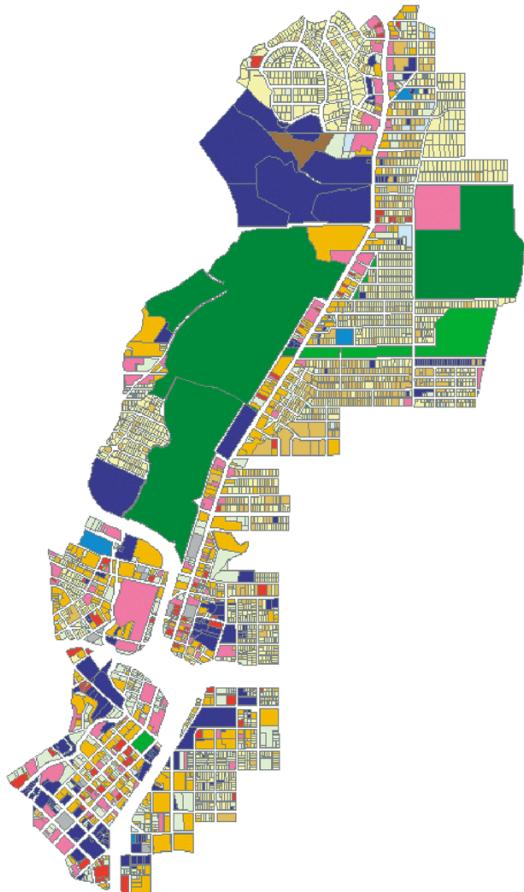
- Customers
- Competitors
- Supply routes

