SKILUP DAYS by: DevOps INSTITUTE

Visualization is the Core of Observability

Danyel Fisher
Principal Design Researcher
Honeycomb.io
@fisherdanyel
danyel@honeycomb.io

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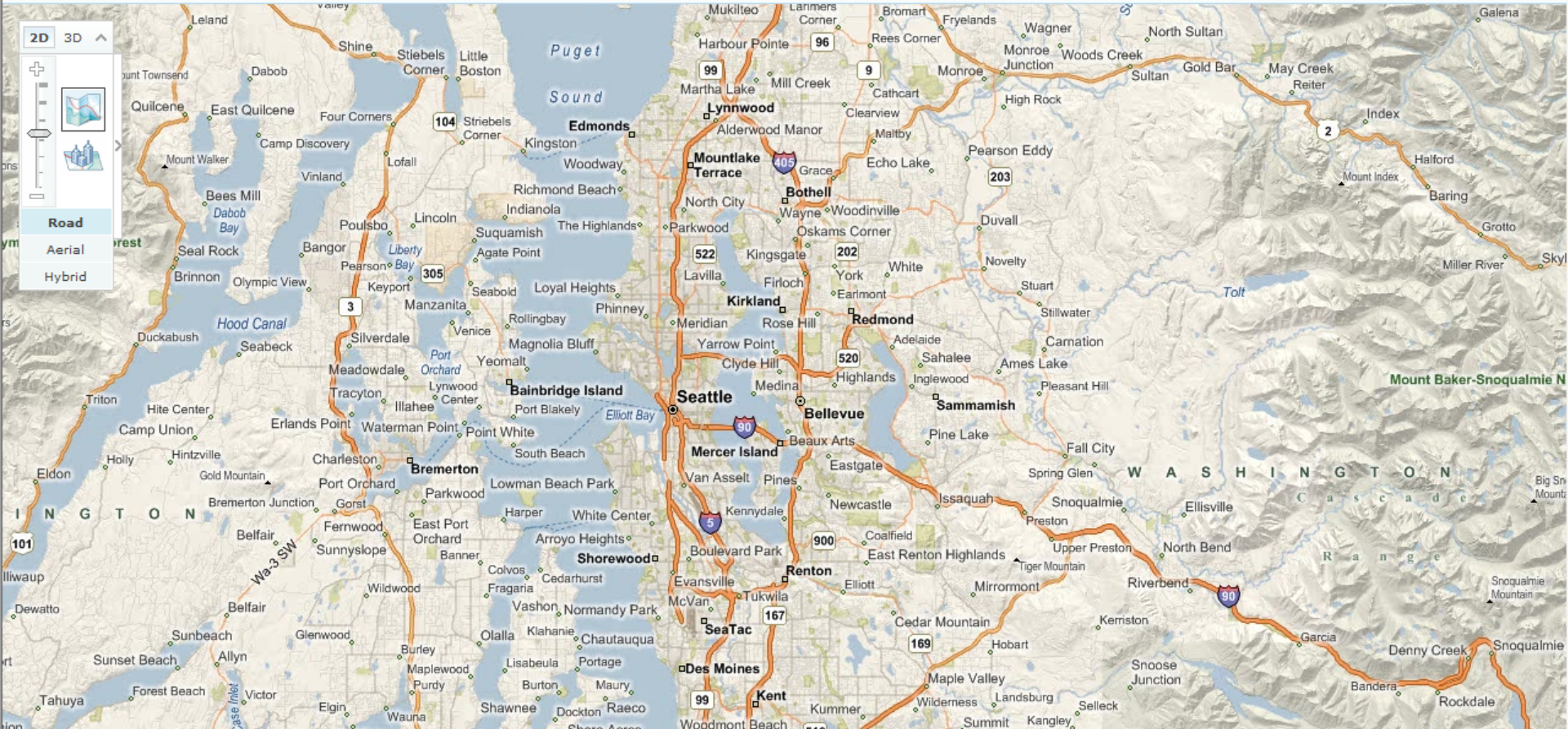

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25.237.139.237 Mozilla/5.0+(compatible;+Googlebot/2.1;++http://www.google.com/bot.html) - 200 0 0 1593
2014-04-10 01:23:34 10.0.7.44 GET /phpMyAdmin/sql.php3 - 443 - 192.128.32.70 - - 404 0 2 62
2014-04-10 01:23:34 10.0.7.44 GET /phprojekt-3.1a/votum/ - 443 - 192.128.32.70 - - 404 0 2 31
2014-04-10 01:23:34 10.0.7.44 GET /iissamples/exair/howitworks/ - 443 - 192.128.32.70 - - 404 0 2 78
2014-04-10 01:23:34 10.0.7.44 GET /arsc/ - 443 - 192.128.32.70 - - 404 0 2 62
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2014-04-10 01:23:34 10.0.7.44 GET /phpBB/ - 443 - 192.128.32.70 - - 404 0 2 62
2014-04-10 01:23:34 10.0.7.44 GET /phpmyadmin/sql.php - 443 - 192.128.32.70 - - 404 0 2 62
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```

Metrics by Location
Raw Hits
UU per 24 hr
UU per week

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2D 3D

Road

Aerial

Hybrid

/tiles/r02123002133111.png

Portage Bay

Husky Stadium

Montlake Playground

Interlaken Park

Lake View Cemetery

Louisa Boren Park

Volunteer Park

Broadway

Broadmoor

Capitol Hill

Lakeview Park

Queen Anne

David Rodgers Park

Kinnear Park

Elliott Bay Park

Edwards Park

Denny Park

South Lake Union Park

Belltown

First Hill

0.6 miles

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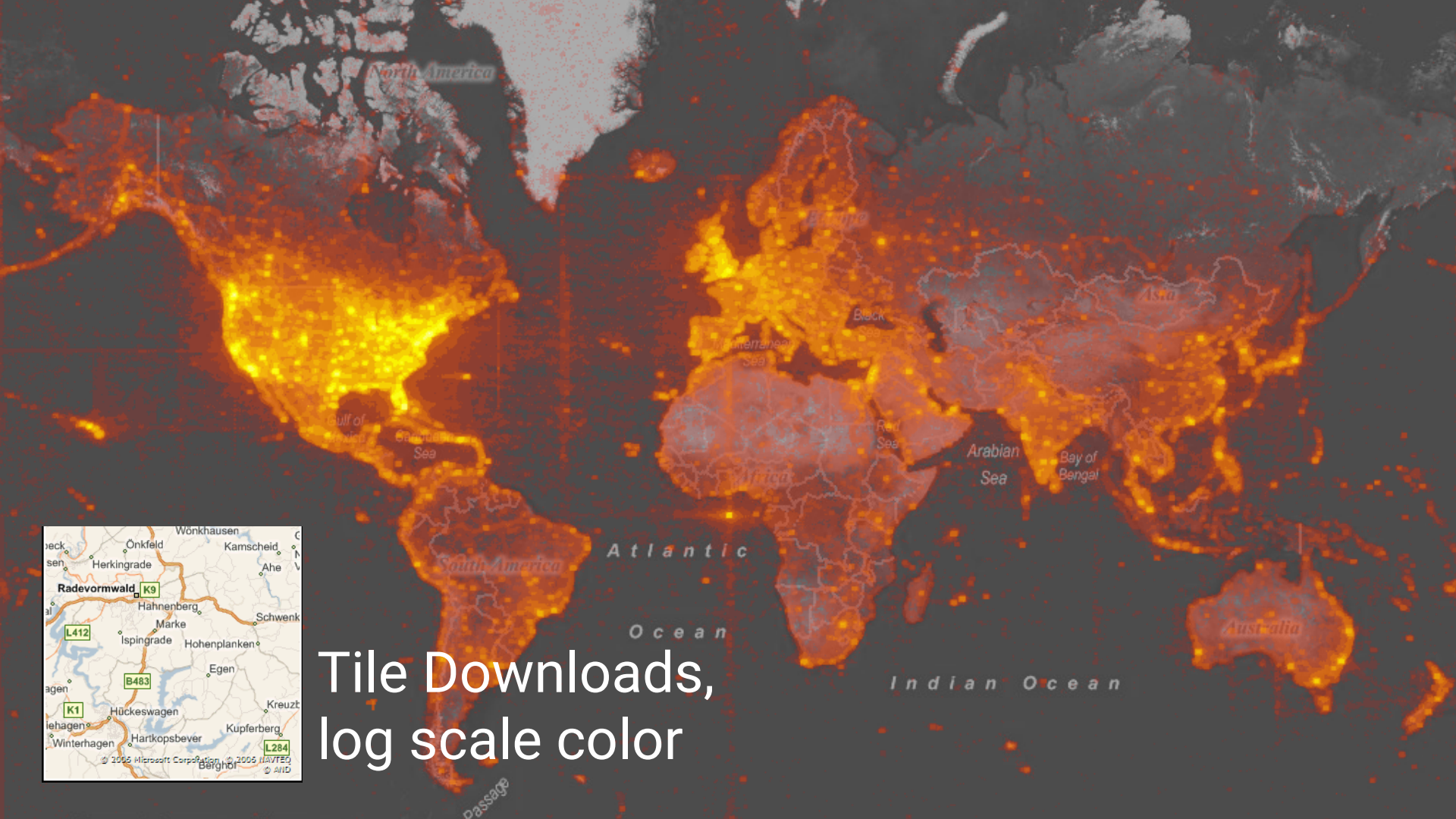
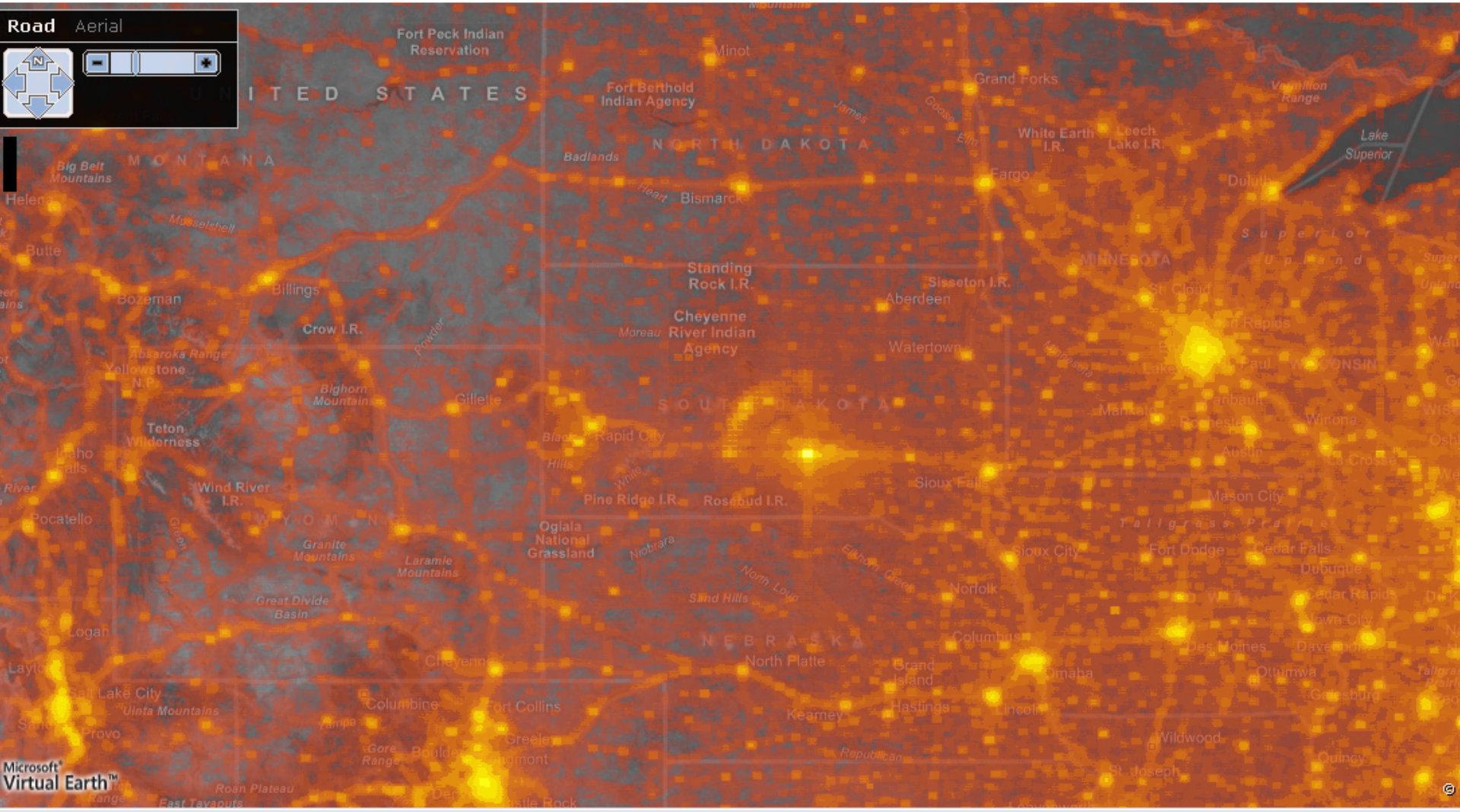


