Where to Build-Back-Better? Analyzing changing risk for post-disaster reconstruction planning

Cees J. Van Westen*

Faculty of Geo-Information and Earth Observation (ITC)
University of Twente, Enschede, The Netherlands
*E-mail: c.j.vanwesten@utwente.nl

Keywords: risk assessment; multi-hazards; post-disaster; reconstruction planning; hazard modelling.

Abstract

Large scale disasters (e.g. earthquakes, tropical cyclones, and wildfires) cause wide-spread losses to buildings, damaging transportation, educational, health, industry, and agricultural infrastructure, leading to direct and indirect social and economic losses (EM_DAT,2018) . After years with large losses by earthquakes (e.g. 2008 China, 2010 Haiti, 2015 Nepal) 2017 was characterized by hurricanes and wildfires, causing a loss of 300 billion Euro (MunichRe, 2018). These events also have a large impact on the natural environment, and critically change the conditions related to vegetation, active processes and hydrology leading to new hazards or increased intensity and frequency of existing hazards (Figure 1). This aspect is often not fully considered in post-disaster reconstruction planning, leading to unfortunate new impacts and losses, and to what could be called "re-reconstruction planning". Land-use planning is a critical action for Priority 4 of the Sendai framework "Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction" (UNISDR, 2015).

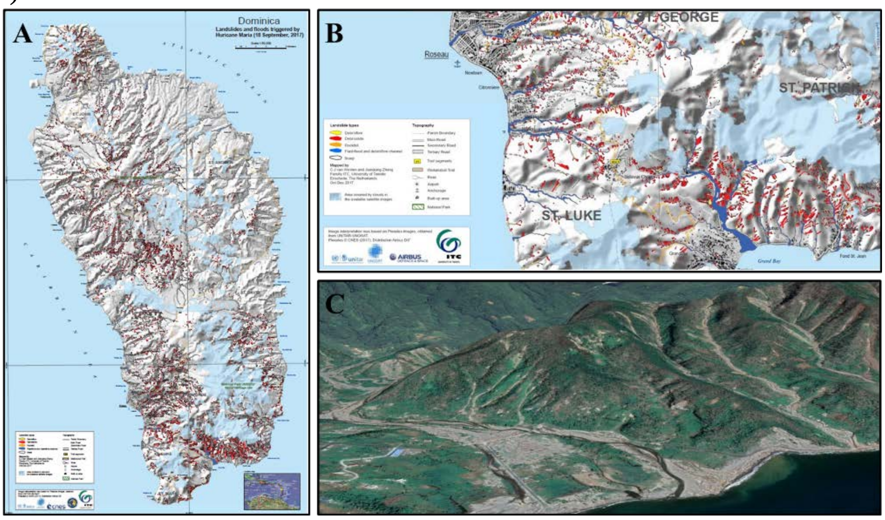

Figure 1 : Example of environmental impact of Hurricane Maria on the island of Dominica. A: Inventory of floods, debris flows and landslides triggered by the event; B: Enlargement of the southern part; C: Post Maria satellite image (Source: Van Westen and Zhang, 2018).

Many activities related to the application of geospatial data in Disaster Management focus on the response phase, where activities such as search & rescue, rapid damage and needs assessments, and the provision of first aid are conducted, followed by the opening and management of temporary shelters. This is followed by the recovery phase, which includes both rehabilitation and reconstruction, as well as full functional recovery (UNISDR, 2017) (Figure 2). Depending on the scale of the disaster, but also the resilience of the affected society and involved institutions, recovery takes different trajectories. Those can range from a more rapid or a slower recovery to pre-event levels, partial recovery, or a slow abandoning of the disaster area, none of which are desirable outcomes. Recovery might also be affected by multiple/successive event in the affected area. The occurrence of a disaster event changes the conditions and makes the area more susceptible to other hazards or similar hazards may affect the same area during the recovery phase (Figure 2). The combination of these factors can be analyzed and quantified (Zobel and Khansa, 2014). Reconstruction to pre-event levels is typically seen as positive recovery. Instead recovery, and in particular reconstruction, should be aligned with the principles of sustainable development and "build back better", to avoid or reduce future disaster risk, i.e. with a clear aim of improving on a situation where risk evidently materialized into a disaster. Therefore, it should be carried out on the basis of a more precise assessment of damage and an assessment of the changes in hazard and risk (Van Westen and Greiving, 2017) . Risk is commonly considered to be a relatively static property, which only changes with gradual natural or anthropogenic processes (e.g. sea level rise or deforestation), urban growth, or better awareness and preparedness of exposed people. However, post-disaster settings have been proven to be more complex and dynamic.