# Who is using GIS professionally?

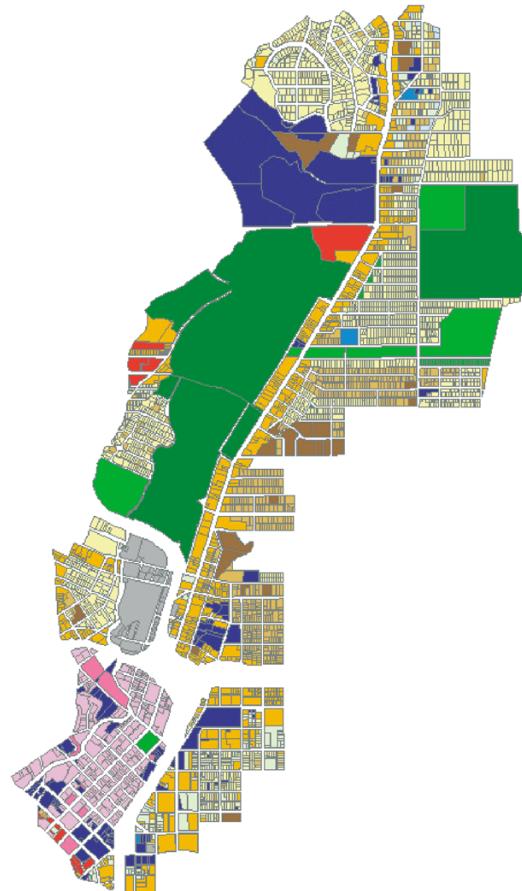


# Who is using GIS professionally?

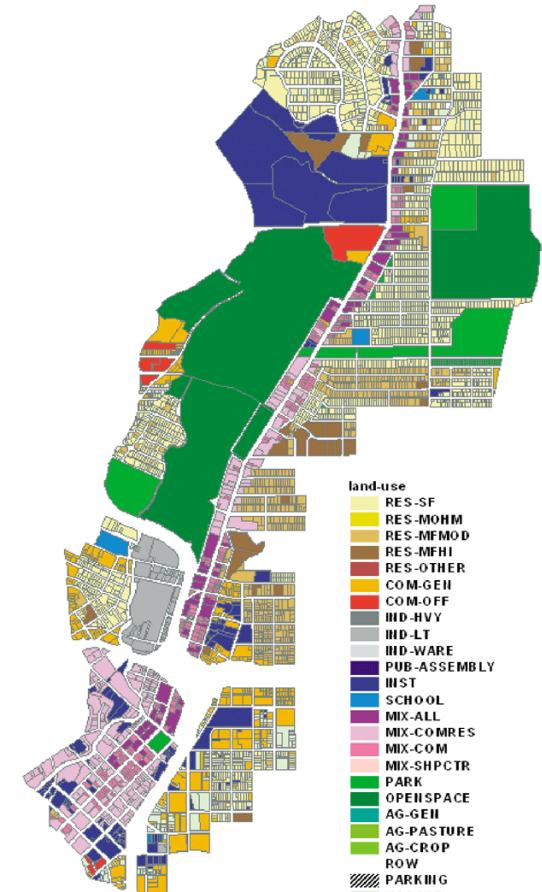
Existing Conditions



Current Plan Build-Out



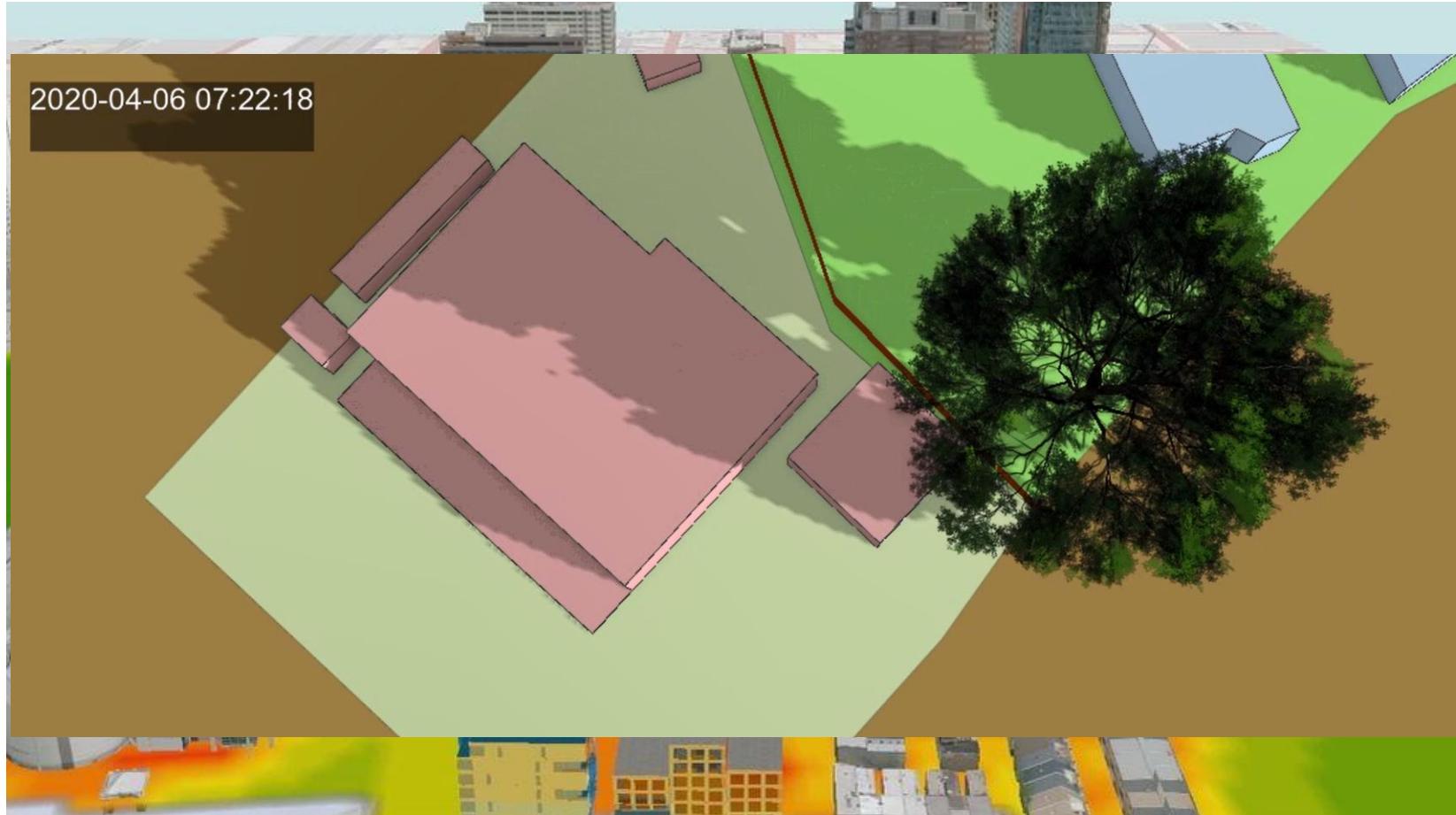
Alternative Plan Build-Out



land-use
RES-SF
RES-MOHM
RES-MFMOD
RES-MFH1
RES-OTHER
COM-GEN
COM-OFF
IID-HVY
IID-LT
IID-WARE
PUB-ASSEMBLY
HIST
SCHOOL
MIX-ALL
MIX-COMRES
MIX-COM
MIX-SHPCTR
PARK
OPENSPACE
AG-GEN
AG-PASTURE
AG-CROP
ROW
PARKING
VACANT
OTHER

