Value in the DETAILS

Understanding detailed data through VISUAL EXPLORATION

Richard Brath
Rob Harper

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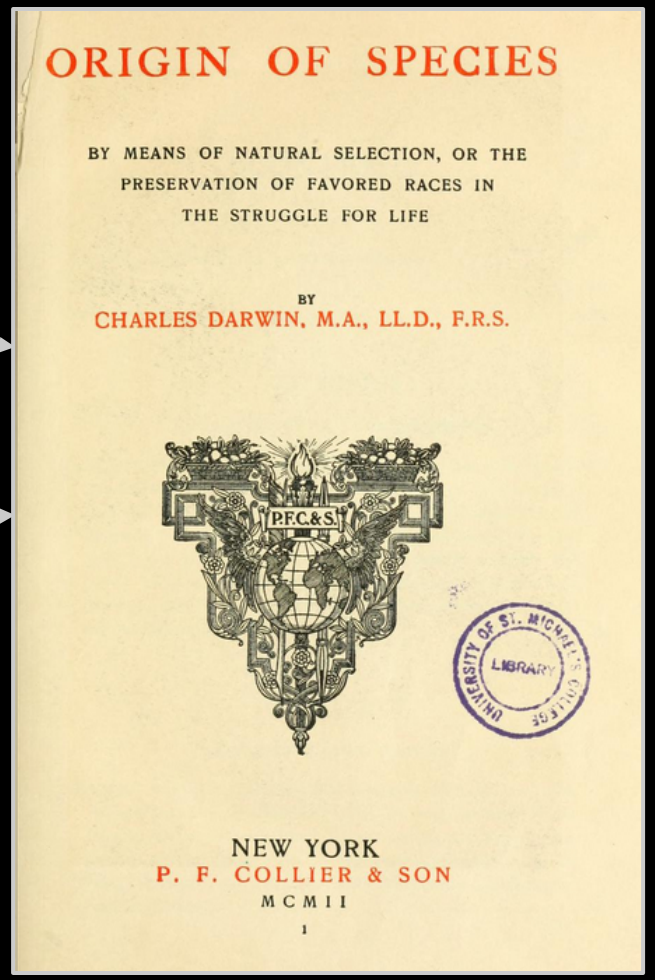
I'll be visually exploring all kinds of interesting patterns in tweets about Trump.
But wait – first what do we mean by visual exploration?

Visual Exploration

Natural Selection?



ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION, OR THE PRESERVATION OF FAVORED RACES IN THE STRUGGLE FOR LIFE

BY

CHARLES DARWIN, M.A., LL.D., F.R.S.

P.F.C.&S.

UNIVERSITY OF ST. MICHAEL'S COLLEGE LIBRARY

NEW YORK

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Visual Exploration Process

1. Collect a lot of data
2. Observe some interesting patterns
3. Hypothesize about why they exist
4. Refine and build models

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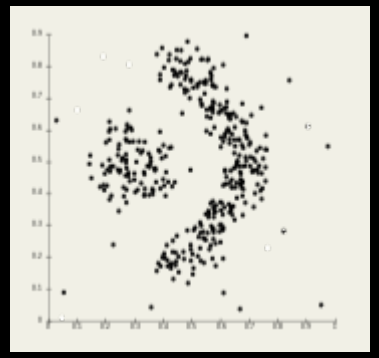
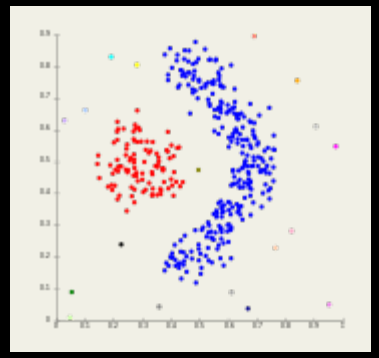
Understanding detail data

Can you see the patterns?

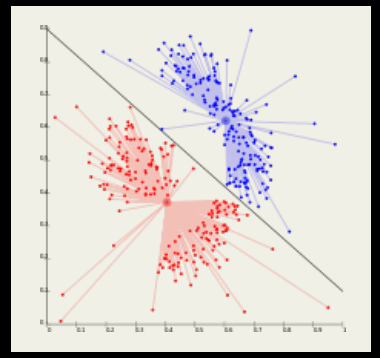
How about these algorithms abilities to find the patterns?



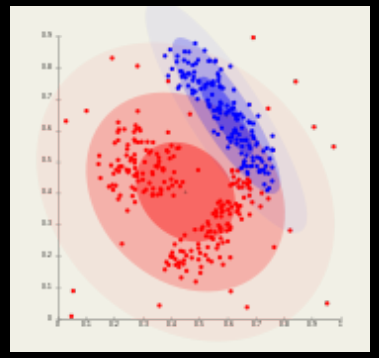
No Clustering



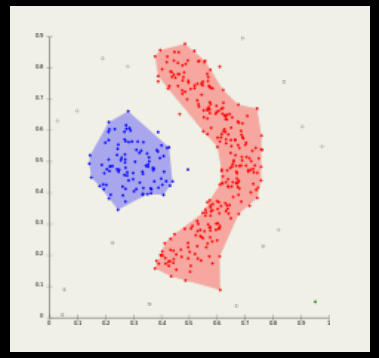
Linkage Clustering



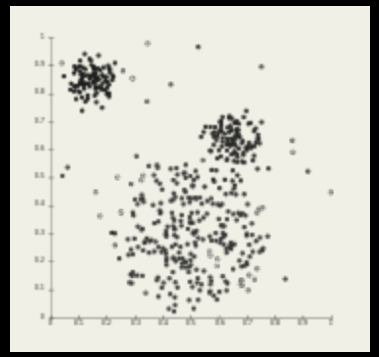
K-Means Clustering

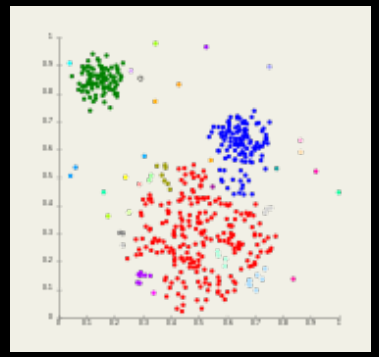


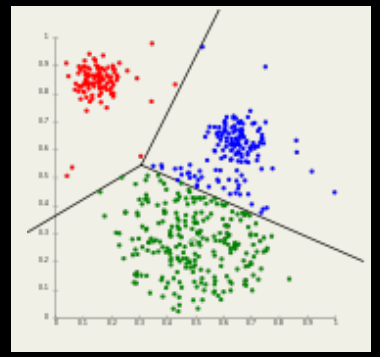
Distribution-based Clustering

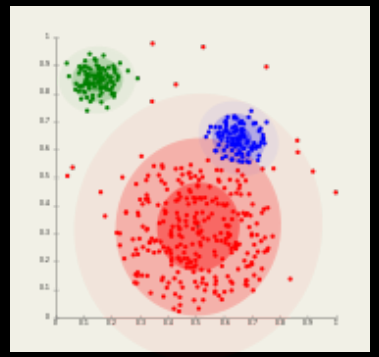


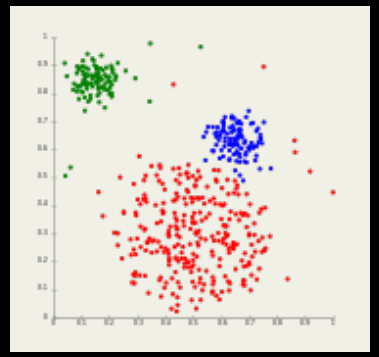
Density-based Clustering











https://en.wikipedia.org/wiki/Cluster_analysis

We see patterns all the time, and quite easily

We tend to group things based on visual cues, such as proximity, alignment and containment.

https://www.flickr.com/photos/tobin/111811243/

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Seeing detailed patterns

Perception can be whole. Once you see it, you won't un-see it.

First publication of the picture probably in Life Magazine:58;7 1965-02-19, p 120.

Also, check out the movie by Wim van de Grind (http://www.michaelbach.de/ot/cog_dalmatian/index.html)

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So what?

Powerful human perception system

- Detects **patterns** in complex data
- Can find **patterns** based on different criteria
- Can find **patterns** at different scales

So what?

Exploratory Data Analysis stems from John Tukey's work in the early 1960s. EDA can be characterized by

a. understanding "what is going on here?"
b. graphic representations of data
c. tentative model building and hypothesis generation
d. robust measures, re-expression, and subset analysis
e. skepticism, flexibility.

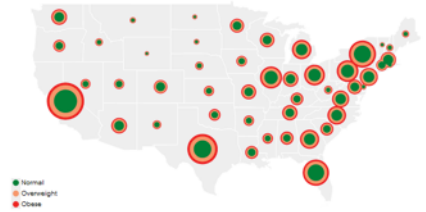
*The goal of Exploratory Data Analysis is to discover **patterns** in data.*

paraphrased from John Behrens, Arizona State University, Principles and Procedures of Exploratory Data Analysis, American Psychological Association, 1997.

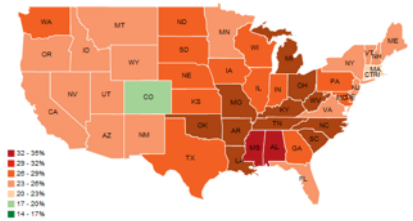
So, why are we summarizing big data into bar charts?

So, why we rolling-up big data into visualizations of 1000 points?

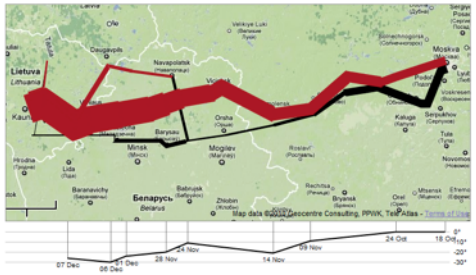
Graduated Symbol Maps



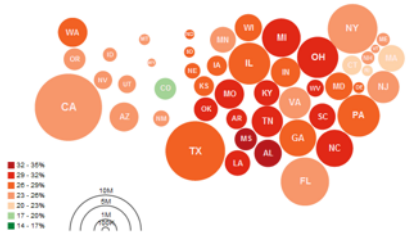
Choropleth Maps



Flow Maps

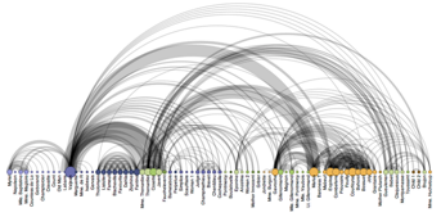


Cartograms



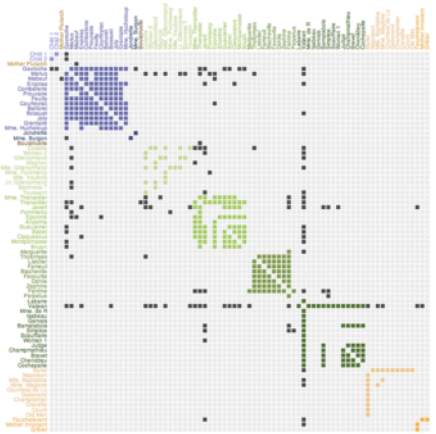
Force-Directed Layout

Arc Diagrams

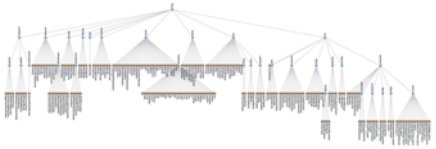


An *arc diagram* uses a one-dimensional layout of nodes, with circular arcs to represent links. While arc diagrams may not convey the overall structure of the graph as effectively as a two-dimensional layout, with a good ordering of nodes it is easy to identify cliques and bridges. And, as with the indented tree layout, multivariate data can easily be displayed alongside nodes. The problem of sorting the nodes in a manner that reveals underlying cluster structure is formally called *seriation*, and has diverse applications in visualization, statistics, and even archaeology!

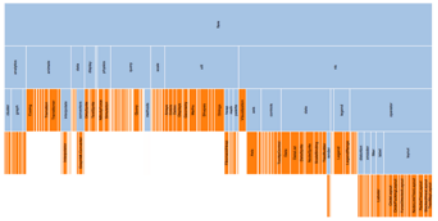
Matrix Views



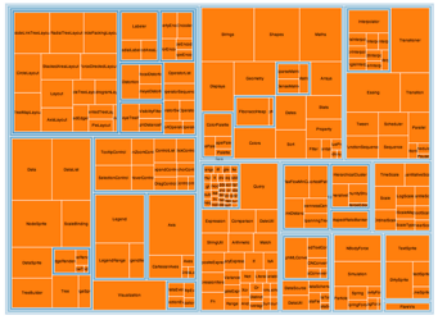
Node-Link Diagrams



Adjacency Diagrams

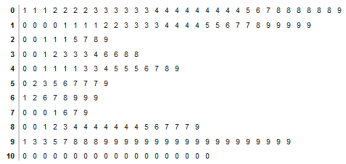


Enclosure Diagrams

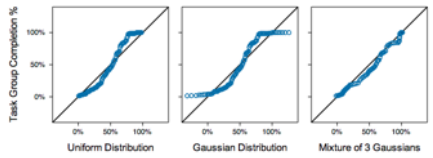


A Tour through the Visualization Zoo
Heer, Bostock, Ogievetsky
http://homes.cs.washington.edu/~jheer/files/zoo/

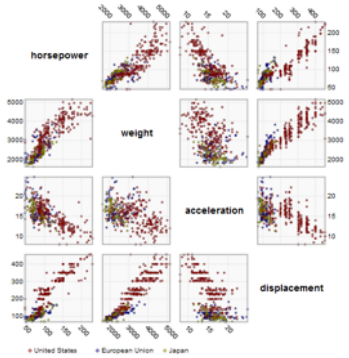
Stem-and-Leaf Plots



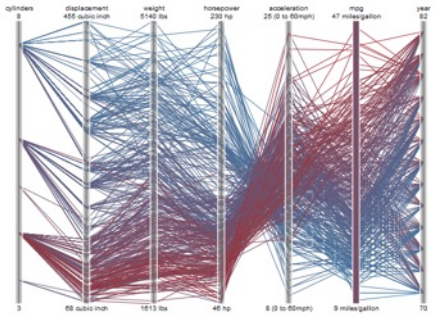
Q-Q Plots



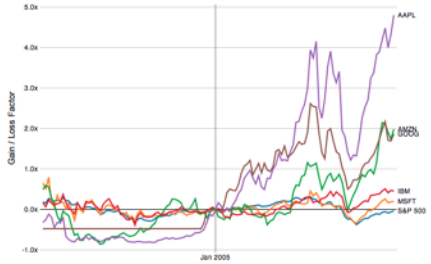
Scatter Plot Matrix (SPLOM)



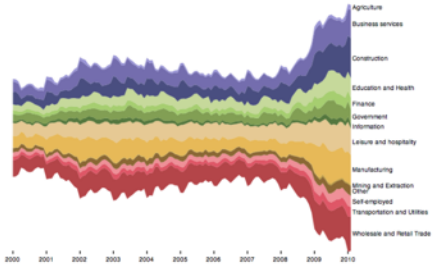
Parallel Coordinates



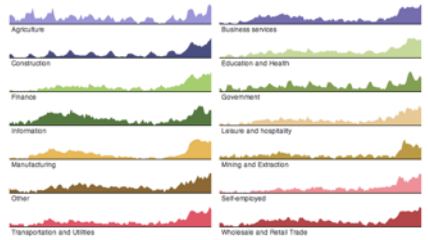
Index Charts



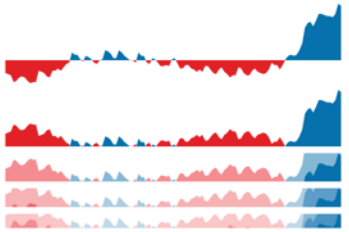
Stacked Graphs



Small Multiples



Horizon Graphs



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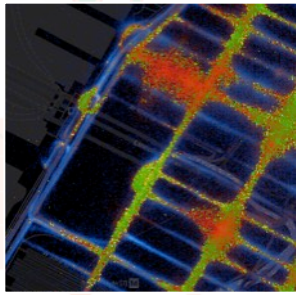
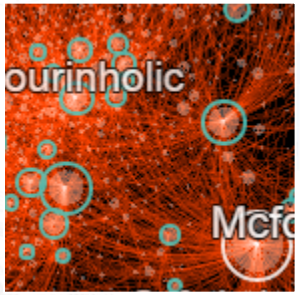
So, how do we visualize 100m data points?

