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Research Article

Low-Cost Solutions for Assessment of Flash Flood Impacts Using Sentinel-1/2 Data Fusion and Hydrologic/Hydraulic Modeling: Wadi El-Natrun Region, Egypt

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Flash floods are among the most common natural hazards in Egyptian and Arabian deserts. In this work, we utilized two Sentinel-1 and Sentinel-2 satellite images, before and after the flash flood, SRTM, and geolocated terrestrial photos captured by volunteers. This paper aims to three substantial objectives: (1) monitoring the flash flood impacts on Wadi El-Natrun region based on free satellite data and mapping the destroyed vegetation cover; (2) the integration of the free remote sensing data, geolocated terrestrial photos, and GIS techniques, along with hydrologic and hydraulic modeling, to evaluate the impact of flash flood hazards on the study area; and (3) assistance of the decision-makers in planning the required protective works to avoid the probable flooding. Two scenarios have been applied to estimate the flash flood effect. The first scenario has relied on Sentinel-1/2 data fusion before and after the flash flood, while the second scenario has been implemented based on the integration of the Sentinel-2 images and hydrologic and hydraulic flood modeling with the help of ArcGIS software to simulate the flash flood route. The results demonstrated that although the first scenario is an efficient solution for continuous monitoring of the change in the water bodies, it is limited in the detection of the submerged vegetation area. On the other hand, the second scenario provided the flash flood route and hydrological parameters, which determine the hazard degree of the basins, thus helping the decision-maker to manage the flood risk. Moreover, the second scenario surpasses the first one by estimating the destroyed infrastructure. Consequently, the second scenario is appropriate to assess the flash flood impacts and mitigate its influence in the future.

1. Introduction

Natural hazards are fundamentally regarded as the most critical challenges facing our world occurred either by rapid or slow onset events which can be geophysical (earthquakes, tsunamis, and volcanic activity) or hydrological (avalanches and floods) [1]. Among these natural hazards, the flash flood is counted the most frequent. One of the main challenges is to get a comprehensive view during the flood event with the accurate extent of the area flooded and then visualize the possible developments. Accordingly, this paper seeks to assess the impacts of the flash flood based on low-cost solution and thus assists the decision-makers [2].