A near real-time visualization for understanding spatio-temporal patterns of violent crime in the District of Columbia

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Introduction

DC CrimeViz is a web-based map application for exploring spatio-temporal patterns of violent crime in the District of Columbia. Utilizing a suite of geovisual analytics tools, analysts can uncover detailed spatio-temporal patterns of DC crime, extending the value of the data served from the existing website.

The client-server application plots up-to-date crime incidents on a basemap using the Google Maps API for Adobe Flash. The user can then filter the visualization by space (e.g. police districts or service areas), time (linear or composite aggregations), and attribute (e.g. type of crime), animating the selections via different temporal aggregations.

Using our application, analysts can generate hypotheses about the etiology of crime clusters [1, 2] to support policy decisions for the reduction and prevention of such crimes.

Data

The District of Columbia publishes violent crime incidents to their web-accessible Data Catalog site in near real-time. This dataset is of particular significance because of its fine spatial and temporal precision -- crime incidents are geocoded to within one-half of a city block by eight-hour police work shifts.

An automated script processes the daily RSS feed broadcast by the DC Data Catalog and stores the cleaned data in a PostgreSQL database on a GeoVISTA Center server. These data are automatically retrieved by the *DC CrimeViz* client at run-time, ensuring the user always has access to the most up-to-date information.

Temporal Aggregation

DC crime data can be temporally aggregated on-the-fly using either linear or composite approaches [3, 4]. **Linear aggregation** chronologically steps through crime incidents using weekly, monthly, or yearly histogram bins. Alternatively, **composite aggregation** groups incidents cyclically to highlight recurring patterns, using day of the week (all Mondays, Tuesdays, etc.), day of the month (1st through 31st), or month of the year (January, February, etc.).

Figure 1. Monthly linear aggregation (A), and composite aggregation by day of the week (B).

Street View

Implementing the Street View capabilities of Google Maps, users can access a street-level perspective of crime scene locations. Employing the principles of "overview first, zoom and filter, then details on demand" [5], *DC CrimeViz* provides the ability to drill-down through multiple levels of spatial and contextual detail.

Figure 4. A Google Street View window is opened by clicking on the crime description.

