



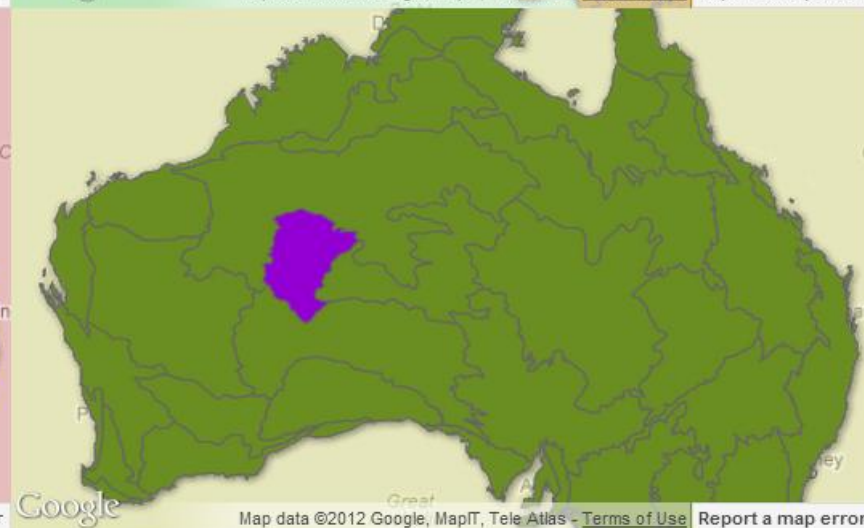
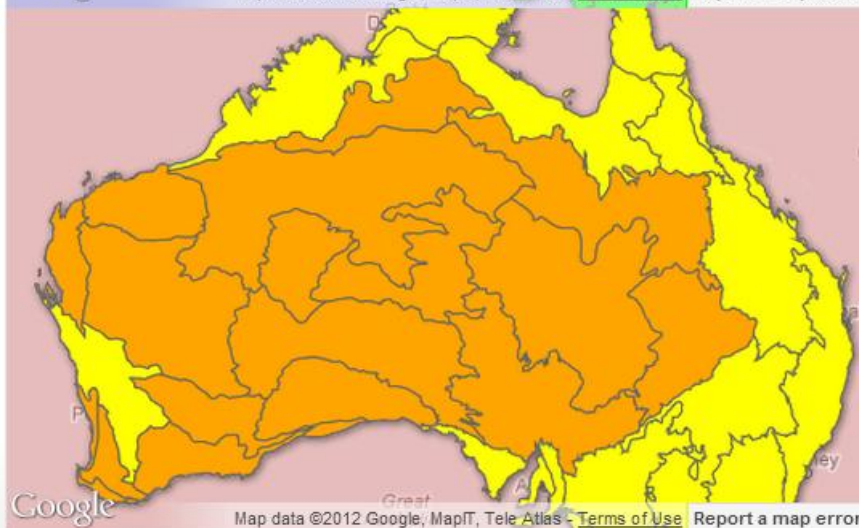
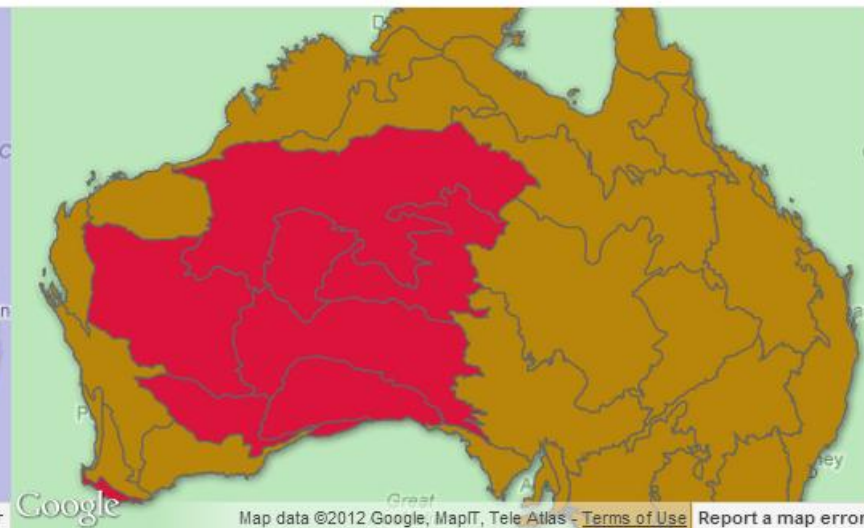
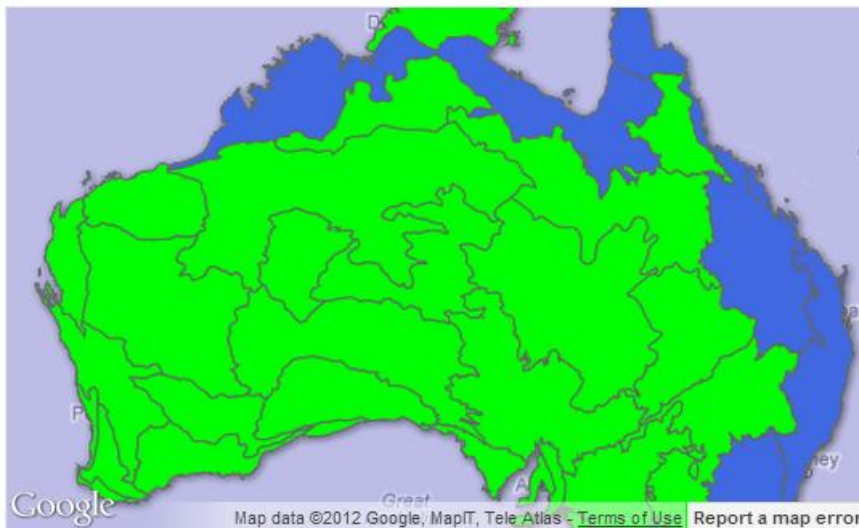


