

Community Mapping Supports Comprehensive Urban Flood Modeling for Flood Risk Management in a Data-Scarce Environment



Louise Petersson^{1*}, Marie-Claire ten Veldhuis², Govert Verhoeven³,
Zoran Kapelan², Innocent Maholi⁴ and Hessel C. Winsemius^{2,3}

¹ Independent consultant, the World Bank

² Department of Water Management, Delft University of Technology, Delft, Netherlands

³ Inland Water Systems Unit, Deltares Research Institute, Delft, Netherlands

⁴ Humanitarian OpenStreetMap Team, Dar es Salaam, Tanzania

ORIGINAL RESEARCH ARTICLE

Front. Earth Sci., 21 July 2020

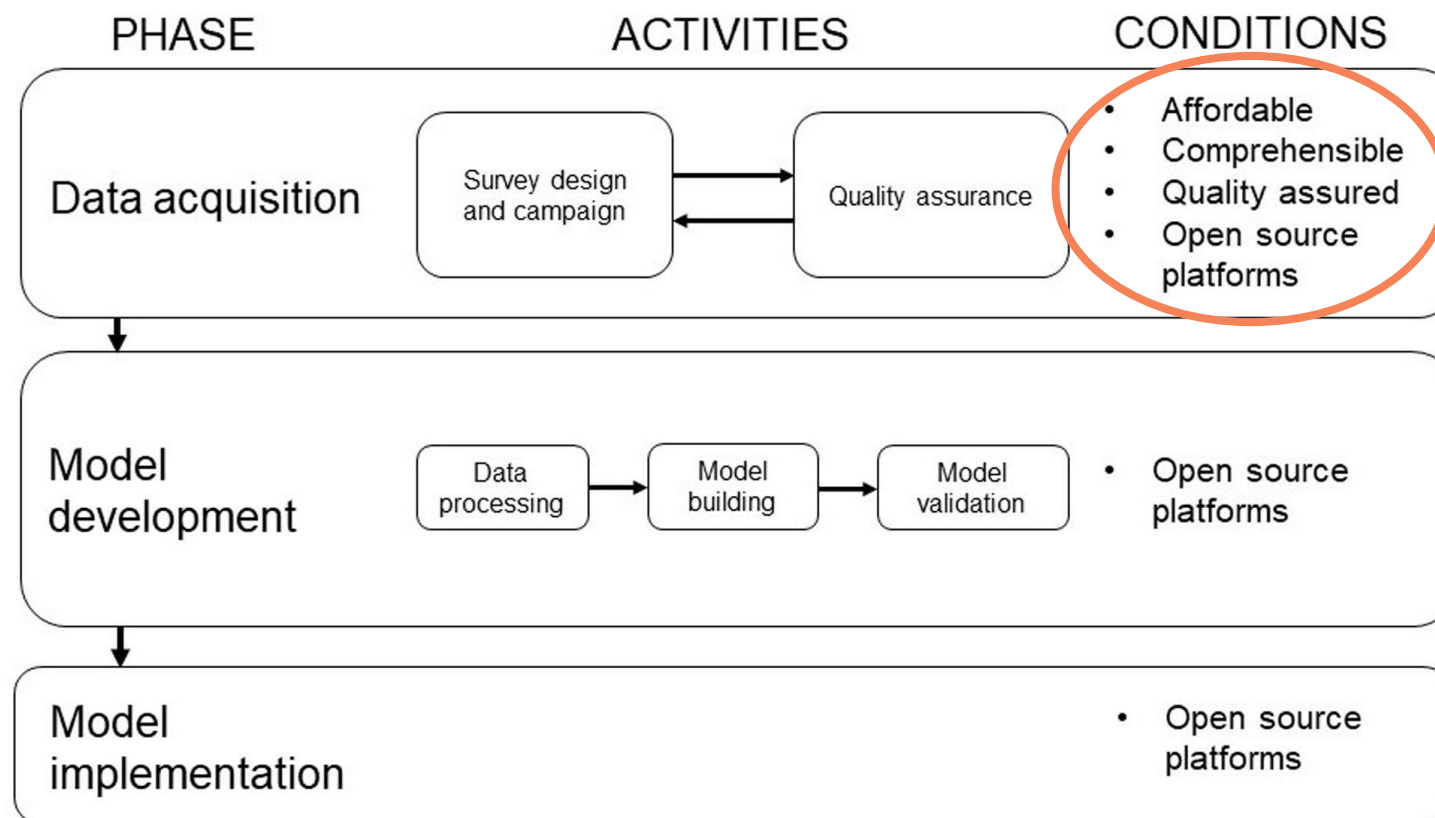
<https://doi.org/10.3389/feart.2020.00304>



