Geolocation and Maps with PHP

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http://derickrethans.nl/talks.html

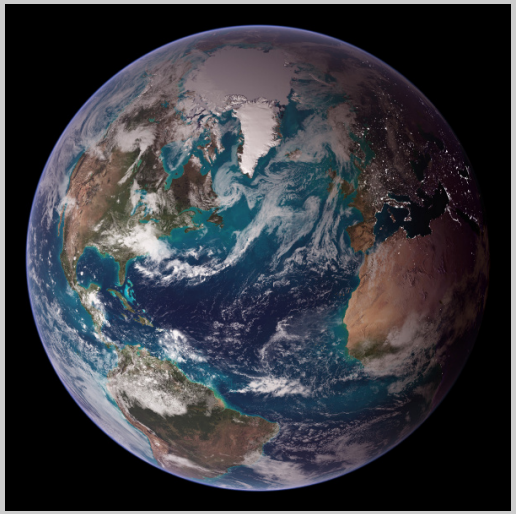
http://joind.in/2103

About Me

Derick Rethans

- Dutchman living in London
- PHP development
- Author of the mcrypt, input_filter, dbus, translit and date/time extensions
- Author of Xdebug
- Contributor to the Apache Zeta Components Incubator project (formerly eZ Components)
- Freelancer doing PHP (internals) development

The Earth is



not a sphere...

... but a bit of a pear.

The Earth's shape

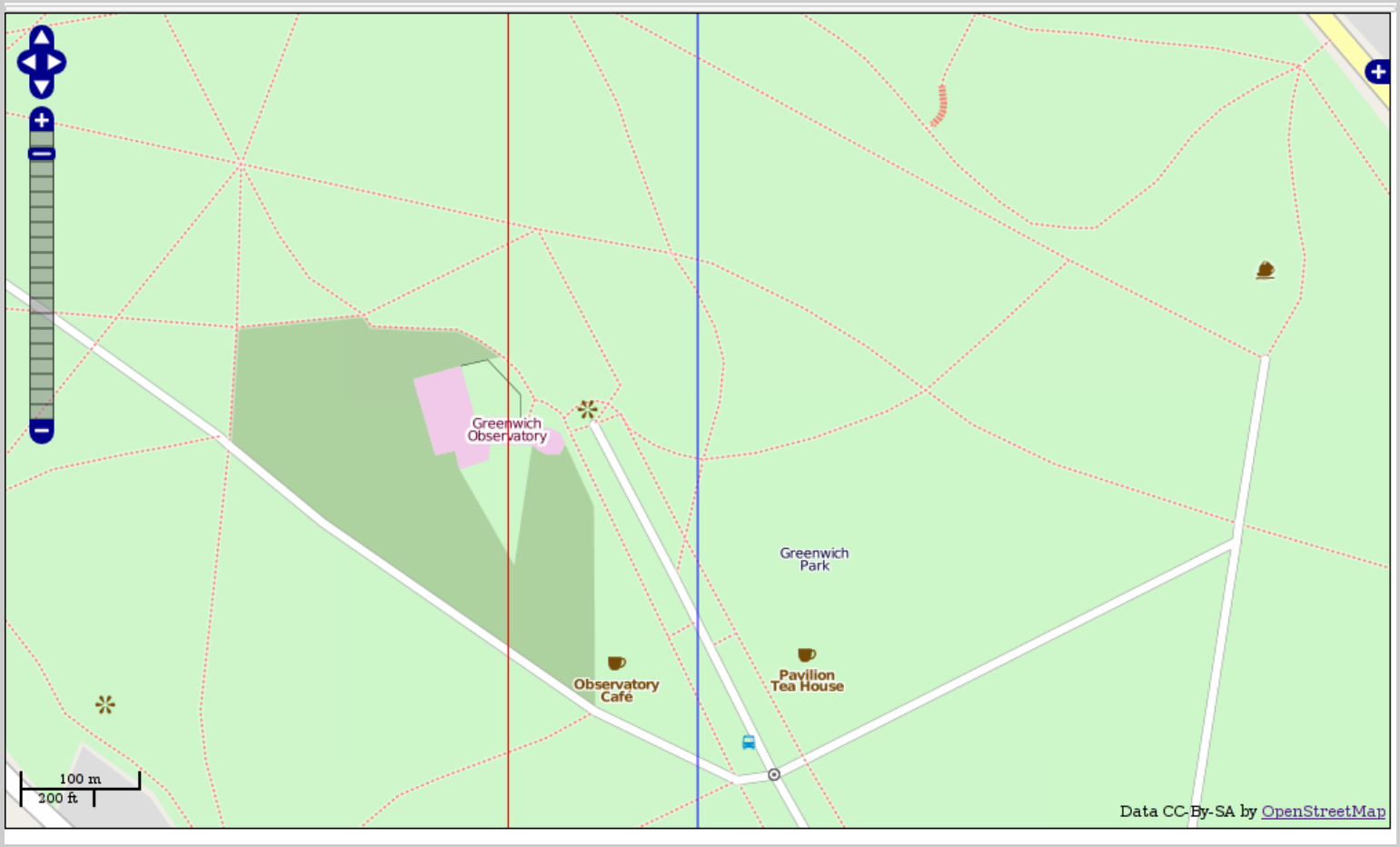
In cartography, the Earth's shape has to be approximated: a reference ellipsoid

- specify the Earth's radius and a flattening constant
- different ones are in use
- also called datum or geodetic system
- for coordinates, a meridian (0° longitude) should also be specified

Important ones are:

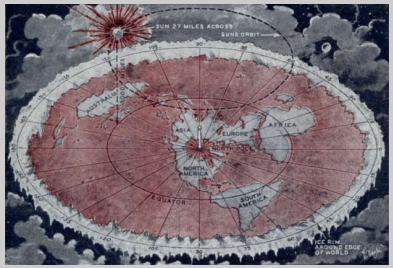
- WGS84: That's what GPS uses
- OSGB36: That's what Ordnance Survey uses
- ED50: That's what we use in most of Europe

