Rethinking dynamic visual variables: towards a framework of dynamic semiology

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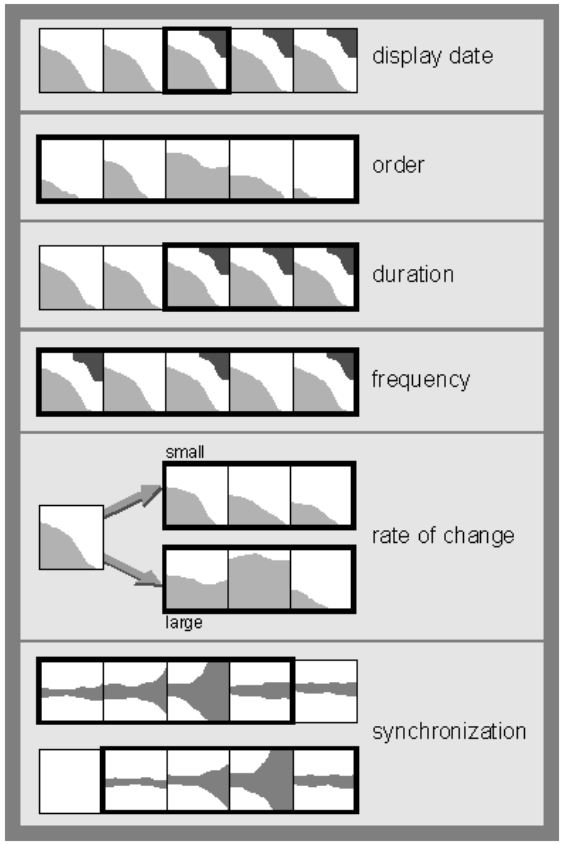
Change mapping and visualization : new challenges for cartography

- A map is an “image” that cannot be animated
  - representation of spatio-temporal changes is a real methodological problem for classical static cartography
- The use of new technologies in the cartographic process could offers a new potential solutions for temporal mapping:
  - questions about their effectiveness and distortive effects for the analysis of spatial and temporal changes
- Are these new technologies changing cartographic process?
  - They are often defined, implicitly, by opposition to classical static variables

Critical analysis of the dynamic visual variables

- moment (display)
- duration,
- order of change
- rate of change,
- frequency,
- synchronization



- when ?
- in what order ?
- how long ?
- how often ?
- how fast ?
- what combination ?

According to DiBiase, MacEachren, Kraak and Blok (1992-2001)

Dynamic visual variables effectiveness evaluation : analogical approach

Static visual variable	Perceptual properties * = weak; ** = good; *** = very good											
	Selection			Association			Order			Quantity		
	Data related to points	Data related to lines	Data related to areas	Data related to points	Data related to lines	Data related to areas	Data related to points	Data related to lines	Data related to areas	Data related to points	Data related to lines	Data related to areas
Shape				***	***	*						
Size	**	**	**				**	**	**	***	***	***
Value	**	**	**				***	***	***			
Colour hue	**	**	**	*	*	*						
Orientation				**		***						
Grain	*	*	*	*	*	**						

Dynamic visual variable	Perceptual properties * = weak; ** = good; *** = very good			
	Selection	Association	Order	Quantity
moment		*		
Duration	*		***	**
Frequency	*	**	**	
order		**	**	
Rate of change			***	*
Synchronization	**	*	*	

« Dynamic visual variables »: the primacy of technical dimension

- **Comparison based on different assumptions**
  - Classical static visual variable have been constructed for data representation (representation = transcription of an idea or data by a graphic symbol)
  - "variables of dynamic visualization" (cf Blok) are for visualization of spatial or time change, the nature of the data is not questioned. (visualization = communication method)

Comparison test : complementarities and divergence

Analysis criteria	Classical visual variables	Dynamic visual variables
Objectives	Data transcription into graphic symbols : representation	Data transcription by motion / or no motion
Evaluation	Effectiveness in the data transcription	Effectiveness in the motion perception
Choosing the most appropriate variables	Depending on the nature of the data, and the geographic settlement of objects. The variable size is the most efficient variable to represent a quantity into a punctual settlement	The proposed visual variables are valid for all animated sequences

Conclusion: Dynamic visual variables can not be approached by analogy to classical visual variables because they are based on a different hypothesis.

question : are the Dynamic visual variables a real new method to represent the change or the movement or are they a simple animation effect ?