Urban development

# Who is using GIS professionally?

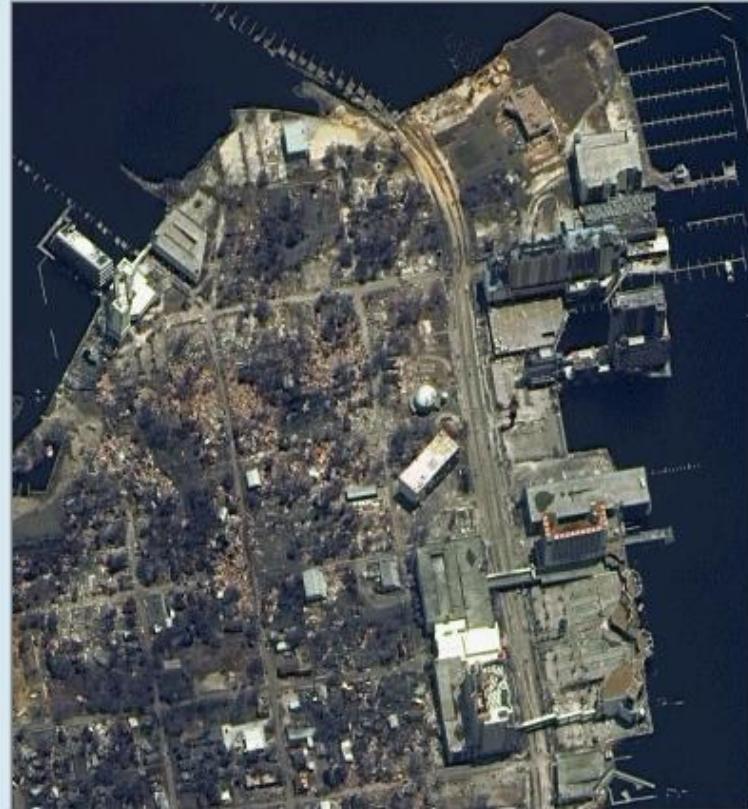


3D models – Scenes and CityEngine

# Who is using GIS professionally?



(a) Before



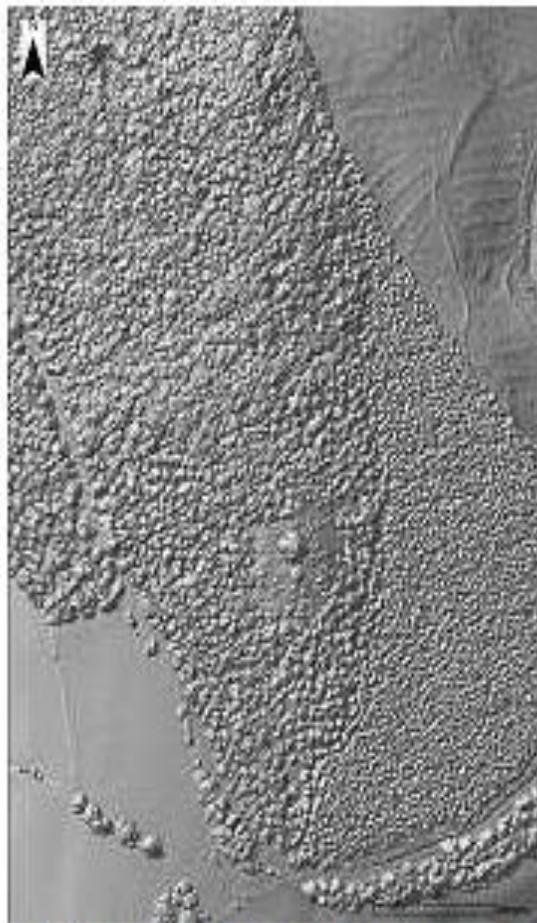
(b) After

Weather forecasts, Catastrophy reporting

