

PostGIS для движущихся целей

Дорофей «Котяра» Пролесковский

PgConf Russia 2017

סחטן

THE SOCIALLY RESPONSIBLE WAY TO RIDE

We built Juno around the belief that when people are treated better, they provide better service. Happy drivers, happy riders.



Only The Best

Juno only accepts the highest rated drivers



Launch Discount

Competitive pricing and 30% Beta discount



True Partners

Juno reserved 50% of its founding shares for drivers



Here For You

24/7 live phone, email and text support

If you can make it in New York City,
you can make it anywhere



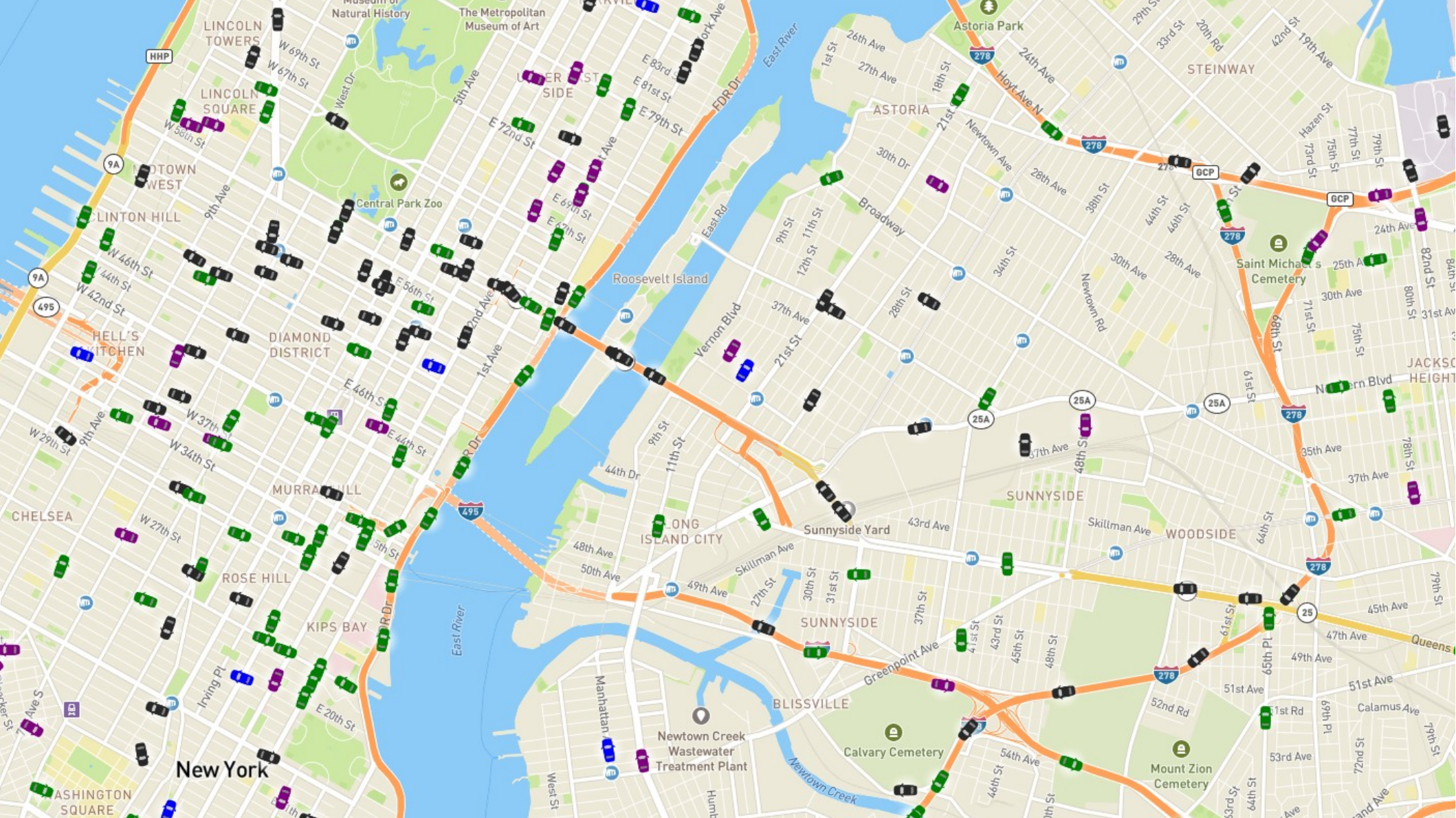
ЧТО? ГДЕ? КОГДА?



ИНТЕЛЛЕКТУАЛЬНЫЙ КЛУБЪ

1975

Что?