Tile Downloads, log scale color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Aerial
Fort Peck Indian Reservation
Minot
Fort Berthold Indian Agency
Grand Forks
Vermilion Range
Lake Superior
White Earth I.R.
Leech Lake I.R.
Badlands
NORTH DAKOTA
Big Belt Mountains
MONTANA
Helena
Fargo
Duluth
Bismarck
Butte
Standing Rock I.R.
Sisseton I.R.
MINNESOTA
Aberdeen
Billings
Bozeman
Crow I.R.
Cheyenne River Indian Agency
Watertown
Absaroka Range
Yellowstone N.P.
Bighorn Mountains
Gillette
SOUTH DAKOTA
Teton Wilderness
Rapid City
Idaho Falls
Wind River I.R.
Pine Ridge I.R.
Rosebud I.R.
Sioux Falls
Pocatello
WYOMING
Ogiala National Grassland
Granite Mountains
Laramie Mountains
Sioux City
Fort Dodge
Cedar Falls
Dubuque
Great Divide Basin
Norfolk
Sand Hills
Logan
NEBRASKA
Columbus
Cheyenne
North Platte
Grand Island
Omaha
Salt Lake City
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Columbine
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Roan Plateau
East Tavaputs
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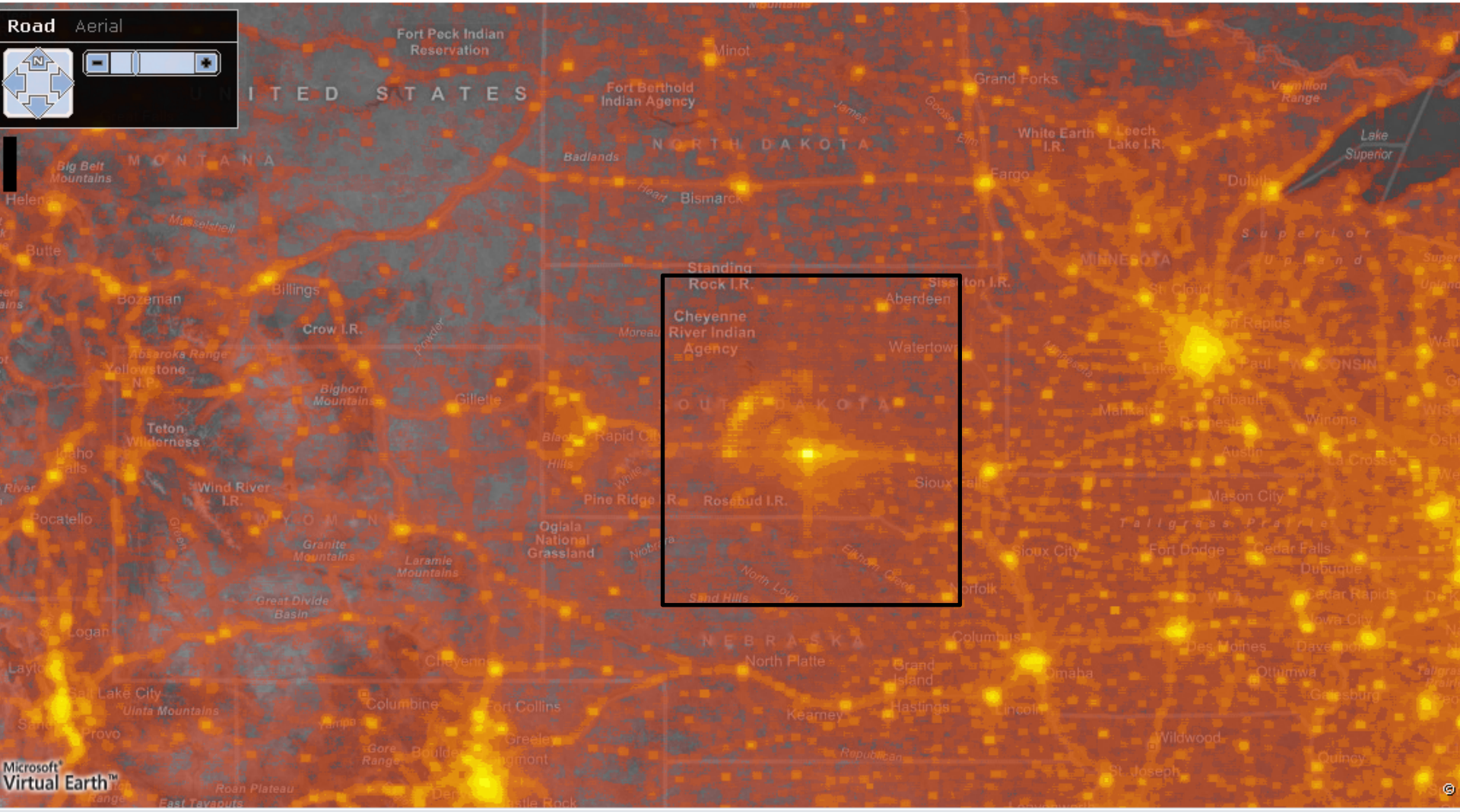
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Rosebud I.R.
Sioux
Ogiala National Grassland
Sand Hills
NEBRASKA
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Grand Island
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Lincoln
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Columbus
Norfolk
Sioux City
Fort Dodge
Mason City
Tallgrass Prairie
Cedar Falls
Dubuque
Cedar Rapids
Iowa City
Des Moines
Davenport
Ottumwa
Galesburg
Wildwood
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Duluth
Superior Upland
Winona
Austin
Mankato
Rochester
Lake City
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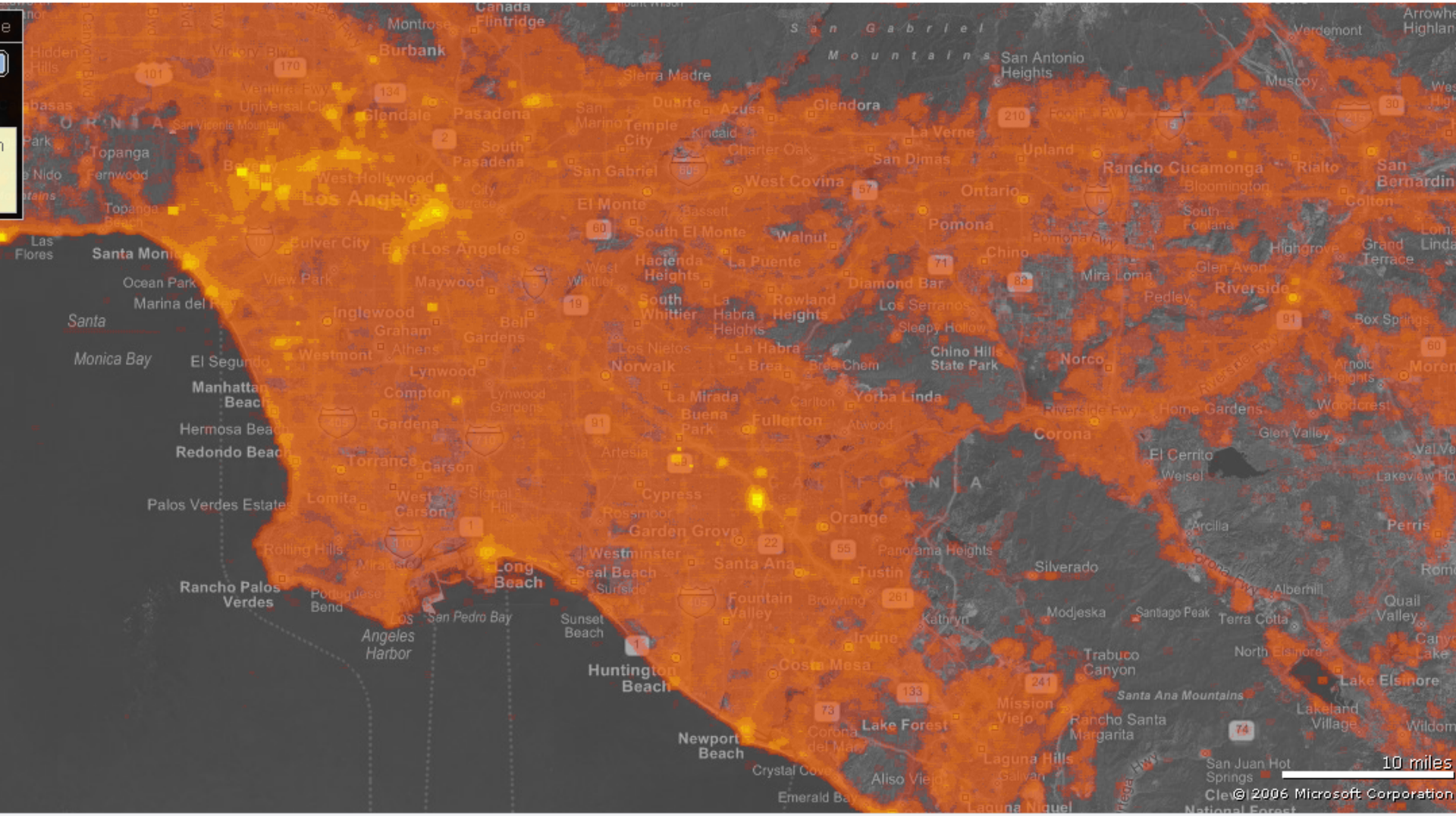
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Canada Flintridge
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San Gabriel Mountains
San Antonio Heights
Verdemont
Arrowhead Highlands
Sierra Madre
Glendale
Pasadena
Duarte
Azusa
Glendora
Muscoy
Topanga
Fernwood
West Hollywood
Los Angeles
San Gabriel
Temple City
Kinkaid
Charter Oak
La Verne
San Dimas
Upland
Rancho Cucamonga
Rialto
San Bernardino
Bloomington
Colton
West Covina
Ontario
El Monte
Bassett
South El Monte
Walnut
Pomona
South Fontana
Las Flores
Santa Monica
Culver City
East Los Angeles
Hacienda Heights
La Puente
Chino
Highgrove
Grand Terrace
Ocean Park
View Park
Maywood
West Whittier
Diamond Bar
Mira Loma
Glen Avon
Riverside
Marina del Rey
Inglewood
South Whittier
La Habra Heights
Rowland Heights
Los Serranos
Pedley
Santa
Graham
Bell Gardens
Sleepy Hollow
Box Springs
Monica Bay
El Segundo
Westmont
Athens
Los Nietos
Norwalk
La Habra
Brea
Chino Hills State Park
Norco
Lynwood
Manhattan Beach
Compton
La Mirada
Buena Park
Yorba Linda
Home Gardens
Woodcrest
Hermosa Beach
Gardena
Fullerton
Corona
Glen Valley
Redondo Beach
Torrance
Carson
Artesia
El Cerrito
Weisel
Palos Verdes Estates
Lomita
West Carson
Cypress
Rossmoor
Garden Grove
Orange
Arcilla
Perris
Rolling Hills
Miraleste
Long Beach
Westminster
Seal Beach
Sunset
Santa Ana
Panorama Heights
Tustin
Silverado
Rancho Palos Verdes
Portuguese Bend
San Pedro Bay
Angeles Harbor
Sunset Beach
Fountain Valley
Browning
Kathryn
Modjeska
Santiago Peak
Terra Cotta
Alberhill
Quail Valley
Irvine
Trabuco Canyon
North Elsinore
Huntington Beach
Costa Mesa
Lake Elsinore
Santa Ana Mountains
Mission Viejo
Lake Forest
Rancho Santa Margarita
Lakeland Village
Newport Beach
Corona del Mar
Laguna Hills
San Juan Hot Springs
Crystal Cove
Aliso Viejo
Emerald Bay
Laguna Niguel
National Forest
10 miles
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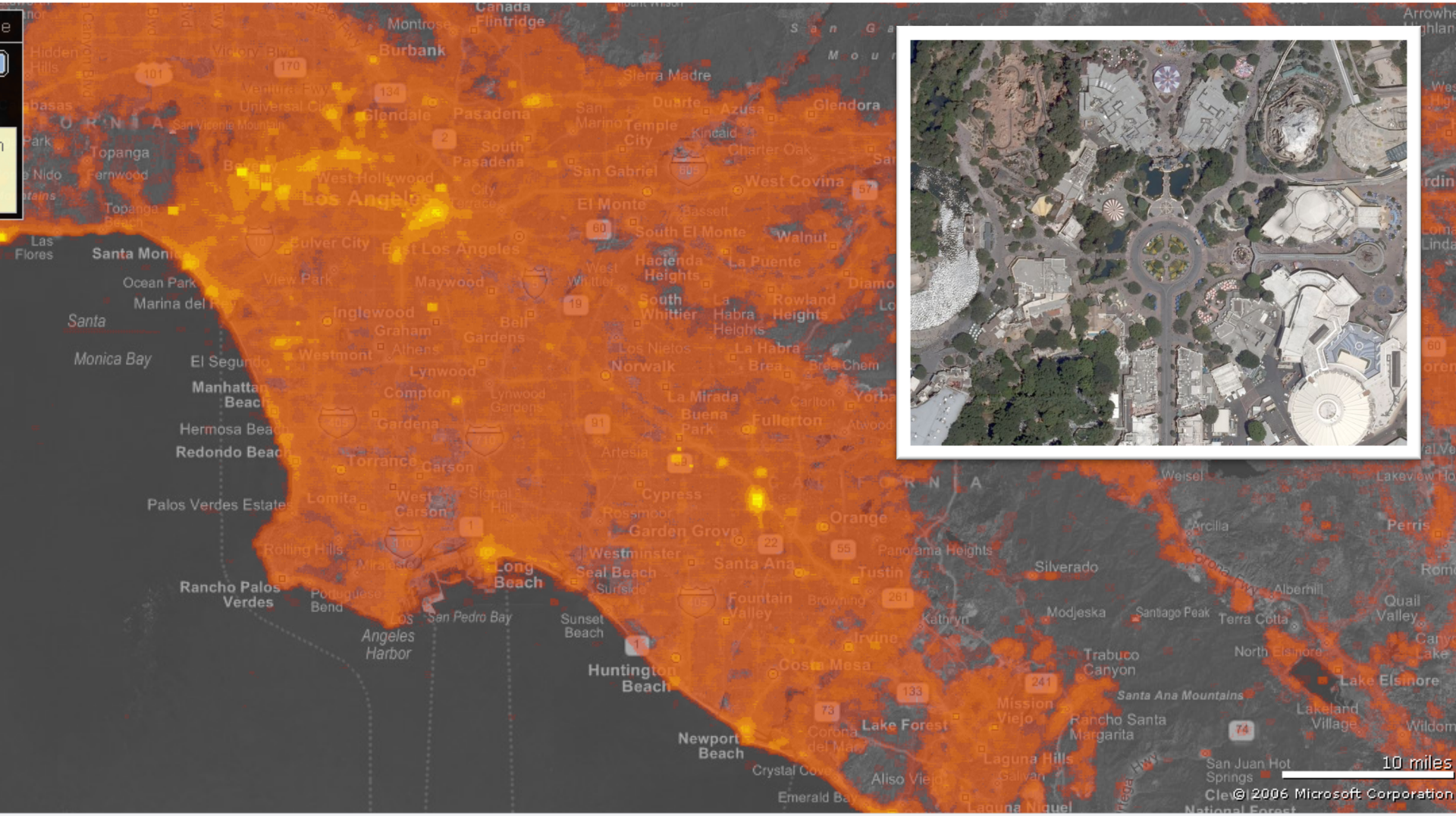
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Los Angeles
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El Monte
South El Monte
Walnut
Las Flores
Santa Monica
Culver City
East Los Angeles
Ocean Park
Marina del Rey
View Park
Maywood
Hacienda Heights
La Puente
Inglewood
Graham
Bell Gardens
South Whittier
La Habra Heights
Rowland Heights
Santa
Monica Bay
El Segundo
Westmont
Athens
Los Nietos
Norwalk
La Habra
Brea
Lynwood
Compton
Manhattan Beach
La Mirada
Buena Park
Fullerton
Hermosa Beach
Redondo Beach
Gardena
Torrance
Carson
Artesia
Palos Verdes Estates
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West Carson
Cypress
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Corona del Mar
10 miles
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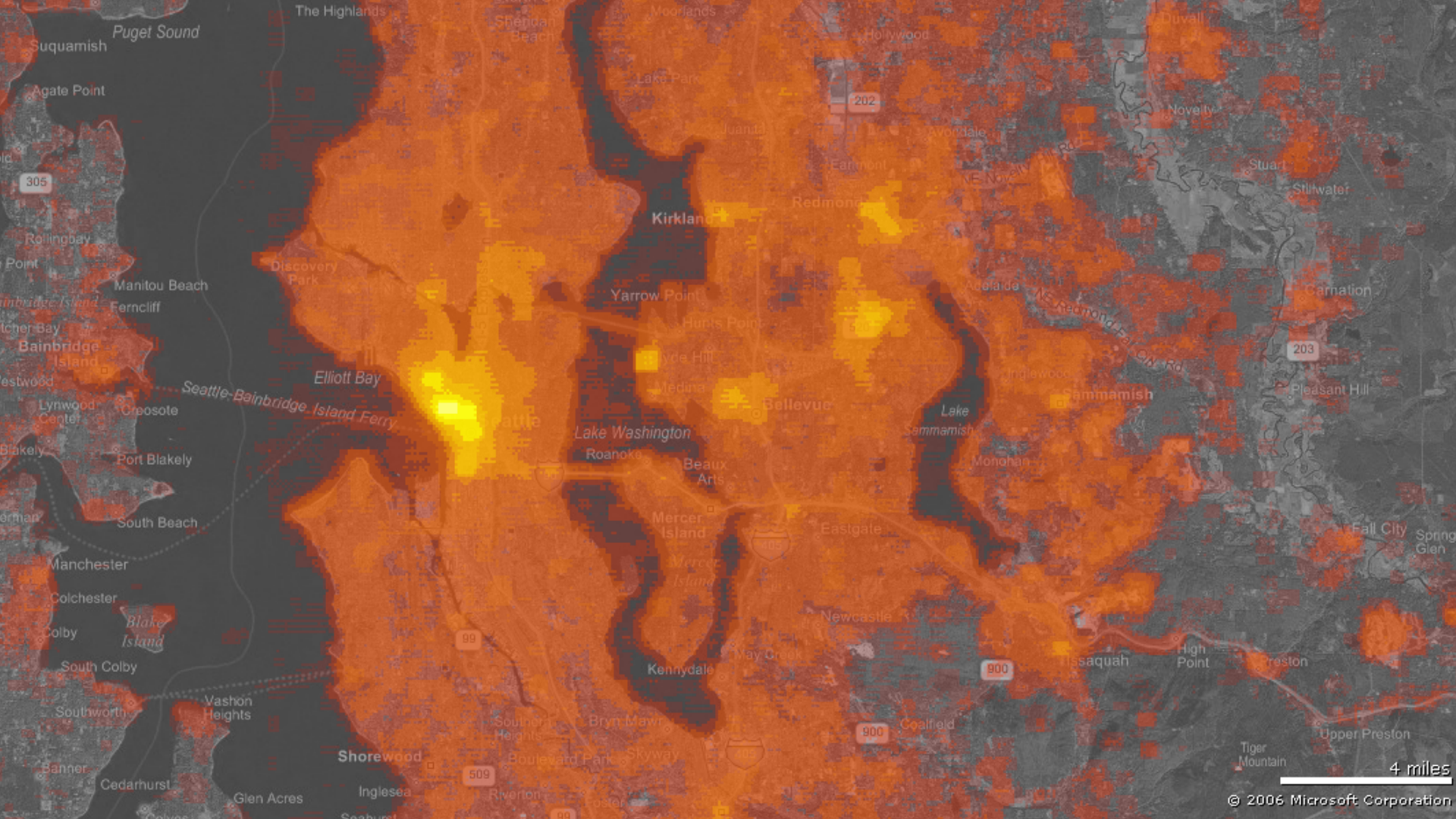
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Suquamish
Agate Point
The Highlands
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Hollywood
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Lake Park
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Novelty
Juanita
Avondale
Stuart
Stillwater
Earlmont
Redmond
Kirkland
305
Rollingbay
Point
Discovery Park
Manitou Beach
Ferncliff
Yarrow Point
Adelaide
Carnation
Bainbridge Island
Hunts Point
203
Elliott Bay
Medina
Bellevue
Sammamish
Pleasant Hill
Lynwood Center
Creosote
Seattle-Bainbridge Island Ferry
Lake Washington
Lake Sammamish
Port Blakely
Roanoke
Beaux Arts
Monohan
South Beach
Mercer Island
Eastgate
Fall City
Spring Glen
Manchester
Colchester
Blake Island
Colby
Newcastle
99
South Colby
Kennydale
Issaquah
High Point
Preston
900
Southworth
Vashon Heights
Bryn Mawr
Coalfield
Upper Preston
Shorewood
Boulevard Park
Skyway
Tiger Mountain
Banner
Cedarhurst
509
Glen Acres
Inglesea
Riverton
4 miles
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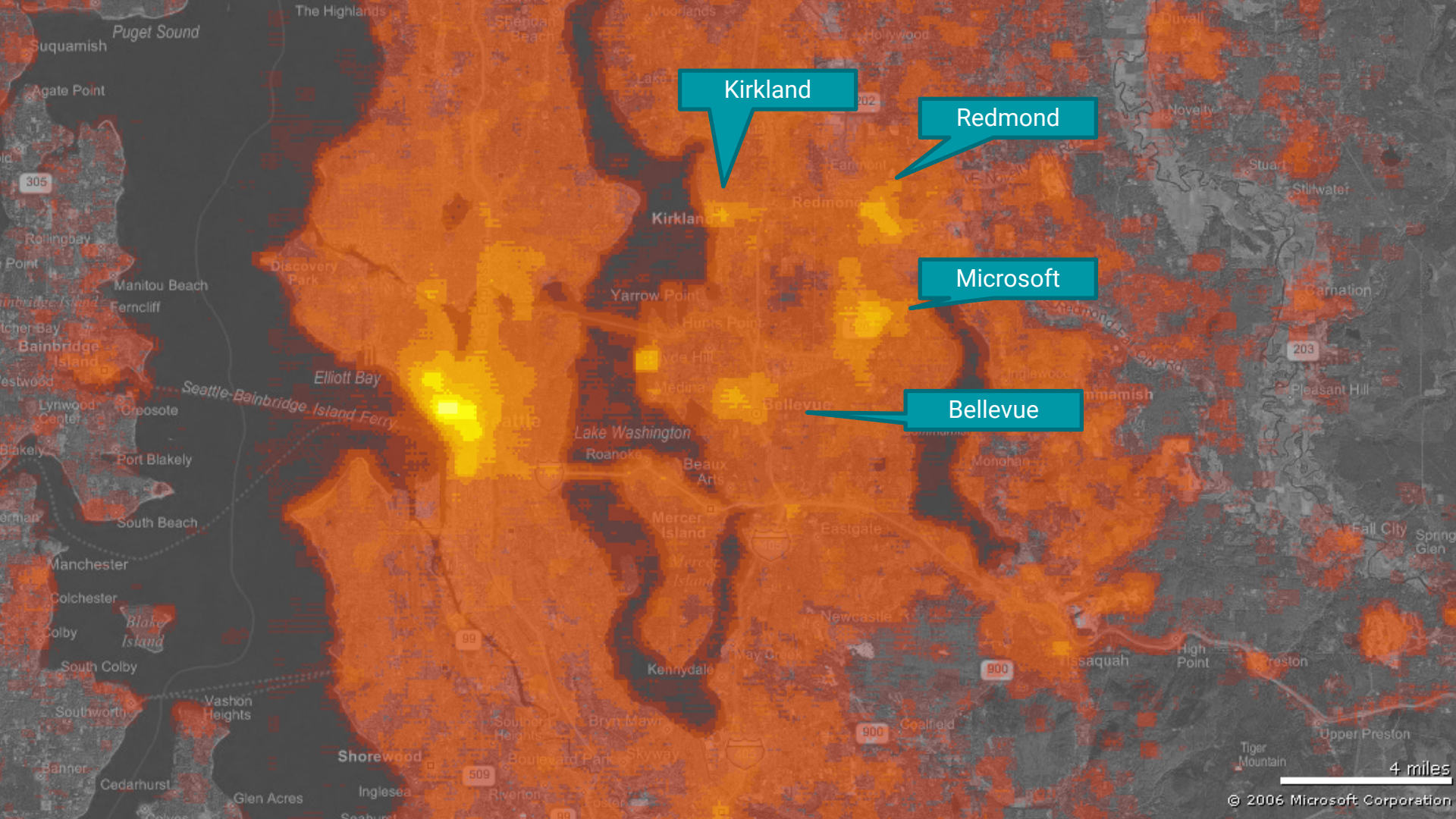
Kirkland
Redmond
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Colchester
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Southworth
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Shorewood
Banner
Cedarhurst
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Riverton
Boulevard Park
Southern Heights
Monohan
Inglewood
Redmond Fall City Rd
4 miles
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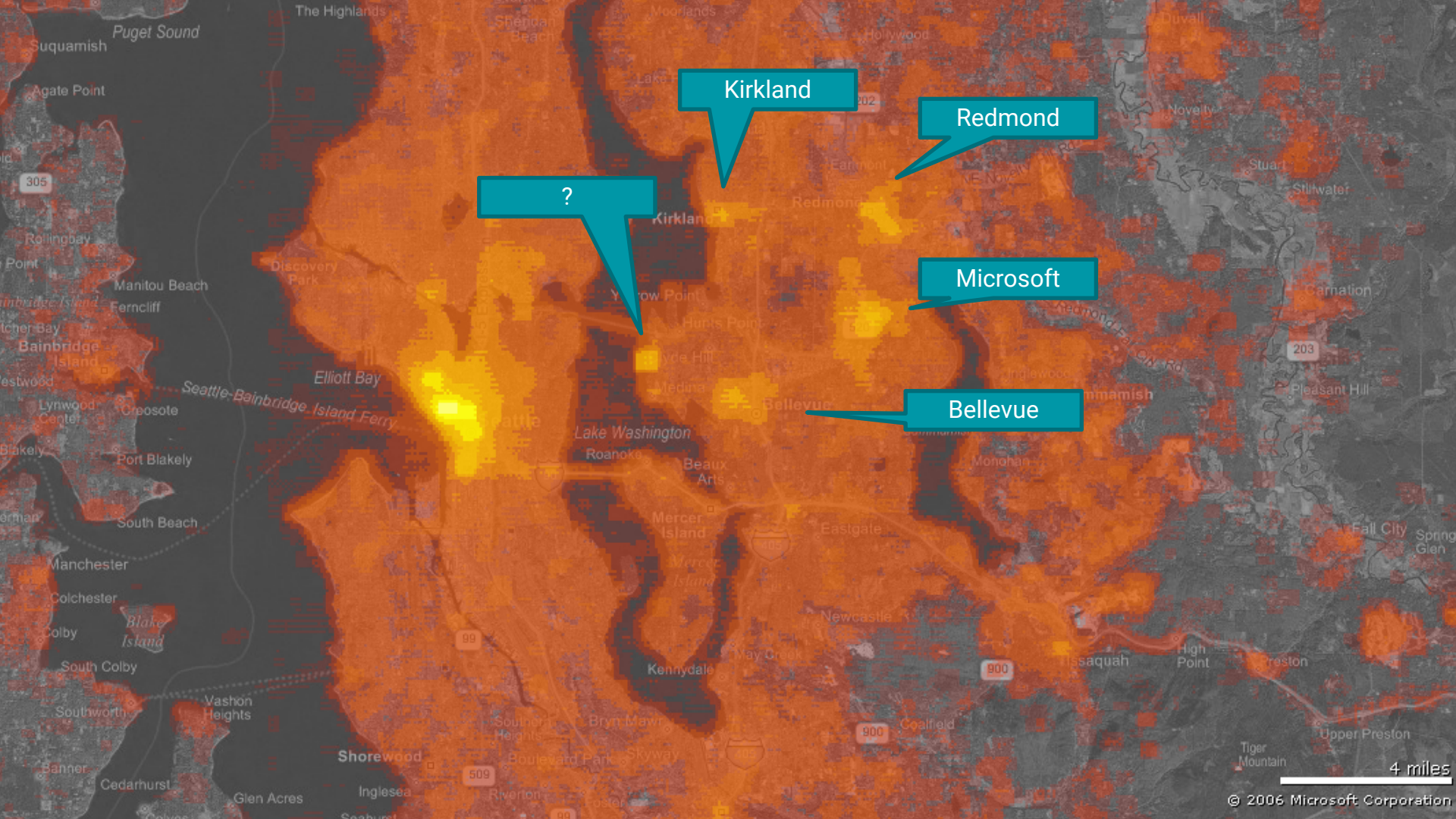
Kirkland
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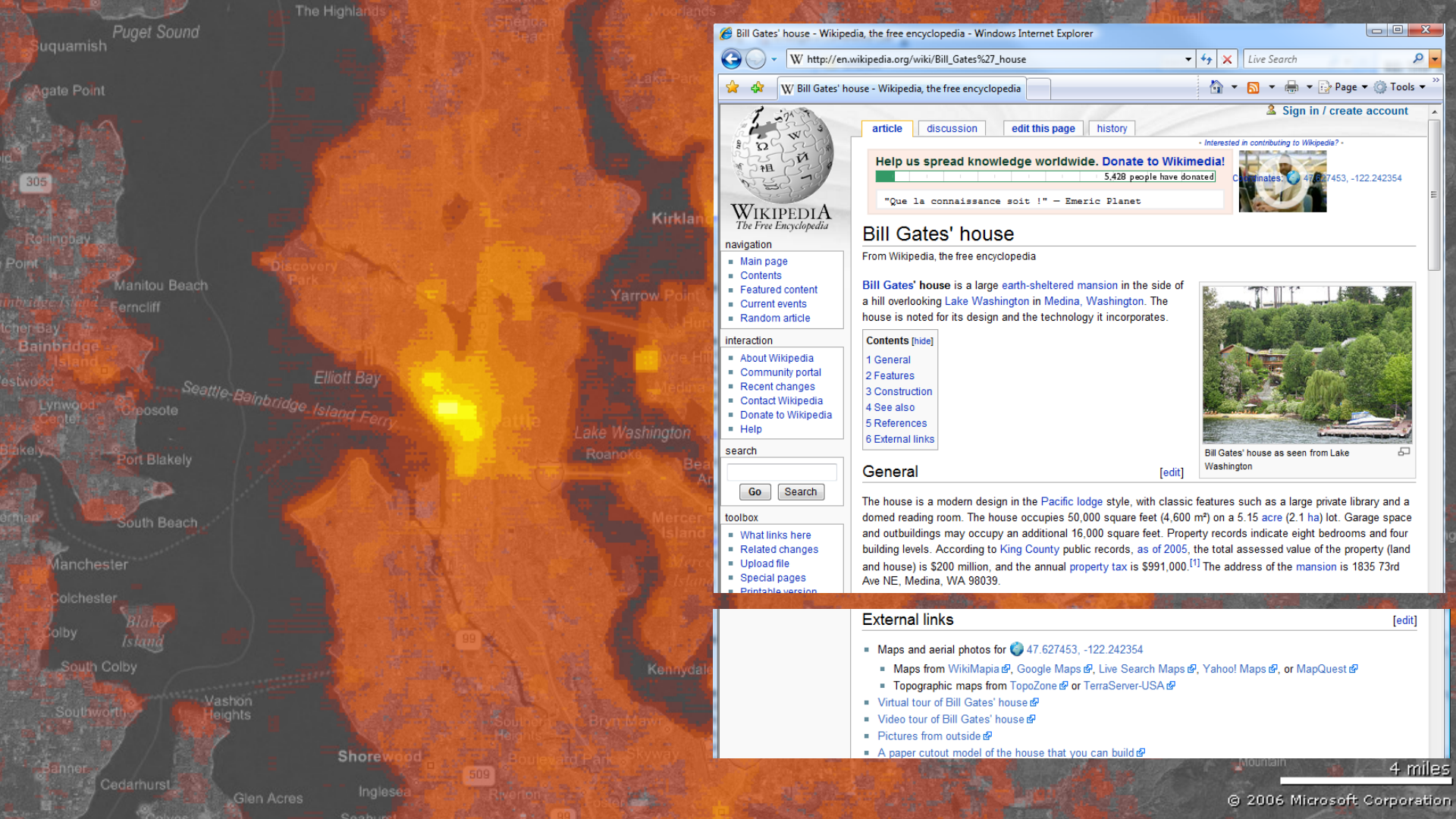
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5,428 people have donated
"Que la connaissance soit !" — Emeric Planet
Coordinates: 47.627453, -122.242354
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The Free Encyclopedia
navigation
Main page
Contents
Featured content
Current events
Random article
interaction
About Wikipedia
Community portal
Recent changes
Contact Wikipedia
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search
Go
Search
toolbox
What links here
Related changes
Upload file
Special pages
Bill Gates' house
From Wikipedia, the free encyclopedia
Bill Gates' house is a large earth-sheltered mansion in the side of a hill overlooking Lake Washington in Medina, Washington. The house is noted for its design and the technology it incorporates.
Contents [hide]
1 General
2 Features
3 Construction
4 See also
5 References
6 External links
Bill Gates' house as seen from Lake Washington
General [edit]
The house is a modern design in the Pacific lodge style, with classic features such as a large private library and a domed reading room. The house occupies 50,000 square feet (4,600 m²) on a 5.15 acre (2.1 ha) lot. Garage space and outbuildings may occupy an additional 16,000 square feet. Property records indicate eight bedrooms and four building levels. According to King County public records, as of 2005, the total assessed value of the property (land and house) is $200 million, and the annual property tax is $991,000.[1] The address of the mansion is 1835 73rd Ave NE, Medina, WA 98039.
External links [edit]
Maps and aerial photos for 47.627453, -122.242354
Maps from WikiMapia, Google Maps, Live Search Maps, Yahoo! Maps, or MapQuest
Topographic maps from TopoZone or TerraServer-USA
Virtual tour of Bill Gates' house
Video tour of Bill Gates' house
Pictures from outside
A paper cutout model of the house that you can build
Puget Sound
Suquamish
Agate Point
Manitou Beach
Ferncliff
Bainbridge Island
Elliott Bay
Seattle-Bainbridge Island Ferry
Lake Washington
Port Blakely
South Beach
Manchester
Colchester
Blake Island
South Colby
Southworth
Vashon Heights
Shorewood
Cedarhurst
Glen Acres
Inglesea
Kirkland
Yarrow Point
Kennydale
4 miles
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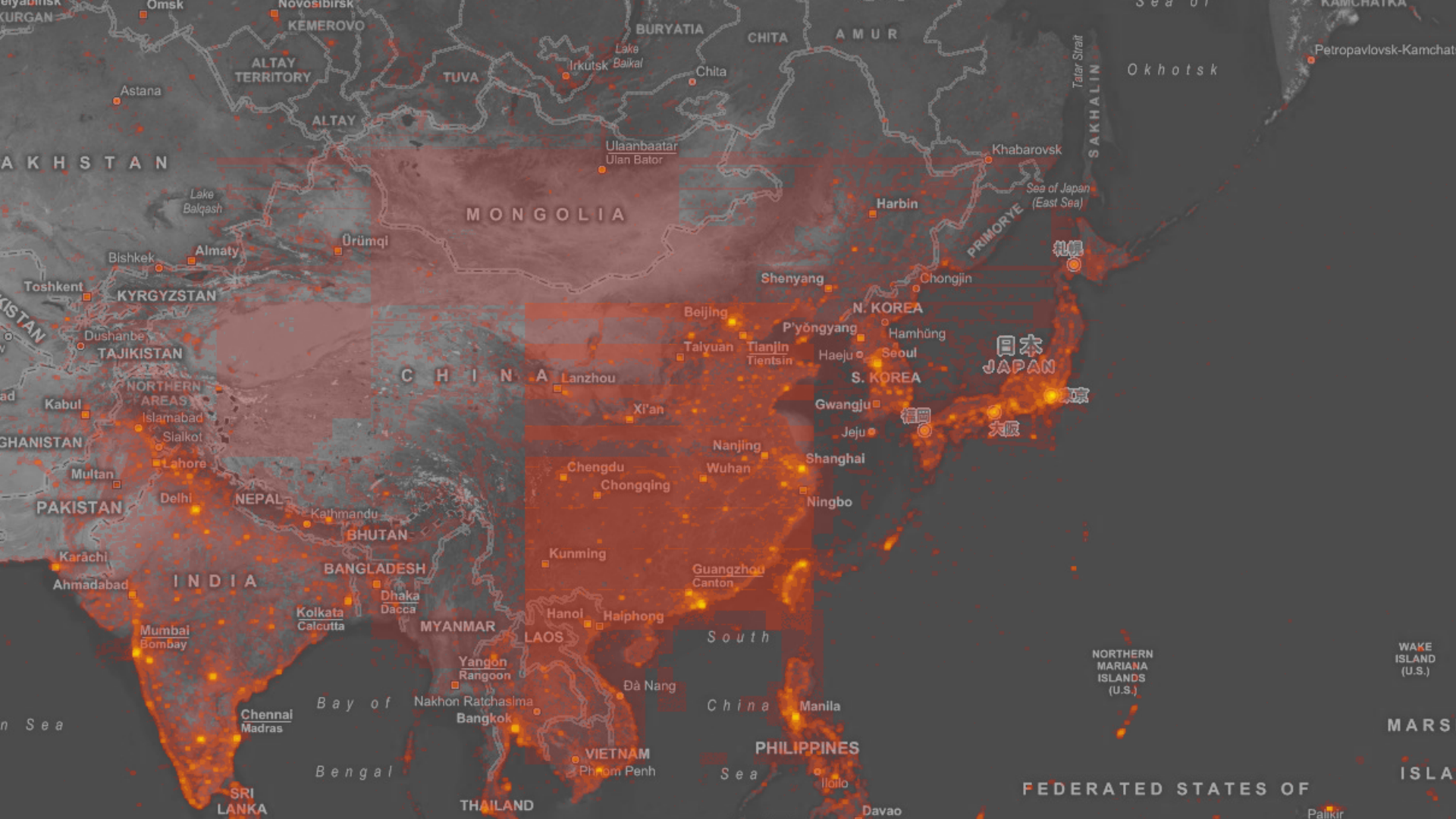