# Who is using GIS professionally?



Aerial photograph  
of woodland

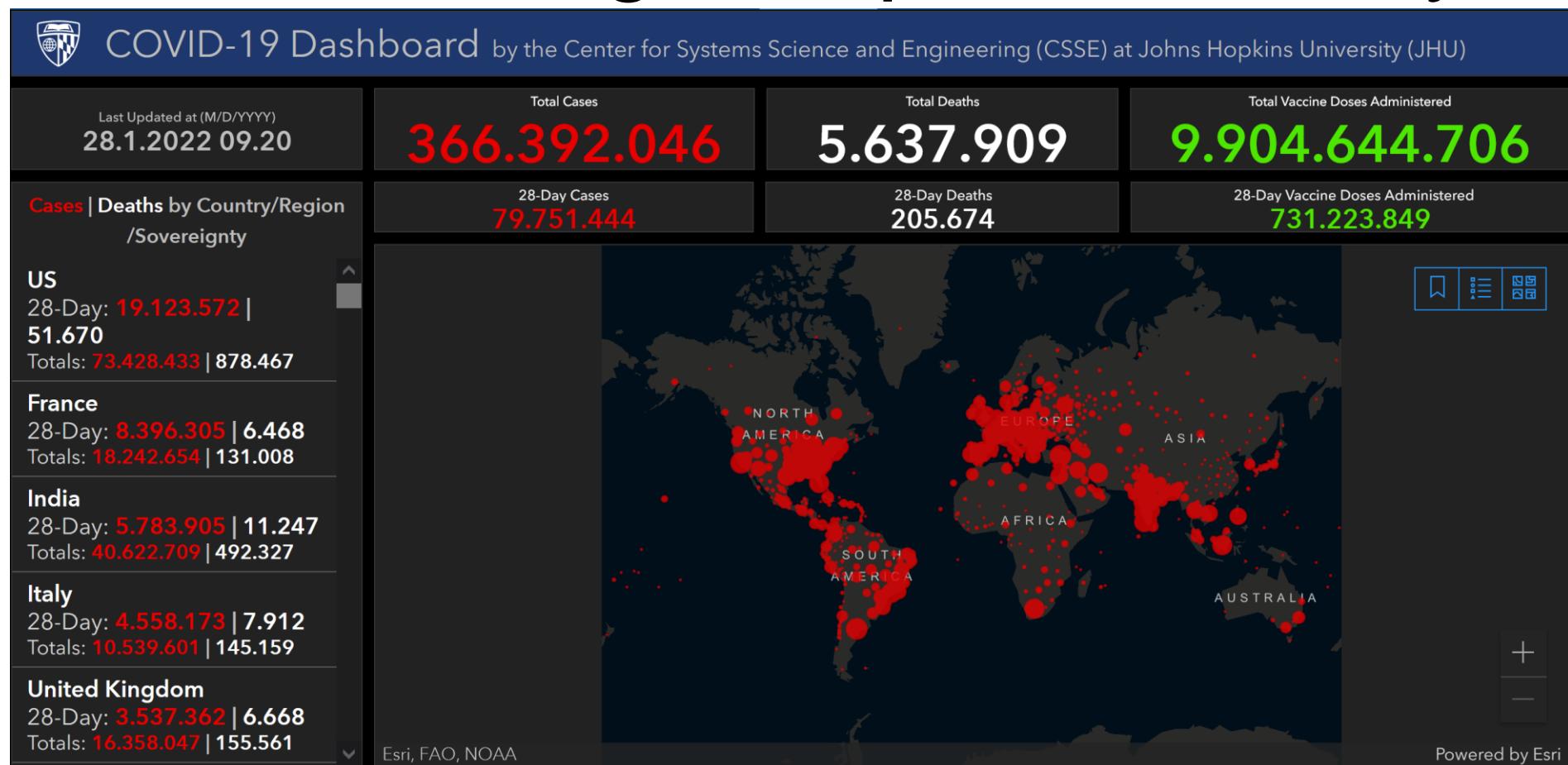


Hillshaded LiDAR image of  
woodland



Hillshaded model of ground  
surface

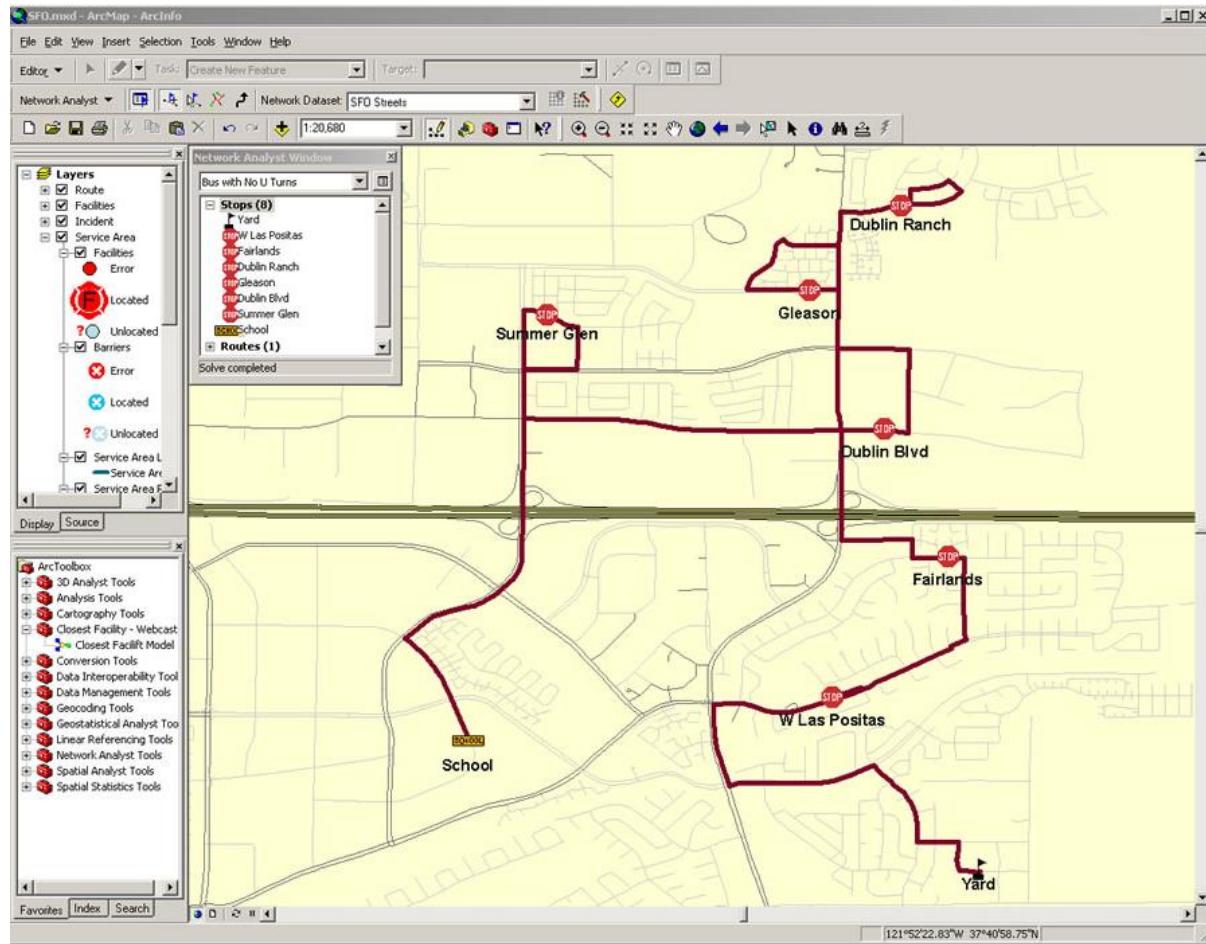
# Who is using GIS professionally?



