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THE VALUE OF DRONES FOR BESPOKE LOCAL FLOOD RISK ASSESSMENT IN THE LICUNGO BASIN

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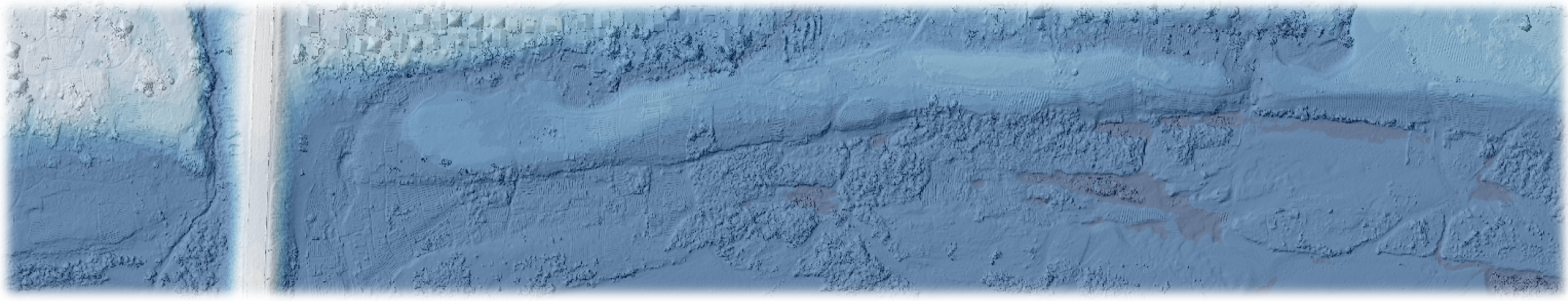
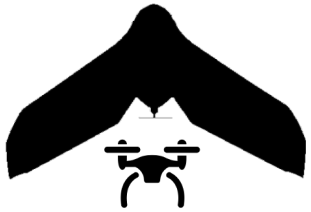


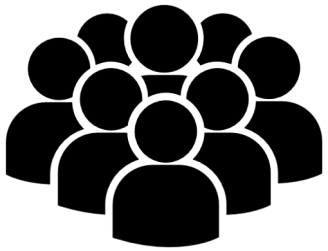
INGC-WFP Partnership

INGC in partnership with WFP has built a very strong capacity to respond to emergency especially with the help of Unmanned Aerial System (UAS) technology. Having a state of the art survey grade drone fleet, high performance computers, trained personnel and capacity to analyze these data will add value to disaster response in the quickest possible time to make sense of this big geospatial data that aims to enable emergency responders, humanitarian organizations, and local government utilize geospatial information for immediate decision making.



12 Drone fleet

4 high end computers



12 personnel trained
6 volunteers

Strong data analysis

Background Context

- Three (3) weeks field support to WFP Mozambique Country Office in Maputo
- Preparedness activity for the Disaster Atlas - Licungo River Basin Drone project
- Funded by the European Civil Protection and Humanitarian Aid Operations (ECHO)
- In partnership with Mozambique government's National Institute for Disaster Management (INGC)

Purpose of the Mission

Provide Technical support to Mozambique Country office (Maputo) on implementing ***preparedness data analysis collected from drone*** *survey and advice on how to scale up the activity*

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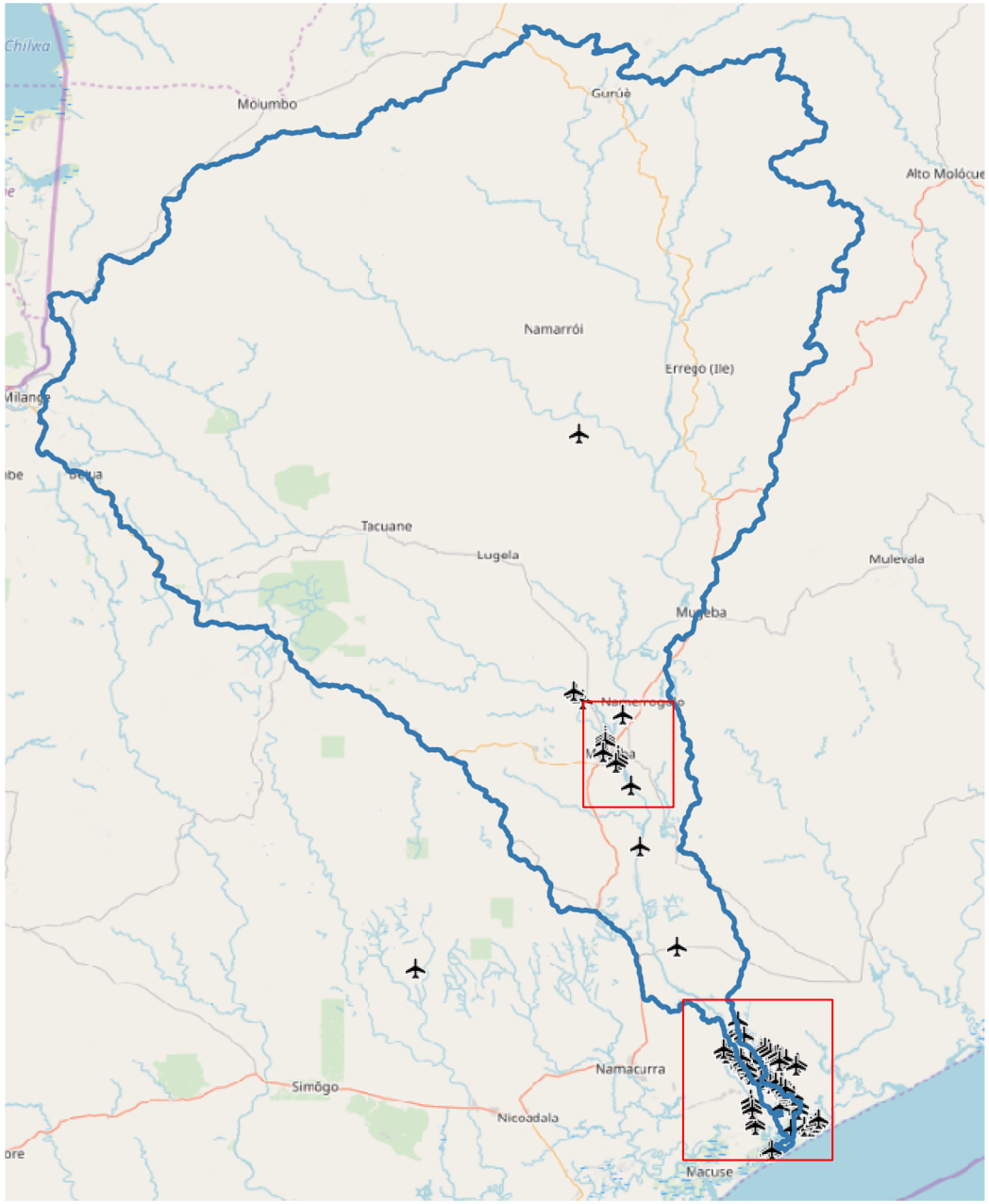
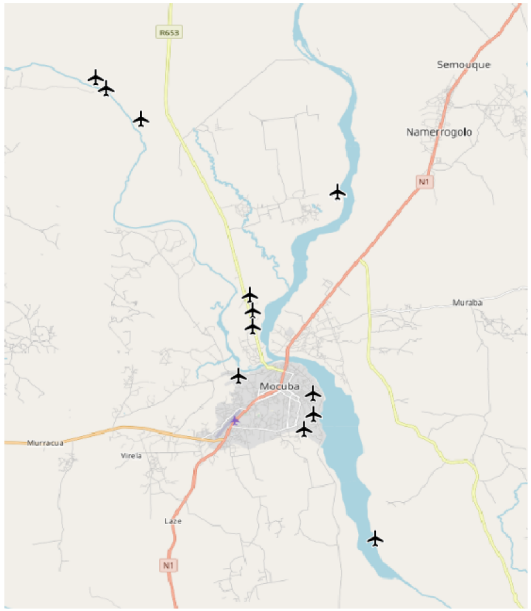
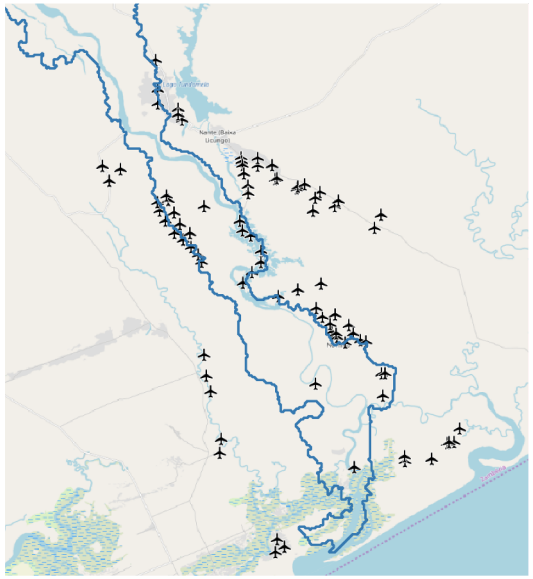
Licungo River Drone Survey Summary







235 Flight Missions

58 Hours of Flight Time

158.5 km^2 area covered

645 GB of Raw Data

293,281 photos

12 persons of 4 teams

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Drone Survey Team

12 Drone fleet

4 high end computers

4 teams (3 members each)

The drone survey was conducted mostly by INGC and some student volunteers from the local university that WFP has partnered with. The survey team has been trained by WFP (ETC) and a drone service providers on how to do mission planning, conduct a safe survey, and basic flying operations.

