

# Disruptors

## Participatory Terrain Data and Modelling



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Enabling Delta Life



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CESIUM

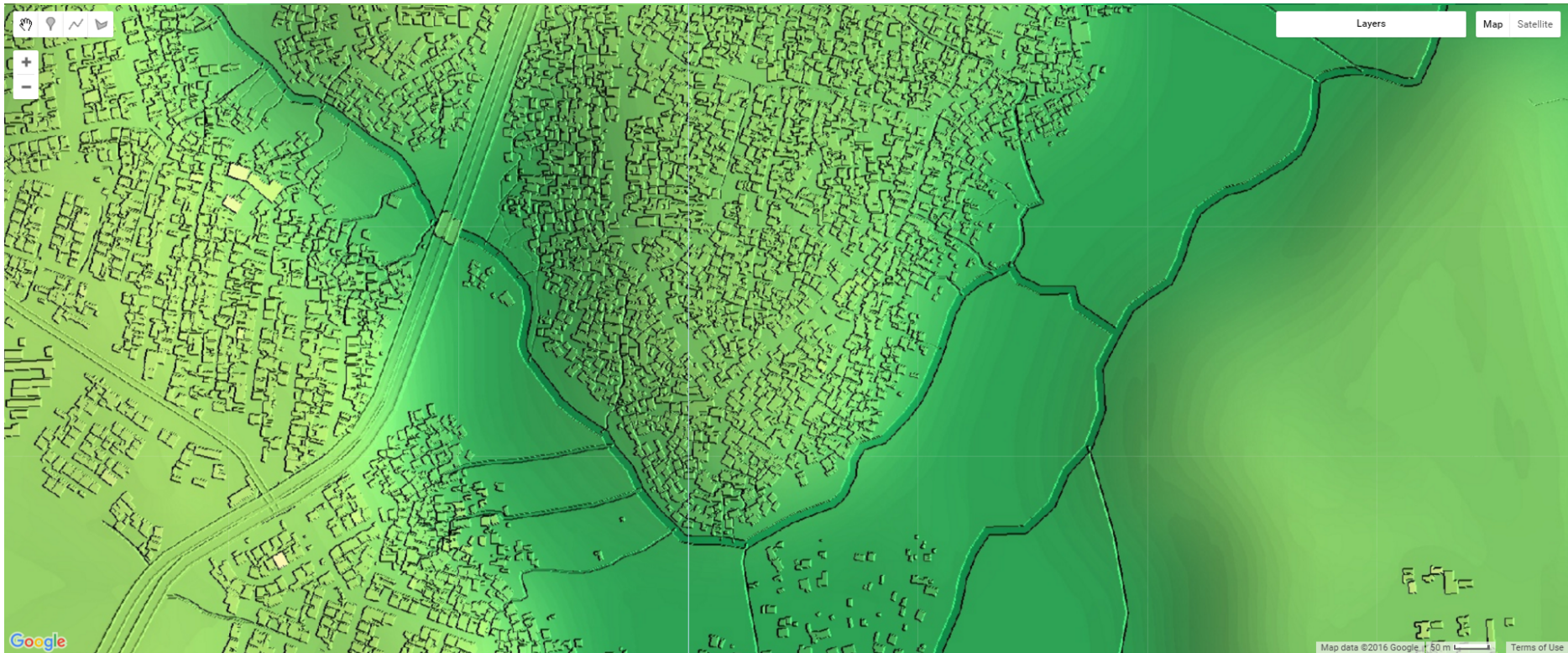
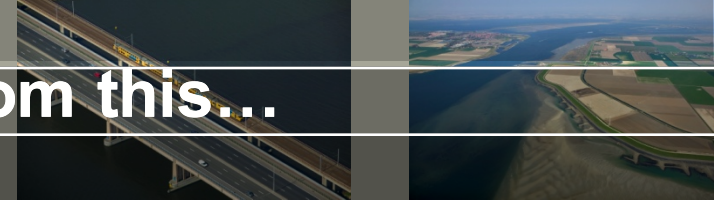
MapQuest, Open Street Map and contributors, CC-BY-SA - © Analytical Graphics Inc., © CGIAR-CSI, Produced using Copernicus data and information funded by the European Union - EU-DEM layers

5 00:00:00 UTC Jul 1 2015 04:00:00 UTC Jul 1 2015 08:00:00 UTC Jul 1 2015 12:00:00 UTC Jul 1 2015 16:00:00 UTC Jul 1 2015 20:00:00 UTC Jul 2 2015



