Research Notes…

Open Cities Africa Seychelles – A community mapping approach to improve disaster risk management in the Seychelles

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1. Introduction

Open Cities Africa is an initiative by the World Bank and the Global Facility for Disaster Reduction and Recovery (GFDRR) aiming at building skills, data and networks to support disaster risk management and urban planning in Africa. There are ten African countries participating in the initiative with Seychelles being one of them. Open Cities Africa Seychelles is targeting the coastal areas of the three main inner islands in particular and is focusing on the risk of urban and coastal flooding.

Figure 1: The three main islands covered under the project

While these risks are real and relevant to anyone situated in the coastal areas, the project is looking at the impact on tourism establishments specifically (with tourism being the main sector of economy in Seychelles).

The project was introduced to the main stakeholders (Department of Risk and Disaster Management, Tourism Department, and several first responders, among others) at a meeting in early 2018.

2. Drone workshop and drone mapping

The project was launched with a drone workshop in April 2018. The workshop was organised by the WB, the local project team, and a team of drone trainers from Zanzibar. A feature story on the drone workshop is available under the link as follows: https://www.gfdrr.org/en/feature-story/drones-eye-view-uav-applications-resilient-seychelles

During the drone workshop some of the priority areas for coastal erosion and flooding were mapped (Figure 2).

Figure 2: Drone mapping coverage, April 2018

The results were orthorectified images (i.e. distortions removed, correct orientation and position, constant scale) with 7cm ground resolution, i.e. one image pixel represents 7cm in nature (Figure 3). These images were later used during the community mapping exercise to identify and trace risk relevant data.

Figure 3: Example drone image (area around the jetty on La Digue)

3. Community mapping

3.1. Open Data

Spatial data (i.e. data that identifies the geographic location of features on Earth) plays a crucial role in supporting better informed decisions in the area of disaster risk management (among numerous areas). Almost any decision in disaster risk management is location-based, be it for risk assessment, prevention and risk reduction, or response and recovery, etc. The Open Cities Africa Initiative encourages a community mapping approach to build and collect relevant spatial data using *OpenStreetMap*. This participatory approach has several benefits over the traditional one (where data is acquired or collected by an individual organisation or contractor) such as:

- More frequent data updates
- Avoiding duplication of efforts
- More and better usage of data
- Building local ownership and trust in the data
- Raising community awareness of the challenges addressed by the particular mapping initiative
- Building (geospatial) capacity within the community

OpenStreetMap is a free spatial database of the world that anyone can contribute to. OpenStreetMap data is *Open Data*, that means:

- It can be freely used, re-used and redistributed by anyone, anywhere, for any purpose
- It is subject only, at most, to the requirement to attribute and share-alike
- It is available in a convenient and modifiable form

Given these characteristics, OpenStreetMap data is also a great choice for school and academic projects where finding appropriate data at low or no cost and without restrictions (regarding usage and sharing) is often a challenge.

The focus of the community mapping exercise under the Open Cities Africa Seychelles Project was on exposure data, in particular data on tourism establishments and public buildings (schools, day-cares, homes for elderly, clinics, etc.). Given that tourism is the main sector of the economy in Seychelles, a disaster might have a severe impact. With regard to public buildings the project looked at capturing those with more vulnerable 'occupants' (such as children and elderly people) who would get priority for prevention and evacuation measures, receiving aid, etc.

Together with the stakeholders the specific data requirements were defined and a data model was drafted as a guideline for the data collectors (Figure 4). The data model specifies what details should be collected for the tourism establishments as well as for the various types of public buildings.

With regard to OpenStreetMap the data model translates to *tags* whereby a tag is pair consisting of a key and a value. E.g. to flag a point or polygon (building footprint) as guesthouse a tag with the key 'tourism' and value 'guest_house' would be assigned.

OpenStreetMap data model

OpenStreetMap does not store data in layers (e.g. layer building, layer river, etc.) as most GIS (Geographic Information Systems) would do. Instead it stores geometries (nodes, ways and relations) that get assigned one or more tags. Only by assigning tags these geometries get a meaning and purpose (e.g. a polygon becomes a school, a line becomes a river, etc.).

Data Model for Open Cities Africa Seychelles

Great guides for mapping with OpenStreetMap:
https://www.mapbox.com/mapping/

Tourism Establishment (area)

Key	Possible Values	Remarks
Tourism establishment compound/campus (area usually matching the parcel boundaries)		
tourism	{hotel | guest_house | apartment | chalet}	
name	Name of the tourism establishment	
beds	Number of beds	
rooms	Number of rooms	
staff	Number of staff	This detail will not be uploaded to OSM!
Individual buildings on the compound (area)		
building	yes	
tourism	{hotel | guest_house | apartment | chalet}	Assign to building only if there is no relating compound/campus!
name	Name of the tourism establishment	Assign to building only if there is no relating compound/campus!
beds	Number of beds	Assign to building only if there is no relating compound/campus!
rooms	Number of rooms	Assign to building only if there is no relating compound/campus!
staff	Number of staff	Assign to building only if there is no relating compound/campus! This detail will not be uploaded to OSM!

Figure 4: Extract from data model

3.2 Capacity building

From April 2018 onwards the project team reached out to various community groups (Red Cross and other community-based NGOs, etc.) and secondary schools, to identify potential volunteers for the community mapping. Several presentations were held to explain the idea and purpose of community mapping (in the context of disaster risk management) and encourage participation.