Greenwich Meridian



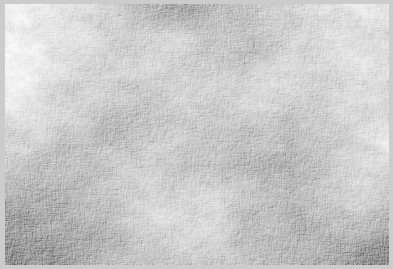
Greenwich Meridian
IRTS Meridian

Map Projections



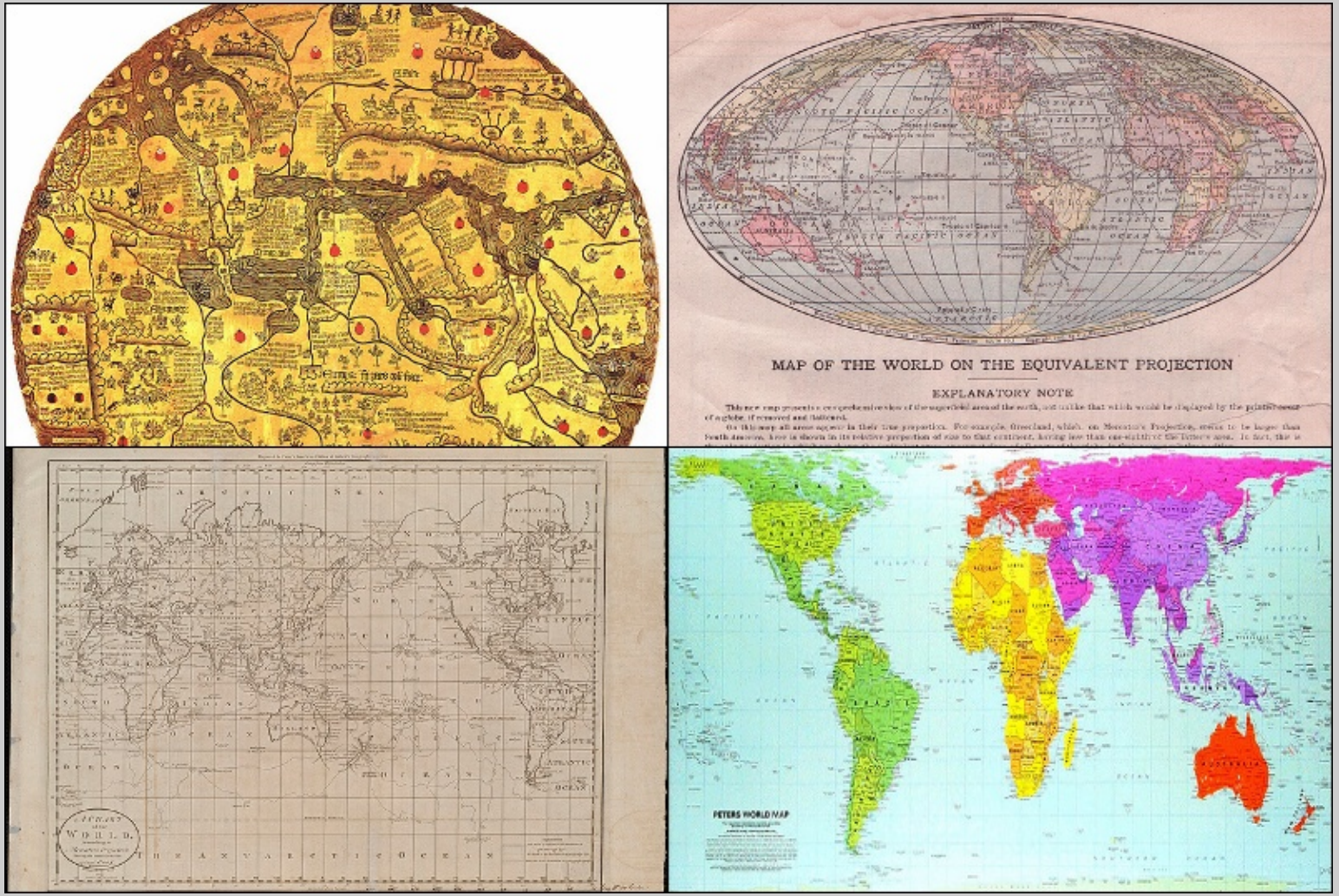
The Earth is not flat

Bringing a globe with you isn't very practical



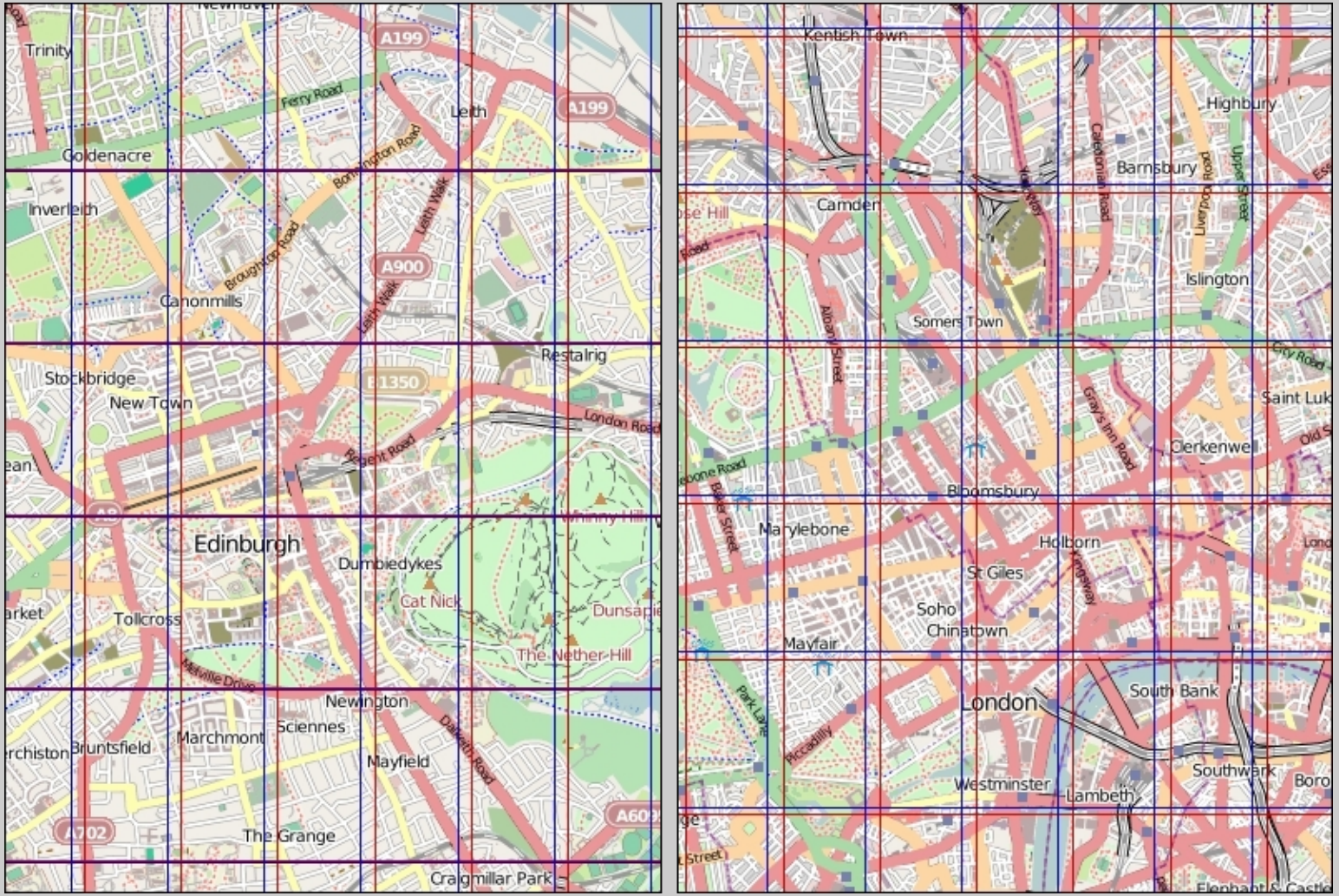
Paper is flat, so we need to project the globe on a 2D plane

