Text Stream Trend Analysis using Multiscale Visual Analytics with Applications to Social Media Systems

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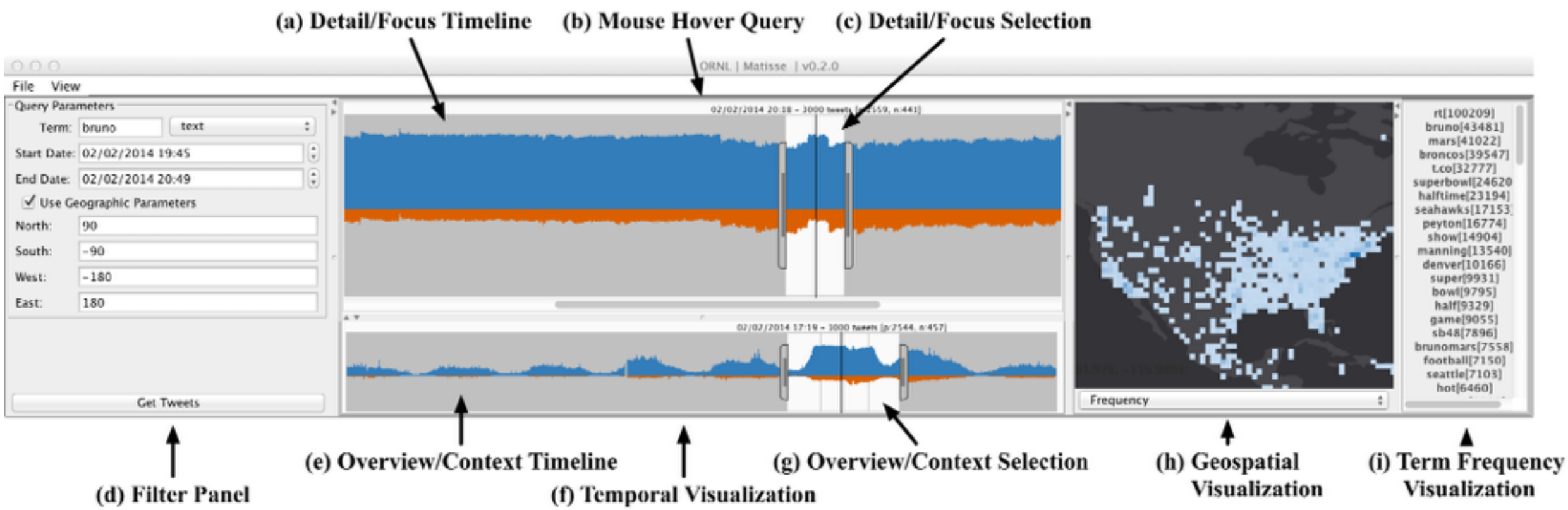
Motivation

