Re-assessment of pre-industrial fires in CMIP6 models and the implications for radiative forcing

EGU2020-18190 Session BG3.17/AS4.26/CL2.24/NH7.3

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Horizon 2020 European Union Funding for Research & Innovation

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Summary

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- Natural emissions are an important contributor to variance in the first aerosol indirect radiative forcing (slide 3)
- Pre-industrial fire emissions have a substantial impact on the strength of the first aerosol indirect radiative forcing in an offline global aerosol model (slide 4)
- When AeroCom or CMIP6 PI fire emissions are used, the model over-predicts the PD / PI black carbon ratio when compared to ice core observations - are the PI fire emissions “too low”? (slide 5)
- What do we see in Earth System Models (slide 6) being used in CMIP6?

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Importance of natural aerosols in the Earth System

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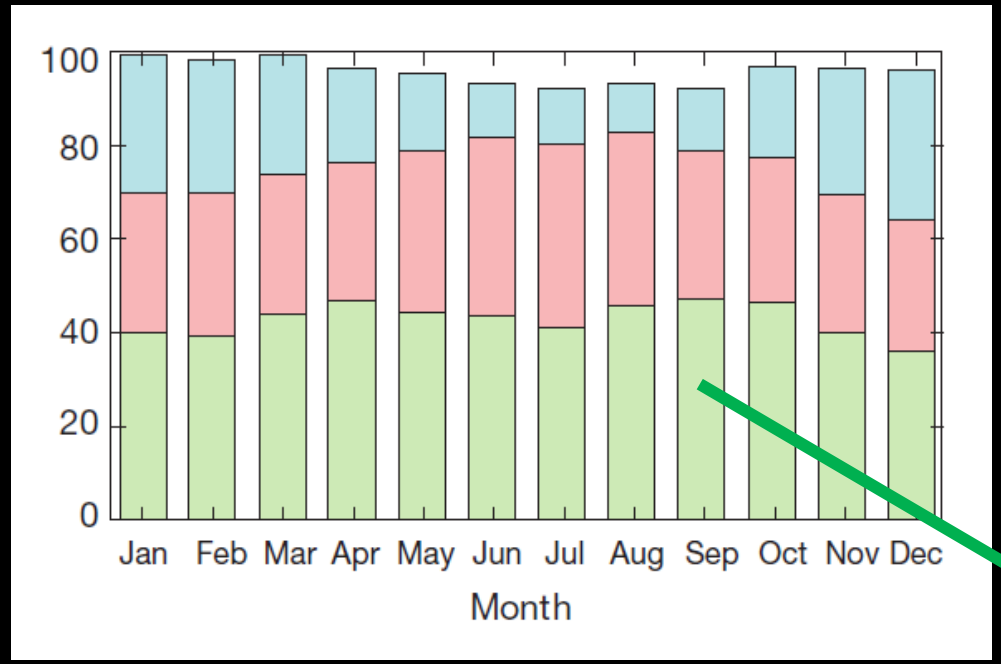
Natural emissions are an important contributor to variance in the first aerosol indirect radiative forcing



(Carslaw *et al.*, 2013; link)

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First aerosol indirect radiative forcing strongly affected by pre-industrial fire emissions

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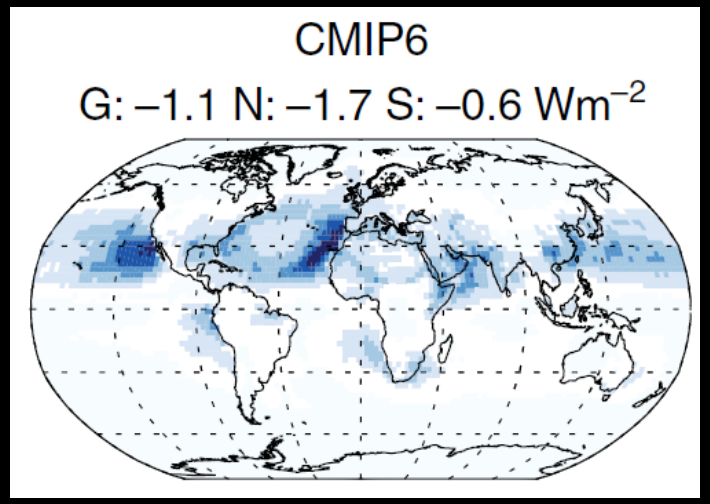
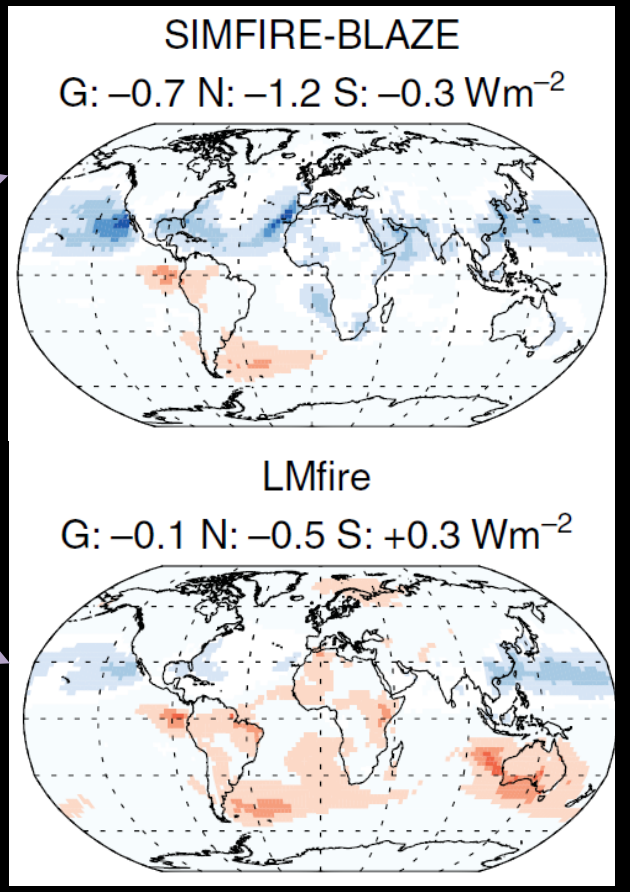
Annual mean first aerosol indirect radiative forcing using GLOMAP-mode aerosol model with ***CMIP6 pre-industrial fire emissions*** (van Marle *et al.*, 2017):



