The faculty of Engineering of the Vrije Universiteit Brussel invites you to attend the public defense leading to the degree of

DOCTOR OF ENGINEERING SCIENCES

of **Seppe Lampe**

The public defense will take place on **Monday 31st August 2026 at 4pm** in room **D.2.01** (Building D, VUB Main Campus)

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QUANTIFYING THE EFFECTS OF CLIMATE CHANGE ON WILDFIRES

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Abstract of the PhD research

Shortly after the first vascular plants began colonising the Earth's surface around 430 million years ago, the first fires appeared in the fossil record. Fire has been a fundamental driver of vegetation structure, composition, and ecosystem dynamics in our terrestrial ecosystems. Fires influence plant evolution, vegetation composition, and the physical, chemical, and biological properties of soils. In turn, many of these ecosystem characteristics also regulate fire behaviour by controlling fuel availability and flammability. Fire therefore forms an integral component of the Earth system, influencing ecosystem dynamics, the carbon cycle, and atmospheric composition. Emissions from vegetation fires affect the Earth's radiative balance: greenhouse gases such CO2 trap energy in the atmosphere, while aerosols released during combustion can reduce incoming solar radiation at the surface. The bidirectional interactions between vegetation, climate, human activity, and fire are therefore complex and far-reaching.

In recent decades, anthropogenic climate change has begun to alter many of the environmental conditions that regulate fire activity. Rising temperatures, changing precipitation patterns, and shifts in vegetation productivity are expected to influence both the occurrence and intensity of fires in many regions of the world. Quantifying the impact of climate change on fire activity is therefore essential for understanding future risks to ecosystems, the carbon cycle, and human societies. Moreover, exploring how fire regimes may evolve under different socioeconomic and climate pathways provides critical insights for long-term mitigation and adaptation strategies. In this context, recent advances in data availability and computational capacity have opened new opportunities for the application of machine learning methods. These approaches offer a powerful framework for simulating complex relationships between fire drivers, and improving our ability to project future fire activity.

This PhD thesis aims to leverage the opportunities from this new AI revolution to (i) improve our understanding of global fire activity during the 20th and early 21st centuries, (ii) quantify the contribution of anthropogenic climate change to present-day fire activity, and (iii) improve projections of future wildfire activity under different socioeconomic and climate pathways.