Opportunity to apply for a postdoc project grant among 10 different aerosol themes at Lund University in Sweden

Are you looking for a postdoc abroad at Lund University in Sweden? This is an excellent opportunity to write a grant application for a 3-year postdoc project together with your potential future supervisor to become postdoc student and work in a supportive team of several fellow students and well-known supervisors in atmospheric sciences.

Choose one of the 10 projects you are most interested in and send your personal motivation letter to the contact person for the project. The top candidate of each project will be selected for the proposal writing. The contact person will be your main mentor if the postdoc proposal gets granted.

We are looking forward to your motivation letter! We encourage to ask the contact person about the project before you send your motivation letter.

Yours

Adam Kristensson - administrator of the 10 projects – adam.kristensson@fysik.lu.se

Timeline:

1. Send in your motivation letter – latest December 20.
2. Feedback with additional questions and if we have chosen you as candidate for the proposal writing – latest January 16.
3. Start of proposal writing – January 22.
4. Deadline with the first draft – February 15.
5. Deadline with first full version - March 14.
6. Proposal submission – March 31.

The FORMAS call is announced: https://www.formas.se/en/start-page/archive/calls/2023-10-16-career-grant-for-early-career-researchers-2024.html

The motivation letter should be maximum two pages and have font times new roman, size 12. Please describe in the motivation letter how your background fits with the proposed research project idea, why you are interested in the project, and how you can contribute to the research. Include a CV description in the two-page motivation letter and what you consider to be your top five research contributions as PhD student, whether it is accepted or submitted papers, stakeholder involvement, outreach, or the like. Write the date of your PhD exam, or the expected date.

Voluntarily: describe if you would like to contribute with your own flavor to the project. For example, if you have old data or new studies you would like to contribute with from your own country, or if you are using complementary methods to investigate the environmental issue in the project. If you have your own funding from your country to come to Sweden on a postdoc and want to apply for this funding, please also denote this in your motivation letter.

1. Where does the aerosol dust come from?

Atmospheric dust particles can have many sources in urban and rural environments. The dust projects aims to quantify experimentally the contribution from various dust sources to the concentration of atmospheric dust measured in northern Europe.

Dust particles in northern Europe can originate from Saharan desert dust, high-latitude dust, tilling, harvesting and loss of topsoil from agricultural fields, road, brake and tire wear, different industry manufacturing and other activities, and many more.

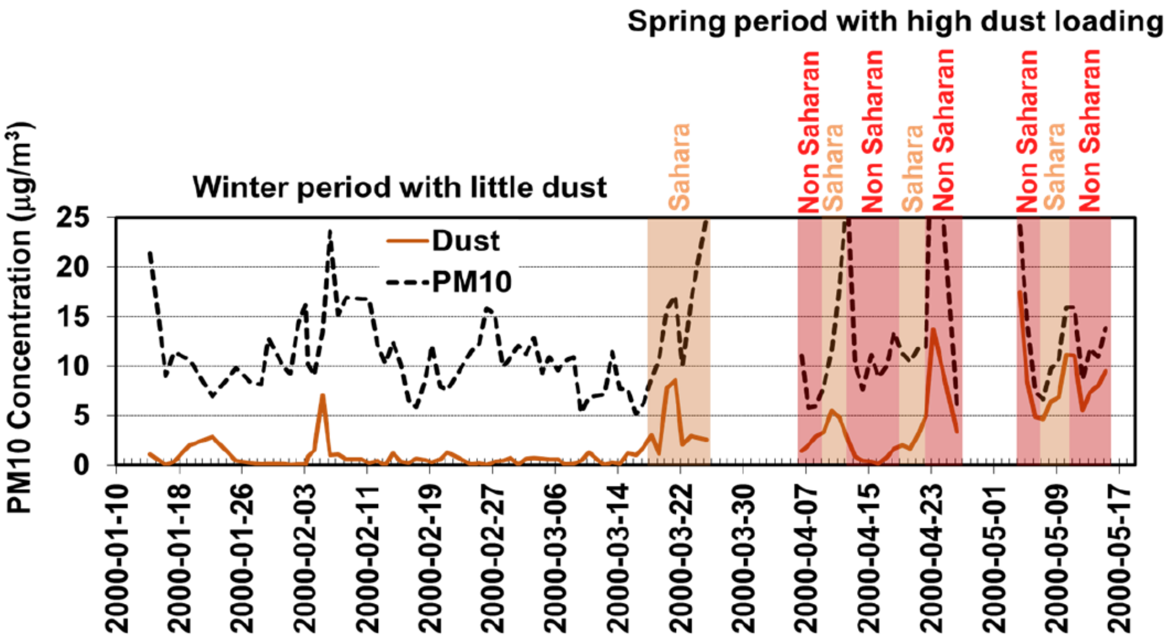
In northern Europe, dust sources become increasingly more and more important than other aerosol sources, due to the gradual reductions of anthropogenic fossil fuel combustion emissions. In spring-time, dust particles contribute to ½ of the total PM10 particle mass concentrations in southern Scandinavia.

