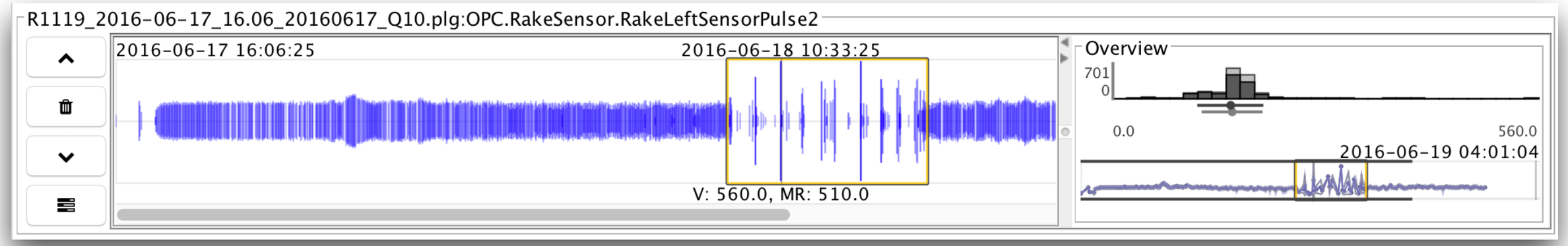
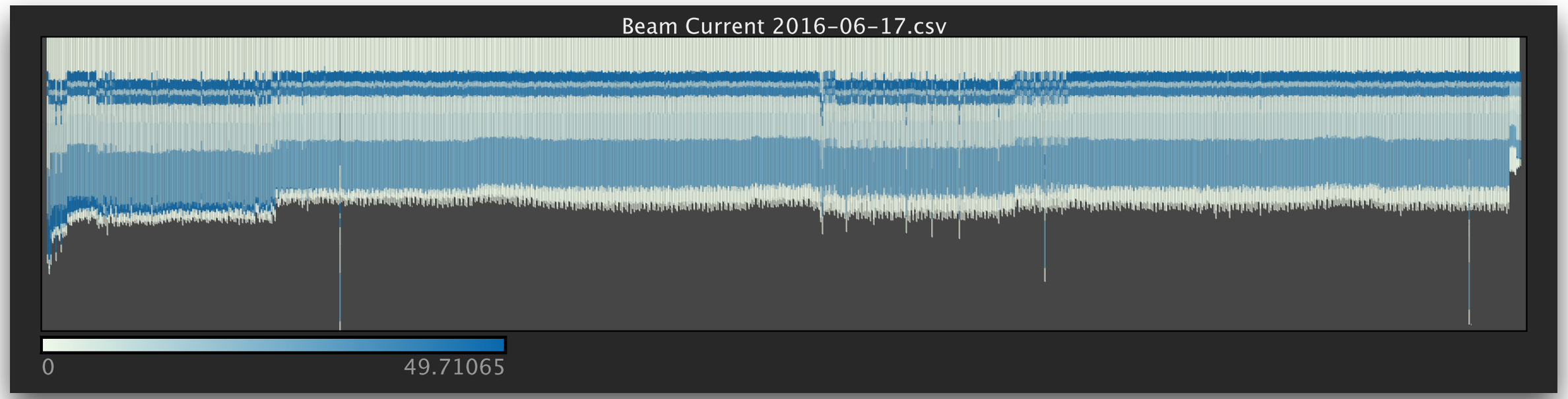
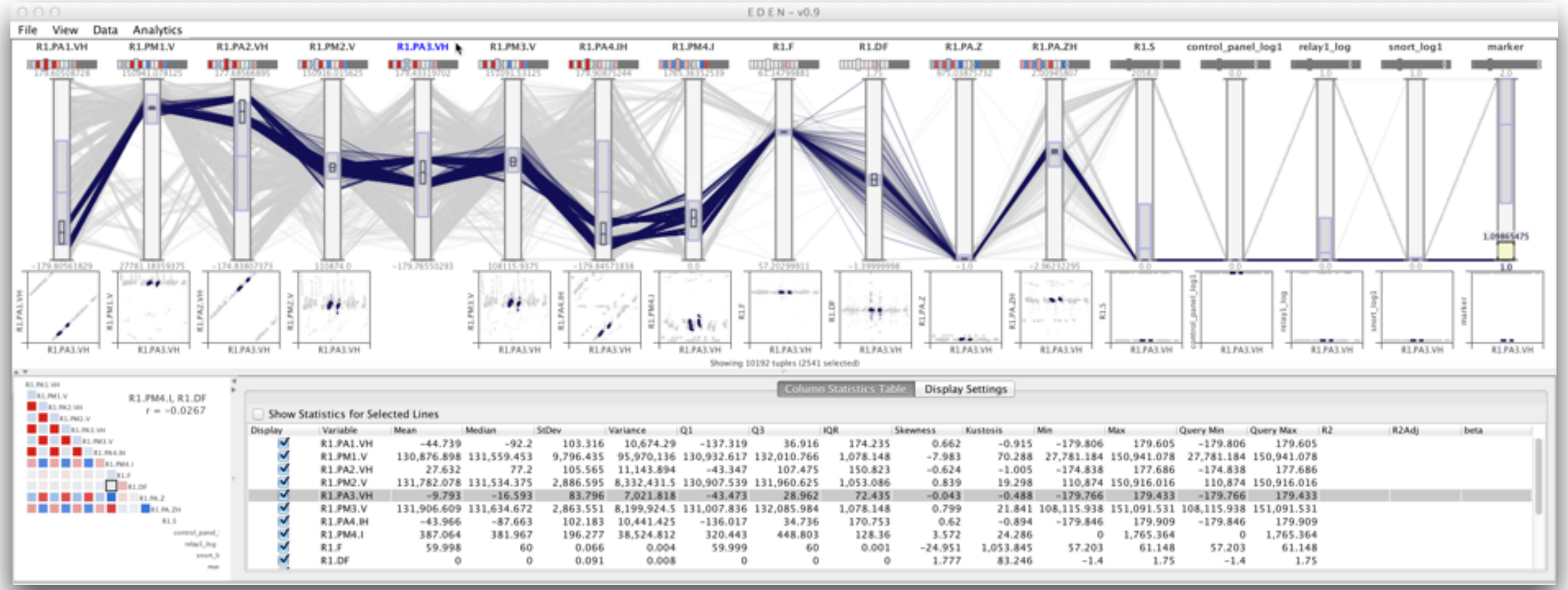




Falcon is a new visual analytics system designed to allow scalable exploratory data analysis of long and complex time series data. Falcon provides temporal and statistical data visualizations with interactive visual queries, variable scale representations, and automated pattern recognition algorithms. The system has been applied to the analysis of network flow information for cyber defense and 3D printer sensor data for advanced manufacturing. Falcon is available at http://github.com/csteed/falcon/.