In August 2018 the project team held a four-day hands-on workshop on GIS and OpenStreetMap for government stakeholders and secondary school teachers applying a train-the-trainers approach (Figure 5). In addition to OpenStreetMap basics and

OpenStreetMap editing tools, the training covered GIS basics and how to use OpenStreetMap data in *QGIS* (a Geographic Information System). While one reason for providing the training was to support the collection of risk-relevant data, the purpose of the training was also to equip the attendees with (spatial) data collection and analysis skills that are valuable far beyond the disaster risk management context. Teachers from six secondary schools and seven government organisations attended the training.

Figure 5: Secondary school teachers attending the training course on GIS and OSM at CARE House / Victoria

3.3. Mapathon preparation

Before August 2018, the amount of data available on OpenStreetMap for buildings (building footprints and details) on the three main islands was rather small. To support the Open Cities Africa Initiative (and other projects, organisations and individuals in need of building related information) the Centre for GIS under the Ministry for Habitat, Infrastructure and Land Transport and the National Bureau for Statistics agreed to contribute their data on buildings as Open Data to the OpenStreetMap Foundation. As a result, the project imported about 32,000 buildings into OpenStreetMap in early August. The project team estimates that OpenStreetMap now covers about 90-95% of the buildings on the three main islands.

Island	Before August 2018	After August 2018
Mahe	5,300	30,700
Praslin	1,200	4,500
La Digue	700	1,800

Table 1: Number of buildings available on OpenStreetMap before and after August 2018

This contribution was extremely valuable and facilitated the work of the mapping teams during the mapathon week. It also helped the project team to prepare some data before the actual mapathon. Via remote mapping ('armchair mapping') the project team managed to identify many of the tourism establishments for which data was to be collected, and assigned the establishments' names to the building(s). The names would appear on the map sheets printed for the mapping teams and make it easier for them to find the place during the data collection exercise in the field. The team printed data collection forms (derived from the data model/specifications) and maps for the priority areas defined for the mapathon (Bel Ombre, Beau Vallon and the South of Mahe, Grand Anse on Praslin and the West of La Digue). While there are several mobile applications available to support the collection of OpenStreetMap data the project team decided to use a paper-based approach to avoid technical issues during the mapping exercise but also taking into account that not all secondary school students necessarily own a smart phone. To prepare the maps for printing the project team used Field Papers, a web-based application that makes it easy to divide an area to be mapped into manageable pieces. Thus, one map sheet could be covered by a mapping team consisting of 2-3 persons.

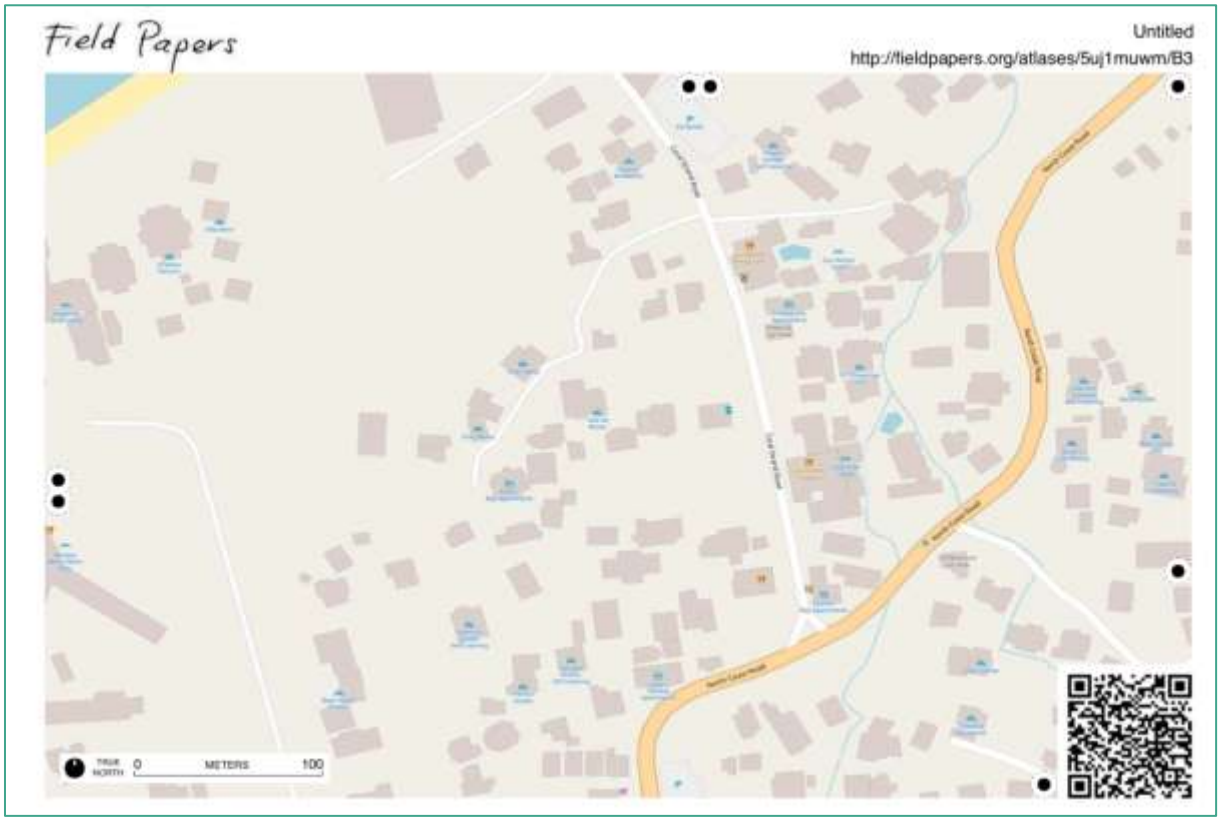

Figure 6: Map sheet generated with Field Papers

The mapping teams would use the printed map sheets to sketch in missing buildings and tourism establishments and to number those they had visited and collected data for (to be able to relate the details captured to the building footprint on the map). Each map sheet generated by Field Papers contains a QR code and several reference points. These are

used to put the map sheet at the correct location automatically when uploading a photo of the map sheet to Field Papers after the field data collection.

