DYNAMIC CARTOGRAPHIC METHODS FOR VISUALIZATION OF HEALTH STATISTICS

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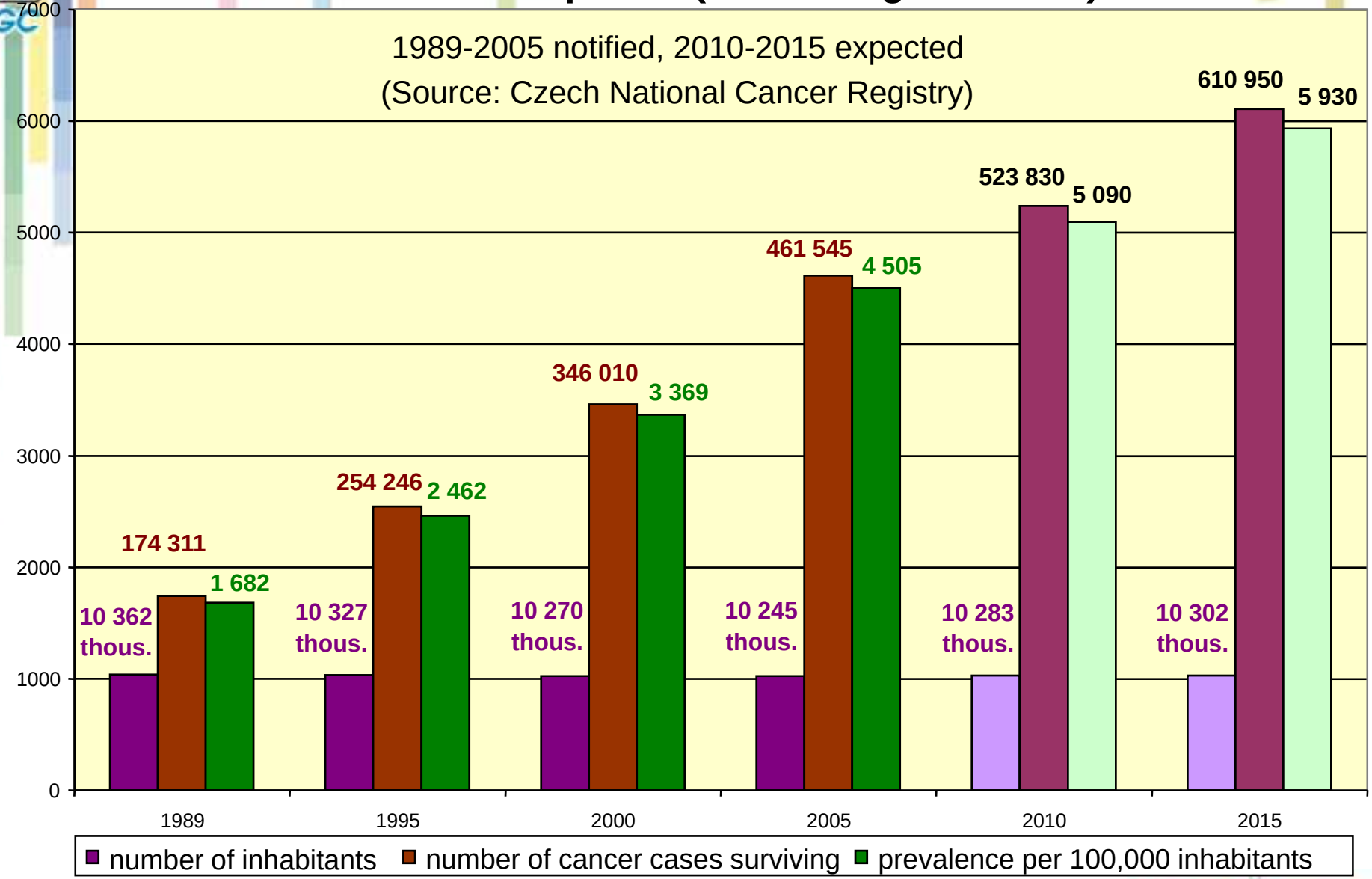
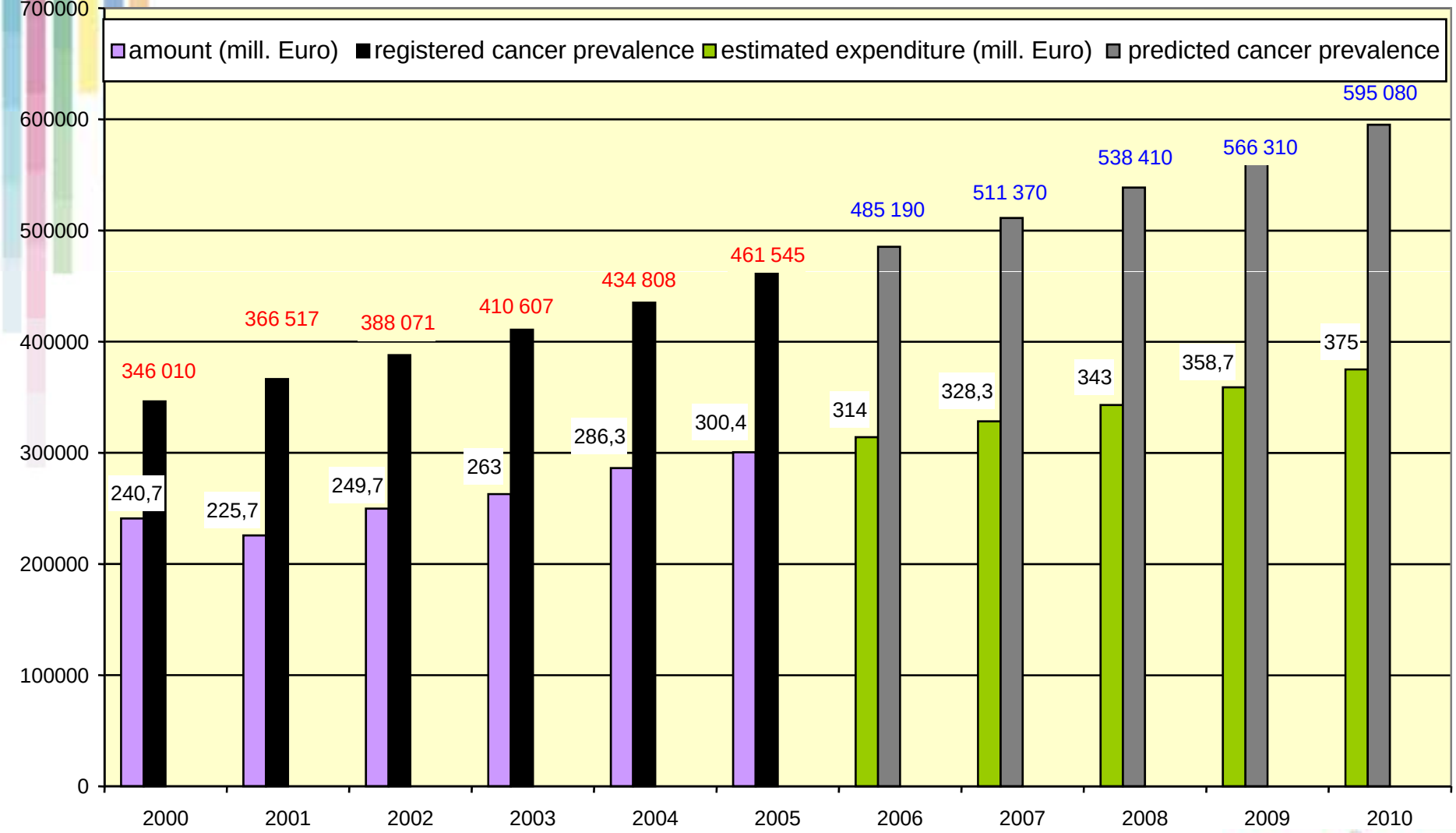
Yearly estimation for 2002 (IARC Lyon Globocan)
for cancers (ICD-10: dg. C00-C96)
10.862 mill. newly diagnosed
6.724 mill. deceased
24.57 mill. patients with 5-year prevalence

