

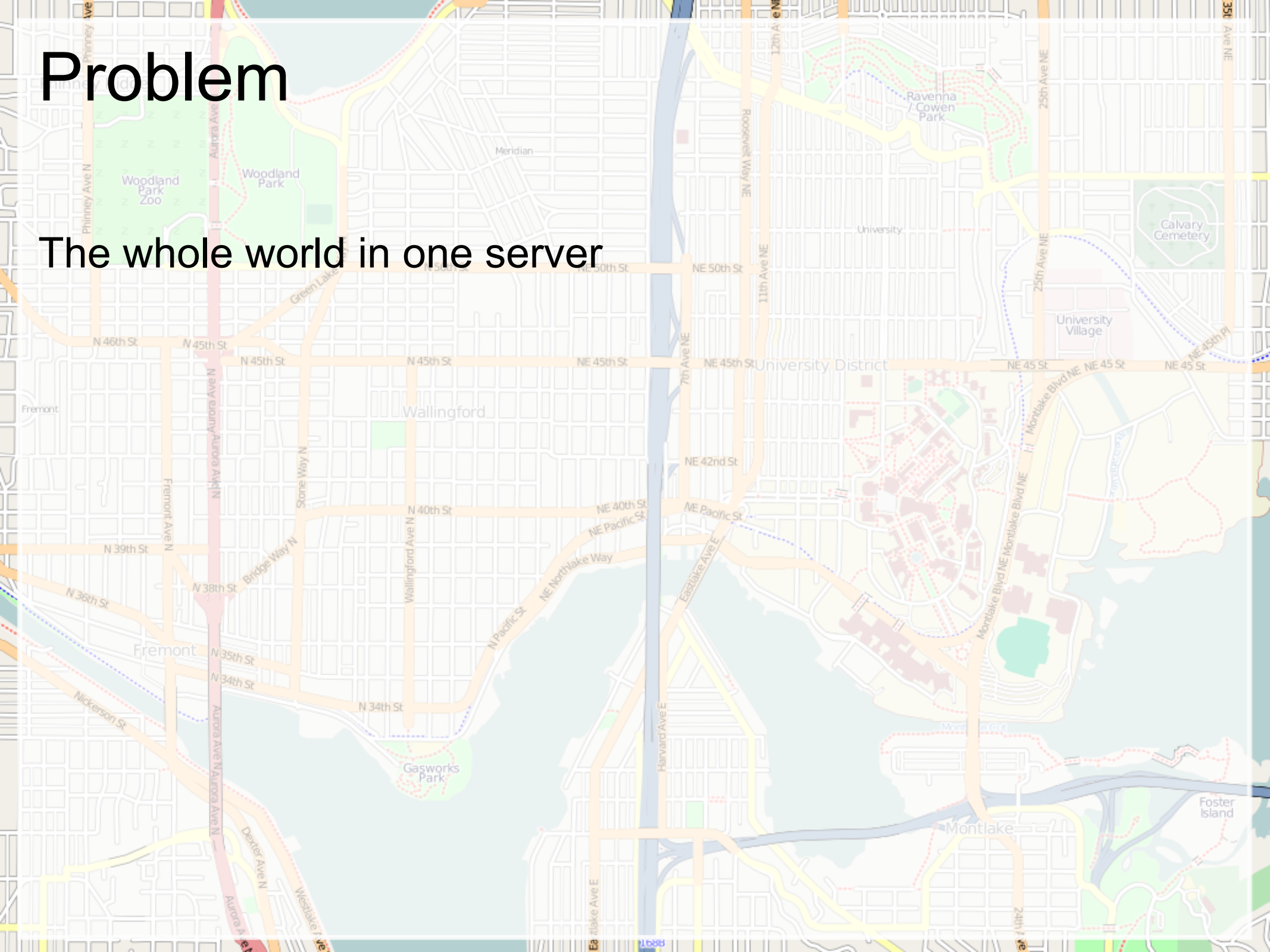


# Menzies

*Distributing the world.*

# Problem

The whole world in one server





# API

**GET node/#id** Returns the XML for that node.

**PUT node/#id** Updates the node, returns new version number.

**DELETE node/#id** Deletes the node, returns new version number(?).

**PUT node/create** Creates the node, returns new node number.

**GET node/#id/history** Returns all versions of the node.

**GET node/#id/#version** Returns the XML for that version of the node.

**GET node/#id/ways** Returns the XML for all ways that this node is part of.

**GET node/#id/relations** Returns the XML for all relations that this node is part of.

**GET nodes?nodes=#id,#id,...** Returns the XML for all given node numbers.

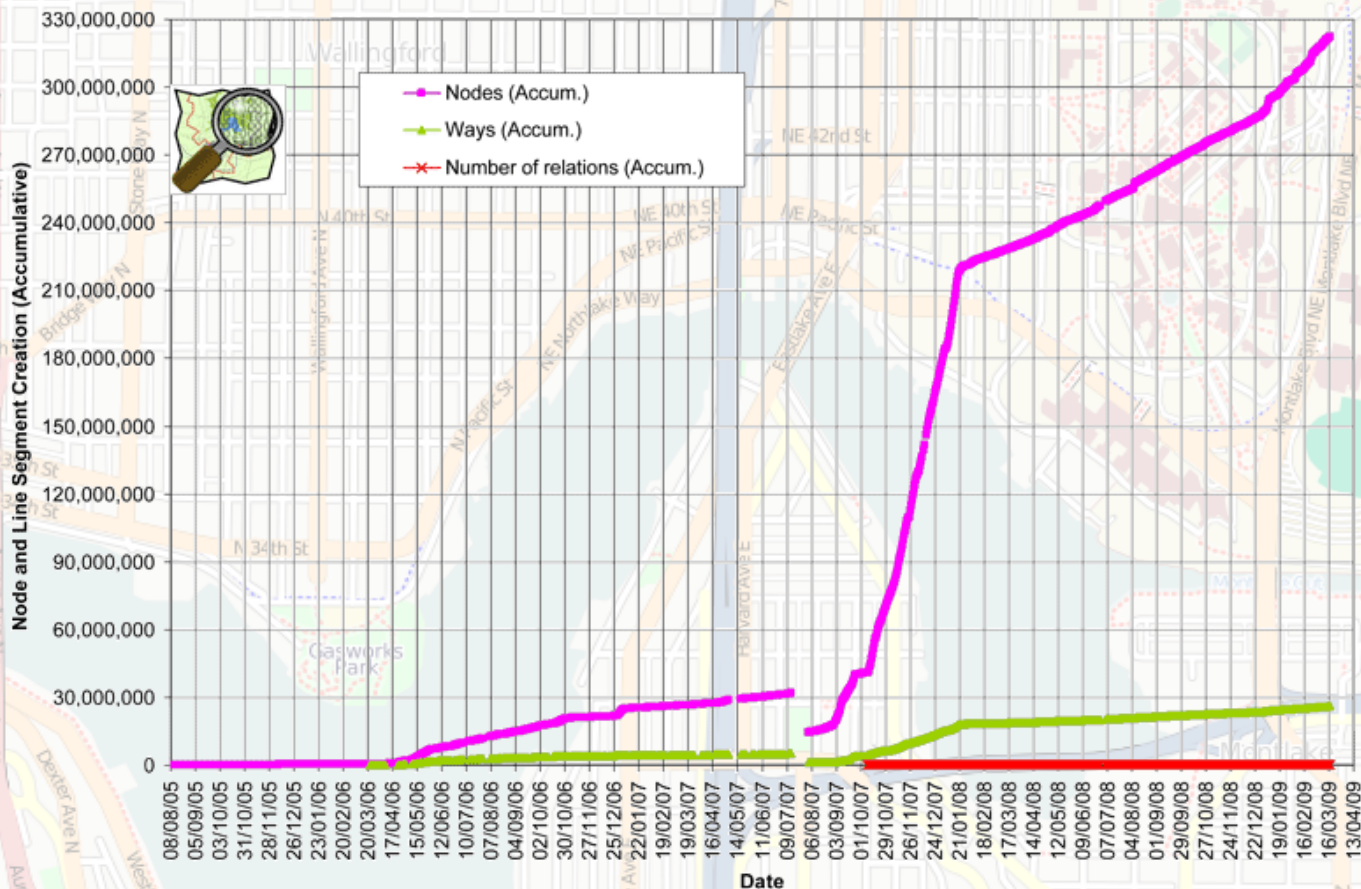
**GET map?bbox=min\_lat,min\_lon,max\_lat,max\_lon** Gets all the way, nodes and relations inside a bounding box

# Challenges

Optimize bounding box.

Distribute data amongst servers.

OpenStreetMap Database Statistics  
Node, Way and Relation Creation





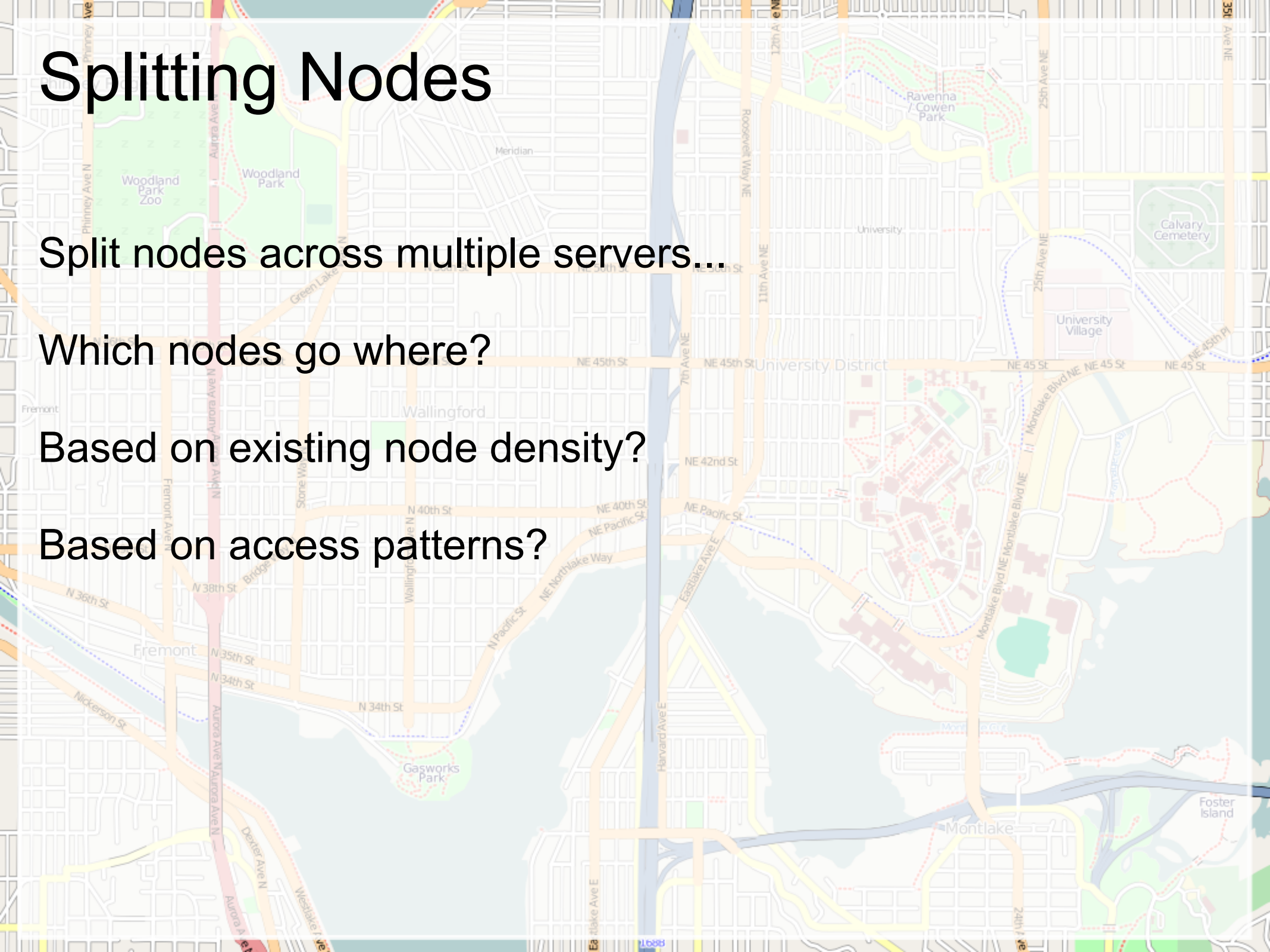
# Splitting Nodes

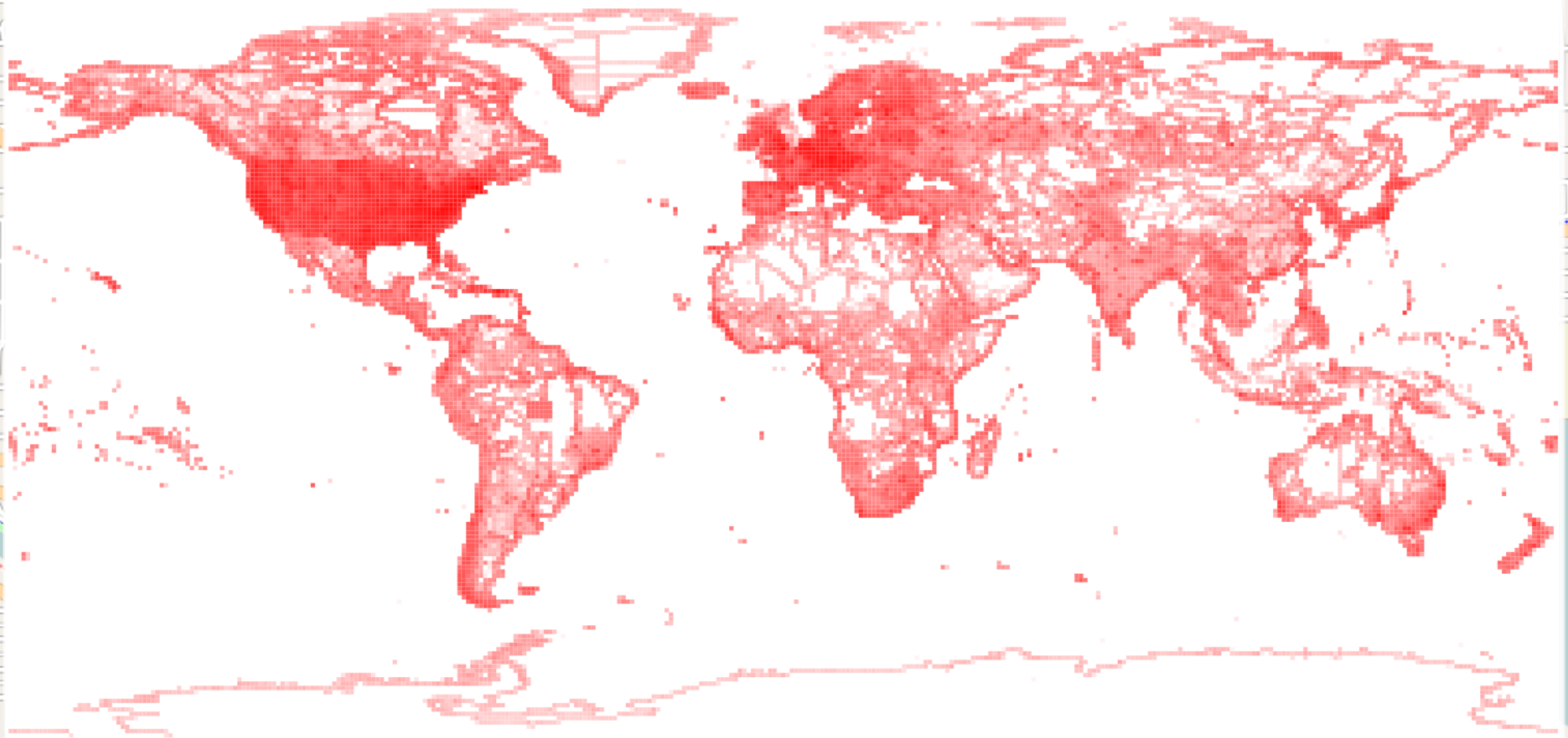
Split nodes across multiple servers...