Spatial Data Visualization

Enoch Lau - Software Engineer, Google

Brendan Kenny - Developer Programs Engineer, Google





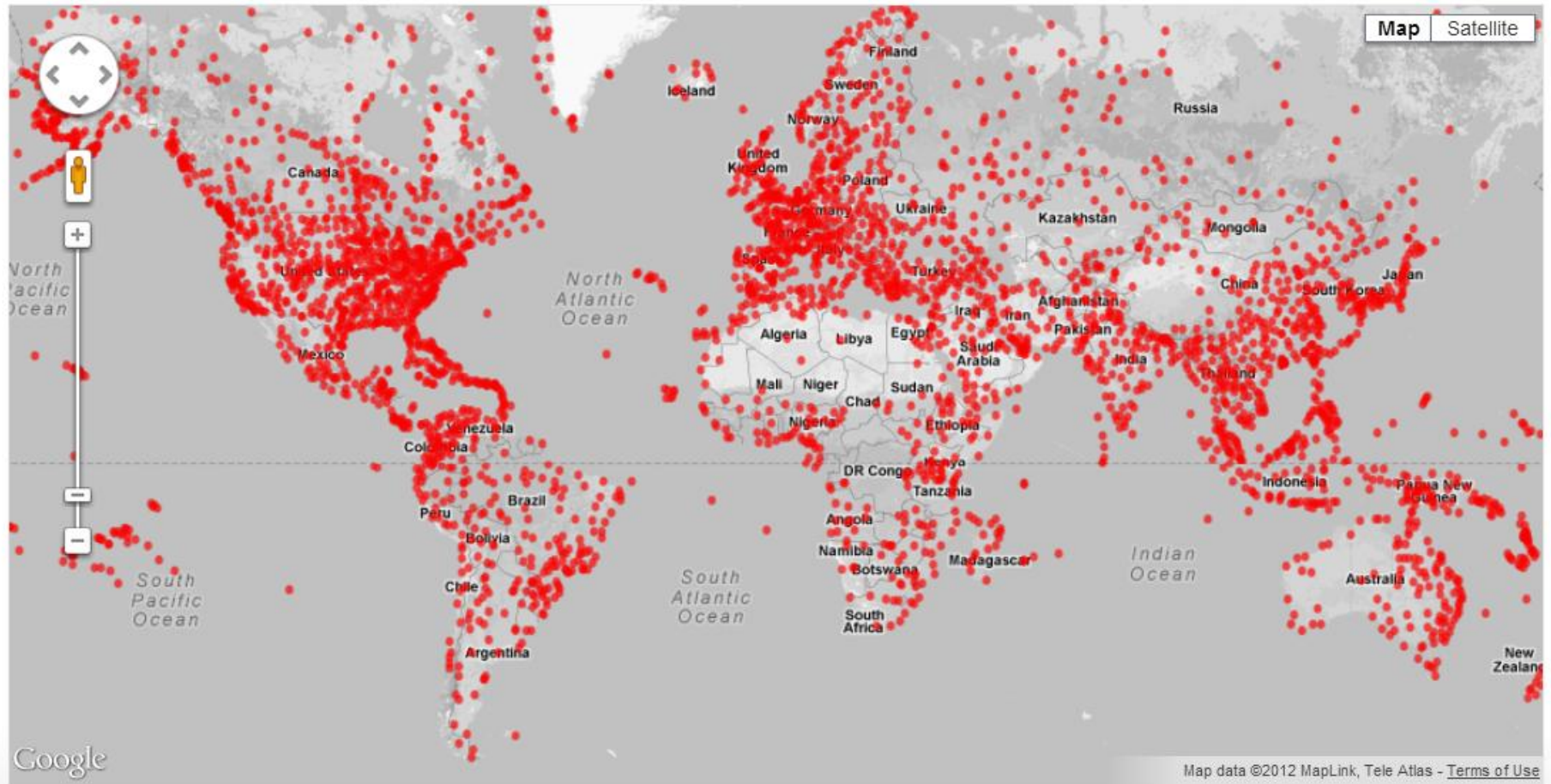
Markers



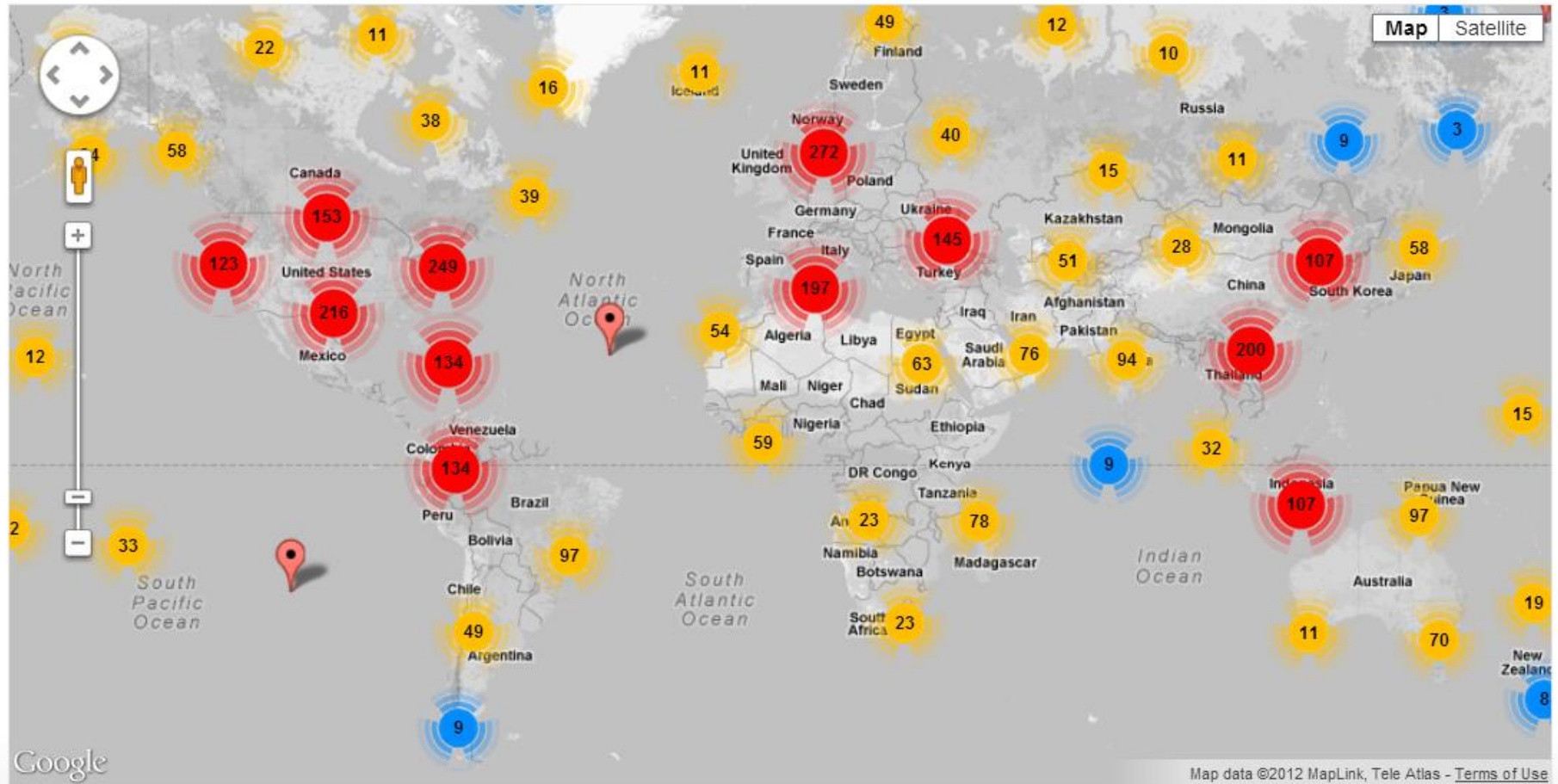
Markers



Custom icons

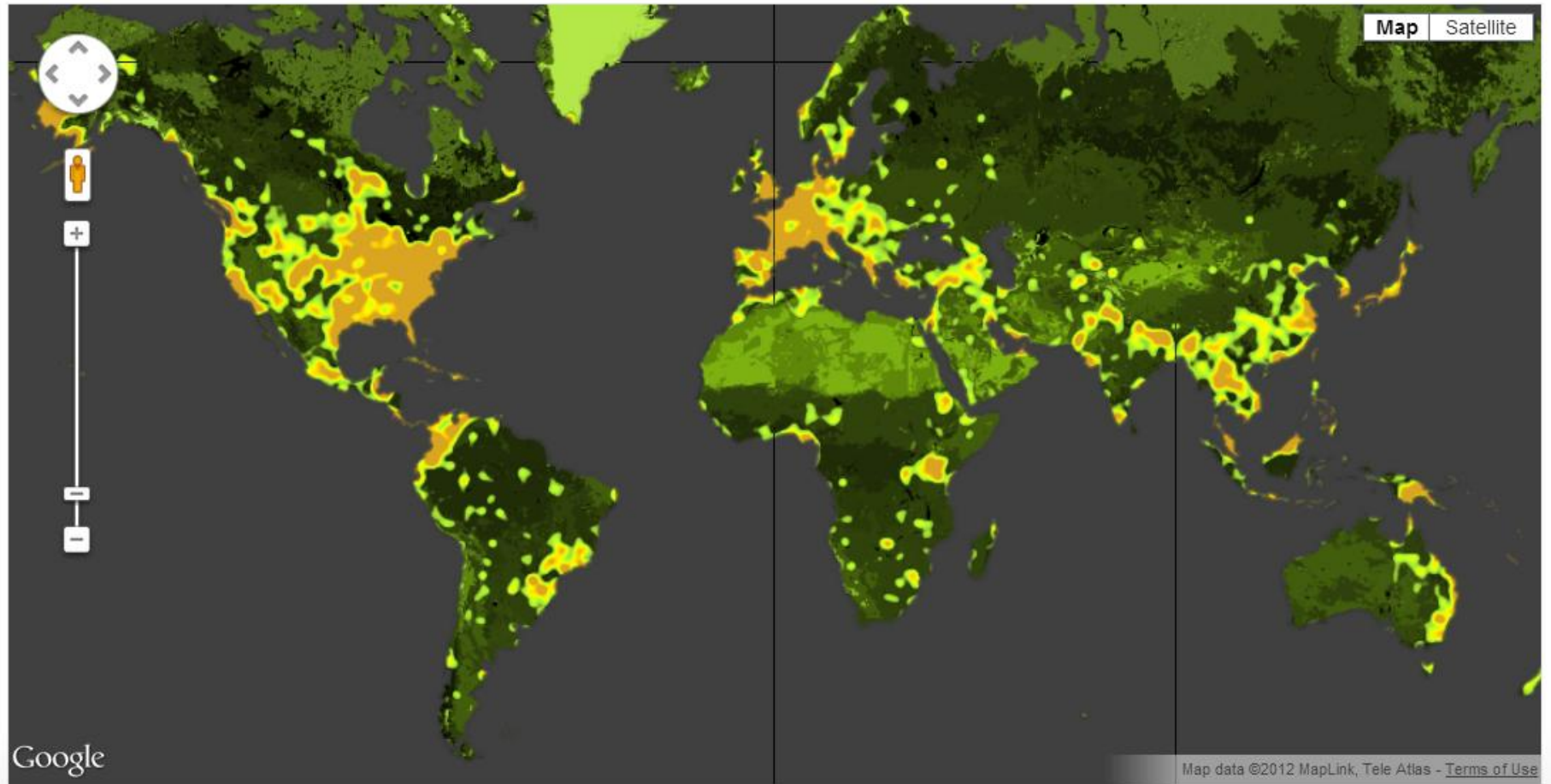


Marker Clusterer



#io12

Heatmaps



New HeatmapLayer in the Maps API

```
<script src="http://maps.googleapis.com/maps/api/js?sensor=false&libraries=visualization">
</script>
```

HTML

```
var heatmap = new google.maps.visualization.HeatmapLayer({
  data: [
    new google.maps.LatLng(1, 2),
    new google.maps.LatLng(3, 4),
    new google.maps.LatLng(5, 6)
  ],
  map: map
});
```

