Tourism Data Visualization of Vipava Valley

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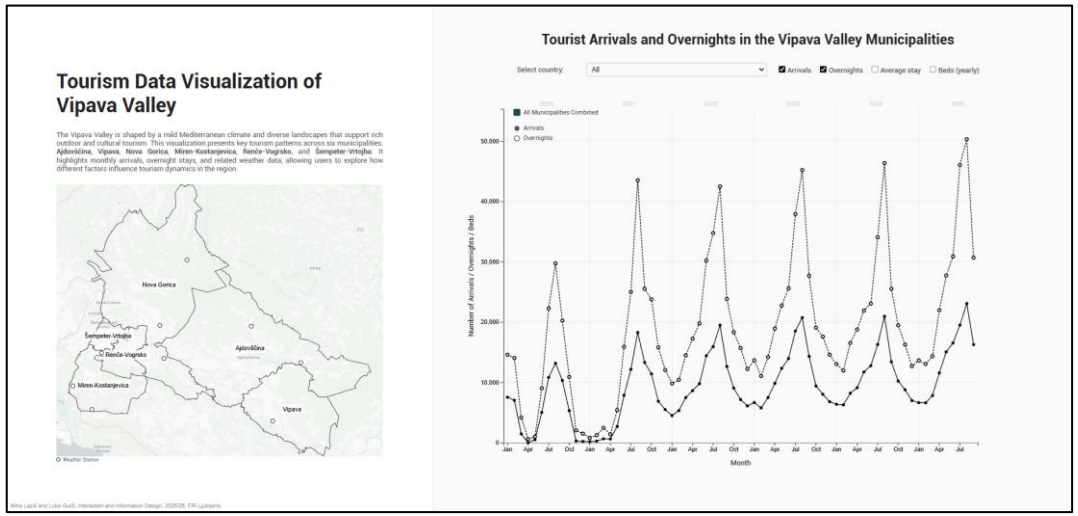

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Problem

Currently, there is no interactive visualization platform available for the **Vipava Valley** that combines tourism and weather data. Existing sources present these datasets separately and in static formats, which makes it difficult for users, researchers, and local authorities to explore correlations between tourism trends and environmental factors across different municipalities.

Solution

We developed an interactive D3.js web application that visualizes various tourism and weather datasets for each municipality in the **Vipava Valley**. The platform includes an interactive map and dynamic graphs, allowing users to easily explore patterns, compare locations, and analyze temporal trends. This approach provides a more engaging and informative way to understand the relationship between tourism activity and weather conditions.

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Related Work

Chang et al. (2015) – Exploring interactive tourism data visualization for effective decision-making and spatial temporal analysis.

- **Case study:** Sarawak, Malaysia (high tourism potential but poor data availability)
- **Key challenges:** Fragmented and heterogeneous datasets, inconsistent formats of official statistics, limited temporal resolution
- **Three-stage methodology:**
  1. Data collection and preprocessing
  2. Iterative visualization design
  3. Qualitative user evaluation
- **Result:** The resulting web-based system, Adventure Sarawak, implemented using D3.js, integrates multiple data sources and supports interaction techniques such as filtering, comparison, details-on-demand, transitions, and coordinated views.
- **Evaluation:** A qualitative user study with 10 participants demonstrates that the system enables efficient and accurate completion of analytical tasks and improves users' understanding of tourism trends.
- **Conclusion:** An 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.

Data

The visualization integrates preprocessed **tourism** and **weather data** from January 2020 to September 2025, for 6 municipalities: *Renče-Vogrsko*, *Miren-Kostanjevica*, *Šempeter-Vrtojba*, *Nova Gorica*, *Vipava* and *Ajdovščina*.

