elastic | The Search AI Company

Elastic and geospatial

Jorge Sanz | jorge.sanz@elastic.co

UN Maps, València, 2024-06-20

https://ela.st/2024-un-maps

Jorge Sanz

jorgesanz.net

- Cartography and Geodesy Engineer (**UPV** 2004)
- Principal Software Engineer at **Elastic** (Presentation & maps team) since 2019, maintainer of the Elastic Maps Service
- Charter Member of the **Open Source Geospatial Foundation** (2008): news editor, marketing committee, Geoinquietos València
- **OpenStreetMap** contributor (2007): casual mapping, coordinating mapping parties, HOT mapathons

elastic

«Understand main features of Elasticsearch and Kibana to store, analyze, and visualize geographic information along with any other data types»

Objectives for today

elastic

Elastic

a brief introduction

elastic

Meet Elastic — The Search AI Company

Elastic helps everyone find answers that matter.
From all data. In real time. At scale.

Founded in 2012

2800+
employees

40+
Countries with
employees

4B+
downloads

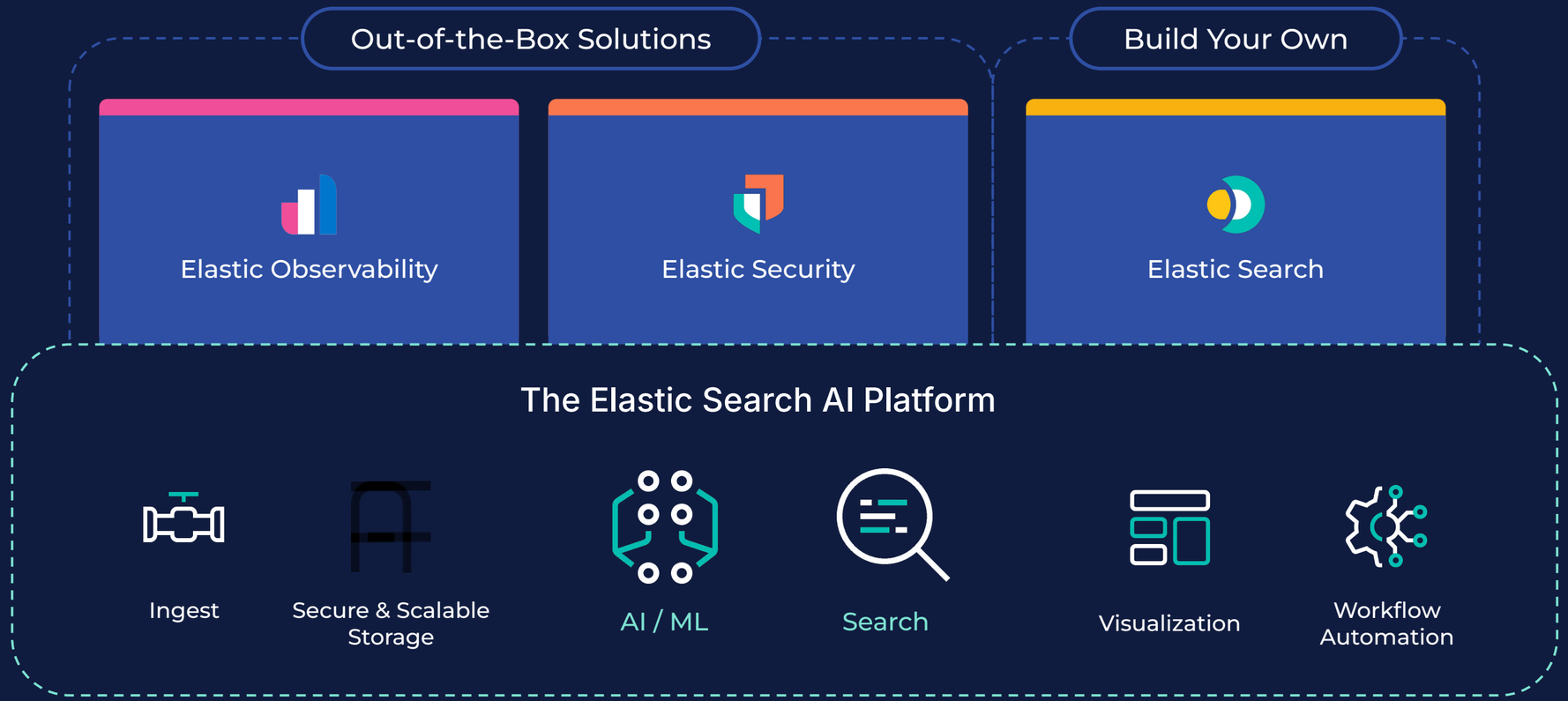
54%
Of Fortune 500
companies trust Elastic

Data as of April 2023

Trusted by Organizations Around the World

TECHNOLOGY	FINANCE	TELCO	CONSUMER	HEALTHCARE	PUBLIC SECTOR	AUTOMOTIVE / TRANSPORTATION	RETAIL
Adobe	BARCLAYS	orange	Uber	VITAS Healthcare	Lawrence Livermore National Laboratory	VOLVO Volvo Group	AutoZone
CISCO	ZURICH	dish media	Grab	UCLA Health	OAK RIDGE National Laboratory	Audi	The Home Depot
workday	USAA	COMCAST	Miles & More Lufthansa	Yale NewHaven Health	De Watergroep WATER. VANDAAG EN MORGEN.	JAGUAR LAND ROVER	ebay
Microsoft	Swift	verizon	ACTIVISION BLIZZARD	MAYO CLINIC	JPL Jet Propulsion Laboratory	BMW	Kroger
INGRAM MICRO	Postbank	T-Mobile	lyft	Pfizer	MENTAT COMPUTE OPTIMIZATION	Volkswagen	Walgreens

One Search AI Platform
Two Out-of-the-Box Solutions
The Freedom to Build Anything



elastic

Elastic is Wherever Your **Data** Lives

- Public Cloud
- Hybrid
- On-Premises

Amazon Web Services Google Cloud Microsoft Azure

50+ Cloud Regions Globally

elastic

Search, Observability and Security are all **Data** Problems

elastic

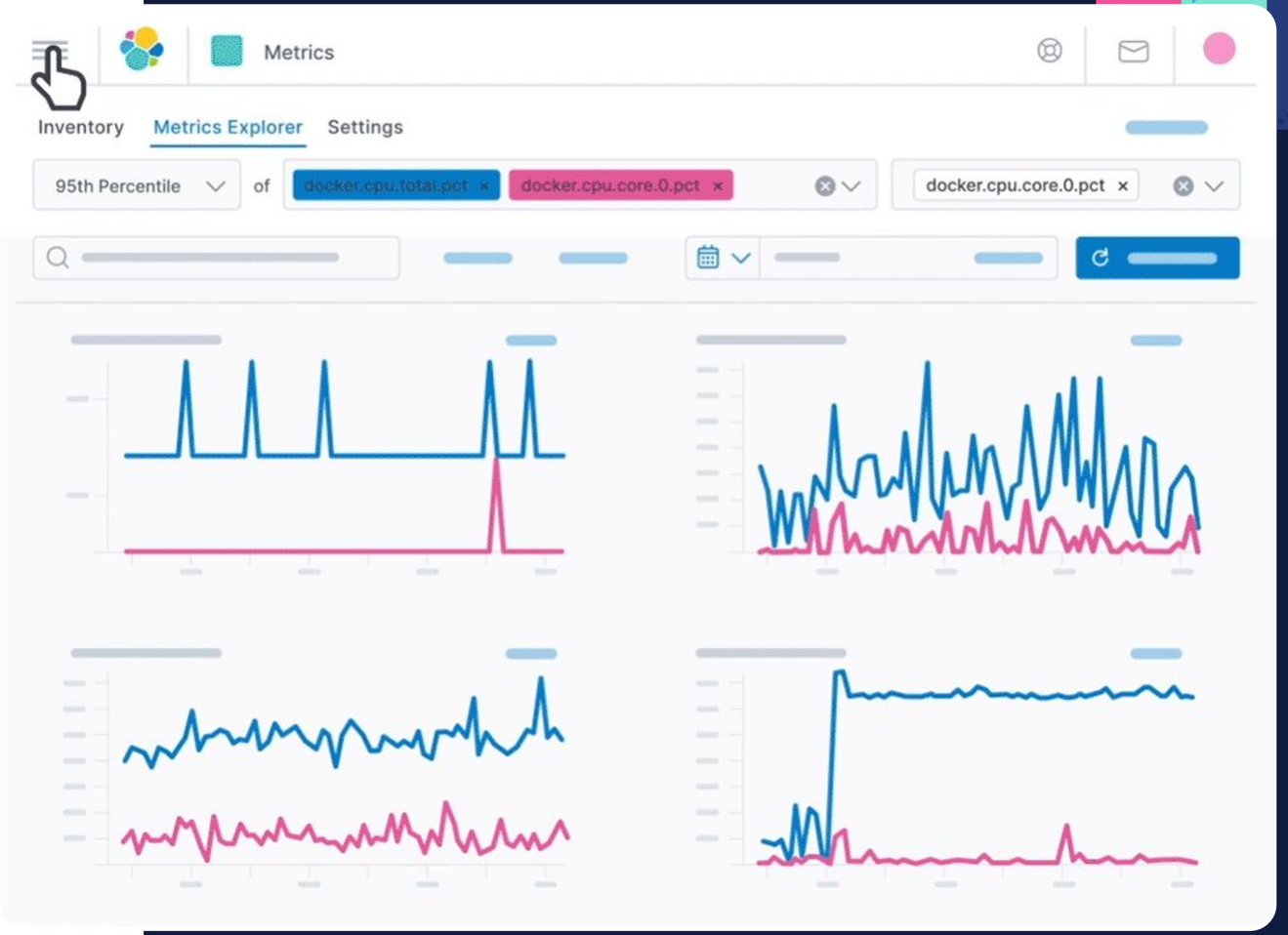
Elastic Search

Build powerful AI and machine learning enabled search applications for your customers and employees.

elastic

Elastic Observability

Converge metrics, logs, traces, and more to deliver unified visibility and actionable insights with the most widely deployed observability solution.



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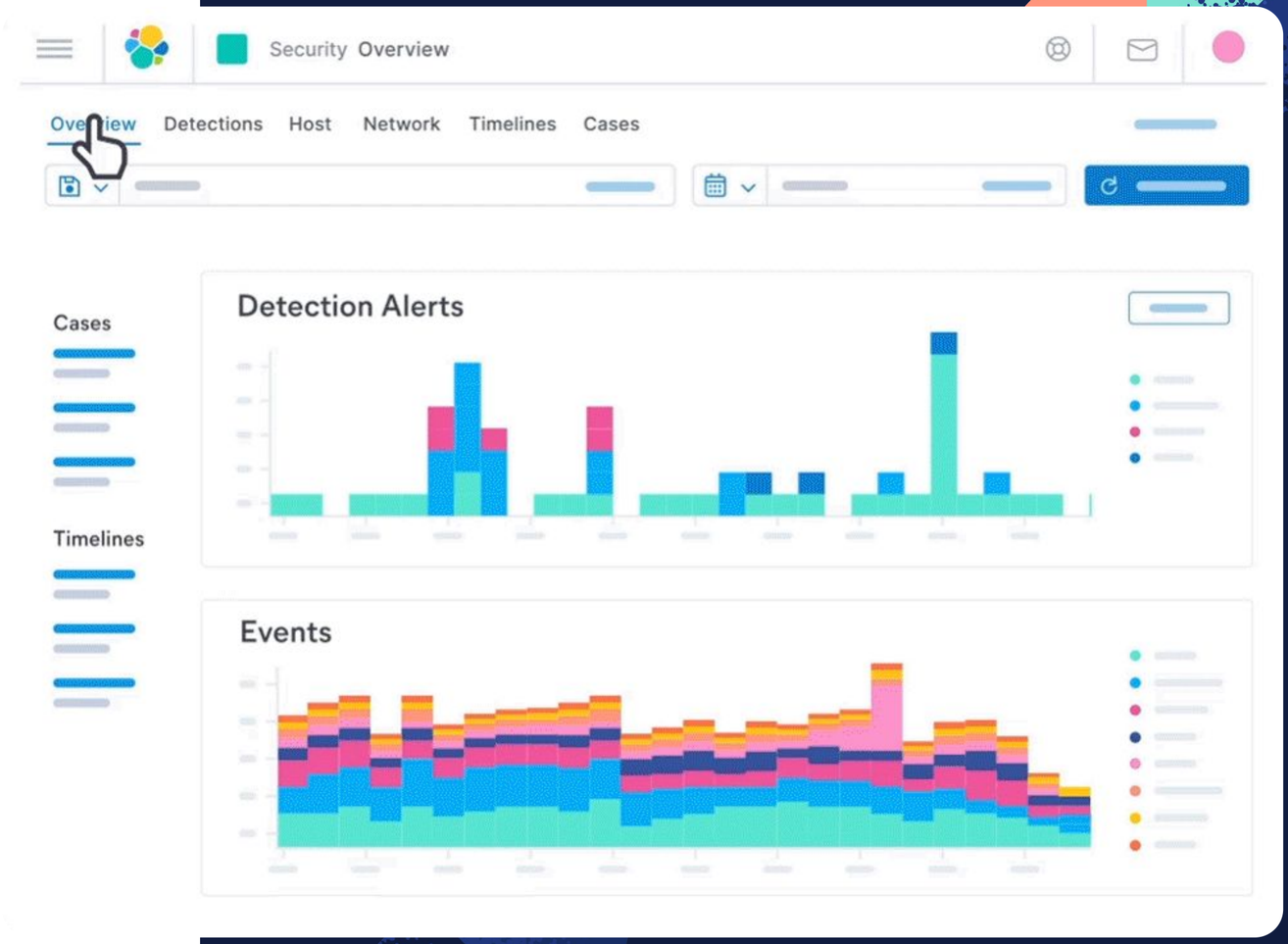
Elastic Security