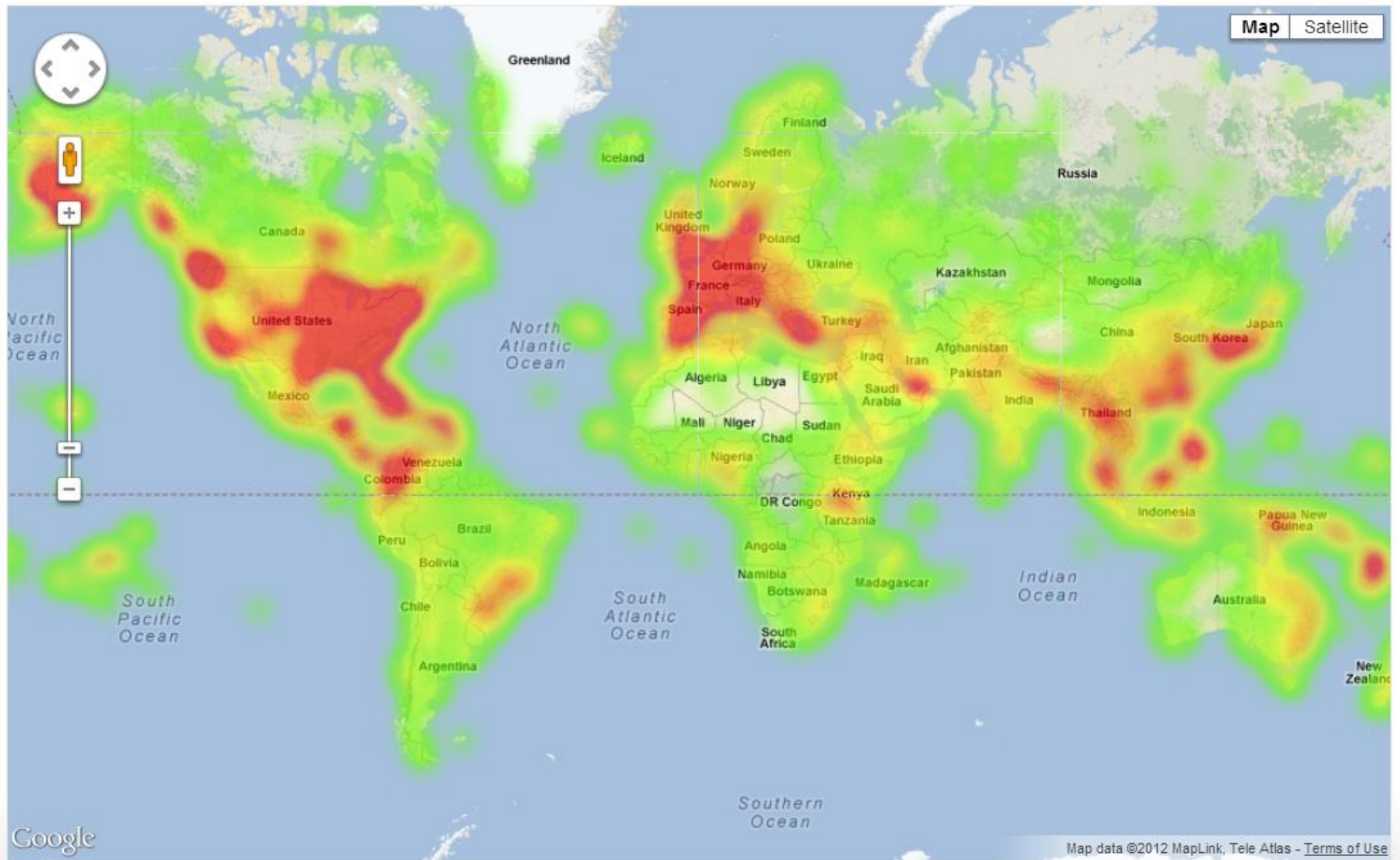
JAVASCRIPT

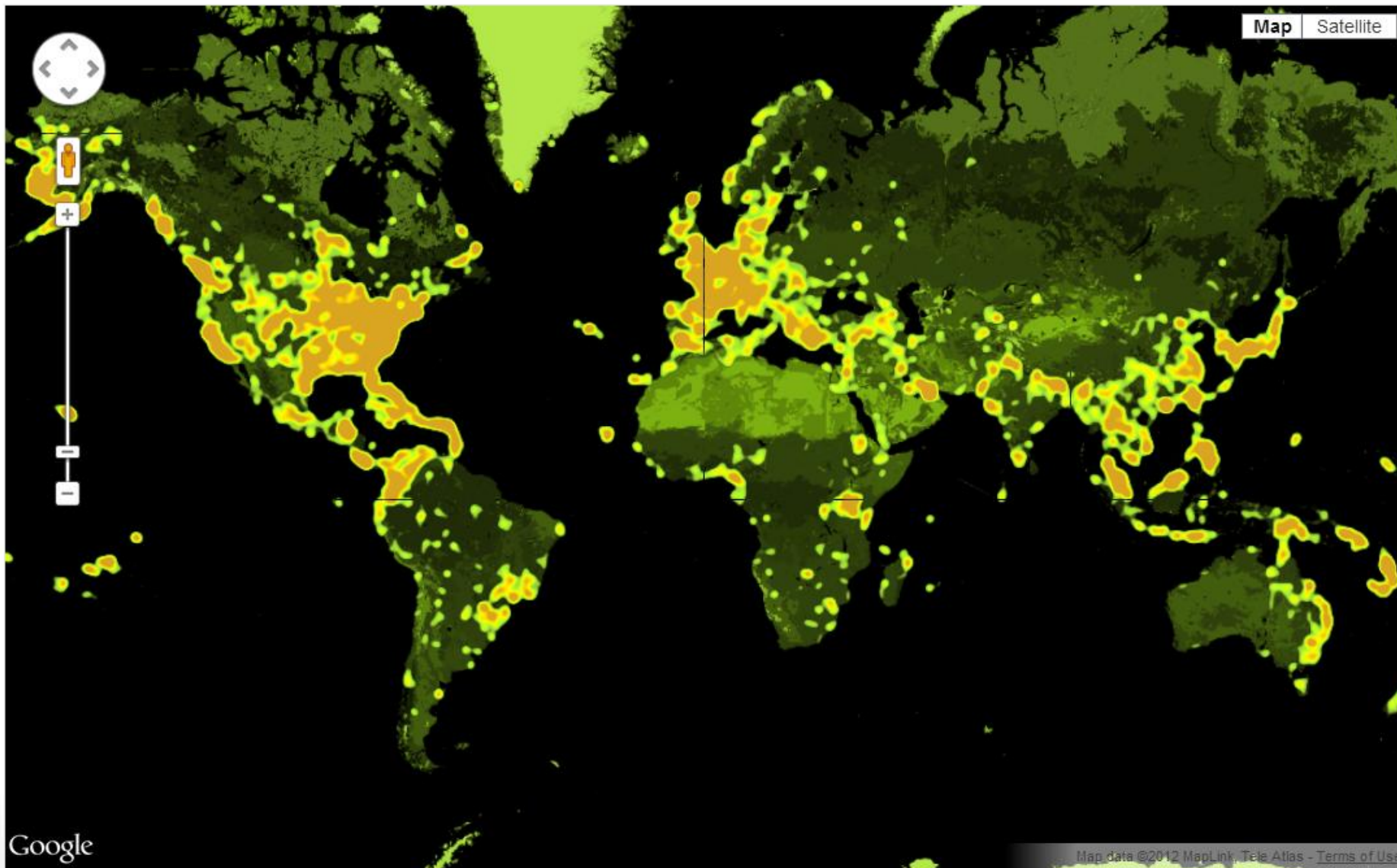


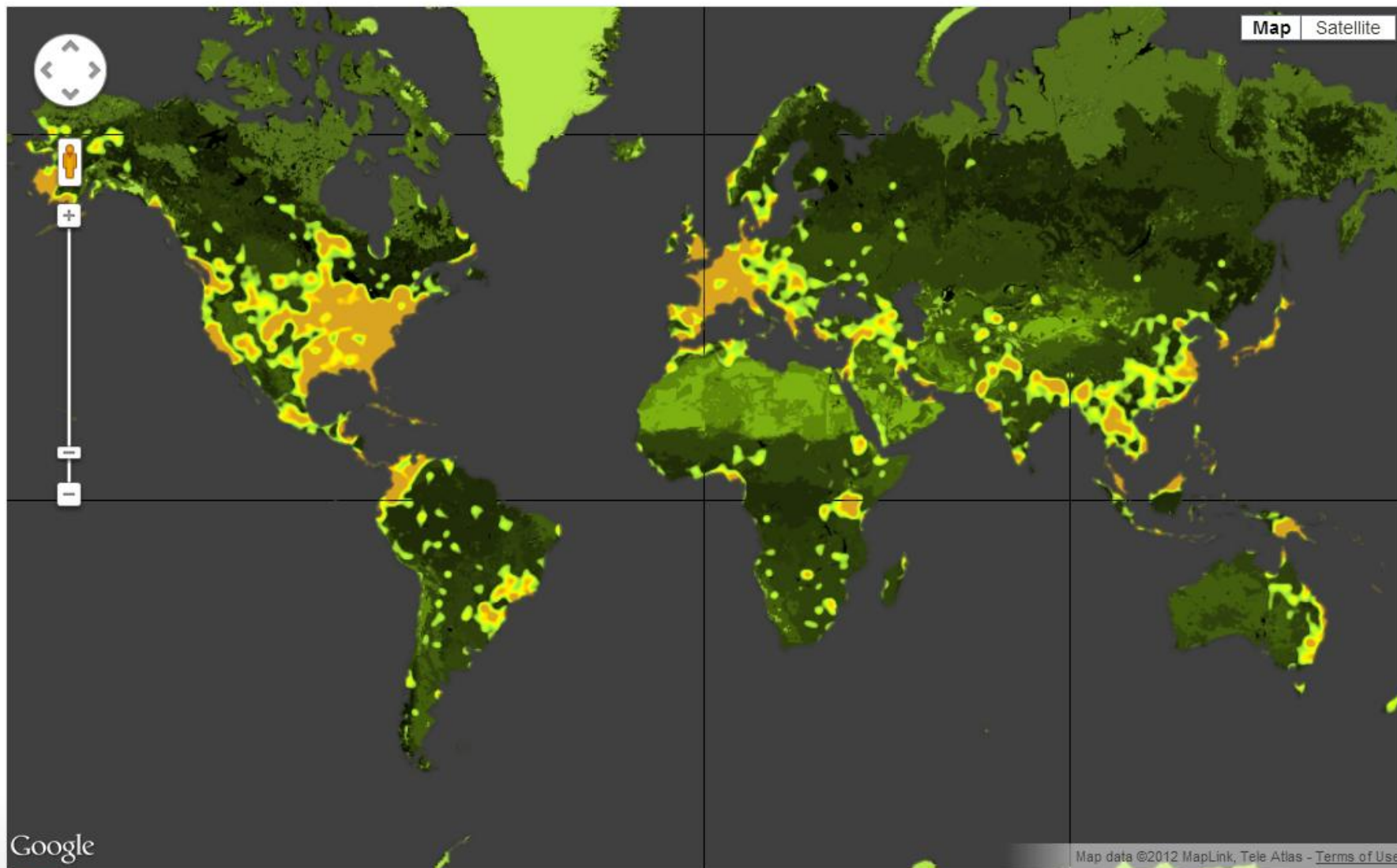
```
google.maps.event.addListener(map, 'mousemove', function(e) {  
    heatmap.getData().push(e.latLng);  
});
```

