Case Study: Wind Sports Mashup on Google App Engine

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Explaining the title

Case Study:
Wind Sports Mashup
on Google App Engine

Explaining the title

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The problem: finding the wind

- direction
- speed
- spot
- time

Explaining the title

Case Study:
Wind Sports Mashup
on Google App Engine

Agenda

Motivation, vision, and demo

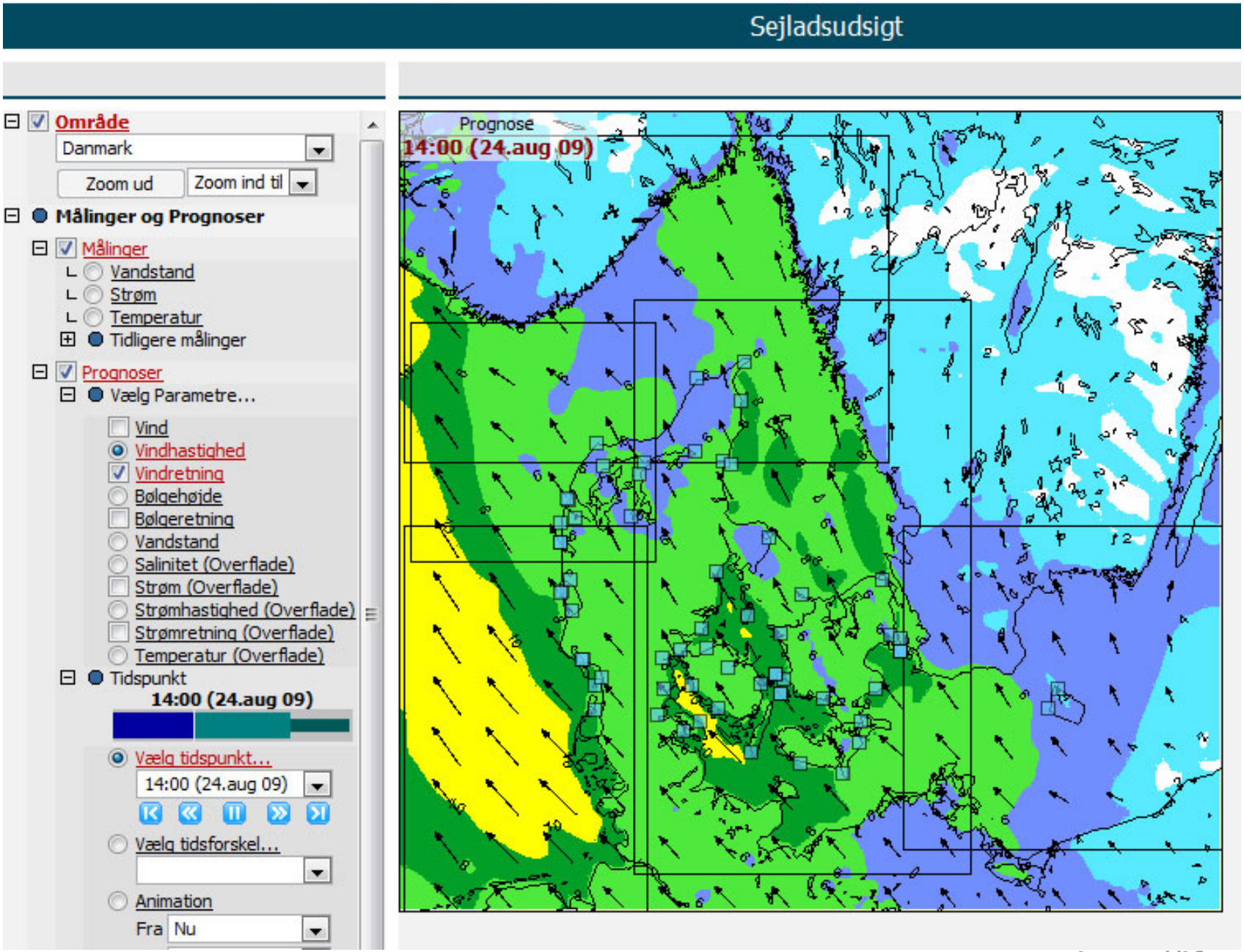
Architectural overview

Problem: No cron jobs (GAE)

Challenge: Inequality filters on one property only (GAE)

Challenge: Result set <= 1000 entities (GAE)

Motivation



http://ifm.frv.dk/

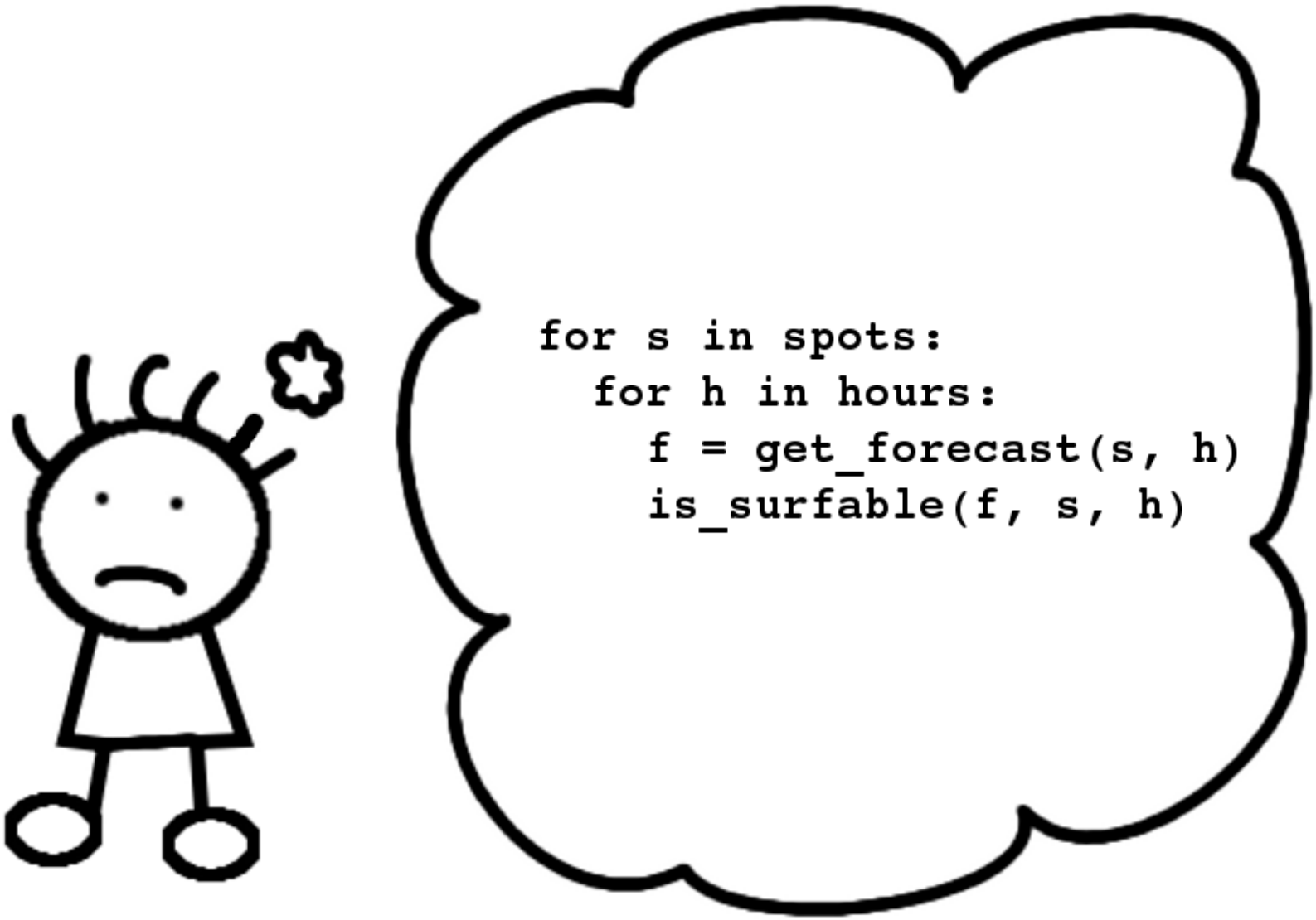
Motivation

http://www.dmi.dk/dmi/index/danmark/borgervejr.htm?map=map1&param=wind

Key predicate

```
is_surfable(direction,
  speed, spot, time)
```

Problem



+

+

+

wind sports info and logic

=

A global mashup that assists practitioners of wind sports

Demo

http://welovewind.com

How to make it fly?