Framework

A framework for flood modeling with community mapped data

- Generic
- Flexible



THE WORLD BANK



Humanitarian
OpenStreetMap
Team

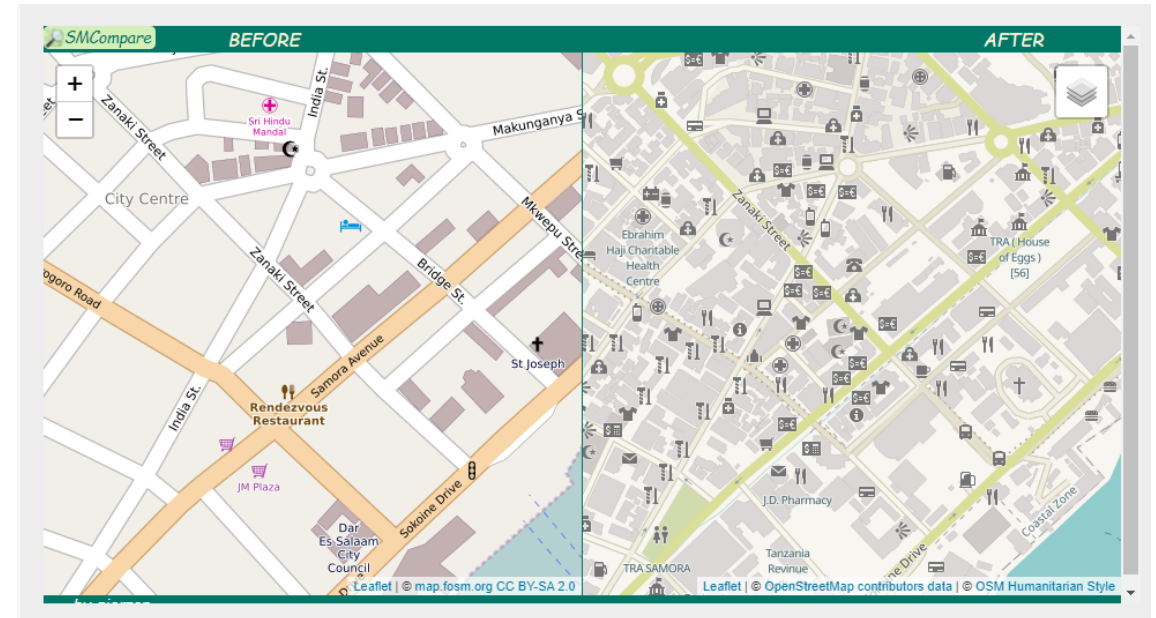


Case study

- Ramani Huria community mapping project, Dar es Salaam, Tanzania, 2017-2020
- More than 1400 students from 4 Tanzanian universities trained in digital skills