JAVASCRIPT

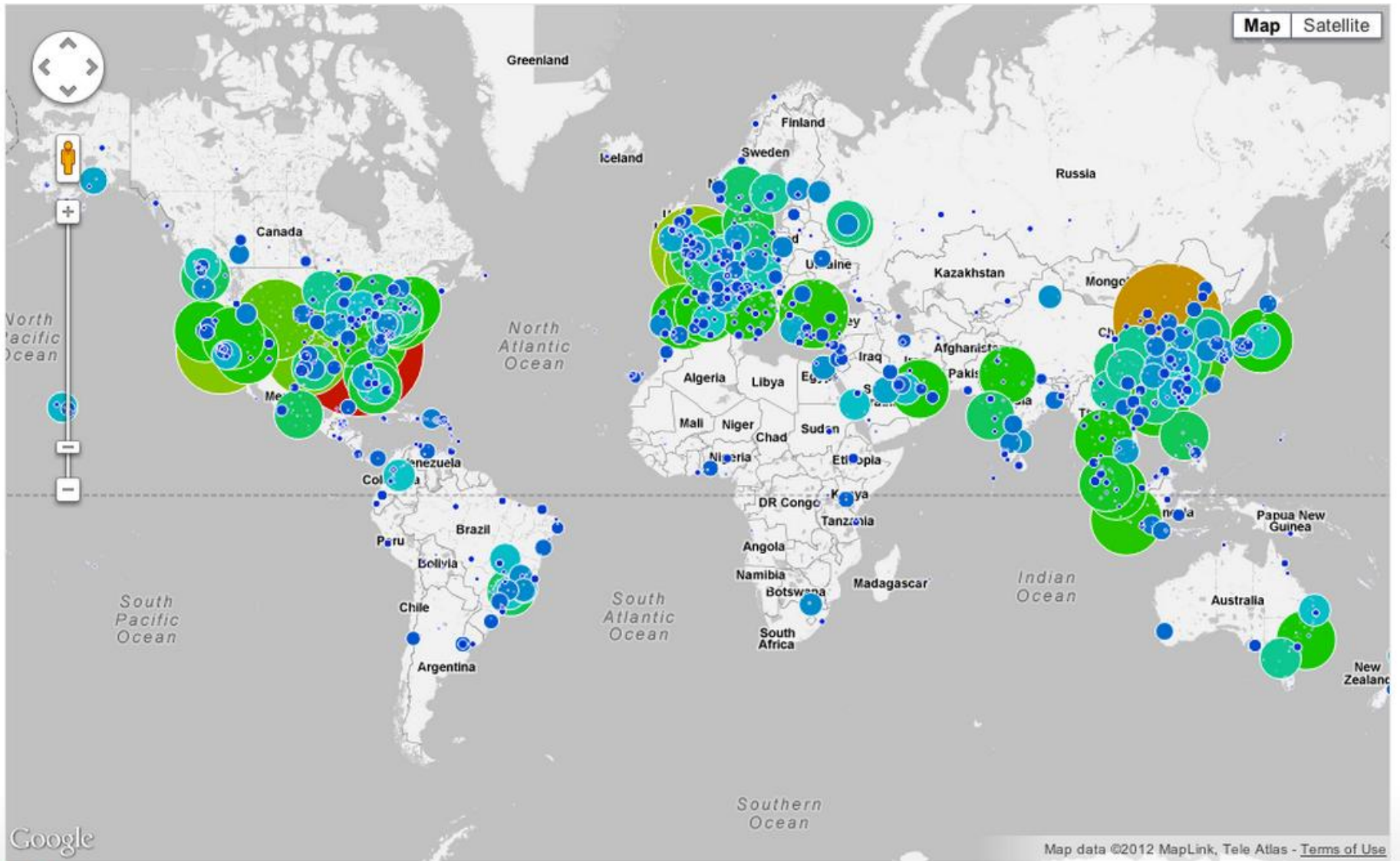












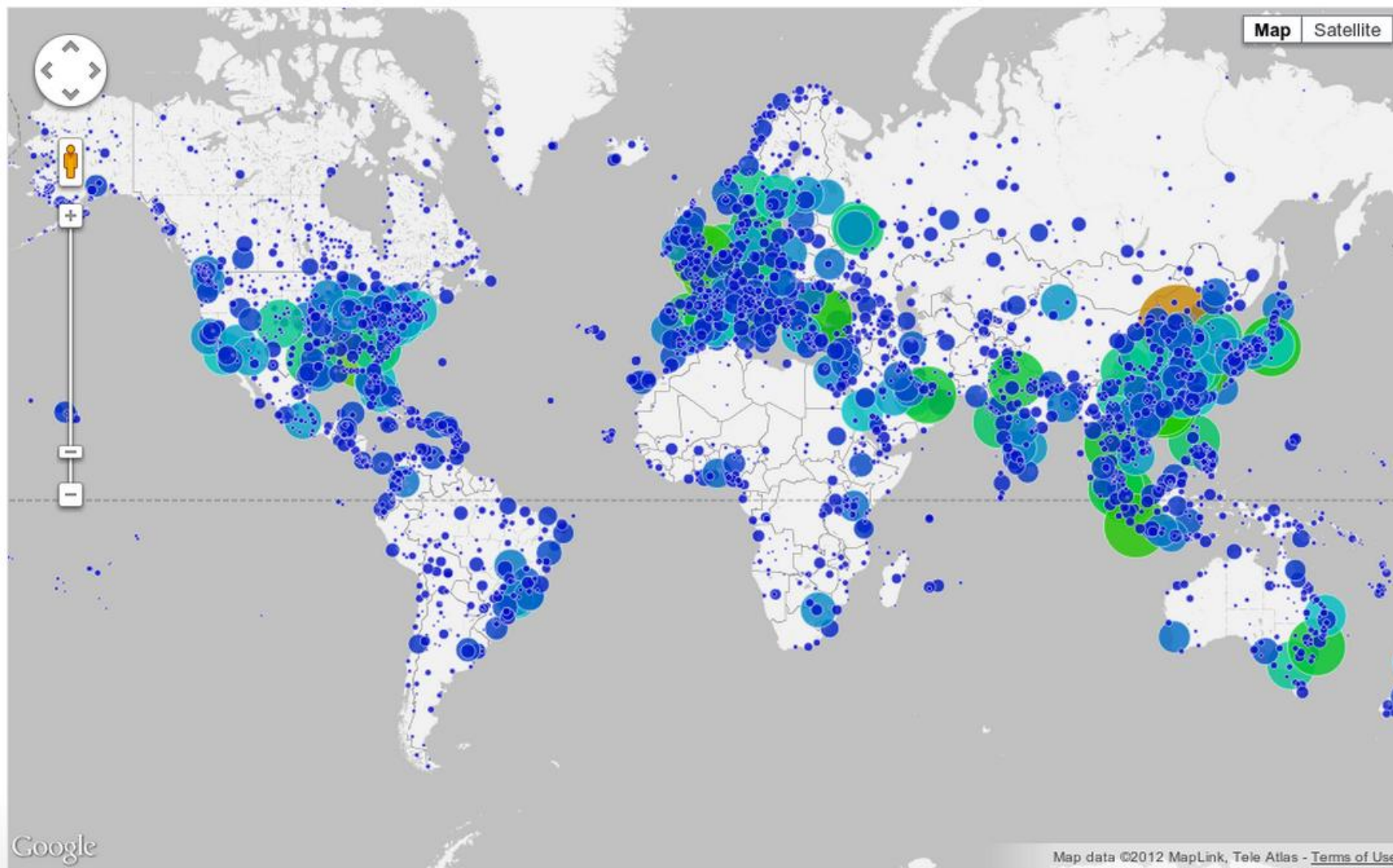
Google

Map data ©2012 MapLink, Tele Atlas - [Terms of Use](#)

New Symbols in the Maps API

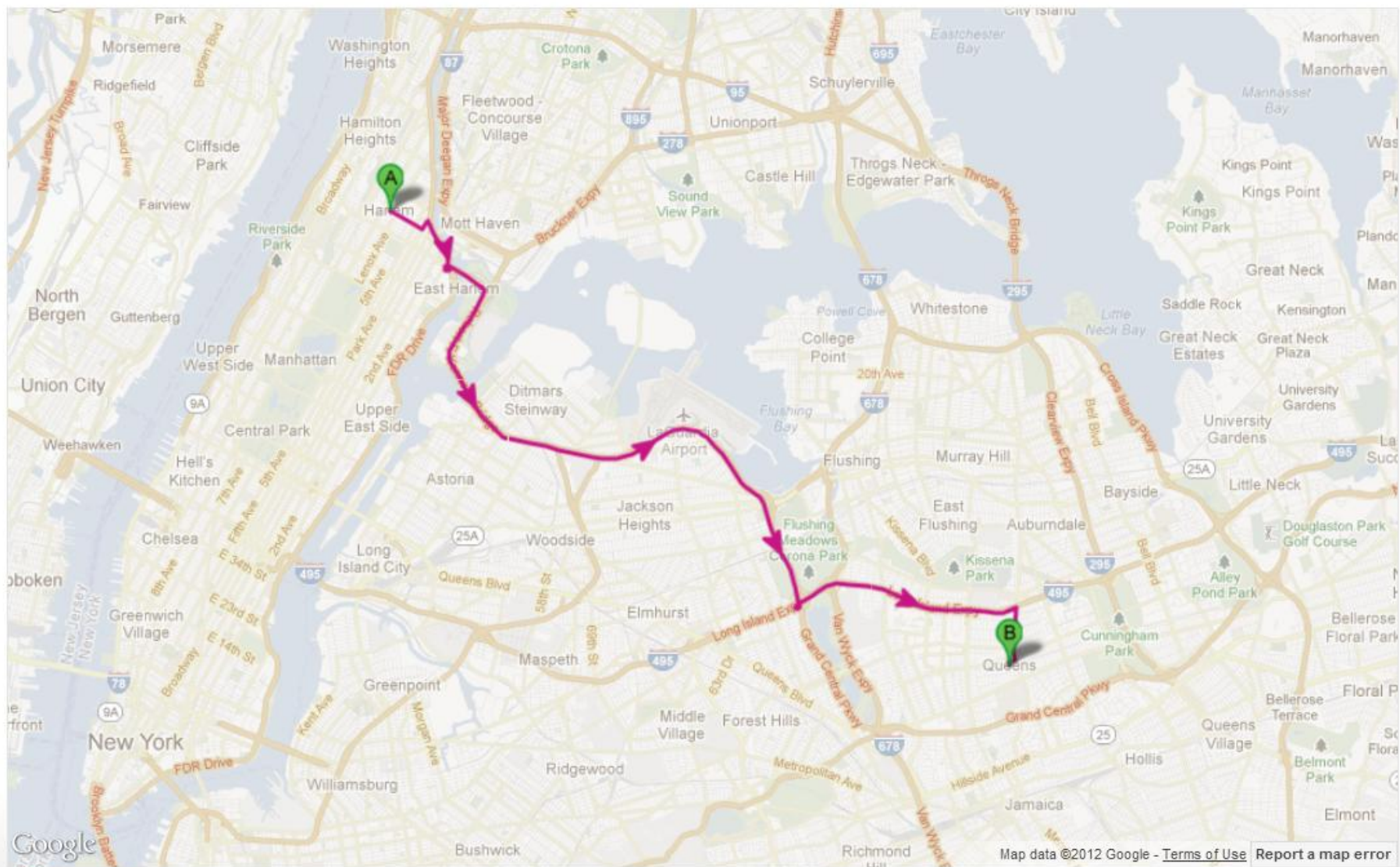
JAVASCRIPT

```
new google.maps.Marker({  
  icon: {  
    path: google.maps.SymbolPath.CIRCLE,  
    scale: 10,  
    strokeColor: 'white',  
    fillColor: 'blue',  
    fillOpacity: 1  
  },  
  ...  
});
```









#io12



Adding symbols to polylines

JAVASCRIPT

```
new google.maps.Polyline({
  path: ...,
  icons: [{
    icon: {
      path: google.maps.SymbolPath.FORWARD_OPEN_ARROW,
      strokeColor: '#ff0000',
      scale: 4
    },
    offset: '50px',
    repeat: '100px'
  }],
  ...
});
```

```
icons: [{  
  icon: {  
    path: google.maps.SymbolPath.FORWARD_OPEN_ARROW  
  },  
  repeat: '0'  
}]
```



Google

[Terms of Use](#)


```
icons: [{  
  icon: {  
    path: google.maps.SymbolPath.FORWARD_OPEN_ARROW  
  },  
  repeat: '25%'  
}]
```



Google

[Terms of Use](#)

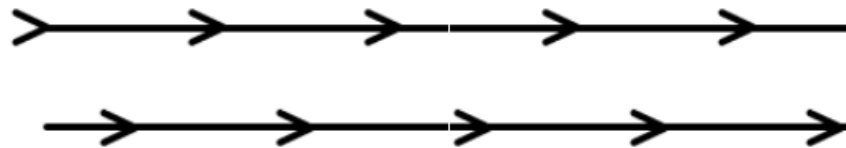
```
icons: [{  
  icon: {  
    path: google.maps.SymbolPath.FORWARD_OPEN_ARROW  
  },  
  repeat: '50px'  
}]
```



Google

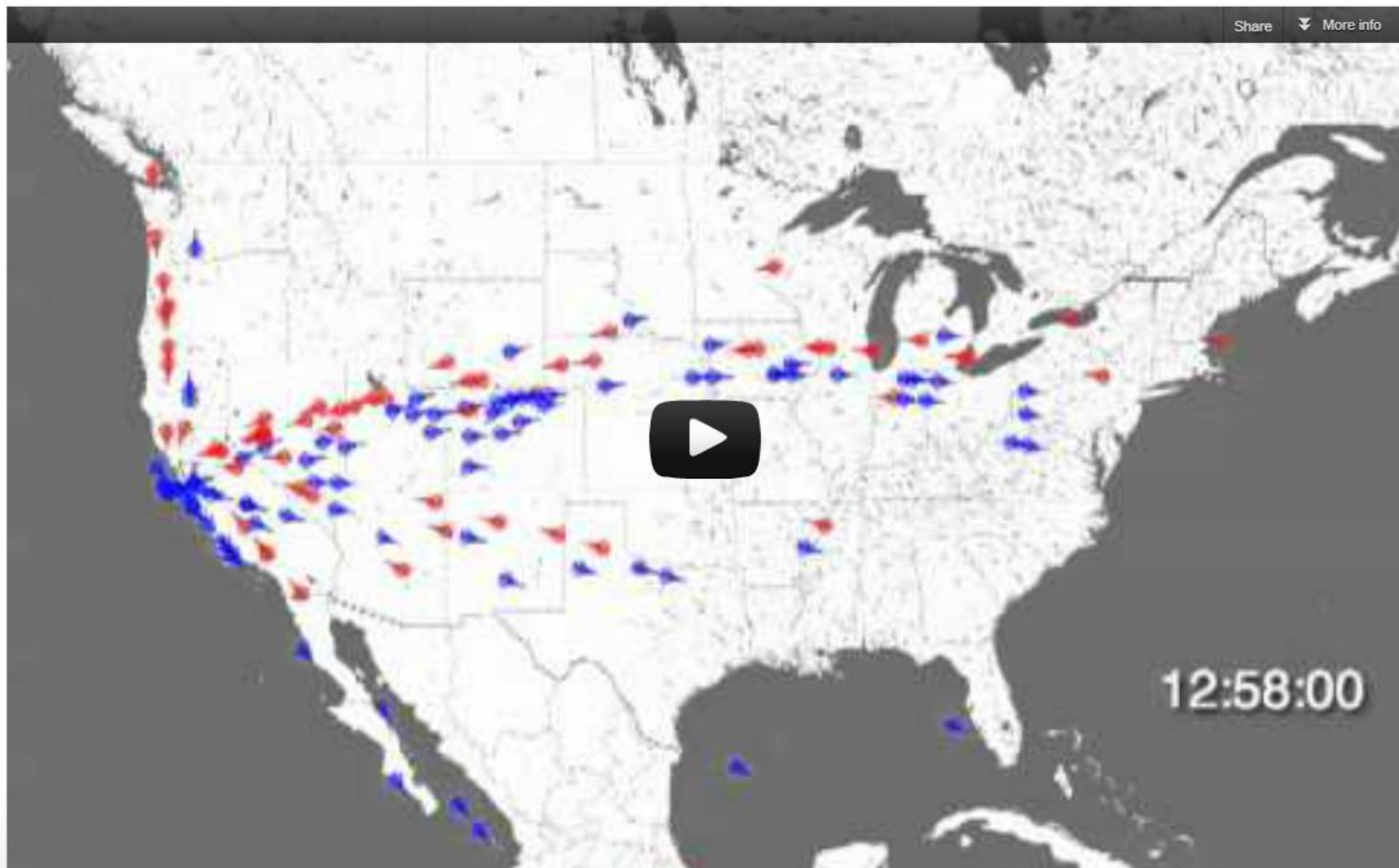
[Terms of Use](#)

```
icons: [{  
  icon: ...  
  offset: '0',  
  repeat: '100px'  
}]  
icons: [{  
  icon: ...  
  offset: '50px',  
  repeat: '100px'  
}]
```