Serving infrastructure

Google App Engine

Google App Engine

GAE Restrictions Feb '09

Python only

Request duration <= 10 seconds

Request only way to start processing

Inequality filters on one property only

...

Restrictions lifted since

Python only (Java, JRE subset)

Request duration <= 10 seconds (30 seconds)

Request only way to start processing
(cron jobs, however, only 20)

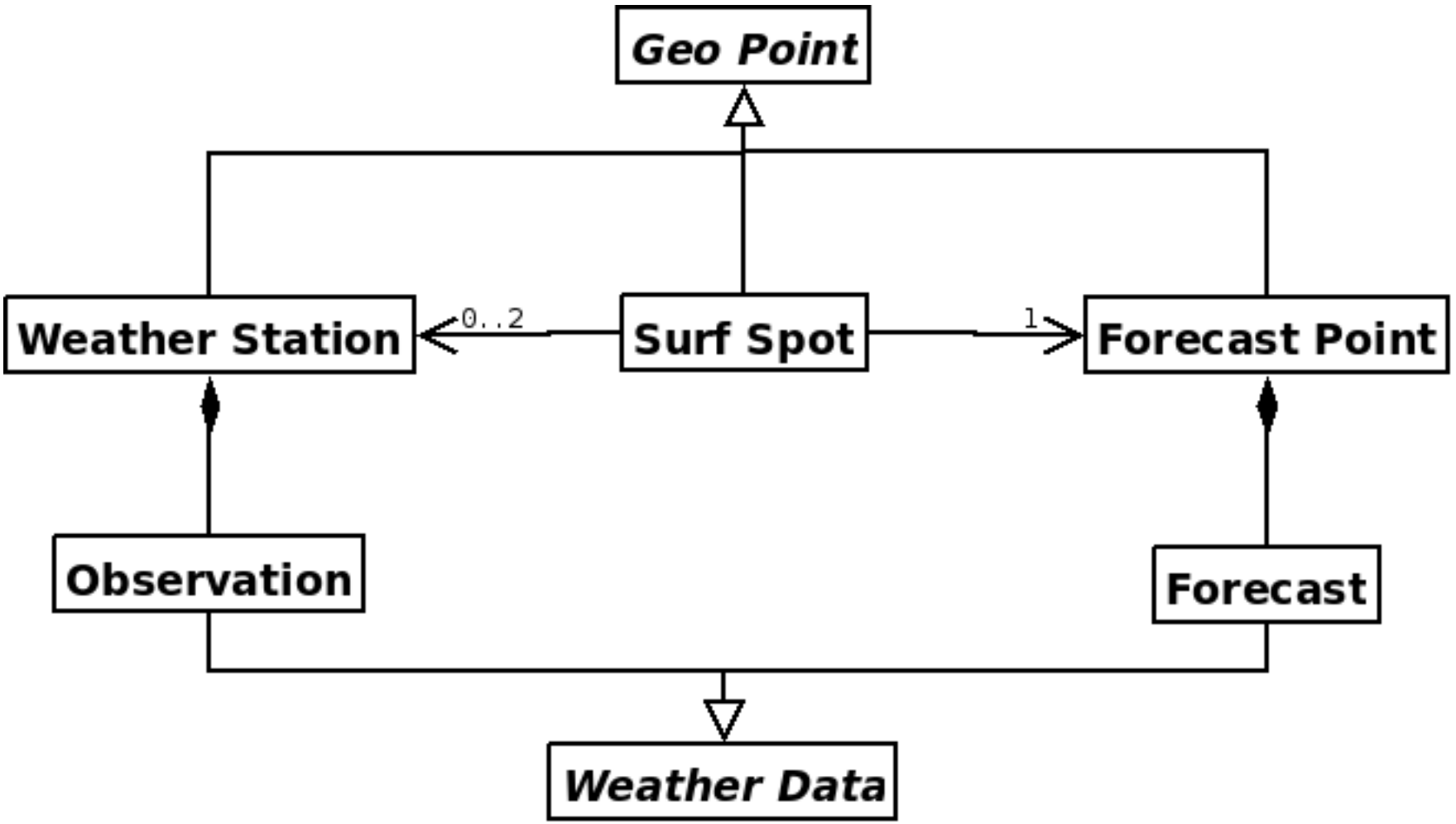
Inequality filters on one property only

Experimental Task Queue for offline processing

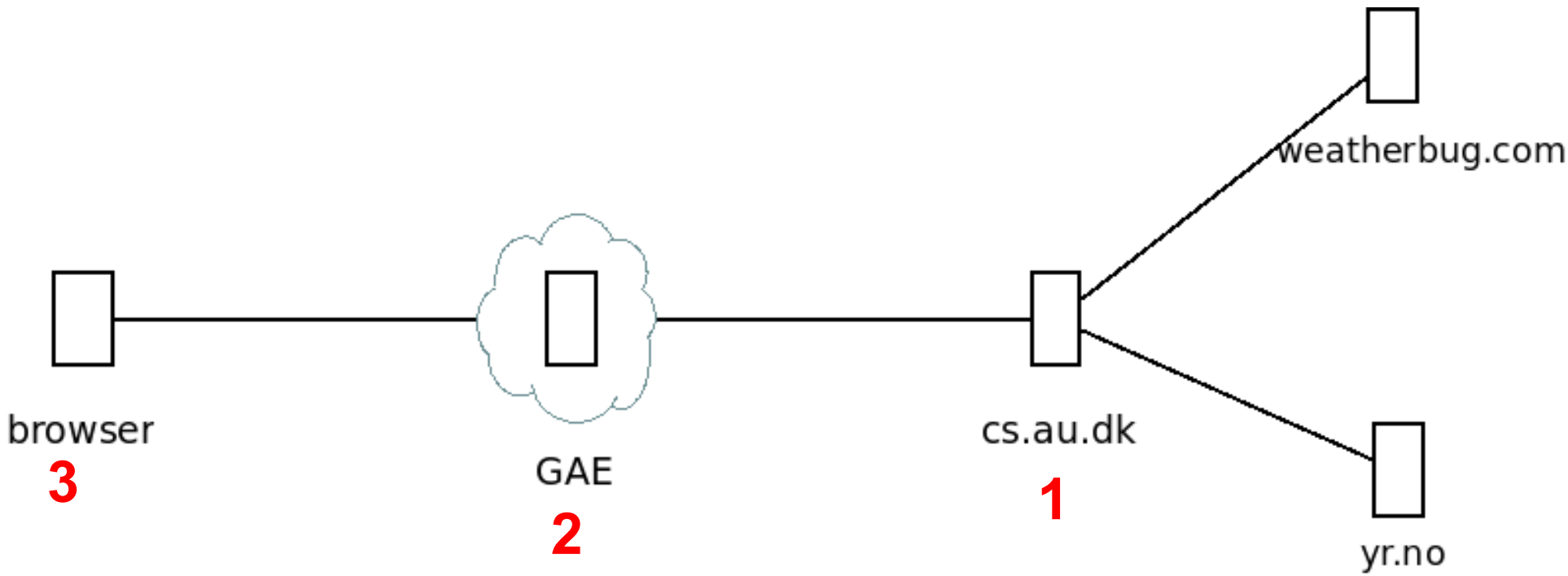
How to make it fly?

