BETTER SAFE THAN SORRY! FIRE AND FLOOD HAZARDS TO PV PARKS

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Overview

The ongoing climate change has undeniably influenced several sectors of the global economy, including Renewable Energy Sources (RES) projects (Xu et al., 2024). Mitigation measures should be implemented at the design phase, as prevention is the most cost-effective and safest method for the infrastructures. In this context, two natural disasters—wildfires and floods—are assessed in a hypothetical photovoltaic (PV) park located in Greece. Using the ArcGIS Pro software toolbox, the potential impact of these hazards can be visualized, and specific mitigation measures can be proposed to reduce the risk of natural disasters.

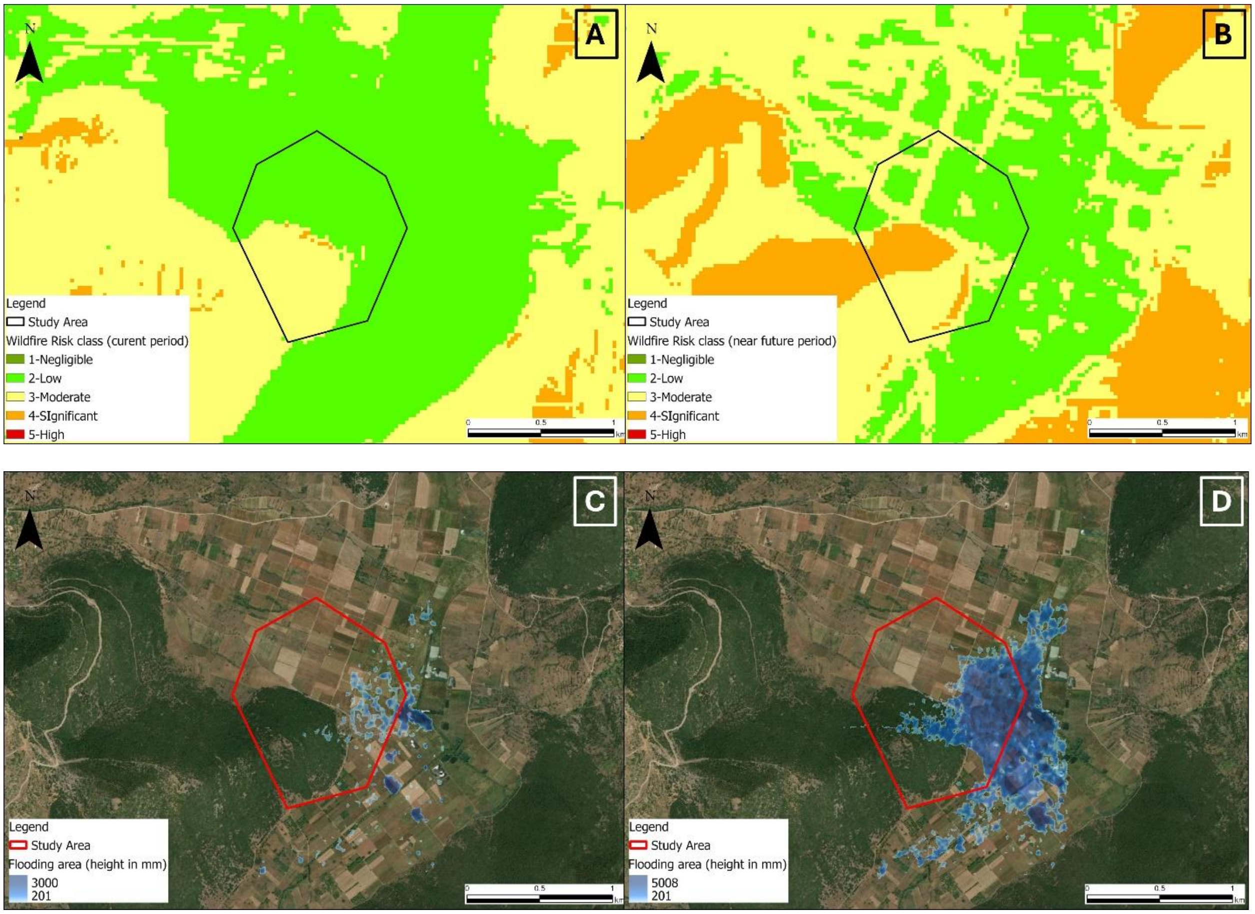
Methods

For the purpose of this research, a hypothetical PV park located in northern Peloponnese has been assessed under the scope of flooding and wildfire events. Using ArcGIS Pro software tools, these two natural disasters have been analyzed in detail. Regarding wildfire risk, Pallikarakis & Konstantopoulou (2024) utilized the multicriteria analysis capabilities of ArcGIS Pro to estimate the potential risk of wildfires in the region of Epirus. In this study, ten factors were considered for the assessment of fire risk, including geomorphological, social, environmental, and climatic factors. Through Multi-Criteria Decision Analysis (MCDA) and the Analytic Hierarchy Process (AHP), fire risk was assessed for both current and future conditions. The Wildfire Hazard Risk has been categorised into five classes, ranging from Negligible (lower scale-1) to High (highest scale-5). The same methodology has been applied to the area of northern Peloponnese to estimate the potential wildfire risk in the area where the hypothetical PV park is located. Regarding the flooding risk, the impact of heavy rainfall on the area of the hypothetical PV park has been analyzed using ArcGIS Pro software tools (Flood Simulation). This tool provides an efficient means to visualize potential flood scenarios for a study area. It also enables accurate flood risk assessment. For this analysis, data such as soil permeability, lithological formations, and rainfall height in the area have been utilized, based on international literature from sources like the Hellenic Survey of Geology and Mineral Exploration (HSGME) and Meteo.gr. For the precipitation height used in the model, two scenarios were considered: the first was based on the actual daily rainfall measured in 2024 at the nearby Ziria station (~85 mm, Meteo.gr) and the other one on an extreme event scenario, where the daily rainfall is equal to the estimated annual precipitation (~720 mm, EMY.gr). For comparison purposes, it is assumed that the rainfall duration in both scenarios is 12 hours.