Tourism

Number of tourist arrivals (monthly), Number of overnight stays (monthly), Number of available tourist beds (annual), Average length of stays.
Source: **SiStat portal**

Weather

10+ weather attributes (e. g. Precipitation Amount [mm]) from 9 weather stations: *Sela na Krasu, Opatje selo, Bilje, Založče, Lokve, Šempas, Podraga, Otlica, Hrušica pri Colu*.
Source: **Slovenian Environment Agency (ARSO)**

GEO

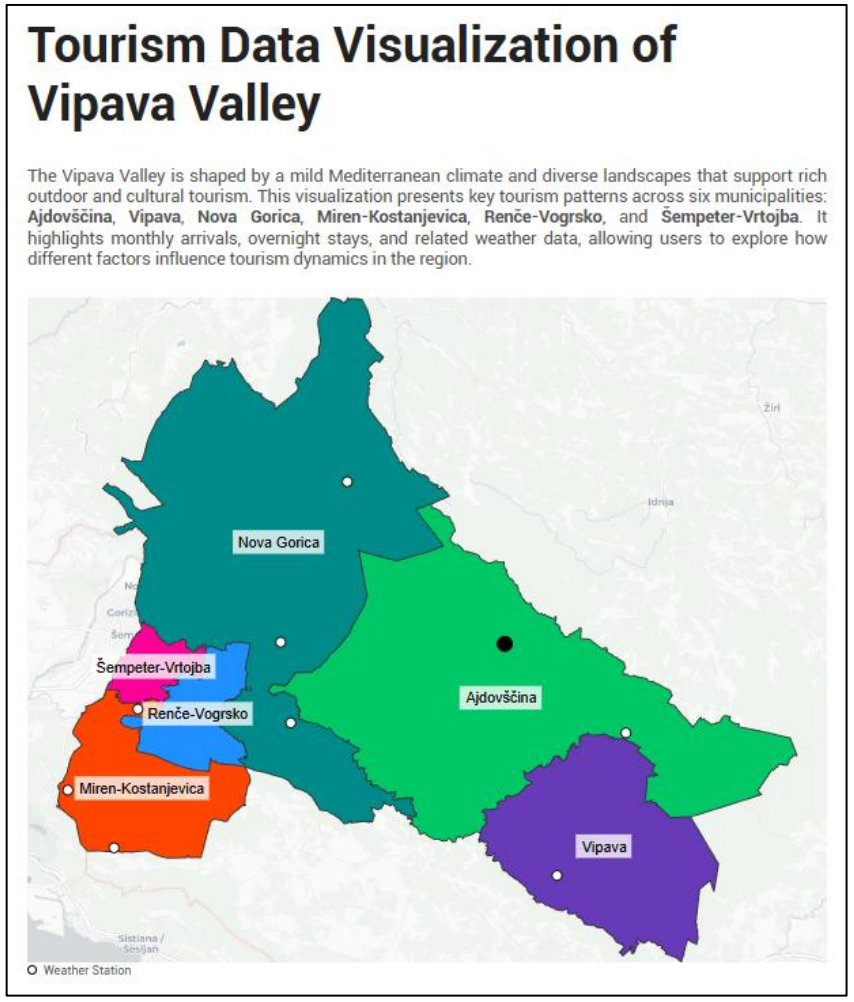
Municipal boundaries in GeoJSON format.
Source: **https://github.com/jeancaffou/gurs-obcine**

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.**

Spatial Selection View

- Choropleth map displaying municipal boundaries and weather stations.
- User can select different municipalities and weather station by clicking on them.
- Municipalities are color-coded. Colors are consistently reused in the Temporal Analysis View.
- Multiple municipalities can be selected at once for direct comparison in the Temporal Analysis View.
- Only one weather station can be selected at the time.

