Japan Flu & Weather Visualization

Introduction

This platform is an advanced analytical tool that reveals the intricate relationships between environmental factors and influenza outbreaks across major Japanese cities. Utilizing historical data from 2019 to 2023, this system combines daily weather metrics with weekly influenza case reports, offering users a powerful means to explore and analyze seasonal and regional variations. Through multi-dimensional visual encoding (e.g., color, size, opacity) and interactive features such as dynamic filters and comparative views, the platform transforms raw data into accessible and actionable insights.

Beyond simply presenting historical trends, this system provides a foundation for understanding how climatic conditions influence disease transmission, enabling public health officials, researchers, and policymakers to craft more effective preventive strategies and allocate resources more efficiently. By bridging the gap between environmental data and epidemiological outcomes, this tool underscores the importance of integrating historical analysis into public health planning to build resilience against future influenza epidemics.

Dataset

- Weather data for each day:
  - 国土交通省気象庁 https://www.data.jma.go.jp/gmd/risk/obsdl/
  - Year: 2019~2023
  - Type: highest temperature, average temperature, lowest temperature, rainfall, snowfall, average humidity
  - City: Tokyo, Osaka, Hokkaido

- Influenza cases data for each week:
  - Year: 2019~2023
  - City: Tokyo, Osaka, Hokkaido
  - Age: <10, 10~19, 20~29, 30~39, 40~49, 50~59, 60~69, 70~79, 80+, all

  - Tokyo:
    - 東京都感染症センター https://survey.tmiph.metro.tokyo.lg.jp/epidinfo/csvinfo.do
    - <5 months old, <1 year old, 2, 3, 4, 5, 6, 7, 8, 9, 10~14, 15~19, 20~29, 30~39, 40~49, 50~59, 60~69, 70~79, 80+, all
  - Osaka:
    - 大阪府感染症情報センター https://www.iph.pref.osaka.jp/infection/2-old.html
    - < 6 months old, < 1 year old, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10~14, 15~19, 20+, all

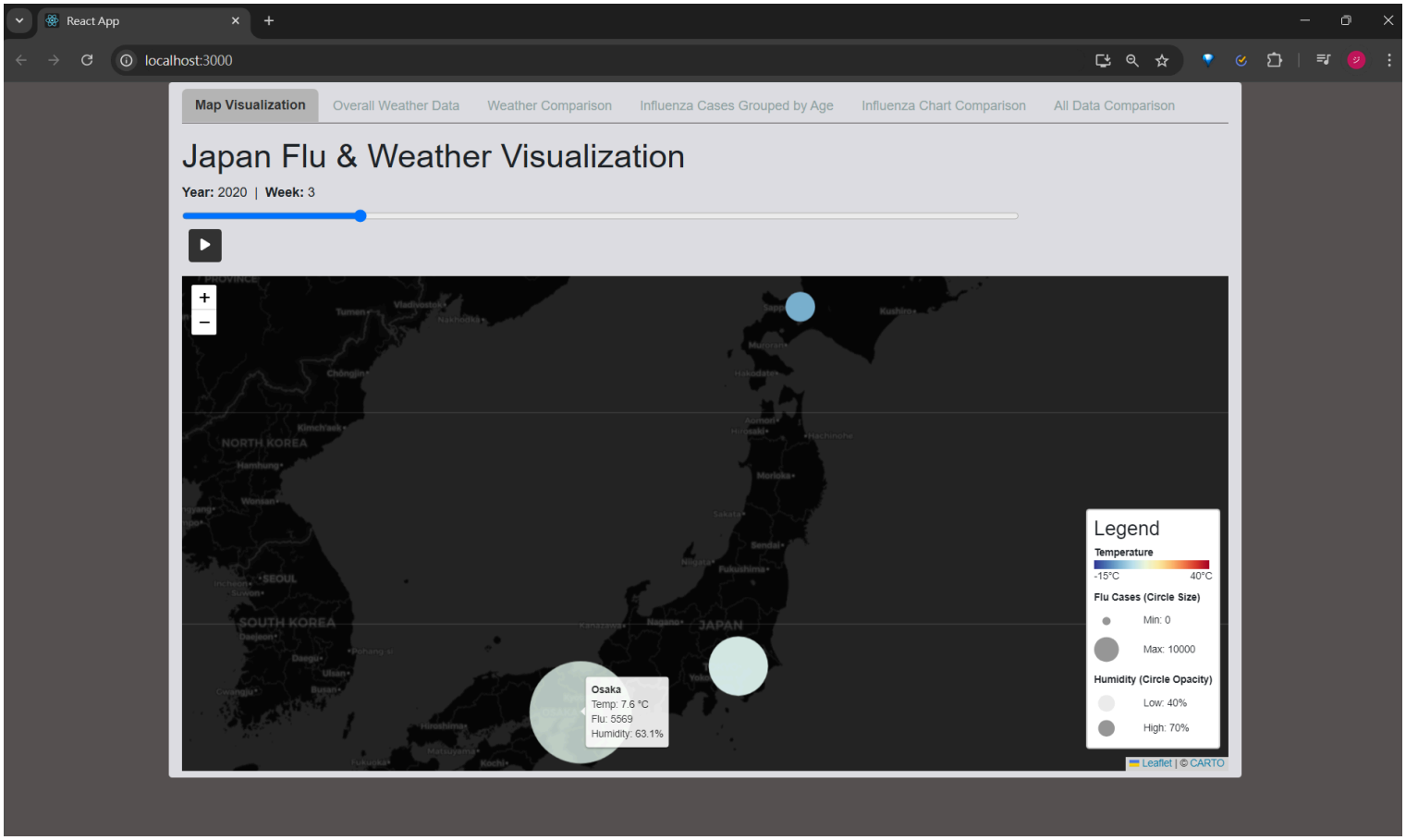
- Hokkaido:
  - 札幌市役所https://www.city.sapporo.jp/eiken/infect/archive.html
  - <6 months old, <1 year old, 1, 2, 3, 4, 5, 6 7, 8, 9, 10~14, 15~19, 20~29, 30~39, 40~49, 50~59, 60~69, 70~79, 80+, all