Results

Based on the multicriteria analysis mentioned earlier, the study area is experiencing low to significant wildfire risk, as illustrated in Figure A below. The majority of the plot falls within an area characterized as Low risk (class 2) and Moderate risk (class 3), while a very small portion is classified as Significant risk (class 4). According to the methodology outlined by Pallikarakis & Konstantopoulou (2024), future risk can be predicted using online data provided by N.E.C.C.A. Consequently, the estimated wildfire risk for the near future period (2031-2060) has been analyzed and presented in Figure B below. Notably, the majority of the studied plot is now classified as Significant and Moderate risk, while half part of the plot is still characterized as Low risk.

Regarding the flood risk, the studied plot has been assessed if it will be affected in the event of a common and a severe rainfall, as shown in Figures A and B below. Notably, during a common rainfall event (85 mm), the flooded area is primarily located near the hydrological network of the area. The maximum height of the flooding surface within the studied plot is less than 0.6 meters (Figure C). In contrast, during an extreme rainfall event, such as Medicane Daniel in September 2020, the flooded area is significantly larger. The water heights in the flooded area near the plot are expected to exceed 5 meters, while within the plot, water heights up to 1.6 meters are anticipated (Figure D).



Conclusions

The analysis of the two phenomena clearly indicates that severe events can cause major issues for the studied PV park. Furthermore, based on the methodologies applied, it is critical to note that RES infrastructures are projected to be significantly impacted by climate change. This underscores the urgent need for proactive measures to mitigate these anticipated adverse effects during the PV park design phase. For example, protecting a PV park from wildfires using Best Available Techniques (BAT) invlolves starightforward measures like adequate spacing between the panels (e.g., Namikawa et al., 2017) and installing fireproofing equipment. Additionally, the industry should consider redesigning PV panels to incorporate even more fireproof materials. Similarly, the technical design of a PV park should consider the impact of flooding events in the project area. The analysis has shown that the project will be significantly influenced by severe rainfall, and measures such as elevated foundations for the PV panels or even relocation of the panels in neighboring plots should be considered.

References

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