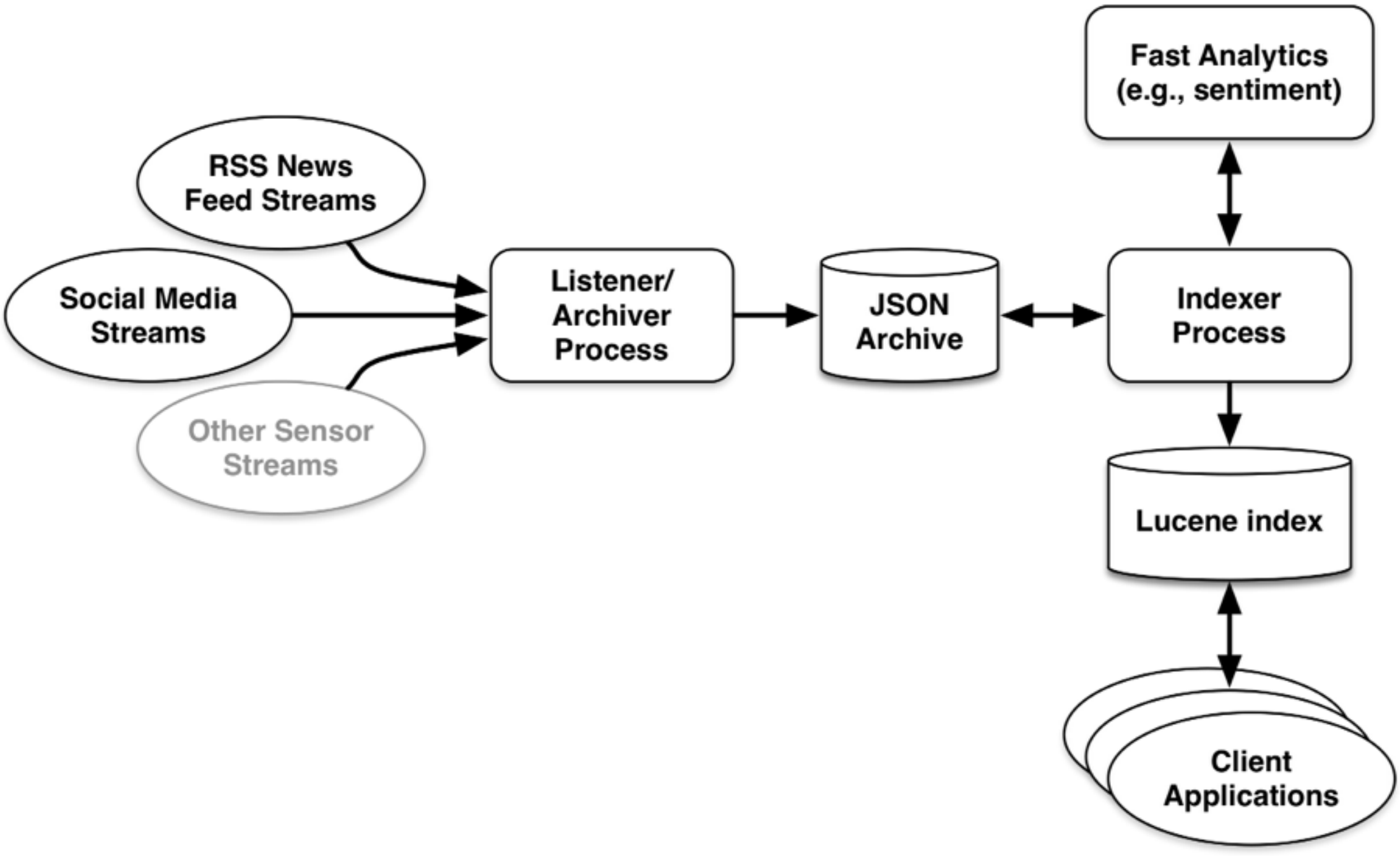
- Text streams are ubiquitous and represent a tremendous resource for understanding global events in real-time.
    - Global event situational awareness for disaster response
- Such streams are a challenge to explore
    - High velocity, semi-structured textual information.
- Its like detective work that can be improved with:
    - Automated analytics to guide analyst to key trends
    - Interaction techniques to drill-down to access increasing detail views.

Matisse: Exploratory Analysis of Text Streams



<u>Design Goal:</u> Enable multi-faceted, exploratory analysis of emotion in social media text streams from overviews to detailed investigation.

Stream Data Management



Positive / Negative Sentiment Analytics

- Estimate positive / negative sentiment based on textual content
- Initial processing modifies raw text to accommodate nuances of Twitter content
- Porter's English stemmer applied and custom stop words are removed
- Train classifier (naive Bayes and Java Maximum Entropy) using pre-coded tweets from Go et al. [4] to create a feature vector.
- Comparable classification accuracy to Go et al. [4] (80% - 90%)