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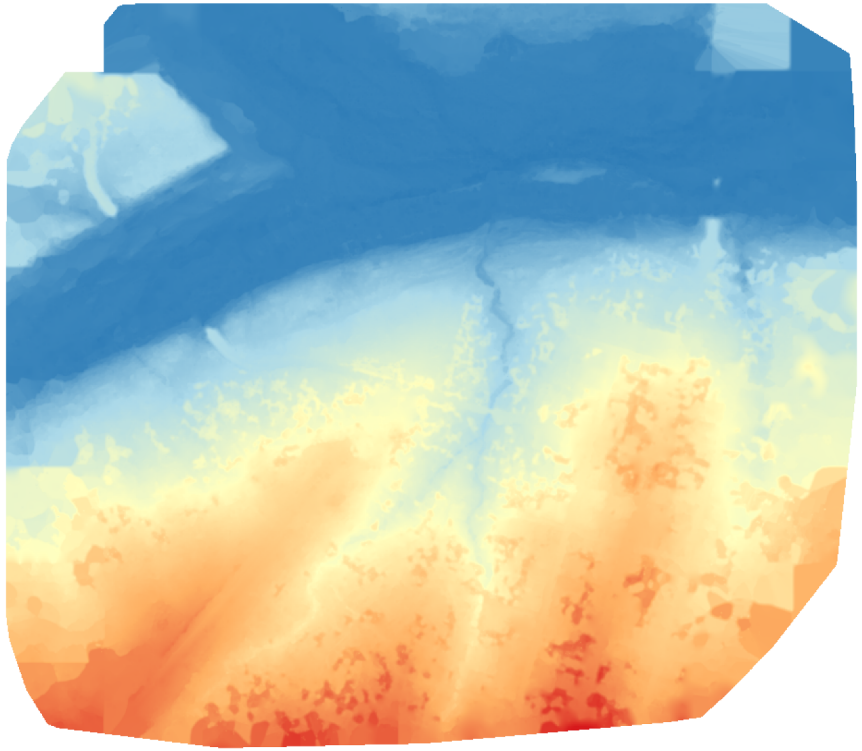
UAV based geospatial products

- Ortho-mosaic
- Digital Elevation Model
- Oblique Photos/Videos



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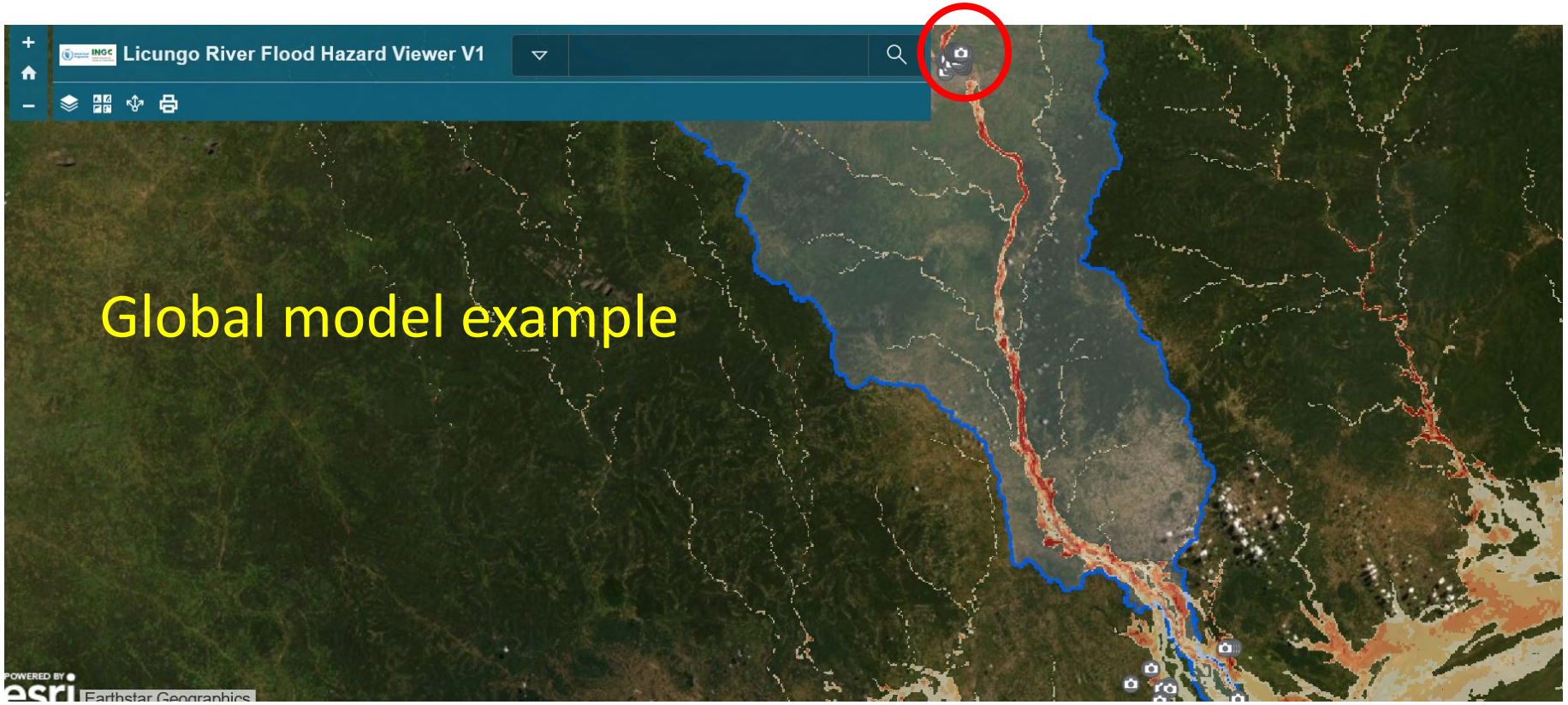
Big Challenge

Estimate people exposed to flood hazard

- Unavailability of high resolution flood hazard model
- Incomplete exposure data on settlements/structures



ReliefWeb Report January 2015 Flooding

A. Situation analysis

Description of the disaster

From November 2014 until late January 2015, Northern and Central parts of Mozambique experienced extensive rainfall which caused serious flooding in many regions. The most critical area affected was in the centre of the country, precisely in the Licungo River Basin (Zambezia province). Floods here reached historical levels (in some areas up to 12m height). On 12 January 2015, the Council of Ministers of Mozambique declared the institutional red alert for the Central and Northern parts of the country due to heavy rains recorded and consequent floods in large areas. Flooding affected communities, public and private telecommunications and energy infrastructures, especially in Zambezia and Nampula provinces. Land transportation was hindered, with many roads and bridges destroyed or completely flooded. The main national road N1 was cut multiple times, mainly in Mocuba and Gúruè districts. Many communities including those around Mopeia and Maganja da Costa were completely isolated and only accessibly by air. Electrical infrastructure and communication were severely impacted. In the North, damage to power-plants left the second largest city of the country, Nampula, without electricity for several weeks. Water supply systems were damaged in many areas making access to safe water difficult.

Houses were destroyed in Lugela, Mocuba district. Photo by CVM

According to the National Disaster Management Institute (INGC), the heavy rains and floods affected about 177,645 people (37,090 families) and temporarily displaced about 44,000 people. The death toll due to floods, house collapse and lightning in the country has risen to 160 of which 134 were recorded in Zambézia province.

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GFDRR Rapid Report January 2015 Flooding

Results

The final report was delivered, and indicated that about 326,000 people were affected 140 were killed; about 30,000 houses 2,362 classrooms and 17 health units were either partially or totally destroyed. 104,430 hectares of crops have been lost during the event, impacting 102,000 farmer households. The cost of damages was estimated by the report to be around US$371 million, or 2.4 percent of GDP, and the costs of recovery and reconstruction at US$490 million. The report also includes recommendations on risk reduction.

Partnerships and Coordination

The report was finalized on April 12, 2015, as a collaborative exercise involving UN, EU, World Bank and all relevant Departments in the Government of Mozambique. Under the overall leadership of the Government of Mozambique, the project was executed by the World Bank, and involved coordination with the EU, the UN, other relevant development partners and Government institutions in charge of transportation, energy, agriculture, water, sanitation, urban development, urban and land-use planning, sustainable land and water management and disaster risk management.

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Very High Resolution Digital Elevation Model

0.36 cm per pixel
0.5 meter vertical accuracy

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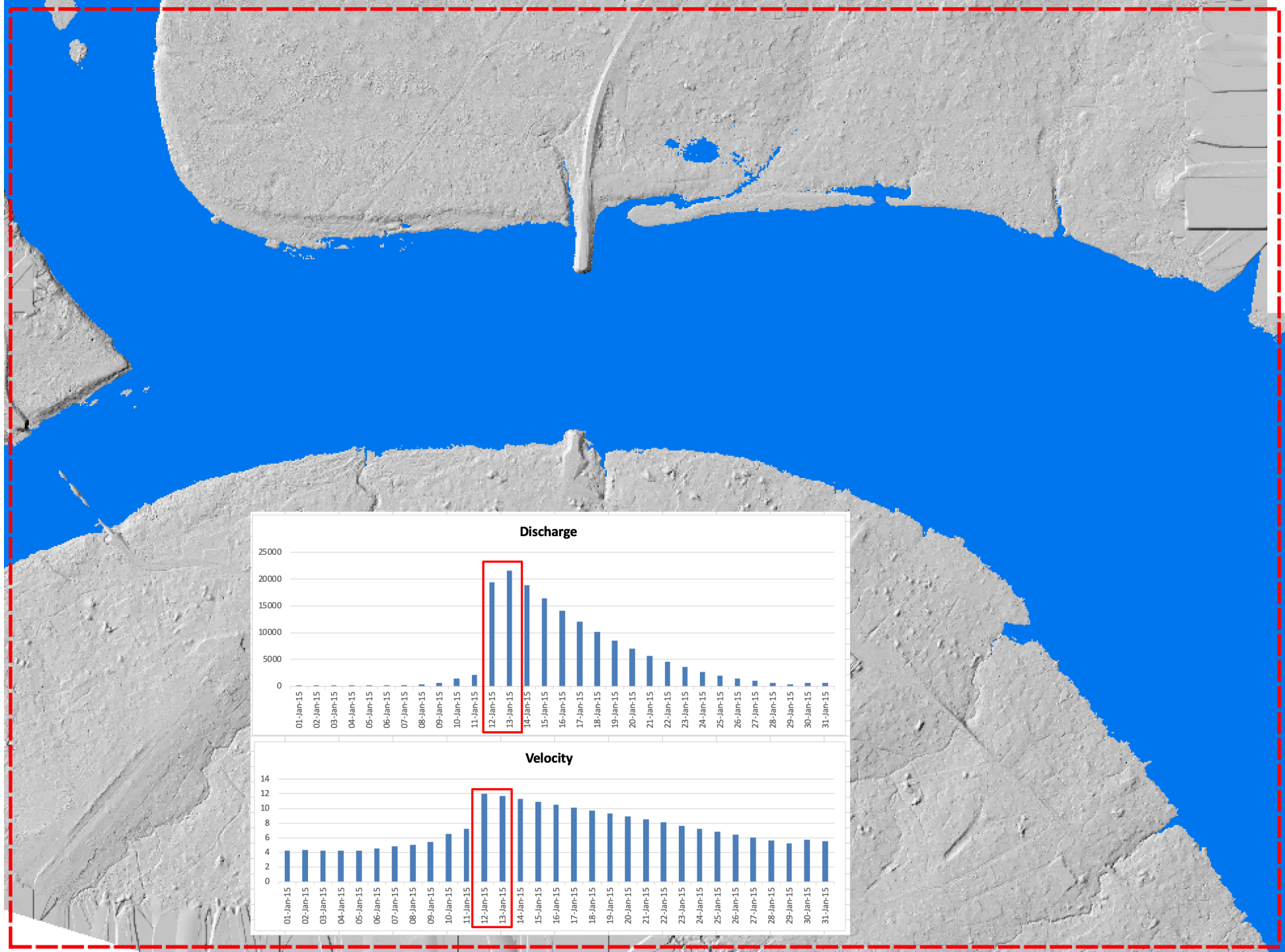
Recreated 2015 event using River discharge data from INGC (also rainfall data)



