DYNAMIC CARTOGRAPHY: MAP-ANIMATION CONCEPTS FOR POINT FEATURES

EuroCarto 2015

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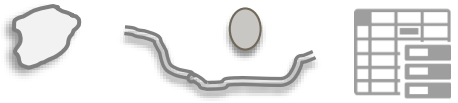
I. motivation and aim

I. **motivation** and aim

- in our field we deal with classical objects and processes that characterize natural environment.

- data collection of natural objects
  - is performed in GIS
  - primarily based on comparable interpretation of remote sensing data and analysis of digital terrain models



- all natural objects
  - are linked by complex relationships and constraints.
  - have at least 3 temporal information: start- , end point and Δt

I. **motivation** and aim

TIME itself represents an attribute that is directly attached to the individual object and its other attribute data

but TIME however,

- is previously documented very inadequate in GIS and mostly resolved on an external timeline

The question is:

Q1 How the temporal aspect of natural objects could be stored and visualized efficiently?

I. motivation and **aim**

- concept for GIS-based data structure to accommodate, access, analyze, and visualize time-dependent objects.

- integrate the TIME (in form of dimension, duration, start/end) directly via the underlying data model!

- geometry + topical attribute + time + graph. attribute

Q2 Could this concept be implemented as a temporal animation based on GIS technologies (e.g. within a dynamic and web-based mapping service)?

II. concept

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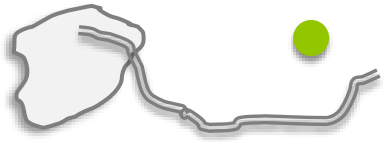
concept based on point symbols
with fixed spatial coordinates, because they



represent the lowest level in geometry and topology

but

provided the highest level of abstraction!

⇨ That implies,
if lowest level of geometry can modelled in time any higher-level or derived object can be modelled equally well.

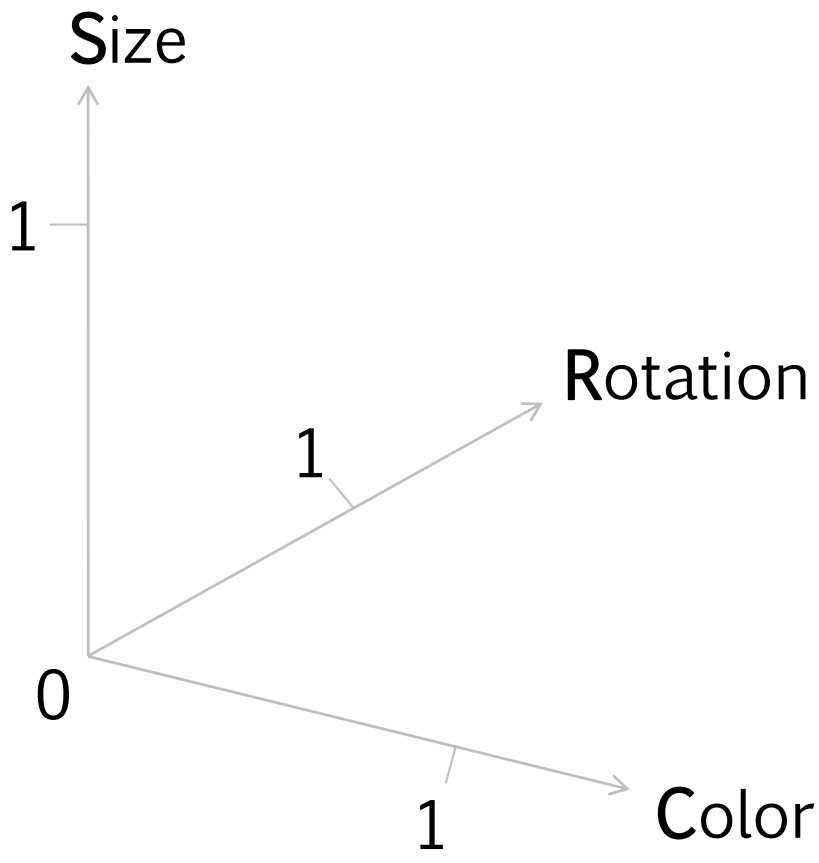
II. concept

time-dependent changes and their graphical variables

possible changes of object	scaling level	possible variables
composition	qualitative and quantitative	color / brightness
size depending on (t) → increasing	quantitative	size
direction depending on (t) → velocity	quantitative	rotation / direction

- object changes, and thus symbol changes, may appear alone but also in combination