Protect, investigate, and respond to complex threats with a security solution that unifies the capabilities of SIEM, endpoint security, and cloud security.



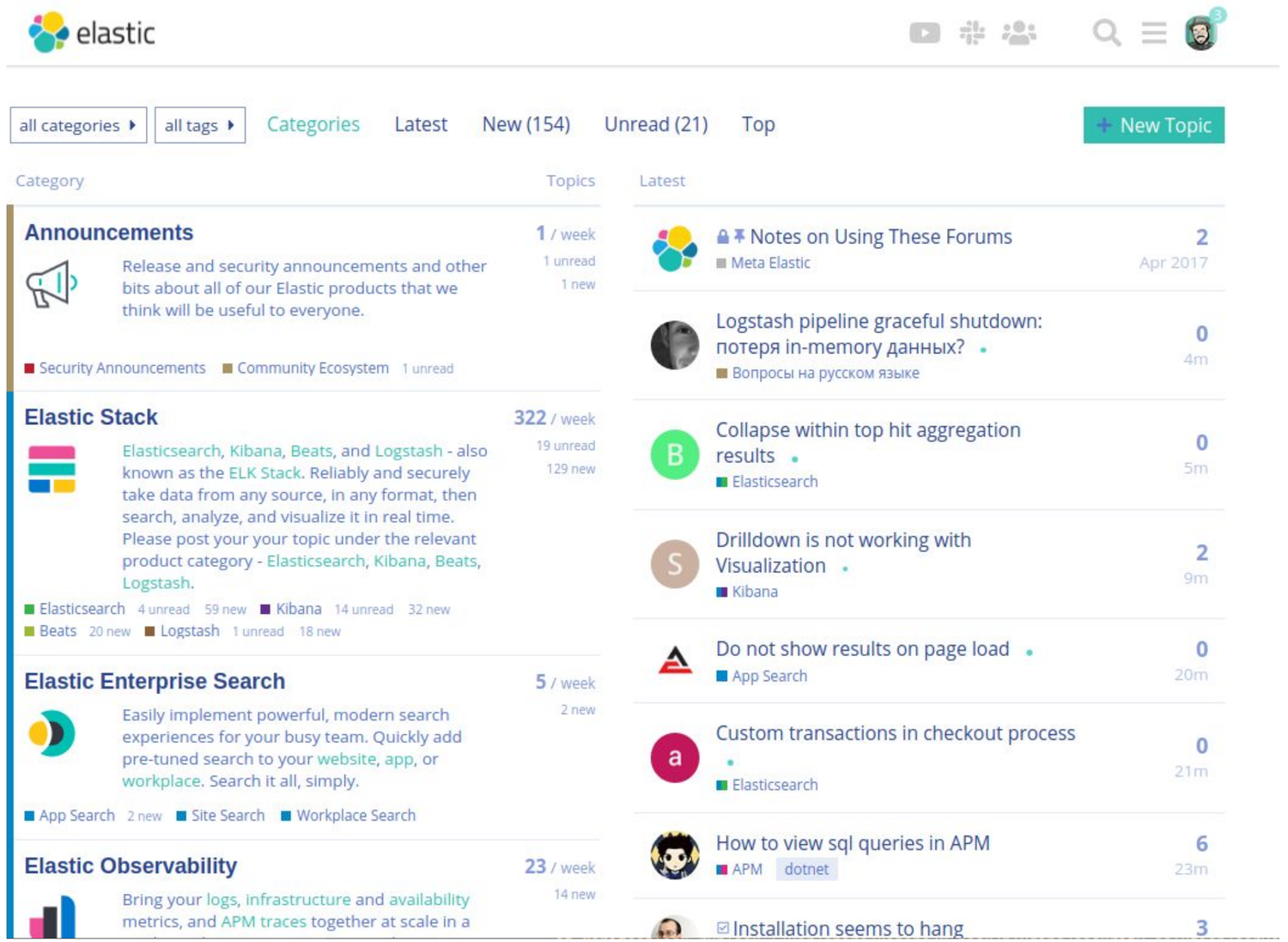
elastic

Community

https://github.com/elastic

https://ela.st/slack

https://discuss.elastic.co



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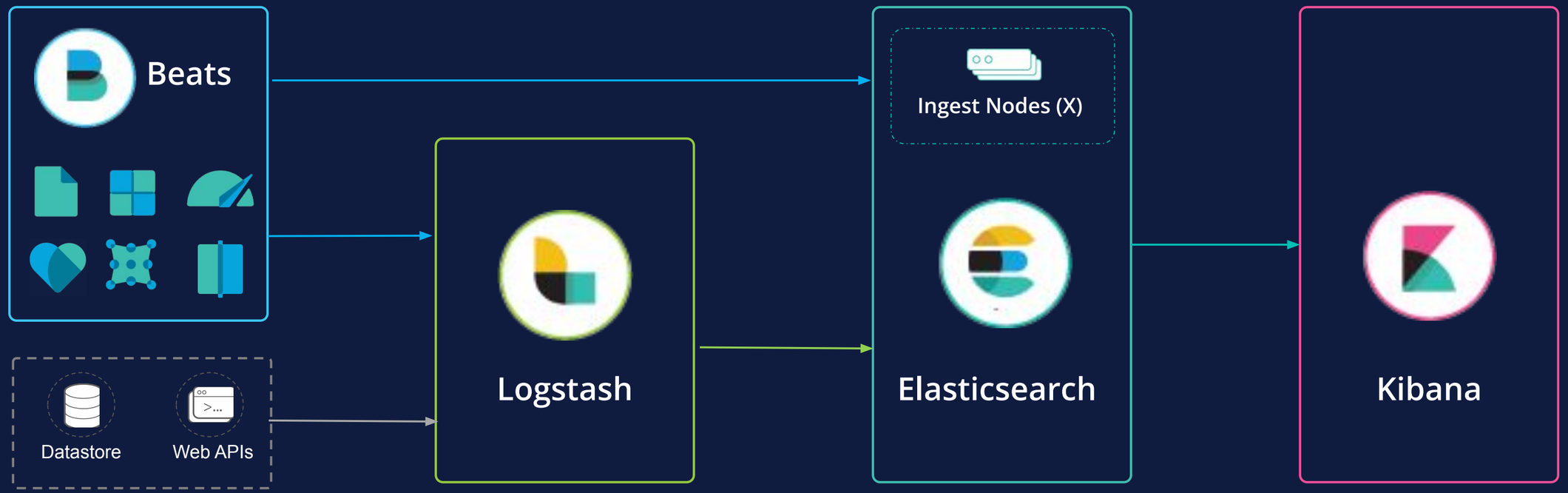
Elastic Stack

elastic

Elastic Stack

Ingest, Store, Search, Visualise



elastic

Elasticsearch

All data is welcome

elastic

Communicating with **Elasticsearch**

- All communication t
  HTTP endpoints 📖
- JSON
- REST methods: GET,
  POST, DELETE
- _cat API for human
  readable display 📖

```
~
→ curl -s --user "${ELASTIC_USER}:${ELASTIC_PASSWORD}" "${ELASTIC_HOST}/" | jq
{
~
→ time curl -s --user "${ELASTIC_USER}:${ELASTIC_PASSWORD}" \
  "${ELASTIC_HOST}/geonames/_search?q=valencia&size=20" |\
  jq -c ".hits.hits[]._source | { g: .location, c: .UNLOCODEName, n: .Name}"
{"g":{"lon":"122.71","lat":"10.668"},"c":"Philippines","n":"East Valencia"}
{"g":{"lon":"30.27718","lat":"-23.87011"},"c":"South Africa","n":"Valencia Estate"}
{"g":{"lon":"-87.45963","lat":"19.69255"},"c":"Mexico","n":"Valencia"}
{"g":{"lon":"-81.41667","lat":"8.06667"},"c":"Panama","n":"La Valencia"}
{"g":{"lon":"-61.19993","lat":"10.64988"},"c":"Trinidad And Tobago","n":"Valencia"}
{"g":{"lon":"-103.4128","lat":"26.29734"},"c":"Mexico","n":"Valencia"}
{"g":{"lon":"-97.90795","lat":"21.584"},"c":"Mexico","n":"La Valencia"}
{"g":{"lon":"-97.55388","lat":"18.65448"},"c":"Mexico","n":"Valencia"}
{"g":{"lon":"-75.11332","lat":"9.13451"},"c":"Colombia","n":"Valencia"}
{"g":{"lon":"-76.6136","lat":"2.44189"},"c":"Colombia","n":"Valencia"}
{"g":{"lon":"-78.4","lat":"-0.36667"},"c":"Ecuador","n":"Hacienda Valencia"}
{"g":{"lon":"-61.1668","lat":"10.68233"},"c":"Trinidad And Tobago","n":"Ward of Valencia"}
{"g":{"lon":"-102.35591","lat":"29.33355"},"c":"Mexico","n":"Valencia"}
{"g":{"lon":"125.0","lat":"7.95"},"c":"Philippines","n":"City of Valencia"}
{"g":{"lon":"-109.80707","lat":"29.09612"},"c":"Mexico","n":"Valencia"}
{"g":{"lon":"124.19428","lat":"13.58267"},"c":"Philippines","n":"Valencia"}
{"g":{"lon":"123.62489","lat":"10.14994"},"c":"Philippines","n":"Valencia"}
{"g":{"lon":"123.39093","lat":"9.7588"},"c":"Philippines","n":"Valencia"}
{"g":{"lon":"121.0378","lat":"14.6104"},"c":"Philippines","n":"Valencia"}
{"g":{"lon":"121.6537","lat":"14.065"},"c":"Philippines","n":"Valencia"}
curl -s --user "${ELASTIC_USER}:${ELASTIC_PASSWORD}"   0,07s user 0,00s system 11% cpu 0,635 to
jq -c ".hits.hits[]._source | { g: .location, c: .UNLOCODEName, n: .Name}"  0,02s user 0,00s sy
```

Ingest

```
PUT airports
{
  "mappings": {
    "properties": {
      "coords": {
        "type": "geo_point"
      },
      "abbrev": {
        "type": "keyword"
      },
      "name": {
        "type": "text"
      },
      "type": {
        "type": "keyword"
      }
    }
  }
}
```

