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Mapping on OpenStreetMap to improve access to health care in a rural district of Madagascar

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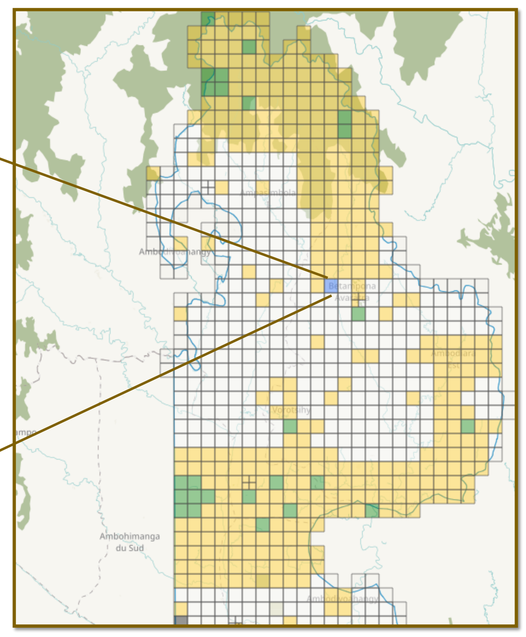
Participatory mapping of Ifanadiana district via OSM

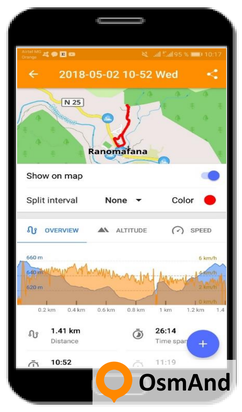
- Since 2014, the NGO PIVOT has worked in Ifanadiana, a district of Madagascar, in partnership with the Ministry of Health to create a "model health district"
- High rates of extreme poverty, geographical barriers, and unreliable health services were associated at baseline of this intervention with very limited access to health care in the district
- Most villages in the District are connected to each other by small paths only accessible by foot

GOAL: to develop very precise, context-specific estimates of geographic accessibility to all levels of care in Ifanadiana district (community health sites, health centers, hospital) to help with the design and implementation of interventions that improve access to care for remote populations



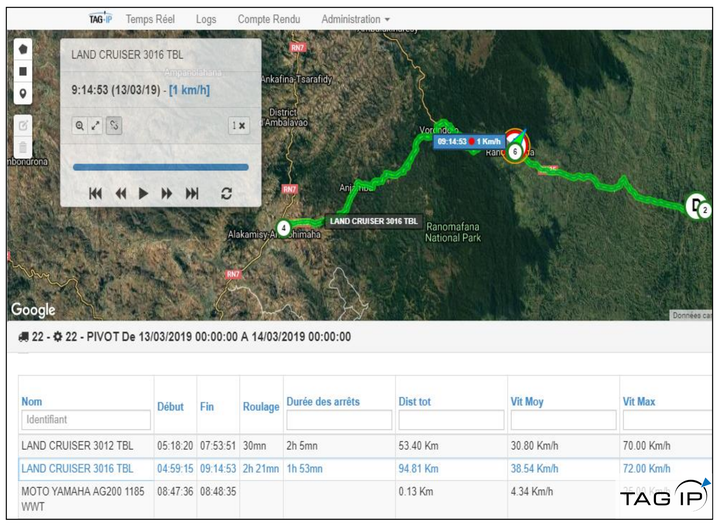
To meet these operational objectives, we needed an accurate geographic database. For this, we conducted an exhaustive mapping of the district on OpenStreetMap to obtain all roads, footpaths, buildings and residential areas. This was done in collaboration with the Humanitarian OSM Team (HOT), who gave us access to their Tasking Manager.

Collection of field data on local travel speeds



To obtain context-specific estimates of travel speed by foot and by motorized vehicles according to terrain characteristics and local conditions, we recorded GPS data from:

1. Nearly **1000 km of walking routes** across 10 out of the 15 communes of Ifanadiana district (top figures) using the OsmAnd software
2. Nearly **80,000 km of motorized vehicle routes** (cars and motorcycles) across Ifanadiana (bottom figures) with the TAG-IP software