Before and after Ramani Huria



www.ramanihuria.org



THE WORLD BANK

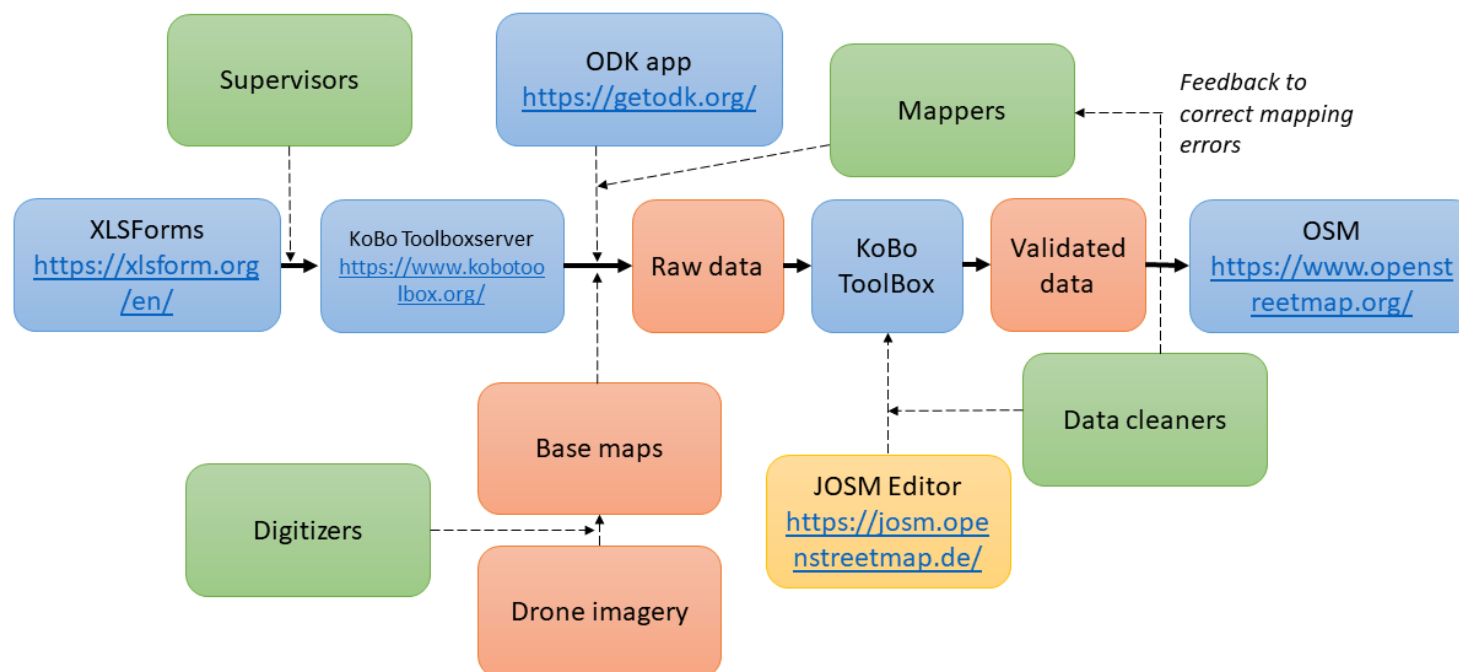
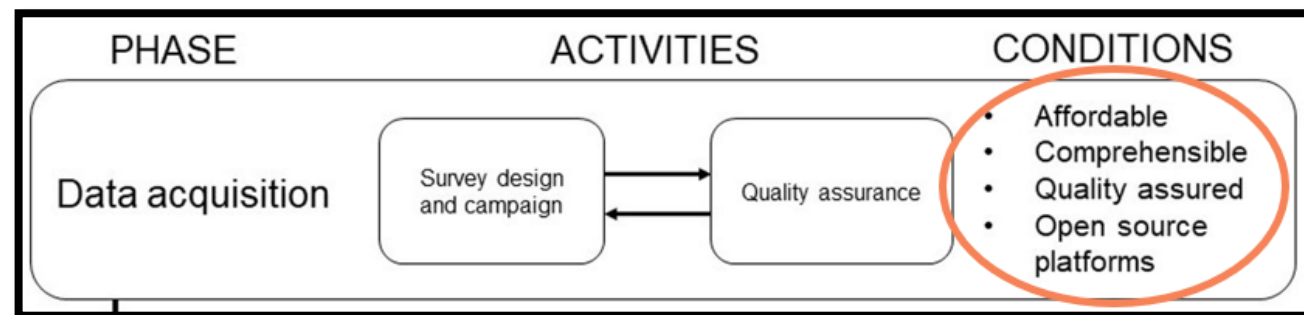


Humanitarian
OpenStreetMap
Team



Data acquisition

Ramani Huria's data acquisition methods



Data acquisition

Drainage data:

Reach, dimensions, bed level, material



Photo: Chris Morgan, the World Bank

All attributes recorded in the ODK collect application

Validation data:

Flood extent survey after flood event (44 data points)



Photo: Chris Morgan, the World Bank

“How deep was the water on the street outside of your house this morning?” (3 March 2019)



THE WORLD BANK

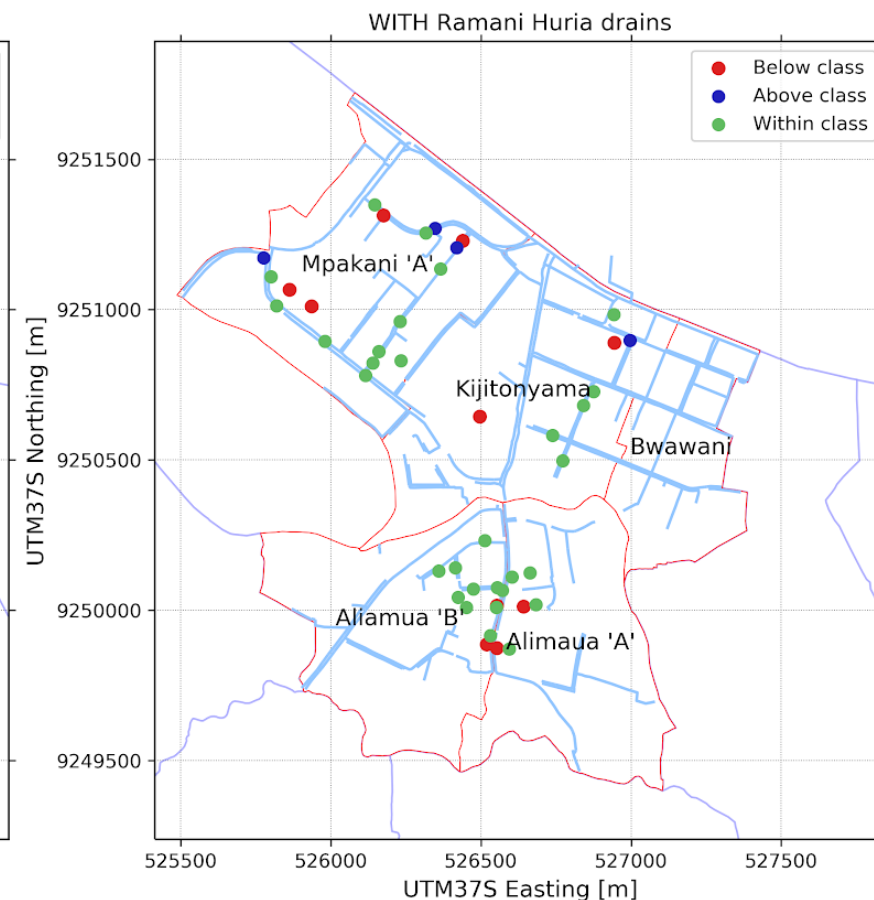
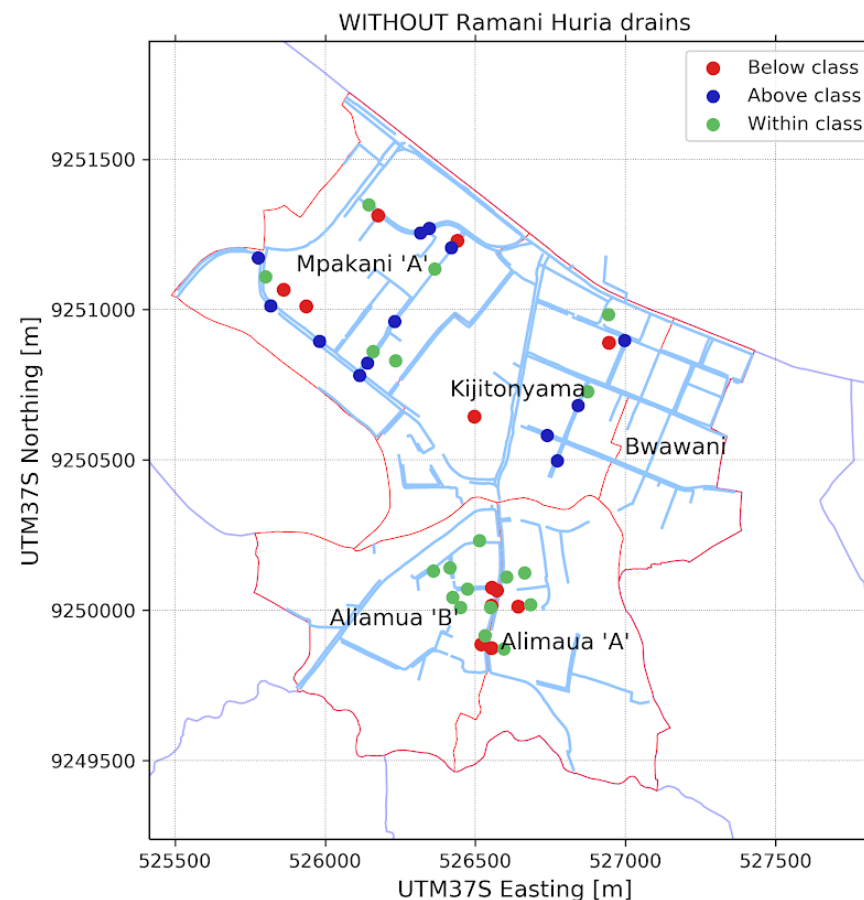