Map Projections



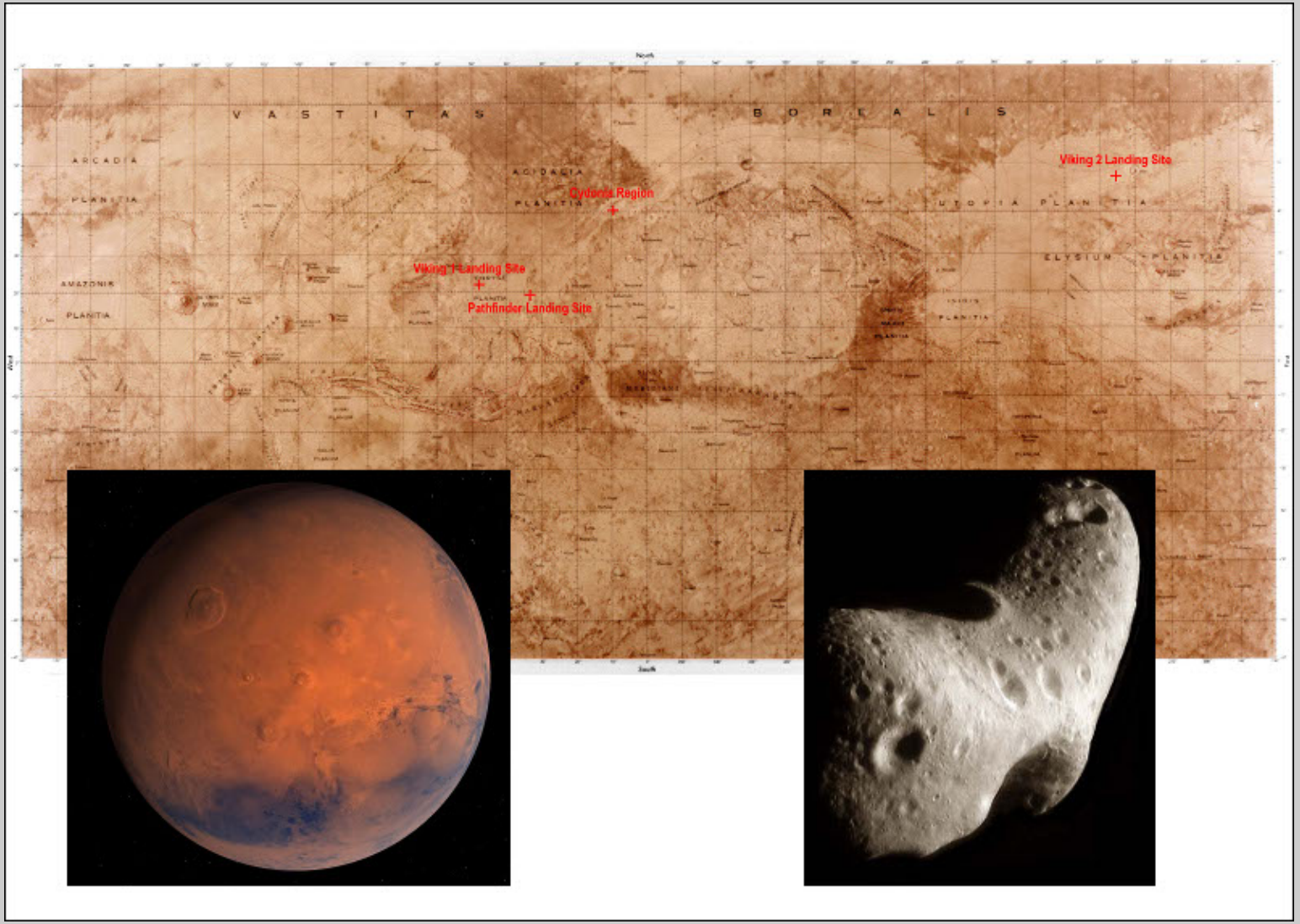
Different projections have different strengths

Geoids and Coordinates



Different geoids give different coordinates for places

Planets



Coordinates have to be agreed on; and can be tricky

Coordinate Transformation

Converting between two datums

Helmert transformation:

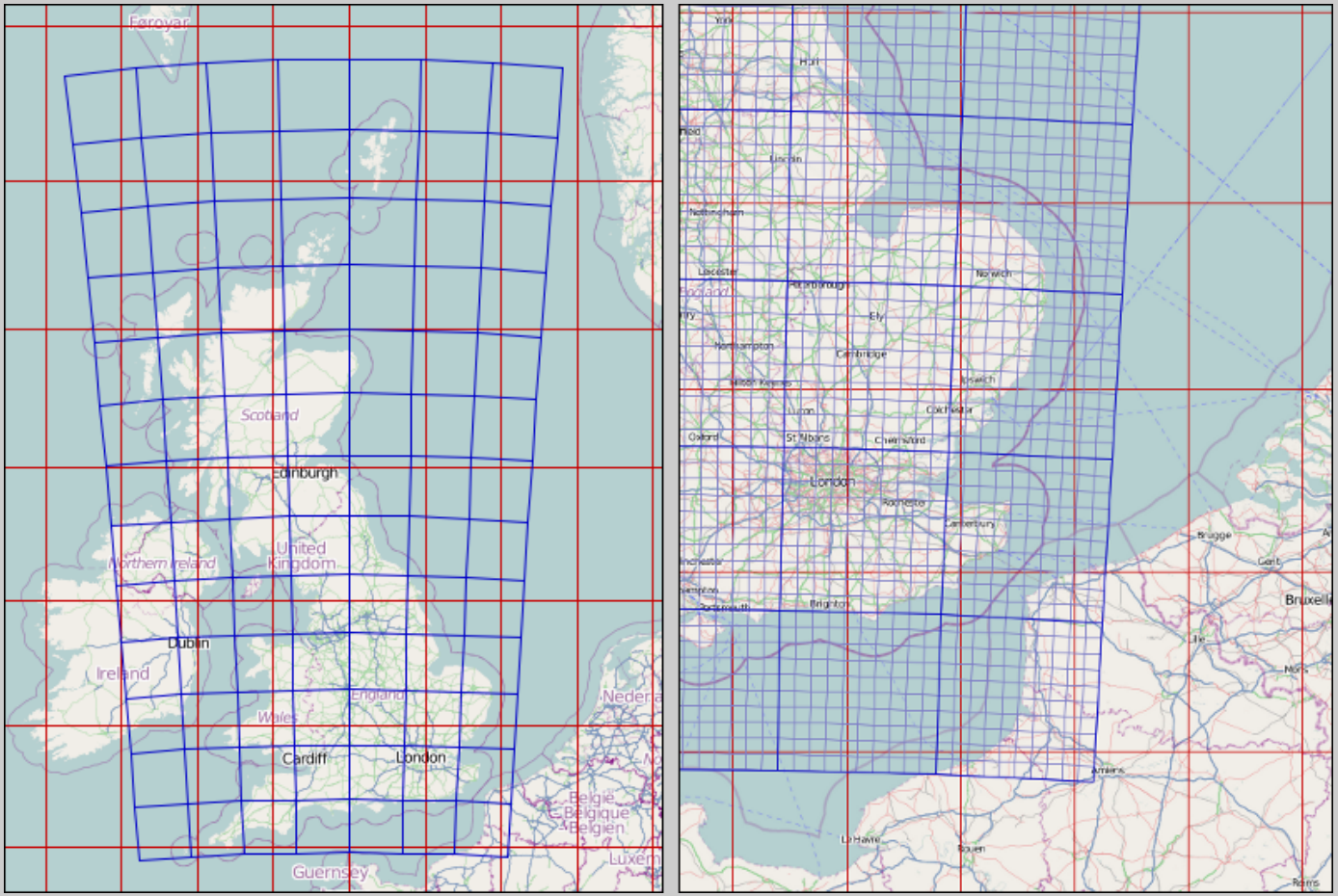
$$
\begin{aligned}
X_B &= c_x + (1 + s \times 10^{-6}) \cdot (X_A - r_z \cdot Y_A + r_y \cdot Z_A) \\
Y_B &= c_y + (1 + s \times 10^{-6}) \cdot (r_z \cdot X_A + Y_A - r_x \cdot Z_A) \\
Z_B &= c_z + (1 + s \times 10^{-6}) \cdot (-r_y \cdot X_A + r_x \cdot Y_A + Z_A).
\end{aligned}
$$

WGS84 to OSGB36:

```
cx: -446.448 cy: 125.157 cz: -542.06
s: 20.4894
rx: -0.1502  ry: -0.247  rz: -0.8421
```

Accuracy of about 7m for a OSGB36/WGS84 transformation

Different coordinate-systems



(2° × 2°) WGS84 Latitude and Longitude (1° × 1°) (100km × 100km) Ordnance Survey National Grid (10km × 10km)

Showing a Map

Google Maps


```
<!DOCTYPE html>
  <html>
  <head>
  <meta name="viewport" content="initial-scale=1.0, user-scalable=no" />
  <style type="text/css">
    html { height: 100% }
    body { height: 100%; margin: 0px; padding: 0px }
    #map_canvas { height: 100% }
  </style>
  <script type="text/javascript" src="http://maps.google.com/maps/api/js?sensor=false">
  </script>
  <script type="text/javascript">
    function initialize() {
      var latlng = new google.maps.LatLng(51.51922, -0.12736);
      var myOptions = {
        zoom: 17, center: latlng,
        mapTypeId: google.maps.MapTypeId.ROADMAP
      };
      var map = new google.maps.Map(document.getElementById("map_canvas"), myOptions);
    }
  </script>
  </head>
  <body onload="initialize()">
    <div id="map_canvas" style="width:100%; height:100%"></div>
  </body>
  </html>
```

Showing a Map

OpenStreetMap

```
<?xml version="1.0" encoding="iso-8859-1"?>
 <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
 "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
 <html xmlns="http://www.w3.org/1999/xhtml" lang="EN">
     <head>
     <style>
         html,body { margin: 0; padding: 0; width: 1004px; height: 590px; }
         #map { width: 100%; height: 100%; border: 1px solid black; float: left; z-index: -1; }
         div.olControlAttribution { bottom: 0.5em; font-size: 70%; }
     </style>
     <script src='OpenLayers.js'></script>
     <script src='osm/OpenStreetMap.js'></script>
     <script type="text/javascript">
     var map; //complex object of type OpenLayers.Map
     var lat=51.51922
     var lon=-0.12736
     var zoom=17
     function init() {
         map = new OpenLayers.Map ("map", {
             controls:[
                 new OpenLayers.Control.PanZoomBar(),
                 new OpenLayers.Control.Attribution()],
             projection: new OpenLayers.Projection("EPSG:900913"),
             displayProjection: new OpenLayers.Projection("EPSG:4326")
         } );

         layerMapnik = new OpenLayers.Layer.OSM.Mapnik("Mapnik");
         map.addLayer(layerMapnik);

         var lonLat = new OpenLayers.LonLat(lon, lat).
             transform(map.displayProjection, map.projection);
         map.setCenter(lonLat, zoom);
     }
     </script>
 </head>
 <body onload="init();">
     <div id='map'></div>
 </body>
 </html>
```

Showing a Map

Looking up latitude and longitude from a location


```
<?php
 $name = urlencode( ':-:location:-:' );
 $baseUrl = 'http://nominatim.openstreetmap.org/search?format=json&q=';
 $data = file_get_contents( "{$baseUrl}{$name}&limit=1" );
 $json = json_decode( $data );
 $lat = $json[0]->lat;
 $lon = $json[0]->lon;
 ?>
 var lat=<?php printf( '%0.3f', $lat ); ?>
 var lon=<?php printf( '%0.3f', $lon ); ?>
 <?php var_dump( $json[0] ); ?>
```