# Are you wondering how we go from this...

# ....to this



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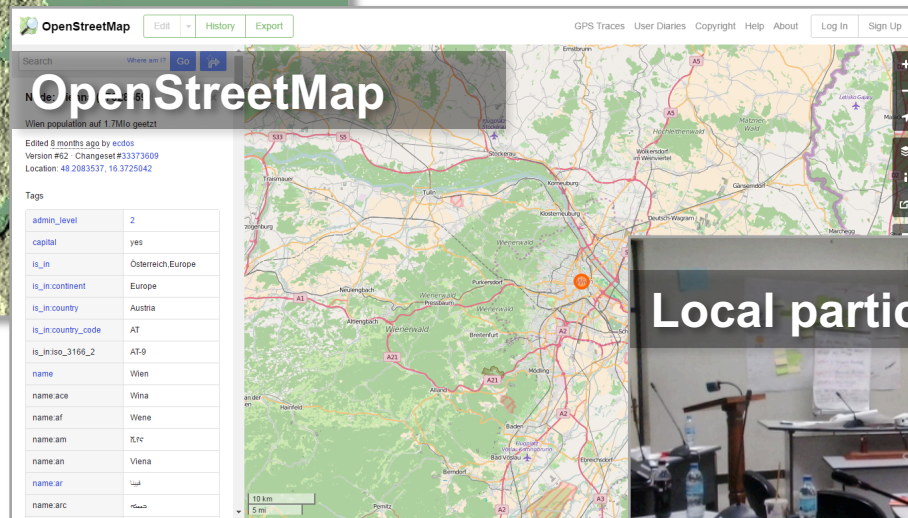
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# 3 key words....

## Satellite terrain



## Local participation



# Google Earth Engine

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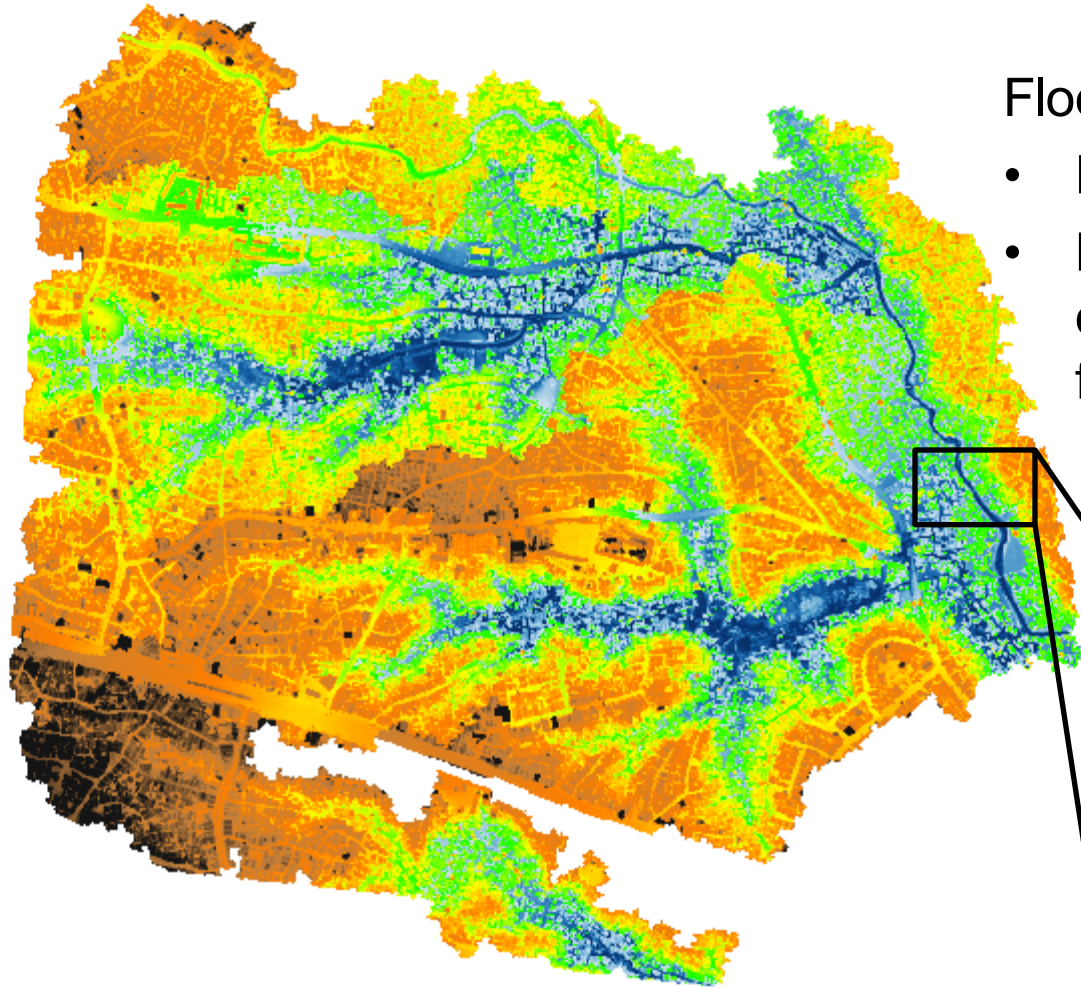
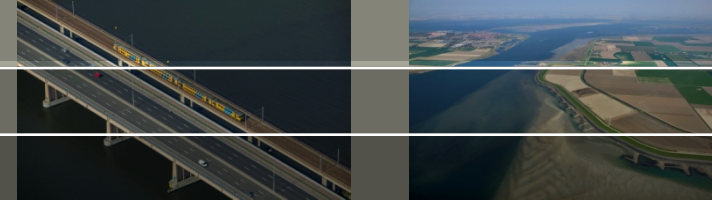
# SRTM is somewhat noisy and coarse scale

