

Atlases and Systems Theory within Systematic Cartography

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OBJECTIVE

three scientific approaches

SYSTEMS
THEORY

ATLAS

TOBLER'S LAW

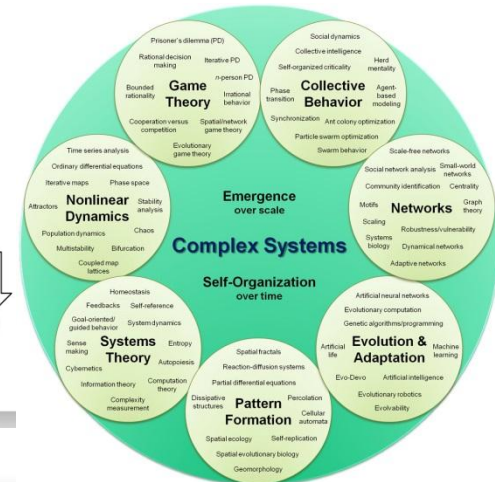
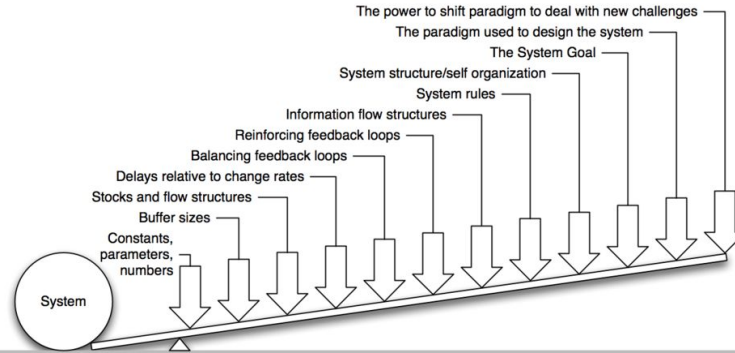
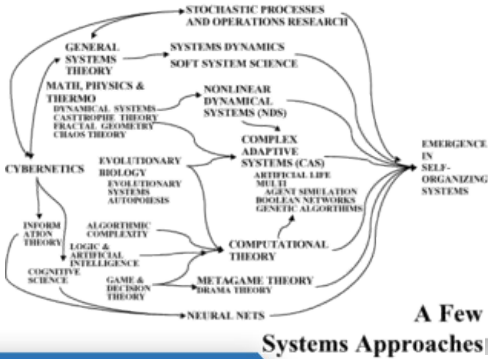
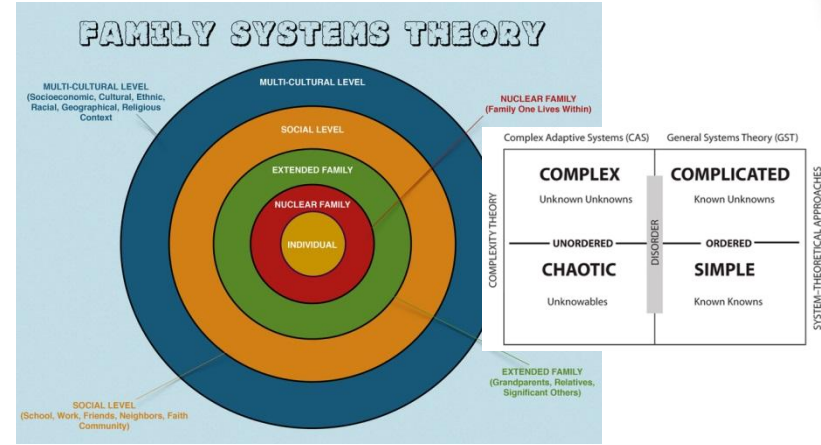


Karl Ludwig von Bertalanffy (1901–1972)



Kenneth E. Boulding
William Ross Ashby
Anatol Rapoport

Systems theory is an interdisciplinary theory about the nature of complex systems in nature, society, and science, and is a framework by which one can investigate and/or describe any group of objects that work together to produce some result.