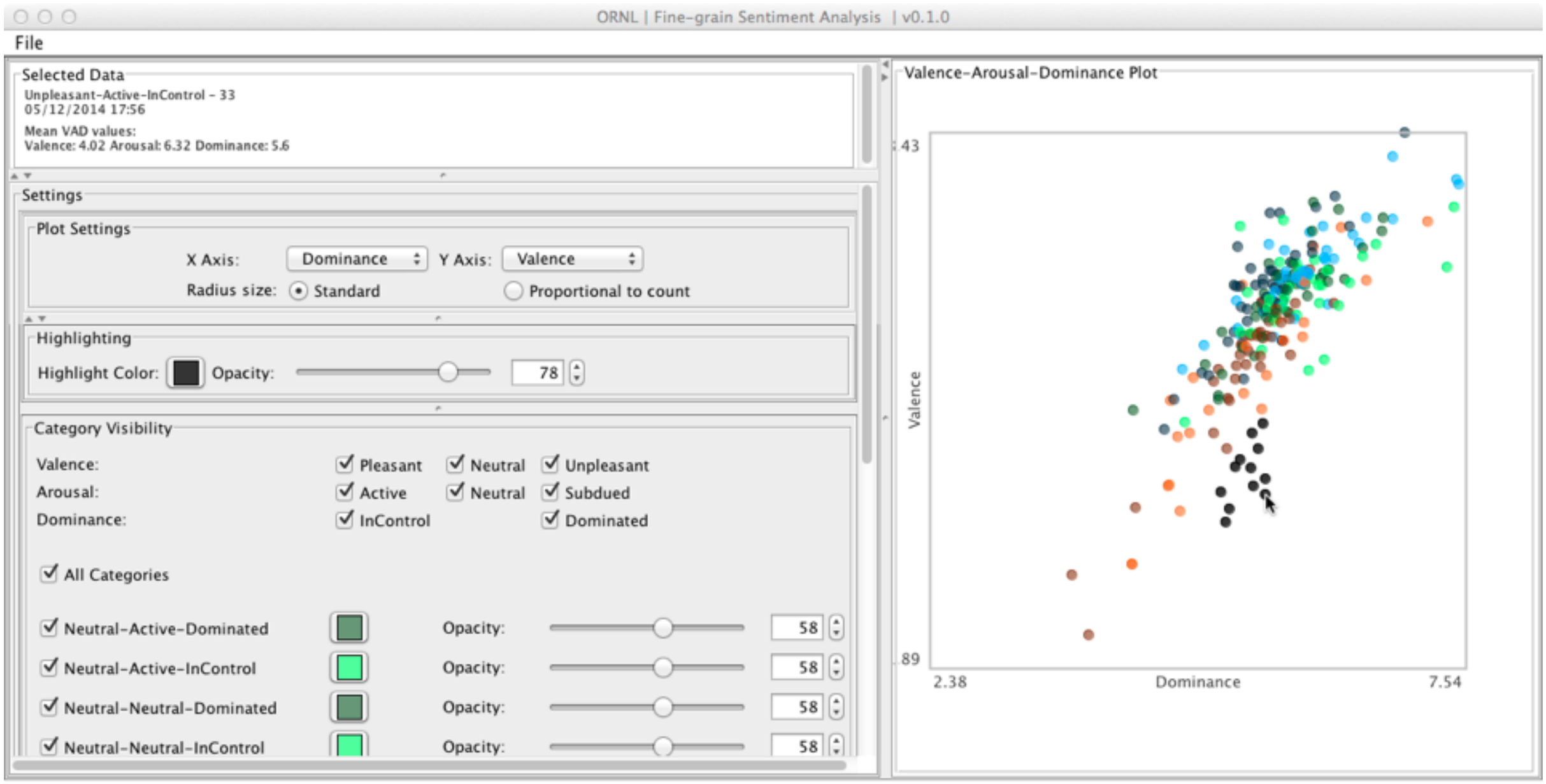
Emotion Classification using Machine Learning

- Estimate textual content's emotion using a ML approach that avoids manual labeling of training data
- Leverage statistical and emotional text analytics trained on pure examples of various emotion classes
- Using ANEW [2] model
  - Valence - positivity/negativity
  - Arousal - excitability
  - Dominance - assertion level of the author