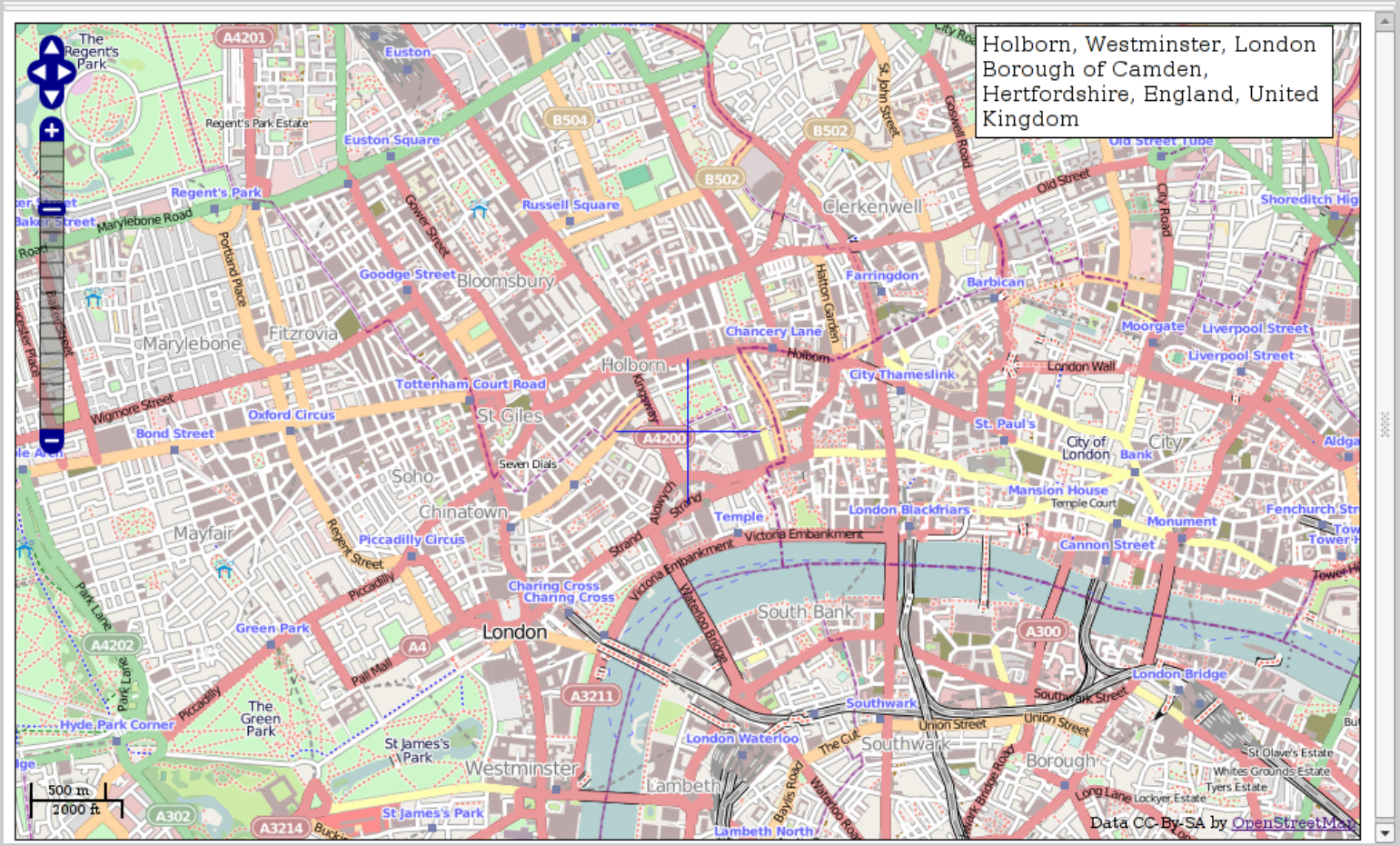
Looking up latitude/longitude

Different services

- Nominatim:http://nominatim.openstreetmap.org/search?format=json&limit=1&q=London
- Yahoo:http://where.yahooapis.com/geocode?flags=GJT&appid=[yourappidhere]&q=London

Reverse Geocoding

Finding a name for coordinates



Finding a name for the current location

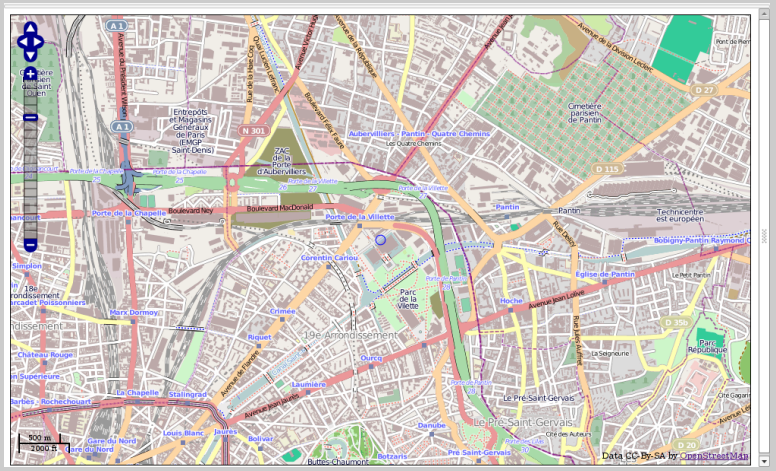
Different services

- Geonames:http://ws.geonames.org/findNearbyPlaceNameJSON?username=derick&style=full&lat={$lat}&lng={$lon}
- Nominatim:http://nominatim.openstreetmap.org/reverse?format=json&lat={$lat}&lon={$lon}&zoom={$z}
- Yahoo:http://where.yahooapis.com/geocode?gflags=R&flags=GJQT&q={$lat},{$lon}

Finding the user

Using JavaScript to locate the user

```
function getPosition()
 {
   navigator.geolocation.getCurrentPosition(iKnowWhereYouAre, notTheFaintestClue,
 {timeout:30000});
 }

 function notTheFaintestClue()
 {
 }

 function iKnowWhereYouAre(position)
 {
   var lonLat = new OpenLayers.LonLat(
     position.coords.longitude, position.coords.latitude
   ).transform(map.displayProjection, map.projection);
   map.setCenter(lonLat, zoom);

   center = map.getCenter().
     transform(map.getProjectionObject(), new OpenLayers.Projection("EPSG:4326"));

   factor = Math.cos(center.lat / (180/Math.PI)), 10 + map.getZoom() * 2;

   multiFeature = new OpenLayers.Feature.Vector(
     OpenLayers.Geometry.Polygon.createRegularPolygon(
       new OpenLayers.Geometry.Point(
         center.lon, center.lat
       ).transform(new OpenLayers.Projection("EPSG:4326"), map.getProjectionObject()),
       position.coords.accuracy / factor, 10
     ),
     {
       color: 'blue',
       align: 'rt'
     }
   );

   vectorLayer.removeAllFeatures();
   vectorLayer.drawFeature(multiFeature);
   vectorLayer.addFeatures([multiFeature]);
 }
```