Google

[Terms of Use](#)



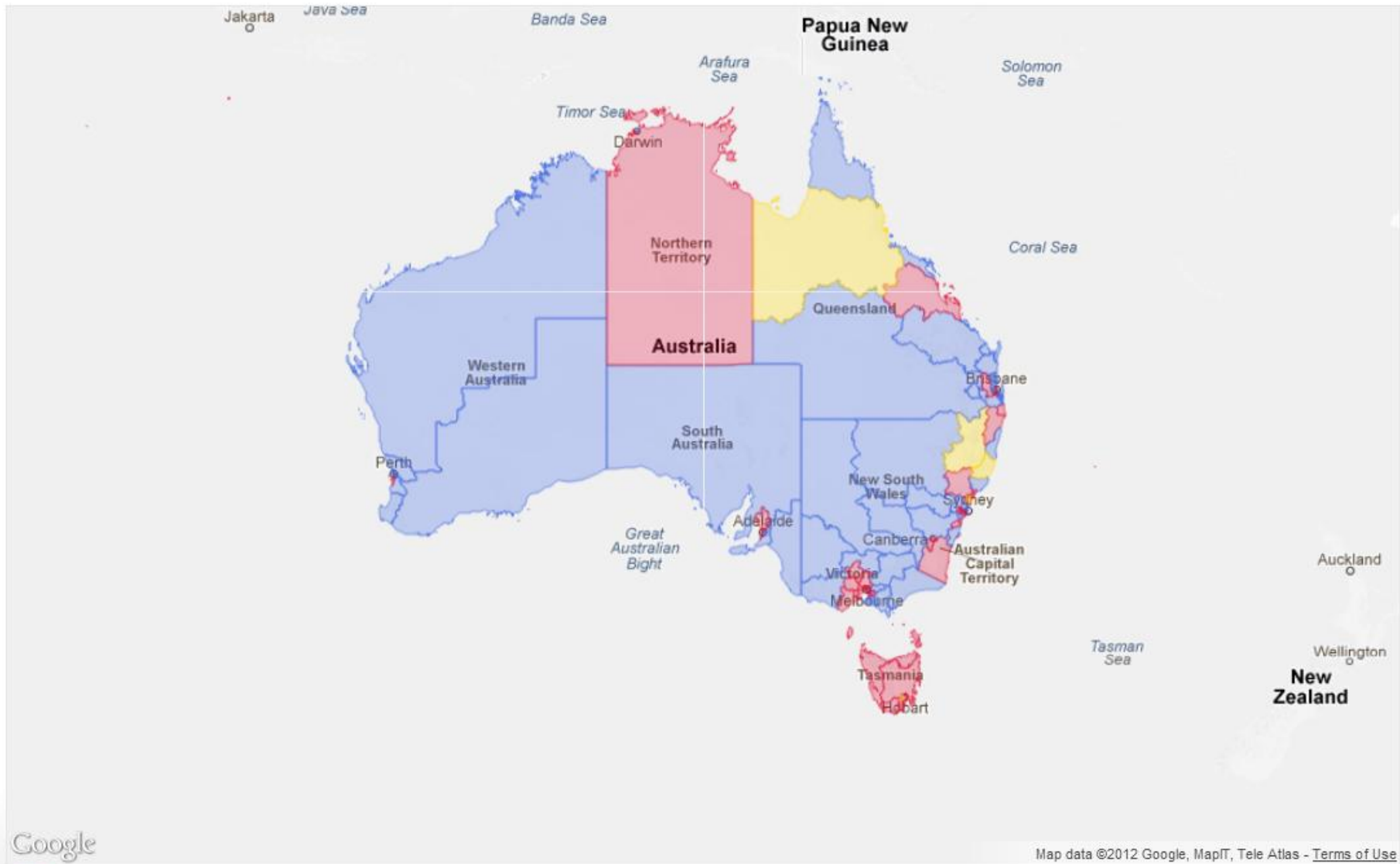


Symbols with SVG path data

JAVASCRIPT

```
icons: [{  
  icon: {  
    path: 'M 0 0 0 20'  
  },  
  offset: '10%'  
}, {  
  icon: {  
    path: 'M 0 0 0 15'  
  },  
  offset: '11%'  
}]
```





Google

#io12

Polyline encoding

JAVASCRIPT

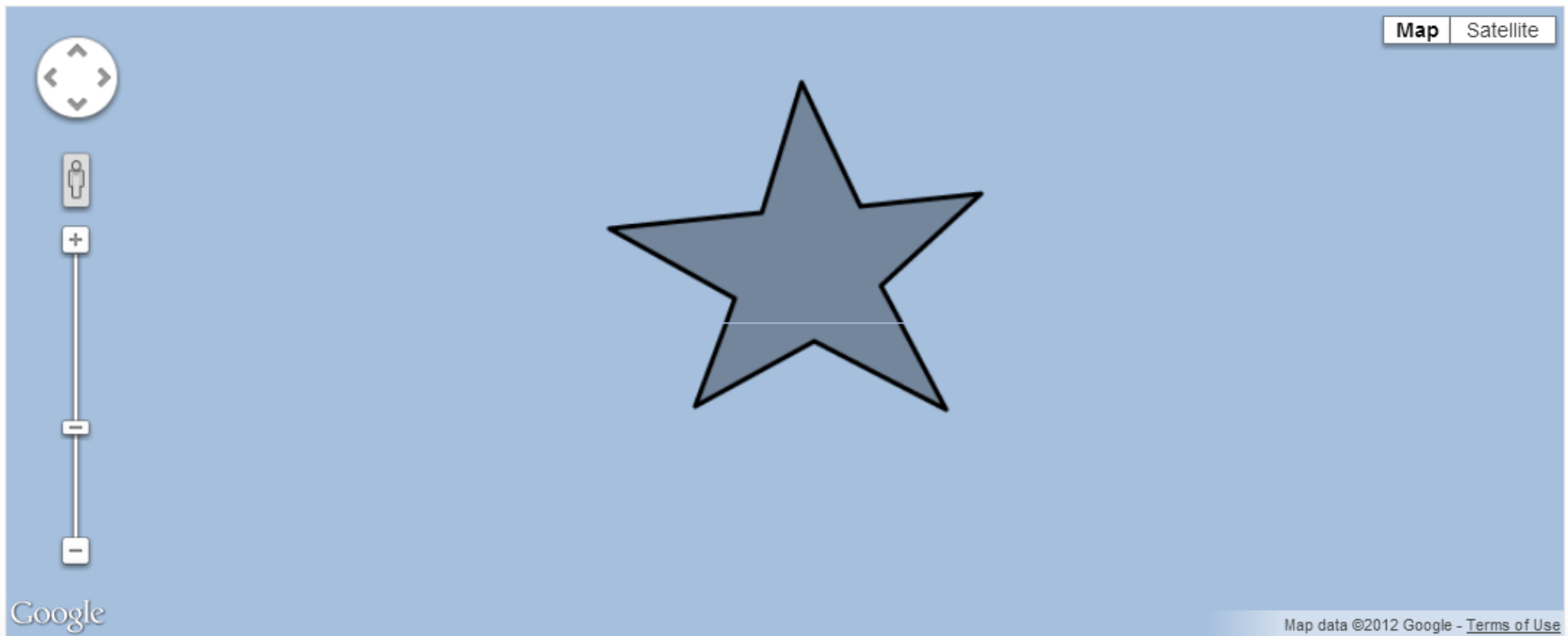
```
google.maps.geometry.encoding.encodePath([  
  new google.maps.LatLng(0.3790, 0.5081),  
  new google.maps.LatLng(0.8294, 0.6400),  
  new google.maps.LatLng(0.4009, 0.8486),  
  new google.maps.LatLng(0.4449, 1.2661),  
  new google.maps.LatLng(0.1263, 0.9201),  
  new google.maps.LatLng(-0.2966, 1.1453),  
  new google.maps.LatLng(-0.0604, 0.6839),  
  new google.maps.LatLng(-0.2856, 0.2774),  
  new google.maps.LatLng(0.0824, 0.4147),  
  new google.maps.LatLng(0.3240, -0.0247)  
]);
```