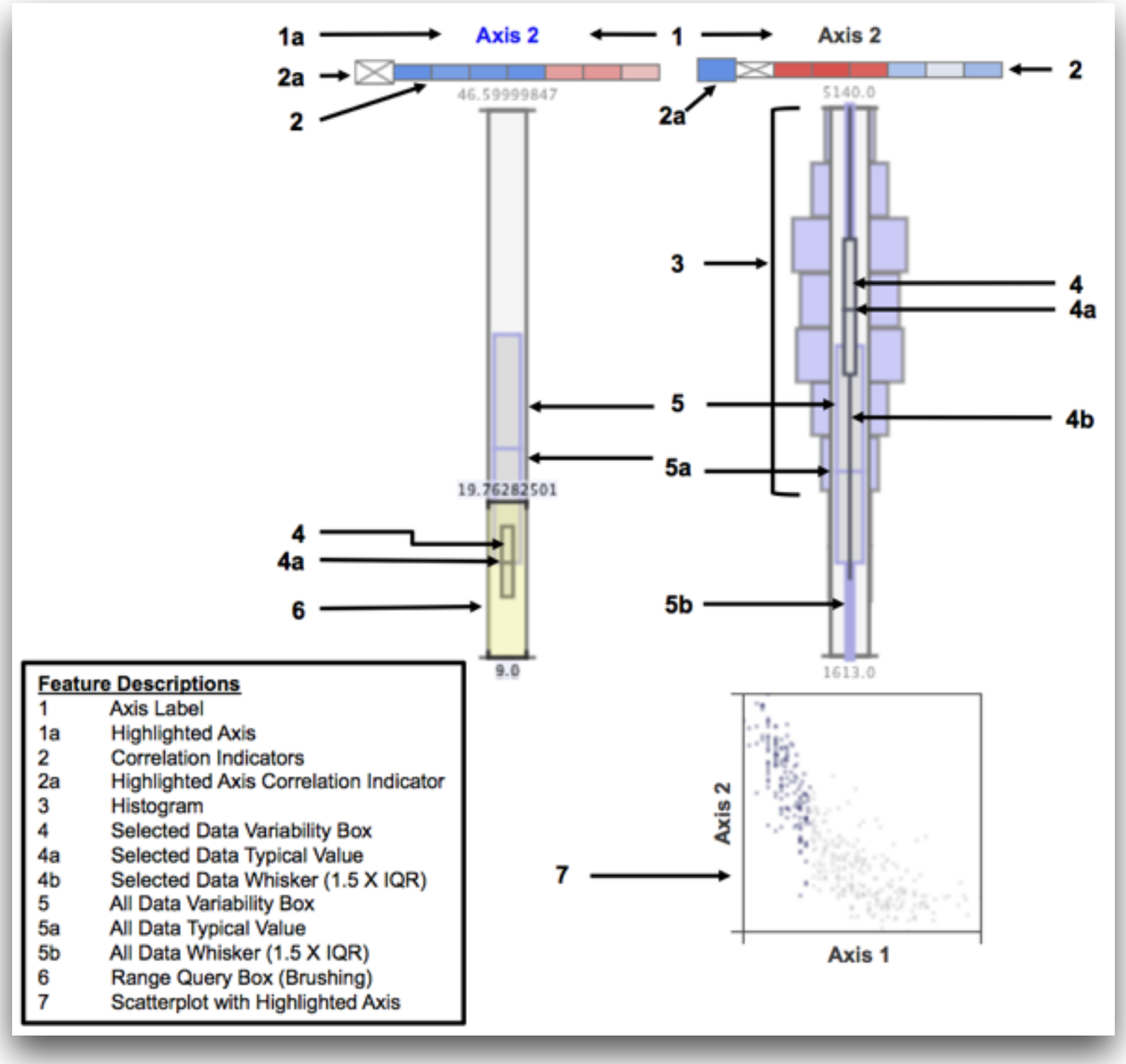
Citation: Chad A. Steed, Ryan Dehoff, William Halsey, Sean Yoder, Vincent Paquit, and Sarah Powers. "Falcon: A Temporal Visual Analytics System Applied to the Analysis of 3D Printer Log Data", ORNL Technical Report ORNL/TM-2016/393, Oak Ridge National Laboratory, Oak Ridge, TN, Aug. 2016. 25 pp.



Display	Variable	Mean	Median	StDev	Variance	Q1	Q3	IQR	Skewness	Kustosis	Min	Max	Query Min	Query Max	R2	R2Adj	beta
✓	R1.PA1.VH	-44.739	-92.2	103.316	10,674.29	-137.319	36.916	174.235	0.662	-0.915	-179.806	179.605	-179.806	179.605			
✓	R1.PM1.V	130,876.898	131,559.453	9,796.435	95,970,136	130,932.617	132,010.766	1,078.148	-7.983	70.288	27,781.184	150,941.078	27,781.184	150,941.078			
✓	R1.PA2.VH	27.632	77.2	105.565	11,143.894	-43.347	107.475	150.823	-0.624	-1.005	-174.838	177.686	-174.838	177.686			
✓	R1.PM2.V	131,782.078	131,534.375	2,886.595	8,332,431.5	130,907.539	131,960.625	1,053.086	0.839	19.298	110,874	150,916.016	110,874	150,916.016			
✓	R1.PA3.VH	-9.793	-16.593	83.796	7,021.818	-43.473	28.962	72.435	-0.043	-0.488	-179.766	179.433	-179.766	179.433			
✓	R1.PM3.V	131,906.609	131,634.672	2,863.551	8,199,924.5	131,007.836	132,085.984	1,078.148	0.799	21.841	108,115.938	151,091.531	108,115.938	151,091.531			
✓	R1.PA4.IH	-43.966	-87.663	102.183	10,441.425	-136.017	34.736	170.753	0.62	-0.894	-179.846	179.909	-179.846	179.909			
✓	R1.PM4.I	387.064	381.967	196.277	38,524.812	320.443	448.803	128.36	3.572	24.286	0	1,765.364	0	1,765.364			
✓	R1.F	59.998	60	0.066	0.004	59.999	60	0.001	-24.951	1,053.845	57.203	61.148	57.203	61.148			
✓	R1.DF	0	0	0.091	0.008	0	0	0	1.777	83.246	-1.4	1.75	-1.4	1.75			

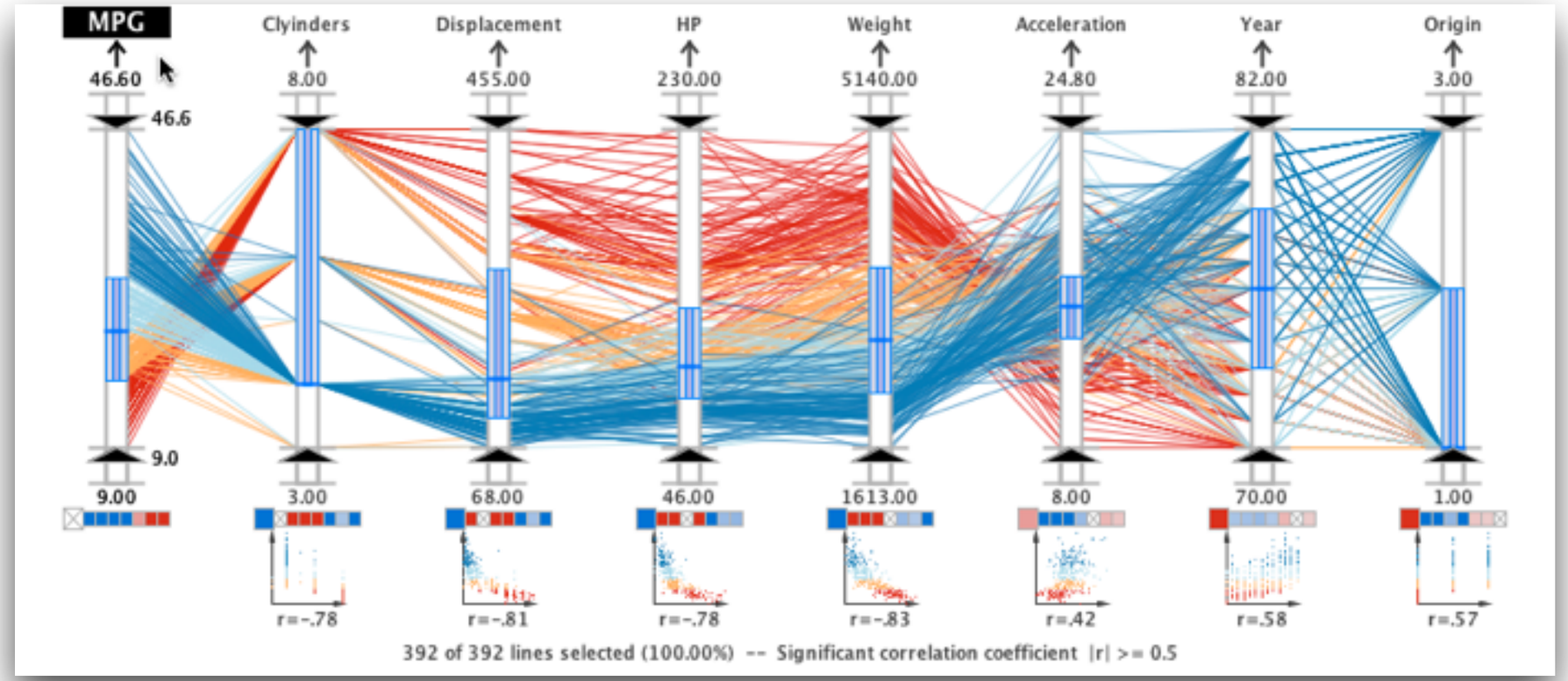
The **Exploratory Data analysis ENvironment (EDEN)** is a highly interactive visual analytics system that allows exploratory analysis of large and complex, multivariate data sets using a parallel coordinates based visual canvas. Multiple visualizations (scatterplots, geographic views, and correlation matrices) are linked to the parallel coordinates panel via a coordinated data model that propagates selections and other user interactions. In the figure above, EDEN is being used to analyze cyber physical data. Other applications of EDEN include energy, climate, manufacturing, cyber security, health care, and materials science. EDEN source code and binaries are available at http://github.com/csteed/eden/.