Which nodes go where?

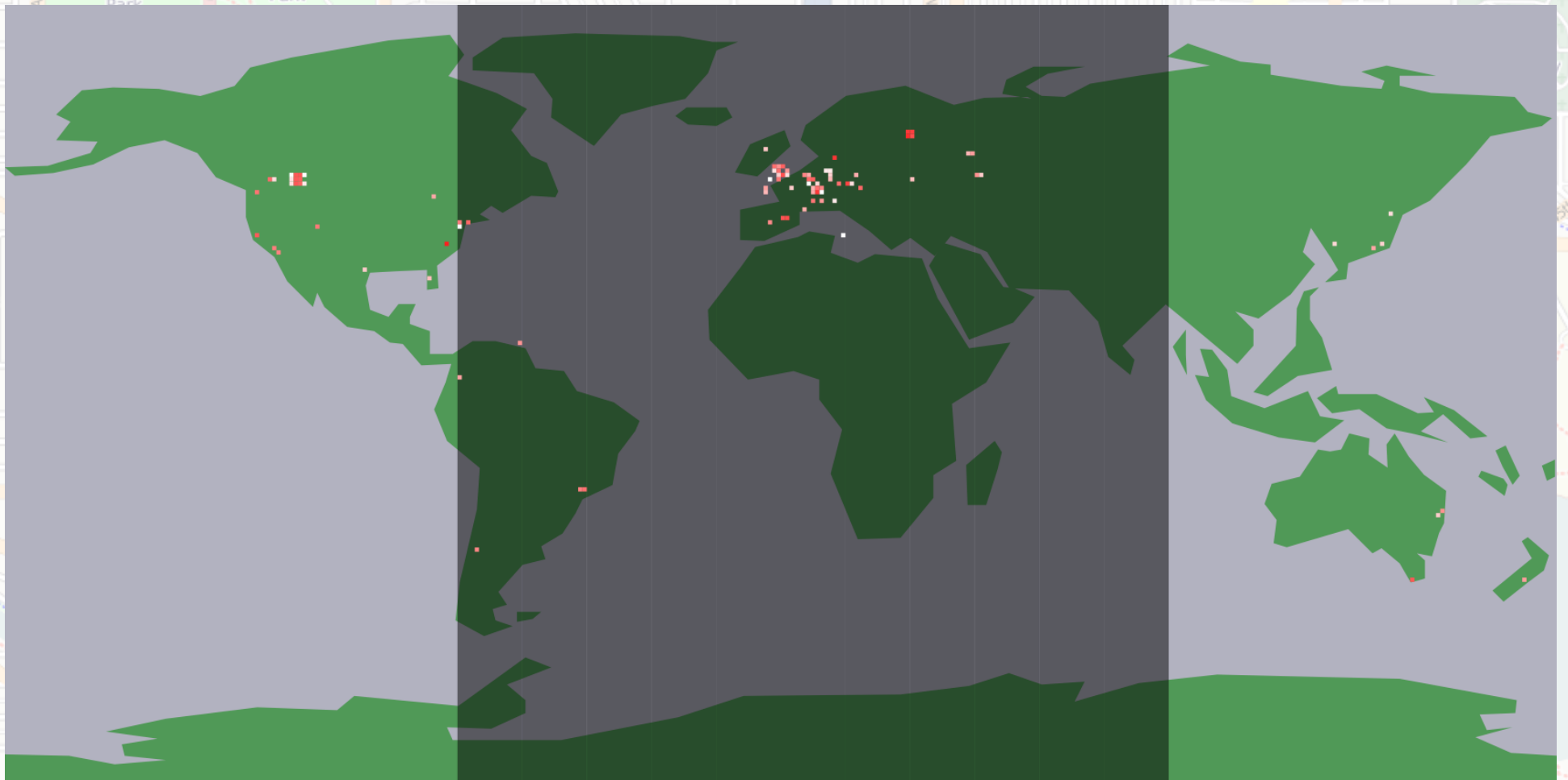
Based on existing node density?

Based on access patterns?