SRTM in Dar Es Salaam area



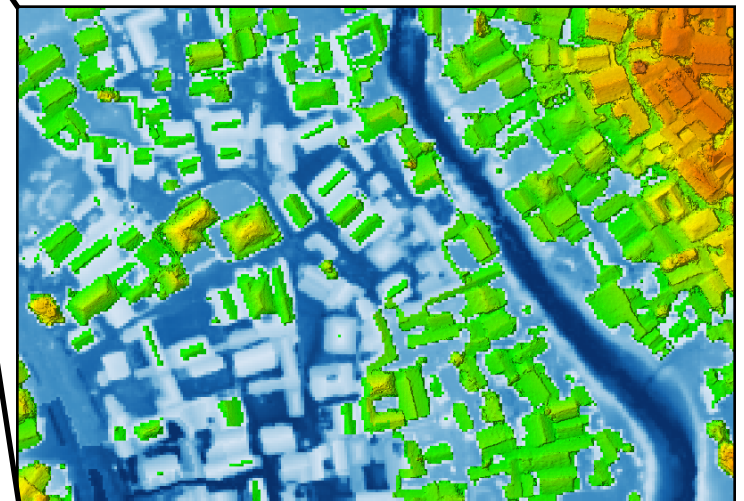


# Terrain data requirements



## Flood modelling with lidar

- Not globally available
- Lidar only observes the top of terrain (not where water flows)





# Terrain data requirements – more than resolution

**Where can water flow? Requires detail!**



Elevated roads



Complex vertical geometries



Ditches (covered or not)



# Important to consider sidewalks and building thresholds

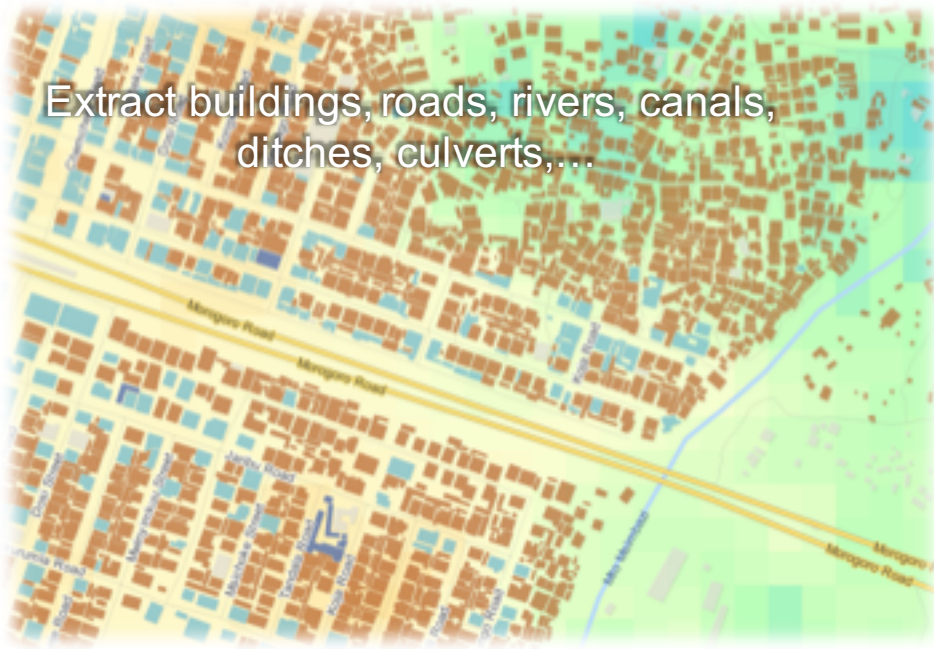
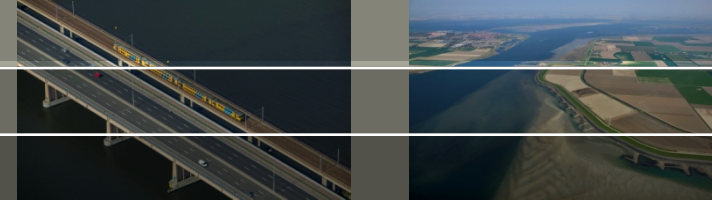


Conveying capacity of road + sidewalks during a rain storm in San Francisco, December 2015





# OpenStreetMap



Extract buildings, roads, rivers, canals,  
ditches, culverts,...

Rapidly growing free vector map

World file is about:

~30 GB compressed

~250 GB uncompressed

~54 000 GB rendered tiles



water = **river**



water = **canal**



highway= **primary**

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# Game changer – Google Earth Engine



Terrain synthesis **on-the-fly**

- Implication: **work with stakeholders** to improve terrain data
- **Ownership** and **understanding**

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# Game changer – Google Earth Engine

The screenshot shows the Google Earth Engine web interface. The left sidebar lists scripts under 'hydro-earth' and 'SRTM\_OSM'. The main editor displays a JavaScript script named 'SRTM\_OSM/validate\_burn\_buildings'. The script includes comments and code for filtering buildings, setting center coordinates, and adding layers for residential, commercial, and school buildings. The Inspector panel on the right shows the details of a selected feature (Feature 81816\_81816), including its geometry (Polygon, 17 vertices) and properties (id: 81816\_81816, address: Mpwapa Street, building: school, etc.).