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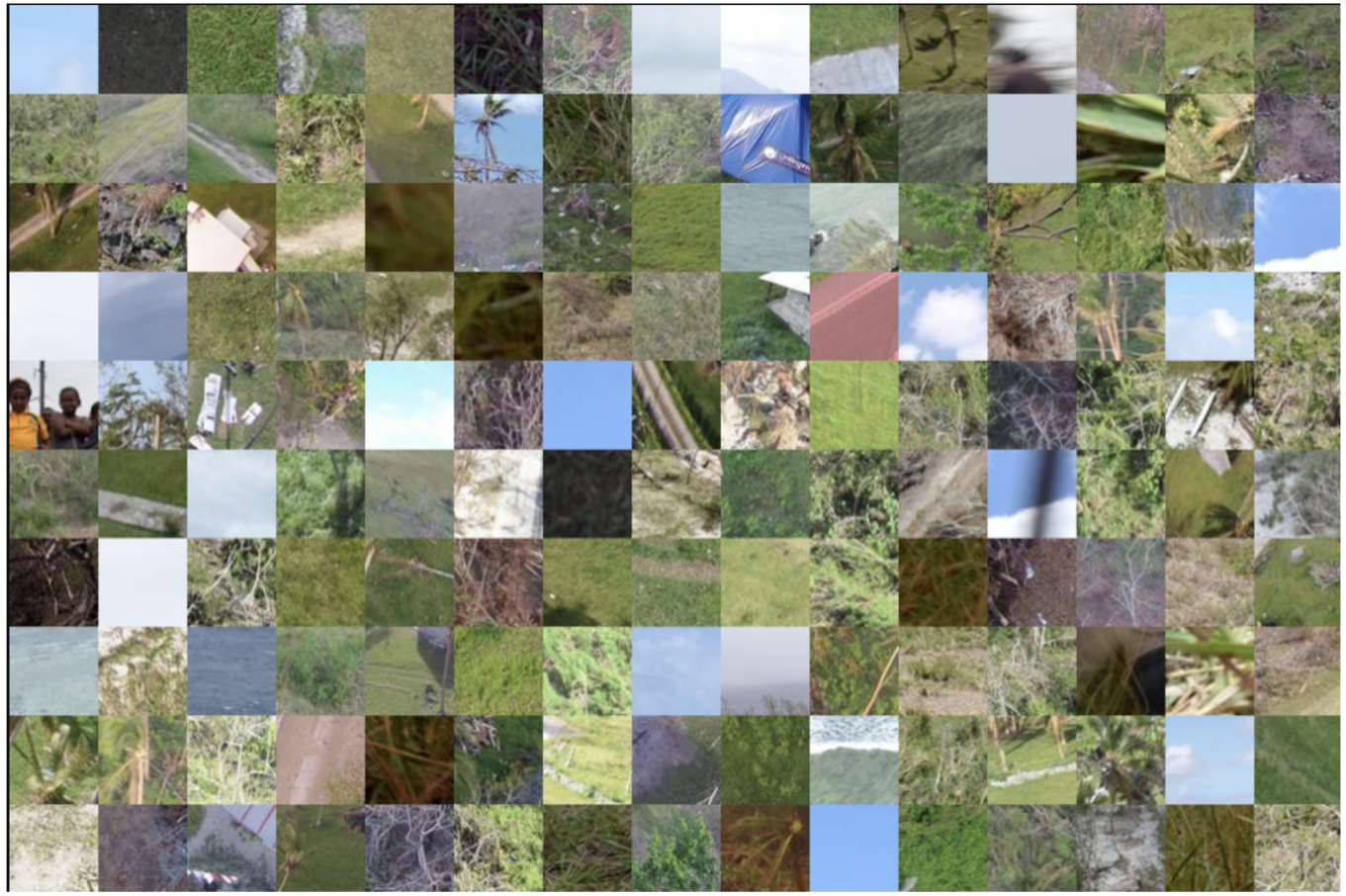
Analysis from Drone Data (Ortho-mosaic)

- Volunteered GIS to update and complete digitization of settlements for high risk areas
- Build Training Data for Machine Learning on infrastructure types (houses)
- Validate Facebook High Resolution Data for Africa
- Contribute Data Back to humanitarian community (OpenAerialMap)

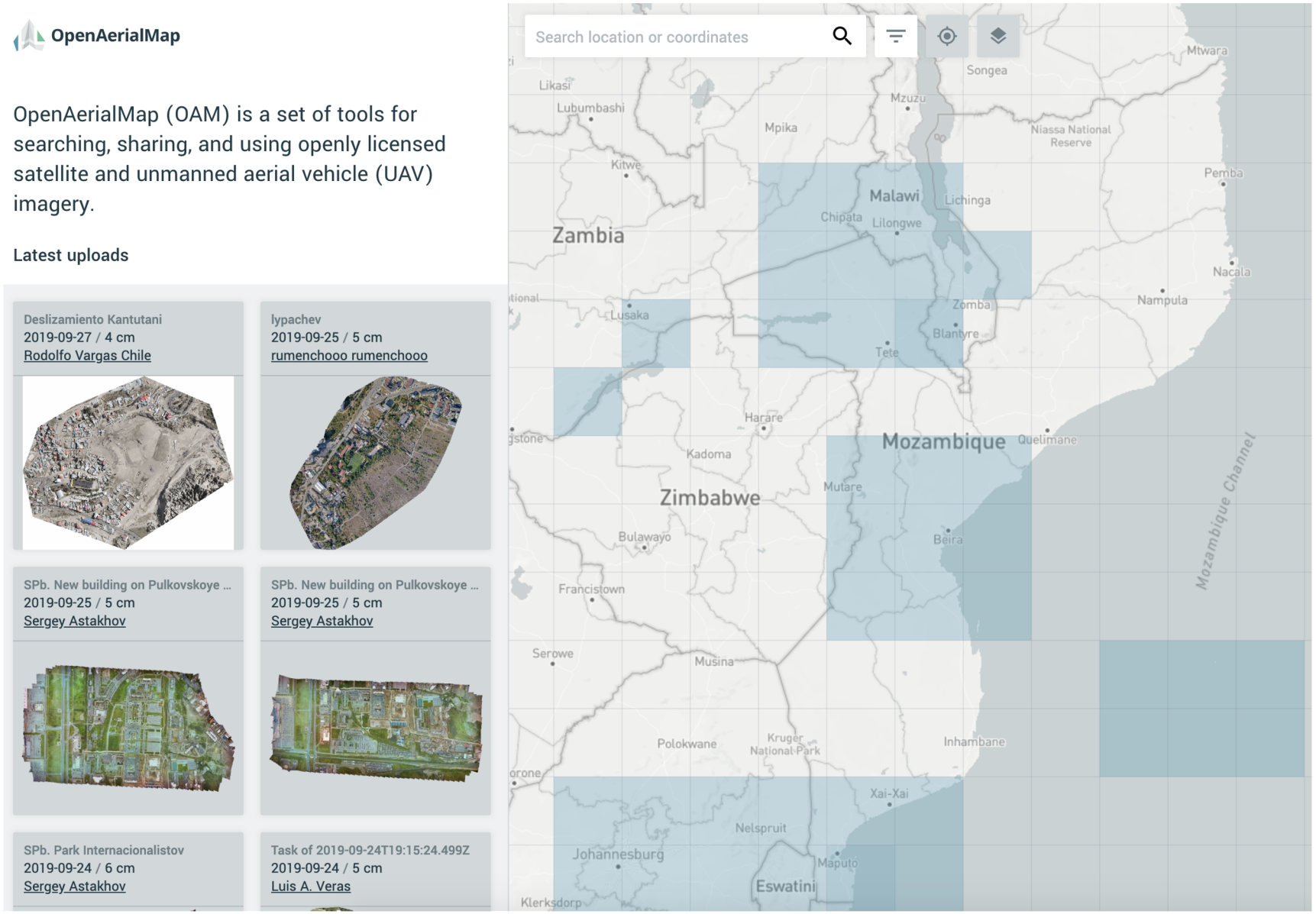
- *Damage assessment/classification using Machine Learning (DEEP)
- *Community Mapping from Red Cross

**Being Implemented Already*

Creation of very high resolution reference data for Machine Learning of Automated Building Damage Detection