A web service for connecting all the distributed resources

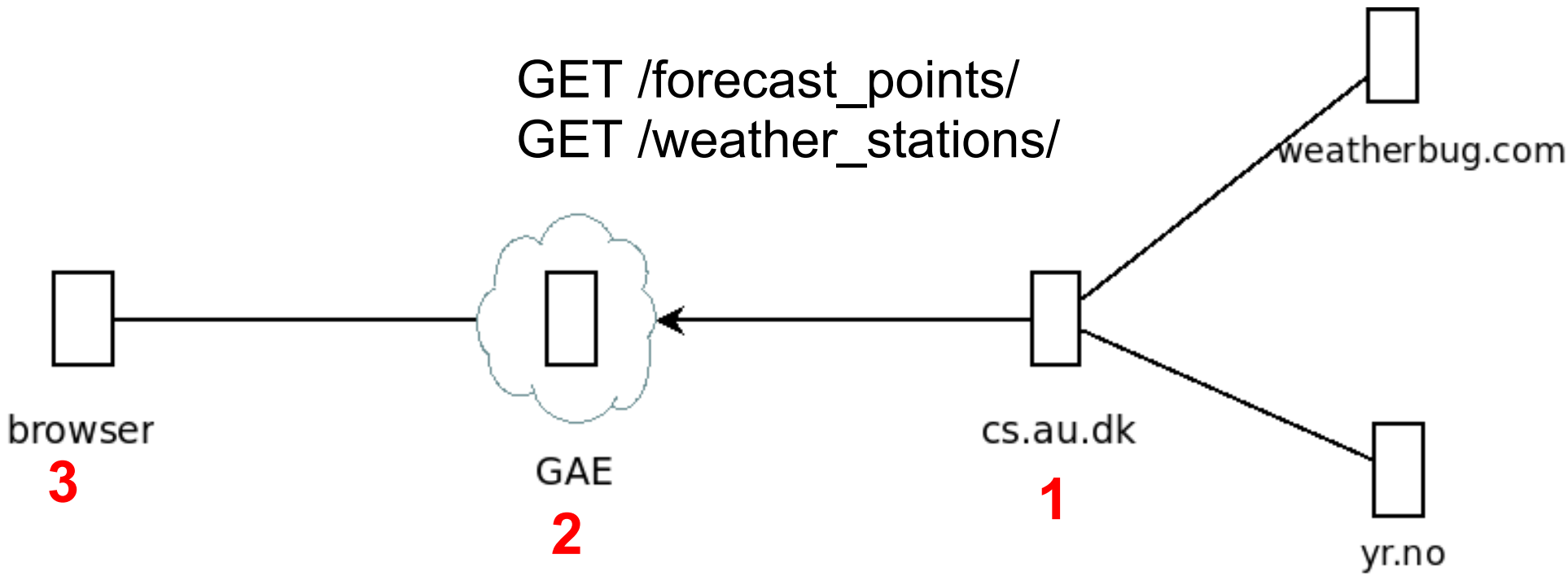
Web service data model



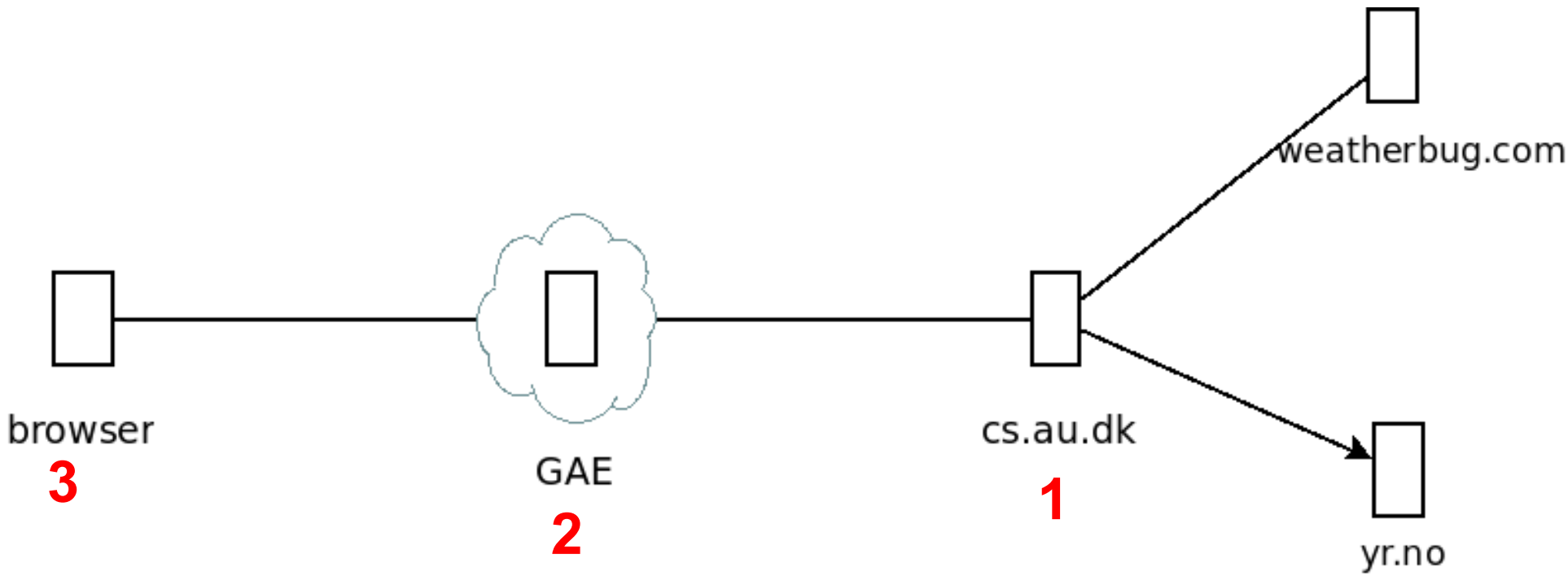
Architecture



Architecture



Architecture

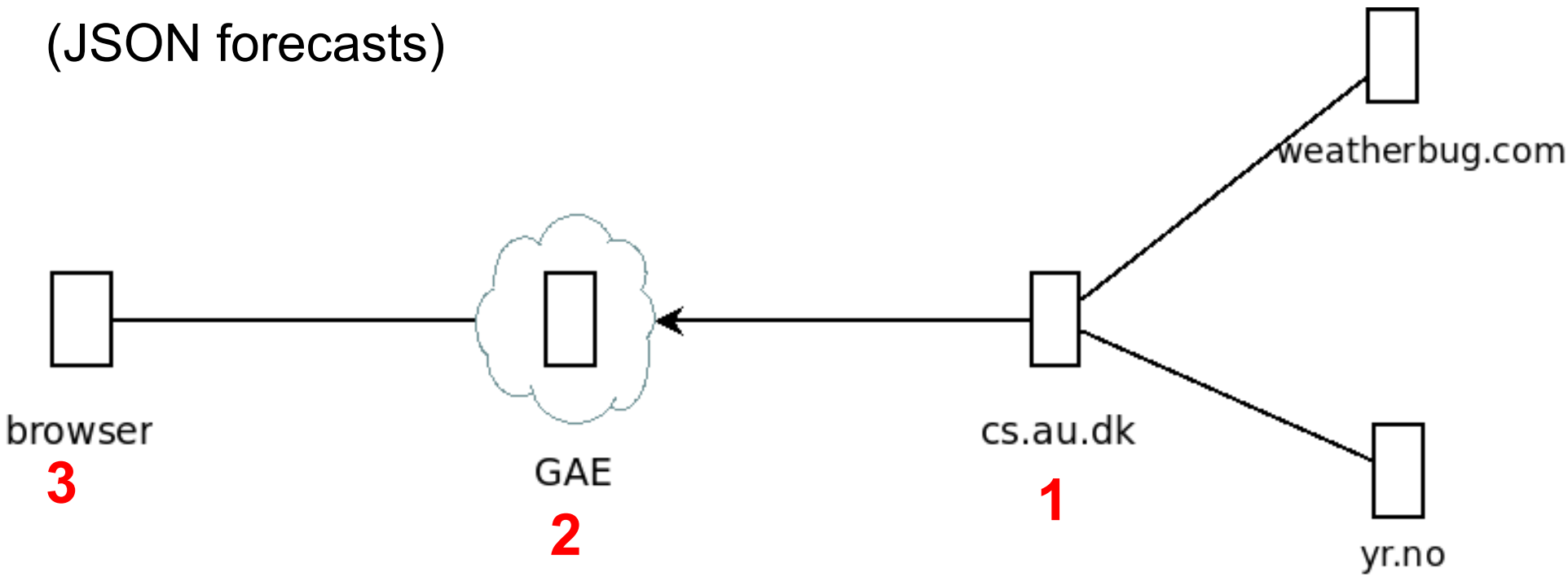


GET /weatherapi/locationforecast/1.6/?lat=56.2274;lon=10.3083
Host: api.yr.no

Architecture

PUT /forecast_points/56.2274,10.3083/

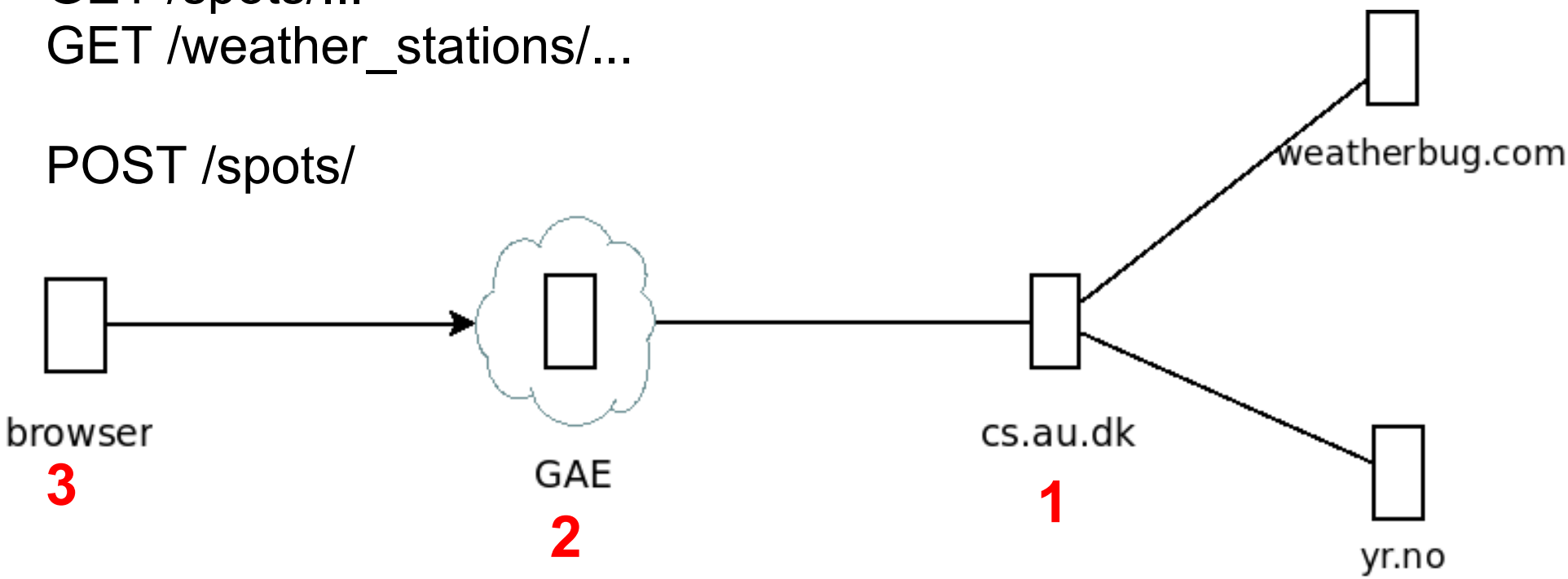
(JSON forecasts)



Architecture

GET /forecast_points/...
GET /spots/...
GET /weather_stations/...

POST /spots/



Problem:

How to flush out stale weather data?

Solutions:

Delete stale data with a cron job.

Solutions:

Delete stale data with a cron job.

Maintain when inserting weather data.

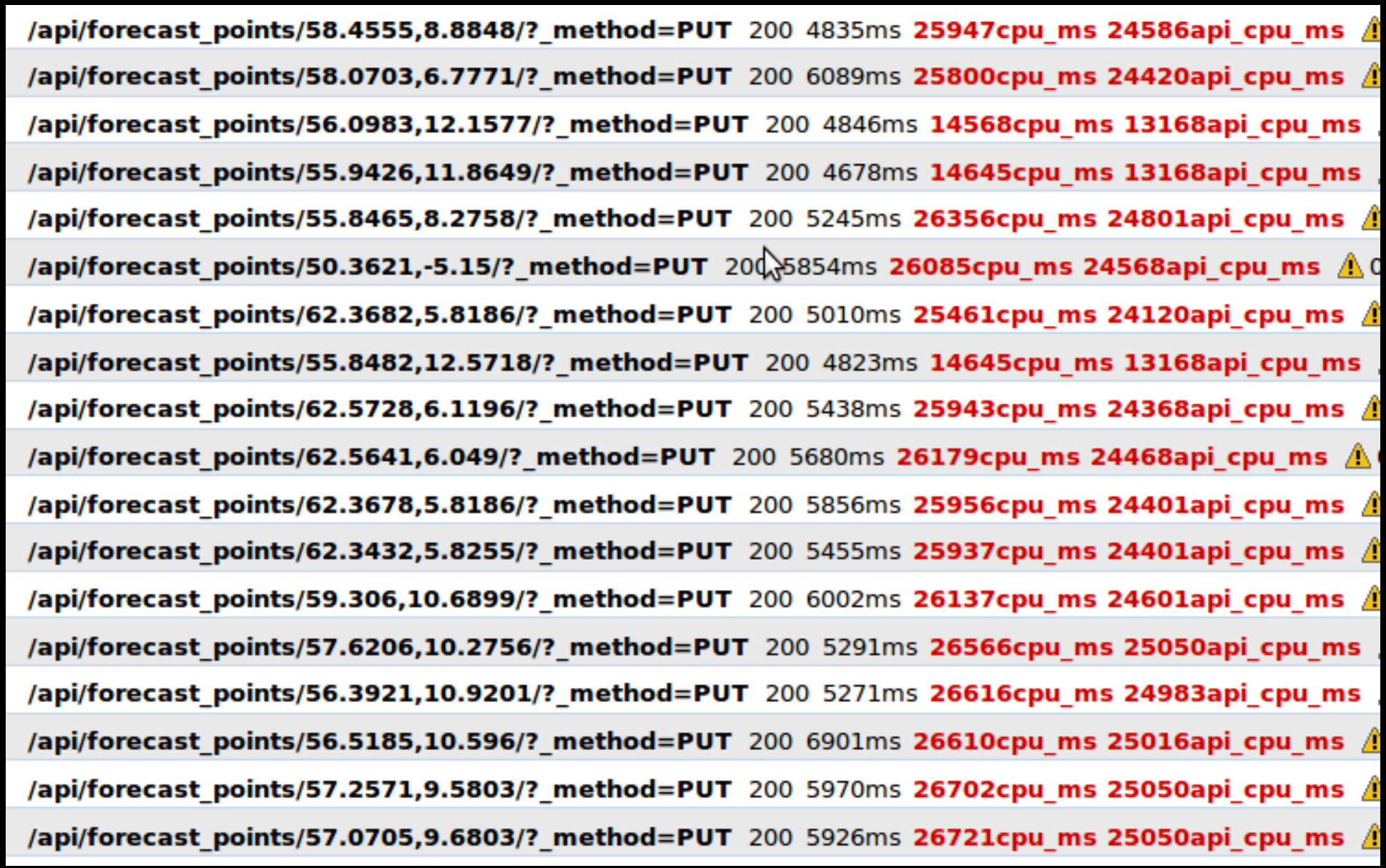
- Update "existing" or insert new entity if non-existing

How? Reuse db keys

Forecast key names:
/forecast_points/-23.0161,-43.3063/time_delta/9/
/forecast_points/-23.0161,-43.3063/time_delta/12/
/forecast_points/-23.0161,-43.3063/time_delta/15/
...

Calculating time delta:
time_delta = forecast time - calculation time

Too resource intensive



~100 entities for each forecast point are updated

Solutions cont'd:

Combine the one-to-many relationship into one entity.

```
class ForecastPoint(db.Model):
  point = db.GeoPtProperty()
  calculation_time = db.DateTimeProperty()
  forecasts = db.TextProperty()
  ...
```

```
class ForecastPoint(db.Model):
  point = db.GeoPtProperty()
  calculation_time = db.DateTimeProperty()
  forecasts = db.TextProperty()
  ...

forecasts is a JSON list:

[
  {
    "direction": 269.1,
    "speed": 6.2,
    "temp": 7.7,
    "time": "2009-10-04T23:00:00"
  },(...)
]
```

Forecasts as entities:

```
/api/forecast_points/58.4555,8.8848/?_method=PUT 200 4835ms 25947cpu_ms 24586api_cpu_ms
/api/forecast_points/58.0703,6.7771/?_method=PUT 200 6089ms 25800cpu_ms 24420api_cpu_ms
```

