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Choosing the appropriate spatial scale for flash flood risk assessments in Mediterranean mountain watersheds

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In the Mediterranean, substantial economic losses are incurred each year due to flash floods; their rapid onset and unpredictability is a significant challenge for regional and national government responses. To help communities foresee and prevent some flood-related impacts, researchers often provide flood risk prevention models that rank different sub-basins within a single watershed from highest to lowest risk. Nevertheless, in countries within the EU, decisions to act against flooding (and other disasters, such as wildfires and storms) are often taken after interaction with the concerned municipality or regional government. We argue here that attempting to act across multiple scales simultaneously adds confusion and limits the capacity for effective disaster operations management. In order to address those complexities and suggest an ideal scale for future modelling of flash flooding in similar areas we focus on Storm Alex which formed on the 30th of September and dissipated on the 3rd of October 2020 producing the worst rainfall in 120 years in the French Provence-Alpes-Côte d'Azur (PACA) region, causing 16 fatalities. The most heavily impacted community was that of Saint-Martin de Vésubie in the Vésubie river watershed. Past research on this event has focused mainly on a) describing how the event unfolded and b) illustrating issues in French Flood Risk Governance (FRG) providing useful data surrounding the event but neglecting the decision-making issue of watershed vs. municipality scales mentioned above. We use Multi-Criteria Decision Analysis (MCDA) that draws information from satellite imagery, GIS and web resources to create a desk-based flash flood risk assessment and then use it to analyze the impacted area in two different scales; a) the watershed scale, dividing the Vésubie watershed into 10 sub-basins following terrain topography, and b) the municipality scale, using the limits of the 11 municipalities covering the Vésubie watershed. MCDA helps decision-makers structure multi-faceted decisions and evaluate alternatives (e.g. sub-basins, municipalities) according to a set of criteria. Here, criteria include building density, average elevation, average river slope, vegetated area, distance from the main river, land cover, past wildfires and past landslides. Our analysis results in two separate rankings (one of sub-basins and one of municipalities) from lowest to highest risk of flash flooding. Depending on the scale chosen, the resulting risk ranking of some areas changes, leading to a new debate on how we should approach flash flood risk in Mediterranean mountain basins in order to take better decisions and

limit economic impacts and loss of life in a changing climate.