Google Geo-location Service

```
<?php
$request = array(
    'version' => '1.1.0',
    'host' => 'example.com',
    'wifi_towers' => array(
        array( 'ssid' => 'ZyXEL_3934rar', 'mac_address' => "00:02:CF:E4:60:CE" )
    )
);
$c = curl_init();
curl_setopt( $c, CURLOPT_URL, 'https://www.google.com/loc/json' );
curl_setopt( $c, CURLOPT_POST, 1 );
curl_setopt( $c, CURLOPT_POSTFIELDS, json_encode( $request ) );
curl_setopt( $c, CURLOPT_RETURNTRANSFER, true );
var_dump( json_decode( curl_exec( $c ) ) );
```

http://code.google.com/intl/es-ES/apis/gears/geolocation_network_protocol.html

OpenStreetMap

- "Wikipedia for Maps"
- Licensed under the Creative Commons Attribution-ShareAlike 2.0 licence (CC-BY-SA): You are free to copy, distribute, transmit and adapt our maps and data, as long as you credit OpenStreetMap and its contributors. If you alter or build upon our maps or data, you may distribute the result only under the same licence.
- Rendered map:
- A lot of data is not rendered, but is available.

Fetching OSM data

```
wget
  http://osmxapi.hypercube.telascience.org/api/0.6/node
  [amenity=pub]
  [bbox=-2.401,53.394,-2.104,53.551]
  -O pubs.osm
```

```
<?xml version='1.0' encoding='UTF-8'?>
<osm version='0.6' generator='xapi: OSM Extended API 2.0' attribution='http://wiki.openstreetmap.org/wiki/Attribution'
xmlns:xapi='http://www.informationfreeway.org/xapi/0.6' xapi:uri='/api/0.6/node[amenity=pub][bbox=-2.401,53.394,-
2.104,53.551]' xapi:planetDate='20101006' xapi:copyright='2010 OpenStreetMap contributors' xapi:license='Creative commons
CC-BY-SA 2.0' xapi:bugs='For assistance or to report bugs contact 80n80n@gmail.com' xapi:instance='zappyHyper'>
<bounds minlat='53.394' minlon='-2.401' maxlat='53.551' maxlon='-2.104'/>
  <node id='275332052' lat='53.548238' lon='-2.3958373' version='2' changeset='4395635'
        user='Steeley' uid='101150' visible='true' timestamp='2010-04-11T17:08:16Z'>
    <tag k='amenity' v='pub'/>
    <tag k='name' v='The Saddle'/>
  </node>
...
  <node id='30732192' lat='53.4647746' lon='-2.2319186' version='3' changeset='5810586'
        user='geordiemanc' uid='345640' visible='true' timestamp='2010-09-18T11:12:50Z'>
    <tag k='address' v='325 Oxford Road'/>
    <tag k='amenity' v='pub'/>
    <tag k='name' v='Kro Bar'/>
    <tag k='phone' v='01612743100'/>
    <tag k='postal_code' v='M13 9PG'/>
    <tag k='real_ale' v='yes'/>
  </node>
```

The Data

- Nodes (Lat/Lon point) <node id='459517295' lat='50.0100766' lon='8.3162402' user='WoGo' timestamp='2009-08-09T11:45:33Z' uid='152395' version='1' changeset='2083951'>
- Ways (Ordered interconnection of nodes)
- Areas (Closed ways) <way id='76174399' user='Derick Rethans' uid='37137' timestamp='2010-09-06T08:30:14Z' version='1' changeset='5695697'> <nd ref='898861293'/> <nd ref='898861305'/> <nd ref='898861298'/> <nd ref='898861315'/> <nd ref='898861293'/> ... </way>
- Tags (Describe an element) <tag k='addr:housenumber' v='375'/> <tag k='addr:street' v='Kilburn High Road'/> <tag k='amenity' v='pub'/> <tag k='building' v='yes'/> <tag k='name' v='North London Tavern'/>

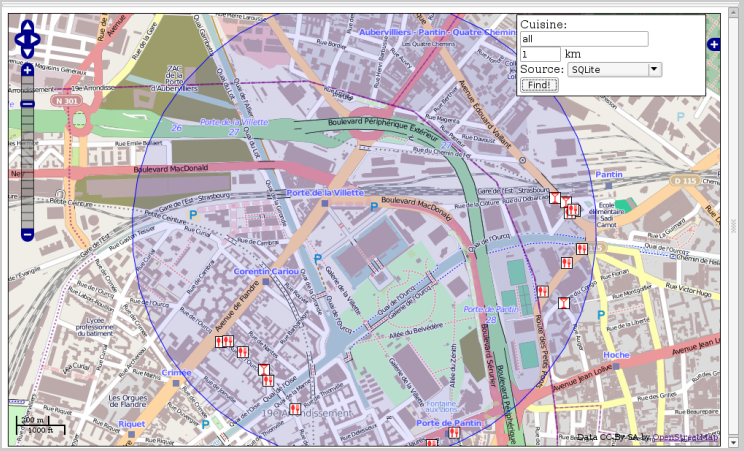
Massage the Data

Process:

- Use XAPI to fetch data
- Parse XML file with PHP into a DB
- Query database
- Show data
- Profit!