Node Density

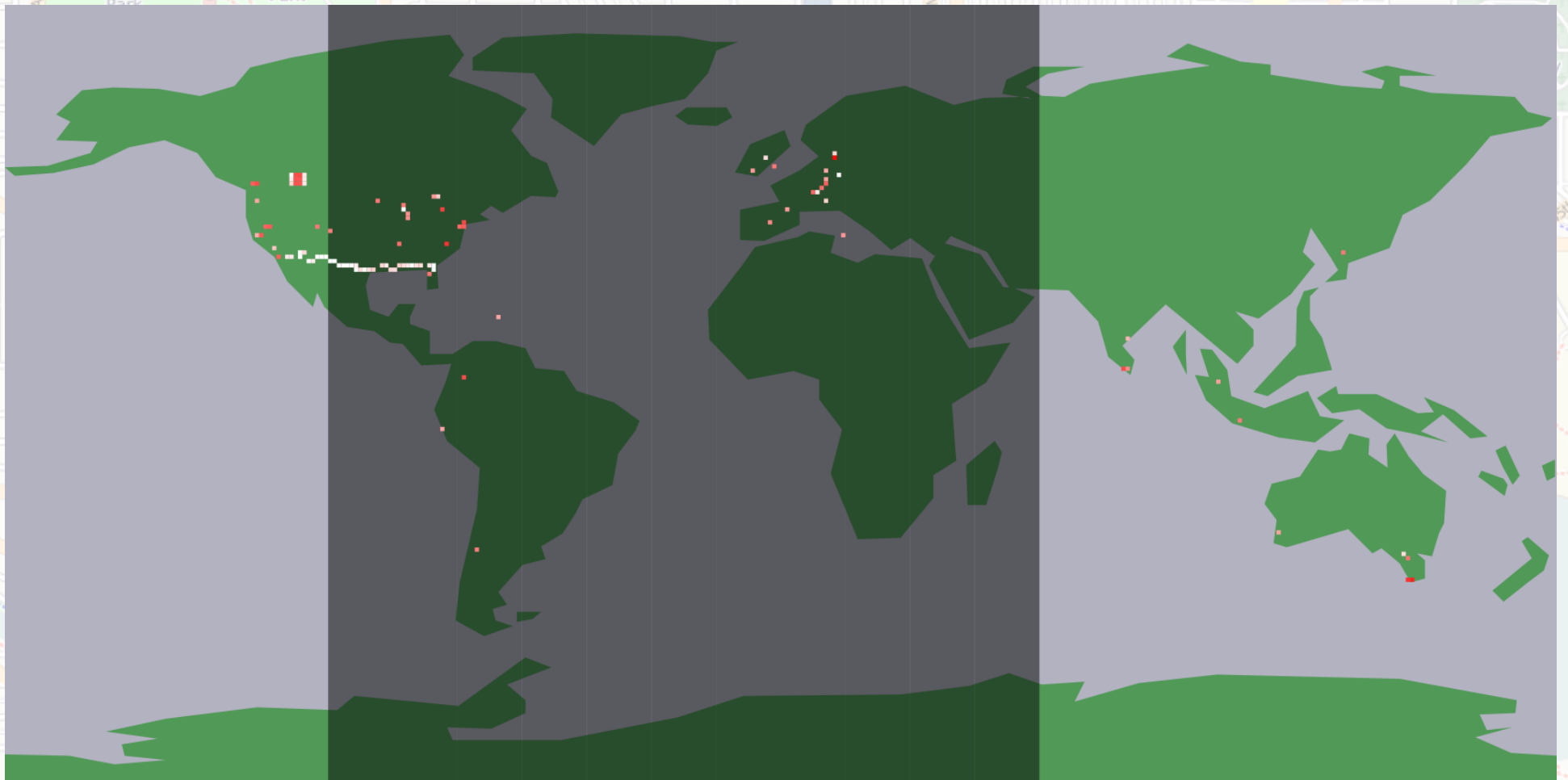


Editing @ Midnight UTC

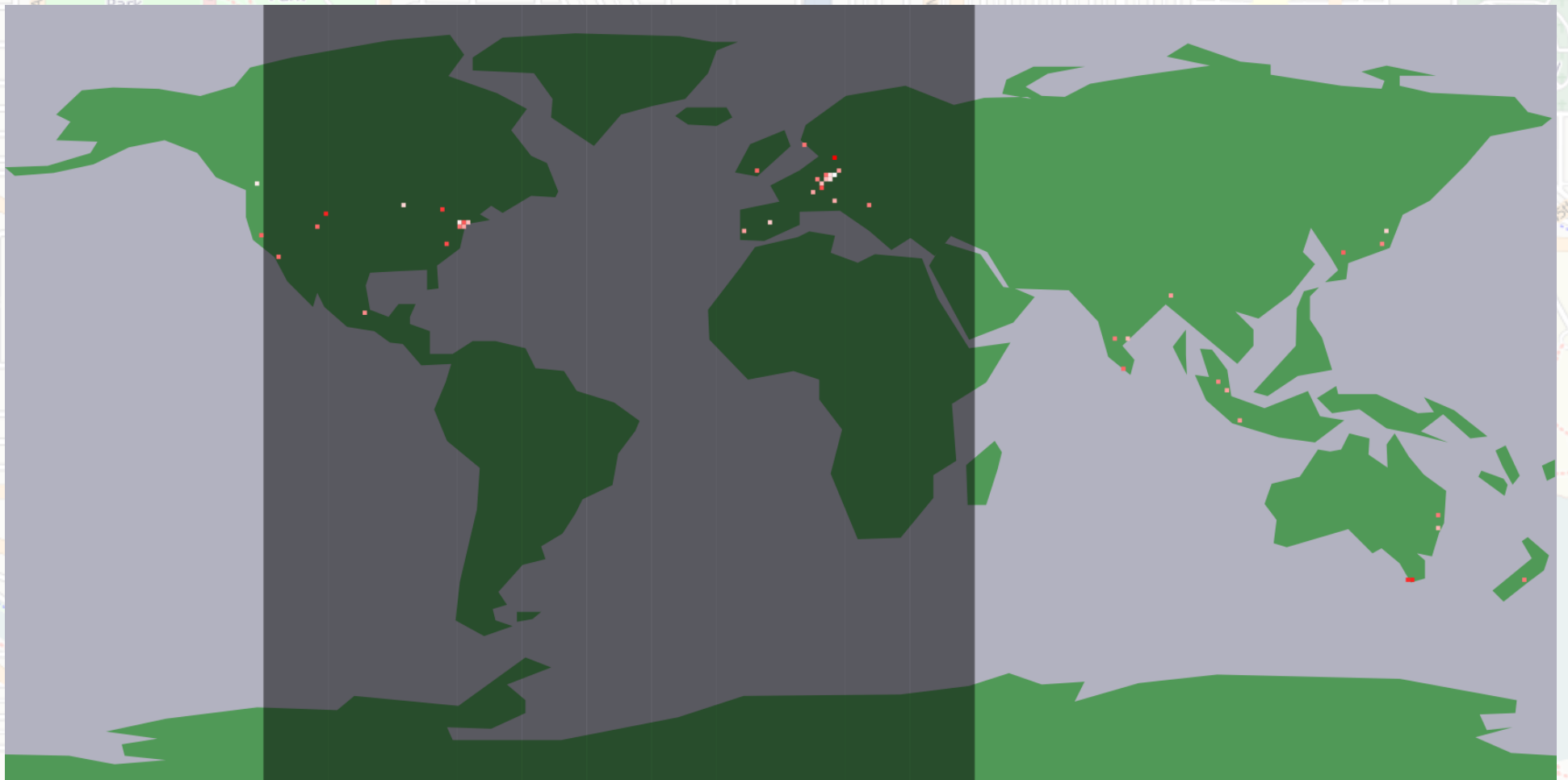


Editing @ 1AM UTC

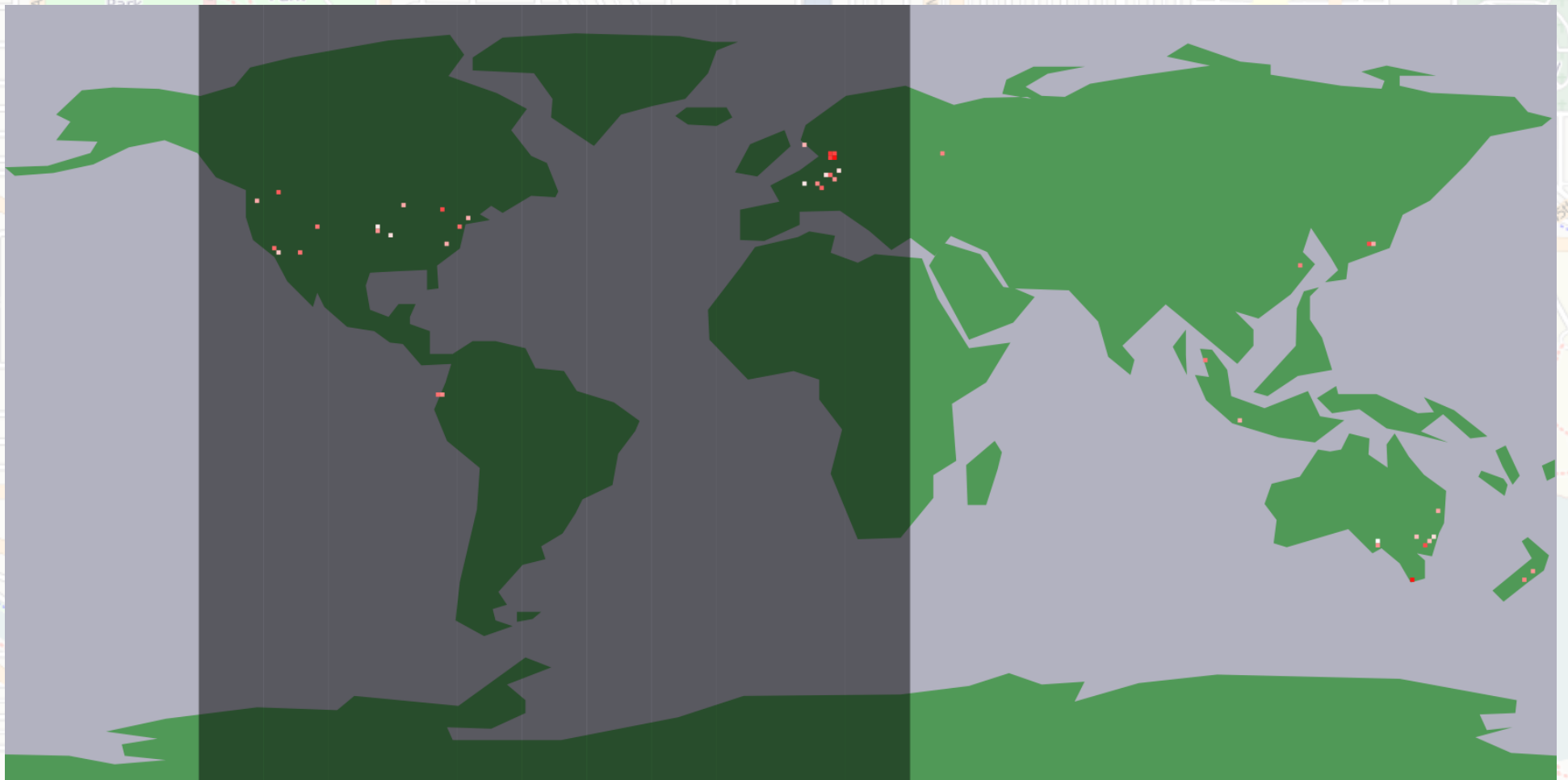




Editing @ 2AM UTC

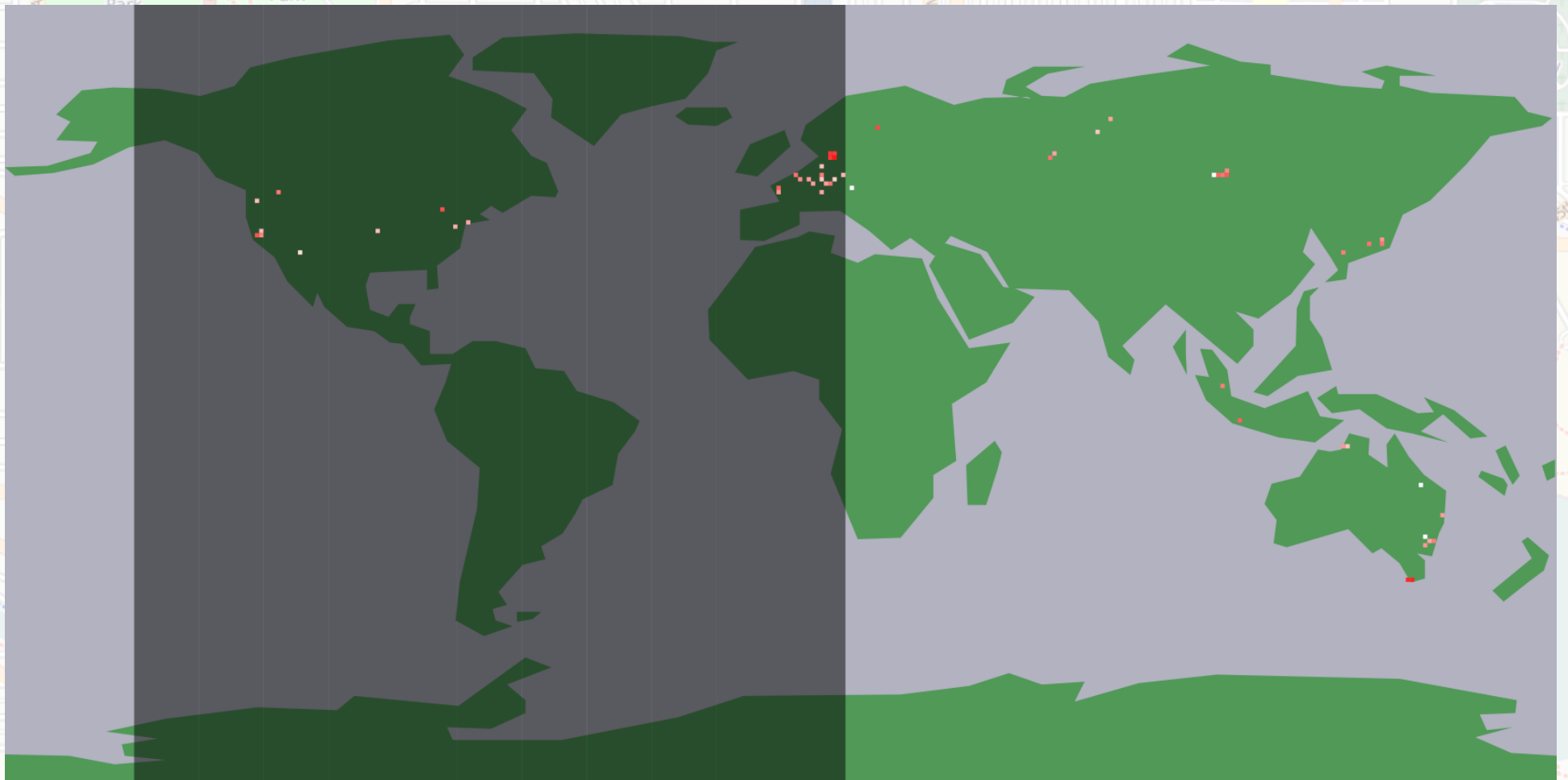


Editing @ 3AM UTC

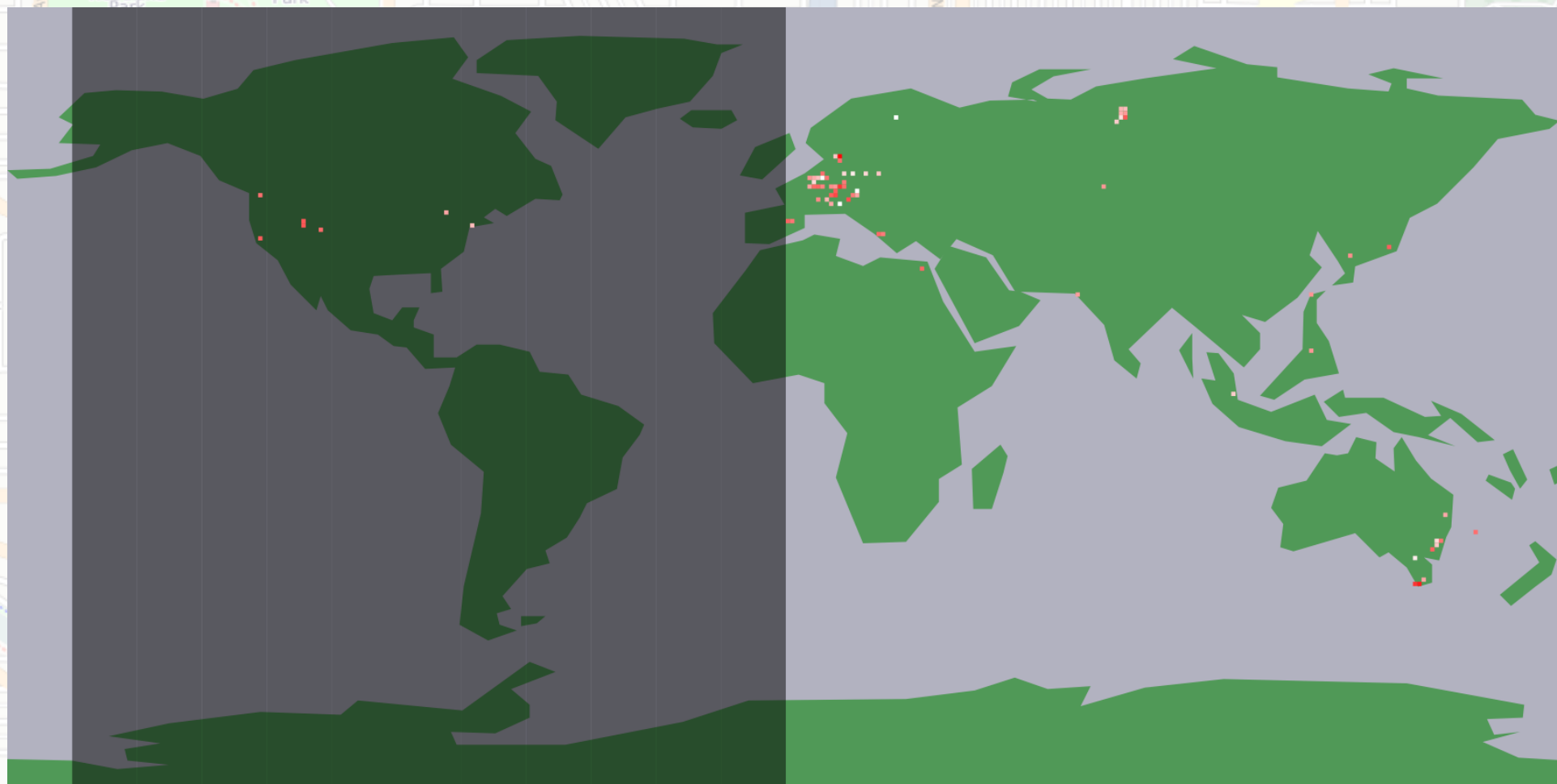


Editing @ 4AM UTC

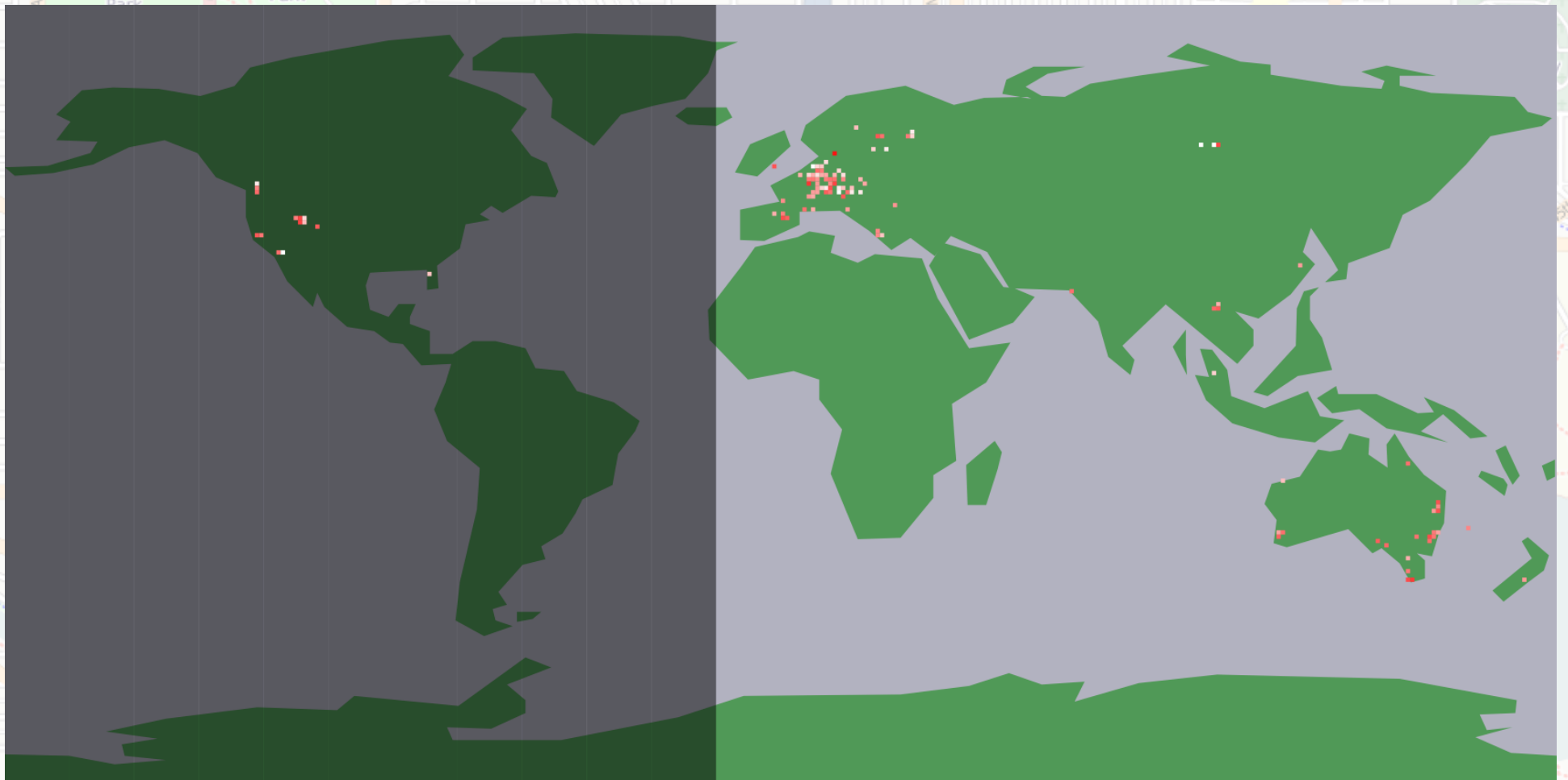