To facilitate the work of the mapping teams and get support from the tourism establishments the Department for Tourism sent out emails to all registered establishments to inform them about the upcoming mapping and data collection exercise.

3.4. Mapathon week

The mapping community coined the term 'Mapathon' as a combination of the words 'Mapping' and 'Marathon'. A mapathon is a coordinated mapping event where the community gathers to collect a lot of data for a particular purpose within a short period of time (often just a day or two). The purpose could simply be to improve map coverage, or to provide current data required for better disaster risk management (as under this project), among others.

The mapathon under the Open Cities Africa Seychelles Project took place in the last week of August 2018. About sixty students and eleven teachers from six secondary schools participated on Mahe, Praslin and La Digue. The mapping teams spent 2.5 days in the field for data collection and 2.5 days indoors (Figure 7) to enter, process and verify the data captured, and upload them to OpenStreetmap. The indoor exercise took place at the MoE Hall on Mahe and at the schools on Praslin and La Digue. An Internet Service Provider agreed to provide fast Internet at no cost during the mapathon at the three venues.

Figure 7: Students on Mahe during the data processing session

Figure 8 shows a screenshot of *JOSM*, the software that the mapathon participants used to process, verify and upload data to OpenStreetMap. It is one of the most mature editing tools for OpenStreetMap, and as most other tools within the OpenStreetMap ecosystem it is Open Source Software.

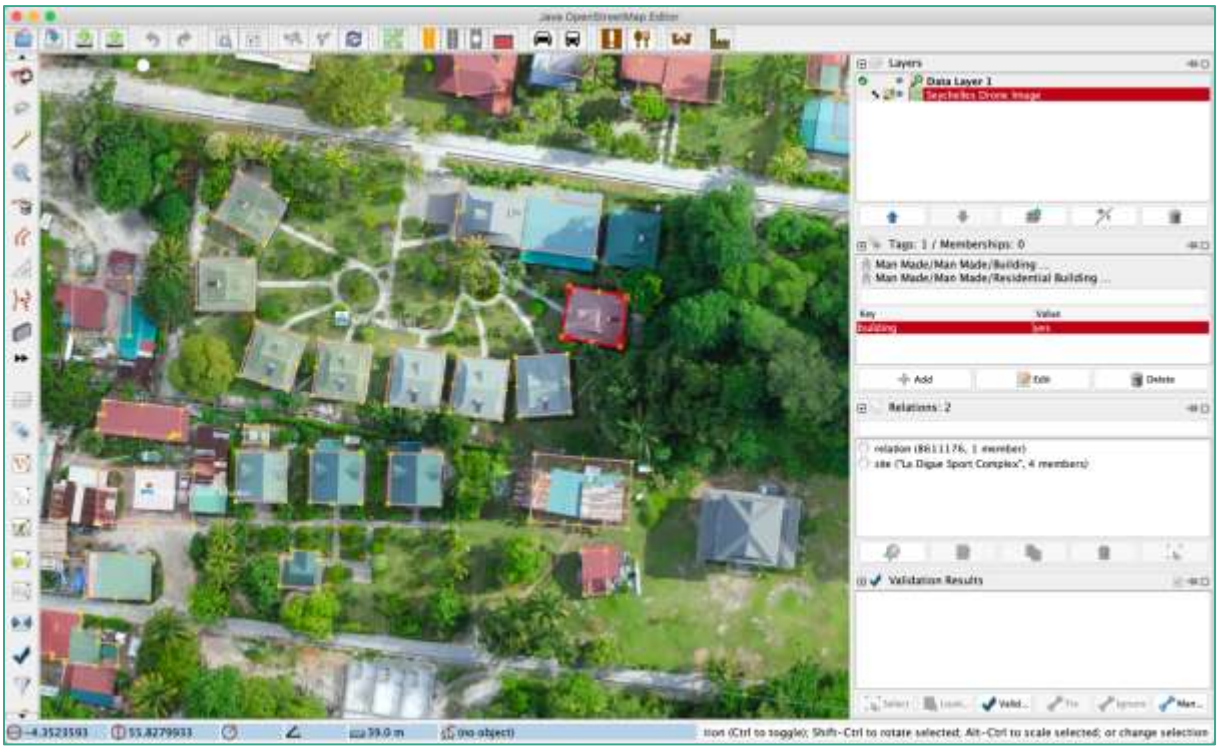

Figure 8: Editing OpenStreetMap data in JOSM using the 2018 drone image to trace building footprints

Besides having strong editing capabilities *JOSM* can be used for data validation. It is crucial that data is validated before uploading it to OpenStreetMap to maintain high quality OpenStreetMap data. Since anyone can contribute and upload data to OpenStreetMap the risk that errors are introduced (accidentally or purposely) increases. However, because there is a large community of mappers behind OpenStreetMap chances that an error is detected and fixed are also much higher. In reality, the benefits of OpenStreetMap and the relating community mapping approach outweigh any potential risk by far.

3.5. Mapathon results

Table 2 shows the results of the one-week mapathon on the three islands in numbers.