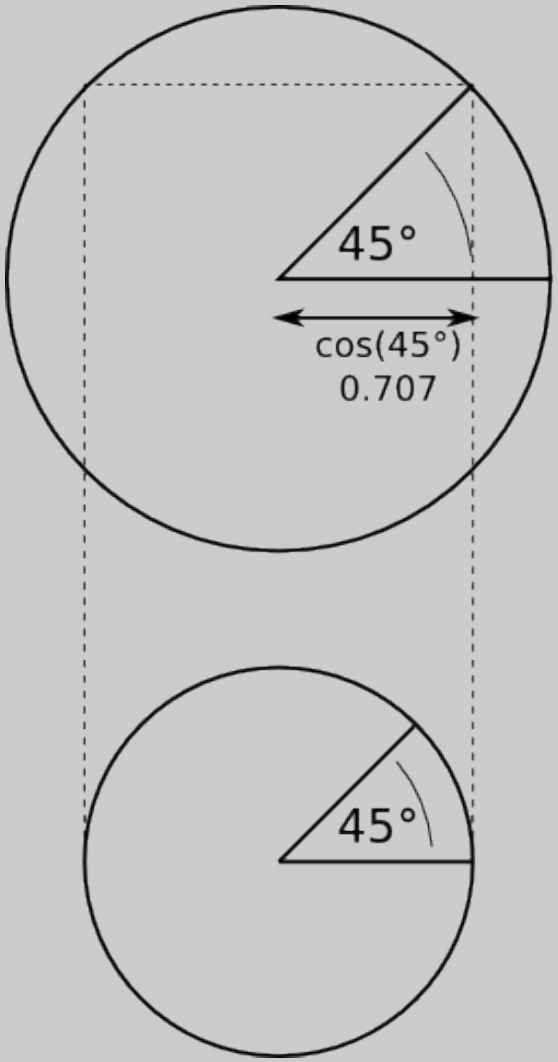
Finding Food

```
function init() {
      map = new OpenLayers.Map ("map", {
          eventListeners: {
              "moveend": moveEndEvent
          },
          controls:[
```




```
function changeQuery()
{
    cuisine = document.getElementById('amenity').value;
    radiusInput = document.getElementById('radius');
    source = document.getElementById('source').value;

    if (source == 'sqlite') { script = 'fetch.php'; }
    if (source == 'mysql') { script = 'fetch-mysql.php'; }
    if (source == 'mongo') { script = 'fetch-mongo.php'; }
    if (source == 'mongo2') { script = 'fetch-mongo-fixed.php'; }

    center = map.getCenter().transform(map.getProjectionObject(), new OpenLayers.Projection("EPSG:4326"));
    pois.destroy();
    pois = new OpenLayers.Layer.Text( "The Shops", {
        location: "./" + script + "?cuisine=" + cuisine +
            '&lat=' + center.lat + '&lon=' + center.lon + '&d=' + radiusInput.value,
        projection: map.displayProjection
    });
    map.addLayer(pois);

    multiFeature = new OpenLayers.Feature.Vector(
        OpenLayers.Geometry.Polygon.createRegularPolygon(
            new OpenLayers.Geometry.Point(center.lon,center.lat).transform(new OpenLayers.Projection("EPSG:4326"),
map.getProjectionObject()),
            radiusInput.value * 1000 / Math.cos(center.lat / (180/Math.PI)), 10 + map.getZoom() * 2, 10
    ),
    {
        color: 'blue',
        align: 'rt'
    });

    vectorLayer.removeAllFeatures();
    vectorLayer.drawFeature(multiFeature);
    vectorLayer.addFeatures([multiFeature]);
}

function moveEndEvent(event)
{
    changeQuery();
}
```

Distances are tricky

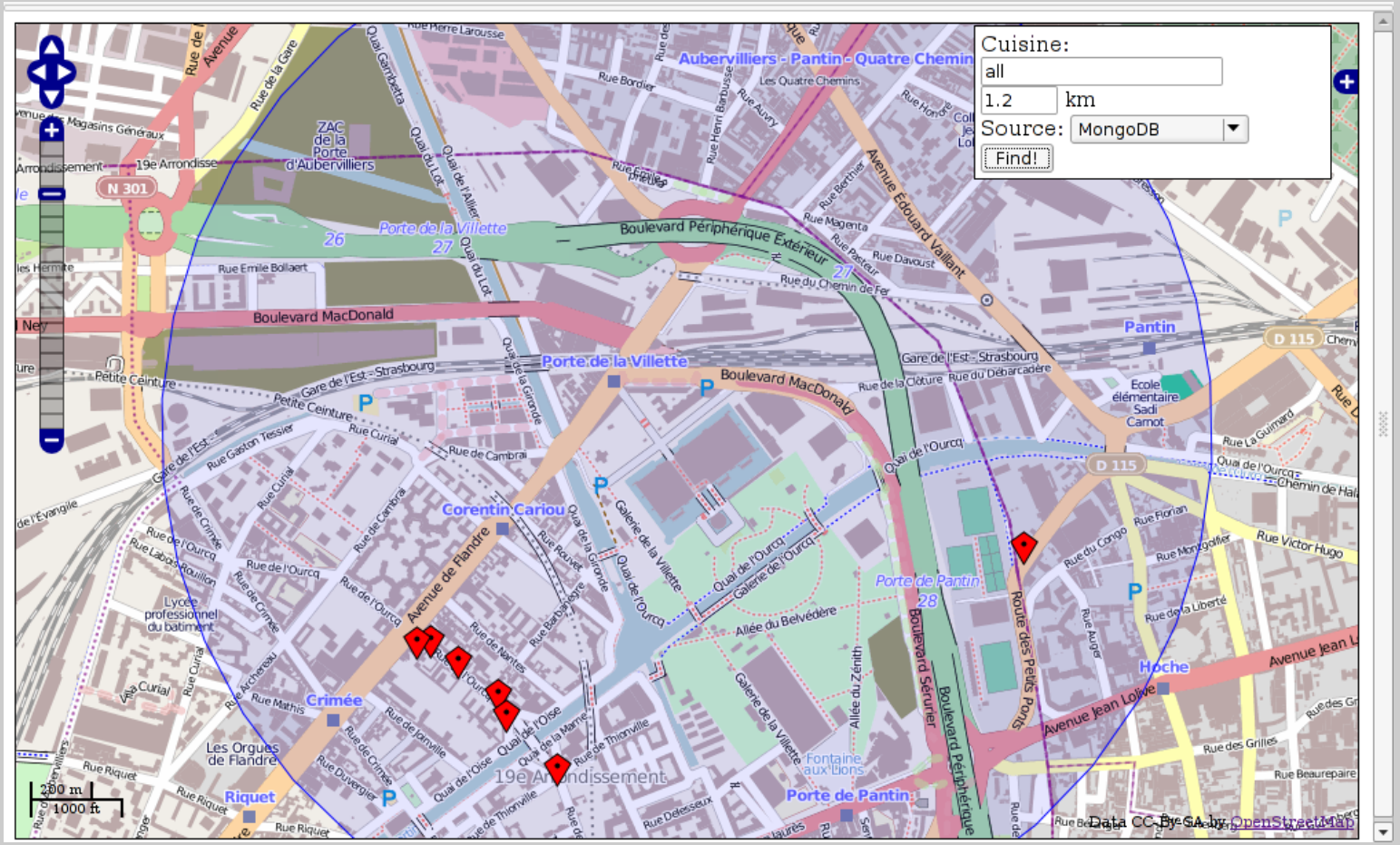


$\frac{1}{8} \cdot 2\pi \cdot 6371\text{km} = 5003\text{km}$

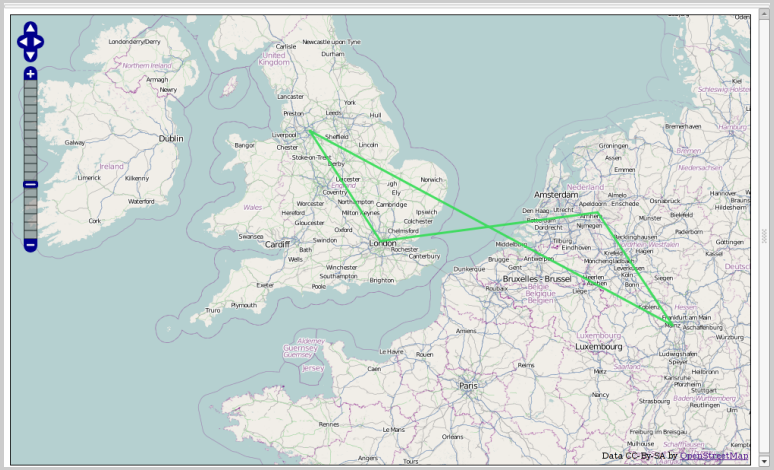
$\frac{1}{8} \cdot 2\pi \cdot 6371\text{km} \cdot \cos(45°) = 3538\text{km}$

note: km / miles ≈ cos(51.5)

