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INVESTIGATION OF GROUND DEFORMATION USING INSAR AND GNSS. A CASE STUDY OF BUDUDA DISTRICT, UGANDA.

BY

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Abstract

The measurement of ground deformation has become a very critical part of landslide hazard assessment because before a landslide happens, ground deformation precedes which when reliably measured, early warning is possible. This leads to timely resettlement of communities which significantly reduces the loss of lives and property due to landslides. However, currently, the measurement and assessment of ground deformation has not considered the whole deformation process, which begins with the favourable casual factors, that progressively lead to accumulation of ground strain, and finally to ground deformation. This is done through measurement of the causal factors, determining their influence on ground deformation and computing ground strain from ground deformation. This was accomplished through a quantitative approach that involved measurement of ground deformation using InSAR and GNSS techniques, computation of ground strain using the least-squares collocation method based on a covariance function and deformation tensor analysis of GNSS derived deformation velocities, and modelling the relationship between casual factors and ground deformation using multivariant linear regression modelling.

Results indicate that deformation magnitudes and velocities in Bududa ranged from -3 to 6 cm and -1 to 4 cm/yr in the LOS direction as measured by InSAR. GNSS showed Bududa to experience horizontal and vertical deformation magnitudes from 0.4 to 7 cm and -10 to 2.5 cm and velocities from 0.1 to 2.3 cm/yr and -4 to 1 cm/yr. The average ground strain in the north, east and vertical direction was 7.11×10^{-5}, 8.52×10^{-5} and 5.17×10^{-5} microstrain/yr respectively. The soils had average silt, clay and sand contents of 20%, 34% and 46% respectively and average infiltration, field capacity, saturation and bulk density of 0.397 cm/hr, 0.292 cm^3water/cm^3soil, 0.490 cm^3water/cm^3soil, and 1.349 g/cm^3 at the GNSS stations. Soil texture, slope, rainfall and soil moisture were observed to significantly influence ground deformation in Bududa.

Ground deformation magnitudes and velocities in Bududa district are high depicting the riskof landslides to the communities. Campaign GNSS has the potential of reliably measuring ground deformation in landslide susceptible areas and soil texture, slope, rainfall and soil moisture can be used to predict ground deformation. Additionally, knowledge of ground deformation can be used in the resettlement of communities at risk in Bududa. It is further encouraged to make more GNSS observations on the established stations, make direct measurement of ground strain and model the relationship between casual factors and ground deformation using Artificial Neural Networks.