The system S is an ordered pair of two sets – a set of elements E and a set of relationships R between them

$$S = \{E, R\}$$

$$E = \{e_1, e_2, e_3, e_4, e_5, \dots \dots \dots e_n\}$$

$$R = \{r_1, r_2, r_3, r_4, r_5, \dots \dots \dots \dots \dots r_m\}$$

- Each element is distinguished by its characteristics.
- Elements can be grouped into components.
- Each system is characterized by **structure** and **behavior**.
- Structure means orientation inside the system – it is the action of elements between themselves within the system
- Behavior is a summary of changes in system elements; result of system behavior is system response to stimuli (influence = set of stimuli)
- The relationship between structure and behavior is very tight – the behavior of the system may change when the structure is changed but the elements

- inputs and outputs
- functions in the system
- sub-systems
- resolution level

We describe structure!

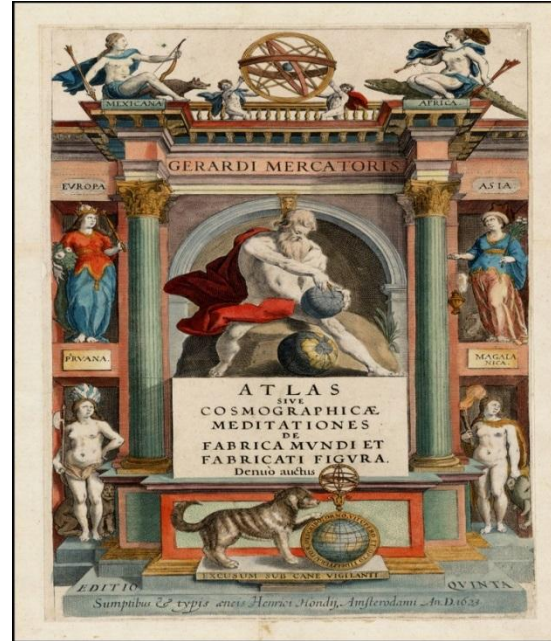
We model behavior!



Atlases

the second approach



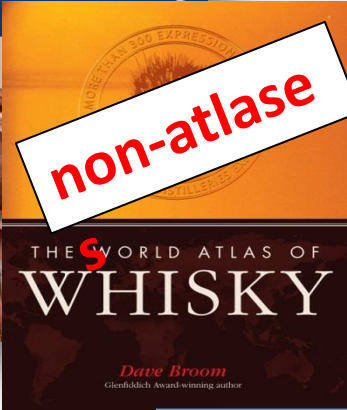


Definitions of atlas

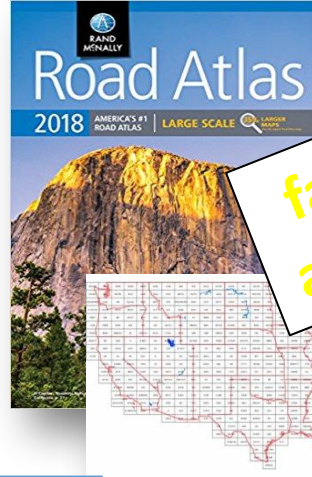
- An atlas is structured in such a way that information items can indeed be seen as part of this overall narrative (*Ormeling, 1993*)
- An atlas as a set of targeted compiled maps systematically organized according to the thematic content, the spatial extent and temporal viewpoint and assembled in a unified map language (*Voženílek, 2014*)
- Atlases are systematic collections of topographic and/or thematic maps with selected scales for a dedicated region and a dedicated goal (*Hake et al., 2002; Kraak and Ormeling, 2010*)
- One of the main tasks of an atlas is to enable comparisons between maps in order to recognise correlations between them (*Hruby, 2015*)
- An atlas is a collection of maps; it is typically a bundle of maps of Earth or a region of Earth (*Wikipedia, 2018*)
- An atlas is a bound collection of maps (*dictionary.com, 2018*)



