Adapting the Sudden Landslide Identification Product (SLIP) and Detecting Real-Time Increased Precipitation (DRIP) algorithms to map and predict rainfall-triggered landslides in the West-Cameroons' highlands (Central-Africa)

CURRENT STATUS: UNDER REVIEW

Geoenvironmental Disasters Springer

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DOI:

10.21203/rs.3.rs-19292/v1

SUBJECT AREAS

Geology Ecological Modeling

KEYWORDS

SLIP, DRIP, Landsat 8, geohazard, West-Cameroons' Highlands, rainfall-triggered Landslides, LHZ, prediction model

Abstract

Background – The SLIP and DRIP algorithms recently developed correlate Landsat 8 images and local daily precipitation records to map and time rainfall-triggered landslides. In many areas recently affected by that geohazard in west-Cameroon's highlands, only the dry season images are available, while rainfall data are recorded on a monthly scale. **Methods** – The SLIP algorithm is modified, integrating the inverse NDVI to assess the soil exposure, the Modified Normalized Multi-band Drought Index (MNMDI) combined with the hydrothermal index to assess soil moisture, and the slopes in degrees. They are converted into binned layers and overlaid to map the recent landslide. The DRIP algorithm is also modified, using the monthly rainfall rescaled to a daily window and the days of rainfall per month. Their probability density function (PDF) curves are superimposed and their intersection are used to propose set dichotomous variables before and after the 28 October 2019 landslide event, for a prediction model. **Results** – The Landslide Hazard Zonation (LHZ) map of latest landslides is effective at 100% , while the overall accuracy is 77.8% when integrating the control point around the disaster area. Moreover, for 1948-2018 individual thresholds of , and 2019 threshold of between June and October, the risk of rainfall-triggered landslide is 95% , while the 'no-landslide' probabilities are between 98.95% and 99.99% . **Conclusions** – Based on the SLIP and DRIP algorithms, the proposed methodology offers a new alternative in case of voids and gaps between data. Improvements and comparisons with others models are in perspective. **Keywords** – SLIP, DRIP, Landsat 8, geohazard, West-Cameroons' Highlands, rainfall-triggered Landslides, LHZ, prediction model.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

Figures

Figure 1

A) Country elevation and landslides events. B) & C) – Subset of study elevation and Landsat OLI-TIRS image. D) 3-dimensional appraisal of the subset elevation.

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Figure 2

Scarps leaved by the landslides of Foumban (2018-A) and Bafoussam (2019-B). Both events were sudden with transitional to rotational movements, but the one in Foumban happened in one-step, while the one in Bafoussam happened during at least two steps (yellow dashed), justifying three main blocks/stairs.

Figure 2

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Figure 3

Subset of Landsat 8 images used for Land cover extent approximation

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Figure 4

Land Use Land Cover (LULC) - comparison for the classification and the NDVI

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Figure 5

Workflow of the SLIP process

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Workflow of the SLIP process

Figure 6

SLIP stretched and conditioned layers. A) INDVI stretched values; B) Barren land binned map; C) MNMDI + hydrothermal stretched map; D) Land moisture binned map; E-Slopes in degrees; F-Slopes binned map. Only remains the triggering factor identified as a long and huge rainfall condition. The DRIP algorithm helps assessing it.

Figure 6

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Figure 7

Monthly rainfall and rainy days sampled for three zones of the study area in 2019

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Figure 8

Percentages of monthly rainfall For June-October period

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Figure 9

Individual PDF curves and their intersections before (A) and in (B) 2019

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Individual PDF curves and their intersections before (A) and in (B) 2019

Figure 10

Workflow of the DRIP process

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Workflow of the DRIP process

Figure 11

LHZ mapping. A) The eight classes and codes. B) Class 2.25 versus the other classes. C1) to C3) Patterns and accuracy assessment in Bafoussam. D1) to D3) Patterns and accuracy assessment in Foumban

Figure 11

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Areas (A) and percentages (B) of LHZ per classes

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The standardized coefficients of the explanatory variables

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The standardized coefficients of the explanatory variables

Figure 15

The Receiver Operating Curve of the model

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