Global annual mean: **-1.1 W m^{-2}**

Strength of first aerosol indirect radiative forcing **reduces** when emissions from ***two alternative pre-industrial fire models*** are used:



Global annual mean:

-0.7 W m^{-2}

-0.1 W m^{-2}

(Hamilton *et al.*, 2018; link)

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How well do models capture the impact of fire emissions on the pre-industrial atmosphere?

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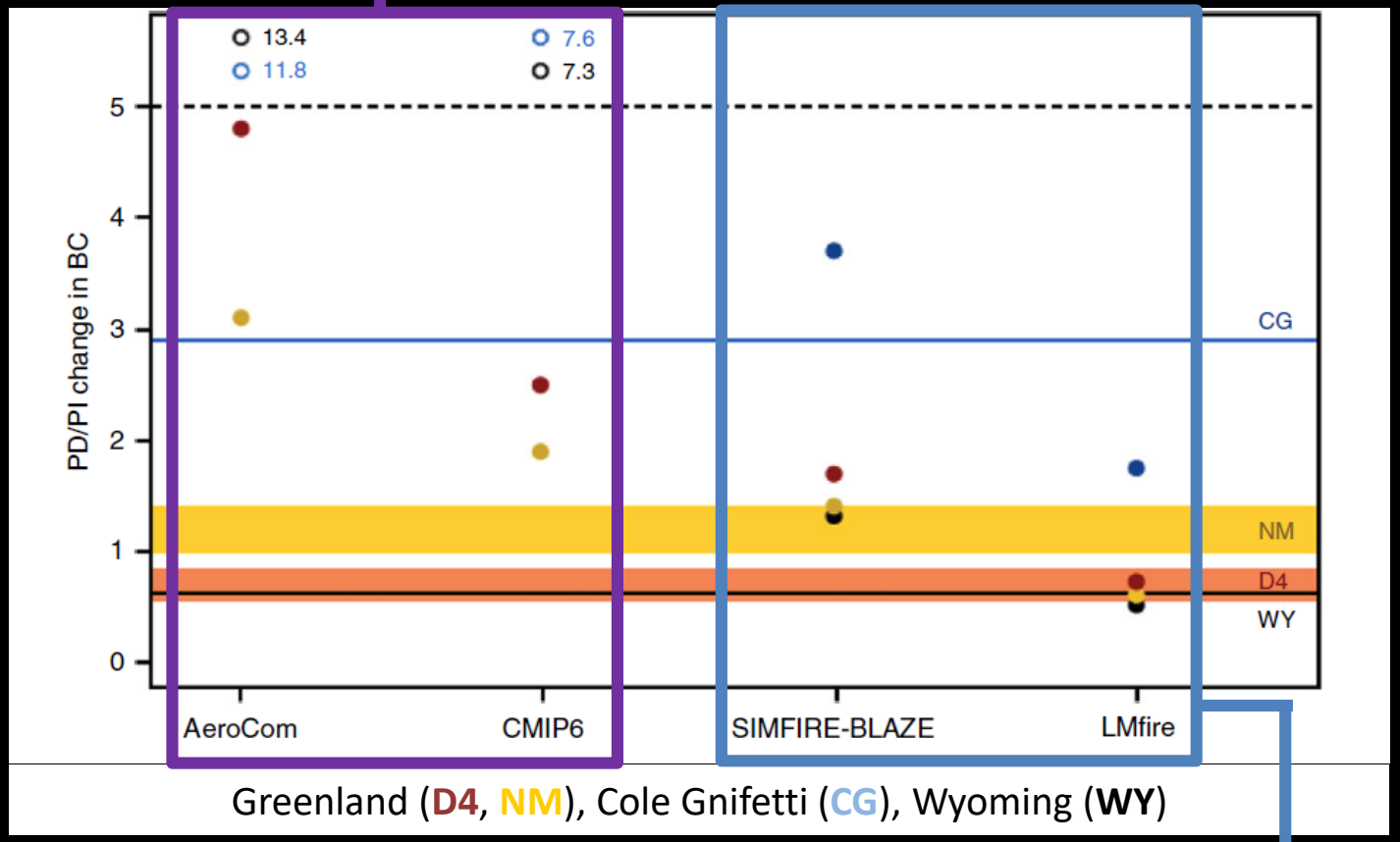
Present day (PD) to pre-industrial (PI) ratio of black carbon (BC) concentration at surface is over-predicted by GLOMAP-mode aerosol model using the AeroCom or CMIP6 emissions, when compared to ice cores from the northern hemisphere

