

# NetworkNarratives: Data Tours for Visual Network Exploration and Analysis

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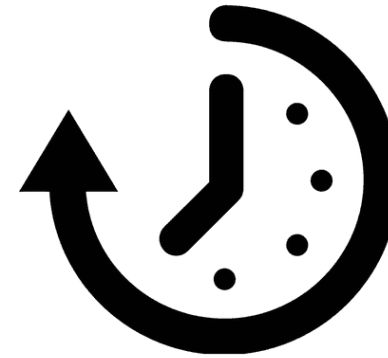
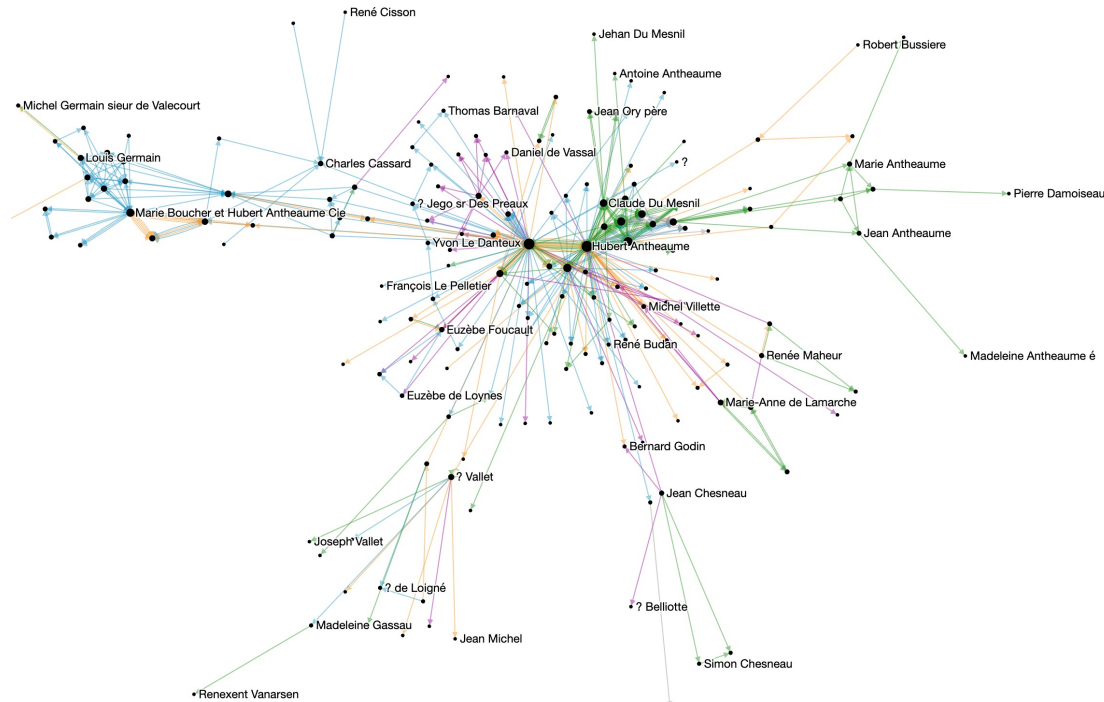


**CHI23**

Hamburg, Germany | Hybrid  
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# Network Exploration



Time-consuming

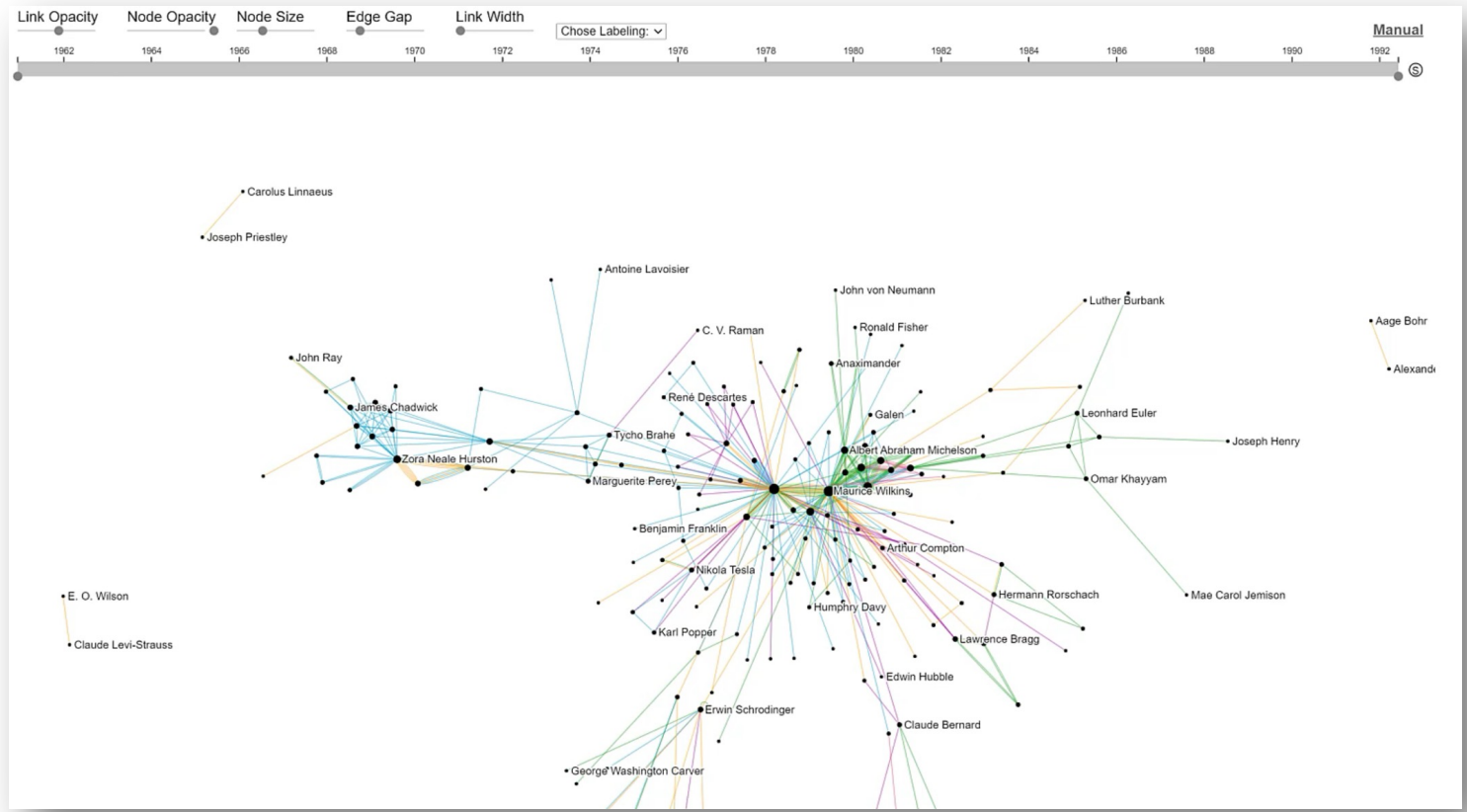


Challenging

Link Opacity    Node Opacity    Node Size    Edge Gap    Link Width    Chose Labeling: ▾    [Manual](#)



Give Feedback



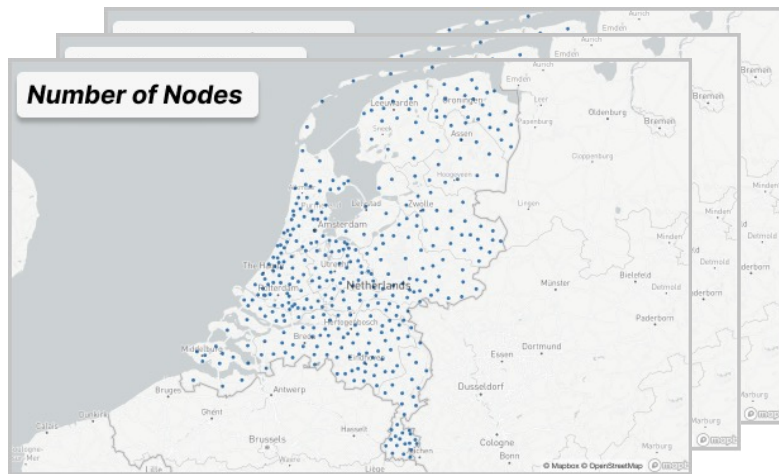


How to support **exploration strategies**?