	Mahe	Praslin	La Digue
Tourism establishments captured	92	41	14
Tourism establishments targeted	149	126	87
Public buildings captured (schools, day-cares, etc.)	6	20	2
Buildings captured in total (public and as part of a tourism establishment)	249	79	67

Table 2: Mapathon results for each of the three islands

The project team used Overpass Turbo (https://overpass-turbo.eu/) to generate maps and statistics for the data collected (Figure 9). Overpass Turbo is a web-based application that allows trivial and complex queries on OpenStreetMap data to be run.

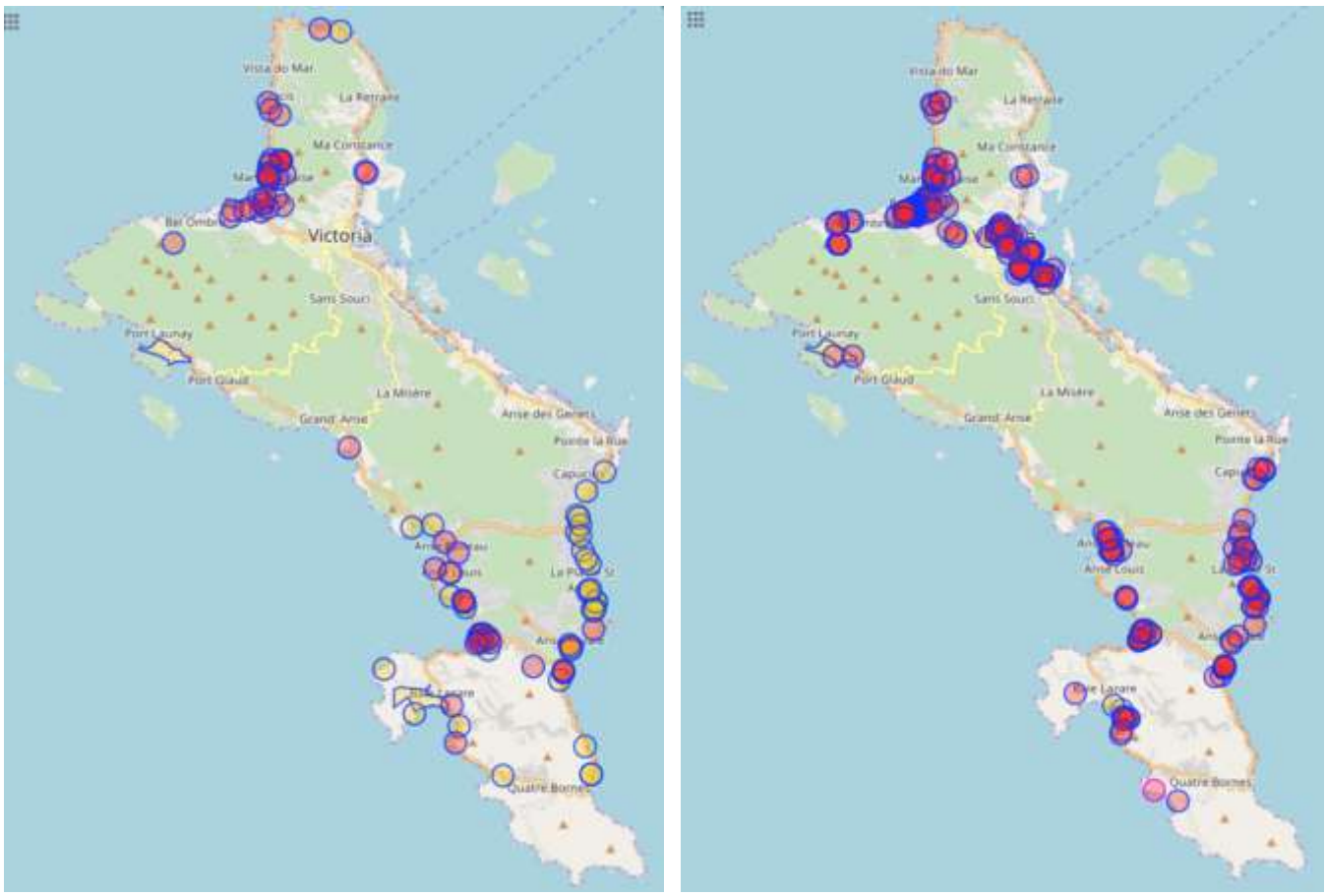

Figure 9: Tourism establishments (left) and buildings (right) captured on Mahe during the mapathon week

Figure 10 shows the attributes/tags collected for an individual building while Figure 11 is an example of the attributes collected for the actual tourism establishment.

