# Tourism Data Visualization of Vipava Valley


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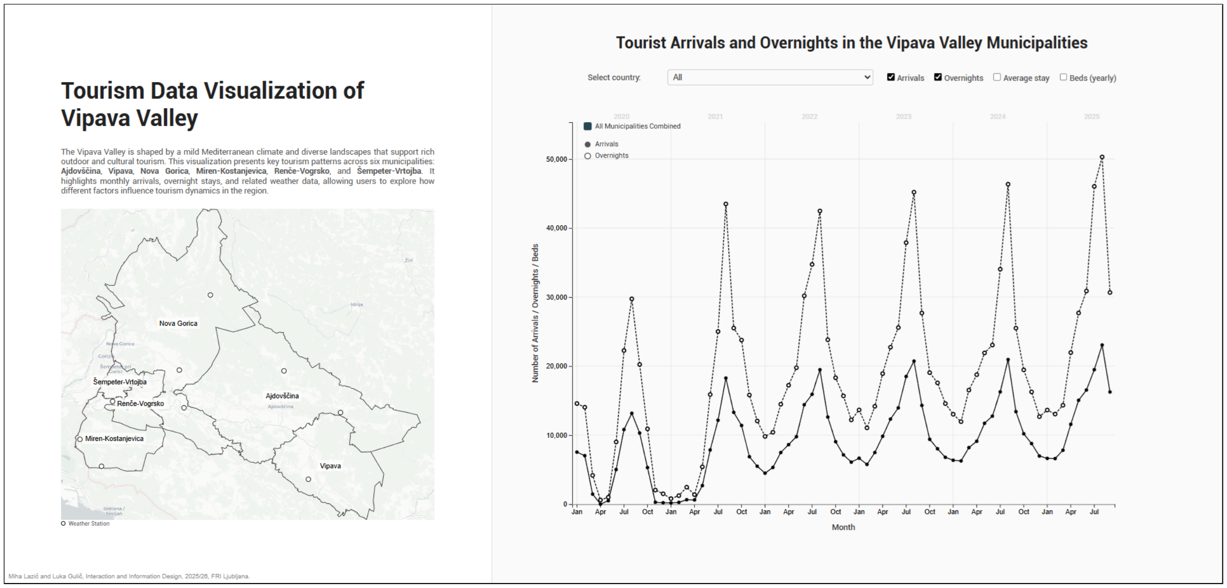


Figure 1: The interactive visualization system combines a choropleth map of municipalities and weather stations with a coordinated multi-attribute temporal chart for tourism and weather analysis in the Vipava Valley.


## Abstract

Tourism analysis requires reasoning about complex spatio-temporal relationships between visitor behavior, infrastructure capacity, and environmental conditions. This paper presents an interactive web-based visualization system for exploring tourism and weather data in the Vipava Valley, Slovenia, covering the period from January 2020 to September 2025. The system integrates a choropleth map with coordinated temporal visualizations that depict tourist arrivals, overnight stays, accommodation capacity, average length of stay, and weather measurements. Built using D3.js, the tool supports interactive spatial selection, multi-municipality comparison, attribute toggling, and aggregation. We demonstrate how the proposed design supports exploratory analysis and regional tourism decision-making through a qualitative, task-based evaluation.



**Index Terms:** Tourism visualization, spatio-temporal data, coordinated views, D3.js, weather data visualization.


## 1 Introduction

Tourism in the Vipava Valley represents an important economic activity shaped by strong seasonality, diverse visitor origins, and environmental factors such as weather conditions. Understanding tourism dynamics at a municipal level requires analyzing multiple interdependent variables over time, including tourist arrivals, overnight stays, accommodation capacity, and average length of stay. Interactive information visualization offers effective means for addressing this kind of challenges by enabling users to explore data through direct manipulation, coordinated views, and dynamic filtering. This project addresses the challenges by developing **an interactive visualization system for the Vipava Valley**. The main contributions of the project are:

- An integrated visualization of tourism and weather data covering January 2020 to September 2025.
- A coordinated choropleth–timeline design enabling comparison across six municipalities and multiple weather stations.
- Interactive mechanisms for attribute toggling, spatial selection, aggregation, and temporal exploration.