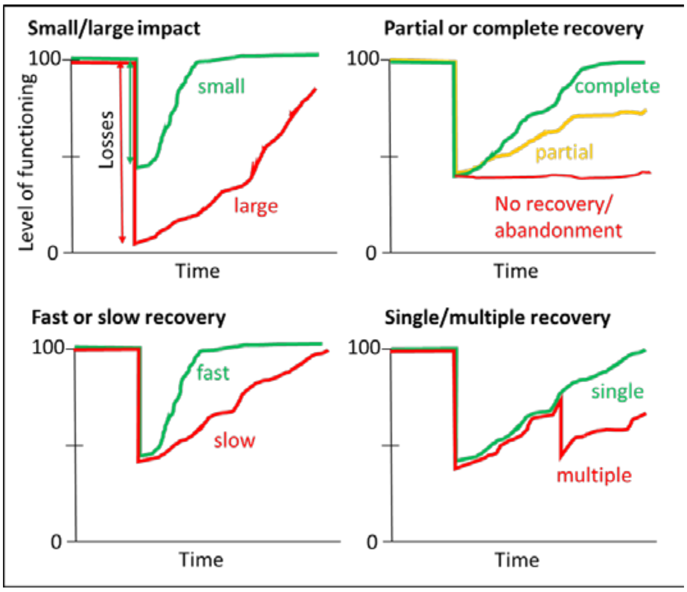

Figure 2 : Schematic representation of recovery and reconstruction.

Large scale disasters have a major effect on the environment, changing the landscape, landforms, active processes, and vegetation in such a manner that new types of hazards may occur in locations where they did not happen before, or the frequency and intensity of existing hazards might increase substantially. Examples are given in Table 1. In addition, the very rebuilding process leads to much more rapid and dynamic changes than is normally the case, necessitating methods for more dynamic risk assessment.

Table 1: Examples of post-disaster changes in hazard and risk

Disaster	Post-disaster problem description
Wildfires	Wildfires in Mediterranean or California, leading to more flooding and debris flows
Climate change	Permafrost decline in high altitude/latitude areas, leading to more slope stability
Earthquakes	Earthquake-induced landslides and floods in mountainous areas (e.g.Nepal, Sichuan)
Hurricanes	Hurricanes causing floods, landslides and debrisflows in hilly terrain.
Urban floods	Climate change and urbanization causing increased flood and landslide risk in cities

Access to accurate and up-to-date information is one of the key challenges in post-disaster reconstruction planning. In order to address post-disaster changes in hazards, combined with the post-disaster changes in the built-up environment, a wide range of new geospatial data is required to portray the new topography, vegetation, and human environment and to monitor the changes that take place . Today there is a myriad of data sources that can support post-disaster rebuilding in the broad sense, from homes to the social structure of a community. However, the large available data volumes pose new challenges in the processing of these data. Recently cloud based platforms have been developed, like Google Earth Engine, that allow more analysis and data integration.