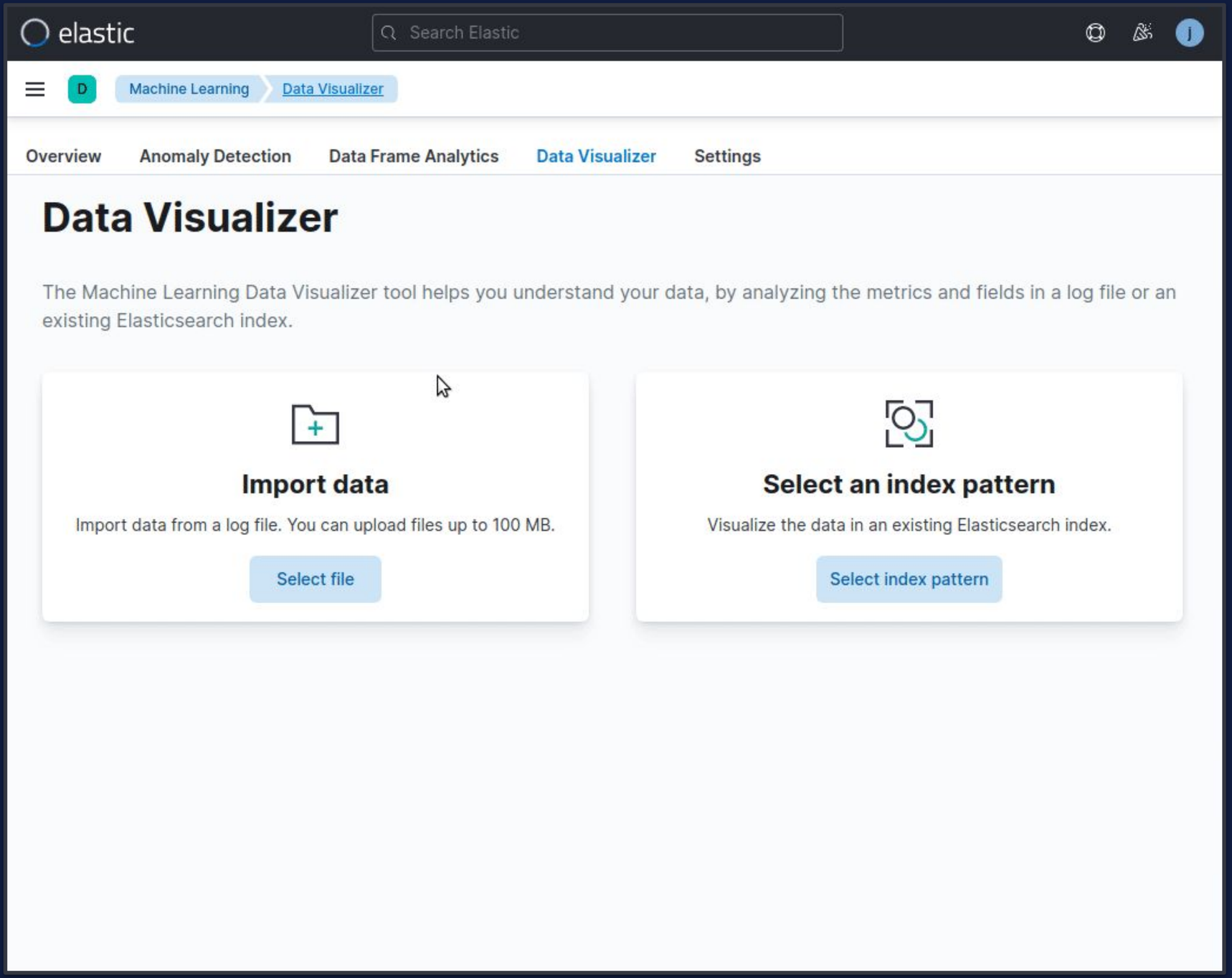
```
POST airports/_doc
{
  "coords":[75.9570722,30.8503599],
  "name":"Sahnewal",
  "abbrev":"LUH",
  "type":"small"
}
```

```
{
  "_index": "airports",
  "_id": "CyQ-kIcB0vAUcSbABKjz",
  "_version": 1,
  "result": "created",
  "_shards": {
    "total": 2,
    "successful": 1,
    "failed": 0
  },
  "_seq_no": 18,
  "_primary_term": 1
}
```

elastic

```
POST _bulk
{ "index" : { "_index" : "airports", "_id" : "1" } }
{"coords":[75.9570722,30.8503599],"name":"Sahnewal","abbrev":"LUH","type":"small"}
{ "index" : { "_index" : "airports", "_id" : "2" } }
{"coords":[75.9330598,17.6254152],"name":"Solapur","abbrev":"SSE","type":"mid"}
{ "index" : { "_index" : "airports", "_id" : "3" } }
{"coords":[85.323597,23.3177246],"name":"Birsa Munda","abbrev":"IXR","type":"mid"}
{ "index" : { "_index" : "airports", "_id" : "4" } }
{"coords":[48.7471065,31.3431586],"name":"Ahwaz","abbrev":"AWZ","type":"mid"}
{ "index" : { "_index" : "airports", "_id" : "5" } }
{"coords":[78.2172187,26.2854877],"name":"Gwalior","abbrev":"GWL","type":"mid and military"}
{ "index" : { "_index" : "airports", "_id" : "6" } }
{"coords":[42.9710963,14.7552534],"name":"Hodeidah Int'l","abbrev":"HOD","type":"mid"}
{ "index" : { "_index" : "airports", "_id" : "7" } }
{"coords":[75.8092915,22.7277492],"name":"Devi Ahilyabai Holkar Int'l","abbrev":"IDR","type":"mid"}
{ "index" : { "_index" : "airports", "_id" : "8" } }
{"coords":[73.8105675,19.9660206],"name":"Gandhinagar","abbrev":"ISK","type":"mid"}
{ "index" : { "_index" : "airports", "_id" : "9" } }
{"coords":[76.8017261,30.6707249],"name":"Chandigarh Int'l","abbrev":"IXC","type":"major and military"}
{ "index" : { "_index" : "airports", "_id" : "10" } }
{"coords":[75.3958433,19.867297],"name":"Aurangabad","abbrev":"IXU","type":"mid"}
{ "index" : { "_index" : "airports", "_id" : "11" } }
{"coords":[72.9878191,31.3627435],"name":"Faisalabad Int'l","abbrev":"LYP","type":"mid and military"}
{ "index" : { "_index" : "airports", "_id" : "12" } }
{"coords":[73.3163595,54.9576483],"name":"Omsk Tsentralny","abbrev":"OMS","type":"mid"}
{ "index" : { "_index" : "airports", "_id" : "13" } }
{"coords":[82.6671525,55.0095847],"name":"Novosibirsk Tolmachev","abbrev":"OVB","type":"mid"}
{ "index" : { "_index" : "airports", "_id" : "14" } }
{"coords":[35.3018729,47.8732636],"name":"Zaporozhye Int'l","abbrev":"OZH","type":"mid and military"}
{ "index" : { "_index" : "airports", "_id" : "15" } }
{"coords":[101.4465693,0.4646009],"name":"Simpang Tiga","abbrev":"PKU","type":"mid"}
{ "index" : { "_index" : "airports", "_id" : "16" } }
{"coords":[145.2439803,14.1717713],"name":"Rota Int'l","abbrev":"ROP","type":"mid"}
{ "index" : { "_index" : "airports", "_id" : "17" } }
{"coords":[73.4084965,61.3401672],"name":"Surgut","abbrev":"SGC","type":"mid"}
```


```
{
  "took": 37,
  "errors": false,
  "items": [
    {
      "index": {
        "_index": "airports",
        "_id": "1",
        "_version": 2,
        "result": "updated",
        "_shards": {
          "total": 2,
          "successful": 1,
          "failed": 0
        },
        "_seq_no": 19,
        "_primary_term": 1,
        "status": 200
      }
    },
    {
      "index": {
        "_index": "airports",
        "_id": "2",
        "_version": 2,
        "result": "updated",
        "_shards": {
          "total": 2,
          "successful": 1,
          "failed": 0
        },
        "_seq_no": 20,
        "_primary_term": 1,
        "status": 200
      }
    },
    {
      "index": {
        "_index": "airports",
```

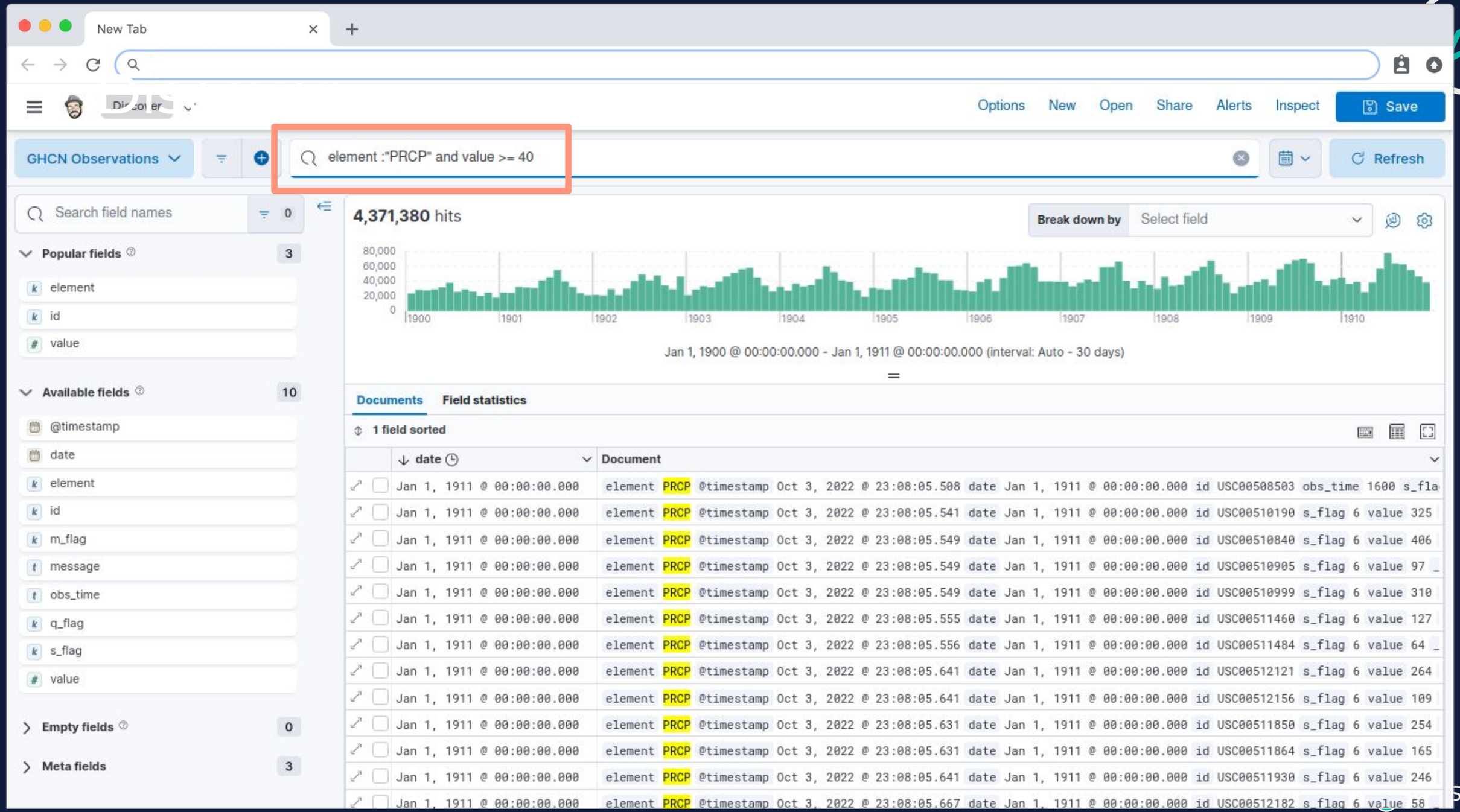

elastic
Search Elastic
D
Machine Learning
Data Visualizer
Overview
Anomaly Detection
Data Frame Analytics
Data Visualizer
Settings
Data Visualizer
The Machine Learning Data Visualizer tool helps you understand your data, by analyzing the metrics and fields in a log file or an existing Elasticsearch index.
Import data
Import data from a log file. You can upload files up to 100 MB.
Select file
Select an index pattern
Visualize the data in an existing Elasticsearch index.
Select index pattern