## 2 Related Work

Chang et al. [3] investigate the use of interactive information visualization to support decision-making and spatio-temporal analysis in tourism, with a particular focus on underexplored regions. The authors highlight that tourism datasets are often fragmented, heterogeneous, and difficult to interpret, especially in contexts where official statistics are published in inconsistent formats or with limited temporal resolution. To address these challenges, they present a case study on tourism in Sarawak, Malaysia, a region with significant economic potential but limited access to structured tourism data. Their work evaluates the feasibility and effectiveness of interactive visualization techniques for understanding tourist flows, seasonal patterns, and spatial differences. The proposed approach follows a three-stage methodology consisting of **data collection and preprocessing**, **iterative visualization design**, and **qualitative user evaluation**. The resulting web-based system, Adventure


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Sarawak, implemented using D3.js, integrates multiple data sources and supports interaction techniques such as filtering, comparison, details-on-demand, transitions, and coordinated views. A qualitative user study with ten participants demonstrates that the system enables efficient and accurate completion of analytical tasks and improves users' understanding of tourism trends. The authors conclude that interactive visualization represents an effective tool for tourism decision support in data-scarce regions, and they identify the integration of predictive models and immersive technologies as promising directions for future work.

## 3 Data

The visualization integrates preprocessed data below spanning January 2020 to September 2025.

### 3.1 Tourism Data

Tourism data was obtained from official SiStat databases [5], available at a monthly resolution for six municipalities: *Renče–Vogrsko*, *Miren–Kostanjevica*, *Šempeter–Vrtojba*, *Nova Gorica*, *Vipava*, and *Ajdovščina*. For each municipality and selected country of origin, the following tourism attributes are provided:

- *Number of tourist arrivals (monthly),*
- *Number of overnight stays (monthly),*
- *Number of available tourist beds (annual),*
- *Average length of stay, computed as the ratio of overnight stays to arrivals (monthly).*

### 3.2 Weather Data

Weather data from the ARSO meteorological archive [1] is provided as monthly measurements from nine weather stations: *Sela na Krasu*, *Opatje Selo*, *Bilje*, *Zalošče*, *Šempas*, *Lokve*, *Podraga*, *Otlica*, and *Hrušica pri Colu*. For each mentioned weather station, minimum of thirteen attributes are provided, such as:

- *Precipitation Amount [mm],*
- *Maximum Precipitation [mm],*
- *Number of Days With Fog, ...*

### 3.3 Geo Data

Municipal boundaries GeoJSON data was taken from a public GitHub repository [2].

## 4 System Design and Implementation

The system is implemented as a client-side web application using D3.js and is organized around two tightly coordinated views: **a spatial selection view** and **a temporal analysis view**.

### 4.1 Spatial View

**The spatial view**, shown in Figure 2, consists of a choropleth map displaying municipal boundaries and weather station locations. Municipalities and stations can be selected through direct interaction. Selected municipalities are color-coded, and these colors are consistently reused in the temporal view. Users may activate multiple municipalities simultaneously for comparison, while at most one weather station can be selected at any time (black circle).