'Real' PI concentrations of BC were likely higher than the model simulates

Using emissions from SIMFIRE-BLAZE and LMfire reduces the overestimate



Greenland (**D4**, **NM**), Cole Gnifetti (**CG**), Wyoming (**WY**)

(Hamilton *et al.*, 2018; link)

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The CRESCENDO Earth System Models

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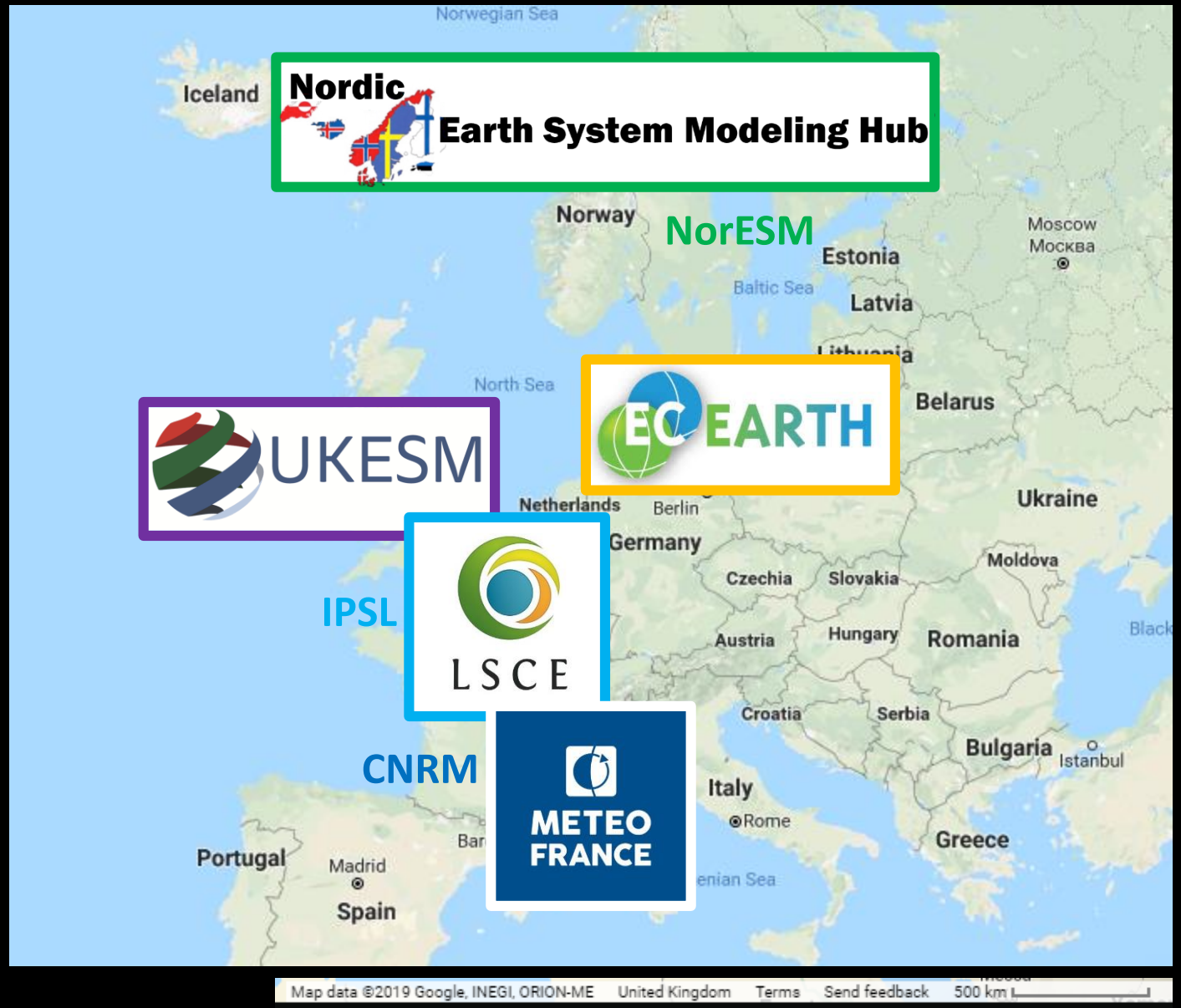

Models being used for CMIP6 (AerChemMIP)

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