II. concept



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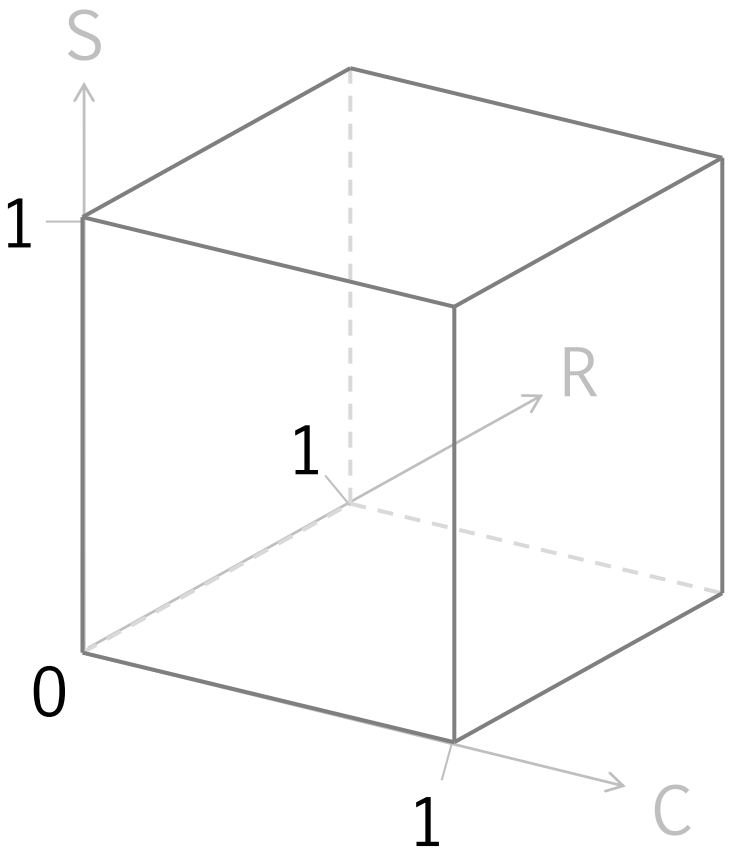

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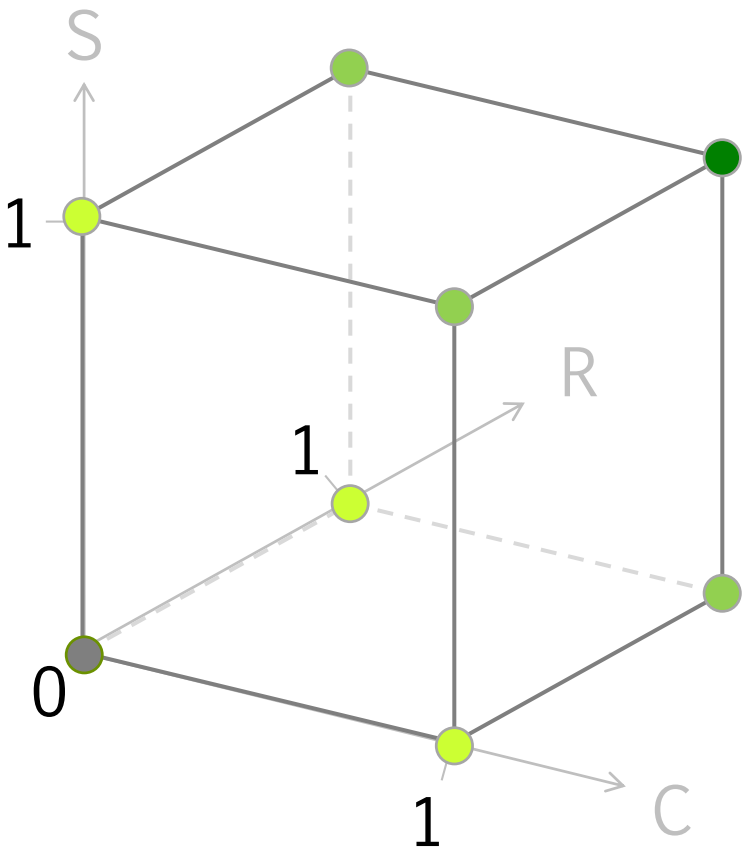

