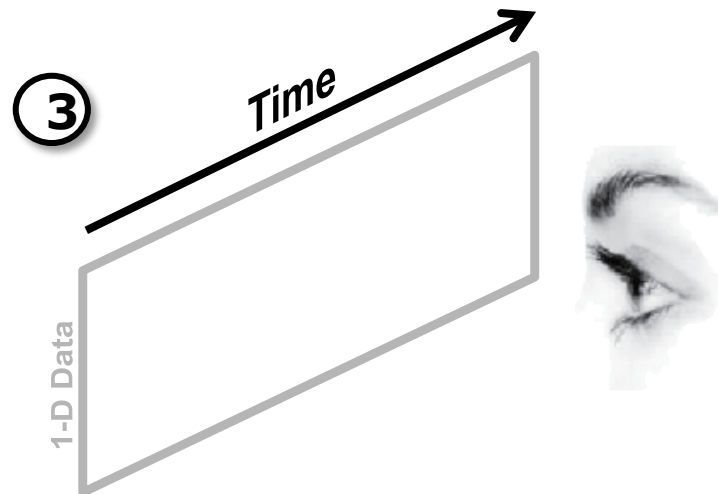
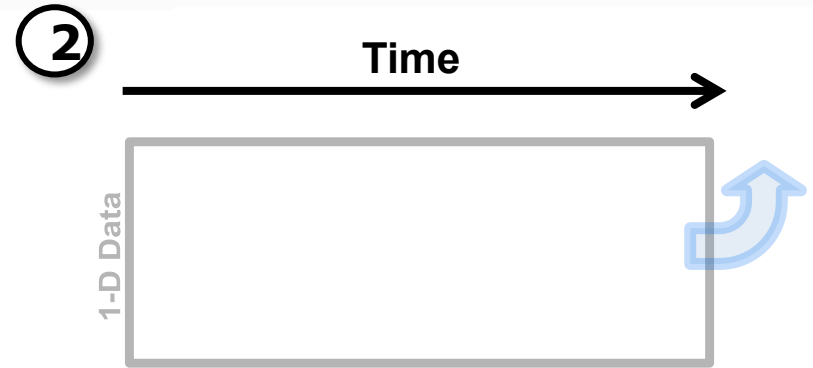
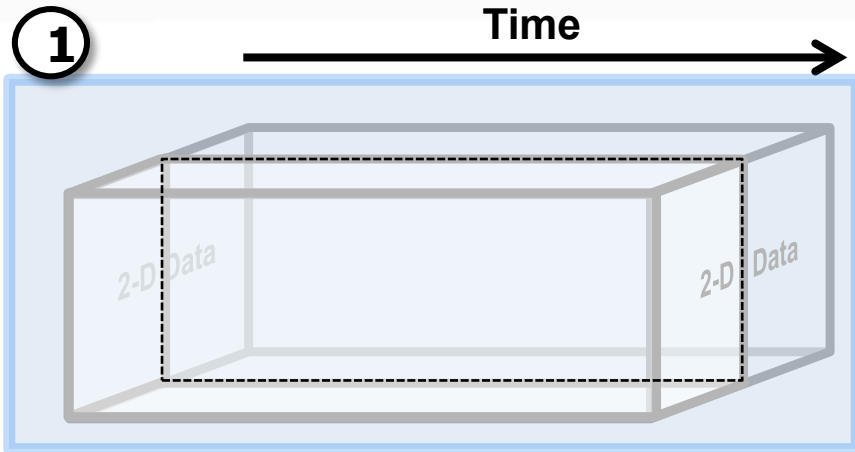


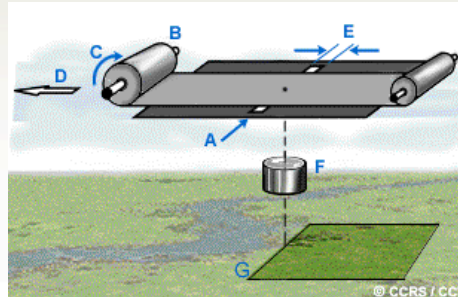
# 2D + Time

## Space Cutting



# 2D + Time

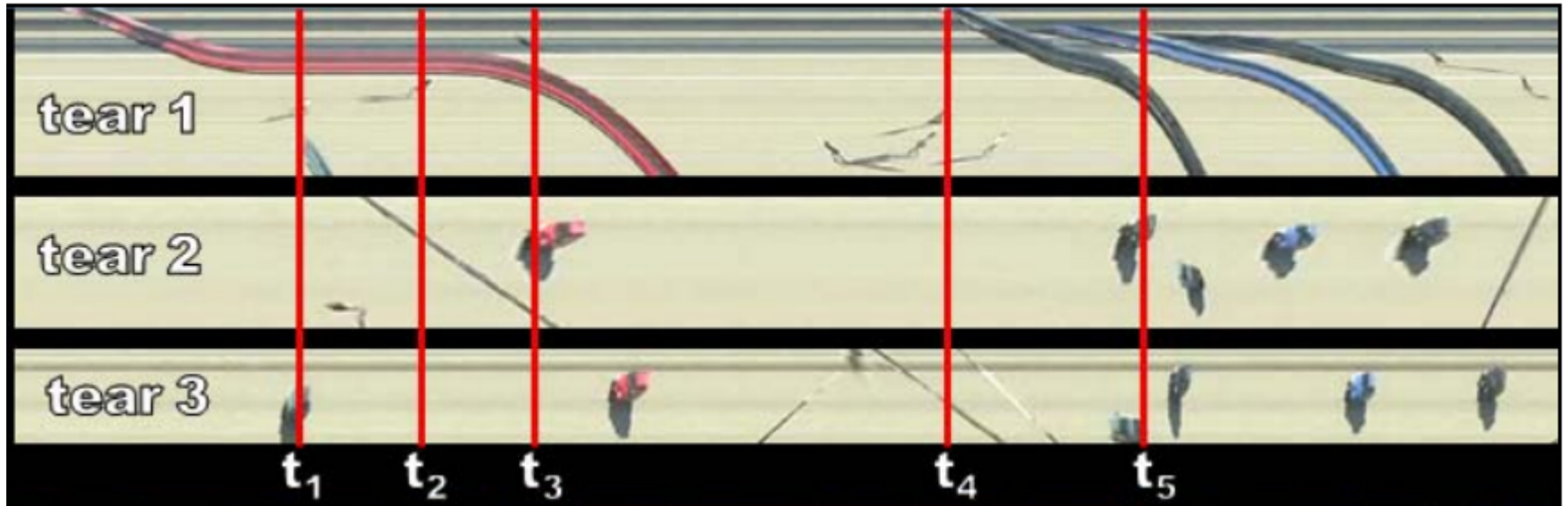
## Slit-Scan Photography



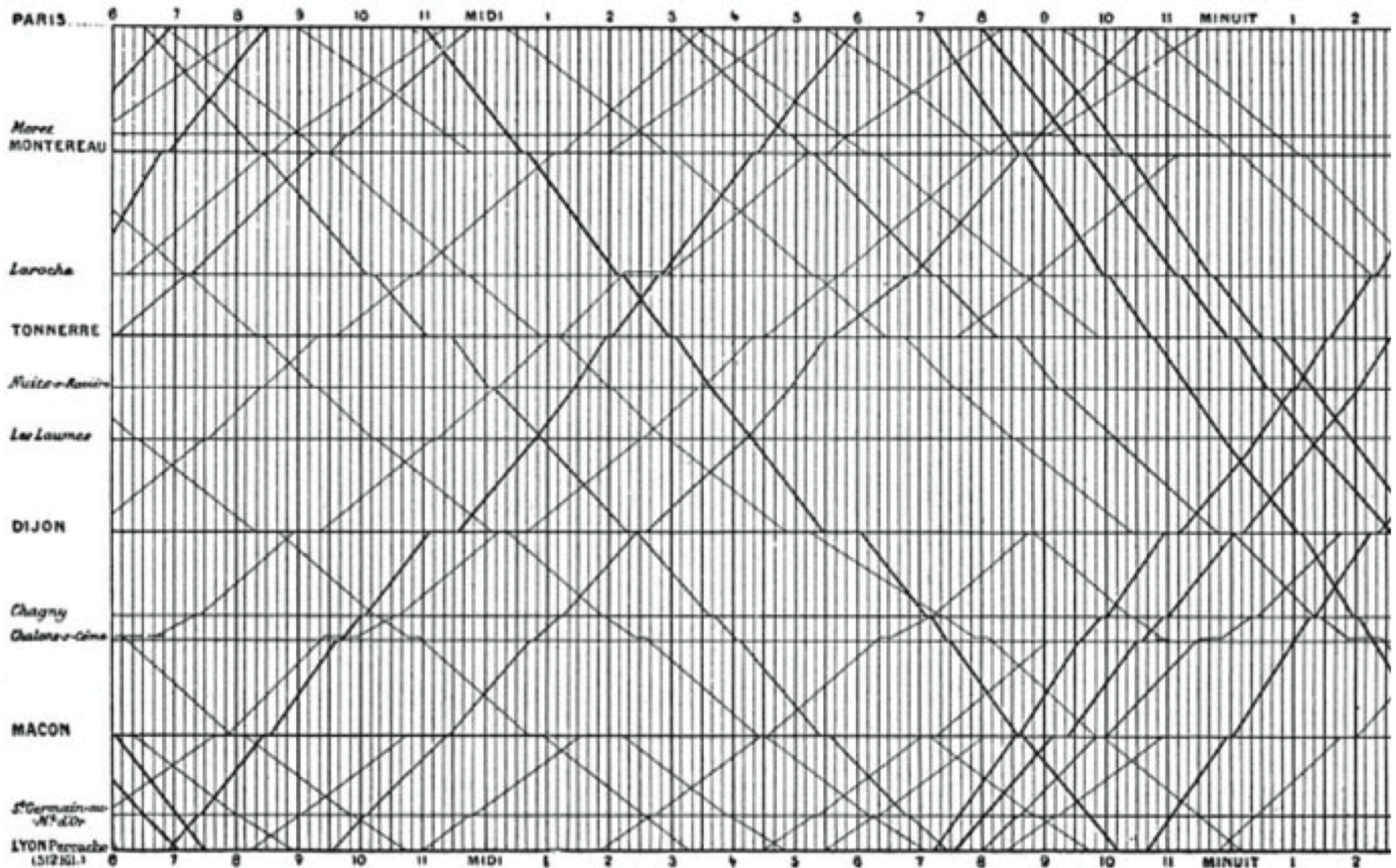
[\(images source\)](#)