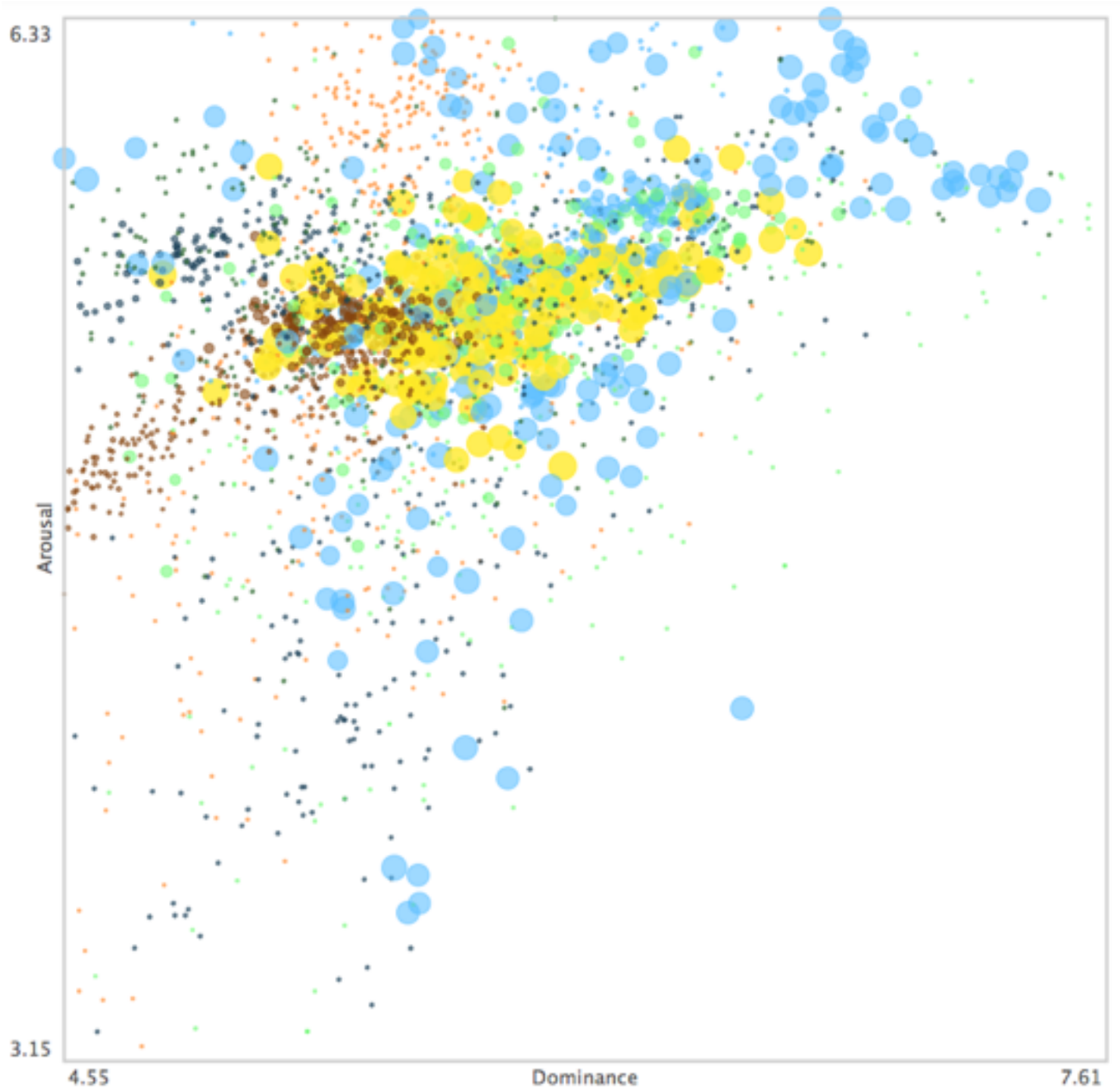
Emotion Classification using Machine Learning

- TF-ICF [6] term weighting method determines significant terms using a vector space model
- Significant terms and ANEW scores are merged as a feature set representative of the content and emotion of the textual record
- A maximum entropy learner from the MinorThird ML library is used to train the model
- Training selects tweets with emotion class explicitly encoded as a hashtag to provide pure representations of each emotion class (automated labeling)
- Classifier is built to predict emotion in new unlabeled records

