



Project Proposal for Ph.D.

Project Details (The research problem must clearly indicate the need for an interdisciplinary approach)

Project Title	Oxidative Potential Weighted PM _{2.5} Exposure Modelling for India and Application to Health Outcome Assessment
Project Summary (Minimum 500 and maximum 2000 characters)	Current air pollution health assessments rely heavily on fine particulate matter (PM_{2.5}) mass concentration, but this metric alone does not adequately capture the underlying toxicity of particulate matter. Epidemiological studies using PM_{2.5} composition reveals that the risk varies across the exposure to individual species and the cumulative risk is greater than what is estimated using PM_{2.5} mass as the metric. Oxidative potential, defined as the ability of PM_{2.5} to generate reactive oxygen species and induce oxidative stress, has emerged as a promising exposure metric with greater biological relevance, since PM_{2.5} induced health impacts is routed through oxidative stress. Despite this background knowledge, how oxidative potential varies with PM_{2.5} composition and how to incorporate this in exposure modelling and health impact assessment framework lacks understanding. This project aims to develop an oxidative potential weighted PM_{2.5} exposure modelling framework for India to better understand how source specific and composition dependent particle toxicity relates to human health outcomes. Delhi NCR will serve as the initial study domain because of its strong spatial and seasonal variability in PM_{2.5}, diverse emission sources, and the availability of high quality atmospheric and health related datasets. The work will integrate field based oxidative potential measurements, PM_{2.5} chemical composition, and source apportionment with land use, meteorological, and satellite derived predictors to build high resolution exposure models using statistical and machine learning approaches. The Delhi NCR framework will then be adapted for broader application across India using scalable geospatial predictors and existing PM_{2.5} datasets. The overall goal is to advance air pollution health assessment in India through a more biologically meaningful exposure metric.

Ph.D. Supervisors* (Supervisor 1 and Supervisor 2 cannot be from the same department of IITD)			
Role	Name of Faculty	Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1*	Prof. Joseph V. Puthussery	Civil and Environmental Engineering	josephvp@civil.iitd.ac.in
Supervisor 2	Prof. Sagnik Dey	Centre for Atmospheric Sciences	sagnik@cas.iitd.ac.in

*Supervisor 1 must be from IIT, Delhi.
+All cells in this table are mandatory fields that need to be filled by faculty for consideration of proposal.
\$The date of superannuation of supervisors should be at least three years from the date of registration of selected candidates.

Project requirements (Student qualifications, experience required, etc)
*The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)

Background in Environmental Engineering, Atmospheric Sciences, Civil Engineering, Chemistry, Public Health, Epidemiology, Data Science, or related fields. Experience in air pollution measurements, PM sampling, exposure modelling, GIS, remote sensing, statistical analysis, machine learning, or R/Python will be preferred. Interest in interdisciplinary research integrating environmental measurements, atmospheric modelling, and health analysis is desirable.

Source of fellowship/funding and project number
(CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any)

Student with own funding from CSIR/UGC/DBT/ICMR or any other sources

Role of Faculty Members involved:

Supervisor-1

PM_{2.5} measurement, oxidative potential analysis, chemical characterization, development of biological endpoints and source apportionment components of the project.

Supervisor-2

Satellite based and chemical transport model based exposure modelling, geospatial exposure assessment, ML based model development, and application of the developed OP weighted exposure framework to health outcome analysis.

Note :-

- 1. Approval from the respective DRC/CRC/ScRC of your Department/Centre/School will be required for using the "Full-time Institute Assistantship (Category-wise) (FIA)" for selecting the students in SIRe.
- 2. Declaration:- Faculty members, please ensure that you have at least 3 years of service left before superannuation along with adequate sitting space & lab facilities for the SIRe student.
- 3. PI/s are also encouraged to submit joint proposals with AIIMS, NII, JNU and institutes with which IITD has an existing MoU. If the Co-PI (Supervisor 2) is from outside IITD, kindly share his/her detailed CV.
- 4. If a research scholar is to be considered for selection under the project fellowship, then the project should have a minimum of two-year duration remaining.
- 5. A candidate applying with a valid JRF/INSPIRE/any national level fellowship should have at least two-year validity from the date of joining the Ph.D. program.
- 6. The third supervisor's name (if required) can be added only after the formation of Student Research Committee (SRC) subject to a strong recommendation of SRC and subsequent approval from the competent authority.
- 7. If Institute fellowship is being sought, then DRC approval of the parent department of Supervisor 1 is required at the time of selection.