- Add filters
- Modify default values
- (Re)generate terrain data
- Export to GeoTIFF

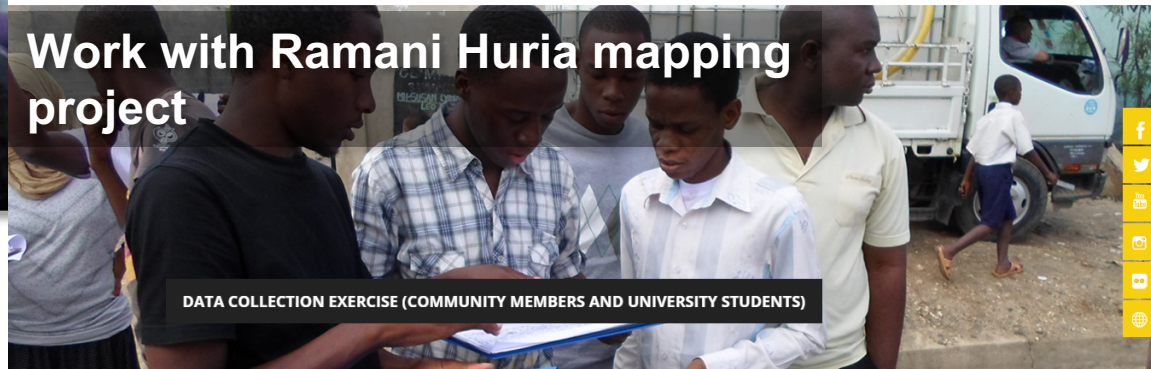
School (with surrounding commercial and residential building)

# Workshop with stakeholders Dar Es Salaam

## Local participation



## Work with Ramani Huria mapping project



<http://ramanihuria.org/>

Improve terrain data on the fly

COMMUNITY MAPPING FOR FLOOD RESILIENCE

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# Example for buildings – use of attributes