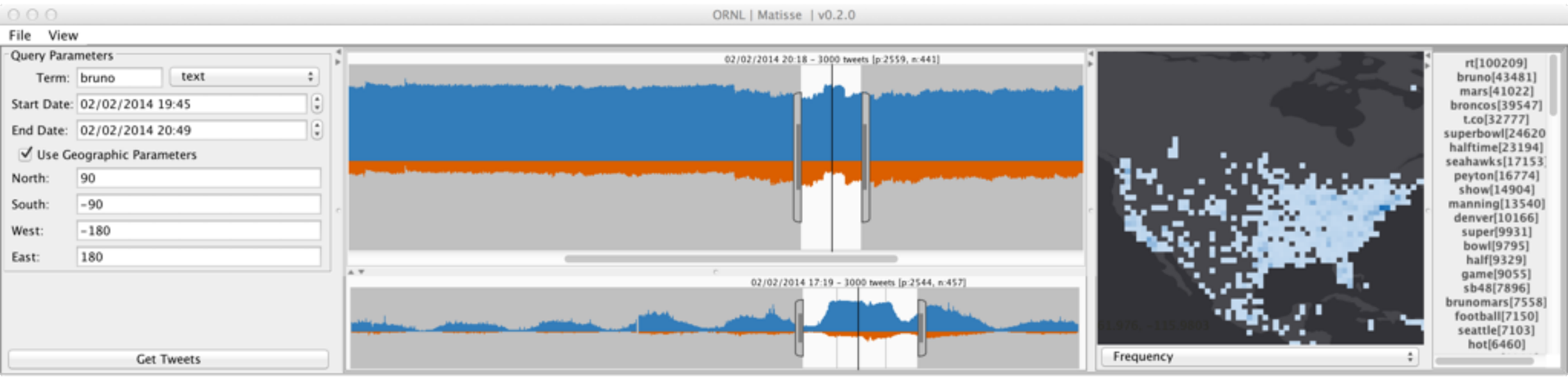
Visualizing Emotion Classifications



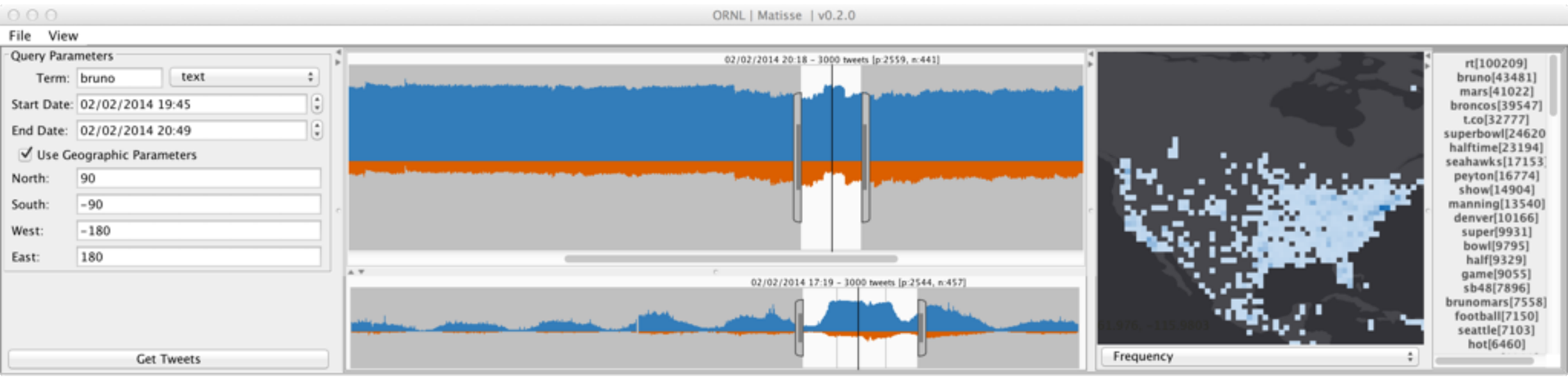
Visualizing Emotion Classifications



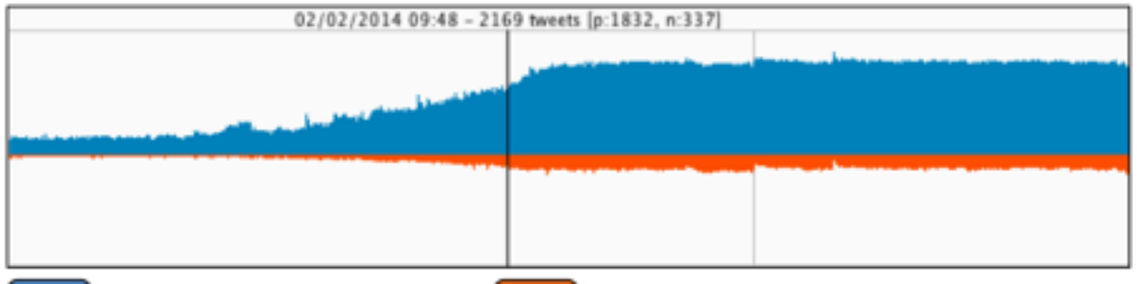
Geospatial + Term Frequency Visualizations