# 2D + Time

## Slit-Tear Exploration of Videos



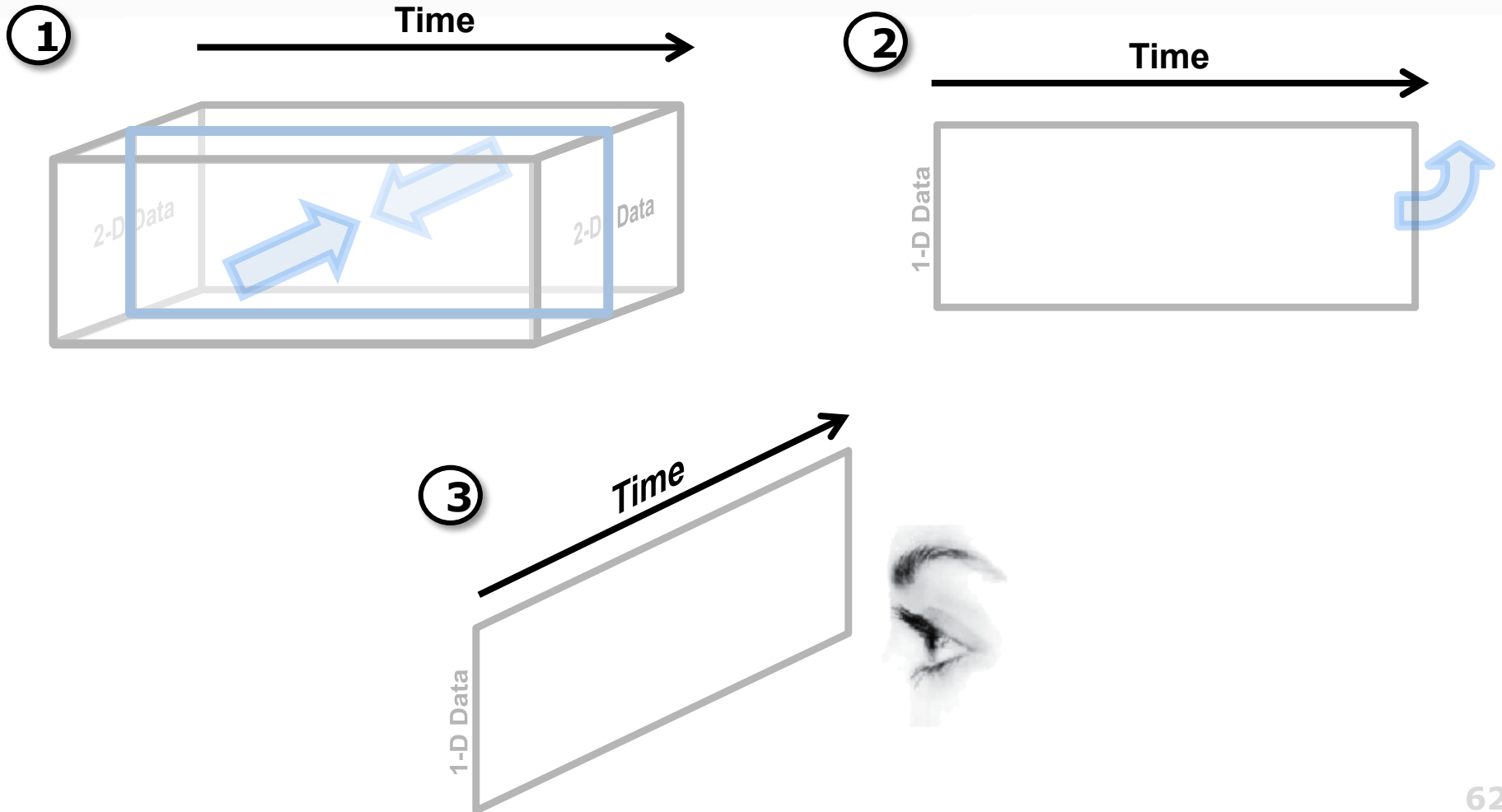
# 2D + Time



Marey, 1878

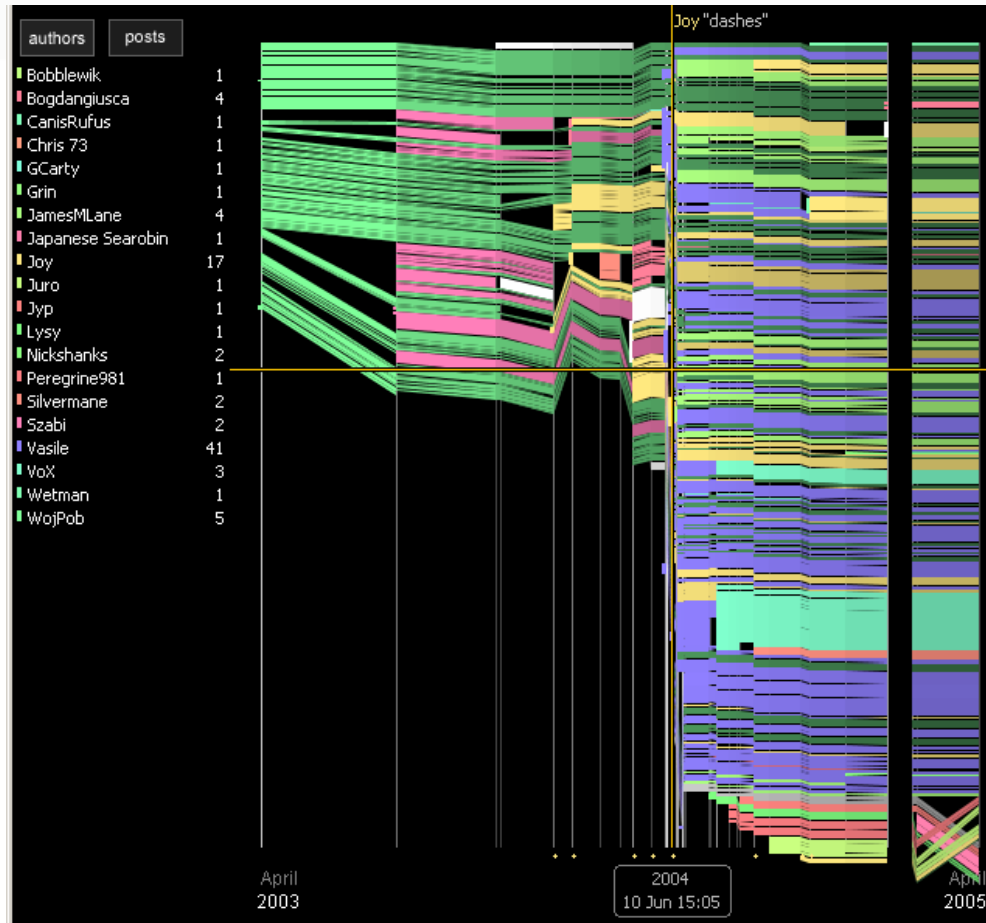
# 2D + Time

## Space Flattening



# 2D + Time

## History Flow



of Hungary was about 45% of the entire population. The provinces Hungary lost in the treaty had significant population of non-Magyars, but also a significant Magyar minority, which can still be found in these countries.

The number of Hungarians in the provinces started decreasing after the treaty. Comparing the Magyar population based on census data before and after the treaty:

\* In **Slovakia**:

\*\* 1910: 884,000 - 30%

\*\* 1930: 592,000 - 18%

\* In **Transylvania** (now in Romania):

\*\* 1910: 1,662,000 - 32%

\*\* 1930: 1,353,000 - 24%

\* In **Voivodina** (now in Serbia and Montenegro):

\*\* 1910: 420,000 - 28%

\*\* 1931: 376,000 - 23%

\* In **Transcarpathia** (now in Ukraine):

\*\* 1910: 183,000 - 30%

\*\* 1930: 123,000 - 17%

\* In **Croatia**:

\*\* 1910: 121,000 - 3.5%

\*\* 1921: 76,000 - 2.2%

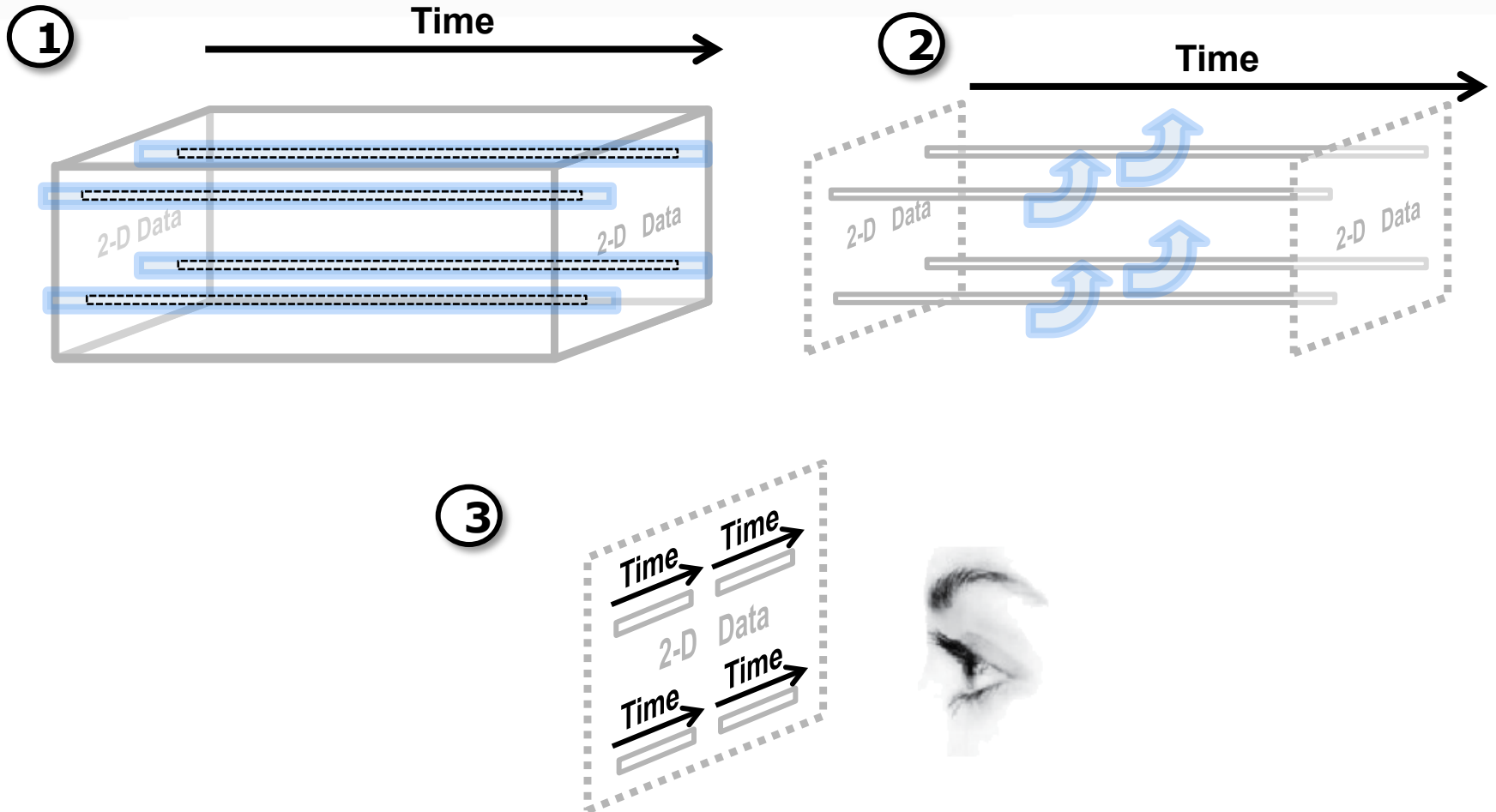
\* In **Slovenia**:

\*\* 1910: 20,800 - 1.6%

\*\* 1921: 15,000 - 1.1%

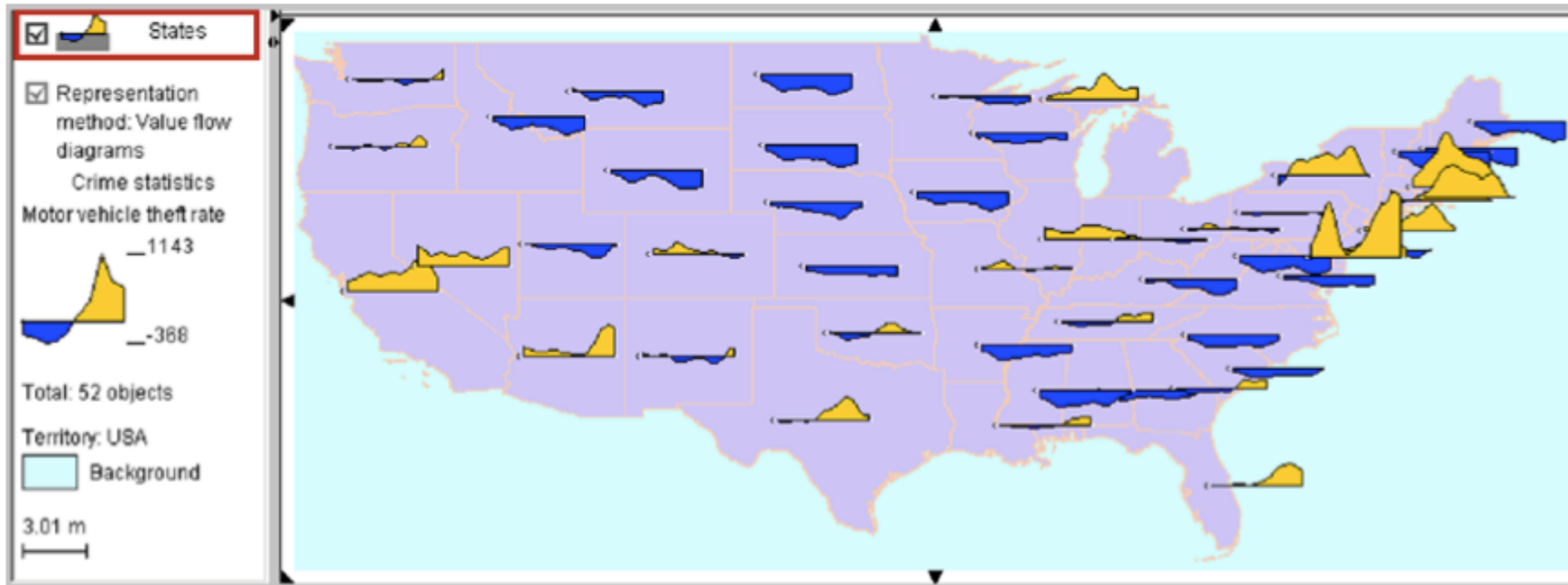
# 2D + Time

## Sampling



# 2D + Time

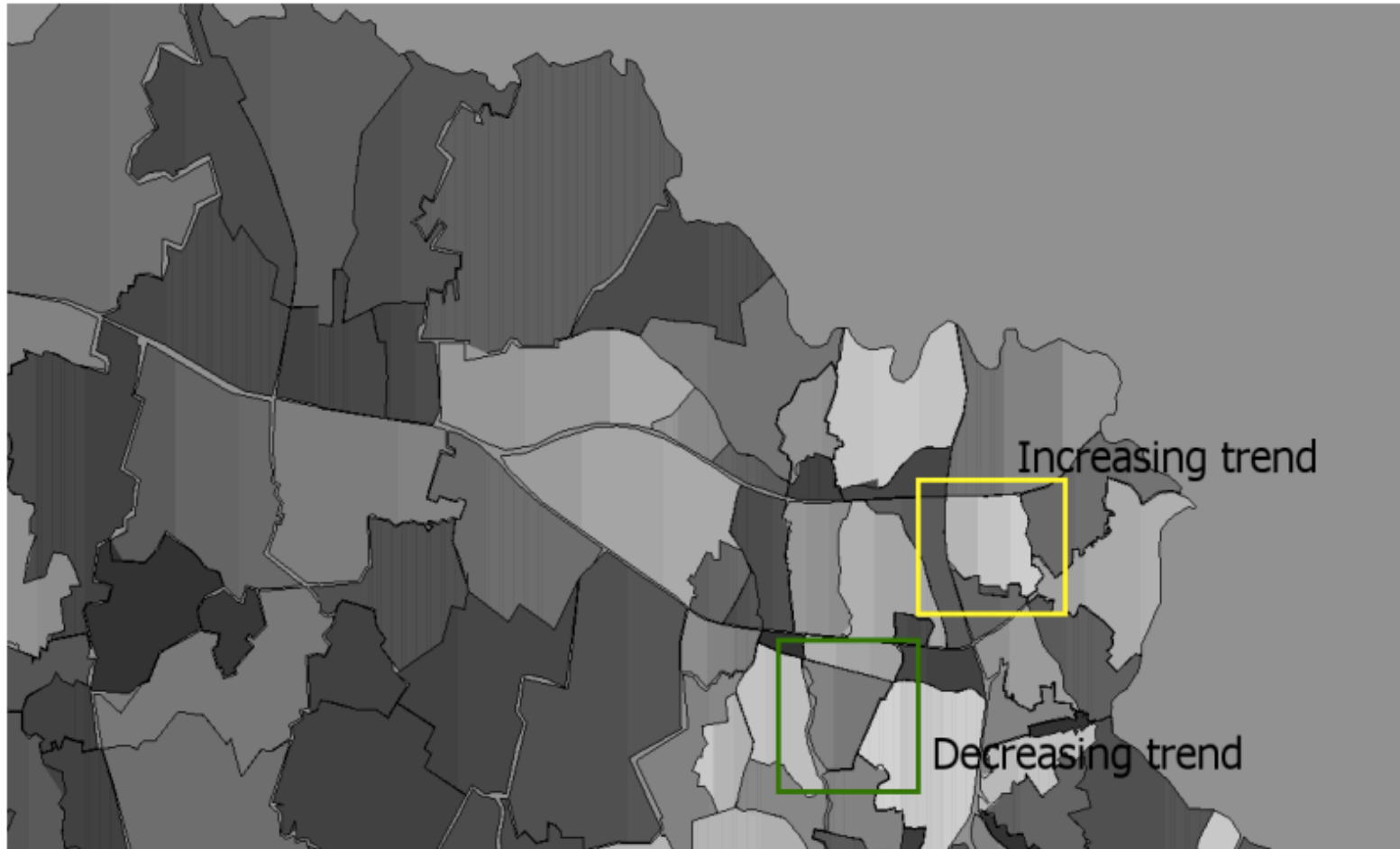
## Multiple Silhouette Graphs





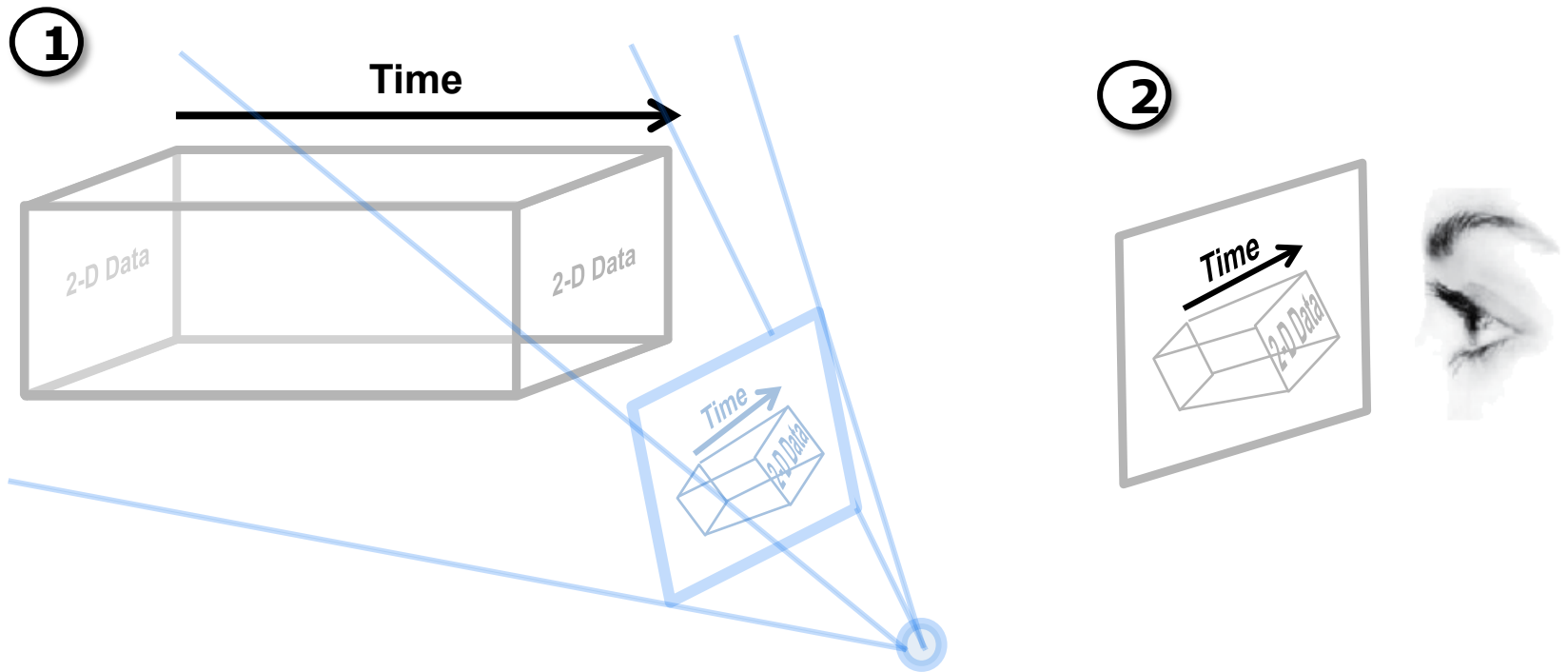
# 2D + Time

## Planning Polygons



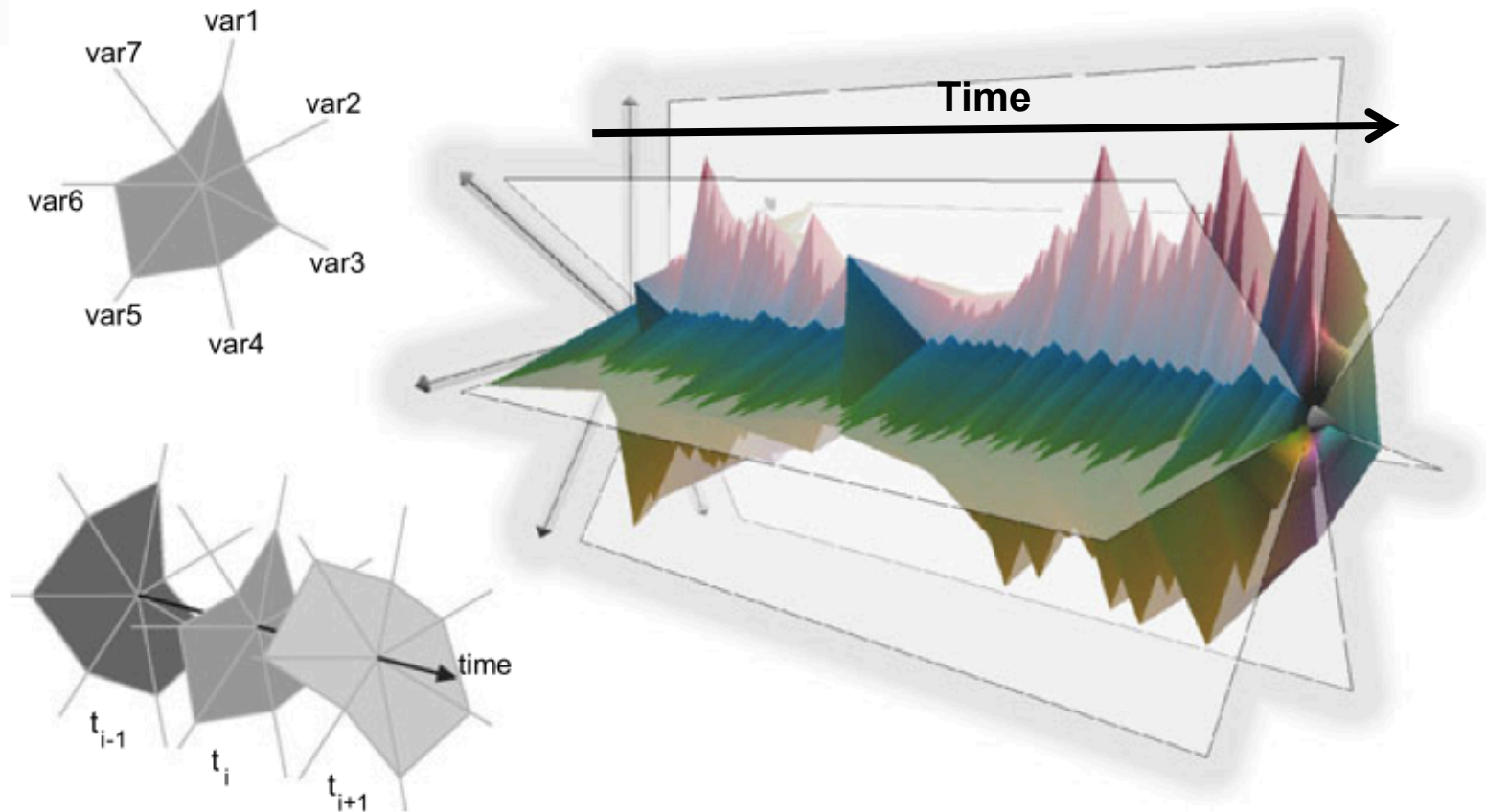
# 2D + Time

## 3D Rendering



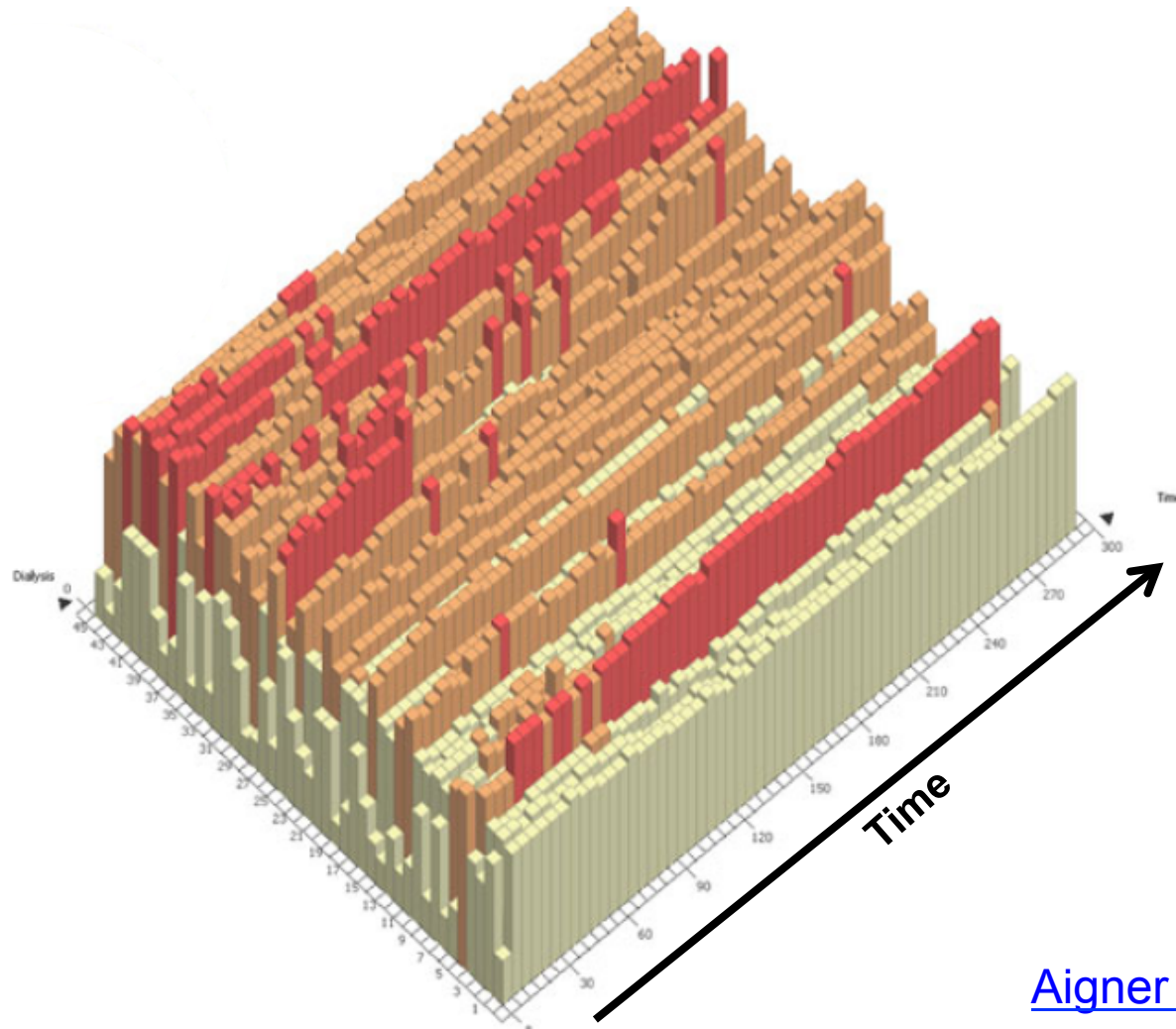