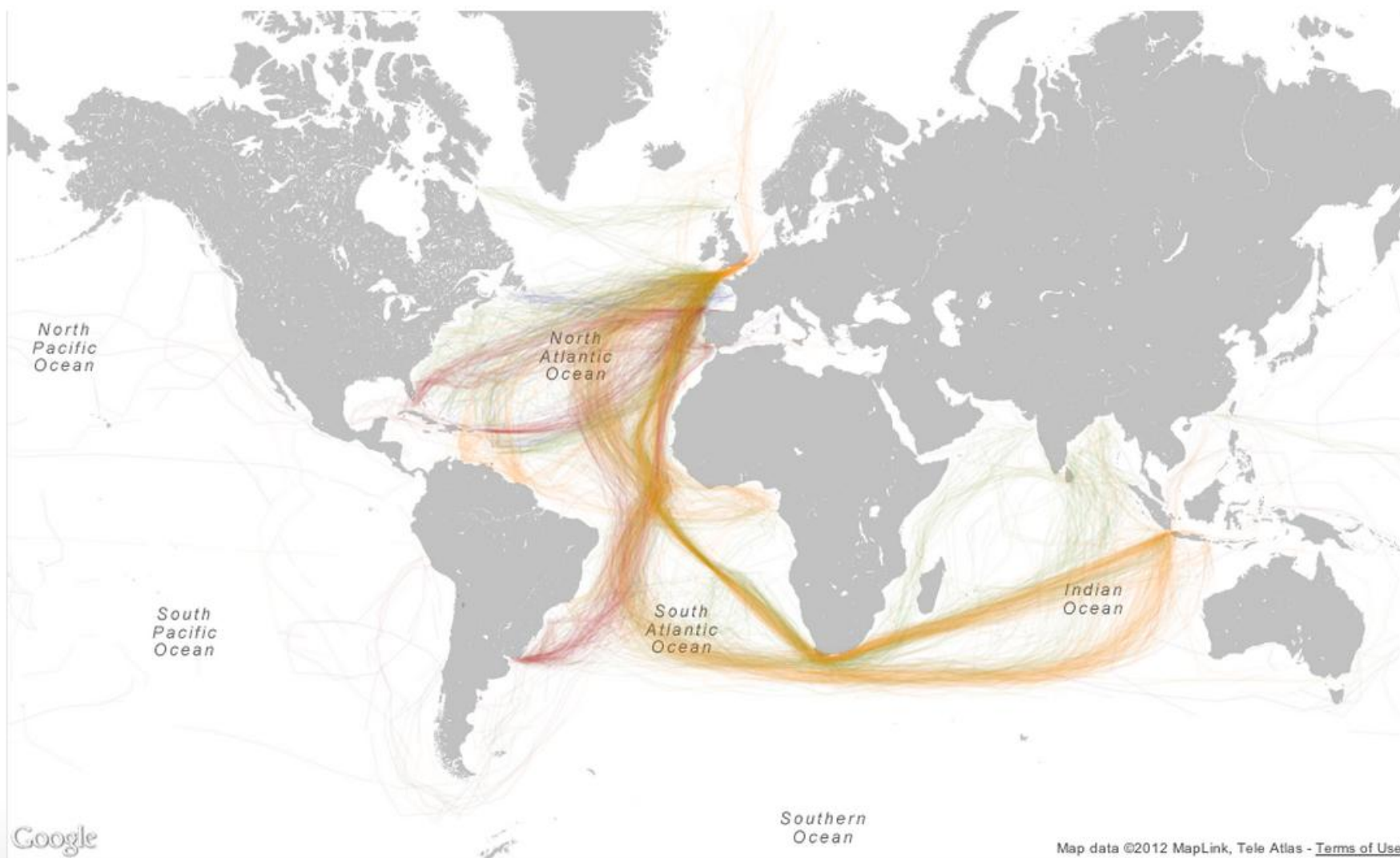
```
"w_iAsfbB_~vAkWxburAwvg@_rGkppAff}@nqbAbrqAo~j@gcm@vbyAn~j@rknA_{fAcyY_en@fyTA"
```

Polyline decoding

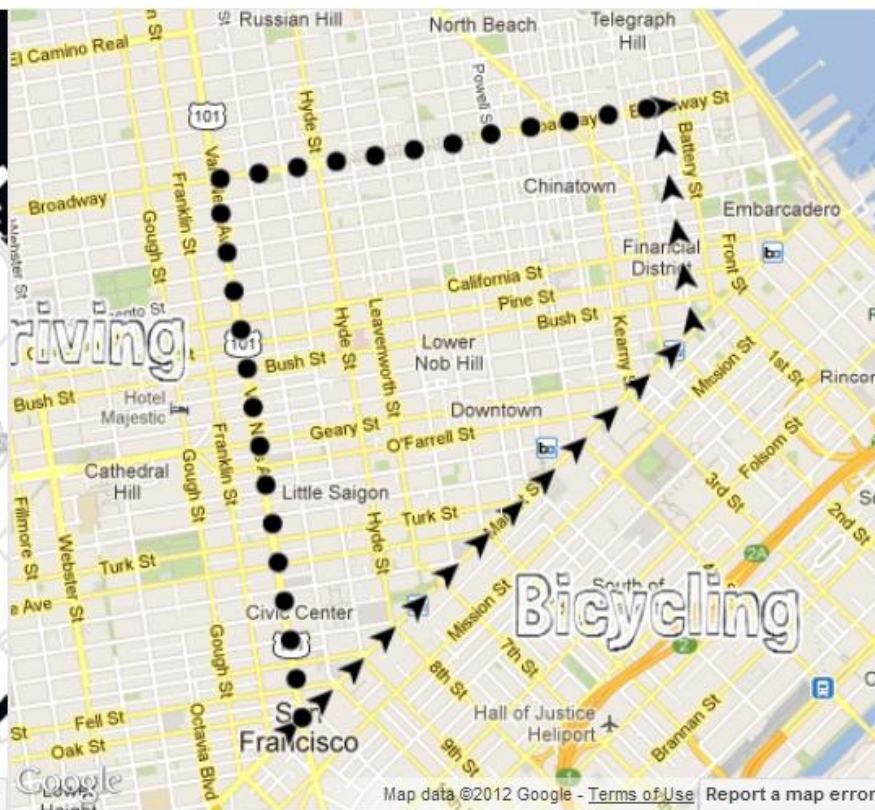
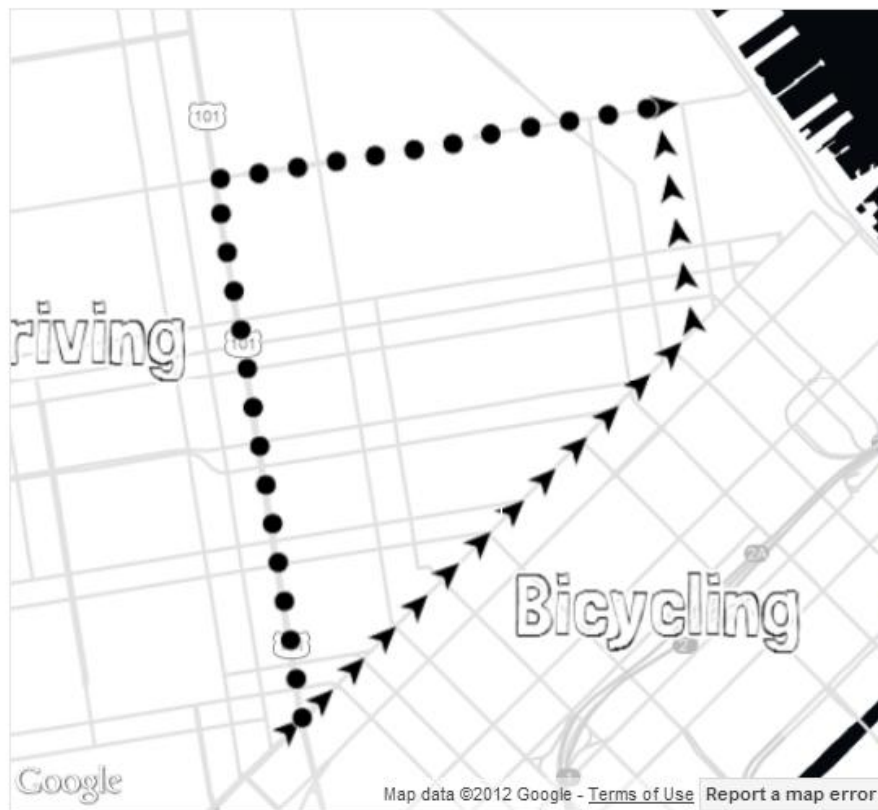
```
google.maps.geometry.encoding.decodePath(  
  "w_iAsfbB_~vAkwXburAwvg@_rGkppAff}@nqbAbrqAo~j@gcm@vbyAn~j@rknA_{fAcyY_en@fytA");
```

JAVASCRIPT





Styled maps



A Master Class in Styling: June 28, 4:00PM–5:00PM in Room 1

Recap: new features

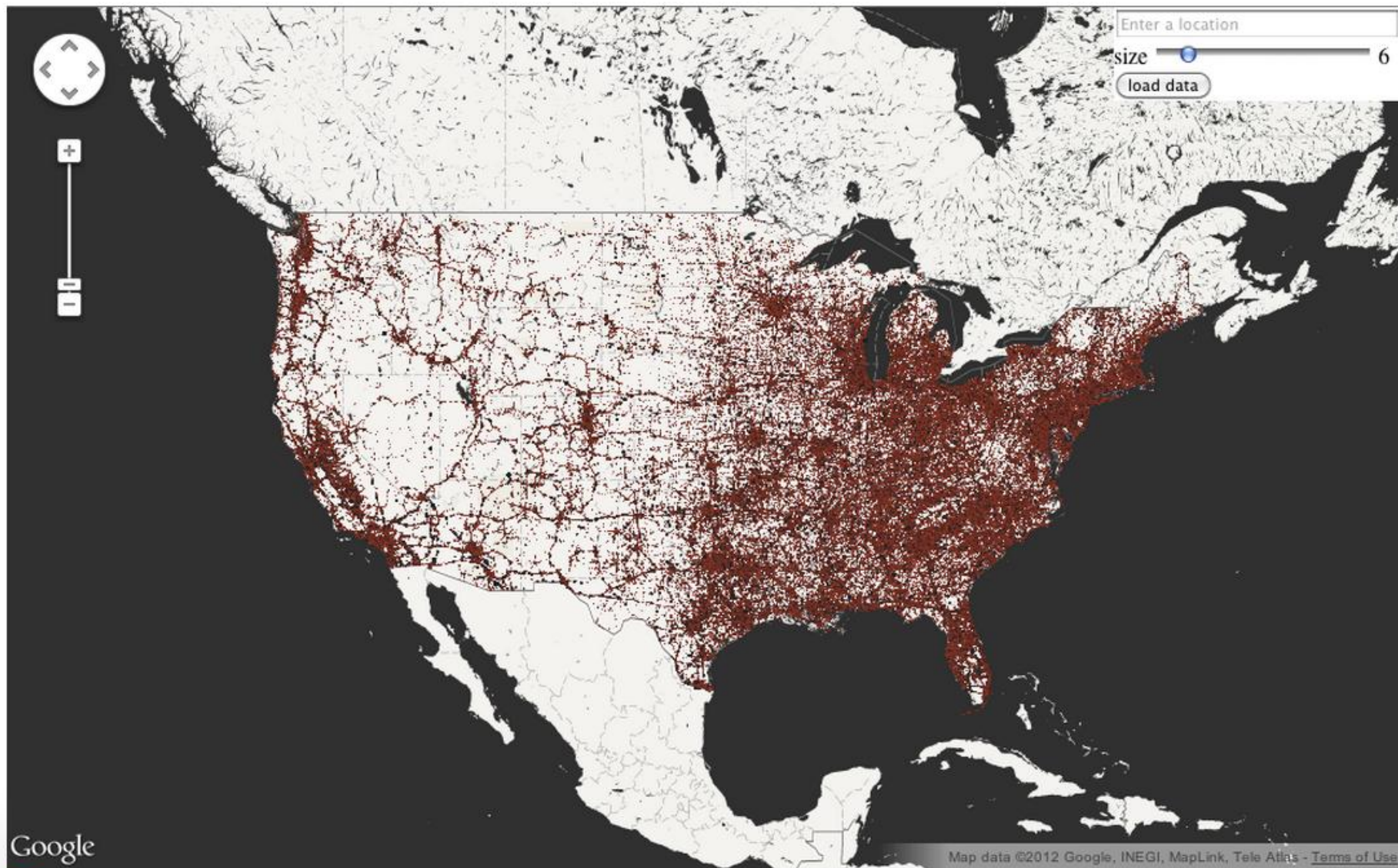
- Heatmaps
- Symbols as markers
- Symbols on polylines



