INFERNO-peat: A representation of northern high latitude peat fires in the JULES-INFERNO fire model

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1. Introduction:

Peatlands are a vital store of carbon[1,2], which are being threatened by the increasing frequency and intensity of peat fires, particularly in the northern high latitudes[3]. Burning peat has the potential to release large amounts of carbon to the atmosphere and release aerosols and particulates resulting in decreases in air quality and hazardous haze events[4]. Despite the importance of peat fires, they are currently not represented in most fire models.

2. Modelling high latitude peat fires:

Utilising knowledge from field and lab studies on the ignition and spread of peat fires[4], here I present a parameterisation of peat fires in the INFERNO fire model. Potential peat fire ignitions are estimated from lightning and population density, combined with a measure of vegetation flammability from INFERNO. Peat combustibility is calculated from various soil properties such as soil moisture. Which, when combined with ignitions, calculates burnt area, burn depth and carbon emissions (*figure 1*). Model outputs are compared to GFED4s, GFED5, GFED500m, GFAS and fireCCILT11 observations[5,6,7,8,9].

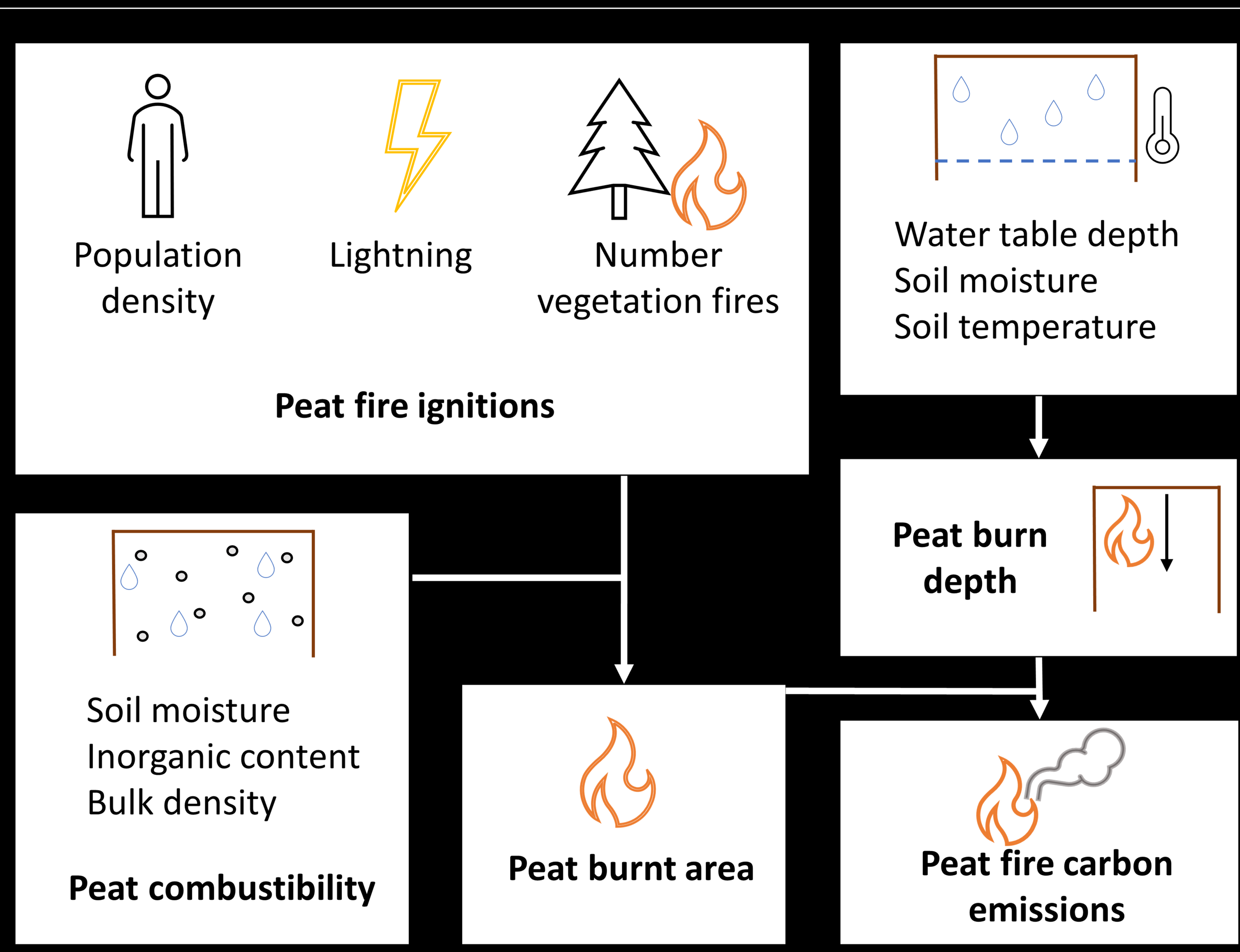

Figure 1 – INFERNO-peat schematic

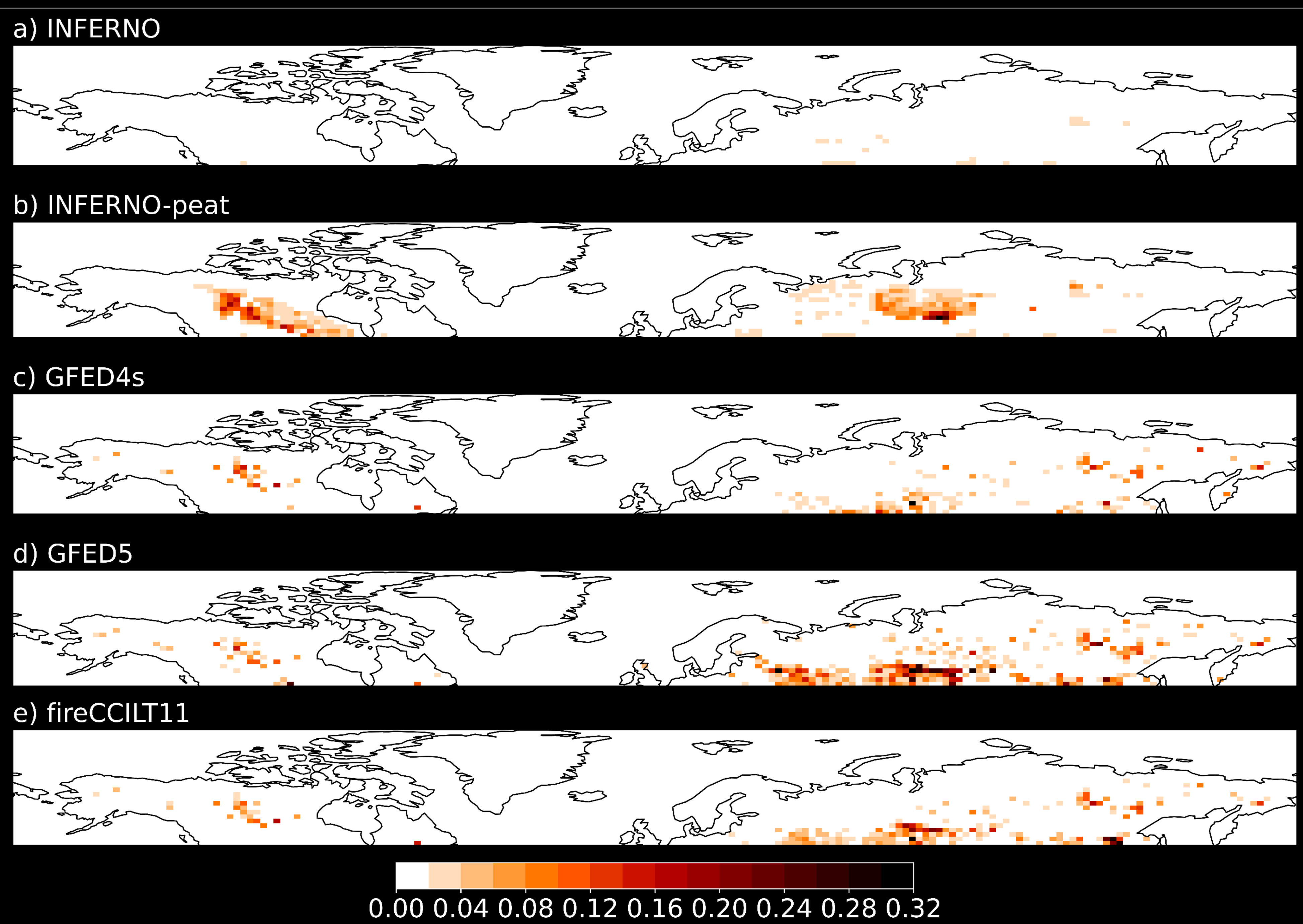

Figure 2 – A comparison of 2010-2014 average burnt area fraction across the northern high latitudes between the models and observations

3. Burnt area results:

INFERNO-peat burns on average 0.43 M km^2 a year in the high latitudes (>50°N). This is significantly more than the 0.22 M km^2 modelled by INFERNO, and much closer to the 0.39 M km^2 a year observed in GFED5, indicating improved spatial representation of burning (*figure 2*). Western Canada and eastern Siberia see large improvements. However, the model overestimates burning in central Canada and Siberia, possibly due to inaccuracies in the soil moisture estimations, and limited PFT representation.