elastic

Kibana

Some basic concepts about Kibana

elastic


New Tab
Discover
Options
New
Open
Share
Alerts
Inspect
Save
GHCN Observations
element :"PRCP" and value >= 40
Refresh
Search field names
Popular fields 3
element
id
value
Available fields 10
@timestamp
date
element
id
m_flag
message
obs_time
q_flag
s_flag
value
Empty fields 0
Meta fields 3
4,371,380 hits
Break down by
Select field
80,000
60,000
40,000
20,000
0
1900
1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
Jan 1, 1900 @ 00:00:00.000 - Jan 1, 1911 @ 00:00:00.000 (interval: Auto - 30 days)
Documents
Field statistics
1 field sorted
date
Document
Jan 1, 1911 @ 00:00:00.000 element PRCP @timestamp Oct 3, 2022 @ 23:08:05.508 date Jan 1, 1911 @ 00:00:00.000 id USC00508503 obs_time 1600 s_fla
Jan 1, 1911 @ 00:00:00.000 element PRCP @timestamp Oct 3, 2022 @ 23:08:05.541 date Jan 1, 1911 @ 00:00:00.000 id USC00510190 s_flag 6 value 325
Jan 1, 1911 @ 00:00:00.000 element PRCP @timestamp Oct 3, 2022 @ 23:08:05.549 date Jan 1, 1911 @ 00:00:00.000 id USC00510840 s_flag 6 value 406
Jan 1, 1911 @ 00:00:00.000 element PRCP @timestamp Oct 3, 2022 @ 23:08:05.549 date Jan 1, 1911 @ 00:00:00.000 id USC00510905 s_flag 6 value 97 _
Jan 1, 1911 @ 00:00:00.000 element PRCP @timestamp Oct 3, 2022 @ 23:08:05.549 date Jan 1, 1911 @ 00:00:00.000 id USC00510999 s_flag 6 value 310
Jan 1, 1911 @ 00:00:00.000 element PRCP @timestamp Oct 3, 2022 @ 23:08:05.555 date Jan 1, 1911 @ 00:00:00.000 id USC00511460 s_flag 6 value 127
Jan 1, 1911 @ 00:00:00.000 element PRCP @timestamp Oct 3, 2022 @ 23:08:05.556 date Jan 1, 1911 @ 00:00:00.000 id USC00511484 s_flag 6 value 64 _
Jan 1, 1911 @ 00:00:00.000 element PRCP @timestamp Oct 3, 2022 @ 23:08:05.641 date Jan 1, 1911 @ 00:00:00.000 id USC00512121 s_flag 6 value 264
Jan 1, 1911 @ 00:00:00.000 element PRCP @timestamp Oct 3, 2022 @ 23:08:05.641 date Jan 1, 1911 @ 00:00:00.000 id USC00512156 s_flag 6 value 109
Jan 1, 1911 @ 00:00:00.000 element PRCP @timestamp Oct 3, 2022 @ 23:08:05.631 date Jan 1, 1911 @ 00:00:00.000 id USC00511850 s_flag 6 value 254
Jan 1, 1911 @ 00:00:00.000 element PRCP @timestamp Oct 3, 2022 @ 23:08:05.631 date Jan 1, 1911 @ 00:00:00.000 id USC00511864 s_flag 6 value 165
Jan 1, 1911 @ 00:00:00.000 element PRCP @timestamp Oct 3, 2022 @ 23:08:05.641 date Jan 1, 1911 @ 00:00:00.000 id USC00511930 s_flag 6 value 246
Jan 1, 1911 @ 00:00:00.000 element PRCP @timestamp Oct 3, 2022 @ 23:08:05.667 date Jan 1, 1911 @ 00:00:00.000 id USC00512182 s_flag 6 value 58 _

Lens

Your data in front of you

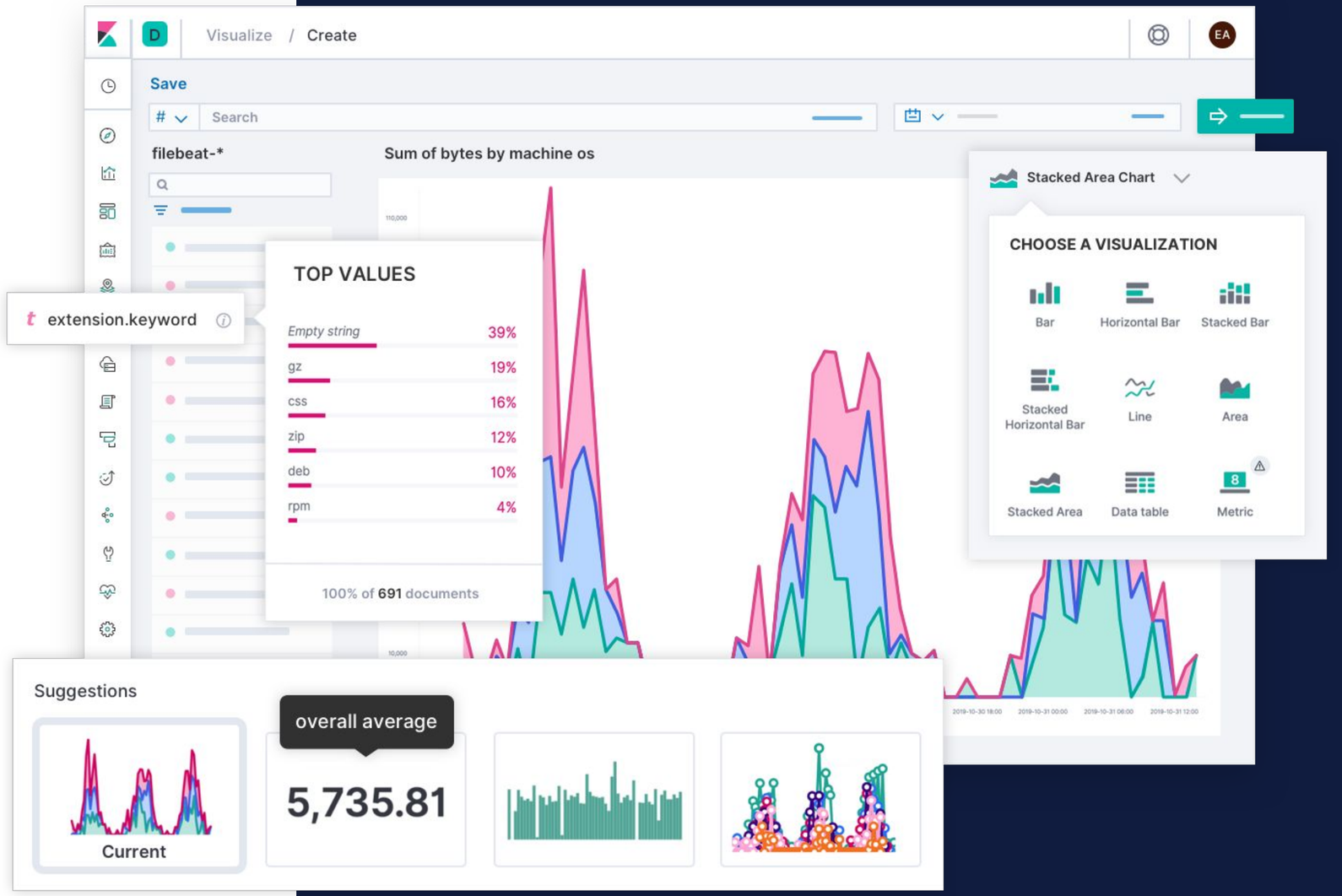
Explore your fields with a single click

Drag and drop

Go from nothing to visual insights with a single mouse gesture.

Smart suggestions

Let Lens help guide your analysis with useful chart suggestions

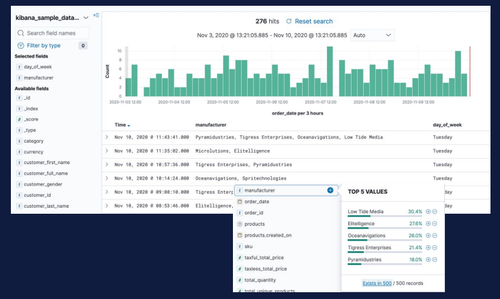


Dashboards

All your information in a single place

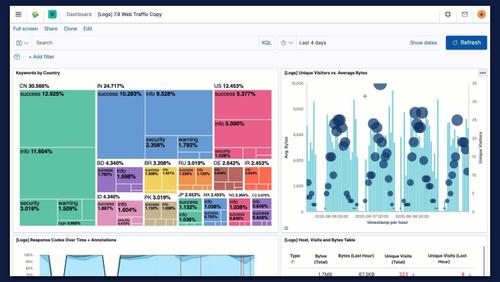
- Combine multiple visualizations: **panels**
- Time Range + Search Bar + Filters
- Panels can use filters to perform **drill downs**
- Panels can have custom **time ranges and filters**
- **Share**
- **Export** to PDF or PNG

Data Analysis with Kibana

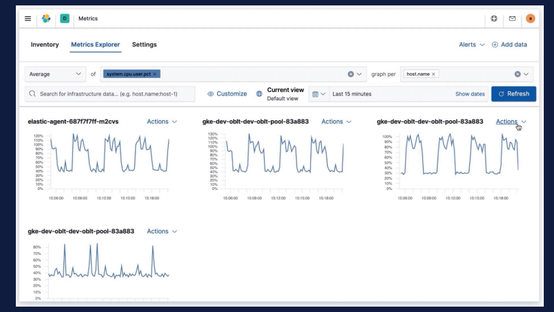


Discover

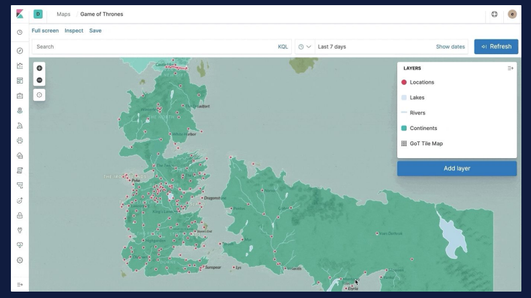
Lens



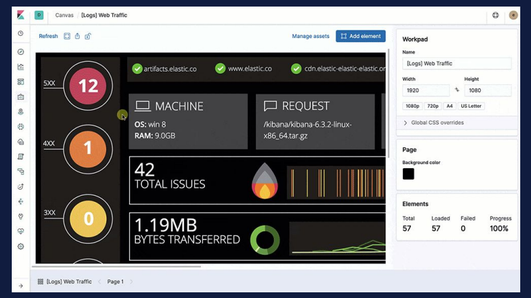
Dashboards & DrillDown



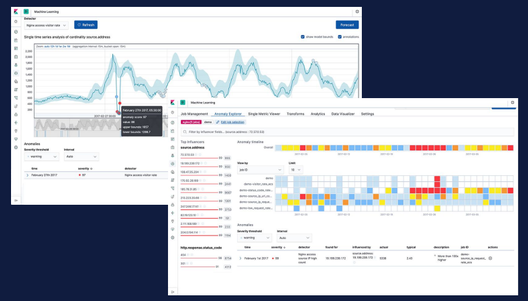
Alerting & Actions



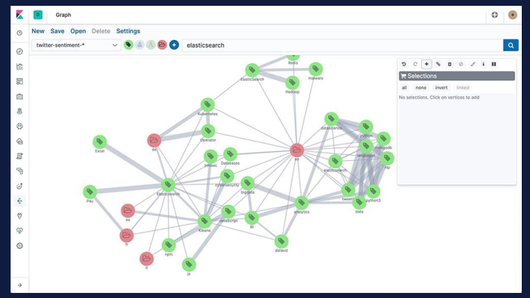
Maps



Canvas



Machine Learning



Graph

and much more ...

elastic

Who uses Kibana?