MAP



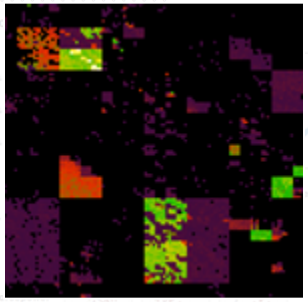
Strata NYC 2014

CONNECT



Strata London 2015

ORDER



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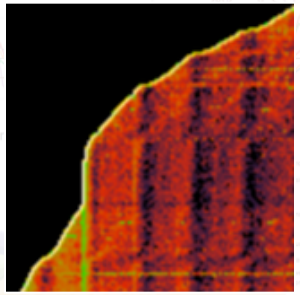
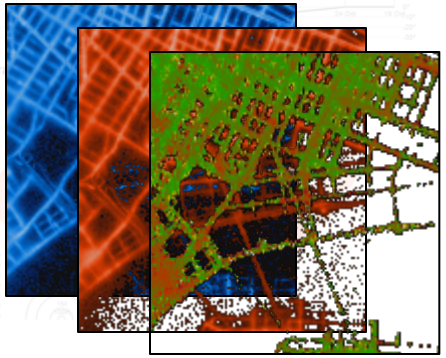
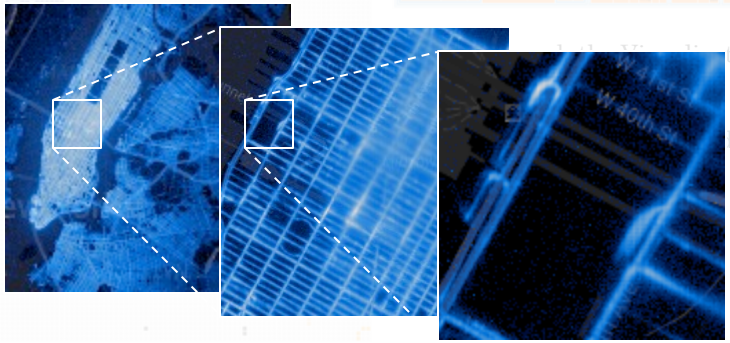


Today

LAYERS

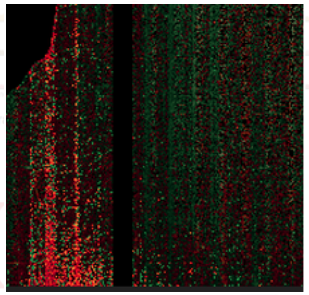


ZOOM



MINE

FILTER



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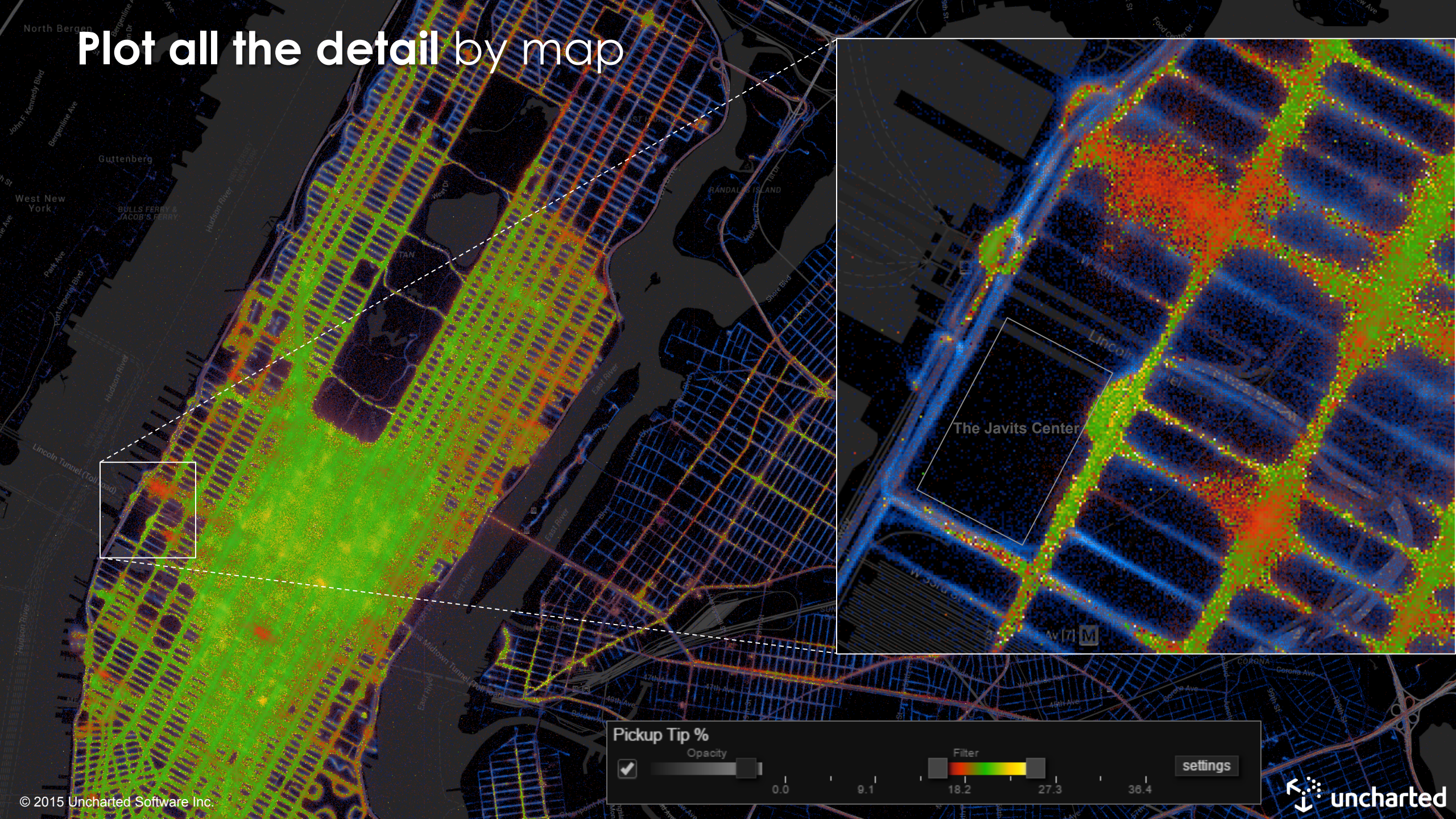
Plot all the detail by map



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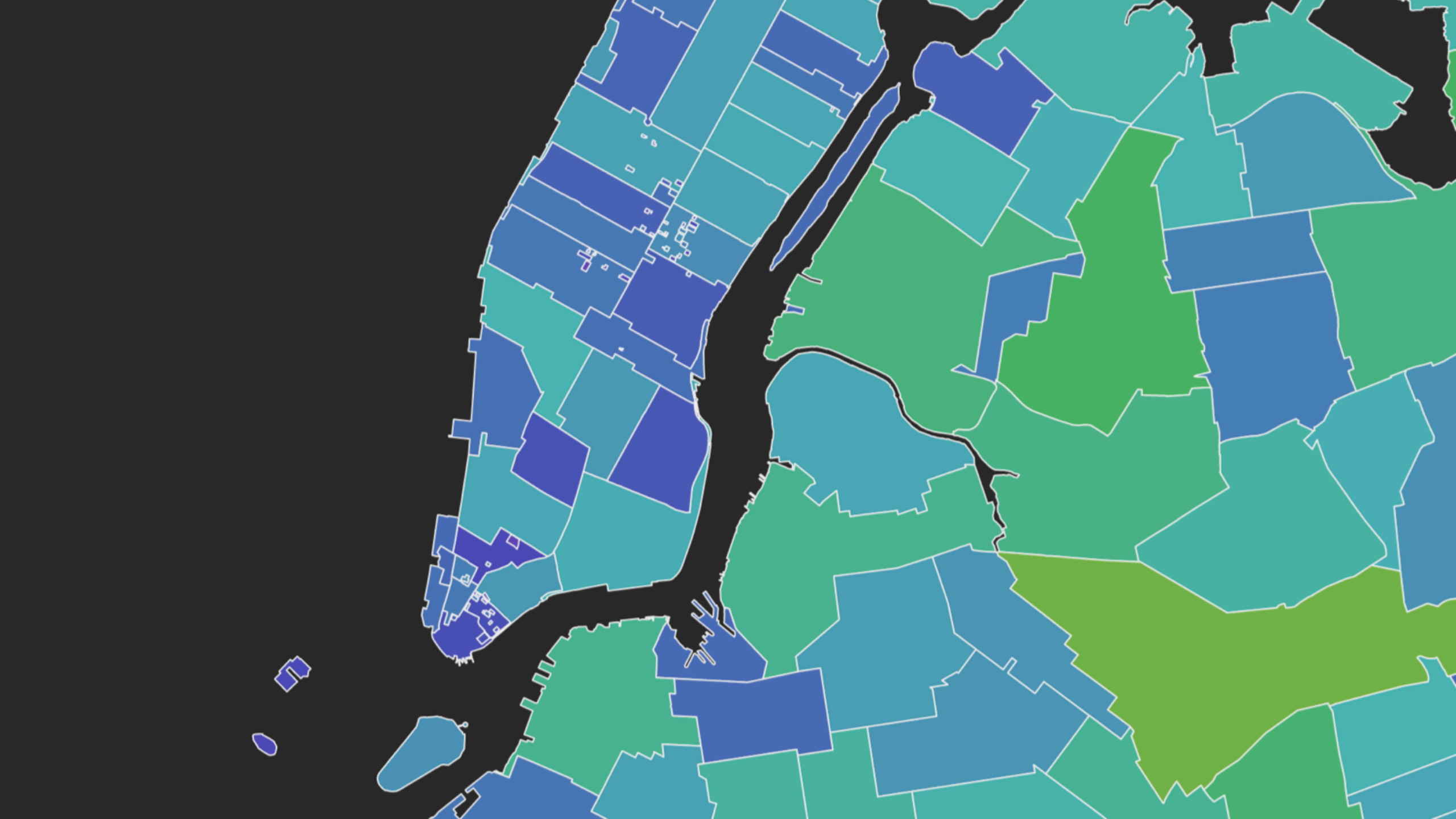
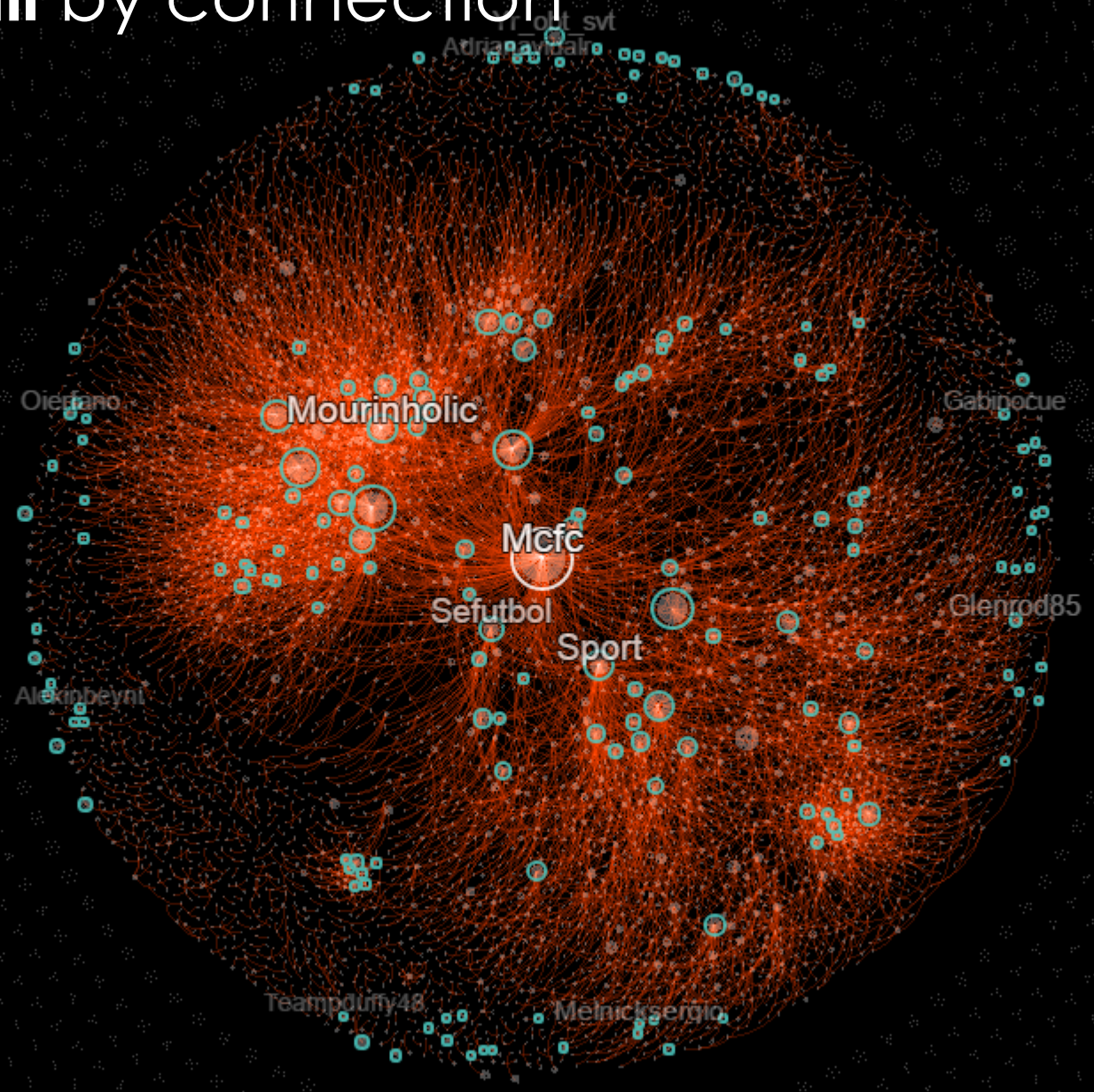


Plot all the detail by connection



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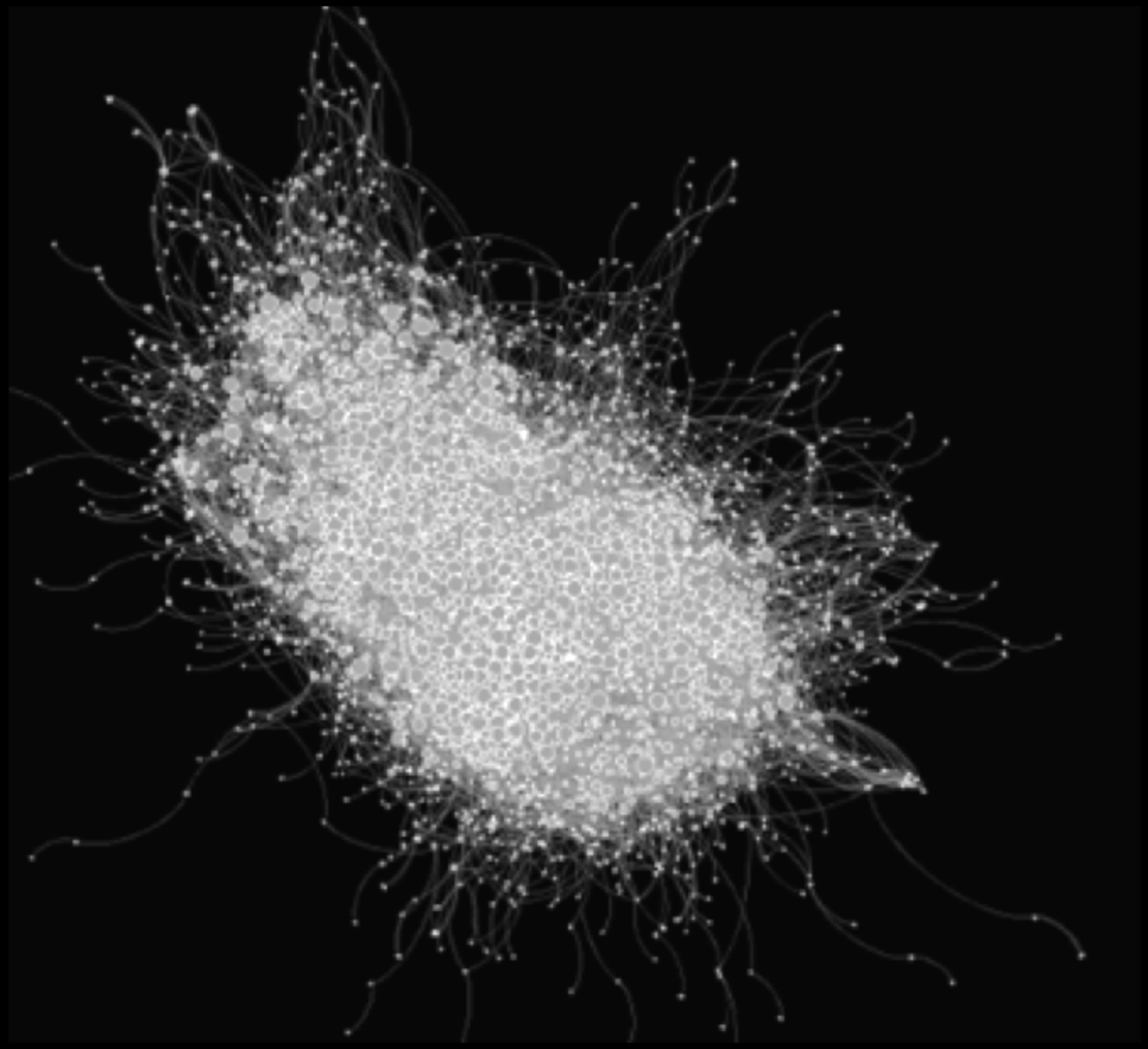