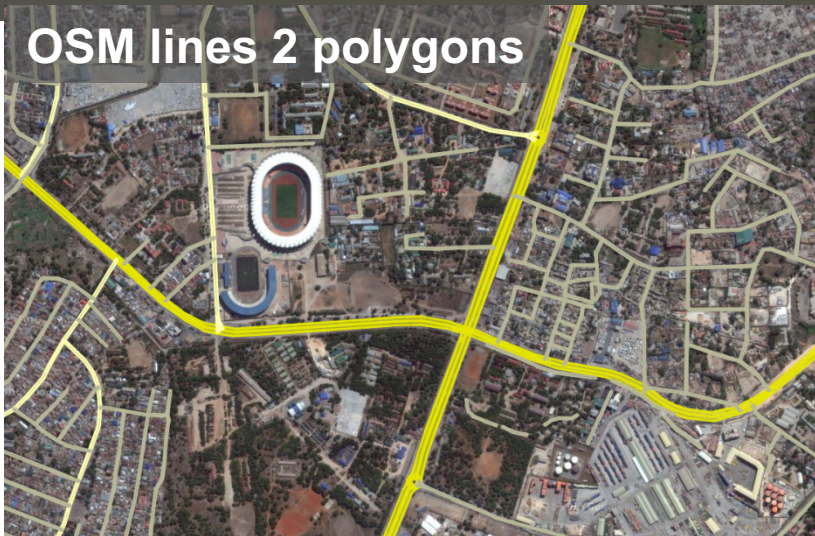
Building heights: Use amount of stories

- Brown: one story buildings
- Yellow: high buildings



# Roads

OSM lines 2 polygons



Road with sidewalks



Road elevation.  
At crossing lowest layer

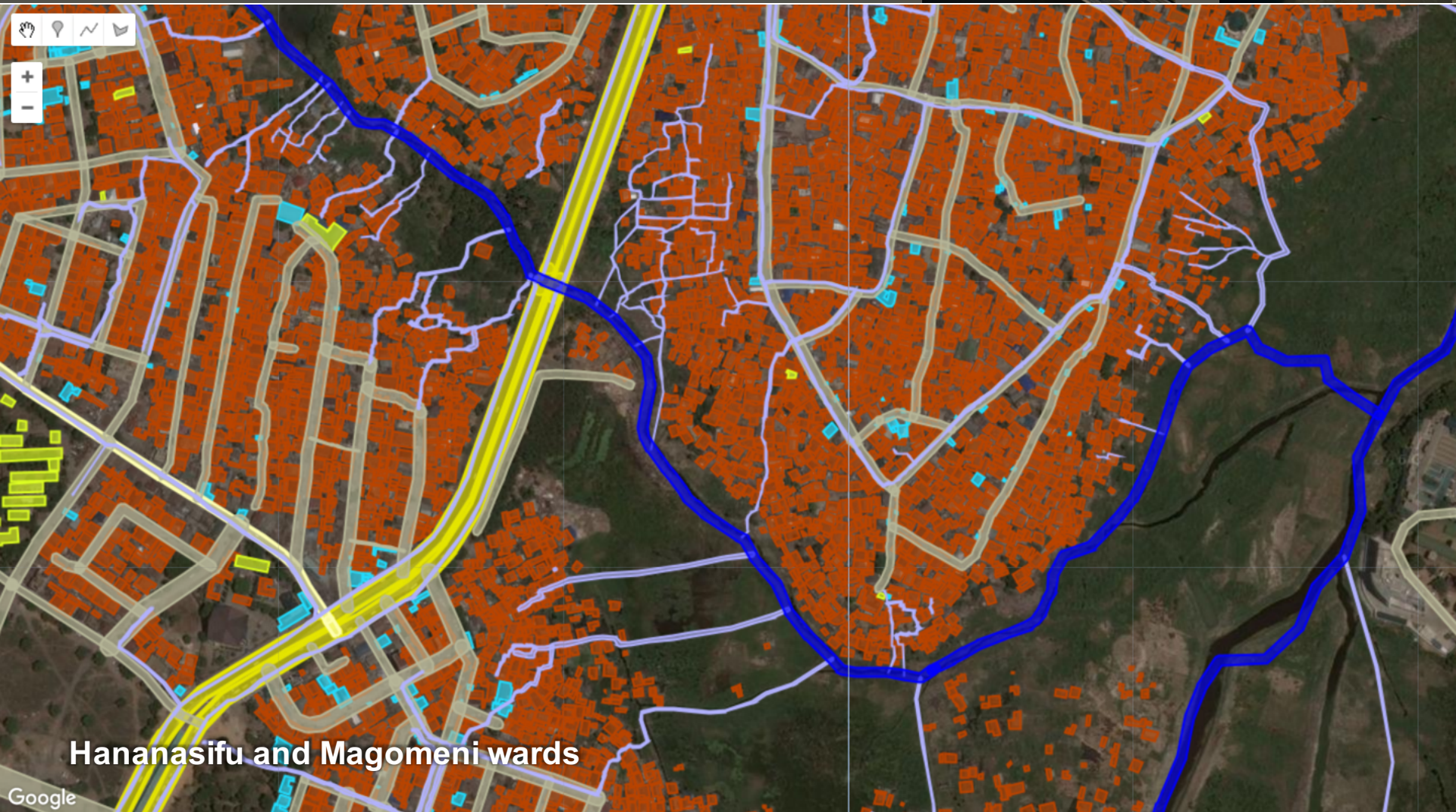


Straighten roads in DEM





# Results – OSM vector data



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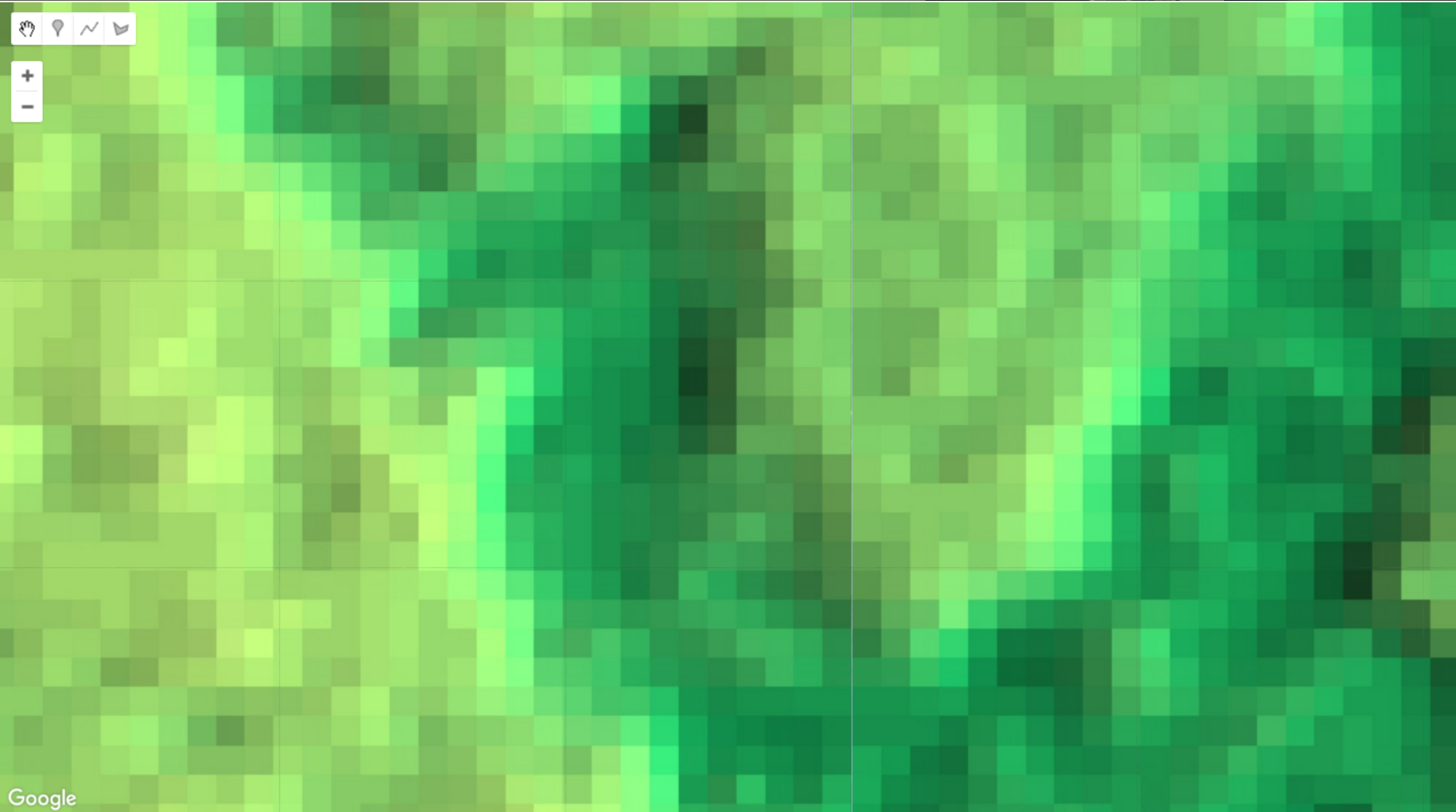
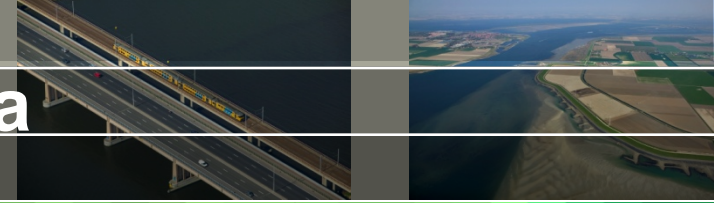
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# Results – SRTM elevation data