Since each city government offers data with different age ranges, we processed the data into units of 10 years. And not all the city governments offer the influenza cases, so we selected some famous cities which offer the complete data we want. We use Python to preprocess the data.

Observation

1. **During the COVID-19 pandemic, there were fewer influenza cases.**
   During the COVID-19 pandemic, the widespread adoption of preventive measures (such as wearing masks and maintaining social distance) effectively suppressed the transmission of influenza. As a result, influenza case numbers were significantly lower than usual during this period.
2. **There are more influenza cases in winter.**
   From the overall trend, cold winter months (approximately December to February) typically see a surge in influenza cases, suggesting that temperature is closely related to flu transmission. Additional factors such as indoor gatherings during colder months may also contribute to higher transmission rates.
3. **The peak of the epidemic was in mid-January, which may have been caused by reunions and travel during the New Year period.**
   By analyzing weekly data across different years, it becomes evident that mid-January is often when influenza cases spike. This may be linked to gatherings and travel during the New Year holiday period, which facilitate easier spread of the virus within communities. Implementing preventive measures during this period could mitigate the impact of such outbreaks.
4. **Although Hokkaido became colder earlier, the timing of the increase in epidemics was consistent with that of the other two places.**
   Hokkaido generally experiences a drop in temperature earlier than Tokyo or Osaka, yet the timing of influenza outbreaks in different areas does not show a distinctly earlier onset. This indicates that while temperature changes are a factor, overall population movement and transmission dynamics also play key roles, resulting in a fairly synchronized peak across regions.
5. **Among all weather data, temperature is most closely related to the number of cases.**
   Compared to other weather indicators, such as precipitation and humidity, temperature exerts the most significant influence on changes in flu case numbers. When temperatures drop, the number of cases typically rises; conversely, when temperatures increase, the epidemic tends to ease.

Map Visualization



Japan Map:

- Uses Leaflet to present the geographical location of Japan.
- The map can be freely zoomed and dragged, allowing users to quickly switch between different areas and viewpoints.

