Flood Detection and Analysis: A Case Study of the Akosombo Dam Spillage Event 2023

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SUMMARY

This research assesses the inundation extent and impact of the Akosombo Dam spillage event from September to October 2023, utilizing advanced remote sensing techniques through the Google Earth Engine (GEE). The study aims to develop accurate flood maps using Sentinel-1 Synthetic Aperture Radar (SAR) data, assess the impact of flooding on agricultural lands and urban areas, and generate a flood hazard map. The study area covers regions downstream of the Akosombo Dam along the Volta River in southeastern Ghana, an area of critical socio-economic importance. Sentinel-1 SAR imagery was selected due to its ability to penetrate cloud cover and provide reliable observations during flood events. Additional geospatial datasets, including the European Space Agency (ESA) WorldCover maps and the Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM), were incorporated to enhance flood mapping accuracy and impact assessment.

The methodology involved metadata filtering, multi-temporal analysis, and post-processing procedures to ensure flood map accuracy. SAR images from multiple dates were compared to detect changes in surface water extent, with thresholding techniques used for flood classification. Preprocessing steps included speckle filtering to reduce noise and improve image clarity. Post-processing methods, such as slope masking, water masking, and connectivity analysis, further refined the flood extent detection. A flood hazard assessment was conducted using indices such as elevation, Topographic Position Index (TPI), proximity to water bodies, vegetation, and moisture indices to generate a comprehensive flood hazard score.

Flood extents were analyzed across multiple dates, with the largest inundation reaching 4,110 hectares by October 16. Croplands and urban areas experienced peak impacts of 753 hectares and 152 hectares, respectively. Over 31,000 people were displaced, with extensive damage to residential areas, infrastructure, and agricultural lands. The flood hazard mapping identified high-risk zones,

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underscoring the need for proactive mitigation measures.

The conclusions highlight the effectiveness of Sentinel-1 SAR and GEE for rapid and accurate flood mapping, providing essential insights for disaster response and risk management. The study underscores the limitations of existing flood management practices and emphasizes the necessity of integrating remote sensing technologies into early warning systems. The findings contribute to future flood risk assessments and disaster preparedness, offering valuable recommendations for policymakers, urban planners, and emergency response agencies to improve resilience against flood hazards.

This research demonstrates the significance of leveraging remote sensing and geospatial analysis for flood monitoring, ensuring better decision-making and resource allocation for future flood events. By providing timely and accurate flood assessments, this study supports sustainable disaster mitigation strategies, ultimately enhancing community resilience and infrastructure protection in flood-prone regions.