Editing @ 5AM UTC

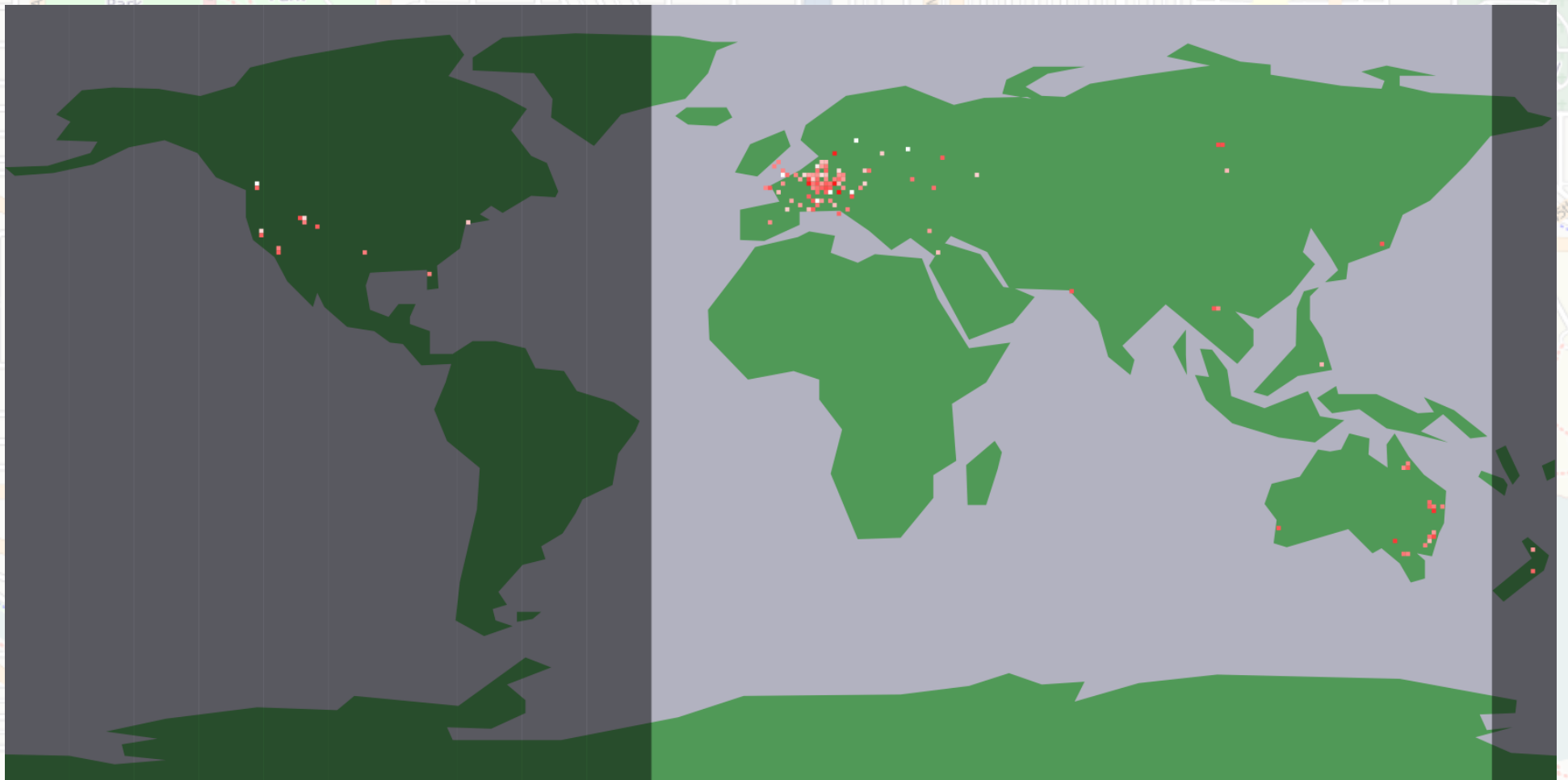


Editing @ 6AM UTC

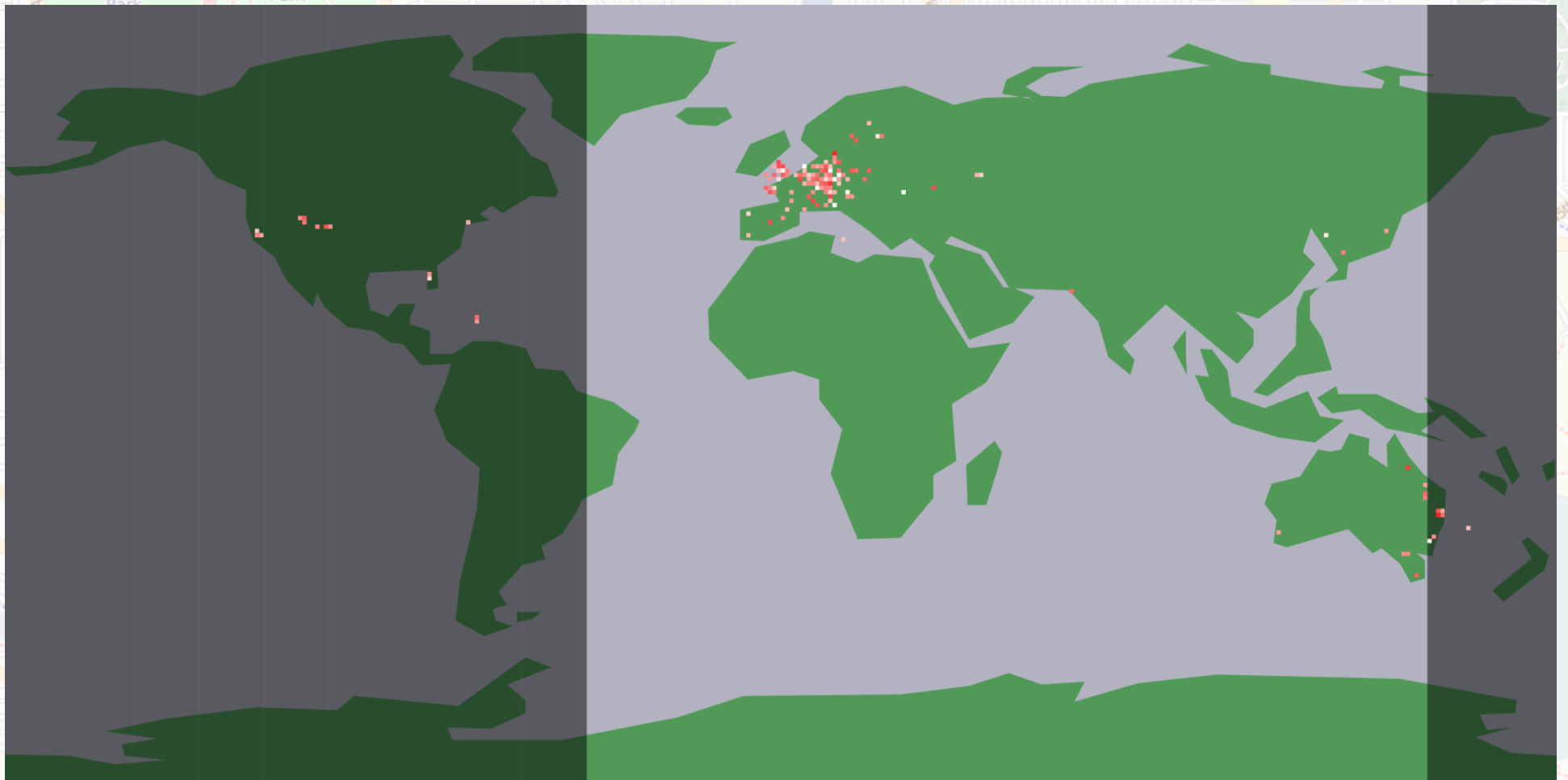


Editing @ 7AM UTC

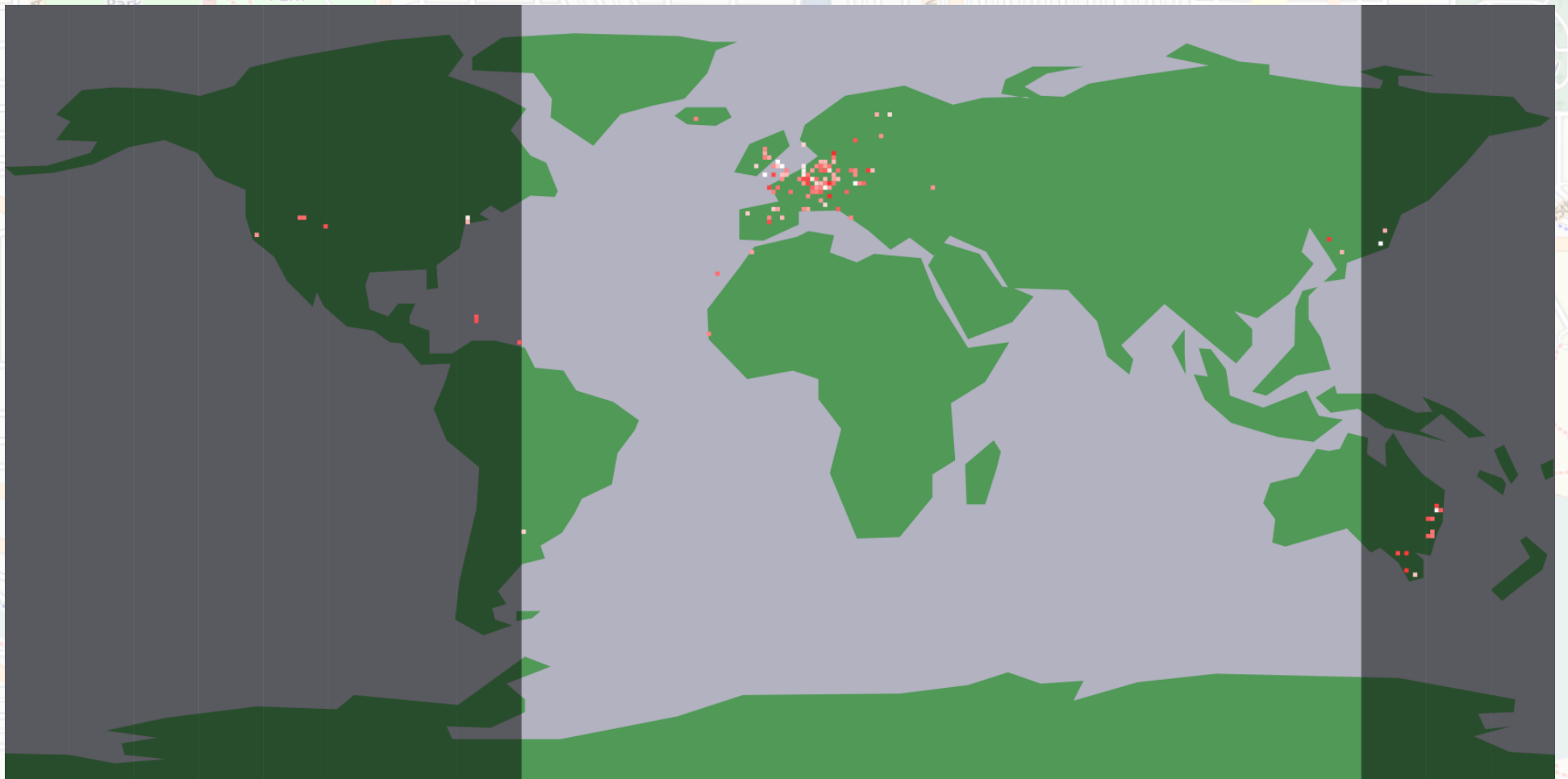




Editing @ 8AM UTC

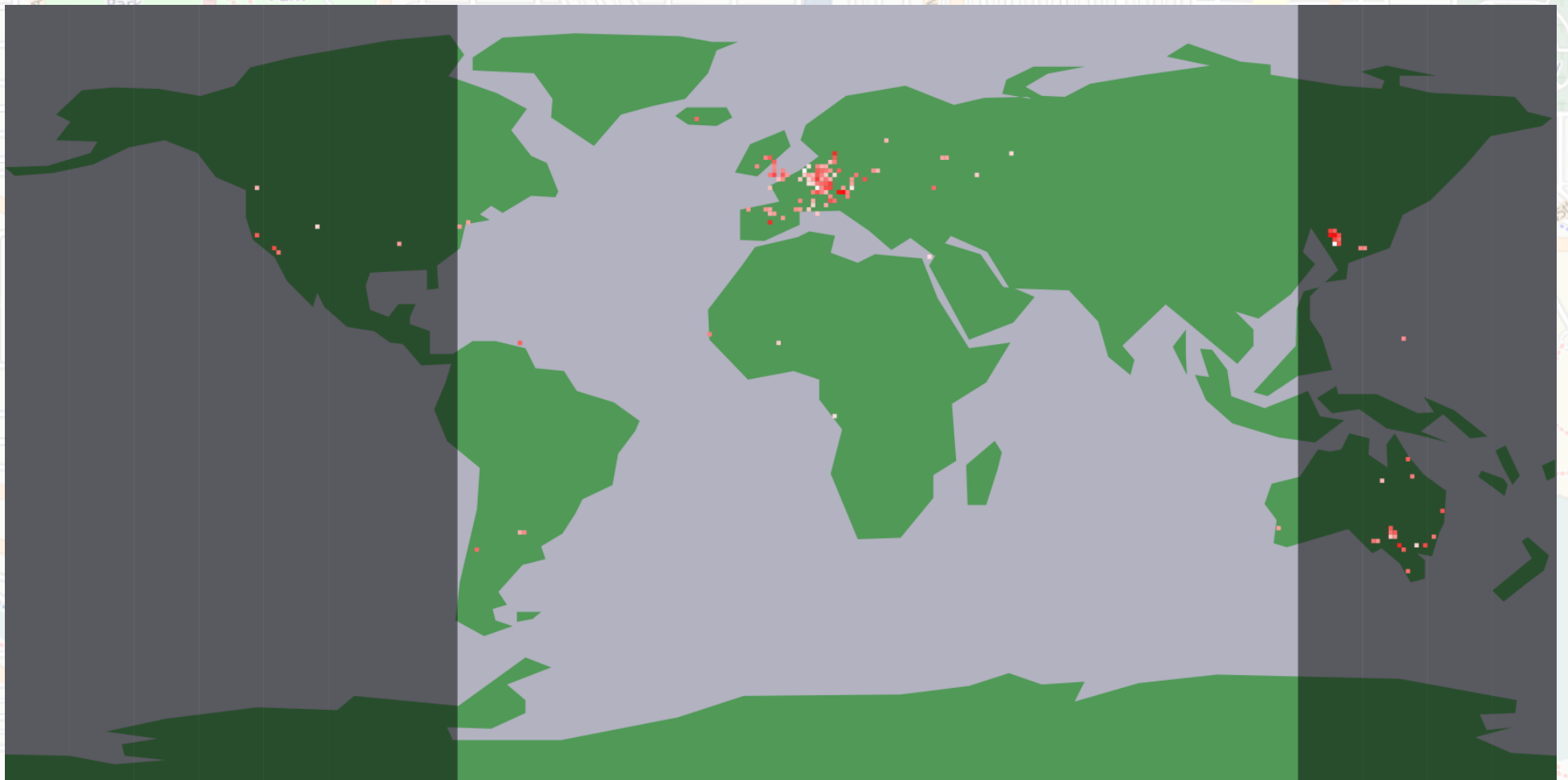


Editing @ 9AM UTC



Editing @ 10AM UTC





Editing @ 11AM UTC



Editing @ Noon UTC

