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Hydro-meteorological hazard analysis for new settlements framed in the Colombian peace process

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Colombia is a country with a recent history of an armed conflict from 1960. In 2012, a negotiation process started between the Colombian National Government and the largest left-wing guerrilla group (FARC - Fuerzas Armadas Revolucionarias de Colombia in Spanish). Finally, in 2016 a final peace agreement was signed, where several compromises were taken by both sides. For starting, one of the most important element of the agreement was to define concentration areas into the Colombia territory, where the entire FARC members should be located transitory, and posteriorly those areas must change to permanent settlements following the current regulation related to land use planning in Colombia. This study shows the hazard, vulnerability and risk assessment for 5 concentration areas, which were prioritized, of 24 total areas established. The multi-hazard assessment was analysed from a regional (10-m resolution) and detailed (0.5-m resolution) approach.

For the regional approach, landslide susceptibility was assessed through analytic hierarchy process and weight of evidence methodologies compared to logistic regression and landslide hazard was evaluated with SHALSTAB and Newmark's models for rainfall and seismic triggers. Floods hazard was analysed through a combined methodology using unit hydrograph and the morphometric descriptor HAND. Meanwhile, torrential flows hazard was analysed from a morphometric evaluation and sediment availability from SHALSTAB unstable areas joined with the flood methodology using sediment and water volumes to establish the corresponding area of impact.

For the detailed approach, through field samples and local geotechnical parameters and using TRIGRS and SCOOPS 3D models, the hazard evaluation was carried out for a deterministic result and using FOSM model results can be processed to obtain a probabilistic hazard map. Flood hazard was estimated using the bidimensional hydrodynamic model IBER and the discharge was enhanced simulating the sediment volumes from unstable areas to assess torrential flows hazard but also the mass flow simulation model r.avaflow was employed for a better simulation of the rheology of the flow using the same discharge rates.

This study shows the role of multi-hazard studies as a fundamental element in a peace process, to establish new settlements in the rural area according to the Colombian land-use planning

regulation, and under very complex and mountainous terrains conditions. One of the critical points in the short and long term for the sustainability of this peace process is to provide safe areas where FARC members may start a new life.

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