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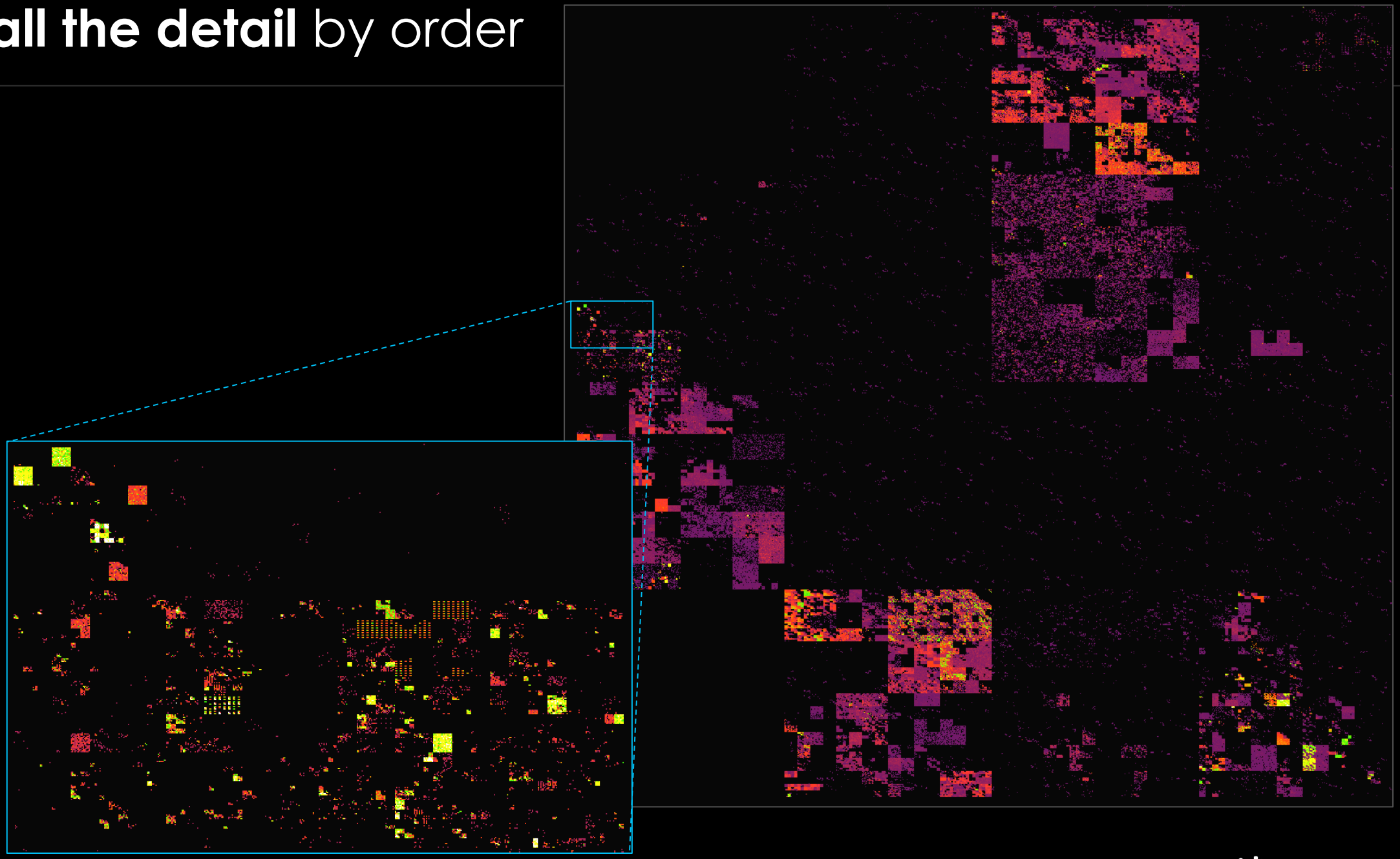
Plot all the detail by order



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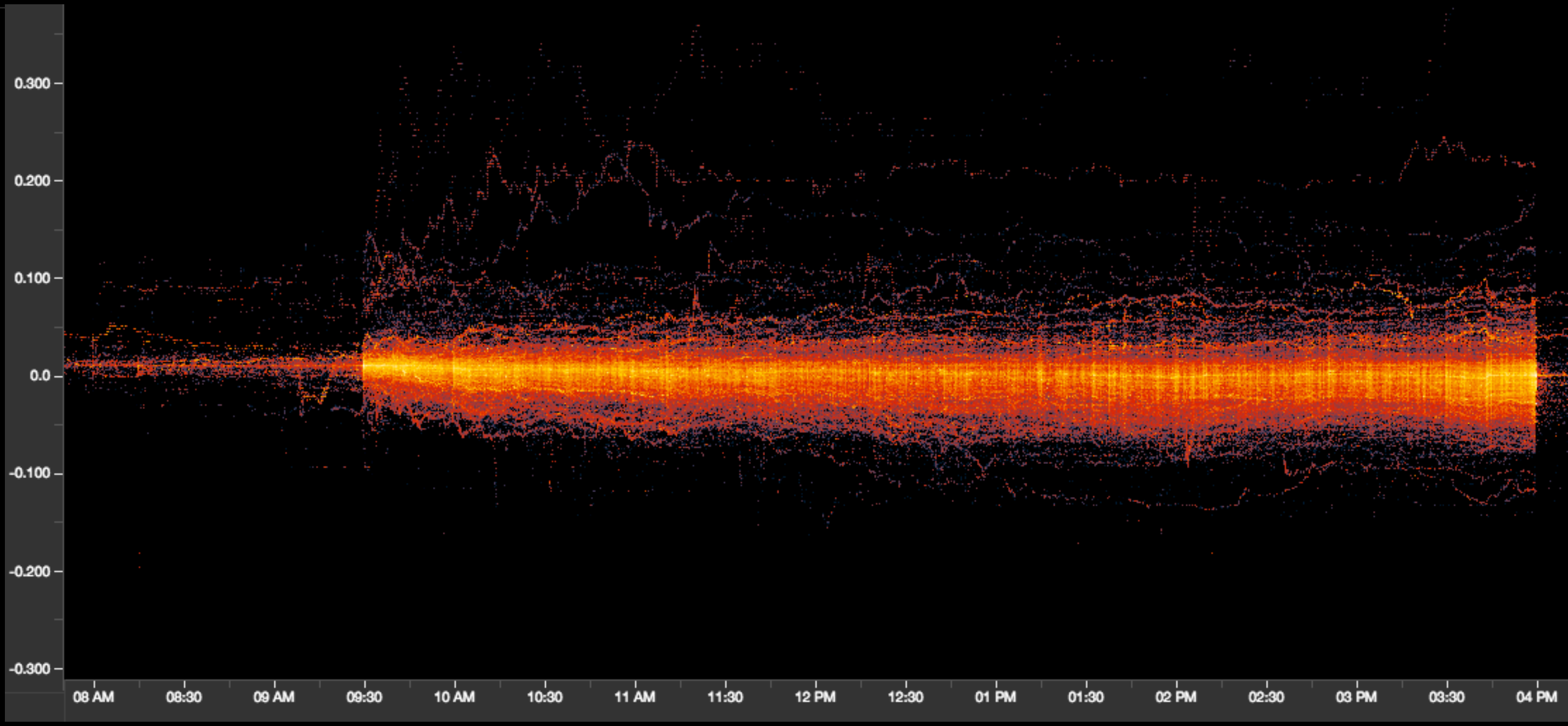
Plot all the detail by time



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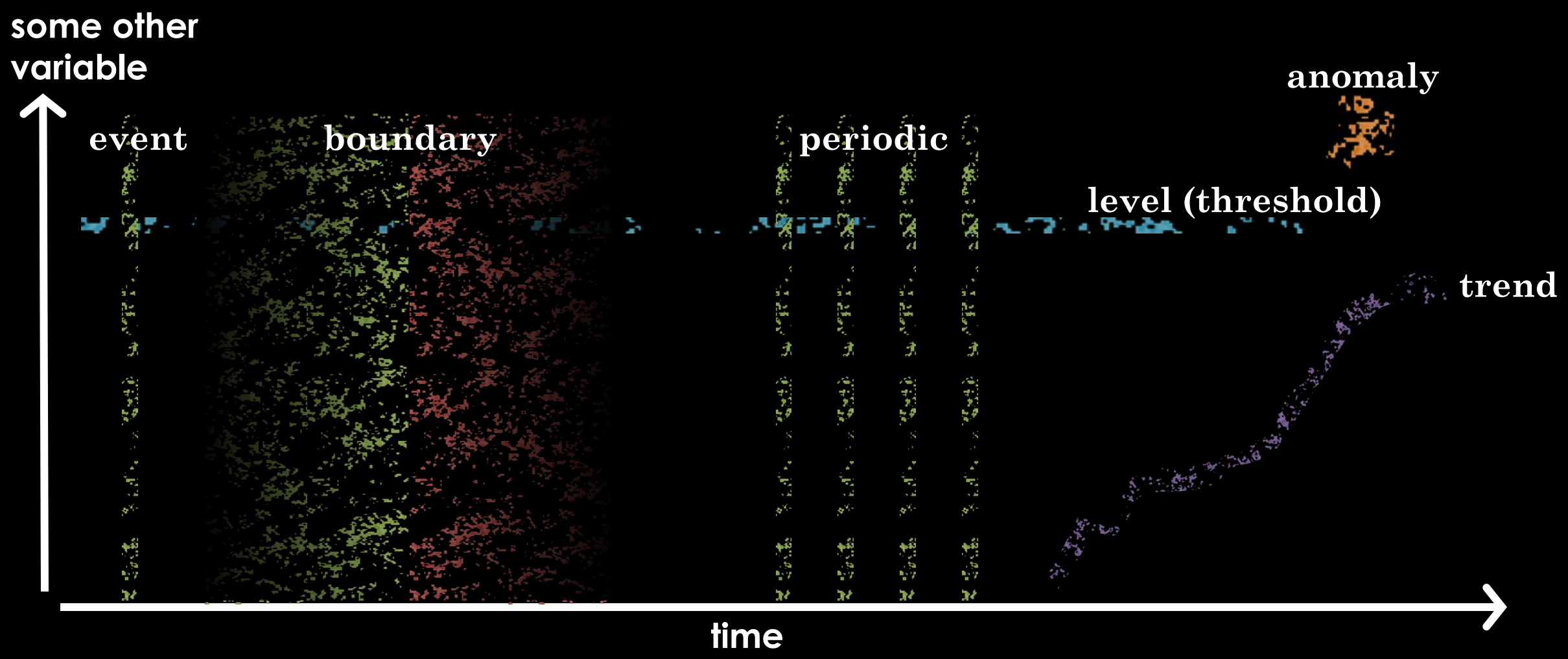
Visual Patterns in Time Plots



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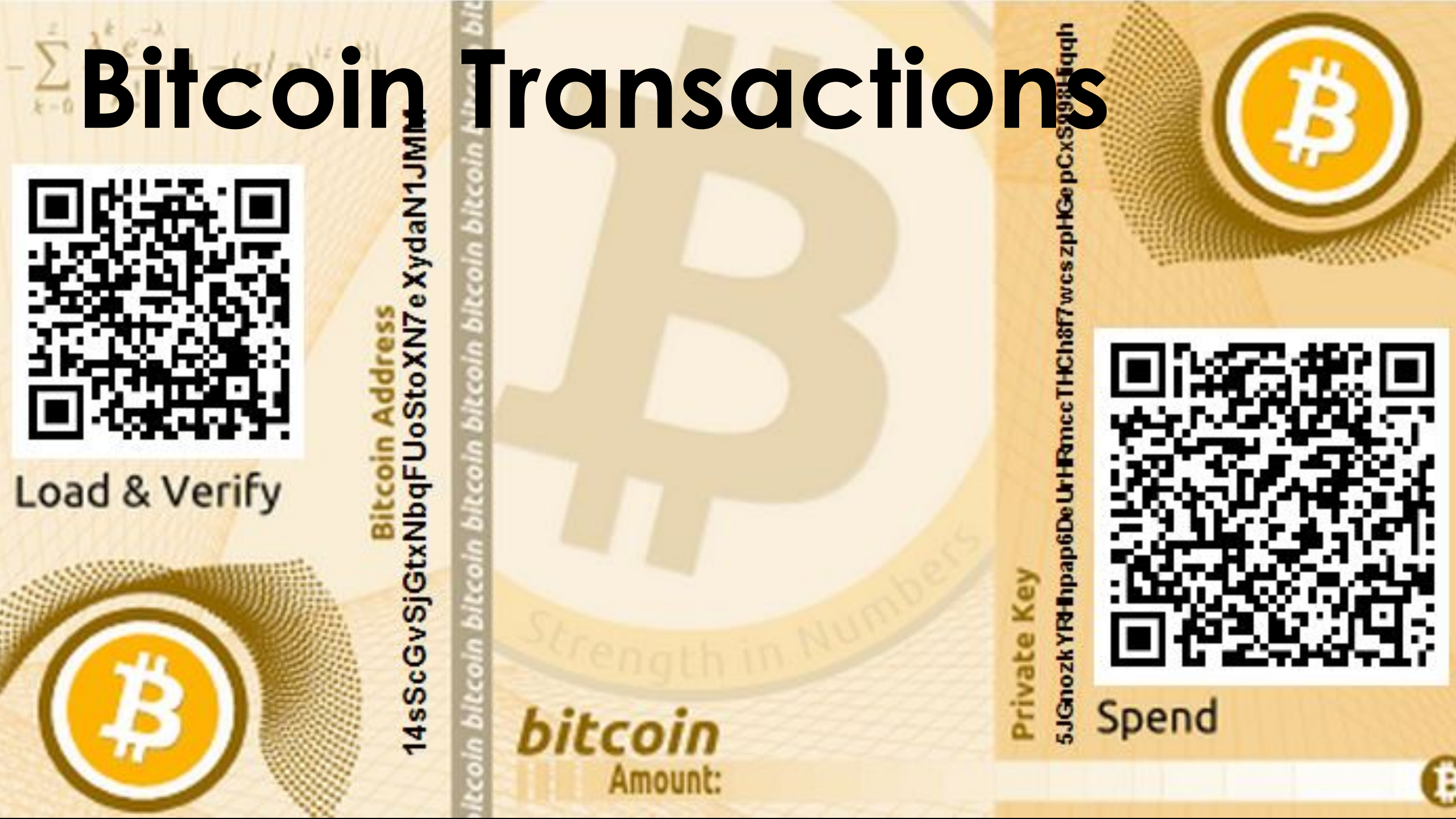
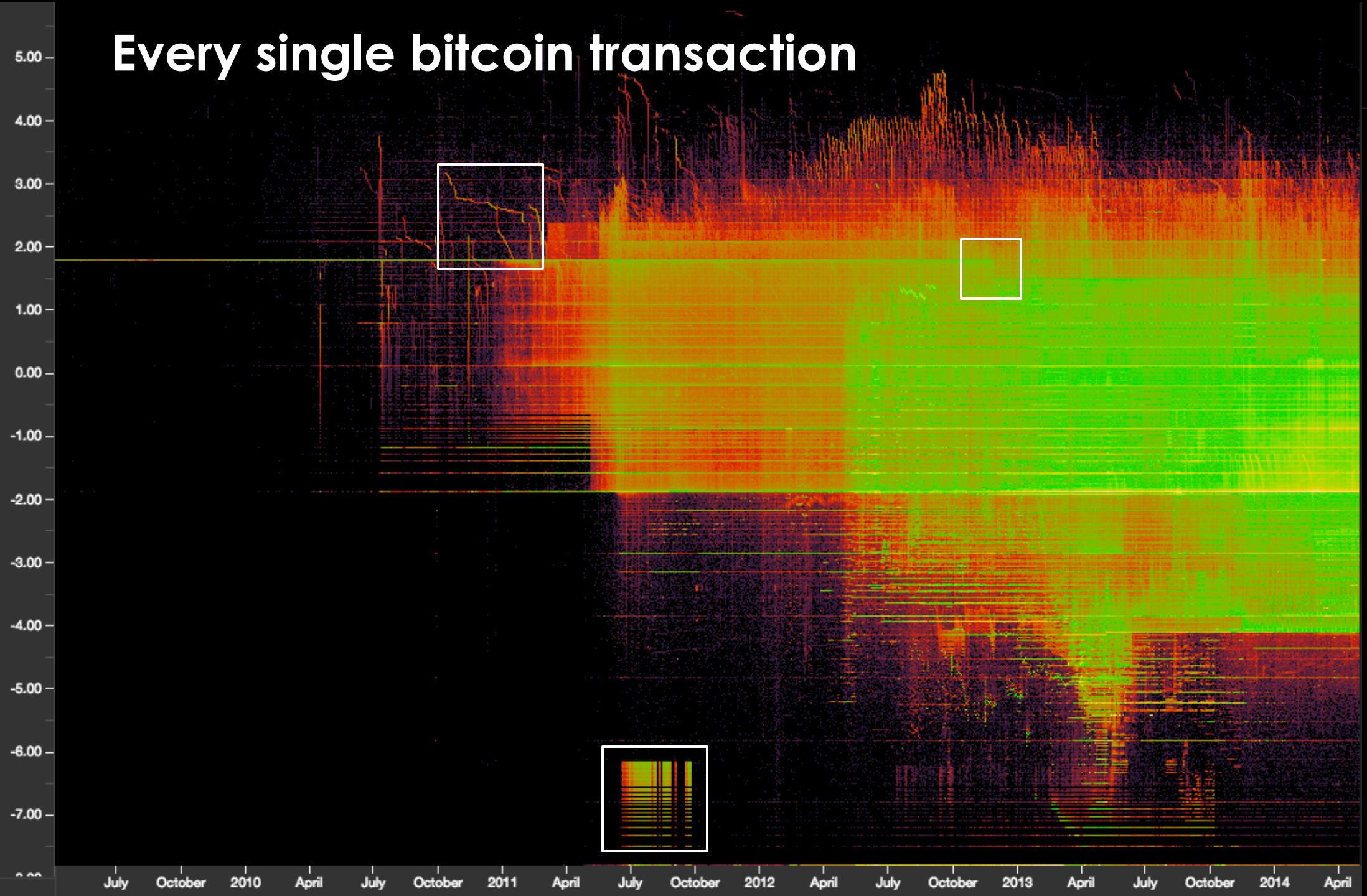
Bitcoin Transactions