However, it is virtually unknown which of the dust sources that contribute to the concentrations, and how these affect climate and health in humans during respiratory inhalation.

The postdoc candidate will utilize existing measurements and in parts new measurements of aerosol particles in southern Swedish field site Hyltemossa. Source/receptor modelling will be employed on the measured concentrations of aerosol PM10 mass and various aerosol source markers to quantify how different dust sources contribute to PM10 concentrations. Additionally, models of air mass transport, data from European remote sensing network and some additional detective work will be used to elucidate how much long-range transported dust contribute to the dust levels.

Contact person: Adam Kristensson, Faculty of Engineering, adam.kristensson@fysik.lu.se

Dust outbreak from agricultural fields in southern Sweden. Photo: Aneta Wierzbicka, May 20, 2019.



Southern Sweden source contribution of dust particles (orange line) to the total PM10 mass concentration of particles (black dashed line) as calculated from Source/receptor modelling during 2000. Episodes in spring, which are likely associated with desert dust outbreaks or episodes which are not likely originating from desert dust are denoted in different color stripes.

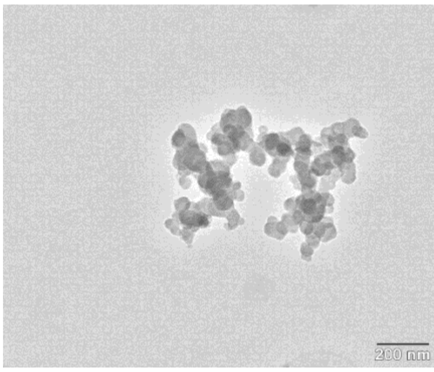
2. Source apportionment of black carbon in Scandinavia

The postdoc candidate performs source apportionment to quantify how different emission sources contribute to health hazardous and climate warming black carbon (BC) soot particles in Scandinavian cities and working environments.

