A HIS-GIS for 200 Years of Belgian Territorial Structures (1796-2000)

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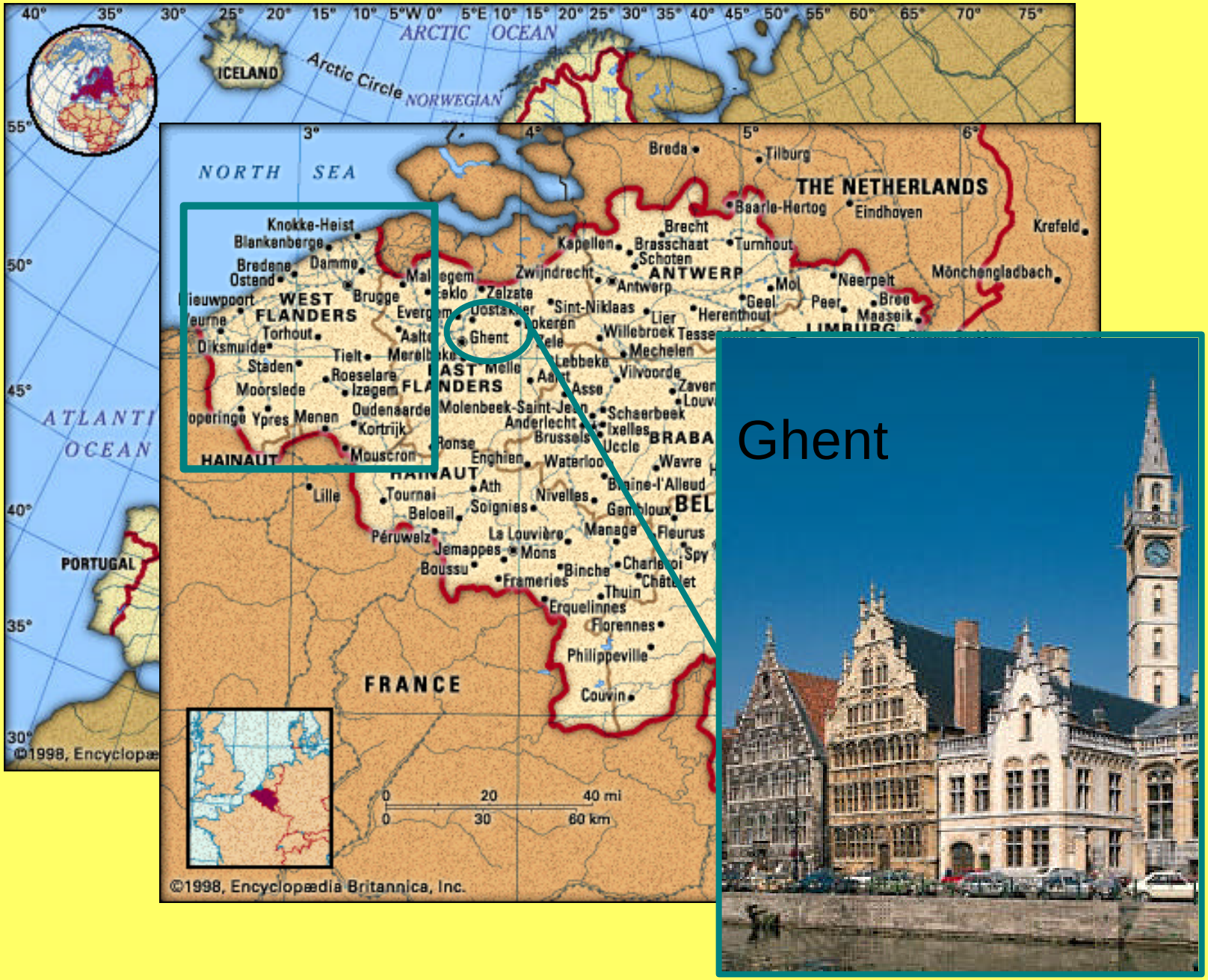

ARCTIC OCEAN
ICELAND
Arctic Circle
NORWEGIAN
NORTH SEA
ATLANTIC OCEAN
PORTUGAL
THE NETHERLANDS
WEST FLANDERS
EAST FLANDERS
HAINAUT
ANTWERP
FRANCE
Ghent
Knokke-Heist
Blankenberge
Bredene
Ostend
Damme
Brugge
Torhout
Diksmuide
Staden
Tielt
Roeselare
Izegem
Moorslede
Ypres
Menen
Oudenaarde
Kortrijk
Mouscron
Lille
Tournai
Ath
Soignies
Beloeil
Péruwelz
Jemappes
Mons
Boussu
Frameries
La Louvière
Binche
Thuin
Erquelinnes
Florennes
Philippeville
Couvin
Nivelles
Waterloo
Enghien
Ronse
Molenbeek-Saint-Jean
Anderlecht
Brussels
Schaerbeek
Ixelles
Uccle
Wavre
Braine-l'Alleud
Gembloux
Manage
Fleurus
Spy
Charleroi
Châtelet
Zwijndrecht
Antwerp
Kapellen
Brasschaat
Schoten
Brecht
Turnhout
Breda
Tilburg
Baarle-Hertog
Eindhoven
Krefeld
Mönchengladbach
Neerpelt
Mol
Geel
Peer
Bree
Maaseik
Herenthout
Lier
Willebroek
Mechelen
Lebbeke
Vilvoorde
Asse
Melle
Zelzate
Sint-Niklaas
Lokeren
Zele
Merelbeke
Aalter
Evergem
Oostakker
©1998, Encyclopædia Britannica, Inc.
0 20 40 mi
0 30 60 km

VERY CONCISE POLITICAL HISTORY OF BELGIUM

- 18th c.: Austrian Habsburg reign
- 1795: annexation of Austrian Netherlands to France
- 1796: introduction of French territorial structures in Belgium
- 1815: « Battle of Waterloo » => Annexation of Belgium to Kingdom of the Netherlands
- 1830: Belgian revolution => foundation of the Belgian state in 1831

WHAT IS A TERRITORIAL STRUCTURE?

- The total of subdivisions of a territory
  - Distinct separate territorial units with different functions in society: administrative, political, judicial, economic, ...
    - Demarcated units -> boundaries
    - Hierarchically structured: from nation to municipality
- Subject to change over time
  - Composite units can change without affecting the boundaries of their parts
  - The parts can have boundary changes without affecting the composition of the composite units

WHY STUDY THE EVOLUTION OF THE TERRITORIAL STRUCTURES?

- For an accurate analysis and presentation of statistical data
  - Territorial units formed the basis for the collection of census data (National Institute for Statistics-NIS)
  - Analysis on different levels of aggregation
  - Analysis for different periods in time: longitudinal and diachronical analysis

    => Long-term geographical analysis is possible
- As a research topic in itself (nation building processes etc.)
- Archival purposes
- …

EVOLUTION OF THE BELGIAN TERRITORIAL STRUCTURE

- Administrative and judicial units
  - Before 1796:

    1. Counties/Duchies
    2. Seignouries
    3. Villages

  - From 1796 onwards:

    1. Departments
    2. Districts
    3. Cantons

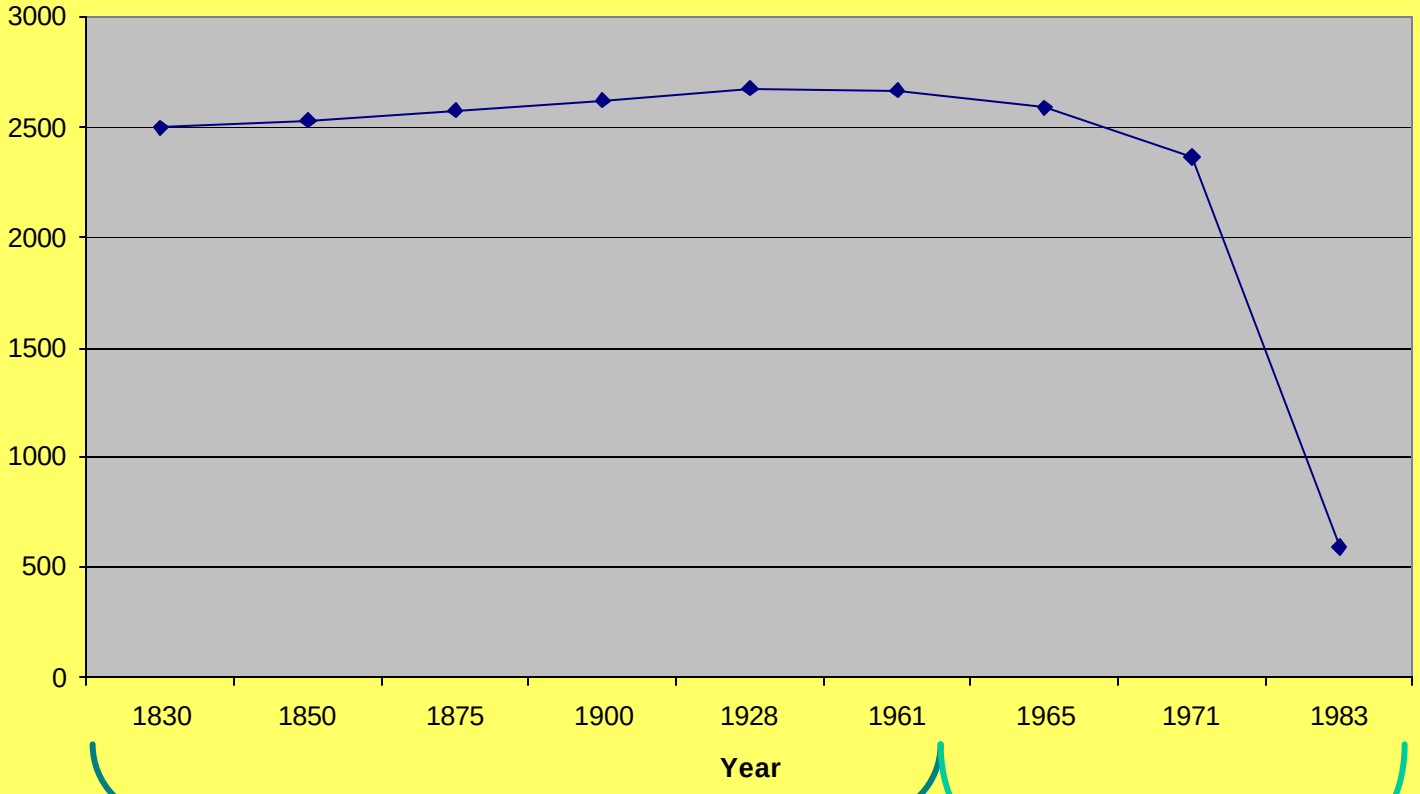
    } composite units

    4. Municipalities -> basic units of

EVOLUTION OF THE BELGIAN TERRITORIAL UNITS

	French period (1796-1815)	Dutch period (1815-1830)	Belgian period (since 1830)
1.	9 départements	9 provinces	9/10 provinces
2.	44 judicial arrondissements 92 administrative arr.	44 judicial arrondissements 61 administrative arr. (1823)	44 judicial arrondissements 61 administrative arr.
3.	278 municipal cantons (administr. until 1800) 275 judicial cantons (after 1800)	275 judicial cantons	275 judicial cantons
4.	Continuously changing number of municipalities		