Humanitarian
OpenStreetMap
Team



Results (model validation)

	Without Ramani Huria Drains	With Ramani Huria Drains
Below reported class	12 (27%)	10 (23%)
In reported class	19 (43%)	30 (68%)
Above reported class	13 (30%)	4 (9%)



Conclusion

- Community mapping can improve flood modeling on a level of detail that is currently inaccessible in many data-scarce environments
- Smartphones, open platforms and extensive quality assurance allows for accurate data sets



Photo: Chris Morgan, the World Bank



THE WORLD BANK

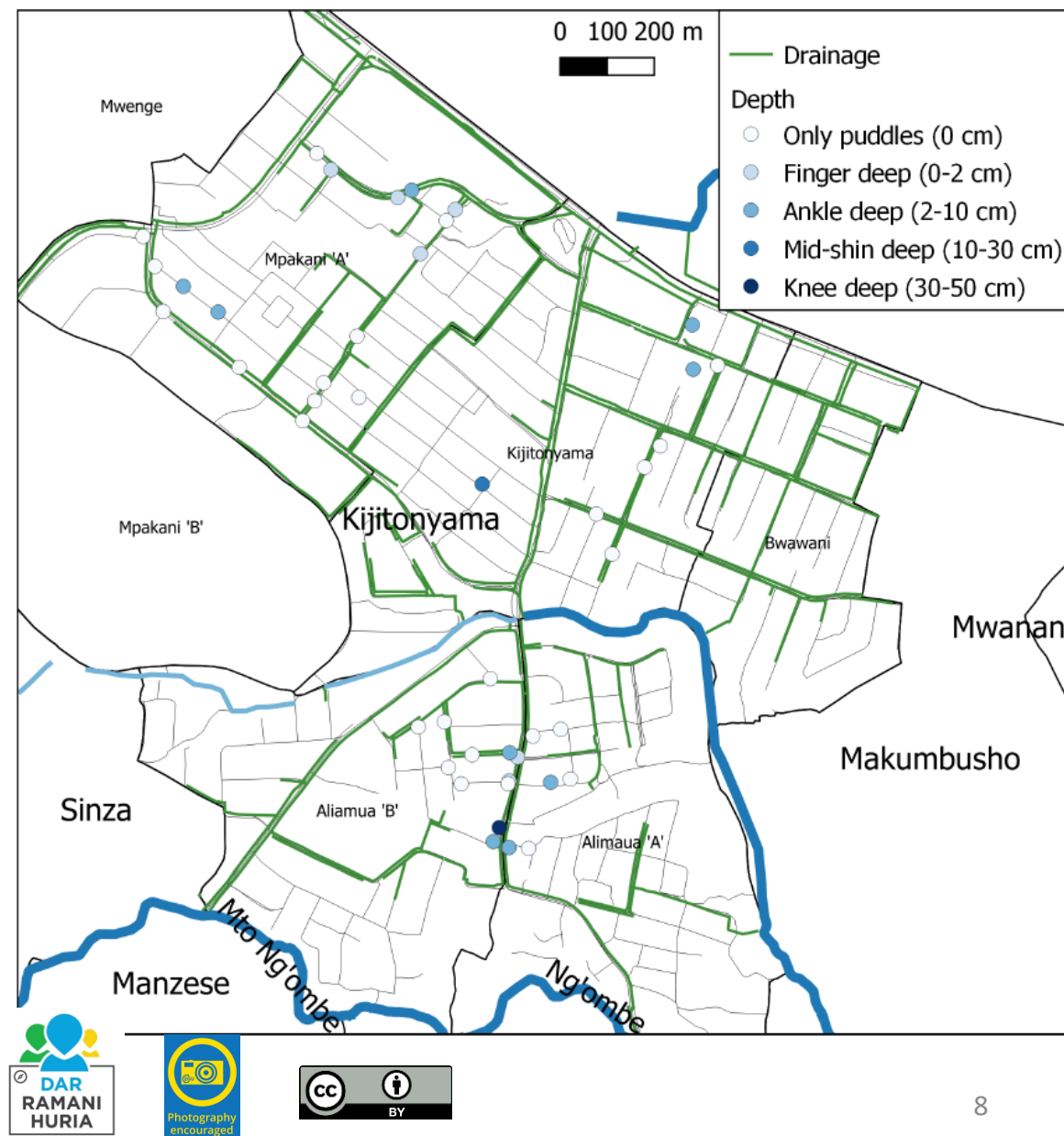


Humanitarian
OpenStreetMap
Team



Model development

- Coupled 1D-2D model of Kijitonyama ward in Dar es Salaam
- Ramani Huria drainage data as 1D schematization
- Rainfall data from nearby weather station (event on 3 March 2019)

