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Design of a low-cost Early Warning System (EWS) in informal settlements in Medellín, Colombia (Project Inform@Risk)

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Recent developments have led to an increased rural depopulation and migration into cities in Andean countries. This is especially the case in Colombia, where immigration from Venezuela has caused an increase in poverty in cities. In Medellín, the second largest Colombian city, this led to an accelerated growth of informal settlements in the steep slopes in the east and west of the city. Combined with the expected increase of heavy rainfall due to climate change, the landslide risk in this area is expected to increase further over the next decades. The risk is highest in the east of the city, where highly weathered dunites are exposed and the slope angle reaches 20-30° and more. In these regions, rotational slides have repeatedly occurred in the past, as detailed mapping has shown.

The project Inform@Risk tries to strengthen the resilience of these settlements against rainfall induced landslides, since relocation of the inhabitants at risk currently is not a feasible option. For this, an innovative low-cost EWS is being developed in the Barrio Bello Oriente in the east of the city. Since the exact location of a future landslide is unknown, the EWS requires a network of geosensors throughout the whole area at risk, whereby the network density is controlled by the landslide risk. This flexibility is achieved by combining horizontally installed CSM (Continuous Shear Monitor) cables with open-source wireless LoRa sensor nodes. The sensor nodes are developed on basis of an Arduino system and can be installed on infrastructure as well as in the ground. They all include a tilt sensor and additionally can be equipped with varying geotechnical and hydrogeological sensors, depending on the location and measuring target (e.g. piezometer, extensometer, inclinometer/tiltmeter).

The data produced by the geosensor network is processed by the Inform@Risk server and made available to the residents and municipal stake holders via an app and homepage. Based on meteorological, hydrological and geotechnical analyses the system can evaluate the current and make predictions of the future hazard situation. If necessary, a warning can be issued via app to the inhabitants. Ultimately, the system should be replicable in other areas in the Andes and elsewhere in the world.

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