Trends of cancer prevalence in the Czech Republic (ICD-10: dg. C00-D09)



Expenditure of health insurance corporations in the Czech Republic on heath care in oncology

(Sources: Czech Statistical Office, Czech Institute of Health Information and Statistics)



Trend is dangerous – we must react

- More than 30% of Czech population is confronted with a cancer during their life and 25% dies of it.
- 300 mill. Euro in all cancers were amounted in 2005 on treatment of Czech cancer sites.
- “No matter what advances there may be in high-technology medicine, any major reduction in deaths and disability from cancer will come from prevention, **not from cure**.”

Mackay, J. et al.: The Cancer Atlas,
American Cancer Society, 2006, p. 82.

- We have to **support people to change** lifestyle, to go to preventive controls. Early recognition of cancer increases probability that therapy will be successful (and cheaper).
- We must **inform them** about situation and possibilities (maybe it is better to said “**terrify them**”!?)

Maps as a way of information sharing

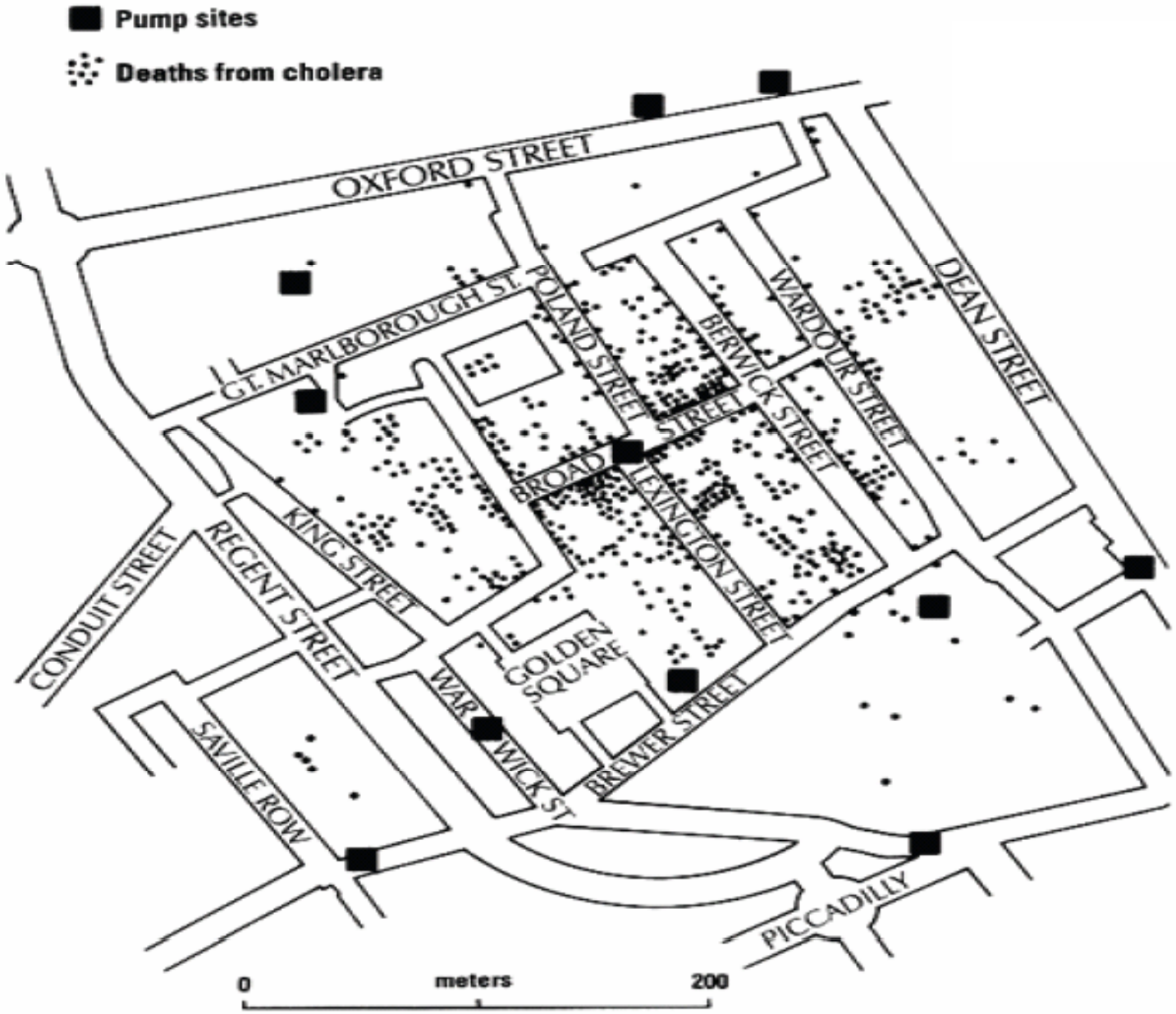
- The cartographic visualization is possible way for health statistics presentation.
- “A picture may be worth a thousand words, but a map can represent millions of data points.”