Finding Food



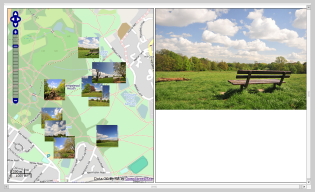
Plotting data




```
<?xml version="1.0" encoding="UTF-8"?>
<gpx
  version="1.0"
  creator="GPSBabel - http://www.gpsbabel.org"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://www.topografix.com/GPX/1/0"
  xsi:schemaLocation="http://www.topografix.com/GPX/1/0 http://www.topografix.com/GPX/1/0/gpx.xsd">
    <trk><name>Conferences</name>
        <trkseg>
            <trkpt lat="51.5393357" lon="-0.1982196"><name>London</name></trkpt>
            <trkpt lat="53.4791466" lon="-2.2447445"><name>Manchester</name></trkpt>
            <trkpt lat="49.9999952" lon="8.2710237"><name>Mainz</name></trkpt>
            <trkpt lat="52.05292"   lon="6.09513"><name>Dieren</name></trkpt>
            <trkpt lat="51.5393357" lon="-0.1982196"><name>London</name></trkpt>
        </trkseg>
    </trk>
</gpx>
```

Flickr

```
function newImageMarker(url, lat, lon)
 {
     w = 85 - ((19-map.getZoom())*4);
     size = new OpenLayers.Size(w,w);
     offset = new OpenLayers.Pixel(-(size.w/2), -(size.h/2));
     icon = new OpenLayers.Icon(url, size, offset);

     marker = new OpenLayers.Marker(
         new OpenLayers.LonLat(lon, lat)
             .transform(
                 new OpenLayers.Projection("EPSG:4326"),
                 map.getProjectionObject()
             ),
         icon.clone()
     );
     marker.events.register(
         'mousedown',
         marker,
         function(evt) { showImage(this.icon); OpenLayers.Event.stop(evt); }
     );
     markers.addMarker(marker);
 }
 function changeQuery()
 {
     markers.clearMarkers();
     $.getJSON('fetch-flickr.php', function(data) {
         $.each(data.items, function(i,item){
             newImageMarker(item.url, item.lat, item.lon);
         });
     });
 }
 <?php
 $d = ezcDbFactory::create( 'sqlite://' . dirname( __FILE__ ) . '/presentations/slides/map/examples/photos.sqlite'
 );
 $q = $d->createSelectQuery();
 $q->select('*')->from('photo')->orderBy( 'date_taken', ezcQuerySelect::DESC )->limit(100);
 $s = $q->prepare();
 $s->execute();

 $items = array();
 foreach ( $s as $photo )
 {
     $items[] = array(
         'lon' => $photo['lon'],
         'lat' => $photo['lat'],
         'url' => $photo['thumb_url']
     );
 }
 echo json_encode(array( 'items' => $items ) );
```



Resources

derick@derickrethans.nl - twitter: @derickr
http://derickrethans.nl/talks.html
http://joind.in/2103

- http://openstreetmap.org
- http://mapref.org
- http://dev.openlayers.org/docs/files/OpenLayers-js.html
- http://data.london.gov.uk/taxonomy/categories/transport
- http://www.flickr.com/services/api/
- http://www.ordnancesurvey.co.uk/oswebsite/gps/information/coordinatesystemsinfo/guidecontents/index.html
- http://en.wikipedia.org/wiki/Helmert_transformation
- http://code.google.com/apis/maps/documentation/javascript/
- http://wiki.openstreetmap.org/wiki/Nominatim
- http://developer.yahoo.com/geo/placefinder/guide/
- http://www.geonames.org/export/web-services.html
- http://code.google.com/intl/es-ES/apis/gears/geolocation_network_protocol.html
- http://www.mongodb.org/display/DOCS/Geospatial+Indexing
- http://en.wikipedia.org/wiki/Gpx

Getting the WLAN info

```
<?php
define( 'NM', "org.freedesktop.NetworkManager" );
$d = new Dbus( Dbus::BUS_SYSTEM, true );
$n = $d->createProxy( NM, "/org/freedesktop/NetworkManager", NM);
$wifi = array();
foreach ($n->GetDevices()->getData() as $device)
{
  $device = $device->getData();
  $dev = $d->createProxy( NM, $device, "org.freedesktop.DBus.Properties");
  $type = $dev->Get(NM . ".Device", "DeviceType")->getData();
  if ( $type == 2 ) // WI-FI
  {
    $wifiDev = $d->createProxy(NM, $device, NM . ".Device.Wireless");
    foreach( $wifiDev->GetAccessPoints()->getData() as $ap )
    {
      $apDev = $d->createProxy(NM, $ap->getData(), "org.freedesktop.DBus.Properties");
      $props = $apDev->GetAll(NM . ".AccessPoint")->getData();
      $ssid = '';
      foreach( $props['Ssid']->getData()->getData() as $n )
      {
        $ssid .= chr($n);
      }
      $wifi[] = array('ssid' => $ssid, "mac_address" =>  $props['HwAddress']->getData() );
    }
  }
}

$request = array( 'version' => '1.1.0', 'host' => 'example.com', 'wifi_towers' => $wifi );

$c = curl_init();
curl_setopt( $c, CURLOPT_URL, 'https://www.google.com/loc/json' );
curl_setopt( $c, CURLOPT_POST, 1 );
curl_setopt( $c, CURLOPT_POSTFIELDS, json_encode( $request ) );
curl_setopt( $c, CURLOPT_RETURNTRANSFER, true );
$result = json_decode( curl_exec( $c ) )->location;
echo "<a href='http://openstreetmap.org/?lat={$result->latitude}&amp;lon={$result->longitude}&amp;zoom=18'>here</a>\n";
?>
```