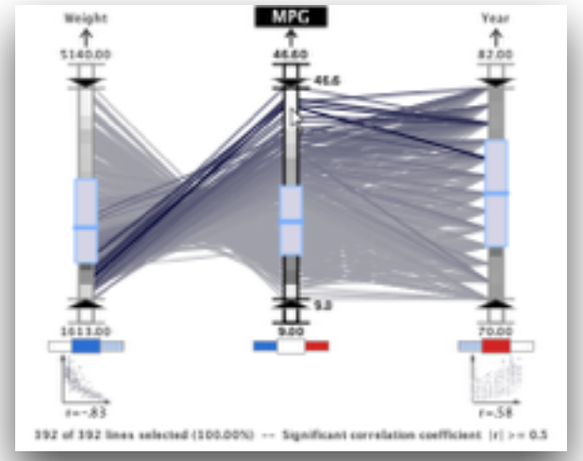
Citation: Chad A. Steed, Daniel M. Ricciuto, Galen Shipman, Brian Smith, Peter E. Thornton, Dali Wang, and Dean N. Williams. "Big Data Visual Analytics for Earth System Simulation Analysis", Computers & Geosciences. vol. 61, Dec. 2013, pp. 71-82. DOI: 10.1016/j.cageo.2013.07.025.

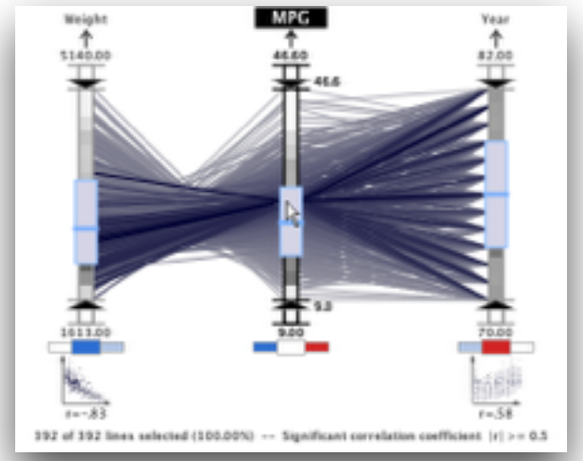


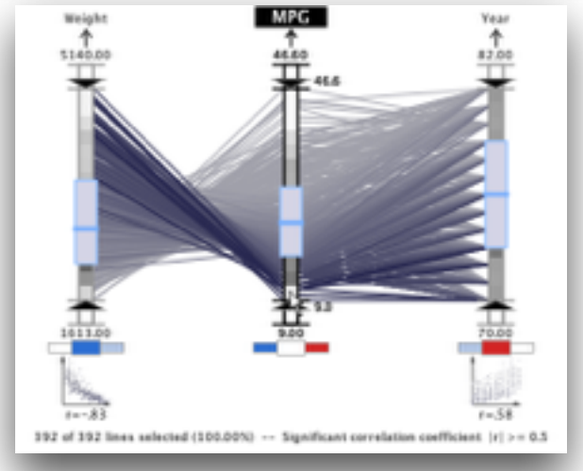
Exploratory Data analysis ENvironment (EDEN) extends the standard parallel coordinates axis with "scented" axis widgets. Key descriptive statistics are used to illuminate the display with dynamic summaries, correlations, and scatterplots. The information from statistical analytics are also visually encoded within each axis interior to emphasize trends and associations in the data. In this way, EDEN allows machine-guided, visual data mining using information scent.

Citation: Chad A. Steed, Daniel M. Ricciuto, Galen Shipman, Brian Smith, Peter E. Thornton, Dali Wang, and Dean N. Williams. "Big Data Visual Analytics for Earth System Simulation Analysis." Computers & Geosciences. vol. 61, Dec. 2013, pp. 71-82. DOI: 10.1016/j.cageo.2013.07.025.



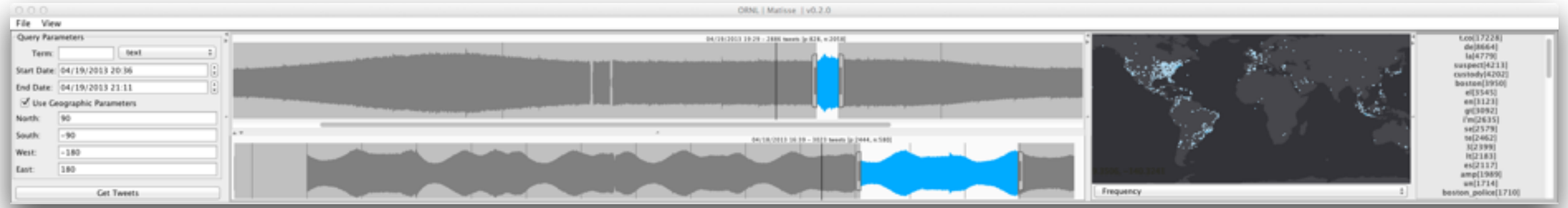


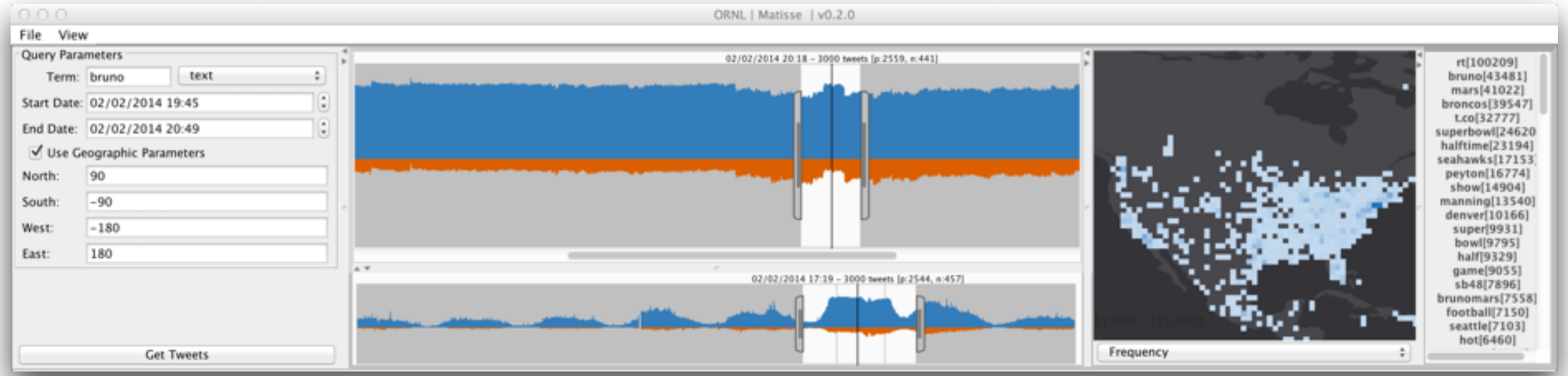




The **Multivariate Data eXplorer (MDX)** is the predecessor to EDEN. MDX also uses a parallel coordinates based canvas to enable multivariate data exploration. MDX includes automated classification algorithms to characterize classes of data cases. The polylines associated with these classes are visually represented by color (top). MDX also includes a proximity shading technique (right) for polylines based on distance to the mouse cursor. The shading technique allows dynamic visual queries and mimics tonal shading in fine art whereby foreground items are more salient and background items have less contrast with the background. A figure from our IEEE VAST paper on MDX was featured on the cover of the proceedings.