Every single bitcoin transaction



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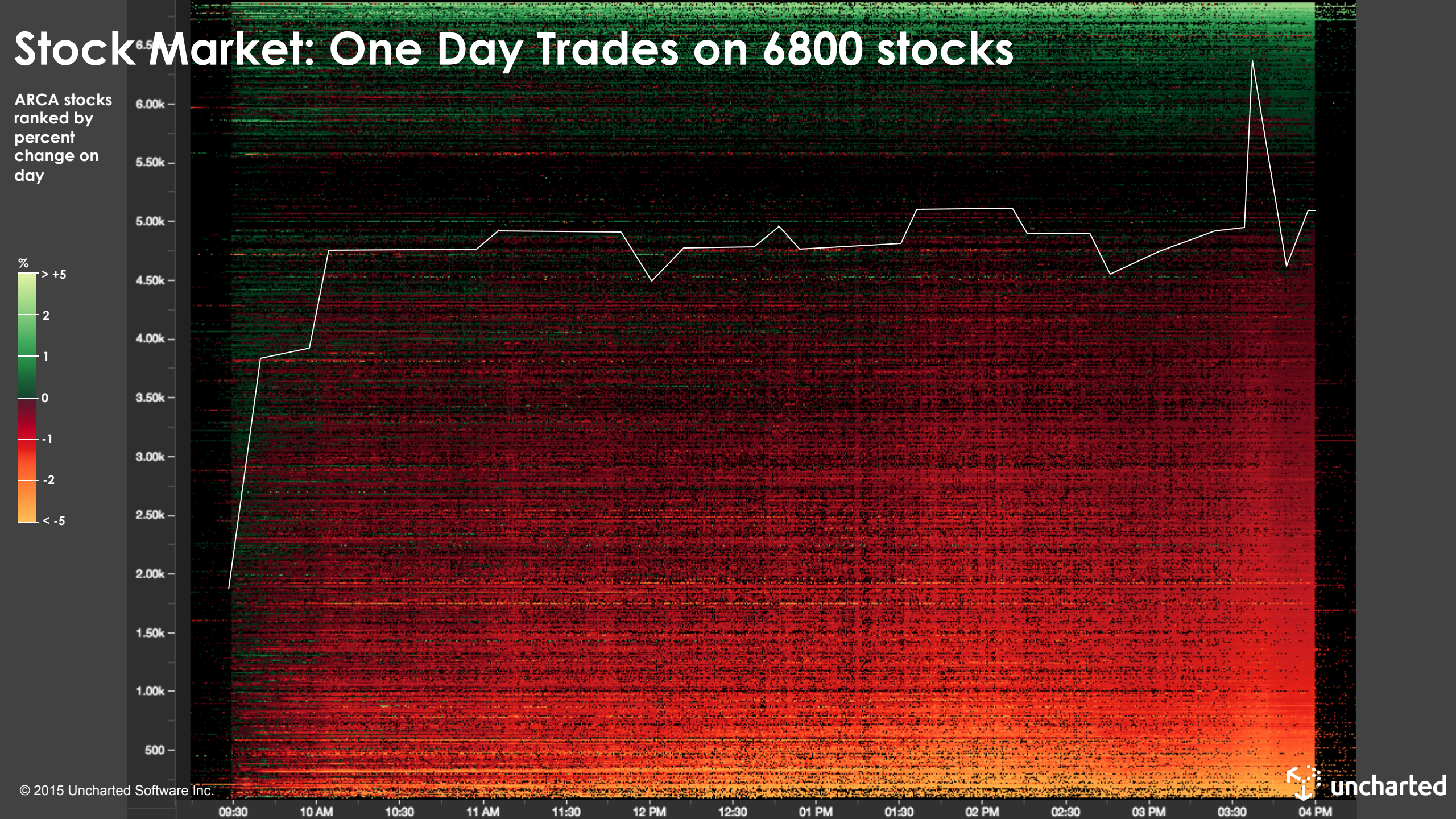
Financial Markets

Stock Market: One Day Trades on 6800 stocks



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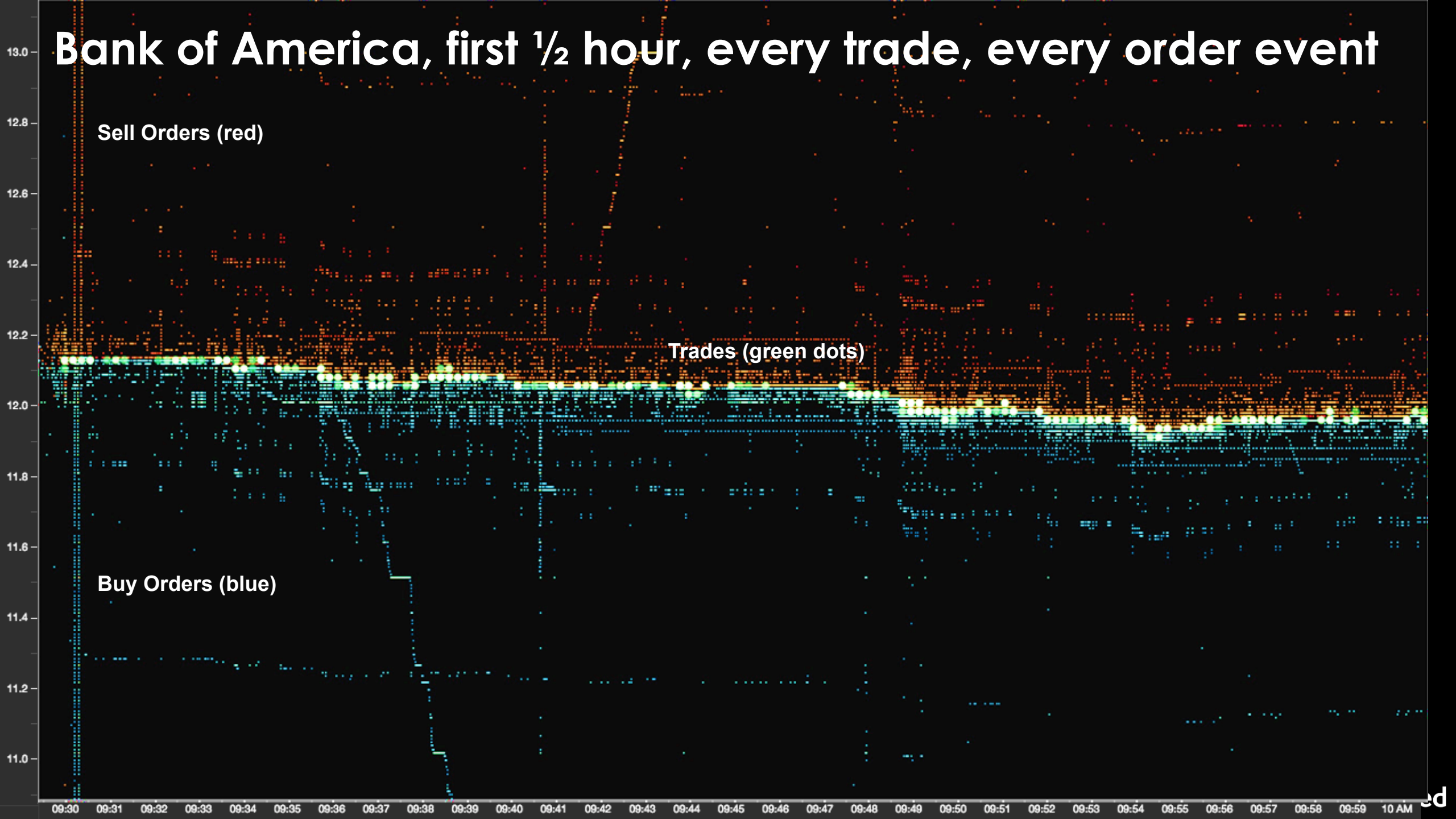
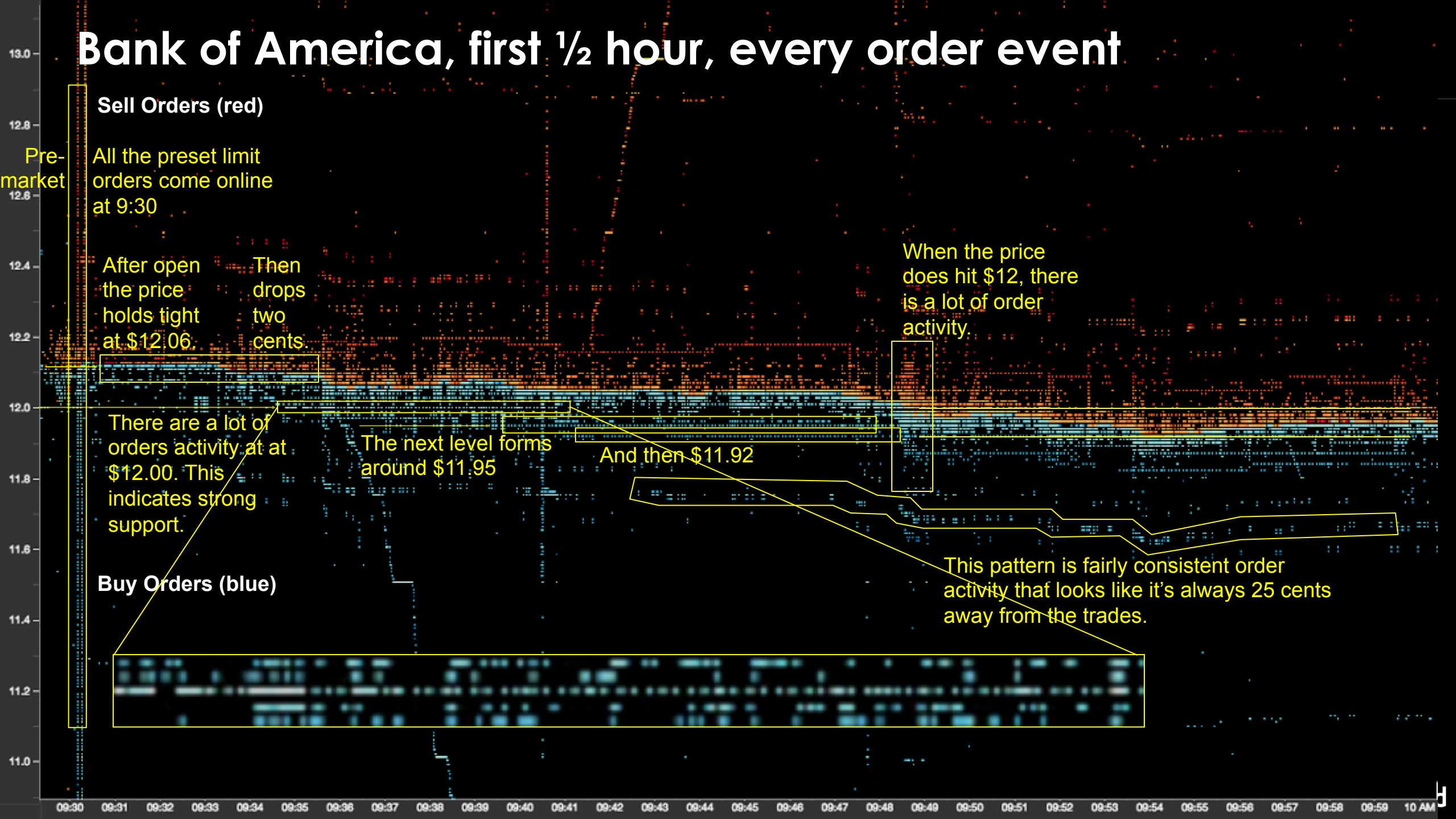
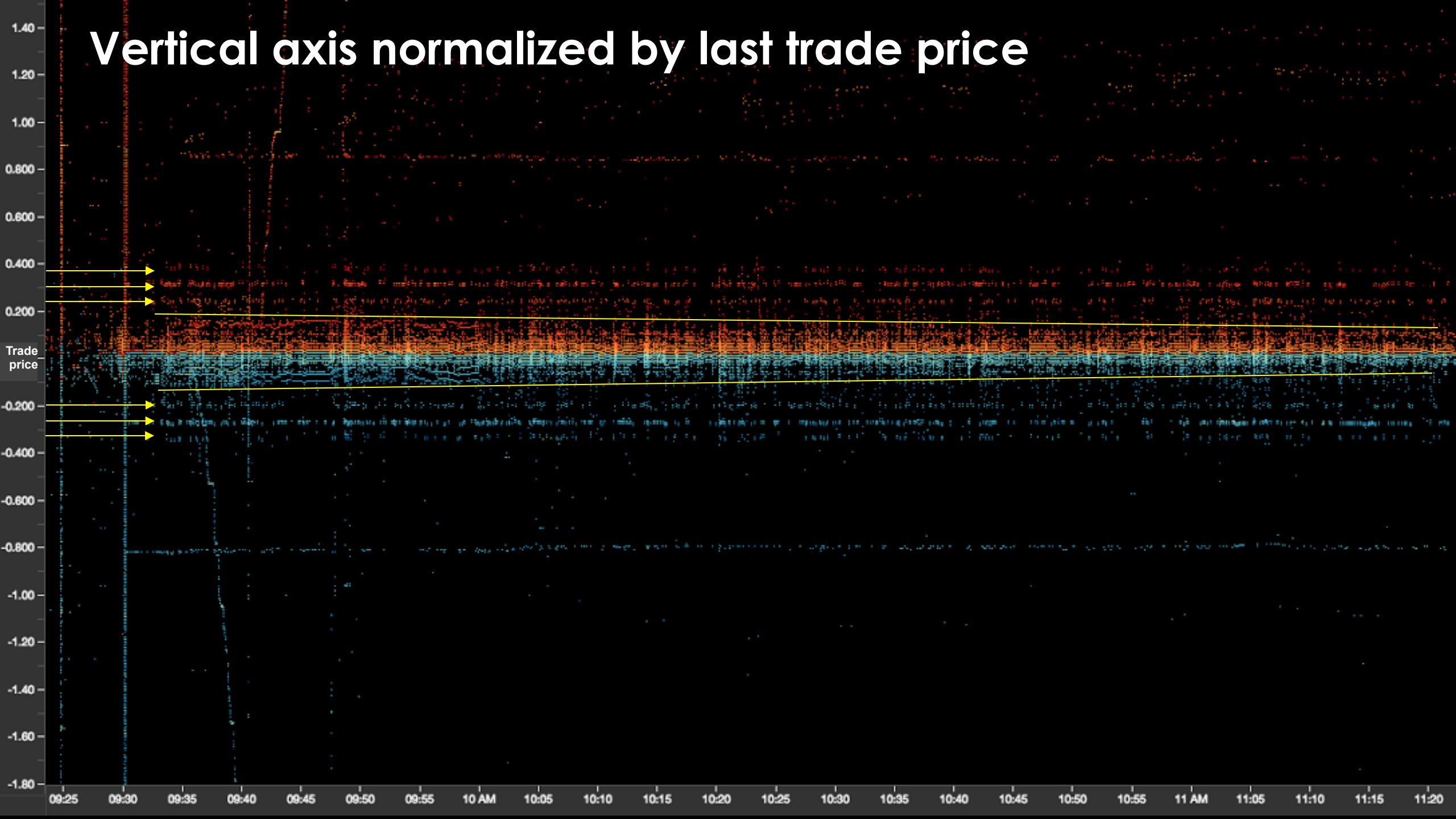
Bank of America, first ½ hour, every trade, every order event



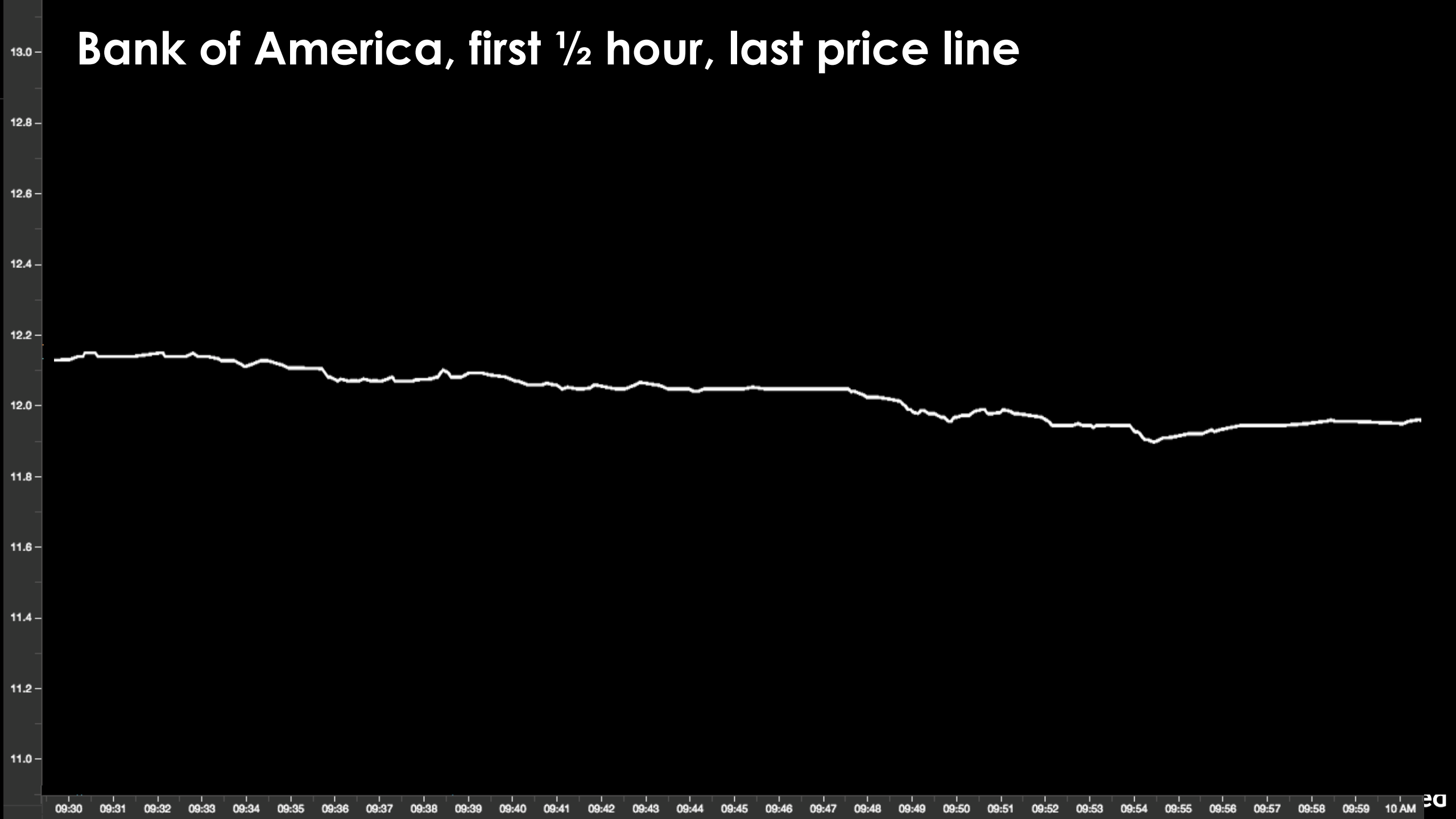
Bank of America, first ½ hour, every order event



Vertical axis normalized by last trade price



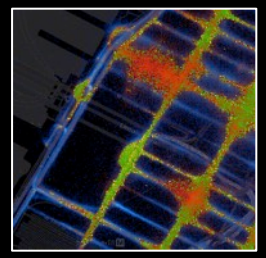
Bank of America, first ½ hour, last price line