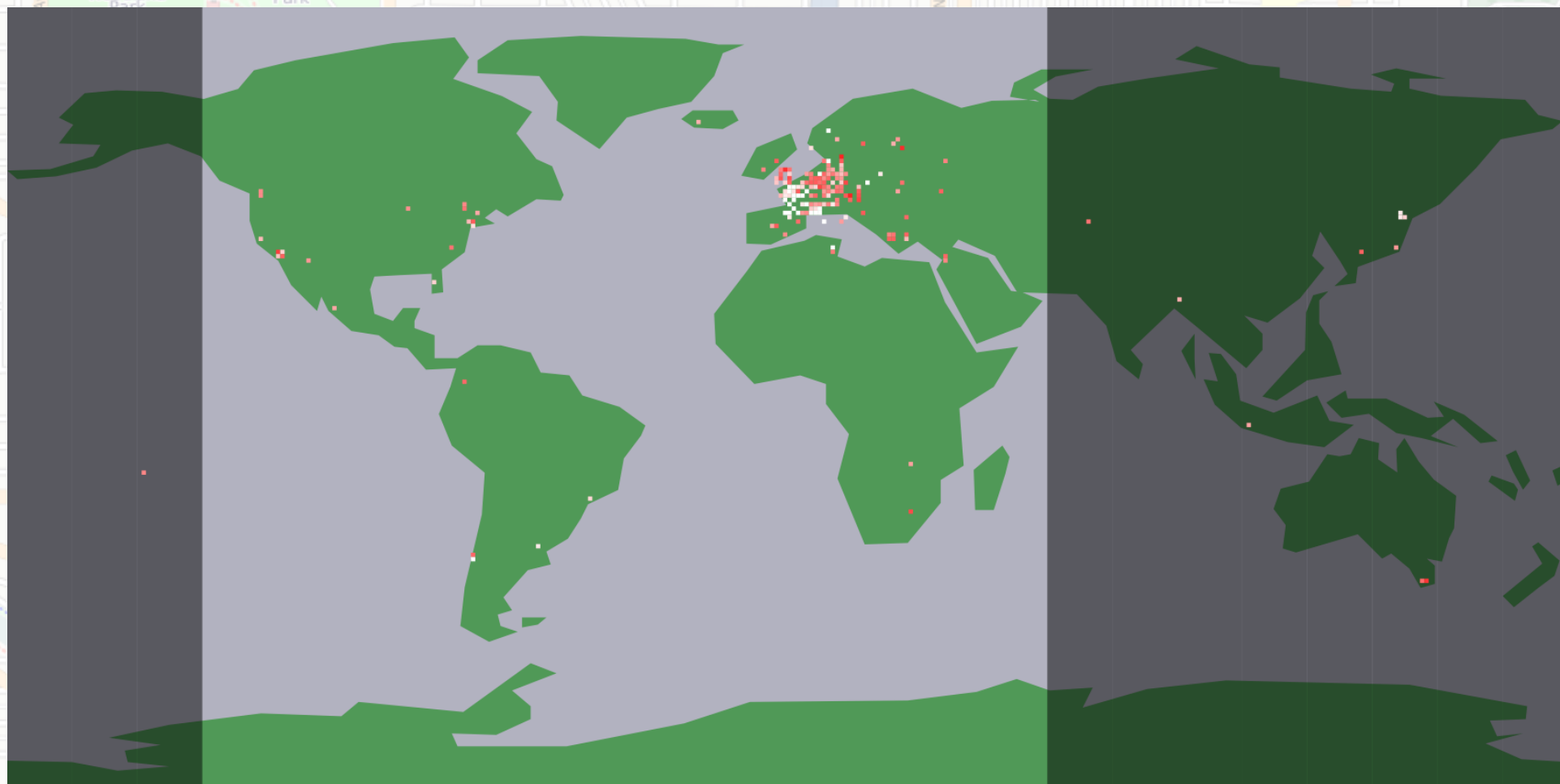


Editing @ 1PM UTC

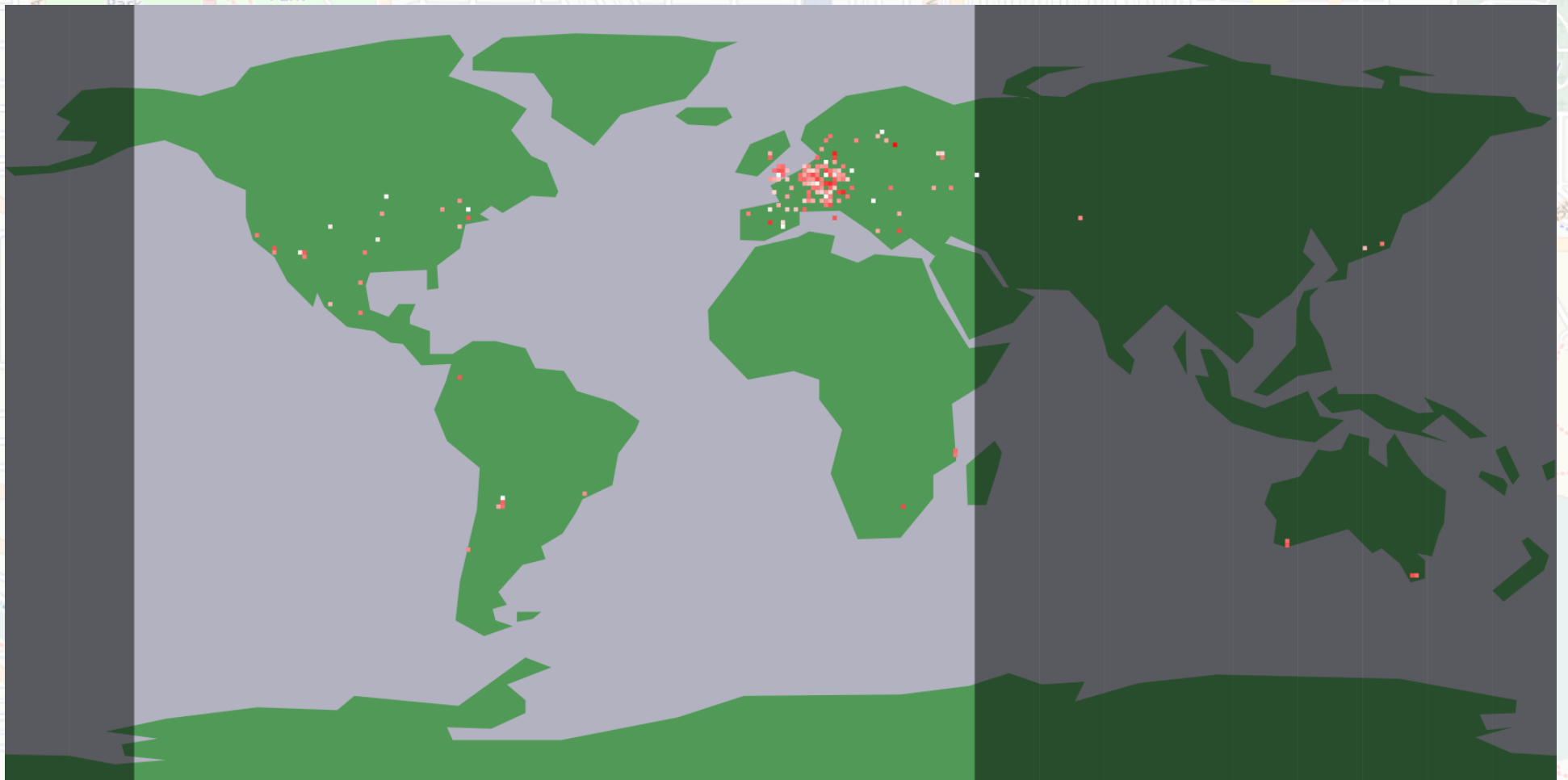




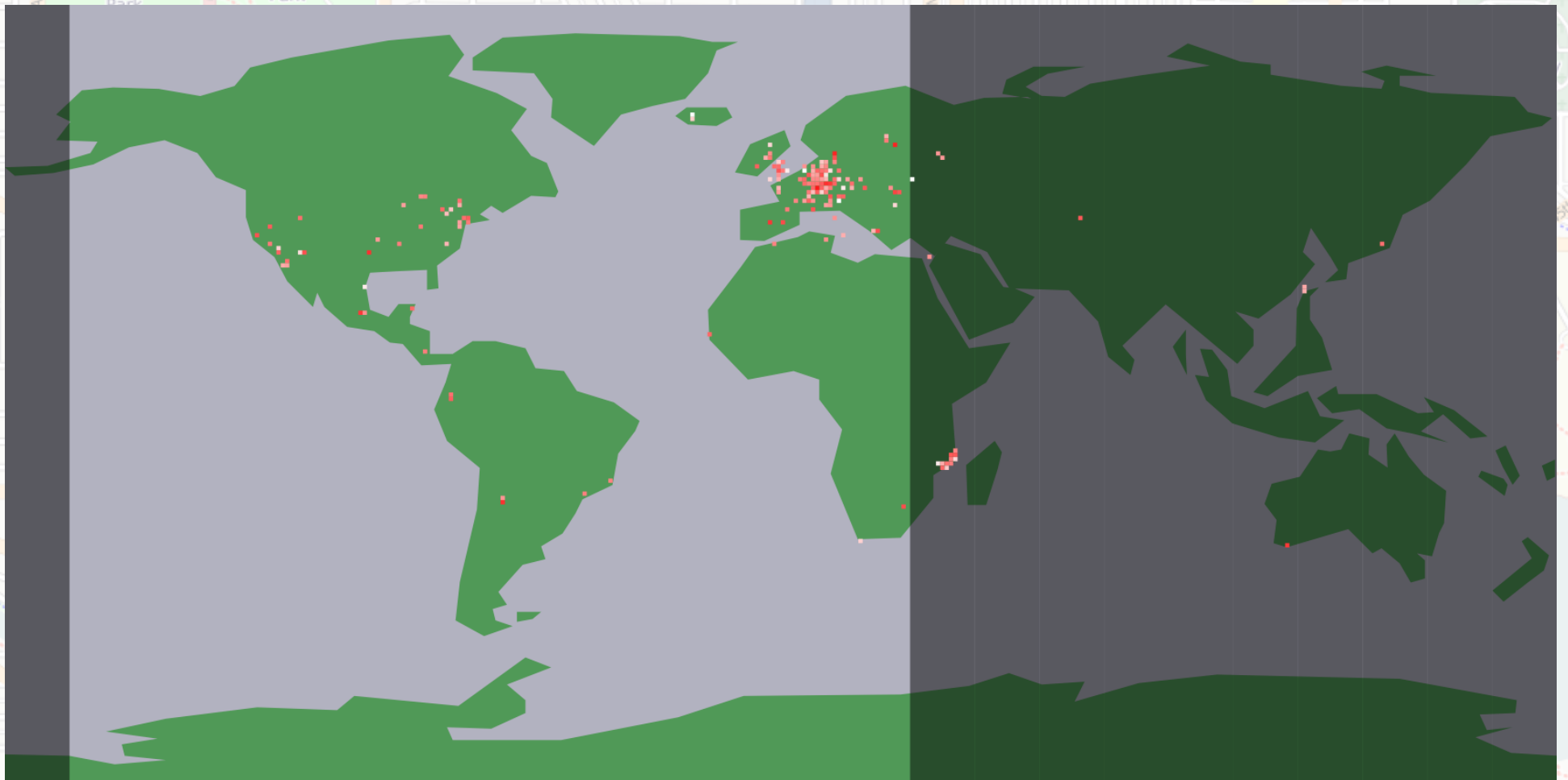
Editing @ 2PM UTC



Editing @ 3PM UTC

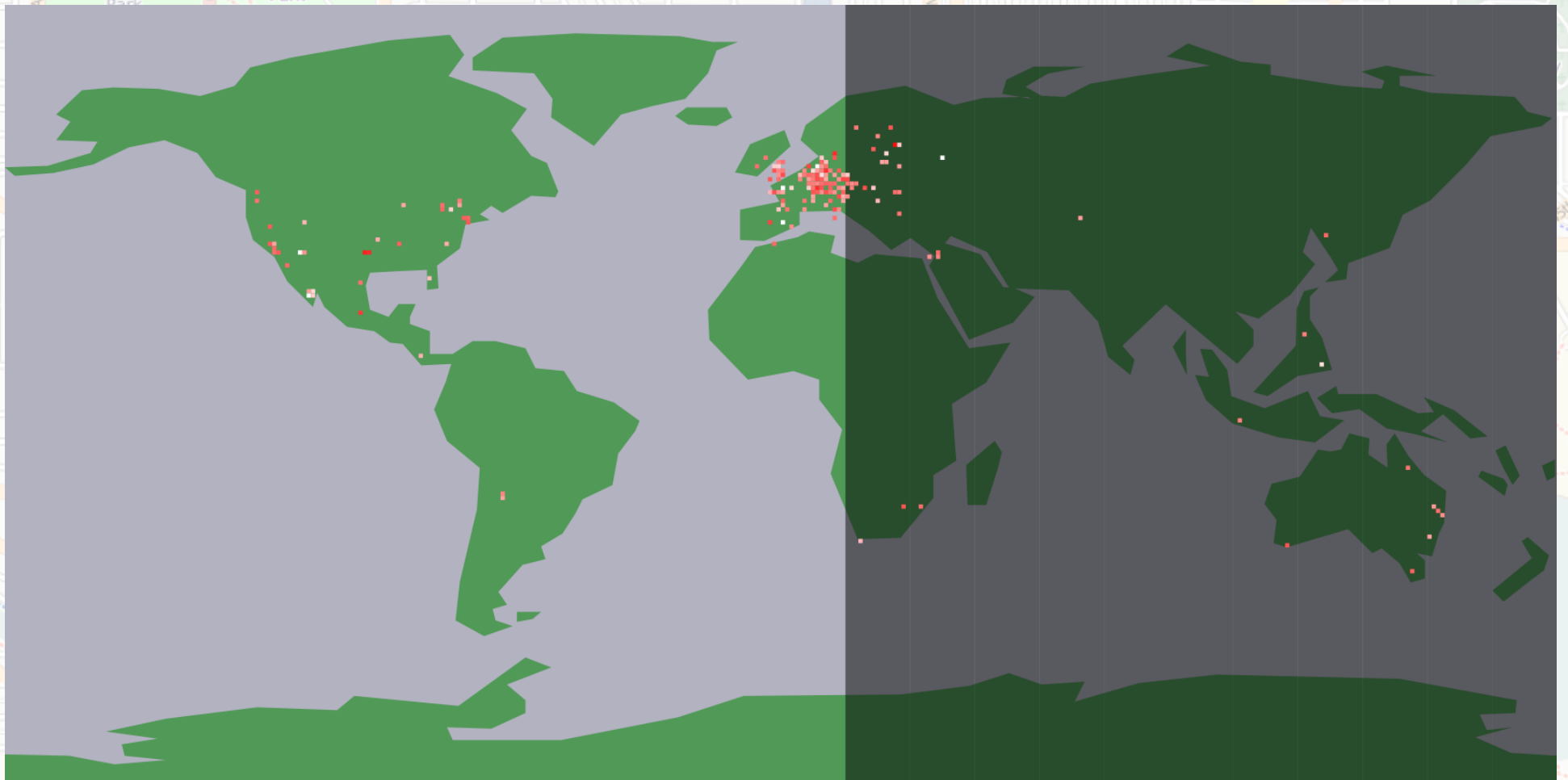


Editing @ 4PM UTC



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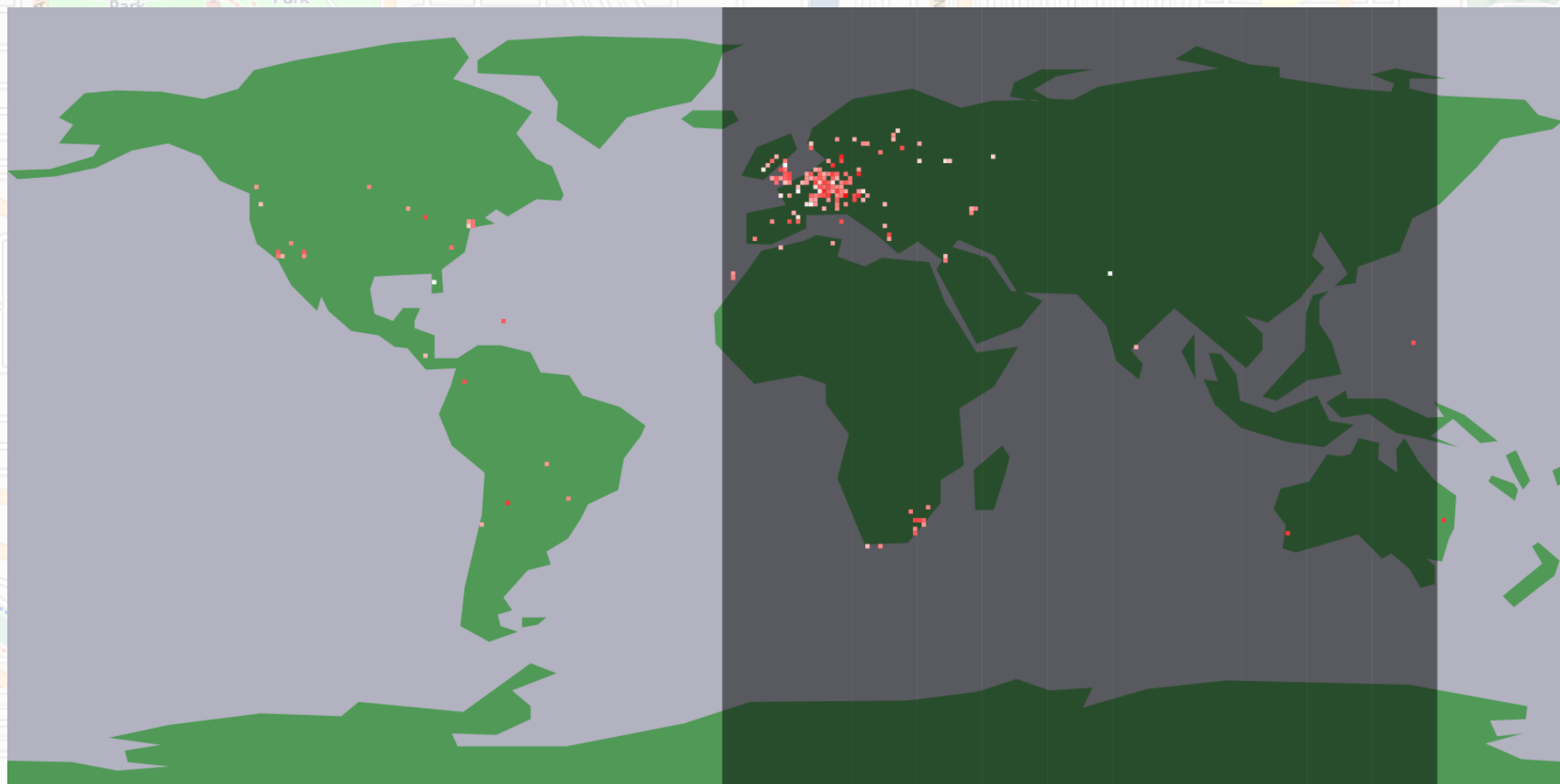