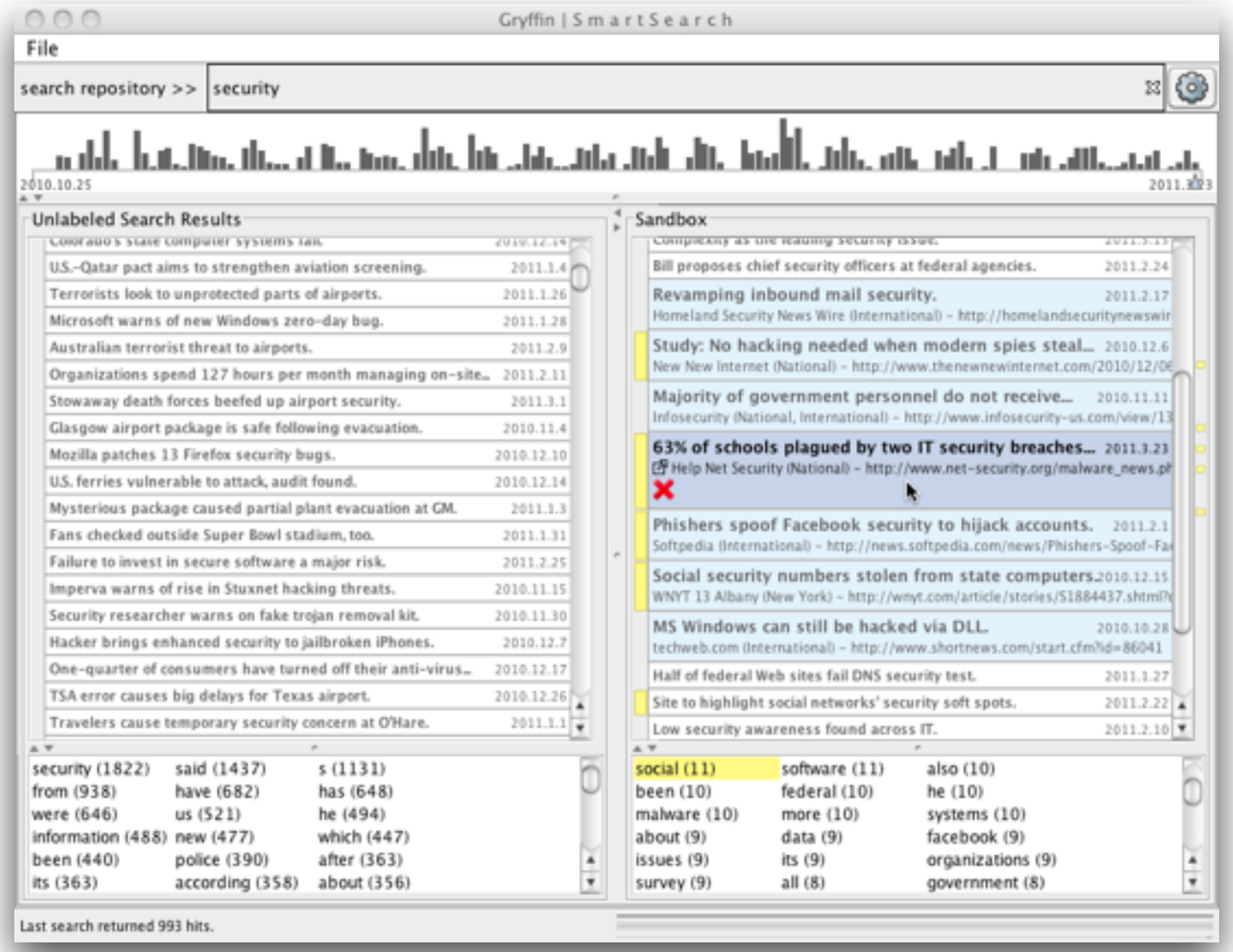
Citation: Chad A. Steed, J. Edward Swan II, T.J. Jankun-Kelly, and Patrick J. Fitzpatrick. "Guided Analysis of Hurricane Trends using Statistical Processes Integrated with Interactive Parallel Coordinates". In Proceedings of IEEE Symposium on Visual Analytics Science and Technology (VAST), pp. 19–26, Oct. 2009.





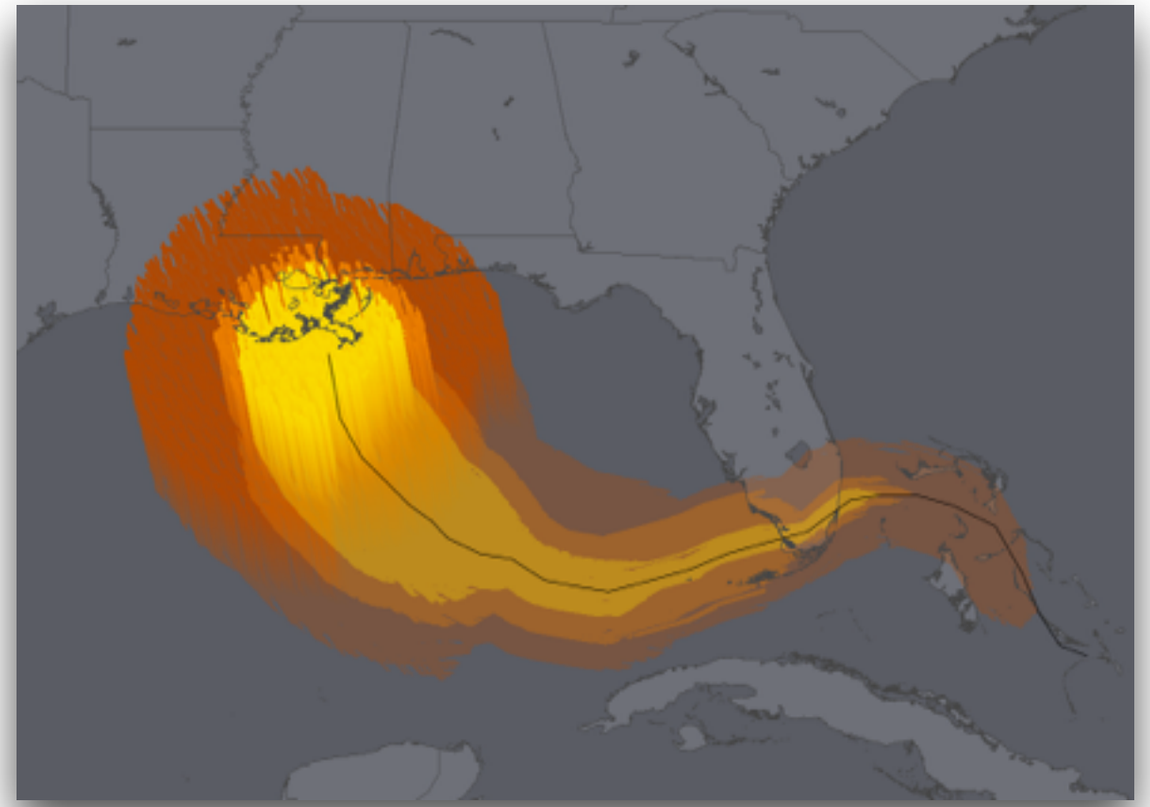
Matisse is a visual analytics system for exploring spatio-temporal patterns in streaming text data, such as social media streams. Matisse provides temporal visualizations with linked geographical and top term views. In addition to univariate statistical views (top), Matisse can encode positive and negative sentiment (bottom) as segmented graphs using blue and orange bars, respectively. In the temporal visualizations, Matisse uses an overview+detail interaction technique, which combines a longer time series (bottom, lower time series) and a detailed view (bottom, upper time series).