LINCOLN TOWERS

W 69th St
W 67th St

LINCOLN SQUARE

W 30th St

W 20th St

W 10th St

W 9th St

W 46th St

W 44th St

W 42nd St

W 37th St

W 34th St

W 29th St

W 27th St

W 20th St

W 15th St

W 10th St

W 5th St

W 1st St

W 1st St

W 1st St

W 1st St

W 1st St

W 1st St

W 1st St

W 1st St

W 1st St

W 1st St

W 1st St

W 1st St

W 1st St

W 1st St

W 1st St

New York

WASHINGTON SQUARE

WASHINGTON SQUARE

Museum of Natural History

The Metropolitan Museum of Art

West Dr

5th Ave

Central Park Zoo

E 56th St

E 54th St

E 52th St

E 50th St

E 48th St

E 46th St

E 44th St

E 42nd St

E 40th St

E 38th St

E 36th St

E 34th St

E 32nd St

E 30th St

E 28th St

E 26th St

E 24th St

E 22nd St

E 20th St

E 18th St

E 16th St

E 14th St

E 12th St

E 10th St

E 8th St

E 6th St

E 4th St

E 2nd St

E 1st St

E 1st St

E 1st St

E 1st St

E 1st St

E 1st St

E 1st St

E 1st St

E 1st St

E 1st St

E 1st St

E 1st St

E 1st St

E 1st St

E 1st St

E 1st St

E 1st St

E 1st St

Roosevelt Island

Vernon Blvd

9th St

11th St

44th Dr

48th Ave

50th Ave

49th Ave

27th St

30th St

31st St

37th St

41st St

43rd St

45th St

48th St

54th Ave

46th St

49th St

51st St

53rd Ave

55th St

57th St

Newtown Creek Wastewater Treatment Plant

Manhattan

Humb

Humb

ASTORIA

26th Ave

27th Ave

28th Ave

30th Dr

Broadway

9th St

11th St

12th St

37th Ave

21st St

28th St

28th St

28th St

28th St

28th St

28th St

28th St

28th St

28th St

28th St

28th St

28th St

28th St

28th St

28th St

28th St

28th St

28th St

28th St

SUNNYSIDE

Sunnyside Yard

43rd Ave

Skillman Ave

49th Ave

27th St

30th St

31st St

37th St

41st St

43rd St

45th St

48th St

54th Ave

WOODSIDE

Skillman Ave

64th St

61st St

65th Pl

47th Ave

49th Ave

51st Ave

51st Rd

53rd Ave

55th St

57th St

59th St

61st St

QUEENSBURY

Queens Blvd

35th Ave

37th Ave

39th Ave

41st Ave

43rd Ave

45th Ave

47th Ave

49th Ave

51st Ave

53rd Ave

55th Ave

57th Ave

JACKSON HEIGHTS

78th St

80th St

82nd St

84th St

86th St

88th St

90th St

92nd St

94th St

96th St

98th St

100th St

102nd St

104th St

106th St

108th St

110th St

112th St

114th St

116th St

118th St

120th St

122nd St

124th St

126th St

128th St

130th St

132nd St

134th St

136th St

138th St

140th St

142nd St

144th St

146th St

148th St

150th St

152nd St

154th St

156th St

158th St

160th St

162nd St

164th St

166th St

168th St

170th St

172nd St

174th St

176th St

178th St

180th St

182nd St

184th St

186th St

188th St

190th St

192nd St

194th St

196th St

198th St

200th St

202nd St

204th St

206th St

208th St

210th St

212th St

214th St

216th St

218th St

220th St

222nd St

224th St

226th St

228th St

230th St

232nd St

234th St

236th St

238th St

240th St

242nd St

244th St

246th St

248th St

250th St

252nd St

254th St

256th St

258th St

260th St

262nd St

264th St

266th St

268th St

270th St

272nd St

274th St

276th St

278th St

280th St

282nd St

284th St

286th St

288th St

290th St

292nd St

294th St

296th St

298th St

300th St

302nd St

304th St

306th St

308th St

310th St

312th St

314th St

316th St

318th St

Что же мы меряем?

- Позицию водителя

Что же мы меряем?

- ~~Позицию водителя~~
- Позицию машины

Что же мы меряем?

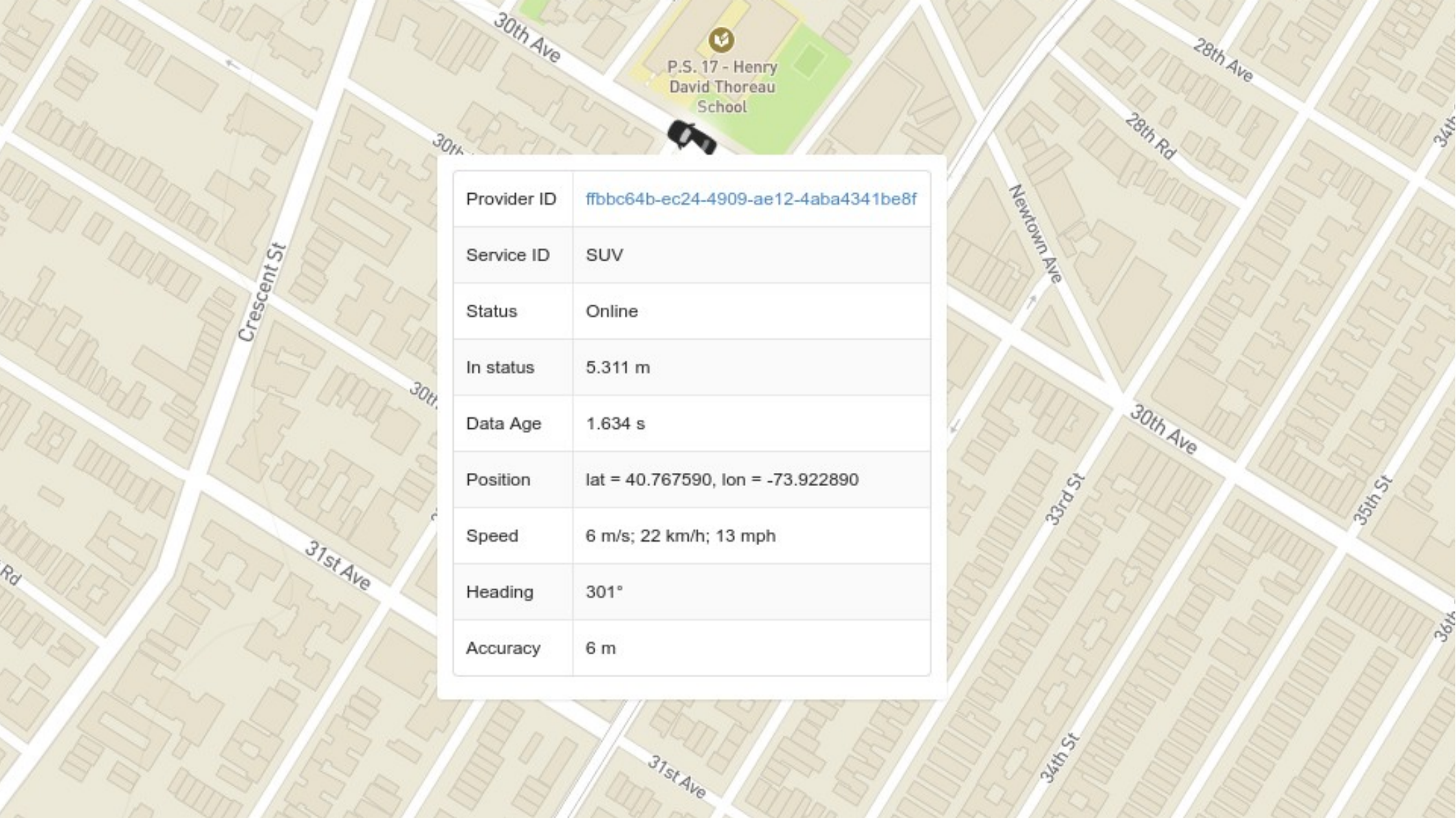
- ~~Позицию водителя~~
- ~~Позицию машины~~
- Позицию телефона

Что же мы меряем?

- ~~Позицию водителя~~
- ~~Позицию машины~~
- ~~Позицию телефона~~
- Позицию спутников

Что же мы меряем?

- ~~Позицию водителя~~
- ~~Позицию машины~~
- ~~Позицию телефона~~
- ~~Позицию спутников~~
- Разность фаз сигналов спутников

A map showing a residential street grid. A school, P.S. 17 - Henry David Thoreau School, is marked with a yellow circle and a building icon. A black car icon is positioned on Crescent St. Street names include Crescent St, 30th Ave, 28th Ave, 28th Rd, Newtown Ave, 30th Ave, 33rd St, 35th St, 31st Ave, 34th St, and 36th St. The school is located at the intersection of 30th Ave and Crescent St.