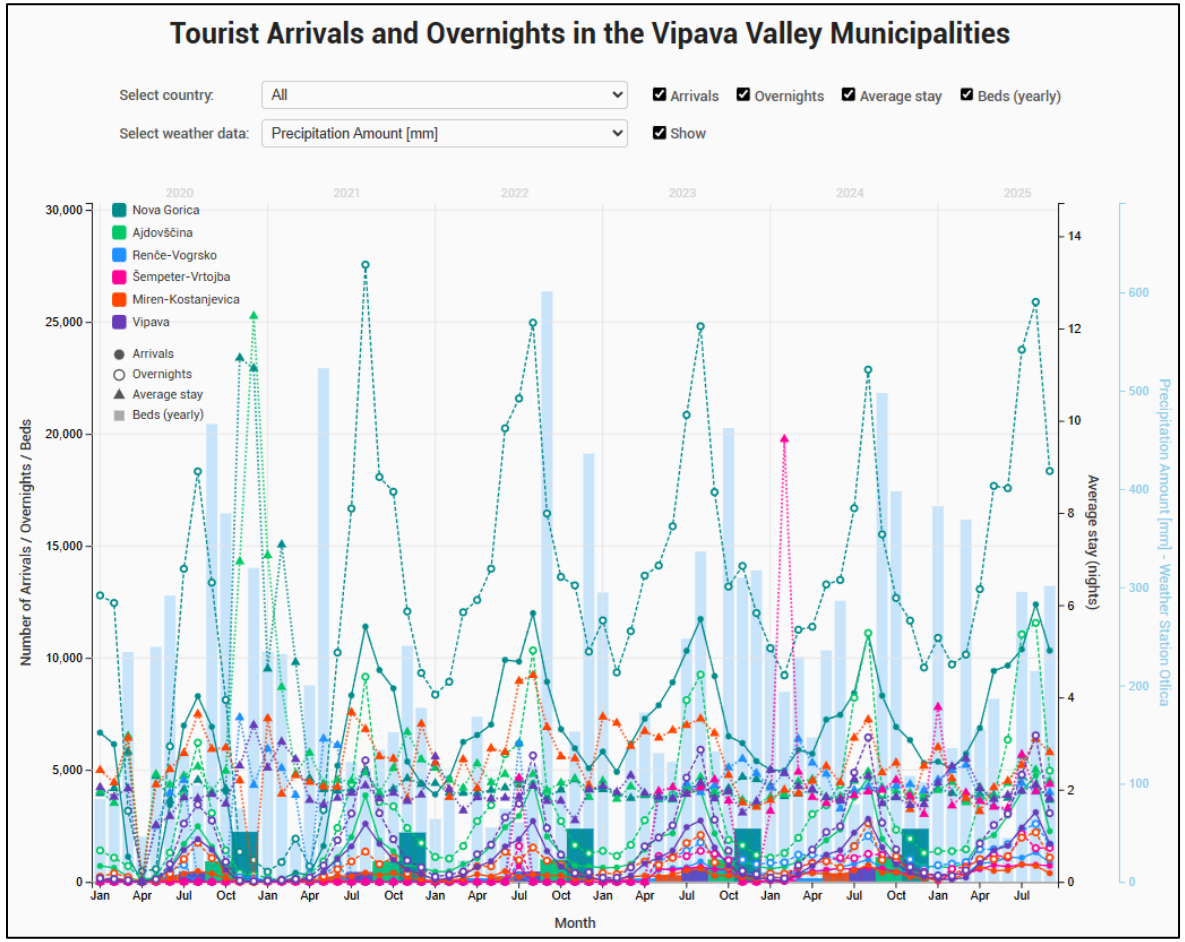


Temporal Analysis View

- Multilayered line and histogram chart that updates dynamically based on spatial selection and user-defined filters.