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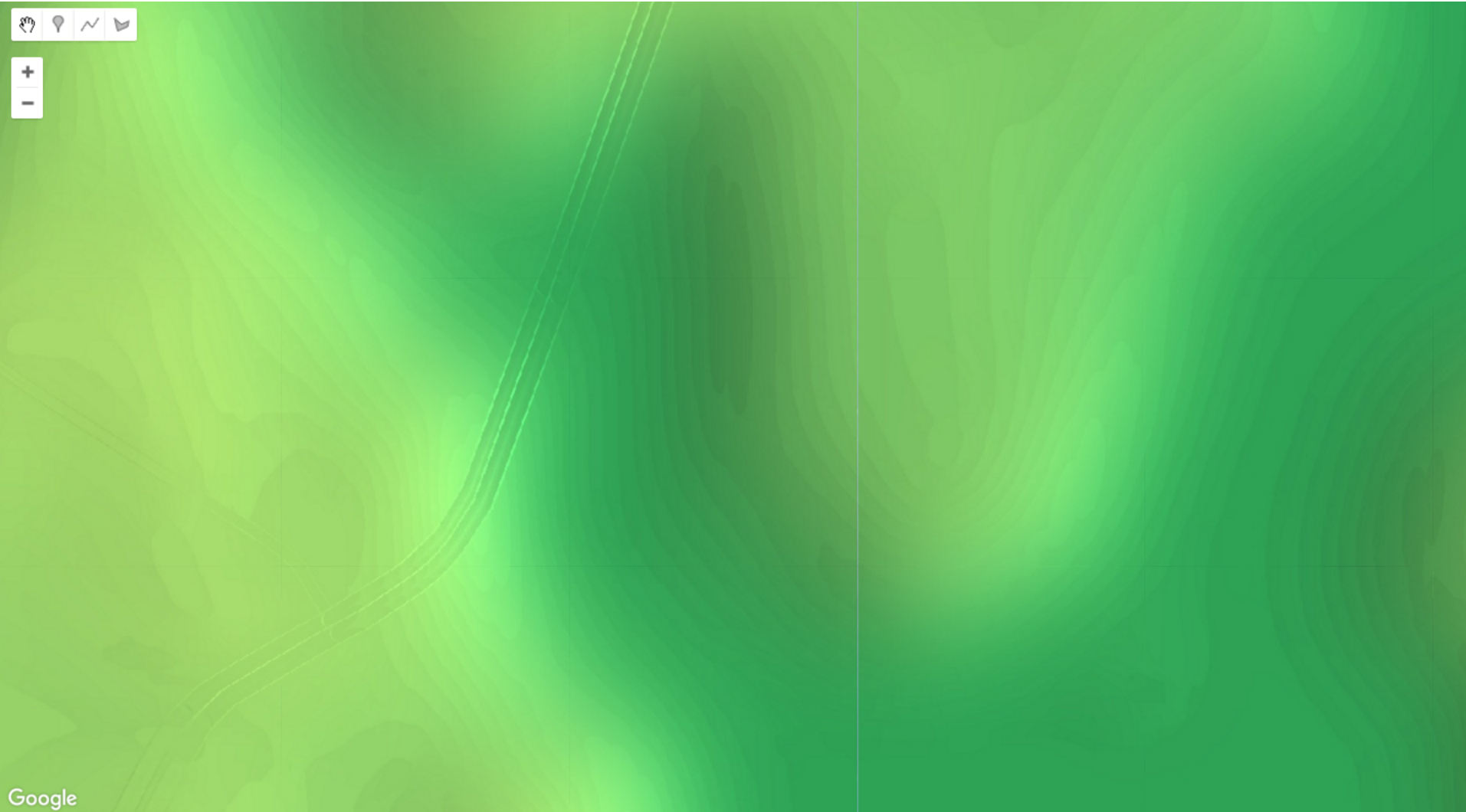
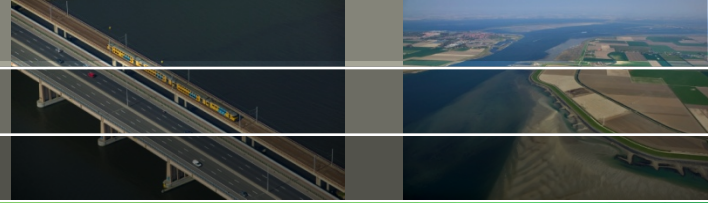


