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Analyzing wildfire exposure on Sardinia, Italy

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We used simulation modeling based on the minimum travel time algorithm (MTT) to analyze wildfire exposure of key ecological, social and economic features on Sardinia, Italy. Sardinia is the second largest island of the Mediterranean Basin, and in the last fifty years experienced large and dramatic wildfires, which caused losses and threatened urban interfaces, forests and natural areas, and agricultural productions. Historical fires and environmental data for the period 1995-2009 were used as input to estimate fine scale burn probability, conditional flame length, and potential fire size in the study area. With this purpose, we simulated 100,000 wildfire events within the study area, randomly drawing from the observed frequency distribution of burn periods and wind directions for each fire. Estimates of burn probability, excluding non-burnable fuels, ranged from 0 to 1.92x10-3, with a mean value of 6.48x10-5. Overall, the outputs provided a quantitative assessment of wildfire exposure at the landscape scale and captured landscape properties of wildfire exposure. We then examined how the exposure profiles varied among and within selected features and assets located on the island. Spatial variation in modeled outputs resulted in a strong effect of fuel models, coupled with slope and weather. In particular, the combined effect of Mediterranean maquis, woodland areas and complex topography on flame length was relevant, mainly in north-east Sardinia, whereas areas with herbaceous fuels and flat areas were in general characterized by lower fire intensity but higher burn probability. The simulation modeling proposed in this work provides a quantitative approach to inform wildfire risk management activities, and represents one of the first applications of burn probability modeling to capture fire risk and exposure profiles in the Mediterranean basin.