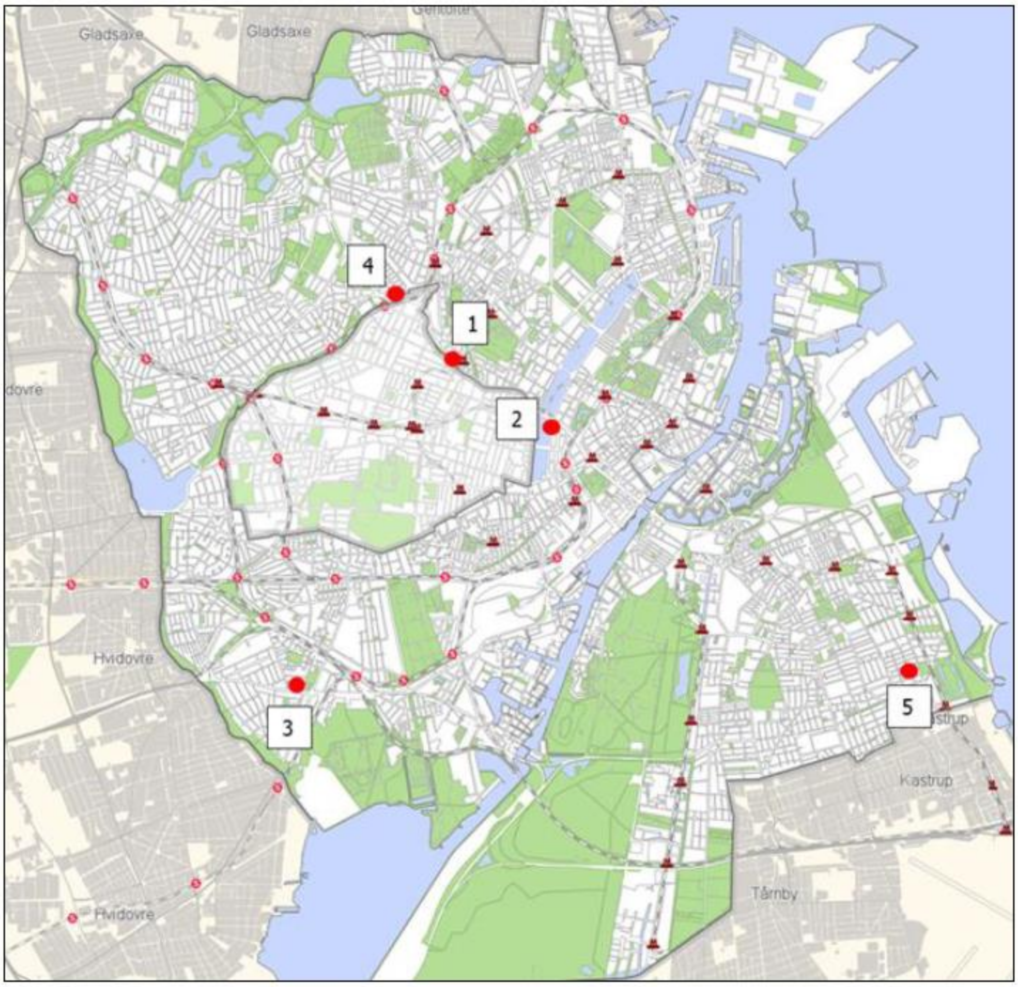
Researchers, private companies, and municipalities in southern Scandinavia are concerned about the black carbon (BC) air pollution in the cities, airports, and other working environments. The source apportionment in the project serves to estimate how different BC sources contribute to the air pollution levels in these environments, which gives powerful tools for policy making to reduce BC pollution from targeted pollution sectors.

BC measurements will be made with both more advanced, and automated measurement methods to infer if automated measurements can replace the more time consuming methods for legislative purposes. Source markers and source/receptor modelling, and other novel approaches, like fast Fourier transform will be used for the source apportionment. Source apportionment will be made at residential dwellings with intense domestic wood combustion, airports, heavily trafficked roads, rural background environments, and it should be able to separate local and long-range transported contributions to BC.

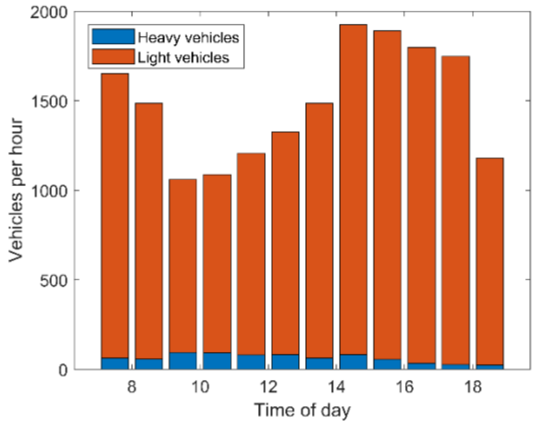
Contact person: Adam Kristensson, Faculty of Engineering, adam.kristensson@fysik.lu.se



Microscopic picture of a soot particle.



Measurement locations of BC in Copenhagen: 1. Krügersgade 5, Nørrebro, 2. Søtorvet 5, Indre By, 3. Folehaven 72**,** Valby, 4. Hillerødgade 79, Bispebjerg, 5. Backersvej/Formosavej, Amager.



Measurement location Folehaven in Copenhagen with traffic density.

3. Source contribution to oxidative potential of atmospheric aerosol particles

In this postdoc project you perform laboratory and field experiments to pin-point the contribution of aerosol sources that cause oxidative stress on our body during respiratory deposition

Oxidative potential is an emerging measure for health effects of aerosol particles. There is however few experimental cases how different sources contribute to the oxidative potential.

