Chapter 28

Trapped on the Seashore, Seaborne Evacuation, Impact of Exposure to $PM_{2.5}$: Demonstration of the UrbanEXODUS Evacuation Model

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Abstract

The 2021 wildfire season affected large communities in over ten countries around the Mediterranean basin consuming an area almost double the area burnt by wildfires over the past twelve years. In many cases, people were exposed to hazardous combustion products that caused mass multimodal evacuations, including pedestrian, vehicle, and seaborne evacuations as well as a large number of fatalities. Evacuation modelling can be used to better understand the processes involved, including the interactions between those processes.

Such a model is urbanEXODUS, utilised during the final exercise (FSX3) for the European Commission's Horizon 2020 project IN-PREP. The tool was used as part of a training platform for incident managers in collaborative response to large scale disasters. The scenario deployed during the FSX3, and presented in this work, involved a traffic accident and cascading effects that start a wildfire at a forested area, initiating a multi-modal evacuation of the local community.

The model, able to simulate multi-modal evacuations, includes pedestrian and vehicle evacuation, and through the development of a flow model, a simplistic representation of boat evacuation. The model is also able to determine the effect of wildfire products using two different datasets that include (a) wildfire perimeter data and (b) smoke plume data that include $PM_{2.5}$ concentration levels. The former limits the escape routes, causing engulfment and fatalities. The latter, through the development of a novel fractional dose model, determines the acute exposure of agents to $PM_{2.5}$ in relation to the World Health Organisation (WHO) daily mean Air Quality Guidelines (AQG).

The model demonstrates key evacuation performance results, including evacuation times, escape route usage and number and locations of fatalities. The results indicate that 6% of the entire population were unable to leave the area and are considered as fatalities. With regard to the evacuees, 69% utilised the road network to leave the area, while 31% utilised the seaborne evacuation. Exposure to $PM_{2.5}$ was zero for 84% of the evacuees, while for 1% it was less than the AQG. However, 15% of the agents received a dosage of $PM_{2.5}$ on average of 7.6 times the AQG (range 1.0 – 28.3, SD = 5.8). This level of exposure is expected to cause health problems including respiratory, cardiovascular and cerebrovascular disorders.

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The model offers detailed evacuation information that is practically impossible to obtain otherwise, allowing crisis managers to make risk-informed decisions when planning for a crisis.

Keywords: multimodal evacuation simulation, seaborne evacuation, wildfire, fractional dose model, casualty estimation, $PM_{2.5}$, computer simulation