# 2D + Time

## 3D visualizations - Kiviat Tube



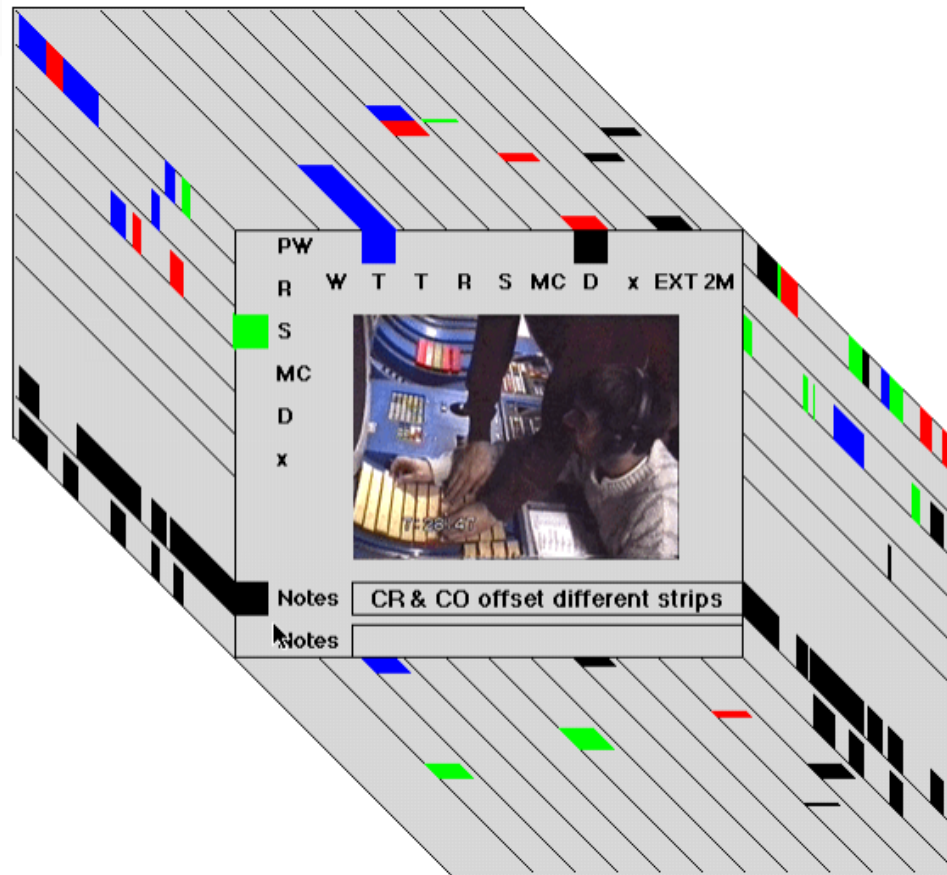
# 2D + Time

## 3D visualizations – 3D bar chart



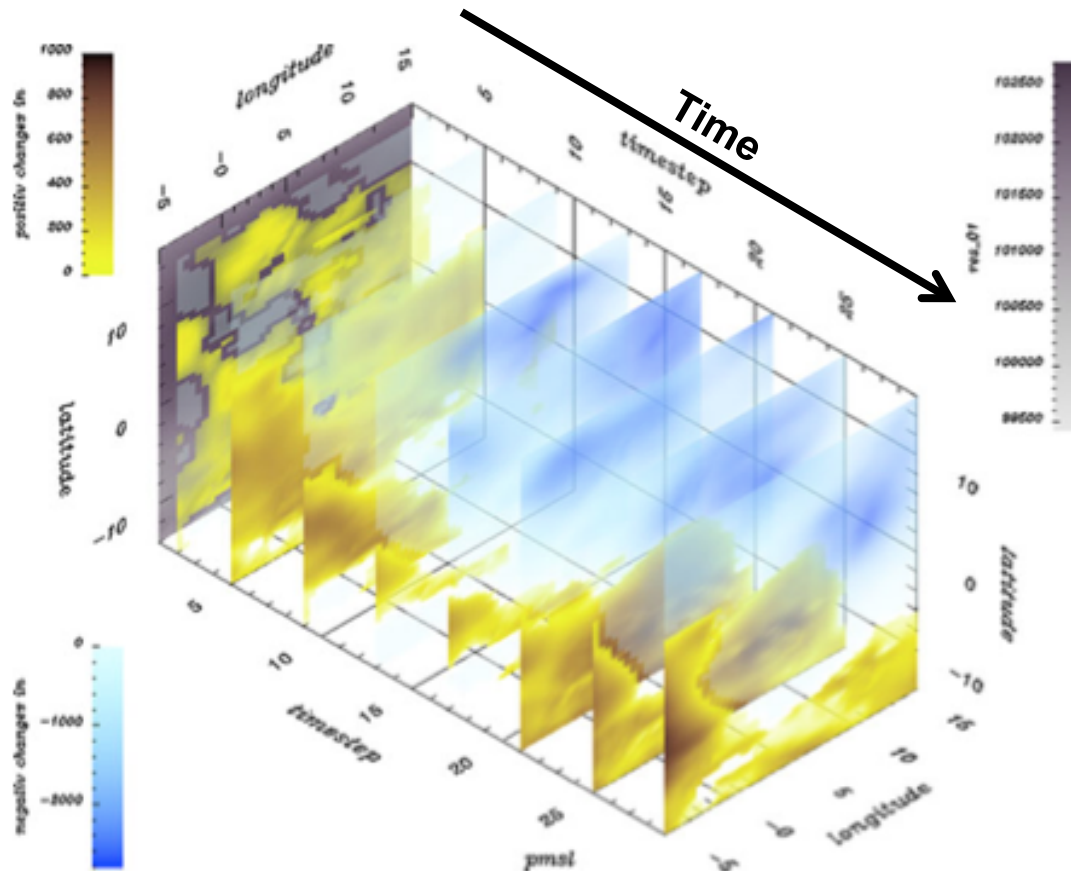
# 2D + Time

## 3D visualizations – DIVA



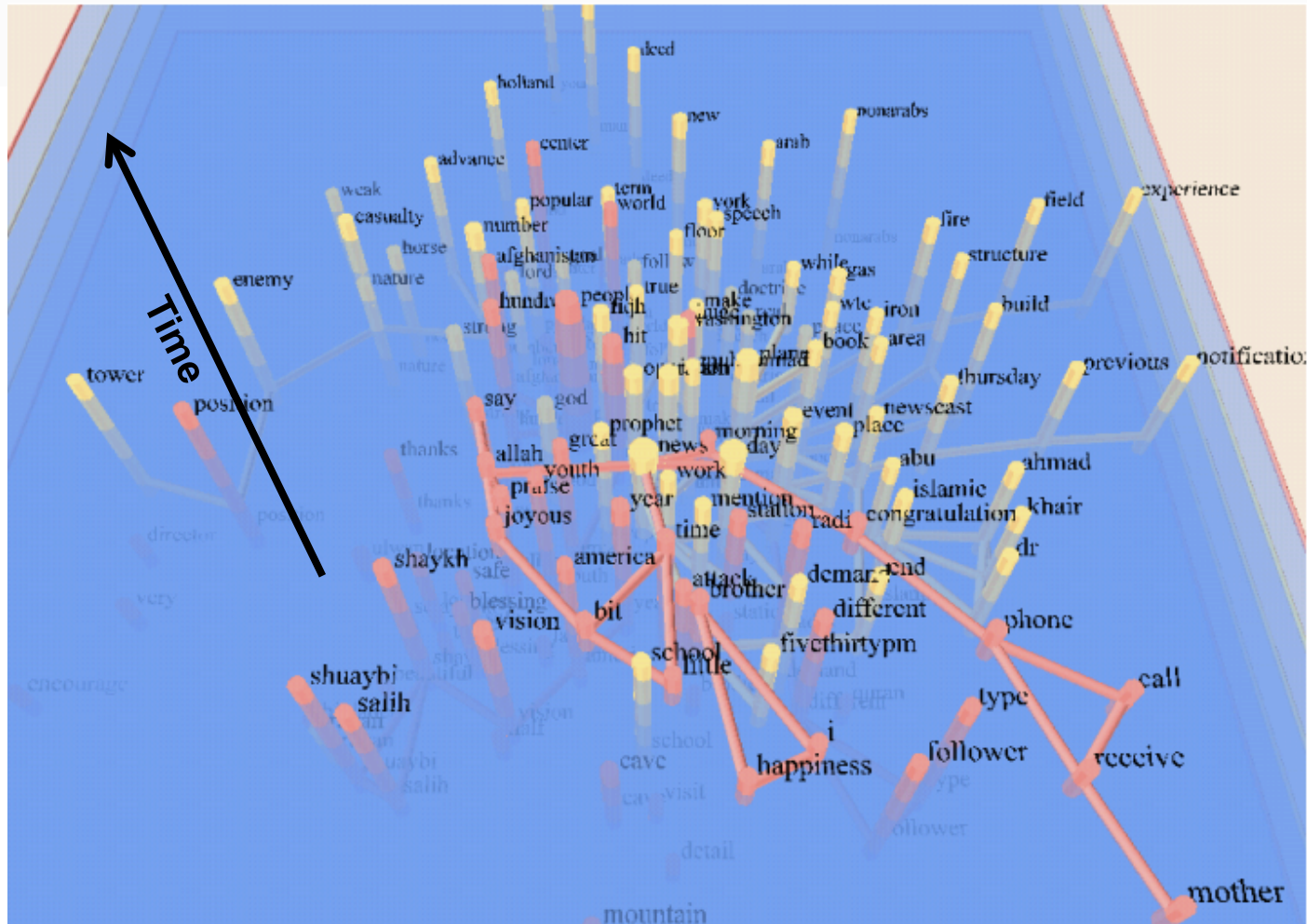
# 2D + Time

## 3D visualizations – Climate data



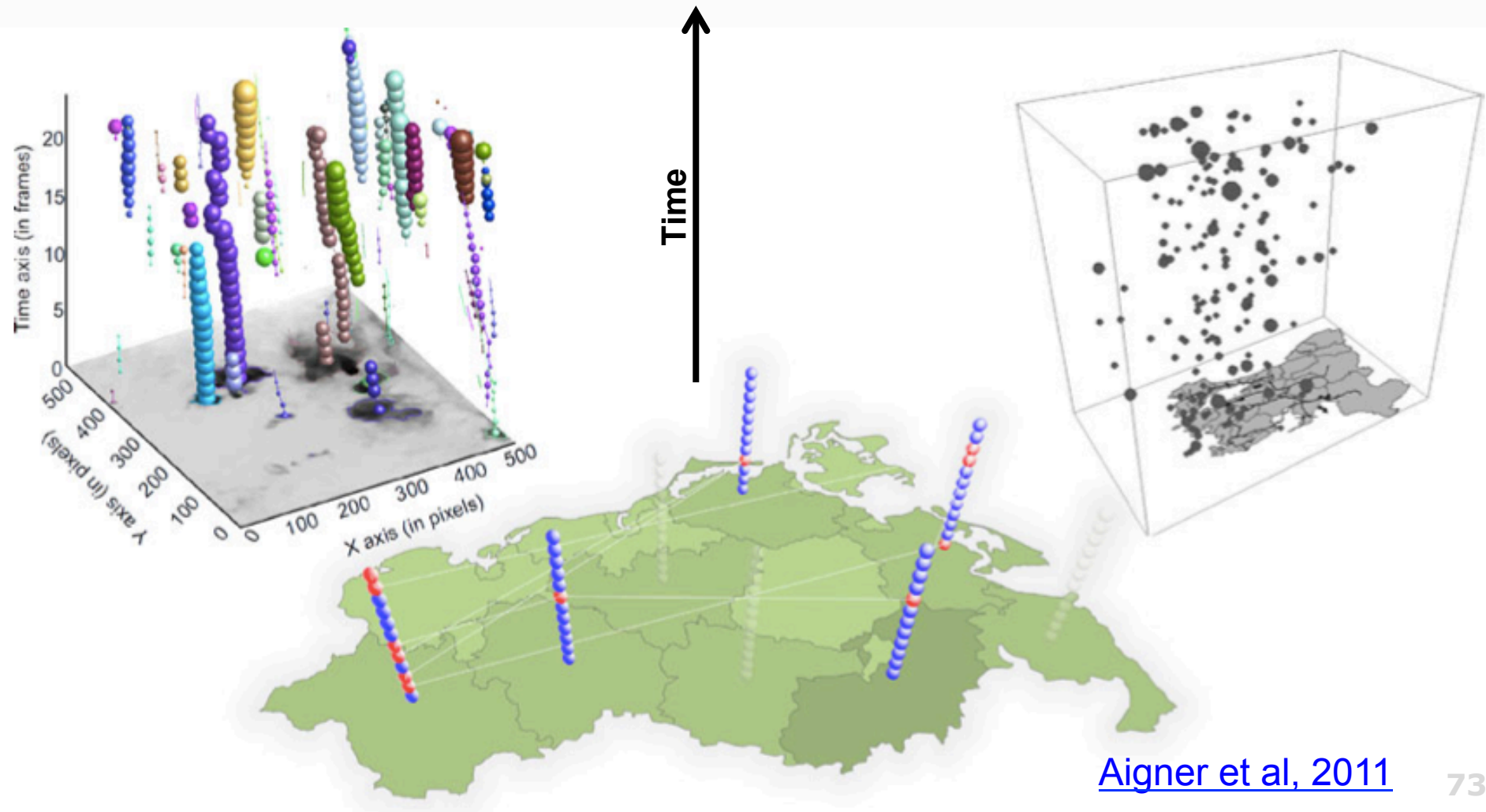
# 2D + Time

## 3D visualizations – Time-evolving graphs



# 2D + Time

## 3D