Pickle, L. W.: Usability testing of map design, 2003,

In Proceedings of the 35th Symposium on the Interface

It is important to add words “**a good map**”!

- The cartography can be also used for monitoring and analyzing of situation – in space as well as in time.


Pump sites
Deaths from cholera
OXFORD STREET
G.T. MARLBOROUGH ST.
POLAND STREET
BERWICK STREET
WARDOUR STREET
DEAN STREET
BROAD STREET
LEXINGTON STREET
KING STREET
REGENT STREET
CONDUIT STREET
GOLDEN SQUARE
WARWICK ST
BREWER STREET
SAVILLE ROW
PICCADILLY
0
meters
200

NATIONAL CANCER INSTITUTE

Cancer Mortality Maps&Graphs

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Customizable Mortality Maps

Charts and Graphs Home

Create maps by selecting from the variables below. View values associated with a geographic area by moving cursor over that area. Drill down from state to county by clicking on state (or "Detail for [state name]" for [d] link).

View Entire US by
- (•) State
- ( ) State Economic Area
- ( ) County

Age
- (•) All Ages
- ( ) 0-19
- ( ) 20-49
- ( ) 50-74
- ( ) 75+

Race/Gender
- (•) White Male
- ( ) White Female
- ( ) Black Male
- ( ) Black Female

Time Period
- ( ) 1950-1994
- ( ) 1950-1969
- ( ) 1950-1954
- ( ) 1955-1959
- ( ) 1960-1964
- ( ) 1965-1969
- (•) 1970-1994
- ( ) 1970-1974
- ( ) 1975-1979
- ( ) 1980-1984
- ( ) 1985-1989
- ( ) 1990-1994

Rate intervals for color shading
- (•) 10 intervals with equal no. of regions
- ( ) User-defined intervals

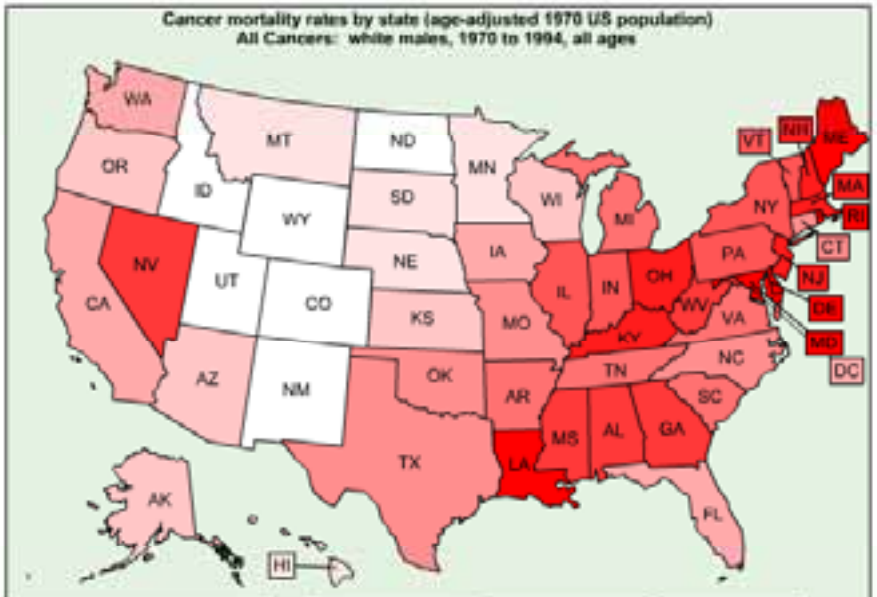
Map color scale (high rates/low rates)
- ( ) Atlas (red/blue)
- (•) Monochrome (red/white)

Compare maps

Map image format: ( ) [D] (•) Flash ( ) JPEG ( ) SVG

Place cursor over map to view geographic location, rate, lower bound to upper bound, no. of deaths, and/or to drill down (outline around state indicates drill down capability)

To print, right-click anywhere on graph and select Print from the popup menu



Rates per 100,000 person-years, 1970 to 1994
- 227.82 - 233.52 (5; 9.8%)
- 220.66 - 227.82 (5; 9.8%)

Mortality rate	Confidence interval	No. of deaths
US 209.47	209.29 - 209.66	5,076,130

Cancer
- (•) All Cancers
- ( ) Bladder
- ( ) Bones and joints
- ( ) Brain and other nervous system
- ( ) Breast
- ( ) Cervix uteri
- ( ) Colon
- ( ) Connective tissue
- ( ) Corpus uteri and uterus NOS
- ( ) Endocrine glands, other
- ( ) Esophagus
- ( ) Eye
- ( ) Hodgkin's disease
- ( ) Kidney, renal pelvis, and ureter
- ( ) Larynx
- ( ) Leukemia
- ( ) Lip
- ( ) Liver, gallbladder, and other biliary tract
- ( ) Liver
- ( ) Gallbladder
- ( ) Biliary tract, other
- ( ) Lung, trachea, bronchus, and pleura

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New technologies – new approaches

- Changes in using of map from data representation to information and hypotheses exploration.
- **Exploratory cartography** - connection of advantages of maps and an electronic environment controlled interactively by a user.
- “Geovisualization tools are born from a desire to build maps that people can **interact** with and **explore** in a real-time, dynamic manner. As analysts are faced with ever-increasing amounts of spatial data, we need to provide maps and other visualizations that facilitate exploration.”