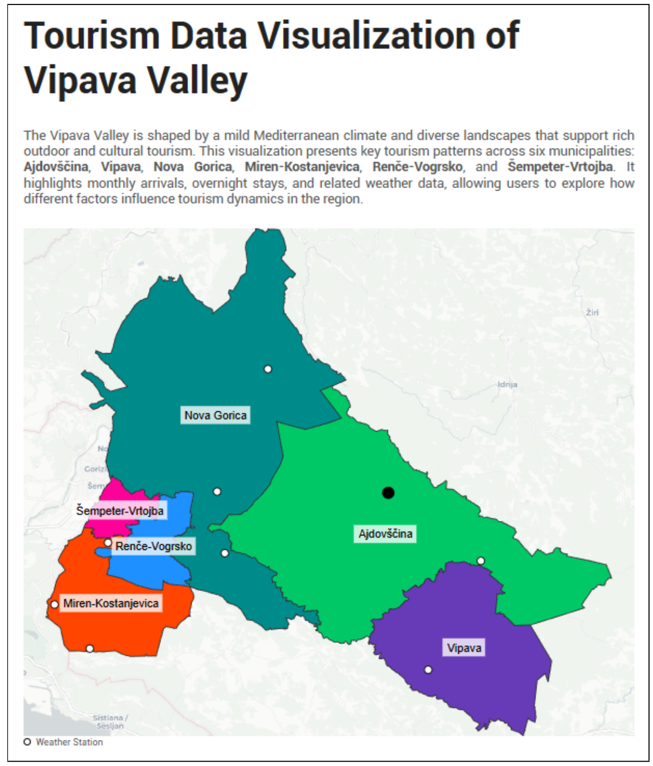


Figure 2: Spatial view of the visualization showing color-coded municipalities and weather stations. Selected municipalities are highlighted using consistent color encoding, while the currently selected weather station is indicated by a black circle and unselected stations by white circles.

### 4.2 Temporal View

**The temporal view**, shown in Figure 3 is a multi-layered line and histogram chart that updates dynamically based on spatial selections and user-defined filters (drop-down menus and checkboxes). The chart includes the following visual encodings:

- Monthly tourist arrivals shown as **solid lines with filled circular markers**.
- Monthly overnight stays shown as **dashed lines with hollow circular markers**.
- Annual number of tourist beds shown as **a semi-transparent histogram** aligned to the left y-axis.
- Average length of stay shown as **a dotted line with triangular markers** mapped to a right y-axis.
- Monthly weather data shown as **a semi-transparent histogram** mapped to a right, blue-colored y-axis.

Arrivals, overnight stays, and accommodation capacity share a black left y-axis, while average length of stay and weather attributes are mapped to separate right y-axes to reduce visual interference.

When no municipality is selected, the chart displays aggregated arrivals and overnight stays across all six municipalities, providing a regional overview, as shown in Figure 1.

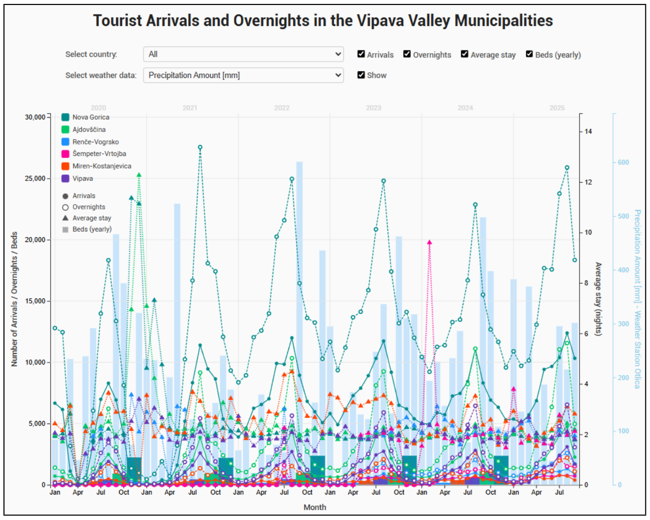


Figure 3: Temporal view of the visualization showing all available municipality data attributes simultaneously. The figure illustrates the potential for visual clutter and motivates the use of interactive checkboxes for selectively enabling and disabling individual data layers.

### 4.3 Interaction Design

The system supports several interaction techniques:

- Spatial selection of municipalities and weather stations via the choropleth map.
- Attribute selection through dropdown menus for country of origin and weather variables.
- Attribute visibility control using checkboxes for each visualized variable.
- Multi-municipality comparison with consistent color encoding.

In addition, the temporal view supports **brushing interaction**: users can select a specific time interval directly on the line chart, upon which the system computes and displays aggregated statistics (e.g., total arrivals, total overnight stays, and average length of stay) for the selected period, based on the currently visible municipalities and attributes, a shown in Figure 4.

## 5 Evaluation

The evaluation was designed as a task-based, comparative assessment to validate whether the proposed system correctly supports typical analytical tasks in regional tourism planning and improves upon existing non-interactive solutions. Rather than conducting a large-scale user study, we adopted a lightweight evaluation approach commonly used for exploratory visualization systems.