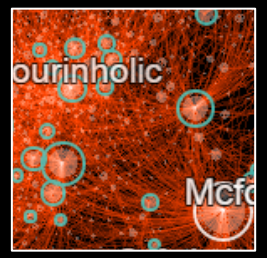
Technical Approach

Exploratory Big Data Analysis

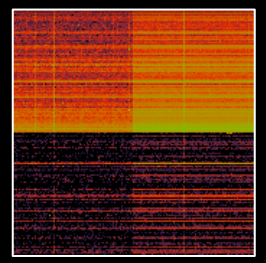
MAP



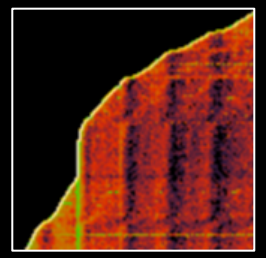
CONNECT



ORDER



TIME



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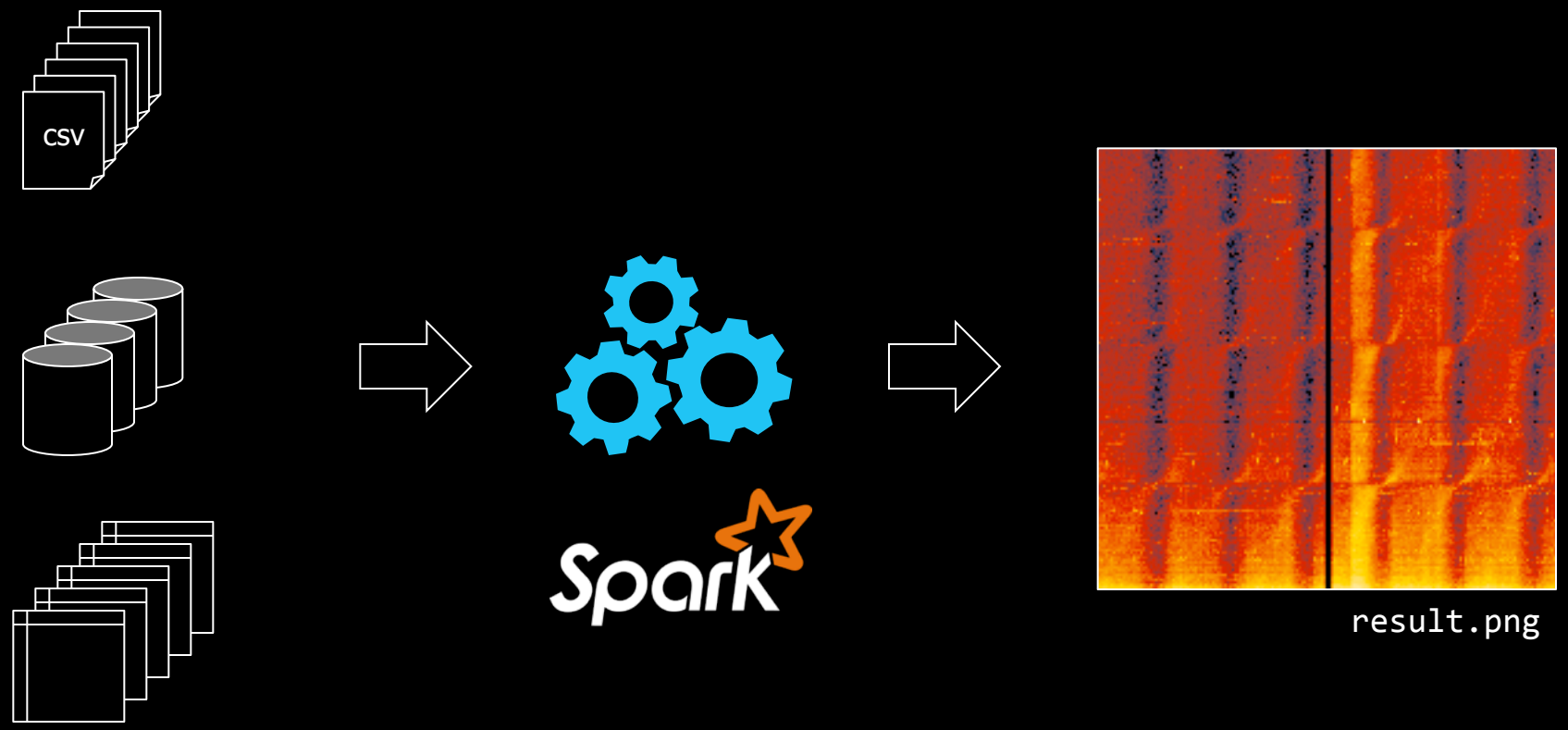

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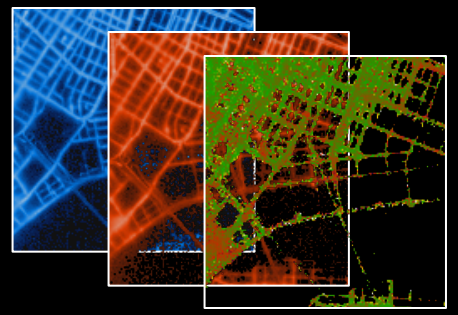
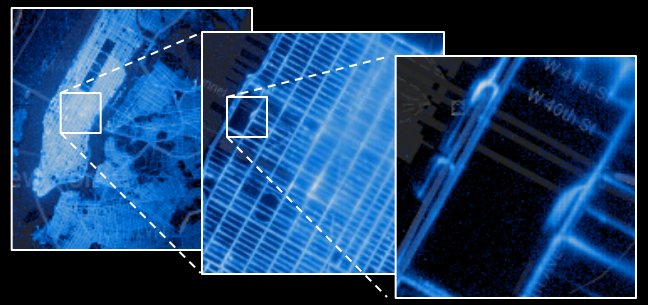
Exploratory Big Data Analysis – Rich Interactions

LAYERS

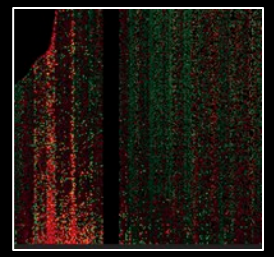


ZOOM



MINE

FILTER



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Spark as a Service

Expressive API

Technical Approach

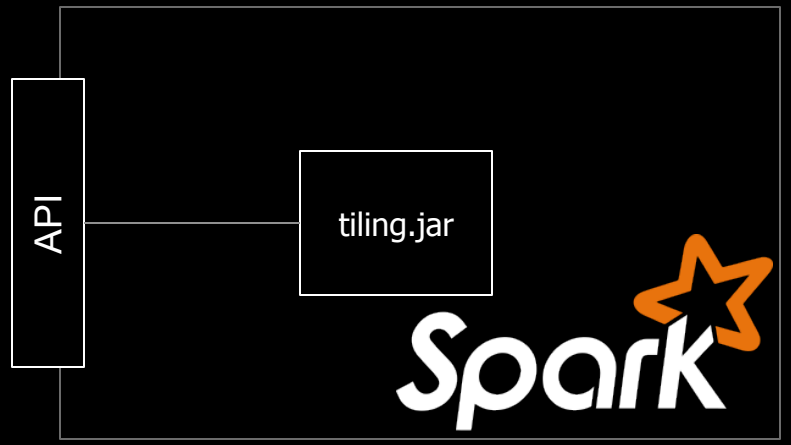
Data Pipeline

- Loading
- Filtering
- Transformation
- Sentiment
- Serialization

Results Generation

- Input mapping
- Projection
- "Pixel"-level analytics
- Area-level analytics
- Dataset-level analytics

Spark Cluster as a Service



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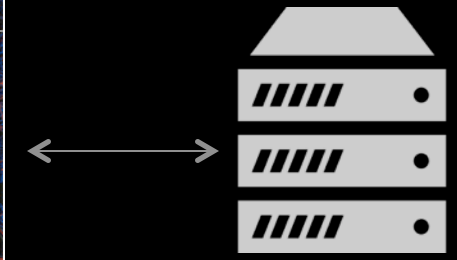
Technical Approach

configuration
sentiment
density
distributions
transformations
term frequencies
summary statistics
filters
data drilldown



Message Queue

RabbitMQ

Shared Storage

Redis

Spark Cluster as a Service

API

Executor
Executor
Executor
Executor
Executor

tiling.jar

Spark

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Technical Approach

github.com/unchartedsoftware

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Trump Tweets

Donald J. Trump
@realDonaldTrump

Follow

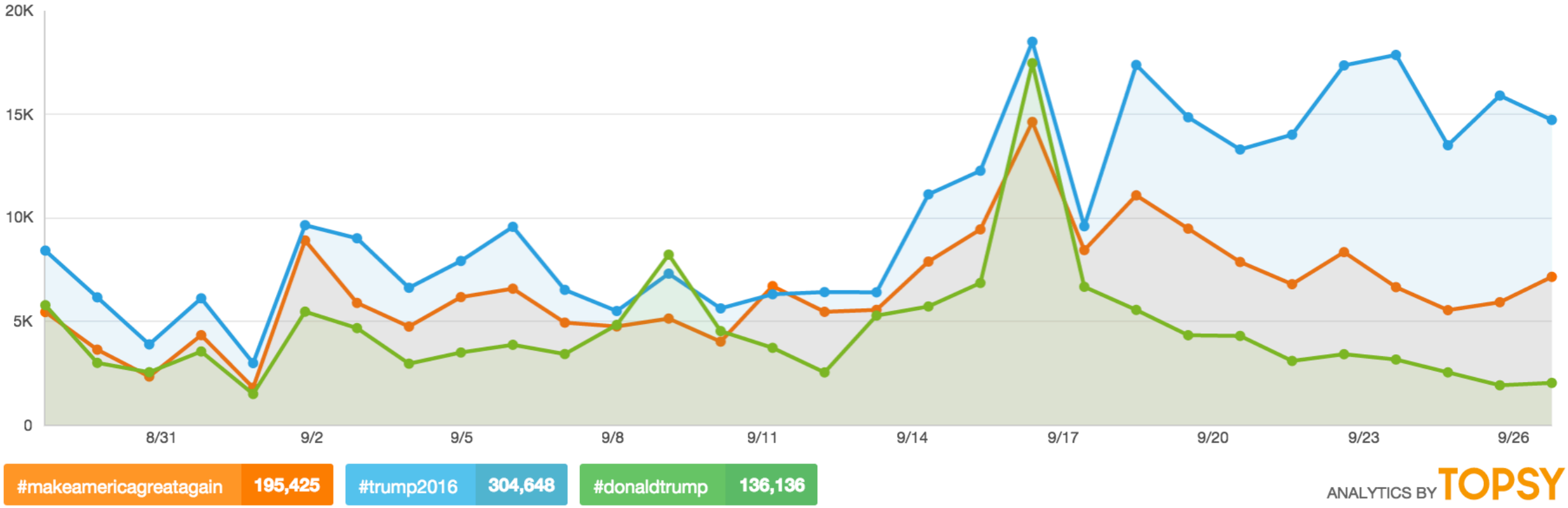
#AskTrump Getting ready to answer your questions.

1:07 PM - 21 Sep 2015

1,037 2,429

Tweets per day: #makeamericagreatagain, #trump2016, and #donaldtrump

August 28th — September 27th



Continue

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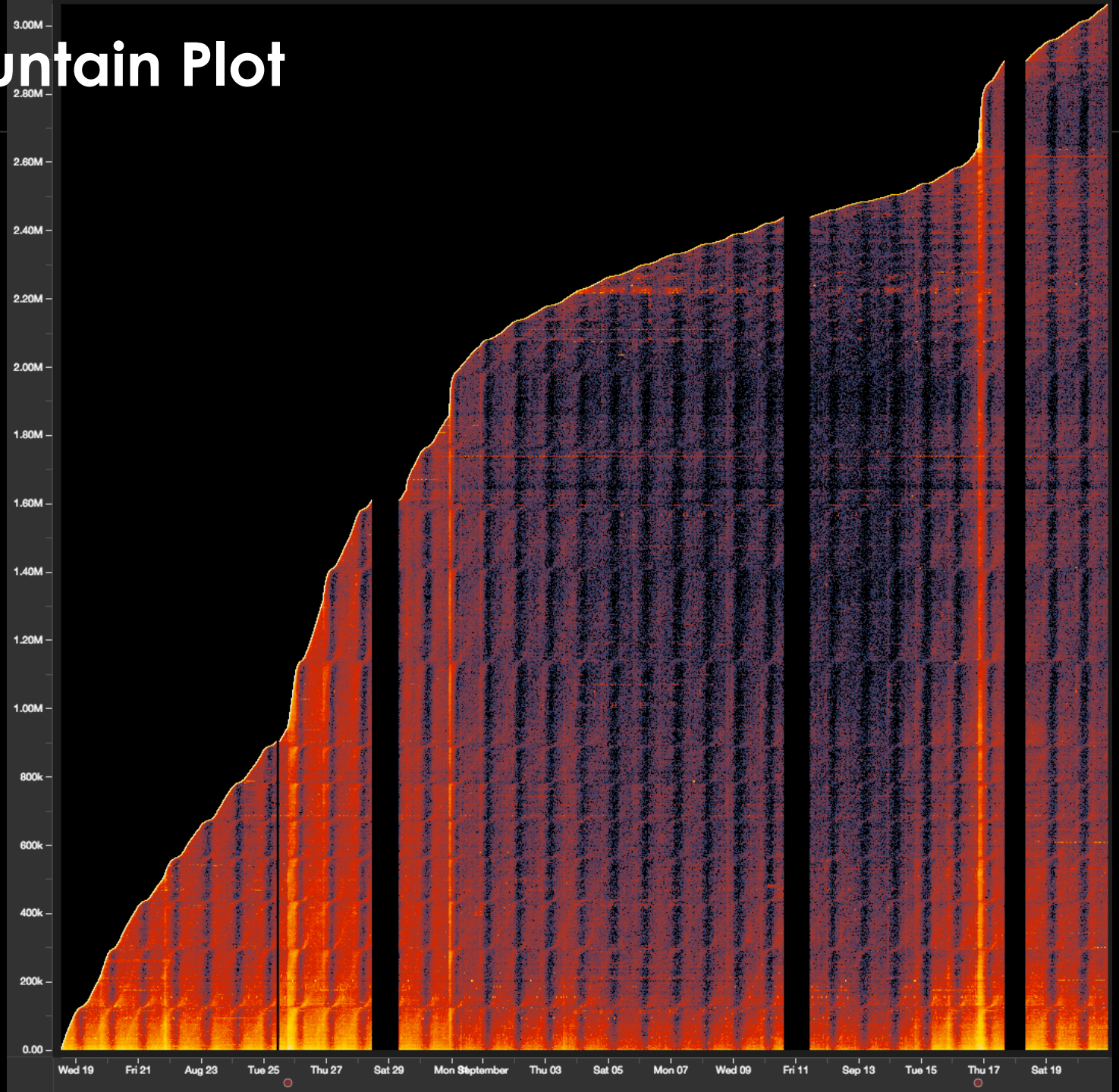
Trump Mountain Plot



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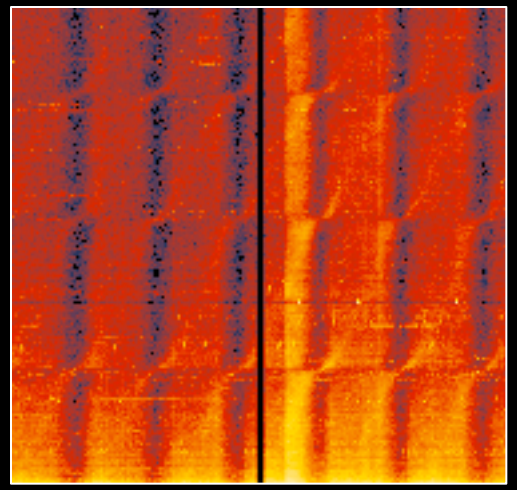
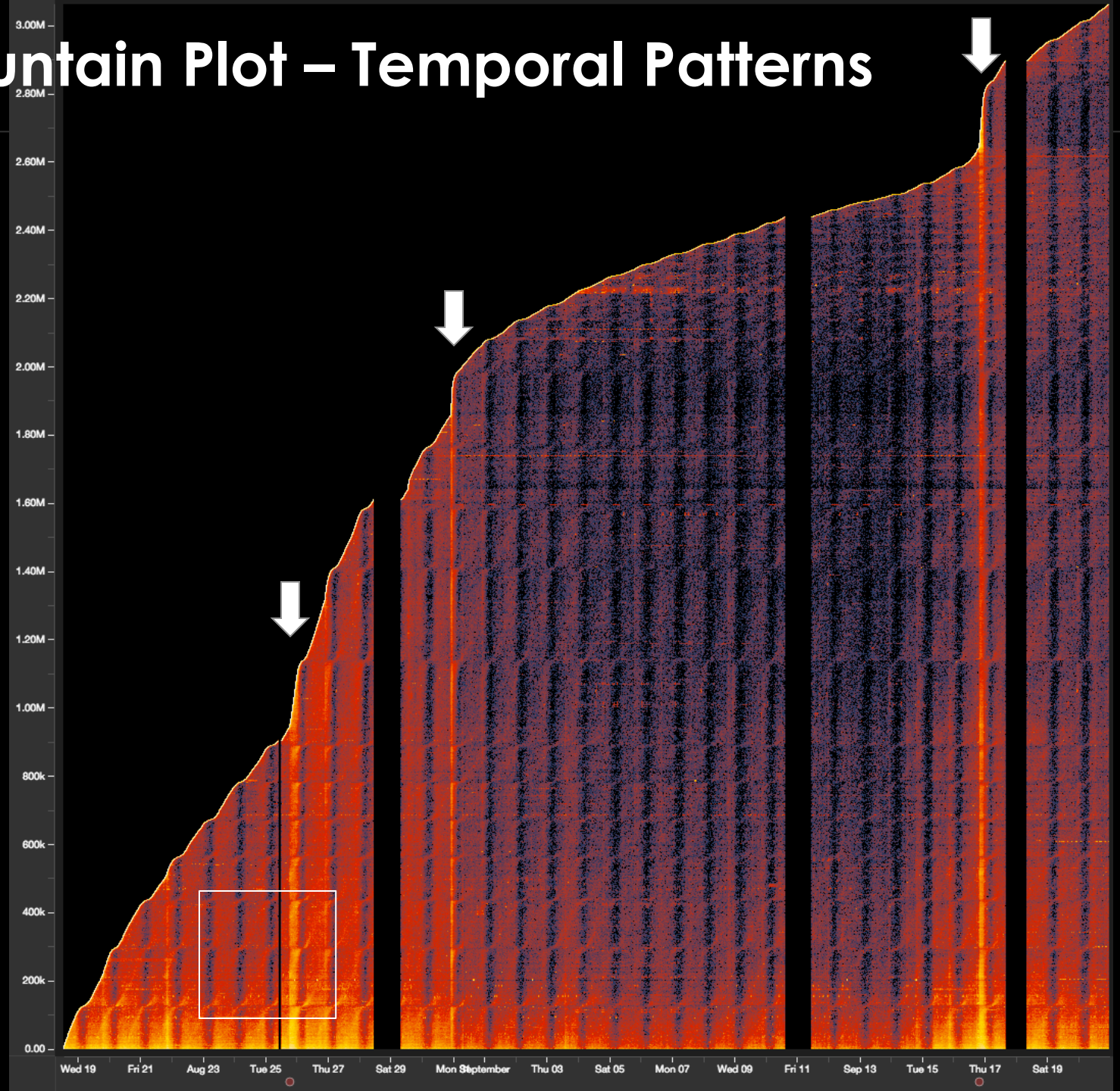
Trump Mountain Plot – Temporal Patterns





