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A globally consistent probabilistic wildfire risk model to assess economic damages

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Wildfire risk around the world is rapidly increasing, leading to dramatic impacts on ecosystems and society. Economic damages of the past seasons threaten individual households, insurance companies, brokers and governmental authorities alike. Here, we present a probabilistic wildfire risk model to assess fire and economic risk. The model creates synthetic fire seasons through probabilistic ignition and dynamic random-walk spreading of fires.

The risk of natural catastrophes is commonly modeled using the three components hazard, exposure and vulnerability. This approach is used in the well-established open-source platform CLIMADA (CLIMate ADAptation). Here we show its extension for a globally consistent wildfire risk model. The model allows for the evaluation of economic damages of past and current wildfire events as well as a probabilistic risk assessment for any exposure on a seasonal basis. It is built on open and global data to ensure consistent modelling, including in data-sparse regions.

The hazard component uses Fire Information for Resource Management System (FIRMS) data acquired by the MODIS and VIIRS satellite missions and provided by Earthdata. We aggregate point information of fire activity using clustering algorithms over space and time to identify separate events while allowing for different resolutions (minimum of 375 m). For the exposure component, CLIMADA's LitPop model is used, which geographically distributes assets using data on night-light intensity and population density. To assess the vulnerability, the model has been calibrated using reported damage data. Although uncertainties remain large, error scores after calibration resemble those of well-established hazards, such as tropical cyclones. To allow for probabilistic risk assessment, synthetic fire seasons are generated using a random-walk-type stochastic fire generator, which hinges on grid-point specific fire spread probabilities combined with an overall fire propagation probability. The framework further allows for a simple integration of additional data in order to reflect climate trends.