Towards a definition of new « dynamic visual variables »

The dynamic visual variables could be defined as multimedia effects emphasizing spatial and temporal changes visualization in a cartographic animated sequence. We can distinguish between technical variables and modeling variables.

The technical variables

Multimedia effects are applied to the figures to highlight the change (its nature, location, and amplitude).
Examples: the flashing, the interpolation (shape or location), thickening of the contour of a surface, etc..

The effectiveness of these effects depends on the characteristics depicted (symbols) (location, data type).

Example, a shape interpolation can be more effective on a surface more than on a line. However, the flashing seems to be more expressive in the case of a point representation.

Anim1 Anim2 Anim3

The modeling variables for temporal animation

The dynamic visualization is not a simple scrolling of a maps series (temporal or non temporal).

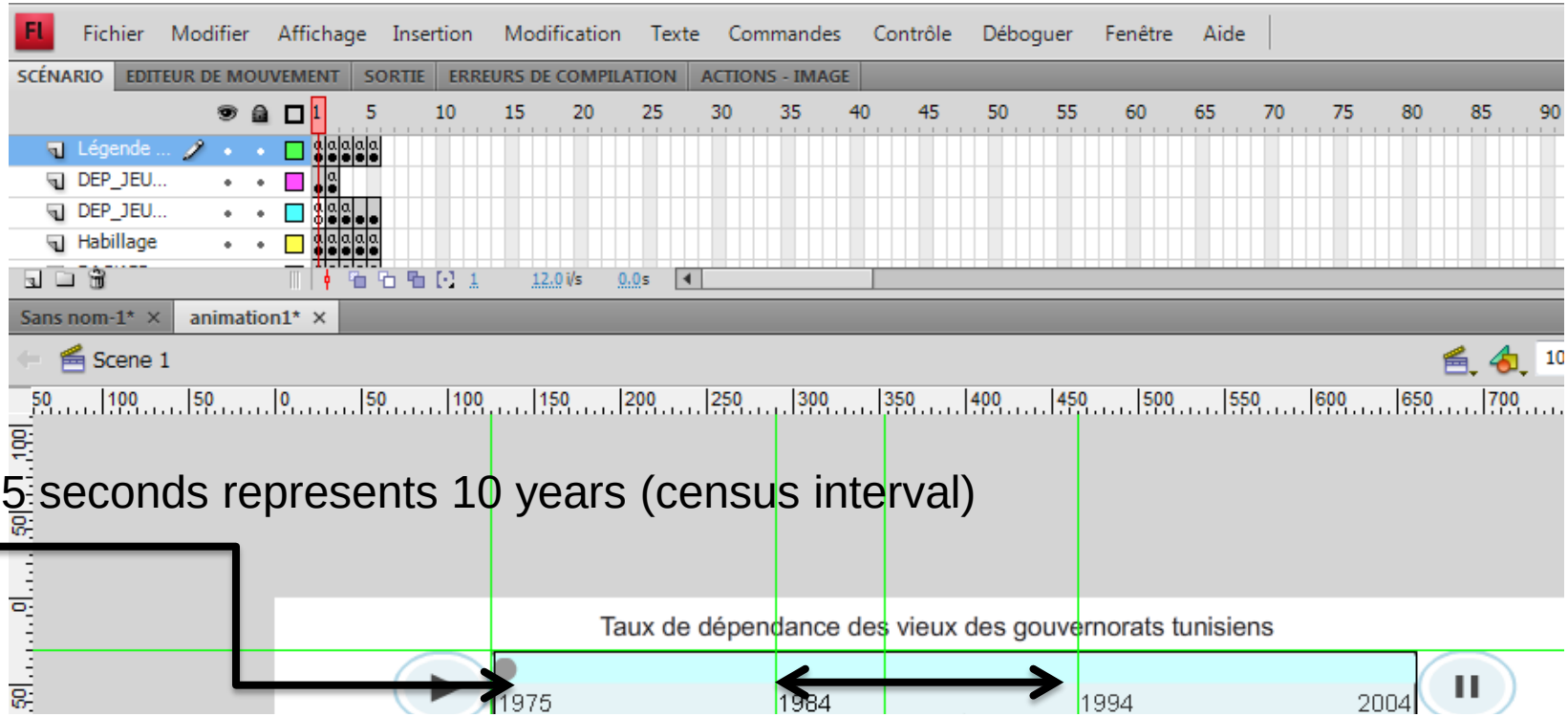
Modeling variables refers to the reflexive dimension of dynamic visualization. They aim to emphasize the main temporal changes characteristics.