Total number of municipalities



GOALS OF THE PROJECT

1. Reconstruction of the Belgian territorial structure since the end of the AR

2. Collect historical attribute data which give an extra dimension to the territorial structure

3. Make collected data available for research, education, public services, …

1. RECONSTRUCTION OF THE TERRITORIAL STRUCTURE

- Geometric data:
  - Boundaries of territorial units
- Qualitative attribute data
  - Gazetteer of territorial units
  - Hierarchy of territorial units: data on functions of and relations between units
  - Evolution of territorial units: data on foundation, abolition and change
  - Composition of territorial units: data on enlargement and reduction

2. THE ATTRIBUTE DIMENSION

- Quantitative attribute data
  - Digitised censuses on different levels (primarily municipality level) for the whole of the area for different moments in time
- Qualitative attribute (meta)data
  - Meta-data: data on method of collection, digitisation,historical critique of censuses
  - Georeferenced maps: topographical maps,…
  - Geocoded object data: raster objects (legal texts, orthophotos, maps), historical websites,...

3. USING THE DATA

- Easy-to-use interface
  - Access via Internet
  - Interactive: add your own data, make your own queries and maps
  - For different target groups: researchers, students, teachers, genealogists,...

STARTING POINT OF PROJECT (1)

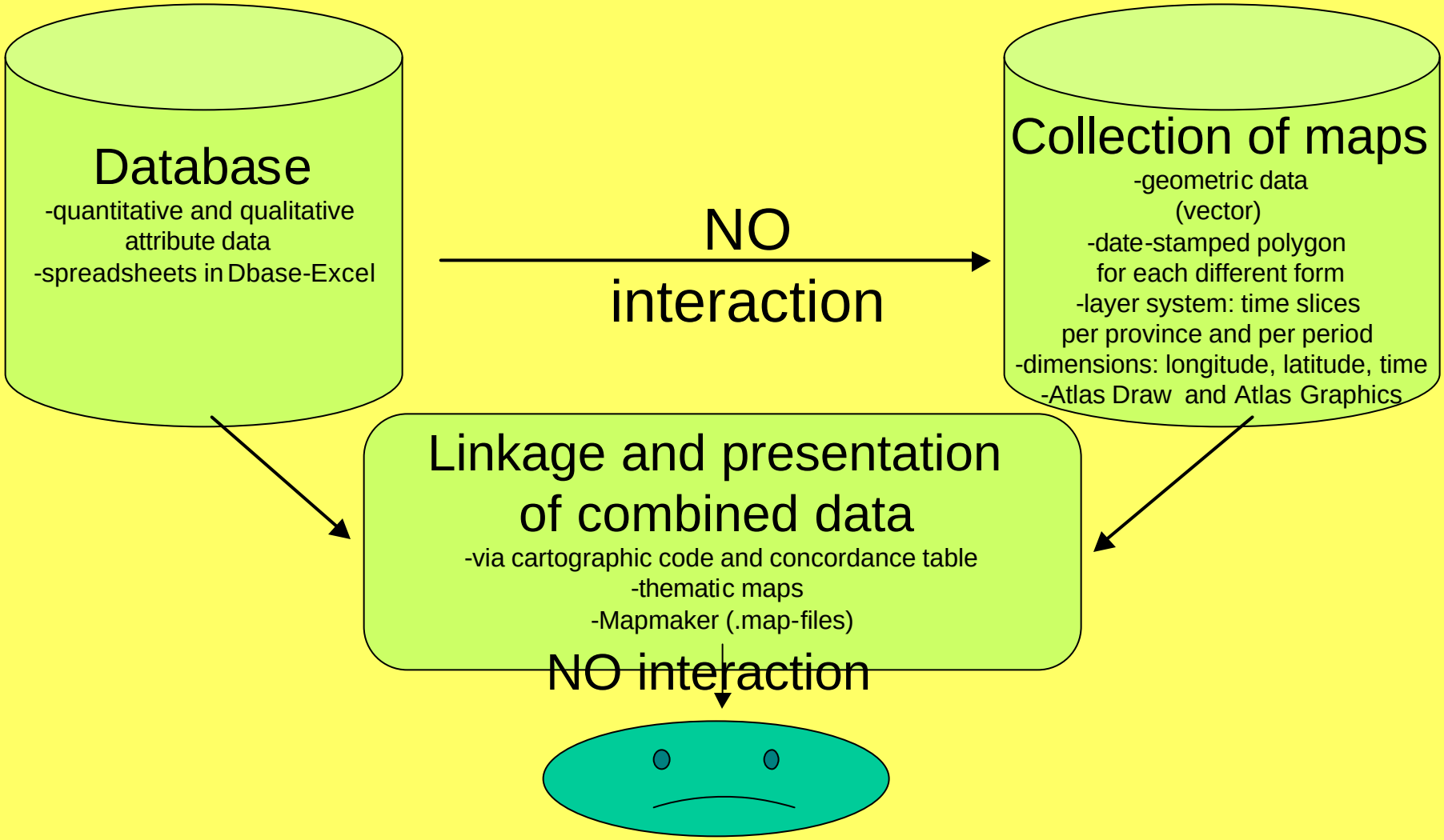
- A large collection of geographical data:
  - Geometric data: vectorised Lambert–coordinates of the boundary changes of most important territorial units for the period 1801-1991
  - Attribute data: all on the municipal level (not lower)
    - *Quantitative data*: digitised census data for period 1796-1991

      on population, agriculture, industry, ...
    - *Qualitative data*: detailed data on the geographic evolution, name, hierarchy and composition of territorial units, metadata

STARTING POINT OF PROJECT (2)

- A simple structure (no G.I.S.) using cartographic codes and a concordance table to link spreadsheets with base-maps
- Usage of different software packages
- A complex and difficult-to-use tool for longitudinal analysis of statistical data and cartographic presentation of these data

ORIGINAL STRUCTURE



PROBLEMS (1)

- Limited analysis possibilities and update difficulties
- Polygons exist independent of each other which makes diachronic analyses difficult
- Excessive number of layers/polygons (high redundancy+unreliable)
- Conversion is necessary and cumbersome

PROBLEMS (2)

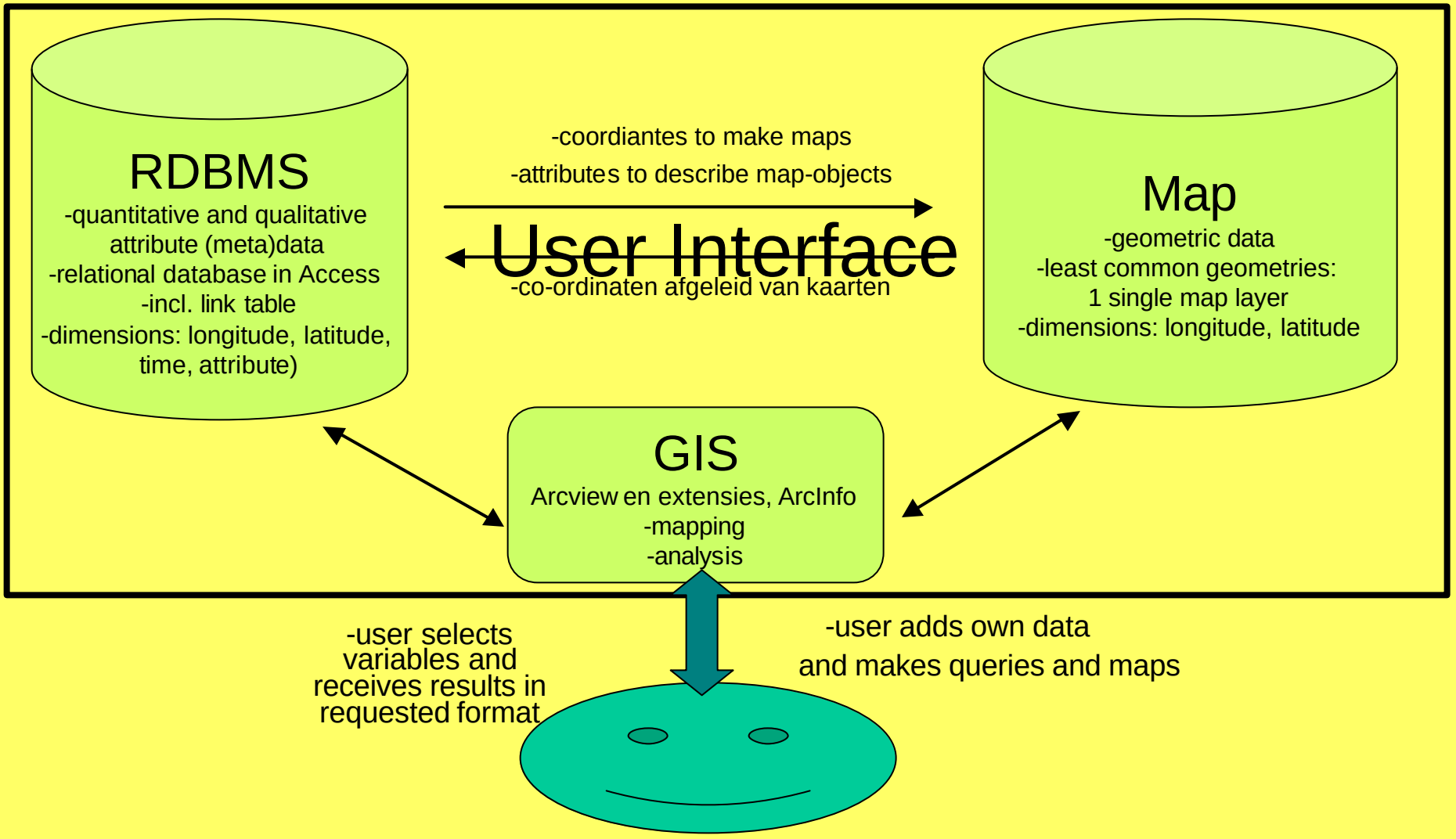
- Map units could not be integrated with topographical maps (Lambert-coordinates but map units in kilometres)
- Access by external users difficult
  - Complexity structure
  - No guidance
  - Limited infrastructure