It is quantified how different natural and anthropogenic sources contribute to atmospheric aerosols using source/receptor models, live data, in downtown and rural areas in Sweden. By performing experimental studies with offline assessment of oxidative potential of specific sources, these data sets/information can be combined. This will give unique insight into how different sources contribute to health effects, and provide us tools for abatement strategies to reduce health impacts on our population.

Contact person: Ville Malmborg, Faculty of Engineering, vilhelm.malmborg@design.lth.se

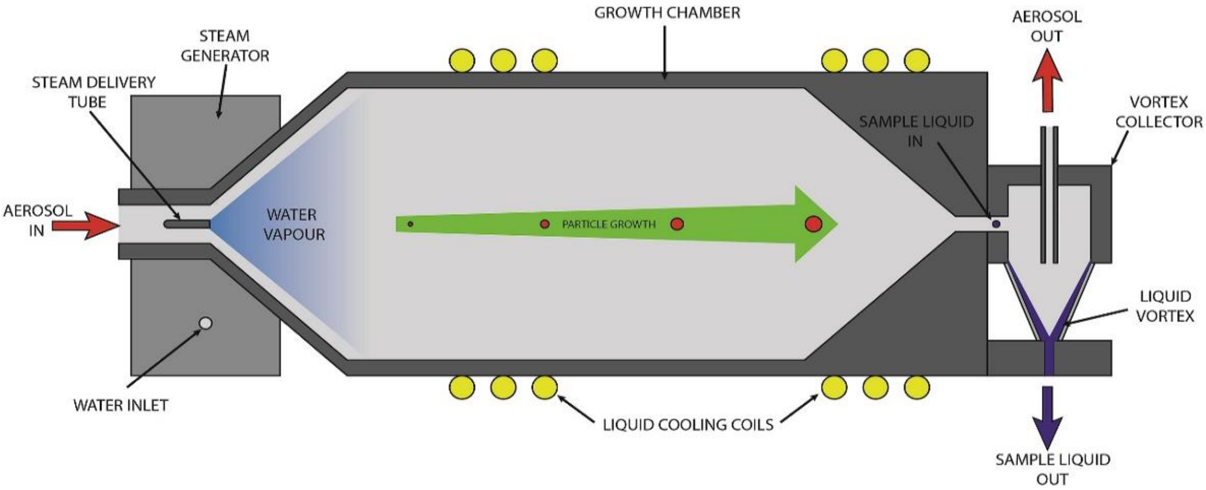
4. Toxicity screening of particles in real time – focus on particles indoors where we spend 90% of our time

We are exposed to airborne pollutants mainly inside buildings as we spent 90% of our time indoors (in homes, workplaces, schools, kindergartens, stores, restaurants), thus it is important to understand what we are exposed to when we are indoors. Airborne particles indoors can have different properties (physical and chemical) in comparison to outdoors, as indoors we are exposed to mixtures of particles that penetrated from outdoors, generated by us indoors (cooking, candle burning, use of fireplaces) and products of their interactions. The toxicity and properties of particles indoors are poorly understood.

Additionally, there is a need for a new health-relevant metric of airborne particles that would capture its toxicity and potential to cause health effects. Currently particle mass concentration is used for legislative purposes and for epidemiological studies. It is known that mass concentration of particles does not reflect their complex and varying chemical composition nor physical properties (dominating size, surface area etc.), all known to influence the toxicity of particles. The particle-induced reactive oxygen species (ROS) are considered the main candidate for the new metric. ROS are a group of free radicals which can be either present on the surface of particles or generated through chemical reactions between PM and cells. In such way ROS contributes to oxidative stress, which is one of mechanisms linking particle exposure and adverse health effects. Apart from potential of becoming a new metric, assessment of ROS can provide an interesting alternative for screening of particle toxicity before further detailed toxicity assessment.

In Aerosol Laboratory we have built an instrument (PINQ, Particle Into Nitroxide Quencher) which can assess ROS on particles in real time (time resolution in minutes) using acellular assay (9,10-bis (phenylethynyl) anthracene-nitroxide (BPEAnit)). PINQ has been developed by researchers in Queensland University of Technology in Australia (Brown et al, 2019), with whom we cooperate in this project. Real time determination of ROS is a huge advantage in comparison to off-line methods as it has been reported that majority of ROS are short-lived and are lost when particles collected on the filter are processed for off-line analysis.

