



Modeling fire occurrence and tree mortality in Belgium for the 21st century using downscaled CMIP6 climate simulations

Nicolas Ghilain^{1,2,4}, Louis Francois², Benjamin Lecart³, Thomas Dethinne¹, Francois Jonard³, and Xavier Fettweis¹

¹ULiège, Climatotology Lab, Liege, Belgium (nicolas.ghilain@meteo.be)

²ULiège, Unit of climate and biogeochemical cycles modeling

³ULiège, Earth Observation and Ecosystem Modelling lab

⁴Royal Meteorological Institute of Belgium, Climate modeling and impact studies

Climate change is expected to significantly alter regional fire regimes and forest vulnerability in temperate regions, including western Europe. In Belgium, wildfires have historically been relatively rare, but recent regional studies show a potential threat to population due to an increase of fire-prone climate conditions (Cerac, 2025). In this study, we assess future fire occurrence and tree mortality in Belgium over the 21st century using high-resolution, downscaled climate projections from the CMIP6 ensemble. Daily temperature, radiation, precipitation, humidity, and wind fields are dynamically downscaled by the regional climate model MAR (Grailet et al, 2025) to drive the dynamical vegetation model CARAIB (Verma et al, 2025) to derive occurrence of vegetation ignition and tree mortality for selected widespread species in Belgium. The simulations are performed for multiple baseline emission scenarios from IPCC (SSP2-4.5, SSP3-7.0 and SSP 5-8.5).

We show the main behavior of fire ignition occurrence and tree mortality obtained from the modeling exercise, first with a verification of the capabilities on the past period (1980-2025) when possible, and then with the future modelled trends (till 2100), especially in relation with the increase in the frequency and duration of summer drought periods and of the compound heat-dry events. Limitations of this exercise will be discussed to frame our future work.

This work provides one of the first climate-driven assessment of future fire risk and forest mortality for Belgium in the wake of the national climate downscaling experiment Cordex.Be2 (<https://cordex.meteo.be/>). It highlights emerging threats to temperate belgian forest ecosystems and offers a frame for quantitative information to support long-term forest management and adaptation strategies.

Cerac(2025): https://www.cerac.be/sites/default/files/media/files/2025-02/rpt_wildfire_risks_in_belgium_20250228_cerac_ngi_en_v2.0.pdf

Verma et al (2025): <https://www.sciencedirect.com/science/article/pii/S0301479725003056>

Grailet et al (2025): <https://gmd.copernicus.org/articles/18/1965/2025/>