How to **learn** about network exploration?

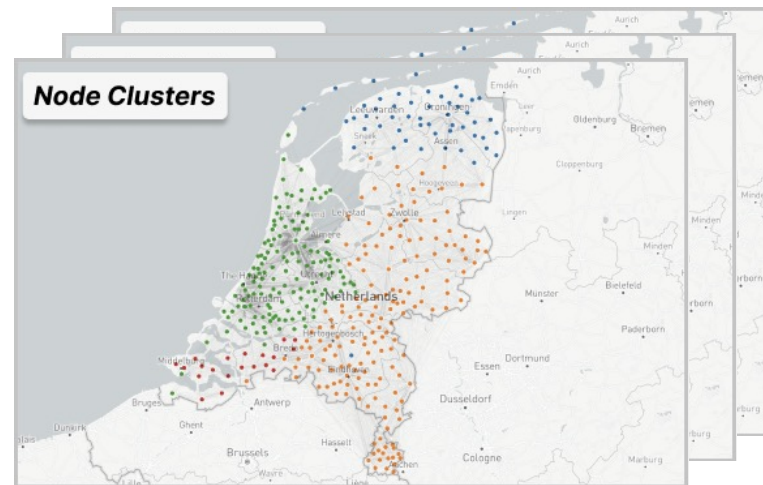
# Semi-automatic Data Tours

## Network overview



This network has 388 cities.

## Community exploration



This network can be divided into 4 clusters.

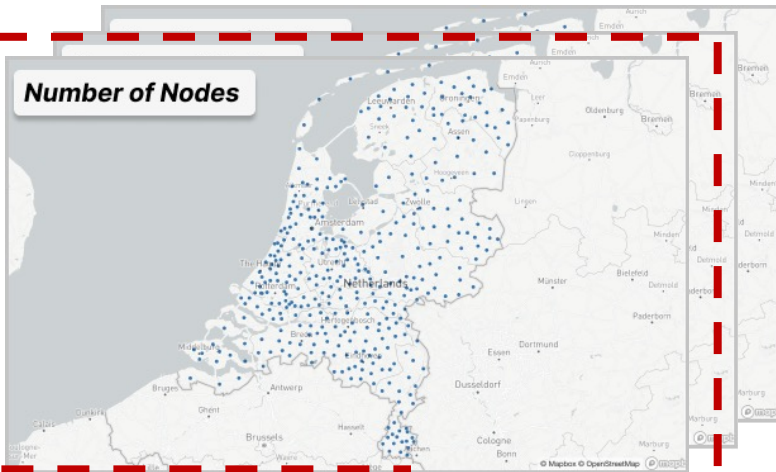
## Ego-network analysis



The city (Amsterdam) has 129,100 incoming flow weight and 326,200 outgoing flow weight.

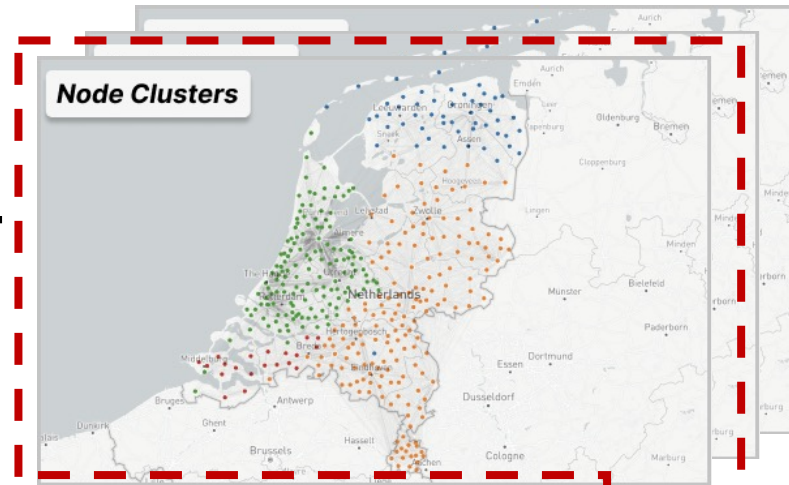
# Slides in a Data Tour

## Network overview



This networks has 388 cities.

## Community exploration

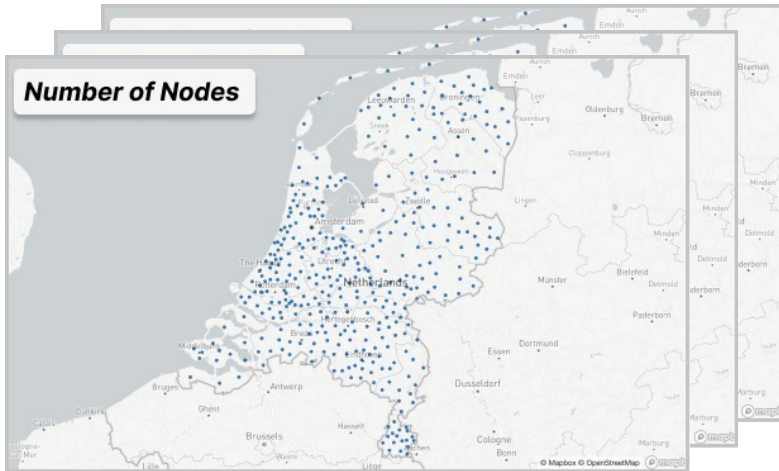


This network can be divided into 4 clusters.

Each **slide** in a tour shows a **piece of information (fact)**

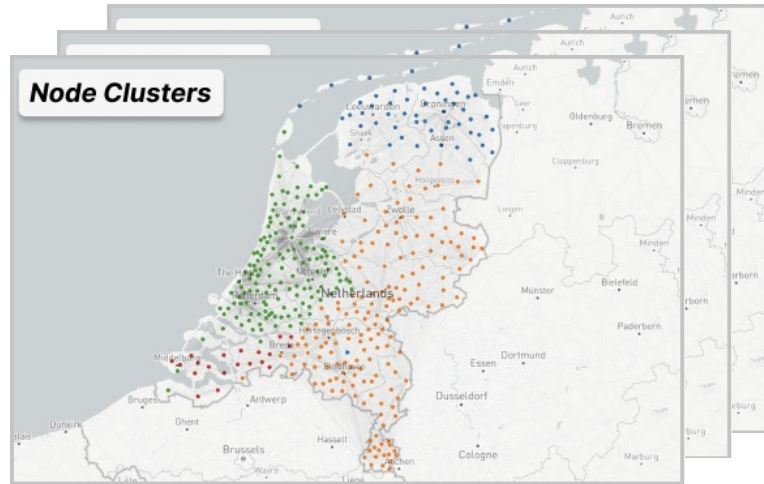
# Main Characteristics of Data Tours

## Network overview



This network has 388 cities.