Robinson, A. C.: Geovisualization and epidemiology: A general design framework, 2005, In Proceedings of the International cartographic Association, La Coruna, Spain

Cognitive studies

- Whether on paper or on web, the map must accept cartographic rules.
- It is even more important when readers have no special training.

- Research showed, that non-cartographers liked classic choropleth (classed, area shaded) maps and used them accurately.

Pickle, L. W. Herrmann, D.: The process of reading statistical maps: The effect of color. In: Statistical Computing and Statistical Graphics Newsletter, 1994

Cognitive studies

- Other studies targeted the using of colors, legend type and many other themes.
- Overview of them is in Pickle, L. W., 2003.

Pickle, L. W.: Usability testing of map design. In: Proceedings of the 35th Symposium on the Interface, 2003

General recommendations for making statistical maps for non-cartographers can be summarized:

- design the map for a particular audience and purpose
- use a standard legend design
- colors should be chosen for the visually impaired and consistent with color conventions
- identify unreliable rates, don’t blank them out

Health data presentation projects

- “Cartographic **visualization and modeling** of contemporary **trends** in health status and healthcare in the Czech Republic”
- “**Visualization** of health data to support interdisciplinary **education** and relations with **general public**”

Team members:

- the Masaryk University, the Faculty of Science, the Department of Geography, the Laboratory on Geoinformatics and Cartography
- the Masaryk University, the Faculty of Social Studies, the Department of Media Studies and Journalism
- the University of West Bohemia in Pilsen, the Faculty of Applied Sciences, the Department of Mathematics, the Section of Geomatics
- University Hospital Brno

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Health data presentation projects

Expected results:

- modern tools (especially cartographic) for dynamic **presentation** and **analysis** of data concerning health conditions and healthcare
- e. g. cancer statistics and their dangerous increasing trend
- one of results will be a **web portal** for data presentation
- substantial part of portal – **tools** for health statistics data **visualization** and exploration
- primarily intended for a general public without GIS or statistical software experience
- easy-to-use, visual, interactive, requiring minimal training and computer literacy

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Types and sources of presented data

- health condition – numbers of cases of various diseases (including cancer and other), numbers of patients, numbers of hospitalizations…
- demographic data – structure of inhabitants…
- economic data – the costs of a cure, …

- the Institute of Health Information and Statistics of the Czech Republic
- the Czech Statistical Office
- …

Data will be:

- analyzed, modeled, predicted
- saved to the database PostgreSQL
- visualized by web portal tools

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Choosing types of tool

- data annually updated – resulted in time series

- **time series** visualization and trends representation **tool**

- searching correlation between quantity and costs of health care
- making hypotheses about risk factors and diagnosis

- **tool** for **exploring relation** between data

- inspiration from already existing tools

Time series tool

- existing tool: Time series graph – form of x-y graph

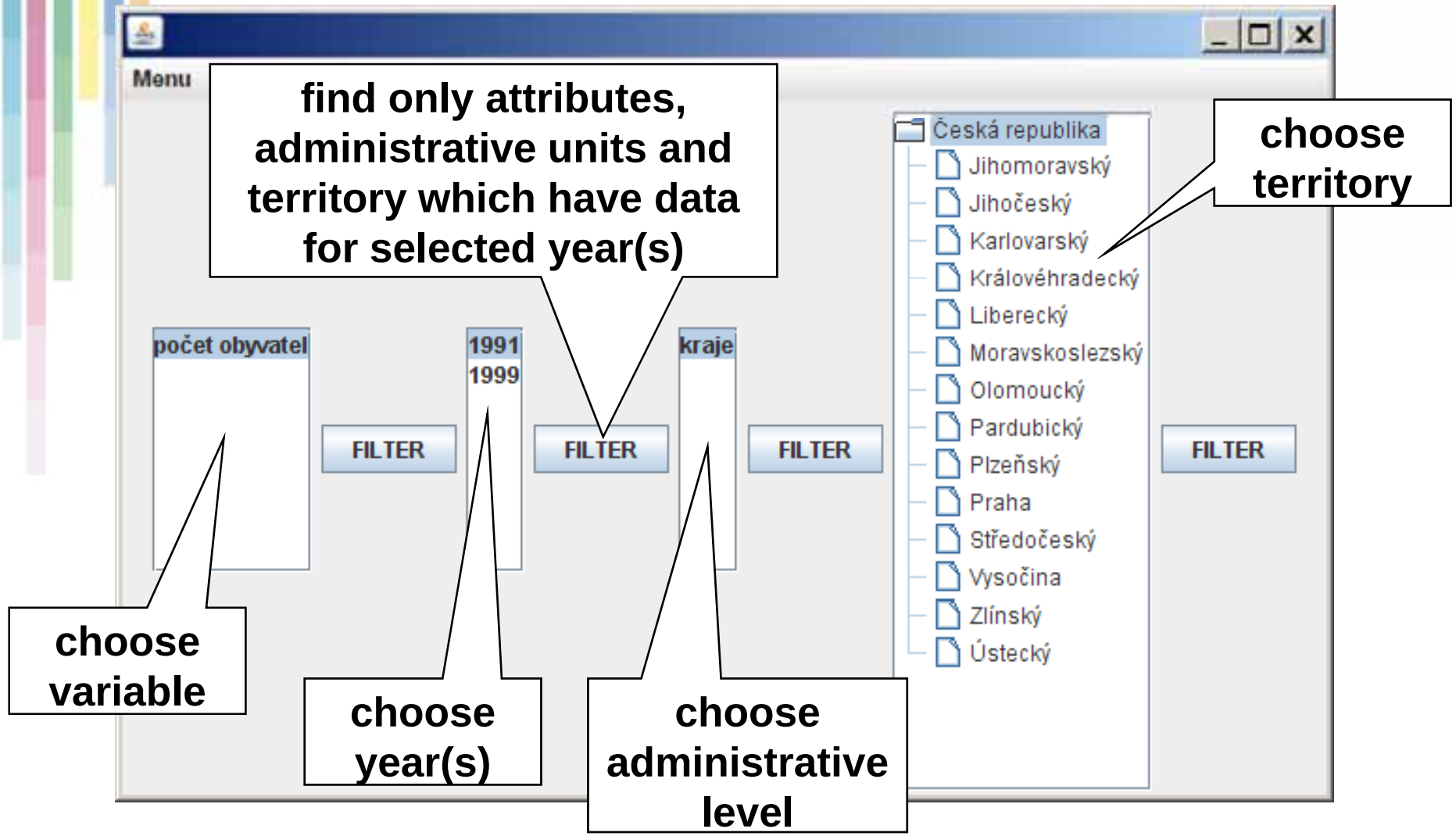
Robinson, A. C.: Geovisualization and epidemiology: A general design framework, 2005, In Proceedings of the International Cartographic Association, La Coruna, Spain