Contribute Orthomosaic to OpenAerialMap.org

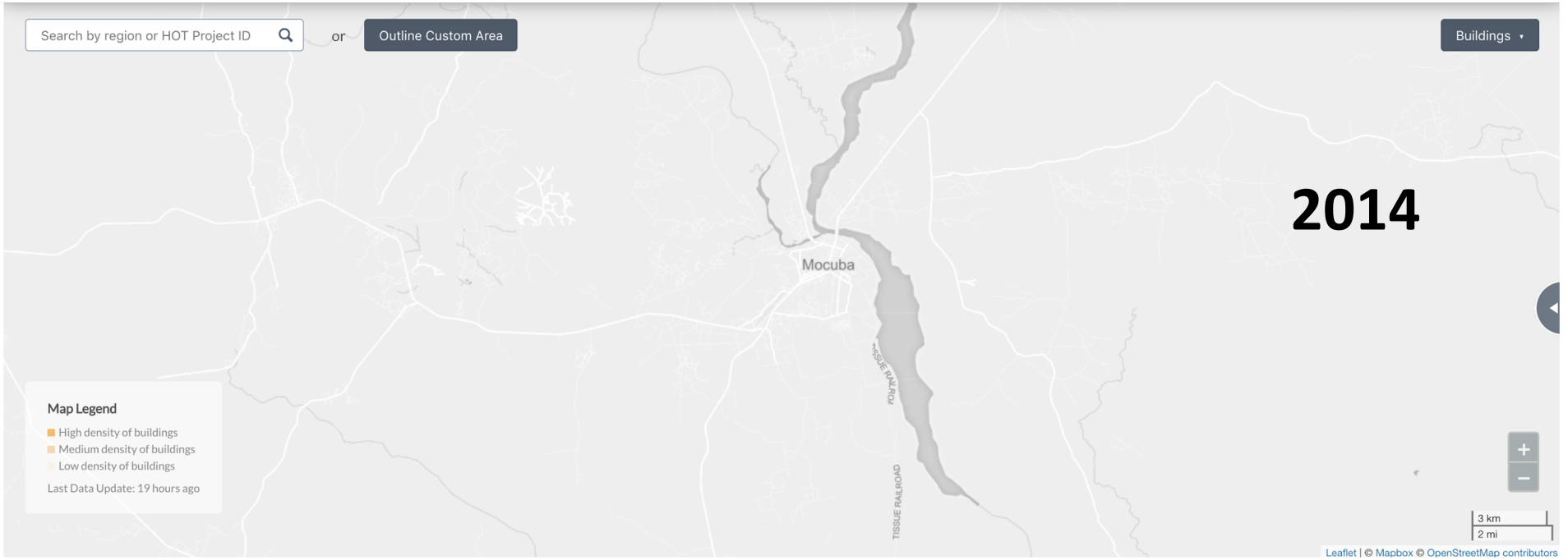


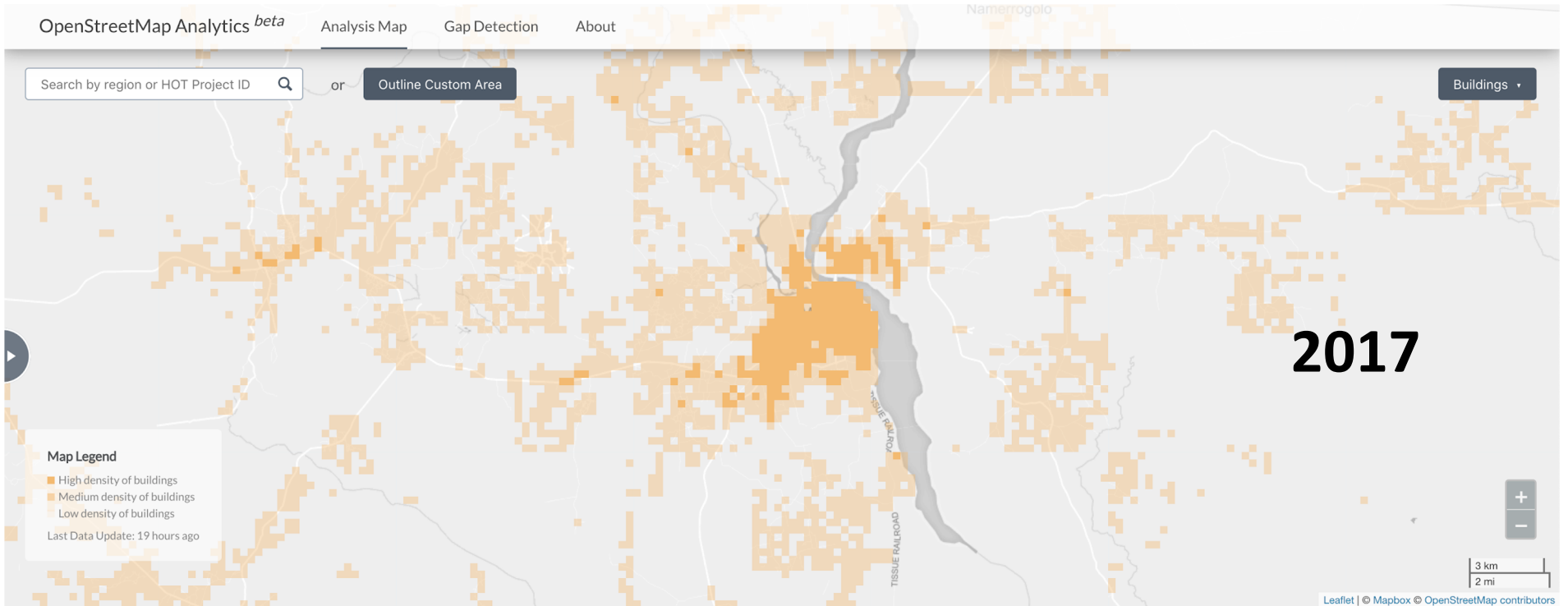
OpenAerialMap is the largest repository of online drone data where humanitarian organizations, government, & academe can freely access detailed high resolution drone dataset.

https://openaerialmap.org/

OpenStreetMap Mapping Contributions Mocuba, Mozambique

In 2014, the entire Mocuba is not mapped in OSM. After the 2015 event, several humanitarian OSM has been activated and mapping has started but the latest update was in 2017.





Exposure Mapping

Drone Aerial Image (2019)

Exposure data from OpenStreetMap

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Overlay exposure Data from Humanitarian OpenStreetMap

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Simulation Result

Maximum Flood Inundation hazard based on 2015 event

Low Hazard	0 – 20 cm
Moderate Hazard	20 – 50 cm
High Hazard	50 cm – 1 meter
Extremely High Hazard	> 1 meter