Forecasts as text:

```
/api/forecast_points/57.6206,10.2756/?_method=PUT 200 130ms 202cpu_ms 115api_cpu_ms 0k
/api/forecast_points/56.3921,10.9201/?_method=PUT 200 232ms 198cpu_ms 115api_cpu_ms 0k
/api/forecast_points/56.5185,10.596/?_method=PUT 200 133ms 195cpu_ms 115api_cpu_ms 0kb
/api/forecast_points/57.2571,9.5803/?_method=PUT 200 129ms 203cpu_ms 115api_cpu_ms 0kb
/api/forecast_points/57.0705,9.6803/?_method=PUT 200 139ms 194cpu_ms 115api_cpu_ms 0kb
/api/forecast_points/57.1233,8.6291/?_method=PUT 200 117ms 200cpu_ms 115api_cpu_ms 0kb
/api/forecast_points/57.0445,8.4787/?_method=PUT 200 119ms 201cpu_ms 115api_cpu_ms 0kb
/api/forecast_points/56.5194,8.7413/?_method=PUT 200 96ms 197cpu_ms 115api_cpu_ms 0kb
/api/forecast_points/58.1905,8.0719/?_method=PUT 200 1106ms 205cpu_ms 115api_cpu_ms 0k
/api/forecast_points/58.8831,5.6025/?_method=PUT 200 121ms 193cpu_ms 115api_cpu_ms 0kb
/api/forecast_points/56.0929,12.4686/?_method=PUT 200 114ms 194cpu_ms 115api_cpu_ms 0k
/api/forecast_points/56.126,12.3105/?_method=PUT 200 341ms 210cpu_ms 115api_cpu_ms 0kb
/api/forecast_points/56.1081,12.3692/?_method=PUT 200 99ms 200cpu_ms 115api_cpu_ms 0kb
/api/forecast_points/55.9272,12.5191/?_method=PUT 200 99ms 200cpu_ms 115api_cpu_ms 0kb
```

Agenda

Motivation, vision, and demo

Architectural overview

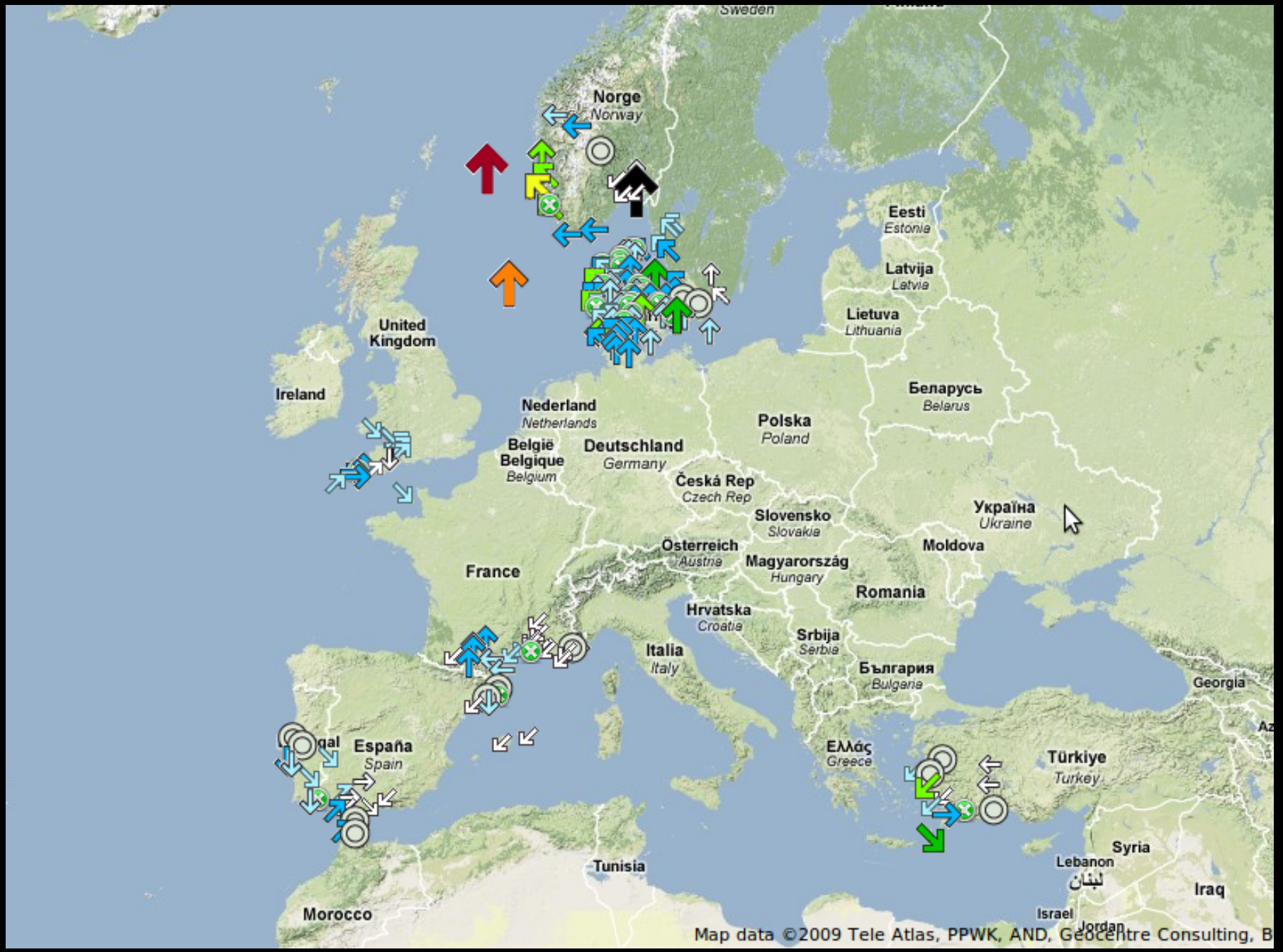
Problem: No cron jobs (GAE)

Challenge: Inequality filters on one property only (GAE)

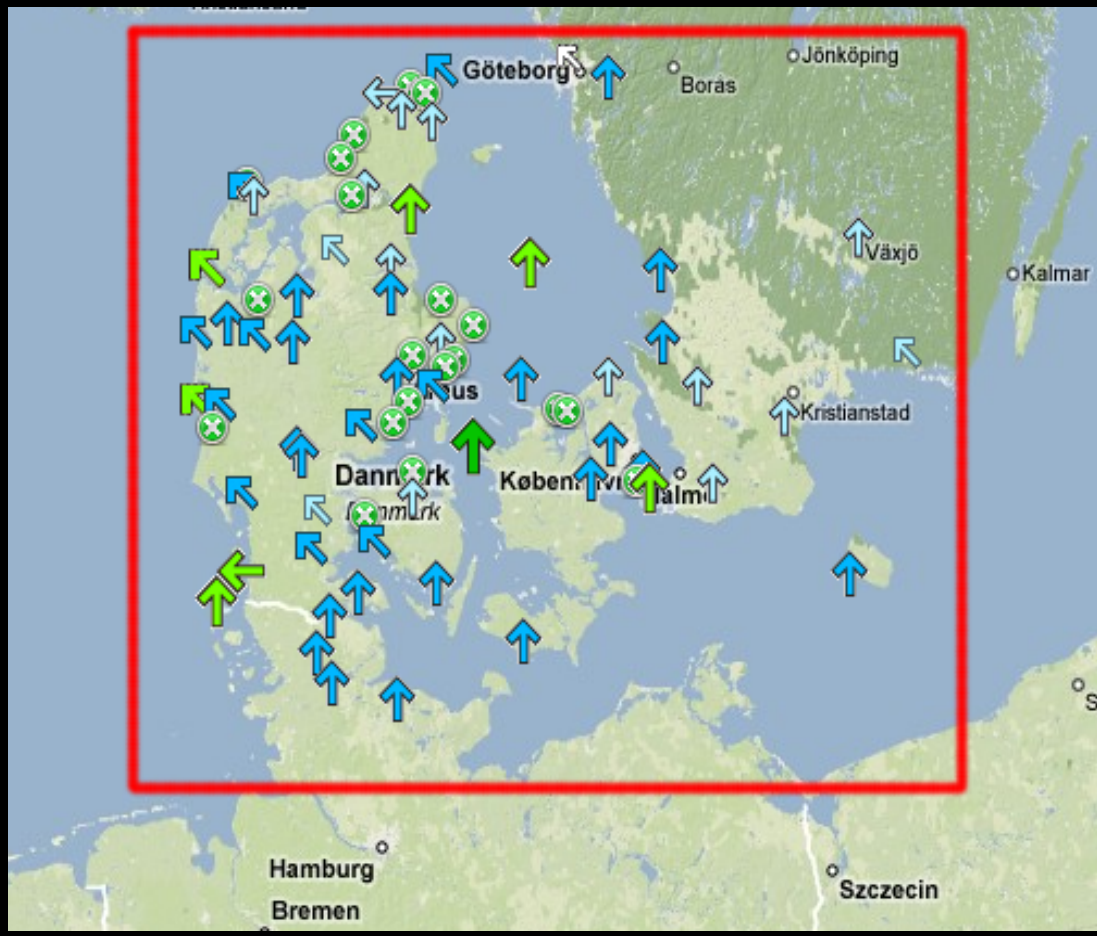
Challenge: Result set <= 1000 entities (GAE)