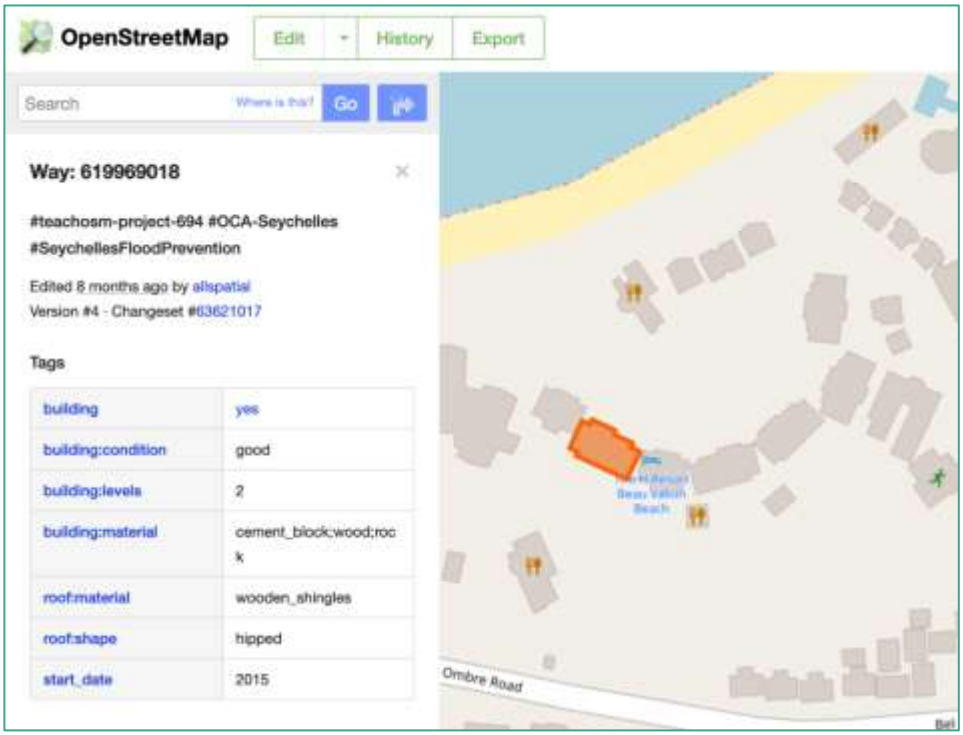

Figure 10: Attributes (details) collected for individual buildings

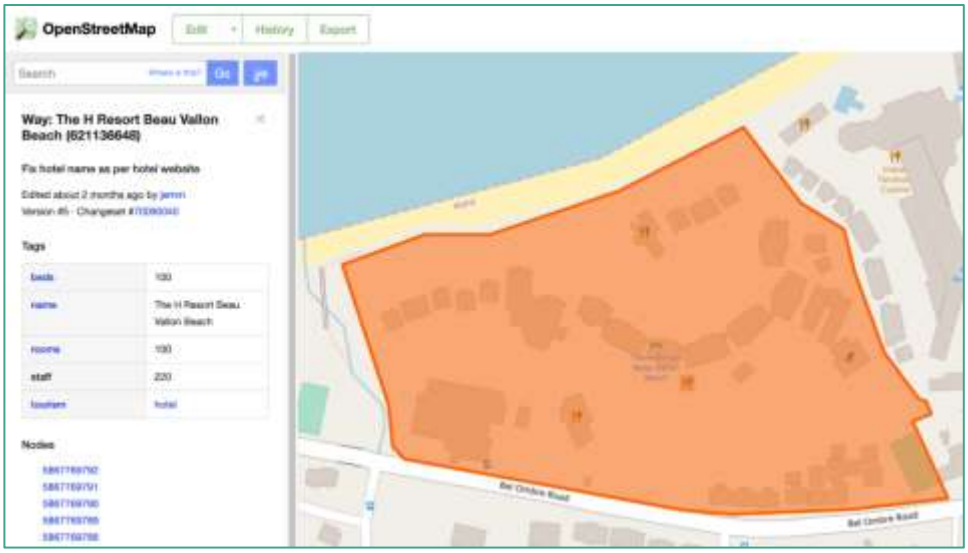

Figure 11: Attributes (details) collected for a tourism establishment

These details combined with hazard information can then be used by first responders (DRDM, Department for Tourism, Seychelles Fire and Rescue Services Agency, etc.) for impact assessments and evacuation planning.

3.6. Challenges faced

Unsurprisingly, the mapathon did not go without challenges. It was the first community mapping event of its kind carried out in Seychelles and thus, some challenges were expected. The main ones that the project team and the mapping teams faced were as follows:

- *No access to tourism establishments*: Although the relevant authority contacted the tourism establishments regarding the data collection exercise quite a few establishments stated that they were not aware of this and denied the mapping teams access to the establishment. Thus, the mapping teams were not able to capture risk relevant data as planned at all the places.
- *Lack of knowledge on how to read a (printed) map*: A few mapping teams had difficulties initially on how to get oriented using a printed map, i.e. how to position the map in the right way. Thus, some buildings were sketched in at the wrong location.
- *Low internet bandwidth initially*: It took the team a few calls to the Internet Service Provider to get sufficient bandwidth to be able to work. Fast Internet is crucial for the indoor sessions (data editing, processing, up- and download). It is so crucial that it can make a mapathon succeed or fail.
- *Hardware issues (insufficient RAM, keyboard failure, no mouse)*: Editing a map with only a touchpad is extremely cumbersome and time consuming.
- *Students without access to email*: Not all students had access to email and arrangements had to be made accordingly. It might be useful if the Ministry of Education offered students training on creating an email account during their schooling.
- *Wrong tag keys and/or values*: Despite a well-defined data model wrong tag keys and/or values were assigned often. Subsequently, this required a lot of data cleaning by the project team.

A few weeks after the mapathon the project team revisited some of the sites on Mahe to improve map coverage, add missing tags and correct tags with wrong keys and/or values. The results after an additional four days spent by each of the four team members are shown in Table 3. Figure 11 shows the results for tourism establishments and buildings in Overpass Turbo.

