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Short-term effects of experimental fire on CO_2, CH_4 and N_2O exchange in a well-drained arctic tundra

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Wildfire frequency in the Arctic has increased in recent years and is projected to increase further with changes in climatic conditions due to warmer and drier summers. Yet, there is a lack of knowledge about the impacts such events may have on the net greenhouse gas (GHG) balances in ecosystems. During three consecutive growing seasons, we investigated the immediate and short-term effects of experimental fire on carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) surface fluxes in a well-drained tundra ecosystem in West Greenland. During the fire, we monitored litter and surface temperature, as well as the soil temperature in the top 0-5 cm. The results showed that surface temperatures exceeded 400 °C during the burning process and combusted all aboveground biomass, which significantly affected the ecosystem carbon (C) balance. Burned plots continued to be a net CO_2 source for at least two years after burning. Meanwhile, soil temperature did not exceed 60 °C during the fire, and soil GHG cycling appeared relatively resistant to these conditions. Burning had an effect on soil properties and CH_4 fluxes only immediately after the fire event and it had no significant effect on ecosystem respiration (ER). Instead net CH_4 uptake and ER correlated ($p<0.05$) with soil moisture and soil temperature, respectively. No significant fire effects were observed in net N_2O fluxes which suggests that processes linked to the nitrogen (N) cycle are driven by factors that were not affected by this moderate fire event.