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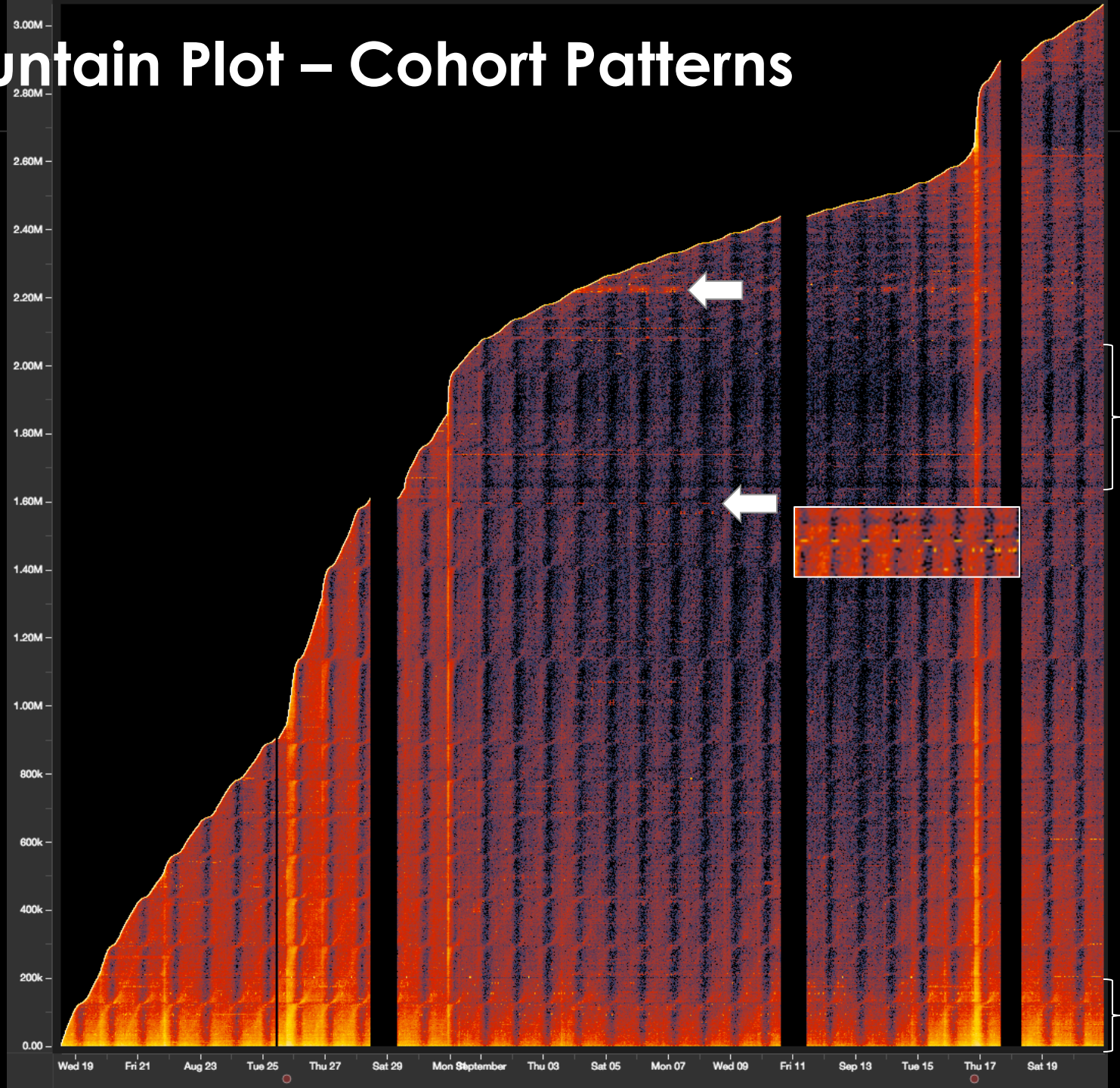
Trump Mountain Plot – Cohort Patterns



Event-driven

Early-engagers

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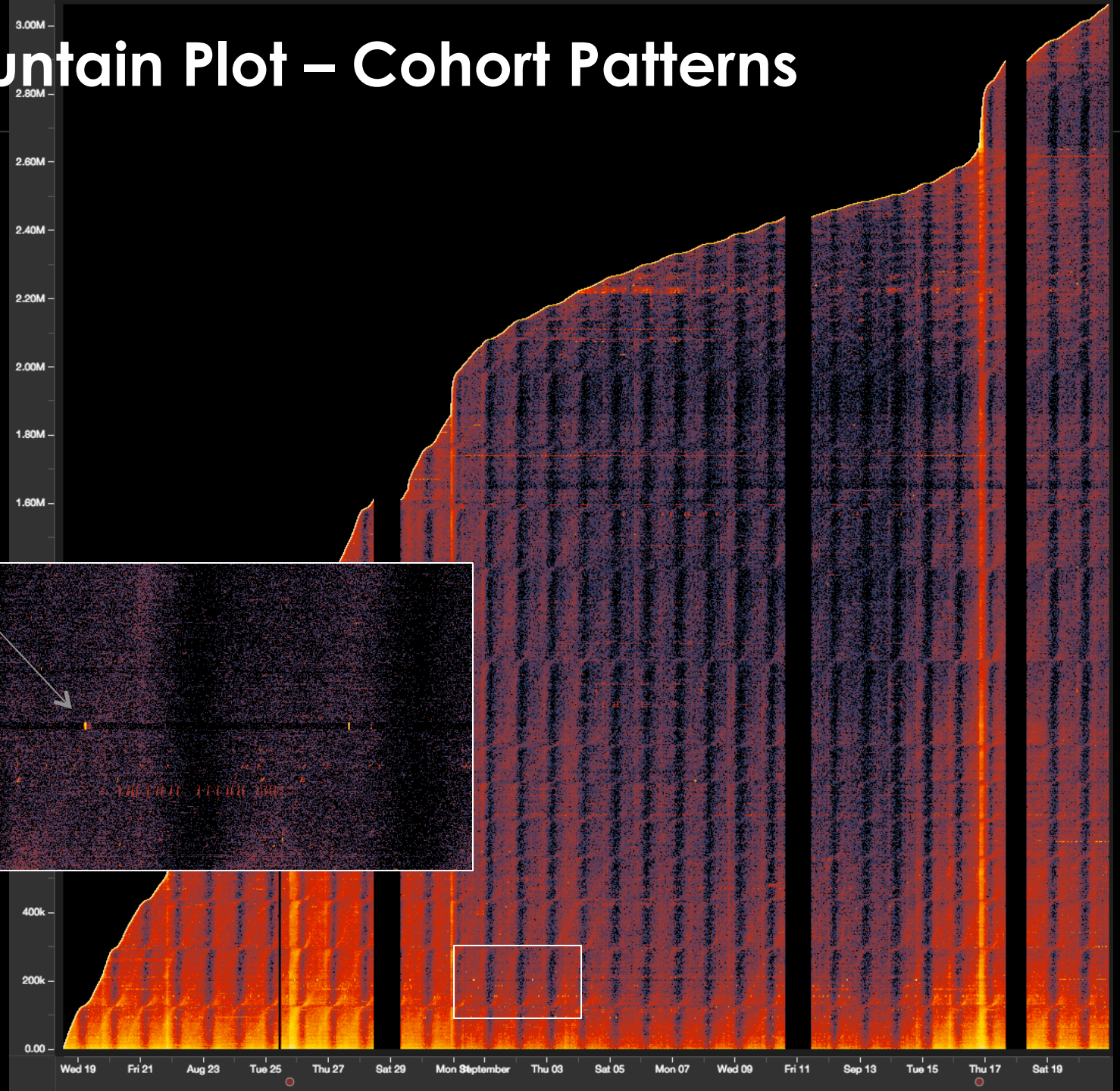
Trump Mountain Plot – Cohort Patterns



4000 coordinated accounts

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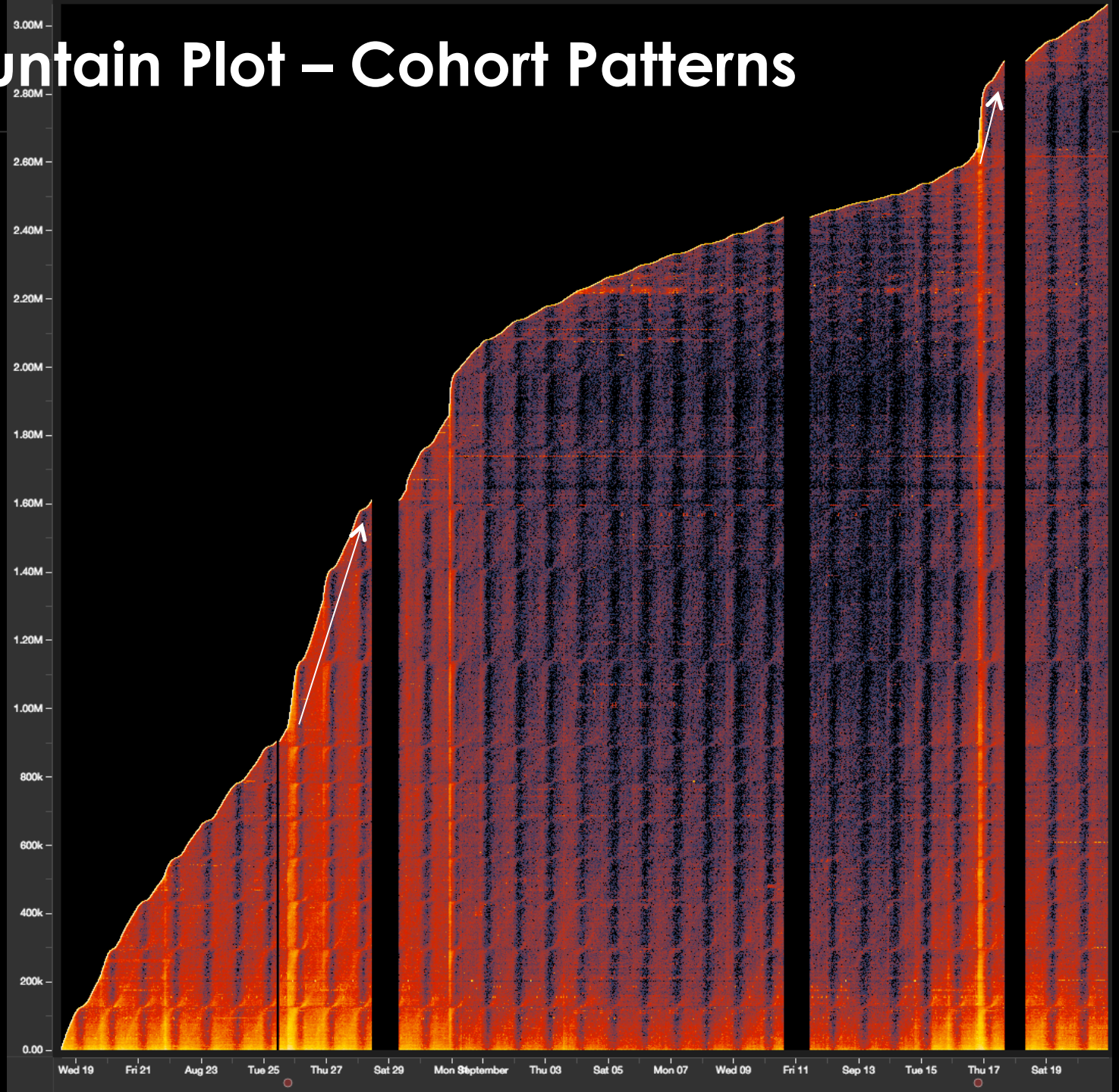
Trump Mountain Plot – Cohort Patterns



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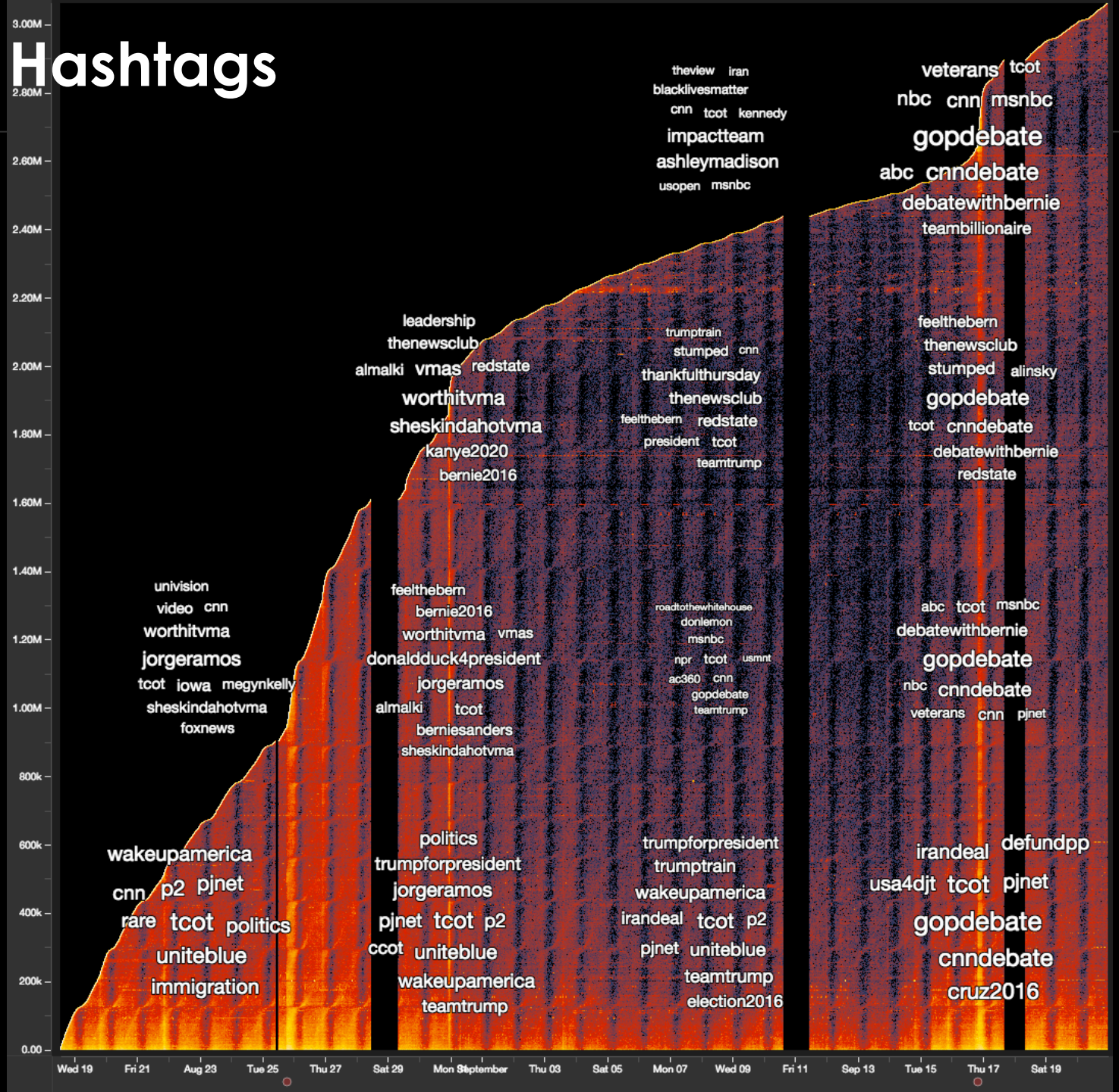
Trump Top Hashtags



