Fire in the Earth System Abstracts
Vol. 2 FES-179
Granada, Spain, 4-8 July, 2023

A method to evaluate the probability of lightning causing wildfires

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Abstract

Finding the lightning event that ignited a natural wildfire is not a trivial task. Several factors, such as data inaccuracies, the possible long duration of the holdover time phenomenon (i.e., the time between lightning-induced fire ignition and fire detection) of lightning-ignited wildfires (LIWs), and the potential large number of lightning events surrounding the location at which the LIW was discovered, complicate the match between lightning and wildfire data. Therefore, usually it is not possible to distinguish unambiguously the lightning strike that ignited a wildfire and so several lightning events may be identified as possible candidates for the ignition source (Moris et al., 2023). Current methods to select lightning causing LIWs are relatively simple and apply some parameters, such as a buffer area centred at the wildfire discovery point to account for location errors of both lightning and wildfires, and a temporal window backwards in time from the wildfire discovery time to account for holdover time (Moris et al., 2020). A selection criterion may then be applied to select a single lightning event that may have ignited the wildfire. However, these methods tend to ignore two issues: (1) the location accuracy data of each single lightning event (i.e., error or confidence ellipses) provided by ground-based lightning locations systems; and (2) the relative frequencies of holdover time (i.e., probability distributions that fit well empirical data on holdover time). Here, we present a new method to evaluate the probability of lightning causing wildfires. This method combines two probabilities. First, a spatial probability of lightning events attaching an area of interest centred at wildfire discovery points. This spatial probability is based on previous work (e.g., Hugh et al., 2017) and has been adapted to fit data on LIWs. Second, a temporal probability using distributions of holdover time built with data from a global database of holdover time (Moris et al., 2022). This temporal probability indicates the probability of reaching a certain holdover duration. The new method can be used to answer two types of questions: (1) what is the probability that a wildfire was caused by lightning?; and (2) what is the most likely lightning event that caused a certain LIW?

Keywords: natural wildfires, lightning, spatial accuracy, holdover time, probability

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Acknowledgments: This research has been supported by a postdoctoral fellowship funded by the government of Asturias (Spain) through FICYT (grant no. AYUD/2021/58534).