- Log/metrics and security **analysts**
- Data service **providers**
- **Business** analysts
- **Data** scientists
- **Anyone** trying to make sense of data

elastic

Elastic and geospatial

elastic

Geospatial timeline

2010-2012

Geo search
Points & Shapes

2014

Geo analysis
Aggregations

2017-2019

Geo at scale
Encoding upgrades

2020-2021

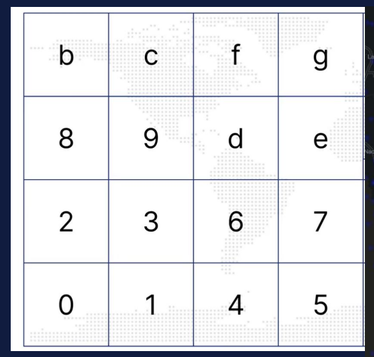
GIS
Maps & analytics

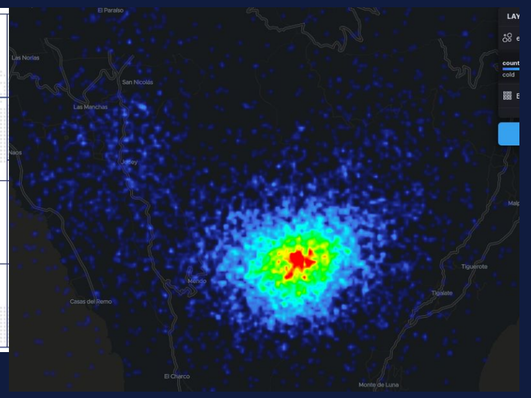
2022-2023

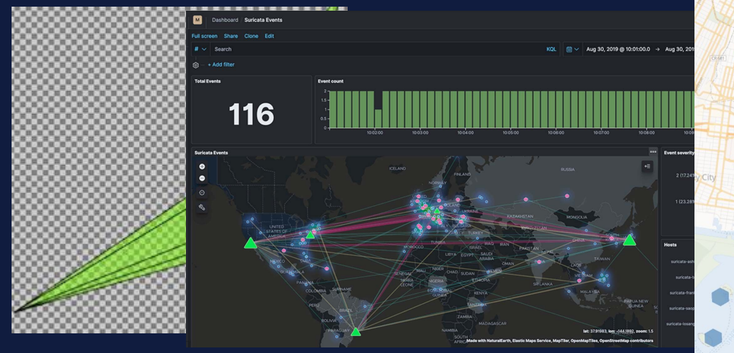
Vector tiles and H3
Fast aggregations
and rendering

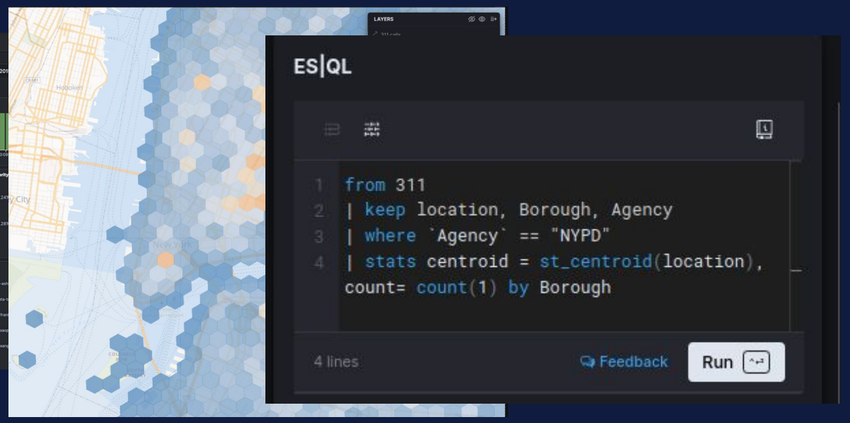
2024

ES|QL
Powerful and
expressive language









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Elasticsearch geospatial **data types**

- `geo_point` 📖
  - A single pair of latitude and longitude **coordinates**
  - Can be inserted as an object, GeoJSON, WKT, array, geohash
- `geo_shape` 📖
  - Supports any **lat/lon** geometry type, incl. envelope and circle
  - Inserted with GeoJSON or WKT notation
- `point` 📖, `shape` 📖
  - Supports any **cartesian** geometry type
  - Inserted with GeoJSON or WKT notation

Vector tiles API

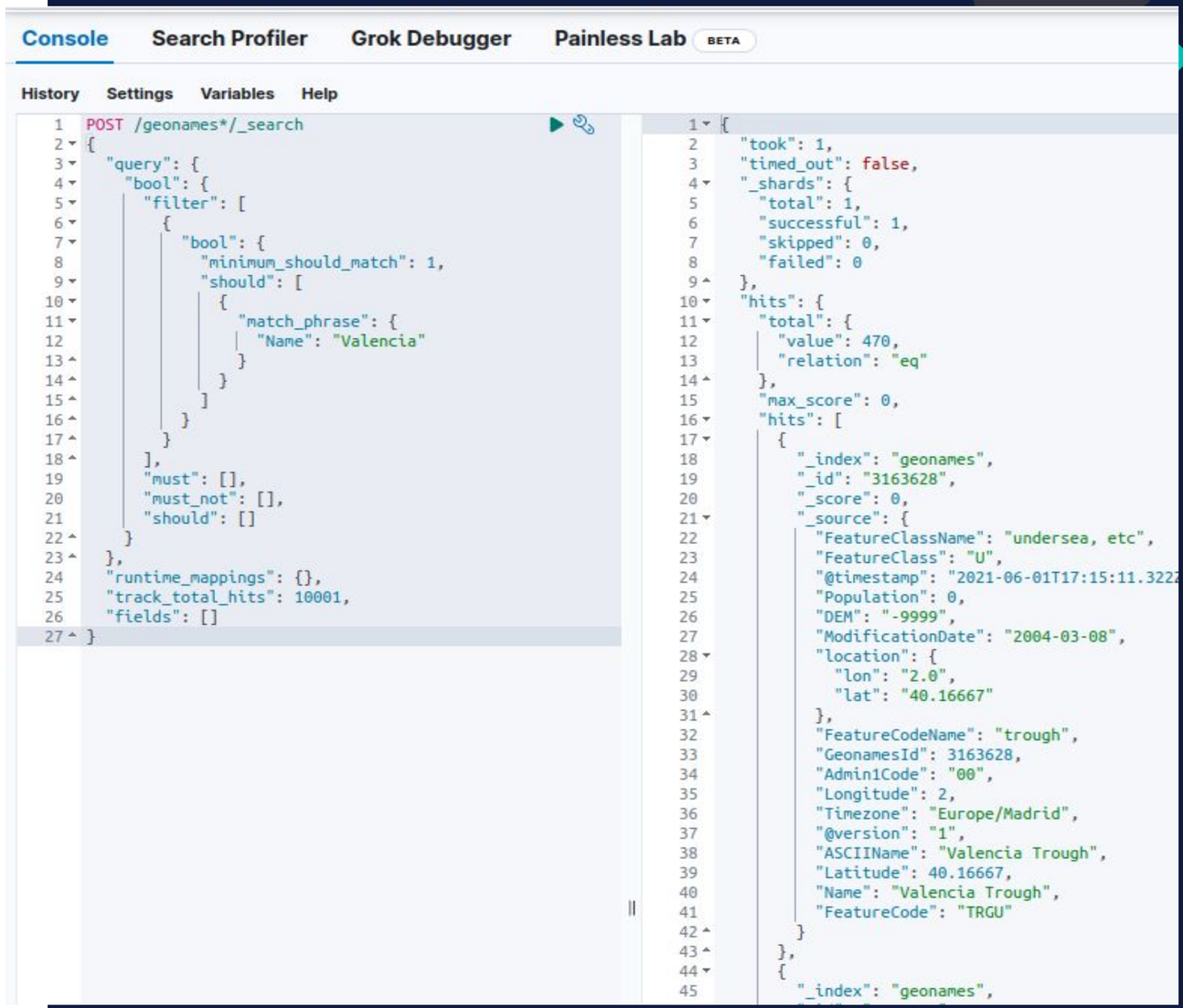
Integrate in to your own system

Elasticsearch `_search` API

- JSON output format
- Search and aggregate

Elasticsearch `_mvt` API

- *protobuf* output format
- Use queries and aggregations to generate standard vector tiles



elastic

Search

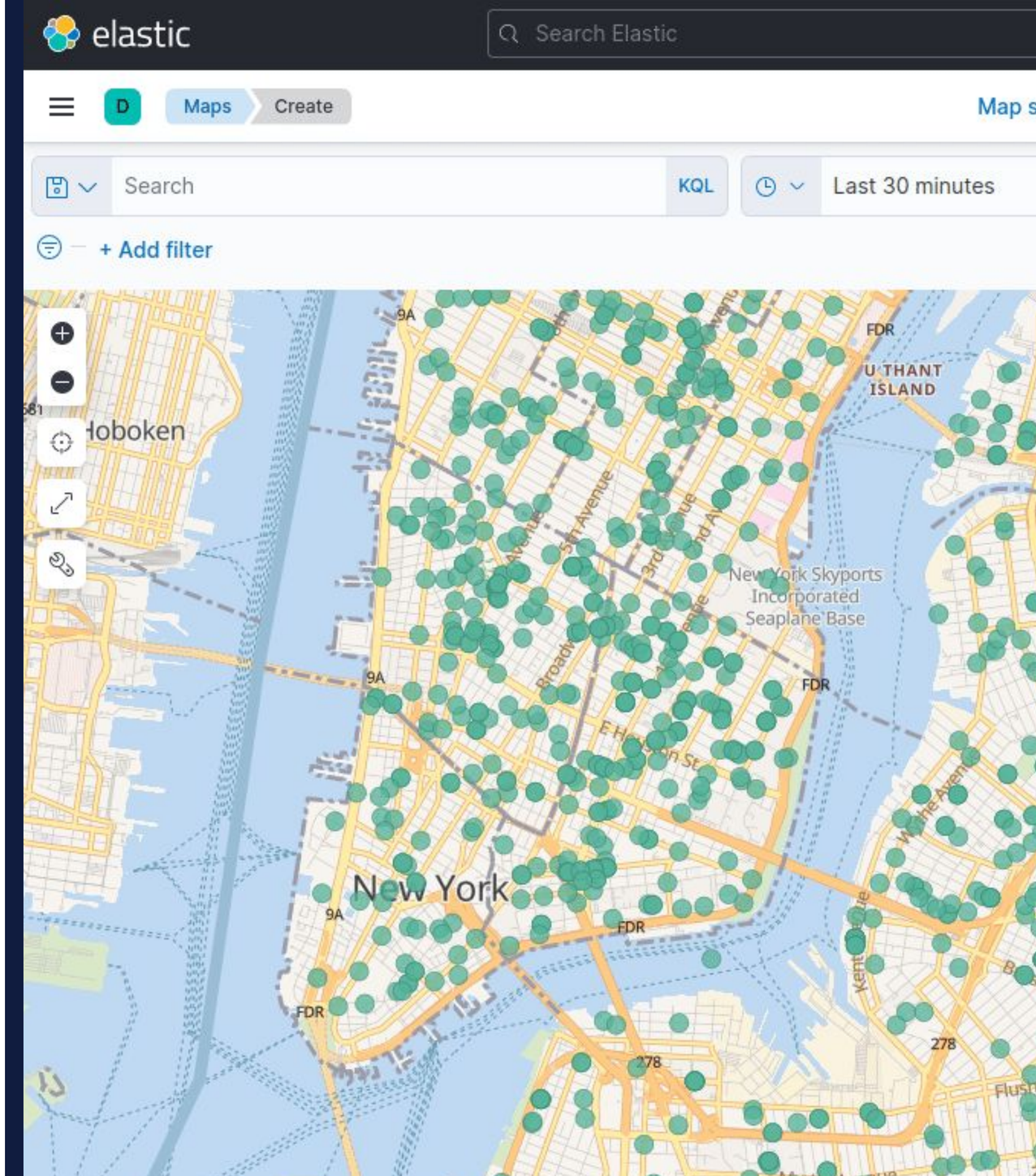
Geospatial filtering

Geo Filters

- Bounding box
- Point and radius
- Polygon
- An indexed geo_shape

Plus every other **Elasticsearch filter**

- Boolean
- Range (numeric, date, IP)
- Unstructured text (stemming, fuzzy ...)