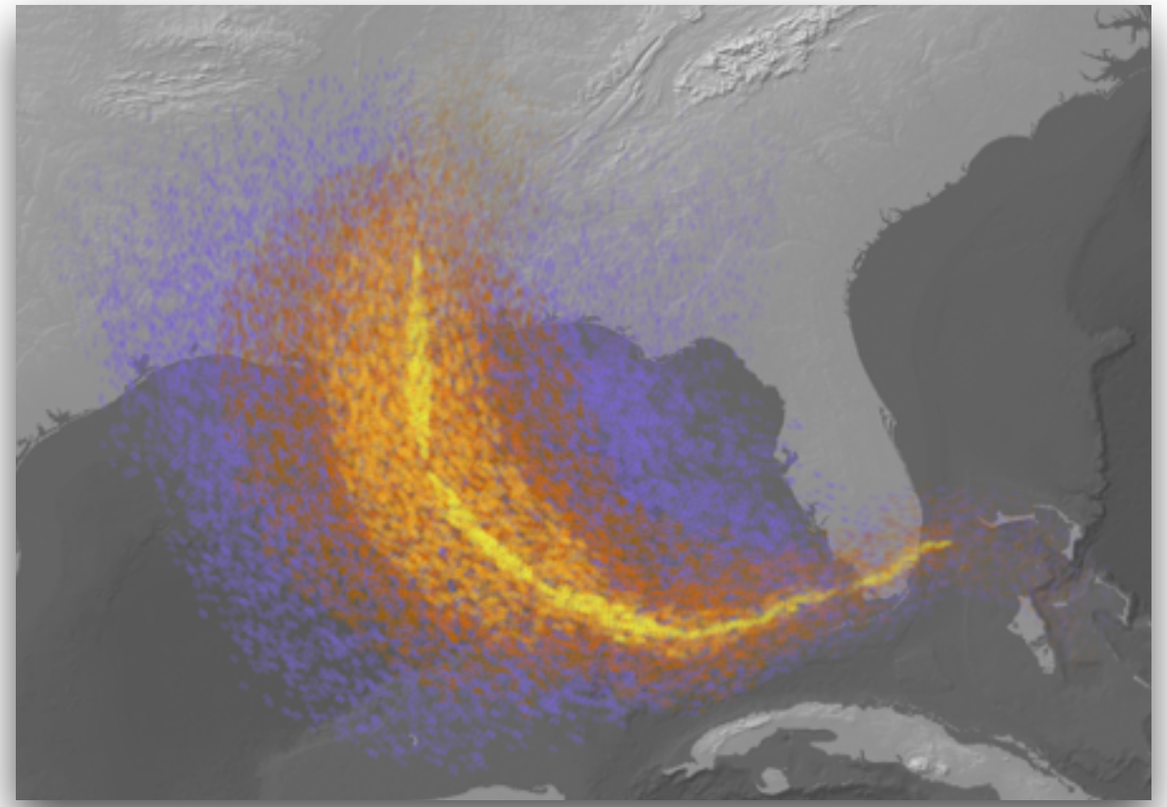
Citation: Chad A. Steed, Margaret Drouhard, Justin Beaver, Joshua Pyle, and Paul L. Bogen II. Matisse: A Visual Analytics System for Exploring Emotion Trends in Social Media Text Streams. In Proceedings of the IEEE International Conference on Big Data (IEEE Big Data 2015), Oct. 2015.

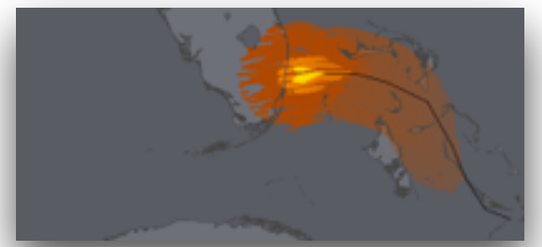


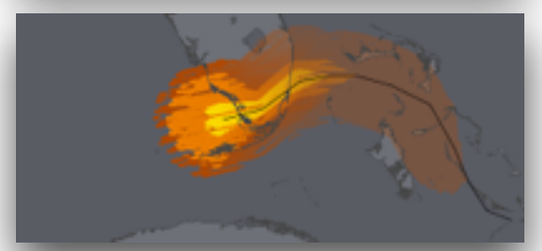
Gryffin is a visual analytics system for personalized text mining of large document collections. Gryffin offers several interactive visualizations with "scented" widgets for search-based exploration via focus+context document list views, temporal timelines, and term-frequency views using a coordinated data model. Furthermore, user interactions are tracked and used to label documents that are relevant or irrelevant to the topic of interest. These labels are then used to drive semi-supervised machine learning algorithms that re-rank unlabeled documents moving potentially relevant records to the top of the list view.

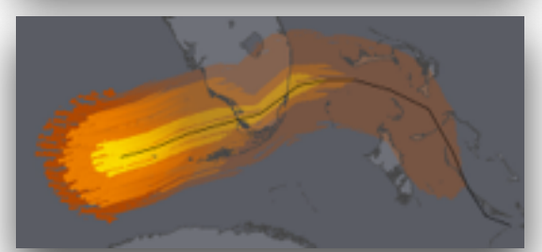
Citation: Chad A. Steed, Christopher Symons, Frank DeNap, and Thomas E. Potok. "Guided Text Analysis Using Adaptive Visual Analytics." In Proceedings of the Visualization and Data Analysis Conference, Jan. 2012. DOI:10.1117/12.904904





