

## Session 4: A Lexicographic Goal Programming Model for Early Supported-Evacuation and Commodities Distribution

Wildfires have affected the Earth's surface and atmosphere since the beginning of time. People have coexisted with fires both provoking them and suffering their consequences. Sometimes, and due to the proximity of a fire, it is necessary to carry out an evacuation, which consists on moving people temporarily to safer places in order to protect them before heat, sparks or flames reach them.

The London Resilience Partnership, a coalition of organizations who have a role in preparing for, responding to, and recovering from emergencies in London, published in 2018 a Mass Evacuation Framework that classified the type of evacuations into three categories: self-evacuation, assisted evacuation and supported evacuation. Most works on evacuation at the risk of approaching wildfires address self-evacuation, the most recommended type, and are concerned with pedestrians and drivers behaviour, congestions, and escaping routes, among others. But there is a part of the population that cannot leave by themselves, and must be evacuated by organizations and taken to shelters.

In this work, the problem of organizing the supported evacuation of the population in need, taking them to previously located shelters, and simultaneously allocating the shelters with the necessary goods, is addressed. To achieve it, a multimodal mixed integer programming optimization model to evacuate vulnerable population from the affected area to safe areas, as well as to guide the geographical location of resources according to needs of evacuees, is introduced. Time horizon has been discretized so that evacuation is dynamic over time. People from affected areas have been classified according to their health condition, to ensure that they are treated accordingly. On the other hand, supplies have been classified into consumables and not consumables, depending on their characteristics. People arrive to the collection points within the risk area along time, according to their own susceptibility about the disaster, and supplies should arrive to the temporary shelters on time to cover people needs.

There are several criteria to be considered, but there is no trade-off between some of them, so a lexicographical goal programming model is chosen. The model determines, at a first level, the maximum number of people that it is possible to evacuate according to the specific characteristics of each case. This value may contribute to the fire managers and other organizations to reach the objective that no person remains at the risk area. Secondly, the objective is to minimize the total required time to evacuate the critical population in order to avoid adverse consequences. At last, total operation cost, total time of operation and under-coverage of basic supplies by the evacuees is minimized.

A case study regarding the Saddleridge fire (Oct 2019) in San Fernando Valley, Los Angeles County, California is presented and analysed.