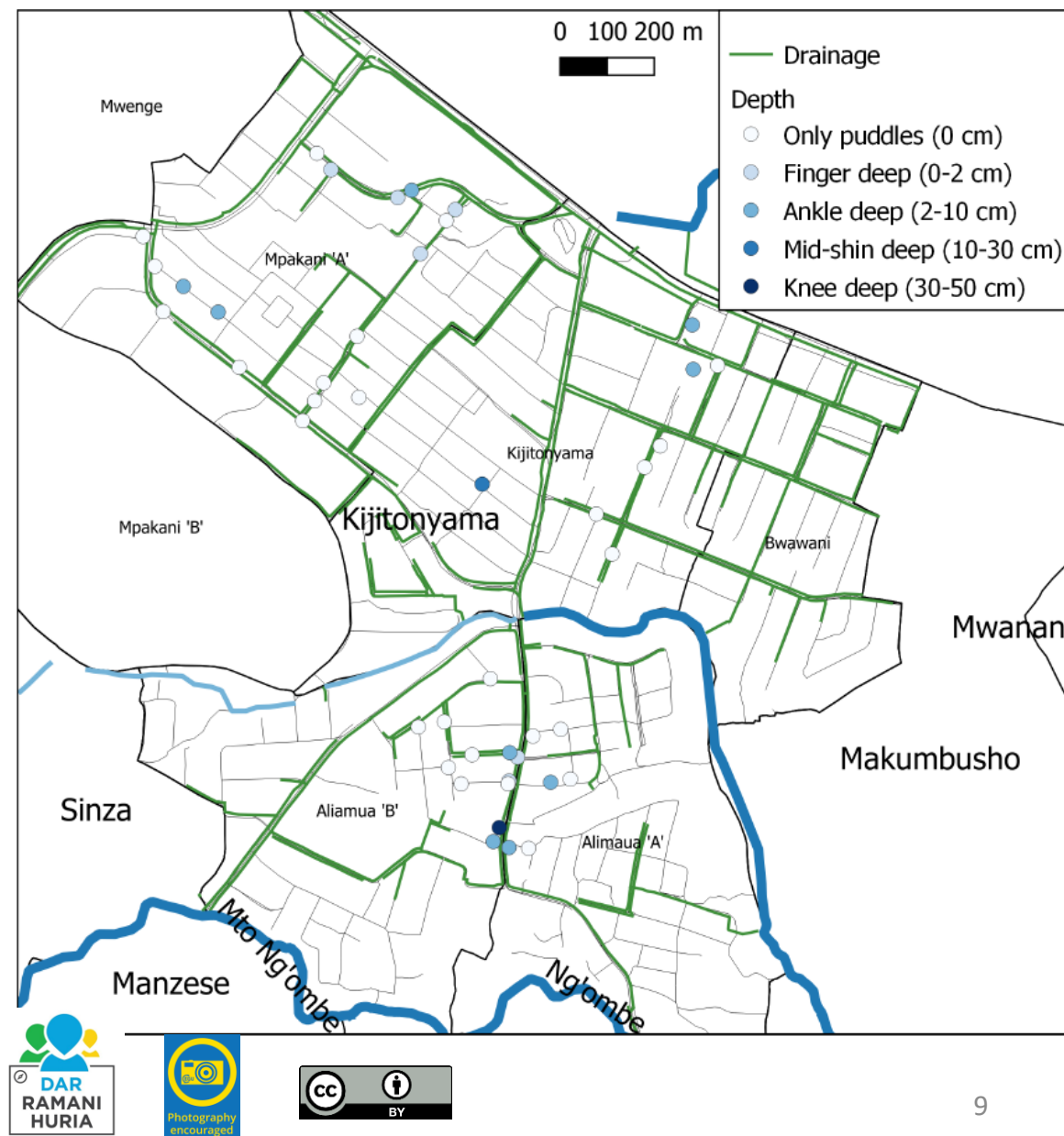


Model validation

- The flood marks were lumped into a few classes that could not be verified against actual records in this study.

Reported depth	Water depth in cm
Only puddles and finger depth	0 - 5
Ankle depth	5 - 20
Mid-shin and knee depth	>20

- An improved method on how to collect flood marks through community mapping is found here: [Flood Extent Depth Measurement - Google Docs](#)



Community mapping in Tanzania

Ramani Huria community mapping project:

www.ramanihuria.org

OpenMap Development Tanzania, a local mapping service provider spin off from Ramani Huria: [omdtz – OpenMap Development Tanzania](http://omdtz.org)

Resilience Academy, a partnership between 4 Tanzanian universities training students in digital skills: [Home - Resilience Academy](http://resilienceacademy.org)



THE WORLD BANK



Humanitarian
OpenStreetMap
Team



Photo: Chris Morgan, the World Bank

Community mapping in Tanzania

Blog posts about research performed within the Resilience Academy: [Resilience Academy – Medium](#)

Database with collected data sets: [Climate Risk Database! - geonode.resilienceacademy.ac.tz](#)

Tanzania Urban Resilience Program: [Tanzania Urban Resilience Program \(TURP\) \(worldbank.org\)](#)