Geo. queries are not directly supported

Too many points



```
SELECT *
FROM Spots
WHERE
    lat > 54 AND
    lat < 58 AND
    lon > 8  AND
    lon < 16;
```

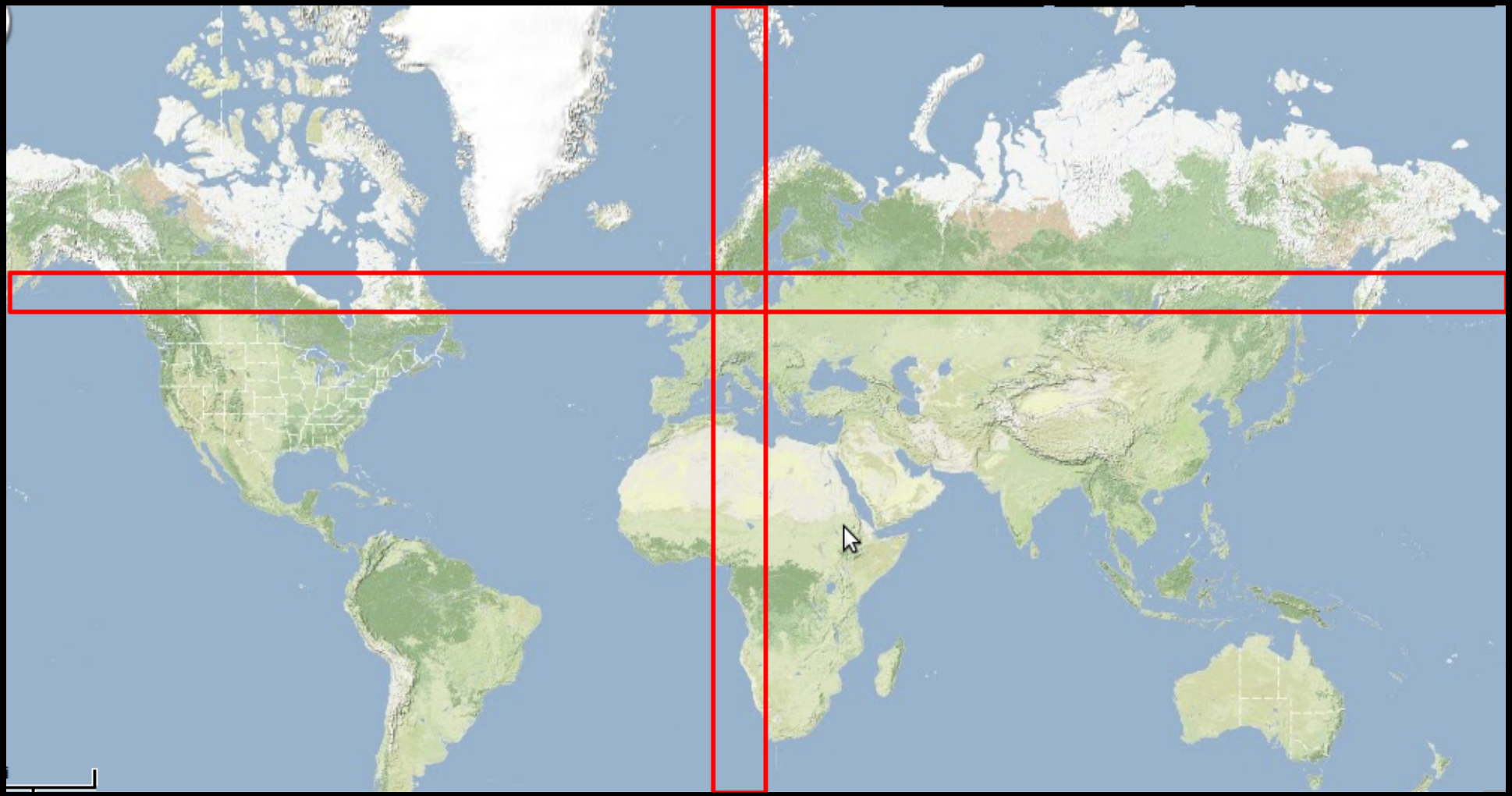


```
SELECT *
FROM Spots
WHERE
    lat > 54 AND
    lat < 58 AND
    lon > 8  AND
    lon < 16;
```

"Inequality Filters Are Allowed On One Property Only"

-- GAE

Bounding box query



Using index on lat. and index on lon.

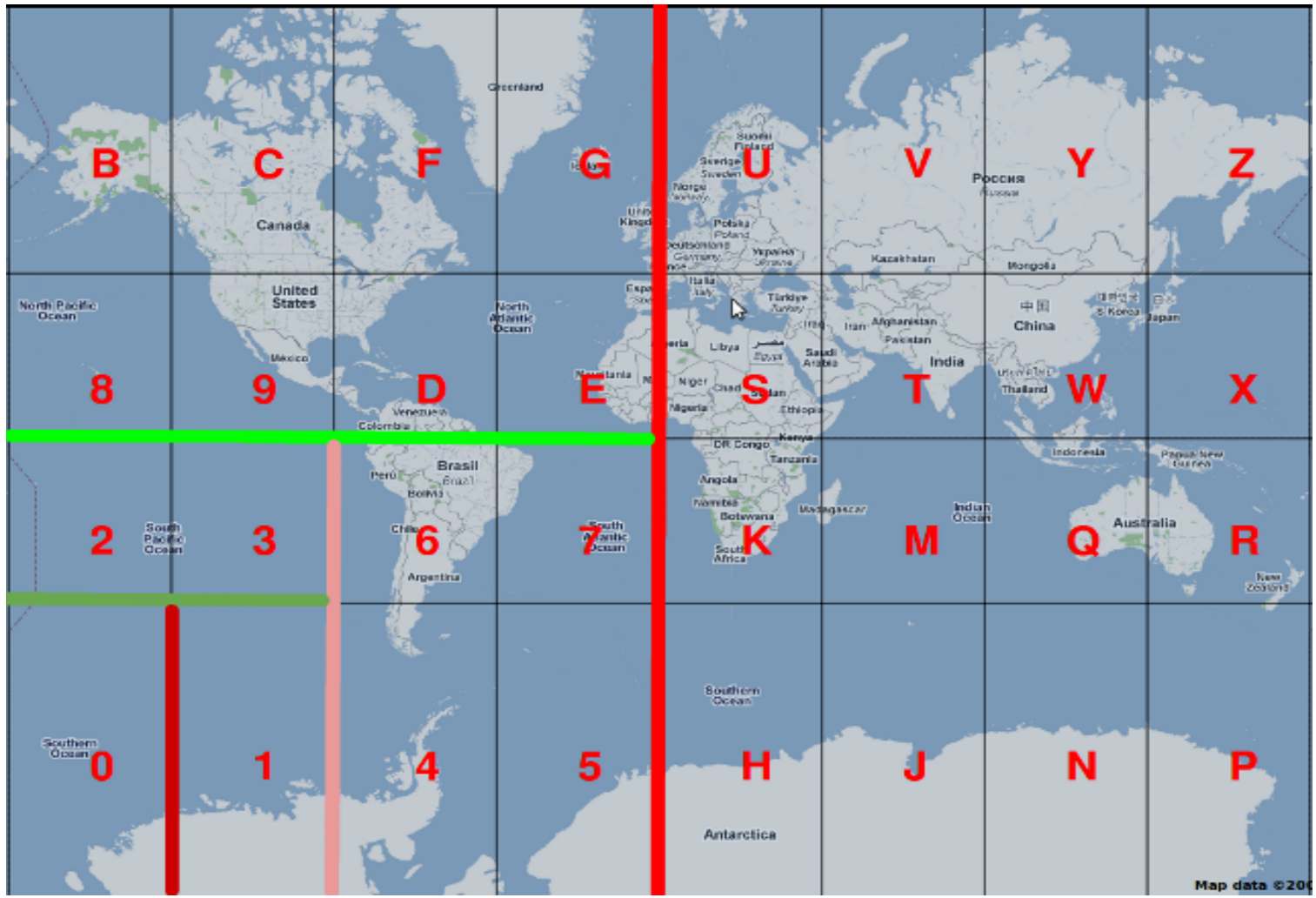
Solution:

Convert points to values
in a single dimension

using a scheme
that preserves proximity.

