Flossie Brown

PhD student

University of Exeter, Exeter, UK, EX4
Email: fb428@exeter.ac.uk
Phone: 07588151587
Citizenship: UK

I have experience in land surface modelling to understand atmosphere-biosphere interactions. Specifically, my PhD investigated surface ozone chemistry and its impacts on plant productivity in the tropics. My research interests include feedbacks between fire, air quality and ecosystem health, and the atmospheric chemistry of extreme events (e.g. ENSO).

Education:

PhD, Department of Mathematics **2020—present**
University of Exeter, Met Office
Next-generation modelling of ozone-plant damage for tropical trees and crops
Supervisors: Stephen Sitch, Gerd Folberth, Jim Haywood, Lina Mercado
Funding: NERC GW4+ DTP partnered with the Met Office

Masters, Chemistry | 1st class **2019—2020**
University of Cambridge, Corpus Christi college
On the magnitude and sensitivity of the QBO to a tropical volcanic eruption
Supervisors: Anja Schmidt, Lauren Marshall

BA, Physical Natural Sciences |1st class **2016—2019**
University of Cambridge, Corpus Christi college

Awards:

Best STEM poster **| 2023**
Poster award, PGR Research Showcase, University of Exeter,

Honorary mention **| 2021**
Poster award, IGAC Conference

Unilever scholarship **| 2020**
Best Physical Chemistry research project, University of Cambridge

Bailey scholarship **| 2019**
In recognition of excellent results in third year examinations

Bailey scholarship **| 2018**
In recognition of excellent results in second year examinations

Morley scholarship **| 2017**
In recognition of excellent results in first year examinations

Training & Research Experience:

Introduction to the UK Chemistry and Aerosol model **2022, 2-day course**
NCAS training course
Experience setting up and running experiments
Practice adding new chemistry to UKCA

Fieldwork, TropOz **2022, 3 week visit**
JCU, Cairns, Australia
Short project investigating change in Vcmax with ozone exposure in sugarcane

Fieldwork, Summer research project **2018, 1 month project**
Vulcano, Sicily
Designed and carried out research into the volcanic history of the island Vulcano
Awarded funding from Corpus Christi college, Cambridge for self-led summer research: £800

Publications:

Brown, F., Marshall, L., Haynes, P. H., Garcia, R. R., Birner, T., and Schmidt, A.: "On the magnitude and sensitivity of the quasi-biennial oscillation response to a tropical volcanic eruption." *Atmospheric Chemistry and Physics,* 23.9 (2023): 12331-12352. https://doi.org/10.5194/acp-23-5335-2023

Contribution: Using climate model UKCA-UM, I showed that stratospheric sulfate injection from a large-magnitude volcanic eruption can disrupt the QBO. I demonstrated the mechanism for the disruption, in response to conflicting ideas from previous literature.

Vieira, I., Verbeeck, H., Meunier, F., Peaucelle, M., Sibret, T., Lefevre, L., Cheesman, A.W., **Brown, F.,** Sitch, S., Mbifo, J. and Boeckx, P.: "Global reanalysis products cannot reproduce seasonal and diurnal cycles of tropospheric ozone in the Congo Basin." *Atmospheric Environment,* 304 (2023): 119773. https://doi.org/10.1016/j.atmosenv.2023.119773

Contribution: I gave advice on reanalysis products and ozone calculations

Brown, F., Folberth, G. A., Sitch, S., Bauer, S., Bauters, M., Boeckx, P., Cheesman, A. W., Deushi, M., Dos Santos Vieira, I., Galy-Lacaux, C., Haywood, J., Keeble, J., Mercado, L. M., O'Connor, F. M., Oshima, N., Tsigaridis, K., and Verbeeck, H.: "The ozone–climate penalty over South America and Africa by 2100." *Atmospheric Chemistry and Physics,* 22.18 (2022): 5335-5353. https://doi.org/10.5194/acp-22-12331-2022

Contribution: I used CMIP6 data from 3 Earth System Models to show that climate change could increase surface ozone over urban areas and areas of biomass burning in the tropics. I also highlight differences in the sensitivity of ozone production to precursor emissions among models, which suggests uncertainty in future surface ozone projections in the tropics.

Working Papers:

Cheesman, A., **Brown, F.,** Ribero, R., Folberth, G., Hayes, F., Moura, B., Paoletti, E., Hoshika, Y., Cernusak, L., Osborne, C., and Sitch, S.: "Impacts of Ozone on Sugarcane Production." **in-review**, Science of the Total environment, *Available at SSRN 4500437*. http://dx.doi.org/10.2139/ssrn.4500437

Contribution: I determined the ozone sensitivity of 4 sugarcane varieties from observational data and used a land surface model to estimate sugarcane yield losses due to ozone-damage.

