

Tackling black carbon research gaps to inform climate change mitigation strategy

**Expression of Interest
October 2024**

Summary

The Clean Air Fund is seeking opportunities to support research on black carbon and black carbon-rich emission sources with a focus on reducing key scientific uncertainties and tackling open research questions on near-term climate change mitigation. Research areas of interest include advancing black carbon observations, advancing black carbon and co-emitted pollutant emission inventories, conducting targeted regional-scale modelling, and exploring suitable climate metrics. The proposed research programme is for up to 2.5 years. Research institutes, universities, think tanks and consortia of interested organisations are encouraged to submit Expression of Interest (Eoi) for this funding by providing short answers to four questions outlined in Section 4. The deadline of Eoi submission is 15 November 2024. The average grant size is USD \$300,000-500,000. CAF is planning to support multiple projects.

1. Context

The Clean Air Fund (CAF) is a global philanthropic organisation working with governments, funders, businesses and campaigners to create a future where everyone breathes clean air. CAF has a programme of work targeting action on super pollutants or short-lived climate pollutants (SLCPs). Through this work, we are supporting and advocating for air pollution and climate change to be tackled together and delivering high-impact projects to help mitigate near-term warming¹, avoid climate tipping points² and reduce the chronic health impacts of air pollution³.

A key focus of our work on super pollutants is on black carbon (see more details [here](#)). Black carbon plays a unique role at the intersection of climate and health as both a climate pollutant and an air pollutant. It is a key component of particulate matter air pollution and also contributes to global warming, disrupts weather patterns and accelerates melting of snow and ice. Some measures to cut emissions from black carbon-rich sources present opportunities to deliver near-term climate change mitigation, avoid climate tipping points, and achieve clean air. At COP28, CAF launched [The Case for Action on Black Carbon](#).

The vision of CAF's 3-year multi-million dollar programme of work is to realise 35% global black carbon emissions reductions by 2030 from a 2010 baseline. The programme will:

- (a) reduce scientific uncertainties and work towards resolving key scientific bottlenecks;
- (b) generate a compelling case for action;
- (c) build coalitions and alliances focussing on health and climate that demand greater action;
- (d) secure pledges by national governments; and
- (e) analyse and showcase the feasibility and potential for impact of existing black carbon emission reduction solutions to drive momentum.

CAF has committed over \$2m to provide financial support to research projects on black carbon and black carbon-rich emission sources. The goals of the research portfolio are to deliver on activity (a) mentioned above, as well as to support other activities where relevant. The primary objective of the programme is to advance science and work towards consensus on the impact of policies and measures on black carbon-rich sources on climate change and human health.

¹ Dreyfus, Gabrielle B., et al. "Mitigating climate disruption in time: A self-consistent approach for avoiding both near-term and long-term global warming." *Proceedings of the National Academy of Sciences* 119.22 (2022): e2123536119. <https://doi.org/10.1073/pnas.2123536119>

² Ritchie, Paul DL, et al. "Tipping points: Both problem and solution." *One Earth* 6.12 (2023): 1610-1613. <https://doi.org/10.1016/j.oneear.2023.11.016>

³ [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)

2. Priority research areas

Black carbon's characteristics – such as its short atmospheric lifetime, effect on snow and ice, dual definition (climate forcer and air pollutant), cloud interactions, and mixing process in the atmosphere – lead to significant uncertainty when estimating the climate impact of policies and measures on black carbon-rich sources. Along with the difficulties in climate model parametrisation of black carbon, emission estimation of black carbon and its co-emitted pollutants from different sources also drive significant uncertainty⁴. For example, different magnitude of emission of co-pollutants such as organic carbon, carbon monoxide, and non-methane volatile organic compounds influence the modelling output.

As a result, gaps exist in our understanding of how to deliver near-term climate change mitigation through policies and measures on black carbon-rich sources. Addressing these research gaps is important for global and local climate and air quality strategies. With a view to reducing the scientific uncertainties around black carbon and its climate impact and generating policy-relevant insights, the following research areas of interest have been identified:

(a) Advancing observations of black carbon

Robust, widespread observations of black carbon are fundamental for advancing our understanding of its role in the climate system and health impact analyses. Black carbon observation is currently limited with major gaps in the Global South and in cryosphere regions where the sources and impacts are highest⁵. Black carbon monitoring is generally limited to advanced monitoring sites (source attribution; e.g. the [SPARTAN network](#)), government mandated super sites (e.g. requirement for monitoring in the [EU's Ambient Air Quality Directive](#)), or sub-national air quality management where black carbon has been prioritised (e.g. [Bogota's monitoring network](#)).