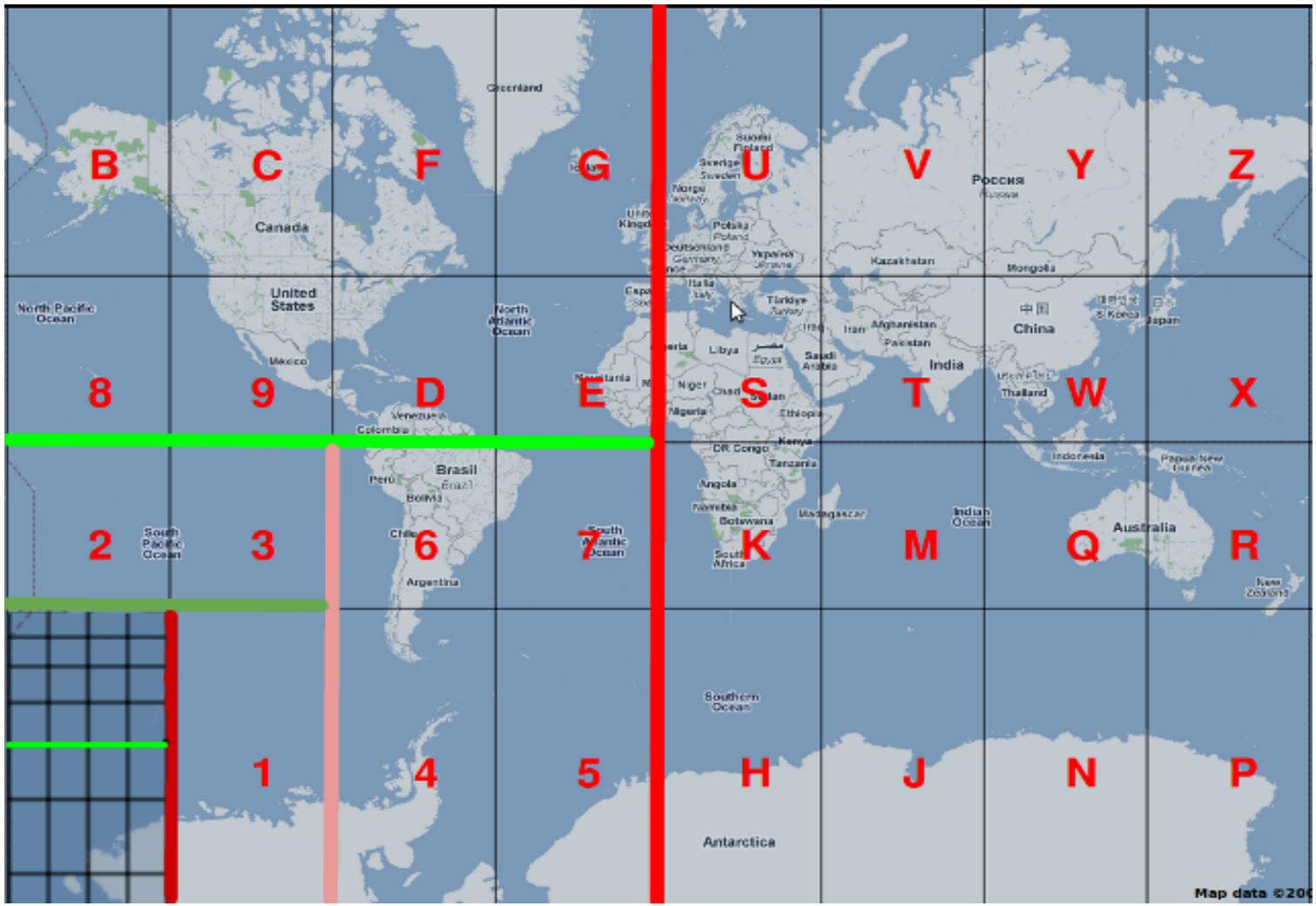
Geohash

```
Base32   = "0123456789bcdefghjkmnpqrstuvwxyz"
Value    =  012...                          31
"0" <=> 00000₂ <=> (-67.5°, -157.5°)
```



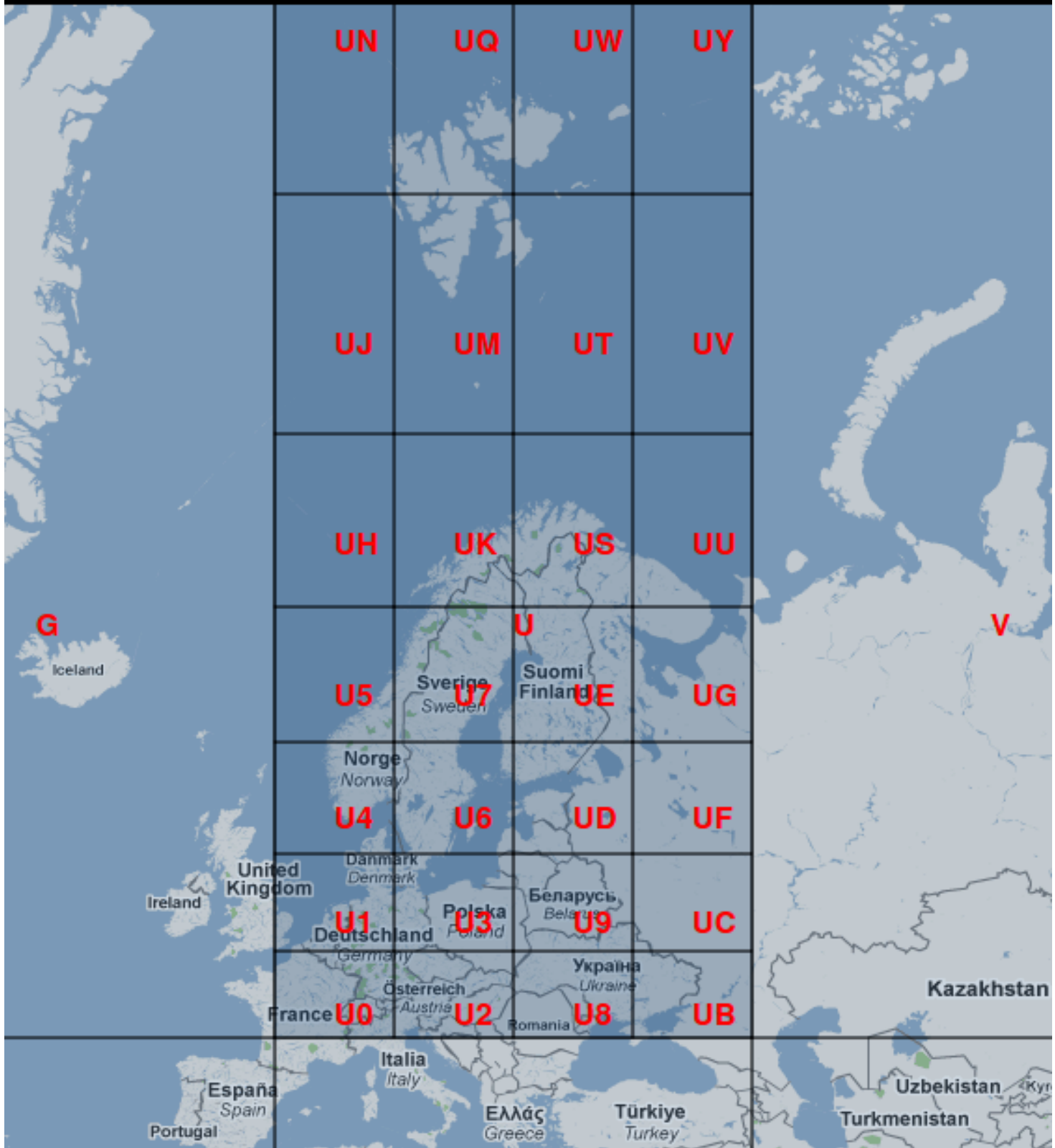
Geohash

```
Base32   = "0123456789bcdefghjkmnpqrstuvwxyz"
Value    =  012...                        31
"00"<=> 00000 00000₂ <=> (-87.1875°,-174.375°)
```



Note:

Points in the same grid cell
have the same geohash prefix


UN
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Iceland
Sverige
Sweden
Suomi
Finland
U5
U7
UE
UG
Norge
Norway
U4
U6
UD
UF
Danmark
Denmark
United
Kingdom
Ireland
Беларусь
Belarus
Polska
Poland
U1
U3
U9
UC
Deutschland
Germany
Україна
Ukraine
Österreich
Austria
Kazakhstan
France
U0
U2
U8
UB
Romania
Italia
Italy
España
Spain
Portugal
Ελλάς
Greece
Türkiye
Turkey
Uzbekistan
Turkmenistan

Prefix query for proximity points (SQL)

```
SELECT *
FROM Spots
WHERE geohash LIKE 'U1%'
```

Prefix query for proximity points (SQL)

```
SELECT *
FROM Spots
WHERE geohash LIKE 'U1%'
```

LIKE not available on GAE!

