

## Impact of Nuclear War on the Carbon Cycle

Supervisors:

Prof. Simon Tett (Geosciences) Simon.Tett@ed.ac.uk

Dr Stephen Welch (Engineering)

Ms Carla Roesch (Geosciences)

- Carry out research into the potential impacts of nuclear war on the Earth's Climate System.
- Take part in fire experiments in the School of Engineering



The project will be hosted by Prof. Simon Tett, in the school of Geosciences, with support from Dr Stephen Welch, in the School of Engineering. One potential impact of a nuclear war is the injection of soot/black carbon into the stratosphere following the mass burning of cities. Once soot reaches the stratosphere it is likely to stay there for several years leading to significant surface cooling (Robock et al., 2007; Robock, Oman and Stenchikov, 2007). This cooling is termed “nuclear winter” and could be an extinction level event for humanity due to the impacts on agriculture. Potential scenarios include a relatively limited nuclear war between India and Pakistan where about 50 Hiroshima-sized bombs are used to a full scale exchange between the US and Russia which could lead to worldwide famine and be potentially humanity destroying (Xia et al., 2022).

The aim of this short research project is to modify the FAMOUS Earth System Model (Williams et al., 2013) so that it can simulate the impact of stratospheric black carbon on the earth system. FAMOUS is a fast earth system model able to simulate centuries in a real-time day or years in a few minutes. The core radiation code (Edwards and Slingo, 1996) is, with some changes, still in use in state-of-the-art climate models. The plan would be to change the background aerosol (Cusack et al., 1998) code to include black carbon above the troposphere. The changes would build on existing code to support stratospheric volcanic aerosol. Having modified and tested FAMOUS then use this modified version of FAMOUS to see what the impact of two nuclear winter scenarios would be on the Earth System examining both the climate and the carbon response. By turning off feedbacks between the carbon cycle and the climate system the student will be able to investigate how important carbon cycle feedbacks are to the simulated response.

Soot/black carbon is complex stuff. Further, the processes by which cities burn and inject soot into the stratosphere are not well understood. To allow the student to understand the complexity of these processes they will spend some time in the School of Engineering fire lab working with a PhD student who is working on fire spread in informal settlements.

#### Detailed Work plan

- Weeks 1-2. Become familiar with earth system model; read literature on model radiation scheme and work out what model needs.
- Weeks 3-5. Working closely with supervisor implement, and test, those changes in the model
- Week 6. Carry out simulations
- Week 7. Analyse simulations using existing software.
- Week 8. Write final report.

#### References

Cusack, S. et al. (1998) 'The radiative impact of a simple aerosol climatology on the Hadley Centre atmospheric GCM', *Quarterly Journal of the Royal Meteorological Society*, 124(551), pp. 2517–2526. Available at: <https://doi.org/10.1002/qj.49712455117>.

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