Contextualizing Crime

DC CrimeViz contextualizes the crime data by providing access to additional data layers available on the DC Data Catalog website. These include emergency response locations (police/fire/hospital), transportation sites (Metro stations, bus stops), neighborhood composition, and socioeconomic statistics aggregated to police service areas. These supplementary data layers assist the analyst in drawing connections between crime "hot spots" in space and time, and potential contributing factors.
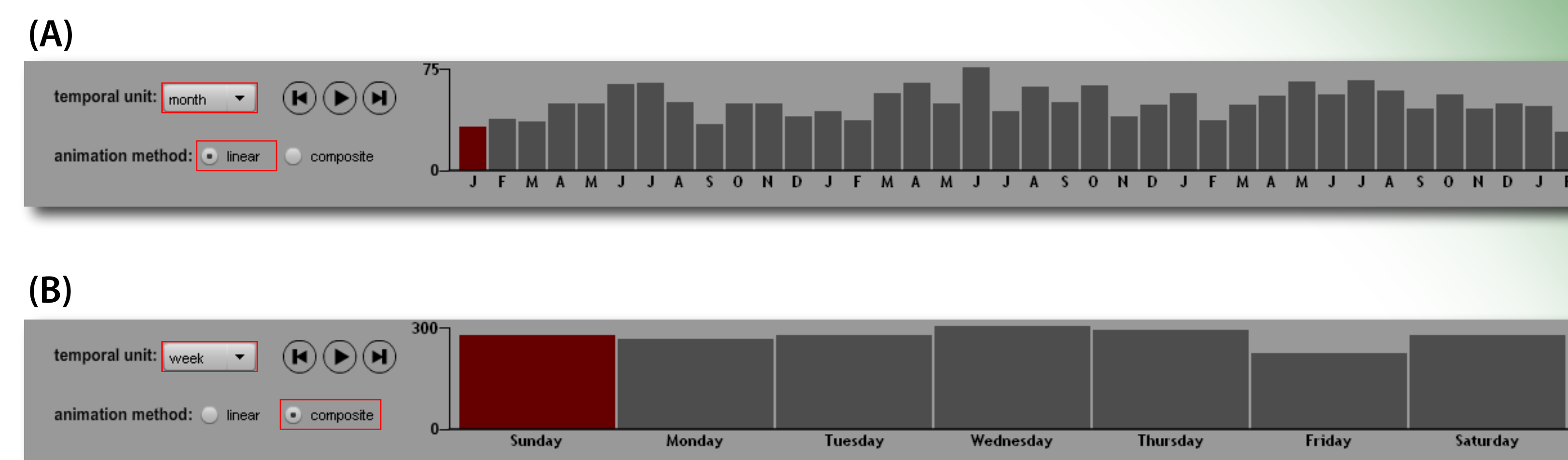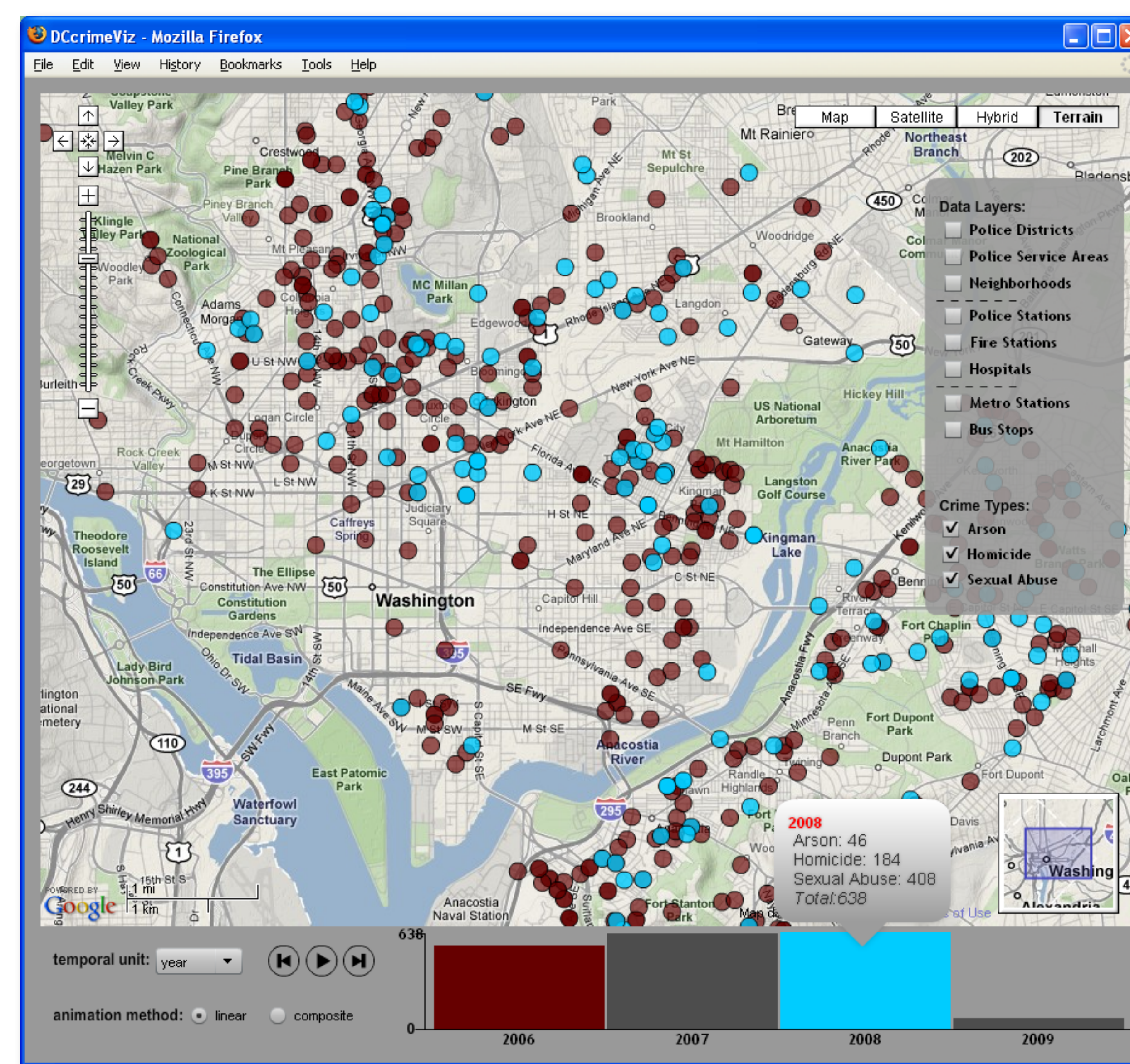