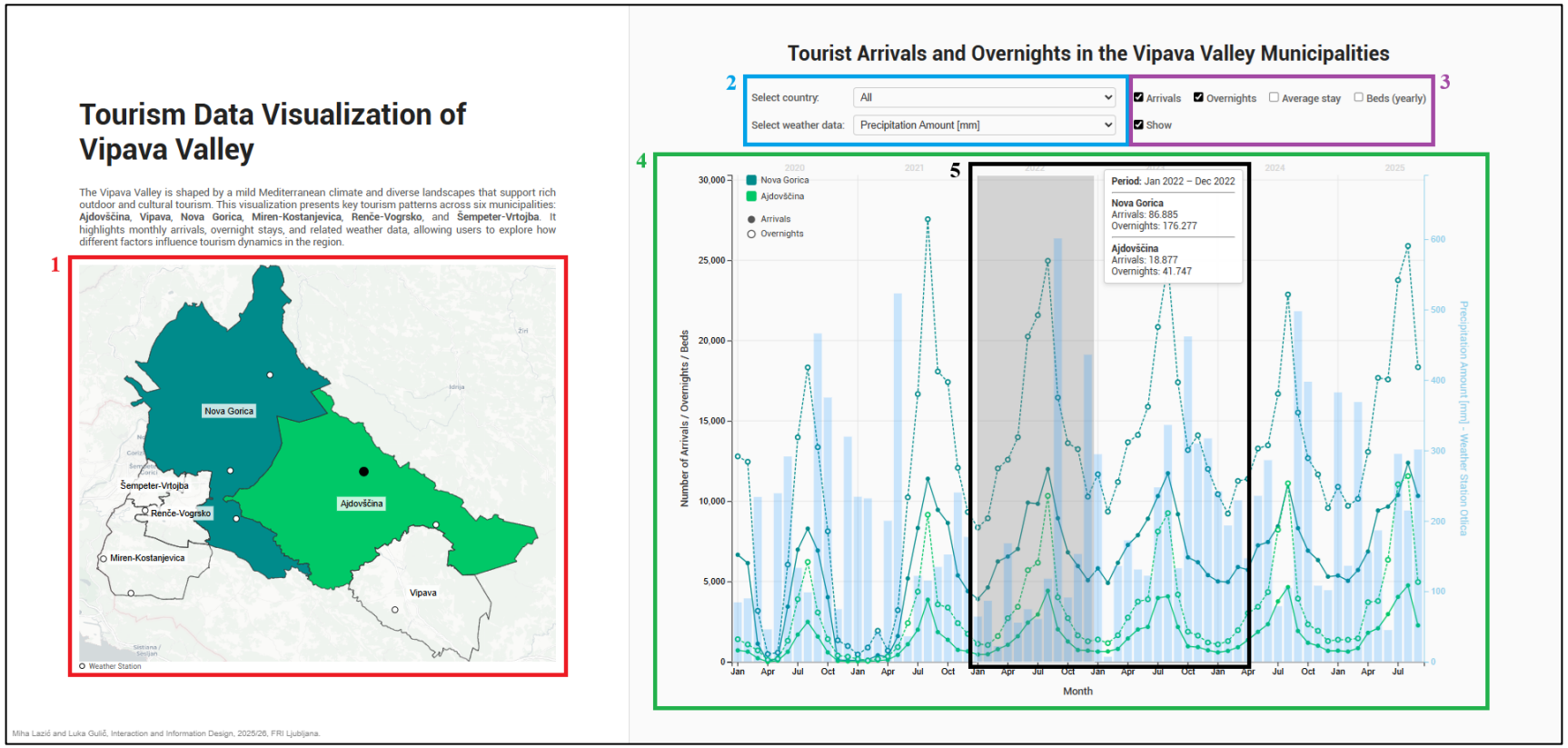
- *Monthly tourist arrivals:* solid lines with filled circles.
- *Monthly overnight stays*: dashed lines with hollow circles.
- *Average length of stays:* dotted lines with triangular markers.
- *Annual number of tourist beds:* grey histogram.
- *Monthly weather data:* shown as blue histogram.

- *Left y-axis:* Arrivals, beds, overnight stays.
- *Right y-axis:* Average length of stays and weather.



Interactions

1. Spatial selection of municipalities and weather stations via choropleth map.
2. Attribute selection from dropdown menus for country of origin and weather variables.
3. Attribute visibility control using checkboxes for each visualized variable.
4. Multi-municipality comparison with consistent color encoding.
5. Brushing allows user to select specific interval and displays aggregated statistics.



Evaluation

1. We defined a set of **real-world analytical tasks**:
   - *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.*

2. For each task, **we compared the workflow required using conventional data sources** (static charts and tabular outputs from the SiStat database and separate weather portals) with the workflow enabled by **our interactive system**.

3. **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 information gathering and comparison across municipalities and time periods.

4. **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.

Conclusion

- Interactive visualization integrates **tourism** and **weather data**
- Supports **spatio-temporal analysis** across municipalities (2020–2025)
- Coordinated views and attribute toggling improve **exploration** and **clarity**
- Enables **efficient comparison for tourism planning**

Limitations & Future Work:

- Scalability remains a limitation when many attributes are displayed simultaneously. Future work could explore **adaptive aggregation** or **focus+context techniques** to address this issue.
- Current system relies exclusively on quantitative indicators. Incorporating **qualitative measures**, such as visitor satisfaction or sustainability metrics, could further enhance decision support.

- Demo: https://lazzo23.github.io/Tourism-Data-Visualization-of-Vipava-Valley/