Omsk
Novosibirsk
KEMEROVO
BURYATIA
CHITA
AMUR
ALTAY TERRITORY
TUVA
Irkutsk
Lake Baikal
Chita
Astana
ALTAY
Ulaanbaatar
Ulan Bator
Khabarovsk
SAKHALIN
Okhotsk
Petropavlovsk-Kamchatsk
Lake Balqash
MONGOLIA
Harbin
Sea of Japan (East Sea)
PRIMORYE
札幌
Ürümqi
Almaty
Bishkek
Toshkent
KYRGYZSTAN
Shenyang
Chongjin
Beijing
N. KOREA
P'yŏngyang
Hamhŭng
Dushanbe
TAJIKISTAN
Taiyuan
Tianjin
Tientsin
Haeju
Seoul
日本
JAPAN
CHINA
Lanzhou
S. KOREA
NORTHERN AREAS
Kabul
Islamabad
Xi'an
Gwangju
東京
福岡
大阪
Sialkot
Jeju
Lahore
Nanjing
Shanghai
Multan
Chengdu
Wuhan
Chongqing
Delhi
NEPAL
PAKISTAN
Kathmandu
Ningbo
BHUTAN
Karachi
Kunming
BANGLADESH
Guangzhou
Canton
Ahmadabad
INDIA
Dhaka
Dacca
Kolkata
Calcutta
Hanoi
Haiphong
MYANMAR
Mumbai
Bombay
LAOS
South
Yangon
Rangoon
Đà Nẵng
Nakhon Ratchasima
Bangkok
China
Manila
Chennai
Madras
Bay of
Sea
VIETNAM
Phnom Penh
PHILIPPINES
Bengal
Sea
Iloilo
SRI LANKA
THAILAND
Davao
NORTHERN MARIANA ISLANDS (U.S.)
WAKE ISLAND (U.S.)
MARS
ISLA
FEDERATED STATES OF
Palikir