P.S. 17 - Henry
David Thoreau
School

Provider ID	ffbbc64b-ec24-4909-ae12-4aba4341be8f
Service ID	SUV
Status	Online
In status	5.311 m
Data Age	1.634 s
Position	lat = 40.767590, lon = -73.922890
Speed	6 m/s; 22 km/h; 13 mph
Heading	301°
Accuracy	6 m

Provider ID	ffbbc64b-ec24-4909-ae12-4aba4341be8f
Service ID	SUV
Status	Online
In status	5.311 m
Data Age	1.634 s
Position	lat = 40.767590, lon = -73.922890
Speed	6 m/s; 22 km/h; 13 mph
Heading	301°
Accuracy	6 m

Где?



Пространство

уменьшение размерности

3D

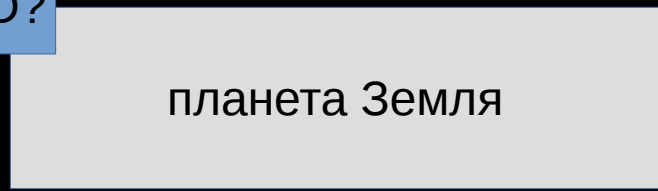


2D



1D?

планета Земля



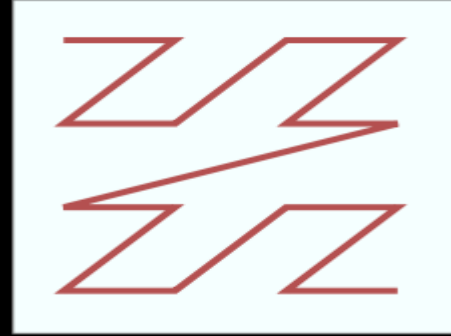
```
select dimension  
from reality  
order by dimension asc  
limit  $\pi$ ;
```

1D

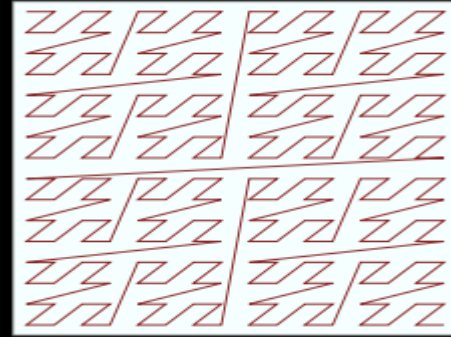
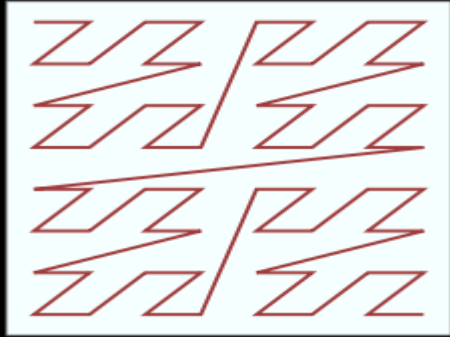
timestamp