## Community exploration



This network can be divided into 4 clusters.

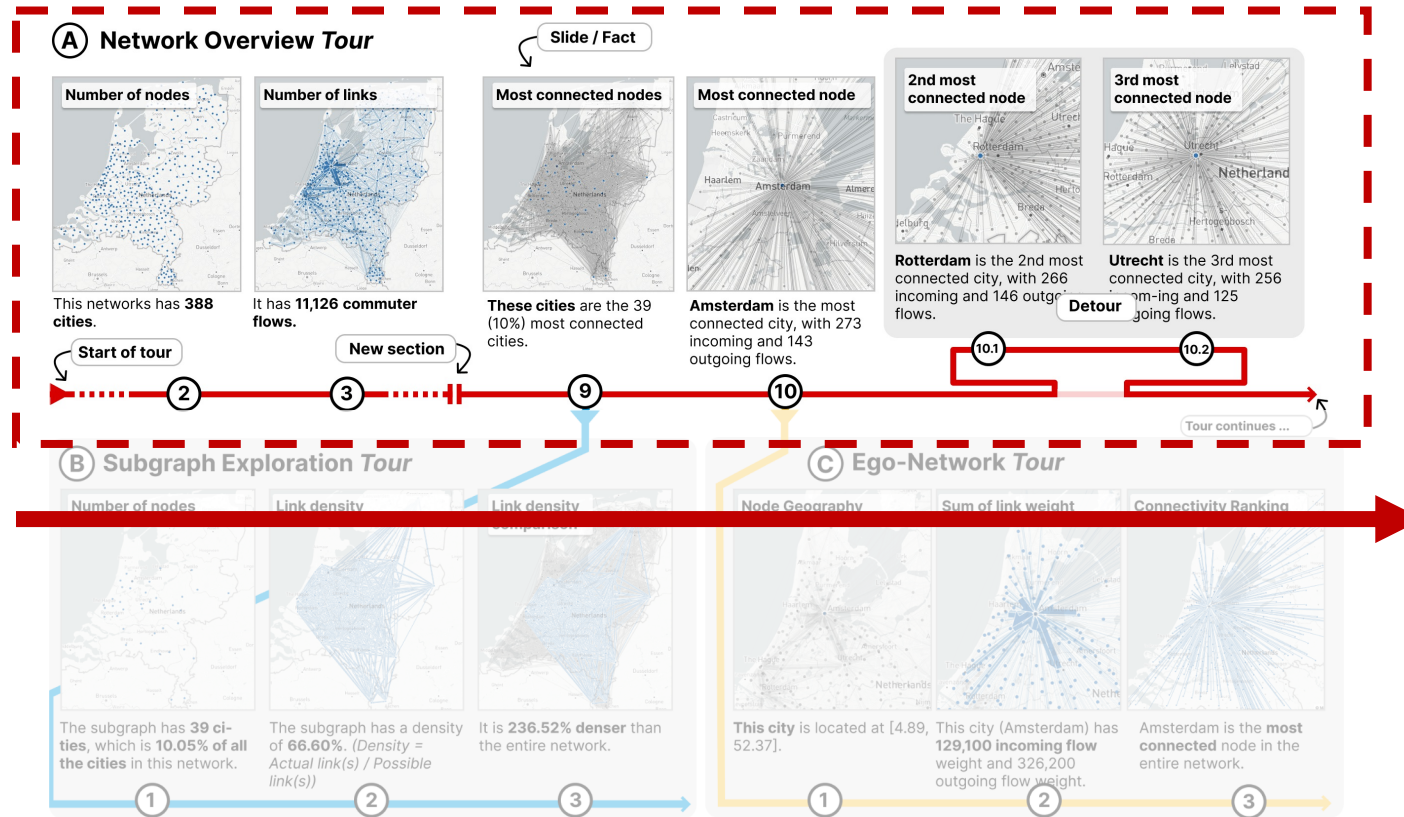
## Ego-network analysis



The city (Amsterdam) has 129,100 incoming flow weight and 326,200 outgoing flow weight.

1. Unlike guidance and recommender systems for visual analytics, our approach is **goal-driven**.

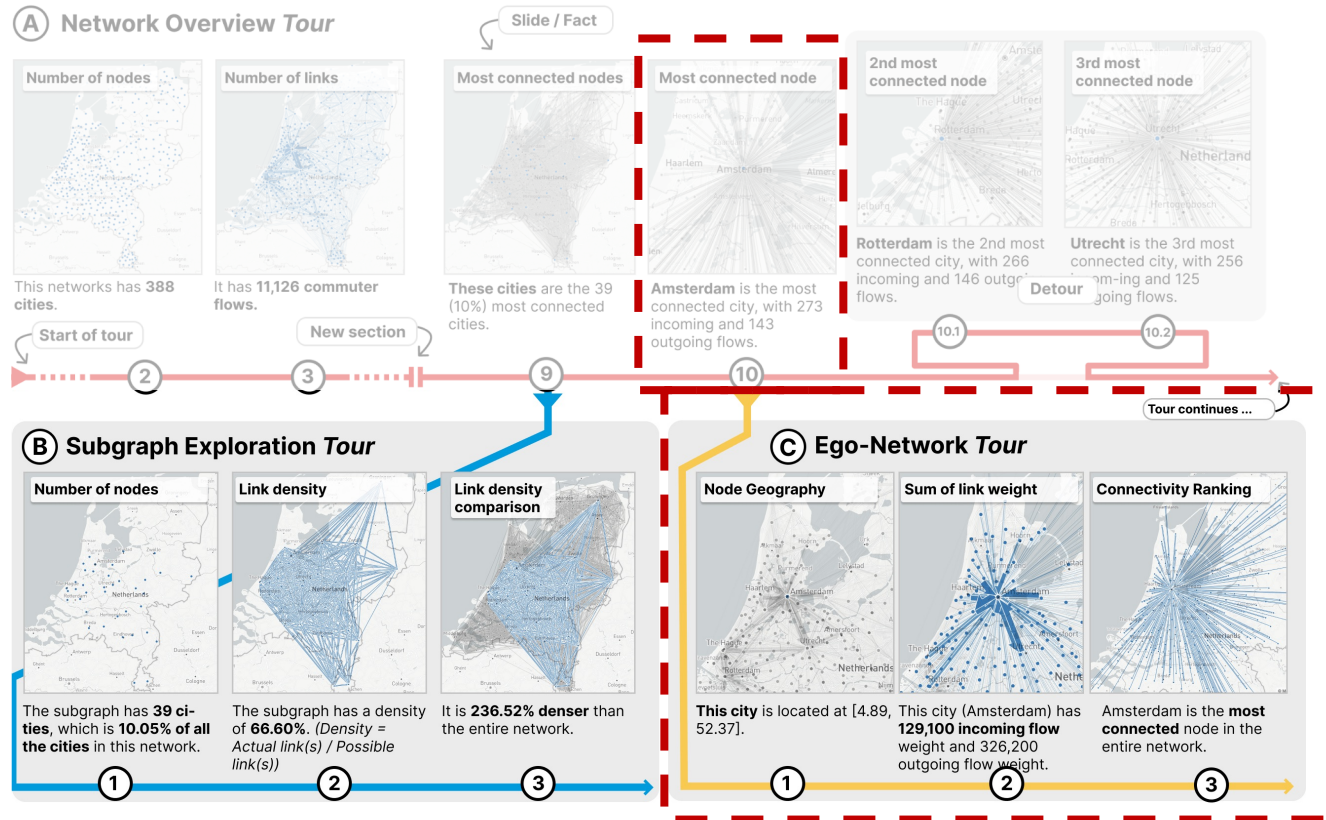
# Main Characteristics of Data Tours



2. Tours are primarily **sequential**.



# Main Characteristics of Data Tours



3. The implemented 10 complementary example data tours can be **linked** so an analyst can pivot between them



# NetworkNarratives User Interface

A screenshot of the NetworkNarratives User Interface. The interface is divided into several sections:

- Configuration:** Includes a "Select example dataset" button, a "Return" button, and a "Selected dataset: [local] Netherlands Co" label. Below this is a "Select a tour:" section with a "Filter" button and a list of tours: "None", "[overall] Network Overview" (highlighted), "[overall] Centrality Exploration", "[overall] Community Exploration", and "[subgraph] Subgraph Overview".
- Topics:** A dropdown menu showing selected topics: "geography", "nodes", "density", "outliers", "statistics", "connectivity", "weight", and "overview".
- General Information:** A section titled "General Information: Number of links" with a "Number of links" item highlighted in blue.
- Link Information:** A section titled "Link Information (4)" with items: "Total link weight", "Average link weight", "Strongest link", and "Weakest link".
- Node Centrality:** A section titled "Node Centrality (5)" with items: "Top connected nodes (highest degree)", "Most connected node", "Node with most incoming links", "Node with most outgoing links", and "Least connected nodes (lowest degree)".
- Map:** A map of the Netherlands showing a dense network of blue nodes and edges. The map is titled "General Information: Number of links" and includes a "The network has 11,216 flow(s)." text below it.
- Navigation:** A bottom navigation bar with buttons for "Previous section", "Previous slide", "Next slide", and "Next section". Below this are buttons for "More about [Number of links]", "More about [General Information]" (highlighted), and "Related tours".

## Configuration

[Select example dataset](#)[Return](#)

Selected dataset: [local]

## Select a tour:

[Filter](#)[Import](#)

None

[overall] Network Overview

[overall] Centrality Exploration

[overall] Community Exploration

[subgraph] Subgraph Overview

Follow the tour, using the navigation panel on the right or the overviews below:

[Outline](#)[Bookmarks](#)[Export](#)[Edit the tour](#)

Please select a tour on the left panel.

[0 / 0]

[Previous section](#)[Previous slide](#)[Next slide](#)[Next section](#)[More about \[the slide\]](#)[More about \[the section\]](#)[Related tours](#)

Configuration

Select example dataset

Return

Selected dataset: [local] Netherlands Commuters

Select a tour:

Filter

Import

None

[overall] Network Overview

[overall] Centrality Exploration

[overall] Community Exploration

[subgraph] Subgraph Overview

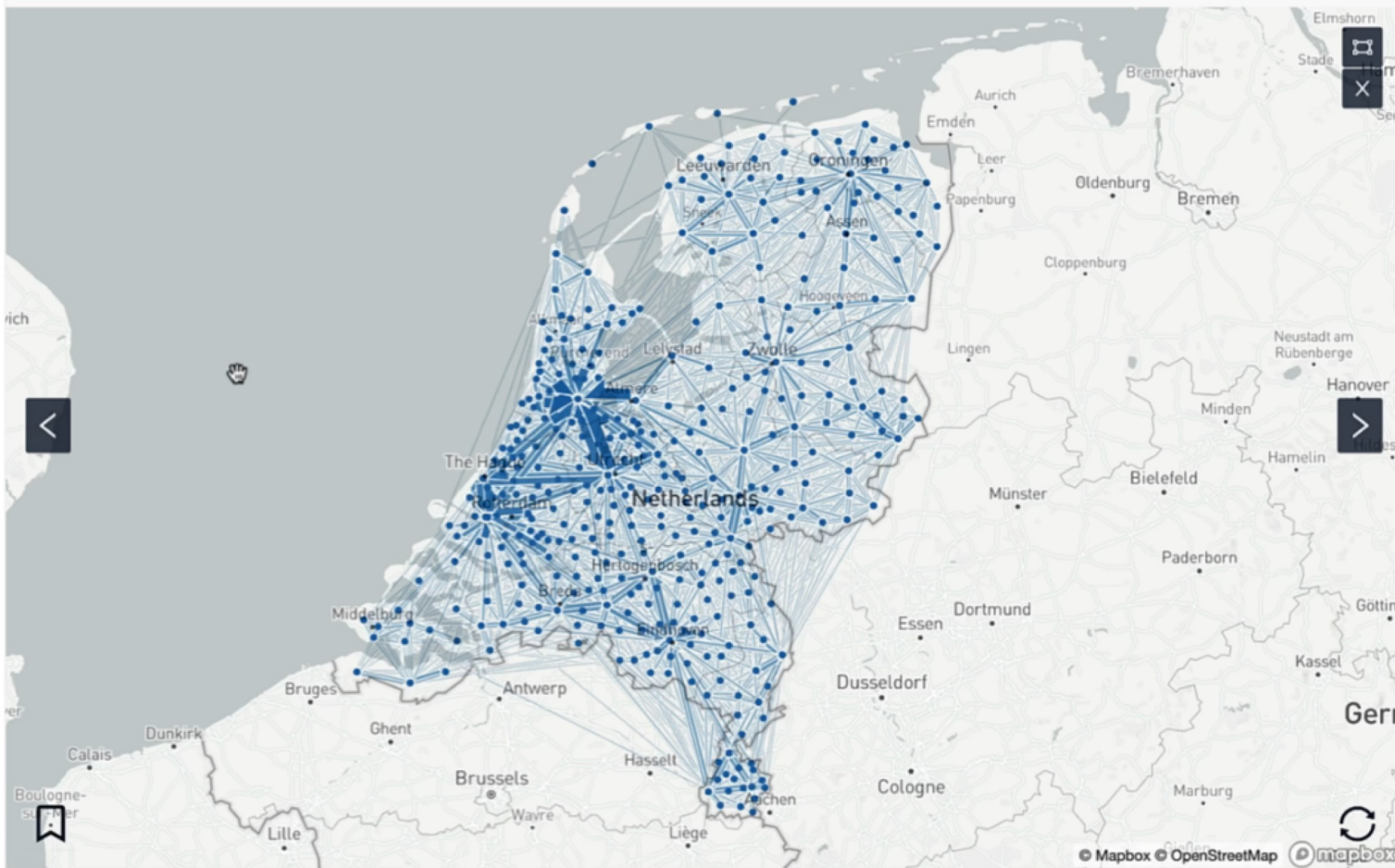
Follow the tour, using the navigation panel on the right or the overviews below:

Outline

Bookmarks

Export

Edit the tour



Please select a tour on the left panel.

