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Modelling Pine Bark Beetle Outbreak Susceptibility in Honduras Using Geographic Information Systems and Remote Sensing Data Under Current Conditions, and Climate Change Scenarios.

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Coniferous forests cover approximately 30% of Honduras territory, and this type of ecosystem remains a key source of many environmental services such as water production, scenic beauty, carbon sequestration, and erosion control. However, pine bark beetle (PBB) (Dendroctonus sp.) outbreaks are an environmental hazard that has caused incalculable ecological and economic impacts in Honduras. There have been PBB outbreaks that have left thousands of hectares of conifer forests depleted (more than 500,000 hectares during the last PBB outbreak), which also caused a change in the intensity of wildfires in areas that have been attacked. It's important to understand the dynamics of this in Honduras as it is a region vulnerable to climate change, and the intensity of the PBB outbreaks has increased enormously, mainly due to extreme climate factors, and poor management. In this research, in order to plan more focalized measures for controlling the PBB outbreaks for the current and future scenarios, it is essential to identify those areas that have high susceptibility. For this purpose, we require to associate the historical PBB outbreak points (2014-2018), with a series of environmental and anthropogenic variables that according to the literature review have affected the initiation and the spread of PBB. To assess the current climatic variables we used precipitation acquired from the Climate Hazards Group Infrared Precipitation with Station data (CHIRPS). CHIRPS incorporates 0.05° resolution satellite imagery with in-situ station data. For current temperature, we use the MODIS land surface temperature product (LST-MOD11A2). To assess vegetation vigor, we use the enhanced vegetation index (EVI) acquired from the MODIS vegetation product, the MODIS Leaf Area Index (LAI-MOD15A2H), and the MODIS Vegetation Continuous Fields (CFV-MOD44B). We included elevation, aspect and slope as variables and acquired this data from the Global multiresolution terrain elevation data (GMTED). Finally, we used geographical information systems data to derive proximity to different types of roads as anthropogenic data. We do a preliminary exploratory analysis of the variables and eliminated those which show least importance. Furthermore, we integrated the most relevant variables identified with the PBB points by using the Random forest (RF) algorithm to fit the model, and then predicted the current PBB outbreak susceptibility. Results indicated that he climatic variables weigh heavily in determining high susceptibility areas, so to assess potential changes, we kept the independent variables described above, but for climatic variables, we used precipitation and temperature data from WorldClim which are prepared under different global circulation models (GCM) with different emission scenarios of greenhouse gases, called representative concentration pathways (RCP's). This datasets are downscaled to 30-seconds (of a longitude/latitude degree) spatial resolution. Our prediction results show high and very high susceptibility in the North-eastern and Central part of the country specially. Results also indicate an increase in the overall susceptibility when including climate change scenario variables. The results acquired, can lead to improved preventive and control measures to reduce the negative ecological effects that are caused, and also avoid an outbreak as large as the one occurred in the 2014-2016 period.