This postdoc project will involve laboratory assessment of ROS in laboratory conditions on different sources of particles (e.g., secondary organic aerosols, particles from electronic cigarettes, cooking, candles) as well as their mixtures with penetrated outdoor particles to resemble real indoor exposures Further the tests will be conducted in private homes to capture real life scenarios. Tests will be supported by range of different aerosol measurements to determine particle size, concentration, surface area and chemical composition. The work may involve (depending on the candidate interest) further optimization of the design of PINQ. We are open for new ideas and suggestions, there is a big flexibility in shaping the project.



PINQ, Particle Into Nitroxide Quencher for real time ROS assessment (Brown et al, 2019)

Contact person: Aneta Wierzbicka, Faculty of Engineering, aneta.wierzbicka@design.lth.se

5. Lagrangian aerosol-chase experiments to quantify sources and aerosol processes

The candidate performs mobile measurements, following the direction and speed of the wind with a road vehicle equipped with aerosol instrumentation. This will provide unique insights about the aerosol emissions along the wind path. A Lagrangian model is used to quantify the strengths of the sources and processes acting on the particles.

You can measure either the mass or number concentration of aerosol particles at a certain background atmospheric field station. By applying traditional source/receptor models in combination with measurements of source markers there are ways to estimate how different natural and anthropogenic aerosol sources contribute to the measured mass concentration at the field site. However, for the size-dependent number concentration of particles it is virtually impossible to correctly apportion certain particles to their correct source emissions. This is due to the change of size of the particles during their long-range transport through several different aerosol processes acting on the particles. With this size shift in mind it is virtually impossible to use source/receptor models that require particles that don't change particle size.

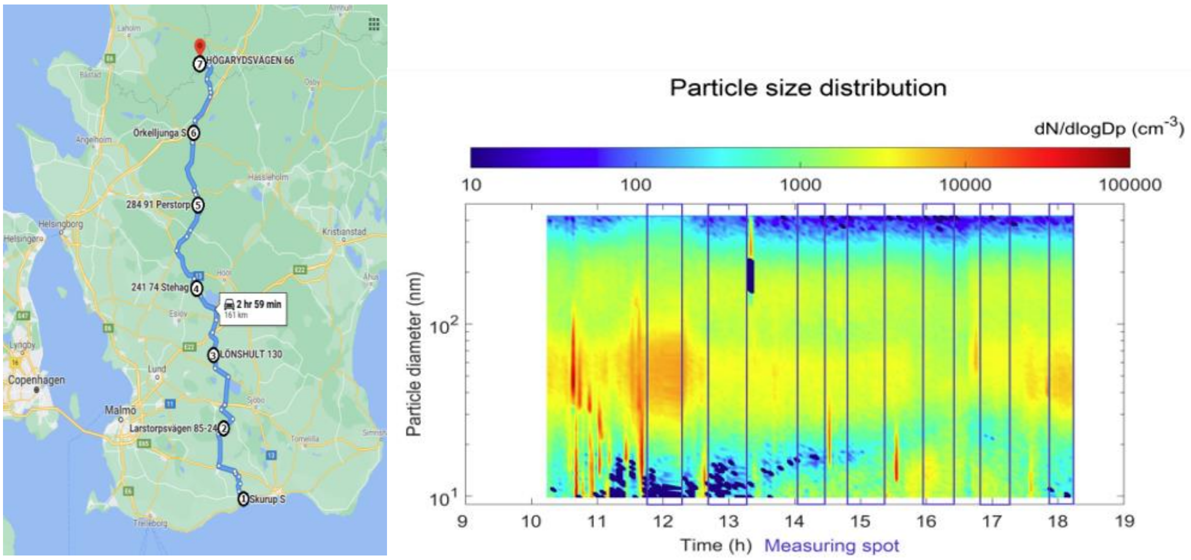
To remedy this difficulty, the novel approach is to measure and follow particles as they are transported by the wind. In this way, you never miss the instance when they are emitted from their sources, and you will also be able to study the processes that create the gradual reshaping of the particle size during long-range transport. This approach is called Lagrangian measurements, or in popular terms, "Aerosol chase experiments". Such studies have never been published before. We have however made a pilot chase once that was successful.