The Bleeding Edge

The Bleeding Edge

- Captives of older browsers
- What can we do without them?
- Traffic Demo



Introducing CanvasLayer

- Open source utility library - available now!
- Maps API overlayView, with some best practices
- html5 <canvas> over a map

CanvasLayer construction

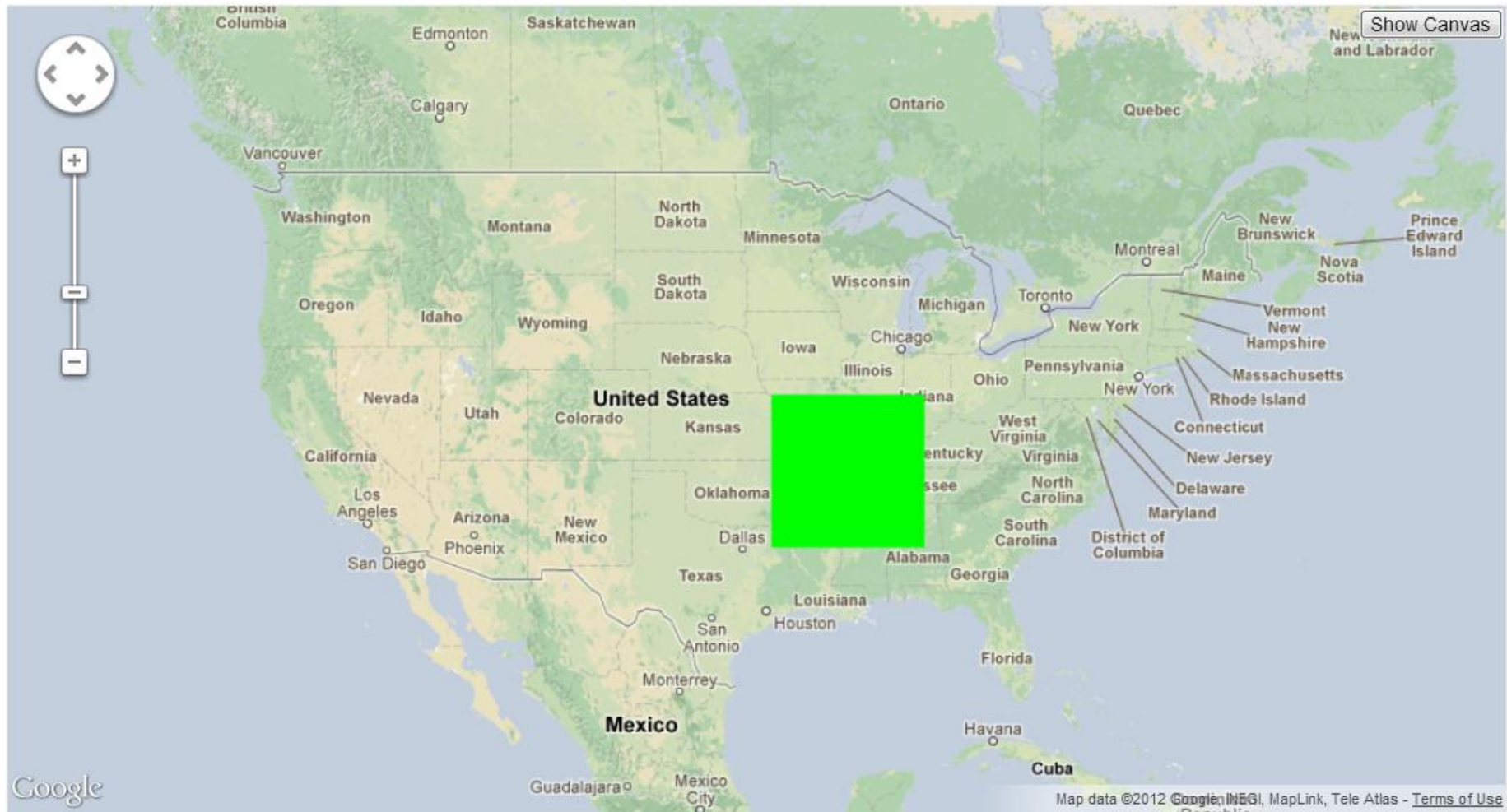
JAVASCRIPT

```
var myCanvasLayer = new CanvasLayer({  
  map: myMap,  
  update: function() { },  
  ...  
});
```




```
var rectLatLng = new google.maps.LatLng(40, -95);  
var point = projection.fromLatLngToPoint(rectLatLng);  
context.fillRect(point.x, point.y, 100, 100);
```

JAVASCRIPT



```
var scale = Math.pow(2, map.zoom);
context.scale(scale, scale);
var offset = projection.fromLatLngToPoint(canvasLayer.getTopLeft());
context.translate(-offset.x, -offset.y);
```

JAVASCRIPT

WebGL

- Canvas 3D -> WebGL under the Khronos Group
- Not OpenGL
- OpenGL ES 2.0 (mostly)

Typical WebGL code

```
var canvas = document.getElementById('canvas');  
var gl = canvas.getContext('experimental-webgl');
```

JAVASCRIPT

```
gl.viewport(0, 0, gl.viewportWidth, gl.viewportHeight);  
gl.clear(gl.COLOR_BUFFER_BIT | gl.DEPTH_BUFFER_BIT);  
  
gl.bindBuffer(gl.ARRAY_BUFFER, vertexPositionBuffer);  
gl.vertexAttribPointer(aVertexPosition, vertexPositionBuffer.itemSize, gl.FLOAT, false, 0, 0);  
gl.bindBuffer(gl.ARRAY_BUFFER, plotPositionBuffer);  
gl.bufferData(gl.ARRAY_BUFFER, f32array, gl.STATIC_DRAW);  
gl.vertexAttribPointer(aPlotPosition, 2, gl.FLOAT, false, 0, 0);  
  
gl.drawArrays(gl.TRIANGLE_STRIP, 0, 4);
```

JAVASCRIPT

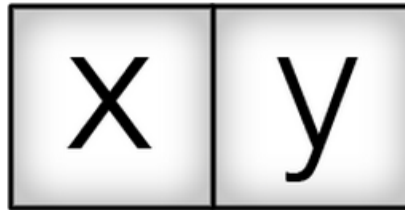
WebGL - Libraries

- [Three.js](#)
- [PhiloGL](#)
- [TDL](#)
- many many (many) more
- http://www.khronos.org/webgl/wiki/User_Contributions

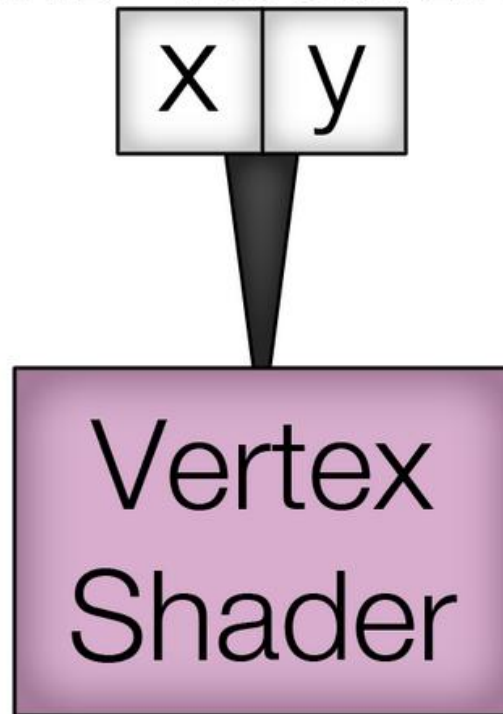
Input - attributes

```
var attributes = new Float32Array([x0, y0, x1, y1, x2, y2, x3, y3, ...]);
```