Farha, M.N., Daniells, J., Cernusak, L.A., Ritmejerytė, E., Wangchuk, P., Sitch, S., Mercado, L.M., Hayes, F., **Brown, F.** and Cheesman, A.W. "Examining Ozone Sensitivity in the Genus Musa (Bananas)." **in-review,** *Available at SSRN 4196791*. http://dx.doi.org/10.2139/ssrn.4196791

Contribution: I calculated ozone flux into banana plants using photosynthesis models.

Brown, F., Folberth, G. A., Sitch, S., and other co-authors TBC: "Evaluation of surface ozone in UKESM1 against observations in the pan-tropics" **in-prep**, *Geoscientific Model Development, TOAR II Community Special Issue*

Contribution: I used new metrics to show that UKESM1 reproduces spatial, seasonal and hourly ozone trends across the tropics, albeit with a systematic high bias. Therefore, with a bias correction, UKESM1 is capable of producing ozone concentrations for human health and ecosystem impact assessment.

Cheesman, A., **Brown, F.** Folberth, G. A., Sitch, S., and other co-authors TBC: "Ozone damage to tropical forests; impacts on carbon uptake and restoration potential." **in-prep**

Contribution: I determined the ozone sensitivity of tropical trees using new observations. I parameterised a land surface model using this new dataset to calculate that areas of current and potential future forest restoration are most at risk of ozone damage. This would decrease the carbon storage potential of these forests unless policy changes occur to reduce ozone pollution.

Brown, F., Folberth, G. A., Sitch, S.**:** "Fire drives interannual variability in plant-ozone damage in the Amazon" **in-prep**

Contribution: I used a land surface model to suggest indirect carbon losses from fire-related ozone damage is ~30% the magnitude of direct carbon losses from Amazon fires, a carbon cost currently overlooked. Ozone damage is consistently higher in drought years (e.g. El Nino), implying future Amazon drying could increase carbon losses.

Conferences & Convening:

Co-convener EGU **2023**

BG9.8: Ozone-vegetation interactions: impacts, air quality and chemistry-carbon-climate modelling

EGU General Assembly | Poster presentation **2023**

Title: Interannual variability in ozone-plant damage to tropical forests

ICP Vegetation | Virtual oral presentation **2023**

Title: Impacts of ozone on sugarcane in Brazil.

iLeaps-OzFlux | Oral presentation **2023**

Title: Ozone damage to tropical trees in a changing climate

IGAC | Oral presentation **2022**

Title: The ozone-climate penalty over South America and Africa by 2100

EGU General Assembly | Oral presentation **2022**

Title: The ozone-climate penalty over South America and Africa by 2100

IGAC | Virtual oral presentation & poster **2021**

Title: Multimodel evaluation of present day and climate-driven changes in ozone over South America and Africa

Atmospheric Sciences, Royal Meteorological Society | Virtual oral presentation **2021**

Title: Future climate change impacts on surface ozone in the tropics

AGU Fall Meeting | Virtual PICO presentation **2021**

Title: On the magnitude and sensitivity of the QBO to a tropical volcanic eruption

Teaching & Outreach:

University of Exeter **2020—present**

Laboratory teaching assistant, Natural Sciences BSc

- Organic chemistry and computational lab demonstrations and teaching
- Assessment grading

University of Oxford, Wadham College **2023**

Summer school lecturer, Chemistry

Pint of Science, Exeter **2023**

Presentation to the public

- Title: 'Can this tree represent the entire Amazon?!'

Work Experience:

Dance & Aerial Instructor **2023—present**

Teaching of a different kind, that I manage around my PhD responsibilities

Goldman Sachs summer analyst **2019**

10 week internship in recruitment team working to increase retention of women and underrepresented groups

Skills:

Collaboration: I have developed a research network spanning institutions and countries, many of whom I have published with or intend to collaborate with on future work.

Independent work: I am strongly self-motivated, having chosen the direction of my Masters project, which was outside of my main supervisors' expertise, including coordinating co-authors with experience in atmospheric dynamics. I also have two papers currently in-prep which are my own ideas.

Model simulation and development: I have experience running simulations with JULES (UK land surface model) and of developing the JULES code to update the ozone-plant damage scheme .

Data analysis: Worked with observational and model datasets using Python, Unix, R, CDO/NCO, and Google Earth Engine, and always aim to present data in a way that is creative and accessible. This includes some novel metrics such as:

- being the first paper to use the 'diurnal ozone range' as a quantitative metric to evaluate the ability of models to reproduce diurnal variability
- evaluating the latitudinal position of the QBO as a metric to quantify a QBO disruption (previous studies only looked at the equator, so I identified a completely new response).