We defined a set of representative analytical tasks derived from real-world tourism analysis scenarios, including:

- Identifying seasonal tourism patterns between 2020 and 2025.
- Comparing tourist arrivals, overnight stays, and average length of stay across municipalities.
- Examining the relationship between tourism dynamics and weather conditions.
- Assessing changes in accommodation capacity over time.

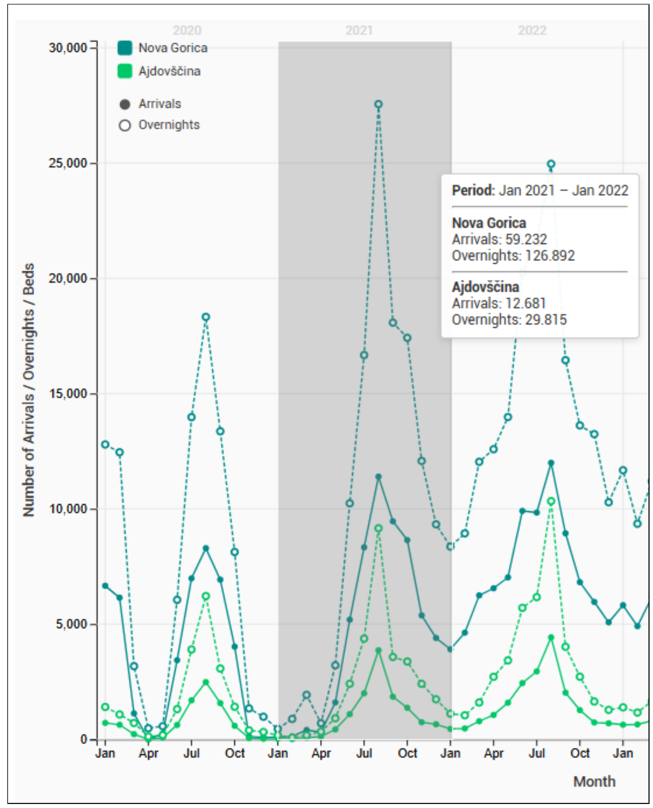


Figure 4: Brushing interaction on the temporal view, enabling users to select a specific time interval and compute aggregated statistics for direct comparison between multiple municipalities.

For each task, we compared the workflow required using conventional data sources—such as static charts and tabular outputs from the SiStat database and separate weather portals—with the workflow enabled by our interactive system. Correctness was validated by verifying that aggregated values produced through interactive operations (e.g., brushing-based time selection) matched manually computed reference values from the raw data.

Qualitative improvements were observed in terms of flexibility, interpretability, and reduced cognitive load. Coordinated views eliminated the need to switch between multiple tools, while interactive filtering, attribute toggling, and brushing enabled rapid hypothesis testing and comparison across municipalities and time periods.

Quantitative improvements were estimated by comparing the number of interaction steps required to complete each task. For example, identifying aggregated summer tourism statistics for a selected municipality required multiple manual filtering and aggregation steps in tabular data, whereas the same task could be completed using a single brushing interaction in our system. This reduction in interaction steps and task completion time indicates improved analytical efficiency.

Overall, the evaluation demonstrates that the proposed visualization system correctly supports key tourism analysis tasks and provides both qualitative and quantitative advantages over traditional, non-interactive data exploration approaches.

## 6 Discussion

The project demonstrates the benefits of integrating tourism and weather data within a single interactive visualization. The ability to toggle attributes and compare multiple municipalities supports exploratory analysis while mitigating visual clutter. However, scalability remains a limitation when many attributes are displayed simultaneously. Future work could explore adaptive aggregation or focus+context techniques to address this issue.

Additionally, the current system relies exclusively on quantitative indicators. Incorporating qualitative measures, such as visitor satisfaction or sustainability metrics, could further enhance decision support.

## 7 Conclusion

We presented an interactive spatio-temporal visualization system for tourism and weather data in the Vipava Valley. By combining a choropleth-based spatial interface with a multi-attribute temporal chart, the system enables detailed exploration of tourism dynamics from January 2020 to September 2025. The project demonstrates how coordinated views and interactive filtering can support regional tourism analysis and planning.

## Supplemental Materials

A live version of the visualization is available at this link. The complete source code, implemented using D3.js, is available in a public GitHub repository [4].

## References


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