адрес

Номер в очереди



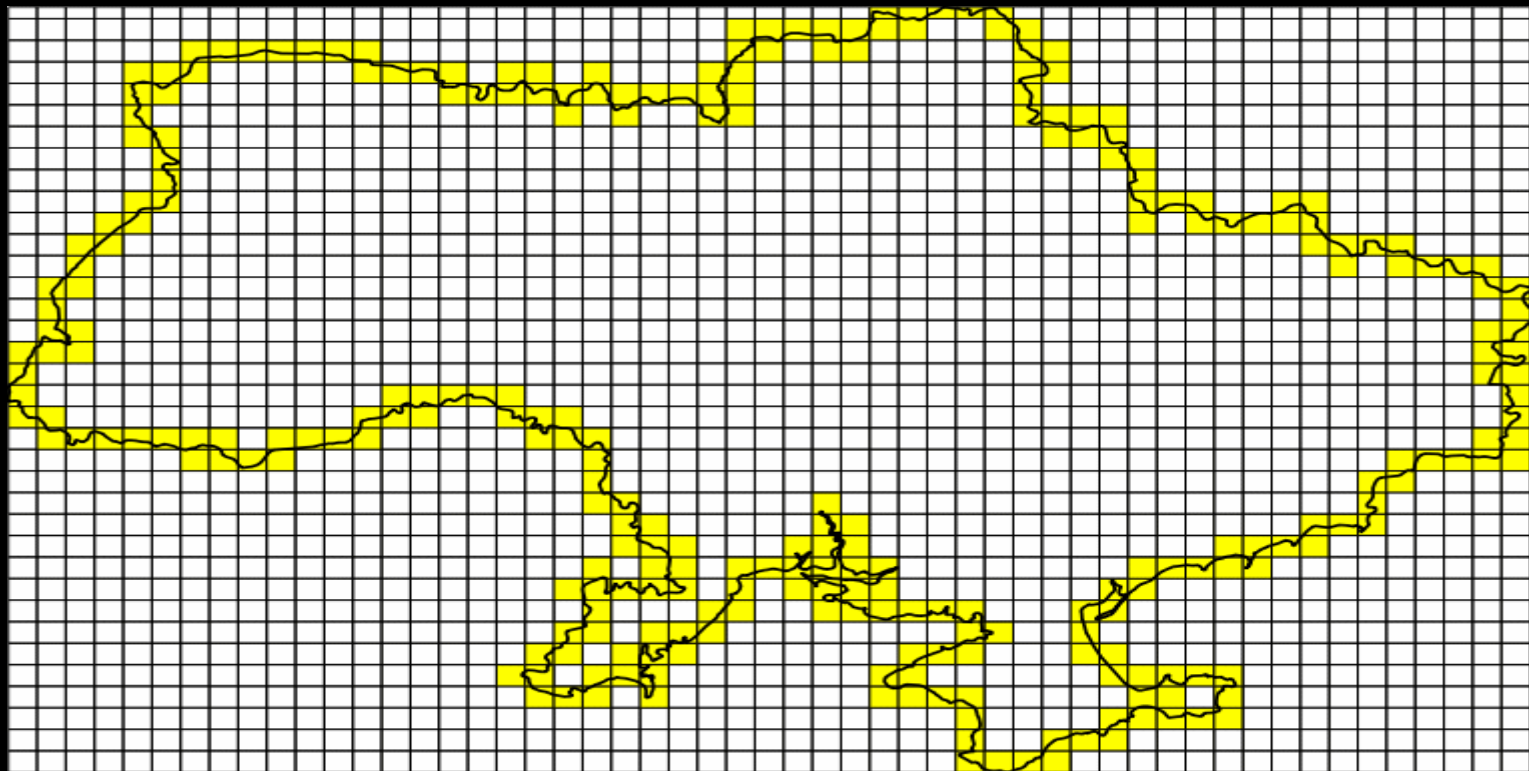
Z order curve

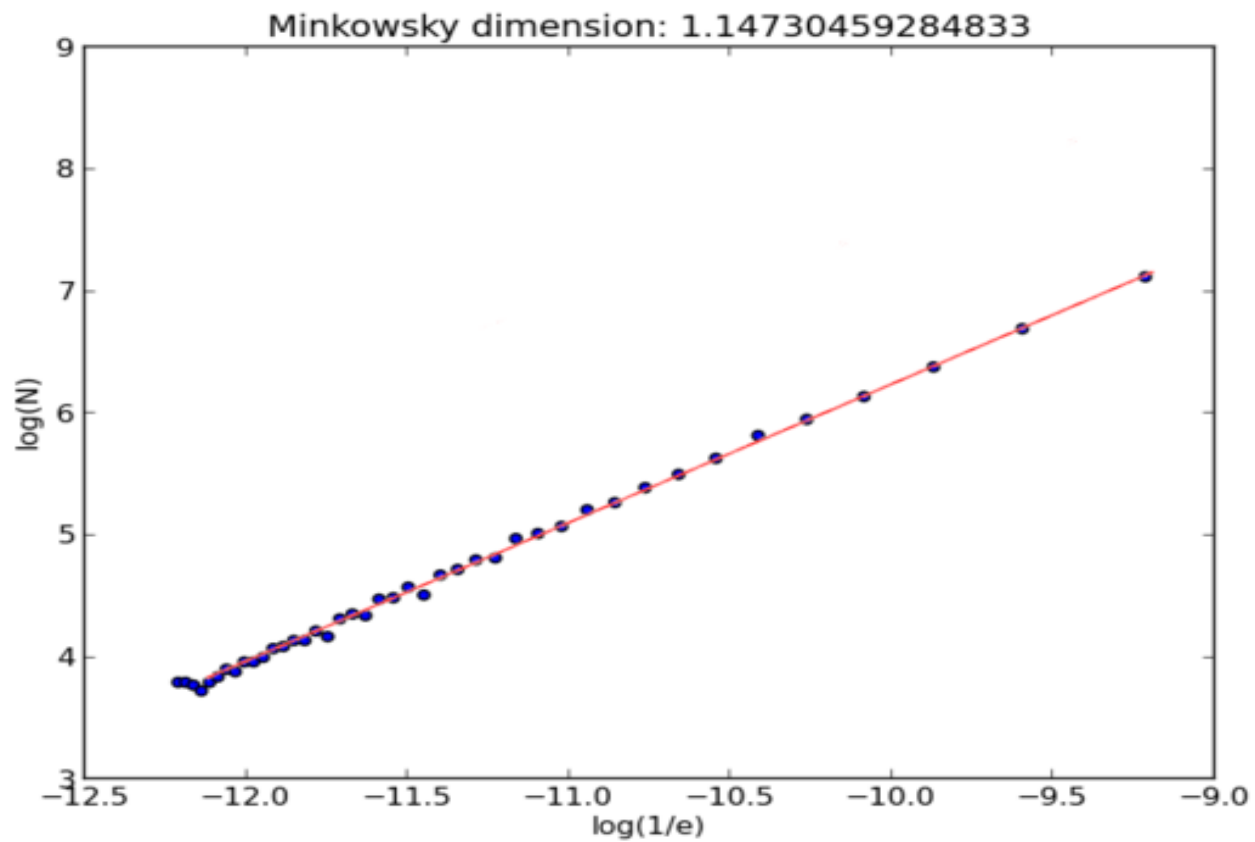


1.14D

Размерность Минковского

Значение размерности Минковского равно угловому коэффициенту линии регрессии, построенной на плоскости по рядам значений $\log(N)$ и $\log(1/e)$.





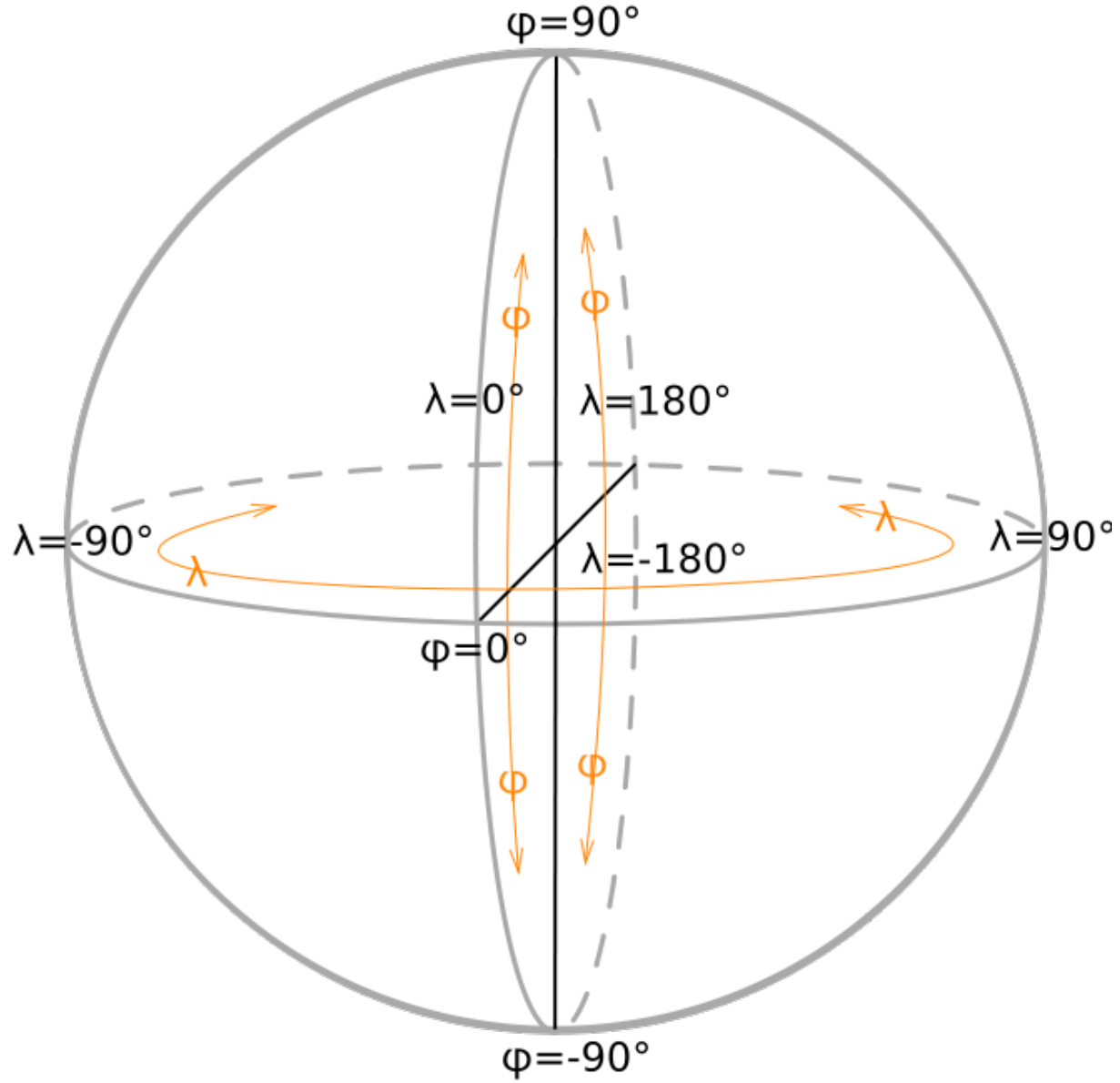
e – размер ячейки
 N – количество квадратов