Multi-dimensional Data Visualization:

- **Color (Temperature)**
  - Converts temperature values into a color gradient using D3's interpolation functions (e.g., interpolateRdYlBu).
  - Higher temperatures appear in warmer colors (reds or oranges), and lower temperatures in cooler colors (blues or purples), letting users instantly grasp temperature distributions across regions.
- **Circle Size (Number of Flu Cases)**
  - Circle size is proportional to the number of flu cases; the greater the number of cases, the larger the circle radius.
  - This helps users quickly identify the severity and concentration of outbreaks in different areas.

- **Circle Opacity (Relative Humidity)**
    - Uses opacity to represent varying humidity levels; the higher the humidity, the more transparent the circle, while lower humidity results in a deeper-colored circle.
    - Provides an intuitive sense of how weather conditions relate to flu transmission.

Time Slider / Weekly Selection:

- The interface features a time slider that lets users select the year and the week number.
- When the selected week changes, the relevant visual elements on the map update in real-time to reflect flu and weather data for that week.
- Includes a Play/Pause option that automatically cycles through weeks, simulating how flu trends change over different periods.

Tooltip for Detailed Information:

- When hovering over a circle marker, an info window pops up displaying detailed data for that region:
    - Total number of flu cases for the week
    - Average or highest temperature for the week
    - Humidity indicators
- This allows users to quickly grasp the status of each city or region directly from the map.

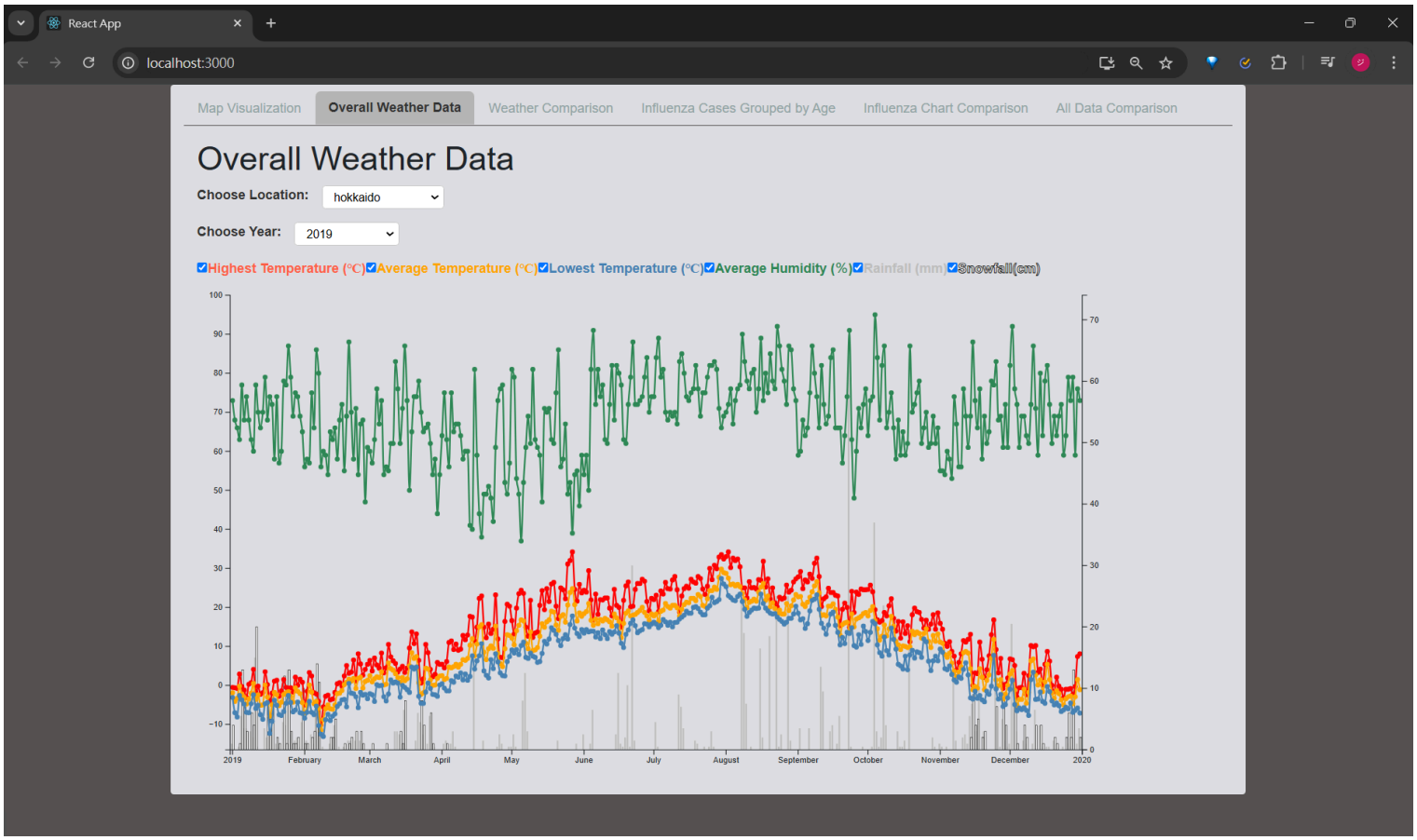
Legend:

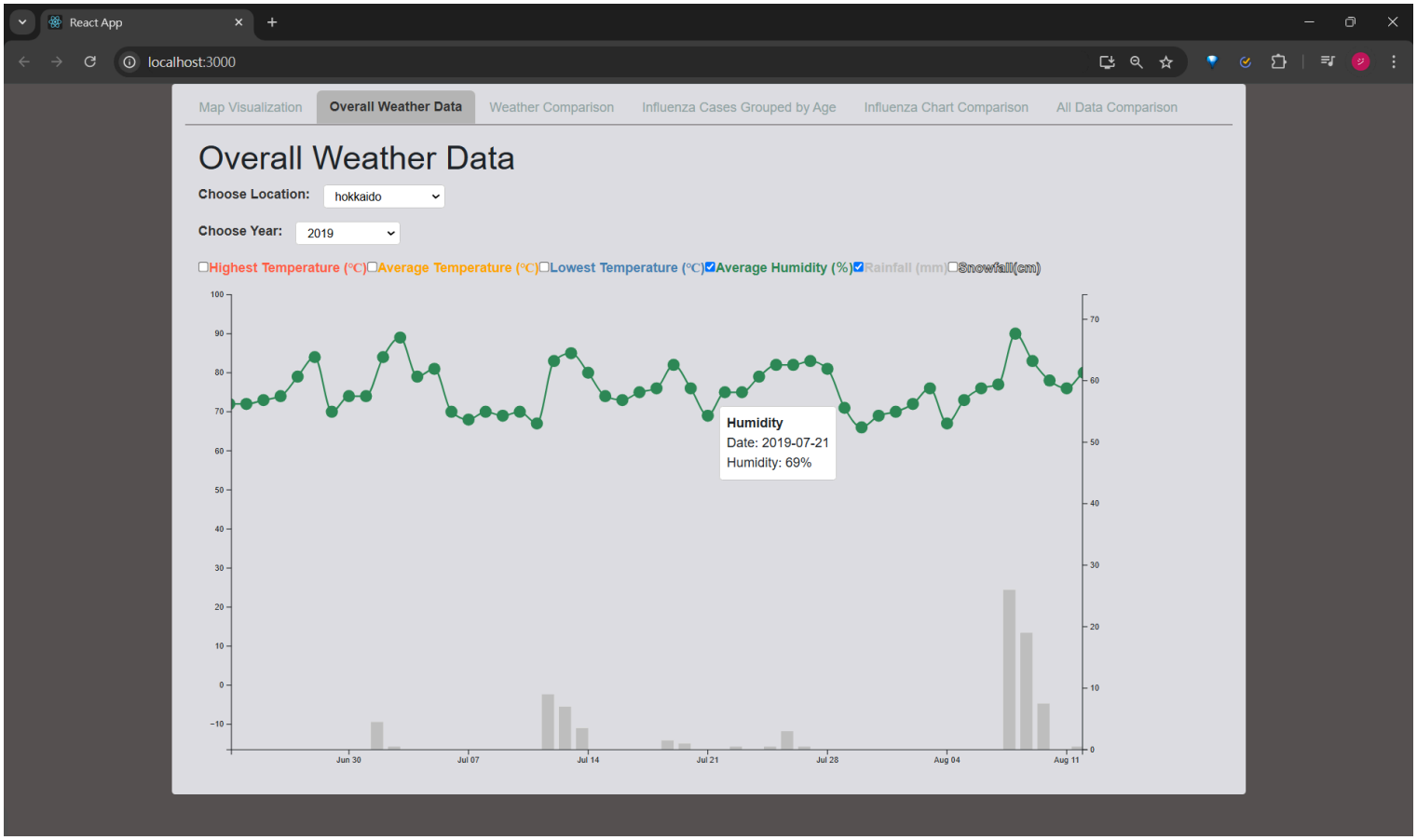
- To help first-time users understand the visual encodings, the system provides an integrated legend in the corner of the map:
    - A color bar showing temperature gradients (from the lowest to highest temperature)
    - Sample circles of different sizes to represent the number of flu cases
    - Samples of varying opacity to explain how humidity corresponds to circle transparency
- Additionally, captions below the legend or in the toolbar can note “Color = Temperature,” “Size = Flu Cases,” and “Opacity = Humidity,” so users can see all mappings at a glance.