90

159

283

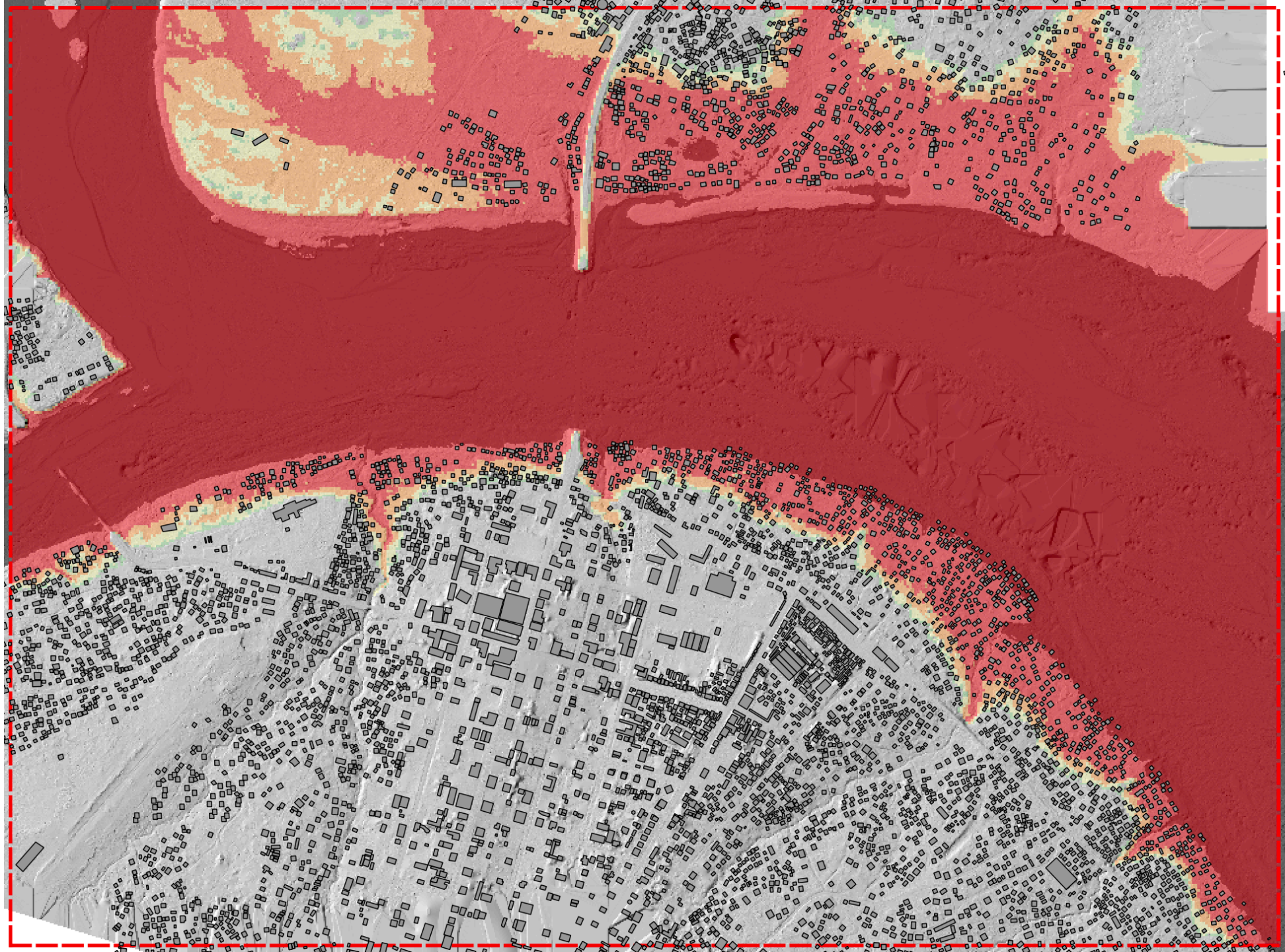
1538

5220

Total: 11,133

1.7 kilometers

7 bridges



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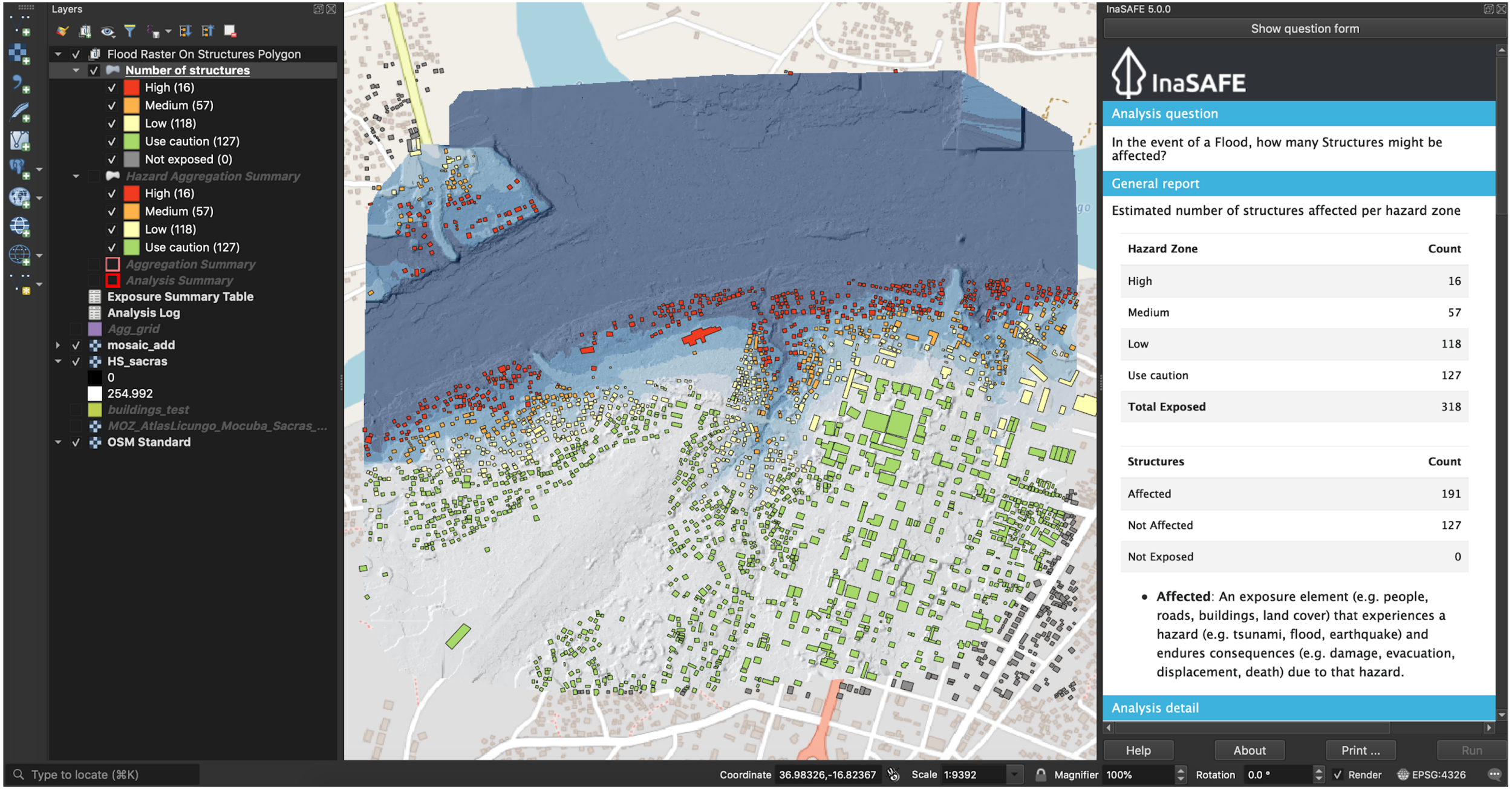
Open Source hazard and exposure analysis tool (InaSAFE)



InaSAFE 5.0.0

Show question form

Analysis detail

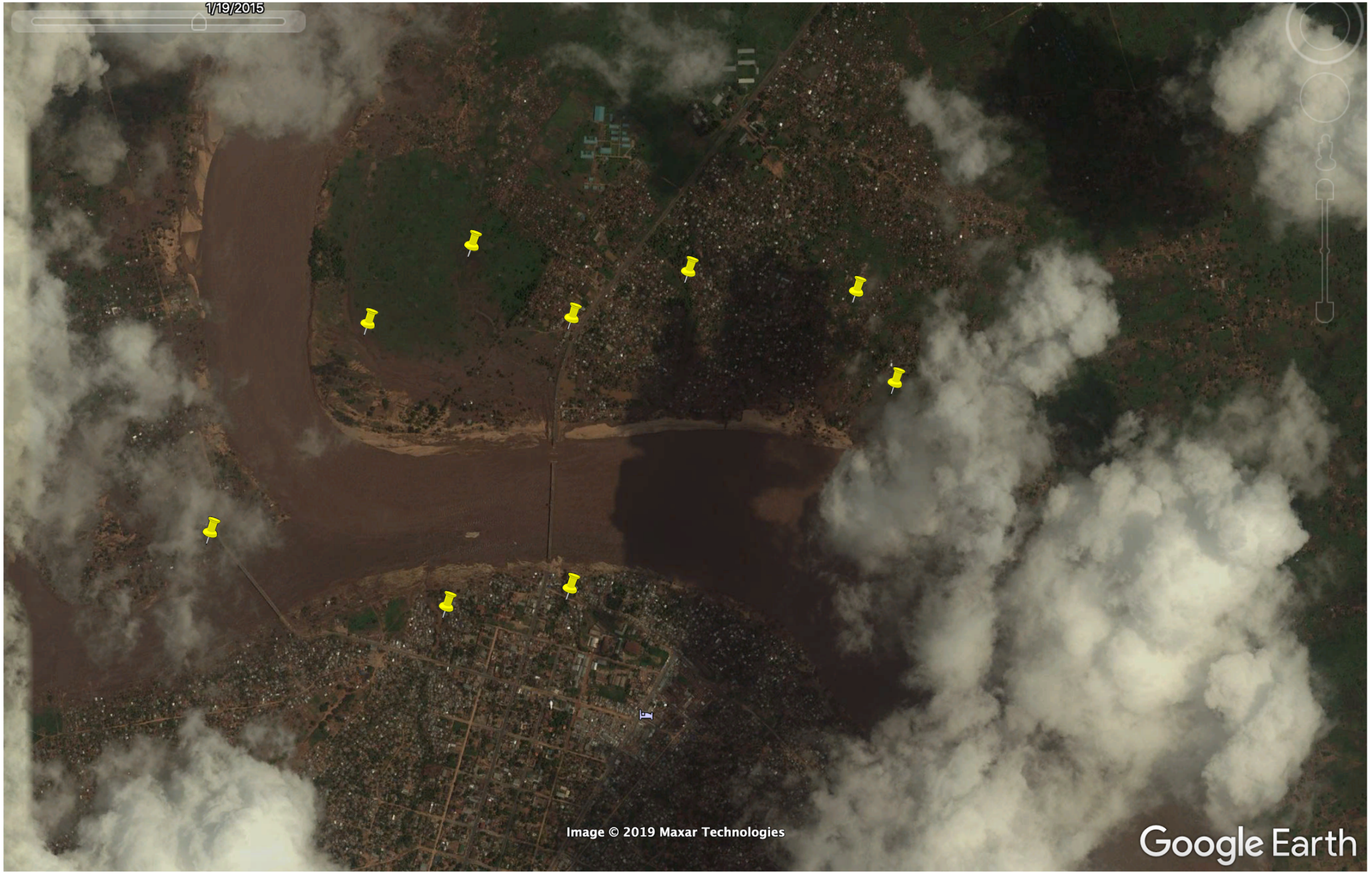
Estimated number of structures affected by structure type

Structure type	Affected			Not affected	Total not exposed	Total
	Medium	Low	Total affected	Total not affected		
Null	0	0	0	0	0	0
Metal roof	0	178	178	0	19	197
Building damage	0	1	1	0	0	1
Damaged roof	0	1	1	0	0	1
Thatched building	0	1	1	0	0	1
Metal building	0	1	1	0	1	2
Thatched roof	0	114	114	0	10	124
Civil war era builiding	0	0	0	0	1	1
Civil war era buildig	0	0	0	0	1	1
Metall roof	0	0	0	0	1	1
Damaged building	0	16	16	0	0	16
Damage buildings	0	1	1	0	0	1
Metal roof building	0	9	9	0	9	18
Metal	0	2	2	0	0	2

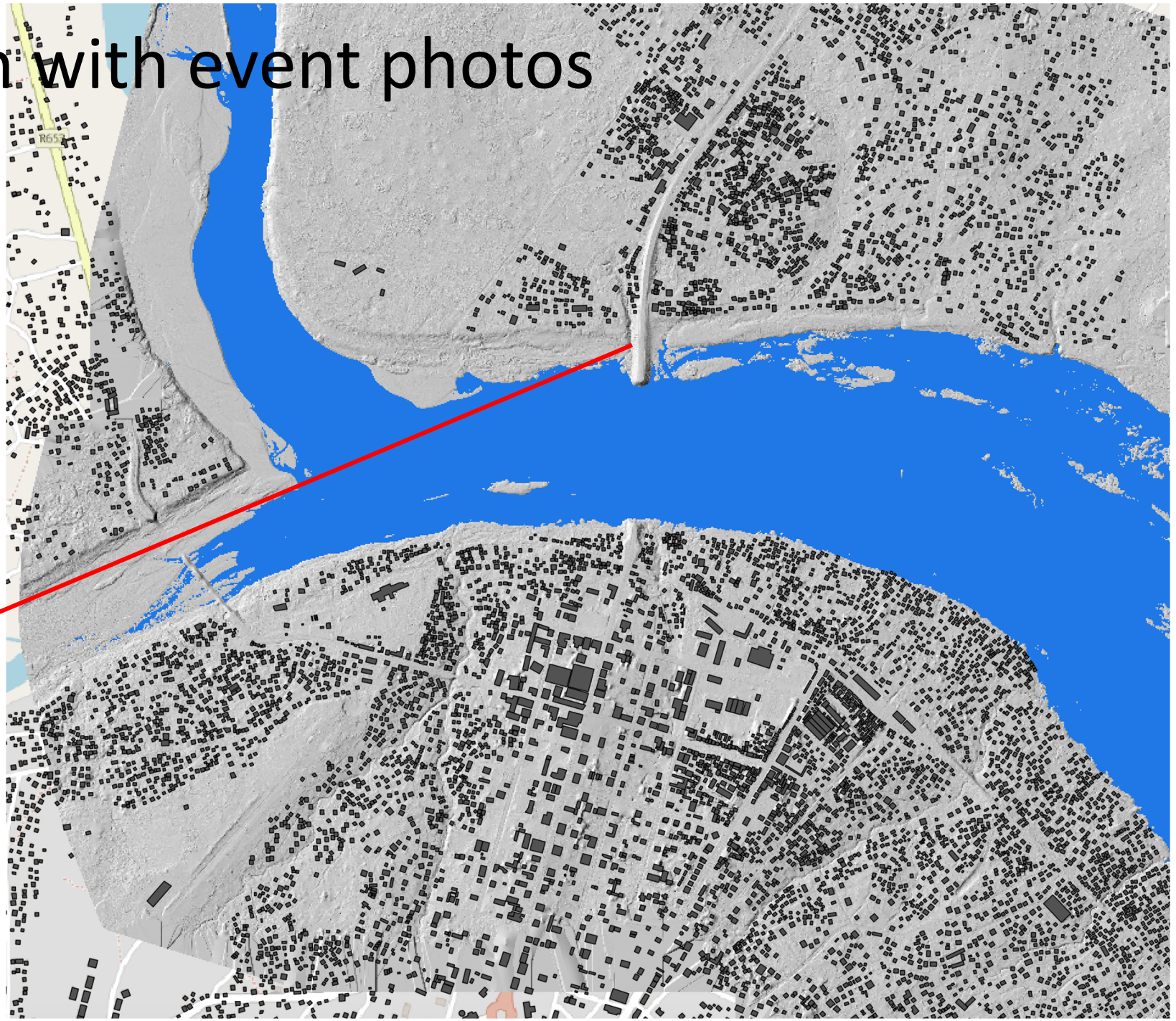
Help | About | Print ... | Run

Coordinate 284310,8138593 | Scale 1:17428 | Magnifier 100% | Rotation 0.0 ° | ✓ Render | EPSG:32737