Multi-scale Temporal Visualizations

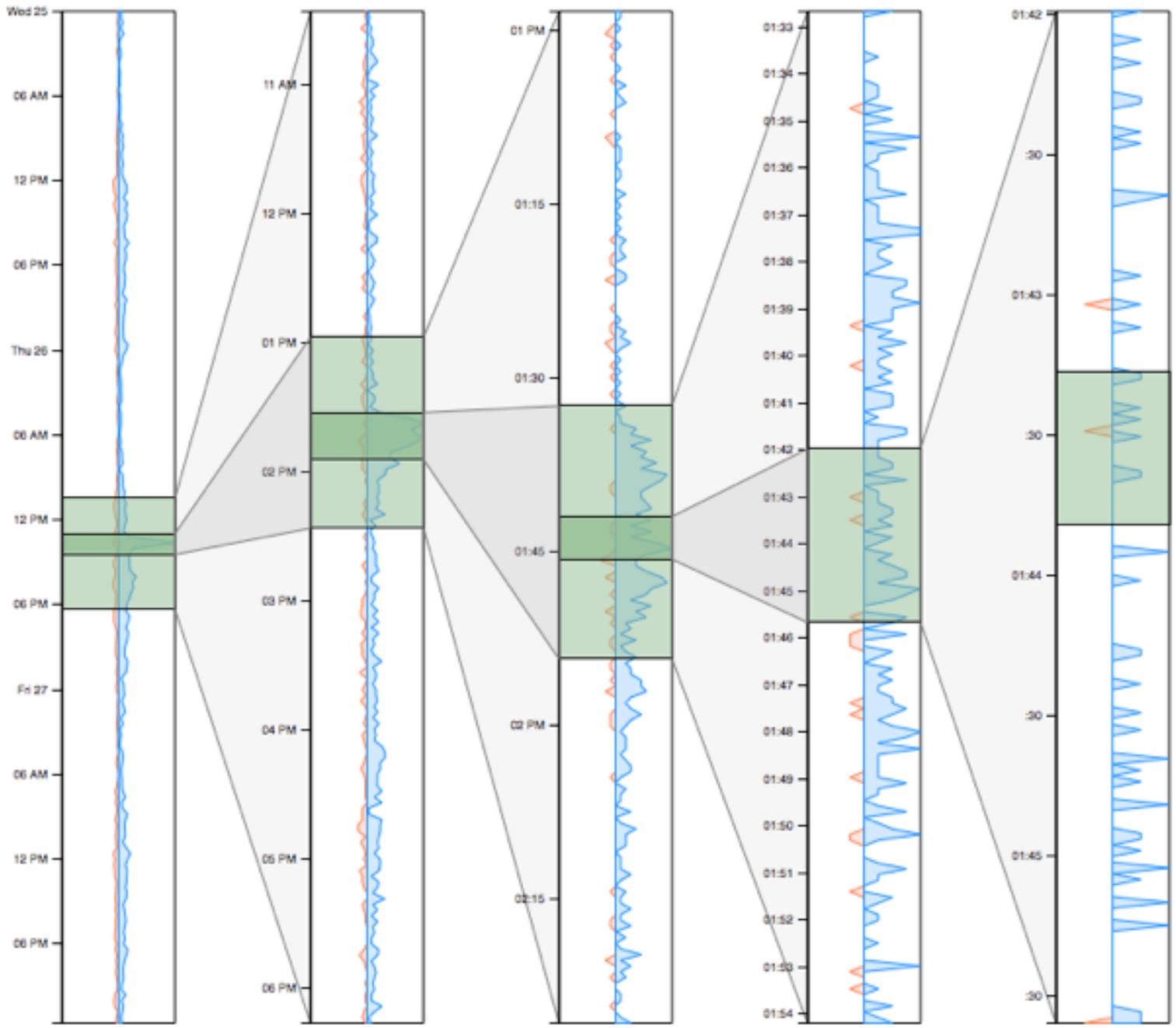


Total Frequency

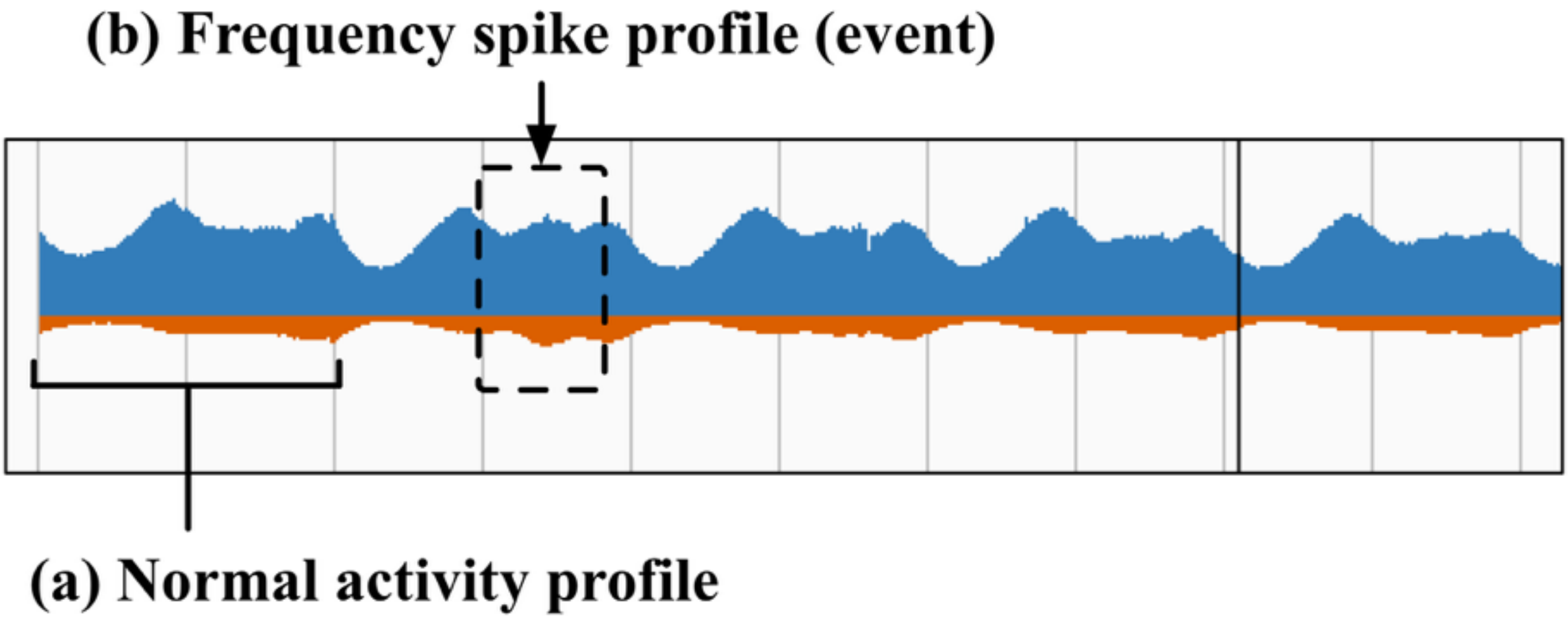


Positive Sentiment **Negative Sentiment**

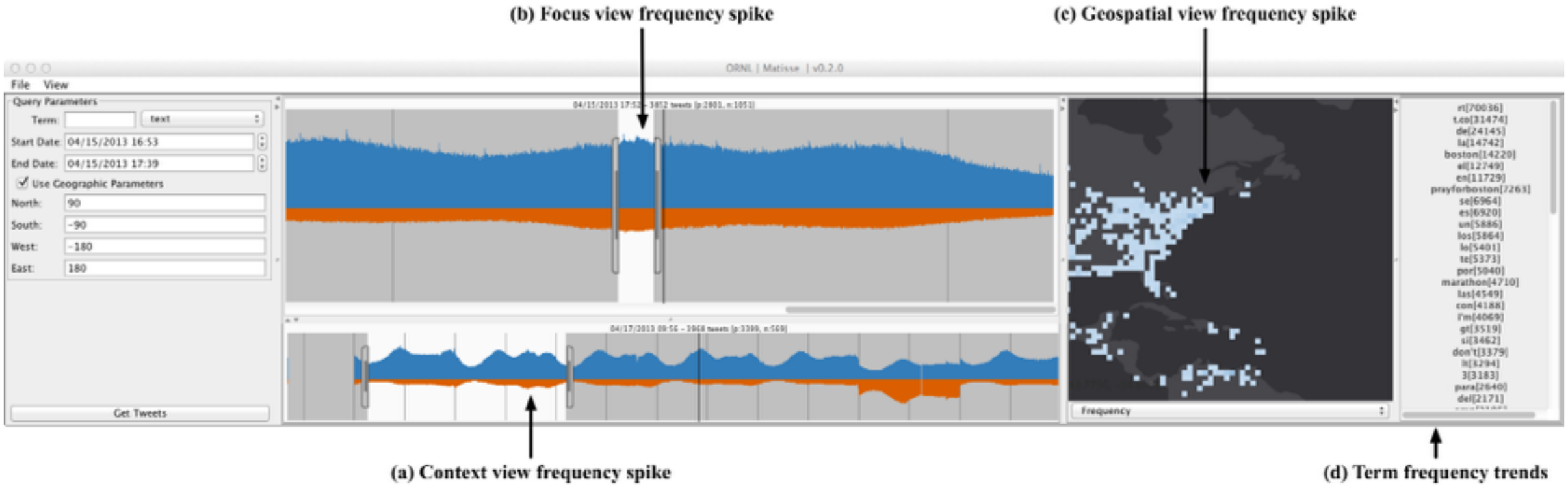
Multi-scale Temporal Visualizations



Temporal Event Detection