- Military, Health Care and Epidemiology, Forestry, Transportation, Geology & Oil/Mining, Meteorology & Hydrology, Recreation & Tourism...

# Then, what is GIS?

What does it take?



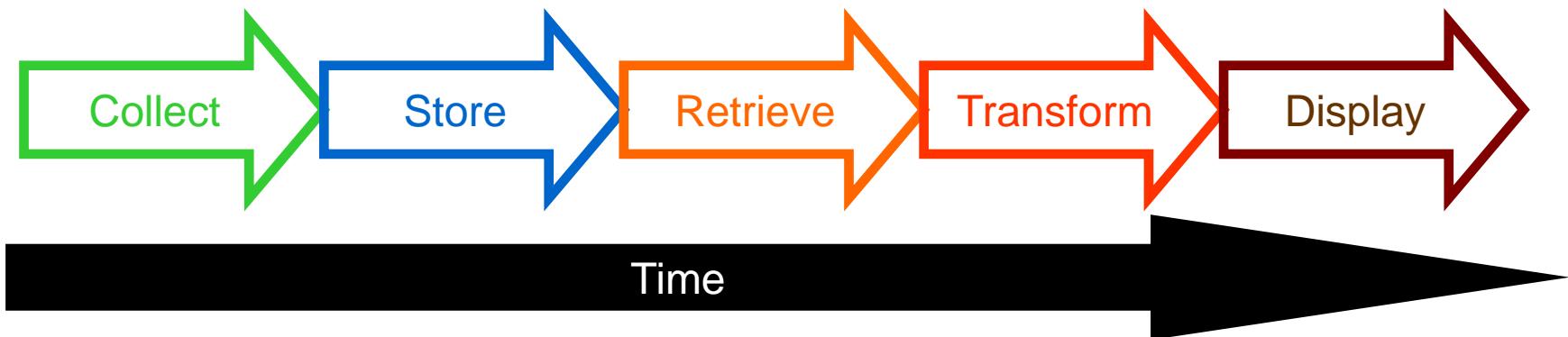
**Geospatial data:**

- Collect
- Store
- Retrieve
- Transform & Analyze
- Display

# Definition of GIS

- Burrough (1986)

*“A powerful set of tools  
for collection, storing, retrieval, transforming and displaying  
spatial data from the real world”*