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# Results – smoothed SRTM



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# Results – OSM object height map



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# Results – Digital Surface Model (as the crow flies)



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# Results – OSM threshold level map



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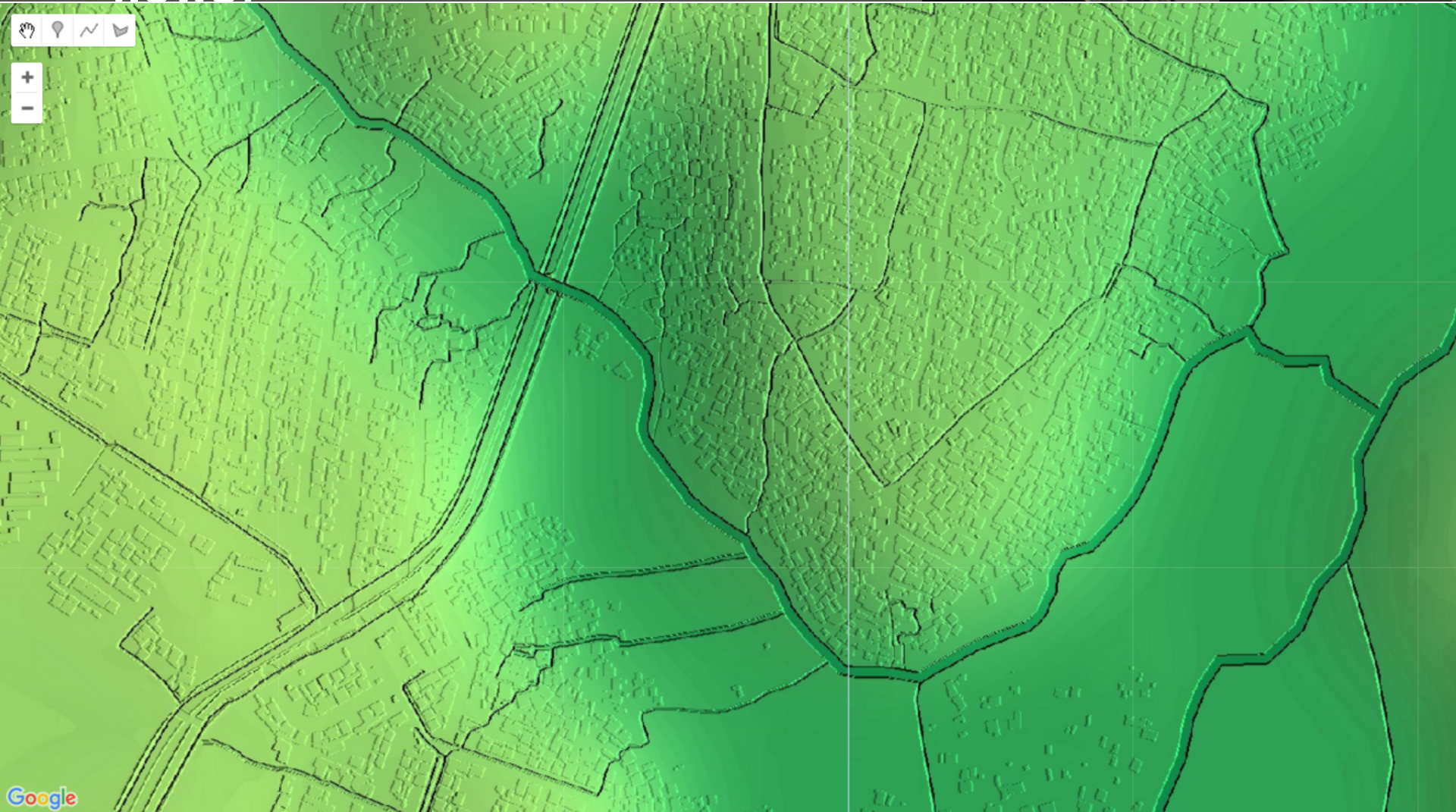