JAVASCRIPT



The WebGL pipeline - Vertex Shader

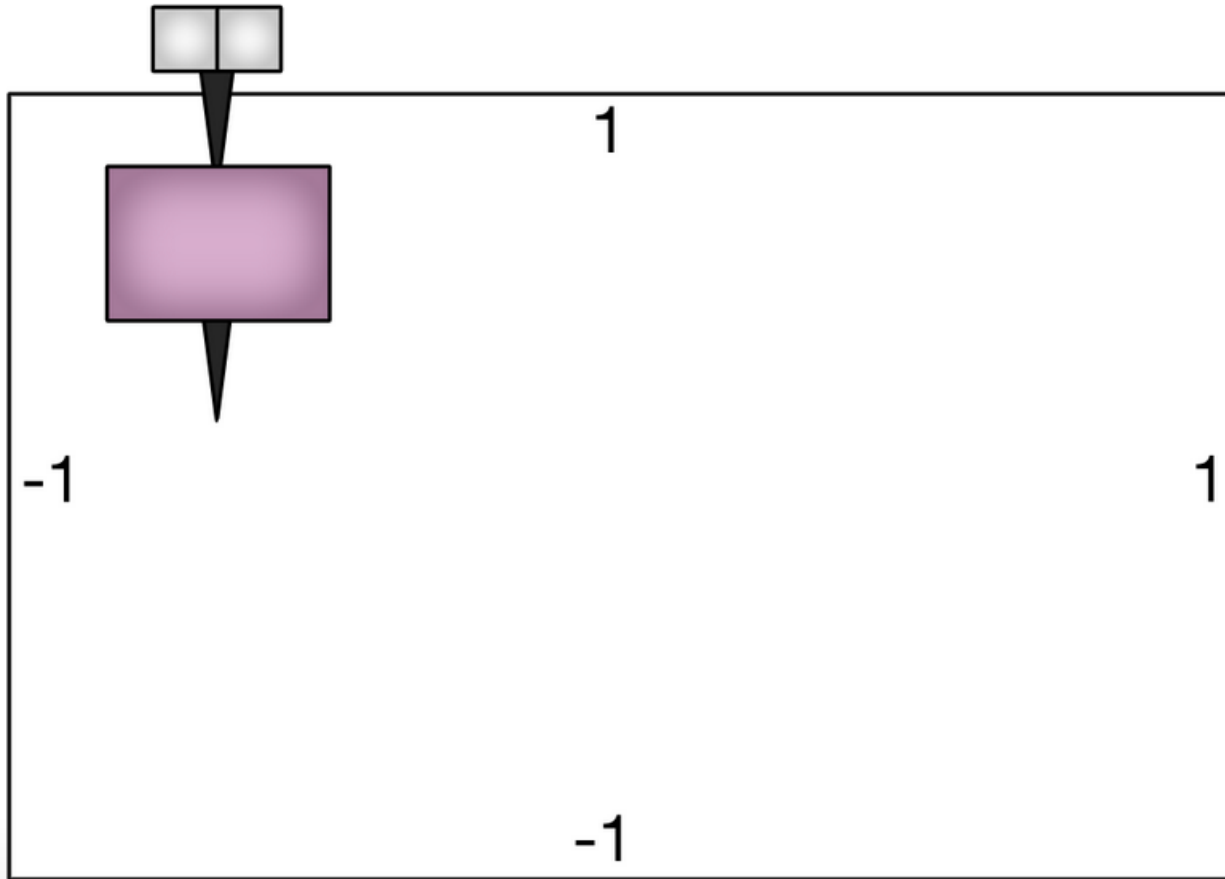


The WebGL pipeline - Vertex Shader

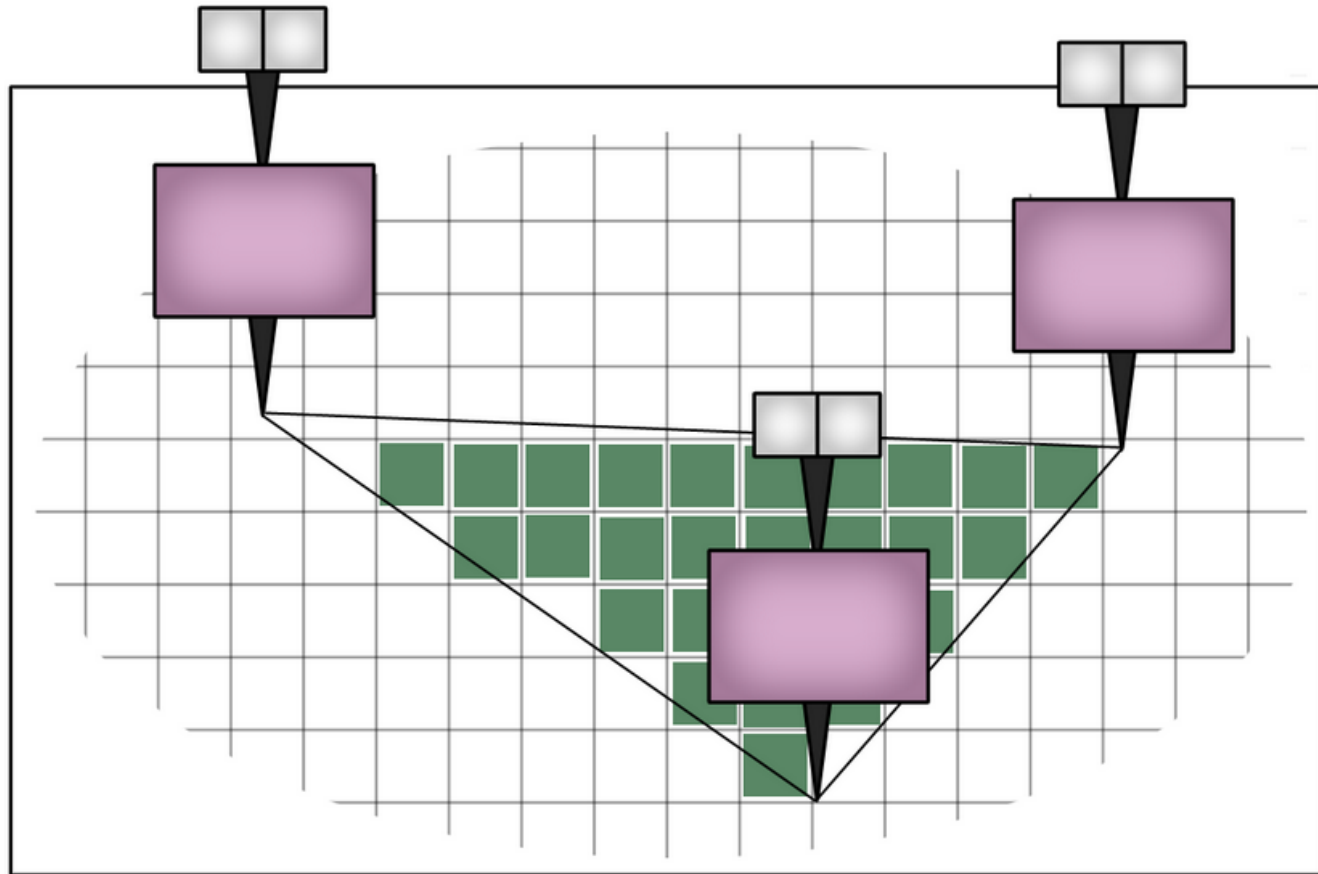
GLSL

```
attribute vec2 vertpos;  
attribute vec2 uv;  
  
uniform mat4 mvp;  
  
void main() {  
    vec4 pos = vec4(vertpos, 0., 1.);  
  
    gl_Position = mvp * pos;  
}
```

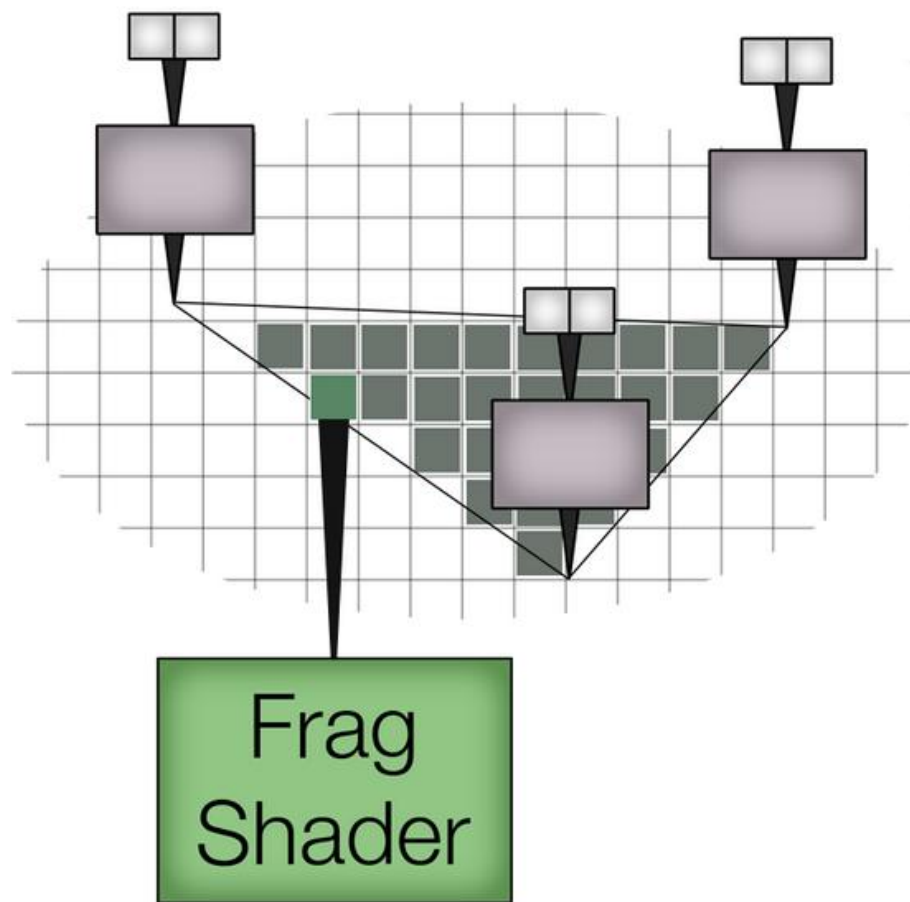
The WebGL pipeline - `gl_Position`



The WebGL pipeline - primitive assembly



The WebGL pipeline - Fragment Shader



The WebGL pipeline - Fragment Shader

GLSL

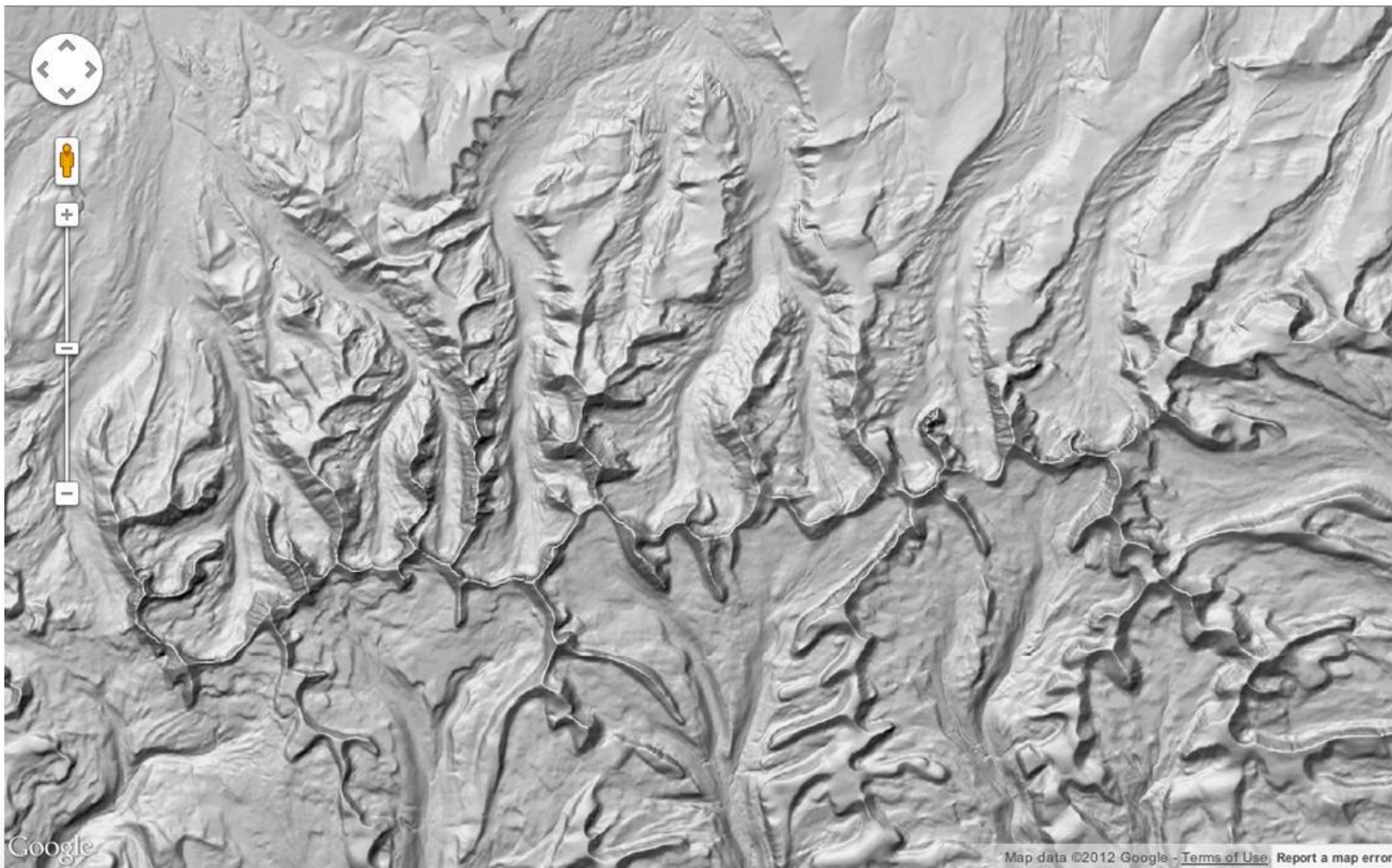
```
void main() {  
    float x = gl_PointCoord[0];  
    float y = gl_PointCoord[1];  
    float edgeX = max(1. - step(.05, x), step(.95, x));  
    float edgeY = max(1. - step(.05, y), step(.95, y));  
    float edge = max(edgeX, edgeY);  
  
    gl_FragColor = vec4(edge, edge, edge, 1.);  
}
```



GLSL as a scripting language



Terrain Demo



Thank You!

<https://developers.google.com/maps>

Enoch Lau - Software Engineer, Google

Brendan Kenny - Developer Programs Engineer, Google