The candidate and diploma workers do these "Aerosol chase experiments" by following the forecasted wind motion close to the ground with a mobile van equipped with state-of-the-art aerosol instrumentation to measure the aerosol particle number size distribution, and different types of aerosol and gas chemistry and markers for various aerosol tracers. However, the lion part of the work for the candidate will be to reproduce measured data by modelling with the Lagrangian aerosol dynamics, chemistry and radiative transfer model called ADCHEM developed in Lund University, which is unique in its wealth of details.

This combined measurement and model program will give a quantification of the contribution of various aerosol sources to the particle number size distribution, and an understanding of the different aerosol processes acting on the particles during long-range transport for the first time ever. In this way, it will become possible to calculate with much better precision how anthropogenic aerosol particles contribute to climate change, and health effects.

Contact person: Adam Kristensson, Faculty of Engineering, adam.kristensson@fysik.lu.se

Several of the stops along one route for the pilot test of the Lagrangian measurement approach.



The route following the wind direction and wind speed during the pilot Lagrangian aerosol experiment with 7 temporary stops to do measurements (left). The results of the particle number size distribution from the 7 temporary stops encompassed with blue rectangles.

6. Epidemiology of source-specific aerosol & Health Impact Assessment

The postdoc assesses health impacts from fossil fuel-related air pollution and source-specific aerosol and develops methods to estimate health impacts due to climate change.

The project addresses Health impact of air quality and climate change and its corresponding key policy actions – addressing SDGs 3, 7, 11 and 13.

Climate change mitigation is not only vital in itself, but can have several co-benefits related to the phase out of fossil fuels such as cleaner air ("*Tackling climate change could be the greatest global health opportunity of the 21st century*"). These health benefits need to be quantified for policy makers to make informed decisions to reach SDG 13. The UNFCCC deems that national governments have a responsibility to carry out formal health risk assessments related to climate change. Scientific challenges to assessing uncertainties in future predictions have hindered this development. A Health Impact Assessment (HIA) has been identified as a valuable and systematic tool for quantifying the health impact of climate change.

Fossil fuel combustion are not only causing climate change, they are also directly leading to increased mortality and morbidity attributed to air pollution, and thereby directly hinder the achievement of SDG 3. These effects have also been seen at low exposure levels (<5 µg m-3, the current WHO, guideline). We will build on HIA methods developed by the WHO. We have previously applied these in work supported by FORMAS related to the health impact of air pollution policies. The results provide the total change in health outcome, for example the number of lives saved due to reductions in air pollution. We use available data from Statistics Sweden and Swedish National Board of Health and Welfare to access sex and age specific baseline disease rates, demographics, and population projections.

Task 1 aims at assessing the health impact of air pollution.

Task 2 aims at developing methods and assessing the health impact of future climate related extreme weather events.

The key scientific questions the core team and the postdoc will address are:

1. What are the long-term health effects from fossil fuel related air pollution (health impacts assessment done based on existing literature)?

2. What are the short-term health effects of source-specific aerosols in Scania (based on measurements from Hyltemossa linked to daily counts of deaths, cardiovascular events and visits to the emergency department)?

3. What are the health effects of climate change (focusing on extreme events) when incorporating uncertainties of future scenarios, with a focus on methodological issues?

4. What are the health costs/benefits of air quality and climate change key policy actions?

Theme 3 will incentivize interventions for clean energy (SDG 7), sustainable cities (SDG 11), climate action (SDG 13) and lower air pollution levels (SDG 3) by making the health and economic costs in action visible in close collaboration with Theme 4. The involved researchers are part of the SFO EpiHealth.

Contact person: Anna Oudin, Faculty of Medicine, anna.oudin@med.lu.se

7. Machine-learning as a tool for post-analysis and short-term forecasts of air quality variables

The candidate will compile and quality-control data from ACTRIS and ICOS stations in Sweden and across Europe, compile meteorological data and air mass back trajectories or FLEXPART source footprints, used these predictor variables to train machine-learning models to predict several air quality variables, also in a forecast mode.

