Scalable, Server-side Mapping in Drupal with the Geocluster-Leaflet Stack

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Phase2

Phase2 Technology

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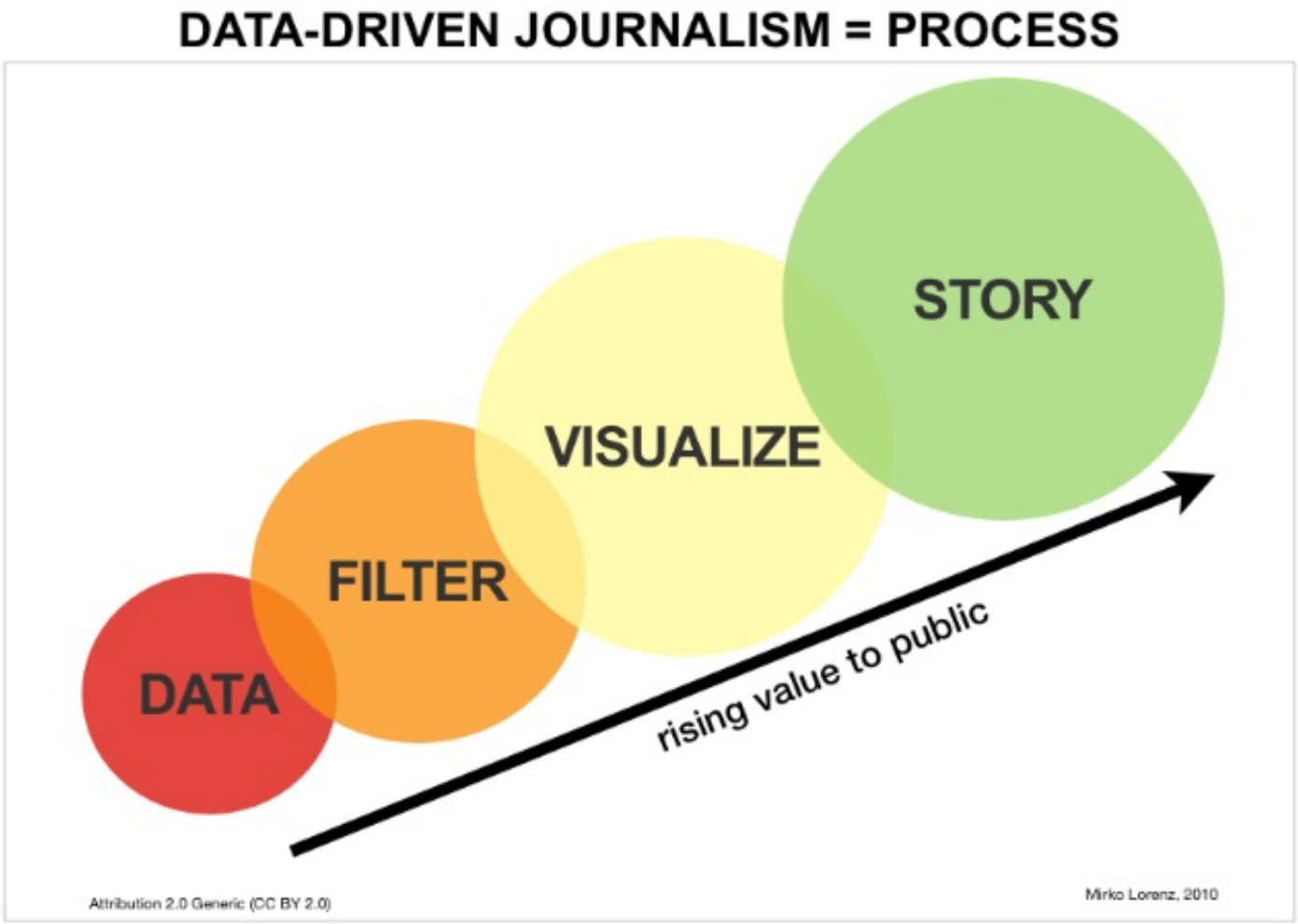
Table of contents

Mapping: What Is Going On Here?



The Process

Data Driven Presentation as a Process

- Data must be found
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This allows content authors to present data in context in ways that would be difficult with words alone.

Mapping: Why is This Important?