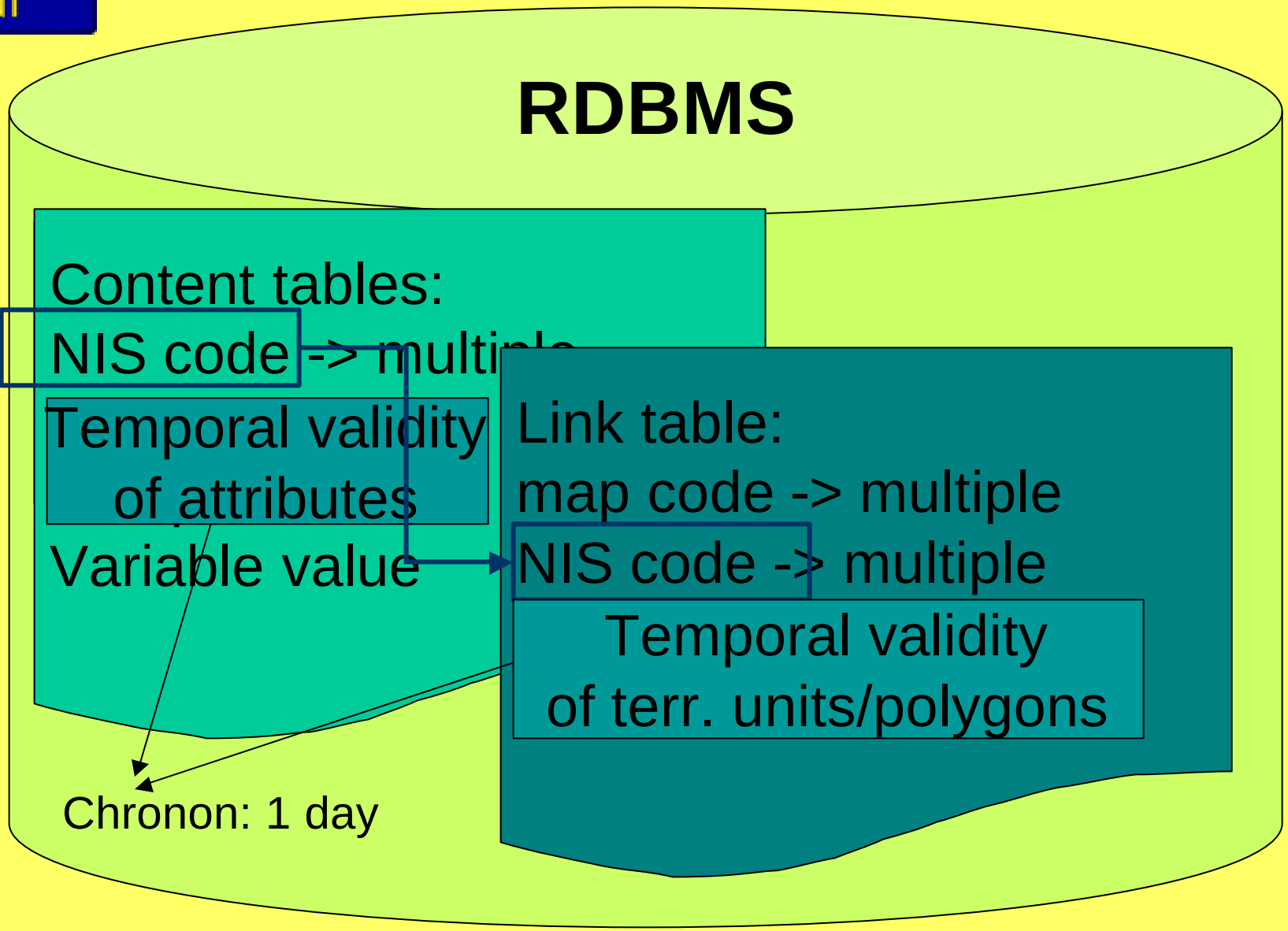
SOLUTIONS

- Relational database: data ordered in normalised tables
- Build a G.I.S.: bring geometric data (polygons) in relation to each other

  ! Difficulty: both attribute data and territorial units change over time and at different time periods/points!
- Use least common geometries method (LCG-method) to build map of smallest map units
- Transformation of map units into meters
- Use integrated software (MS Access + Arcview)
- Access via user-friendly interface

NEW STRUCTURE




RDBMS
Content tables:
NIS code -> multiple
Temporal validity
of attributes
Variable value
Link table:
map code -> multiple
NIS code -> multiple
Temporal validity
of terr. units/polygons
Chronon: 1 day

MAP METHOD

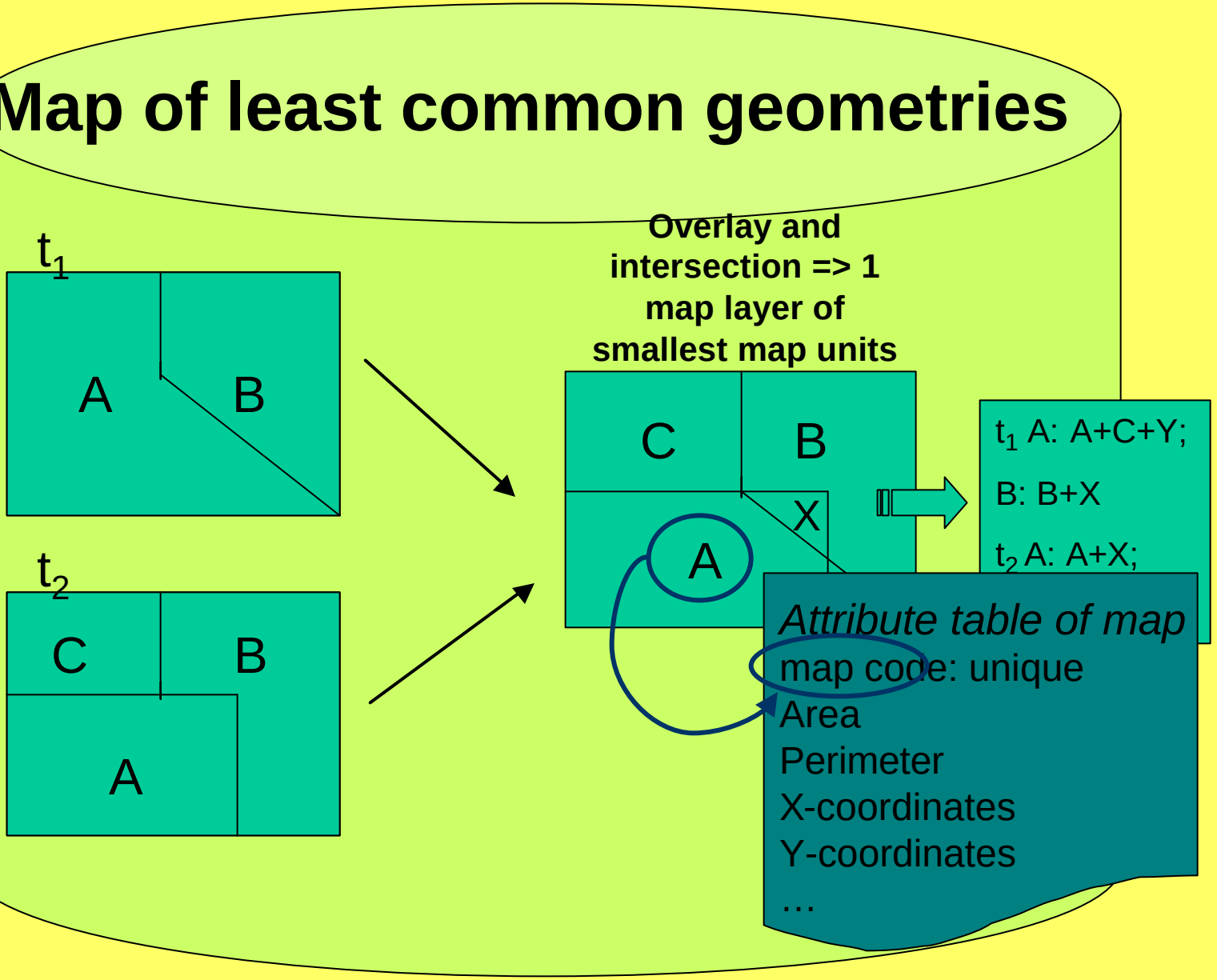
- Originally: simple layer model:

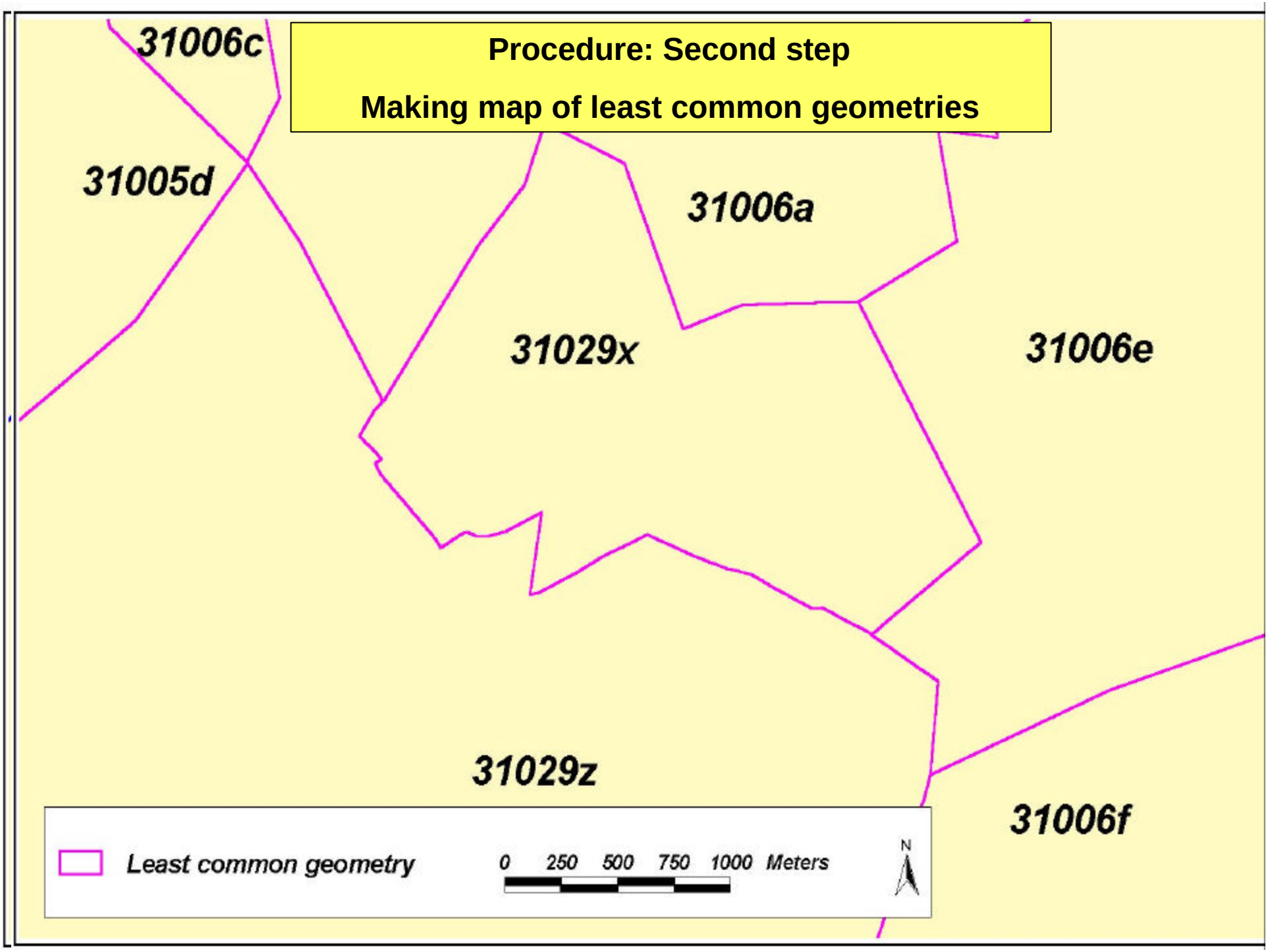
  New polygons with new ID-codes for every new form of a territorial unit
- New method: from spaghetti map to least common geometries map*:
  1. Time slices of layer model are overlayed =>spaghetti-file
  2. Intersection of all spatial objects (polygons)

     => new objects => map of smallest map units
  3. New layers are made by activating right objects
  – Types: space-time-composite with polygons or with lines

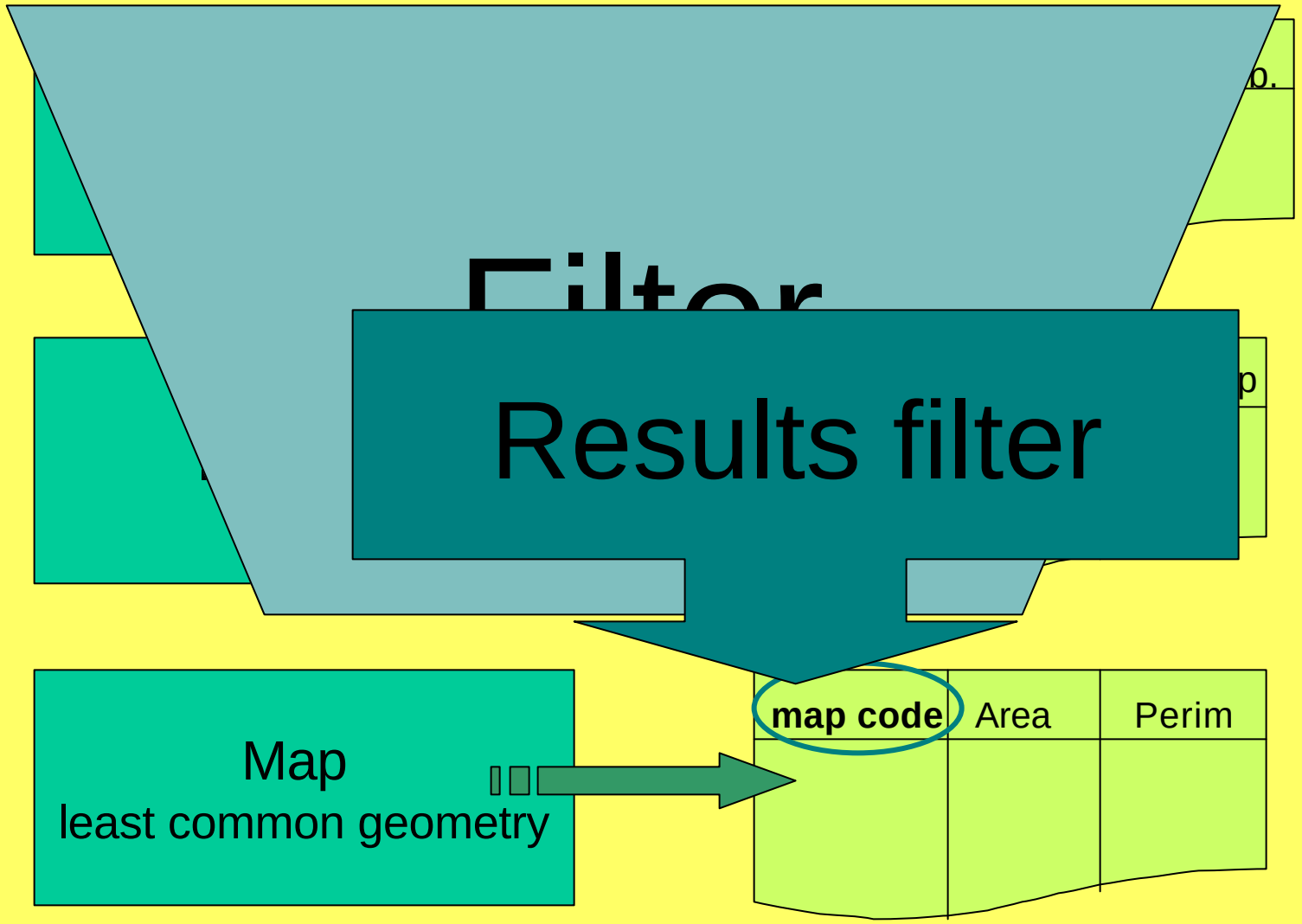
*Ott & Swiaczny, *Time-integrative GIS*, 2001

Map of least common geometries




Procedure: Second step
Making map of least common geometries
31006c
31005d
31006a
31029x
31006e
31029z
31006f
Least common geometry
0 250 500 750 1000 Meters
N

LINKING DATABASE WITH MAP



FILTER QUERY (municipalities)

Veld:	KAART_CODE	NIS_CODE	MOD_NAAM	BEGIN	EINDE
Tabel:	voorbeeld	voorbeeld	tbl_nis_gem	voorbeeld	voorbeeld
Totaal:	Group By	Group By	Group By	Group By	Group By
Sorteervolgorde:					
Weergeven:	☑	☑	☑	☑	☑
Criteria:				<=1990	>=1990
Of:					

link table

KAART_CODE	NIS_CODE	BEGIN	EINDE
31005d	31005D	1796	1960
31005d	31005A	1960	2000
31006a	31006A	1796	2000
31006a	31006C	1796	1960
31006a	31006A	1960	2000
31006e	31006E	1796	1960
31006e	31006A	1960	2000
31006f	31006F	1796	1960
31006f	31006A	1960	2000
31029x	31005E	1796	1960
31029x	31006A	1960	2000
31029z	31005E	1796	1960
31029z	31005A	1960	2000

Multiple

Unique

Results query 1950

KAART_CODE	N	_NAAM	BEGIN	EINDE
31005d	31	kerke	1796	1960
31006a	31006A	Damme	1796	2000
31			796	1960

Results query 1990

Multiple

KAART_CODE	NIS_CODE		EGIN	EINDE
31005d	31005A	Brugge	1960	2000
31006a	31006A	Damme	1796	2000
31006c	31006A	Damme	1960	2000
31006e	31006A	Damme	1960	2000
31006f	31006A	Damme	1960	2000
31029x	31006A	Damme	1960	2000
31029z	31005A	Brugge	1960	2000

ADVANTAGES OF LCG-METHOD

- Spatially and temporally reliable
- Can generate boundaries for each given time point
- Covers time slices and continual records of change
- No redundant information
- Can be implemented with each layer GIS
- High versatility and flexibility of analysis

Example 1

The evolution of the boundaries of the administrative arrondissements for the province of West-Flanders