There are many developments in the field of advanced geospatial methods for monitoring complex environmental parameters. These data may come from optical and radar satellite data, especially the Sentinel missions but also dedicated LiDAR and UAVs surveys, as well as crowdsourcing initiatives. This requires qualified scientists to design the specific data collection methods for the individual tools, but even more so expertise on how information from different tools can be integrated and how these can provide information on how the individual risk components (hazard, exposure, vulnerability) have changed. Data needs to become information at the right level. Detailed geospatial data might be needed for earth scientist to re-analyze the hazards in a disaster affected area, which in turn forms input data for local governments and non-governmental organization in the reconstruction planning process. The integration of the technologies requires a dedicated spatial decision support tool (Figure 3).

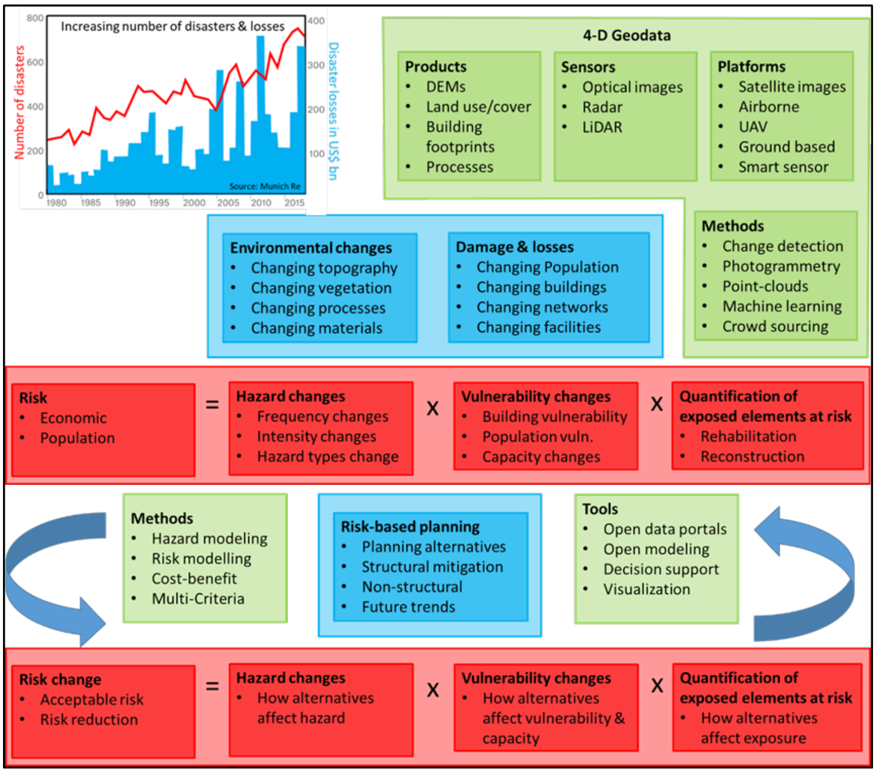

Figure 3 : Pictorial representation of the WhereBBB framework of the evaluation of environmental change scenarios in post-disaster risk management

References

EM-DAT (2018)(EM-DAT,2018): The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium.

MunichRe (2018). https://www.munichre.com/topics-online/en/2018/01/2017-year-in-figures

UNISDR (2015) Sendai Framework for Disaster Risk Reduction. http://www.unisdr.org/we/coordinate/sendai-framework

UNISDR (2017), Words into Action guidelines: Build back better in recovery, rehabilitation and reconstruction https://www.unisdr.org/we/inform/publications/53213

van Westen, C.J. and Greiving, S. (2017) Environmental Hazards Methodologies for Risk Assessment and Management. In: Environmental hazards Methodologies for Risk Assessment and Management / ed. by . N.R. Dalezios. London: International Water Institute (IWA) publishing

Van Westen, C.J. and Zhang, J. (2018). Tropical Cyclone Maria. Inventory of landslides and flooded areas. Product ID: 2762. UNITAR-UNOSAT. https://unitar.org/unosat/node/44/2762

Zobel, C.W. and Khansa, L. (2014) Characterizing multi-event disaster resilience. https://doi.org/10.1016/j.cor.2011.09.024