Aggregate

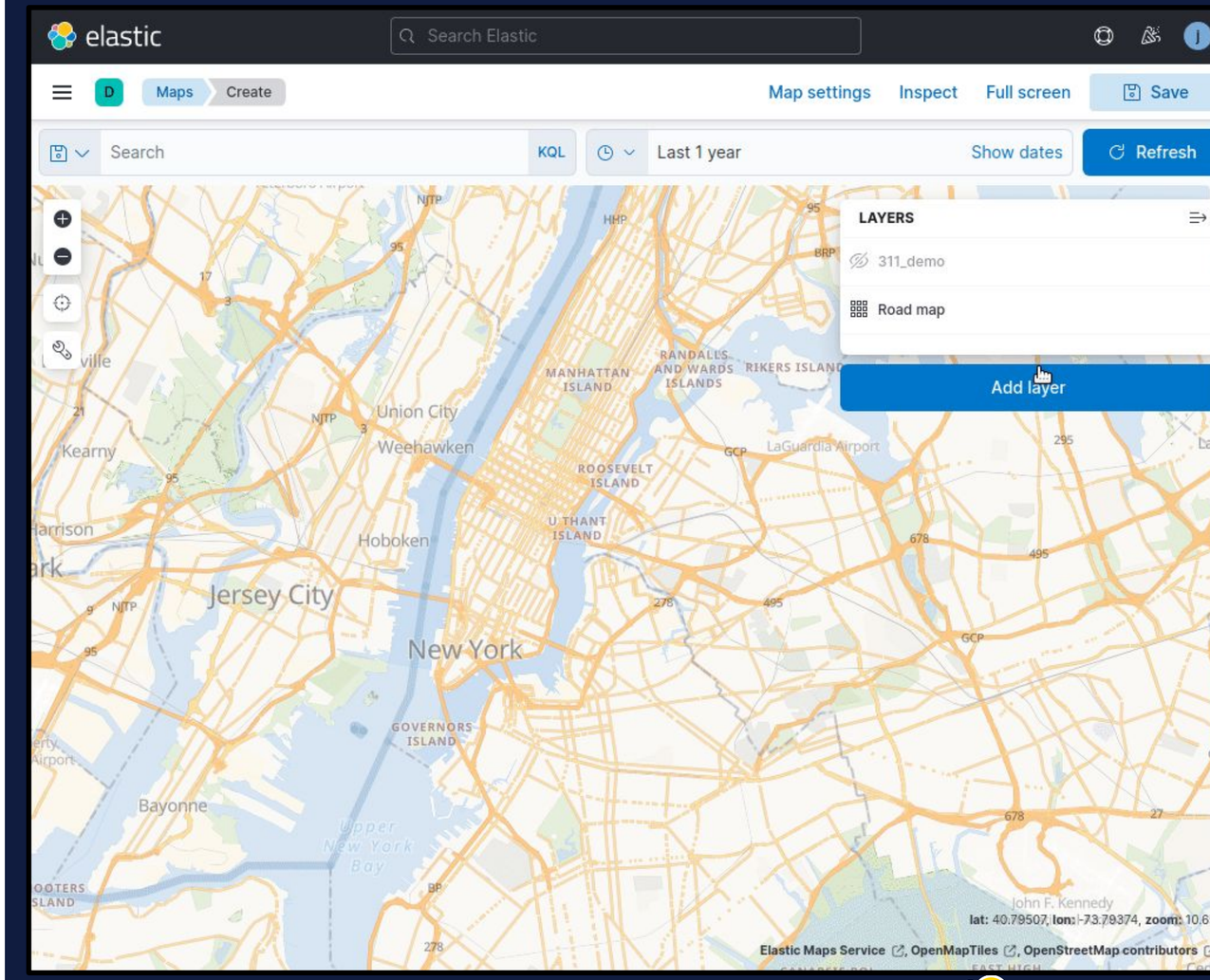
Binning (bucket agg)

- Distance (rings) 📖
- Hash 📖
- Geotile 📖
- Hex Grid 📖

Derived geometries (metric agg)

- Centroid 📖
- Bounds 📖
- Geoline 📖

Non-geo aggregations: Huge range of bucket and metric aggregations 📖



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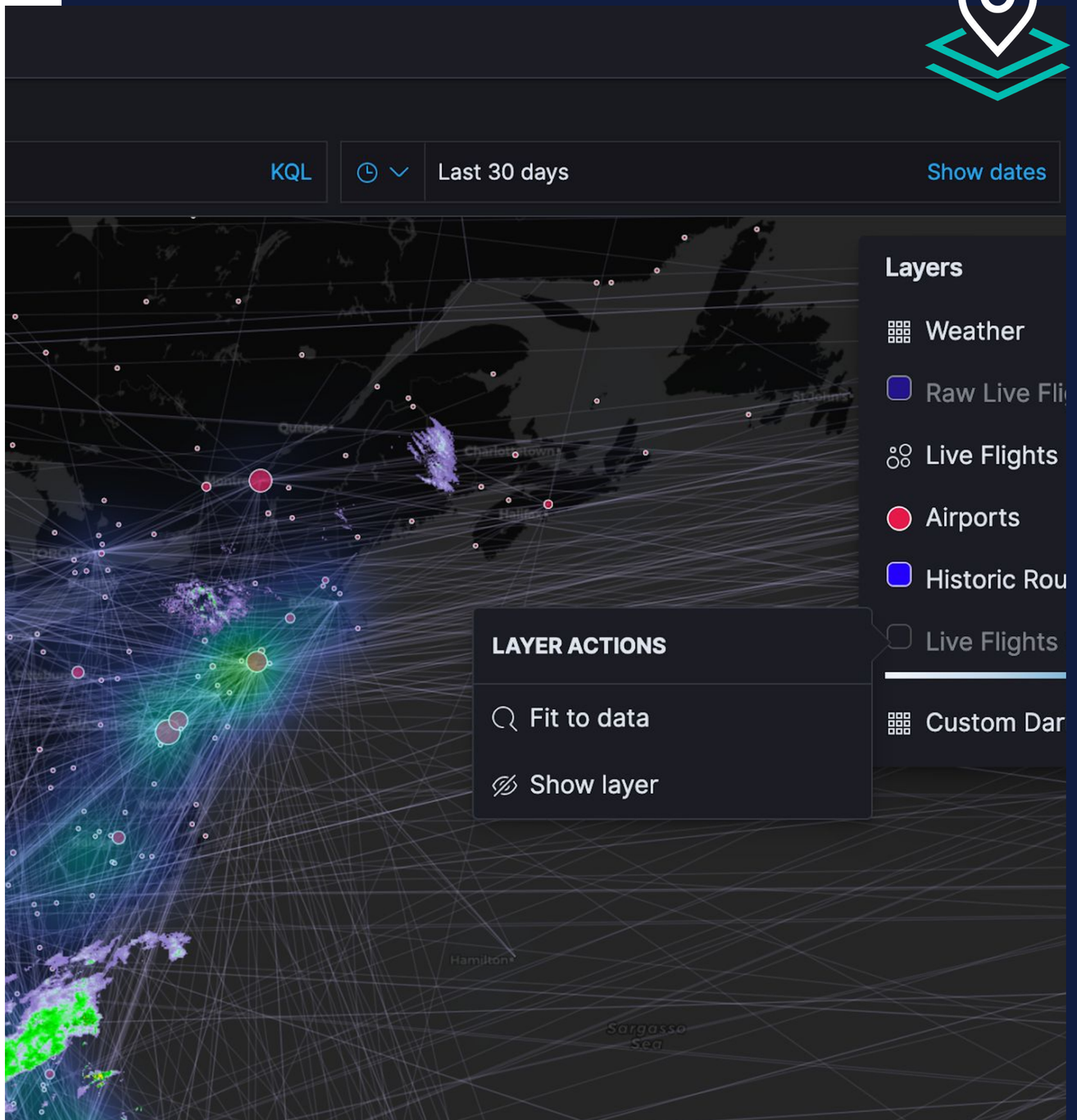
Elastic Maps

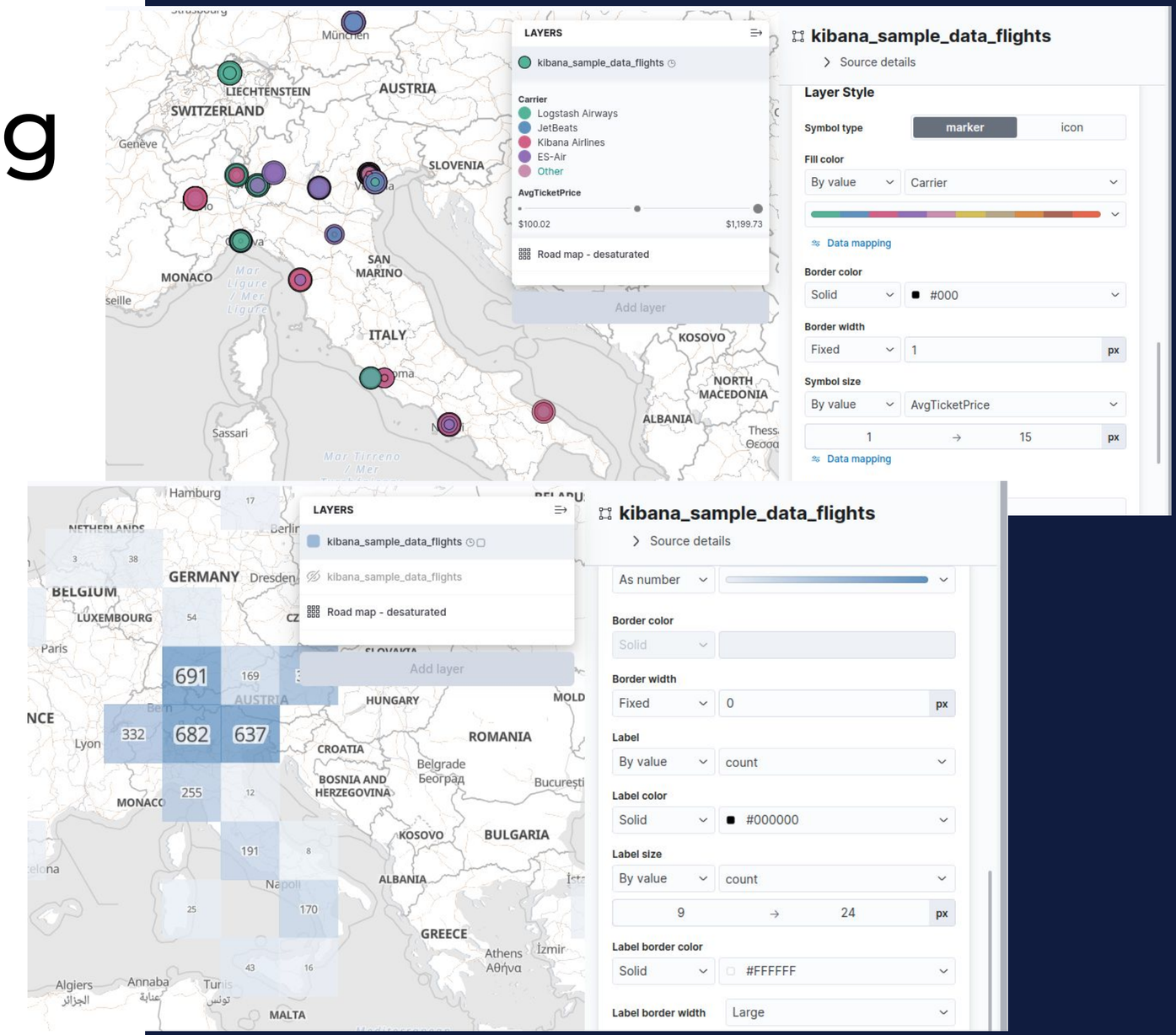
Geo Analytics interface within Kibana

- **Friendly** user experience
- **Aggregations**: heat map, clustering, grids, geoline
- Data driven **styling**
- **Tools** for drawing, filtering, measuring
- Add layers from **external** tile servers
- Used alone or in dashboards or Canvas workpads
- **Embedded** in other apps