The research project concepts under "Advancing observation of black carbon" may cover (i) short-term black carbon monitoring campaigns (in air and snow) in the Arctic, Himalayas or other data-poor cryosphere regions; (ii) air-borne and remote-sensing campaigns on vertical distribution of black carbon in upper troposphere and associated atmospheric heating; and (iii) synthesis of state-of-the-art black carbon datasets from existing observations and model-based studies. It is important that any proposed monitoring project should be linked to improved parameterisation or validation of present emission inventories and climate model outputs. Due to the limited funding and time period, we are unable to support long-term monitoring campaigns.

(b) Regional-scale modelling of policies and measures on black carbon-rich sources

Regional impacts of black carbon and its co-emitted pollutants on disrupting precipitation patterns, temperature responses, and increasing snow and ice melt are relatively well established. However, these regional impacts are less studied over some regions e.g. Asia, Africa and Latin America. Although there is strong evidence to show that targeted action on black carbon can deliver near-term climate mitigation.⁶ There is a fundamental gap in evidence around the regional-scale climate and health impacts of policy pathways and specific measures on black carbon-rich sources. For many global regions, the near-term and local climate effects of many policies and measures are unclear. This is an important gap for determining what actions offer potential to deliver near-term climate change mitigation in different regions, whilst also providing local air quality, health and economic benefits.

We welcome research proposals studying the regional impacts of emissions reductions from black carbon-rich source sectors. Examples for such projects may include estimating climate impact of (i) shifting to cleaner brick kilns over the Indo-Gangetic Plain; (ii) shifting to clean lighting in Africa; (iii) mitigation of forest fire in the Amazon, (iv) evaluating different cross-sectoral policy pathways in highly-affected regions etc. Proposed research should consist of adequate post-research stakeholder engagement plans and draw on local expertise. A further potential objective is to generate evidence on particular, locally-relevant co-benefits. For example, building the evidence basis for how reducing black carbon and co-pollutant emissions could be a climate change adaptation and resilience project in some regions e.g. affecting water security in South Asia, drought and extreme heat in West Africa.

(c) Improving emission inventory

⁴ https://www.ccacoalition.org/sites/default/files/resources/2018_Science-Update-Black-Carbon-Briefing_CCAC.pdf

⁵ Gertler, Charles G., et al. "Black carbon and the Himalayan cryosphere: A review." *Atmospheric environment* 125 (2016): 404-417. <https://doi.org/10.1016/j.atmosenv.2015.08.078>

⁶ Dreyfus, Gabrielle B., et al. "Mitigating climate disruption in time: A self-consistent approach for avoiding both near-term and long-term global warming." *Proceedings of the National Academy of Sciences* 119.22 (2022): e2123536119. <https://www.pnas.org/doi/10.1073/pnas.2123536119>

Robust emissions data is a key input for climate modelling studies and is needed for governments to report and set targets on emission levels. The source of uncertainty in the emissions estimates primarily comes from a) emission factors and b) activity data. Depending upon fuel composition, mode of combustion, meteorology, emission factors from some sectors for black carbon can vary up to [4-5 orders of magnitude](#). Highest uncertainty in emission factors exists on sectors like biomass burning, agriculture and wildfires. In low- and middle-income countries, emission factors are often taken from the databases of [regulatory agencies](#) in high-income countries, or sometimes a ratio between [PM2.5 and black carbon](#)⁷. Both practices can lead to large uncertainties in black carbon estimations. Comparing the top 10 countries' total black carbon emissions between the two leading global inventories – CEDS and EDGAR – highlights disagreement in national emissions in the range of -40% to 594% for 2022. Such variability in emission estimates leads to substantial challenges in downstream analysis of impacts and potential benefits. The IPCC is developing a [Methodology Report on Short-Lived Climate Forcers](#), which may be informed through further work in this area.

The proposed research may aim to improve emission estimation of black carbon and co-emitted pollutants in targeted sectors. For example, the development of local emission factors and activity data collection for black carbon over priority regions for priority source sectors, improvement of emission estimation from global wildfires, etc. Potential projects on emissions estimates may be associated or followed by modelling exercises for validating the emission data and/or providing a comparison with existing emissions inventory dataset.