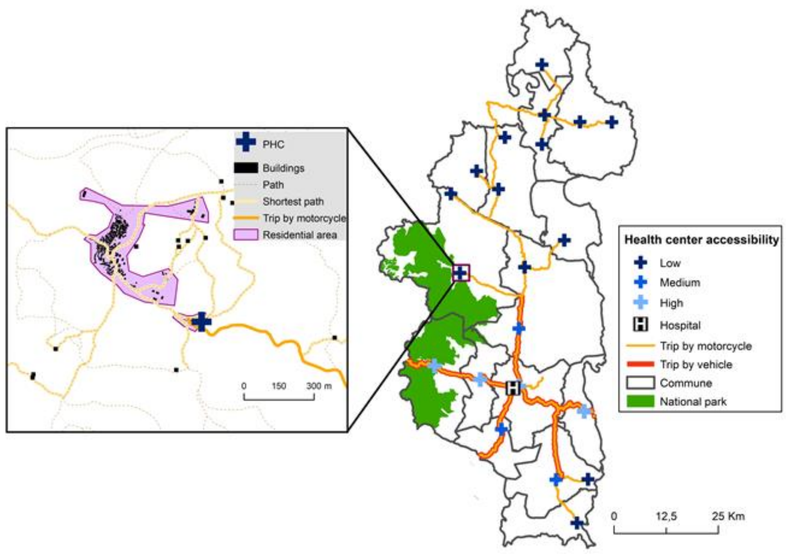


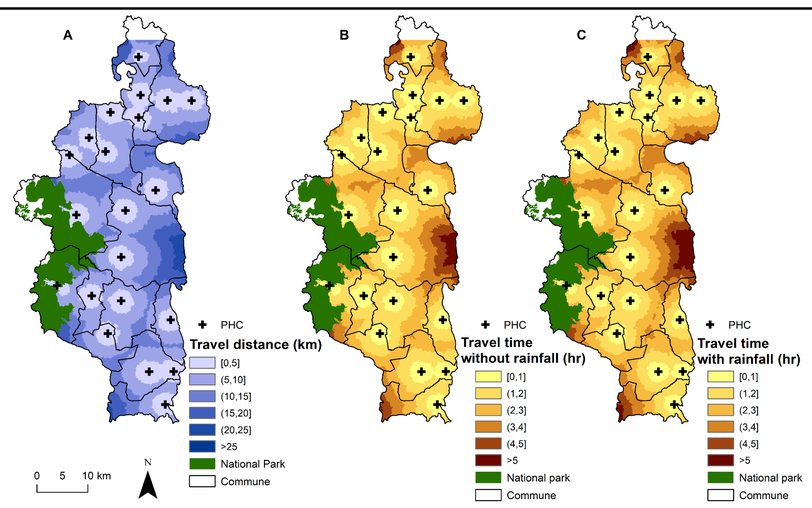
Estimation of travel distance and travel time at each level of care

Data finally available on OSM after our mapping:

- Over 22,000 km of footpaths
- Nearly 5000 residential areas
- Nearly 150,000 buildings
- Hundreds of village names and health facilities

Once mapping of all buildings and footpaths was finalized, we used the Open Source Routing Machine (OSRM) software (http://project-osrm.org/) to calculate the distance of the shortest path between each building and the closest health facility. Then, we used statistical models of travel speed calibrated with field data to predict **travel time from each of the 146,000 buildings to the closest facility at each level of care.**





Geographic distribution of shortest travel distance and time from households to reach the closest health center. Similar estimations were produced for each level of care: community health sites, health centers and hospital.

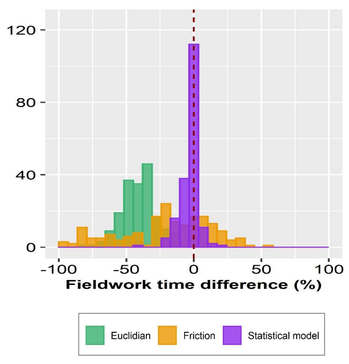
Maps are taken from the paper : Ihantamalala, F.A., Herbreteau, V., Révillion, C., Randriamihaja, M., Commins, J., Andréambeloson, T., Rafenoarimalala, F. H., Randrianambinina, A., Cordier, L. F., Bonds, M. H., & Garchitorena, A. Improving geographical accessibility modeling for operational use by local health actors. Int J Health Geogr 19, 27 (2020). https://doi.org/10.1186/s12942-020-00220-6).

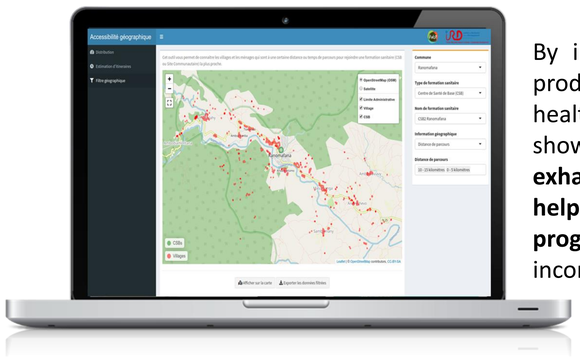
Results

Very low geographic accessibility to health care in our setting:

- Over three quarters of the population lived more than one hour away from a health center. We identified areas in the North and East of the district where the nearest health center was further than 5 h away.
- 10–15% lived more than 1h away from a community health site.
- Only about 10% of the population lived less than 2 hours from the district hospital, and more than half lived over 4 hours away, with variable access depending on climatic conditions.