visualizations - Points





# 2D + Time

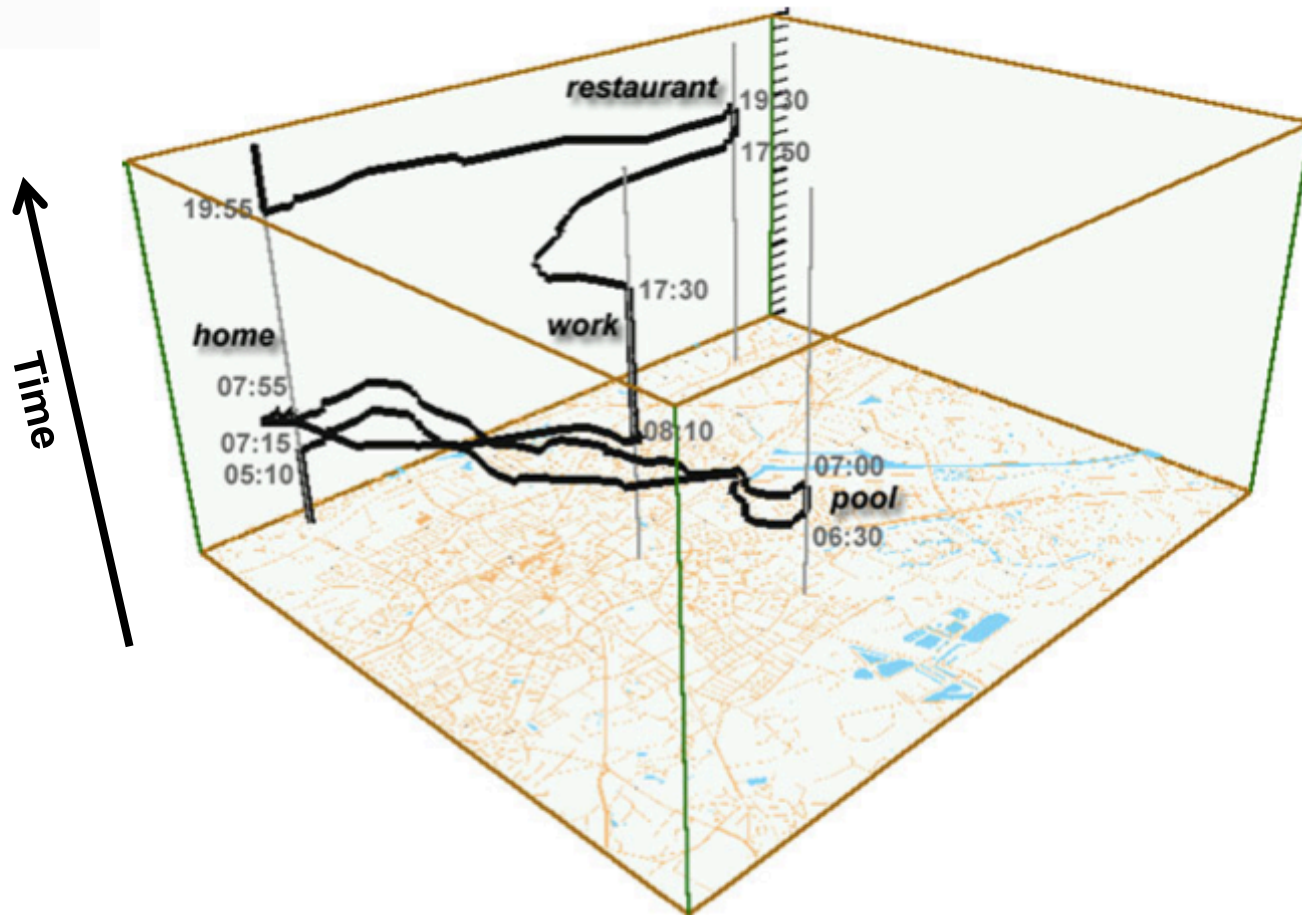
## 3D visualizations - Points



[\(video source\)](#)

# 2D + Time

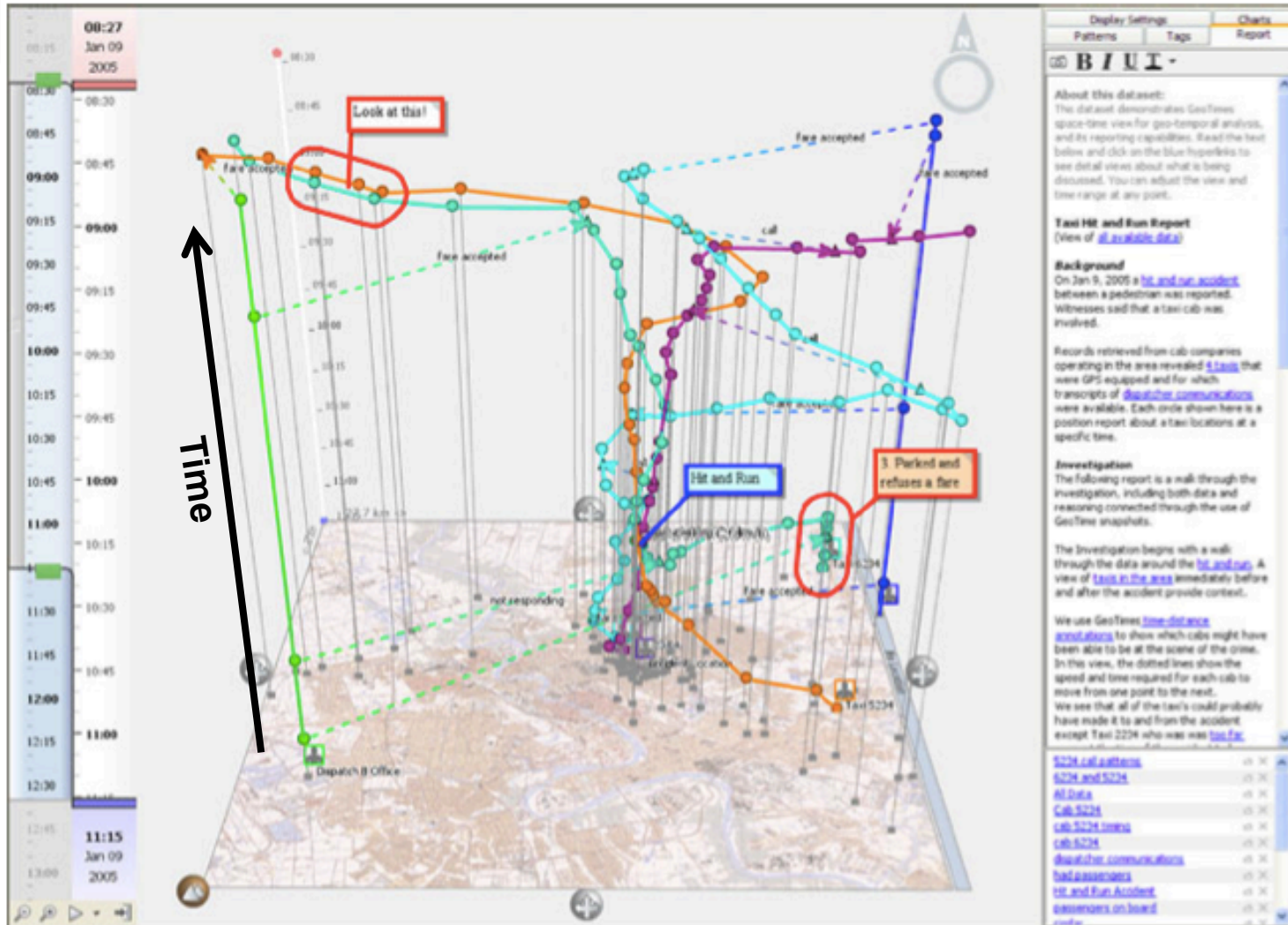
## 3D visualizations - Paths



# 2D + Time

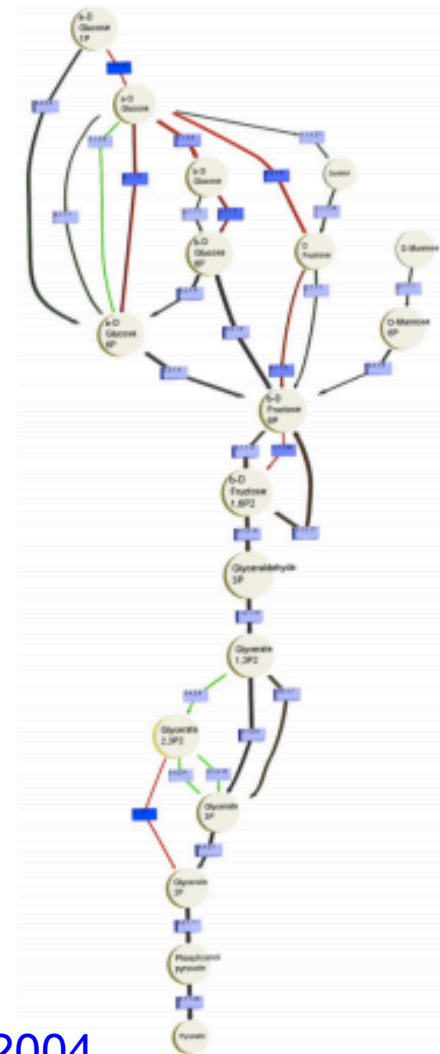
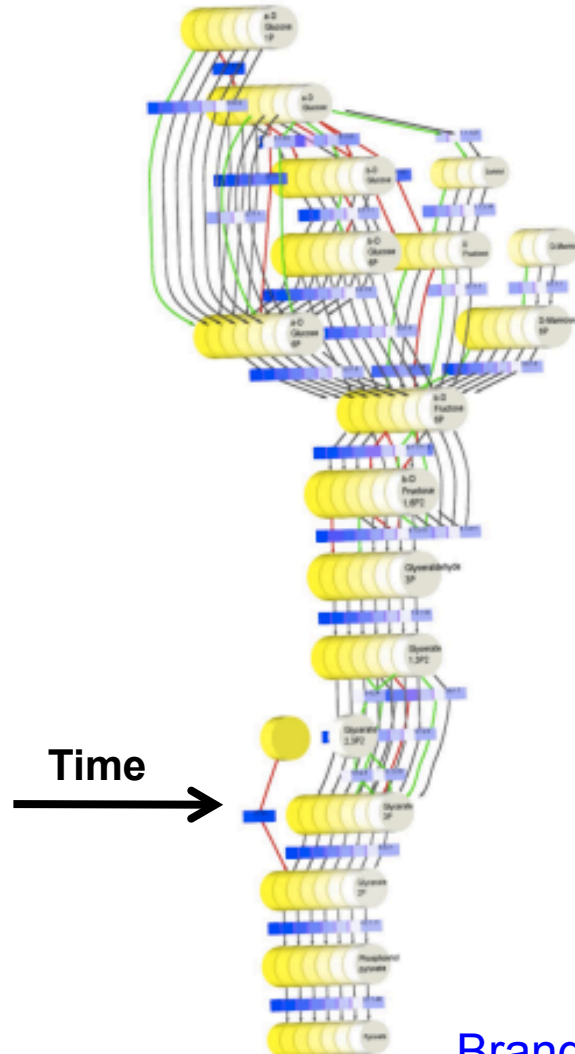
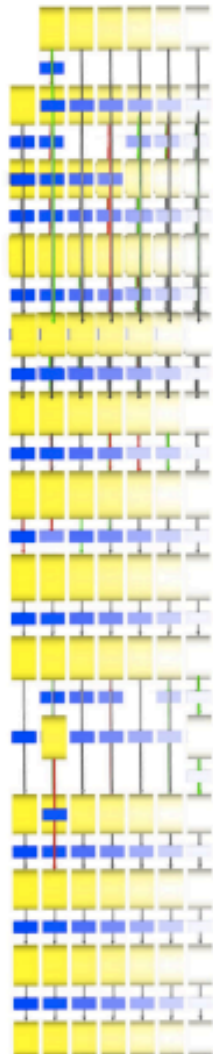
## 3D visualizations - GeoTime

[geotime.com](http://geotime.com)