RELATIONSHIPS BETWEEN TABLES

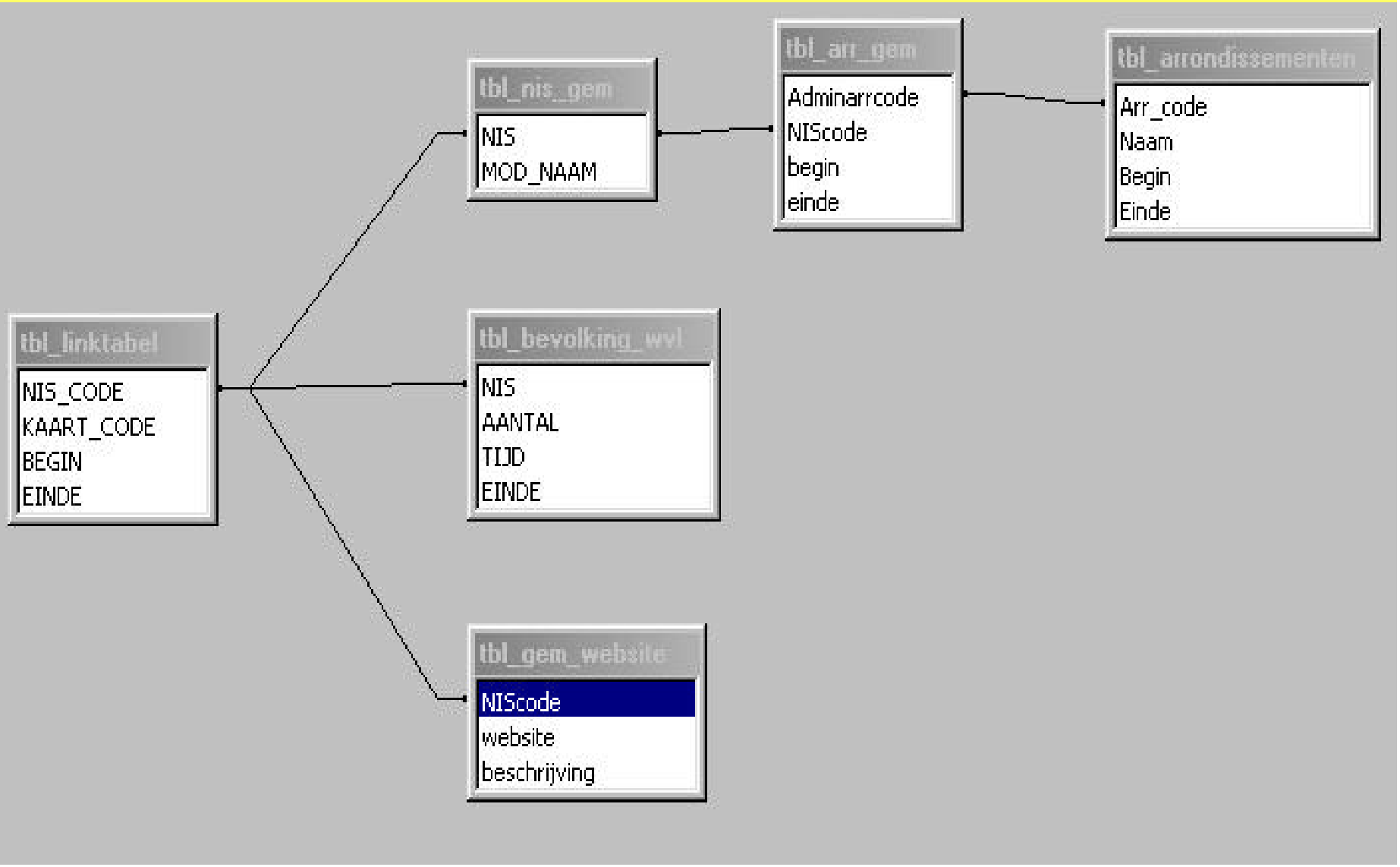


Table arrondissements

Arr_code	Naam	Begin	Einde
31	Brugge	17-2-1800	2-8-63
32	Diksmuide	7-3-1823	2-8-63
33	Ieper	17-2-1800	2-8-63
34	Kortrijk	17-2-1800	2-8-63
35	Oostende	3-1-1818	2-8-63
36	Roeselare	3-1-1818	2-8-63
37	Tielt	3-1-1818	2-8-63
38	Veurne	17-2-1800	2-8-63
40	Aalst	3-1-1818	2-8-63
40	Sint-Niklaas	3-1-1818	2-8-63
41	Gent	17-2-1800	2-8-63
42	Oudenaarde	17-2-1800	2-8-63
43	Dendermonde	17-2-1800	2-8-63
44	Eeklo/Sas van Gent	17-2-1800	2-8-63

link table of municipalities/arrondissements

Adminarrcode	NIScode	begin	einde
31	31003A	17- 2-1800	2- 8-1 63
31	31003B	17- 2-1800	2- 8-1 63
31	31003C	17- 2-1800	2- 8-1 63
31	31004A	17- 2-1800	2- 8-1 63
31	31004B	17- 2-1800	2- 8-1 63
31	31005A	17- 2-1800	2- 8-1 63
31	31005A29	17- 2-1800	12- 7-1899
31	31005B	17- 2-1800	10-10-1 42
31	31005B	1- 9-1 44	2- 8-1 63
31	31005C	17- 2-1800	2- 8-1 63
31	31005D	17- 2-1800	10-10-1 42
31	31005D	1- 9-1 44	2- 8-1 63
31	31005E	17- 2-1800	10-10-1 42
31	31005E	1- 9-1 44	2- 8-1 63
31	31005F	17- 2-1800	10-10-1 42

Table of municipalities

NIS	MOD_NAAM
31003A	Mannekensverre
31003B	Oedelem
31003C	Sint-Joris
31004A	Blankenberge
31004B	Uitkerke
31005A	Brugge
31005A29	Sint-Pieters-op-de-Dijk
31005B	Lissewege
31005C	Dudzele
31005D	Koolkerke
31005E	Sint-Kruis
31005F	Assebroek
31005G	Sint-Michiels
31005H	Sint-Andries
31006A	Damme
31006C	Oostkerke
31006C1	Hoeke
31006D	Lapscheure
31006E	Moerkerke