# Definition and Course

Week (of Blok 3)	Date	Hour	Subject	Moment (L/E/P)	Teacher	Location
1	5/2 Mon.	13-15	Basic Mapping and GIS	L	HSP	A2-11.01- CPSC1
		15-17	Introduction To Course	L	PAKN	A2-11.01- CPSC1
	7/2 Wed.	8-10	Cartography – Map Communication	L	HSP	A2-11.01- CPSC1
2		10-12	Cartography – Map Communication	E	PAKN	CGD
		13-15	"	E	PAKN	CGD
		15-17	Map Types + Searching/Retrieving Geodata	L	HSP	A2-11.01- CPSC1
3	12/2 Mon.	13-15	Map Types + Searching/Retrieving Geodata	E	PAKN	CGD
		15-17	"	E	PAKN	CGD
	14/2 Wed.	8-10	Data Capture – Georectification	E	PAKN	CGD
4		10-12	Data Capture – Digitizing	E	PAKN	CGD
		13-15	Data Capture – Remote Sensing: Satellite Images, Orthophotos and LiDAR	L	BF	A2-11.01- CPSC1
	19/2 Mon.	13-14	Geodatabases & Attribute Tables	L	CHFE	A2-11.01- CPSC1
5		14-15	Project Introduction	L	PAKN	A2-11.01- CPSC1
		15-17	Geodatabases & Attribute Tables	E	PAKN	CGD
	21/2 Wed.	8-10	Data Capture – GPS and Drones	L/E	AWN	Auditorium A
6		10-11	"	L/E	AWN	Auditorium A
		13-15	Geodata Transformation & Analysis	L	HSP	A2-11.01- CPSC1
		15-17	Geodata Transformation & Analysis (Task A)	E	PAKN	CGD
7	26/2 Mon.	13-15	Geodata Transformation & Analysis (Task B)	E	PAKN	CGD
		15-17	"	E	PAKN	CGD
	28/2 Wed.	8-10	Geodata Transformation & Analysis (Task C)	E	PAKN	CGD
8		10-12	"	E	PAKN	CGD
		13-15	(Optional: Raster Overlay Analysis)	E	(Self study)	CGD
		15-17	("")	E	(Self study)	CGD
9	4/3 Mon.	13-15	Network Analysis	L	TB	CGD
		15-17	"	E	TB	CGD
	6/3 Wed.	9-10	The Raster Data Model and Processing	L/E	TB	CGD
10		10-12	"	E	TB	CGD
		13-15	"	E	TB	CGD
		15-17	"	E	TB	CGD
11	11/3 Mon.	13-15	GIS in the Cloud and on the Net	E	PAKN	CGD
		15-17	Project prep. (alt. Catch-up prev. exercises)	E	PAKN	CGD
	13/3 Wed.	8-10	Quality & Accuracy Assessment	L	HSP	A2-11.01- CPSC1
12		10-12	"	E	PAKN	CGD
		13-15	GIS in the Cloud and on the Net	L	ASOL	A2-11.01- CPSC1
		15-17	"	E	ASOL	A2-11.01- CPSC1
13	18/3 Mon.	13-15	Project weeks	P	PAKN	CGD
		15-17	"	P	PAKN	CGD
	20/3 Wed.	8-10	Project weeks	P	PAKN	CGD
14		10-12	"	P	PAKN	CGD
		13-15	"	P	PAKN	CGD
		15-17	"	P	PAKN	CGD
15	25/3-29/3		Easter Holidays			
	1/4 Mon.					
	3/4 Wed.					

- Collect/Capture

- Store  
- Retrieve

- Transform  
& Analyze

- Display

What's missing?

- Communication  
- People

# The Teaching Team

- Patrik Karlsson Nyed
- Hans Skov-Petersen
- Andreas Westergaard-Nielsen
- Bjarne Fog
- Thomas Balstrøm
- Anton Stahl Olafsson
- + Exercise/Project supervisors

# Patrik Karlsson Nyed

- Swedish
- Course Coordinator



- E-mail: [pakn@ign.ku.dk](mailto:pakn@ign.ku.dk) (preferably)
- Tel. 35 33 18 32 (urgent)
- Mob. +46 79 339 00 01 (S.O.S.)

- Background: PhD Ecology ?!
- GIS consultant & Geodata manager

# Hans Skov-Petersen



- My predecessor,  
and now Professor
- GIS guru
- Beatles buff
- GIS coordinator at the IGN (Frederiksberg campus)



# Andreas Westergaard-Nielsen



- Expertise: Drones
- GPS/GNSS
- GIS lecturer at the Geography section, IGN



# Bjarne Fog



- Geodata manager
- GIS lecturer at the Geography section, IGN
- Point cloud data expert

# Anton Stahl Olafsson

- Crowdsourcing GIS solutions
  - PPGIS
  - VGIS
- WebGIS
- Research in Outdoor Recreation



# Thomas Balstrøm

- Expertise: Raster GIS and Python
- Teaching various GIS courses
- Author of GIS book (in Danish)



# Christian Fertner

- Expertise: Databases
- Teaching Urban Planning



# Exercise/Project Supervisors



Patrik, Erling, Christian, Hans

Sr. researchers

# And, yes you've made the right choice...



## Studentermedhjælper med gode GIS-kompetencer til Renhold og Driftsviden i afdelingen for Parker, Kirkegårde og Renhold

Københavns Kommune · Halsnæs Kommune, Capital Region, Denmark · 1 day ago · 1 applicant



On-site · Part-time · Internship



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2 connections work here · 9 company alumni work here · 33 school alumni work here



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# ...GIS may open so many new doors for you.



# Exciting opportunities ahead:

- Thesis
- Joining a research project.  
(GIS skills often needed)
- Volunteer actions  
([GIS Corps](#), [HOT](#), [MapAction](#))