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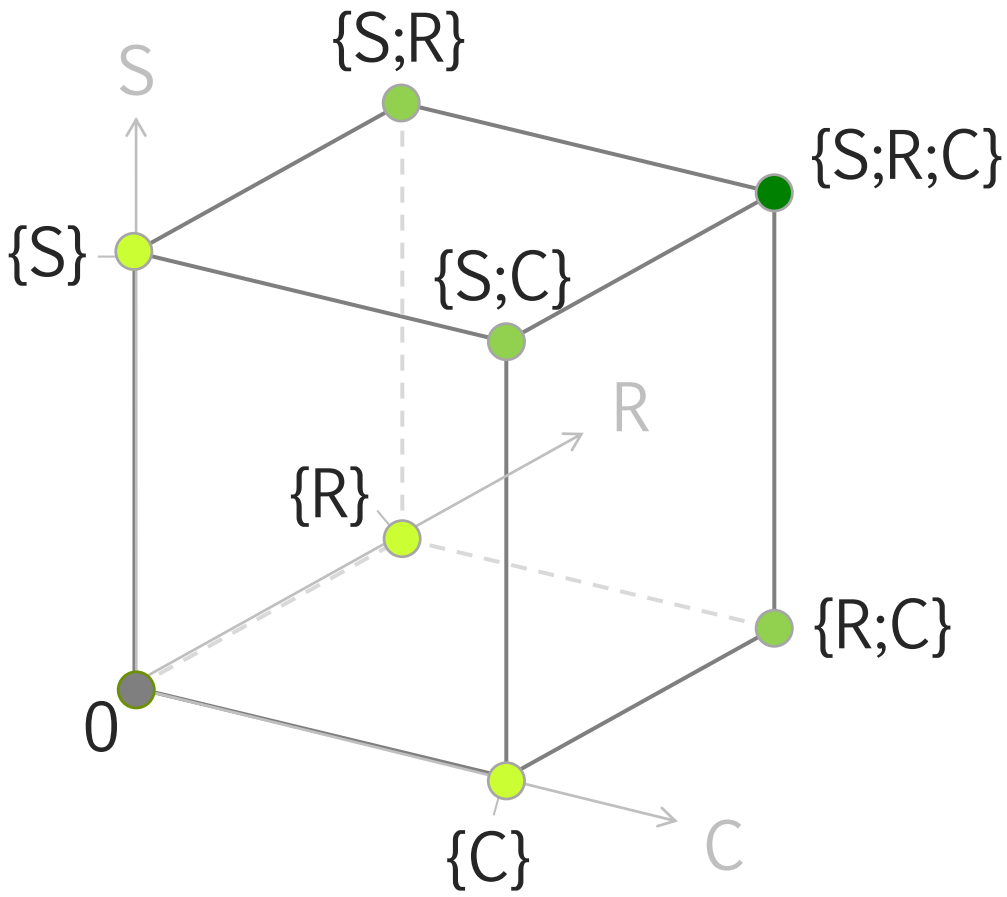
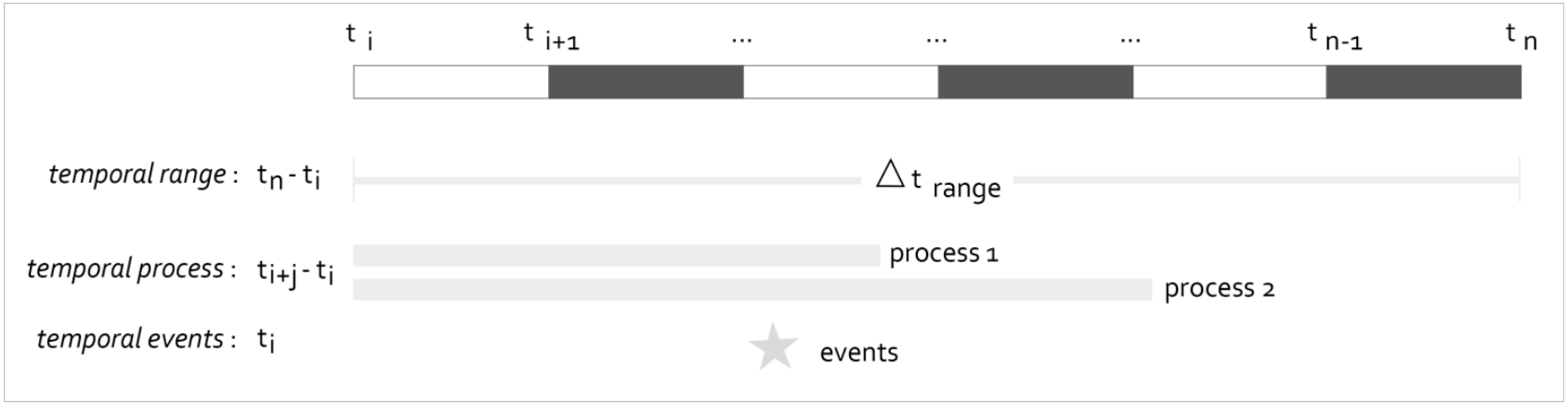


- 0-dimensional signature
- 1-dimensional signature
- 2-dimensional signature
- 3-dimensional signature

II. concept

objects + processes and their temporal reference



- 2 types of (condition) change by objects + processes
  - to an amount: always positive and absolutely {∈ R^+}
  - by an amount: can be positive or negative, as well as absolute and relative {∈ R}