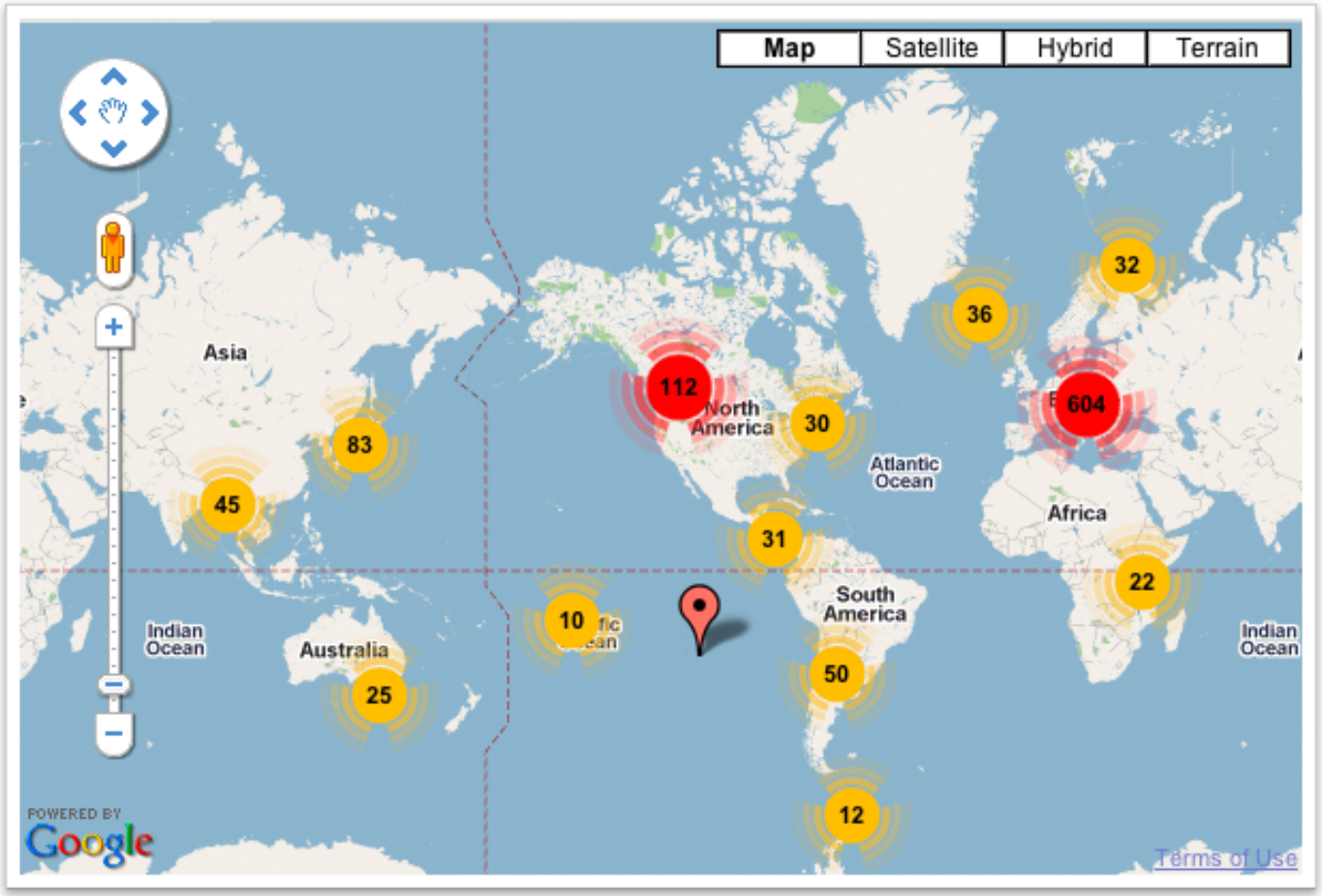
The Problem: Dense-Point Data

First pass: we have point crowding.

Really not usable.