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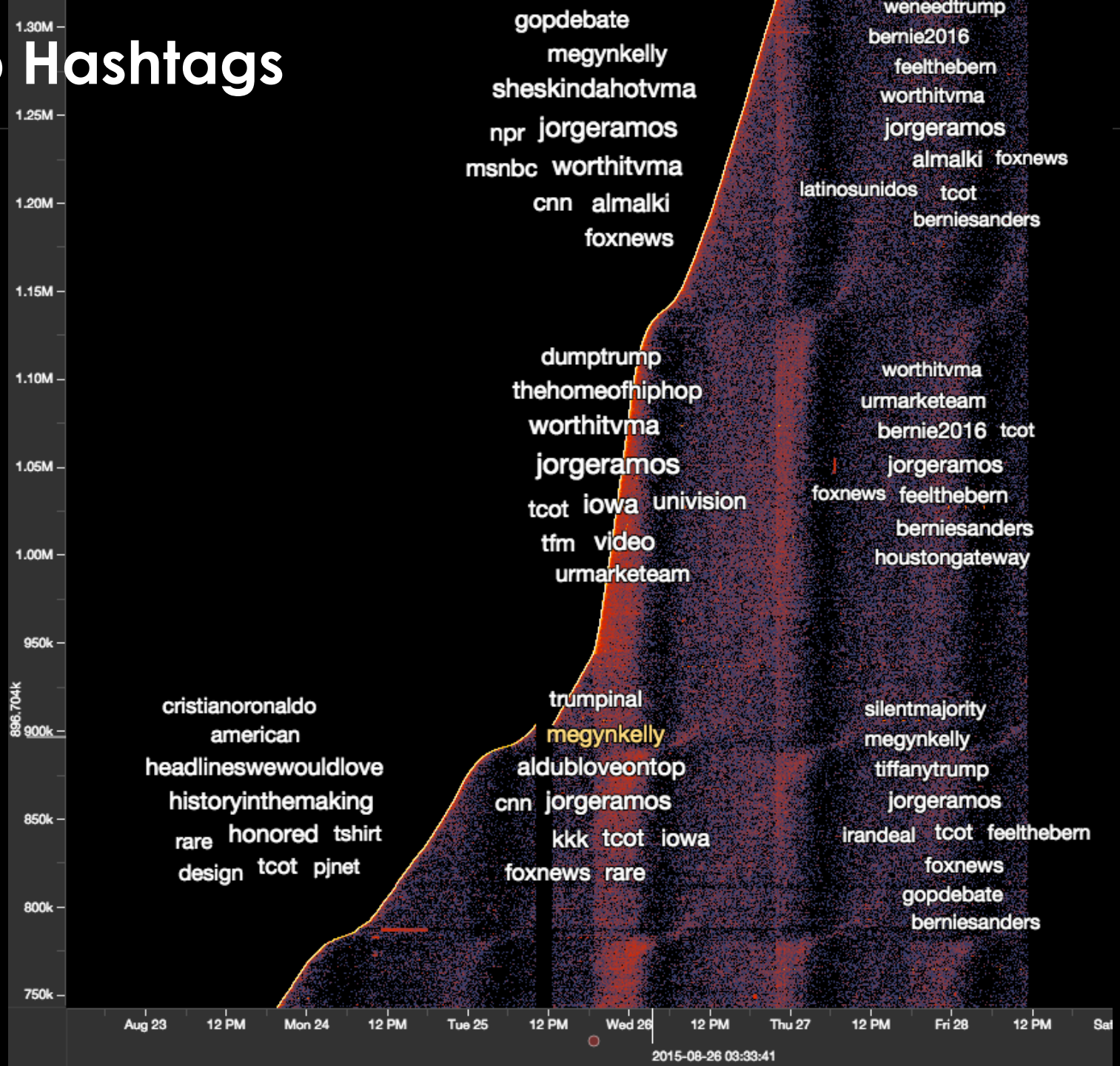
Trump Top Hashtags



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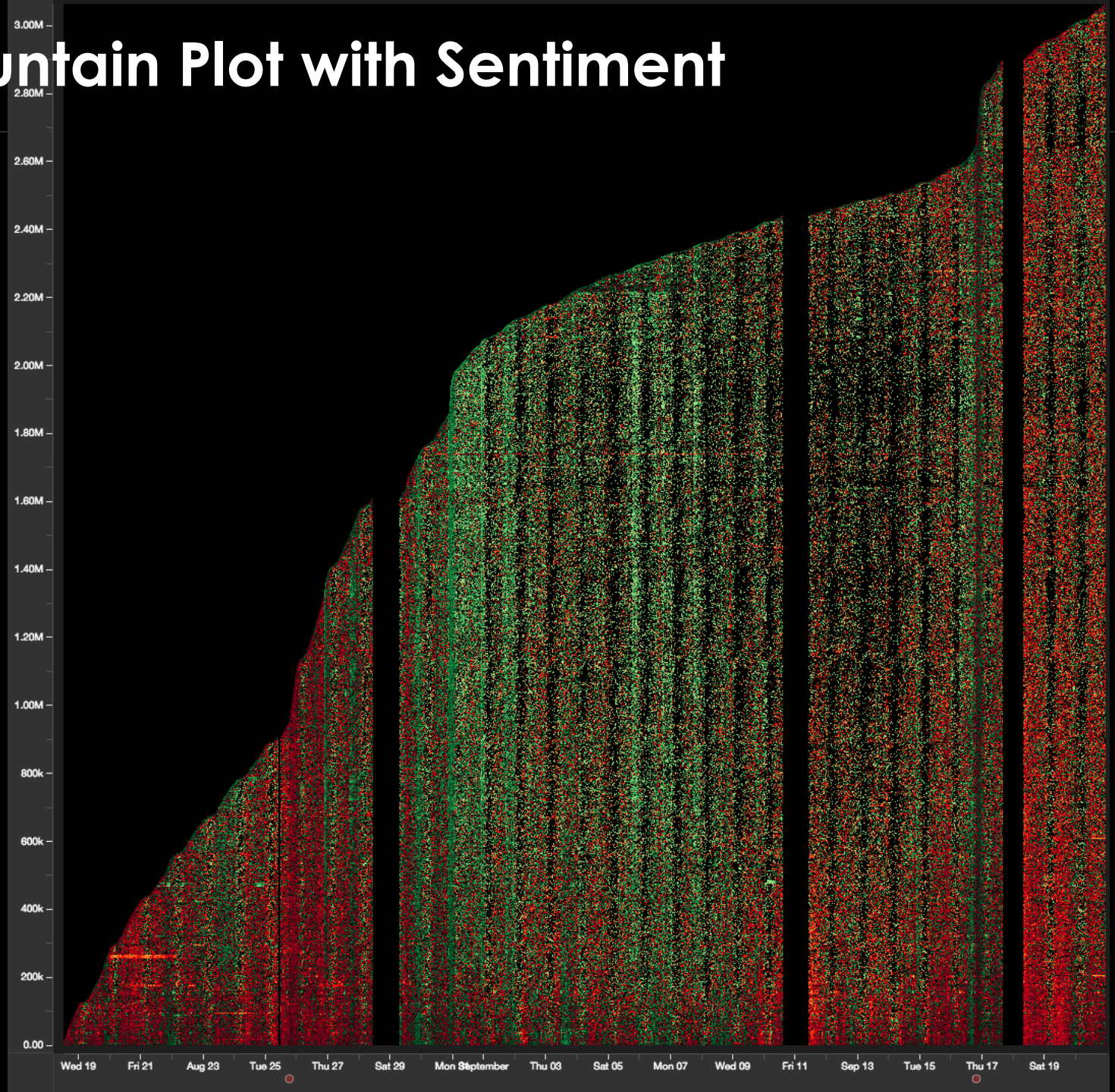
Trump Mountain Plot with Sentiment



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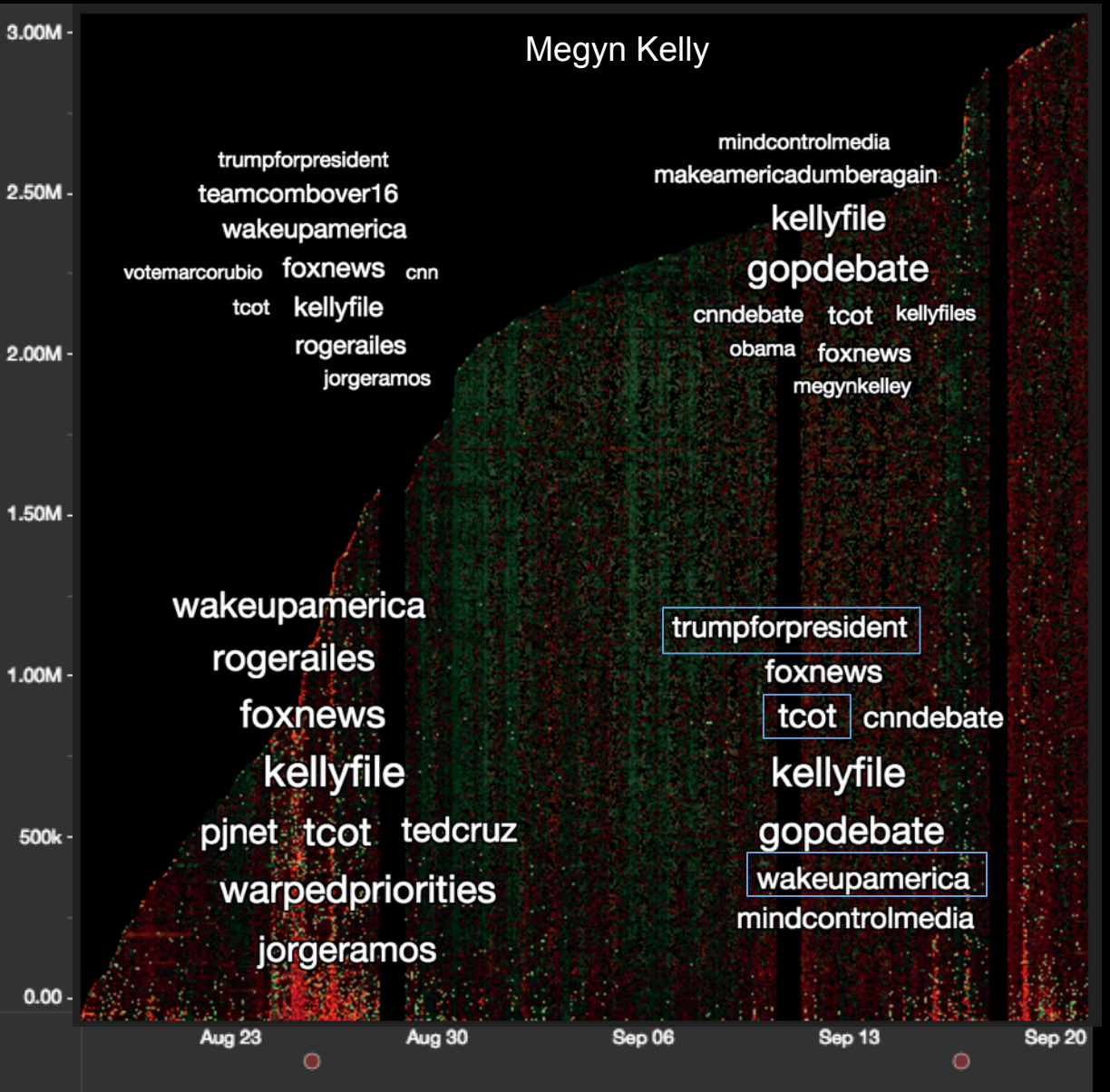
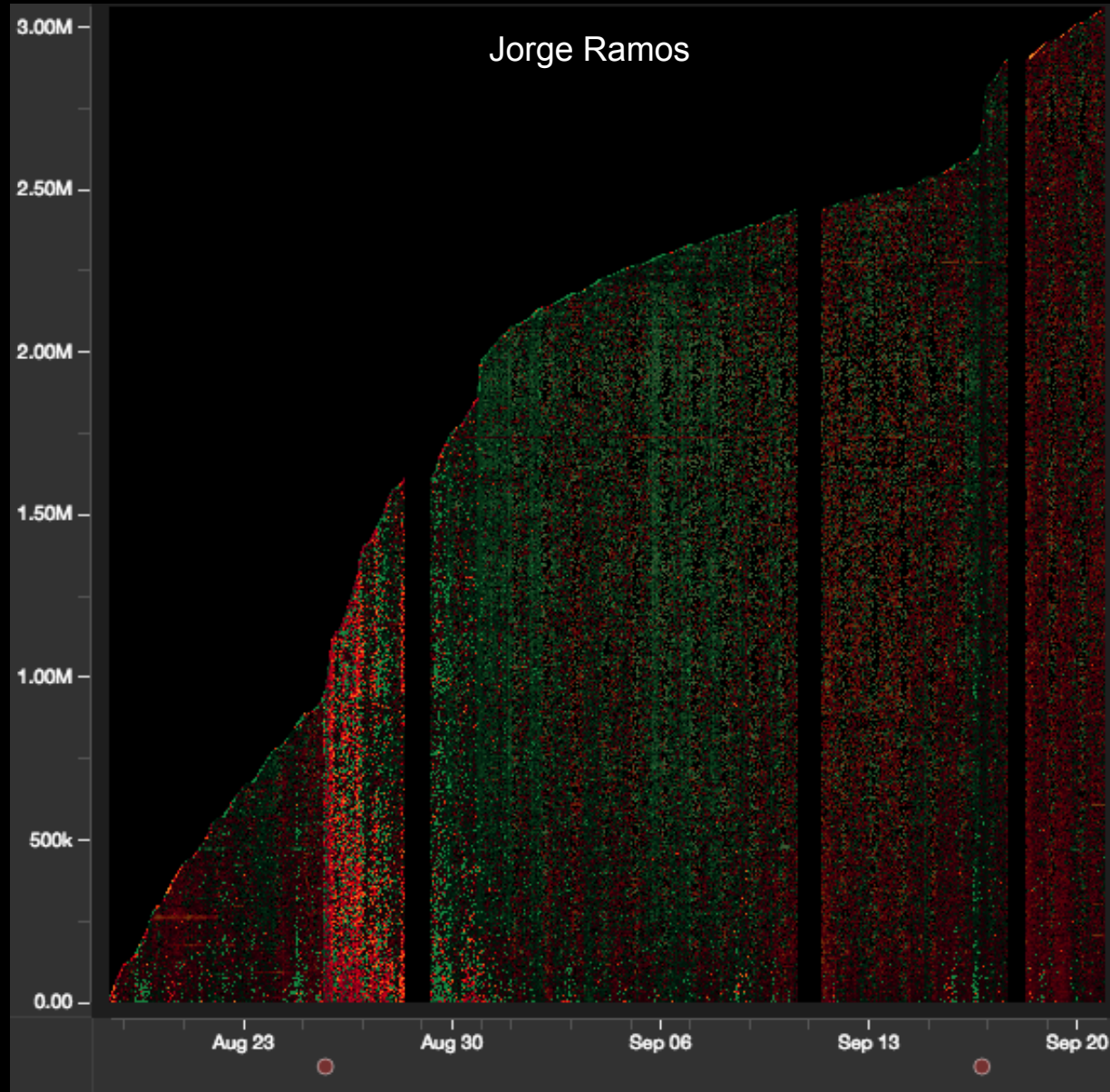
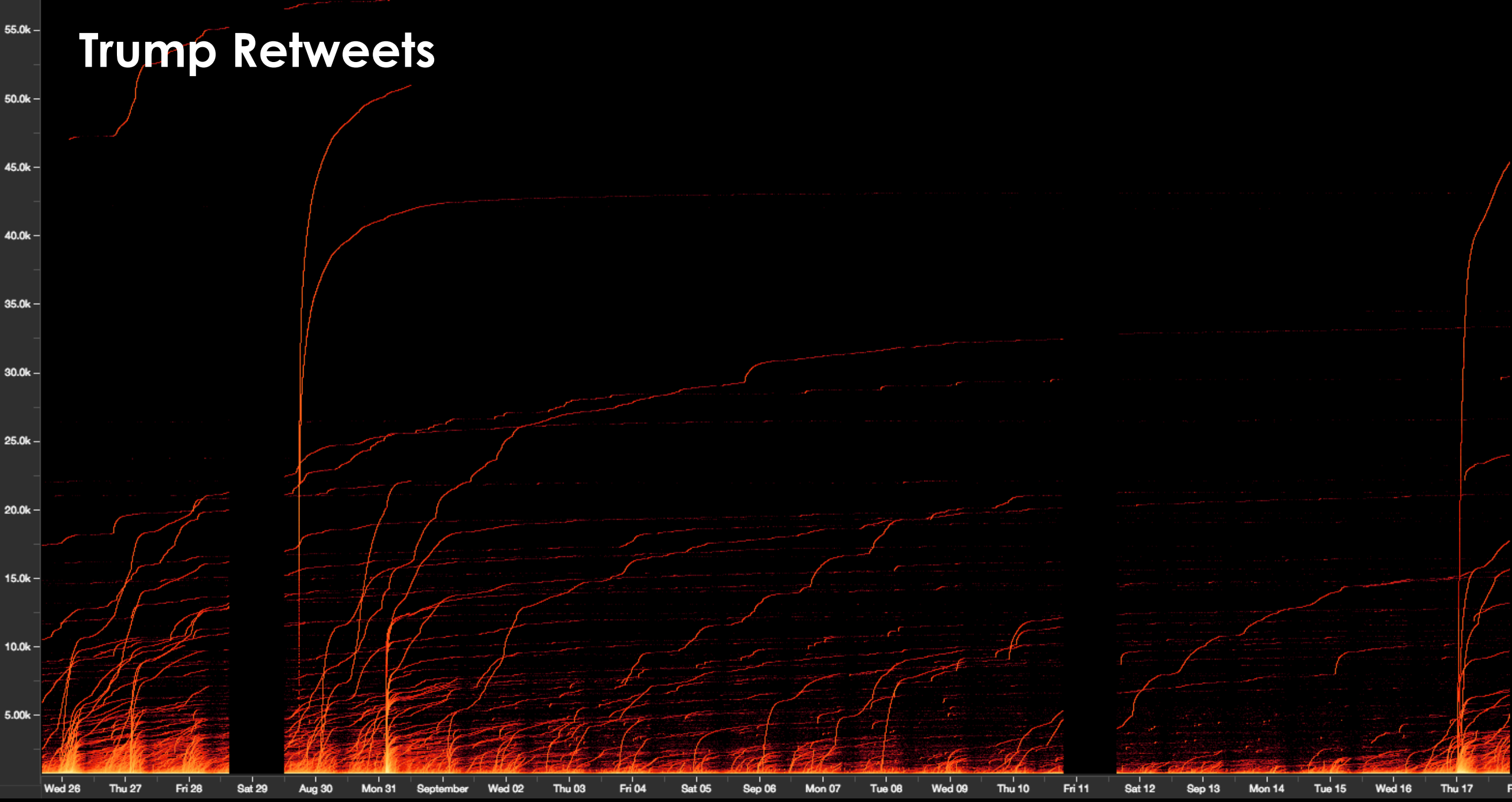
Trump Mountain Plot with Sentiment – Megyn / Jorge