A Useful Representation

Software bug
User behavior
Usability
Security

Represent tiles
Reorganize, store, aggregate
Color transform & render

Think about the data **flexibly**

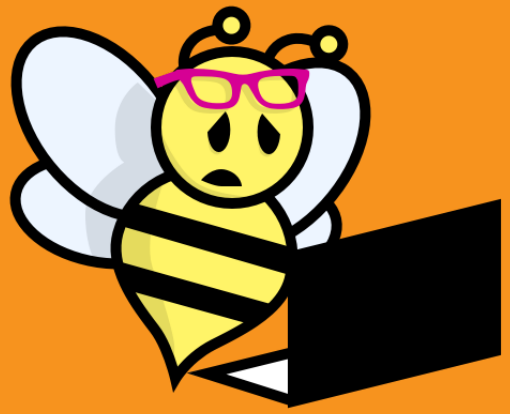
SKILUP DAYS

Today’s Agenda

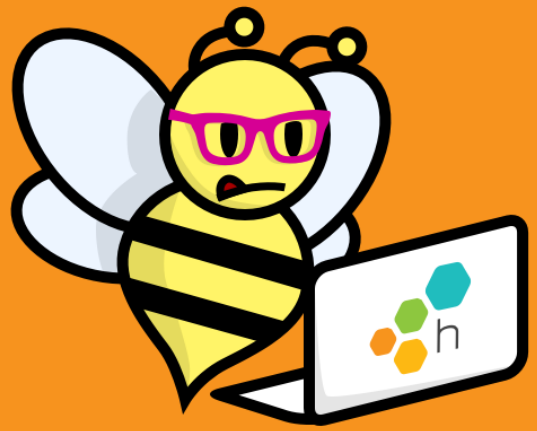
The Core Analysis Loop for Observability
High Dimensional Data
My Three Favorite Techniques
Using it for Observability

SKILUP DAYS

Observability scenarios



CRISIS



DEPLOY

DEBUG

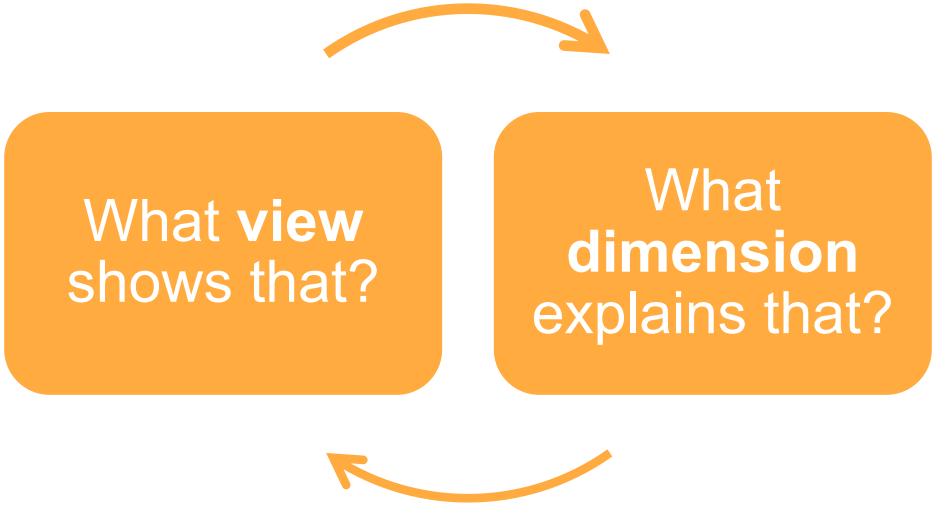
Core Analysis Loop

- “Something is weird!”
  - Alerts are going off
  - Pages are loading slow
  - Unexpected errors

SKILup DAYS

Core Analysis Loop

- “Something is weird!”



SKILUP DAYS

Availability Zone	string
build_id	string
customer_id	string
durationMs	float
endpoint	string
endpoint_shape	string
error	string
fraud_dur	float
hostname	string
id	string

mysql_dur	float
name	string
parentId	string
platform	string
query	string
serviceName	string
status_code	float
traceId	string
user_id	string
error_rate	derived

High Dimensionality

aggregates	string
alias	string
availability_zone	string
boardDescription	string
boardId	string
boardName	string
board_pk	string
boards	bool
build_id	string
caption	string
captionChanged	bool
class	string
cold	bool
coldDefaultKB	float
columnIndex	float
connection_rtt	float
connection_type	string
connection_type_effective	string
datasetName	string
datasetSlug	string
dataset_type	string
datum	string
description	string
descriptionChanged	bool
edit_duration_msec	float
enabled	bool
endTime	string
end_time	float
env	string
err	string
error_count	float
events	bool
expression	string
fieldUpdated	string
filter	string
filter_set	string
flags.allocationEnforcement	bool
flags.allocationNotification	bool
flags.allowAnnotations	bool
flags.allowColdStorageUI	bool
flags.allowCreateMarkerFromUI	bool
flags.allowDetailedMiniDiff	bool
flags.allowNewBoardUserManagement	bool
flags.allowSearch	bool
flags.allowSmallMultiples	bool
flags.allowTemplatizedQueries	bool

flags.allowTriggersWithBreakdown	bool
flags.allowTriggersWithBreakdowns	bool
flags.allowVariableFreqTriggers	bool
flags.apiKeyResourceAccess	bool
flags.billingCenterV2	bool
flags.boardsAPI	bool
flags.boardsRevamp	bool
flags.displayAttribution	bool
flags.displayStaleSchema	bool
flags.drilldown	bool
flags.drilldownUniformSample	bool
flags.freemium	bool
flags.gentleHeatmapColors	bool
flags.instantGratification	bool
flags.navigationRevamp	bool
flags.ponies	bool
flags.renderRangedMarkers	bool
flags.shortTrial	bool
flags.singleTraceRevamp	bool
flags.singleTraceRevampMinimap	bool
flags.singleTraceRevampSidebar	bool
flags.singleTraceRevampTraceNav	bool
flags.singleTraceRevampWaterfall	bool
flags.starterQueryBoards	bool
flags.traceSummaries	bool
flags.traceSummaries.	bool
flags.traceSummaries.class	bool
flags.traceSummaries.class()	bool
flags.triggersAPI	bool
flags.weightedAutocomplete	bool
global.availability_zone	string
global.build_id	string
global.env	string
global.infra_type	string
global.instance_type	string
global.memory_inuse	float
global.num_goroutines	float
global.os_version	string
global.process_uptime_seconds	float
global.role	string
global.server_hostname	string
goji_pattern	string
group	string
groups	string
header	string
infra_type	string