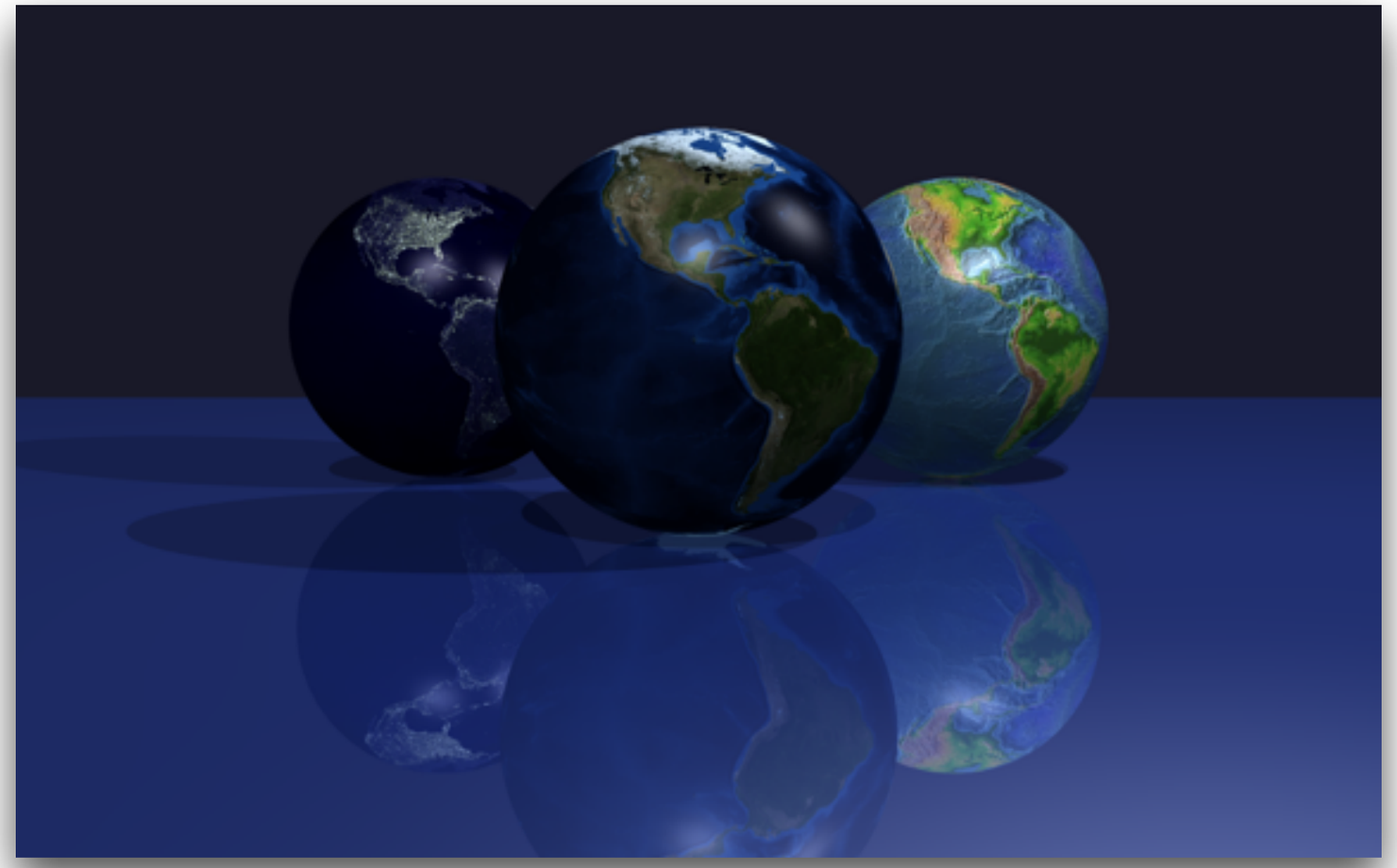


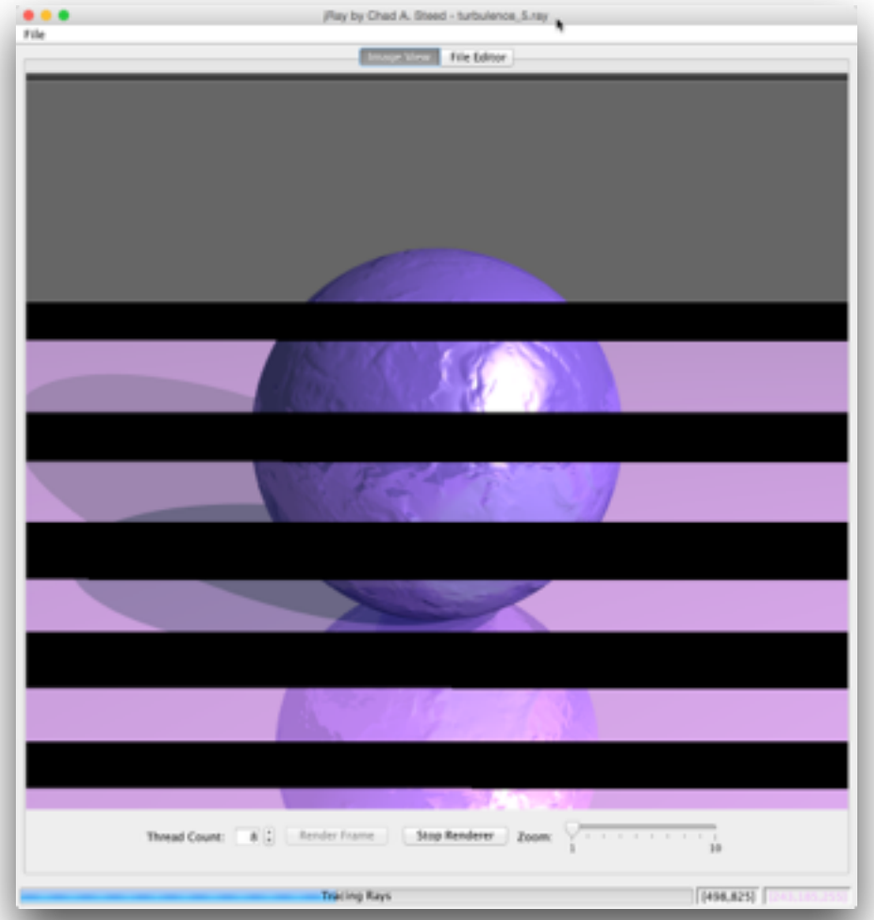




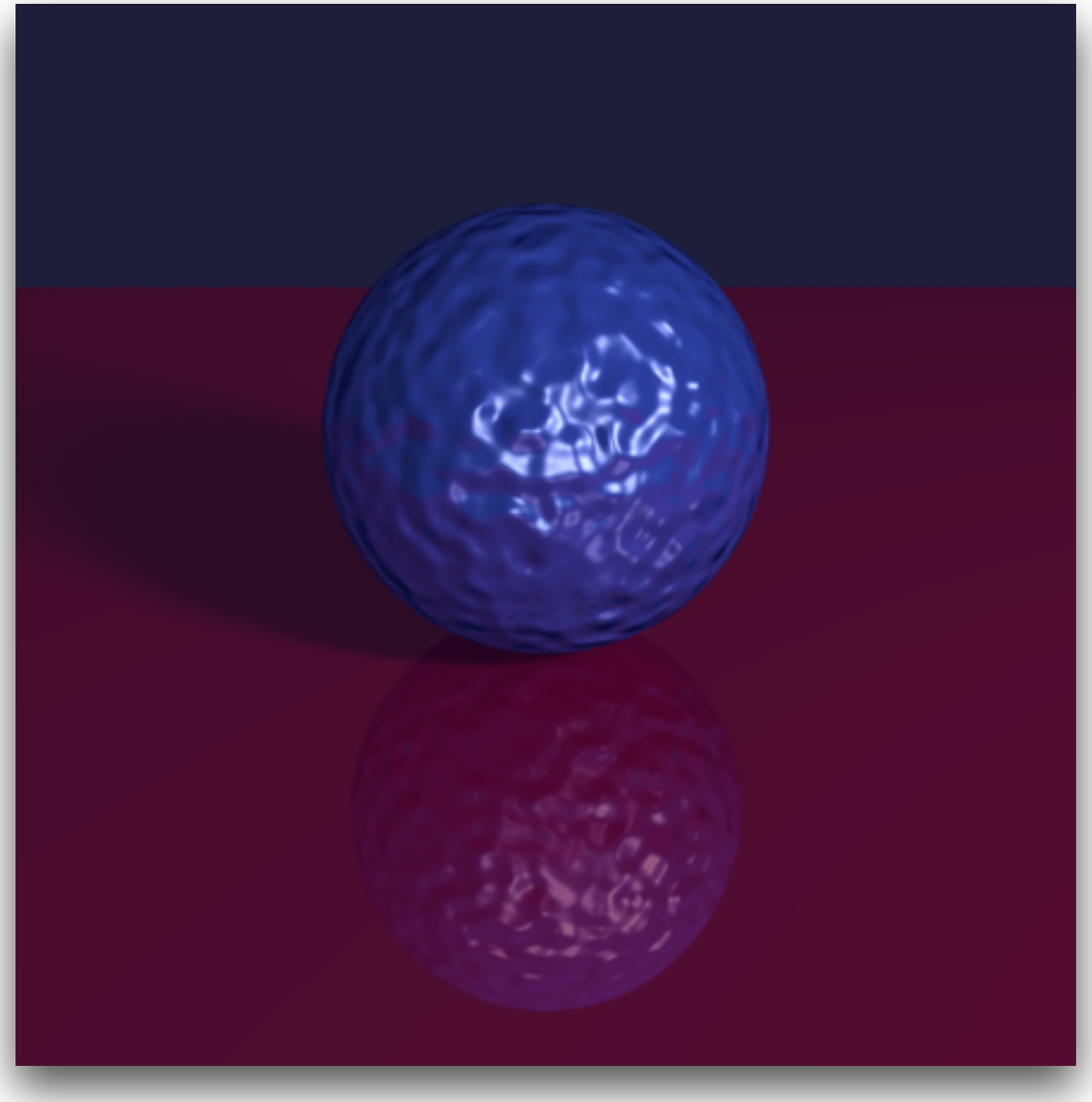
An art-inspired illustrative visualization encodes multiple data dimensions using visual features that resemble artistic brush strokes. The long brush stroke method (left) resembles a large bristle brush stroke. A small stroke method (right) is designed to mimic an impressionist style painting with many small brush marks. The technique can be animated (bottom right) to track a hurricane's progression while representing several dimensions in a single display. The technique is generalizable to any quantitative multi-dimensional dataset such as simulated data from ocean models using glyph attributes.