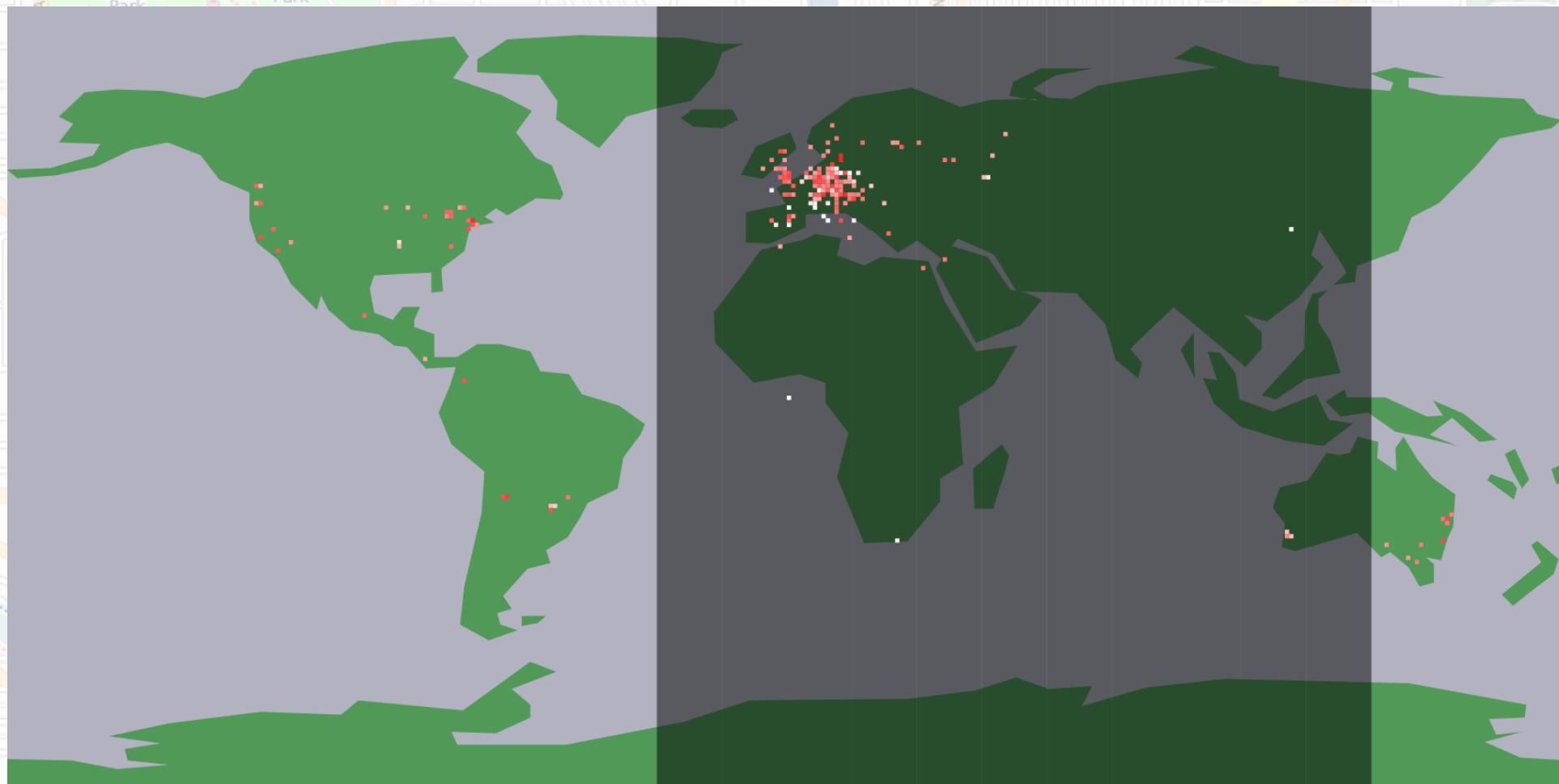
Editing @ 6PM UTC



Editing @ 7PM UTC

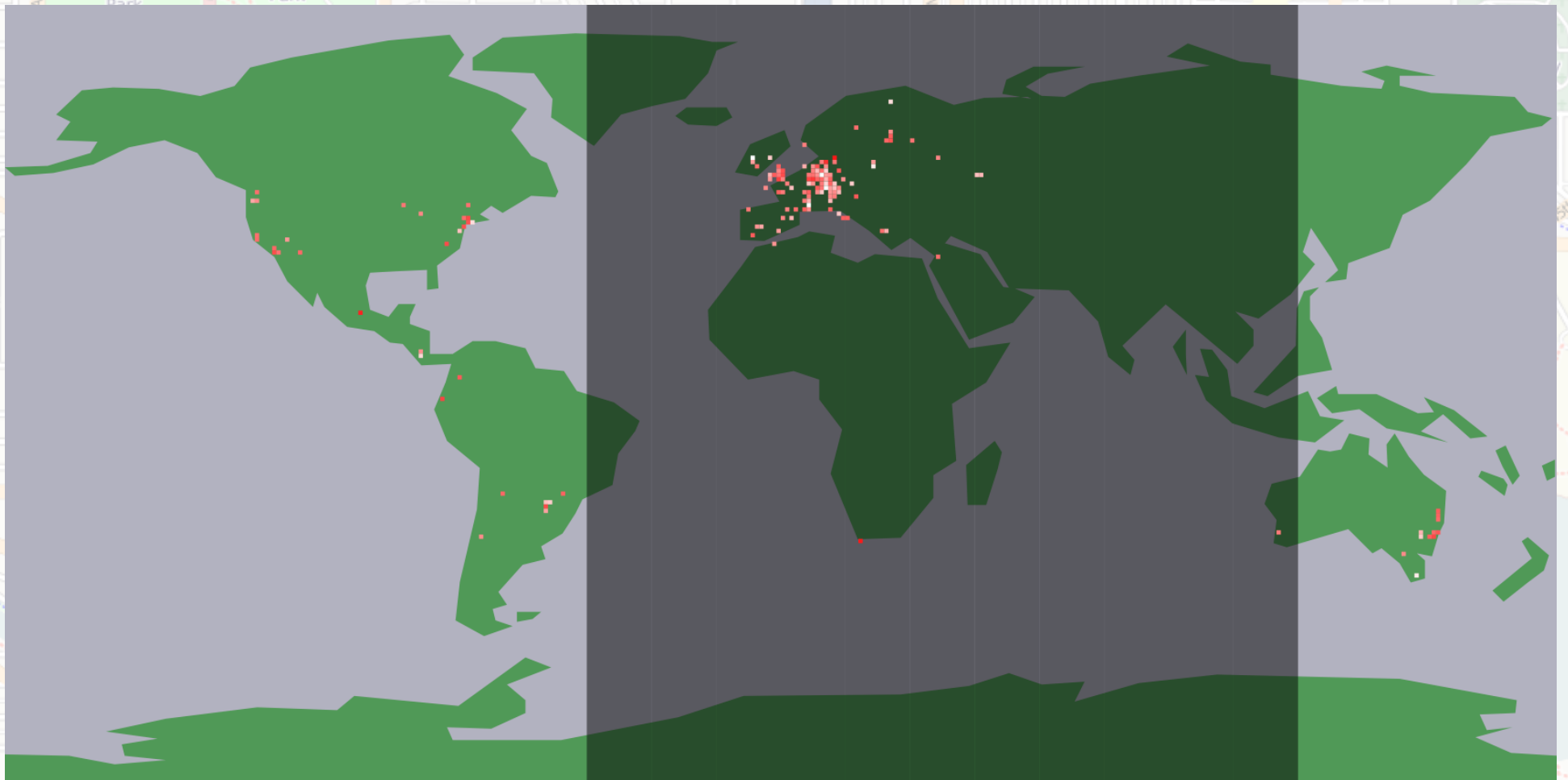


Editing @ 8PM UTC

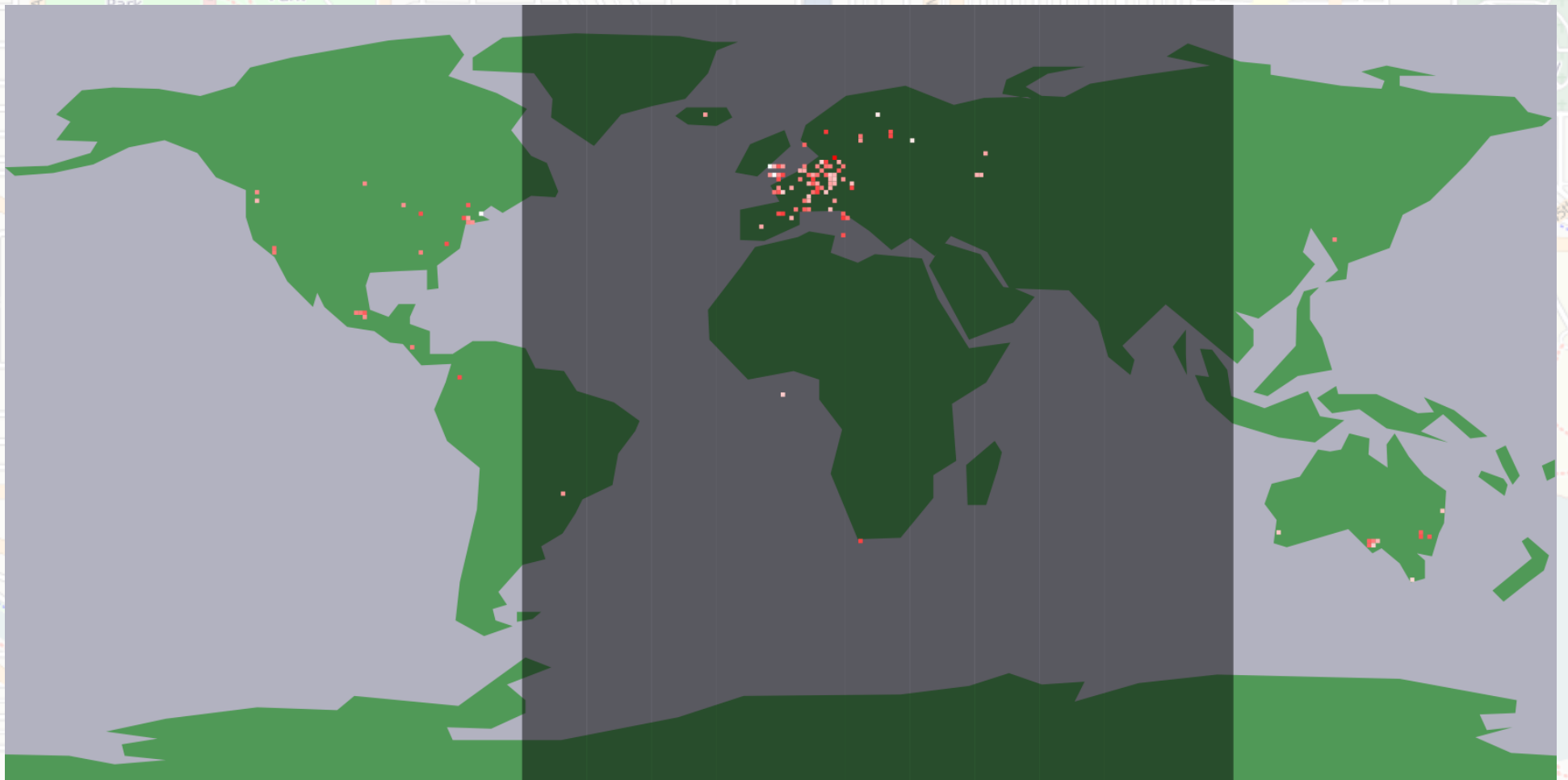


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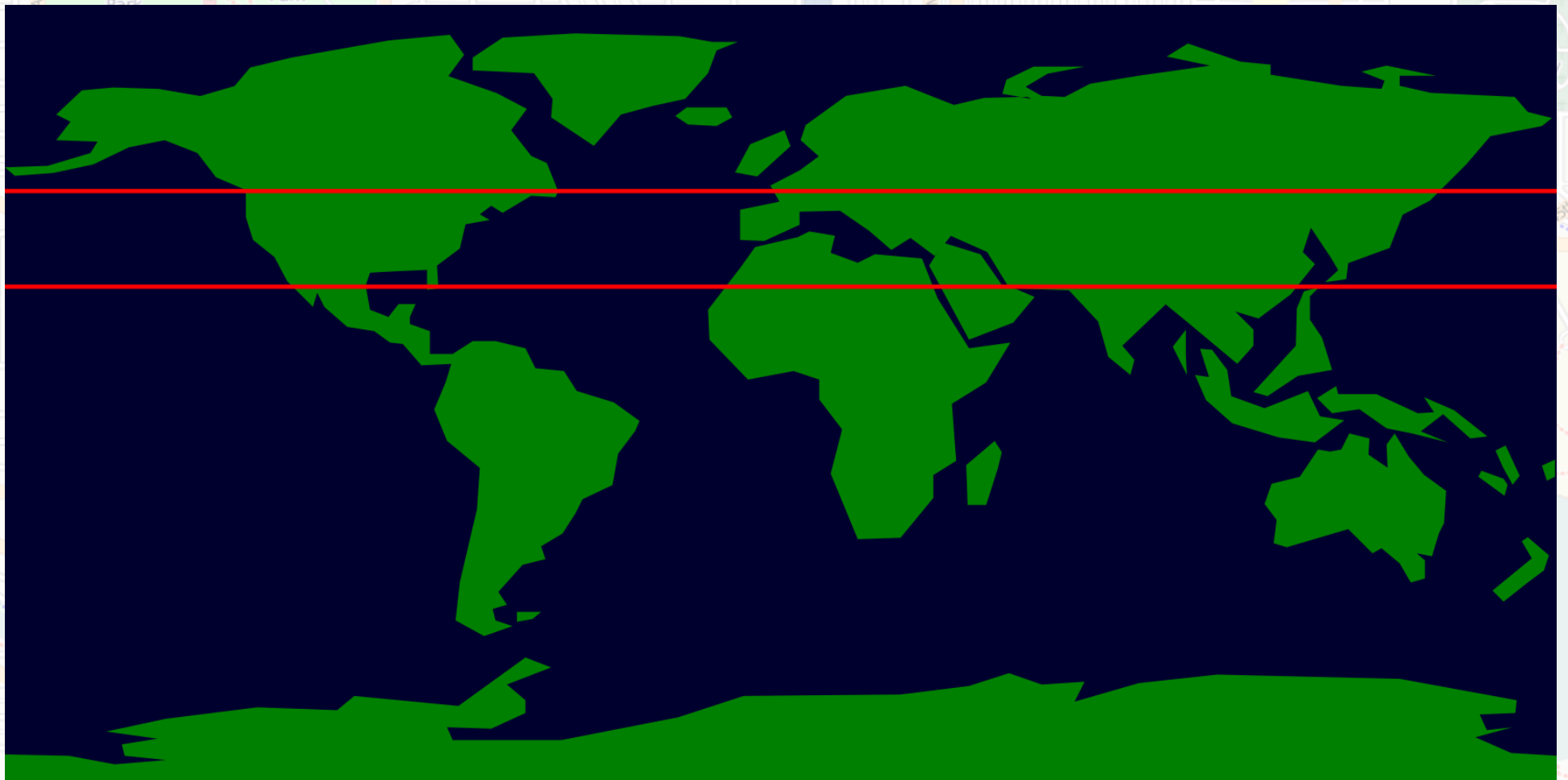




Editing @ 10PM UTC



Editing @ 11PM UTC



Static Latitude (3 servers)