[0 / 0]

Previous section

Previous slide

Next slide

Next section

More about [the slide]

More about [the section]

Related tours



Configuration

Select example dataset Return

Selected dataset: [local] Netherlands Commuters

Select a tour: Filter Import

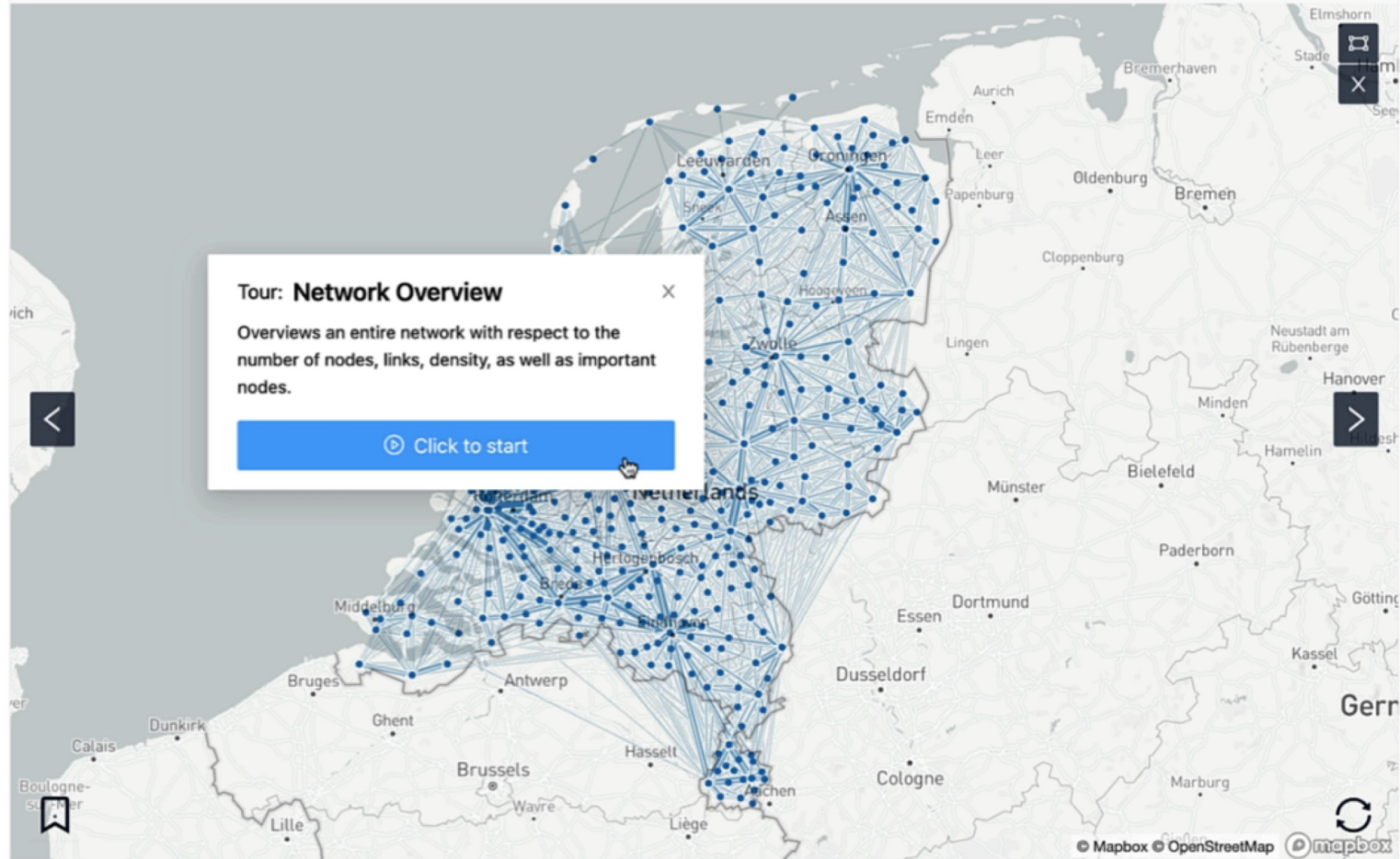
- None
- [overall] Network Overview**
- [overall] Centrality Exploration
- [overall] Community Exploration
- [subgraph] Subgraph Overview

Follow the tour, using the navigation panel on the right or the overviews below:

Outline Bookmarks Export

- General Information (4)
  - Geographic position
  - Number of nodes
  - Number of links
  - Network density
- Link Information (4)
  - Total link weight
  - Average link weight
  - Strongest link
  - Weakest link
- Node Centrality (5)
  - Top connected nodes (highest degree)
  - Most connected node
  - Node with most incoming links
  - Node with most outgoing links
  - Least connected nodes (lowest degree)

Edit the tour



Please select a tour on the left panel.

[0 / 14]

Navigation controls:

- Previous section
- Previous slide
- Next slide
- Next section
- More about [the slide]
- More about [the section]
- Related tours

Configuration

Select example dataset

Return

Selected dataset: [local] Netherlands Commuters

Select a tour:

Filter

Import

None

[overall] Network Overview

[overall] Centrality Exploration

[overall] Community Exploration

[subgraph] Subgraph Overview

Follow the tour, using the navigation panel on the right or the overviews below:

Outline

Bookmarks

Export

General Information (3)

- Number of nodes
- Number of links
- Network density

Link Information (4)

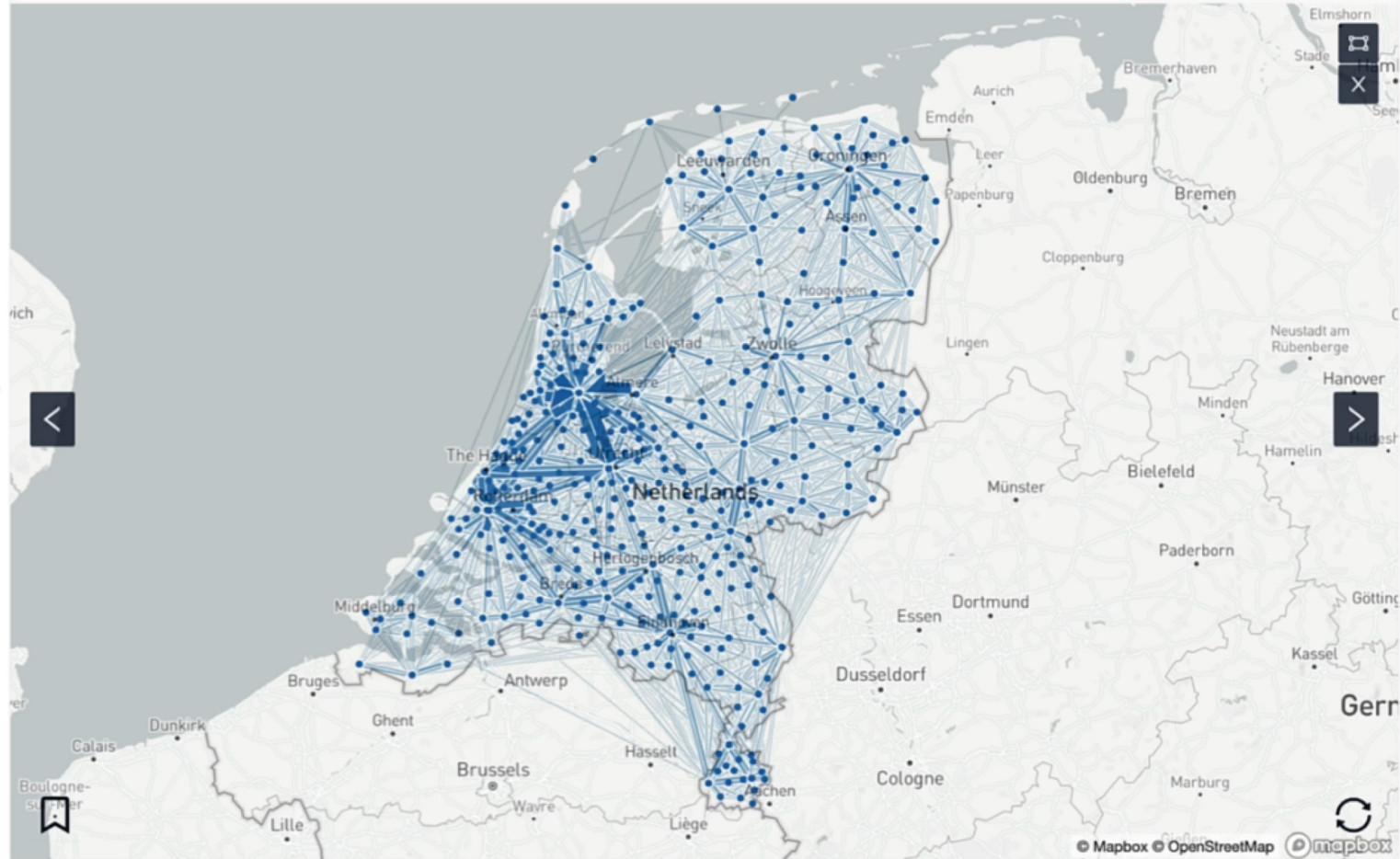
- Total link weight
- Average link weight
- Strongest link
- Weakest link