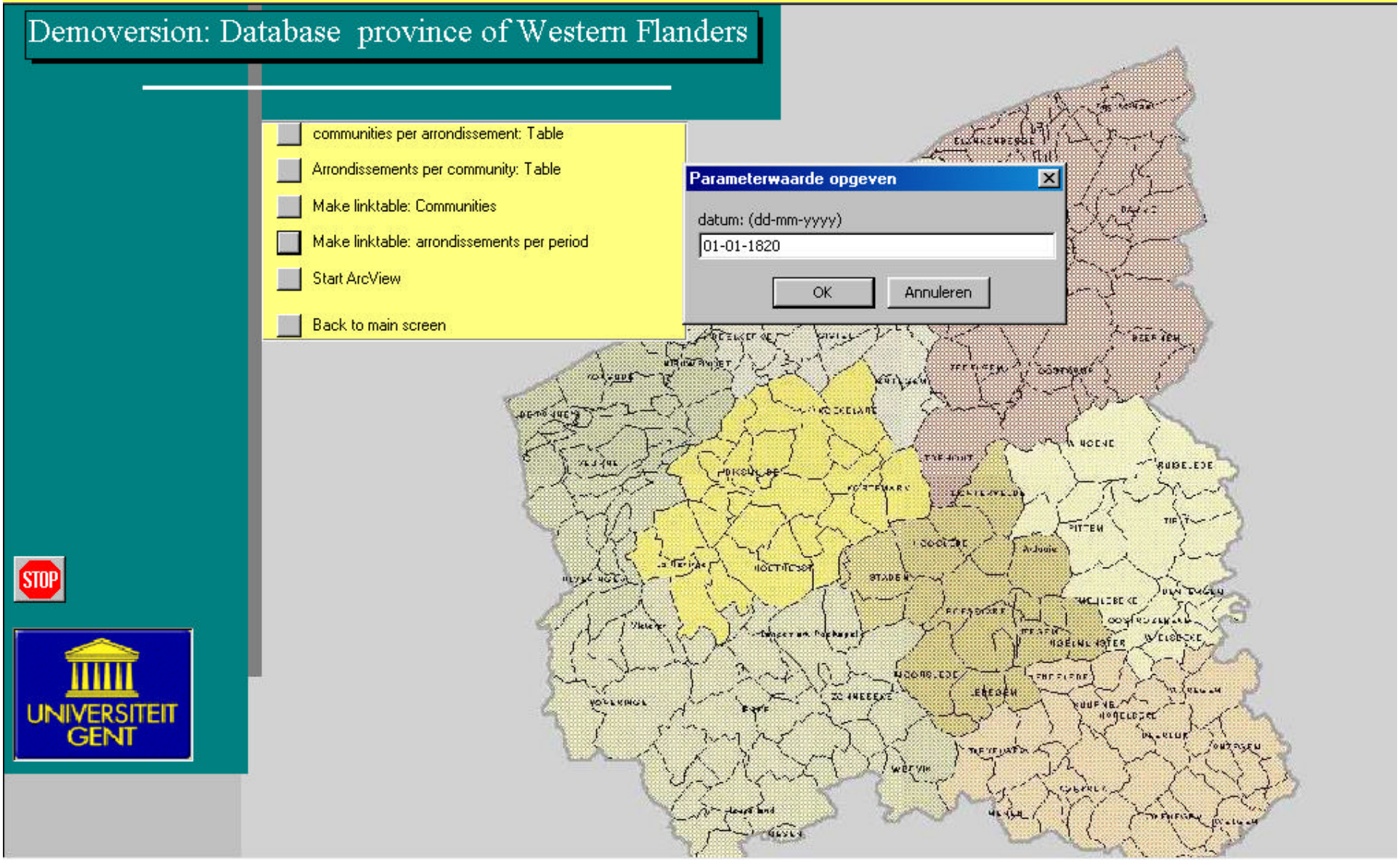
link table of municipalities/map

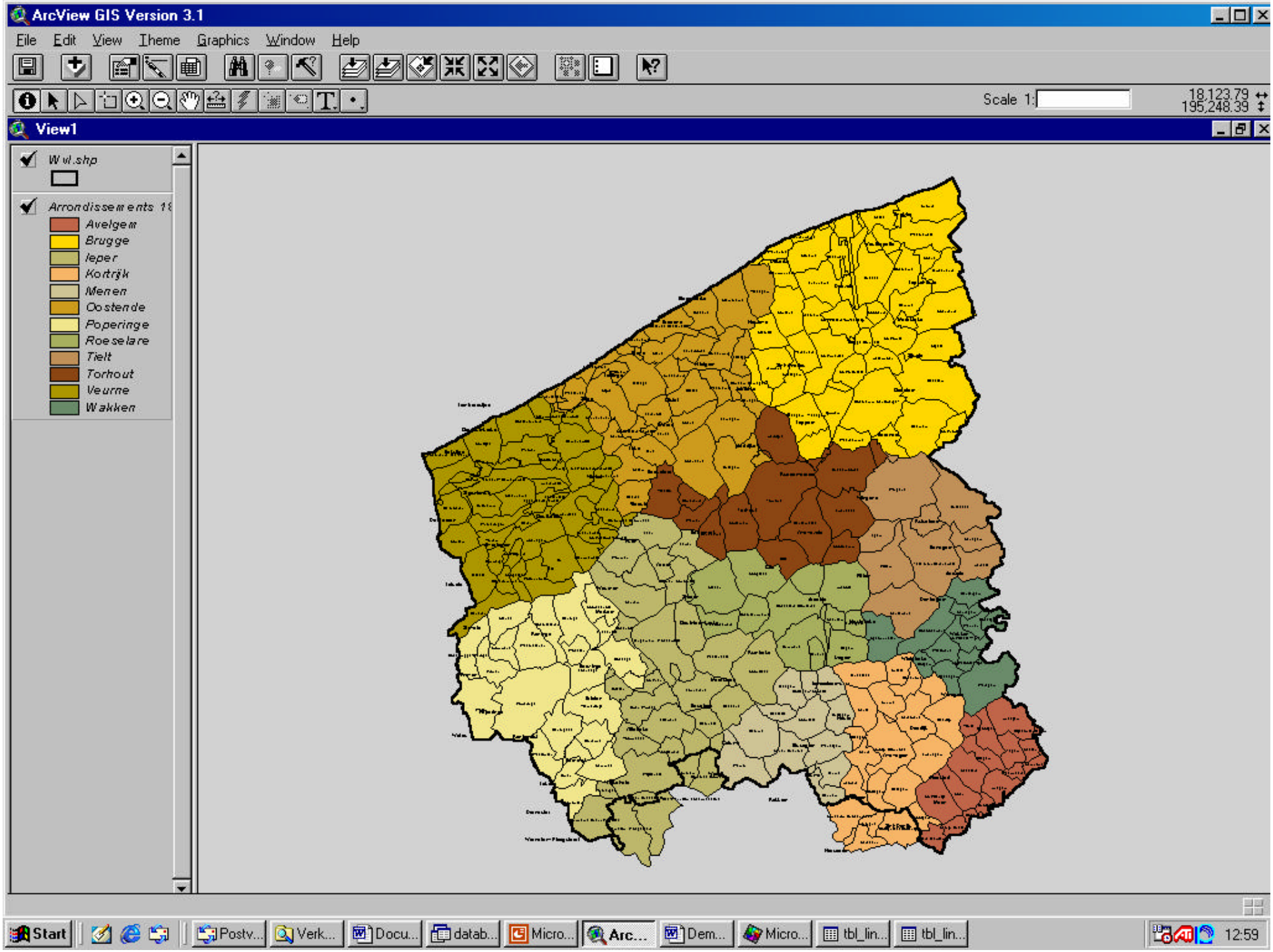
NIS_CODE	KAART_CODE	BEGIN	EINDE
31003A	31003a	1796	2000
31003B	31003b	1796	1970
31003A	31003b	1970	2000
31003C	31003c	1796	1970
31003A	31003c	1970	2000
31004A	31004a	1796	2000
31004B	31004b	1796	1970
31004A	31004b	1970	2000
31005B	31005a	1796	1950
31005A	31005a	1950	2000
31005B	31005b	1796	1970
31005A	31005b	1970	2000
31005C	31005c	1796	1970

e.g. 1960

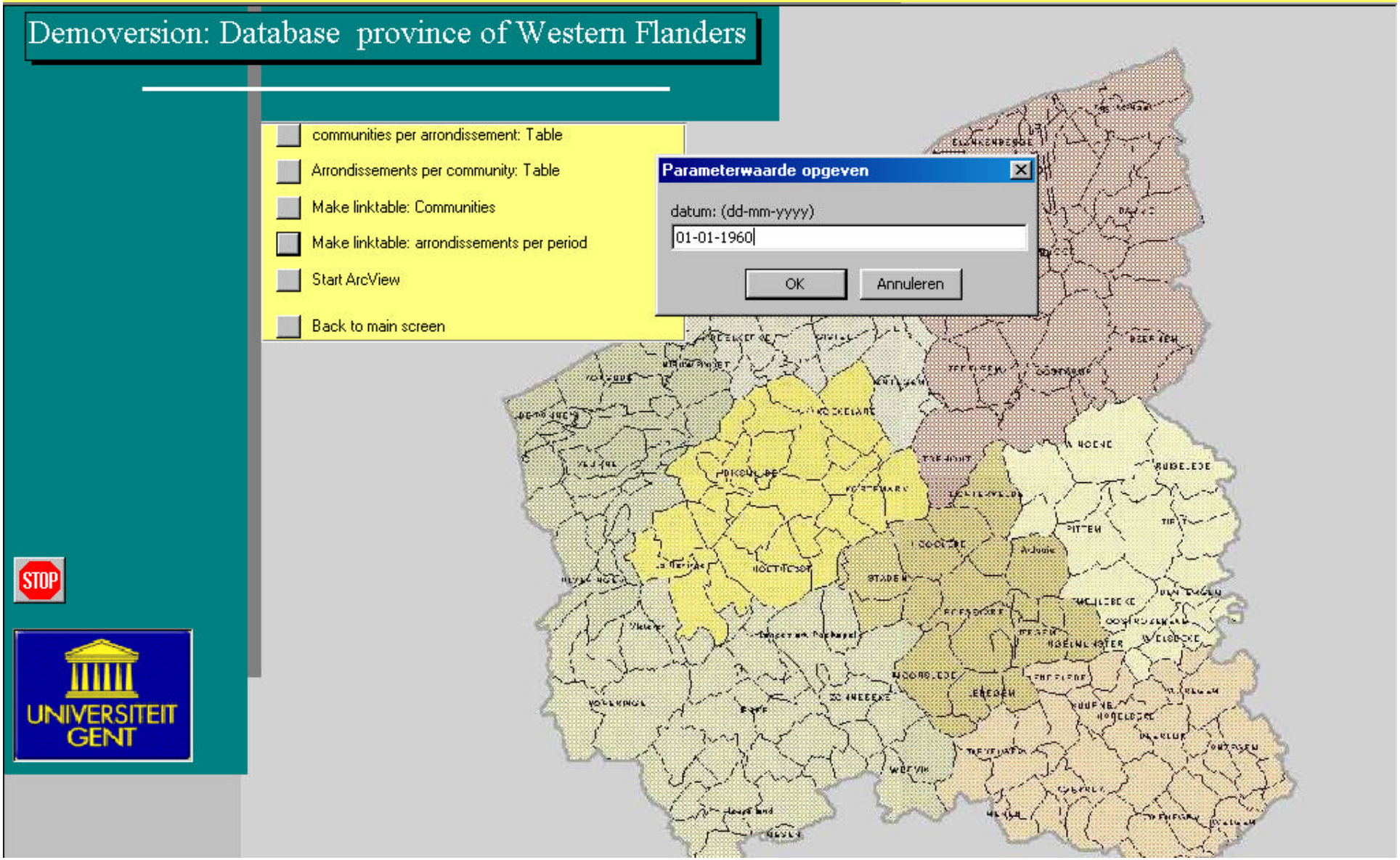
e.g. 1990

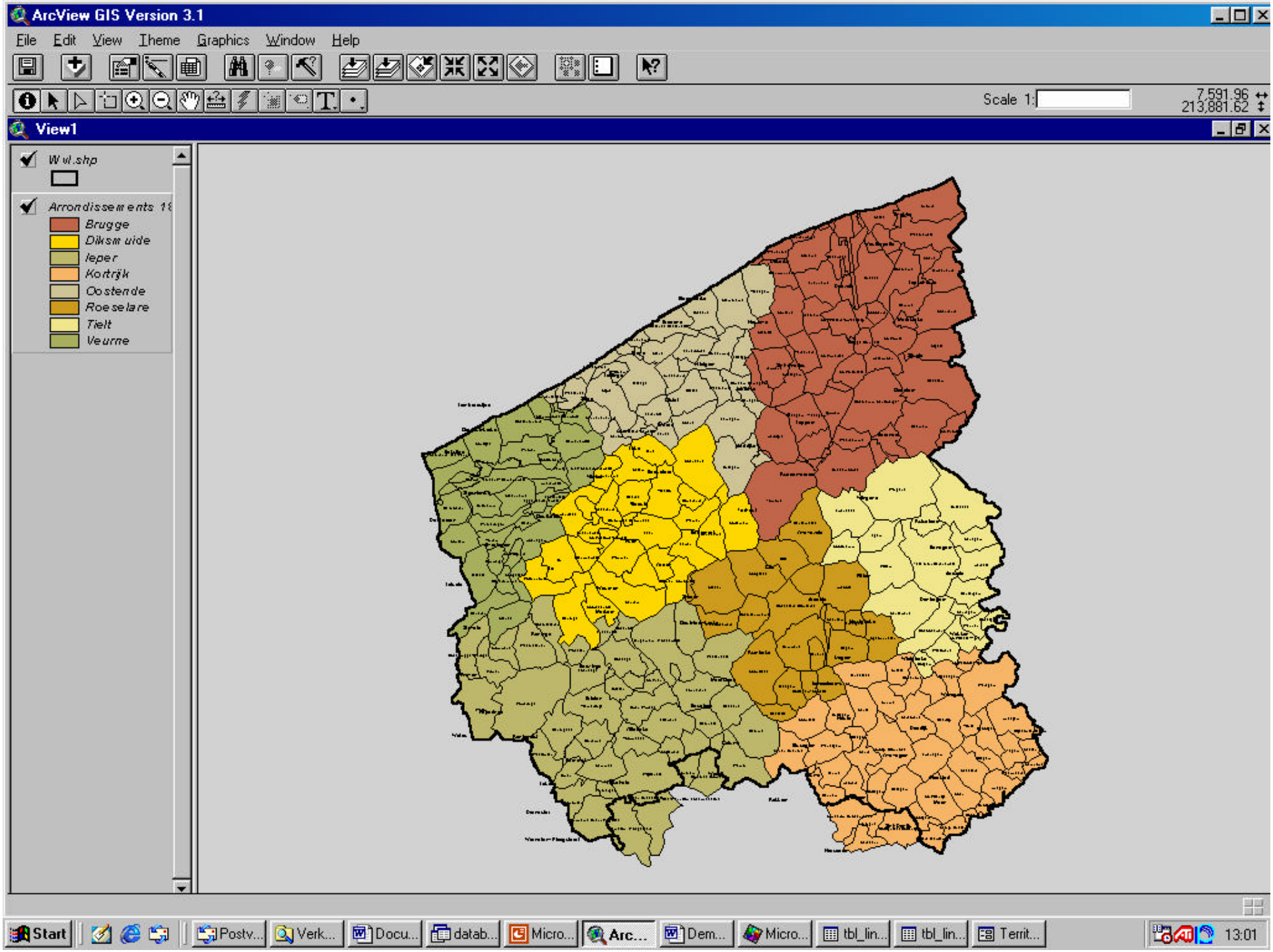
SELECT ARR. 1820




ArcView GIS Version 3.1
File Edit View Theme Graphics Window Help
Scale 1:
18,123.79
195,248.39
View1
Wwl.shp
Arrondissements 1
Avelgem
Brugge
Ieper
Kortrijk
Menen
Oostende
Poperinge
Roeselare
Tielt
Torhout
Veurne
Wakken
Start
Postv...
Verk...
Docu...
datab...
Micro...
Arc...
Dem...
Micro...
tbl_lin...
tbl_lin...
12:59