Atlas of Anatomy



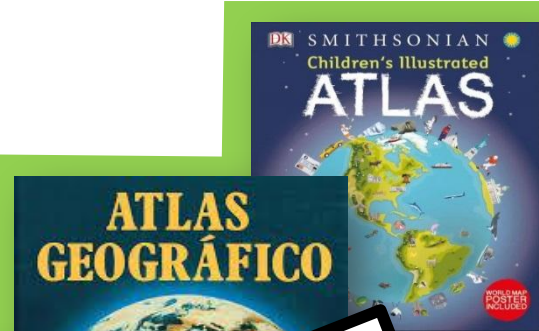
non-atlase



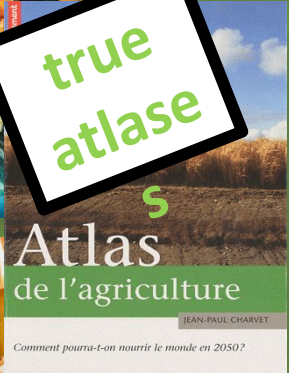
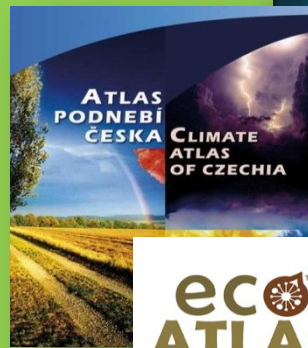
false atlase



primitiv
e
atlases



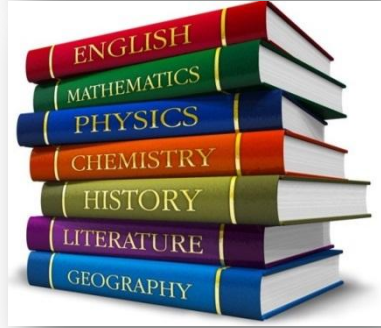
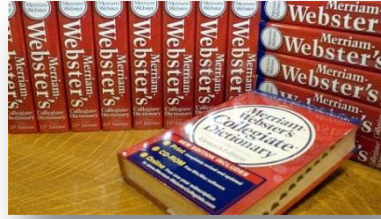
true atlase



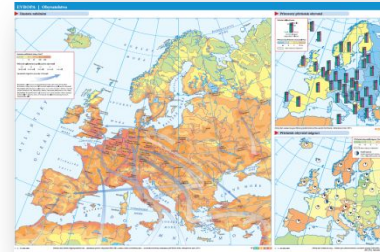
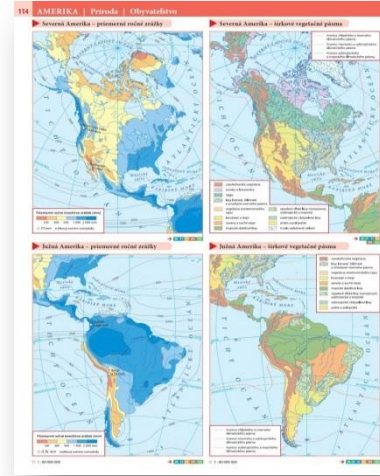
HERBARIU



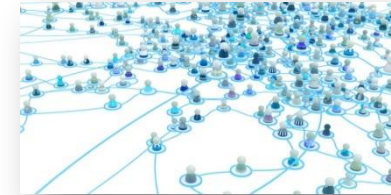
DICTIONAR



ATLA



SYSTE



Tobler's law of geography

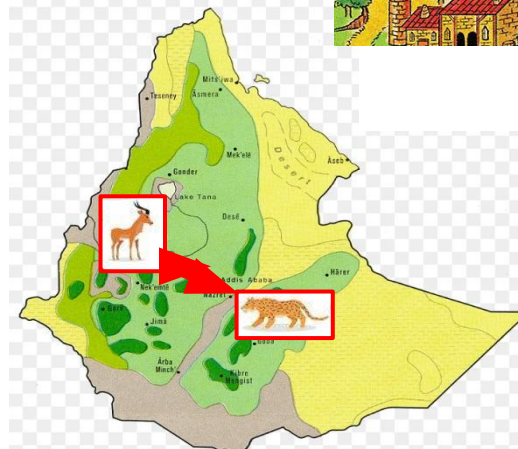
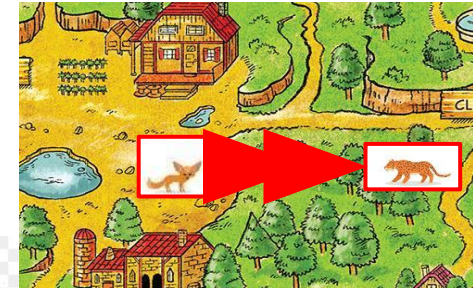
the third approach



Waldo Tobler 1930-2018



"everything is related to everything else, but near things are more related than distant things"



Tobler's first law of geography

... introduced into the geographical literature in an article that Waldo Tobler published in the journal *Economic Geography* in **1970**. He described a simulation of population growth in Detroit.