# 2D + Time

## 3D visualizations – Time-evolving graphs

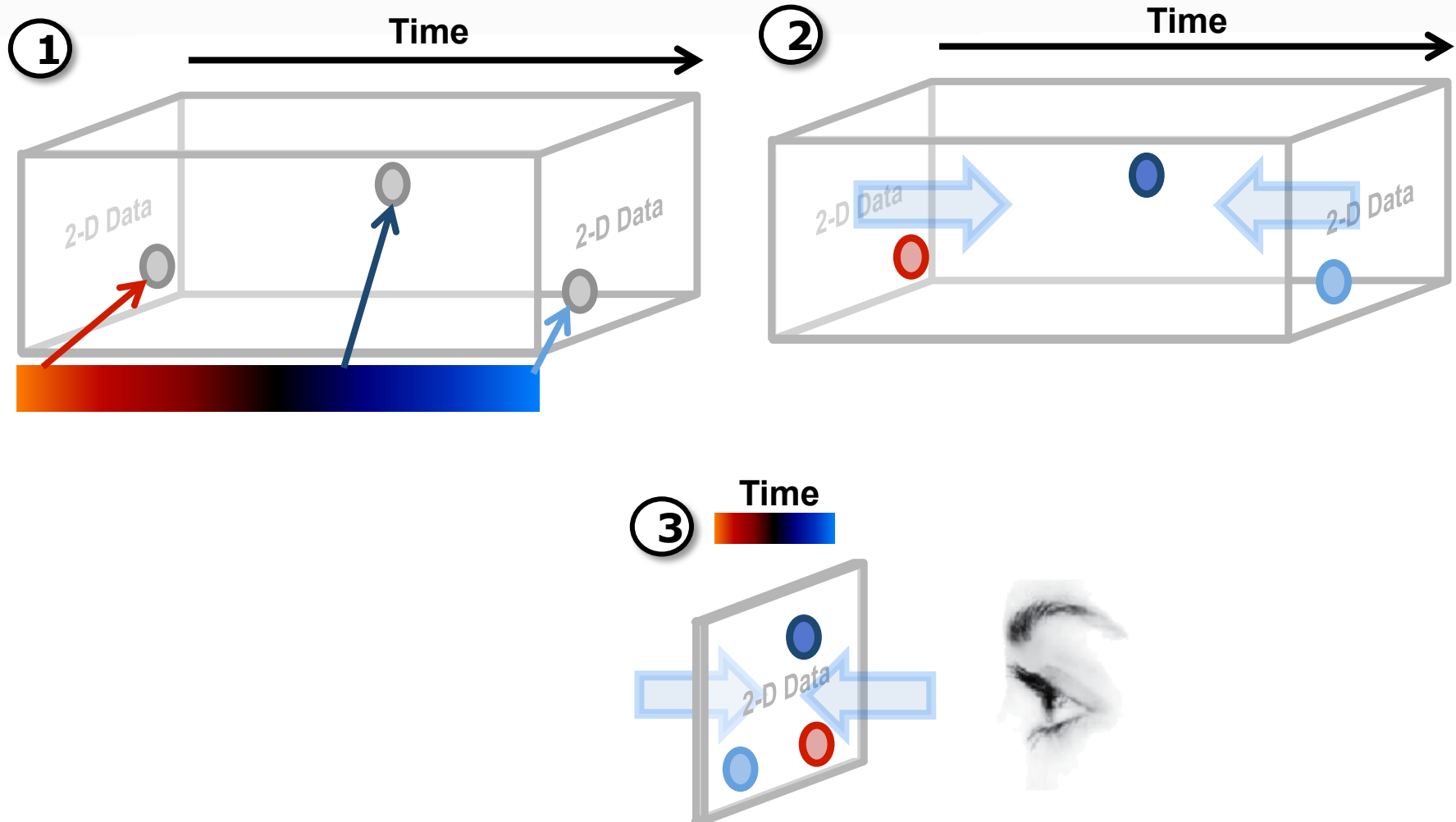


[Brandes et al, 2004](#)

# Mapping Time to Space

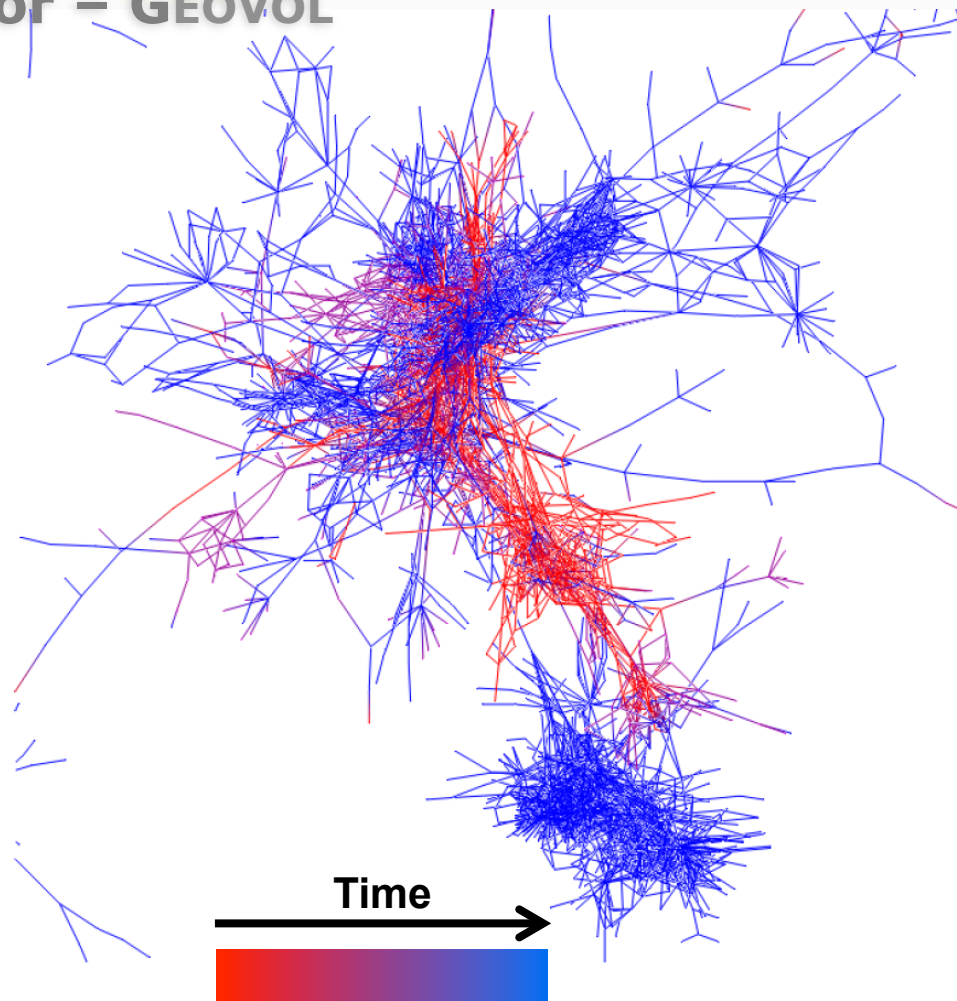
# 2D + Time

## Colored Time Flattening



# 2D + Time

Using Color – GEOVOL



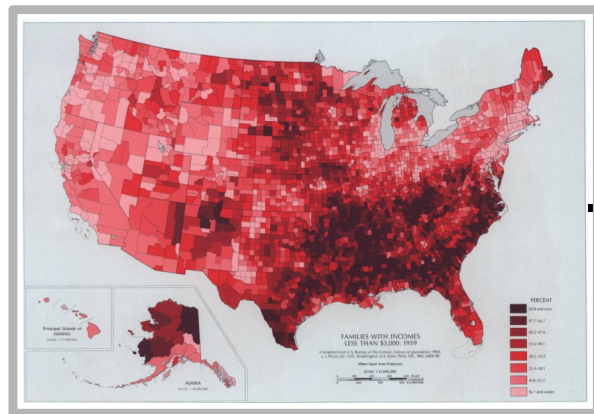
# 2D + Time

Using Color – Stroke Order





# Mapping Time to an Axis

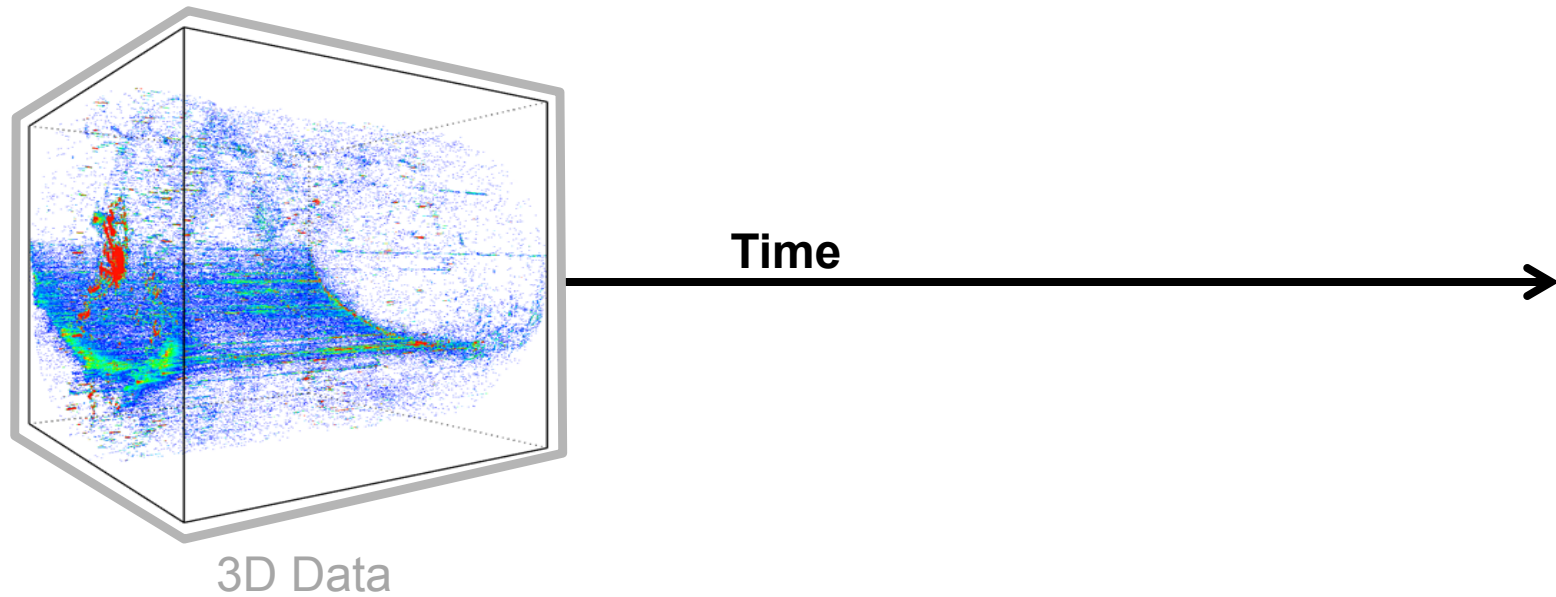


Time



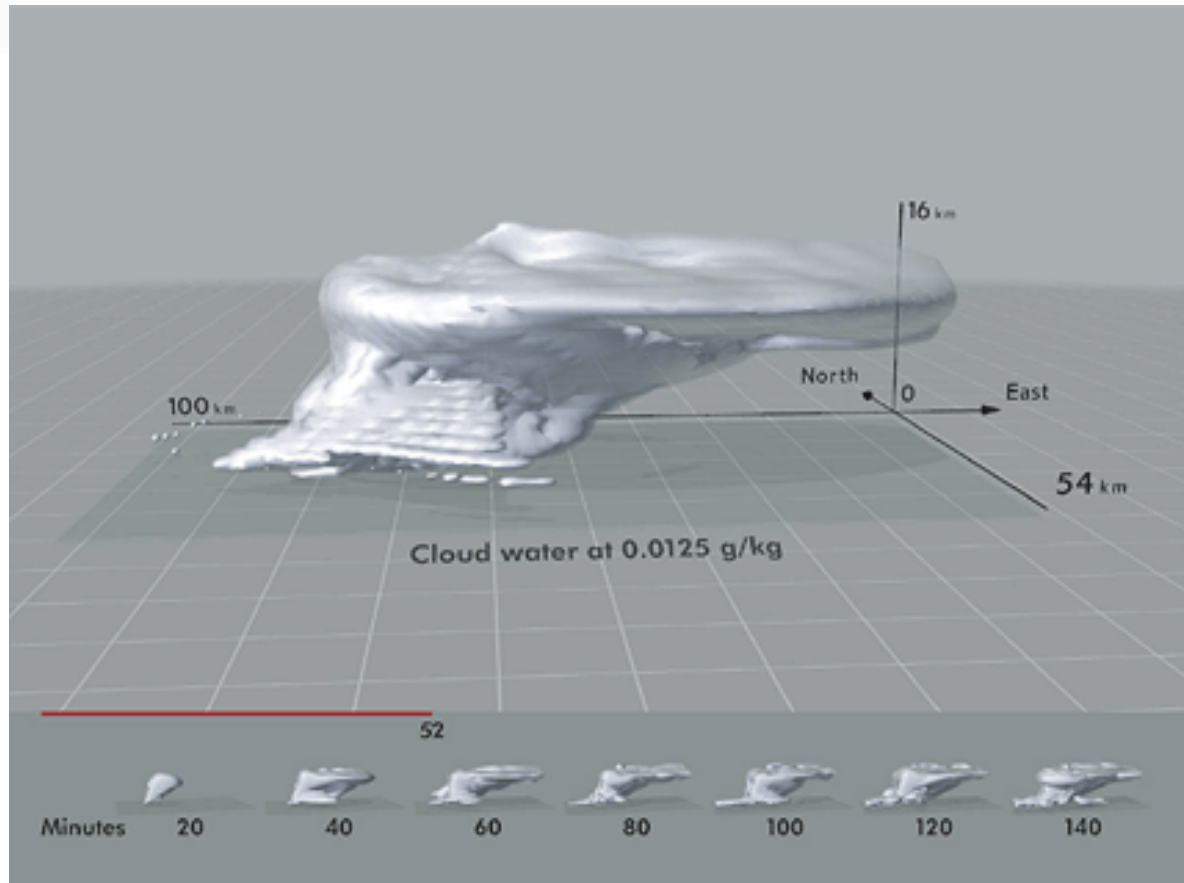
2D Data

# Mapping Time to an Axis



# 3D + Time

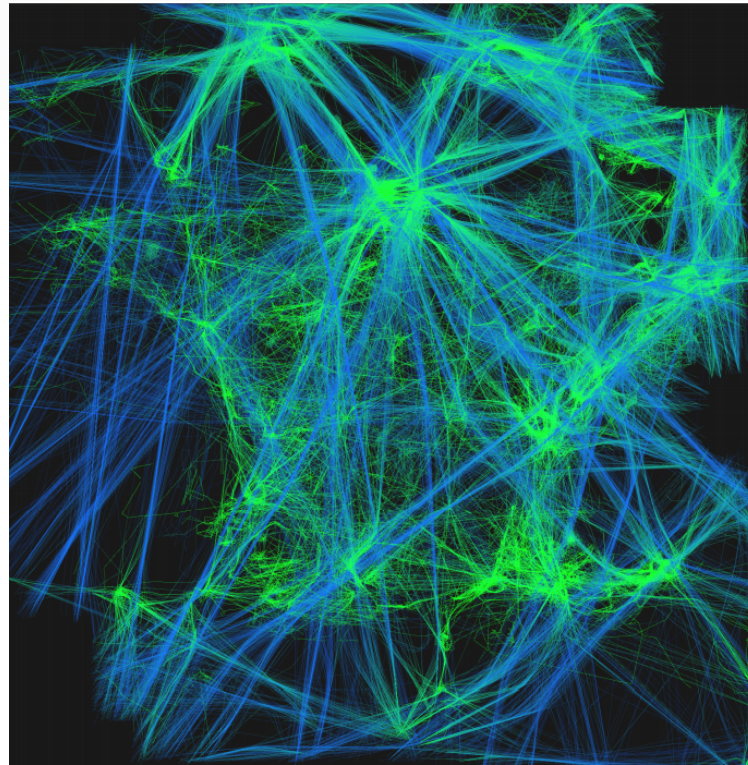
## Slicing + Juxtaposing – 3D Small Multiples