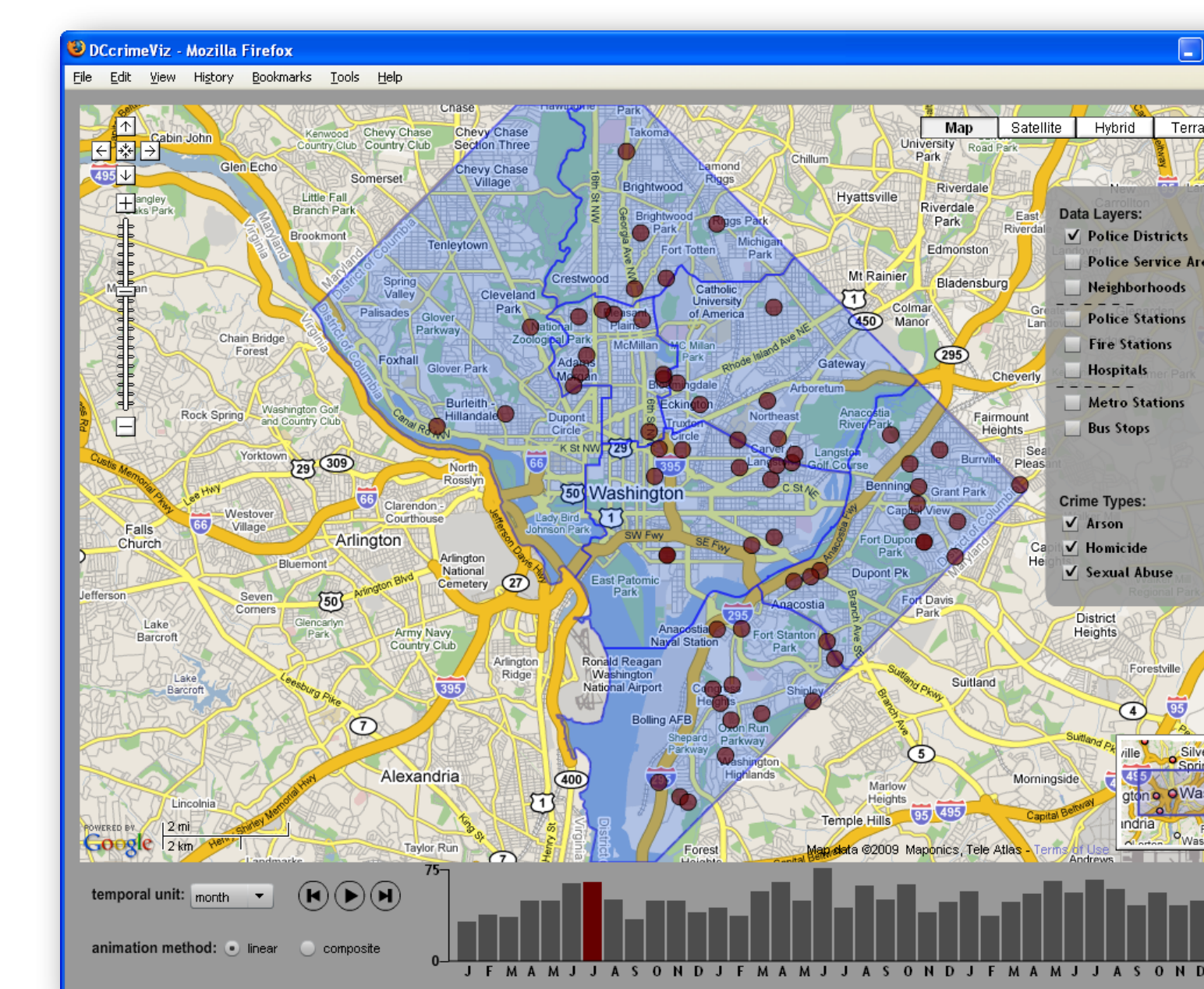**Figure 5.** The *DC CrimeViz* application, displaying incidents for 2006 and 2008.

Figure 3. Overlay of Police District boundaries.