Can the Tobler's law be applied in cartography when we replace objects with maps?

How can “near” and “distant” be measured in an atlas?

Is it right for Euclidean and network space?



Systematic cartography

Intersection of approaches



Systematic cartography

Systematic cartography is a set of interrelated approaches for visualizing spatial information by various cartographical techniques with respect to **structure** and **behavior** of systems.

A traditional field of systematic cartography is atlas production.



A book called atlas

no maps

???? ATLAS ????

only maps

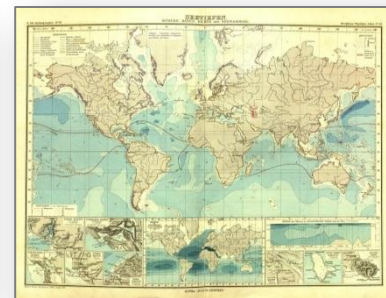
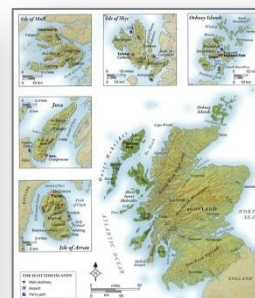
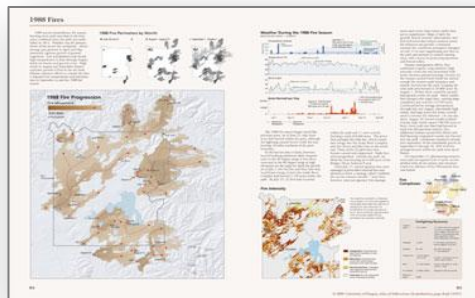
0

25

50

75

100
% of maps



Relationships in atlases

- atlas content follows the structure and logic of the main theme
- maps are organized **gradually**
 - from simple analytical maps (of the main theme components)
 - to the complex and synthesis maps
- the content of the thematic atlas is arranged like a **story book**
 - from simple to complex
 - from basic information to the culmination as the main message
 - spatial synthesis – typology and regionalization



The relationships relate to map language

in map series

- a single map – wide scope of cartographic creativity
- an atlas – additional requirements on a key map and narrower way for the map key compilation