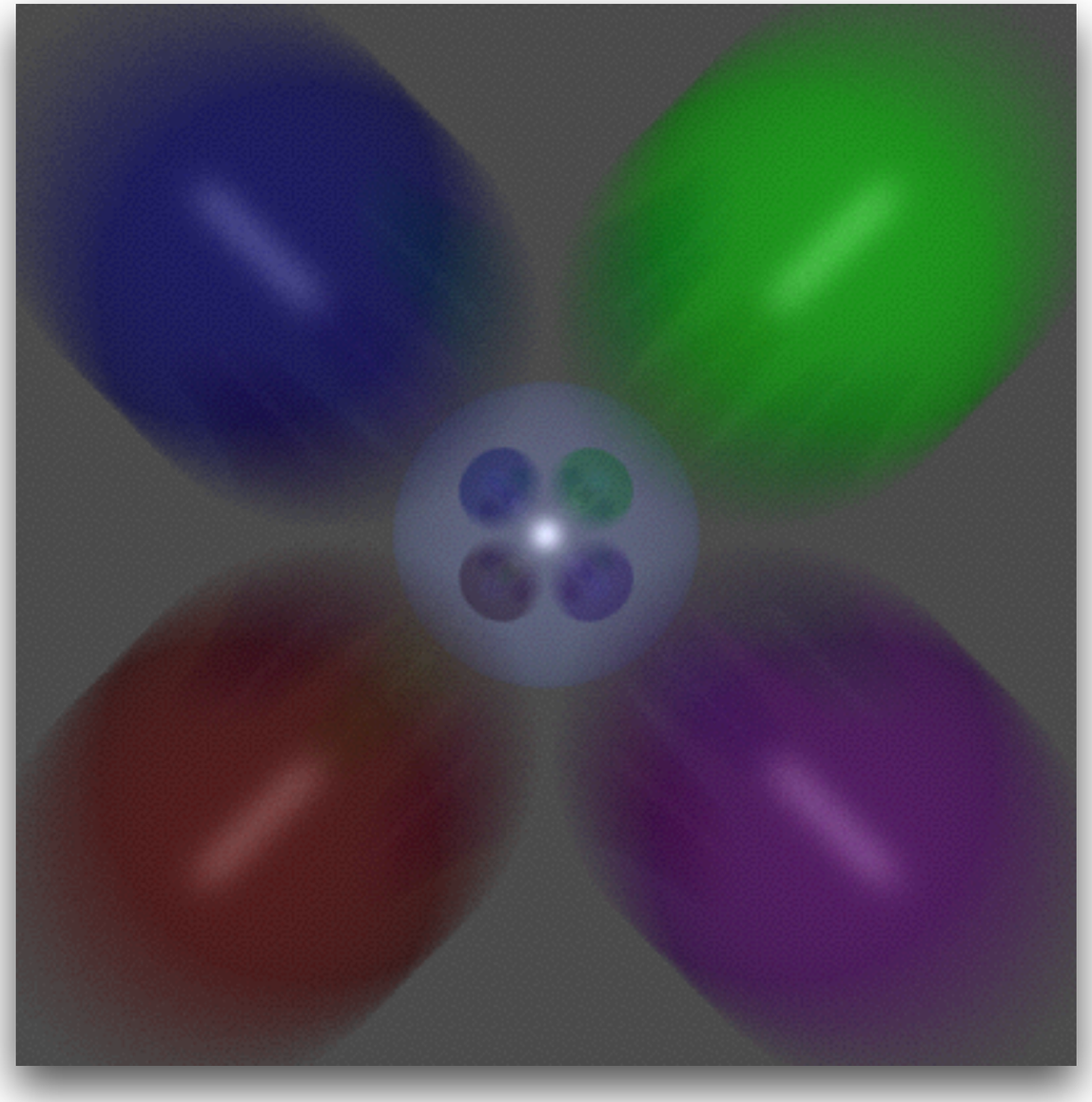
Citation: Chad A. Steed, T.J. Jankun-Kelly, and J. Edward Swan II. "Illustrative Visualization of Hurricane Advisory Information." In Proceedings of MTS/IEEE Oceans 2009, pp. 1–9, Oct. 2009.