	Mahe
Tourism establishments captured	183
Tourism establishments targeted	149
Public buildings captured (schools, day-cares, etc.)	42
Buildings captured in total (public and as part of a tourism establishment)	572

Table 3: Mapping results for Mahe after revisiting some of the sites

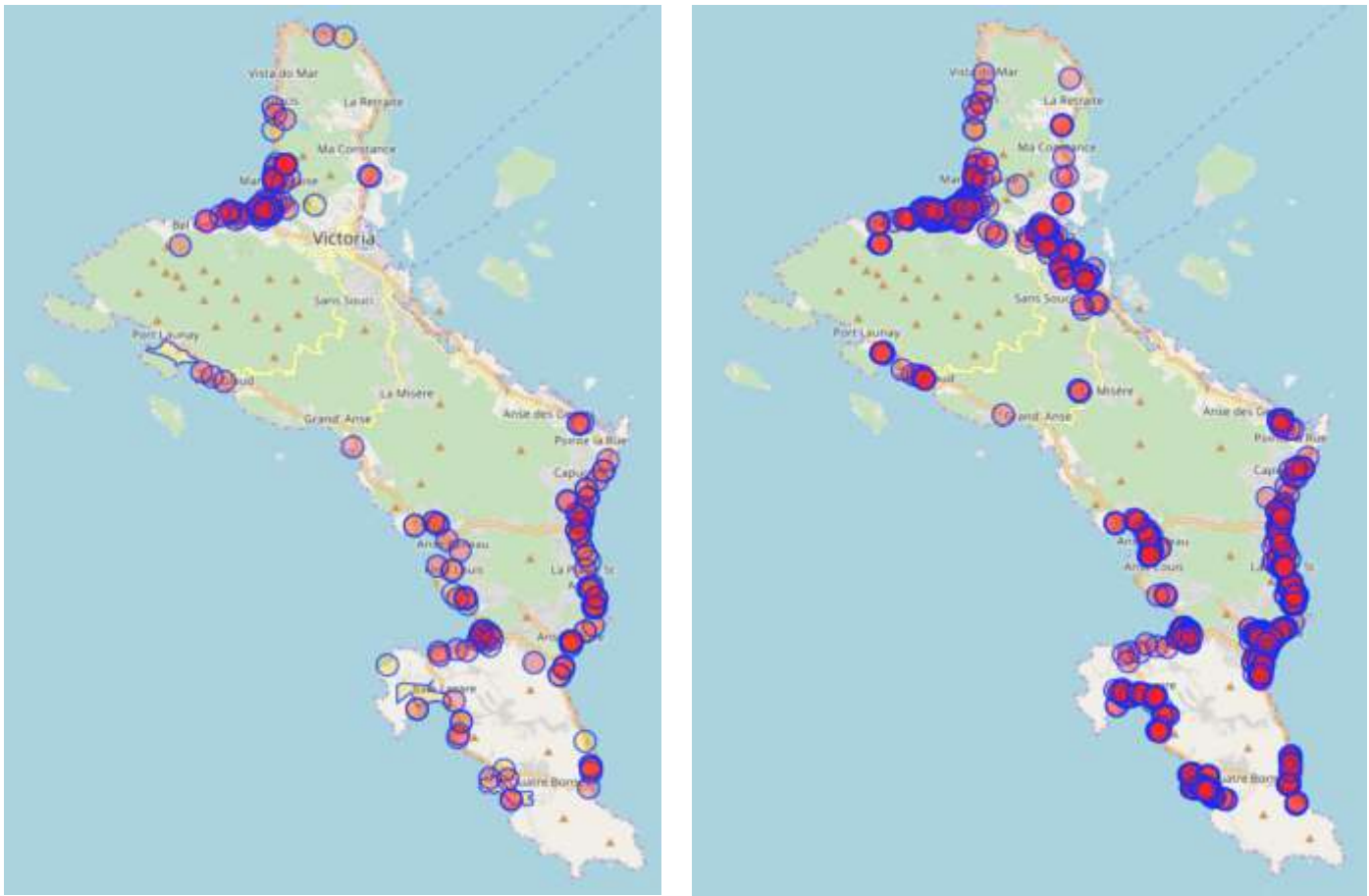

Figure 12: Tourism establishments (left) and buildings (right) captured on Mahe after revisiting some of the sites

These numbers allowed the project team to come up with some figures that should help to plan the required effort and manpower for similar events in the future more accurately. The figures assume that most of the establishments are located close to each other and can be reached by walking (such as in Beau Vallon and Bel Ombre).

Task	OSM beginner	Experienced mapper
Remote mapping ('armchair mapping')	10-15 establishments (with 1-5 buildings per establishment)	40-50 establishments (with 1-5 buildings per establishment)
Field survey / data collection	10-25 buildings	50-75 buildings
JOSM work (data entry, processing and validation)	10-15 buildings	50 buildings

Table 4: Results achievable within half a day

3.7. Lessons learnt and recommendations

Based on the challenges faced during the mapathon the project team put together a few recommendations that should facilitate the organisation of subsequent mapathons.

- Train the mapping supervisors sufficiently (6-8 days): For a successful 'train-the-trainers' approach it is crucial to train the trainers well. The team realised that 4 days were not enough and would recommend a 6-8 days training for similar events in the future. The team acknowledges that a training of 6 or even 8 days in a row is difficult to attend for many potential participants because of other commitments they might have (family, job, etc.). This is even more valid given that the participation in a community mapping event is purely voluntary and can often not be compensated for (at least not monetary). Thus, one option would be to split the training in several sessions (e.g. 4 x 2 days).
- Have the mapping supervisors train the mapping team members for at least two days: Although some of the teachers managed to spend half a day before the mapathon to introduce the students to OpenStreetMap and the idea of community mapping, two days would be more appropriate.
- A mapathon with school children participating requires additional logistics and planning. There should be breakfast and lunch provided, and ideally transport should be organised to and from the mapping site. In addition, a guardian should accompany the students during the data collection exercise (unless parents explicitly approve that this is not necessary).
- Test equipment, software and Internet before the mapathon. It can easily save a day's work during the actual mapathon.
- Make sure that the owners/managers of the places to be mapped are informed about the mapathon. Include a confirmation form in the email that the owners/managers have to sign and return.
- Bring lots of pencils/pens for the field data collection.