<http://gis-lab.info/qa/minkowski-dimension-qgis.html>

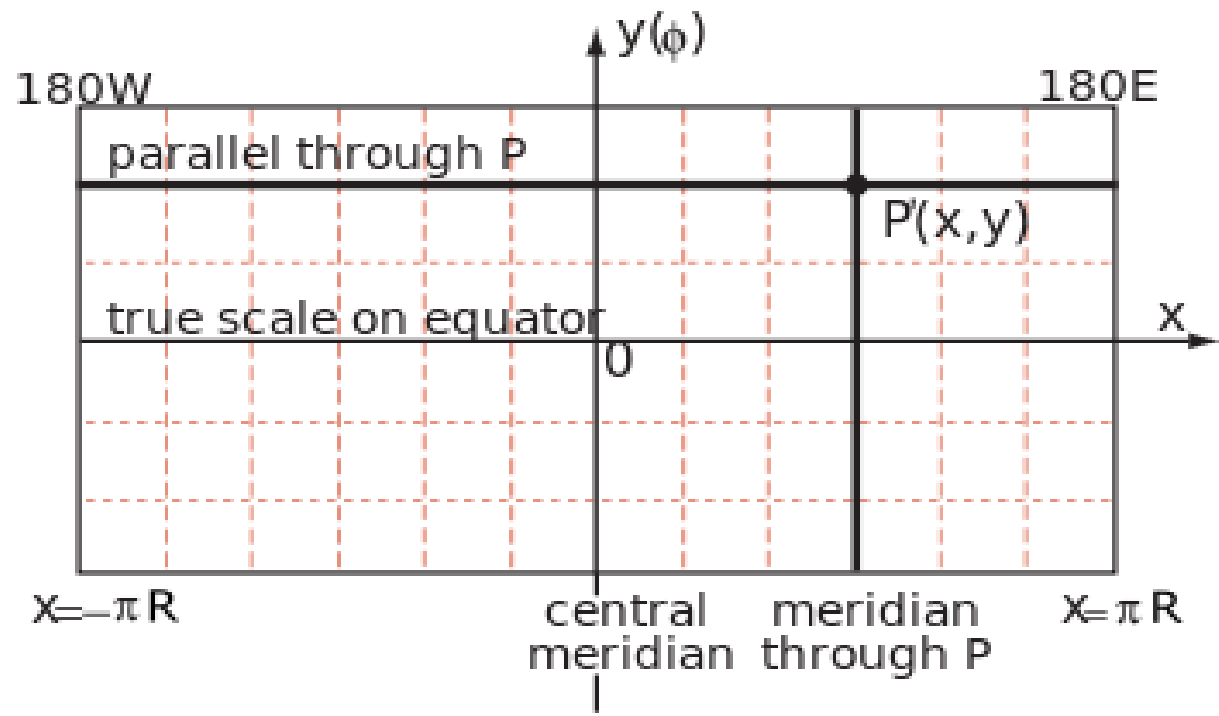
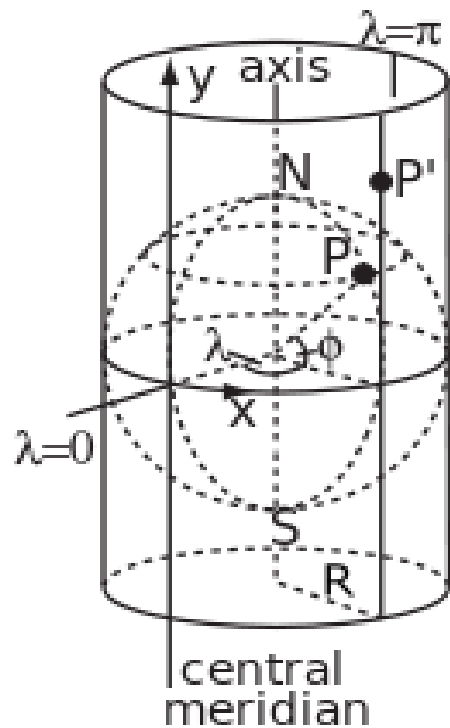
2D

pixel space

angular coordinates



projected map units



Земля плоская.