II. concept

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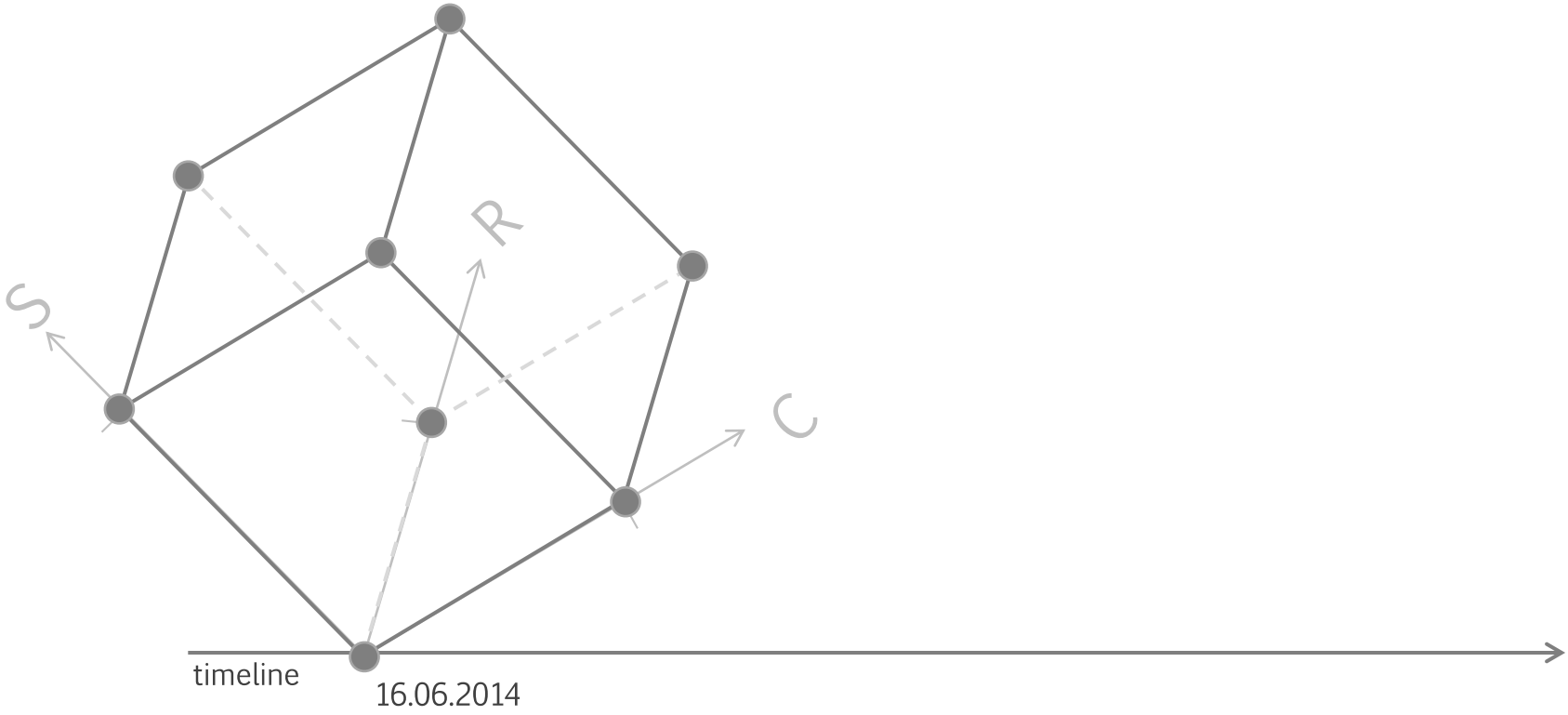
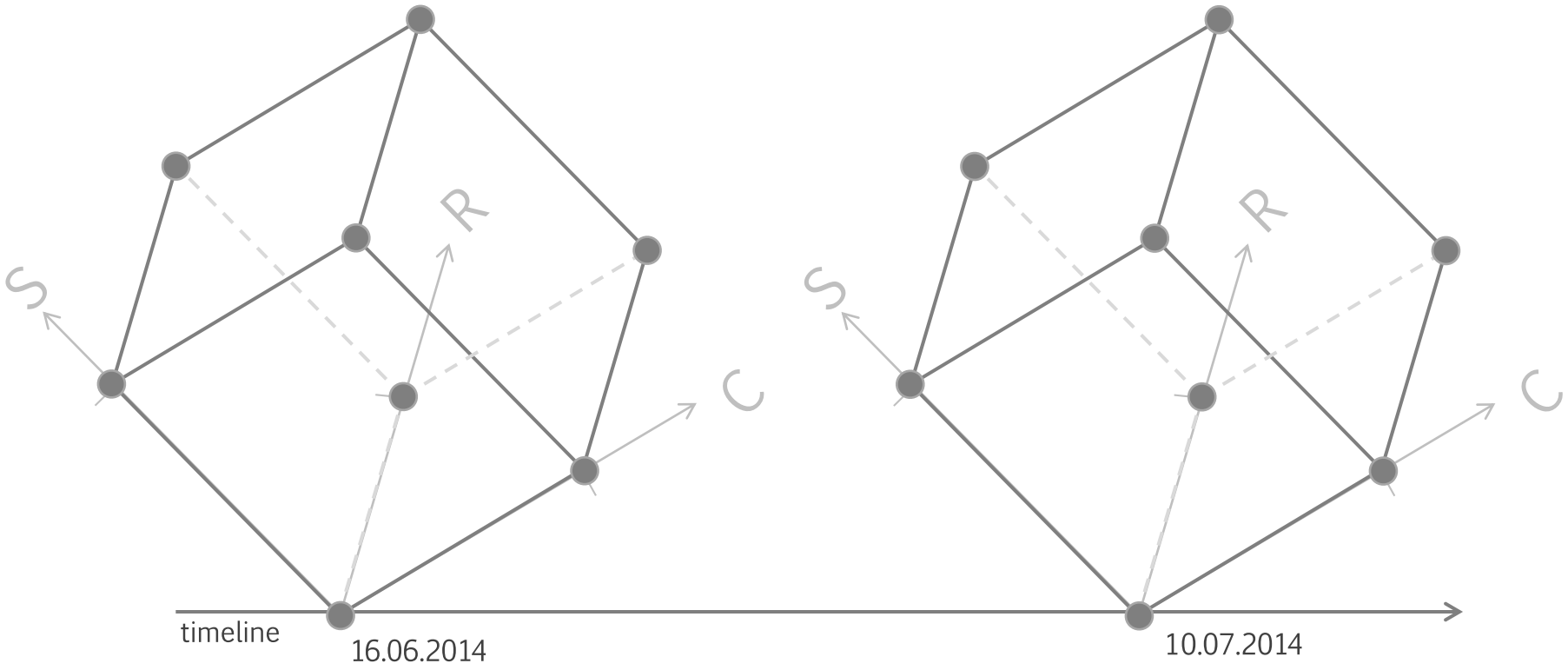