Case Study: Boston Marathon Bombing



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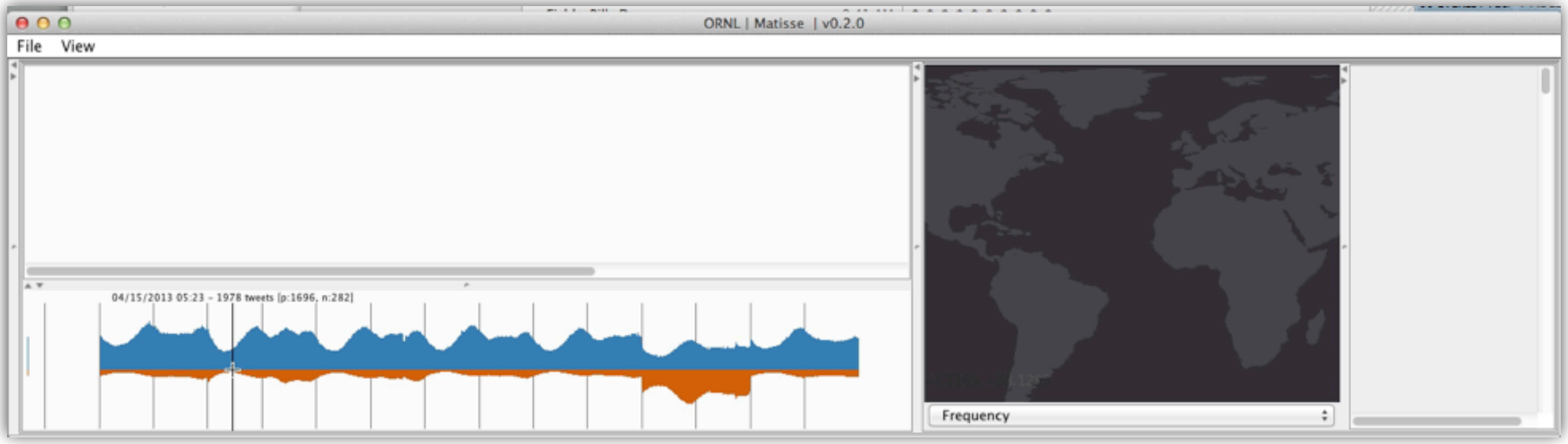

Twitter 1% Sample Stream
Week of Boston Marathon Bombing
14-20 April, 2013

Conclusions

- Multi-scale visualizations enable scalable exploratory analysis.
  - More intermediate views and scaled analytics are needed.
- Automated analytics (sentiment / emotion) help guide analysis.
  - ML emotion classification needs validation and expansion.
- Linked views and interactions foster more creative analysis.
  - Additional views and interactions are needed.