One Solution: Client-Side Clustering

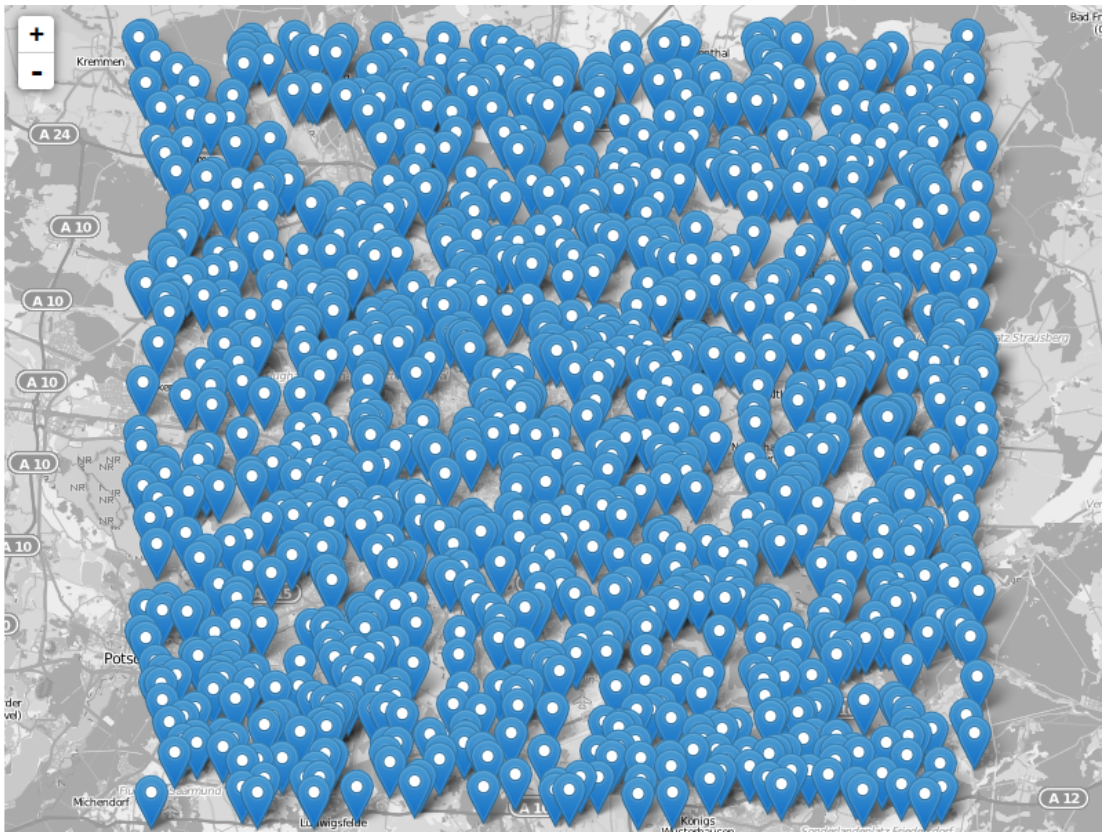
First step: lets cluster on the client side.



More usable, we gain context and can zoom in on areas of interest.

Solution Breakdown: Clustering Thousands of Points

What if we have thousands of points?



Client-side clustering breaks down upwards of a few hundred points.

Roadblock: Client-Side Clustering at Large Scale

Why Does it Break?

1. Views (PHP) renders each data point as a row of output, one at a time (thousands).
2. Views (PHP) renders the popup info (hidden) at page-load time.
3. The mapping library (JS) must parse the data.
4. The mapping library (JS) clusters the points.
5. The mapping library (JS) renders the map.