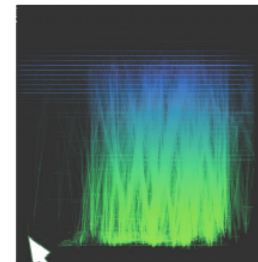
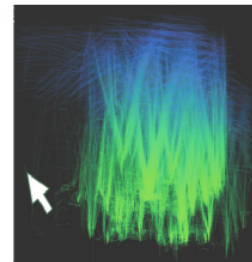
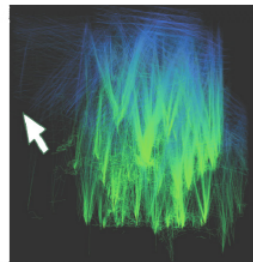
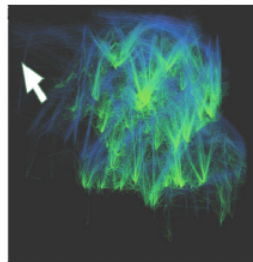
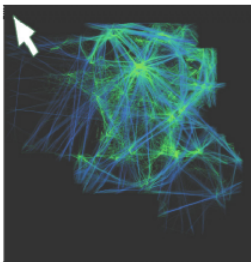
[Tufté and Bushell, 2005](#)

# 3D + Time

## Time and Space Flattening - FromDaDy



[Hurter et al, 2009](#)

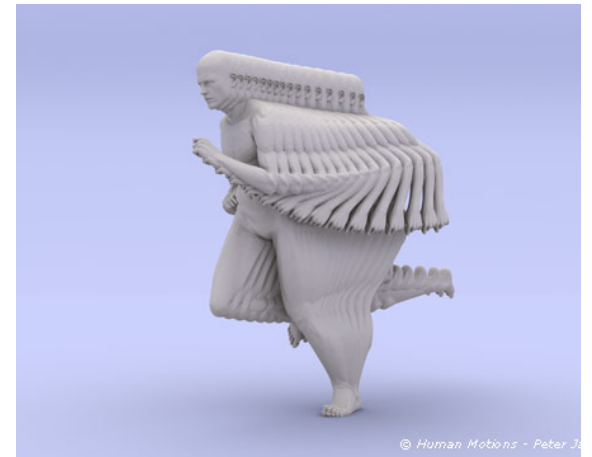
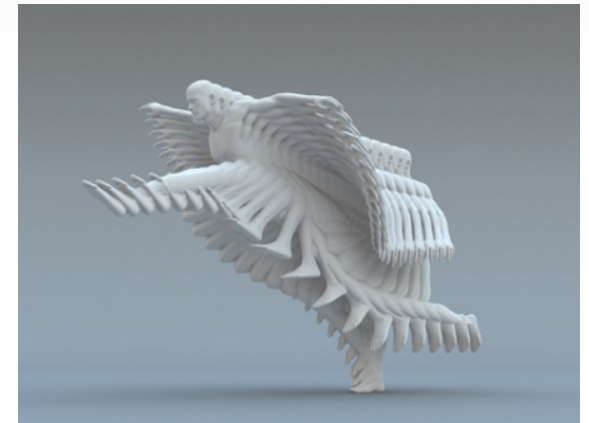


# 3D + Time

## Discrete time flattening – Marey & Peter Jansen's Sculptures



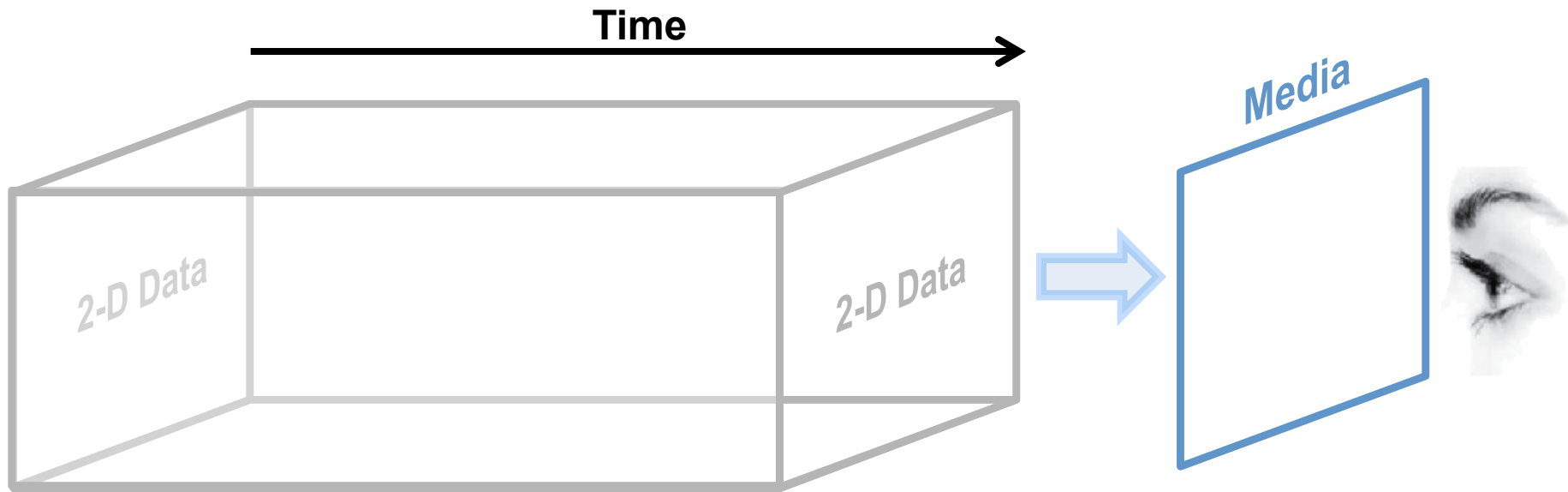
Marey, 1887



Peter Jansen. [humanmotions.com](http://humanmotions.com)

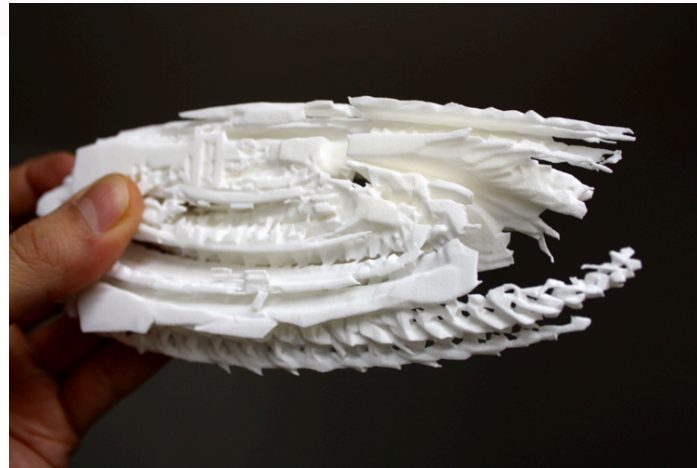
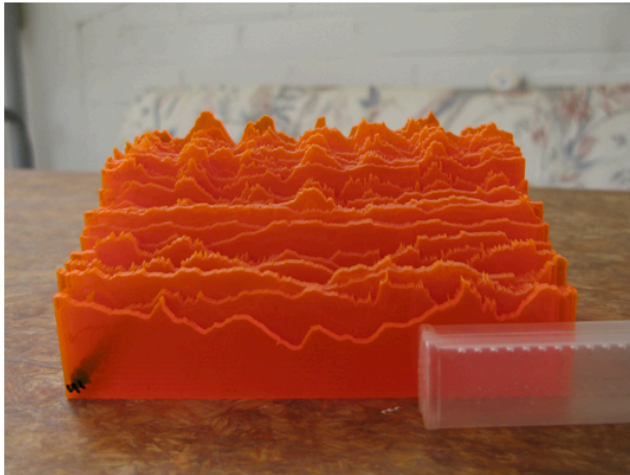
# 2D + Time

## Space-Time Cube Model



# Physical visualizations

[dataphys.org/list](http://dataphys.org/list)



# **Animations and Interaction**



# Animation

# Animation

- **Static Visual Content**
  - **Visual content that is fixed over time**

# Animation

- **Static Visual Content**
  - **Visual content that is fixed over time**
- **Dynamic Visual Content**
  - **Visual content that changes over time**

# Animation

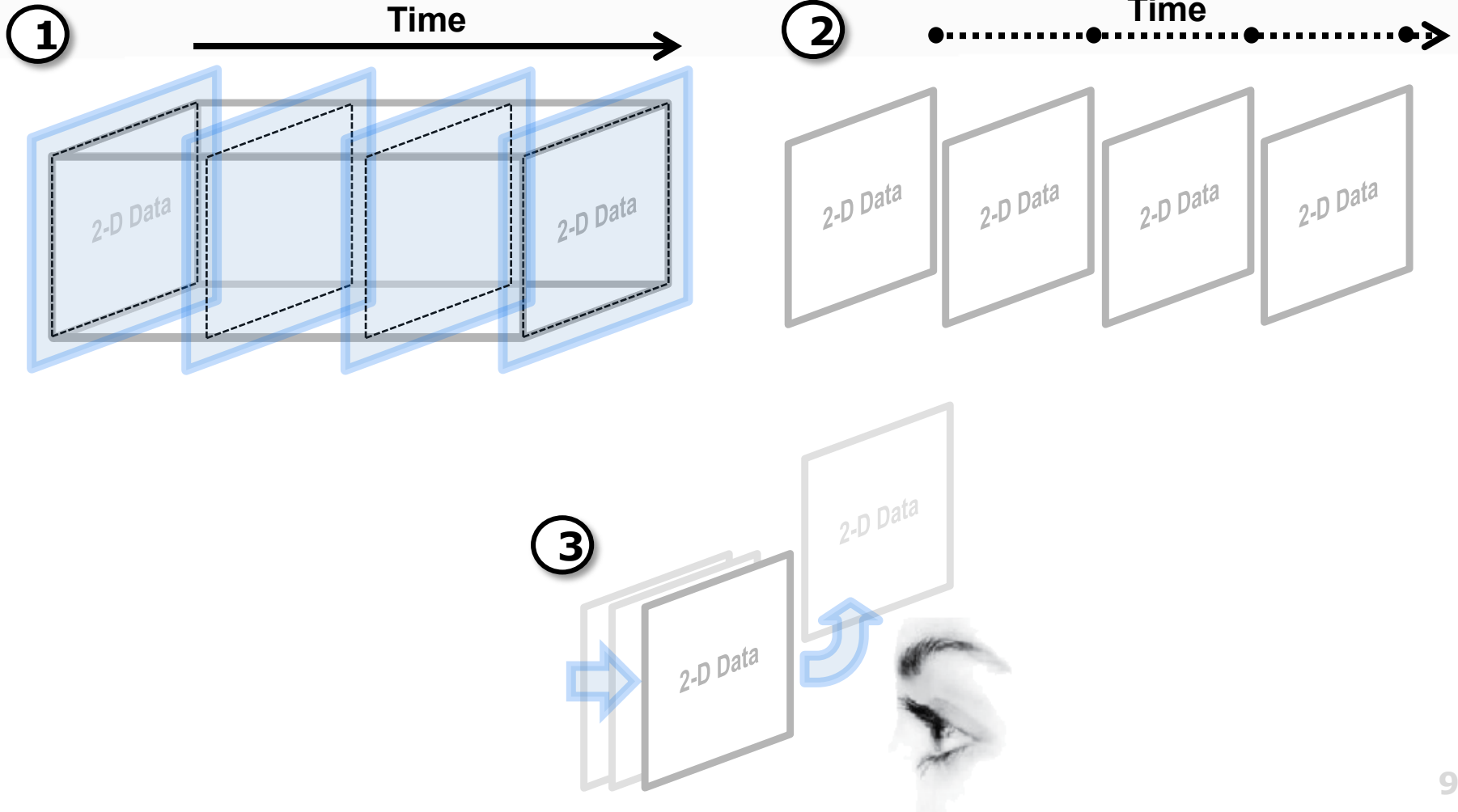
- **Static Visual Content**
  - Visual content that is fixed over time
- **Dynamic Visual Content**
  - Visual content that changes over time
- **Interactive Visual Content**
  - Visual content that changes over time
  - Under the user's influence