FLAT EARTH SOCIETY



NEW YORK

LONDON

PARIS

BEIJING

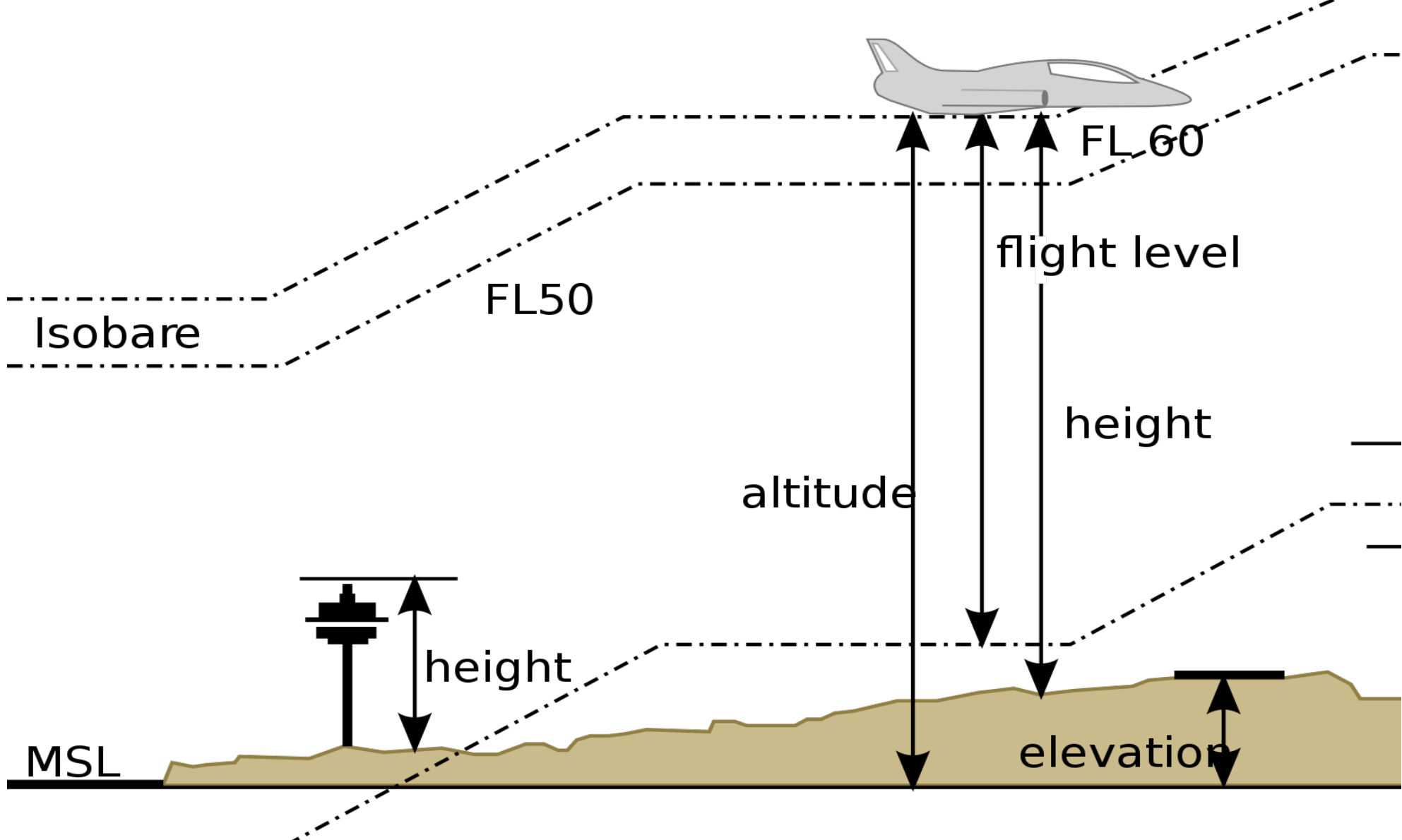
TOKYO



Hankin

3D

ВЫСОТА



погрешность

getAccuracy

Added in [API level 1](#)

```
float getAccuracy ()
```

Get the estimated accuracy of this location, in meters.

We define accuracy as the radius of 68% confidence. In other words, if you draw a circle centered at this location's latitude and longitude, and with a radius equal to the accuracy, then there is a 68% probability that the true location is inside the circle.

In statistical terms, it is assumed that location errors are random with a normal distribution, so the 68% confidence circle represents one standard deviation. Note that in practice, location errors do not always follow such a simple distribution.

This accuracy estimation is only concerned with horizontal accuracy, and does not indicate the accuracy of bearing, velocity or altitude if those are included in this Location.

If this location does not have an accuracy, then 0.0 is returned. All locations generated by the [LocationManager](#) include an accuracy.

Returns

float

<по заявкам>

OGC Simple Features

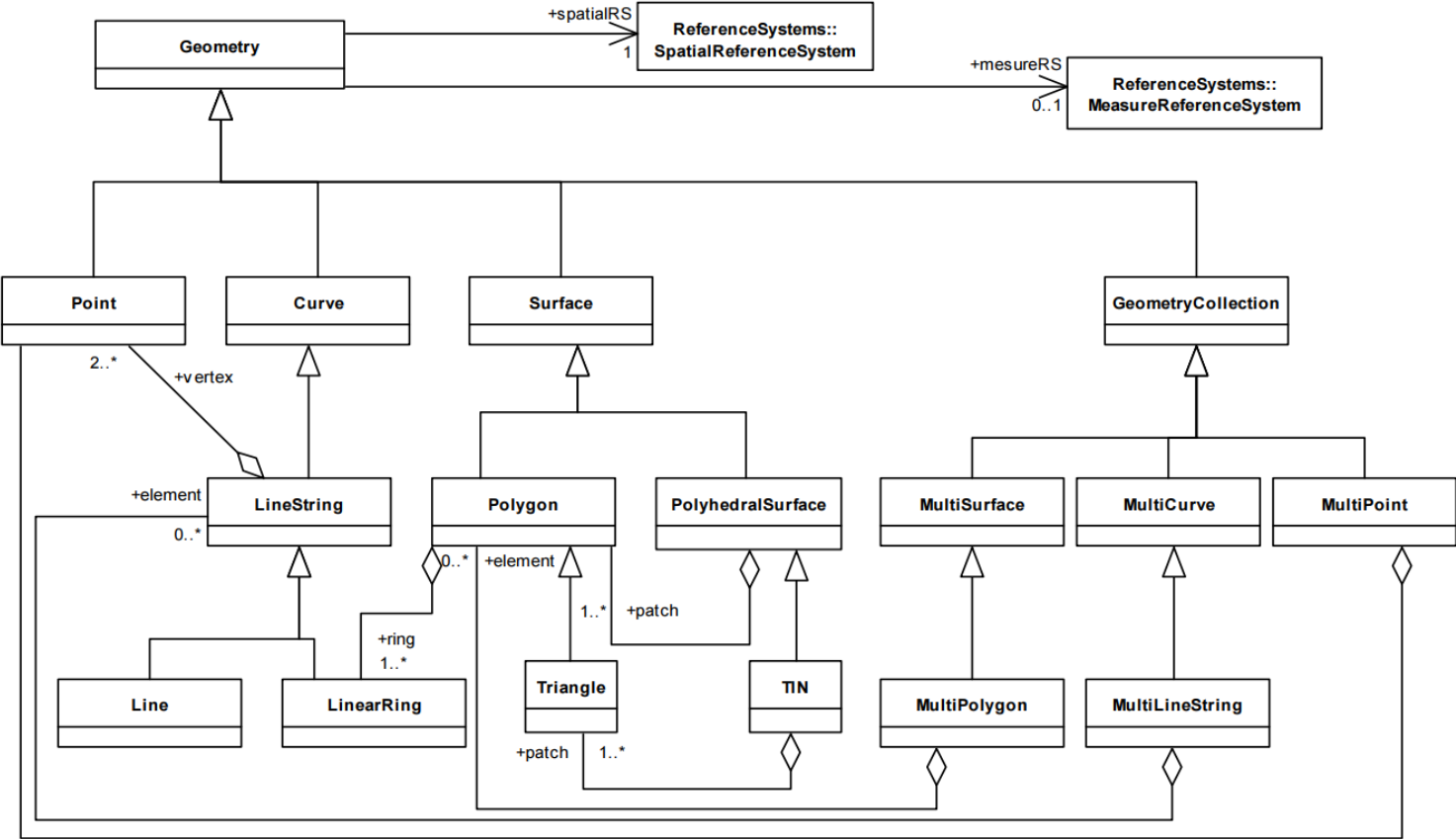
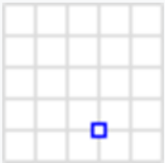
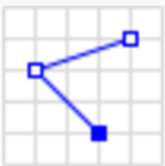
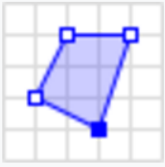
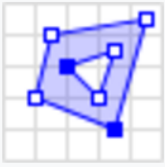