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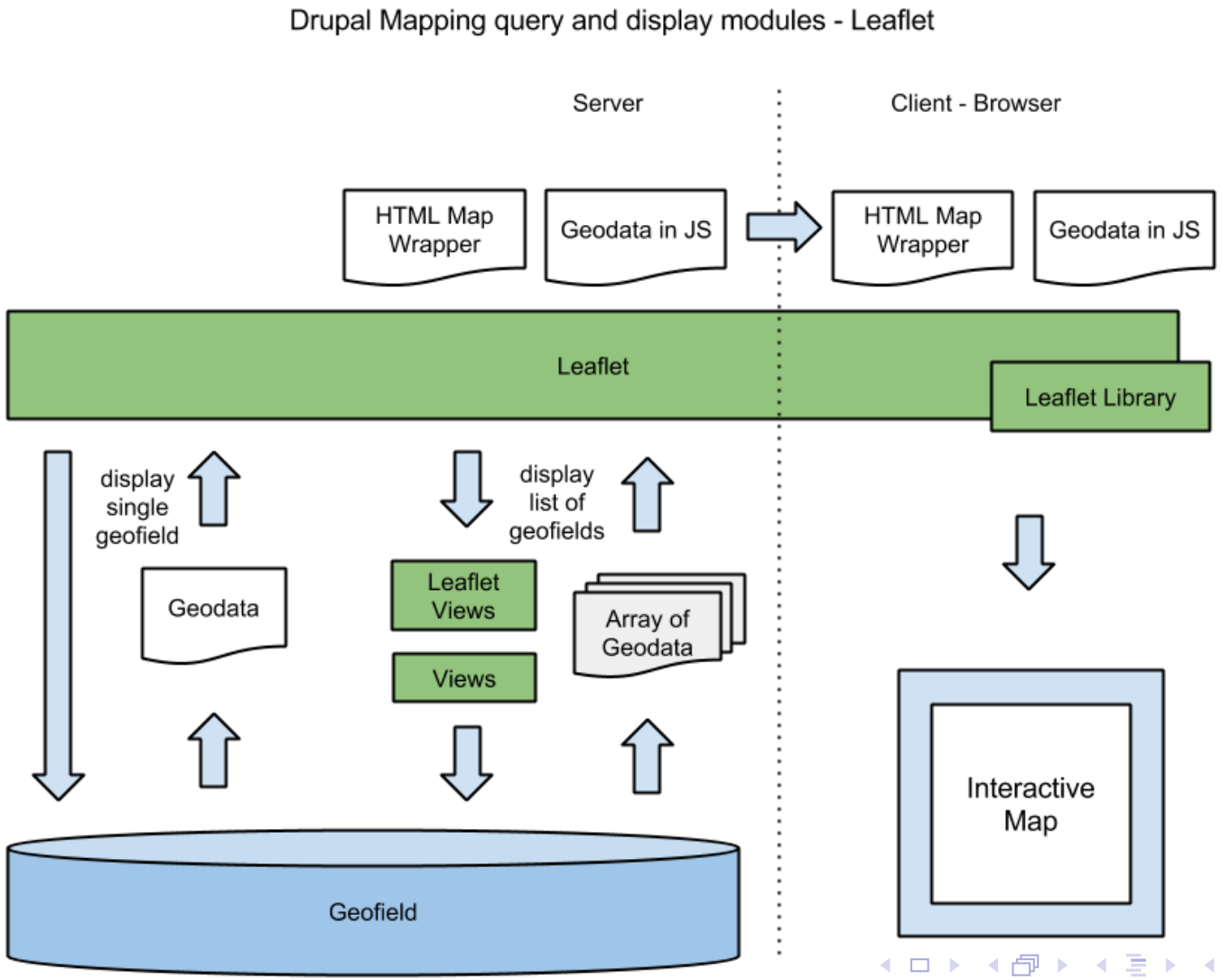
Both PHP and JS are asked to do too much at once.

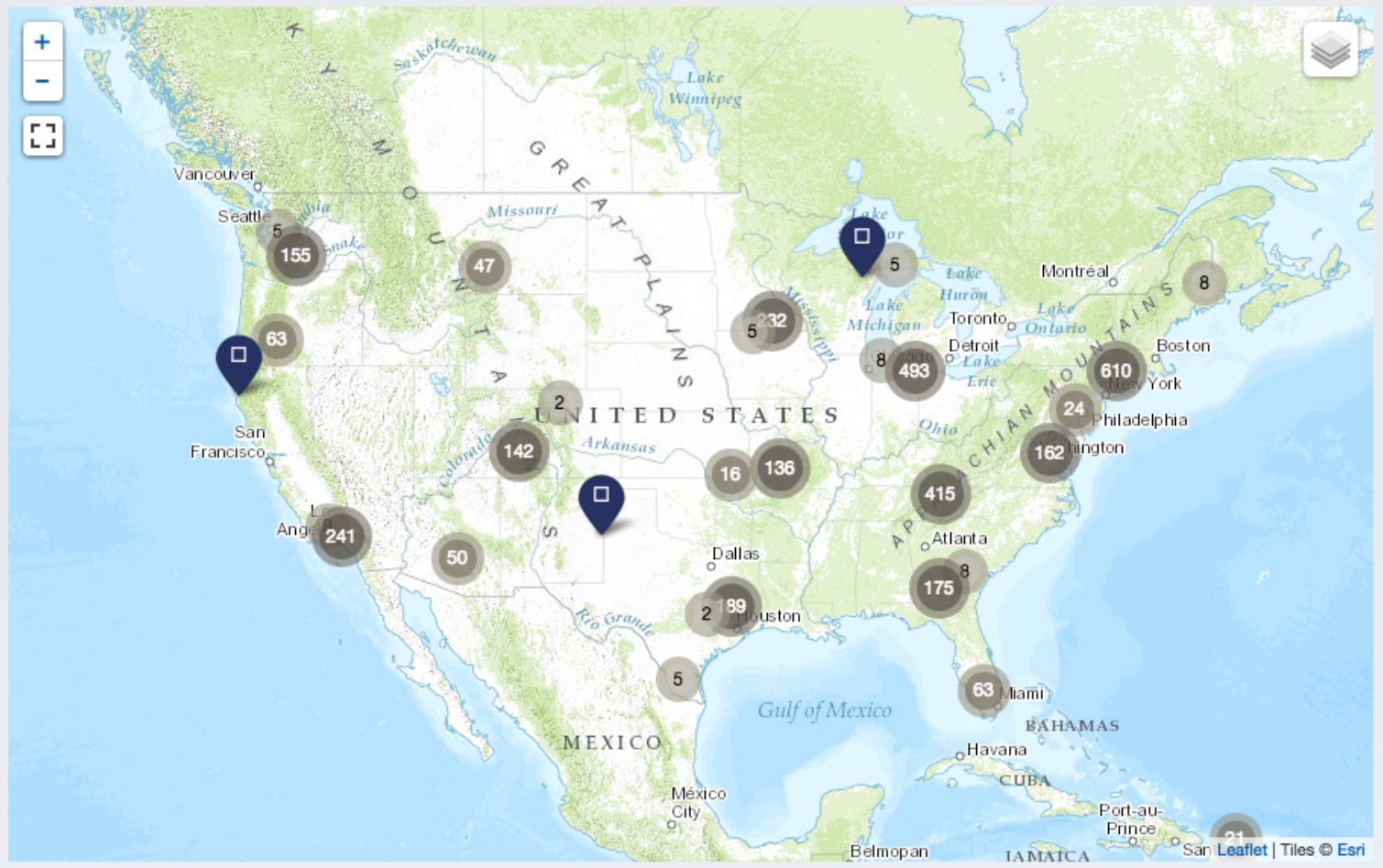
- The breaking point is about 300 data points (empirical).