ingestLimitGB	float
initialPage	string
instance_type	string
inviteeEmail	string
isPrivate	bool
js_heap_change_b	float
js_heap_size_total_b	float
js_heap_size_used_b	float
js_heap_size_used_start_b	float
limit	string
limitGB	float
markers	bool
maxVal	float
memberEmail	string
memberEmails	string
memory_inuse	float
meta.beeline_version	string
meta.local_hostname	string
minVal	float
modification	string
name	string
nameChanged	bool
newLimit	float
newPrivacyValue	bool
newState	bool
next	bool
numResults	float
numVisibleRuns	float
num_edits	float
num_goroutines	float
onOff	string
op	string
orders	string
os_version	string
pageIndex	float
pageLoadId	float
pageURL	string
page_load_id	float
primaryDefaultKB	float
primaryLimitGB	float
process_uptime_seconds	float
queries	bool
queryId	string
queryRunPK	string
reason	string
recip	string

recip	string
recipients	string
redirect_count	float
resource_count	float
resource_main_css_decoded_size_kb	float
resource_main_css_encoded_size_kb	float
resource_main_css_hash	string
resource_main_css_timing_duration_ms	float
resource_main_js_decoded_size_kb	float
resource_main_js_encoded_size_kb	float
resource_main_js_hash	string
resource_main_js_timing_duration_ms	float
resource_runtime_js_decoded_size_kb	float
resource_runtime_js_encoded_size_kb	float
resource_runtime_js_hash	string
resource_runtime_js_timing_duration_ms	float
resource_vendor_css_decoded_size_kb	float
resource_vendor_css_encoded_size_kb	float
resource_vendor_css_hash	string
resource_vendor_css_timing_duration_ms	float
resource_vendor_js_decoded_size_kb	float
resource_vendor_js_encoded_size_kb	float
resource_vendor_js_hash	string
resource_vendor_js_timing_duration_ms	float
resultsChanged	bool
role	string
rowKey	string
runId	string
runs_since_page_load	float
saveFormat	string
save_error	string
screen_height	float
screen_width	float
secondaryLimitGB	float
selectedPlan	string
server_hostname	string
session_id	string
startTime	string
start_time	float
step	float
style	string
styleChanged	bool
teamName	string
teamSlug	string
team_id	float
time	string

time_since_last_run
timing_dns_duration_ms
timing_dns_end_ms
timing_dom_complete_ms
timing_dom_interactive_ms
timing_dom_loaded_duration_ms
timing_dom_loaded_ms
timing_first_contentful_paint_ms
timing_first_paint_ms
timing_ms_first_paint
timing_response_end_ms
timing_server_duration_ms
timing_ssl_duration_ms
timing_ssl_end_ms
timing_total_duration_ms
toAbs
toMinimized
toMode
total_page_duration_msec
traceID
triggers
type
user_agent
user_email
user_id
user_timing_window_open_duration_s
window_height
window_width
device
edit_duration_sec
honeycomber
isPlay
ran_query_without_editing
screen_pixels
screen_used
sec_since_last_run
total_page_duration_sec
window_pixels

Actual production dataset

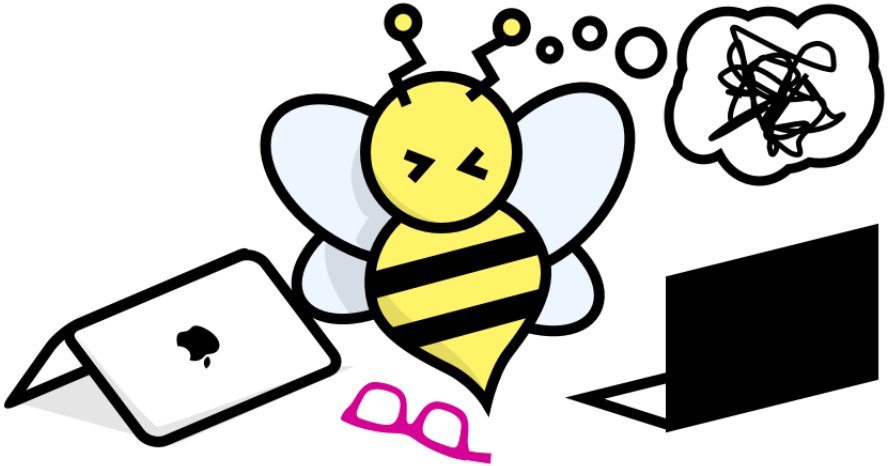
Availability Zone	string
build_id	string
customer_id	string
durationMs	float
endpoint	string
endpoint_shape	string
error	string
fraud_dur	float
hostname	string
id	string
mysql_dur	float
name	string
parentId	string
platform	string
query	string
serviceName	string
status_code	float
traceId	string
user_id	string
error_rate	derived

High Cardinality

This makes everything worse

High dimensional data?
Where do I look first?

High cardinality data?
Which are interesting?



SKILUP DAYS

In Search of the Perfect Interface

I have data. Can you visualize it for me?

I have data. Can you visualize it for me?

What do you want to see?

I have data. Can you visualize it for me?

What do you want to see?

I want to know if my sales are doing well

I have data. Can you visualize it for me?

What do you want to see?

I want to know if my sales are doing well

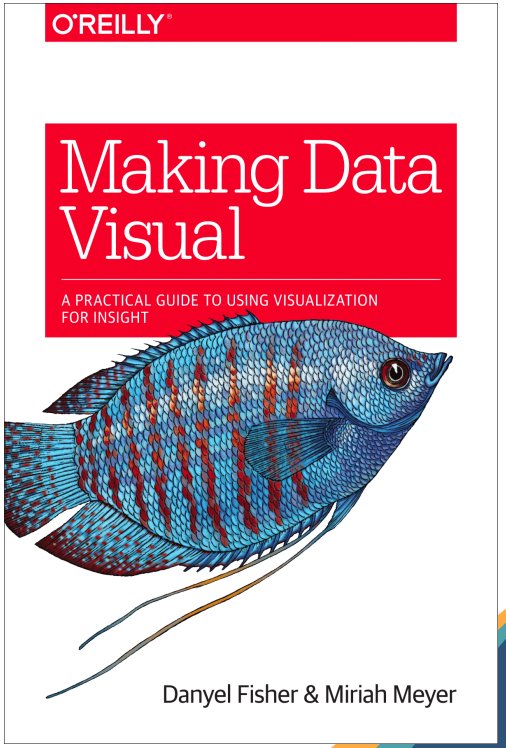
What would it mean for sales to do well?

Data Counseling

What do you think is happening?

What would it mean for it to happen?

What would it look like in the data?



SKILUP DAYS

The Sad Truth

Basic visualizations are usually Just Fine.

3D (almost) never pays off

Animations (almost always) are annoying

SKILUP DAYS

Great News!

Basic visualizations are usually Just Fine.