Figure 1: Geometry class hierarchy

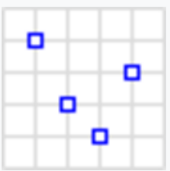
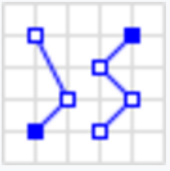
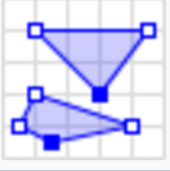

Все́м известны́й текст: WKT

Geometry primitives (2D)

Type	Examples	
Point		<code>POINT (30 10)</code>
LineString		<code>LINestring (30 10, 10 30, 40 40)</code>
Polygon		<code>POLYGON ((30 10, 40 40, 20 40, 10 20, 30 10))</code>
		<code>POLYGON ((35 10, 45 45, 15 40, 10 20, 35 10), (20 30, 35 35, 30 20, 20 30))</code>

Не всем известный WKT

Multipart geometries (2D)

Type	Examples	
MultiPoint		MULTIPOINT ((10 40), (40 30), (20 20), (30 10))
		MULTIPOINT (10 40, 40 30, 20 20, 30 10)
MultiLineString		MULTILINESTRING ((10 10, 20 20, 10 40), (40 40, 30 30, 40 20, 30 10))
MultiPolygon		MULTIPOLYGON (((30 20, 45 40, 10 40, 30 20)), ((15 5, 40 10, 10 20, 5 10, 15 5)))
		MULTIPOLYGON (((40 40, 20 45, 45 30, 40 40)), ((20 35, 10 30, 10 10, 30 5, 45 20, 20 35), (30 20, 20 15, 20 25, 30 20)))

Геометрии-невидимки

POINT EMPTY
LINESTRING EMPTY
POLYGON EMPTY
GEOMETRYCOLLECTION EMPTY
MULTIPOINT EMPTY

GEOMETRYCOLLECTION(POINT EMPTY, LINESTRING
EMPTY)

</по заявкам>

heading

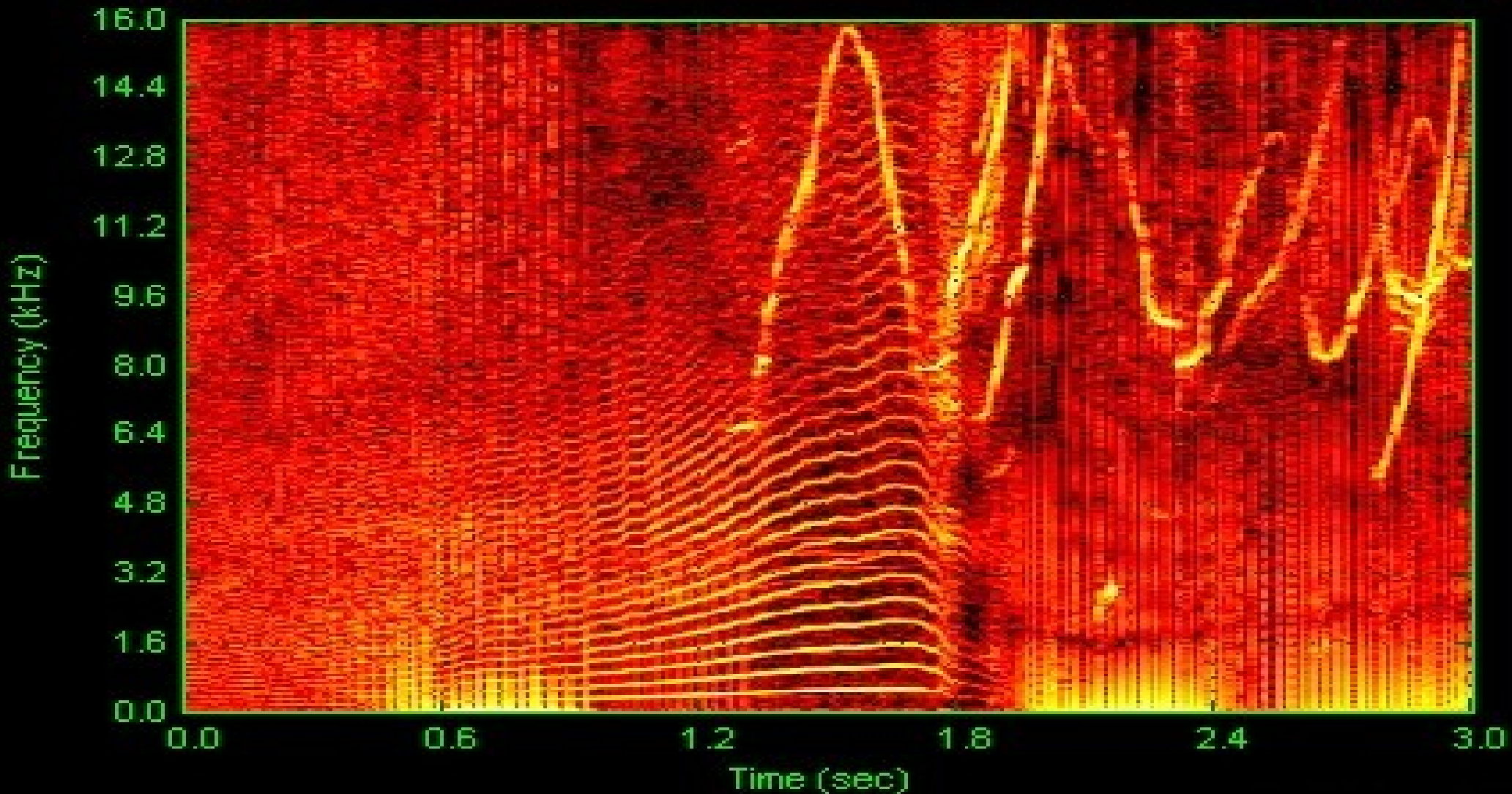
speed

Когда?

2D + время

-81.0 dB

31.0 dB



2017-03-15 19:06:40.306968+03

1489667394.510320

1489667394510.320

1489667394510320.

1489667394.510320

1489667394510.320

1489667394510320.

copy from stdin with csv;
не копирует в timestamp

К чему это всё?

ST_
SpatioTemporal_

where is temporal?