Client-Side Clustering Visualized



Demo

http://vistacampus.gov/map



Demo: Things of Note

- Bounded mapping (bbox strategy)
- Load time under 1sec
- Clusters are single things, not collections of things
- On-demand, ajax-delivered infobubbles
- Dynamic reclustering on pan/zoom
- About 4K points
- Layer interference (boo!)

Starter Build

If you really want to build this...

1. Clone the starter build
2. Modify to suit

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Starter Build:
http://cgit.drupalcode.org/geocluster/tree/modules/geocluster_demo

- Instructions: https://www.drupal.org/node/1962198

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Why?

- The configuration is tedious and complex.
- Way too easy to break to start from scratch.

The Recipe

Basic Recipe

- Address Field (location storage)
- Geocoder (geocoding addresses, requires GeoPHP)
- Geofield (geocode storage)
- **Geocluster** (server-side clustering)
- Views
- Views GeoJSON (GeoJSON feeds)
- Leaflet GeoJSON (2.x for Panels support, 1.x for Bean)
- Leaflet Integration (requires Leaflet core library)

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But... we need lots of patches.

A Working Model

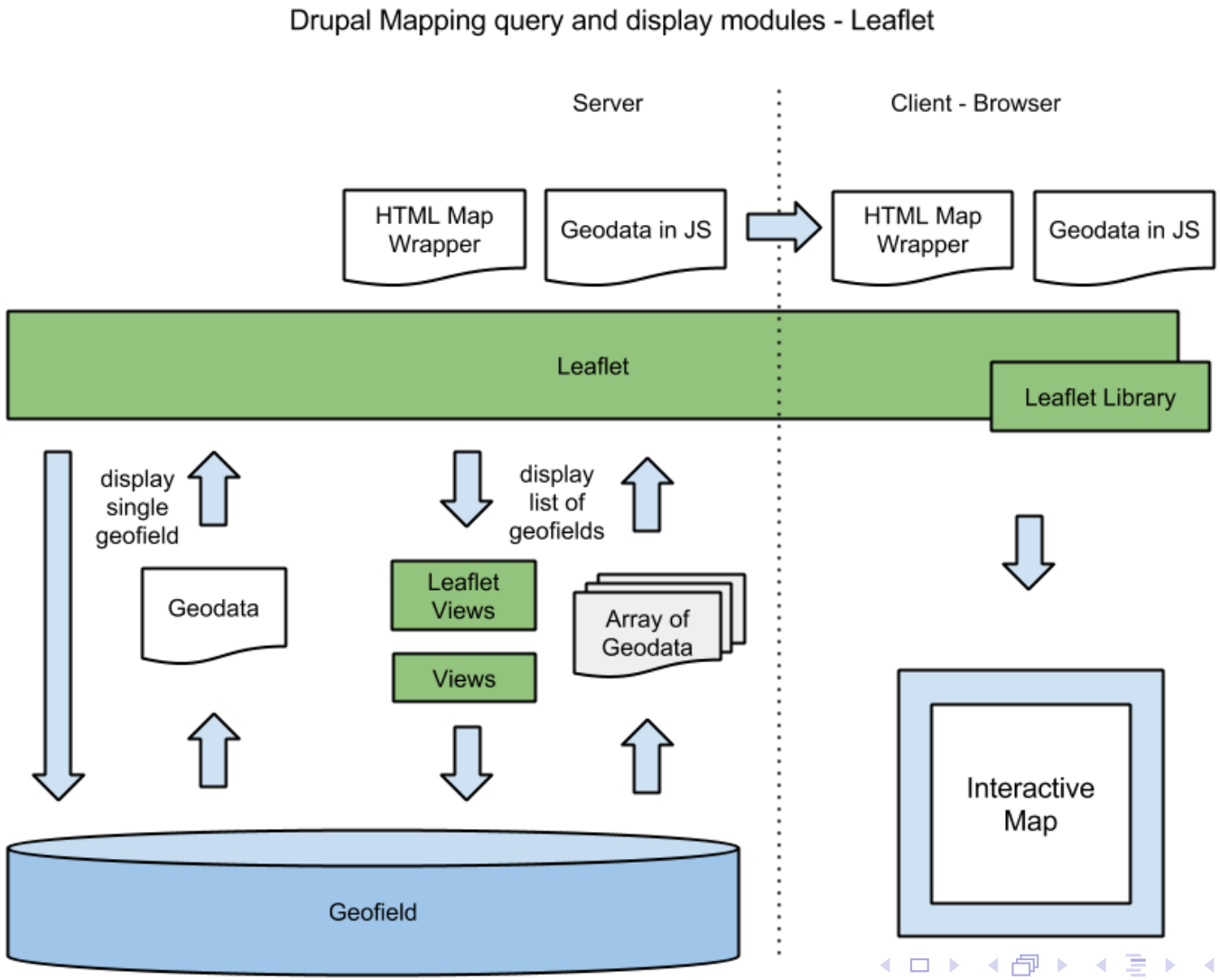
The client build has been released as GPL2.0

- https://github.com/mpgeek/VistaMap

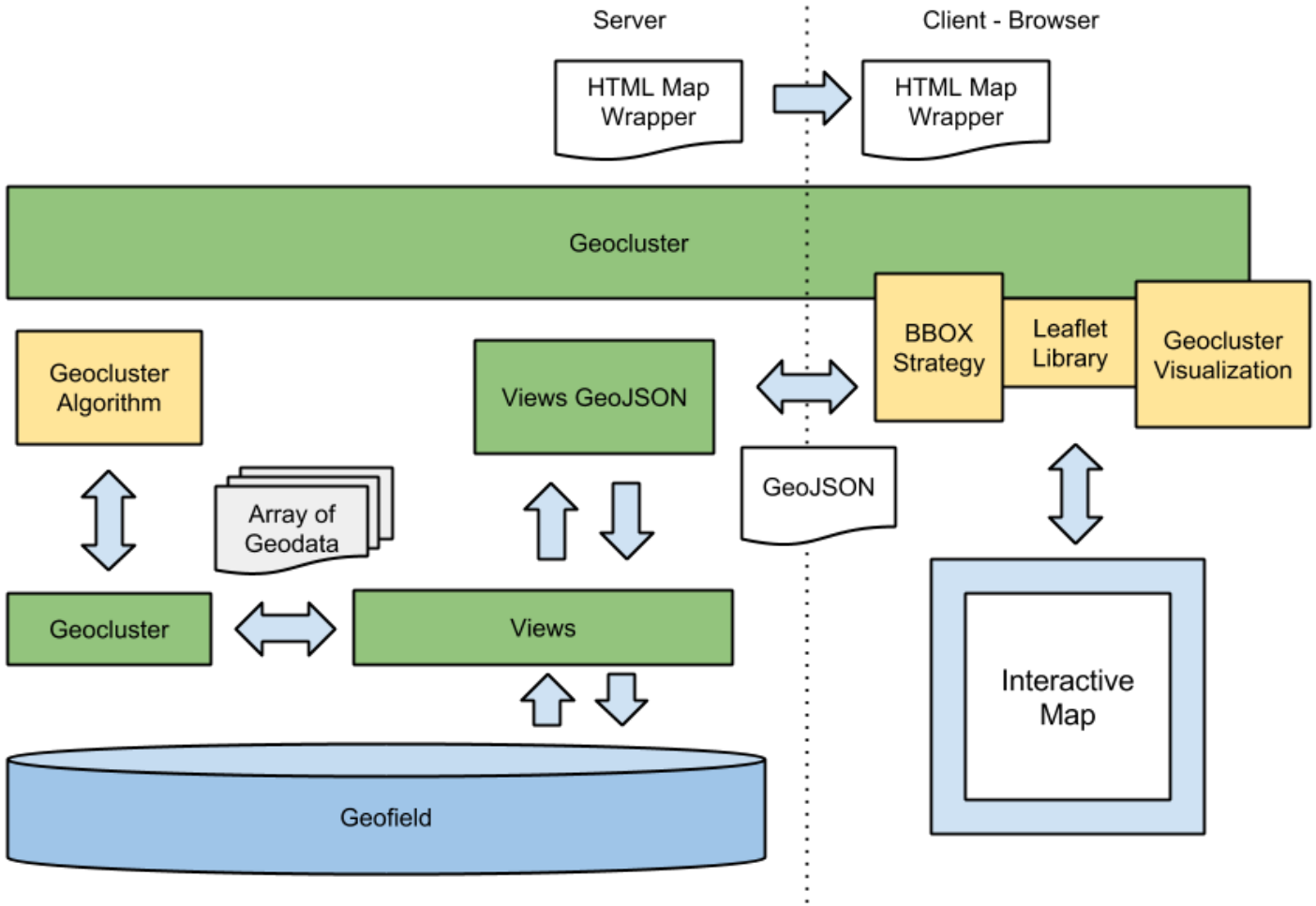
Patch mania! How about a makefile?