SELECT ARR. 1960




ArcView GIS Version 3.1
File Edit View Theme Graphics Window Help
Scale 1:
7,591.96
213,881.62
View1
Wwl.shp
Arrondissements 19
Brugge
Diksmuide
Ieper
Kortrijk
Oostende
Roeselare
Tielt
Veurne
Start
Postv...
Verk...
Docu...
datab...
Micro...
Arc...
Dem...
Micro...
tbl_lin...
tbl_lin...
Territ...
13:01

Example 2

Population density in West-Flanders
between 1846 and 1991

(on municipality level)

Table of municipality names

NIS	MOD_NAAM
35029	De Haan
38025K	De Moeren
38008A	De Panne
34009A	Deerlijk
37002A	Dentergem
34040C	Desselgem
33011H	Dikkebus
32003A	Diksmuide
54007D	Dottignies
33039E	Dranouter
31005C	Dudzele
35006B	Eernegem
37011B	Egem

Table of population (absolute fig.)

NIS	AANTAL	TIJD
31005C	2025	1856
31005C	2259	1930
31005C	2128	1880
31005C	2028	1846
31005C	2116	1876
31005C	1268	1806
31005C	2049	1961
31005C	2063	1890
31005C	1687	1830
31005D	892	1920
31005D	922	1831
31005D	815	1930
31005D	671	1800

link table municipalities/map, 1846

kaart code	MOD_NAAM	tijd-begin	tijd-einde
33011h	Dikkebus	1796	1850
32003a	Diksmuide (Dixm	1796	1850
54007d	Dottignies (Dotte	1796	1850
33039e	Dranouter	1796	1850
31005i	Dudzele	1796	1850
31005c	Dudzele	1796	1850
31005j	Dudzele	1796	1850
31044i	Dudzele	1796	1850
35006b	Eernegem	1796	1850
37011b	Egem	1796	1850
38025d	Eggewaartskape	1796	1850
33011f	Elverdinge	1796	1850

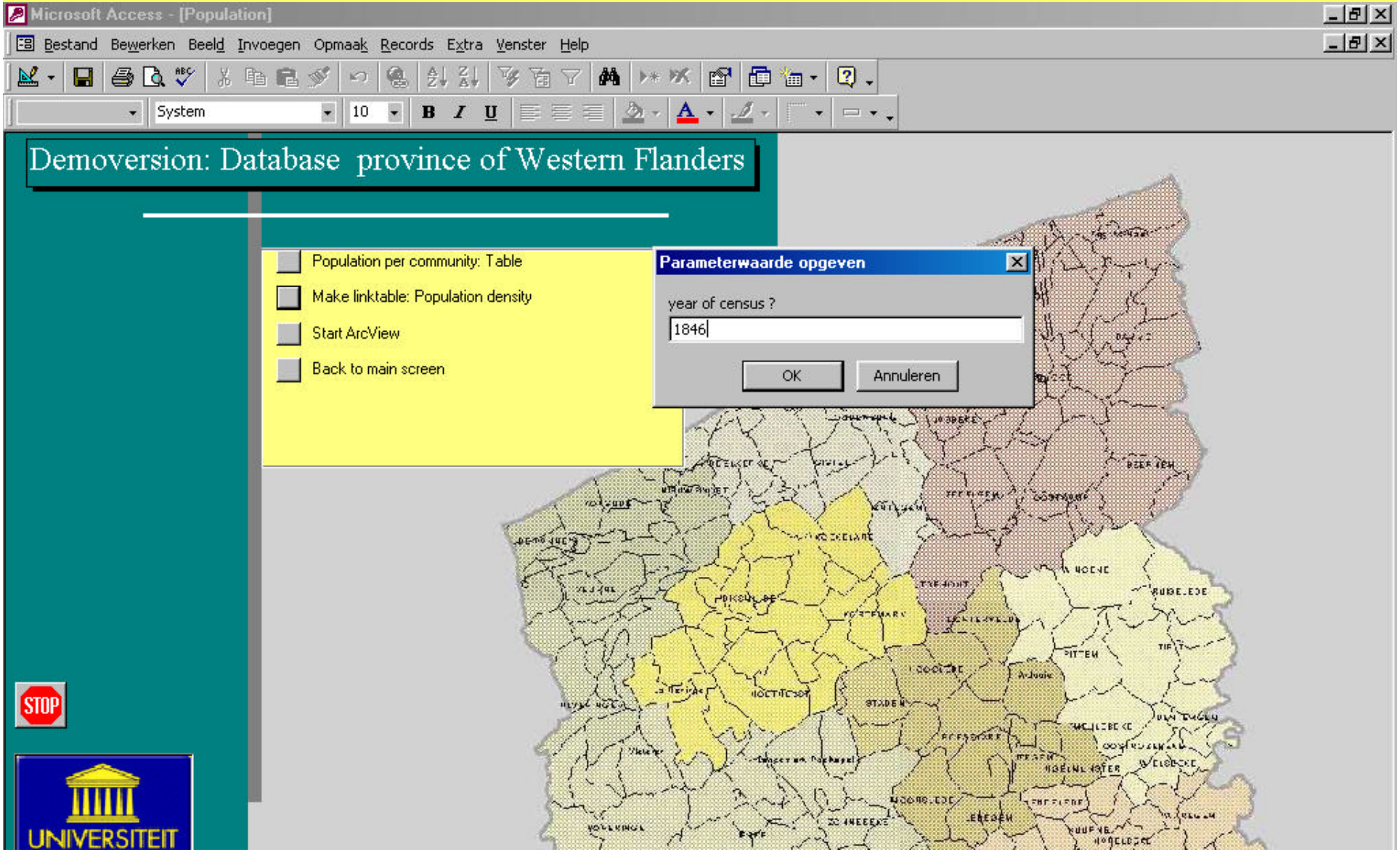
Table of area of polygons

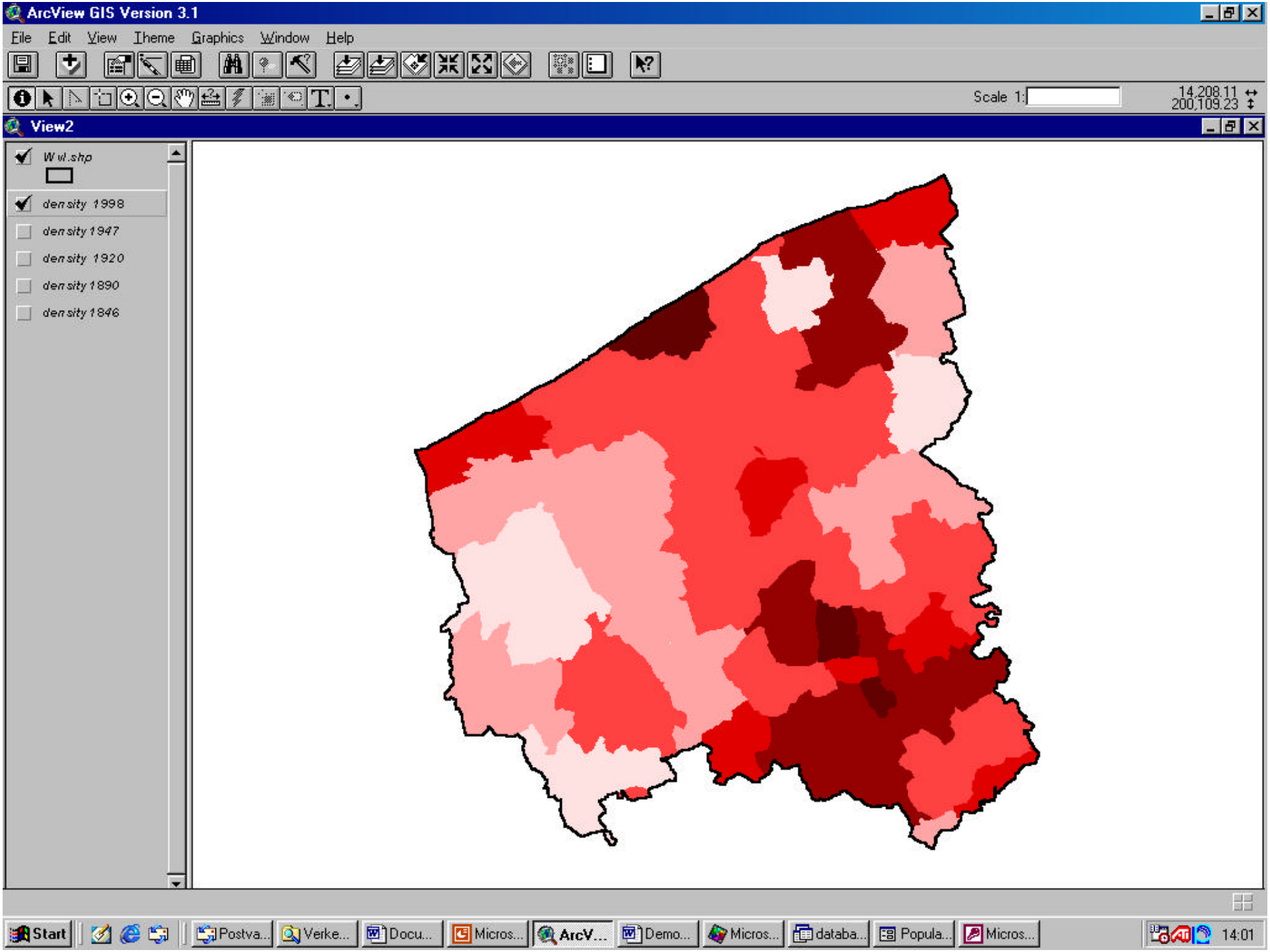
AREA	ATLAS_P
28,437749	31003a
37,622756	31003b
6,509631	31003c
2,256008	31004a
15,539493	31004b
3,709209	31005a
7,405702	31005b
19,180163	31005c
4,194852	31005d
0,86915	31005e
8,818799	31005f
9,666548	31005g
20,894492	31005h
1,279897	31005i
3,951815	31005j