t1 | S1 | C1 | R1

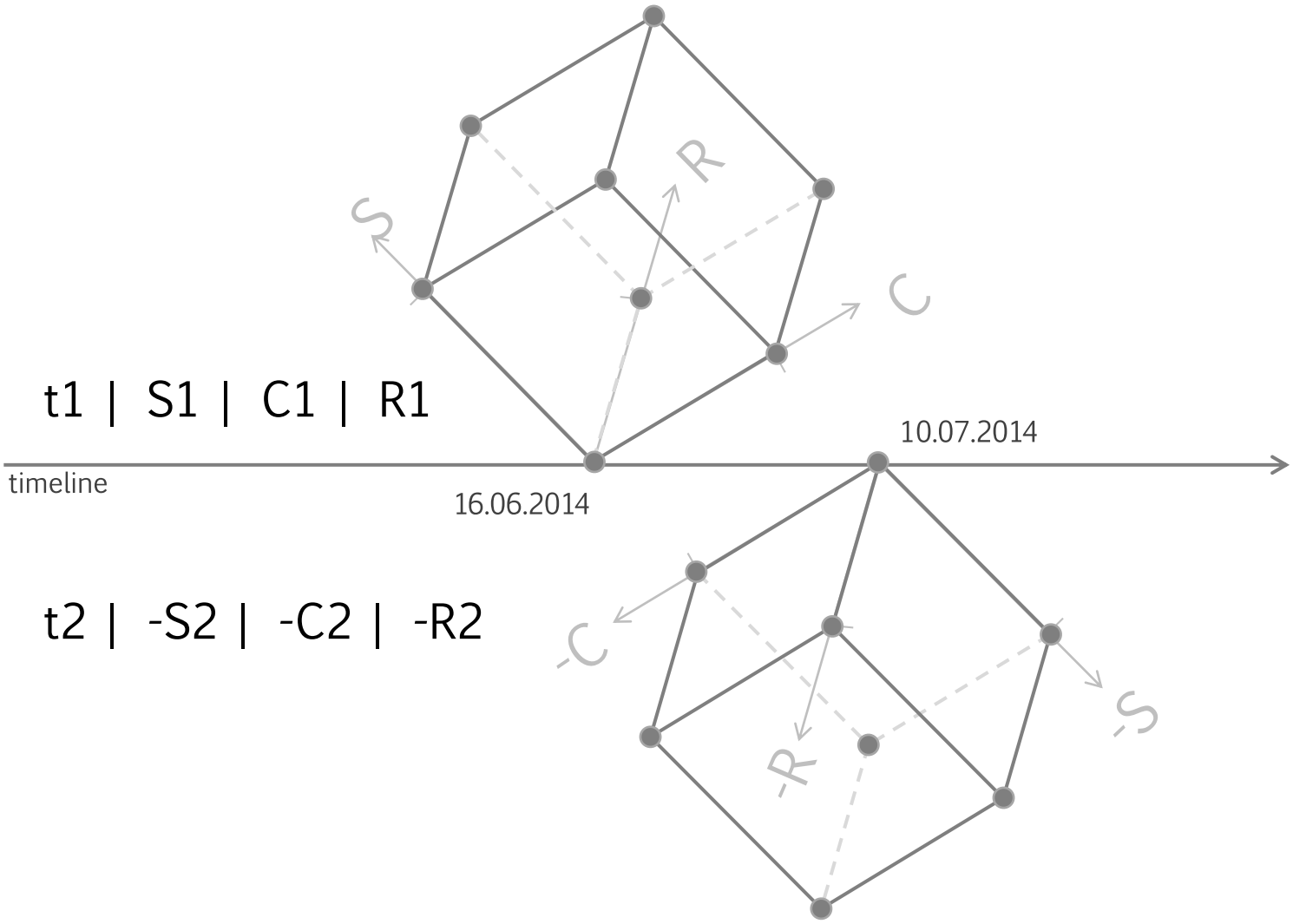
II. concept



t1 | S1 | C1 | R1

t2 | S2 | C2 | R2

II. concept



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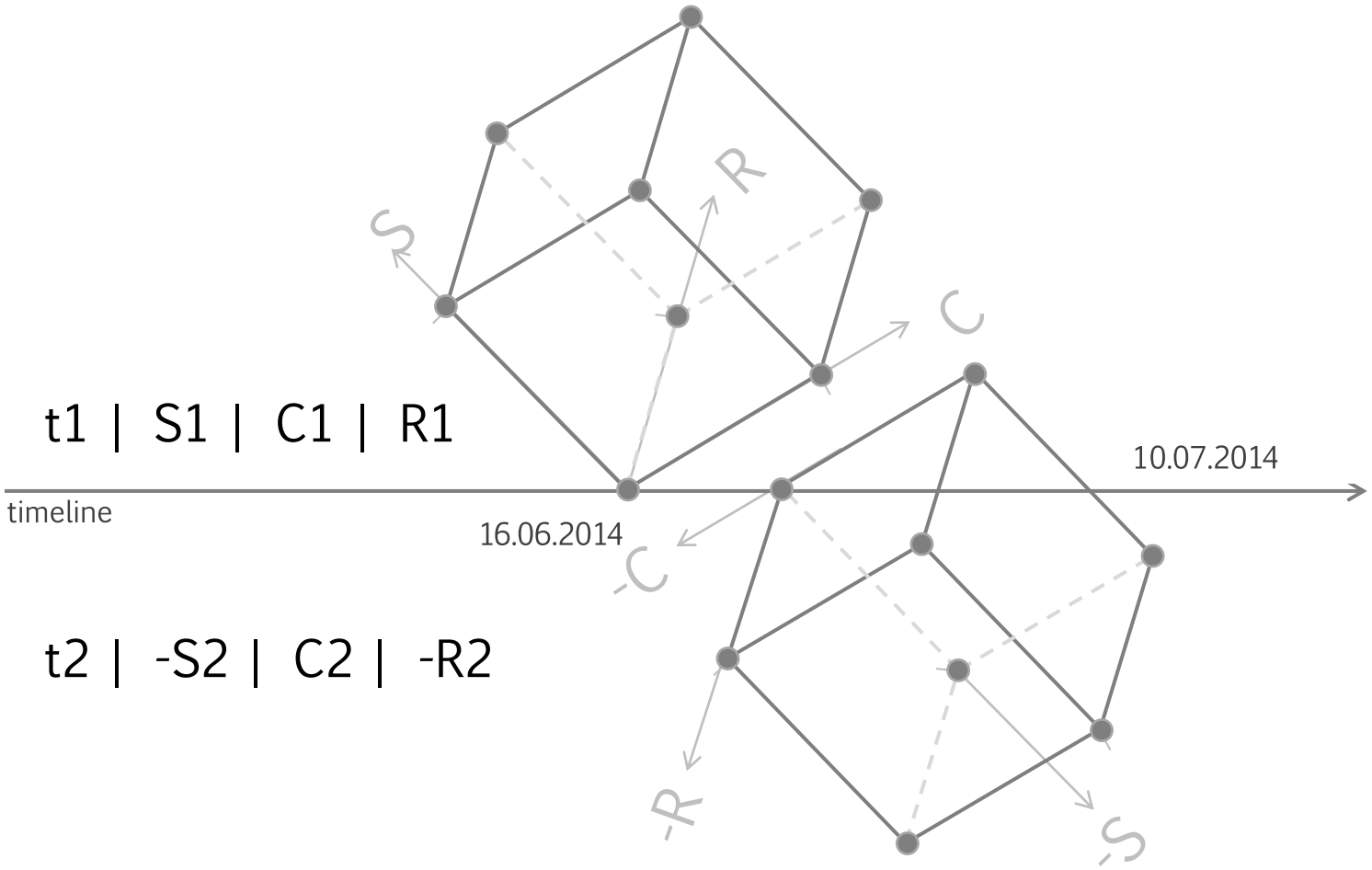

III. changes of symbols

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changing color or brightness

- bipolar or multipolar or brightness?
- CMYK, RGB, HSI etc.

- range of values
  - to an amount → $c_i = \{n \in \{RGB \mid HSI \mid CMYK\}\}$
  - by an amount → $c_i = \{\Delta RGB \mid \Delta HSI \mid \Delta CMYK\}$

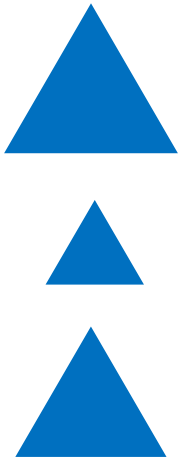
- examples
  - classes of risk (not continuous but discrete classes)
  - resizing of masses (continuous!)