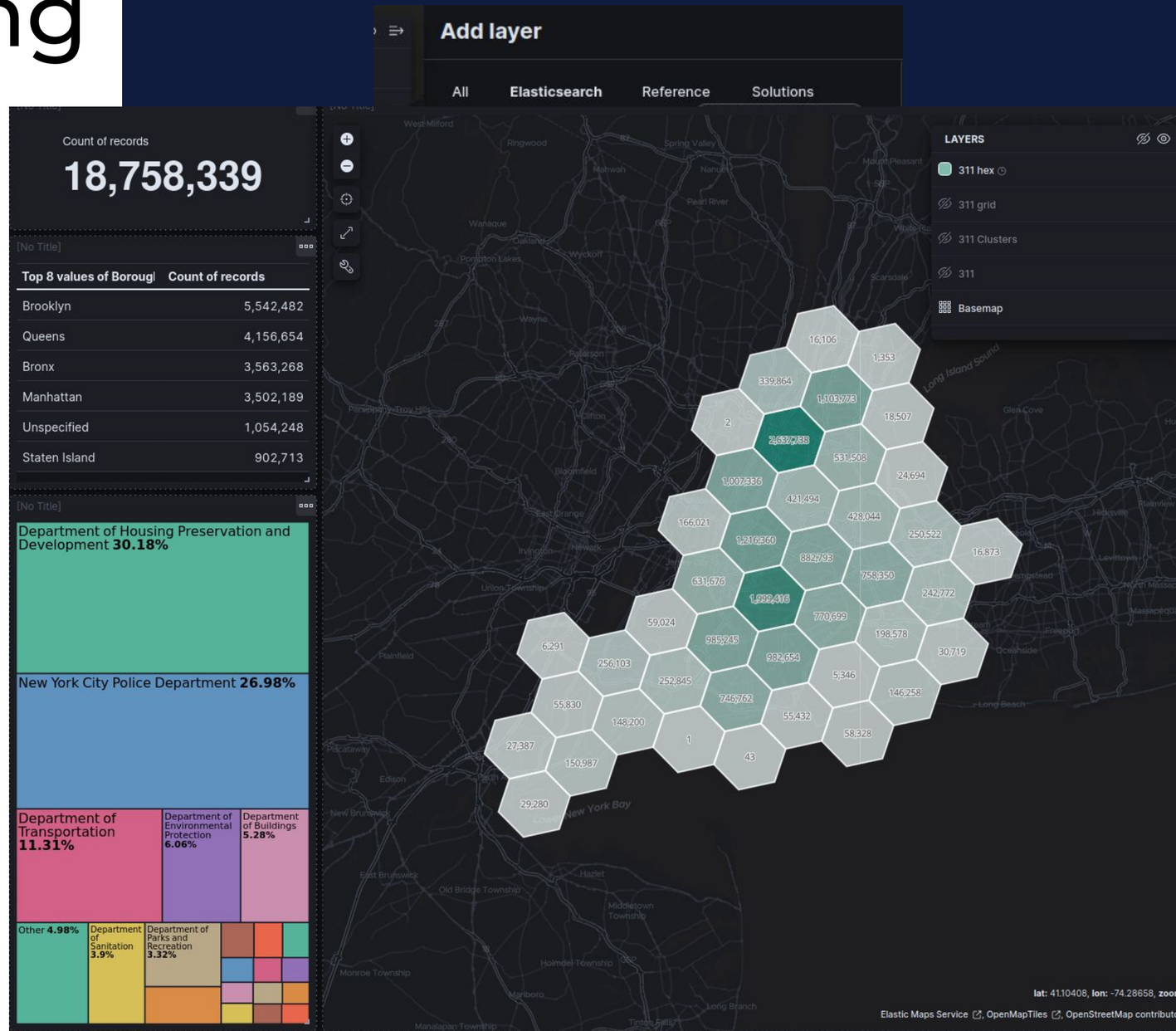
Data driven styling

- Quantitative:
  - Size
  - Widths
  - Color ramp
  - Label text
- Qualitative
  - Color palette
  - Label text

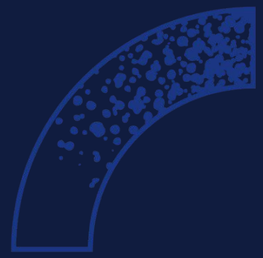


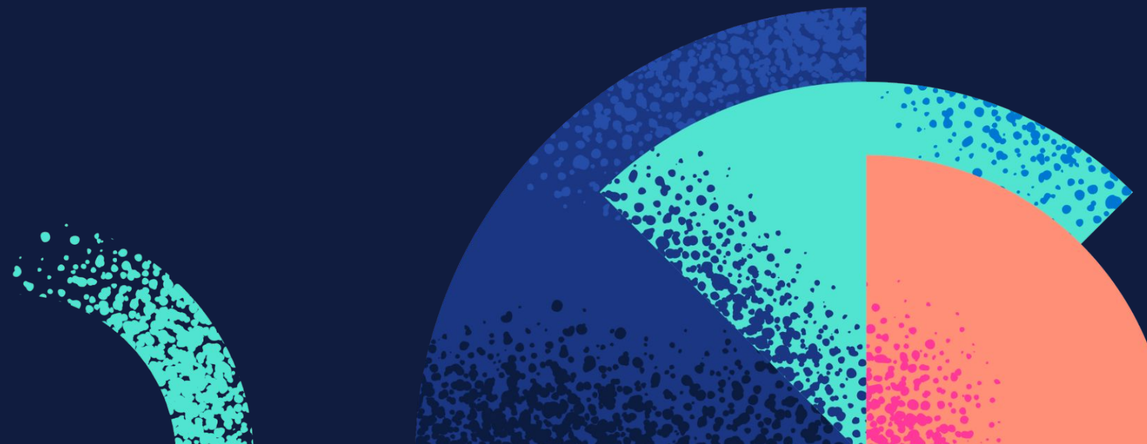
Big Data Rendering

- Heatmap
- Clusters
- Tile aggregation
- Hexagon aggregation



Demos





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Visualizing natural disaster data

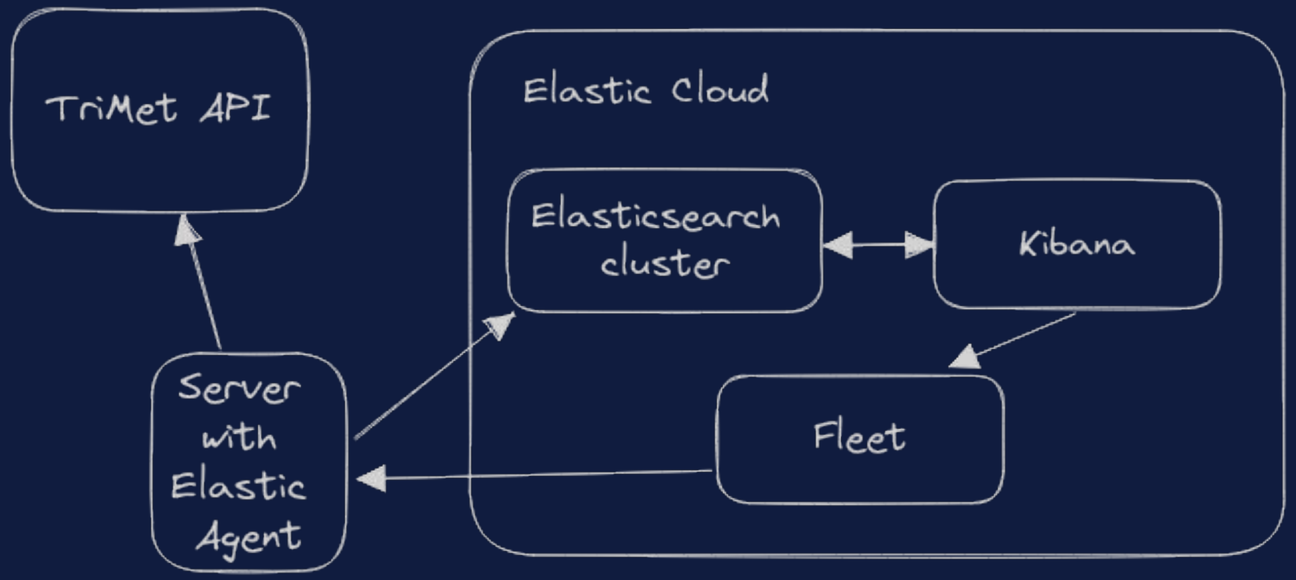
The Cumbre Vieja eruption

- ela.st/cumbre-vieja-eruption
- September to December of 2021 in La Palma island
- Data:
  - Earthquakes
  - Daily lava flow perimeters
  - Affected buildings
- More details:
  - Blog post
  - Blog post

Visualize and analyze real time assets

Portland public transportation network

- Kibana:
  - https://ela.st/2024-un-maps-kibana (only up during the conference week)
  - User: `viewer`/ Password: `un-maps-viewer`
- Tutorial to get the Portland TriMet data in real time



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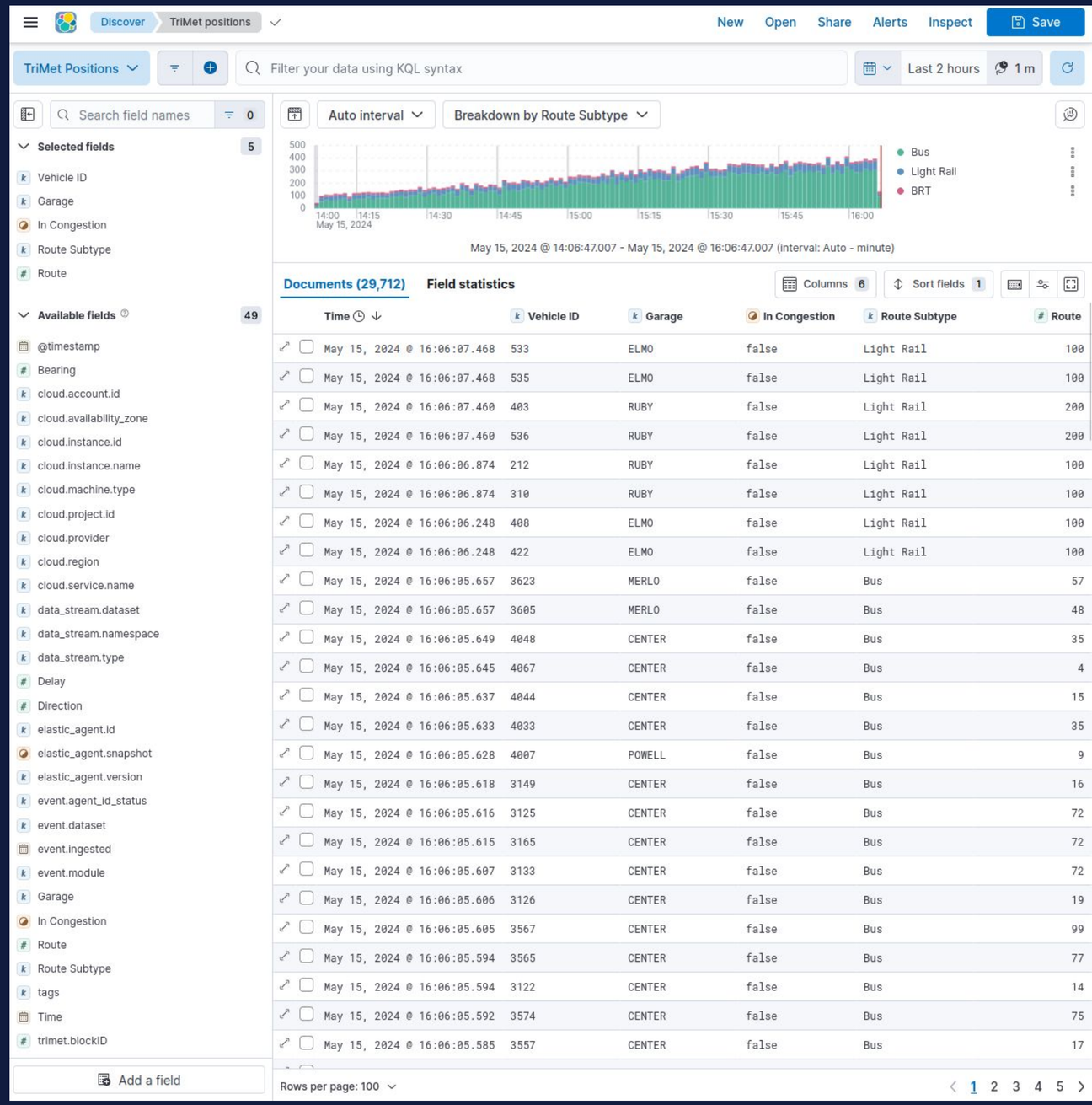
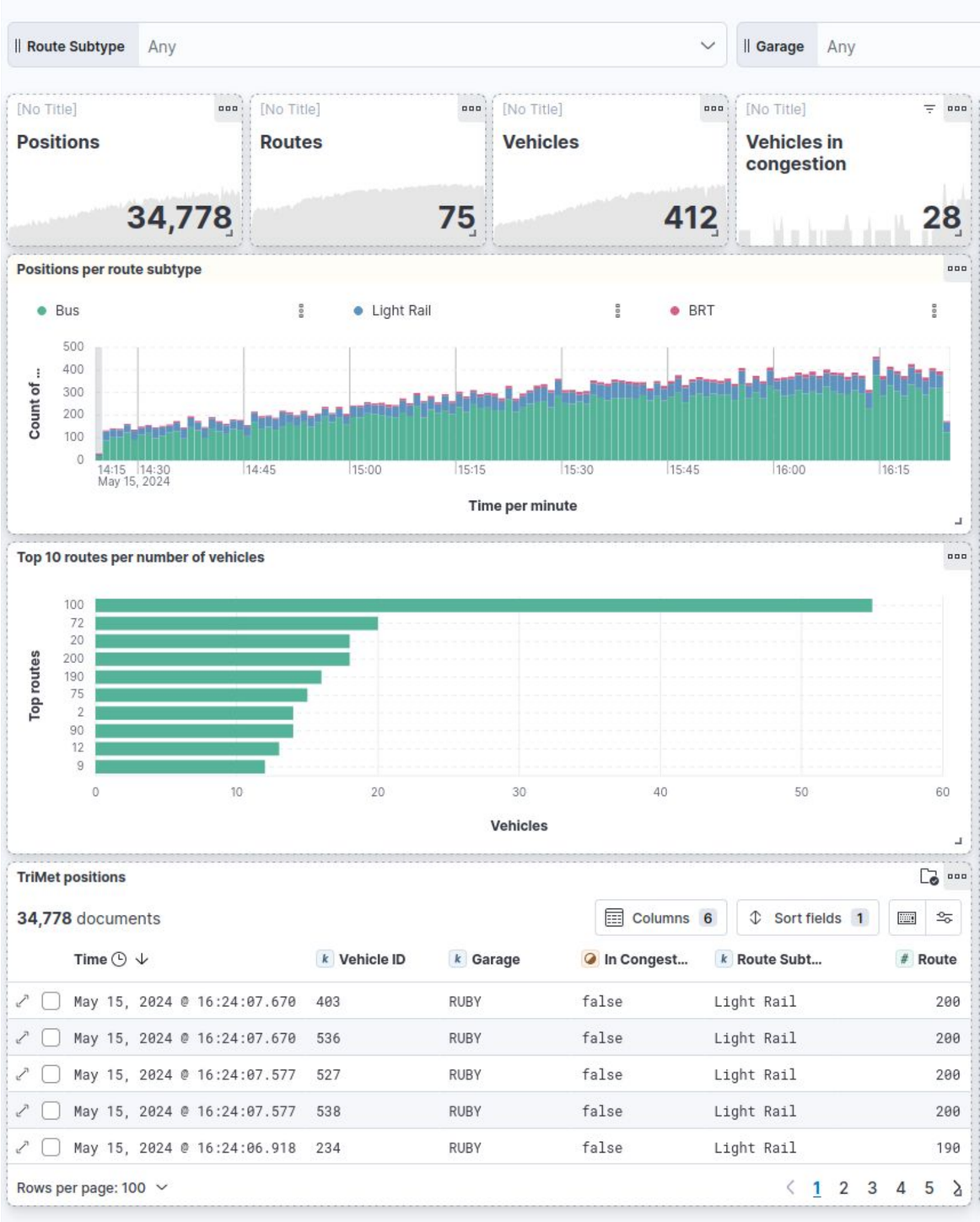
Discover