- https://github.com/mpgeek/Vista-Map/blob/master/vista_map.make

Client-Side Clustering Visualized (Redux)



Server-Side Clustering with Geocluster Visualized



Key Architectural Feature

Geocluster Keys

- Clustering is performed at the query level by Geocluster
- PHP and JS only see the clusters as single (Views) rows.
- This feature alone is almost entirely responsible for the performance gain.

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But How?

- By geohashing!

Geocluster & Geohash

In a nutshell:

- Geocluster adds a hierarchical, spatial index to geofields based on the Geohash algorithm.
- Each geofield has columns for varying levels of precision (geohash index) created/updated on `entity_save`.
- A query for points/clusters specifies a geohash index and asks for clusters based on that index.

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Notice:

- The clustering information is created when the content is created.
- A request for points and clusters doesn't actually cluster. Rather it's a simple query of a spatial index.

Near-point Clusters vs. Exact-point Clusters

Monolithic Clusters

- Leaflet doesn't discern between points that are near to one another versus multiple points at the same location.
- We needed to create two cluster types, on for each condition.

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- `vista_map.module`, lines 115-155

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AJAX!

- We don't load the popup info into the DOM at map-load time (performance tactic).
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Current-user Zoom

Focus the Map on the Current-user's Location

- One of the purposes of the map was to emphasize making local connections.
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Limit Geocoder Granularity

Geocode to Center of ZIP-code Only

- One of two data layers needed to geocode only to ZIP-code precision.
- Removing more-specific information and passing abbreviated info only to geocoder.

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- `vista_map.module`, lines 12-72

Multiple Data Layers

Implement Data Layering and Panels Support

- OG membership drove layer membership, and source geofield.
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Implement Data Layering and Panels Support

- OG membership drove layer membership, and source geofield.
- Views necessitated that different source geofields be separate data layers.
- Contiributed the 2.x branch of Leaflet GeoJSON for panels support with multiple data layers (https://www.drupal.org/node/2225815)

Scalability Requirement

How big did we need to go?