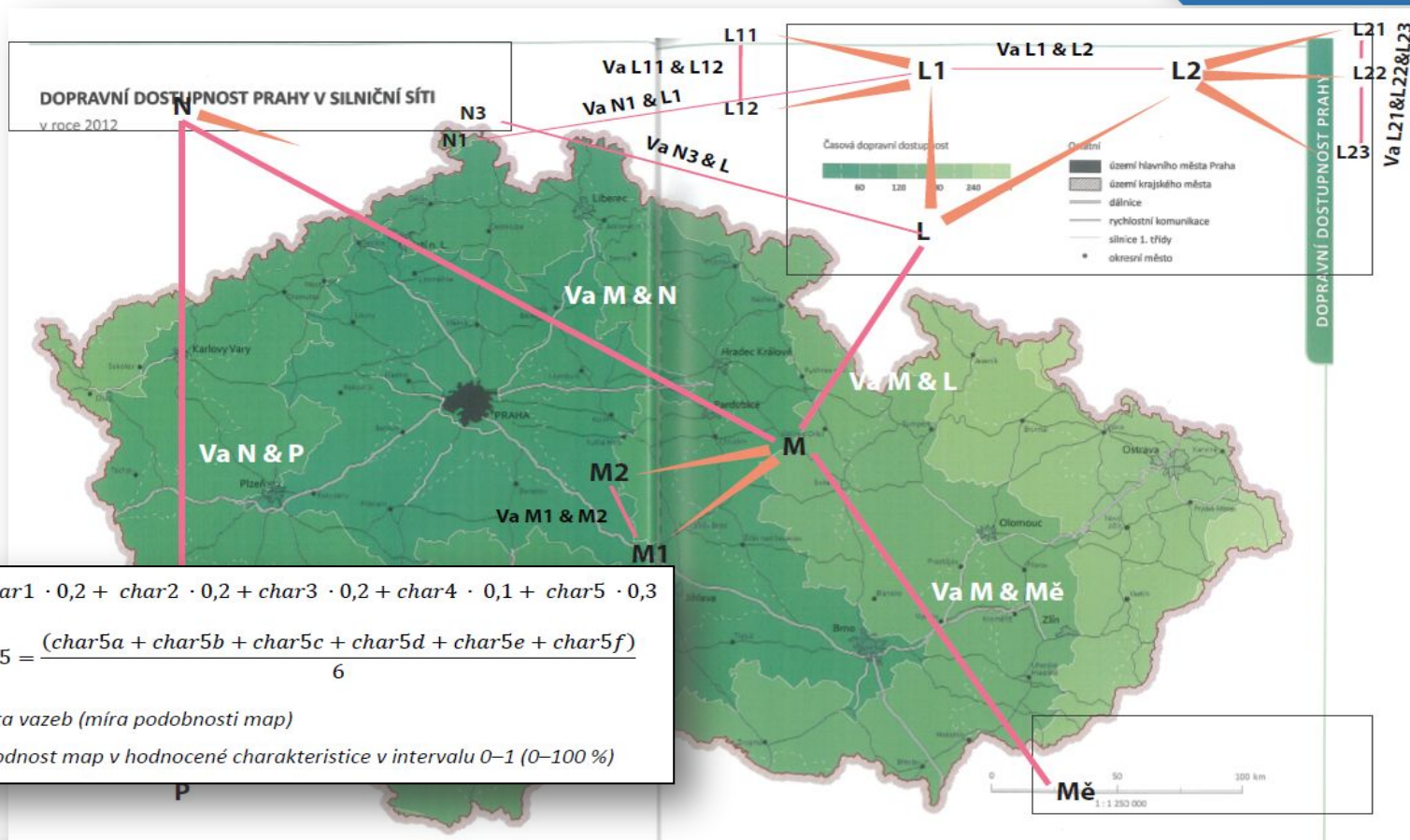
in atlas structure and design

- graphic relationships – unique symbols or their elements (shape, colour, fragment etc.), chapters, titles, subtitles, figure outlines, registers etc.
- semantic relationship – standardized terminological, stylistic and typographic framework of text

between maps vs. graphs, tables and figures

- graphic and semantic regulations from a map key





$$V = \text{char}1 \cdot 0,2 + \text{char}2 \cdot 0,2 + \text{char}3 \cdot 0,2 + \text{char}4 \cdot 0,1 + \text{char}5 \cdot 0,3$$

$$\text{char}5 = \frac{(\text{char}5a + \text{char}5b + \text{char}5c + \text{char}5d + \text{char}5e + \text{char}5f)}{6}$$

kde *V* ... intenzita vazeb (míra podobnosti map)

charX ... shodnost map v hodnocené charakteristice v intervalu 0–1 (0–100 %)



MY VIEW ON TOBLER'S LAW FOR CARTOGRAPHY



Can atlas be described as a system?

A system consists of elements and relationships between them.

An atlas consists of maps and relationships between them.

A system has a structure and behavior.

An atlas has a structure and usage.

A system has a language – information is passed through the information channels.

An atlas passes spatial information through map language.

If we describe an atlas as a system we might measure atlas and then improve it, redesign it, reuse it etc.



"everything is related to everything else,
but near things are more related than
distant things"

Tobler



Vozenile



„all maps are related to each other everywhere,
but maps in an atlas even at one atlas page are
more related than in distant documents"

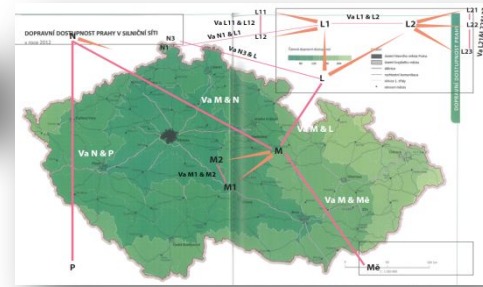


Conclusions

General Systems Theory is useful to any approaches describing the Earth – **cartography** is one of them.

- **Cartography employs systems** to develop analytical models with which they seek to understand and explain spatial patterns and interactions.
- **Cartographers use the systems model**, for example, to examine human migration patterns, the diffusion of ideas, and the spread of information.
- Moreover, **research about maps relies on understanding the systems in which information and communication processes operate.**
- Cartographers are interested in identifying, explaining, and predicting information flows in maps. They also seek **to identify, describe, and explain cycles and patterns in both maps and map collections.**





Thank you for your attention.



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