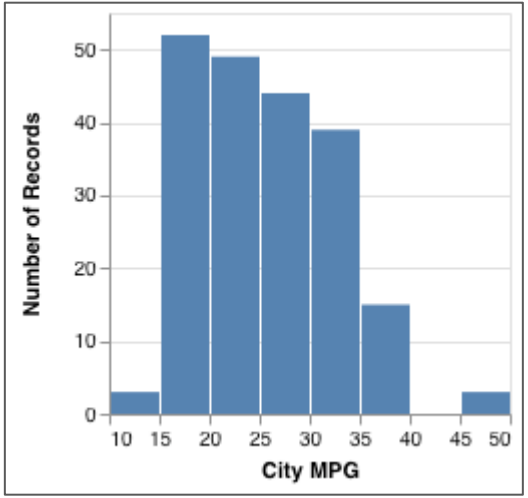
3D (almost) never pays off

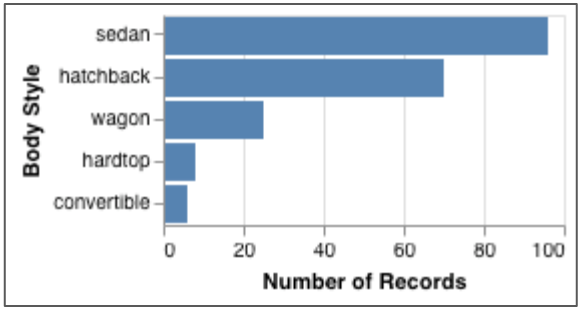
Animations (almost always) are annoying

SKILUP DAYS

My three favorite tools

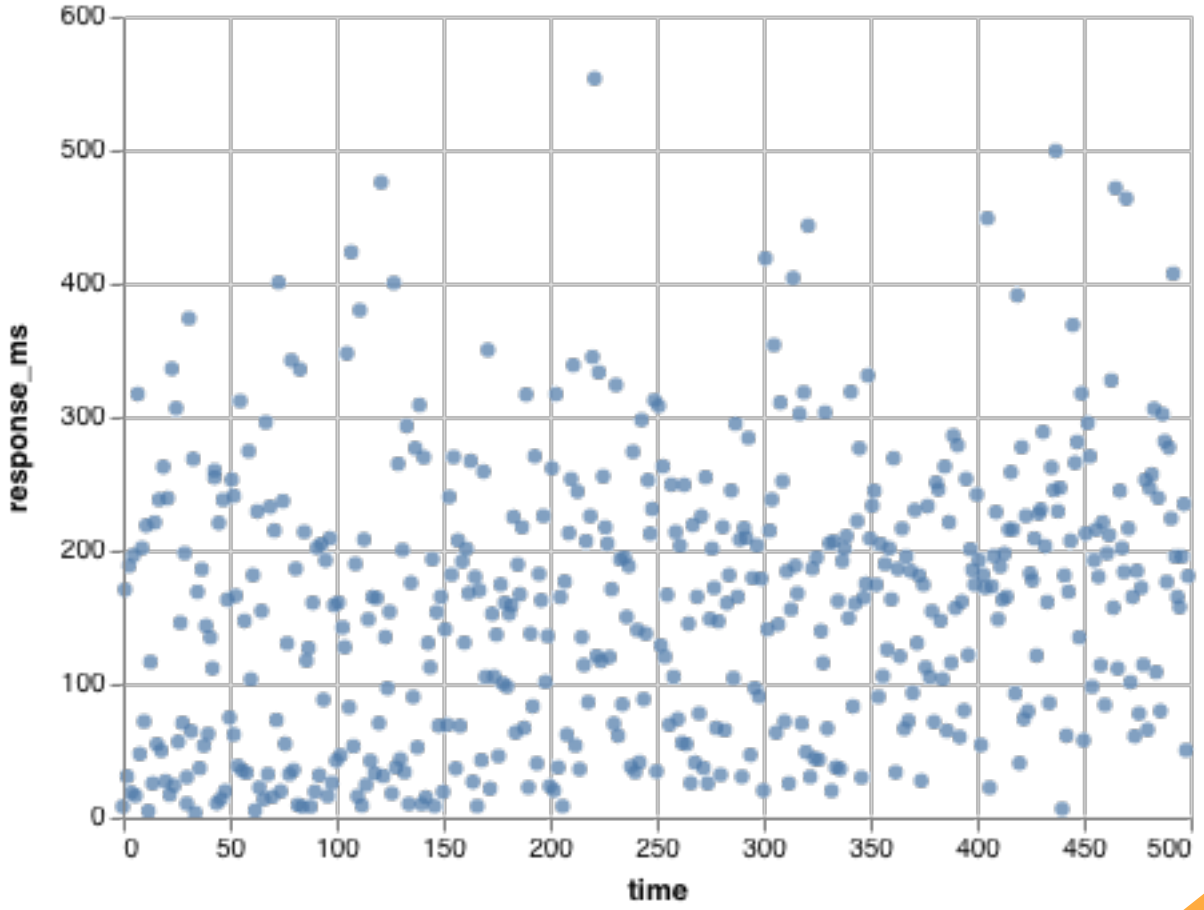
ONE DIMENSIONAL DATA: HISTOGRAMS



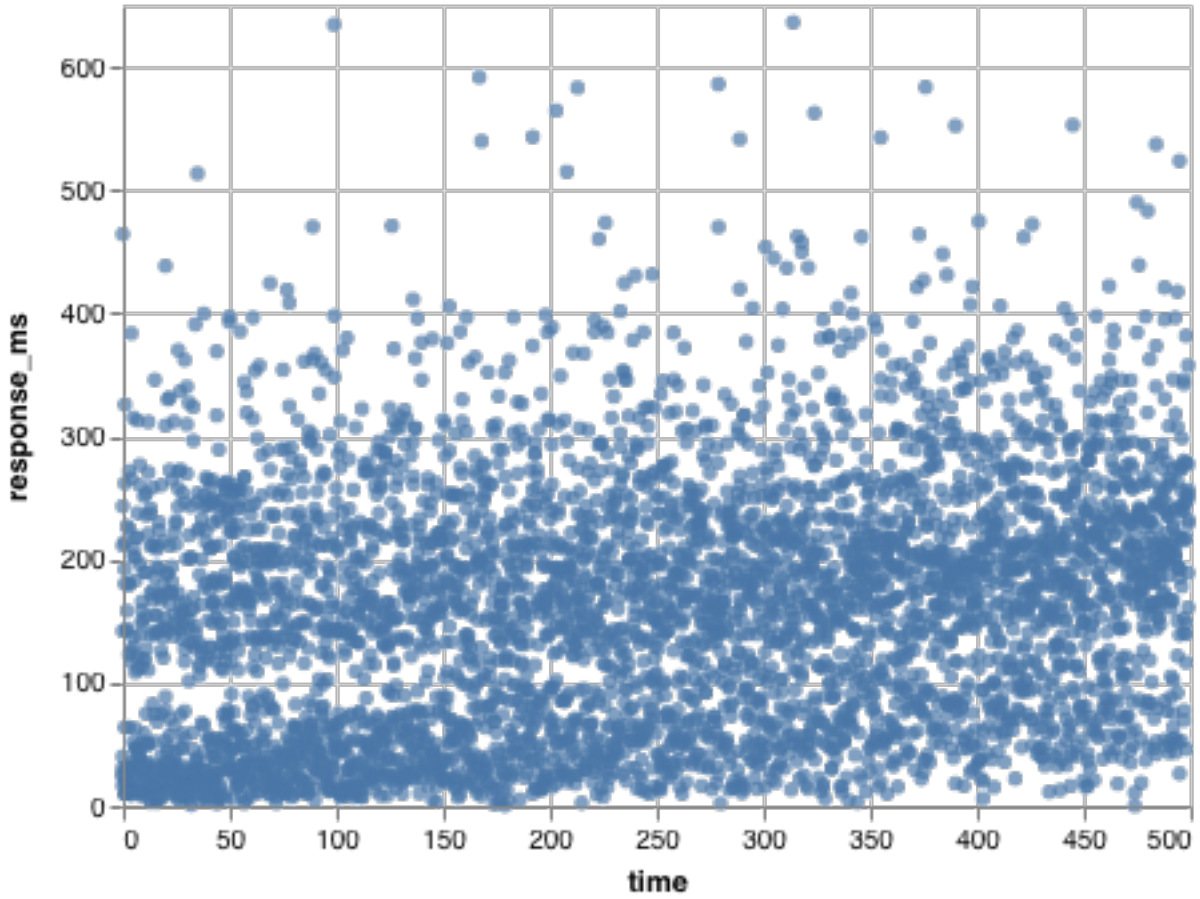


TWO DIMENSIONAL DATA

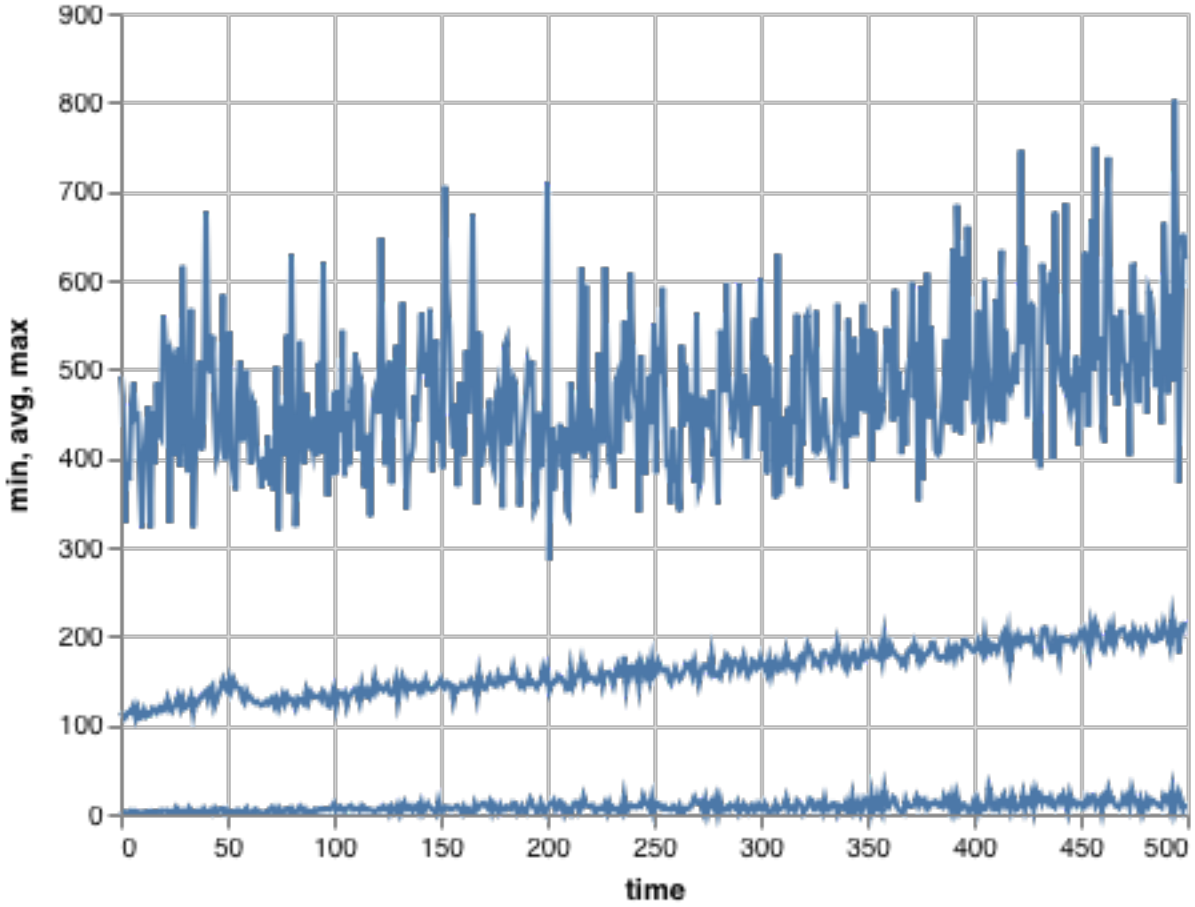
500 points



4500 points

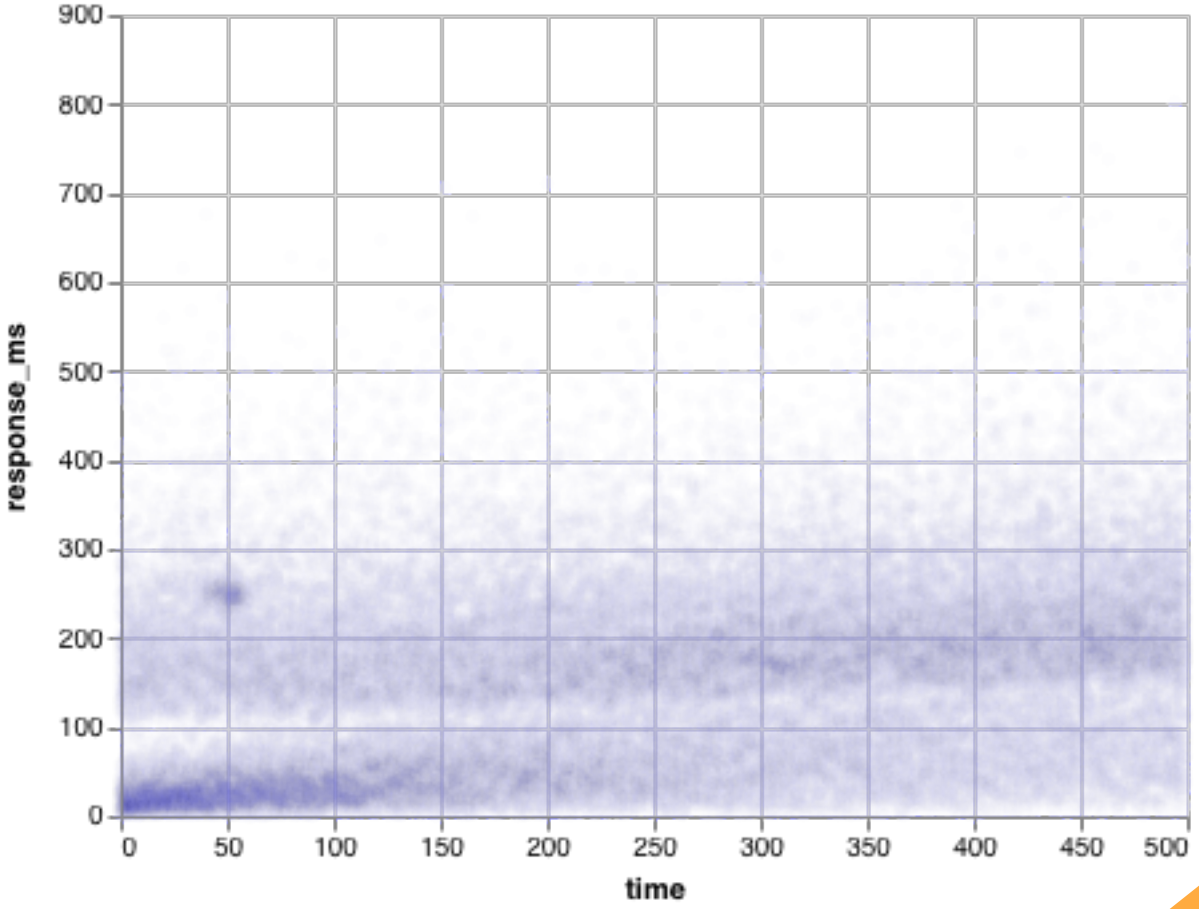

response_ms
600
500
400
300
200
100
0
0
50
100
150
200
250
300
350
400
450
500
time

4500 points



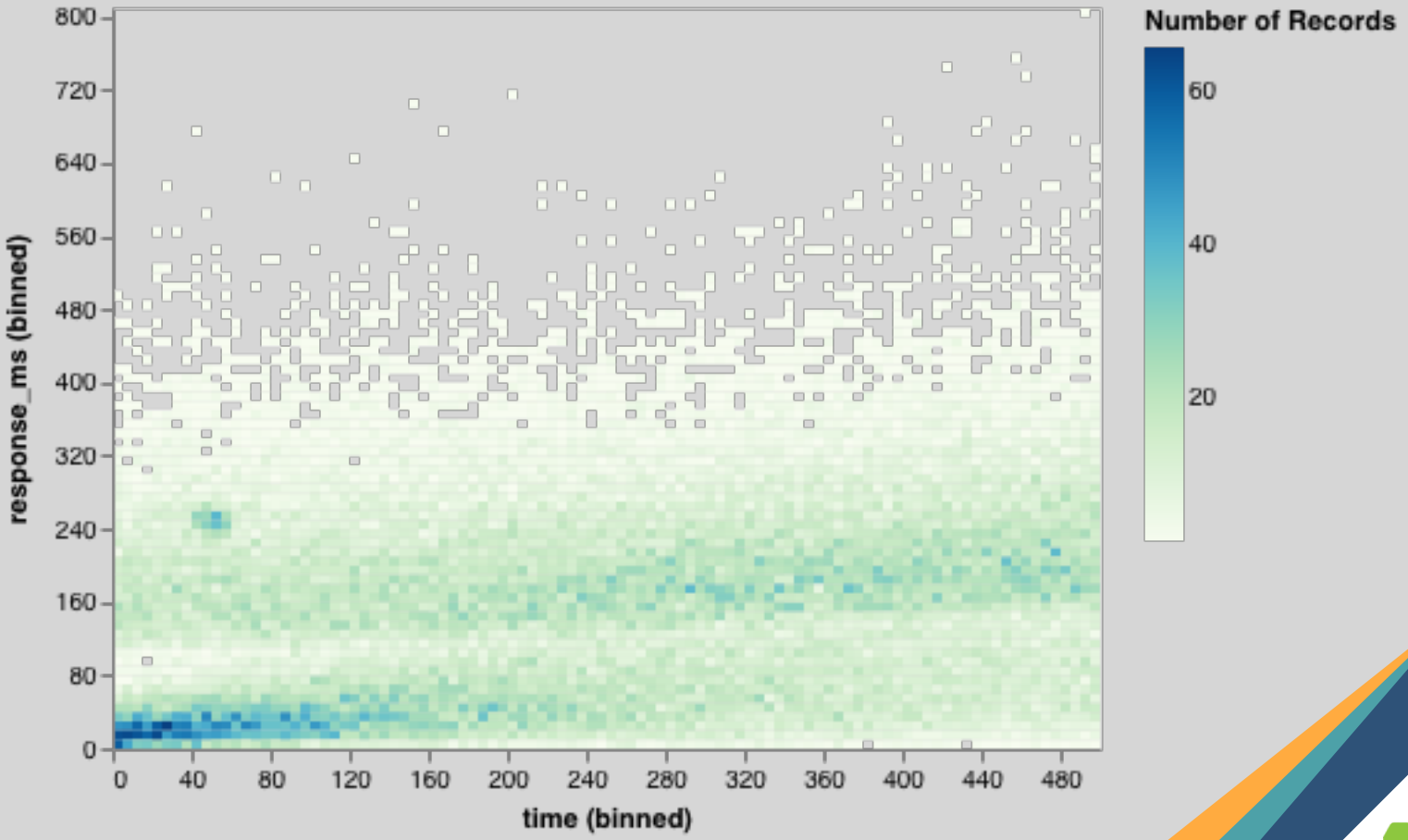
SKILUP DAYS

4500 points

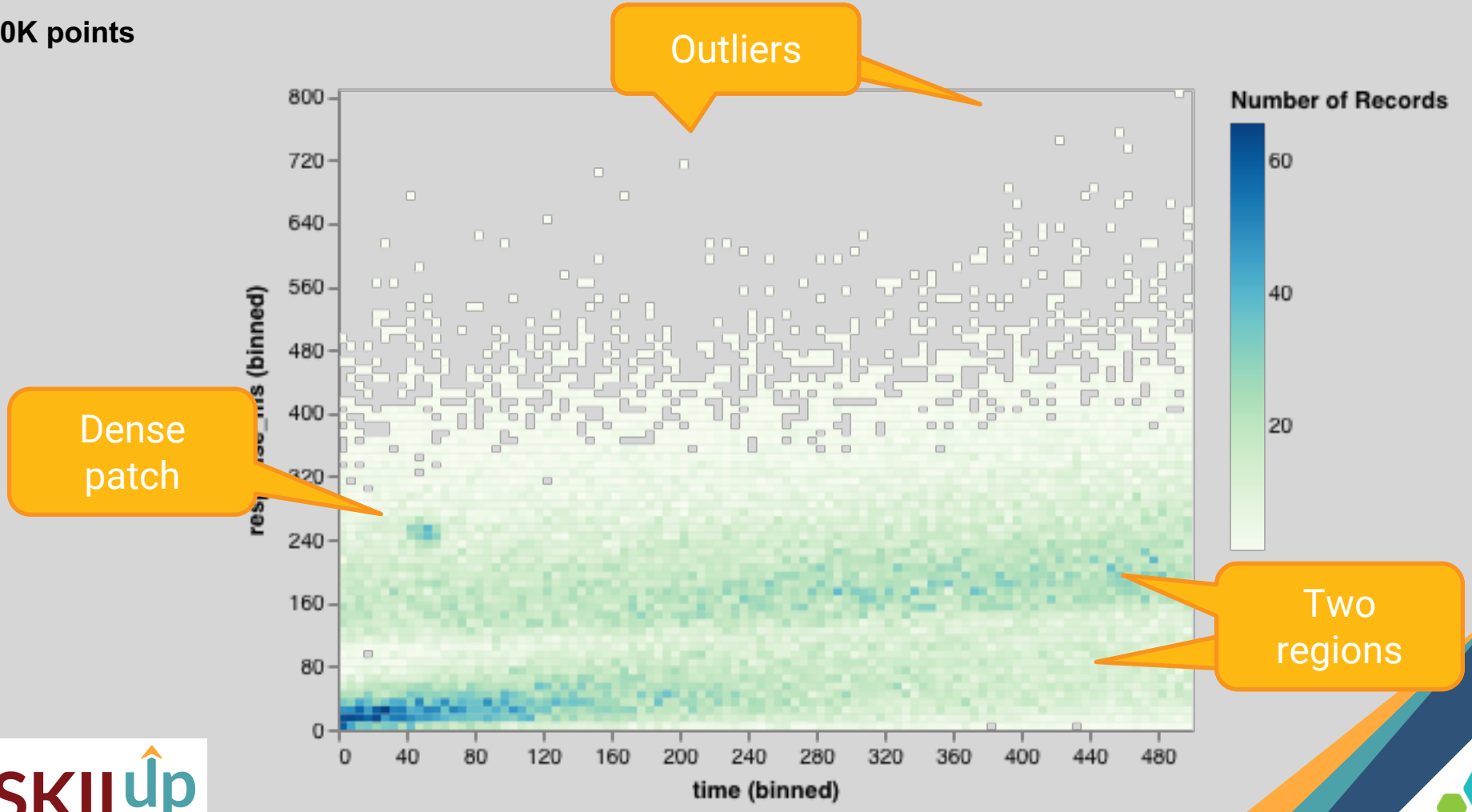


SKILUP DAYS

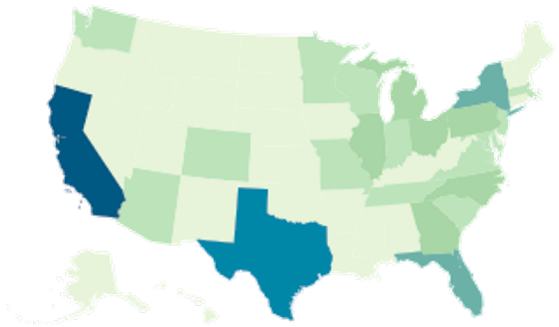
50K points


Number of Records
60
40
20
response_ms (binned)
800
720
640
560
480
400
320
240
160
80
0
time (binned)
0
40
80
120
160
200
240
280
320
360
400
440
480