4. Carbon emission results:

INFERNO-peat vastly increases the interannual variability in carbon emissions seen in the model (*figure 3*). INFERNO-peat shows better temporal correlation with GFED observations compared to INFERNO, with peat fires emitting, on average, an additional 253.14 Tg C each year.

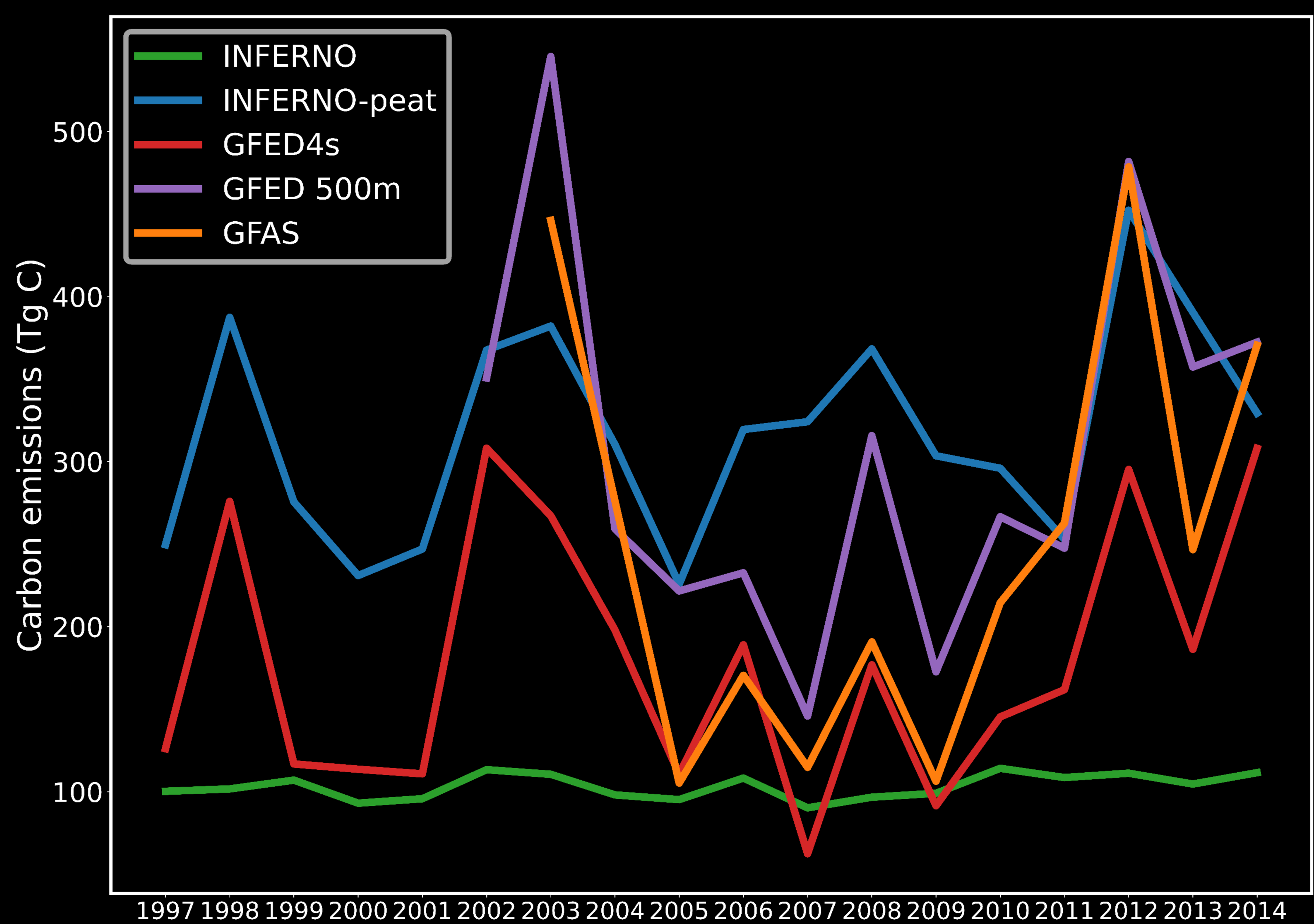

Figure 3 – Average annual carbon emissions from 1997 - 2014 from INFERNO and INFERNO-peat compared to observations.

5. Take home messages:

INFERNO-peat improves the representation of interannual variability in carbon emissions across the high latitudes. The spatial patterns in burnt area are also notably better represented in INFERNO-peat, significantly improving our ability to model fires across the Northern high latitudes.

References:
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