(d) Improvement in black carbon/short-lived climate forcer climate metrics

[Climate metrics](#) are used to standardise and evaluate the climate impacts of different greenhouse gases (GHG) and aerosols and are used widely in climate frameworks and reporting. They are a key tool in setting emissions targets, developing climate policies, and facilitating international cooperation for climate action. Climate metrics (such as Global Warming Potential (GWP100, GWP20), Global Temperature Potential (GTP100, GTP20)) have been a core part of climate reporting and accountability since their adoption in the Kyoto Protocol in 1997. They are used by intergovernmental bodies such as the UNFCCC and IPCC, for national GHG inventories and corporate reporting. This widespread acceptance and usage incentivises action to reduce GHG emission such as CO₂, however, none of the present climate metrics can fully capture the regional, temporal, direct and indirect impacts of black carbon and several other short-lived climate forcers.

Potential areas of interest include:

- Exploring alternative or complimentary climate metrics that allow for a more robust assessment of the climate effects of short-lived climate forcers and associated measures to reduce them.
- An intercomparison of metrics (current or new) at the country level to highlight disparities in black carbon and short-lived climate forcer contributions, estimating the often unaccounted for local and short-term climate effects and assessing the relative importance of accounting for these.
- Investigating sector-specific and region-specific tools for precise calculation of black carbon and co-pollutant influence, helping to target high-emission industries and areas where short-lived climate forcers make up the majority of climate forcing.
- Inclusion of climate tipping points within metrics or qualitative analysis that helps understand relative risk and mitigation options.
- Integrating metrics with Sustainable Development Goals (SDGs) or other development indicators to ensure that climate actions align with broader socio-economic objectives, enhancing policy relevance.

(e) Other potential research area

We are open to receive and consider other ideas which are not explicitly mentioned above but that align with objectives and intended outcomes of this programme, for example on research gaps related to black carbon and brown carbon. However please keep in mind that the causal pathway to reduced climate uncertainty and evidence-informed policy making needs to be clearly articulated.

⁷ Rönkkö, Topi, et al. "Review of black carbon emission factors from different anthropogenic sources." *Environmental Research Letters* 18.3 (2023): 033004. <https://doi.org/10.1088/1748-9326/acbb1b>

3. Intended outcomes

The intended outcome of this research programme is to answer policy-relevant questions including those relevant to global and regional regulatory frameworks, action planning and reporting e.g. Nationally Determined Contributions (NDCs), and intergovernmental organizations like IPCC. Although there is strong evidence to show we can avoid significant near-term warming via black carbon-rich sources⁸. There is limited consensus on what are the priority policy levers and associated regional variations. Through the evidence-based outcome of this research programme, we aim to advance knowledge on mitigation of black carbon and to support evidence-informed policy making.

4. Who could apply and what to include in EoI

Research institutes, universities, think tanks and consortia of interested organisations are encouraged to submit the Expression of Interest (EoI). We are open to receive EoIs from any global region and any organizations working on climate change and relevant fields at any capacity and any scale. With this in mind, we are first requesting for an EoI to gain an understanding of who is interested in doing what. Please provide answers to four key questions as outlined below in a maximum of 4 pages and share your approach for this potential grant.

1. What are the specific research questions on black carbon that you would like to address through this grant? Please also provide a brief overview of the types of research activities as relevant to these research questions.
2. Why do you believe that addressing this question will help to inform climate change mitigation strategy and why you are prioritising these questions?
3. What science and policy outcomes (real-world changes that may occur that are beyond the sphere of control of the grant itself) are expected from the research?
4. What relevant experience and expertise does your organisation have on black carbon and the relevant research area?

5. How to submit your expression of interest

Please send us your response to the questions above in a document format (word, pdf). Kindly limit your response in maximum 4 pages (excluding references). For EoI of more than 4 pages, only the initial 4 pages will be able to be reviewed. If you have any questions, please submit it before 5pm GMT on 10th November 2024. The deadline for submission of EoI is 15th November 5pm GMT. Questions and EoI must be submitted via email to superpollutants@cleanairfund.org.

6. Process

After we received and reviewed the EoI, we will get in touch with selected organisations towards developing a full project, including budget. We will work closely to help develop a potential grant. Unfortunately, we will not be able to move forward with all expressions of interest. We are looking forward to support multiple projects of an average grant size of USD 300k-500k. If this time, your idea is not within the scope of this funding, we will keep you in the loop and hope to include you in our broader network for future opportunities.

7. Timeline

Activity	Deadline
Publish Expression of Interest	30 th October 2024
Question/clarification	10 th November 2024
Deadline for Expression of Interest	15 th November 2024
Review of Expressions of Interest	16 th November – 21 st November
Final CAF decision	22 nd November

⁸ Dreyfus, Gabrielle B., et al. "Mitigating climate disruption in time: A self-consistent approach for avoiding both near-term and long-term global warming." *Proceedings of the National Academy of Sciences* 119.22 (2022): e2123536119. <https://www.pnas.org/doi/10.1073/pnas.2123536119>