Trump Retweets



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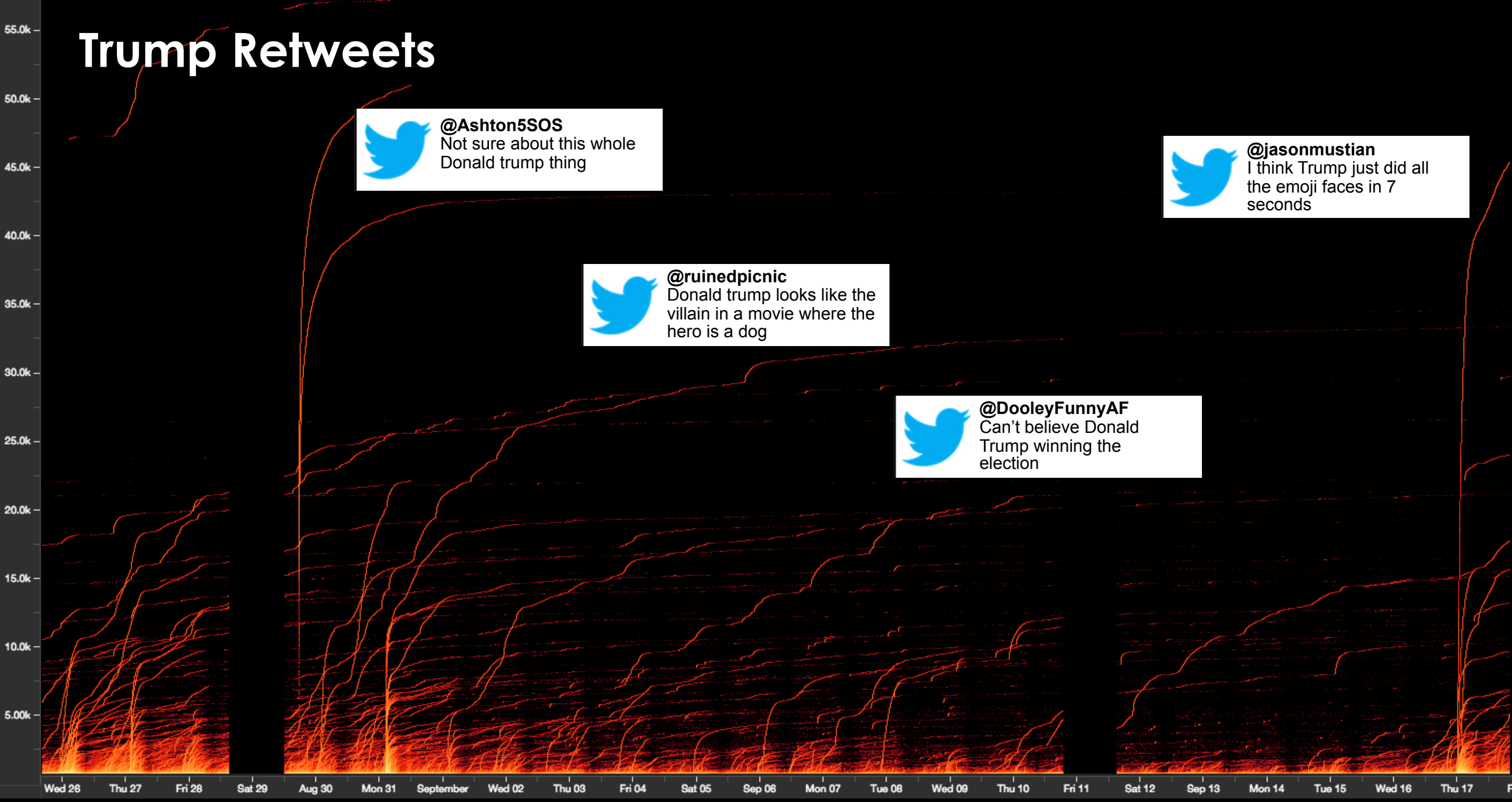
Trump Retweets



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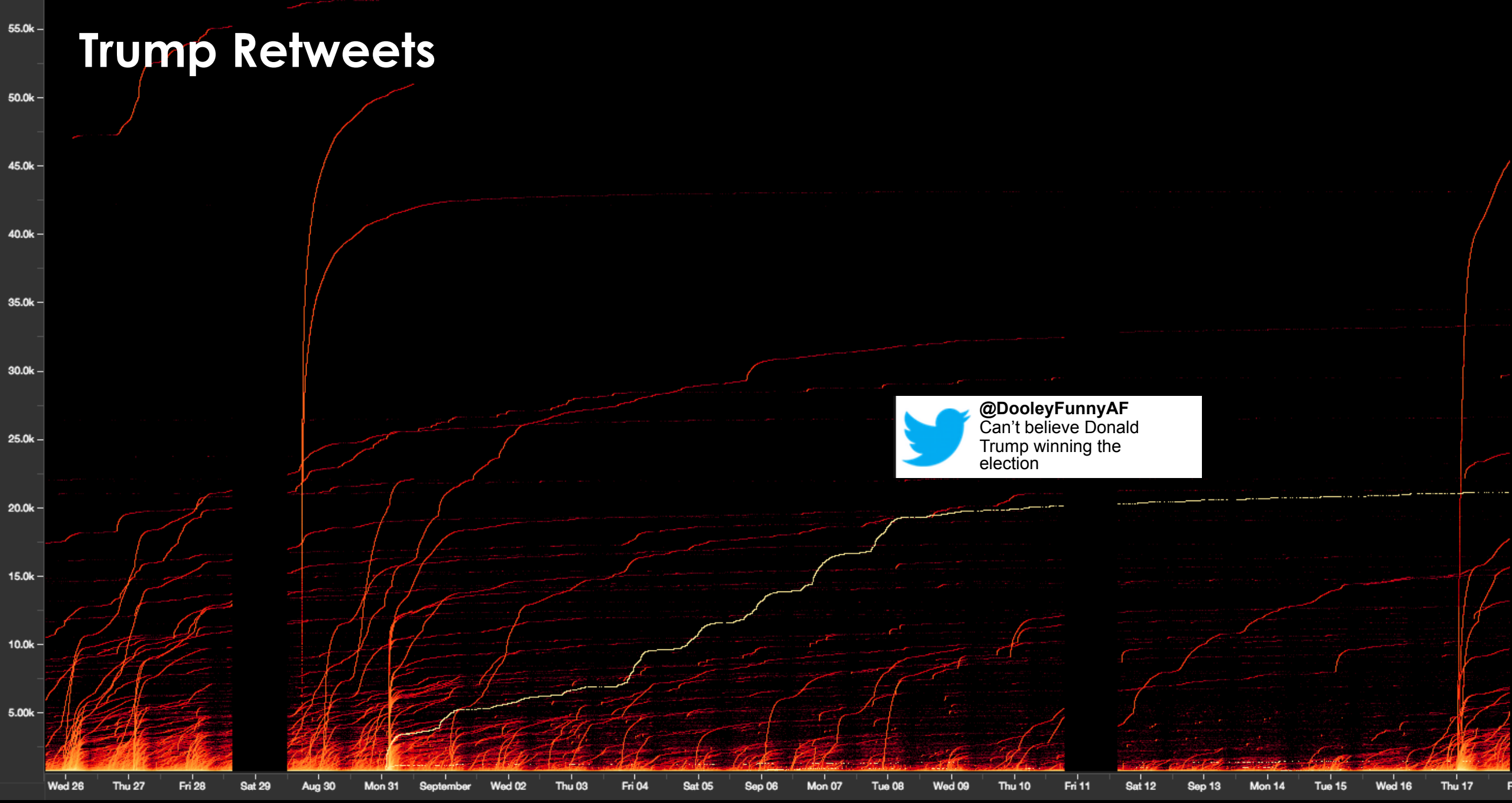
Trump Retweets



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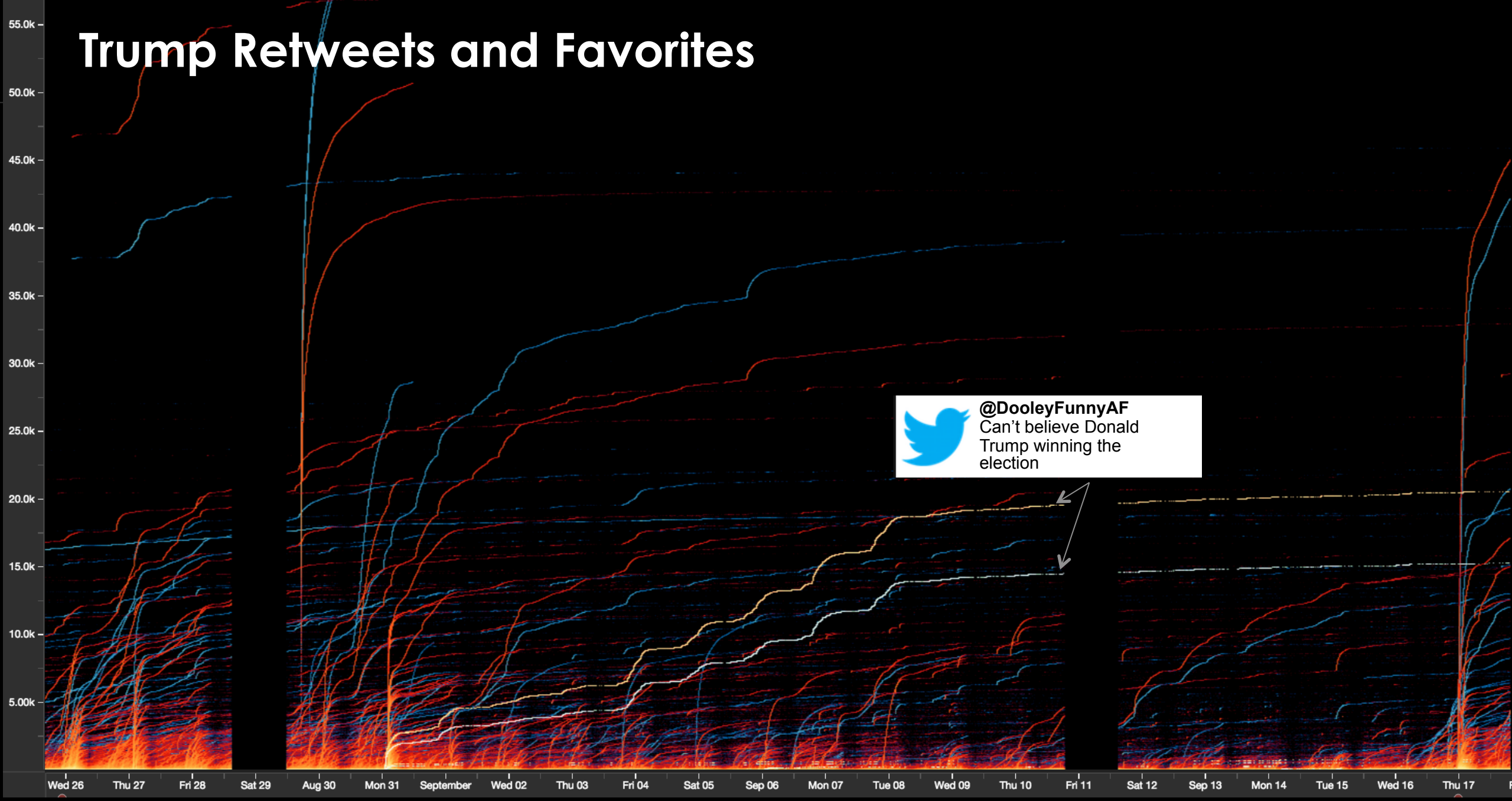
Trump Retweets and Favorites



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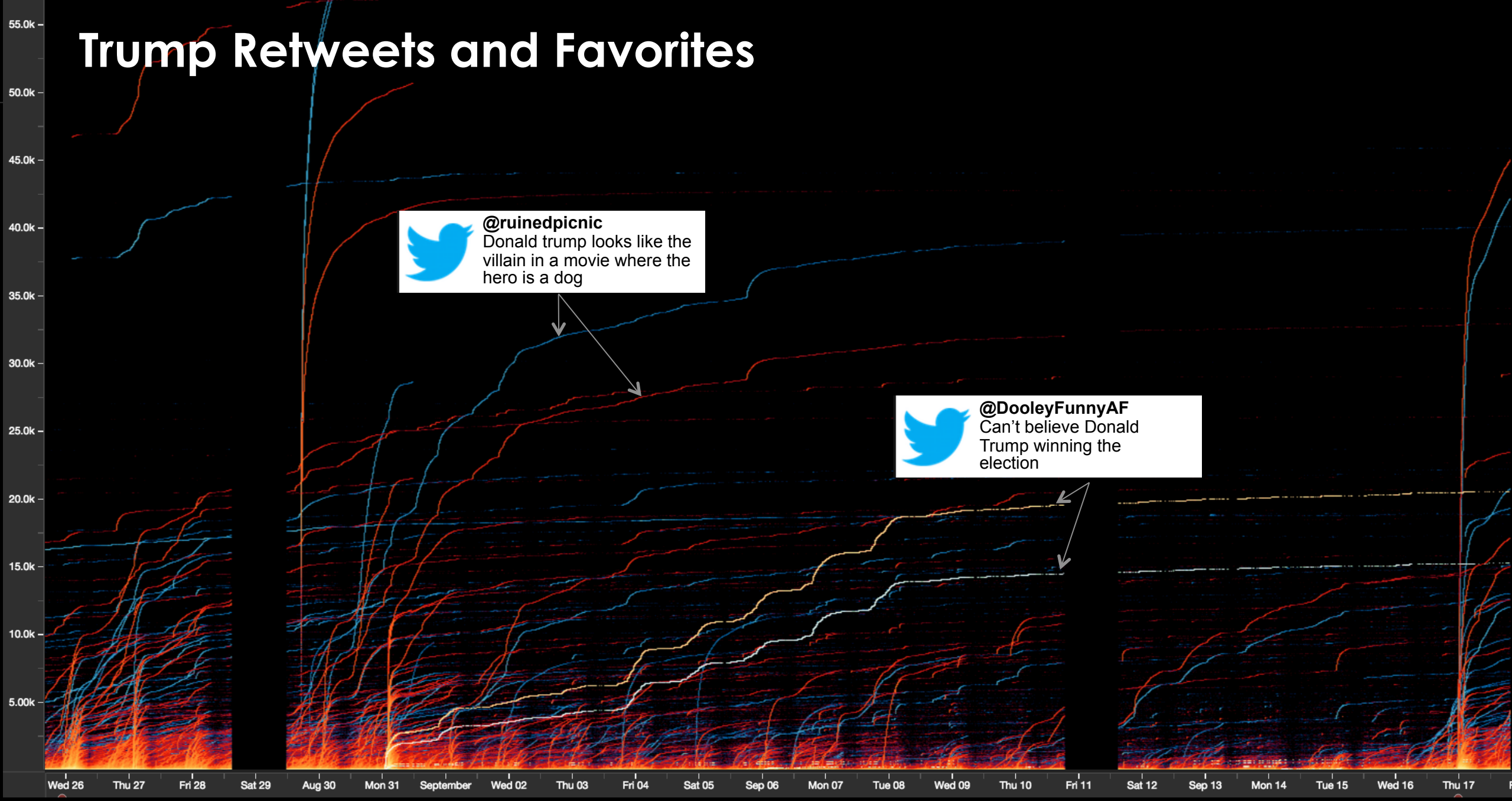
Trump Retweets and Favorites



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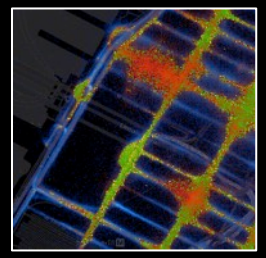
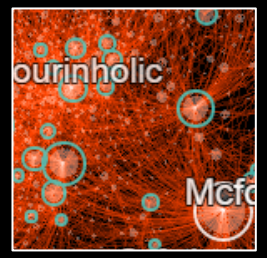
KEY TAKE AWAYS

1. Plot all the data

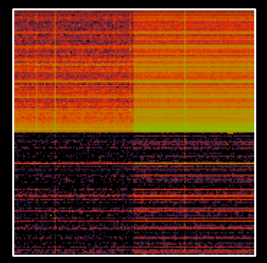
MAP



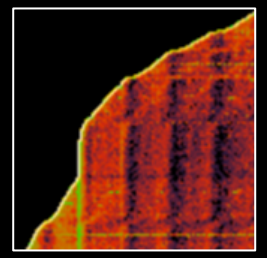
CONNECT



ORDER

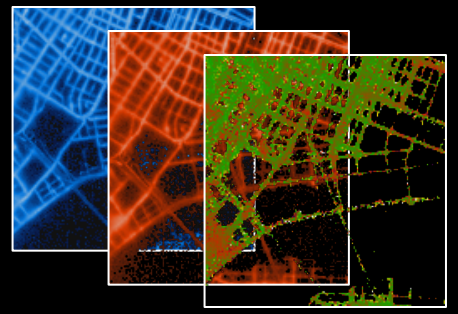


TIME

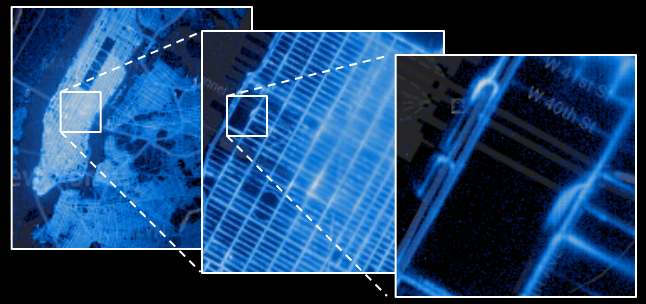


2. Explore it

LAYERS

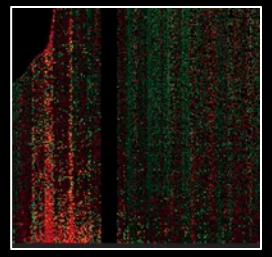


ZOOM



MINE

FILTER



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