Node Centrality (5)

- Top connected nodes (highest degree)
- Most connected node
- Node with most incoming links
- Node with most outgoing links
- Least connected nodes (lowest degree)

Clusters (1)

Edit the tour



Please select a tour on the left panel.

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Navigation controls including buttons for 'Previous section', 'Previous slide', 'Next slide', 'Next section', 'More about [the slide]', 'More about [the section]', and 'Related tours'.



Configuration

Select example dataset

Return

Selected dataset: [local] Netherlands Commuters

Select a tour:

Filter

Import

None

[overall] Network Overview

[overall] Centrality Exploration

[overall] Community Exploration

[subgraph] Subgraph Overview

Follow the tour, using the navigation panel on the right or the overviews below:

Outline

Bookmarks

Export

General Information (4)

Geographic position

Number of nodes

Number of links

Network density

Link Information (7)

Total link weight

Average link weight

Median link weight

Strongest link

Weakest link

Nodes with link gains

Nodes with link loses

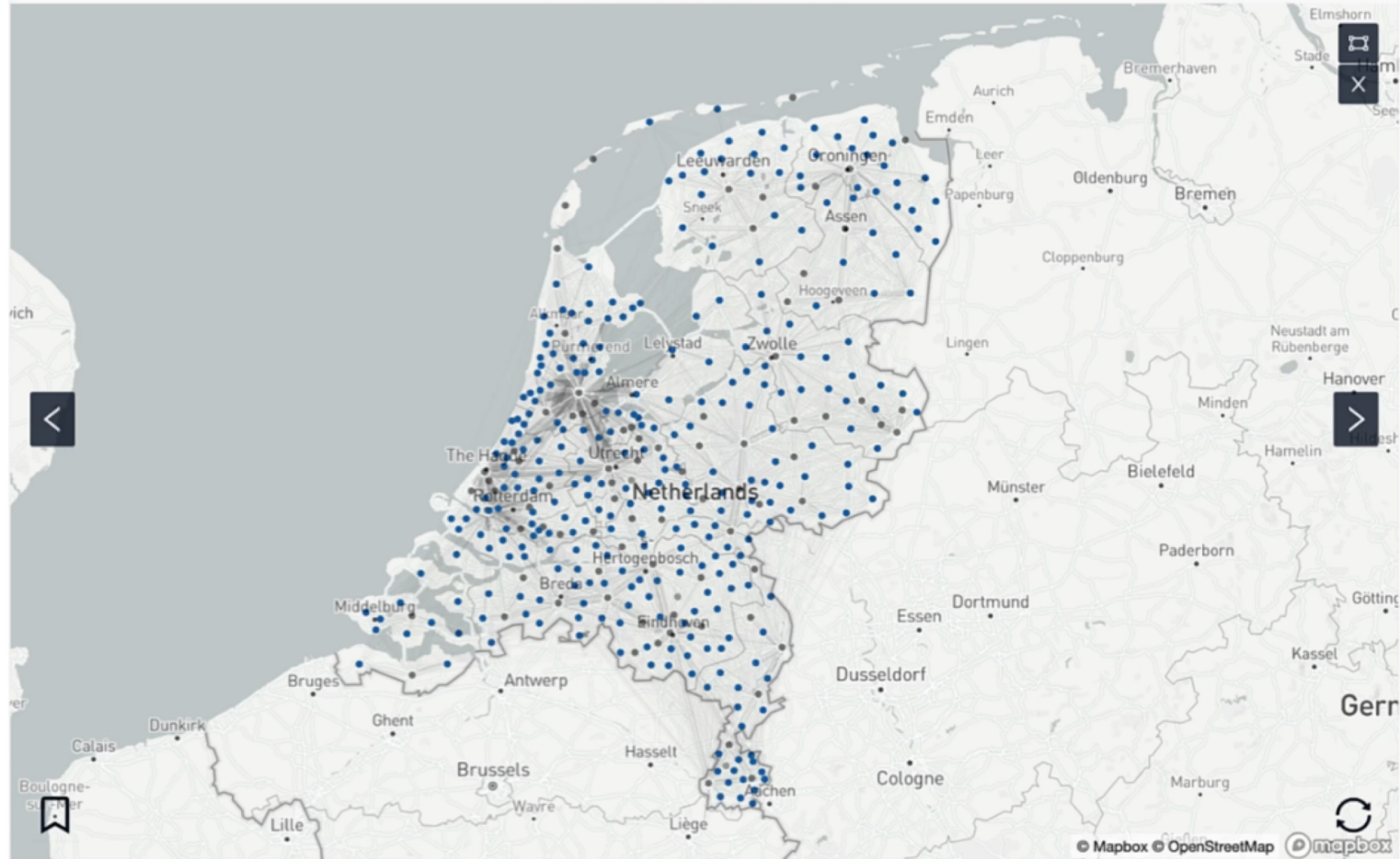
Largest link gain

Node Centrality (5)

Top connected nodes (highest degree)

Edit the tour

Link Information: Nodes with link loses



302 of the cities have flow loss (77.8%).

[ 11 / 18 ]

Previous section

Previous slide

Next slide

Next section

More about [Nodes with link lose...]