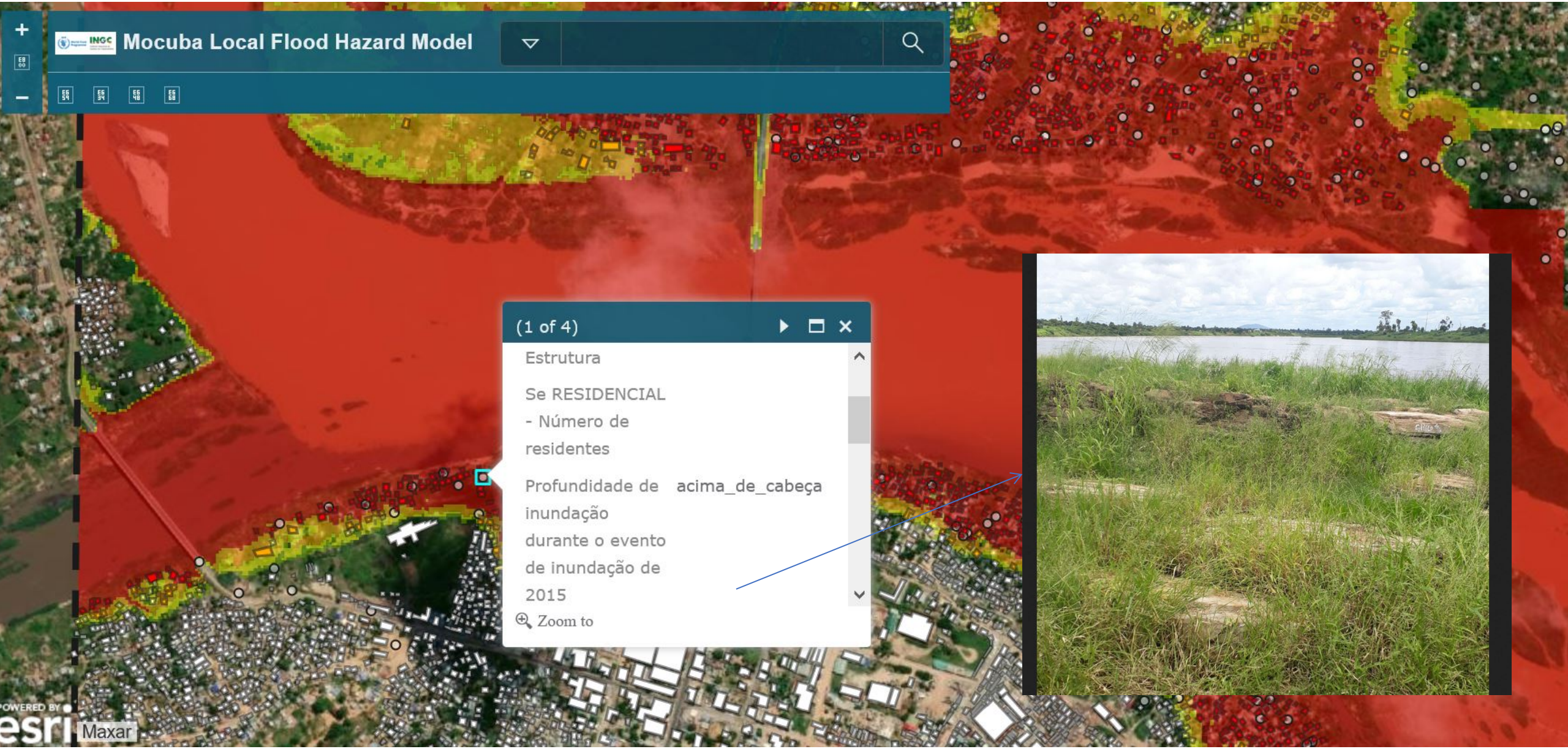
High Resolution Reference Image from Digital Globe (Jan 19, 2015)