Animation

After applying **space, time, or attribute** filters, the resulting subset of data can then be animated using one of six available temporal aggregations.
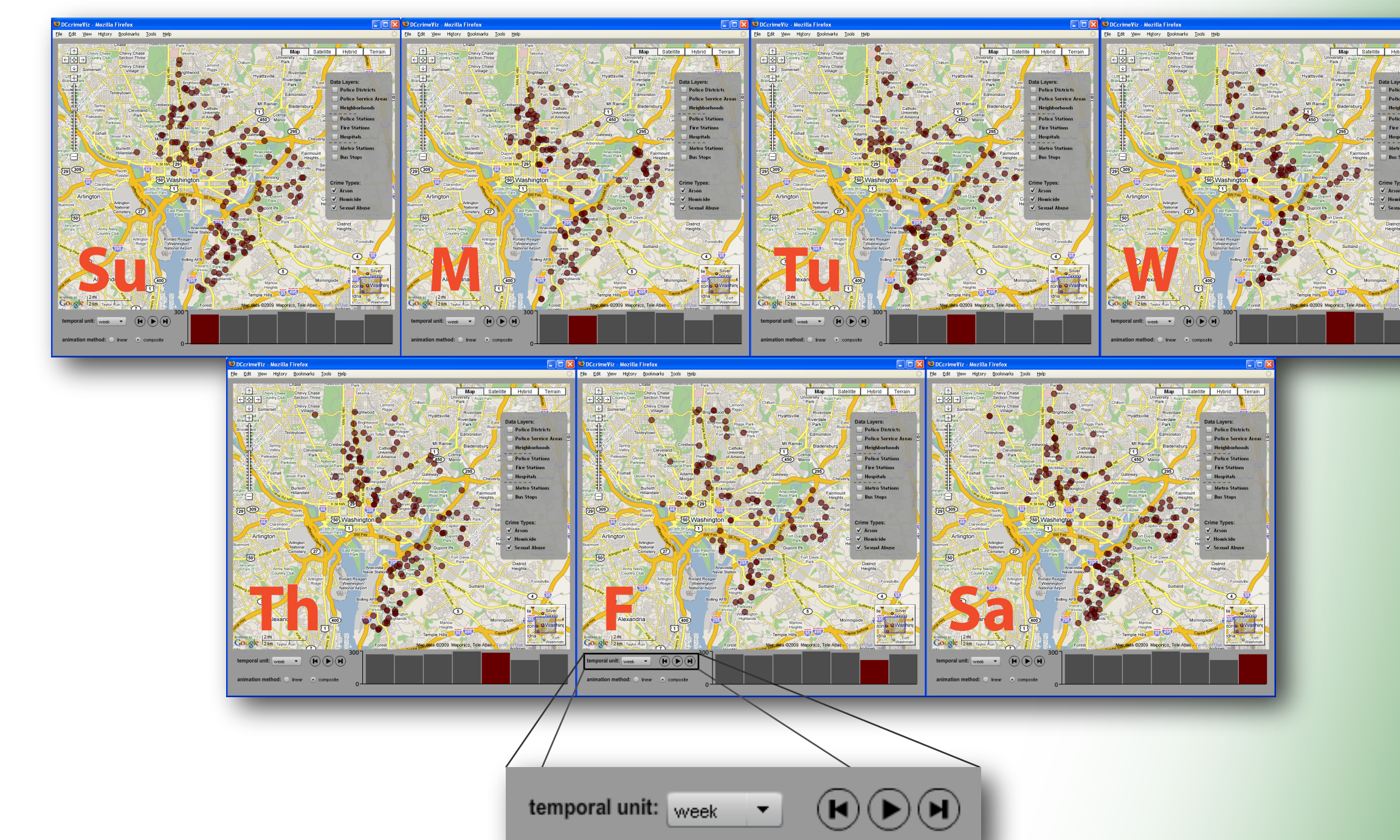

Figure 2. Seven progressive screen captures of an animation using weekly composite aggregation. Frames can be incremented manually or automatically.

Education

We have developed a geovisual analytics course exercise based on the DC crime incidents dataset, with the goal of supporting exploration of complex spatio-temporal data in a web-map application. A comprehensive tutorial walks beginning users through the process of writing their own web-map application using the Adobe Flash CS4 authoring environment. Detailed instructions, screenshots, sample ActionScript code and a subset of the full DC crime incidents dataset have been packaged into a .zip file that is available on the GeoVISTA Center website.

Literature Cited

[1] Gouvis, C., Johnson, C., DeStefano, C.D., Solomon, A., and Waul, M. 2001. 'Violence in the District of Columbia: Patterns from 1999', *Published by the Urban Institute Justice Policy Center*.

[2] Harries, K. 1999. Mapping Crime: Principle and Practice, *Published by the National Institute of Justice* <http://www.ncjrs.gov/html/nij/mapping/>

[3] Chung, W., H. Chen, L. G. Chaboya, C. D. O'Toole, & H. Atabakhsh. 2005. 'Evaluating event visualization: a usability study of COPLINK spatio-temporal visualizer', *International Journal of Human-Computer Studies* 62(1), pp. 127-157.

[4] Weaver, C., Fyfe D., Robinson, A., Holdsworth D., Peuquet, D., & A. M. MacEachren. 2007. 'Visual Analysis of Historic Hotel Visitation Patterns', *Information Visualization*, 6, pp. 89-103.

[5] Shneiderman, B. 1996. 'The eyes have it: A task by data type taxonomy for information visualizations', *IEEE Workshop in Visual Languages '96*, Los Alamos, CA, September 1996, pp. 336-343.

Acknowledgements

Further Information

DC Data Catalog: http://data.octo.dc.gov/

DC CrimeViz Application & Materials: http://www.geovista.psu.edu/DCcrimeViz

The GeoVISTA Center: http://www.geovista.psu.edu/

North-East Visualization & Analytics Center: http://www.geovista.psu.edu/ NEVAC/index.html