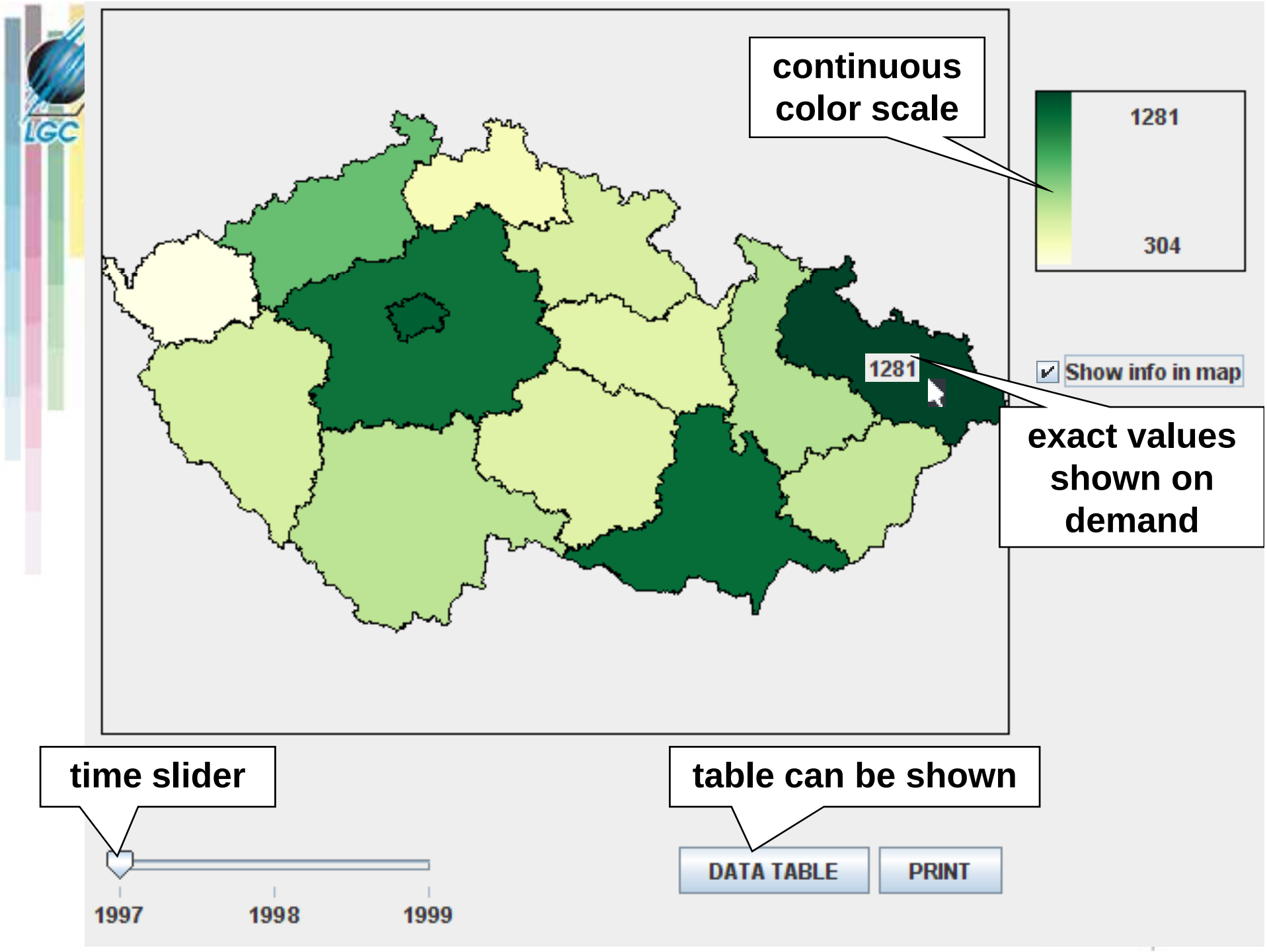
We want to implement it as a map changing in time:

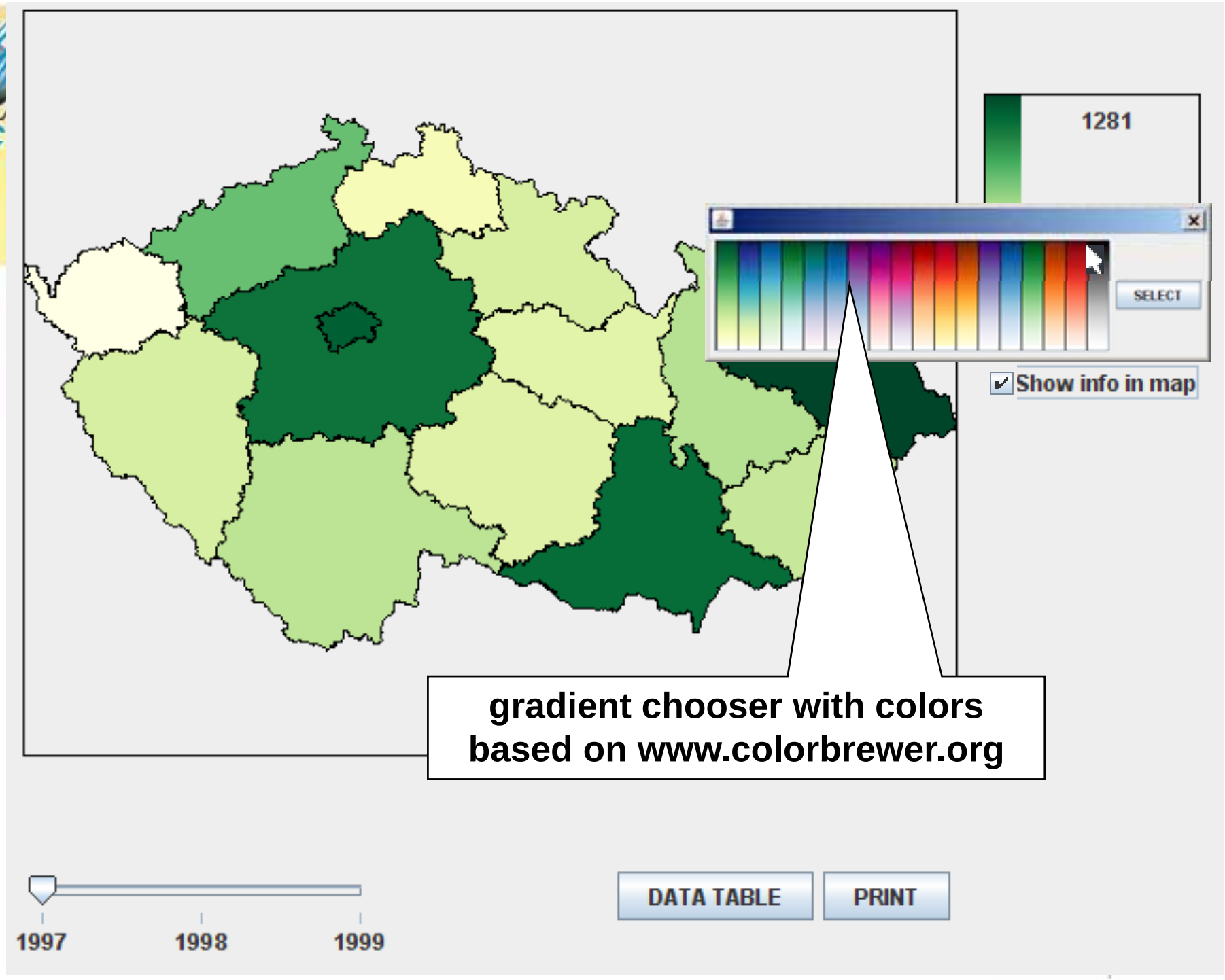
- possibility to see relation between the value and its location
- classic choropleth map well-known for users
- administrative units – presented statistics are collected only for these units

- Disease does not respect administrative borders – user can zoom to the smaller units (e. g. municipalities) – natural pattern preserved.

Time series tool




continuous color scale
1281
304
1281
Show info in map
exact values shown on demand
time slider
1997
1998
1999
table can be shown
DATA TABLE
PRINT


1281
SELECT
Show info in map
gradient chooser with colors
based on www.colorbrewer.org
1997
1998
1999
DATA TABLE
PRINT

Time series tool

Other useful features planned for implementation:

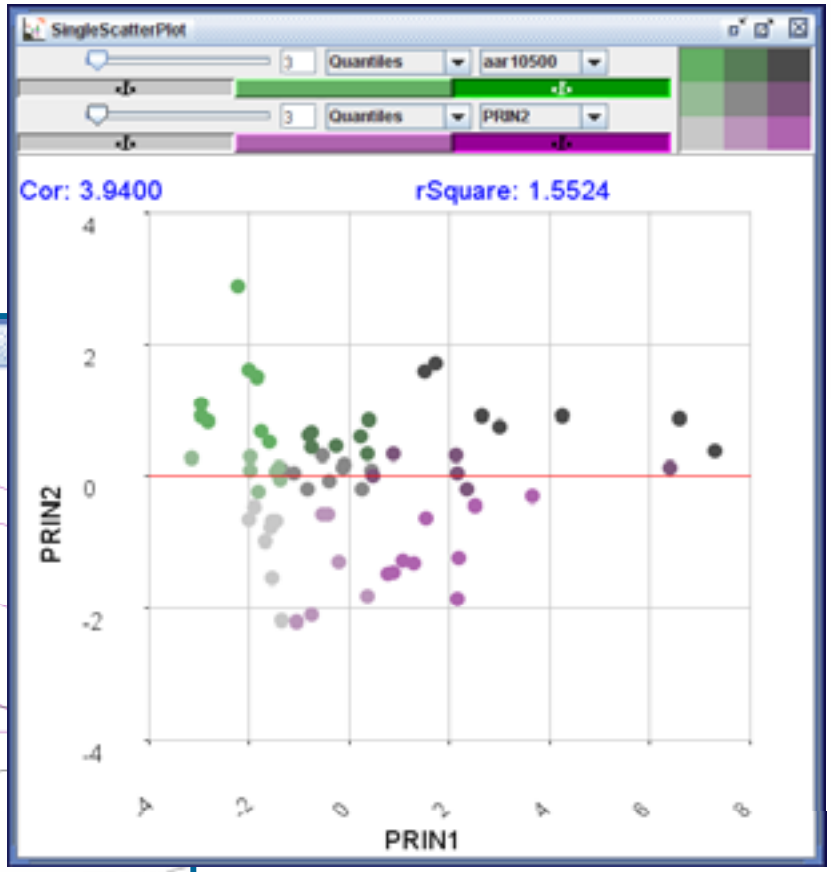
- statistical distribution
- zoom to subpart of map
- visualization of two or more maps in one moment – comparing of more variables or one variable in various years
- interactive animation