Ramani Huria's mapping methods

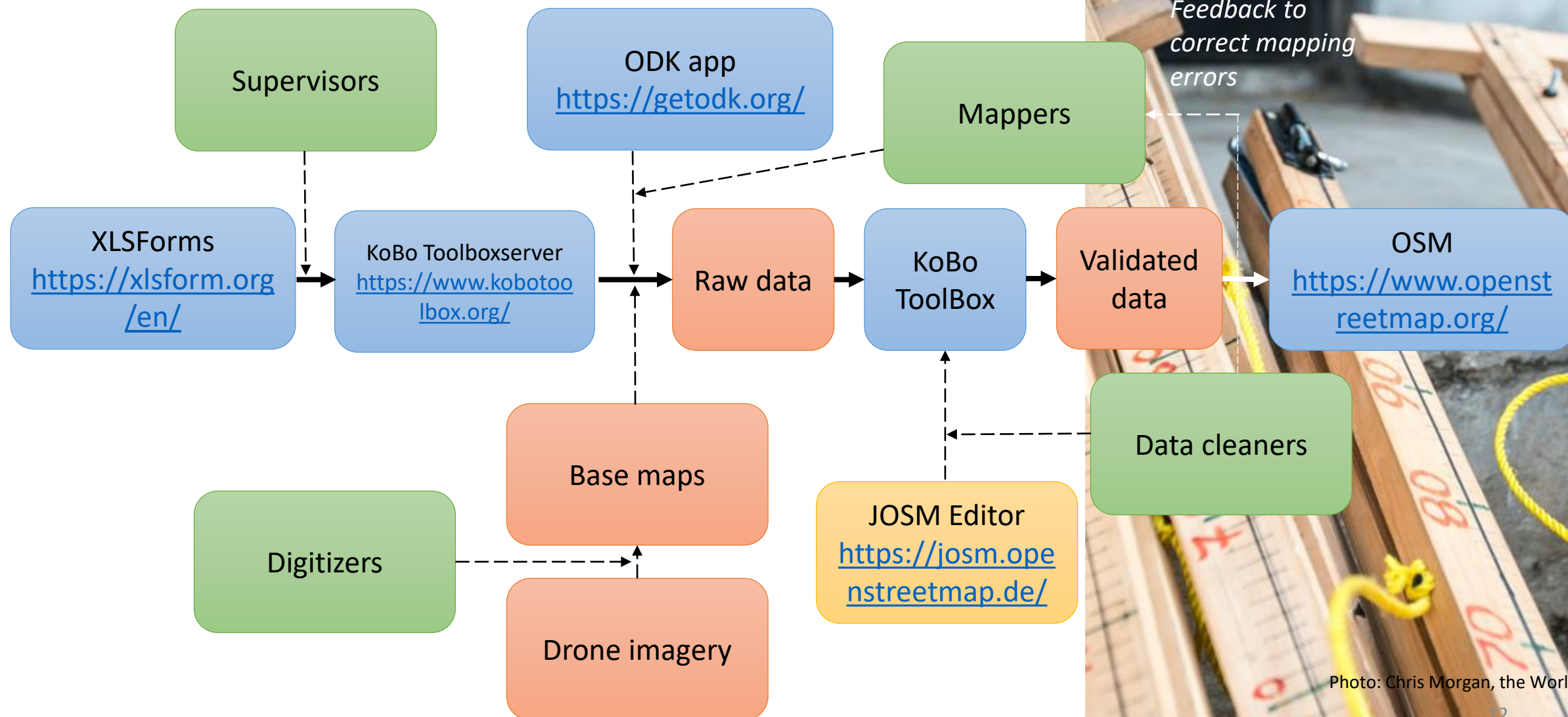


Photo: Chris Morgan, the World Bank

References

- Butler, D., Digman, C. J., Makropoulos, C., and Davies, J. W. (2018). *Urban Drainage*. Boca Raton, FL: CRC Press.
- Deletic, A., Dotto, C. B., McCarthy, D. T., Kleidorfer, M., Freni, G., Mannina, G., et al. (2012). Assessing uncertainties in urban drainage models. *Phys. Chem. Earth Parts ABC* 42, 3–10. doi: 10.1016/j.pce.2011.04.007
- Etter, S., Strobl, B., Seibert, J., and Meerveld, I. V. (2019). Value of crowd-based water level class observations for hydrological model calibration. *Water Resour. Res.* 56:e2019WR026108.
- Goodchild, M. F. (2007). Citizens as sensors: the world of volunteered geography. *GeoJournal* 69, 211–221. doi: 10.1007/s10708-007-9111-y
- Iliffe, M. P. (2017). *The Praxis of Community Mapping in Developing Countries*. Doctoral dissertation, University of Nottingham, Nottingham.
- Parker, B. (2006). Constructing community through maps? Power and praxis in community mapping. *Prof. Geogr.* 58, 470–484. doi: 10.1111/j.1467-9272.2006.00583.x
- Strobl, B., Etter, S., Meerveld, I. V., and Seibert, J. (2019). Accuracy of crowdsourced streamflow and stream level class estimates. *Hydrol. Sci. J.* 65, 823–841. doi: 10.1080/02626667.2019.1578966