Using OSM data mapped and locally calibrated models significantly improved the accuracy of estimates, as compared with other techniques commonly used in multi-country studies of geographic accessibility to care (right)

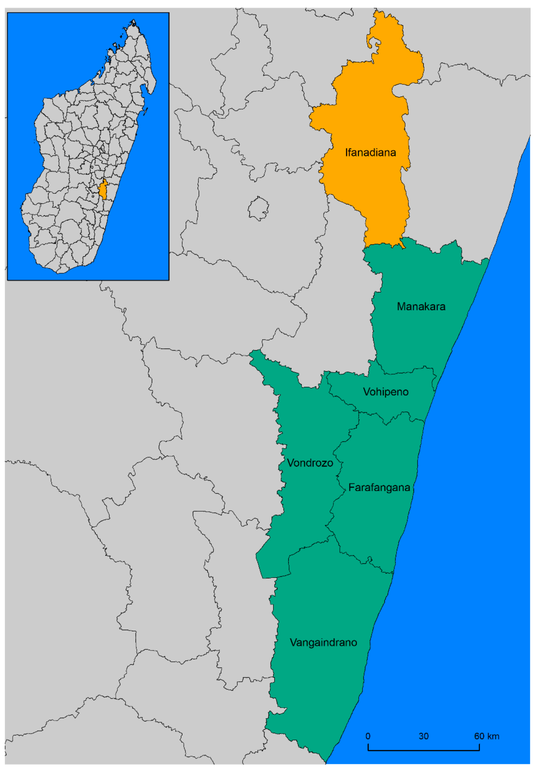


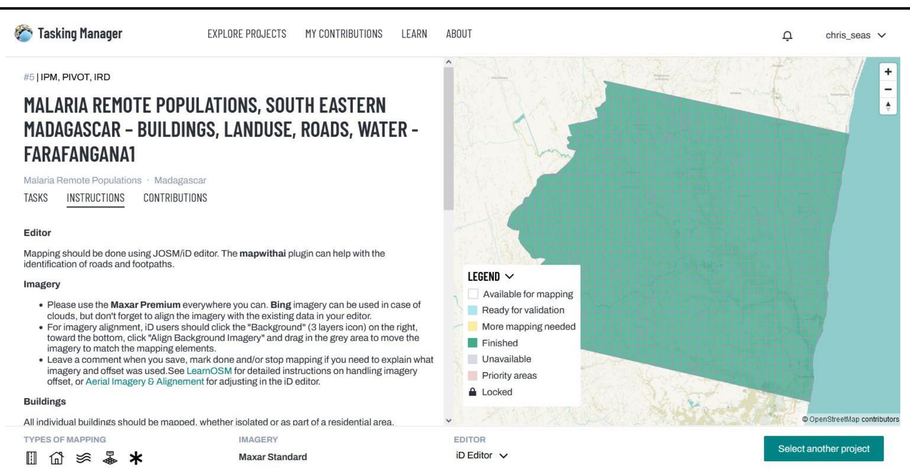


By integrating key information produced in our project into e-health tools (left), we have also shown how **conducting exhaustive OSM mapping can help to improve local health programs** in rural areas of low income countries.

Scale-up and perspectives

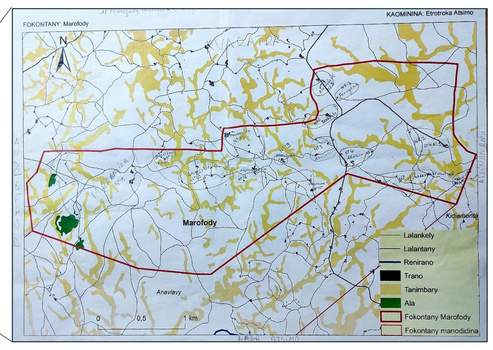
Based on this first experience, PIVOT and IRD are collaborating with IPM to scale-up the project to **5 additional districts in South Eastern Madagascar** to help fight malaria, with financial support from USAID-PMI.





In this new project, we are piloting new activities to improve over the previous one:

1. We have adapted open source code for the HOT Tasking Manager to create our own and increase the control we have over the mapping process at a lower cost
2. We are conducting participatory mapping sessions on the field with local community health workers to obtain the name of all villages in the districts we have mapped.



OpenStreetMap State Of The Map, Firenze, August 19 – 21, 2022 Thanks to : HOT

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