# Animation

- **Static Visual Content**
  - Visual content that is fixed over time
- **Dynamic Visual Content**
  - Visual content that changes over time
- **Interactive Visual Content**
  - Visual content that changes over time
  - Under the user's influence
- **Animation**
  - Visual content that changes over time
  - Outside the user's influence

# 2D + Time

## Animated Time Cutting



# 2D + Time

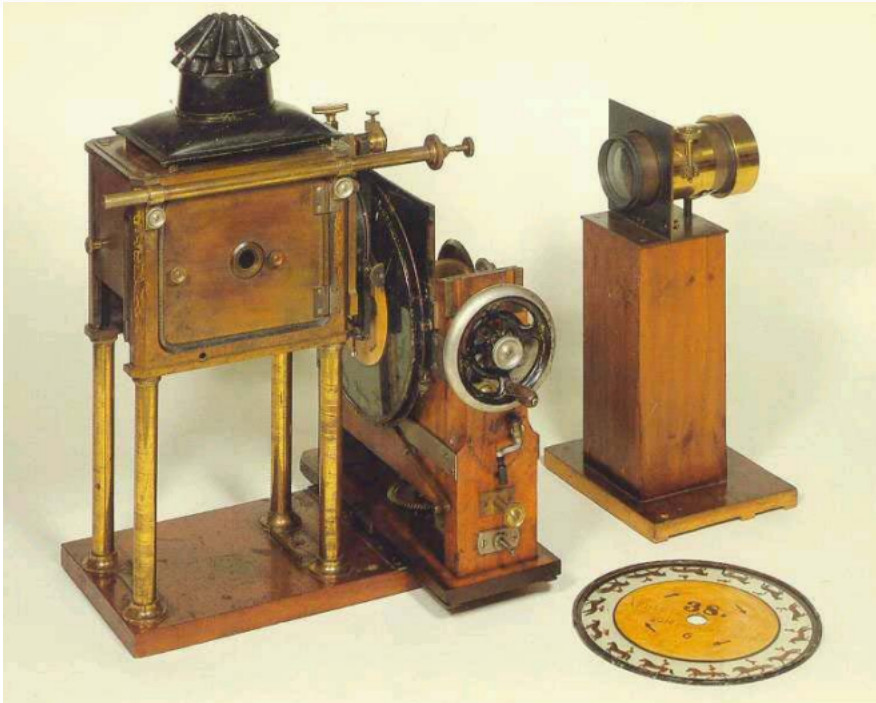
## Movies and Cartoons



Eadweard J. Muybridge, 1879

# 2D + Time

## Zoopraxiscope



[\(image source\)](#)



[\(image source\)](#)

Eadweard J. Muybridge, 1879



# 2D + Time

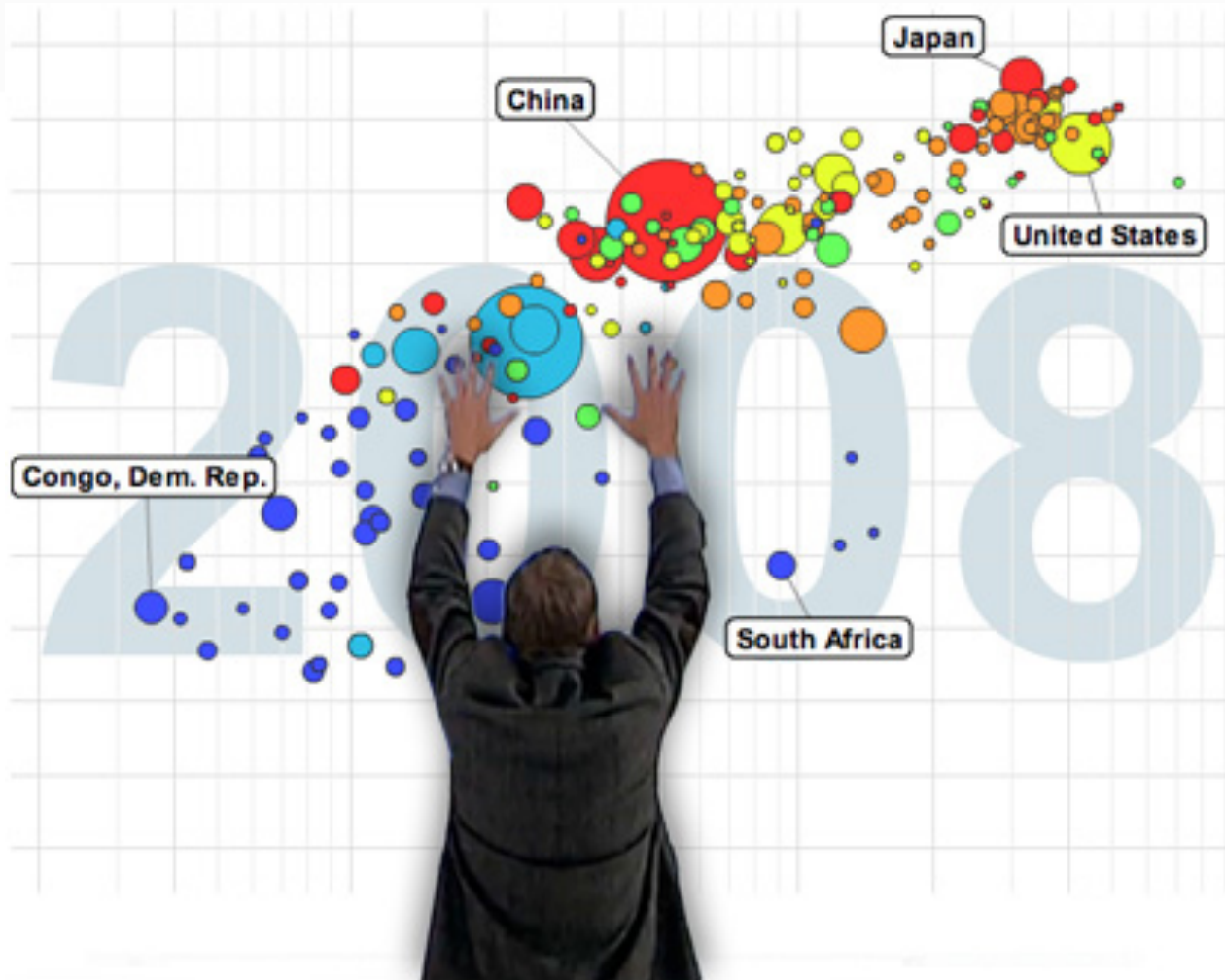
## Zoetrope



William G. Horner, 1833  
also Ting Huan, 180 AD  
([source](#))

# 2D + Time

## Animation – Gap Minder



[\(image source\)](#)

# 2D + Time

## Animation – Gap Minder



[\(video source\)](#)

# 2D + Time

## Animation vs. Other Approaches



[\(image source\)](#)

# 2D + Time

## Animation vs. Other Approaches



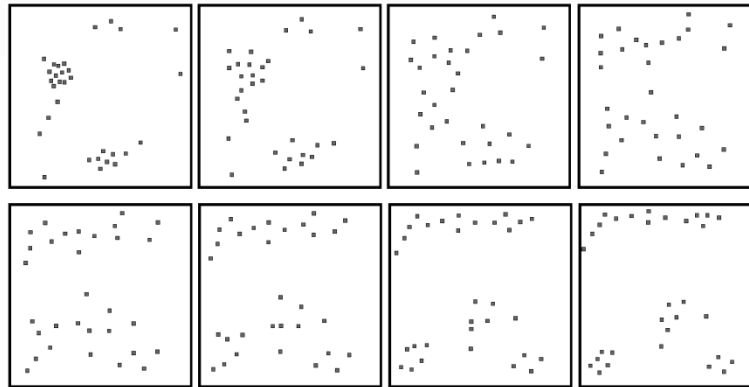
[\(image source\)](#)



# 2D + Time

## Animation vs. Other Approaches

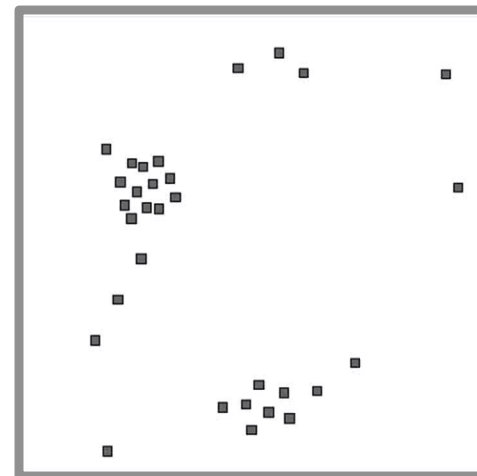
Small Multiples (Time Juxtaposing)



Trails (Coloring + Flattening)

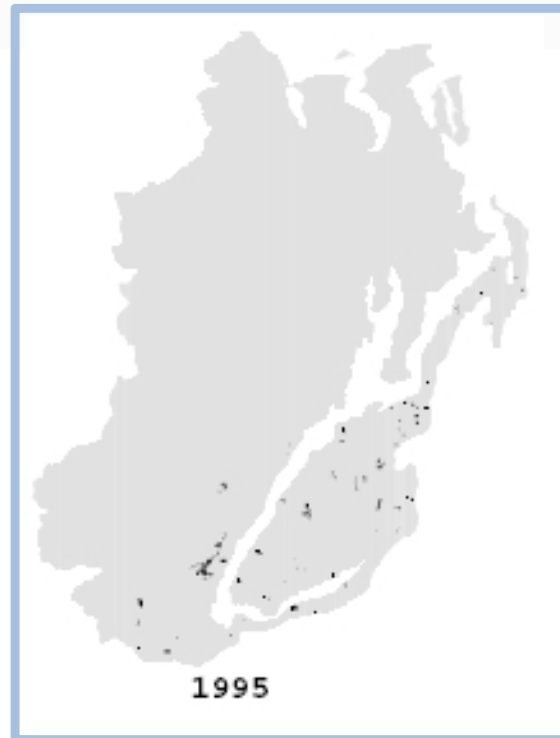


Animation



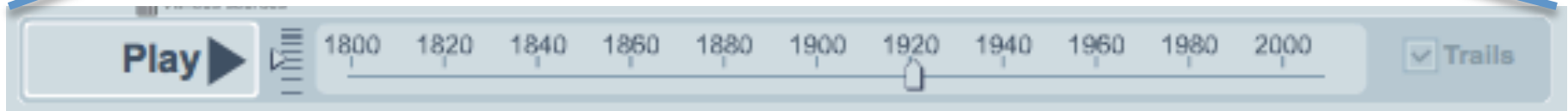
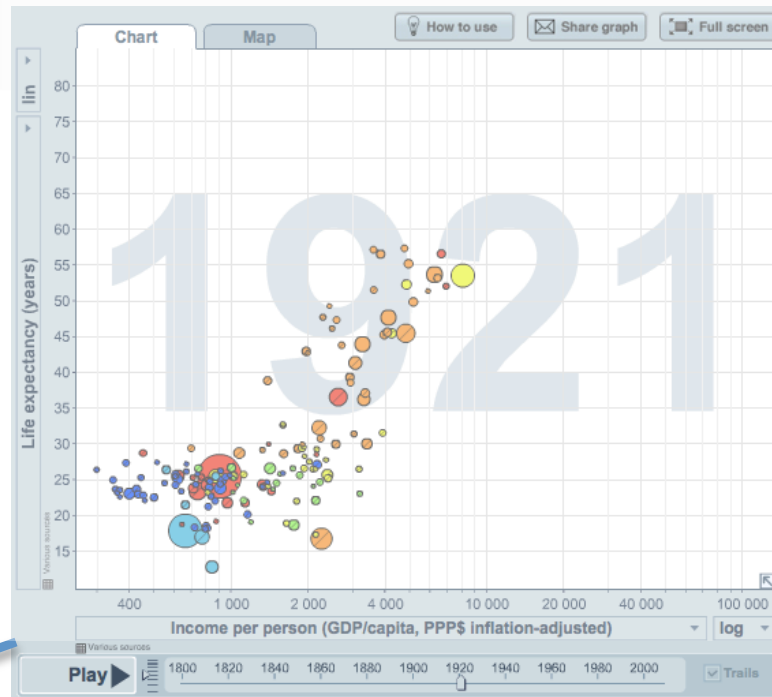
# 2D + Time

## Animation vs. Other Approaches



# 2D + Time

## Time Slider – GapMinder





# Space-time cube survey

		Operations	Time	Space	
Extraction	Point	Point Extraction			
	Curve	Planar Drilling	Orthogonal Drilling	Time Drilling	Space Drilling
			Oblique Drilling		
		Planar Curvilinear Drilling			
		Non-Planar Drilling			
	Surface	Planar Cutting	Orthogonal Cutting	Time Cutting	Linear Space Cutting
			Oblique Cutting		
		Non-Planar Cutting	Curvilinear Space Cutting		
			Other		
	Volume	Planar Chopping	Orthogonal Chopping	Time Chopping	Linear Space Chopping
			Oblique Chopping		
			Operations	Time	Space
	Filling	Orthogonal Interpolation		Time Interpolation	Space Interpolation
		Volume Interpolation			
	Geometry Transformation	Rigid Transformation	Translation	Time Shifting	Space Shifting
			Rotation	Yaw	
Pitch					
Roll					
Scaling		Time Scaling	Space Scaling		
Bending					
Unfolding					
Recoloring	Time Coloring		Time Coloring	Space Coloring	
	Difference Coloring				

[tinyurl.com/spacetime-bach](http://tinyurl.com/spacetime-bach)