Data science for geo-referenced and heterogeneous data analysis with applications in the emergency management domain

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Abstract

Natural hazards affect every year thousands of lives, damaging cities, forests, and habitats, other than causing large economical losses. The European Commission and its Member States are involved in fighting the phenomena, cooperating and supporting several initiatives to reduce disasters impacts. Among its initiatives, the EU funds research projects to innovate and support emergency management operations.

This thesis presents several works partially carried out during two of these projects, focusing on data science approaches for the exploitation of satellite acquisitions and social media data to support emergency operations during and after the wildfire and flood events.

Satellite data provide a wide and complete view of regions hit by a hazardous event. Those data are employed to localize the affected areas and to estimate their damage. In this regard, we adapted machine learning approaches and we assessed their performances in both tasks. Furthermore, we studied novel approaches, able to solve the same problems with higher performances and using less information than the ones currently adopted in the literature. Then, we operationalized the approaches through the development of a platform that is able to provide an end-to-end mapping service.

Social media data provide a large volume of information in near-real-time and can contribute to increase the general knowledge about

the context of an emergency and to help coordinating emergency operations. To this end, we dealt with heterogeneous information which included textual and visual data, proposing novel challenging approaches. Firstly, we aimed to detect people potentially in danger through the evaluation of flooded sources depth and then, we wanted to detect flooded roads that could be still viable, useful for transporting emergency support to victims.