# Finding Nodes

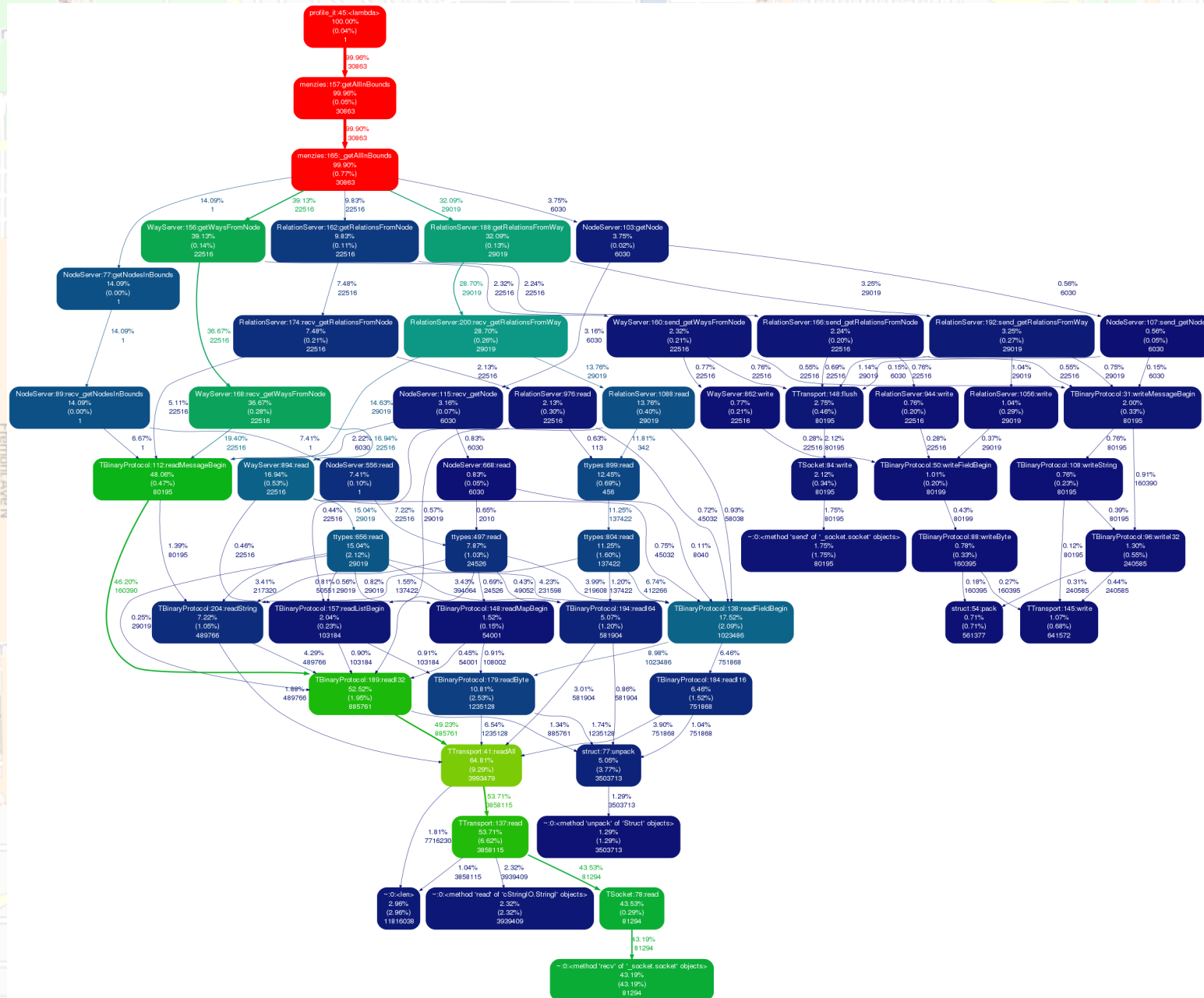
R-tree: Spatial index implementation



Three levels of the R-tree containing Africa



# Before Profiling

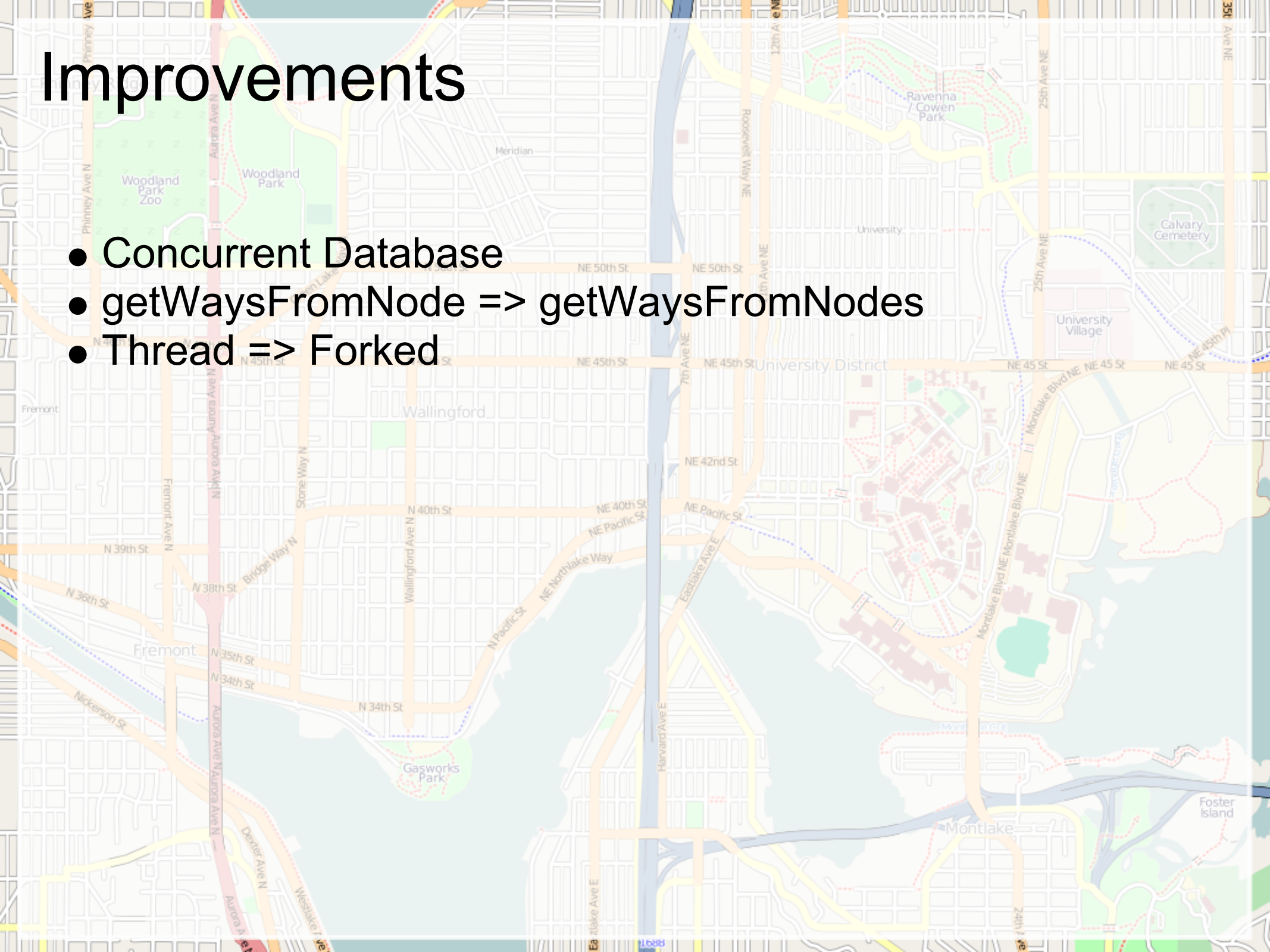




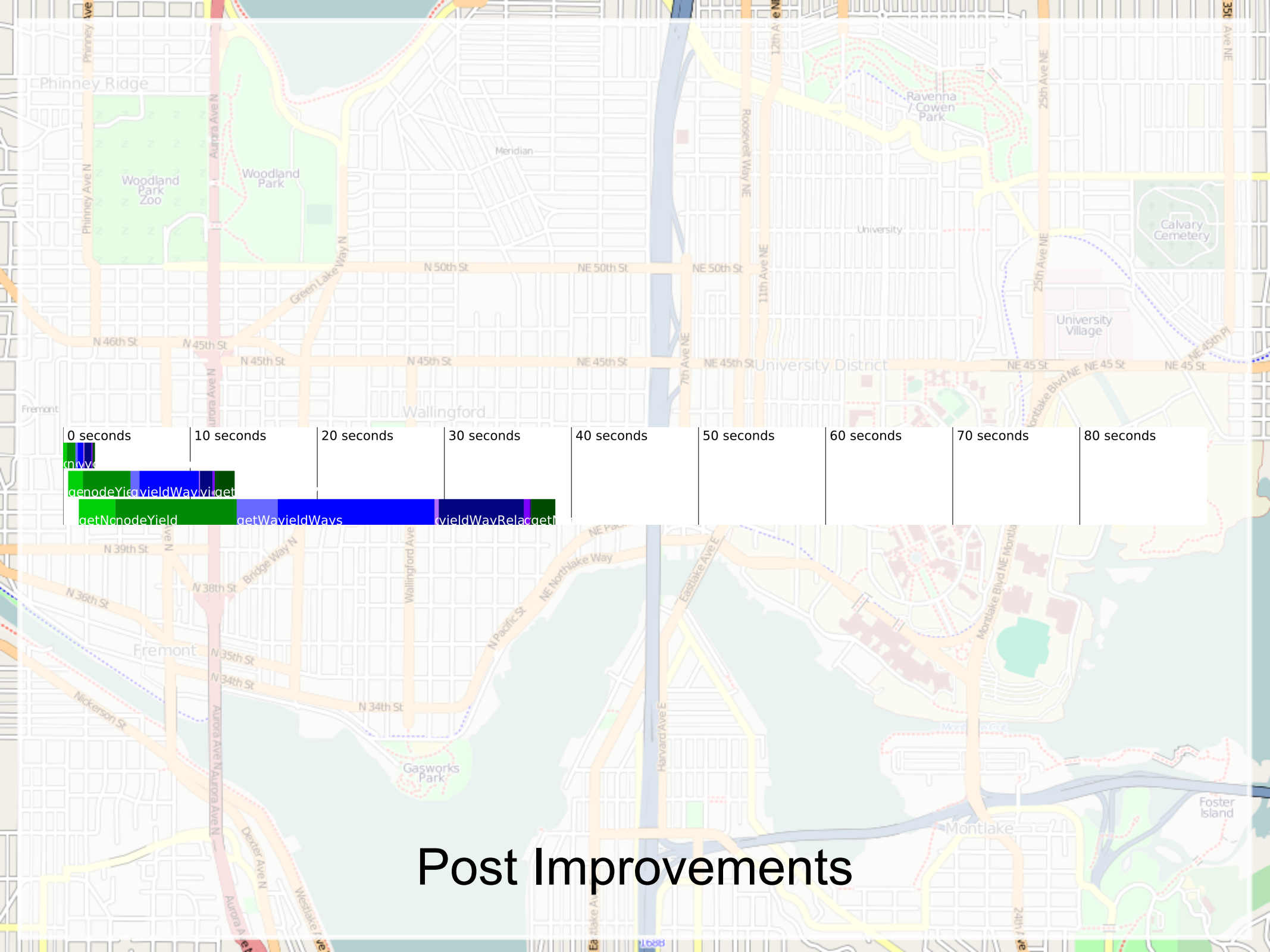
# UW, London and Brazil at Once

# Improvements

- Concurrent Database
- getWaysFromNode => getWaysFromNodes
- Thread => Forked







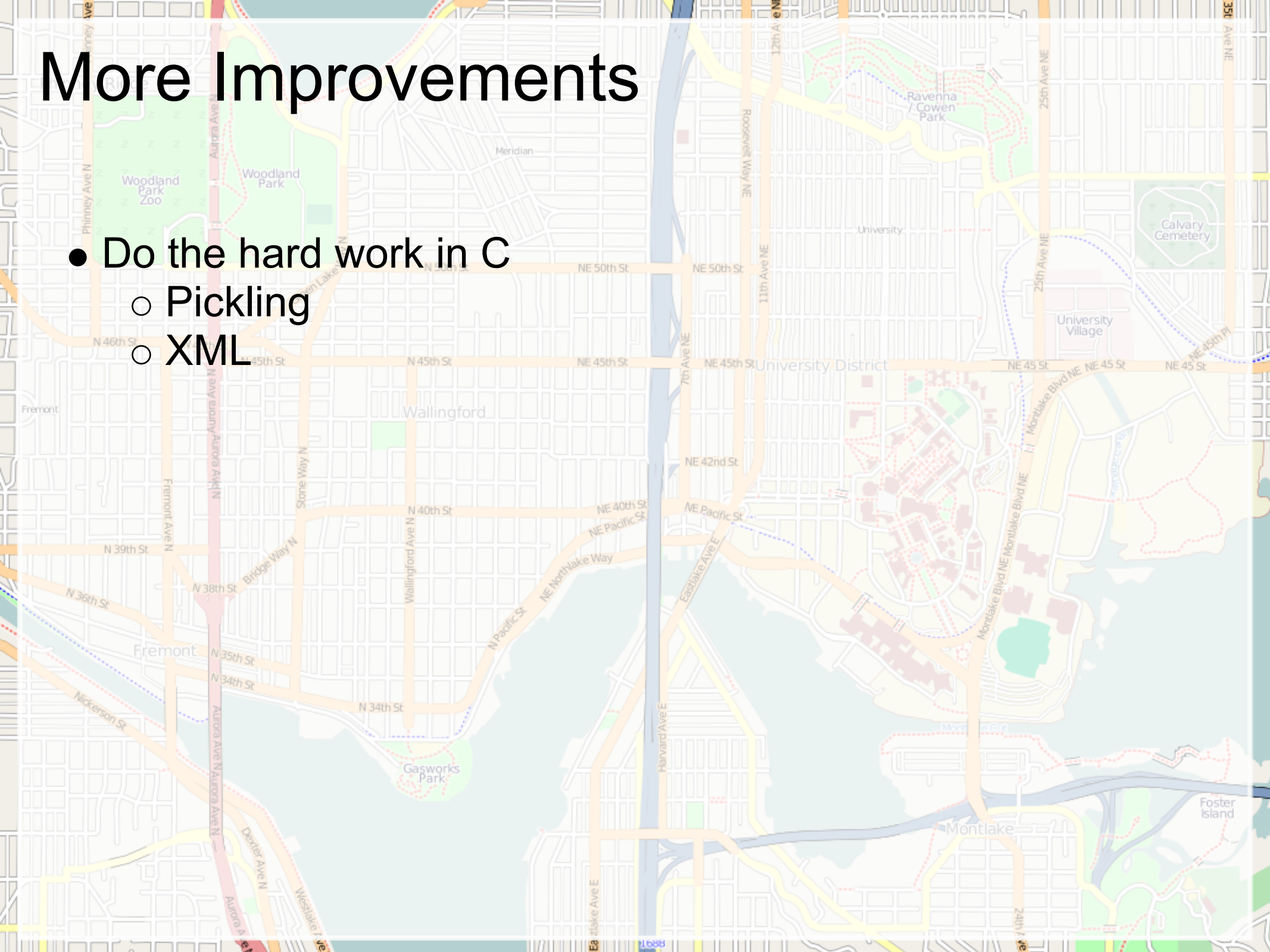
0 seconds	10 seconds	20 seconds	30 seconds	40 seconds	50 seconds	60 seconds	70 seconds	80 seconds
getNonNodeYield	getWayfieldWays	getWayfieldWays	getWayfieldWays	getWayfieldWays	getWayfieldWays	getWayfieldWays	getWayfieldWays	getWayfieldWays
getNonNodeYield	getWayfieldWays	getWayfieldWays	getWayfieldWays	getWayfieldWays	getWayfieldWays	getWayfieldWays	getWayfieldWays	getWayfieldWays