User Actions and Strategic Recommendations:

- The primary intended users include public health agencies, local government authorities, and researchers. Through this system, they can:
    - Quickly interpret how flu outbreaks in different regions correlate with changing weather conditions.
    - Facilitate resource allocation (e.g., medical supplies, vaccination campaigns) or assess community containment measures during peak flu seasons.

Weather Visualization ①

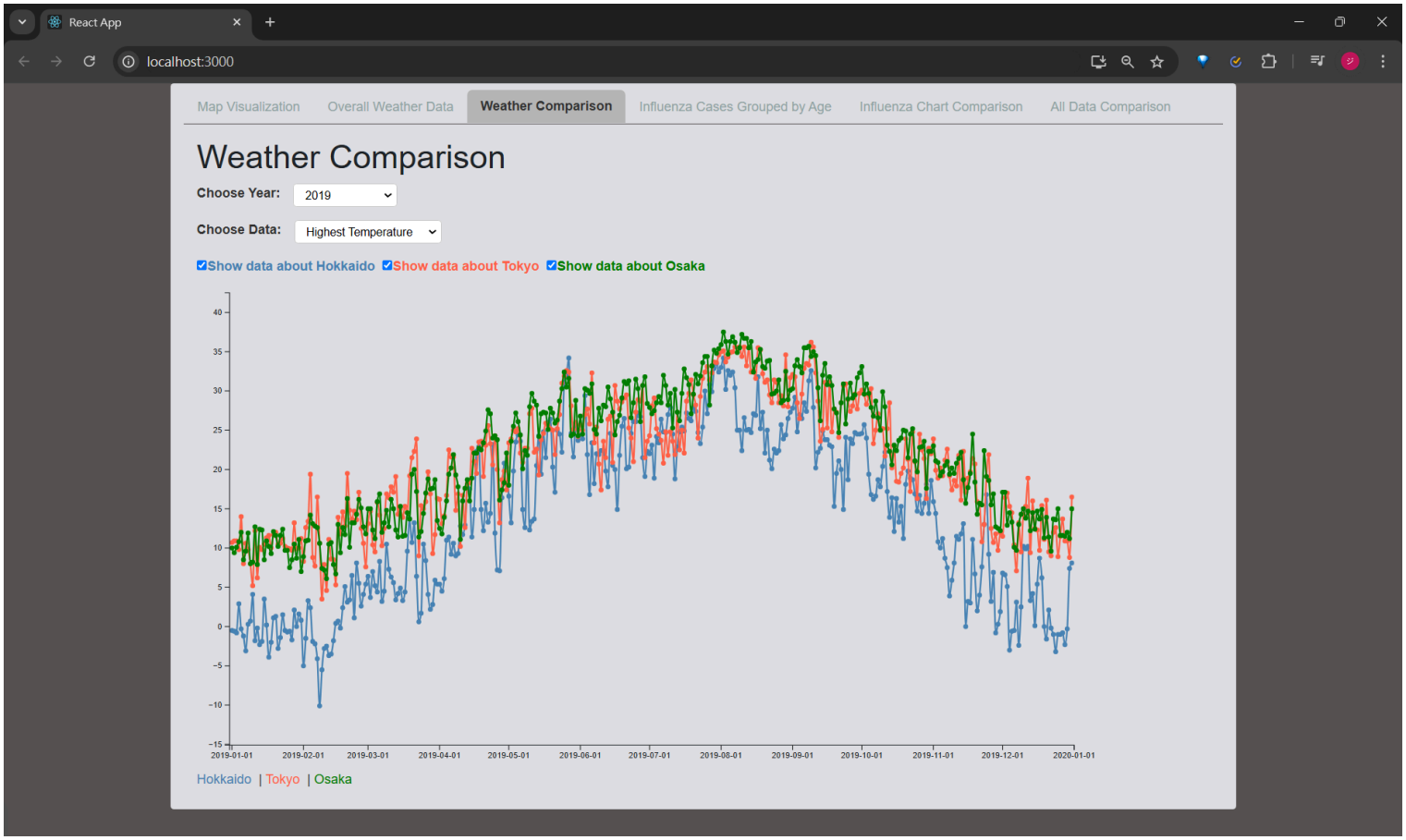




This chart shows the weather records for each day of a certain year in a certain place.

1. **Two Y-axes**: The left y-axis is for temperature or humidity and the right y-axis is for rainfall and snowfall.
2. **Location and Year Selection**: Users can select their desired location and year using drop-down lists.
3. **Weather Information Filters**: Users can filter specific weather data by selecting options via checkboxes.
4. **Legend**: The checkboxes also serve as the legend for the visualized data.
5. **Interactive Details**: Hovering over the graph displays detailed information for precise insights. (Fig. 2)
6. **Dynamic X-Axis Controls**: Users can zoom in on the x-axis by scrolling and adjust the visible range by clicking and dragging the mouse. (Fig. 2)

Weather Visualization ②



This chart shows a comparison of specific daily weather information for a particular year across three locations.

1. **Auto Adjusting Y-axis**: The y-axis can automatically adjust the range depending on the weather information selected by the user.
2. **Weather Parameter and Year Selection**: Users can select their desired weather parameter and year using drop-down lists.
3. **Location Filters**: Users can filter specific locations by selecting options via checkboxes.
4. **Legend**: The checkboxes also serve as the legend for the visualized data. And there is also a legend at the bottom of the chart.
5. **Interactive Details**: Hovering over the graph displays detailed information for precise insights. (Fig. 2)
6. **Dynamic X-Axis Controls**: Users can zoom in on the x-axis by scrolling and adjust the visible range by clicking and dragging the mouse. (Fig. 2)

Influenza Visualization ①

This chart shows the influenza cases for each week of a certain year in a certain place.