50K points

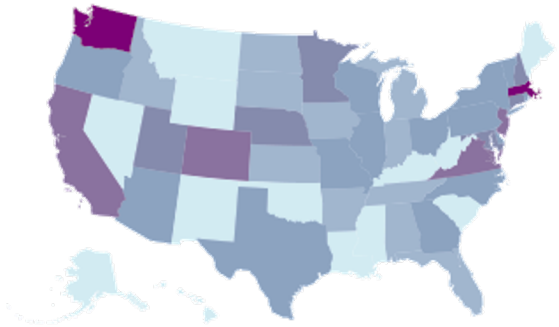


SKILUP DAYS



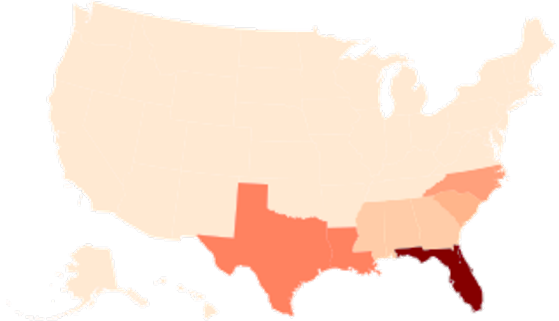
Population per state

- < 4,881,558
- 4,881,558–9,177,616
- 9,177,616–13,473,673
- 13,473,673–17,769,730
- 17,769,730–22,065,788
- 22,065,788–26,361,845
- 26,361,845–30,657,902
- 30,657,902–34,953,960
- ≥ 34,953,960



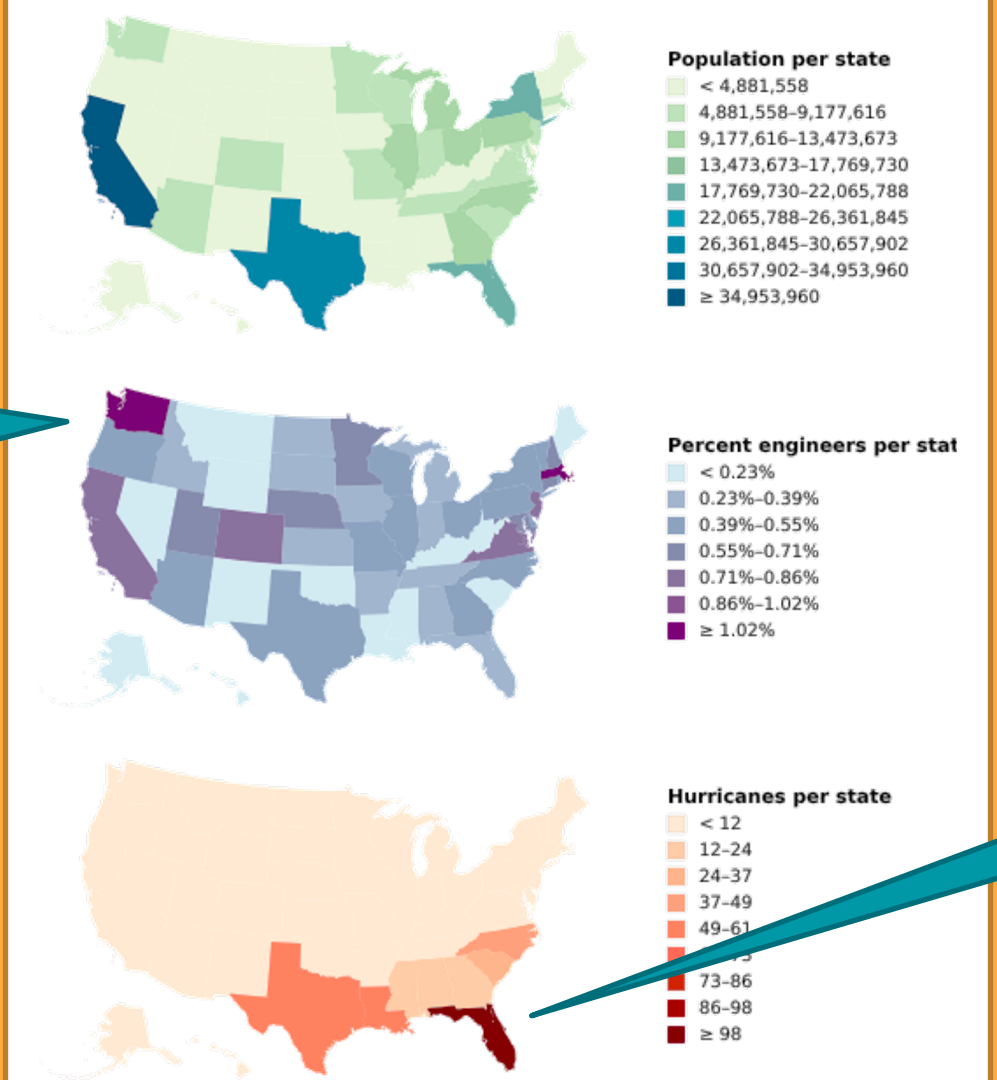
Percent engineers per stat

- < 0.23%
- 0.23%–0.39%
- 0.39%–0.55%
- 0.55%–0.71%
- 0.71%–0.86%
- 0.86%–1.02%
- ≥ 1.02%



Hurricanes per state

- < 12
- 12–24
- 24–37
- 37–49
- 49–61
- 61–73
- 73–86
- 86–98
- ≥ 98



Lots of engineers

Lots of hurricanes

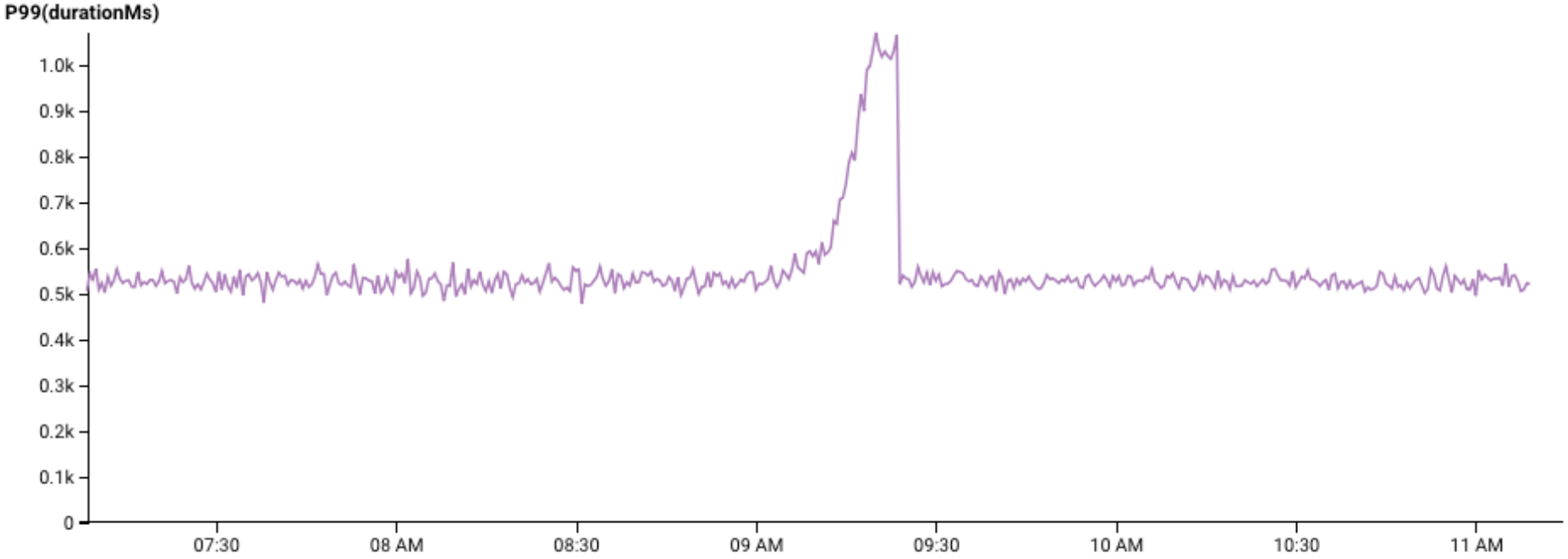
The Toolbox

- Data Counseling to understand the question
- Identify dimensions in the data
- Choose representations by task

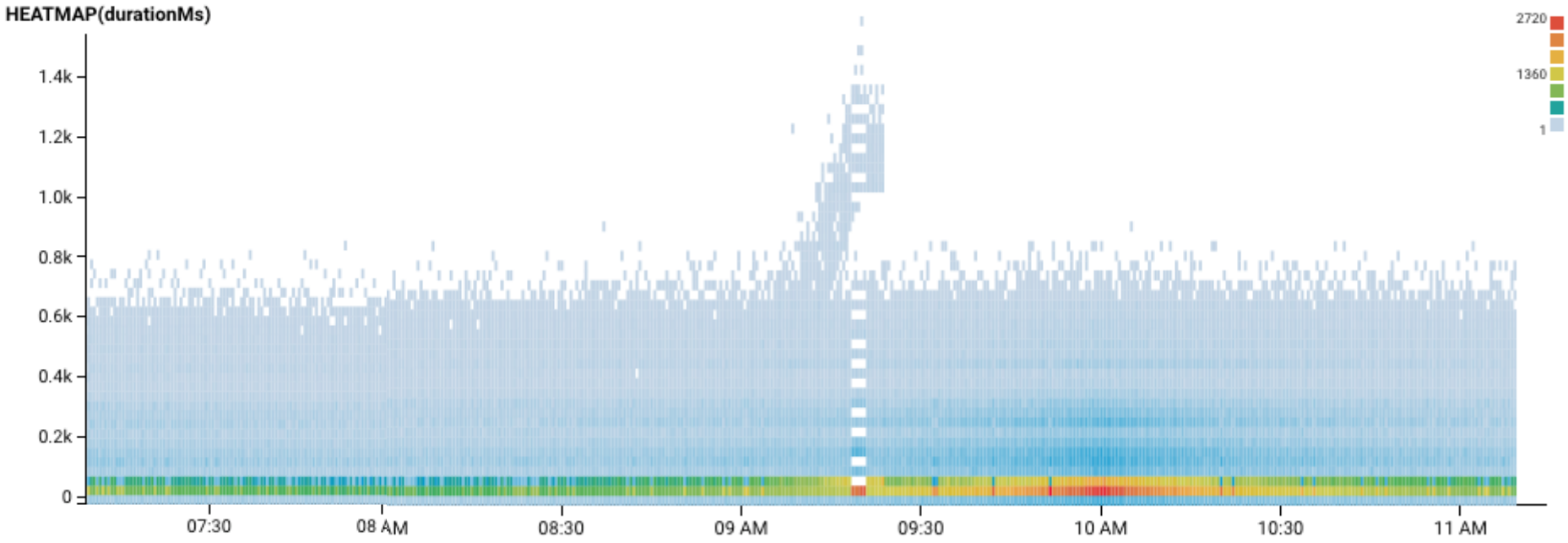
- **Histograms**
- **Heatmaps**
- **Small multiples**

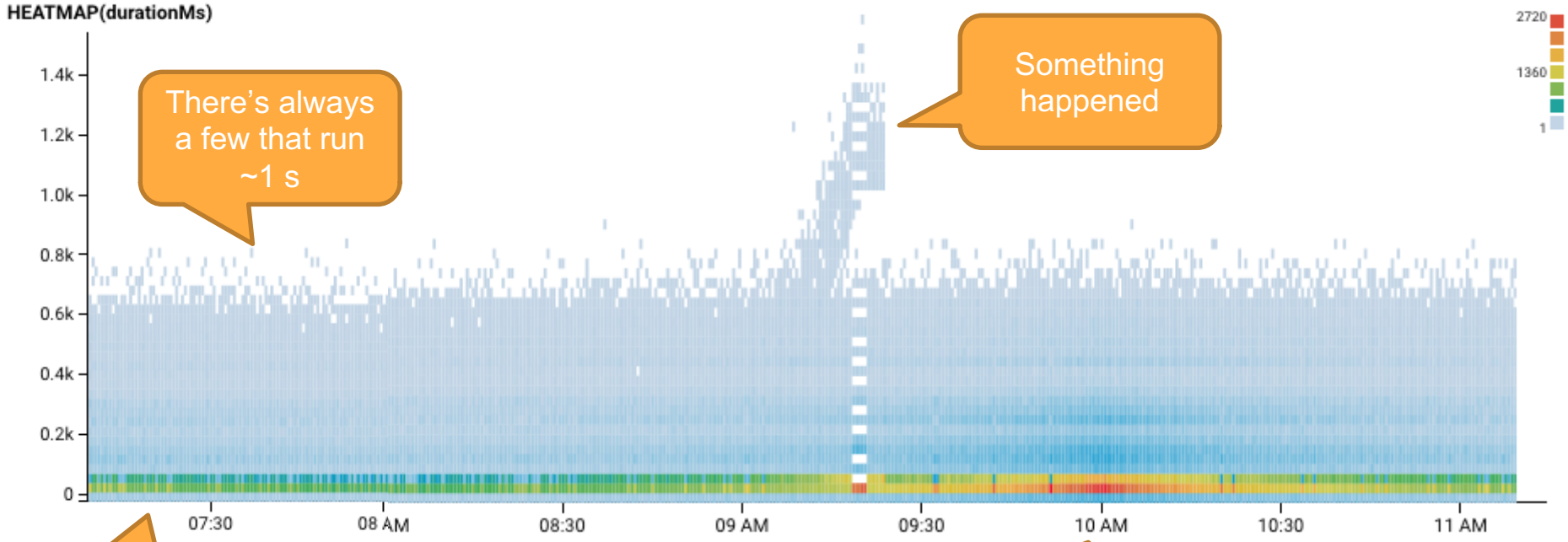
SKILUP DAYS

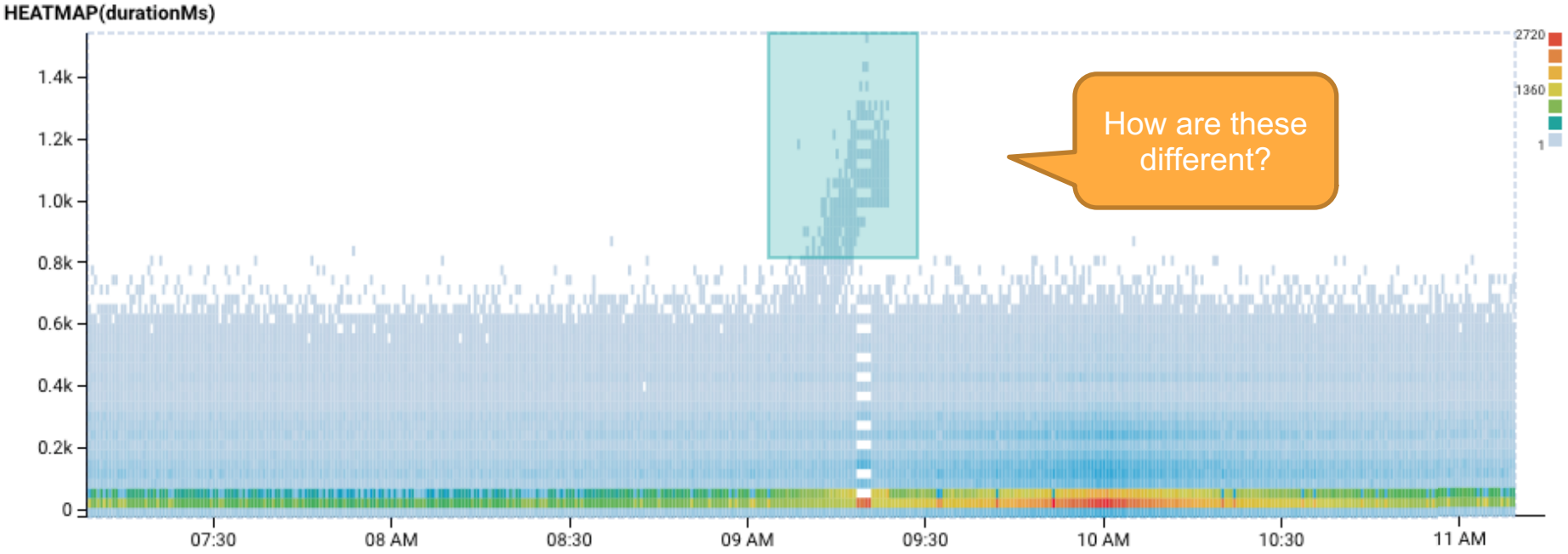
Something is wrong!