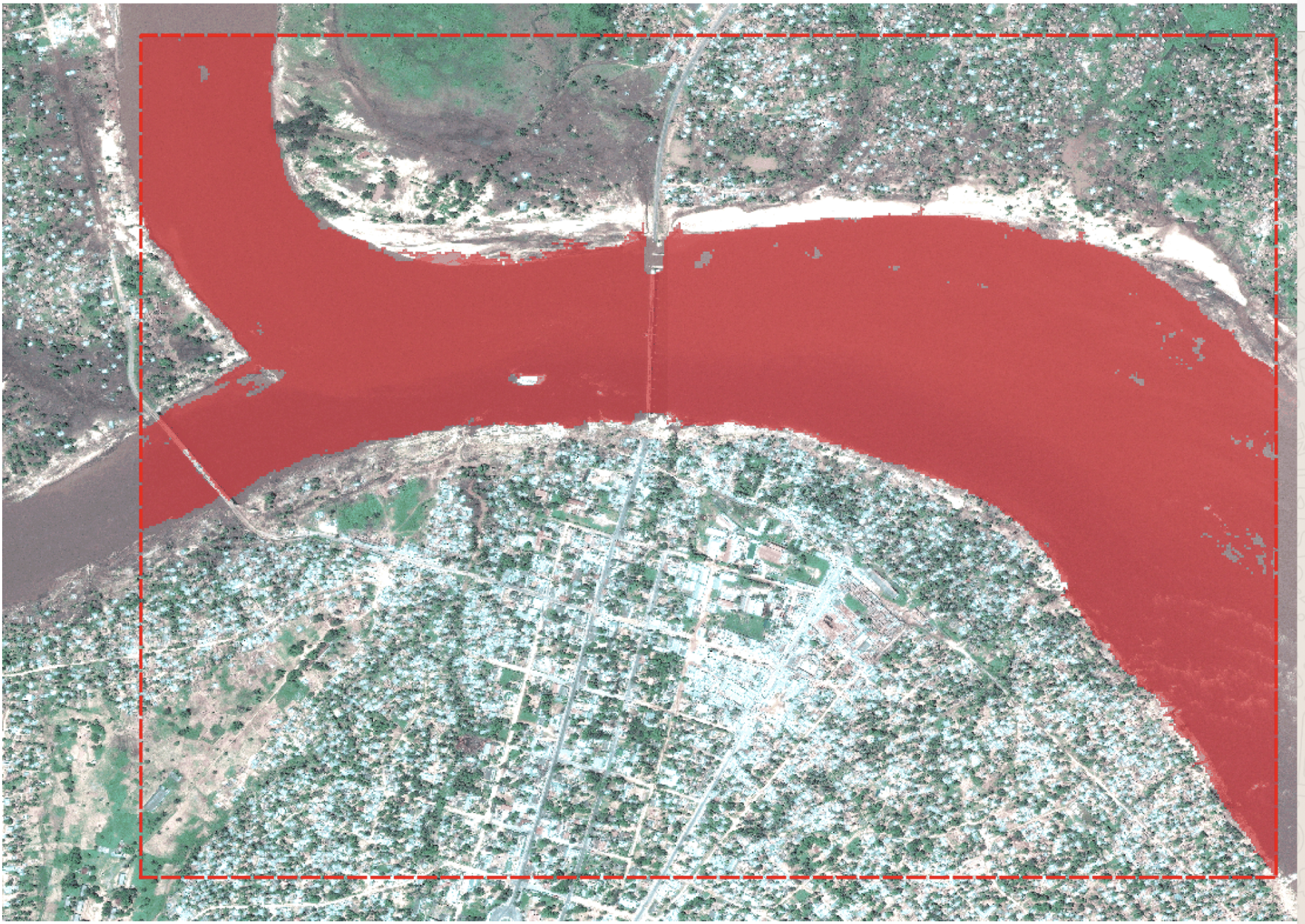
Validation with event photos



Survey-based impact-scale validation



Real-time validation example



VodaCom 3G 10:25 AM

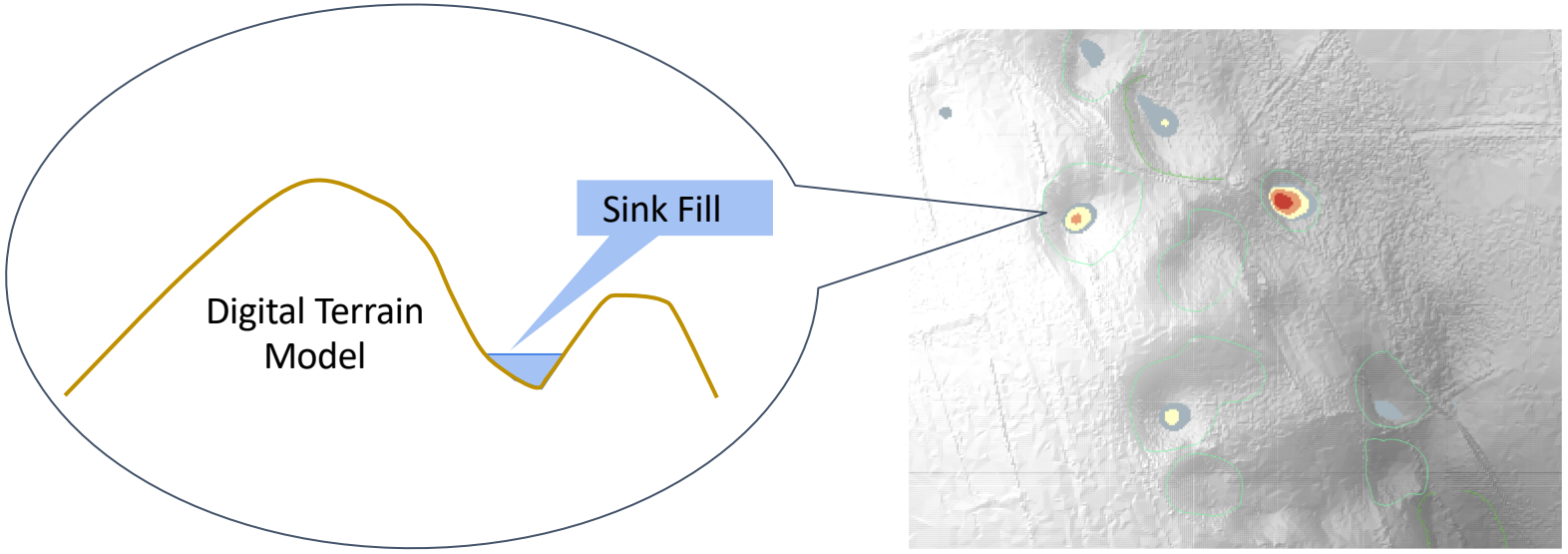
+258 82 705 9560

Forwarded
Bacia do Licungo
Mocuba
Dia 21/01/2020
15:00h 5.88m
17:00h 5.96m
Dia 22/01/2020
06:00h 6.90m
2:27 PM

Forwarded
Bacia do Licungo
Mocuba
Dia 21/01/2020
15:00h 5.88m
17:00h 5.96m
Dia 22/01/2020
06:00h 6.90m
07:00h 6.85m
2:27 PM

Forwarded
Rio Licungo em Mocuba
9h 6.65m
10h 6.60 m
11h 6.70 m
Oscilacao dos niveis com tendencia a subir
2:27 PM

Other Innovative Uses: Potential Mosquito Breeding locs



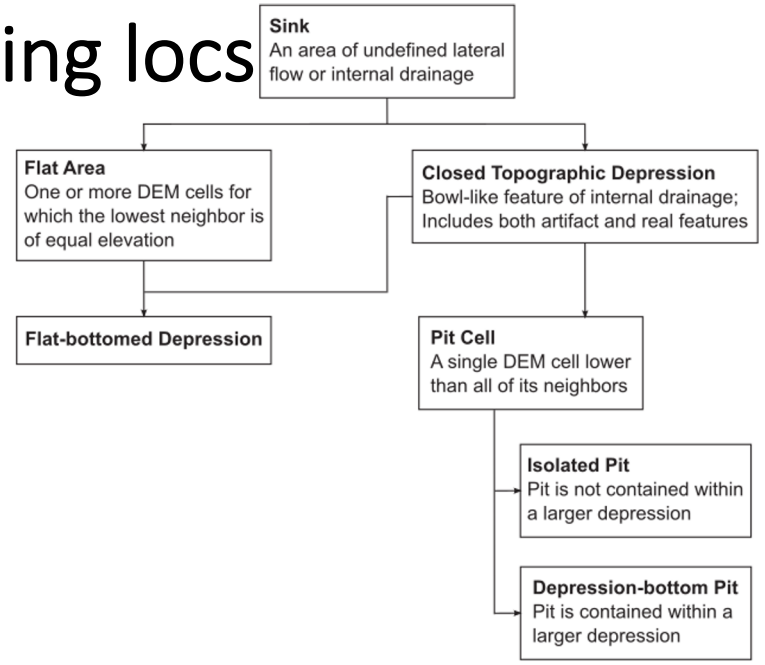
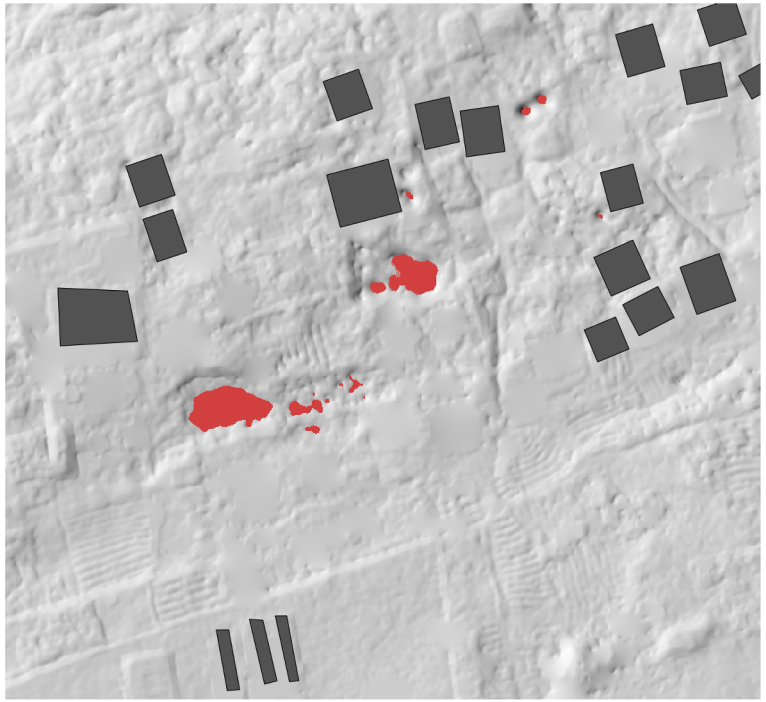
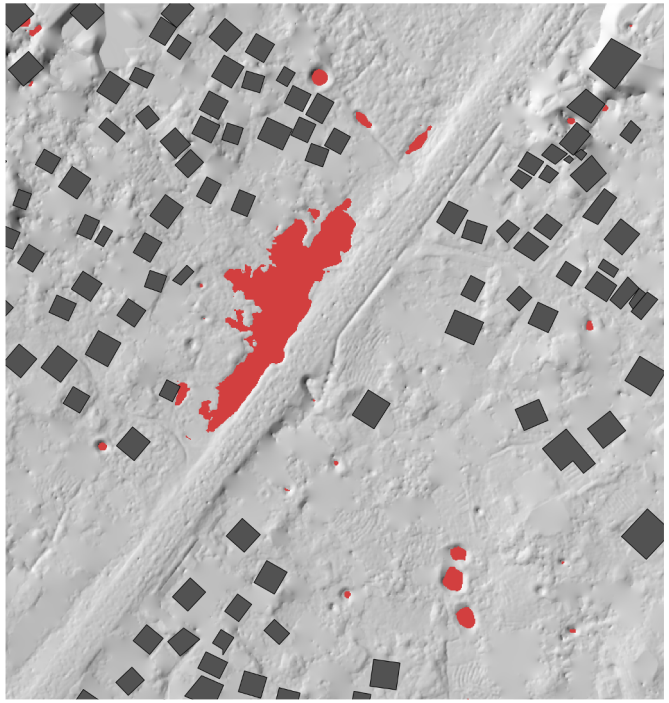
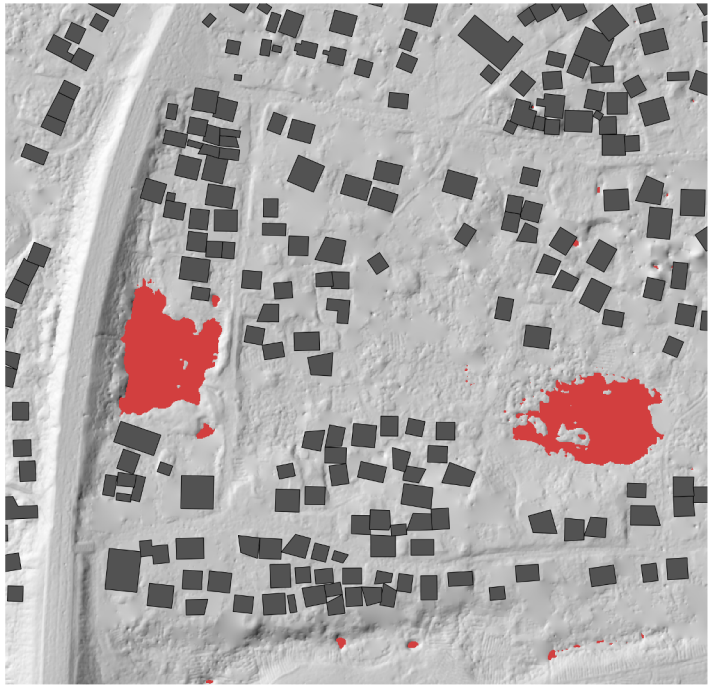


Figure 1. A typology of features found within DEMs that interrupt modelled flow paths and require flow enforcement