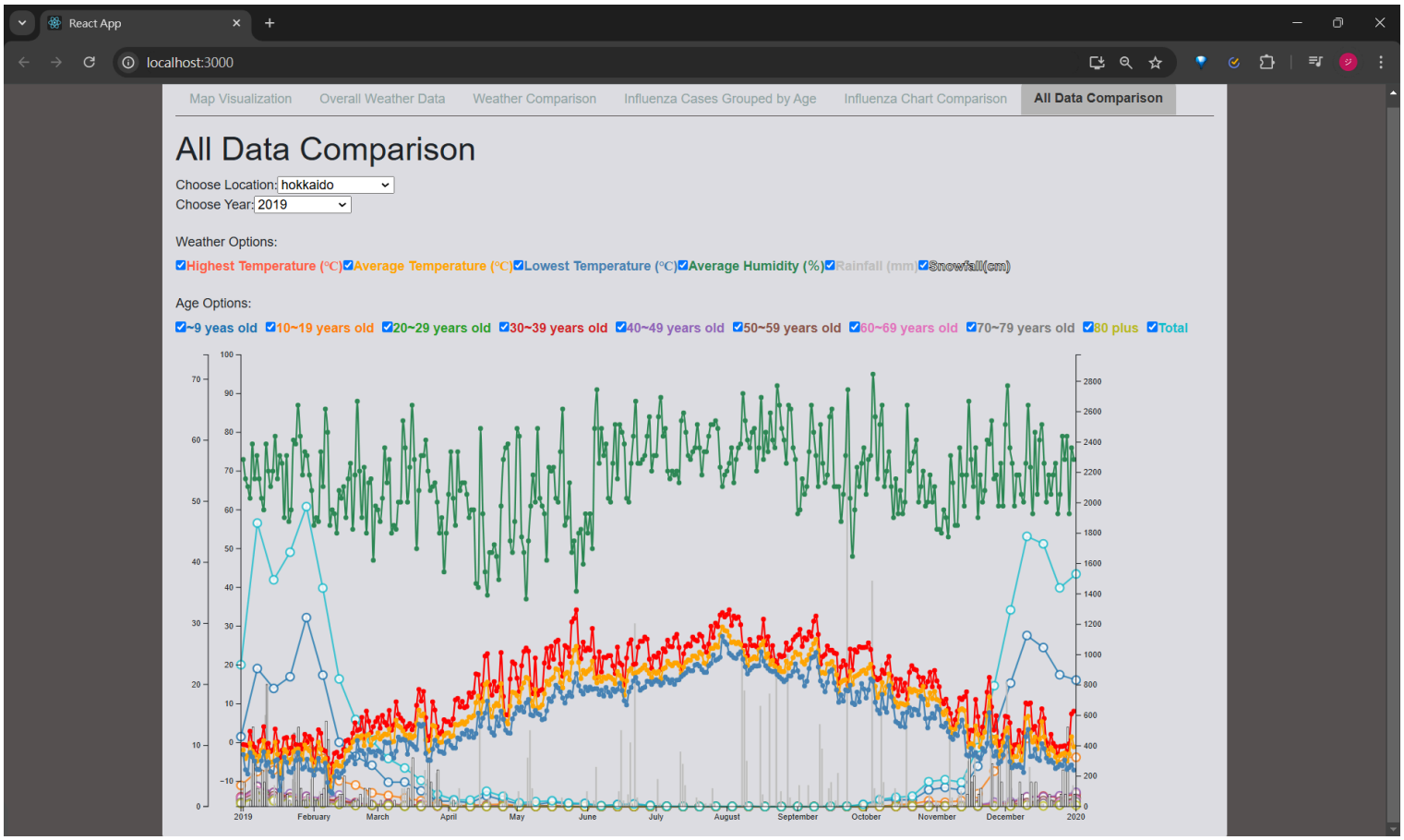
1. **Auto Adjusting Y-axis**: The y-axis can automatically adjust the range depending on the maximum influenza cases.
2. **Location and Year Selection**: Users can select their desired location and year using drop-down lists.
3. **Age Filters**: Users can filter specific age categories by selecting options via checkboxes.
4. **Legend**: The checkboxes also serve as the legend for the visualized data.
5. **Interactive Details**: Hovering over the graph displays detailed information for precise insights and highlights the hovered data. (Fig. 2)

