Fire behavior modeling on urban area: Haifa case study

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The threat to life, economic losses and environmental damage associated with the natural process of wildfires require management, particularly in areas close to human habitation, namely the wildland urban interface (WUI). The concept of WUI was proposed in the late 1980s in the USA regarding adjustment of fire management practices in settlements in and around forests. Considering that cities themselves mainly consist of fire-resistant objects and green elements occupy relatively small areas, the WUI concept considers cities as non-flammable and consequently excluded them from fire management strategies.

Land-use regimes near cities, forming buffer zones, and compact urban planning were considered sufficient to prevent fire penetration into the city. Nevertheless, experience has proven the ineffectiveness of the nonflammable city approach: Greece (Athens 2009&2015, Thasos 2016, Mati 2018), France (Marseilles 2009&2016), Spain (Javea 2012&2016) etc. Despite the increasing frequency and losses from WUI fires, there has been little research on WUI fire dynamics in genereal and even less on the effect of urban vegetation on fire spread within the built-up environment. A new outlook on the city as a fire-sensitive territory requires revision and validation of fire behavior models for urban areas.

The current study assessed fire spread (dynamics and patterns) in Mediterranean urban areas using the Haifa fire event on November 24, 2016 as an example. Haifa is a typical Mediterranean city located on the northern slopes of Mount Carmel in the north-western part of Israel. The dynamics of this fire event were reconstructed and mapped from the list of incoming calls to fire stations and supplemented by reports from the firefighters and surveys of the burned areas. Fire behavior modeling was implemented in a FARSITE environment. The results of modeled fire spread were compared with the reconstructed fire propagation to assess the applicability of existing fire modeling approaches and highlight the environmental parameters that are important for predicting wildfire spread in an urban setting.

The results show that the FARSITE raster-based approach for fire modeling is limited in urban areas. When simulated fire meets fire resistant objects (e.g. in built up environments) it stops because of a lack of fuel. However, in actuality the fire crossed most of the city. In order to assess the potential application of fire models to urban areas, the standard fuel zoning was replaced by vegetation connectivity maps. The outputs of the adjusted simulation correspond to the fire behavior observed in Haifa 2016.