A33J-2668 Determining the role of continuing currents in lightning-induced wildfires by using optical measurements

Wednesday, 13 December 2023

23:10 - 03:30

Poster Hall A-C - South (Exhibition Level, South, MC)

Abstract

Lightning flashes are an important source of wildfires worldwide, contributing to the emission of trace gases to the atmosphere. Based on experiments and field observations, continuing currents in lightning have since a long time been proposed to play a significant role in the ignition of wildfires. However, simultaneous detections of optical and radio signals from fire-igniting lightning confirming the role of continuing currents in igniting wildfires are rare. In this work, we first analyze the optical signal of fire-igniting flashes reported by the Geostationary Lightning Mapper over the Contiguous United States (CONUS) during the summer of 2018, and we then analyze the optical and the Extremely Low Frequency signal of a confirmed fire-igniting lightning flash in the Swiss Alps. Despite data uncertainties, we found that the probability of ignition of a lightning flash with Continuing Current (CC) lasting more than 10 ms is higher than that of cloud-to-ground lightning in CONUS. Finally, we confirm the existence of a long continuing current (lasting about 400 ms) associated with a long-lasting optical signal (lasting between 2 and 4 s) of a video-recorded fire-igniting lightning flash. These results suggest that parameterizations of flashes with CC in atmospheric models [1] together with information on forest types and their fuel characteristics may improve the forecasting of lightning-induced wildfires.

[1] Pérez-Invernón, F. J., Huntrieser, H., Jöckel, P., and Gordillo-Vázquez, F. J.: A parameterization of long-continuing-current (LCC) lightning in the lightning submodel LNOX (version 3.0) of the Modular Earth Submodel System (MESSy, version 2.54), Geosci. Model Dev., 15, 1545–1565, https://doi.org/10.5194/gmd-15-1545-2022, 2022.

Plain-language Summary

Lightning plays a significant role in initiating natural fires. Previous research has shown that a specific kind of lightning, called continuing current lightning, has a greater chance of starting fires. Continuing current lightning is when electrical charge flows through the lightning channel for extended periods, lasting tens or hundreds of milliseconds, which can result in higher temperatures in vegetation.

In our study, we utilized data from the Geostationary Lightning Mapper (GLM) to estimate the likelihood of wildfires caused by both regular lightning and continuing current lightning in the United States. To gain more insights, we also analyzed ground camera videos and extremely low-frequency radio signals to carefully examine the duration of continuing current in a lightning strike that caused a fire in the Alps.

The results of our research indicate that the probability of a fire occurring is higher when continuing current lightning is present compared to typical lightning strikes. This emphasizes the importance of comprehending the characteristics of lightning and its various impacts on assessing the risk of wildfires.

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