More about [Link Information]

Related tours

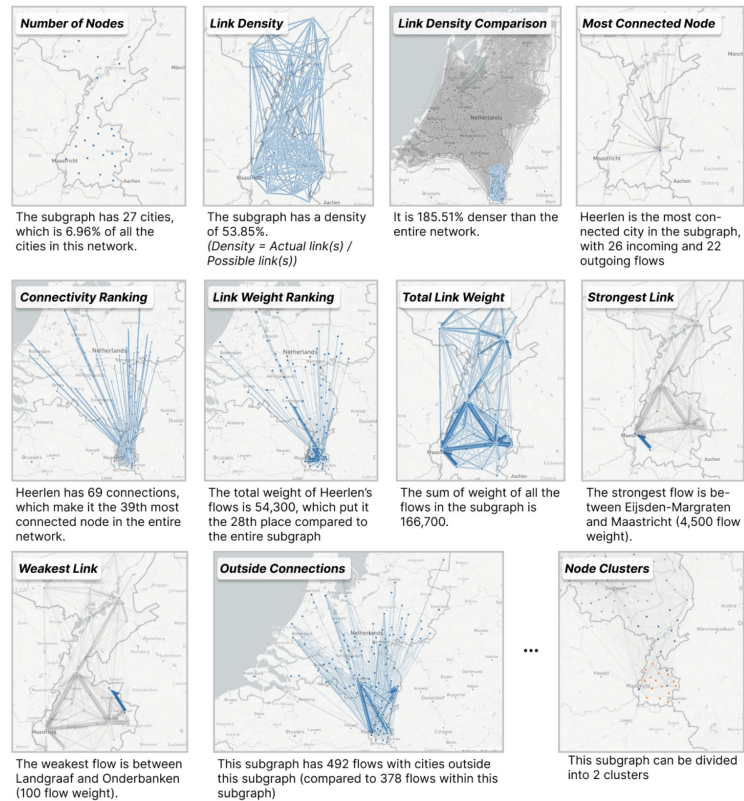


# Please visit: <https://networknarratives.github.io>



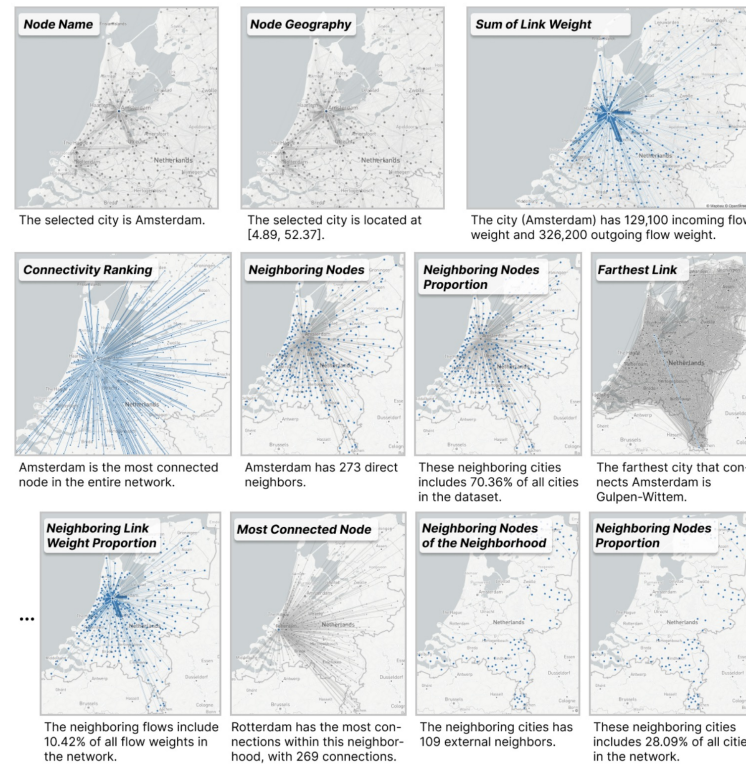
## Subgraph Overview

Subgraph Overview is similar to Network Overview but focuses on a specific subgraph. It shows the subgraph's size and the percentage of the network's nodes it comprises, important nodes, density, and important links to the rest of the network. After selecting the templates, a user is asked to select a subgraph using a lasso selection tool.



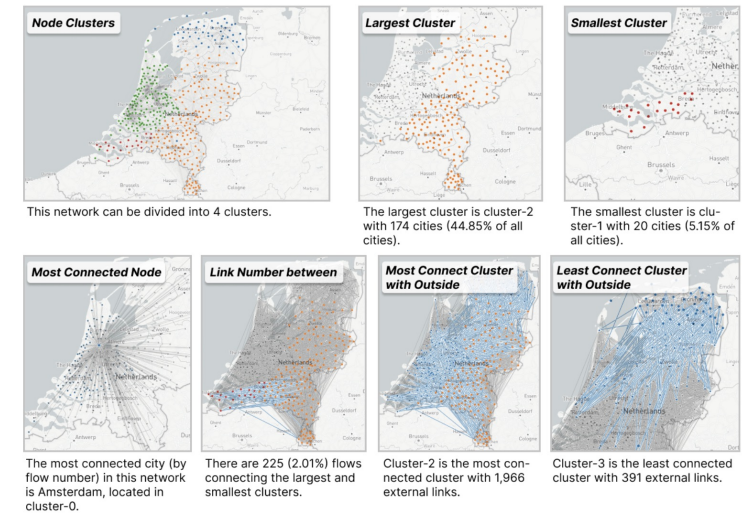
## Ego-Network Exploration

This data tour explores the network around a selected node and its neighbors. The tour starts with the selected node and its position within the entire network. The template then explores the node's direct neighborhood (nodes, links, strong connections), then their mutual connections, and finally, its neighbors' neighbors. Possible Paths explores a set of possible paths between two selected nodes. The tour reports on path length, combined weights along each path, and the minimum link weight within each path. This data tour was motivated by Archaeologist's desire to explore historical travel costs between cities.



## Centrality Exploration

This data tour explores nodes based on different centrality measures (e.g., degree or betweenness). For example, we compute the node with the Highest centrality for both Betweenness centrality and Closeness centrality. Possible extensions include the comparison of several centrality measures. Subgraph Comparison compares two specified subsets of nodes and links (e.g., regions, subgraphs). Selecting this template prompts the user to select two sets of nodes. The tour first mentions the Number of nodes and the Number of links for each subgraph, then details important nodes such as the Most connected node in each, and finally shows links between the two subgraphs (e.g., Number of links, their Total link weight, and the Strongest link among them).



# Evaluating Data Tours

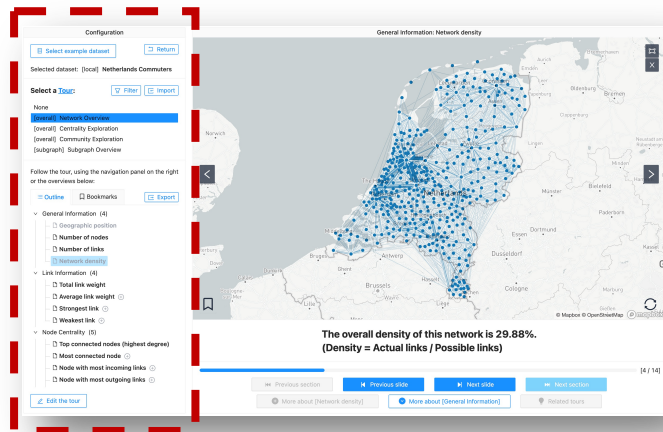
1. Expert study with 8 network analysis experts
  - Backgrounds in social science, history, archaeology, ...
  - Run online demo with their own data
  - Qualitative feedback from the semi-structured interview