III. changes of symbols

changing size

- percentage or absolute?

- range of values
  - to an amount → $s_i = \{n \in R^+, O \ldots n\}$
  - by an amount → $s_i = \{n \in R, -n \ldots O \ldots n\}$

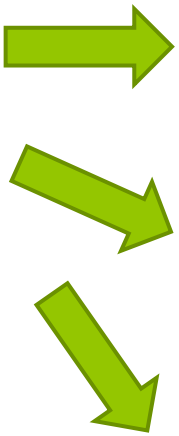


- examples
  - enhancement of land slide
  - flooded land by tsunami

III. changes of symbols

changing direction or rotation

- start-/+ end angle OR
  360° with constant velocity



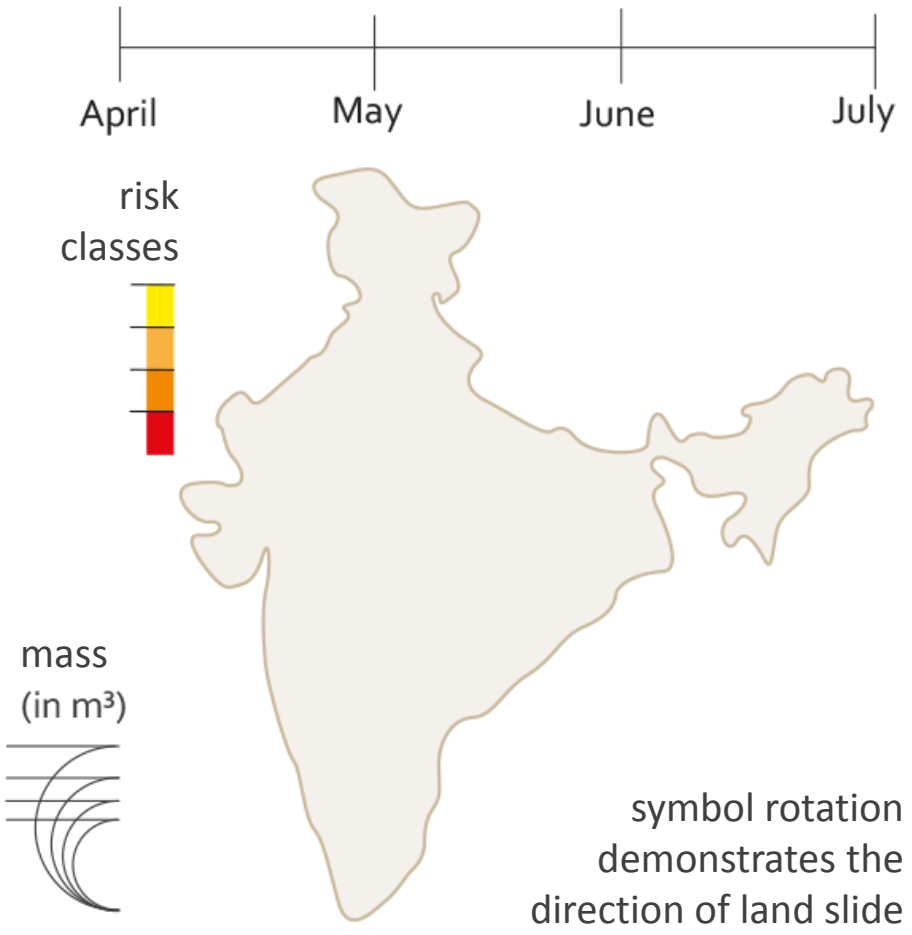
- range of values
  - to an amount → $\varphi_i = \{n \in R^+, O \dots n\}$
  - by an amount → $\varphi_i = \{n \in R, -n \dots O \dots n\}$

- examples
  - land slides with a velocity x downhill
  - rock measurement

IV. map example

thematic 3-dimensional point symbol

land slide mapped by
mass (size),
direction (rotation) and
classes of risk (color).