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# Results – Digital Hydro Elevation Map (as the water flows)



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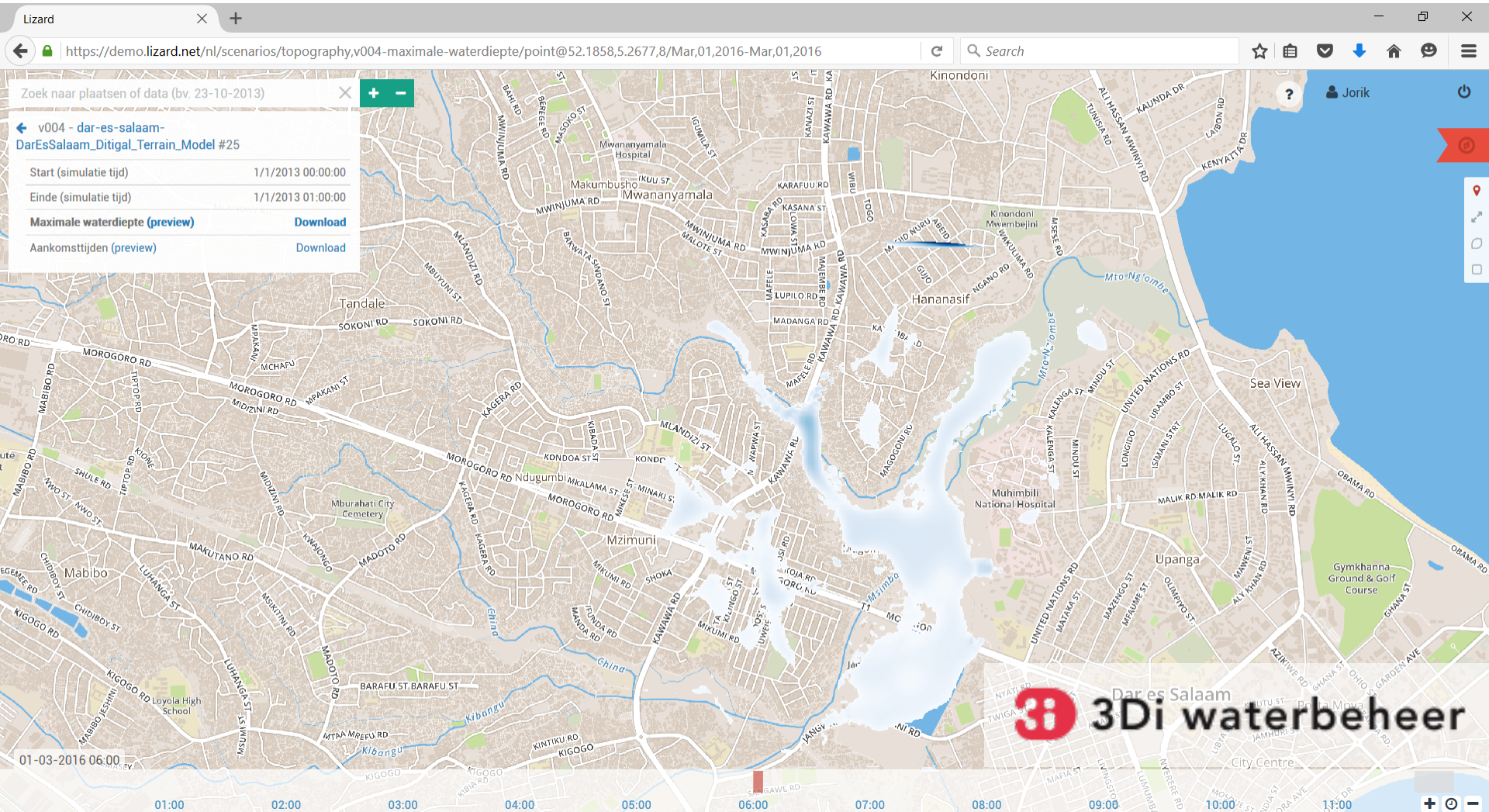


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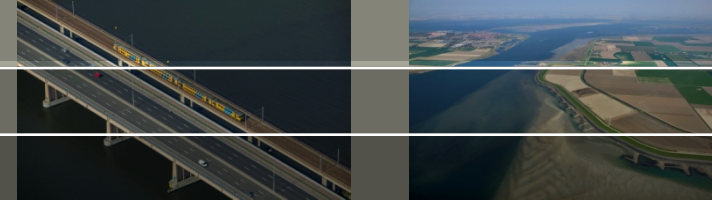


# Results – first flood simulation (using 3Di)





# Conclusions



## Conclusions and outlook

1. We are able to synthesize terrain data (0.5 meter) with a fusion between crowd-sourced data from OpenStreetMap and generally available satellite terrain data
2. So far accomodation of:
  1. Buildings (thresholds)
  2. Roads (including straightening and sidewalks)
  3. Open water bodies
  4. Ditches and culverts
3. We can utilize terrain in pluvial flood simulations with 3Di
4. We will pilot if we can assess changes, improvement, scenarios in the terrain with local stakeholders