- Bring lots of extension cables for the indoor sessions of the mapathon.
- Be prepared for plenty of issues and questions during data capture, entry, processing, and validation. This is where well-trained and skilled mapping supervisors become indispensable.

3.8. Getting the data

All data that was collected during the project is available on OpenStreetMap and thus, can be downloaded together with any other OpenStreetMap data available for Seychelles. There are plenty of tools available to download OpenStreetMap data. One very easy to use is the *OSMDownloader* plugin for *QGIS*. Once data is downloaded, the assigned tags can then be used to extract specific information only (e.g. on tourism establishments, schools, etc.). To facilitate access to the data collected under this project in particular, the project team set up a tool that extracts the relevant layers from OpenStreetMap automatically once a day and stores them in a *GeoPackage*. *GeoPackage* is standard format for storing geospatial data and is supported by most current geospatial libraries and applications (such as *QGIS*, *ArcGIS*, etc.). The GeoPackage can be downloaded under this link:https://www.webgis.gov.sc/osm_data/sey_osm_layers.gpkg and contains the layers shown in Figure 13.

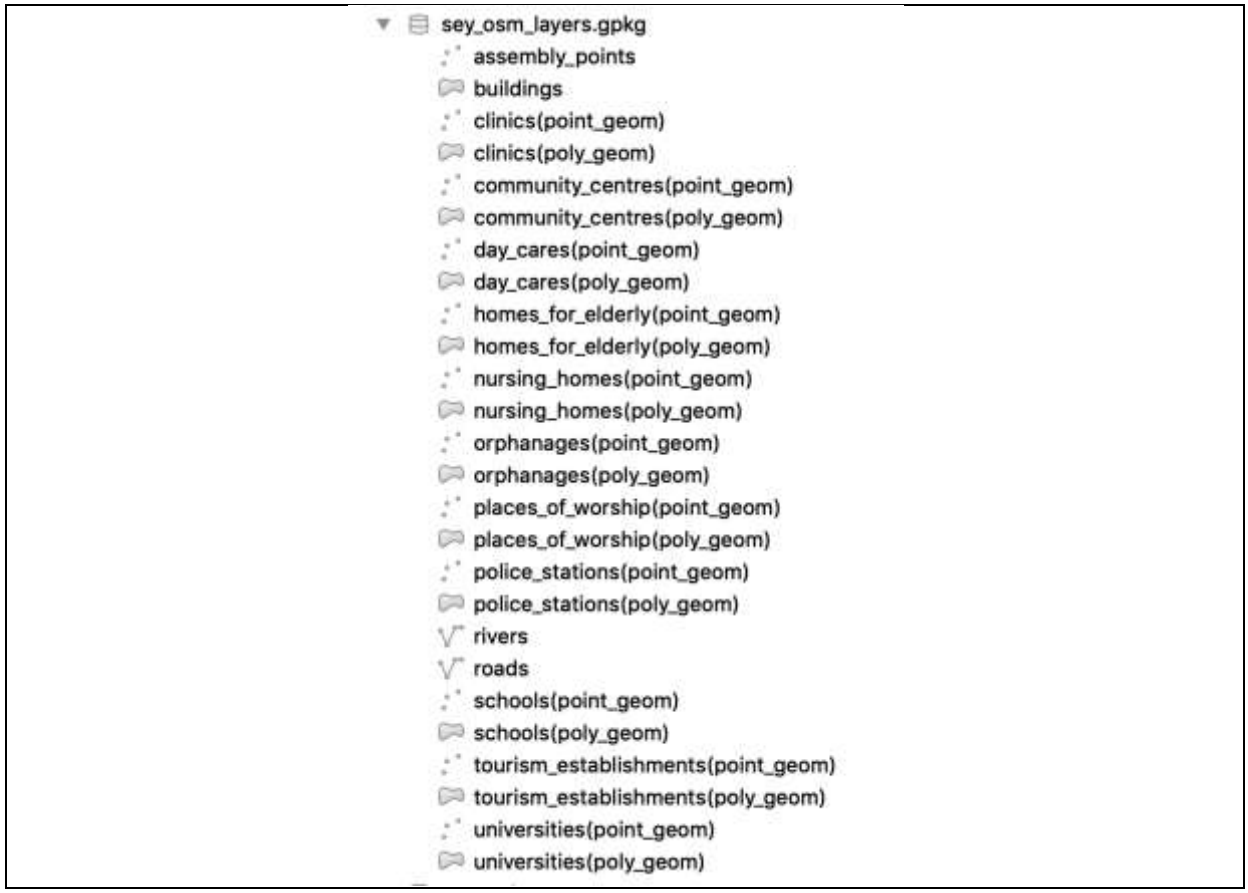

Figure 13: Layers available in the GeoPackage extracted from OpenStreetMap data on a daily basis

4. Next steps

The Open Cities Africa Seychelles Project ends in July 2019. Data collected under this project should be updated continuously (as new tourism establishments open and some existing ones close, etc.). Ideally, the government organizations in need of disaster relevant data would integrate OpenStreetMap data in their relevant workflows and contribute to OpenStreetMap on a regular basis. They could organize mapathons several times a year engaging NGOs, schools, the academic sector, and communities to improve the map. At the same time, they would benefit from data contributed to OpenStreetMap by anyone else (e.g. a lot of visitors like to map the guesthouse or hotel they stayed at and thus, do their part to contribute to the map). The Ministry of Education could add geospatial topics (such as OpenStreetMap and GIS) to the curriculum of the secondary schools (and maybe even primary schools if this is well received) and thus, get students involved, interested and capacitated early on.