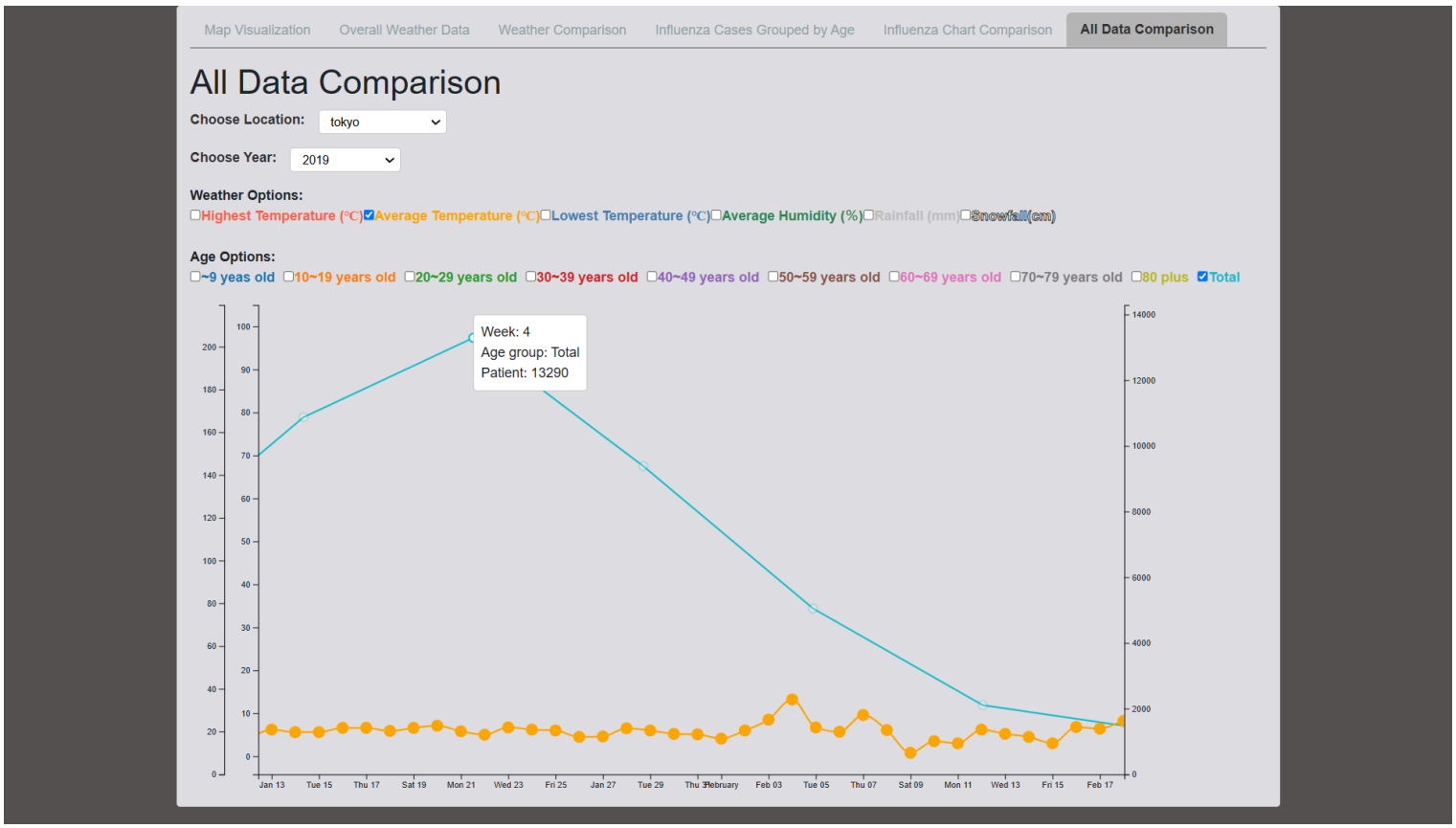
Influenza Visualization ②

This chart shows a comparison of influenza cases for a particular year across three locations.

1. **Auto Adjusting Y-axis**: The y-axis can automatically adjust the range depending on the maximum influenza cases.
2. **Year Selection**: Users can select their desired year using drop-down lists.
3. **Age Filters**: Users can filter specific age categories by selecting options via checkboxes.
4. **Legend**: The checkboxes also serve as the legend for age categories, and the legend for locations is located on the right of the chart.
5. **Interactive Details**: Hovering over the graph displays detailed information for precise insights and highlights the hovered data. (Fig. 2)

Overall Visualization





This chart shows the overall/mix data visualization. We combined the daily weather data and weekly case numbers into the same chart.

1. **Three Y-axis**: The first y-axis on the left represents both temperature and humidity. The second y-axis on the left represents rainfall and snowfall. The y-axis on the right represents influenza cases.
2. **Location and Year Selection**: Users can select their desired location and year using drop-down lists.
3. **Weather Parameter and Age Filters**: Users can filter specific weather parameters and age categories by selecting options via checkboxes.
4. **Legend**: The checkboxes also serve as the legend.
5. **Interactive Details**: Hovering over the graph displays detailed information for precise insights and highlights the hovered data. (Fig. 2)
6. **Dynamic X-Axis Controls**: Users can zoom in on the x-axis by scrolling and adjust the visible range by clicking and dragging the mouse. (Fig. 2)