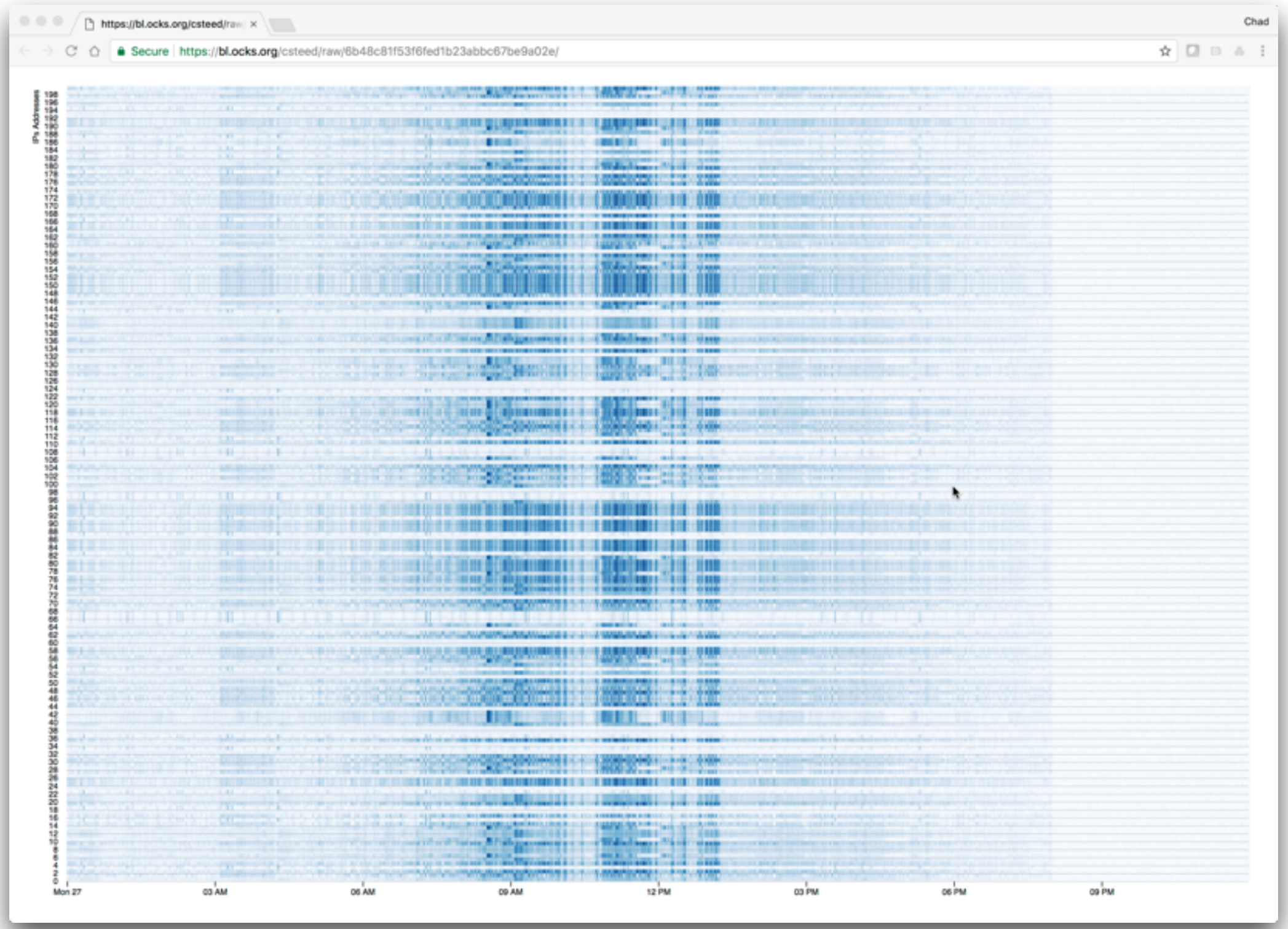


jRay is a java ray tracing system I developed from scratch during my Ph.D. studies. Initially developed as a project for my Advanced Computer Graphics course, I wrapped the library with a Java GUI to edit the custom scene parameters and launch/monitor the ray tracing process. As shown in the right image, the rendering process is multi-threaded. Each thread writes to the GUI display independently using a multiple pass scheme for fast viewing. Several advanced rendering options are available to achieve complex surface properties, antialias settings, reflections, textures, etc. The system also generates movies of procedurally generated Perlin noise textures mapped to geometric objects.



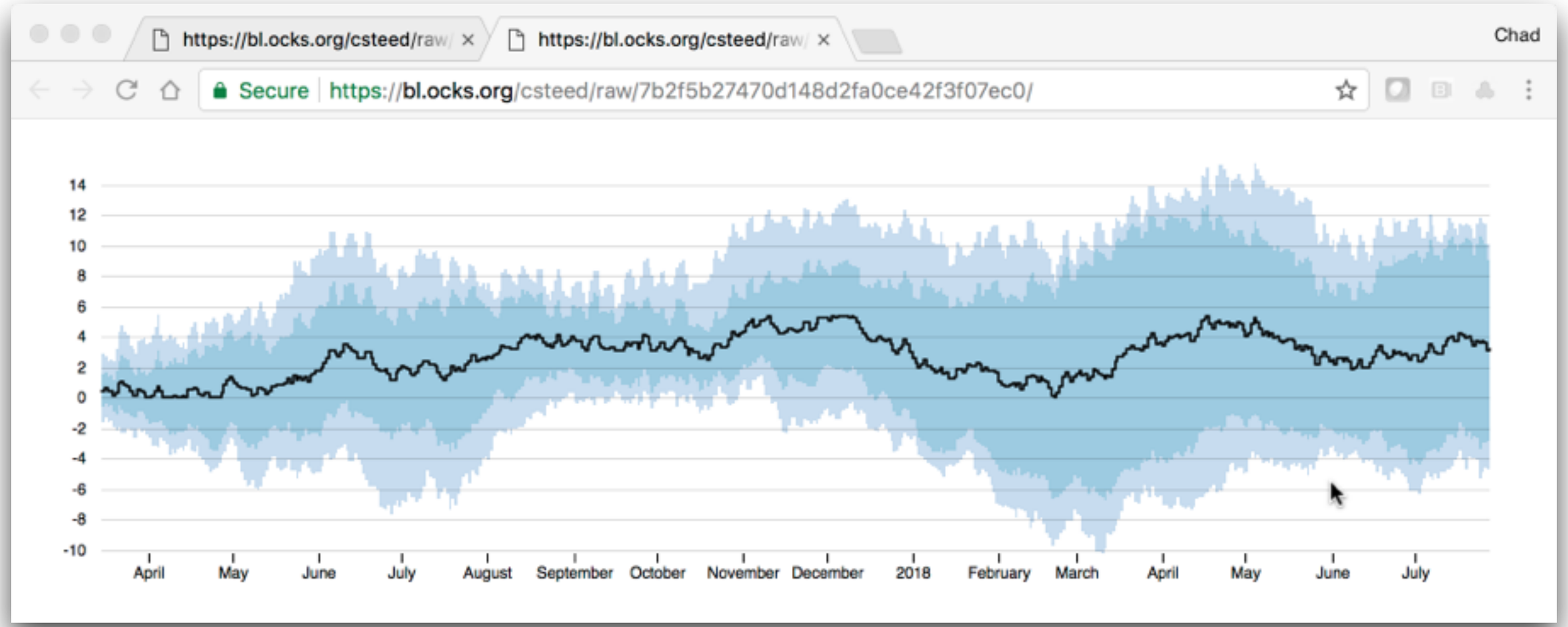


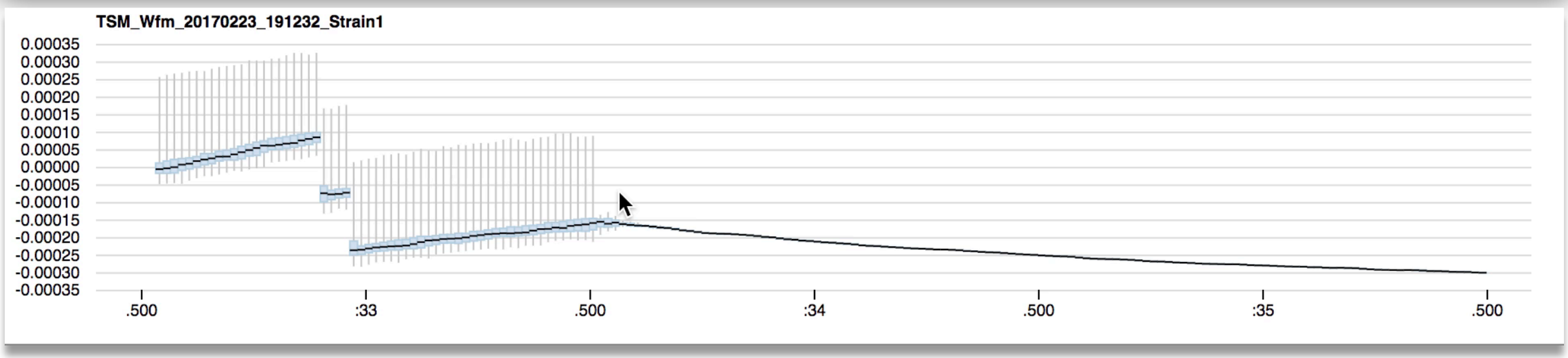
Additional output images from **jRay** demonstrating Perlin noise textures (left) and motion blur / reflections (right).



This web-based visualization of computer network flow information is designed to show anomalous communication patterns between interconnected computer systems. A blue saturation color scale is used to encode the data for each of the 200 IP addresses where more saturated blues indicate larger values.

This web-based visualization shows strain sensor data from the ORNL Spallation Neutron Source (SNS). Each vertical bar visually summaries a neutron pulse from the SNS system. The color scale maps the strain sensor data on a yellow to green to blue value scale. Patterns emerge such as the odd pulse behavior at :23 seconds.





These web-based visualizations show two ways to summary large time series data. The top visualization summarizes the data with a black mean line and two color filled polygons that represent the 95% and 99% confidence intervals. The bottom visualization shows a statistic summary of SNS pulse data where each vertical graphic summarizes a pulse. The black bar is the mean value, the blue box is the 95% confidence interval, and the vertical line is the min/max value range for each segment's values.