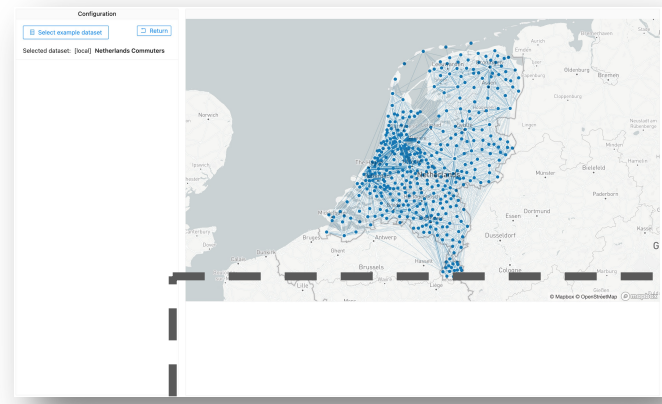
# Evaluating Data Tours

## 2. Novice study with 14 novice analysts

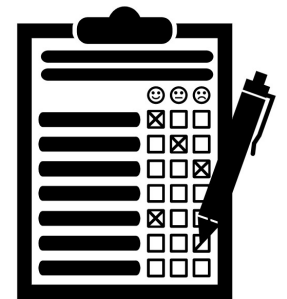
- With/Without data tour conditions (within-subject)
- 2 dataset
- Subjective ratings
- Qualitative feedback from the semi-structured interview



TOUR



FREE-FORM



# Finding from the evaluation

1. Tours are an **extensible** concept

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2. Data tours are **complementary** to free-form tools

Cond.	Advantages	Disadvantages
TOURS	Orients users with a narrative. Automatically provides facts. Can inspire deepened exploration. May lead to additional discoveries. Easy navigation. Saves time. Helps learn about analysis.	Can limit thinking and feel passive. Explanations need to be chosen carefully. Supports a rich set of views.
FREE-FORM	Provides greater flexibility for exploration.	Harder to obtain deep insights or spot patterns with low prominence. Requires more time and effort to interact. Requires users to know where to look/have an exploration strategy.



# Finding from the evaluation

1. Tours are an **extensible** concept
2. Data tours are **complementary** to free-form tools
3. Data tours are a means to **accelerate** analysis and exploration
  - *“The slideshow analogy is helpful [...] I can see my time saving with this”*
  - *“The way of clicking the next button only is very friendly to me. I don’t need other hints or reminder for what to do”*



# Finding from the evaluation

1. Tours are an **extensible** concept
2. Data tours are **complementary** to free-form tools
3. Data tours are a means to **accelerate** analysis and exploration
4. Quick overview can **prevent analysts from getting lost**
  - *“I like [data tours] because the data facts are organized systematically”*
  - *“easy to find back the information”*

# Finding from the evaluation

1. Tours are an **extensible** concept
2. Data tours are **complementary** to free-form tools
3. Data tours are a means to **accelerate** analysis and exploration
4. Quick overview can **prevent** analysts **from getting lost**
5. Sequential tours support novice analysts **learning** about analysis methods and concepts
  - “[data tours] teach me how to analyze the network. Tours are like stories with different steps. I don’t need to remember the key concepts. The network visualization explains well and clearly”

# Finding from the evaluation

1. Tours are an **extensible** concept
2. Data tours are **complementary** to free-form tools
3. Data tours are a means to **accelerate** analysis and exploration
4. Quick overview can **prevent** analysts **from getting lost**
5. Sequential tours support novice analysts **learning** about analysis methods and concepts
6. Tours provide a **serendipitous** element to exploration

*“The recommendation for querying more information around a specific topic would be useful when I have no idea about what story I could tell”*

# Discussion

## 1. Possible extensions

- Handling more **complex types** of networks and analyses

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- Additional **visual representations** and presenting **formats**

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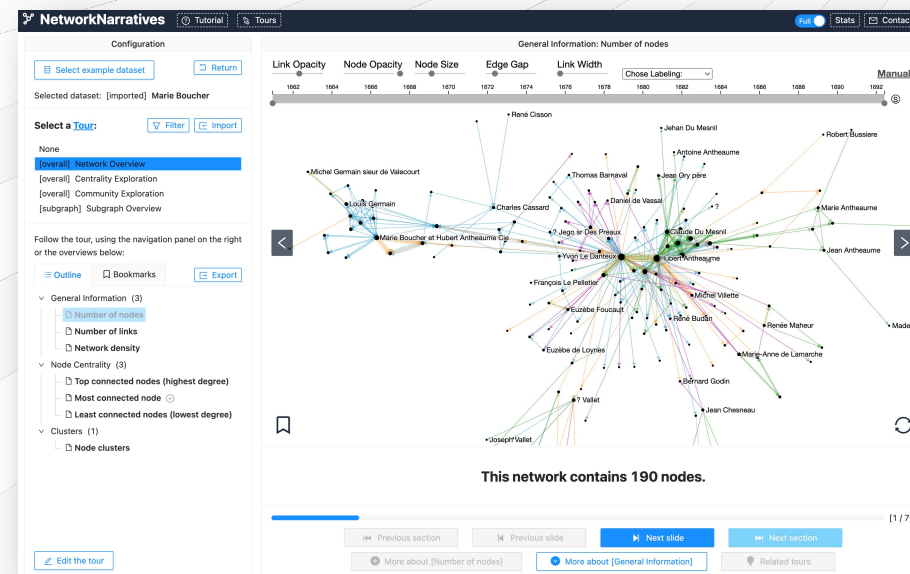
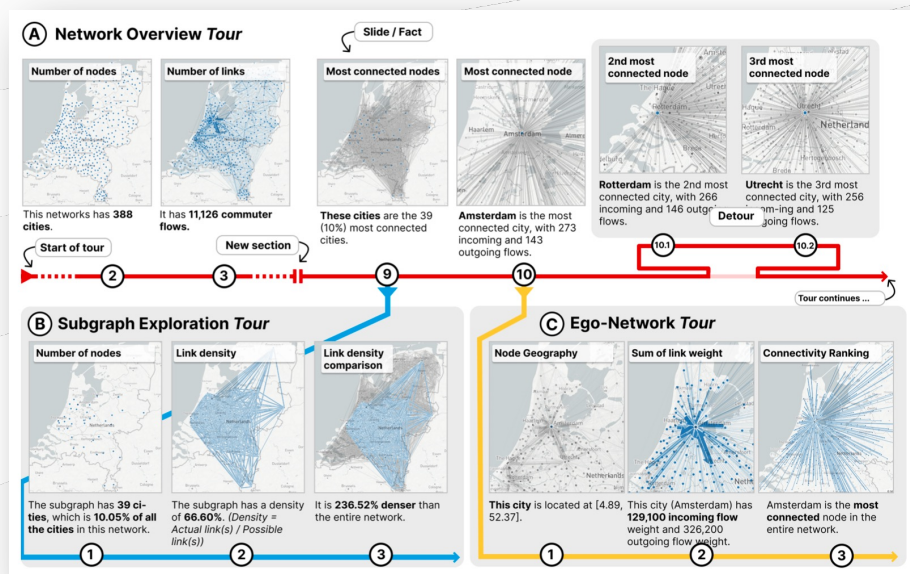
## 2. Balance between the **completeness** and **conciseness**



# Discussion

1. Possible extensions
  - Handling more complex types of networks and analyses
  - Additional visual representations and presenting formats
2. Balance between the **completeness** and **conciseness**
3. Challenges for **automation**

# NetworkNarratives: Data Tours for Visual Network Exploration and Analysis



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<https://networknarratives.github.io>

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