Prefix query for proximity points (SQL)

```
SELECT *
FROM Spots
WHERE geohash LIKE 'U1%'

LIKE not available on GAE!

SELECT *
FROM Spots
WHERE geohash >= 'U1' AND
      geohash  < 'U2'
```

Prefix query for proximity points (GAE)

```
query = db.Query(Spot)
query.filter('geohash >=', 'u1')
query.filter('geohash <', 'u1' + u'\ufffd')
```

The largest possible unicode char: 

Advantage: proximity queries supported by index

Kind	Property	Value	Key
Spot	geohash	sws8whkz7yzb	.
Spot	geohash	u1vvsqd1rzrb	.
Spot	geohash	u1yznthncyzb	.
Spot	geohash	u1zjy5pd7fxg	.
...			
Spot	geohash	u3bqk1wvrgzy	.

Challenge:

"If more than 1000 entities
match the query
only the first 1000 results are returned"

-- GAE doc.

Solution:

Apply paging using the geohash index.

Paging: only by using the geohash index

Kind	Property	Value	Key
Spot	geohash	sws8whkz7yzb	...
Spot	geohash	u1vvsqd1rzrb	...
Spot	geohash	u1yznthncyzb	...
Spot	geohash	u1zjy5pd7fxg	...
...			
Spot	geohash	u3bqk1wvrgzy	...

Spots Paging: using the geohash index

```
.../api/spots/?gh_prefix=u1&gh_offset=u1zrfef3xbzg
PAGE_SIZE = 2
def index(request):
  prefix = request.GET.get('gh_prefix', '')
  offset = request.GET.get('gh_offset', prefix)

  (...)
```

Spots Paging: using the geohash index

```
.../api/spots/?gh_prefix=u1&gh_offset=u1zrfef3xbzg
PAGE_SIZE = 2
def index(request):
  prefix = request.GET.get('gh_prefix', '')
  offset = request.GET.get('gh_offset', prefix)

  q = db.Query(Spot)
  q.filter('geohash >=', offset)
  q.filter('geohash <', prefix + u'\ufffd')
  q.order('geohash')

  spots = q.fetch(PAGE_SIZE + 1)

  (...)
```

Spots Paging: using the geohash index

```
.../api/spots/?gh_prefix=u1&gh_offset=u1zrfef3xbzg
PAGE_SIZE = 2
def index(request):
  prefix = request.GET.get('gh_prefix', '')
  offset = request.GET.get('gh_offset', prefix)

  q = db.Query(Spot)
  q.filter('geohash >=', offset)
  q.filter('geohash <', prefix + u'\ufffd')
  q.order('geohash')

  spots = q.fetch(PAGE_SIZE + 1)

  has_next_page = len(spots) > PAGE_SIZE
  if has_next_page:
    qs = request.GET.copy()
    qs['gh_offset'] = spots[-1].geohash
    spots = spots[:-1]
  # create representation with uri to next page
  (...)
```

Spots Representation:

http://welovewind.com/api/spots/?gh_prefix=u1


```
{ "items":[
  {
    "name": "Bork Havn",
    "lon": 8.2757949829101562,
    "lat": 55.84650606768372,
    "uri": "/api/spots/dk/bork_havn/",
    "forecast_point":
          "/api/forecast_points/55.8465,8.2758/",
    "country_code": "dk"
  },(...)],
  "next":
      "/api/spots/?gh_prefix=u1&gh_offset=u1zrfef3xbzg"
}
```

Challenge:

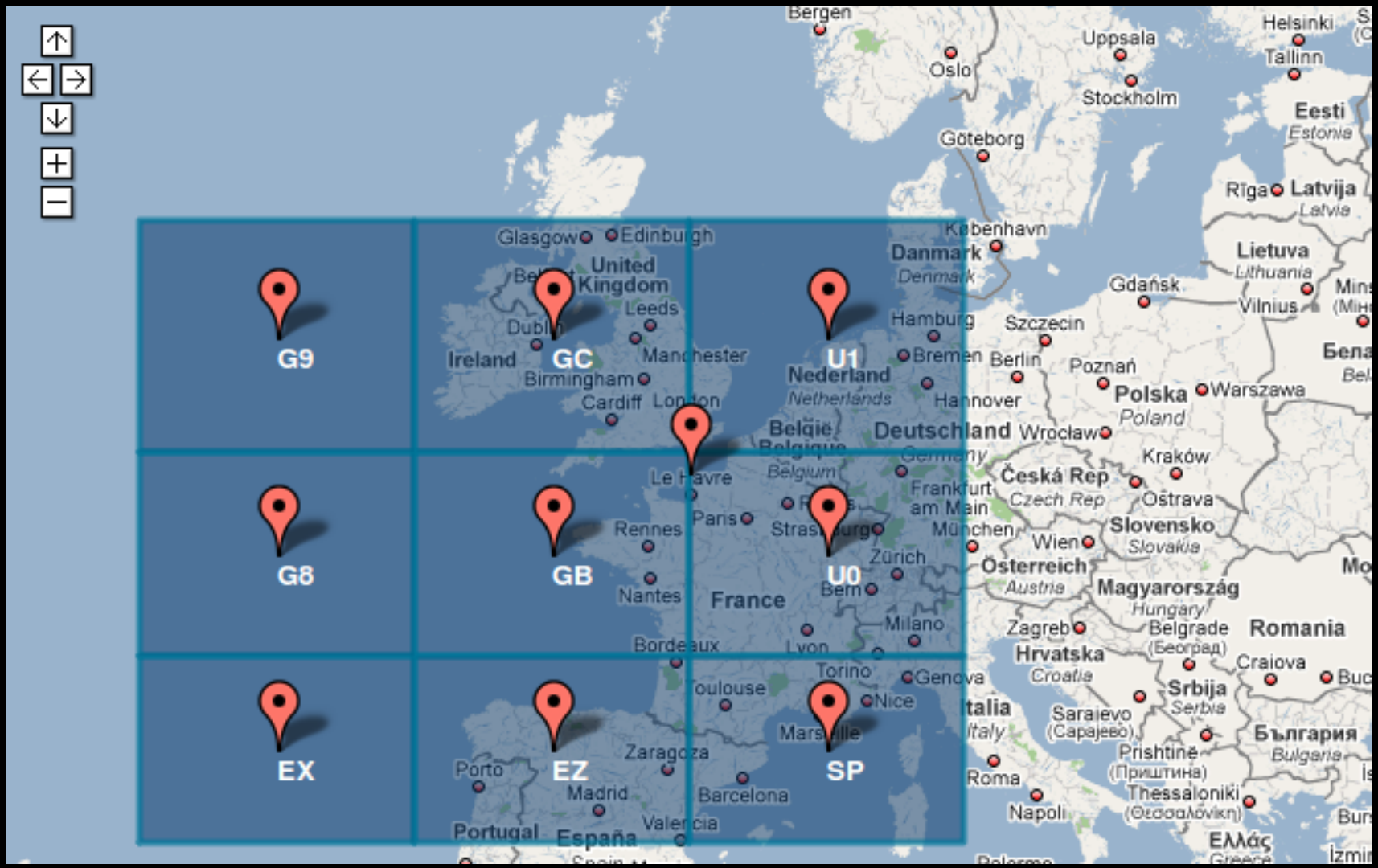
The proximity property
is not preserved
in all cases with geohash.

Problem: Proximity property of geohash

g...

u...

Include all neighbor cells



http://www.welovewind.com/examples/geohash/index.html

Conclusion

In this talk

- Motivation and vision
- Architectural overview
- Problem: No cron jobs
- Challenge: Limited inequality operators
- Challenge: Result set <= 1000 entities

The **challenges** are your friend.

The result

- A mashup designed with high scalability.

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The **challenges** are your friend.

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More info

- http://welovewind.com/about

Thank you.