Air pollution, most importantly aerosol particles, is estimated to be responsible for around 350 000 premature deaths in EU-27 annually of which 7000 in Sweden. The recently updated WHO air quality guidelines are much stricter and will influence the new EU Air Quality Directive that is now under revision. It is therefore important to observe and also forecast air quality variables that are believed to be detrimental to human health.

Machine-learning models may provide an efficient future tool for short-term air quality forecasts and thus complement the already operational chemical transport models that are expensive to operate in terms of computer resources and man-power.

This project will develop machine-learning (ML) modelling tools for short-term forecasts of Swedish air quality in both background and urban air. Forecasted air quality concentrations include PM1, PM2.5. PM10, Black Carbon, among others. Only basic meteorological input complemented with air mass back trajectories or FLEXPART source footprints will be used as predictor variables making the training of the models very efficient.

The machine-learning tool will also identify exceptional pollution events for further post-analysis that will be used to explain the underlying factors and help improve dispersion models such as European CAMS models in Sweden and Denmark.

The project will utilize existing long-term and quality-controlled air quality and meteorological data from the co-located ACTRIS and ICOS stations at Hyltemossa in southern Sweden and Norunda north of Stockholm. Urban roof-top data from the nearby cities of Stockholm and Malmö will also be used. Data from a multitude of other European ACTRIS (https://www.actris.eu) and ICOS (https://www.icos-cp.eu/) stations may also be used.

Since only readily available meteorological inputs are needed, the forecasts are transferable to other background locations. Typical traffic patterns will be added for the urban models.

One project aim is that the computationally efficient ML forecasts will be included in public air quality warning systems, such as the existing "Luft Stockholm". The Stockholm municipality is expected to be a project partner.

Contact person: Erik Swietlicki, Faculty of Engineering, erik.swietlicki@fysik.lu.se

8. An improved stratospheric aerosol dataset for realistic climate projections

Single volcanic eruptions and large forest fires inject Millions of tons of aerosol to the stratosphere. The stratospheric aerosol cools the climate and destroys ozone, creating holes in the ozone layer. Difficulties in quantifying the stratospheric aerosol load leads to uncertainties in today's climate projections, as well as in studies of the future of the ozone layer.

This project aims to cover knowledge gaps in both climate sensitivity and ozone depletion, by producing a stratospheric aerosol dataset based on satellite instruments from NASA and ESA. AI/ML will be used for data classification and cloud screening to retrieve clean signals of stratospheric aerosol. The data will be used as input to an Earth system model to simulate the stratospheric aerosols' climate impact in the past decades.

Contact person: Johan Friberg, Faculty of Engineering, johan.friberg@fysik.lu.se

9. Developing and applying advanced laser-based techniques for ranging atmospheric aerosols

PM2.5 is a type of particulate matter that poses a significant threat to human health and the global climate. It is emitted from a variety of sources, including construction sites, unpaved roads, fields, smokestacks, and wildfires.
Our project aims to develop and utilize advanced laser-based techniques for the quantitative and qualitative measurement and classification of atmospheric aerosols, including PM2.5. This approach will enable us to better understand the sources and characteristics of various aerosols and improve our ability to assess their impacts on human health and the environment. To achieve this, we will conduct field measurements in different countries across Europe, Asia, and Africa.
Contact person: Kim Cuong Le, Faculty of Engineering, thi_kim_cuong.le@forbrf.lth.se

10. Optimizing aerosol dilution and concentration techniques for online measurement of semi-volatile particle composition using mass spectrometry and synchrotron light

Aerosol particles are important atmospheric constituents with large, yet incompletely understood effects on human health and climate. These effects arise from physicochemical particle properties many of which are changed by collection and subsequent "offline" measurement. Therefore, online aerosol mass spectrometry (AMS) was developed and used to study "bulk" particle composition particularly for secondary organic aerosols. We have recently developed a synchrotron-based measurement (ASDS, aerosol sample delivery system at MAX IV) which captures particle surface composition and gas phase by means of

X-ray photoelectron spectroscopy (XPS). Together AMS and ASDS will give “the full picture” of aerosols: bulk, surface, and surrounding gas. We are looking for a skilled experimentalist to optimize concentration control (by means of e.g., ejector dilutor and virtual impactor) for efficient atmospheric science by AMS+ASDS.

Contact person: Axel Eriksson, Faculty of Engineering, axel.eriksson@design.lth.se