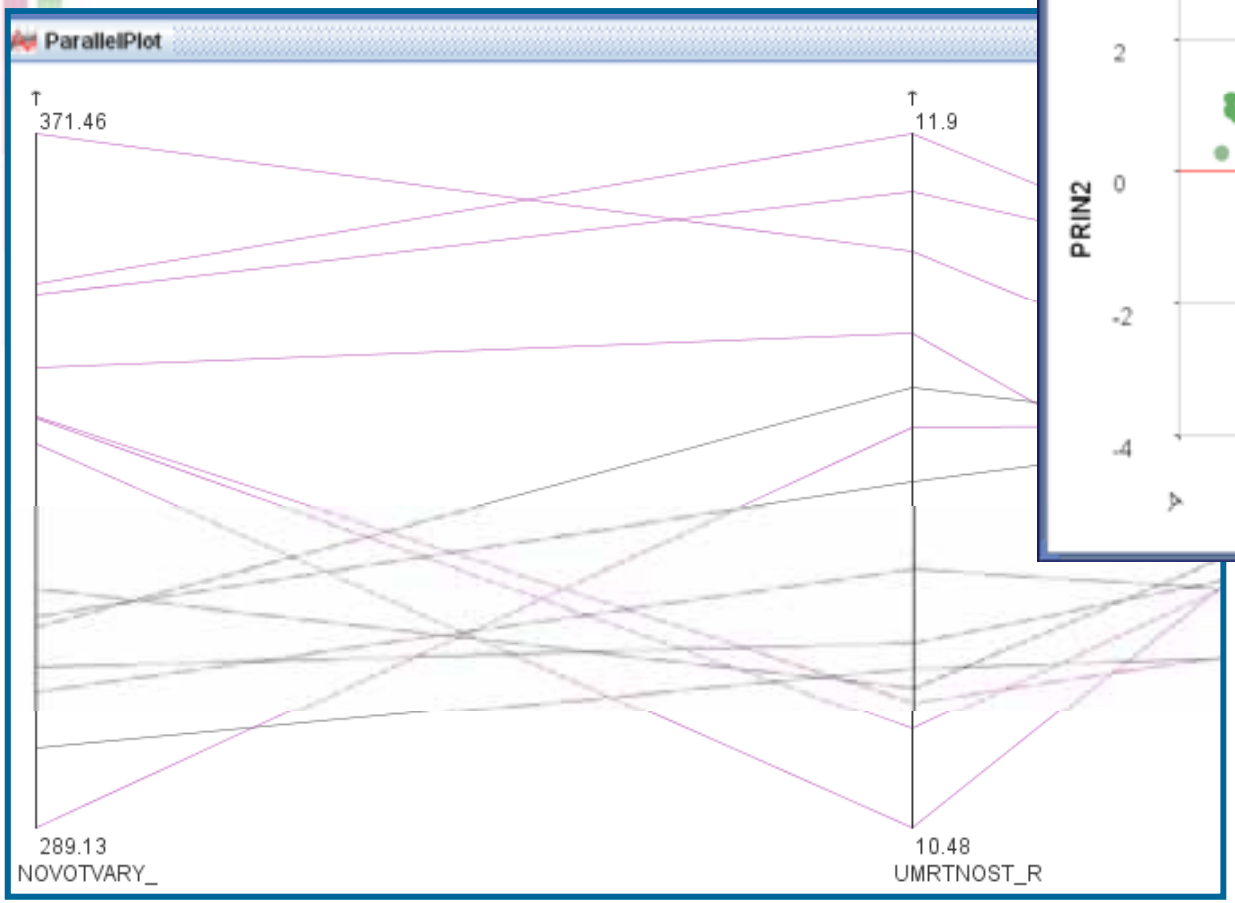
Correlation exploring tool

possible tools: eg. GeoDa, Geoviz…

scatter-plot

parallel coordinate plot (PCP)