- Mapping user profiles, about 18k users were migrated
- Originally, it was expected that all users would be map
- Application scale, then is 10^4

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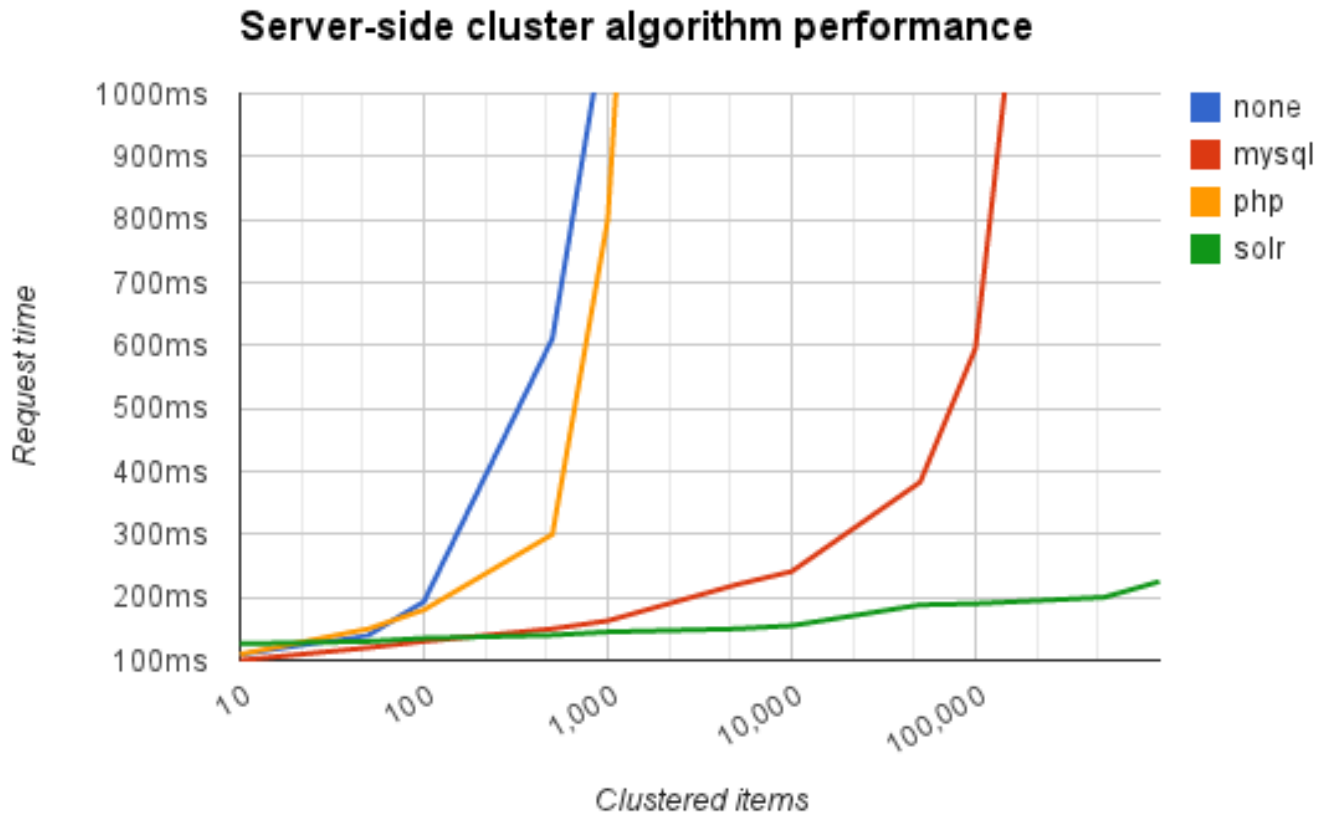
Geocluster's clustering backend is pluggable

- PHP clustering (post-query clusternig)
- MySQL clustering (query-level clustering)
- Apache solr clustering (alternative query-level clustering)

Scalability Metrics

Cold caches



We implemented MySQL clustering

Possible Improvements

Geocluster

- Progressively enhance with client side clustering below a certain point threshold.
  https://www.drupal.org/node/1914704

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Leaflet GeoJSON

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- Collapse clusters to a single layer to eliminate layer interference.
- Make data feeds cacheable by quantizing bounding box parameters.
  `/$view_url?bbox=$left,$right,$top,$bottom?zoom=$zoom_level`
  - The `bbox` arguments are floating-point numbers that depend on viewport size and zoom. Takes a long time for caches to warm up for non-mobile viewports.
  - https://www.drupal.org/node/1868982

Take-out Knowledge

What we know

- Using the Leaflet-Geocluster stack, and healthy dose of patches, it is possible to deploy a scalable map application suitable for production use.

References & Resources

Things we saw and more resources:

- Map application in production:
  http://www.vistacampus.gov/map
- Map application Drupal feature:
  https://github.com/mpgeek/Vista-Map
- Geohash Algorithm:
  http://en.wikipedia.org/wiki/Geohash
- Geocluster Master's Thesis (by @dasjo):
  http://dasjo.at/thesis