- Go to **discover**
- Search through positions
- Add `trimet...` fields
- Explore individual documents
- Change time ranges
- Set up auto-refresh
- Save the search



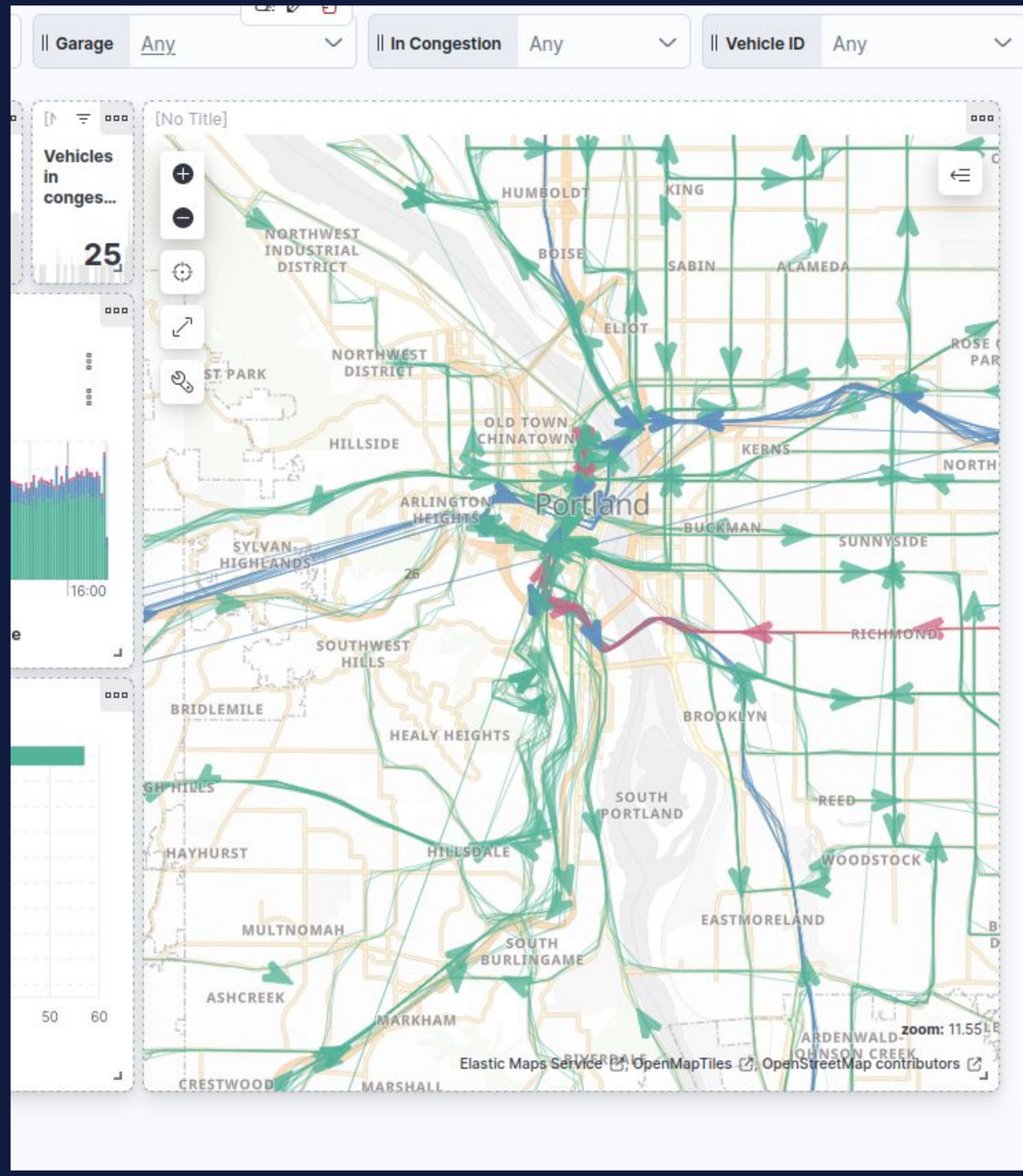
Dashboard

- Create a new dashboard
- Add different panels
  - a count of all positions
  - a count of vehicles or routes
  - a bar chart with vehicles per route subtype
  - a histogram of vehicle counts per route subtype
  - saved search from Discover
- Add controls for some fields



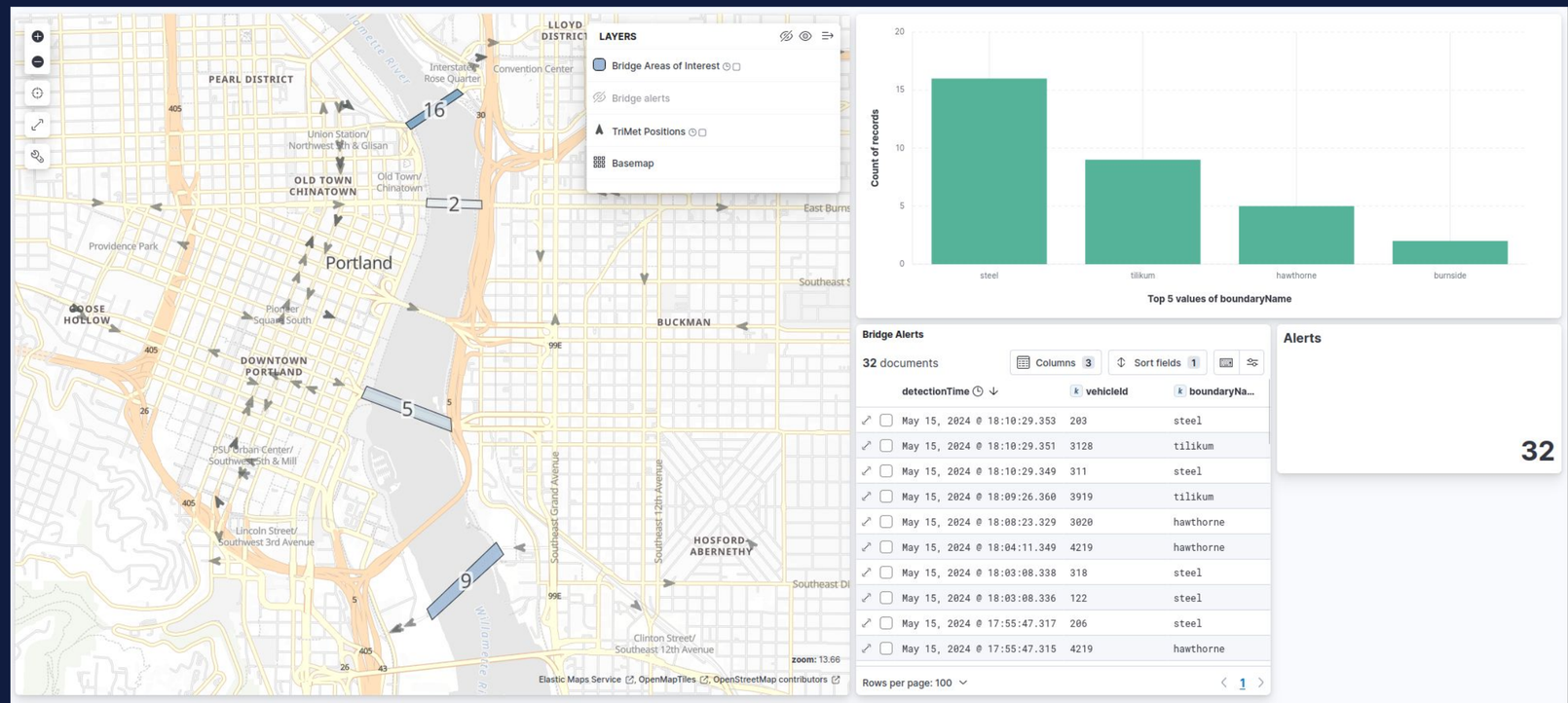
Maps

- Add a new **map** to the dashboard
- Try aggregated layers for the individual positions
  - Heatmap
  - Cluster/Grid/HexGrid
- Add individual positions
- "Top Hits": add the latest position per route
- "Tracks": render the routes



Extra: alerting

- One type of rule is checking for **geospatial containment**
- A rule is counting vehicles that **enter four polygons** on some Portland bridges
- Explore the **Bridge Alerts** dashboard



Learn more about Elastic and Geospatial:

- Start a trial at cloud.elastic.co/registration
- Learn more at elastic.co
- Check out our /geospatial and /maps pages
- Register for an upcoming event at /events

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Elastic and geospatial
https://ela.st/2024-un-maps

Thank you!

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