Calculation of population density

Area in 1846 = som of polygons: 28.44 km²
Population in 1846 = 2028
Density = 2028/28.44 =
71.31 inh./km²

SELECT POP. 1846

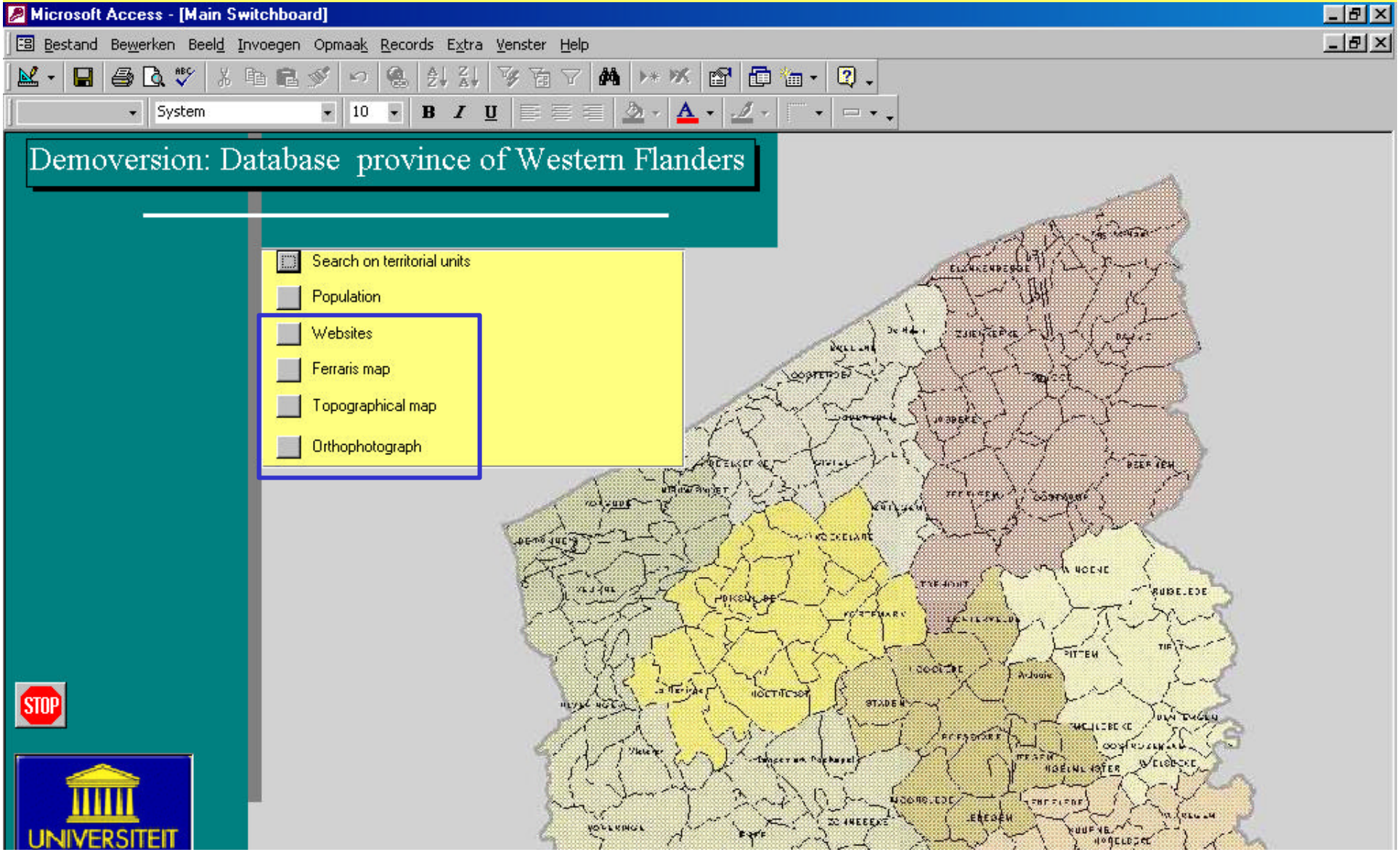


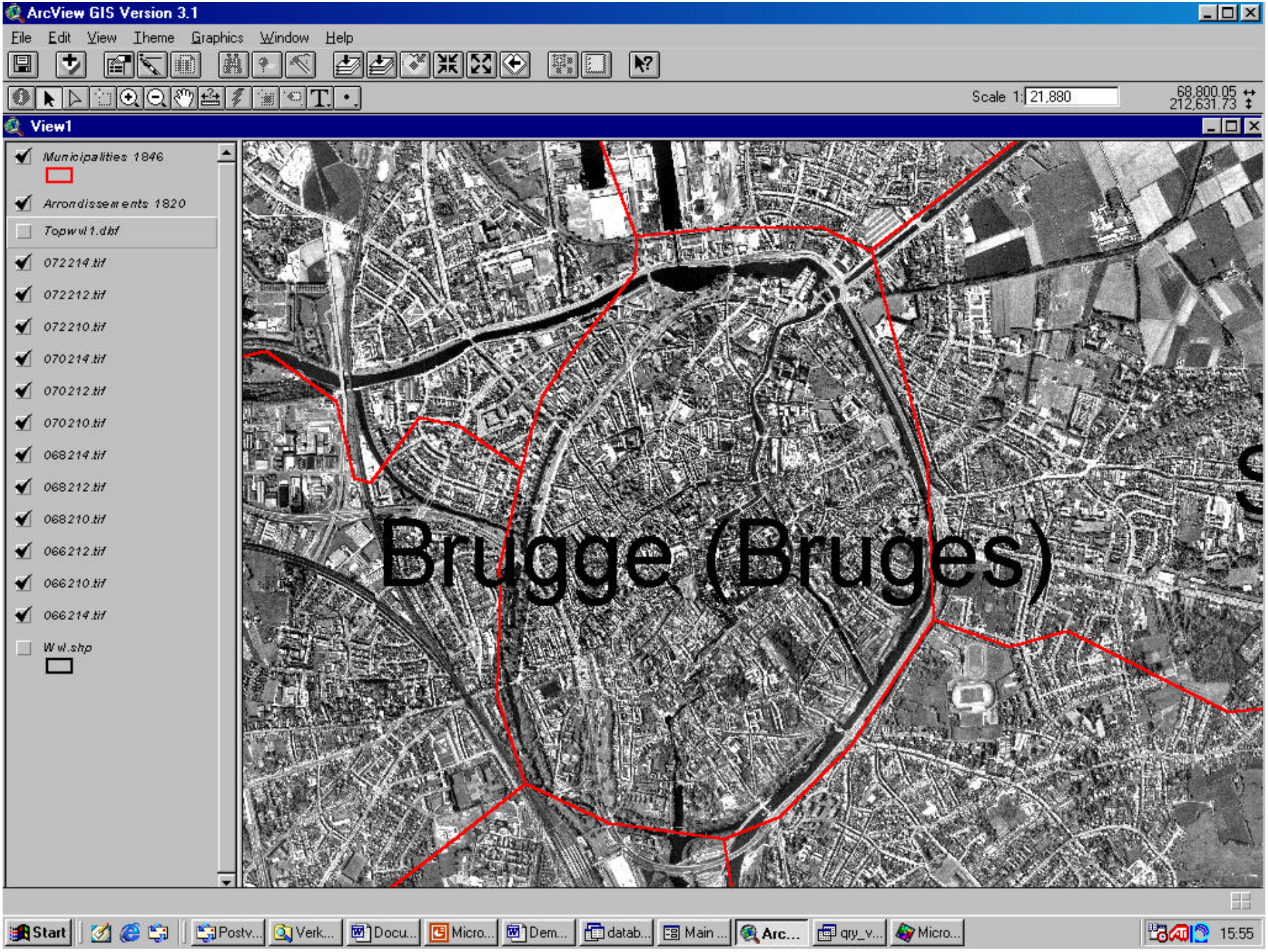

ArcView GIS Version 3.1
File Edit View Theme Graphics Window Help
Scale 1:
14,208.11
200,109.23
View2
W wl.shp
density 1998
density 1947
density 1920
density 1890
density 1846
Start
Postva...
Verke...
Docu...
Micros...
ArcV...
Demo...
Micros...
databa...
Popula...
Micros...
14:01

Example 3

Show topographical map and orthophoto for Bruges

SELECT OBJECT




ArcView GIS Version 3.1
File Edit View Theme Graphics Window Help
Scale 1: 21,880
68,800.05
212,631.73
View1
Municipalities 1846
Arrondissements 1820
Topwvl1.dbf
072214.tif
072212.tif
072210.tif
070214.tif
070212.tif
070210.tif
068214.tif
068212.tif
068210.tif
066212.tif
066210.tif
066214.tif
Wvl.shp
Brugge (Bruges)
Start
Postv...
Verk...
Docu...
Micro...
Dem...
datab...
Main ...
Arc...
qry_v...
Micro...
15:55

INTERFACE

- Distribution of data
- Collection of data
- Access via internet
- Special viewer for MS-Access and Arcview
- ArcIMS-server
- Restricted access? Copyright?

POSSIBLE CRITIQUE

- Flexibility can be enhanced:

  Instead of map layers (“complex” maps/simple database): spatial databases (more complex database /simpler maps)

- User can use and enter data but not changethe structure of database

FUTURE PERSPECTIVES

- Add more data on all territorial levels
- Extension in time: link to Ancien Regime
- Linkage with datbases of public services
- Integration into a historical data and metadata archive for geographical and non-geographical historical data

UNIVERSITEIT
GENT