In addition to the previous suggestions, the author is encouraging anyone to help build an active OpenStreetMap community in Seychelles. Please contact the author mwagner@allspatial.info if you would like to get involved.

The amount of data already available on OpenStreetMap for Seychelles in general is quite impressive, in particular given the fact that there is no local mapping community established yet. Figure 14 is a screenshot that the author took in May this year of three mobile map applications, with the map showing the Beau Vallon area. The app on the left side (*Maps.Me*) is using OpenStreetMap as primary data source while the apps in the centre (*Google Maps*) and on the right side (*Apple Maps*) are using their own data sources.

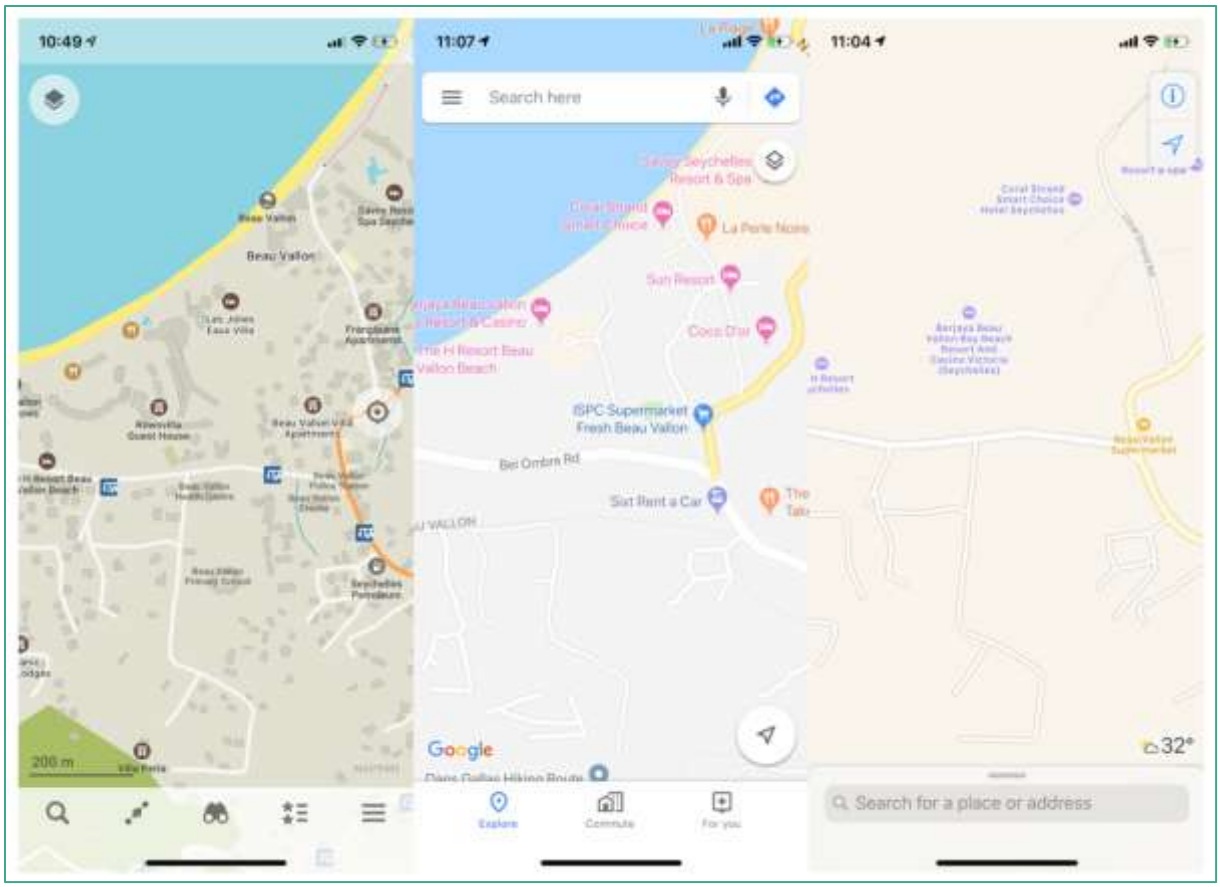

Figure 14: Comparison of data available in three mobile map apps (Maps.Me, Google Maps and Apple Maps)

Annex: List of tools from the OpenStreetMap ecosystem used by the Open Cities Africa Seychelles Project

- **iD**: Built-in OpenStreetMap editor of the OpenStreetMap website
- **JOSM**: Standalone OpenStreetMap editor with offline editing capabilities
- **Tasks TeachOSM**: Web-based tool to plan and coordinate larger OpenStreetMap projects with many contributors
- **Field Papers**: Web-based tool to print map sheets for field data collection
- **Overpass Turbo**: Web-based tool to run arbitrary queries on OpenStreetMap data (and validate OpenStreetMap data)
- **OSMCha:** Web-based tool to validate OpenStreetMap data
- **QGIS:** Geographic Information System (GIS) with powerful editing and analysis capabilities
- **Maps.Me:** Mobile map app using OpenStreetMap as primary data source