SKILUP DAYS


HEATMAP(durationMs)
1.4k
1.2k
1.0k
0.8k
0.6k
0.4k
0.2k
0
07:30
08 AM
08:30
09 AM
09:30
10 AM
10:30
11 AM
2720
1360
1


HEATMAP(durationMs)
1.4k
1.2k
1.0k
0.8k
0.6k
0.4k
0.2k
0
07:30
08 AM
08:30
09 AM
09:30
10 AM
10:30
11 AM
2720
1360
1
There's always a few that run ~1 s
Something happened
Most events are completed < 1/10 second
Traffic got high here

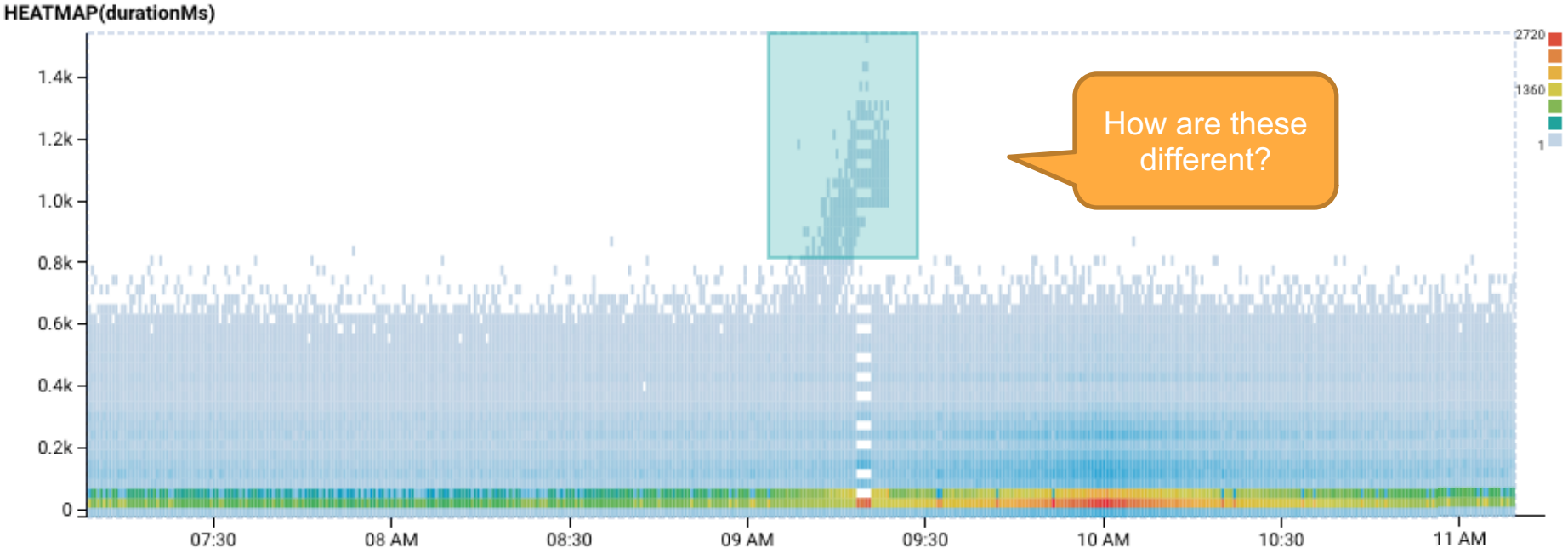

HEATMAP(durationMs)
1.4k
1.2k
1.0k
0.8k
0.6k
0.4k
0.2k
0
07:30
08 AM
08:30
09 AM
09:30
10 AM
10:30
11 AM
2720
1360
1
How are these different?

SKILUP DAYS

Availability Zone	string
build_id	string
customer_id	string
durationMs	float
endpoint	string
endpoint_shape	string
error	string
fraud_dur	float
hostname	string
id	string

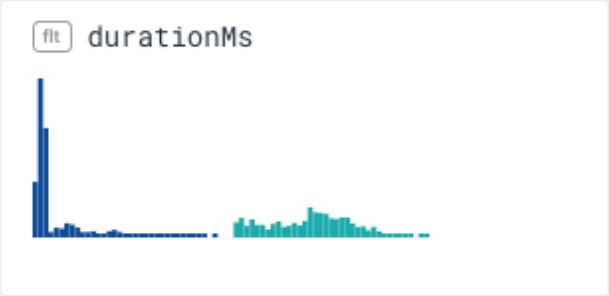
mysql_dur	float
name	string
parentId	string
platform	string
query	string
serviceName	string
status_code	float
traceId	string
user_id	string
error_rate	derived

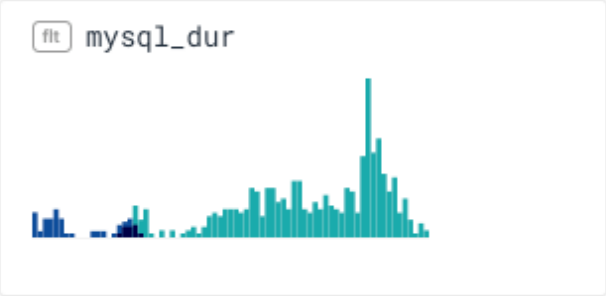
High Dimensionality

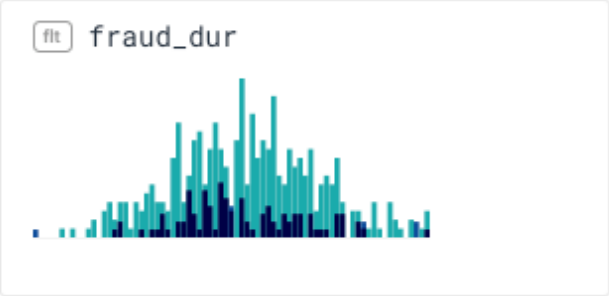

HEATMAP(durationMs)
1.4k
1.2k
1.0k
0.8k
0.6k
0.4k
0.2k
0
07:30
08 AM
08:30
09 AM
09:30
10 AM
10:30
11 AM
2720
1360
1
How are these different?

SKILUP DAYS

BubbleUp: measures





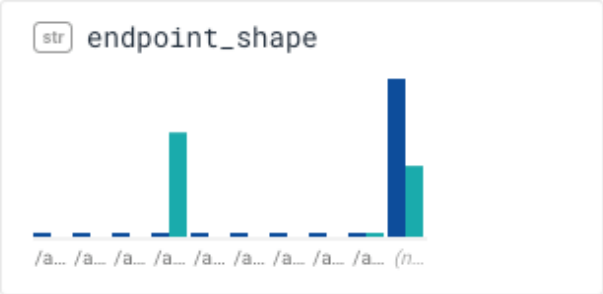


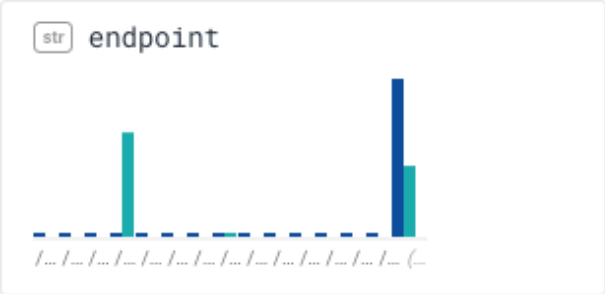
They took longer

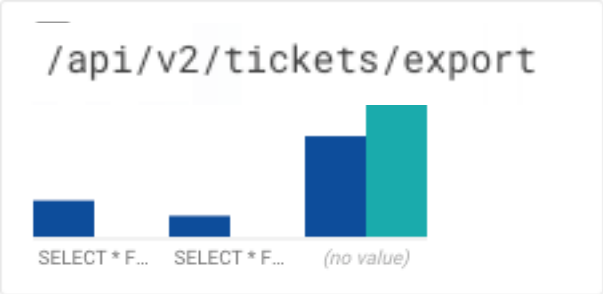
Especially their MYSQL calls

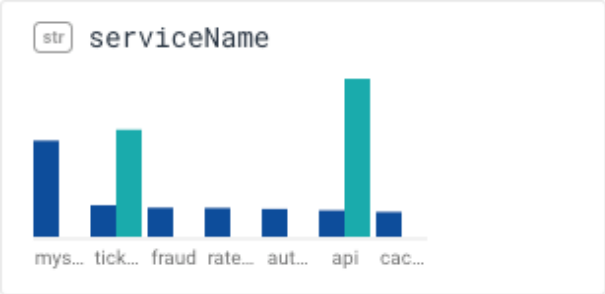
SKILUP DAYS

BubbleUp: dimensions



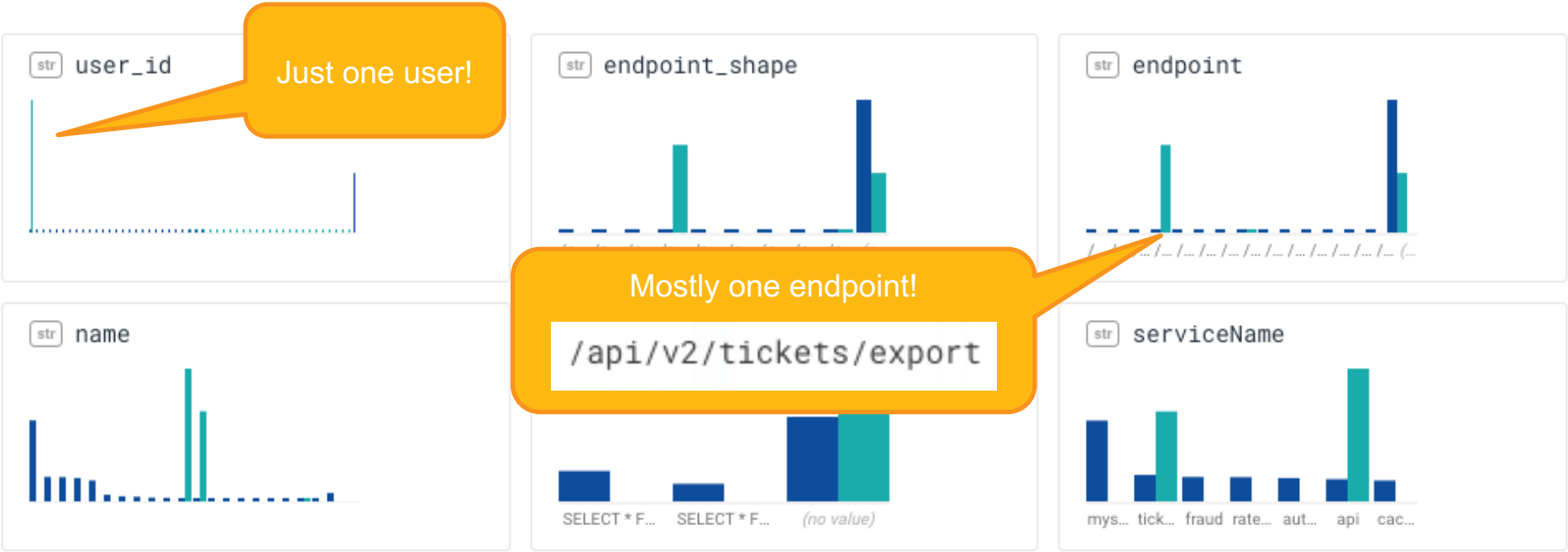






SKILUP DAYS

BubbleUp: dimensions



SKILUP DAYS

CAUTION: Remember that every unique combination of key-value label pairs represents a new time series, which can dramatically increase the amount of data stored. Do not use labels to store dimensions with high cardinality (many different label values), such as user IDs, email addresses, or other unbounded sets of values.

This breaks my heart.
Worse, it breaks observability

Ingredients for Observability

Understand the Question

Flexible Views

Fine Grained Events

High Dimensional Data

High Cardinality Data

Use these to tell *your service's* story

SKILUP DAYS

THANK YOU!

Meet me in the Network Chat Lounge for questions

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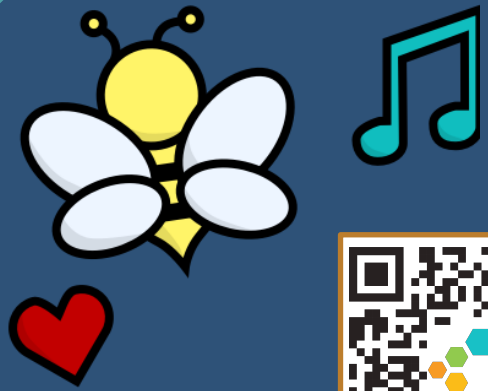

SKILUP DAYS

References & Further Reading

- Hotmap: Looking at Geographic Attention (IEEE TVCG, Fisher, 2007)
- Observability for Developers (Honeycomb e-book)
- Achieving Observability (Honeycomb e-book)
- Heatmaps Make Ops Better (blog, 11/9/2018)
- The Core Analysis Loop (blog, 11/16/2018)
- Diving into Data with Honeycomb (blog, 11/28/2018)
- Making Data Visual (O'Reilly Press, 2018)
- Trust Me, I'm Partially Right (ACM SIGCHI, Fisher, 2012)

SKILup DAYS