The Dynamic visual variables proposed include:

- The proportionality variable ⇨
- The rhythm variable ⇨
- The trajectory variable ⇨

The proportionality variable:

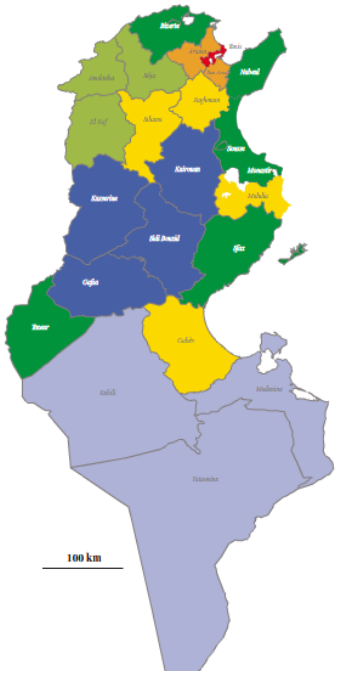
duration of the animation scene should be proportionately related to the real time duration. Intervals must reflect the regularity -or lack- of regularity

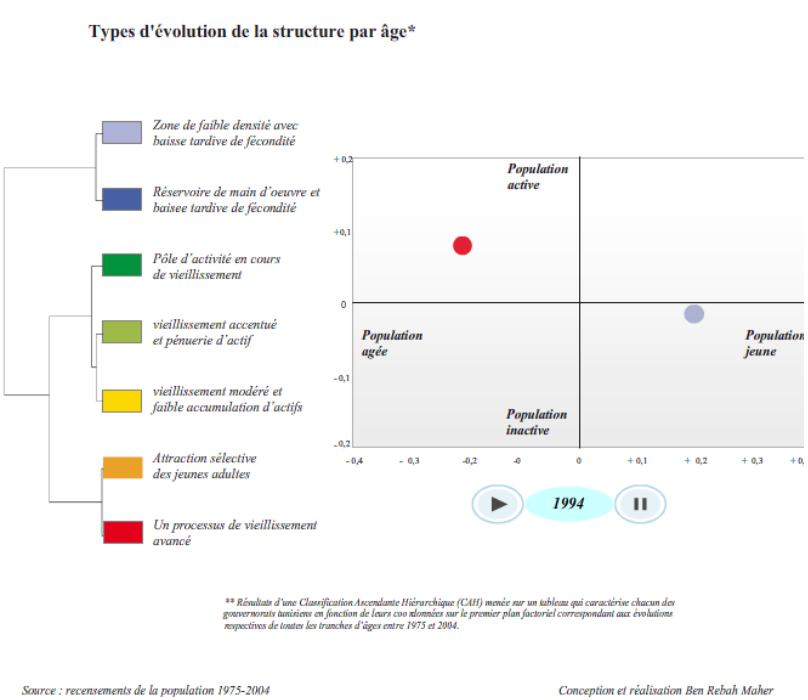


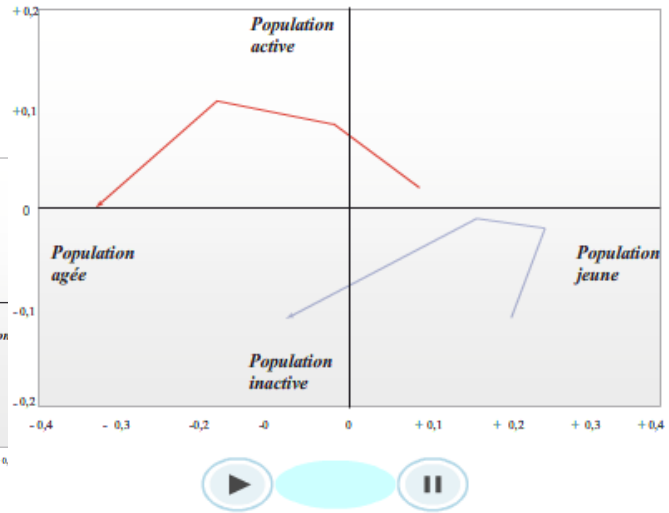
Anim4

The change rhythm:

the speed of the animation must show the change magnitude.





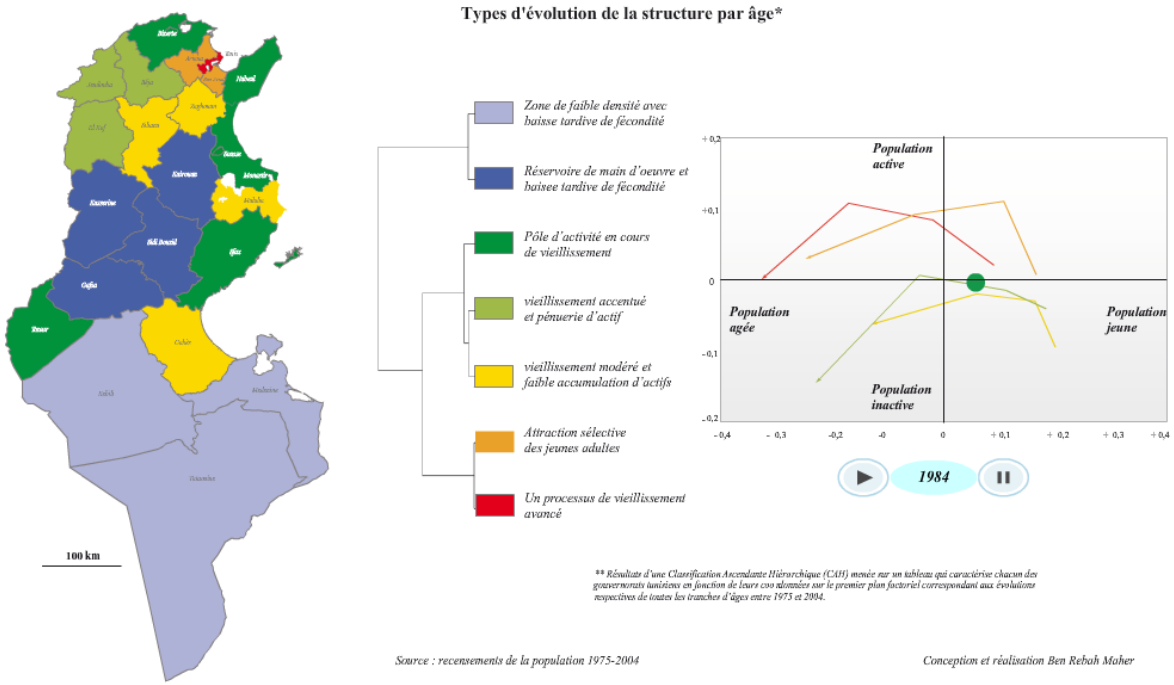


The red point moves in a faster way than the blue one as the demographic profile change is more important.

Anim5

Trajectory variable:

retrace the evolution of a given phenomenon



The movement of the point indicating the demographic profile of the region leaves a linear trace behind.

Anim5

Discussions and perspectives

- Complementarities between Bertin's graphic semiology and « dynamic » semiology.
- Dynamic visualization can't be standardized or normalized.
- Interactive and animated dynamic cartography goes beyond a normative mapping semiology.
- Interactivity will contribute to rethink these visual variables and representation problems.

Thank you for your attention!
Any question ?

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