Mapping and analysing Human Exposure to Wildfires in a Central European Context

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Climate change has been causing a noticeable rise in disastrous wildfires across Southern Europe. However Central Europe is not immune to such destructive events either, as a recent wildfire in 2022 burned significant parts of two National Parks and Conservation areas in Germany and Czech Republic. This acted as a warning for the scientific community and local stakeholders, that demonstrated the need to adapt to this new reality. In this context, this thesis attempts to create a wildfire exposure map, for the four aforementioned areas.

Introduction

Wildfire exposure is the spatial juxtaposition of wildfire likelihood and intensity metrics with the location of Highly Valued Resources and Assets [1]. Such two metrics (Fame Length - FL for intensity and Burn Probability - BP for likelihood) were derived through usage of the fire modelling software FlamMap [2]. Assets in this thesis were considered to be settlements located in two National Parks and two Conservation Areas in Germany and Czech Republic

Methods

Wildfire exposure maps were created for the study area through the following steps:

1. A fire modelling landscape was created. This served as a geospatial characterisation of the study area. Fuel models were derived from Beetz (2023) [3].
2. Nine wildfire scenarios were devised, variating the modelled fires' duration (1, 2, or 3 days) and weather (middle, high or very high potential for wildfire). Weather was classified according to values of the index *Waldbrandgefahrenindex* (WBI) which showcases the meteorological potential for forest fire hazard risk.
3. For each of the three weather scenarios, three prominent winds were identified as the most representative.
4. For each of the nine wildfire scenarios, three modelling runs were undertaken in FlamMap, each for one of the three prominent winds. Each run resulted in one FL and one BP raster.
5. The weighted mean of the three resulting FL and BP rasters was calculated for each scenario. These two were then combined into a bivariate raster (see Figure 1).
6. The resulting nine bivariate rasters were overlaid with the local settlements' locations, as well as the locations of fire stations and the local transportations network, which serve as support capability indicators.

Results

Two maps were developed; a preliminary

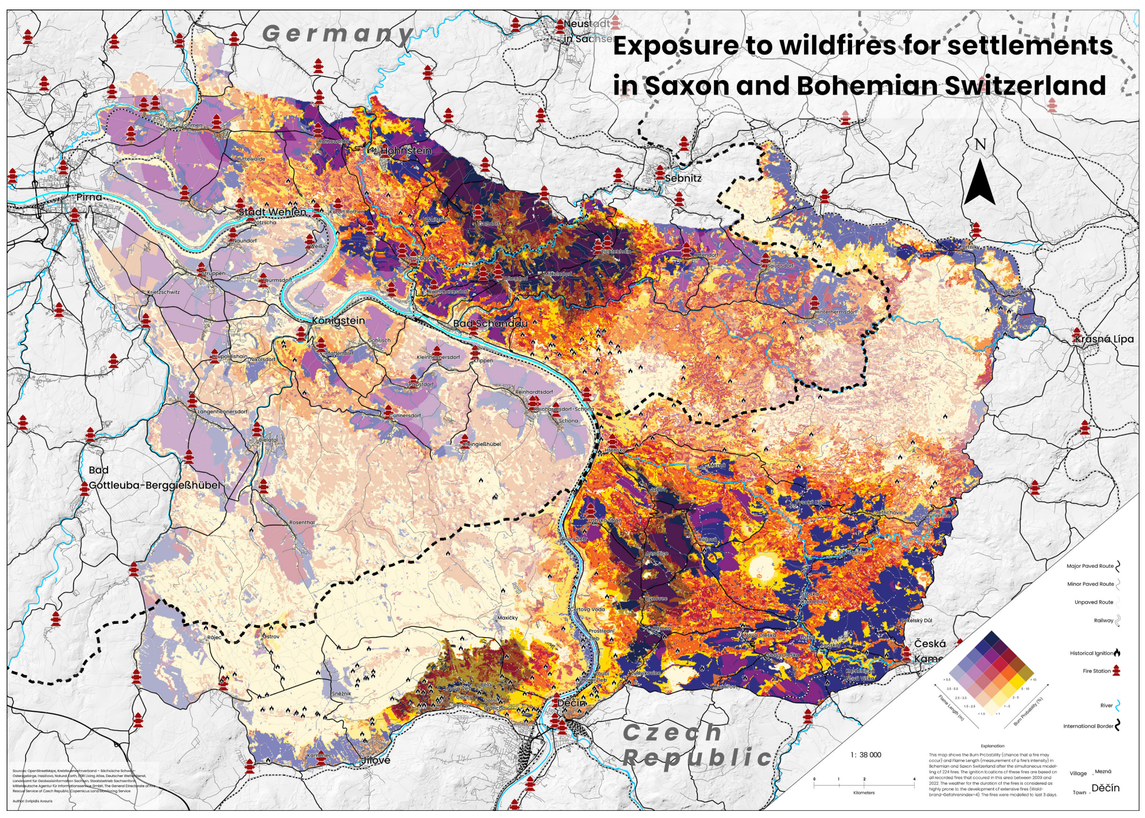

Figure 2 – Preliminary static map showcasing the transboundary study area and settlements' exposure to wildfire for scenario WBI = 5 and duration = 3 days. Intended print size: A0.

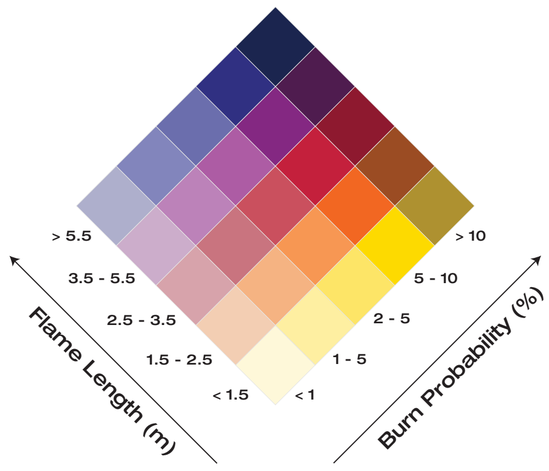

Figure 1 – Bivariate Raster Legend showing how each colour represents both a value of Flame Length and of Burn Probability.

static one, and a web-based interactive one. The static map is able to visualize wildfire exposure for only one of the nine scenarios (see Figure 2), however the interactive one allows the user to switch between multiple layers, i.e., multiple scenarios, and to also pan, zoom and search.

Evaluation

The nine devised scenarios were compared to the fire extent of the 2022 wildfire. The scenarios showed good ability to replicate local wildfires, although to a limited extent due to the short maximum duration of the scenarios. FlamMap's ability to accurately replicate local wildfires was tested by comparing modelled fires with fires detected from MODIS and VIIRS satellite-based sensors. Results showed a significant overlap between the two. Answers to usability questionnaires demonstrated the relative ease of understanding of the interactive map, compared to the complexity of the data. Usefulness questionnaires showed that further communication needs to be established with stakeholders to better take into account their needs.

Conclusions

Wildfire exposure mapping in the thesis' study area is still at a relatively early stage, but it is an area where wildfires are expected to become an ever increasing threat due to climate change. Although the resulting maps successfully showcase local settlements exposure to wildfires, more validation data showing local historical wildfires' extent would help to better calibrate wildfire modelling. Finally, fieldwork would help assess the accuracy of the fuel models used.

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