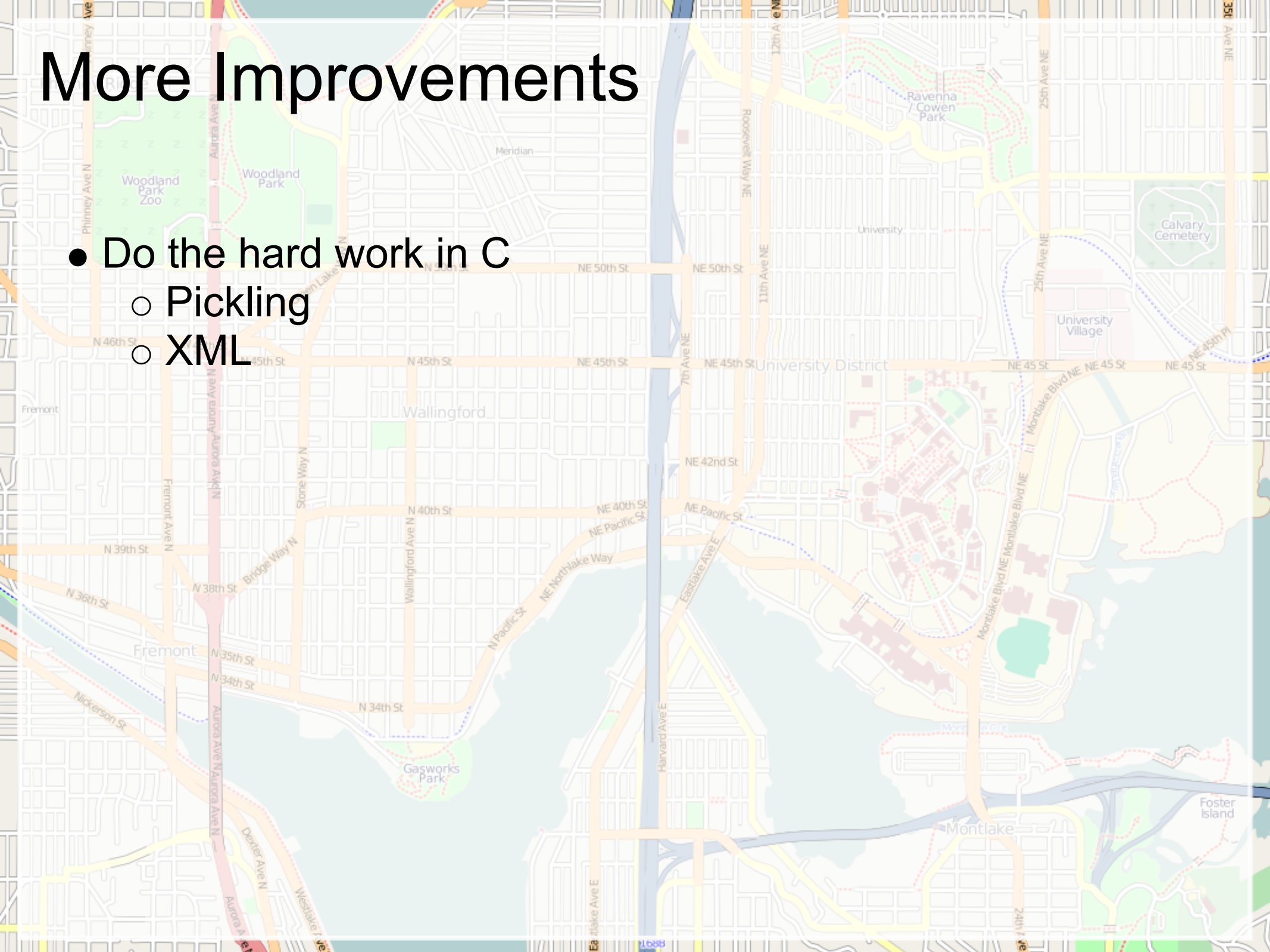
Post Improvements

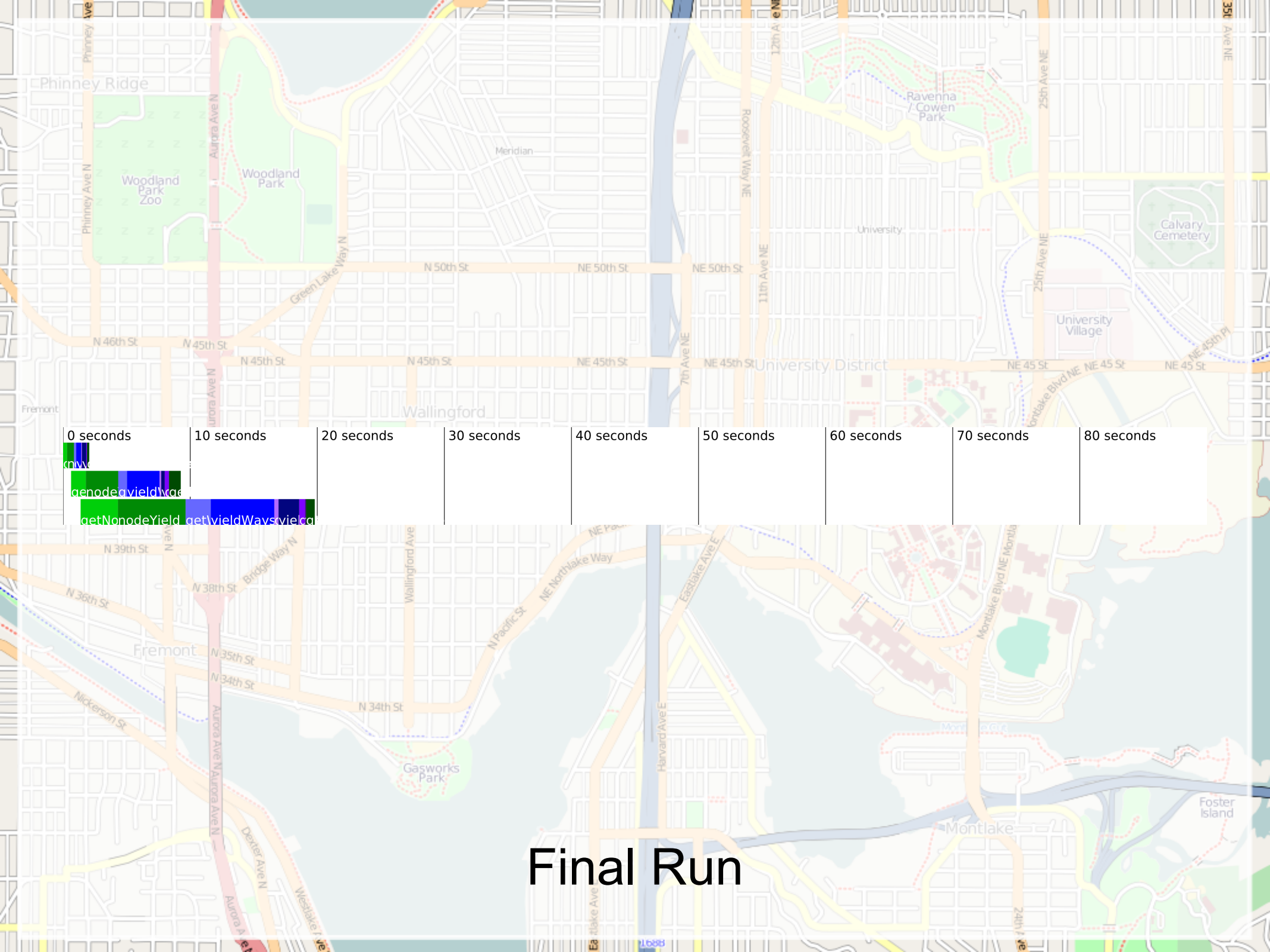


# More Improvements

- Do the hard work in C
  - Pickling
  - XML

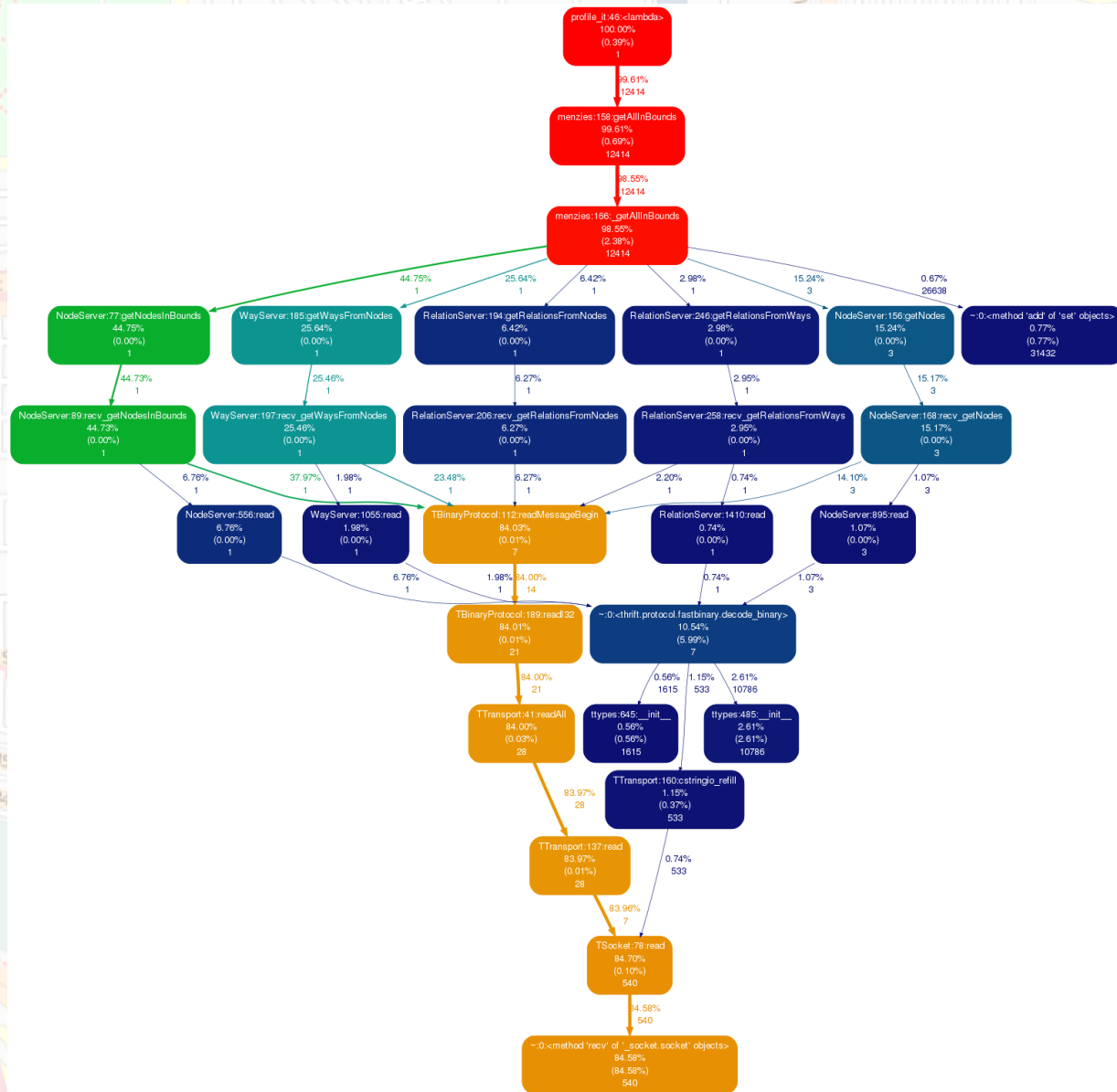


- # More Improvements
- Do the hard work in C
    - Pickling
    - XML
- 
- A map of the University District in Seattle, Washington. The map shows a grid of streets including NE 50th St, NE 45th St, NE 40th St, NE 35th St, NE 30th St, NE 25th St, NE 20th St, NE 15th St, NE 10th St, NE 5th St, NE 1st St, NE 48th St, NE 46th St, NE 44th St, NE 42nd St, NE 40th St, NE 38th St, NE 36th St, NE 34th St, NE 32nd St, NE 30th St, NE 28th St, NE 26th St, NE 24th St, NE 22nd St, NE 20th St, NE 18th St, NE 16th St, NE 14th St, NE 12th St, NE 10th St, NE 8th St, NE 6th St, NE 4th St, NE 2nd St, NE 1st St, NE 48th St, NE 46th St, NE 44th St, NE 42nd St, NE 40th St, NE 38th St, NE 36th St, NE 34th St, NE 32nd St, NE 30th St, NE 28th St, NE 26th St, NE 24th St, NE 22nd St, NE 20th St, NE 18th St, NE 16th St, NE 14th St, NE 12th St, NE 10th St, NE 8th St, NE 6th St, NE 4th St, NE 2nd St, NE 1st St. Landmarks include Woodland Park, Gasworks Park, University Village, and Foster Island. The map is overlaid with a grid of streets and a network of red and blue lines representing transit routes.



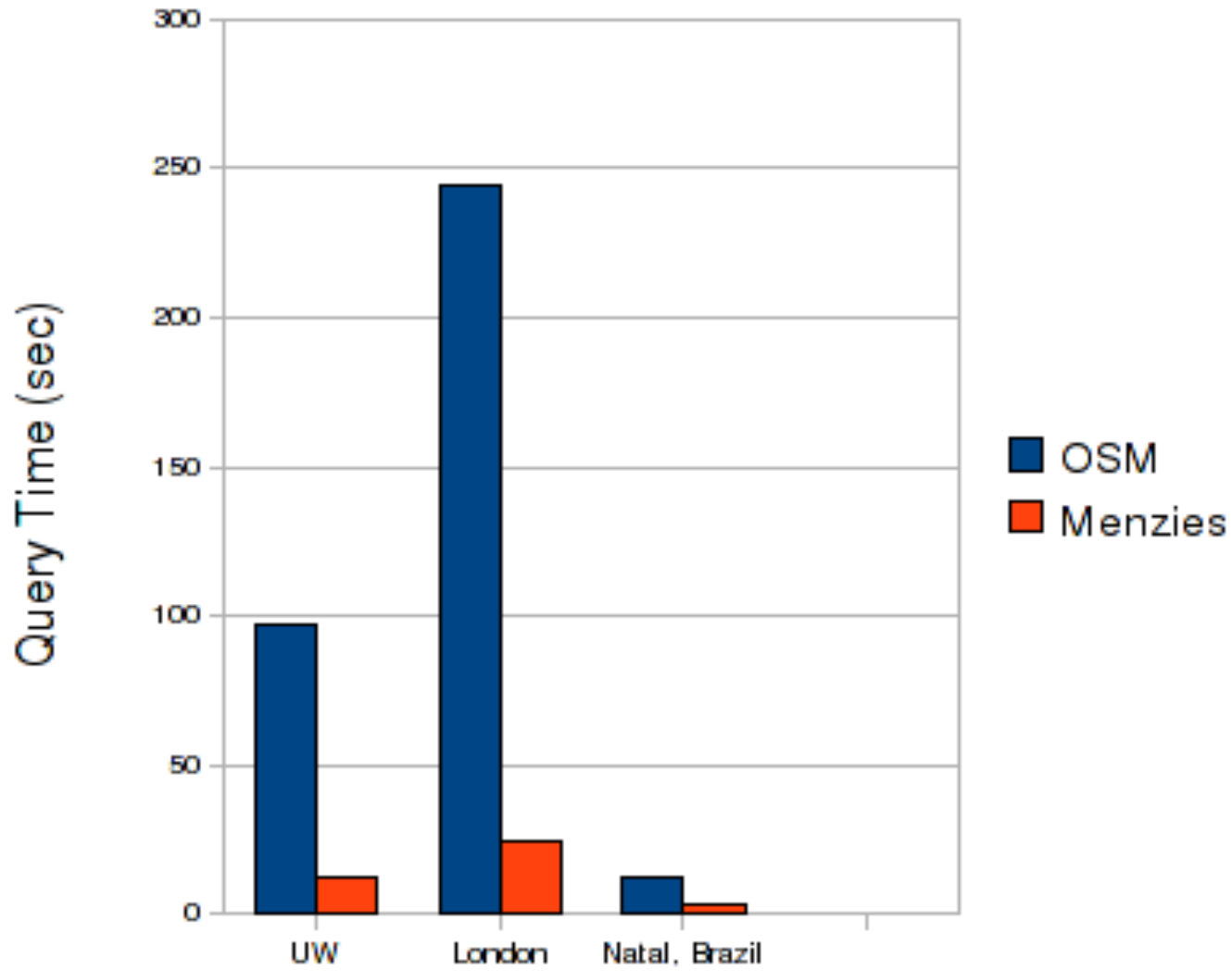
Final Run

# After Profiling





# Comparison



Bounding Box Queries