<https://github.com/gojuno/lostgis>

TPV: Time, Position, Velocity

(
Point
Accuracy

Speed
Heading

Timestamp
)

reproject(tpv, timestamp)


```
timedelta =  
extract(epoch from new_time - tpv.ts);
```

```
merc_path_length =  
p_tpv.speed * timedelta * icoslat(p_tpv);
```

$$\text{icoslat} = 1/\cos(\text{geom.lat})$$

$$\begin{aligned} & \text{icoslat(merc_geom)} = \\ & 1 / \text{sqrt}(\\ & \quad 1 - \text{tanh}(\\ & \quad \quad \text{ST_Y(merc_geom) / 6378137} \\ & \quad \quad \quad) ^ 2) \end{aligned}$$


```
p_tpv.geom =  
    ST_Translate(  
        p_tpv.geom,  
  
        sind(p_tpv.heading) *  
            merc_path_length,  
  
        cosd(p_tpv.heading) *  
            merc_path_length  
    );
```

```
p_tpv.accuracy = p_tpv.accuracy +  
                  1.373 * abs(timedelta) +  
0.82 * p_tpv.speed * abs(timedelta) +  
                  0.5 * sign(timedelta);
```

madlib


```
[more] ( > ) on true
```

```
[more] ( > );
```

```
SELECT 317652
```

```
Time: 45844,549 ms
```

```
[local] gis@gis=# select timedelta, count(*) from accuracy_deltas_unrolled
```

```
WARNING: 57P02: terminating connection because of crash of another server
```

```
DETAIL: The postmaster has commanded this server process to roll back the
```

```
HINT: In a moment you should be able to reconnect to the database and repe
```

```
LOCATION: quickdie, postgres.c:2601
```

```
server closed the connection unexpectedly
```

```
This probably means the server terminated abnormally
```

```
before or while processing the request.
```

```
The connection to the server was lost. Attempting reset: Failed.
```

```
Time: 139590,803 ms
```

```
@!>
```

```
@!>
```

```
>!
```



любое взаимодействие с accuracy_deltas_unrolled_b приводит к сегфолту

15.04

accuracy_deltas_unrolled? accuracy_deltas_unrolled_big?

15.05 ✓✓



стоп, любое - в том числе попытка рекавери?

15.05 ✓✓



Grigory Smolkin

ага

15.05



15.06 ✓✓

Grigory Smolkin

техническое обоснование проблемы:
релейшен проклят

15.07

ST_Distance(tpv, tpv)

tpv[]

```
gis=# select ST_Length ('[
  {
    "lon": -73.9,
    "lat": 40.7
  },
  {
    "lon": -73.9,
    "lat": 40.6
  },
  {
    "lon": -73.9,
    "lat": 40.5
  }
]') :: jsonb :: tpv[] :: geography);
st_length
```

22209.2369146675
(1 row)

Not yet published

- Heading accuracy
- Filters
- External services integration

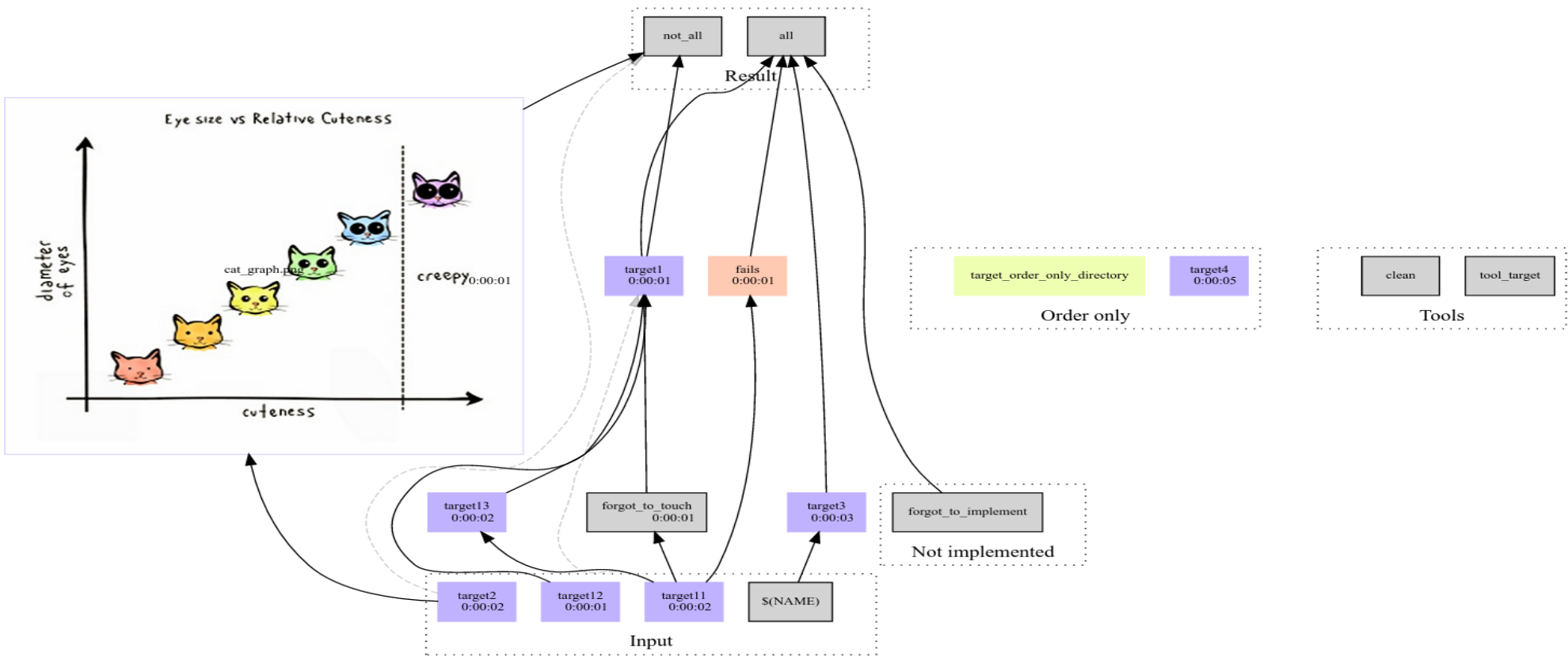
Спасибо!

вопросы?

<https://t.me/komzpa>
me@komzpa.net


```
heading_accuracy =  
-24 + 7.3 * sign(p_tpv.timedelta) +  
0.147 * abs(p_tpv.timedelta) +  
-0.0367 * p_tpv.timedelta +  
117.78 / greatest(p_tpv.speed, 0.001) +  
-66.3 / greatest(p_tpv.speed * p_tpv.speed, 0.001) +  
1.8 * p_tpv.speed +  
1.2 * p_tpv.accuracy +  
-0.11 * p_tpv.speed * p_tpv.accuracy +  
-2 * p_tpv.speed / p_tpv.accuracy;
```

BONUS:



<https://github.com/gojuno/make-profiler>