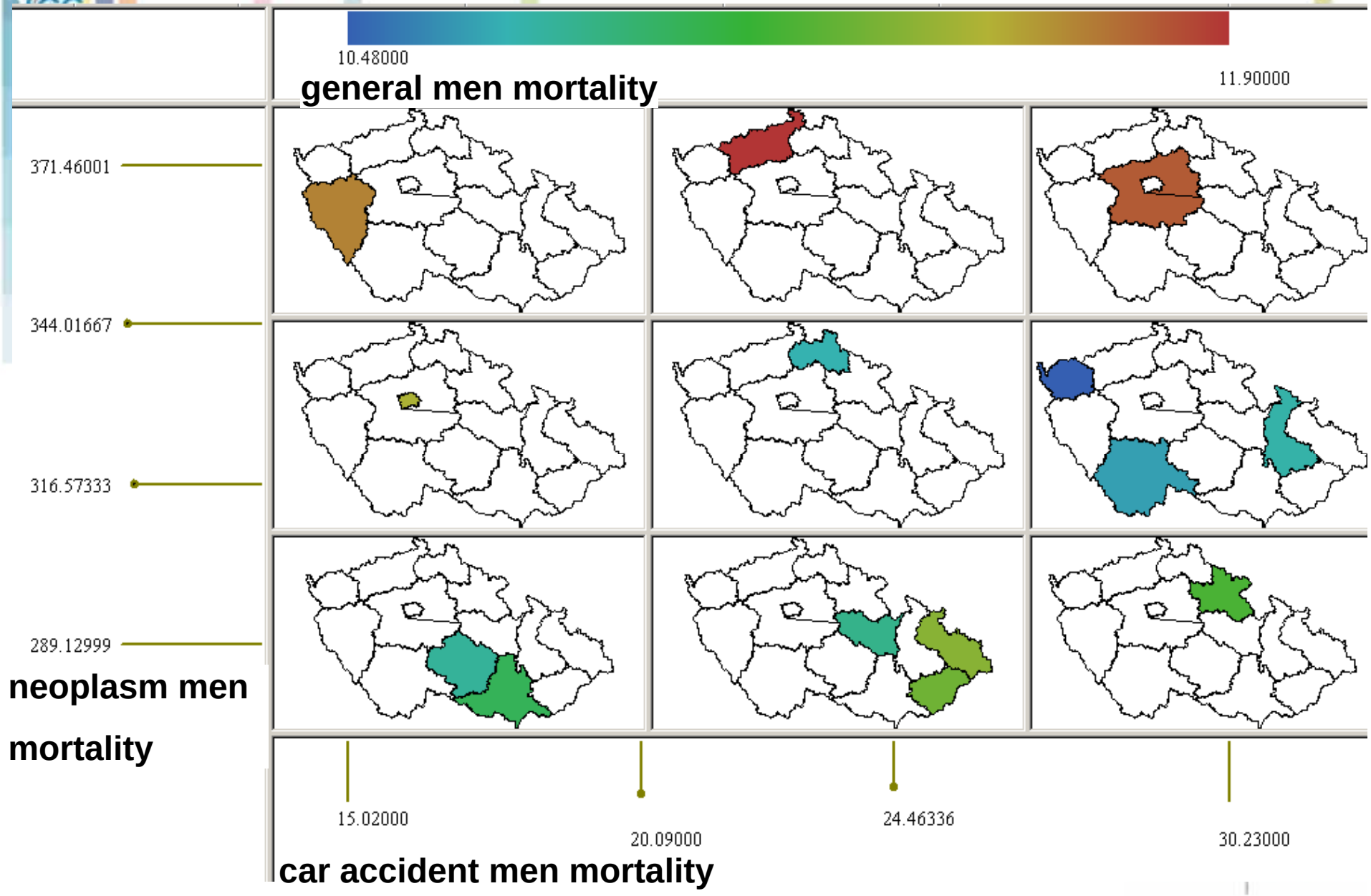




Correlation exploring tool

- Conditional maps tool is different from others “correlation exploring tools” – it uses a map.
- Single choropleth three-class map is decomposed into nine micro-choropleth maps.
- 1 variable presented by color of micro-choropleth map
- 2 axes of conditioning variables, 3 intervals on each axe
- Limits of intervals can be shifted.

Correlation exploring tool



Correlation exploring tool

- Firstly developed by Carr D. et al. in 2002 as a Java tool directly on user's computer.

Carr D. et al.: Interactive linked micromap plots and dynamically conditioned choropleth maps, 2002, In Proceedings of the 2002 annual national conference on Digital government research

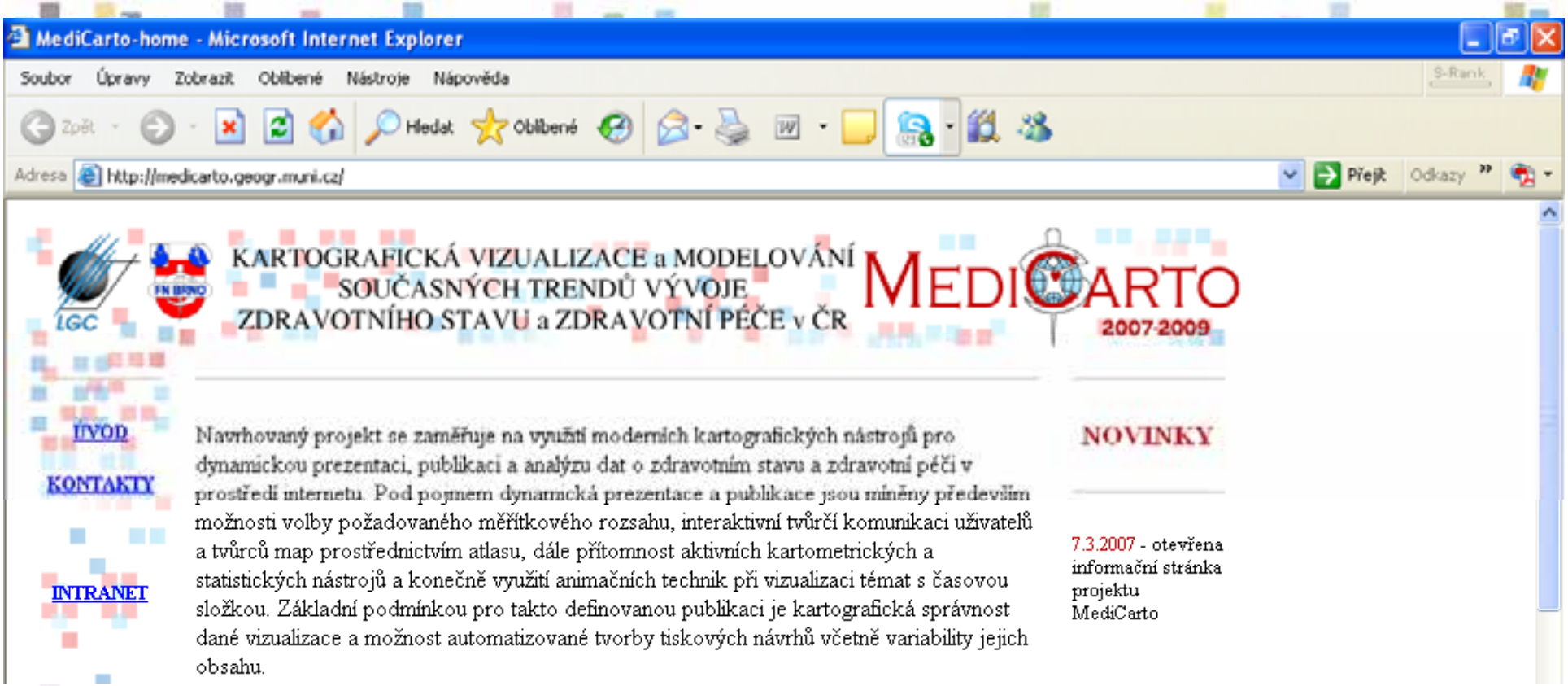
- In 2006 implemented as a tool to a desktop software GeoDa.

Anselin et al.: GeoDa: An Introduction to Spatial Data Analysis, 2006, In Geographical Analysis 38

- But our tool should work on web server with connection to database.
- We have not decided yet, if we will use and modify an original application from Carr et al. or if we will develop a new tool on the same principle.

For future...

- Finishing of health data representing web portal – till end of 2009.
- An improvement of web portal tools is planned with use of portal users' feedback.
- It is possible that other tools will be implemented in next phases.



http://lgc.geogr.muni.cz
http://medicarto.geogr.muni.cz
http://mapserver.geogr.muni.cz/visu

We are calling for participants for new projects!

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http://c4c.geogr.muni.cz

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Thank you for your attention!

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Any questions?