IV. implementation in object tables

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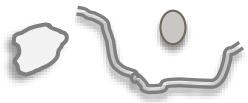
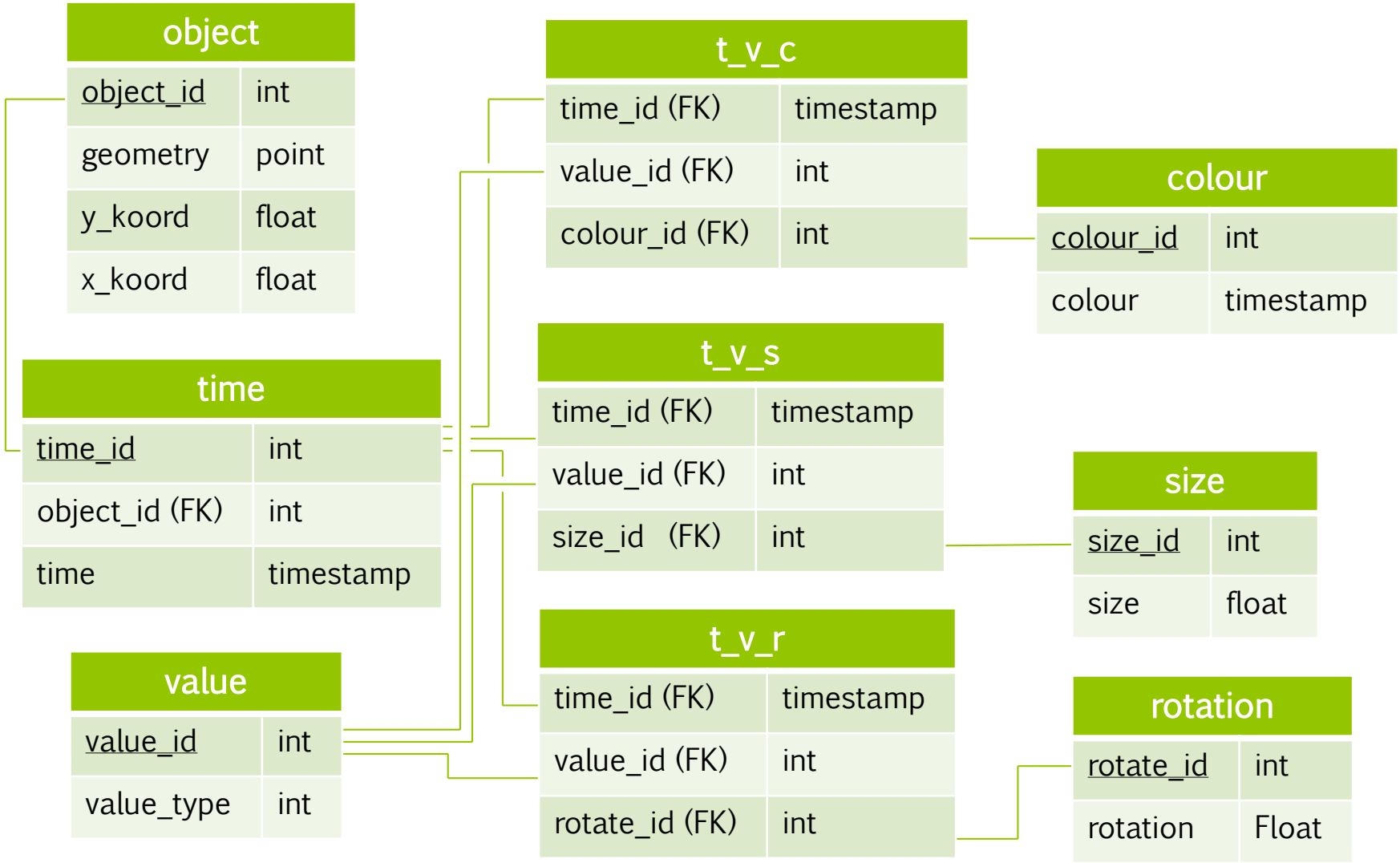
object	
Id	int
geometry	point
y_koord	float
x_koord	float
time	timestamp
value_1	{int, float, char}
c_a (FK)	int
c_r (FK)	int
value_2	{int, float, char}
s_a	float
s_r	float
value_3	{int, float, char}
r_a	float
r_c	float



IV. implementation in object tables



V. conclusion and open questions

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Q1 How the temporal aspect of natural objects could be stored and visualized efficiently?

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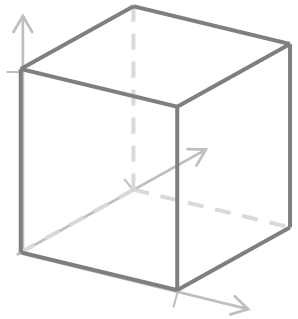
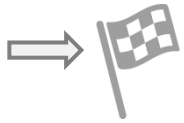
- trough the time-based signature-cube all possible visualization combinations of point features could be illustrated.



That serves as basis concept for a .....

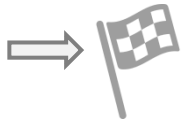
- GIS-based data structure that directly integrates and cartographically animates the temporal character of natural objects within an underlying data model.

V. conclusion and **open questions**



Q2 Could this concept be implemented as a temporal animation based on GIS technologies?

V. conclusion and **open questions**



Q2 Could this concept be implemented as a temporal animation based on GIS technologies?

- possibilities for animation via moving paths?
  current solution based on illustration of instances (via single frames)!
- concrete storage of values for color-, size- and rotation symbol variation?
- implement graphical information directly into the data model e.g. by *.svg-script?
- connection to a dynamic and web-based mapping service?

THANK YOU FOR YOUR ATTENTION!

QUESTIONS?

or mail to **andrea.nass@dlr.de**