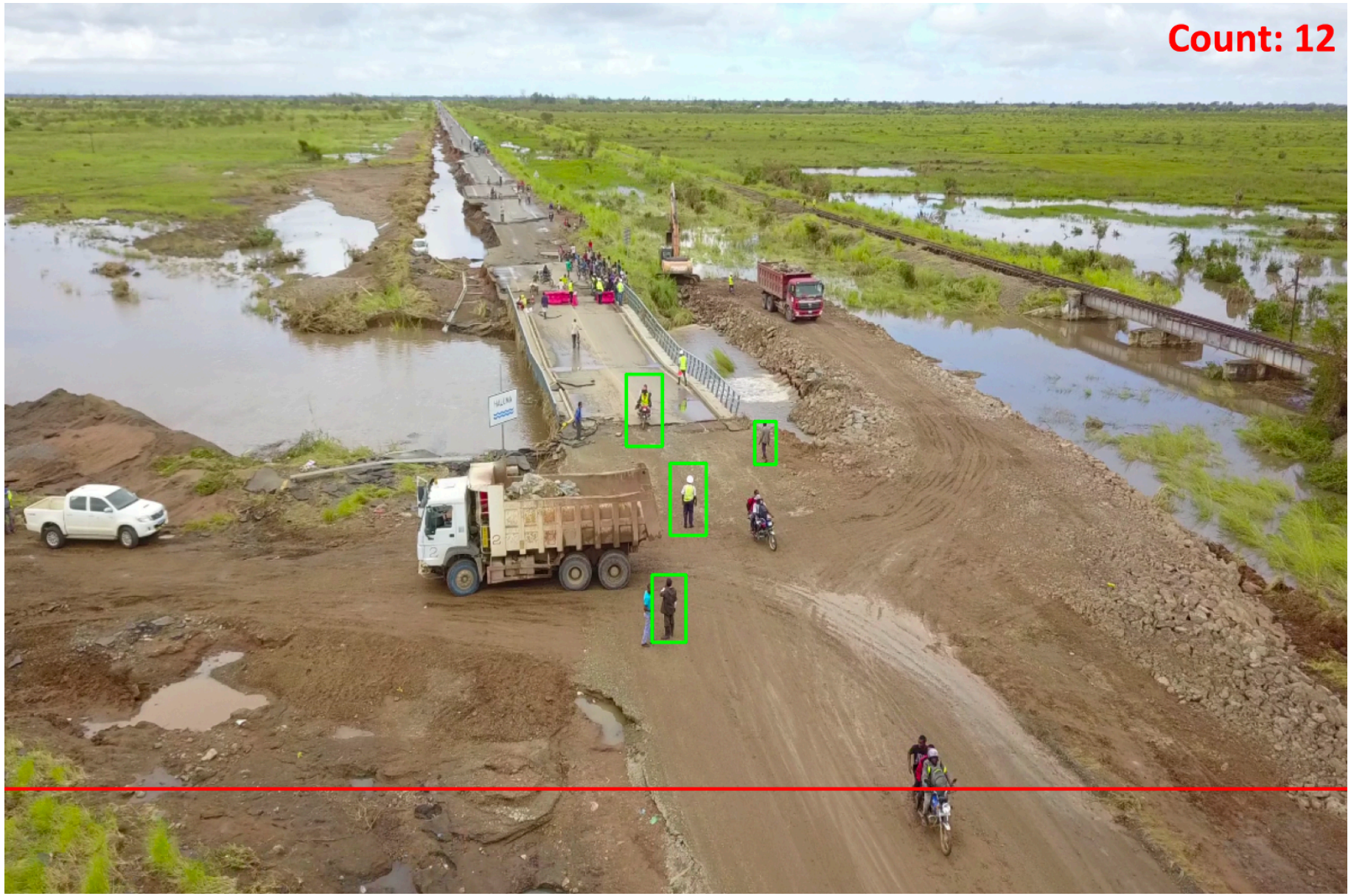




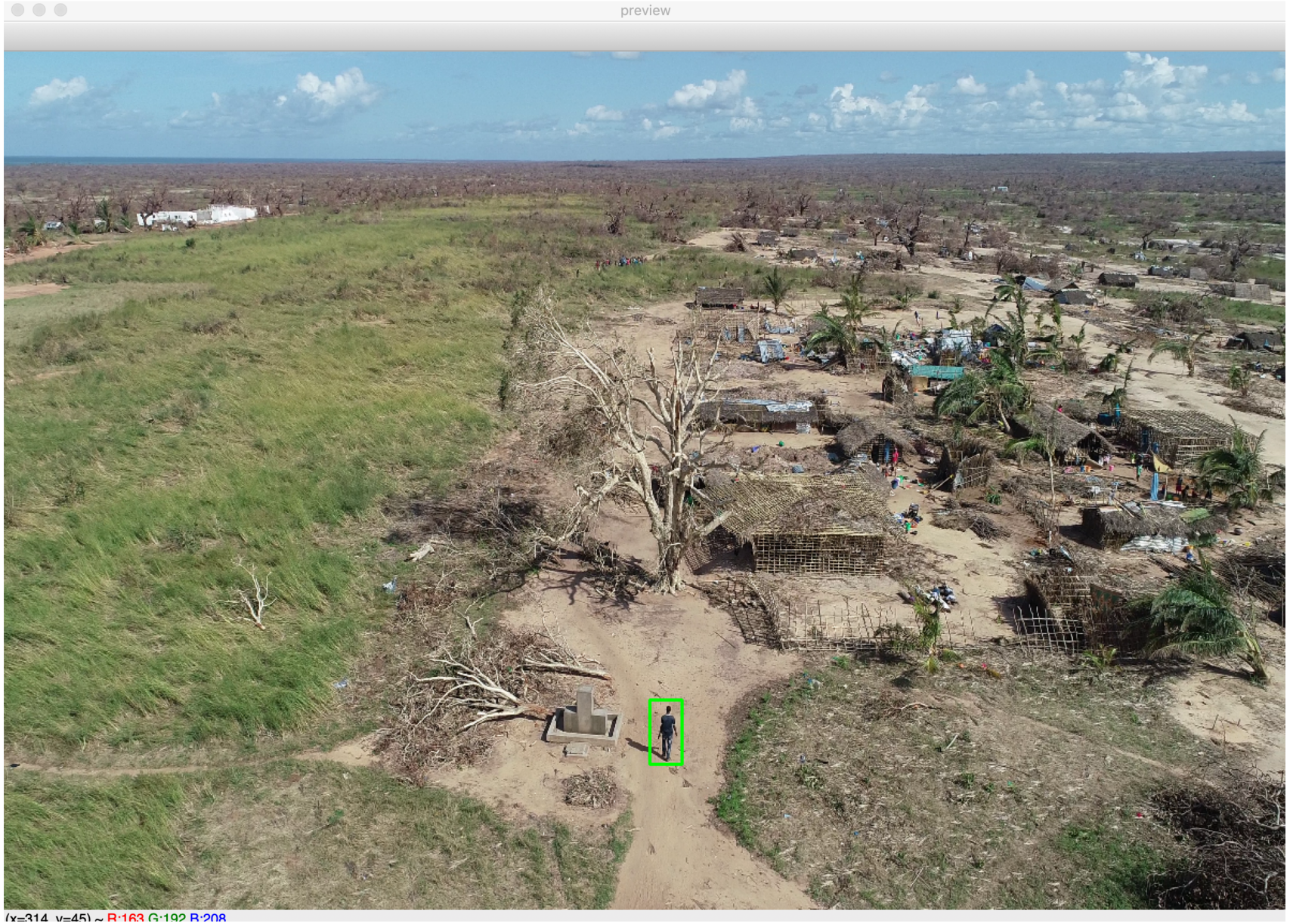


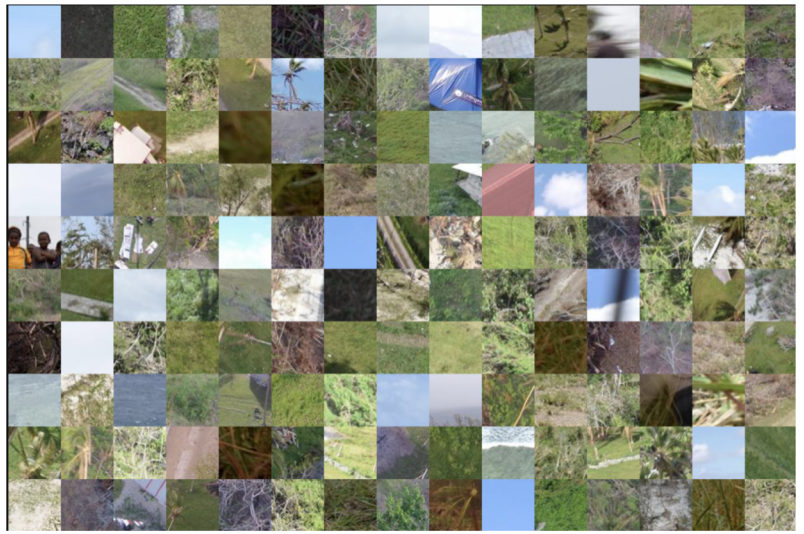
Since the DTM is high resolution, we are able to identify areas that are not drained during a rain event and hence, potential breeding locations for mosquitos. Then we can estimate populations exposed

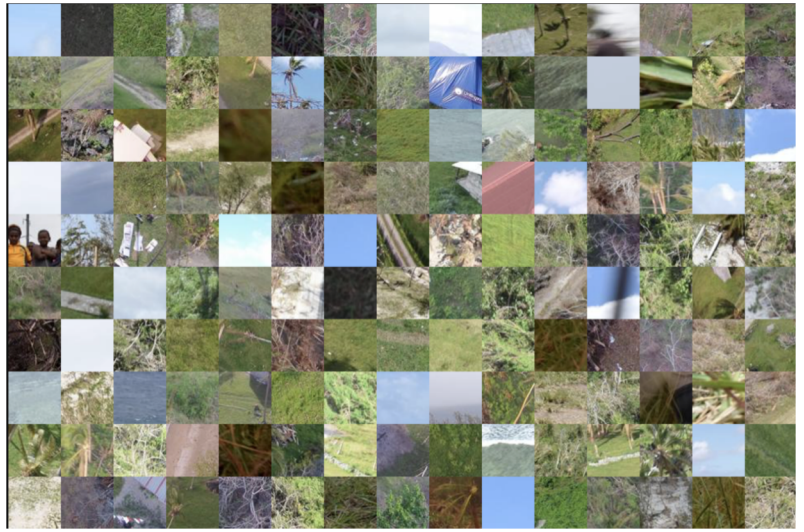
Drone Computer Vision (human counter)



Innovation (Computer Vision for DRR /Search and Rescue)







Presentation of Results

- WFP RBJ (Nicolas Babu)
- ECHO Representative
- INGC Director and Deputy Director
- WFP HQ
- Representative from Belgian Government

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Drones for Impact: Drones for Emergency Appli
By the numbers
25+ drone fleet
50+ locations mapped
20+ analysis produced
12+ partners assisted
12 terabytes of data
Flood Hazard Modelling
Drone Data Analysis
Innovation
INGC
Belgium


APC
Flood Hazard Modelling

Next Steps

- Strengthen and streamline activities with partners
- Validate Results for *Zambezia* Province
- Scale-up of project to other River basins
- Training of Coaches for INGC by WFP
- Implement Drone Innovation – new activity
- Collaboration with Spanish Red Cross (Community Based Disaster Preparedness Activity)
- ESA In-Cubed Program: “FloodSENS” (in preparation)

Thank you!

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